MAKING MODERN LIVING POSSIBLE

Instruction

VLT® HVAC Basic Drive Cascade Controller

VLT®
THE REAL DRIVE

1.1 Cascade Controller

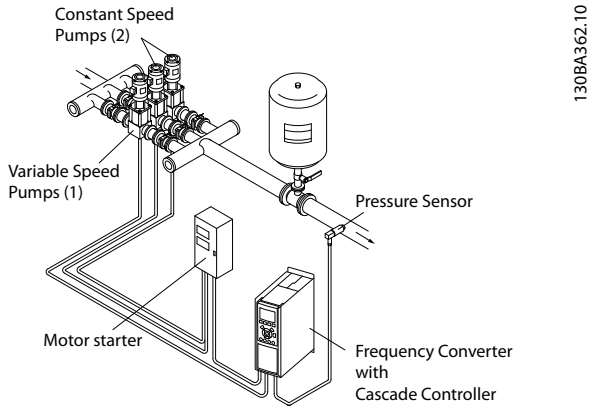

Illustration 1.1 Cascade Controller

The Cascade Controller is used for pump applications where a certain pressure ("head") or level needs to be maintained over a wide dynamic range. Running a large pump at variable speed over a wide for range is not an ideal solution because of low pump efficiency and because there is a practical limit of about 25% rated full load speed for running a pump.

In the Cascade Controller the frequency converter controls a variable speed motor as the variable speed pump (lead) and can stage up to two additional constant speed pumps on and off. By varying the speed of the initial pump, variable speed control of the entire system is provided. This maintains constant pressure while eliminating pressure surges, resulting in reduced system stress and quieter operation in pumping systems.

Fixed Lead Pump

The motors must be of equal size. The Cascade Controller allows the frequency converter to control up to 5 equal size pumps using the drives two built-in relays and terminal 27, 29 (digital input/digital output). When the variable pump (lead) is connected directly to the frequency converter, the other 4 pumps are controlled by the two built-in relays and terminal 27, 29 (digital input/digital output). Lead pump alternation can not be chosen when lead pump is fixed.

Lead Pump Alternation

The motors must be of equal size. This function makes it possible to cycle the frequency converter between the pumps in the system (when *25-57 Relays per Pump* =1, maximum pump is 4. When *25-57 Relays per Pump* =2, maximum pump is 3). In this operation the run time between pumps is equalized reducing the required pump maintenance and increasing reliability and lifetime of the system. The alternation of the lead pump can take place at a command signal or at staging (adding lag pump).

The command can be a manual alternation or an alternation event signal. If the alternation event is selected, the lead pump alternation takes place every time the event occurs. Selections include whenever an alternation timer expires, when the lead pump goes into sleep mode. Staging is determined by the actual system load.

25-55 Alternate if Load⇐50%=1, if load >50% Alternation will not happen. If load ⇐50% Alternation will happen. When *25-55 Alternate if Load⇐50%* =0, Alternation will happen no matter with Load. Total pump capacity is determined as lead pump plus lag speed pumps capacities.

Bandwidth Management

In cascade control systems, to avoid frequent switching of fixed speed pumps, the desired system pressure is kept within a bandwidth rather than at a constant level. The Staging Bandwidth provides the required bandwidth for operation. When a large and quick change in system pressure occurs, the Override Bandwidth overrides the Staging Bandwidth to prevent immediate response to a short duration pressure change. An Override Bandwidth Timer can be programmed to prevent staging until the system pressure has stabilized and normal control established.

When the Cascade Controller is enabled and running normally and the frequency converter issues a trip alarm, the system head is maintained by staging and destaging fixed speed pumps. To prevent frequent staging and destaging and minimize pressure fluxuations, a wider Fixed Speed Bandwidth is used instead of the Staging bandwidth.

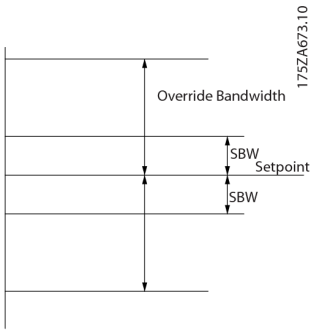

Illustration 1.2 Bandwidth

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1.1.1 System Status and Operation

Only when lead pump is working, the frequency converter can go into sleep mode. When the Cascade Controller is enabled, the operation status for each pump and the Cascade Controller is displayed by *25-81, Pump Status* and *25-80, Cascade Status* on the LCP. Cascade Controller information displayed includes:

- Pumps Status, is a read out of the status for the relays assigned to each pump. The display shows pumps that are disabled, off, running on the frequency converter or running on the mains/ motor starter.
- Cascade Status, is a read out of the status for the Cascade Controller. The display shows the Cascade Controller is disabled, all pumps are running off, fixed speed pumps are being staged/de-staged and lead pump alternation is occurring.

1.1.2 Start/Stop Conditions

See *5-1* Digital Inputs*.

Digital input commands	Variable speed pump (lead)	Fixed speed pumps (lag)
Start (SYSTEM START/STOP)	Ramps up (if stopped and there is a demand)	Staging (if stopped and there is a demand)
Lead Pump Start	Ramps up if SYSTEM START is active	Not affected
Coast (EMERGENCY STOP)	Coast to stop	Cut out (correspond relays, terminal 27/29 and 42/45)
External Interlock	Coast to stop	Cut out (built-in relays are de-energized)

Table 1.1 Commands Assigned to Digital Inputs

LCP keys	Variable speed pump (lead)	Fixed speed pumps (lag)
[Hand On]	Ramps up (if stopped by a normal stop command) or stays in operation if already running	Destaging (if running)
[Off]	Ramps down	Destaging
[Auto On]	Starts and stops according to commands via terminals or serial bus cascade controller only can work when drive in "Auto ON" mode	Staging/Destaging

Table 1.2 Function of Keys on LCP

1.1.3 Cascade Controller Parameter Detail

Parameter	Range	Default	Function
25-00 Cascade Controller	*[0] Disabled [1] Enabled	*[0] Disabled	Enable/disable the cascade controller which is used for staging multiple pumps.
25-04 Pump Cycling	*[0] Disabled [1] Enabled	*[0] Disabled	Select the method for determining the order of cutting in/out the fixed speed pumps.

Parameter	Range	Default	Function
25-05 Fixed Lead Pump	[0] No *[1] Yes	*[1] Yes	Select if the lead pump is fixed (Yes) or can be cycled (No).
25-06 Number of Pumps	2 - Expres-sionlimit (5)	*2	Set the total number of pumps including the variable speed pump.

Parameter	Range	Default	Function
25-20 Staging Bandwidth	1 - Expressionlimit (100) %	*10%	Set the SBW percentage to accommodate system pressure fluctuation.
	Expressionlimit (100) - 100%	*100%	Set the OBW for when to override the staging/destaging timers for immediate response.
25-22 Fixed Speed Bandwidth	Expressionlimit (1) - Expressionlimit (100) %	*Expressionlimit (10)%	Set the staging bandwidth to use when only fixed speed pumps are running.
25-23 SBW Staging Delay	0-3000 s	*15 s	Staging a pump on is delayed by the length of time programmed.
25-24 SBW Destaging Delay	0-3000 s	*15 s	Destaging a pump is delayed by the length of time programmed.
25-25 OBW Time	0-300 s	*10 s	OBW timer prevents staging a pump until the system pressure is stabilised.
25-27 Stage Function	[0] Disabled *[1] Enabled	*[1] Enabled	Enables the stage function timer.
25-28 Stage Function Time	0-300 s	*15 s	With the lead pump at maximum speed, a fixed speed pump is staged on when the programmed time expires.
25-29 Destage Function	[0] Disabled *[1] Enabled	*[1] Enabled	Enables the destage function timer.
25-30 Destage Function Time	0-300 s	*15 s	With the lead pump at minimum speed, a fixed speed pump is destaged when the programmed time expires.

Parameter	Range	Default	Function
25-42 Staging Threshold	Expressionlimit (0)-100%	*90%	The percentage [%] of maximum pump speed to stage on a fixed speed pump.
25-43 Destaging Threshold	Expressionlimit (0)-100%	*50%	The percentage [%] of maximum pump speed to destage a fixed speed pump.
25-45 Staging Speed [Hz]	0-400 Hz	*0.0 Hz	The actual staging speed based on the staging threshold.
25-47 Destaging Speed [Hz]	0-400 Hz	*0.0 Hz	The actual destaging speed based on the destaging threshold.
25-50 Lead Pump Alternation	*[0] Off [1] At staging [2] At command [3] At staging or command	*[0] Off	Changes the lead pump so all pumps run equal time.
25-51 Alternation Event	*[0] External [1] Alternation Time Interval [2] Sleep Mode	*[0] External	Choose the event that will change the lead pump.
25-52 Alternation Time Interval	1-999	*24	Set the time period between automatic alternation of the lead pump.
25-53 Alternation Timer Value			View the actual value of the Alternation Time Interval timer.
25-55 Alternate if Load <= 50%	[0] Disabled *[1] Enabled	*[1] Enabled	Choose enable to change the variable speed pump only if the pump load is less than 50%.
25-56 Staging Mode at Alternation	*[0] Slow [1] Quick	*[0] Slow	
25-57 Relays per Pump	1-2	*1	The number of relays used per pump.

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Parameter	Range	Default	Function
25-58 Run Next Pump Delay	0.1-5.0 s	*0.1 s	Time between stopping the old variable speed pump and starting the new appointed pump.
25-59 Run on Mains Delay	Expressionlimit (0.1)-5.0 s	*0.5 s	Time delay before a fixed speed pump is staged on according to normal staging sequence.
25-80 Cascade Status			View the control status for the Cascade Controller.
25-81 Pump Status	0-0	* 0	View the status for the pumps connected: X=Disabled, O=Off, D=Speed controlled, R=Mains.
25-84 Pump ON Time	0-2147483647	* 0	View the total operating hours of the connected pumps. Can be reset by writing 0..
25-90 Pump Interlock	*[0] Off [1] On	*[0] Off	Choose the pump to interlock for e.g. service. The pump will be taken out of any pump cycling etc.

Table 1.3

1.2 Installation

1.2.1 Control Terminals

Illustration 1.3 shows all control terminals of the frequency converter. Applying Start (terminal 18), connection between terminal 12-27 and an analog reference (terminal 53 or 54 and 55) make the frequency converter run.

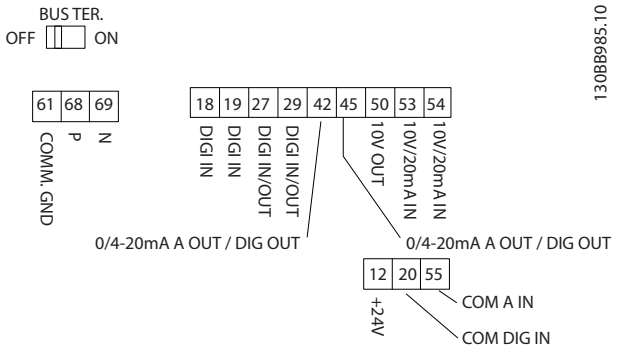

Illustration 1.3 Control Terminals

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1.2.2 Electrical Overview

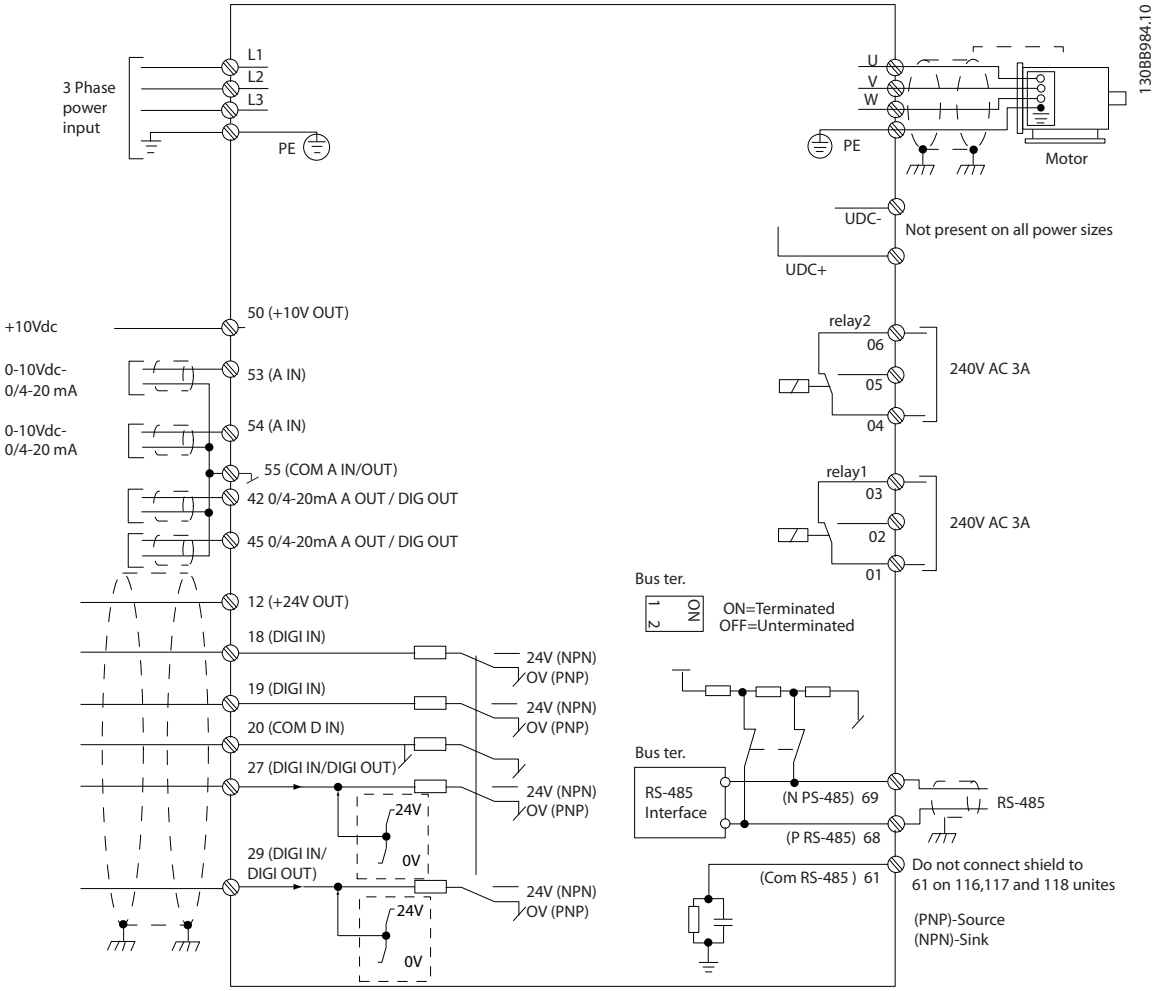

Illustration 1.4 Electrical Overview

NOTE

There is no access to UDC- and UDC+ on the following units:
IP20 380-480 V, 30-90 kW

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1.3 Specifications

1.3.1 Product General Specifications

Frequency Converter	PK37	PK75	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5	P11K
Typical shaft output [kW]	0.37	0.75	1.5	2.2	3.0	4.0	5.5	7.5	11
IP20 Frame	H1	H1	H1	H2	H2	H2	H3	H3	H4
RFI Class	A1	A1	A1	A1	A1	A1	A1	A1	A1
PCB	Coated	Coated	Coated	Coated	Coated	Coated	Coated	Coated	Coated

Table 1.4

Frequency Converter	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical shaft output [kW]	15	18	22	30	37	45	55	75	90
IP20 Frame	H4	H5	H5	H6	H6	H6	H7	H7	H8
RFI Class	A1	A1	A1	A1	A1	A1	A1	A1	A1
PCB	Coated	Coated	Coated	Coated	Coated	Coated	Coated	Coated	Coated

Table 1.5

1.4.1 Main Menu Structure

- **0-** Operation / Display**
  - **0-0* Basic Settings**
    - 0-01 Language
    - 0-03 Regional Settings
    - 0-04 Operating State at Power-up
    - 0-06 GridType
    - 0-07 Auto DC Braking
  - **0-1* Set-up Operations**
    - 0-10 Active Set-up
    - 0-11 Programming Set-up
    - 0-12 Link Setups
  - **0-3* LCP Custom Readout**
    - 0-30 Custom Readout Unit
    - 0-31 Custom Readout Min Value
    - 0-32 Custom Readout Max Value
    - 0-37 Display Text 1
    - 0-38 Display Text 2
    - 0-39 Display Text 3
  - **0-4* LCP Keypad**
    - 0-40 [Hand on] Key on LCP
    - 0-42 [Auto on] Key on LCP
    - 0-44 [Off/Reset] Key on LCP
  - **0-5* Copy/Save**
    - 0-50 LCP Copy
    - 0-51 Set-up Copy
  - **0-6* Password**
    - 0-60 Main Menu Password
- **1-** Load and Motor**
  - **1-0* General Settings**
    - 1-00 Configuration Mode
    - 1-01 Motor Control Principle
    - 1-03 Torque Characteristics
    - 1-06 Clockwise Direction
    - 1-08 Motor Control Bandwidth
  - **1-1* Motor Selection**
    - 1-10 Motor Construction
    - 1-14 Damping Gain
    - 1-15 Low Speed Filter Time Const
    - 1-16 High Speed Filter Time Const
    - 1-17 Voltage filter time const
  - **1-2* Motor Data**
    - 1-20 Motor Power
    - 1-22 Motor Voltage
    - 1-23 Motor Frequency
    - 1-24 Motor Current
    - 1-25 Motor Nominal Speed
    - 1-26 Motor Cont. Rated Torque
    - 1-29 Automatic Motor Adaption (AMA)
  - **1-3* Adv. Motor Data**
    - 1-30 Stator Resistance (Rs)
    - 1-33 Stator Leakage Reactance (X1)
    - 1-35 Main Reactance (Xh)
    - 1-37 d-axis Inductance (Ld)
    - 1-39 Motor Poles
  - **1-4* Adv. Motor Data II**
    - 1-40 Back EMF at 1000 RPM
    - 1-42 Motor Cable Length
    - 1-43 Motor Cable Length Feet
  - **1-5* Load Indep. Setting**
    - 1-50 Motor Magnetisation at Zero Speed
    - 1-52 Min Speed Normal Magnetising [Hz]
    - 1-55 U/f Characteristic - U
    - 1-56 U/f Characteristic - F
  - **1-6* Load Depen. Setting**
    - 1-60 Low Speed Load Compensation
    - 1-61 High Speed Load Compensation
    - 1-62 Slip Compensation
    - 1-63 Slip Compensation Time Constant
    - 1-64 Resonance Dampening
    - 1-65 Resonance Dampening Time Constant
    - 1-66 Min. Current at Low Speed
  - **1-7* Start Adjustments**
    - 1-71 Start Delay
    - 1-72 Start Function
    - 1-73 Flying Start
  - **1-8* Stop Adjustments**
    - 1-80 Function at Stop
    - 1-82 Min Speed for Function at Stop [Hz]
  - **1-9* Motor Temperature**
    - 1-90 Motor Thermal Protection
    - 1-93 Thermistor Source
- **2-** Brakes**
  - **2-0* DC-Brake**
    - 2-00 DC Hold/Motor Preheat Current
    - 2-01 DC Brake Current
    - 2-02 DC Braking Time
    - 2-04 DC Brake Cut In Speed
    - 2-06 Parking Current
    - 2-07 Parking Time
  - **2-1* Brake Energy Funct.**
    - 2-10 Brake Function
    - 2-16 AC Brake, Max current
    - 2-17 Over-voltage Control
- **3-** Reference / Ramps**
  - **3-0* Reference Limits**
    - 3-02 Minimum Reference
    - 3-03 Maximum Reference
  - **3-1* References**
    - 3-10 Preset Reference
    - 3-11 Jog Speed [Hz]
    - 3-14 Preset Relative Reference
    - 3-15 Reference 1 Source
    - 3-16 Reference 2 Source
    - 3-17 Reference 3 Source
  - **3-4* Ramp 1**
    - 3-41 Ramp 1 Ramp Up Time
    - 3-42 Ramp 1 Ramp Down Time
  - **3-5* Ramp 2**
    - 3-51 Ramp 2 Ramp Up Time
    - 3-52 Ramp 2 Ramp Down Time
  - **3-8* Other Ramps**
    - 3-80 Jog Ramp Time
    - 3-81 Quick Stop Ramp Time
- **4-** Limits / Warnings**
  - **4-1* Motor Limits**
    - 4-10 Motor Speed Direction
    - 4-12 Motor Speed Low Limit [Hz]
    - 4-14 Motor Speed High Limit [Hz]
    - 4-18 Current Limit
    - 4-19 Max Output Frequency
  - **4-4* Adj. Warnings 2**
    - 4-40 Warning Freq. Low
    - 4-41 Warning Freq. High
  - **4-5* Adj. Warnings**
    - 4-50 Warning Current Low
    - 4-51 Warning Current High
    - 4-54 Warning Reference Low
    - 4-55 Warning Reference High
    - 4-56 Warning Feedback Low
    - 4-57 Warning Feedback High
    - 4-58 Missing Motor Phase Function
  - **4-6* Speed Bypass**
    - 4-61 Bypass Speed From [Hz]
    - 4-63 Bypass Speed To [Hz]
    - 4-64 Semi-Auto Bypass Set-up
- **5-** Digital In/Out**
  - **5-0* Digital I/O mode**
    - 5-00 Digital Input Mode
    - 5-01 Terminal 27 Mode
    - 5-02 Terminal 29 Mode
    - 5-03 Digital Input 29 Mode
  - **5-1* Digital Inputs**
    - 5-10 Terminal 18 Digital Input
    - 5-11 Terminal 19 Digital Input
    - 5-12 Terminal 27 Digital Input
    - 5-13 Terminal 29 Digital Input
  - **5-3* Digital Outputs**
    - 5-30 Terminal 27 Digital Output
    - 5-31 Terminal 29 Digital Output
    - 5-34 On Delay, Digital Output
    - 5-35 Off Delay, Digital Output
  - **5-4* Relays**
    - 5-40 Function Relay
    - 5-41 On Delay, Relay
    - 5-42 Off Delay, Relay
  - **5-5* Pulse Input**
    - 5-50 Term. 29 Low Frequency
    - 5-51 Term. 29 High Frequency
    - 5-52 Term. 29 Low Ref./Feedb. Value
    - 5-53 Term. 29 High Ref./Feedb. Value
  - **5-9* Bus Controlled**
    - 5-90 Digital & Relay Bus Control
- **6-** Analog In/Out**
  - **6-0* Analog I/O Mode**
    - 6-00 Live Zero Timeout Time
    - 6-01 Live Zero Timeout Function
  - **6-1* Analog Input 53**
    - 6-10 Terminal 53 Low Voltage
    - 6-11 Terminal 53 High Voltage
    - 6-12 Terminal 53 Low Current
    - 6-13 Terminal 53 High Current
    - 6-14 Terminal 53 Low Ref./Feedb. Value
    - 6-15 Terminal 53 High Ref./Feedb. Value
    - 6-16 Terminal 53 Filter Time Constant
    - 6-19 Terminal 53 mode
  - **6-2* Analog Input 54**
    - 6-20 Terminal 54 Low Voltage
    - 6-21 Terminal 54 High Voltage
    - 6-22 Terminal 54 Low Current
    - 6-23 Terminal 54 High Current
    - 6-24 Terminal 54 Low Ref./Feedb. Value
    - 6-25 Terminal 54 High Ref./Feedb. Value
    - 6-26 Terminal 54 Filter Time Constant
    - 6-29 Terminal 54 mode
  - **6-7* Analog/Digital Output 45**
    - 6-70 Terminal 45 Mode
    - 6-71 Terminal 45 Analog Output
    - 6-72 Terminal 45 Digital Output
    - 6-73 Terminal 45 Output Min Scale
    - 6-74 Terminal 45 Output Max Scale
    - 6-76 Terminal 45 Output Bus Control
  - **6-9* Analog/Digital Output 42**
    - 6-90 Terminal 42 Mode
    - 6-91 Terminal 42 Analog Output
    - 6-92 Terminal 42 Digital Output
    - 6-93 Terminal 42 Output Min Scale
    - 6-94 Terminal 42 Output Max Scale
    - 6-96 Terminal 42 Output Bus Control
    - 6-98 Drive Type
- **8-** Comm. and Options**
  - **8-0* General Settings**
    - 8-01 Control Site
    - 8-02 Control Source
    - 8-03 Control Timeout Time
    - 8-04 Control Timeout Function
  - **8-3* FC Port Settings**
    - 8-30 Protocol
    - 8-31 Address
    - 8-32 Baud Rate
    - 8-33 Parity / Stop Bits
    - 8-35 Minimum Response Delay
    - 8-36 Maximum Response Delay
    - 8-37 Maximum Inter-char delay
  - **8-4* FC MC protocol set**
    - 8-42 PCD Write Configuration
    - 8-43 PCD Read Configuration
  - **8-5* Digital/Bus**
    - 8-50 Coasting Select
    - 8-51 Quick Stop Select
    - 8-52 DC Brake Select
    - 8-53 Start Select
    - 8-54 Reversing Select
    - 8-55 Set-up Select
    - 8-56 Preset Reference Select
  - **8-7* BACnet**
    - 8-70 BACnet Device Instance
    - 8-72 MS/TP Max Masters
    - 8-73 MS/TP Max Info Frames
    - 8-74 "I am" Service
    - 8-75 Intialisation Password
    - 8-79 Protocol Firmware version
  - **8-8* FC Port Diagnostics**
    - 8-80 Bus Message Count
    - 8-81 Bus Error Count
    - 8-82 Slave Messages Rcvd
    - 8-83 Slave Error Count
    - 8-84 Slave Messages Sent
    - 8-85 Slave Timeout Errors
    - 8-88 Reset FC port Diagnostics
  - **8-9* Bus Feedback**
    - 8-94 Bus Feedback 1
- **13-** Smart Logic**
  - **13-0* SLC Settings**
    - 13-00 SL Controller Mode
    - 13-01 Start Event
    - 13-02 Stop Event
    - 13-03 Reset SLC
  - **13-1* Comparators**
    - 13-10 Comparator Operand
    - 13-11 Comparator Operator
    - 13-12 Comparator Value
  - **13-2* Timers**
    - 13-20 SL Controller Timer
  - **13-4* Logic Rules**
    - 13-40 Logic Rule Boolean 1
    - 13-41 Logic Rule Operator 1
    - 13-42 Logic Rule Boolean 2
    - 13-43 Logic Rule Operator 2
    - 13-44 Logic Rule Boolean 3
  - **13-5* States**
    - 13-51 SL Controller Event
    - 13-52 SL Controller Action
- **14-** Special Functions**
  - **14-0* Inverter Switching**
    - 14-01 Switching Frequency
    - 14-03 Overmodulation
    - 14-08 Damping Gain Factor
  - **14-1* Mains On/Off**
    - 14-12 Function at Mains Imbalance
  - **14-2* Reset Functions**
    - 14-20 Reset Mode
    - 14-21 Automatic Restart Time
    - 14-22 Operation Mode
    - 14-23 Typecode Setting
    - 14-27 Action At Inverter Fault
    - 14-28 Production Settings
    - 14-29 Service Code
  - **14-4* Energy Optimising**
    - 14-40 VT Level
    - 14-41 AEO Minimum Magnetisation
  - **14-5* Environment**
    - 14-50 RFI Filter
    - 14-51 DC-Link Voltage Compensation
    - 14-52 Fan Control
    - 14-53 Fan Monitor
    - 14-55 Output Filter
  - **14-6* Auto Derate**
    - 14-63 Min Switch Frequency
- **15-** Drive Information**
  - **15-0* Operating Data**
    - 15-00 Operating hours

15-01 Running Hours
15-02 kWh Counter
15-03 Power Up's
15-04 Over Temp's
15-05 Over Volt's
15-06 Reset kWh Counter
15-07 Reset Running Hours Counter
15-3* Alarm Log
15-30 Alarm Log: Error Code
15-31 InternalFaultReason
15-4* Drive Identification
15-40 FC Type
15-41 Power Section
15-42 Voltage
15-43 Software Version
15-44 Ordered TypeCode
15-46 Drive Ordering No
15-47 Power Card Ordering No
15-48 LCP Id No
15-49 SW ID Control Card
15-50 SW ID Power Card
15-51 Drive Serial Number
15-53 Power Card Serial Number
15-9* Parameter Info
15-92 Defined Parameters
15-97 Application Type
15-98 Drive Identification
16- Data Readouts**
16-0* General Status
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference [%]
16-03 Status Word
16-05 Main Actual Value [%]
16-09 Custom Readout
16-1* Motor Status
16-10 Power [kW]
16-11 Power [hp]
16-12 Motor Voltage
16-13 Frequency
16-14 Motor current
16-15 Frequency [%]
16-18 Motor Thermal
16-3* Drive Status
16-30 DC Link Voltage
16-34 Heatsink Temp.
16-35 Inverter Thermal
16-36 Inv. Nom. Current
16-37 Inv. Max. Current
16-38 SL Controller State
16-5* Ref. & Feedb.
16-50 External Reference
16-52 Feedback[Unit]
16-6* Inputs & Outputs
16-60 Digital Input
16-61 Terminal 53 Setting
16-62 Analog Input AI53
16-63 Terminal 54 Setting
16-64 Analog Input AI54
16-65 Analog Output AO42 [mA]
16-66 Digital Output
16-67 Pulse Input #29 [Hz]
16-71 Relay Output [bin]
16-72 Counter A
16-73 Counter B
16-79 Analog Output AO45
16-8* Fieldbus & FC Port
16-86 FC Port REF 1
16-9* Diagnosis Readouts
16-90 Alarm Word
16-91 Alarm Word 2
16-92 Warning Word
16-93 Warning Word 2
16-94 Ext. Status Word
16-95 Ext. Status Word 2
18- Info & Readouts**
18-1* Fire Mode Log
18-10 FireMode Log:Event
20- Drive Closed Loop**
20-0* Feedback
20-00 Feedback 1 Source
20-01 Feedback 1 Conversion
20-8* PI Basic Settings
20-81 PI Normal/ Inverse Control
20-83 PI Start Speed [Hz]
20-84 On Reference Bandwidth
20-9* PI Controller
20-91 PI Anti Windup
20-93 PI Proportional Gain
20-94 PI Integral Time
20-97 PI Feed Forward Factor
22- Appl. Functions**
22-4* Sleep Mode
22-40 Minimum Run Time
22-41 Minimum Sleep Time
22-43 Wake-Up Speed [Hz]
22-44 Wake-Up Ref./FB Diff
22-45 Setpoint Boost
22-46 Maximum Boost Time
22-47 Sleep Speed [Hz]
22-6* Broken Belt Detection
22-60 Broken Belt Function
22-61 Broken Belt Torque
22-62 Broken Belt Delay
24- Appl. Functions 2**
24-0* Fire Mode
24-00 FM Function
24-05 FM Preset Reference
24-09 FM Alarm Handling
24-1* Drive Bypass
24-10 Drive Bypass Function
24-11 Drive Bypass Delay Time
25- Cascade Controller**
25-0* System Settings
25-00 Cascade Controller
25-04 Pump Cycling
25-05 Fixed Lead Pump
25-06 Number of Pumps
25-2* Bandwidth Settings
25-20 Staging Bandwidth
25-21 Override Bandwidth
25-22 Fixed Speed Bandwidth
25-23 SBW Staging Delay
25-24 SBW Destaging Delay
25-25 OBW Time
25-27 Stage Function
25-28 Stage Function Time
25-29 Destage Function
25-30 Destage Function Time
25-4* Staging Settings
25-42 Staging Threshold
25-43 Destaging Threshold
25-45 Staging Speed [Hz]
25-47 Destaging Speed [Hz]
25-5* Alternation Settings
25-50 Lead Pump Alternation
25-51 Alternation Event
25-52 Alternation Time Interval
25-53 Alternation Timer Value
25-55 Alternate if Load <= 50%
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