World Class Design | World Class Function | 30 Years Expertise in Industrial Motor Control

DC MOTOR DRIVE

PL / PLX

SPRINT ELECTRIC

Product Manual

HG105281EN00 Issue 1 (03/2024)

Please read this information before installing or using the product.

Install, use and maintain this product following the procedures provided.
The manual(s) cannot provide all details, variations and contingencies required for your installation, operation and maintenance of this product or the apparatus with this product installed. For further help or information, refer to your local Supplier sales office.

Application area

The equipment described is intended for industrial (non-consumer) motor speed control.

Intended users

To safely enable the user to obtain maximum benefit from the equipment:

- Ensure this information is available to all persons required to install, configure or service the described equipment or any other associated operation.
- Always store the manual in a conveniently accessible area for quick reference.
- Make it available for the next user/owner of the product.

This product is of the restricted sales distribution class according to IEC 61800-3 and has a "professional equipment" designation as defined in EN 61000-3-2.

Safety

Ensure all users and operators understand the included WARNINGS, CAUTIONS and NOTES, which alert the user to safety issues. COMPLY WITH WARNINGS AND CAUTIONS AT ALL TIMES. Each of these carries a special meaning and should be read carefully:

WARNING!

A WARNING is given when non-compliance with the warning may result in personal injury and/or equipment damage.

CAUTION!

A CAUTION is given when non-compliance with the caution may result in permanent equipment damage.

NOTE A note provides specific information to make important instructions clear.

Symbols

Attention	**Electrostatic Discharge (ESD)**	**Electric Shock Hazard**
See the instructions for use. Specific warnings not found on the label.	This equipment contains ESD sensitive parts. Observe static control precautions when handling, installing and servicing this product.	Disconnect the mains supply before working on the unit. **Do not touch presets, switches and jumpers!** Always use the correct insulated adjustment tools.

WARNING!

Only qualified personnel must install, operate and maintain this equipment.
A qualified person is someone technically competent and familiar with all safety information, established safety practices, installation, operation, maintenance and the hazards involved with this equipment and any associated machinery.

Hazards

This equipment can endanger life through rotating machinery and high voltages.

WARNING!
PERSONAL INJURY AND/OR ELECTRICAL SHOCK HAZARD

- Always isolate all power supplies from the equipment before starting any work.
- Never perform high voltage resistance checks on the wiring without first disconnecting the product from the circuit under test.
- Use guarding and additional safety systems to prevent injury and electric shock.
- Metal parts may reach 90°C during operation.

CAUTION!
EQUIPMENT DAMAGE HAZARD

- We thoroughly test our products. However, before installation and start-up, inspect all equipment for transit damage, loose parts, packing materials, etc.
- Installation must observe the required environmental conditions for safe and reliable operation.
- In a domestic environment, this product may cause radio interference, requiring adequate measures to be taken. Obtain the permission of the supply authority before connecting to the low voltage supply.

General risks

Installation

- Ensure mechanically secure fixings are in use as recommended.
- Ensure cooling airflow around the product is as recommended.
- Ensure cables/wire terminations are as recommended and are torqued correctly.
- Ensure the product rating is correct - do not exceed the rating.

Application risk

Electromechanical safety is the responsibility of the user. The integration of this product into other apparatus or systems is not the manufacturer's or distributor of the product's responsibility. It is the user's responsibility to ensure the compliance of the installation with any regulations in force.

Health and safety at work

Electrical devices can constitute a safety hazard. Thorough personnel training is an aid to SAFETY and productivity. SAFETY awareness not only reduces the risk of accidents and injuries in your plant but also has a direct impact on improving product quality and costs. If you have any doubts about the SAFETY of your system or process, consult an expert immediately. Do not proceed without doing so. If in doubt, refer to the Supplier.

Weight

Consideration should be given to the weight of our heavier products when handling.

Risk assessment

Under fault conditions or conditions not intended: the motor speed may be incorrect; the motor speed may be excessive; the direction of rotation may be incorrect; the motor may be energised.

In all situations, the user should provide sufficient guarding and/or additional redundant monitoring and safety systems to prevent risk of injury.

NOTE: During a power loss event, the product will commence a sequenced shut-down procedure. Therefore, the system designer must provide suitable protection for this case.

Maintenance

Only qualified personnel should maintain and effect repair using only the recommended spares, alternatively return the equipment to the factory for repair. The use of unapproved parts may create a hazard and risk of injury.

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

When replacing a product, all user-defined parameters that define the product's operation must be installed correctly before returning to use. Failure to do so may create a hazard and risk of injury.

The packaging is inflammable and incorrect disposal may lead to the generation of lethal toxic fumes.

Repairs

Repair reports can only be given if the user makes sufficient and accurate defect reporting. Remember that the product without the required precautions can represent an electrical hazard and risk of injury, and that rotating machinery is a mechanical hazard.

Protective insulation

Isolated product

WARNING!

The drive and motor must be connected to an appropriate safety earth.
Failure to do so presents an electrical shock hazard. Exposed metal work in this equipment is protected by basic insulation and bonding to a safety earth.

This product is classified as a component and must be used in a suitable enclosure.

1. This is achieved through basic insulation and protective earth grounding, or double-insulation to provide SELV Control Circuits.
2. This protection allows a safe connection to other low voltage equipment.
3. **Earth bonding is the responsibility of the installer.**

Hazards

The following WARNINGS are contained in the text of this manual.

The Hazard symbols are page links in the pdf of this manual.

WARNING!

PERSONAL INJURY HAZARD

Read and understand the General Risks given at the front of this manual when performing measurements and investigating failures.
This applies to electrical and mechanical systems.

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Electric shock risk! Electrical devices constitute a safety hazard.

Do not attempt to commission the PL/X unless you:

- are qualified and have the knowledge and skills to use it safely.
- thoroughly understand the operation of the machine which has the PL/X installed.
- have read and understood this document, and are familiar with electrical wiring and safety standards.

Only use qualified personnel to design, construct, operate and maintain your systems.

Ensure personnel who use or maintain the equipment know of all hazards involved in your equipment and processes.

If you have any doubts about the safety of your system or process, do not proceed without first consulting an expert.

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Before beginning to connect the drive, make sure that all power is OFF.

Make sure that power and control wiring are routed in separate conduit / cable trays and that wiring meets all applicable national and local electrical regulations.

Make sure that the voltages on the EL1/EL2/EL3 terminals are in-phase with the voltages on L1/L2/L3.

For reliable operation, the PL/X must control the supply side or dc side contactor through its CON1 and CON2 terminals.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Perform the QuickStart steps ("3 QuickStart Guide" on page 12) as written and in the correct sequence.

WARNING!
EQUIPMENT DAMAGE HAZARD

It may be necessary for installations to have over-riding external independent systems for de-energising the supply side or dc contactor. In this case, we recommend that the CSTOP terminal is opened 100 ms prior to de-energising the supply side or dc side contactor. Failure to achieve this may result in damage to the PL/X.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

When using a dc side contactor, the armature **MUST** be connected to remote sense terminals T41 and T43, as shown on Page 54, to ensure that the PL/X can measure armature voltage when the dc side contactor is de-energised. Failure to do this will cause a flashover of the commutator because the AVF feedback is lost when the contactor opens.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Ensure that all wiring is electrically isolated and cannot be made "live" unintentionally by other personnel.

If performing high voltage or dielectric tests on the motor or wiring, you **must** disconnect the PL/X first. Failure to do so will invalidate Warranty.

WARNING!
PERSONAL INJURY HAZARD

Do not rely on any drive function to prevent the motor from operating when personnel are undertaking maintenance or when machine guards are open. The Safety Codes do not accept electronic control as a sole means of inhibition for the PL/X. Always isolate the power source before working on the PL/X or the motor or load.

WARNING!
PERSONAL INJURY HAZARD

Do not use Armature Volts Feedback mode (AVF) with field weakening systems.

WARNING!
EQUIPMENT DAMAGE HAZARD

Field reversal or disconnection.
After the PL/X inhibits the field output, it can take several seconds for the field current to decay to zero due to the high inductance of motor fields.
Do not open-circuit the field unless the field current has reached zero.
You cannot use the field current monitors or field active flag to confirm that zero current is flowing because the PL/X cannot measure the decaying current after an inhibit. You must:

1. Observe the current on an external instrument and time how long it takes to decay.
2. Use the interval timer block to implement a safety delay before opening the field circuit.

Failure to observe this warning may cause flashover of the field circuit and result in damage to the system.

WARNING!
EQUIPMENT DAMAGE HAZARD

The protection provided in field weakening mode is limited to total feedback loss only because the speed/AVF relationship is not maintainable in the field weakening mode. If a partial loss of feedback occurs, the motor may run to excessive speed. When the field is entirely weakened and is at its minimum level, the armature overvoltage trip will operate. It may only occur at dangerous speeds. Therefore, we recommend using a mechanical device, a backup system, or both to protect against this possibility.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Semiconductor electronics deliver all sixteen motor drive alarms. Local safety codes may mandate the use of electro-mechanical alarm systems.
Test all alarms in the final application before use.
The manufacturer and suppliers of the PL/X are not responsible for system safety.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Do not rely on the action of parameter 183)EXT TRIP RESET for safety.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

When using armature voltage feedback the IR drop may be sufficient to provide a signal in excess of 117)ZERO INTLK SPD % preventing the stall alarm from operating. To rectify, set 14)IR COMPENSATION as accurately as possible; then test the alarm with a stalled motor (disable the field); progressively increase current limit to above the 179)STALL CUR LEVEL; now check that the AV speed feedback remains below 117)ZERO INTLK SPD %. It may be necessary to increase 117)ZERO INTLK SPD % to ensure tripping.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

The PL/X suspends Comms operation while in CONFIGURATION mode. Refer to the FIELDBUS manual, HG105409EN00.

WARNING!
PERSONAL INJURY HAZARD EQUIPMENT DAMAGE HAZARD

It is important that the parameter 680)Iarm BURDEN OHMS, is set as closely as possible to the actual resistance used on the power board.
Do not allow the model current rating to exceed that stated in the rating table and on the product label found on the side of the PL/X. Failure to heed this warning will invalidate any Warranty, and violate approval standards.
The manufacturer and distributor accept no liability for faults caused by rerating of the product.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

PROTECT ALL DRIVES BY USING CORRECTLY RATED SEMICONDUCTOR FUSES.
Failure to do so will invalidate the Warranty.

WARNING!
PERSONAL INJURY HAZARD

DO NOT use AC supply filters on supplies that are un-balanced or float with respect to earth.

The drive and AC filter MUST have a permanent earth connection. Plugs/sockets are NOT allowed in the AC supply.

The AC supply filter contains high voltage capacitors.
DO NOT touch for at least 20 seconds after the removal of the AC supply.

WARNING!
PERSONAL INJURY HAZARD

Safety earthing always takes precedence over EMC earthing.

The following CAUTIONS are contained in the text of this manual.

CAUTION!

Do not use field weakening when using Armature Voltage Feedback, selected in the CALIBRATION menu.

If AVF is selected and field weakening is enabled, the PL/X will trip when entering the field weakening region. **NOTE**: The action of changing feedback mode to AVF will automatically rescale the 100% speed feedback referring to 18)RATED ARM VOLTS. To continue running in this mode (e.g. if tacho has failed) and prevent tripping, avoid the field weakening region remaining at a speed that produces an armature voltage below 109)SPILLOVER AVF %.
130)MOTOR RPM monitor will show an incorrect value unless you re-adjust 6)DESIRED MAX RPM to the base RPM.
If this trip occurs, the DRIVE TRIP MESSAGE will be SPEED FBK MISMATCH.

CAUTION!

EQUIPMENT DAMAGE HAZARD

For rated field currents that are less than 25% of model rating the alarm threshold may be too low to trigger. Test the alarm. To defeat this problem, set 4) RATED FIELD AMPS to a higher level and 114)FIELD REFERENCE to a lower level to raise the threshold, e.g. set PIN 4 to twice motor rating and PIN 114 to 50.00%.

CAUTION!

EQUIPMENT DAMAGE HAZARD

If, due to the mechanical arrangement of the machine it is impossible to achieve sufficiently low losses, then use a closed-loop system of tension control which could use dancing arm methods or a tension transducer loadcell feedback system.

CAUTION!

EQUIPMENT DAMAGE HAZARD

The field-to-earth voltage of the motor must have the correct rating for the voltage applied to EL2.

CAUTION!

EQUIPMENT DAMAGE HAZARD

Check that the calibration parameters and drive personality Iarm burden value are correct after restoring factory defaults. These may also need re-entering.

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1 Introduction

Sprint Electric PL/X Digital DC Drives are for use in industrial (non-domestic) applications to control the speed of dc motors.

The PL/X series comprises five frame sizes. Each frame size offers several different current ratings in two quadrant and four quadrant configurations.

This manual is for use by the installer, operator, and programmer of the PL/X Digital DC Drive. It assumes that you have relevant experience in these disciplines.

Use this manual to commission the PL/X using the keypad and display:

1. Follow the steps outlined in the Commissioning section on Page 12.

   This entails:

   a. Mechanically installing the PL/X.
   b. Electrically installing the PL/X.
   c. Conducting vital pre-start checks.
   d. Completing the QuickStart Guide.
   e. Performing a PARAMETER SAVE to conclude the commissioning process.

2. At this point, you might:
   - Add a password (0000, by default): Page 243.
   - Create Drive Personalities: Page 363.
   - Further program and control the PL/X, or multiple PL/X, using a configuration tool.
   - Configure the special Application Blocks supplied with the PL/X: Page 245.

This manual is written for PL/X software version 6.42.

Frame 1 - PL/X5-50

Frame 2 - PL/X65-145

Frame 3 - PL/X185-265

Frame 4 - PL/X275-440

Frame 5 - PL/X520-980

1.1 Product overview

1.1.1 Features and benefits

Applications advice and training is available from Sprint Electric.

- **General:**
    - The PL/X unit is an open-chassis component for use in a suitable enclosure.
    - Calibration requires no setting of switches or soldering of resistors.
    - The drive prevents armature current settings in excess of the model rating.
    - It uses closed-loop control of armature current and voltage to give precise control of motor torque and speed. The unit also controls the motor excitation field.
    - Use the keypad and display on the front panel to commission and program the drive, or do this remotely using an ethernet-based distributed control system (DCS) hardware and software.
    - Connect and configure a range of built-in software blocks. These contain user-programmable control parameters that allow control of both simple and complex motion control applications.
    - Comprehensive fault monitoring and serial communications allow off-site programming and remote diagnostics.
- **We recommend always beginning with a QuickStart (Armature Voltage Feedback):**
    - The speed feedback is always present and in the correct polarity.
    - The motor, load or both can be seen to be rotating correctly and at approximately the correct speed.
    - If a tachogenerator or encoder is present, you can check for correct polarity and output levels before including it in the feedback loop.
    - You can check and set other parameters, such as ramp rates and stopping modes, before progressing to a final, accurate Calibration.
- **For systems using torque control:**
    - We recommend the QuickStart, setting up in basic speed mode for armature voltage feedback to establish correct speed loop functioning and calibration and then switching to torque control.
- **For systems using field weakening:**
    - We recommend the QuickStart, setting up in basic speed mode for armature voltage feedback first to verify normal operation up to base speed. Then introduce field weakening only after careful calibration and switching to either tacho or encoder feedback.
- **The system may need a pre-test before shipping, and there is no tachogenerator available:**
    - Only the QuickStart Calibration parameters require setting when following the QuickStart procedure.
    - It is easy to change to a set of default parameters specifically for use with very small motors suitable for testing.

1.2 PL/X principle of operation

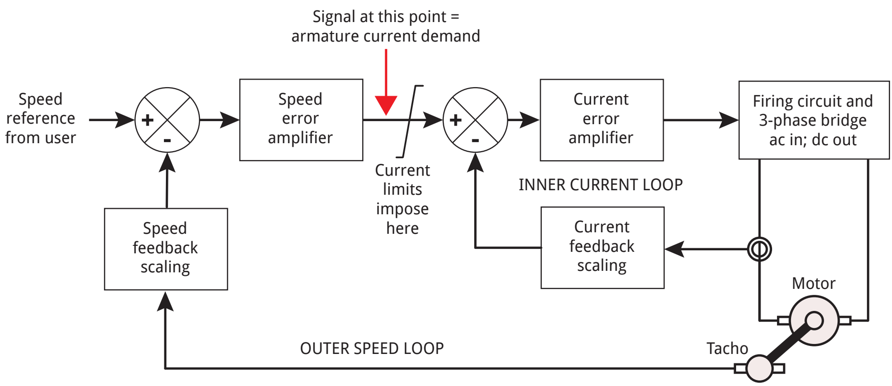


Figure 1 The basic arrangement of the PL/X control loop

Inner Current Loop

The 3-phase thyristor bridge is a phase-controlled rectifier that delivers power to the motor armature. Sensing of the armature current (proportional to motor torque) provides feedback to the inner current loop. The current error amplifier compares and detects any difference between this and the current demand, forcing the current feedback to be equal to the current demand (i.e. the current error is zero) in the steadystate. Various limits are imposed to current demand depending on application requirements.

Outer Speed Loop

The outer speed loop works similarly but uses different parameters. In the example above, the demand is the user's speed reference, and the speed feedback is from a shaft-mounted tachogenerator. Any difference between the two is detected and used to modify the demand for the inner current loop. The change in current demand changes the motor torque accordingly and, through the action of the inner current loop and the 3-phase bridge, this reduces the speed error to zero.

The PL/X control loop performs this process continuously, giving high levels of speed accuracy and dynamic performance.

1.3 Useful page references

We recommend that you complete the QuickStart, which includes an Autotune procedure. To properly configure your drive for the specific motor, you will need to enter relevant parameter settings into the Calibration menu.	Page 12
The PL/X has a built-in default configuration suitable for most applications that you can modify if required.	Page 50
• To modify a parameter in the Configuration menu, you **must** first set ENABLE GOTO, GETFROM to ENABLE.	Page 77
• Any changes you make to a parameter become effective immediately but you **must** perform a PARAMETER SAVE before removing the PL/X control supply to prevent losing your changes.	Page 79
• To restore the default configuration, hold down all four keys on the drive's keypad while applying the control supply. The Calibration values relevant to the motor are unaffected by this process.	Page 79
• Up to three Drive Personalities can be stored.	Page 363
• Special Application Blocks, including signal processors, PIDs, etc., are available. Usually, these are disabled unless activated by the User. They are not necessary for motor control purposes but can be used to construct more complex systems.	Page 245
Internal connections between function blocks and parameters are easily changed to suit specialist applications.	Page 77
• All parameters have a unique identification number called a PIN (Parameter Identification Number).	Page 374
• Most parameters are adjustable while the drive is running to assist commissioning. Where not possible, the PL/X requests a stop condition by displaying the STOP DRIVE TO ADJUST message.	Page 31
• There is a facility for an improved small-signal current response for high-performance applications.	Page 365
The PL/X provides robust and configurable I/O to interface with instruments and PLCs.	Page 68
A Diagnostics menu allows monitoring of all relevant inputs and outputs in engineering units and percentages.	Page 205
There are also default % Diagnostic Summary screens.	Page 74
With the drive commissioned safely, you can now:	
• Begin implementing more complex Applications blocks.	Page 245
• You can enter a password to prevent unauthorised re-calibration	Page 243

1.4 Testing using a small motor

Select from two different motor parameter sets for the PL/X: MOTOR 1 (default) and MOTOR 2. Refer to "11.1.15 20)MOTOR 1,2 SELECT" on page 126.

MOTOR 2 contains a set of parameters with values to suit very small motors for use during a system test:

- Selecting MOTOR 2 saves time, as there is no need to alter and reset the PASSIVE MOTOR SET parameters listed below. These six parameters constitute the difference between the MOTOR 1 and MOTOR 2 parameter sets.
- Note that the dynamic performance of the small test motor will not be as good as that of a correctly calibrated and Autotuned motor, but it should be sufficient for most purposes.

Reselecting MOTOR 1 will re-install the MOTOR 1 parameter settings as the active set.

Parameter	Range	Defaults		PIN	Details
		MOTOR 1	MOTOR 2		
CALIBRATION / 4)RATED FIELD AMPS	0.1 – 100% A	25% Amp	1 Amp	4	Page 117
SPEED CONTROL / 71)SPEED PROP GAIN	0 – 200.00	15.00	5.00	71	Page 162
CURRENT CONTROL / 81)CUR CLAMP SCALER	0 - 150.00%	150.00%	10.00%	81	Page 169
CURRENT CONTROL / 93)CUR PROP GAIN	0 – 200.00	30.00	5.00	93	Page 172
CURRENT CONTROL / 94)CUR INT GAIN	0 – 200.00	3.00	1.00	94	Page 172
CURRENT CONTROL / 95)CUR DISCONTINUITY	0 – 200.00%	13.00%	0.00%	95	Page 173

NOTE: Using a very small, unloaded motor on high-rated PL/X units may trigger a missing pulse alarm because the armature current demand exceeds the missing pulse detection threshold. Set parameter "13.1.5 175)MISSING PULSE EN" on page 228 "to DISABLED to prevent the alarm.

Refer also to "17.19.3.3.1 Jumper selections (50% / 100% rating)" on page 369 for details of the burden jumper, where opting to use a high-value burden resistor provides an alternative method of testing the PL/X using small motors.

1.5 Configuration tool

The PL/X series of DC Drives operate with several ethernet-based distributed control systems (DCS) hardware and software. These software tools may create a diagram of the control system.

Implement your system economically using off-the-shelf ethernet hubs and connection cables to connect multiple drives into a control system using virtual connections.

Please contact Sprint-Electric for details of using DCS.

1.6 Archiving PL/X Recipes

After establishing a working set of parameters and configuration connections, we recommend archiving your changes. DCS tools are available for creating an archive.

Please contact Sprint-Electric for details of using DCS.

1.7 What to do in the event of a problem

Is the PL/X being commissioned for the first time? If so, have you been able to tick the boxes in "3.4 Essential pre-start checks" on page 22?

1.7.1 A simple clarification of a technical issue

A telephone call, fax or email can often resolve problems. If telephoning, please have this manual to hand at the time of calling. When forwarding information about your enquiry, please include the following information:

- Product serial number.
- Software version number (if possible) - refer to "15.1.3 SOFTWARE VERSION" on page 242.

1.7.2 A complete system failure

Contact the equipment supplier for assistance. The experienced engineer helping you understands the importance of delivering a solution, considering that you may be working in challenging conditions. Please provide the following:

- Product serial number.
- Software version number (if possible) - refer to "15.1.3 SOFTWARE VERSION" on page 242.
- Wiring diagram of the PL/X installation with details of external signals connected to the PL/X.
- Machine schematic with details of the intended function of the motor being driven by the PL/X.
- All possible motor details.
- A precise description of the fault condition, including any alarm messages issued by the PL/X.
- Operating conditions before and at the point of the failure (if possible).
- The precise parameter changes made to the default values, or provide a Recipe file.

WARNING!

PERSONAL INJURY HAZARD

Read and understand the General Risks given at the front of this manual when performing measurements and investigating failures.
This applies to electrical and mechanical systems.

1.7.3 Finding the software version of the unit

Refer to "15.1.3 SOFTWARE VERSION" on page 242.

1.7.4 How to reset the unit

Refer to "17.19.1 677)RECIPE PAGE" on page 363:

- NORMAL RESET
- 2-KEY RESET
- 3-KEY RESET
- 4-KEY ROM RESET

1.7.4.1 4-KEY RESET (to factory defaults)

Performing a 4-KEY RESET restores the factory block connections and parameter defaults, with the exceptions listed below. You must carry out a PARAMETER SAVE to retain the newly installed default settings.

- The PASSWORD is reset to 0000. Refer to "15.2 DISPLAY FUNCTIONS / PASSWORD CONTROL" on page 243.
- The 4-KEY RESET does NOT affect the prevailing MOTOR 1 and MOTOR 2 Calibration parameters, which are:
  - parameters PIN 2 to PIN 20
  - 100)FIELD VOLTS OP %
  - 680)Iarm BURDEN OHMS
- The MOTOR 1,2 SELECT parameter is NOT overwritten by the 4-KEY RESET.

For more information:

Refer to "1.4 Testing using a small motor" on page 5.

Refer to "9.3 Restoring parameters to default conditions" on page 79.

Refer to "17.19.1 677)RECIPE PAGE" on page 363.

2 Commissioning

The suggested Commissioning strategy starts in the safest possible mode of operation and progressively exercises each element of the system to achieve full functionality.

IMPORTANT: Incorrect control of the main contactor is the most common failure encountered, and we highly recommend that you read this chapter very carefully.

The following table outlines the sequential steps for commissioning the drive. Create your application by selecting a Power Wiring method and a Control Wiring method from various interchangeable options. The default Drive Personality, which includes programming and defaults, is suitable for most applicaitons. After the intitial setup, you can customise and refine each application, saving up to three different Recipe pages.

NOTE: The simple installation provided by "3 QuickStart Guide" on page 12 (and also the separate PL/X QuickStart Guide booklet) combines "METHOD 1 - Power Wiring" and "METHOD 1 - Control Wiring". It is described by the Basic Application drawing "Figure 14 Basic application wiring diagram: speed or torque control" on page 59.

1	**Main contactor operation**	Read and understand about the main contactor operation.	Page 9
2	**Mechanical installation**	Install on a wall or in an enclosure. All PL/X drives have venting requirements but note that larger drives have internal fans requiring a separate power source. These drives may also benefit from using the optional venting kit.	Page 35
3	**Study the QuickStart's basic application wiring diagrams.**	Note how you can interchange the various wiring methods.	Page 50
4	**Electrical installation**	Select from three Power Wiring methods - each method has its advantages and disadvantages. Wire your selected Power Wiring method. Select from three Control Wiring methods. Wire your selected Control wiriring method.	Page 52 Page 58
5	**Display and MMI**	Read and understand how to operate the drive using the display and programming keys.	Page 76 Page 74
6	**QuickStart Guide**	Complete the QuickStart Guide to perform essential pre-start checks, power-up the drive, enter CALIBRATION parameters and follow the steps to starting the drive.	Page 12
7	**Further commissioning**	Modify the QuickStart's basic installation.	Page 1

2.1 Understanding main contactor operation

The purpose of the main contactor is to provide electro-mechanical isolation of the motor armature from the power supply.

The essential elements of controlling the contactor are as follows:

1. **It must be possible to release the contactor without relying on electronics.**
2. **The contactor must not break current. To obey this rule, the following applies:**
    a. **The PL/X must not attempt to deliver armature current until after the contactor closes.**
    b. **The armature current must be at zero before the contactor opens.**
3. **The contactor control circuit must be compatible with all likely application requirements.**

The PL/X can control all of the above requirements in the use of the main contactor.

In the event of an emergency, it must be possible for the supply to be removed electromechanically (without the aid of semiconductor electronics).
This requirement is usually mandated by safety codes.

Under normal operation, the PL/X controls the contactor according to the programmed requirements of the user - refer to Page 149.

The CSTOP (coast stop) terminal T34 goes directly to the 24 V coil of the internal contactor control relay (the relay contacts are on T45 and T46).

- If 24 V is supplied to CSTOP (T34) then the relay (and hence the main contactor) is ready to be controlled by the PL/X.
- If 24 V is **not** supplied to CSTOP (T34), the relay is de-energised, thereby releasing the main contactor, or it is not energised.

A capacitor across the relay coil causes it to have a defined drop-out time of approximately 100 ms, ensuring that the PL/X has time to commutate the armature current to zero before the contacts open.

WARNING!

EQUIPMENT DAMAGE HAZARD

It may be necessary for installations to have over-riding external independent systems for de-energising the supply side or dc contactor. In this case, we recommend that the CSTOP terminal is opened 100 ms prior to de-energising the supply side or dc side contactor. Failure to do so may result in damage to the PL/X.

2.1.1 Main contactor control Q & A

Question	**Why is it so important to prevent the contactor from** **1) Breaking current** **or** **2) Making current?**
Answer	**1) Breaking current** The motor armature is an inductive load, helping to smooth the current by storing electrical energy during a charging period and releasing it during a discharging period. However, if the circuit breaks suddenly, stored energy has nowhere to go and causes a rapid rise in voltage as the inductor (motor armature) tries to find a discharge path. This rapid transient can cause thyristors in the armature bridge to become conductive. If this happens to a pair of thyristors, an effective short-circuit can form across the armature. A second effect then occurs. Abruptly shorting a rotating motor causes mechanical energy stored in the rotation of the motor and load to generate into the short-circuit. It could be a destructive amount of energy. Thyristors can become permanently shorted and, the next time the contactor closes, the supply fuses will likely blow.
Solution	Always allow the PL/X to control the contactor. It can hold in the contactor while safely quenching the armature current. Use CSTOP (T34) for the emergency opening of the contactor via the PL/X. This electro-mechanical terminal ensures that the PL/X quenches the armature current in time. If Safety Codes prevent the PL/X from being used in the emergency stop sequence, ensure that CSTOP opens 100 ms before the main contactor opens.
Answer	**2) Making current** The motor cannot rotate if the PL/X attempts to start making current without the main contactor being closed, causing the PL/X to phase further forward in an attempt to produce the desired speed. In this situation, closing the contactor presents a stationary motor armature onto a fully phased-forward stack, straight onto the supply, producing destructive current. All this occurs in a few current cycles, far too fast for the speed loss alarms to operate.
Solution	Insert an auxiliary normally open contact on the main contactor in series with the RUN input on T31. Alternatively, use the contactor wiring method shown in "7.3.2 METHOD 2 - Power wiring" on page 53.
Question	**Many systems appear not to suffer from failures due to opening the contactor incorrectly, so why is it so important?**
Answer	If the armature current is discontinuous, which is very common, there is much less stored inductive energy, and the current also goes to zero with every current cycle. This makes a destructive situation much less likely to occur. The high-risk situations are regenerative applications and continuous current modes. However, these cases do not always result in a destructive sequence.

Question	**Even if the contactor operates according to recommendations, how is protection provided if the contactor coil supply is lost?**
Answer	It is a complicated problem to solve using electronics. The only reliable insurance is to insert a DC semiconductor fuse in the armature circuit. This fuse should open before the thyristor junction fails.
Question	**What if the grid system completely fails?**
Answer	It is not as bad as losing the contactor coil supply. Most installations naturally have other loads that provide a safe discharge path before the contactor opens.
Question	**What if the grid system fails for a few cycles? (brown-outs)**
Answer	The PL/X can ride through these kinds of supply dips. As soon as it loses synchronisation, the armature current quenches. The PL/X monitors the armature voltage so that, when the supply returns, it picks up into the rotating load at the correct speed.
Question	**What other sorts of problems occur?**
Answer	Most problems occur when users are retrofitting the PL/X into an existing system. Sometimes the system has previously controlled the contactor via a PLC or Drive healthy relay. It may not interface correctly with the PL/X, and situations may occur to drop out the contactor too quickly or bring it in too late. The common problem is that the contactor is controlled correctly during normal running but incorrectly during jogging or an emergency stop. Another instance is where the commissioning engineer uses a local operator station in a correctly designed system to get each PL/X going, but the system has an in-built control problem.

Summary:

- **Use the PL/X to control the main contactor for STOP, START, jogging and emergency stop. All sequencing occurs automatically.**
- **Fit semiconductor fuses in the AC supply and armature circuit**s.

The cost of a fuse is marginal compared to the cost of repairing a damaged drive and suffering machine downtime and engineer call-out costs.

NOTE: If your main contactor has a closing time delay of greater than 75 ms, take essential steps to delay the release of armature current until the main contact has closed:

1. **Wire an auxiliary normally-open contact on the main contactor in series with the RUN input on T31 - refer to** "7.3.3 METHOD 3 - Power wiring" on page 54**.**
2. **Alternatively use the contactor wiring method shown in** "7.3.2 METHOD 2 - Power wiring" on page 53**.**

Contactor coils usually have a high inductance.

When the contactor is de-energised, it can produce high energy arcing on the internal PL/X control relay that may degrade the life of the relay and/or produce excessive EMC emissions.

Ensure that the contactor coil has a snubber (resistor/capacitor combination) fitted.

3 QuickStart Guide

3.1 Introduction

Follow the steps outlined in this guide to install and initiate the PL/X as a **basic** speed controller, employing ARMATURE VOLTAGE feedback mode for optimal safety.

The PL/X drive displays user-friendly menus and parameter names. Use the key sequences we provide at each step to navigate and edit parameter values with no knowledge of the menu system required.

When finished:

- Refer to "7 Electrical installation" on page 49 for further information, including alternative power wiring and control wiring methods.

NOTE: The simple installation provided by this QuickStart Guide combines "METHOD 1 - Power Wiring" and "METHOD 1 - Control Wiring". It is described by "Figure 23 Basic application wiring diagram: speed or torque control" on page 50.

3.1.1 Important safety notes

Pay particular attention to all the safety warnings in this guide.

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Electric shock risk! Electrical devices constitute a safety hazard.

Do not attempt to commission the PL/X unless you:

- are qualified and have the knowledge and skills to use it safely.
- thoroughly understand the operation of the machine having the PL/X installed.
- have read and understood this document, and are familiar with electrical wiring and safety standards.

Only use qualified personnel to design, construct, operate and maintain your systems.

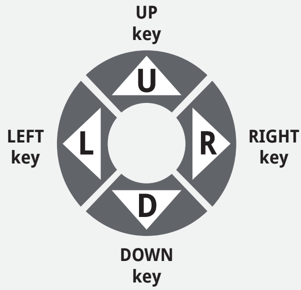
Ensure personnel who use or maintain the equipment know of all hazards involved in your equipment and processes.

If you have any doubts about the safety of your system or process, do not proceed without first consulting an expert.

Entering key sequences

Use the PL/X keypad to enter the key sequences in the order given. This will navigate the menus in the fewest key presses.

Several sequences reset at the Diagnostic Summary screens, located at the top of the menu system. This reset is used as a helpful reference point in case you lose your way.



L	Press the **LEFT** key once	**R**	Press the **RIGHT** key once
U	Press the **UP** key once	**D**	Press the **DOWN** key once
Nx	Press the indicated key **N** times. **N** specifies the number of times to press the key. For example, **8xD** means press the **DOWN** key **8** times.		
U/D	Use the **UP** and **DOWN** keys to increase/decrease values		

With the Diagnostic Summary screens displayed, an example key sequence is:

R-R-U-R-8xD-R-R-U/D (navigates to PIN 10, **U/D** changes the parameter value)

NOTE: Hold a key down to advance rapidly to a distant selection or value.

About Diagnostic Summary screens

To quickly return to the Diagnostic Summary screens from any point in the menu, hold down the **LEFT** key, releasing the key to remove the ENTRY MENU reminder screen.

```
SPD% Iarm Ifld RJSC
0    0    0    0000
```

```
Sref Ilim -Ilim mode
0    0    0     STOP
```

```
ENTRY MENU    LEVEL 1
```

At the top of the menu system are two alternating Diagnostic Summary screens. To access the ENTRY MENU from this point, press the RIGHT key.

ENTRY MENU reminder screen

This screen reminds you to press the **RIGHT** key to view the ENTRY MENU. It displays when you press the **LEFT**, **UP** or **DOWN** key while viewing the Diagnostic Summary screens.

```
PRESS RIGHT KEY FOR
ENTRY MENU    LEVEL 1
```

How to save parameters

Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key. Enter the sequence **R-U-R-U**.

Key	Action
R	Display the PARAMETER SAVE screen
U	
R	
U	Press the **UP** key to continue and save

```
PARAMETER SAVE      2
 UP KEY TO CONTINUE
```

3.2 Record your CALIBRATION parameter data

Measure the supply voltage and record it below. Also, record the parameter values from the motor and feedback device nameplates for entry into the Calibration menu later.

Description	Example values	Record your value	Units	Property "S"
2)RATED ARM AMPS Rated armature current	35		Adc	S
3)CURRENT LIMIT(%) Current limit	your setting:		%	-
4)RATED FIELD AMPS Field current @ base speed	1.35		Adc	S
5)BASE RATED RPM Base speed	1750		rpm	S
6) DESIRED MAX RPM Maximum speed	2300		rpm	-
9)SPEED FBK TYPE Speed feedback type		ARMATURE VOLTAGE		S
18)RATED ARM VOLTS Rated armature volts	500		Vdc	S
19)EL1/2/3 RATED AC Supply voltage	480		Vac	S
Field volts (refer to PIN 4)	used to calculate field current if not known		Vdc	
ENCODER / TACHO information				
8)MAX TACHO VOLTS DC tachogenerator	60		V/1000 rpm	S
11)ENCODER LINES Encoder lines	1024		PPR	S
Encoder volts	5 - 24		Vdc	
Field weakening information				
Field current @ maximum speed			Adc	

3.1.2 Property "S" parameters

Refer to "18 PIN tables" on page 374 to identify all parameters with property "S".

- The PL/X keys will not change the values of property "S" parameters while the motor is running.
- A change made to the 20)MOTOR 1,2 SELECT parameter while the motor is running will NOT become active until after a STOP sequence.

This functionality provides an extra level of safety during motor running while allowing dynamic alteration of important parameters.

3.3 Installation

3.3.1 Connect the drive

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Before beginning to connect the drive, ensure that all power is OFF.

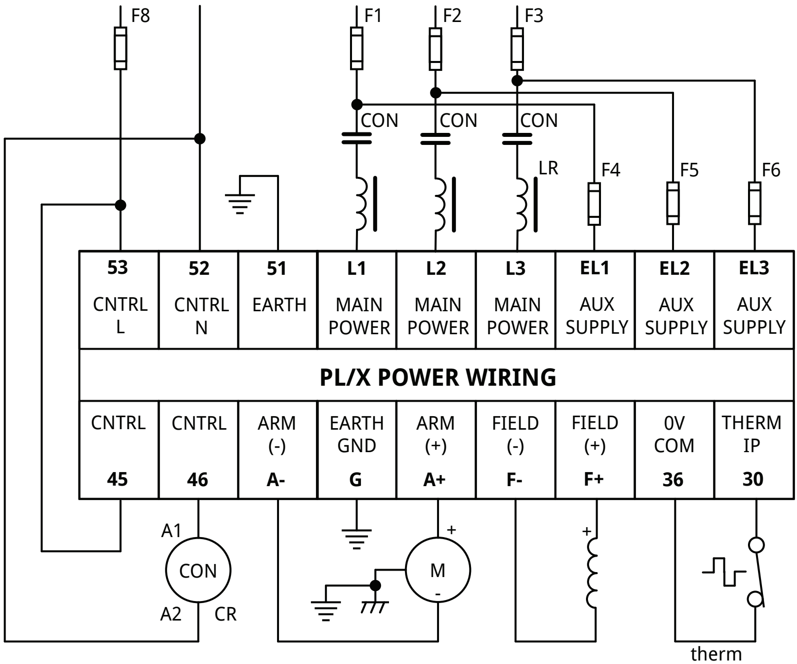
Make sure that you route power and control wiring in separate conduit/cable trays. Wiring must meet all applicable national and local electrical regulations.

Make sure that the voltages on the EL1/EL2/EL3 terminals are in-phase with the voltages on L1/L2/L3.

For reliable operation, the PL/X must control the supply side or dc side contactor through its CON1 and CON2 terminals terminals (T45 and T46).

3.3.1.1 Wiring diagrams

NOTE: Refer to "10.5 Fuses" on page 96 for fuse specifications.



UL Requirement:
a thermistor **must** be fitted.

If not fitting a thermistor to the motor, short together terminals 36 and 30.

Figure 2 Power wiring diagram

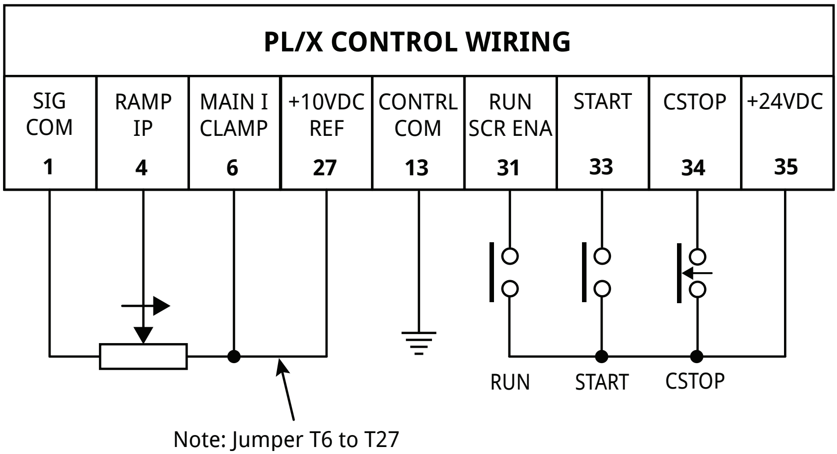


Figure 3 Control wiring diagram

3.3.1.2 Optional feedback devices

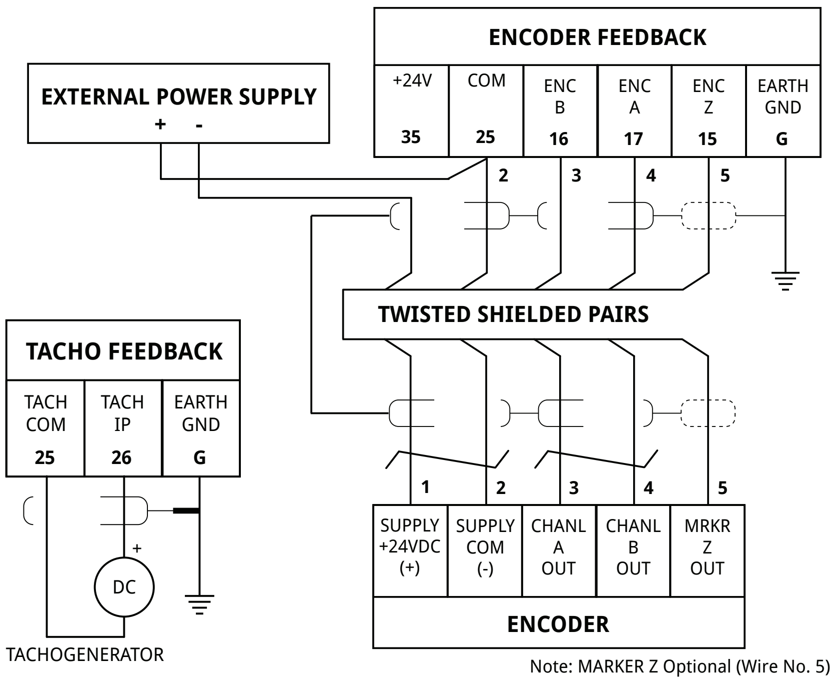


Figure 4 DC tachogenerator

Figure 5 Encoder

3.3.2 Frame 1 - PL/X5-50

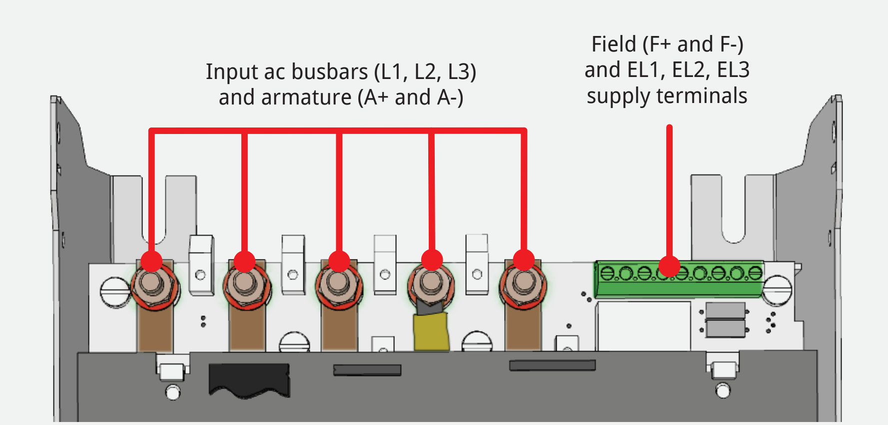


Figure 6 Frame 1 - top connections

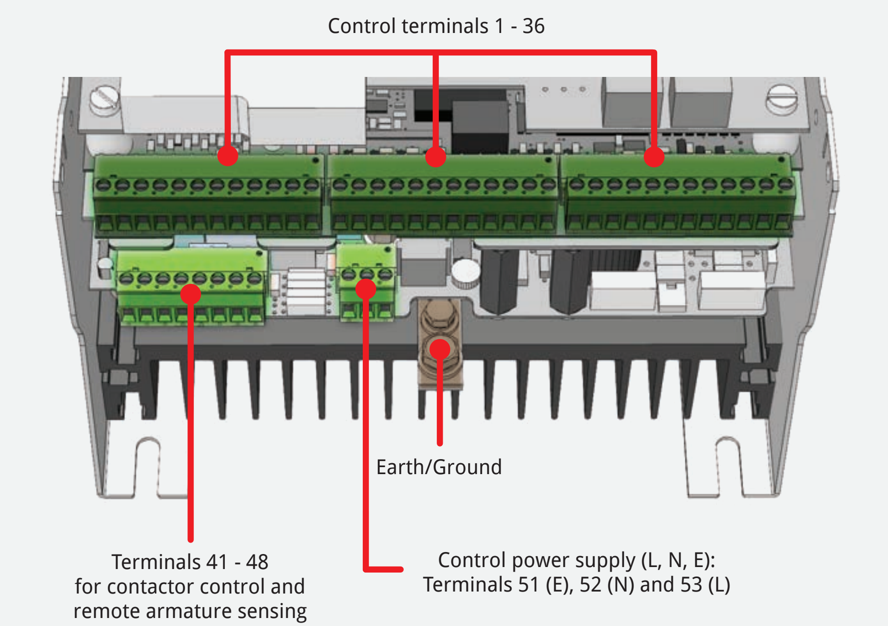


Figure 7 Frame 1 - bottom connections

3.3.3 Frame 2 - PL/X65-145

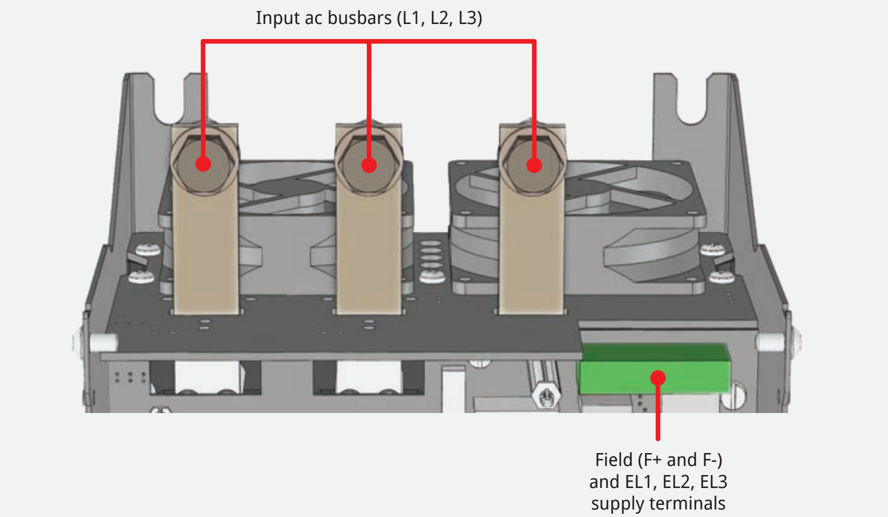


Figure 8 Frame 2 - top connections

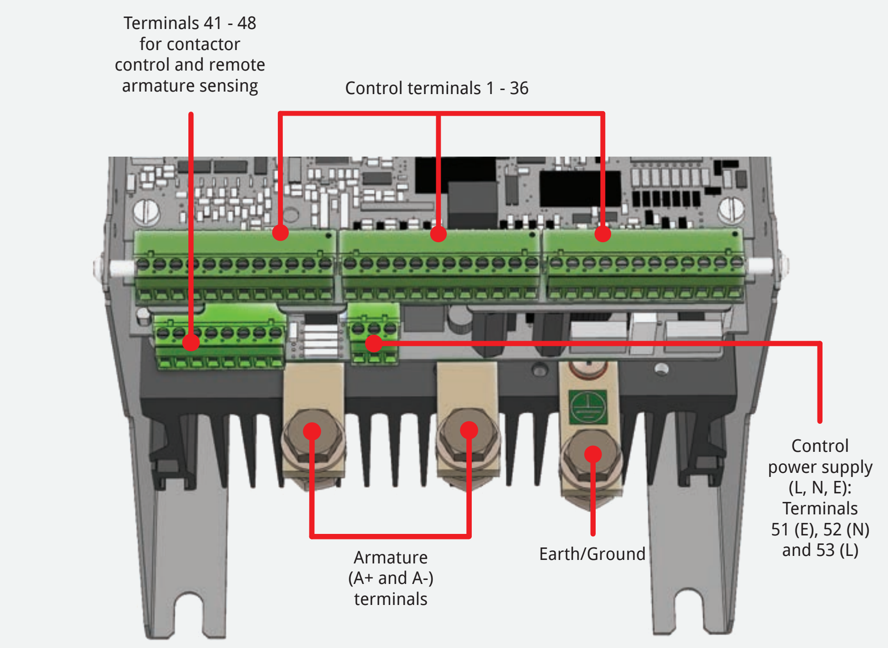


Figure 9 Frame 2 - bottom connections

3.3.4 Frame 3 - PL/X185-265

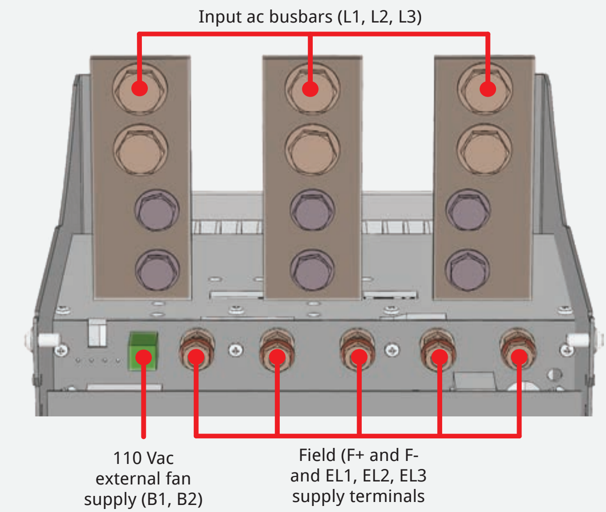


Figure 10 Frame 3 - top connections

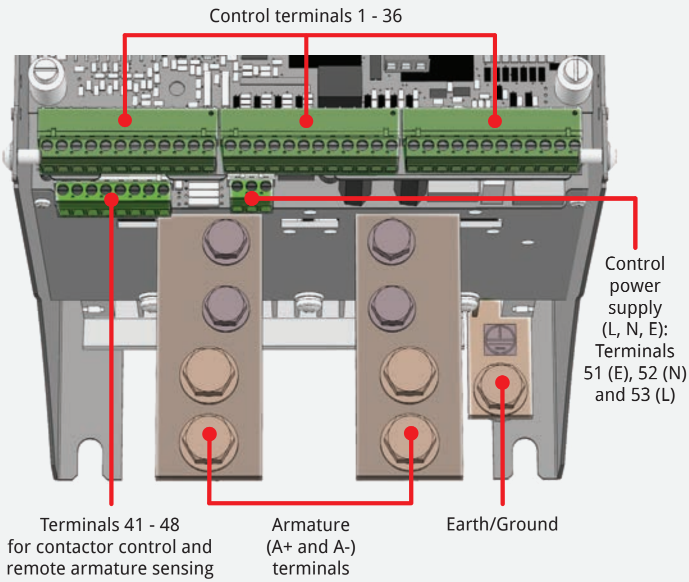


Figure 11 Frame 3 - bottom connections

3.3.5 Frame 4 - PL/X275-440

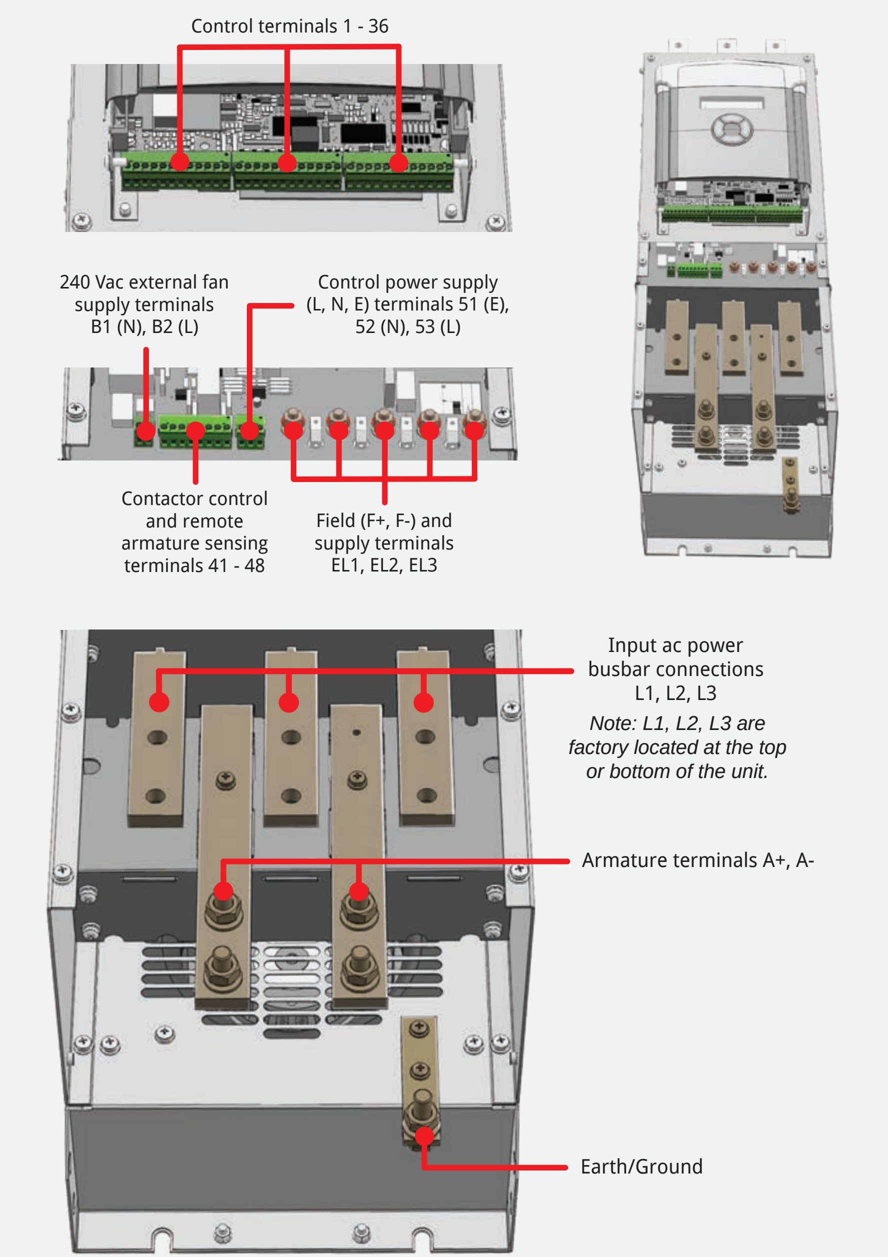


Figure 12 Frame 4 - top and bottom connections

3.3.6 Frame 5 - PL/X520-980

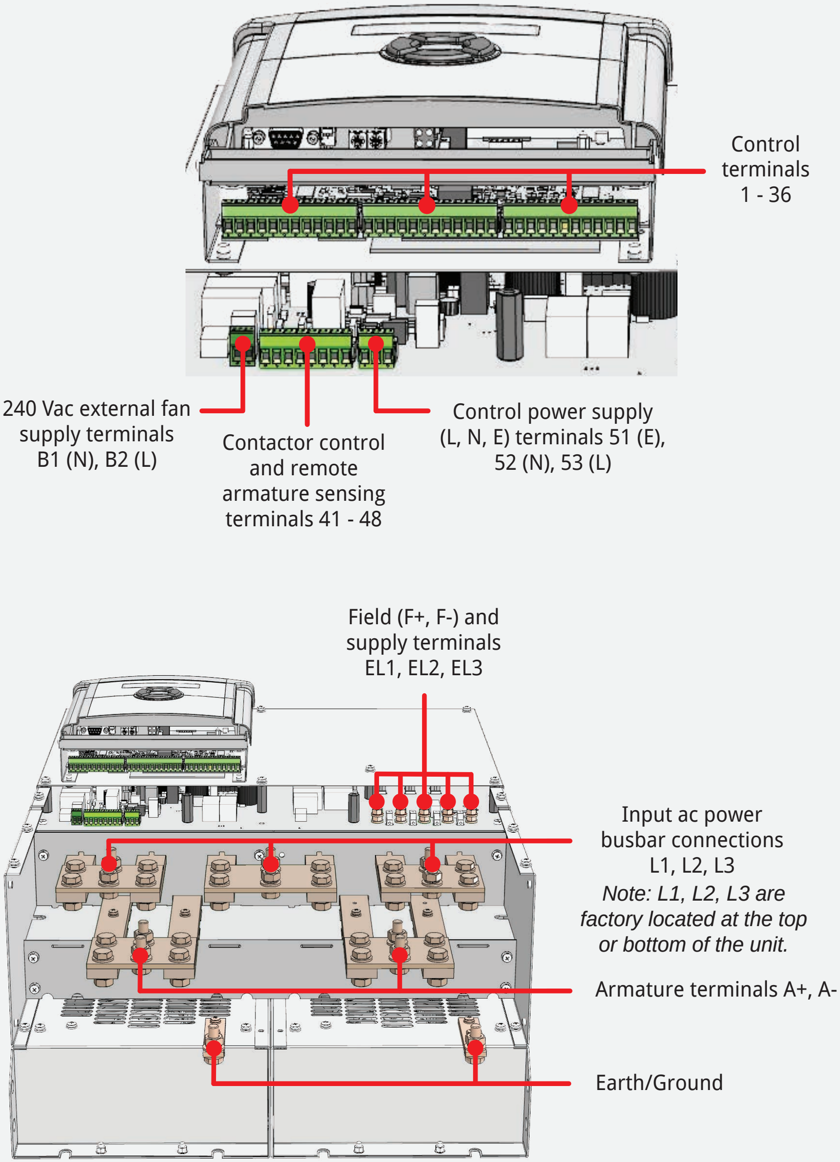


Figure 13 Frame 5 - top and bottom connections

3.4 Essential pre-start checks

Make the essential mechanical and electrical pre-start checks before applying power to the motor. You need to ensure that you can mark each item on the checklists as completed.

Failing to comply with these requirements may cause incorrect functioning or damage to the drive and/or installation - **this will invalidate any Warranty**.

3.4.1 CHECK LIST: Mechanical

	Tick each each item when complete.	☑
1	Check that the motor, and load if fitted, are free to rotate without causing damage or injury even in the event of incorrect rotation direction or loss of control.	☐
2	Blow clean, dry air over the commutator to clear it of extraneous matter. Check the brushes are correctly seated and that the brush tensions are correct.	☐
3	Check the motor vent blower is free to rotate. Remember to re-check the airflow when the blower is operating.	☐
4	Check the emergency stopping and safety procedure, including local and remote actuators, before applying power to the motor.	☐
5	Check the installation is clean and free of debris, swarf, clippings, tools etc. Check the enclosure has adequate ventilation with clean, dry, cool, filtered air. Check the PL/X heatsink fans are operating and that the flow of air over the heatsink is unobstructed when the motor is running. Refer to "10 Technical specifications" on page 91 for cooling airflow data.	☐

3.4.2 CHECK LIST: Electrical

Tick each each item when complete. ☑

1	Check that all external fuses are of the correct rating and type. The total clearing I^2t ratings of the main fuse and auxiliary fuse must be smaller in value than the rating specified in the rating tables. Refer to "10 Technical specifications" on page 91 - semiconductor fuse ratings.	☐
2	Check the motor armature resistance, expected to be a few Ohms over a 360° rotation dependent upon the size of the motor, i.e. not a short-circuit. Check that the field resistance in Ohms = (field data plate volts) / (field data plate current). Check inside the motor terminal box to verify the correct wiring.	☐
3	Check the 3-phase auxiliary supply phasing on EL1/2/3 equates to the phasing of the main stack supply on L1/2/3, and the 1ph control supply on T52/53 is correct.	☐
4	Check that the drive and 3-phase supply current and voltage ratings are compatible with the motor and load requirements (both armature and field, current and voltage).	☐
5	Check that the cables and termination are rated to carry the rated current, with no more than a 25°C temperature rise. Check all terminations are tight to the correct torque. Refer to "7.4.3 Terminal tightening torques" on page 56.	☐
6	Check that the main contactor operates by using the CON1/2 contact on terminals T45 and T46.	☐
7	Check the wiring for short-circuit faults: **AC power** to ground, to signal and to control; **DC power** to ground, to signal and to control; **signal** to control and to ground. Disconnect the drive for wiring tests using a Megger (control terminals are a plug-in type).	☐
8	Check that the engineering standards used will comply with any local, national, or international codes in force. Safety requirements take priority.	☐
9	If the load regenerates or if regenerative braking is in use, then we highly recommend using a DC rated armature fuse with the correct I^2t rating in series with the motor armature. Refer to "10.5 Fuses" on page 96.	☐
10	Check that a protective chassis earth connection, in accordance with the relevant codes, exists at the terminal bar provided at the bottom edge of the PL/X.	☐
11	Check that a protective clean earth connection exists at the control 0 V on T13 to ensure that the installation complies with the protective Class 1 requirements.	☐

3.5 Final checks BEFORE applying power

- Recheck all wiring, especially the drive's chassis ground.
- Use a multimeter to check the L1, L2, L3, F+, F-, A+, and A- terminals for short-circuits to ground. All readings should be greater than 1 MΩ.

If any resistances are lower than 1 MΩ, correct them before you apply power.

3.5.1 CSTOP/RUN/START control terminal functions

WARNING!

PERSONAL INJURY HAZARD

The Safety Codes do not accept electronic control as a sole means of inhibition for the PL/X. Do not rely on any drive function to prevent the motor from operating when personnel are undertaking maintenance or when machine guards are open. Always isolate the power source before working on the PL/X or the motor or load.

CSTOP **Coast Stop**

For correct sequencing, this must close before all other control signals. When opened, the drive immediately stops generating rotor current, and the contactor drops out. The motor will coast to a stop.

RUN **Run - NOT SAFETY RATED**

Electronic inhibit for all operation modes. May be connected to terminal T35 with a jumper in most applications, or preferably to an auxiliary normally-open contact on the main contactor. When closed, the drive may generate current. When opened, the drive generates no rotor current.

START **Start**

When closed, the drive's contactor operates, and the motor runs at the potentiometer's speed setting. When opened, the drive ramps to zero, and the contactor opens after a delay (default: 2 seconds).

3.6 Apply control power to the PL/X

Is the PL/X being commissioned for the first time? If so, you must be able to complete "3.4 Essential pre-start checks" on page 22?

Now apply 110 - 240 Vac control power to terminal T53 (Line) and T52 (Neutral). After a short self-test, the PL/X will display the Diagnostic Summary screens at the top of the menu system.

3.7 QuickStart steps

Always commission the drive using ARMATURE VOLTAGE feedback, even if the motor has a dc tacho or encoder. It allows verification of the feedback polarity, ensuring that the motor does not run out of control.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Follow the QuickStart steps below as written and in the correct numerical order.

Calibrate the drive to the motor

Enter your values from Page 14.
NOTE: U/D means to use the **UP** and **DOWN** keys freely to change the values.

1	Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.		
2	Rated Armature Current	**R-R-U-R-R-U/D**	2)RATED ARM AMPS 35.0 AMPS
3	Rated Field Current	**L-D-D-R-U/D**	4)RATED FIELD AMPS 2.00 AMPS
4	Rated Base Speed	**L-D-R-U/D**	5)BASE RATED RPM 1750 RPM
5	Required Maximum Speed	**L-D-R-U/D**	6)DESIRED MAX RPM 1750 RPM
	NOTE: The base speed is the same as maximum speed unless using field weakening to extend the speed range. ("3.8.2 Field weakening" on page 30).		
6	Rated Armature Volts	**L-9xD-R-U/D**	18)RATED ARM VOLTS 500.0 VOLTS
7	Supply Voltage	**L-D-R-U/D**	19)EL1/2/3 RATED AC 460.0 VOLTS
	Check the following have not been modified from their factory default settings. If necessary, correct the selections to those shown below.		
8	Motor 1/2 Select	**L-D-R-U/D**	20)MOTOR 1,2 SELECT MOTOR 1
9	Speed Feedback Type	**L-8xU-R-U/D**	9)SPEED FBK TYPE ARMATURE VOLTS
10	**Save the parameters**. Refer to Page 13.		

Check the control terminals

Complete these checks to ensure that the drive contactor is sequenced correctly before the 3-phase power is applied.

NOTE: The value under the letters TRJSC in the display indicates the actual Control input terminal status.

Letter	Terminal	Function
T	30	THERMISTOR
R	31	RUN
J	32	JOG
S	33	START
C	34	CSTOP

11 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

12 Leave the CSTOP contact open (zero displays under the C) and close the other control contacts.

R-D-R-4xD-R-D-D-R

```
164)DOP 123TRJSC CIP
        10101110
```

Check that the digit under the appropriate letter changes as you cycle the contact.

NOTE: Generally **1 = ON** and **0 = OFF** (however, for the thermistor T, **0 = 0k** while **1 = Motor Overtemp**).

When T, R and S control inputs are operating correctly, leave R and S **OFF** and check the C control input for correct operation.

```
164)DOP 123TRJSC CIP
        10100000
```

Apply main 3-phase power to the PL/X

13 **Apply main 3-phase power.**

Autotune the PL/X

Before running the motor, you **must** perform the Autotune as follows. This procedure automatically tunes the drive's current loop by adjusting parameters 93, 94, and 95.

14 Set RUN and CSTOP high but leave START low. The control inputs should match TRJSC opposite.

Continuing from " Check the control terminals" on page 26 above.

```
164)DOP 123TRJSC CIP
        10101001
```

15 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

16 Enable the autotune mode.

R-R-6xD-R-7xD-R-U

```
92)AUTOTUNE ENABLE
      ENABLED
```

17 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

18 Start the drive by energising the Start input (T33).

RJSC can also be seen on the Diagnostic Summary screens

```
SPD% Iarm Ifld RJSC
0    0    0    1011
```

19 The contactor closes, and the drive Autotunes (it takes 10 - 60 seconds). When complete, the drive's contactor opens. Turn off the Start input (T33).

- Autotune is a static test.
- There is no need to disconnect the motor from the load.
- The motor field is automatically disabled.
- If the motor back emf is detected to be above a certain level implying excessive rotation, Autotune aborts.
- Completing the Autotune routine forces the main contactor to drop-out, and AUTOTUNE ENABLE to reset to DISABLED.

Should Autotune fail, refer to "11.10.6 92)AUTOTUNE ENABLE" on page 171, or contact your Supplier.

Motor rotational checks

Disconnect the motor from the gearbox and machine before commencing these checks.

20 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

21 Reduce the current limit.

As an added precaution, restrict the available current to the drive by reducing the Current Limit to provide just enough current to turn the motor (usually 5 to 10%).

R-R-U-R-D-R

```
3)CURRENT LIMIT(%)
     5.00 %
```

22 Check the speed potentiometer operation.

Monitor the Ramp input to check the operation of the speed potentiometer. Leave the reference at zero when operating correctly.

L-L-D-R-5xD-R

```
26)RAMP INPUT
    75.14 %
```

23 **Save the parameters**. Refer to Page 13.

Reconnect the motor to the gearbox and machine.

24 Start the drive.

Energise the START input (T33) to start the drive. Check the field voltage at the F+ and F- terminals. When the motor is cold, you will measure less than the rated field voltage.

25 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

26 Confirm the field current matches the nameplate data.

R-D-R-D-D-R-D-D-R

```
145)FLD CUR AMPS MON
    1.35 AMPS
```

27 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

28 Increase the potentiometer setting until the motor turns slowly.

Check motor rotation. If it is turning backwards, stop, turn off ALL power to the drive and swap the armature leads (A+ and A-). Recheck after changes.	**L-L-D-R-5xD-R**	26)RAMP INPUT 75.14 %

29 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

30 Slowly bring the motor to full speed.

Check the voltage on the A+ and A- terminals as you slowly bring the motor up to full speed.	**R-D-R-R-3xD-R**	126)ARM VOLTS MON 500.0 VOLTS

31 **Save the parameters**. Refer to Page 13.

Increase the current limit to rated value

31 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

32 Return the current limit to 150%.

	R-R-U-R-D-R-U	3)CURRENT LIMIT(%) 150.00 %

33 **Save the parameters**. Refer to Page 13.

The PL/X Digital DC Drive is now successfully commissioned.

3.8 Options

3.8.1 Feedback

3.8.1.1 Feedback calibration

Enter your values from Page 14 for DC Tachogenerator or Encoder:

1 Start the drive.

Energise the START input (T33) to start the drive. Check the field voltage at the F+ and F- terminals. When the motor is cold, you will measure less than the rated field voltage.

2 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

3 **DC Tachogenerator**

For a dc tachogenerator, calibrate the drive to the expected dc voltage for base speed.

Base Tacho Voltage = (Base Speed/1000) x Tacho Volts per 1000 rpm.

The tacho voltage must not exceed 200 Vdc.

R-R-U-R-6xD-R-U/D

```
8)MAX TACHO VOLTS
   87.50 VOLTS
```

4 **Encoder/PPR**

If the encoder is a quadrature type, enable 10)QUADRATURE ENABLE as below. For a pulse and direction type encoder, the parameter must be DISABLED.

R-R-U-R-8xD-R-R-U/D

```
10)QUADRATURE ENABLE
     ENABLED
```

NOTE: On PL models only, it is also possible to operate with a pulse-only encoder (no direction signal).

In both cases (**4**), set the number of encoder lines (PPR: pulses per revolution).

L-D-R-U/D

```
11)ENCODER LINES
      1024
```

5 **Save the parameters**. Refer to Page 13.

3.8.1.2 Preparing for Tacho/Encoder use

6 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

7 Check to ensure the speed reference is positive (+):

R-D-R-R-R

```
123)TOTAL SPD REF MN
      26.50 %
```

8 Check the sign of the feedback:

DC tachogenerator: **6xD**

```
129)TACHO VOLTS MON
     23.19 AMPS
```

If positive (+), continue to step 9 below. If negative (-), stop and power-off the drive. Exchange the tachogenerator leads on T25 and T26 and recheck.

Encoder: **2xD**

```
132)ENCODER RPM MON
      464 RPM
```

If positive (+), continue to step 9 below. If negative (-), stop and power-off the drive. Exchange the encoder leads on T16 and T17 and recheck. Alternatively, check and adjust `13)ENCODER SIGN`:

3xL-U-R-U-R-8xD-R-3xD-R-U/D

```
13)ENCODER SIGN
       INVERT
```

3.8.1.3 Selecting Tacho/Encoder feedback type

9 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

10 Stop the drive and select the appropriate feedback type as follows:

DC tachogenerator: **R-R-U-R-7xD-R-U/D**

```
9)SPEED FBK TYPE
    ANALOG TACHO
```

Encoder: **R-R-U-R-7xD-R-U/D**

```
9)SPEED FBK TYPE
       ENCODER
```

11 **Save the parameters**. Refer to Page 13.

12 Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

13 Start the drive and make sure the maximum speed is achievable, and the armature voltage does not exceed the nameplate armature voltage.

14 Stop the drive.

3.8.2 Field weakening

When using either tacho or encoder feedback, you can enable field weakening for a motor which supports an extended speed range. Refer to "11.14 CHANGE PARAMETERS / FIELD CONTROL/FLD WEAKENING MENU" on page 188.

4 Self-test messages

A group of self-test messages provide information about problems occurring in the PL/X that are not related to the motion control system. A message displays when a problem occurs and is not saved internally for later access. Take remedial action to cure the problem, which clears the message.

Self Test Message	
The PL/X has facilities to allow all the parameter settings to be transferred serially from another source using PARAMETER EXCHANGE. This transfer may be from another drive or computer. The process is called DRIVE RECEIVE. Refer to the PL/X Serial Communications Manual, HG105289EN00 (DRIVE RECEIVE).	INITIALISING DATA CORRUPTION

This alarm appears at the end of the DRIVE RECEIVE parameter transfer process if the transfer corrupts the drive parameters. The most likely cause for this problem is DRIVE RECEIVE of a corrupted parameter file. The contents of the target Recipe page will now show corruption.

It is possible to restore the original Recipe to the PL/X if the PL/X still holds the prevailing parameters and settings before the corruption. To restore the parameters from the PL/X's volatile memory:

1. Press the LEFT key. The PL/X now displays the parameters before corruption.
2. Go to the PARAMETER SAVE menu and save these parameters to overwrite the corrupt data held in the target Recipe page.

Unfortunately, you cannot use the desired new file (now known to be corrupted).

If the alarm appears at power-up, then the LEFT key restores factory defaults. Perform a PARAMETER SAVE after checking the following:

CAUTION!

EQUIPMENT DAMAGE HAZARD

Check that the calibration parameters and drive personality Iarm burden value are correct after restoring factory defaults. These may also need re-entering.

Refer to "17.19.1 677)RECIPE PAGE" on page 363 and "17.19.3 680)Iarm BURDEN OHMS" on page 365.

Self Test Message	
The ENABLE GOTO,GETFROM configuration selection has been left in the ENABLED state. Set to DISABLED to run the PL/X.	parameter name DISABLE GOTO, GETFROM
This alarm will appear at power-up if the self-calibration of the analog inputs has exceeded their normal tolerance. Press the LEFT key to relax this tolerance by 0.1%. Repeat to enable the PL/X to operate, although possibly at reduced accuracy. It indicates an aged component that has drifted slightly or a pollution problem.	INITIALISING SELF CAL TOLERANCE
This alarm will appear at power-up if the self-calibration of the Proportional armature current amplifier has failed. If turning the control supply off and on does not remove the problem, then a hardware failure is suspected.	INITIALISING PRP ARM CUR CAL FAIL
This alarm will appear at power-up if the self-calibration of the Integral armature current amplifier has failed. If turning the control supply off and on does not remove the problem, then a hardware failure is suspected.	INITIALISING INT ARM CUR CAL FAIL
This message will appear when attempting to alter a parameter belonging to the class that you cannot adjust while the motor is running. The message will blink when pressing the UP/DOWN keys, and the parameter remains unaltered. The PL/X must stop for the parameter to be adjusted.	parameter name STOP DRIVE TO ADJUST
This message will appear when attempting to alter a parameter before entering the correct password. The message will blink when pressing the UP/DOWN keys. Refer to "15.2 DISPLAY FUNCTIONS / PASSWORD CONTROL" on page 243.	parameter name ENTER PASSWORD
This message will appear when attempting to configure connections without first setting ENABLE GOTO,GETFROM to ENABLED. The message will blink when pressing the UP/DOWN keys.	parameter name ENABLE GOTO, GETFROM

Self Test Message

At the end of a configuration session, the ENABLE GOTO,GETFROM window must be set to DISABLED. This message appears if any PIN has more than one GOTO accidentally connected to it during the session. It will also appear as an alarm message when asking the PL/X to run while there is a GOTO CONFLICT, e.g. if a parameter file containing a GOTO CONFLICT is loaded.

```
!!!!!! ALARM !!!!!!!
GOTO CONFLICT
```

Refer to "17.21 CONFIGURATION / CONFLICT HELP MENU" on page 373.

This message will appear for a variety of reasons:

```
INTERNAL ERROR CODE
0001
```

- Codes `0001 / 2 / 3` indicate a microprocessor system problem. Please consult the supplier.
- The message `SUPPLY PHASE LOSS` indicates the control supply has dipped. Refer to "10.7 Supply loss shutdown" on page 106.
- The PL/X attempts to make and measure a small test current every time it actions a run condition.
    - Code `0005` can appear if a very small motor runs on a large PL/X with a high inductance 3-phase supply. In this case, it is necessary to re-calibrate the model rating to a lower current. Refer to "17.19.3 680)Iarm BURDEN OHMS" on page 365, and "17.19.3 680)Iarm BURDEN OHMS" on page 365 - 50% / 100% rating select.
    - Code `0005` will appear if the armature is open circuit.
    - Code `0005` will appear if supplies are missing on terminals L1, L2, L3.
    - Code `0005` will appear if not producing thyristor firing pulses.

If `INTERNAL ERROR CODE` appears when running, then:

1. The armature current will quench.
2. The main contactor and field will de-energise.
3. The digital outputs will be disabled.
4. The HEALTHY flag (PIN 698) will be set low.

The normal operation may be re-instated by pressing the LEFT key or turning the PL/X control supply off and on again.

Self Test Message	
This message will appear if a PARAMETER SAVE on RECIPE PAGE = 3-KEY RESET or a DRIVE RECEIVE of a page 3 file is attempted, **AND** the Supplier has locked the page. A Page 3 lock may be protecting a Recipe from being overwritten. Please contact your Supplier. It may also appear if changing some "special" parameters; however, this is unlikely to happen in normal operation. **IMPORTANT**: The lock status is also included in and transfers with a page 3 file. Receiving a page 3 file with a locked status will automatically lock any unlocked page 3. Refer to the PL/X Serial Communications Manual, HG105289EN00 (PARAMETER EXCHANGE with a locked RECIPE.	parameter name AUTHORISATION NEEDED
This message will usually appear if the control supply is below 90 Vac and indicates a save problem.	parameter name MEMORY WRITE ERROR
This message will appear when a file SAVED using PARAMETER SAVE, with more recent software, has been loaded onto a PL/X with incompatible older software: **By host computer using parameter exchange:** To correct the problem, press the LEFT key, and the PL/X will return to its factory default values. Unfortunately, any desired parameter changes will need to be re-entered and SAVED. Alternatively, it may be possible to use an ethernet-based distributed control system (DCS) to transfer the file. Refer to "1.5 Configuration tool" on page 5. **By transfer of EEPROM:** In this case, the original file in the EEPROM will still be intact and still work with the original younger version of the software. Refer to the PL/X Serial Communications Manual, HG105289EN00 (Parameter drive / EEPROM transfer between drives). Refer to the PL/X Serial Communications Manual, HG105289EN00 (Rules of parameter exchange relating to software version).	parameter name MEMORY VERSION ERROR

5 Mechanical installation

5.1 Cover dimensions for the PL/X family

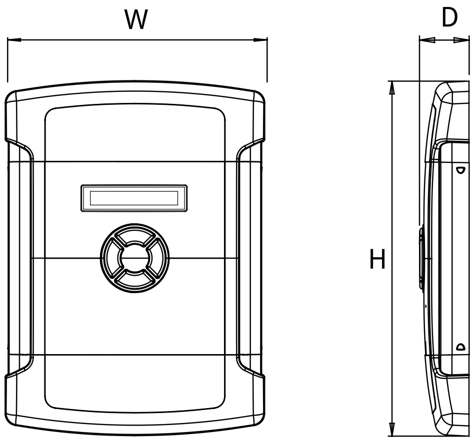


Figure 14 PL/X family - cover dimensions

Model		**Width**	**Height**	**Depth**
PL 2-quadrant		W	H	D
PLX 4-quadrant		(mm)	(mm)	(mm)
PL and PLX	5 - 980	216	292	116

NOTE: The PL/X is an open chassis component for use in a suitable enclosure.

5.2 Mechanical installation - Frame 1 PL/X 5-50

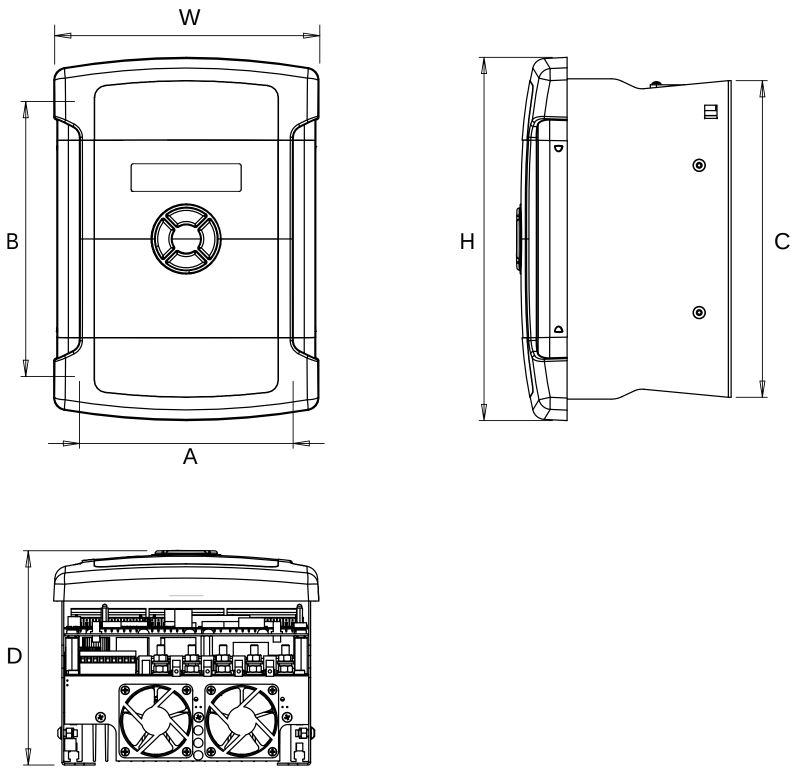


Figure 15 Frame 1 PL/X 5-50 dimensions

Model PL 2-quadrant PLX 4-quadrant		**Width**	**Height**	**Depth**	**Fixing centres**		**Height at rear**	**Weight**	**Force vented**
		W	H	D	A	B	C		
		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	
PL and PLX	5-20	216	292	175	174	224	258	5	NO
PL and PLX	30-50	216	292	175	174	224	258	5	YES

5.2.1 Mounting the Frame 1 PL/X 5-50

- Mount the PL/X vertically (as shown) using the four mounting slots: M6 (1/4 inch) screws. All mounting hole dimensions are ±2 mm.
- The rating table specifies the nominal cooling air throughput (use cool, clean, dry, filtered air).
- Do not block the heatsink fins. Allow at least 50 mm (2 inches) space above and below the PL/X.

5.3 Mechanical installation - Frame 2 PL/X 65-145

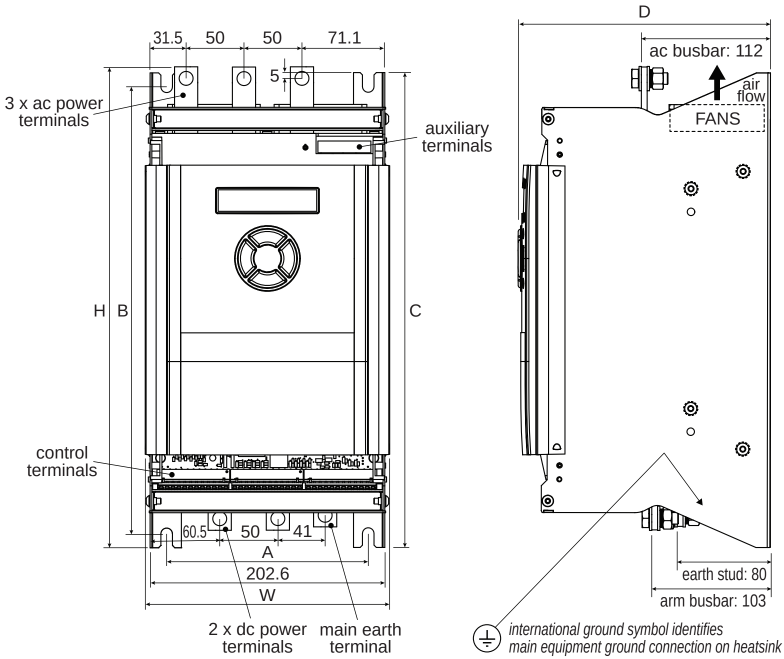


Figure 16 Frame 2 PL/X 65-145 dimensions

Model PL 2-quadrant PLX 4-quadrant		Width	Height (terminals)	Depth	Fixing centres		Height at rear	Weight	Force vented
		W	H	D	A	B	C		
		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	
PL and PLX	65-145	216	415	218	174	386	410	11	YES

5.3.1 Mounting the Frame 2 PL/X 65-145

- Mount the PL/X vertically (as shown) using the four mounting slots: M8 (5/16 inch) screws. All mounting hole dimensions are ±2 mm.
- **Mount the main contactor to avoid the transmission of mechanical operating shock to the PL/X busbars, for example, by ensuring to fit the Line Reactor between the contactor and PL/X.**
- The rating table specifies the nominal cooling air throughput (use cool, clean, dry, filtered air).
- Do not block the heatsink fins. Allow at least 100 mm (4 inches) air clearance above and below the PL/X.

5.4 Mechanical installation - Frame 3 PL/X 185-265

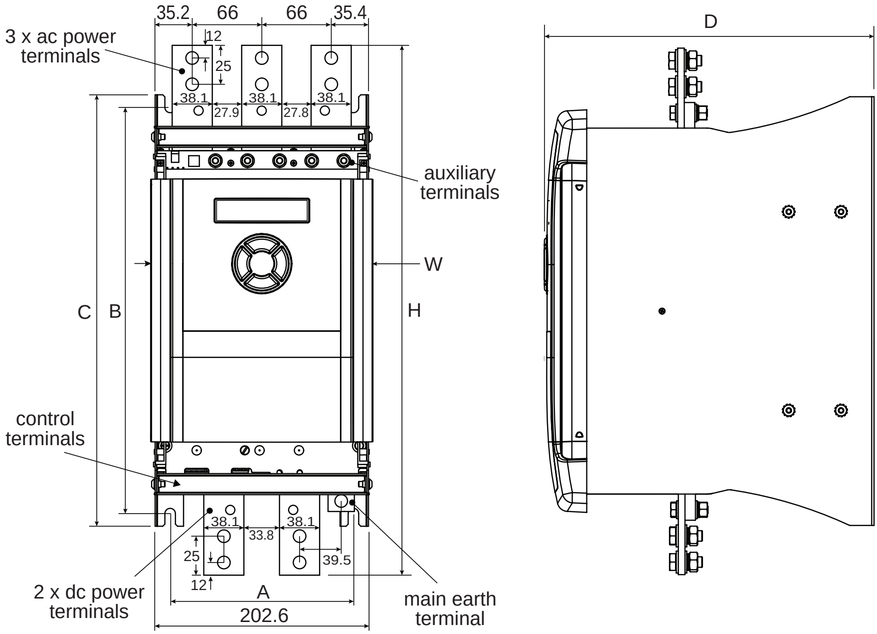


Figure 17 Frame 3 PL/X 185-265 dimensions

Model PL 2-quadrant PLX 4-quadrant		**Width**	**Height (teminals)**	**Depth**	**Fixing centres**		**Height at rear**	**Weight**	**Force vented**
		W	H	D	A	B	C		
		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	
PL and PLX	185-225	216	504	315	174	386	410	17	YES
PL only	265	216	504	315	174	386	410	17	YES

5.4.1 Mounting the Frame 3 PL/X 185-265

- Mount the PL/X vertically (as shown) using the four mounting slots: M8 (5/16 inch) screws. All mounting hole dimensions are ±2 mm.
- **Mount the main contactor to avoid the transmission of mechanical operating shock to the PL/X busbars, for example, by ensuring to fit the Line Reactor between the contactor and PL/X.**
- The rating table specifies the nominal cooling air throughput (use cool, clean, dry, filtered air).
- Do not block the heatsink fins. Allow at least 100 mm (4 inches) air clearance above and below the PL/X.
- **Note that the connection terminals for the main fan are at the top left-hand corner of the PL/X.**

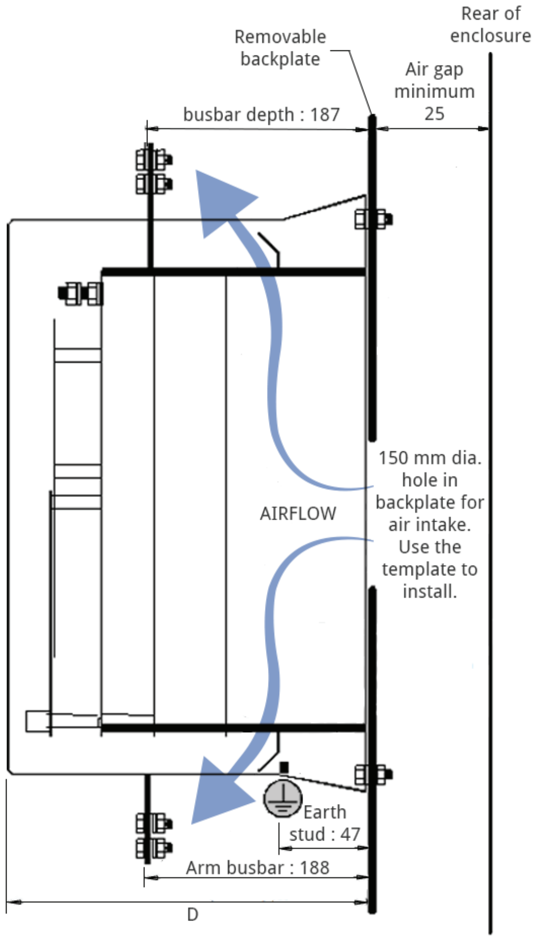
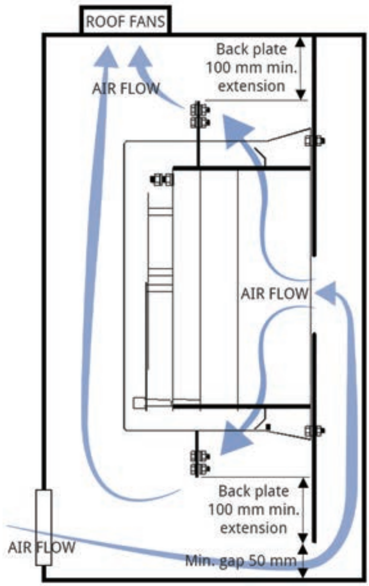


Figure 18 Frame 3 PL/X 185-265 dimensions and airflow

5.4.1.1 Venting using a back panel aperture



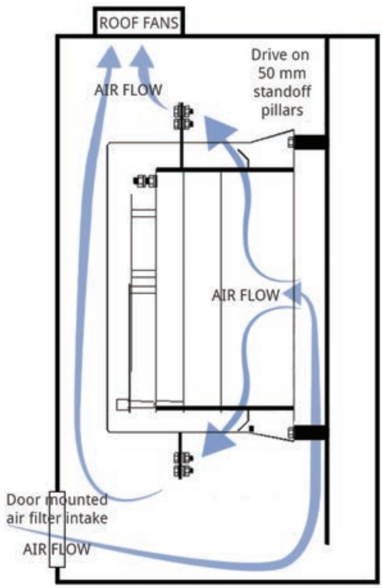
Cut out an aperture in the back panel using the template provided. This preferred mounting method allows the maximum volume of cool air to flow over the PL/X's heatsink.

For installations requiring a 50°C internal enclosure ambient, this method is a requirement.

The source of the clean, filtered, cool, dry air required for venting the PL/X must arrive at the bottom of the enclosure and then be able to flow freely, without obstruction, to the back aperture. A powerful integral fan sucks this air into the rear of the heatsink. It is exhausted at the top and bottom of the PL/X. Extract the exhaust air from the enclosure using roof-mounted fans capable of a throughput rate specified in the rating table.

NOTE: When calculating the required air throughput, you must consider the dissipation of all heat-generating components. Refer to the relevant sections in "10 Technical specifications" on page 91 for cooling, main fuses and line reactors.

5.4.1.2 Venting using standoff pillars



This mounting method may be the only practical technique in retrofit installations if cutting an aperture in the back panel is not possible.

To be as effective as the back panel aperture method, provide an air duct with an aperture area of greater than 180 sq cm that can transport air unimpeded to the rear of the PL/X.

The PL/X comes with a mounting kit consisting of four 50 mm standoff pillars (LA102752).

The highest enclosure ambient temperature allowed using this method is 35°C.

There must be no obstructions to the flow of air to the rear of the PL/X. The method has a lower enclosure ambient rating because some exhaust air may recirculate over the heatsink leading to a loss of efficiency. Any steps taken to minimise this are advantageous. (The 35°C rating applies to installations having no complete separation of the incoming air from the cooling air).

5.5 Mechanical installation - Frame 4 PL/X 275-440

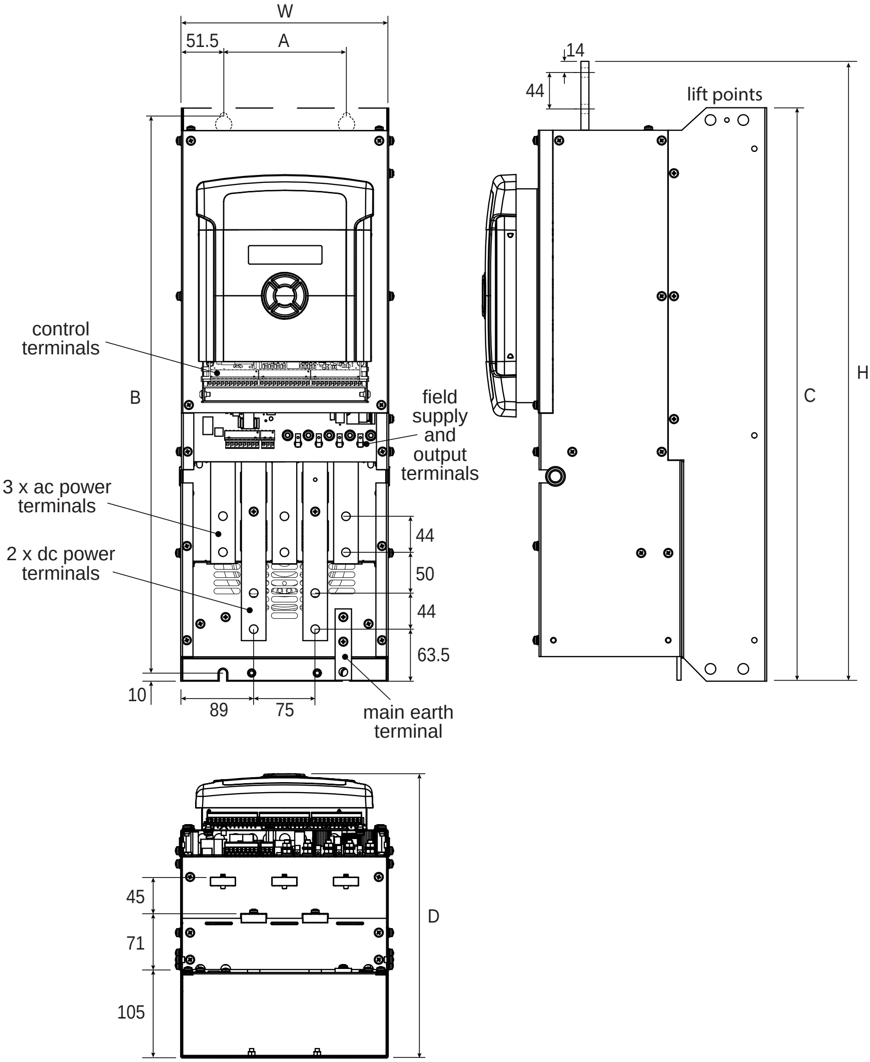


Figure 19 Frame 4 PL/X 275-440 dimensions

Model PL 2-quadrant PLX 4-quadrant		Width	Height (terminals)	Depth	Fixing centres		Height at rear	Weight	Force vented
		W	H	D	A	B	C		
		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	
PL and PLX	275-400	253	757	349	150	680	700	17	YES

5.5.1 Mounting the Frame 4 PL/X 275-440

Refer to "6 Venting for PL/X 275-980" on page 45.

- Mount the drive vertically (as shown) using the four mounting slots: M8 (5/16 inch) screws. All mounting hole dimensions are ±2 mm.
- **Mount the main contactor to avoid the transmission of mechanical operating shock to the PL/X busbars, for example, by ensuring to fit the Line Reactor between the contactor and PL/X.**
- The rating table specifies the nominal cooling air throughput (use cool, clean, dry, filtered air).
- Do not block the heatsink fins. Allow at least 200mm (8 inches) air clearance above and below the PL/X.
- **Note that the connection terminals for the main fan are at the bottom left-hand corner of the PL/X.**

When using a venting kit is impractical : Models PL/X 275/315/360

For these models, it is usually sufficient to ensure that the enclosure, fitted with exhaust fans, can expel air at a rate equal to or greater than the drive's fan, while staying within the capacity of the enclosure inlet filter.

Refer to "10.8 Cooling" on page 109 for airflow ratings.

Ensure that the enclosure fans are positioned in the roof directly above the exhaust outlet of the PL/X.

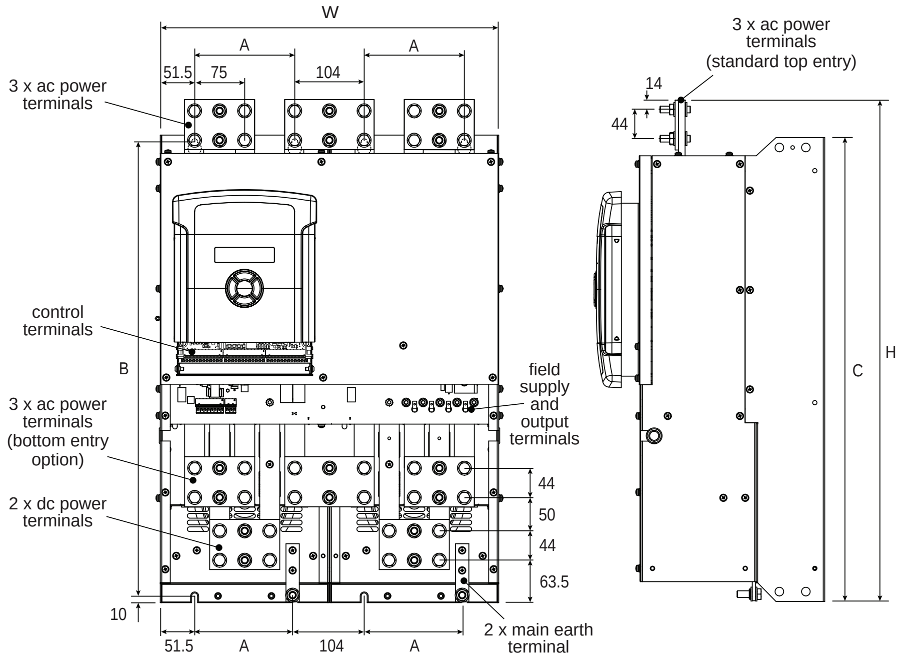
When using a venting kit is impractical : Models PL/X 400/440

For these models, it is essential to maintain separation between the exhaust air emitted from the top end of the fin section and the rest of the enclosure. This is achieved by constructing a duct to evacuate the enclosure's exhaust air. If an indirect route is necessary, external fans may be required to ensure the required airflow.

Refer to "10.8 Cooling" on page 109 for airflow ratings.

Ensure that pollutants cannot enter the port. If there is a risk of birds or vermin entering, consider using a suitable grill.

5.6 Mechanical installation - Frame 5 PL/X 520-980



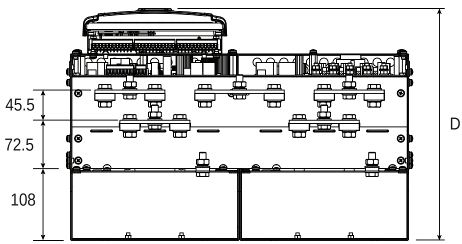


Figure 20 Frame 5 PL/X 520-980 dimensions

Model PL 2-quadrant PLX 4-quadrant		Width	Height (terminals)	Depth	Fixing centres		Height at rear	Weight	Force vented
		W	H	D	A	B	C		
		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	
PL and PLX	520-980	507	757	349	150	680	700	17	YES

5.6.1 Mounting the Frame 5 PL/X 520-980

Refer to "6 Venting for PL/X 275-980" on page 45.

- Mount vertically (as shown) using the eight mounting slots: M8 (5/16 inch) screws. All mounting hole dimensions are ±2 mm.
- **Mount the main contactor to avoid the transmission of mechanical operating shock to the PL/X busbars, for example, by ensuring to fit the Line Reactor between the contactor and PL/X.**
- The rating table specifies the nominal cooling air throughput (use cool, clean, dry, filtered air).
- Do not block the heatsink fins. Allow at least 100mm (4 inches) air clearance above and below the unit.
- **Note that the connection terminals for the main fan are at the bottom left-hand corner of the PL/X.**

When using a venting kit is impractical : Models PL/X 520/600

For these models, it is usually sufficient to ensure that the enclosure, fitted with exhaust fans, can expel air at a rate equal to or greater than the drive's fan, while staying within the capacity of the enclosure inlet filter.

Refer to "10.8 Cooling" on page 109 for airflow ratings.

Ensure that the enclosure fans are positioned in the roof directly above the exhaust outlet of the PL/X.

When using a venting kit is impractical : Models PL/X 700/800/900/980

For these models, it is essential to maintain separation between the exhaust air emitted from the top end of the fin section and the rest of the enclosure. This is achieved by constructing a duct to evacuate the enclosure's exhaust air. If an indirect route is necessary, external fans may be required to ensure the required airflow.

Refer to "10.8 Cooling" on page 109 for airflow ratings.

Ensure that pollutants cannot enter the port. If there is a risk of birds or vermin entering, consider using a suitable grill.

6 Venting for PL/X 275-980

These Frame 4 and Frame 5 drives have a very efficient cooling system consisting of a powerful integral centrifugal fan mounted at the bottom of the PL/X. It blows air over a high dissipation heatsink to maintain the required operating temperatures under all operating limits. Cool air is drawn in at the top and bottom of the PL/X to pass over the internal heatsink fins to exhaust at the top of the PL/X. This warm air must vent from the drive enclosure.

The optional venting kit prevents the warm exhaust air from mixing with the intake air. Therefore the PL/X will run cooler and is less stressed.

This diagram shows a side view of a PL/X in an enclosure

We recommend this arrangement for the flow of cooling air.

The fan in the PL/X draws air into the top and bottom air intakes.

There are two air inlet filters mounted on the door:

- One adjacent to the lower air intake of the PL/X.
- The other is adjacent to the upper air intake of the PL/X.

The exhaust air exits the enclosure via the venting kit assembly, shown with the cowl fitting to the enclosure roof.

Hot exhaust air can raise the temperature of the system. Direct it away from the system if this occurs.

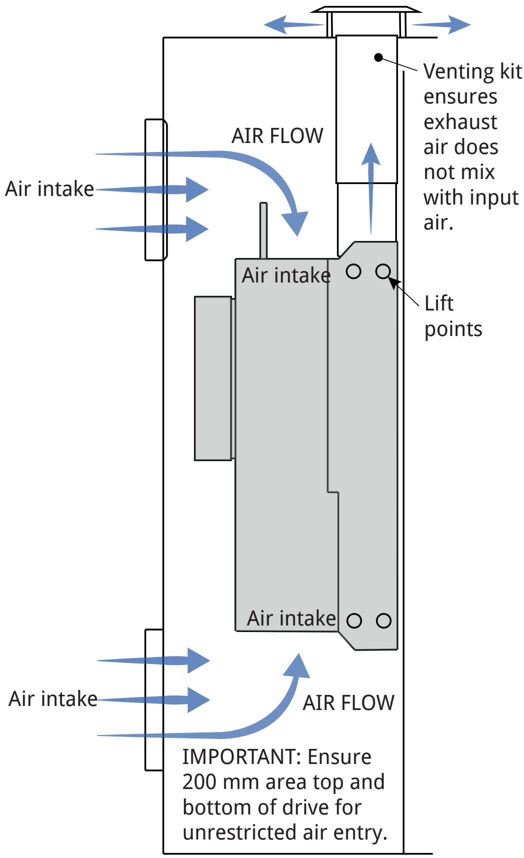


Figure 21 Venting air flow

6.1 Venting summary

- Ensure a clean uninterruptible supply of cool filtered air is available for the PL/X; and the safe, adequate removal of the exhaust air.
- Use the venting kit (optional)/exhaust fans and ducting, or both to keep the hot exhaust air separate from the cooling input air within the enclosure.
- Ensure the cooling air is available at the top and bottom of the PL/X.
- Observe good engineering practice and keep all the components within the enclosure as cold as possible, consistent with avoiding condensation.
- For installations subjected to high ambient temperatures, consider using air conditioning to achieve these requirements. The PL/X will survive running at high ambient temperatures but possibly at the expense of its potential life span.

6.1.1 Air supply to enclosure

It is essential to supply the enclosure that houses the PL/X with sufficient cool, clean air to satisfy the throughput requirements of the PL/X and any other devices within the housing. Do not forget that the current-carrying components associated with the PL/X will be dissipating a considerable amount of heat, especially when the system is running at its highest capacity.

6.1.2 Air filters

Fit the enclosure with two air filters suitable for the airborne pollutants encountered within its environment: one provides air to the lower input port and the other to the upper. Together, they must have a rated throughput of sufficient capacity for all exhaust fans used in the enclosure. If the PL/X uses a venting kit and another exhaust fan is also operating to cool other components, this auxiliary fan must not starve the PL/X of its air supply. Avoid using this fan if the input filters have sufficient capacity. We recommend the PL/X uses dedicated filters and an enclosure partition to isolate it from the influence of the rest of the enclosure cooling arrangements.

Fit the inlet filters to the enclosure adjacent to the input ports at the lower and upper ends of the PL/X. In this way, the air draws in close where needed. Fitting filters at the top and bottom of the PL/X helps maintain the air path, which might otherwise be restricted when using only one filter in an enclosure whose door is close to the face of the PL/X.

6.1.3 Exhaust air

Provide adequate ventilation in the room containing the enclosure to prevent an increase in ambient temperature by the air exiting the housing. Alternatively, obtain a supply of cooling air from outside, and duct it to the enclosure.

6.2 Venting kit (optional)

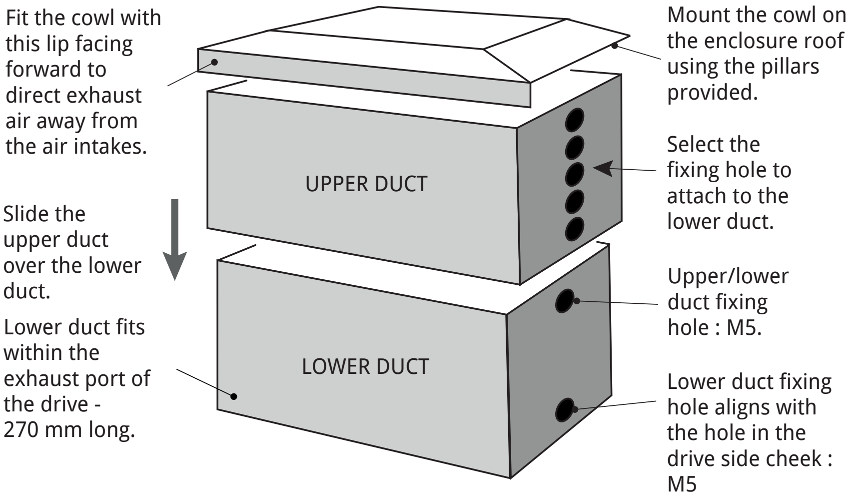
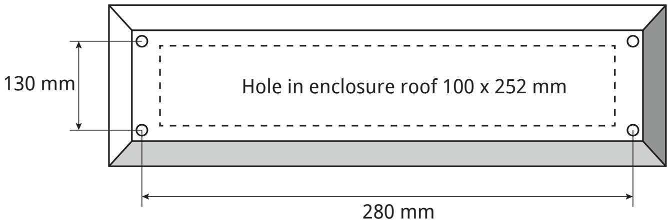


Figure 22 Venting kit (optional)

6.2.1 Venting kit for PL/X 275 - 440

This venting kit comprises two steel ducts designed to telescope together, providing an adjustable duct length of between 270 mm to 538 mm. It consists of three main components:

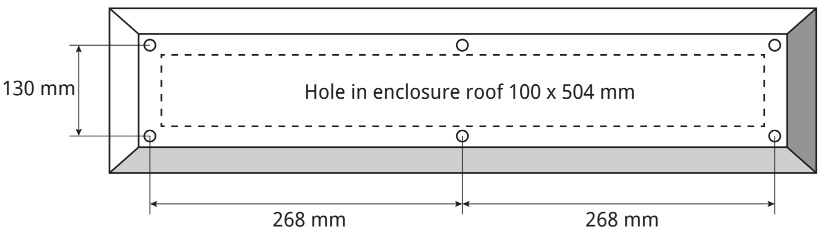
1. **The lower duct.** Fit this within the side cheeks, directly above the heatsink exhaust area. Refer to "Figure 19 Frame 4 PL/X 275-440 dimensions" on page 41 for fixing point drawing.
2. **The upper duct.** The upper ducting must fit through a tight-fitting rectangular hole in the enclosure roof (hole size 100 mm x 252 mm) to protrude above the enclosure roof by 10-20 mm. Fit the upper duct over the lower duct section and extend to the required height through the hole. Secure the upper ducting to the lower ducting, inserting screws through both sides into the best-fit holes (the adjustment is in steps of approximately 20 mm). Seal any gap between the duct and enclosure roof using tape or flexible filler to ensure that exhaust air and pollutants cannot enter the enclosure.
3. **The cowl.** Fit the cowl to the top of the enclosure to prevent pollutants from dropping into the outlet. Drill four M6 holes in the enclosure roof for the four 70 mm mounting pillars, such that the cowl is positioned centrally over the protruding duct (the cowl overhangs the duct by 70 mm on all sides). If there is a danger of birds or vermin entering the exhaust port, we recommend adding a suitable grille around the edge of the cowl.



6.2.2 Venting kit for PL/X 520 - 980

This venting kit comprises a single cowl and two pairs of extendable steel ducts. The venting kit's construction and assembly are similar to the PL/X 275-440 venting kit described above, except that:

- The kit provides an adjustable duct length of between 270 mm to 535 mm.
- The hole in the enclosure roof is 100 mm x 504 mm. There are two exhaust ports at the top of the PL/X and each pair of ducts is used with one of the ports.
- The cowl is supported on six 50 mm mounting pillars.
- Seal the interface between the ducts where they exit the roof of the enclosure.



7 Electrical installation

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Electric shock risk! Electrical devices constitute a safety hazard.

Do not attempt to commission the PL/X unless you:

- are qualified and have the knowledge and skills to use it safely.
- thoroughly understand the operation of the machine which has the PL/X installed.
- have read and understood this document, and are familiar with electrical wiring and safety standards.

Only use qualified personnel to design, construct, operate and maintain your systems.

Ensure personnel who use or maintain the equipment know of all hazards involved in your equipment and processes.

If you have any doubts about the safety of your system or process, do not proceed without first consulting an expert.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Before beginning to connect the drive, ensure that all power is OFF.

Make sure that you route power and control wiring in separate conduit/cable trays. Wiring must meet all applicable national and local electrical regulations.

Make sure that the voltages on the EL1/EL2/EL3 terminals are in-phase with the voltages on L1/L2/L3.

For reliable operation, the PL/X must control the supply side or dc side contactor through its CON1 and CON2 terminals.

CAUTION!
EQUIPMENT DAMAGE HAZARD

Avoid dropping small objects into the PL/X.

If the PL/X is in the horizontal plane, there is a danger that objects may be accidentally dropped into the air intake grille when connecting the busbars to the terminals. When the PL/X is vertical, items may fall into the fin section at the top or through the upper air intake grill.

As a precaution, we advise fitting a temporary cover over these areas when working on the PL/X, e.g. a piece of cardboard. Do not forget to remove the temporary cover before starting the PL/X. Anything dropped into the PL/X may interfere with the fan rotation.

7.1 Basic application wiring diagram

Below is a very basic speed or torque control application, combining Method 1 Power Wiring and Method 1 Control Wiring, which can later be adapted to your requirements. Note that this arrangement of the contactor allows continuous phase sensing on EL1/2/3.

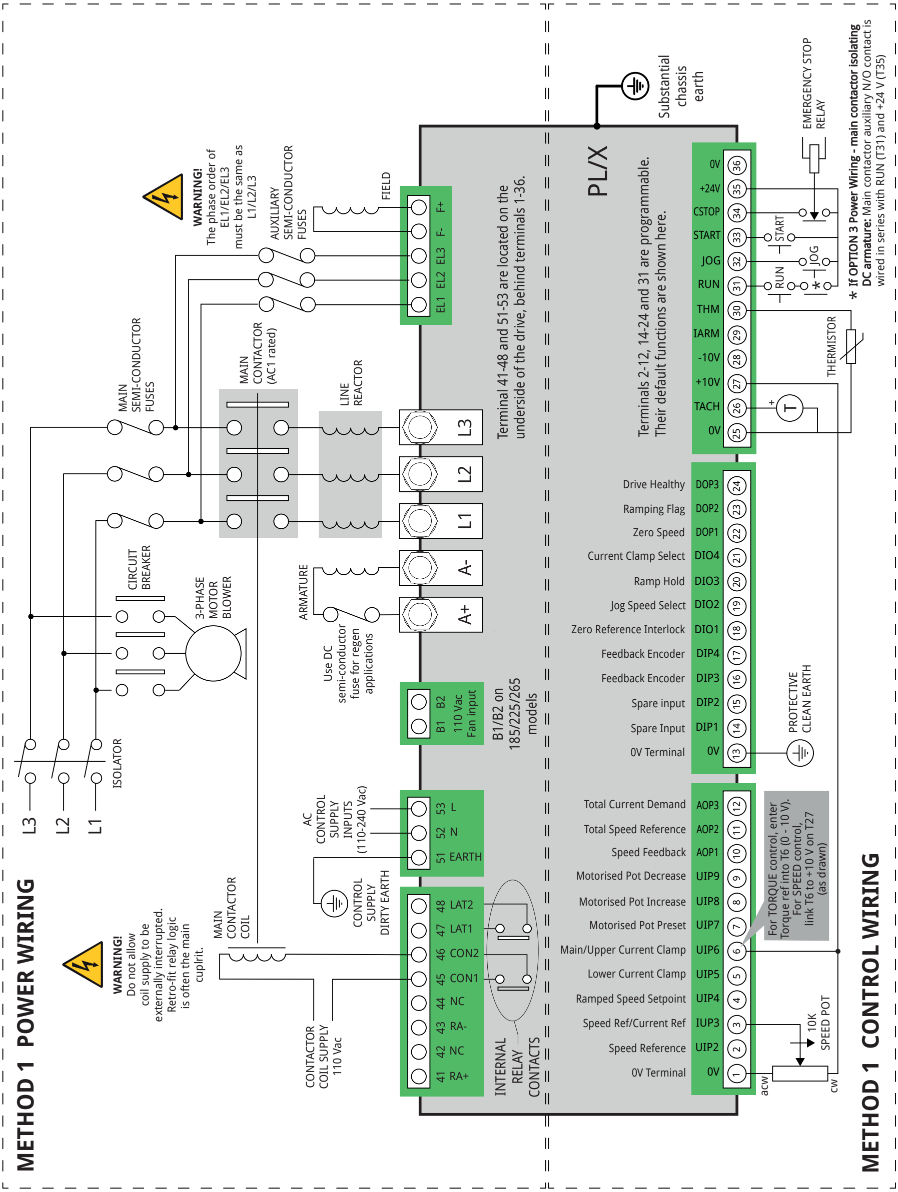


Figure 23 Basic application wiring diagram: speed or torque control

7.2 Power wiring connections

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Ensure that all wiring is electrically isolated and cannot be made "live" unintentionally by other personnel.

If performing high voltage or dielectric tests on the motor or wiring, you **must** disconnect the PL/X first. Failure to do so will invalidate the Warranty.

7.2.1 Forces applied to the power terminals

Avoid applying mechanical stress to the heavy-current terminals L1/2/3 and A+ A-. Within the enclosure, support any cables or busbars bolted to these terminals. Do not rely on the drive terminals to support the weight of the external connections.

Do not use the connecting bolt to hold both the terminal and the connecting cable or busbar in alignment. It will cause permanent stress on the terminal if levered into alignment before inserting the bolt. Always support the connection to the terminal so that the terminal bolt only tightens them together, and is not used to maintain their relative positions to each other. The respective holes in the terminal and the connecting busbar should remain in alignment without the aid of the terminal bolt. You can then be sure that there is minimum stress on the drive terminal busbar.

When tightening the connecting bolts of terminals L1/2/3 and A+ A-, do not subject the busbar to a turning moment when tightening the nut. To do this, always use two spanners; one on the bolt head to provide a counter torque and one on the nut for the tightening torque.

7.3 Power wiring methods

IMPORTANT: Please read the General Risks and safety information at the front of this manual before proceeding.

There are various ways of implementing main contactor control, and each method has its advantages and disadvantages.

Refer to "Figure 23 Basic application wiring diagram: speed or torque control" on page 50 and substitute your selected Power Wiring method into the diagram.

- Refer to "10.9 Installation guide for EMC" on page 110.
- Refer to "Figure 35 Earthing diagram for a typical installation" on page 112.
- Refer also to "Figure 34 Wiring diagram for AC supply level to L1/2/3 different to EL1/2/3 (e.g. low voltage field)" on page 107.

7.3.1 METHOD 1 - Power wiring (QuickStart)

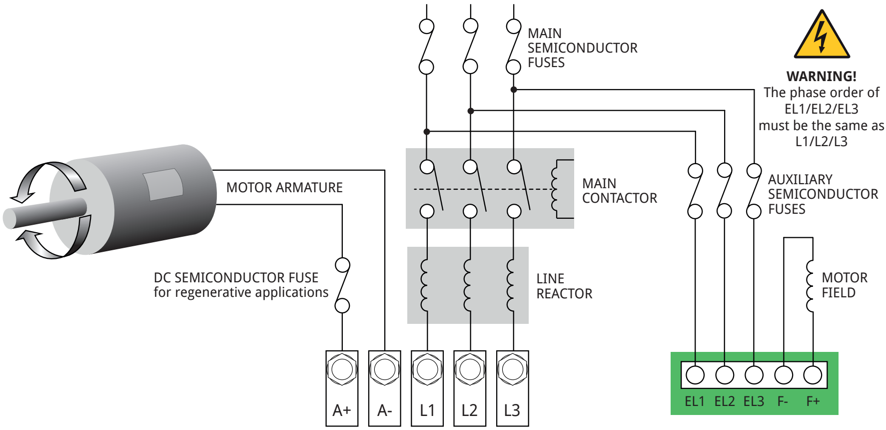


Figure 24 Main contactor isolating AC stack supply

Advantages	Disadvantages
• The auxiliary supplies are permanently energised, allowing the synchronisation circuits to lock onto the supply before applying power to the motor resulting in a fast release of current to the armature because it avoids the synchronisation delay. • The field can remain energised after contactor drop-out, allowing dynamic braking and/or condensation prevention in standby field mode.	• The main contactor does not electro-mechanically isolate the field winding. Without additional measures, this may contravene safety codes. • The field standby level may not be set to a low enough level by the user and could cause overheating of the field winding. • Phase forward may occur before the contactor has closed, causing fault current. (The time delay from START command to phase forward is 75 ms.)

7.3.2 METHOD 2 - Power wiring

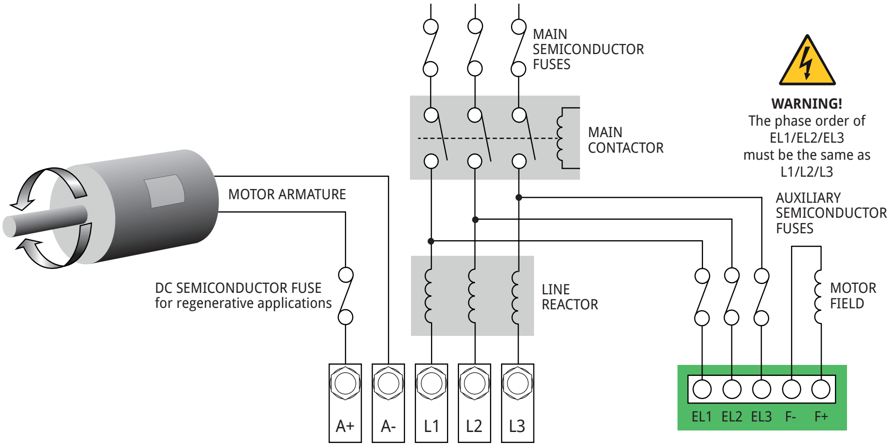


Figure 25 Main contactor isolating AC stack and auxiliary supplies

Advantages	Disadvantages
• The main contactor electro-mechanically isolates the field winding. • Some retro-fit installations can only provide the three main phases because the main contactor is remotely located to the drive panel, in which case this may be the preferred wiring method. • The PL/X cannot phase forward until the contactor has closed because EL1/2/3 take time to synchronise.	• The auxiliary supplies are de-energised by the main contactor, causing a turn-on delay of approximately 0.75 seconds for the synchronisation circuits to establish a lock onto the supply before applying power to the motor. • The field cannot remain energised after contactor drop-out, thus prohibiting dynamic braking and/or condensation prevention in standby field mode.

7.3.3 METHOD 3 - Power wiring

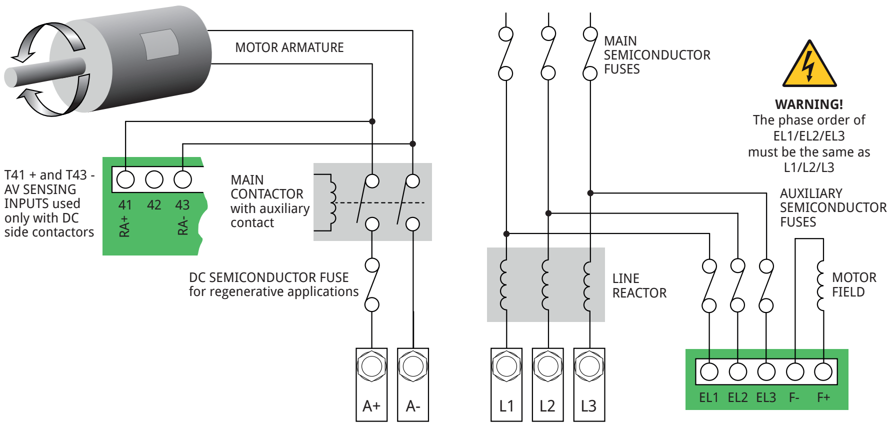


Figure 26 Main contactor isolating DC armature

Advantages	Disadvantages
• The auxiliary supplies are permanently energised, allowing the synchronisation circuits to lock onto the supply before applying power to the motor resulting in a fast release of current to the armature because it avoids the synchronisation delay. • The field can remain energised after contactor drop-out, allowing dynamic braking and/or condensation prevention in standby field mode.	• The main contactor does not electro-mechanically isolate the field winding. Without additional measures, this may contravene safety codes. • The field standby level may not be set to a low enough level by the user and could cause overheating of the field winding. • The AC supply is permanently connected to the PL/X unless further provision is made to isolate the supplies.

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

When using a dc side contactor, the armature **MUST** be connected to the remote sense terminals T41 and T43, as shown on Page 54, to ensure that the PL/X can measure armature voltage when the dc side contactor is de-energised. Failure to do this will cause a flashover of the commutator because the AVF feedback is lost when the contactor opens.

Refer also to "11.6 CHANGE PARAMETERS / STOP MODE RAMP" on page 149 and "Figure 42 Contactor Control - block diagram" on page 150.

7.4 Power wiring connections

POWER WIRING CONNECTIONS

1 Use the quick-release catches on the sides of the endcaps to remove the PL/X top and bottom endcaps.

2 Connect all power supplies: **L1**, **L2**, **L3**, **EL1**, **EL2**, **EL3**, **T51**, **T52**, **T53,** and **B1**, **B2** (where fitted). Refer to "7.4.4 Power supplies" on page 57.

NOTE The phase rotation of the 3-phase supply is unimportant. However, there **MUST** be phase-equivalence for L1 to EL1, L2 to EL2, and L3 to EL3. Take particular care where L1/2/3 and EL1/2/3 are feeding from different sides of a transformer:

Only use star-star or delta-delta transformers. If the transformer is star-delta, there will be a phase mismatch, and the PL/X will fail to operate correctly.

Power wiring	Use cables with a minimum rating of 1.25 x full load current. Copper conductors must be rated for 60°C, or 75°C if rated at over 100 A.
Protective Earth (PE) connections	Connect a substantial earth (ground) to the busbar provided at the base of the drive. The terminal is identified by the international ground symbol.
3-phase contactor	Fit a 3-phase contactor having suitable voltage and current ratings (AC1) in the main AC supply. Provide the contactor coil with the appropriate control supply, which is applied by the PL/X to the contactor coil using terminals 45 and 46. • The contactor is not required to switch current but is involved with sequencing and carrying power to the PL/X. • If safety mandates require that the contactor coil must be able to be de-energised externally to the drive, then you must arrange for the CSTOP terminal 35 to open at least 100 ms before the main contactor opens. **Failure to do so will invalidate the Warranty and may damage the PL/X** by preventing the armature current from having the ability to commutate to zero before supply removal. Refer to "7.3 Power wiring methods" on page 52 for advice on using DC side contactors or other power sequencing options. • If the contactor coil's VA rating exceeds the ratings of terminals 45 and 46, you must use a slave relay of a suitable rating to drive the contactor coil. **NOTE** If your main contactor has a final closing time delay of greater than 75 ms, you must insert an auxiliary normally-open contact on the main contactor in series with the RUN input on T31. This will prevent the PL/X from trying to deliver power until the main contact has closed. Alternatively, use the contactor wiring method shown on Page 61.
3-phase line reactor	Fit this in series with the AC supply between the contactor and power terminals. It also helps in avoiding the transmission of main contactor mechanical operating shock to the PL/X busbars.

POWER WIRING CONNECTIONS

	Fusing	Protect the PL/X using correctly rated semiconductor fuses - three main fuses and three auxiliary fuses. Failure to do so will invalidate the Warranty.
	NOTE	For applications where regeneration occurs most or all of the time, we recommend also fitting a DC-side semiconductor fuse to provide extra protection for the PL/X in the event of an unsequenced power loss when regeneration is taking place. Refer to "10 Technical specifications" on page 91 for fuse ratings.
3	Ensure all connections to the power terminals are tight. Refer to "7.4.3 Terminal tightening torques" on page 56. Power terminal fastenings are: PL/X 5-50 M6 PL/X65-980 M10	

7.4.1 Output voltage range

PL/X 5-980

Armature **PL** 0 to 1.3 x AC supply (absolute upper limits)
PL* 0 to 1.2 x AC supply
PLX 0 to 1.2 x AC supply
Note that 1.1 x AC supply is recommended if supply variations exceed -6%.

Field 0 to 0.9 x AC supply on auxiliary terminals (EL1, EL2, EL3).

* PL arranged to use regenerative braking.

7.4.2 Output current range

PL/X 5-980

Armature * 0 to 105% continuous. 150% for 25 seconds. +/- for PLX.

Field Programmable minimum to 100% continuous with fail alarm

* 0 to 105% continuous for models having overload capability. Models PL440, PLX440, PL980, PLX980 have no overload capability.

NOTE: There is a factory option available to allow high inductance loads to be driven by the armature output.

7.4.3 Terminal tightening torques

Terminals	Model	Tightening torque
T1 to T53	PL/X 5-980	0.5 Nm (4 in.lbf)
EL1, EL2, EL3, F+, F-	PL/X 5-145	1.0 Nm (9 in.lbf)
EL1, EL2, EL3, F+, F-	PL/X 185-980	3.9 Nm (35 in.lbf)
L1, L2, L3, A+, A-	PL/X 5-50	3.9 Nm (35 in.lbf)
L1, L2, L3, A+, A-	PL/X 65-980	27.0 Nm (242 in.lbf)
Fan supply terminals	PL/X 185-980	1.0 Nm (9 in.lbf)

7.4.4 Power supplies

The power supplies you provide MUST be suitable for the motor used.

PL/X 275-980 models are available with the L1, L2, L3 main supply terminals with a top entry (standard) or bottom entry (option).

7.4.4.1	**Main supply inputs: L1, L2, L3**	
	PL/X 5-265	12-500 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating) 12-480 Vac nominal ±10%, 50-60 Hz, 3-phase (UL rating)
	PL/X 275-980	**standard model** 12-500 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating)
		MV model (option) 12-600 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating)
		HV model (option) 12-690 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating)
7.4.4.2	**Auxiliary supply inputs: EL1, EL2, EL3**	
	PL/X 5-265	100-500 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating) 100-480 Vac nominal ±10%, 50-60 Hz, 3-phase (UL rating)
	PL/X 275-980	**standard model** 100-480 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating)
		MV model (option) 100-600 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating)
		HV model (option) 100-690 Vac nominal ±10%, 50-60 Hz, 3-phase (CE rating)
7.4.4.3	**Control supply inputs: T51, T52, T53**	
	PL/X 5-980	110-240 Vac ±10%, 50-60 Hz, 1-phase, 50 VA
7.4.4.4	**Supply input for the internal fan: B1, B2**	
	PL/X 185-265	110 Vac, 50/60 Hz, 50 VA
	PL/X 275-440	240 Vac, 50/60 Hz, 100 VA
	PL/X 520-980	240 Vac, 50/60 Hz, 200 VA

Table 7 Power supplies - ratings

Refer to "10.7.2 L1/2/3 AC supply level different to EL1/2/3" on page 107 if your supplies are different when using a single-phase isolated transformer. **Only use star-star or delta-delta transformers**. If the transformer is star-delta, there will be a phase mismatch, and the unit will fail to operate correctly.

7.5 Control wiring methods

Study this section carefully and choose the control wiring mode required for your application.

Refer to "Figure 23 Basic application wiring diagram: speed or torque control" on page 50 and substitute your selected Control Wiring method into the diagram.

7.5.1 METHOD 1 - Control wiring (QuickStart)

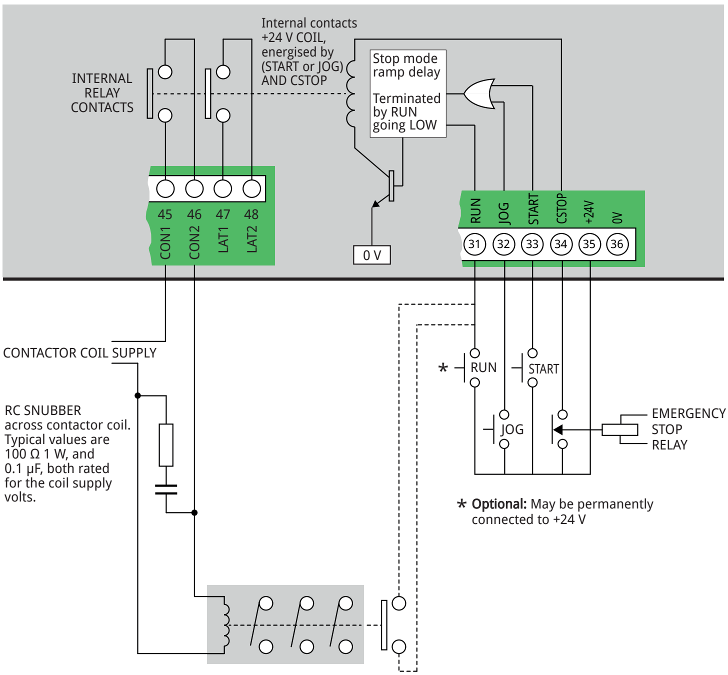


Figure 27 Using normally-open contacts for simple STOP/START/JOG

We recommend using an auxiliary contactor of the main contactor that is in series with RUN whether or not an ac or dc side contactor is in use. It prevents problems due to a slow closing contactor and ensures that current will cease should the contactor open due to coil failure or loss of coil supply. RUN (T31) must be at 24 V (T35) to enable the current to flow.

NOTE: START or JOG contacts will energise the contactor. Removal of START will result in the STOP MODE RAMP block taking control over stopping time and contactor de-energisation. Removal of JOG will result in the JOG/SLACK RAMP block taking control over stopping time and contactor de-energisation. Stopping time depends on whether regeneration is possible. Interruption of the RUN command together with START or JOG will result in termination of the STOP MODE RAMP or JOG/SLACK RAMP block, whichever is appropriate. The CSTOP must be high for at least 50 ms before START or JOG goes high. Refer to "7.3.3 METHOD 3 - Power wiring" on page 54 (with ramp to stop, jog and slack take up).

Refer to "11.6 CHANGE PARAMETERS / STOP MODE RAMP" on page 149.

7.5.2 METHOD 2 - Control wiring

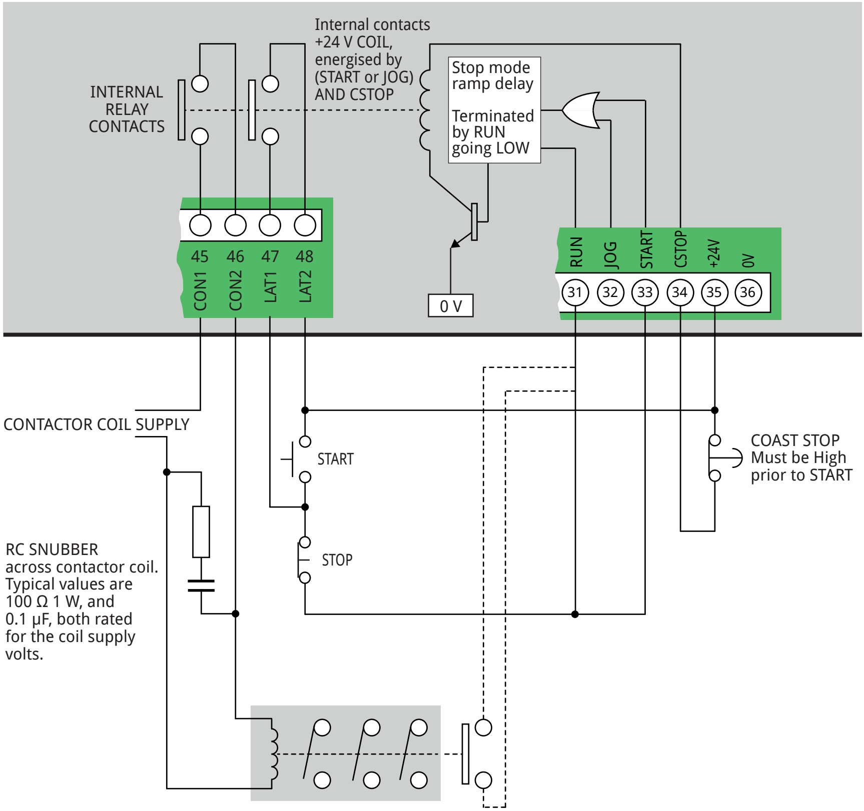


Figure 28 Using push buttons for simple STOP/START (coast to stop)

We recommend using an auxiliary contactor of the main contactor that is in series with RUN whether or not an ac or dc side contactor is in use. It prevents problems due to a slow closing contactor and ensures that current will cease should the contactor open due to coil failure or loss of coil supply. RUN (T31) must be at 24 V (T35) to enable the current to flow.

NOTE: START or JOG contacts will energise the contactor. Removal of START will result in the STOP MODE RAMP block taking control over stopping time and contactor de-energisation. Removal of JOG will result in the JOG/SLACK RAMP block taking control over stopping time and contactor de-energisation. Stopping time depends on whether regeneration is possible. Interruption of the RUN command together with START or JOG will result in termination of the STOP MODE RAMP or JOG/SLACK RAMP block, whichever is appropriate.

NOTE: The CSTOP must be high for at least 50 ms before START or JOG goes high.

Refer to "7.3.3 METHOD 3 - Power wiring" on page 54 (with ramp to stop, jog and slack take up).

Refer to "11.6 CHANGE PARAMETERS / STOP MODE RAMP" on page 149.

7.5.3 METHOD 3 - Control wiring

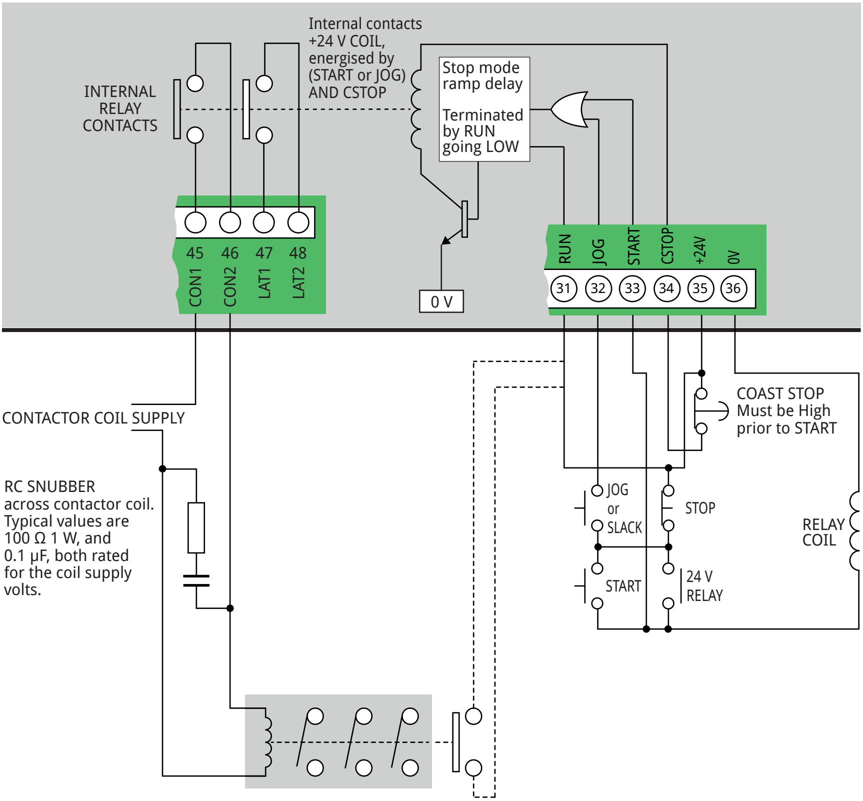


Figure 29 Using push buttons for STOP/START (with ramp to stop, jog, slack take-up)

We recommend using an auxiliary contactor of the main contactor that is in series with RUN whether or not an ac or dc side contactor is in use. It prevents problems due to a slow closing contactor and ensures that current will cease should the contactor open due to coil failure or loss of coil supply. RUN (T31) must be at 24 V (T35) to enable the current to flow.

NOTE: This circuit will cause the STOP MODE RAMP to operate when the STOP button opens during running. The speed then ramps down under the control of the STOP MODE RAMP. The main contactor will de-energise after the STOP MODE RAMP parameters have been satisfied. Refer to "Figure 44 Contactor drop-out" on page 152.

NOTE: The CSTOP must be HIGH for at least 50 ms before START goes HIGH.

Models that have the regenerative stopping facility will regenerate to maintain the ramp rate.

The JOG button operates as a JOG function when the drive is stopped (START is open), and operates as the SLACK 1 take-up function when the drive is running (START is closed).

With the STOP button held open, no running button is operative (JOG/SLACK or START).

7.6 Control wiring connections

IMPORTANT: Please read the General Risks and safety information at the front of this manual before proceeding.

There are various ways of implementing main contactor control, and each method has its advantages and disadvantages.

Refer to "Figure 23 Basic application wiring diagram: speed or torque control" on page 50 and substitute elements of your Power Wiring and Control Wiring method selections into the diagram as required.

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Ensure that all wiring is electrically isolated and cannot be made "live" unintentionally by other personnel.

If performing high voltage or dielectric tests on the motor or wiring, you **must** disconnect the PL/X first. Failure to do so will invalidate the Warranty.

---

1. Connect all control wiring.
2. Remember to make a control clean protective earth connection to terminal 13.

NOTE: Control wiring should have a minimum cross-section of 0.75 mm^2.

The following interfaces are provided:

- **Digital inputs** able to recognise logic levels using 24 V logic.
  - Digital inputs for encoder signals of various amplitudes and type.
- **Digital outputs** able to drive 24 V relays, lamps, sensors, etc.
- **Analog inputs** able to accept linear bipolar reference or feedback signals.
- **Analog outputs** able to provide linear bipolar signals.

Because many of the terminals are dual-function, there are up to:

- 17 digital inputs
- 8 analog inputs (can also be used as digital inputs)
- 7 digital outputs (4 digital outputs can be independently programmed as inputs)
- 4 analog outputs (3 are programmable)

NOTE:

- Use DIP digital inputs on T14-17 as encoder inputs (low noise immunity).
- Use DIO digital input/outputs on T18-21 for 24 V logic (standard noise immunity).
- Use UIP analog inputs on T2-9 as digital inputs (optimum noise immunity).

7.6.1 About digital inputs

The most frequent types of problem is short-circuits and excessive voltages when applied to the digital inputs and outputs:

- All digital inputs and outputs can withstand up to +50 V applied continuously.
- All digital outputs, including the 24 V customer supply, can withstand a direct short-circuit to 0 V.

7.6.1.1 RUN digital input

The RUN input provides a means of electronically inhibiting PL/X operation. A low RUN input inhibits all control loops causing the armature current to cease and can cause the motor to stop. RUN also controls the field. Refer to "11.13 CHANGE PARAMETERS / FIELD CONTROL" on page 182.

The RUN input going low also causes an immediate contactor drop-out when the contactor is either being held in by the zero speed detector while the motor is decelerating or by the contactor drop-out delay.

WARNING!

PERSONAL INJURY HAZARD

Do not rely on any drive function to prevent the motor from operating when personnel are undertaking maintenance or when machine guards are open. The Safety Codes do not accept electronic control as a sole means of inhibition for the PL/X. Always isolate the power source before working on the PL/X or the motor or load.

7.6.1.2 START and JOG digital inputs

The START (T33) and JOG (T32) inputs provide the following operating features:

- Normal running.
- Jogging with two selectable jog speeds and programmable contactor drop-out delay.
- Crawling - the crawl speed is a programmable parameter.
- Slack take-up with two selectable take-up speeds.

With START high and JOG low, JOG going high acts as a slack take-up.

With START low, the JOG input is a jog control. T19 (Jog mode select) input selects between jog/slack speed 1 and jog/slack speed 2:

With JOG low and T19 (Jog mode select) high, then START going high acts as the crawl control. Crawl uses the Run mode ramp times to accelerate, and the Stop mode ramp times to stop. Refer to "11.4.6 42)JOG MODE SELECT" on page 142.

7.6.1.3 Encoder inputs

- DIP3 (T16, B train or sign) and DIP4 (T17, A train) can accept bi-directional encoder pulse trains.
- DIP2 (T15) can accept a MARKER for spindle orientation.

The outputs from the encoder must be able to provide a logic low below 2 V, a logic high above 4 V; and may range up to 50 V maximum, up to 100 kHz. These two inputs are single-ended and non-isolated. For other types of encoder output, you must provide some external conditioning circuitry. The encoder format may be pulse-only for single-direction, pulse with sign, or phase quadrature. Refer to "11.2 CHANGE PARAMETERS/CALIBRATION/ENCODER SCALING" on page 127. **NOTE:** The Universal Inputs (UIPs) offer much higher noise immunity for 24 V logic signals.

7.6.2 About digital outputs

When digital outputs become shorted, the 24 V output continues to operate with a current capability of 50 mA to ensure that the CSTOP line does not go low and shut down the PL/X. If the PL/X must continue to run when experiencing a shorted digital output, a digital output set permanently high may be used as an auxiliary 24 V power output for other tasks, allowing the main 24 V output to be devoted entirely to the CSTOP function.

Each output is fitted with a flywheel diode to allow the safe driving of inductive loads and, because of the current limiting, it is possible to drive lamps that may have low cold resistance.

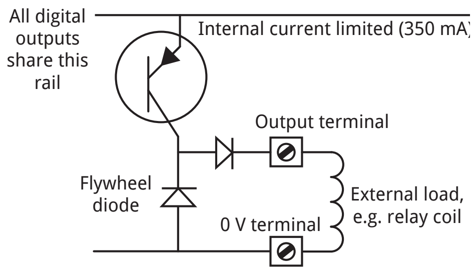


Figure 30 Output configuration (DOP1 to DOP3, DIO1 to DIO4)

PL/X digital outputs can be ORed together or ORed with outputs from other drives, proving useful if an external event must wait for several outputs to go low.

7.6.2.1 Short-circuit/overload condition

If a short-circuit or overload occurs on one or more digital outputs, all digital outputs are disabled, and the short-circuit condition is flagged. In this event, it is possible to enable or disable a drive trip. If the drive trip is disabled, the PL/X will continue to run (providing the fault has not caused external user relay logic to interrupt normal running).

The short-circuit condition may be signalled on one of the outputs by a low state if desired.

If the short-circuit is removed, the digital outputs will recover to their original state - refer to "13.1.4 174)DOP SCCT TRIP EN" on page 228 and "13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE" on page 234 and "12.6 DIAGNOSTICS / DIGITAL IO MONITOR" on page 218.

7.6.3 About analog inputs

These accurately measure ±10 V signals with excellent response time and with up to 2 mV +sign resolution.

You can monitor all analog input voltages - refer to "12.5 DIAGNOSTICS / ANALOG IO MONITOR" on page 216.

Also, the voltage range of each input can be set to ±5, ±10, ±20 or ±30 V, allowing the use of signals other than 10 V full scale and enabling you to use the input as a sophisticated digital input. To do this, program the input to the 30 V range and set the programmable threshold detector at 15 V to recognise a 0 or 1.

Refer to "11.9.1 Using small speed inputs" on page 164. The default gives low gain for small inputs.

NOTE: Using Universal Inputs (UIPs) as digital inputs provides improved noise immunity and adjustable threshold.

To use 4-20 mA loop signals, fit an external burden resistor of 220 Ω between the input and 0 V. Then, set up the relevant UIP to read the resulting voltage signal generated by passing the signal current through the burden.

Refer to "17.4.2.1 4-20 mA loop input SETUP" on page 330.

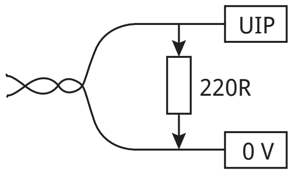


Figure 31 A 4-20 mA signal flowing through an external burden resistor

7.6.3.1 Analog tachogenerator input

This input is intended solely for the connection of an analog bipolar DC tachogenerator.

> The PL series 2-quadrant drives can also use an AC tachogenerator with a rectified output, but we do not recommend this. Connect the tachogenerator to terminals T25 (0 V) and T26 (TACH). A dc voltage of up to ±200 Vdc maximum can be applied directly to T26 with respect to T25.
>
> Refer to "11.1.8 9)SPEED FBK TYPE" on page 120 to select tacho feedback, and "11.1.7 8)MAX TACHO VOLTS" on page 119 to match the 100% feedback voltage and sign on T26.

For forward motor rotation corresponding to a positive reference signal, the tachogenerator feedback voltage sign at terminal T26 (TACH) with respect to T25 (0 V) must correspond to the sign selected in the calibration menu.

Feedback voltages down to 0 V can be selected. However, it is not advisable to use tachos with a voltage less than 10 V at full speed in the interest of accuracy and smooth operation.

7.6.4 Motor thermistor

UL Requirement: a thermistor **must** be fitted.

It is good practice to protect DC motors against sustained thermal overloads by fitting temperature sensitive resistors or switches in the field and inter-pole windings of the machine.

7.7 Control terminals - electrical specification

Below is the electrical specification for each terminal. Making changes to factory default settings does not affect the electrical specification.

Control terminals - electrical specification		Terminal	
0 V		0 V	1
Universal Inputs	8 analog inputs with up to 2 mV +sign resolution. 4 input voltage ranges ±5/10/20/30 V on each input. 8 digital inputs with adjustable thresholds. Input impedance 100 kΩ for input scaling at 5 and 10 V range. Input impedance 50 kΩ for input scaling above 10 V range.	UIP2	2
		UIP3	3
		UIP4	4
		UIP5	5
		UIP6	6
		UIP7	7
		UIP8	8
		UIP9	9
Analog Outputs (and Iarm on T29)	4 analog outputs (±0.4%). 3 programmable, plus 1 output representing armature current. 2.5 mV +sign resolution. Individually short-circuit protected to 0 V - however, they are not protected for simultaneous shorts. Output current ±5 mA maximum. Output range 0 to ±11 V.	AOP1	10
		AOP2	11
		AOP3	12
0 V	Control clean protective earth connection.	0 V	13
Digital Inputs	Logic low below 2 V. Logic high above 4 V. Low noise immunity. DIP3 and DIP4 may also be used for encoder quadrature signals. Refer to "7.6.1.3 Encoder inputs" on page 62 and "11.2 CHANGE PARAMETERS/CALIBRATION/ENCODER SCALING" on page 127 for encoder information.	DIP1	14
		DIP2	15
		DIP3	16
		DIP4	17
Digital In/Outputs	4 digital inputs. Also programmable as outputs (refer to Digital outputs below). Logic low below 6 V. Logic high above 16 V. Refer to DOP1-3 below when used as digital outputs.	DIO1	18
		DIO2	19
		DIO3	20
		DIO4	21
Digital Outputs	This specification also applies to DIO1/2/3/4 when they are programmed as outputs. 3 outputs (for 4 more outputs, use DIO1/2/3/4). Short-circuit protected (range 22 to 32 V for OP high). Over-temperature and over-voltage protected to +50 V. Each output can deliver up to 350 mA. Total for all outputs is 350 mA.	DOP1	22
		DOP2	23
		DOP3	24

This terminal connector is devoted to essentially fixed function controls:

Control terminals - electrical specification

		Terminal	
0 V	Control clean protective earth connection.	0 V	25
Tacho Input	±200 V range. Input impedance 150 kΩ.	TACH	26
Reference Outputs	±10.00 V, 0.5%, 10 mA maximum. Short-circuit protection to 0 V.	+10 V	27
		-10 V	28
Armature Current Output	±5 V linear output for ±100% model rating current. Output current capability 10 mA maximum. Short-circuit protection to 0 V. Programmable Uni-polar or Bipolar output mode (tolerance ±5%).	Iarm	29
Thermistor	UL Requirement: a thermistor **must** be fitted. Motor temperature thermistor. If unused then connect to 0 V. OK<200 Ω, Overtemp >2 kΩ. Connect from THM to 0 V.	THM	30
Contactor Control	DRIVE ENABLE: 24 V Logic input. Logic low below 6 V. Logic high above 16 V. Input impedance 10 kΩ.	RUN	31
	JOG: 24 V Logic input. Logic low below 6 V. Logic high above 16 V. Input impedance 10 kΩ.	JOG	32
	START/STOP: 24 V Logic input. Logic low below 6 V. Logic high above 16 V. Input impedance 10 kΩ.	START	33
	COAST STOP: 24 V Logic input. Logic low below 6 V. Logic high above 16 V. Input impedance 10 kΩ.	CSTOP	34
	+24 V SUPPLY OUTPUT: Short-circuit protected with fault annunciation. Refer to "7.6 Control wiring connections" on page 61. Over-voltage protection to +50 V. Shares total current capability of ‘Digital Outputs’ (350 mA), plus extra 50 mA of its own. Total maximum available 400 mA.	+24 V	35
0 V	Control clean protective earth connection.	0 V	36

These terminal connectors are on the lower power board:

Control terminals - electrical specification		Terminal	
Remote AVF	RA+ RA- used for remote sensing of armature volts. **NOTE:** when using remote AVF the armature volts signal is read 3.3% high.	RA+	41
	Do not connect to this terminal.	NC	42
	RA+ RA- used for remote sensing of armature volts. **NOTE:** when using remote AVF the armature volts signal is read 3.3% high.	RA-	43
	Do not connect to this terminal.	NC	44
Volt-Free Contacts	Volt-free contacts for main contactor coil Rating up to 240 Vac, 500 VA.	CON1	45
		CON2	46
Latch	Volt-free contact operates at same time as CON1/2, 240 Vac, 500 VA.	LAT1	47
		LAT2	48

Earth	Used for dirty earth connection of control supply.	EARTH	51
Control Power	**L**ive and **N**eutral connections for control power 100-240 Vac, 50-60 Hz ±10%, 50 VA. **NOTE: The control supply is required to power the PL/X electronics and must be applied before running.**	N	52
		L	53

7.8 Control terminals - default functions

The default functions will suit most applications. However, you can select an alternative function for all programmable terminals. **NOTE:** Control terminals on the lower power board, terminal numbers 41 to 53, are not programmable.

To restore the PL/X to its default settings, refer to "1.7.4 How to reset the unit" on page 7. Also, refer to "17.19.1 677)RECIPE PAGE" on page 363.

Control terminals - default functions

		Terminal	
0 V terminal	This **MUST** be used for protective clean earth connection.	0 V	1
Aux. Speed Reference	ANALOG INPUT: 0 to ±10 V linear input for 0 to ±100% speed.	UIP2	2
Speed Reference / Current Demand	ANALOG INPUT: 0 to ±10 V linear input for 0 to ±100% speed. **NOTE:** This analog input is sampled faster than the others, for very rapid response applications, e. g. as a current reference. Refer to "Figure 46 SPEED CONTROL - block diagram" on page 161. Refer to "11.9.1 Using small speed inputs" on page 164. The default gives a low gain for small inputs.	UIP3	3
Ramped Speed Reference	ANALOG INPUT: 0 to ±10 V linear input for 0 to ±100% speed. This input is routed through a programmable up/down ramp. Refer to "11.9.1 Using small speed inputs" on page 164. The default gives a low gain for small inputs.	UIP4	4
Lower Current Clamp (-ve)	ANALOG INPUT: 0 to -10 V linear input for 0 to -150% armature current clamp level. **NOTE:** When negative, it operates as a clamp on the current demand generated by the speed loop. When positive, it drives the demand and ignores the speed loop. Note that a demand level cannot override a clamp level. Refer also to T21.	UIP5	5
Main Current Limit / Upper Current Clamp (+ve)	ANALOG INPUT: 0 to +10 V linear input for 0 to +150% armature current clamp level. **NOTE:** When positive, it operates as a clamp on the current demand generated by the speed loop. When negative, it drives the demand and ignores the speed loop. Note that a demand level cannot override a clamp level. Refer also to T21.	UIP6	6
Motorised pot simulator, preset value enable	DIGITAL INPUT: While this terminal is held high, the motorised pot simulator is moved immediately to 0.00% (default preset value). When it is taken low, the motorised pot simulator output moves according to the Increase/Decrease inputs on terminals T8/T9.	UIP7	7
Motorised pot simulator	DIGITAL INPUT: Increase.	UIP8	8
Motorised pot simulator	DIGITAL INPUT: Decrease.	UIP9	9
Speed Feedback	ANALOG OUTPUT: 0 to ±10 V linear output for 0 to ±100% speed feedback. Programmable Uni-polar or Bipolar output mode.	AOP1	10

Control terminals - default functions		Terminal	
Total Speed Reference	ANALOG OUTPUT: 0 to ±10 V linear output for 0 to ±100% total speed reference.	AOP2	11
Total Current Demand	ANALOG OUTPUT: 0 to ±10 V linear output for 0 to ±100% current demand. Programmable Unipolar or Bipolar output mode.	AOP3	12
0 V terminal	This **MUST** be used for protective clean earth connection.	0 V	13
Spare input	DIGITAL INPUT: Encoder use	DIP1	14
Marker input	DIGITAL INPUT: Encoder use	DIP2	15
Encoder (B train or sign)	DIGITAL INPUT: Encoder use	DIP3	16
Encoder (A train)	DIGITAL INPUT: Encoder use	DIP4	17
Zero Reference Interlock	DIGITAL INPUT: Selects an interlock (CHANGE PARAMETERS / ZERO INTERLOCKS) to prevent the main contactor from energising if the speed reference does not first return to less than the 117)ZERO INTLK SPD % setting.	DIO1	18
Jog Mode Select	DIGITAL INPUT: A low input selects jog/slack speed 1. A high input selects jog/slack speed 2. Refer to CHANGE PARAMETERS / JOG CRAWL SLACK.	DIO2	19
Ramp Hold	DIGITAL INPUT: When the input is high, the CHANGE PARAMETERS / RUN MODE RAMPS output is held at the last value, irrespective of the ramped reference input. When the input is low, the CHANGE PARAMETERS / RUN MODE RAMPS output follows the ramped reference input, with a ramp time determined by the 22)FORWARD UP TIME, 23)FORWARD DOWN TIME, 24)REVERSE UP TIME, 25)REVERSE DOWN TIME parameters.	DIO3	20
Dual Current Clamp Enable	DIGITAL INPUT: This input alters the configuration of the current clamps. When the input is low, analog input T6 provides a symmetric bipolar current limit. When the input is high, analog input T6 is the positive current clamp and analog input T5 is the negative current clamp.	DIO4	21
Zero Speed Digital output	DIGITAL OUTPUT:117)ZERO INTLK SPD % can modify the operating level of this output to give the desired speed threshold of operation. A high output +24 V indicates zero speed.	DOP1	22
Ramping flag	DIGITAL OUTPUT: This output goes high when CHANGE PARAMETERS / RUN MODE RAMPS is ramping. (Used to prevent speed loop integration during ramp).	DOP2	23
Drive Healthy	DIGITAL OUTPUT: This output is high when the PL/X is healthy, meaning that no alarms have tripped and the PL/X is ready to run.	DOP3	24

Control terminals - default functions		Terminal	
0 V terminal	This **MUST** be used for protective clean earth connection.	0 V	25
DC Tachogenerator	INPUT: Full speed setting range: ±10 V to ±200 V. Refer to 8)MAX TACHO VOLTS.	TACH	26
User +10 V Reference Output	+10 V.	+10 V	27
User -10 V Reference Output	-10 V.	- 10 V	28
Armature Current Output	0 to ±5 V linear output for 0 to ±100% model rating current.	IARM	29
Motor Thermistor Input	UL Requirement: a thermistor **must** be fitted. Connect the motor over-temperature sensors in series between terminals T30 and T36. A motor over-temperature alarm is displayed if the external resistance between T30 and T36 exceeds 1800 Ω ±200 Ω. Refer to "13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE" on page 234 - THERMISTOR ON T30. **Terminals T30 and T36 (0 V COM) must be linked if not using external over-temperature sensors.**	THM	30
RUN	DIGITAL INPUT: Drive enable. Electronic enable for current loop and contactor drop out delays. The RUN input provides a means of electronically inhibiting PL/X operation. If the RUN input goes low during the stopping process, either heading for zero speed or during the delay period, the contactor will drop out straight away, causing the motor to stop. RUN also controls the field - refer to "11.13 CHANGE PARAMETERS / FIELD CONTROL" on page 182. RUN may also be used as a programmable digital input if not required as a RUN function. **WARNING!** Do not rely on any drive function to prevent the motor from operating when personnel are undertaking maintenance, or when machine guards are open. The Safety Codes do not accept electronic control as a sole means of inhibition for the PL/X. Always isolate the power source before working on the PL/X or the motor or load.	RUN	31

Control terminals - default functions			Terminal
JOG	DIGITAL INPUT: Jog input with programmable contactor drop-out delay. When the Jog input is held high, the PL/X jogs (rotates slowly while being requested), provided that T33 (START) is low. Remove the Jog input to cause the PL/X to ramp down to zero and obey the Jog/Slack Ramp time. Input T19 selects the jog speeds. Refer to START input below for further information about the jog control. Refer to "11.4.6 42)JOG MODE SELECT" on page 142.	JOG	32
START/STOP main contactor control	DIGITAL INPUT: Start/stop. This drops the contactor out at zero speed. The drive will not start unless all alarms are clear. The PL/X will not restart after alarm-induced contactor drop-out unless START is removed for at least 50 ms and re-applied. When the input is high, the PL/X will operate provided that: • There are no alarms. • The coast stop input (T34) is already high. • The PL/X run input (T31) is high. • The Jog input is low. When the input is low, the PL/X performs a ramped stop to zero speed. The rate of deceleration is set according to the programmed 56)STOP RAMP TIME. Refer to CHANGE PARAMETERS / STOP MODE RAMP for other parameters affecting this ramped stop. For all PL/X models, the main contactor de-energises when the motor reaches zero speed. Refer to "11.4.6 42)JOG MODE SELECT" on page 142. **NOTE:** The user control input contact must be maintained using external interlocking relay logic, or LAT1/2 on terminals 47 and 48. Refer to "7.5.1 METHOD 1 - Control wiring (QuickStart)" on page 58. Refer to "7.5.2 METHOD 2 - Control wiring" on page 59. Refer to "7.5.3 METHOD 3 - Control wiring" on page 60.	START	33

Control terminals - default functions			Terminal
COAST STOP main contactor control	DIGITAL INPUT: Coast stop. This drops the contactor out immediately (100 ms). When the input is high, the PL/X operates normally. When the input is low (0 V) or open-circuit, the main contactor is open and the PL/X no longer operates. When the input goes low during running, the main contactor de-energises within 100 ms and the motor coasts to rest under the influence of either external factors, e.g. friction and inertia, or by using an external dynamic braking resistor to dissipate the rotational energy **NOTE:** CSTOP must be high for at least 50 ms before START goes high. **NOTE:** When digital outputs short-circuit, the 24 V output (T35) continues to operate with a current capability of 50 mA. Therefore, the CSTOP line does not go low and shut down the PL/X.	CSTOP	34
+24 V Supply	+24 V SUPPLY OUTPUT: for external logic (range 22-32 V)	+24 V	35
0 V terminal	This **MUST** be used for protective clean earth connection.		36
Remote AVF Positive input from motor armature	INPUT: RA+ RA- used for remote sensing of armature volts (automatic internal disconnection). Using a DC contactor with field weakening allows the field control circuit to continue to sense the back-emf of the motor after the contactor has opened and hence prevent a sudden dangerous strengthening of the field current. **NOTE:** The AVF is increased by 3.3% when using remote sensing, causing a -3.3% speed scale change.	RA+	41
Unconnected terminal	Do not connect to this terminal.	NC	42
Remote AVF Negative input from motor armature	Refer to T41.	RA-	43
Unconnected terminal	Do not connect to this terminal.	NC	44
Volt-Free Contact	For main contactor - operated by START/JOG function when CSTOP is high.	CON1	45
Volt-Free Contact	For main contactor - operated by START/JOG function when CSTOP is high.	CON2	46
Volt-Free Contact	For latching main contactor push button.	LAT1	47
Volt-Free Contact	For latching main contactor push button.	LAT2	48

Control terminals - default functions		Terminal	
Earth	Used for dirty earth connection of control supply.	EARTH	51
Control Power	If the voltage falls below 80 Vac, the PL/X begins an orderly shutdown sequence. Refer to "10.7 Supply loss shutdown" on page 106.	N	52
		L	53

7.9 Signal test pins

These test pins are used to monitor certain feedback signals:

0V Ia If AVF Vref

The **Ia** signal is an attenuated, unfiltered, inverted version of terminal 29 and may be used to observe the current response of the PL/X. Refer to "17.19.2 678)MAX CUR RESPONSE" on page 365. Refer also to "17.5.1 250)Iarm OP RECTIFY" on page 336. Its signal sign and amplitude is 0 to ±2 V linear output for 0 to ±100% model rating current (inverted) for the unrectified mode, and 0 to -2 V linear output for 0 to ±100% model rating current for the rectified mode (refer to "17.5.1 250)Iarm OP RECTIFY" on page 336).

The other feedback signals are for factory use only.

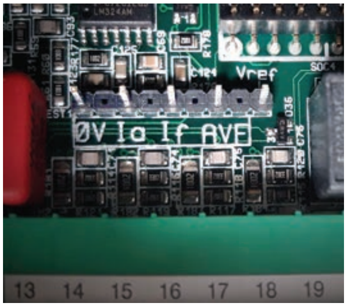


Figure 32 Signal test pins

8 How to use the keypad

8.1 Diagnostic Summary screens

The Diagnostic Summary screens are at the top of the menu system, alternating approximately every five seconds. Press the **RIGHT** key to view the ENTRY MENU.

Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

```
SPD% Iarm Ifld RJSC      Sref Ilim -Ilim mode      ENTRY MENU    LEVEL 1
0    0    0    0000      0    0    0     STOP
```

The linear parameters are integer %.

NOTE: The two Diagnostic Summary screens alternate approximately every five seconds.

However, this stops when the drive is left with ENABLE GOTO, GETFROM set to ENABLED. The drive cannot be run in this state and mode (above) displays CONF to indicate this. To run the drive, set ENABLE GOTO, GETFROM to DISABLED. Refer to Page 77.

The screens represent the following parameters:

SPD%	131)SPEED FBK MON	Monitor the value of the speed feedback as a % of full scale.
Iarm	134)ARM CUR % MON	Monitor the value of the average DC armature current, expressed as a percentage.
Ifld	144)FIELD CUR % MON	Monitor the value of the average DC field current, expressed as a percentage.
RJSC	164)DOP 123TRJSC CIP	Monitor the digital logic level for (DOP1 to 3 and Therm - not shown here), **R**un, **J**og, **S**tart, **C**stop

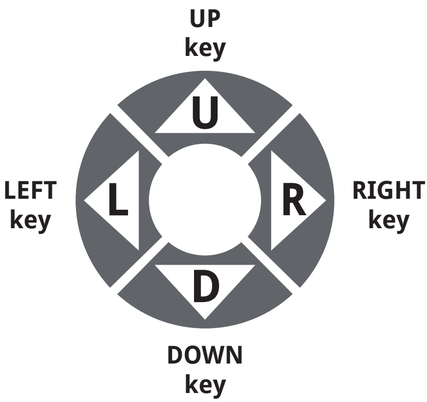
Sref	124)SPEED DEMAND MON	Monitor the % value of the total speed demand after the STOP RAMP BLOCK.
Ilim	138)ACTUAL UPPER LIM	Monitor the % value of the prevailing upper limit in the current clamp block.
-Ilim	139)ACTUAL LOWER LIM	Monitor the % value of the prevailing lower limit in the current clamp block.
Mode	167)DRIVE RUN FLAG	Monitor if a command to RUN has been issued to the current loop.

8.2 Keypad functions

Use the PL/X keypad to navigate through the menus and change parameter settings.

Press a key by tapping it quickly (use your fingertip for more accurate results). Hold the key down to advance rapidly to a distant selection or value.

Also, you can use the keypad to load a Drive Personality. The NORMAL page is pre-loaded from the factory. Refer to "17.19 CONFIGURATION / DRIVE PERSONALITY" on page 363.



L	Press the **LEFT** key to display the previous menu level/parameter	**R**	Press the **RIGHT** key to display the next menu level/parameter/ parameter setting
U	Press the **UP** key to move upwards through the list of menus/ parameters/selections, or to increase a value	**D**	Press the **DOWN** key to move downwards through the list of menus/parameters/selections, or to decrease a value

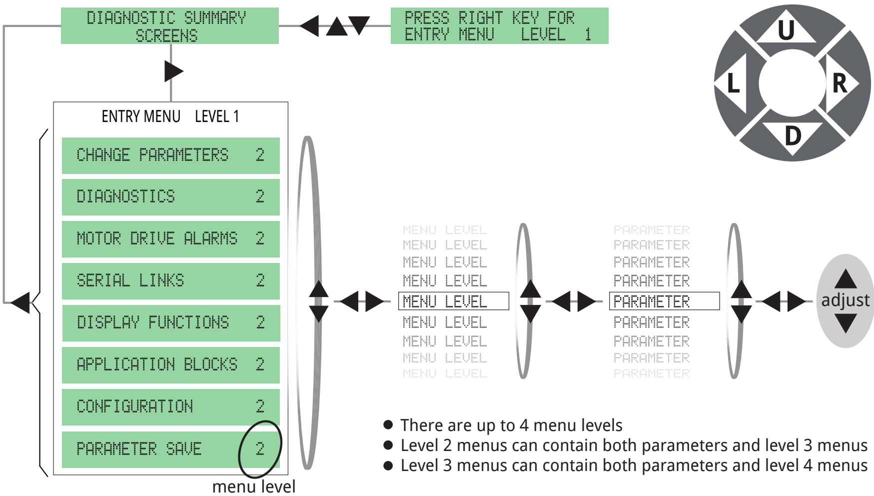
9 About the Menu System

The menu system forms a tree-like structure, divided into four levels, with two Diagnostic Summary screens as the entry point to Level 1.

You can select to view the FULL menu system containing over 700 parameters arranged into blocks or a REDUCED menu system holding approximately 50 of the often-used adjustable parameters contained in their relevant blocks.

Ⓡ Throughout the manual, Ⓡ indicates parameters in the REDUCED menu system (note that these parameters also appear in the FULL menu system).

- FULL/REDUCED menu - refer to "15.1 DISPLAY FUNCTIONS" on page 241.



- There are up to 4 menu levels
- Level 2 menus can contain both parameters and level 3 menus
- Level 3 menus can contain both parameters and level 4 menus

ENTRY MENU LEVEL 1 screen

PRESS RIGHT KEY FOR
ENTRY MENU LEVEL 1

This screen appears momentarily at start-up (just before the unit's self-test counter), and will appear if you press the LEFT, UP and DOWN keys when already at the top of the menu structure, i.e. viewing the Diagnostic Summary screens. It reminds you to press the RIGHT key for entry to Menu Level 1.

HINT: While we mention pressing the LEFT key "at least five times (**5xL**) to display the Diagnostic Summary screens", in practice, you can continuously hold down the LEFT key from any point in the menu until the Level 1 screen is displayed. Release the key to display the Diagnostic Summary screens.

DIAGNOSTIC menu/parameter easy access

Many DIAGNOSTIC parameters have easy access to the next window. Tap the RIGHT key repeatedly until the end of the menu branch is displayed. For rapid access:

- Press the UP key to display the end of the menu branch for the menu/parameter above.
- Press the DOWN key to display the end of the menu branch for the menu/parameter below.

9.1 Configuring the drive

The PL/X menu system comprises both "hard-wired" blocks and blocks that can be re-wired to create a user configuration.

Each block holds parameters.

Each parameter stores a value.

A parameter is identifiable by its PIN (Parameter Identification Number).

There are PIN tables at the back of this manual. Use the tables to find a parameter's location within the menu system, its parameter range, default setting and property.

When configuring the drive:

- You can change a parameter value, followed by a PARAMETER SAVE.

or

- You can begin a Configuration session and, by connecting parameters of configurable blocks, pass the value of a source parameter to a target parameter to re-wire the block diagram. Follow this with a PARAMETER SAVE.

Configuration using the HMI

To begin a Configuration session, you must set CONFIGURATION / ENABLE GOTO, GETFROM **to ENABLED.**

ENABLE GOTO,GETFROM
ENABLED

Attempting to make a connection without doing this will cause ENABLE GOTO, GETFROM to be displayed.

To end a Configuration session, you must set CONFIGURATION / ENABLE GOTO, GETFROM **to DISABLED.**

ENABLE GOTO,GETFROM
DISABLED

The PL/X now runs a "Conflict Checker" to warn of GOTO connection conflicts.

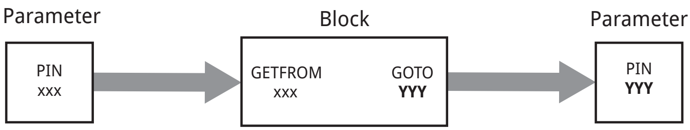
Refer to "17.1.1 CONFLICT HELP MENU" on page 323.

There are four methods of connecting parameters during a Configuration session using a configurable block's inputs and outputs:

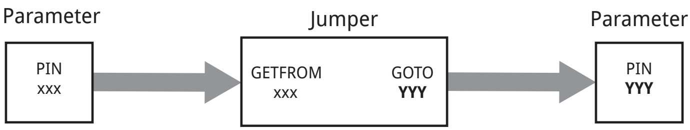
GOTO	This is the output of a block. It can connect to any parameter, except the output from another block. It cannot connect directly to a GETFROM.
GET FROM	This is the input of a block. It can connect from any parameter. A block may also have an AUX GETFROM (which is a second GETFROM).
JUMPER	This is a virtual wire that connects two parameters using its own GOTO and GETFROM.
STAGING POST	This is a spare parameter which can be used to connect a GOTO to a GETFROM. Any other unused parameter can be used for the same purpose.

Using a combination of these methods, you can construct very simple to very complex systems.

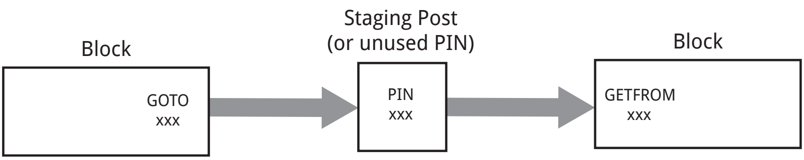
- **A parameter can only be written to by one GOTO.**
- **A GET FROM can only be read from one parameter.**
- **The same parameter can connect to multiple GET FROMs.**



Write a value to a block (to perform some function on the value) and read the new value



Pass a value (unchanged) from a PIN to a different PIN



Pass a value (unchanged) from a Block to a different Block - the value can be viewed at the Staging Post (or unused PIN)

Figure 33 Configuring the PL/X

For a detailed explanation, refer to "17.2 CONFIGURATION" on page 324.

HINT: When viewing a GET FROM, get quick access to all available parameters by pressing the UP/DOWN keys. This shortcut also works for AUX GET FROMs and GOTOs.

To configure the PL/X, CONFIGURATION / ENABLE GOTO, GETFROM **must be set to ENABLED**.

9.2 Saving your changes

- Changes made to parameters are effective immediately.
- To make configuration changes using the HMI, set ENABLE GOTO,GETFROM to ENABLED. Configuration changes become effective when you set ENABLE GOTO,GETFROM to DISABLED. (When using a serially connected configuration tool, setting ENABLE GOTO,GETFROM to ENABLED prevents changes from being made).

Changes are not permanent until a PARAMETER SAVE is performed.

9.2.1 How to save parameters

1. Hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.
2. Enter the sequence **R-U-R-U**.

Key	Action	
R	Display the PARAMETER SAVE screen	PARAMETER SAVE 2 UP KEY TO CONTINUE
U		
R		
U	Press the UP key to continue and save	

3. Press the UP (**U**) key to perform a PARAMETER SAVE.
4. When the save is FINISHED, hold down the **LEFT** key to display the Diagnostic Summary screens. Release the key.

You can change the write destination of the PARAMETER SAVE operation. Refer to "17.19.1 677)RECIPE PAGE" on page 363, which discusses four possible options:

- NORMAL RESET
- 2-KEY RESET
- 3-KEY RESET
- 4-KEY ROM RESET

Refer to "Figure 89 Recipe Page - functional diagram" on page 364.

9.2.2 Abandoning unwanted changes

Removing power from the PL/X before performing a PARAMETER SAVE will restore parameters and configuration settings to their previous condition.

9.3 Restoring parameters to default conditions

It might be beneficial to reset a unit to its default setup condition. For instance, if a trial configuration proves unworkable, starting anew may be considered easier.

The 4-KEY ROM RESET will restore the default connections and parameters (with a few convenient exceptions). Refer to "1.7.4.1 4-KEY RESET (to factory defaults)" on page 7.

9.4 400)BLOCK DISCONNECT

Connecting the GOTO of a block to 400)BLOCK DISCONNECT de-activates the block. Using any other PIN activates the block.

In the ENABLE GOTO,GETFROM menus, 400)BLOCK DISCONNECT is located approximately mid-way in any of the lists.

9.5 The menu tree structure

The QuickStart parameters and PARAMETER SAVE are highlighted in **red**.

```
SPD% Iarm Ifld RJSC     Sref Ilim -Ilim mode     ENTRY MENU   LEVEL 1
0    0    0    0000     0    0    0     STOP
```

CHANGE PARAMETERS 2

- DIAGNOSTICS 2
- MOTOR DRIVE ALARMS 2
- SERIAL LINKS 2
- DISPLAY FUNCTIONS 2
- APPLICATION BLOCKS 2
- CONFIGURATION 2
- PARAMETER SAVE 2

RUN MODE RAMPS 3

- 21)RAMP OP MONITOR
- 22)FORWARD UP TIME
- 23)FORWARD DOWN TIME
- 24)REVERSE UP TIME
- 25)REVERSE DOWN TIME
- 26)RAMP INPUT
- 27)FORWARD MIN SPEED
- 28)REVERSE MIN SPEED
- 29)RAMP AUTO PRESET
- 30)RAMP EXT PRESET
- 31)RAMP PRESET VALUE
- 32)RAMP S-PROFILE %
- 33)RAMP HOLD
- 34)RAMPING THRESHOLD
- 35)RAMPING FLAG

JOG CRAWL SLACK 3

- 37)JOG SPEED 1
- 38)JOG SPEED 2
- 39)SLACK SPEED 1
- 40)SLACK SPEED 2
- 41)CRAWL SPEED
- 42)JOG MODE SELECT
- 43)JOG/SLACK RAMP

MOTORISED POT RAMP 3

- 45)MP OP MONITOR
- 46)MP UP TIME
- 47)MP DOWN TIME
- 48)MP UP COMMAND
- 49)MP DOWN COMMAND
- 50)MP MAX CLAMP
- 51)MP MIN CLAMP
- 52)MP PRESET
- 53)MP PRESET VALUE
- 54)MP MEMORY BOOT-UP

STOP MODE RAMP 3

- 56)STOP RAMP TIME
- 57)STOP TIME LIMIT
- 58)LIVE DELAY MODE
- 59)DROP-OUT SPEED
- 60)DROP-OUT DELAY

SPEED REF SUMMER 3

- 62)INT SPEED REF 1
- 63)SPEED REF 2
- 64)SPEED REF 3 MON
- 65)RAMPED SPD REF 4
- 66)SPD/CUR REF3 SIGN
- 67)SPD/CUR RF3 RATIO

- CHANGE PARAMETERS 2
  - SPEED CONTROL 3
    - 69)MAX POS SPEED REF
    - 70)MAX NEG SPEED REF
    - 71)SPEED PROP GAIN
    - 72)SPEED INT T.C.
    - 73)SPEED INT RESET
    - **SPEED PI ADAPTION 4**
      - 74)SPD ADPT LO BRPNT
      - 75)SPD ADPT HI BRPNT
      - 76)LO BRPNT PRP GAIN
      - 77)LO BRPNT INT T.C.
      - 78)INT % DURING RAMP
      - 79)SPD ADAPT ENABLE
  - CURRENT CONTROL 3
    - 81)CUR CLAMP SCALER
    - **CURRENT OVERLOAD 4**
      - 82)O/LOAD % TARGET
      - 83)O/LOAD RAMP TIME
    - **I DYNAMIC PROFILE 4**
      - 84)I PROFILE ENABLE
      - 85)SPD BRPNT AT HI I
      - 86)SPD BRPNT AT LO I
      - 87)CUR LIMIT AT LO I
    - 88)DUAL I CLAMP ENBL
    - 89)UPPER CUR CLAMP
    - 90)LOWER CUR CLAMP
    - 91)EXTRA CUR REF
    - 92)AUTOTUNE ENABLE
    - 93)CUR PROP GAIN
    - 94)CUR INT GAIN
    - 95)CUR DISCONTINUITY
    - 96)4-QUADRANT MODE
    - 97)SPD BYPASS CUR EN
  - FIELD CONTROL 3
    - 99)FIELD ENABLE
    - 100)FIELD VOLTS OP %
    - 101)FIELD PROP GAIN
    - 102)FIELD INT GAIN
    - **FLD WEAKENING MENU 4**
      - 103)FLD WEAK ENABLE
      - 104)FLD WK PROP GAIN
      - 105)FLD WK INT TC ms
      - 106)FLD WK DRV TC ms
      - 107)FLD WK FB DRV ms
      - 108)FLD WK FB INT ms
      - 109)SPILLOVER AVF %
      - 110)MIN FLD CURRENT
    - 111)STANDBY FLD ENBL
    - 112)STANDBY FLD CUR
    - 113)FLD QUENCH DELAY
    - 114)FIELD REFERENCE
  - ZERO INTERLOCKS 3
    - 115)STANDSTILL ENBL
    - 116)ZERO REF START
    - 117)ZERO INTLK SPD %
    - 118)ZERO INTLK CUR %
    - 119)AT ZERO REF FLAG
    - 120)AT ZERO SPD FLAG
    - 121)AT STANDSTILL
    - **SPINDLE ORIENTATE 4**
      - 122)ZERO SPEED LOCK
      - 240)MARKER ENABLE
      - 241)MARKER OFFSET
      - 242)POSITION REF
      - 243)MARKER FREQ MON
      - 244)IN POSITION FLAG
  - CALIBRATION 3
    - 2)RATED ARM AMPS
    - 3)CURRENT LIMIT(%)
    - 4)RATED FIELD AMPS
    - 5)BASE RATED RPM
    - 6)DESIRED MAX RPM
    - 7)ZERO SPD OFFSET
    - 8)MAX TACHO VOLTS
    - 9)SPEED FBK TYPE
    - **ENCODER SCALING 4**
      - 10)QUADRATURE ENABLE
      - 11)ENCODER LINES
      - 12)MOT/ENC SPD RATIO
      - 13)ENCODER SIGN
    - 14)IR COMPENSATION
    - 15)FIELD CUR FB TRIM
    - 16)ARM VOLTS TRIM
    - 17)ANALOG TACHO TRIM
    - 18)RATED ARM VOLTS
    - 19)EL1/2/3 RATED AC
    - 20)MOTOR 1,2 SELECT

SPD% Iarm Ifld RJSC
0 0 0 0000

Sref Ilim -Ilim mode
0 0 0 STOP

ENTRY MENU LEVEL 1

- CHANGE PARAMETERS 2
- **DIAGNOSTICS 2**
  - **SPEED LOOP MONITOR 3**
    - 123)TOTAL SPD REF MN
    - 124)SPEED DEMAND MON
    - 125)SPEED ERROR MON
    - 126)ARM VOLTS MON
    - 127)ARM VOLTS % MON
    - 128)BACK EMF % MON
    - 129)TACHO VOLTS MON
    - 130)MOTOR RPM MON
    - 132)ENCODER RPM MON
    - 131)SPEED FBK MON
  - **ARM I LOOP MONITOR 3**
    - 133)ARM CUR DEM MON
    - 134)ARM CUR % MON
    - 135)ARM CUR AMPS MON
    - 136)UPPER CUR LIM MN
    - 137)LOWER CUR LIM MN
    - 138)ACTUAL UPPER LIM
    - 139)ACTUAL LOWER LIM
    - 140)O/LOAD LIMIT MON
    - 141)AT CURRENT LIMIT
  - **FIELD I LOOP MONITOR 3**
    - 143)FIELD DEMAND MON
    - 144)FIELD CUR % MON
    - 145)FLD CUR AMPS MON
    - 146)ANGLE OF ADVANCE
    - 147)FIELD ACTIVE MON
  - **ANALOG IO MONITOR 3**
    - 150)UIP2 (T2) MON
    - 151)UIP3 (T3) MON
    - 152)UIP4 (T4) MON
    - 153)UIP5 (T5) MON
    - 154)UIP6 (T6) MON
    - 155)UIP7 (T7) MON
    - 156)UIP8 (T8) MON
    - 157)UIP9 (T9) MON
  - **DIGITAL IO MONITOR 3**
    - 162)UIP 23456789
    - 163)DIP 12341234 DIO
    - 164)DOP 123TRJSC CIP
    - 165)+ARM BRIDGE FLAG
    - 166)DRIVE START FLAG
    - 167)DRIVE RUN FLAG
    - 168)RUNNING MODE MON
  - **BLOCK OP MONITOR 3**
    - 21)RAMP OP MONITOR
    - 45)MP OP MONITOR
    - 192)REF XC MASTER MN
    - 401)SUMMER1 OP MON
    - 415)SUMMER2 OP MON
    - 429)PID1 OP MONITOR
    - 452)PID2 OP MONITOR
    - 475)PROFILE Y OP MON
    - 483)DIAMETER OP MON
    - 494)TOTAL TENSION MN
    - 500)TORQUE DEMAND MN
    - 523)PRESET OP MON
    - 560)LATCH OUTPUT MON
    - 568)FILTER1 OP MON
    - 573)FILTER2 OP MON
    - 578)COUNTER COUNT
    - 583)TMR ELAPSED TIME
- MOTOR DRIVE ALARMS 2
- SERIAL LINKS 2
- DISPLAY FUNCTIONS 2
- APPLICATION BLOCKS 2
- CONFIGURATION 2
- PARAMETER SAVE 2

DIAGNOSTICS 2

FIELDBUS 3

169)EL1/2 RMS MON

170)DC KILOWATTS MON

200)FBUS ON-LINE MON
203)FBUS BITS INPUT
213)FBUS BITS OUTPUT
223)ANYBUS TYPE

SPD% Iarm Ifld RJSC
0 0 0 0000

Sref Ilim -Ilim mode
0 0 0 STOP

ENTRY MENU LEVEL 1

U L R D

CHANGE PARAMETERS 2
DIAGNOSTICS 2
MOTOR DRIVE ALARMS 2
SERIAL LINKS 2
DISPLAY FUNCTIONS 2
APPLICATION BLOCKS 2
CONFIGURATION 2
PARAMETER SAVE 2

171)SPD TRIP ENABLE
172)SPEED TRIP TOL
173)FLD LOSS TRIP EN
174)DOP SCCT TRIP EN
175)MISSING PULSE EN
176)REF EXCH TRIP EN
177)OVERSPEED DELAY
STALL TRIP MENU 3
181)ACTIVE TRIP MON
182)STORED TRIP MON
183)EXT TRIP RESET

123)TOTAL SPD REF MN
124)SPEED DEMAND MON
125)SPEED ERROR MON
126)ARM VOLTS MON
127)ARM VOLTS % MON
128)BACK EMF % MON
129)TACHO VOLTS MON
130)MOTOR RPM MON

DRIVE TRIP MESSAGE 3

NO ALARMS DETECTED

SPD% Iarm Ifld RJSC
0 0 0 0000

Sref Ilim -Ilim mode
0 0 0 STOP

ENTRY MENU LEVEL 1

U L R D

CHANGE PARAMETERS 2
DIAGNOSTICS 2
MOTOR DRIVE ALARMS 2
SERIAL LINKS 2
DISPLAY FUNCTIONS 2
APPLICATION BLOCKS 2
CONFIGURATION 2
PARAMETER SAVE 2

RS232 PORT1 3

187)PORT1 BAUD RATE
188)PORT1 FUNCTION
PARAMETER EXCHANGE 4

DRIVE TRANSMIT 5
DRIVE RECEIVE 5
MENU LIST TO HOST 5

REFERENCE EXCHANGE 4

189)REF XC SLV RATIO
190)REF XC SLV SIGN
191)REF XC SLAVE MON
192)REF XC MASTER MN
GET FROM

PORT1 COMMS LINK 4

193)PORT1 GROUP ID
194)PORT1 UNIT ID
195)PORT1 ERROR CODE
196)P1 DOP3 RTS MODE

SPD% Iarm Ifld RJSC
0 0 0 0000

Sref Ilim -Ilim mode
0 0 0 STOP

ENTRY MENU LEVEL 1

CHANGE PARAMETERS 2
DIAGNOSTICS 2
MOTOR DRIVE ALARMS 2
SERIAL LINKS 2
DISPLAY FUNCTIONS 2
- REDUCED MENU ENABLE
- **PASSWORD CONTROL 3**
  - ENTER PASSWORD
  - ALTER PASSWORD
- LANGUAGE SELECT
- SOFTWARE VERSION

APPLICATION BLOCKS 2
CONFIGURATION 2
PARAMETER SAVE 2

SPD% Iarm Ifld RJSC
0 0 0 0000

Sref Ilim -Ilim mode
0 0 0 STOP

ENTRY MENU LEVEL 1

CHANGE PARAMETERS 2
DIAGNOSTICS 2
MOTOR DRIVE ALARMS 2
SERIAL LINKS 2
DISPLAY FUNCTIONS 2
APPLICATION BLOCKS 2
- **SUMMER 1 3**
- **SUMMER 2 3**
- **PID 1 3**
- **PID 2 3**
- **PARAMETER PROFILER 3**
- **REEL DIAMETER CALC 3**
- **TAPER TENSION CALC 3**
- **TORQUE COMPENSATOR 3**
- **PRESET SPEED 3**
- **MULTI-FUNCTION 1 3**
- **MULTI-FUNCTION 2 3**
- **MULTI-FUNCTION 3 3**
- **MULTI-FUNCTION 4 3**
- **MULTI-FUNCTION 5 3**
- **MULTI-FUNCTION 6 3**
- **MULTI-FUNCTION 7 3**
- **MULTI-FUNCTION 8 3**
- **LATCH 3**
- **FILTER 1 3**
- **FILTER 2 3**
- **BATCH COUNTER 3**
- **INTERVAL TIMER 3**
- **COMPARATOR 1 3**
- **COMPARATOR 2 3**
- **COMPARATOR 3 3**
- **COMPARATOR 4 3**
- **C/O SWITCH 1 3**
- **C/O SWITCH 2 3**
- **C/O SWITCH 3 3**
- **C/O SWITCH 4 3**
- **16-BIT DEMULTIPLEX 3**

Refer to "16 The APPLICATION BLOCKS menu" on page 245

CONFIGURATION 2
PARAMETER SAVE 2

SPD% Iarm Ifld RJSC
0 0 0 0000

Sref Ilim -Ilim mode
0 0 0 STOP

ENTRY MENU LEVEL 1

- CHANGE PARAMETERS 2
- DIAGNOSTICS 2
- MOTOR DRIVE ALARMS 2
- SERIAL LINKS 2
- DISPLAY FUNCTIONS 2
- APPLICATION BLOCKS 2
- **CONFIGURATION 2**
  - ENABLE GOTO,GETFROM
  - **UNIVERSAL INPUTS 3**
    - **UIP2 (T2) SETUP 4**
      - 320)UIP2 IP RANGE
      - 321)UIP2 IP OFFSET
      - 322)UIP2 CAL RATIO
      - 323)UIP2 MAX CLAMP
      - 324)UIP2 MIN CLAMP
      - UIP ANALOG GOTO
      - UIP DIGITAL OP1 GOTO
      - UIP DIGITAL OP2 GOTO
      - 325)UIP2 HI VAL OP1
      - 326)UIP2 LO VAL OP1
      - 327)UIP2 HI VAL OP2
      - 328)UIP2 LO VAL OP2
      - 329)UIP2 THRESHOLD
    - **UIP3 (T3) SETUP 4**
      - 330)UIP3 IP RANGE
      - 331)UIP3 IP OFFSET
      - 332)UIP3 CAL RATIO
      - 333)UIP3 MAX CLAMP
      - 334)UIP3 MIN CLAMP
      - UIP ANALOG GOTO
      - UIP DIGITAL OP1 GOTO
      - UIP DIGITAL OP2 GOTO
      - 335)UIP3 HI VAL OP1
      - 336)UIP3 LO VAL OP1
      - 337)UIP3 HI VAL OP2
      - 338)UIP3 LO VAL OP2
      - 339)UIP3 THRESHOLD
    - **UIP4 (T4) SETUP 4**
      - 340)UIP4 IP RANGE
      - 341)UIP4 IP OFFSET
      - 342)UIP4 CAL RATIO
      - 343)UIP4 MAX CLAMP
      - 344)UIP4 MIN CLAMP
      - UIP ANALOG GOTO
      - UIP DIGITAL OP1 GOTO
      - UIP DIGITAL OP2 GOTO
      - 345)UIP4 HI VAL OP1
      - 346)UIP4 LO VAL OP1
      - 347)UIP4 HI VAL OP2
      - 348)UIP4 LO VAL OP2
      - 349)UIP4 THRESHOLD
    - **UIP5 (T5) SETUP 4**
      - 350)UIP5 IP RANGE
      - 351)UIP5 IP OFFSET
      - 352)UIP5 CAL RATIO
      - 353)UIP5 MAX CLAMP
      - 354)UIP5 MIN CLAMP
      - UIP ANALOG GOTO
      - UIP DIGITAL OP1 GOTO
      - UIP DIGITAL OP2 GOTO
      - 355)UIP5 HI VAL OP1
      - 356)UIP5 LO VAL OP1
      - 357)UIP5 HI VAL OP2
      - 358)UIP5 LO VAL OP2
      - 359)UIP5 THRESHOLD
- PARAMETER SAVE 2

CONFIGURATION 2

UNIVERSAL INPUTS 3

UIP6 (T6) SETUP 4

360)UIP6 IP RANGE
361)UIP6 IP OFFSET
362)UIP6 CAL RATIO
363)UIP6 MAX CLAMP
364)UIP6 MIN CLAMP
UIP ANALOG GOTO
UIP DIGITAL OP1 GOTO
UIP DIGITAL OP2 GOTO
365)UIP6 HI VAL OP1
366)UIP6 LO VAL OP1
367)UIP6 HI VAL OP2
368)UIP6 LO VAL OP2
369)UIP6 THRESHOLD

UIP7 (T7) SETUP 4

370)UIP7 IP RANGE
371)UIP7 IP OFFSET
372)UIP7 CAL RATIO
373)UIP7 MAX CLAMP
374)UIP7 MIN CLAMP
UIP ANALOG GOTO
UIP DIGITAL OP1 GOTO
UIP DIGITAL OP2 GOTO
375)UIP7 HI VAL OP1
376)UIP7 LO VAL OP1
377)UIP7 HI VAL OP2
378)UIP7 LO VAL OP2
379)UIP7 THRESHOLD

UIP8 (T8) SETUP 4

380)UIP8 IP RANGE
381)UIP8 IP OFFSET
382)UIP8 CAL RATIO
383)UIP8 MAX CLAMP
384)UIP8 MIN CLAMP
UIP ANALOG GOTO
UIP DIGITAL OP1 GOTO
UIP DIGITAL OP2 GOTO
385)UIP8 HI VAL OP1
386)UIP8 LO VAL OP1
387)UIP8 HI VAL OP2
388)UIP8 LO VAL OP2
389)UIP8 THRESHOLD

UIP9 (T9) SETUP 4

390)UIP9 IP RANGE
391)UIP9 IP OFFSET
392)UIP9 CAL RATIO
393)UIP9 MAX CLAMP
394)UIP9 MIN CLAMP
UIP ANALOG GOTO
UIP DIGITAL OP1 GOTO
UIP DIGITAL OP2 GOTO
395)UIP9 HI VAL OP1
396)UIP9 LO VAL OP1
397)UIP9 HI VAL OP2
398)UIP9 LO VAL OP2
399)UIP9 THRESHOLD

- **CONFIGURATION 2**
  - **ANALOG OUTPUTS 3**
    - 250)Iarm OP RECTIFY
    - **AOP1 (T10) SETUP 4**
      - 251)AOP1 DIVIDER
      - 252)AOP1 OFFSET
      - 253)AOP1 RECTIFY EN
      - GET FROM
    - **AOP2 (T11) SETUP 4**
      - 254)AOP2 DIVIDER
      - 255)AOP2 OFFSET
      - 256)AOP2 RECTIFY EN
      - GET FROM
    - **AOP3 (T12) SETUP 4**
      - 257)AOP3 DIVIDER
      - 258)AOP3 OFFSET
      - 259)AOP3 RECTIFY EN
      - GET FROM
    - 260)SCOPE OP SELECT
  - **DIGITAL INPUTS 3**
    - **DIP1 (T14) SETUP 4**
      - 310)DIP1 IP HI VALUE
      - 311)DIP1 IP LO VALUE
      - GOTO
    - **DIP2 (T15) SETUP 4**
      - 312)DIP2 IP HI VALUE
      - 313)DIP2 IP LO VALUE
      - GOTO
    - **DIP3 (T16) SETUP 4**
      - 314)DIP3 IP HI VALUE
      - 315)DIP3 IP LO VALUE
      - GOTO
    - **DIP4 (T17) SETUP 4**
      - 316)DIP4 IP HI VALUE
      - 317)DIP4 IP LO VALUE
      - GOTO
    - **RUN INPUT SETUP 4**
      - 318)RUN IP HI VALUE
      - 319)RUN IP LO VALUE
      - GOTO

CONFIGURATION 2

DIGITAL IN/OUTPUTS 3

- DIO1 (T18) SETUP 4
  - 271)DIO1 OP MODE
  - 272)DIO1 RECTIFY EN
  - 273)DIO1 THRESHOLD
  - 274)DIO1 INVERT MODE
  - GET FROM
  - GOTO
  - 275)DIO1 IP HI VALUE
  - 276)DIO1 IP LO VALUE
- DIO2 (T19) SETUP 4
  - 277)DIO2 OP MODE
  - 278)DIO2 RECTIFY EN
  - 279)DIO2 THRESHOLD
  - 280)DIO2 INVERT MODE
  - GET FROM
  - GOTO
  - 281)DIO2 IP HI VALUE
  - 282)DIO2 IP LO VALUE
- DIO3 (T20) SETUP 4
  - 283)DIO3 OP MODE
  - 284)DIO3 RECTIFY EN
  - 285)DIO3 THRESHOLD
  - 286)DIO3 INVERT MODE
  - GET FROM
  - GOTO
  - 287)DIO3 IP HI VALUE
  - 288)DIO3 IP LO VALUE
- DIO4 (T21) SETUP 4
  - 289)DIO4 OP MODE
  - 290)DIO4 RECTIFY EN
  - 291)DIO4 THRESHOLD
  - 292)DIO4 INVERT MODE
  - GET FROM
  - GOTO
  - 293)DIO4 IP HI VALUE
  - 294)DIO4 IP LO VALUE

- CONFIGURATION 2
  - DIGITAL OUTPUTS 3
    - DOP1 (T22) SETUP 4
      - 261)DOP1 RECTIFY EN
      - 262)DOP1 THRESHOLD
      - 263)DOP1 INVERT MODE
      - GET FROM
    - DOP2 (T23) SETUP 4
      - 264)DOP2 RECTIFY EN
      - 265)DOP2 THRESHOLD
      - 266)DOP2 INVERT MODE
      - GET FROM
    - DOP3 (T24) SETUP 4
      - 267)DOP3 RECTIFY EN
      - 268)DOP3 THRESHOLD
      - 269)DOP3 INVERT MODE
      - GET FROM
  - STAGING POSTS 3
    - 296)DIGITAL POST 1
    - 297)DIGITAL POST 2
    - 298)DIGITAL POST 3
    - 299)DIGITAL POST 4
    - 300)ANALOG POST 1
    - 301)ANALOG POST 2
    - 302)ANALOG POST 3
    - 303)ANALOG POST 4
  - SOFTWARE TERMINALS 3
    - 305)ANDED RUN
    - 306)ANDED JOG
    - 307)ANDED START
    - 308)INTERNAL RUN IP
  - JUMPER CONNECTIONS 3
    - JUMPER 1 4 … JUMPER 16 4
      - GET FROM
      - GOTO
  - BLOCK OP CONFIG 3
    - RUN MODE RAMPS GOTO
    - MOTORISED POT GOTO
    - REF EXCH SLAVE GOTO
    - SUMMER1 GOTO
    - SUMMER2 GOTO
    - PID1 GOTO
    - PID2 GOTO
    - PARAMETER PROFL GOTO
    - DIAMETER CALC GOTO
    - TAPER CALC GOTO
    - T/COMP +CUR LIM GOTO
    - T/COMP -CUR LIM GOTO
    - PRESET SPEED GOTO
    - LATCH GOTO
    - FILTER1 GOTO
    - FILTER2 GOTO
    - BATCH COUNTER GOTO
    - INTERVAL TIMER GOTO

CONFIGURATION 2

- FIELDBUS CONFIG 3
  - JUMPER 1 4 — GET FROM
  - JUMPER 2 4
  - BIT-PACKED GETFROM
  - JUMPER 9 4 — GOTO
  - JUMPER 16 4
  - BIT-PACKED GOTO
  - 199)FBUS DATA CONTROL
  - 202)FBUS NODE ID
  - 224)FBUS BAUD RATE
- DRIVE PERSONALITY 3
  - PASSIVE MOTOR SET 4 — Refer to "17.20 CONFIGURATION/DRIVE PERSONALITY/PASSIVE MOTOR SET" on page 371.
  - 677)RECIPE PAGE
  - 678)MAX CUR RESPONSE
  - 679)ID ABCXRxxx MON
  - 680)Iarm BURDEN OHMS
- CONFLICT HELP MENU 3
  - NUMBER OF CONFLICTS
  - MULTIPLE GOTO ON PIN

```
SPD% Iarm Ifld RJSC
0    0    0    0000
```

```
Sref Ilim -Ilim mode
0    0    0     STOP
```

```
ENTRY MENU    LEVEL 1
```

CHANGE PARAMETERS 2
DIAGNOSTICS 2
MOTOR DRIVE ALARMS 2
SERIAL LINKS 2
DISPLAY FUNCTIONS 2
APPLICATION BLOCKS 2
CONFIGURATION 2

PARAMETER SAVE 2 — UP KEY TO CONTINUE

10 Technical specifications

10.1 General information

	General information	
Ingress Protection	IP00. This product is classified as a component and must be used in a suitable enclosure.	
Control circuits	Fully isolated from power circuit.	
Control action	Advanced PI with fully adaptive current loops for optimum dynamic performance. Self-tuning current loop using "Autotune" algorithm. Adjustable speed PI with integral defeat.	
Speed control	By armature voltage feedback with IR compensation. By encoder feedback or analog tachogenerator feedback. By a combination of encoder feedback and analog tachogenerator feedback or armature voltage feedback.	
Steady-state accuracy	0.1% analog tachogenerator feedback (subject to tachogenerator) 2% armature voltage feedback 0.01% Encoder only, Encoder + tacho, encoder + armature voltage feedback (with digital reference)	
Protection	Armature overvolts Bad reference exchange Contactor lock out Field failure Field overcurrent High energy MOV'S Interline device networks Motor over-temperature Overcurrent (instantaneous) Overload 150% for 25s Overspeed Short circuit on digital outputs	Speed feedback mismatch Stall protection Stall trip Standstill logic Supply loss Synchronisation loss Tacho failure (with auto AVF backup option) Thyristor "Trigger" failure Thyristor Stack over-temperature User alarm Zero-speed detection
Field output modes	Constant current, constant voltage, automatic weakening. Delayed quenching after stop command to allow dynamic braking. Standby mode to leave field excited at low level to prevent motor cooling. Field supply inputs independent from armature supply inputs. Current controlled with voltage limit or voltage controlled with current limit, automatic field weakening.	

General information		
Diagnostics	With first fault latch, automatic display and power off memory. Diagnostic monitoring of all parameters in engineering and/or % units. Full diagnostic information available over RS232 or ethernet (with additional hardware) when using a distributed control systems (DCS) software graphical tool. Digital I/O logic status plus automatic default % diagnostic summary displays.	
Temperature	0-40ºC ambient operating temperature (35ºC for PL/X900 and PL/X980). Derate by 1% per ºC above 40ºC up to 50ºC maximum. Storage 5-55ºC. Protect from direct sunlight. Ensure dry, corrosive free environment.	
Humidity	85% Relative humidity maximum. Note: - Relative humidity is temperature dependent, do not allow condensation.	
Atmosphere	Non-flammable, non-condensing. Pollution Degree: 2. Installation Cat: 3.	
Altitude	Derate by 1% per 100 metres above 1000 metres.	
Short-circuit rating	Suitable for use on a circuit capable of delivering not more than 5000 A PL/X5-30; 10000 A PL/X40-145; 18000 A PL/X185-275; 30000A PL/X315-400; 42000A PL/X440-600; 85000A PL/X700-980. Refer to "10.4 Short-circuit ratings" on page 95.	
Special features	Motorised pot simulator Connection Conflict Checker Dual motor swap	Spindle orientation 3 Total Instrument Recipe pages PC configuration and monitoring tool
Application blocks	Centre winding 2 Summers Batch counter Latch 8 Multi-function Preset Speed	2 PIDs Parameter profiler 4 Comparators 4 Changeover switches Delay timer Filters 16-bit demultiplexer
Serial comms	RS232 port ANSI-X3.28-2.5-B I multi-drop	Fieldbus options

10.2 Product rating labels

Product rating labels and any applicable product standard labels are on the side of the drive. We use the unique product serial number to identify the drive's model type and power ratings.

10.3 Electrical ratings

- The motor output power rating is based on the power output of the drive and a motor efficiency of 90%: Va*Ia*0.9.
- The output power available will depend on the actual efficiency of the motor.
- The Models PL/X 900/980 have a maximum ambient temperature rating of 35°C. Derate by 100 Amps for use at 40°C.

10.3.1 Frame 1 - PL/X 5-50

Model PL 2-quadrant PLX 4-quadrant		Maximum continuous shaft ratings					
		Maximum continuous current (A)			Output power		Losses @ full load*
		Output DC	Input AC	100% Field Amps	kW at 460 V	hp at 500 V	W
PL and PLX	**5**	12	10	8	5	7.5	36
PL and PLX	**10**	24	20	8	10	15	72
PL and PLX	**15**	36	30	8	15	20	108
PL and PLX	**20**	51	40	8	20	30	153
PL and PLX	**30**	72	60	8	30	40	216
PL and PLX	**40**	99	80	8	40	60	297
PL and PLX	**50**	123	100	8	50	75	369

High-power field output option available at extra cost. Specify at the time of order - contact Sprint-Electric.

*Losses are calculated using the equation: Loss = 3 x Rated Output Current.
Loss figures do not include the field bridge losses which can also be up to 3 X actual field current.

10.3.2 Frame 2 - PL/X 65-145

Model PL 2-quadrant PLX 4-quadrant		Maximum continuous shaft ratings				
		Maximum continuous current (A)			Output power	
		Output DC	Input AC	100% Field Amps	kW at 460 V	hp at 500 V
PL and PLX	**65**	155	124	16	65	100
PL and PLX	**85**	205	164	16	85	125
PL and PLX	**115**	270	216	16	115	160
PL and PLX	**145**	330	270	16	145	200

High-power field output option available at extra cost. Specify at the time of order - contact Sprint-Electric.

10.3.3 Frame 3 - PL/X 185-265

Model PL 2-quadrant PLX 4-quadrant		Maximum continuous shaft ratings				
		Maximum continuous current (A)			Output power	
		Output DC	Input AC	100% Field Amps	kW at 460 V	hp at 500 V
PL and PLX	**185**	430	350	32	185	270
PL and PLX	**225**	530	435	32	225	330
PL and PLX	**265**	630	520	32	265	400

High-power field output option available at extra cost. Specify at the time of order - contact Sprint-Electric.

10.3.4 Frame 4 - PL/X 275-440

Model PL 2-quadrant PLX 4-quadrant		Nominal maximum continuous shaft ratings					
		Maximum continuous current (A)			Output power		
					380-415 Vac	480 Vac	690 Vac
		Output DC	Input AC	100% Field Amps	kW at 460 V	hp at 500 V	hp at 750 V HV models
PL and PLX	**275**	650	530	32	275	400	600
PL and PLX	**315**	750	615	32	315	460	690
PL and PLX	**360**	850	700	32	360	520	780
PL and PLX	**400**	950	780	32	400	580	875
PL* and PLX*	**440**	1050	860	32	440	640	970

600 Vac and 690 Vac variants available at extra cost. Specify at the time of order -suffix MV or HV.
Suffix BE for bottom entry 3-phase power; suffix TE for top entry 3-phase power.
Example order codes: PLX275BE, PLX520TEHV

* Model has no overload capability.

10.3.5 Frame 5 - PL/X 520-980

Model PL 2-quadrant PLX 4-quadrant		Nominal maximum continuous shaft ratings					
		Maximum continuous current (A)			Output power		
					380-415 Vac	480 Vac	690 Vac
		Output DC	Input AC	100% Field Amps	kW at 460 V	hp at 500 V	hp at 750 V HV models
PL and PLX	**520**	1250	1025	64	520	760	1140
PL and PLX	**600**	1450	1190	64	600	880	1320
PL and PLX	**700**	1650	1350	64	700	1020	1530
PL and PLX	**800**	1850	1520	64	800	1170	1760
PL and PLX	**900**	2050	1680	64	900	1300	1950
PL* and PLX*	**980**	2250	1845	64	980	1430	2145

600 Vac and 690 Vac variants available at extra cost. Specify at the time of order -suffix MV or HV.
Suffix BE for bottom entry 3-phase power; suffix TE for top entry 3-phase power.
Example order codes: PLX275BE, PLX520TEHV

* Model has no overload capability.

10.4 Short-circuit ratings

These products are suitable for use on a circuit capable of delivering not more than the short circuit ratings given below at 480Vac maximum when used with Semiconductor Fuses Classes aR, gR or gS. Short Circuit Values are based on UL508C Table 45.1 (products are pre February 1st 2020 - UL 61800-5-1).

Output Ratings	**460 Vdc**	**500 Vdc**	**RMS Symmetrical Amps**
Amps	kW	HP	Short Circuit Rating
12	5	7.5	5,000
24	10	15	5,000
36	15	20	5,000
51	20	30	5,000
72	30	40	5,000
99	40	60	10,000
123	50	75	10,000
155	65	100	10,000
205	85	125	10,000
270	115	160	10,000
330	145	200	10,000
430	185	270	18,000
530	225	330	18,000
630	265	400	18,000
650	275	400	18,000
750	315	460	30,000
850	360	520	30,000
950	400	580	30,000
1050	440	640	42,000
1250	520	760	42,000
1450	600	880	42,000
1650	700	1020	85,000
1850	800	1170	85,000
2050	900	1300	85,000
2250	980	1430	85,000

10.5 Fuses

- Use only UL Recognised fuses in all installations.
- All fuses intended to protect the Semiconductors must be type aR or gS(gR).
    - **DO NOT** use type aR fuses for branch protection as they provide no overload protection. Type aR fuses are for Semiconductor protection only.
    - Type gS(gR) are Semiconductor fuses with overload limiting capability, type gS having a lower power loss than a gR. They have a lower power dissipation than aR fuses.

10.5.1 Semiconductor fuse ratings

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

PROTECT ALL DRIVES BY USING CORRECTLY RATED SEMICONDUCTOR FUSES.
Failure to do so will invalidate the Warranty.

In general, the input AC supply current per phase is 0.82 x the DC output current, and the fuse rating should be approximately 1.25 x the AC input current.

The fuses specified in the tables are rated:

- to include the 150% overload capability
- to operate at up to 50°C ambient
- for the maximum drive rating.

To select a fuse when using the drive at less than the drive rating (for example, when using a motor rated at lower current than the PL/X or operating at a reduced maximum current limit setting), choose a fuse with a current rating closest to the armature current and with an I^2t rating less than the maximum shown in the table.

The table below gives the maximum typical operating voltage for various time constants (inductance/resistance).

Please refer to the fuse manufacturer's data for further information.

Maximum working DC voltage	Maximum allowable time constant
500	10 ms
450	20 ms
400	30 ms
380	40 ms
360	50 ms

10.5.2 500 V: main and auxiliary fuses

	Output	MAIN FUSES				AUX FUSES				
Model	**DC Amps**	**I^2t [A^2s]**	**Part No.**	**Holders**	**Size**	**I^2t [A^2s]**	**Part No.**	**Holders**	**Size**	**AC Fuse Kit ***
PL/PLX5	12	90	CH01612A	CP105004‡	10*38	55	CH01610A	CP105004‡	10*38	ACFUSEKIT-PL/X5
PL/PLX10	24	500	CH00730A	CP102053‡	14*51	55	CH01610A	CP105004‡	10*38	ACFUSEKIT-PL/X10
PL/PLX15	36	750	CH00740A	CP102053‡	14*51	55	CH01610A	CP105004‡	10*38	ACFUSEKIT-PL/X15
PL/PLX20	51	770	CH00850A	CP105503#	000	55	CH01610A	CP105004‡	10*38	ACFUSEKIT-PL/X20
PL/PLX30	72	2550	CH00880A	CP105503#	000	55	CH01610A	CP105004‡	10*38	ACFUSEKIT-PL/X30
PL/PLX40	99	4650	CH008100	CP105503#	000	55	CH01610A	CP105004‡	10*38	ACFUSEKIT-PL/X40
PL/PLX50	123	8500	CH008125	CP105503#	000	55	CH01610A	CP105004‡	10*38	ACFUSEKIT-PL/X50
PL/PLX65	155	16000	CH008160	CP105503#	000	245	CH01620A	CP105004‡	10*38	ACFUSEKIT-PL/X65
PL/PLX85	205	28500	CH009250	CP105507#	1	245	CH01620A	CP105004‡	10*38	ACFUSEKIT-PL/X85
PL/PLX115	270	28500	CH009250	CP105507#	1	245	CH01620A	CP105004‡	10*38	ACFUSEKIT-PL/X115
PL/PLX145	330	135000	CH010550	CP105509#	3	245	CH01620A	CP105004‡	10*38	ACFUSEKIT-PL/X145
PL/PLX185	430	135000	CH010550	CP105509#	3	750	CH00740A	CP102053‡	14*51	ACFUSEKIT-PL/X185
PL/PLX225	530	135000	CH010550	CP105509#	3	750	CH00740A	CP102053‡	14*51	ACFUSEKIT-PL/X225
PL265	630	300000	CH010700	CP105509#	3	750	CH00740A	CP102053‡	14*51	ACFUSEKIT-PL265
				Fuse Assy						
PL/PLX275	650	210k	CH014K63	CH103301	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X275
PL/PLX315	750	300k	CH014K70	CH103302	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X315
PL/PLX360	850	490k	CH014K80	CH103303	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X360
PL/PLX400	950	700k	CH014K90	CH103304	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X400
PL/PLX440	1050	900k	CH0141K0	CH103305	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X440
PL/PLX520	1250	1260k	CH0141K1	CH103306	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X520
PL/PLX600	1450	1850k	CH0141K25	CH103307	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X600
PL/PLX700	1650	2500k	CH0141K4	CH103308	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X700
PL/PLX800	1850	1900k	2*CH014K80	CH103309	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X800
PL/PLX900	2050	2800k	2*CH014K90	CH103310	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X900
PL/PLX980	2250	3100k	2*CH0141K0	CH103467	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X980

‡ 1 Pole Fuse Holder
# 3 Pole Fuse Disconnector

* The AC Fuse Kit contains the Main AC Fuses and Auxiliary Fuses complete with disconnectors.

10.5.3 500 V: DC fuses

We recommend fitting a DC-side semiconductor fuse to PL/X units used in applications where regeneration occurs most or all of the time to add increased protection against an unsequenced power loss during regeneration.

	Output	DC FUSES			
Model	**DC Amps**	**I^2t [A^2s]**	**Part No.**	**Holders**	**Size**
PL/PLX5	12	48	CH00816A	CP105504#	00
PL/PLX10	24	270	CH00832A	CP105504#	00
PL/PLX15	36	270	CH00940A	CP105506#	1
PL/PLX20	51	770	CH00963A	CP105506#	1
PL/PLX30	72	1250	CH00980A	CP105506#	1
PL/PLX40	99	3700	CH009125	CP105506#	1
PL/PLX50	123	7500	CH009160	CP105506#	1
PL/PLX65	155	15000	CH009200	CP105506#	1
PL/PLX85	205	28500	CH009250	CP105506#	1
PL/PLX115	270	46500	CH009315	CP105506#	1
PL/PLX145	330	105000	CH009400	CP105506#	1
PL/PLX185	430	145000	CH013500	CP102949‡	2
PL/PLX225	530	190000	CH013550	CP102949‡	2
PL265	630	-	-	-	-
				Fuse Assy	
PL/PLX275	650	490k	CH014K80	CH103303	33
PL/PLX315	750	700k	CH014K90	CH103304	33
PL/PLX360	850	900k	CH0141K0	CH103305	33
PL/PLX400	950	1260k	CH0141K1	CH103306	33
PL/PLX440	1050	1850k	CH0141K25	CH103307	33
PL/PLX520	1250	2500k	CH0141K4	CH103308	33
PL/PLX600	1450	1900k	2*CH014K80	CH103309	2*33
PL/PLX700	1650	2800k	2*CH014K90	CH103310	2*33
PL/PLX800	1850	3100k	2*CH0141K0	CH103467	2*33
PL/PLX900	2050	4400k	2*CH0141K1	CH103330	2*33
PL/PLX980	2250	6600k	2*CH0141K25	CH103469	2*33

3 Pole Fuse Disconnector
‡ 1 Pole Fuse Holder

These DC fuses are specified for operation up to 500 Vdc for armature circuit time constants up to 10 ms.

DC fuses are not required for non-regenerative (2Q) models

10.5.4 600/690 V: main and auxiliary fuses

	Output	MAIN FUSES				AUX FUSES				
Model PL	**DC Amps**	**I²t [A²s]**	**Part No.**	**Fuse Assembly**	**Size**	**I²t [A²s]**	**Part No.**	**Holders**	**Size**	**AC Fuse Kit ***
PL275MV/HV	650	210k	CH014K63	CH103301	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X275
PL315MV/HV	750	300k	CH014K70	CH103302	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X315
PL360MV/HV	850	490k	CH014K80	CH103303	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X360
PL400MV/HV	950	700k	CH014K90	CH103304	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X400
PL440MV/HV	1050	900k	CH0141K0	CH103305	33	770	CH00850A	CP105503#	000	ACFUSEKIT-PL/X440
PL520MV/HV	1250	1260k	CH0141K1	CH103306	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X520
PL600MV/HV	1450	1850k	CH0141K25	CH103307	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X600
PL700MV/HV	1650	2500k	CH0141K4	CH103308	33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X700
PL800MV/HV	1850	1900k	2*CH014K80	CH103309	2*33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X800
PL900MV/HV	2050	2800k	2*CH014K90	CH103310	2*33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X900
PL980MV/HV	2250	3100k	2*CH0141K0	CH103467	2*33	4650	CH008100	CP105503#	000	ACFUSEKIT-PL/X980
Model PLX										
PLX275MV/HV	650	485k	CH015K63	CH103341	73	770	CH00850A	CP105503#	000	-
PLX315MV/HV	750	640k	CH015K70	CH103342	73	770	CH00850A	CP105503#	000	-
PLX360MV/HV	850	1090k	CH015K80	CH103343	73	770	CH00850A	CP105503#	000	-
PLX400MV/HV	950	1440k	CH015K90	CH103344	73	770	CH00850A	CP105503#	000	-
PLX440MV/HV	1050	2130k	CH0151K0	CH103345	73	770	CH00850A	CP105503#	000	-
PLX520MV/HV	1250	2430k	CH0151K1	CH103346	73	4650	CH008100	CP105503#	000	-
PLX600MV/HV	1450	3080k	CH0151K25	CH103347	73	4650	CH008100	CP105503#	000	-
PLX700MV/HV	1650	4100k	CH0151K4	CH103348	73	4650	CH008100	CP105503#	000	-
PLX800MV/HV	1850	4400k	2*CH015K80	CH103349	2*73	4650	CH008100	CP105503#	000	-
PLX900MV/HV	2050	5800k	2*CH015K90	CH103350	2*73	4650	CH008100	CP105503#	000	-
PLX980MV/HV	2250	8500k	2*CH0151K0	CH103471	2*73	4650	CH008100	CP105503#	000	-

3 Pole Fuse Disconnector

* The AC Fuse Kit contains the Main AC Fuses and Auxiliary Fuses complete with disconnectors/holders.

10.5.5 600/690 V: DC fuses

We recommend fitting a DC-side semiconductor fuse to PL/X units used in applications where regeneration occurs most or all of the time to add increased protection against an unsequenced power loss during regeneration.

	Output	DC FUSES			
Model PL	**DC Amps**	**I^2t [A^2s]**	**Part No.**	**Holder**	**Size**
PL275MV/HV	650	-	-	-	-
PL315MV/HV	750	-	-	-	-
PL360MV/HV	850	-	-	-	-
PL400MV/HV	950	-	-	-	-
PL440MV/HV	1050	-	-	-	-
PL520MV/HV	1250	-	-	-	-
PL600MV/HV	1450	-	-	-	-
PL700MV/HV	1650	-	-	-	-
PL800MV/HV	1850	-	-	-	-
PL900MV/HV	2050	-	-	-	-
PL980MV/HV	2250	-	-	-	-
Model PLX					
PLX275MV/HV	650	1090k	CH015K80	CH103343	73
PLX315MV/HV	750	1440k	CH015K90	CH103344	73
PLX360MV/HV	850	2130k	CH0151K0	CH103345	73
PLX400MV/HV	950	2430k	CH0151K1	CH103346	73
PLX440MV/HV	1050	3080k	CH0151K25	CH103347	73
PLX520MV/HV	1250	4100k	CH0151K4	CH103348	73
PLX600MV/HV	1450	4400k	2*CH015K80	CH103349	2*73
PLX700MV/HV	1650	5800k	2*CH015K90	CH103350	2*73
PLX800MV/HV	1850	8500k	2*CH0151K0	CH103351	2*73
PLX900MV/HV	2050	9632k	2*CH0151K1	CH103360	2*73
PLX980MV/HV	2250	12075k	2*CH0151K25	CH103472	2*73

These fuses are specified for operation up to 500 Vdc for armature circuit time constants up to 10 ms.

DC fuses are not required for non-regenerative (2Q) models

10.5.6 Square body fuses for frames 4 and 5

We offer a range of Square Body Semiconductor Fuses for our high current DC drives, frames 4 and 5.

A frame 5 drive may require two parallel fuses depending on its supply current requirements.

It is important that these fuses are mounted correctly to ensure optimum performance.

10.5.6.1 Size 33 - 690 Vac - 74.5 mm x 74.5 mm x 50.6 mm - M12

Product	DC Output Current	AC Input Current	Main AC Fuse Rating	Fuse Provided	Armature Fuse Rating (1)	Fuse Provided (2)
PL/PLX275 - PL275HV	650	530	630	1 * 630	800	1 * 800
PL/PLX315 - PL315HV	750	615	700	1 * 700	900	1 * 900
PL/PLX360 - PL360HV	850	700	800	1 * 800	1000	1 * 1000
PL/PLX400 - PL400HV	950	780	900	1 * 900	1100	1 * 1100
PL/PLX440 - PL440HV	1050	860	1000	1 * 1000	1250	1 * 1250
PL/PLX520 - PL520HV	1250	1025	1100	1 * 1100	1400	1 * 1400
PL/PLX600 - PL600HV	1450	1190	1250	1 * 1250	1600	2 * 800
PL/PLX700 - PL700HV	1650	1350	1400	1 * 1400	1800	2 * 900
PL/PLX800 - PL800HV	1850	1520	1600	2 * 800	2000	2 * 1000
PL/PLX900 - PL900HV	2050	1680	1800	2 * 900	2200	2 * 1100
PL/PLX980 - PL980HV	2250	1845	2000	2 * 1000	2500	2 * 1250

10.5.6.2 Size 73 - 1300 Vac - 74.5 mm x 74.5 mm x 74 mm - M12

Product	DC Output Current	AC Input Current	Main AC Fuse Rating	Fuse Provided	Armature Fuse Rating (1)	Fuse Provided (2)
PLX275HV	650	530	630	1 * 630	800	1 * 800
PLX315HV	750	615	700	1 * 700	900	1 * 900
PLX360HV	850	700	800	1 * 800	1000	1 * 1000
PLX400HV	950	780	900	1 * 900	1100	1 * 1100
PLX440HV	1050	860	1000	1 * 1000	1250	1 * 1250
PLX520HV	1250	1025	1100	1 * 1100	1400	2 * 700
PLX600HV	1450	1190	1250	2 * 630	1600	2 * 800
PLX700HV	1650	1350	1400	2 * 700	1800	2 * 900
PLX800HV	1850	1520	1600	2 * 800	2000	2 * 1000
PLX900HV	2050	1680	1800	2 * 900	2200	2 * 1100
PLX980HV	2250	1845	2000	2 * 1000	2500	2 * 1250

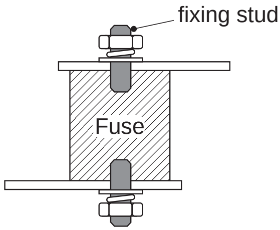
Notes:

1. An armature fuse is not required for a PL Drive - 2Q Drive.
2. Where two fuses are provided, take care to ensure they share the current equally.

10.5.6.3 Mounting square body semiconductor fuses

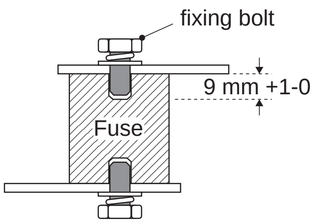
It is essential that the fuse body makes good contact with the copper busbar. Fit the fuses as shown below.

a. **Preferred fixing method**



1. Fit the M12 studs through the busbars (clearance hole required) and into the fuse. Tighten the stud using a suitable hex key to 15Nm.
2. *Apply a suitable conductive jointing compound to the face of the fuse.
3. Secure the busbar to the fuse using a nut, plain washer and spring washer. Tighten the nut to 46 Nm.

b. **Alternative method using a fixing bolt**



1. *Apply a suitable conductive jointing compound to the face of the fuse.
2. Ensure that the fixing bolt does not bottom-out in the fuse. Tighten the bolt to 46 Nm.

***Note**: Apply the conductive jointing compound between the fuse and the busbar to ensure a gas tight joint with improved electrical and thermal conductivity. We recommend Compound SCX13.

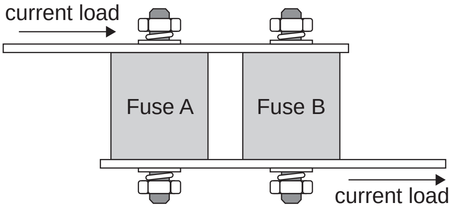
10.5.6.4 Parelleling semiconductor fuses - frame 5

Two semiconductor fuses of the same current rating must be used in parallel in the DC output or AC supply if the frame 5 DC drive has a current rating larger than 1850 Adc - 800 kW 2Q or 1450 Adc – 600 kW 4Q.

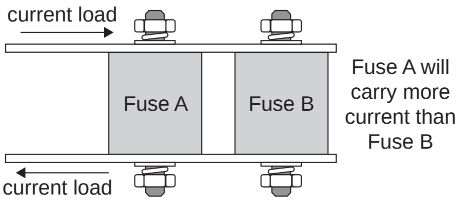
However, precautions must be taken to ensure that the two fuses share the load current equally:

a. **Current path**

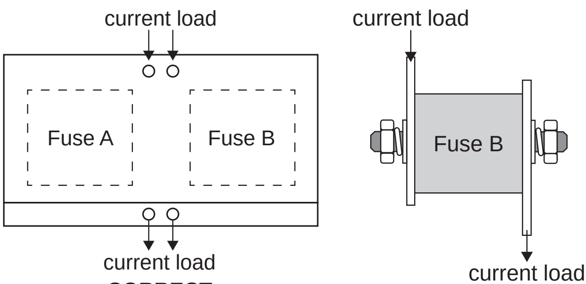
It is important that the length of the current path is equal for both fuses otherwise the fuses will not share the current equally.



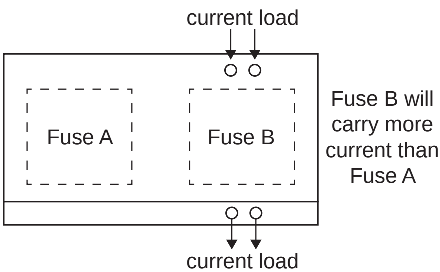
CORRECT



INCORRECT



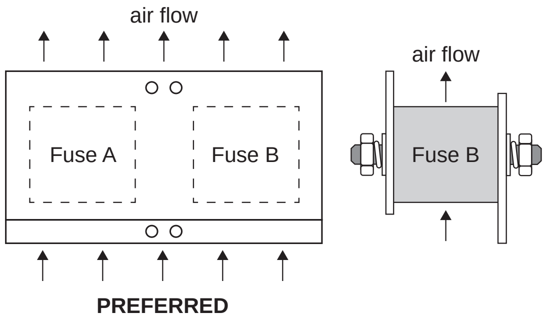
CORRECT



INCORRECT

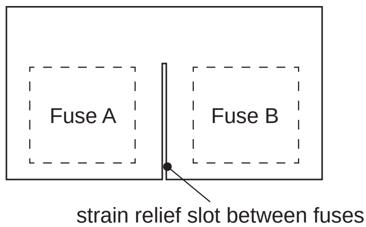
b. **Cooling**

Try to ensure that one fuse does not heat the other.



c. **Mechanical stress**

Provide allowance for minor length variations on the two fuses.



10.6 Line reactors

Only use CSA/UL certified line reactors for installations complying with CSA/UL codes. These line reactors are not certified. Refer to supplier for certified alternatives and reactor dimensions.

10.6.2 Frames 1-3 - PL/X 5-265

Model PL 2-quadrant PLX 4-quadrant	**Maximum continuous current (A)**		**Line Reactor type**
	Input AC	Output DC	
PL/X 5	10	12	LR48
PL/X 10	20	24	LR48
PL/X 15	30	36	LR48
PL/X 20	40	51	LR48
PL/X 30	60	72	LR120
PL/X 40	80	99	LR120
PL/X 50	100	123	LR120
PL/X 65	124	155	LR330
PL/X 85	164	205	LR330
PL/X 115	216	270	LR330
PL/X 145	270	330	LR330
PL/X 185	350	430	LR530
PL/X 225	435	530	LR530
PL 265	520	630	LR650

10.6.1 Frames 4-5 - PL/X 275-980

Model PL 2-quadrant PLX 4-quadrant	**Maximum continuous current (A)**		**Line Reactor type**	
	Input AC	Output DC	500 V AC supply	690 Vac supply
PL/X275	530	650	LR650	LR650HV
PL/X315	615	750	LR750	LR750HV
PL/X360	700	850	LR850	LR850HV
PL/X400	780	950	LR950	LR950HV
PL/X440	860	1050	LR1050	LR1050HV
PL/X520	1025	1250	LR1250	LR1250HV
PL/X600	1190	1450	LR1450	LR1450HV
PL/X700	1350	1650	LR1650	LR1650HV
PL/X800	1520	1850	LR1850	LR1850HV
PL/X900	1680	2050	LR2050	LR2050HV
PL/X980	1845	2250	LR2250	LR2250HV

10.7 Supply loss shutdown

The drive has three supply ports:

PORT 1	Control supply, 1-phase.	Provides power for the internal control electronics.
PORT 2	EL1/2/3 Auxiliary supply, 3-phase.	Provides power for the field and is used for synchronisation.
PORT 3	L1/2/3 Main supply, 3-phase.	Provides power for the armature bridge.

- The missing pulse detector recognises a loss of any line on PORT 3.
- The field loss (EL3), phase loss (EL1/2), or synchronisation loss (EL1/2) detectors recognise a loss of any line on PORT 2. **NOTE:** PORTS 2 and 3 are ultimately fed from the same supply, although via different fuses or step-up/down transformers. Hence a supply loss may simultaneously be recognised by PORT 2 and PORT 3.

Refer to "13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE" on page 234.

The unit recognises a loss on PORT 1 when below approximately 80 Vac.

10.7.1 Effects of supply loss or dips

The armature and field current will phase back to zero; the contactor control will de-energise; the drive permanently saves any valid trip message. Refer to "9.2 Saving your changes" on page 79.

If a control supply dip occurs, the message INTERNAL ERROR CODE / SUPPLY PHASE LOSS will appear on the PL/X display. Press the LEFT key to reset. (This message may be briefly visible when turning off the control supply).

Refer to "13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE" on page 234 / SUPPLY PHASE LOSS for details on ride-through times.

10.7.2 L1/2/3 AC supply level different to EL1/2/3

It is not unusual for the armature voltage and the field voltage of old motors, in particular, to be different enough to warrant supplying them with independent levels of AC voltage, e.g. low voltage field.

The PL/X has independent control bridges and supply inputs for the armature (L1/2/3) and field (EL1/2/3).

Usually, the L1/2/3 and EL1/2/3 ports originate from the same AC supply voltage. If the field voltage is lower than might usually be expected for the prevailing supply, then the control loop will phase back the output voltage accordingly.

However, when the difference becomes excessive, it may be preferable to feed the two power ports from different supply voltages. The reason for this is usually to prevent high peak voltages from being imposed on a winding where the supply voltage is much higher than the winding rating. Also, a winding designed to run at full voltage fully phased forward will be subjected to a worse form factor when run continuously phased right back, leading to overheating.

The wiring diagram below shows the preferred method of supplying the ports with different AC voltages. It uses a single-phase auto transformer from L2 / 3 levels to EL2 / 3 to suit the field.

In the example diagram below, the motor armature may be rated at 460 Vdc and supplied from a 415 Vac supply. Field voltage may be rated at 100 Vdc, originally designed to be supplied from a rectified 110 Vac supply.

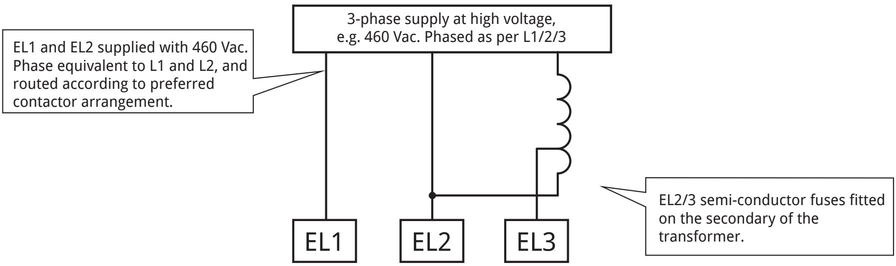


Figure 34 Wiring diagram for AC supply level to L1/2/3 different to EL1/2/3 (e.g. low voltage field)

The advantages of this method are:

1. It only requires a low-cost, readily available, single-phase auto transformer.
2. The EL1/2 connections do not suffer any phase lags or leads because they connect as per standard schemes, which is important because EL1/2 sense the synchronisation.
3. This scheme works equally well for step-up or step-down transformers.

The phase equivalence of EL1/2/3 must at all times relate to L1/2/3.

The in-rush current of the transformer will probably blow the semiconductor fuses. Hence, fit the fuses on the secondary of the transformer for EL2/3. Fit HRC fuses in the primary feeds.

The field voltage required in the above example is 100 V, probably for operation from a rectified 110 V supply. However, with the PL/X ability to control the field current, it is preferable to feed the field supply with a higher voltage, e.g. 130 V. This provides the control loop with a supply margin, enabling more effective control.

CAUTION!

EQUIPMENT DAMAGE HAZARD

The field-to-earth voltage of the motor must have the correct rating for the voltage applied to EL2.

10.7.3 Changing control or power cards

When replacing either the control card or the power assembly or transferring a control card to a new power assembly, check the values of 680)Iarm BURDEN OHMS and the physical burden resistance. You **must** confirm and enter the correct burden resistor value 680)Iarm BURDEN OHMS if necessary. Refer to the WARNING in "17.19.3 680)Iarm BURDEN OHMS" on page 365.

Removing the control card

1. Remove the PL/X's end caps.
2. Remove the four fixing screws at the edges of the top cover. Lift it away, making sure not to stress the HMI ribbon cable connections.
3. Unplug the ribbons from the control card to separate the top cover. The ribbon cable plugs have a keyway to ensure correct reconnection.
4. Remove the two retaining screws at the lower corners of the control card. Lift the lower edge of the control card. The card hinges on the upper pair of plastic retainers. The only resisting force is from the 2 x 20 mm interconnect pins in their sockets, just above terminals T17 to T30. Once these pins have fully withdrawn from their sockets, hinge the card gently away to an angle of about 30 degrees. At this point, the upper hinges are open. Ease the card out of the hinges.
5. To re-assemble, perform the above procedure in reverse order. The control card is guided by the hinges back onto the interconnect pins. It is not possible to screw the control card flat unless the interconnect pins are all correctly located.

10.8 Cooling

- Please consider the total component dissipation within the enclosure when calculating the required air throughput, including the fuses, line reactors and other sources of dissipation.
- Refer to "10 Technical specifications" on page 91 - line reactor and semiconductor fuse ratings for component dissipation ratings.
    - 35 cubic feet per minute is approximately equivalent to 1 cubic metre per minute.
    - 180 cubic feet per minute is approximately equivalent to 6 cubic metres per minute.
    - 400 cubic feet per minute is approximately equivalent to 12 cubic metres per minute.
    - 800 cubic feet per minute is approximately equivalent to 24 cubic metres per minute.

Model PL 2-quadrant PLX 4-quadrant	**Cooling air flow and dissipation**	
	cfm	Watts
PL/X 5	17	45
PL/X 10	17	80
PL/X 15	17	120
PL/X 20	17	120
PL/X 30	35	200
PL/X 40	35	300
PL/X 50	35	320
PL/X 65	60	350
PL/X 85	60	475
PL/X 115	60	650
PL/X 145	60	850
PL/X 185	180	1000
PL/X 225	180	1300
PL 265	180	1600

Model PL 2-quadrant PLX 4-quadrant	**Cooling air flow and dissipation**	
	cfm	Watts
PL/X275	400	1700
PL/X315	400	2000
PL/X360	400	2300
PL/X400	400	2500
PL/X440	400	2800
PL/X520	800	3200
PL/X600	800	3700
PL/X700	800	4200
PL/X800	800	4700
PL/X900	800	5200
PL/X980	800	5700

10.8.1 Internal fan

Refer to "7.4.4.4 Supply input for the internal fan: B1, B2" on page 57 for frame 3, frame 4 and frame 5 supply details. Note that frame 1 and frame 2 PL/Xs have internal fan supplies.

NOTE: A warning message HEATSINK OVERTEMP displays to prevent the motor from operating if the fan supply fails or is not present on power-up. Refer to "13 The MOTOR DRIVE ALARMS menu" on page 223 for further details of this message related to actual overtemp events.

PL/X 275-980: Remove the bus bar cover plate to reveal the power board terminals. The fan supply input terminals are located on the lower left-hand edge of the powerboard, marked AC FAN SUPPLY B1 N, B2 L.

10.9 Installation guide for EMC

Give special consideration to installations in member states of the European Union regarding noise suppression and immunity. IEC 1800-3 (EN61800-3) classifies the drive units as Basic Drive Modules (BDM) only for professional assemblers and the Industrial environment.

Although CE Marking affirms compliance with the EMC Directive, the application of EN 61800-3 means that no RF emission limits apply. The drive manufacturer is responsible for the provision of installation guidelines. The resulting EMC behaviour is the responsibility of the manufacturer of the system or installation. The units are also subject to the LOW VOLTAGE DIRECTIVE 73/23/EEC and are CE marked accordingly.

To comply with the European regulations usually requires you to follow the procedures outlined for the drive system - some systems may require different measures.

Installers must have a level of technical competence to install the drive correctly. Although the drive unit itself does not require control of RF emissions, it complies with the most stringent emissions and immunity requirements on all ports.

10.9.1 EN61800-3 operating environments

The 3-phase power supply port is subject to alternative guidelines. It may or may not require compliance with emissions limits, depending on the environment. Fitting a separate filter unit can help to achieve compliance, if necessary.

EN61800-3 specified operating environments	Mains conducted or radiated emissions	Filter required for compliance
Domestic (1st environment)	Mains conducted emission limits	**YES** Refer to supplier for a suitable filter to meet the Class A (EN 61800-3 restricted distribution, domestic environment)
Industrial (2nd environment)	No limits	**NO** It is usual for the filter to be omitted in industrial systems

Definition of an industrial environment - includes all establishments (other than those directly connected to a low voltage power supply network that supplies buildings used for domestic purposes).

10.9.1.1 Guidelines when using a filter

WARNING!

PERSONAL INJURY HAZARD

DO NOT use AC supply filters on supplies that are un-balanced or float with respect to earth.

The drive and AC filter **MUST** have a permanent earth connection. Plugs/sockets are NOT allowed in the AC supply.

The AC supply filter contains high voltage capacitors.
DO NOT touch for at least 20 seconds after the removal of the AC supply.

1. The AC connections from the filter to the drive must be less than 0.3 m long. If longer, they must be correctly screened.
2. The AC filter, drive earth and motor cable screen should connect directly to the metal of the cabinet.
3. Do not run filtered and unfiltered AC supply cables together.
4. The AC input filter has earth leakage currents. RCD devices may need setting at 5% of rated current.
5. The AC supply filter must have a good earth connection to the enclosure backplane. Take care with painted metal. Remove paint and ensure good contact.

10.9.2 Earthing and screening guidelines

WARNING!

PERSONAL INJURY HAZARD

Safety earthing always takes precedence over EMC earthing.

- Connect a separate earth conductor between the motor housing and the main earth terminal on the drive. Run this conductor adjacent to the drive conductors. Do not ground this conductor to any other earth point.
- Connect the drive's earth terminal to the cabinet's star point or earth busbar.
- Connect the drive's Terminal 13 (0 V) to the cabinet's star point or earth busbar.
- Segregate the motor drive and 3-phase supply cables from other cables in the cabinet by at least 300 mm.
- Motor drive cables may be the screened type or armoured. Bond this pathway between the motor housing and the cabinet's point of entry using 360° gland techniques for EMC compliance.

If the motor and control cabinet are in widely different locations, bonding both ends of the screening and earth conductors may result in significant earth current flow creating large earth potential differences. In these circumstances, we recommend that a separate parallel earth conductor (PEC), possibly a bonded metal conduit, is used alongside the drive cables to give a preferential route for this current. Refer to IEC 61000-5-2 for more detail. Installation in conformance with this Standard is regarded as good practice and will result in improved EMC of the whole system.

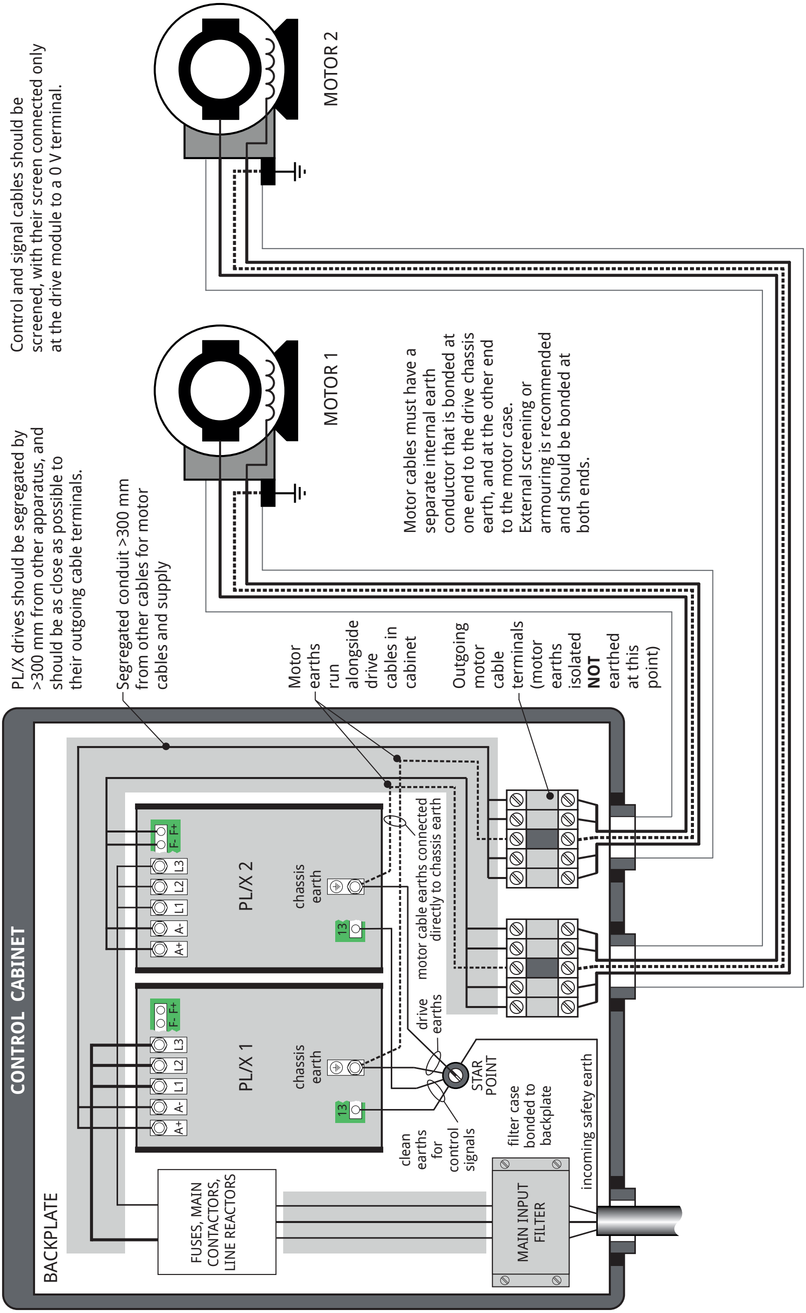


Figure 35 Earthing diagram for a typical installation

10.10 Approvals UL, cUL, CE

10.10.1 EMC Compliance statement for PL/X

This apparatus complies with the protection requirements of the EMC Directive 2014/30/EU as follows:

10.10.1.1 CE Emissions

Control supply port and control signal port
Conducted and radiated emissions comply with the following standards:

Description	General Standard	Referenced Standard
Radiated emissions (30.0 MHz to 1.0 GHz)	EN 61000-6-4:2007 inc A1:2011	CISPR 16-1-4:2007†, Class A
Conducted emissions		CISPR 16-1-1:2010†, Class A
Mains harmonics	EN 61000-3-2:2014	EN 61000-3-2:2014, Class A
Mains voltage flicker (dmax=4%)	EN 61000-3-3:2013	EN 61000-3-3:2013
Conducted emissions	EN 61800-3:2018	CISPR 16-1-4:2007†, Class B
		CISPR 16-1-1:2010†, Class B

Mains harmonics - the control supply port active input power is less than 50 W with the class D waveshape and therefore meets EN 61000-3-2:2014 with no limits applied.

3-phase motor supply port:
Class B (EN 61800-3 unrestricted distribution, industrial environment) limits. No filter required.

To meet Class A (EN 61800-3 restricted distribution, domestic environment) mains conducted emissions limits on this port requires a separate filter. Please refer to the supplier.

10.10.1.2 CE Immunity

The unit complies with the following standards:

Description	General Standard	Referenced Standard
Electrostatic discharge	EN 61000-6-2:2005	EN 61000-4-2:2009
Radiated RF immunity		EN 61000-4-3:2006 inc A1:2008 & A2:2010
Fast transient bursts		EN 61000-4-4:2012
Surges		EN 61000-4-5:2014
Conducted immunity	EN 61800-3:2018	EN 61000-4-6:2014
Voltage dips and interruptions (PLD)		EN 61000-4-34:2007

10.10.2 UL, cUL

The PL/X range frame 1, 2, 3 is UL and cUL listed. File number E168302.

11 The CHANGE PARAMETERS menu

This section lists the editable menus and parameters contained in the CHANGE PARAMETERS menu.

Most parameter "factory settings" are suitable for use, but you MUST enter the maximum ratings for your motor and PL/X into the CALIBRATION menu below.

11.1 CHANGE PARAMETERS/CALIBRATION

These parameters set the maximum ratings for the motor and PL/X.

The parameters marked with an asterisk (*) are required information, mostly taken from the PL/X and motor rating plates. These are the "QuickStart" parameters - refer to "3 QuickStart Guide" on page 12.

Refer to "8 How to use the keypad" on page 74 for help with making and saving your changes.

In addition:

- You can restore the default parameter settings: refer to "9.3 Restoring parameters to default conditions" on page 79.
- The PL/X can store and retrieve up to three complete instrument Recipes: refer to "17.19.1 677)RECIPE PAGE" on page 363 for details of 2 and 3-key reset operation. **IMPORTANT: Recipe pages 2 and 3 each have self-contained Calibration parameters, so be careful to check them all before running the PL/X.**
- If you transfer the PL/X's control card to a different power chassis or install a brand new control card, the new frame size will be automatically determined. But you **must** check and enter the correct burden resistor value into the PL/X: refer to "17.19.3 680) Iarm BURDEN OHMS" on page 365.

	R	ENTRY MENU LEVEL 1
	R	CHANGE PARAMETERS 2
	R	CALIBRATION 3
*	R	2)RATED ARM AMPS
*	R	3)CURRENT LIMIT(%)
*	R	4)RATED FIELD AMPS
*	R	5)BASE RATED RPM
*	R	6)DESIRED MAX RPM
	R	7)ZERO SPD OFFSET
	R	8)MAX TACHO VOLTS
*	R	9)SPEED FBK TYPE
	R	ENCODER SCALING 4
	R	14)IR COMPENSATION
	R	15)FIELD CUR FB TRIM
	R	16)ARM VOLTS TRIM
	R	17)ANALOG TACHO TRIM
*	R	18)RATED ARM VOLTS
*	R	19)EL1/2/3 RATED AC
	R	20)MOTOR 1,2 SELECT

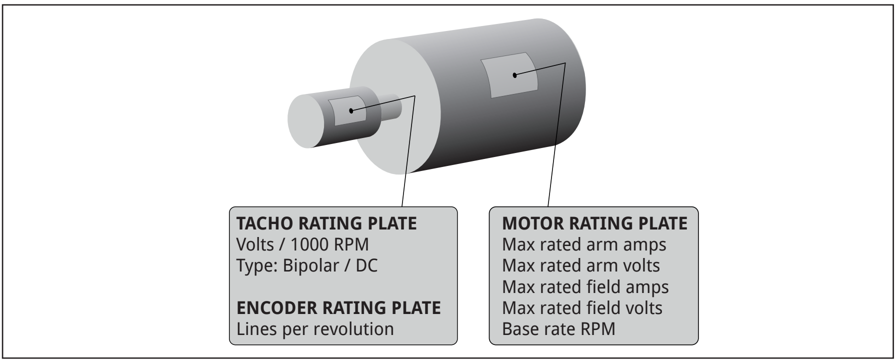


Figure 36 Rating plate information

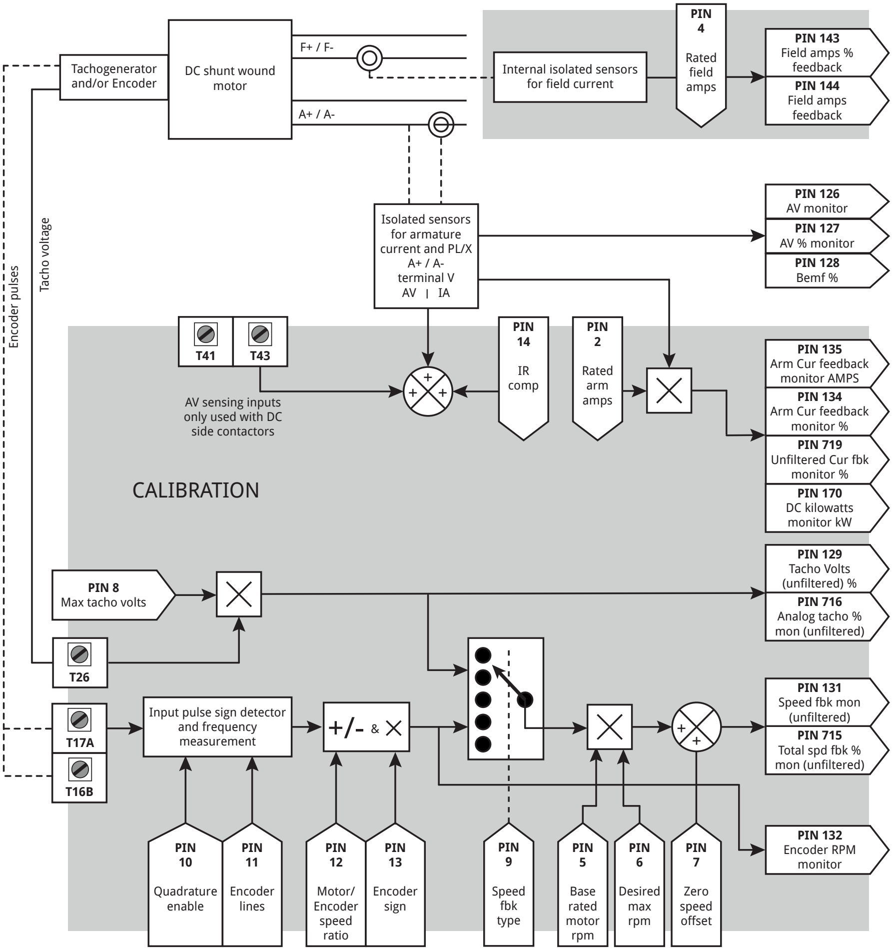


Figure 37 CALIBRATION - block diagram

11.1.1 2)RATED ARM AMPS

Set the desired 100% continuous rated motor current in Amps.

PIN	Parameter description	Range	Default
2	RATED ARMATURE AMPS	33-100% of PL/X rating	(33%) XXX.X A

We state this parameter in Amps. For example, the PLX15 range of values is 36 A (100%) to 12 A (33%).

- It is possible to enter a lesser value than the current stated on the motor rating plate.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CALIBRATION 3
R 2)RATED ARM AMPS

Full load motor current (82)O / LOAD % TARGET) as a % of 2) RATED ARM AMPS	Maximum available	Maximum overload % available (with respect to full load motor current)
100%	150%	150 / 100 = 150%
90%	150%	150 / 90 = 166%
80%	150%	150 / 80 = 187%
75%	150%	150 / 75 = 200%
60%	150%	150 / 60 = 250%
50%	150%	150 / 50 = 300%
37.5%	150%	150 / 37.5 = 400%
30%	150%	150 / 30 = 500%

Table 11 Maximum overloads according to:
Full load motor current, as a % of 2)RATED ARM AMPS.

11.1.2 3)CURRENT LIMIT(%)

Set the desired current limit percentage of parameter 2)RATED ARM AMPS.

PIN	Parameter description	Range	Default
3	CURRENT LIMIT PERCENTAGE	0-150.00% of rated armature Amps	150.00%

You can adjust this parameter while the PL/X is running.

- If the current exceeds the level set by the overload target, it reduces progressively to the overload target level after an appropriate dwell time.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CALIBRATION 3
R 3)CURRENT LIMIT(%)

11.1.3 4)RATED FIELD AMPS

Set the desired 100% DC output field current in Amps.

PIN	Parameter description	Range	Default
4	RATED FIELD AMPS	0.1 A -100% of model rating	25% Amps

Enter the rated field current from the motor rating plate.

If you don't have a value:

- Approximate it by measuring the resistance of the field winding, then use the following equation:
  Field current = Field rating plate Volts / Resistance in Ohms

  With the motor at rated temperature, recheck the motor field resistance to adjust 2)RATED FIELD AMPS more accurately if necessary.

- Alternatively, if you know the rated field voltage:
  1. Adjust 100)FIELD VOLTS OP % until the field output voltage matches the value on the motor rating plate, as a % of the AC supply Volts on EL2/3.
  2. Set 4)RATED FIELD AMPS to maximum.

  Note that 4)RATED FIELD AMPS scaled by 114)FIELD REFERENCE sets the demand for the field current control loop with 100)FIELD VOLTS OP % operating as a clamp on the field bridge firing angle. The one that results in the lower output, has priority. Hence it is possible to function with the field current control prevailing and the voltage % as a higher safety clamp, or the voltage % clamp prevailing and the field current control as a higher safety level.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
R  CALIBRATION               3
R   4)RATED FIELD AMPS
```

11.1.4 5)BASE RATED RPM

Set the revolutions per minute of the motor, at full field and armature Volts.

PIN	Parameter description	Range	Default
5	BASE RATED RPM	0-6000 rpm	1500 rpm

Enter the base rated rpm from the motor rating plate.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
R  CALIBRATION               3
R   5)BASE RATED RPM
```

11.1.5 6)DESIRED MAX RPM

Set the desired maximum speed of the motor in revolutions per minute.

PIN	Parameter description	Range	Default
6	DESIRED MAXIMUM RPM	0-6000 rpm	1500 rpm

This rpm value will represent a 100% speed.

- If your desired maximum rpm is lower than 5)BASE RATED RPM, be aware of the heat dissipation in the motor at full torque. Use force venting of the motor if necessary.
- If your desired maximum rpm is higher than 5)BASE RATED RPM, you must implement field weakening in the CHANGE PARAMETERS / FIELD CONTROL menu. **Be sure to verify that your motor and load rating is correct for rotation above base speed. Failure to do so may result in mechanical breakdown with disastrous consequences.**

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CALIBRATION	3
R	6)DESIRED MAX RPM	

11.1.6 7)ZERO SPD OFFSET

Correct any offset from the speed feedback source.

PIN	Parameter description	Range	Default
7	ZERO SPEED OFFSET	±5.00%	0.00%

This parameter is helpful when correcting a tachogenerator feedback derived from an external amplifier having a slight offset.

If this parameter is adjusted unnecessarily, then it will appear as an offset on the speed feedback. Refer to "12.2.10 131)SPEED FBK MON" on page 209.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CALIBRATION	3
R	7)ZERO SPD OFFSET	

11.1.7 8)MAX TACHO VOLTS

Scale the tacho input for full feedback Volts at 100% speed.

PIN	Parameter description	Range	Default
8	MAXIMUM TACHO VOLTS	±200.00 V	60.00 V

Find the tacho scaling. For example:

tacho rating	x 100% speed of tacho	=	tacho scaling
0.06V	x 2000rpm	=	120.00V

Alternatively, for systems NOT using field weakening:

1. Run the system in AVF at desired full-speed and read the full-speed tacho volts:
   - To select the speed feedback type, refer to "11.1.8 9)SPEED FBK TYPE" on page 120.
   - To read the tacho volts, refer to "12.2.7 129) TACHO VOLTS MON" on page 208.
2. Enter the reading as MAXIMUM TACHO VOLTS and select a tacho feedback as the speed feedback type.

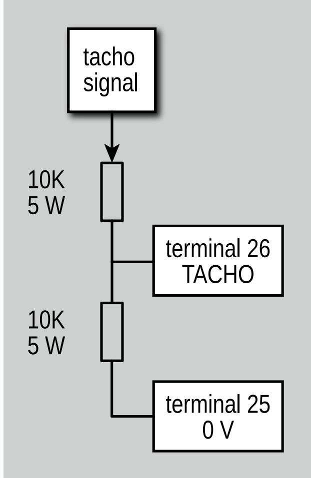
The sign for the MAXIMUM TACHO VOLTS setting should correspond to the sign of the tacho volts for positive speed demand.

For tacho volts that exceed 200 V full scale, you must provide the external resistor dropper network, as shown opposite, which then permits full-scale voltages up to 400 V. You are then able to set MAXIMUM TACHO VOLTS to half the full-scale tacho Volts. **Take appropriate measures to dissipate any heat from the dropper resistors.** The total power in Watts dissipated will be (Tacho signal volts)^2 / 20,000.

You can configure the tacho failure detection system to either trip the PL/X or automatically switch to AVF - refer to "13.1.1 171)SPD TRIP ENABLE" on page 225. Refer also to "7.6.3.1 Analog tachogenerator input" on page 64.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  CALIBRATION             3
R  | 8)MAX TACHO VOLTS
```

Refer to "11.1.12 17)ANALOG TACHO TRIM" on page 124 to obtain a precise value.



Resistor Dropper Network

11.1.8 9)SPEED FBK TYPE

Select the source of speed feedback.

PIN	Parameter description	Range	Default
9	SPEED FEEDBACK TYPE	ARMATURE VOLTS ANALOG TACHO ENCODER ENCODER + ARM VOLTS ENCODER + TACHO	ARMATURE VOLTS

We derive Speed Feedback from a combination (one or more) of three fundamental sources. These may be independently monitored (refer to "12.2 DIAGNOSTICS / SPEED LOOP MONITOR" on page 206).

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  CALIBRATION             3
R   9)SPEED FBK TYPE
```

0) ARMATURE VOLTS (AVF):

An internal, isolated signal that is always available.

WARNING!
PERSONAL INJURY HAZARD
Do not use Armature Volts Feedback mode (AVF) with field weakening systems.

Initially, we recommend using the armature volts feedback (AVF) mode during the commissioning of the PL/X. When using a tachogenerator or encoder, you can check correct polarity and input levels before including them in the feedback loop.

To use armature volts feedback, enter the 100% speed feedback volts from the motor rating plate into parameter 18)RATED ARM VOLTS. Note: For parameter 130)MOTOR RPM MON to be accurate, you must also set parameter 6)DESIRED MAX RPM to this same value.

AVF feedback contains more ripple than tacho feedback, and for smooth operation, it may be necessary to reduce the SPEED CONTROL loop gain with AVF - refer to "11.8.3 71)SPEED PROP GAIN" on page 162.

For systems using a DC contactor you must use T41 and T43 for remote AVF.

The accuracy of AVF is about 2% of full speed. You can improve this in two ways:

1) Apply IR compensation to the feedback to remove the IR drop (caused by the armature current flowing through the armature resistance). Refer to "11.1.9 14)IR COMPENSATION" on page 123.

2) Run the field control in CURRENT mode, forcing the field current (and hence flux) to remain constant, making the relationship between speed and AVF more accurate.

Refer also to "13.1.1 171)SPD TRIP ENABLE" on page 225.

1) ANALOG TACHO:

This transducer will provide a DC voltage that is proportional to speed. Refer to "7.6.3.1 Analog tachogenerator input" on page 64.

Note: With an additional bi-directional, shaft-mounted encoder it is possible to lock and/or orientate the shaft at zero speed. Refer to "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

2) ENCODER:

NOTE: Encoder lines are equivalent to pulse per revolution (PPR).

This shaft-mounted transducer provides a stream of pulses with a frequency proportional to speed. Pulses can be either a single stream with a separate direction logic output (low for Reverse, high for Forward) or a dual stream of pulses in phase quadrature that the PL/X decodes to determine the direction of rotation. Enable PHASE QUADRATURE in the ENCODER SCALING sub-menu.

Note that low frequencies give poor performance. The lower frequency limit for satisfactory performance is a 100% input frequency (i.e. at full speed of encoder) of 15 kHz (450 lines at 2000 rpm single-pulse train, or 225 lines at 2000 rpm for quadrature type). With more lines, the performance improves; with fewer lines, dynamic stability degrades.

Parameter 6)DESIRED MAX RPM determines the value of the 100% speed feedback RPM.

For other types of encoder electrical output, you must provide some external conditioning circuitry. The output format may be pulse-only for single direction, pulse-with-sign, or phase quadrature. Refer to "11.2 CHANGE PARAMETERS/ CALIBRATION/ENCODER SCALING" on page 127.

You can configure an encoder failure detection system to either trip the PL/X or automatically switch to AVF - refer to "13.1.1 171)SPD TRIP ENABLE" on page 225.

For lower full-scale frequencies, see type 3 or type 4 feedback modes below.

Note: With bi-directional encoder feedback, it is possible to lock or orientate the shaft, or both, at zero speed. Refer to "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

DIP3 (T16) and DIP4 (T17) accept bi-directional encoder pulse trains.

The encoder outputs must be able to provide a logic low below 2 V, and a logic high above 4 V. They may range up to 50 V maximum, and up to 100 kHz.

Both inputs are single-ended and non-isolated.

3) ENCODER + ARM VOLTS:

In this mode, the AVF provides the main dynamic feedback, while the encoder feedback is trimming the accuracy to an extremely high level.

Note that low frequencies give poor performance. The lower frequency limit for satisfactory performance with encoder + AV feedback is a 100% input frequency of 2 kHz (i.e. 60 lines at 2000 rpm single-pulse train, or 30 lines at 2000 rpm for a quadrature encoder). With more lines, the performance improves. With fewer lines, the dynamic stability degrades, mostly at low speeds.

In this mode, when using a non-quadrature, single-line encoder, the AVF automatically provides the feedback sign. The T16 digital input is made available for other uses (unless using zero speed lock - refer to "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

The value entered in `6)DESIRED MAX RPM` determines the final steady-state 100% speed feedback RPM, and the value for `18)RATED ARM VOLTS` produces the dynamic scaling. These two full-scale settings must correspond with each other for optimum performance.

4) ENCODER + TACHO:

In this mode, the tachogenerator provides the main dynamic feedback, and the encoder trims the accuracy to an extremely high level.

Note that low frequencies give poor performance. The lower frequency limit for reasonable performance with encoder + tacho feedback is a 100% input frequency of 2 kHz (i.e. 60 lines at 2000 rpm single-pulse train, or 30 lines at 2000 rpm for a quadrature encoder). With more lines, the performance improves. With fewer lines, the dynamic stability degrades, mostly at low speeds.

In this mode, when using a non-quadrature, single-line encoder, the Tacho automatically provides the feedback sign. The T16 digital input is made available for other uses (unless using zero speed lock - refer to "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

The value entered in `6)DESIRED MAX RPM` determines the final steady-state 100% speed feedback RPM, and the value of `8)MAX TACHO VOLTS` produces the dynamic scaling. These two full-scale settings must correspond with each other for optimum performance.

AVF feedback usually contains ripple. It is therefore advisable to reduce the SPEED CONTROL loop gains with AVF feedback selected. Refer to "11.8.3 71) SPEED PROP GAIN" on page 162.

11.1.9 14)IR COMPENSATION

Set the % compensation for the AVF signal due to IR drop.

PIN	Parameter description	Range	Default
14	IR COMPENSATION	0-100.00%	0.00 %

This parameter is for when ARMATURE VOLTS speed feedback is selected.

To set this parameter with AVF feedback:

1. If possible, apply a significant load change to the system.
2. Slowly increment the parameter until the load change has a minimum effect on the speed holding.
   Alternatively, calculate the parameter using the formula below and initially enter this value:

   IR (%) = (motor I x Arm Res/motor V) x 100.

Note: Excessive compensation may lead to instability.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  CALIBRATION              3
 R └ 14)IR COMPENSATION
```

NOTE: Speed is proportional to the back EMF of the motor, therefore:

Back EMF = AVF – IR drop

IR drop is a result of armature current flowing through the armature resistance. Hence, when the armature current is high, the IR drop is high. At zero armature current, the IR drop is zero

11.1.10 15)FIELD CUR FB TRIM

Set a positive trim factor for the field current feedback.

PIN	Parameter description	Range	Default
15	FIELD CURRENT FEEDBACK TRIM	1.0000 to 1.1000	1.0000

You can apply this trim factor with the PL/X running.

The factor is always greater than unity and hence can only increase the strength of the feedback. The closed-loop system then receives feedback that is too high and causes a reduction of the controlled field current.

The trim is useful to run the PL/X starting with a higher than expected value of feedback to discover a precise value for 4)RATED FIELD AMPS when not known.

Determine the correct level of feedback using this trim (use the DIAGNOSTICS menu to monitor actual levels of feedback).

Enter the new precise value into 4)RATED FIELD AMPS and return this trim to 1.0000.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  CALIBRATION              3
 R └ 15)FIELD CUR FB TRIM
```

11.1.11 16)ARM VOLTS TRIM

Set a positive trim factor for armature volts feedback.

PIN	Parameter description	Range	Default
16	ARMATURE VOLTS TRIM	1.0000 to 1.1000	1.0000

You can apply this trim factor with the PL/X running.

The factor is always greater than unity and thus can only increase the strength of the feedback. The closed-loop system then receives a feedback signal that is too high. It causes a reduction of the armature voltage feedback and hence a speed reduction.

Use this trim to run the PL/X when starting with a higher than expected value of feedback to discover a precise value for 18)RATED ARM VOLTS when not known.

Determine the correct level of feedback using this trim (use the DIAGNOSTICS menu to monitor actual levels of feedback).

Enter the new precise value into 18)RATED ARM. VOLTS and return this trim to 1.0000.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  CALIBRATION              3
 R └ 16)ARM VOLTS TRIM
```

11.1.12 17)ANALOG TACHO TRIM

Set a positive trim factor for analog tacho feedback.

PIN	Parameter description	Range	Default
17	ANALOG TACHO TRIM	1.0000 to 1.1000	1.0000

You can apply this trim factor with the PL/X running.

The factor is always greater than unity and thus can only increase the strength of the feedback. The closed-loop system then receives a feedback signal that is too high. It causes a reduction of the armature voltage feedback and hence a speed reduction.

Use this trim to run the PL/X when starting with a higher than expected value of feedback to discover a precise value for 8)MAX TACHO VOLTS when not known.

Determine the correct level of feedback using this trim (use the DIAGNOSTICS menu to monitor actual levels of feedback).

Enter the new precise value into 8)MAX TACHO VOLTS and return this trim to 1.0000.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  CALIBRATION              3
 R └ 17)ANALOG TACHO TRIM
```

11.1.13 18)RATED ARM VOLTS

Set the desired maximum armature voltage.

PIN	Parameter description	Range	Default
18	RATED ARMATURE VOLTS	0.0 to 1000.0 V	460.0 V DC

NOTE: This value must not exceed the maximum rated armature volts defined on the motor rating plate.

The armature volts is approximately proportional to the motor speed. For example:

> A motor rated at 400 V, 2000 rpm, is required to run at a maximum speed of 1000 rpm. Therefore the rated armature volts at 1000 rpm is 200 V, representing a 100% speed.

Refer to "11.1.11 16)ARM VOLTS TRIM" on page 124 to obtain a precise value.

If the desired maximum rpm is higher than the base rpm, then implement field weakening in the CHANGE PARAMETERS / FIELD CONTROL menu. **Be sure to verify that your motor and load rating is correct for rotation above base speed. Failure to do so may result in mechanical breakdown with disastrous consequences.** In this mode, the rated armature volts is usually set to the rating plate value to make full use of the motor ratings. Field weakening provides a further speed increase, and therefore, the armature voltage remains clamped at the maximum rated value. The Field Weakening menu refers to this as the spillover voltage.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  CALIBRATION             3
 R  └ 18)RATED ARM VOLTS
```

Note: At low speeds, be aware of heat dissipation in the motor at full torque. Use force venting of the motor if necessary.

11.1.14 19)EL1/2/3 RATED AC

Enter the value of the lowest AC supply voltage connected to either EL1, EL2 or EL3.

PIN	Parameter description	Range	Default
19	EL1/2/3 RATED AC	0-1000.0 V	415.0 V AC

Refer to "12.1.1 169)EL1/2 RMS MON" on page 205 to monitor the actual AC volts.

Refer to "10.7.2 L1/2/3 AC supply level different to EL1/2/3" on page 107

The SUPPLY PHASE LOSS alarm uses this parameter to determine the alarm threshold. The loss detection threshold is approximately 75% of the voltage entered here. By entering a voltage higher or lower than the rated voltage, it is possible to accommodate systems requiring detection at higher or lower thresholds.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  CALIBRATION             3
 R  └ 19)EL1/2/3 RATED AC
```

Example:

- With 19)EL1 / 2 / 3 RATED AC set to 500 V, the alarm will detect at 375 V on EL1/2/3. (75% of 500 = 375)

Refer to "13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE" on page 234 - SUPPLY PHASE LOSS, also refer to "10.7 Supply loss shutdown" on page 106.

11.1.15 20)MOTOR 1,2 SELECT

Select Motor 1 or Motor 2 editable parameter set to be active.

PIN	Parameter description	Range	Default
20	MOTOR 1,2 SELECT	MOTOR 1 MOTOR 2	MOTOR 1

This parameter comprises two identical sets of parameters: MOTOR 1 and MOTOR 2.

The MOTOR 1,2 SELECT parameter determines which parameter set becomes active (the unselected one becoming passive).

- Each parameter set can have a different setting for the same parameter.
- The parameters are all editable.
- You can edit the active parameter set within the CHANGE PARAMETERS menu.
- Edit the passive parameter set within the CONFIGURATION / DRIVE PERSONALITY / PASSIVE MOTOR SET menu.
- You can edit MOTOR 1,2 SELECT using a digital input to provide external set selection.
- Also, use MOTOR 1,2 SELECT as a diagnostic to identify the active set and optionally connect to a digital output if desired.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CALIBRATION 3
R 20)MOTOR 1,2 SELECT

11.2 CHANGE PARAMETERS/CALIBRATION/ENCODER SCALING

The ENCODER SCALING menu allows you to set the encoder parameters. (Ignore this menu if there is no encoder).

NOTE: You can monitor the Encoder RPM whether it is being used for feedback or not:

DIAGNOSTICS / SPEED LOOP MONITOR / 132) ENCODER RPM MON

Refer to "12.2.9 132)ENCODER RPM MON" on page 209.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  CALIBRATION              3
R  ENCODER SCALING          4
   R  10)QUADRATURE ENABLE
      11)ENCODER LINES
      12)MOT/ENC SPD RATIO
      13)ENCODER SIGN
```

11.2.1 10)QUADRATURE ENABLE

Program the encoder inputs T16 and T17.

PIN	Parameter description	Range	Default
10	QUADRATURE ENABLE	DISABLED ENABLED	ENABLED

The encoder inputs on T16 and T17 can be programmed to accept two types of encoder pulse trains:

0) Pulse with sign
10)QUADRATURE ENABLE is DISABLED

The encoder provides a single train of pulses on T17. You make available a rotation direction logic signal on T16 (low for reverse, high for forward), which you can invert using the 13)ENCODER SIGN parameter.
NOTE: If this type of encoder in conjunction with AVF or tacho, the analog feedback automatically provides the feedback sign, making the T16 digital input available for other uses (unless zero speed lock requires T16 for the encoder direction). Refer to "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

Refer also to "11.1.8 9)SPEED FBK TYPE" on page 120.

1) Two pulse trains in phase quadrature
10)QUADRATURE ENABLE is ENABLED.

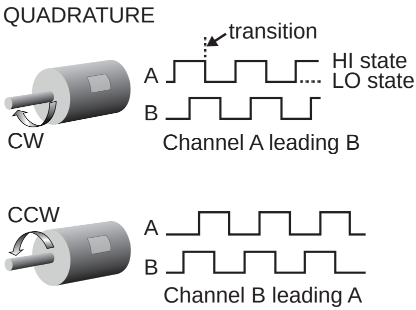
The encoder provides two pulse trains that are phase-shifted by 90 degrees.

The PL/X automatically decodes the quadrature information to produce a rotation direction sign. You can invert this using the 13)ENCODER SIGN parameter.

With the PL/X rotating to ±100% speed using AVF as the feedback source, use a high-quality oscilloscope

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  CALIBRATION              3
R  ENCODER SCALING          4
   R  10)QUADRATURE ENABLE
```

Refer to "3.3.1.2 Optional feedback devices" on page 16 and "7.6.1.3 Encoder inputs" on page 62.



to observe the pulse trains and check for good phase holding and no interference.

- Low-frequency feedback may give poor results at low speed. Therefore, we recommend using the Mode 3 or Mode 4 combined feedback type for an encoder (or other types of pick-up) that provides less than 15 kHz at full speed. Refer to "11.1.8 9) SPEED FBK TYPE" on page 120.
- The signal inputs to T16 and T17 must be clean and noise-free - the encoder inputs must deal with and recognise very short pulses preventing the use of heavy noise filtering on these inputs.
- Ground loops are one of the prime causes of unwanted noise on encoder signals. Ensure the encoder electronics 0 V is separately wired back to 0 V on terminal 13, with no encoder wiring earth connections at the motor end.
- The encoder casing will probably be earthed because of its mechanical connection to the motor or machine. It is usually acceptable as long as the internal electronics 0 V has a separate connection point. Some encoder manufacturers provide a by-pass capacitor inside the encoder between the electronics 0 V and the casing. Unfortunately, this capacitor makes a very effective high-frequency ground loop and may require removing to prevent ground loop noise on the encoder signals - consult the encoder supplier.
- Ultimately, it may be necessary to install an isolation link in the encoder loop.
- Route all encoder wiring away from heavy current or other noise-generating cables. Use an insulated screened cable with a separate screen for each encoder signal connected at the drive terminal T13. This cable should also be screening the encoder 0 V and power supply within the cable.

Note that encoders with quadrature outputs require the phase difference between the two pulse trains to remain as close to 90 degrees as possible:

- If the encoder is not mounted and centred accurately on the shaft, it can impact the pulse train phase relationship.
- If the encoder appears to gyrate as the shaft rotates you must correct the problem before commissioning.

11.2.2 11)ENCODER LINES

Enter the encoder resolution in pulses per revolution.

PIN	Parameter description	Range	Default
11	ENCODER LINES	1-6000	1000

Enter the number of lines from the encoder rating plate.

Alternatively, enter the number of cycles of high/low for one pulse train during one revolution. For example, for a toothed gear wheel with 60 teeth and a magnetic pick-up, enter the number 60.

Note that there is an upper-frequency limit of 100 kHz.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CALIBRATION	3
R	ENCODER SCALING	4
R	11)ENCODER LINES	

11.2.3 12)MOT/ENC SPD RATIO

Set the motor revolutions as a ratio of the encoder revolutions.

PIN	Parameter description	Range	Default
12	MOTOR/ENCODER SPEED RATIO	0-3.0000	1.0000

MOT/ENC SPD RATIO = Motor RPM / Encoder RPM
(true for all speeds)

This parameter can correct for variances between the motor RPM and the encoder RPM. For example: :

- Sometimes the encoder is not fixed to the motor shaft and may rotate at an RPM that is a non-unity ratio of the motor RPM.
- Sometimes systems may have the encoder geared up to obtain a higher feedback frequency.

The encoder RPM % is provided by the hidden parameter 709)MOTOR RPM %.

6)DESIRED MAX RPM then scales this to 100%

It is also scaled by 12)MOT / ENC SPD RATIO acting as a pure multiplying factor.

Both 132)ENCODER RPM MON and 709)MOTOR RPM % parameters are purely encoder signals that work independently of the type of feedback selected. They both read zero when there are no pulses on the encoder inputs.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CALIBRATION	3
R	ENCODER SCALING	4
R	12)MOT/ENC SPD RATIO	

Before using the encoder as a feedback source:

1. Run in AVF feedback mode and verify the integrity of the encoder feedback signals using an oscilloscope.
2. Set the QUADRATURE ENABLE and ENCODER LINES parameters.
3. Run in AVF feedback mode and monitor the 132)ENCODER RPM MON parameter in the DIAGNOSTICS menu to verify the encoder operates as expected.

11.2.4 13)ENCODER SIGN

Modify the encoder rotation sign.

PIN	Parameter description	Range	Default
13	ENCODER SIGN	INVERT NON-INVERT	NON-INVERT

Use this parameter to invert the encoder feedback sign.

NOTE: The armature voltage or Tacho component automatically provides the feedback sign while using combined feedback modes type 3 and type 4 with single line encoders

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CALIBRATION	3
R	ENCODER SCALING	4
R	13)ENCODER SIGN	

11.3 CHANGE PARAMETERS / RUN MODE RAMPS

This block sets the rate of acceleration and deceleration of the motor independently of the incoming reference.

There are four independent up/down/forward/reverse ramp times and an output that indicates that ramping is taking place. The output can be held, or preset to any value with preset commands from various sources to help with many applications.

The ramp shape can be profiled to a classic S shape for smooth control. Refer to "11.3.12 32)RAMP S-PROFILE %" on page 137.

RUN MODE RAMPS may be programmed to be active when the PL/X is in stop mode. Refer to the table below. This function is useful in cascaded systems.

NOTE: Other ramp times overide the run mode ramps:

- Set a different down ramp time for stopping modes. Refer to "11.6.2 56)STOP RAMP TIME" on page 153.
- Set a different up/down ramp time Jor JOG control. Refer to "11.4.7 43)JOG/SLACK RAMP" on page 143.

The incoming reference can have a minimum speed imposed in either direction. The ramp preset function is momentary in jog mode.

```
R  ENTRY MENU     LEVEL  1
R  CHANGE PARAMETERS     2
R  RUN MODE RAMPS        3
  R  21)RAMP OP MONITOR
  R  22)FORWARD UP TIME
  R  23)FORWARD DOWN TIME
  R  24)REVERSE UP TIME
  R  25)REVERSE DOWN TIME
     26)RAMP INPUT
     27)FORWARD MIN SPEED
     28)REVERSE MIN SPEED
     29)RAMP AUTO PRESET
     30)RAMP EXT PRESET
     31)RAMP PRESET VALUE
     32)RAMP S-PROFILE %
     33)RAMP HOLD
     34)RAMPING THRESHOLD
  R  35)RAMPING FLAG
```

The GOTO of this block resides in the CONFIGURATION / BLOCK OP CONFIG menu - refer to Page 361.

Mode	29)RAMP AUTO PRESET	30)RAMP EXT PRESET	Action of run mode ramps	Action of jog mode ramps
1	DISABLED	DISABLED	Held at zero when stopped. Starts from zero.	Held at zero when stopped. Starts from zero.
2	DISABLED	ENABLED	Held at PRESET VALUE permanently.	Held at PRESET VALUE when stopped. Starts from PRESET VALUE.
3	ENABLED	DISABLED	Ramp continues to follow input reference when stopped. Starts from PRESET VALUE.	Ramp continues to follow input reference when stopped. Starts from PRESET VALUE.
4	ENABLED	ENABLED	Held at PRESET VALUE permanently.	Held at PRESET VALUE when stopped. Starts from PRESET VALUE.

Mode 1 ensures that the ramp output resets to 0.00% during all stopping modes.

Modes 2/3/4 have an active ramp output during all stopping modes that are useful in cascaded systems. The action of momentarily starting presets the ramps. (Default value 0.00%).

NOTE: 30)RAMP EXT PRESET has permanent action on run mode ramps and, if already high, has a momentary action at the start of a JOG request. The 29)RAMP AUTO PRESET input is ANDed with 720)SYSTEM RESET pulse, which is simultaneous with the release of the current loop.

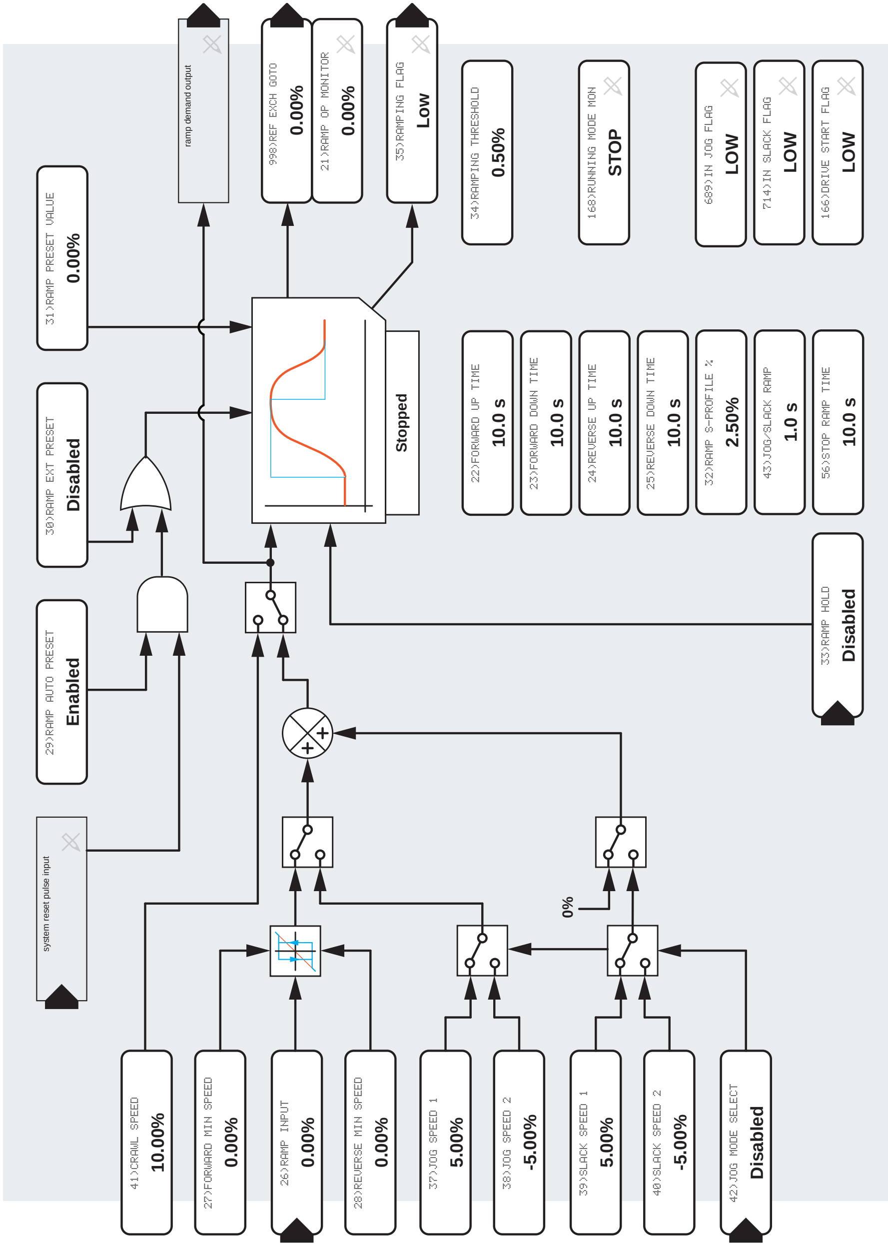


Figure 38 RUN MODE RAMPS, including JOG CRAWL SLACK - block diagram

Operating Function Refer to parameter 168)RUNNING MODE MON	**JOG MODE SELECT** input level **T19**	**START** input level **T33**	**JOG** input level **T32**	**RAMP** input total value	**Applied Ramp Time**	**Contactor State**
Stopped	low	low	low	reference	Stop ramp	OFF
Stopped	high	low	low	reference	Stop ramp	OFF
Running	low	high	low	reference	Run mode ramp	ON
Crawl	high	high	low	Crawl speed	Run mode ramp	ON
Jog speed 1	low	low	high	Jog speed 1	Jog/slack ramp	ON
Jog speed 2	high	low	high	Jog speed 2	Jog/slack ramp	ON
Slack 1 take-up	low	high	high	ref + slack 1	Jog/slack ramp	ON
Slack 2 take-up	high	high	high	ref + slack 2	Jog/slack ramp	ON

11.3.1 21)RAMP OP MONITOR

Monitor the output level of the ramp block.

PIN	Parameter description	Range
21	RAMP OUTPUT MONITOR	±300.00%

When viewing 21)RAMP OP MONITOR, you can branch hop (press the UP key) to 35)RAMPING FLAG.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
R 21)RAMP OP MONITOR

11.3.2 22)FORWARD UP TIME

Set the ramp time for 0-100% of the forward (positive) reference.

PIN	Parameter description	Range	Default
22	FORWARD UP TIME	0.1 to 600.0 seconds	10.0 seconds

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
R 22)FORWARD UP TIME

11.3.3 23)FORWARD DOWN TIME

Set the ramp time for 100-0% of the forward (positive) reference.

PIN	Parameter description	Range	Default
23	FORWARD DOWN TIME	0.1 to 600.0 seconds	10.0 seconds

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
R 23)FORWARD DOWN TIME

11.3.4 24)REVERSE UP TIME

Set the ramp time for 0-100% of the reverse (negative) reference.

PIN	Parameter description	Range	Default
24	REVERSE UP TIME	0.1 to 600.0 seconds	10.0 seconds

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
R 24)REVERSE UP TIME

11.3.5 25)REVERSE DOWN TIME

Set the ramp time for 100-0% of the reverse (negative) reference.

PIN	Parameter description	Range	Default
25	REVERSE DOWN TIME	0.1 to 600.0 seconds	10.0 seconds

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
R 25)REVERSE DOWN TIME

11.3.6 26)RAMP INPUT

Set the run mode ramps input value.

PIN	Parameter description	Range	Default
26	RAMP INPUT	±105.00%	0.00%

By default this parameter connects to T4, allowing an external analog reference to enter the ramp input value. This parameter then behaves as a monitor of the ramp input value.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
26)RAMP INPUT

11.3.7 27)FORWARD MIN SPEED

Support the forward (positive) ramp output at a minimum level.

PIN	Parameter description	Range	Default
27	FORWARD MINIMUM SPEED	0.00 to 105.00%	0.00%

With 27)FORWARD MIN SPEED set to greater than 0.5%, **and** 28)REVERSE MIN SPEED set from 0 to -0.5%, then 27)FORWARD MIN SPEED is operative and preventing a negative ramp output. This facility will prevent accidental negative rotation.

When parameters 27)FORWARD MIN SPEED **and** 28)REVERSE MIN SPEED are set outside a band of ±0.5%, then both minimum speeds are active, with 0.5% hysteresis around zero.

NOTE: With 27)FORWARD MIN SPEED set from 0 to +0.5%, the ramp output follows the input at the desired ramp rates through zero, i.e. no minimum speeds are operating, and there is no hysteresis around zero.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
27)FORWARD MIN SPEED

11.3.8 28)REVERSE MIN SPEED

Support the reverse (negative) ramp output at a minimum level.

PIN	Parameter description	Range	Default
28	REVERSE MINIMUM SPEED	0.00 to -105.00%	0.00%

With 27)FORWARD MIN SPEED set to greater than 0.5%, **and** 28)REVERSE MIN SPEED set from 0 to -0.5%, then 27)FORWARD MIN SPEED is operative and preventing a negative ramp output. This facility will prevent accidental negative rotation.

When parameters 28)REVERSE MIN SPEED **and** 27)FORWARD MIN SPEED are set outside a band of ±0.5%, then both minimum speeds are active, with 0.5% hysteresis around zero.

NOTE: With 27)FORWARD MIN SPEED set from 0 to +0.5%, the ramp output follows the input at the desired ramp rates through zero, i.e. no minimum speeds are operating, and there is no hysteresis around zero.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
28)REVERSE MIN SPEED

11.3.9 29)RAMP AUTO PRESET

Enable the system reset pulse to also preset the ramp.

PIN	Parameter description	Range	Default
29	RAMP AUTOMATIC PRESET	DISABLED ENABLED	ENABLED

Enable the system reset pulse to set the ramp value to the value of 31)RAMP PRESET VALUE.

Each time the main contactor energises, 720)SYSTEM RESET produces a logic pulse (5 ms).

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
29)RAMP AUTO PRESET

11.3.10 30)RAMP EXT PRESET

Enable to hold the ramp in preset mode.

PIN	Parameter description	Range	Default
30	RAMP EXTERNAL PRESET	DISABLED ENABLED	DISABLED

A logic high enables this preset mode.

R	ENTRY MENU LEVEL 1
R	CHANGE PARAMETERS 2
R	RUN MODE RAMPS 3
	30)RAMP EXT PRESET

11.3.11 31)RAMP PRESET VALUE

Set a run mode ramps block output value for when the ramp is preset.

PIN	Parameter description	Range	Default
31	RAMP PRESET VALUE	±300.00%	0.00%

Sets the value appearing on the output of the run mode ramps block when the run mode ramps block is preset by 29)RAMP AUTO PRESET or 30)RAMP EXT PRESET.

R	ENTRY MENU LEVEL 1
R	CHANGE PARAMETERS 2
R	RUN MODE RAMPS 3
	31)RAMP PRESET VALUE

11.3.12 32)RAMP S-PROFILE %

Set the % of the S ramp shape at each end.

PIN	Parameter description	Range	Default
32	RAMP S-PROFILE %	0.00 to 100.00%	0.50%

A value of 0.00% produces a linear ramp.

Larger values produce an increase in the length of the S ramp at each end of the linear ramp. The rate of change in the remaining linear portion is maintained. Therefore the ramp time becomes longer as the value of RAMP S-PROFILE % increases.

R	ENTRY MENU LEVEL 1
R	CHANGE PARAMETERS 2
R	RUN MODE RAMPS 3
	32)RAMP S-PROFILE %

11.3.13 33)RAMP HOLD

Enable to hold the ramp at the present value.

PIN	Parameter description	Range	Default
33	RAMP HOLD	DISABLED ENABLED	DISABLED

NOTE: The 30)RAMP EXT PRESET function overrides the 33)RAMP HOLD function.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
33)RAMP HOLD

11.3.14 34)RAMPING THRESHOLD

Set the operating threshold for the 35)RAMPING FLAG output.

PIN	Parameter description	Range	Default
34	RAMPING THRESHOLD	0.00 to 100.00%	2.50%

35)RAMPING FLAG output is low when the output of the ramp is within this % tolerance of its target value.

35)RAMPING FLAG output is HIGH when the output of the ramp is NOT within this % tolerance of its target value. And HIGH when the PL/X holds the ramp at a value differing from the input by more than the threshold. Refer to "11.3.15 35)RAMPING FLAG" on page 138.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
34)RAMPING THRESHOLD

11.3.15 35)RAMPING FLAG

The ramping flag is set HIGH when ramping.

PIN	Parameter description	Range	Default
35	RAMPING FLAG	LOW HIGH	LOW

You can use the ramping flag to modify the speed loop integrator during ramping. Refer to "11.9.6 78)INT % DURING RAMP" on page 166.

By default, Digital output DOP2 on terminal 23 connects to 35)RAMPING FLAG.

Refer also to "11.6.1 Precise stopping" on page 152.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R RUN MODE RAMPS 3
R 35)RAMPING FLAG

11.4 CHANGE PARAMETERS / JOG CRAWL SLACK

This menu provides adjustment for parameters associated with jogging, slack take-up and crawling.

Refer to "11.4.6 42)JOG MODE SELECT" on page 142 for a table showing the eight modes of operation available.

Two hidden PINs provide output flags:

- 689)IN JOG FLAG
  This parameter is HIGH during the jogging process. It goes LOW when the ramp returns to the current run level.
- 714)IN SLACK FLAG
  This parameter is HIGH during the slack take-up process. It goes LOW when the ramp returns to the current run level. Refer to "16.6 APPLICATION BLOCKS / TORQUE COMPENSATOR" on page 279.

```
R ENTRY MENU      LEVEL  1
R CHANGE PARAMETERS      2
R JOG CRAWL SLACK        3
  R 37)JOG SPEED 1
  R 38)JOG SPEED 2
  R 39)SLACK SPEED 1
  R 40)SLACK SPEED 2
  R 41)CRAWL SPEED
  R 42)JOG MODE SELECT
  R 43)JOG/SLACK RAMP
```

Mode	29)RAMP AUTO PRESET	30)RAMP EXT PRESET	Action of run mode ramps	Action of jog mode ramps
1	DISABLED	DISABLED	Held at zero when stopped. Starts from zero.	Held at zero when stopped. Starts from zero.
2	DISABLED	ENABLED	Held at PRESET VALUE permanently.	Held at PRESET VALUE when stopped. Starts from PRESET VALUE.
3	ENABLED	DISABLED	Ramp continues to follow input reference when stopped. Starts from PRESET VALUE.	Ramp continues to follow input reference when stopped. Starts from PRESET VALUE.
4	ENABLED	ENABLED	Held at PRESET VALUE permanently.	Held at PRESET VALUE when stopped. Starts from PRESET VALUE.
Mode 1 ensures that the ramp output resets to 0.00% during all stopping modes. Modes 2/3/4 have an active ramp output during all stopping modes that are useful in cascaded systems. The action of momentarily starting presets the ramps. (Default value 0.00%). **NOTE:** 30)RAMP EXT PRESET has permanent action on run mode ramps and, if already high, has a momentary action at the start of a JOG request. The 29)RAMP AUTO PRESET input is ANDed with 720)SYSTEM RESET pulse, which is simultaneous with the release of the current loop.				

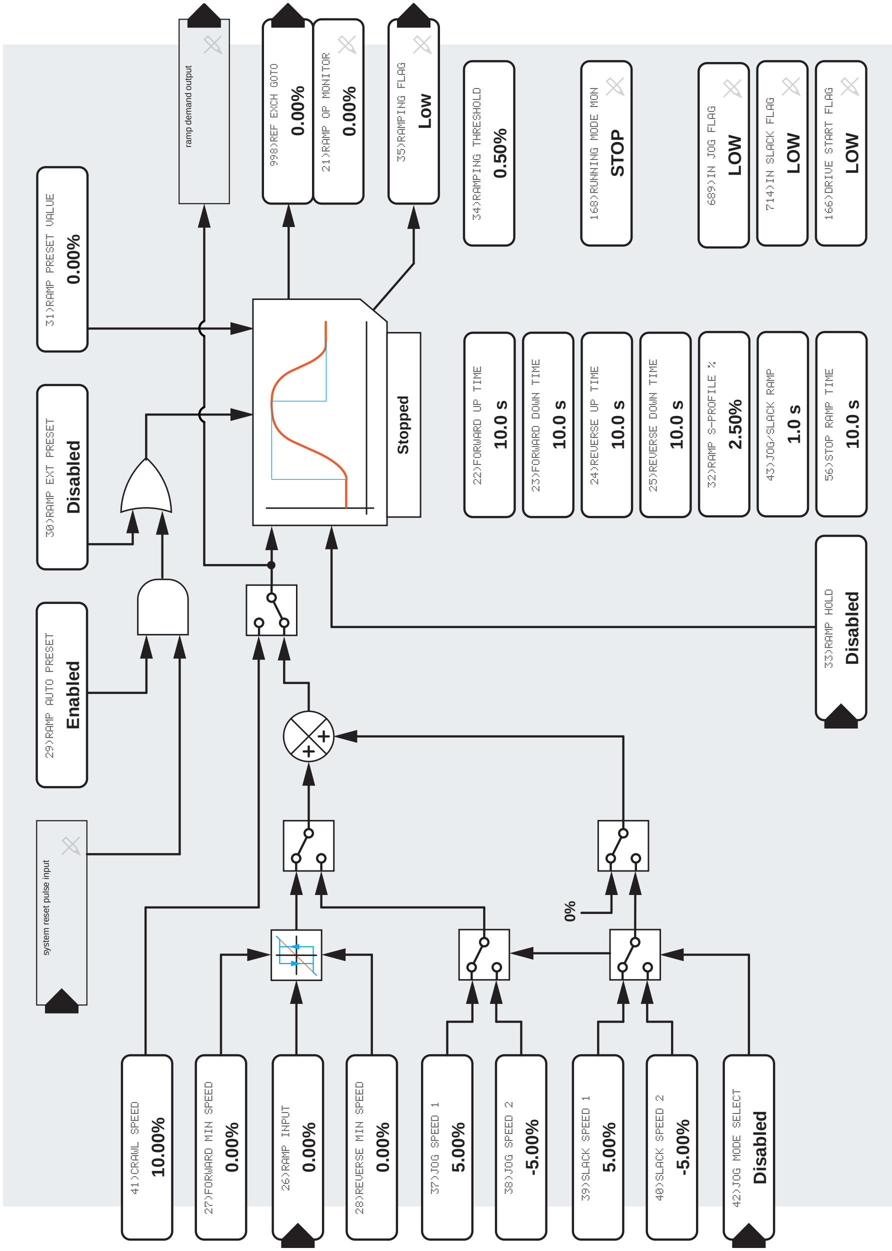


Figure 39 JOG CRAWL SLACK, including RUN MODE RAMPS - block diagram

11.4.1 37)JOG SPEED 1

Set the value of jog speed 1, usually used for a forward jog.

PIN	Parameter description	Range	Default
37	JOG SPEED 1	±100.00%	5.00%

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  JOG CRAWL SLACK          3
R  37)JOG SPEED 1
```

11.4.2 38)JOG SPEED 2

Set the value of jog speed 2, usually used for a reverse jog.

PIN	Parameter description	Range	Default
38	JOG SPEED 2	±100.00%	-5.00%

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  JOG CRAWL SLACK          3
R  38)JOG SPEED 2
```

11.4.3 39)SLACK SPEED 1

Set the value of slack speed 1, usually used to increase speed.

PIN	Parameter description	Range	Default
39	SLACK SPEED 1	±100.00%	5.00%

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  JOG CRAWL SLACK          3
R  39)SLACK SPEED 1
```

11.4.4 40)SLACK SPEED 2

Set the value of slack speed 2, usually used to decrease speed.

PIN	Parameter description	Range	Default
40	SLACK SPEED 2	±100.00%	-5.00%

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  JOG CRAWL SLACK          3
R  40)SLACK SPEED 2
```

11.4.5 41)CRAWL SPEED

Set the value of crawl speed.

PIN	Parameter description	Range	Default
41	CRAWL SPEED	±100.00%	10.00%

```
R  ENTRY MENU       LEVEL   1
R  CHANGE PARAMETERS        2
R  JOG CRAWL SLACK          3
R   41)CRAWL SPEED
```

11.4.6 42)JOG MODE SELECT

Select a JOG mode.

PIN	Parameter description	Range	Default
42	JOG MODE SELECT	LOW HIGH	LOW

This parameter combines with the JOG/START inputs to provide a jog/crawl/slack mode.

```
R  ENTRY MENU       LEVEL   1
R  CHANGE PARAMETERS        2
R  JOG CRAWL SLACK          3
R   42)JOG MODE SELECT
```

Operating Function Refer to parameter 168)RUNNING MODE MON	**JOG MODE SELECT** input level **T19**	**START** input level **T33**	**JOG** input level **T32**	**RAMP** input total value	**Applied Ramp Time**	**Contactor State**
Stopped	low	low	low	reference	Stop ramp	OFF
Stopped	high	low	low	reference	Stop ramp	OFF
Running	low	high	low	reference	Run mode ramp	ON
Crawl	high	high	low	Crawl speed	Run mode ramp	ON
Jog speed 1	low	low	high	Jog speed 1	Jog/slack ramp	ON
Jog speed 2	high	low	high	Jog speed 2	Jog/slack ramp	ON
Slack 1 take-up	low	high	high	ref + slack 1	Jog/slack ramp	ON
Slack 2 take-up	high	high	high	ref + slack 2	Jog/slack ramp	ON

11.4.7 43)JOG/SLACK RAMP

Set a ramp time for jog/slack mode.

PIN	Parameter description	Range	Default
43	JOG/SLACK RAMP	0.1 to 600.0 seconds	1.0 seconds

The jog and slack modes use this ramp time:

- This ramp time applies irrespective of ramp speed demand polarity and direction.
- It is the time taken to accomplish a 100% change in ramp speed demand.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
R  JOG CRAWL SLACK           3
R  └ 43)JOG/SLACK RAMP
```

11.5 CHANGE PARAMETERS / MOTORISED POT RAMP

This menu controls parameters for the motorised potentiometer function (MP) (the default terminal function for terminals T7, T8, T9).

The motorised potentiometer function provides a ramping facility that is in addition to the usual reference ramp.

The GOTO of this block resides in the CONFIGURATION/ BLOCK OP CONFIG menu - refer to Page 361.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
   MOTORISED POT RAMP       3
     45)MP OP MONITOR
     46)MP UP TIME
     47)MP DOWN TIME
     48)MP UP COMMAND
     49)MP DOWN COMMAND
     50)MP MAX CLAMP
     51)MP MIN CLAMP
     52)MP PRESET
     53)MP PRESET VALUE
     54)MP MEMORY BOOT-UP
```

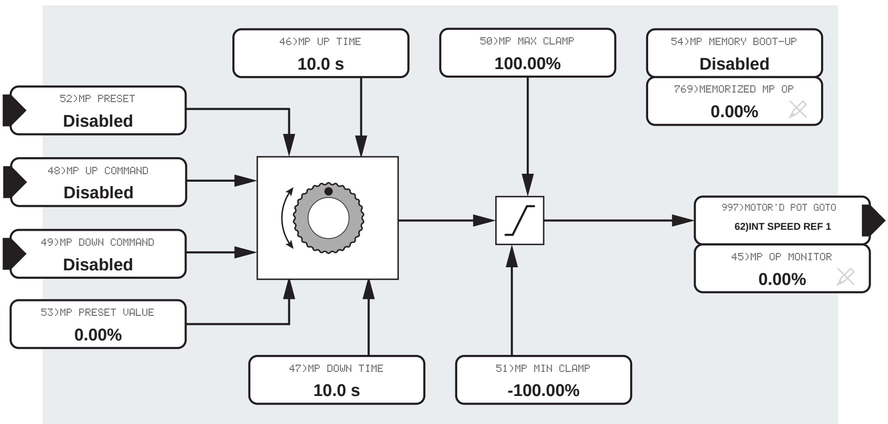


Figure 40 MOTORISED POT RAMP - block diagram

11.5.1 45)MP OP MONITOR

Monitor the output value of the motorised potentiometer function.

PIN	Parameter description	Range
45	MOTORISED POTENTIOMETER OUTPUT MONITOR	±300.00%

Refer to "11.7.1 62)INT SPEED REF 1" on page 158.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
   MOTORISED POT RAMP        3
     └ 45)MP OP MONITOR
```

11.5.2 46)MP UP TIME

Set a time for a 100% change in the positive direction.

PIN	Parameter description	Range	Default
46	MOTORISED POTENTIOMETER UP TIME	0.1 to 600.0 seconds	10.0 seconds

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
   MOTORISED POT RAMP        3
     └ 46)MP UP TIME
```

11.5.3 47)MP DOWN TIME

Set a time for a 100% change in the negative direction.

PIN	Parameter description	Range	Default
47	MOTORISED POTENTIOMETER DOWN TIME	0.1 to 600.0 seconds	10.0 seconds

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
   MOTORISED POT RAMP        3
     └ 47)MP DOWN TIME
```

11.5.4 48)MP UP COMMAND

Enable the motorised potentiometer to rotate towards the positive limit.

PIN	Parameter description	Range	Default
48	MOTORISED POTENTIOMETER UP COMMAND	DISABLED ENABLED	DISABLED

NOTE: There is no ramping when parameters 48)MP UP COMMAND and 49)MP DOWN COMMAND are both ENABLED.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
MOTORISED POT RAMP 3
48)MP UP COMMAND

11.5.5 49)MP DOWN COMMAND

Enable the motorised potentiometer to rotate towards the negative limit.

PIN	Parameter description	Range	Default
49	MOTORISED POTENTIOMETER DOWN COMMAND	DISABLED ENABLED	DISABLED

NOTE: There is no ramping when parameters 48)MP UP COMMAND and 49)MP DOWN COMMAND are both ENABLED.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
MOTORISED POT RAMP 3
49)MP DOWN COMMAND

11.5.6 50)MP MAX CLAMP

Set the limit of positive (clockwise) rotation of the motorised potentiometer.

PIN	Parameter description	Range	Default
50	MOTORISED POTENTIOMETER MAXIMUM CLAMP	±300.00%	100.00%

Clamps the 53)MP PRESET VALUE parameter:

- Always ensure the maximum and the minimum clamps allow for movement between them.
- **Do not** let the clamps cross each other. Always set a maximum clamp value that is greater than the minimum clamp value.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
MOTORISED POT RAMP 3
50)MP MAX CLAMP

11.5.7 51)MP MIN CLAMP

Set the limit of negative (anti-clockwise) rotation of the motorised potentiometer.

PIN	Parameter description	Range	Default
51	MOTORISED POTENTIOMETER MINIMUM CLAMP	±300.00%	-100.00%

Clamps the 53)MP PRESET VALUE parameter:

- Always ensure the maximum and the minimum clamps allow for movement between them.
- **Do not** let the clamps cross each other. Always set a maximum clamp value that is greater than the minimum clamp value.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
   MOTORISED POT RAMP       3
     51)MP MIN CLAMP
```

11.5.8 52)MP PRESET

Enable to set the output to the MP PRESET VALUE.

PIN	Parameter description	Range	Default
52	MOTORISED POTENTIOMETER PRESET	DISABLED ENABLED	DISABLED

720)SYSTEM RESET can connect to this parameter rather than the default connection from UIP7 if requiring an automatic preset upon start.

Refer to "17.16 CONFIGURATION / JUMPER CONNECTIONS" on page 360.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
   MOTORISED POT RAMP       3
     52)MP PRESET
```

11.5.9 53)MP PRESET VALUE

Set the output value used when MP PRESET is set to enabled.

PIN	Parameter description	Range	Default
53	MOTORISED POTENTIOMETER PRESET VALUE	±300.00%	0.00%

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
   MOTORISED POT RAMP       3
     53)MP PRESET VALUE
```

11.5.10 54)MP MEMORY BOOT-UP

Select to restore the last value of the MOP when powering up the PLX.

PIN	Parameter description	Range	Default
54	MOTORISED POTENTIOMETER MEMORY BOOT-UP	DISABLED ENABLED	DISABLED

Enabling this parameter allows the last output value of the motorised output potentiometer to be saved on power-down and restored on power-up.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
   MOTORISED POT RAMP        3
     54)MP MEMORY BOOT-UP
```

11.6 CHANGE PARAMETERS / STOP MODE RAMP

Use this menu to control the behaviour when removing START.

Refer to "Figure 46 SPEED CONTROL - block diagram" on page 161.

```
R  ENTRY MENU       LEVEL   1
R  CHANGE PARAMETERS        2
R  STOP MODE RAMP           3
  R  56)STOP RAMP TIME
     57)STOP TIME LIMIT
     58)LIVE DELAY MODE
  R  59)DROP-OUT SPEED
     60)DROP-OUT DELAY
```

Operating Function Refer to parameter 168)RUNNING MODE MON	**JOG MODE SELECT** input level	**START** input level **T33**	**JOG** input level **T32**	**RAMP** input total value	**Applied Ramp Time**	**Contactor State**
Stopped	low	low	low	reference	Stop ramp	OFF
Stopped	high	low	low	reference	Stop ramp	OFF
Running	low	high	low	reference	Run mode ramp	ON
Crawl	high	high	low	Crawl speed	Run mode ramp	ON
Jog speed 1	low	low	high	Jog speed 1	Jog/slack ramp	ON
Jog speed 2	high	low	high	Jog speed 2	Jog/slack ramp	ON
Slack 1 take-up	low	high	high	ref + slack 1	Jog/slack ramp	ON
Slack 2 take-up	high	high	high	ref + slack 2	Jog/slack ramp	ON

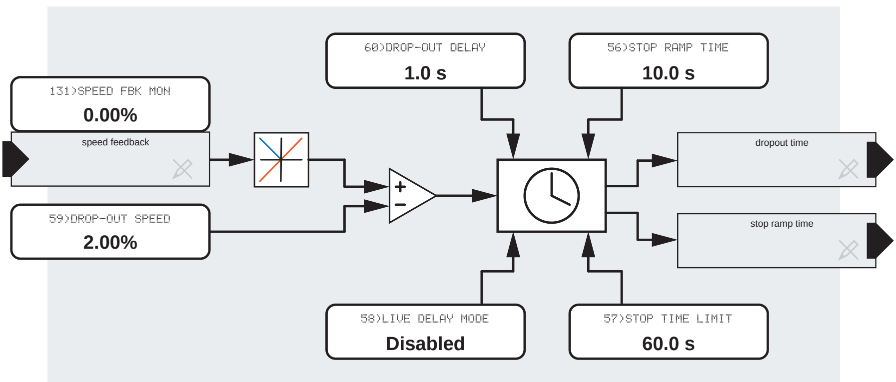


Figure 41 STOP MODE RAMP - block diagram

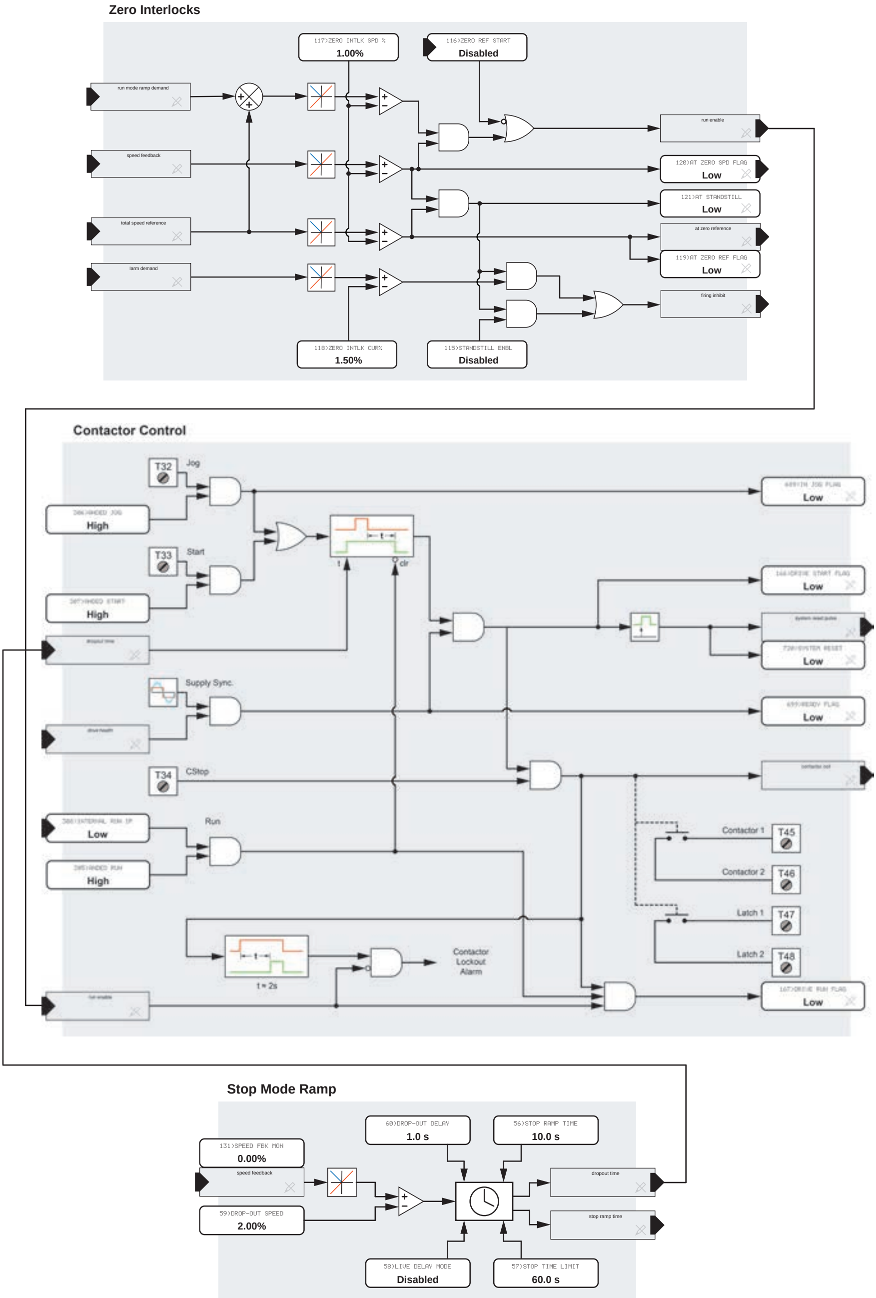


Figure 42 Contactor Control - block diagram

The following conditions must be true for the main contactor to be energised and remain energised:

1. All alarms AND supply synchronisation healthy. (699)READY FLAG).
2. CSTOP at 24 V.
   NOTE: CSTOP must be high for at least 50 ms prior to START and/or JOG going high.
3. Start AND/OR Jog high.

When the contactor has energised, the PL/X will run if the RUN input is high **and**, if enabled, the ZERO INTERLOCK is satisfied.

The contactor will de-energise after approximately 100 milliseconds if 699)READY FLAG goes low, **or** CSTOP goes low.

- If the zero interlock is enabled and requests a non-run action, then the contactor will energise for approximately two seconds, but no current will flow. The contactor will drop out if the zero reference interlock condition is not satisfied within approximately 2 seconds. The display will show CONTACTOR LOCK OUT.
- The contactor will de-energise if START and JOG are both low. In this case, the time taken for the contactor to de-energise depends on the STOP MODE RAMP when stopping from a running mode, or JOG/SLACK RAMP when stopping from a jog mode.

Note these flags are on hidden PINs:

689)IN JOG FLAG	698)HEALTHY FLAG
699)READY FLAG	714)IN SLACK FLAG
720)SYSTEM RESET pulse	

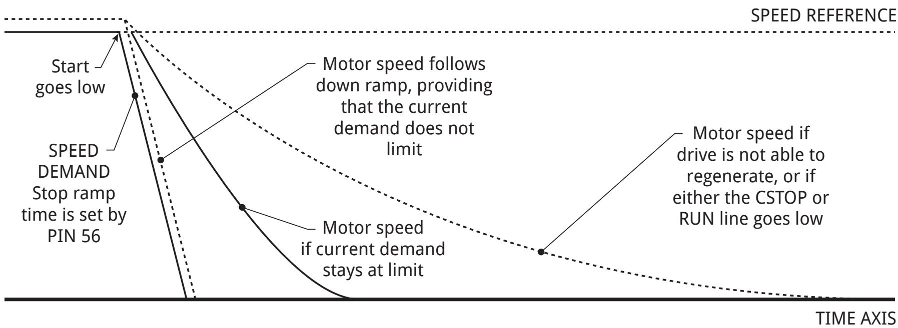


Figure 43 Speed profile when stopping

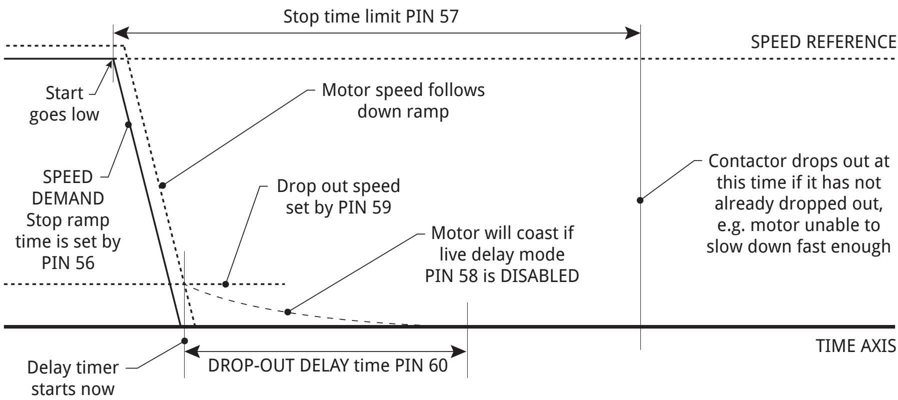


Figure 44 Contactor drop-out

If START or JOG goes high during the 60)DROP-OUT DELAY time, the contactor stays energised, and the PL/X will restart immediately. The 60)DROP-OUT DELAY timer resets to zero upon restarting, allowing for jogging without the contactor dropping in and out.

The configuration of the PL/X power terminals using L1/2/3 for stack and EL1/2/3 for field and synchronisation is very versatile, allowing for various main contactor arrangements:

1. EL1/2/3 permanently energised with contactor on L1/2/3, gives very fast starting and allows the field to remain energised. (Required for dynamic braking or to prevent condensation in cold climates).
2. EL1/2/3 and L1/2/3 energised with the main contactor allow total electrical isolation of the motor.
3. The main contactor on DC armature terminals allows for dynamic braking/isolation of the motor.
4. Use L1/2/3 at a very low voltage, e. g. using PL/X as a battery charger.

Refer to "7.3 Power wiring methods" on page 52.

11.6.1 Precise stopping

For a precise performance at the ramp endpoints, e. g. stopping, it is advantageous to RESET the SPEED LOOP integrator during the ramping process. Holding it in RESET during the ramping process delivers no undesirable integral term history to interfere with the loop at the end of the ramp.

Achieve this RESET by connecting a JUMPER from 35)RAMPING FLAG to 73)SPEED INT RESET.

Refer to "17.16 CONFIGURATION / JUMPER CONNECTIONS" on page 360.

Ensure that no small demand signals enter the speed loop by disconnecting unwanted inputs to the SPEED REFERENCE SUMMER and setting 67)SPD / CUR RF3 RATIO to zero - refer to "11.8 CHANGE PARAMETERS / SPEED CONTROL" on page 160.

Also, it may help if 74)SPD ADPT LO BRPNT is set to 0.2% and 76)LO BRPNT PRP GAIN is low (e.g. 5.00) to minimise the effects of tacho noise at the stopping point. Refer to "11.9.2 74)SPD ADPT LO BRPNT" on page 165 and "11.9.4 76)LO BRPNT PRP GAIN" on page 165.

Refer also to "11.15.7.1 Low speed performance" on page 196.

11.6.2 56)STOP RAMP TIME

Set the 100-0% down ramp time upon removal of START.

PIN	Parameter description	Range	Default
56	STOP RAMP TIME	0.1 to 600.0 seconds	10.0 seconds

A standard 4-quadrant drive can motor and brake in both forward and reverse directions. It can also stop quickly, returning mechanical rotational energy to the supply using the motor as a generator and the supply as a load.

A standard 2-quadrant drive can only motor in the forward direction and cannot regenerate when stopping.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  STOP MODE RAMP          3
   R  56)STOP RAMP TIME
```

11.6.3 57)STOP TIME LIMIT

Set the maximum time limit before contactor drop-out in Stop mode.

PIN	Parameter description	Range	Default
57	STOP TIME LIMIT	0.1 to 600.0 seconds	60.0 seconds

The Start input going low initiates the stop time limit.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  STOP MODE RAMP          3
      57)STOP TIME LIMIT
```

11.6.4 58)LIVE DELAY MODE

Enable the drive during the drop-out delay time.

PIN	Parameter description	Range	Default
58	LIVE DELAY MODE	DISABLED ENABLED	DISABLED

Use this to maintain the drive's enabled state whenever the contactor drop-out delay timer is running. For example, when an unwanted external force is trying to rotate the load or when a final shaft positioning routine is operating. Refer to "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

Refer to "11.15 CHANGE PARAMETERS / ZERO INTERLOCKS" on page 192 for details of other zero speed functions.

Changing this parameter during the drop-out delay time only affects subsequent contactor drop-outs.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  STOP MODE RAMP           3
     └ 58)LIVE DELAY MODE
```

11.6.5 59)DROP-OUT SPEED

Set the speed level at which the drop-out delay timer starts.

PIN	Parameter description	Range	Default
59	DROP-OUT SPEED	0.00 to 100.00%	2.00%

NOTE: With this parameter set to 100%, a STOP command will immediately start the drop-out delay timer. The speed level set by this parameter is symmetrical for forward and reverse rotation.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  STOP MODE RAMP           3
   R └ 59)DROP-OUT SPEED
```

11.6.6 60)DROP-OUT DELAY

Add a time delay to the drop-out command.

PIN	Parameter description	Range	Default
60	DROP-OUT DELAY	0.1 to 600.0 seconds	1.0 seconds

You can use this function to prevent frequent contactor drop-outs during jogging.

It works by adding a time delay to the function that tells the main contactor to de-energise. The time delay begins when the motor reaches the 59)DROP-OUT SPEED threshold. Restarting the PL/X before the contactor finally drops out resets the timer.

If the RUN input goes low during the stopping process, either heading for zero speed or during the delay period, the contactor will drop out straight away, causing the motor to stop.

During the timer sequence, the PL/X inhibits the drive loops to prevent the motor from making small, unwanted movements. Parameter 58)LIVE DELAY MODE can override this when a final shaft positioning routine is operating or if the system must maintain power while waiting for drop-out, e.g. for when an unwanted external force is trying to rotate the load. Refer to "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

Refer to "11.15 CHANGE PARAMETERS / ZERO INTERLOCKS" on page 192 for details of other zero speed functions.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R STOP MODE RAMP 3
60)DROP-OUT DELAY

11.7 CHANGE PARAMETERS / SPEED REF SUMMER

The block diagram below shows the signal paths for the speed loop error amplifier. There are four speed reference inputs:

- Motorised potentiometer to 62)INT SPEED REF 1.
- UIP2/T2 to 63)SPEED REF 2.
- UIP3/T3 internally connected to 64)SPEED REF3 MON.
- UIP4/T4 Run mode ramp to 65)RAMPED SPD REF 4.

Connections PIN 62 and 63 may be re-programmed.

The inputs are summed and then subjected to programmable maximum +ve and –ve clamps. The output after the clamps is the final speed reference selected during normal running, which is available to be monitored. During a stop sequence, this resets to zero at the programmed STOP rate. Refer to "11.3 CHANGE PARAMETERS / RUN MODE RAMPS" on page 131 for resetting functions.

The STOP ramp is immediately released when running is resumed. The output after this selection is the speed demand, and this is summed with negative speed feedback to produce a speed error which is then processed in the speed loop P + I error amplifier. This block's output is the current reference sent to the current control blocks during normal running.

Refer to "11.8 CHANGE PARAMETERS / SPEED CONTROL" on page 160.

```
R  ENTRY MENU     LEVEL    1
R  CHANGE PARAMETERS       2
R  SPEED REF SUMMER        3
   R  62)INT SPEED REF 1
   R  63)SPEED REF 2
   R  64)SPEED REF 3 MON
   R  65)RAMPED SPD REF 4
   R  66)SPD/CUR REF3 SIGN
   R  67)SPD/CUR RF3 RATIO
```

64)SPEED REF 3 MON is a monitor of UIP3 only when used as a speed reference and with 97)SPD BYPASS CUR EN disabled. It can be inverted and scaled, or both, if required, and is sampled rapidly to produce a maximum response. Refer to "11.10.11 97)SPD BYPASS CUR EN" on page 174.

NOTE: The STOP command overrides and disables the speed bypass mode, ensuring a controlled stop to zero speed when using the speed bypass mode.

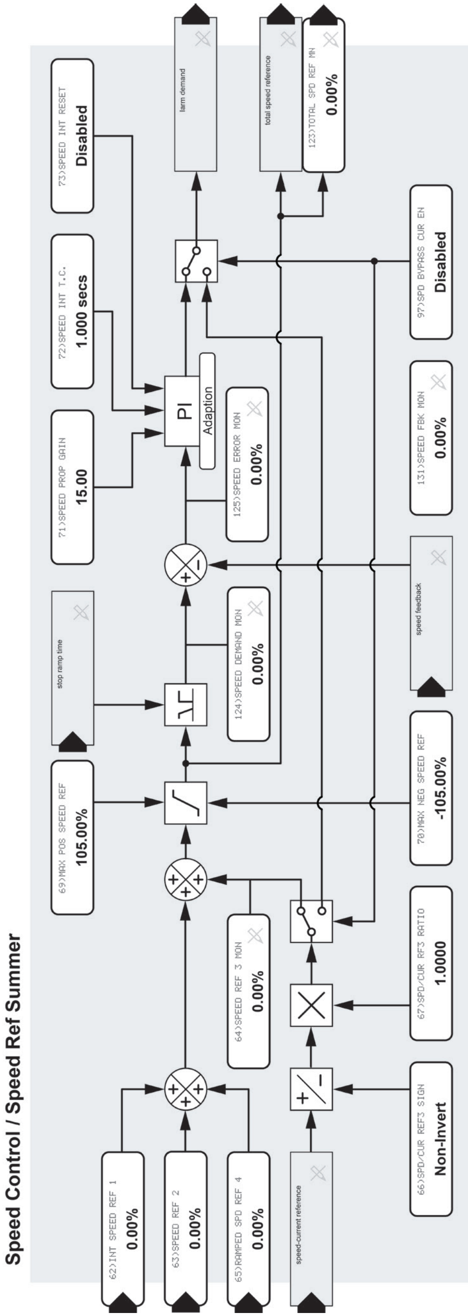


Figure 45 SPEED REF SUMMER - block diagram

11.7.1 62)INT SPEED REF 1

Set the level of internal speed reference 1.

PIN	Parameter description	Range	Default
62	INTERNAL SPEED REFERENCE 1	±105.00%	0.00%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED REF SUMMER 3
R 62)INT SPEED REF 1

11.7.2 63)SPEED REF 2

Set the level of auxiliary speed reference 2.

PIN	Parameter description	Range	Default
63	SPEED REFERENCE 2	±105.00%	0.00%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED REF SUMMER 3
R 63)SPEED REF 2

11.7.3 64)SPEED REF 3 MON

Monitor the level of speed reference 3.

PIN	Parameter description	Range
64	SPEED REFERENCE 3 MONITOR	±105.00%

64)SPEED REF 3 MON is permanently, internally connected to UIP3 (T3) and functions as a monitor for the T3 input value.

NOTE: Enabling 97)SPD BYPASS CUR EN sets this monitor to zero. Use 133)ARM CUR DEM MON.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED REF SUMMER 3
R 64)SPEED REF 3 MON

11.7.4 65)RAMPED SPD REF 4

Monitor of speed reference 4.

PIN	Parameter description	Range	Default
65	RAMPED SPEED REFERENCE 4	±105.00%	0.00%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED REF SUMMER 3
R 65)RAMPED SPEED REF 4

11.7.5 66)SPD/CUR REF3 SIGN

Invert the speed/current reference 3.

PIN	Parameter description	Range	Default
66	SPEED/CURRENT REFERENCE 3 SIGN	INVERT NON-INVERT	NON-INVERT

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED REF SUMMER 3
R 66)SPD/CUR REF3 SIGN

11.7.6 67)SPD/CUR REF3 RATIO

Set a scaling factor for speed/current reference 3.

PIN	Parameter description	Range	Default
67	SPEED/CURRENT REFERENCE 3 RATIO	±3.0000	1.0000

The internal connection from UIP3 to 64)SPEED REF 3 MON is permanent. However, 64)SPEED REF 3 MON may be disconnected from the SPEED REF SUMMER by setting 67)SPD / CUR RF3 RATIO to 0.0000.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED REF SUMMER 3
R 67)SPD/CUR REF3 RATIO

11.8 CHANGE PARAMETERS / SPEED CONTROL

Parameter adjustment of the speed loop error amplifier is available via this menu and the SPEED PI ADAPTION sub-menu.

The SPEED CONTROL menu refers to the block diagram below, starting after the second summing junction:

The summed value of all the references is subject to a maximum +ve and -ve clamp. The stop mode ramp block then superimposes a ramp to zero at a programmed rate on the prevailing input signal during a stop command.

When a run command is received, the output immediately assumes the level then prevailing at the input. This level will normally also be zero, providing the run mode ramp block has also been reset. The signal is then compared with the speed feedback, and processed by the speed loop error amplifier.

The simple PI gain and time constants are adjustable in this menu. Go to the SPEED PI ADAPTION sub-menu to refine them further. The signal then output from the error amplifier represents the current reference.

The speed bypass change-over switch then selects this current reference for output. However, if the speed bypass mode is enabled, then input reference 3 is selected.

NOTE: The default values in this menu are suitable for tacho or encoder feedback. AVF feedback usually contains more ripple than tacho or encoder feedback, so it is advisable to reduce the SPEED CONTROL loop gains whenever AVF or ENCODER + ARM VOLTS feedback is selected. Refer to "11.8.3 71)SPEED PROP GAIN" on page 162.

In the case of AVF, we suggest the values for the following parameters are changed as follows:

- "11.8.3 71)SPEED PROP GAIN" on page 162 set to 7.00.
- "11.9.7 79)SPD ADAPT ENABLE" on page 166 set to DISABLED.

These are the suggested starting points for smooth, responsive control. However, it may be possible to make further improvements with experimentation.

```
R  ENTRY MENU       LEVEL   1
R  CHANGE PARAMETERS        2
R  SPEED CONTROL            3
   R  69)MAX POS SPEED REF
   R  70)MAX NEG SPEED REF
   R  71)SPEED PROP GAIN
   R  72)SPEED INT T.C.
      73)SPEED INT RESET
      SPEED PI ADAPTION     4
```

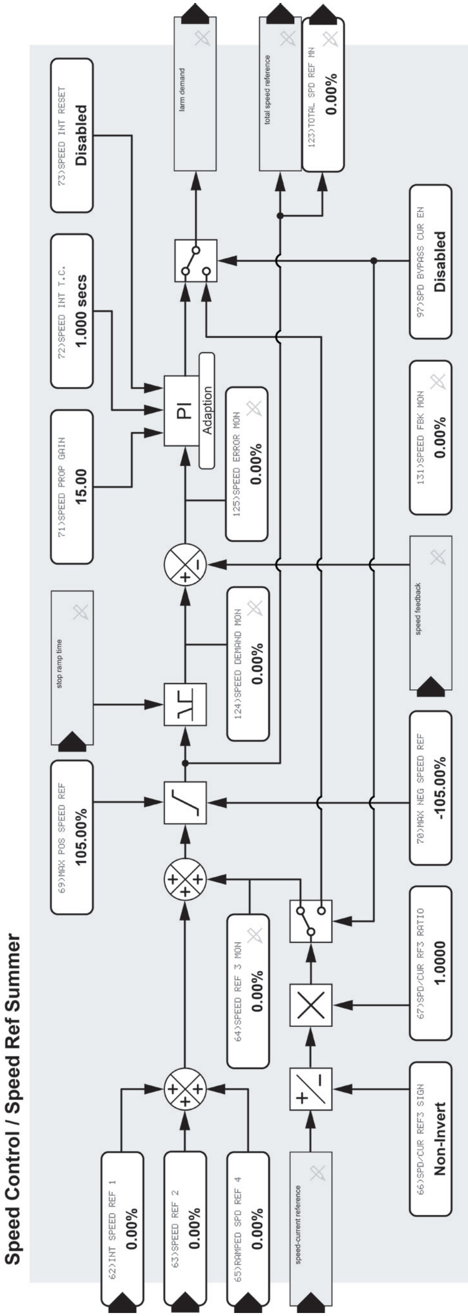


Figure 46 SPEED CONTROL - block diagram

11.8.1 69)MAX POS SPEED REF

Set the positive limit level of total speed reference.

PIN	Parameter description	Range	Default
69	MAXIMUM POSITIVE SPEED REFERENCE	0.00 to +105.00%	105.00%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED CONTROL 3
R 69)MAX POS SPEED REF

11.8.2 70)MAX NEG SPEED REF

Set the negative limit level of total speed reference.

PIN	Parameter description	Range	Default
70	MAXIMUM NEGATIVE SPEED REFERENCE	0.00 to -105.00%	-105.00%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED CONTROL 3
R 70)MAX NEG SPEED REF

11.8.3 71)SPEED PROP GAIN

Set the proportional gain of the speed loop error amplifier.

PIN	Parameter description	Range	Default
71	SPEED PROPORTIONAL GAIN	0.00 to 200.00	15.00

Increase proportional gain to improve the response time. However, excessive values may cause instability.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED CONTROL 3
R 71)SPEED PROP GAIN

11.8.4 72)SPEED INT T.C.

Set the integral time constant of the speed loop error amplifier.

PIN	Parameter description	Range	Default
72	SPEED INTEGRAL TIME CONSTANT	0.001 to 30.000 seconds	1.000 seconds

Match this to the mechanical time constant of the motor/load combination. Generally, an increased integral time will slow the response.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED CONTROL 3
R 72)SPEED INT T.C.

11.8.5 73)SPEED INT RESET

Enable to reset the integrator.

PIN	Parameter description	Range	Default
73	SPEED INTEGRATOR RESET	DISABLED ENABLED	DISABLED

Set to ENABLED to reset the integrator, leaving only the proportional gain element of the speed loop amplifier active.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R SPEED CONTROL 3
73)SPEED INT RESET

11.9 CHANGE PARAMETERS / SPEED CONTROL / SPEED PI ADAPTION

You can modify the gains of the proportional and integral terms set in the SPEED CONTROL menu.

In this menu, you can enter the low to high values of gain change to be applied linearly between selectable low and high breakpoints as a percentage of the speed loop error provided by the SPEED CONTROL menu. (The breakpoints work symmetrically for each polarity of error.)

The low breakpoint is the starting level for gain changing, and the high breakpoint is the finishing level:

- Below the low breakpoint, the terms are set in this sub-menu by parameters 76)LOW BRPT PRP GAIN and 77)LOW BRPT INT T.C.
- Above the high breakpoint, the terms are set in the SPEED CONTROL menu by parameters 71)SPEED PROP GAIN and 72)SPEED INT T.C.

The most frequently encountered requirement is for the gain term of the speed loop error amplifier to be high for large speed errors and low for small.

A decreasing gain with error is also possible by choosing appropriate term values in this menu and the SPEED CONTROL menu.

11.9.1 Using small speed inputs

Applications requiring precise control at very low speeds, e.g. positioning, may function better with SPEED PI ADAPTION disabled as default settings deliver low gain for small errors giving smooth running at speed. Alternatively, modify the parameters to provide a higher gain for small errors- refer to "11.15.7.1 Low speed performance" on page 196.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	SPEED CONTROL	3
	SPEED PI ADAPTION	4

74)SPD ADPT LO BRPNT
75)SPD ADPT HI BRPNT
76)LO BRPNT PRP GAIN
77)LO BRPNT INT T.C.
78)INT % DURING RAMP
79)SPD ADAPT ENABLE

When enabled by parameter 79)SPD ADAPT ENABLE, the default values in this SPEED PI ADAPTION sub-menu are:

Proportional gain:
5 for errors below 1.00%
15 for errors above 2.00%

Chosen as a starting point, this results in a linear change from 5 to 15 between 1.00% and 2.00%. These default settings will deliver lower gain with low error to give smooth running at speed.

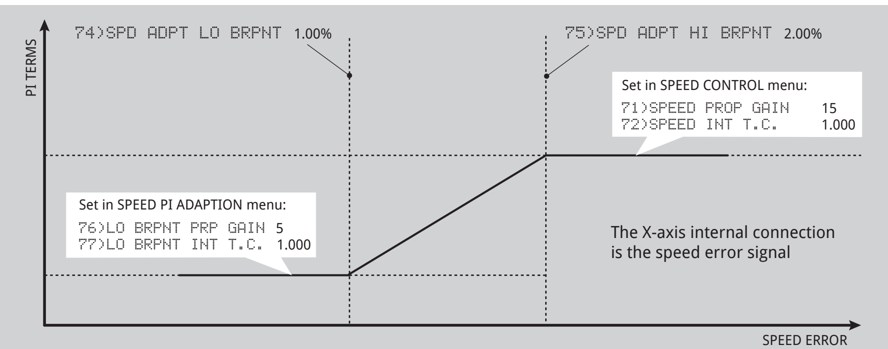


Figure 47 Graph showing adaption profile for default values

11.9.2 74)SPD ADPT LO BRPNT

Set the low breakpoint for the commencement of gain change.

PIN	Parameter description	Range	Default
74	SPEED ADAPTION LOW BREAKPOINT	0.00 to 100.00%	1.00%

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  SPEED CONTROL            3
   SPEED PI ADAPTION        4
     74)SPD ADPT LO BRPNT
```

11.9.3 75)SPD ADPT HI BRPNT

Set the high breakpoint for the end of linear gain change.

PIN	Parameter description	Range	Default
75	SPEED ADAPTION HIGH BREAKPOINT	0.00 to 100.00%	2.00%

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  SPEED CONTROL            3
   SPEED PI ADAPTION        4
     75)SPD ADPT HI BRPNT
```

11.9.4 76)LO BRPNT PRP GAIN

Set the proportional gain of the speed loop error amplifier below the low breakpoint.

PIN	Parameter description	Range	Default
76	LOW BREAK PROPORTIONAL GAIN	0.00 to 200.00	5.00

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  SPEED CONTROL            3
   SPEED PI ADAPTION        4
    76)LO BRPNT PRP GAIN
```

11.9.5 77)LO BRPNT INT T.C.

Set the integral time constant below the low breakpoint.

PIN	Parameter description	Range	Default
77	LOW BREAKPOINT INTEGRAL TIME CONSTANT	0.001 to 30.000 seconds	1.000 seconds

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  SPEED CONTROL            3
   SPEED PI ADAPTION        4
     77)LO BRPNT INT T.C.
```

11.9.6 78)INT % DURING RAMP

Set the integral time constant % scaler if RAMPING flag is high.

PIN	Parameter description	Range	Default
78	INTEGRAL % DURING RAMP	0.00 to 100.00%	100.00%

This parameter does not reset the integrator but merely alters the % of integration.

Refer also to "11.6.1 Precise stopping" on page 152.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  SPEED CONTROL            3
   SPEED PI ADAPTION        4
     78)INT % DURING RAMP
```

11.9.7 79)SPD ADAPT ENABLE

Enable the mode that varies the terms between breakpoints.

PIN	Parameter description	Range	Default
79	SPEED ADAPTION ENABLE	DISABLED ENABLED	DISABLED

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  SPEED CONTROL            3
   SPEED PI ADAPTION        4
     79)SPD ADAPT ENABLE
```

11.10 CHANGE PARAMETERS / CURRENT CONTROL

The current control menu looks complex but is not too difficult to understand when considered as separate blocks.

Refer to "Figure 48 CURRENT CONTROL: block diagram" on page 168.

The current control loop gets its current reference from the output of the speed loop error amplifier.

The reference enters the current control section and is subject to a series of four clamps:

1. 3)CURRENT LIMIT(%). This provides the absolute limits of overload. (Refer to "11.1 CHANGE PARAMETERS/CALIBRATION" on page 114).
2. CURRENT OVERLOAD. This sub-menu allows the PL/X to modify the current overload actively. The overload reduction rate is adjustable. After overload, the load must return below the target level for an equivalent time to re-enable the overload capability.
3. I DYNAMIC PROFILE. Use this sub-menu to protect motors with problems commutating current at high speeds in field weakening mode of operation. This function allows the setting of breakpoints that profile the current according to the motor speed.
4. 89)UPPER CUR CLAMP and 90)LOWER CUR CLAMP. These clamps adjust the current limits from the external signals. They accept a single positive input and produce a scaled bipolar clamp or separate positive and negative inputs for the upper clamp and lower clamp. Scaling is achievable by a master current scaler.

The four clamps operate such that the lowest has priority. The actual prevailing clamp level is available as a diagnostic for +ve and –ve current.

The output of the clamping stage becomes the Current Demand Input that the PL/X compares to the armature current feedback in a P + I error amplifier. The control terms and a non-linear adaptive algorithm are available for programming. There is also the facility for an improved small-signal current response. Refer to "17.19.2 678) MAX CUR RESPONSE" on page 365.

The output becomes the phase angle demand for the thyristor stack.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CURRENT CONTROL	3
R	81)CUR CLAMP SCALER	
	CURRENT OVERLOAD	4
	I DYNAMIC PROFILE	4
	88)DUAL I CLAMP ENBL	
	89)UPPER CUR CLAMP	
	90)LOWER CUR CLAMP	
	91)EXTRA CUR REF	
	92)AUTOTUNE ENABLE	
R	93)CUR PROP GAIN	
R	94)CUR INT GAIN	
R	95)CUR DISCONTINUITY	
R	96)4-QUADRANT MODE	
	97)SPD BYPASS CUR EN	
	98)ARM FIR.FRNT STOP	

IMPORTANT:

Repeat the AUTOTUNE routine if you change your supply voltage, current calibration, or motor type. This will:

- **Re-adjust** 93)CUR PROP GAIN
- **Re-adjust** 94)CUR INT GAIN
- **Re-adjust** 95)CUR DISCONTINUITY

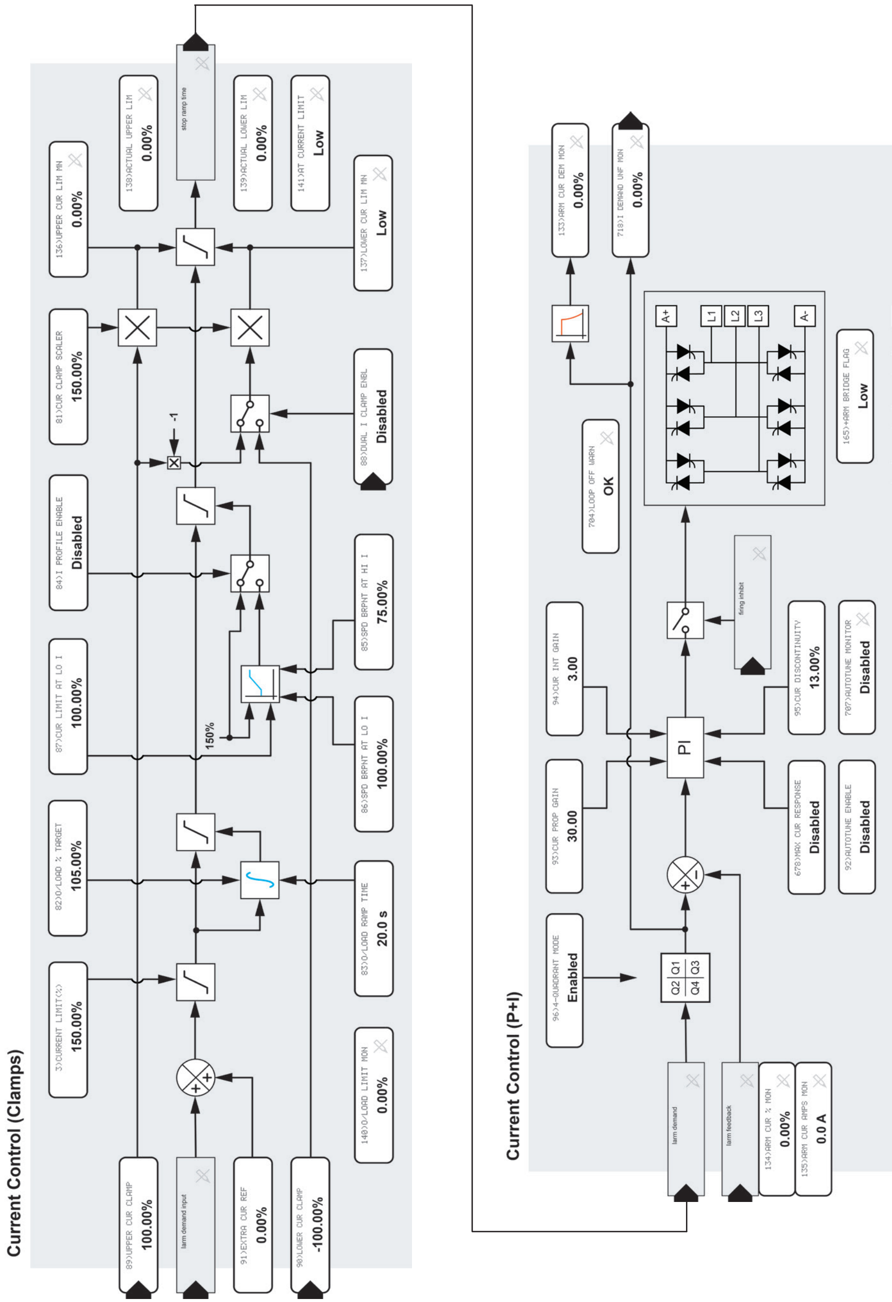


Figure 48 CURRENT CONTROL: block diagram

11.10.1 81)CUR CLAMP SCALER

Set the clamp scaling value for the upper/lower clamps.

PIN	Parameter description	Range	Default
81	CURRENT CLAMP SCALER	0.00 to 150.00%	150.00%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
R 81)CUR CLAMP SCALER

11.10.2 88)DUAL I CLAMP ENBL

Enable the upper and lower dual clamps to be independent.

PIN	Parameter description	Range	Default
88	DUAL CURRENT CLAMP ENABLE	DISABLED ENABLED	DISABLED

If 88)DUAL I CLAMP ENBL is disabled, then 89) UPPER CUR CLAMP produces symmetrical positive and negative current limits in conjunction with 81)CUR CLAMP SCALER.

If 88)DUAL I CLAMP ENBL (default terminal T21) is enabled, then 89)UPPER CUR CLAMP controls the positive and 90)LOWER CURRENT CLAMP controls the negative current limits in conjunction with 81)CUR CLAMP SCALER.

Each clamp can work in each polarity, provided the upper is algebraically above the lower. However:

- With the upper clamp set to negative and the lower clamp set to positive, the result is 0.00%.
- If the value for the lower clamp is a higher positive number than the upper clamp in the positive region, then the upper clamp behaves as a current demand.
- If the value for the upper clamp is a more negative number than the lower clamp in the negative region, then the lower clamp behaves as a current demand.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
88)DUAL I CLAMP ENBL

11.10.3 89)UPPER CUR CLAMP

Modify the upper current limit percentage.

PIN	Parameter description	Range	Default
89	UPPER CURRENT CLAMP	±100.00%	+100.00%

The product of this parameter and 81)CUR CLAMP SCALER sets the limit.

With the upper clamp set to negative and the lower clamp set to positive, the result is 0.00%.

```
R  ENTRY MENU        LEVEL    1
R  CHANGE PARAMETERS          2
R  CURRENT CONTROL            3
      89)UPPER CUR CLAMP
```

11.10.4 90)LOWER CUR CLAMP

Modify the lower current limit percentage.

PIN	Parameter description	Range	Default
90	LOWER CURRENT CLAMP	±100.00%	-100.00%

The product of this parameter and 81)CUR CLAMP SCALER sets the limit.

With the upper clamp set to negative and the lower clamp set to positive, the result is 0.00%.

```
R  ENTRY MENU        LEVEL    1
R  CHANGE PARAMETERS          2
R  CURRENT CONTROL            3
      90)LOWER CUR CLAMP
```

11.10.5 91)EXTRA CUR REF

Set the value of an extra current reference input.

PIN	Parameter description	Range	Default
91	EXTRA CURRENT REFERENCE	±300.00%	0.00%

```
R  ENTRY MENU        LEVEL    1
R  CHANGE PARAMETERS          2
R  CURRENT CONTROL            3
      91)EXTRA CUR REF
```

11.10.6 92)AUTOTUNE ENABLE

Enable the Autotune routine.

PIN	Parameter description	Range	Default
92	AUTOTUNE ENABLE	DISABLED ENABLED	DISABLED

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
92)AUTOTUNE ENABLE

When ENABLED, the Autotune routine operates once the main contactor energises and the PL/X runs. Typically, Autotuning can take from a few seconds to one minute to complete.

- Autotune is a static test.
- There is no need to disconnect the motor from the load.
- The motor field is automatically disabled.
- If the motor back emf is detected to be above a certain level implying excessive rotation, Autotune aborts.
- Completing the Autotune routine forces the main contactor to drop-out, and AUTOTUNE ENABLE to reset to DISABLED.

After the Autotune routine completes, save the new parameter settings using the PARAMETER SAVE menu.

NOTE: The Autotune routine makes a one-off adjustment to the current loop error amplifier terms to achieve optimum performance.

There are two stages to the Autotune routine:

Stage 1: The current automatically increases in the positive until it becomes continuous.

Stage 2: The current demand is automatically perturbated in the continuous current region while the current loop response is optimised.

If the routine is interrupted by a power loss or alarm then it is aborted, and the existing parameter values are left intact.

If the motor has a short time constant, the armature current may remain discontinuous, even at a current above 100%. There are two possible outcomes:

1. The Autotune will find that the current never goes continuous up to 150% in Stage 1. It abandons Stage 2. The Autotune automatically sets the following parameters:
   93)CUR PROP GAIN is set to 1.00.
   94)CUR INT GAIN is set to 7.00.
   95)CURRENT DISCONTINUITY is set to 0.00%.

Repeat the AUTOTUNE routine if you change your supply voltage, current calibration, or motor type.

IMPORTANT:
If the maximum motor armature current rating is less than approximately 50% of the maximum model rating, the AUTOTUNE results may not be optimum.

There are two ways of overcoming this:

1. Set the current loop control terms manually. Refer to "11.10.9 95) CUR DISCONTINUITY" on page 173.

or

2. Re-burden the PL/X using the 50% / 100% burden jumper on the power board. Refer to "17.19.3 680)Iarm BURDEN OHMS" on page 365.

2. The Autotune will find that the current goes continuous at a high level in Stage 1. During Stage 2, the induced current demand perturbations cause a current overload to occur, and the Autotune then aborts, leaving the existing parameter values intact. In this case, we suggest setting the following parameters manually:

   93)CUR PROP GAIN is set to 1.00.
   94)CUR INT GAIN is set to 7.00.
   95)CURRENT DISCONTINUITY is set to 0.00%.

   Although this is a good starting point, the current loop response may be slow when the armature current is high (above the discontinuous current level).

NOTE: There is a hidden PIN which contains 707) AUTOTUNE MONITOR flag (High for start).

Refer to Page 238 - CANNOT AUTOTUNE, and Page 239 - AUTOTUNE QUIT.

11.10.7 93)CUR PROP GAIN

Set the proportional gain of the current error amplifier.

PIN	Parameter description	Range	Default
93	CURRENT PROPORTIONAL GAIN	0.00 to 200.00	30.00

Performing an Autotune will set the Proportional Gain. You can increase the proportional gain to improve response. However, too much may cause instability.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
R 93)CUR PROP GAIN

11.10.8 94)CUR INT GAIN

Set the integral gain of the current error amplifier.

PIN	Parameter description	Range	Default
94	CURRENT INTEGRAL GAIN	0.00 to 200.00	3.00

Performing an Autotune will set the Integral Gain. Generally, an increased integral gain will improve the response.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
R 94)CUR INT GAIN

11.10.9 95)CUR DISCONTINUITY

Set the discontinuous current boundary level of the motor.

PIN	Parameter description	Range	Default
95	CURRENT DISCONTINUITY	0.00 to 200.00%	13.00%

Performing an Autotune will set this parameter. The motor/supply combination will possess a property called the discontinuous-continuous current point that is important for the optimum tuning of the current loop.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  CURRENT CONTROL         3
R  └ 95)CUR DISCONTINUITY
```

11.10.9.1 Setting the current loop control terms manually

As the current increases, the pulses in the waveform join together and become continuous. At this point, the natural gain of the system changes dramatically. If the PL/X knows this point, it can automatically compensate for the gain change and produce an optimum response.

Here you are entering the current level % of rated motor current at which it occurs. If you change your supply voltage, current calibration, or motor type, you must adjust the three values for PINs 93/94/95 accordingly.

To observe the current signal, you must use the signal test pin we provide on the PL/X and a quality storage oscilloscope.

Refer to "12.3.2 134)ARM CUR % MON" on page 210 to monitor the percentage value at the boundary.

Refer to the table below to determine the other current loop control terms.

134)ARM CUR % MON at boundary point	Suggested value for 93)CUR PROP GAIN	Suggested value for 94)CUR INT GAIN
10.00%	40.00	4.00
20.00%	20.00	2.00
40.00%	10.00	1.00
60.00%	10.00	1.00
80.00%	10.00	1.00
100.00%	10.00	1.00

11.10.10 96)4-QUADRANT MODE

Allow models with regenerative capabilities to be 2-quadrant.

PIN	Parameter description	Range	Default
96	4-QUADRANT MODE	DISABLED ENABLED	ENABLED

If 96)4-QUADRANT MODE is ENABLED, then the regenerative capability will be determined by the model.

Refer to "10 Technical specifications" on page 91.

R ENTRY MENU LEVEL 1

R CHANGE PARAMETERS 2

R CURRENT CONTROL 3

R 96)4-QUADRANT MODE

11.10.11 97)SPD BYPASS CUR EN

Enable a current reference input to by-pass the speed loop.

PIN	Parameter description	Range	Default
97	SPEED BYPASS CURRENT ENABLE	DISABLED ENABLED	DISABLED

There is an internal connection from T3 via UIP3 to 64)SPEED REF3 MON.

This parameter determines whether T3 is a speed or current reference. If ENABLED, the speed loop output is automatically disconnected.

NOTE: Enabling this parameter sets 64)SPEED REF 3 MON to zero. Use 133)ARM CUR DEM MON.

NOTE: The summing junction for this input is shown in "Figure 46 SPEED CONTROL - block diagram" on page 161.

R ENTRY MENU LEVEL 1

R CHANGE PARAMETERS 2

R CURRENT CONTROL 3

97)SPD BYPASS CUR EN

11.10.12 98)ARM FIR.FRNT STOP

Set the the minimum firing delay.

PIN	Parameter description	Range	Default
98	ARMATURE FIRING FRONT STOP	0 - 15000	624

Scaling: 16384 = 210 degrees, or each bit is 0.012817°
(624 = 8°).
(Available for software releases >V6.13).

R ENTRY MENU LEVEL 1

R CHANGE PARAMETERS 2

R CURRENT CONTROL 3

98)ARM FIR.FRNT STOP

11.11 CHANGE PARAMETERS / CURRENT CONTROL / CURRENT OVERLOAD

The CURRENT OVERLOAD menu allows you to set the current % target limit.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  CURRENT CONTROL         3
   CURRENT OVERLOAD        4
     ├ 82)O/LOAD % TARGET
     └ 83)O/LOAD RAMP TIME
```

It is usually the full-load current of the motor.

Having the facility to set this parameter independently of 2)RATED ARM AMPS allows further flexibility.

This block allows for load currents of up to 150% of 2)RATED ARM AMPS. (If any other lower limits are prevailing, they will, of course, determine the current limit). Refer to "Figure 48 CURRENT CONTROL: block diagram" on page 168.

The table below shows maximum overloads according to full load motor current, as a % of 2)RATED ARM AMPS.

Refer to "11.11.1.1 Achieving overloads >150%" on page 177.

<table>
<tr><th>Full load motor current [82)O/LOAD % TARGET] as a % of 2)RATED ARM AMPS</th><th>Maximum available</th><th>Maximum overload % available (with respect to full load motor current)</th></tr>
<tr><td>100</td><td>150%</td><td>150 / 100 = 150%</td></tr>
<tr><td>90%</td><td>150%</td><td>150 / 90 = 166%</td></tr>
<tr><td>80%</td><td>150%</td><td>150 / 80 = 187%</td></tr>
<tr><td>75%</td><td>150%</td><td>150 / 75 = 200%</td></tr>
<tr><td>60%</td><td>150%</td><td>150 / 60 = 250%</td></tr>
<tr><td>50%</td><td>150%</td><td>150 / 50 = 300%</td></tr>
<tr><td>37.5%</td><td>150%</td><td>150 / 37.5 = 400%</td></tr>
<tr><td>30%</td><td>150%</td><td>150 / 30 = 500%</td></tr>
<tr><td colspan="3">There are two overcurrent trip mechanisms:
1. A software threshold which is set at 300% of 2)RATED ARM AMPS.
2. A hardware threshold which activates in excess of 150% of the maximum PL/X model rating.
Autotune with 2)RATED ARM AMPS set to its final value. See the example below for a 9 A motor:
Set 8.1.8.2 STALL TRIP MENU / Stall current level PIN 179 to a value less than 82)O/LOAD % TARGET.
If 3)CURRENT LIMIT(%) or 82)O/LOAD % TARGET level is set to 0%, then no current will flow.</td></tr>
</table>

Table 11 Maximum Overload Table

11.11.1 82)O/LOAD % TARGET

Set the current limit target level after excessive load.

PIN	Parameter description	Range	Default
82	OVERLOAD % TARGET	0.00 to 105.00%	105.00%

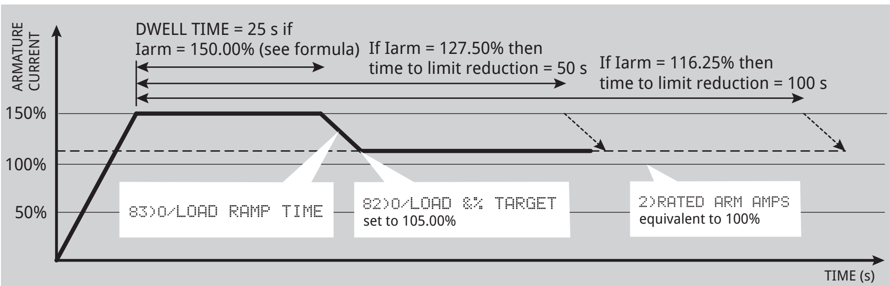
R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
CURRENT OVERLOAD 4
82)O/LOAD % TARGET

An internal integrator with a finite capacity fills up when the armature current exceeds PIN 82 (82)O/LOAD % TARGET). It empties for armature current less than PIN 82. The unused capacity of the integrator determines the time remaining before automatic reduction of the current limit commences. A 150% limit is available until the integrator becomes full. Then the current limit is linearly reduced in this block from 150% towards PIN 82. **NOTE:** The limit reduction always starts from 150% and ramps down towards 82)O/LOAD % TARGET. Refer to "11.11.2 83)O/LOAD RAMP TIME" on page 178.

If the load continues to require current above the target level for PIN 82, then it is limited to the PIN 82 level. (**NOTE**: This implies the speed loop is not getting the current demanded, hence, there will be a speed error).

If the load required subsequently falls beneath the PIN 82 target level, then the internal integrator starts to de-integrate back to its empty state (ready for another overload). The overload capacity available will begin to increase. However, full de-integration is required before the maximum overload capacity is available once more.

NOTE: For small overloads, it may take a long time for the integrator to fill. However, filling the 150% limit will quickly result in the current limit reducing to the PIN 82 level.



Formula for calculating Dwell time for a given PIN82 Overload % target and PIN138 prevailing Current Limit%:
DWELL TIME = (150%-PIN82%) x 25/(I limit%-PIN82%) in seconds. (Assuming current remains at the limit).

Formula for calculating Current limit setting required for a given PIN82 Overload % target and DWELL TIME:
Current limit% required = PIN82% + (150% - PIN82%) x 25/DWELL TIME secs

Formula for calculating PIN82 Overload % target required for a given Current limit% and DWELL TIME:
PIN82 Overload % target = (DWELL TIME secs x Current limit% - 3750) / (DWELL TIME secs - 25)

Figure 49 O/LOAD % TARGET set to 105%

11.11.1.1 Achieving overloads >150%

Use this to provide higher overload percentages on motors with a smaller rating than the PL/X model. The example below shows how parameter 82)O / LOAD % TARGET delivers a 200% overload for a 9 A motor using a 12 A PL/X5:

1. For the PL/X5, a setting of 100% in 2)RATED ARM AMPS represents 12 A, the drive's full-load motor current. Usually, you set a value suitable for the motor - in this case, 75% for a 9 A motor. But for this application, we deliberately set it to 12 A.
2. Set parameter 82)O / LOAD % TARGET to a level that is equivalent to the motor's full load motor current of 9 A. In this case, set it to 75% (of 12 A, as set in 2)RATED ARM AMPS).
3. 18 A (the 150% maximum available limit for the 12 A PL/X5) is now double the 82)O / LOAD % TARGET (75%) and so provides a 200% overload capability with respect to the full load motor current (9 A).
4. Perform an Autotune with 2)RATED ARM AMPS set at 12 A. Refer to "11.10.6 92) AUTOTUNE ENABLE" on page 171.
5. Set 179)STALL CUR LEVEL **to a value less than** 82)O / LOAD % TARGET, currently 75%. The default for this parameter is 95%, so in this case, set it to 71.25%. Refer to "13.2.2 179)STALL CUR LEVEL" on page 233.

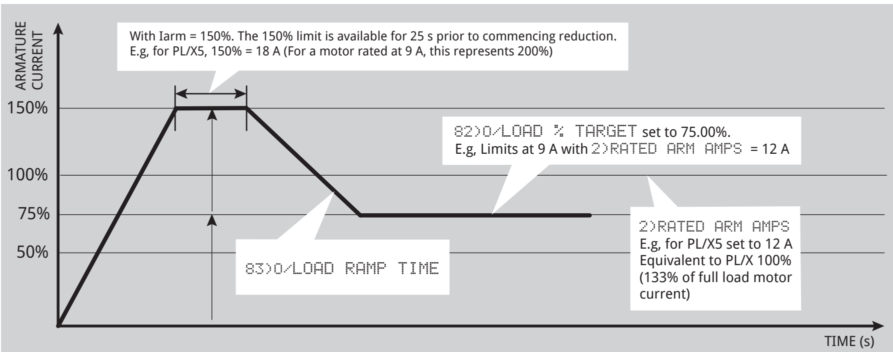


Figure 50 How to achieve overloads greater than 150%

11.11.2 83)O/LOAD RAMP TIME

Set the time taken to reduce the current limit by 100%.

PIN	Parameter description	Range	Default
83	OVERLOAD RAMP TIME	0.1 to 20.0 seconds	20.0 seconds

For example, if:

Current Limit = 150%

83)O/LOAD RAMP TIME = 20 seconds

82)O/LOAD % TARGET = 105%

Then ramp time to target = 9 seconds (i.e. 45% [150 minus 105] of 20 seconds).

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CURRENT CONTROL	3
	CURRENT OVERLOAD	4
	83)O/LOAD RAMP TIME	

11.12 CHANGE PARAMETERS / CURRENT CONTROL / I DYNAMIC PROFILE

NOTE: This function works for rotation in both directions.

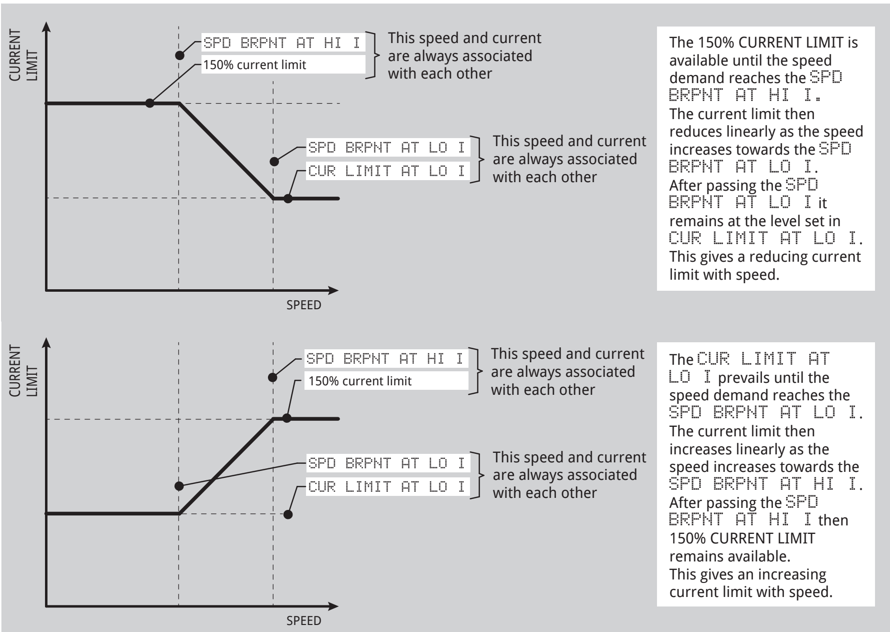
Use this clamp to change the current limit according to speed. For example:

1. To protect motors that have problems commutating current at high speeds in field weakening mode of operation.
2. To prevent motors overheating at low speeds.

The calculation uses an upper current limit with a fixed value of 150%.

- The setting for 3)CURRENT LIMIT(%) will prevail if it is less than 150%.
- If the limits in the other current limit blocks are lower, then they will prevail.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
I DYNAMIC PROFILE 4
- 84)I PROFILE ENABLE
- 85)SPD BRPNT AT HI I
- 86)SPD BRPNT AT LO I
- 87)CUR LIMIT AT LO I



NOTE: You can set the SPEED breakpoints so that the profile starts low and goes high if required. If you try to bring the two speed breakpoints closer than within 10% of each other, then the higher speed breakpoint is internally assumed to be equal to the lower speed breakpoint plus 10%.

Figure 51 I DYNAMIC PROFILE

11.12.1 84)I PROFILE ENABLE

Enable the dynamic profile function.

PIN	Parameter description	Range	Default
84	CURRENT PROFILE ENABLE	DISABLED ENABLED	DISABLED

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CURRENT CONTROL	3
	I DYNAMIC PROFILE	4
	84)I PROFILE ENABLE	

11.12.2 85)SPD BRPNT AT HI I

Set the speed breakpoint for 150% CURRENT LIMIT.

PIN	Parameter description	Range	Default
85	SPEED BREAKPOINT AT HIGH CURRENT	0.00 to 105.00%	75.00%

NOTE: The setting for 3)CURRENT LIMIT(%) set in the CALIBRATION menu will prevail. It is the normal current limit setting. However, the profile calculation starts or ends at 150%.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CURRENT CONTROL	3
	I DYNAMIC PROFILE	4
	85)SPD BRPNT AT HI I	

11.12.3 86)SPD BRPNT AT LO I

Set the speed breakpoint for 87)CUR LIMIT AT LO I.

PIN	Parameter description	Range	Default
86	SPEED BREAKPOINT AT LOW CURRENT	0.00 to 105.00%	100.00%

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	CURRENT CONTROL	3
	I DYNAMIC PROFILE	4
	86)SPD BRPNT AT LO I	

11.12.4 87)CUR LIMIT AT LO I

Set the current limit prevailing at 86)SPEED BRPNT AT LO I.

PIN	Parameter description	Range	Default
87	CURRENT LIMIT AT LOW CURRENT	0.00 to 150.00%	100.00%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R CURRENT CONTROL 3
I DYNAMIC PROFILE 4
87)CUR LIMIT AT LO I

11.13 CHANGE PARAMETERS / FIELD CONTROL

The field controller within the PL/X consists of a single-phase, half-controlled thyristor bridge with a flywheel path. Terminals EL2 and EL3 deliver the AC supply to the bridge, and the rectified output appears at terminals F+ and F-. The supply can be anywhere in the range of 100 to 500 Vac but must be at least 1.1 times the maximum field output voltage you require. Note that the supply to EL2 and EL3 also determines the phase rotation of the local supply.

The purpose of the field winding in a motor is to provide flux that intersects the armature windings. The flux generated is a function of the CURRENT flowing in the field coils. When considering the set-up of the field output, you can use one of two kinds of control strategy:

1. **Voltage Output Clamp** with higher current limit protection.
2. **Current Control** with higher voltage clamp protection.

Motor field windings are usually very inductive, with a long time constant resulting in a smooth current in the field. Therefore, the field current reading is reasonably accurate irrespective of when sampled.

However, some motor field winding time constants are shorter than usual, resulting in up to 20% ripple. In this case, the PL/X may sample the current at a non-ideal point in the cycle, which results in a slightly incorrect control level (usually no more than a few per cent). If required, you can normalise the field current to a proper level using the field current trim (refer to "11.1.10 15)FIELD CUR FB TRIM" on page 123) or re-calibrate the field current to overcome the inaccuracy.

Voltage Output Clamp

This open-loop setting of the field bridge firing angle allows the DC output voltage setting to be between 0 and 90% of the incoming supply voltage. For example, for an AC supply of 400 V, the 90% output voltage is 360 Vdc. Note that if the AC supply varies, then the field output voltage will vary in proportion. Also, if the field resistance changes, then the resulting output current will change.

If you know the rated field voltage you can set the 100)FIELD VOLTS OP % clamp parameter value in this menu. Adjust the field output voltage to the data plate value as a percentage of the applied AC supply.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	FIELD CONTROL	3
R	99)FIELD ENABLE	
R	100)FIELD VOLTS OP %	
	101)FIELD PROP GAIN	
	102)FIELD INT GAIN	
	FLD WEAKENING MENU	4
	111)STANDBY FLD ENBL	
	112)STANDBY FLD CUR	
	113)FLD QUENCH DELAY	
	114)FIELD REFERENCE	

WARNING: Field reversal or disconnection.

After the PL/X inhibits the field output, it can take several seconds for the field current to decay to zero due to the high inductance of motor fields.

Do not open-circuit the field unless the field current has reached zero.

You cannot use the field current monitors or field active flag to confirm that zero current is flowing because the PL/X cannot measure the decaying current after an inhibit.
You must:

1. Observe the current on an external instrument and time how long it takes to decay.
2. Use the interval timer block to implement a safety delay before opening the field circuit.

Failure to observe this warning may cause flashover of the field circuit and result in damage to the system.

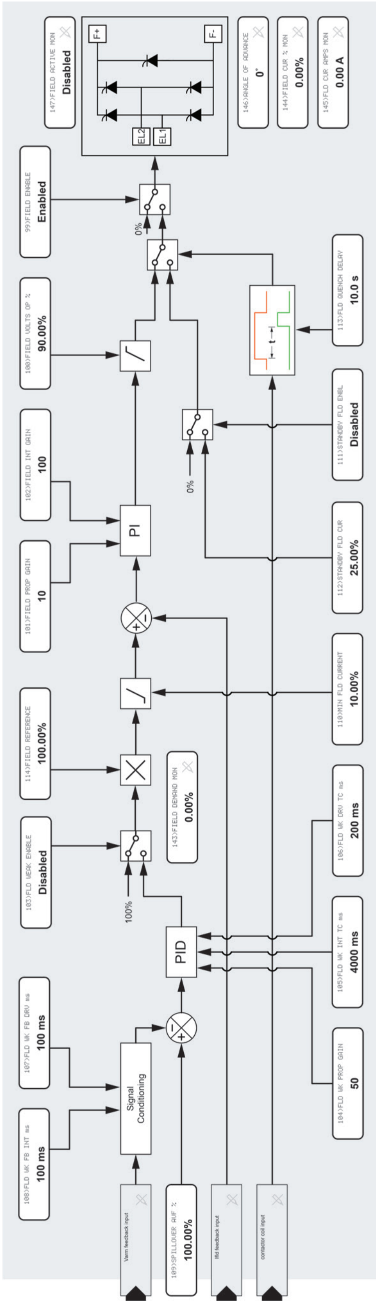


Figure 52 FIELD CONTROL - block diagram

NOTE: Please ensure that 4)RATED FIELD AMPS is sufficiently high to force the 100)FIELD VOLTS OP % clamp into operation at the desired voltage under all conditions.

4)RATED FIELD AMPS, scaled by 114)FIELD REFERENCE, sets the demand for the field current control loop. 100)FIELD VOLTS OP % operates as a clamp on the field bridge firing angle. If the current demand is satisfied at a voltage output below the clamp level, then the current loop will prevail.

Current Control (preferred control strategy)

In this mode, the output voltage range is the same as in the voltage output clamp mode. However, the control loop operates on the actual current flowing in the field and works to maintain this at the desired value. The motor back emf is a linear representation of its speed, and this is improved if the field current and hence flux is kept constant. Consequently, with the field in current control mode, AVF speed control accuracy is improved. It is good practice in control engineering to minimise the error correction requirements of any loop, so also having a current-controlled field is recommended when using a tachogenerator.

Field weakening in current mode is required when the desired maximum speed of the motor exceeds its base speed. The field current is held at its rated value until the armature voltage reaches its spillover value. Reducing the field current rather than increasing the armature voltage then satisfies any further increase in speed demand. When considering the field quenching modes, the field must be present after removing the drive armature output if dynamic braking is required. Without the field, the motor could not act as a generator and dissipate its rotational energy into the braking resistor.

When motors are standing still for extended periods, it is wise to apply a reduced field current to prevent overheating, save energy, and prevent condensation or freezing in cold climates.

The field quenches during any non-running mode. A RUN input going low during the stopping process, either heading for zero speed or during the delay period, drops out the contactor straight away and quenches the field. Parameters 111)STANDBY FIELD ENBL, 112)STANDBY FLD CUR and 113)FLD QUENCH DELAY determine the quench condition.

Refer to "Figure 34 Wiring diagram for AC supply level to L1/2/3 different to EL1/2/3 (e.g. low voltage field)" on page 107.

11.13.1 99)FIELD ENABLE

Enable/disable the field output.

PIN	Parameter description	Range	Default
99	FIELD ENABLE	DISABLED ENABLED	ENABLED

NOTE: Disabling the field control will automatically inhibit the field fail alarm.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	FIELD CONTROL	3
R	99)FIELD ENABLE	

11.13.2 100)FIELD VOLTS OP %

Set the DC field voltage clamp as a % of the AC supply volts.

PIN	Parameter description	Range	Default
100	FIELD VOLTS OUTPUT %	0.00 to 100.00%	90.00%

NOTE: The value of this parameter is not restored to default by a 4-KEY RESET (factory default reset). It remains as calibrated.

It may be necessary to set the field voltage instead of the field current. For example, there may only be a volts rating on the rating plate. Refer to "12.4.4 146)ANGLE OF ADVANCE" on page 214.

This parameter sets an upper clamp level for the field current loop, allowing you to achieve voltage mode. **NOTE:** The rated field amps current setting in the calibration menu is the limiting value irrespective of this clamp voltage setting. This protects the PL/X and the motor.

Conversely, this voltage clamp setting will be a limiting value irrespective of the rated field amps setting. Set the rated field amps to a level that is slightly in excess of the cold field current to ensure the field output voltage always remains at the clamp voltage. Then as the field warms up, any voltage rise needed by the field current loop will be clamped to the level set.

The clamp will work with the rated field amps set to maximum. However, this might not provide enough protection for the motor if there is a problem in the field winding resulting in overcurrent.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	FIELD CONTROL	3
R	100)FIELD VOLTS OP %	

Refer to "Figure 34 Wiring diagram for AC supply level to L1/2/3 different to EL1/2/3 (e.g. low voltage field)" on page 107.

11.13.3 101)FIELD PROP GAIN

Set the proportional gain of the field current control loop.

PIN	Parameter description	Range	Default
101	FIELD PROPORTIONAL GAIN	0 to 1000	10

Increase the parameter value to improve response. However, too much may cause instability in the field current.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
     101)FIELD PROP GAIN
```

11.13.4 102)FIELD INT GAIN

Set the integral gain of the field current control loop.

PIN	Parameter description	Range	Default
102	FIELD INTEGRAL GAIN	0 to 1000	100

Increase the parameter value to improve response. However, too much may cause instability in the field current.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
     102)FIELD INT GAIN
```

11.13.5 111)STANDBY FLD ENBL

Enable/disable the standby field quench mode.

PIN	Parameter description	Range	Default
111	STANDBY FIELD ENABLE	DISABLED ENABLED	DISABLED

Use this to keep the motor warm during off periods to prevent condensation in cold climates. When DISABLED, the field quenches to zero. Refer to "11.13.6 112) STANDBY FLD CUR" on page 187.

A run condition is enabled by (START or JOG) **and** RUN. This parameter prevails for non-running conditions.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
     111)STANDBY FLD ENBL
```

11.13.6 112)STANDBY FLD CUR

Set the standby value of the field current.

PIN	Parameter description	Range	Default
112	STANDBY FIELD CURRENT	0.00 to 100.00%	25.00%

Use this to keep the motor warm during off periods to help prevent condensation in cold climates.

100.00% represents 4)RATED FIELD AMPS, as set in the CALIBRATION menu.

```
R  ENTRY MENU        LEVEL    1
R  CHANGE PARAMETERS          2
R  FIELD CONTROL              3
     112)STANDBY FLD CUR
```

11.13.7 113)FLD QUENCH DELAY

Set the field quench delay time after main contactor drop-out.

PIN	Parameter description	Range	Default
113	FIELD QUENCH DELAY	0.0 to 600.0 seconds	10.0 seconds

Use this to ensure the motor can generate into a dynamic braking resistor after the main contactor drops out.

A run condition is enabled by (START or JOG) **and** RUN. This delay activates when a non-running condition begins.

```
R  ENTRY MENU        LEVEL    1
R  CHANGE PARAMETERS          2
R  FIELD CONTROL              3
     113)FLD QUENCH DELAY
```

11.13.8 114)FIELD REFERENCE

Set the value of an external field reference input.

PIN	Parameter description	Range	Default
114	FIELD REFERENCE	0.00 to 100.00%	100.00%

This parameter is a scaler of "11.1.3 4)RATED FIELD AMPS" on page 117.

Use this with systems requiring an external field reference input. The minimum field clamp will operate if the reference goes below the minimum field.

```
R  ENTRY MENU        LEVEL    1
R  CHANGE PARAMETERS          2
R  FIELD CONTROL              3
     114)FIELD REFERENCE
```

11.14 CHANGE PARAMETERS / FIELD CONTROL/FLD WEAKENING MENU

Enable this function to control field weakening.

There are five adjustable control terms:

- error terms:
  1. proportional (P)
  2. integral (I)
  3. derivative (D)
- feedback terms:
  4. derivative
  5. integral.

All control terms are associated with the armature voltage spillover loop, and the values chosen give the best response without excessive overshoots or instability of the armature voltage.

The control loop monitors the armature voltage and compares it to the desired spillover voltage. It then controls the field current to optimise the speed control of the PL/X in the field weakening region.

When the armature voltage reaches the spillover voltage, field weakening achieves further speed increases and effectively clamps the armature voltage at the spillover voltage. In this region, the output power is constant for a given armature current.

Refer to "11.1.9 14)IR COMPENSATION" on page 123. Further accuracy can be achieved with IR COMP.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
   FIELD WEAKENING MENU     4
     103)FLD WEAK ENABLE
     104)FLD WK PROP GAIN
     105)FLD WK IN TC ms
     106)FLD WK DRV TC ms
     107)FLD WK FBK DRV ms
     108)FLD WK FBK INT ms
     109)SPILLOVER AVF %
     110)MIN FLD CURRENT
```

NOTE: The limit of field weakening range is 10 : 1.

Refer to "13.1.1 171)SPD TRIP ENABLE" on page 225.

WARNING!

EQUIPMENT DAMAGE HAZARD

When using field weakening and a dc side contactor, the armature **MUST** be connected to remote sense terminals T41 and T43, as shown on Page 54. It ensure that the PL/X can measure armature voltage with the dc side contactor de-enesrgised. Failure to do this will cause a flashover of the commutator because the AVF feedback is lost when the contactor opens.

CAUTION!

Do not use field weakening when using Armature Voltage Feedback, selected in the CALIBRATION menu.

If AVF is selected and field weakening is enabled, the PL/X will trip when entering the field weakening region. **NOTE:** The action of changing feedback mode to AVF will automatically rescale the 100% speed feedback referring to 18)RATED ARM VOLTS. To continue running in this mode (e.g. if tacho has failed) and prevent tripping, avoid the field weakening region remaining at a speed that produces an armature voltage below 109)SPILLOVER AVF %.

130)MOTOR RPM monitor will show an incorrect value unless you re-adjust 6)DESIRED MAX RPM to the base RPM.

If this trip occurs, the DRIVE TRIP MESSAGE will be SPEED FBK MISMATCH.

11.14.1 103)FLD WEAK ENABLE

Enable/disable the field weakening.

PIN	Parameter description	Range	Default
103	FIELD WEAKENING ENABLE	DISABLED ENABLED	DISABLED

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
   FIELD WEAKENING MENU     4
     103)FLD WEAK ENABLE
```

11.14.2 104)FLD WK PROP GAIN

Set the proportional gain of the field weakening loop.

PIN	Parameter description	Range	Default
104	FIELD WEAKENING PROPORTIONAL GAIN	0 to 1000	50

Generally, an increased proportional value will speed up the response to the armature voltage when operating around the spillover voltage point, and a decrease will slow it.

Increasing the value too far may cause instability of the armature voltage and possible overvolting of the commutator.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
   FIELD WEAKENING MENU     4
     104)FLD WK PROP GAIN
```

11.14.3 105)FLD WK INT TC ms

Set the integral time constant of the weakening loop.

PIN	Parameter description	Range	Default
105	FIELD WEAKENING INTEGRAL TIME CONSTANT in milliseconds	0 to 20000	4000

Generally, an increased integral time constant will slow the response to the armature voltage when operating around the spillover voltage point, and a decrease will improve the response.

Decreasing the value too far may cause instability of the armature voltage and possible overvolting of the commutator.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
   FIELD WEAKENING MENU     4
     105)FLD WK INT TC ms
```

11.14.4 106)FLD WK DRV TC ms

Set the derivative time constant of the weakening loop.

PIN	Parameter description	Range	Default
106	FIELD WEAKENING DERIVATIVE TIME CONSTANT in milliseconds	10 to 5000	200

Generally, keep this parameter between 5 and 10% of the 105)FLD WK INT TC ms setting to provide correct attenuation to the response of the weakening loop at high frequencies.

A higher setting may cause instability of the armature voltage and possible overvolting of the commutator.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
R  FIELD CONTROL             3
   FIELD WEAKENING MENU      4
    └ 106)FLD WK DRV TC ms
```

11.14.5 107)FLD WK FB DRV ms

Set the feedback derivative time constant in milliseconds.

PIN	Parameter description	Range	Default
107	FIELD WEAKENING FEEDBACK DERIVATIVE in milliseconds	10 to 5000	100

This parameter affects the armature voltage overshoot when accelerating rapidly through the base speed. An increasing ratio (of the 107)FLD WK FB DRV ms parameter to the 108)FLD WK FB INT ms parameter (D/I)) tends to reduce overshoots, a ratio of unity has no effect, and a ratio of three or more tends to instability.

The absolute values of the two parameters have only a 2nd order effect on the response.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
R  FIELD CONTROL             3
   FIELD WEAKENING MENU      4
    └ 107)FLD WK FB DRV ms
```

11.14.6 108)FLD WK FBK INT ms

Set the feedback integral time constant in milliseconds.

PIN	Parameter description	Range	Default
108	FIELD WEAKENING FEEDBACK INTEGRAL in milliseconds	10 to 5000	100

This parameter affects the armature voltage overshoot when accelerating rapidly through the base speed. An increasing ratio (of the 107)FLD WK FB DRV ms parameter to the 108)FLD WK FB INT ms parameter (D/I)) tends to reduce overshoots, a ratio of unity has no effect, and a ratio of three or more tends to instability.

The absolute values of the two parameters have only a 2nd order effect on the response.

```
R  ENTRY MENU       LEVEL    1
R  CHANGE PARAMETERS         2
R  FIELD CONTROL             3
   FIELD WEAKENING MENU      4
    └ 108)FLD WK FB DRV ms
```

11.14.7 109)SPILLOVER AVF %

Set the armature voltage % at which field weakening begins.

PIN	Parameter description	Range	Default
109	SPILLOVER ARMATURE VOLTAGE FEEDBACK %	0.00 to 100.00% of rated AVF	100.00%

NOTE: The rated armature voltage is settable in the CALIBRATION menu.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
   FIELD WEAKENING MENU     4
     └ 109)SPILLOVER AVF %
```

11.14.8 110)MIN FIELD CURRENT

Set the minimum field current as a % of the rated amps.

PIN	Parameter description	Range	Default
110	MINIMUM FIELD CURRENT	0.00 to 100.00% of rated IF	10.00%

NOTE: When setting the minimum percentage, allow an extra 5% margin below the desired minimum to accommodate a response transient. If the minimum is below 10%, there may be a field failure alarm caused by an undershoot.

```
R  ENTRY MENU      LEVEL    1
R  CHANGE PARAMETERS        2
R  FIELD CONTROL            3
   FIELD WEAKENING MENU     4
     └ 110)MIN FIELD CURRENT
```

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

The protection provided in field weakening mode is limited to total feedback loss only because the speed/AVF relationship is not maintainable in the field weakening mode. If a partial loss of feedback occurs, the motor may run to excessive speed. When the field is entirely weakened and is at its minimum level, the armature overvoltage trip will operate. It may only occur at dangerous speeds. Therefore, we recommend using a mechanical device, a backup system, or both to protect against this possibility.

Correct setting of `110)MIN FIELD CURRENT` will ensure that the overvolts TRIP occurs just above the maximum operating speed.

11.15 CHANGE PARAMETERS / ZERO INTERLOCKS

Use this menu to enable two interlocking functions that are associated with zero speed. Their normal standstill behaviour is as follows.

The condition of 'zero speed and current demand' AND 'zero speed feedback' being satisfied removes the firing pulses. All other loops remain active to enable a rapid response for a new request for speed.

- 117)ZERO INTLK SPD % sets the threshold for both the zero speed reference and feedback decisions.
- 118)ZERO INTLK CUR % sets the threshold for the zero current demand decision. **A setting of 0.00% for this parameter does NOT remove the firing pulses.**

Due to the rapid response of the above condition, it may be necessary to implement 115)STANDSTILL ENBL. Without this quench function enabled, the motor may continuously move as the system responds to slight variations, which may be undesirable.

1. 115)STANDSTILL ENBL provides an extra level of inhibiting as it not only removes firing pulses but also quenches the loops. It operates after meeting the requirements of zero speed reference and zero speed feedback. 117)ZERO INTLK SPD % sets the threshold for both the zero speed ref and feedback decisions.
2. 116)ZERO REF START. This parameter prevents the current control from enabling after a start command if the total speed reference to the PL/X or the input to the RUN MODE RAMPS is not at zero. Use this if inadvertently starting the motor is undesirable. The message CONTACTOR LOCK OUT will appear after approximately 2 seconds if this function is not satisfied. The contactor is de-energised. For example, if an extruder is full of cold plastic, starting it may damage the screw. By implementing this function, the operator must deliberately set the references to zero to commence running.

For these functions to work, the zero threshold levels 117)ZERO INTLK SPD % and 118)ZERO INTLK CUR % must be defined. All the threshold levels are symmetrical for reverse rotation and have a hysteresis of ±0.5% around the chosen value.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  ZERO INTERLOCKS         3
  R  115)STANDSTILL ENBL
     116)ZERO REF START
  R  117)ZERO INTLK SPD %
  R  118)ZERO INTLK CUR %
     119)AT ZERO REF FLAG
     120)AT ZERO SPD FLAG
     121)AT STANDSTILL
     SPINDLE ORIENTATE   4
```

For systems using a shaft encoder, there is a sub-menu for implementing spindle orientation and zero speed shaft position lock or both.
In addition to the adjustable parameters, there are four diagnostic monitoring flags.

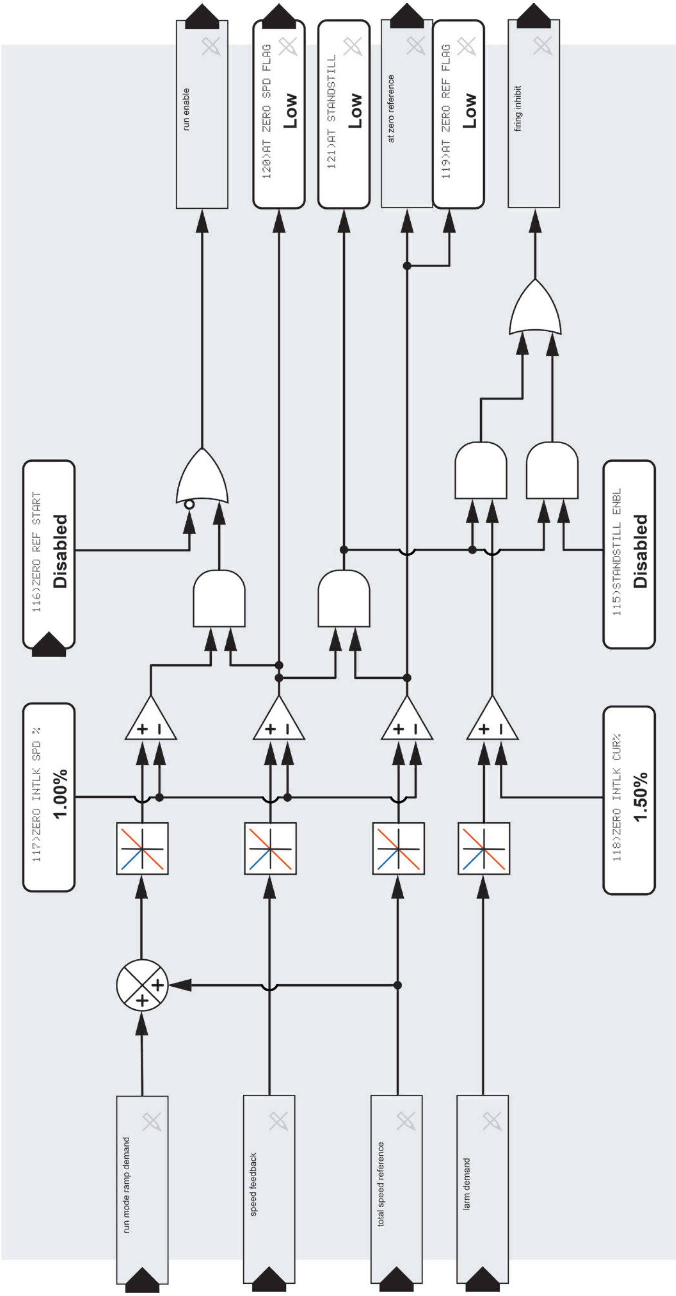


Figure 53 ZERO INTERLOCKS - block diagram

11.15.1 115)STANDSTILL ENBL

Enable/disable the standstill function.

PIN	Parameter description	Range	Default
115	STANDSTILL ENABLE	DISABLED ENABLED	DISABLED

If enabled, the standstill function will inhibit the stack firing when there is a zero reference AND zero speed.

This parameter must be DISABLED for the operation of "11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE" on page 197.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  ZERO INTERLOCKS         3
R   115)STANDSTILL ENBL
```

11.15.2 116)ZERO REF START

Enable/disable the zero reference start function.

PIN	Parameter description	Range	Default
116	ZERO REFERENCE START	DISABLED ENABLED	DISABLED

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  ZERO INTERLOCKS         3
    116)ZERO REF START
```

11.15.3 117)ZERO INTLK SPD %

Set the speed level for the zero reference start and standstill blocks.

PIN	Parameter description	Range	Default
117	ZERO INTERLOCK SPEED %	0.00 to 100.00%	1.00%

The signals detected are total speed reference and speed feedback. The input depends on the function ("total speed reference" for standstill, and the total speed inputs prior to the normal ramp for zero reference start).

This speed level also sets the threshold for 120)AT ZERO SPD FLAG.

```
R  ENTRY MENU      LEVEL   1
R  CHANGE PARAMETERS       2
R  ZERO INTERLOCKS         3
R   117)ZERO INTLK SPD %
```

11.15.4 118)ZERO INTLK CUR %

Set the current % for the start and standstill blocks.

PIN	Parameter description	Range	Default
118	ZERO INTERLOCK CURRENT %	0.00 to 100.00%	1.50%

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
R 118)ZERO INTLK CUR %

11.15.5 119)AT ZERO REF FLAG

Monitor the total speed reference zero status.

PIN	Parameter description	Range
119	AT ZERO REFERENCE FLAG	LOW HIGH (at zero)

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
119)AT ZERO REF FLAG

11.15.6 120)AT ZERO SPD FLAG

Monitor the zero speed reference.

PIN	Parameter description	Range
120	AT ZERO SPEED FLAG	LOW HIGH (at zero)

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
120)AT ZERO SPD FLAG

11.15.7 121)AT STANDSTILL

Monitor the standstill status.

PIN	Parameter description	Range
121	AT STANDSTILL	LOW HIGH (at standstill)

This flag operates irrespective of the state of 115) STANDSTILL ENBL.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
121)AT STANDSTILL

Refer to "11.9.7 79)SPD ADAPT ENABLE" on page 166.

Refer to "11.9.1 Using small speed inputs" on page 164 and "11.6.1 Precise stopping" on page 152.

11.15.7.1 Low speed performance

When running at very low speeds, the SPEED PI ADAPTION may need adjustment for optimum performance.

The default settings for SPEED PI ADAPTION give lower gain with low error to provide smooth steady-state performance. However, applications that require precise control at very low speeds may function better with the adaption disabled.

If you require the adaption to be on during normal running and off at low speeds, use a MULTI-FUNCTION block to connect an inversion of 120)AT ZERO SPD FLAG to 79)SPD ADAPT ENABLE.

11.16 CHANGE PARAMETERS / ZERO INTERLOCKS / SPINDLE ORIENTATE

This sub-menu provides spindle orientation when the mechanical system is fitted with an incremental encoder (a bi-directional incremental encoder, with A and B channels plus marker output) to provide position feedback. If not using the SPINDLE ORIENTATE function, terminal T16 becomes available for other use.

```
R  ENTRY MENU    LEVEL   1
R  CHANGE PARAMETERS     2
R  ZERO INTERLOCKS       3
   SPINDLE ORIENTATE     4
     122)ZERO SPEED LOCK
     240)MARKER ENABLE
     241)MARKER OFFSET
     242)POSITION REF
     243)MARKER FREQ MON
     244)IN POSITION FLAG
```

NOTE: Only use this function with PLX models that have the regenerative stopping facility. Refer to "10.3 Electrical ratings" on page 93.

Operating the SPINDLE ORIENTATE block does not disturb the function of an encoder selected as a speed feedback option in the CALIBRATION menu.

The spindle orientation will function irrespective of the speed feedback type.

The block uses the encoder marker to provide the PL/X with the absolute position angle of the encoder. The encoder marker is input via terminal T15.

PL models with the regenerative stopping facility can only orientate during the contactor drop-out delay.

To maintain position lock during a contactor drop-out delay, ensure "11.6.4 58)LIVE DELAY MODE" on page 154 is set to ENABLED. Refer also to "11.6.6 60)DROP-OUT DELAY" on page 155.

The encoder pulses are input on terminals T16 and T17. (**NOTE**: We recommend Quadrature type encoders because they usually provide more accurate counting during reversals than pulse and direction types).

Use the CALIBRATION / ENCODER SCALING menu to program the encoder input type and scale by selecting the encoder type, sign, encoder lines and rpm.

The SPINDLE ORIENTATE block counts the pulses from the encoder using a bi-directional counter, counting forwards or backwards, depending on the direction of rotation. This counter represents the amount of angular rotation of the encoder and hence the motor shaft. The PL/X compares the position count and the spindle orientation reference to produce an error signal for use in the PL/X's negative feedback loop. The motor then rotates in a direction that reduces this error to zero, and hence brings the encoder marker to the spindle position reference.

The marker uniquely defines the absolute position of the rotating encoder to the machine. If 241)MARKER OFFSET and 242)POSITION REF are both zero, then the encoder shaft will be positioned at the marker. However, the marker will likely be in an arbitrary position. The PL/X uses 241)MARKER OFFSET to defeat this problem, performing a one-off positioning of the shaft to a known position each time the spindle orientate block actions, e.g. to top dead centre. 242) POSITION REF is then always referred to this known position.

To summarise:

Dropping below the zero speed threshold activates the orientation function, and by commencing orientation, actions the 241)MARKER OFFSET just once. 242) POSITION REF is then followed with respect to the 241)MARKER OFFSET position.

The orientation function is de-activated by increasing the speed demand above the zero speed threshold.

242)POSITION REF may be changed as many times as required, and the shaft position will track it relative to the 241)MARKER OFFSET position. Each time 242) POSITION REF changes to a new value, 244)IN POSITION FLAG reports on the new position.

The gain and hence response of the position control loop is set by 122)ZERO SPEED LOCK. A value of zero will turn off the position loop.

The block also provides 243)MARKER FREQ MON, indicating marker frequency.

For systems that require position locking at zero speed but where the absolute position is unimportant, use 122)ZERO SPEED LOCK only. In this case, set 240) MARKER ENABLE to DISABLED.

11.16.1 Spindle orientate operation

For all speeds above 117)ZERO INTLK SPD %, the spindle orientate control action is disabled. However, the marker frequency monitor will function within its defined limits providing 240)MARKER ENABLE is enabled.

NOTE: The marker used for orientation is the last input before the speed falls below the 117)ZERO INTLK SPD % threshold. (This is normally within 1 revolution of the shaft prior to the threshold).

The spindle orientate function operates when the speed falls below 117)ZERO INTLK SPD % providing that the 122)ZERO SPEED LOCK setting is a nonzero value and 240)MARKER ENABLE is set to ENABLED. It continues to function while the speed demand is below 117)ZERO INTLK SPD %. Actual speed is allowed to exceed 117) ZERO INTLK SPD % without turning the block off.

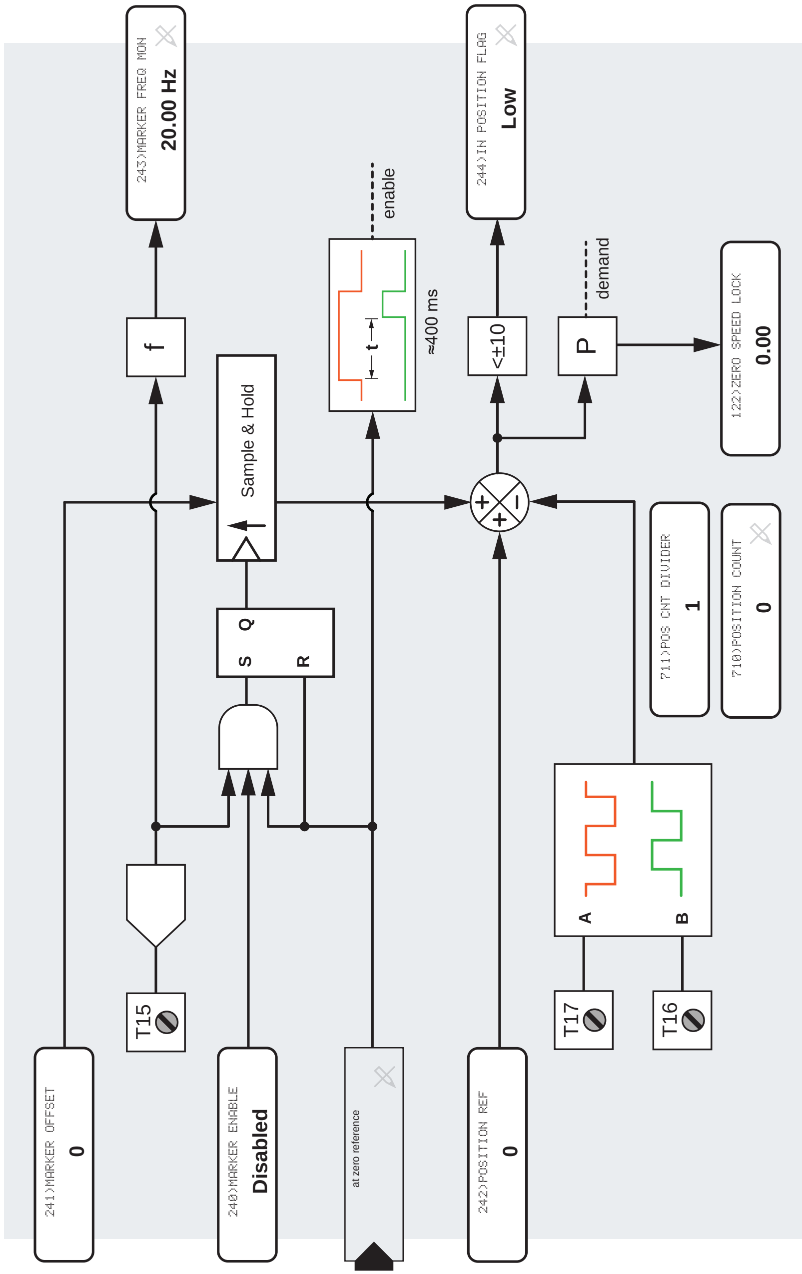


Figure 54 SPINDLE ORIENTATE - block diagram

The sequence of operation is as follows.

1. The speed demand and feedback fall and remain below 117)ZERO INTLK SPD % for 400 ms. It includes stopping sequences using terminals T33 or T32.
2. The spindle orientation block is activated.
3. The PL/X calculates the shaft position at the last marker to be input before the speed falls below 117)ZERO INTLK SPD %.
4. The shaft seeks the 241)MARKER OFFSET position.
5. As the shaft approaches the marker offset position, the block checks for the 242)POSITION REF target.
6. If the position reference is nonzero, the shaft immediately seeks the position reference with respect to the marker offset without waiting to stop at the marker offset position.
7. When the shaft reaches 242)POSITION REF target, the 244)IN POSITION FLAG goes high.
8. If a new 242)POSITION REF is entered, the shaft immediately seeks the new 242)POSITION REF target.
9. When the shaft reaches the new 242)POSITION REF target, the 244)IN POSITION FLAG goes high again.
10. The sequence of 8 and 9 may repeat as many times as desired as long as the speed demand remains below 117)ZERO INTLK SPD %.

NOTE: 241)MARKER OFFSET and 242)POSITION REF, or both, may be positive or negative, giving a choice of clockwise/anti-clockwise search. This ability becomes usable if the speed direction changes and shaft reversal is undesirable. It may be helpful to use position references that include extra complete turns to provide smoother stopping. The block waits for approximately 400 ms before activating to allow undisturbed speed traverse through zero.

Two hidden PINs allow access to the position counter (e.g. with serial link):

- 710)POSITION COUNT gives a running total (four counts per line in quadrature mode or two counts per line in single-pulse train mode).
- 711)POS CNT DIVIDER is a decimal number input in the range 1 to 30,000, usually sent by a host computer, and is used to divide the total position count so that the receiving host does not have to poll at a high rate.

11.16.2 122)ZERO SPEED LOCK

Set the position control gain for zero speed shaft lock.

PIN	Parameter description	Range	Default
122	ZERO SPEED LOCK	0.00 to 100.00	0.00

NOTE: If this value is nonzero, AND both speed demand and feedback are less than 117)ZERO INTLK SPD%, an encoder position control loop activates.

The motor must have a bi-directional output shaft encoder (quadrature, OR pulse and direction). When locked, the speed may exceed 117)ZERO INTLK SPD% without losing the lock. Zero speed shaft lock is only released when speed demand > 117)ZERO INTLK SPD%.

The suggested value for 122)ZERO SPEED LOCK is 10.00. Increasing it improves the position response. Excessive gain may cause position instability.

Refer to "11.1.8 9)SPEED FBK TYPE" on page 120.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	ZERO INTERLOCKS	3
	SPINDLE ORIENTATE	4
	122)ZERO SPEED LOCK	

11.16.3 240)MARKER ENABLE

Enable the marker to determine the spindle orientation.

PIN	Parameter description	Range	Default
240	MARKER ENABLE	ENABLED DISABLED	DISABLED

DISABLED turns off the spindle orientate function and the marker frequency monitor function.

NOTE: 122)ZERO SPEED LOCK function will continue to work; however, the stopping position is arbitrary.

R	ENTRY MENU LEVEL	1
R	CHANGE PARAMETERS	2
R	ZERO INTERLOCKS	3
	SPINDLE ORIENTATE	4
	240)MARKER ENABLE	

11.16.3.1 Marker specification

The logic threshold levels for T15 are:

0 < 2 V

1 > 4 V

The maximum input voltage is 50 V. The minimum width specification for the marker is 10 µs.

The precise point of reference is the rising edge of the marker. The system can use various marker signal types, although some are less prone to noise than others.

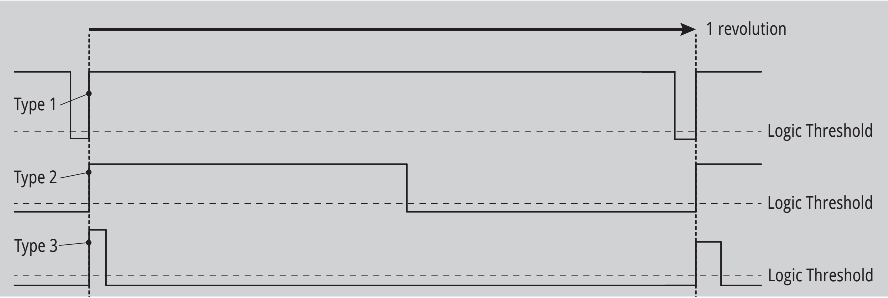


Figure 55 MARKER ENABLE

Type 1 is the preferred marker signal because it is well away from the logic threshold for most of the time, and so noise is very unlikely to cause a false marker reading.

However, Types 2 and 3 spend significant time near the logic threshold level, and therefore noise is more likely to produce a false marker reading.

11.16.4 241)MARKER OFFSET

Offset an arbitrary marker to a defined position.

PIN	Parameter description	Range	Default
241	MARKER OFFSET	±15000 counts	0

NOTE: This offset is added just once at the beginning of orientation. Changing the value of 241)MARKER OFFSET before the subsequent orientation sequence does not affect the existing position. When seeking the offset, its sign determines the rotation direction.

The count value needed for any offset angle depends on the resolution of the feedback encoder and the type of encoder output. Quadrature encoders provide four counts per line. Single-pulse and direction encoders provide two counts per line:

Example:

Encoder has 3600 lines
Encoder type is QUADRATURE.

This gives 3600 X 4 counts per rev = 14400.
That is 14400/360 = 40 counts per degree of displacement. Hence, if an offset 56.8 degrees is required, enter counts of 56.8 X 40 = 2272.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
SPINDLE ORIENTATE 4
241)MARKER OFFSET

Example:

If the encoder mounts on the motor shaft, but the spindle requiring orientation connects to the motor via a gearbox (meaning the motor shaft and therefore encoder rotate faster than the spindle), then the number of counts per revolution of the spindle increases by a factor equal to the gearbox ratio.

Counts per degree at the motor shaft = 40.

Reduction gearbox ratio = 3 : 1.

Therefore, counts per degree at the spindle = 120.

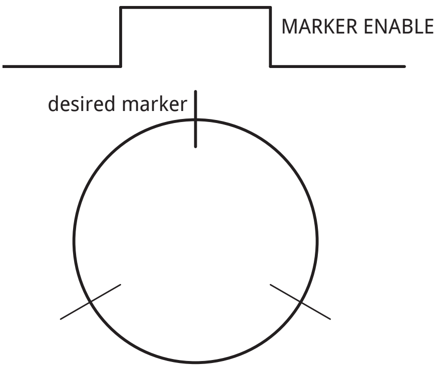
NOTE: In systems with reduction gearboxes, the motor encoder will provide more than one marker per revolution of the spindle. There are two ways to overcome this problem:

For non-integer ratio and integer ratio gearing:

1. Provide another marker that occurs only once for each spindle revolution, e.g. a magnetic pick-up sensing a tab on the spindle.

OR, for integer ratio gearing only:

2. Use the `240)MARKER ENABLE` parameter to select the required marker at the appropriate position. To do this, use a microswitch that operates while the required marker is present, but does not operate with other markers.



11.16.5 242)POSITION REF

Enter a position reference referred to 241)MARKER OFFSET.

PIN	Parameter description	Range	Default
242	POSITION REFERENCE	±30000 counts	0 counts

NOTE: 242)POSITION REF may be adjusted at any time. If the system is above the zero lock threshold, then changing this value will have no effect. It can be changed as many times as required while operating in the zero speed lock region.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
SPINDLE ORIENTATE 4
242)POSITION REF

11.16.6 243)MARKER FREQ MON

Monitor the frequency of the marker pulse on T15.

PIN	Parameter description	Range	Default
243	MARKER FREQUENCY MONITOR	20.00 to 655.35 Hz	0.0 Hz

This output function measures the period between successive marker pulses to calculate the output frequency accurately.

NOTE: For frequencies below 20 Hz, the monitor will display a random reading.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
SPINDLE ORIENTATE 4
243)MARKER FREQ MON

11.16.7 244)IN POSITION FLAG

Monitor the position error.

PIN	Parameter description	Range	Default
244	IN POSITION FLAG	LOW HIGH	LOW

This flag goes HIGH if the position error is approximately <20 counts.

NOTE: The flag may oscillate whilst the loop is settling if 122)ZERO SPEED LOCK (gain) is high enough to cause overshoot.

R ENTRY MENU LEVEL 1
R CHANGE PARAMETERS 2
R ZERO INTERLOCKS 3
SPINDLE ORIENTATE 4
244)IN POSITION FLAG

12 The DIAGNOSTICS menu

The diagnostics menu provides a monitoring facility for all the main drive parameters.

12.1 DIAGNOSTICS

The Diagnostics menu monitors important parameters within permanently functioning blocks (less important parameters can be found in their block menus).

The Application and some other block outputs are all made available in the BLOCK OP MONITOR menu. Also, for most blocks, the monitoring points are found within the block menus themselves.

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R   |SPEED LOOP MONITOR    3
R   |ARM I LOOP MONITOR    3
R   |FLD I LOOP MONITOR    3
R   |ANALOG IO MONITOR     3
R   |DIGITAL IO MONITOR    3
R   |BLOCK OP MONITOR      3
R   |169)EL1/2 RMS MON
R   |170)DC KILOWATTS MON
```

12.1.1 169)EL1/2 RMS MON

Monitor the rms AC supply voltage applied to the EL1, EL2 terminals (±5%).

PIN	Parameter description	Range
169	EL1/2 RMS MONITOR	0.0 to 1000.0 V

NOTE: There may be a slight offset affecting the displayed value when no voltage is applied. It depends upon the drive frame size due to differing power board designs.

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R   |169)EL1/2 RMS MON
```

12.1.2 170)DC KILOWATTS MON

Monitor the output power in kilowatts at the drive A+/A- terminals.

PIN	Parameter description	Range
170	DC KILOWATTS MONITOR	±3000.0 kW

NOTE: A negative output power shows that the PL/X is regenerating into the AC supply.

The power available at the motor shaft will depend on the motor efficiency (typically 90 to 95%).

To convert Kilowatts to Horsepower, multiply by a scaling factor of 1.34.

The limits for this parameter (±3000.0 kW) equate to approximately 7500 A at 400 V or 4000 A at 750 V armature.

NOTE: For the PL/XD stack driver usable in applications over 3000 kW, refer to the separate PL/XD Stack Driver manual.

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R   |170)DC KILOWATTS MON
```

12.2 DIAGNOSTICS / SPEED LOOP MONITOR

This menu allows monitoring of the parameters associated with the speed loop.

Feedback sources can also be read in engineering units, eliminating difficult-to-interpret voltmeter readings during commissioning.

For convenience, 127)ARM VOLTS % MON shows armature voltage as a % of maximum rated value.

The monitors for armature volts, tacho volts, and encoder rpm all function continuously regardless of which is the source of feedback. These signal channels are also useful for tasks other than speed feedback.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  SPEED LOOP MONITOR     3
   R  123)TOTAL SPD REF MN
      124)SPEED DEMAND MON
      125)SPEED ERROR MON
   R  126)ARM VOLTS MON
      127)ARM VOLTS % MON
      128)BACK EMF % MON
   R  129)TACHO VOLTS MON
   R  130)MOTOR RPM MON
   R  132)ENCODER RPM MON
   R  131)SPEED FBK MON
```

12.2.1 123)TOTAL SPD REF MN

Monitor the % value of the total speed reference before the STOP RAMP BLOCK.

PIN	Parameter description	Range
123	TOTAL SPEED REFERENCE MONITOR	±300.00%

This parameter is a summation of all possible speed references, including the RUN MODE RAMP.

Note that the RUN MODE RAMP may be active when the PL/X is in Stop mode. If a member of a cascaded system stops, this feature continues to allow the system to function. Refer to "11.3 CHANGE PARAMETERS / RUN MODE RAMPS" on page 131.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  SPEED LOOP MONITOR     3
   R  123)TOTAL SPD REF MN
```

12.2.2 124)SPEED DEMAND MON

Monitor the % value of the total speed demand after the STOP RAMP BLOCK.

PIN	Parameter description	Range
124	SPEED DEMAND MONITOR	±300.00%

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  SPEED LOOP MONITOR     3
      124)SPD DEMAND MON
```

12.2.3 125)SPEED ERROR MON

Monitor the value of the speed error as a % of full scale.

PIN	Parameter description	Range
125	SPEED ERROR MONITOR	±300.00%

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R SPEED LOOP MONITOR 3
125)SPD ERROR MON

12.2.4 126)ARM VOLTS MON

Monitor the average DC armature voltage independently of feedback type.

PIN	Parameter description	Range
126	ARMATURE VOLTS MONITOR	±1250.0 V

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R SPEED LOOP MONITOR 3
R 126)ARM VOLTS MON

12.2.5 127)ARM VOLTS % MON

Monitor the value of the average DC armature voltage as a % of the desired maximum armature volts.

PIN	Parameter description	Range
127	ARMATURE VOLTS % MONITOR	±300.00%

NOTE: The 100% level is equivalent to 18)RATED ARM VOLTS.

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R SPEED LOOP MONITOR 3
127)ARM VOLTS % MON

12.2.6 128)BACK EMF % MON

Monitor the value of the average DC back emf as a % of the desired maximum back emf.

PIN	Parameter description	Range
128	BACK EMF % MONITOR	±300.00%

NOTE: Back EMF = AVF – IR drop.

R	ENTRY MENU LEVEL	1
R	DIAGNOSTICS	2
R	SPEED LOOP MONITOR	3
	128)BACK EMF % MON	

12.2.7 129)TACHO VOLTS MON

Monitor the average DC tachogenerator voltage independently of feedback type.

PIN	Parameter description	Range
129	TACHO VOLTS MONITOR	±220.00 V

NOTE: Hidden parameter 716)TACHO % UNF MON is an unfiltered % version of this value.

R	ENTRY MENU LEVEL	1
R	DIAGNOSTICS	2
R	SPEED LOOP MONITOR	3
R	129)TACHO VOLTS MON	

12.2.8 130)MOTOR RPM MON

Monitor the average DC tachogenerator voltage independently of feedback type.

PIN	Parameter description	Range
130	MOTOR RPM MONITOR	±7500 rpm

NOTE: 130)MOTOR RPM MON will only be accurate when:

1. In AVF feedback mode, 18)RATED ARM VOLTS corresponds to 6)DESIRED MAX RPM for 100% speed.
2. In ANALOG TACHO feedback mode, 8)MAX TACHO VOLTS corresponds to 6)DESIRED MAX RPM for 100% speed.

R	ENTRY MENU LEVEL	1
R	DIAGNOSTICS	2
R	SPEED LOOP MONITOR	3
R	130)MOTOR RPM MON	

NOTE: There is an unfiltered version of this value on hidden PIN 717.

12.2.9 132)ENCODER RPM MON

Monitor the value of the encoder revs per minute independently of feedback type.

PIN	Parameter description	Range
132	ENCODER RPM MONITOR	±7500 rpm

Refer to "11.2.3 12)MOT/ENC SPD RATIO" on page 129.

R	ENTRY MENU LEVEL	1
R	DIAGNOSTICS	2
R	SPEED LOOP MONITOR	3
R	132)ENCODER RPM MON	

12.2.10 131)SPEED FBK MON

Monitor the value of the speed feedback as a % of full scale.

PIN	Parameter description	Range
131	SPEED FEEDBACK MONITOR	±300.00%

NOTE: Hidden parameter 715)SPD FBK % UNF MON is an unfiltered % version of this value.

R	ENTRY MENU LEVEL	1
R	DIAGNOSTICS	2
R	SPEED LOOP MONITOR	3
R	131)SPEED FBK MON	

12.3 DIAGNOSTICS / ARM I LOOP MONITOR

This menu allows monitoring of the parameters associated with the current loop.

Feedback current can also be read in Amps, eliminating difficult-to-interpret ammeter readings during commissioning.

For convenience, 134)ARM CUR % MON shows armature current as a % of maximum rated value.

```
R  ENTRY MENU     LEVEL    1
R  DIAGNOSTICS             2
R  ARM I LOOP MONITOR      3
   R  133)ARM CUR DEM MON
   R  134)ARM CUR % MON
   R  135)ARM CUR AMPS MON
      136)UPPER CUR LIM MN
      137)LOWER CUR LIM MN
   R  138)ACTUAL UPPER LIM
   R  139)ACTUAL LOWER LIM
      140)O/LOAD LIMIT MON
      141)AT CURRENT LIMIT
```

12.3.1 133)ARM CUR DEM MON

Monitor the value of the total armature current demand as a % of full scale.

PIN	Parameter description	Range
133	ARMATURE CURRENT DEMAND MONITOR	±150.00%

NOTE: Hidden parameter 718)I DEMAND UNF MON is an unfiltered version of current demand

```
R  ENTRY MENU     LEVEL    1
R  DIAGNOSTICS             2
R  ARM I LOOP MONITOR      3
   R  133)ARM CUR DEM MON
```

12.3.2 134)ARM CUR % MON

Monitor the value of the average DC armature current as a % of 2)RATED ARM AMPS.

PIN	Parameter description	Range
133	ARMATURE CURRENT % MONITOR	±150.00%

NOTE: Hidden parameter 719)CUR FBK % DEMAND UNF MN is an unfiltered version of this value.

```
R  ENTRY MENU     LEVEL    1
R  DIAGNOSTICS             2
R  ARM I LOOP MONITOR      3
   R  134)ARM CUR % MON
```

12.3.3 135)ARM CUR AMPS MON

Monitor the value of the average DC armature current in Amps.

PIN	Parameter description	Range
135	ARMATURE CURRENT AMPS MONITOR	±3000.0 A

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R ARM I LOOP MONITOR 3
R 135)ARM CUR AMPS MON

12.3.4 136)UPPER CUR LIM MN

Monitor the % value of the scaled upper current limit in the current clamp block.

PIN	Parameter description	Range
136	UPPER CURRENT LIMIT MONITOR	±150.00%

The scaled upper current limit is the last stage clamp in the block diagram. Refer to "Figure 48 CURRENT CONTROL: block diagram" on page 168.

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R ARM I LOOP MONITOR 3
136)UPPER CUR LIM MN

12.3.5 137)LOWER CUR LIM MN

Monitor the % value of the scaled lower current limit in the current clamp block.

PIN	Parameter description	Range
137	LOWER CURRENT LIMIT MONITOR	±150.00%

The scaled lower current limit is the last stage clamp in the block diagram. Refer to "Figure 48 CURRENT CONTROL: block diagram" on page 168.

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R ARM I LOOP MONITOR 3
137)LOWER CUR LIM MN

12.3.6 138)ACTUAL UPPER LIM

Monitor the % value of the prevailing upper limit in the current clamp block.

PIN	Parameter description	Range
138	ACTUAL UPPER LIMIT	±150.00%

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R ARM I LOOP MONITOR 3
R 138)ACTUAL UPPER LIM

12.3.7 139)ACTUAL LOWER LIM

Monitor the % value of the prevailing lower limit in the current clamp block.

PIN	Parameter description	Range
139	ACTUAL LOWER LIMIT	±150.00%

The prevailing source is the clamp with the lowest setting. Refer to "Figure 48 CURRENT CONTROL: block diagram" on page 168.

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R  ARM I LOOP MONITOR      3
R    139)ACTUAL LOWER LIM
```

12.3.8 140)O/LOAD LIMIT MON

Monitor the prevailing % value of the overload limit in the current clamp block.

PIN	Parameter description	Range
140	OVERLOAD LIMIT MONITOR	0.00 to 150.00%

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R  ARM I LOOP MONITOR      3
     140)O/LOAD LIMIT MON
```

12.3.9 141)AT CURRENT LIMIT

Monitor if the armature current has reached the prevailing current limit clamp.

PIN	Parameter description	Range
141	AT CURRENT LIMIT	LOW HIGH

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R  ARM I LOOP MONITOR      3
     141)AT CURRENT LIMIT
```

12.4 DIAGNOSTICS / FIELD I LOOP MONITOR

This menu allows monitoring of the parameters associated with the field control loop.

The motor field current can also be read in Amps, eliminating difficult-to-interpret ammeter readings during commissioning.

For convenience, 144)FIELD CUR % MON shows field current as a % of maximum rated value.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  FIELD I LOOP MONITOR   3
 R  143)FIELD DEMAND MON
 R  144)FIELD CUR % MON
 R  145)FLD CUR AMPS MON
    146)ANGLE OF ADVANCE
    147)FIELD ACTIVE MON
```

12.4.1 143)FIELD DEMAND MON

Monitor the value of the field current demand as a % of full scale.

PIN	Parameter description	Range
143	FIELD DEMAND MONITOR	0.00 to 100.00%

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  FIELD I LOOP MONITOR   3
 R  143)FIELD DEMAND MON
```

12.4.2 144)FIELD CUR % MON

Monitor the value of the average DC motor field current as a % of rated field Amps.

PIN	Parameter description	Range
144	FIELD CURRENT % MONITOR	0.00 to 125.00%

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  FIELD I LOOP MONITOR   3
 R  144)FIELD CUR % MON
```

12.4.3 145)FIELD CUR AMPS MON

Monitor the value of the average DC motor field current in Amps.

PIN	Parameter description	Range
145	FIELD CURRENT AMPS MONITOR	0.00 to 100.00 A

This parameter is model dependent to 50 A, and is extended to 100 A with the special option field in frame 5 drives.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  FIELD I LOOP MONITOR   3
 R  145)FIELD CUR AMPS MON
```

12.4.4 146)ANGLE OF ADVANCE

Monitor the value of the field bridge firing angle of advance in degrees.

PIN	Parameter description	Range
146	ANGLE OF ADVANCE	0 to 180 DEG

NOTE: This parameter is only updated if the field is enabled. The convention used is 0 degrees = no firing, and 180 degrees = full firing. The formula for calculating the field volts is as follows:

Volts = 0.45 x AC supply volts x (1-cos alpha)

where firing Angle of Advance (degrees) = alpha.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  FIELD I LOOP MONITOR   3
     146)ANGLE OF ADVANCE
```

Firing angle (deg)	AC supply 200	AC supply 240	AC supply 380	AC supply 415	AC supply 480
25	Minimum field	Minimum field	Minimum field	Minimum field	Minimum field
30	12	14	22	24	28
40	20	24	39	42	49
50	31	37	60	65	76
60	44	53	84	92	107
70	58	70	111	121	141
80	73	88	140	154	177
90	89	107	170	185	215
100	104	125	199	218	252
110	119	143	228	249	288
120	134	161	255	279	324
130	146	176	279	305	353
140	157	189	300	328	380
150	166	200	318	347	402
160	173	208	330	361	416
170	177	213	338	369	427
177	179	215	341	372	430

When operating in current control mode, you should realise that, after about 150 degrees, there are only about 5% more volts available. The volts need to move higher to maintain the correct current as the field warms up and field winding resistance increases. It is also necessary to allow a margin for supply tolerance.

When the field is at its highest operating temperature, the firing angle should not usually exceed 150 degrees to prevent saturation of the control loop. A typical field winding resistance will change by about 20% between a cold and a running temperature. Hence the maximum cold firing angle will be at about 125 degrees. If the field loop does saturate, the speed loop will have to work harder to maintain control. In AVF (Armature voltage feedback) systems, the speed holding may be less accurate.

12.4.5 147)FIELD ACTIVE MON

Monitor the field output for being active (ENABLED) or inactive (DISABLED).

PIN	Parameter description	Range
147	FIELD ACTIVE MONITOR	DISABLED ENABLED

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  FIELD I LOOP MONITOR   3
    147)FIELD ACTIVE MON
```

12.5 DIAGNOSTICS / ANALOG IO MONITOR

This menu allows monitoring of the analog input and output functions.

UIP2 to UIP9 are universal inputs and are usable as digital inputs, analog inputs, or both. The analog value appears in this menu, and simultaneously the digital logic level appears in the DIGITAL IO MONITOR menu. The UIP number corresponds to its terminal number.

Note that the analog output monitors for AOP1/2/3 show the value written to that output. If it is overloaded or shorted, the PL/X cannot display the correct value.

```
R ENTRY MENU       LEVEL   1
R DIAGNOSTICS              2
R ANALOG IO MONITOR        3
   R  150)UIP2 (T2) MON
   R  151)UIP3 (T3) MON
   R  152)UIP4 (T4) MON
      153)UIP5 (T5) MON
      154)UIP6 (T6) MON
      155)UIP7 (T7) MON
      156)UIP8 (T8) MON
      157)UIP9 (T9) MON
      159)AOP1 (T10) MON
      160)AOP2 (T11) MON
      161)AOP3 (T12) MON
```

12.5.1 150)UIP2 (T2) MON to 157)UIP9 (T9) MON

Monitor the analog voltage for the universal inputs 2 to 9.

PIN	Parameter description	Range
150-157	UNIVERSAL INPUT MONITOR	±30.730 V

The monitoring range depends upon the UIP range selected: ±5, ±10, ±20, or ±30 V:

Range for 5 V is ±5.3 V.
Absolute accuracy worst case 0.4%, typically 0.1%.

Range for 10 V is ±10.4 V.
Absolute accuracy worst case 0.4%, typically 0.1%.

Range for 20 V is ±20.6 V.
Absolute accuracy worst case 4%, typically 1%.

Range for 30 V is ±30.8 V.
Absolute accuracy worst case 4%, typically 1%.

```
R ENTRY MENU       LEVEL   1
R DIAGNOSTICS              2
R ANALOG IO MONITOR        3
   R  150)UIP2 (T2) MON
   R  151)UIP3 (T3) MON
   R  152)UIP4 (T4) MON
      153)UIP5 (T5) MON
      154)UIP6 (T6) MON
      155)UIP7 (T7) MON
      156)UIP8 (T8) MON
      157)UIP9 (T9) MON
```

12.5.2 159)AOP1 (T10) MON to 161)AOP3 (T12) MON

Monitor the analog output voltage for AOP1/2/3.

PIN	Parameter description	Range
159-161	ANALOG OUTPUT MONITOR	±11.300 V

Note that the analog output monitors for AOP1/2/3 show the value written to that output. If it is overloaded or shorted, the PL/X cannot display the correct value.

```
R  ENTRY MENU      LEVEL     1
R  DIAGNOSTICS               2
R  ANALOG IO MONITOR         3
     159)AOP1 (T10) MON
     160)AOP2 (T11) MON
     161)AOP3 (T12) MON
```

12.6 DIAGNOSTICS / DIGITAL IO MONITOR

This menu allows monitoring of the digital input and output functions.

UIP2 to UIP9 are universal inputs and are usable as digital inputs, analog inputs, or both. The digital logic level appears in this menu, and simultaneously the analog value appears in the ANALOG IO MONITOR menu. The UIP number corresponds to its terminal number.

PINS 162 to 164 arrange the logic inputs into groups for ease of viewing.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  DIGITAL IO MONITOR     3
R    162)UIP 23456789
R    163)DIP 12341234 DIO
R    164)DOP 123TRJSC CIP
     165)+ARM BRIDGE FLAG
R    166)DRIVE START FLAG
R    167)DRIVE RUN FLAG
R    168)RUNNING MODE MON
```

12.6.1 162)UIP 23456789

Monitor the digital logic level for UIP2 to 9.

PIN	Parameter description	Range
162	UNIVERSAL INPUT MONITOR	0 / 1 for each UIP (0 = low)

NOTE: Set the logic threshold in the Configuration menu.

NOTE: When this value connects to another PIN, the PL/X uses the pure binary to decimal equivalent (the most significant bit on the right, the least significant on the left).

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  DIGITAL IO MONITOR     3
R    162)UIP 23456789
```

12.6.2 163)DIP 12341234 DIO

Monitor the digital logic level present at the DIP1-4 and DIO1-4 terminals.

PIN	Parameter description	Range
163	DIGITAL INPUT DIGITAL OUTPUT	0 / 1 for each DIP/DIO (0 = low)

NOTE: When this value connects to another PIN, the PL/X uses the pure binary to decimal equivalent (the most significant bit on the right, the least significant on the left).

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
R  DIGITAL IO MONITOR     3
R    163)DIP 12341234 DIO
```

12.6.3 164)DOP 123TRJSC CIP

Monitor the digital logic level for DOP1 to 3 and Therm, Run, Jog, Start, Cstop

PIN	Parameter description	Range
164	DIGITAL OUTPUT CONTROL INPUT	0 / 1 for 8 signals (0 = low)

The DOP value shown is the intended value. If the DOP is shorted, a 1 still shows as a 1.

NOTE: When this value connects to another PIN, the PL/X uses the pure binary to decimal equivalent (the most significant bit on the right, the least significant on the left).

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R  DIGITAL IO MONITOR      3
R   164)DOP 123TRJSC CIP
```

	1	2	3	T	R	J	S	C
	Bit7	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
Function	DOP1	DOP2	DOP3	Therm	Run	Jog	Start	Coast
Terminal	T22	T23	T24	T30	T31	T32	T33	T34

12.6.4 165)+ARM BRIDGE FLAG

Monitor if the positive or negative armature bridge is active.

PIN	Parameter description	Range
165	POSITIVE ARMATURE BRIDGE FLAG	LOW (- bridge) HIGH (+ bridge)

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R  DIGITAL IO MONITOR      3
    165)+ARM BRIDGE FLAG
```

12.6.5 166)DRIVE START FLAG

Monitor the status of the internal drive START (may be set low by alarms).

PIN	Parameter description	Range
166	DRIVE START FLAG	LOW (off) HIGH (on)

```
R  ENTRY MENU      LEVEL   1
R  DIAGNOSTICS             2
R  DIGITAL IO MONITOR      3
R   166)DRIVE START FLAG
```

12.6.6 167)DRIVE RUN FLAG

Monitor if a command to RUN has been issued to the current loop.

PIN	Parameter description	Range
167	DRIVE RUN FLAG	LOW (Stop) HIGH (Run)

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R DIGITAL IO MONITOR 3
R 167)DRIVE RUN FLAG

12.6.7 168)RUNNING MODE MON

Monitor the mode selected by START (T33), JOG (T32) and 42)JOG MODE SELECT.

PIN	Parameter description	Range
168	RUNNING MODE MONITOR	1 of 7 modes displayed

The 7 modes (with their numeric codes) displayed are:

(0 or 1) STOP
(2) RUN
(3) CRAWL
(4) JOG SPEED 1
(5) JOG SPEED 2
(6) SLACK SPEED 1
(7) SLACK SPEED 2

R ENTRY MENU LEVEL 1
R DIAGNOSTICS 2
R DIGITAL IO MONITOR 3
R 168)RUNNING MODE MON

12.7 DIAGNOSTICS / BLOCK OP MONITOR

The majority of blocks have an output monitor, usually the first parameter in the associated menu.

The outputs are contained in each functional block because, when programming, it is convenient to have the output monitor in the same menu as the relevant adjustment parameters. This menu contains all block outputs grouped for rapid sequential access.

Refer to "17.17 CONFIGURATION / BLOCK OP CONFIG" on page 361 for parameter information.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
   BLOCK OP MONITOR       3
     21)RAMP OP MONITOR
     45)MP OP MONITOR
     192)REF XC MASTER MN
     401)SUMMER1 OP MON
     415)SUMMER2 OP MON
     429)PID1 OP MONITOR
     452)PID2 OP MONITOR
     475)PROFILE Y OP MON
     483)DIAMETER OP MON
     494)TOTAL TENSION MN
     500)TORQUE DEMAND MN
     523)PRESET OP MON
     560)LATCH OUTPUT MON
     568)FILTER1 OP MON
     573)FILTER2 OP MON
     578)COUNTER COUNT
     583)TMR ELAPSED TIME
```

12.8 DIAGNOSTICS / FIELDBUS

This menu provides information about the status of the Fieldbus communications.

Refer to the FIELDBUS manual, HG105409EN00.

```
R  ENTRY MENU     LEVEL   1
R  DIAGNOSTICS            2
   FIELDBUS               3
     ├ 200)FBUS ON-LINE MON
     ├ 203)FBUS BITS INPUT
     ├ 213)FBUS BITS OUTPUT
     └ 223)ANYBUS TYPE
```

13 The MOTOR DRIVE ALARMS menu

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Semiconductor electronics deliver all sixteen motor drive alarms. Local safety codes may mandate the use of electro-mechanical alarm systems.
Test all alarms in the final application before use.
The manufacturer and suppliers of the PL/X are not responsible for system safety.

13.1 MOTOR DRIVE ALARMS

Sixteen alarms continuously monitor the essential parameters of the motor drive system:

- Ten of the alarms are permanently enabled.
- Six of the alarms can be enabled or disabled using this menu.

The PL/X also monitors the alarm status.

Triggering an enabled alarm causes it to latch, shutting down the PL/X and de-energising the main contactor.

If the alarm is disabled, then it is not latched and does not affect the operation of the PL/X, although monitoring is still possible.

There are three monitoring functions for all sixteen alarms:

1. An active monitor prior to the alarm latching.
2. A monitor of the latched status of the alarm.
3. A message displayed to show which alarm has caused the PL/X to shut down. This message automatically appears whenever the PL/X is running. To remove the message from the display, tap the LEFT key or start the PL/X. **Re-examine the message using the DRIVE TRIP MESSAGE menu. Removing the control supply will store the message.**

The PL/X alarms have a delay timer associated with them such that they only become latched if the fault condition persists for the whole of the delay period. We give values of this delay period for individual alarms.

These times are typical since the delay uses microprocessor "cycle time" units which vary with microprocessor loading. To access the alarms prior to the trigger, use the active monitor window for advance notification.

There is a USER ALARM on hidden parameter 712) USER ALARM INPUT. You can connect this to any flag to trip the PL/X.

```
R  ENTRY MENU      LEVEL   1
R  MOTOR DRIVE ALARMS      2
 R  171)SPD TRIP ENABLE
    172)SPEED TRIP TOL
 R  173)FLD LOSS TRIP EN
    174)DOP SCCT TRIP EN
    175)MISSING PULSE EN
    176)REF EXCH TRIP EN
    177)OVERSPEED DELAY
 R  STALL TRIP MENU      3
    181)ACTIVE TRIP MON
    182)STORED TRIP MON
    183)EXT TRIP RESET
 R  DRIVE TRIP MESSAGE 3
```

If an alarm enables, triggers and latches, causing the PL/X to shut down, then after a further 10 ms, no additional alarms will be latched. Hence when monitoring for the latched status of alarms, it is unlikely that more than one alarm will be present.

If more than one alarm is present, use the DRIVE TRIP MESSAGE menu to determine the first alarm to arrive and cause the shutdown.

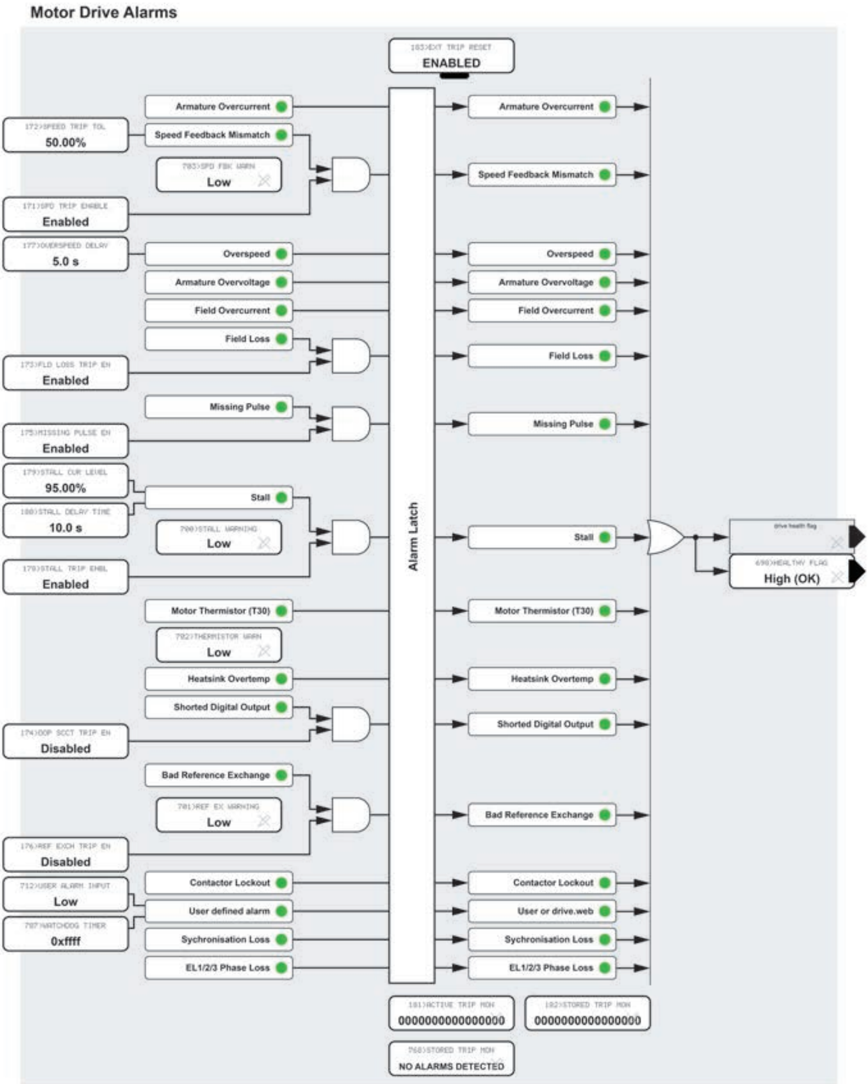


Figure 56 MOTOR DRIVE ALARMS - block diagram

13.1.1 171)SPD TRIP ENABLE

Enable/disable the speed feedback mismatch TRIP.

PIN	Parameter description	Range	Default
171	SPEED TRIP ENABLE	DISABLED ENABLED	ENABLED

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
R 171)SPD TRIP ENABLE

NOTE: Using armature voltage feedback suppresses this alarm.

The PL/X continuously compares the speed feedback to the armature voltage feedback. This alarm operates when the difference between the two is more than the value set by 172)SPEED TRIP TOL.

The PL/X suspends the comparison in the field weakening region (the region where the drive clamps the volts to a maximum value) if 103)FLD WEAK ENABLE is enabled. Instead, in this region, it checks if the speed feedback is below 10% of full speed, i.e. 10:1 range. If so, the alarm operates to indicate that it is not practical to start field weakening.

If 171)SPD TRIP ENABLE is disabled, then an automatic switch to AVF is implemented for tacho and encoder feedback, or both.

The automatic "switch to AVF" feature allows for continued running, although at the lower accuracy level of Armature Voltage Feedback. The AVF remains the source of feedback until the subsequent STOP / START sequence. The PL/X then restores the original feedback source and resets the alarm reset to allow auto AVF protection once again. It may be necessary to reduce the 172)SPEED TRIP TOL to about 15% if a smooth transfer to auto AVF is required. However, if the threshold is too low then an unwarranted transfer may occur during speed transients.

Hidden parameter 703)SPD FBK WARN signals a speed mismatch after the usual delay time. This flag is reset by the removal of START or JOG. To provide a warning that the auto AVF has occurred, we recommend configuring the flag to a digital output. Usually, the failure of the feedback mechanism triggers the speed feedback mismatch alarm in one of the following ways:

1. Disconnection of wiring.
2. Failure of the tachogenerator or encoder.
3. Failure of the tachogenerator or encoder mechanical coupling.

NOTE: Alarm delay time: 0.4 seconds to TRIP, 0.2 seconds to automatic AVF switch.

Correct setting of 110)MIN FIELD CURRENT should ensure that the overvolts TRIP occurs just above the maximum operating speed.

Feedback type	Fault mode	Result if trip ENABLED	Result if trip DISABLED
Armature Voltage	No faults normally possible.	Alarm suppressed	Alarm suppressed
	Armature voltage mode selected with field weakening enabled.	Drive TRIP when field weakening region entered.	Drive TRIP when field weakening region entered.
Tacho OR Encoder	Incorrect polarity and 172) SPEED TRIP TOL set to less than approximately 20%	Drive TRIP	Automatic switch to AVF
	Incorrect polarity and 172) SPEED TRIP TOL set to greater than approximately 20%	Drive TRIP	Drive TRIP
	Feedback loss and 172)SPEED TRIP TOL exceeded	Drive TRIP	Automatic switch to AVF
Tacho OR Encoder With field weakening	Incorrect polarity	Drive TRIP	Drive TRIP
	Total feedback loss (<10% signal)	Drive TRIP when field weakening region entered.	Drive TRIP when field weakening region entered.
	Partial feedback loss	Protection limited to armature overvolts TRIP at minimum field current	Protection limited to armature overvolts TRIP at minimum field current
Encoder + Armature Volts OR Encoder + Tacho. Combinational feedback	Incorrect encoder and/or tacho polarity and 172)SPEED TRIP TOL set to less than approximately 20%	Drive TRIP	Automatic switch to AVF
	Incorrect encoder and/or tacho polarity and 172)SPEED TRIP TOL set to greater than approximately 20%	Drive TRIP	Drive TRIP
	Encoder loss and 172)SPEED TRIP TOL exceeded.	Drive TRIP	Automatic switch to AVF. (The speed mismatch may be small because the AVF component is still valid, hence 172)SPEED TRIP TOL must be set low enough to ensure an automatic switch occurs).
	Tacho loss and 172)SPEED TRIP TOL exceeded	Drive TRIP	Automatic switch to AVF
Encoder + Armature Volts OR Encoder + Tacho. Combinational feedback with field weakening	Incorrect encoder and/or tacho polarity	Drive TRIP	Drive TRIP
	Total encoder and/or tacho loss (<10% signal)	Drive TRIP when field weakening region entered.	Drive TRIP when field weakening region entered.
	Partial encoder and/or tacho loss	Protection limited to armature overvolts TRIP at minimum field current	Protection limited to armature overvolts TRIP at minimum field current
	Encoder + Armature voltage mode selected with field weakening enabled	Drive TRIP when field weakening region entered.	Drive TRIP when field weakening region entered.

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

The protection provided in field weakening mode is limited to total feedback loss only because the speed/AVF relationship is not maintainable in the field weakening mode. If a partial loss of feedback occurs, the motor may run to excessive speed. When the field is entirely weakened and is at its minimum level, the armature overvoltage trip will operate. It may only occur at dangerous speeds. Therefore, we recommend using a mechanical device, a backup system, or both to protect against this possibility.

13.1.2 172)SPEED TRIP TOL

Set the speed feedback mismatch trip tolerance.

PIN	Parameter description	Range	Default
172	SPEED TRIP TOLERANCE	0.00 to 100.00%	50.00%

If this value is set too low, then spurious alarms may be caused by dynamic lags or non-linear effects.

Mismatched calibration between the AVF calibration, and the calibration of the tacho and encoder or both, erodes this margin.

Hidden parameter 703)SPD FBK WARN signals a speed mismatch after the normal delay time. A START or JOG command resets this flag.

```
R  ENTRY MENU        LEVEL   1
R  MOTOR DRIVE ALARMS        2
     └172)SPEED TRIP TOL
```

13.1.3 173)FLD LOSS TRIP EN

Enable/disable the field failure alarm trip.

PIN	Parameter description	Range	Default
173	FIELD LOSS TRIP ENABLE	DISABLED ENABLED	ENABLED

Alarm delay time: 2.00 seconds.

This alarm usually triggers if the field current drops below 20% of the rated current (5% in field weakening mode). Faulty operation of the field controller may also cause a motor field fail alarm. The most frequent cause for the motor field alarm is an open-circuit motor field. If this alarm occurs, check the motor field connections and measure the field resistance.

The resistance of the field = data plate field volts/data plate field current.

```
R  ENTRY MENU        LEVEL   1
R  MOTOR DRIVE ALARMS        2
   R └173)FLD LOSS TRIP EN
```

CAUTION!

EQUIPMENT DAMAGE HAZARD

For rated field currents that are less than 25% of model rating, the alarm threshold may be too low to trigger. Test the alarm. To defeat this problem, set 4)RATED FIELD AMPS to a higher level and 114)FIELD REFERENCE to a lower level to raise the threshold, e.g. set PIN 4 to twice motor rating and PIN 114 to 50.00%.

If the PL/X is feeding a load that requires no field supply, for example, a permanent magnet motor, then set 99)FIELD ENABLE to DISABLED to automatically inhibit the field fail alarm.

13.1.4 174)DOP SCCT TRIP EN

Enable/disable the digital output short-circuit alarm trip.

PIN	Parameter description	Range	Default
174	DIGITAL OUTPUT SHORT-CIRCUIT TRIP ENABLE	DISABLED ENABLED	DISABLED

All digital outputs and the 24 V user supply will withstand a direct short-circuit to 0 V. This will trigger an internal alarm and disable the remaining digital outputs, resulting in low output. (Short-circuit current is approximately 350 mA for digital outputs and 400 mA for +24 V).

The PL/X will continue to run if the alarm is disabled, and the shorting fault has not prevented the normal running of the PL/X.

NOTE: The +24 V terminal T35 will remain active with a capability of 50 mA if any digital output is shorting. Shorting the +24 V output activates the short-circuit alarm, causing all digital outputs to go low. In this case, if the +24 V is being used to enable CSTOP or START, then the PL/X will stop.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
174)DOP SCCT TRIP EN

13.1.5 175)MISSING PULSE EN

Enable/disable the missing pulse alarm trip.

PIN	Parameter description	Range	Default
175	MISSING PULSE ENABLE	DISABLED ENABLED	ENABLED

Alarm delay: approximately 30 seconds.

The PL/X continuously monitors the armature current waveform. If a fault develops within the PL/X or the armature bridge, one or more pulses may be missing from the normal 6-pulse armature current waveform. Although the PL/X may appear to function normally, the motor will experience excess heating due to the distorted current waveform.

If at least one of the six current pulses is missing from the feedback waveform, and the current demand is above the level set in 95)CUR DISCONTINUITY then the system will start counting missing pulses. The alarm will trigger after a sequential series of missing pulses lasting approximately 30 seconds.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
175)MISSING PULSE EN

The most frequent causes of missing pulses are:

- An open circuit main supply fuse.
- Gate lead plug not properly connected after a stack maintenance procedure.
- Failure to perform a current loop autotune.
- Excessive speed feedback ripple.

13.1.6 176)REF EXCH TRIP EN

Enable/disable the REFERENCE EXCHANGE data link alarm trip.

PIN	Parameter description	Range	Default
176	REFERENCE EXCHANGE TRIP ENABLE	DISABLED ENABLED	DISABLED

Alarm delay: 1.5 seconds.

The PL/X can transmit and receive a speed reference, or any other single parameter, to or from another drive using the serial port.

During the receive cycle, the PL/X checks that the data received is valid. Invalid data will raise the alarm. It only applies when operating in SLAVE mode. Refer to the PL/X Serial Communications Manual, HG105289EN00. (RS232 PORT 1). The alarm flag is available on hidden parameter 701)REF XC WARNING.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
176)REF EXCH TRIP EN

13.1.7 177)OVERSPEED DELAY

Set the delay time before the overspeed alarm is latched.

PIN	Parameter description	Range	Default
177	OVERSPEED DELAY	0.1 to 600.0 seconds	5.0 seconds

Refer to "13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE" on page 234 - OVERSPEED.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
177)OVERSPEED DELAY

13.1.8 181)ACTIVE TRIP MON

Monitor the status of the 16 active alarms (4 groups of 4 in HEX code) - prior to latch.

PIN	Parameter description	Range
181	ACTIVE TRIP MONITOR	Refer to table below.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
181)ACTIVE TRIP MON

13.1.9 182)STORED TRIP MON

Monitor the status of the 16 active alarms (4 groups of 4 in HEX code).

PIN	Parameter description	Range
182	STORED TRIP MONITOR	Refer to table below.

The four characters in the window are HEX codes. Codes 0, 1, 2, 4, 8 are the most likely. Other codes only occur when two or more alarms are active in any group. The table below shows HEX code binary equivalents and how you can decode them to binary logic into sixteen flags from right to left, in four groups of four.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
182)STORED TRIP MON

HEX Code	Binary	HEX Code	Binary
0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

NOTE: When this value connects to another PIN, then the pure binary to decimal equivalent is used (the most significant bit on the right, the least significant on the left).

Example display: 0005 shows ARMATURE OVERCURRENT and OVERSPEED
0060 shows FIELD LOSS and MISSING PULSE.

NOTE: There is an Application Block called 16-BIT DEMULTIPLEX which can extract a flag for each of these Alarms. Refer to "16 The APPLICATION BLOCKS menu" on page 245 for more detail.

		HEX	HEX	HEX	HEX	
		decode	decode	decode	decode	
		0000	0000	0000	0000	
		0	0	0	5	Example displays
		0	0	6	0	
List of motor alarms	**Bits for 16-BIT DEMULTIPLEX Application Block**					
ARMATURE OVERCURRENT	Bit 1				0001	
SPEED FBK MISMATCH	Bit 2				0010	
OVERSPEED	Bit 3				0100	
ARMATURE OVERVOLTS	Bit 4				1000	
FIELD OVERCURRENT	Bit 5			0001		
FIELD LOSS	Bit 6			0010		
MISSING PULSE	Bit 7			0100		
STALL TRIP	Bit 8			1000		
THERMISTOR ON T30	Bit 9		0001			
HEATSINK OVERTEMP	Bit 10		0010			
SHORT CCT DIG OP	Bit 11		0100			
BAD REFERENCE EXCH	Bit 12		1000			
CONTACTOR LOCK OUT	Bit 13	0001				
USER ALARM INPUT (PIN 712)	Bit 14	0010				
SYNCHRONIZATION LOSS	Bit 15	0100				
SUPPLY PHASE LOSS	Bit 16	1000				

13.1.10 183)EXT TRIP RESET

Enable/disable the trip to be reset by START on T33 going low.

PIN	Parameter description	Range	Default
183	EXTERNAL TRIP RESET	DISABLED ENABLED	ENABLED

When DISABLED, this prevents re-starting after a trip.

R ENTRY MENU LEVEL 1

R MOTOR DRIVE ALARMS 2

183)EXT TRIP RESET

WARNING!

PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

Do not rely on the action of parameter 183)EXT TRIP RESET for safety.

13.2 MOTOR DRIVE ALARMS / STALL TRIP MENU

Refer to"11.11.1.1 Achieving overloads >150%" on page 177. In this case, you must set 179)STALL CUR LEVEL set below 82)O / LOAD % TARGET for stall protection.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
R STALL TRIP MENU 3
R 178)STALL TRIP ENBL
R 179)STALL CUR LEVEL
R 180)STALL DELAY TIME

13.2.1 178)STALL TRIP ENBL

Enable/disable the motor stall alarm trip.

PIN	Parameter description	Range	Default
178	STALL TRIP ENABLE	DISABLED ENABLED	ENABLED

Some DC motors are not capable of carrying large amounts of current when stationary. If the current exceeds a particular limit and the motor is static, the PL/X can provide this stall trip alarm.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

When using **armature voltage feedback**, the IR drop may be sufficient to provide a signal in excess of 117)ZERO INTLK SPD % preventing the stall alarm from operating. To rectify, set 14)IR COMPENSATION as accurately as possible; then test the alarm with a stalled motor (disable the field); progressively increase current limit to above the 179)STALL CUR LEVEL; now check that the AV speed feedback remains below 117)ZERO INTLK SPD %. It may be necessary to increase 117)ZERO INTLK SPD % to ensure tripping.

R ENTRY MENU LEVEL 1
R MOTOR DRIVE ALARMS 2
R STALL TRIP MENU 3
R 178)STALL TRIP ENBL

The alarm is activated if:

- 178)STALL TRIP ENBL is enabled
- **and** the current is above 179)STALL CUR LEVEL
- **and** the motor is at zero speed (below ZERO INTERLOCKS / 117)ZERO INTLK SPD %) for longer than 180)STALL DELAY TIME.

13.2.2 179)STALL CUR LEVEL

Set the stall alarm trip LEVEL as a % of rated motor Amps.

PIN	Parameter description	Range	Default
179	STALL CURRENT LEVEL	0.00 to 150.00%	95.00%

```
R  ENTRY MENU      LEVEL    1
R  MOTOR DRIVE ALARMS       2
R  STALL TRIP MENU          3
R   └179)STALL CUR LEVEL
```

13.2.3 180)STALL DELAY TIME

Set the delay time between stall being detected and alarm trigger.

PIN	Parameter description	Range	Default
180	STALL DELAY TIME	0.1 to 600.0 seconds	10.0 seconds

```
R  ENTRY MENU      LEVEL    1
R  MOTOR DRIVE ALARMS       2
R  STALL TRIP MENU          3
R   └180)STALL DELAY TIME
```

13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE

The name of the active alarm that triggers the PL/X to shut down is stored and displayed. For example, the PL/X may show the following:

R	ENTRY MENU LEVEL 1
R	MOTOR DRIVE ALARMS 2
R	DRIVE TRIP MESSAGE 3

```
!!!!!! ALARM !!!!!!!
 THERMISTOR ON T30
```

- To clear the alarm from the display, tap the LEFT key or start the PL/X.
- To see the last alarm, view the DRIVE TRIP MESSAGE menu. This menu will store this alarm even after removing the control supply.
- To remove the stored last alarm, view the DRIVE TRIP MESSAGE menu and tap the DOWN key.

If no alarm is triggered or stored, the DRIVE TRIP MESSAGE menu will display:

```
MOTOR DRIVE ALARMS 2
 NO ALARMS DETECTED
```

The following alarms may be triggered:

DRIVE TRIP MESSAGE : **Alarms**	R
Alarm delay time: 1.5 seconds. This alarm operates for current feedback values exceeding 170% of the maximum model current, or 300% of 2)RATED ARM AMPS, whichever occurs first. Motor Faults: If the motor armature windings fail, the armature impedance may drop sharply. It may cause excessive armature current, which will activate the current trip. If this occurs, check the motor armature insulation resistance (using a Megger), which must be above acceptable limits. (Disconnect the PL/X when using a Megger). If the motor becomes completely short-circuited, the current trip will not protect the PL/X. Always provide high-speed semiconductor thyristor fusing to protect the thyristor stack. Alarm delay time: The alarm will allow 300% loading for approximately 10 ms and 400% for 5 ms.	!!!!!! ALARM !!!!!!! ARMATURE OVERCURRENT
This alarm operates if the motor armature voltage feedback exceeds 18)RATED ARM VOLTS by more than 20%. 18)RATED ARM VOLTS may be lower than the data plate maximum. This alarm operates with any source of speed feedback. The causes for this alarm can be a poorly adjusted field voltage setting, field current loop, field-weakening back emf loop or speed loop overshooting.	!!!!!! ALARM !!!!!!! ARMATURE OVERVOLTS

Alarm delay time: 15 seconds. The PL/X checks that the field current does not exceed 115% of 4)RATED FIELD AMPS. Regulator failure, or a poorly tuned control loop causing overshoots, can cause this alarm to activate.	!!!!!! ALARM !!!!!!! FIELD OVERCURRENT
Alarm delay time: 2 seconds. Refer to "13.1.3 173)FLD LOSS TRIP EN" on page 227.	!!!!!! ALARM !!!!!!! FIELD LOSS
Alarm delay time: 0.5 seconds. Hidden PIN 712 will cause a trip if it goes high. Use a jumper to connect to the flag source. Refer to "17.16 CONFIGURATION / JUMPER CONNECTIONS" on page 360.	!!!!!! ALARM !!!!!!! USER TRIP
Alarm delay time: 10 seconds. This alarm operates if the resistance between T30 and T36 exceeds 1800 Ohm. There is no motor temperature alarm inhibit. You must link terminals T30 and T36 if you are not fitting sensors. • Temperature-sensitive resistors have low resistance (typically 200 Ω) up to a reference temperature of 125°C. Above this, their resistance rises rapidly to greater than 2000 Ω. • Temperature switches are usually normally-closed, opening at about 105°C. **NOTE:** Hidden parameter 702)THERMISTOR WARN signals a thermistor over-temperature after the normal delay time. A START or JOG command resets this flag.	!!!!!! ALARM !!!!!!! THERMISTOR ON T30 Motors overheat due to many factors, but the most common cause is inadequate ventilation. Check for: • Blower failure. • Incorrect rotation of the blower. • Ventilation slots blocked. • Air filters clogged. Other causes of overheating relate to excessive field current and excessive armature current: • Check the nominal armature current on the motor nameplate against the current calibration for the PL/X. **The motor must be allowed to cool before restarting the PL/X.**

Alarm delay time: 0.5 seconds + 177)OVERSPEED DELAY (Refer to "13.1.7 177)OVERSPEED DELAY" on page 229).

This alarm operates if the speed feedback signal exceeds 110% of the rated speed for longer than the alarm delay time.

A likely cause for the alarm is a poorly adjusted speed loop or the overhauling of motors controlled by 2-quadrant models.

```
!!!!!! ALARM !!!!!!!
     OVERSPEED
```

This alarm operates if trying to field weaken with armature voltage feedback mode selected.

A likely cause for the alarm is incorrect tacho polarity, scaling and encoder scaling.

Refer to "13.1.1 171)SPD TRIP ENABLE" on page 225.

```
!!!!!! ALARM !!!!!!!
 SPEED FBK MISMATCH
```

This alarm operates if the current exceeds a particular limit and the motor is stationary.

Refer to "13.2.1 178)STALL TRIP ENBL" on page 232.

```
!!!!!! ALARM !!!!!!!
     STALL TRIP
```

This alarm operates after a sequential series of missing pulses lasting for approximately 30 seconds.

Refer to "13.1.5 175)MISSING PULSE EN" on page 228.

```
!!!!!! ALARM !!!!!!!
   MISSING PULSE
```

Alarm delay time: 2.0 seconds.

11. This alarm operates if the EL1 and/or EL2 supplies are lost at any time START or JOG is made. The incoming supply of the EL1, EL2 connections are continuously monitored. The subsequent control action depends on the running condition at the time the alarm is triggered.
    The main contactor de-energises after the ride-through time of 2 seconds elapses if energised at the time of the failure. Restoring the supply before the ride-through time elapses resumes normal running. During the temporary supply loss period, the PL/X will shut off the armature current demand until it is safe to restore. The PL/X measures the back emf to calculate a safe start into the rotating load.

    If the main contactor de-energises at the time of the supply loss, then a Start command will allow the contactor to energise but inhibits the armature current. After a few seconds, the contactor will be de-energised.

```
!!!!!! ALARM !!!!!!!
 SUPPLY PHASE LOSS
```

In the case of a supply phase loss alarm, check:

- The supply to the PL/X.
- The auxiliary and main high-speed semiconductor fuses.

Refer to "10.7 Supply loss shutdown" on page 106.

The PL/X monitors the supply on EL1/2, allowing using AC supply or DC outgoing main contactors.

Continued...

!!!!!! ALARM !!!!!!!
SUPPLY PHASE LOSS

The Control Supply on T52 and T53 can tolerate a supply loss for 300 ms at 240 Vac, and 30 ms at 110 Vac, before requesting permanent shut down. Refer to "11.1.14 19)EL1/2/3 RATED AC" on page 125.

The PL/X will detect a total failure of the supply and a missing phase under most circumstances. However, the PL/X may be sharing a supply with other equipment that is regenerating a voltage onto the supply lines during the missing phase period. Under these circumstances, the SUPPLY PHASE LOSS alarm may be unable to detect the failure of the incoming supply and hence not operate.

MOTOR DRIVE ALARMS 2
SYNCHRONIZATION LOSS

Alarm delay time: 0.5 seconds.

This alarm operates if the supply frequency exceeds the minimum/maximum limits or if the PL/X uses a power supply having excessive distortion, causing synchronisation errors.

The PL/X automatically "locks on" to any 3-phase supply within a frequency range of 45 to 65 Hertz. It allows the thyristors to fire at the correct instant during each supply cycle. The synchronisation circuit can cope with a sizeable level of supply distortion to ensure operation with very distorted supplies. The lock-on time is 0.75 seconds. By adopting the standard wiring configuration with EL1/2/3 permanently energised, the phase lock only needs to lock on during the first application of power, enabling the main contactor to be operated very rapidly with minimal start-up delay if required.

Wiring configurations that involve the application of the auxiliary supply coincident with a start requirement will have 0.75 second delay prior to main contactor energisation.

NOTE: This alarm will operate during running. If there is a failure to achieve synchronisation at Start, then the alarm CONTACTOR LOCK OUT is displayed. Refer to "13.3 MOTOR DRIVE ALARMS / DRIVE TRIP MESSAGE" on page 234 - CONTACTOR LOCK OUT.

Alarm delay time: 0.75 seconds. This alarm operates if there is a blower failure or restriction of the cooling airflow causing the heatsink temperature to rise to an unacceptable level. • If this alarm operates on PL/Xs fitted with a heatsink blower, check the unit and cooling air path for obstructions. • Models with twin top-mounted fans have fan stall protection. Removing an obstruction should restart the fan. If the fan does not run, replace the fan assembly. • For PL/Xs with an AC-driven rear-mounted fan (PL/X 185/225/265), check that the 110 Vac fan supply is present on terminals B1, B2. • For PL/X 275 - 980, check that the 240 Vac fan supply is present on the terminals provided under the lower connection cover.	!!!!!! ALARM !!!!!!! HEATSINK OVERTEMP • Always supply the PL/X enclosure with sufficient cool, dry clean air. Refer to "10 Technical specifications" on page 91. • The PL/X must be allowed to cool before attempting to restart.
This alarm operates if a digital output experiences a short circuit. Refer to "13.1.4 174)DOP SCCT TRIP EN" on page 228.	!!!!!! ALARM !!!!!!! DIGITAL OP SHORTED
This alarm operates if the PL/X receives invalid data. Refer to "13.1.6 176)REF EXCH TRIP EN" on page 229. **NOTE:** Hidden parameter 701)REF XC WARNING signals a bad reference exchange.	!!!!!! ALARM !!!!!!! BAD REFERENCE EXCH
This alarm operates if, during the autotune activity, speed feedback is >20% of rated speed, or field current feedback is >5% of rated field current. During Autotune, the PL/X turns off the field to prevent shaft rotation. **NOTE:** Speed feedback being >20% may be caused by residual field magnetisation resulting in shaft rotation. If so, retry the Autotune with the motor shaft being mechanically locked.	MOTOR DRIVE ALARMS 2 CANNOT AUTOTUNE

This alarm operates if the User aborts Autotune: • It quits the Autotune function if the coast stop, start or run terminals are disabled (taken low). • It quits if the ANDED START or ANDED RUN is taken low. • Alternatively, this message displays if 92) AUTOTUNE ENABLE is DISABLED during its Autotune sequence. Refer to "11.10.6 92) AUTOTUNE ENABLE" on page 171. • Autotune aborts if the Autotune function times out (after approximately 2 minutes).	MOTOR DRIVE ALARMS 2 AUTOTUNE QUIT
Two events may cause this alarm to trigger when RUN is requested: 1. The incoming 3-phase supply may be of insufficient quality to allow the synchronisation circuit to measure its frequency and phase rotation, or both. It may be due to an intermittent or missing phase on EL1/2/3. 2. The ZERO REFERENCE interlock function is enabled, but the operator fails to reset the external speed references to zero. Refer to "11.15 CHANGE PARAMETERS / ZERO INTERLOCKS" on page 192. On triggering the alarm, the current loop inhibits, followed by de-energisation of the contactor.	!!!!!! ALARM !!!!!!! CONTACTOR LOCK OUT

14 The SERIAL LINKS menu

NOTE: We retain references to PL PILOT and early Windows PCs in this manual for users with older PL/Xs. A Recipe (backed-up configuration) created in the legacy Pilot configuration tool is not (necessarily) the same as one of the three Recipe pages described on Page 363.

WARNING!
PERSONAL INJURY AND/OR EQUIPMENT DAMAGE HAZARD

The PL/X suspends Comms operation while in CONFIGURATION mode. Refer to "17 The CONFIGURATION menu" on page 323 and "17.2.1 CONFIGURATION / ENABLE GOTO,GETFROM" on page 325.

```
R  ENTRY MENU      LEVEL    1
R  SERIAL LINKS             2
R  RS232 PORT1              3
   R  187)PORT1 BAUD RATE
      188)PORT1 FUNCTION
      PARAMETER EXCHANGE 4
      REFERENCE EXCHANGE 4
      PORT1 COMMS LINK   4
```

The Serial Links Manual, HG105289EN00, describes how to identify the PL/X and establish a connection with the host PC or DCS.

It shows how to configure the PL/X to:

- Remotely control one or more PL/Xs from a host computer using a serial link.
- Configure one or more PL/Xs using "drive.web® savvy®", a PC based configuration tool.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   FIELDBUS CONFIG          3
      JUMPER 1           4
      JUMPER 2           4
      JUMPER 3           4
      JUMPER 4           4
      JUMPER 5           4
      JUMPER 6           4
      JUMPER 7           4
      JUMPER 8           4
      BIT-PACKED GETFROM
      JUMPER 9           4
      JUMPER 10          4
      JUMPER 11          4
      JUMPER 12          4
      JUMPER 13          4
      JUMPER 14          4
      JUMPER 15          4
      JUMPER 16          4
      BIT-PACKED GOTO
      199)FBUS DATA CONTRL
```

The FIELDBUS manual, HG105409EN00, describes using the FIELDBUS board and installing the Anybus CompactCom module to:

- Communicate using a variety of Fieldbus protocols by fitting an AnybusCompactCom module.

NOTE: Port1 is a non-isolated RS232 port used for PL/X configuration and serial communications.

15 The DISPLAY FUNCTIONS menu

Use this menu to adjust the display presentation, provide password control, select a display language, and display the software version.

15.1 DISPLAY FUNCTIONS

The REDUCED MENU shows only the more commonly used parameters, and this will help you navigate the menu structure more rapidly.

```
R  ENTRY MENU      LEVEL   1
R  DISPLAY FUNCTIONS       2
 R  REDUCED MENU ENABLE
 R  PASSWORD CONTROL      3
    LANGUAGE SELECT
 R  SOFTWARE VERSION
```

15.1.1 REDUCED MENU ENABLE

Enable/disable the reduced menu display.

	Parameter description	Range	Default
	REDUCED MENU ENABLE	DISABLED ENABLED	DISABLED

```
R  ENTRY MENU      LEVEL   1
R  DISPLAY FUNCTIONS       2
 R  REDUCED MENU ENABLE
```

15.1.2 LANGUAGE SELECT

Select display language.

	Parameter description	Range	Default
	LANGUAGE SELECT	0 : ENGLISH 1-3 not in use	ENGLISH

In the future, this parameter will select an alternative display language.

```
R  ENTRY MENU      LEVEL   1
R  DISPLAY FUNCTIONS       2
    LANGUAGE SELECT
```

15.1.3 SOFTWARE VERSION

The software version of the installed code.

	Parameter description	Range
	SOFTWARE VERSION	Version number

```
R  ENTRY MENU      LEVEL    1
R  DISPLAY FUNCTIONS        2
  R └ SOFTWARE VERSION
```

15.2 DISPLAY FUNCTIONS / PASSWORD CONTROL

The password will prevent alteration by unauthorised users.

The default password and power-up entry are set to 0000, thereby unlocking the PL/X.

- If you change the password, you must perform a PARAMETER SAVE to store it.
- You must enter the correct password to make parameter changes.
- An incorrect password flashes the message ENTER PASSWORD when pressing the UP/DOWN keys. Refer also to "17.19.1 677)RECIPE PAGE" on page 363.
- Even though each Recipe page can have a separate password, we recommend using the same password to avoid confusion.
- The password from a source page is included with the file when using parameter exchange for use by the Recipe page of the receiving drive. **Managing this requires careful housekeeping.**

```
R  ENTRY MENU      LEVEL    1
R  DISPLAY FUNCTIONS        2
 R  ├ PASSWORD CONTROL      3
 R  ├ ENTER PASSWORD
 R  └ ALTER PASSWORD
```

NOTE: PL PILOT software, 188)PORT1 FUNCTION and 187)PORT1 BAUD RATE are not subject to password control. Therefore, you can overcome the problem of forgotten passwords by using the PL PILOT config tool to save the Recipe, which you can then reload after the password has been restored to 0000 on the Recipe page NORMAL RESET, using a 4-KEY RESET. Refer to "9.3 Restoring parameters to default conditions" on page 79.

If you have lost your password, contact Sprint Electric for assistance.

15.2.1 ENTER PASSWORD

Enter the correct password here to unlock the parameters.

	Parameter description	Range	Default
	ENTER PASSWORD	0000 to FFFF	0000

```
ENTRY MENU     LEVEL   1
DISPLAY FUNCTIONS      2
R  ENTER PASSWORD
```

- Entering a correct password causes ALTER PASSWORD to display the password.
- Entering an incorrect password causes ALTER PASSWORD to display ****.

Each Recipe page may have its own password. Refer to "17.19.1 677)RECIPE PAGE" on page 363.

15.2.2 ALTER PASSWORD

Set a new password here to unlock the parameters.

	Parameter description	Range	Default
	ALTER PASSWORD	0000 to FFFF	0000

```
ENTRY MENU     LEVEL   1
DISPLAY FUNCTIONS      2
R  ALTER PASSWORD
```

To set a new password:

1. In ENTER PASSWORD, enter the existing password.
2. In ALTER PASSWORD, enter your new password.

The new password is active immediately. ENTER PASSWORD now displays the new password.

Now perform a PARAMETER SAVE to store the new password.

16 The APPLICATION BLOCKS menu

The PL/X contains a comprehensive range of extra system application blocks. Use these to create complex control applications.

When application blocks are processed, the workload on the internal microprocessor increases:

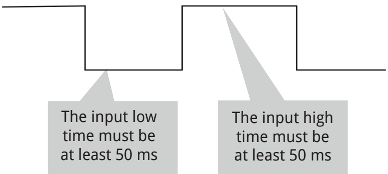
- With no application blocks activated, the time taken to perform all the necessary tasks (cycle time) is approximately 5 ms.
- With all the application blocks activated, the cycle time is approximately 10 ms.

With these timings in mind, we recommend that external logic signals are stable long enough to be recognised. The logic input, minimum dwell time, has been specified at 50 ms to achieve this. Much lower dwell times than this are possible for straightforward installations where the cycle time is less. However, the risk is that a future re-configuration of the blocks might increase the cycle time sufficiently to cause sampling problems.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
SUMMER 1 3
SUMMER 2 3
PID 1 3
PID 2 3
PARAMETER PROFILER 3
REEL DIAMETER CALC 3
TAPER TENSION CALC 3
TORQUE COMPENSATOR 3
PRESET SPEED 3
MULTI-FUNCTION 1 3
MULTI-FUNCTION 2 3
MULTI-FUNCTION 3 3
MULTI-FUNCTION 4 3
MULTI-FUNCTION 5 3
MULTI-FUNCTION 6 3
MULTI-FUNCTION 7 3
MULTI-FUNCTION 8 3
LATCH 3
FILTER 1 3
FILTER 2 3
BATCH COUNTER 3
INTERVAL TIMER 3
COMPARATOR 1 3
COMPARATOR 2 3
COMPARATOR 3 3
COMPARATOR 4 3
C/O SWITCH 1 3
C/O SWITCH 2 3
C/O SWITCH 3 3
C/O SWITCH 4 3
16-BIT DEMULTIPLEX 3

Logic levels

Logic inputs will recognise the value zero (any units) as a logic LOW. All other numbers, including negative numbers, will be recognised as a logic HIGH.



Activating blocks

Refer to "9.1 Configuring the drive" on page 77 for information about activating blocks and connecting parameters.

Order of processing

The table below shows the block processing order within each cycle.

1	C/O switch 1-4	7	Taper Tension Calc	13	Batch Counter
2	Multi-function 1-8	8	Summer 2 (output maths)	14	Interval Timer
3	Summer 1 & 2 (input deadband)	9	Torque Compensator	15	Filter 1 & 2
4	PID 1 & 2	10	Preset Speed	16	Comparator 1-4
5	Summer 1 (output maths)	11	Parameter Profiler	17	16-Bit Demultiplex
6	Reel Diameter Calc	12	Latch	18	LP Filter

16.1 APPLICATION BLOCKS / SUMMER 1, 2

Program a general-purpose signal summing and scaling block. There are two identical, independent SUMMER blocks. They identify by the suffix 1 and 2. This description shows only the PINs for SUMMER1.

Parameter	SUMMER 1	SUMMER 2
OP MON	401	415
SIGN1	402	416
SIGN2	403	417
RATIO1	404	418
RATIO2	405	419
DIVIDER1	406	420
DIVIDER2	407	421
INPUT1	408	422
INPUT2	409	423
INPUT3	410	424
DEADBAND	411	425
OP INVRT	412	426
CLAMP	413	427

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
    SUMMER 1              3
    401)SUMMER1 OP MON
    402)SUMMER1 SIGN1
    403)SUMMER1 SIGN2
    404)SUMMER1 RATIO1
    405)SUMMER1 RATIO2
    406)SUMMER1 DIVIDER1
    407)SUMMER1 DIVIDER2
    408)SUMMER1 INPUT1
    409)SUMMER1 INPUT2
    410)SUMMER1 INPUT3
    411)SUMMER1 DEADBAND
    412)SUMMER1 OP INVRT
    413)SUMMER1 CLAMP
```

The GOTO of this block resides in the CONFIGURATION/BLOCK OP CONFIG menu - refer to Page 361.

There are two hidden PINs in each block for CH2 and CH1 subtotal outputs.

SUMMER1: Hidden PINs 691 CH2 and 692 CH1

SUMMER2: Hidden PINs 693 CH2 and 694 CH1

PINs 401 and 415 are outputs (monitors). Connect the block's GOTO to have the SUMMER block calculate the output.

16.1.1 401)SUMMER 1 OP MON

Monitor the final total output value of the SUMMER1 block.

PIN	Parameter description	Range
401	SUMMER 1 OUTPUT MONITOR	±200.00%

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
    SUMMER 1              3
    401)SUMMER1 OP MON
```

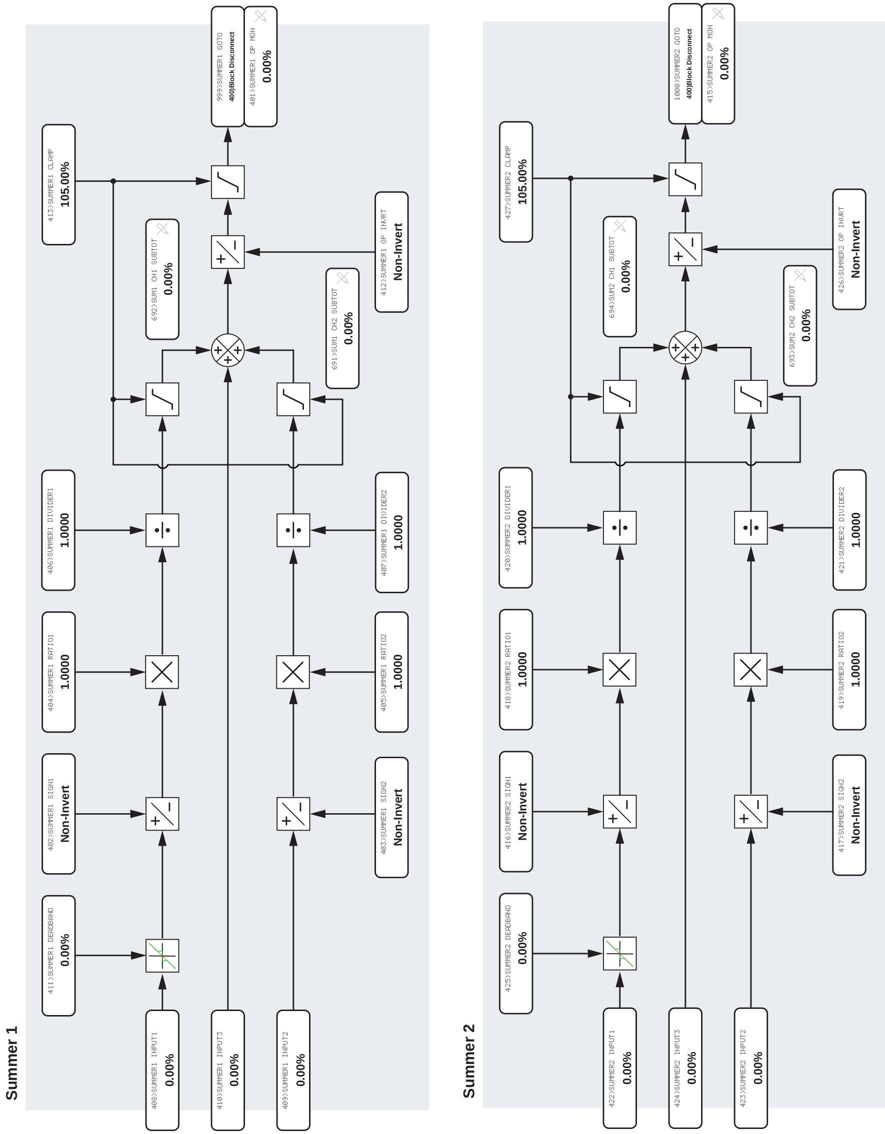


Figure 57 SUMMER1, SUMMER 2 - block diagrams

16.1.2 402)SUMMER1 SIGN1

Invert the signal arriving at Input 1.

PIN	Parameter description	Range	Default
402	SUMMER1 SIGN1	INVERT NON-INVERT	NON-INVERT

```
R  ENTRY MENU     LEVEL    1
   APPLICATION BLOCKS      2
     SUMMER 1              3
     402)SUMMER1 SIGN1
```

16.1.3 403)SUMMER1 SIGN2

Invert the signal arriving at Input 2.

PIN	Parameter description	Range	Default
403	SUMMER1 SIGN2	INVERT NON-INVERT	NON-INVERT

```
R  ENTRY MENU     LEVEL    1
   APPLICATION BLOCKS      2
     SUMMER 1              3
     403)SUMMER1 SIGN2
```

16.1.4 404)SUMMER1 RATIO1

Set the ratio value for the signal arriving at Input 1.

PIN	Parameter description	Range	Default
404	SUMMER1 RATIO1	±3.0000	1.0000

```
R  ENTRY MENU     LEVEL    1
   APPLICATION BLOCKS      2
     SUMMER 1              3
     404)SUMMER1 RATIO1
```

16.1.5 405)SUMMER1 RATIO2

Set the ratio value for the signal arriving at Input 2.

PIN	Parameter description	Range	Default
405	SUMMER1 RATIO2	±3.0000	1.0000

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
      SUMMER 1              3
      405)SUMMER1 RATIO2
```

16.1.6 406)SUMMER1 DIVIDER1

Set the divisor for the signal arriving at Input 1.

PIN	Parameter description	Range	Default
406	SUMMER1 DIVIDER1	±3.0000	1.0000

A zero gives zero output.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
      SUMMER 1              3
      406)SUMMER1 DIVIDER1
```

16.1.7 407)SUMMER1 DIVIDER2

Set the divisor for the signal arriving at Input 2.

PIN	Parameter description	Range	Default
407	SUMMER1 DIVIDER2	±3.0000	1.0000

A zero gives zero output.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
      SUMMER 1              3
      407)SUMMER1 DIVIDER2
```

16.1.8 408)SUMMER1 INPUT1

Set the value for Input 1.

PIN	Parameter description	Range	Default
408	SUMMER1 INPUT1	±300.00%	0.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
      SUMMER 1              3
      408)SUMMER1 INPUT1
```

16.1.9 409)SUMMER1 INPUT2

Set the value for Input 2.

PIN	Parameter description	Range	Default
409	SUMMER1 INPUT2	±300.00%	0.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
      SUMMER 1              3
      409)SUMMER1 INPUT2
```

16.1.10 410)SUMMER1 INPUT3

Set the value for Input 3.

PIN	Parameter description	Range	Default
410	SUMMER1 INPUT3	±300.00%	0.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
      SUMMER 1              3
      410)SUMMER1 INPUT3
```

16.1.11 411)SUMMER1 DEADBAND

Set ±% deadband width, centred on 0.00%, for Input 1.

PIN	Parameter description	Range	Default
411	SUMMER1 DEADBAND	0.00 to 100.00%	0.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     SUMMER 1               3
     411)SUMMER1 DEADBAND
```

16.1.12 412)SUMMER1 OP INVRT

Invert the output signal from the SUMMER1 block.

PIN	Parameter description	Range	Default
412	SUMMER1 OUTPUT INVERT	INVERT NON-INVERT	NON-INVERT

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     SUMMER 1               3
     412)SUMMER1 OP INVRT
```

16.1.13 413)SUMMER1 CLAMP

Set the value of a symmetrical clamp for Input 1, Input 2 and Output.

PIN	Parameter description	Range	Default
413	SUMMER1 CLAMP	0.00 to 200.00%	105.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     SUMMER 1               3
     413)SUMMER1 CLAMP
```

16.2 APPLICATION BLOCKS / PID 1, 2

The PID block performs the function of a classical PID to allow the implementation of an external control loop. Typical uses are Dancer Arm, Loadcell Tension, Centre Driven Winding.

There are two identical, independent PID blocks. They identify by the suffix 1 and 2. This description shows only the PINs for PID1.

Parameter	PID 1	PID 2
OP MONITOR	429	452
INPUT1	430	453
RATIO1	431	454
DIVIDER1	432	455
INPUT2	433	456
RATIO2	434	457
DIVIDER2	435	458
PROP GAIN	436	459
INTEGRAL TC	437	460
DERIV TC	438	461
FILTER TC	439	462
INT PRESET	440	463
PRESET VAL	441	464
RESET	442	465
POS CLAMP	443	466
NEG CLAMP	444	467
PID1 OUTPUT TRIM	445	468
PROFL MODE	446	469
MIN PROP GN	447	470
X-AXIS MIN	448	471
PROFILED GN	449	472
CLAMP FLAG	450	473
ERROR MON	451	474

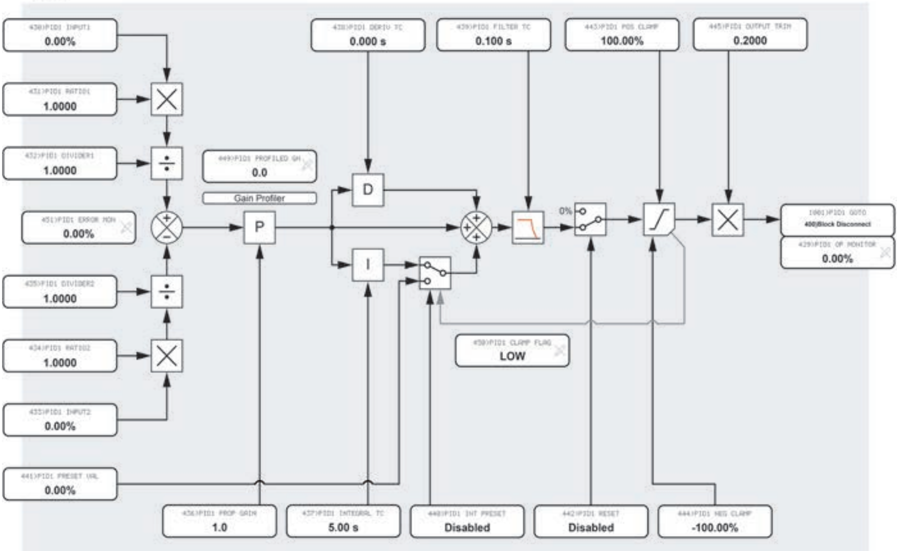
R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
429)PID1 OP MONITOR
430)PID1 INPUT1
431)PID1 RATIO1
432)PID1 DIVIDER1
433)PID1 INPUT2
434)PID1 RATIO2
435)PID1 DIVIDER2
436)PID1 PROP GAIN
437)PID1 INTEGRAL TC
438)PID1 DERIV TC
439)PID1 FILTER TC
440)PID1 INT PRESET
441)PID1 PRESET VAL
442)PID1 RESET
443)PID1 POS CLAMP
444)PID1 NEG CLAMP
445)PID1 OUTPUT TRIM
446)PID1 PROFL MODE
447)PID1 MIN PROP GN
448)PID1 X-AXIS MIN
PID1 X-AXIS GET FROM
449)PID1 PROFILED GN
450)PID1 CLAMP FLAG
451)PID1 ERROR MON

Features:

- Independent adjustment and selection of P, I, D.
- Scaling of feedback and reference inputs.
- Adjustable filter.
- Preset mode for the integral term.
- Output scaler with independent ± limit clamps.
- Built-in gain profiling option.

The GOTO of this block resides in the CONFIGURATION/BLOCK OP CONFIG menu - refer to Page 361.

PID 1



PID 2

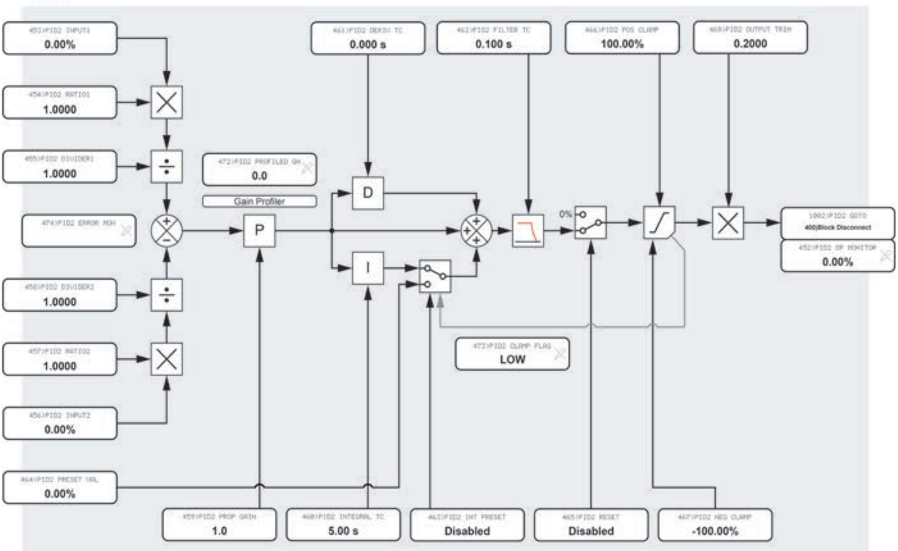


Figure 58 PID 1, 2 - block diagram

16.2.1 429)PID1 OP MONITOR

Monitor the final output of the PID1 block.

PIN	Parameter description	Range
429	PID1 OUTPUT MONITOR	±300.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
429)PID1 OP MONITOR

16.2.2 430)PID1 INPUT1

Set the value for PID Input 1.

PIN	Parameter description	Range	Default
430	PID1 INPUT1	±300.00%	0.00%

This is normally the PID reference.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
430)PID1 INPUT1

16.2.3 431)PID1 RATIO1

Set the scaling factor for the PID Input 1 value.

PIN	Parameter description	Range	Default
431	PID1 RATIO1	±3.0000	1.0000

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
431)PID1 RATIO1

16.2.4 432)PID1 DIVIDER1

Set the divisor for the Input 1 signal channel.

PIN	Parameter description	Range	Default
432	PID1 DIVIDER1	±3.0000	1.0000

Zero gives a zero output.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
432)PID1 DIVIDER1

16.2.5 433)PID1 INPUT2

Set the value for PID Input 2.

PIN	Parameter description	Range	Default
433	PID1 INPUT2	±300.00%	0.00%

This is normally the PID feedback.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1             3
     433)PID1 INPUT2
```

16.2.6 434)PID1 RATIO2

Set the scaling factor for the PID Input 2 value.

PIN	Parameter description	Range	Default
434	PID1 RATIO2	±3.0000	1.0000

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1             3
     434)PID1 RATIO2
```

16.2.7 435)PID1 DIVIDER2

Set the divisor for the Input 2 signal channel.

PIN	Parameter description	Range	Default
435	PID1 DIVIDER2	±3.0000	1.0000

Zero gives a zero output.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1             3
     435)PID1 DIVIDER2
```

16.2.8 436)PID1 PROP GAIN

Set the PID gain independently of the I and D time constants.

PIN	Parameter description	Range	Default
436	PID1 PROPORTIONAL GAIN	0.0 to 100.0	1.0

Proportional output = gain x (1 + DiffT/IntT) X error%.
A higher gain usually provides a faster response.

Normally the DiffT is much smaller than IntT hence the equation then approximates to:

Prop output = gain x error%.

For example, a gain of 10 and a step-change in the error of 10% will result in a step-change at the output of 100%.

NOTE: Profile the gain using the PARAMETER PROFILE section within this menu.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1              3
     436)PID1 PROP GAIN
```

16.2.9 437)PID1 INTEGRAL TC

Set the PID integrator time constant.

PIN	Parameter description	Range	Default
437	PID1 INTEGRAL TIME CONSTANT	0.01 to 100.00 seconds	5.00 seconds

NOTE: Processes that take a long time to react will usually require a longer integrator time constant.

When the PID output reaches the clamp limits, the PL/X holds the integrator at the prevailing condition.

The clamp levels are also separately applied to the internal integrator term result.

Refer to "16.2.16 444)PID1 NEG CLAMP" on page 258 and 467)PID2 NEG CLAMP.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1              3
     437)PID1 INTEGRAL TC
```

16.2.10 438)PID1 DERIV TC

Set the PID derivative time constant.

PIN	Parameter description	Range	Default
438	PID1 DERIVATIVE TIME CONSTANT	0.000 to 10.000 seconds	0.000 seconds

Setting the derivative time constant to 0.000 removes the D term from the block effectively.

Loops that suffer from overshoot but require a rapid response usually benefit from a shorter derivative time constant.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1              3
     438)PID1 DERIV TC
```

16.2.11 439)PID1 FILTER TC

Set the time constant of the PID output filter.

PIN	Parameter description	Range	Default
439	PID1 FILTER TIME CONSTANT	0.000 to 10.000 seconds	0.100 seconds

The derivative of a noisy error signal can lead to unwanted output excursions.

Typically, you set this filter time constant to DERIV TC/5 (one fifth, see above). A filter time constant of 0.000 will turn the filter off. The filter applies to the sum of the P, I and D terms.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
     PID 1              3
     439)PID1 FILTER TC
```

16.2.12 440)PID1 INT PRESET

Enable/disable the integrator being preset to the value of PIN 441.

PIN	Parameter description	Range	Default
440	PID1 INTEGRAL PRESET	DISABLED ENABLED	DISABLED

NOTE: The PID INT PRESET function operates independently from the PID RESET function.

If the integrator preset is permanently enabled, then the I term is effectively removed from the block.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
     PID 1              3
     440)PID1 INT PRESET
```

16.2.13 441)PID1 PRESET VAL

Set the integrator preset value.

PIN	Parameter description	Range	Default
441	PID1 PRESET VAL	±300.00%	0.00%

440)PID1 INT PRESET enables this integrator preset value.

NOTE: The PID RESET function overrides the preset function.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
     PID 1              3
     441)PID1 PRESET VAL
```

16.2.14 442)PID1 RESET

Enable/disable PID1 RESET.

PIN	Parameter description	Range	Default
442	PID1 RESET	DISABLED ENABLED	DISABLED

- When DISABLED, this turns on the Output and releases the integrator.
- When ENABLED, the Output stage and the integrator set to 0.00%.

NOTE: The PID RESET operates independently from and has priority over the integrator preset function.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
    PID 1             3
    442)PID1 RESET
```

16.2.15 443)PID1 POS CLAMP

Set the positive clamp level for the PID output.

PIN	Parameter description	Range	Default
443	PID1 POSITIVE CLAMP	0.00 to 105.00%	100.00%

NOTE: The act of clamping the output at this level holds the prevailing value of the integrator.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
    PID 1             3
    443)PID1 POS CLAMP
```

16.2.16 444)PID1 NEG CLAMP

Set the negative clamp level for the PID output.

PIN	Parameter description	Range	Default
444	PID1 NEGATIVE CLAMP	0.00 to -105.00%	-100.00%

NOTE: The act of clamping the output at this level holds the prevailing value of the integrator.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
    PID 1             3
    444)PID1 NEG CLAMP
```

16.2.17 445)PID1 OUTPUT TRIM

Set the scaling trim factor for the PID output.

PIN	Parameter description	Range	Default
445	PID1 OUTPUT TRIM	±3.0000	0.2000

Invert the output of the PID by selecting a negative trim factor.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1              3
     445)PID1 OUTPUT TRIM
```

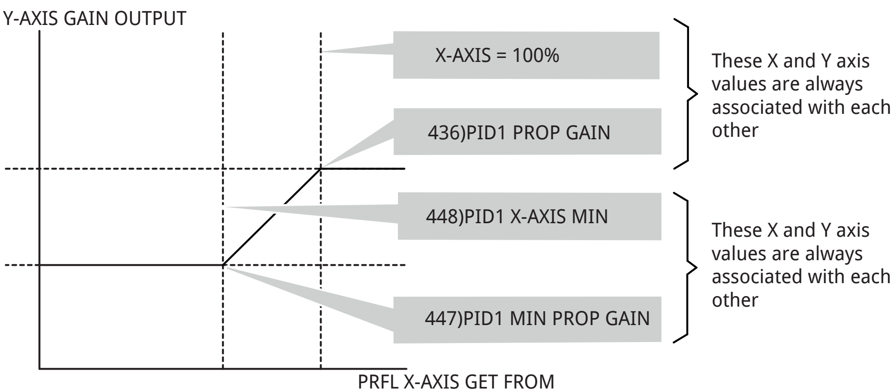
16.2.18 446)PID1 PROFL MODE

Select a gain profile curve shape.

PIN	Parameter description	Range	Default
446	PID1 PROFL MODE	0 – 4 modes	0

Mode	Law of profile curve
0	Yaxis output = Yaxis MAX
1	Yaxis output = Linear change between MIN and MAX
2	Yaxis output = Square law change between MIN and MAX
3	Yaxis output = Cubic law change between MIN and MAX
4	Yaxis output = 4th power law change between MIN and MAX

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1              3
     446)PID1 PROFL MODE
```



16.2.19 447)PID1 MIN PROP GN

Set the minimum value for the PID parameter profile output.

PIN	Parameter description	Range	Default
447	PID1 MINIMUM PROPORTIONAL GAIN	0.00 to 100.00%	20.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
447)PID1 MIN PROP GN

16.2.20 448)PID1 X-AXIS MIN

Set the minimum value for the PID parameter profile X-AXIS.

PIN	Parameter description	Range	Default
448	PID1 X-AXIS MINIMUM	0.00 to 100.00%	20.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
448)PID1 X-AXIS MIN

16.2.21 PID1 X-AXIS GET FROM

Set the PIN for the profile X-AXIS input signal source.

	Parameter description	Range	Default
	PID1 X-AXIS GET FROM	000 to 720	400)Block Disconnect

NOTE: This GETFROM input has a built-in rectifier and hence will accept bipolar or unipolar inputs.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PID 1 3
PID1 X-AXIS GET FROM

16.2.22 449)PID1 PROFILED GN

Monitor the PID profiled proportional gain.

PIN	Parameter description	Range
449	PID1 PROFILED PROPORTIONAL GAIN	0.0 to 100.0

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1                3
     449)PID1 PROFILED GN
```

16.2.23 450)PID1 CLAMP FLAG

Monitor the PID output for having reached the clamp limits.

PIN	Parameter description	Range
450	PID1 CLAMP FLAG	LOW HIGH (clamped)

Refer to "16.2.16 444)PID1 NEG CLAMP" on page 258 and 467)PID2 NEG CLAMP.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1                3
     450)PID1 CLAMP FLAG
```

16.2.24 451)PID1 ERROR MON

Monitor the PID1 error signal.

PIN	Parameter description	Range
451	PID1 ERROR MONITOR	LOW HIGH (clamped)

This parameter is the result of summing inputs 1 and 2.

NOTE: This error signal is clamped internally at ±105.00%.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
     PID 1                3
     451)PID1 ERROR MON
```

16.3 APPLICATION BLOCKS/ PARAMETER PROFILER

Use this block to modulate one parameter according to the magnitude of another. A typical example is changing the gain of a block as the error increases.

The block symbol shows the profiler working in the positive quadrant by using a rectified version of the input signal to indicate the position on the profile X-axis. The related Y-axis amplitude then appears at the block output.

Both axes can impose maximum and minimum levels to the profile translation. The profile curve can adopt several different modes.

It is possible to use the block in up to 4 quadrants for specialist applications.

```
R  ENTRY MENU        LEVEL  1
   APPLICATION BLOCKS       2
   PARAMETER PROFILER       3
      475)PROFILE Y OP MON
      476)PROFILER MODE
      477)PROFLR Y AT Xmin
      478)PROFLR Y AT Xmax
      479)PROFILER Xmin
      480)PROFILER Xmax
      481)PROFLR X RECTIFY
      PRFL X-AXIS GET FROM
```

The GOTO of this block resides in the CONFIGURATION / BLOCK OP CONFIG menu - refer to Page 361.

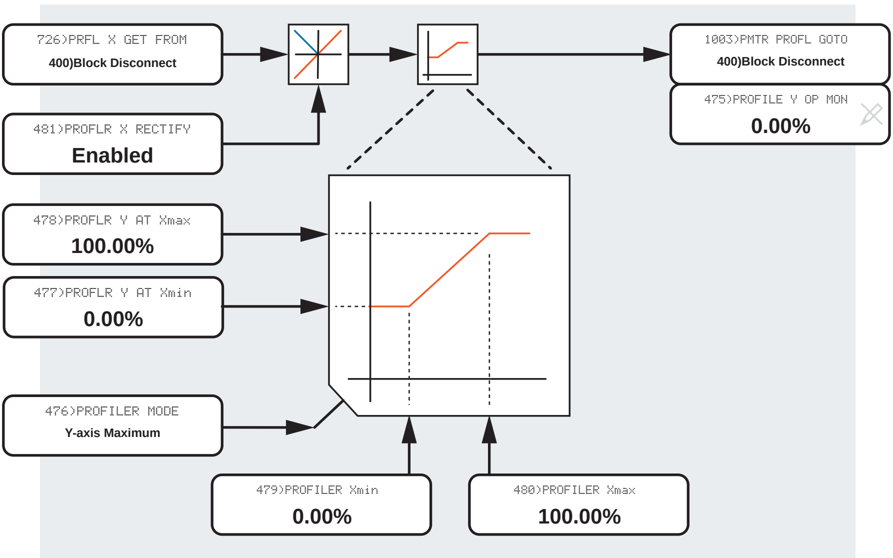
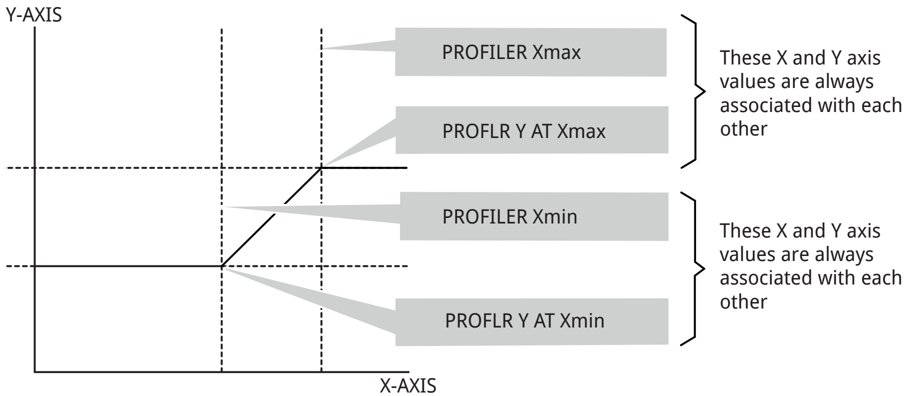
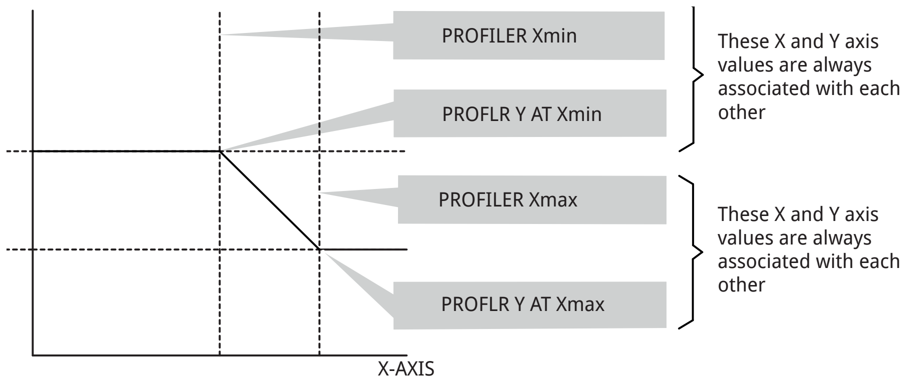


Figure 59 PARAMETER PROFILER - block diagram



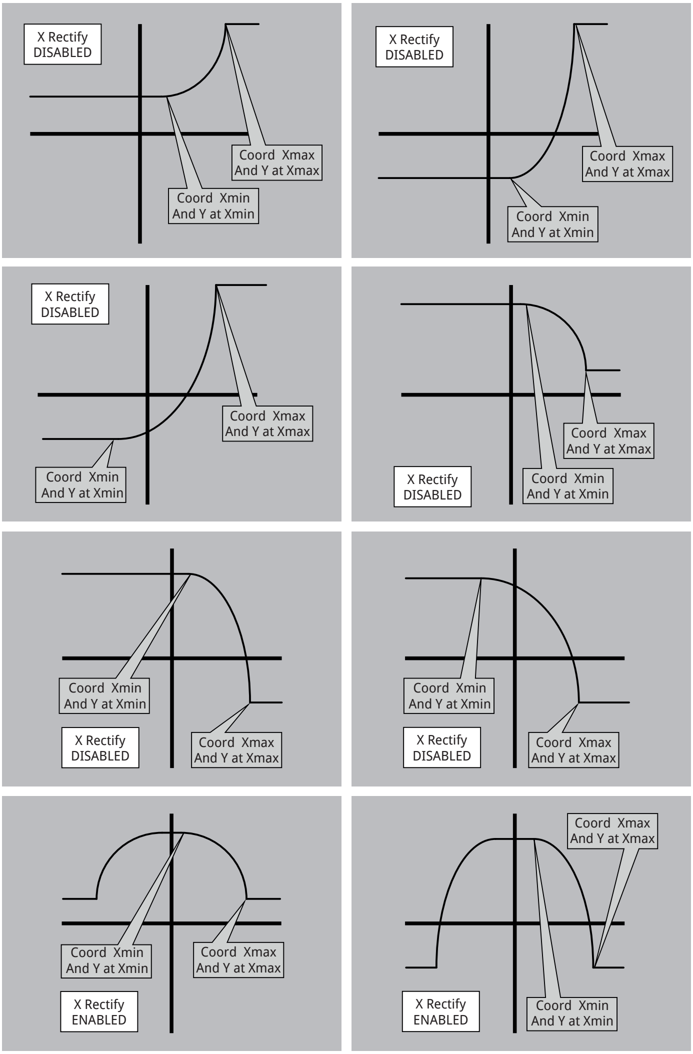
The graph shows the positive quadrant only. It is helpful to consider as coordinates each pair of minimum and maximum values.

Figure 60 PARAMETER PROFILE - Profile for Y increasing with X



The graph shows the positive quadrant only. It is helpful to consider as coordinates each pair of minimum and maximum values.

Figure 61 PARAMETER PROFILE - Profile for Y decreasing with X



When using 2nd, 3rd or 4th order modes, the curve always approaches the Xmin coordinate asymptotically.

If Xmin ≥ Xmax, then Y is constant and equal to PROFLR Y AT Xmax.

With the PROFILER MODE set to 0, then Y is constant and equal to PROFLR Y AT Xmax.

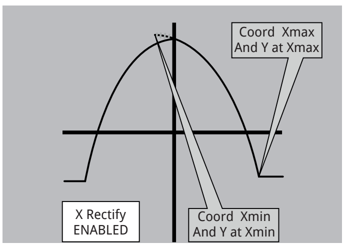


Figure 62 PARAMETER PROFILE - Examples of general profiles

16.3.1 475)PROFILE Y OP MON

Monitor the final output of the parameter profiler block.

PIN	Parameter description	Range
475	PROFILE Y OUTPUT MONITOR	±300.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   PARAMETER PROFILER       3
     475)PROFILE Y OP MON
```

16.3.2 476)PROFILER MODE

Set the mode for the profile curve between minimum and maximum.

PIN	Parameter description	Range	Default
476	PROFILER MODE	1 of 5 modes	0

Mode	Law of profile curve
0	Yaxis output = Y at Xmax
1	Yaxis output = Linear change between minimum and maximum coordinates
2	Yaxis output = Square law change between minimum and maximum coordinates
3	Yaxis output = Cubic law change between minimum and maximum coordinates
4	Yaxis output = 4th power law change between minimum and maximum coordinates

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   PARAMETER PROFILER       3
     476)PROFILER MODE
```

16.3.3 477)PROFLR Y AT Xmin

Set the corresponding value for the Y-axis at Xmin.

PIN	Parameter description	Range	Default
477	PROFILER Y AT Xmin	±300.00%	0.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   PARAMETER PROFILER       3
     477)PROFLR Y AT Xmin
```

16.3.4 478)PROFLR Y AT Xmax

Set the corresponding value for the Y-axis at Xmax.

PIN	Parameter description	Range	Default
478	PROFILER Y AT Xmax	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PARAMETER PROFILER 3
478)PROFLR Y AT Xmax

16.3.5 479)PROFILER Xmin

Set the minimum value for the X-axis input.

PIN	Parameter description	Range	Default
479	PROFILER Xmin	±300.00%	0.00%

NOTE: If the value for Xmin is greater or equal to Xmax, then Y is constant and equal to PROFLR Y AT Xmax.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PARAMETER PROFILER 3
479)PROFILER Xmin

16.3.6 480)PROFILER Xmax

Set the maximum value for the X-axis input.

PIN	Parameter description	Range	Default
480	PROFILER Xmax	±300.00%	0.00%

NOTE: If the value for Xmin is greater or equal to Xmax, then Y is constant and equal to PROFLR Y AT Xmax.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PARAMETER PROFILER 3
480)PROFILER Xmax

16.3.7 481)PROFLR X RECTIFY

Enable/disable the X-axis input.

PIN	Parameter description	Range	Default
481	PROFILER X RECTIFY	DISABLED ENABLED	ENABLED

Enable to rectify the X-axis input.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
  PARAMETER PROFILER      3
   481)PROFLR X RECTIFY
```

16.3.8 PRFL X-AXIS GET FROM

Set the PIN for the profile X-axis input signal source.

	Parameter description	Range	Default
	PROFILER X-AXIS GET FROM	000 to 720	400)Block Disconnect

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
  PARAMETER PROFILER      3
   PRFL X-AXIS GET FROM
```

16.4 APPLICATION BLOCKS / REEL DIAMETER CALC

This block performs reel diameter calculation and provides a diameter output for control of web winding tension systems.

For a constant web speed, the reel shaft slows down as the reel diameter increases. Dividing the web speed by the shaft speed gives the reel diameter.

The diameter value can be independently preset to any value allowing seamless take-up for winding or unwinding applications. There is a provision made to suspend diameter calculation if the speed falls below a user preset threshold. The diameter can be programmed to be retained indefinitely during power loss if desired. It includes a filter with an adjustable time constant to smooth the calculation output and a web break alarm flag output, with an adjustable threshold, to compare the input and output of the smoothing filter.

With this measure of the reel diameter, it is possible to control the torque of the reel shaft to give constant tension in the web. This tension control method is an open-loop technique and relies on the system properties remaining constant over time.

Not all of the torque at the shaft goes into web tension. Some go towards overcoming losses in the mechanical system. These can be caused by:-

- Static or starting friction.
- Dynamic friction due to windage etc.
- The fixed inertia of the motor and transmission.
- The varying inertia of the increasing reel.

A torque compensation block ("16.6 APPLICATION BLOCKS / TORQUE COMPENSATOR" on page 279) is available to provide a compensatory signal which adds just sufficient torque to overcome the losses. For good results, it is essential to keep the torque required for loss compensation as low as possible compared with that required to make tension. For example, if the torque required to overcome the losses is 10% of the torque required to provide the desired web tension, then a drift of 25% in the losses results in a tension error of 2.5%. However, if the torque required to overcome losses is the same (100%) as the torque required to provide the desired web tension, then a drift of 25% in the losses results in a tension error of 25%. Also, it becomes harder to estimate the absolute magnitude of the losses as they increase.

```
R ENTRY MENU        LEVEL   1
  APPLICATION BLOCKS        2
  REEL DIAMETER CALC        3
   ├ 483)DIAMETER OP MON
   ├ 484)DIA WEB SPEED IP
   ├ 485)DIA REEL SPD IP
   ├ 486)DIAMETER MIN
   ├ 487)DIA MIN SPEED
   ├ 488)DIAMETER HOLD
   ├ 489)DIA FILTER TC
   ├ 490)DIAMETER PRESET
   ├ 491)DIA PRESET VALUE
   ├ 492)DIA WEB BRK THR
   └ 493)DIA MEM BOOT-UP
```

The GOTO of this block resides in the CONFIGURATION/BLOCK OP CONFIG menu - refer to Page 361.

Some systems require the tension of the web to taper according to the reel diameter. This technique will prevent reel collapse or damage to delicate materials.

A taper control block is available for this function: "16.5 APPLICATION BLOCKS / TAPER TENSION CALC" on page 275.

If the diameter calculation requires holding, then connect to hidden parameter 697)UNFILTERED DIA. that contains the unheld diameter calculation.

CAUTION!

EQUIPMENT DAMAGE HAZARD

If, due to the mechanical arrangement of the machine it is impossible to achieve sufficiently low losses, then use a closed-loop system of tension control which could use dancing arm methods or a tension transducer loadcell feedback system

NOTE: Usually, this block is used in conjunction with the TAPER TENSION CALC and TORQUE COMPENSATOR blocks. In this case, the diameter result is automatically connected to these blocks via internal software connections. Hence the GOTO of this block must be connected to a staging post for example, in order to activate the block. Refer to "16.7 Centre winding block arrangement" on page 292.

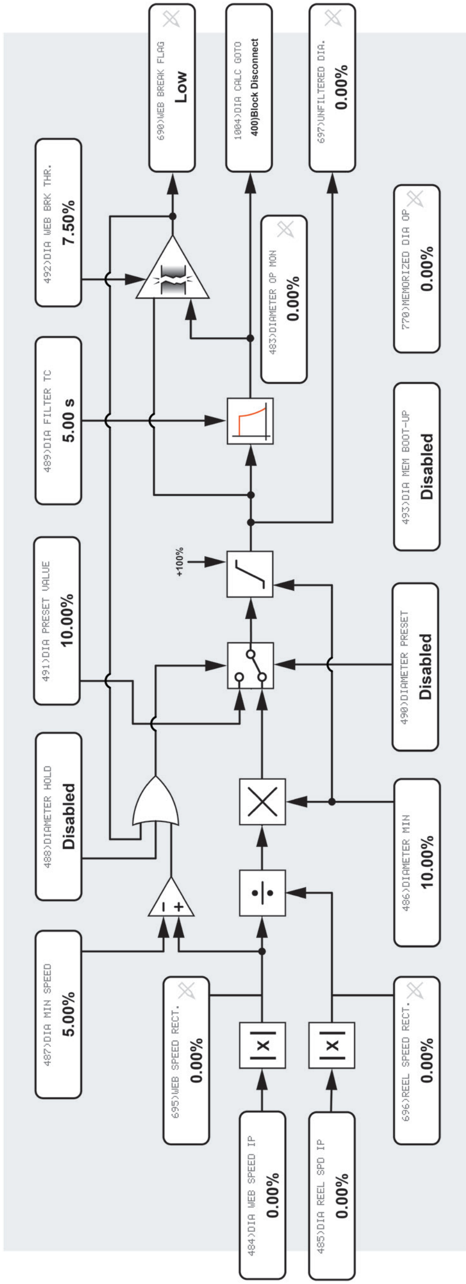


Figure 63 REEL DIAMETER CALC - block diagram

16.4.1 483)DIAMETER OP MON

Monitor the output result of the diameter calculator.

PIN	Parameter description	Range
483	DIAMETER OUTPUT MONITOR	0.00 to +100.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
REEL DIAMETER CALC 3
483)DIAMETER OP MON

16.4.2 484)DIA WEB SPEED IP

Set the input value for the web speed prior to rectifying.

PIN	Parameter description	Range	Default
484	DIAMETER WEB SPEED INPUT	±105.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
REEL DIAMETER CALC 3
484)DIA WEB SPEED IP

16.4.3 485)DIA REEL SPD IP

Set the input value for the reel speed prior to rectifying.

PIN	Parameter description	Range	Default
485	DIAMETER REEL SPEED INPUT	±105.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
REEL DIAMETER CALC 3
485)DIA REEL SPD IP

16.4.4 486)DIAMETER MIN

Set a minimum clamp level for the diameter calculator.

PIN	Parameter description	Range	Default
486	DIAMETER MINIMUM	0.00 to +100.00%	10.00%

Also, use this value as a scaling factor for the diameter calculation.

Result (%) = (Web/Reel) x (Dia min).

```
R  ENTRY MENU       LEVEL   1
   APPLICATION BLOCKS       2
   REEL DIAMETER CALC       3
     486)DIAMETER MIN
```

16.4.5 487)DIA MIN SPEED

Set a web speed % below which the calculation is held.

PIN	Parameter description	Range	Default
487	DIAMETER MINIMUM SPEED	±105.00%	0.00%

```
R  ENTRY MENU       LEVEL   1
   APPLICATION BLOCKS       2
   REEL DIAMETER CALC       3
     487)DIA MIN SPEED
```

16.4.6 488)DIAMETER HOLD

Enable/disable hold of the last calculated diameter.

PIN	Parameter description	Range	Default
488	DIAMETER HOLD	DISABLED ENABLED	DISABLED

```
R  ENTRY MENU       LEVEL   1
   APPLICATION BLOCKS       2
   REEL DIAMETER CALC       3
     488)DIAMETER HOLD
```

16.4.7 489)DIA FILTER TC

Set the filter time constant for the diameter calculation.

PIN	Parameter description	Range	Default
489	DIAMETER FILTER TIME CONSTANT	0.00 to 200.00 seconds	5.00 seconds

This value applies a filter to the output to remove small transients in the raw calculation. The difference between the input and output of the filter also provides a comparison measurement for the web break detector. Refer to "16.4.10 492)DIA WEB BRK THR." on page 274.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   REEL DIAMETER CALC       3
     489)DIA FILTER TC
```

16.4.8 490)DIAMETER PRESET

Enable/disable the preset value used by the calculator.

PIN	Parameter description	Range	Default
490	DIAMETER PRESET	DISABLED ENABLED	DISABLED

The calculator is set to this preset value when setting to ENABLED.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   REEL DIAMETER CALC       3
     490)DIAMETER PRESET
```

16.4.9 491)DIA PRESET VALUE

Set a preset value for the calculator, set by DIAMETER PRESET.

PIN	Parameter description	Range	Default
491	DIAMETER PRESET VALUE	0.00 to +100.00%	10.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   REEL DIAMETER CALC       3
     491)DIA PRESET VALUE
```

16.4.10 492)DIA WEB BRK THR.

Set the threshold at which the web break flag will be activated.

PIN	Parameter description	Range	Default
492	DIAMETER WEB BREAK THRESHOLD	0.00 to +100.00%	7.50%

A break in the web will cause a sudden change in the diameter calculation due to the breakdown of the speed relationship.

Hence, if the raw calculation value changes at a rate that causes it to differ from the filtered calculation result by more than this threshold value, then the web break flag on hidden PIN 690 will be set high. Refer to "16.4.7 489)DIA FILTER TC" on page 273.

NOTE: This flag will also go high if the calculator output is preset to a value that differs from the calculated value (derived from the prevailing web and reel speeds) by more than the threshold.

```
R  ENTRY MENU     LEVEL    1
   APPLICATION BLOCKS      2
   REEL DIAMETER CALC      3
     492)DIA WEB BRK THR.
```

16.4.11 493)DIA MEM BOOT-UP

Enable/disable to select a value for the calculator on power-up.

PIN	Parameter description	Range	Default
493	DIAMETER MEMORY BOOT-UP	DISABLED ENABLED	DISABLED

DISABLED : Set the value of the calculator on control supply power-up to 486)DIAMETER MIN.

ENABLED : Retain the current value of the calculator during control supply power-off. Set the value on control supply power-up to the retained setting.

```
R  ENTRY MENU     LEVEL    1
   APPLICATION BLOCKS      2
   REEL DIAMETER CALC      3
     493)DIA MEM BOOT-UP
```

16.5 APPLICATION BLOCKS / TAPER TENSION CALC

This block allows the introduction of positive or negative taper to a tension reference and the capability for externally trimming the final output.

The taper profile can be selected to be hyperbolic or linear to suit most types of winding requirements.

NOTE: This block has internal connections from the REEL DIAMETER CALC block that require activation to allow the taper calculation to proceed.

```
R  ENTRY MENU       LEVEL    1
   APPLICATION BLOCKS        2
   TAPER TENSION CALC        3
      494)TOTAL TENSION MN
      495)TENSION REF
      496)TAPER STRENGTH
      497)HYPERBOLIC TAPER
      498)TENSION TRIM IP
      499)TAPERED TENS.MON
```

The GOTO of this block resides in the CONFIGURATION/BLOCK OP CONFIG menu - refer to Page 361.

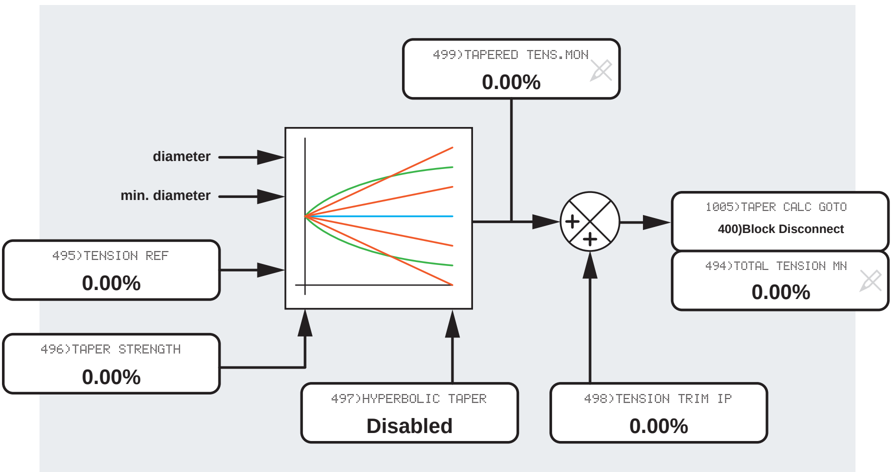


Figure 64 TAPER TENSION CALC - block diagram

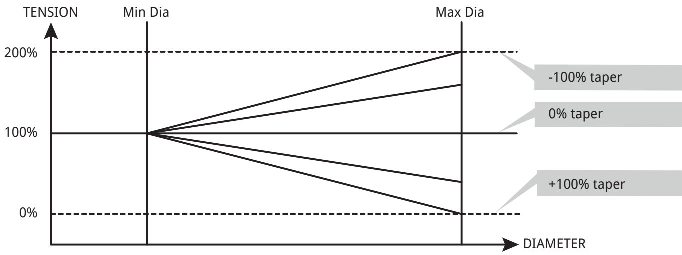
16.5.1 Linear taper equation

Tapered tension% = (Tension ref% / 100%) X (100% - (Dia% - Min dia%) X Taper strength% / 100%).

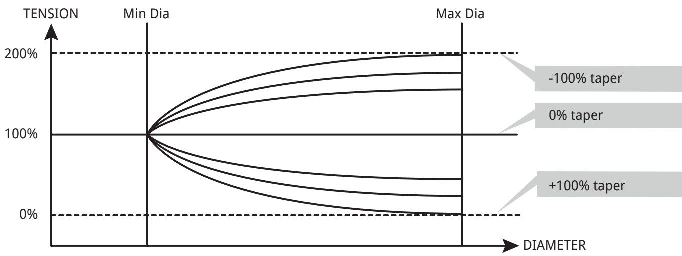
16.5.2 Hyperbolic taper equation

Tapered tension% = (Tension ref% / 100%) X (100% - (Dia% - Min dia%) X Taper strength% / Dia%).

16.5.2.1 Taper graphs showing tension versus diameter



Tension graph for **linear** taper



Tension graph for **hyperbolic** taper

Figure 65 Taper graphs showing tension versus diameter

16.5.3 494)TOTAL TENSION MN

Monitor the total output of the taper tension calculator.

PIN	Parameter description	Range
494	TOTAL TENSION MONITOR	±100.00%

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   TAPER TENSION CALC      3
     494)TOTAL TENSION MN
```

16.5.4 495)TENSION REF

Set the tension reference for the taper tension calculator.

PIN	Parameter description	Range
495	TENSION REFERENCE	0.00 to +100.00%

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   TAPER TENSION CALC      3
     495)TENSION REF
```

16.5.5 496)TAPER STRENGTH

Set the amount of taper for the taper tension calculator.

PIN	Parameter description	Range
496	TAPER STRENGTH	±100.00%

The taper may be linear or hyperbolic. Refer to "16.5.6 497)HYPERBOLIC TAPER" on page 278.

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   TAPER TENSION CALC      3
     496)TAPER STRENGTH
```

16.5.6 497)HYPERBOLIC TAPER

Enable/disable the taper profile.

PIN	Parameter description	Range	Default
497	HYPERBOLIC TAPER	DISABLED ENABLED	DISABLED

When ENABLED, the taper profile is hyperbolic.

When DISABLED, the taper profile is linear.

Refer to "16.5.5 496)TAPER STRENGTH" on page 277.

```
R ENTRY MENU      LEVEL    1
  APPLICATION BLOCKS       2
  REEL DIAMETER CALC       3
    497)HYPERBOLIC TAPER
```

16.5.7 498)TENSION TRIM IP

Set a trim input level that is added to the tapered tension.

PIN	Parameter description	Range	Default
498	TENSION TRIM INPUT	±100.00%	0.00%

```
R ENTRY MENU      LEVEL    1
  APPLICATION BLOCKS       2
  REEL DIAMETER CALC       3
    498)TENSION TRIM IP
```

16.5.8 499)TAPERED TENS.MON

Monitor the output of the taper tension calculator before the addition of 498)TENSION TRIM INPUT.

PIN	Parameter description	Range
499	TAPERED TENSION MONITOR	±100.00%

```
R ENTRY MENU      LEVEL    1
  APPLICATION BLOCKS       2
  REEL DIAMETER CALC       3
    499)TAPERED TENS MON
```

16.6 APPLICATION BLOCKS / TORQUE COMPENSATOR

Use this block to add loss compensation to the tension demand signal generated by the TAPER TENSION CALC block. The result is steered to the positive or negative current limits to provide a torque clamp giving the correct tension. The losses in the winding system are friction and inertia.

When winding, the drive system relies on arranging the speed loop to saturate, thus the speed demand remains unsatisfied under all conditions, and so the speed loop is always asking for more current than the clamps will allow. Hence, the current is operating at the limit determined by the torque compensator.

You can accomplish Speed loop saturation by using the SLACK take-up function. Refer to "11.4 CHANGE PARAMETERS / JOG CRAWL SLACK" on page 139. The hidden parameter 714)IN SLACK FLAG stays high during the slack take-up mode, including during the ramp-up/down periods. Use this FLAG to operate 518)TENSION ENABLE.

Friction: This block provides compensation for stiction, static friction and dynamic friction. Stiction compensation gets the system moving and is applied only if the web speed exceeds its programmed threshold (e. g. 5%) and the reel speed remains below 2%. The block applies static friction compensation at a constant level and dynamic friction compensation that linearly increases with speed.

Inertia: When accelerating or decelerating, torque is required to overcome the mechanical inertia of the total load. Without compensation, this torque is no longer available to provide tension. Hence to control the tension more accurately, the block provides compensation for both fixed and variable inertia. The fixed inertia compensation accelerates all fixed-mass components of the system (e.g. motor, gearbox, reel former, etc.). The variable inertia compensation accelerates the process material, the mass of which is changing as the reel diameter changes. There is also a provision for compensating for different material widths.

Find the compensation factors by pure calculation, or empirically. The descriptions here outline empirical methods using only the reel drive and a full and an empty reel.

```
R  ENTRY MENU     LEVEL    1
   APPLICATION BLOCKS      2
   TORQUE COMPENSATOR      3
     500)TORQUE DEMAND MN
     501)TORQUE TRIM IP
     502)STICTION COMP
     503)STIC.WEB SPD THR
     504)STATIC FRICTION
     505)DYNAMIC FRICTION
     506)FRICTION SIGN
     507)FIXED INERTIA
     508)VARIABLE INERTIA
     509)MATERIAL WIDTH
     510)ACCEL LINE SPEED
     511)ACCEL SCALER
     512)ACCEL INPUT/MON
     513)ACCEL FILTER TC
     514)TENSION DEM IP
     515)TENSION SCALER
     516)TORQUE MEM SEL
     517)TORQUE MEM INPUT
     518)TENSION ENABLE
     519)OVER/UNDERWIND
     520)INERTIA COM MON
```

The GOTO of this block resides in the CONFIGURATION / BLOCK OP CONFIG menu - refer to Page 361.

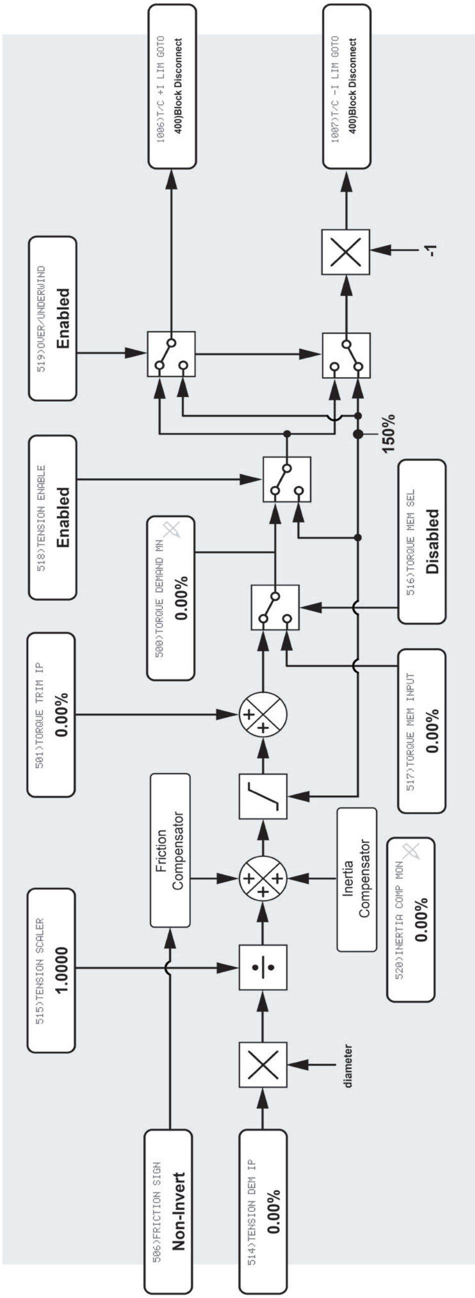


Figure 66 TORQUE COMPENSATOR - block diagram

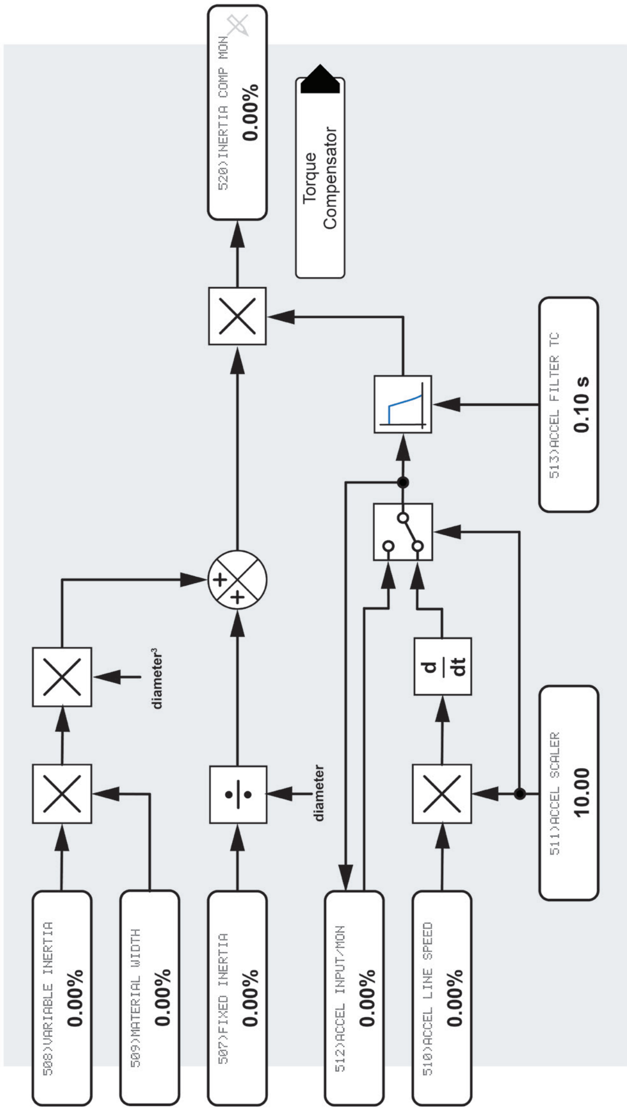


Figure 67 TORQUE COMPENSATOR INERTIA COMPENSATOR - block diagram

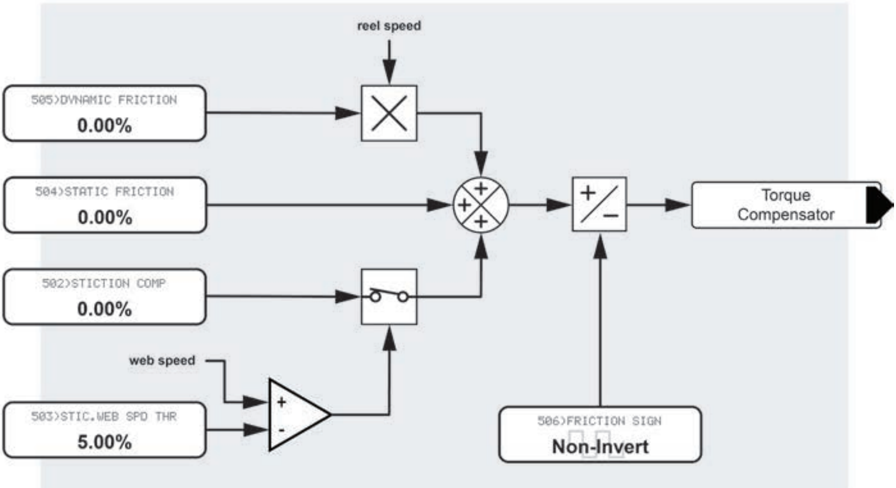


Figure 68 TORQUE COMPENSATOR FRICTION COMPENSATOR - block diagram

16.6.1 500)TORQUE DEMAND MN

Monitor the total torque demand reference.

PIN	Parameter description	Range
500	TORQUE DEMAND MONITOR	±300.00%

The torque demand reference is the sum of all the compensation components and the scaled tension demand.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
500)TORQUE DEMAND MN

16.6.2 501)TORQUE TRIM IP

Add a torque trim input to the compensation.

PIN	Parameter description	Range	Default
501	TORQUE TRIM INPUT	±150.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
501)TORQUE TRIM IP

16.6.3 502)STICTION COMP

Set the level of compensation required to overcome stiction.

PIN	Parameter description	Range	Default
502	STICTION COMPENSATION	±300.00%	0.00%

Refer to 16.6.4 below.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
502)STICTION COMP

16.6.4 503)STIC.WEB SPD THR

Set the web speed below which stiction compensation occurs.

PIN	Parameter description	Range	Default
503	STICTION WEB SPEED THRESHOLD	0.00 to 10.00%	5.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
503)STIC.WEB SPD THR

Some systems require extra torque to overcome starting friction. Setting this level will ensure the reel motor starts rotating.

We suggest a value of 5.00% as a starting point.

The threshold is not signed and can apply to both directions of rotation.

The system adds the compensation set by 502)STICTION COMP when:

The web speed reference is greater than the threshold

AND

The reel speed feedback is less than 2.00%.

Hence, the compensation is only active during the stiction phase and will not permanently apply at zero web speed reference.

16.6.5 504)STATIC FRICTION

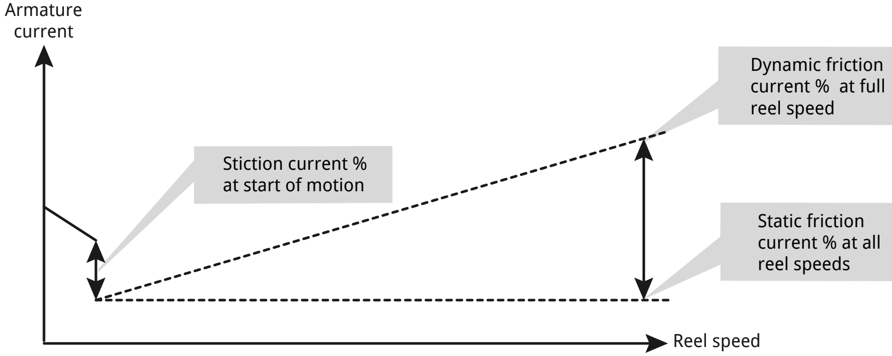
Set the compensation required to overcome static friction.

PIN	Parameter description	Range	Default
504	STATIC FRICTION	±300.00%	0.00%

A compensation applied at a constant level throughout the speed range.

Record the value for ARM CUR % MON (in the Diagnostics menu) when running with an empty reel at 10% speed, and enter the value into this parameter.

R		
	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	TORQUE COMPENSATOR	3
	504)STATIC FRICTION	



16.6.6 505)DYNAMIC FRICTION

Set the compensation required to overcome dynamic friction.

PIN	Parameter description	Range	Default
505	DYNAMIC FRICTION	±300.00%	0.00%

A compensation applied at a level proportional to speed. Record the value for ARM CUR % MON (in the Diagnostics menu) when running with an empty reel at 100% speed, and here enter the difference between this value and the value for 504)STATIC FRICTION. The block then automatically adjusts the compensation, scaling it according to web speed.

Refer to the diagram in **16.6.5** above.

R		
	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	TORQUE COMPENSATOR	3
	505)DYNAMIC FRICTION	

16.6.7 506)FRICTION SIGN

Set the total friction compensation polarity for forward or reverse.

PIN	Parameter description	Range	Default
506	FRICTION SIGN	INVERT NON-INVERT	NON-INVERT

```
R ENTRY MENU      LEVEL    1
  APPLICATION BLOCKS       2
  TORQUE COMPENSATOR       3
    506)FRICTION SIGN
```

16.6.8 507)FIXED INERTIA

Set the compensation required to overcome fixed mass inertia.

PIN	Parameter description	Range	Default
507	FIXED INERTIA	±300.00%	0.00%

This compensation depends upon the reel diameter, so the REEL DIAMETER CALC application block must be active to acquire the diameter value.

The gain of this input is proportional to 1/DIA. It is unity for minimum diameter and 1/(build-up ratio) at maximum diameter.

For a suitable value to enter here, measure the armature current with a separate empty reel running in speed control mode.

First, reprogram the reel drive speed ramp to be the same ramp time as the web speed.

Then set the speed reference to a constant 95% and note ARM CUR % MON in the diagnostics menu. Increase the speed reference to 100%. While the reel is ramping up to the new speed, measure the increased ARM CUR % MON in the diagnostics menu. The change is the current% required to accelerate the fixed mass from 95% to 100% speed at the normal maximum acceleration rate. Enter this change in current% in the FIXED INERTIA parameter.

```
R ENTRY MENU      LEVEL    1
  APPLICATION BLOCKS       2
  TORQUE COMPENSATOR       3
    507)FIXED INERTIA
```

For complete accuracy, determine the fixed mass inertia value for each reel core when they have different reel core sizes or masses.

The fixed inertia compensation has the most influence on tension accuracy for empty reels. These have higher speeds and a higher ratio of fixed mass to variable mass. Hence for good results, it is important to make accurate measurements to determine the compensation.

16.6.9 508)VARIABLE INERTIA

Set the compensation required to overcome variable mass inertia.

PIN	Parameter description	Range	Default
508	VARIABLE INERTIA	±300.00%	0.00%

This compensation depends upon the reel diameter, so the REEL DIAMETER CALC application block must be active to acquire the diameter value.

The gain curve of this input is proportional to DIA^3.
It is zero at the minimum diameter and unity for the maximum diameter.

To arrive at a suitable value to enter here, you must measure the armature current with a separate full reel running in speed control mode.

This experiment simulates the condition of unity gain to this input and allows you to measure the torque required to accelerate the mass. This condition occurs at the maximum diameter and hence minimum reel speed.

1. Calculate the build-up ratio. For example, if your core diameter is 0.1 metres, and the full reel diameter is 0.5 metres, then the build-up ratio is 5.
2. Reprogram the reel drive speed ramp to a new longer ramp time as follows:

   New ramp time = the web speed ramp time X the build-up ratio.

   For example: for a web speed ramp time of 10 seconds and a build-up ratio of 5, adjust the reel speed ramp time to 50 seconds (10 x 5) for the duration of the experiment. Remember to return the reel speed ramp time to the original setting when the reading is complete.
3. Set the speed of the reel drive to 100% / build-up ratio (in this example, this results in a 20% speed).
4. Increase the speed reference by 5% and, while accelerating the reel of material, note the change in ARM CUR % MON in the diagnostics menu. From this change value, subtract the value of 507)FIXED INERTIA. The result represents the current% required to accelerate the mass of the material. Enter this value into the VARIABLE INERTIA parameter.

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	TORQUE COMPENSATOR	3
	508)VARIABLE INERTIA	

16.6.10 509)MATERIAL WIDTH

Set a ratio % to accommodate material width or mass changes.

PIN	Parameter description	Range	Default
509	MATERIAL WIDTH	200.00%	100.00%

The material used during the empirical measurement of inertia compensation currents is the 100% width/ mass. For example:

- For material twice as wide as the measurement material, set this value to 200.00%
- For material of a specific gravity which is 80% of the measurement material, set the value to 80.00%.
- For material of a specific gravity which is 80% of the measurement material and twice as wide, set the value to 160.00%.

NOTE: The formula used by the block assumes an air core. The value for fixed mass inertia compensation accommodates the mass of the reel core. If the reel mass changes in addition to the material, then both FIXED INERTIA and MATERIAL WIDTH will require adjusting.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   TORQUE COMPENSATOR       3
     509)MATERIAL WIDTH
```

16.6.11 510)ACCEL LINE SPEED

Enter the web speed reference to calculate the acceleration.

PIN	Parameter description	Range	Default
510	ACCELERATION LINE SPEED	±105.00%	0.00%

The acceleration of the system is required to calculate the total inertia compensation. There are two ways of arriving at a value for acceleration:

1. Input the acceleration value directly from an external source to PIN 512.
2. Let the block calculate the value by differentiating the line or web speed for input to PIN 510.

When using method 2, a line or web speed reference is input. **NOTE:** The line speed reference will usually come from an external source via an analog input terminal.

The input speed is scaled by 511)ACCEL SCALER.

NOTE: Setting 511)ACCEL SCALER to 0.00 opens an internal switch to allow 512)ACCEL INPUT/MON to become an input. Otherwise, it remains a monitor of the calculated acceleration. Arrange for the resulting value on 512)ACCEL INPUT/MON to be 100.00% for maximum acceleration by either method.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   TORQUE COMPENSATOR       3
     510)ACCEL LINE SPEED
```

16.6.12 511)ACCEL SCALER

Set a scaling factor to normalise the acceleration calculation.

PIN	Parameter description	Range	Default
511	ACCELERATION SCALER	±100.00	10.00

Typically set this value to equal the 100% ramp time. For example, if the total ramp time equals 10 seconds, set this parameter to 10.00.

Refer to "16.6.11 510)ACCEL LINE SPEED" on page 287.

NOTE: Setting 511)ACCEL SCALER to 0.00 opens an internal switch to allow 512)ACCEL INPUT/MON to become an input. Otherwise, it remains a monitor of the calculated acceleration.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
511)ACCEL SCALER

16.6.13 512)ACCEL INPUT/MON

Monitor acceleration, or input an external acceleration signal.

PIN	Parameter description	Range	Default
512	ACCELERATION INPUT/MONITOR	0 to 105.00%	0.00%

Refer to "16.6.11 510)ACCEL LINE SPEED" on page 287.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
512)ACCEL INPUT/MON

16.6.14 513)ACCEL FILTER TC

Set a filter time constant for the line acceleration signal.

PIN	Parameter description	Range	Default
513	ACCELERATION FILTER TIME CONSTANT	0.00 to 200.00 seconds	0.10 seconds

Refer to "16.6.11 510)ACCEL LINE SPEED" on page 287.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
513)ACCEL FILTER TC

16.6.15 514)TENSION DEM IP

Set the tension demand input.

PIN	Parameter description	Range	Default
514	TENSION DEMAND INPUT	±100.00%	0.00%

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	TORQUE COMPENSATOR	3
	514)TENSION DEM IP	

16.6.16 515)TENSION SCALER

Scale the tension from the taper tension block.

PIN	Parameter description	Range	Default
515	TENSION SCALER	±3.0000	1.0000

The factor you enter here divides the result of the product of the tension input and the diameter.

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	TORQUE COMPENSATOR	3
	515)TENSION SCALER	

16.6.17 516)TORQUE MEM SEL

Enable/disable an external torque source.

PIN	Parameter description	Range	Default
516	TORQUE MEMORY SELECT	DISABLED ENABLED	DISABLED

ENABLE to select the value set in 517)TORQUE MEM INPUT.

This parameter is helpful if you need to hold the torque at a stored value because the input speeds are not available at the levels required to provide a calculated output, for example, during a reel changeover sequence.

The stored value may be obtained using a sample and hold. Refer to "16.9 APPLICATION BLOCKS / MULTI-FUNCTION 1 TO 8" on page 298.

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	TORQUE COMPENSATOR	3
	516)TORQUE MEM SEL	

16.6.18 517)TORQUE MEM INPUT

Set the input value for parameter 516)TORQUE MEM SEL.

PIN	Parameter description	Range	Default
517	TORQUE MEMORY INPUT	±300.00%	0.00%

This parameter is helpful if you need to hold the torque at a stored value because the input speeds are not available at the levels required to provide a calculated output, for example, during a reel changeover sequence, for example, during a line stopping sequence.

The stored value may be obtained using a sample and hold. Refer to "16.9 APPLICATION BLOCKS / MULTI-FUNCTION 1 TO 8" on page 298.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
517)TORQUE MEM INPUT

16.6.19 518)TENSION ENABLE

Select the torque reference, or the prevailing current limit.

PIN	Parameter description	Range	Default
518	TENSION ENABLE	DISABLED ENABLED	ENABLED

By selecting the prevailing current limit (DISABLED), the system can operate as a speed controller. When the torque demand is ENABLED, the torque compensator provides the new current limit.

When winding, the drive system relies on arranging the speed loop to saturate so that the current is operating at the limit determined by the torque compensator. You can use the SLACK take-up function to accomplish speed loop saturation. Refer to "11.4 CHANGE PARAMETERS / JOG CRAWL SLACK" on page 139.

The hidden parameter 714)IN SLACK FLAG stays high during the slack take-up mode, including the ramp-up/down periods. Use this FLAG to operate 518)TENSION ENABLE.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
518)TENSION ENABLE

16.6.20 519)OVER/UNDERWIND

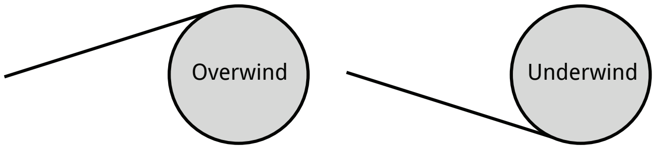
Select the direction of layer addition on the reel.

PIN	Parameter description	Range	Default
519	OVER/UNDERWIND	DISABLED ENABLED	ENABLED

ENABLED = Overwind.
DISABLED = Underwind.

The term overwinding refers to the chosen direction of layer addition on the reel. It assumes that the web winds onto the reel in the direction that requires a positive current clamp. If the web winds on in the underwind direction, then the reel must change the direction of rotation and the negative current clamp is operative.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
519)OVER/UNDERWIND



16.6.21 520)INERTIA COMP MON

Monitor the final result of inertia compensation.

PIN	Parameter description	Range
520	INERTIA COMPENSATION MONITOR	±300.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
TORQUE COMPENSATOR 3
520)INERTIA COMP MON

16.7 Centre winding block arrangement

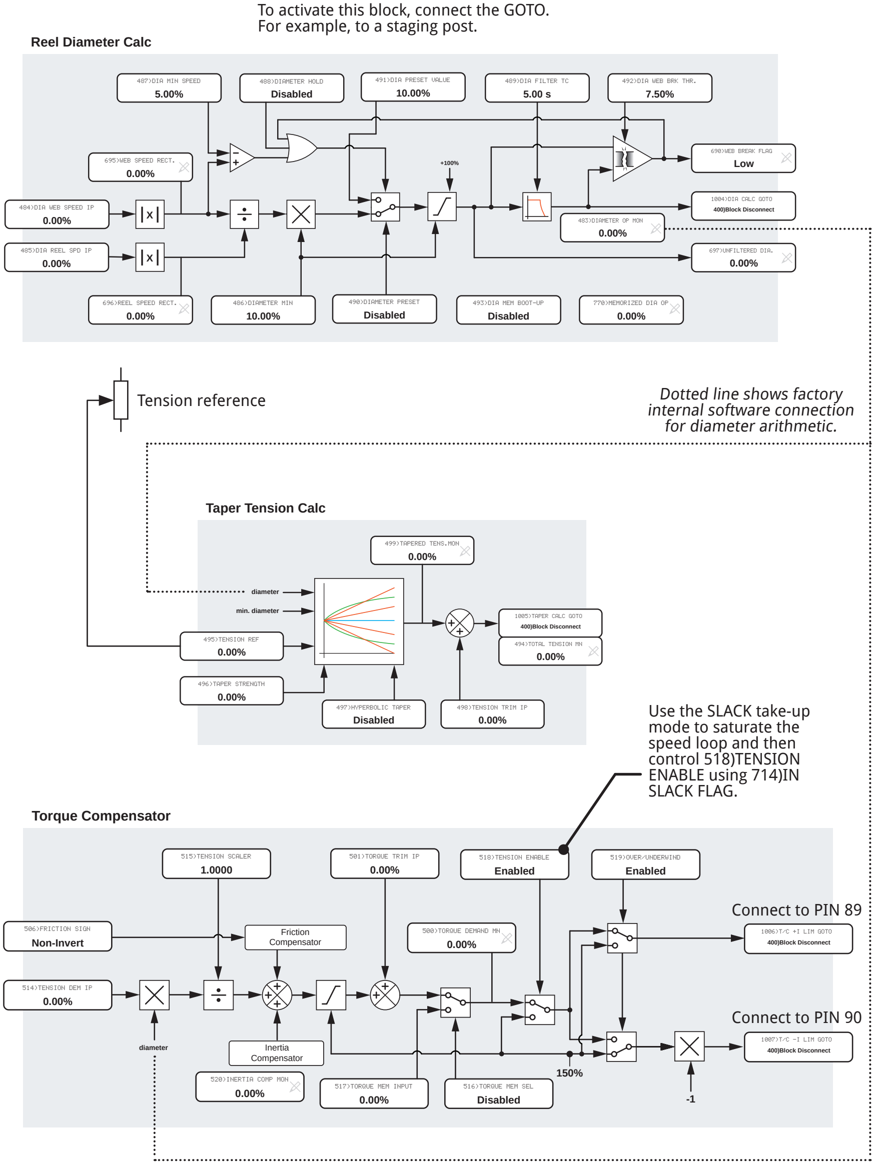


Figure 69 Centre winding block arrangement

16.8 APPLICATIONS BLOCK / PRESET SPEED

This block provides a versatile preset value selection machine. Its primary use is for preset speeds.

By defining output values for each of eight possible input combinations, it is possible to create various preset modes types, for example, input priority, input summing, BCD thumbwheel code.

- This block contains eight consecutive PINs with a range of ±300.00% (527 to 534).
- SEL3,2,1 refer to the value of parameters 526, 525, 524 (LOW=0, HIGH=1).

Refer to the examples on the following page.

```
R ENTRY MENU     LEVEL   1
  APPLICATION BLOCKS     2
  PRESET SPEED           3
    523)PRESET OP MON
    524)PRESET SEL1(LSB)
    525)PRESET SELECT2
    526)PRESET SEL3(MSB)
    527)PR.VALUE FOR 000
    528)PR.VALUE FOR 001
    529)PR.VALUE FOR 010
    530)PR.VALUE FOR 011
    531)PR.VALUE FOR 100
    532)PR.VALUE FOR 101
    533)PR.VALUE FOR 110
    534)PR.VALUE FOR 111
```

The GOTO of this block resides in the CONFIGURATION/BLOCK OP CONFIG menu - refer to Page 361.

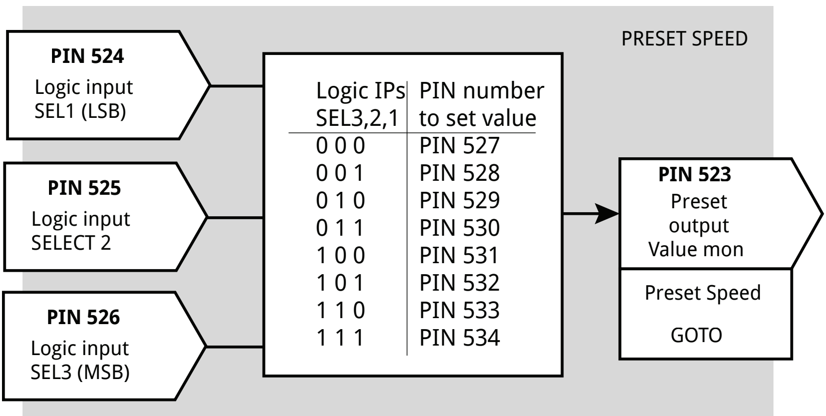


Figure 70 PRESET SPEED - block diagram

Inputs SEL3,2,1	PIN number to set value	Actual value
0 0 0	PIN 527	0.00%
0 0 1	PIN 528	W%
0 1 0	PIN 529	X%
0 1 1	PIN 530	X%
1 0 0	PIN 531	Y%
1 0 1	PIN 532	Y%
1 1 0	PIN 533	Y%
1 1 1	PIN 534	Y%

Ascending priority

Assuming that there are three output values (1 for W, 2 for X, 3 for Y) required and that logic select input 3 has the highest priority, followed by 2 and 1 in that order.

Enter the values for each PIN as shown in the table opposite to obtain the desired result.

Inputs SEL3,2,1	PIN number to set value	Actual value
0 0 0	PIN 527	0.00%
0 0 1	PIN 528	10.00%
0 1 0	PIN 529	20.00%
0 1 1	PIN 530	30.00%
1 0 0	PIN 531	40.00%
1 0 1	PIN 532	50.00%
1 1 0	PIN 533	60.00%
1 1 1	PIN 534	70.00%

Binary coded decimal

This combination will give eight values up to 70.00% for the 8 BCD codes.

Inputs SEL3,2,1	PIN number to set value	Actual value
0 0 0	PIN 527	25.00%
0 0 1	PIN 528	50.00%
0 1 0	PIN 529	75.00%
0 1 1	**PIN 530**	**62.50%**
1 0 0	PIN 531	100.00%
1 0 1	PIN 532	75.00%
1 1 0	**PIN 533**	**87.50%**
1 1 1	PIN 534	0.00%

4 digital inputs for 4 preset speeds

Make the GOTO connection to the Value for low PIN on a digital input, e.g. DIP1 on T14. Then connect the GOTO of DIP1 to the desired preset speed target PIN.

The DIP1 digital input will be the 25% input.

The preset speed select1 input will be the 50% input.

The preset speed select2 input will be the 75% input.

The preset speed select3 input will be the 100% input.

The intermediate combinations are shown here bolded with intermediate values for a smoother transition but set values as desired.

16.8.1 523)PRESET SPEED MON

Monitor the preset speed block output.

PIN	Parameter description	Range
523	PRESET SPEED MONITOR	±300.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   PRESET SPEED             3
     523)PRESET SPEED MON
```

16.8.2 524)PRESET SEL1(LSB)

Set the logic state of the preset speed block digital input.

PIN	Parameter description	Range	Default
524	PRESET SELECT1 (LEAST SIGNIFICANT BIT)	LOW HIGH	LOW

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   PRESET SPEED             3
     524)PRESET SEL1(LSB)
```

16.8.3 525)PRESET SELECT 2

Set the logic state of the preset speed block digital input.

PIN	Parameter description	Range	Default
525	PRESET SELECT 2	LOW HIGH	LOW

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   PRESET SPEED             3
     525)PRESET SELECT 2
```

16.8.4 526)PRESET SEL3(MSB)

Set the logic state of the preset speed block digital input.

PIN	Parameter description	Range	Default
526	PRESET SELECT3 (MOST SIGNIFICANT BIT)	LOW HIGH	LOW

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   PRESET SPEED             3
     526)PRESET SEL3(MSB)
```

16.8.5 527)PR.VALUE FOR 000

Set a value for the preset speed block digital input code 000.

PIN	Parameter description	Range	Default
527	PRESET VALUE FOR 000	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
527)PR.VALUE FOR 000

16.8.6 528)PR.VALUE FOR 001

Set a value for the preset speed block digital input code 001.

PIN	Parameter description	Range	Default
528	PRESET VALUE FOR 001	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
528)PR.VALUE FOR 001

16.8.7 529)PR.VALUE FOR 010

Set a value for the preset speed block digital input code 010.

PIN	Parameter description	Range	Default
529	PRESET VALUE FOR 010	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
529)PR.VALUE FOR 010

16.8.8 530)PR.VALUE FOR 011

Set a value for the preset speed block digital input code 011.

PIN	Parameter description	Range	Default
530	PRESET VALUE FOR 011	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
530)PR.VALUE FOR 011

16.8.9 531)PR.VALUE FOR 100

Set a value for the preset speed block digital input code 100.

PIN	Parameter description	Range	Default
531	PRESET VALUE FOR 100	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
531)PR.VALUE FOR 100

16.8.10 532)PR.VALUE FOR 101

Set a value for the preset speed block digital input code 101.

PIN	Parameter description	Range	Default
532	PRESET VALUE FOR 101	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
532)PR.VALUE FOR 101

16.8.11 533)PR.VALUE FOR 110

Set a value for the preset speed block digital input code 110.

PIN	Parameter description	Range	Default
533	PRESET VALUE FOR 110	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
533)PR.VALUE FOR 110

16.8.12 534)PR.VALUE FOR 111

Set a value for the preset speed block digital input code 111.

PIN	Parameter description	Range	Default
534	PRESET VALUE FOR 111	±300.00%	0.00%

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
PRESET SPEED 3
534)PR.VALUE FOR 111

16.9 APPLICATION BLOCKS / MULTI-FUNCTION 1 TO 8

There are eight identical, independent MULTI-FUNCTION blocks, identified by the suffix 1 to 8. This description shows only the PINs for MULTI-FUNCTION 1.

They are used to perform simple signal processing on 1 or 2 signals.

Available functions are comparator, AND, OR, LOGIC INVERT, sign change, rectify, sample and hold.

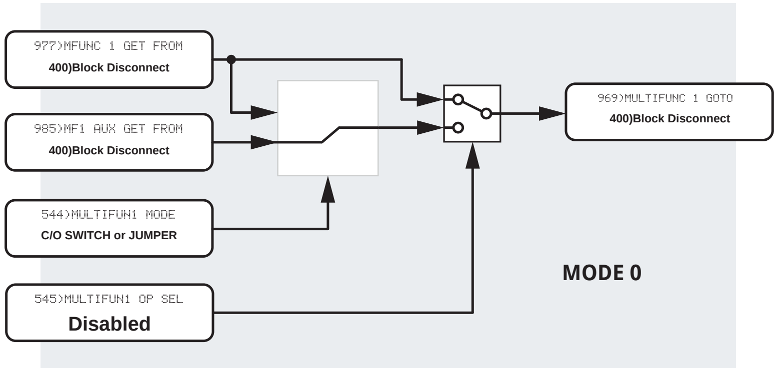
These blocks may also be used as JUMPERS to make connections.

The following few pages show MULTI-FUNCTION 1 parameters.

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
  MULTI-FUNCTION 1        3
     544)MULTIFUN1 MODE
     545)MULTIFUN1 OP SEL
     GET FROM
     AUX GET FROM
     GOTO
```

Parameter	MULTI-FUNCTION 1	MULTI-FUNCTION 2	MULTI-FUNCTION 3	MULTI-FUNCTION 4	MULTI-FUNCTION 5	MULTI-FUNCTION 6	MULTI-FUNCTION 7	MULTI-FUNCTION 8
MODE	544	546	548	550	552	554	556	558
OP SEL	545	547	549	551	553	555	557	559

Multi-function 1



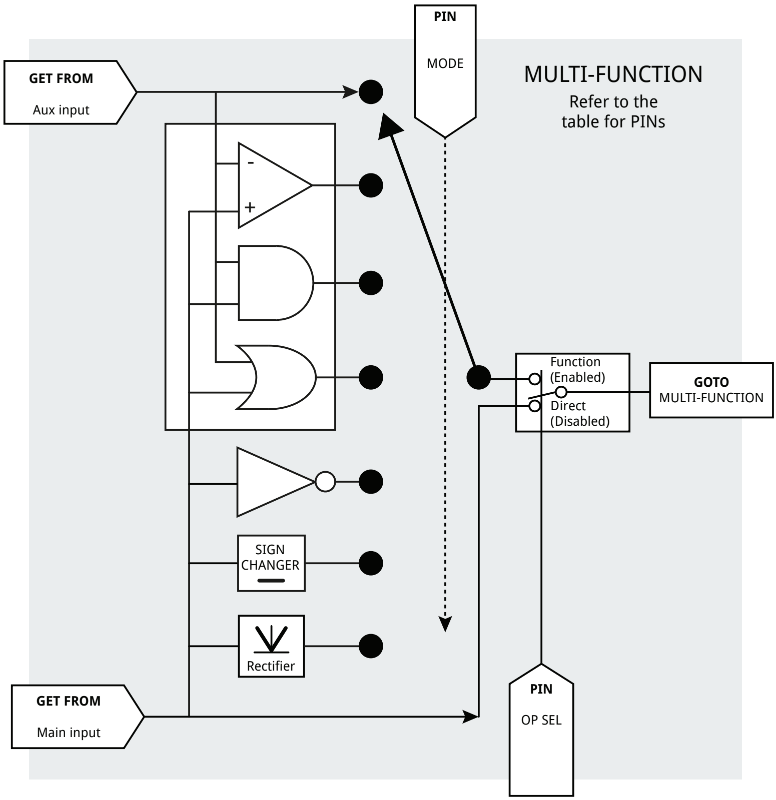


Figure 71 MULTI-FUNCTION - block diagram

16.9.1 544)MULTIFUN1 MODE

Select one of seven transfer functions.

PIN	Parameter description	Range	Default
544	MULTI-FUNCTION 1 MODE	1 of 7 functions	C/O SWITCH

NOTE: A logical function will treat a linear signal as a logical 0 if its value is zero (any units). Any other value, including negative values, will be treated as a logical 1.

```
R  ENTRY MENU       LEVEL    1
   APPLICATION BLOCKS        2
   MULTI-FUNCTION 1          3
     544)MULTIFUN1 MODE
```

Mode	Function	Function type	Output Description for MULTIFUN1 OP SEL Enabled		
0	C/O SWITCH Or JUMPER	Linear or logical	The value at the aux input Use this for connections if JUMPERS are all used		
1	COMPARATOR	2 linear inputs, logical output	If MAIN > AUX output = 1 If MAIN < AUX output = 0		
2	AND GATE	2 logical inputs, logical output	MAIN 0 0 1 1	AUX 0 1 0 1	Output 0 0 0 1
3	OR GATE	2 logical inputs, logical output	MAIN 0 0 1 1	AUX 0 1 0 1	Output 0 1 1 1
4	INVERT	1 logical input, logical output	MAIN 0 1	Output 1 0	(The invert function output is also the EXOR (exclusive OR) of MAIN and OP SELECT inputs)
5	SIGN CHANGER	1 linear input, logical output	Output = MAIN X (-1)		
6	RECTIFIER	1 linear input, linear output	Output = | MAIN |		

16.9.1.1 Sample and hold function

To perform a sample and hold, set both the AUX GET FROM source PIN and GOTO destination PIN to the same parameter, and set the MODE to 0. When OUTPUT SELECT is DISABLED, the output value follows the main input, whereas ENABLED causes it to hold the value pertaining at that time. Refer to "16.15.1 Sample and hold function" on page 318.

NOTE: To create an Exclusive OR function easily - the INVERT mode output is the EXOR (exclusive OR) of the MAIN and OP SELECT inputs.

16.9.2 545)MULTIFUN1 OP SEL

Enable/disable the output selected by the 544)MULTIFUN1 MODE parameter.

PIN	Parameter description	Range	Default
545	MULTI-FUNCTION 1 OUTPUT SELECT	DISABLED ENABLED	DISABLED

- When DISABLED, the main GETFROM value flows directly to the GOTO.
- When ENABLED, 1 of 7 transfer functions selected by the logic mode switch is then output to the GOTO.

When using this PIN as a logic GETFROM value with the main GETFROM value in INVERT mode, the GOTO is EXOR of the two GETFROM values.

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	MULTI-FUNCTION 1	3
	545)MULTIFUN1 OP SEL	

16.9.3 GET FROM

Set the PIN for the main GET FROM value source.

	Parameter description	Range	Default
	GET FROM	000 to 720	400)Block Disconnect

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	MULTI-FUNCTION 1	3
	GET FROM	

16.9.4 AUX GET FROM

Set the PIN for the auxiliary GET FROM value source.

	Parameter description	Range	Default
	AUX GET FROM	000 to 720	400)Block Disconnect

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	MULTI-FUNCTION 1	3
	AUX GET FROM	

16.9.5 GOTO

Set the target PIN for the multi-function GOTO signal.

	Parameter description	Range	Default
	GOTO	000 to 720	400)Block disconnect

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   MULTI-FUNCTION 1         3
     └ GOTO
```

16.10 APPLICATION BLOCKS / LATCH

This block provides a standard D type latch function.

The PL/X scans the logic inputs at least once every 50 ms, and so the maximum operating frequency is 10 Hz.

The GOTO of this block resides in the CONFIGURATION / BLOCK OP CONFIG menu - refer to Page 361.

```
R  ENTRY MENU     LEVEL   1
   APPLICATION BLOCKS     2
   LATCH                  3
     560)LATCH OUTPUT MON
     561)LATCH DATA IP
     562)LATCH CLOCK IP
     563)LATCH SET IP
     564)LATCH RESET IP
     565)LATCH HI VALUE
     566)LATCH LO VALUE
```

Truth Table

SET	RESET	CLOCK	DATA	OUTPUT
High	Low	Unimportant	Unimportant	Value for high
Low	High	Unimportant	Unimportant	Value for low
High	High	Unimportant	Unimportant	Value for high
Low	Low	+VE EDGE	LOW	Value for low
Low	Low	+VE EDGE	HIGH	Value for high

16.10.1 560)LATCH DATA MON

Monitor the output value of the latch block.

PIN	Parameter description	Range
560	LATCH DATA MONITOR	±300.00%

```
R  ENTRY MENU     LEVEL   1
   APPLICATION BLOCKS     2
   LATCH                  3
     560)LATCH DATA MON
```

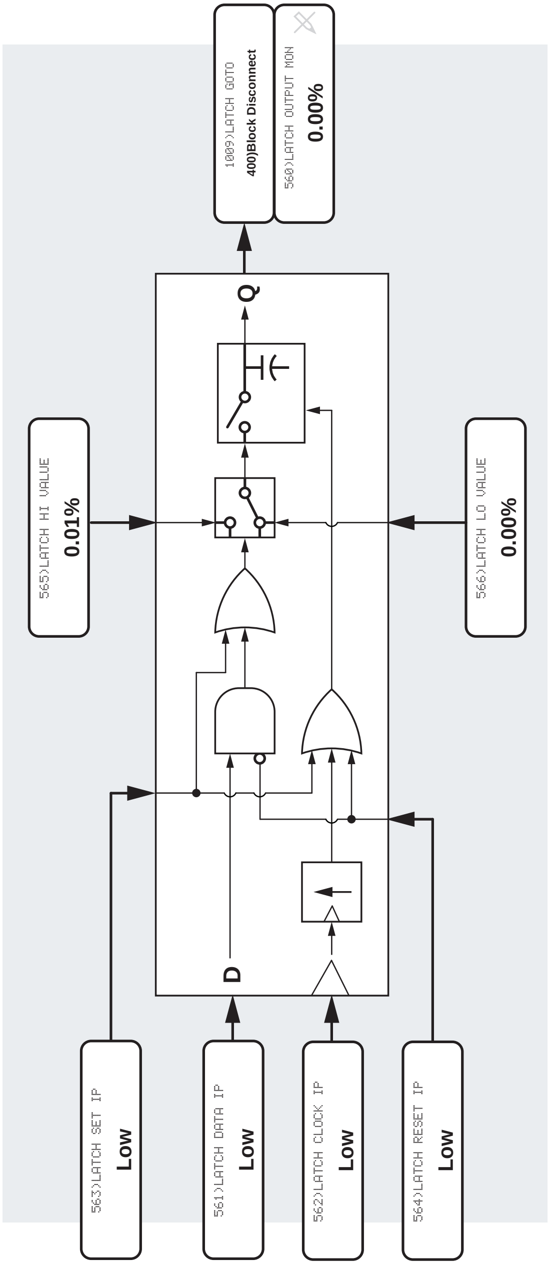


Figure 72 LATCH - block diagram

16.10.2 561)LATCH DATA IP

Set the logic level for the latch data input.

PIN	Parameter description	Range	Default
561	LATCH DATA INPUT	LOW HIGH	LOW

If the clock level has changed from a low to a high since the last sample, then the logic level of the data input (high or low) is placed on the latch output stage, giving an output value for high or low.

The minimum dwell time is 50 ms.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   LATCH                    3
     561)LATCH DATA IP
```

16.10.3 562)LATCH CLOCK IP

Set the logic level for the latch clock input.

PIN	Parameter description	Range	Default
562	LATCH CLOCK INPUT	LOW HIGH	LOW

If the clock level has changed from a low to a high since the last sample, then the logic level of the data input (high or low) is placed on the latch output stage giving an output value for high or low. Refer to the truth table for a complete definition.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   LATCH                    3
     562)LATCH CLOCK IP
```

16.10.4 563)LATCH SET IP

Set the logic level for the latch set input.

PIN	Parameter description	Range	Default
563	LATCH SET INPUT	LOW HIGH	LOW

Refer to the truth table for a complete definition.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   LATCH                    3
     563)LATCH SET IP
```

16.10.5 564)LATCH RESET IP

Set the logic level for the latch reset input.

PIN	Parameter description	Range	Default
564	LATCH RESET INPUT	LOW HIGH	LOW

Refer to the truth table for a complete definition.

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	LATCH	3
	564)LATCH RESET IP	

16.10.6 565)LATCH HI VALUE

Set the output value for the latch high result.

PIN	Parameter description	Range	Default
565	LATCH HIGH VALUE	±300.00%	0.01%

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	LATCH	3
	565)LATCH HI VALUE	

16.10.7 566)LATCH LO VALUE

Set the output value for the latch low result.

PIN	Parameter description	Range	Default
566	LATCH LOW VALUE	±300.00%	0.00%

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	LATCH	3
	566)LATCH LO VALUE	

16.11 APPLICATION BLOCKS / FILTER 1, 2

These filters help eliminate mechanical resonance effects from the control system closed-loop. There are two identical FILTER blocks, identified by the suffix 1 and 2. This description shows only the PINs for FILTER 1.

Parameter	FILTER 1	FILTER 2
OP MON	568	573
TC	569	574

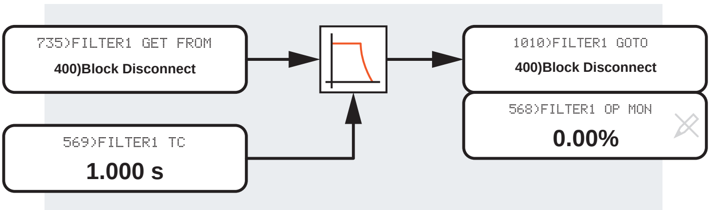
```
R  ENTRY MENU       LEVEL   1
   APPLICATION BLOCKS       2
   FILTER 1                 3
     568)FILTER1 OP MON
     569)FILTER1 TC
     GET FROM
     GOTO
```

Each filter has a time constant set by the user. With a value of 0.000, the filter is transparent.

There is also a simple low pass filter in the hidden PIN list: input is PIN 705, and output is PIN 706.

The GOTO of this block resides in the CONFIGURATION / BLOCK OP CONFIG menu - refer to Page 361.

Filter 1



Filter 2

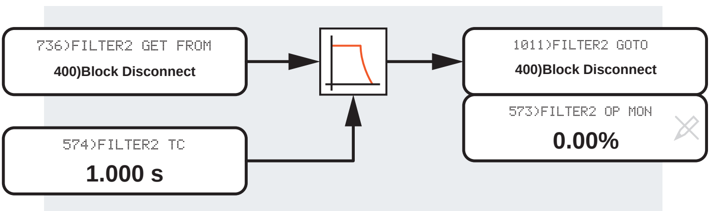


Figure 73 FILTER - block diagram

16.11.1 568)FILTER1 OP MON

Monitor the Filter 1 output.

PIN	Parameter description	Range
568	FILTER1 OUTPUT MONITOR	±315.00%

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   FILTER 1                 3
     568)FILTER1 OP MON
```

16.11.2 569)FILTER1 TC

Set the value of the time constant for the Filter 1 block.

PIN	Parameter description	Range	Default
569	FILTER1 TIME CONSTANT	0.000 to 32.000 seconds	1.000 seconds

Cascade the filters for filter time constants over 32.000 seconds.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   FILTER 1                 3
     569)FILTER1 TC
```

16.11.3 GET FROM

Set the PIN for the filter input.

	Parameter description	Range	Default
	GET FROM	000 to 720	400)Block disconnect

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   FILTER 1                 3
     GET FROM
```

16.11.4 Fixed low pass filter

A simple low pass filter function with a cut-off frequency of approximately 10 Hz.

It can help with smoothing linear signals or eliminating resonances.

It uses hidden pins, and so the filter has no adjustments.

To use the filter, connect its input using a GOTO from another block and connect the output using the GETFROM of the destination block.

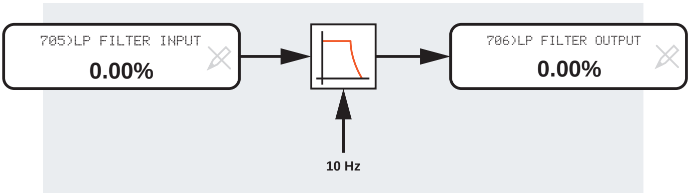


Figure 74 LOW PASS FILTER - block diagram

16.12 APPLICATION BLOCKS / BATCH COUNTER

This block provides a batch counter function. The minimum low or high logic input dwell time is 50 ms giving a maximum count frequency of 10 Hz. A positive clock transition causes the counter to count up.

If the count is equal to or greater than the target, then 582)COUNTER >=TARGET flag is set high.

The counter continues to count positive clock transitions unless the reset input is HIGH or until the counter reaches 32000. This feature is useful when using the counter to signal intermediate points within a complete batch.

The count target can change without interfering with the counting process.

The reset input resets the counter to zero.

R ENTRY MENU LEVEL 1

APPLICATION BLOCKS 2

BATCH COUNTER 3

- 578)COUNTER COUNT
- 579)COUNTER CLOCK
- 580)COUNTER RESET
- 581)COUNTER TARGET
- 582)COUNTER>=TARGET

The GOTO of this block resides in the CONFIGURATION / BLOCK OP CONFIG menu - refer to Page 361.

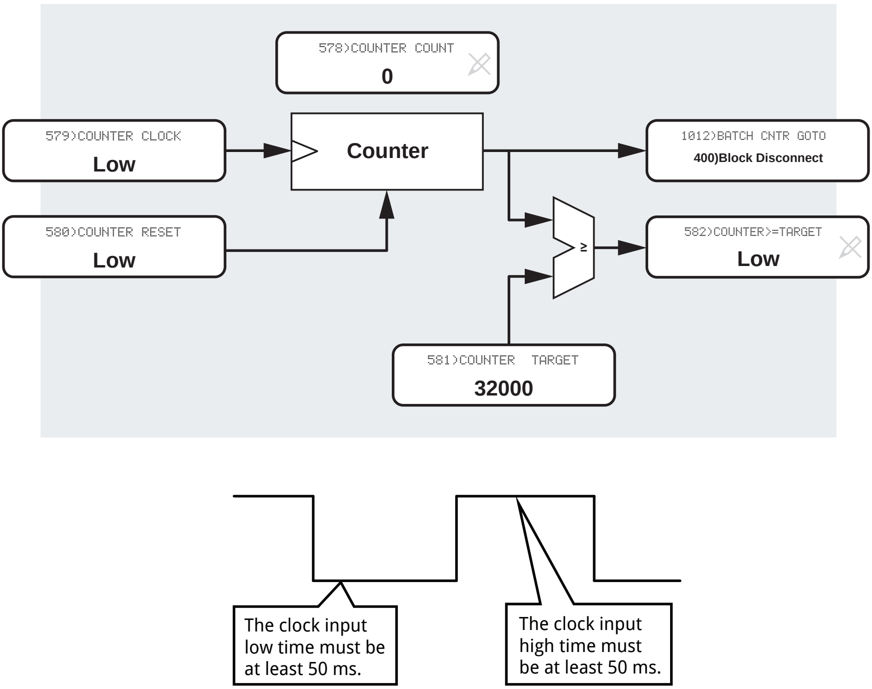


Figure 75 BATCH COUNTER - block diagram and sample times

16.12.1 578)COUNTER COUNT

Monitor the batch counter value.

PIN	Parameter description	Range	Default
578	COUNTER COUNT	0 to 32000	0

NOTE: This value also appears on the GOTO.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   BATCH COUNTER            3
     └578)COUNTER COUNT
```

16.12.2 579)COUNTER CLOCK

The clock input logic level for the batch counter.

PIN	Parameter description	Range	Default
579	COUNTER CLOCK	LOW HIGH	LOW

The counter will increment on a positive clock transition.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   BATCH COUNTER            3
     └579)COUNTER CLOCK
```

16.12.3 580)COUNTER RESET

Set the reset input for the batch counter.

PIN	Parameter description	Range	Default
580	COUNTER RESET	LOW HIGH	LOW

The reset input resets the counter to zero. The counter holds reset while the reset input is high.

```
R  ENTRY MENU      LEVEL    1
   APPLICATION BLOCKS       2
   BATCH COUNTER            3
     └580)COUNTER RESET
```

16.12.4 581)COUNTER TARGET

Set the target number for the batch counter.

PIN	Parameter description	Range	Default
581	COUNTER TARGET	0 to 32000	32000

When the batch counter value equals or exceeds the target value, the output 582)COUNTER >=TARGET goes high.

Changing the counter target does not interfere with the counting process.

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	BATCH COUNTER	3
	581)COUNTER TARGET	

16.12.5 582)COUNTER >=TARGET

Monitor the equal or greater flag.

PIN	Parameter description	Range	Default
582	COUNTER >=TARGET	LOW HIGH	LOW

When the batch counter value equals or exceeds the target value, this flag goes HIGH.

NOTE: By using a jumper to connect this flag to 580) COUNTER RESET, it is possible to make the counter rollover at the counter target number and continue counting from 0 again.

R	ENTRY MENU LEVEL	1
	APPLICATION BLOCKS	2
	BATCH COUNTER	3
	582)COUNTER >=TARGET	

16.13 APPLICATION BLOCKS / INTERVAL TIMER

The INTERVAL TIMER can control event sequencing in systems applications. For example, you can use it to make a motion control sequence wait before starting or delay a relay changeover.

```
R  ENTRY MENU        LEVEL   1
   APPLICATION BLOCKS        2
   INTERVAL TIMER            3
      583)TMR ELAPSED TIME
      584)TIMER RESET
      585)TIMER INTERVAL
      586)TMR EXPIRED FLAG
```

The GOTO of this block resides in the CONFIGURATION / BLOCK OP CONFIG menu - refer to Page 361.

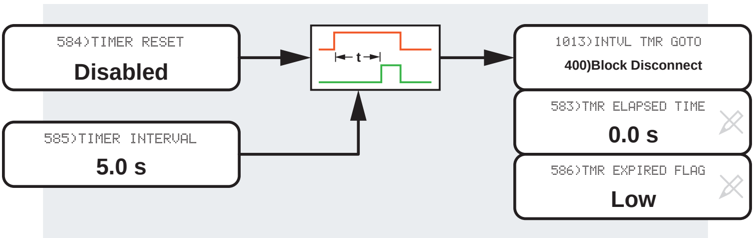


Figure 76 INTERVAL TIMER - block diagram

16.13.1 583)TMR ELAPSED TIME

Monitor the interval timer elapsed time.

PIN	Parameter description	Range	Default
583	TIMER ELAPSED TIME	0.1 to 600.0 seconds	0.0 seconds

NOTE: This value is the output of the block GOTO connection.

```
R  ENTRY MENU        LEVEL   1
   APPLICATION BLOCKS        2
   INTERVAL TIMER            3
      583)TMR ELAPSED TIME
```

16.13.2 584)TIMER RESET

Enable/disable the resetting of the timer.

PIN	Parameter description	Range	Default
584	TIMER RESET	DISABLED ENABLED	DISABLED

When ENABLED, the timer is reset and held at zero.

When DISABLED, the timer commences timing.

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   INTERVAL TIMER          3
     584)TIMER RESET
```

16.13.3 585)TIMER INTERVAL

Set the time delay for the interval timer.

PIN	Parameter description	Range	Default
585	TIMER INTERVAL	0.1 to 600.0 seconds	5.0 seconds

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   INTERVAL TIMER          3
     585)TIMER INTERVAL
```

16.13.4 586)TMR EXPIRED FLAG

Monitor the interval timer expired flag.

PIN	Parameter description	Range	Default
586	TMR EXPIRED FLAG	LOW HIGH	LOW

When the timer interval has expired, the timer expired flag goes high. It stays high until the next DISABLE input.

NOTE: By connecting this flag to 584)TIMER RESET using a jumper, it is possible to make the timer automatically reset and repeat timing from zero once the timer interval has expired.”

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   INTERVAL TIMER          3
     586)TMR EXPIRED FLAG
```

16.14 APPLICATION BLOCKS / COMPARATOR 1 to 4

There are four identical COMPARATOR blocks, identified by the suffix 1 to 4, each with adjustable hysteresis and a window comparator mode option. This description shows only the PINs for COMPARATOR 1.

Parameter	COMPARATOR 1	COMPARATOR 2	COMPARATOR 3	COMPARATOR 4
INPUT 1	588	592	596	600
INPUT 2	589	593	597	601
WINDOW SEL	590	594	598	602
HYSTERESIS	591	595	599	603

```
R ENTRY MENU      LEVEL   1
  APPLICATION BLOCKS      2
  COMPARATOR 1            3
    588)COMP1 INPUT 1
    589)COMP1 INPUT 2
    590)COMP1 WINDOW SEL
    591)COMP1 HYSTERESIS
    GOTO
```

If the window comparator mode is DISABLED, the block functions as a comparator with Input 1 on the comparator's positive input and Input 2 on the negative. It applies the hysteresis level above and below the value of input 1. The hysteresis range is 0 - 10.00%.

If the window comparator mode is ENABLED, the value on Input 2 creates a symmetrical window around zero. If the value on Input 1 lies within the window, the comparator output is HIGH. Any hysteresis in the window mode applies at each boundary.

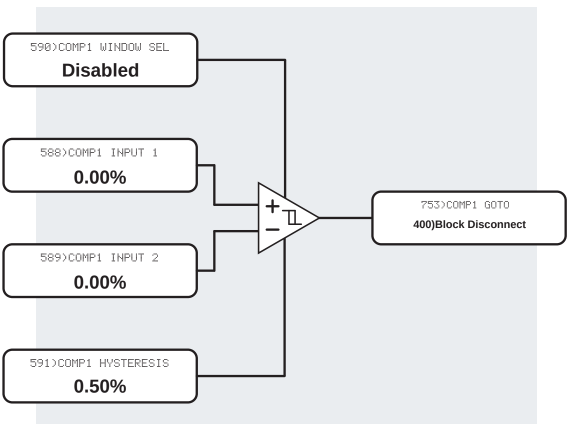


Figure 77 COMPARATOR 1 - block diagram

16.14.1 588)COMP1 INPUT 1

Set the level of input 1 of comparator 1.

PIN	Parameter description	Range	Default
588	COMPARATOR1 INPUT 1	±300.00%	0.00%

The GOTO is high for Input 1 > Input 2 (algebraic).

The GOTO is low for Input 1 =< Input 2 (algebraic).

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
COMPARATOR 1 3
588)COMP1 INPUT 1

16.14.2 589)COMP1 INPUT 2

Set the level of input 2 of comparator 1.

PIN	Parameter description	Range	Default
589	COMPARATOR1 INPUT 2	±300.00%	0.00%

The GOTO is high for Input 1 > Input 2 (algebraic).

The GOTO is low for Input 1 =< Input 2 (algebraic).

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
COMPARATOR 1 3
589)COMP1 INPUT 2

16.14.3 590)COMP1 WINDOW SEL

Enable/disable the window comparator mode.

PIN	Parameter description	Range	Default
590	COMPARATOR1 WINDOW SELECT	DISABLED ENABLED	DISABLED

The GOTO is low for Input 1 > or =< the window amplitude created by Input 2 (algebraic).

The window is created symmetrically around 0.00% and has a range of ± Input 2.

If hysteresis is applied, it operates at each boundary of the window.

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
COMPARATOR 1 3
590)COMP1 WINDOW SEL

16.14.4 591)COMP1 HYSTERISIS

Set the level of hysteresis applied to input 1.

PIN	Parameter description	Range	Default
591	COMPARATOR1 HYSTERESIS	0 to 10.00%	0.50%

For example, a value of 1.00% would require:

- Input 1 to exceed Input 2 by more than 1.00% for a HIGH output,
- Input 1 to fall below Input 2 by 1.00% or more for a LOW output.

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   COMPARATOR 1            3
     591)COMP1 HYSTERESIS
```

16.14.5 GOTO

Set the PIN for the GOTO connection target parameter.

	Parameter description	Range	Default
	GOTO	2 to 720	400)Block Disconnect

NOTE: To activate the block, connect the GOTO to a PIN other than `400)Block Disconnect`.

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   COMPARATOR 1            3
     GOTO
```

16.15 APPLICATION BLOCKS / C/O SWITCH 1 TO 4

There are four identical Changeover Switch blocks, each with two inputs and one output. They are identified by the suffix 1 to 4. This description shows only the PINs for C/O SWITCH 1.

Parameter	C/O SWITCH 1	C/O SWITCH 2	C/O SWITCH 3	C/O SWITCH 4
CONTROL	604	607	610	613
HI VALUE	605	608	611	614
LO VALUE	606	609	612	615

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
C/O SWITCH 1 3
604)C/O SW1 CONTROL
605)C/O SW1 HI VALUE
606)C/O SW1 LO VALUE
GOTO

16.15.1 Sample and hold function

A sample and hold function can be implemented by connecting the output to 606)C/O SW1 LO VALUE:

- The value on 605)C/O SW1 HI VALUE transfers to 606)C/O SW1 LO VALUE when 604)C/O SW1 CONTROL is HIGH.
- The value on 605)C/O SW1 HI VALUE holds at the value pertaining when 604)C/O SW1 CONTROL is LOW.

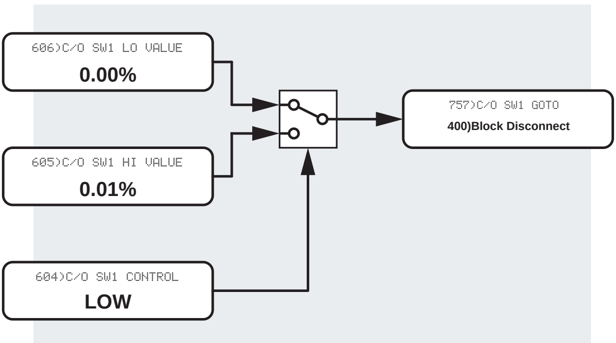


Figure 78 C/O SWITCH 1 - block diagram

16.15.2 604)C/O SW1 CONTROL

Set the changeover switch position to the LO or HI input.

PIN	Parameter description	Range	Default
604	CHANGEOVER SWITCH 1 CONTROL	LOW HIGH	LOW

R ENTRY MENU LEVEL 1

APPLICATION BLOCKS 2

C/O SWITCH 1 3

604)C/O SW1 CONTROL

16.15.3 605)C/O SW1 HI VALUE

Set the level for the input selected by a logic HIGH control mode.

PIN	Parameter description	Range	Default
605	CHANGEOVER SWITCH 1 HIGH VALUE	±300.00%	0.00%

R ENTRY MENU LEVEL 1

APPLICATION BLOCKS 2

C/O SWITCH 1 3

605)C/O SW1 HI VALUE

16.15.4 606)C/O SW1 LO VALUE

Set the level for the input selected by a logic LOW control mode.

PIN	Parameter description	Range	Default
606	CHANGEOVER SWITCH 1 LOW VALUE	±300.00%	0.00%

R ENTRY MENU LEVEL 1

APPLICATION BLOCKS 2

C/O SWITCH 1 3

606)C/O SW1 LO VALUE

16.15.5 C/O SW1 LO VALUE

Set the PIN for the GOTO connection target parameter.

	Parameter description	Range	Default
	GOTO	2 to 720	400)Block Disconnect

NOTE: To activate the block, connect the GOTO to a PIN other than `400)Block Disconnect`.

```
R  ENTRY MENU      LEVEL   1
   APPLICATION BLOCKS      2
   C/O SWITCH 1            3
    └ GOTO
```

16.16 APPLICATION BLOCKS / 16-BIT DEMULTIPLEX

The primary use for this block is to extract individual alarm flags from parameters 181)ACTIVE TRIP MON **or** 182)STORED TRIP MON.

The valued stored in the Alarms monitor parameters is a 4-character hex code containing 16 different alarm flags.

Connect a GET FROM to PIN 181 for the active flags or PIN 182 for the stored flags to retrieve a 4-character hex code.

If used for this purpose, the individual O/P bits 1 to 16 are available on the allocated PINs:

Description	PIN
Armature overcurrent	535
Speed fbk mismatch	536
Overspeed	537
Armature overvolts	538
Field overcurrent	539
Field loss	540
Missing pulse	541
Stall trip	542
Thermistor on T30	543
Heatsink overtemp	567
Short circuit digital output	570
Bad reference Exch	571
Contactor lockout	572
User alarm input (PIN 712)	575
Synchronisation loss	576
Supply phase loss	577

R ENTRY MENU LEVEL 1
APPLICATION BLOCKS 2
16-BIT DEMULTIPLEX 3
GET FROM
535)DEMULX O/P BIT1
536)DEMULX O/P BIT2
537)DEMULX O/P BIT3
538)DEMULX O/P BIT4
539)DEMULX O/P BIT5
540)DEMULX O/P BIT6
541)DEMULX O/P BIT7
542)DEMULX O/P BIT8
543)DEMULX O/P BIT9
567)DEMULX O/P BIT10
570)DEMULX O/P BIT11
571)DEMULX O/P BIT12
572)DEMULX O/P BIT13
575)DEMULX O/P BIT14
576)DEMULX O/P BIT15
577)DEMULX O/P BIT16

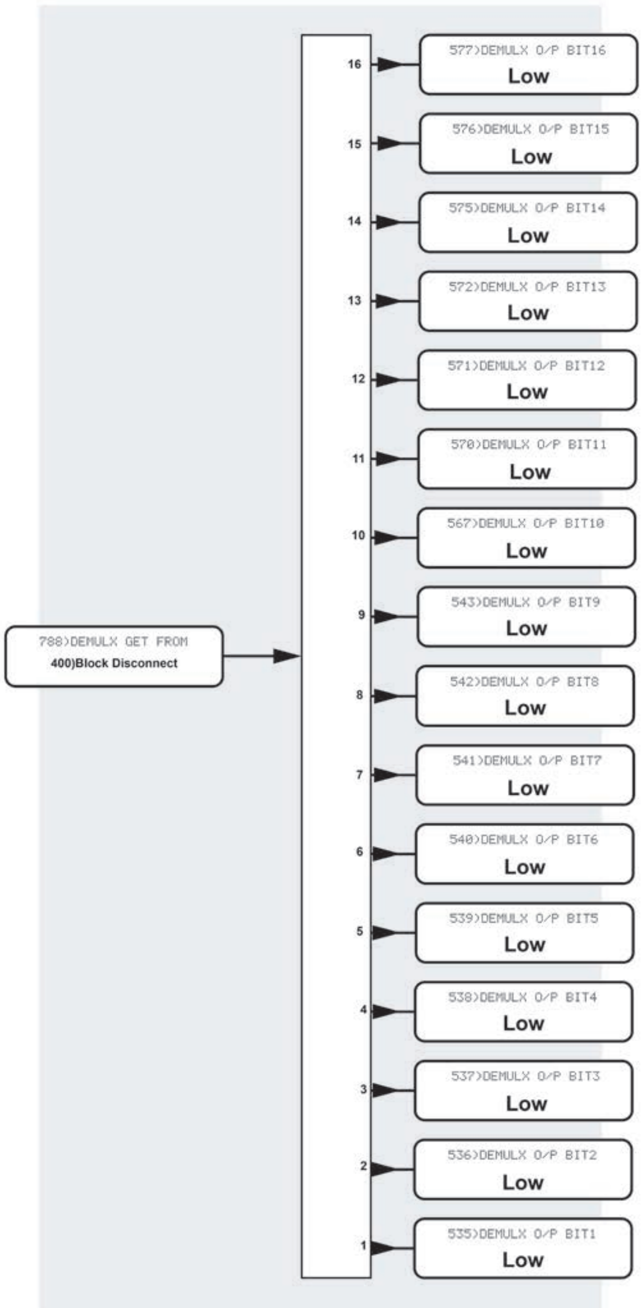


Figure 79 16-bit Demultiplex - block diagram

17 The CONFIGURATION menu

The drive's internal block diagram connections can be re-configured using the legacy PL PILOT configuration tool or the HMI.[1]

> **To begin a configuration session, you must set the parameter** CONFIGURATION / ENABLE GOTO, GETFROM **to ENABLED.**
>
> **To end a configuration session, you must set the parameter** CONFIGURATION / ENABLE GOTO, GETFROM **to DISABLED.**

17.1 How to configure blocks

For example, to activate a block in the BLOCK OP CONFIG menu:

1. Set CONFIGURATION / ENABLE GOTO, GETFROM to ENABLED.
2. In the CONFIGURATION menu, navigate to BLOCK OP CONFIG to find the appropriate GOTO.

GOTOs in CONFIGURATION / BLOCK OP CONFIG	
RUN MODE RAMPS GOTO	TAPER CALC GOTO
MOTORISED POT GOTO	T / COMP +CUR LIM GOTO
REF EXCH SLAVE GOTO	T / COMP -CUR LIM GOTO
SUMMER1 GOTO	PRESET SPEED GOTO
SUMMER2 GOTO	LATCH GOTO
PID1 GOTO	FILTER1 GOTO
PID2 GOTO	FILTER2 GOTO
PARAMETER PRFL GOTO	BATCH COUNTER GOTO
DIAMETER CALC GOTO	INTERVAL TIMER GOTO

NOTE: You can find the GOTOs for MULTI-FUNCTION 1 to 8, COMPARATOR 1 to 4, and C/O SWITCH 1 to 4 in their respective block menus in the CONFIGURATION MENU.

3. Configure the desired block's GOTO to a PIN other than the default setting of 400) BLOCK DISCONNECT.
4. Set CONFIGURATION / ENABLE GOTO, GETFROM to DISABLED. This action will begin a background "conflict checker" to look for and report any conflicts (below).

17.1.1 CONFLICT HELP MENU

When you set CONFIGURATION / ENABLE GOTO, GETFROM to DISABLED having finished configuring blocks, a background conflict checker is initiated that looks for conflicts.

It is not possible to make illegal connections (e.g. from an output to an output). However, you can incorrectly connect more than one GOTO to a legal pin (e.g. an input), resulting in an error at the target pin.

When the "conflict checker" finds a conflict:

1. The message GOTO CONFLICT is displayed.
2. Correct the conflict.

This process repeats until no conflicts are displayed.

---

1 You can also use an Ethernet-based distributed control system (DCS) hardware and software. It may complete the ENABLE GOTO, GETFROM settings automatically.

17.2 CONFIGURATION

There are 720 parameters used in the process of configuration, each with a unique identifying PIN. The PINs identify the connection points made during Configuration.

```
R ENTRY MENU    LEVEL  1
  CONFIGURATION        2
   ENABLE GOTO,GETFROM
   UNIVERSAL INPUTS    3
   ANALOG OUTPUTS      3
   DIGITAL INPUTS      3
   DIGITAL IN/OUTPUTS  3
   DIGITAL OUTPUTS     3
   STAGING POSTS       3
   SOFTWARE TERMINALS  3
   JUMPER CONNECTIONS  3
   BLOCK OP CONFIG     3
   FIELDBUS CONFIG     3
   DRIVE PERSONALITY   3
   CONFLICT HELP MENU  3
```

Each parameter stores a value. By connecting parameters, you can pass the value of the source parameter to the target parameter.

There are four methods of connecting parameters during a Configuration session using a configurable block's inputs and outputs:

GOTO	This is the output of a block. It can connect to any parameter but not to another GOTO or a GET FROM.
GET FROM	This is the input of a block. It can connect to any parameter but not to another GET FROM or a GOTO. A block may also have an AUX GET FROM (which is a second GET FROM).
JUMPER	This is a virtual wire that connects two parameters using its own GOTO and GET FROM.
STAGING POST	This is a parameter that stores a value and connects to a GOTO and a GET FROM.

Using a combination of these methods, you can construct very simple to very complex systems.

- **Any parameter can only be written to by one GOTO.**
- **A GET FROM can only be read from one parameter.**
- **Connect the same parameter to multiple GET FROMs**

17.2.1 CONFIGURATION / ENABLE GOTO,GETFROM

ENABLE/DISABLE the option to configure the internal system connections.

An Ethernet-based distributed control system (DCS) hardware and software may complete the following automatically.

Configuration using the HMI

To begin a Configuration session, you must set CONFIGURATION / ENABLE GOTO, GETFROM **to ENABLED.**

ENABLE GOTO,GETFROM
ENABLED

Attempting to make a connection without doing this will cause ENABLE GOTO,GETFROM to be displayed.

To end a Configuration session, you must set CONFIGURATION / ENABLE GOTO, GETFROM **to DISABLED.**

ENABLE GOTO,GETFROM
DISABLED

The PL/X now runs a "Conflict Checker" to warn of GOTO connection conflicts.

Refer to "17.1.1 CONFLICT HELP MENU" on page 323.

R ENTRY MENU LEVEL 1

CONFIGURATION 2

ENABLE GOTO,GETFROM

17.3 CONFIGURATION / UNIVERSAL INPUTS

The PL/X has eight analog inputs.

The voltage range for each input is programmable to ± 5/10/20/30 V. This allows for using signals other than 10 V full scale, enabling it for use as a sophisticated digital input. To achieve this, for example, select the input to the 30 V range, and set the programmable logic threshold to be 15 V to recognise a 0 or 1.

UIP3 is specially adapted to acquire signals with a faster response than the other inputs and is therefore valuable for inputting to a speed/current loop that requires a quicker response.

There is a permanent internal connection to the speed/current loop from UIP3 to 64)SPEED REF 3 MON:

- The default connection configures the linear GOTO of UIP3 to 400)Block Disconnect and operates independently of the internal connection to the speed/current loop.
- To connect UIP3 elsewhere, nullify this internal connection by setting 67)SPD / CUR RF3 RATIO in the CHANGE PARAMETERS / SPEED REF SUMMER menu to 0.0000, then reconfigure the linear GOTO as required. The parameter 64)SPEED REF 3 MON is a monitor of the UIP3 analog output.

R	ENTRY MENU LEVEL	1
	CONFIGURATION	2
	UNIVERSAL INPUTS	3
	UIP2 (T2) SETUP	4
	UIP3 (T3) SETUP	4
	UIP4 (T4) SETUP	4
	UIP5 (T5) SETUP	4
	UIP6 (T6) SETUP	4
	UIP7 (T7) SETUP	4
	UIP8 (T8) SETUP	4
	UIP9 (T9) SETUP	4

17.4 CONFIGURATION / UNIVERSAL INPUTS / UIP2 to 9

PL/X terminals T2 to T9 are provided respectively with their processing block UIP2 to UIP9. Each processing block has three outputs: one linear output and a dual-logic output. This description shows only the PINs for UIP2.

NOTE: UIPs offer increased noise immunity when compared to DIPs and DIOs.

The processing block provides the following functions:

- Range selectable ± (5, 10, 20, 30V)
- Linear functions
- Linear offset
- Signed scaling
- Clamping of the linear output

Logic functions

- An adjustable threshold for logic level detection.
- The UIP2 THRESHOLD comparator output can be a low or a high:
  - The high state results in the HI VAL being output.
  - The low state results in the LO VAL being output.

  To turn the function into a changeover switch for dynamic values, enter the values for LO VAL and HI VAL using the display and keys, or connect to them from other PINs using JUMPERS:

    There are two sets of HI VAL and LO VAL parameters. Each pair possess a GOTO connection facility, allowing independent output values for two logic high inputs and two logic low inputs. These versatile

R ENTRY MENU LEVEL 1
CONFIGURATION 2
UNIVERSAL INPUTS 3
UIP2 (T2) SETUP 4
- 320)UIP2 IP RANGE
- 321)UIP2 IP OFFSET
- 322)UIP2 CAL RATIO
- 323)UIP2 MAX CLAMP
- 324)UIP2 MIN CLAMP
- UIP ANALOG GOTO
- UIP DIGITAL OP1 GOTO
- UIP DIGITAL OP2 GOTO
- 325)UIP2 HI VAL OP1
- 326)UIP2 LO VAL OP1
- 327)UIP2 HI VAL OP2
- 328)UIP2 LO VAL OP2
- 329)UIP2 THRESHOLD

Parameter	UIP2	UIP3	UIP4	UIP5	UIP6	UIP7	UIP8	UIP9
IP RANGE	320	330	340	350	360	370	380	390
OFFSET	321	331	341	351	361	371	381	391
CAL RATIO	322	332	342	352	362	372	382	392
MAX CLAMP	323	333	343	353	363	373	383	393
MIN CLAMP	324	334	344	354	364	374	384	394
HI VAL OP1	325	335	345	355	365	375	385	395
LO VAL OP1	326	336	346	356	366	376	386	396
HI VAL OP2	327	337	347	357	367	377	387	397
LO VAL OP2	328	338	348	358	368	378	388	398
THRESHOLD	329	339	349	359	369	379	389	399

parameter changeover functions are selectable by a single input.

For example, you might have the `DIGITAL OP1 GOTO` value change to target PIN XXX and simultaneously have `DIGITAL OP2 GOTO` logic change to target PIN YYY.

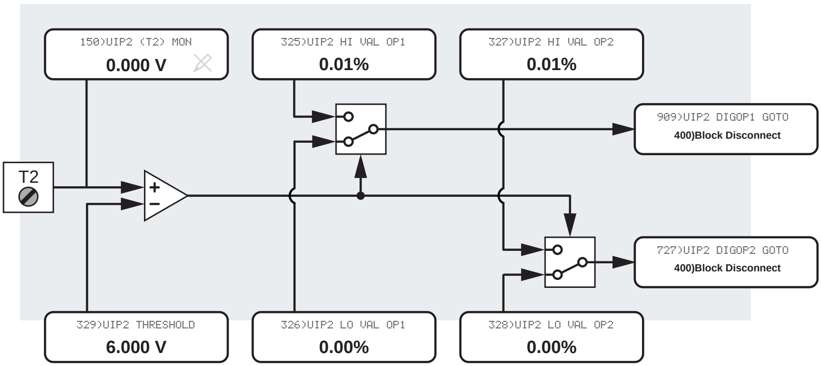
For logic-only usage:

- A value of 0.00% reads as a LOW
- Any nonzero ± value reads as a HIGH

Invert the logic by entering:

0.00% in the HI VAL parameter and 0.01% in the LO VAL parameter.

UIP2 (T2) Digital IO Monitor



UIP2 (T2) Speed Reference

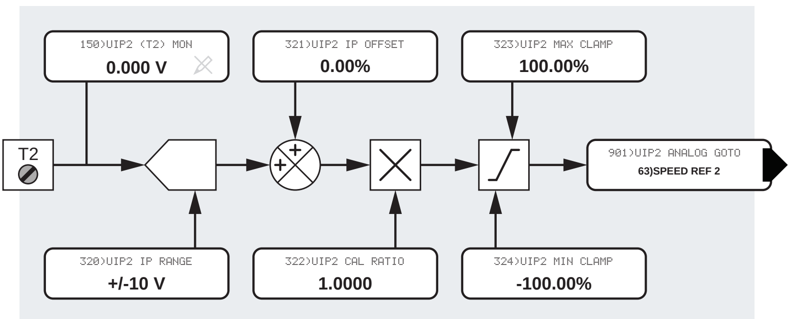


Figure 80 UIP2 (Universal Inputs) - block diagram

17.4.1 320)UIP2 IP RANGE

Select the '0 to ±100%' voltage range of the UIP2 input signal.

PIN	Parameter description	Range	Default
320	UIP2 INPUT RANGE	±10 V ±5 V ±20 V ±30 V	±10 V

For example: for a range setting of 0, an input signal of ±10 V = 100%. Similarly, for a range setting of 1, an input signal of ±5 V = 100%, and so on.

The ±5 V and ±10 V ranges are the most accurate (0.4%, typically 0.1%).

The ±20 V and ±30 V ranges use resistor divider networks and their absolute accuracy is 4%. Also, the source impedance of the signal connected to the terminal must be as low as possible if it is in use externally elsewhere because the input impedance for these ranges can vary between 100K and 50K as the PL/X scans the inputs. A source of signal with a high input impedance will be affected by the change in input resistance. It will not affect the reading's accuracy within the PL/X, but may cause an external measurement by another instrument to vary. It is important to remember this when commissioning, as readings at the control terminals with a voltmeter may show slight variations if the source impedance is high. The 5 V and 10 V ranges are not affected by source impedance.

```
R ENTRY MENU      LEVEL   1
  CONFIGURATION           2
  UNIVERSAL INPUTS        3
  UIP2 (T2) SETUP         4
    320)UIP2 IP RANGE
```

17.4.2 321)UIP2 IP OFFSET

Set the level of bipolar offset to be added to the input signal.

PIN	Parameter description	Range	Default
321	UIP2 INPUT OFFSET	±100.00%	0.00%

R ENTRY MENU LEVEL 1
CONFIGURATION 2
UNIVERSAL INPUTS 3
UIP2 (T2) SETUP 4
321)UIP2 IP OFFSET

NOTE: +/-100% always represents a +/-10 V offset, independent of the selected range. Therefore when selecting range 5 V, 20 V or 30 V, the offset addition remains at +/10 V for +/-100% and hence no longer represents a true percentage of the range. Whereas, for the default 10V input range, the offset percentage represents the volts and the true percentage.

For example, for a 2 V offset to a signal using the range 5 V, 20 V, 30 V or 10 V, enter the value 20.00%.

The addition/subtraction of the offset occurs before the scaling function. The offset does not affect the signal used for the digital threshold comparison.

17.4.2.1 4-20 mA loop input SETUP

When using 4-20 mA loop signals, fit an external burden resistor of 220 Ω between the input and 0 V. By passing the signal current through the burden, the resulting voltage signal generated will be +0.88 V for 4 mA (representing 0%) and 4.4V for 20 mA (representing 100%).

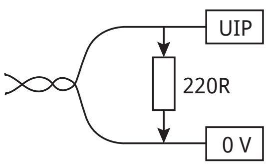
Using the appropriate UIPX SETUP block, select the following:

IP RANGE = 5 V (maximum voltage generated by loop across the burden = 4.4V)

IP OFFSET = -8.8% (4 mA gives 0.88 V). (Note that offset is always for +/-100% = +/-10 V)

CAL RATIO = 1.420 scaling factor
((4.4 – 0.88) x 1.420= 5 V, i.e. 100%)

For burden resistors of other values, the range, offset, and scale will differ accordingly.



17.4.3 322)UIP2 CAL RATIO

Set a linear scaling factor for the signal at the UIP2 input.

PIN	Parameter description	Range	Default
322	UIP2 CALIBRATION RATIO	±3.0000	1.0000

NOTE: This linear scaling factor does not affect the signal used for the digital THRESHOLD comparison.

Use this scaling factor to introduce an inversion by selecting a negative number. A scaling factor of 1.0000 is equivalent to 100.00%. In this case, the full range of the input selection in the range selection window corresponds to a 100.00% signal:

For example, with the 30 V range selected and a scaling factor of 1.0000, then a signal of 30 V would represent a demand of 100.00% speed.

R	ENTRY MENU LEVEL	1
	CONFIGURATION	2
	UNIVERSAL INPUTS	3
	UIP2 (T2) SETUP	4
	322)UIP2 CAL RATIO	

17.4.4 323)UIP2 MAX CLAMP

Set an upper clamp level for the scaled linear input signal.

PIN	Parameter description	Range	Default
323	UIP2 MAXIMUM CLAMP	±300.00%	+100.00%

R	ENTRY MENU LEVEL	1
	CONFIGURATION	2
	UNIVERSAL INPUTS	3
	UIP2 (T2) SETUP	4
	323)UIP2 MAX CLAMP	

17.4.5 324)UIP2 MIN CLAMP

Set a lower clamp level for the scaled linear input signal.

PIN	Parameter description	Range	Default
324	UIP2 MINIMUM CLAMP	±300.00%	-100.00%

R	ENTRY MENU LEVEL	1
	CONFIGURATION	2
	UNIVERSAL INPUTS	3
	UIP2 (T2) SETUP	4
	324)UIP2 MIN CLAMP	

17.4.6 UIP ANALOG GOTO

Set the target destination PIN for the analog connection to UIPx.

	Parameter description	Range	Default
	UIP ANALOG GOTO	000 to 720	See table

R
ENTRY MENU LEVEL 1
CONFIGURATION 2
UNIVERSAL INPUTS 3
UIP2 (T2) SETUP 4
UIP ANALOG GOTO

UIPX	Term	Analog GOTO	Default connection name	Default connection PIN
UIP2	2	Analog GOTO	Auxiliary speed reference	63)SPEED REF 2
UIP3	3	Analog GOTO	Speed reference / current demand (Fast IP) (internally connected, not using the GOTO)	400)Block Disconnect
UIP4	4	Analog GOTO	Ramp input	26)RAMP INPUT
UIP5	5	Analog GOTO	Lower current clamp (-ve)	90)LOWER CUR CLAMP
UIP6	6	Analog GOTO	Main current limit / Upper current clamp +ve	89)UPPER CUR CLAMP
UIP7	7	Analog GOTO	Not connected	400)Block Disconnect
UIP8	8	Analog GOTO	Not connected	400)Block Disconnect
UIP9	9	Analog GOTO	Not connected	400)Block Disconnect

17.4.7 UIP DIGITAL OP1 GOTO

Set the target destination PIN for the logic connection to UIPx.

	Parameter description	Range	Default
	UIP DIGITAL OP1 GOTO	000 to 720	See table

R
ENTRY MENU LEVEL	1
CONFIGURATION	2
UNIVERSAL INPUTS	3
UIP2 (T2) SETUP	4

UIP DIGITAL OP1 GOTO

UIPX	Term	DIG OP1 GOTO	Default connection name	Default connection PIN
UIP2	2	DIG OP1 GOTO	Not connected	400)Block Disconnect
UIP3	3	DIG OP1 GOTO	Not connected	400)Block Disconnect
UIP4	4	DIG OP1 GOTO	Not connected	400)Block Disconnect
UIP5	5	DIG OP1 GOTO	Not connected	400)Block Disconnect
UIP6	6	DIG OP1 GOTO	Not connected	400)Block Disconnect
UIP7	7	DIG OP1 GOTO	Motorised pot preset enable	52)MP PRESET
UIP8	8	DIG OP1 GOTO	Motorised pot up command	48)MP UP COMMAND
UIP9	9	DIG OP1 GOTO	Motorised pot down command	49)MP DOWN COMMAND

17.4.8 UIP DIGITAL OP2 GOTO

Set the target destination PIN for the logic connection to UIPx.

	Parameter description	Range	Default
	UIP DIGITAL OP2 GOTO	000 to 720	400)Block Disconnect

The default setting for all UIP DIGITAL OP2 GOTO connections is 400)Block Disconnect.

R
ENTRY MENU LEVEL	1
CONFIGURATION	2
UNIVERSAL INPUTS	3
UIP2 (T2) SETUP	4

UIP DIGITAL OP2 GOTO

17.4.9 325)UIP2 HI VAL OP1

Set the OP1 value selected by a high UIP2 input.

PIN	Parameter description	Range	Default
325	UIP2 HIGH VALUE OUTPUT1	±300.00%	0.01%

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   UNIVERSAL INPUTS        3
   UIP2 (T2) SETUP         4
     325)UIP2 HI VAL OP1
```

17.4.10 326)UIP2 LO VAL OP1

Set the OP1 value selected by a low UIP2 input.

PIN	Parameter description	Range	Default
326	UIP2 LOW VALUE OUTPUT1	±300.00%	0.01%

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   UNIVERSAL INPUTS        3
   UIP2 (T2) SETUP         4
     326)UIP2 LO VAL OP1
```

17.4.11 327)UIP2 HI VAL OP2

Set the OP2 value selected by a high UIP2 input.

PIN	Parameter description	Range	Default
327	UIP2 HIGH VALUE OUTPUT2	±300.00%	0.01%

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   UNIVERSAL INPUTS        3
   UIP2 (T2) SETUP         4
     327)UIP2 HI VAL OP2
```

17.4.12 328)UIP2 LO VAL OP2

Set the OP2 value selected by a low UIP2 input.

PIN	Parameter description	Range	Default
328	UIP2 LOW VALUE OUTPUT1	±300.00%	0.01%

```
R  ENTRY MENU     LEVEL    1
   CONFIGURATION           2
   UNIVERSAL INPUTS        3
   UIP2 (T2) SETUP         4
      328)UIP2 LO VAL OP2
```

17.4.13 329)UIP2 THRESHOLD

Set the threshold determining logic HI/LO for UIP2.

PIN	Parameter description	Range	Default
329	UIP2 THRESHOLD	±30.000 V	6.000 V

For example, by setting the range input to 20 or 30 V, a threshold of 15.000 V causes the output to go high for signals greater than +15.000 V and low for signals less than or equal to +15.000 V.

```
R  ENTRY MENU     LEVEL    1
   CONFIGURATION           2
   UNIVERSAL INPUTS        3
   UIP2 (T2) SETUP         4
      329)UIP2 THRESHOLD
```

17.5 CONFIGURATION / ANALOG OUTPUTS

There are four analog outputs: AOP1 to AOP3 (terminals T10 to T12) are programmable, plus one analog output on T29 representing armature current.

AOP1/2/3 - Programmable output specification:

- 12-bit +sign resolution (2.5 mV steps).
- Short-circuit protection to 0 V. (Protection is only available for any one of the outputs. More than one output shorted may damage the PL/X).
- Output current +/-5 mA maximum.
- Output range 0 to +/-11.300 V. (10 V normally represents 100%).

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   ANALOG OUTPUTS           3
     250)Iarm OP RECTIFY
     AOP1 (T10) SETUP       4
     AOP2 (T11) SETUP       4
     AOP3 (T12) SETUP       4
     260)SCOPE OP SELECT
```

17.5.1 250)Iarm OP RECTIFY

Select Iarm output (T29) mode to bipolar (disabled) or rectified (enabled).

PIN	Parameter description	Range	Default
250	Iarm OUTPUT RECTIFY	DISABLED ENABLED	DISABLED

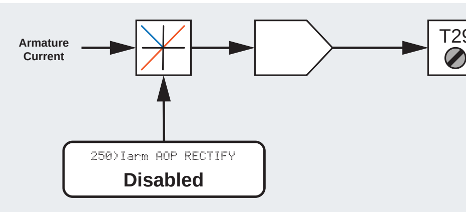


Figure 81 AOP4 (T29) Current Feedback - block diagram

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   ANALOG OUTPUTS           3
     250)Iarm OP RECTIFY
```

ENABLED = Rectified.
DISABLED = Bipolar.

17.5.2 260)SCOPE OP SELECT

Enable/disable the AOP3 outputting of any parameter shown on the HMI.

PIN	Parameter description	Range	Default
260	SCOPE OUTPUT SELECT	DISABLED ENABLED	DISABLED

When ENABLED, AOP3 outputs a linear signed signal representing whichever parameter is displaying currently on the HMI. Use parameter 257)AOP3 DIVIDER to scale the output (default 100% gives 10 V). **NOTE:** Any internal GETFROM connection made to AOP3 is left intact but ignored by this 260)SCOPE OP SELECT function.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   ANALOG OUTPUTS           3
     260)SCOPE OP SELECT
```

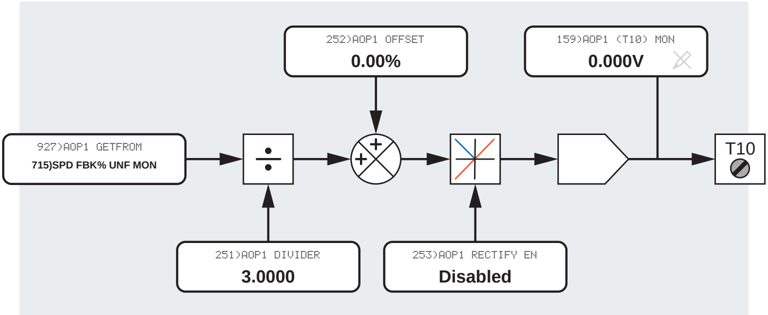


Figure 82 AOP1 (T10) Speed Feedback - block diagram

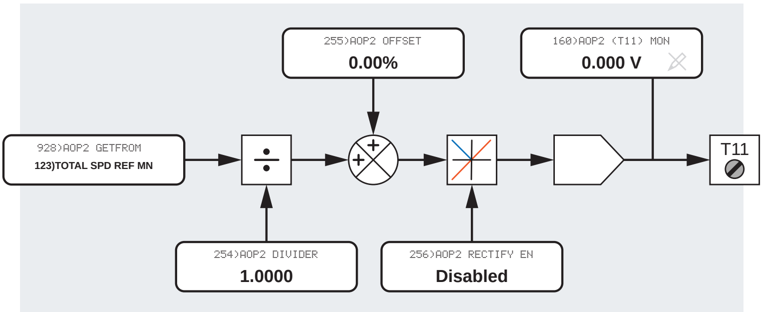


Figure 83 AOP2 (T11) Total Speed Reference - block diagram

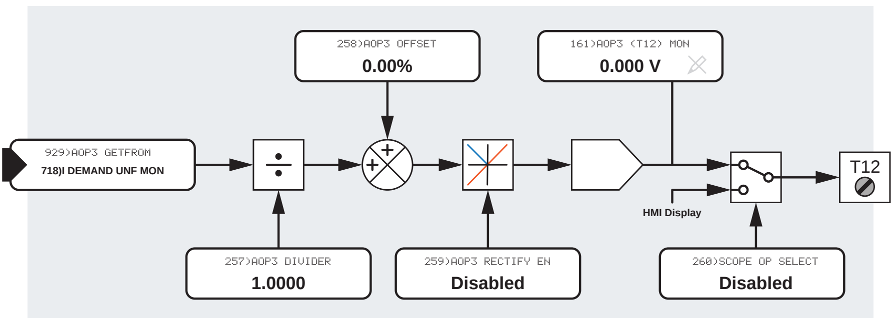


Figure 84 AOP3 (T12) Total Current Demand - block diagram

17.6 ANALOG OUTPUTS / AOP1/2/3 SETUP

There are three menus, one for each analog output.

Parameter	AOP1	AOP2	AOP3
DIVIDER	251	254	257
OFFSET	252	255	258
RECTIFY EN	253	256	259

Before placing this output on the terminal as a linear voltage, you can select these outputs to be BIPOLAR or RECTIFIED.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   ANALOG OUTPUTS          3
   AOP1 (T10) SETUP        4
     ├ 251)AOP1 DIVIDER
     ├ 252)AOP1 OFFSET
     ├ 253)AOP1 RECTIFY EN
     └ GET FROM
```

17.6.1 Default connections for AOP1/2/3

AOPX	Function	Terminal	GET FROM
AOP1	Unfiltered total speed feedback	T10	715)SPD FBK % UNF
AOP2	Unfiltered total speed reference	T11	123)TOTAL SPD REF MN
AOP3	Unfiltered armature current demand	T12	718)CUR DEMAND UNF

17.6.2 251)AOP1 DIVIDER

Set a signed factor to divide the GET FROM signal source.

PIN	Parameter description	Range	Default
251	AOP1 DIVIDER	±3.0000	+1.0000

This is usually set to provide a maximum amplitude of 10 V for the terminal signal voltage:

> The PL/X default 100.00% voltage is 10.00 V. Therefore, a dividing factor of 1.000 gives 10.00 V amplitude for 100.00% signals.

The divider function allows high gains, if required, by dividing by numbers less than 1.0000. This scaling takes place before the addition of the OFFSET parameter.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   ANALOG OUTPUTS          3
   AOP1 (T10) SETUP        4
     └ 251)AOP1 DIVIDER
```

17.6.3 252)AOP1 OFFSET

Set the level of bipolar offset to be added to the final signal.

PIN	Parameter description	Range	Default
252	AOP1 OFFSET	±100.00%	0.00%

NOTE: 100.00% is equivalent to 10.00V. Changing the divider factor will not affect the offset value.

```
R  ENTRY MENU     LEVEL   1
   CONFIGURATION          2
   ANALOG OUTPUTS         3
   AOP1 (T10) SETUP       4
    └ 252)AOP1 OFFSET
```

17.6.4 253)AOP1 RECTIFY EN

Select AOP1 (T10) output mode to select bipolar or rectified.

PIN	Parameter description	Range	Default
253	AOP1 RECTIFY EN	DISABLED ENABLED	DISABLED

ENABLED = Rectified.
DISABLED = Bipolar.

```
R  ENTRY MENU     LEVEL   1
   CONFIGURATION          2
   ANALOG OUTPUTS         3
   AOP1 (T10) SETUP       4
    └ 253)AOP1 RECTIFY EN
```

17.6.5 GET FROM

Set the source PIN for the connection to AOPX.

	Parameter description	Range	Default
	GET FROM	PIN 000 to 720	See table

```
R  ENTRY MENU     LEVEL   1
   CONFIGURATION          2
   ANALOG OUTPUTS         3
   AOP1 (T10) SETUP       4
    └ GET FROM
```

17.7 CONFIGURATION / DIGITAL INPUTS

There are four digital logic inputs DIP1/2/3/4 located on terminals T14/15/16/17, plus the RUN input on T31. You can use the DIP inputs for incremental encoder or register mark inputs. In this case, the logic functions will continue to operate as described here.

Parameter	DIP1	DIP2	DIP3	DIP4
IP HI VALUE	310	312	314	316
IP LO VALUE	311	313	315	317

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL INPUTS          3
      DIP1 (T14) SETUP     4
      DIP2 (T15) SETUP     4
      DIP3 (T16) SETUP     4
      DIP4 (T17) SETUP     4
      RUN IP SETUP         4
```

17.7.1 Using DIP inputs for encoder signals

Logic thresholds: 0 < 2V, 1 > 4V.

NOTE: When using encoders with quadrature outputs, the phase relationship of the two pulse trains must remain as close to 90 degrees as possible. Mounting the encoder inaccurately and off-centre can cause skewing of the internal optics as the shaft rotates through 360 degrees producing a severe degradation of the phase relationship on a cyclical basis.

If the encoder appears to gyrate as the shaft rotates, you must rectify the problem before proceeding with commissioning. The best way of checking the output is to use a high-quality oscilloscope and observe both pulse trains for good phase holding and no interference. Do this with the drive rotating to ±100% speed using AVF as the feedback source.

Refer to "11.2 CHANGE PARAMETERS/CALIBRATION/ ENCODER SCALING" on page 127 for more information about encoder feedback.

NOTE: If a logic input with high noise immunity is required, we recommend using a UIP.

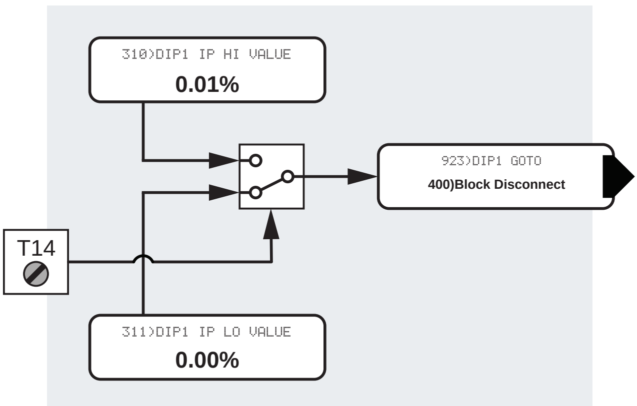


Figure 85 Digital inputs, showing DIP1 (T14) - block diagram

17.8 CONFIGURATION / DIGITAL INPUTS / DIP1 (T14) SETUP

Drive terminals T14 to T17 are provided with processing blocks DIP1 to DIP4, respectively. This description shows only the PINs for DIP1.

Enter the LO VAL and HI VAL values using the PL/X HMI, or use JUMPERS to retrieve them from other PINs. This turns the function into a change-over switch for dynamic values:

For logic-only usage:

- A value of 0.00% is read as a low
- Any nonzero ± value is read as a high

Achieve logic inversion by entering:

0.00% in the HI VAL parameter and 0.01% in the LO VAL parameter.

```
R  ENTRY MENU     LEVEL   1
   CONFIGURATION          2
   DIGITAL INPUTS         3
   DIP1 (T14) SETUP       4
     310)DIP1 IP HI VALUE
     311)DIP1 IP LO VALUE
     GOTO
```

17.8.1 310)DIP1 IP HI VALUE

Set the level of the value selected by a high DIP1 input.

PIN	Parameter description	Range	Default
310	DIP1 INPUT HIGH VALUE	±300.00%	0.01%

NOTE: You can make a simple AND gate by selecting this as the target PIN of a logical GOTO.

```
R  ENTRY MENU     LEVEL   1
   CONFIGURATION          2
   DIGITAL INPUTS         3
   DIP1 (T14) SETUP       4
     310)DIP1 IP HI VALUE
```

17.8.2 311)DIP1 IP LO VALUE

Set the level of the value selected by a low DIP1 input.

PIN	Parameter description	Range	Default
311	DIP1 INPUT LOW VALUE	±300.00%	0.00%

NOTE: You can make a simple OR gate by selecting this as the target PIN of a logical GOTO.

```
R  ENTRY MENU     LEVEL   1
   CONFIGURATION          2
   DIGITAL INPUTS         3
   DIP1 (T14) SETUP       4
     311)DIP1 IP LO VALUE
```

17.8.3 GOTO

Set the target source PIN for the connection to DIP1.

	Parameter description	Range	Default
	GOTO	PIN 000 to 720	See table

R ENTRY MENU LEVEL 1

CONFIGURATION 2

DIGITAL INPUTS 3

DIP1 (T14) SETUP 4

GOTO

DIPX	Terminal	Function	High value	Low value	Default connection PIN
DIP1	T14	Spare input	0.01% (High)	0.00% (Low)	400)Block Disconnect
DIP2	T15	Marker input	0.01% (High)	0.00% (Low)	400)Block Disconnect
DIP3	T16	Encoder input (B train)	0.01% (High)	0.00% (Low)	400)Block Disconnect
DIP4	T17	Encoder input (A train)	0.01% (High)	0.00% (Low)	400)Block Disconnect

17.9 CONFIGURATION / DIGITAL INPUTS / RUN IP SETUP

In the unlikely event that there is a shortage of digital inputs, you can use the RUN input.

The default GOTO PIN usually used by the RUN input is called 308)INTERNAL RUN IP and must be set to a logic high when the RUN input terminal is disconnected.

Refer to "17.15.4 308)INTERNAL RUN IP" on page 359.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL INPUTS          3
   RUN IP SETUP            4
      318)RUN IP HI VALUE
      319)RUN IP LO VALUE
      GOTO
```

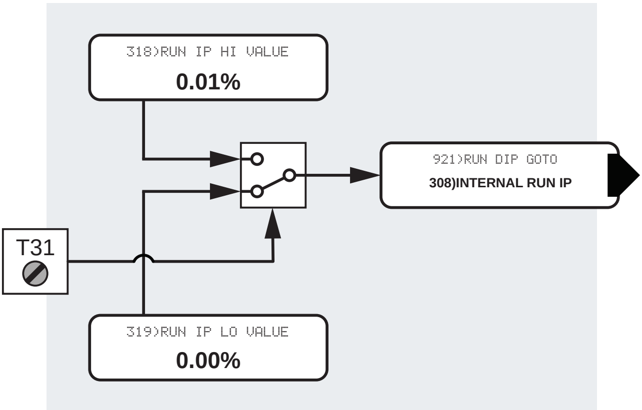


Figure 86 RUN DIP (T31) - block diagram

17.9.1 318)RUN IP HI VALUE

Set the level of the value selected by a high RUN input.

PIN	Parameter description	Range	Default
318	RUN INPUT HIGH VALUE	±300.00%	0.01%

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL INPUTS          3
   RUN IP SETUP            4
      318)RUN IP HI VALUE
```

17.9.2 319)RUN IP LO VALUE

Set the level of the value selected by a low RUN input.

PIN	Parameter description	Range	Default
319	RUN INPUT LOW VALUE	±300.00%	0.00%

```
R ENTRY MENU     LEVEL  1
  CONFIGURATION         2
  DIGITAL INPUTS        3
  RUN IP SETUP          4
   └ 319)RUN IP LO VALUE
```

17.9.3 GOTO

Set the target PIN for the connection from RUN IP.

	Parameter description	Range	Default
	GOTO	PIN 000 to 720	308)INTERNAL RUN IP

```
R ENTRY MENU     LEVEL  1
  CONFIGURATION         2
  DIGITAL INPUTS        3
  RUN IP SETUP          4
   └ GOTO
```

17.10 CONFIGURATION / DIGITAL IN/OUTPUTS

There are four digital input/outputs, DIO1/2/3/4, located on terminals T18/19/20/21.

Parameter	DIO1	DIO2	DIO3	DIO4
OP MODE	271	277	283	289
RECTIFY EN	272	278	284	290
THRESHOLD	273	279	285	291
INVERT MODE	274	280	286	292
IP HI VALUE	275	281	287	293
IP LO VALUE	276	282	288	294

R ENTRY MENU LEVEL 1
CONFIGURATION 2
DIGITAL IN/OUTPUTS 3
- DIO1 (T18) SETUP 4
- DIO2 (T19) SETUP 4
- DIO3 (T20) SETUP 4
- DIO4 (T21) SETUP 4

The digital output function connects to the terminal via a diode, shown in the block diagram. If required, you can take the terminal HIGH when the output mode is selected.

NOTE: To implement a DIOX OP MODE change, the PL/X must be in the stopped condition.

17.11 CONFIGURATION / DIGITAL IN/OUTPUTS / DIO1/2/3/4

There are four digital input/outputs, DIO1/2/3/4, located on terminals T18/19/20/21. This description shows only the PINs for DIO1.

- **By selecting DISABLED** in 271)DIO OP MODE, the output switch is permanently open, and the terminal behaves as a digital input only. You can still use the digital output processing function internally even though the output switch is open.
- **By selecting ENABLED** in 271)DIO OP MODE, the output switch is permanently closed, and the terminal behaves as a digital output. The input function still operates, and you can use this to monitor the terminal state at any time. Refer to "7.6 Control wiring connections" on page 61 and "12.6.2 163)DIP 12341234 DIO" on page 218.

R ENTRY MENU LEVEL 1
CONFIGURATION 2
DIGITAL IN/OUTPUTS 3
DIO1 (T18) SETUP 4
- 271)DIO1 OP MODE
- 272)DIO1 RECTIFY EN
- 273)DIO1 THRESHOLD
- 274)DIO1 INVERT MODE
- GET FROM
- GOTO
- 275)DIO1 IP HI VALUE
- 276)DIO1 IP LO VALUE

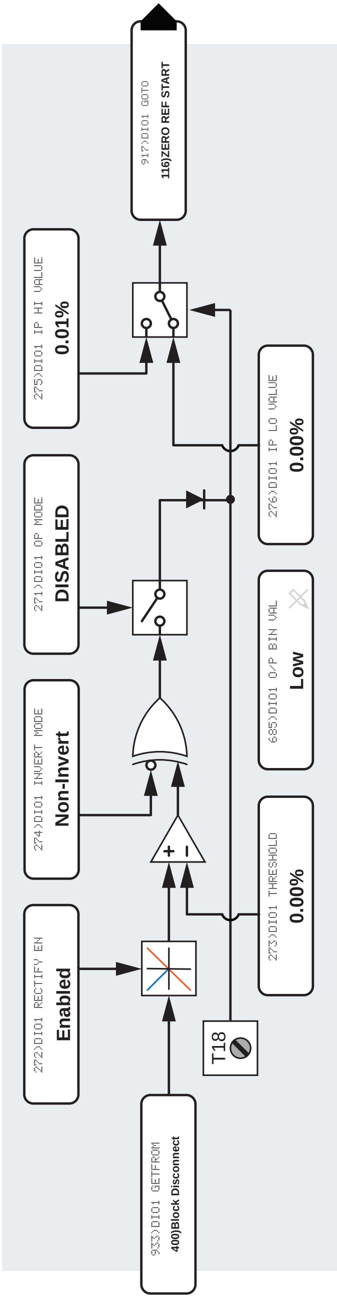


Figure 87 DIO1 Digital IO - block diagram

17.11.1 271)DIO1 OP MODE

Enable/disable the output mode operation of the DIO1 terminal.

PIN	Parameter description	Range	Default
271	DIO1 OUTPUT MODE	DISABLED ENABLED	DISABLED

NOTE: The input function senses the terminal logic level irrespective of the output mode selection.

```
R  ENTRY MENU       LEVEL   1
   CONFIGURATION            2
   DIGITAL IN/OUTPUTS       3
   DIO1 (T18) SETUP         4
     271)DIO1 OP MODE
```

17.11.2 272)DIO1 RECTIFY EN

Enable/disable the rectified mode for DIO1 OP.

PIN	Parameter description	Range	Default
272	DIO1 RECTIFY ENABLE	DISABLED ENABLED	ENABLED

ENABLED = Rectified   DISABLED = Bipolar

The comparison of an internal linear or logic signal with a threshold generates the digital output, for example, linear speed feedback.

The rectified mode will enable the digital output to change state at a chosen speed for both directions of rotation.

The bipolar mode will enable the digital output to change state at just one chosen point in the whole range of positive or negative rotation.

```
R  ENTRY MENU       LEVEL   1
   CONFIGURATION            2
   DIGITAL IN/OUTPUTS       3
   DIO1 (T18) SETUP         4
     272)DIO1 RECTIFY EN
```

17.11.3 273)DIO1 THRESHOLD

Set the comparator threshold for DIO1 OP.

PIN	Parameter description	Range	Default
273	DIO1 THRESHOLD	±300.00%	0.00%

The output of the comparator will be high when the signal from the rectifier mode function exceeds the threshold. The comparator output is low for identical inputs. For comparing logic values, always put 0.00% in the threshold window.

```
R  ENTRY MENU       LEVEL   1
   CONFIGURATION            2
   DIGITAL IN/OUTPUTS       3
   DIO1 (T18) SETUP         4
     273)DIO1 THRESHOLD
```

17.11.4 274)DIO1 INVERT MODE

Invert/non-invert the logic for DIO1.

PIN	Parameter description	Range	Default
274	DIO1 INVERT MODE	INVERT NON-INVERT	NON-INVERT

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL IN/OUTPUTS      3
   DIO1 (T18) SETUP        4
     274)DIO1 INVERT MODE
```

17.11.5 GET FROM

Set the source PIN for connection to DIO1.

	Parameter description	Range	Default
	GET FROM	PIN 000 to 720	400)Block Disconnect

This parameter provides the connection from the digital output source block - refer to the GET FROM shown in "Figure 87 DIO1 Digital IO - block diagram" on page 346. It may be a linear or logic value. After processing by the rectifier function, the PL/X compares the value to the threshold. The comparator output state HIGH or LOW is then inverted or not inverted by the inverter mode function. It then proceeds to the output stage, through the digital output enable switch, and becomes a 24 V logic signal. It is also available for internal connection.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL IN/OUTPUTS      3
   DIO1 (T18) SETUP        4
     GET FROM
```

Refer to "7.6.1 About digital inputs" on page 62 and "7.6.2 About digital outputs" on page 63.

17.11.6 GOTO

Set the destination PIN for connection from DIO1.

	Parameter description	Range	Default
	GOTO	PIN 000 to 720	Refer to table opposite

This parameter is the connection for the digital input HI or LO result GOTO destination - refer to the GOTO shown in "Figure 87 DIO1 Digital IO - block diagram" on page 346.

Enter the values for LO VAL and HI VAL using the display and keys. To switch dynamically changing values, connect them using jumpers to the LO/HI value PINS.

For logic-only usage:

- A value of 0.00% reads as a LOW
- Any nonzero value reads as HIGH

Invert the logic by entering:

0.00% in the HI VAL parameter and 0.01% in the LO VAL parameter.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   DIGITAL IN/OUTPUTS       3
   DIO1 (T18) SETUP         4
     GOTO
```

17.11.7 275)DIO1 IP HI VALUE

Set the level of the value selected by a high DIO1 input.

PIN	Parameter description	Range	Default
275	DIO1 INPUT HIGH VALUE	±300.00%	0.01%

Refer to "17.11.6 GOTO" on page 349 - make input GOTO destination connection.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   DIGITAL IN/OUTPUTS       3
   DIO1 (T18) SETUP         4
     275)DIO1 IP HI VALUE
```

17.11.8 276)DIO1 IP LO VALUE

Set the level of the value selected by a low DIO1 input.

PIN	Parameter description	Range	Default
276	DIO1 INPUT LOW VALUE	±300.00%	0.01%

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL IN/OUTPUTS      3
   DIO1 (T18) SETUP        4
    276)DIO1 IP LO VALUE
```

Refer to "17.11.6 GOTO" on page 349 - make input GOTO destination connection.

NOTE: You can make a simple OR gate by selecting this as the target PIN of a logical GOTO.

17.11.9 Hidden PINs 685/686/687/688

685)DIO1 O/P BIN VAL
686)DIO2 O/P BIN VAL
687)DIO3 O/P BIN VAL
688)DIO4 O/P BIN VAL

There is a hidden PIN for each block to enable the internal connection of the output processing part of the block. This section of the block will continue to function irrespective of the output mode.

DIOX	Terminal	Function	High value	Low value	Default connection PIN
DIO1	T18	Zero reference interlock	0.01% (High)	0.00% (Low)	116)ZERO REF START
DIO2	T19	Jog Mode select	0.01% (High)	0.00% (Low)	42)JOG MODE SELECT
DIO3	T20	Ramp Hold	0.01% (High)	0.00% (Low)	33)RAMP HOLD
DIO4	T21	Dual current clamp enable	0.01% (High)	0.00% (Low)	88)DUAL I CLAMP ENBL

17.12 CONFIGURATION / DIGITAL OUTPUTS

There are three digital outputs, DOP1/2/3, located on terminals T22/23/24.

Parameter	DOP1	DOP2	DOP3
RECTIFY EN	261	264	267
THRESHOLD	262	265	268
INVERT MODE	263	266	269

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL OUTPUTS         3
     DOP1 (T22) SETUP      4
     DOP2 (T23) SETUP      4
     DOP3 (T24) SETUP      4
```

Refer to "7.6 Control wiring connections" on page 61 (DOP3 may be used to control external serial link converters.)

17.13 CONFIGURATION / DIGITAL OUTPUTS / DOP1/2/3

There are three identical digital outputs, DOP1/2/3. This description shows only the PINs for DOP 1.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DIGITAL OUTPUTS         3
   DOP1 (T22) SETUP        4
     261)DOP1 RECTIFY EN
     262)DOP1 THRESHOLD
     263)DOP1 INVERT MODE
     GET FROM
```

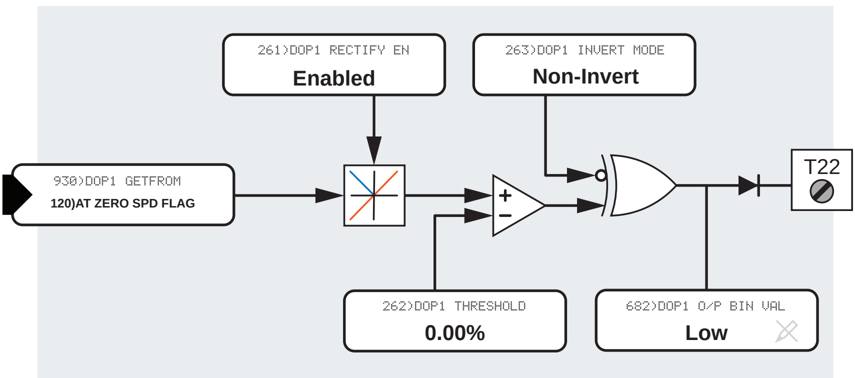


Figure 88 DOP1 (T22) Zero Speed - block diagram

17.13.1 261)DOP1 RECTIFY EN

Enable/disable the rectified mode for DOP1 OP.

PIN	Parameter description	Range	Default
261	DOP1 RECTIFY ENABLE	DISABLED ENABLED	DISABLED

ENABLED = Rectified.
DISABLED = Bipolar.

An internal linear or logic signal is compared with a threshold to generate the digital output, for example, Linear speed feedback.

The rectified mode will enable the digital output to change state at a chosen speed for both directions of rotation.

The bipolar mode will enable the digital output to change state at just one chosen point in the whole range of positive or negative rotation.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   DIGITAL IN/OUTPUTS       3
   DOP1 (T22) SETUP         4
     261)DOP1 RECTIFY EN
```

17.13.2 262)DOP1 THRESHOLD

Set the comparator threshold for DOP1 OP.

PIN	Parameter description	Range	Default
263	DOP1 THRESHOLD	±300.00%	0.00%

The output of the comparator will be high when the signal from the rectifier mode function exceeds the threshold. The comparator output is low for identical inputs. For comparing logic values, always put 0.00% in the threshold window.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   DIGITAL IN/OUTPUTS       3
   DOP1 (T22) SETUP         4
     262)DOP1 THRESHOLD
```

17.13.3 263)DOP1 INVERT MODE

Invert/non-invert the logic for DOP1.

PIN	Parameter description	Range	Default
263	DOP1 INVERT MODE	INVERT NON-INVERT	NON-INVERT

R	ENTRY MENU LEVEL	1
	CONFIGURATION	2
	DIGITAL IN/OUTPUTS	3
	DOP1 (T22) SETUP	4
	263)DOP1 INVERT MODE	

17.13.4 GET FROM

Set the source PIN for connection to DOP1.

	Parameter description	Range	Default
	GET FROM	PIN 000 to 720	400)Block Disconnect

This parameter provides the connection from the digital output source block - refer to GET FROM shown in "Figure 88 DOP1 (T22) Zero Speed - block diagram" on page 351. It may be a linear or logical value. After processing by the rectifier function, the PL/X compares the amount to the threshold. The comparator output state HIGH or LOW is then inverted or not inverted by the inverter mode function. It then becomes a 24 V logic signal. For comparing logic values, always put 0.00% in the Threshold window. The comparator output is low for identical inputs.

R	ENTRY MENU LEVEL	1
	CONFIGURATION	2
	DIGITAL IN/OUTPUTS	3
	DOP1 (T22) SETUP	4
	GET FROM	

17.13.4.1 Hidden PINs 682/683/684

682)DOP1 O/P BIN VAL
683)DOP2 O/P BIN VAL
684)DOP3 O/P BIN VAL

The binary result of these outputs is available for internal use on the hidden pins.

17.13.4.2 Default connections for DOP1/2/3

DOPX	Terminal	Function	Threshold	GET FROM source	GET FROM PIN
DOP1	T22	Zero speed	0.00% (Low)	Zero speed	120)AT ZERO SPD FLAG
DOP2	T23	Ramping flag	0.00% (Low)	Ramping flag	35)RAMPING FLAG
DOP3	T24	Drive healthy	0.00% (Low)	Drive healthy	698)HEALTHY FLAG

17.14 CONFIGURATION / STAGING POSTS

There are four digital posts and four analog posts, acting like virtual wire-wrap posts. This description shows only the PINs for POST 1.

Each post has a PIN and can contain a value or act as a constant for setting a value.

They store data when receiving values via a serial link. You can then connect them to the desired destinations.

Blocks in the Applications menu are usually dormant. You activate a block by connecting its output to a PIN destination other than `400)Block Disconnect`. However, you can also activate a block by connection to a staging post which is of great use during system commissioning to examine a block's output before inclusion into the system. You can then monitor it via the display, and if required, connect it to an analog output terminal using the terminal's GET FROM link to allow monitoring with an oscilloscope. Refer to "17.5.2 260)SCOPE OP SELECT" on page 336. When satisfied with the output functionality, you can then connect it to the final system destination.

Use the analog posts for linear or logic values.

Use the digital posts for logic values:

- A zero value is a logic low
- A nonzero value is a logic high

NOTE: Also, use staging posts for making connections between a GOTO and a GETFROM.

NOTE: Any unused settable PIN may perform the function of a staging post. For example, the PRESET SPEED application block contains a convenient cluster of 8 PINs.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   STAGING POSTS           3
     296)DIGITAL POST 1
     297)DIGITAL POST 2
     298)DIGITAL POST 3
     299)DIGITAL POST 4
     300)ANALOG POST 1
     301)ANALOG POST 2
     302)ANALOG POST 3
     303)ANALOG POST 4
```

17.14.1 Connecting PINs with different units

Connecting PINS having different units and scaling ranges causes no problems because blocks are processed using an internal system of pure numbers. For example, the output of the analog input terminal using "%" can connect to the ramp parameter called FORWARD UP TIME using "seconds".

The internal pure number range is a five-digit number equal to ±32,000. All linear parameters work with numbers that lie within this range.

17.14.1.1 Connecting linear values with different units

To find the pure number, remove the decimal point and the units, for example:

0.1 = 1
5.00% = 500
200.00 = 20000

60)Drop-out DELAY range 0.1 to 600.0 seconds.
In this case, the pure number range is 1 to 6000.

59)Drop-out SPEED range 0.00 to 100.00%.
In this case, the pure number range is 0 to 10000.

It is the pure number that transfers from the output to the input during processing. If the pure number arriving at the target PIN extends outside the range of that PIN, then it is automatically clamped to the maximum limit of the target PIN.

For example, VOLTS to SECONDS:

129)TACHO VOLTS MON = 190.00 V (pure number = 19000) is connected to 24)REVERSE UP TIME which has a range of 0.1 to 600.0 s (pure number = 6000). The pure number of 19000 is now clamped to 6000 and displayed as 600.0 s.

17.14.1.2 Connecting logic values with different messages

In the system, several parameters have only two states, and some have more than two. For example:

64)SPD/CUR REF 3 SIGN	INVERT NON-INVERT	State 0 State 1	2 states
29)RAMP AUTO PRESET	ENABLED DISABLED	State 0 State 1	2 states
9)SPEED FBK TYPE	ARMATURE VOLTAGE TACHOGENERATOR ENCODER ENCODER + AVF ENCODER + TACHO	State 0 State 1 State 2 State 3 State 4	5 states

When using two-state logic parameters, the system sees one state as a "1" and the other as a "0", according to the following table:

LOGIC 1 PARAMETER	LOGIC 0 PARAMETER
HIGH	LOW
ENABLED	DISABLED
MOTOR 2	MOTOR 1
INVERT	NON-INVERT
Nonzero in logic statement	Zero value in logic statement

If the value from a PIN uses a binary or hexadecimal string (for example, digital IO monitor), then the pure decimal equivalent is used. When calculating the decimal equivalent, the most significant bit is on the right and the least significant on the left.

17.14.1.3 Connecting to multi-state logic parameters

When connecting to multi-state logic parameters (e.g. SPEED FBK TYPE or UIPX RANGE), the states are placed in numerical order as follows:

1st Type	= value of pure number 0
2nd Type	= value of pure number 1
3rd Type	= value of pure number 2
4th Type	= value of pure number 3
5th Type	= value of pure number 4

(where "Type" above is an available selection for the parameter).

- To switch between, say, Type 4 (value of pure number 3) and Type 5 (value of pure number 4), use 0.03% for LOW and 0.04% for HIGH.
- You can connect a normal logic flag as the control source to switch between Type 1 (value of pure number 0) and Type 2 (value of pure number 1). Note: If the block providing the instruction to change state possesses a value for HIGH/LOW output, (e.g. digital input DIP1), ensure that a LOW is 0.00% value, and a HIGH is 0.01% value.
- You can use one of the C/O SWITCHES if the source of the logic state is internal and does not possess a value for HIGH/LOW. Refer to the "16.15 APPLICATION BLOCKS / C/O SWITCH 1 TO 4" on page 318. For example, the C/O SWITCH uses a logic value to switch between a HIGH and LOW value input:
    - Thus when the logic value is 0, the C/O SWITCH sends the value of pure number 3 to the multi-state PIN, selecting Type 4.
    - Likewise, when the logic value is 1, the C/O SWITCH sends the value of pure number 4 to the multi-state PIN, selecting Type 5.

17.14.2 296)DIGITAL POST 1

A storage PIN for a logic state and/or connecting point.

PIN	Parameter description	Range	Default
296	DIGITAL POST 1	LOW HIGH	LOW

When a pure logic value of 0 arrives at a DIGITAL POST, the display shows LOW; when a pure logic value of 1 arrives, the display shows HIGH.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   STAGING POSTS           3
     296)DIGITAL POST 1
```

17.14.3 300)ANALOG POST 1

A storage PIN for a linear value or logic state.

PIN	Parameter description	Range	Default
300	ANALOG POST 1	±300.00%	0.00%

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   STAGING POSTS           3
     300)ANALOG POST 1
```

17.15 CONFIGURATION / SOFTWARE TERMINALS

The three drive control functions (RUN, JOG, START) are ANDed with their respective hardware equivalent input terminals. The resulting output controls the drive.

It allows a remote command to override the local terminal function or a local terminal to override a remote command.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   SOFTWARE TERMINALS       3
     305)ANDED RUN
     306)ANDED JOG
     307)ANDED START
     308)INTERNAL RUN IP
```

17.15.1 305)ANDED RUN

Set a logic input to an internal AND gate to control RUN.

PIN	Parameter description	Range	Default
305	ANDED RUN	LOW HIGH	HIGH

A serial link might typically use 305)ANDED RUN to control the drive.

NOTE: If using the RUN terminal as a general digital input, then 308)INTERNAL RUN IP must be set HIGH for the drive to run.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   SOFTWARE TERMINALS       3
     305)ANDED RUN
```

17.15.2 306)ANDED JOG

Set a logic input to an internal AND gate to control JOG.

PIN	Parameter description	Range	Default
306	ANDED JOG	LOW HIGH	HIGH

A serial link might typically use 306)ANDED JOG to control the drive.

```
R  ENTRY MENU      LEVEL    1
   CONFIGURATION            2
   SOFTWARE TERMINALS       3
     306)ANDED JOG
```

17.15.3 307)ANDED START

Set a logic input to an internal AND gate to control START.

PIN	Parameter description	Range	Default
307	ANDED START	LOW HIGH	HIGH

A serial link might typically use 307)ANDED START to control the drive.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   SOFTWARE TERMINALS      3
      307)ANDED START
```

17.15.4 308)INTERNAL RUN IP

Set the RUN mode if the RUN terminal is reprogrammed.

PIN	Parameter description	Range	Default
308	INTERNAL RUN INPUT	LOW HIGH	LOW

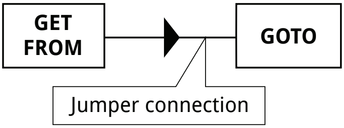
The RUN command usually comes from the default RUN terminal (T31), and this parameter will show the state of T31.

You can also use this terminal as a programmable terminal if short of digital inputs. In this case, disconnect 308)INTERNAL RUN IP from the RUN terminal and set this parameter HIGH to allow the PL/X to run.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   SOFTWARE TERMINALS      3
      308)INTERNAL RUN IP
```

17.16 CONFIGURATION / JUMPER CONNECTIONS

There are sixteen uncommitted JUMPER CONNECTIONS blocks, and this menu defines their JUMPER connection PINS by using GET FROMs and GOTOs. This description shows only the PINs for JUMPER 1.




```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   JUMPER CONNECTIONS      3
     JUMPER 1              4
     JUMPER 2              4
     JUMPER 3              4
     JUMPER X              4
     JUMPER 16             4
```

17.16.1 GET FROM

Set the source PIN for connection to JUMPER 1.

	Parameter description	Range	Default
	GET FROM	PIN 000 to 720	400)Block Disconnect

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   JUMPER CONNECTIONS      3
   JUMPER 1                4
     GET FROM
```

17.16.2 GOTO

Set the destination PIN for connection from JUMPER 1.

	Parameter description	Range	Default
	GOTO	PIN 000 to 720	400)Block Disconnect

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   JUMPER CONNECTIONS      3
   JUMPER 1                4
     GOTO
```

17.17 CONFIGURATION / BLOCK OP CONFIG

Use this menu to connect the Application Block diagrams.

This Block Output Configuration menu conveniently displays just the GOTO connections of many Application Block diagrams.

Connecting the GOTO to a PIN other than 400)Block Disconnect causes activation of the block.

You can access all the GET FROMs from within their block menus.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   BLOCK OP CONFIG         3
     RUN MODE RAMPS GOTO
     MOTORISED POT GOTO
     REF EXCH SLAVE GOTO
     SUMMER1 GOTO
     SUMMER2 GOTO
     PID1 GOTO
     PID2 GOTO
     PARAMETER PROFL GOTO
     DIAMETER CALC GOTO
     TAPER CALC GOTO
     T/COMP +CUR LIM GOTO
     T/COMP -CUR LIM GOTO
     PRESET SPEED GOTO
     LATCH GOTO
     FILTER1 GOTO
     FILTER2 GOTO
     BATCH COUNTER GOTO
     INTERVAL TIMER GOTO
```

17.17.1 Other GOTOs

The following GOTO connections, not in this menu, are only found in their block menus:

Input/output terminals
Multi-function blocks 1-8
Jumpers
Comparators
C/O switches

17.17.2 GOTO

Set the destination PIN for connection from the block output.

	Parameter description	Range	Default
	GOTO	PIN 000 to 720	400)Block Disconnect

Select a PIN other than 400)Block Disconnect to make the GOTO connection.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   BLOCK OP CONFIG         3
     (description) GOTO
```

17.18 CONFIGURATION / FIELDBUS CONFIG

Use this menu to select parameters for transmitting to or receiving from the host drive using, for example, PROFIBUS protocol.

Refer to the FIELDBUS manual, HG105409EN00.

```
R ENTRY MENU      LEVEL  1
  CONFIGURATION          2
  FIELDBUS CONFIG        3
    JUMPER 1             4
    JUMPER 2             4
    JUMPER 3             4
    JUMPER 4             4
    JUMPER 5             4
    JUMPER 6             4
    JUMPER 7             4
    JUMPER 8             4
    BIT-PACKED GETFROM
    JUMPER 9             4
    JUMPER 10            4
    JUMPER 11            4
    JUMPER 12            4
    JUMPER 13            4
    JUMPER 14            4
    JUMPER 15            4
    JUMPER 16            4
    BIT-PACKED GOTO
    199)FBUS DATA CONTRL
    202)FBUS NODE ID
    224)FBUS BAUD RATE
```

17.19 CONFIGURATION / DRIVE PERSONALITY

Use this menu to modify or monitor various aspects of the PL/X personality.

- PASSIVE MOTOR SET contains all the parameters in ascending PIN order to set the passive reduced values for motor 1 or 2.
- RECIPE PAGE sets the target page for a PARAMETER SAVE operation. There are three separate pages that each allow a total instrument to be stored. To recall any page requires the appropriate power up-reset choice.
- MAX CUR RESPONSE allows for an improved small-signal current response.
- Suppliers of the PL/X use ID ABCXRxxx MON to identify the power chassis. It has no other purpose. A binary code is displayed.
- Iarm BURDEN OHMS is used along with the physical burden to determine and possibly derate the model armature current.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DRIVE PERSONALITY       3
     PASSIVE MOTOR SET     4
     677)RECIPE PAGE
     678)MAX CUR RESPONSE
     679)ID   ABCXRxxx MON
     680)Iarm BURDEN OHMS
```

17.19.1 677)RECIPE PAGE

Set the Recipe page for the PARAMETER SAVE function.

PIN	Parameter description	Range	Default
677	RECIPE PAGE	NORMAL RESET 2-KEY RESET 3-KEY RESET 4-KEY RESET	NORMAL RESET

Save a Recipe in the NORMAL page to make it permanently operative. Recalling any page requires the appropriate power-up reset choice (pressing keys during the application of the Control supply).

NOTE: During a power-off sequence, the drive stores parameters and saves them to the selected page.

- This parameter signs any parameter(s) sent using drive transmit so that the parameter(s) return to the correct Recipe page.
- The parameter shows the current Recipe in force.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   DRIVE PERSONALITY       3
     677)RECIPE PAGE
```

A Recipe (backed-up configuration) created in the legacy Pilot configuration tool is not (necessarily) the same as one of the three Recipe pages described here.

Selected Page / (type of power-up)	SOURCE page	Destination for Save Operations
NORMAL RESET / (no keys)	NORMAL page	PARAMETER SAVE overwrites NORMAL page
2-KEY RESET / (UP/DOWN keys)	Page 2	PARAMETER SAVE overwrites Page 2
3-KEY RESET / (UP/DOWN/RIGHT keys)	Page 3	PARAMETER SAVE overwrites Page 3
4-KEY ROM RESET / (all 4 keys)	Factory Defaults	PARAMETER SAVE overwrites NORMAL page

To install a Recipe

1. Remove power from the drive.
2. Press and hold the required key combination, now reapply the control supply to the PL/X.
3. The PL/X displays `LEFT KEY TO RESTART` on the HMI.
4. Press the LEFT key within 15 seconds to install your selected Recipe. (The PL/X will revert to the NORMAL page if this operation times out.)
5. To store the Recipe, perform a PARAMETER SAVE. This Recipe will be in use next time the PL/X is powered up. `677)RECIPE PAGE` displays the name of this Recipe.

NOTE: If `AUTHORISATION NEEDED` is displayed when SAVING, it means that the page is LOCKED and is read-only. Refer to your supplier or system integrator. The page's Recipe may not allow for it to be over-written. Each page may have an individual password, but be aware it is possible to overwrite the password when saving parameters from a different Recipe page. For this reason, we recommend using the same password for each page.

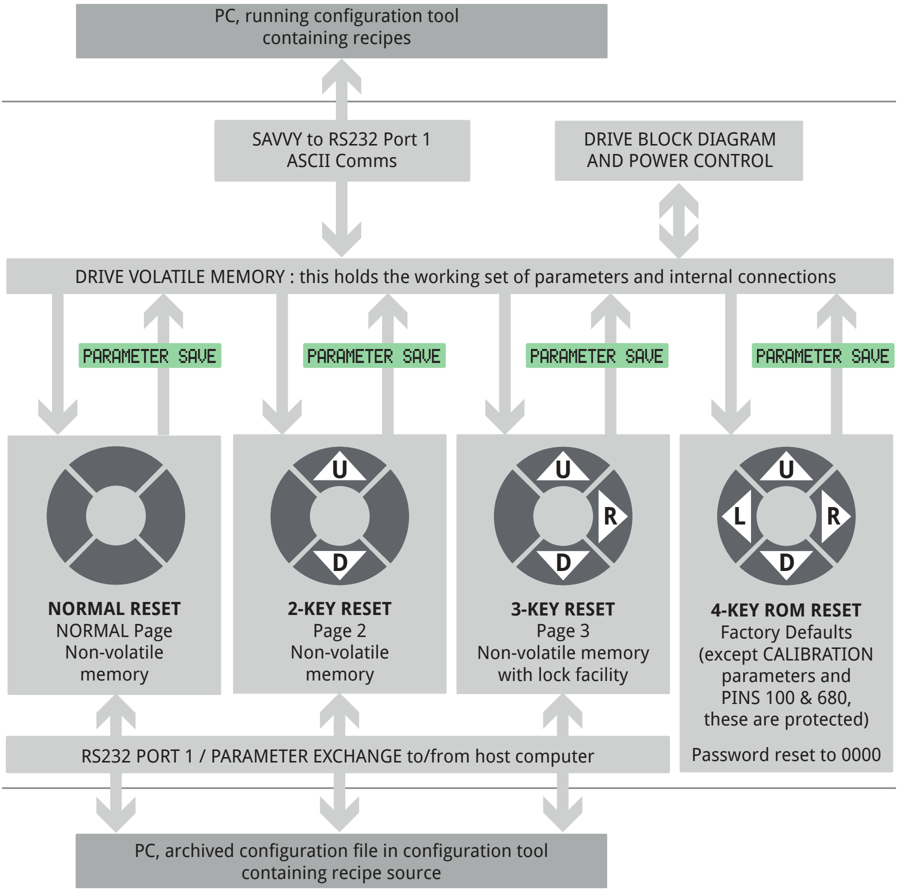


Figure 89 Recipe Page - functional diagram

17.19.2 678)MAX CUR RESPONSE

Enable to activate an improved small-signal current response.

PIN	Parameter description	Range	Default
678	MAXIMUM CURRENT RESPONSE	DISABLED ENABLED	DISABLED

R ENTRY MENU LEVEL 1
CONFIGURATION 2
DRIVE PERSONALITY 3
678)MAX CUR RESPONSE

When ENABLED:

- You can adjust the internally adjusted current loop algorithm to provide a reduced dead band when switching bridges. Refer to the supplier. Set the speed and current control terms carefully for optimum performance, or else current overshoots or noisy feedback signals may cause instability.

When DISABLED:

- The current response is similar to a standard performance DC drive, which in most cases is acceptable; also, the PL/X is more tolerant of poor feedback/control term settings.

17.19.3 680)Iarm BURDEN OHMS

Set this value to be the same as the physical burden resistance value.

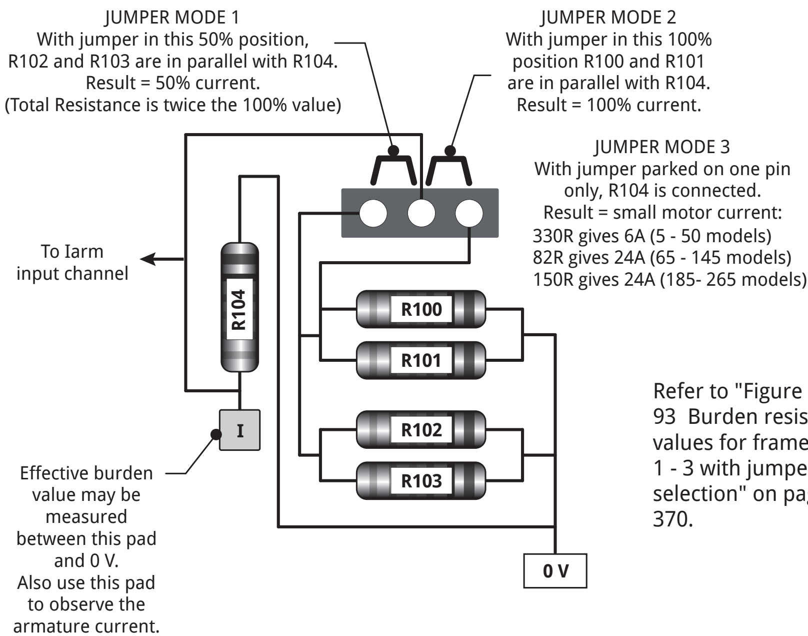
PIN	Parameter description	Range	Default
680	ARMATURE CURRENT BURDEN OHMS	0.00 to 320.00	According to MODEL

R ENTRY MENU LEVEL 1
CONFIGURATION 2
DRIVE PERSONALITY 3
680)Iarm BURDEN OHMS

WARNING!
PERSONAL INJURY HAZARD
EQUIPMENT DAMAGE HAZARD

It is important that parameter 680)Iarm BURDEN OHMS is set as closely as possible to the actual resistance in use on the power board.
Do not allow the model's current rating to exceed the value stated in the rating table and on the product label found on the side of the drive. Failure to heed this warning will invalidate any Warranty and violate approval standards.
The manufacturer and distributor accept no liability for faults caused by re-rating of the product.

17.19.3.1 Frames 1 - 3 (PL/X5 - PL/X265)



Refer to "Figure 93 Burden resistor values for frames 1 - 3 with jumper selection" on page 370.

Figure 90 Burden and jumper selections for Frames 1 - 3 (PL/X5 - PL/X265)

The burden resistors are on the lower edge of the power board, to the right of the 8-way terminal block.

(R100//R101 100% parallel back pair) or (R102//R103 50% parallel front pair) selected by jumper.

Formula for PL/X 5 - 145:

Combined value of BURDEN OHMS = 2000/maximum model Amps

Formula for PL/X 185 - 225:

Combined value of BURDEN OHMS = 4000/maximum model Amps

To apply changes made to parameter 680)Iarm BURDEN OHMS:

1. Save the new value by performing a PARAMETER SAVE.
2. Turn the PL/X control supply off, then back on again.
3. Adjust parameter 2)RATED ARM AMPS in the CALIBRATION menu:
    1. Adjust it to its maximum setting (100%).
    2. Adjust it to its minimum setting (33%) (Note that the values are 100% Amps and 33% Amps of new ratings with changed burden).
    3. Adjust it to the desired value for your motor.
4. Save the new value by performing a PARAMETER SAVE.

17.19.3.2 Frame 4 (PL/X275 - PL/X440)

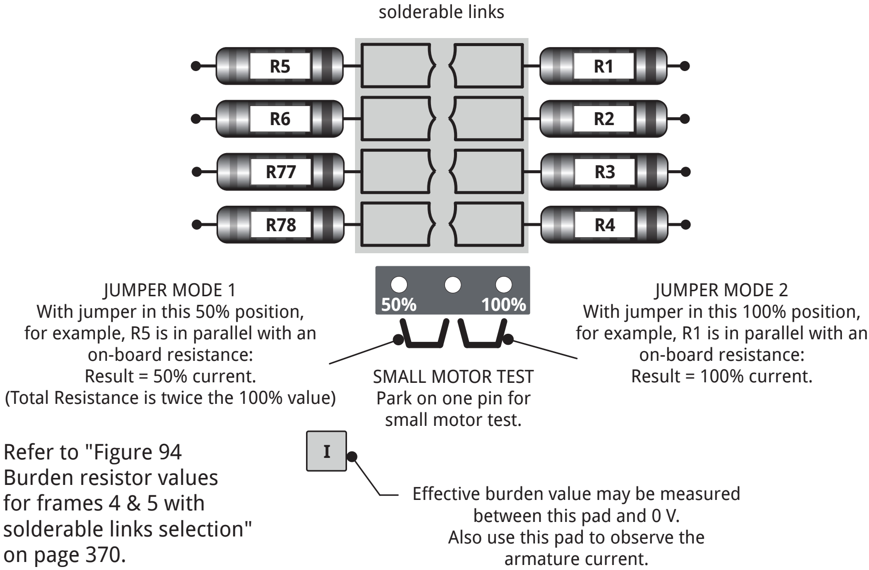


Figure 91 Burden and jumper selections for Frame 4 (PL/X275 - PL/X440)

The burden resistors are on the lower edge of the power board, to the right of the 8-way terminal block.

Solderable links connect R1, R2, R3, R4, R77 and R78 into circuit depending on drive model.

On-board resistances R104 (100%) or R102 (50%) are selected by jumper.

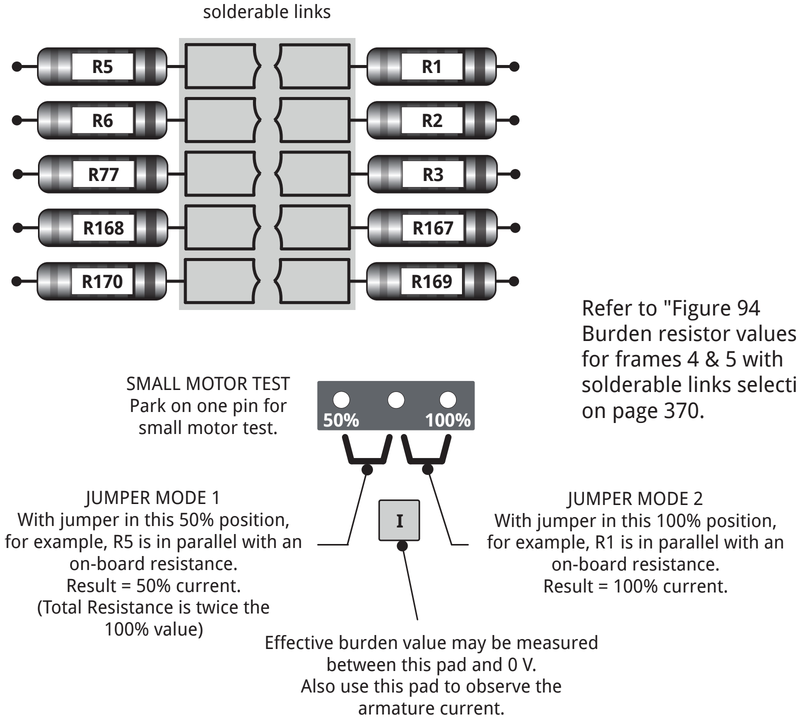
Formula for PL/X 275 - 440:

Combined value of BURDEN OHMS = 4000/maximum model Amps

To apply changes made to parameter 680)Iarm BURDEN OHMS:

1. Save the new value by performing a PARAMETER SAVE.
2. Turn the PL/X control supply off, then back on again.
3. Adjust parameter 2)RATED ARM AMPS in the CALIBRATION menu:
    1. Adjust it to its maximum setting (100%).
    2. Adjust it to its minimum setting (33%) (Note that the values are 100% Amps and 33% Amps of new ratings with changed burden).
    3. Adjust it to the desired value for your motor.
4. Save the new value by performing a PARAMETER SAVE.

17.19.3.3 Frame 5 (PL/X520 - PL/X980)



Refer to "Figure 94 Burden resistor values for frames 4 & 5 with solderable links selection" on page 370.

Figure 92 Burden and jumper selections for Frame 5 (PL/X520 - PL/X980)

The burden resistors are on the lower edge of the power board, to the right of the 8-way terminal block.

Solderable links connect R1, R2, R3, R5, R6, R77, R167, R168, R169 and R170 into circuit depending on drive model.

On-board resistances are selected by jumper.

Formula for PL/X 520 - 980:

Combined value of BURDEN OHMS = 4000/maximum model Amps

To apply changes made to parameter 680)Iarm BURDEN OHMS:

1. Save the new value by performing a PARAMETER SAVE.
2. Turn the PL/X control supply off, then back on again.
3. Adjust parameter 2)RATED ARM AMPS in the CALIBRATION menu:
    1. Adjust it to its maximum setting (100%).
    2. Adjust it to its minimum setting (33%) (Note that the values are 100% Amps and 33% Amps of new ratings with changed burden).
    3. Adjust it to the desired value for your motor.
4. Save the new value by performing a PARAMETER SAVE.

17.19.3.3.1 Jumper selections (50% / 100% rating)

Model	JUMPER MODE 1 (left-hand position)	JUMPER MODE 2 (right-hand position)	JUMPER MODE 3 (parked position)	
PL/X 5-50	50% of maximum model rating	100% of maximum model rating	6 A maximum	330R
PL/X 65-145	50% of maximum model rating	100% of maximum model rating	24 A maximum	82R
PL/X 185-265	50% of maximum model rating	100% of maximum model rating	24 A maximum	150R
PL/X 275-440	50% of maximum model rating	100% of maximum model rating	36 A maximum	110R
PL/X520-980	50% of maximum model rating	100% of maximum model rating	36 A maximum	110R

The burden resistors **and** a selection jumper are on the power board offering JUMPER MODES 1, 2 and 3.

The left-hand position of the jumper, JUMPER MODE 1, sets the actual burden resistance to twice the standard value and hence reduces the model rating to 50%. (Higher burden values give lower model ratings).

Using this with DRIVE PERSONALITY / 680)Iarm BURDEN OHMS provides a 6 - 1 calibration range.

Parking the jumper on one pin, JUMPER MODE 3, causes the actual burden resistance to be high. You can use this to test small motors without changing the actual burden resistor value. Refer also to "1.4 Testing using a small motor" on page 5.

NOTE: When using the parked position for small test motors, you may choose to set CONFIGURATION / DRIVE PERSONALITY / 680)Iarm BURDEN OHMS to the parked value or leave it at the prevailing model rating.

- If you set it to the parked value, the armature current calibration range of the PL/X will reflect the parked position for small motors.
- If you leave it set to the prevailing model rating, the PL/X parameters will assume the normal full ratings despite the scaling (to the parked position range for small motors) of the actual current. Doing this is useful when the configuration involves armature current related parameters that require testing at full value, even though only a low current is flowing.

  For example, calibrate the PLX50 for 110 A:
  Park the jumper. Use a 6 A motor to test the PL/X without altering 680)Iarm BURDEN OHMS. At 100% current, 6 A will be flowing in the armature, but 110 A will display on 135)ARM CUR AMPS MON.

Refer to "17.19.3 680)Iarm BURDEN OHMS" on page 365 for burden formula.

Measuring burden resistance:

Frames 1 - 3:

To measure the actual burden resistance connect an ohmmeter between the pad marked **I** and the right-hand end of the front resistor (R103) **0 V**.

Frame 4:

To measure the actual burden resistance connect an ohmmeter between the pad marked **I** and common, **0 V**.

Frame 5:

To measure the actual burden resistance connect an ohmmeter between the pad marked **I** and common, **0 V**.

Drive Type	Current calibration (burden) resistors (values in Ohms)				680)Iarm BURDEN OHMS and measured burden resistance (Ohms)
	R100	R101	R102	R103	
PL/X5	680	680	not fitted	10K5	166.66
PL/X10	220	220	680	680	83.33
PL/X15	66.5		332	332	55.55
* PL/X15	68	3K3	332	332	55.55
PL/X20	88.7	88.7	205	205	39.21
PL/X30	60.4	60.4	not fitted	66.5	27.77
* PL/X30	60.4	60.4	3K3	68	27.77
PL/X40	43	43	not fitted	46.4	20.20
PL/X50	34	34	not fitted	36	16.26
PL/X65	30.1	30.1	not fitted	37.4	12.90
PL/X85	22.1	22.1	51.1	51.1	9.75
PL/X115	16.2	16.2	36	36	7.40
PL/X145	13	13	28	28	6.06
PL/X185	19.6	19.6	42.2	42.2	9.30
PL/X225	15.8	15.8	33.2	33.2	7.54
PL265	13.3	13.3	27.4	27.4	6.34

***** Alternative values for when 66.5 Ohm resistors are not available.

Figure 93 Burden resistor values for frames 1 - 3 with jumper selection

Drive Type	Burden resistor links fitted					680)Iarm BURDEN OHMS and measured burden resistance (Ohms)
	R1/R5	R2/R6	R3/R77	R4/R78		
PL/X275	×	×	×	×		6.15
PL/X315	✓	×	×	×		5.33
PL/X360	✓	✓	×	×		4.71
PL/X400	✓	✓	✓	×		4.21
PL/X440	✓	✓	✓	✓		3.80
	R1/R5	**R2/R6**	**R3/R77**	**R167/R168**	**R169/R170**	
PL/X520	×	×	×	×	×	3.20
PL/X600	✓	×	×	×	×	2.76
PL/X700	✓	✓	×	×	×	2.42
PL/X800	✓	✓	✓	×	×	2.16
PL/X900	✓	✓	✓	✓	×	1.95
PL/X980	✓	✓	✓	✓	✓	1.77

Figure 94 Burden resistor values for frames 4 & 5 with solderable links selection

17.20 CONFIGURATION/DRIVE PERSONALITY/PASSIVE MOTOR SET

This menu displays the passive motor set (either MOTOR 1 or MOTOR 2). You can change the values in the passive motor set here.

For example, if MOTOR 1 is selected (as active) in 20)MOTOR 1,2 SELECT (this is the default), then the parameters contained in MOTOR 2 (now passive) are stored here.

The MOTOR 1 and MOTOR 2 parameter lists are identical, except for their values which can be different.

PIN TABLE FOR PASSIVE MOTOR SET
Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST

Property	Paragraph number	Menu / Description	Range	Default Values	PIN
R/P/S	11.1.1	CALIBRATION / Rated armature amps **QuickStart**	33% – 100%	33% Amps	**2**
R/P	11.1.2	CALIBRATION / Current limit% **QuickStart**	0.00 – 150.00%	150.00%	**3**
R/P/S	11.1.3	CALIBRATION / Rated field amps **QuickStart**	0.1 – 100.0% A	1.0 A	**4**
R/P/S	11.1.4	CALIBRATION / Base rated motor rpm **QuickStart**	0 – 6000 rpm	1500 rpm	**5**
R/P	11.1.5	CALIBRATION / Desired max rpm **QuickStart**	0 – 6000 rpm	1500 rpm	**6**
R/P	11.1.6	CALIBRATION / Zero speed offset	±5.00%	0.00%	**7**
R/P/S	11.1.7	CALIBRATION / Max tacho volts	±200.00 V	60.00 V	**8**
R/P/S	11.1.8	CALIBRATION / Speed feedback type **QuickStart**	0 ARMATURE VOLTS 1 ANALOG TACHO 2 ENCODER 3 ENCODER + ARM VOLTS 4 ENCODER + TACHO	0	**9**
R/P/S	11.2.1	ENCODER SCALING / Quadrature enable	0 DISABLED 1 ENABLED	0	**10**
R/P/S	11.2.2	ENCODER SCALING / Encoder lines	1 – 6000	1000	**11**
R/P/S	11.2.3	ENCODER SCALING / Motor / encoder speed ratio	0.0000 – 3.0000	1.0000	**12**
R/P/S	11.2.4	ENCODER SCALING / Encoder sign	0 INVERT 1 NON-INVERT	1	**13**
R/P	11.1.9	CALIBRATION / IR compensation	0.00 – 100.00%	0.00%	**14**
R/P	11.1.10	CALIBRATION / Field current feedback trim	1.0000 – 1.1000	1.0000	**15**
R/P	11.1.11	CALIBRATION / Armature volts trim	1.0000 – 1.1000	1.0000	**16**
R/P	11.1.12	CALIBRATION / Analog tacho trim	1.0000 – 1.1000	1.0000	**17**
R/P/S	11.1.13	CALIBRATION / Rated armature volts **QuickStart**	0.0 – 1000.0 V	460.0 V	**18**
R	11.3.2	RUN MODE RAMPS / Forward up time	0.1 – 600.0 s	10.0 s	**22**
R	11.3.3	RUN MODE RAMPS / Forward down time	0.1 – 600.0 s	10.0 s	**23**
R	11.3.4	RUN MODE RAMPS / Reverse up time	0.1 – 600.0 s	10.0 s	**24**
R	11.3.5	RUN MODE RAMPS / Reverse down time	0.1 – 600.0 s	10.0 s	**25**
R	11.4.1	JOG CRAWL SLACK / Jog speed 1	±100.00%	5.00%	**37**
R	11.4.2	JOG CRAWL SLACK / Jog speed 2	±100.00%	-5.00%	**38**
R	11.4.3	JOG CRAWL SLACK / Slack speed 1	±100.00%	5.00%	**39**
R	11.4.4	JOG CRAWL SLACK / Slack speed 2	±100.00%	5.00%	**40**
R	11.4.5	JOG CRAWL SLACK / Crawl speed	±100.00%	10.00%	**41**
R	11.4.6	JOG CRAWL SLACK / Jog mode select	0 LOW 1 HIGH	0	**42**

PIN TABLE FOR PASSIVE MOTOR SET Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Values**	**PIN**
R	**11.4.7**	JOG CRAWL SLACK / Jog/Slack ramp	0.1 – 600.0 s	1.0 s	**43**
R	**11.6.2**	STOP MODE RAMP / Stop ramp time	0.1 – 600.0 s	10.0 s	**56**
R	**11.6.5**	STOP MODE RAMP / Drop-out speed	0 – 100.00%	2.00%	**59**
R	**11.7.1**	SPEED REF SUMMER / Internal speed reference 1	±105.00%	0.00%	**62**
R	**11.7.2**	SPEED REF SUMMER / Auxiliary speed reference 2	±105.00%	0.00%	**63**
R	**11.7.3**	SPEED REF SUMMER / Speed reference 3 monitor	±105.00%	0.00%	**64**
R	**11.7.4**	SPEED REF SUMMER / Ramped speed reference 4	±105.00%	0.00%	**65**
R	**11.7.5**	SPEED REF SUMMER / Speed/ Current reference 3 sign	0 INVERT 1 NON-INVERT	1	**66**
R	**11.7.6**	SPEED REF SUMMER / Speed/ Current reference 3 ratio	±3.0000	1.0000	**67**
R	**11.8.1**	SPEED CONTROL / Max+ speed reference	0.00 – 105.00%	105.00%	**69**
R	**11.8.2**	SPEED CONTROL / Max- speed reference	0.00 – -105.00%	-105.00%	**70**
R	**11.8.3**	SPEED CONTROL / Speed proportional gain	0.00 – 200.00	5.00	**71**
R	**11.8.4**	SPEED CONTROL / Speed integral time constant	0.001 – 30.000 s	1.000 s	**72**
R	**11.10.1**	CURRENT CONTROL / Current clamp scaler	0.00 – 150.00%	10.00%	**81**
R	**11.10.7**	CURRENT CONTROL / Current amp proportional gain	0.00 – 200.00	5.00	**93**
R	**11.10.8**	CURRENT CONTROL / Current amp integral gain	0.00 – 200.00	1.00	**94**
R	**11.10.9**	CURRENT CONTROL / Discontinuous current point	0.00 – 200.00%	0.00%	**95**
R/S	**11.10.10**	CURRENT CONTROL / 4-quadrant mode enable	0 DISABLED 1 ENABLED	1	**96**
R/S	**11.13.1**	FIELD CONTROL / Field enable	0 DISABLED 1 ENABLED	1	**99**
R/P	**11.13.2**	FIELD CONTROL / Voltage output %	0.00 – 100.00%	90.00%	**100**
R	**11.15.1**	ZERO INTERLOCKS / Standstill enable	0 DISABLED 1 ENABLED	0	**115**
R	**11.15.3**	ZERO INTERLOCKS / Zero interlocks speed level	0.00 – 100.00%	1.00%	**117**
R	**11.15.4**	ZERO INTERLOCKS / Zero interlocks current level	0.00 – 100.00%	1.50%	**118**

17.21 CONFIGURATION / CONFLICT HELP MENU

This menu identifies and warns of accidental User programming that has connected a single PIN to more than one GOTO.

An automatic conflict check is performed at the end of each configuration session whenever you set ENABLE GOTO, GETFROM to DISABLED.

Finding a conflict causes the alarm message GOTO CONFLICT to be displayed. Refer to "4 Self-test messages" on page 31.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   CONFLICT HELP MENU      3
      NUMBER OF CONFLICTS
      MULTIPLE GOTO ON PIN
```

17.21.1 NUMBER OF CONFLICTS

Display the number of active GOTO conflicts.

	Parameter description	Range
	NUMBER OF CONFLICTS	0 to 50

NOTE: There will be at least two conflicts for each conflict PIN. Removing one GOTO from the conflict PIN will reduce the conflict number by 1.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   CONFLICT HELP MENU      3
      NUMBER OF CONFLICTS
```

17.21.2 MULTIPLE GOTO ON PIN

Display the next PIN having more than one GOTO connected.

	Parameter description	Range
	MULTIPLE GOTO ON PIN	0 to 720

NOTE: There will be at least two conflicts for each conflict PIN. Removing one GOTO from the conflict PIN will reduce the conflict number by 1.

PIN 400 is "block disconnect". It indicates no conflicts.

```
R  ENTRY MENU      LEVEL   1
   CONFIGURATION           2
   CONFLICT HELP MENU      3
      MULTIPLE GOTO ON PIN
```

18 PIN tables

18.1 CHANGE PARAMETERS: 1 – 122

PIN TABLE FOR CHANGE PARAMETERS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
		Reserved			**1**
R/P/S	11.1.1	CALIBRATION / Rated armature amps **QuickStart**	33% – 100%	33% A	**2**
R/P	11.1.2	CALIBRATION / Current limit% **QuickStart**	0.00 – 150.00%	150.00%	**3**
R/P/S	11.1.3	CALIBRATION / Rated field amps **QuickStart**	0.1 – 100.0% A	25.0% A	**4**
R/P/S	11.1.4	CALIBRATION / Base rated motor rpm **QuickStart**	0 – 6000 rpm	1500 rpm	**5**
R/P	11.1.5	CALIBRATION / Desired max rpm **QuickStart**	0 – 6000 rpm	1500 rpm	**6**
R/P	11.1.6	CALIBRATION / Zero speed offset	±5.00%	0.00%	**7**
R/P/S	11.1.7	CALIBRATION / Max tacho volts	±200.00 V	60.00 V	**8**
R/P/S	11.1.8	CALIBRATION / Speed feedback type **QuickStart**	0 : ARMATURE VOLTS 1 : ANALOG TACHO 2 : ENCODER 3 : ENCODER + ARM VOLTS 4 : ENCODER + TACHO	0	**9**
R/P/S	11.2.1	ENCODER SCALING / Quadrature enable	0 : DISABLED 1 : ENABLED	1	**10**
R/P/S	11.2.2	ENCODER SCALING / Encoder lines	1 – 6000	1000	**11**
R/P/S	11.2.3	ENCODER SCALING / Motor / encoder speed ratio	0.0000 – 3.0000	1.0000	**12**
R/P/S	11.2.4	ENCODER SCALING / Encoder sign	0 : NON-INVERT 1 : INVERT	0	**13**
R/P	11.1.9	CALIBRATION / IR compensation	0.00 – 100.00 %	0.00%	**14**
R/P	11.1.10	CALIBRATION / Field current feedback trim	1.0000 – 1.1000	1.0000	**15**
R/P	11.1.11	CALIBRATION / Armature volts trim	1.0000 – 1.1000	1.0000	**16**
R/P	11.1.12	CALIBRATION / Analog tacho trim	1.0000 – 1.1000	1.0000	**17**
R/P/S	11.1.13	CALIBRATION / Rated armature volts **QuickStart**	0.0 – 1000.0 V	460.0 V	**18**
R/P/S	11.1.14	CALIBRATION / EL1/2/3 Rated AC volts **QuickStart**	0.0 – 1000.0 V	415.0 V	**19**
R/P	11.1.15	CALIBRATION / MOTOR 1 or 2 select	0 : MOTOR 1 1 : MOTOR 2	0	**20**
R	11.3.1	RUN MODE RAMPS / Ramp output monitor	±100.00%	0.00%	**21**
R	11.3.2	RUN MODE RAMPS / Forward up time	0.1 – 600.0 s	10.0 s	**22**
R	11.3.3	RUN MODE RAMPS / Forward down time	0.1 – 600.0 s	10.0 s	**23**
R	11.3.4	RUN MODE RAMPS / Reverse up time	0.1 – 600.0 s	10.0 s	**24**
R	11.3.5	RUN MODE RAMPS / Reverse down time	0.1 – 600.0 s	10.0 s	**25**
	11.3.6	RUN MODE RAMPS / Ramp input	±105.00%	0.00%	**26**
	11.3.7	RUN MODE RAMPS / Forward minimum speed	0.00 – 105.00%	0.00%	**27**
	11.3.8	RUN MODE RAMPS / Reverse minimum speed	0.00 – -105.00%	0.00%	**28**
	11.3.9	RUN MODE RAMPS / Ramp automatic preset enable	0 : DISABLED 1 : ENABLED	1	**29**

PIN TABLE FOR CHANGE PARAMETERS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	11.3.10	RUN MODE RAMPS / Ramp external preset enable	0 : DISABLED 1 : ENABLED	0	**30**
	11.3.11	RUN MODE RAMPS / Ramp preset value	±300.00%	0.00%	**31**
	11.3.12	RUN MODE RAMPS / Ramp S profile %	0.00 – 100.00%	2.50%	**32**
	11.3.13	RUN MODE RAMPS / Ramp hold enable	0 : DISABLED 1 : ENABLED	0	**33**
	11.3.14	RUN MODE RAMPS / Ramping flag threshold	0.00 – 100.00%	0.50%	**34**
R	11.3.15	RUN MODE RAMPS / Ramping flag	0 : LOW 1 : HIGH	0	**35**
		Reserved		0	**36**
R	11.4.1	JOG CRAWL SLACK / Jog speed 1	±100.00%	5.00%	**37**
R	11.4.2	JOG CRAWL SLACK / Jog speed 2	±100.00%	-5.00%	**38**
R	11.4.3	JOG CRAWL SLACK / Slack speed 1	±100.00%	5.00%	**39**
R	11.4.4	JOG CRAWL SLACK / Slack speed 2	±100.00%	-5.00%	**40**
R	11.4.5	JOG CRAWL SLACK / Crawl speed	±100.00%	10.00%	**41**
R	11.4.6	JOG CRAWL SLACK / Jog mode select	0 : DISABLED 1 : ENABLED	0	**42**
R	11.4.7	JOG CRAWL SLACK / Jog/Slack ramp	0.1 – 600.0 s	1.0 s	**43**
		Reserved		0	**44**
	11.5.1	MOTORISED POT RAMP / Motor pot output monitor	±300.00%	0.00%	**45**
	11.5.2	MOTORISED POT RAMP / MP Up time	0.1 – 600.0 s	10.0 s	**46**
	11.5.3	MOTORISED POT RAMP / MP Down time	0.1 – 600.0 s	10.0 s	**47**
	11.5.4	MOTORISED POT RAMP / MP Up command	0 : DISABLED 1 : ENABLED	0	**48**
	11.5.5	MOTORISED POT RAMP / MP Down command	0 : DISABLED 1 : ENABLED	0	**49**
	11.5.6	MOTORISED POT RAMP / MP Maximum clamp	±300.00%	100.00%	**50**
	11.5.7	MOTORISED POT RAMP / MP Minimum clamp	±300.00%	-100.00%	**51**
	11.5.8	MOTORISED POT RAMP / MP preset enable	0 : DISABLED 1 : ENABLED	0	**52**
	11.5.9	MOTORISED POT RAMP / MP Preset value	±300.00%	0.00%	**53**
	11.5.10	MOTORISED POT RAMP / MP memory boot-up mode	0 : DISABLED 1 : ENABLED	0	**54**
		Reserved		0	**55**
R	11.6.2	STOP MODE RAMP / Stop ramp time	0.1 – 600.0 s	10.0 s	**56**
	11.6.3	STOP MODE RAMP / Stop time limit	0.0 – 600.0 s	60.0 s	**57**
	11.6.4	STOP MODE RAMP / Live delay mode	0 : DISABLED 1 : ENABLED	0	**58**
R	11.6.5	STOP MODE RAMP / Drop-out speed	0.00 – 100.00%	2.00%	**59**
	11.6.6	STOP MODE RAMP / Drop-out delay	0.1 – 600.0 s	1.0 s	**60**
		Reserved		0	**61**
R	11.7.1	SPEED REF SUMMER / Internal speed reference 1	±105.00%	0.00%	**62**
R	11.7.2	SPEED REF SUMMER / Auxiliary speed reference 2	±105.00%	0.00%	**63**
R	11.7.3	SPEED REF SUMMER / Speed reference 3 monitor	±105.00%	0.00%	**64**
R	11.7.4	SPEED REF SUMMER / Ramped speed reference 4	±105.00%	0.00%	**65**

PIN TABLE FOR CHANGE PARAMETERS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
R	11.7.5	SPEED REF SUMMER / Speed/ Current reference 3 sign	0 : NON-INVERT 1 : INVERT	0	**66**
R	11.7.6	SPEED REF SUMMER / Speed/ Current reference 3 ratio	±3.0000	1.0000	**67**
		Reserved		0	**68**
R	11.8.1	SPEED CONTROL / Max+ speed reference	0.00 – 105.00%	105.00%	**69**
R	11.8.2	SPEED CONTROL / Max- speed reference	0.00 – -105.00%	-105.00%	**70**
R	11.8.3	SPEED CONTROL / Speed proportional gain	0.00 – 200.00	15.00	**71**
R	11.8.4	SPEED CONTROL / Speed integral time constant	0.001 – 30.000 s	1.000 s	**72**
	11.8.5	SPEED CONTROL / Speed integral reset	0 : DISABLED 1 : ENABLED	0	**73**
	11.9.2	SPEED PI ADAPTION / Low breakpoint	0.00 – 100.00%	1.00%	**74**
	11.9.3	SPEED PI ADAPTION / High breakpoint	0.00 – 100.00%	2.00%	**75**
	11.9.4	SPEED PI ADAPTION / Low breakpoint proportional gain	0.00 – 200.00	5.00	**76**
	11.9.5	SPEED PI ADAPTION / Low breakpoint integral time constant	0.001 – 30.000 s	1.000 s	**77**
	11.9.6	SPEED PI ADAPTION / Integral % during ramp	0.00 – 100.00%	100.00%	**78**
	11.9.7	SPEED PI ADAPTION / Adapt input enable	0 : DISABLED 1 : ENABLED	0	**79**
		Reserved		0	**80**
R	11.10.1	CURRENT CONTROL / Current clamp scaler	0.00 – 150.00%	150.00%	**81**
S	11.11.1	CURRENT OVERLOAD / Overload % target value	0.00 – 105.00%	105.00%	**82**
S	11.11.2	CURRENT OVERLOAD / Overload ramp time	0.0 – 20.0 s	20.0 s	**83**
	11.12.1	I DYNAMIC PROFILE / I Profile enable	0 : DISABLED 1 : ENABLED	0	**84**
	11.12.2	I DYNAMIC PROFILE / Speed breakpoint at high current	0.00 – 105.00%	75.00%	**85**
	11.12.3	I DYNAMIC PROFILE / Speed breakpoint at low current	0.00 - 105.00%	100.00%	**86**
	11.12.4	I DYNAMIC PROFILE / Current limit at low current	0.00 – 150.00%	100.00%	**87**
	11.10.2	CURRENT CONTROL / Dual current clamps enable	0 : DISABLED 1 : ENABLED	0	**88**
	11.10.3	CURRENT CONTROL / Upper current clamp	±100.00%	100.00%	**89**
	11.10.4	CURRENT CONTROL / Lower current clamp	±100.00%	-100.00%	**90**
	11.10.5	CURRENT CONTROL / Extra current reference	±300.00%	0.00%	**91**
S	11.10.6	CURRENT CONTROL / Autotune enable	0 : DISABLED 1 : ENABLED	0	**92**
R	11.10.7	CURRENT CONTROL / Current amp proportional gain	0.00 – 200.00	30.00	**93**
R	11.10.8	CURRENT CONTROL / Current amp integral gain	0.00 – 200.00	3.00	**94**
R	11.10.9	CURRENT CONTROL / Discontinuous current point	0.00 – 200.00%	13.00%	**95**
R/S	11.10.10	CURRENT CONTROL / 4-quadrant mode enable	0 : DISABLED 1 : ENABLED	1	**96**
	11.10.11	CURRENT CONTROL / Speed bypass current demand enable	0 : DISABLED 1 : ENABLED	0	**97**
	11.10.12	CURRENT CONTROL / Armature front stop	0 – 15000	624	**98**

PIN TABLE FOR CHANGE PARAMETERS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
R/S	11.13.1	FIELD CONTROL / Field enable	0 : DISABLED 1 : ENABLED	1	**99**
R/P	11.13.2	FIELD CONTROL / Voltage output %	0.00 – 100.00%	90.00%	**100**
	11.13.3	FIELD CONTROL / Field proportional gain	0 – 1000	10	**101**
	11.13.4	FIELD CONTROL / Field integral gain	0 – 1000	100	**102**
S	11.14.1	WEAKENING MENU / Field weakening enable	0 : DISABLED 1 : ENABLED	0	**103**
	11.14.2	WEAKENING MENU / Field weakening proportional gain	0 – 1000	50	**104**
	11.14.3	WEAKENING MENU / Field weakening integral TC	0 – 20000 ms	4000 ms	**105**
	11.14.4	WEAKENING MENU / Field weakening derivative TC	10 – 5000 ms	200 ms	**106**
	11.14.5	WEAKENING MENU / Field weakening feedback deriv TC	10 – 5000 ms	100 ms	**107**
	11.14.6	WEAKENING MENU / Field weakening feedback int TC	10 – 5000 ms	100 ms	**108**
	11.14.7	WEAKENING MENU / Spillover armature voltage %	0.00 – 100.00%	100.00%	**109**
	11.14.8	WEAKENING MENU / Minimum field current %	0.00 – 100.00%	10.00%	**110**
	11.13.5	FIELD CONTROL / Standby field enable	0 : DISABLED 1 : ENABLED	0	**111**
	11.13.6	FIELD CONTROL / Standby field value	0.00 – 100.00%	25.00%	**112**
	11.13.7	FIELD CONTROL / Field quench delay	0.0 – 600.0 s	10.0 s	**113**
	11.13.8	FIELD CONTROL / Field reference	0.00 – 100.00%	100.00%	**114**
R	11.15.1	ZERO INTERLOCKS / Standstill enable	0 : DISABLED 1 : ENABLED	0	**115**
	11.15.2	ZERO INTERLOCKS / Zero reference start enable	0 : DISABLED 1 : ENABLED	0	**116**
R	11.15.3	ZERO INTERLOCKS / Zero interlocks speed level	0.00 – 100.00%	1.00%	**117**
R	11.15.4	ZERO INTERLOCKS / Zero interlocks current level	0.00 – 100.00%	1.50%	**118**
	11.15.5	ZERO INTERLOCKS / At zero reference flag	0 : LOW 1 : HIGH	0	**119**
	11.15.6	ZERO INTERLOCKS / At zero speed flag	0 : LOW 1 : HIGH	0	**120**
	11.15.7	ZERO INTERLOCKS / At standstill flag	0 : LOW 1 : HIGH	0	**121**
	11.16.2	SPINDLE ORIENTATE / Zero speed lock	0.00 – 100.00	0.00	**122**

18.2 DIAGNOSTICS: 123 – 170

PIN TABLE FOR DIAGNOSTICS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
R	12.2.1	SPEED LOOP MONITOR / Total speed reference monitor	±300.00%	0.00%	**123**
	12.2.2	SPEED LOOP MONITOR / Speed demand monitor	±300.00%	0.00%	**124**
	12.2.3	SPEED LOOP MONITOR / Speed error monitor	±300.00%	0.00%	**125**
R	12.2.4	SPEED LOOP MONITOR / Armature volts monitor	±1250.0 V	0.0 V	**126**
	12.2.5	SPEED LOOP MONITOR / Armature volts % monitor	±300.00%	0.00%	**127**
	12.2.6	SPEED LOOP MONITOR / Back emf % monitor	±300.00%	0.00%	**128**
R	12.2.7	SPEED LOOP MONITOR / Tachogenerator volts monitor	±220.00 V	0.00 V	**129**
R	12.2.8	SPEED LOOP MONITOR / Motor RPM monitor	±7500 rpm	0 rpm	**130**
R	12.2.10	SPEED LOOP MONITOR / Speed feedback % monitor	±300.00%	0.00%	**131**
R	12.2.9	SPEED LOOP MONITOR / Encoder RPM monitor	±7500 rpm	0 rpm	**132**
R	12.3.1	ARM I LOOP MONITOR / Arm current demand monitor	±150.00%	0.00%	**133**
R	12.3.2	ARM I LOOP MONITOR / Arm current % monitor	±150.00%	0.00%	**134**
R	12.3.3	ARM I LOOP MONITOR / Arm current amps monitor	±3000.0 A	0.00 A	**135**
	12.3.4	ARM I LOOP MONITOR / Upper current limit monitor	±150.00%	0.00%	**136**
	12.3.5	ARM I LOOP MONITOR / Lower current limit monitor	±150.00%	0.00%	**137**
R	12.3.6	ARM I LOOP MONITOR / Actual upper limit monitor	±150.00%	0.00%	**138**
R	12.3.7	ARM I LOOP MONITOR / Actual lower limit monitor	±150.00%	0.00%	**139**
	12.3.8	ARM I LOOP MONITOR / Overload limit monitor	0 – 150.00%	0.00%	**140**
	12.3.9	ARM I LOOP MONITOR / At current limit flag	0 : LOW 1 : HIGH	0	**141**
		Reserved		0	**142**
R	12.4.1	FIELD MONITOR / Field demand monitor	0 .00– 100.00%	0.00%	**143**
R	12.4.2	FIELD MONITOR / Field current % monitor	0.00 – 125.00%	0.00%	**144**
R	12.4.3	FIELD MONITOR / Field amps monitor	0.00 – 50.00 A	0.00 A	**145**
	12.4.4	FIELD MONITOR / Field firing angle monitor	0 – 155°	0°	**146**
	12.4.5	FIELD MONITOR / Field active monitor	0 : DISABLED 1 : ENABLED	0	**147**
		Reserved		0	**148**
		Reserved		0	**149**
R	12.5.1	ANALOG IO MONITOR / UIP2 analog input monitor	±30.730 V	0.000 V	**150**
R	12.5.1	ANALOG IO MONITOR / UIP3 analog input monitor	±30.730 V	0.000 V	**151**
R	12.5.1	ANALOG IO MONITOR / UIP4 analog input monitor	±30.730 V	0.000 V	**152**

PIN TABLE FOR DIAGNOSTICS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	12.5.1	ANALOG IO MONITOR / UIP5 analog input monitor	±30.730 V	0.000 V	**153**
	12.5.1	ANALOG IO MONITOR / UIP6 analog input monitor	±30.730 V	0.000 V	**154**
	12.5.1	ANALOG IO MONITOR / UIP7 analog input monitor	±30.730 V	0.000 V	**155**
	12.5.1	ANALOG IO MONITOR / UIP8 analog input monitor	±30.730 V	0.000 V	**156**
	12.5.1	ANALOG IO MONITOR / UIP9 analog input monitor	±30.730 V	0.000 V	**157**
		Reserved		0	**158**
	12.5.2	ANALOG IO MONITOR / AOP1 analog output monitor	±11.300 V	0.000 V	**159**
	12.5.2	ANALOG IO MONITOR / AOP2 analog output monitor	±11.300 V	0.000 V	**160**
	12.5.2	ANALOG IO MONITOR / AOP3 analog output monitor	±11.300 V	0.000 V	**161**
R	12.6.1	DIGITAL IO MONITOR / UIP2 to 9 digital input monitor	0/1 for each UIP (0 = low)	00000000	**162**
R	12.6.2	DIGITAL IO MONITOR / DIP1-4 and DIO1-4 dig IP monitor	0/1 for each DIP/DIO (0 = low)	00000000	**163**
R	12.6.3	DIGITAL IO MONITOR / DOP1-3 + Control IPs dig OP mon	0/1 for each UIP (0 = low)	00000000	**164**
	12.6.4	DIGITAL IO MONITOR / +Armature bridge flag	0 : LOW 1 : HIGH	0	**165**
R	12.6.5	DIGITAL IO MONITOR / Drive start flag	0 : LOW 1 : HIGH	0	**166**
R	12.6.6	DIGITAL IO MONITOR / Drive run flag	0 : LOW 1 : HIGH	0	**167**
R	12.6.7	DIGITAL IO MONITOR / Internal running mode monitor	0 : STOP 1 : STOP 2 : RUN 3 : CRAWL 4 : JOG SPEED 1 5 : JOG SPEED 2 6 : SLACK SPEED 1 7 : SLACK SPEED 2	0	**168**
R	12.1.1	DIAGNOSTICS / EL1/2 RMS monitor	0.0 – 1000.0 V	0.0 V	**169**
R	12.1.2	DIAGNOSTICS / DC KILOWATTS monitor	±3000.0 kW	0.0 kW	**170**

18.3 MOTOR DRIVE ALARMS: 171 – 183

PIN TABLE FOR MOTOR DRIVE ALARMS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
R	13.1.1	MOTOR DRIVE ALARMS / Speed fb mismatch trip enable	0 : DISABLED 1 : ENABLED	1	**171**
	13.1.2	MOTOR DRIVE ALARMS / Speed fb mismatch tolerance	0.00 – 100.00%	50.00%	**172**
R	13.1.3	MOTOR DRIVE ALARMS / Field loss trip disable	0 : DISABLED 1 : ENABLED	1	**173**
	13.1.4	MOTOR DRIVE ALARMS / Dig OP short-circuit trip enable	0 : DISABLED 1 : ENABLED	0	**174**
	13.1.5	MOTOR DRIVE ALARMS / Missing pulse trip enable	0 : DISABLED 1 : ENABLED	1	**175**
	13.1.6	MOTOR DRIVE ALARMS / Reference exchange trip enable	0 : DISABLED 1 : ENABLED	0	**176**
	13.1.7	MOTOR DRIVE ALARMS / Overspeed delay time	0.1 – 600.0 s	5.0 s	**177**
R	13.2.1	STALL TRIP MENU / Stall trip enable	0 : DISABLED 1 : ENABLED	1	**178**
R	13.2.2	STALL TRIP MENU / Stall current level	0.00 – 150.00%	95.00%	**179**
R	13.2.3	STALL TRIP MENU / Stall delay time	0.1 – 600.0 s	10.0 s	**180**
	13.1.8	MOTOR DRIVE ALARMS / Active trip monitor	0000 - FFFF (hex)	0000	**181**
	13.1.9	MOTOR DRIVE ALARMS / Stored trip monitor	0000 - FFFF (hex)	0000	**182**
	13.1.10	MOTOR DRIVE ALARMS / External trip reset enable	0 : DISABLED 1 : ENABLED	1	**183**

18.4 SERIAL LINKS: 184 – 244

PIN TABLE FOR SERIAL LINKS

Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST

Property	Paragraph number	Menu / Description	Range	Default Value	PIN
		Reserved		0	**184**
		Reserved		0	**185**
		Reserved		0	**186**
R	**14**	RS232 PORT1 / Port1 Baud rate	0 : 300 1 : 600 2 : 1200 3 : 2400 4 : 4800 5 : 9600 6 : 19200 7 : 34800 8 : 57600	5	**187**
S	**14**	PORT1 FUNCTION / Port1 function mode	0 : PARAM EXCH SELECT 1 : REF EXCHANGE MASTER 2 : REF EXCHANGE SLAVE 3 : ASCII COMMS	0	**188**
	14	PORT1 REF EXCHANGE / Ref exchange slave ratio	±3.0000	1.0000	**189**
	14	PORT1 REF EXCHANGE / Ref exchange slave sign	0 : NON-INVERT 1 : INVERT	0	**190**
	14	PORT1 REF EXCHANGE / Ref exchange slave monitor	±300.00%	0.00%	**191**
	14	PORT1 REF EXCHANGE / Ref exchange master monitor	±300.00%	0.00%	**192**
	14	PORT 1 COMMS LINK / Port 1 group ID	0 – 7	0	**193**
	14	PORT 1 COMMS LINK / Port 1 unit ID	0 – 15	0	**194**
	14	PORT 1 COMMS LINK / Port 1 error code	1 – 8	1	**195**
S	**14**	PORT 1 COMMS LINK / Port 1 DOP3 RTS mode	0 : DISABLED 1 : ENABLED	0	**196**
		Reserved			**197**
		Reserved			**198**
	17.18	FIELDBUS CONFIG / Fieldbus data control	00 – 11 (binary)	00	**199**
	12.8	FBUS ON-LINE MON (Hidden pin)	0 : LOW 1 : HIGH	0	**200**
		Reserved			**201**
R	**17.18**	FIELDBUS CONFIG / Fieldbus node ID	0 - 127	0	**202**
R	**12.8**	FIELDBUS / Fieldbus bits input diagnostic	00000000 - 11111111		**203**
		Reserved			**204 to 212**
R	**12.8**	FIELDBUS / Fieldbus bits output diagnostic	00000000 - 11111111		**213**
		Reserved			**214 to 222**

18.5 CONFIGURATION: 250 – 400

PIN TABLE FOR CONFIGURATION Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
R	12.8	FIELDBUS / Anybus type diagnostic Note: M30 variants (Range values 9 to 18) are only supported in drive software issues >=V6.43.	0 : NOT FITTED 1 : NOT SUPPORTED 2 : PROFIBUS DPV1 3 : PROFINET 4 : ETHERNET/IP 5 : MODBUS TCP 6 : DEVICENET 7 : CANOPEN 8 : ETHERCAT 9 : PROFIBUS DPV1 (M30) 10: PROFINET (M30) 11 : ETHERNET/IP (M30) 12 : MODBUS TCP (M30) 13 : DEVICENET (M30) 14 : CANOPEN (M30) 15 : ETHERCAT (M30) 16 : PROFINET 1P (M30) 17 : ETHERNET/IP 1P (M30) 18 : MODBUS TCP 1P (M30)		**223**
R	17.18	FIELDBUS CONFIG / Fieldbus baud rate	0 : 125 kbps 1 : 250 kbps 2 : 500 kbps 3 : 800 kbps 4 : 1 Mbps	0	**224**
		Reserved			**225 to 239**
	11.16.3	SPINDLE ORIENTATE / Marker enable	0 : DISABLED 1 : ENABLED	0	**240**
	11.16.4	SPINDLE ORIENTATE / Marker offset	±15,000	0	**241**
	11.16.5	SPINDLE ORIENTATE / Position reference	±30,000	0	**242**
	11.16.6	SPINDLE ORIENTATE / Marker frequency monitor	20.00 – 655.35 Hz	0.00 Hz	**243**
	11.16.7	SPINDLE ORIENTATE / In position flag	0 : LOW 1 : HIGH	0	**244**
		Reserved			**245 to 249**
	17.5.1	ANALOG OUTPUTS / Iarm o/p rectify enable	0 : DISABLED 1 : ENABLED	0	**250**
	17.6.2	AOP1 (T10) SETUP / AOP1 Dividing factor	±3.0000	1.0000	**251**
	17.6.3	AOP1 (T10) SETUP / AOP1 Offset	±100.00%	0.00%	**252**
	17.6.4	AOP1 (T10) SETUP / AOP1 Rectifier mode enable	0 : DISABLED 1 : ENABLED	0	**253**
	17.6.2	AOP2 (T11) SETUP / AOP2 Dividing factor	±3.0000	1.0000	**254**
	17.6.3	AOP2 (T11) SETUP / AOP2 Offset	±100.00%	0.00%	**255**
	17.6.4	AOP2 (T11) SETUP / AOP2 Rectifier mode enable	0 : DISABLED 1 : ENABLED	0	**256**
	17.6.2	AOP3 (T12) SETUP / AOP3 Dividing factor	±3.0000	1.0000	**257**
	17.6.3	AOP3 (T12) SETUP / AOP3 Offset	±100.00%	0.00%	**258**
	17.6.4	AOP3 (T13) SETUP / AOP3 Rectifier mode enable	0 : DISABLED 1 : ENABLED	0	**259**
	17.5.2	ANALOG OUTPUTS / Scope output select on AOP3	0 : DISABLED 1 : ENABLED	0	**260**
	17.13.1	DOP1 (T22) SETUP / DOP1 Output value rectifier enable	0 : DISABLED 1 : ENABLED	1	**261**

PIN TABLE FOR CONFIGURATION					
Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	17.13.2	DOP1 (T22) SETUP / DOP1 OP comparator threshold	±300.00%	0.00%	**262**
	17.13.3	DOP1 (T22) SETUP / DOP1 Output inversion mode	0 : NON-INVERT 1 : INVERT	0	**263**
	17.13.1	DOP2 (T23) SETUP / DOP2 Output value rectifier enable	0 : DISABLED 1 : ENABLED	1	**264**
	17.13.2	DOP2 (T23) SETUP / DOP2 OP comparator threshold	±300.00%	0.00%	**265**
	17.13.3	DOP2 (T23) SETUP / DOP2 Output inversion mode	0 : NON-INVERT 1 : INVERT	0	**266**
	17.13.1	DOP3 (T24) SETUP / DOP3 Output value rectifier enable	0 : DISABLED 1 : ENABLED	1	**267**
	17.13.2	DOP3 (T24) SETUP / DOP3 OP comparator threshold	±300.00%	0.00%	**268**
	17.13.3	DOP3 (T24) SETUP / DOP3 Output inversion mode	0 : NON-INVERT 1 : INVERT	0	**269**
		Reserved		0	**270**
S	17.11.1	DIO1 (T18) SETUP / DIO1 Output mode enable	0 : DISABLED 1 : ENABLED	0	**271**
	17.11.2	DIO1 (T18) SETUP / DIO1 Output value rectify enable	0 : DISABLED 1 : ENABLED	1	**272**
	17.11.3	DIO1 (T18) SETUP / DIO1 OP comparator threshold	±300.00%	0.00%	**273**
	17.11.4	DIO1 (T18) SETUP / DIO1 Output inversion mode	0 : NON-INVERT 1 : INVERT	0	**274**
	17.11.7	DIO1 (T18) SETUP / DIO1 Input HI value	±300.00%	0.01%	**275**
	17.11.8	DIO1 (T18) SETUP / DIO1 Input LO value	±300.00%	0.00%	**276**
S	17.11.1	DIO2 (T19) SETUP / DIO2 Output mode enable	0 : DISABLED 1 : ENABLED	0	**277**
	17.11.2	DIO2 (T19) SETUP / DIO2 Output value rectify enable	0 : DISABLED 1 : ENABLED	1	**278**
	17.11.3	DIO2 (T19) SETUP / DIO2 OP comparator threshold	±300.00%	0.00%	**279**
	17.11.4	DIO2 (T19) SETUP / DIO2 Output inversion mode	0 : NON-INVERT 1 : INVERT	0	**280**
	17.11.7	DIO2 (T19) SETUP / DIO2 Input HI value	±300.00%	0.01%	**281**
	17.11.8	DIO2 (T19) SETUP / DIO2 Input LO value	±300.00%	0.00%	**282**
S	17.11.1	DIO3 (T20) SETUP / DIO3 Output mode enable	0 : DISABLED 1 : ENABLED	0	**283**
	17.11.2	DIO3 (T20) SETUP / DIO3 Output value rectify enable	0 : DISABLED 1 : ENABLED	1	**284**
	17.11.3	DIO3 (T20) SETUP / DIO3 OP comparator threshold	±300.00%	0.00%	**285**
	17.11.4	DIO3 (T20) SETUP / DIO3 Output inversion mode	0 : NON-INVERT 1 : INVERT	0	**286**
	17.11.7	DIO3 (T20) SETUP / DIO3 Input HI value	±300.00%	0.01%	**287**
	17.11.8	DIO3 (T20) SETUP / DIO3 Input LO value	±300.00%	0.00%	**288**
S	17.11.1	DIO4 (T21) SETUP / DIO4 Output mode enable	0 : DISABLED 1 : ENABLED	0	**289**
	17.11.2	DIO4 (T21) SETUP / DIO4 Output value rectify enable	0 : DISABLED 1 : ENABLED	1	**290**
	17.11.3	DIO4 (T21) SETUP / DIO4 OP comparator threshold	±300.00%	0.00%	**291**
	17.11.4	DIO4 (T21) SETUP / DIO4 Output inversion mode	0 : NON-INVERT 1 : INVERT	0	**292**

PIN TABLE FOR CONFIGURATION					
Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	17.11.7	DIO4 (T21) SETUP / DIO4 Input HI value	±300.00%	0.01%	**293**
	17.11.8	DIO4 (T21) SETUP / DIO4 Input LO value	±300.00%	0.00%	**294**
		Reserved		0	**295**
	17.14.2	STAGING POSTS / Digital post 1	0 : LOW 1 : HIGH	0	**296**
	17.14.2	STAGING POSTS / Digital post 2	0 : LOW 1 : HIGH	0	**297**
	17.14.2	STAGING POSTS / Digital post 3	0 : LOW 1 : HIGH	0	**298**
	17.14.2	STAGING POSTS / Digital post 4	0 : LOW 1 : HIGH	0	**299**
	17.14.3	STAGING POSTS / Analog post 1	±300.00%	0.00%	**300**
	17.14.3	STAGING POSTS / Analog post 2	±300.00%	0.00%	**301**
	17.14.3	STAGING POSTS / Analog post 3	±300.00%	0.00%	**302**
	17.14.3	STAGING POSTS / Analog post 4 PIN 303	±300.00%	0.00%	**303**
		Reserved		0	**304**
	17.15.1	SOFTWARE TERMINALS / Anded run	0 : LOW 1 : HIGH	1	**305**
	17.15.2	SOFTWARE TERMINALS / Anded jog	0 : LOW 1 : HIGH	1	**306**
	17.15.3	SOFTWARE TERMINALS / Anded start	0 : LOW 1 : HIGH	1	**307**
	17.15.4	SOFTWARE TERMINALS / Internal run	0 : LOW 1 : HIGH	0	**308**
		Reserved		0	**309**
	17.8.1	DIP1 (T14) SETUP / DIP1 Input HI value	±300.00%	0.01%	**310**
	17.8.2	DIP1 (T14) SETUP / DIP1 Input LO value	±300.00%	0.00%	**311**
	17.8.1	DIP2 (T15) SETUP / DIP2 Input HI value	±300.00%	0.01%	**312**
	17.8.2	DIP2 (T15) SETUP / DIP2 Input LO value	±300.00%	0.00%	**313**
	17.8.1	DIP3 (T16) SETUP / DIP3 Input HI value	±300.00%	0.01%	**314**
	17.8.2	DIP3 (T16) SETUP / DIP3 Input LO value	±300.00%	0.00%	**315**
	17.8.1	DIP4 (T17) SETUP / DIP4 Input HI value	±300.00%	0.01%	**316**
	17.8.2	DIP4 (T17) SETUP / DIP4 Input LO value	±300.00%	0.00%	**317**
	17.9.1	RUN INPUT SETUP / RUN input HI value	±300.00%	0.01%	**318**
	17.9.2	RUN INPUT SETUP / RUN input LO value	±300.00%	0.00%	**319**
	17.4.1	UIP2 (T2) SETUP / UIP2 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**320**
	17.4.2	UIP2 (T2) SETUP / UIP2 Input offset	±100.00%	0.00%	**321**
	17.4.3	UIP2 (T2) SETUP / UIP2 Linear scaling factor	±3.0000	1.0000	**322**
	17.4.4	UIP2 (T2) SETUP / UIP2 Max clamp level	±300.00%	100.00%	**323**
	17.4.5	UIP2 (T2) SETUP / UIP2 Min clamp level	±300.00%	-100.00%	**324**
	17.4.9	UIP2 (T2) SETUP / UIP2 Digital IP, HI value for output 1	±300.00%	0.01%	**325**
	17.4.10	UIP2 (T2) SETUP / UIP2 Digital IP, LO value for output 1	±300.00%	0.00%	**326**
	17.4.11	UIP2 (T2) SETUP / UIP2 Digital IP, HI value for output 2	±300.00%	0.01%	**327**
	17.4.12	UIP2 (T2) SETUP / UIP2 Digital IP, LO value for output 2	±300.00%	0.00%	**328**

PIN TABLE FOR CONFIGURATION Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	17.4.13	UIP2 (T2) SETUP / UIP2 Threshold	±30.000 V	6.000 V	**329**
	17.4.1	UIP3 (T3) SETUP / UIP3 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**330**
	17.4.2	UIP3 (T3) SETUP / UIP3 Input offset	±100.00%	0.00%	**331**
	17.4.3	UIP3 (T3) SETUP / UIP3 Linear scaling factor	±3.0000	1.0000	**332**
	17.4.4	UIP3 (T3) SETUP / UIP3 Max clamp level	±300.00%	100.00%	**333**
	17.4.5	UIP3 (T3) SETUP / UIP3 Min clamp level	±300.00%	-100.00%	**334**
	17.4.9	UIP3 (T3) SETUP / UIP3 Digital IP, HI value for output 1	±300.00%	0.01%	**335**
	17.4.10	UIP3 (T3) SETUP / UIP3 Digital IP, LO value for output 1	±300.00%	0.00%	**336**
	17.4.11	UIP3 (T3) SETUP / UIP3 Digital IP, HI value for output 2	±300.00%	0.01%	**337**
	17.4.12	UIP3 (T3) SETUP / UIP3 Digital IP, LO value for output 2	±300.00%	0.00%	**338**
	17.4.13	UIP3 (T3) SETUP / UIP3 Threshold	±30.000 V	6.000 V	**339**
	17.4.1	UIP4 (T4) SETUP / UIP4 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**340**
	17.4.2	UIP4 (T4) SETUP / UIP4 Input offset	±100.00%	0.00%	**341**
	17.4.3	UIP4 (T4) SETUP / UIP4 Linear scaling factor	±3.0000	1.0000	**342**
	17.4.4	UIP4 (T4) SETUP / UIP4 Max clamp level	±300.00%	100.00%	**343**
	17.4.5	UIP4 (T4) SETUP / UIP4 Min clamp level	±300.00%	-100.00%	**344**
	17.4.9	UIP4 (T4) SETUP / UIP4 Digital IP, HI value for output 1	±300.00%	0.01%	**345**
	17.4.10	UIP4 (T4) SETUP / UIP4 Digital IP, LO value for output 1	±300.00%	0.00%	**346**
	17.4.11	UIP4 (T4) SETUP / UIP4 Digital IP, HI value for output 2	±300.00%	0.01%	**347**
	17.4.12	UIP4 (T4) SETUP / UIP4 Digital IP, LO value for output 2	±300.00%	0.00%	**348**
	17.4.13	UIP4 (T4) SETUP / UIP4 Threshold	±30.000 V	6.000 V	**349**
	17.4.1	UIP5 (T5) SETUP / UIP5 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**350**
	17.4.2	UIP5 (T5) SETUP / UIP5 Input offset	±100.00%	0.00%	**351**
	17.4.3	UIP5 (T5) SETUP / UIP5 Linear scaling factor	±3.0000	1.0000	**352**
	17.4.4	UIP5 (T5) SETUP / UIP5 Max clamp level	±300.00%	100.00%	**353**
	17.4.5	UIP5 (T5) SETUP / UIP5 Min clamp level	±300.00%	-100.00%	**354**
	17.4.9	UIP5 (T5) SETUP / UIP5 Digital IP, HI value for output 1	±300.00%	0.01%	**355**
	17.4.10	UIP5 (T5) SETUP / UIP5 Digital IP, LO value for output 1	±300.00%	0.00%	**356**
	17.4.11	UIP5 (T5) SETUP / UIP5 Digital IP, HI value for output 2	±300.00%	0.01%	**357**
	17.4.12	UIP5 (T5) SETUP / UIP5 Digital IP, LO value for output 2	±300.00%	0.00%	**358**
	17.4.13	UIP5 (T5) SETUP / UIP5 Threshold	±30.000 V	6.000 V	**359**

PIN TABLE FOR CONFIGURATION					
Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	17.4.1	UIP6 (T6) SETUP / UIP6 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**360**
	17.4.2	UIP6 (T6) SETUP / UIP6 Input offset	±100.00%	0.00%	**361**
	17.4.3	UIP6 (T6) SETUP / UIP6 Linear scaling factor	±3.0000	1.0000	**362**
	17.4.4	UIP6 (T6) SETUP / UIP6 Max clamp level	±300.00%	100.00%	**363**
	17.4.5	UIP6 (T6) SETUP / UIP6 Min clamp level	±300.00%	-100.00%	**364**
	17.4.9	UIP6 (T6) SETUP / UIP6 Digital IP, HI value for output 1	±300.00%	0.01%	**365**
	17.4.10	UIP6 (T6) SETUP / UIP6 Digital IP, LO value for output 1	±300.00%	0.00%	**366**
	17.4.11	UIP6 (T6) SETUP / UIP6 Digital IP, HI value for output 2	±300.00%	0.01%	**367**
	17.4.12	UIP6 (T6) SETUP / UIP6 Digital IP, LO value for output 2	±300.00%	0.00%	**368**
	17.4.13	UIP6 (T6) SETUP / UIP6 Threshold	±30.000 V	6.000 V	**369**
	17.4.1	UIP7 (T7) SETUP / UIP7 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**370**
	17.4.2	UIP7 (T7) SETUP / UIP7 Input offset	±100.00%	0.00%	**371**
	17.4.3	UIP7 (T7) SETUP / UIP7 Linear scaling factor	±3.0000	1.0000	**372**
	17.4.4	UIP7 (T7) SETUP / UIP7 Max clamp level	±300.00%	100.00%	**373**
	17.4.5	UIP7 (T7) SETUP / UIP7 Min clamp level	±300.00%	-100.00%	**374**
	17.4.9	UIP7 (T7) SETUP / UIP7 Digital IP, HI value for output 1	±300.00%	0.01%	**375**
	17.4.10	UIP7 (T7) SETUP / UIP7 Digital IP, LO value for output 1	±300.00%	0.00%	**376**
	17.4.11	UIP7 (T7) SETUP / UIP7 Digital IP, HI value for output 2	±300.00%	0.01%	**377**
	17.4.12	UIP7 (T7) SETUP / UIP7 Digital IP, LO value for output 2	±300.00%	0.00%	**378**
	17.4.13	UIP7 (T7) SETUP / UIP7 Threshold	±30.000 V	6.000 V	**379**
	17.4.1	UIP8 (T8) SETUP / UIP8 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**380**
	17.4.2	UIP8 (T8) SETUP / UIP8 Input offset	±100.00%	0.00%	**381**
	17.4.3	UIP8 (T8) SETUP / UIP8 Linear scaling factor	±3.0000	1.0000	**382**
	17.4.4	UIP8 (T8) SETUP / UIP8 Max clamp level	±300.00%	100.00%	**383**
	17.4.5	UIP8 (T8) SETUP / UIP8 Min clamp level	±300.00%	-100.00%	**384**
	17.4.9	UIP8 (T8) SETUP / UIP8 Digital IP, HI value for output 1	±300.00%	0.01%	**385**
	17.4.10	UIP8 (T8) SETUP / UIP8 Digital IP, LO value for output 1	±300.00%	0.00%	**386**
	17.4.11	UIP8 (T8) SETUP / UIP8 Digital IP, HI value for output 2	±300.00%	0.01%	**387**
	17.4.12	UIP8 (T8) SETUP / UIP8 Digital IP, LO value for output 2	±300.00%	0.00%	**388**
	17.4.13	UIP8 (T8) SETUP / UIP8 Threshold	±30.000 V	6.000 V	**389**

PIN TABLE FOR CONFIGURATION Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	17.4.1	UIP9 (T9) SETUP / UIP9 Input range	0 : ±10 V 1 : ±5 V 2 : ±20 V 3 : ±30 V	0	**390**
	17.4.2	UIP9 (T9) SETUP / UIP9 Input offset	±100.00%	0.00%	**391**
	17.4.3	UIP9 (T9) SETUP / UIP9 Linear scaling factor	±3.0000	1.0000	**392**
	17.4.4	UIP9 (T9) SETUP / UIP9 Max clamp level	±300.00%	100.00%	**393**
	17.4.5	UIP9 (T9) SETUP / UIP9 Min clamp level	±300.00%	-100.00%	**394**
	17.4.9	UIP9 (T9) SETUP / UIP9 Digital IP, HI value for output 1	±300.00%	0.01%	**395**
	17.4.10	UIP9 (T9) SETUP / UIP9 Digital IP, LO value for output 1	±300.00%	0.00%	**396**
	17.4.11	UIP9 (T9) SETUP / UIP9 Digital IP, HI value for output 2	±300.00%	0.01%	**397**
	17.4.12	UIP9 (T9) SETUP / UIP9 Digital IP, LO value for output 2	±300.00%	0.00%	**398**
	17.4.13	UIP9 (T9) SETUP / UIP9 Threshold	±30.000 V	6.000 V	**399**
	9.4	Block disconnect			**400**

18.6 APPLICATION: 401 – 680

PIN TABLE FOR APPLICATION BLOCKS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	16.1.1	SUMMER 1 / Total output value monitor	±200.00%	0.00%	**401**
	16.1.2	SUMMER 1 / Sign 1	0 : NON-INVERT 1 : INVERT	0	**402**
	16.1.3	SUMMER 1 / Sign 2	0 : NON-INVERT 1 : INVERT	0	**403**
	16.1.4	SUMMER 1 / Ratio 1	±3.0000	1.0000	**404**
	16.1.5	SUMMER 1 / Ratio 2	±3.0000	1.0000	**405**
	16.1.6	SUMMER 1 / Divider 1	±3.0000	1.0000	**406**
	16.1.7	SUMMER 1 / Divider 2	±3.0000	1.0000	**407**
	16.1.8	SUMMER 1 / Input 1	±300.00%	0.00%	**408**
	16.1.9	SUMMER 1 / Input 2	±300.00%	0.00%	**409**
	16.1.10	SUMMER 1 / Input 3	±300.00%	0.00%	**410**
	16.1.11	SUMMER 1 / Deadband	0.00 – 100.00%	0.00%	**411**
	16.1.12	SUMMER 1 / Output sign inverter	0 : NON-INVERT 1 : INVERT	0	**412**
	16.1.13	SUMMER 1 / Symmetrical clamp	0.00 – 200.00%	105.00%	**413**
		Reserved			**414**
	16.1.1	SUMMER 2 / Total output value monitor	±200.00%	0.00%	**415**
	16.1.2	SUMMER 2 / Sign 1	0 : NON-INVERT 1 : INVERT	0	**416**
	16.1.3	SUMMER 2 / Sign 2	0 : NON-INVERT 1 : INVERT	0	**417**
	16.1.4	SUMMER 2 / Ratio 1	±3.0000	1.0000	**418**
	16.1.5	SUMMER 2 / Ratio 2	±3.0000	1.0000	**419**
	16.1.6	SUMMER 2 / Divider 1	±3.0000	1.0000	**420**
	16.1.7	SUMMER 2 / Divider 2	±3.0000	1.0000	**421**
	16.1.8	SUMMER 2 / Input 1	±300.00%	0.00%	**422**
	16.1.9	SUMMER 2 / Input 2	±300.00%	0.00%	**423**
	16.1.10	SUMMER 2 / Input 3	±300.00%	0.00%	**424**
	16.1.11	SUMMER 2 / Deadband	0.00 – 100.00%	0.00%	**425**
	16.1.12	SUMMER 2 / Output sign inverter	0 : NON-INVERT 1 : INVERT	0	**426**
	16.1.13	SUMMER 2 / Symmetrical clamp	0.00 – 200.00%	105.00%	**427**
		Reserved		0	**428**
	16.2.1	PID 1 / Pid1 output value monitor	±300.00%	0.00%	**429**
	16.2.2	PID 1 / Pid1 IP1 value	±300.00%	0.00%	**430**
	16.2.3	PID 1 / Pid1 IP1 ratio	±3.0000	1.0000	**431**
	16.2.4	PID 1 / Pid1 IP1 divider	±3.0000	1.0000	**432**
	16.2.5	PID 1 / Pid1 IP2 value	±300.00%	0.00%	**433**
	16.2.6	PID 1 / Pid1 IP2 ratio	±3.0000	1.0000	**434**
	16.2.7	PID 1 / Pid1 IP2 divider	±3.0000	1.0000	**435**
	16.2.8	PID 1 / Pid1 proportional gain	0.0 – 100.0	1.0	**436**
	16.2.9	PID 1 / Pid1 integrator time constant	0.01 – 100.00 s	5.00 s	**437**
	16.2.10	PID 1 / Pid1 derivative time constant	0.000 – 10.000s	0.000 s	**438**
	16.2.11	PID 1 / Pid1 derivative filter time constant	0.000 – 10.000s	0.100 s	**439**

PIN TABLE FOR APPLICATION BLOCKS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	16.2.12	PID 1 / Pid1 integrator preset enable	0 : DISABLED 1 : ENABLED	0	**440**
	16.2.13	PID 1 / Pid1 integrator preset value	±300.00%	0.00%	**441**
	16.2.14	PID 1 / Pid1 reset enable	0 : DISABLED 1 : ENABLED	0	**442**
	16.2.15	PID 1 / Pid1 positive clamp level	0.00 – 105.00%	100.00%	**443**
	16.2.16	PID 1 / Pid1 negative clamp level	0.00 – -105.00%	-100.00%	**444**
	16.2.17	PID 1 / Pid1 output % trim	±3.0000	0.2000	**445**
	16.2.18	PID 1 / Pid1 Profile mode select	0 – 4 modes	0 (constant)	**446**
	16.2.19	PID 1 / Pid1 Minimum proportional gain %	0.00 – 100.00%	20.00%	**447**
	16.2.20	PID 1 / Pid1 Profile X-axis minimum	0.00 – 100.00%	0.00%	**448**
	16.2.22	PID 1 / Pid1 Profiled proportional gain output	0.0 – 100.0	0.0	**449**
	16.2.23	PID 1 / Pid1 clamp flag monitor	0 : LOW 1 : HIGH	0	**450**
	16.2.24	PID 1 / Pid1 error value monitor	±105.00%	0.00%	**451**
	16.2.1	PID 2 / Pid2 output value monitor	±300.00%	0.00%	**452**
	16.2.2	PID 2 / Pid2 IP1 value	±300.00%	0.00%	**453**
	16.2.3	PID 2 / Pid2 IP1 ratio	±3.0000	1.0000	**454**
	16.2.4	PID 2 / Pid2 IP1 divider	±3.0000	1.0000	**455**
	16.2.5	PID 2 / Pid2 IP2 value	±300.00%	0.00%	**456**
	16.2.6	PID 2 / Pid2 IP2 ratio	±3.0000	1.0000	**457**
	16.2.7	PID 2 / Pid2 IP2 divider	±3.0000	1.0000	**458**
	16.2.8	PID 2 / Pid2 proportional gain	0.00 – 100.0	1.0	**459**
	16.2.9	PID 2 / Pid2 integrator time constant	0.01 – 100.00 s	5.00 s	**460**
	16.2.10	PID 2 / Pid2 derivative time constant	0.000 – 10.000 s	0.000 s	**461**
	16.2.11	PID 2 / Pid2 derivative filter time constant	0.000 – 10.000 s	0.100 s	**462**
	16.2.12	PID 2 / Pid2 integrator preset enable	0 : DISABLED 1 : ENABLED	0	**463**
	16.2.13	PID 2 / Pid2 integrator preset value	±300.00%	0.00%	**464**
	16.2.14	PID 2 / Pid2 reset enable	0 : DISABLED 1 : ENABLED	0	**465**
	16.2.15	PID 2 / Pid2 positive clamp level	0.00 – 105.00%	100.00%	**466**
	16.2.16	PID 2 / Pid2 negative clamp level	0.00 – -105.00%	-100.00%	**467**
	16.2.17	PID 2 / Pid2 output % trim	±3.0000	0.2000	**468**
	16.2.18	PID 2 / Pid2 Profile mode select	0 – 4 modes	0 (constant)	**469**
	16.2.19	PID 2 / Pid2 Minimum proportional gain %	0.00 – 100.00%	20.00%	**470**
	16.2.20	PID 2 / Pid2 Profile X-axis minimum	0.00 – 100.00%	0.00%	**471**
	16.2.22	PID 2 / Pid2 Profiled proportional gain output	0.0 – 100.0	0.0	**472**
	16.2.23	PID 2 / Pid2 clamp flag monitor	0 : LOW 1 : HIGH	0	**473**
	16.2.24	PID 2 / Pid2 error value monitor	±105.00%	0.00%	**474**
	16.3.1	PARAMETER PROFILER / Profile Y output monitor	±300.00%	0.00%	**475**
	16.3.2	PARAMETER PROFILER / Profiler mode	0 – 4 modes	0 (constant)	**476**
	16.3.3	PARAMETER PROFILER / Profile Y at Xmin	±300.00%	0.00%	**477**
	16.3.4	PARAMETER PROFILER / Profile Y at Xmax	±300.00%	100.00%	**478**
	16.3.5	PARAMETER PROFILER / Profile X-axis minimum	±300.00%	0.00%	**479**

PIN TABLE FOR APPLICATION BLOCKS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	16.3.6	PARAMETER PROFILER / Profile X-axis maximum	±300.00%	100.00%	**480**
	16.3.7	PARAMETER PROFILER / Profile X-axis rectify	0 : DISABLED 1 : ENABLED	1	**481**
		Reserved			**482**
	16.4.1	REEL DIAMETER CALC / Diameter output monitor	0.00 – 100.00%	0.00%	**483**
	16.4.2	REEL DIAMETER CALC / Web speed input	±105.00%	0.00%	**484**
	16.4.3	REEL DIAMETER CALC / Reel speed input	±105.00%	0.00%	**485**
	16.4.4	REEL DIAMETER CALC / Minimum diameter input	0.00 – 100.00%	10.00%	**486**
	16.4.5	REEL DIAMETER CALC / Diameter calculation min speed	±105.00%	5.00%	**487**
	16.4.6	REEL DIAMETER CALC / Diameter hold enable	0 : DISABLED 1 : ENABLED	0	**488**
	16.4.7	REEL DIAMETER CALC / Diameter filter time constant	0.00 – 200.00 s	5.00 s	**489**
	16.4.8	REEL DIAMETER CALC / Diameter preset enable	0 : DISABLED 1 : ENABLED	0	**490**
	16.4.9	REEL DIAMETER CALC / Diameter preset value	0.00 – 100.00%	10.00%	**491**
	16.4.10	REEL DIAMETER CALC / Diameter web break threshold	0.00 – 100.00%	7.50%	**492**
	16.4.11	REEL DIAMETER CALC / Diameter memory boot-up	0 : DISABLED 1 : ENABLED	0	**493**
	16.5.3	TAPER TENSION CALC / Total tension output monitor	±100.00%	0.00%	**494**
	16.5.4	TAPER TENSION CALC / Tension reference	0.00 – 100.00%	0.00%	**495**
	16.5.5	TAPER TENSION CALC / Taper strength input	±100.00%	0.00%	**496**
	16.5.6	TAPER TENSION CALC / Hyperbolic taper enable	0 : DISABLED 1 : ENABLED	0	**497**
	16.5.7	TAPER TENSION CALC / Tension trim input	±100.00%	0.00%	**498**
	16.5.8	TAPER TENSION CALC / Tapered tension monitor	±100.00%	0.00%	**499**
	16.6.1	TORQUE COMPENSATOR / Torque demand monitor	±300.00%	0.00%	**500**
	16.6.2	TORQUE COMPENSATOR / Torque trim input	±150.00%	0.00%	**501**
	16.6.3	TORQUE COMPENSATOR / Stiction compensation	±300.00%	0.00%	**502**
	16.6.4	TORQUE COMPENSATOR / Stiction web speed threshold	0.00 – 10.00%	5.00%	**503**
	16.6.5	TORQUE COMPENSATOR / Static friction comp	±300.00%	0.00%	**504**
	16.6.6	TORQUE COMPENSATOR / Dynamic friction comp	±300.00%	0.00%	**505**
	16.6.7	TORQUE COMPENSATOR / Friction sign	0 : NON-INVERT 1 : INVERT	0	**506**
	16.6.8	TORQUE COMPENSATOR / Fixed mass inertia	±300.00%	0.00%	**507**
	16.6.9	TORQUE COMPENSATOR / Variable mass inertia	±300.00%	0.00%	**508**
	16.6.10	TORQUE COMPENSATOR / Material width	0.00 – 200.00%	100.00%	**509**
	16.6.11	TORQUE COMPENSATOR / Accel line speed input	±105.00%	0.00%	**510**
	16.6.12	TORQUE COMPENSATOR / Accel scaler	±100.00	10.00	**511**

PIN TABLE FOR APPLICATION BLOCKS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	16.6.13	TORQUE COMPENSATOR / Accel input/mon	0.00 – 105.00%	0.00%	**512**
	16.6.14	TORQUE COMPENSATOR / Accel filter time constant	0.00 – 200.00 s	0.10 s	**513**
	16.6.15	TORQUE COMPENSATOR / Tension demand IP	±100.00%	0.00%	**514**
	16.6.16	TORQUE COMPENSATOR / Tension scaler	±3.0000	1.0000	**515**
	16.6.17	TORQUE COMPENSATOR / Torque memory select enable	0 : DISABLED 1 : ENABLED	0	**516**
	16.6.18	TORQUE COMPENSATOR / Torque memory input	±300.00%	0.00%	**517**
	16.6.19	TORQUE COMPENSATOR / Tension enable	0 : DISABLED 1 : ENABLED	1	**518**
	16.6.20	TORQUE COMPENSATOR / Overwind/ underwind	0 : DISABLED 1 : ENABLED	1	**519**
	16.6.21	TORQUE COMPENSATOR / Inertia comp monitor	±300.00%	0.00%	**520**
		Reserved			**521**
		Reserved			**522**
	16.8.1	PRESET SPEED / Preset speed output monitor	±300.00%	0.00%	**523**
	16.8.2	PRESET SPEED / Digital input 1 LSB	0 : LOW 1 : HIGH	0	**524**
	16.8.2	PRESET SPEED / Digital input 2	0 : LOW 1 : HIGH	0	**525**
	16.8.2	PRESET SPEED / Digital input 3 MSB	0 : LOW 1 : HIGH	0	**526**
	16.8.5	PRESET SPEED / Value for 000	±300.00%	0.00%	**527**
	16.8.5	PRESET SPEED / Value for 001	±300.00%	0.00%	**528**
	16.8.5	PRESET SPEED / Value for 010	±300.00%	0.00%	**529**
	16.8.5	PRESET SPEED / Value for 011	±300.00%	0.00%	**530**
	16.8.5	PRESET SPEED / Value for 100	±300.00%	0.00%	**531**
	16.8.5	PRESET SPEED / Value for 101	±300.00%	0.00%	**532**
	16.8.5	PRESET SPEED / Value for 110	±300.00%	0.00%	**533**
	16.8.5	PRESET SPEED / Value for 111	±300.00%	0.00%	**534**
	16.16	16-BIT DEMULTIPLEX (bits 1-9) Armature overcurrent 535, Speed fbk mismatch 536, Overspeed 537, Armature overvolts 538, Field overcurrent 539, Field loss 540, Missing pulse 541, Stall trip 542, Thermistor on T30 543	0 : LOW 1 : HIGH	0	**535 to 543**
	16.9.1	MULTI-FUNCTION 1 Function mode 1	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**544**
	16.9.2	MULTI-FUNCTION 1 Output select 1	0 : DISABLED 1 : ENABLED	0	**545**
	16.9.1	MULTI-FUNCTION 2 Function mode 2	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**546**
	16.9.2	MULTI-FUNCTION 2 Output select 2	0 : DISABLED 1 : ENABLED	0	**547**

PIN TABLE FOR APPLICATION BLOCKS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	16.9.1	MULTI-FUNCTION 3 Function mode 3	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**548**
	16.9.2	MULTI-FUNCTION 3 Output select 3	0 : DISABLED 1 : ENABLED	0	**549**
	16.9.1	MULTI-FUNCTION 4 Function mode 4 PIN 550	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**550**
	16.9.2	MULTI-FUNCTION 4 Output select 4 PIN 551	0 : DISABLED 1 : ENABLED	0	**551**
	16.9.1	MULTI-FUNCTION 5 Function mode 5 PIN 552	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**552**
	16.9.2	MULTI-FUNCTION 5 Output select 5 PIN 553	0 : DISABLED 1 : ENABLED	0	**553**
	16.9.1	MULTI-FUNCTION 6 Function mode 6 PIN 554	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**554**
	16.9.2	MULTI-FUNCTION 6 Output select 6 PIN 555	0 : DISABLED 1 : ENABLED	0	**555**
	16.9.1	MULTI-FUNCTION 7 Function mode 7 PIN 556	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**556**
	16.9.2	MULTI-FUNCTION 7 Output select 7 PIN 557	0 : DISABLED 1 : ENABLED	0	**557**
	16.9.1	MULTI-FUNCTION 8 Function mode 8 PIN 558	0 : C/O SWITCH or Jumper 1: COMPARATOR 2 : AND GATE 3 : OR GATE 4 : INVERT 5 : SIGN CHANGER 6 : RECTIFIER	0	**558**
	16.9.2	MULTI-FUNCTION 8 Output select 8 PIN 559	0 : DISABLED 1 : ENABLED	0	**559**
	16.10.1	LATCH / Latch output monitor PIN 560	±300.00%	0.00%	**560**
	16.10.2	LATCH / Latch data input PIN 561	0 : LOW 1 : HIGH	0	**561**
	16.10.3	LATCH / Latch clock input PIN 562	0 : LOW 1 : HIGH	0	**562**

PIN TABLE FOR APPLICATION BLOCKS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	16.10.4	LATCH / Latch set input PIN 563	0 : LOW 1 : HIGH	0	**563**
	16.10.5	LATCH / Latch reset input PIN 564	0 : LOW 1 : HIGH	0	**564**
	16.10.6	LATCH / Latch value for high output PIN 565	±300.00%	0.01%	**565**
	16.10.7	LATCH / Latch value for low output PIN 566	±300.00%	0.00%	**566**
	16.16	16-BIT DEMULTIPLEX (bit 10) Heatsink overtemp	0 : LOW 1 : HIGH	0	**567**
	16.11.1	FILTER 1 / Filter1 output monitor PIN 568	±315.00%	0.00%	**568**
	16.11.2	FILTER 1 / Filter1 time constant PIN 569	0.000 – 32.000 s	1.000 s	**569**
	16.16	16-BIT DEMULTIPLEX (bits 11 – 13) Short cct digital output 570, Bad reference Exch 571, Contactor lock out 572	0 : LOW 1 : HIGH	0	**570 to 572**
	16.11.1	FILTER 2 / Filter2 output monitor PIN 573	±315.00%	0.00%	**573**
	16.11.2	FILTER 2 / Filter2 time constant PIN 574	0.000 – 32.000 s	1.000 s	**574**
	16.16	16-BIT DEMULTIPLEX (bits 14-16) User Alarm input (PIN 712) 575, Synchronisation loss 576, Supply phase loss 577	0 : LOW 1 : HIGH	0	**575 to 577**
	16.12.1	BATCH COUNTER / Counter value monitor PIN 578	0 – 32000	0	**578**
	16.12.2	BATCH COUNTER / Clock input PIN 579	0 : LOW 1 : HIGH	0	**579**
	16.12.3	BATCH COUNTER / Reset enable input PIN 580	0 : LOW 1 : HIGH	0	**580**
	16.12.4	BATCH COUNTER / Counter target number PIN 581	0 – 32000	32000	**581**
	16.12.5	BATCH COUNTER / Count >= target flag PIN 582	0 : LOW 1 : HIGH	0	**582**
	16.13.1	INTERVAL TIMER / Time elapsed monitor PIN 583	0.1 – 600.0 s	0.0 s	**583**
	16.13.2	INTERVAL TIMER / Timer reset enable input PIN 584	0 : DISABLED 1 : ENABLED	0	**584**
	16.13.3	INTERVAL TIMER / Timer interval PIN 585	0.1 – 600.0 s	5.0 s	**585**
	16.13.4	INTERVAL TIMER / Timer expired flag PIN 586	0 : LOW 1 : HIGH	0	**586**
		Reserved			**587**
	16.14.1	COMPARATOR 1 / Input 1 PIN 588	±300.00%	0.00%	**588**
	16.14.2	COMPARATOR 1 / Input 2	±300.00%	0.00%	**589**
	16.14.3	COMPARATOR 1 / Window mode select	0 : DISABLED 1 : ENABLED	0	**590**
	16.14.4	COMPARATOR 1 / Hysteresis	0.00 – 10.00%	0.50%	**591**
	16.14.1	COMPARATOR 2 / Input 1	±300.00%	0.00%	**592**
	16.14.2	COMPARATOR 2 / Input 2	±300.00%	0.00%	**593**
	16.14.3	COMPARATOR 2 / Window mode select	0 : DISABLED 1 : ENABLED	0	**594**
	16.14.4	COMPARATOR 2 / Hysteresis	0.00 – 10.00%	0.50%	**595**
	16.14.1	COMPARATOR 3 / Input 1	±300.00%	0.00%	**596**
	16.14.2	COMPARATOR 3 / Input 2	±300.00%	0.00%	**597**
	16.14.3	COMPARATOR 3 / Window mode select	0 : DISABLED 1 : ENABLED	0	**598**
	16.14.4	COMPARATOR 3 / Hysteresis	0.00 – 10.00%	0.50%	**599**
	16.14.1	COMPARATOR 4 / Input 1	±300.00%	0.00%	**600**

PIN TABLE FOR APPLICATION BLOCKS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	16.14.2	COMPARATOR 4 / Input 2	±300.00%	0.00%	**601**
	16.14.3	COMPARATOR 4 / Window mode select	0 : DISABLED 1 : ENABLED	0	**602**
	16.14.4	COMPARATOR 4 / Hysteresis	0.00 – 10.00%	0.50%	**603**
	16.15.2	C/O SWITCH 1 / Control	0 : LOW 1 : HIGH	0	**604**
	16.15.3	C/O SWITCH 1 / Input HI value	±300.00%	0.01%	**605**
	16.15.4	C/O SWITCH 1 / Input LO value	±300.00%	0.00%	**606**
	16.15.2	C/O SWITCH 2 / Control	0 : LOW 1 : HIGH	0	**607**
	16.15.3	C/O SWITCH 2 / Input HI value	±300.00%	0.01%	**608**
	16.15.4	C/O SWITCH 2 / Input LO value	±300.00%	0.00%	**609**
	16.15.2	C/O SWITCH 3 / Control	0 : LOW 1 : HIGH	0	**610**
	16.15.3	C/O SWITCH 3 / Input HI value	±300.00%	0.01%	**611**
	16.15.4	C/O SWITCH 3 / Input LO value	±300.00%	0.00%	**612**
	16.15.2	C/O SWITCH 4 / Control	0 : LOW 1 : HIGH	0	**613**
	16.15.3	C/O SWITCH 4 / Input HI value	±300.00%	0.01%	**614**
	16.15.4	C/O SWITCH 4 / Input LO value	±300.00%	0.00%	**615**

18.7 DRIVE PERSONALITY: 677 – 680

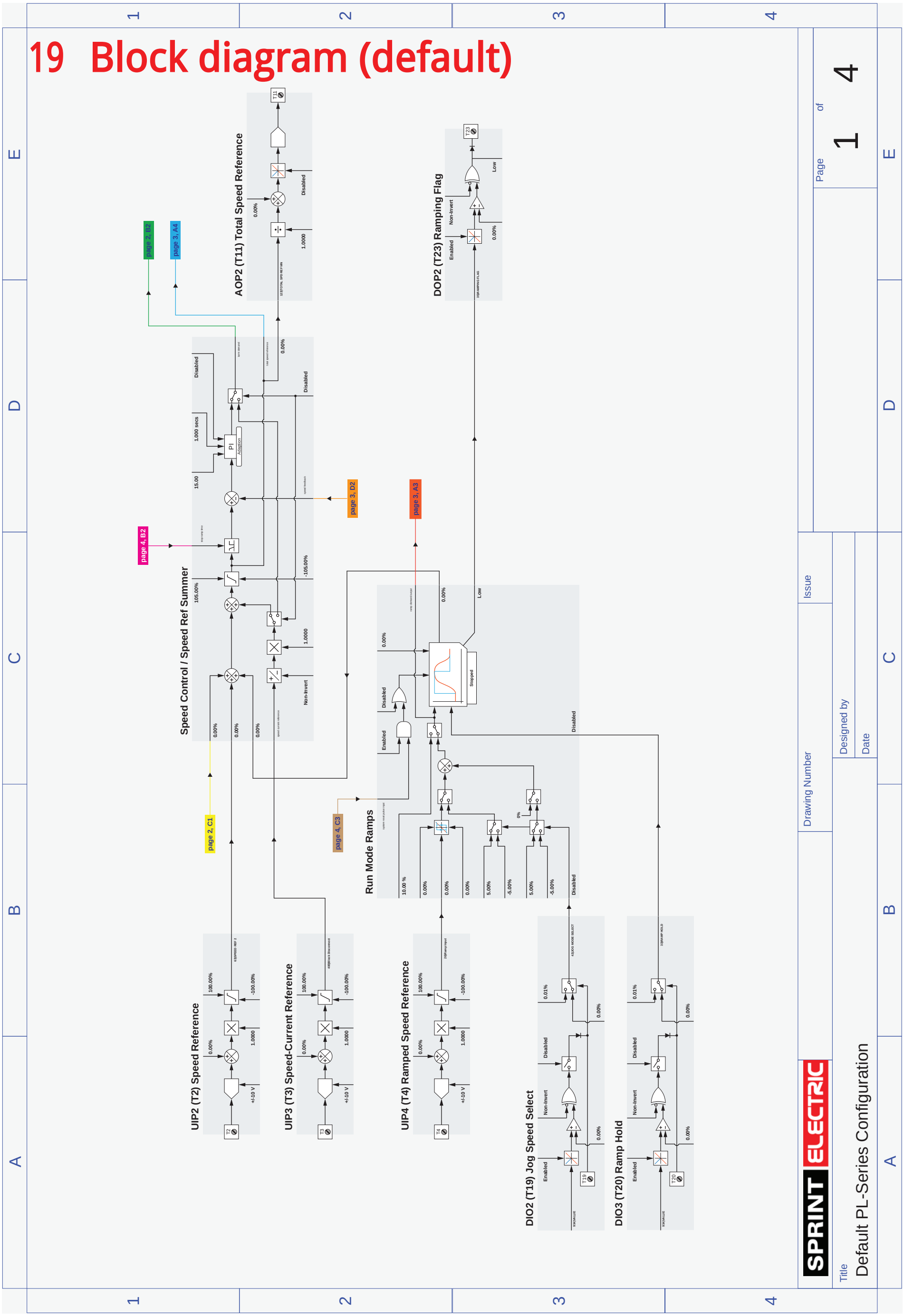
PIN TABLE FOR DRIVE PERSONALITY Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST					
Property	**Paragraph number**	**Menu / Description**	**Range**	**Default Value**	**PIN**
	17.19.1	DRIVE PERSONALITY / Recipe page	0 : NORMAL RESET 1 : 2-KEY RESET 2 : 3-KEY RESET 3 : 4-KEY RESET	0	677
S	**17.19.2**	DRIVE PERSONALITY / Max current response	0 : DISABLED 1 : ENABLED	0	678
	17.19	DRIVE PERSONALITY / ID ABCXRxxx MON	Binary value	By model	679
P	**17.19.3**	DRIVE PERSONALITY / Iarm BURDEN OHMS	0.00 to 320.00	By model	680

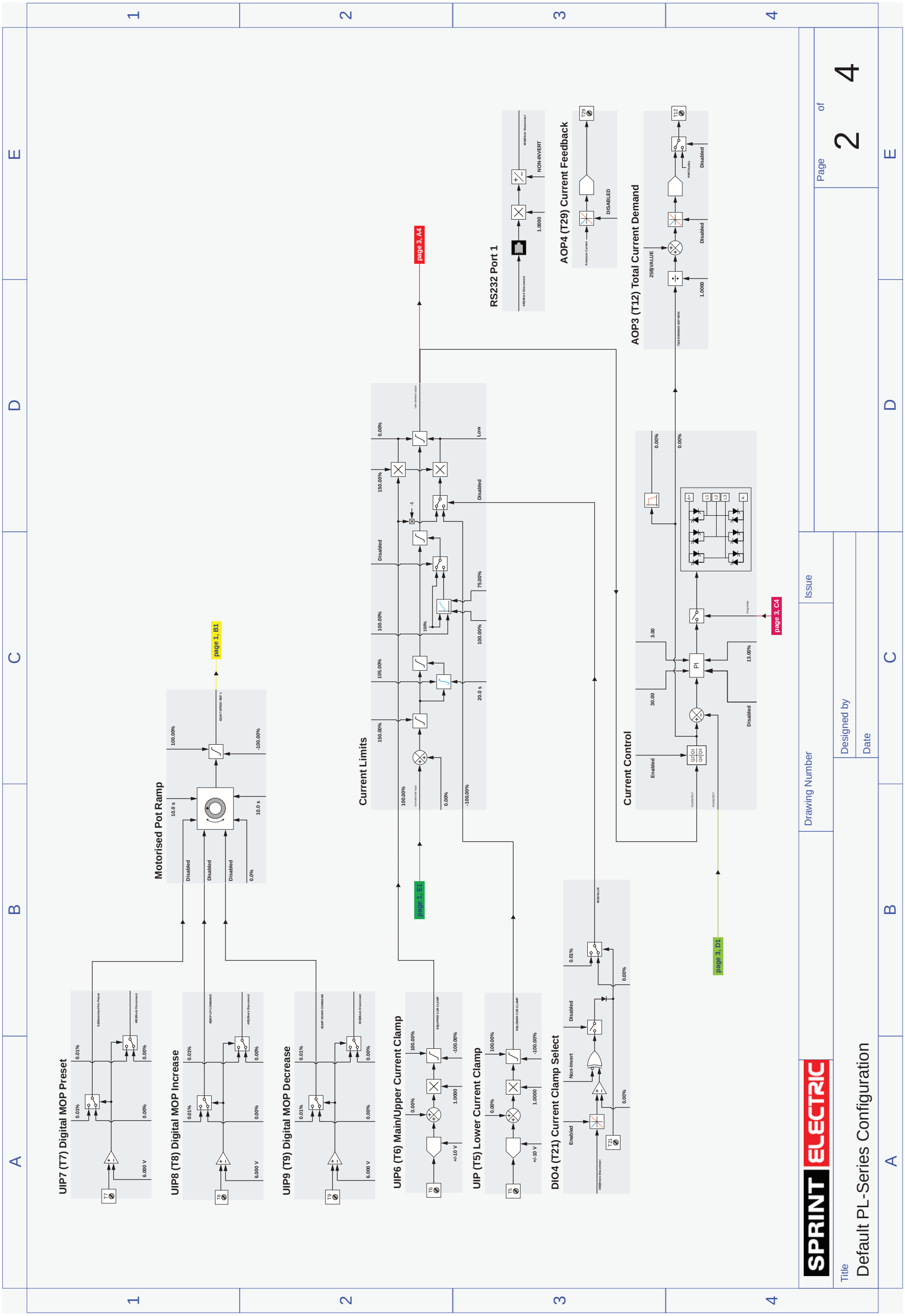
18.8 Hidden pins: 681 – 720

PIN TABLE FOR HIDDEN PINS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST				
Paragraph number	**Menu / Description**	**Range**	**Default Value**	**PIN**
10.7.1	POWER SAVED ONCE MON	0 : LOW 1 : HIGH	0	681
17.13.4.1	DOP1 O/P BIN VAL	0 : LOW 1 : HIGH	0	682
17.13.4.1	DOP2 O/P BIN VAL	0 : LOW 1 : HIGH	0	683
17.13.4.1	DOP3 O/P BIN VAL	0 : LOW 1 : HIGH	0	684
17.11.9	DIO1 O/P BIN VAL	0 : LOW 1 : HIGH	0	685
17.11.9	DIO2 O/P BIN VAL	0 : LOW 1 : HIGH	0	686
17.11.9	DIO3 O/P BIN VAL	0 : LOW 1 : HIGH	0	687
17.11.9	DIO4 O/P BIN VAL	0 : LOW 1 : HIGH	0	688
11.4	IN JOG FLAG / In Jog mode process flag	0 : LOW 1 : HIGH	0	689
16.4.10	WEB BREAK FLAG	0 : LOW 1 : HIGH	0	690
16.1	SUM1 CH2 SUBTOT / Summer1 Ch2 subtotal monitor	±200.00%	0.00%	691
16.1	SUM1 CH1 SUBTOT / Summer1 Ch1 subtotal monitor	±200.00%	0.00%	692
16.1	SUM2 CH2 SUBTOT / Summer2 Ch2 subtotal monitor	±200.00%	0.00%	693
16.1	SUM2 CH1 SUBTOT / Summer2 Ch1 subtotal monitor	±200.00%	0.00%	694
16.4	WEB SPEED RECT.	0.00 – 105.00%	0.00%	695
16.4	REEL SPEED RECT.	0.00 – 105.00%	0.00%	696
16.4	UNFILTERED DIAMETER	0.00 – 100.00%	0.00%	697
11.6	HEALTHY FLAG / Healthy flag output	0 : LOW 1 : HIGH	0	698
11.6	READY FLAG / Ready flag output	0 : LOW 1 : HIGH	0	699
	STALL WARNING / Stall warning	0 : LOW 1 : HIGH	0	700
	REF XC WARNING / Reference exchange error warning	0 : LOW 1 : HIGH	0	701
	THERMISTOR WARN / Thermistor overtemp warning	0 : LOW 1 : HIGH	0	702
	SPEED FBK WARN / Speed feedback mismatch warning	0 : LOW 1 : HIGH	0	703
	I LOOP OFF WARN / Current loop off warning	0 : LOW 1 : HIGH	0	704
16.11	LP FILTER INPUT / Low pass filter input	±300.00%	0.00%	705
16.11	LP FILTER OUTPUT / Low pass filter output	±300.00%	0.00%	706
11.10.6	AUTOTUNE MONITOR / Autotune in progress flag	0 : LOW 1 : HIGH	0	707
	REMOTE PARAM RCV / Remote receive input	0 : LOW 1 : HIGH	0	708
11.2.3	MOTOR RPM % /Encoder RPM % mon (scaled by 12)MOT/ ENC ratio)	±300.00%	0.00%	709
11.16	POSITION COUNT / Running position counter	0 – 65535	0	710
11.16	POS CNT DIVIDER / Position count divider input	1 – 30000	1	711

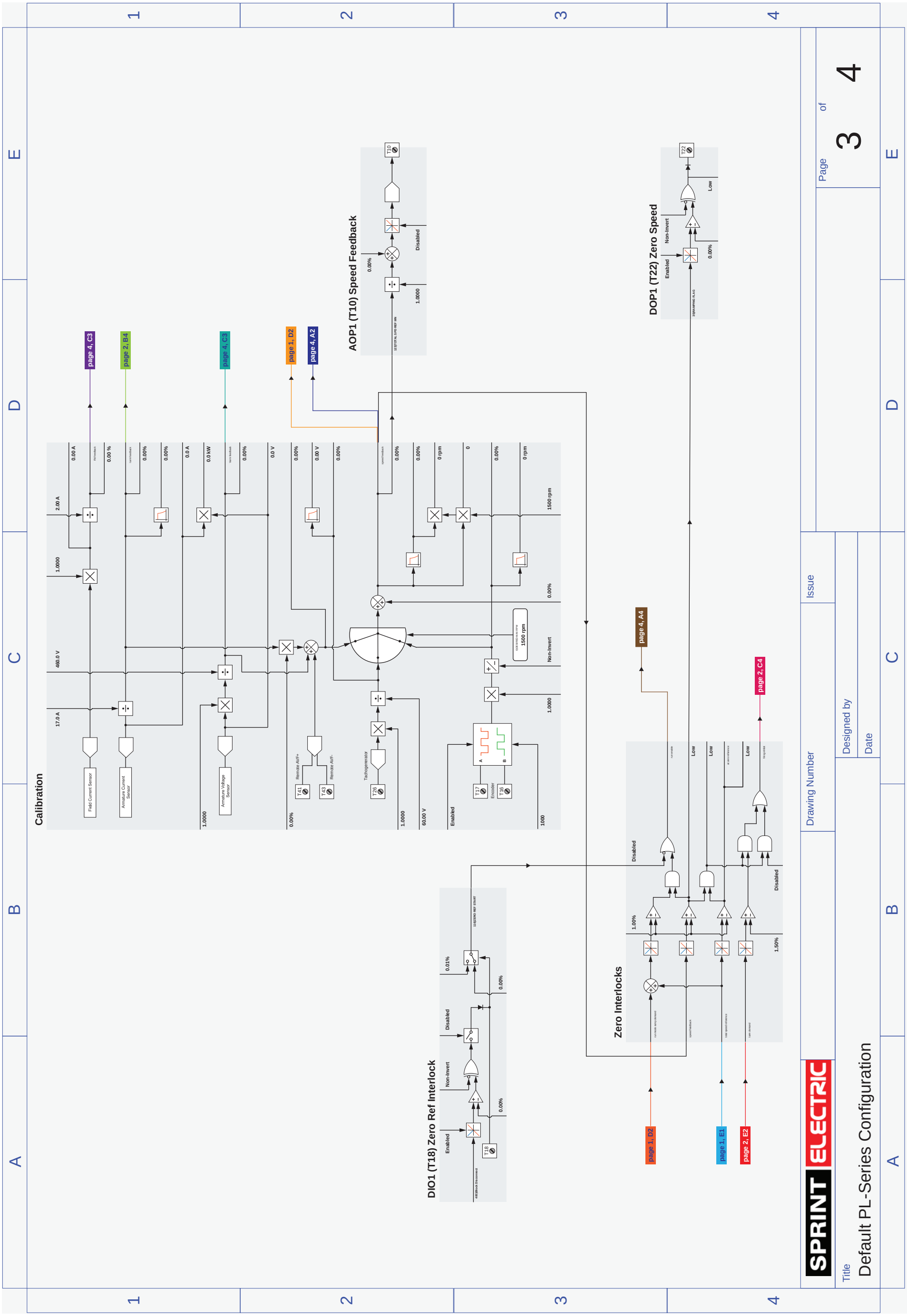
PIN TABLE FOR HIDDEN PINS Key to Properties: R = in REDUCED MENU, P = Not changed by 4-key reset, S = STOP DRIVE TO ADJUST				
Paragraph number	**Menu / Description**	**Range**	**Default Value**	**PIN**
13.1	USER ALARM INPUT	0 : LOW 1 : HIGH	0	712
11.8	SPEED LOOP PI OP / Speed loop PI output monitor	±200.00%	0.00%	713
11.4	IN SLACK FLAG / In Slack mode process flag	0 : LOW 1 : HIGH	0	714
12.2.10	SPD FBK % UNF/ Unfiltered total speed feedback % mon	±300.00%	0.00%	715
12.2.7	TACHO % UNF / Unfiltered analog tacho % mon	±300.00%	0.00%	716
12.2.8	MOTOR RPM UNF / Unfiltered motor RPM monitor	±6000	0	717
12.3.1	CUR DEMAND UNF / Unfiltered current demand monitor	±150.00%	0.00%	718
12.3.2	CUR FBK % UNF / Unfiltered current feedback % monitor	±150.00%	0.00%	719
11.3.9	SYSTEM RESET / System reset pulse output	0 : LOW 1 : HIGH	0	720

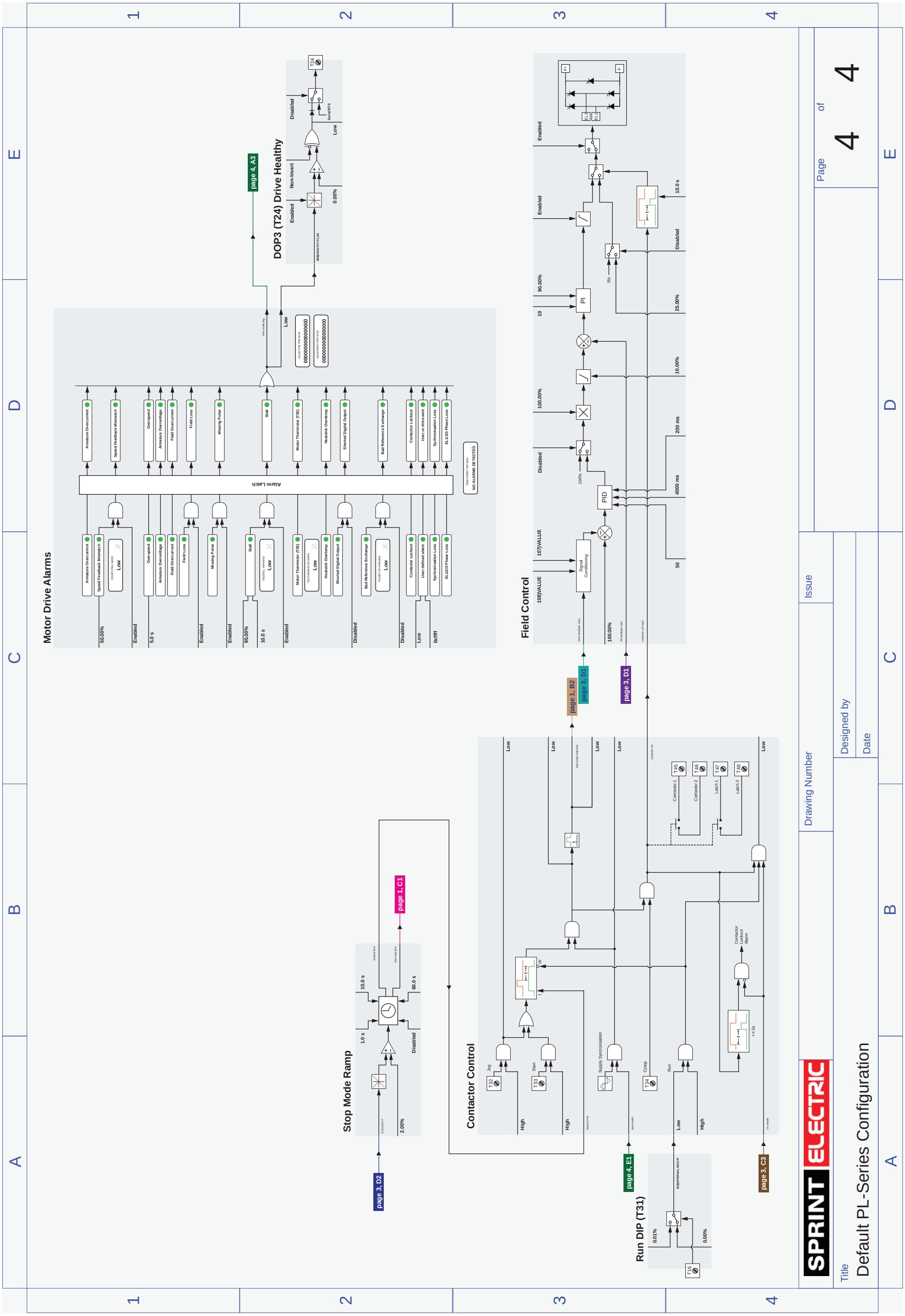
19 Block diagram (default)





UIP7 (T7) Digital MOP Preset
UIP8 (T8) Digital MOP Increase
UIP9 (T9) Digital MOP Decrease
Motorised Pot Ramp
page 1, B1
UIP6 (T6) Main/Upper Current Clamp
UIP (T5) Lower Current Clamp
DIO4 (T21) Current Clamp Select
page 1, E1
Current Limits
page 3, A4
page 3, D1
Current Control
page 3, C4
RS232 Port 1
AOP4 (T29) Current Feedback
AOP3 (T12) Total Current Demand
SPRINT ELECTRIC
Title
Default PL-Series Configuration
Drawing Number
Designed by
Date
Issue
Page
2
of
4


Calibration
AOP1 (T10) Speed Feedback
DOP1 (T22) Zero Speed
Zero Interlocks
DIO1 (T18) Zero Ref Interlock
Field Current Sensor
Armature Current Sensor
Armature Voltage Sensor
Tachogenerator
Encoder
page 4, C3
page 2, B4
page 4, C3
page 1, D2
page 4, A2
page 4, A4
page 2, C4
page 1, D2
page 1, E1
page 2, E2
SPRINT ELECTRIC
Title
Default PL-Series Configuration
Drawing Number
Issue
Designed by
Date
Page
3
of
4


Motor Drive Alarms
Alarm Latch
DOP3 (T24) Drive Healthy
Field Control
Stop Mode Ramp
Contactor Control
Run DIP (T31)
SPRINT ELECTRIC
Title
Default PL-Series Configuration
Drawing Number
Designed by
Date
Issue
Page 4 of 4

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