



User Guide

Duty Assist



Software for
Unidrive-SP

Part Number: SSP-3200-0030

Issue Number: 2

Safety Information

Persons supervising and performing the electrical installation or maintenance of a Drive and/or an external Option Unit must be suitably qualified and competent in these duties. They should be given the opportunity to study and if necessary to discuss this User Guide before work is started.

The voltages present in the Drive and external Option Units are capable of inflicting a severe electric shock and may be lethal. The Stop function of the Drive does not remove dangerous voltages from the terminals of the Drive and external Option Unit. Mains supplies should be removed before any servicing work is performed.

The installation instructions should be adhered to. Any questions or doubt should be referred to the supplier of the equipment. It is the responsibility of the owner or user to ensure that the installation of the Drive and external Option Unit, and the way in which they are operated and maintained complies with the requirements of the Health and Safety at Work Act in the United Kingdom and applicable legislation and regulations and codes of practice in the UK or elsewhere.

The Drive software may incorporate an optional Auto-start facility. In order to prevent the risk of injury to personnel working on or near the motor or its driven equipment and to prevent potential damage to equipment, users and operators, all necessary precautions must be taken if operating the Drive in this mode.

The Stop and Start inputs of the Drive should not be relied upon to ensure safety of personnel. If a safety hazard could exist from unexpected starting of the Drive, an interlock should be installed to prevent the motor being inadvertently started.

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive (Drive) with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of this guide, without notice.

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1 Introduction

1.1 Who Should Read This Manual?

This manual is intended to assist the engineer in commissioning the application software, and should be read in conjunction with the documentation that is supplied with the drive and other associated hardware. The safety systems that are required to prevent risk of injury to persons operating or maintaining the machine are not discussed in this manual. The engineer must be familiar with and able to implement the required safety systems. This manual assumes that the engineer is familiar with relevant Control Techniques products and understands the requirements for the application.

If you do not feel confident of the above, then you should contact your local Control Techniques drive centre or distributor to obtain service / advice.

1.2 Application Overview

The Duty Assist control is an effective method of controlling multiple pumps or fans in parallel, to maintain the required process demand.

Pumps and fans are often used in parallel banks to:

- Avoid motor Overload
- Guaranteed security of supply (system redundancy)
- Reduce running cost due to system load cycles
- Provide wide range of control & flexibility

The system consists of a 'Duty' Unidrive-SP and assist starters. The assist starters can be of any type, (e.g. D.O.L, Star-Delta, Auto-Transformer, Soft Starter or Inverter); the choice is dependant on the system limits.

The Duty drive can control one dedicated motor ('Fixed Duty'), or with additional external switchgear could be selected to control other motors within the parallel configuration (Flexible Duty).

The Duty is controlled by a PID loop which will maintain the process level required, if the demand exceeds the capacity that can be derived from the Duty, then an Assist starter will be enabled to assist with the delivery. If the demand continues to increase additional starters will be called. When the demand decreases, then each assist starter will be deselected to reduce the delivery to the required demand.

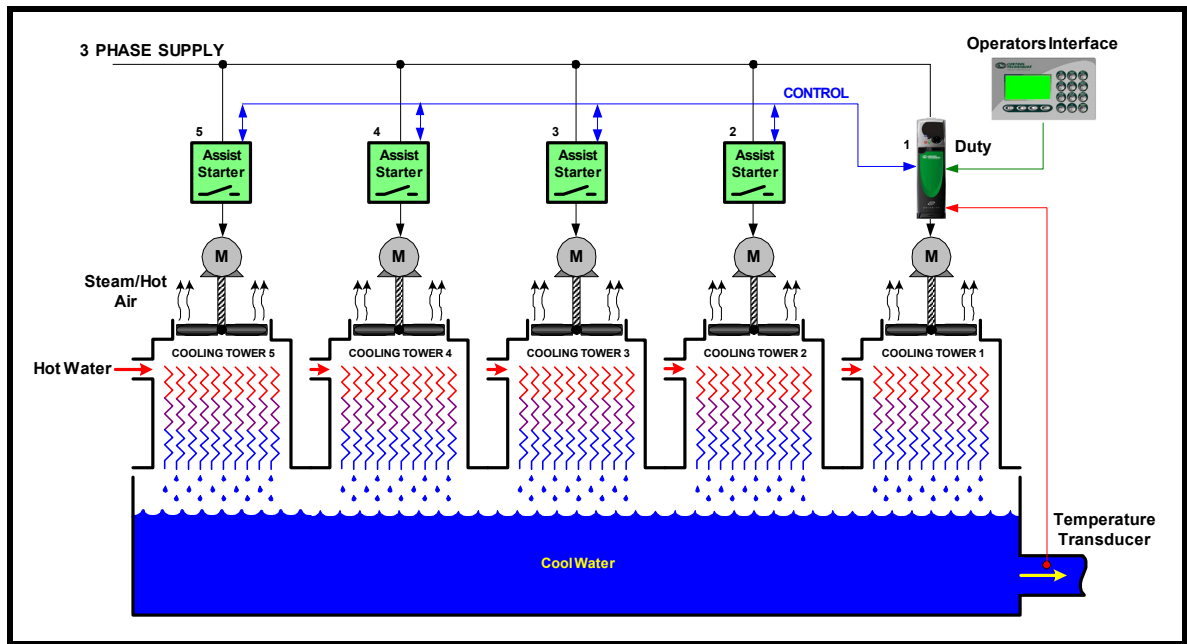
Typically in a parallel bank of four, it is usual to find three running and one standby. The Duty assist can control up to 4 assist starters with a 'Fixed Duty', and 3 assist starters with a 'Flexible Duty' selection.

One SM Applications Module, located within the Duty Unidrive-SP achieves all the system control. The standard and optional I/O on the drive provides the I/O interfacing to the other starters and the process.

Typical processes that can be controlled with parallel configurations using the Duty Assist software are:

1. Pressure
2. Flow
3. Temperature
4. Tank/reservoir level
5. Sewage aeration

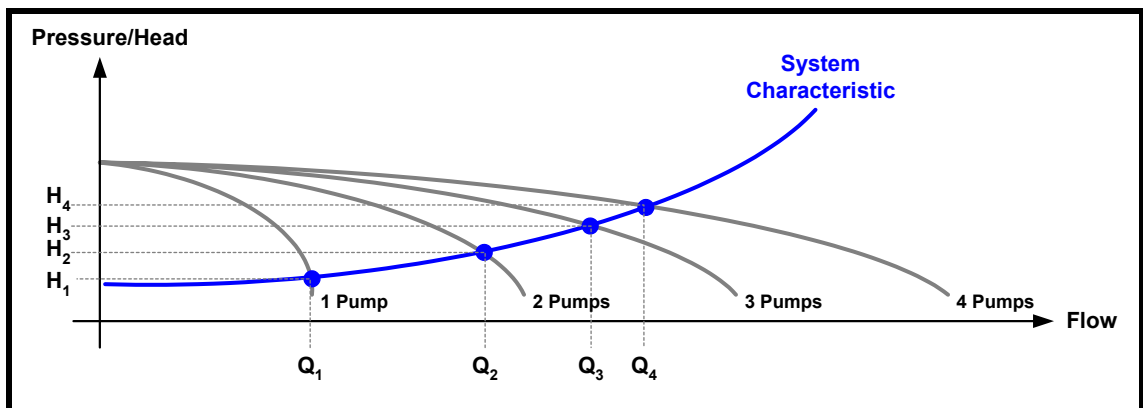
Typical configuration for controlling Cooling Towers in temperature control



1.2.1 Parallel Operation of Fans or Pumps

Contrary to commonly held beliefs, the flow does not double on addition of a second similar pump/fan in parallel. In fact each successive pump or fan adds a smaller amount to the total system pressure and flow, although the total flow is split equally between each pump/fan.

Typical System Curves for parallel pump/fan operation



1.2.2 Features

- Fixed Duty Motor - up to 4 Assist starters can be controlled
- Flexible Duty Selection - up to 3 Assist starters can be controlled.
- Assist or Duty selection can be by Runtime or by a set sequence.
- Automatic reselection if the requested assist fails to start.
- Local/Remote; Digital control selection from the Unidrive-SP terminal I/O or via fieldbus
- Standalone or system configurable
- Set points and feedbacks can be derived as direct analog signals or by fieldbus.
- Process High and Low trip thresholds, (selectable).
- Inverse Speed characteristic, (selectable).
- No Flow Protection, (selectable).
- Wake/Sleep, energy save function, (selectable).
- Dynamic V/F, energy save function, (selectable).
- Cascade System Stop, (selectable).
- Two selectable preset process set points for day/night control with external clock. (Standard feature when CTIU is used with real time clock function).
- Auto-changeover to ensure starters is not continually running for long periods of time, (selectable).
- Assists Number of starts per Hour protection, (selectable).
- Assist Override to react to peak demands, (selectable).
- All data set up in Real Engineering Units.
- Optional Fieldbus Interfaces: Profibus-DP, Interbus, DeviceNet, Modbus, CNet, CANopen & CAN.
- CTIU110 operator Interface compatible.

2 Mechanical Installation

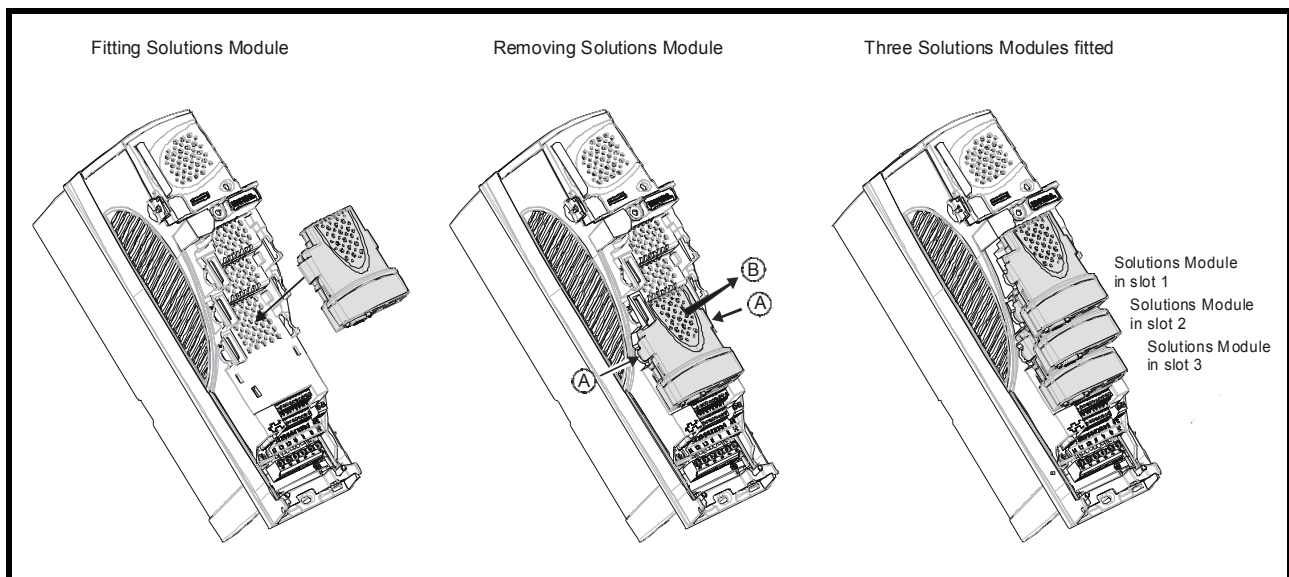
NOTE

Ensure the Unidrive-SP is correctly installed in accordance to the Unidrive-SP Installation Manual

2.1 Fitting of Option Modules

Unidrive-SP 'SM' option modules are truly universal and can be fitted to any of the 3 option slots provided on the drive. The following procedure is applicable for all the 'SM' option modules:

- Isolate the Drive from the main supply and allow 5 minutes for the DC Bus capacitors to discharge.
- To insert the SM option module, press down in the direction shown below until it clicks into place. The option module can be inserted into any of the 3 universal slots.
- To remove the SM option module, press inwards at the points shown (A) and pull in the direction shown (B).
- The Unidrive-SP must be disconnected from the mains supply before installing or removing an option module.



3 Electrical Installation

3.1 Unidrive-SP

3.1.1 Control

+24V digital supply (Terminal 22)

Supply for external digital signal devices

Voltage Tolerance:	±10%
Nominal output current:	200mA
Overload output current:	240mA
Protection:	Current fold-back above 240mA

+10V analog supply (Terminal 4)

Supply for external analog signal devices

Voltage Tolerance:	±1%
Nominal output current:	10mA
Protection:	Current limit and thermal trip

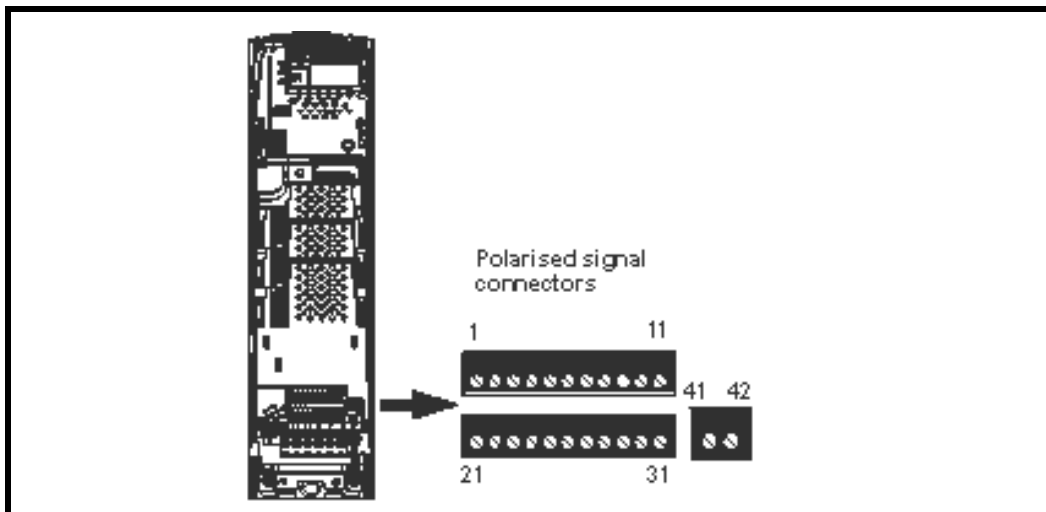
3.2 Power / Motor Connections

Please refer to the Unidrive-SP documentation for the relevant information regarding:

- Voltage Rating
- Current rating
- Motor Connections
- Encoder / Resolver Connections

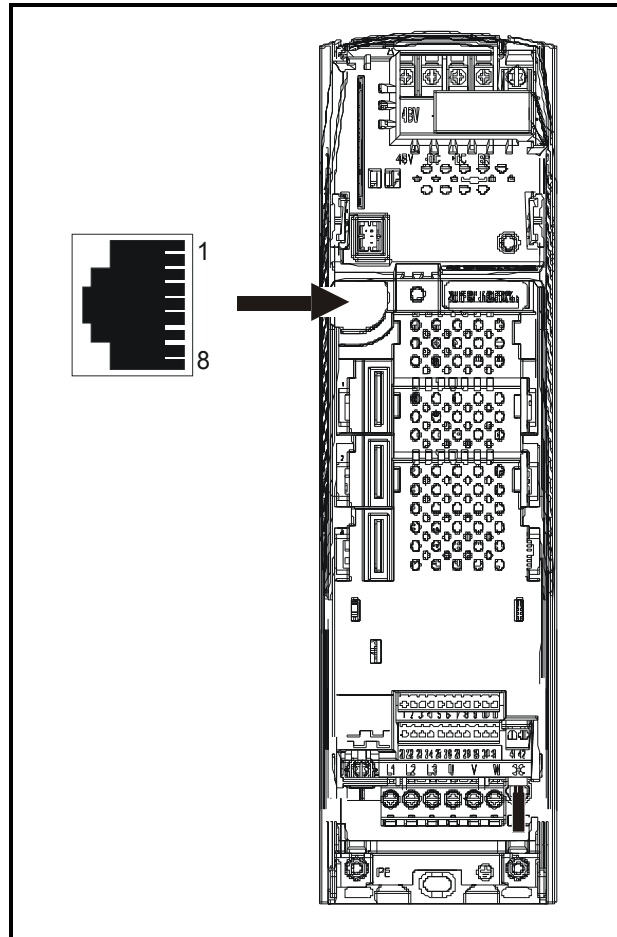
3.3 Connector Location

3.3.1 Unidrive-SP Control Terminal Connections



Term	Function
1	0V Common
2	24Vdc external Input supply
3	0v common
4	+10Vdc Analog supply
5	Analog Input 1 (Non-Inverting)
6	Analog Input 1 (Inverting)
7	Analog Input 2
8	Analog Input 3
9	Analog Output 1
10	Analog Output 1
11	0v common
21	0v common
22	24Vdc user output supply
23	0v common
24	Digital I/O 1
25	Digital I/O 2
26	Digital I/O 3
27	Digital Input 1
28	Digital Input 2
29	Digital Input 3
30	0v common
31	Drive Enable
41	Relay Output
42	

3.3.2 Unidrive-SP RS485 Port

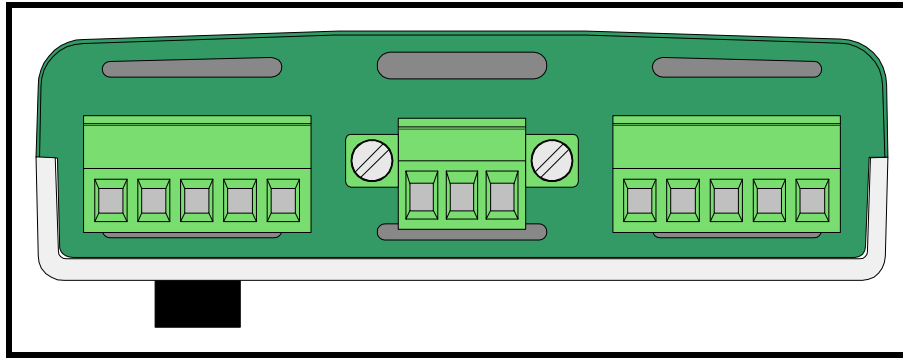


RJ45 Connector Pin out

Term	Function
1	Terminating Resistor
2	RX - TX EIA-RS485
3	0V
4	24Vdc
5	Not Used
6	Tx Enable
7	/Rx - /Tx EIA-RS485
8	Linked to Pin 7

3.3.3 Application Module Connections

The SM-Applications module has a single 17-way screw terminal block.

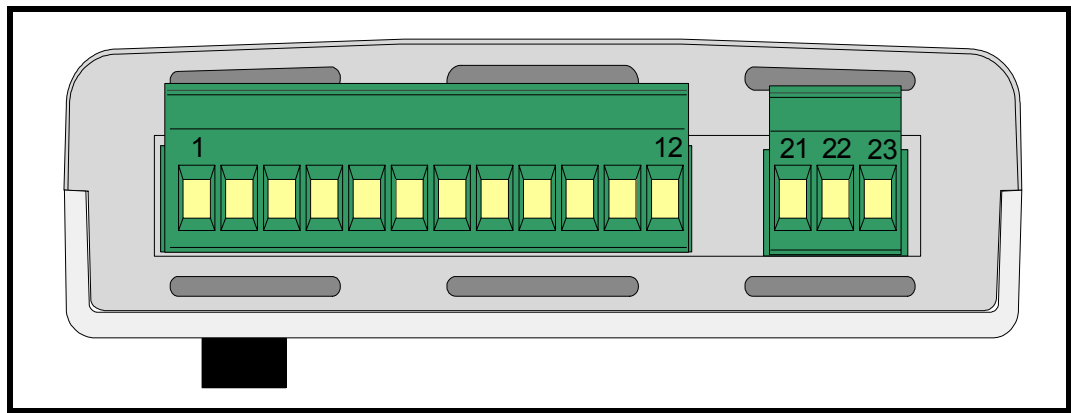


SM-Applications Module - Front View

The terminals are numbered from terminal 1 on the left hand side to terminal 13 on the right. The terminal functions are given in the table below:

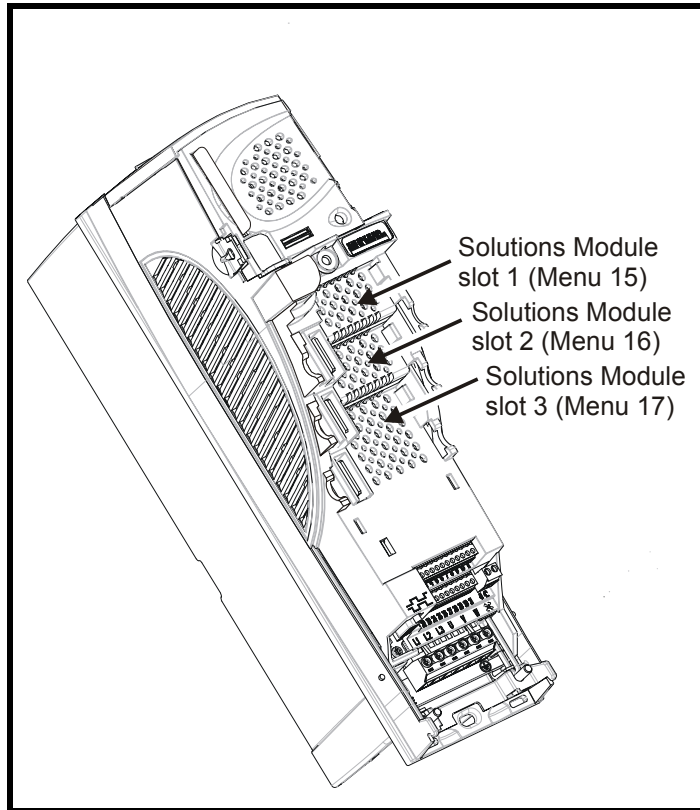
Term	Function	Description
1	0V SC	0V connection for RS485 port
2	/RX EIA-RS485	Receive line (negative). Incoming
3	RX EIA-RS485	Receive line (positive). Incoming
4	/TX EIA-RS485	Transmit line (negative). Outgoing
5	TX EIA-RS485	Transmit line (positive). Outgoing
6	CTNET+	CTNet data line (positive)
7	CTNET-	CTNet data line (negative)
8	CTNet Shield	Shield connection for CTNet
9	CTNET+	CTNet data line (positive)
10	CTNET-	CTNet data line (negative)
11	CTNet Shield	Shield connection for CTNet
12	N/C	No connection
13	0V	0V connection for digital I/O
14	DIO	Digital input 0
15	DI1	Digital input 1
16	DO0	Digital output 0
17	DO1	Digital output 1

3.3.4 Additional I/O SM Option Module



Term	Function
1	0V common (digital)
2	Digital input/output 1
3	Digital input/output 2
4	Digital input/output 3
5	0V common (digital)
6	Digital input 4
7	Digital input 5
8	Digital input 6
9	Analog input 4
10	Analog input 5
11	0V common (analog)
12	Analog output 3
21	Relay 1
22	Relay common
23	Relay 2

3.3.5 Slot Menus



3.4 Analog Set points and Feedbacks

3.4.1 Specification

Analog Inputs

Specification	Unidrive-SP I/O	Optional I/O
Type of Input	1 x Differential 1 x Single-ended	Single-ended
Max. output voltage	-10V to +10V	-10V to +10V
Input resistance	100 kohm	> 20 kohm
Absolute Maximum Input	± 13 V with respect to 0 V	± 36 V with respect to 0 V
Resolution	Differential = 12-bit plus sign Single-ended = 10-bit plus sign	10-bit plus sign
Update period	4ms	Dependant on the number of I/O option modules fitted: 8ms: 1xSM-I/O 16ms: 2xSM-I/O

Analog Outputs

Specification	Unidrive-SP I/O	Optional I/O
Type of output:	Single-ended	Single-ended
Max. output voltage:	-10V to +10V	-10V to +10V
Load resistance:	10 kohm min.	> 1 kohm
Protection:	Short-circuit proof	Short-circuit proof
Resolution:	10-bit plus sign	10-bit plus sign
Update period:	4ms	Dependant on the number of I/O option modules fitted: 8ms: 1xSM-I/O 16ms: 2xSM-I/O

3.4.2 Analog Signal Types

UNDRIVE-SP ANALOG INPUTS

The Unidrive-SP analog inputs can accept current or voltage signals as tabulated below:

Number	Parameter Mnemonic	Signal Type
0	0 - 20	0 – 20mA
1	20 - 0	20 – 0mA
2	4-20.tr	4 – 20mA (Trip on <3mA)
3	20-4.tr	20 – 4mA (Trip on loss <3mA)
4	4-20	4 – 20mA (No trip on loss)
5	20-4	20 – 4mA (No trip on loss)
6	VOLt	+/- 10V input
7	th.SC	Motor Thermistor with trip on short circuit detection*
8	th	Motor Thermistor without short circuit detection*
9	Th.diSp	Thermistor mode with display only and no trip

The above are configured by the following parameters:

07.11 – Analog Input 2, Terminal 7

07.15 – Analog Input 3, Terminal 8

The Unidrive-SP Analog Outputs can derive current or voltage signals as tabulated below.

To maintain maximum flexibility no specific assignments of analog inputs are provided. Possible input signals may include Tension Set Point, dancer/tension roll feedback, diameter and line speed.

All these signals are available and can re-directed to the required analog input parameter.

UNDRIVE ANALOG OUTPUTS

Number	Parameter Mnemonic	Signal Type
0	VOLt	Output range $\pm 10V$.
1	0 – 20	Output range 0 - 20 mA.
2	4 – 20	Output range 4 - 20 mA.
3	HSPd	High speed up date mode

The above are configured by the following parameters:

07.21 – Analog Output 1, Terminal 9

07.24 – Analog Output 2, Terminal 10

Again, to maintain maximum flexibility, no specific assignments of analog outputs are provided. Possible output signals may include Final Tension Set Point for use with an Electronic to Pneumatic transducer to control dancer roll loading. Actual Tension as measured by a load cell or simply winder speed and torque.

All these signals are available and can re-directed to the required analog output terminal.

OTHER INDUSTRIAL SIGNALS

Interfacing to the Unidrive-SP analog inputs with other industrial feedback sources, like resistive sensing PT100, Thermocouples, etc an external signal converter is required.

3.4.3 Unidrive-SP Analog I/O Allocation

The **Default** analog I/O signals are allocated as tabulated below:

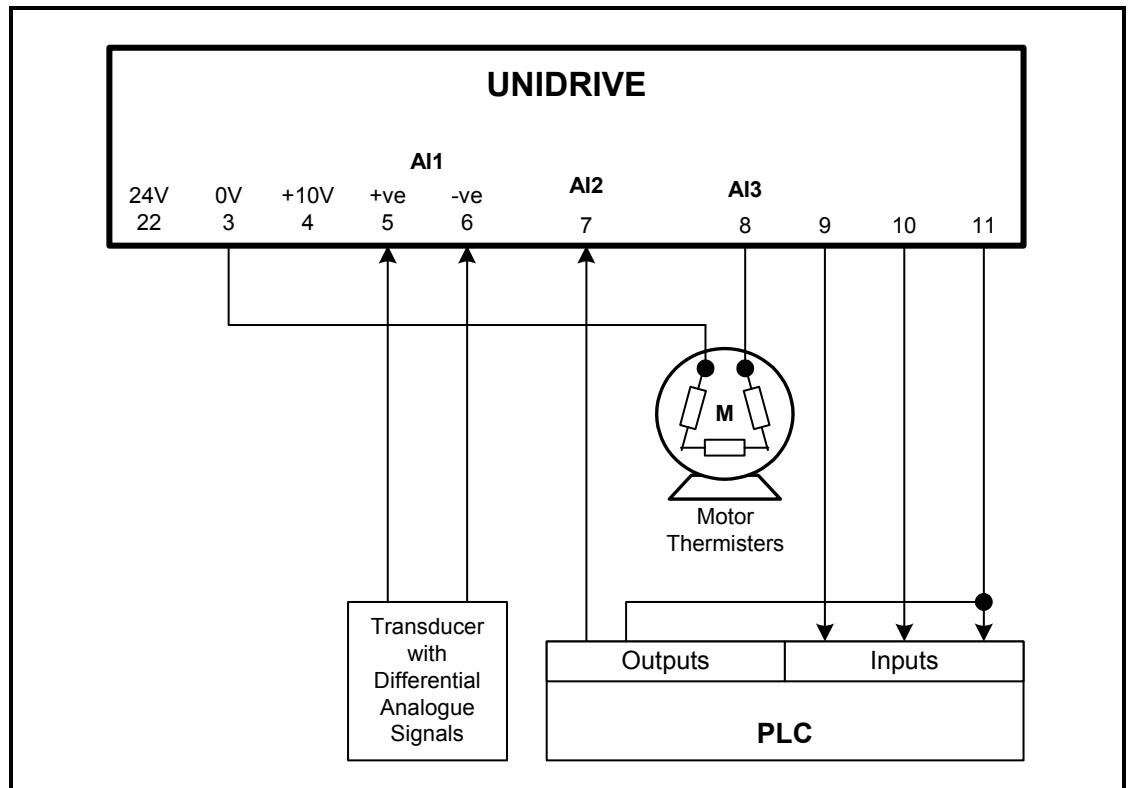
UNIDRIVE-SP STANDARD ANALOG I/O					
No	Description	Term No.	I/O	Res.	Type
AI1	Process Feedback	5&6	Input	12bit+sign	Diff
AI2	Process/Speed Set point	7	Input	10bit+sign	SE
AI3	Thermister Protection	8	Input	10bit+sign	SE
	0v	3	-	-	-
	+10Vdc	4	-	-	-
A01	Motor Frequency		Output	10bit+sign	SE
A02	Process Feedback		Output	10bit+sign	SE
-	0v	11	-	-	-

NOTE SE – Denotes Single Ended: Diff – Denotes Differential Signal.

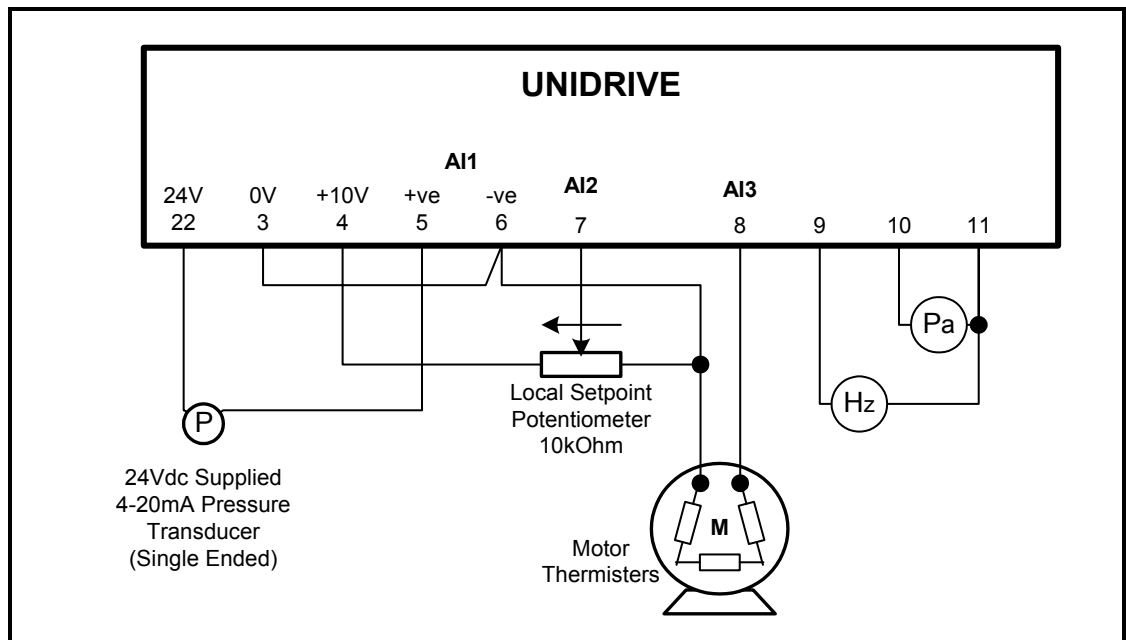
UNIDRIVE-SP ADDITIONAL I/O OPTION					
No	Description	Term No.	I/O	Res.	Type
AI4	Speed analog Ref.1 (N/A for application)	51	Input	10bit+sign	Diff
AI5	Speed analog Ref.2 (N/A for application)	52	Input	10bit+sign	SE
A03	Motor Current	54	Output	10bit+sign	SE
-	0v	53, 55	-	-	-

3.4.4 Typical Analog Set-point & Feedback Connection Diagram

Example 1 (with differential voltage Feedback signal)



Example 2 (with single-ended current Feedback signal)



3.5 Digital I/O

3.5.1 Specification

Digital Input/Outputs

Specification	Unidrive-SP I/O	Optional I/O
Type of Input/output	Positive or negative logic digital inputs or negative logic push-pull or open collector outputs. Complies with IEC1131(positive logic only).	Positive or negative logic digital inputs or positive logic only digital outputs. Complies with IEC1131(positive logic only).
Voltage range	- 0V to +24V	- 0V to +24V
Absolute max. Voltage range	-3V to +30V	-3V to +30V
Input current @ +24V	>2mA @ 15Vdc	>2mA @ 15Vdc
Output current	200mA	250mA
Overload	240mA	500mA
Update period	4ms	Dependant on the number of I/O option modules fitted: 8ms: 1xSM-I/O 16ms: 2xSM-I/O

Digital Inputs

Specification	Unidrive-SP I/O	Optional I/O
Type of Input	Negative or Positive logic	Negative logic
Voltage range	- 0V to +24V	- 0V to +24V
Absolute max. Voltage range:	-15V to +30V	-15V to +30V
Input current @ +24V	>2mA @ 15Vdc	>2mA @ 15Vdc
Update period	4ms	Dependant on the number of I/O option modules fitted: 8ms: 1xSM-I/O 16ms: 2xSM-I/O

Relay Outputs

Specification	Unidrive-SP I/O	Optional I/O
Contact Voltage Rating	240Vac, insulation cat.2	250Vac
Max Current	5A Resistive	2A AC 240V 4A DC 30V resistive load
Contact minimum recommended rating	12V 100mA	12V 100mA
Update period	4mS	Dependant on the number of I/O option modules fitted: 8ms: 1xSM-I/O 16ms: 2xSM-I/O

3.5.2 Polarity of Logic and I/O Address Parameters

The logic polarity can be configured for 'Positive Logic (Sink)' or 'Negative Logic (Source)', where 24Vdc supply can be sourced locally from the Unidrive-SP (Terminal 22) or from an external power supply.

Positive Logic Select Parameters

Unidrive-SP Standard Digital I/O = 08.29.

Unidrive-SP Optional Digital I/O = ##.29.

Unidrive-SP

UNIDRIVE-SP STANDARD DIGITAL I/O					
Specification				Parameters	
Term No.	I/O	Ind	Output Select	Invert	Dest./ Source
41&42	Relay	08.07	-	08.17	08.27
22	24Vdc	-	-	-	-
23	0Vdc	-	-	-	-
24	I/O	08.01	08.31	08.11	08.21
25	I/O	08.02	08.32	08.12	08.22
26	I/O	08.03	08.33	08.13	08.23
27	Input	08.04	-	08.14	08.24
28	Input	08.05	-	08.15	08.25
29	Input	08.06	-	08.16	08.26
31	0v	-	-	-	-
30	Input	08.08	-	-	Enable

SM Additional I/O

UNIDRIVE-SP STANDARD DIGITAL I/O					
Specification				Parameters	
Term No.	I/O	Ind	Output Select	Invert	Dest./ Source
1	0V (digital)	-	-	-	-
2	I/O	##.09	##.31	##.11	##.21
3	I/O	##.10	##.32	##.12	##.22
4	I/O	##.03	##.33	##.13	##.23
5	0V	-	-	-	-
6	input	##.04		##.14	##.24
7	input	##.05		##.15	##.25
8	input	##.06		##.16	##.26
21	Relay 1	##.07		##.17	##.27
22	Relay com	-	-	-	-
23	Relay 2	##.08		##.18	##.28

NOTE

##. Denote the menu corresponding to the slot number where the SM option module is fitted. Refer to section Slot Menus for more details. Note
Use an external 24Vdc supply when the Unidrive-SP 24Vdc internal supply 200mA current capacity is exceeded.

3.5.3 Suppression

To help reduce magnetic transient interference, it is recommended that all contactor, relay and actuator coils are suppressed, with diodes on dc circuits, or RC configurations on ac circuit.

3.5.4 Unidrive-SP Digital I/O Allocation

There are 3 selectable digital I/O terminal allocations as follows:

Mode 0 – No Default Allocation

Parameter 19.25 = 0

This mode allows complete flexibility in defining I/O allocation. It is recommended the user consult the Unidrive-SP user manual regarding how to redefine the Digital I/O mappings.

Mode 1 – Unidrive-SP Only

Parameter 19.25 = 1

This mode only optimises the standard Unidrive-SP terminal I/O and only allows up to two external starters to be controlled.

UNIDRIVE-SP STANDARD I/O			
No	Description	Terminal	I/O
F1	Starter 1 Available	24	Input
F2	Starter 1 Running / Duty Ack.	25	Input
F3	Starter 1 Run	26	Output
F4	Starter 2 Available	27	Input
F5	Starter 2 Running / Duty Ack.	28	Input
F6	System Run	29	Input
F7	Inhibit	31	Input
F8	Starter 2 Run	41 & 42	Relay Output
	+24Vdc, 200mA Supply	22	-
	0v Supply	21, 23 & 31	-

Mode 2 – Unidrive-SP Plus additional I/O Option Module

Parameter 19.25 = 2

This mode configures the Unidrive-SP and the Additional I/O and can control up to 4 external starters.

UNIDRIVE-SP STANDARD I/O			
No	Description	Terminal	I/O
F1	Starter 1 Available	24	Input
F2	Starter 1 Running / Duty Ack.	25	Input
F3	Starter 1 Run	26	Output
F4	Starter Reset	27	Input
F5	Starter Auto Select	28	Input
F6	System Run	29	Input
F7	Inhibit	30	Input
F8	Starter 2 Run	41 & 42	Relay Output
	+24Vdc, 200mA Supply	22	-
	0v Supply	21, 23 & 31	-

NOTE Each Unidrive-SP digital output is capable of driving a maximum of 100mA.

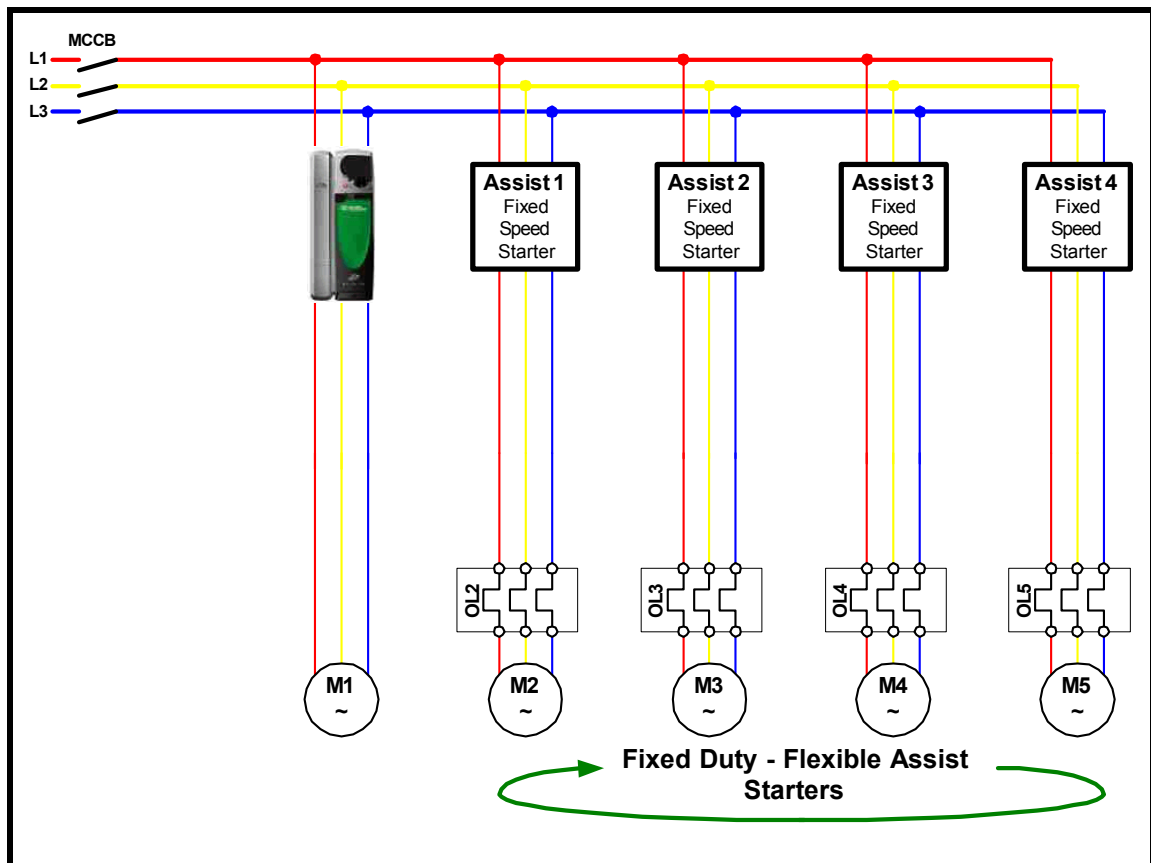
UNIDRIVE-SP ADDITIONAL I/O OPTION			
No	Description	Terminal	I/O
F9	Starter 2 Available	2	Input
F10	Starter 2 Running / Duty Ack.	3	Input
F11	Starter 3 Available	4	Input
F12	Starter 3 Running / Duty Ack.	6	Input
F13	Starter 4 Available	7	Input
F14	Starter 4 Running / Duty Ack.	8	Input
F15	Starter 3 Run	21	Relay Output
F16	Starter 4 Run	23	Relay Output
		22	Relay Com.
	0v Supply	1 & 5	-

NOTE Each Unidrive-SP digital output is capable of driving a maximum of 100mA.

NOTE The I/O module fitted in the lowest slot number will be used for the terminal default allocation for Duty assist software, where more than 1 I/O module is used.

3.6 Fixed Duty Configurations

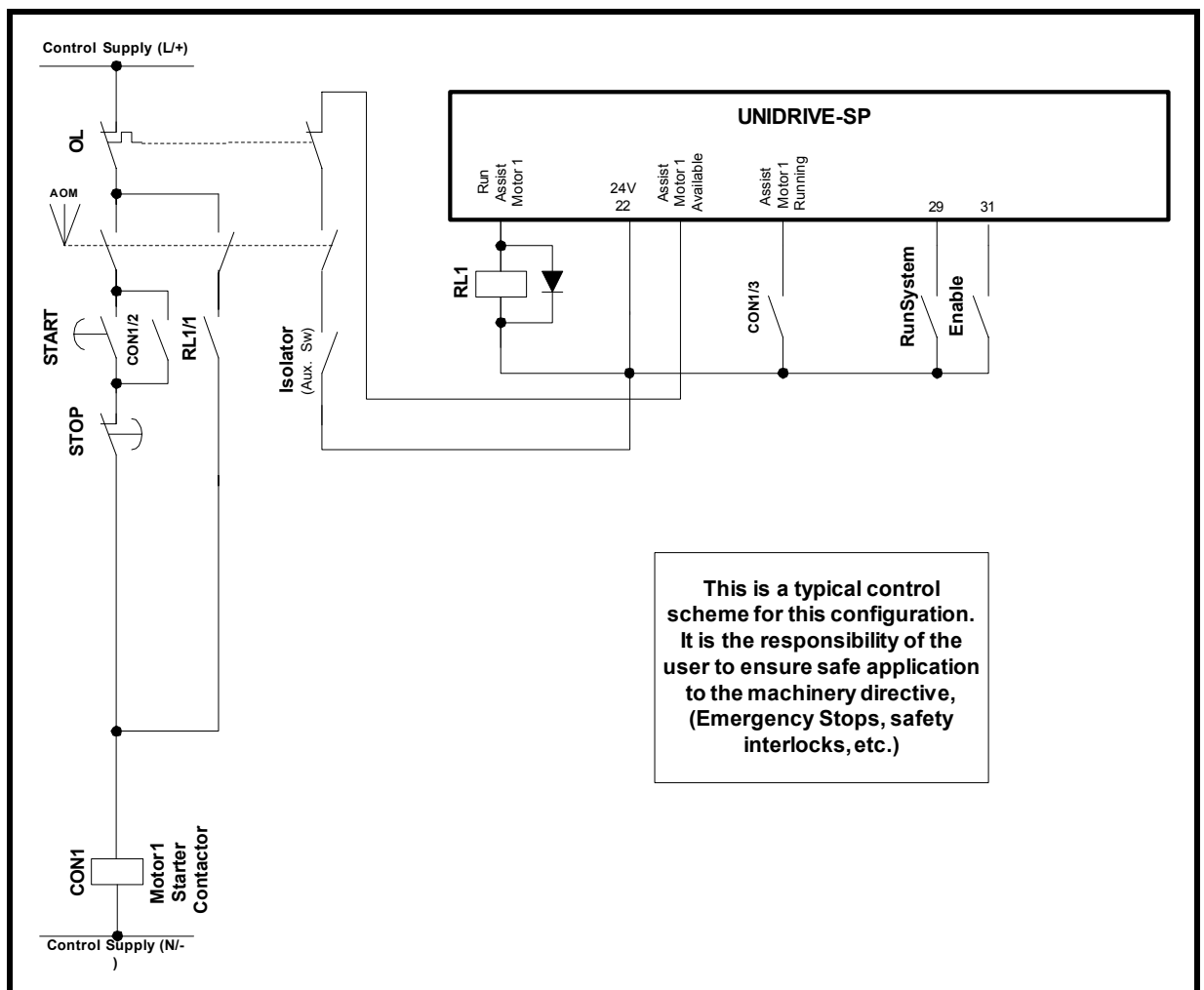
3.6.1 Power scheme



Refer to Appendix 1 at the end of the manual for more detailed information.

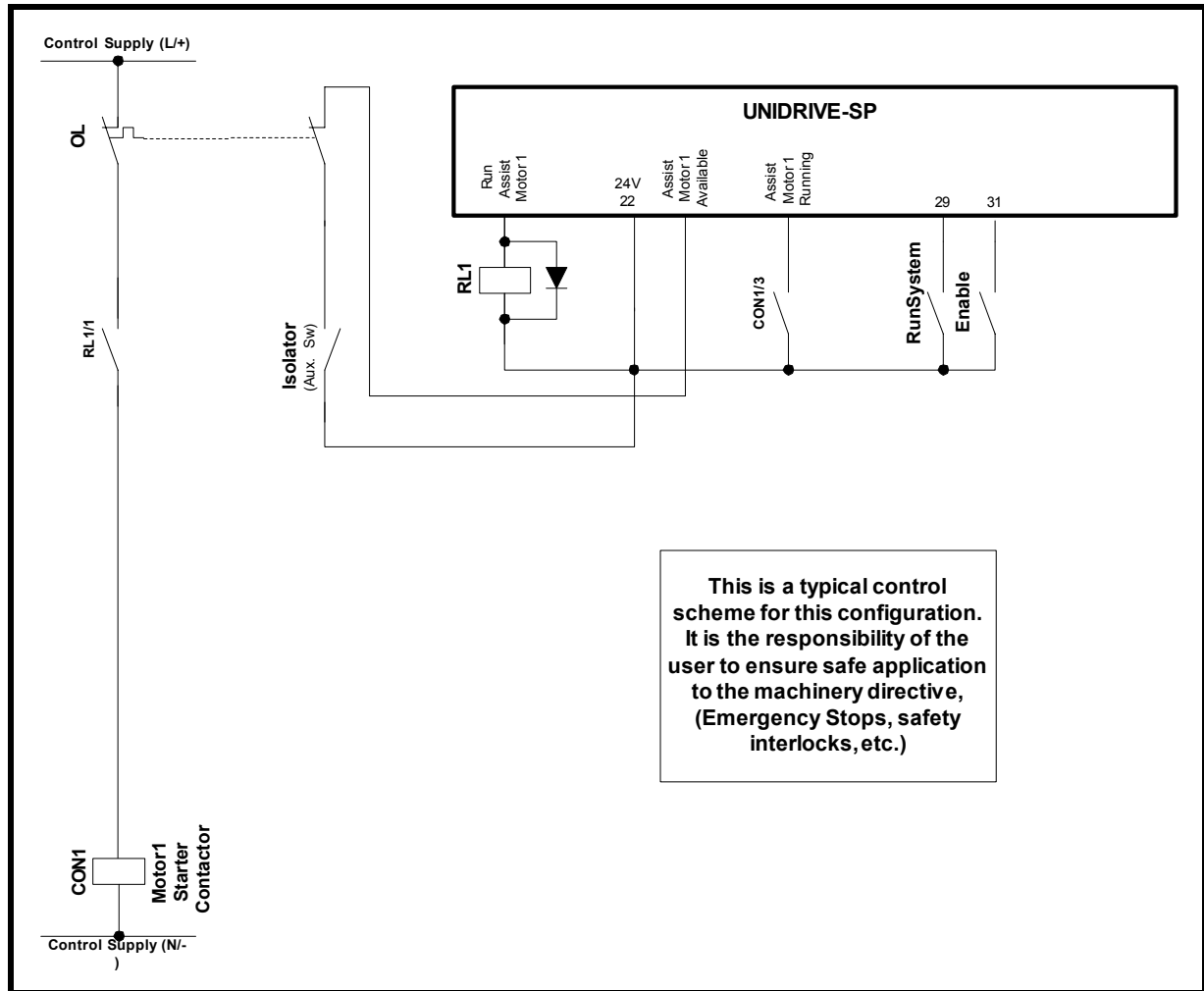
3.6.2 Control Scheme

With local Auto/Man selection on each starter



Refer to Appendix 1 at the end of the manual for more detailed information.

Without local Auto/Man selection on each starter



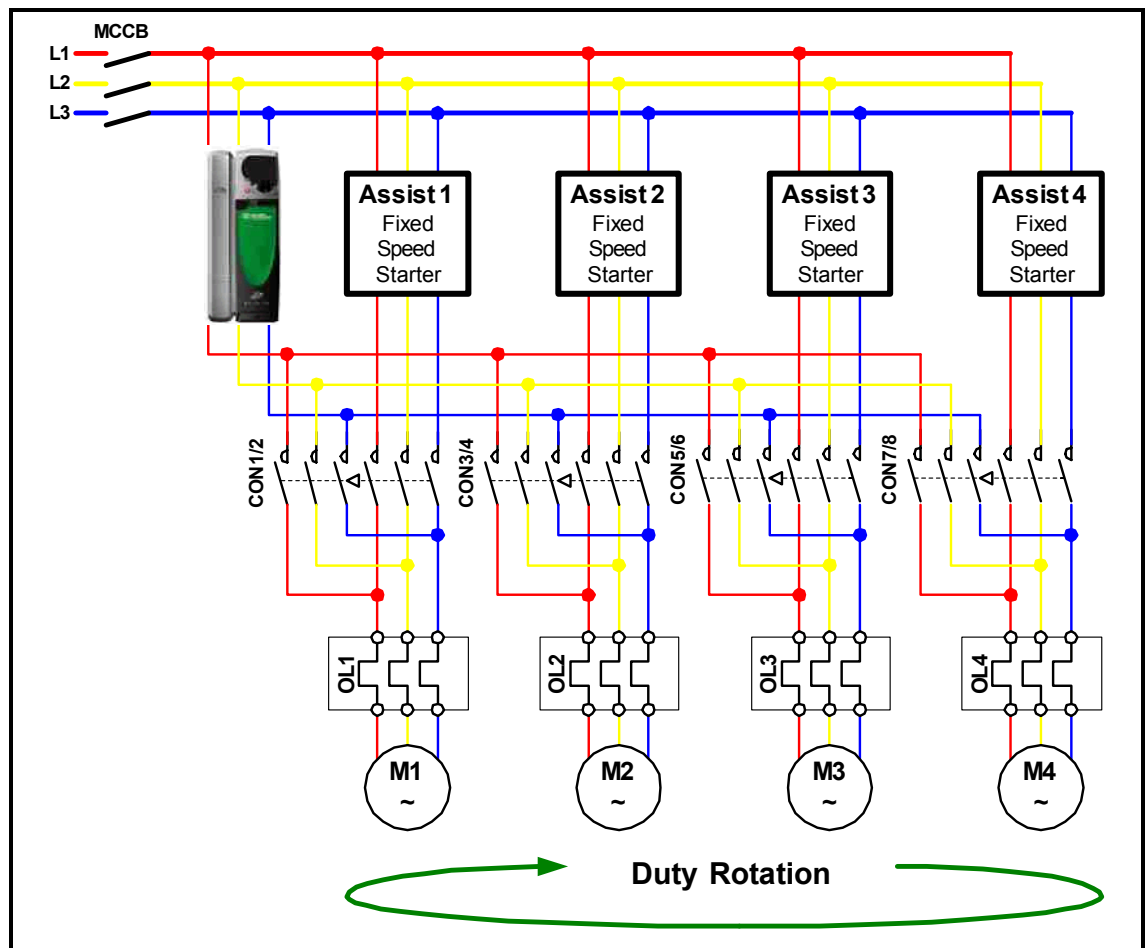
Refer to Appendix 1 at the end of the manual for more detailed information

3.6.3 Unidrive-SP Digital I/O Allocation

Ref to section 3.3.2

3.7 Flexible Duty Configurations

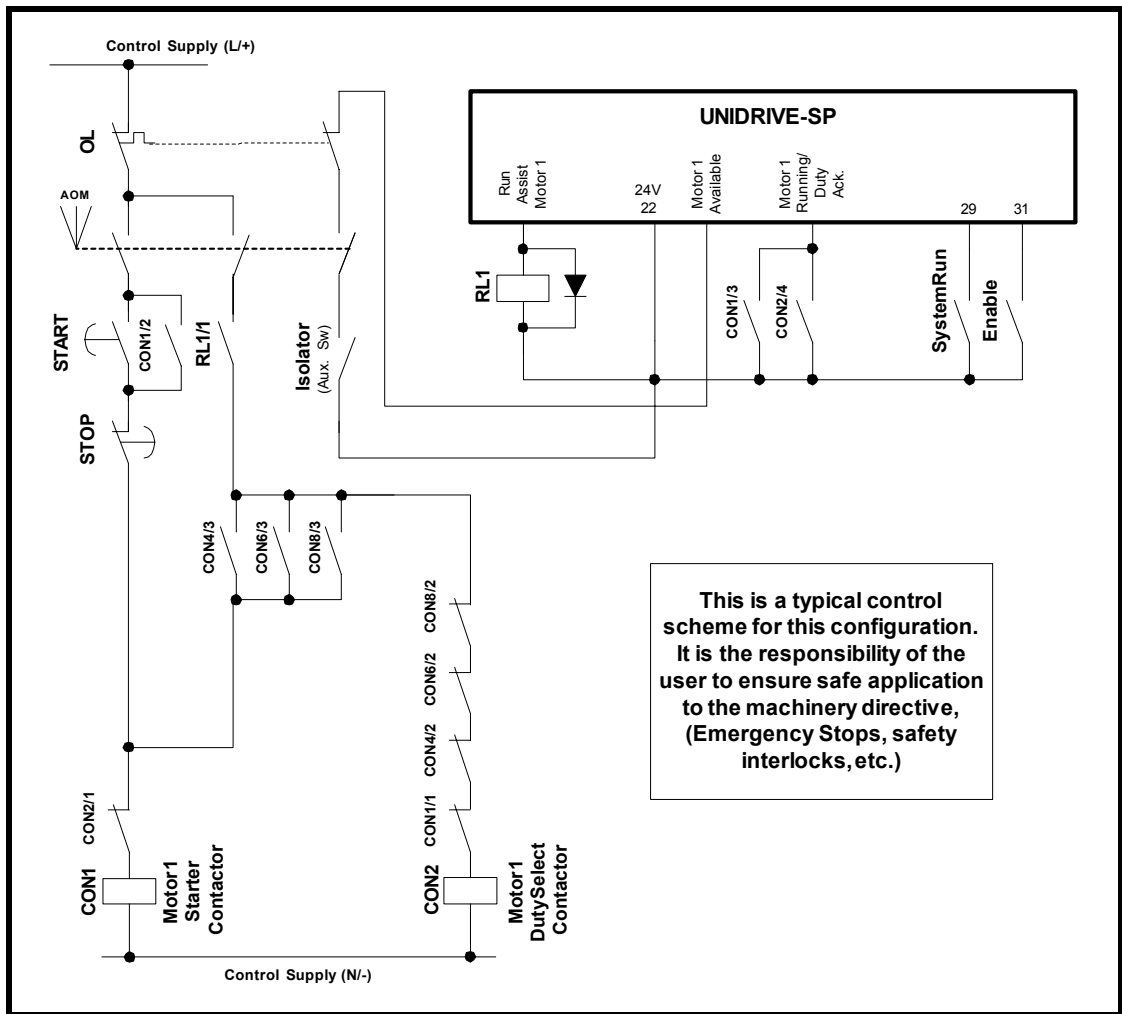
3.7.1 Power scheme



Refer to Appendix 1 at the end of the manual for more detailed information.

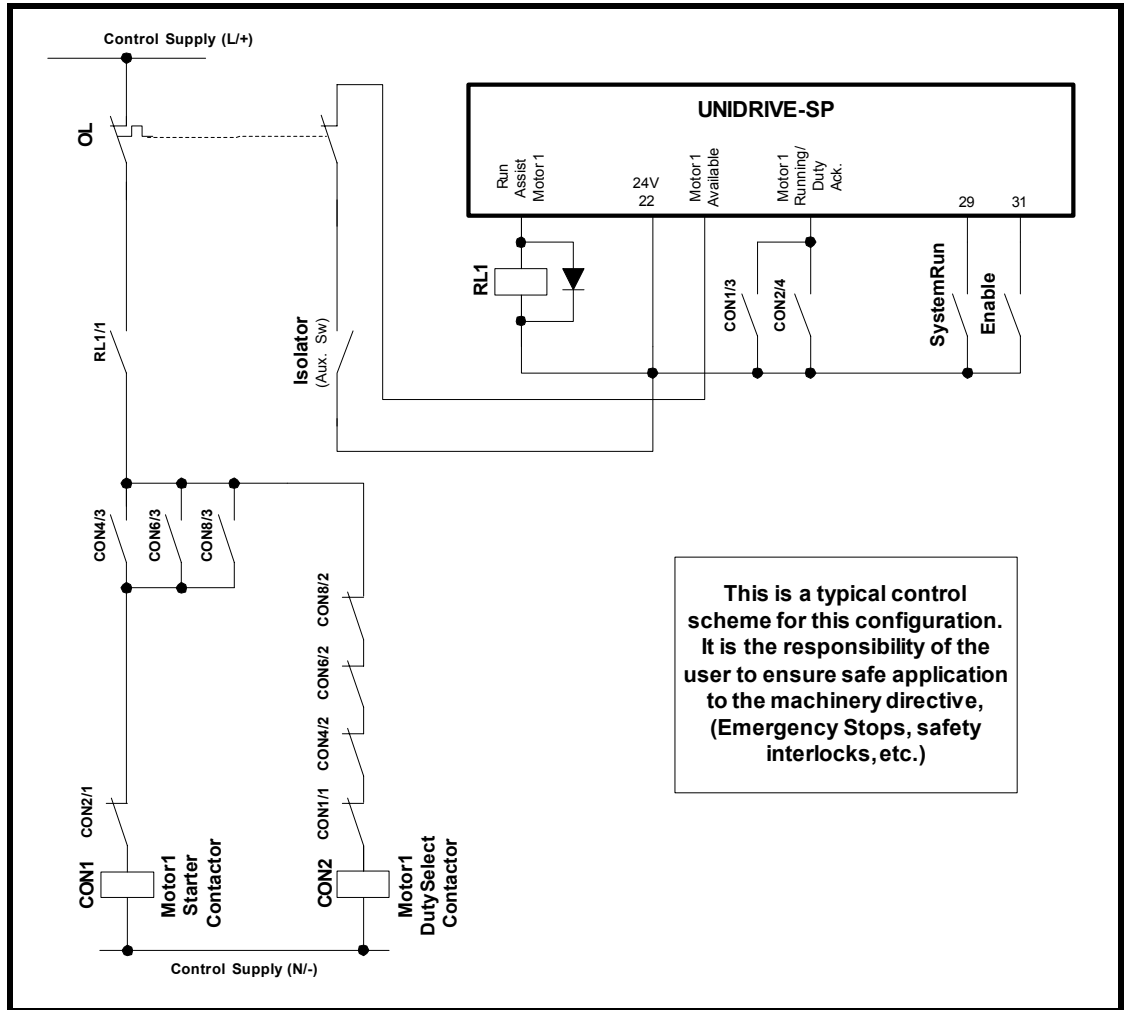
NOTE A Mechanical interlock must be used between the duty and starter selection contactors. (eg. with reference to diagram above CON1 & 2, CON3 & 4, CON5 & 6 and CON7 & 8).

3.7.2 Control Scheme With local Auto/Man selection on each starter



Refer to Appendix 1 at the end of the manual for more detailed information.

Without local Auto/Man selection on each starter



Refer to Appendix 1 at the end of the manual for more detailed information.

3.7.3 Unidrive-SP Digital I/O Allocation

Ref to section 3.3.2

4 Software Installation

There are two software files that are required to be installed within the Application module, these are as follows:

1. Application file- SPDutyAs.bin
2. System file -

Depending on which slot the SM-application module is fitted, (Refer to section Slot Menus for further details regarding the slot menu), the following parameters indicate the installed software version. '0' denotes no software file is installed.

Parameter	Description	Parameter Notation
##.02	System file version number	2.81 = V02.08.01
20.20	Application file version number	20801 = V02.08.01

To download the system and/or the application file to the application module the following is required:

Hardware – Communications Connection

Communications between the PC and Unidrive-SP can either be RS485 or CTNet(SM-Applications only):

Unidrive-SP RS485 Port

For this the CT RS232 to RS485 converter lead is required. The RS232 D-type connects to PC and the RJ45 connects the Unidrive-SP RS485 port. The following parameters are to be set to ensure successful communications:

Parameter	Description	Value
11.23	Node address	11
11.24	Serial Mode	rU
11.25	Baud Rate	Set to PC

CTNet

Refer to the SM-Application module manual for connection and Parameter details.

Software

To download the file Control Techniques Windows™ 'WinFlasher' software utility is required. This software is available on the CD, from any Control Techniques drive centre, or comes complete with 'Sypt' programming tool.

4.1 CTIU Software

When the CTIU110 is used the following software file is required to be downloaded to the unit:

- SP Duty Assist.cmc.

Refer to section 10.10.2 *Software Version Page (2nd Page)* for more details.

The software can be downloaded using Control Techniques Winflasher or the CTIU programming tool.

The serial communication lead should be connected between the PC serial port and the RS232 port (9way D-type), on the CTIU.

5 Getting Started

5.1 Unidrive-SP

1. It is recommended to commission the Unidrive-SP in OPEN LOOP mode before attempting to set up the Duty Assist Application. Consult the Unidrive-SP Getting Started Manual for more details.
2. For guidance, all or some of the related parameters that are listed in section 5.1 may need to be configured.

Depending on which slot the SM-application module is fitted, (Refer to section Slot Menus for further details regarding the slot menu); the following ensure parameter ##.13 = 1. This enables the Duty Assist software to auto-run on power up. If not set perform the following procedure:

- i. Set parameter ##.13 =1
- ii. Set parameter 00.00 = 1000 and press the reset. This will save all current settings of parameters in menus 1 to 19 to non-volatile memory.
- iii. Set parameter 00.00 = 1070 and press the reset. This will reboot the SM-Applications module and run installed application software.

5.2 Duty Assist

The following details a simple procedure for getting started with the Duty assist application software. Optional features such as the sleep function, Cycle function, Start per hour protection, No flow protection and the process alarm are not detailed in this section. For information on these features refer to the relevant functional description in section Functional Description.

1. Switch off the Unidrive-SP. Insert the SM-Applications module and additional I/O module as detailed in section 2.1 *Fitting of Option Modules* .
2. Connect the Unidrive-SP control I/O to the required configuration. E.g. Flexible or Fixed Duty, and the number of starters to be controlled. Refer to sections Unidrive-SP Analog I/O Allocation & Unidrive-SP Digital I/O Allocation.
3. If Flexible duty is required check that all electrical and Mechanical interlocks are functioning correctly.
4. Ensure the Enable input, terminal 31 is open circuit and switch on power to the Unidrive-SP. The LED display should indicate the drive is in a inhibit state 'inh'.
5. Check to ensure the correct application and system software versions are installed. If the files are not installed or the versions are incorrect, download the correct files using Control Techniques 'Win-flasher' software.

6. Default the Duty Assist application parameter in Menus 18 –20 by setting parameter 19.24 = 1. Note: this will automatically reset to 0 when all parameters have been defaulted.
7. Select the required terminal allocation by setting parameter 19.25 to one of the following:
 - 0 = No selection. User must define all control parameter mappings.
 - 1 = Unidrive-SP I/O only, this will control up to 2 starters only.
 - 2 = Unidrive-SP I/O & additional I/O, this will control up to 4 starters.
 When mode 0 is selected refer to the Unidrive-SP user manual for guidance of the configuration of the digital I/O.
8. If terminal allocation mode 1 or 2 is set in parameter 19.25, then check the routing of the digital inputs are correct, by acknowledging the digital states of the following parameters:

Terminal Mode 1 (19.25 =1)

Terminal	Terminal Parameter	Description	Application Parameter
24	08.01	Starter 1 Available	19.43
25	08.02	Starter 1 Running	19.44
27	08.04	Starter 2 Available	19.45
28	08.05	Starter 2 Running	19.46
29	08.06	System Run	18.40

Terminal Mode 2 (19.25 = 2)

Terminal	Terminal Parameter	Description	Application Parameter
24	8.01	Starter 1 Available	19.43
25	8.02	Starter 1 Running	19.44
27	8.04	System Reset	18.50
28	8.05	System Auto Select	18.41
29	8.06	System Run	18.40
2	x.09	Starter 2 Available	19.45
3	x.10	Starter 2 Running	19.46
4	x.03	Starter 3 Available	19.47
6	x.04	Starter 3 Running	19.48
7	x.05	Starter 4 Available	19.49
8	x.06	Starter 4 Running	19.50

9. Determine if the Start/stop control is to be done locally by Unidrive-SP terminal 29 input, or remotely via serial communication using the controlword. Set 18.42= 1 if remote serial communication control is required.

10. Determine if the each set point and feedback is to be derived to the Unidrive-SP as an analog signal, or by serial communications. Set the following parameter appropriately:

Process Set point

18.37 = 0: Set point is written to parameter 18.11 by the Unidrive-SP keypad or by serial communications, in Engineering Units.

18.37 = 1: Set point is set by an analog signal connected to terminal 7.

Process Feedback

18.38 = 0: Feedback is written to parameter 18.01 by serial communications in Terminal Interface Units.

18.38 = 1: Feedback is set by an analog signal connected to terminal 5 & 6 differential or 5 single ended (6 connected to 3).

Manual Speed Set point

18.39 = 0: Speed set point is written to parameter 20.02 by the Unidrive-SP keypad or by serial communications in 0.1Hz (fixed Point Integer value).

18.39 = 1: Speed set point is set by an analog signal connected to terminal 7 & 3(0v). Used in manual mode only.

11. Where analog signals are used, set the required analog signal type; refer to section Analog Signal Types.

NOTE Analog input 1 is only configure to accept voltage signal, if a different type is required please refer to the end of section Real Engineering Units and Scaling for more details

12. Acknowledge the signal/s are present by monitoring the values on the following parameters:

Terminal	Terminal Parameter	Allocation	Application Parameter	Range
5 & 6	07.01	Process feedback	18.01	0 – 4000
7	07.02	Process set point		
8		Thermister		
9	x.04	Speed ref.1		
10	x.05	Speed ref.2		

The terminal input parameter will indicate 0-100.0, which corresponds to 0 to full range of signal.

13. Set the feedback scaling for working with real engineering units.
Refer to section Real Engineering Units and Scaling. Example set ups are shown below:

Example 1 Local analog feedback

A pressure transducer has a working range of 2-10bar the set-point and control resolution is to 0.01bar. The scaling parameters are set as follows:

- 18.12 = 1000- EGU High (Fixed point integer to 2 decimal places and is equivalent to 10.00bar)
- 18.13 = 4000- TIU High, (Default max analog 1 range value that corresponds to the Max EGU value)
- 18.14 = 200- EGU Low (Fixed point integer to 2 decimal places and is equivalent to 2.00bar)
- 18.15 = 0- TIU Low (Default min analog 1 range value that corresponds to the Min EGU value)

Example 1 Remote analog feedback derived over serial communications

The pressure feedback signal is derived as value between the ranges of 0 – 1023, which corresponds to 2-10bar. The set point and control resolution is to 0.01bar. The scaling parameters are set as follows:

- 18.12 = 1000- EGU High (fixed point integer to 2 decimal places and is equivalent to 10.00bar)
- 18.13 = 1023- TIU High, (Max range value corresponding to the Max EGU value)
- 18.14 = 200- EGU Low (fixed point integer to 2 decimal places and is equivalent to 2.00bar)
- 18.15 = 0- TIU min, (Min range value corresponding to the Min EGU value)

14. Check the selected Process set point (18.03) and feedback (18.02) parameters are indicating the correct values in the defined Engineering units range. This can be achieved by varying the set point and feedback source between the min and max range.
15. Select the required Duty Assist control Mode in parameter 18.29 to one of the following:
 - 1 = Fixed Duty, with up to 4 assist starter selected by order of a set Sequence.
 - 2 = Duty rotated, with up to 3-assist starter selected by order of a set Sequence.
 - 3 = Fixed Duty, with up to 4 assist starter selected by order of Runtime.
 - 4 = Duty rotated, with up to 3-assist starter selected by order of Runtime.
16. Set the Number of Motors to be controlled in parameter 18.30. If one of the fixed duty modes is selected, (e.g. 18.29 = 1 or 3), then the motor being controlled by the Unidrive-SP is to be excluded.

17. When one of the Sequence modes is selected, (e.g. 18.29 = 1 or 2), then set the sequence order in parameter 19.19. This parameter will restrict the entry of duplicate starter numbers. The starting order is always from the most significant digit and vice versa for stopping. This is applicable to any number of starters used. E.g. if 3 starters are used, it is important to ensure the first 3 MSD's values correspond to the starters required to be controlled.
18. Before running the process in closed loop, the sequencing/selection of each starter can be checked, by applying a manual speed reference and using the default thresholds and time delays. This is described in the following points.
19. Set to Manual mode:

Terminal Mode (19.25)	Remote Mode (18.42)	Action to select Manual Mode
2	0 or 1	Open contact on input to terminal 28
0 or 1	0	Set parameter 18.41=0
0 or 1	1	Set bit4 to 0 of control word parameter 73.70

20. Enable the drive by closing enable input on terminal 31, and also if Remote mode is selected, set bit0 of control word parameter 70.70. The drive should display 'rdy' on the LED keypad.

21. Run the system by:

Terminal Mode (19.25)	Remote Mode (18.42)	Action to Run System
1 or 2	0	Closing contact on terminal 29
0	0	Set parameter 18.40=1
0, 1, 2	1	Set bit1 to 1 of control word parameter 73.70

With fixed duty mode the drive should immediately go to a run state. The drive keypad should display 'run'.

Flexible duty mode the Unidrive-SP will go to a run state approximately 2 seconds after the Duty starter contactor has been selected.

NOTE

The user must make sure that all the relevant valves & dampers are open to ensure no system overpressures and damage to the pump/fan can occur, before running.

22. Apply a manual speed reference by:

Terminal Mode (19.25)	Analog Enable (18.39)	Action to set Manual Speed reference
Any	1	Varying the analog signal on terminal 7
Any	0	Setting the required speed on parameter 20.02 in 0.1Hz

23. Increase the speed so it exceeds the assist start threshold set in parameter 18.20. After the start time delay has elapsed, set in parameter 18.21, the first assist starter will be selected. Adjust the start threshold & delay if required. If the speed set point remains above the start threshold, then after a time delay set in the transition delay parameter 19.18 the next assist starter will be selected. This will continue until all assist starters are running.

Check!

Sequence mode (18.29 = 1 or 2) – Ensure each starter is selected in order detailed by parameter 19.19, (most significant digit is the first starter to be selected).
Runtime mode (18.29 = 3 or 4) – Ensure each starter is selected in order of the least number or of runtime hours.

24. When the speed is reduced below the assist start threshold the assist starters should remain on, until the speed reference is reduced below the assist stop threshold, set in parameter 18.22, one of the running assist starters will be stopped, after the stop time delay has elapsed, set in parameter 18.23. Adjust the stop threshold & delay if required. If the speed set point remains below the stop threshold, then after a time delay set in the transition delay parameter 19.18, the next assist starter will be selected to stop. This will continue until all assist starters are stopped.

Check!

Sequence mode (18.29 = 1 or 2) – Ensure each starter is deselected in order detailed by parameter 19.19, (least significant digit is the first starter to be deselected).

Runtime mode (18.29 = 3 or 4) – Ensure each starter is deselected in order of the most number or of runtime hours.

For more information on the start/stop thresholds refer to section Assist Start/Stop.

25. To set-up the overall stopping functionality for the system, set the speed reference above the start threshold again, allow all starter to be selected, as detailed in point 21. To stop the system select one of the following methods:

i. **Controlled Stop**, by disabling the System Run, the assist starters will be stopped to one of the methods detailed below:

- **Cascade stop:** each assist starter is stopped individually in sequence to a predefined delay set in parameter 20.03. When all the assist starters have stopped the Duty Unidrive-SP will ramp down to a stop.
- **Normal crash stop:** all assist starters are stop together after the duty drive is ramped down to a stop.

ii. **Crash Inhibit stop**, by disabling the Enable input, all starters and the Unidrive-SP are stopped altogether. The Unidrive-SP will free wheel, uncontrolled to a stop and instantaneously be set to an inhibit state, 'inh'.

26. The system is now ready to be set up in Automatic (PID) mode. Ensure the system is stopped and select 'Auto' Mode as follows:

Terminal Mode (19.25)	Remote Mode (18.42)	Action to select Manual Mode
2	0 or 1	Close contact on input to terminal 28
0 or 1	0	Set parameter 18.41=1
0 or 1	1	Set bit 4 to 1 of control word, parameter 73.70

27. Determine the speed profile required for the process and set Inverse speed profile parameter 18.31 accordingly.

Example: *does the speed of the duty motor vary proportionally or inversely proportionally to the process error?*

Refer to section Inverse Speed Profile for more details.

The following table are speed profile with respect to typical processes and is to be used as guidance only.

Process	Speed Profile	18.31
Pressure Supply	Inverse	0
Temperature Cooling Tower	Proportional	1
Aeration tank	Inverse	0
Level Tank/reservoir supply	Inverse	0
Level Tank/reservoir discharge	Proportional	0

28. Ensure the following features are disabled.

Feature	Parameter
Override Enable	18.32 = 0
Sleep Enable	18.33 = 0
Process Alarms	18.35 = 0
No Flow Protection	18.36 = 0
Cycle Enable	18.49 = 0
Starts per Hour protection	19.31 = 0
CTIU Watchdog Enable	20.18 = 0

29. Set the ramp rates on the drive, parameters 2.11 and 2.21, to suit the load and the process. (the ramp rates are set in sec/100Hz).

NOTE

Setting the ramps will have an effect with the overall tuning of the system, as the ramps are a lagging component in the forward path. It is advisable to ensure the ramp rates are kept to a minimum for dynamic responsive processes like pressure control and extended, if required, for longer process times like temperature.

30. Set the PID gains to the following:

Gain	Equivalent Setting	Parameter
Proportional	1	18.17 = 1000
Integral	0	18.18 = 0
Differential	0	18.19 = 0

Only setting the P term will enable the system to run with minimum instability, but to derive a speed set point from the PID there will have to be a steady state process error.

31. Set process set point so a positive error would be generated. This can be found by comparing the selected process set-point (18.03) with the feedback (18.02), or by looking at the process error parameter (18.05). Note the process error parameter 18.05 will not display the error value until the system is started unless the PID always enabled parameter (18.44) is set to 1.

Apply process set point as follows:

Terminal Mode (19.25)	Analog Enable (18.37)	Action to set Manual Speed reference
1 or 2	1	Varying the analog signal on terminal 7
0	0	Setting the required set point on parameter 18.11 in EGU

32. Enable and run the Duty drive.

33. The Duty drive will ramp to the speed set in parameter 1.21. This is derived from the output of the PID as follows:

$$01.21 = 20.05 / (20.01 * 10)$$

Where:

01.21 = Preset speed reference parameter

20.05 = PID scaled output parameter

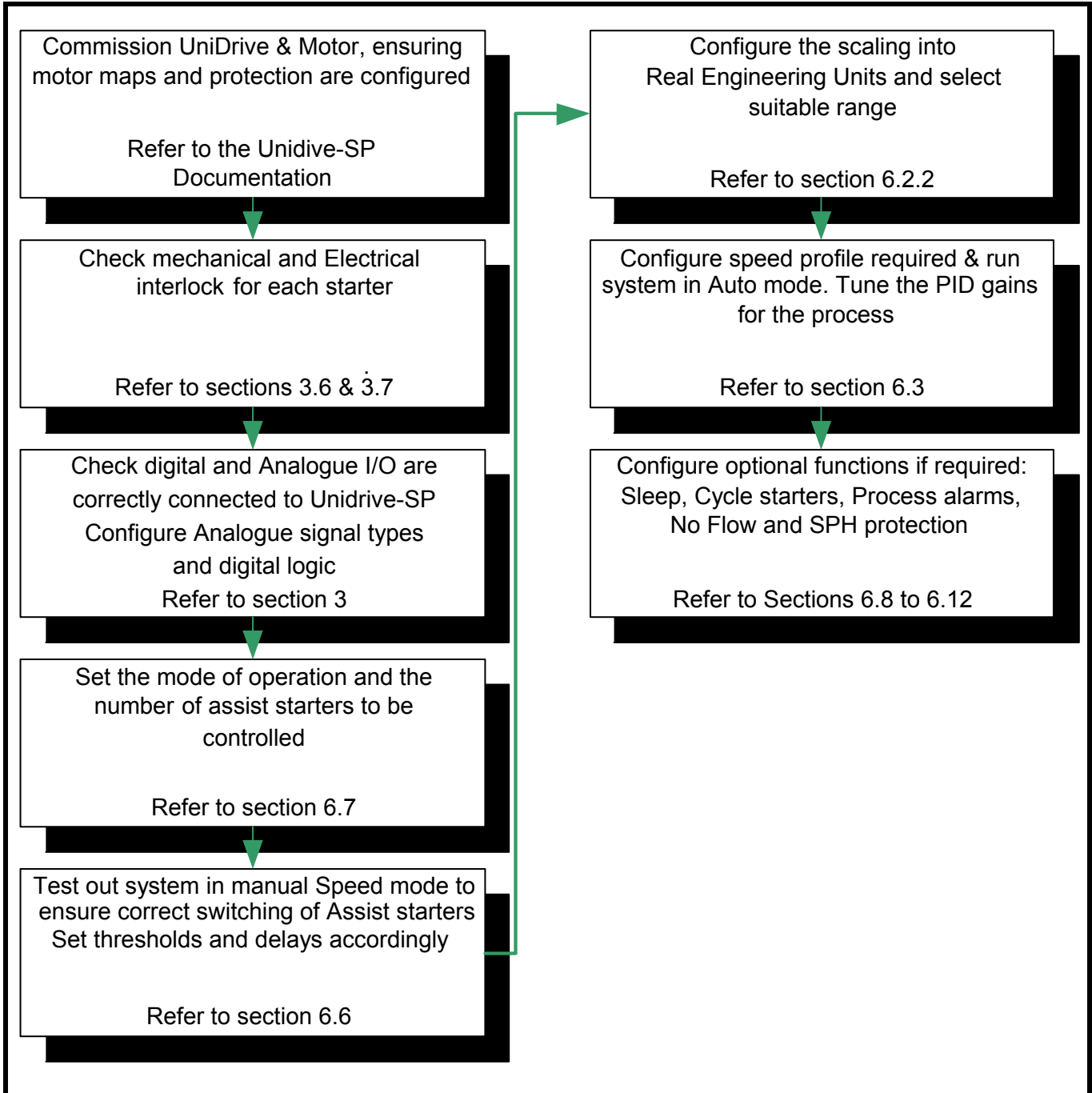
20.01 = PID output scalar parameter (default 1)

With only the Proportional gain set the speed set point is proportional to the error as follows:

$$\text{Speed setpoint}(01.21) = (\text{error}(18.05) * \text{Pgain}(18.17)) / (20.01 * 1000 * 10)$$

34. Adjust the process set point so the output of the PID/speed setpoint is not saturated to the Max or Min speed of the drive. Ensure it is lying between these values and also not exceeding the start or stop thresholds.
35. There will be a Process error present in parameter 18.05, to reduce this increase the integral gain, parameter 18.18, until the error is zero.
36. To complete the tuning of the PID, a stepped reference is required to ensure the PID loop reacts correctly for the process, increasing, or decreasing the process set point can achieve this.
Monitor the duty speed overshoot and steady state error and adjust the gains to ensure minimum error and overshoot. Refer to section PID Operation for more information.
37. Once satisfied with the gain settings, adjust the Process set point so the assist starters are started and stopped. Monitor the system response and adjust PID gains if required. A process error will occur when an assist starter is started or stopped (e.g. process stepped change), if the gains are set correctly the Duty drive should reacted effectively to reduce the error, with minimal overshoot and delay.
38. A slew limit can be used to reduce the rate of change on the process set point, adjusting parameter 18.16. This may help with tuning on start up and large changes of process set points.
39. This completes the getting started procedure. This has covered the majority of the commissioning for the Duty Assist application software. For set-up of the optional features refer to the relevant functional description in section Functional Description.
40. To save & retain parameter values during power off perform the following procedures:
 - i. Ensure the system is stopped.
 - ii. Menus 0 to 19
 - Enter 1000 to any parameter XX.00
 - Preset 'Reset' button
 - iii. Menu 20
 - Depending on which slot the SM-application module is fitted, (Refer to section Slot Menus for further details regarding the slot menu); enter 1 to parameter ##.19. The value should automatically reset to 0, if save was successfully completed.

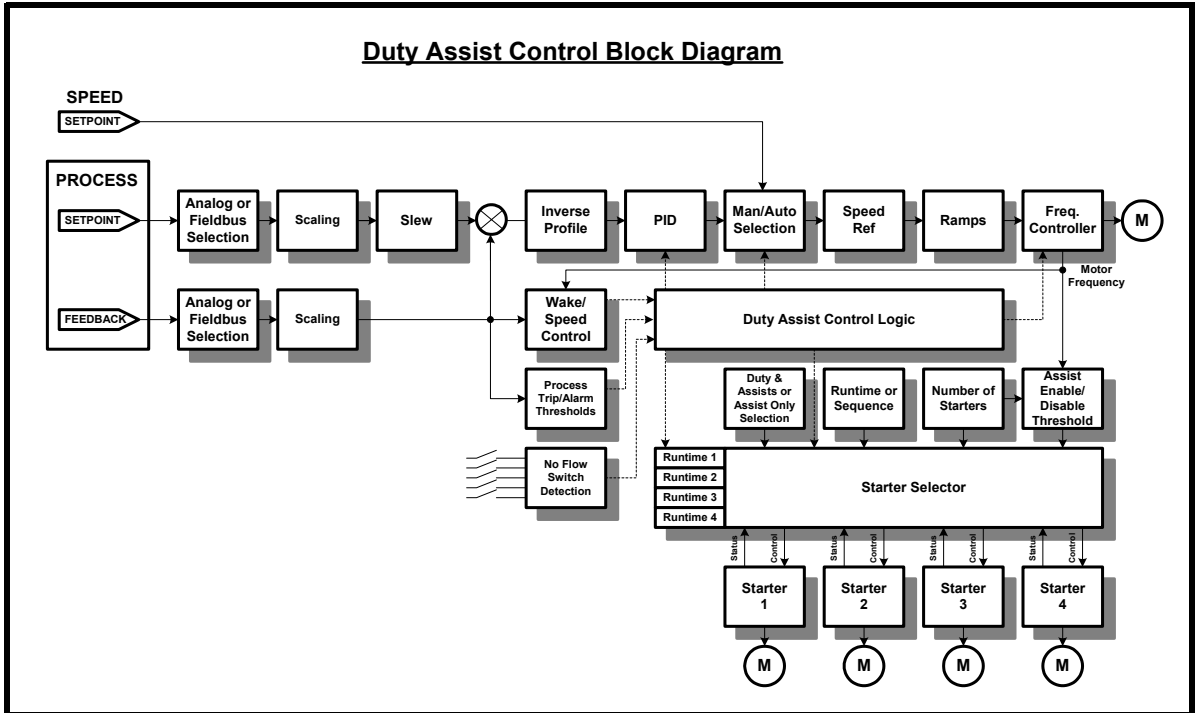
5.3 Commissioning Sequence



6 Functional Description

6.1 Overview

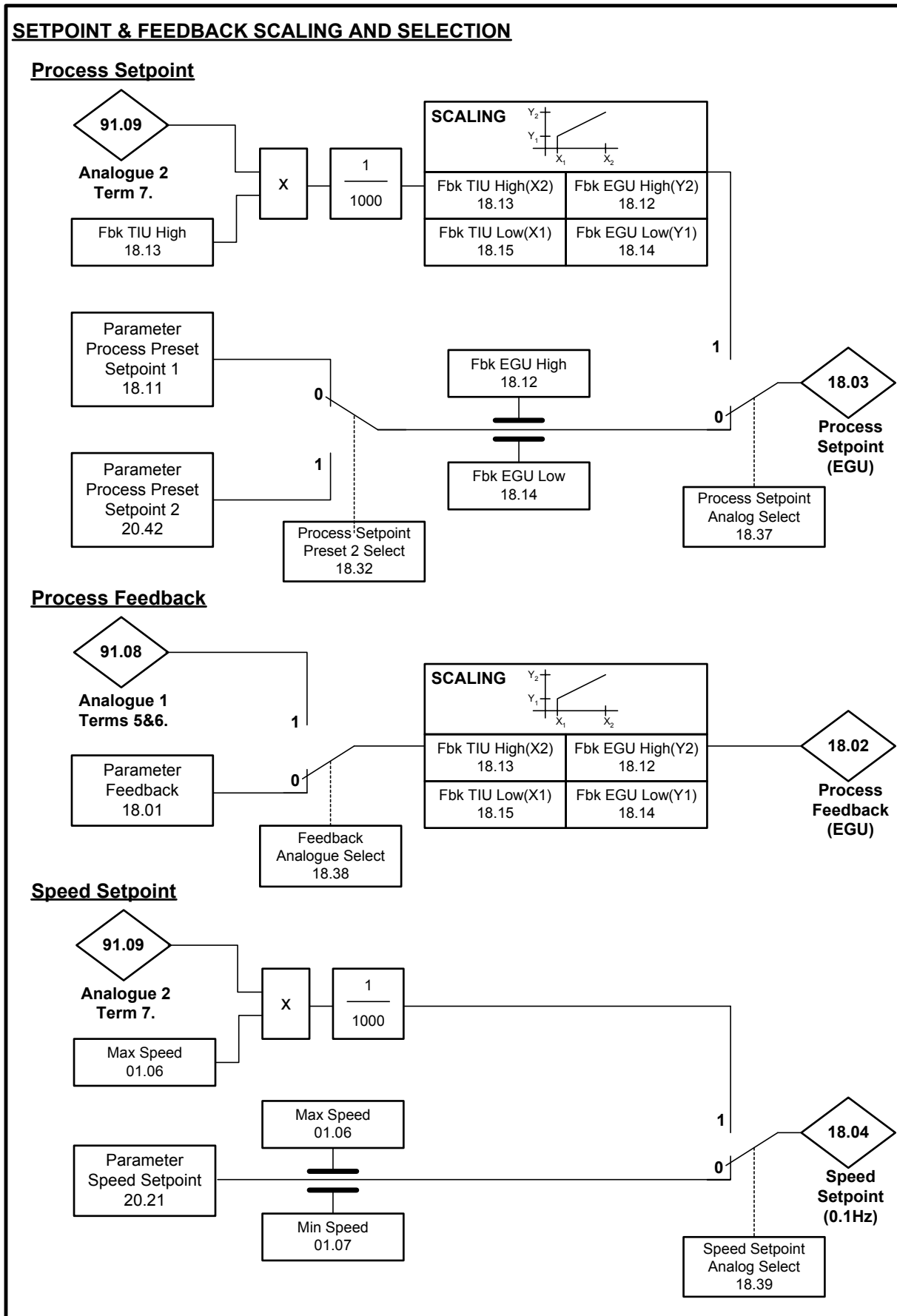
The diagram below illustrates the Duty Assist application broken down into individual functions, where some are mandatory for the software to operate correctly and others are optional. The purpose for the optional functions is to reduce the requirement for addition external periphery, therefore help to save time and money with system integration.



The Control Techniques Duty Assist software has 4 operational modes, which are follows:

1. Fixed Variable speed Duty with up to 4 Assist Starters selected by a predefined sequence.
2. Flexible Variable speed Duty selection with up to 3 Assist Starters selected by a predefined sequence.
3. Fixed Variable speed Duty with up to 4 Assist Starters selected by a their runtime.
4. Flexible Variable speed Duty selection with up to 3 Assist Starters selected by a their runtime.

6.2 Set-point/Feedback Scaling & Selection



6.2.1 Terminal or Parameter Selection

The source for each the process feedback & set point, and speed set point can be selected from the Unidrive-SP analog terminals or direct from a parameter. The parameter selection enables the values to be set directly from the keypad or written to via serial communications. A combination of terminal and parameter sources can be configured as each set point/feedback has its own unique selection parameter as detailed in the following table:

Set point/Reference	Selection Parameter	Source
Process Set point	18.37 = 0	Parameter 18.11
	18.37 = 1	Terminal 7
Process Feedback	18.38 = 0	Parameter 18.01
	18.38 = 1	Terminal 5 & 6
Speed Set point	18.39 = 0	Parameter 20.02
	18.39 = 1	Terminal 7

NOTE Process set point & and speed set point share the same analog input as they are only operational in one of the control modes Auto or Manual. The standard analog terminal allocations are not user configurable. Selecting the 'Parameter' source for set point/feedback is the only method of reconfiguring the analog source. The required analog input can then be mapped and scaled accordingly from the standard Unidrive-SP parameters (Menu 7 or 16).

For information on the analog input signal types that can be connected to the Unidrive-SP refer to section 3.2.1.

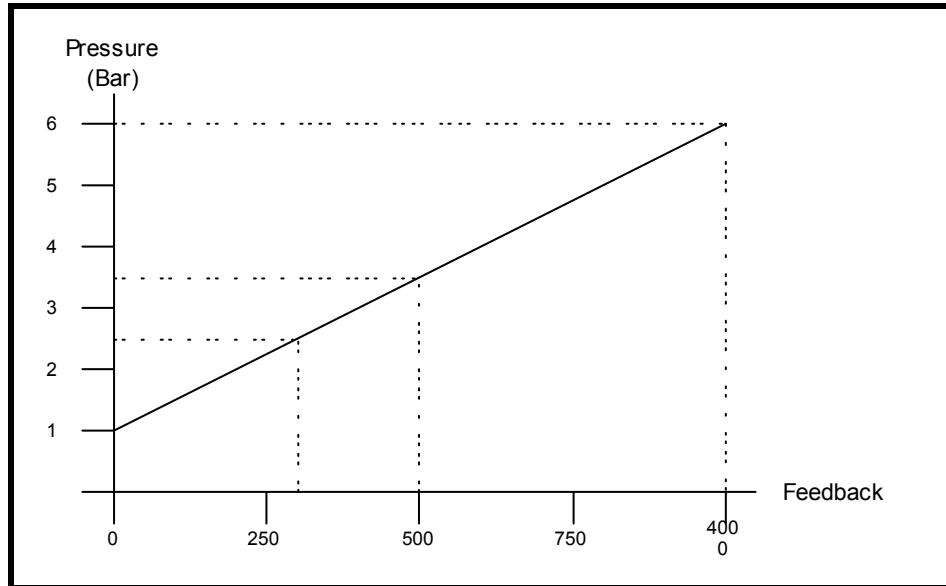
6.2.2 Parameter Process Preset Set-points

Two different preset set points can be selected when in parameter mode, (18.37=1). This can be used to alternate the Process set point for two separate conditions. E.g. Day & Nigh, (High & Low) Duty conditions. The preset set points are selected between the main parameter set point (18.11) and the preset set point 2 parameter (20 .42) by the preset set point 2 select parameter (18.32).

NOTE The Unidrive-SP and the SM-Applications module do not support a real-time clock, therefore to achieve a Day/Night set point selection an external device (with real time clock) is require to control the preset set point 2 select parameter (18.32) either via a Unidrive-SP terminal, mapped to the parameter or via serial communications using the control word, bit 9.

6.2.3 Real Engineering Units and Scaling

With a linear feedback transducer, two known points on the feedback graph must be defined. Two known real pressure points should be entered, along with the feedback value into the drive for each point. This allows two equations to be derived that allow the feedback values from the transducer in Terminal Interface Units (TIU), to be converted to real EnGineering Units (EGU), and vice versa.



Typically, the defined points will be the maximum (10Vdc) and minimum points (0V), but this does not have to be the case. Any two points will provide the necessary information.

When a trip threshold is specified, it would be specified as “4.78 bar”. The specified data to convert the above graph would be:

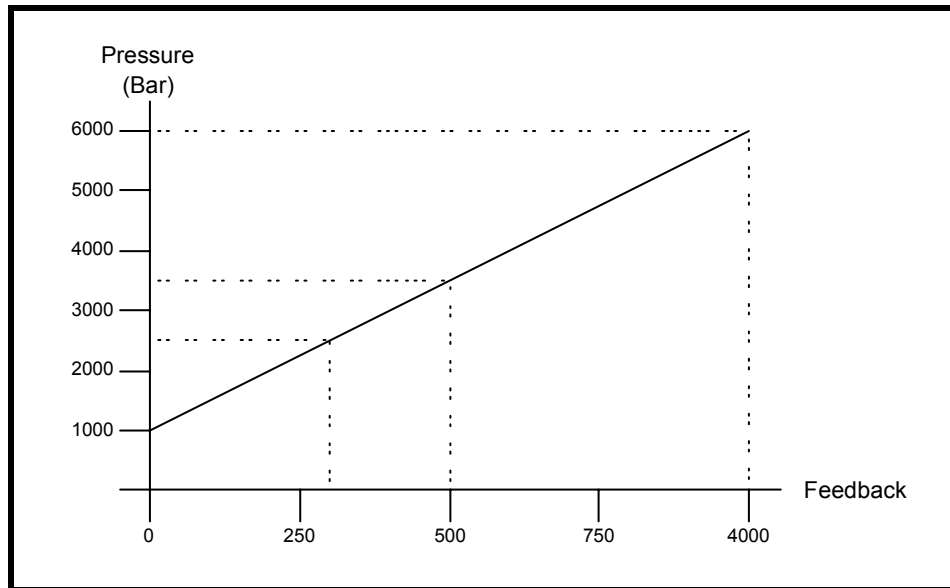
Minimum Point

Feedback TIU Low (18.15) = 0
Feedback EGU Low (18.14) = 1

Maximum Point

Feedback TIU High (18.13) = 4000
Feedback EGU High (18.12) = 6

There is a slight problem with the above figures. When the fixed points are defined, decimal places are not available with the drive parameters. Therefore, in the above example, the resolution on the real pressure parameters is 1 bar, with no points in between. The scaled feedback value will only resolve to 1 bar, with no resolution for points in between, and the same will apply to the maximum and minimum thresholds. Therefore, only 4 bar or 5 bar can be set as the maximum pressure.



To increase the resolution, fixed-point maths needs to be used. To set the real pressure in units of milli-bar, let 1000 = 1 bar. Values returned from the equation derived will therefore * 1000, providing an effective resolution of three decimal places. The specified data to convert the above graph would now be:

Minimum Point:

Feedback TIU Low (18.15) = 0

Feedback EGU Low (18.14) = 1000

Maximum Point:

Feedback TIU High (18.13) = 4000

Feedback EGU High (18.12) = 6000

The trip threshold specified, as “4.78 bar” would now be entered as milli-bar, so a value of 478 would be entered. This would be converted to transducer units as 756, or 75.6% feedback.

Unidrive-SP analog internal range

Analog Input	Signal Type	Range TIU Min & Max
1 (term 5/6)	-10 - 0 - +10V	-4000 - 0 - +4000
2 & 3 (term 7 & 8)	-10 - 0 - +10V	-1023 - 0 - +1023
	0 - 20mA	0 - +1023
	0 - 10Vdc	
	4 - 20mA	200 - 1000

NOTE

When the Unidrive-SP 4-20mA analog signals are required to be used, then the TIU minimum will need to be offset by 4mA, as 0mA = 0.

For example:

1. Analog 2 input Terminal 7
 - 10bit signal $1000 * (4 / 20) = 200$
2. Analog 1 input Terminal 5 & 6
 - This is a voltage input only!

To apply a 4-20mA Process feedback signal then 2 options are available when using the standard Unidrive-SP Analog inputs:

1. To maintain maximum resolution an external signal converter is required, to convert the feedback 4-20mA signal to 0-10Vdc.
2. With reduced resolution, Analog 3 can be used by deselecting the standard default configuration for the Process feedback on Analog 1 and mapping Analog 3 to the Process feedback parameter 18.01, this is achieved as follows:
 - a. Set the mode for Analog 3 to 4-20mA
 - b. $07.15 = 4-20^{**}$
 - c. Set feedback to read parameter 18.01:
 $18.38 = 0.$
 - d. Map Analog input 3 to destination to 18.01:
 $07.10 = 18.01$
 - e. Set the TIU min and max values to parameter 18.02 range:
 - i. Min range $32767 * 4 / 20 = 6554$
 $18.15 = 6554$
(fine adjustment may be required)
 - ii. Max range
 $18.13 = 32767$
 - f. Remember if one of the drive analog outputs is used for indication of the process feedback to re-map the source parameter from 7.01 to 7.03.

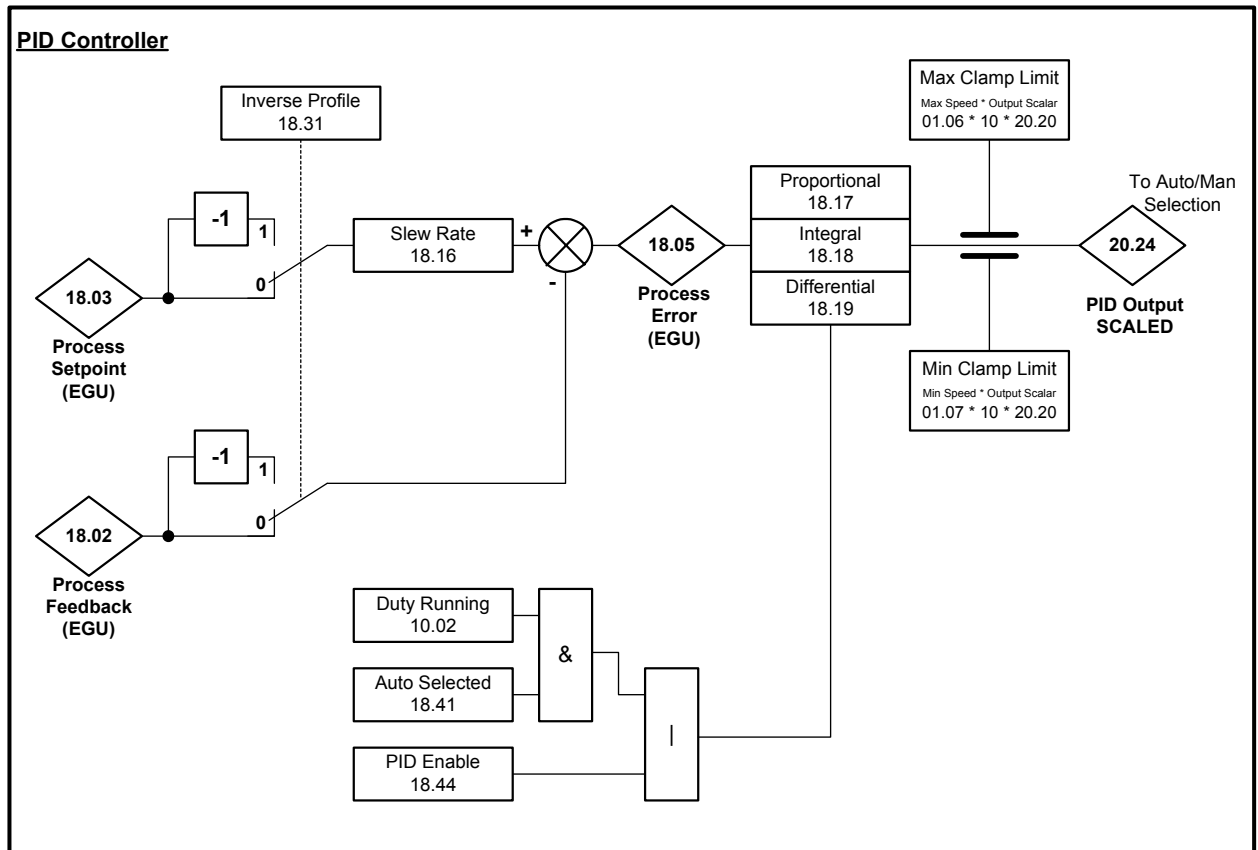
NOTE

The drive motor thermister protection feature cannot be used when analog input 3 is used.

6.3 PID Controller

6.3.1 PID Description

The PID, (Proportional-Integral-Derivative) provides closed loop regulation to maintain process consistency and compensate for any external disturbances. Example uses are for temperature, flow, pressure, level, etc.



6.3.2 PID Operation

The Process set point (18.03) represents the demanded value to be reached, and the Process feedback (18.02) is the current, actual value being read from the process transducer. The set point and the feedback are compared and the difference between these values is known as the process error (18.05). The process error is used to derive a speed set point to the motor to force the Process feedback to equal the Process set point. The response & the regulation accuracy of the process is dependant on the PID gain setting.

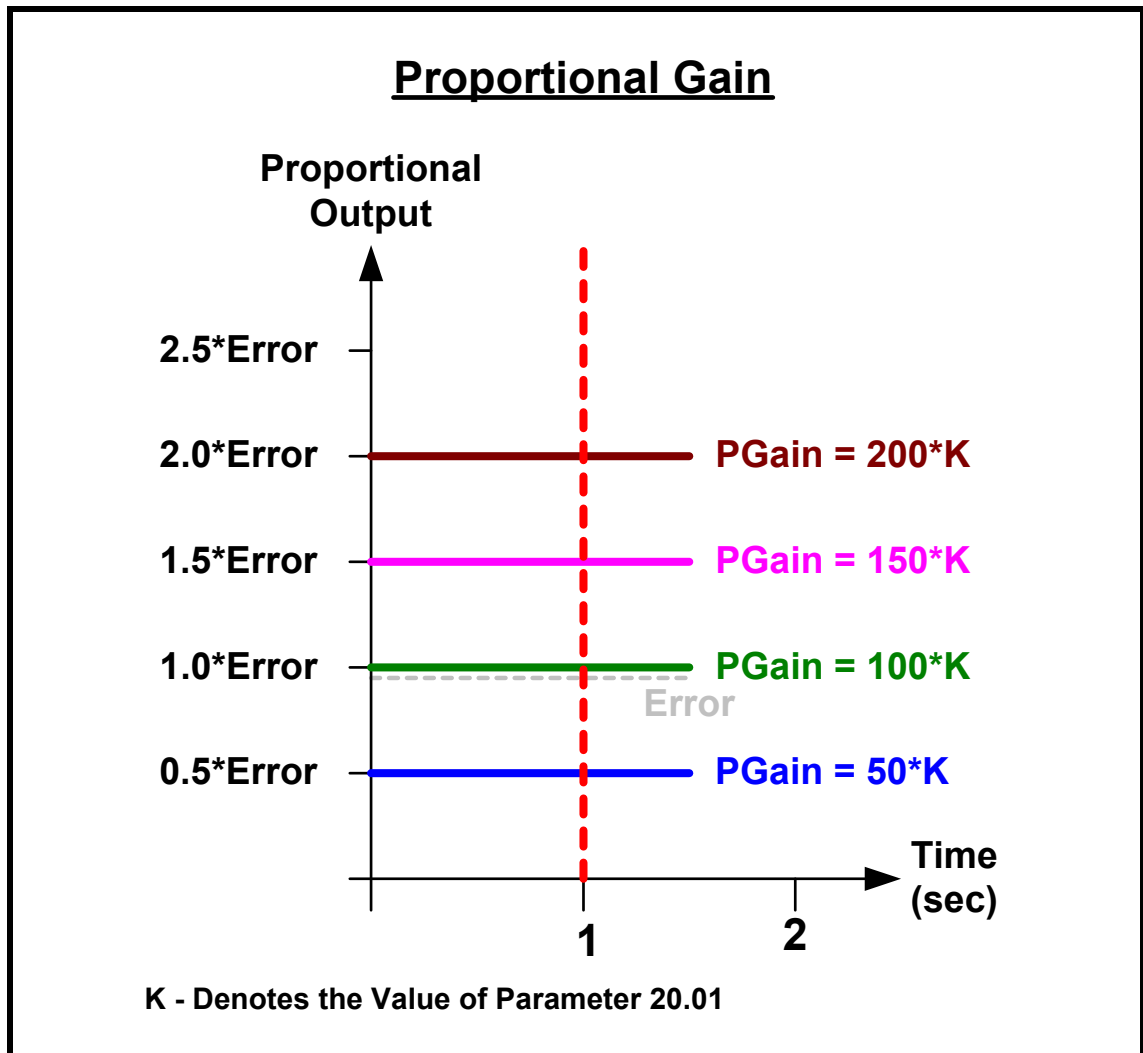
The rate of change of the process set point can be limited by the slew rate (18.16). This is useful to limit the system overshoot when the set point is changed.

6.3.3 Proportional Gain Kp

The Proportional gain is the instantaneous amplification factor that is applied to the process error.

$$P_{out} = K_p \cdot \varepsilon$$

The Proportional term must have an error to produce an output. The magnitude of the output is dependant on the magnitude of the error and the amount of proportional gain.



For a process error of 1, and a Proportional gain of 100, the output of the P term will be 1 (0.1Hz). The Gain is set as a fixed-point integer.

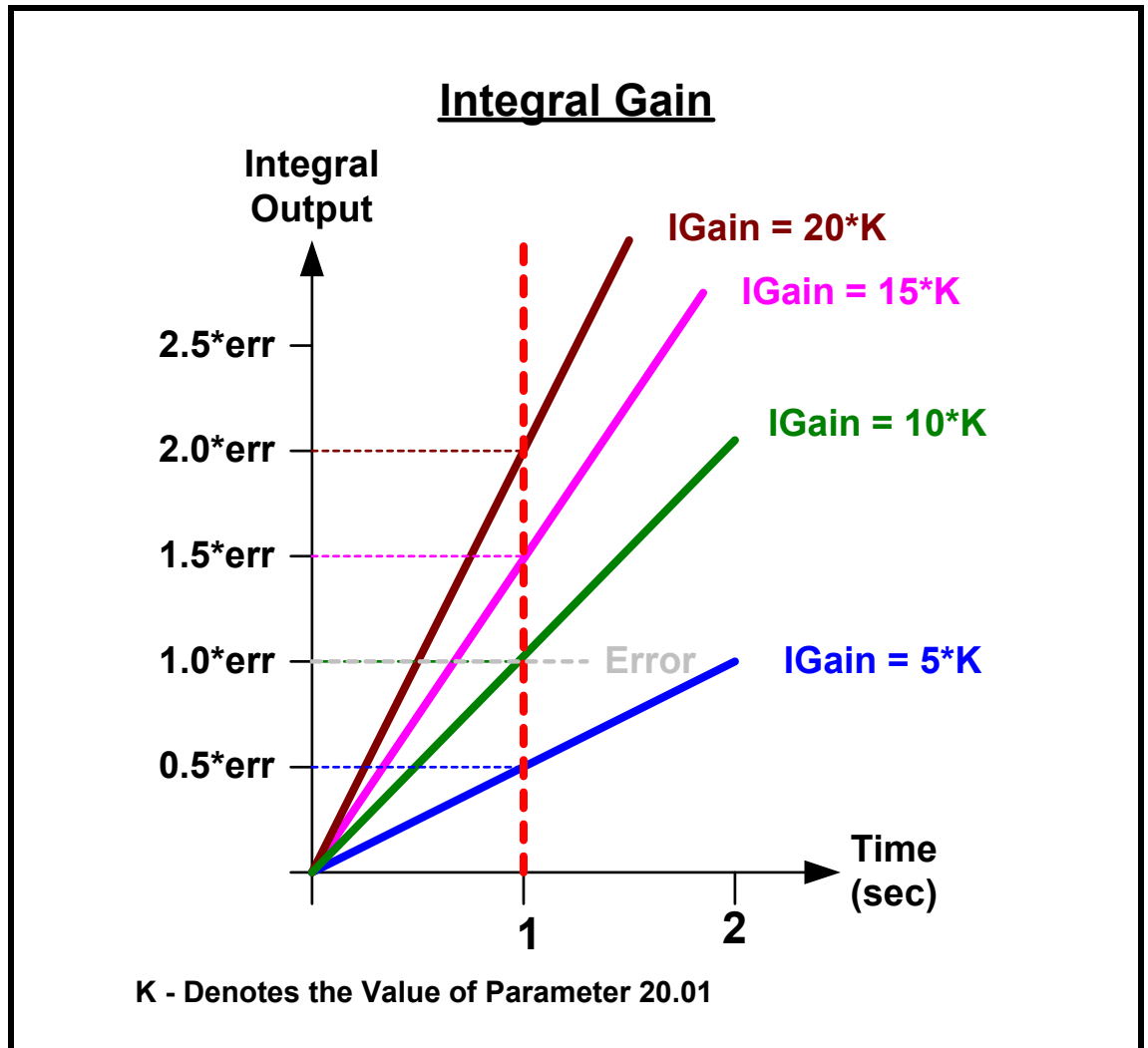
When the PID output scalar is set greater than 1, then for the same output with the given error, the gain must be multiplied by the PID output scalar value. Refer to the PID Output scalar section PID Output Scalar.

6.3.4 Integral Gain Ki

The integral gain is amplification factor of the error over time.

$$I_{out} = (K_I \cdot \int \epsilon \cdot dt) / 10$$

The integral term accumulates any error over time to help reduce any offset or long-term errors. Ki is a multiplication co-efficient of the integrated value.



For a constant error of 1, and an Integral gain of 10, the output of the Iterm will reach 1 (0.1Hz) after 1 second. The Gain is set as a fixed-point integer.

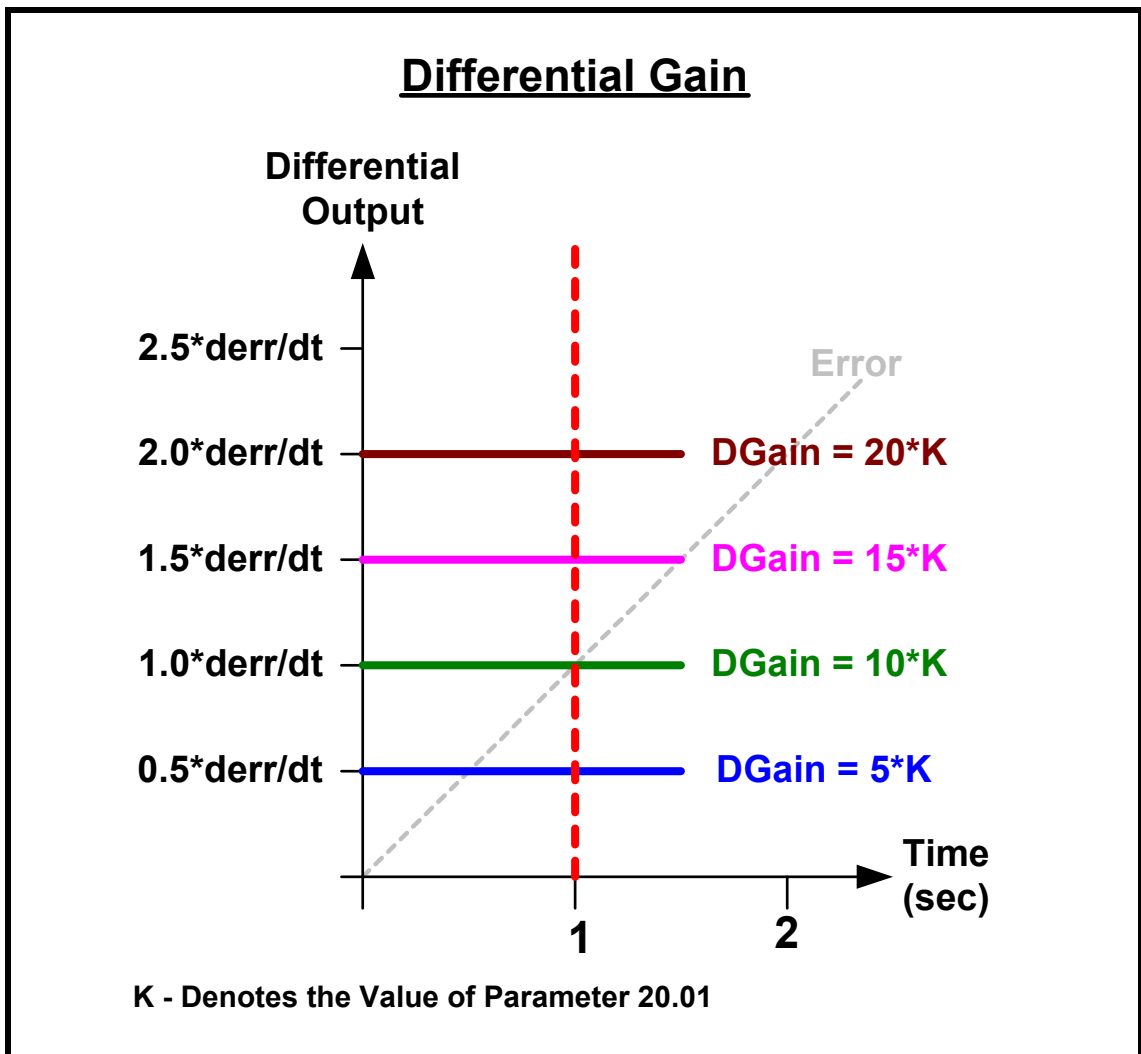
When the PID output scalar is set greater than 1, then for the same output with the given error, the gain must be multiplied by the PID output scalar value. Refer to the PID Output scalar section PID Output Scalar.

6.3.5 Differential Gain Kd

The derivative gain is amplification factor of the rate of change of error.

$$D_{out} = (K_d \cdot \delta\varepsilon/\delta t) / 10$$

The Differential term is the rate of change of the error multiplied by the Kp co-efficient. This is responsive during transient conditions; therefore it is zero during steady state condition. It is useful to reduce the overshoot during large disturbances. The differential gain is rarely used in most applications as it will amplify any unwanted noise to the system and can cause instability.



For a constant rate of change of error of 1 unit per second and a differential gain of 10, the output of the D term will be 1 (0.1Hz). The Gain is set as a fixed-point integer.

When the PID output scalar is set greater than 1, then for the same output with the given error, the gain must be multiplied by the PID output scalar value. Refer to the PID Output scalar section PID Output Scalar.

6.3.6 PID Output

The PID output is the summation of all the terms above as follows:

$$\text{PID}_{\text{Output}} = \left[\begin{array}{c} \text{Max Limit} = (\text{Max Speed} * K) \\ \left(\frac{K_p}{100} \cdot \text{error} \right) + \left(\frac{K_i}{10} \cdot \int \text{error} \cdot dt \right) + \left(\frac{K_d}{10} \cdot \frac{d\text{error}}{dt} \right) \\ \text{Min Limit} = (\text{Min Speed} * K) \end{array} \right]$$

The PID output is clamped between two limits, which are the Min and Max frequency settings of the Unidrive-SP (01.07 & 01.06 respectively), multiplied by PID Output Scalar (20.01). These limits define a working area within the PID. If the output crosses one of the limits, the PID output will be clamped until the output returns within these limits. The limits will also stop the integrator accumulating until the integrated error is back in the working range.

6.3.7 PID Output Scalar

The PID output scalar, (K) enables the PID gains to have different operating ranges with their settings, as the table below details:

NOTE

Each gain parameter range is limited to 0 - +32767.

The speed set point range (Output of the PID 20.05), is displayed as a fixed-point integer value e.g. 500 = 50.0. The max set point resolution is to 0.1Hz.

PID Scalar	1	10	100
Speed Set point	0 - 500	0 - 500	0 - 500
PID Output	0 - 500	0 - 5000	0 - 50000
P Gain Range	0 - 320.00	0 - 32.000	0 - 3.2000
I & D Gain Range	0 - 3200.0	0 - 320.00	0 - 32.000

This scalar is provided suit the required gain setting range of the process and it is more beneficial for the integrator and derivative gains. The following examples demonstrate this with integral gain:

With the PID scalar set to 1 and a steady state error of 1, The rate of integrator time range that can be set is:

Max: 3200 units step in a second or 320.0hz in 1 second (Shortest Time)

Min: 0.1 unit step in a second or 0.1Hz in 10 seconds (Longest Time)

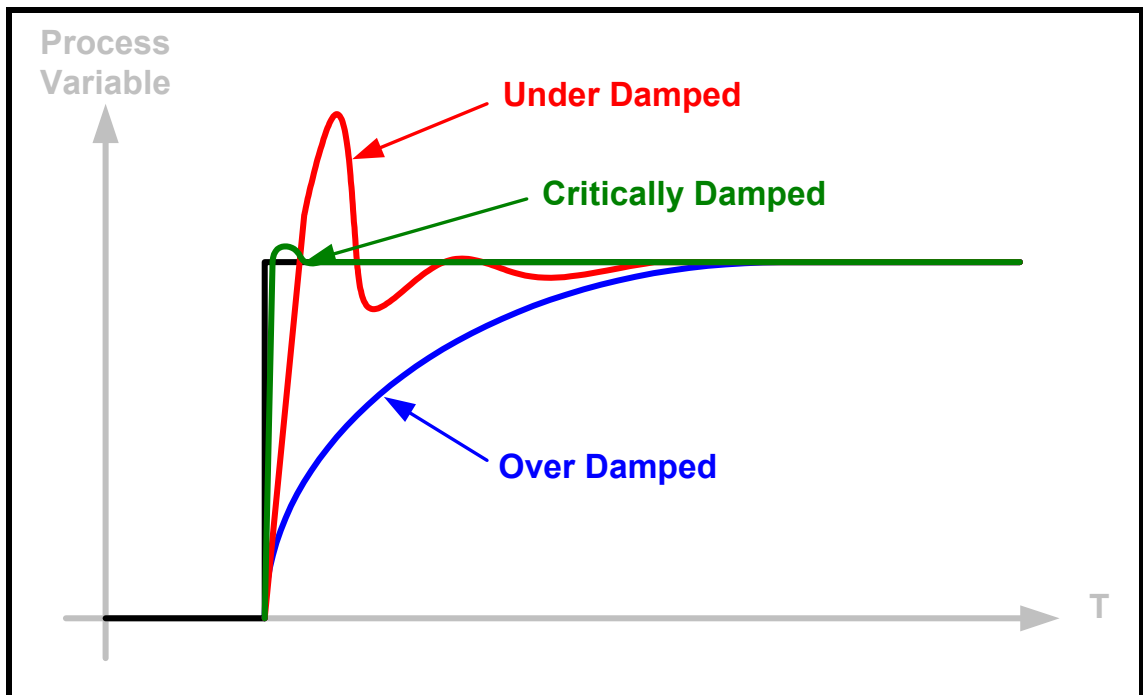
With the PID scalar set to 10 and a steady state error of 1, The rate of integrator time range that can be set is:

Max: 320 units step in a second or 32.0hz in 1 second (Shortest Time)

Min: 0.01 unit step in a second or 0.1Hz in 100 seconds (Longest Time)

6.3.8 Transient Response

If a step change was set on the input of the PID the Process can react in the following manner, which is dependant on the setting on the PID gains.



The PID gains should be set, (or tuned) to ensure the Process has a 'critically damped' response.

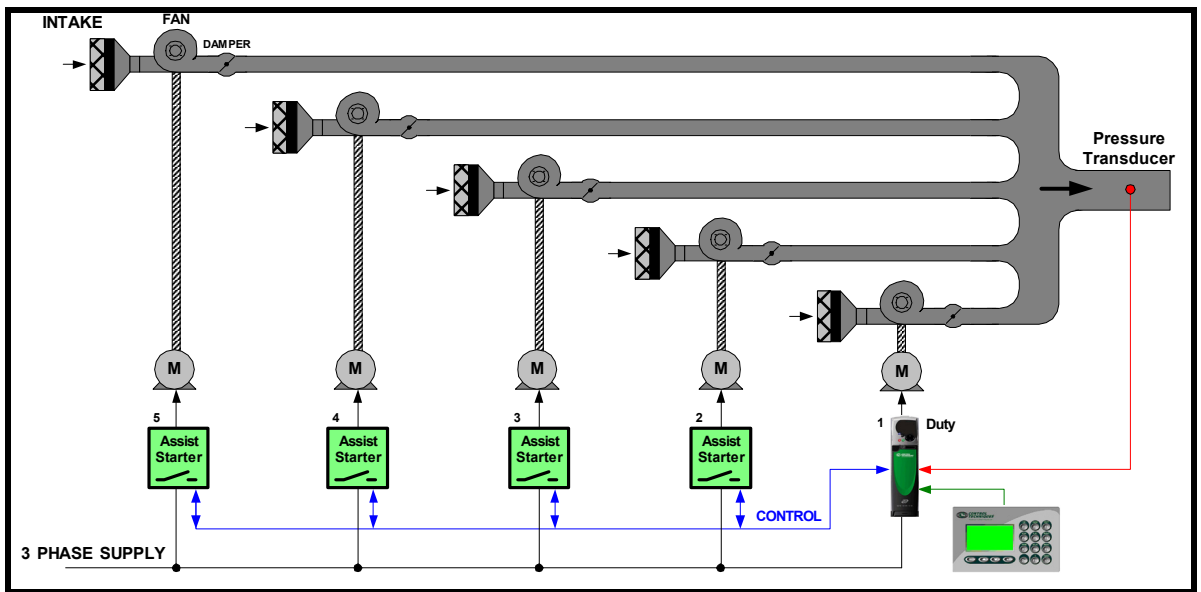
6.3.9 PID Control

The PID can be selected to be operation all the time or it can be disabled when it is not running in Auto operation. This operation is determined by the setting of the PID enable parameter (18.44).

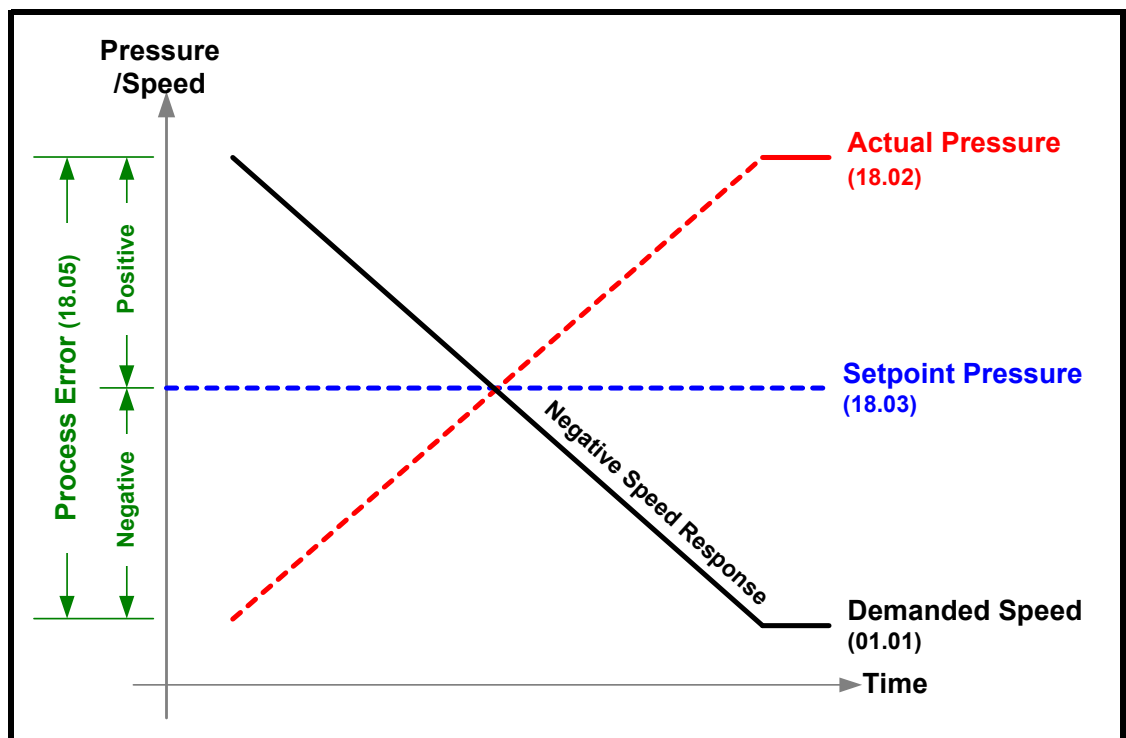
6.3.10 Inverse Speed Profile

This feature determines the PID output speed profile with respect to the process error, below are two typical application examples, which demonstrate this feature.

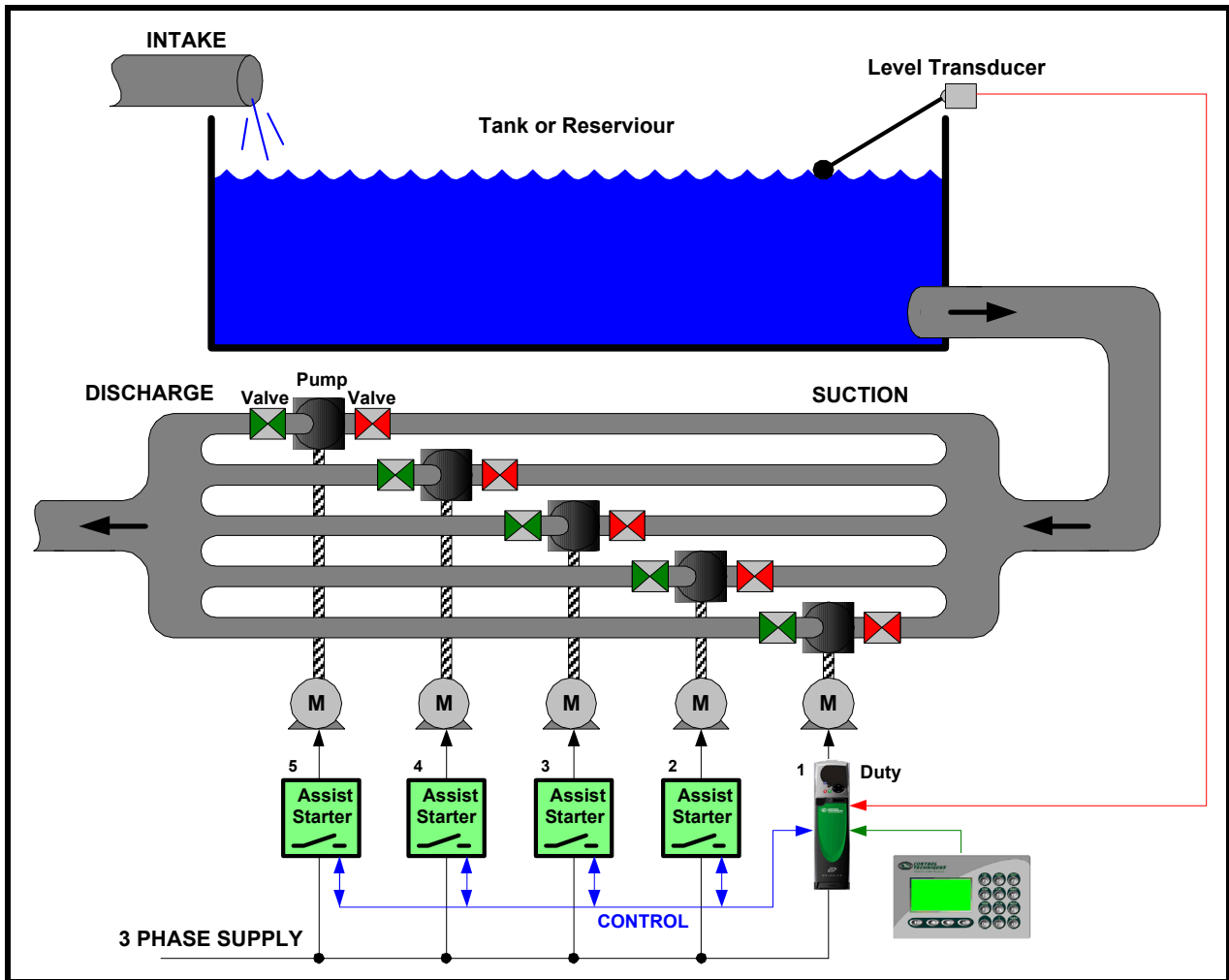
Pressure Control – (Inverse Speed Profile 18.31 =0)



This system will regulate a constant pressure where the speed demand for the inverter should vary, inversely proportional to the system process error, natural PID response. That is: Pressure increases the inverter speed decreases, and vice versa, as shown below:

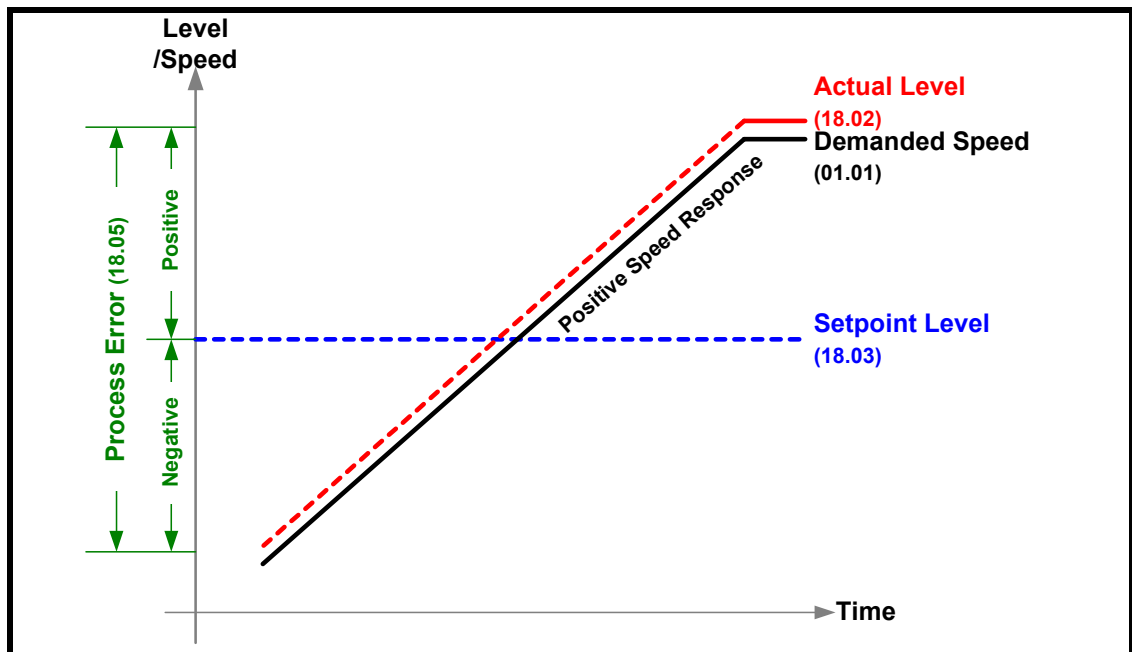


Level Control with Discharge Pump – (Proportional Speed Profile 18.31 =1)

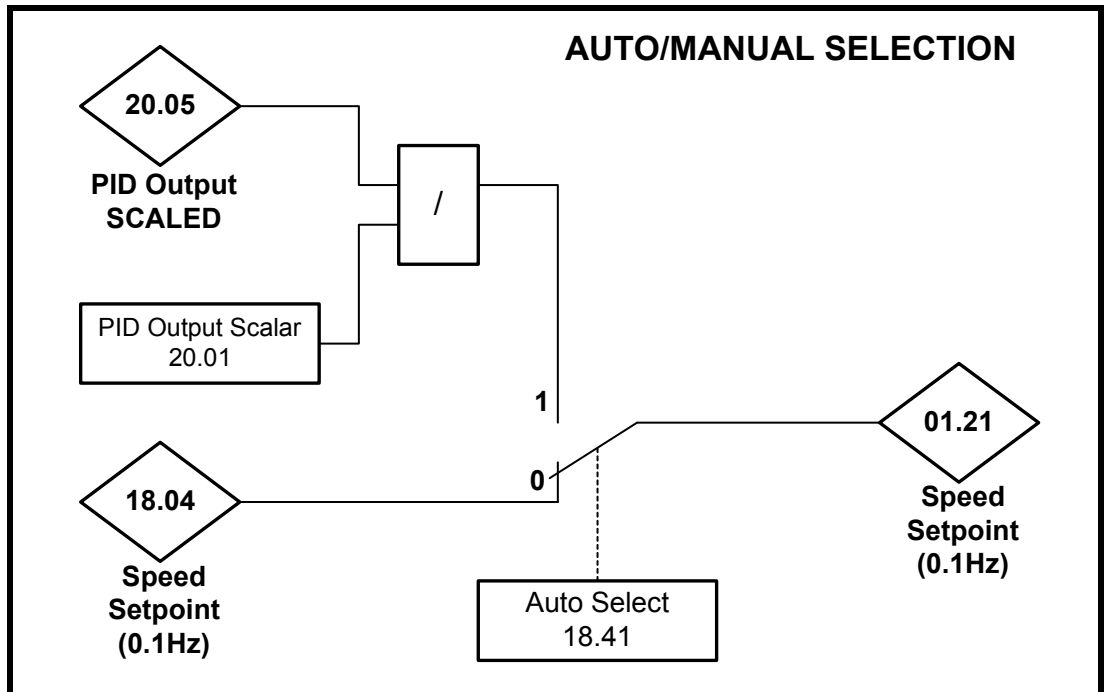


This system will regulate a constant level where the speed demand for the inverter should vary proportionally to the system process error.

That is: Level increases, the inverter speed also increases, and vice versa.



6.4 Auto/Manual Selection



The speed reference to the Duty drive can be derived from one of two sources:

1. Manual - A direct speed reference. Refer to section Set-point/Feedback Scaling & Selection for speed set point selection.

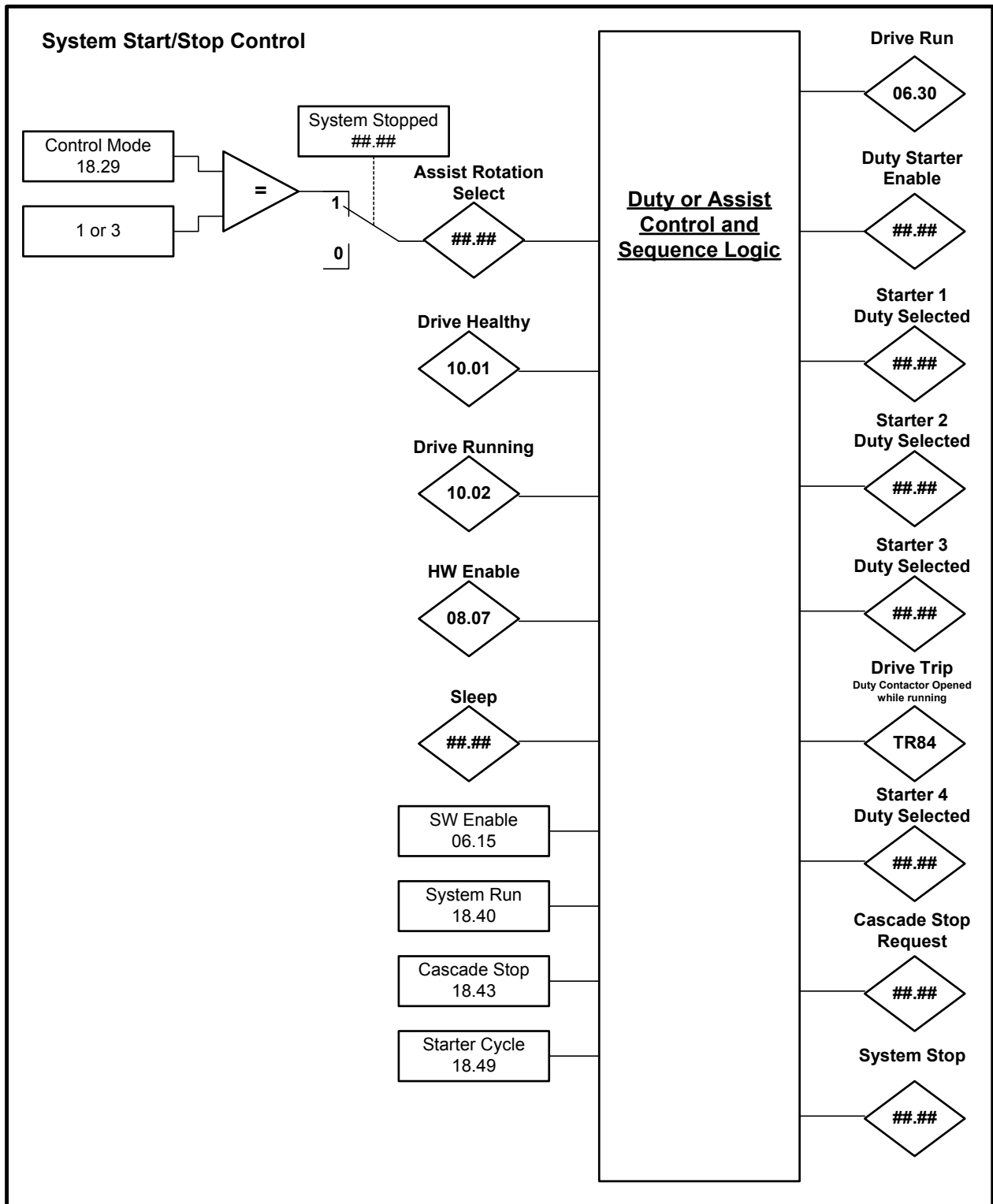
This mode can be used to:

- Run process open loop for tests or emergency situations.
- Checkout the assists, start and stop sequencing without any influence of the process feedback. (Care must be taken not to exceed process limits).
- Accept speed signal derived from an external PID controller as the assist call control and protection logic is still active and available.

Sleep function is not available in this mode.

2. Auto - The speed is derived from the resultant output of the inbuilt PID function, which is dependant on the process error and the gains set. The selection is determined by the Auto select parameter 18.40.

6.5 System Start/Stop Control Logic



###.## - Denotes internal variable and no visible parameter is assigned.

6.5.1 Fixed Duty Mode

With the Duty drive available the system can be started & stopped.

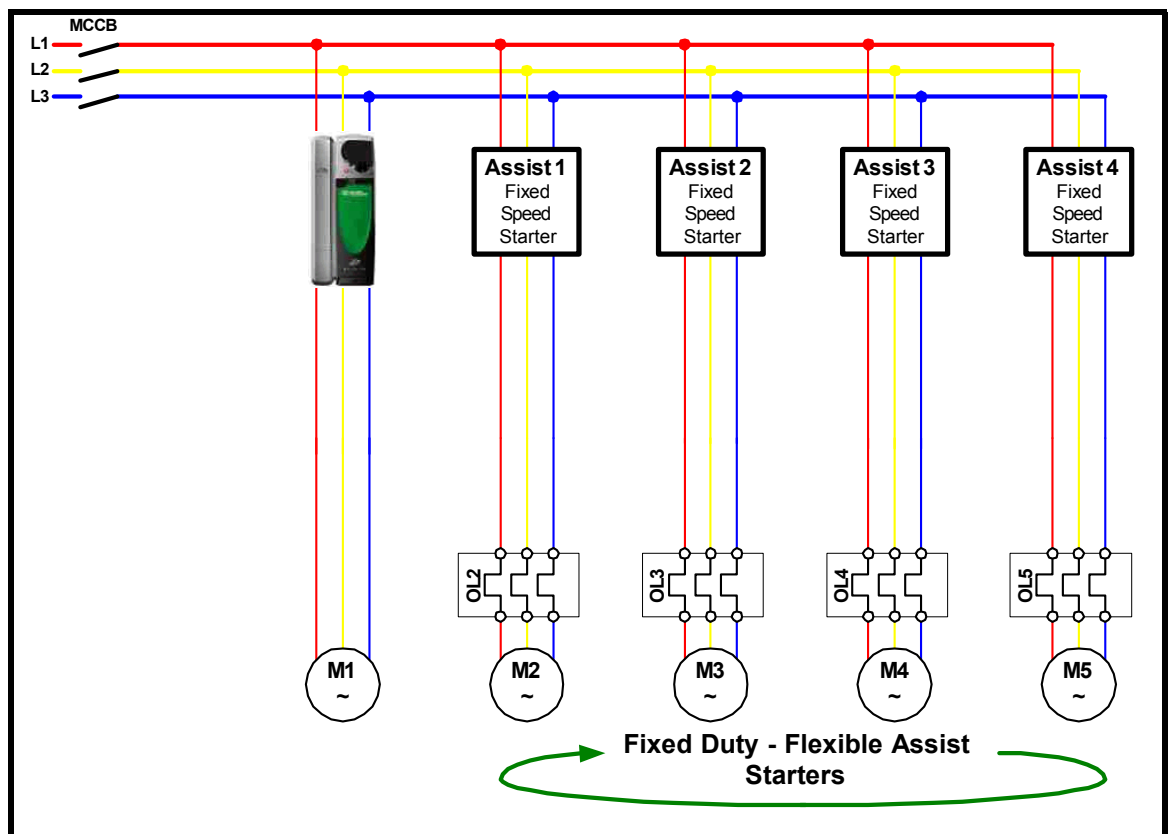
The NORMAL STOP mode will ramp down the duty drive first and stopped. On acknowledgement of duty drive stop all starters will be disabled.

The CASCADE STOP will stop each starter in order determined by mode set (Runtime or sequence). The Duty drive will be the last starter to be stopped.

The starters can also be stopped automatically if Cycle or the Sleep functions are selected, but the system will remain enabled. (Please refer to the Sleep and Cycle function for more details).

The SLEEP Function is active when this feature is enabled and the Duty is the only starter running.

The CYCLE Function is active when this feature is enabled and not all starters are running in one of the runtime modes.



6.5.2 Flexible Duty Mode

The flexible duty system logic operation is slightly different to the fixed duty system logic, as the drive output contactor for the selected motor is required to be controlled.

With the Duty drive available and the run is closed the Duty output contactor is selected, (from lowest runtime or first in sequence).

On acknowledgment of the contactor being closed the drive is started after 2 seconds has elapsed. This is to ensure there is sufficient time for the contactor to close.

Stopping the system is done in the reverse order the drive is stopped first and 2 seconds after the selected output contactor is opened.

The NORMAL STOP mode will ramp down the Duty drive first and stop. On acknowledgement of drive stop all starter will be disabled and the duty output contactor will be opened after 2 seconds has elapsed.

The CASCADE STOP will stop each starter in order determined by mode set (runtime or sequence), the Duty drive will be the last starter to be stopped. When the drive has ramped to zero and stopped and the output contactor will be opened when 2 seconds has elapsed.

The drive will trip 'TR84' if the Duty output contactor opens during operation.

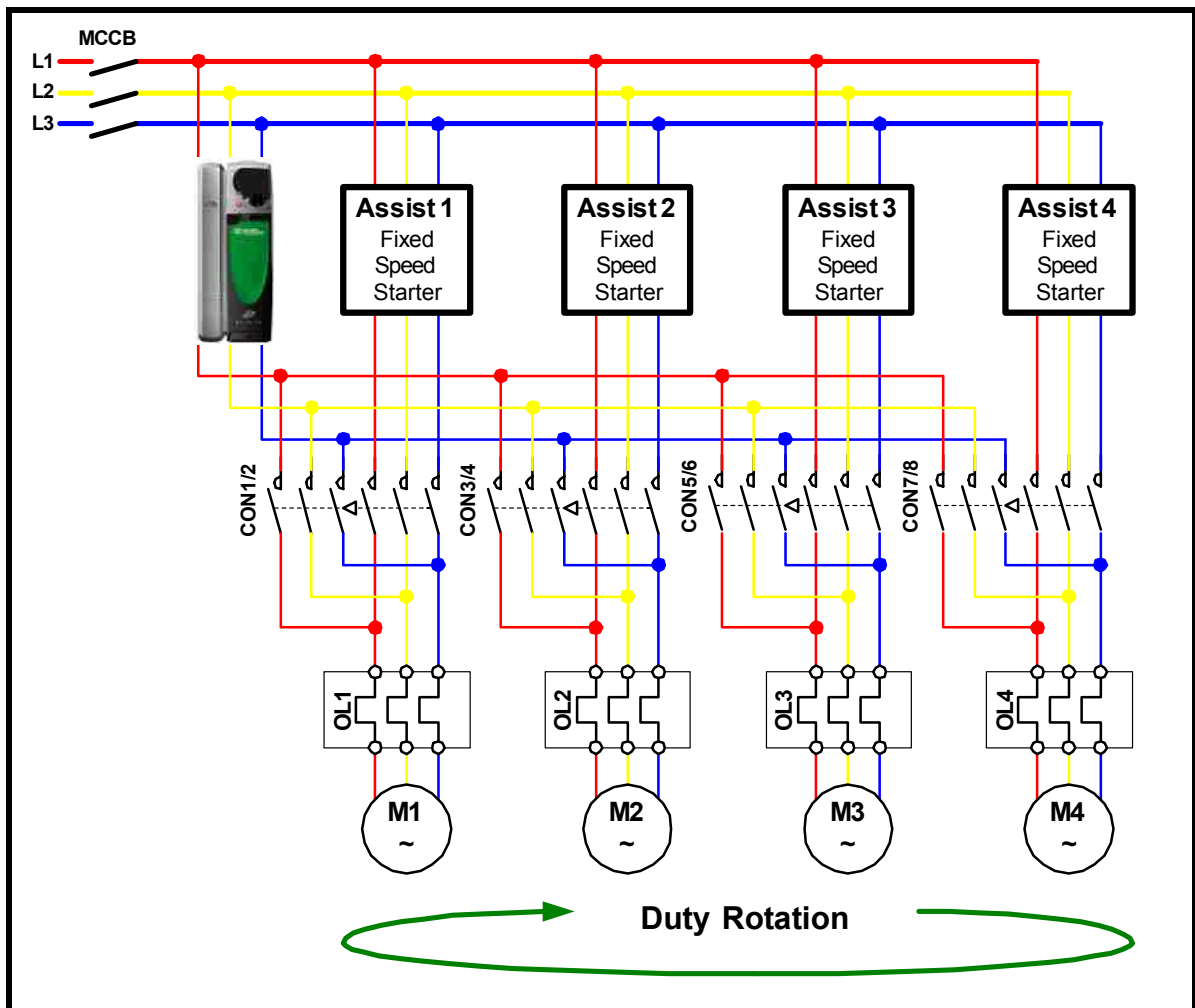
The duty motor/output contactor is selected by:

- Available and Not already running
- Mode - runtime or the order of sequence

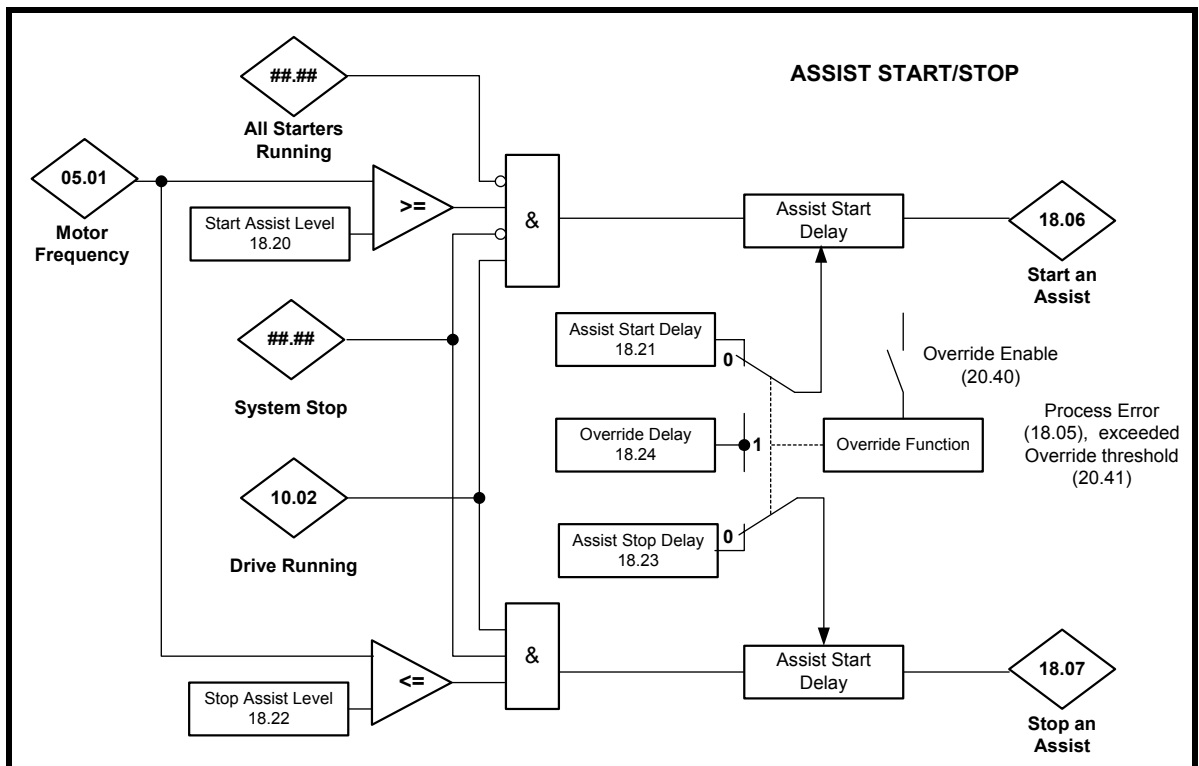
The starters can be stopped if Cycle or the Sleep functions are selected, but the system will remain enabled. (Please refer to the Sleep and Cycle function for more details).

The SLEEP Function is active when this feature is enabled and the Duty is the only starter running.

The CYCLE Function is active when this feature is enabled and not all starters are running in one of the runtime modes.



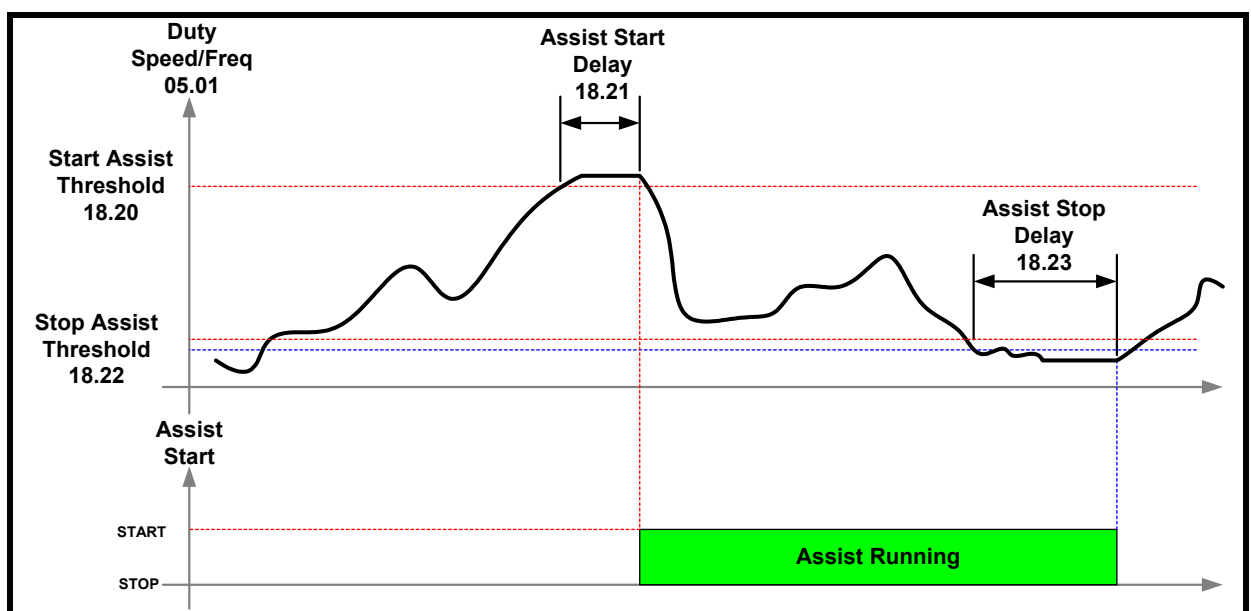
6.6 Assist Start/Stop



- Denotes internal variable and no visible parameter is assigned.

The Duty drive will always be running within the system as long as there is a process demand. If the demand exceeds the capacity of the Duty then an assist starter will be requested to start, to help to meet the required demand. If the demand reduces below the duty supply capacity, then the Duty will request an assist starter to stop.

The threshold for the Assist start/stop are set with respect to the Duty Speed as this is a good indication of Duty flow capacity, (e.g. Speed is proportional to flow). Typically the Assist Start/Stop thresholds are set to variable Duty working speed range (60-100% or 30 to 50Hz). To ensure there are no spurious start/stopping of the Assist, Start/Stop time delays are available.

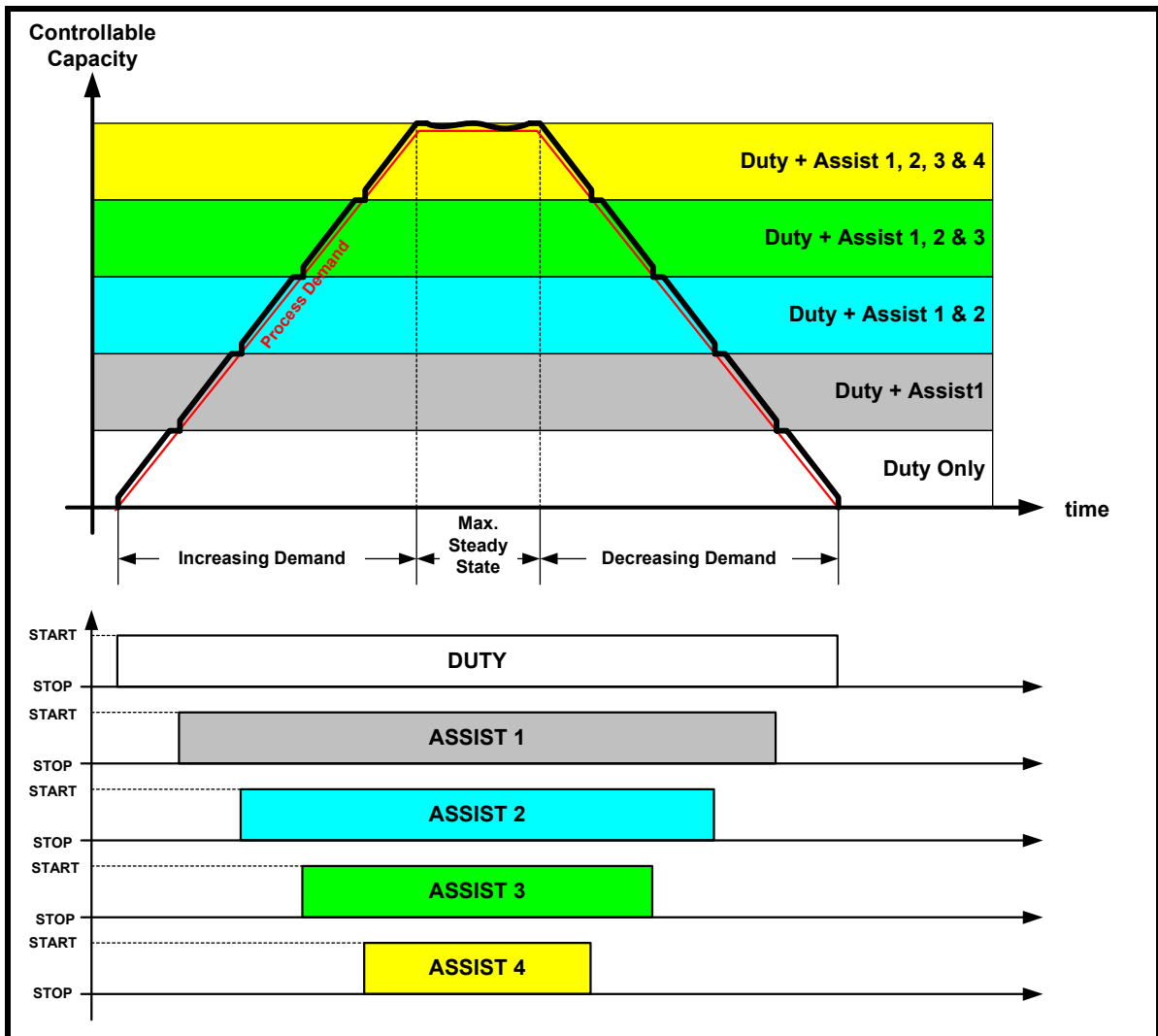


Effect of the Duty control when the Assist Started & Stopped

The following simply explains a Duty Assist system controlling pressure.

When the duty is at maximum speed for a predetermined time period the assist will be commanded to start. The assist motor will quickly accelerated to full speed and the delivery pressure will also increase correspondingly. If the process set point is exceeded the Duty speed will be reduced by the PID controller to compensate for this increase.

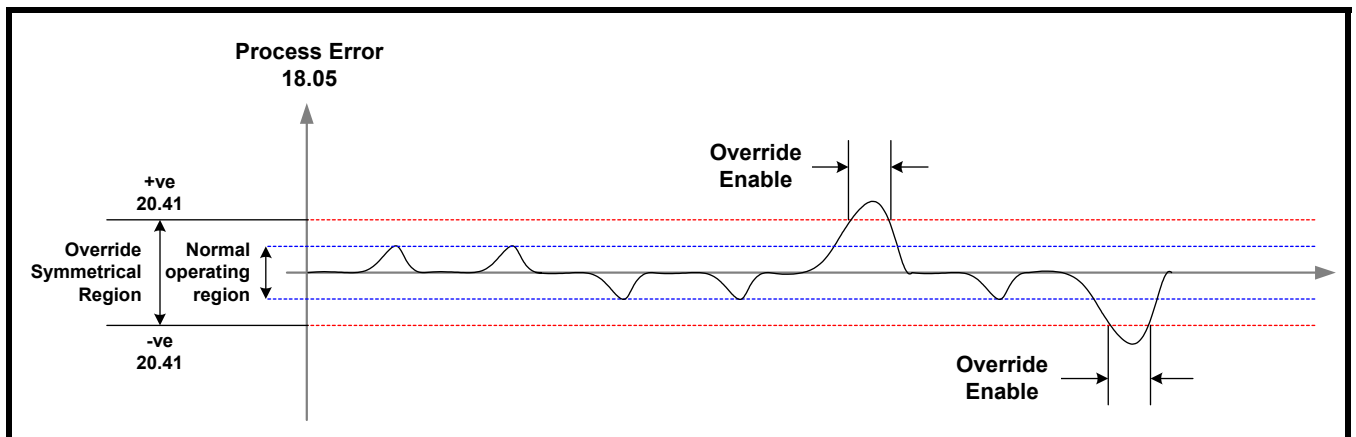
When the assist is stopped, while the Duty is at minimum speed for a predetermined time, the delivery pressure will decrease correspondingly, therefore if the delivery falls below the demanded set point the Duty speed will increase by the PID controller to compensate for this decrease.



6.6.1 Assist Start/Stop Override

In some cases during the day or week there may occur a peak loading on the system, where it may be required for the system to react a lot quicker to meet the demand. For this requirement a shorter start/stop time delay can be introduced by enabling the override function (20.40).

The override function operates by setting a symmetrical threshold (20.41), around the process error, if exceeded the override delay (18.24) is used instead of the normal start/stop delays defined in parameters (18.21 & 18.23 respectively). The override thresholds should be set with some margin outside the normal operating region of the process error.

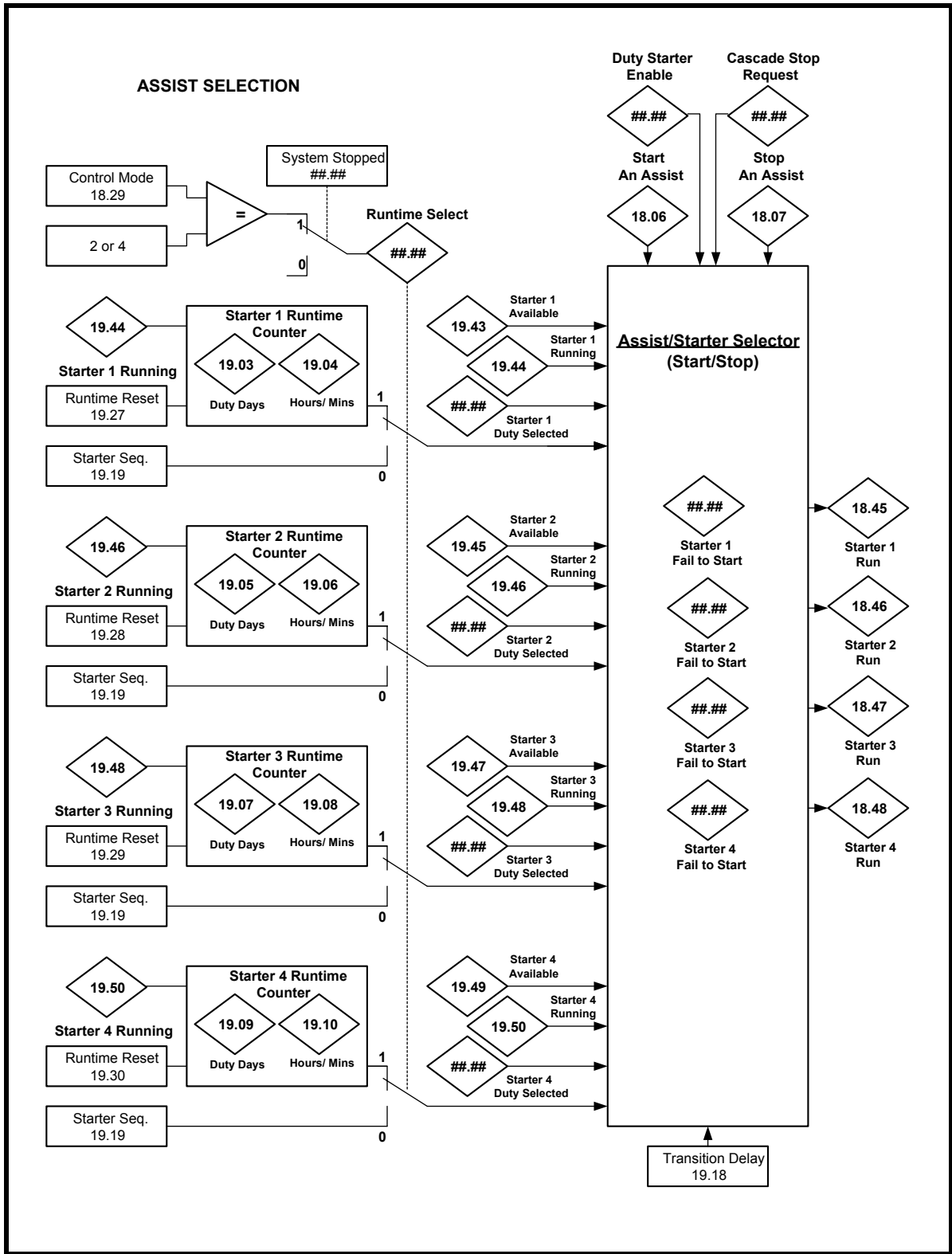


NOTE This does not override the transition delay (19.18).



Set the override level with some margin, within the max error band and outside the normal operating region. This will ensure no spurious switching between normal and override delay selection. It is advisable to configure this feature once the system is running satisfactory in Auto mode, (PID) and the start/stop level have been correctly set.

6.7 Assist Selection



###.## - Denotes internal variable and no visible parameter is assigned.

6.7.1 Assist Selection Description

This function determines which starter is to be selected, for start or stop. The selection is determined on the following criteria:

Selecting Starter to Start

1. Start request.
 - a. Assistance required to help meet process demand, refer to previous section Assist Start/Stop.
 - b. Initial Duty starter selection when a start is commanded. Only applicable in flexible duty modes 2 and 4 are used (18.29)
2. Starter must be stopped, (e.g. not already selected or running in manual mode when a mode selector switch is used on each starter)
3. Available to start, (e.g. Healthy, no trip interlocks and in Auto mode when a mode selector switch is used on each starter).
4. Sequence or Runtime.

Selecting Starter to Stop

1. Stop request.
 - a. Assistance not required to help meet process demand, refer to previous section Assist Start/Stop.
 - b. Duty starter stop when a stop is commanded. The duty cannot be stopped until all assist starters have stopped. Only applicable when flexible duty modes 2 and 4 are used (18.29)
2. Starter must be running.
3. Available to stop, (e.g. In Auto mode when a mode selector switch is used on each starter).
4. Sequence or Runtime.

6.7.2 Sequence Selection

Each starter is selected in a predefined order set by the user in parameter 19.19. The most to the least significant digit defines the order of each starter to be selected to start, and in the reverse order for stopping. For example:

Starting:

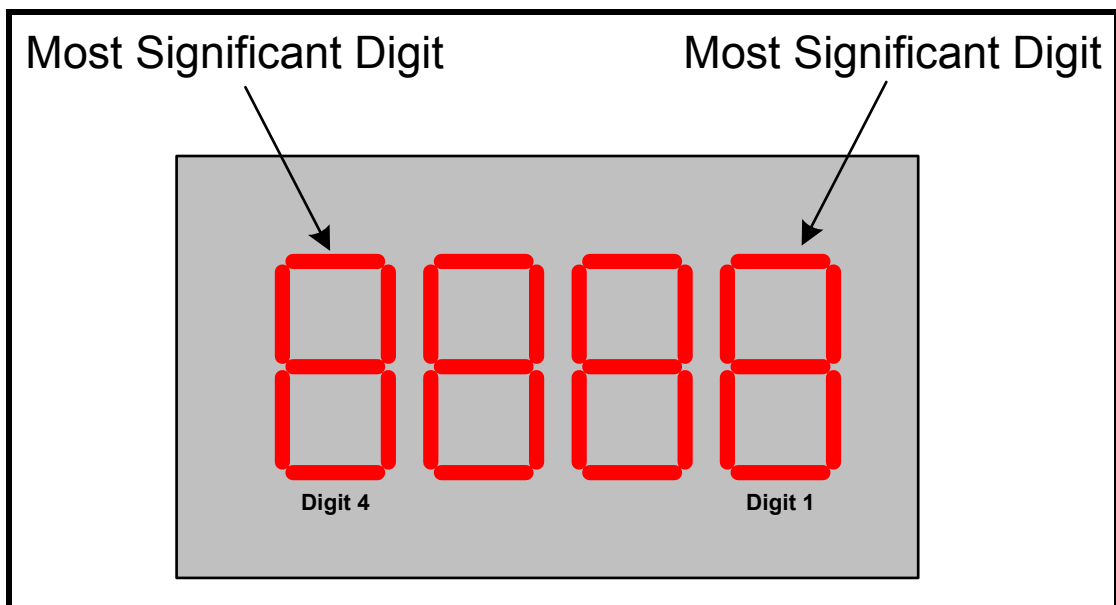
Most significant Digit is the first starter be selected to start and the least significant digit is the last.

Stopping:

Least significant Digit is the first starter be selected to stop and the most significant digit is the last.

This is applicable to any number of starters used. E.g. if 3 starters are used, (parameter 18.30 = 3), it is important to ensure the first 3 digits, from most significant digit (digit 4), values correspond to the starters required to be controlled. The least significant digit (digit 1), will be ignored.

When the selected starter fails to start, or not available or already running then the next starter in the sequential order will be started. When the starter becomes available again then it will be selected when the next assist start is requested.



6.7.3 Runtime Selection

Each starter is selected by the number of run time hours. The order of starting will begin with the starter with the less runtime hours commencing to the starter with the most. The order of stopping will begin with the starter running with the most runtime hours commencing to the starter with the least.

When the selected starter fails to start, or not available or already running then the next starter with the lowest runtime will be started. When the starter becomes available again then it will be selected when the next assist start is requested.

6.7.4 Transitional Delay

The transitional delay, parameter 19.18 defines the delay for the next starter to be started or stopped if the start/stop request remains high. This may occur due to the process demand not being satisfied with the original requested starter, (e.g. starter Failed to start or more capacity required). This delay should be set to allow enough time for the assist to have an effect on the system, (for the Assist start/stop request to go low), This will therefore guard against premature starting of assists starters in slow reacting loads, like temperature or level control processes.

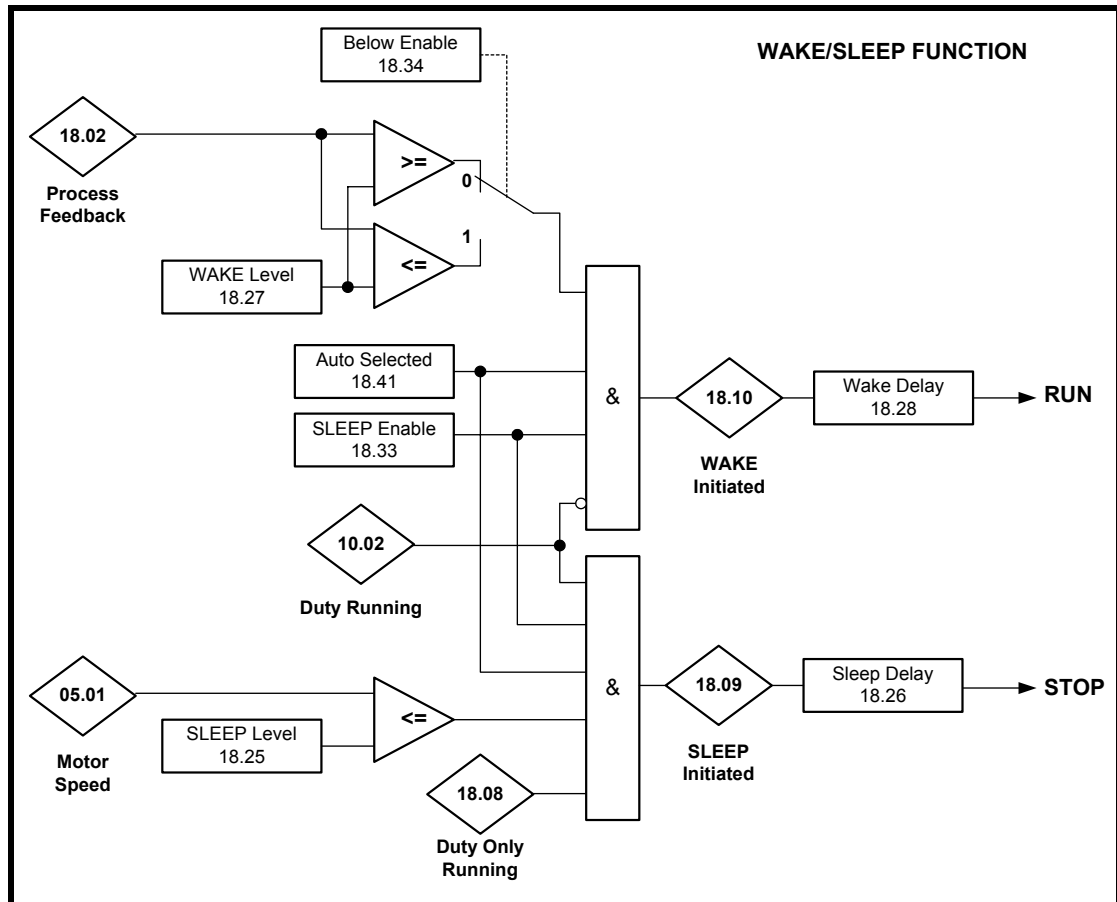
6.7.5 Assist Fail to Start

When an assist starter fails to start on selection, due to a loose wire etc, within the transitional delay time, the starter will be lock out to enable another assist starter to start. To enable the failed starter to be available for reselected, the system reset is required to be performed. This is achievable by following methods:

1. Terminal 2 mode is selected (19.25 =2), closed input on term 27.
2. No terminal allocation, set parameter 18.50 = 1.
3. Serial communications, set bit 6 of the control word parameter 73.70.

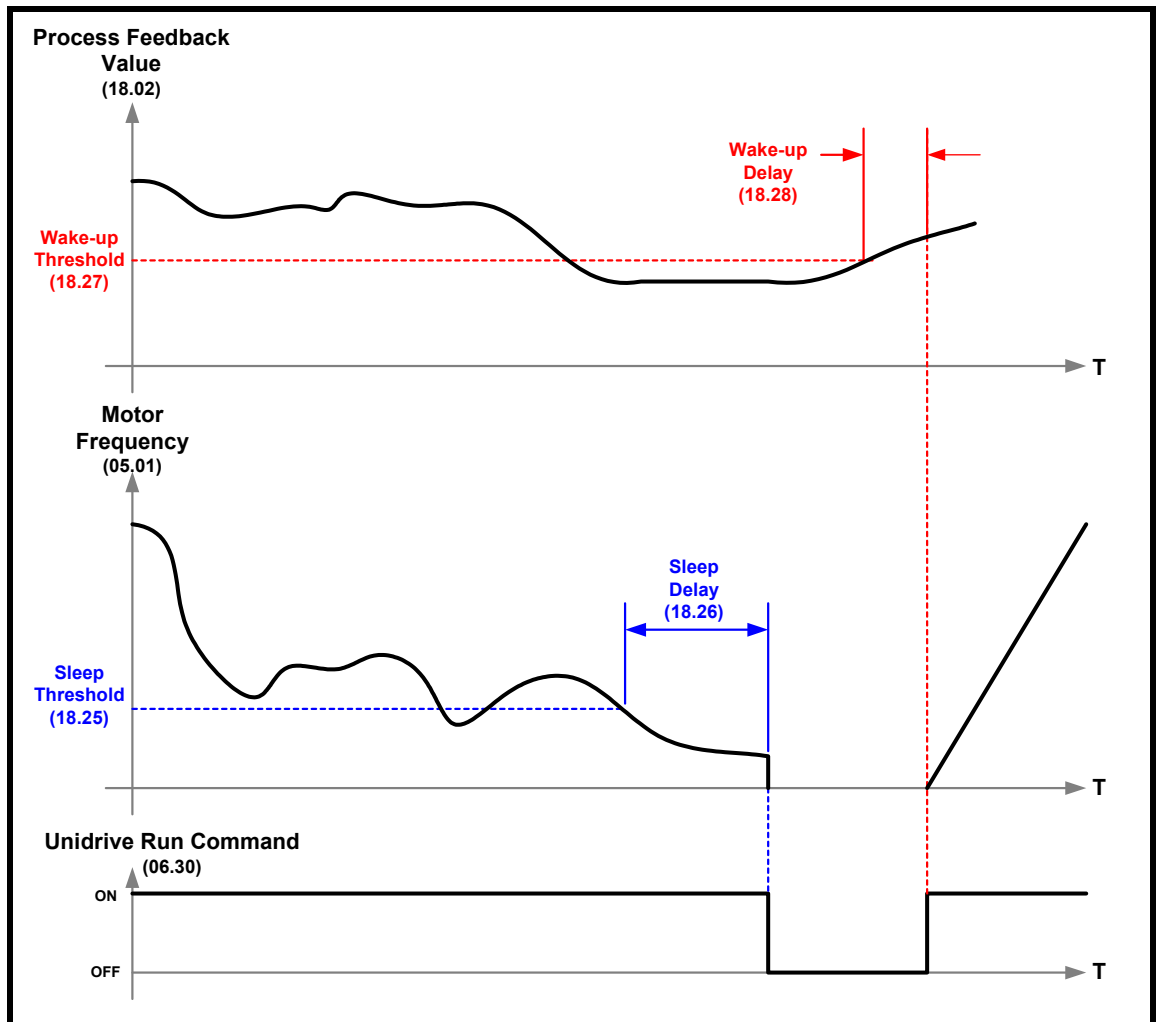
Indication of the assist starters, in order of failure is displayed in parameter 19.22. Bit parameter 19.32, a global assist starter fail-to-start flag, is set when any of the starters have failed.

6.8 Wake/Sleep Function



When the variable speed demand on a centrifugal type load is less than 40% the system load power is negligible, due to the power being proportional to the cube of speed. The majority of the power derived to system at low speeds is supporting the system static losses (e.g. Inverter, motor, pump, gearbox, etc), though this power loss is small in comparison to the total load power the annual costs can be quite significant. To help reduce the cost of this waste of power over long periods of time, the controller can sense a speed threshold where the motor is practically running at no load, and switch-off /stop the inverter. The inverter can be switch-on/started again when the system demand increases to a suitable level. This function is known as 'Sleep' and 'Wake' function, where sleep mode is when the inverter switches off and wake mode is when the inverter switched back on line. This function is used in applications with wide controllable ranges or slow process updates like temperature control that have large system time constants.

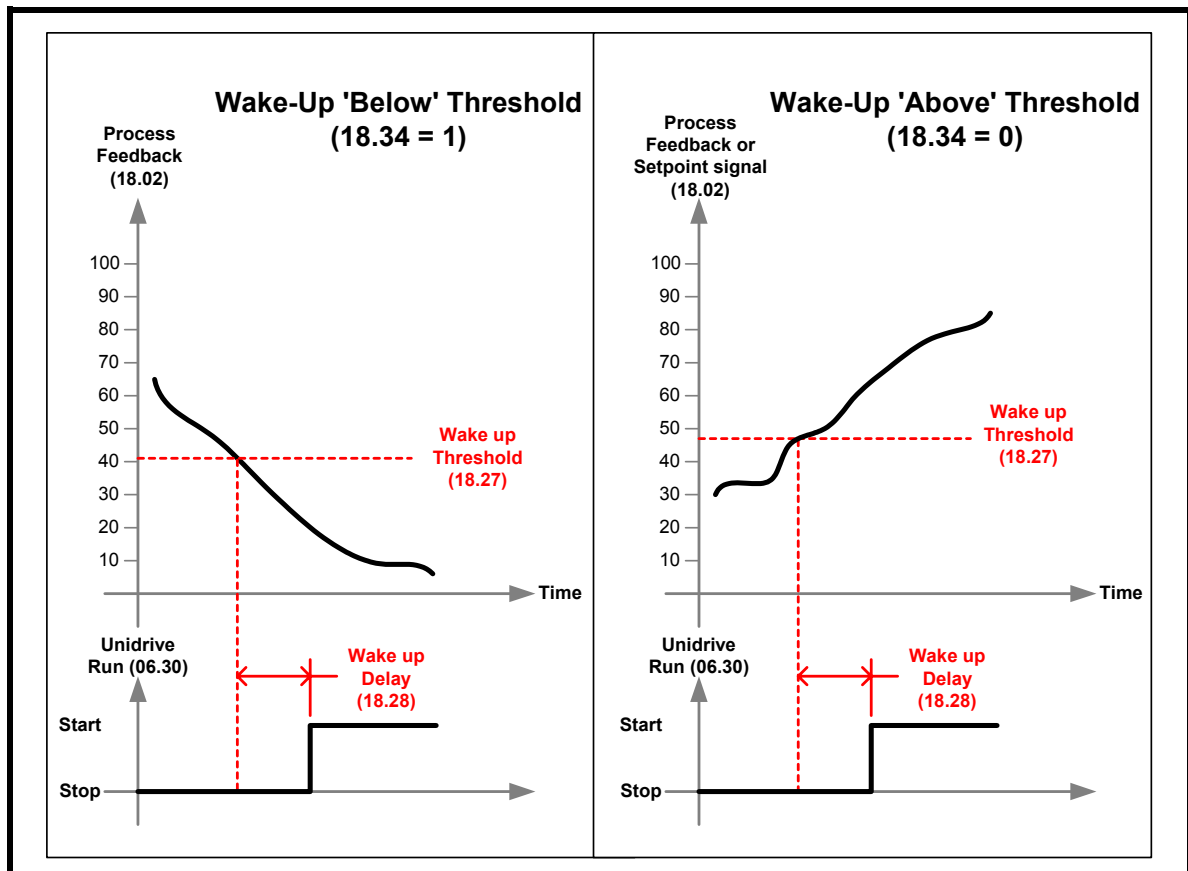
The Wake/Sleep function is enabled by parameter 18.33 and is only operational when the Duty Assist system is in 'Auto, mode (18.41=1). To 'Sleep', the duty must be the only starter running and the duty motor frequency must be equal or below the sleep threshold for the duration, that exceeds the sleep time delay. To 'Wake', the duty must not be running, while the process feedback has exceeded the wake threshold for the duration that exceeds the wake time delay.



The wake function can be set to start the Duty drive when process feedback is above or below the wake threshold as shown below. This is set dependant on the speed profile set for the process being controlled.

Example

1. In processes where the speed increases proportionally with the process feedback, (e.g. Temperature), the duty drive is required to 'sleep' at low speeds, where the process feedback should be below the wake threshold. The drive will 'wake' when the process feedback exceeds, or is above the wake threshold. In this case it is advisable to set the wake threshold ABOVE the process set-point.
2. In processes where the speed increases inversely proportionally with the process feedback, (e.g. Pressure), the duty drive is required to 'sleep' at low speeds, where the process feedback should be above the wake threshold. The drive will 'wake' when the process feedback is 'below' the wake threshold. In this case it is advisable to set the wake threshold BELOW the process set-point.



Drive could Start and Stop un-expectedly when this feature is enabled as it is automatically under control of the feedback signal and drive frequency.

6.9 Cycle Starters

The Cycle Function ensures that all the starters are rotated during lengthy operation times, and it is only applicable when operating in one of the runtimes modes, (18.29 = 3 or 4).

Though the assist selection function ensures each assist starter is selected by its runtime when started and stopped, on some occasions the same starters may remain running for lengthy period of time, as these are sufficient to meet the current process demand. Meaning the other starters may not or never get selected. This is common in systems where one or more starters are for standby operation.

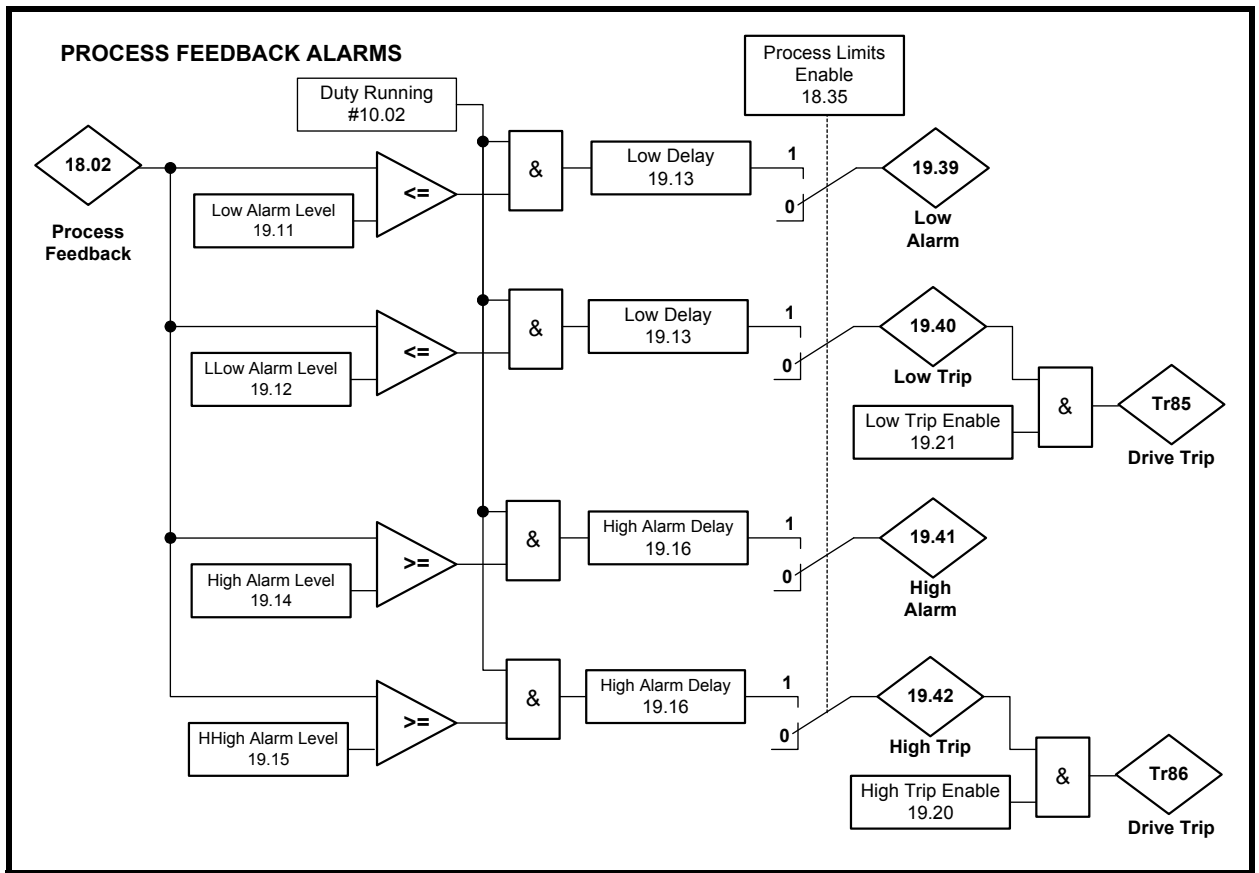
Setting the Cycle parameter (18.49 = 1) will stop the system starters, after a predefined time set in parameter 20.04. The system will restart again allowing the starter with lowest runtime to be selected.

This will function is inhibited when all starters are running together.



Drive could Start and Stop unexpectedly when this feature is enabled as it is automatically under control of the feedback signal and drive frequency.

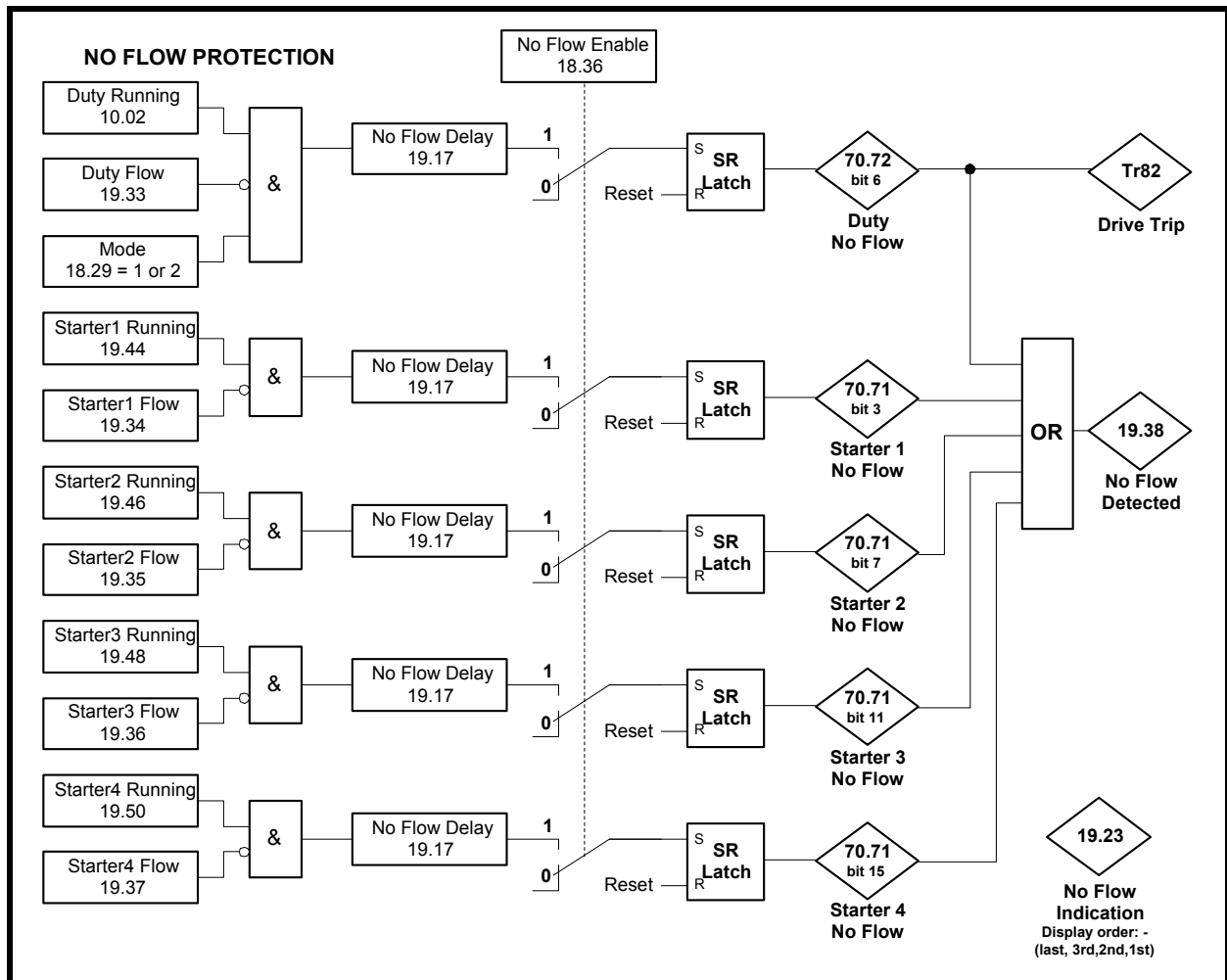
6.10 Process Feedback Alarms



The Process Feedback Alarms provides indication and when required, integrated protection for the process. Four alarms thresholds with respect to the process feedback can be set-up and monitored when the duty drive is running. Two are high alarms, that are set when the process feedback exceeds the thresholds set in 19.14 & 19.15, and two are Low alarms, that are set when the process feedback fall below the thresholds set. Two common alarm delays are available, (Low delay 19.13; High Delay 19.16), to help reduce any spurious tripping or indication.

The High-High and Low-Low alarms can be set to trip the Unidrive-SP/system, (Tr81 or Tr80), when the process feedback is equal or outside these thresholds, (19.20=1 or 19.21=1 respectively). The trips can be reset by the 'System reset'.

6.11 No Flow Protection



No flow protection ensures the system or machine, whether it is a Fan or a pump, is not damaged when operational for long durations of time with no flow.

A flow switch mounted on the machine manifold is set to detect/acknowledge minimum allowable flow for the machine. The flow switch is usually a fail-safe contact, closed for flow & open for no flow. The flow protection is monitored when this feature is enabled (18.36=1) and the motor starter is running. A common no flow time delay is used to ensure flow is established. The delay time should be set for the worst case, which is usually dependant on the starter with the longest ramp time to establish flow.

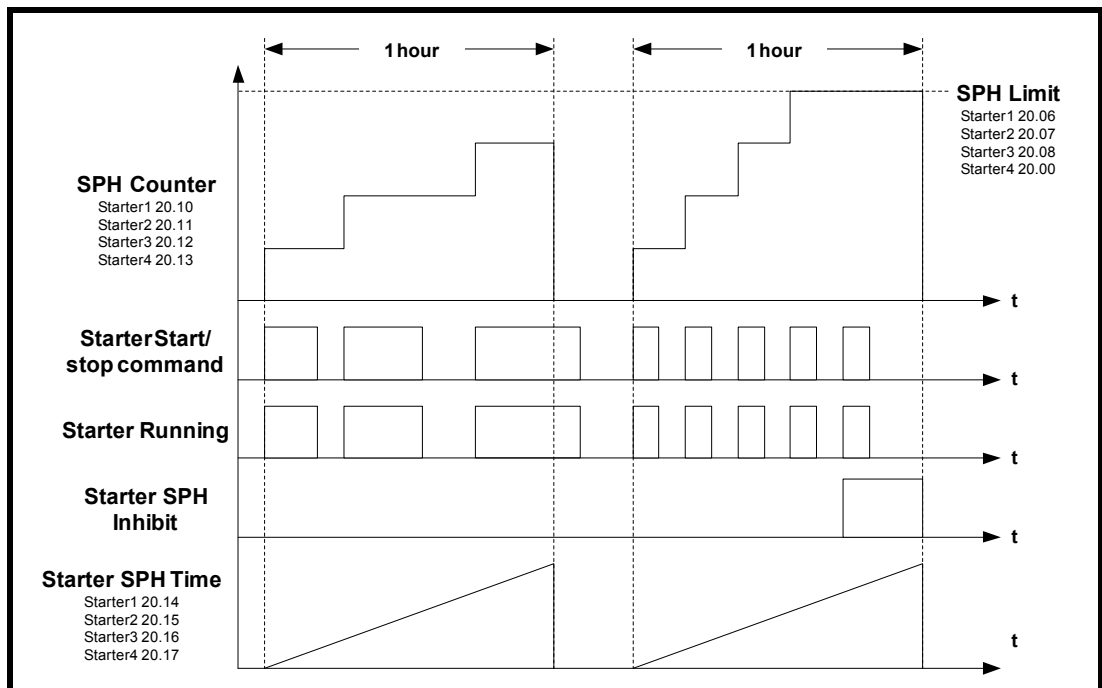
When no flow has been detected on a machine the corresponding starter will be stopped. The starter will be made unavailable to start until a system reset has been performed. Parameter 19.38 when set, indicates a no flow on one or more machine has been detected. Indication of the starters with no flow detected and the order they occurred is displayed in parameter 19.23. The least significant digit is the first and the most significant digit is the last starter with no flow detected.

An independent no flow protection is used for the duty when the mode is selected to any of the two fixed duty modes (18.29 = 1 or 3). If no flow is detected on the fixed duty the drive will trip 'TR82'.

When a no flow is detected on the selected duty motor, operating in Flexible duty mode (18.29 = 2 or 4), each assist starter is stopped in turn, the duty is then ramped down to stop and 2 seconds after the output contactor is opened. A new duty motor is reselected and the duty is ramped back up to speed. The previous duty starter will be locked out from being selected until a system reset is performed.

The No flow inputs can be sourced from local Unidrive-SP inputs or via serial communications. Standard terminal defaults (19.25 = 1 or 2), do not source any of the no flow inputs.

6.12 Number Starts per Hour Protection



The assist starters in most cases will be fixed speed starters like Direct-On-Line, Soft starter, Auto-Transformer & Star-Delta starters. The motor will be restricted to a limited number of starts per hour due to these fixed speed, starting methods. Consult the motor manufacturers documentation for this information.

The Number of SPH protection function enables the user to limit the number of starts per hour on each fixed speed motor. If the limit is exceeded, the corresponding starter will be inhibited and made unavailable for selection. The starter will be available for selection again when the remaining time left within the hour has elapsed, to allow the motor to cool down.

Each starter is monitored and a count value is accumulated every time it is started. This protection is only active when the SM-Applications is powered up and the feature is enabled, parameter 19.31 = 1.

The Count value is reset every Hour, which allows the starter to be restarted to the maximum defined limit.

When in Duty Rotation mode the selected Duty motor SPH counter is inhibited, as it is not application for variable speed drives.

NOTE Additional Overload protection is required for each fixed speed starter, fuses & Thermal Overloads. These should be adequately rated to provide the primary protection.

7 Parameter Descriptions

7.1 Unidrive-SP Parameters

The following parameters listed are only relevant to this application (in open loop mode). A short description of the parameter is given but for more information please refer to the Unidrive-SP manuals.

7.1.1 Saving parameters

To save parameters to Non-volatile memory enter 1000 to any of the XX.00 parameters and press the reset button.

7.1.2 Other documentation references

Manual Description	CT Part Number
Unidrive-SP User Guide	0471 - 0000
Unidrive-SP Advanced User Guide	0447 – 0002-XX

7.1.3 Menu 1

01.01	Reference selected
Coding	RO, B, P
Range:	$\pm 1000.0^*$
Units:	Hz
Default settings:	

Indication of the reference being used by the drive is given for system set up and fault finding.

01.06	Maximum Frequency Clamp
Coding	RO, B, P
Range:	± 3000.0
Units:	Hz
Default settings:	50.0

Defines drive absolute maximum frequency reference.

01.07	Minimum Frequency Clamp
Coding	RO, B, P
Range:	± 3000.0
Units:	Hz
Default settings:	0.0

Defines drive absolute minimum frequency reference.

01.10	Bipolar reference select
Coding	RW, B,
Default settings:	0

If the user requires changing the direction of rotation with a bipolar reference, this parameter should be set. If it is not, all negative references are treated as zero.

Application Recommended setting = 3.

01.11	Reference enabled indicator
Coding	RO, Bit, P

The drive sequencer defined in Menu 6 controls this indicator. This is set when commanded to run with the drive enabled and healthy.

01.14	Reference selector
Coding	RW, Uni
Range:	0-5
Default settings:	0

This parameter is used to select a speed reference as follows:

- 0 Analogue 1. & Analogue 2 *Selected by terminal input
- 1 Analogue1.or Preset Speed References*
- 2 Analogue2.or Preset Speed References*
- 3 Preset Speed References Only
- 4 Keypad Reference
- 5 Precision Speed Reference

(*Preset reference dependent on parameter 01.15)

Application Recommended setting = 3.

01.15 Preset selector	
Coding	RW, Uni
Range:	0-9
Default settings:	0

This parameter is used to select a preset speed reference as follows:

- 0 Preset selection by terminal input
- 1 Preset 1 selected
- 2 Preset 2 selected
- 3 Preset 3 selected
- 4 Preset 4 selected
- 5 Preset 5 selected
- 6 Preset 6 selected
- 7 Preset 7 selected
- 8 Preset 8 selected
- 9 Preset selection by timer

Application Recommended setting = 1.

01.21 Preset Speed reference 1	
Coding	RW, Bi
Range:	±3000.0
Units:	Hz
Default settings:	0.0

Preset speed reference 1.

This is the speed reference is derived from the application software within the SM-Applications Module.

7.1.4 Menu 2

02.01 Post ramp speed reference	
Coding	RO, Bi, P
Range:	±1000.0
Units:	Hz

This is the speed reference after the ramps. The range of this parameter is restricted so that it cannot be larger than the range set by Pr 01.06 (maximum speed clamp) and Pr 01.07 (minimum speed clamp).

02.04 Ramp mode	
Coding	RW, Txt
Range:	0 – 2
Default settings:	2

This parameter has 3 settings as follows:

- 0 FAST Fast ramp
- 1 Std Standard ramp with ramp control
- 2 Std.hV Standard ramp with motor voltage boost

Application Recommended setting = 1.

02.10 Acceleration Selector	
Coding	RW, Uni
Range:	0 – 9
Default settings:	0

This parameter is used to select acceleration ramp rates as follows:

- 0 Ramp rate selection by terminal input
- 1 Ramp rate 1 selected
- 2 Ramp rate 2 selected
- 3 Ramp rate 3 selected
- 4 Ramp rate 4 selected
- 5 Ramp rate 5 selected
- 6 Ramp rate 6 selected
- 7 Ramp rate 7 selected
- 8 Ramp rate 8 selected
- 9 Ramp rate selection by preset reference selection

Application Recommended setting = 0 or 1.

02.11 Acceleration Rate	
Coding	RW, Uni
Range:	0.0 - 3200.0
Units:	s/100Hz
Default settings:	5.0

This sets the Acceleration rate for Post ramp reference to ramp up to Pre ramp reference. when Post ramp reference is less than Pre-ramp reference.

02.20 Deceleration Selector	
Coding	RW, Uni
Range:	0 – 9
Default settings:	0

This parameter is used to select Deceleration ramp rates as follows:

- 0 Ramp rate selection by terminal input
- 1 Ramp rate 1 selected
- 2 Ramp rate 2 selected
- 3 Ramp rate 3 selected
- 4 Ramp rate 4 selected
- 5 Ramp rate 5 selected
- 6 Ramp rate 6 selected
- 7 Ramp rate 7 selected
- 8 Ramp rate 8 selected
- 9 Ramp rate selection by preset reference selection

Application Recommended setting = 0 or 1.

02.21 Deceleration Rate	
Coding	RW, Uni
Range:	Open loop 0.0 - 3200.0
Units:	Open loop s/100Hz
Default settings:	5.0

This sets the Deceleration rate for Post ramp reference to ramp down to Pre ramp reference when Post ramp reference is greater than Pre-ramp reference.

7.1.5 Menu 3

03.05 Zero Speed Threshold	
Coding	RW, Uni
Range:	0 – 20.0
Units:	Hz

If the speed feedback (parameter 03.02) is at or below the level defined by this parameter in either direction the Zero speed flag (parameter 10.03) is 1, otherwise the flag is 0.

7.1.6 Menu 4

04.01 Motor current magnitude	
Coding	RO, Uni, P
Range:	0 to maximum drive current
Units:	Amps

This parameter is the rms current from each output phase of the drive.

04.07 Symmetrical Current Limit	
Coding	RW, Uni
Range:	0 to 400%
Units:	% of rated active current
Default settings:	150

This sets the symmetrical current as a percentage of Motor rated current.

04.15 Thermal Time Constant	
Coding	RW, Uni
Range:	0 to 400
Units:	s
Default settings:	Vector = 89 : Servo = 20

The temperature of the motor as a percentage of maximum temperature, with a constant current magnitude of I , constant value of K and constant value of Motor Rated Current after time t is given by:

$$\text{Temp} = [I^2 / (K \times \text{Motor rated current})^2] (1 - e^{-t/t}) \times 100\%$$

This assumes that the maximum allowed motor temperature is produced $K \times$ Motor rated current and that t is the thermal time constant of the point in the motor that reaches it maximum allowed temperature first. t is defined by parameter 04.15. The estimated motor temperature is given by parameter 04.19 as a percentage of maximum temperature. If 04.15 is set to zero the thermal protection system is disabled. Otherwise 04.15 defines the thermal time constant, except if the parameter has a value between 0.0 and 1.0 the thermal time constant is taken as 1.0

7.1.7 Menu 5

05.01 Motor Frequency	
Coding	RO, Bi, P
Range:	0 - 1000.0
Units:	Hz

This is the indication of Motor frequency. The range of this parameter is the maximum magnitude of Pr 01.06 and 01.07 plus whatever is added or subtracted for the slip compensation.

05.02 Motor Voltage	
Coding	RO, Bi, P
Range:	0 – 528
Units:	Volts

This Indicates the Motor terminal voltage.

05.03 Motor Power	
Coding	RO, Bi, P
Range:	+/- Max Drive power
Units:	kW

This Indicates the Motor Power.

05.04 Motor Speed	
Coding	RO, Bi, P
Range:	+/- 60,000
Units:	rpm

The motor rpm is calculated from the post ramp reference.

05.05 DC Bus Voltage	
Coding	RO, Uni, P
Range:	0 - 830
Units:	Volts

Voltage across the internal d.c. link of the drive.

05.06 Motor rated Frequency	
Coding	RW, Uni
Range:	0 to 1000
Units:	Hz
Default settings:	Eur = 50.0 : USA = 60.0

The motor nameplate rated frequency.

05.07 Motor rated Current	
Coding	RW, Uni
Range:	0 to Drive Rating
Units:	Amps
Default settings:	Drive Rating

The motor nameplate rated Current.

05.08 Motor rated Full load rpm	
Coding	RW, Uni
Range:	0 to 40,000
Units:	rpm
Default settings:	0

The motor nameplate rated speed. If set greater than 0 in open loop this will enable slip compensation.

Application Recommended setting = 0.

05.09 Motor rated Voltage	
Coding	RW, Uni
Range:	0 to 480
Units:	Volts
Default settings:	Eur = 400 : USA = 460

The motor nameplate rated Voltage.

05.10 Motor rated Power Factor	
Coding	RW, Uni, S, P
Range:	0 to 1.000
Default settings:	0.920

The motor nameplate rated Power factor. This automatically set when an auto-tune is performed. When set manually it is suggested that the motor nameplate value divided by 0.95 is used to allow for the effect of motor leakage inductance.

This is necessary because the Unidrive-SP power factor parameter represents $\cos(i_{\text{torque}}/i_{\text{rated}})$ whereas the motor manufacturer defines the power factor as $\cos(i_{\text{real}}/i_{\text{rated}})$ where i_{real} is the in phase component of current.

Winders operating in Torque mode above motor base speed require accurate control of motor torque, an indication of the accuracy of this function and hence the validity of the motor map parameters, may be assessed by checking the values of 4.02 (active current) and 4.17 (magnetising current) throughout the speed range.

In the constant torque area 4.02 should vary in relation to tension set point and diameter (Total torque) whilst 4.17 (Magnetising current) should remain constant. When the constant power region is reached 4.17 should reduce weakening the flux as the speed is increased and 4.02 should show a related increase in value to compensate for the reduction in flux.

05.11 Motor Number of Poles	
Coding	RW, Txt, P
Range:	0 - 60
Units:	poles
Default settings:	0 = Auto

Set to the no. of poles for the motor being used.

05.12 Magnetising Current test Enable	
Coding	RW, Uni
Default settings:	0

1 Stationary test

The stationary test measures the stator resistance (05.17) and voltage offset (05.23). The power factor (05.10) is not affected.

2 Rotating test

A stationary test is performed to measure stator resistance (05.17), voltage offset (05.23) and transient inductance (05.24). The transient inductance is not used directly by the drive, but is an intermediate value in determining the power factor after the rotating test. This is followed by a rotating test in which the motor is accelerated with the currently selected ramps to 2/3 of rated speed and held at this speed for several seconds. Once the test is complete the power factor (05.10) is updated and the motor coasts to a stop. The motor should be unloaded for this test to produce correct results.

05.13 Dynamic V/F select	
Coding	RW, Bit
Default settings:	0

Setting this bit enables dynamic V / F mode which is intended for applications where power loss should be kept to a minimum under low load conditions. The rated frequency used to derive the Voltage / Frequency characteristic of the drive is varied with load.

Application Recommended setting = 1.

05.14 Voltage Mode select	
Coding	RW, Txt, P
Range:	0 - 5
Default settings:	4

This parameter selects the voltage control mode used by the open loop drive. This falls into two categories: vector mode and fixed boost.

- 0 Ur_S Stator resistance and voltage offset measured at each start
- 1 Ur No measurements 2 = Ur
- 2 Fd Fixed boost mode.
- 3 Ur_Auto Stator resistance and voltage offset measured at first drive enable
- 4 Ur_l Stator resistance and voltage offset measured at each power-up
- 5 SrE Square law characteristic

Application Recommended setting = 2, 4 or 5.

05.15 Voltage Boost	
Coding	RW, Uni
Range:	0 to 25.0
Units:	% of motor Volts
Default settings:	3.0

The boost level for the fixed boost characteristic is defined by this parameter, when parameter 05.14 = 3.

05.18 Switching Frequency	
Coding	RW, Txt
Range:	3- 16
Units:	kHz
Default settings:	3

This defines the PWM switching frequency, selection range: - 3kHz, 4kHz, 6kHz, 8kHz, 12kHz & 16kHz.

7.1.8 Menu 6

06.01 Stop mode selector	
Coding	RW, Txt
Range:	0 - 4
Default settings:	1

Defines the type of stopping mode when the run signal is removed.

- 0 COASt Coast stop
- 1 rP Ramp stop
- 2 rP.dcl Ramp stop + 1 second dc injection
- 3 dcl Injection braking stop with detection of zero speed
- 4 td.dcl Timed injection braking stop

Application Recommended setting = 1.

06.04 Sequencing Mode	
Coding	RW, Uni, P
Range:	0 - 4
Default settings:	4

This parameter is provided to allow the user to select several predefined digital input routing macros to control the sequencer. When a value between 0 and 3 is selected the drive processor continuously updates the destination parameters for digital I/O F2, F3 and F4, and to the enable sequencer latching bit (06.40). When a value of 4 is selected the destination parameters for these digital I/O and parameter 06.40 can be modified by the user.

NOTE Any changes made to the destination parameters only become active after a drive reset.

06.04	F2	F3	F4	06.40
0	*06.29	06.30 Run Forward	06.32 Run Reverse	0 (non latching)
1	06.39 Not stop	06.30 Run Forward	06.32 Run Reverse	1 (latching)
2	*06.29	06.34 Run	06.33 Fwd /Rev	0 (non latching)
3	06.39 Not stop	06.34 Run	06.33 Fwd/Rev	1 (latching)
4	User prog	User prog	User prog	User prog

Application Recommended setting = 4.

06.09 Synchronize to a spinning motor	
Coding	RW, Uni
Range:	0 - 3
Default settings:	0

When the drive is enabled with this bit at zero, the output frequency starts at zero and ramps to the required reference. When the drive is enabled when this parameter has a non-zero value, the drive performs a start-up test to determine the motor speed and then sets the initial output frequency to the synchronous frequency of the motor. Restrictions may be placed on the frequencies detected by the drive as follows:

06.09	Function
0	Disabled
1	Detect all frequencies
2	Detect positive frequencies only
3	Detect negative frequencies only

06.15 Drive enable	
Coding	RW, Bit
Default settings:	1

Setting this parameter to 0 will disable the drive. It must be at 1 for the drive to run.

The Application software controls this parameter.

06.40 Enable sequencer latching	
Coding	RW, Bit
Default settings:	0

Setting this parameter to 0 will disable the drive. It must be at 1 for the drive to run.

Application Recommended setting = 0.

7.1.9 Menu 7

07.01 Terminal 5 & 6 - Analogue Input 1 Value	
Coding	R0
Range	±100.00

07.02 Terminal 7 - Analogue Input 2 Value	
Coding	R0
Range	±100.00

07.03 Terminal 8 - Analogue Input 3 Value	
Coding	R0
Range	±100.00

These parameters should be used to configure the users selection of analogue I/O. In most instances it should only be necessary to enter address pointer data. Offsets and scale factors should normally be left at default.

07.07 Analogue Input 1 Offset trim	
Coding	RW, Txt
Range	±10.000
Default settings:	0

Trims any offset in the reference signal.

Application recommended setting = 0.

07.08 Analogue Input 1 Scaling	
Coding	RW, Uni
Range	0.000 – 4.000
Default settings:	1.000

Allows scaling of analogue signals, should not be necessary.

Application recommended setting = 1.000.

07.09 Analogue Input 1 Invert	
Coding	RW, Bit
Range	0-1
Default settings:	0

Inverts the polarity of the analogue signal.

Application recommended setting = 0.

07.10 Analogue Input 1 destination address	
Coding	RW, Uni
Range	0.00 – 21.51
Default settings:	1.36

Sets the parameter, which the analogue input, is to control. Modifications are only accepted after a reset.

Application recommended setting = 0.

07.11 Analogue Input 2 Mode selector	
Coding	RW, Txt
Default settings:	0

Determines the type of signal to be handled.

Refer to section 3.4.2 *Analog Signal Types* for more details.

07.12 Analogue Input 2 Scaling	
Coding	RW, Uni
Range	0.000 – 4.000
Default settings:	1.000

Allows scaling of analogue signals, should not be necessary

Application recommended setting =1.000.

07.13 Analog Input 2 Invert	
Coding	RW, Bit
Range	0-1
Default settings:	0

Inverts the polarity of the analogue signal.

Application recommended setting = 0.

07.14 Analog Input 2 destination address	
Coding	RW, Uni
Range	0.00 – 21.51
Default settings:	0

Sets the parameter, which the analogue input, is to control. Modifications are only accepted after a reset.

Application recommended setting = 0.

07.15 Analog Input 3 Mode selector	
Coding	RW, Txt
Default settings:	0

Determines the type of signal to be handled.

Refer to section 3.4.2 *Analog Signal Types* for more details.

07.16 Analog Input 3 Scaling	
Coding	RW, Uni
Range	0.000 – 4.000
Default settings:	1.000

Allows scaling of analogue signals, should not be necessary.

Application recommended setting = 1.000.

07.17 Analog Input 3 Invert	
Coding	RW, Bit
Range	0-1
Default settings:	0

Inverts the polarity of the analogue signal.

Application recommended setting = 0.

07.18 Analog Input 3 destination address	
Coding	RW, Uni
Range	0.00 – 21.51
Default settings:	0

Sets the parameter, which the analogue input is to control. Modifications are only accepted after a reset.

Application recommended setting = 0.

07.19 Analog Output 1 source parameter	
Coding	RW, Uni
Range	0.00 – 21.51
Default settings:	3.02

Sets the parameter, which is to be output. Modifications are only accepted after a reset.

07.20 Analog Output 1 scaling	
Coding	RW, Uni
Range	0.000 – 4.000
Default settings:	1.000

Scales the analog output with respect to the parameter value.

07.21 Analog Output 1 mode selector	
Coding	RW, Txt
Range	0 - 2
Default settings:	VOLT

Determines the type of signal produced by the analog output.

- i. VOLT
- ii. 0 – 20
- iii. 4 – 20

07.22 Analog Output 2 source parameter	
Coding	RW, Uni
Range	0.00 – 21.51
Default settings:	4.02

Sets the parameter, which is to be output. Modifications are only accepted after a reset.

07.23 Analog Output 2 scaling	
Coding	RW, Uni
Range	0.000 – 4.000
Default settings:	1.000

Scales the analog output with respect to the parameter value.

07.24 Analog Output 2 mode selector	
Coding	RW, Txt
Range	0 - 2
Default settings:	VOLT

Determines the type of signal produced by the analog output.

- i. VOLT
- ii. 0 – 20
- iii. 4 – 20

For details of other Menu 7 analog configuration parameters see the Unidrive-SP Manual.

7.1.10 Menu 8

The following parameters may be used to monitor and configure the digital control functions. Settings will depend upon the desired functionality of the particular installation.

08.01 Terminal 24 Digital I/O State indicator	
Coding	RO, Bit
Range	0 - 1

08.02 Terminal 25 Digital I/O State indicator	
Coding	RO, Bit
Range	0 - 1

08.03 Terminal 26 Digital I/O State indicator	
Coding	RO, Bit
Range	0 - 1

08.04 Terminal 27 Digital I/P State indicator	
Coding	RO, Bit
Range	0 - 1

08.05 Terminal 28 Digital I/P State indicator	
Coding	RO, Bit
Range	0 - 1

08.06 Terminal 29 Digital I/P State indicator	
Coding	RO, Bit
Range	0 - 1

08.07 Terminal 41&42 Status Relay indicator	
Coding	RO, Bit
Range	0 - 1

08.09 Terminal 31 Enable I/P State	
Coding	RO, Bit
Range	0 - 1

08.10	Enable mode select
Coding	RO, Bit
Range	0 - 1

Application recommended setting 1.

08.21	Terminal 24 destination or source parameter
Coding	RW, Uni
Range	0.00 – 21.51
Default setting:	10.03 (At Zero Speed)

08.11	Terminal 24 invert
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.31	Terminal 24 output enable
Coding	RW, Bit
Range	0 - 1
Default setting:	1

08.22	Terminal 25 destination or source parameter
Coding	RW, Uni
Range	0.00 – 21.51
Default setting:	10.33 (Reset)

08.12	Terminal 25 invert
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.32	Terminal 25 output enable
Coding	RW, Bit
Range	0 - 1
Default setting:	1

08.23 Terminal 26 destination or source parameter	
Coding	RW, Uni
Range	0.00 – 21.51
Default setting:	06.30 (Run Forward)

NOTE This Parameter should be set to another parameter destination other than the Default. Parameter 06.30 is set within the Winder Program, using this default setting will cause incorrect operation of the winder.

08.13 Terminal 26 invert	
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.33 Terminal 26 output enable	
Coding	RW, Bit
Range	0 - 1
Default setting:	1

08.24 Terminal 27 destination or source parameter	
Coding	RW, Uni
Range	0.00 – 21.51
Default setting:	06.32 (Run Reverse)

NOTE This Parameter should be set to another parameter destination other than the Default. Parameter 06.32 is set within the Winder Program, using this default setting will cause incorrect operation of the winder.

08.14 Terminal 27 invert	
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.25 Terminal 28 destination or source parameter	
Coding	RW, Uni
Range	0.00 – 21.51
Default setting:	01.41 (Analogue ref. 2 select)

08.15 Terminal 28 invert	
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.26 Terminal 29 destination or source parameter	
Coding	RW, Uni
Range	0.00 – 21.51
Default setting:	06.31 (Jog)

NOTE This Parameter should be set to another parameter destination other than the Default. Parameter 06.31 is set within the Winder Program, using this default setting will cause incorrect operation of the winder.

08.16 Terminal 29 invert	
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.27 Relay source parameter	
Coding	RW, Uni
Range	0.00 – 21.51
Default setting:	10.01 (Drive Healthy)

08.17 Relay invert	
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.29 Positive logic select	
Coding	RW, Bit
Range	0 - 1
Default setting:	0

08.30 Open collector outputs select	
Coding	RW, Bit
Range	0 - 1
Default setting:	0

Allows outputs to be wired in parallel.

08.39	F5 and F6 auto-selection
Coding	RW, Bit
Range	0 - 1
Default setting:	0

When this parameter is 0, parameters 08.25 and 08.26 are set up automatically according to the setting of the reference select parameter 01.14. Setting this parameter to 1 disables this function.

Application Recommended setting = 1.

7.1.11 Menu 10

10.34	No. of auto reset attempts
Coding	RW, Uni
Range:	0 - 5
Default settings:	0

If this parameter is set to zero then no auto reset attempts are made. Any other value will cause the drive to automatically reset following a trip for the number of times programmed. Pr 10.35 defines the time between the trip and the auto reset. The reset count is only incremented when the trip is the same as the previous trip, otherwise it is reset to 0. When the reset count reaches the programmed value, any further trip of the same type will not incur an auto-reset.

If there has been no trip for 5 minutes then the reset count is cleared.

10.35	Auto reset delay
Coding	RW, Uni
Range:	0.0 - 25.0
Units:	s
Default settings:	1.0

This parameter defines the time between a trip and an auto reset subject to the minimum trip time for IGBT over-current trips.

7.1.12 Menu 11

11.23 Serial comms. address	
Coding	RW, Uni
Range:	0 - 247
Default settings:	1

Used to define the unique address for the drive for the serial interface. The drive is always a slave.

ANSI

When the ANSI protocol is used the first digit is the group and the second digit is the address within a group. The maximum permitted group number is 9 and the maximum permitted address within a group is 9. Therefore, parameter 11.23 is limited to 99 in this mode. The value 00 is used to globally address all slaves on the system, and x0 is used to address all slaves of group x, therefore these addresses should not be set in this parameter.

Modbus RTU

When the Modbus RTU protocol is used addresses between 0 and 247 are permitted. Address 0 is used to globally address all slaves, and so this address should not be set in this parameter.

11.24 Serial comms. mode selector	
Coding	RW, Txt, R, P
Range:	0 - 1
Default settings:	1

This parameter defines the communications protocol used by the 485 comms port on the drive. This parameter can be changed via the drive keypad, via an option module or via the comms interface itself. If it is changed via the comms interface, the response to the command uses the original protocol. The master should wait at least 20ms before send a new message using the new protocol. (Note: ANSI uses 7 data bits, 1 stop bit and even parity; Modbus RTU uses 8 data bits, 2 stops bits and no parity.)

Parameter value String Comms mode:

- 0 = AnSI ANSIx3.28 protocol
- 1 = rtU Modbus RTU protocol

11.25 Serial comms. baud rate selector	
Coding	RW, Txt, P
Range:	0 - 9
Default settings:	6 (19200)

Used in all comms modes to define the baud rate.

This parameter can be changed via the drive keypad, via an option module or via the comms interface itself. If it is changed via the comms interface, the response to the command uses the original baud rate. The master should wait at least 20ms before send a new message using the new baud rate.

Parameter value String/baud rate:

- 0 = 300
- 1 = 600
- 2 = 1200
- 3 = 2400
- 4 = 4800
- 5 = 9600
- 6 = 19200
- 7 = 38400
- 8* = 57600
- 9* = 115200

*Modbus RTU only

11.26 Minimum Comms Transmit Delay	
Coding	RW, Uni
Range:	0 to 250
Units:	ms
Default settings:	2

There will always be a finite delay between the end of a message from the host (master) and the time at which the host is ready to receive the response from the drive (slave). The drive does not respond until at least 1ms after the message has been received from the host allowing 1ms for the host to change from transmit to receive mode. This delay can be extended using parameter 11.26 if required for both ANSI and Modbus RTU protocols.

7.1.13 Menu 15, 16 & 17

These are used for the SM-option module set up parameters and are allocated depending on the Slot the SM option module is fitted, (refer to section Slot Menus). For Further information on SM-option module set ip menus please refer to the relevant manual, detailed below:

Manual Description	CT Part Number
SM-DeviceNet	0471-0009
SM-PROFIBUS-DP	0471-0008
SM-Applications	0471-0007
SM-I/O Plus	0471-0006
SM-Universal Encoder Plus	0471-0005

7.1.14 SM-Application Menu

##.13 Auto-run	
Coding	RW, Bit
Default settings:	1

Setting this parameter to 1 will cause the program in the SM-APPLICATIONS MODULE to automatically execute whenever the drive is powered up. If this parameter is set to a zero, a run command is required via Sypt for the program to run.

NOTE The following parameters are set by the Duty Assist application software on power up/ reset and should not be changed by the user.

Parameter	Description	Setting
06.40	Enable sequencer latching	0
##.11	SM-App. Clock Task tick time	10
##.12	SM-App. Position Task Update	0
##.14	SM-App. Global runtime trip enable	1
##.17	SM-App. Parameter Over-range trip	0
##.20	SM-App. Save NV data on power down save.	1
##.21	SM-App. - Save Menu 20 Parameters within flash memory.	1

Changing these parameters will effect the overall operation of this software.

7.2 Application Parameters

7.2.1 Saving parameters

To save Menu 18 & 19 parameters to Non-volatile memory enter 1000 to any of the XX.00 parameters and press the reset button.

For Menu 20, set parameter 17.19 =1. This will automatically reset to 0 when the save has completed.

Menu 20 parameters will also be automatically saved to non-volatile memory on a power down.

7.2.2 Menu 18

18.01 Process Feedback	
Coding	RO, U
Range:	0 - 32767
Units:	TIU

This indicates the Feedback signal in terminal interface units. E.g. the feedback signal value from the A to D converter. This parameter can be written to via serial communication when feedback is source remotely.

18.02 Process Feedback Selected	
Coding	RO, U
Range:	18.14 to 18.12
Units:	EGU

Indication of the selected feedback used by the PID. This is scaled in Engineering units, which is determined by the scaling parameters 18.12 to 18.15. The selected feedback can be derived from Analog 1 (default, or from parameter 18.01. Refer to Analog feedback Enable parameter 18.38.

18.03 Process Set-point Selected	
Coding	RO, U
Range:	18.14 to 18.12
Units:	EGU

Indication of the selected process set-point used by the PID. The selected feedback can be derived from Analog 1 (default), scaled in Engineering units, (determined by the scaling parameters 18.12 to 18.15) or from parameter 18.01. Refer to the Analog set point Enable parameter 18.37.

18.04 Manual Speed Set-point Selected	
Coding	RO, U
Range:	0 – 01.06
Units:	0.1Hz

Indication of the selected speed reference used by the Unidrive-SP when manual mode (Auto Select parameter 18.41=0). The selected set-point can be derived from Analog 2 (default) or from parameter 20.02. Refer the Analog Speed set-point Enable parameter 18.39.

18.05 Process PID Error	
Coding	RO, U
Range:	18.14 to 18.12
Units:	EGU

Indication of the process error used by the PID and is the resultant of the process selected set-point & feedback, and Inverse Speed Profile Enable Parameter (18.31).

18.31 = 0

Error = Set-point (18.03) - Feedback (18.02)

18.31 = 1

Error = Feedback (18.02) – Set-point (18.03)

This error indication is dependant on the setting of the PID Always enabled parameter (18.44):

18.44 = 0

The error value is only visible when the system is in Auto and running.

18.44 = 1

The error value is visible always.

18.06 Start Assist Request	
Coding	RO, Bit

This indicates an assist starter is requested to start.

18.07 Stop Assist Request	
Coding	RO, Bit
Range:	0 – 32767

This indicates an assist starter is requested to stop.

18.08 Duty Only Running	
Coding	RO, Bit

This indicates only the duty drive is currently running with no assist starters.

18.09	Sleep Initiated
Coding	RO, Bit

This indicates the Sleep threshold (18.25) has been exceeded and a sleep-to-stop the drive has been initiated. The drive will stop when the Sleep delay (18.26) has been exceeded.

18.10	Wake Initiated
Coding	RO, Bit

This indicates the Wake threshold (18.27) has been exceeded and a wake-to-start the drive has been initiated. The drive will start when the Wake delay (18.28) has been exceeded.

18.11	Process Preset Set-point 1
Coding	RW, U
Range:	18.14 to 18.12
Units:	EGU
Default settings:	500

This is the parameter for the process set-point and it is enable by selecting analog set-point enable parameter 18.37 = 0. This parameter can be set locally from the Unidrive-SP keypad or written to remotely via serial communication.

18.12	Feedback Scaling EGU High Value
Coding	RW, B
Range:	-32768 - + 32767
Units:	EGU
Default settings:	1000

This scales the required EnGineering Units high value to the corresponding Terminal Interface Unit high value. The value is to be set as an integer, therefore to maintain resolution of controllable engineering range, the value can be set as a fixed point integer as shown below.

e.g. A linear feedback source is connected to analog input 1, where the input resolution is 0 – 4000 then,

$$\text{TIU low (18.15) = 0 \& TIU High (18.13) = 4000}$$

The required equivalent real Engineering Unit range is 4.00 to 10.00bar therefore,

$$\text{EGU Low (18.14) = 400 \& EGU High (18.12) = 1000}$$

18.13 Feedback Scaling TIU High Value	
Coding	RW, B
Range:	-32768 - + 32767
Units:	TIU
Default settings:	4000

This defines the terminal interface unit's High value and it corresponds to the max range of the analog A-D range.

Refer to parameter 18.12 example.

18.14 Feedback Scaling EGU Low Value	
Coding	RW, B
Range:	-32768 - + 32767
Units:	EGU
Default settings:	0

This scales the required Engineering Units Low value to the corresponding Terminal interface Unit Low value (18.15). The value is to be set as an integer, therefore to maintain resolution of controllable engineering range the value can be set as a fixed point integer as shown below.

Refer to parameter 18.12 example.

18.15 Feedback Scaling TIU Low Value	
Coding	RW, U
Range:	-32768 - + 32767
Units:	TIU
Default settings:	0

This defines the terminal interface unit's High value and it corresponds to the max range of the analog A-D range.

Refer to parameter 18.12 example.

18.16 Process Set-point Slew Rate	
Coding	RW, U
Range:	0 – 32767
Units:	EGU's / second
Default settings:	0

This sets the process set-point slew rate and limits the rate of change of the applied set-point value to the PID. This parameter is useful in reducing system oscillations with large changes with the set-point, typical application pressure control with high lift pumps, e.g. borehole pumps.

18.17 PID Proportional Gain	
Coding	RW, U
Range:	0 – 32767
Units:	0.01Kp
Default settings:	100

This sets the proportion gain applied to the PID error.

For a process error of 1, and a Proportional gain of 100, the output of the P term will be 1, which is equivalent to 0.1Hz.

NOTE Refer to parameter PID output scalar, (20.20) for changes with gain range/scaling.

18.18 PID Integral Gain	
Coding	RW, U
Range:	0 – 32767
Units:	0.1Ki.sec
Default settings:	50

This sets the Integral gain applied to the PID error.

For a constant error of 1, and an Integral gain of 10, the output of the Iterm will reach 1 after 1 second, which is equivalent to 0.1Hz.

NOTE Refer to parameter PID output scalar, (20.01) for changes with gain range/scaling.

18.19 PID Differential Gain	
Coding	RW, U
Range:	0 – 32767
Units:	0.1Kd /sec
Default settings:	0

This sets the Differential gain applied to the PID error.

For a constant rate of change of error of 1 count per second and a differential gain of 10, the output of the D term will be 1, which is equivalent to 0.1Hz.

NOTE Refer to parameter PID output scalar, (20.01) for changes with gain range/scaling.

18.20 Start Assist Threshold	
Coding	RW, U
Range:	01.07 – 01.06
Units:	0.1 Hz
Default settings:	450

This sets the motor frequency threshold level to request an assistance of an additional starter. This should be set higher than stop assist threshold (18.22).

18.21 Start Assist Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

This defines the delay for the assist starter to start when the start threshold (18.20) has been exceeded.

18.22 Stop Assist Threshold	
Coding	RW, U
Range:	01.07 – 01.06
Units:	0.1 Hz
Default settings:	100

This sets the motor frequency threshold level to request the stopping of an assist starter. This should be set lower than start assist threshold (18.20).

18.23 Stop Assist Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

This defines the delay for the assist starter to stop when the stop threshold (18.22) has been exceeded.

18.24 Override Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	20

This will override the start and stop assist delay (18.21 & 18.23) when the Override enable parameter (18.32) is set and the process error exceeds the override symmetrical threshold (20.21).

18.25 Sleep Threshold	
Coding	RW, U
Range:	01.07 – 01.06
Units:	0.1 Hz
Default settings:	200

This defines the speed threshold level to initiate the drive to sleep. This is active when the Sleep/Wake Enable parameter (18.33) is set and the Duty drive is running only (18.08 =1). This should be set lower than the start assist threshold parameter (18.20).

18.26 Sleep Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

This defines the delay for the Duty drive to stop & sleep, when the sleep threshold (18.25) has been exceeded.

18.27 Wake Threshold	
Coding	RW, U
Range:	18.14 – 18.12
Units:	EGU
Default settings:	210

This defines the process feedback threshold level to initiate the drive to wake. This is active when the Sleep/Wake Enable parameter (18.33) is set. The wake threshold can be configured to wake above or below this threshold by wake below parameter (18.34).

18.28 Wake Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

This defines the delay for the Duty drive to start & wake when the wake threshold (18.27) has been exceeded.

18.29 Mode Select	
Coding	RW, U
Range:	1 – 4
Units:	N/A
Default settings:	1

This selects the required control Mode configuration:

- 1 – Fixed Duty, with 4 assist starter enabled by order of Sequence.
- 2 – Duty rotated, with 3 assist starter enabled by order of Sequence.
- 3 – Fixed Duty, with 4 assist starter enabled by order of Runtime.
- 4 – Duty rotated, with 3 assist starter enabled by order of Runtime.

This parameter can only be changed when the system is stopped. (E.g. Duty drive not running and assist starter are not running in auto).

Sequence mode:

Each starter is selected/deselected by a predefined, fixed sequence defined by Sequence parameter (19.19).

Runtime:

Each starter is selected/deselected by its runtime.

Fixed Duty:

The Duty drive is allocated to one motor only.

Duty Rotated:

The Duty drive can be selected to any motor on the system by switching external contactors.

18.30 Number of Starters	
Coding	RW, U
Range:	1 – 4
Units:	N/A
Default settings:	4

This defines the number of Starter on the system, excluding the duty drive.

In sequence modes, (18.29 = 1 or 3) this will limit the number of starters to be sequentially started and stopped. Refer to the sequence parameter (19.19), for more details on the set up of the order with respect to number of starters.

In runtime mode this will also limit the number starters to started and stopped, but it is important for to ensure the available status on the starters not in used is set to 0, therefore they will be ignored during Runtime selection. Refer to available parameters 19.43, 19.45, 19.47 & 19.49.

This parameter can only be changed when the system is stopped. (E.g. Duty drive not running and assist starter are not running in auto).

18.31	Inverse Speed Profile
Coding	RW, B
Default settings:	0

When set will invert the process set-point and feedback values to give an inverted speed characteristic on the output of the PID. This is applicable to processes where the speed is required to reduce with a positive increase in PID error. E.g. Temperature control by Fan cooling.

18.32	Process Preset Set point 2 Select
Coding	RW, B
Default settings:	0

This parameter selects the source of the set point parameter reference, when in parameter mode (18.37=0).

- 0 = Preset Set point 1 (18.11)
- 1 = Preset Set point 2 (20.23)

18.33	Sleep/Wake Enable
Coding	RW, B
Default settings:	0

This will set the Sleep/Wake feature.

Corresponding parameters (18.25 to 18.28 & 18.34)



Drive could Start and Stop un-expectedly when this feature is enabled as it is automatically under control of the feedback signal and drive frequency.

18.34	Wake Below Enable
Coding	RW, B
Default settings:	0

When set this will Wake/start the drive when the process feedback signal falls below the Wake threshold (18.27) and the wake delay has elapsed (18.28).

When set to zero this will Wake/start the drive when the process feedback signal goes above the Wake threshold (18.27) and the wake delay has elapsed (18.28).

18.35	Process Feedback Alarms Enable
Coding	RW, B
Default settings:	0

When set will enable the process feedback alarm thresholds to be active.

18.36 No Flow Protection Enable	
Coding	RW, B
Default settings:	0

When set will enable the No flow protection on each starter. When Fix Duty mode is selected (18.29 = 1 or 3), the duty no flow will trip the Unidrive-SP, 'TR82' when detected.

18.37 Analog Process Set-point Enable	
Coding	RW, B
Default settings:	1

This will select the source of the process set-point.

- 0 – Preset set-point from parameter 18.11
- 1 – Analog reference from AN2 input terminal 7

18.38 Analog Process Feedback Enable	
Coding	RW, B
Default settings:	1

This will select the source of the process feedback.

- 0 – Feedback is written directly to parameter 18.01. This is only achievable via serial communications.
- 1 – Analog reference from AN1 input terminal 5 & 6

18.39 Analog Speed Set-point Enable	
Coding	RW, B
Default settings:	1

This will select the source of the Manual Speed reference.

- 0 – Speed set-point from parameter 20.02
- 1 – Analog reference from AN2 input terminal 7

NOTE This has the same analog input as the process analog set-point, but its function is determine by the Auto/man mode selected (18.41)

18.40 System Run	
Coding	RW, B
Default settings:	0

Set to 1 will run the system. Set to 0 will stop the system.

Terminal default setting: Digital input F6 Terminal 29.

NOTE This bit parameter does not indicate the status when the corresponding run bit is used with the remote control word (73.70 bit 1).

18.41	System Auto Select
Coding	RW, B
Default settings:	1

Set to 1 the system will be in automatic mode and the Duty drive speed will be controlled from the process PID.

Set to 0 the system will be in manual mode and the Duty drive speed will be derived from the manual speed set-point.

Terminal default setting mode 2 (19.25): Digital input F5 Terminal 28.

This bit parameter can be set remotely by using the Auto bit 5 of the Remote control word parameter (73.70), when remote select parameter (18.42) is set. Sourcing from the Unidrive-SP digital inputs will have priority over the control word auto bit.

18.42	Remote Select
Coding	RW, B
Default settings:	0

This determines the source of the I/O control.

Set to 0, the System Run and Auto select is provided locally by parameters 18.40 & 18.41 respectively.

Set to 1, System Run and Auto select is provided remotely by the control word parameter 73.70).

This parameter can be set by sourcing a local digital input or by the control word parameter (73.70 bit 4).

Sourcing from the Unidrive-SP digital inputs will have priority over the control word auto bit.

18.43	Cascade Stop Enable
Coding	RW, B
Default settings:	1

Set to 1, will cascade stop each starter running in a controlled manner. This will minimise any hydraulic or pressure shocks during stopping of the process. The cascade delay between each starter is set by parameter 20.03.

Set to 0, the system starters are all stopped instantaneously after the duty has ramped to stop.

18.44	PID Always Enable
Coding	RW, B
Default settings:	0

This will enable the PID to be active when the duty drive is stopped or running. When set to 0 the PID is only active the Duty drive is running in Auto mode.



In some applications it is advisable that the drive ramps are set when using this feature. This will ensure when the drive is enabled, with a large process error present, the drive will ramp up to speed in a controlled manner within the system limits.

18.45	Starter 1 Enable
Coding	RO, B

This indicates the enable for starter 1.

Terminal default settings (19.25):

Mode 1 - Digital Output F3 Terminal 26

Mode 2 - Digital Output F3 Terminal 26

18.46	Starter 2 Enable
Coding	RO, B

This indicates the enable for starter 2.

Terminal default settings (19.25):

Mode 1 - Relay Output Terminals 1 & 2

Mode 2 - Relay Output Terminals 1 & 2

18.47	Starter 3 Enable
Coding	RO, B

This indicates the enable for starter 3.

Terminal default settings (19.25):

Mode 2 - Relay Output Terminals 21 & 22 (SM-Additional I/O Option Module)

18.48	Starter 4 Enable
Coding	RO, B

This indicates the enable for starter 4.

Terminal default settings (19.25): 2

Mode 2 - Relay Output Terminals 23 & 22 (SM-Additional I/O Option Module)

18.49 Cycle Enable	
Coding	RW, B
Default settings:	0

This feature is only applicable in runtime Modes (18.29 = 3 or 4)

When set this will ensure the system starters are rotated during lengthy operation times. On occasions not all the starters are required to run to meet required demand range, therefore the same starters may be running for long durations. Setting the Cycle Enable will stop the starters after a Cycle delay time has elapsed (20.04). The system will be automatically restarted again allowing the lowest starter to be selected.

18.50 System Reset	
Coding	RW, B
Default settings:	0

When set will reset the system and Drive.

Terminal default setting mode 2 (19.25): Digital input F4 Terminal 27.

This parameter can be set by sourcing a local digital input or by the control word (73.70 bit 6). If source directly to a local I/O this would have priority over the control word bit.

7.2.3 Menu 19

19.01 Duty Runtime Hours & Minutes	
Coding	RO, U
Range:	0 - 2359
Units:	HHMM

Together with the parameter 19.02 the application software records the amount of time the Duty drive has been running in Hours and minutes. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.26 = 1 will reset the current runtime value.

NOTE The Duty Runtime parameter is enabled only in Fixed Duty Mode (18.29 = 1 or 3).

19.02 Duty Runtime Days	
Coding	RO, U
Range:	0 – 32767
Units:	Days

Together with the parameter 19.01 the application records the amount of time the Duty drive has been running in Days. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.26 = 1 will reset the current runtime value.

NOTE The Duty Runtime parameter is enabled only in Fixed Duty Mode (18.29 = 1 or 3).

19.03 Starter 1 Runtime Hours & Minutes	
Coding	RO, U
Range:	0 – 2359
Units:	HHMM

Together with the parameter 19.04 the application software records the amount of time Starter 1 has been running in Hours and minutes. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.27 = 1 will reset the current runtime value.

19.04 Starter 1 Runtime Days	
Coding	RO, U
Range:	0 – 32767
Units:	Days

Together with the parameter 19.03 the application software records the amount of time Starter 1 has been running in Days. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.27 = 1 will reset the current runtime value.

19.05 Starter 2 Runtime Hours & Minutes	
Coding	RO, U
Range:	0 -2359
Units:	HHMM

Together with the parameter 19.06 the application software records the amount of time Starter 2 has been running in Hours and minutes. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.28 = 1 will reset the current runtime value.

19.06 Starter 2 Runtime Days	
Coding	RO, U
Range:	0 - 32767
Units:	Days

Together with the parameter 19.05 the application software records the amount of time Starter 2 has been running in Days. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.28 = 1 will reset the current runtime value.

19.07 Starter 3 Runtime Hours & Minutes	
Coding	RO, U
Range:	2359
Units:	HHMM

Together with the parameter 19.08 the application software records the amount of time Starter 3 has been running in Hours and minutes. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.29 = 1 will reset the current runtime value.

19.08 Starter 3 Runtime Days	
Coding	RO, U
Range:	0 - 32767
Units:	Days

Together with the parameter 19.07 the application software records the amount of time Starter 3 has been running in Days. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.29 = 1 will reset the current runtime value.

19.09 Starter 4 Runtime Hours & Minutes	
Coding	RO, U
Range:	0 - 2359
Units:	HHMM

Together with the parameter 19.10 the application software records the amount of time Starter 4 has been running in Hours and minutes. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.30 = 1 will reset the current runtime value.

19.10 Starter 4 Runtime Days	
Coding	RO, U
Range:	0 - 32767
Units:	Days

Together with the parameter 19.09 the application software records the amount of time Starter 4 has been running in Days. This parameter is non-volatile therefore the value is retained during a power down. Setting the Run time reset parameter 19.30 = 1 will reset the current runtime value.

19.11 Low Alarm Threshold	
Coding	RW, U
Range:	18.14 to 18.12
Units:	EGU
Default settings:	100

This defines the Low Alarm Threshold of the process feedback signal.

This is only monitored when the Process Feedback Alarms are enabled (18.35) and the Duty Drive is running (10.02).

This threshold can be used as a pre-alarm for the Low-Low threshold parameter (19.12)

19.12 Low-Low Alarm Threshold	
Coding	RW, U
Range:	18.14 to 18.12
Units:	EGU
Default settings:	50

This defines the Low-Low Alarm Threshold of the process feedback signal.

This is only monitored when the Process Feedback Alarms are enabled (18.35) and the Duty Drive is running (10.02).

If the Low trip enable parameter (19.21) is set, this threshold will be configured as the ultimate Low trip level, which will trip the Unidrive-SP on 'TR80'.

The Low Alarm threshold (19.11) will be ignored this threshold is set higher.

19.13 Low Alarm Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

To reduce spurious indication, this provides a time delay for the acknowledgment of any of the Low Alarms.

19.14 High Alarm Threshold	
Coding	RW, U
Range:	18.14 to 18.12
Units:	EGU
Default settings:	900

This defines the High Alarm Threshold of the process feedback signal.

This is only monitored when the Process Feedback Alarms are enabled (18.35) and the Duty Drive is running (10.02).

This threshold can be used as a pre-alarm for the High-High threshold parameter (19.15)

19.15 High-High Alarm Threshold	
Coding	RW, U
Range:	18.14 to 18.12
Units:	EGU
Default settings:	1000

This defines the High-High Alarm Threshold of the process feedback signal.

This is only monitored when the Process Feedback Alarms are enabled (18.35) and the Duty Drive is running (10.02).

If the Low trip enable parameter (19.20) is set, this threshold will be configured as the ultimate Low trip level, which will trip the Unidrive-SP on 'TR81'.

The High Alarm threshold (19.14) will be ignored if this threshold is set higher.

19.16 High Alarm Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

To reduce spurious indication, this provides a time delay for the acknowledgment of any of the High Alarms.

19.17 No Flow Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

This defines the overall time delay for acknowledgment of a No Flow alarms. The delay should be set to a value that ensures enough time for the slowest starter* to get up to a speed and establish adequate flow for the flow switch to activate.

- Defines the starter with the slowest acceleration time. This is usually the Duty Unidrive-SP as the ramps are user definable.

19.18 Transition Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default settings:	100

This delay time is used in two control functions:

1. Defines the time to start another starter if the Request to Start (18.06) remains high due to:
 - i. The previous Assist had failed to start.
 - II. The demand was not fulfilled with the previous starter.
2. Defines the time to stop another starter if the Request to Stop (18.07) remains high due to:
 - i. The demand was not fulfilled with the previous starter.

19.19 Starter Sequence	
Coding	RW, U
Range:	1234 – 4321
Units:	N/A
Default settings:	1234

This defines the start/stop order of the starters when operating in one of the fixed sequence modes, (18.29 = 1 or 2).

e.g. With the sequence set to 1234, the starting order when requested to start will be starter 1, 2, 3, & 4. The stopping order when requested to stop will be vice versa, starter 4, 3, 2 & 1.

No starter number can be repeated more than once. The order always starts from the most significant digit and is applicable to any number of starters used (18.30). E.g. with 3 starters it is the responsibility of the user to ensure the first 3 digits values correspond to the starters used.

19.20 Process Feedback High Trip Enable	
Coding	RW, B
Default settings:	0

When set this enable the drive to trip (Tr81) when the High-High Threshold (19.15) has been exceeded for the high threshold duration (19.16)

19.21 Process Feedback Low Trip Enable	
Coding	RW, B
Default settings:	0

When set this enable the drive to trip (Tr80) when the Low-Low Threshold (19.12) has been exceeded for the Low threshold duration (19.13)

19.22	Assist Fail to Start Trip Indication
Coding	RO, Uni

When an assist has failed to start this indicates each starter number that has failed and the order each were detected.

For example, if the system has 3 starters that has fail to start and they were detected in the following order:

- Starter 2 failed first
- Starter 4 failed second
- Starter 3 failed third

Then this parameter would display '342', where the least significant number was the first starter to fail.

This parameter will be set to zero when a system reset has been performed.

19.23	Starter No Flow Trip Indication
Coding	RO, Uni

When a starter No Flow has been detected this indicates each starter number that has failed and the order each were detected.

For example, if the system has 3 starters that has fail to start and they were detected in the following order:

- Starter 2 failed first
- Starter 4 failed second
- Starter 3 failed third

Then this parameter would display '342', where the least significant number was the first starter to fail.

19.24	Parameter Defaults Enable
Coding	RW, B
Default settings:	0

This will set Duty-Assist application parameters to default values. It will also configure the following Unidrive-SP parameters, as these are essential settings for this application to run successfully.

- 01.10 Bipolar Reference Enable = 0
- 01.14 Reference Selector = 3
- 01.15 Preset Speed Selector = 1
- 06.01 Stopping Mode = 1
- 06.04 Sequencing Logic Mode = 4

This parameter can only be changed when the system is stopped. (For example, Duty drive not running and assist starter are not running in auto).

Set to 1 the software will default parameters and when successfully completed will reset this parameter back to 0.

19.25 Terminal I/O Select	
Coding	RW, Uni
Range	0 – 2
Default settings:	0

This selects the terminal default mappings for the application. There are two selections available:

- 0 = No selection, user fully configurable.
- 1 = Unidrive-SP I/O only, to control up to 2 starters only.
- 2 = Unidrive-SP I/O & SM-Additional I/O option module, to control up to 4 starters.

If terminal mode 2 is selected without the I/O module being fitted the system will trip 'Tr85'.

This parameter can only be changed when the system is stopped. (E.g. Duty drive not running and assist starter are not running in auto).

19.26 Duty Runtime Reset	
Coding	RW, B
Default settings:	0

When set will reset the Duty runtime counter values (19.01 & 19.02).

19.27 Starter 1 Runtime Reset	
Coding	RW, B
Default settings:	0

When set will reset Starter 1 runtime counter values (19.03 & 19.04).

19.28 Starter 2 Runtime Reset	
Coding	RW, B
Default settings:	0

When set will reset Starter 2 runtime counter values (19.05 & 19.06).

19.29 Starter 3 Runtime Reset	
Coding	RW, B
Default settings:	0

When set will reset Starter 3 runtime counter values (19.07 & 19.08).

19.30 Starter 4 Runtime Reset	
Coding	RW, B
Default settings:	0

When set will reset Starter 4 runtime counter values (19.09 & 19.10).

19.31	Starts Per Hour Protection Enable
Coding	RW, B
Default settings:	0

This will enable the number of starts per hour protection for each starter. Refer to parameters 20.06 to 20.14 for set up and indication. When a starter reaches its limit of number of starts it will not be permitted to restart until the current active hour has elapsed.

19.32	Assist Fail to Start
Coding	RO, B
Default settings:	0

This indicates one or more Assist starters has failed to start. Refer to Assist Fail to Start Trip Indication parameter (19.22) to determine the starter that has failed. If all assist starters fail to start then the drive will trip (TR83).

19.33	Duty No Flow
Coding	RW, B
Default settings:	0

This parameter is indication of the status of the Duty flow switch and when required should be sourced from a local digital input, on the Unidrive-SP or SM Additional I/O option module, or set remotely via serial communications.

0 = No Flow (Fail safe) and 1 = Flow.

If Fix Duty mode is selected (18.29 = 1 or 3), the duty no flow will trip the Unidrive-SP when detected on (TR82).

19.34	Starter 1 No Flow
Coding	RW, B
Default settings:	0

This parameter is indication of the status of the Starter 1 flow switch and if required should be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module, or set remotely via serial communications.

0 = No Flow (Fail safe) and 1 = Flow.

19.35	Starter 2 No Flow
Coding	RW, B
Default settings:	0

This parameter is indication of the status of the Starter 2 flow switch and if required should be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module, or set remotely via serial communications.

0 = No Flow (Fail safe) and 1 = Flow.

19.36	Starter 3 Flow
Coding	RW, B
Default settings:	0

This parameter is indication of the status of the Starter 3 flow switch and if required should be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module, or set remotely via serial communications.

0 = No Flow (Fail safe) and 1 = Flow.

19.37	Starter 4 No Flow
Coding	RW, B
Default settings:	0

This parameter is indication of the status of the Starter 4 flow switch and if required should be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module, or set remotely via serial communications.

0 = No Flow (Fail safe) and 1 = Flow.

19.38	No Flow Flag
Coding	RO, B

This indicates No flow has been detected with one or more starters. Refer to Starter No Flow Trip Indication parameter (19.23) to determine the starter that has failed.

19.39	Low Alarm Flag
Coding	RO, B

This indicates the process feedback is equal or below the Low alarm threshold (19.11) for the duration that exceeds the Low alarm delay (19.13).

19.40	Low-Low Alarm Flag
Coding	RO, B

This indicates the process feedback is equal or below the Low-Low alarm threshold (19.12) for the duration that exceeds the Low alarm delay (19.13).

19.41	High Alarm Flag
Coding	RO, B

This indicates the process feedback is equal or above High alarm threshold (19.14) for the duration that exceeds the High alarm delay (19.16).

19.42	High-High Alarm Flag
Coding	RW, B

This indicates the process feedback is equal or above High-High alarm threshold (19.15) for the duration that exceeds the High alarm delay (19.16).

19.43 Starter 1 Available	
Coding	RW, B
Default settings:	0

This indicates the availability status of Starter 1, e.g. Starter ready for selection - healthy and auto mode is selected locally on starter, (When Auto/Man control modes are adopted on starter panel). This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Not Available and 1 = Available.

Terminal default settings (19.25):

Mode 1 – Digital Input F1 Terminal 24

Mode 2 - Digital Input F1 Terminal 24

19.44 Starter 1 Running	
Coding	RW, B
Default settings:	0
Default settings:	0

This indicates the running status of Starter 1. This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Stopped and 1 = Running.

Terminal default settings (19.25):

Mode 1 – Digital Input F2 Terminal 25

Mode 2 - Digital Input F2 Terminal 25

19.45 Starter 2 Available	
Coding	RW, B
Default settings:	0

This indicates the availability status of Starter 2, e.g. Starter ready for selection - healthy and auto mode is selected locally on starter, (When Auto/Man control modes are adopted on starter panel). This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Not Available and 1 = Available.

Terminal default settings (19.25):

Mode 1 - Digital Input F4 Terminal 27

Mode 2 - Digital Input F9 Terminal 2 (SM Additional I/O option module,)

19.46	Starter 2 Running
Coding	RW, B
Default settings:	0

This indicates the running status of Starter 2. This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Stopped and 1 = Running.

Terminal default settings (19.25):

Mode 1 – Digital Input F5 Terminal 28

Mode 2 - Digital Input F10 Terminal 3 (SM Additional I/O option module,)

19.47	Starter 3 Available
Coding	RW, B
Default settings:	0

This indicates the availability status of Starter 3, e.g. Starter ready for selection - healthy and auto mode is selected locally on starter, (When Auto/Man control modes are adopted on starter panel). This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Not Available and 1 = Available.

Terminal default settings (19.25):

Mode 1 - N/A

Mode 2 - Digital Input F11 Terminal 4 (SM Additional I/O option module,)

19.48	Starter 3 Running
Coding	RW, B
Default settings:	0

This indicates the running status of Starter 3. This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Stopped and 1 = Running.

Terminal default settings (19.25):

Mode 1 - N/A

Mode 2 - Digital Input F12 Terminal 6 (SM Additional I/O option module,)

19.49	Starter 4 Available
Coding	RW, B
Default settings:	0

This indicates the availability status of Starter 3, e.g. Starter ready for selection - healthy and auto mode is selected locally on starter, (When Auto/Man control modes are adopted on starter panel). This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Not Available and 1 = Available.

Terminal default settings (19.25):

Mode 1 - N/A

Mode 2 - Digital Input F13 Terminal 7 (SM Additional I/O option module,)

19.50	Starter 4 Running
Coding	RW, B
Default settings:	0

This indicates the running status of Starter 4. This can be sourced from a local digital input on the Unidrive-SP or SM Additional I/O option module.

0 = Stopped and 1 = Running.

Terminal default settings (19.25):

Mode 1 - N/A

Mode 2 - Digital Input F14 Terminal 46 (SM Additional I/O option module,)

7.2.4 Menu 20

20.01 PID Output Scalar	
Coding	RW, U
Range:	1 – 32767
Units:	%
Default:	1

This is a PID output scalar to increase the range of the PID output to enable longer integration times if required.

For example, if the PID scalar is set to 1, the PID output range is 0 – (Max Speed *10), Therefore the Integral gain if set to 10 (gain of 1), and there is a steady state error of 1, the PID output will increase by 0.1Hz every second.

If the scalar was set to 10, with the same Integral gain and error above then the output will increase by 0.01Hz every second

20.02 Remote Speed Reference	
Coding	RW, U
Range:	01.07 – 01.06
Units:	0.1Hz
Default:	0

This is the parameter speed set-point and it is enable by selecting analog speed set-point enable parameter 18.39 = 0. This parameter can be used locally from the Unidrive-SP keypad or written to remotely via serial communication.

20.03 Cascade Stop Delay	
Coding	RW, U
Range:	0 – 32767
Units:	0.1 Seconds
Default:	20

This defines the interval time between each starter stop command when the Cascade stop is enabled (18.43) and the System stop is commanded (18.40).

20.04 Cycle Time	
Coding	RO, U
Range:	1 – 32767
Units:	Hours
Default:	24

When the Cycle Enable parameter (18.49) is set, this time delay defines the period for the system to cycle the starters.

For example, if the same starters have been running for same or longer than the cycle time, then the system will stop and restart with the selecting the starter with the lowest runtime. This feature is only applicable in runtime Modes (18.29 = 3 or 4).

20.05 PID Output Scaled	
Coding	RO, U
Range:	+/- 32767
Units:	Hz * (10 * 20.01)

This indicates the scaled PID output.

$$20.05 = (01.07 - 01.06) * 10 * 20.01$$

NOTE This will saturate at +/-32767.

20.06 Starter 1 Number of Starts Per Hour	
Coding	RW, U
Range:	1 – 32767
Default:	5

When the Start per hour protection is enabled (19.31), this defines the maximum permitted number of start per hour for Starter 1. This is dependant on the fixed starting method used. Please consult your motor manufacturer/manual for correct setting.

20.07 Starter 2 Number of Starts Per Hour	
Coding	RW, U
Range:	1 – 32767
Default:	5

When the Start per hour protection is enabled (19.31), this defines the maximum permitted number of start per hour for Starter 2. This is dependant on the starting method used. Please consult your motor manufacturer/manual for correct setting.

20.08 Starter 3 Number of Starts Per Hour	
Coding	RW, U
Range:	1 – 32767
Default:	5

When the Start per hour protection is enabled (19.31), this defines the maximum permitted number of start per hour for Starter 3. This is dependant on the starting method used. Please consult your motor manufacturer/manual for correct setting.

20.09 Starter 4 Number of Starts Per Hour	
Coding	RW, U
Range:	1 – 32767
Default:	5

When the Start per hour protection is enabled (19.31), this defines the maximum permitted number of start per hour for Starter 4. This is dependant on the starting method used. Please consult your motor manufacturer/manual for correct setting.

20.10 Starter 1 Number of Starts Per Hour Counter	
Coding	RO, U
Range:	1 to 20.06
Units:	No of Starts

This indicates Starter 1 number of starts counted for within the current Elapsed hour (20.14). This is reset when an hour has elapsed.

20.11 Starter 2 Number of Starts Per Hour Counter	
Coding	RO, U
Range:	1 to 20.07
Units:	No of Starts

This indicates Starter 2 number of starts counted within the current Elapsed hour (20.15). This is reset when an hour has elapsed.

20.12 Starter 3 Number of Starts Per Hour Counter	
Coding	RO, U
Range:	1 to 20.08
Units:	No of Starts

This indicates Starter 3 number of starts counted within the current Elapsed hour (20.16). This is reset when an hour has elapsed.

20.13 Starter 4 Number of Starts Per Hour Counter	
Coding	RO, U
Range:	1 to 20.25
Units:	No of Starts

This indicates Starter 4 number of starts counted within the current elapsed hour (20.17). This is reset when an hour has elapsed.

20.14 Starter 1 Start per Hour Elapse Time	
Coding	RO, U
Range:	0 – 59
Units:	Minutes

The hour timer is started when the starter is run with no current counts accumulated in the SPH Counter (18.29). This is reset to 0 when an hour has elapsed.

20.15	Starter 2 Start per Hour Elapse Time
Coding	RO, U
Range:	0 – 59
Units:	Minutes

The hour timer is started when the starter is run with no current counts accumulated in the SPH Counter (18.29). This is reset to 0 when an hour has elapsed.

20.16	Starter 3 Start per Hour Elapse Time
Coding	RO, U
Range:	0 - 60
Units:	Minutes

The hour timer is started when the starter is run with no current counts accumulated in the SPH Counter (18.29). This is reset to 0 when an hour has elapsed.

20.17	Starter 4 Start per Hour Elapse Time
Coding	RO, U
Range:	0 - 60
Units:	Minutes

The hour timer is started when the starter is run with no current counts accumulated in the SPH Counter (18.29). This is reset to 0 when an hour has elapsed.

20.18	Communications Watchdog Enable
Coding	RW, B
Default settings:	0

When set will enable the Communication watchdog. Performs two tasks:

1. The watchdog monitors the Boolean heart beat from the remote device (PLC, HMI etc), on bit 15 of the Communication control word (73.70). If the bit does not change with the Watchdog Trip Delay Time (20.20) the Drive will trip (TR99).
2. Generate a Boolean heartbeat to Remote device with bit 15 of the status word (72.70), the Boolean heartbeat clock time define in parameter 20.19.

20.19	Watchdog Clock time
Coding	RW, U
Range:	1 – 32767
Units:	0.01 seconds
Default:	50

The time set is half the symmetrical clock time and is used for the Drives communications heartbeat to the remote device (PLC, HMI etc).

20.20 Watchdog Trip Delay	
Coding	RW, U
Range:	1 – 32767
Units:	0.1 seconds
Default:	20

This delay defines the maximum time for the incoming heartbeat from the remote device to change state, before the drive will trip with loss of communications (TR99). This should be set according to the network traffic and update with enough margin to reduce spurious tripping.

20.21 Override Enable	
Coding	RW, B
Default settings:	0

When set this will enable the override function, which will override the assist Start & Stop delays (18.21 & 18.23) with the override delay (18.24) when the process error (18.05) exceeds the Override symmetrical threshold (20.22). This is useful to maintain closer control where the peak demand increases/decreases dramatically and the assists are required to be called for starting/stopping more quickly.

20.22 Override Symmetrical Threshold	
Coding	RW, U
Range:	18.14 – 18.12
Units:	EGU
Default:	10

This defines the symmetrical threshold around the process error (18.05) for Start/stop delays (18.21 & 18.23), to be overwritten with the Override delay (18.24). This is only active when Override Enable parameter, (20.21) is set.

20.23 Process Preset Set-point 2	
Coding	RW, U
Range:	18.14 to 18.12
Units:	EGU
Default settings:	100

This is an optional process preset set point that can be selected alternatively to the main parameter preset set point (18.11). This can be selected by disabling analog set-point enable parameter (18.37 = 0) and setting the Process Preset Set point 2 Select parameter (18.32 = 1). This parameter can be set locally from the Unidrive-SP keypad or written to remotely via serial communication.

20.39	Application Software Version
--------------	-------------------------------------

Coding	R0, U
--------	-------

This indicates the current duty assist application software version used within the SM-Applications module.

The parameter version is displayed as an integer value for example, 10208 denotes V01.02.08.

7.2.5 Internal PLC Registers

The non-volatile 70.90 to 70.99 (P registers), have been reserved for this application software.

8 Troubleshooting

8.1 Unidrive-SP

Refer to Unidrive-SP documentation for Unidrive-SP and option module trip codes.

8.2 Application

8.2.1 Trip Codes

Trip Number	Description	Trip Enable Parameter
Tr80	Low Feedback Threshold Exceeded	19.21 & 18.35
Tr81	High Feedback Threshold Exceeded	19.20 & 18.35
Tr82	Low Flow on Duty Starter	18.36
Tr83	Total Starter failure	N/a
Tr84	Duty Contactor opened while drive running	N/a
Tr85	Error with setting Terminal Defaults	N/a
Tr98	Communication Remote Trip	N/a
Tr99	Communication Watchdog Trip	20.18

8.2.2 Alarm Indication

Alarm Parameter	Description	Enable Parameter
19.39	Low process feedback threshold exceeded	18.35
19.40	Low-Low process feedback threshold exceeded	18.35
19.41	High process feedback threshold exceeded	18.35
19.42	High-High process feedback threshold exceeded	18.35
19.38	No Flow occurred on one of the starters	18.36
19.23	Order of each starter that had no flow	18.36
19.22	Assist failed to start	
19.17	Order of each starter that failed to start	
19.32	Global Assist failed to start	
20.10-13	Starts per hour counters	19.31

8.2.3 Fault Reset

The 'system reset' must be used to reset the Duty-Assist system from one of the following fault condition:

1. Drive Trip (TrXX)
2. Assist fail-to-start
3. No Flow

A system reset can be achieved by performing one of the following methods:

1. When terminal 2 default mode is selected (19.25 =1), closed input on term 27.
2. No terminal allocation, set parameter 18.50 = 1.
3. Serial communications set bit 6 of the control word parameter 73.70.
4. Alternatively power OFF and ON the Duty Unidrive-SP.

NOTE

The standard drive reset pushbutton will only reset drive trips. The no-flow and assist fail-to start failures will lock out the availability of the respective starter, within the SM-Applications module software. Therefore to reset these conditions the 'system reset' is required.

9 Advanced Features

9.1 Serial Communications

9.1.1 Control Word

Introduction

The fieldbus control word is an efficient way of remotely controlling the motion of a Drive. Due to the restriction of most fieldbus word length the control word length will be no more than 16bits, SM-Applications Module/MD29 PLC register `_S70%`, (parameter 73.70) will be used to ensure full resolution is maintained (e.g. drive parameter limited to 32767).

Standard

Each bit in the fieldbus control word has a particular function, and provides a method of controlling the output functions of the Drive (RUN, RESET, TRIP, etc.) with a single data word, (16Bits).

b15	b14	b13	b12	b11	b10	b9	b8
Wdin	Application Dependant					Preset 2 Select	SAVE

b7	b6	b5	b4	b3	b2	b1	b0
TRIP	RESET	AUTO	MASK	Reserved	Reserved	RUN FWD	ENABLE

To use the fieldbus control word, the ENABLE terminal on the drive must be closed, and the MASK bit must be set to 1. The 0-1 transition of the MASK bit will cause the digital I/O control to be switched from local terminal mode to fieldbus control.

When the MASK bit is reset to 0, the Digital I/O control is switched terminal control mode.

A selector switch can also be used to select between local (terminal) and remote (fieldbus) control of the Drive. If a digital input is configured to directly control mode parameter assigned 18.42, the value written by the Main Title interface will be immediately overwritten by the digital input.

Control Word- _S70% (Parameter 72.70)

Bit	Function	Description
0	ENABLE	Must be set to 1 to put the Commander SE in READY mode. Resetting to 0 will immediately disable the Drive, and the motor will coast to stop.
1	RUN FWD	Set to 1 (with ENABLE set to 1) to run the motor in the forward direction. When reset to 0, the Commander SE will decelerate the motor to a controlled stop before the outputs disabled
2	Reserved	
3	Reserved	
4	MASK	A 0-1 transition of this bit will set 18.42 to 1 to enable fieldbus control of the Drive. 18.42 can subsequently be over-written by a digital input if a Local – Remote (terminal or fieldbus), control selector switch is required. (A 1-0 transition will reset 18.42 to 0.)
5	AUTO	A 0-1 transition of this bit will set 18.41 to 1 to enable fieldbus control of the Drive. 18.41 can subsequently be over-written by a digital input if a Auto-Man (PID or speed), control selector switch is required. (A 1-0 transition will reset 18.41 to 0.)
6	RESET	A 0-1 transition will reset the Unidrive-SP from any trip condition. If the cause of the trip has not been cleared, the Drive will trip again immediately. The mask bit does not required to be set to use this control bit function.
7	TRIP	A 0-1 transition will force a “tr98” trip on the Unidrive-SP. If the RESET and TRIP bits change from 0 to 1 on the same cycle, the TRIP bit will take priority. The mask bit does not required to be set to use this control bit function.
8	SAVE	A 1-0 (-ve edge), transition will save all the Unidrive-SP parameters (Menus 0 –19), and all the application parameters (Menu 20 & internal PLC menus 70 &71). The parameter save can only be performed while the drive/system is stopped. NOTE The SM-Applications module will be reset during a parameters save.
9	Preset 2 select	A 0-1 transition of this bit will set 18.32 to 1 to select Process Preset Set point 2 (20.23). 18.32 can subsequently be over-written by a digital input this will have priority. A 1-0 transition will reset 18.32 to 0.
9-14	Reserved	
15	WDIn	Watchdog In Comms clock from remote device. The mask bit does not required to be set to use this control bit function.

When a Drive trip occurs, the Drive automatically sets the Drive control word to 0 when reset. This ensures that, for safety reasons, the Drive does not start up immediately when it is reset.

The recommended control method for the PLC program is to reset the fieldbus control word to a safe state, e.g. Drive disabled, when a fault is detected in either the Application software, (The Drive control word is reset to 0 automatically when the Drive resets from a trip.) When the Serial Communication link is healthy again, the appropriate fieldbus control word can be set, a change of fieldbus control is detected, the Drive control word will be updated and the Drive will restart. Some example fieldbus control word values to control the Drive are given in the table below.

Wdin is the communication watchdog bit transmitted from remote intelligent device, (keypad or CTIU, etc).

Control Word (Hex)	Control Word (Dec)	Action
0x0000	0	Control word disabled, Drive will operate under terminal control
0x0010	16	Drive disabled
0x0011	17	Drive enabled and stopped
0x0013	19	Drive enabled and run forwards
0x0080	128	Trip Drive
0x0040	64	Reset Drive

9.1.2 Status Words

The status word returns the status of multiple functions with the Duty-Assist system, e.g. at speed, zero speed, Drive healthy, etc., and provides a quick method of checking the current status remotely with serial communication.

Status Word1 - _R70% (Parameter 72.70)

b15	b14	b13	b12	b11	b10	b9	b8
WDout	19.50	19.49	19.48	19.47	19.46	19.45	19.44

b7	b6	b5	b4	b3	b2	b1	b0
19.43		18.42	18.41	Inh.	10.03	10.02	10.01

Bit	Parameter	Description
0	10.01	Duty drive healthy
1	10.02	Duty drive running
2	10.03	Duty drive at zero speed
3	8.07 & 06.15	Duty drive Enabled (Ready)
4	18.41	Auto control Selected
5	18.42	Remote digital control Selected
6		Sleeping
7	19.43	Starter 1 Available
8	19.44	Starter 1 Running
9	19.45	Starter 2 Available
10	19.46	Starter 2 Running
11	19.47	Starter 3 Available
12	19.48	Starter 3 Running
13	19.49	Starter 4 Available
14	19.50	Starter 4 Running
15	WDout	Watchdog out Comms. Clock

Wdout is the communication watchdog bit transmitted from the SM-Applications Module/MD29 to a remote intelligent device, (keypad or CTIU, etc).

Status Word 2 - _R71% (Parameter 72.71)

b15	b14	b13	b12	b11	b10	b9	b8
WDout							
b7	b6	b5	b4	b3	b2	b1	b0
				19.42	19.41	19.40	19.39

Bit	Parameter	Description
0	19.39	Process Feedback Low Alarm
1	19.40	Process Feedback Low-Low Alarm
2	19.41	Process Feedback High Alarm
3	19.42	Process Feedback High-High Alarm
4		Starter 1 Starts per Hours failure
5		Starter 1 Fail to Start failure
6		Starter 1 No Flow failure
7		Starter 2 Starts per Hours failure
8		Starter 2 Fail to Start failure
9		Starter 2 No Flow failure
10		Starter 3 Starts per Hours failure
11		Starter 3 Fail to Start failure
12		Starter 3 No Flow failure
13		Starter 4 Starts per Hours failure
14		Starter 4 Fail to Start failure
15		Starter 4 No Flow failure

Status Word 3 - _R72% (Parameter 72.72)

b15	b14	b13	b12	b11	b10	b9	b8
b7	b6	b5	b4	b3	b2	b1	b0
		Preset 2	Duty4	Duty3	Duty2	Duty1	Cycle

Bit	Parameter	Description
0		Starters are being Cycled
1		Starter 1 is selected as Duty
2		Starter 2 is selected as Duty
3		Starter 3 is selected as Duty
4		Starter 4 is selected as Duty
5	18.32	Process Preset Set point 2 selected
6		
7		
8		
9		
10		
11		

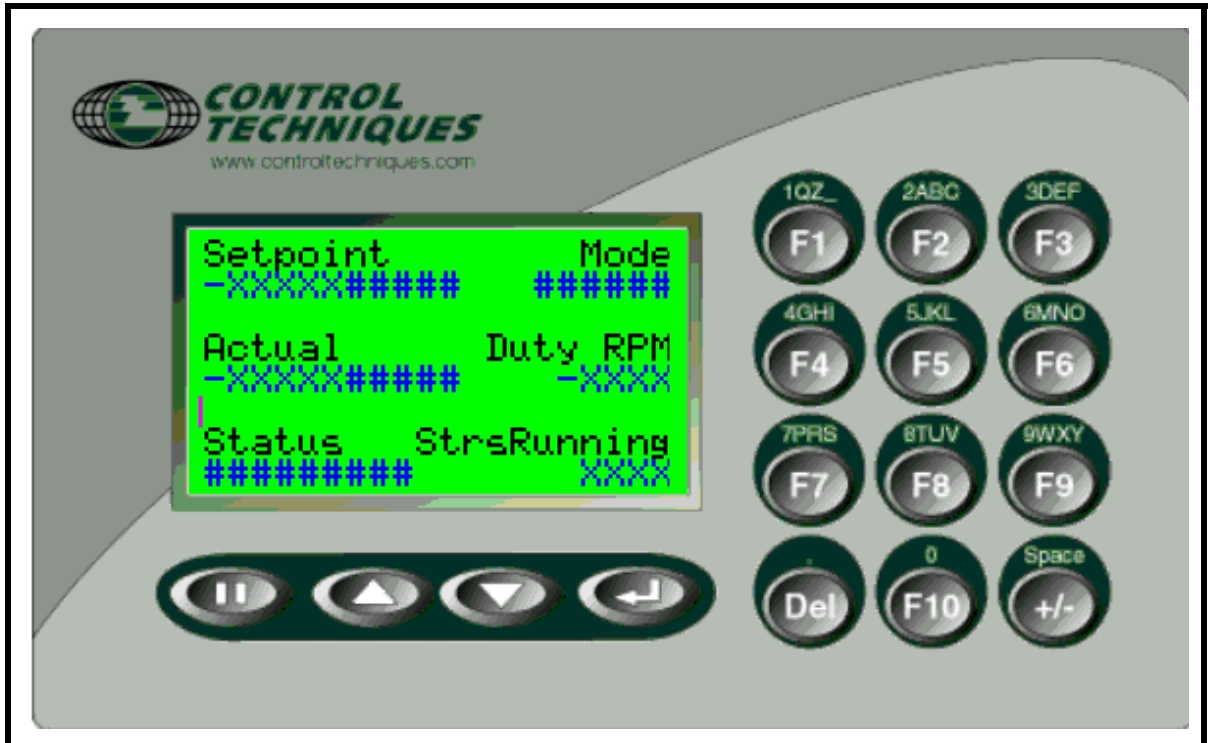
NOTE Resetting from a fault of performing a parameter save will clear the status word for a short period of (approx 0.7 seconds), while the SM-Applications Module reinitialises.

10 CTIU – Operator Panel

10.1 Introduction

The CTIU operator interface enables the user to monitor, set-up and control the Duty Assist application remotely without the need to use the manual or Unidrive-SP parameter numbers. All parameters are displayed in text rather than using it's Unidrive-SP parameter number. Textual descriptions are also given for trips/alarms, Boolean statuses/settings and selection parameters. On line Help descriptions are available for further information on the configuration parameters.

Front View of CTIU110

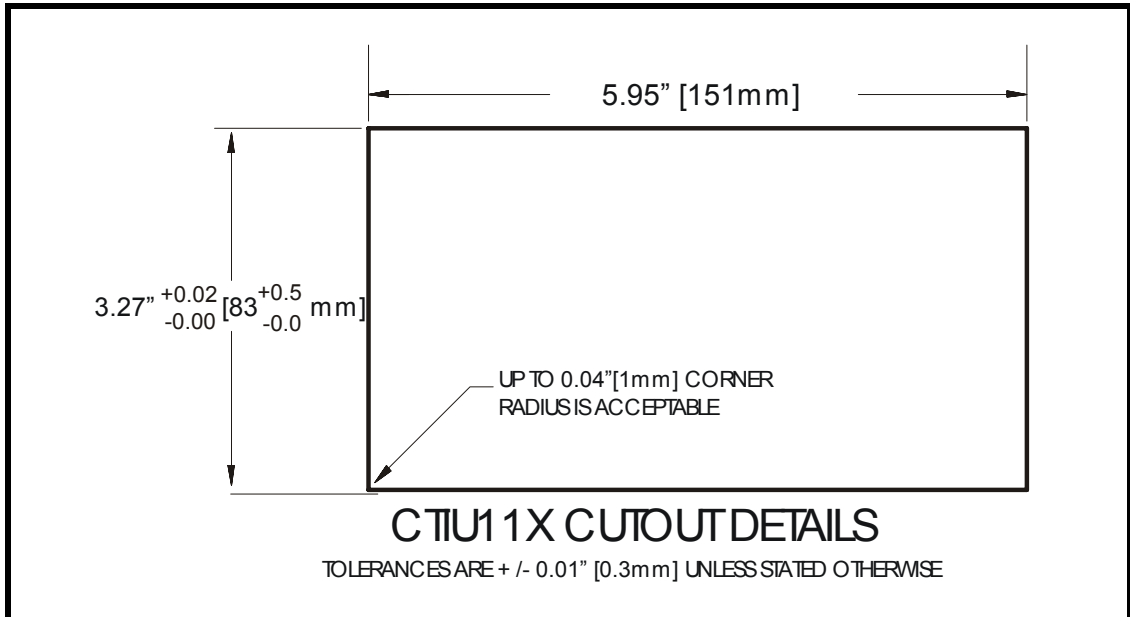


10.2 Software Version

CTIU Software Version – V01.00.00 or greater, this will be displayed on the CTIU second splash screen or can be found under the 'Drive Diagnostics' menu

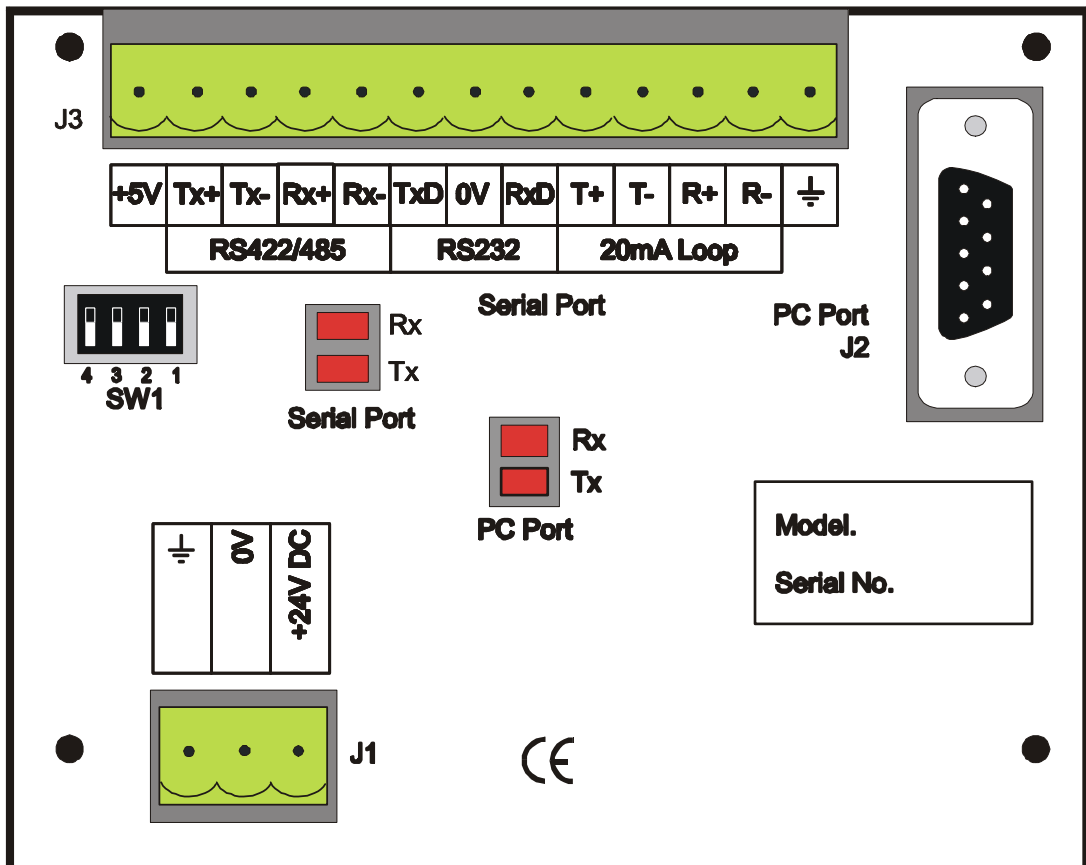
10.3 Mechanical Installation

10.3.1 Panel Cut-out Detail



10.4 Electrical Installation

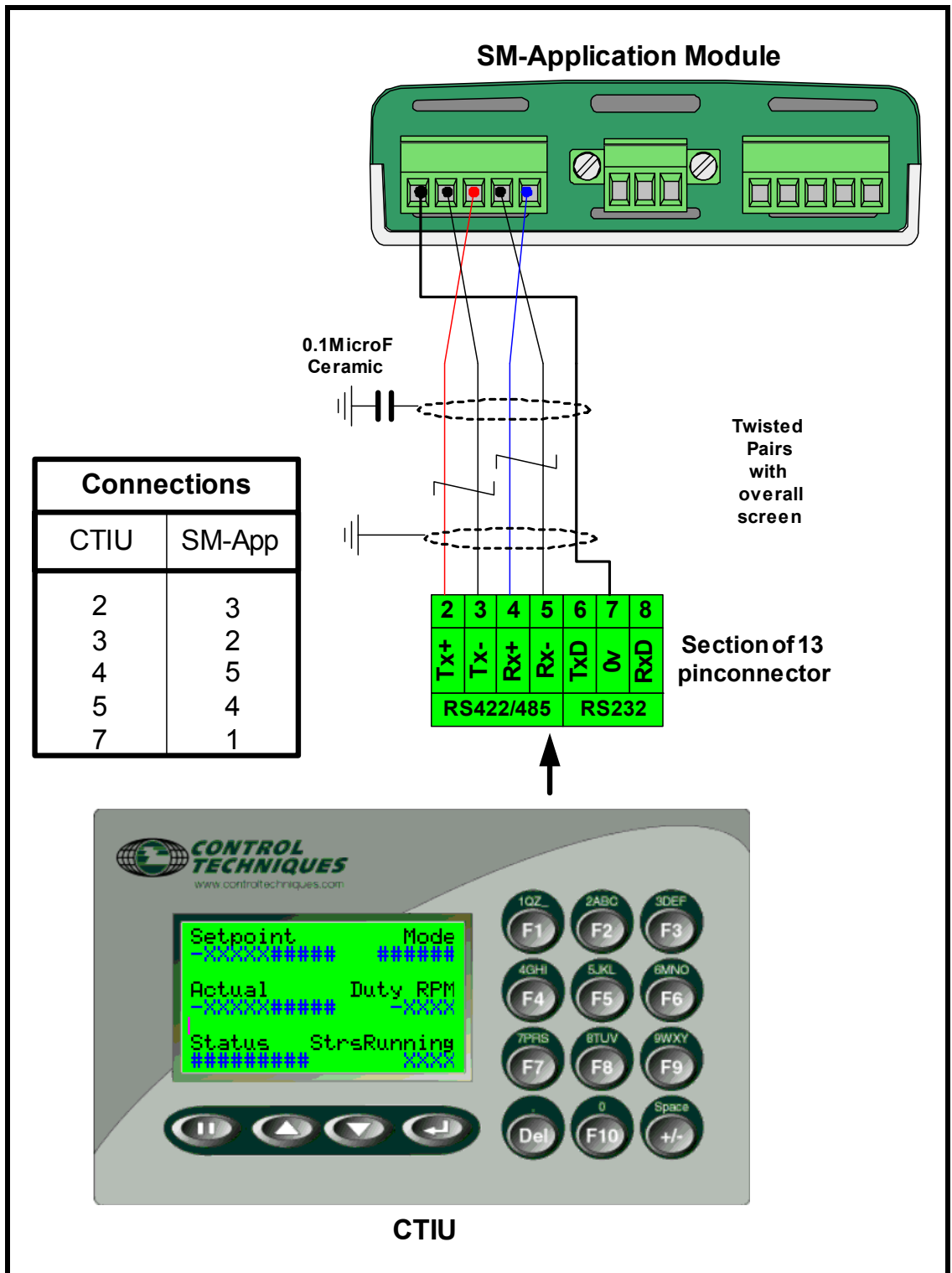
10.4.1 CTIU110 Rear View



24Vdc Power Supply Requirements (J1)

Peak Inrush – 240mA
Continuous – 100mA

10.4.2 Serial Communications Cable Connections



Recommended Cables

Belden No. 8105, 9807 or 9832 – General Purpose

Belden No. 8165 – Heavy Noise Environment

10.5 Unidrive-SP set-up

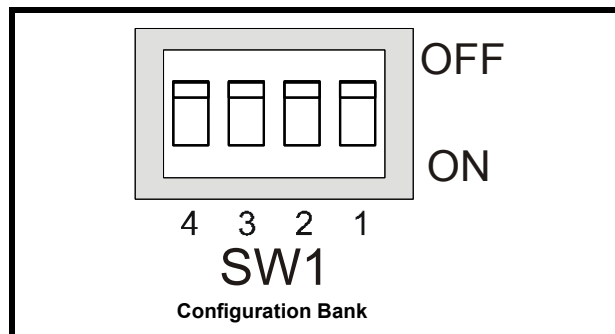
The protocol used between the CTIU110 and the Unidrive-SP application module is Modbus RTU. To establish communications the Unidrive-SP Address, Baud rate and Protocol is required to be set, the following table details the required parameters to be set:

Configuration Bank

Parameter	Setting	Description
##.05	11	Drive address
##.06	13	RS485 Modbus-RTU protocol mode
##.07	19200	Baud rate

NOTE Perform a Drive save to save these setting during power down.
e.g. XX.00 = 1000 followed by reset.

10.5.1 CTIU110 Configuration of the RS-485 Port



The configuration bank sets the parameters of the RS-485 port as described in the following table:

Configuration Bank Description	
Switch 1	ON: Pull-up (must be used together with switch 3) OFF: no Pull-up
Switch 2	ON: 120Ω termination OFF: no termination
Switch 3	ON: Pull-down (must be used together with switch 1) OFF: no Pull-down
Switch 4	Reserved for future use
NOTE	Switch 1 and 3 must be used together. Either both pull-up and pull-down are used or neither is used.

Pull-up and **Pull-down** switches are used to increase the signal level on the RS-485 bus. This is useful if there is a long bus and a significant amount of attenuation is anticipated.

Termination resistance of 120Ω must be placed across each end of the RS-485 bus. With switch 2 ON, a 120Ω resistance is placed across the bus. This should only be used if the CTIU050/100/110 is the last device at either end of the bus.

10.6 Operation Button Selection Actions

PAUSE key selects data for editing OR exits from data editing.

PAUSE & DOWN keys pressed together, enters sub menu pages.

PAUSE & UP keys pressed together, exits sub menus to the parent menu pages.

UP key selects the previous menu page, sub menu page, alarms, and increments data

DOWN key selects the next menu page, sub menu page, alarms and also decrements data.

ENTER key sends data to the automation equipment, accepts alarms, and displays accepted alarms.

ALPHANUMERIC KEYPAD and **PROGRAMMABLE KEYS** can be used to enter data or can be used to preform some pre-programmed action.

Contrast Adjustment

On menu page 1 (after the start-up screen), hold the **ENTER** key and press the **UP** or **DOWN** key to adjust the contrast. The contrast setting is stored and not lost after removing power.

10.7 Navigation

The Duty assist screens are split into 2 sections:

- Operator section
- Configuration section

The Duty Assist parameters are grouped into relevant application menus to aid with efficient navigation to each parameter. Each menu has two parts,:

A parent menu page, this is the menu header and displays the menu description.

Sub-menu page/s contain all the relevant parameters for the menu.

For example:

Parent Menu Page: I/O Diagnostics

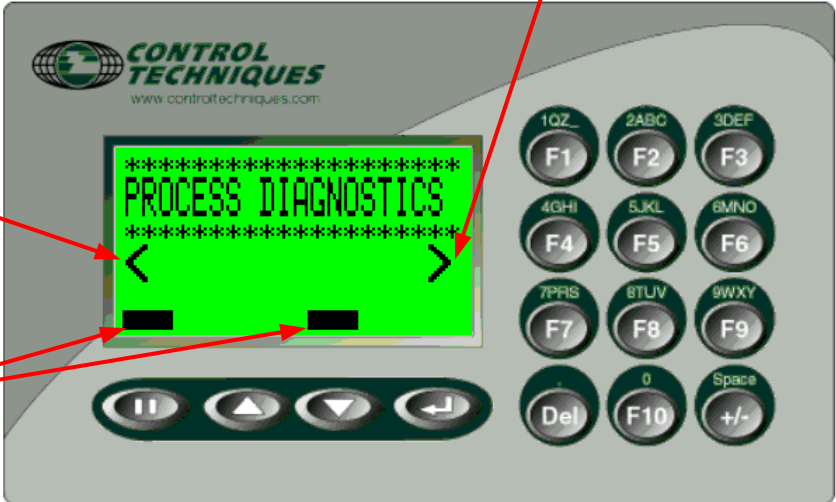
Sub-menu Pages contain relevant parameter for the Parent Menu:

All status of the Digital Inputs and Outputs Terminals: 1&2, 24-30 and 40-50.

The current values on all Analogue input terminal: 05-08 and 51-52.

Using on-screen graphical icons the following sections describes how to navigate between Parent and sub-menu screens.

10.7.1 Parent Menu Pages Navigation



The diagram shows a control panel with a green LCD screen displaying 'PROCESS DIAGNOSTICS' between two asterisk lines. Below the screen are four navigation keys: a pause key, an up arrow, a down arrow, and a left arrow. To the right is a numeric keypad with function keys F1-F10 and a +/- key. Red arrows point from text boxes to the left and right arrow keys on the screen, and from the pause and down arrow keys to the 'Sub-menu Access' text box.

Parent Menu Page UP
This signifies the parent menu navigation direction. When this symbol is shown, pressing the 'Up' key will display the next parent menu page up from the current.

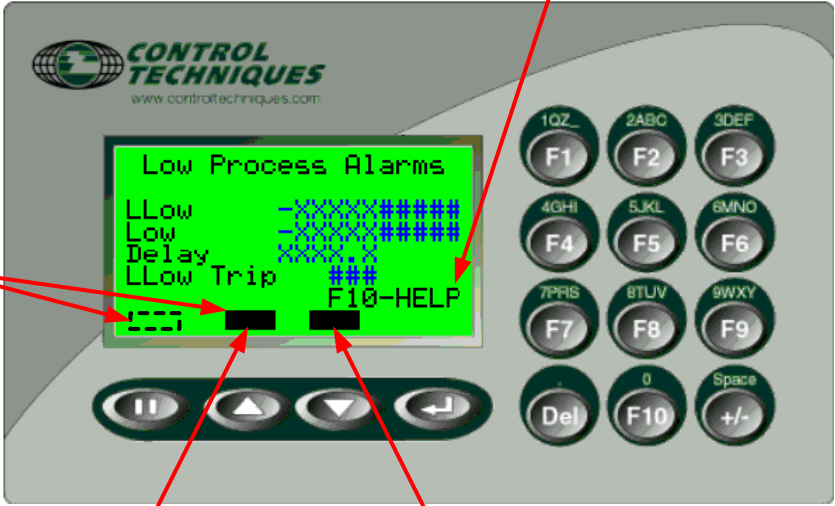
Parent Menu Page Down
This signifies the parent menu navigation direction. When this symbol is shown, pressing the 'Down' key will display the next parent menu page down from the current.

Sub-menu Access
This indicates the two key that need to be pressed to access the Parent sub-menu.
e.g. to access the Process Diagnostic sub-menu pages, press the Pause and Down keys together.

10.7.2 Sub-menu Pages Navigation

Help
All the configuration sub-menu pages are provided with a brief help description for each parameter. Pressing the F10 key will display the help information for the parameters displayed on the current sub-menu page .

Parent Menu Access
Press the Pause and the Up keys together to go back to the Parent menu page. This will be indicated on the last page on each sub-menu



Sub-menu Page UP
This signifies the sub-menu navigation direction. When this symbol is shown, pressing the 'Up' key will display the next sub-menu page up from the current.

Sub-menu Page Down
This signifies the sub-menu navigation direction. When this symbol is shown, pressing the 'Down' key will display the next sub-menu page down from the current.

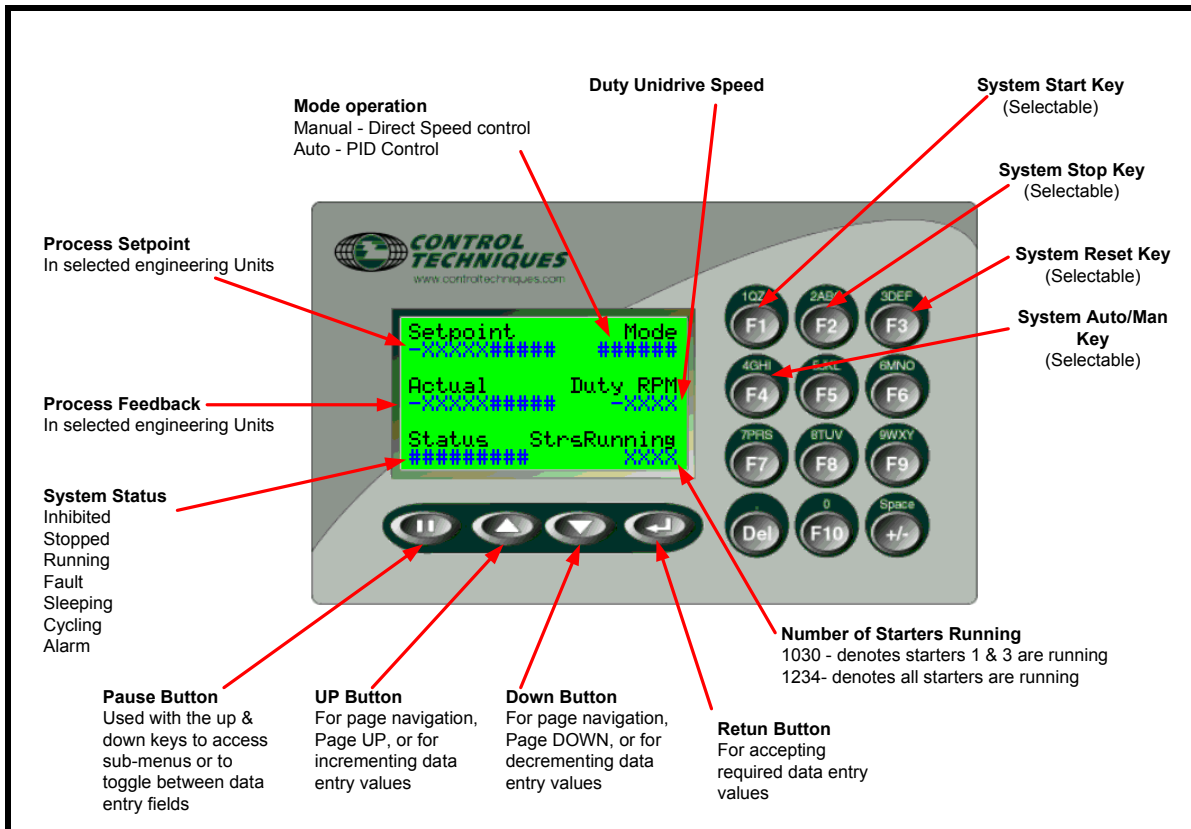
10.8 Operators Screens Description

The operator screens consist of:

- Top-level main page which provides an overview of all the important parameters of the process on one screen
- Diagnostic information for Process, starters, drive and I/O.
- Process set points.

These screens are detailed in the Operators navigation diagram shown below.

10.8.1 Top Level Screen and Functionality



The top-level screen indicates all the common variables for process/application, e.g. set points, feedbacks, status etc. The Top level screen is always the first menu Page to be displayed. A Menu Timeout, safety feature is used to force the CTIU display focus back to the first (main) menu page after a set time period. The Menu Timeout period is set to 120second (2mins).

10.8.2 Process Set points

The process set point menu is password to restrict access to unauthorised personnel.

The password to access the set point menu is 5555.

Auto mode

Process Set points 1 & 2 (Day & Night)

Manual mode

Frequency Set point

10.8.3 Diagnostic Screens

The following diagnostic screens are available:

Process Diagnostics

Displays parameters directly related to the process control, Feedback alarm thresholds; Feedback; Current alarm status.

Starter Diagnostics

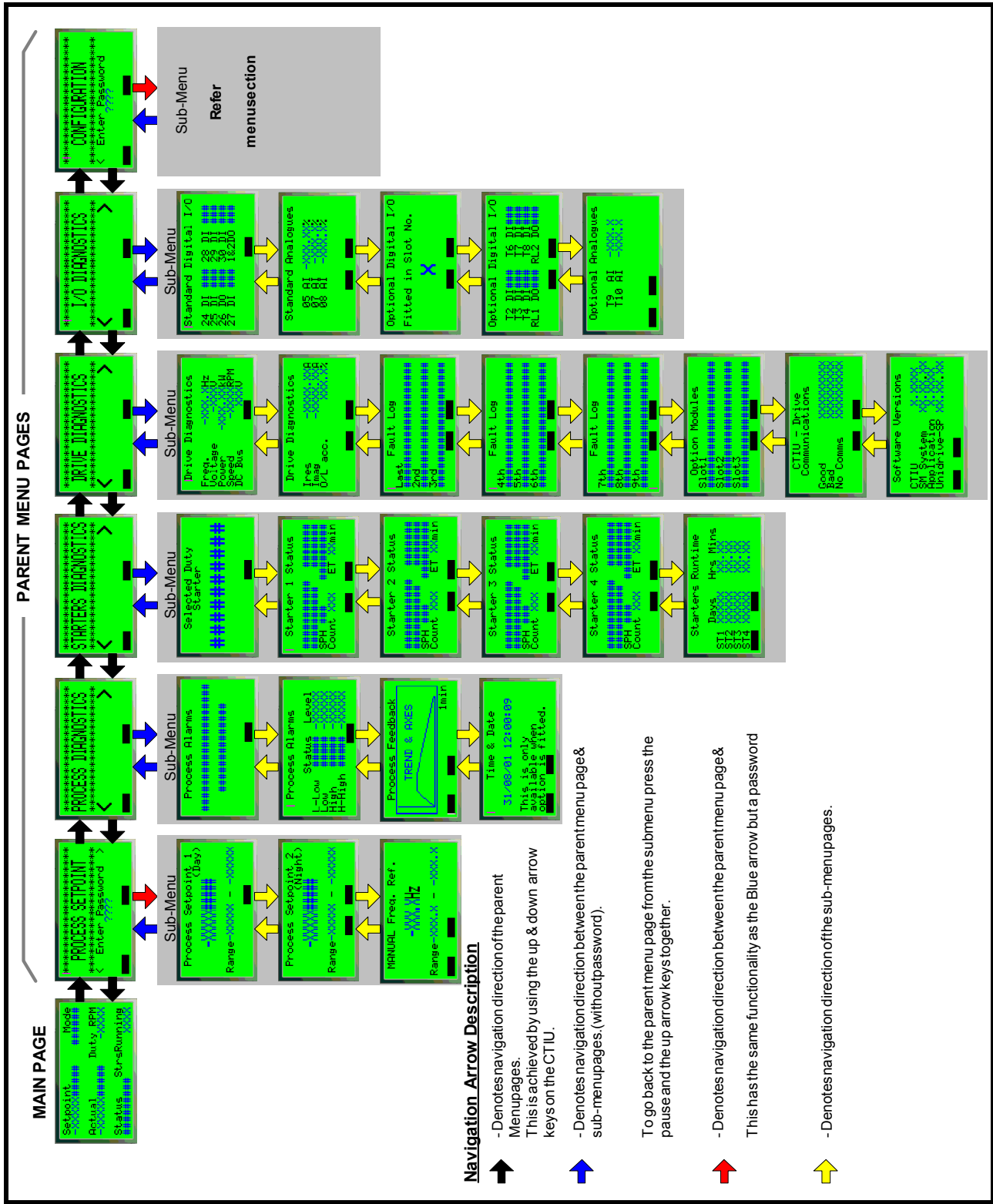
Displays parameters directly related to each starter, Running Status; Availability Status; SPH, No Flow, Fail to Start Alarms; Runtime; Selected Duty Starter when in flexible duty mode.

Drive Diagnostics

Displays parameters directly related to the Duty drive, Frequency, Volts, Power, Speed, DC Bus Volts, Current, Overload accumulator; Fault log; Software versions.

I/O Diagnostics

Displays parameters directly related to the Duty drive inputs & outputs, Unidrive-SP standard and option digital status's and analogue current values.



Ancillary

Configuration parameter for ancillary features for the Duty assist application
Terminal default mode, Default parameters, Duty & assists Runtime counter reset.

Motor Details

Duty drive motor map parameters.

Current, voltage, frequency, Number of poles, speed, Power factor.

Drive Settings

Applicable drive configuration parameters for the Duty-Assist applications.

Min & Max Frequency range, Current limit, Ramp rates, stopping mode, ramp mode, V-F profile, voltage mode, Switching frequency, Catch spinning motor set-up, Auto reset.

10.9.1 Parameter Help

A Help feature is provided for all configuration parameters, by pressing F10 function, (where displayed see section 1.22) will give a brief description of the parameters currently displayed on the CTIU.

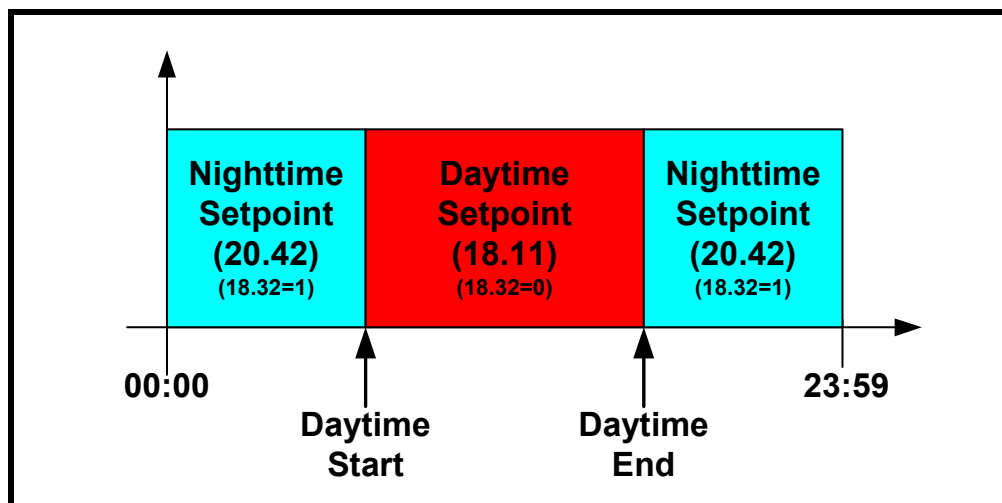
10.9.2 Day/Night Function

The CTIU with Real Time Clock option must be used when the Day/night function is required.

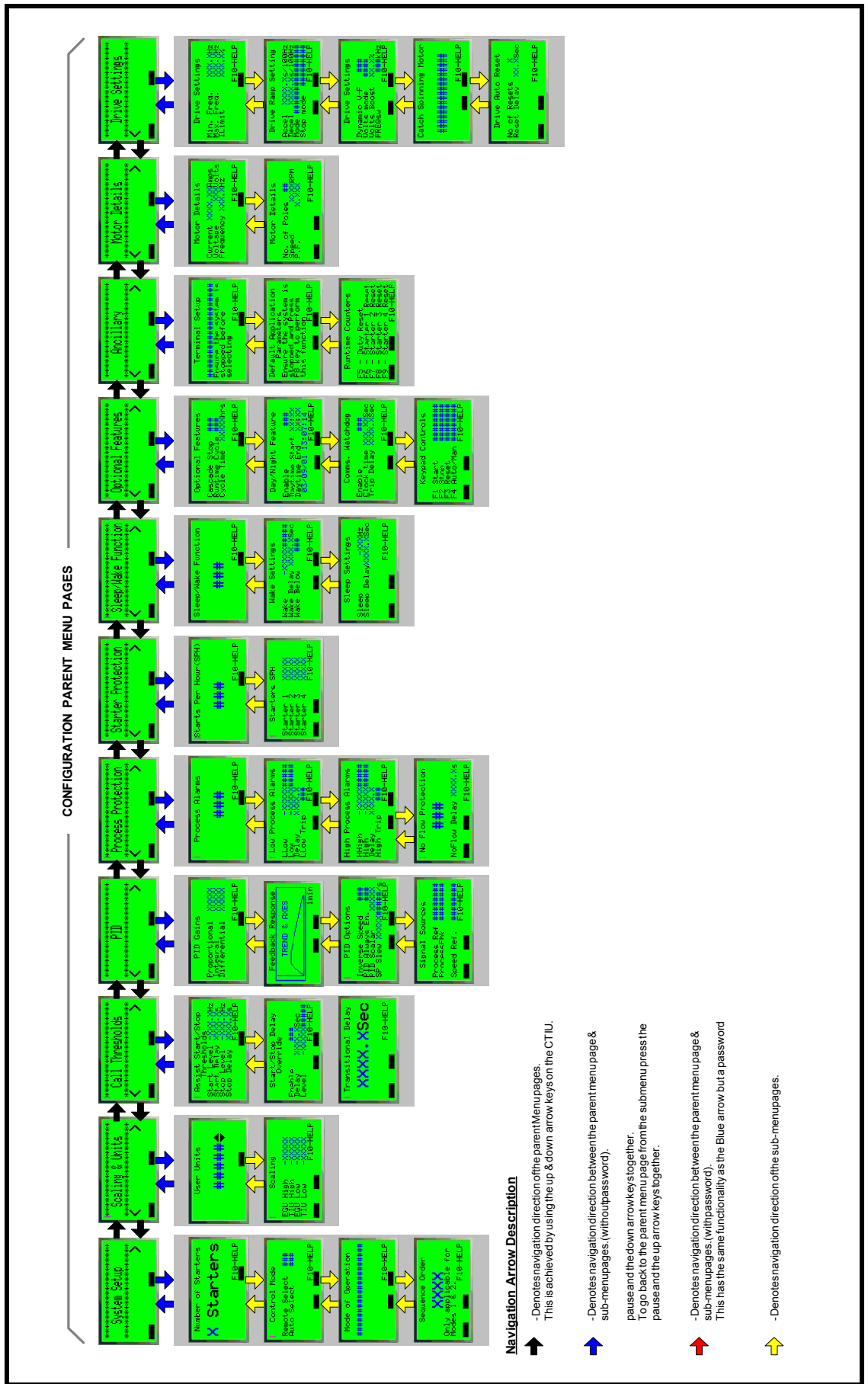
This feature uses the Process Preset Set point parameters, where the main process set point, (preset 1, parameter 18.11) is used for the daytime set point and the process preset set point 2, (20.23) is used for the night-time set point.

(Note: the Analogue Process Set point enable parameter 18.37, must be set to 0).

The Daytime start and end points are set on the CTIU configuration 'Optional Features' menu, page 2, when the clock time is within the Daytime start and end points, the daytime set point is used (preset set point 2 select parameter 18.32 = 0), and when the time is outside these points the night time set point is used (preset set point 2 select parameter 18.32 = 1).



Configuration Navigation



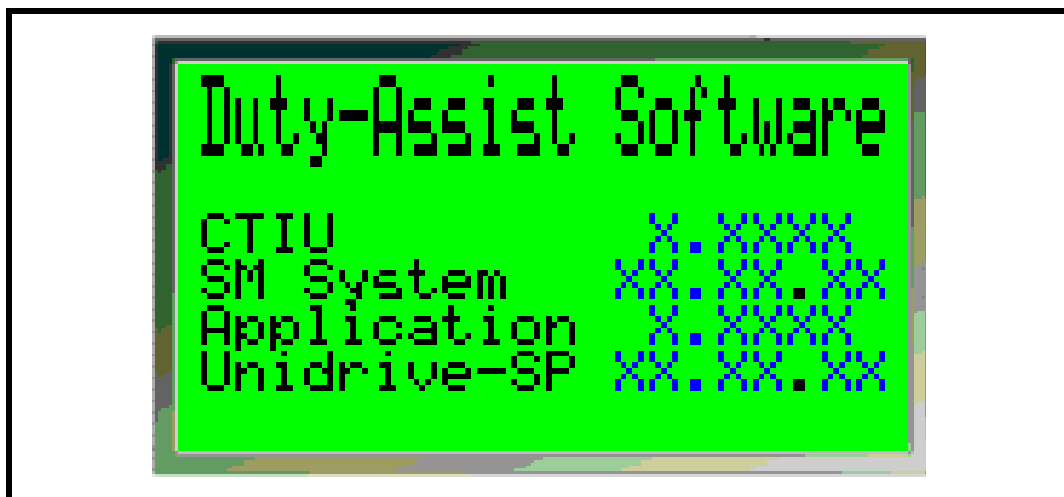
10.10 Splash Screens

There are two splash screens displayed in sequence during initial power up. These detail the application and software version information.

10.10.1 Application Page (1st Page)



10.10.2 Software Version Page (2nd Page)



10.11 Parameter Save

When any of the editable data fields has been changed within the configuration menus and the Top-level menu page (1) is display (due to timeout, or forced by the user), a parameter save will be prompted to the operator.

10.11.1 Parameter Save Main Screen



This is the first screen to be displayed, where it indicates to the user to save parameters by pressing Function key F5. To save the parameters the Duty Unidrive-SP must be in stopped state, a flashing message will be displayed to advise if a save can be performed.

For example: Flashing Message

Drive Running - Stop Drive to Save

Drive Stopped - OK to Save

If a parameter save is not required the pause (||) key can be press to quit back to the Top-level menu page (1).

10.11.2 Parameter Save Acknowledgement Screen



When function key F5 is press with the Drive stopped the above screen will appear acknowledging a parameter save is being performed. After approximately 5 seconds the top level menu page (1) will re-appear, confirming the save has completed.

10.12 Trip & Alarm indication

There are two types of Alarm pages:

- Trip – Indication that the system has tripped and needs a reset to resume operation. (Unless the result of the trip has caused permanent damage).

There are 4 'Trip' Pages

Main Drive Trip

3 Slot Option Trips

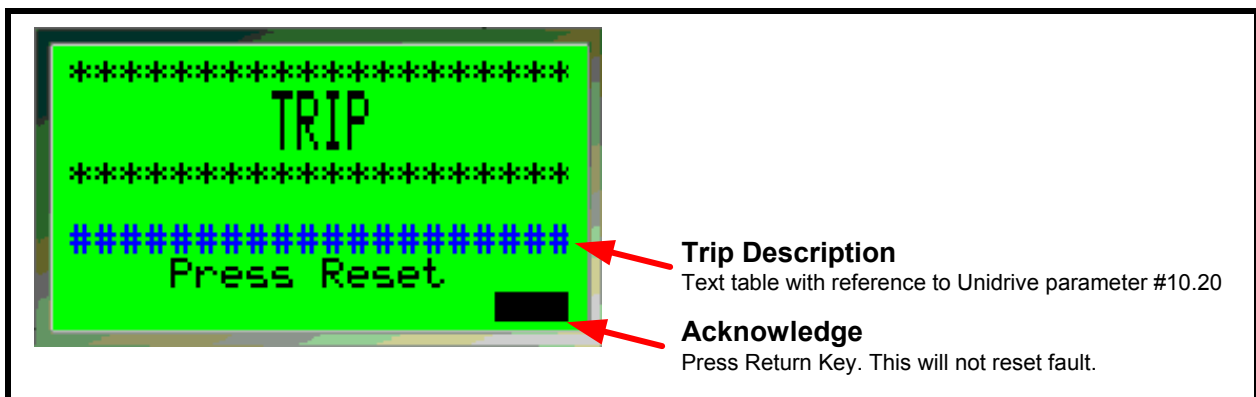
- Alarm – Indication of non-critical alarms that will not stop the system but may restrict the operation, or advise the process is close to or on process limits.

Starter alarms will lock out the corresponding starter and make it unavailable for selection, these alarm require a reset to make the starter available again. Indication is given where a reset is required with an alarm.

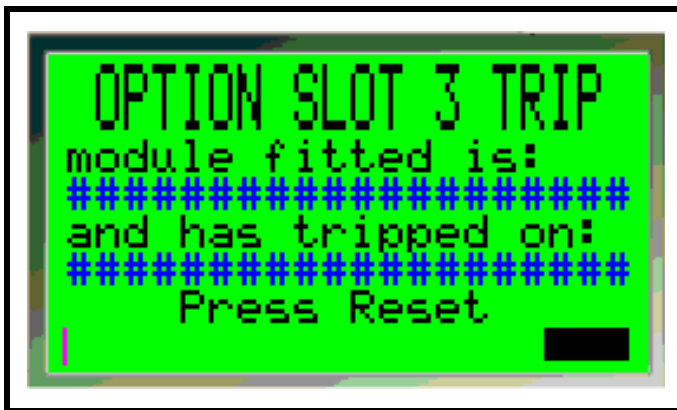
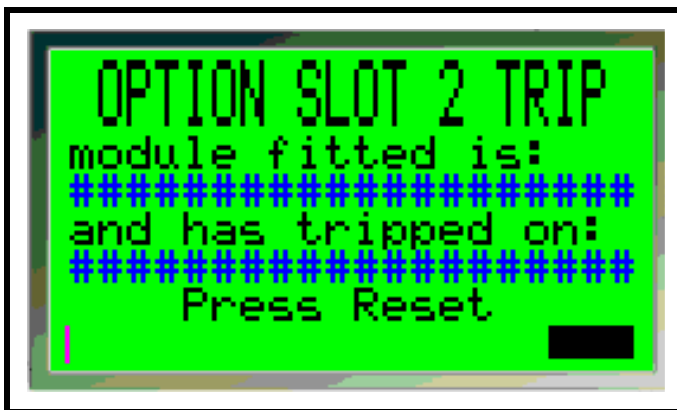
All pages have to be acknowledged by the pressing of the 'Return' key. This will remove the Alarm page from the display only; this will not reset any trips or alarms on the drive. A trip or alarm reset is a separate function and can be performed from the CTIU (F3 key when feature is enabled), or from another source (Pushbutton, PLC, etc). When a trip or an alarm is acknowledged but not reset, the Alarm page will be removed from the display of the CTIU. To make the operator aware this is still a trip or an alarm still present, the top level menu page (1), 'Status' data field will indicate that the system has a 'Fault' or an 'Alarm' present. Pressing the 'Return' key while on the top-level menu page (1) will toggle between the Alarm page/s and the top-level menu page. The alarms and trips can also be review in the following 'Diagnostic Menus':

- Alarms – Process Diagnostics (page 1 of sub menu)
- Trips – Drive Diagnostics (Page 3 Last Fault logged)

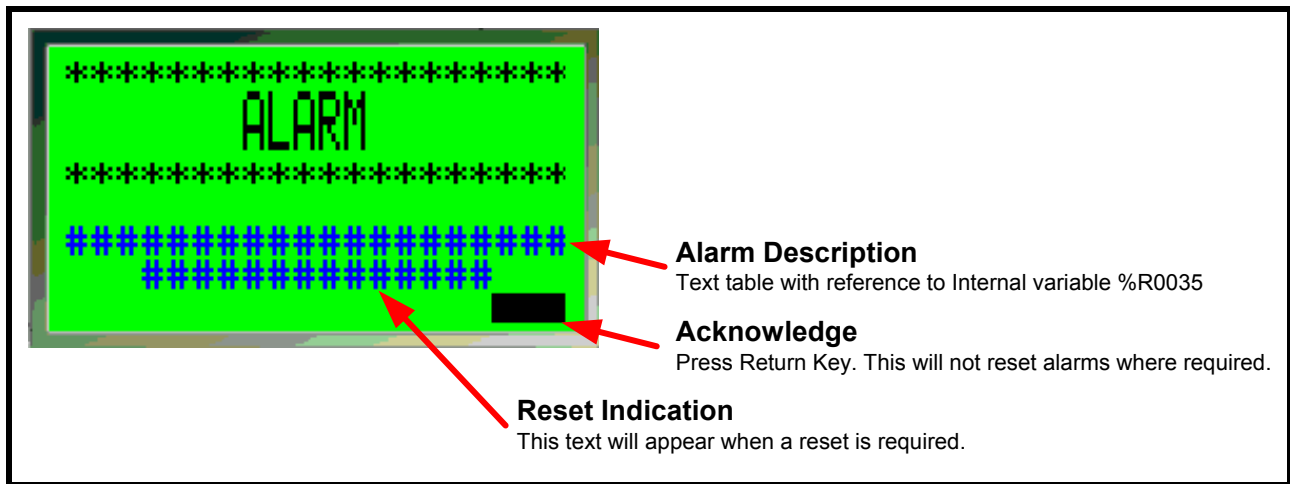
10.12.1 TRIP Page (Alarm page 1)



10.12.2Slot TRIP Pages(Alarm Pages 3-5)



10.12.3 ALARM Page (Alarm page 2)



10.13 CTIU Function Keys Allocation

10.13.1 Global Control Function Keys

The following Function keys can be optionally configured from the Configuration 'Optional Features' menu. These functions allow the duty assist application to be fully controlled from the CTIU without the need for addition switchgear (switches, pushbuttons etc). These function keys, when selected, are active on every display focus and will control the application provide the 'Remote select' parameter is set (18.42 =1):

F1 – Start, sets bit 1 of the control word when the function key is enabled and pressed.

F2 – Stop, reset bits 1 of the control word when the function key is enabled and pressed.

F3 – Reset, sets bit 6 of the control word when function key is enabled and pressed and resets to zero when released (pushbutton type).

F4 – Auto/Man, toggles bit 5 of the control word when the function key is enabled and pressed.

NOTE When using the start/stop function keys to control the application it is advisable to enable the communications watchdog, so the drive trips 'TR99', when the communication is lost.

10.13.2 Local Function Keys

The following are defined as local function keys as they only apply to one or a range of pages:

- F10 – Call On-line help. This is only available in the configuration pages and provides information for each parameter displayed on the current page.
- F5 – Parameter Save. This is only available when the parameter save status page is displayed. When pressed will save the parameters within the drive and second processor.
- F8 – Page 2 of the Configuration 'Ancillary' menu. This will default the application parameter when pressed.
- F4 to F8 – Page 3 of the Configuration 'Ancillary' menu. These are allocated to reset the runtime counters when pressed:
 - o F5 – Duty Runtime reset.
 - o F6 – Starter 1 Runtime reset.
 - o F7 – Starter 2 Runtime reset
 - o F8 – Starter 3 Runtime reset
 - o F9 – Starter 4 Runtime reset

11 Quick Reference

11.1 Unidrive-SP

11.1.1 Relevant Parameter

01.01	Reference selected
01.06	Maximum Frequency Clamp
01.07	Minimum Frequency Clamp
01.10	Bipolar reference select
01.11	Reference enabled indicator
01.14	Reference selector
01.15	Preset selector
01.21	Preset Speed reference 1
02.01	Post ramp speed reference
02.04	Ramp mode
02.10	Acceleration Selector
02.11	Acceleration Rate
02.20	Deceleration Selector
02.21	Deceleration Rate
03.05	Zero Speed Threshold
04.01	Motor current magnitude
04.07	Symmetrical Current Limit
04.15	Thermal Time Constant
05.01	Motor Frequency
05.02	Motor Voltage
05.03	Motor Power
05.04	Motor Speed
05.05	DC Bus Voltage
05.06	Motor rated Frequency
05.07	Motor rated Current
05.08	Motor rated Full load rpm
05.09	Motor rated Voltage
05.10	Motor rated Power Factor
05.11	Motor rated Voltage
05.12	Magnetising Current test Enable
05.13	Dynamic V/F select
05.14	Voltage Mode select
05.15	Voltage Boost
05.18	Switching Frequency
06.01	Stop mode selector
06.04	Sequencing Mode
06.09	Synchronize to a spinning motor
06.15	Drive enable
06.40	Enable sequencer latching
10.34	No. of auto reset attempts
10.35	Auto reset delay
11.23	Serial comms. address
11.24	Serial comms. mode selector
11.25	Serial comms. baud rate selector
11.26	Serial comms. two wire mode delay selector

11.1.2 I/O Parameters

Standard Unidrive-SP I/O

No.	Description	Term.
07.01	Analogue Input 1 Indication	5 & 6
07.02	Analogue Input 2 Indication	7
07.03	Analogue Input 3 Indication	8
07.08	Analogue input 1 scaling	
07.09	Analogue input 1 invert	
07.10	Analogue input 1 destination	
07.11	Analogue input 2 mode selector	
07.12	Analogue input 2 scaling	
07.13	Analogue input 2 invert	
07.14	Analogue input 2 destination	
07.15	Analogue input 3 mode selector	
07.16	Analogue input 3 scaling	
07.17	Analogue input 3 invert	
07.18	Analogue input 3 destination	
07.19	Analogue output 1 source	9
07.20	Analogue output 1 scaling.	
07.21	Analogue output 1 mode selector	
07.22	Analogue output 2 source	10
07.23	Analogue output 2 scaling.	
07.24	Analogue output 2 mode selector	
08.01	Digital input / output F1 state indicator	24
08.02	Digital input / output F2 state indicator	25
08.03	Digital input / output F3 state indicator	26
08.04	Digital input F4 state indicator	27
08.05	Digital input F5 state indicator	28
08.06	Digital input F6 state indicator	29
08.07	Relay 1 output indicator	41 & 42
08.09	External trip / inhibit input state indicator	31
08.10	External trip / inhibit input mode select	
08.21	F1 destination or source parameter	
08.11	F1 Invert	
08.31	F1 output enable	
08.22	F2 destination or source parameter	
08.12	F2 Invert	
08.32	F2 output enable	
08.23	F3 destination or source parameter	
08.13	F3 Invert	
08.33	F3 output enable	
08.24	F4 destination or source parameter	
08.14	F4 Invert	
08.25	F5 destination or source parameter	
08.15	F5 Invert	
08.26	F6 destination or source parameter	
08.16	F6 Invert	
08.27	Relay 1 source	
08.17	Relay 1 output Invert	
08.29	Positive logic select	
08.30	Open Collector Outputs	
08.39	F5 and F6 auto-selection	

Additional I/O Option Module

No.	Description	Term.
##.07	Relay 2 output indicator	21-22
##.08	Relay 3 output indicator	23-42
##.40	Analogue input 4 level	9
##.44	Analogue input 5 level	10
##.09	Digital Input / Output F7 state indicator	2
##.10	Digital Input / Output F8 state indicator	3
##.03	Digital Input / Output F9 state indicator	4
##.04	Digital Input F10 state indicator	6
##.05	Digital Input F11 state indicator	7
##.06	Digital Input F12 state indicator	8
##.41	Analogue input 4 scaling	
##.42	Analogue input 4 invert bit	
##.43	Analogue input 4 destination	
##.45	Analogue input 5 scaling	
##.46	Analogue input 5 invert bit	
##.47	Analogue input 5 destination	
##.48	Analogue Output 3 source	54
##.49	Analogue output 3 scaling	
##.21	F7 destination or source parameter	
##.11	F7 Invert	
##.31	F7 output enable	
##.22	F8 destination or source parameter	
##.12	F8 Invert	
##.32	F8 output enable	
##.23	F9 destination or source parameter	
##.13	F9 Invert	
##.33	F9 output enable	
##.24	F10 destination parameter	
##.14	F10 Invert	
##.25	F11 destination parameter	
##.15	F11 Invert	
##.26	F12 destination parameter	
##.16	F12 Invert	
##.27	Relay 2 source	
##.17	Relay 2 output Invert	
##.28	Relay 3 source	
##.18	Relay 3 output Invert	
##.29	Logic input polarity	

11.2 Application

11.2.1 Menu 18

No.	Description	Type	Units	Range	Default	Setting
18.01	Process Feedback	RO	TIU	0-32767	-	
18.02	Process Feedback Selected	RO	EGU	18.14-18.12	-	
18.03	Process Set point Selected	RO	EGU	18.14-18.12	-	
18.04	Manual Speed Set point Selected	RO	0.1Hz	01.07-01.06	-	
18.05	Process PID Error	RO	EGU	18.14-18.12	-	
18.06	Start Assist Request	RO	Bit	-	-	
18.07	Stop Assist Request	RO	Bit	-	-	
18.08	Duty Only Running	RO	Bit	-	-	
18.09	Sleep Initiated	RO	Bit	-	-	
18.10	Wake Initiated	RO	Bit	-	-	
18.11	Process Preset Set point 1	RW	EGU	18.14-18.12	500	
18.12	Feedback Scaling EGU High Value	RW	EGU	-/+32767	1000	
18.13	Feedback Scaling TIU High Value	RW	TIU	-/+32767	4000	
18.14	Feedback Scaling EGU Low Value	RW	EGU	-/+32767	0	
18.15	Feedback Scaling TIU Low Value	RW	TIU	-/+32767	0	
18.16	Process Set point Slew Rate	RW	EGU/s	0-32767	0	
18.17	PID Proportional Gain	RW	0.01Kp	0	100	
18.18	PID Integral Gain	RW	0.1Ki	0	50	
18.19	PID Differential Gain	RW	0.1Ki	0	0	
18.20	Start Assist Threshold	RW	0.1Hz	01.07-01.06	450	
18.21	Start Assist Delay	RW	0.1sec	0-32767	100	
18.22	Stop Assist Threshold	RW	0.1Hz	01.07-01.06	100	
18.23	Stop Assist Delay	RW	0.1sec	0-32767	100	
18.24	Override Delay	RW	0.1sec	0-32767	20	
18.25	Sleep Threshold	RW	0.1Hz	01.07-01.06	200	
18.26	Sleep Delay	RW	0.1sec	0-32767	100	
18.27	Wake Threshold	RW	EGU	18.14-18.12	210	
18.28	Wake Delay	RW	0.1Hz	0-32767	100	
18.29	Mode Select	RW	-	1-4	1	
18.30	Number of Starters	RW	-	1-4	4	
18.31	Inverse Speed Profile	RW	Bit	-	0	
18.32	Process Preset Set point 2 Select	RW	Bit	-	0	
18.33	Sleep/Wake Enable	RW	Bit	-	0	
18.34	Wake Below Enable	RW	Bit	-	0	
18.35	Process Feedback Alarms Enable	RW	Bit	-	0	
18.36	No Flow Protection Enable	RW	Bit	-	0	
18.37	Analogue Process Set point Enable	RW	Bit	-	1	

18.38	Analogue Process Feedback Enable	RW	Bit	-	1	
18.39	Analogue Speed Set point Enable	RW	Bit	-	1	
18.40	System Run	RW	Bit	-	0	
18.41	System Auto Select	RW	Bit	-	1	
18.42	Remote Select	RW	Bit	-	0	
18.43	Cascade Stop Enable	RW	Bit	-	1	
18.44	PID Always Enable	RW	Bit	-	0	
18.45	Starter 1 Enable	RO	Bit	-	-	
18.46	Starter 2 Enable	RO	Bit	-	-	
18.47	Starter 3 Enable	RO	Bit	-	-	
18.48	Starter 4 Enable	RO	Bit	-	-	
18.49	Cycle Enable	RW	Bit	-	0	
18.50	System Reset	RW	Bit	-	0	

11.2.2 Menu 19

No.	Description	Type	Units	Range	Default	Setting
19.01	Duty Runtime Hours & Minutes	RO	HHMM	0-2359	-	
19.02	Duty Runtime Days	RO	Days	0-32767	-	
19.03	Starter 1 Runtime Hours & Minutes	RO	HHMM	0-2359	-	
19.04	Starter 1 Runtime Days	RO	Days	0-32767	-	
19.05	Starter 2 Runtime Hours & Minutes	RO	HHMM	0-2359	-	
19.06	Starter 2 Runtime Days	RO	Days	0-32767	-	
19.07	Starter 3 Runtime Hours & Minutes	RO	HHMM	0-2359	-	
19.08	Starter 3 Runtime Days	RO	Days	0-32767	-	
19.09	Starter 4 Runtime Hours & Minutes	RO	HHMM	0-2359	-	
19.10	Starter 4 Runtime Days	RO	Days	0-32767	-	
19.11	Low Alarm Threshold	RW	EGU	18.14-18.12	100	
19.12	Low-Low Alarm Threshold	RW	EGU	18.14-18.12	50	
19.13	Low Alarm Delay	RW	0.1sec	0-32767	100	
19.14	High Alarm Threshold	RW	EGU	18.14-18.12	900	
19.15	High-High Alarm Threshold	RW	EGU	18.14-18.12	1000	
19.16	High Alarm Delay	RW	0.1sec	0-32767	100	
19.17	No Flow Delay	RW	0.1sec	0-32767	100	
19.18	Transition Delay	RW	0.1sec	0-32767	100	
19.19	Starter Sequence	RW	-	1234-4321	1234	
19.20	Process Feedback High Trip Enable	RW	Bit	-	0	
19.21	Process Feedback Low Trip Enable	RW	Bit	-	0	
19.22	Assist Fail to Start Trip Indication	RO	-	1234-4321	-	
19.23	Starter No Flow Trip Indication	RO	-	1234-4321	-	
19.24	Parameter Defaults Enable	RW	Bit	-	0	
19.25	Terminal I/O Select	RW	-	0-2	0	
19.26	Duty Runtime Reset	RW	Bit	-	0	
19.27	Starter 1 Runtime Reset	RW	Bit	-	0	
19.28	Starter 2 Runtime Reset	RW	Bit	-	0	
19.29	Starter 3 Runtime Reset	RW	Bit	-	0	
19.30	Starter 4 Runtime Reset	RW	Bit	-	0	
19.31	Starts Per Hour Protection Enable	RW	Bit	-	0	
19.32	Assist Fail to Start Flag	RO	Bit	-	-	

19.33	Duty No Flow	RW	Bit	-	0	
19.34	Starter 1 No Flow	RW	Bit	-	0	
19.35	Starter 2 No Flow	RW	Bit	-	0	
19.36	Starter 3 Flow	RW	Bit	-	0	
19.37	Starter 4 No Flow	RW	Bit	-	0	
19.38	No Flow Flag	RO	Bit	-	-	
19.39	Low Alarm Flag	RO	Bit	-	-	
19.40	Low-Low Alarm Flag	RO	Bit	-	-	
19.41	High Alarm Flag	RO	Bit	-	-	
19.42	High-High Alarm Flag	RO	Bit	-	-	
19.43	Starter 1 Available	RW	Bit	-	0	
19.44	Starter 1 Running	RW	Bit	-	0	
19.45	Starter 2 Available	RW	Bit	-	0	
19.46	Starter 2 Running	RW	Bit	-	0	
19.47	Starter 3 Available	RW	Bit	-	0	
19.48	Starter 3 Running	RW	Bit	-	0	
19.49	Starter 4 Available	RW	Bit	-	0	
19.50	Starter 4 Running	RW	Bit	-	0	

11.2.3 Menu 20

No.	Description	Type	Units	Range	Default	Setting
20.01	Reserved for Fieldbus option	-	-	-	-	
to		-	-	-	-	
20.19		-	-	-	-	
20.01	PID Output Scalar	RW	x0.1Hz		1	
20.02	Remote Speed Reference	RW	0.1Hz	01.07-01.06	0	
20.03	Cascade Stop Delay	RW	0.1sec	0-32767	20	
20.04	Cycle Time	RW	hours	0-32767	24	
20.05	PID Output Scaled	RO	0.1Hz*20.01	0-32767	-	
20.06	Starter 1 Number of Starts Per Hour	RW	-	0-32767	5	
20.07	Starter 2 Number of Starts Per Hour	RW	-	0-32767	5	
20.08	Starter 3 Number of Starts Per Hour	RW	-	0-32767	5	
20.09	Starter 4 Number of Starts Per Hour	RW	-	0-32767	5	
20.10	Starter 1 Number of Starts Per Hour Counter	RO	-	0-20.06	-	
20.11	Starter 2 Number of Starts Per Hour Counter	RO	-	0-20.07	-	
20.12	Starter 3 Number of Starts Per Hour Counter	RO	-	0-20.08	-	
20.13	Starter 4 Number of Starts Per Hour Counter	RO	-	0-20.09	-	
20.14	Starter 1 Start per Hour Elapse Time	RO	Mins.	0-59	-	
20.15	Starter 2 Start per Hour Elapse Time	RO	Mins.	0-59	-	
20.16	Starter 3 Start per Hour Elapse Time	RO	Mins.	0-59	-	
20.17	Starter 4 Start per Hour Elapse Time	RO	Mins.	0-59	-	
20.18	Communications Watchdog Enable	RW	Bit	-	0	
20.19	Watchdog Clock time	RW	0.01sec	0-32767	50	
20.20	Watchdog Trip Delay	RW	0.1sec	0-32767	20	
20.21	Override Enable	RW	Bit	-	0	
20.22	Override Symmetrical Threshold	RW	EGU	18.14-18.12	10	
20.23	Process Preset Set point 2	RW	EGU	18.14-18.12	100	
20.39	Application Software Version	RO	-	0-999999	-	

NOTE

1. Units

EGU – EnGineering Units

TIU – Terminal Interface Units (A/D output resolution)

Sec – Seconds

Mins – Minutes

Hz – Hertz

2. Ranges

18.14 – 18.12 denotes range is defined by specified parameter settings, in this example parameter 18.14 (min) to 18.12 (max).

12

12.1

I/O Defaults

Terminal Mode 1

Parameter 19.25 =1

Term.	Type	Terminal Parameter	Description	Application Parameter
3	0V		Analogue 0v	
4	+10V		Analogue Supply	
5	ANI1+	7.01	Process Feedback	
6	ANI1-	7.01		
7	ANI2	7.02	Auto – Process set point Man – Speed set point	
8	ANI3	7.03	Motor Thermisters	
9	ANO1		Motor Frequency	2.01
10	ANO2		Process Feedback out	7.01
11	0V		Analogue 0v	
22	+24V		Digital Supply	
23	0V		Digital 0V	
24	DI1	8.01	Starter 1 Available	19.43
25	DI2	8.02	Starter 1 Running	19.44
26	DO3	8.03	Starter 1 Run	18.45
27	DI4	8.04	Starter 2 Available	19.45
28	DI5	8.05	Starter 2 Running	19.46
29	DI6	8.06	System Run	18.40
30	0V		Digital 0V	
31	DI	8.09	Enable/Inhibit	
41	Relay	8.07	Starter 2 Run	18.46
42	Relay	8.07		

12.2 Terminal Mode 2

Parameter 19.25 = 2

Term.	Type	Terminal Parameter	Description	Application Parameter
3	0V		Analogue Supply	
4	+10V		Analogue 0V	
5	ANI1+	7.01	Process Feedback	
6	ANI1-	7.01		
7	ANI2	7.02	Auto – Process set point Man – Speed set point	
8	ANI3	7.03	Motor Thermisters	
9	ANO1		Motor Frequency	2.01
10	ANO2		Process Feedback out	7.01
11	0V		Analogue Supply	
22	+24V		Digital 0v	
23	0V		Digital Supply	
24	DI	8.01	Starter 1 Available	19.43
25	DI	8.02	Starter 1 Running	19.44
26	DO	8.03	Starter 1 Run	18.45
27	DI	8.04	System Reset	18.50
28	DI	8.05	System Auto Select	18.41
29	DI	8.06	System Run	18.40
30	0V		Digital 0v	
31	DI	8.09	Enable/Inhibit	
41	Relay	8.07	Starter 2 Run	18.46
42	Relay	8.07		
1	0V		Digital 0V	
2	DI	##.09	Starter 2 Available	19.45
3	DI	##.10	Starter 2 Running	19.46
4	DI	##.03	Starter 3 Available	19.47
5	0V		Digital 0V	
6	DI	##.04	Starter 3 Running	19.48
7	DI	##.05	Starter 4 Available	19.49
8	DI	##.06	Starter 4 Running	19.50
9	ANI	##.40	Speed analogue Ref.1	1.36
10	ANI	##.44	Speed analogue Ref.2	1.37
11	0V		Analogue 0V	
12	ANO		Motor current	4.01
21	Relay 2	##.07	Starter 3 Run	18.47
23	Relay 3	##.08	Starter 4 Run	18.48
22	Relay C			

NOTE The I/O module fitted in the lowest slot number will be used for the terminal default allocation for Duty Assist.

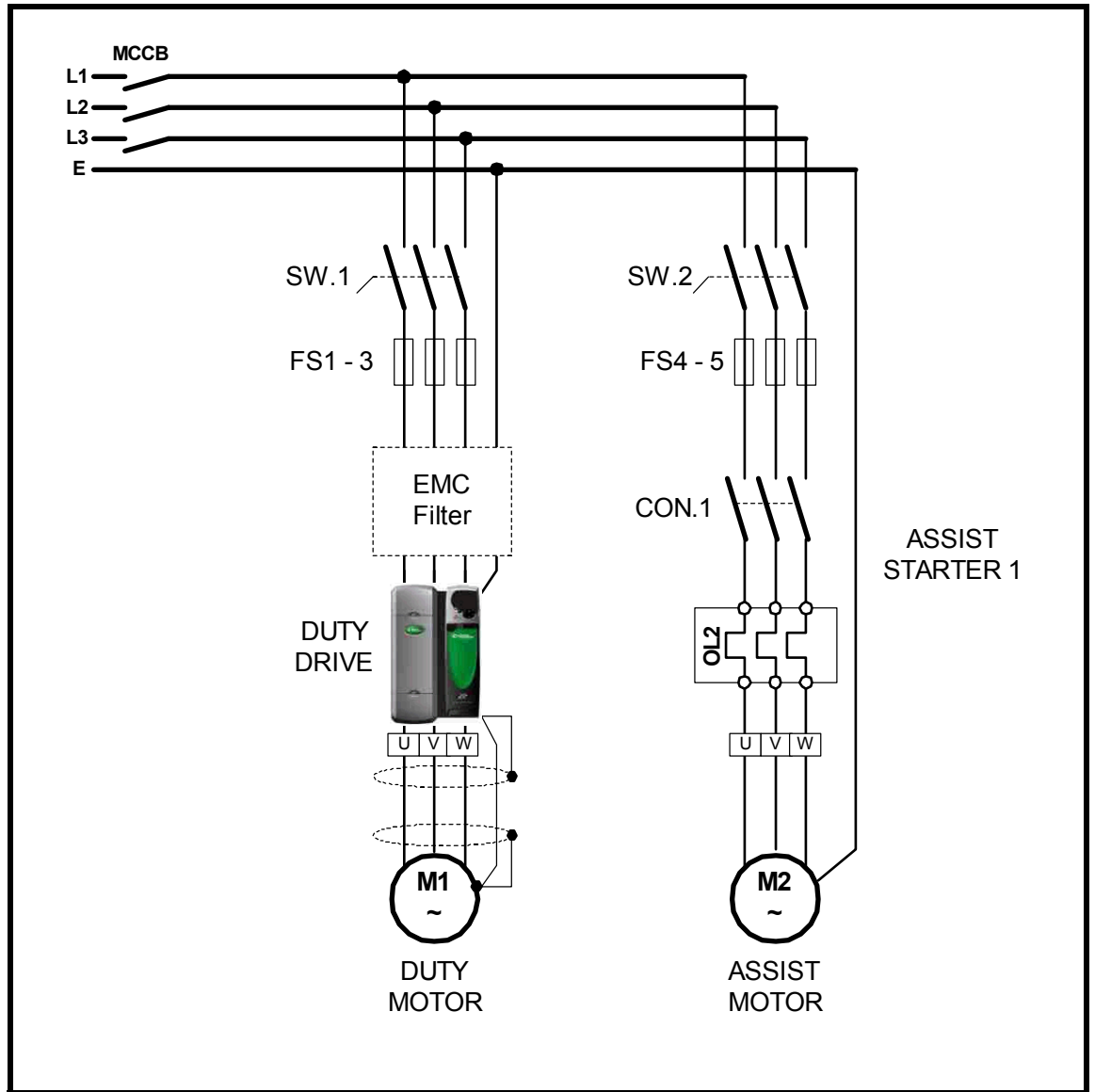
13 Documentation Reference

Manual Description	CT Part Number
Unidrive-SP User Guide	0471 - 0000
Unidrive-SP Advanced User Guide	0447 – 0002-XX
SM-DeviceNet	0471-0009
SM-PROFIBUS-DP	0471-0008
SM-Applications	0471-0007
SM-I/O Plus	0471-0006
SM-Universal Encoder Plus	0471-0005

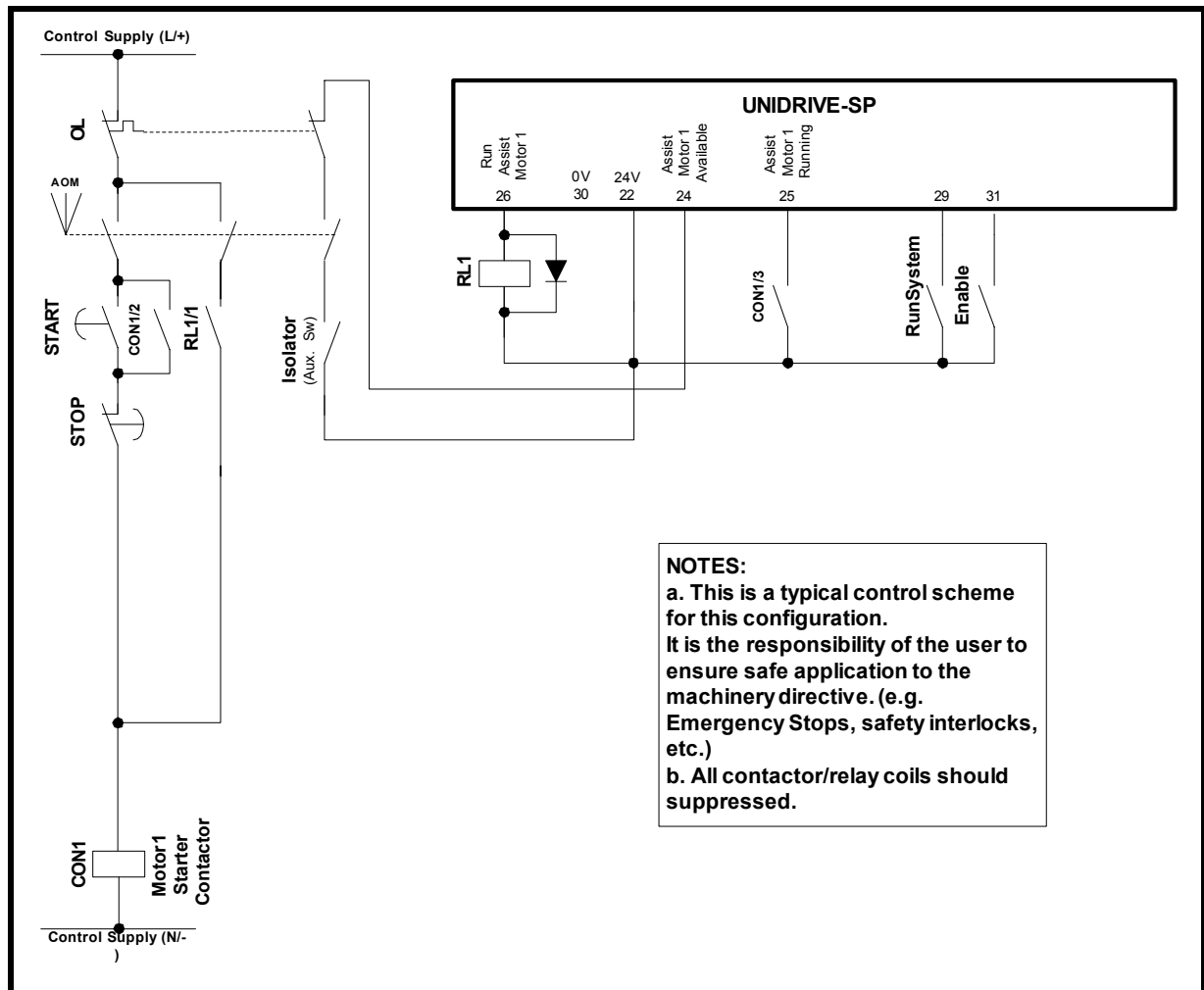
14 Appendix 1

14.1 Controlling Two Motors in "Fixed Duty" Mode

14.1.1 Power Scheme



14.1.2 Control Scheme



14.2.2 Control Scheme

