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1 Introduction

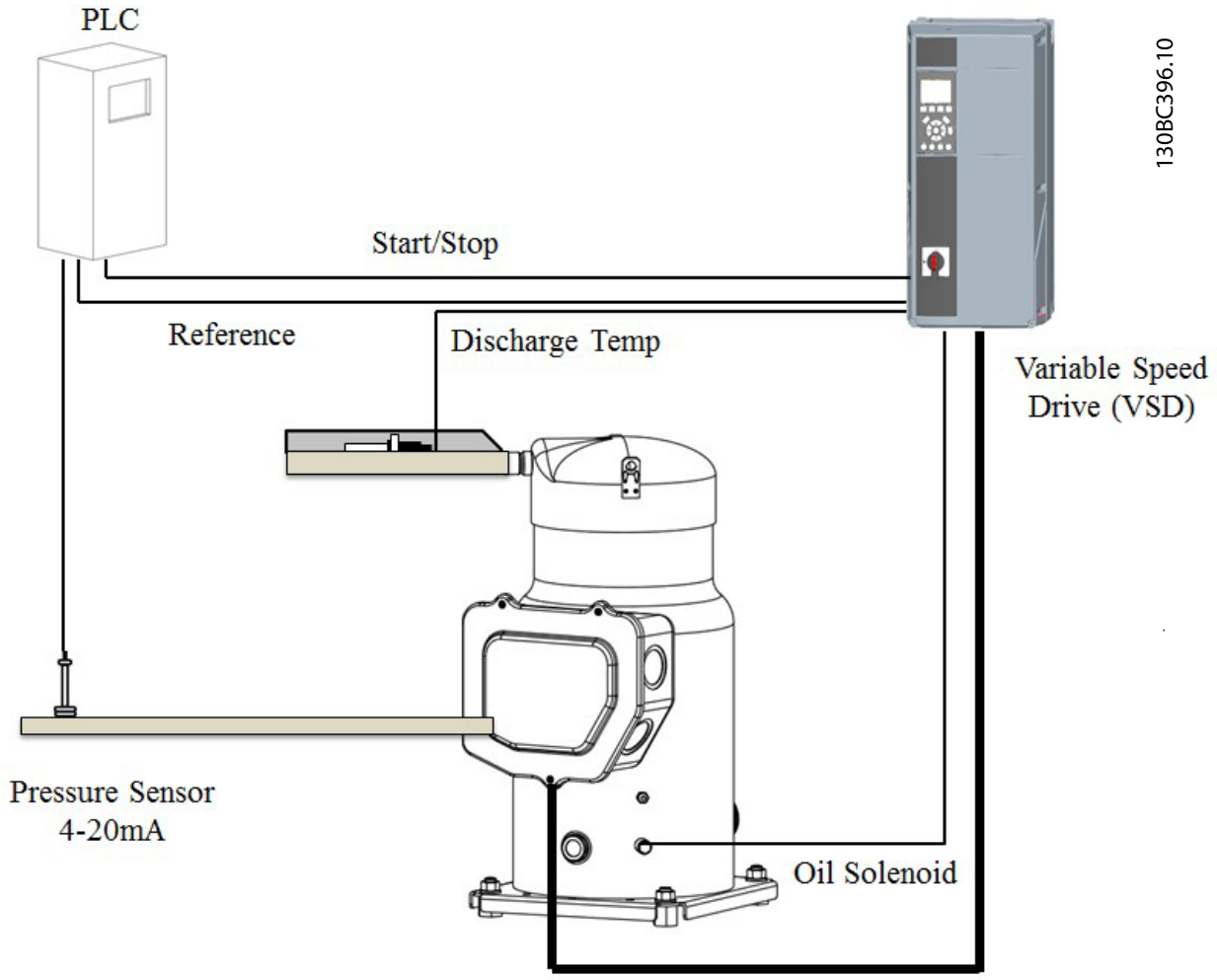

Illustration 1.1 Compressor Drive System

The Compressor Drive® utilises and combines Danfoss design and manufacturing expertise. Our extensive application knowledge of Refrigeration, Air Conditioning and Motion Controls ensures an optimised product design and package solution:

- One package “plug & play” solution.
- Operation efficiency.
- Flexibility & best control accuracy.
- Innovative and reliable solution.

The frequency converter is 100% pre-set for speed open loop configuration with 0-10 V reference corresponding to 1800 to 5400 RPM for CDS302 and 1500 to 6000 RPM for CDS303.

The dedicated frequency converter functionality includes:

- **Start Up**
  Once the frequency converter has a start command, the compressor runs up to 3000 RPM and remains at that speed for 10 s. Once this initial time is complete, the frequency converter slowly ramps to the reference speed.
- **Shut Down**
  The stop command bypasses the normal ramp time and the frequency converter ramps the compressor to stop fast.
- **Short Cycle Prevention**
  The frequency converter has a minimum running time of 12 s, with an interval between starts of 5 minutes (300 s). The short cycle delay values are adjustable in parameter group *28-0* Short Cycle Protection*.

- **Oil Injection**
  The frequency converter cycles a solenoid valve via its relay 1. This ensures that the oil is distributed to the scroll set, improves tightness, and reduces internal gas leakage during the compression process.
- **Oil Management**
  If the speed of the compressor is below 3000 RPM for a determined amount of time (within 60 minutes), the boost cycle runs the compressor back to 4200 RPM for a determined amount of time (within 90 s). The maximum time between fixed boosts is limited to a determined amount of time (within 24 hours).
- **Discharge Temperature Limit**
  If the discharge temperature exceeds the warning level of 130 °C, the compressor drops in speed by 10 Hz for the next 3 minutes, then continues to drop 10 Hz for each 3 minutes for as long as the temperature is over the warning level. If the discharge temperature exceeds the emergency level of 145 °C, the compressor is stops.
- **Crankcase Heater**
  On VSH088 and VSH117, when the compressor is stopped, the frequency converter provides a DC current to the compressor motor to keep the oil warm and to avoid needing an external crankcase heater.
  VSH170 needs an external crankcase heater (surface sump heater or belt type).
- **Low Pressure Switch**
  An LP switch is mandatory with the frequency converter compressor in any type of application.
- **High Pressure Switch**
  The high pressure switch must be connected to input terminal 27 of the frequency converter in series with the other safety devices.

1.1.1 Sequence of Operation

All compressor types have strong demands to speed limits to ensure the oil lubrication of the bearings. This is the main reason for accelerating from standstill to minimum speed as fast as possible with a special start ramp when a start command is given. This is also the reason why the Compressor Drive trips with an alarm [A49] Speed Limit, if the speed falls below minimum speed e.g. when the current limit controller reduces the speed due to a high load. This alarm will be reset automatically after 30 s and the compressor will restart.

In case of a blocked rotor, the Compressor Drive trips with an alarm [A18] *Start failed*, if the speed fails to get above the minimum speed limit for the compressor within 2 s. This alarm will be reset automatically after 30 s and the compressor will restart.

The necessary start settings, motor data and all the other preferred settings for each compressor type/size are set up by the manufacturer and are automatically set up by selecting the actual compressor in *1-13 Compressor Selection*.

2 Safety Instructions and General Warnings

2

2.1 Safety and Warnings

2.1.1 High Voltage Warning

⚠WARNING

The voltage of the frequency converter is dangerous whenever the converter is connected to mains. Incorrect fitting of the motor or frequency converter may cause damage to the equipment, serious injury or death. Consequently, it is essential to comply with the instructions in this manual as well as local and national rules and safety regulations.

⚠WARNING

Installation in high altitudes:
By altitudes above 2 km, please contact Danfoss regarding PELV.

2.1.2 Caution

⚠CAUTION

The CDS302 and CDS303 Compressor Drive™ DC link capacitors remain charged after power has been disconnected. To avoid an electrical shock hazard, disconnect the frequency converter from the mains before carrying out maintenance. Wait at least as follows before doing service on the frequency converter:
CDS302: 11-22 kW 15 minutes
CDS303: High voltage can be present on the DC link even when the LEDs are turned off.

2.1.3 Disposal

Illustration 2.1

Drive
Equipment containing electrical components may not be disposed together with domestic waste. It must be separate collected with Electrical and Electronic Waste according to local and currently valid legislation.

Compressors
Do not to throw away a used compressor, but dispose of it and its oil at a specialised recycling company site.

2.1.4 Software Version

CDS302 Operating Instructions Software version: 2.3x
These Operating Instructions can be used for all CDS302 Compressor Drives® with software version 2.3x. The software version number can be read in *15-43 Software Version*.

Table 2.1

CDS303 Operating Instructions Software version: 1.0x
These Operating Instructions can be used for all CDS303 Compressor Drives® with software version 1.0x. The software version number can be read in *15-43 Software Version*.

Table 2.2

2.1.5 Safety Instructions

- Make sure that the frequency converter is properly connected to earth
- Do not remove mains plugs or motor plugs while the frequency converter is connected to mains
- Protect users against supply voltage
- Protect the motor against overloading according to national and local regulations
- Motor overload protection is included in the default settings
- The earth leakage current exceeds 3.5 mA
- The [Off] key is not a safety switch. It does not disconnect the frequency converter from mains

2.1.6 General Warning

⚠WARNING

Warning:
Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains. Also make sure that other voltage inputs have been disconnected, such as load-sharing (linkage of DC intermediate circuit). Using CDS302 Compressor Drives®: Wait at least 15 minutes.
Shorter time is allowed only if indicated on the nameplate for the specific unit.

2.1.7 Leakage Current

⚠CAUTION

The earth leakage current from the frequency converter exceeds 3.5 mA. To ensure that the earth cable has a good mechanical connection to the earth connection (terminal 95), the cable cross section must be at least 10 mm² or 2 times rated earth wires terminated separately.

2.1.8 Residual Current Device

⚠CAUTION

This product can cause a DC current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product. See also *RCD Application Note, MN90G*. Protective earthing of the frequency converter and the use of RCDs must always follow national and local regulations.

2.1.9 IT Mains

⚠CAUTION

Do not connect 400 V frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V. For IT mains and delta earth (grounded leg), mains voltage may exceed 440 V between phase and earth. Use *14-50 RFI 1* on the frequency converter to disconnect the internal RFI capacitors from the RFI filter to ground. If this is done, it will reduce the RFI performance to A2 level.

2.1.10 Avoid Unintended Start

While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the Local Control Panel (LCP). Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended start. To avoid unintended start, always press the [OFF] key before changing parameters. An electronic fault, temporary overload, a fault in the mains supply, or lost motor connection may cause a stopped motor to start. A frequency converter with Safe Stop provides a certain degree of protection against such unintended start, if the Safe Stop Terminal 37 is on low voltage level or disconnected.

2.2 Safe Stop of the Frequency Converter

The frequency converter can perform the safety function *Safe Torque Off* (STO, as defined by EN IEC 61800-5-2[1]) and *Stop Category 0* (as defined in EN 60204-1[2]).
Danfoss has named this functionality *Safe Stop*. Before integration and use of Safe Stop in an installation, perform a thorough risk analysis to determine whether the Safe Stop functionality and safety levels are appropriate and sufficient. Safe Stop is designed and approved suitable for the requirements of:

- Safety Category 3 in EN 954-1 (and EN ISO 13849-1)
- Performance Level "d" in EN ISO 13849-1:2008
- SIL 2 Capability in IEC 61508 and EN 61800-5-2
- SILCL 2 in EN 62061

[1] Refer to EN IEC 61800-5-2 for details of Safe torque off (STO) function.
[2] Refer to EN IEC 60204-1 for details of stop category 0 and 1.

Activation and Termination of Safe Stop
The Safe Stop (STO) function is activated by removing the voltage at Terminal 37 of the Safe Inverter. By connecting the Safe Inverter to external safety devices providing a safe delay, an installation for a safe Stop Category 1 can be obtained. The Safe Stop function can be used for asynchronous, synchronous, and permanent magnet motors.

⚠WARNING

After installation of Safe Stop (STO), a commissioning test as specified in section *Safe Stop Commissioning Test* of the Design Guide must be performed. A passed commissioning test is mandatory after first installation and after each change to the safety installation.

Safe Stop Technical Data
The following values are associated to the different types of safety levels:

Reaction time for T37
- Typical reaction time: 10 ms

Reaction time = delay between de-energizing the STO input and switching off the frequency converter output bridge.

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Data for EN ISO 13849-1

- Performance Level "d"
- $MTTF_d$ (Mean Time To Dangerous Failure): 24816 years
- DC (Diagnostic Coverage): 99%
- Category 3
- Lifetime 20 years

Data for EN IEC 62061, EN IEC 61508, EN IEC 61800-5-2

- SIL 2 Capability, SILCL 2
- PFH (Probability of Dangerous failure per Hour)=7e-10FIT=7e-19/h
- SFF (Safe Failure Fraction) >99%
- HFT (Hardware Fault Tolerance)=0 (1001 architecture)
- Lifetime 20 years

Data for EN IEC 61508 low demand

- PFDavg for one year proof test: 3, 07E-14
- PFDavg for three year proof test: 9, 20E-14
- PFDavg for five year proof test: 1, 53E-13

SISTEMA Data

Functional safety data is available via a data library for use with the SISTEMA calculation tool from the IFA (Institute for Occupational Safety and Health of the German Social Accident Insurance), and data for manual calculation. The library is permanently completed and extended.

Abbrev.	Ref.	Description
Cat.	EN 954-1	Category, level "B, 1-4"
FIT		Failure In Time: 1E-9 hours
HFT	IEC 61508	Hardware Fault Tolerance: HFT = n means, that n+1 faults could cause a loss of the safety function
MTTFd	EN ISO 13849-1	Mean Time To Failure - dangerous. Unit: years
PFH	IEC 61508	Probability of Dangerous Failures per Hour. Consider the PFH value when the safety device is operated in high demand (more often than once per year); or operated in continuous mode, where the frequency of demands for operation made on a safety-related system is greater than one per year.
PL	EN ISO 13849-1	Discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions. Levels a-e.
SFF	IEC 61508	Safe Failure Fraction [%]; Percentage part of safe failures and dangerous detected failures of a safety function or a subsystem related to all failures.
SIL	IEC 61508	Safety Integrity Level
STO	EN 61800-5-2	Safe Torque Off
SS1	EN 61800 -5-2	Safe Stop 1

Table 2.3 Abbreviations Related to Functional Safety

The PFD_{avg} value (Probability of Failure on Demand) Failure probability in the event of a request of the safety function.

2.2.1 Terminal 37 Safe Stop Function

The frequency converter is available with safe stop functionality via control terminal 37. Safe stop disables the control voltage of the power semiconductors of the frequency converter output stage. This in turn prevents generating the voltage required to rotate the motor. When the Safe Stop (T37) is activated, the frequency converter issues an alarm, trips the unit, and coasts the motor to a stop. Manual restart is required. The safe stop function can be used as an emergency stop for the frequency converter. In normal operating mode when safe stop is not required, use the regular stop function instead. When automatic restart is used, ensure the requirements of ISO 12100-2 paragraph 5.3.2.5 are fulfilled.

Liability Conditions

It is the responsibility of the user to ensure that qualified personnel installs and operates the safe stop function:

- Read and understand the safety regulations concerning health and safety/accident prevention
- Understand the generic and safety guidelines given in this description and the extended description in the *Design Guide*
- Have a good knowledge of the generic and safety standards applicable to the specific application

User is defined as: integrator, operator, service technician, maintenance technician.

Standards

Use of safe stop on terminal 37 requires that the user satisfies all provisions for safety including relevant laws, regulations and guidelines. The optional safe stop function complies with the following standards.

- EN 954-1: 1996 Category 3
- IEC 60204-1: 2005 category 0 – uncontrolled stop
- IEC 61508: 1998 SIL2
- IEC 61800-5-2: 2007 – safe torque off (STO) function
- IEC 62061: 2005 SIL CL2

- ISO 13849-1: 2006 Category 3 PL d
- ISO 14118: 2000 (EN 1037) – prevention of unexpected startup

The information and instructions of the instruction manual are not sufficient for a proper and safe use of the safe stop functionality. The related information and instructions of the relevant *Design Guide* must be followed.

Protective Measures

- Qualified and skilled personnel are required for installation and commissioning of safety engineering systems
- The unit must be installed in an IP54 cabinet or in an equivalent environment. In special applications a higher IP degree is required
- The cable between terminal 37 and the external safety device must be short circuit protected according to ISO 13849-2 table D.4
- When external forces influence the motor axis (for example, suspended loads), additional measures are required (for example, a safety holding brake) to eliminate potential hazards

Safe Stop Installation and Set-Up

⚠WARNING

SAFE STOP FUNCTION!

The safe stop function does NOT isolate mains voltage to the frequency converter or auxiliary circuits. Perform work on electrical parts of the frequency converter or the motor only after isolating the mains voltage supply and waiting the length of time specified in *2.1 Safety and Warnings*. Failure to isolate the mains voltage supply from the unit and waiting the time specified could result in death or serious injury.

- It is not recommended to stop the frequency converter by using the Safe Torque Off function. If a running frequency converter is stopped by using the function, the unit trips and stops by coasting. If unacceptable or dangerous, use another stopping mode to stop the frequency converter and machinery, before using this function. Depending on the application, a mechanical brake can be required.
- For synchronous and permanent magnet motor frequency converters, in a multiple IGBT power semiconductor failure: In spite of the activation of the Safe Torque Off function, the system can produce an alignment torque which maximally rotates the motor shaft by 180/p degrees. p denotes the pole pair number.
- This function is suitable for performing mechanical work on the system or affected area of a machine only. It does not provide electrical safety. Do not use this function as a control for starting and/or stopping the frequency converter.

Follow these steps to perform a safe installation of the frequency converter:

1. Remove the jumper wire between control terminals 37 and 12 or 13. Cutting or breaking the jumper is not sufficient to avoid short-circuiting. (See jumper on *Illustration 2.2*.)
2. Connect an external Safety monitoring relay via a NO safety function to terminal 37 (safe stop) and either terminal 12 or 13 (24 V DC). Follow the instruction for the safety device. The Safety monitoring relay must comply with Category 3 (EN 954-1)/PL "d" (ISO 13849-1) or SIL 2 (EN 62061).

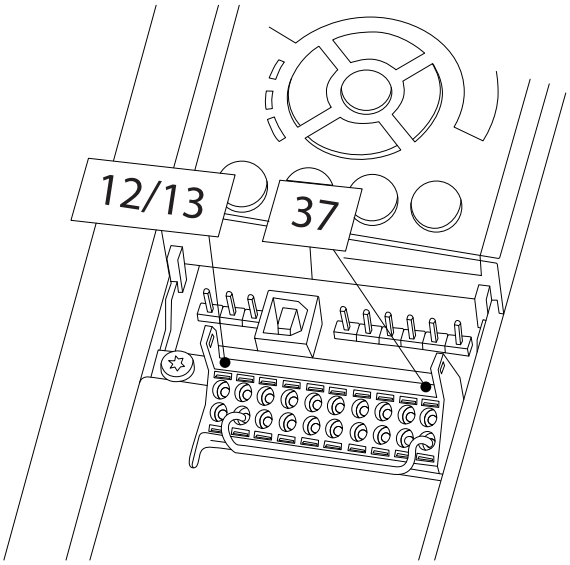

Illustration 2.2 Jumper between Terminal 12/13 (24 V) and 37

2

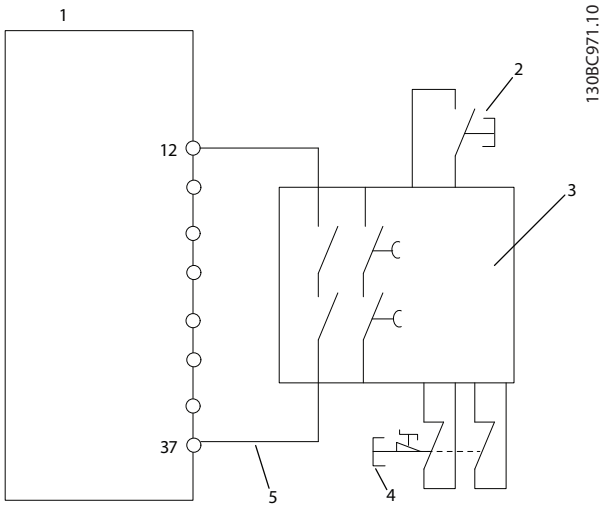

Illustration 2.3 Installation to Achieve a Stopping Category 0 (EN 60204-1) with Safety Cat. 3 (EN 954-1) / PL "d" (ISO 13849-1) or SIL 2 (EN 62061).

1	Frequency converter
2	[Reset] key
3	Safety relay (cat. 3, PL d or SIL2
4	Emergency stop button
5	Short-circuit protected cable (if not inside installation IP54 cabinet)

Table 2.4

Safe Stop Commissioning Test

After installation and before first operation, perform a commissioning test of the installation using safe stop. Moreover, perform the test after each modification of the installation.

Example with STO

A safety relay evaluates the E-Stop button signals and triggers an STO function on the frequency converter in the event of an activation of the E-Stop button (See *Illustration 2.4*). This safety function corresponds to a category 0 stop (uncontrolled stop) in accordance with IEC 60204-1. If the function is triggered during operation, the motor runs down in an uncontrolled manner. The power to the motor is safely removed, so that no further movement is possible. It is not necessary to monitor plant at a standstill. If an external force effect can occur, provide additional measures to prevent any potential movement (for example mechanical brakes).

NOTE

For all applications with Safe Stop it is important that short circuit in the wiring to T37 can be excluded. Exclude the short circuit as described in EN ISO 13849-2 D4 by the use of protected wiring (shielded or segregated).

Example with SS1

SS1 corresponds to a controlled stop, stop category 1 according to IEC 60204-1 (see *Illustration 2.5*). When activating the safety function, the frequency converter performs a normal controlled stop. This can be activated through terminal 27. After the safe delay time has expired on the external safety module, the STO will be triggered and terminal 37 will be set low. Ramping down as configured in the frequency converter. If the frequency converter is not stopped after the safe delay time, the activation of STO will coast the frequency converter.

NOTE

When using the SS1 function, the brake ramp of the frequency converter is not monitored with respect to safety.

Example with Category 4/PL e application

Where the safety control system design requires two channels for the STO function to achieve Category 4/PL e, implement one channel via Safe Stop T37 (STO) and the other by a contactor. Connect the contactor in either the frequency converter input or output power circuits and controlled by the Safety relay (see *Illustration 2.6*). The contactor must be monitored through an auxiliary guided contact, and connected to the reset input of the Safety Relay.

Paralleling of Safe Stop input the one Safety Relay

Safe Stop inputs T37 (STO) may be connected directly if it is required to control multiple frequency converters from the same control line via one Safety Relay (see *Illustration 2.7*). Connecting inputs increases the probability of a fault in the unsafe direction. A fault in one frequency converter can result in all frequency converters becoming enabled. The probability of a fault for T37 is so low, that the resulting probability still meets the requirements for SIL2.

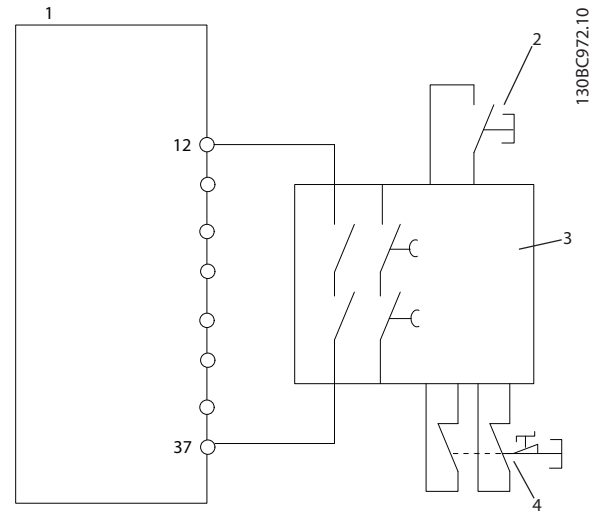

Illustration 2.4 STO Example

1	Frequency converter
2	[Reset] key
3	Safety relay
4	Emergency stop

Table 2.5

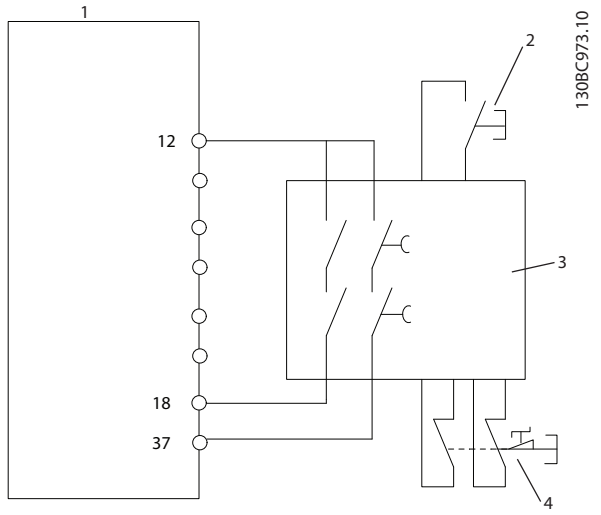

Illustration 2.5 SS1 Example

1	Frequency converter
2	[Reset] key
3	Safety relay
4	Emergency stop

Table 2.6

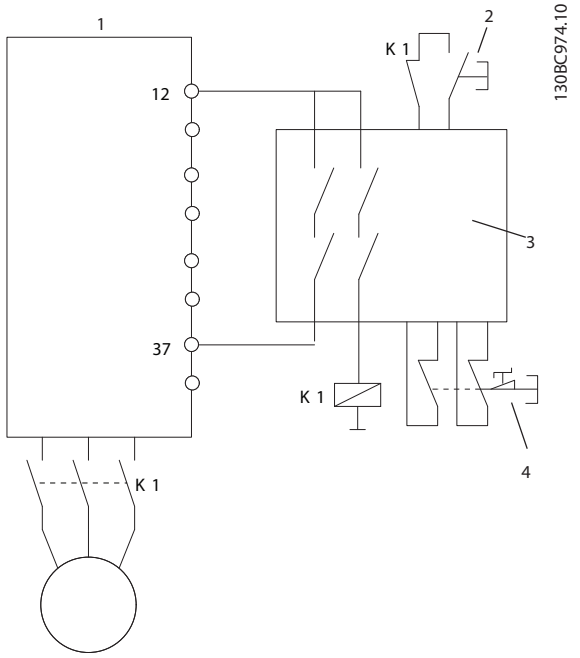

Illustration 2.6 STO Category 4 Example

1	Frequency converter
2	[Reset] key
3	Safety relay
4	Emergency stop

Table 2.7

2

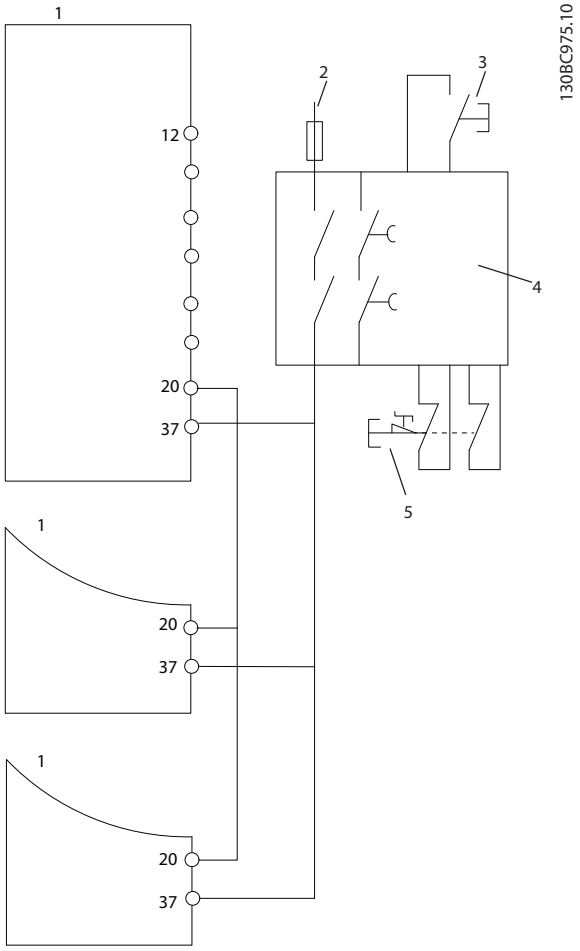

Illustration 2.7 Paralleling of Multiple Drives Example

1	Frequency converter
2	24 V DC
3	[Reset] key
4	Safety relay
5	Emergency stop

Table 2.8

⚠WARNING

Safe Stop activation (that is removal of 24 V DC voltage supply to terminal 37) does not provide electrical safety. The Safe Stop function itself is therefore not sufficient to implement the Emergency-Off function as defined by EN 60204-1. Emergency-Off requires measures of electrical isolation, for example, by switching off mains via an additional contactor.

1. Activate the Safe Stop function by removing the 24 V DC voltage supply to the terminal 37.
2. After activation of Safe Stop (that is, after the response time), the frequency converter coasts (stops creating a rotational field in the motor). The response time is typically less than 10 ms.

The frequency converter is guaranteed not to restart creation of a rotational field by an internal fault (in accordance with Cat. 3 of EN 954-1, PL d acc. EN ISO 13849-1 and SIL 2 acc. EN 62061). After activation of Safe Stop, the display shows the text "Safe Stop activated". The associated help text says, "Safe Stop has been activated. This means that the Safe Stop has been activated, or that normal operation has not been resumed yet after Safe Stop activation".

NOTE

The requirements of Cat. 3 (EN 954-1)/PL "d" (ISO 13849-1) are only fulfilled while 24 V DC supply to terminal 37 is kept removed or low by a safety device which itself fulfills Cat. 3 (EN 954-1) PL "d" (ISO 13849-1). If external forces act on the motor, it must not operate without additional measures for fall protection. External forces can arise for example, in the event of vertical axis (suspended loads) where an unwanted movement, for example caused by gravity, could cause a hazard. Fall protection measures can be additional mechanical brakes.

By default the Safe Stop function is set to an Unintended Restart Prevention behaviour. Therefore, to resume operation after activation of Safe Stop,

1. reapply 24 V DC voltage to terminal 37 (text Safe Stop activated is still displayed)
2. create a reset signal (via bus, Digital I/O, or [Reset] key.

The Safe Stop function can be set to an Automatic Restart behaviour. Set the value of *5-19 Terminal 37 Safe Stop* from default value [1] to value [3].
Automatic Restart means that Safe Stop is terminated, and normal operation is resumed, as soon as the 24 V DC are applied to Terminal 37. No Reset signal is required.

⚠WARNING

Automatic Restart Behaviour is permitted in one of the two situations:

1. **The Unintended Restart Prevention is implemented by other parts of the Safe Stop installation.**
2. **A presence in the dangerous zone can be physically excluded when Safe Stop is not activated. In particular, paragraph 5.3.2.5 of ISO 12100-2 2003 must be observed**

2.2.2 Safe Stop Commissioning Test

After installation and before first operation, perform a commissioning test of an installation or application, using Safe Stop.
Perform the test again after each modification of the installation or application involving the Safe Stop.

NOTE

A passed commissioning test is mandatory after first installation and after each change to the safety installation.

The commissioning test (select one of cases 1 or 2 as applicable):

Case 1: Restart prevention for Safe Stop is required (that is Safe Stop only where *5-19 Terminal 37 Safe Stop* is set to default value [1], or combined Safe Stop and MCB 112 where *5-19 Terminal 37 Safe Stop* is set to *[6] PTC 1 & Relay A* or *[9] PTC 1 & Relay W/A*):

1.1 Remove the 24 V DC voltage supply to terminal 37 using the interrupt device while the frequency converter drives the motor (that is mains supply is not interrupted). The test step is passed when

- the motor reacts with a coast, and
- the mechanical brake is activated (if connected)
- the alarm "Safe Stop [A68]" is displayed in the LCP, if mounted

1.2 Send Reset signal (via Bus, Digital I/O, or [Reset] key). The test step is passed if the motor remains in the Safe Stop state, and the mechanical brake (if connected) remains activated.

1.3 Reapply 24 V DC to terminal 37. The test step is passed if the motor remains in the coasted state, and the mechanical brake (if connected) remains activated.

1.4 Send Reset signal (via Bus, Digital I/O, or [Reset] key). The test step is passed when the motor becomes operational again.

The commissioning test is passed if all four test steps 1.1, 1.2, 1.3 and 1.4 are passed.

Case 2: Automatic Restart of Safe Stop is wanted and allowed (that is, Safe Stop only where *5-19 Terminal 37 Safe Stop* is set to [3], or combined Safe Stop and MCB 112 where *5-19 Terminal 37 Safe Stop* is set to *[7] PTC 1 & Relay W* or *[8] PTC 1 & Relay A/W*):

2.1 Remove the 24 V DC voltage supply to terminal 37 by the interrupt device while the frequency converter drives the motor (that is mains supply is not interrupted). The test step is passed when

- the motor reacts with a coast, and
- the mechanical brake is activated (if connected)
- the alarm "Safe Stop [A68]" is displayed in the LCP, if mounted

2.2 Reapply 24 V DC to terminal 37.

The test step is passed if the motor becomes operational again. The commissioning test is passed if both test steps 2.1 and 2.2 are passed.

NOTE

See warning on the restart behaviour in *2.2.1 Terminal 37 Safe Stop Function*

NOTE

The Safe Stop function can be used for asynchronous, synchronous and permanent magnet motors. Two faults can occur in the power semiconductor of the frequency converter. When using synchronous or permanent magnet motors a residual rotation can result from the faults. The rotation can be calculated to Angle = 360/(Number of Poles). The application using synchronous or permanent magnet motors must take this residual rotation into consideration and ensure that it does not pose a safety risk. This situation is not relevant for asynchronous motors.

NOTE

The Safe Stop function can be used for asynchronous, synchronous and permanent magnet motors. It may happen that two faults occur in the frequency converter's power semiconductor. When using synchronous or permanent magnet motors this may cause a residual rotation. The rotation can be calculated to Angle = 360/(Number of Poles). The application using synchronous or permanent magnet motors must take this into consideration and ensure that this is not a safety critical issue. This situation is not relevant for asynchronous motors.

3 How to Install

3

3.1 Environment

3.1.1 Ambient Temperature and Altitude

The normal ambient temperature supported by the CDS is -10 °C to +50 °C without derating. The CDS operates normally down to -20 °C with only the LCP display function impaired but without performance reduction.

For ambient temperatures above +50 °C it is mandatory to integrate the derating output factor for the maximum compressor electrical motor power/current.

For altitudes above 1000 m, apply derating as shown in *Table 3.1*.

For more details on derating due to environmental factors, contact Danfoss technical support.

Altitude [m]	Derating factor
1000	1
1500	0.95
2000	0.90
2500	0.86
3000	0.82
3500	0.78

Table 3.1 Altitude Derating Factor

3.1.2 Environmental Requirements for Mechanical Installation

The unit is cooled by means of air circulation.
To protect the unit from overheating, ensure that the ambient temperature does not exceed the maximum temperature stated for the 24-hour average temperature. If the ambient temperature is in the range of 45 °C to 55 °C, derating will become relevant. The service life of the unit is reduced if derating for ambient temperature is not taken into account.

3.2 Mechanical Installation

3.2.1 Accessory Bags

Find the following parts included in the CDS302 Accessory Bag

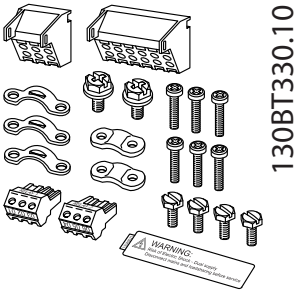

Illustration 3.1 Frame Sizes B1 and B2, IP21/IP55/Type 1/Type 12

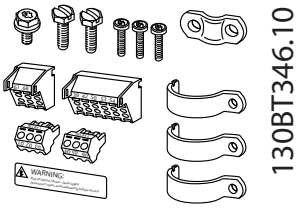

Illustration 3.2 Frame Size B3, IP20/Chassis

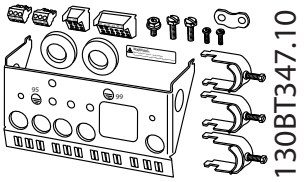

Illustration 3.3 Frame Size B4, IP20/Chassis

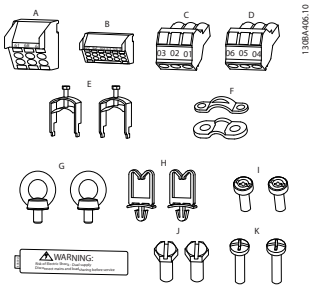

Illustration 3.4 Frame Sizes C1 and C2, IP55/66/Type 1/Type 12

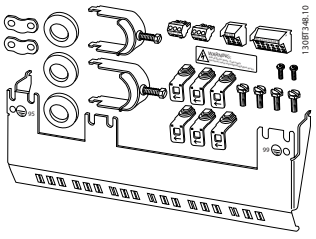

Illustration 3.5 Frame Size C3, IP20/Chassis

3.2.2 Mechanical Mounting

1. Drill holes in accordance with the measurements given.
2. Provide screws suitable for the surface on which the CDS302 is to be mounted.
3. Retighten all four screws.

The frequency converter IP20 allows side-by-side installation. Because of the need for cooling, there must be a minimum of 100 mm free air passage above and below the frequency converter.
The back wall must always be solid. All frequency converters are equipped with a back metal plate to guarantee proper heat exchanger ventilation. Never remove this metal sheet.

3.2.3 Mechanical Dimensions

IP 20 Chassis	T2 (240 V)	T4 (480 V)	T6 (575 V)
VSH088 (15 kW)	B4	B3	B3
VSH117 (18 kW)	C3	B4	B4
VSH170 (22 kW)	C3	B4	B4
IP 55 NEMA 12			
VSH088 (15 kW)	C1	B1	B1
VSH117 (18 kW)	C1	B2	B2
VSH170 (22 kW)	C1	B2	B2

Table 3.2 Related VSH Numbers

3

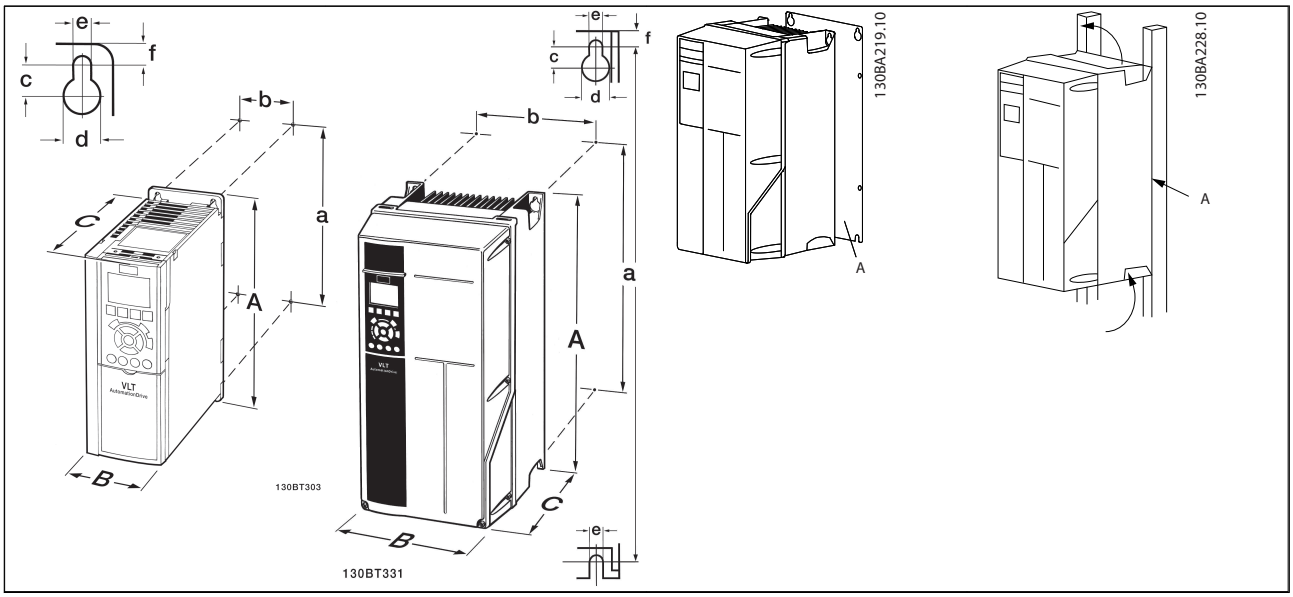

Table 3.3

		Frame size B1	Frame size B2	Frame size B3	Frame size B4	Frame size C1	Frame size C3
Height [mm]							
Backplate	A	480	650	399	520	680	550
Distance between mounting holes	a	454	624	380	495	648	521
Width [mm]							
Back plate	B	242	242	165	230	308	308
Distance between mounting holes	b	210	210	140	200	272	270
Depth [mm]							
Without option	C	260	260	249	242	310	333
With option	C	260	260	262	242	310	333
Screw holes							
	c	12.0	12.0	8		12.0	
	d	Ø 19.0	Ø 19.0	12		Ø 19.0	
	e	Ø 9.0	Ø 9.0	8.8	8.5	Ø 9.0	8.5
	f	9.0	9.0	7.9	15	9.8	17
Max. weight [kg]		23.0	27.0	12	23.5	45	50

Table 3.4 Mechanical Dimensions

3.3 Electrical Installation

3.3.1 Cables General

⚠CAUTION

Cables general:
Always comply with national and local regulations on cable cross-sections.

Frame size	200-240 V [kW]	380-500 V [kW]	525-690 V [kW]	Cable for	Tightening up torque [Nm]
B1	5.5-7.5	11-15	15	Mains, Motor cables	1.8
				Relay	0.5-0.6
				Earth	2-3
B2	11	18.5-22	18.5-22	Mains	4.5
				Motor cables	4.5
				Relay	0.5-0.6
				Earth	2-3
B3	5.5-7.5	11-15	15	Mains, Motor cables	1.8
				Relay	0.5-0.6
				Earth	2-3
B4	11-15	18.5-30	18.5-22	Mains, Motor cables	4.5
				Relay	0.5-0.6
				Earth	2-3

Table 3.5 Tightening-up Torque

3.3.2 Removal of Knockouts for Extra Cables

- Remove cable entry from the frequency converter (Avoiding foreign parts in the frequency converter when removing knockouts)
- Cable entry has to be supported around the knockout that is to be removed
- The knockout can now be removed with a strong mandrel and a hammer
- Remove burrs from the hole
- Mount cable entry on frequency converter

3.3.3 Mains Connection for B1, B2 and B3

NOTE

Frequency converter sizes differ, but terminal numbers are always the same. Incoming power is always 91, 92, 93 labeled L1, L2, L3.

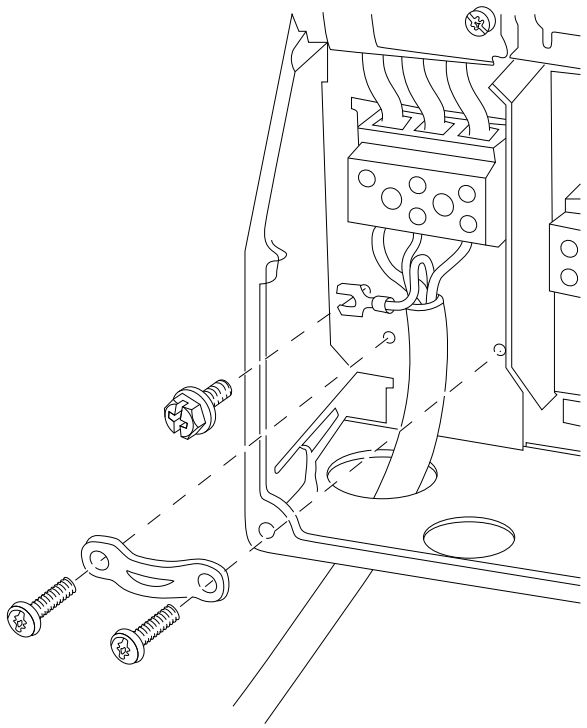

Illustration 3.6 How to Connect to Mains and Earthing for B1 and B2

3

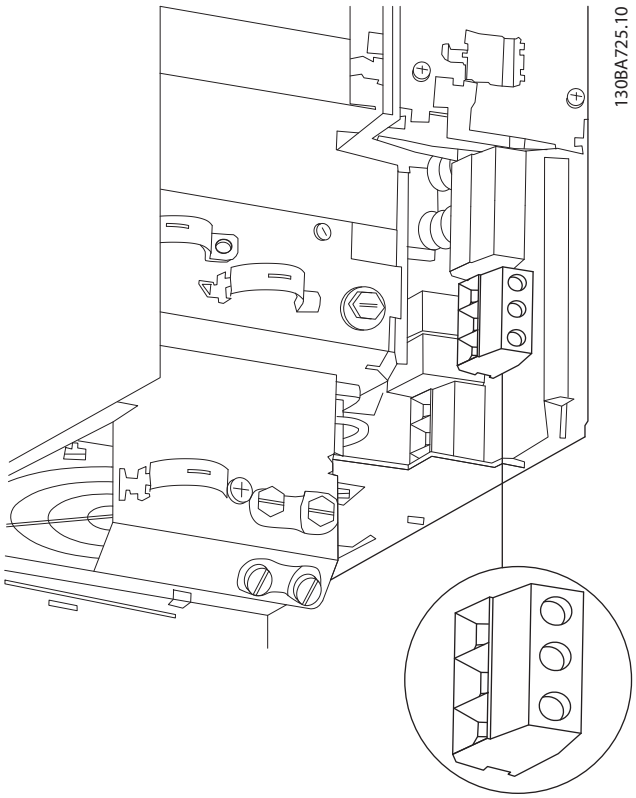

Illustration 3.7 How to Connect to Mains and Earthing for B3 without RFI.

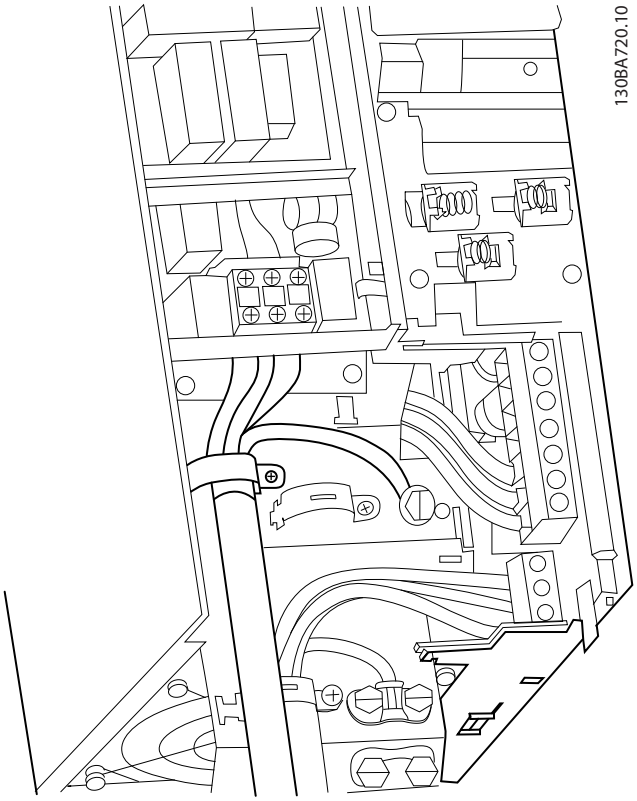

Illustration 3.8 How to Connect to Mains and Earthing for B3 with RFI.

NOTE

For correct cable dimensions see *8 General Specifications*.

3.3.4 Mains connection for B4, C1 and C3

NOTE

Frequency converter sizes differ but terminal numbers are always the same. Incoming power is always 91, 92, 93 labeled L1, L2, L3.

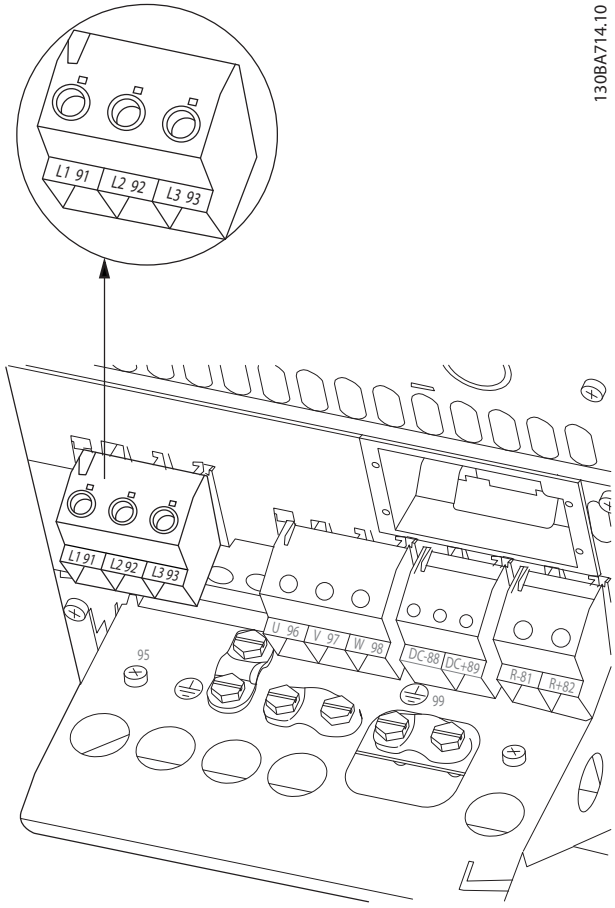

Illustration 3.9 How to Connect to Mains and Earthing for B4.

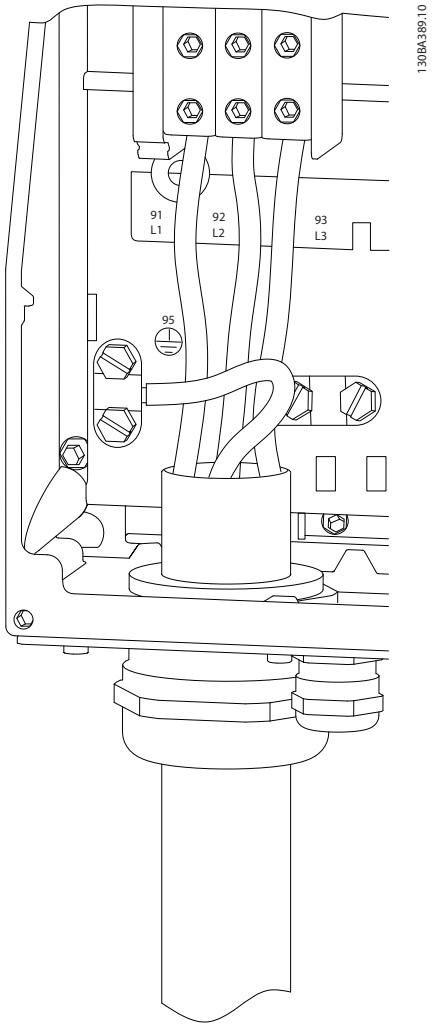

Illustration 3.10 How to Connect to Mains and Earthing for C1 and C2.

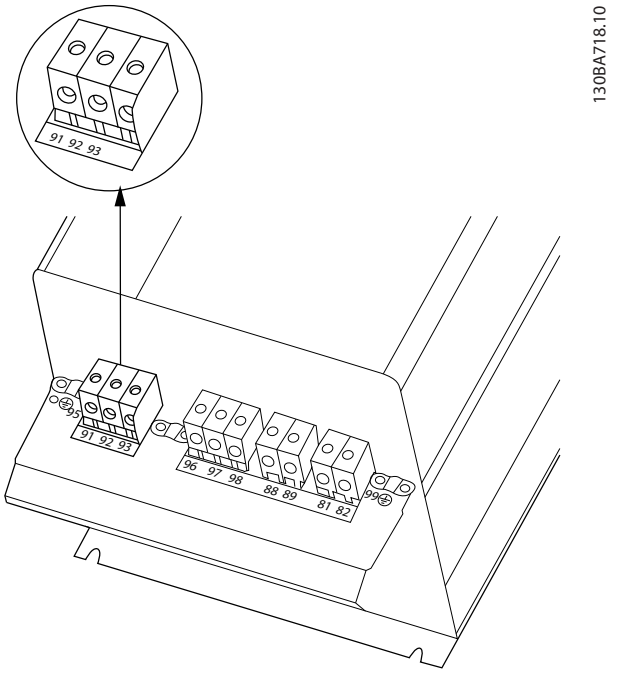

Illustration 3.11 How to Connect C3 to Mains and Earthing.

3. Connect to earth connection (terminal 99) on decoupling plate with screws from the accessory bag.
4. Insert terminals 96 (U), 97 (V), 98 (W) and motor compressor cable to terminals labelled MOTOR.
5. Fasten screened cable to decoupling plate with screws and washers from the accessory bag.
6. U, V, W for motor compressor need to be clockwise connected.

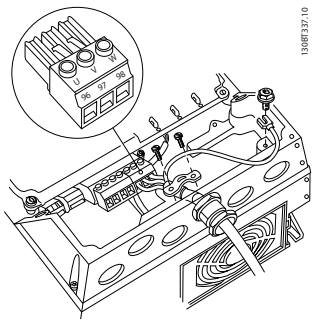

Illustration 3.13

3.3.5 Motor Compressor Connection

NOTE

Always wire terminal 96 (U) to T1, 97 (V) to T2, and 98 (W) to T3.

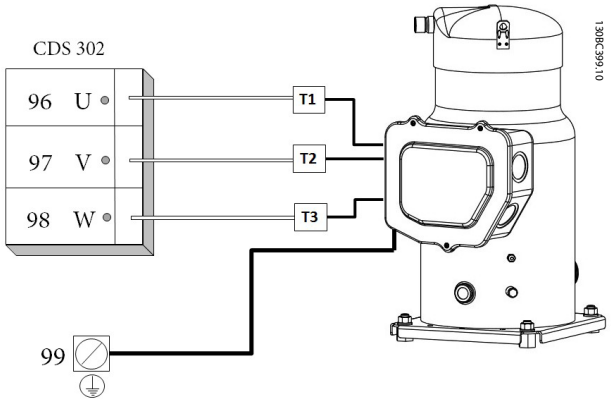

Illustration 3.12 Motor/Compressor Wiring

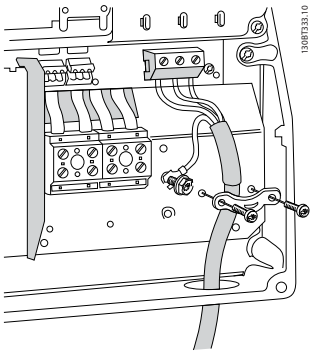

Illustration 3.14

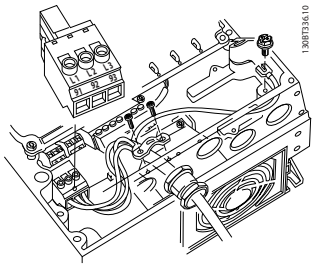

Illustration 3.15

Motor compressor cable must be screened/armoured. If an unscreened/unarmoured cable is used, some EMC requirements are out of compliance. For more information, see EMC specifications.

1. Fasten decoupling plate to the bottom of the frequency converter with screws and washers from the accessory bag.
2. Attach motor compressor cable to terminals 96 (U), 97 (V), 98 (W).

3.3.6 Motor Compressors Cables

Correct dimensioning of motor compressor cable cross-section and length is described in the application manual.

- Use a screened/armoured motor compressor cable to comply with EMC emission specifications
- Keep the motor compressor cable as short as possible to reduce the noise level and leakage currents
- Connect the motor compressor cable screen to both the decoupling plate of the frequency converters and to the metal cabinet of the motor compressor
- Make the screen connections with the largest possible surface area (cable clamp). This is done by using the supplied installation devices in the frequency converter.

3.3.7 Electrical Installation of Motor Compressor Cables

Screening of cables
Avoid installation with twisted screen ends (pigtails). They reduce the screening effect at higher frequencies.

Cable length and cross-section
The frequency converter has been tested with a given length of cable and a given cross-section of that cable. If the cross-section is increased, the cable capacitance - and thus the leakage current - may increase, and the cable length must be reduced correspondingly.

Aluminium conductors
Aluminium conductors are not recommended. Terminals can accept aluminium conductors but the conductor surface has to be clean and the oxidation must be removed and sealed by neutral acid free Vaseline grease before the conductor is connected. Furthermore, the terminal screw must be retightened after two days due to the softness of the aluminium. It is crucial to keep the connection a gas tight joint, otherwise the aluminium surface will oxidize again.

3.3.8 Compressor Motor Protection

The electrical compressor motor protection is fully provided by the frequency converter.

- The frequency converter makes through an Electronic current measurement anti-overload and lock-rotor compressor motor protection (see description in the application manual).
- The frequency converter is protected against short-circuits on compressor terminals T1, T2, T3.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- If a compressor motor phase is missing, the frequency converter trips.
- The frequency converter is protected against earth faults on compressor motor terminals T1, T2, T3.

3.3.9 Access to Control Terminals

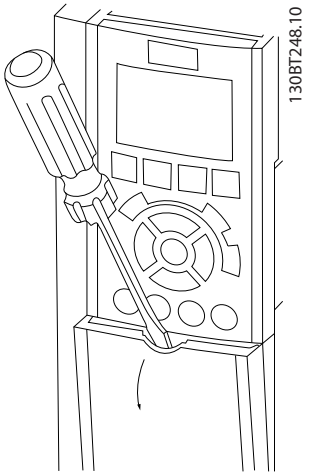

Illustration 3.16 B3, B4 and C3 Enclosures

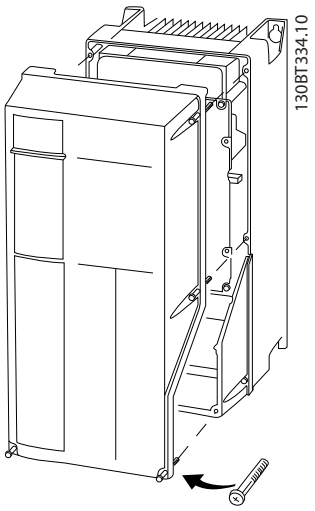

Illustration 3.17 C1, B1 and B2 Enclosures

1. 10 pole plug digital I/O
2. 3 pole plug RS485 Bus

3. 6 pole analog I/O
4. USB Connection

Control terminals are located beneath the LCP. The inside of the removable cover shows the terminals.

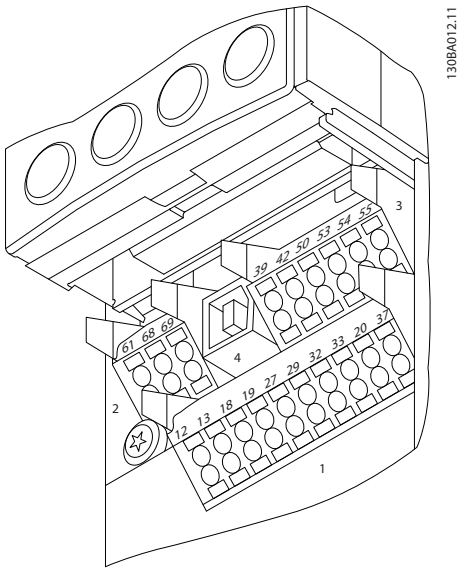

Illustration 3.18 Control Terminals

To mount the cable to the terminal:

1. Strip isolation of 9-10 mm
2. Insert a screwdriver in the square hole.
3. Insert the cable in the adjacent circular hole.
4. Remove the screwdriver. The cable is now mounted to the terminal

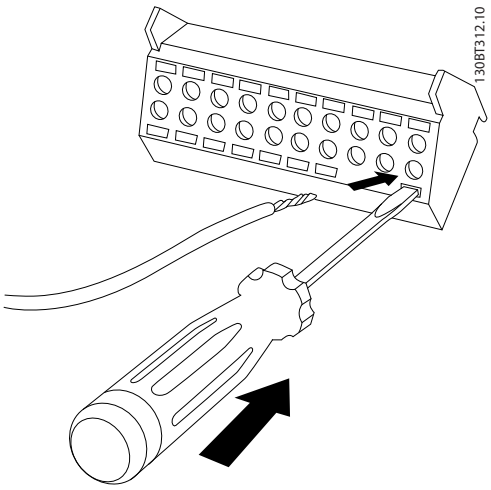

Illustration 3.19

To remove the cable from the terminal:

1. Insert a screwdriver in the square hole.
2. Pull out the cable

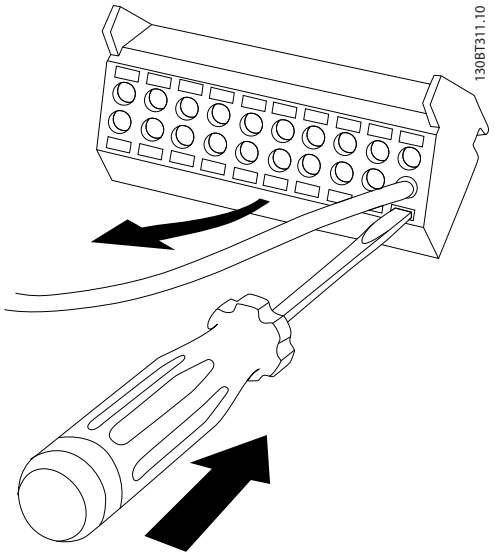

Illustration 3.20

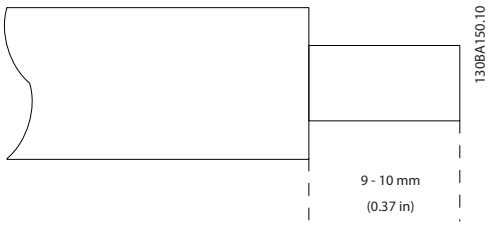

Illustration 3.21

3.3.10 Basic Wiring Example

1. Mount terminals from the accessory bag to the front of the frequency converter.

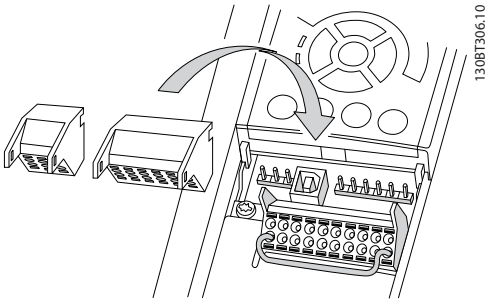

Illustration 3.22

2. Connect terminals 18, 27 and 37 to +24 V (terminal 12/13)

Default settings:
18 = start
27 = coast inverse

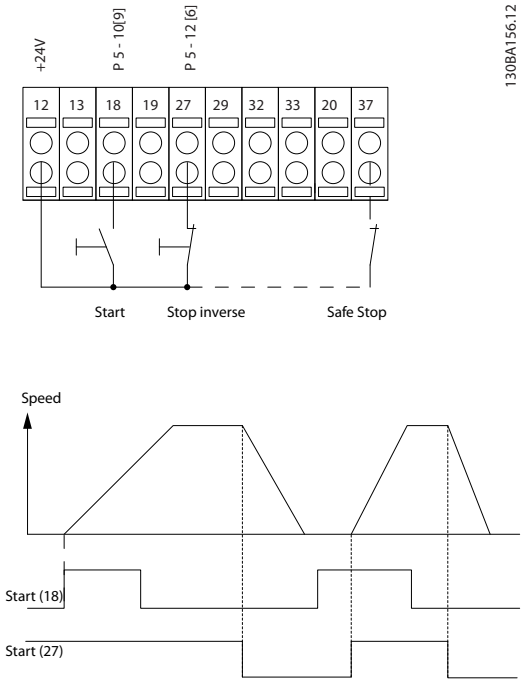

Illustration 3.23

3.3.11 Electrical Installation, Control Cables

Terminal 37 is the input to be used for Safe Stop. Control cables more than 100 m (330 ft) and analog signals may in rare cases and depending on installation result in 50/60 Hz earth loops due to noise from mains supply cables. If this occurs, break the screen or insert a 100 nF capacitor between screen and chassis. The digital and analog in- and outputs must be connected separately to the frequency converter common inputs (terminal 20, 55, 39) to avoid ground currents from both groups to affect other groups.

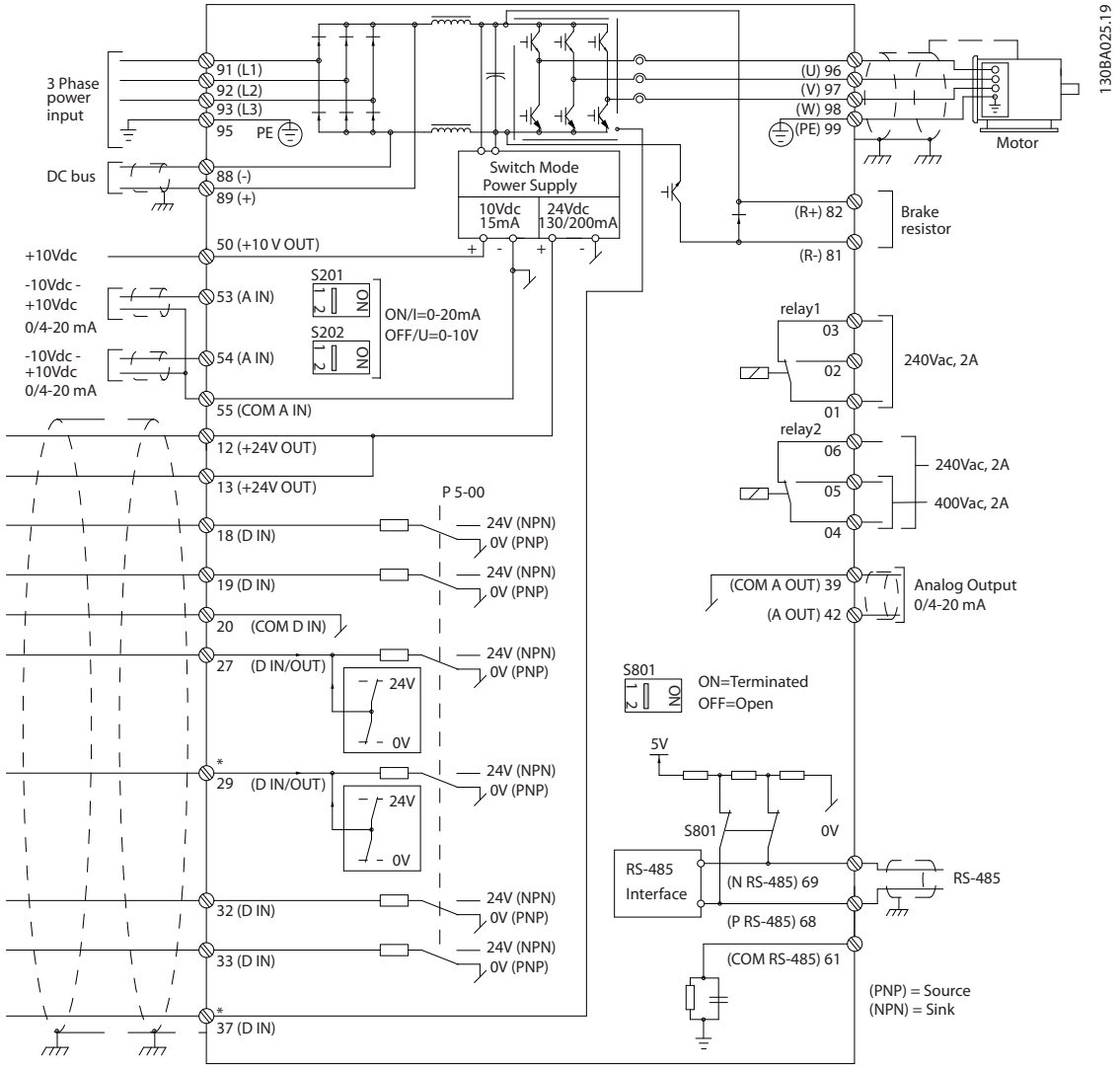

Illustration 3.24

Control cables must be screened/armoured. Use a clamp from the accessory bag to connect the screen to the frequency converter decoupling plate for control cables.

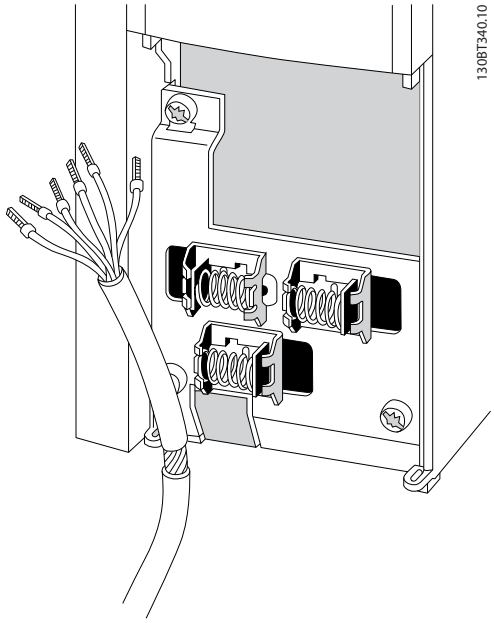

Illustration 3.25

Generally speaking, control cables must be braided screened/armoured and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the unit. The drawing indicates how correct earthing is carried out and what to do if in doubt.

a. Correct earthing
Control cables and cables for serial communication must be fitted with cable clamps at both ends to ensure the best possible electrical contact.

b. Wrong earthing
Do not use twisted cable ends (pigtails). They increase the screen impedance at high frequencies.

c. Protection with respect to earth potential between PLC(Program Logic Controller) and frequency converter
If the earth potential between the frequency converter and the PLC (etc.) is different, electric noise may occur that will disturb the entire system. Solve this problem by fitting an equalising cable, next to the control cable. Minimum cable cross-section: 16 mm^2.

d. For 50/60 Hz earth loops
If very long control cables are used, 50/60 Hz earth loops may occur. Solve this problem by connecting one end of the screen to earth via a 100 nF capacitor (keeping leads short).

e. Cables for serial communication
Eliminate low-frequency noise currents between two frequency converters by connecting one end of the screen to terminal 61. This terminal is connected to earth via an internal RC link. Use twisted-pair cables to reduce the differential mode interference between the conductors.

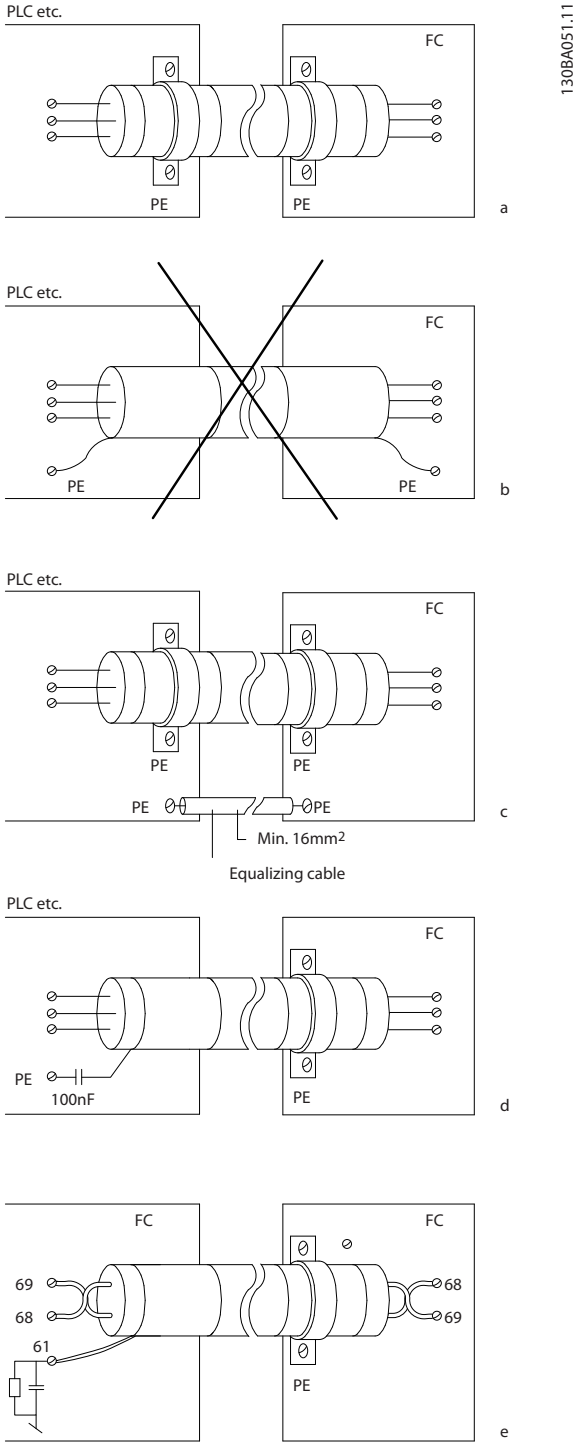

Illustration 3.26

3

3.3.12 Electrical Installation - EMC Protection

The following is a guideline to good engineering practice when installing frequency converters. Follow these guidelines to comply with EN 61800-3 First environment. If the installation is in EN 61800-3 Second environment, i.e. industrial networks, or in an installation with its own transformer, deviation from these guidelines is allowed but not recommended.

Good engineering practice to ensure EMC-correct electrical installation

- Use only braided screened/armoured motor compressor cables and braided screened/ armoured control cables. The screen should provide a minimum coverage of 80%. The screen material must be metal, not limited to but typically copper, aluminium, steel or lead. There are no special requirements for the mains cable.
- Installations using rigid metal conduits are not required to use screened cable, but the motor compressor cable must be installed in conduit separate from the control and mains cables. Full connection of the conduit from the frequency converter to the motor compressor is required. The EMC performance of flexible conduits varies a lot and information from the manufacturer must be obtained.
- Connect the screen/armour/conduit to earth at both ends for motor compressor cables as well as for control cables. In some cases, it is not possible to connect the screen in both ends. If so, connect the screen at the frequency converter. See also *3.3.11 Electrical Installation, Control Cables*.
- Avoid terminating the screen/armour with twisted ends (pigtails). It increases the high frequency impedance of the screen, which reduces its effectiveness at high frequencies. Use low impedance cable clamps or EMC cable glands instead.
- Avoid using unscreened/unarmoured motor compressor or control cables inside cabinets housing the frequency converter(s), whenever this can be avoided.

Leave the screen as close to the connectors as possible.

Illustration 3.27 shows an example of an EMC-correct electrical installation of an IP 20 frequency converter. The frequency converter is fitted in an installation cabinet with an output contactor and connected to a PLC, which is installed in a separate cabinet. Other ways of doing the installation may have just as good an EMC performance, provided the above guide lines to engineering practice are followed. If the installation is not carried out according to the guideline and if unscreened cables and control wires are used, some emission requirements are not complied with, although the immunity requirements are fulfilled. See the paragraph.

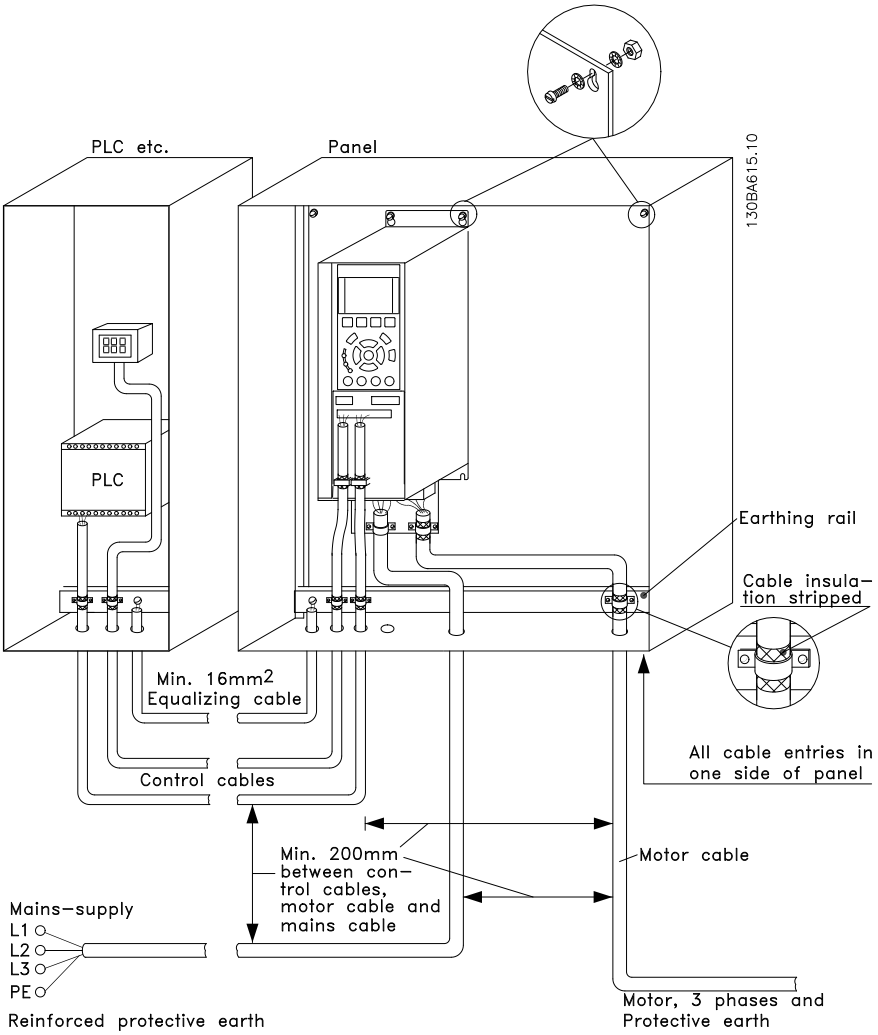

Illustration 3.27 EMC Correct Installation of an IP20 Frequency Converter

3.3.13 Safety Earth Connection

The frequency converter has a high leakage current and must be earthed appropriately for safety reasons according to EN 50178. The earth leakage current from the frequency converter exceeds 3.5 mA. To ensure a good mechanical connection from the earth cable to the earth connection (terminal 95), the cable cross-section must be at least 10 mm^2 or 2 rated earth wires terminated separately.

3.3.14 Basic Examples of Control Connections

Controls using an external controller with 0-10 V signal. It is not necessary to change any parameters, as this is the default value.

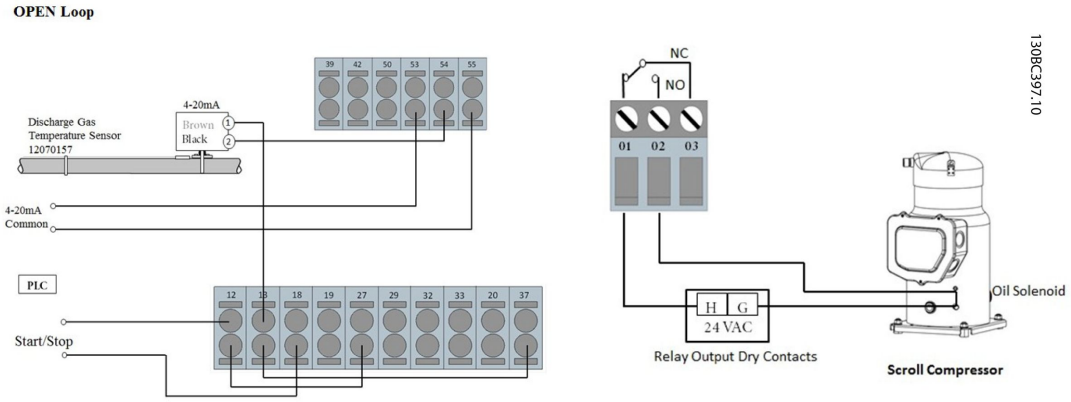

Illustration 3.28

Controls using an external controller with 4-20 mA signal. Change switch 53 from U to I. It is not necessary to change any parameters, as this is the default value.

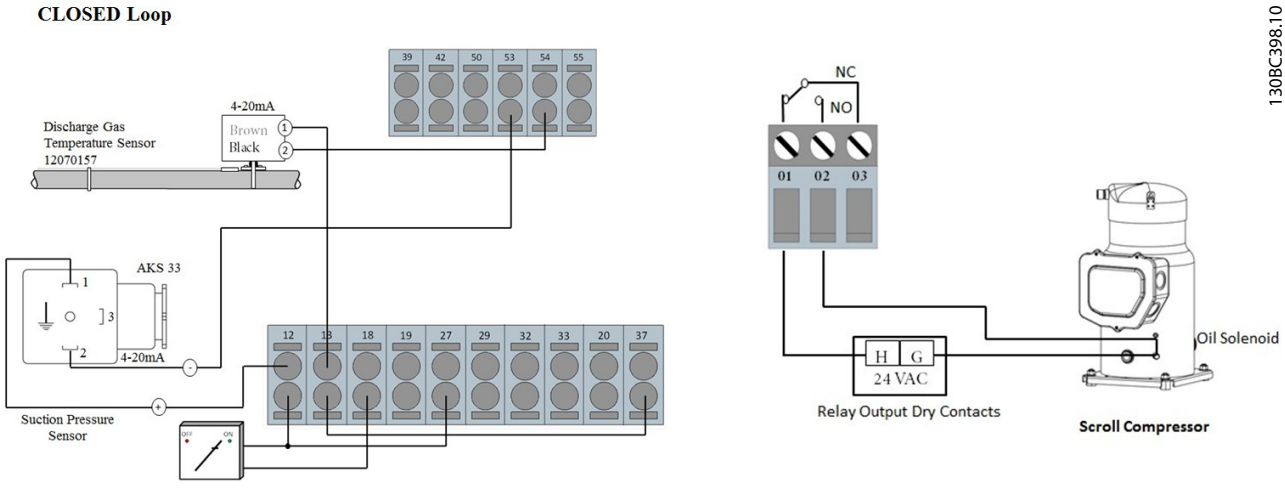

Illustration 3.29

3.3.15 High Voltage Test

Carry out a high voltage test by short-circuiting terminals U, V, W, L1, L2 and L3. Energize by max. 2.15 kV DC for one second between this short-circuit and the chassis.

NOTE

When running high voltage tests of the entire installation, frequency converter and compressor electrical motor compressor test can be conducted together.

⚠WARNING

When conducting a high voltage test make sure the system is not under vacuum: this may cause electrical motor compressor failure.

⚠WARNING

Never apply the high voltage test to the control circuit.

3.4 Fuses and Circuit Breakers

3.4.1 Fuses

NOTE

Use fuses and/or circuit breakers on the supply side of the unit for protection of electrical components within the frequency converter in order to ensure compliance with IEC 60364 for CE or NEC 2009 for UL.

⚠WARNING

Personnel and property must be protected against the consequence of component break-down internally in the frequency converter.

Branch Circuit Protection

To protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be protected against short-circuit and over-current according to national/international regulations.

NOTE

The recommendations given do not provide UL branch circuit protection.

Danfoss recommends using the fuses/circuit breakers listed below to protect service personnel and property in case of component break-down in the frequency converter.

3.4.2 Recommendations

⚠WARNING

In case of malfunction, ignoring recommended fuse types may result in personnel risk and damage to the frequency converter and other equipment.

The following tables list the recommended rated current. Recommended fuses are of the type gG for small to medium power sizes. For larger powers, aR fuses are recommended. For circuit breakers, Moeller types have been tested to have a recommendation. Other types of circuit breakers may be used provide they limit the energy into the to a level equal to or lower than the Moeller types.

For further information, see Application Note *Fuses and Circuit Breakers, MN90T*

3

3.4.3 CE Compliance

Fuses or circuit breakers are mandatory to comply with IEC 60364. Danfoss recommends using a selection of the following.

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240V, 480V, 500V, or 600V depending on the unit's voltage rating. With the proper fusing, the frequency converter short circuit current rating (SCCR) is 100,000 Arms.

Enclosure	Power	Recommended fuse size	Recommended Max. fuse	Recommended circuit breaker	Max trip level
Size	[kW]			Moeller	[A]
B1	5.5-7.5	gG-25 (5.5) gG-32 (7.5)	gG-80	PKZM4-63	63
B2	11	gG-50	gG-100	NZMB1-A100	100
B3	5.5	gG-25	gG-63	PKZM4-50	50
B4	7.5-15	gG-32 (7.5) gG-50 (11) gG-63 (15)	gG-125	NZMB1-A100	100
C1	15-22	gG-63 (15) gG-80 (18.5) gG-100 (22)	gG-160 (15-18.5) aR-160 (22)	NZMB2-A200	160
C2	30-37	aR-160 (30) aR-200 (37)	aR-200 (30) aR-250 (37)	NZMB2-A250	250
C3	18.5-22	gG-80 (18.5) aR-125 (22)	gG-150 (18.5) aR-160 (22)	NZMB2-A200	150
C4	30-37	aR-160 (30) aR-200 (37)	aR-200 (30) aR-250 (37)	NZMB2-A250	250

Table 3.6 200-240 V, Frame Sizes B and C

Enclosure	Power	Recommended fuse size	Recommended Max. fuse	Recommended circuit breaker	Max trip level
Size	[kW]			Moeller	[A]
B1	11-15	gG-40	gG-80	PKZM4-63	63
B2	18.5-22	gG-50 (18.5) gG-63 (22)	gG-100	NZMB1-A100	100
B3	11-15	gG-40	gG-63	PKZM4-50	50
B4	18.5-30	gG-50 (18.5) gG-63 (22) gG-80 (30)	gG-125	NZMB1-A100	100
C1	30-45	gG-80 (30) gG-100 (37) gG-160 (45)	gG-160	NZMB2-A200	160
C2	55-75	aR-200 (55) aR-250 (75)	aR-250	NZMB2-A250	250
C3	37-45	gG-100 (37) gG-160 (45)	gG-150 (37) gG-160 (45)	NZMB2-A200	150
C4	55-75	aR-200 (55) aR-250 (75)	aR-250	NZMB2-A250	250

Table 3.7 380-500 V, Frame Sizes B and C

Enclosure	Power	Recommended fuse size	Recommended Max. fuse	Recommended circuit breaker	Max trip level
Size	[kW]			Moeller	[A]
B1	11-18	gG-25 (11) gG-32 (15) gG-40 (18.5)	gG-80	PKZM4-63	63
B2	22-30	gG-50 (22) gG-63 (30)	gG-100	NZMB1-A100	100
B3	11-15	gG-25 (11) gG-32 (15)	gG-63	PKZM4-50	50
B4	18.5-30	gG-40 (18.5) gG-50 (22) gG-63 (30)	gG-125	NZMB1-A100	100
C1	37-55	gG-63 (37) gG-100 (45) aR-160 (55)	gG-160 (37-45) aR-250 (55)	NZMB2-A200	160
C2	75	aR-200 (75)	aR-250	NZMB2-A250	250
C3	37-45	gG-63 (37) gG-100 (45)	gG-150	NZMB2-A200	150
C4	55-75	aR-160 (55) aR-200 (75)	aR-250	NZMB2-A250	250

Table 3.8 525-600 V, Frame Sizes B and C

UL Compliance

Fuses or circuit breakers are mandatory to comply with NEC 2009. Danfoss recommends using a selection of the following.

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240 V, 480 V, 500 V, or 600 V depending on the unit's voltage rating. With the proper fusing the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

	Recommended max. fuse					
Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
11	KTN-R-80	JKS-80	JJN-80	-	-	-
15-18.5	KTN-R-125	JKS-125	JJN-125	-	-	-
22	KTN-R-150	JKS-150	JJN-150	-	-	-
30	KTN-R-200	JKS-200	JJN-200	-	-	-
37	KTN-R-250	JKS-250	JJN-250	-	-	-

Table 3.9 200-240 V, Frame Sizes B and C

	Recommended max. fuse			
Power	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	Type RK1	Type RK1	Type CC	Type RK1
11	5014006-080	KLN-R-80	-	A2K-80-R
15-18.5	2028220-125	KLN-R-125	-	A2K-125-R
22	2028220-150	KLN-R-150	-	A2K-150-R
30	2028220-200	KLN-R-200	-	A2K-200-R
37	2028220-250	KLN-R-250	-	A2K-250-R

Table 3.10 200-240 V, Frame Sizes B and C

3

	Recommended max. fuse			
Power	Bussmann	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	Type JFHR2[1)]	JFHR2	JFHR2[2)]	J
11	FWX-80	-	-	HSJ-80
15-18.5	FWX-125	-	-	HSJ-125
22	FWX-150	L25S-150	A25X-150	HSJ-150
30	FWX-200	L25S-200	A25X-200	HSJ-200
37	FWX-250	L25S-250	A25X-250	HSJ-250

Table 3.11 200-240 V, Frame Sizes B and C

[1)] FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.

[2)] A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V frequency converters.

	Recommended max. fuse					
Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
11	KTS-R-40	JKS-40	JJS-40	-	-	-
15	KTS-R-50	JKS-50	JJS-50	-	-	-
18	KTS-R-60	JKS-60	JJS-60	-	-	-
22	KTS-R-80	JKS-80	JJS-80	-	-	-
30	KTS-R-100	JKS-100	JJS-100	-	-	-
37	KTS-R-125	JKS-125	JJS-125	-	-	-
45	KTS-R-150	JKS-150	JJS-150	-	-	-
55	KTS-R-200	JKS-200	JJS-200	-	-	-
75	KTS-R-250	JKS-250	JJS-250	-	-	-

Table 3.12 380-500 V, Frame Sizes B and C

	Recommended max. fuse			
Power	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	Type RK1	Type RK1	Type CC	Type RK1
11	5014006-040	KLS-R-40	-	A6K-40-R
15	5014006-050	KLS-R-50	-	A6K-50-R
18	5014006-063	KLS-R-60	-	A6K-60-R
22	2028220-100	KLS-R-80	-	A6K-80-R
30	2028220-125	KLS-R-100	-	A6K-100-R
37	2028220-125	KLS-R-125	-	A6K-125-R
45	2028220-160	KLS-R-150	-	A6K-150-R
55	2028220-200	KLS-R-200	-	A6K-200-R
75	2028220-250	KLS-R-250	-	A6K-250-R

Table 3.13 380-500 V, Frame Sizes B and C

	Recommended max. fuse			
Power	Bussmann	Ferraz- Shawmut	Ferraz- Shawmut	Littel fuse
[kW]	JFHR2	J	JFHR2[1)]	JFHR2
11	FWH-40	HSJ-40	-	-
15	FWH-50	HSJ-50	-	-
18	FWH-60	HSJ-60	-	-
22	FWH-80	HSJ-80	-	-
30	FWH-100	HSJ-100	-	-
37	FWH-125	HSJ-125	-	-
45	FWH-150	HSJ-150	-	-
55	FWH-200	HSJ-200	A50-P-225	L50-S-225
75	FWH-250	HSJ-250	A50-P-250	L50-S-250

Table 3.14 380-500 V, Frame Sizes B and C

[1)] Ferraz-Shawmut A50QS fuses may substitute for A50P fuses.

	Recommended max. fuse					
Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann
[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
11	KTS-R-35	JKS-35	JJS-35	-	-	-
15	KTS-R-45	JKS-45	JJS-45	-	-	-
18	KTS-R-50	JKS-50	JJS-50	-	-	-
22	KTS-R-60	JKS-60	JJS-60	-	-	-
30	KTS-R-80	JKS-80	JJS-80	-	-	-
37	KTS-R-100	JKS-100	JJS-100	-	-	-
45	KTS-R-125	JKS-125	JJS-125	-	-	-
55	KTS-R-150	JKS-150	JJS-150	-	-	-
75	KTS-R-175	JKS-175	JJS-175	-	-	-

Table 3.15 525-600 V, Frame Sizes B and C

	Recommended max. fuse			
Power	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
[kW]	Type RK1	Type RK1	Type RK1	J
11	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
15	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
18	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
22	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
30	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
37	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
45	2028220-125	KLS-R-125	A6K-125-R	HSJ-125
55	2028220-150	KLS-R-150	A6K-150-R	HSJ-150
75	2028220-200	KLS-R-175	A6K-175-R	HSJ-175

Table 3.16 525-600 V, Frame Sizes B and C

[1)] 170M fuses shown from Bussmann use the -/80 visual indicator. –TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted.

3.5 Application Example - Pack Controller

3.5.1 BASIC Cascade/Pack Controller

3

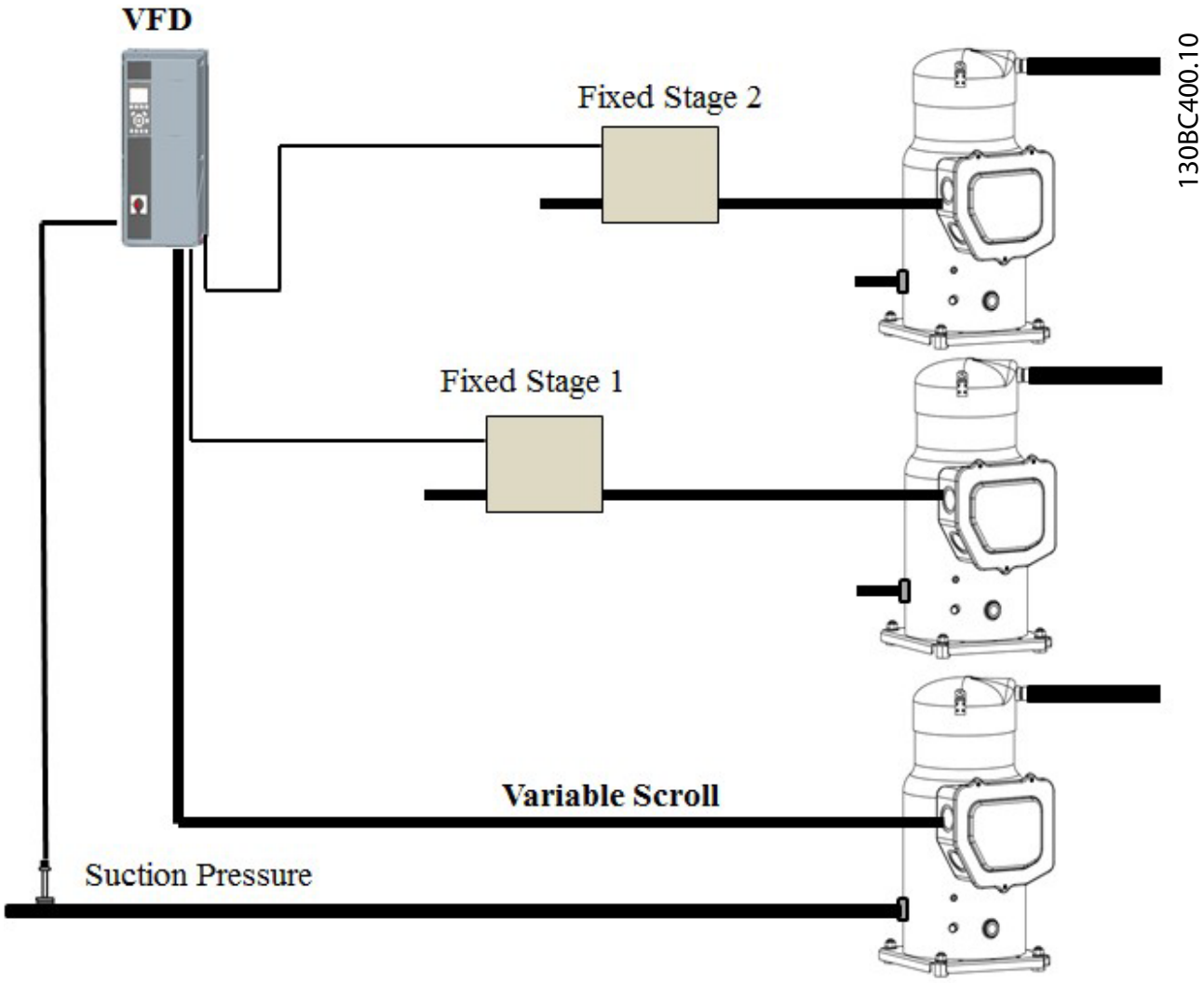

Illustration 3.30

The BASIC Cascade/Pack Controller is used for up to three compressors to control up to two on/off compressors together with one variable speed compressor. The capacity control is typically based on suction pressure feedback, but it could also be e.g. a cold room temperature.

Fixed Lead Compressor

The BASIC Pack Controller allows the frequency converter to control up to 3 compressors using the frequency converter's two built-in relays. The variable compressor (lead) is connected directly to the frequency converter, the other 2 compressors are controlled by the two built-in relays.

NOTE

Only one fixed speed compressor can be controlled with the built-in relays. To control two fixed compressors, an extra relay is needed via the MCB 105 Relay Option.

Bandwidth Management

In pack control systems, to avoid frequent switching of fixed speed compressors, the desired system load 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 load occurs, the Override Bandwidth overrides the Staging Bandwidth to prevent immediate response to a short duration load change. An Override Bandwidth Timer can

be programmed to prevent staging until the system load has stabilized and normal control established.

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

3.5.2 System Status and Operation

When the pack controller is enabled, the operation status for each compressor and the pack controller is displayed on the Local Control Panel. Information displayed includes:

- Compressor Status, is a read out of the status for the relays assigned to each compressor. The display shows compressors that are disabled, off, running on the frequency converter or running on the mains
- Pack Status, is a read out of the status for the Pack Controller. The display shows the Pack Controller is disabled, all compressors are off, and emergency has stopped all compressors, all compressors are running, fixed speed compressors are being staged/destaged.
- If a no load need occurs then destaging ensures that all fixed speed compressors are stopped individually followed by the variable speed compressor.

3.5.3 Pack Compressor Wiring Diagram

The wiring diagram shows an example with the built in BASIC cascade controller with one variable speed compressor (lead) and two fixed speed compressors, a 4-20 mA transmitter and System Safety Interlock.

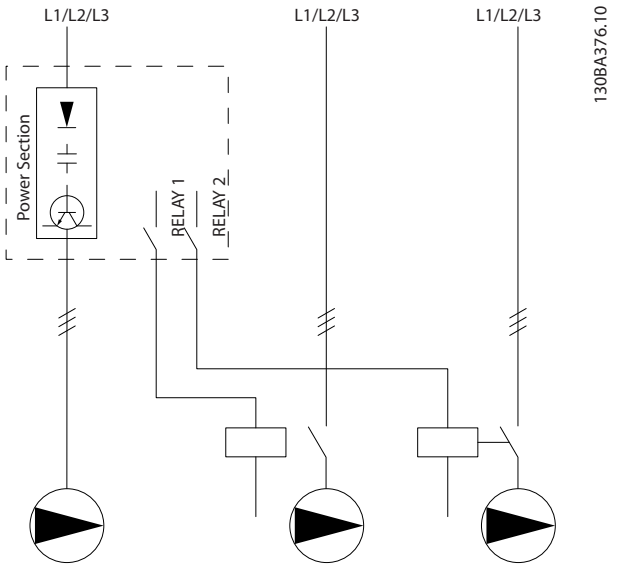

Illustration 3.31

3

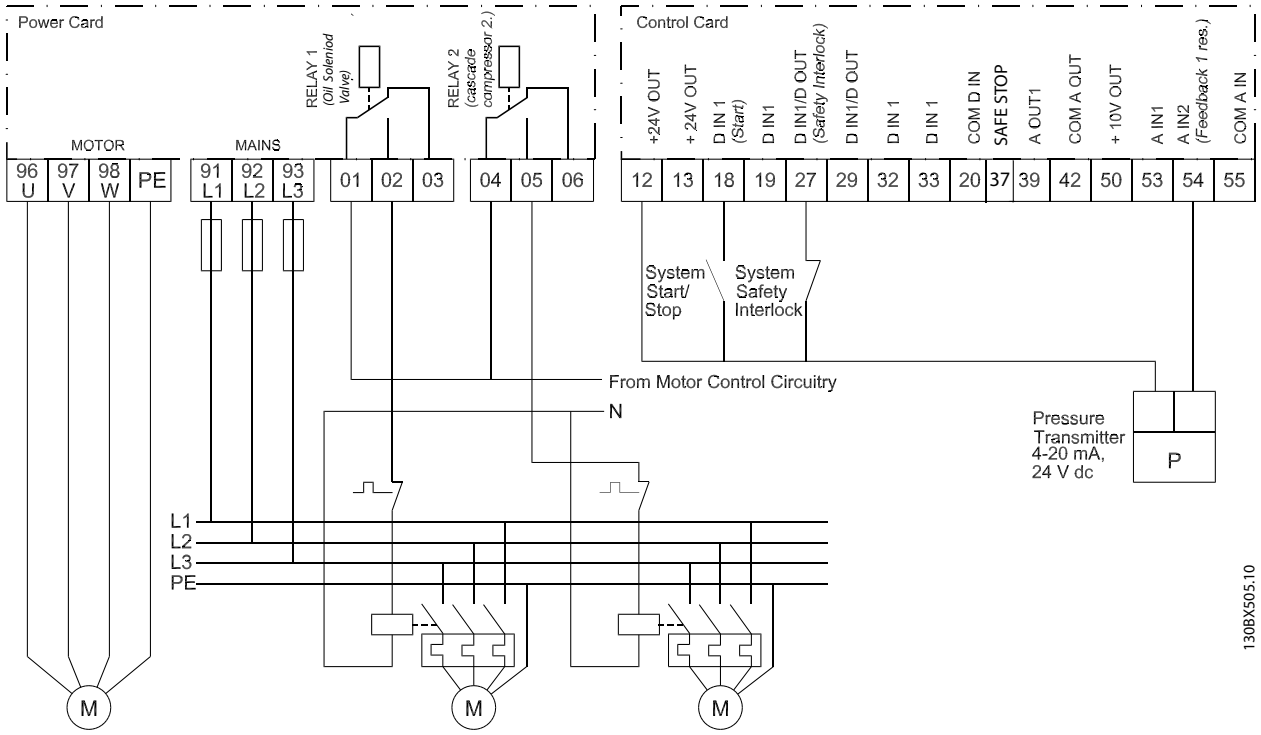

Illustration 3.32

4 Quick Set-up

The following describes the basic procedure for running the frequency converter.

⚠CAUTION

When the connections are made, the compressor starts automatically.

1. Connect the power supply to the terminals (L1, L2 and L3) of the frequency converter as shown in *3.3.4 Mains connection for B4, C1 and C3*.
2. Connect motor cable between the frequency converter (U, V & W) and Compressor (Clockwise on terminal), see *3.3.5 Motor Compressor Connection*. (The connectors utilised in these first 2 steps are provided in the accessory bag which accompanies the frequency converter).
3. Press [Quick Menu] and go to quick setup. Ensure that the correct compressor model is selected in *1-13 Compressor Selection*.
4. Make connections between the terminals 12 and 18 (start signal), connections between terminal 12 and 27 (inverse coast signal) and terminals 12 and 37* (safe stop inverse signal).

*See *3.3.10 Basic Wiring Example* and *2.2.1 Terminal 37 Safe Stop Function*.

⚠CAUTION

If detecting an error that causes the frequency converter to trip, it automatically tries to restart the compressor after 30 s (unless the error is severe and causes a trip lock). See also *14-20 Reset Mode* and *14-21 Automatic Restart Time*.

Open Loop with external reference:

1. Apply analogue speed reference signal (0-10 V) on terminal 53 using the terminal 55 as common. See *3.3.14 Basic Examples of Control Connections*.
2. Check if switch A53 is positioned to U (voltage) instead of I (current). The switch A53 is located on the frequency converter and is visible when the LCP is removed.
3. Ready to Run: If the frequency converter is supplied with display: Press [Hand On] to set a local speed reference in the display (good for testing purposes). Press [Auto On] for running in operation and with an external reference.

This is what the screen will look like after configuring the frequency converter for *Speed Open loop* application, *Hand On mode*.

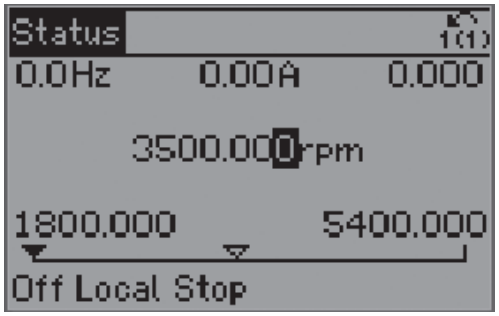

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Illustration 4.1

This is what the screen will look like after configuring the frequency converter for *Speed Open loop* application, *Auto On mode*:

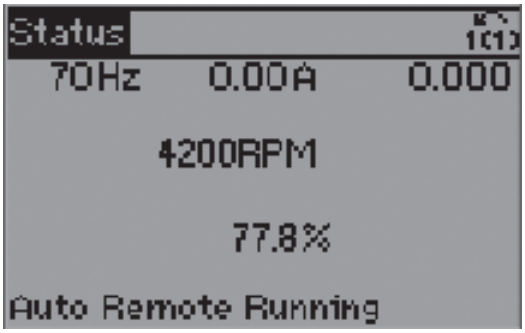

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Illustration 4.2

4. Done.

PID closed loop with 4-20 mA pressure transmitter:

1. Connect pressure transmitter to analogue input on terminal 54 according to *3.3.14 Basic Examples of Control Connections*.
2. Make sure that the switch for analogue input 54 is set to "I" for current input.
3. Press [Quick Menu], go to "PID Closed Loop" and then to "Basic PID Settings) menu.
   Now change parameters to
   1-00 Configuration Mode: Select *[3] Process*
   3-01 Reference/Feedback Unit: Select *[71] Bar*

4

3-02 Minimum Reference and *3-03 Maximum Reference*: Enter the lower and upper limits of the set-point range [bar].
3-15 Reference Resource 1: Select *[0] No function* for fixed set-point.
6-22 Terminal 54 Low Current + 6-23 Terminal 54 High Current: The values of these parameters should match the output of the pressure transmitter (4-20 mA for example is the factory setting).
6-24 Terminal 54 Low Ref./Feedb. Value + 6-25 Terminal 54 High Ref./Feedb. Value: Set range of pressure transmitter (factory setting -1/+12 bar)
Return to *3-13 Reference Site*: Select *[2] Local* to run with a fixed set-point adjustable via LCP. Select *[1] Remote* if the set-point is given by the analogue input (as defined in).

4. Press [Quick Menu], go to *My Personal Menu*, go to *0-22 Display Line 1.3 Small* and select *[1652] Feedback [unit]*. The pressure [bar] is going to be shown in the upper right corner of the display

This is what the screen will look like, after configuring the frequency converter for *Closed loop* application.

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Illustration 4.3

5. Ready to Run: Press [Hand On] and set reference in bars using the arrows on the display. Before leaving the site never forget the next step.
6. Ready to Run: Press [Auto On].

For more details on PID Closed Loop, see *Illustration 4.4*.

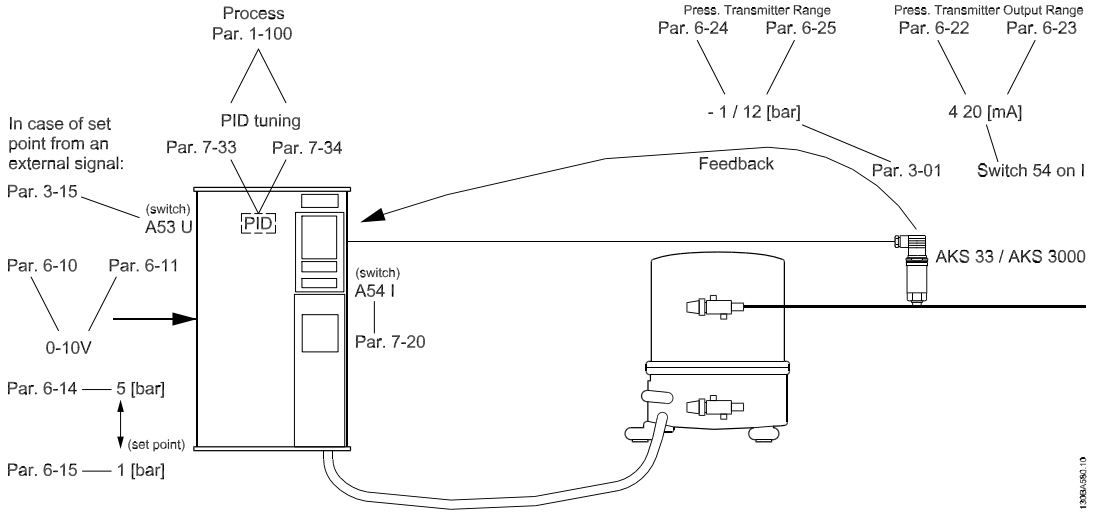

Illustration 4.4

Other Compressor Features:

To set up other dedicated compressor features press [Quick Menu] and go to Q4 or follow *Illustration 4.5*.

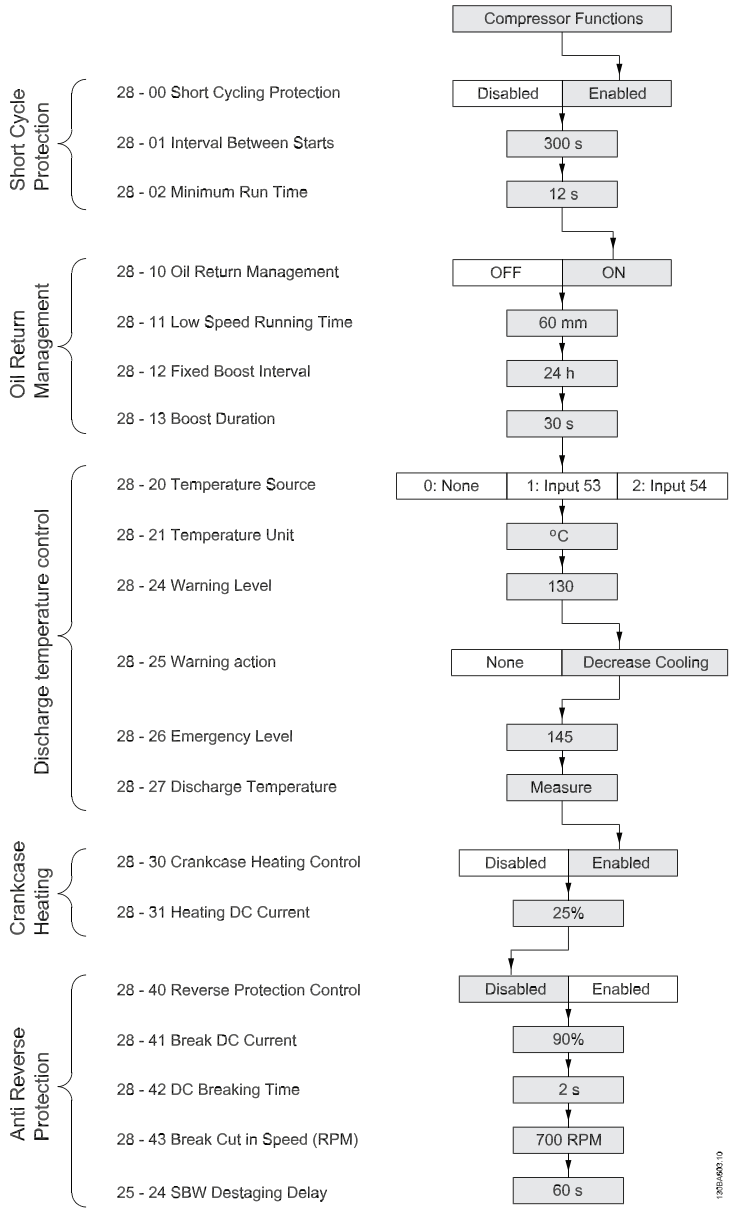

Illustration 4.5 Flowchart

5 How to Program

5.1 How to Program on the Graphical LCP

5.1.1 Control Panel

The following instructions are valid for the graphical LCP (LCP 102):
The control panel is divided into four functional groups: 1.

1. Graphical display with Status lines. All data is displayed in a graphical LCP display, which can show up to five items of operating data while displaying [Status].
2. Menu keys and indicator lights - changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

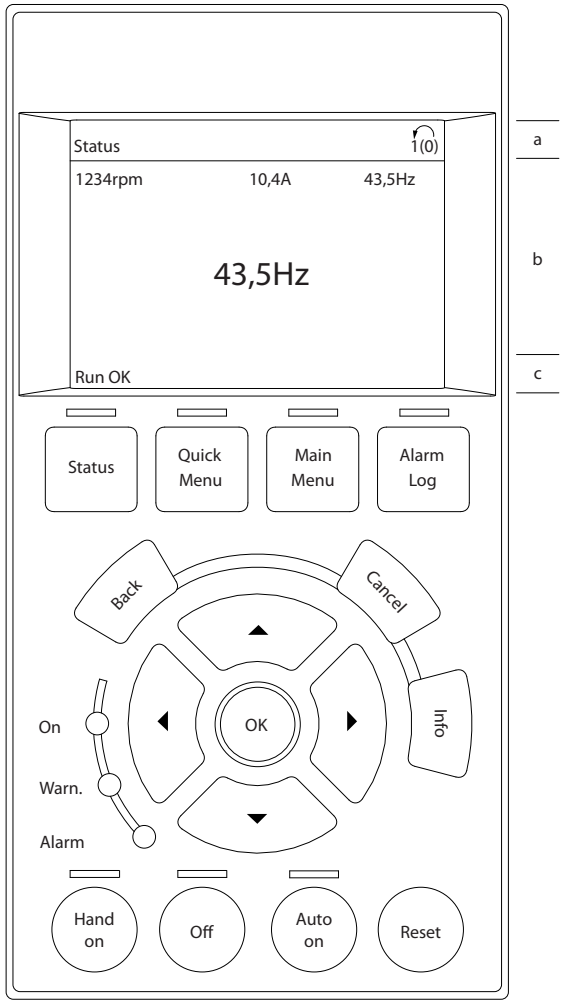

Illustration 5.1

5.1.2 Display Lines

a. Status line:
Status messages displaying icons and graphic.
b. Line 1-2:
Operator data lines displaying data defined or chosen by the user. By pressing the [Status] key, up to one extra line can be added.
c. Status line:
Status messages displaying text.

5.1.3 Display Contrast Adjustment

Press [Status] and [▼] for darker display
Press [Status] and [▲] for brighter display

5.1.4 Indicator Lights

If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear on the control panel. The on LED is activated when the frequency converter receives mains voltage.

- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm

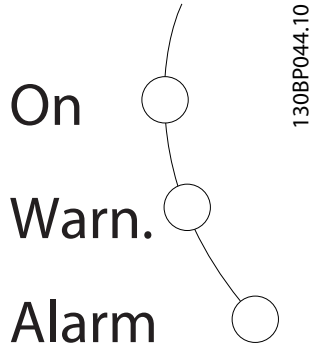

Illustration 5.2

5.2 LCP Keys

5.2.1 Function Keys

The control keys are divided into functions. The keys below the display and indicator lamps are used for parameter Set-up, including choice of display indication during normal operation.

Illustration 5.3

[Status] indicates the status of the frequency converter and/or the compressor motor. Choose between 3 different readouts by pressing the [Status] key: 5 line readouts, 4 line readouts or Smart Logic Control by pushing [Status] twice.
Press [Status] to select the display mode or to change back to Display mode from either Quick Menu mode, Main Menu mode or Alarm mode. Also press [Status] to toggle single or double read-out mode.

[Quick Menu] allows quick access to different Quick Menus such as:

Q1 - My Personal Menu

Q2 - Quick Set-up

Q3 – PID Process Loop

Q4 - Compressor Functions

Q5 - Changes Made

Q6 - Loggings

Q7 - Load Profile

Use [Quick Menu] for programming the parameters belonging to the Quick Menu. It is possible to switch directly between Quick Menu mode and Main Menu mode.

5.2.2 Navigation Keys

The four navigation keys are used to navigate between the different choices available in [Quick Menu], [Main Menu] and [Alarm Log]. Use the keys to move the cursor.
[OK] is used for choosing a parameter marked by the cursor and for enabling the change of a parameter and loggings from Quick Menu.

5.2.3 Local Control Keys

Local Control Keys for local control are found at the bottom of the control panel.

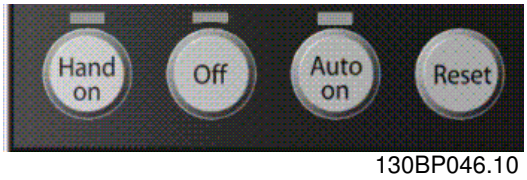

Illustration 5.4

[Hand On] enables control of the frequency converter via the LCP. [Hand on] also starts the motor compressor, and it is now possible to enter the motor compressor speed data by means of the arrow keys. The key can be selected as *[1] Enable* or *[0] Disable* via *0-40 [Hand on] Key on LCP*.
External stop signals activated by means of control signals or a serial bus will override a "start" command via the LCP. The following control signals will still be active when [Hand on] is activated:

- [Hand On] - [Off] - [Auto On]
- Reset
- Coasting stop inverse
- Reversing
- Set-up select lsb (least significant bit) - Set-up select msb (most significant bit)
- Stop command from serial communication
- Quick stop
- DC brake

[Off] stops the connected motor compressor. The key can be selected as *[1] Enable* or *[0] Disable* via *0-41 [Off] Key on LCP*.
If no external stop function is selected and the [Off] key is inactive the motor compressor can be stopped by disconnecting the voltage.

[Auto On] enables the frequency converter is to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the frequency converter will start. The key can be selected as *[1] Enable* or *[0] Disable* via *0-42 [Auto on] Key on LCP*.

5

NOTE

An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand on] and [Auto on].

[Reset] is used for resetting the frequency converter after an alarm (trip). It can be selected as *[1] Enable* or *[0] Disable* via *0-43 [Reset] Key on LCP*.

The **parameter shortcut** can be carried out by holding down the [Main Menu] key for 3 seconds. The parameter shortcut allows direct access to any parameter.

5.2.4 Quick Transfer of Parameter Settings

Once the set-up of a frequency converter is complete, store the data in the LCP or on a PC via MCT 10 Set-up Software Tool.

5.2.5 Data Storage in LCP

1. Go to *0-50 LCP Copy* using Main Menu.
2. Press [OK].
3. Select *[1] All to LCP*.
4. Press [OK].

All parameter settings are now stored in the LCP indicated by the progress bar. When 100% is reached, press [OK].

NOTE

Stop the motor compressor before performing this operation. The LCP can now be connected to another frequency converter and the parameter settings copied to this frequency converter as well.

5.2.6 Initialisation to Default Settings

Initialise the frequency converter to default settings in two ways:

Recommended initialisation (via*14-22 Operation Mode*)

1. Select *14-22 Operation Mode*.
2. Press [OK].
3. Select *[2] Initialisation*.
4. Press [OK] .
5. Disconnect mains supply and wait until the display turns off.
6. Reconnect the mains supply.
7. Drive initialised [A80] (Alarm 80) appears - the frequency converter is now reset.

14-22 Operation Mode initialises all except:

- 8-30 Protocol
- 8-31 Address
- 8-32 FC Port Baud Rate
- 8-33 Parity / Stop Bits
- 8-34 Estimated cycle time
- 8-35 Minimum Response Delay
- 8-36 Max Response Delay
- 8-37 Max Inter-Char Delay
- 14-50 RFI Filter
- 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
- 15-20 Historic Log: Event
- 15-21 Historic Log: Value
- 15-22 Historic Log: Time
- 15-30 Fault Log: Error Code
- 15-31 Fault Log: Value
- 15-32 Fault Log: Time

Manual initialisation

1. Disconnect from mains and wait until the display turns off.
2. Press [Status] - [Main Menu] - [OK] at the same time while power up for LCP 102, Graphical Display.
3. Release the keys after 5 s.
4. The frequency converter is now programmed according to default settings.

This procedure initialises all except:

- 15-00 Operating Hours
- 15-03 Power Up's
- 15-04 Over Temp's
- 15-05 Over Volt's

5.2.7 Data Transfer from LCP to Frequency Converter

NOTE

Stop the motor compressor before performing this operation.

1. Go to *0-50 LCP Copy*.
2. Press [OK].
3. Select *[2] All from LCP*.
4. Press [OK] again.

The parameter settings stored in the LCP are now transferred to the frequency converter indicated by the progress bar. When 100% is reached, press [OK].

5.2.8 Parameter Selection

In the *Main menu mode*, the parameters are divided into groups. Use the navigation keys for selecting a parameter group.
The following parameter groups are accessible:

- 0-** Operation/Display
- 1-** Load/Motor
- 2-** Brakes
- 3-** Reference/Ramps
- 4-** Limits/Warnings
- 5-** Digital In/Out
- 6-** Analog In/Out
- 7-** Controls
- 8-** Comm. and Options
- 13-** Smart Logic
- 14-** Special Functions
- 15-** Drive Information
- 16-** Data Readouts
- 25-** Cascade Controller
- 28-** Compressor Functions

After selecting a parameter group, choose a parameter with the navigation keys. The middle section on the display shows the parameter number and name as well as the selected parameter value.

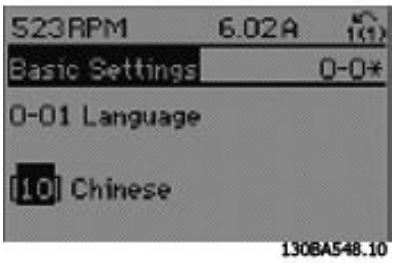

Illustration 5.5

5.2.9 Changing Data

The procedure for changing data is the same in both the Quick menu and the Main menu mode.

Press [OK] to change the selected parameter. The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

5.2.10 Changing a Text Value

If the selected parameter is a text value, change the text value by pressing the [▲]/[▼] navigation keys. [▲] increases the value and [▼] decreases the value. Place the cursor on the value and press [OK] to save.

5.2.11 Changing a Group of Numeric Data Values

If the chosen parameter represents a numeric data value, change it by pressing the navigation keys. Press [◄]/[►] to move the cursor horizontally. Press [▲]/[▼] to change the data value. [▲] enlarges the data value, and [▼] reduces the data value. Place the cursor on the value and press [OK] to save.

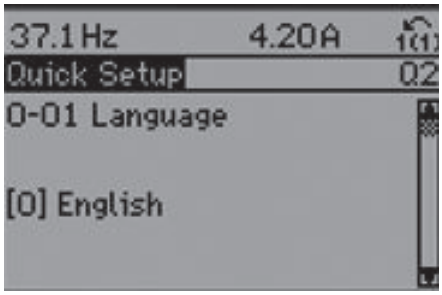

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Illustration 5.6

5

6 Parameter Descriptions

6.1 LCP Display

6.1.1 LCP Programming

Table 6.1 lists the parameters that cannot be changed from the LCP. These parameters are defined by the compressor choice made in *1-13 Compressor Selection*.

Parameter	Parameter	Parameter
1-01 Motor Control Principle	1-45 q-axis Inductance (Lq) 200% I_{NOM}	5-41 On Delay, Relay
1-03 Torque Characteristics	1-40 Back EMF at 1000 RPM	5-42 Off Delay, Relay
1-04 Overload Mode	1-47 Low Speed Torque Calibration	7-00 Speed PID Feedback Source
1-05 Local Mode Configuration	1-49 Current at min. inductance	7-02 Speed PID Proportional Gain
1-10 Motor Construction	1-62 Slip Compensation	
1-20 Motor Power [kW]	1-66 Min. Current at Low Speed	7-04 Speed PID Differentiation Time
1-22 Motor Voltage	1-68 Minimum Inertia	7-05 Speed PID Diff. Gain Limit
1-23 Motor Frequency	1-69 Maximum Inertia	13-10 Comparator Operand
1-24 Motor Current	1-71 Start Delay	13-11 Comparator Operator
1-25 Motor Nominal Speed	1-72 Start Function	13-12 Comparator Value
1-26 Motor Cont. Rated Torque	1-73 Flying Start	14-00 Switching Pattern
1-29 Automatic Motor Adaptation (AMA)	1-74 Start Speed [RPM]	14-01 Switching Frequency
1-30 Stator Resistance (Rs)	1-76 Start Current	14-10 Mains Failure
1-31 Rotor Resistance (Rr)	1-77 Compressor Start Min Speed [RPM]	14-11 Mains Voltage at Mains Fault
1-33 Stator Leakage Reactance (X1)	1-79 Compressor Start Max Time to Trip	14-21 Automatic Restart Time
1-34 Rotor Leakage Reactance (X2)	1-86 Compressor Min. Speed for Trip [RPM]	14-25 Trip Delay at Torque Limit
1-35 Main Reactance (Xh)	3-82 Starting Ramp Up Time	14-26 Trip Delay at Inverter Fault
1-36 Iron Loss Resistance (Rfe)	4-10 Motor Speed Direction	28-30 Crankcase Heating Control
1-37 d-axis Inductance (Ld)	4-11 Motor Speed Low Limit [RPM]	28-31 Heating DC Current
1-38 q-axis Inductance (Lq)	4-13 Motor Speed High Limit [RPM]	28-40 Reverse Protection Control
1-39 Motor Poles	4-16 Torque Limit Motor Mode	28-41 DC Brake Current
1-40 Back EMF at 1000 RPM	4-18 Current Limit	28-42 DC Braking Time
1-44 d-axis Inductance (Ld) 200% I_{NOM}	4-19 Max Output Frequency	28-43 DC Brake Cut In Speed [RPM]

Table 6.1 Compressor Related Parameters

6.2 Parameters: 0-** Operation and Display

6.2.1 0-0* Basic Settings

0-01 Language

Option:		Function:
		Defines the language to be used in display.
[0] *	English	
[1]	German	
[2]	French	
[3]	Danish	
[4]	Spanish	
[5]	Italian	

0-02 Motor Speed Unit

Option:		Function:
		Select display of motor speed parameters (i.e. references, feedbacks and limits) in terms of shaft speed (RPM) or output frequency to the motor (Hz).
[0] *	RPM	
[1]	Hz	

NOTE

This parameter cannot be adjusted while the motor is running.

0-04 Operating State at Power-up (Hand)

Option:		Function:
		Selects the operating mode upon reconnection of the frequency converter to mains voltage after power down in Hand (local) operation mode.
[0]	Resume	Restarts the frequency converter, maintaining the same and the same start/stop settings (applied by [Hand On/Off]) as before the frequency converter was powered down.
[1] *	Forced stop, ref=old	Restarts the frequency converter with a saved local reference, after mains voltage reappears and after pressing [Hand On].
[2]	Forced stop, ref=0	Resets the local reference to 0 upon restarting the frequency converter.

0-10 Active Set-up

Option:		Function:
		Select the set-up to control the frequency converter functions.
[0]	Factory setup	Cannot be changed. It contains the Danfoss data set, and can be used as a data source when returning the other set-ups to a known state.
[1] *	Set-up 1	*[1] Set-up 1* to *[4] Set-up 4* are the four separate parameter set-ups within which all parameters can be programmed.

0-10 Active Set-up

Option:		Function:
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]	Multi Set-up	Remote selection of set-ups using digital inputs and the serial communication port. This set-up uses the settings from *0-12 This Set-up Linked to*. Stop the frequency converter before making changes to open- and closed loop functions

Use *0-51 Set-up Copy* to copy a set-up to one or all other set-ups. Stop the frequency converter before switching between set-ups where parameters marked 'not changeable during operation' have different values. To avoid conflicting settings of the same parameter within two different set-ups, link the set-ups together using *0-12 This Set-up Linked to*. Parameters which are 'not changeable during operation' are marked FALSE in the parameter lists in *6.16 Parameter Lists*.

0-11 Edit Set-up

Option:		Function:
		Select the set-up to be edited (i.e. programmed) during operation; either the active set-up or one of the inactive set-ups.
[0]	Factory setup	Cannot be edited but it is useful as a data source to return the other set-ups to a known state.
[1] *	Set-up 1	*[1] Set-up 1* to *[4] Set-up 4* can be edited freely during operation, independently of the active set-up.
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]	Active Set-up	Can also be edited during operation. Edit the chosen set-up from a range of sources: LCP, FC RS-485, FC USB or up to five fieldbus sites.

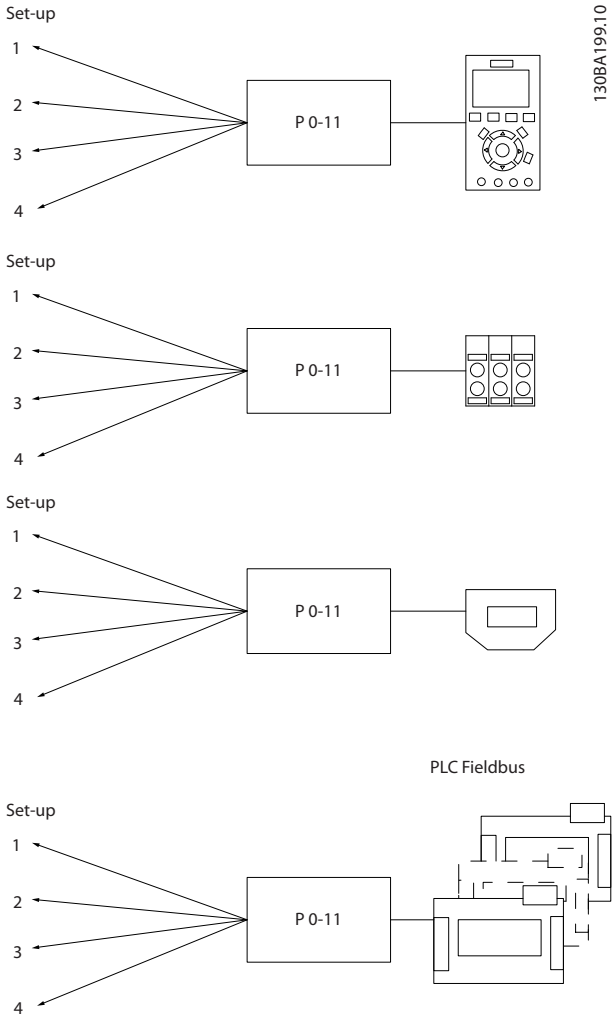
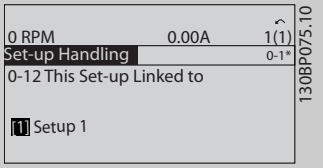
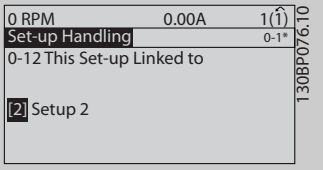


Illustration 6.1

0-12 This Set-up Linked to		
Option:		**Function:**
		To enable conflict-free changes from one set-up to another during operation, link set-ups containing parameters which are not changeable during operation. The link will ensure synchronising of the 'not changeable during operation' parameter values when moving from one set-up to another during operation. 'Not changeable during operation' parameters can be identified by the label FALSE in the parameter lists in the section *Parameter Lists*. *0-12 This Set-up Linked to* is used by Multi set-up in *0-10 Active Set-up*. Multi set-up is used to move from one set-up to another during operation (i.e. while the motor is running). Example: Use Multi set-up to shift from Set-up 1 to Set-up 2 whilst the motor is running. Programme in Set-up 1 first, then ensure that Set-up 1 and Set-up 2 are synchronised (or 'linked'). Synchronisation can be performed in two ways: 1. Change the edit set-up to *Set-up 2* [2] in *0-11 Edit Set-up* and set *0-12 This Set-up Linked to* to *Set-up 1* [1]. This will start the linking (synchronising) process.  **Illustration 6.2** OR 2. While still in Set-up 1, copy Set-up 1 to Set-up 2. Then set *0-12 This Set-up Linked to* to *Set-up 2* [2]. This will start the linking process.  **Illustration 6.3** After the link is complete, *0-13 Readout: Linked Set-ups* will read {1,2} to indicate that all 'not changeable during operation' parameters are now the same in Set-up 1 and Set-up 2. If there are changes to a 'not changeable during operation' parameter, e.g. *1-30 Stator Resistance (Rs)*, in Set-up 2, they will also be changed automatically in Set-up 1. A switch between Set-up 1 and Set-up 2 during operation is now possible.
[0] *	Not linked	
[1]	Set-up 1	
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	

6

0-13 Readout: Linked Set-ups

Array [5]

Range:		Function:
0 *	[0 - 255]	View a list of all the set-ups linked by means of *0-12 This Set-up Linked to*. The parameter has one index for each parameter set-up. The parameter value displayed for each index represents which set-ups are linked to that parameter set-up.

Index	LCP value
0	{0}
1	{1,2}
2	{1,2}
3	{3}
4	{4}

Table 6.3 Example: Set-up 1 and Set-up 2 are linked

0-14 Readout: Edit Set-ups / Channel

Range:		Function:
0 *	[-2147483648 - 2147483647]	View the setting of *0-11 Edit Set-up* for each of the four different communication channels. When the number is displayed in hex, as it is in the LCP, each number represents one channel. Numbers 1-4 represent a set-up number; 'F' means factory setting; and 'A' means active set-up. The channels are, from right to left: LCP, FC-bus, USB, HPFB1-5. Example: The number AAAAAA21h means that the FC bus selected Set-up 2 in *0-11 Edit Set-up*, the LCP selected Set-up 1 and all others used the active set-up.

6.2.2 0-2* LCP Display

Define the display in the Graphical Logic Control Panel.

0-20 Display Line 1.1 Small

Option:		Function:
		Select a variable for display in line 1, left position.
[0]	None	
[1501]	Running Hours	
[1502]	kWh Counter	
[1508]	Number of Starts	
[1509]	Number of Resets	
[1600]	Control Word	
[1601]	Reference [Unit]	
[1602]	Reference %	
[1603]	Status Word	
[1605]	Main Actual Value [%]	
[1609]	Custom Readout	
[1610]	Power [kW]	

0-20 Display Line 1.1 Small

Option:		Function:
[1611]	Power [hp]	
[1612]	Motor Voltage	
[1613]	Frequency	
[1614]	Motor Current	
[1615]	Frequency [%]	
[1616]	Torque	
[1617] *	Speed [RPM]	
[1618]	Motor Thermal	
[1619]	KTY sensor temperature	
[1620]	Motor Angle	
[1622]	Torque %	
[1630]	DC Link Voltage	
[1632]	Brake Energy /s	
[1633]	Brake Energy /2 min	
[1634]	Heatsink Temp.	
[1635]	Inverter Thermal	
[1636]	Inv. Nom. Current	
[1637]	Inv. Max. Current	
[1638]	SL Control State	
[1639]	Control Card Temp	
[1650]	External Reference	
[1651]	Pulse Reference	
[1652]	Feedback [Unit]	
[1653]	Digi Pot Reference	
[1654]	Feedback 1 [Unit]	
[1655]	Feedback 2 [Unit]	
[1660]	Digital Input	
[1661]	Terminal 53 Switch Setting	
[1662]	Analog Input 53	
[1663]	Terminal 54 Switch Setting	
[1664]	Analog Input 54	
[1665]	Analog Output 42 [mA]	
[1666]	Digital Output [bin]	
[1667]	Freq. Input #29 [Hz]	
[1668]	Freq. Input #33 [Hz]	
[1669]	Pulse Output #27 [Hz]	
[1670]	Pulse Output #29 [Hz]	
[1671]	Relay Output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1684]	Comm. Option STW	
[1685]	FC Port CTW 1	
[1686]	FC Port REF 1	
[1690]	Alarm Word	
[1691]	Alarm Word 2	
[1692]	Warning Word	
[1693]	Warning Word 2	
[1694]	Ext. Status Word	
[2580]	Cascade Status	
[2581]	Compressor Status	

0-20 Display Line 1.1 Small

Option:		Function:
[2587]	Inverse Interlock	
[2827]	Discharge Temperature	

0-21 Display Line 1.2 Small

Option:		Function:
		Options are the same as in *0-20 Display Line 1.1 Small*
[1614] *	Motor Current [A]	

0-22 Display Line 1.3 Small

Option:		Function:
		Options are the same as in *0-20 Display Line 1.1 Small*.
[1610] *	Power [kW]	

0-23 Display Line 2 Large

Option:		Function:
		Options are the same as in *0-20 Display Line 1.1 Small*.
[1613] *	Frequency [Hz]	

0-24 Display Line 3 Large

Option:		Function:
		Options are the same as in *0-20 Display Line 1.1 Small*.
[1662] *	Analog Input 53	

0-25 My Personal Menu

Option:		Function:
		Define up to 20 parameters to include in the Q1 Personal Menu, accessible via the [Quick Menu] key on the LCP. The parameters will be displayed in the Q1 Personal Menu in the order they are programmed into this array parameter. Delete parameters by setting the value to « 0000 ».

0-30 Unit for User-defined Readout

Option:		Function:
		It is possible to program a value to be shown in the display of the LCP. The value will have a linear, squared or cubed relation to speed. This relation will depend on the unit selected (see table above). The actual calculated value can be read in *16-09 Custom Readout*, and/or shown in the display be selecting Custom Readout [16-09] in *0-20 Display Line 1.1 Small* to *0-24 Display Line 3 Large*.
[0] *	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	rpm	
[12]	Pulse/s	
[20]	l/s	

0-30 Unit for User-defined Readout

Option:	Function:
[21]	l/min
[22]	l/h
[23]	m^3/s
[24]	m^3/min
[25]	m^3/h
[30]	kg/s
[31]	kg/min
[32]	kg/h
[33]	t/min
[34]	t/h
[40]	m/s
[41]	m/min
[45]	m
[60]	°C
[70]	mbar
[71]	bar
[72]	Pa
[73]	kPa
[74]	m WG
[80]	kW
[120]	GPM
[121]	gal/s
[122]	gal/min
[123]	gal/h
[124]	CFM
[125]	ft^3/s
[126]	ft^3/min
[127]	ft^3/h
[130]	lb/s
[131]	lb/min
[132]	lb/h
[140]	ft/s
[141]	ft/min
[145]	ft
[160]	°F
[170]	psi
[171]	lb/in^2
[172]	in WG
[173]	ft WG
[180]	HP

0-31 Min Value of User-defined Readout

Range:		Function:
0.00 Custom-ReadoutUnit*	[-999999.99 - par. 0-32 CustomRea-doutUnit]	This parameter sets the min. value of the custom defined readout (occurs at zero speed). Only possible to set different from 0 is when selecting a linear unit in *0-30 Unit for User-defined Readout*. For Quadratic and

0-31 Min Value of User-defined Readout		
Range:		**Function:**
		Cubic units the minimum value will be 0.

0-32 Custom Readout Max Value		
Range:		**Function:**
100.00 Custom-ReadoutUnit*	[par. 0-31 - 999999.99 CustomRea-doutUnit]	This parameter sets the max value to be shown when the speed of the motor has reached the set value for *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]* (depends on setting in *0-02 Motor Speed Unit*).

6.2.3 0-4* LCP Keypad

Enable and disable individual keys on the LCP keypad.

0-40 [Hand on] Key on LCP		
Option:		**Function:**
		If *0-40 [Hand on] Key on LCP* is included in the Quick Menu, then define the password in *0-65 Quick Menu Password*.
[0]	Disabled	Prevents accidental start of the frequency converter in Hand mode.
[1] *	Enabled	Prevents unauthorised start in Hand mode.

0-41 [Off] Key on LCP		
Option:		**Function:**
		Options are the same as in *0-40 [Hand on] Key on LCP*.

0-42 [Auto on] Key on LCP		
Option:		**Function:**
		Options are the same as in *0-40 [Hand on] Key on LCP*.

0-43 [Reset] Key on LCP		
Option:		**Function:**
		Options are the same as in *0-40 [Hand on] Key on LCP*.

6.2.4 0-5* Copy/Save

Copy parameter settings between set-ups and to/from the LCP.

0-50 LCP Copy		
Option:		**Function:**
[0] *	No copy	
[1]	All to LCP	Copies all parameters in all set-ups from the frequency converter memory to the LCP memory.

0-50 LCP Copy		
Option:		**Function:**
[2]	All from LCP	Copies all parameters in all set-ups from the LCP memory to the frequency converter memory.
[3]	Size indep. from LCP	Copies only the parameters that are independent of the motor size.

0-51 Set-up Copy		
Option:		**Function:**
[0]	No copy	
[1]	Copy to set-up 1	Copies all parameters in the present edit set-up (defined in par. 0-11 Edit Set-up) to Set-up 1. Likewise, select the option corresponding to the other set-up(s).
[2]	Copy to set-up 2	
[3]	Copy to set-up 3	
[4]	Copy to set-up 4	
[9]	Copy to all	Copies the parameters in the present set-up over to each of the set-ups 1 to 4.

6.2.5 0-6* Password

Define password access to menus.

0-60 Main Menu Password		
Option:		**Function:**
		Define the password for access to the Main Menu via the [Main Menu] key. If *0-61 Access to Main Menu w/o Password* is set to *[0] Full access*, this parameter will be ignored.

0-61 Access to Main Menu w/o Password		
Option:		**Function:**
[0] *	Full access	Disables the password defined in *0-60 Main Menu Password*.
[1]	Read only	Prevents unauthorised editing of Main Menu parameters.
[2]	No access	Prevents unauthorised viewing and editing of Main Menu parameters.

NOTE

If *[0] Full access* is selected, *0-60 Main Menu Password*, *0-65 Quick Menu Password* and *0-66 Access to Quick Menu w/o Password* are ignored.

0-65 Quick Menu Password		
Option:		**Function:**
		Define the password for access to the Quick Menu via the [Quick Menu] key. If *0-66 Access to Quick Menu w/o Password* is set to *[0] Full access*, this parameter will be ignored.

0-66 Access to Quick Menu w/o Password

Option:		Function:
[0] *	Full access	Disables the password defined in *0-65 Quick Menu Password*.
[1]	Read only	Prevents unauthorised editing of Quick Menu parameters.
[2]	No access	Prevents unauthorised viewing and editing of Quick Menu parameters.

NOTE

If *0-61 Access to Main Menu w/o Password* is set to *[0] Full access*, this parameter will be ignored.

6

6.3 Parameters: 1-** Load and Motor

6.3.1 1-0* General Settings

Define whether the frequency converter operates in speed mode or torque mode; and whether the internal PID control should be active or not. All parameters from *1-01 Motor Control Principle* (included) to *1-81 Min Speed for Function at Stop [RPM]* (included) are read only. Only *1-13 Compressor Selection* remains accessible for compressor selection.

1-00 Configuration Mode

Option:		Function:
		Select the application control principle to be used when a Remote Reference (via analog input) is active. A Remote Reference can only be active when *3-13 Reference Site* is set to [0] or [1].
[0] *	Speed open loop	Enables speed control (without feedback signal from motor) to the input signal over the compressor speed range.
[3]	Process	Enables the use of process control in the frequency converter. The process control parameters are set in parameter groups *7-2* Process PID Feedback* and *7-3* Process PID Control*.

NOTE

This parameter cannot be adjusted while the motor is running.

1-13 Compressor Selection

Range:		Function:
		The default setting of most of the parameters in the frequency converter (e.g. motor data, limits, ramps etc.) depends upon the compressor and system refrigerant selected for the frequency converter. The frequency converter selects the default compressor based upon the power size and voltage range for the frequency converter. Under normal circumstances this should not be changed. During test/repair situations a different compressor can be selected – or if the system is not using the default refrigerant. **NOTE** **If the compressor selection is changed, then all dependent parameters reset to default and any user settings will be lost.**
Size dependent.	[]	Select the compressor/refrigerant combination for the system.

6.4 Parameters: 3 -** Reference/Ramps

6.4.1 3-0* Reference Limits

Parameters for reference handling, definition of limitations, and configuration of the reaction of the frequency converter to changes.

3-00 Reference Range

Option:		Function:
		Select the range of the reference signal and the feedback signal. Signal values can be positive only, or positive and negative. The minimum limit may have a negative value, unless *[1] Speed closed loop* control is selected in *1-00 Configuration Mode*.
[0] *	Min. - Max	For positive values only
[1]	-Max - +Max	For both positive and negative values

3-01 Reference/Feedback Unit

Option:		Function:
		Select the unit to be used in Process PID Control references and feedbacks.
[0]	None	
[71] *	bar	
[60]	°C	
[160]	°F	
[170]	psi	

3-02 Minimum Reference

Option:		Function:
		Enter the minimum reference. The minimum reference is the lowest value obtainable by summing all references. Minimum reference is active only when *3-00 Reference Range* is set to *[0] Min.- Max.*. **The minimum reference unit matches:** • The choice of configuration in *1-00 Configuration Mode*: for *[1] Speed closed loop*. • The unit selected in *3-01 Reference/Feedback Unit*.

3-03 Maximum Reference

Option:		Function:
		Enter the maximum reference.

3-10 Preset Reference

Array [8]

0.00%*	[-100.00 - 100.00 %]	Must remain 0 for Open Loop Control. The preset reference is stated as a percentage of the value Ref_{MAX} (*3-03 Maximum Reference*) or as a percentage of the other external references. If a Ref_{MIN} 0 (*3-02 Minimum Reference*) is programmed, the preset reference is calculated as a percentage of the full reference range, i.e. on the basis of the difference between Ref_{MAX} and Ref_{MIN}. Afterwards, the value is added to Ref_{MIN}. When using preset references, select *[16] Preset ref. bit 0, [17] Preset ref. bit 1* or *[18] Preset ref. bit 2* for the corresponding digital inputs in parameter group *5-1* Digital Inputs*.

3-12 Catch up/slow Down Value

Range:		Function:
0.00 %*	[0.00 - 100.00 %]	Enter a percentage (relative) value to be either added to or deducted from the actual reference for Catch up or Slow down respectively. If *Catch up* is selected via one of the digital inputs (*5-10 Terminal 18 Digital Input* to *5-15 Terminal 33 Digital Input*), the percentage (relative) value is added to the total reference. If *Slow down* is selected via one of the digital inputs (*5-10 Terminal 18 Digital Input* to *5-15 Terminal 33 Digital Input*), the percentage (relative) value is deducted from the total reference. Obtain extended functionality with the DigiPot function. See parameter group *3-9* Digital Potentiometer*.

3-13 Reference Site

Option:		Function:
		Select which reference site to activate.
[0]	Linked to Hand / Auto	Use the local reference when in Hand mode; or the remote reference when in Auto mode
[1]	Remote	Use the remote reference in both Hand mode and Auto mode
[2]	Local	Use the local reference in both Hand mode and Auto mode

3-14 Preset Relative Reference

Range:		Function:
0.00%*	[-100.00 - 100.00 %]	Define a fixed value (in %) to be added to the variable value (defined in *3-18 Relative Scaling Reference Source*). The sum of the fixed and variable values is multiplied with the actual reference. This product is then added to the actual reference (X+X*Y/100) to give the resultant actual reference.

3-15 Reference Resource 1

Option:		Function:
		Select the reference input to be used for the first reference signal. *3-15 Reference Resource 1*, *3-16 Reference Resource 2* and *3-17 Reference Resource 3* define up to three different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	

3-15 Reference Resource 1

Option:		Function:
[1] *	Analog input 53	
[2]	Analog input 54	
[7]	Frequency input 29	
[8]	Frequency input 33	
[11]	Local bus reference	
[20]	Digital pot.meter	

NOTE

This parameter cannot be adjusted while the motor is running.

3-16 Reference Resource 2

Option:		Function:
		Select the reference input to be used for the second reference signal. Parameters *3-15 Reference Resource 1*, *3-16 Reference Resource 2* and *3-17 Reference Resource 3* define up to three different reference signals. The sum of these reference signals defines the actual reference. Same options as *3-15 Reference Resource 1*.
[0] *	No function	

NOTE

This parameter cannot be adjusted while the motor is running.

3-17 Reference Resource 3

Option:		Function:
		Select the reference input to be used for the third reference signal. *3-15 Reference Resource 1*, *3-16 Reference Resource 2* and *3-17 Reference Resource 3* define up to three different reference signals. The sum of these reference signals defines the actual reference. Same options as *3-15 Reference Resource 1*.
[0] *	No function	

NOTE

This parameter cannot be adjusted while the motor is running.

3-18 Relative Scaling Reference Resource

Option:		Function:
		Select a variable value to be added to the fixed value (defined in *3-14 Preset Relative Reference*). The sum of the fixed and variable values is multiplied with the actual reference. This product is then added to the actual reference (X+X*Y/100) to give the resultant actual reference Same options as *3-15 Reference Resource 1*.
[0] *	No function	

3-19 Jog Speed [RPM]

Range:		Function:
Size related*	[0 - par. 4-13 RPM]	Enter a value for the jog speed n_{JOG}, which is a fixed output speed. The frequency converter runs at this speed when the jog function is activated. The maximum limit is defined in *4-13 Motor Speed High Limit [RPM]*. See also *3-80 Jog Ramp Time*.

3-40 Ramp 1 Type

Option:		Function:
		Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp will give constant acceleration during ramping.
[0] *	Linear	

3-41 Ramp Up Time Running (sec)

Range:		Function:
5 s min.*	[Comp dependent]	Enter the ramp-up time, i.e. the acceleration time to reach the system required motor speed.

3-42 Ramp Down Time Running (sec)

Range:		Function:
5 s min.*	[Comp dependent]	Enter the ramp-down time, i.e. the deceleration time to reach compressor minimum motor speed.

3-50 Ramp 2 Type

Option:		Function:
		Select the ramp type, depending on requirements for acceleration/deceleration. A linear ramp will give constant acceleration during ramping. An S-ramp will give non-linear acceleration, compensating for jerk in the application.
[0] *	Linear	
[1]	S-ramp Const Jerk	Acceleration with lowest possible jerk
[2]	S-ramp Const Time	S-ramp based on the values set in *3-51 Ramp 2 Ramp up Time* and *3-52 Ramp 2 Ramp down Time*

NOTE

If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed the ramp time may be prolonged in order to realize a jerk free movement which may result in a longer start or stop time.
Additional adjustment of the S-ramp ratios or switching initiators may be necessary.

3-51 Ramp 2 Ramp up Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the rated motor speed n_s. Choose a ramp-up time such that the output current does not exceed the current limit in *4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *3-52 Ramp 2 Ramp down Time*. $Par.\ 3-51 = \frac{t_{acc}[s] \times n_s[RPM]}{ref[RPM]}$

3-52 Ramp 2 Ramp down Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the ramp-down time, i.e. the deceleration time from the rated motor speed n_s to 0 RPM. Choose a ramp-down time such that no over-voltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *3-51 Ramp 2 Ramp up Time*. $Par.\ 3-52 = \frac{t_{dec}[s] \times n_s[RPM]}{ref[RPM]}$

3-60 Ramp 3 Type		
Option:		**Function:**
		Select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp will give constant acceleration during ramping. An S-ramp will give non-linear acceleration, compensating for jerk in the application.
[0] *	Linear	
[1]	S-ramp Const Jerk	Accelerates with lowest possible jerk.
[2]	S-ramp Const Time	S-ramp based on the values set in *3-61 Ramp 3 Ramp up Time* and *3-62 Ramp 3 Ramp down Time*

NOTE

If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed the ramp time may be prolonged in order to realize a jerk free movement which may result in a longer start or stop time.
Additional adjustment of the S-ramp ratios or switching initiators may be necessary.

3-61 Ramp 3 Ramp up Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the rated motor speed n_s. Choose a ramp-up time such that the output current does not exceed the current limit in *4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *3-62 Ramp 3 Ramp down Time*.

3-62 Ramp 3 Ramp down Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the ramp-down time, i.e. the deceleration time from the rated motor speed n_s to 0 RPM. Choose a ramp-down time such that no over-voltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *3-61 Ramp 3 Ramp up Time*. $Par.\ 3-62 = \frac{t_{dec}[s] \times n_s[RPM]}{ref[RPM]}$

3-70 Ramp 4 Type		
Option:		**Function:**
		Select the ramp type, depending on requirements for acceleration and deceleration. A linear ramp will give constant acceleration during ramping. An S-ramp will give non-linear acceleration, compensating for jerk in the application
[0] *	Linear	
[1]	S-ramp Const Jerk	Accelerates with lowest possible jerk.
[2]	S-ramp Const Time	S-ramp based on the values set in *3-71 Ramp 4 Ramp up Time* and *3-72 Ramp 4 Ramp Down Time*.

NOTE

If *[1] S-ramp Const Jerk* is selected and the reference during ramping is changed the ramp time may be prolonged in order to realize a jerk free movement which may result in a longer start or stop time.
Additional adjustment of the S-ramp ratios or switching initiators may be necessary.

3-71 Ramp 4 Ramp up Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the rated motor speed n_s. Choose a ramp-up time such that the output current does not exceed the current limit in *4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *3-72 Ramp 4 Ramp Down Time*. $Par.\ 3-71 = \frac{t_{acc}[s] \times n_s[RPM]}{ref[RPM]}$

3-72 Ramp 4 Ramp Down Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the ramp-down time, i.e. the deceleration time from the rated motor speed n_s to 0 RPM. Choose a ramp-down time such that no over-voltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *3-71 Ramp 4 Ramp up Time*. $Par.\ 3-72 = \frac{t_{dec}[s] \times n_s[RPM]}{ref[RPM]}$

3-80 Jog Ramp Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the jog ramp time, i.e. the acceleration/deceleration time between 0 RPM and the rated motor frequency n_s. Ensure that the resultant output current required for the given jog ramp time does not exceed the current limit in *4-18 Current Limit*. The jog ramp time starts upon activation of a jog signal via the LCP, a selected digital input, or the serial communication port. When jog state is disabled then the normal ramping times are valid.

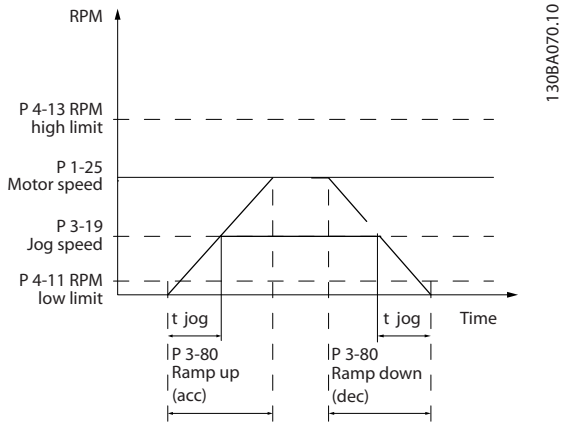


Illustration 6.4

$$Par.\ 3-80 = \frac{t_{jog}[s] \times n_s[RPM]}{\Delta\ jog\ speed\ (par.\ 3-19)[RPM]}$$

3-81 Quick Stop Ramp Time		
Range:		**Function:**
Size related*	[0.01 - 3600.00 s]	Enter the quick–stop ramp-down time, i.e. the deceleration time from the synchronous motor speed to 0 RPM. Ensure that no resultant over-voltage will arise in the inverter due to regenerative operation of the motor required to achieve the given ramp-down time. Ensure also that the generated current required to achieve the given ramp-down time does not exceed the current limit (set in *4-18 Current Limit*). Quick-stop is activated by means of a signal on a selected digital input, or via the serial communication port.

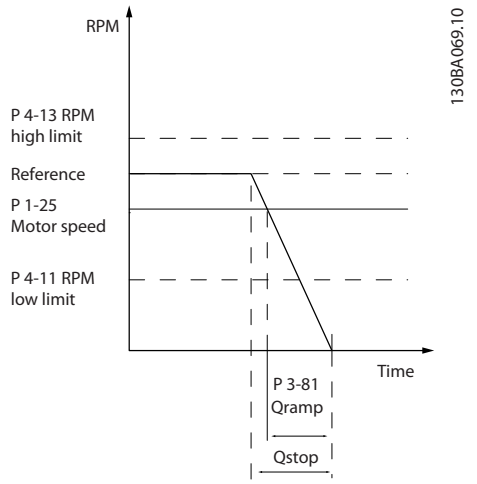


Illustration 6.5

6.5 Parameters: 4-** Limits/Warnings

6.5.1 4-1* Motor Limits

Define torque, current and speed limits for the motor, and the reaction of the frequency converter when the limits are exceeded.
A limit may generate a message on the display. A warning will always generate a message on the display or on the fieldbus. A monitoring function may initiate a warning or a trip, upon which the frequency converter will stop and generate an alarm message.

4-20 Torque Limit Factor Source

Option:		Function:
		Select an analog input for scaling the settings in *4-16 Torque Limit Motor Mode* and *4-17 Torque Limit Generator Mode* from 0% to 100% (or inverse). The signal levels corresponding to 0% and 100% are defined in the analog input scaling, e.g. parameter group 6-1*. This parameter is only active when *1-00 Configuration Mode* is in *Speed Open Loop* or *Speed Closed Loop*.
[0] *	No function	
[2]	Analog in 53	
[4]	Analog in 53 inv	
[6]	Analog in 54	
[8]	Analog in 54 inv	
[10]	Analog in X30-11	
[12]	Analog in X30-11 inv	
[14]	Analog in X30-12	
[16]	Analog in X30-12 inv	

4-21 Speed Limit Factor SourceOption

Option:		Function:
		Select an analog input for scaling the settings in *4-19 Max Output Frequency* from 0% to 100% (or vice versa). The signal levels corresponding to 0% and 100% are defined in the analog input scaling, e.g. parameter group 6-1*. This parameter is only active when *1-00 Configuration Mode* is in *Torque Mode*.
[0] *	No function	
[2]	Analog input 53	
[4]	Analog input 53 inv	
[6]	Analog input 54	
[8]	Analog input 54 inv	
[10]	Analog input X30-11	

4-21 Speed Limit Factor SourceOption

Option:		Function:
[12]	Analog input X30-11 inv	
[14]	Analog input X30-12	
[16]	Analog input X30-12 inv	

6.5.2 4-5* Adjustable Warnings

Use these parameters to adjust warning limits for current, speed, reference and feedback. Warnings that are shown on the display can be programmed as an output or sent via serial bus.

4-50 Warning Current Low

Range:		Function:
0 A*	[0 - par. 4-51 A]	Enter the I_{LOW} value. When the motor current falls below this limit, the display reads *Current Low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02. Refer to .

4-51 Warning Current High

Range:		Function:
Size related*	[par. 4-50 - par. 16-37 A]	Enter the I_{HIGH} value. When the motor current exceeds this limit, the display reads *Current High*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02. Refer to .

4-52 Warning Speed Low

Range:		Function:
Size related*	[0 - par. 4-53 RPM]	Enter the n_{LOW} value. When the motor speed exceeds this limit, the display reads *Speed Low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-53 Warning Speed High

Range:		Function:
Size related*	[par. 4-52 - par. 4-13 RPM]	

4-54 Warning Reference Low

Range:		Function:
-999999.999 *	[-999999.999 - par. 4-55]	Enter the lower reference limit. When the actual reference falls below this limit, the display indicates Ref_{LOW}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-55 Warning Reference High		
Range:		**Function:**
999999.999 *	[par. 4-54 - 999999.999]	Enter the upper reference limit. When the actual reference exceeds this limit, the display reads Ref High. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-56 Warning Feedback Low		
Range:		**Function:**
-999999.999 ReferenceFeed-backUnit*	[-999999.999 - par. 4-57 ReferenceFeed-backUnit]	Enter the lower feedback limit. When the feedback falls below this limit, the display reads Feedb Low. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-57 Warning Feedback High		
Range:		**Function:**
999999.999 ReferenceFeed-backUnit*	[par. 4-56 - 999999.999 ReferenceFeed-backUnit]	Enter the upper feedback limit. When the feedback exceeds this limit, the display reads Feedb High. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-58 Missing Motor Phase Function		
Displays alarm 30, 31 or 32 in the event of a missing motor phase. It is strongly recommended to enable to avoid motor damage.		
Option:		**Function:**
[0]	Off	No alarm is displayed if a missing motor phase occurs.
[1]	On	

NOTE

This parameter cannot be adjusted while the motor is running.

6.5.3 4-6* Speed Bypass

Some systems call for avoiding certain output frequencies or speeds, due to resonance problems in the system. A maximum of four frequency or speed ranges can be avoided.

4-60 Bypass Speed From [RPM]		
Array [4]		
Range:		**Function:**
Size related*	[0 - par. 4-13 RPM]	Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

4-61 Bypass Speed From [Hz]		
Array [4]		
Range:		**Function:**
Size related*	[0.0 - par. 4-14 Hz]	Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

4-62 Bypass Speed To [RPM]		
Array [4]		
Range:		**Function:**
Size related*	[0 - par. 4-13 RPM]	Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

4-63 Bypass Speed To [Hz]		
Array [4]		
Range:		**Function:**
Size related*	[0.0 - par. 4-14 Hz]	Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

6.6 Parameters: 5-** Digital In/Out

6.6.1 5-** Digital In/Out

Parameter group for configuring the digital input and output.

6.6.2 5-0* Digital In/Out Mode

5-00 Digital In/Out Mode

Option:		Function:
		Digital inputs and programmed digital outputs are pre-programmable for operation either in PNP or NPN systems.
[0] *	PNP	Action on positive directional pulses.
[1]	NPN	

5-01 Terminal 27 Mode

Option:		Function:
[0] *	Input	Defines terminal 27 as a digital input.

5-01 Terminal 27 Mode

Option:		Function:
[1]	Output	Defines terminal 27 as a digital output.

NOTE

This parameter cannot be adjusted while the motor is running.

5-02 Terminal 29 Mode

Option:		Function:
		Similar to Terminal 27

6.6.3 5-1* Digital Inputs

Parameters for configuring the input functions for the input terminals.
The digital inputs are used for selecting various functions in the frequency converter. All digital inputs can be set to the following functions:

Digital input function	Select	Terminal
No operation	[0]	All *term 19, 29, 33
Reset	[1]	All *term 32
Coast inverse	[2]	All
Coast and reset inverse	[3]	All
Quick stop inverse	[4]	All
DC-brake inverse	[5]	All
Stop inverse	[6]	All *term 27
Start	[8]	All *term 18
Latched start	[9]	All
Reversing	[10]	All
Start reversing	[11]	All
Enable start forward	[12]	All
Enable start reverse	[13]	All
Jog	[14]	All
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Speed down	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Catch up	[28]	All
Slow down	[29]	All
Pulse input	[32]	29, 33
Ramp bit 0	[34]	All
Ramp bit 1	[35]	All
Mains failure inverse	[36]	All
Day/night control	[39]	All
DigiPot Increase	[55]	All

Digital input function	Select	Terminal
DigiPot Decrease	[56]	All
DigiPot Clear	[57]	All
Counter A (up)	[60]	29, 33
Counter A (down)	[61]	29, 33
Reset Counter A	[62]	All
Counter B (up)	[63]	29, 33
Counter B (down)	[64]	29, 33
Reset Counter B	[65]	All
Lead pump start	[120]	All
Lead pump alternation	[121]	All
Comp. 1 Interlock	[130]	All
Comp. 2 Interlock	[131]	All
Comp. 3 Interlock	[132]	All
Comp. 1 Inv. interlock	[139]	All
Comp. 2 Inv. interlock	[140]	All
Comp. 3 Inv. interlock	[141]	All

Table 6.4

Functions dedicated to only one digital input are stated in the associated parameter.

All digital inputs can be programmed to these functions:

[0]	No operation	No reaction to signals transmitted to the terminal.
[1]	Reset	Resets frequency converter after a TRIP/ ALARM. Not all alarms can be reset.
[2]	Coast inverse	(Default Digital input 27): Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic '0' ⇒ coasting stop.
[3]	Coast and reset inverse	Reset and coasting stop Inverted input (NC). Leaves motor in free mode and resets drive. Logic '0' ⇒ coasting stop and reset.
[4]	Quick stop inverse	Inverted input (NC). Generates a stop in accordance with quick-stop ramp time set in *3-81 Quick Stop Ramp Time*. When motor stops, the shaft is in free mode. Logic '0' ⇒ Quick-stop.
[5]	DC-brake inverse	Inverted input for DC braking (NC). Stops motor by energizing it with a DC current for a certain time period. See *2-01 DC Brake Current* to *2-03 DC Brake Cut In Speed [RPM]*. The function is only active when the value in *2-02 DC Braking Time* is different from 0. Logic '0' ⇒ DC braking.
[6]	Stop inverse	Stop Inverted function. Generates a stop function when the selected terminal goes from logical level '1' to '0'. The stop is performed according to the selected ramp time (*3-42 Ramp 1 Ramp Down Time*, *3-52 Ramp 2 Ramp Down Time*, *3-62 Ramp 3 Ramp down Time*, *3-72 Ramp 4 Ramp Down Time*). **NOTE** **When the frequency converter is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the frequency converter stops, configure a digital output to *[27] Torque limit & stop* and connect this digital output to a digital input that is configured as coast.**
[8]	Start	(Default Digital input 18): Select start for a start/stop command. Logic '1' = start, logic '0' = stop.
[9]	Latched start	The motor starts, if a pulse is applied for min. 2 ms. The motor stops when Stop inverse is activated.
[10]	Reversing	(Default Digital input 19). Change the direction of motor shaft rotation. Select Logic '1' to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in *4-10 Motor Speed Direction*. The function is not active in process closed loop.
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[12]	Enable start forward	Rotates motor shaft clockwise at start.
[13]	Enable start reverse	Rotates motor shaft counterclockwise at start.
[14]	Jog	(Default Digital input 29): Use to activate jog speed. See *3-11 Jog Speed [Hz]*.
[15]	Preset reference on	Shifts between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *3-04 Reference Function*. Logic '0' = external reference active; logic '1' = one of the eight preset references is active.
[16]	Preset ref bit 0	Preset ref. bit 0,1, and 2 enables a choice between one of the eight preset references according to *Table 6.5*.
[17]	Preset ref bit 1	Same as Preset ref bit 0 [16].
[18]	Preset ref bit 2	Same as Preset ref bit 0 [16].

Preset ref. bit	2	1	0
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0
Preset ref. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

Table 6.5

[19]	Freeze ref	Freezes the actual reference, which is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (*3-51 Ramp 2 Ramp Up Time* and *3-52 Ramp 2 Ramp Down Time*) in the range 0 - *3-03 Maximum Reference*.
[20]	Freeze output	Freezes the actual motor frequency (Hz), which is now the point of enable/condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2 (*3-51 Ramp 2 Ramp Up Time* and *3-52 Ramp 2 Ramp Down Time*) in the range 0 to *1-23 Motor Frequency*. **NOTE** **When Freeze output is active, the frequency converter cannot be stopped via a low *[8] start* signal. Stop the frequency converter via a terminal programmed for *[2] Coasting inverse* or *[3] Coast and reset, inverse*.**
[21]	Speed up	Select Speed up and Speed down if digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed

		up/ down is activated for less than 400 ms the resulting reference will be increased/ decreased by 0.1 %. If Speed up/ down is activated for more than 400 ms the resulting reference will follow the setting in ramping up/ down parameter 3-x1/ 3-x2.

	Shut down	Catch up
Unchanged speed	0	0
Reduced by %-value	1	0
Increased by %-value	0	1
Reduced by %-value	1	1

Table 6.6

[22]	Speed down	Same as Speed up [21].
[23]	Set-up select bit 0	Select Set-up select bit 0 or Select Set-up select bit 1 to select one of the four set-ups. Set *0-10 Active Set-up* to Multi Set-up.
[24]	Set-up select bit 1	(Default Digital input 32): Same as *[23] Set-up select bit 0*.
[28]	Catch up	Increases or reduces reference value set in *3-12 Catch up/slow Down Value*.
[29]	Slow down	*[28] Same as Catch up*.
[30]	Counter input	Precise stop function in *1-83 Precise Stop Function* acts as Counter stop or speed compensated counter stop with or without reset. The counter value must be set in *1-84 Precise Stop Counter Value*.
[32]	Pulse input	Use pulse sequence as either reference or feedback. Scaling is done in parameter group *5-5* Pulse Input*.
[34]	Ramp bit 0	Enables a choice between one of the 4 ramps available, according to *Table 6.7*.
[35]	Ramp bit 1	Same as *[34] Ramp bit 0*.

Preset ramp bit	1	0
Ramp 1	0	0
Ramp 2	0	1
Ramp 3	1	0
Ramp 4	1	1

Table 6.7

[36]	Mains failure inverse	Activates *14-10 Mains Failure*. Mains failure inverse is active in the Logic .0. situation.
[39]	Day/Night Control	Reduce the max. frequency with the setting in *28-74 Night Speed Drop [RPM]*.
[41]	Latched Precise Stop inverse	Sends a latched stop signal when the precise stop function is activated in *1-83 Precise Stop Function*. The Latched Precise stop inverse function is available for terminals 18 or 19.
[55]	DigiPot Increase	INCREASE signal to the Digital Potentiometer function described in parameter group *3-9* Digital Potmeter*.
[56]	DigiPot Decrease	DECREASE signal to the Digital Potentiometer function described in parameter group *3-9* Digital Potmeter*
[57]	DigiPot Clear	Clears the Digital Potentiometer reference described in parameter group *3-9* Digital Potmeter*
[60]	Counter A	(Terminal 29 or 33 only) Input for increment counting in the SLC counter.
[61]	Counter A	(Terminal 29 or 33 only) Input for decrement counting in the SLC counter.
[62]	Reset Counter A	Input for reset of counter A.
[63]	Counter B	(Terminal 29 or 33 only) Input for increment counting in the SLC counter.
[64]	Counter B	(Terminal 29 or 33 only) Input for decrement counting in the SLC counter.
[65]	Reset Counter B	Input for reset of counter B.
[70]	Mech. Brake Feedback	Brake feedback for hoisting applications
[71]	Mech. Brake Feedback inv.	Inverted brake feedback for hoisting applications
[80]	PTC Card 1	All Digital Inputs can be set to *[80] PTC Card 1*. However, only one Digital Input must be set to this choice.
[121]	Lead Pump Alternation	
[130]	Compressor Interlock	Use with cascade controller. Logic 1 will stop the fixed speed compressor and give a warning
[131]	Compressor Interlock	Use with cascade controller. Logic 1 will stop the fixed speed compressor and give a warning
[132]	Compressor Interlock	Use with cascade controller. Logic 1 will stop the fixed speed compressor and give a warning

5-10 Terminal 18 Digital Input

Option:		Function:
[8] *	Start	Functions are described under parameter group *5-1* Digital Inputs*

5-11 Terminal 19 Digital Input

Option:		Function:
[10] *	Reversing	Functions are described under parameter group *5-1* Digital Inputs*

5-12 Terminal 27 Digital Input

Option:		Function:
[2] *	Coast inverse	Functions are described under parameter group *5-1* Digital Inputs*

5-13 Terminal 29 Digital Input

Option:		Function:
		Select the function from the available digital input range and the additional options [60], [61], [63] and [64]. Counters are used in Smart Logic Control functions.

5-13 Terminal 29 Digital Input

Option:		Function:
[14] *	Jog	
[60]	Counter A (up)	
[61]	Counter A (down)	
[63]	Counter B (up)	
[64]	Counter B (down)	

5-14 Terminal 32 Digital Input

Option:		Function:
		Select the function from the available digital input range.
[0] *	No operation	Functions are described under *5-1* Digital Inputs*

5-15 Terminal 33 Digital Input

Option:		Function:
		Select the function from the available digital input range and the additional options [60], [61], [63] and [64]. Counters are used in Smart Logic Control functions.
[0] *	No operation	Functions are described under *5-1* Digital Inputs*

6.6.4 5-3* Digital Outputs

Parameters for configuring the output functions for the output terminals. The 2 solid-state digital outputs are common for terminals 27 and 29. Set the I/O function for terminal 27 in *5-01 Terminal 27 Mode*, and set the I/O function for terminal 29 in *5-02 Terminal 29 Mode*. Digital outputs appear if *5-01 Terminal 27 Mode* or *5-02 Terminal 29 Mode* are set to output.

NOTE

These parameters cannot be adjusted while the motor is running.

NOTE

Only for activating 24 V DC devices – restricted use for relays.

		The digital outputs can be programmed with these functions:
[0]	No operation	*Default for all digital outputs and relay outputs*
[1]	Control ready	The control board receives supply voltage.
[2]	Drive ready	The frequency converter is ready for operation and applies a supply signal on the control board.
[3]	Drive ready / remote control	The frequency converter is ready for operation and is in Auto On mode.
[4]	Stand-by / no warning	The frequency converter is ready for operation. No start or stop command is been given (start/disable). There are no warnings.
[5]	Running	The motor is running.
[6]	Running / no warning	The output speed is higher than the speed set in *1-81 Min Speed for Function at Stop [RPM]*. The motor is running and there are no warnings.
[7]	Run on reference / no warning	The motor runs at reference speed.
[8]	Run in range / no warning	The motor runs in speed range.
[9]	Alarm	An alarm activates the output. There are no warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in *4-16 Torque Limit Motor Mode* or *1-17 Voltage filter time const.* has been exceeded.
[12]	Out of current range	The motor current is outside the range set in *4-18 Current Limit*.
[13]	Below current, low	The motor current is lower than set in *4-50 Warning Current Low*.
[14]	Above current, high	The motor current is higher than set in *4-51 Warning Current High*.
[15]	Out of speed range	The output speed is outside the range set in *4-52 Warning Speed Low* and *4-53 Warning Speed High*.
[16]	Below speed, low	The output speed is lower than the setting in *4-52 Warning Speed Low*.
[17]	Above speed, high	The output speed is higher than the setting in *4-53 Warning Speed High*.
[18]	Out of feedback range	The feedback is outside the range set in *4-56 Warning Feedback Low* and *4-57 Warning Feedback High*.
[19]	Below feedback low	The feedback is below the limit set in *4-56 Warning Feedback Low* Warning Feedback Low.
[20]	Above feedback high	The feedback is above the limit set in *4-57 Warning Feedback High Warning Feedback High*.
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor, or the thermistor.
[25]	Reverse	*Reversing. Logic '1'* = relay activated, 24 V DC when CW rotation of the motor. Logic '0' = relay not activated, no signal, when CCW rotation of the motor.
[26]	Bus OK	Active communication (no time-out) via the serial communication port.
[27]	Torque limit and stop	Use in performing a coasting stop and in torque limit condition. If the frequency converter has received a stop signal and is at the torque limit, the signal is Logic '0'.

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[28]	Brake, no warning	The brake is active and there are no warnings.
[29]	Brake ready, no fault	The brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	The output is Logic '1' when the brake IGBT is short-circuited. Use this function to protect the frequency converter if there is a fault on the brake modules. Use the output/relay to cut out the main voltage from the frequency converter.
[33]	Safe Stop Active	Indicates that the safe stop on terminal 37 is active.
[35]	External Interlock	External Interlock function has been activated via one of the digital inputs.
[40]	Out of ref range	Active when the actual speed is outside the settings in *4-52 Warning Speed Low* to *4-55 Warning Reference High*.
[41]	Below reference low	Active when the actual speed is below the speed reference setting.
[42]	Above reference high	Active when the actual speed is above the speed reference setting.
[45]	Bus Ctrl	Control output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. The output state is retained in the event of bus time-out.
[46]	Bus Ctrl 1 if timeout	Controls output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. In the event of bus time-out the output state is set low (On).
[47]	Bus Ctrl 0 if timeout	Controls output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. In the event of bus time-out the output state is set low (Off).
[55]	Pulse output	
[60]	Comparator 0	See parameter group *13-1* Comparators*. If Comparator 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[61]	Comparator 1	See parameter group *13-1* Comparators*. If Comparator 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[62]	Comparator 2	See parameter group *13-1* Comparators*. If Comparator 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[63]	Comparator 3	See parameter group *13-1* Comparators*. If Comparator 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[64]	Comparator 4	See parameter group *13-1* Comparators*. If Comparator 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[65]	Comparator 5	See parameter group *13-1* Comparators*. If Comparator 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[70]	Logic Rule 0	See parameter group *13-4* Logic Rules*. If Logic Rule 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[71]	Logic Rule 1	See parameter group *13-4* Logic Rules* If Logic Rule 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[72]	Logic Rule 2	See parameter group *13-4* Logic Rules*. If Logic Rule 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[73]	Logic Rule 3	See parameter group *13-4* Logic Rules*. If Logic Rule 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[74]	Logic Rule 4	See parameter group *13-4* Logic Rules*. If Logic Rule 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[75]	Logic Rule 5	See parameter group *13-4* Logic Rules*. If Logic Rule 5 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[80]	SL Digital Output A	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action *[38] Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action *[32] Set dig. out. A low* is executed.
[81]	SL Digital Output B	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action *[39] Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action *[33] Set dig. out. A low* is executed.
[82]	SL Digital Output C	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action *[40] Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action *[34] Set dig. out. A low* is executed.
[83]	SL Digital Output D	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action *[41] Set dig. out. A* high is executed. The input will go low whenever the Smart Logic Action *[35] Set dig. out. A low* is executed.
[84]	SL Digital Output E	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action *[42] Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action *[36] Set dig. out. A low* is executed.

[85]	SL Digital Output F	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action *[43] Set dig. out. A high* is executed. The input will go low whenever the Smart Logic Action *[37] Set dig. out. A low* is executed.
[122]	No alarm	The output is high when no alarm is present.
[123]	Start command active	The output is high when there is an active Start command (i.e. via digital input bus connection or [Hand on] or [Auto on], and no Stop or Start command is active.
[124]	Running reverse	The output is high when the frequency converter is running counter clockwise (the logical product of the status bits 'running' AND 'reverse').
[125]	Drive in hand mode	The output is high when the frequency converter is in Hand on mode (as indicated by the LED light above [Hand on].
[126]	Drive in auto mode	The output is high when the frequency converter is in Hand on mode (as indicated by the LED light above [Auto on].
[139]	Compressor Inv. Interlock	Use with cascade controller. Logic will stop the fixed speed compressor and give a warning.
[140]	Compressor Inv. Interlock	Use with cascade controller. Logic will stop the fixed speed compressor and give a warning.
[141]	Compressor Inv. Interlock	Use with cascade controller. Logic will stop the fixed speed compressor and give a warning.
[195]	Bypass Valve Control	The bypass valve control (Digital/Relay output in the frequency converter) is used for compressor systems to unload the compressor during start-up by using a bypass valve. After the start command is given the bypass valve will be open until the frequency converter reaches *4-11 Motor Speed Low Limit [RPM]*). After the limit has been reached the bypass valve will be closed, allowing the compressor to operate normally. This procedure will not be activated again before a new start is initiated and the frequency converter speed is zero during the receiving of start signal. *1-71 Start Delay* can be used in order to delay the motor start. The bypass valve control principle:

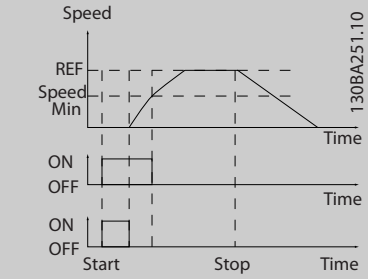

Illustration 6.6

The below setting options are all related to the Cascade Controller.
Wiring diagrams and settings for parameter, see parameter group *25-** Cascade Pack Controller* or more details.

6.6.5 5-4* Relays (Dry Contacts)

NOTE

Relays 7, 8, and 9 are only available if MCB 105 relay card is installed.

NOTE

Relay 1 is dedicated to controlling the solenoid valve.

Parameters for configuring the timing and the output functions for the relays.

5-40 Function Relay

Array [8] (Relay 1 [0], Relay 2 [1], Relay 7 [6], Relay 8 [7], Relay 9 [8])

[0]	No Operation	
[1]	Control Ready	
[2]	Drive Ready	
[3]	Drive Ready/Remote	
[4]	Stand-by/No Warning	
[5] *	Running	
[6]	Running/No Warning	
[8]	Run on Ref./No Warning	
[9]	Alarm	
[10]	Alarm or Warning	
[11]	At Torque Limit	
[12]	Out of Current Range	
[13]	Below Current, low	
[14]	Above Current, high	
[15]	Out of Speed Range	
[16]	Below Speed, low	
[17]	Above Speed, high	
[18]	Out of Feedb. Range	
[19]	Below Feedback, low	
[20]	Above Feedback, high	
[21]	Thermal Warning	

[22]	Ready, no thermal w	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque Limit & Stop	
[28]	Brake, No Warning	
[29]	Brake Ready, No Fault	
[30]	Brake Fault (IGBT)	
[31]	Relay 123	
[32]	Mech brake ctrl	
[33]	Safe stop active	
[35]	External Interlock	
[36]	Control Word Bit 11	
[37]	Control Word Bit 12	
[40]	Out of Ref. Range	
[41]	Below Reference, low	
[42]	Above Ref. high	
[45]	Bus ctrl	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[70]	Logic Rule 0	
[71]	Logic Rule 1	
[72]	Logic Rule 2	
[73]	Logic Rule 3	
[74]	Logic Rule 4	
[75]	Logic Rule 5	
[80]	SL Digital Output A	
[81]	SL Digital Output B	
[82]	SL Digital Output C	
[83]	SL Digital Output D	
[84]	SL Digital Output E	
[85]	SL Digital Output F	
[120]	Local Ref. Active	
[121]	Remote Ref. Active	
[122]	No Alarm	
[123]	Start Cmd. Active	
[124]	Running Reverse	
[125]	Drive in Hand Mode	
[126]	Drive in Auto Mode	
[195]	Bypass Valve Control	
[211]	Cascade Compressor 1	
[212]	Cascade Compressor 2	
[213]	Cascade Compressor 3	

5-50 Term. 29 Low Frequency

Range:		Function:
100 Hz*	[0 - 110000 Hz]	Enter the low frequency limit corresponding to the low motor shaft speed (i.e. low reference value) in

5-50 Term. 29 Low Frequency

Range:		Function:
		5-52 Term. 29 Low Ref./Feedb. Value. Refer to the diagram in this section.

5-51 Term. 29 High Frequency

Range:		Function:
100 Hz*	[0 - 110000 Hz]	Enter the high frequency limit corresponding to the high motor shaft speed (i.e. high reference value) in *5-53 Term. 29 High Ref./Feedb. Value*.

5-52 Term. 29 Low Ref./Feedb. Value

Range:		Function:
0 ReferenceFeedbackUnit*	[-999999.999 - 999999.999 ReferenceFeedbackUnit]	Enter the low reference value limit for the motor shaft speed [RPM]. This is also the lowest feedback value, see also *5-57 Term. 33 Low Ref./Feedb. Value*. Set terminal 29 to digital input (*5-02 Terminal 29 Mode = [0] input* (default) and *5-13 Terminal 29 Digital Input* = applicable value).

5-53 Term. 29 High Ref./Feedb. Value

Range:		Function:
Size related*	[-999999.999 - 999999.999 ReferenceFeedbackUnit]	Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also *5-58 Term. 33 High Ref./Feedb. Value*. Select terminal 29 as a digital input (*5-02 Terminal 29 Mode = [0] input* (default) and *5-13 Terminal 29 Digital Input* = applicable value).

5-54 Pulse Filter Time Constant #29

Range:		Function:
100 ms*	[1 - 1000 ms]	Enter the pulse filter time constant. The pulse filter dampens oscillations of the feedback signal, which is an advantage if there is a lot of noise in the system. A high time constant value results in better dampening but also increases the time delay through the filter.

NOTE

This parameter cannot be adjusted while the motor is running.

5-55 Term. 33 Low Frequency		
Range:		**Function:**
100 Hz*	[0 - 110000 Hz]	Enter the low frequency corresponding to the low motor shaft speed (i.e. low reference value) in *5-57 Term. 33 Low Ref./Feedb. Value*.

5-56 Term. 33 High Frequency		
Range:		**Function:**
100 Hz*	[0 - 110000 Hz]	Enter the high frequency corresponding to the high motor shaft speed (i.e. high reference value) in *5-58 Term. 33 High Ref./Feedb. Value*.

5-57 Term. 33 Low Ref./Feedb. Value		
Range:		**Function:**
0.000 *	[-999999.999 - 999999.999]	Enter the low reference value [RPM] for the motor shaft speed. This is also the low feedback value, see also *5-52 Term. 29 Low Ref./Feedb. Value*.

5-58 Term. 33 High Ref./Feedb. Value		
Range:		**Function:**
Size related*	[-999999.999 - 999999.999 ReferenceFeedbackUnit]	Enter the high reference value [RPM] for the motor shaft speed. See also *5-53 Term. 29 High Ref./ Feedb. Value*.

5-59 Pulse Filter Time Constant #33		
Range:		**Function:**
100 ms*	[1 - 1000 ms]	Enter the pulse filter time constant. The low-pass filter reduces the influence on and dampens oscillations on the feedback signal from the control. This is an advantage, e.g. if there is a great amount on noise in the system.

NOTE

This parameter cannot be adjusted while the motor is running.

5-60 Terminal 27 Pulse Output Variable		
Option:		**Function:**
[0]	No operation	Select the desired display output for terminal 27.
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[51]	MCO controlled	
[100]	Output frequency	
[101]	Reference	
[102]	Feedback	
[103]	Motor current	
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	
[107]	Speed	
[108]	Torque	
[109]	Max Out Freq	
[119]	Torque % lim	

5-60 Terminal 27 Pulse Output Variable		
Option:		**Function:**
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	
[107]	Speed	
[108]	Torque	
[109]	Max Out Freq	
[119]	Torque % lim	

5-62 Pulse Output Max Freq #27		
Range:		**Function:**
Size related*	[0 - 32000 Hz]	Set the maximum frequency for terminal 27, corresponding to the output variable selected in *5-60 Terminal 27 Pulse Output Variable*.

5-63 Terminal 29 Pulse Output Variable		
Option:		**Function:**
[0] *	No operation	Select the desired display output for terminal 29.
[45]	Bus ctrl.	
[48]	Bus ctrl., timeout	
[51]	MCO controlled	
[100]	Output frequency	
[101]	Reference	
[102]	Feedback	
[103]	Motor Current	
[104]	Torque rel to limit	
[105]	Torq relate to rated	
[106]	Power	
[107]	Speed	
[108]	Torque	
[109]	Max Out Freq	

5-65 Pulse Output Max Freq #29		
Set the maximum frequency for terminal 29 corresponding to the output variable set in *5-63 Terminal 29 Pulse Output Variable*.		
Range:		**Function:**
5000 Hz*	[0 - 32000 Hz]	

5-90 Digital & Relay Bus Control		
Range:		**Function:**
0 *	[0 - 2147483647]	This parameter holds the state of the digital outputs and relays that is controlled by bus. A logical '1' indicates that the output is high or active. A logical '0' indicates that the output is low or inactive.

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Bit 0	Digital Output Terminal 27
Bit 1	Digital Output Terminal 29
Bit 2	Digital Output Terminal X 30/6
Bit 3	Digital Output Terminal X 30/7
Bit 4	Relay 1 output terminal
Bit 5	Relay 2 output terminal
Bit 6	Option B Relay 1 output terminal
Bit 7	Option B Relay 2 output terminal
Bit 8	Option B Relay 3 output terminal
Bit 9-15	Reserved for future terminals
Bit 16	Option C Relay 1 output terminal
Bit 17	Option C Relay 2 output terminal
Bit 18	Option C Relay 3 output terminal
Bit 19	Option C Relay 4 output terminal
Bit 20	Option C Relay 5 output terminal
Bit 21	Option C Relay 6 output terminal
Bit 22	Option C Relay 7 output terminal
Bit 23	Option C Relay 8 output terminal
Bit 24-31	Reserved for future terminals

Table 6.8

5-93 Pulse Out #27 Bus Control		
Range:		**Function:**
0.00 %*	[0.00 - 100.00 %]	Set the output frequency transferred to the output terminal 27 when the terminal is configured as *[45] Bus Controlled* in *5-60 Terminal 27 Pulse Output Variable*.

5-95 Pulse Out #29 Bus Control		
Range:		**Function:**
0.00 %*	[0.00 - 100.00 %]	Set the output frequency transferred to the output terminal 29 when the terminal is configured as *[45] Bus Controlled* in *5-63 Terminal 29 Pulse Output Variable*.

6.7 Parameters: 6-** Analog In/Out

Parameter group for configuration of the analog input and output.

6.7.1 6-0* Analog In/Out Mode

Parameter group for setting up the analog In/Out configuration.

The frequency converter is equipped with 2 analog inputs: Terminal 53 and 54. The analog inputs on the frequency converter can freely be allocated to either voltage (-10 V to +10 V) or current input (0/4 to 20 mA).

6-00 Live Zero Timeout Time

Range:		Function:
10 s*	[1 - 99 s]	Enter the Live Zero Time-out time period. Live Zero Time-out Time is active for analog inputs, i.e. terminal 53 or terminal 54, used as reference or feedback sources. If the reference signal value associated with the selected current input falls below 50% of the value set in *6-10 Terminal 53 Low Voltage*, *6-12 Terminal 53 Low Current*, *6-20 Terminal 54 Low Voltage* or *6-22 Terminal 54 Low Current* for a time period longer than the time set in *6-00 Live Zero Timeout Time*, the function selected in *6-01 Live Zero Timeout Function* will be activated.

6-01 Live Zero Timeout Function

Option:		Function:
		Select the time-out function. The function set in *6-01 Live Zero Timeout Function* will be activated if the input signal on terminal 53 or 54 is below 50% of the value in *6-10 Terminal 53 Low Voltage*, *6-12 Terminal 53 Low Current*, *6-20 Terminal 54 Low Voltage* or *6-22 Terminal 54 Low Current* for a time period defined in *6-00 Live Zero Timeout Time*. If several time-outs occur simultaneously, the frequency converter prioritises the time-out functions as follows: 1. *6-01 Live Zero Timeout Function* 2. *8-04 Control Word Timeout Function*
[1]	Freeze Output	Frozen at the present value
[0] *	Off	
[1]	Freeze output	Frozen at the present value
[2]	Stop	Overruled to stop
[3]	Jogging	Overruled to jog speed
[4]	Max. speed	Overruled to max. speed
[5]	Stop and trip	Overruled to stop with subsequent trip

6.7.2 6-1* Analog Input 1

Parameters for configuring the scaling and limits for analog input 1 (terminal 53).

NOTE

Analog input 53 is preset for usage with "open loop" control on 0-10 V. Terminal 54 is preset for "Process Loop" control using a pressure sensor AKS with a pressure range of -1 : 12 bar.

6-10 Terminal 53 Low Voltage

Range:		Function:
0.00V*	[-10.0 - par. 6-11]	This analog input scaling value should correspond to the minimum reference value, set in *3-02 Minimum Reference*.

6-11 Terminal 53 High Voltage

Range:		Function:
10.00V*	[6-10 to 10 V]	This analog input scaling value should correspond to the maximum reference value, set in *3-03 Maximum Reference*.

6-12 Terminal 53 Low Current

Range:		Function:
4.0mA*	[0.0 to par. 6-13 mA]	This reference signal should correspond to the minimum reference value, set in *3-02 Minimum Reference*.

6-13 Terminal 53 High Current

Range:		Function:
20.0mA*	[6-12 to 20 mA]	This reference signal should correspond to the maximum reference value, set in *3-02 Minimum Reference*.

6-14 Terminal 53 Low Ref./Feedb. Value

Range:		Function:
Size related*	[Enter the analog input scaling value that corresponds to the low voltage/low current set in *6-10 Terminal 53 Low Voltage* and *6-12 Terminal 53 Low Current*.]	

6-15 Terminal 53 High Ref./Feedb. Value

Range:		Function:
Size related*	[]	
		Enter the analog input scaling value that corresponds to the maximum reference feedback value set in *6-11 Terminal 53 High Voltage* and *6-13 Terminal 53 High Current*.

6-16 Terminal 53 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 53. A high time constant value improves dampening but also increases the time delay through the filter.

NOTE

This parameter cannot be adjusted while the motor is running.

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6.7.3 6-2* Analog Input 2

Parameters for configuring the scaling and limits for analog input 2 (terminal 54).

NOTE

Analog input 53 is preset for usage with "open loop" control on 0-10 V. Terminal 54 is preset for "Process Loop" control using a pressure sensor AKS with a pressure range of -1 : 12 bar.

6-20 Terminal 54 Low Voltage		
Range:		**Function:**
1.00V*	[-10.0 - par. 6-11]	This analog input scaling value should correspond to the minimum output value of the pressure sensor

6-21 Terminal 54 High Voltage		
Range:		**Function:**
5.00V*	[6-10 to 10 V]	This analog input scaling value should correspond to the maximum output value of the pressure sensor.

6-22 Terminal 54 Low Current		
Range:		**Function:**
4.0mA *	[0.0 to par. 6-13 mA]	This reference signal should correspond to the minimum output value of the pressure sensor.

6-23 Terminal 54 High Current		
Range:		**Function:**
20.0mA *	[6-12 to 20 mA]	This reference signal should correspond to the maximum output value of the pressure sensor.

6-24 Terminal 54 Low Ref./Feedb.		
Range:		**Function:**
-1 (bar)	[Value]	Enter the analog input scaling value that corresponds to the minimum reference feedback value set in *3-02 Minimum Reference*.

6-25 Terminal 54 High Ref./Feedb.		
Range:		**Function:**
12 (bar)	[Value]	Enter the analog input scaling value that corresponds to the maximum reference feedback value set in *3-03 Maximum Reference*.

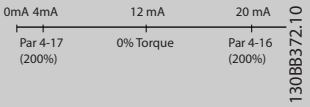
6-26 Terminal 54 Filter Time Constant		
Range:		**Function:**
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 54. A high time constant value improves dampening but also increases the time delay through the filter.

NOTE

This parameter cannot be adjusted while the motor is running.

6-50 Terminal 42 Output		
Option:		**Function:**
		Select the function of Terminal 42 as an analog current output. Depending on the selection the output is either a 0-20 mA or 4-20 mA output. The current value can be read out in LCP in *16-65 Analog Output 42 [mA]*.
[0]	No operation	There is no signal on the analog output.
[100]	Output frequency 0-20 mA	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference 0-20 mA	*3-00 Reference Range* [Min - Max] 0% = 0 mA; 100% = 20 mA *3-00 Reference Range* [-Max - Max] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA
[103]	Motor current 0-20 mA	Value is taken from *16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20 mA. Example: Inverter norm current (11 kW) = 24 A. 160% = 38.4 A. Motor norm current = 22 A Read-out 11.46 mA. $\frac{20\ mA \times 22\ A}{38.4\ A} = 11.46\ mA$ In case the norm motor current is equal to 20 mA, the output setting of *6-52 Terminal 42 Output Max Scale* is: $\frac{I_{VLT_{Max}} \times 100}{I_{Motor_{Norm}}} = \frac{38.4 \times 100}{22} = 175\ \%$
[104]	Torque rel to lim 0-20 mA	The torque setting is related to setting in *4-16 Torque Limit Motor Mode*

6-50 Terminal 42 Output

Option:		Function:
[105]	Torque rel to rated motor torque 0-20 mA	The torque is related to the motor torque setting.
[106]	Power 0-20 mA	Taken from *1-20 Motor Power [kW]*.
[107]	Speed 0-20 mA	Taken from *3-03 Maximum Reference*. 20 mA = value in *3-03 Maximum Reference*
[108]	Torque ref. 0-20 mA	Torque reference related to 160% torque.
[109]	Max Out Freq 0-20 mA	In relation to *4-19 Max Output Frequency*.
[134]	Torque% lim. 4-20 mA	The torque setting is related to setting in *4-16 Torque Limit Motor Mode*.
[135]	Torque% nom 4-20 mA	The torque setting is related to the motor torque setting.
[141]	Bus ctrl. 0-20 mA, timeout	*4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus time-out.
[142]	Bus ctrl. 4-20 mA, timeout	*4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus time-out.
[150]	Max Out Freq 4-20 mA	In relation to *4-19 Max Output Frequency*.
[119]	Torque % lim	
[149]	Torque % lim 4-20mA	Analog output at zero torque = 12 mA. Motoric torque will increase the output current to max torque limit 20 mA (set in *4-16 Torque Limit Motor Mode*). Generative torque will decrease the output to torque limit Generator Mode (set in *4-17 Torque Limit Generator Mode*) Ex: *4-16 Torque Limit Motor Mode*: 200% and *4-17 Torque Limit Generator Mode*: 200%. 20 mA = 200% Motoric and 4 mA = 200% Generatoric.  **Illustration 6.7**
[0] *	No operation	When no signal on the analog output.
[52]	MCO 0-20mA	

6-50 Terminal 42 Output

Option:		Function:
[53]	MCO 4-20mA	
[100]	Output frequency	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference	*3-00 Reference Range* [Min - Max] 0% = 0 mA; 100% = 20 mA *3-00 Reference Range* [-Max - Max] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA
[102]	Feedback	
[103]	Motor current	Value is taken from *16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20 mA. Example: Inverter norm current (11 kW) = 24 A. 160% = 38.4 A. Motor norm current = 22A Read-out 11.46 mA. $\frac{20\ mA \times 22\ A}{38.4\ A} = 11.46\ mA$ In case the norm motor current is equal to 20 mA, the output setting of *6-52 Terminal 42 Output Max Scale* is: $\frac{I_{VLT_{Max}} \times 100}{I_{Motor_{Norm}}} = \frac{38.4 \times 100}{22} = 175\ \%$
[104]	Torque rel to limit	The torque setting is related to setting in *4-16 Torque Limit Motor Mode*
[105]	Torq relate to rated	The torque is related to the motor torque setting.
[106]	Power	Taken from *1-20 Motor Power [kW]*.
[107]	Speed	Taken from *3-03 Maximum Reference*. 20 mA = value in *3-03 Maximum Reference*
[108]	Torque	Torque reference related to 160% torque.
[109]	Max Out Freq	0 Hz = 0 mA,*4-19 Max Output Frequency* = 20 mA.
[130]	Output freq. 4-20mA	0 Hz = 4 mA, 100 Hz = 20 mA
[131]	Reference 4-20mA	*3-00 Reference Range* [Min-Max] 0% = 4 mA; 100% = 20 mA *3-00 Reference Range* [-Max-Max] -100% = 4 mA; 0% = 12 mA; +100% = 20 mA
[132]	Feedback 4-20mA	
[133]	Motor cur. 4-20mA	Value is taken from *16-37 Inv. Max. Current*. Inverter max. current (160% current) is equal to 20 mA. Example: Inverter norm current (11 kW) = 24 A. 160% = 38.4 A. Motor norm current = 22 A Read-out 11.46 mA. $\frac{16\ mA \times 22\ A}{38.4\ A} + 4\ mA = 13.17\ mA$ In case the norm motor current is equal to 20 mA, the output setting of *6-62 Terminal X30/8 Max. Scale* is: $\frac{I_{VLT_{Max}} \times 100}{I_{Motor_{Norm}}} = \frac{38.4 \times 100}{22} = 175\ \%$

6

6-50 Terminal 42 Output

Option:		Function:
[134]	Torq.% lim 4-20 mA	The torque setting is related to setting in *4-16 Torque Limit Motor Mode*.
[135]	Torq.% nom 4-20 mA	The torque setting is related to the motor torque setting.
[136]	Power 4-20mA	Taken from *1-20 Motor Power [kW]*
[137]	Speed 4-20mA	Taken from *3-03 Maximum Reference*. 20 mA = Value in *3-03 Maximum Reference*.
[138]	Torque 4-20mA	Torque reference related to 160% torque.
[139]	Bus ctrl. 0-20 mA	An output value set from fieldbus process data. The output will work independently of internal functions in the frequency converter.
[140]	Bus ctrl. 4-20 mA	An output value set from fieldbus process data. The output will work independently of internal functions in the frequency converter.
[141]	Bus ctrl 0-20mA t.o.	*4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus time-out.
[142]	Bus ctrl 4-20mA t.o.	*4-54 Warning Reference Low* defines the behaviour of the analog output in case of bus time-out.
[150]	Max Out Fr 4-20mA	0 Hz = 0 mA,*4-19 Max Output Frequency* = 20 mA.

6-51 Terminal 42 Output Min Scale

Range:		Function:
0.00 %*	[0.00 - 200.00 %]	Scale for the minimum output (0 or 4 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in *6-50 Terminal 42 Output*.

6-52 Terminal 42 Output Max Scale

Range:		Function:
100.00 %*	[0.00 - 200.00 %]	Scale the maximum output of the selected analog signal at terminal 42. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale; or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the desired output current at a value between 0 - 100% of the full-scale output, programme the percentage value in the parameter, i.e. 50% = 20 mA. If a current between 4 and 20 mA is desired at maximum output (100%), calculate the percentage value as follows:

20 *mA* / *desired maximum current* x 100 %

i.e. 10 *mA* : $\frac{20}{10}$ x 100 = 200 %

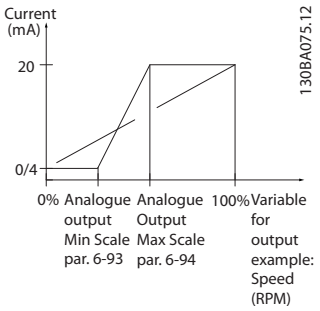


Illustration 6.8

6-53 Terminal 42 Output Bus Control

Range:		Function:
0.00 %*	[0.00 - 100.00 %]	Holds the level of Output 42 if controlled by bus.

6.8 Parameters: 7-** Controllers

7-06 Speed PID Lowpass Filter Time		
Range:		**Function:**
Size related*	[1.0 - 100.0 ms]	Set a time constant for the speed control low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the feedback signal. This is an advantage if there is a great amount on noise in the system, see *Illustration 6.9*. For example, if a time constant (τ) of 100 ms is programmed, the cut-off frequency for the low-pass filter will be 1/0.1= 10 RAD/s., corresponding to (10/2 x π) = 1.6 Hz. The PID regulator only regulates a feedback signal that varies by a frequency of less than 1.6 Hz. If the feedback signal varies by a higher frequency than 1.6 Hz, the PID regulator does not react. Practical settings of *7-06 Speed PID Lowpass Filter Time* taken from the number of pulses per revolutions from encoder:

Encoder PPR	7-06 Speed PID Lowpass Filter Time
512	10 ms
1024	5 ms
2048	2 ms
4096	1 ms

Table 6.9

NOTE

Severe filtering can be detrimental to dynamic performance.
This parameter is used with *1-00 Configuration Mode [1] Speed closed loop* and *[2] Torque* control.
The filter time in flux sensorless must be adjusted to 3-5 ms.

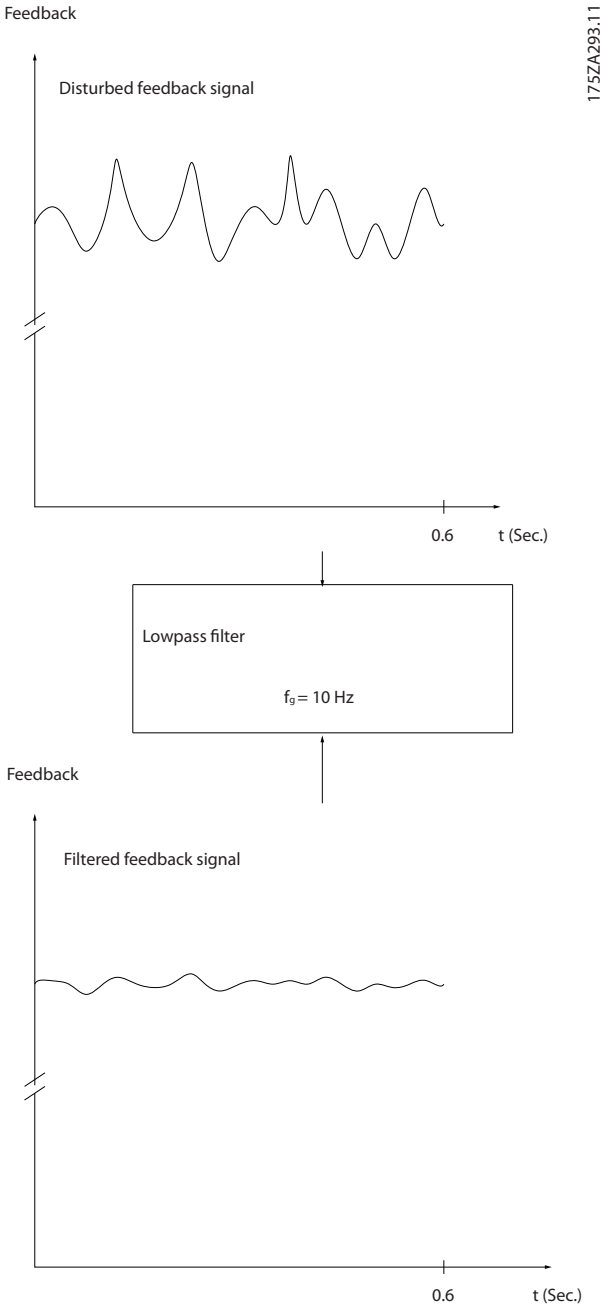


Illustration 6.9

6.8.1 7-2* Process PID Feedback

Select the feedback sources for the Process PID Control, and how this feedback should be handled.

7-20 Process CL Feedback 1 Resource		
Option:		**Function:**
		For process loop with current input, 54 switch has to be positionned on I (current).
[0]	No function	
[1]	Analog input 53	

7-20 Process CL Feedback 1 Resource

Option:		Function:
[2] *	Analog input 54	
[3]	Frequency input 29 (FC 302 only)	
[4]	Frequency input 33	

7-22 Process CL Feedback 2 Resource

Option:		Function:
		The effective feedback signal is made up of the sum of up to two different input signals. Select which input should be treated as the source of the second of these signals. The first input signal is defined in *7-20 Process CL Feedback 1 Resource*.
[0] *	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Frequency input 29	
[4]	Frequency input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[15]	Analog Input X48/2	

7-30 Process PID Normal/Inverse Control

Option:		Function:
		Inverse action has to be selected for a process loop using a suction pressure sensor to control the system.
[0]	Normal	
[1] *	Inverse	

7-31 Process PID Anti Windup

Option:		Function:
[0]	Off	Continue regulation of an error when the output frequency can no longer be adjusted.
[1] *	On	Continue regulation of an error even when the output frequency cannot be increased or decreased.

7-32 Process PID Start Speed

Range:		Function:
3000 [RPM]	[Set point]	Enter the motor speed to be attained as a start signal for commencement of PID control. When the power is switched on, the frequency converter will commence ramping and then operate under speed open loop control. Thereafter, when the Process PID start speed is reached, the frequency converter will change over to Process PID control.

7-33 Process PID Proportional Gain

Range:		Function:
2.00N/A	[0.00 - 10.00 N/A]	Enter the PID proportional gain. The proportional gain multiplies the error between the set point and the feedback signal.

7-34 Process PID Integral Time

Range:		Function:
9.00 s*	[0.01 - 10000.00]	Enter the PID integral time. The integrator provides an increasing gain at a constant error between the set point and the feedback signal. The integral time is the time needed by the integrator to reach the same gain as the proportional gain.

7-35 Process PID Differentiation Time

Range:		Function:
0.00 s*	[0.00 - 10.00 s]	Enter the PID differentiation time. The differentiator does not react to a constant error, but provides a gain only when the error changes. The shorter the PID differentiation time, the stronger the gain from the differentiator.

NOTE

This PID parameters are confortable to start any system, but depending on its design they have to be adjusted to follow the inertia and all responses of the real refrigeration machine.

7-36 Process PID Diff. Gain Limit

Range:		Function:
5.0 *	[1.0 - 50.0]	Enter a limit for the differentiator gain (DG). If there is no limit, the DG will increase when there are fast changes. Limit the DG to obtain a pure differentiator gain at slow changes and a constant differentiator gain where fast changes occur.

7-38 Process PID Feed Forward Factor

Range:		Function:
0 %*	[0 - 200 %]	Enter the PID feed forward (FF) factor. The FF factor sends a constant fraction of the reference signal to bypass the PID control, so the PID control only affects the remaining fraction of the control signal. Any change to this parameter will thus affect the motor speed. When the FF factor is activated it provides less overshoot, and high dynamics when changing the set point. *7-38 Process PID Feed Forward Factor* is active when *1-00 Configuration Mode* is set to *[3] Process*.

7-39 On Reference Bandwidth		
Range:		**Function:**
5 %*	[0 - 200 %]	Enter the On Reference bandwidth. When the PID Control Error (the difference between the reference and the feedback) is less than the set value of this parameter the On Reference status bit is high, i.e. =1.

6.8.2 7-6* Feedback Conversion

Select how the signals from the feedback sources must be converted.

7-60 Feedback 1 Conversion		
Option:		**Function:**
		Selects the conversion to apply to the feedback signal measured on the analog input selected as feedback 1 source in *7-20 Process CL Feedback 1 Resource*.
[0] *	Linear	No conversion is applied. The feedback signal is assumed to be in the unit selected in *3-01 Reference/Feedback Unit* and enters the process controller unchanged.
[1]	Square root	The square root of the feedback signal is calculated before passing it to the process controller.
[2]	Pressure to temperature	The feedback signal is a pressure with units as specified in *7-61 Feedback 1 Source Unit*. It is converted to a temperature before passing it to the process controller. The pressure to temperature conversion is based on the refrigerant selected in *7-70 Refrigerant*.

7-61 Feedback 1 Source Unit		
Option:		**Function:**
		Select the pressure unit applicable to feedback source 1 defined in *7-20 Process CL Feedback 1 Resource*.
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[170] [171]	psi lb/in2	
[172]	in WG	
[173]	ft WG	

7-62 Feedback 2 Conversion		
Option:		**Function:**
		Selects the conversion to apply to the feedback signal measured on the analog input selected as feedback 2 source in *7-22 Process CL Feedback 2 Resource*.
[0] *	Linear	No conversion is applied. The feedback signal is assumed to be in the unit selected in *3-01 Reference/Feedback Unit* and enters the process controller unchanged.
[1]	Square root	The square root of the feedback signal is calculated before passing it to the process controller.
[2]	Pressure to temperature	The feedback signal is a pressure with units as specified in *7-62 Feedback 2 Source Unit*. It is converted to a temperature before passing it to the process controller. The pressure to temperature conversion is based on the refrigerant selected in *7-70 Refrigerant*.

7-63 Feedback 2 Source Unit		
Option:		**Function:**
		Select the pressure unit applicable to feedback source 1 defined in *7-22 Process CL Feedback 2 Resource*.
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[170] [171]	psi lb/in2	
[172]	in WG	
[173]	ft WG	

6.8.3 7-7* Pressure to Temperature Conversion

The conversion of a feedback signal P in units of a pressure to a temperature T is accomplished via the formula:

$T = A2/(\log(P+1)-A1) - A3$

where A1, A2 and A3 are refrigerant dependent constants.

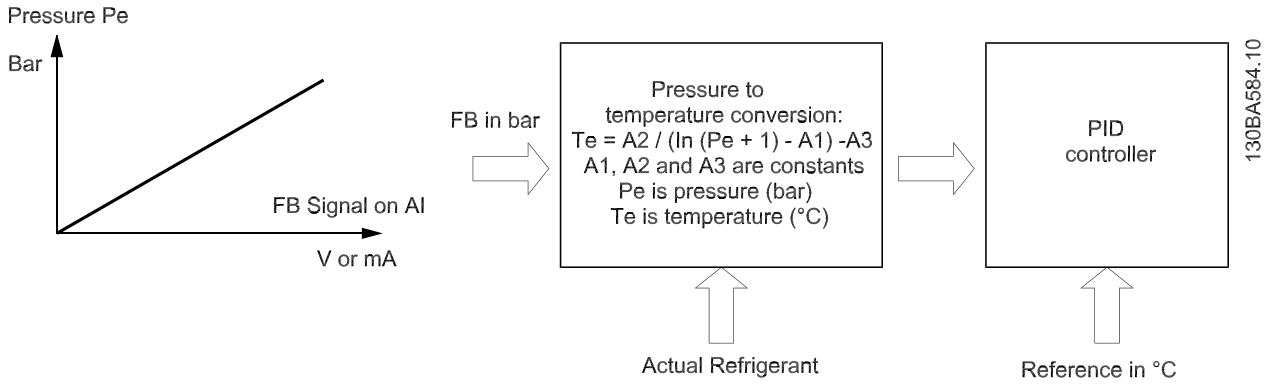


Illustration 6.10

6

The parameters in this group allow selection of a refrigerant, which implicitly determines the constants A1, A2 and A3. Alternatively, user defined constants can be programmed explicitly.

7-70 Refrigerant

Option:		Function:
[0]	R22	
[1]	R134a	
[2] *	R404A	
[3]	R407C	
[4]	R410A	
[5]	R502	
[6]	R744	
[7]	User defined	

7-71 User Defined Refrigerant A1

Range:	Function:
[8.0000 – 12.0000]	Selects the value used for the constant A1 in the pressure to temperature conversion formula (see parameter group *7-7* Pressure to Temperature Conversion*).

7-72 User Defined Refrigerant A2

Range:	Function:
[-3000.00 – -1500.00]	Selects the value used for the constant A2 in the pressure to temperature conversion formula (see parameter group *7-7* Pressure to Temperature Conversion*).

7-73 User Defined Refrigerant A3

Range:	Function:
[200.000 – 300.000]	Selects the value used for the constant A3 in the pressure to temperature conversion formula (see parameter group *7-7* Pressure to Temperature Conversion*).

6.8.4 7-8* Thermostat/Pressostat Function

The Thermostat-Pressostat Function (TPF) can be used to stop and start the compressor when running in closed loop. The TPF monitors and compares the resulting feedback with the Cut-out value in *7-81 Cut-out Value*. When the resulting feedback gets below *7-81 Cut-out Value* a stop signal is generated and the compressor stops. When the resulting feedback gets above the Cut-in value in *7-82 Cut-in Value* the stop signal is removed and the compressor starts again.

The Set-point should be set to a value in between Cut-in and Cut-out.

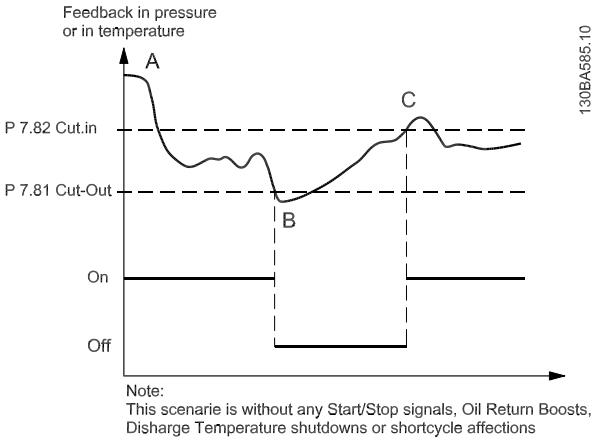


Illustration 6.11

Point A: At start-up the temperature will be higher than wanted in the evaporator and therefore a higher pressure than the Cut-in level and the compressor must run. Another situation could be that the start situation is where the feedback is between Cut-out and Cut-in. In that case, no STOP is initiated.

Point B: After some time the cut-out level may be reached and the compressor must be shut off.

Point C: Cut-in is reached and the compressor is restarted.

NOTE

When using the TPF together with the Cascade Controller further consideration must be taken. The Cut-Out value should be below the Override Bandwidth setting (see *25-21 Override Bandwidth*). Cut-In should be set above the set-point and below the value for Staging Bandwidth (see *25-20 Staging Bandwidth*).

7-80 Thermostat/Pressostat Function

Option:		Function:
[0] *	Off	Function is inactive
[1]	On	Function is active

7-81 Cut-out Value

Range:		Function:
1 bar*	[-3000 - par.7-82]	Select the Cut-out Level where the stop signal is activated and the compressor stops.

7-82 Cut-in Value

Range:		Function:
3 bar*	[Par.7-81 – 3000]	Select the Cut-in Level where the stop signal is de-activated and the compressor starts.

6.9 Parameters: 8-** Communications and Options

6.9.1 8-0* General Settings

8-01 Control Site

Option:		Function:
		The setting in this parameter overrides the settings in *8-50 Coasting Select* to *8-56 Preset Reference Select*.
[0] *	Digital and ctrl.word	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Controlword only	Control by using control word only.

8-02 Control Word Source

Select the source of the control word: one of two serial interfaces or four installed options. During initial power-up, the frequency converter automatically sets this parameter to *[3] Option A* if it detects a valid fieldbus option installed in slot A. If the option is removed, the frequency converter detects a change in the configuration, sets *8-02 Control Word Source* back to default setting RS-485, and the frequency converter trips. If an option is installed after initial power-up, the setting of *8-02 Control Word Source* does not change, but the frequency converter trips and displays: Alarm 67 *Option Changed*.
When retrofitting a bus option into a frequency converter, that did not have a bus option installed to begin with, take an ACTIVE decision to move the control to Bus based. This is done for safety reasons to avoid an accidental change.

Option:		Function:
[0]	None	
[1] *	FC RS485	
[2]	FC USB	
[3] *	Option A	
[4]	Option B	
[5]	Option C0	
[6]	Option C1	
[30]	External Can	

NOTE

This parameter cannot be adjusted while the motor is running.

8-03 Control Word Timeout Time

Range:		Function:
[1.0 s]	0.1-18000.0 s	Enter the maximum time expected to pass between the reception of two consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in *8-04 Control Word Timeout Function* is then carried out. A valid control word triggers the time-out counter.
20 s*	[0.1 - 18000.0 s]	Enter the maximum time expected to pass between the reception of two consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in *8-04 Control Word Timeout Function*is then carried out. A valid control word triggers the time-out counter.

8-04 Control Word Timeout Function

Select the time-out function. The time-out function activates when the control word fails to be updated within the time period specified in *8-03 Control Word Timeout Time*.

Option:		Function:
[0] *	Off	Resumes control via serial bus (fieldbus or standard) using the most recent control word.
[1]	Freeze output	Freezes output frequency until communication resumes.
[2]	Stop	Stops with auto restart when communication resumes.
[3]	Jogging	Runs the motor at JOG frequency until communication resumes.
[4]	Max. speed	Runs the motor at maximum frequency until communication resumes.
[5]	Stop and trip	Stops the motor, then resets the frequency converter to restart: via the fieldbus, via [Reset], or via a digital input.
[7]	Select setup 1	Changes the set-up upon reestablishment of communication following a control word time-out. If communication resumes after a time-out, *8-05 End-of-Timeout Function* defines whether to resume the set-up used before the time-out, or to retain the set-up endorsed by the time-out function.
[8]	Select setup 2	See *[7] Select setup 1*
[9]	Select setup 3	See *[7] Select setup 1*
[10]	Select setup 4	See *[7] Select setup 1*
[26]	Trip	

NOTE

To change the set-up after a time-out, the following configuration is required:
Set *0-10 Active Set-up* to *[9] Multi set-up* and select the relevant link in *0-12 This Set-up Linked to*.

8-05 End-of-Timeout Function		
Option:		**Function:**
		Select the action after receiving a valid control word following a time-out. This parameter is active only when *8-04 Control Timeout Function* is set to *[7] Set-up 1*, *[8] Set-up 2*, *[9] Set-up 3* or *[10] Set-up 4*.
[0]	Hold set-up	Retains the set-up selected in *8-04 Control Timeout Function* and displays a warning, until *8-06 Reset Control Timeout* toggles. Then the frequency converter resumes its original set-up.
[1] *	Resume set-up	Resumes the set-up active before the time-out.

8-06 Reset Control Word Timeout		
This parameter is active only when *[0] Hold set-up* has been selected in *8-05 End-of-Timeout Function*.		
Option:		**Function:**
[0] *	Do not reset	Retains the set-up specified in *8-04 Control Word Timeout Function*, following a control word time-out.
[1]	Do reset	Returns the frequency converter to the original set-up following a control word time-out. The frequency converter performs the reset and then immediately reverts to the *[0] Do not reset* setting

6.9.2 8-1* Ctrl. Word Settings

8-10 Control Word Profile		
Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A will be visible in the LCP display. For guidelines in selection of *[0] FC profile* and *[1] PROFIdrive profile*, refer to the *Serial communication via RS-485 Interface* section in the Design Guide. For additional guidelines in the selection of *[1] PROFIdrive profile*, refer to the Operating Instructions for the installed fieldbus.		
Option:		**Function:**
[0] *	FC profile	
[1]	PROFIdrive profile	

8-13 Configurable Status Word STW		
Option:		**Function:**
[0]	No function	The input is always low.
[1] *	Profile Default	Depended on the profile set in *8-10 Control Profile*.
[2]	Alarm 68 Only	The input goes high whenever Alarm 68 is active and goes low whenever no alarm 68 is actived
[3]	Trip excl Alarm 68	

8-13 Configurable Status Word STW		
Option:		**Function:**
[16]	T37 DI status	The input goes high whenever T37 has 0 V and goes low whenever T37 has 24 V

6.9.3 8-3* FC Port Settings

8-30 Protocol		
Option:		**Function:**
		Select the protocol to be used. Changing protocol will not be effective until after powering off the frequency converter.
[0] *	FC	
[1]	FC MC	
[2]	Modbus RTU	

8-31 Address		
Range:		**Function:**
Size related*	[1. - 255.]	Enter the address for the FC (standard) port. Valid range: 1-126.

8-32 FC Port Baud Rate		
Option:		**Function:**
[0]	2400 Baud	Baud rate selection for the FC (standard) port.
[1]	4800 Baud	
[2] *	9600 Baud	
[3]	19200 Baud	
[4]	38400 Baud	
[5]	57600 Baud	
[6]	76800 Baud	
[7]	115200 Baud	

8-33 Parity / Stop Bits		
Option:		**Function:**
[0]	Even Parity, 1 Stop Bit	
[1]	Odd Parity, 1 Stop Bit	
[2]	No Parity, 1 Stop Bit	
[3]	No Parity, 2 Stop Bits	

8-35 Minimum Response Delay		
Range:		**Function:**
10 ms*	[1 - 10000. ms]	Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Max Response Delay		
Range:		**Function:**
Size related*	[11. - 10001 ms]	Specify the maximum permissible delay time between transmitting a request and receiving a response. If a response from the frequency converter is exceeding the time setting then it will be discarded.

8-37 Max Inter-Char Delay		
Range:		**Function:**
Size related*	[0.00 - 35.00 ms]	

6.9.4 8-5* Digital/Bus

Parameters for configuring the control word Digital/Bus merging.

NOTE

These parameters are active only when *8-01 Control Site* is set to *[0] Digital and control word*.

8-50 Coasting Select		
Option:		**Function:**
		Select control of the coasting function via the terminals (digital input) and/or via the bus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-51 Quick Stop Select		
Select control of the Quick Stop function via the terminals (digital input) and/or via the bus.		
Option:		**Function:**
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3] *	Logic OR	

8-52 DC Brake Select		
Option:		**Function:**
		Select control of the DC brake via the terminals (digital input) and/or via the fieldbus.

8-52 DC Brake Select		
Option:		**Function:**
		NOTE **Only selection *[0] Digital input* is available when *1-10 Motor Construction* is set to *[1] PM non-salient SPM*.**
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-53 Start Select		
Option:		**Function:**
		Select control of the frequency converter start function via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-54 Reversing Select		
Option:		**Function:**
[0]	Digital input	Select control of the frequency converter reverse function via the terminals (digital input) and/or via the fieldbus.
[1]	Bus	Activates the Reverse command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates the Reverse command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Reverse command via the fieldbus/serial communication port OR via one of the digital inputs.

8-55 Set-up Select		
Option:		**Function:**
		Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates the set-up selection via the fieldbus/ serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activate the set-up selection via the fieldbus/ serial communication port OR via one of the digital inputs.

8-56 Preset Reference Select		
Option:		**Function:**
		Select control of the frequency converter Preset Reference selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Preset Reference selection via a digital input.
[1]	Bus	Activates Preset Reference selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Preset Reference selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Preset Reference selection via the fieldbus/serial communication port OR via one of the digital inputs.

6.9.5 8-8* FC Port Diagnostics

These parameters are used for monitoring the Bus communication via the FC Port.

8-80 Bus Message Count		
Range:		**Function:**
0 *	[0 - 0]	This parameter shows the number of valid telegrams detected on the bus.

8-81 Bus Error Count		
Range:		**Function:**
0 *	[0 - 0]	This parameter shows the number of telegrams with faults (e.g. CRC fault), detected on the bus.

8-82 Slave Messages Rcvd		
Range:		**Function:**
0 *	[0 - 0]	This parameter shows the number of valid telegrams addressed to the slave, sent by the frequency converter.

8-83 Slave Error Count		
Range:		**Function:**
0 *	[0 - 0]	This parameter shows the number of error telegrams, which could not be executed by the frequency converter.

6.9.6 8-9* Bus Jog

8-90 Bus Jog 1 Speed		
Range:		**Function:**
100 RPM*	[0 - par. 4-13 RPM]	Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option.

8-91 Bus Jog 2 Speed		
Range:		**Function:**
200 RPM*	[0 - par. 4-13 RPM]	Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option.

6.10 Parameters: 13-** Smart Logic Control

6.10.1 Prog. Features

Smart Logic Control (SLC) is essentially a sequence of user defined actions (see *13-52 SL Controller Action* [x]) executed by the SLC when the associated user defined *event* (see *13-51 SL Controller Event* [x]) is evaluated as TRUE by the SLC.
The condition for an event can be a particular status or that the output from a Logic Rule or a Comparator Operand becomes TRUE. That will lead to an associated Action as illustrated:

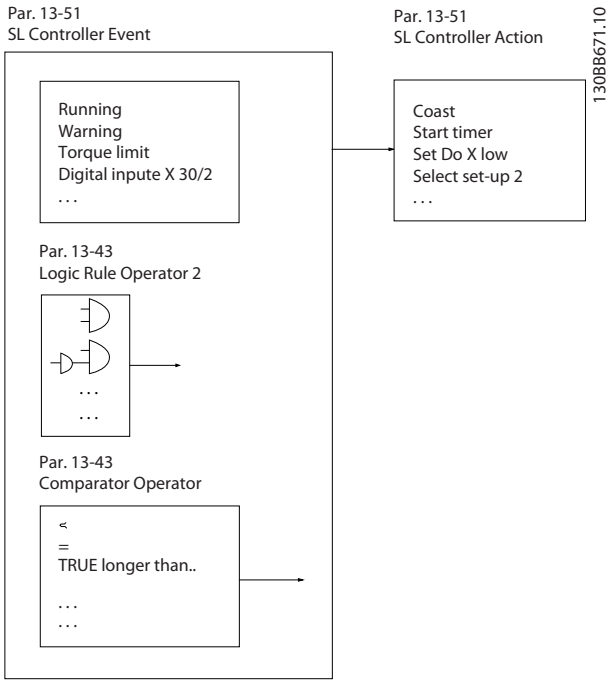


Illustration 6.12

Events and *actions* are each numbered and linked together in pairs (states). This means that when *event* [0] is fulfilled (attains the value TRUE), *action* [0] is executed. After this, the conditions of *event* [1] will be evaluated and if evaluated TRUE, *action* [1] will be executed and so on. Only one *event* will be evaluated at any time. If an *event* is evaluated as FALSE, nothing happens (in the SLC) during the current scan interval and no other *events* will be evaluated. This means that when the SLC starts, it evaluates *event* [0] (and only *event* [0]) each scan interval. Only when *event* [0] is evaluated TRUE, will the SLC execute *action* [0] and start evaluating *event* [1]. It is possible to programme from 1 to 20 *events* and *actions*. When the last *event* / *action* has been executed, the sequence starts over again from *event* [0] / *action* [0]. The illustration shows an example with three event / actions:

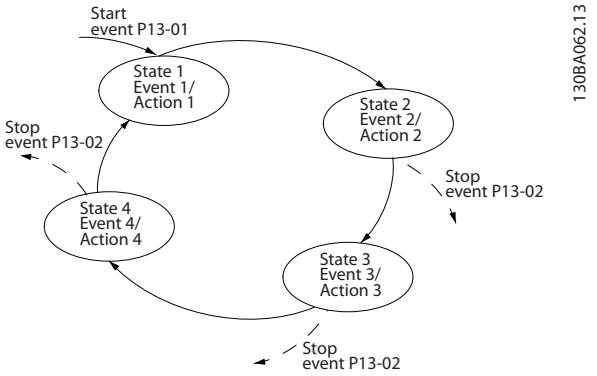


Illustration 6.13

Starting and stopping the SLC:
Starting and stopping the SLC can be done by selecting .On [1]. or .Off [0]. in *13-00 SL Controller Mode*. The SLC always starts in state 0 (where it evaluates *event* [0]). The SLC starts when the Start Event (defined in *13-01 Start Event*) is evaluated as TRUE (provided that *On* [1] is selected in *13-00 SL Controller Mode*). The SLC stops when the *Stop Event* (*13-02 Stop Event*) is TRUE. *13-03 Reset SLC* resets all SLC parameters and start programming from scratch.

NOTE

SLC is only active in AUTO mode, not Hand On mode

6.10.2 13-0* SLC Settings

Use the SLC settings to activate, deactivate and reset the Smart Logic Control sequence. The logic functions and comtors are always running in the background, which opens for sete control of digital inputs and outputs.

13-00 SLC Controller Mode

Option:		Function:
[0] *	Off	Disables the Smart Logic Control.
[1]	On	Enables the Smart Logic Control to start when a start command is present, e.g. via a digital input.

13-01 Start Event

Option:		Function:
[0] *	False	Select the boolean (TRUE or FALSE) input to activate Smart Logic Control. Enters the fixed value - FALSE
[1]	True	Enters the fixed value - TRUE.
[2]	Running	The motor is running.
[3]	In range	The motor is running within the programmed current and speed ranges set in *4-50 Warning Current Low* to *4-53 Warning Speed High*.
[4]	On reference	The motor is running on reference.

13-01 Start Event		
Option:		**Function:**
[5]	Torque limit	The torque limit, set in *4-16 Torque Limit Motor Mode* or *4-17 Torque Limit Generator Mode*, has been exceeded.
[6]	Current limit	The motor current limit, set in *4-18 Current Limit*, has been exceeded.
[7]	Out of current range	The motor current is outside the range set in *4-18 Current Limit*.
[8]	Below I low	The motor current is lower than set in *4-50 Warning Current Low*.
[9]	Above I high	The motor current is higher than set in *4-51 Warning Current High*.
[10]	Out of speed range	The speed is outside the range set in *4-52 Warning Speed Low* and *4-53 Warning Speed High*.
[11]	Below speed low	The output speed is lower than the setting in *4-52 Warning Speed Low*.
[12]	Above speed high	The output speed is higher than the setting in *4-53 Warning Speed High*.
[13]	Out of feedb. range	The feedback is outside the range set in *4-56 Warning Feedback Low* and *4-57 Warning Feedback High*.
[14]	Below feedb. low	The feedback is below the limit set in *4-56 Warning Feedback Low*.
[15]	Above feedb. high	The feedback is above the limit set in *4-57 Warning Feedback High*.
[16]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor or the thermistor.
[17]	Mains out of range	The mains voltage is outside the specified voltage range.
[18]	Reversing	The output is high when the frequency converter is running counter clockwise (the logical product of the status bits "running" AND "reverse").
[19]	Warning	A warning is active.
[20]	Alarm (trip)	A (trip) alarm is active.
[21]	Alarm (trip lock)	A (Trip lock) alarm is active.
[22]	Comparator 0	Use the result of comparator 0.
[23]	Comparator 1	Use the result of comparator 1.
[24]	Comparator 2	Use the result of comparator 2.
[25]	Comparator 3	Use the result of comparator 3.
[26]	Logic rule 0	Use the result of logic rule 0.
[27]	Logic rule 1	Use the result of logic rule 1.

13-01 Start Event		
Option:		**Function:**
[28]	Logic rule 2	Use the result of logic rule 2.
[29]	Logic rule 3	Use the result of logic rule 3.
[33]	Digital input DI18	Use the result of digital input 18.
[34]	Digital input DI19	Use the result of digital input 19.
[35]	Digital input DI27	Use the result of digital input 27.
[36]	Digital input DI29	Use the result of digital input 29.
[37]	Digital input DI32	Use the result of digital input 32.
[38]	Digital input DI33	Use the result of digital input 33.
[39]	Start command	A start command is issued.
[40]	Drive stopped	A stop command (Jog, Stop, Qstop, Coast) is issued – and not from the SLC itself.
[41]	Reset Trip	A reset is issued
[42]	Auto-reset Trip	An Auto reset is performed.
[43]	Ok key	The [OK] key is pressed.
[44]	Reset key	The [Reset] key is pressed.
[45]	Left key	The [◄] key is pressed.
[46]	Right key	The [►] key is pressed.
[47]	Up key	The [▲] key is pressed.
[48]	Down key	The [▼] key is pressed.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

13-02 Stop Event		
Select the boolean (TRUE or FALSE) input to activate Smart Logic Control.		
Option:		**Function:**
[0] *	False	For descriptions [0]-[61], see *13-01 Start Event Start Event*
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	

6

13-02 Stop Event		
Select the boolean (TRUE or FALSE) input to activate Smart Logic Control.		
Option:		**Function:**
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	
[42]	Auto-reset Trip	
[43]	Ok key	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	Smart Logic Controller timer 3 is timed out.

13-02 Stop Event		
Select the boolean (TRUE or FALSE) input to activate Smart Logic Control.		
Option:		**Function:**
[71]	SL Time-out 4	Smart Logic Controller timer 4 is timed out.
[72]	SL Time-out 5	Smart Logic Controller timer 5 is timed out.
[73]	SL Time-out 6	Smart Logic Controller timer 6 is timed out.
[74]	SL Time-out 7	Smart Logic Controller timer 7 is timed out.
[75]	Start command given	
[76]	Digital input x30/2	
[77]	Digital input x30/3	
[78]	Digital input x30/4	
[79]	Digital input x46/1	
[80]	Digital input x46/3	
[81]	Digital input x46/5	
[82]	Digital input x46/7	
[83]	Digital input x46/9	
[84]	Digital input x46/11	
[85]	Digital input x46/13	
[90]	ATEX ETR cur. warning	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output will be 1.
[91]	ATEX ETR cur. alarm	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output will be 1.
[92]	ATEX ETR freq. warning	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]]. If the alarm 163 ATEX ETR cur.lim.warning is active, the output will be 1.
[93]	ATEX ETR freq. alarm	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the warning 165 ATEX ETR freq.lim.warning is active, the output will be 1.
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

13-03 Reset SLC		
Option:		**Function:**
[0] *	Do not reset SLC	Retains programmed settings in all parameter group *13-** Smart Logic Control*.
[1]	Reset SLC	Resets all parameters in parameter group *13-** Smart Logic Control* to default settings.

6.10.3 13-1* Comparators

Comparators are used for comparing continuous variables (i.e. output frequency, output current, analog input etc.) to fixed preset values.

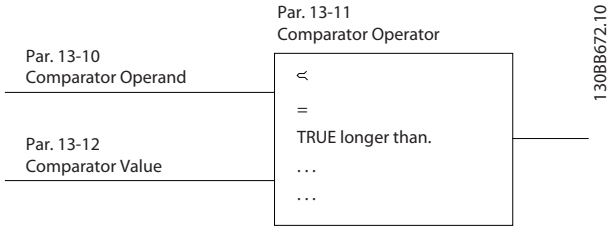


Illustration 6.14

In addition, there are digital values that will be compared to fixed time values. See explanation in *13-10 Comparator Operand*. Comparators are evaluated once in each scan interval. Use the result (TRUE or FALSE) directly. All parameters in this parameter group are array parameters with index 0 to 5. Select index 0 to programme Comparator 0, select index 1 to programme Comparator 1, and so on.

13-10 Comparator Operand		
Array [6]		
Option:		**Function:**
		Choices [1] to [31] are variables which will be compared based on their values. Choices [50] to [186] are digital values (TRUE/FALSE) where the comparison is based on the amount of time during which they are set to TRUE or FALSE, respectively. See *13-11 Comparator Operator*. Select the variable to be monitored by the comparator.
[0] *	DISABLED	The comparator is disabled.
[1]	Reference	The resulting remote reference (not local) as a percentage.
[2]	Feedback	In the unit [RPM] or [Hz]
[3]	Motor speed	[RPM] or [Hz]
[4]	Motor current	[A]

13-10 Comparator Operand		
Array [6]		
Option:		**Function:**
[5]	Motor torque	[Nm]
[6]	Motor power	[kW] or [hp]
[7]	Motor voltage	[V]
[8]	DC-link voltage	[V]
[9]	Motor thermal	Expressed as a percentage.
[10]	Drive thermal	Expressed as a percentage.
[11]	Heat sink temp.	Expressed as a percentage.
[12]	Analog input AI53	Expressed as a percentage.
[13]	Analog input AI54	Expressed as a percentage.
[14]	Analog input AIFB10	[V]. AIFB10 is internal 10 V supply.
[15]	Analog input AIS24V	[V] Analog input AICCT [17] [°]. AIS24V is switch mode power supply: SMPS 24V.
[17]	Analog input AICCT	[°]. AICCT is control card temperature.
[18]	Pulse input FI29	Expressed as a percentage.
[19]	Pulse input FI33	Expressed as a percentage.
[20]	Alarm number	The error number.
[21]	Warning number	
[22]	Analog input x30 11	
[23]	Analog input x30 12	
[30]	Counter A	Number of counts
[31]	Counter B	Number of counts
[50]	FALSE	Enters the fixed value of false in the comparator.
[51]	TRUE	Enters the fixed value of true in the comparator.
[52]	Control ready	The control board receives supply voltage
[53]	Drive ready	The frequency converter is ready for operation and applies a supply signal on the control board.
[54]	Running	The motor is running.
[55]	Reversing	The output is high when the frequency converter is running counter clockwise (the logical product of the status bits “running” AND “reverse”)
[56]	In range	The motor is running within the programmed current and speed ranges set in *4-50 Warning Current Low* to *4-53 Warning Speed High*.
[60]	On reference	The motor is running on reference.

13-10 Comparator Operand		
Array [6]		
Option:		**Function:**
[61]	Below reference, low	The motor is running below the value given in *4-54 Warning Reference Low*
[62]	Above ref, high	The motor is running above the value given in *4-55 Warning Reference High*
[65]	Torque limit	The torque limit, set in *4-16 Torque Limit Motor Mode* or *4-17 Torque Limit Generator Mode*, has been exceeded.
[66]	Current limit	The motor current limit, set in *4-18 Current Limit*, has been exceeded.
[67]	Out of current range	The motor current is outside the range set in *4-18 Current Limit*.
[68]	Below I low	The motor current is lower than set in *4-50 Warning Current Low*.
[69]	Above I high	The motor current is higher than set in *4-51 Warning Current High*.
[70]	Out of speed range	The speed is outside the range set in *4-52 Warning Speed Low* and *4-53 Warning Speed High*.
[71]	Below speed low	The output speed is lower than the setting in *4-52 Warning Speed Low*.
[72]	Above speed high	The output speed is higher than the setting in *4-53 Warning Speed High*.
[75]	Out of feedb. range	The feedback is outside the range set in *4-56 Warning Feedback Low* and *4-57 Warning Feedback High*.
[76]	Below feedb. low	The feedback is below the limit set in *4-56 Warning Feedback Low*.
[77]	Above feedb. high	The feedback is above the limit set in *4-57 Warning Feedback High*.
[80]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter, the brake resistor or thermistor.
[82]	Mains out of range	The mains voltage is outside the specified voltage range.
[85]	Warning	A warning is active.
[86]	Alarm (trip)	A (trip) alarm is active.
[87]	Alarm (trip lock)	A (Trip lock) alarm is active.
[90]	Bus OK	Active communication (no time-out) via the serial communication port.
[91]	Torque limit & stop	If the frequency converter has received a stop signal and is at the torque limit, the signal is logic "0".
[92]	Brake fault (IGBT)	The brake IGBT is short circuited.
[93]	Mech. brake control	The mechanical brake is active.

13-10 Comparator Operand		
Array [6]		
Option:		**Function:**
[94]	Safe stop active	
[100]	Comparator 0	The result of comparator 0.
[101]	Comparator 1	The result of comparator 1.
[102]	Comparator 2	The result of comparator 2.
[103]	Comparator 3	The result of comparator 3.
[104]	Comparator 4	The result of comparator 4.
[105]	Comparator 5	The result of comparator 5.
[110]	Logic rule 0	The result of Logic rule 0.
[111]	Logic rule 1	The result of Logic rule 1.
[112]	Logic rule 2	The result of Logic rule 2.
[113]	Logic rule 3	The result of Logic rule 3.
[114]	Logic rule 4	The result of Logic rule 4.
[115]	Logic rule 5	The result of Logic rule 5.
[120]	SL Time-out 0	The result of SLC timer 0.
[121]	SL Time-out 1	The result of SLC timer 1.
[122]	SL Time-out 2	The result of SLC timer 2.
[123]	SL Time-out 3	The result of SLC timer 3.
[124]	SL Time-out 4	The result of SLC timer 4.
[125]	SL Time-out 5	The result of SLC timer 5.
[126]	SL Time-out 6	The result of SLC timer 6.
[127]	SL Time-out 7	The result of SLC timer 7.
[130]	Digital input DI18	Digital input 18. High = True.
[131]	Digital input DI19	Digital input 19. High = True.
[132]	Digital input DI27	Digital input 27. High = True.
[133]	Digital input DI29	Digital input 29. High = True.
[134]	Digital input DI32	Digital input 32. High = True.
[135]	Digital input DI33	Digital input 33. High = True.
[150]	SL digital output A	Use the result of the SLC output A.
[151]	SL digital output B	Use the result of the SLC output B.
[152]	SL digital output C	Use the result of the SLC output C.
[153]	SL digital output D	Use the result of the SLC output D.
[154]	SL digital output E	Use the result of the SLC output E.
[155]	SL digital output F	Use the result of the SLC output F.
[160]	Relay 1	Relay 1 is active
[161]	Relay 2	Relay 2 is active
[180]	Local ref. active	High when *3-13 Reference Site = [2] Local* or when *3-13 Reference Site* is *[0]*

13-10 Comparator Operand		
Array [6]		
Option:		**Function:**
		Linked to hand Auto, at the same time as the LCP is in Hand On mode.
[181]	Remote ref. active	High when *3-13 Reference Site= [1] Remote* or *[0] Linked to hand/auto*, while the LCP is in Auto On mode.
[182]	Start command	High when there is an active start command, and no stop command.
[183]	Drive stopped	A stop command (Jog, Stop, Qstop, Coast) is issued – and not from the SLC itself.
[185]	Drive in hand mode	High when the frequency converter is in hand mode.
[186]	Drive in auto mode	High when the frequency converter is in auto mode.
[187]	Start command given	
[190]	Digital input x30 2	
[191]	Digital input x30 3	
[192]	Digital input x30 4	
[193]	Digital input x46 1	
[194]	Digital input x46 2	
[195]	Digital input x46 3	
[196]	Digital input x46 4	
[197]	Digital input x46 5	
[198]	Digital input x46 6	
[199]	Digital input x46 7	

13-11 Comparator Operator		
Array [6]		
Option:		**Function:**
		Select the operator to be used in the comparison. This is an array parameter containing comparator operators 0 to 5.
[0]	<	The result of the evaluation is TRUE, when the variable selected in *13-10 Comparator Operand* is smaller than the fixed value in *13-12 Comparator Value*. The result is FALSE, if the variable selected in *13-10 Comparator Operand* is greater than the fixed value in *13-12 Comparator Value*.
[1] *	≈ (equal)	The result of the evaluation is TRUE, when the variable selected in *13-10 Comparator Operand* is approximately equal to the fixed value in *13-12 Comparator Value*.
[2]	>	Inverse logic of option < [0].
[5]	TRUE longer than..	
[6]	FALSE longer than..	

13-11 Comparator Operator		
Array [6]		
Option:		**Function:**
[7]	TRUE shorter than..	
[8]	FALSE shorter than..	

13-12 Comparator Value		
Array [6]		
Range:		**Function:**
Size related*	[-100000.000 - 100000.000]	Enter the 'trigger level' for the variable that is monitored by this comtor. This is an array parameter containing comtor values 0 to 5.

6.10.4 13-1* RS Flip Flops

The Reset-Set Flip Flops hold the signal until set/reset.

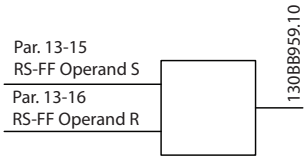


Illustration 6.15

Two parameters are used and the output can be used in the logic rules and as events.

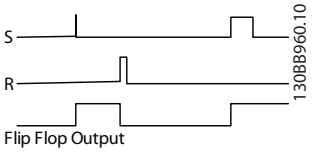


Illustration 6.16

The two operators can be selected from a long list. As a special case, the same digital input can be used as both Set and Reset, making it possible to use the same digital input as start/stop. The following settings can be used to set up the same digital input as start/stop (example given with DI32 but is not a requirement).

Parameter	Setting	Notes
13-00 SL Controller Mode	On	
13-01 Start Event	TRUE	
13-02 Stop Event	FALSE	

Parameter	Setting	Notes
13-40 Logic Rule Boolean 1 [0]	[37] Digital Input DI32	
13-42 Logic Rule Boolean 2 [0]	[2] Running	
13-41 Logic Rule Operator 1 [0]	[3] AND NOT	
13-40 Logic Rule Boolean 1 [1]	[37] Digital Input DI32	
13-42 Logic Rule Boolean 2 [1]	[2] Running	
13-41 Logic Rule Operator 1 [1]	[1] AND	
13-15 RS-FF Operand S [0]	[26] Logicrule 0	Output from 13-41 [0]
13-16 RS-FF Operand R [0]	[27] Logicrule 1	Output from 13-41 [1]
13-51 SL Controller Event [0]	[94] RS Flipflop 0	Output from evaluating 13-15 and 13-16
13-52 SL Controller Action [0]	[22] Run	
13-51 SL Controller Event [1]	[27] Logicrule 1	
13-52 SL Controller Action [1]	[24] Stop	

Table 6.10

13-15 RS-FF Operand S		
Option:		Function:
[0]	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	

13-15 RS-FF Operand S		
Option:		Function:
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	
[42]	Auto-reset Trip	
[43]	Ok key	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[75]	Start command given	
[76]	Digital input x30/2	
[77]	Digital input x30/3	
[78]	Digital input x30/4	
[79]	Digital input x46/1	
[80]	Digital input x46/3	
[81]	Digital input x46/5	
[82]	Digital input x46/7	
[83]	Digital input x46/9	
[84]	Digital input x46/11	
[85]	Digital input x46/13	
[90]	ATEX ETR cur. warning	
[91]	ATEX ETR cur. alarm	
[92]	ATEX ETR freq. warning	
[93]	ATEX ETR freq. alarm	
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	

13-15 RS-FF Operand S		
Option:		Function:
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

13-16 RS-FF Operand R		
Option:		Function:
[0]	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	
[42]	Auto-reset Trip	
[43]	Ok key	
[44]	Reset key	

13-16 RS-FF Operand R		
Option:		Function:
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[75]	Start command given	
[76]	Digital input x30/2	
[77]	Digital input x30/3	
[78]	Digital input x30/4	
[79]	Digital input x46/1	
[80]	Digital input x46/3	
[81]	Digital input x46/5	
[82]	Digital input x46/7	
[83]	Digital input x46/9	
[84]	Digital input x46/11	
[85]	Digital input x46/13	
[90]	ATEX ETR cur. warning	
[91]	ATEX ETR cur. alarm	
[92]	ATEX ETR freq. warning	
[93]	ATEX ETR freq. alarm	
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

6.10.5 13-2* Timers

Use the result (TRUE or FALSE) from *timers* directly to define an *event* (see *13-51 SL Controller Event*), or as boolean input in a *logic rule* (see *13-40 Logic Rule Boolean 1*, *13-42 Logic Rule Boolean 2* or *13-44 Logic Rule Boolean 3*). A timer is only FALSE when started by an action (i.e. *[29] Start timer 1*) until the timer value entered in this parameter is elapsed. Then it becomes TRUE again. All parameters in this parameter group are array parameters with index 0 to 2. Select index 0 to program Timer 0, select index 1 to program Timer 1, and so on.

13-20 SL Controller Timer		
Range:		**Function:**
Size related*	[0.000 - 0.000]	Enter the value to define the duration of the FALSE output from the programmed timer. A timer is only FALSE if it is started by an action (i.e. *Start timer 1 [29]*) and until the given timer value has elapsed.

6.10.6 13-4* Logic Rules

Combine up to three boolean inputs (TRUE/FALSE inputs) from timers, comtors, digital inputs, status bits and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in *13-40 Logic Rule Boolean 1*, *13-42 Logic Rule Boolean 2* and *13-44 Logic Rule Boolean 3*. Define the operators used to logically combine the selected inputs in *13-41 Logic Rule Operator 1* and *13-43 Logic Rule Operator 2*.

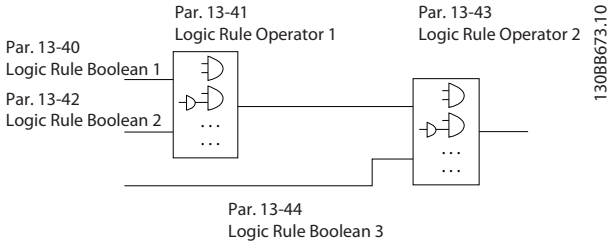


Illustration 6.17

Priority of calculation

The results of *13-40 Logic Rule Boolean 1*, *13-41 Logic Rule Operator 1* and *13-42 Logic Rule Boolean 2* are calculated first. The outcome (TRUE/FALSE) of this calculation is combined with the settings of *13-43 Logic Rule Operator 2* and *13-44 Logic Rule Boolean 3*, yielding the final result (TRUE/FALSE) of the logic rule.

13-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[0] *	False	Select the first boolean (TRUE or FALSE) input for the selected logic rule. See *13-01 Start Event* ([0] - [61]) and *13-02 Stop Event* ([70] - [75]) for further description.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	

13-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	
[42]	Auto-reset Trip	
[43]	Ok key	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[75]	Start command given	

13-40 Logic Rule Boolean 1

Array [6]

Option:		Function:
[76]	Digital input x30/2	
[77]	Digital input x30/3	
[78]	Digital input x30/4	
[79]	Digital input x46/1	
[80]	Digital input x46/3	
[81]	Digital input x46/5	
[82]	Digital input x46/7	
[83]	Digital input x46/9	
[84]	Digital input x46/11	
[85]	Digital input x46/13	
[90]	ATEX ETR cur. warning	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output will be 1.
[91]	ATEX ETR cur. alarm	Selectable if*1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output will be 1.
[92]	ATEX ETR freq. warning	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output will be 1.
[93]	ATEX ETR freq. alarm	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output will be 1.
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

13-41 Logic Rule Operator 1

Array [6]

Option:		Function:
		Select the first logical operator to use on the Boolean inputs from *13-40 Logic Rule Boolean 1* and *13-42 Logic Rule Boolean 2*. [13-**] signifies the boolean input of parameter group *13-** Smart Logic Control*.

13-41 Logic Rule Operator 1

Array [6]

Option:		Function:
[0] *	DISABLED	Ignores *13-42 Logic Rule Boolean 2*, *13-43 Logic Rule Operator 2*, and *13-44 Logic Rule Boolean 3*.
[1]	AND	Evaluates the expression [13-40] AND [13-42].
[2]	OR	Evaluates the expression [13-40] OR [13-42].
[3]	AND NOT	Evaluates the expression [13-40] AND NOT [13-42].
[4]	OR NOT	Evaluates the expression [13-40] OR NOT [13-42].
[5]	NOT AND	Evaluates the expression NOT [13-40] AND [13-42].
[6]	NOT OR	Evaluates the expression NOT [13-40] OR [13-42].
[7]	NOT AND NOT	Evaluates the expression NOT [13-40] AND NOT [13-42].
[8]	NOT OR NOT	Evaluates the expression NOT [13-40] OR NOT [13-42].

13-42 Logic Rule Boolean 2

Array [6]

Option:		Function:
[0] *	False	Select the second boolean (TRUE or FALSE) input for the selected logic rule. See *13-01 Start Event* ([0] - [61]) and *13-02 Stop Event* ([70] - [75]) for further description.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	

13-42 Logic Rule Boolean 2		
Array [6]		
Option:		**Function:**
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	
[42]	Auto-reset Trip	
[43]	Ok key	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[75]	Start command given	
[76]	Digital input x30/2	
[77]	Digital input x30/3	
[78]	Digital input x30/4	
[79]	Digital input x46/1	
[80]	Digital input x46/3	
[81]	Digital input x46/5	
[82]	Digital input x46/7	
[83]	Digital input x46/9	
[84]	Digital input x46/11	
[85]	Digital input x46/13	
[90]	ATEX ETR cur. warning	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output will be 1.
[91]	ATEX ETR cur. alarm	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output will be 1.
[92]	ATEX ETR freq. warning	Selectable if*1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output will be 1.
[93]	ATEX ETR freq. alarm	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output will be 1.
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

13-43 Logic Rule Operator 2		
Array [6]		
Option:		**Function:**
		Select the second logical operator to be used on the boolean input calculated in *13-40 Logic Rule Boolean 1*, *13-41 Logic Rule Operator 1*, and *13-42 Logic Rule Boolean 2*, and the boolean input coming from *13-42 Logic Rule Boolean 2*. [13-44] signifies the boolean input of *13-44 Logic Rule Boolean 3*. [13-40/13-42] signifies the boolean input calculated in *13-40 Logic Rule Boolean 1*, *13-41 Logic Rule Operator 1*, and *13-42 Logic Rule Boolean 2*. *[0] DISABLED* (factory setting). select this option to ignore *13-44 Logic Rule Boolean 3*.
[0] *	DISABLED	
[1]	AND	
[2]	OR	
[3]	AND NOT	
[4]	OR NOT	
[5]	NOT AND	
[6]	NOT OR	
[7]	NOT AND NOT	
[8]	NOT OR NOT	

13-44 Logic Rule Boolean 3		
Array [6]		
Option:		**Function:**
[0] *	False	Select the third boolean (TRUE or FALSE) input for the selected logic rule. See *13-01 Start Event* ([0] - [61]) and *13-02 Stop Event* ([70] - [75]) for further description.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	

13-44 Logic Rule Boolean 3		
Array [6]		
Option:		**Function:**
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	
[42]	Auto-reset Trip	
[43]	Ok key	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[75]	Start command given	
[76]	Digital input x30/2	
[77]	Digital input x30/3	
[78]	Digital input x30/4	
[79]	Digital input x46/1	
[80]	Digital input x46/3	
[81]	Digital input x46/5	
[82]	Digital input x46/7	
[83]	Digital input x46/9	
[84]	Digital input x46/11	
[85]	Digital input x46/13	
[90]	ATEX ETR cur. warning	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR*

13-44 Logic Rule Boolean 3		
Array [6]		
Option:		**Function:**
		or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output will be 1.
[91]	ATEX ETR cur. alarm	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output will be 1.
[92]	ATEX ETR freq. warning	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output will be 1.
[93]	ATEX ETR freq. alarm	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*]. If the warning 165 ATEX ETR freq.lim.warning is active, the output will be 1.
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

6.10.7 13-5* States

13-51 SL Controller Event		
Array [20]		
Option:		**Function:**
[0] *	False	Select the boolean input (TRUE or FALSE) to define the Smart Logic Controller event. See *13-01 Start Event* ([0] - [61]) and *13-02 Stop Event* ([70] - [74]) for further description.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	

13-51 SL Controller Event		
Array [20]		
Option:		**Function:**
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset Trip	
[42]	Auto-reset Trip	
[43]	Ok key	
[44]	Reset key	
[45]	Left key	
[46]	Right key	
[47]	Up key	
[48]	Down key	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[75]	Start command given	
[76]	Digital input x30/2	
[77]	Digital input x30/3	
[78]	Digital input x30/4	
[79]	Digital input x46/1	

13-51 SL Controller Event		
Array [20]		
Option:		**Function:**
[80]	Digital input x46/3	
[81]	Digital input x46/5	
[82]	Digital input x46/7	
[83]	Digital input x46/9	
[84]	Digital input x46/11	
[85]	Digital input x46/13	
[90]	ATEX ETR cur. warning	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output will be 1.
[91]	ATEX ETR cur. alarm	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*]. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output will be 1.
[92]	ATEX ETR freq. warning	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the alarm 163 ATEX ETR cur.lim.warning is active, the output will be 1.
[93]	ATEX ETR freq. alarm	Selectable if *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* or *[21] Advanced ETR*. If the warning 165 ATEX ETR freq.lim.warning is active, the output will be 1.
[94]	RS Flipflop 0	
[95]	RS Flipflop 1	
[96]	RS Flipflop 2	
[97]	RS Flipflop 3	
[98]	RS Flipflop 4	
[99]	RS Flipflop 5	
[100]	RS Flipflop 6	
[101]	RS Flipflop 7	

13-52 SL Controller Action		
Array [20]		
Option:		**Function:**
[0] *	DISABLED	Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in *13-51 SL Controller Event*) is evaluated as true. The following actions are available for selection: *[0] *DISABLED*
[1]	No action	
[2]	Select set-up 1	Changes the active set-up (*0-10 Active Set-up*) to '1'.

13-52 SL Controller Action		
Array [20]		
Option:		**Function:**
		If the set-up is changed, it will merge with other set-up commands coming from either the digital inputs or via a fieldbus.
[3]	Select set-up 2	Changes the active set-up *0-10 Active Set-up*) to '2'. If the set-up is changed, it will merge with other set-up commands coming from either the digital inputs or via a fieldbus.
[4]	Select set-up 3	Changes the active set-up (*0-10 Active Set-up*) to '3'. If the set-up is changed, it will merge with other set-up commands coming from either the digital inputs or via a fieldbus.
[5]	Select set-up 4	Changes the active set-up (*0-10 Active Set-up*) to '4'. If the set-up is changed, it will merge with other set-up commands coming from either the digital inputs or via a fieldbus.
[10]	Select preset ref 0	Selects preset reference 0. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[11]	Select preset ref 1	Selects preset reference 1. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[12]	Select preset ref 2	Selects preset reference 2. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[13]	Select preset ref 3	Selects preset reference 3. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[14]	Select preset ref 4	Selects preset reference 4. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[15]	Select preset ref 5	Selects preset reference 5. If the active preset reference is changed, it will merge with other preset reference

13-52 SL Controller Action		
Array [20]		
Option:		Function:
		commands coming from either the digital inputs or via a fieldbus.
[16]	Select preset ref 6	Selects preset reference 6. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[17]	Select preset ref 7	Selects preset reference 7. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[18]	Select ramp 1	Selects ramp 1.
[19]	Select ramp 2	Selects ramp 2.
[20]	Select ramp 3	Selects ramp 3.
[21]	Select ramp 4	Selects ramp 4.
[22]	Run	Issues a start command to the frequency converter.
[23]	Run reverse	Issues a start reverse command to the frequency converter.
[24]	Stop	Issues a stop command to the frequency converter.
[25]	Qstop	Issues a quick stop command to the frequency converter.
[26]	Dcstop	Issues a DC stop command to the frequency converter.
[27]	Coast	The frequency converter coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the frequency converter.
[29]	Start timer 0	Starts timer 0, see *13-20 SL Controller Timer* for further description.
[30]	Start timer 1	Starts timer 1, see *13-20 SL Controller Timer* for further description.
[31]	Start timer 2	Starts timer 2, see *13-20 SL Controller Timer* for further description.
[32]	Set digital out A low	Any output with SL output A will be low.
[33]	Set digital out B low	Any output with SL output B will be low.
[34]	Set digital out C low	Any output with SL output Cwill be low.
[35]	Set digital out D low	Any output with SL output D will be low.

13-52 SL Controller Action		
Array [20]		
Option:		Function:
[36]	Set digital out E low	Any output with SL output E will be low.
[37]	Set digital out F low	Any output with SL output F will be low.
[38]	Set digital out A high	Any output with SL output A will be high.
[39]	Set digital out B high	Any output with SL output B will be high.
[40]	Set digital out C high	Any output with SL output C will be high.
[41]	Set digital out D high	Any output with SL output D will be high.
[42]	Set digital out E high	Any output with SL output E will be high.
[43]	Set digital out F high	Any output with SL output Fwill be high.
[60]	Reset Counter A	Resets Counter A to zero.
[61]	Reset Counter B	Resets Counter B to zero.
[70]	Start timer 3	Start Timer 3, see *13-20 SL Controller Timer* for further description.
[71]	Start timer 4	Start Timer 4, see *13-20 SL Controller Timer* for further description.
[72]	Start timer 5	Start Timer 5, see *13-20 SL Controller Timer* for further description.
[73]	Start timer 6	Start Timer 6, see *13-20 SL Controller Timer* for further description.
[74]	Start timer 7	Start Timer 7, see p*13-20 SL Controller Timer* for further description.

6.11 Parameters: 14-** Special Functions

6.11.1 14-** Special Functions

Parameter group for configuring special frequency converter functions.

6.11.2 14-0* Inverter Switching

Parameters for configuring the inverter switching.

14-03 Overmodulation

Option:		Function:
[0]	Off	Connect the overmodulation function for the output voltage, to obtain an output voltage up to 15% greater than the mains voltage.
[1] *	On	No overmodulation of the output voltage, in order to avoid torque ripple on the motor shaft. This feature may be useful for applications such as grinding machines.

6.11.3 14-1* Mains On/Off

Parameters for configuring mains failure monitoring and handling.

14-12 Function at Mains Imbalance

Option:		Function:
		Operation under severe main imbalance conditions reduces the lifetime of the motor. Conditions are considered severe if the motor is operated continuously near nominal load.
[0]	Trip	Trips the frequency converter
[1] *	Warning	Issues a warning
[2]	Disabled	No action

6.11.4 14-2* Trip Reset

Parameters for configuring auto reset handling, special trip handling and control card self test or initialisation.

14-20 Reset Mode

Option:		Function:
		Select the reset function after tripping. Once reset, the frequency converter can be restarted.
[0]	Manual reset	Performs a reset via [Reset] or via the digital inputs.
[10] *	Automatic reset x 10	Performs between one and twenty automatic resets after tripping.

NOTE

If the specified number of AUTOMATIC RESETs is reached within 10 minutes, the frequency converter enters *[0] Manual reset* mode. After the Manual reset is performed, the setting of *14-20 Reset Mode* reverts to the original selection. If the number of AUTOMATIC RESETs is not reached within 10 minutes, or when a Manual reset is performed, the internal AUTOMATIC RESET counter returns to zero.

⚠CAUTION

The motor may start without warning.

Application Tip:
Since the default setting of the reset mode in the compressor drive is set up to auto-reset after 30 s this should be taken in consideration if a relay output is set to call for a service technician in case of an alarm. By setting *5-40 Function Relay* to *[9] Alarm* and *5-41 On Delay, Relay* to 40 s the relay will only activate at either a trip lock alarm or an alarm, which could not be auto-reset. Only the relay output can be used for this; the digital outputs do not have the On Delay feature.

14-21 Automatic Restart Time

Range:		Function:
30 s*	[0 - 600 s]	Enter the time interval from trip to start of the automatic reset function. This parameter is active when *14-20 Reset Mode* is set to Automatic reset.

14-22 Operation Mode

Option:		Function:
		Use this parameter to specify normal operation; to perform tests; or to initialise all parameters except *15-03 Power Up's*, *15-04 Over Temp's* and *15-05 Over Volt's*. This function is active only when the power is cycled to the frequency converter.
[0] *	Normal operation	Normal operation of the frequency converter with the motor in the selected application.
[1]	Control card test	Tests the analog and digital inputs and outputs and the +10 V control voltage. The test requires a test connector with internal connections. **Use the following procedure for the control card test:** 1. Select Control card test [1]. 2. Disconnect the mains supply and wait for the light in the display to go out. 3. Set switches S201 (A53) and S202 (A54) = ON./I. 4. Insert the test plug (see below). 5. Connect to mains supply.

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14-22 Operation Mode

Option:		Function:
		6. Carry out various tests. 7. The results are displayed on the LCP and the frequency converter moves into an infinite loop. 8. *14-20 Reset Mode* is automatically set to Normal operation. Carry out a power cycle to start up in Normal operation after a control card test. **If the test is OK:** LCP read-out: Control Card OK. Disconnect the mains supply and remove the test plug. The green LED on the Control Card will light up. **If the test fails:** LCP read-out: Control Card I/O failure. Replace the frequency converter or Control card. The red LED on the Control Card is turned on. Test plugs (connect the following terminals to each other): 18 - 27 - 32; 19 - 29 - 33; 42 - 53 - 54 1.
[2]	Initiali-sation	Resets all parameter values to default settings, except for *15-03 Power Up's*, *15-04 Over Temp's* and *15-05 Over Volt's*. The frequency converter will reset during the next power-up. *14-20 Reset Mode* will also revert to the default setting *[0] Normal operation*.

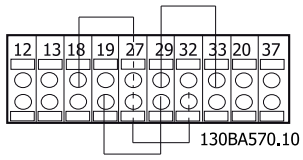

Illustration 6.18

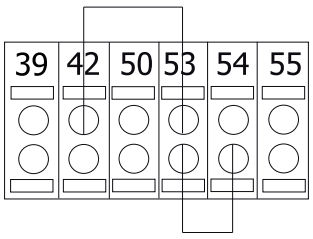

Illustration 6.19

14-52 Fan Control

Option:		Function:
		Select the minimum speed of the internal fan.
[0] *	Auto	Runs the fan only when the internal temperature of the frequency converter is in the range 35 °C . approx. 55 °C. The fan will run at low speed at 35 °C, and at full speed at approx. 55 °C.
[1]	On 50%	
[2]	On 75%	
[3]	On 100%	

14-53 Fan Monitor

Option:		Function:
		Select which reaction the frequency converter should take in case a fan fault is detected.
[0]	Disabled	
[1] *	Warning	
[2]	Trip	

14-60 Function at Over Temperature

Option:		Function:
		If either heatsink or control card temperature exceeds a factory-programmed temperature limit, a warning will be activated. If the temperature increases further, select whether the frequency converter should trip (trip locked) or derate the output current.
[0]	Trip	The frequency converter will trip (trip locked) and generate an alarm. Power must be cycled to reset the alarm, but will not allow restart of the motor until the heat sink temperature has dropped below the alarm limit.
[1] *	Derate	If the critical temperature is exceeded the output current will be reduced until the allowable temperature has been reached.

14-61 Function at Inverter Overload

Option:		Function:
		Is used in case of steady overload beyond the thermal limits (110% for 60 sec.).
[0]	Trip	The frequency converter trips and provides an alarm.
[1] *	Derate	Reduce pump speed to decrease the load on the power section and allowing this to cool down.

14-62 Inv. Overload Derate Current

Range:		Function:
95 %*	[50 - 100 %]	Defines the desired current level (in % of rated output current for the frequency converter) when running with reduced pump speed after load on the frequency converter has exceeded the allowable limit (110% for 60 s).

14-90 Fault Level		
Option:		**Function:**
[0] *	Off	Use this parameter to customize Fault levels. Use *[0] Off* with caution as it will ignore all Warnings & Alarms for the chosen source.

14-90 Fault Level		
Option:		**Function:**
[1]	Warning	
[2]	Trip	
[3]	Trip Lock	

Failure	Alarm	Off	Warning	Trip	Trip Lock
Over Current	13			D	X
Motor phase missing	30			D	X
Motor phase missing	31			D	X
Motor phase missing	32			D	X

Table 6.11 Table for Selection of Choice of Action when Selected Alarm Appears

D = Default setting. x = possible selection.

1) Only high power drives

In FC small and medium A69 is only a warning

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6.12 Parameters: 15-** Drive Information

6.12.1 15-** Drive Information

Parameter group containing compressor drive information such as operating data, hardware configuration and software versions.

6.12.2 15-0* Operating data

Parameter group containing operating data, e.g. counters.

15-00 Operating Hours

Range:		Function:
0 h*	[0 - 2147483647 h]	View how many hours the frequency converter has run. The value is saved when the frequency converter is turned off.

15-01 Running Hours

Range:		Function:
0 h*	[0 - 2147483647 h]	View how many hours the motor has run. Reset the counter in *15-07 Reset Running Hours Counter*. The value is saved when the frequency converter is turned off.

15-02 kWh Counter

Range:		Function:
0 kWh*	[0 - 2147483647 kWh]	Registering the power consumption of the motor as a mean value over one hour. Reset the counter in *15-06 Reset kWh Counter*.

15-03 Power Up's

Range:		Function:
0 *	[0 - 2147483647]	View the number of times the frequency converter has been powered up.

15-04 Over Temp's

Range:		Function:
0 *	[0 - 65535]	View the number of frequency converter temperature faults which have occurred.

15-05 Over Volt's

Range:		Function:
0 *	[0 - 65535]	View the number of frequency converter overvoltages which have occurred.

15-06 Reset kWh Counter

Option:		Function:
[0] *	Do not reset	Nno reset of the kWh counter is desired.
[1]	Reset counter	Press [OK] to reset the kWh counter to zero (see *15-02 kWh Counter*).

NOTE

The reset is carried out by pressing [OK].

15-07 Reset Running Hours Counter

Option:		Function:
[0] *	Do not reset	
[1]	Reset counter	Select *[1] Reset* and press [OK] to reset the Running Hours counter to zero (see *15-01 Running Hours*). This parameter cannot be selected via the serial port, RS-485. Select *[0] Do not reset* if no reset of the Running Hours counter is desired.

15-08 Number of Starts

Range:	Function:
[0 - 4294967295]	View the total number of starts performed since power-on. The value is cleared to zero at power-up.

15-09 Number of Auto Resets

Range:	Function:
[0 - 4294967295]	View the total number of auto resets performed since power-on. The counter is cleared to zero at power-up.

6.13 Parameters: 16-** Data Read-outs

16-00 Control Word		
Range:		**Function:**
0 *	[0 - 65535]	View the Control word sent from the frequency converter via the serial communication port in hex code.

16-01 Reference [Unit]		
Range:		**Function:**
0.000 ReferenceFeedbackUnit*	[-999999.000 - 999999.000 ReferenceFeedbackUnit]	View the present reference value applied on impulse or analog basis in the unit resulting from the configuration selected in *1-00 Configuration Mode* (Hz, Nm or RPM).

16-02 Reference [%]		
Range:		**Function:**
0.0 %*	[-200.0 - 200.0 %]	View the total reference. The total reference is the sum of digital, analog, preset, bus, and freeze references, plus catch-up and slow-down.

16-03 Status Word		
Range:		**Function:**
0 *	[0 - 65535]	View the Status word sent from the frequency converter via the serial communication port in hex code.

16-05 Main Actual Value [%]		
Range:		**Function:**
0.00 %*	[-100.00 - 100.00 %]	View the two-byte word sent with the Status word to the bus Master reporting the Main Actual Value.

16-09 Custom Readout		
Range:		**Function:**
0.00 CustomReadoutUnit*	[0.00 - 0.00 CustomReadoutUnit]	View the value of custom readout from *0-30 Unit for User-defined Readout* to *0-32 Custom Readout Max Value*

6.13.1 16-1* Motor Status

16-10 Power [kW]		
Range:		**Function:**
0.00 kW*	[0.00 - 10000.00 kW]	Displays motor power in kW. The value shown is calculated on the basis of the actual motor voltage and motor current. The value is filtered, and therefore approx. 30 ms may pass from when an input value changes to when the data read-out values change. The resolution of read-out value on fieldbus is in 10 W steps.

16-11 Power [hp]		
Range:		**Function:**
0.00 hp*	[0.00 - 10000.00 hp]	View the motor power in HP. The value shown is calculated on the basis of the actual motor voltage and motor current. The value is filtered, and therefore approximately 30 ms may pass from when an input value changes to when the data read-out values change.

16-12 Motor Voltage		
Range:		**Function:**
0.0 V*	[0.0 - 6000.0 V]	View the motor voltage, a calculated value used for controlling the motor.

16-13 Frequency		
Range:		**Function:**
0.0 Hz*	[0.0 - 6500.0 Hz]	View the motor frequency, without resonance dampening.

16-14 Motor Current		
Range:		**Function:**
0.00 A*	[0.00 - 10000.00 A]	View the motor current measured as a mean value, I_{RMS}. The value is filtered, and thus approximately 30 ms may pass from when an input value changes to when the data read-out values change.

16-15 Frequency [%]		
Range:		**Function:**
0.00 %*	[-100.00 - 100.00 %]	View a two-byte word reporting the actual motor frequency (without resonance dampening) as a percentage (scale 0000-4000 Hex) of *4-19 Max Output Frequency*. Set *9-16 PCD Read Configuration* index 1 to send it with the Status Word instead of the MAV.

16-16 Torque [Nm]		
Range:		**Function:**
0.0 Nm*	[-3000.0 - 3000.0 Nm]	View the torque value with sign, applied to the motor shaft. Linearity is not exact between 160% motor current and torque in relation to the rated torque. Some motors supply more than 160% torque. Consequently, the min. value and the max. value will depend on the max. motor current

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16-16 Torque [Nm]		
Range:		**Function:**
		as well as the motor used. The value is filtered, and thus approx. 30 ms may pass from when an input changes value to when the data read-out values change.

16-17 Speed [RPM]		
Range:		**Function:**
0 RPM*	[-30000 - 30000 RPM]	View the actual motor RPM. In open loop or closed loop process control the motor RPM is estimated. In speed closed loop modes the motor RPM is measured.

16-18 Motor Thermal		
Range:		**Function:**
0 %*	[0 - 100 %]	View the calculated thermal load on the motor. The cut-out limit is 100%. The basis for calculation is the ETR function selected in *1-90 Motor Thermal Protection*.

16-19 KTY sensor temperature		
Range:		**Function:**
0 °C*	[0 - 0 °C]	Returning the actual temperature on KTY sensor buil into the motor. See parameter group *1-9* Motor Temperature*.

16-20 Motor Angle		
Range:		**Function:**
0 *	[0 - 65535]	View the current encoder/resolver angle offset relative to the index position. The value range of 0-65535 corresponds to 0-2*pi (radians).

16-21 Torque [%] High Res.		
Range:		**Function:**
0.0 %*	[-200.0 - 200.0 %]	The value shown is the torque in percent of nominal torque, with sign and 0.1% resolution, applied to the motor shaft.

16-22 Torque [%]		
Range:		**Function:**
0 %*	[-200 - 200 %]	Value shown is the torque in percent of nominal torque, with sign, applied to the motor shaft.

16-25 Torque [Nm] High		
Range:		**Function:**
0.0 Nm*	[-200000000.0 - 200000000.0 Nm]	View the torque value with sign, applied to the motor shaft. Some motors supply more than 160% torque. Consequently, the min. value and the max. value will depend on the max. motor current as well as the

16-25 Torque [Nm] High		
Range:		**Function:**
		motor used. This specific readout has been adapted to be able to show higher values than the standard readout in *16-16 Torque [Nm]*.

6.13.2 16-3* Drive Status

16-30 DC Link Voltage		
Range:		**Function:**
0 V*	[0 - 10000 V]	View a measured value. The value is filtered with an 30 ms time constant.

16-32 Brake Energy /s		
Range:		**Function:**
0.000 kW*	[0.000 - 10000.000 kW]	View the brake power transmitted to an external brake resistor, stated as an instan-taneous value.

16-33 Brake Energy /2 min		
Range:		**Function:**
0.000 kW*	[0.000 - 10000.000 kW]	View the brake power transmitted to an external brake resistor. The mean power is calculated on an average basis for the most recent 120 s.

16-34 Heatsink Temp.		
Range:		**Function:**
0 °C*	[0 - 255 °C]	View the frequency converter heatsink temperature. The cut-out limit is 90 ±5 °C, and the motor cuts back in at 60 ±5 °C.

16-35 Inverter Thermal		
Range:		**Function:**
0 %*	[0 - 100 %]	View the percentage load on the inverter.

16-36 Inv. Nom. Current		
Range:		**Function:**
Size related*	[0.01 - 10000.00 A]	View the inverter nominal current, which should match the nameplate data on the connected motor. The data are used for calculation of torque, motor protection, etc.

16-37 Inv. Max. Current		
Range:		**Function:**
Size related*	[0.01 - 10000.00 A]	View the inverter maximum current, which should match the nameplate data on the connected

16-37 Inv. Max. Current		
Range:		**Function:**
		motor. The data are used for calculation of torque, motor protection, etc.

16-38 SL Controller State		
Range:		**Function:**
0 *	[0 - 100]	View the state of the event under execution by the SL controller.

16-39 Control Card Temp.		
Range:		**Function:**
0 °C*	[0 - 100 °C]	View the temperature on the control card, stated in °C

16-40 Logging Buffer Full		
Option:		**Function:**
		View whether the logging buffer is full (see parameter group *15-1* Data Log Settings*). The logging buffer will never be full when *15-13 Logging Mode* is set to *[0] Log always*.
[0] *	No	
[1]	Yes	

16-48 Speed Ref. After Ramp [RPM]		
Range:		**Function:**
0 RPM*	[-30000 - 30000 RPM]	This parameter specifies the reference given to the frequency converter after the speed ramp.

6.13.3 16-5* Ref. & Feedb.

16-50 External Reference		
Range:		**Function:**
0.0 *	[-200.0 - 200.0]	View the total reference, the sum of digital, analog, preset, bus and freeze references, plus catch-up and slow-down.

16-51 Pulse Reference		
Range:		**Function:**
0.0 *	[-200.0 - 200.0]	View the reference value from programmed digital input(s). The read-out can also reflect the impulses from an incremental encoder.

16-52 Feedback [Unit]		
Range:		**Function:**
0.000 Reference-FeedbackUnit*	[-999999.999 - 999999.999 ReferenceFeed-backUnit]	View the feedback unit resulting from the selection of unit and scaling in *3-00 Reference Range*, *3-01 Reference/*

16-52 Feedback [Unit]		
Range:		**Function:**
		Feedback Unit, *3-02 Minimum Reference* and *3-03 Maximum Reference*.

16-53 Digi Pot Reference		
Range:		**Function:**
0.00 *	[-200.00 - 200.00]	View the contribution of the Digital Potentiometer to the actual reference.

16-57 Feedback [RPM]		
Range:		**Function:**
0 RPM*	[-30000 - 30000 RPM]	Read-out parameter where the actual motor RPM from the feed-back source can be read in both closed loop and open loop. The feed-back source is selected by *7-00 Speed PID Feedback Source*.

6

6.13.4 16-6* Inputs and Outputs

16-60 Digital Input

Range:		Function:
0 *	[0 - 1023]	View the signal states from the active digital inputs. Example: Input 18 corresponds to bit no. 5, '0' = no signal, '1' = connected signal. Bit 6 works in the opposite way, on = '0', off = '1' (safe stop input).

Bit 0	Digital input term. 33
Bit 1	Digital input term. 32
Bit 2	Digital input term. 29
Bit 3	Digital input term. 27
Bit 4	Digital input term. 19
Bit 5	Digital input term. 18
Bit 6	Digital input term. 37
Bit 7	Digital input GP I/O term. X30/4
Bit 8	Digital input GP I/O term. X30/3
Bit 9	Digital input GP I/O term. X30/2
Bit 10-63	Reserved for future terminals

Table 6.15

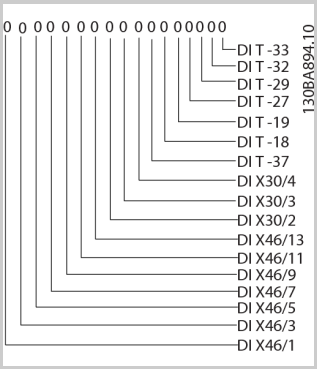


Illustration 6.22

16-61 Terminal 53 Switch Setting

Option:		Function:
		View the setting of input terminal 53. Current = 0; Voltage = 1.
[0]	Current	
[1]	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

16-62 Analog Input 53

Range:		Function:
0.000 *	[-20.000 - 20.000]	View the actual value at input 53.

16-63 Terminal 54 Switch Setting

Option:		Function:
		View the setting of input terminal 54. Current = 0; Voltage = 1.
[0]	Current	
[1]	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

16-64 Analog Input 54

Range:		Function:
0.000 *	[-20.000 - 20.000]	View the actual value at input 54.

16-65 Analog Output 42 [mA]

Range:		Function:
0.000 *	[0.000 - 30.000]	View the actual value at output 42 in mA. The value shown reflects the selection in *6-50 Terminal 42 Output*.

16-66 Digital Output [bin]

Range:		Function:
0 *	[0 - 15]	View the binary value of all digital outputs.

16-67 Pulse Input #29 [Hz]

Range:		Function:
0 *	[0 - 130000]	View the actual frequency rate on terminal 29.

16-68 Freq. Input #33 [Hz]

Range:		Function:
0 *	[0 - 130000]	View the actual value of the frequency applied at terminal 33 as an impulse input.

16-69 Pulse Output #27 [Hz]

Range:		Function:
0 *	[0 - 40000]	View the actual value of pulses applied to terminal 27 in digital output mode.

16-70 Pulse Output #29 [Hz]

Range:		Function:
0 *	[0 - 40000]	View the actual value of pulses at terminal 29 in digital output mode.

16-71 Relay Output [bin]		
Range:		Function:
0 *	[0 - 511]	View the settings of all relays.

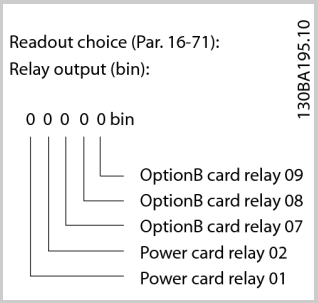


Illustration 6.24

16-72 Counter A		
Range:		Function:
0 *	[-2147483648 - 2147483647]	View the present value of Counter A. Counters are useful as comparator operands, see *13-10 Comparator Operand*. The value can be reset or changed either via digital inputs (parameter group *5-1* Digital Inputs*) or by using an SLC action (*13-52 SL Controller Action*).

16-73 Counter B		
Range:		Function:
0 *	[-2147483648 - 2147483647]	View the present value of Counter B. Counters are useful as comparator operands (*13-10 Comparator Operand*). The value can be reset or changed either via digital inputs (parameter group 5-1*) or by using an SLC action (*13-52 SL Controller Action*).

16-74 Prec. Stop Counter		
Range:		Function:
0 *	[0 - 2147483647]	Returns the actual counter value of precise counter (*1-84 Precise Stop Counter Value*).

6.13.5 16-8* Fieldbus & FC Port

Parameters for reporting the BUS references and control words.

16-80 Fieldbus CTW 1		
Range:		Function:
0 *	[0 - 65535]	View the two-byte Control word (CTW) received from the Bus-Master. Interpretation of the Control word depends on the Fieldbus option installed and the Control word profile selected in *8-10 Control Profile*.

16-80 Fieldbus CTW 1		
Range:		Function:
		For more information, refer to the relevant Fieldbus manual.

16-82 Fieldbus REF 1		
Range:		Function:
0 *	[-200 - 200]	View the two-byte word sent with the control word form the Bus-Master to set the reference value. For more information, refer to the relevant fieldbus manual.

16-84 Comm. Option STW		
Range:		Function:
0 *	[0 - 65535]	View the extended Fieldbus comm. option status word. For more information, refer to the relevant Fieldbus manual.

16-85 FC Port CTW 1		
Range:		Function:
0 *	[0 - 65535]	View the two-byte Control word (CTW) received from the Bus-Master. Interpretation of the control word depends on the Fieldbus option installed and the Control word profile selected in *8-10 Control Profile*.

16-86 FC Port REF 1		
Range:		Function:
0 *	[-200 - 200]	View the two-byte Status word (STW) sent to the Bus-Master. Interpretation of the Status word depends on the fieldbus option installed and the Control word profile selected in *8-10 Control Profile*.

6.13.6 16-9* Diagnosis Read-Outs

16-90 Alarm Word		
Range:		Function:
0 *	[0 - 4294967295]	View the alarm word sent via the serial communication port in hex code.

16-91 Alarm Word 2		
Range:		Function:
0 *	[0 - 4294967295]	View the alarm word sent via the serial communication port in hex code.

16-92 Warning Word		
Range:		Function:
0 *	[0 - 4294967295]	View the warning word sent via the serial communication port in hex code.

16-93 Warning Word 2		
Range:		**Function:**
0 *	[0 - 4294967295]	View the warning word sent via the serial communication port in hex code.

16-94 Ext. Status Word		
Range:		**Function:**
0 *	[0 - 4294967295]	Returns the extended warning word sent via the serial communication port in hex code.

16-95 Ext. Status Word 2		
Range:		**Function:**
0 *	[0 - 4294967295]	Returns the extended warning word 2 sent via the serial communication port in hex code.

6.14 Parameters: 25-** Cascade Controller

Parameters for configuring the Basic Cascade Controller for sequence control of multiple compressors.

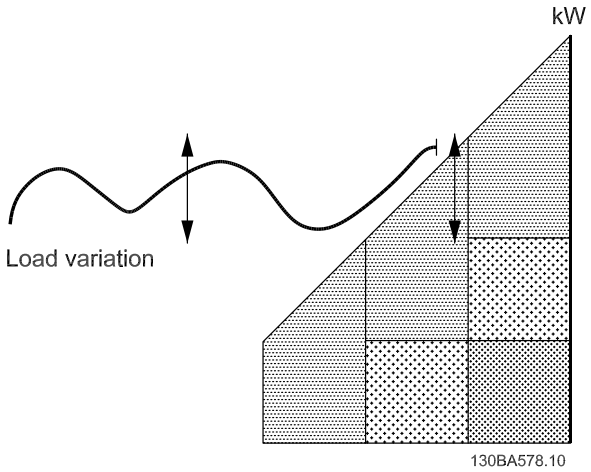


Illustration 6.25 Cascade Controller Feedback Signals

To configure the Cascade Controller to the actual system and the desired control strategy, it is recommended to follow the below sequence, starting with parameter group *25-0* System Settings*, and next parameter group *25-5* Alternation Settings*. These parameters can normally be set in advance.
Parameters in parameter group *25-2* Bandwidth Settings* and *25-4* Staging settings* will often be dependent on the dynamic of the system and final adjustment to be done at the commissioning of the plant.

NOTE

The Cascade Controller is supposed to operate in closed loop controlled by the built-in PI controller (*[1] Speed Closed Loop* selected in *1-00 Configuration Mode*). If *[0] Speed Open Loop* is selected in *1-00 Configuration Mode*, all fixed speed compressors will be destaged, but the variable speed compressor will still be controlled by the frequency converter, now as an open loop configuration:

6

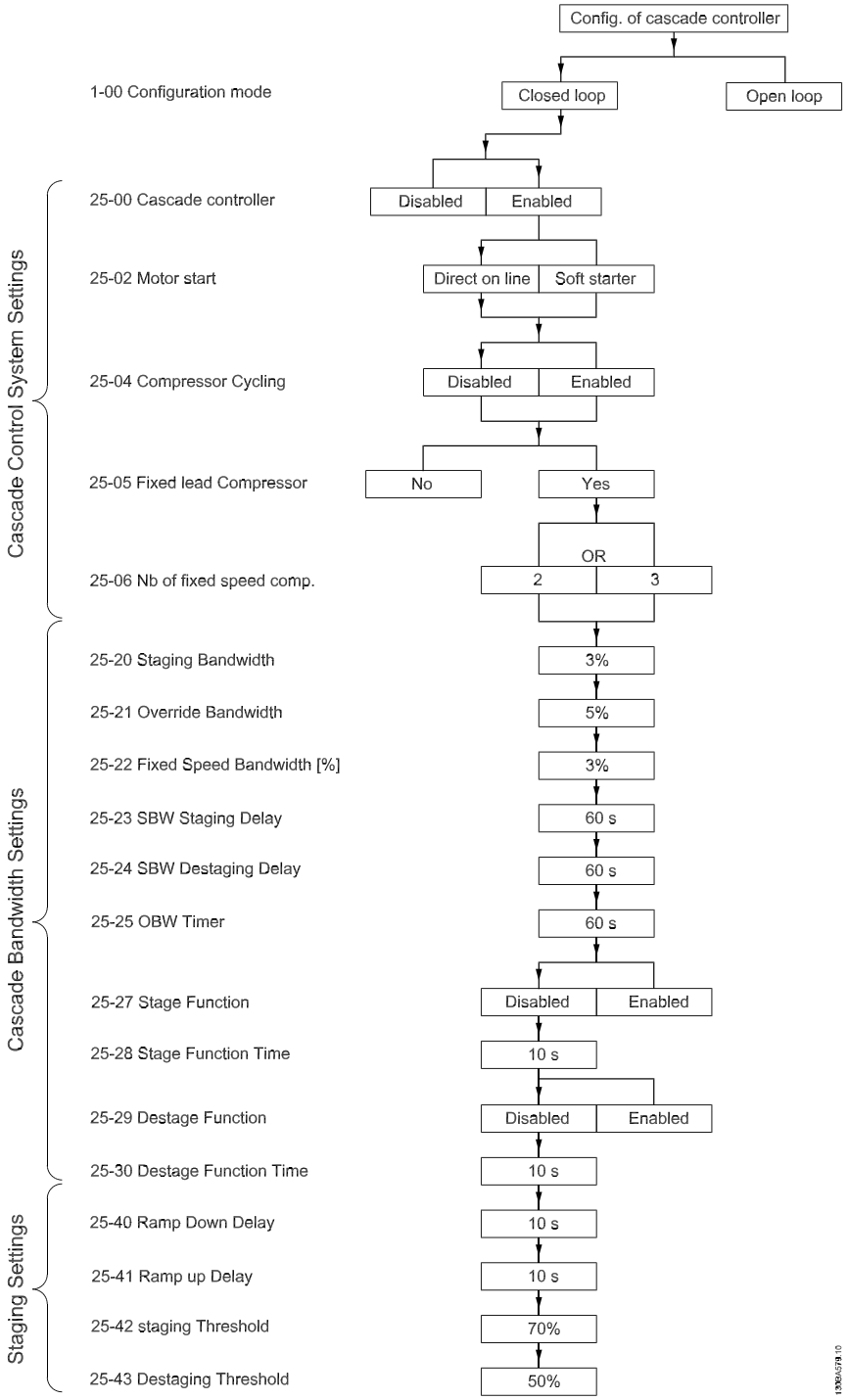


Illustration 6.26

6.14.1 25-0* System Settings

Parameters related to control principles and configuration of the system.

25-00 Cascade Controller

Option:		Function:
		For operation of multiple devices (compressor) systems where capacity is adapted to actual load by means of speed control combined with on/off control of the devices. For simplicity only compressor systems are described.
[0] *	Disabled	The Cascade Controller is not active. All built-in relays assigned to compressor motors in the cascade function will be de-energized. If a variable speed compressor is connected to the frequency converter directly (not controlled by a built-in relay), this compressor will be controlled as a single compressor system.
[1]	Enabled	The Cascade Controller is active and will stage/destage compressors according to load on the system.

NOTE

This parameter can only be *[1] Enabled*, if *22-75 Short Cycle Protection* is set to *[0] Disabled*.

25-02 Motor Start

Option:		Function:
		Motors are connected to the mains directly with a contactor or with a soft starter. When the value of *25-02 Motor Start* is set to an option other than *[0] Direct on Line*, then *25-50 Lead Compressor Alternation* is automatically set to the default of *[0] Direct on Line*.
[0] *	Direct on Line	Each fixed speed compressor is connected to line directly via a contactor.
[1]	Soft starter	Each fixed speed compressor is connected to line via a soft starter.

25-04 Compressor Cycling

Option:		Function:
		To provide equal hours of operation with fixed speed compressors, the compressor use can be cycled. The selection of compressor cycling is either "first in – last out" or equal running hours for each compressor.
[0] *	Disabled	The fixed speed compressors will be connected in the order 1 – 2 – 3 and disconnected in the order 3 – 2 – 1. (First in – last out)
[1]	Enabled	The fixed speed compressors will be connected/disconnected to have equal running hours for each compressor.

25-05 Fixed Lead Compressor

Option:		Function:
		Fixed Lead Compressor means that the variable speed compressor is connected directly to the frequency converter and if a contactor is applied between frequency converter and compressor, this contactor will not be controlled by the frequency converter.
[0]	No	The lead compressor function can alternate between the compressors controlled by the two built in relays. One compressor must be connected to the built-in RELAY 1, and the other compressor to RELAY 2. The compressor function (Cascade Compressor1 and Cascade Compressor2) will automatically be assigned to the relays (maximum two compressors can in this case be controlled from the frequency converter).
[1] *	Yes	The lead compressor will be fixed (no alternation) and connected directly to the frequency converter. The *25-50 Lead Compressor Alternation* is automatically set to *[0] Off*. Built-in relays Relay 1 and Relay 2 can be assigned to separate fixed speed compressors. In total three compressors can be controlled by the frequency converter.

25-06 Number of Compressors

Option:		Function:
		The number of compressors connected to the Cascade Controller including the variable speed compressor. If the variable speed compressor is connected directly to the frequency converter and the other fixed speed compressors (lag compressors) are controlled by the two built in relays, three compressors can be controlled. If both the variable speed and fixed speed compressors are to be controlled by built-in relays, only two compressors can be connected.
[0] *	2 compressors	If *25-05 Fixed Lead Compressor* is set to *[0] No*: one variable speed compressor and one fixed speed compressor; both controlled by built in relay. If *25-05 Fixed Lead Compressor* is set to *[1] Yes*: one variable speed compressor and one fixed speed compressor controlled by built-in relay
[1]	3 compressors	*[1] 3 Compressors*: One lead compressor, see *25-05 Fixed Lead Compressor*. Two fixed speed compressors controlled by built-in relays.

6.14.2 25-2* Bandwidth Manager

Parameters for setting the bandwidth within which the pressure/temperature will be allowed to operate before staging/destaging fixed speed compressors. Also includes various timers to stabilize the control.

25-20 Staging Bandwidth [%]

Range:		Function:
10%*	[1 - 100 %]	Set the staging bandwidth (SBW) percentage to accommodate normal system pressure fluctuation. In cascade control systems, to avoid frequent switching of fixed speed compressors, the desired system pressure is typically kept within a bandwidth rather than at a constant level. The SBW is programmed as a percentage of the numerically larger value of *3-03 Maximum Reference* and *3-02 Minimum Reference*. For example, if *3-03 Maximum Reference* is 10 bar and the SBW is set at 10%, a system pressure between 4.0 and 6.0 bar is tolerated if the setpoint is 5 bar. No staging or destaging will occur within this bandwidth.

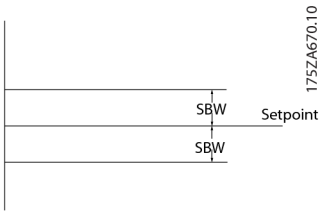


Illustration 6.27

25-21 Override Bandwidth [%]

Range:		Function:
100% = Disabled*	[1 – 100%]	When a large and quick change in the system demand occurs, the system pressure rapidly changes and an immediate staging or destaging of a fixed speed compressor becomes necessary to match the requirement. The override bandwidth (OBW) is programmed to override the staging/ destaging timer (*25-23 SBW Staging Delay*/ *25-24 SBW Destaging Delay*) for immediate response. The OBW must always be programmed to a higher value than the value set in *25-20 Staging Bandwidth* (SBW). The OBW is a percentage of *3-03 Maximum Reference*.

25-21 Override Bandwidth [%]

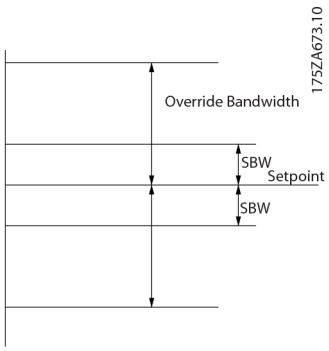
Range:		Function:
		

Illustration 6.28

Setting the OBW too close to the SBW could defeat the purpose with frequent staging at momentary pressure changes. Setting the OBW too high might lead to unacceptably high or low pressure in the system while the SBW timers are running. The value can be optimized with increased familiarity with the system. See *25-25 OBW Time*.
To avoid unintended staging during the commissioning phase and fine tuning of the controller, initially leave the OBW at the factory setting of 100% (Off). When the fine tuning is completed, the OBW should be set to the desired value. An initial value of 10% is suggested.

25-22 Fixed Speed Bandwidth [%]

Range:		Function:
10%*	[1 - 100%]	When the cascade control system is running normally and the frequency converter issues a trip alarm, it is important to maintain the system head. The Cascade Controller does this by continuing to stage/destage the fixed speed compressor on and off. Due to the fact that keeping the head at the setpoint would require frequent staging and destaging when only a fixed speed compressor is running, a wider Fixed Speed Bandwidth (FSBW) is used instead of SBW. It is possible to stop the fixed speed compressors, in case of an alarm situation, by pressing the LCP OFF or HAND ON keys or if the signal programmed for Start on digital input goes low. In case the issued alarm is a trip-lock alarm then the Cascade Controller must stop the system immediately by cutting out all the fixed speed compressors. This is basically the same as Emergency Stop (Coast/Coast inverse Command) for the Cascade Controller.

25-23 SBW Staging Delay

Range:		Function:
60 sec.*	[0-3000 sec.]	Immediate staging of a fixed speed compressor is not desirable when a momentary pressure drop in the system exceeds the Staging Bandwidth (SBW). Staging is delayed by the length of time programmed. If the pressure increases to within the SBW before the timer has elapsed, the timer is reset.

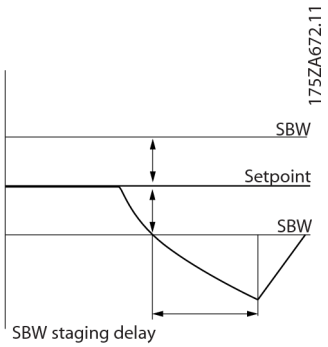


Illustration 6.29

25-24 SBW Destaging Delay

Range:		Function:
60 sec.*	[0-3000 sec.]	Immediate destaging of a fixed speed compressor is not desirable when a momentary pressure increase in the system that exceeds the Staging Bandwidth (SBW). Destaging is delayed by the length of time programmed. If the pressure decreases to within the SBW before the timer has elapsed, the timer is reset.

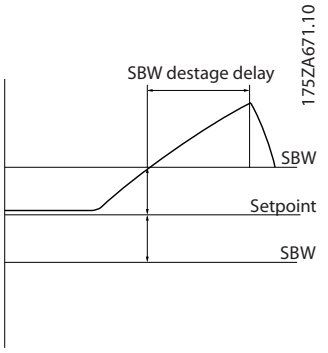


Illustration 6.30

25-25 OBW Time

Range:		Function:
60 sec.*	[0 – 300 sec.]	Staging a fixed speed compressor creates a momentary pressure peak in the system, which might exceed the Override Bandwidth (OBW). It is not desirable to destage a compressor in response to a staging pressure peak. The OBW Time can be programmed to prevent staging until the system pressure has stabilized and normal control established. Set the timer to a value that allows the system to stabilize after staging. The 10 second factory setting is appropriate in most applications. In highly dynamic systems, a shorter time may be desirable.

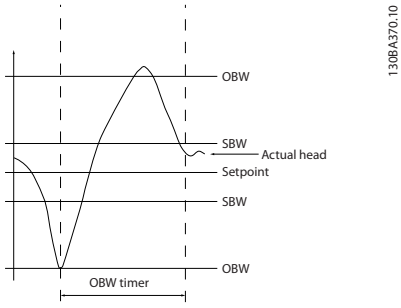


Illustration 6.31

25-27 Stage Function

Option:		Function:
[0] *	Disabled	
[1]	Enabled	If the Stage Function is set to *[0] Disabled*, *25-28 Stage Function Time* will not be activated.

25-28 Stage Function Time

Range:		Function:
10 sec.*	[0 – 300 sec.]	The Stage Function Time is programmed to avoid frequent staging of the fixed speed compressors. The Stage Function Time starts if it is *[1] Enabled* by *25-27 Stage Function* and when the variable speed compressor is running at *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]* (or at *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]* if *7-30 Process PID Normal/ Inverse Control* is programmed to Inverse), with at least one fixed speed compressor in the stop position. When the programmed value of the timer expires, a fixed speed compressor is staged.

25-29 Destage Function

Option:		Function:
[0] *	Disabled	
[1]	Enabled	The Destage Function ensures that the lowest numbers of compressors are running to save energy. If the Destage Function is set to *[0]*

25-29 Destage Function

Option:	Function:
	Disabled, the *25-30 Destage Function Time* will not be activated.

25-30 Destage Function Time

Range:		Function:
10 sec.*	[0 – 300 sec.]	The Destage Function Timer is programmable to avoid frequent staging/destaging of the fixed speed compressors. The Destage Function Time starts when the adjustable speed compressor is running at *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]* (or at *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]* if *7-30 Process PID Normal/ Inverse Control* is programmed to Inverse), with one or more fixed speed compressors in operation and system requirements satisfied. In this situation, the adjustable speed compressor contributes little to the system. When the programmed value of the timer expires, a stage is removed.

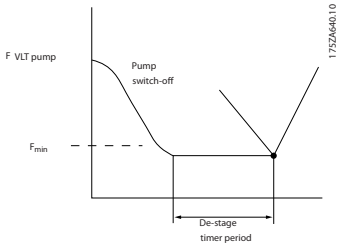


Illustration 6.32

6.14.3 25-4* Staging Settings

Parameters determining conditions for staging/destaging the compressors.

25-40 Ramp Down Delay

Range:		Function:
10 sec.*	[0 – 120 sec.]	When adding a fixed speed compressor controlled by a soft starter, it is possible to delay the ramp down of the lead compressor until a preset time after the start of the fixed speed compressor to eliminate pressure surges in the system. Only to be used if *[1] Soft Starter* is selected in *25-02 Motor Start*.

25-41 Ramp Up Delay

Range:		Function:
10 sec.*	[0 – 120 sec.]	When removing a fixed speed compressor controlled by a soft starter, it is possible to delay the ramp up of the lead compressor until a preset time after the stopping of the fixed speed compressor to eliminate pressure surges in the system. Only to be used if *[1] Soft Starter* is selected in *25-02 Motor Start*.

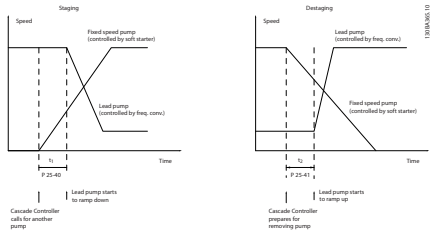


Illustration 6.33

25-42 Staging Threshold

Range:		Function:
90%*	[0 – 100%]	When adding a fixed speed compressor, in order to prevent an overshoot of pressure, the variable speed compressor ramps down to a lower speed. When the variable speed compressor reaches the "Staging Speed" the fixed speed compressor is staged on. The Staging Threshold is used to calculate the speed of the variable speed compressor when the "cut-in point" of the fixed speed compressor occurs. The calculation of the Staging Threshold is the ratio of *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]* to *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]* expressed in percent. Staging Threshold must range from $\eta_{STAGE\%} = \frac{\eta_{LOW}}{\eta_{HIGH}} \times 100\,\%$ to 100%, where n_{LOW} is Motor Speed Low Limit and n_{HIGH} is Motor Speed High Limit.

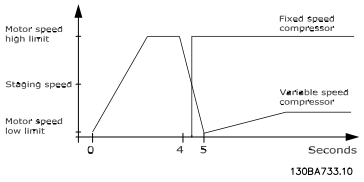


Illustration 6.34

25-43 Destaging Threshold

Range:		Function:
50%*	[0 – 100%]	When removing a fixed speed compressor, in order to prevent an undershoot of pressure, the variable speed compressor ramps up to a higher speed. When the variable speed compressor reaches the "Destaging Speed" the fixed speed compressor is destaged. The Destaging Threshold

25-43 Destaging Threshold

Range: **Function:**

is used to calculate the speed of the variable speed compressor when the destaging of the fixed speed compressor occurs. The calculation of the Destaging Threshold is the ratio of *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]* to *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]* expressed in percent.

Destaging Threshold must range from

$$\eta_{STAGE\%} = \frac{\eta_{LOW}}{\eta_{HIGH}} \times 100\,\%$$

to 100%, where n_{LOW} is Motor Speed Low Limit and n_{HIGH} is Motor Speed High Limit.

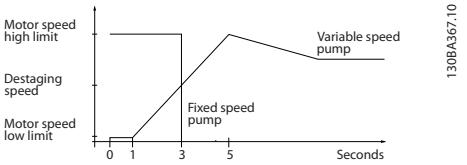


Illustration 6.35

25-44 Staging Speed [RPM]

Option: **Function:**

	0 N/A	Readout of the below calculated value for Staging Speed. When adding a fixed speed compressor, in order to prevent an overshoot of pressure, the variable speed compressor ramps down to a lower speed. When the variable speed compressor reaches the "Staging Speed" the fixed speed compressor is staged on. Staging Speed calculation is based on *25-42 Staging Threshold* and *4-13 Motor Speed High Limit [RPM]*. Staging Speed is calculated with the following formula: $\eta_{STAGE} = \eta_{HIGH}\frac{\eta_{STAGE\%}}{100}$ where n_{HIGH} is Motor Speed High Limit and $n_{STAGE100\%}$ is the value of Staging Threshold.

25-45 Staging Speed [Hz]

Option: **Function:**

	0 N/A	Readout of the below calculated value for Staging Speed When adding a fixed speed compressor, in order to prevent an overshoot of pressure, the variable speed compressor ramps down to a lower speed. When the variable speed compressor reaches the "Staging Speed" the fixed speed compressor is staged on. Staging Speed calculation is based on *25-42 Staging Threshold* and *4-14 Motor Speed High Limit [Hz]*. Staging Speed is calculated with the following formula: $\eta_{STAGE} = \eta_{HIGH}\frac{\eta_{STAGE\%}}{100}$ where n_{HIGH} is Motor Speed High Limit and $n_{STAGE100\%}$ is the value of Staging Threshold.

25-46 Destaging Speed [RPM]

Option: **Function:**

	0 N/A	Readout of the below calculated value for Destaging Speed. When removing a fixed speed compressor, in order to prevent an undershoot of pressure, the variable speed compressor ramps up to a higher speed. When the variable speed compressor reaches the "Destaging Speed" the fixed speed compressor is destaged. Destaging Speed is calculated based on *25-43 Destaging Threshold* and *4-13 Motor Speed High Limit [RPM]*. Destaging Speed is calculated with the following formula: $\eta_{DESTAGE} = \eta_{HIGH}\frac{\eta_{DESTAGE\%}}{100}$ where n_{HIGH} is Motor Speed High Limit and $n_{DESTAGE100\%}$ is the value of Destaging Threshold.

25-47 Destaging Speed [Hz]

Option: **Function:**

		Readout of the below calculated value for Destaging Speed. When removing a fixed speed compressor, in order to prevent an undershoot of pressure, the variable speed compressor ramps up to a higher speed. When the variable speed compressor reaches the "Destaging Speed" the fixed speed compressor is destaged. Destaging Speed is calculated based on *25-43 Destaging Threshold* and *4-14 Motor Speed High Limit [Hz]* Destaging Speed is calculated with the following formula: $\eta_{DESTAGE} = \eta_{HIGH}\frac{\eta_{DESTAGE\%}}{100}$ where n_{HIGH} is Motor Speed High Limit and $n_{DESTAGE100\%}$ is the value of Destaging Threshold.

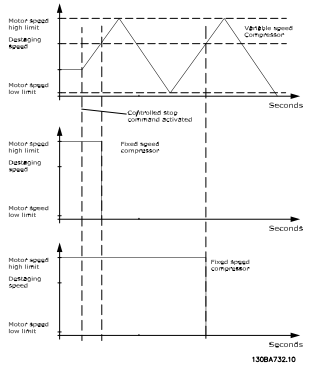


Illustration 6.36

6

6.14.4 25-5* Alternation Settings

Parameters for defining the conditions for alternation of the variable speed compressor (lead), if selected as part of the control strategy.

25-50 Lead Compressor Alternation

Option:		Function:
		Lead compressor alternation equalizes the use of compressors by periodically changing the compressor that is speed controlled. This ensures that compressors are equally used over time. Alternation equalizes the usage of compressors by always choosing the compressor with the lowest number of used hours to stage on next.
[0] *	Off	No alternation of lead compressor function will take place. It is not possible to set this parameter to options other that *[0] Off* if *25-02 Motor Start* is set other than *[0] Direct on Line*. **NOTE** **It is not possible to select other than *[0] Off* if *25-05 Fixed Lead Compressor* is set to *[1] Yes*.**
[1]	At Staging	Alternation of the lead compressor function will take place when staging another compressor.
[2]	At Command	Alternation of the lead compressor function will take place at an external command signal or a pre-programmed event. See *25-51 Alternation Event* for available options.
[3]	At Staging or at Command	Alternation of the variable speed (lead) compressor will take place at staging or the "At Command" signal. (See above.)

25-51 Alternation Event

Option:		Function:
		This parameter is only active if the options *[2] At Command* or *[3] At Staging or Command* have been selected in *25-50 Lead Compressor Alternation*. If an Alternation Event is selected, the alternation of lead compressor takes place every time the event occurs.
[0] *	External	Takes place when a signal is applied to one of the digital inputs on the terminal strip and this input has been assigned to *[121] Lead Compressor Alternation* in parameter group *5-1* Digital Inputs*.
[1]	Alternation Time Interval	Takes place every time *25-52 Alternation Time Interval* expires.

25-52 Alternation Time Interval

Range:		Function:
24 h*	[1 – 999 h]	If *[1] Alternation Time Interval* option in *25-51 Alternation Event* is selected, the alternation of the variable speed compressor takes place every time the Alternation Time Interval expires (can be checked out in *25-53 Alternation Timer Value*).

25-53 Alternation Time Value

Option:		Function:
	0 N/A	Readout parameter for the Alternation Time Interval value set in *25-52 Alternation Time Interval*.

25-55 Alternation if Capacity < 50%

Option:		Function:
[0]	Disabled	
[1] *	Enabled	If Alternation If Capacity <50% is enabled, the compressor alternation can only occur if the capacity is equal to or below 50%. The capacity calculation is the ratio of running compressors (including the variable speed compressor) to the total number of available compressors (including variable speed compressor, but not those interlocked). $\text{Capacity} = \frac{N\text{Running}}{N\text{Total}} \times 100\,\%$ For the Basic Cascade Controller all compressors are equal size. *Disabled* [0]: The lead compressor alternation will take place at any compressor capacity. *Enabled* [1]: The lead compressor function will be alternated only if the numbers of compressors running are providing less than 50% of total compressor capacity. Only valid if *25-50 Lead Compressor Alternation* is different from *[0] Off*.

25-56 Staging Mode at Alternation

Option:		Function:
		This parameter is only active if the option selected in *25-50 Lead Compressor Alternation* is different from *[0] Off*. Two types of staging and destaging of compressors are possible. Slow transfer makes staging and destaging smooth. Quick Transfer makes staging and destaging as fast as possible; the variable speed compressor is just cut out (coasted).
[0] *	Slow	At alternation, the variable speed compressor is ramped up to maximum speed and then ramped down to a stand still.
[1]	Quick	At alternation, the variable speed compressor is ramped up to maximum speed and then coasted to stand still.

Illustration 6.37 is an example of the Slow transfer staging. The variable speed compressor (top graph) and one fixed speed compressor (bottom graph) are running before the staging command. When the *[0] Slow* transfer command is

activated, an alternation is carried out by ramping the variable speed compressor to *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]*, and then decelerated to zero speed. After a "Delay Before Starting Next Compressor" (*25-58 Run Next Compressor Delay*) the next lead compressor (middle graph) is accelerated and another original lead compressor (top graph) is added after the "Delay Before Running On Mains" (*25-59 Run on Mains Delay*) as a fixed speed compressor. The next lead compressor (middle graph) is decelerated to Motor Speed Low Limit and then allowed to vary speed to maintain system pressure.

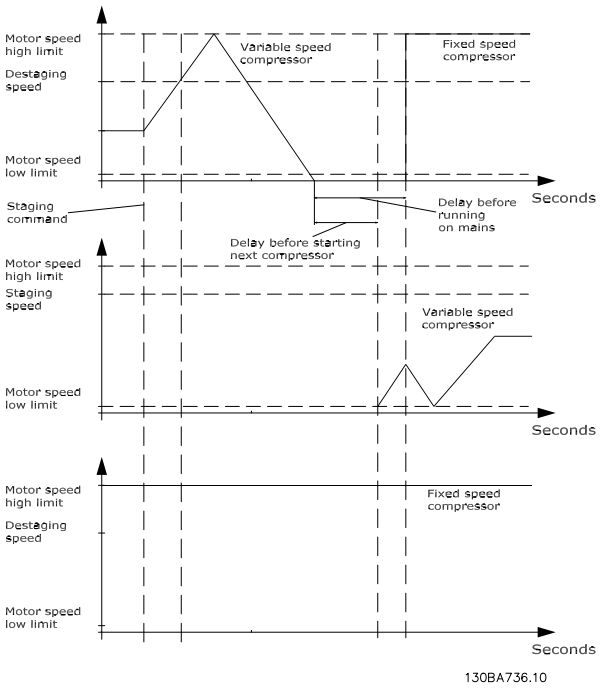


Illustration 6.37

25-58 Run Next Compressor Delay

Range:		Function:
0.5 sec*	[*25-58 Run Next Compressor Delay* – 5.0 sec]	This parameter is only active if the option selected in *25-50 Lead Compressor Alternation*, is different from *[0] Off*. This parameter sets the time between stopping the old variable speed compressor and starting another compressor as a new variable speed compressor. Refer to *25-56 Staging Mode at Alternation* and *Illustration 6.37* for description of staging and alternation.

25-59 Run on Mains Delay

Range:		Function:
0.5 sec*	[*25-58 Run Next Compressor Delay* – 5.0 sec]	This parameter is only active if the option selected in *25-50 Lead Compressor Alternation*, is different from *[0] Off*. This parameter sets the time between stopping the old variable speed compressor and starting this compressor as a new fixed speed compressor. Refer to *25-56 Staging Mode at Alternation* and *Illustration 6.37* for description of staging and alternation.

6.14.5 25-8* Status

Readout parameters informing about the operating status of the cascade controller and the compressors controlled.

25-80 Pack Status

Option:	Function:
	Read out of the status of the Pack Controller.
Disabled	Pack Controller is disabled (*25-00 Cascade Controller*).
Emergency	All compressors have been stopped by means of a Coast/Coast inverse or an External Interlock command applied to the frequency converter.
Off	All compressors have been stopped by means of a Stop command applied to the frequency converter.
In Open Loop	*1-00 Configuration Mode* has been set for *[0] Open Loop*. All fixed speed compressors are stopped. The variable speed compressor will continue to run.
Frozen	Staging/destaging of compressors has been locked and reference locked.
Jogging	All fixed speed compressors are stopped. When stopped, the variable speed compressor will run at jog speed.
Running	A Start command is applied to the frequency converter and the Pack controller is controlling the compressors.
Running FSBW	The frequency converter is tripped off and the Pack Controller is controlling the fixed speed compressors based on *4-14 Motor Speed High Limit [Hz]*.
Staging	The Pack Controller is staging fixed speed compressors.
Destaging	The Pack Controller is destaging fixed speed compressors.
Lead Not Set	No compressor available to be assigned as variable speed compressor.

25-81 Compressor Status

Option:		Function:
		Compressor Status shows the status for the number of compressors selected in *25-06 Number of Pumps*. It is a readout of the status for each of the compressors showing a string, which consists of compressor number and the current status of the compressor. Example: Readout is with the abbreviation like "1:D 2:O" This means that compressor 1 is running and speed controlled by the frequency converter and compressor 2 is stopped.
[X]	Disabled	The compressor is interlocked either via *25-90 Pump Interlock*, or signal on a digital input programmed for Compressor (number on compressor) Interlock in parameter group *5-1* Digital Inputs*. Can only refer to fixed speed compressors.
[O]	Off	Stopped by the cascade controller (but not interlocked).
[D]	Running on Frequency Converter	Variable speed compressor, regardless if connected directly or controlled via relay in the frequency converter.
[R]	Running on Mains	Running on mains. Fixed speed compressor running.

25-82 Lead Compressor

Option:	Function:	
	0 N/A	Readout parameter for the actual variable speed compressor in the system. It is updated to reflect the current variable speed compressor in the system when an alternation takes place. If no lead compressor is selected (Cascade Controller disabled or all compressors interlocked) the display will show NONE.

25-83 Relay Status

Array [2]

	On	
	Off	Read out of the status for each of the relays assigned to control the compressors. Every element in the array represents a relay. If a relay is activated, the corresponding element is set to "On". If a relay is deactivated, the corresponding element is set to "Off".

25-84 Compressor ON Time

Array [2]

0 h*	[0 – 2147483647 h]	Readout of the value for Compressor ON Time. The Cascade Controller has sete counters for the compressors and for the relays that control the compressors. Compressor ON Time monitors the "operating hours" of each compressor. The value of each Compressor ON Time counter can be reset to 0 by writing in the parameter, e.g. if the compressor is replaced in case of service.

25-85 Relay ON Time

Array [2]

0 h*	[0 – 2147483647 h]	Readout of the value for Relay ON time. The Cascade Controller has set counters for the compressors and for the relays that control the compressors. Compressor cycling is always done based on the relay counters, otherwise it would always use the new compressor if a compressor is replaced and its value in *25-84 Pump ON Time* counter is reset. In order to use *25-04 Pump Cycling*, the Cascade Controller is monitoring the Relay ON time.

25-86 Reset Relay Counters

Option:		Function:
[0] *	Do not reset	
[1]	Do reset	Resets all elements in *25-85 Relay ON Time*.

6.14.6 25-9* Service

Parameters used in case of service on one or more of the compressors controlled.

25-90 Compressor Interlock

Array [2]

		In this parameter, it is possible to disable one or more of the fixed lead compressors. For example, the compressor will not be selected for staging on even if it is the next compressor in the operation sequence. It is not possible to disable the lead compressor with the Compressor Interlock command. The digital input interlocks are selected as *[130 – 132] Compressor 1-3 Interlock* in parameter group *5-1* Digital Inputs*.
[0] *	Off	The compressor is active for staging/destaging.
[1]	On	The Compressor Interlock command is given. If a compressor is running it is immediately destaged. If the compressor is not running it is not allowed to stage on.

25-91 Manual Alternation

Option:		Function:
[0] *	0 = Off - Number of Compressors	This parameter is only active if the options *At Command* or *At Stating or Command* are selected in *25-50 Lead Compressor Alternation*. The parameter is for manually setting of what compressor to be assigned as variable speed compressor. The default value of Manual Alternation is *[0] Off*. If a

25-91 Manual Alternation		
Option:		Function:
		value other than *[0] Off* is set, the alternation is carried out immediately and the compressor that is selected with Manual Alternation is the new variable speed compressor. After the alternation has been carried out, the Manual Alternation parameter is reset to *[0] Off*. If the parameter is set to the number which equals the actual variable speed compressor, the parameter will be reset to [0] immediately after.

6.15 Parameters: 28-** Compressor Functions

6.15.1 28-0* Short Cycle Protection

When controlling refrigeration compressors, often there will be a need for limiting the numbers of starts. One way to do this is to ensure a minimum run time (time between a start and a stop) and a minimum interval between starts. This means that any normal stop command can be overridden by *28-02 Minimum Run Time* and any normal start command (Start/Jog/Freeze) can be overridden by the *28-01 Interval between Starts*.
None of the two functions are active if *Hand On* or *Off* modes have been activated via the LCP. If selecting *Hand On* or *Off*, the two timers will be reset to 0, and not start counting until *Auto* is pressed and an active start command applied.

28-00 Short Cycle Protection

Option:		Function:
[0]	Disabled	Timer set in *28-01 Interval between Starts* is disabled.
[1] *	Enabled	Timer set in *28-01 Interval between Starts* is enabled.

NOTE

This parameter can only be *[1] Enabled* if *25-00 Cascade Controller* is set to *[0] Disabled*.

28-01 Interval Between Starts

Range:		Function:
300 s*	[0 - 3600 s]	Sets the time desired as minimum time between two starts. Any normal start command (Start/Jog/Freeze) will be disregarded until the timer has expired.

28-02 Minimum Run Time

Range:		Function:
12 s*	[0 - par. 28-01]	Sets the time desired as minimum run time after a normal start command (Start/Jog/Freeze). Any normal stop command will be disregarded until the set time has expired. The timer will start counting following a normal start command (Start/Jog/Freeze). The timer will be overridden by a Coast (Inverse) or an External Interlock command.

NOTE

Does not work in cascade mode.

6.15.2 28-1* Oil Return Management

Insufficient lubrication can be the result of oil depositing itself in pipes and bends. The oil deposits can be returned to the crankcase by increasing velocity for short periods at regular time intervals or when velocity is too low to ensure adequate oil return.

With Oil Return Management, these two oil return mechanisms can be programmed into the Compressor Drive™. With Oil Return Management enabled, the frequency converter performs oil return by boosting the compressor speed to 4200 RPM (70 Hz) for a selectable duration (as programmed in *28-13 Boost Duration*). The boosts are performed at fixed time intervals (as programmed in *28-12 Fixed Boost Interval*) or if the compressor speed has been less than 3000 RPM (50 Hz) for too long (as programmed in *28-11 Low Speed Running Time*), whichever occurs first. Thus, the maximum time between two consecutive oil return boosts is as programmed in *28-12 Fixed Boost Interval*. Oil return boosts are indicated by a text message on the LCP.

NOTE

If *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]* is set to the boost speed 4200 RPM an oil boost may cause unwanted staging or destaging if parameter group *25- Cascade Controller* is active.**

28-10 Oil Return Management

Option:		Function:
[0] *	Off	No function
[1]	On	Oil return mechanism is active.

28-11 Low Speed Running Time

Range:		Function:
60 min*	[1 – 1440 min]	Running at low speeds for extended periods may result in inadequate oil return to the compressor crankcase. Set this parameter to the maximum running time the compressor is allowed to run at a speed below 3000 RPM/50 Hz. An oil return boost is performed each time the compressor has been running at a low speed for this maximum time.

28-12 Fixed Boost Interval

Range:		Function:
24 h *	[1 – 168 h]	An oil return boost is performed at fixed time intervals to complement the oil return boosts triggered by inadequate flow speeds (*28-11 Low Speed Running Time*). The fixed interval boosts ensure that oil return boosts are performed even when no boosts have occurred due to low flow speed (*28-11 Low Speed Running Time*).

28-13 Boost Duration

Range:		Function:
30 s *	[10 – 120 s]	This parameter controls the duration of oil return boosts.

6.15.3 28-2* Discharge Temperature Monitor

The Discharge Temperature Monitor (DTM) can be used to prevent the discharge temperature from reaching dangerous levels.

Two temperature levels of increasing severity can be programmed. These levels are called warning level (set in *28-24 Warning Level*) and emergency level (set in *28-24 Warning Level*) in order of increasing severity. Each level corresponds to a particular set of preventive actions.

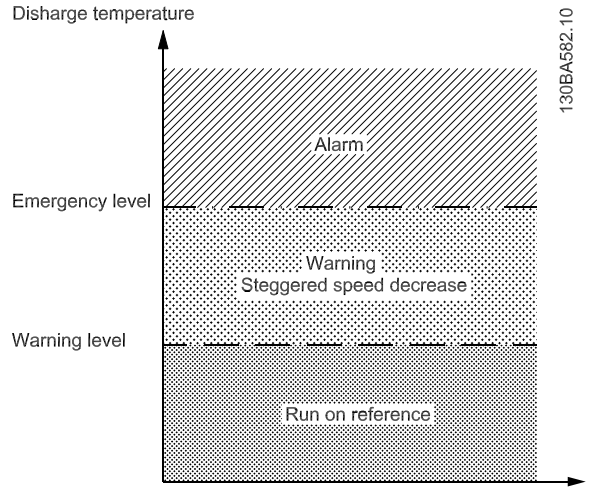


Illustration 6.38

Discharge temperatures above the Emergency level cause an alarm and an immediate trip to prevent damage to the compressor.

Normal operations apply for discharge temperatures below Warning level. The discharge temperature is passively monitored without affecting frequency converter operations.

Discharge temperatures in the range from Warning level to Emergency level trigger a warning and an action set by *28-25 Warning Action*. The action can be None or Decrease cooling. If the action is set to Decrease cooling the cooling is decreased as a preventive action in an attempt to lower the discharge temperature.

Cooling is decreased by step-wise lowering of the shaft speed until the discharge temperature either drops below warning level or exceeds emergency level. Each step represents a three minute period during which the maximum allowed shaft speed is 10 Hz lower than the previous step. The initial step occurs when the discharge temperature rises from below to above warning level and uses the current shaft speed as basis for the 10 Hz speed reduction.

The speed steps enforce maximum shaft speeds. If the reference corresponds to a lesser speed, the reference is obeyed. If it corresponds to a higher speed, the speed is limited to the maximum shaft speed for that step.

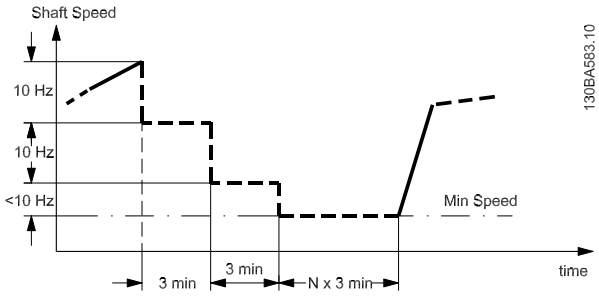


Illustration 6.39

NOTE

If the Cascade Controller is active, unwanted staging or destaging may result if the Discharge Temperature Monitor reduces the speed to *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]*.

28-20 Temperature Source

Option:		Function:
		Selects the input terminal to which the discharge temperature measurement device is connected.
[0] *	None	No Source. The Discharge Temperature Monitor is not active.
[1]	Analog input 53	The measurement device is connected to input terminal 53. Program *6-10 Terminal 53 Low Voltage* to *6-15 Terminal 53 High Ref./Feedb. Value* to match the characteristics of the device.
[2]	Analog input 54	The measurement device is connected to input terminal 54. Program *6-20 Terminal 54 Low Voltage* to *6-25 Terminal 54 High Ref./Feedb. Value* to match the characteristics of the device.
[3]	Bus	The actual discharge temperature should be sent via Modbus RTU or FC protocol to *28-27 Discharge temperature*. The temperature could be set via PCD write in *8-42 PCD write configuration*.

28-21 Temperature Unit

Option:		Function:
		Selects the unit of the discharge temperature.
[60] *	°C	
[160]	°F	

6

28-24 Warning Level

Range:		Function:
130 *	[10– *28-26 Emergency Level*]	Selects the temperature at which a warning shall be issued. The action selected in *28-25 Warning Action* becomes active at this temperature. Enter the temperature measured in the unit selected in *28-21 Temperature Unit*.

28-25 Warning Action

Option:		Function:
		Selects the action to be taken by the frequency converter for discharge temperatures above the value programmed in *28-21 Temperature Unit* but below the value programmed in *28-26 Emergency Level*.
[0]	None	No action. Only a warning will be issued.
[1] *	Decrease cooling	A warning is issued and the motor speed is lowered in steps of 10 Hz every 3 minutes until the temperature either drops below the level programmed in *28-24 Warning Level* or exceeds the level programmed in *28-26 Emergency Level*.

28-26 Emergency Level

Range:		Function:
145*	[*28-24 Warning Level*-300]	Selects the temperature at which an alarm shall be issued. Enter the temperature in the unit programmed in *28-21 Temperature Unit*.

28-27 Discharge Temperature

Range:		Function:
0*	[-2147483648 – 2147483648]	Returns the actual value of the discharge temperature.

6.15.4 28-3* Crankcase Heating

A DC-hold Current through the motor windings can be used as an alternative to an external crankcase heater to keep the compressor warm when stopped.

The efficiency of the Crankcase Heating depends upon the physical placing of the actual motor in the compressor.

If the Crankcase Heating is used together with Anti-Reverse Protection then the drive will first brake for the set duration followed by the heating current.

28-30 Crankcase Heating Control

Option:		Function:
		Activate the DC-hold current when the motor is stopped. The current level is defined in *28-31 Heating DC Current*.
[0] *	Disabled	

28-30 Crankcase Heating Control

Option:		Function:
[1]	Enabled	

28-31 Heating DC Current

Range:		Function:
20% *	[0 – 25%]	Set the DC-hold current as percentage of the rated motor current in *1-24 Motor Current*.

28-32 Crankcase Heating Delayed

Range:		Function:
5 s*	[5-65534 s]	This time defines the delay after a stop and until Crank Case Heating is applied to the compressor.

6.15.5 28-4* Anti-reverse Protection

A compressor may have a preferred rotation direction and the instructions for cabling should always be followed, but the consequences of a reverse rotation are normally not fatal. The parameter group *28-4* Anti-reverse Protection* can be set up to prevent reverse rotation at stop by injecting a DC-brake current into the motor a few seconds after stop followed by the eventual coast of the motor when the discharge valve has closed.

NOTE

The DC-brake Function is not operational before any Start Function has completed. In case of an emergency stop before the starting sequence has completed then the compressor may rotate reverse for a short moment after stop. Under normal circumstances the correct sequence is ensured by the Short Cycle Protection feature.

28-40 Reverse Protection Control

Option:		Function:
		Activate a DC-brake current when the motor is stopped. The current level is defined in *28-41 DC Brake Current*. Not recommended for Piston compressors.
[0] *	Disabled	
[1]	Enabled	

28-41 DC Brake Current

Range:		Function:
90% *	[0 – max motor current]	Set the DC-brake current as percentage of the rated motor current in *1-24 Motor Current*.

28-42 DC Braking Time

Range:		Function:
2.0 Sec*	[0 – 60.0 Sec]	Set the duration of the DC-brake current.

28-43 DC Brake Cut-in Speed [RPM]		
Range:		**Function:**
700 RPM '0' = Off*	[0 – max motor speed]	Set the speed where the DC-brake Current should cut in. The speed must be higher than 0 RPM for the DC-brake to activate before the motor is coasted at 0 RPM to prevent a reverse rotation.

6.15.6 28-5* Load Profile

The Load Profiler is used to get a graphical presentation of the load pattern a cooling system has been subjected to over the last 6 months. The system load is assumed to be proportional to the compressor speed, and the Load Profiler measures the load as the running hours spent operating within certain speed intervals.

The speed intervals are calculated based on *4-11 Motor Speed Low Limit [RPM]* (*4-13 Motor Speed High Limit [RPM]*) and *4-13 Motor Speed High Limit [RPM]* (*4-14 Motor Speed High Limit [Hz]*) to match 0%, 25%, 50%, 75% and 100% loads as good as possible. The speed intervals are denoted "Off", "Low", "Med.", "High" and "Full" and are calculated in the following manner:

$$\Delta = \textit{Motor Speed High Limit} - \textit{Motor Speed Low Limit}$$

Off: Speed = 0

Low: $\textit{Motor Speed Low Limit} \leq \textit{Speed} < \textit{Motor Speed Low Limit} + \Delta / 6$

Med.

$\textit{Motor Speed Low Limit} + \Delta / 6 \leq \textit{Speed} < \textit{Motor Speed Low Limit} + \Delta / 2$

High:

$\textit{Motor Speed Low Limit} + \Delta / 2 \leq \textit{Speed} < \textit{Motor Speed Low Limit} + 5 \times \Delta / 6$

Full:

$\textit{Motor Speed Low Limit} + 5 \times \Delta / 6 \leq \textit{Speed} \leq \textit{Motor Speed High Limit}$

For example, if *4-11 Motor Speed High Limit* is 5400 RPM and *Motor Speed Low Limit* is 1800 RPM the four calculated intervals become

Low: 1800 RPM ≤ speed < 2350 RPM

Med: 2350 RPM ≤ speed < 3450 RPM

High: 3450 RPM ≤ speed < 4550 RPM

Full: 4550 RPM ≤ speed ≤ 5400 RPM

The profile is presented on the LCP as a histogram. In each speed interval the indicated running time is accurate to within 1 hour.

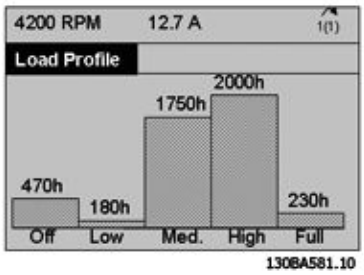


Illustration 6.40

The Load Profile is not updated if the Off key is pressed on the LCP.

28-50 Reset Load Profile		
Option:		**Function:**
[0] *	Do not reset	No function
[1]	Reset	Clears the measured running time in all five speed intervals.

28-74 Night Speed Drop [RPM]		
Range:		**Function:**
	[]	The value in this parameter will decrement the value in *4-13 Motor Speed High Limit [RPM]* which becomes active when night mode is activated.

6.16 Parameter Lists

Changes during operation
"TRUE" means that the parameter can be changed while the frequency converter is in operation. "FALSE" means that the frequency converter must be stopped before a change can be made.

4-Set-up
'All set-ups': the parameter can be set individually in each of the four set-ups, i. e. one single parameter can have four different data values.
'1 set-up': data value will be the same in all set-ups.

Data type	Description	Type
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	Uint8
6	Unsigned 16	Uint16
7	Unsigned 32	Uint32
9	Visible String	VisStr
33	Normalized value 2 bytes	N2
35	Bit sequence of 16 boolean variables	V2
54	Time difference w/o date	TimD

Table 6.16

6.16.1 Conversion

The various attributes of each parameter are displayed in Factory Setting. Parameter values are transferred as whole numbers only. Conversion factors are therefore used to transfer decimals.

4-12 Motor Speed Low Limit [Hz] has a conversion factor of 0.1. To preset the minimum frequency to 10 Hz, transfer the value 100. A conversion factor of 0.1 means that the value transferred is multiplied by 0.1. The value 100 is therefore read as 10.0.

Examples:
0s ⇒ conversion index 0
0.00s ⇒ conversion index -2
0ms ⇒ conversion index -3
0.00ms ⇒ conversion index -5

Conversion index	Conversion factor
100	
75	
74	
67	
6	1000000
5	100000
4	10000
3	1000
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001
-5	0.00001
-6	0.000001
-7	0.0000001

Table 6.17 Conversion Table

6.16.2 0-** Operation/Display

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
0-0* Basic Settings						
0-01	Language	[0] English	1 set-up	TRUE	-	Uint8
0-02	Motor Speed Unit	[1] Hz	2 set-ups	FALSE	-	Uint8
0-03	Regional Settings	ExpressionLimit	2 set-ups	FALSE	-	Uint8
0-04	Operating State at Power-up	[0] Resume	All set-ups	TRUE	-	Uint8
0-05	Local Mode Unit	[0] As Motor Speed Unit	2 set-ups	FALSE	-	Uint8
0-1* Set-up Operations						
0-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
0-11	Programming Set-up	[9] Active Set-up	All set-ups	TRUE	-	Uint8
0-12	This Set-up Linked to	[0] Not linked	All set-ups	FALSE	-	Uint8
0-13	Readout: Linked Set-ups	0 N/A	All set-ups	FALSE	0	Uint16
0-14	Readout: Prog. Set-ups / Channel	0 N/A	All set-ups	TRUE	0	Int32
0-2* LCP Display						
0-20	Display Line 1.1 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
0-21	Display Line 1.2 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
0-22	Display Line 1.3 Small	ExpressionLimit	All set-ups	TRUE	-	Uint16
0-23	Display Line 2 Large	ExpressionLimit	All set-ups	TRUE	-	Uint16
0-24	Display Line 3 Large	ExpressionLimit	All set-ups	TRUE	-	Uint16
0-25	My Personal Menu	ExpressionLimit	1 set-up	TRUE	0	Uint16
0-3* LCP Custom Readout						
0-30	Custom Readout Unit	[1] %	All set-ups	TRUE	-	Uint8
0-31	Custom Readout Min Value	ExpressionLimit	All set-ups	TRUE	-2	Int32
0-32	Custom Readout Max Value	100 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
0-37	Display Text 1	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-38	Display Text 2	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-39	Display Text 3	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-4* LCP Keypad						
0-40	[Hand on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-41	[Off] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-42	[Auto on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-43	[Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-5* Copy/Save						
0-50	LCP Copy	[0] No copy	All set-ups	FALSE	-	Uint8
0-51	Set-up Copy	[0] No copy	All set-ups	FALSE	-	Uint8
0-6* Password						
0-60	Main Menu Password	100 N/A	1 set-up	TRUE	0	Int16
0-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
0-65	Personal Menu Password	200 N/A	1 set-up	TRUE	0	Int16
0-66	Access to Personal Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
0-67	Bus Password Access	0 N/A	All set-ups	TRUE	0	Uint16
0-7* Clock Settings						
0-70	Set Date and Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay
0-71	Date Format	ExpressionLimit	1 set-up	TRUE	-	Uint8
0-72	Time Format	ExpressionLimit	1 set-up	TRUE	-	Uint8
0-74	DST/Summertime	[0] Off	1 set-up	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
0-76	DST/Summertime Start	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-77	DST/Summertime End	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-79	Clock Fault	[0] Disabled	1 set-up	TRUE	-	Uint8
0-81	Working Days	ExpressionLimit	1 set-up	TRUE	-	Uint8
0-82	Additional Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-83	Additional Non-Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-89	Date and Time Readout	0 N/A	All set-ups	TRUE	0	VisStr[25]

Table 6.18

6.16.3 1-** Load/Motor

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
1-0* General Settings						
1-00	Configuration Mode	ExpressionLimit	All set-ups	TRUE	-	Uint8
1-03	Torque Characteristics	[0] Compressor CT	All set-ups	TRUE	-	Uint8
1-1* Motor Selection						
1-10	Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8
1-1* VVC+ PM						
1-14	Damping Gain	120 %	All set-ups	TRUE	0	Int16
1-15	Low Speed Filter Time Const.	ExpressionLimit	All set-ups	TRUE	-2	Uint16
1-16	High Speed Filter Time Const.	ExpressionLimit	All set-ups	TRUE	-2	Uint16
1-17	Voltage filter time const.	ExpressionLimit	All set-ups	TRUE	-3	Uint16
1-2* Motor Data						
1-20	Motor Power [kW]	ExpressionLimit	All set-ups	FALSE	1	Uint32
1-21	Motor Power [HP]	ExpressionLimit	All set-ups	FALSE	-2	Uint32
1-22	Motor Voltage	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-23	Motor Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-24	Motor Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
1-25	Motor Nominal Speed	ExpressionLimit	All set-ups	FALSE	67	Uint16
1-26	Motor Cont. Rated Torque	ExpressionLimit	All set-ups	FALSE	-1	Uint32
1-28	Motor Rotation Check	[0] Off	All set-ups	FALSE	-	Uint8
1-29	Automatic Motor Adaptation (AMA)	[0] Off	All set-ups	FALSE	-	Uint8
1-3* Adv. Motor Data						
1-30	Stator Resistance (Rs)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-31	Rotor Resistance (Rr)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-35	Main Reactance (Xh)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-36	Iron Loss Resistance (Rfe)	ExpressionLimit	All set-ups	FALSE	-3	Uint32
1-37	d-axis Inductance (Ld)	ExpressionLimit	All set-ups	FALSE	-6	Int32
1-39	Motor Poles	ExpressionLimit	All set-ups	FALSE	0	Uint8
1-40	Back EMF at 1000 RPM	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-5* Load Indep. Setting						
1-50	Motor Magnetisation at Zero Speed	100 %	All set-ups	TRUE	0	Uint16
1-51	Min Speed Normal Magnetising [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-52	Min Speed Normal Magnetising [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-58	Flystart Test Pulses Current	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-59	Flystart Test Pulses Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-6* Load Depen. Setting						
1-60	Low Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-61	High Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-62	Slip Compensation	0 %	All set-ups	TRUE	0	Int16
1-63	Slip Compensation Time Constant	ExpressionLimit	All set-ups	TRUE	-2	Uint16
1-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16
1-65	Resonance Dampening Time Constant	5 ms	All set-ups	TRUE	-3	Uint8
1-66	Min. Current at Low Speed	ExpressionLimit	All set-ups	TRUE	0	Uint8
1-7* Start Adjustments						
1-70	PM Start Mode	[1] Parking	All set-ups	TRUE	-	Uint8
1-71	Start Delay	00 s	All set-ups	TRUE	-1	Uint16
1-72	Start Function	ExpressionLimit	All set-ups	TRUE	-	Uint8
1-73	Flying Start	ExpressionLimit	All set-ups	FALSE	-	Uint8
1-74	Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-75	Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
1-76	Start Current	0 A	All set-ups	TRUE	-2	Uint32
1-77	Compressor Start Max Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-78	Compressor Start Max Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-79	Compressor Start Max Time to Trip	5 s	All set-ups	TRUE	-1	Uint8
1-8* Stop Adjustments						
1-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8
1-81	Min Speed for Function at Stop [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-82	Min Speed for Function at Stop [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-86	Compressor Min. Speed for Trip [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-87	Compressor Min. Speed for Trip [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-9* Motor Temperature						
1-90	Motor Thermal Protection	ExpressionLimit	All set-ups	TRUE	-	Uint8
1-91	Motor External Fan	[0] None	All set-ups	TRUE	-	Uint8
1-93	Thermistor Source	[0] None	All set-ups	TRUE	-	Uint8

Table 6.19

6.16.4 3-** Reference/Ramps

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
3-0* Reference Limits						
3-02	Minimum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
3-03	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
3-04	Reference Function	[0] Sum	All set-ups	TRUE	-	Uint8
3-1* References						
3-10	Preset Reference	0 %	All set-ups	TRUE	-2	Int16
3-11	Jog Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
3-13	Reference Site	[0] Linked to Hand / Auto	All set-ups	TRUE	-	Uint8
3-14	Preset Relative Reference	0 %	All set-ups	TRUE	-2	Int32
3-15	Reference 1 Source	[1] Analog Input 53	All set-ups	TRUE	-	Uint8
3-16	Reference 2 Source	[20] Digital pot.meter	All set-ups	TRUE	-	Uint8
3-17	Reference 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
3-19	Jog Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
3-4* Ramp 1						
3-41	Ramp 1 Ramp Up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-42	Ramp 1 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-5* Ramp 2						
3-51	Ramp 2 Ramp Up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-52	Ramp 2 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-8* Other Ramps						
3-80	Jog Ramp Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-81	Quick Stop Ramp Time	ExpressionLimit	2 set-ups	TRUE	-2	Uint32
3-82	Starting Ramp Up Time	ExpressionLimit	2 set-ups	TRUE	-2	Uint32
3-9* Digital Pot.Meter						
3-90	Step Size	0.10 %	All set-ups	TRUE	-2	Uint16
3-91	Ramp Time	1 s	All set-ups	TRUE	-2	Uint32
3-92	Power Restore	[0] Off	All set-ups	TRUE	-	Uint8
3-93	Maximum Limit	100 %	All set-ups	TRUE	0	Int16
3-94	Minimum Limit	0 %	All set-ups	TRUE	0	Int16
3-95	Ramp Delay	1 N/A	All set-ups	TRUE	-3	TimD

Table 6.20

6.16.5 4-** Limits / Warnings

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
4-1* Motor Limits						
4-10	Motor Speed Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8
4-11	Motor Speed Low Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-12	Motor Speed Low Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-13	Motor Speed High Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-14	Motor Speed High Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-16	Torque Limit Motor Mode	110 %	All set-ups	TRUE	-1	Uint16
4-17	Torque Limit Generator Mode	100 %	All set-ups	TRUE	-1	Uint16
4-18	Current Limit	ExpressionLimit	All set-ups	TRUE	-1	Uint32
4-19	Max Output Frequency	ExpressionLimit	All set-ups	FALSE	-1	Uint16
4-5* Adj. Warnings						
4-50	Warning Current Low	0 A	All set-ups	TRUE	-2	Uint32
4-51	Warning Current High	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32
4-52	Warning Speed Low	0 RPM	All set-ups	TRUE	67	Uint16
4-53	Warning Speed High	outputSpeedHighLimit (P413)	All set-ups	TRUE	67	Uint16
4-54	Warning Reference Low	-999999 N/A	All set-ups	TRUE	-3	Int32
4-55	Warning Reference High	999999 N/A	All set-ups	TRUE	-3	Int32
4-56	Warning Feedback Low	-999999 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
4-57	Warning Feedback High	999999 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
4-58	Missing Motor Phase Function	ExpressionLimit	All set-ups	TRUE	-	Uint8
4-6* Speed Bypass						
4-60	Bypass Speed From [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-61	Bypass Speed From [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-62	Bypass Speed To [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-63	Bypass Speed To [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-64	Semi-Auto Bypass Set-up	[0] Off	All set-ups	FALSE	-	Uint8

Table 6.21

6.16.6 5-** Digital In/Out

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
5-0* Digital I/O mode						
5-00	Digital I/O Mode	[0] PNP - Active at 24V	All set-ups	FALSE	-	Uint8
5-01	Terminal 27 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-02	Terminal 29 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-1* Digital Inputs						
5-10	Terminal 18 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-11	Terminal 19 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-12	Terminal 27 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-13	Terminal 29 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-14	Terminal 32 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-15	Terminal 33 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-16	Terminal X30/2 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-17	Terminal X30/3 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-18	Terminal X30/4 Digital Input	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-19	Terminal 37 Safe Stop	[1] Safe Stop Alarm	All set-ups	TRUE	-	Uint8
5-3* Digital Outputs						
5-30	Terminal 27 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-31	Terminal 29 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-32	Term X30/6 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-33	Term X30/7 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-4* Relays						
5-40	Function Relay	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-41	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-42	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-5* Pulse Input						
5-50	Term. 29 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-52	Term. 29 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
5-53	Term. 29 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
5-54	Pulse Filter Time Constant #29	100 ms	All set-ups	FALSE	-3	Uint16
5-55	Term. 33 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-56	Term. 33 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-57	Term. 33 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
5-58	Term. 33 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
5-59	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16
5-6* Pulse Output						
5-60	Terminal 27 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-62	Pulse Output Max Freq #27	5000 Hz	All set-ups	TRUE	0	Uint32
5-63	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-65	Pulse Output Max Freq #29	5000 Hz	All set-ups	TRUE	0	Uint32
5-66	Terminal X30/6 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-68	Pulse Output Max Freq #X30/6	5000 Hz	All set-ups	TRUE	0	Uint32
5-9* Bus Controlled						
5-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32
5-93	Pulse Out #27 Bus Control	0 %	All set-ups	TRUE	-2	N2
5-94	Pulse Out #27 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
5-95	Pulse Out #29 Bus Control	0 %	All set-ups	TRUE	-2	N2
5-96	Pulse Out #29 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
5-97	Pulse Out #X30/6 Bus Control	0 %	All set-ups	TRUE	-2	N2

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
5-98	Pulse Out #X30/6 Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16

Table 6.22

6.16.7 6-** Analog In/Out

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
6-0* Analog I/O Mode						
6-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	Uint8
6-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-02	Fire Mode Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-1* Analog Input 53						
6-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-11	Terminal 53 High Voltage	10 V	All set-ups	TRUE	-2	Int16
6-12	Terminal 53 Low Current	4 mA	All set-ups	TRUE	-5	Int16
6-13	Terminal 53 High Current	20 mA	All set-ups	TRUE	-5	Int16
6-14	Terminal 53 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
6-15	Terminal 53 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
6-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-17	Terminal 53 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-2* Analog Input 54						
6-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-21	Terminal 54 High Voltage	10 V	All set-ups	TRUE	-2	Int16
6-22	Terminal 54 Low Current	4 mA	All set-ups	TRUE	-5	Int16
6-23	Terminal 54 High Current	20 mA	All set-ups	TRUE	-5	Int16
6-24	Terminal 54 Low Ref./Feedb. Value	-1 N/A	All set-ups	TRUE	-3	Int32
6-25	Terminal 54 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
6-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-27	Terminal 54 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-3* Analog Input X30/11						
6-30	Terminal X30/11 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-31	Terminal X30/11 High Voltage	10 V	All set-ups	TRUE	-2	Int16
6-34	Term. X30/11 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
6-35	Term. X30/11 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
6-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-37	Term. X30/11 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-4* Analog Input X30/12						
6-40	Terminal X30/12 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-41	Terminal X30/12 High Voltage	10 V	All set-ups	TRUE	-2	Int16
6-44	Term. X30/12 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
6-45	Term. X30/12 High Ref./Feedb. Value	100 N/A	All set-ups	TRUE	-3	Int32
6-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-47	Term. X30/12 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-5* Analog Output 42						
6-50	Terminal 42 Output	[100] Output frequency	All set-ups	TRUE	-	Uint8
6-51	Terminal 42 Output Min Scale	0 %	All set-ups	TRUE	-2	Int16
6-52	Terminal 42 Output Max Scale	100 %	All set-ups	TRUE	-2	Int16
6-53	Terminal 42 Output Bus Control	0 %	All set-ups	TRUE	-2	N2
6-54	Terminal 42 Output Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16
6-6* Analog Output X30/8						
6-60	Terminal X30/8 Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-61	Terminal X30/8 Min. Scale	0 %	All set-ups	TRUE	-2	Int16
6-62	Terminal X30/8 Max. Scale	100 %	All set-ups	TRUE	-2	Int16
6-63	Terminal X30/8 Output Bus Control	0 %	All set-ups	TRUE	-2	N2

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
6-64	Terminal X30/8 Output Timeout Preset	0 %	1 set-up	TRUE	-2	Uint16

Table 6.23

6.16.8 7-** Controllers

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
7-0* Speed PID Ctrl.						
7-00	Speed PID Feedback Source	null	All set-ups	FALSE	-	Uint8
7-02	Speed PID Proportional Gain	App.Dependent	All set-ups	TRUE	-3	Uint16
7-03	Speed PID Integral Time	App.Dependent	All set-ups	TRUE	-4	Uint32
7-04	Speed PID Differentiation Time	App.Dependent	All set-ups	TRUE	-4	Uint16
7-05	Speed PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
7-06	Speed PID Lowpass Filter Time	App.Dependent	All set-ups	TRUE	-4	Uint16
7-07	Speed PID Feedback Gear Ratio	1.0000 N/A	All set-ups	FALSE	-4	Uint32
7-08	Speed PID Feed Forward Factor	0%	All set-ups	FALSE	0	Uint16
7-09	Speed PID Error Correction w/ Ramp	300RPM	All set-ups	TRUE	67	Uint32
7-1* Torque PI Ctrl.						
7-12	Torque PI Proportional Gain	100%	All set-ups	TRUE	0	Uint16
7-13	Torque PI Integration Time	0.020 s	All set-ups	TRUE	-3	Uint16
7-2* Process Ctrl. Feedb						
7-20	Process CL Feedback 1 Resource	[0] No function	All set-ups	TRUE	-	Uint8
7-22	Process CL Feedback 2 Resource	[0] No function	All set-ups	TRUE	-	Uint8
7-3* Process PID Ctrl.						
7-30	Process PID Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
7-31	Process PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
7-32	Process PID Start Speed	0 RPM	All set-ups	TRUE	67	Uint16
7-33	Process PID Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
7-34	Process PID Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
7-35	Process PID Differentiation Time	0.00 s	All set-ups	TRUE	-2	Uint16
7-36	Process PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
7-38	Process PID Feed Forward Factor	0%	All set-ups	TRUE	0	Uint16
7-39	On Reference Bandwidth	5%	All set-ups	TRUE	0	Uint8

Table 6.24

6.16.9 8-** Comm. and Options

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
8-0* General Settings						
8-01	Control Site	ExpressionLimit	All set-ups	TRUE	-	Uint8
8-02	Control Source	ExpressionLimit	All set-ups	TRUE	-	Uint8
8-03	Control Timeout Time	ExpressionLimit	1 set-up	TRUE	-1	Uint32
8-04	Control Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
8-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8
8-06	Reset Control Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
8-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
8-1* Control Settings						
8-10	Control Profile	[0] FC profile	All set-ups	TRUE	-	Uint8
8-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
8-3* FC Port Settings						
8-30	Protocol	[0] FC	1 set-up	TRUE	-	Uint8
8-31	Address	ExpressionLimit	1 set-up	TRUE	0	Uint8
8-32	Baud Rate	ExpressionLimit	1 set-up	TRUE	-	Uint8
8-33	Parity / Stop Bits	ExpressionLimit	1 set-up	TRUE	-	Uint8
8-35	Minimum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
8-36	Maximum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
8-37	Maximum Inter-Char Delay	ExpressionLimit	1 set-up	TRUE	-5	Uint16
8-4* Adv. Protocol Set.						
8-40	Telegram Selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8
8-45	BTM Transaction Command	[0] Off	All set-ups	FALSE	-	Uint8
8-46	BTM Transaction Status	[0] Off	All set-ups	TRUE	-	Uint8
8-47	BTM Timeout	60 s	1 set-up	FALSE	0	Uint16
8-5* Digital/Bus						
8-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-52	DC Brake Select	ExpressionLimit	All set-ups	TRUE	-	Uint8
8-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-54	Reversing Select	ExpressionLimit	All set-ups	TRUE	-	Uint8
8-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-8* FC Port Diagnostics						
8-80	Bus Message Count	0 N/A	All set-ups	TRUE	0	Uint32
8-81	Bus Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-82	Slave Message Count	0 N/A	All set-ups	TRUE	0	Uint32
8-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-9* Bus Jog / Feedback						
8-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16
8-91	Bus Jog 2 Speed	ExpressionLimit	All set-ups	TRUE	67	Uint16
8-94	Bus Feedback 1	0 N/A	1 set-up	TRUE	0	N2
8-95	Bus Feedback 2	0 N/A	1 set-up	TRUE	0	N2
8-96	Bus Feedback 3	0 N/A	1 set-up	TRUE	0	N2

Table 6.25

6.16.10 14-** Special Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
14-0* Inverter Switching						
14-00	Switching Pattern	[0] 60 AVM	All set-ups	TRUE	-	Uint8
14-01	Switching Frequency	ExpressionLimit	All set-ups	TRUE	-	Uint8
14-03	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
14-04	PWM Random	[0] Off	All set-ups	TRUE	-	Uint8
14-1* Mains On/Off						
14-12	Function at Mains Imbalance	[0] Trip	All set-ups	TRUE	-	Uint8
14-2* Reset Functions						
14-20	Reset Mode	[3] Automatic reset x 3	All set-ups	TRUE	-	Uint8
14-21	Automatic Restart Time	300 s	All set-ups	TRUE	0	Uint16
14-22	Operation Mode	[0] Normal operation	All set-ups	TRUE	-	Uint8
14-23	Typecode Setting	ExpressionLimit	2 set-ups	FALSE	-	Uint8
14-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8
14-26	Trip Delay at Inverter Fault	ExpressionLimit	All set-ups	TRUE	0	Uint8
14-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8
14-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32
14-3* Current Limit Ctrl.						
14-30	Current Lim Ctrl, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
14-31	Current Lim Ctrl, Integration Time	ExpressionLimit	All set-ups	FALSE	-3	Uint16
14-32	Current Lim Ctrl, Filter Time	ExpressionLimit	All set-ups	TRUE	-4	Uint16
14-4* Energy Optimising						
14-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
14-41	AEO Minimum Magnetisation	ExpressionLimit	All set-ups	TRUE	0	Uint8
14-42	Minimum AEO Frequency	10 Hz	All set-ups	TRUE	0	Uint8
14-43	Motor Cosphi	ExpressionLimit	All set-ups	TRUE	-2	Uint16
14-5* Environment						
14-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
14-52	Fan Control	[0] Auto	All set-ups	TRUE	-	Uint8
14-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8
14-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8
14-6* Auto Derate						
14-60	Function at Over Temperature	[0] Trip	All set-ups	TRUE	-	Uint8
14-61	Function at Inverter Overload	[0] Trip	All set-ups	TRUE	-	Uint8
14-62	Inv. Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16

Table 6.26

6.16.11 15-** Drive Information

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
15-0* Operating Data						
15-00	Operating hours	0 h	All set-ups	FALSE	74	Uint32
15-01	Running Hours	0 h	All set-ups	FALSE	74	Uint32
15-02	kWh Counter	0 kWh	All set-ups	FALSE	75	Uint32
15-03	Power Up's	0 N/A	All set-ups	FALSE	0	Uint32
15-04	Over Temp's	0 N/A	All set-ups	FALSE	0	Uint16
15-05	Over Volt's	0 N/A	All set-ups	FALSE	0	Uint16
15-06	Reset kWh Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-08	Number of Starts	0 N/A	All set-ups	FALSE	0	Uint32
15-1* Data Log Settings						
15-10	Logging Source	0	2 set-ups	TRUE	-	Uint16
15-11	Logging Interval	ExpressionLimit	2 set-ups	TRUE	-3	TimD
15-12	Trigger Event	[0] False	1 set-up	TRUE	-	Uint8
15-13	Logging Mode	[0] Log always	2 set-ups	TRUE	-	Uint8
15-14	Samples Before Trigger	50 N/A	2 set-ups	TRUE	0	Uint8
15-2* Historic Log						
15-20	Historic Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
15-21	Historic Log: Value	0 N/A	All set-ups	FALSE	0	Uint32
15-22	Historic Log: Time	0 ms	All set-ups	FALSE	-3	Uint32
15-23	Historic log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
15-3* Alarm Log						
15-30	Alarm Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint8
15-31	Alarm Log: Value	0 N/A	All set-ups	FALSE	0	Int16
15-32	Alarm Log: Time	0 s	All set-ups	FALSE	0	Uint32
15-33	Alarm Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
15-34	Alarm Log: Status	0 N/A	All set-ups	FALSE	0	Uint8
15-35	Alarm Log: Alarm Text	0 N/A	All set-ups	FALSE	0	VisStr[32]
15-4* Drive Identification						
15-40	FC Type	0 N/A	All set-ups	FALSE	0	VisStr[6]
15-41	Power Section	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-42	Voltage	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-43	Software Version	0 N/A	All set-ups	FALSE	0	VisStr[5]
15-44	Ordered Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-46	Frequency Converter Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-47	Power Card Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-48	LCP Id No	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-49	SW ID Control Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-50	SW ID Power Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-51	Frequency Converter Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[10]
15-53	Power Card Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[19]
15-6* Option Ident						
15-60	Option Mounted	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-61	Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-62	Option Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-63	Option Serial No	0 N/A	All set-ups	FALSE	0	VisStr[18]
15-70	Option in Slot A	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-71	Slot A Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
15-72	Option in Slot B	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-73	Slot B Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-74	Option in Slot C0/E0	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-75	Slot C0/E0 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-76	Option in Slot C1/E1	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-77	Slot C1/E1 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-9* Parameter Info						
15-92	Defined Parameters	0 N/A	All set-ups	FALSE	0	Uint16
15-93	Modified Parameters	0 N/A	All set-ups	FALSE	0	Uint16
15-99	Parameter Metadata	0 N/A	All set-ups	FALSE	0	Uint16

Table 6.27

6.16.12 16-** Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
16-0* General Status						
16-00	Control Word	0 N/A	All set-ups	FALSE	0	V2
16-01	Reference [Unit]	0 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
16-02	Reference [%]	0 %	All set-ups	FALSE	-1	Int16
16-03	Status Word	0 N/A	All set-ups	FALSE	0	V2
16-05	Main Actual Value [%]	0 %	All set-ups	FALSE	-2	N2
16-09	Custom Readout	0 CustomReadoutUnit	All set-ups	FALSE	-2	Int32
16-1* Motor Status						
16-10	Power [kW]	0 kW	All set-ups	FALSE	1	Int32
16-11	Power [hp]	0 hp	All set-ups	FALSE	-2	Int32
16-12	Motor Voltage	0 V	All set-ups	FALSE	-1	Uint16
16-13	Frequency	0 Hz	All set-ups	FALSE	-1	Uint16
16-14	Motor current	0 A	All set-ups	FALSE	-2	Int32
16-15	Frequency [%]	0 %	All set-ups	FALSE	-2	N2
16-16	Torque [Nm]	0 Nm	All set-ups	FALSE	-1	Int32
16-17	Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32
16-18	Motor Thermal	0 %	All set-ups	FALSE	0	Uint8
16-22	Torque [%]	0 %	All set-ups	FALSE	0	Int16
16-3* Drive Status						
16-30	DC Link Voltage	0 V	All set-ups	FALSE	0	Uint16
16-32	Brake Energy /s	0 kW	All set-ups	FALSE	0	Uint32
16-33	Brake Energy /2 min	0 kW	All set-ups	FALSE	0	Uint32
16-34	Heatsink Temp.	0 °C	All set-ups	FALSE	100	Uint8
16-35	Inverter Thermal	0 %	All set-ups	FALSE	0	Uint8
16-36	Inv. Nom. Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
16-37	Inv. Max. Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
16-38	SL Controller State	0 N/A	All set-ups	FALSE	0	Uint8
16-39	Control Card Temp.	0 °C	All set-ups	FALSE	100	Uint8
16-40	Logging Buffer Full	[0] No	All set-ups	TRUE	-	Uint8
16-41	LCP Bottom Statusline	0 N/A	All set-ups	TRUE	0	VisStr[50]
16-5* Ref. & Feedb.						
16-50	External Reference	0 N/A	All set-ups	FALSE	-1	Int16
16-52	Feedback[Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-53	Digi Pot Reference	0 N/A	All set-ups	FALSE	-2	Int16
16-54	Feedback 1 [Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-55	Feedback 2 [Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-56	Feedback 3 [Unit]	0 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-6* Inputs & Outputs						
16-60	Digital Input	0 N/A	All set-ups	FALSE	0	Uint16
16-61	Terminal 53 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
16-62	Analog Input 53	0 N/A	All set-ups	FALSE	-3	Int32
16-63	Terminal 54 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
16-64	Analog Input 54	0 N/A	All set-ups	FALSE	-3	Int32
16-65	Analog Output 42 [mA]	0 N/A	All set-ups	FALSE	-3	Int16
16-66	Digital Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
16-67	Pulse Input #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-68	Pulse Input #33 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-69	Pulse Output #27 [Hz]	0 N/A	All set-ups	FALSE	0	Int32

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
16-70	Pulse Output #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-71	Relay Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
16-72	Counter A	0 N/A	All set-ups	TRUE	0	Int32
16-73	Counter B	0 N/A	All set-ups	TRUE	0	Int32
16-75	Analog In X30/11	0 N/A	All set-ups	FALSE	-3	Int32
16-76	Analog In X30/12	0 N/A	All set-ups	FALSE	-3	Int32
16-77	Analog Out X30/8 [mA]	0 N/A	All set-ups	FALSE	-3	Int16
16-8* Fieldbus & FC Port						
16-80	Fieldbus CTW 1	0 N/A	All set-ups	FALSE	0	V2
16-82	Fieldbus REF 1	0 N/A	All set-ups	FALSE	0	N2
16-84	Comm. Option STW	0 N/A	All set-ups	FALSE	0	V2
16-85	FC Port CTW 1	0 N/A	All set-ups	FALSE	0	V2
16-86	FC Port REF 1	0 N/A	All set-ups	FALSE	0	N2
16-9* Diagnosis Readouts						
16-90	Alarm Word	0 N/A	All set-ups	FALSE	0	Uint32
16-91	Alarm Word 2	0 N/A	All set-ups	FALSE	0	Uint32
16-92	Warning Word	0 N/A	All set-ups	FALSE	0	Uint32
16-93	Warning Word 2	0 N/A	All set-ups	FALSE	0	Uint32
16-94	Ext. Status Word	0 N/A	All set-ups	FALSE	0	Uint32
16-95	Ext. Status Word 2	0 N/A	All set-ups	FALSE	0	Uint32
16-96	Maintenance Word	0 N/A	All set-ups	FALSE	0	Uint32

Table 6.28

6.16.13 25-** Cascade Pack Controller

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
25-0* System Settings						
25-00	Pack Controller	[0] Disabled	2 set-ups	FALSE	-	Uint8
25-04	Compressor Cycling	[0] Disabled	All set-ups	TRUE	-	Uint8
25-06	Number of Compressors	2 N/A	2 set-ups	FALSE	0	Uint8
25-2* Zone Settings						
25-20	Neutral Zone [unit]	4 ReferenceFeedbackUnit	All set-ups	TRUE	-2	Uint32
25-21	+ Zone [unit]	3 ReferenceFeedbackUnit	All set-ups	TRUE	-2	Uint32
25-22	- Zone [unit]	3 ReferenceFeedbackUnit	All set-ups	TRUE	-2	Uint32
25-23	Fixed Speed neutral Zone [unit]	4 ReferenceFeedbackUnit	All set-ups	TRUE	-2	Uint32
25-24	+ Zone Delay	120 s	All set-ups	TRUE	0	Uint32
25-25	- Zone Delay	60 s	All set-ups	TRUE	0	Uint32
25-26	++ Zone Delay	60 s	All set-ups	TRUE	0	Uint32
25-27	-- Zone Delay	30 s	All set-ups	TRUE	0	Uint32
25-3* Staging Functions						
25-30	Destage At No-Flow	[0] Disabled	All set-ups	TRUE	-	Uint8
25-31	Stage Function	[0] Disabled	All set-ups	TRUE	-	Uint8
25-32	Stage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-33	Destage Function	[0] Disabled	All set-ups	TRUE	-	Uint8
25-34	Destage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-4* Staging Settings						
25-42	Staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-43	Destaging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-44	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-45	Staging Speed [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
25-46	Destaging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-47	Destaging Speed [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
25-8* Status						
25-80	Pack Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
25-81	Compressor Status	0 N/A	All set-ups	TRUE	0	VisStr[25]
25-82	Lead Compressor	0 N/A	All set-ups	TRUE	0	Uint8
25-83	Relay Status	0 N/A	All set-ups	TRUE	0	VisStr[4]
25-84	Compressor ON Time	0 h	All set-ups	TRUE	74	Uint32
25-85	Relay ON Time	0 h	All set-ups	TRUE	74	Uint32
25-86	Reset Relay Counters	[0] Do not reset	All set-ups	TRUE	-	Uint8
25-87	Inverse Interlock	0 N/A	All set-ups	TRUE	0	Uint16
25-88	Pack capacity [%]	0 %	All set-ups	TRUE	0	Uint16
25-9* Service						
25-90	Compressor Interlock	[0] Off	All set-ups	TRUE	-	Uint8
25-91	Manual Alternation	0 N/A	All set-ups	TRUE	0	Uint8

Table 6.29

6.16.14 28-** Compressor Function

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
28-2* Discharge Temperature Monitor						
28-20	Temperature Source	[0] None	All set-ups	FALSE	-	Uint8
28-21	Temperature Unit	[60] °C	All set-ups	FALSE	-	Uint8
28-24	Warning Level	130 N/A	All set-ups	FALSE	0	Uint16
28-25	Warning Action	[1] Decrease cooling	All set-ups	FALSE	-	Uint8
28-26	Emergency Level	145 N/A	All set-ups	FALSE	0	Uint16
28-27	Discharge Temperature	0 DTM_ReadoutUnit	All set-ups	TRUE	0	Int32
28-7* Day/Night Settings						
28-71	Day/Night Bus Indicator	[0] Day	All set-ups	TRUE	-	Uint8
28-72	Enable Day/Night Via Bus	[0] Disabled	All set-ups	TRUE	-	Uint8
28-73	Night Setback	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
28-74	Night Speed Drop [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
28-75	Night Speed Drop Override	0 N/A	All set-ups	TRUE	-3	Int32
28-76	Night Speed Drop [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
28-8* P0 Optimization						
28-81	dP0 Offset	0 K	All set-ups	TRUE	-1	Int32
28-82	P0	0 K	All set-ups	TRUE	-3	Int32
28-83	P0 Setpoint	0 K	All set-ups	TRUE	-3	Int32
28-84	P0 Reference	0 K	All set-ups	TRUE	-3	Int32
28-85	P0 Minimum Reference	0 K	All set-ups	TRUE	0	Int32
28-86	P0 Maximum Reference	0 K	All set-ups	TRUE	0	Int32
28-87	Most Loaded Controller	0 N/A	All set-ups	TRUE	0	Int16
28-9* Injection Control						
28-90	Injection On	[0] Off	All set-ups	TRUE	-	Uint8
28-91	Delayed Compressor Start	[0] No	All set-ups	TRUE	-	Uint8

Table 6.30

7 Troubleshooting

7.1.1 Warnings/Alarm Messages

A warning or an alarm is signalled by the relevant LED on the front of the frequency converter and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the frequency converter will have tripped. Alarms must be reset to restart operation once their cause has been rectified.

7

This may be done in three ways

- By pressing [Reset].
- Via a digital input with the "Reset" function.
- Via serial communication/optional fieldbus.

NOTE

After a manual reset pressing [Reset], [Auto On] must be pressed to restart the motor.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also *Table 7.1*).

Alarms that are trip-locked offer additional protection, meaning that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in *14-20 Reset Mode* (Warning: automatic wake-up is possible!)

If a warning and alarm is marked against a code in *Table 7.1*, this means that either a warning occurs before an alarm, or else that it is possible to specify whether it is a warning or an alarm that is to be displayed for a given fault.

This is possible, for instance, in *1-90 Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash. Once the problem has been rectified, only the alarm continues flashing until the frequency converter is reset.

NOTE

No missing motor phase detection (numbers 30-32) and no stall detection is active when *1-10 Motor Construction* is set to *[1] PM non salient SPM*.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		6-01 Live Zero Timeout Function
3	No motor	(X)			1-80 Function at Stop
4	Mains phase loss	(X)	(X)	(X)	14-12 Function at Mains Imbalance
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over-voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR over temperature	(X)	(X)		1-90 Motor Thermal Protection
11	Motor thermistor over temperature	(X)	(X)		1-90 Motor Thermal Protection
12	Torque limit	X	X		
13	Over Current	X	X	X	

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
14	Earth Fault	X	X		
15	Hardware mismatch		X	X	
16	Short Circuit		X	X	
17	Control word time-out	(X)	(X)		8-04 Control Word Timeout Function
18	Start Failed		X		1-77 Compressor Start Max Speed [RPM] and 1-79 Compressor Start Max Time to Trip
19	Discharge Temp. High	X	X		*28-2x Discharge Temp. Monitor*
20	Temp. Input Error				
21	Param Error				
22	Hoist Mech. Brake	(X)	(X)		Parameter group 2-2*
23	Internal Fans	X			
24	External Fans	X			
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		2-13 Brake Power Monitoring
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		2-15 Brake Check
29	Heatsink temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
31	Motor phase V missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
32	Motor phase W missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
33	Inrush Fault		X	X	
34	Fieldbus communication fault	X	X		
35	Option Fault				
36	Mains failure	X	X		
37	Phase imbalance		X		
38	Internal Fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			5-00 Digital I/O Mode, 5-01 Terminal 27 Mode
41	Overload of Digital Output Terminal 29	(X)			5-00 Digital I/O Mode, 5-02 Terminal 29 Mode
42	Ovrld X30/6-7	(X)			
43	Ext. Supply (option)				
45	Earth Fault 2	X	X		
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit		X		1-86 Trip Speed Low [RPM]
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA time-out		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External Interlock	X	X		
61	Feedback Error	(X)	(X)		4-30 Motor Feedback Loss Function
62	Output Frequency at Maximum Limit	X			
63	Mechanical Brake Low		(X)		2-20 Release Brake Current
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop	(X)	(X)[1)]		5-19 Terminal 37 Safe Stop
69	Pwr. Card Temp		X	X	
70	Illegal FC configuration			X	
71	PTC 1 Safe Stop				
72	Dangerous failure				
73	Safe Stop Auto Restart	(X)	(X)		5-19 Terminal 37 Safe Stop
74	PTC Thermistor			X	
75	Illegal Profile Sel.		X		
76	Power Unit Setup	X			
77	Reduced power mode	X			14-59 Actual Number of Inverter Units
78	Tracking Error	(X)	(X)		4-34 Tracking Error Function
79	Illegal PS config		X	X	
80	Drive Initialized to Default Value		X		
81	CSIV corrupt		X		
82	CSIV parameter error		X		
83	Illegal Option Combination			X	
84	No Safety Option		X		
88	Option Detection			X	
89	Mechanical Brake Sliding	X			
90	Feedback Monitor	(X)	(X)		17-61 Feedback Signal Monitoring
91	Analog input 54 wrong settings			X	S202
163	ATEX ETR cur.lim.warning	X			
164	ATEX ETR cur.lim.alarm		X		
165	ATEX ETR freq.lim.warning	X			
166	ATEX ETR freq.lim.alarm		X		
250	New spare parts			X	
251	New Type Code		X	X	

Table 7.1 Alarm/Warning Code List

(X) Dependent on parameter

1) Can not be Auto reset via 14-20 Reset Mode

A trip is the action when an alarm has appeared. The trip will coast the motor and can be reset by pressing [Reset] or make a reset by a digital input (parameter group 5-1*

[1]). The origin event that caused an alarm cannot damage the frequency converter or cause dangerous conditions. A trip lock is an action when an alarm occurs, which may damage the frequency converter or connected parts. A Trip Lock situation can only be reset by a power cycling.

LED indication	
Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Table 7.2

Bit	Hex	Dec	Alarm Word	Alarm Word 2	Warning Word	Warning Word 2	Extended Status Word
Alarm Word Extended Status Word							
0	00000001	1	Brake Check (A28)	ServiceTrip, Read/ Write	Brake Check (W28)	reserved	Ramping
1	00000002	2	Heatsink temp. (A29)	ServiceTrip, (reserved)	Heatsink temp. (W29)	reserved	AMA Running
2	00000004	4	Earth Fault (A14)	ServiceTrip, Typecode/ Sparepart	Earth Fault (W14)	reserved	Start CW/CCW start_possible is active, when the DI selections [12] OR [13] are active and the requested direction matches the reference sign
3	00000008	8	Ctrl.Card Temp (A65)	ServiceTrip, (reserved)	Ctrl.Card Temp (W65)	reserved	Slow Down slow down command active, e.g. via CTW bit 11 or DI
4	00000010	16	Ctrl. Word TO (A17)	ServiceTrip, (reserved)	Ctrl. Word TO (W17)		Catch Up catch up command active, e.g. via CTW bit 12 or DI
5	00000020	32	Over Current (A13)	reserved	Over Current (W13)	reserved	Feedback High feedback > 4-57
6	00000040	64	Torque Limit (A12)	reserved	Torque Limit (W12)	reserved	Feedback Low feedback < 4-56
7	00000080	128	Motor Th Over (A11)	reserved	Motor Th Over (W11)	reserved	Output Current High current > 4-51
8	00000100	256	Motor ETR Over (A10)	reserved	Motor ETR Over (W10)	reserved	Output Current Low current < 4-50
9	00000200	512	Inverter Overld. (A9)	reserved	Inverter Overld (W9)	reserved	Output Freq High speed > 4-53
10	00000400	1024	DC under Volt (A8)	reserved	DC under Volt (W8)		Output Freq Low speed < 4-52
11	00000800	2048	DC over Volt (A7)	reserved	DC over Volt (W7)		Brake Check OK brake test NOT ok
12	00001000	4096	Short Circuit (A16)	reserved	DC Voltage Low (W6)	reserved	Braking Max BrakePower > BrakePowerLimit (2-12)
13	00002000	8192	Inrush Fault (A33)	reserved	DC Voltage High (W5)		Braking
14	00004000	16384	Mains ph. Loss (A4)	reserved	Mains ph. Loss (W4)		Out of Speed Range
15	00008000	32768	AMA Not OK	reserved	No Motor (W3)		OVC Active
16	00010000	65536	Live Zero Error (A2)	reserved	Live Zero Error (W2)		AC Brake

Bit	Hex	Dec	Alarm Word	Alarm Word 2	Warning Word	Warning Word 2	Extended Status Word
17	00020000	131072	Internal Fault (A38)	KTY error	10V Low (W1)	KTY Warn	Password Timelock number of allowed password trials exceeded - timelock active
18	00040000	262144	Brake Overload (A26)	Fans error	Brake Overload (W26)	Fans Warn	Password Protection 0-61 = ALL_NO_ACCESS OR BUS_NO_ACCESS OR BUS_READONLY
19	00080000	524288	U phase Loss (A30)	ECB error	Brake Resistor (W25)	ECB Warn	Reference High reference > 4-55
20	00100000	1048576	V phase Loss (A31)	reserved	Brake IGBT (W27)	reserved	Reference Low reference < 4-54
21	00200000	2097152	W phase Loss (A32)	reserved	Speed Limit (W49)	reserved	Local Reference reference site = REMOTE -> auto on pressed & active
22	00400000	4194304	Fieldbus Fault (A34)	reserved	Fieldbus Fault (W34)	reserved	Protection Mode
23	00800000	8388608	24 V Supply Low (A47)	reserved	24V Supply Low (W47)	reserved	Unused
24	01000000	16777216	Mains Failure (A36)	reserved	Mains Failure (W36)	reserved	Unused
25	02000000	33554432	1.8V Supply Low (A48)	reserved	Current Limit (W59)	reserved	Unused
26	04000000	67108864	Brake Resistor (A25)	reserved	Low Temp (W66)	reserved	Unused
27	08000000	134217728	Brake IGBT (A27)	reserved	Voltage Limit (W64)	reserved	Unused
28	10000000	268435456	Option Change (A67)	reserved	Encoder loss (W90)	reserved	Unused
29	20000000	536870912	Drive Initialized(A80)	Feedback Fault (A61, A90)	Feedback Fault (W61, W90)		Unused
30	40000000	1073741824	Safe Stop (A68)	PTC 1 Safe Stop (A71)	Safe Stop (W68)	PTC 1 Safe Stop (W71)	Unused
31	80000000	2147483648	Mech. brake low (A63)	Dangerous Failure (A72)	Extended Status Word		Unused

Table 7.3 Description of Alarm Word, Warning Word and Extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnose. See also *16-94 Ext. Status Word*.

WARNING 1, 10 Volts low

The control card voltage is below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

This condition can be caused by a short in a connected potentiometer or improper wiring of the potentiometer.

Troubleshooting

Remove the wiring from terminal 50. If the warning clears, the problem is with the customer wiring. If the warning does not clear, replace the control card.

WARNING/ALARM 2, Live zero error

This warning or alarm only appears if programmed by the user in *6-01 Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

Troubleshooting

Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

Check that the frequency converter programming and switch settings match the analog signal type.

Perform Input Terminal Signal Test.

WARNING/ALARM 3, No motor

No motor has been connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss
A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed at *14-12 Function at Mains Imbalance*.

Troubleshooting
Check the supply voltage and supply currents to the frequency converter.

WARNING 5, DC link voltage high
The intermediate circuit voltage (DC) is higher than the high voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

WARNING 6, DC link voltage low
The intermediate circuit voltage (DC) is lower than the low voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage
If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

Troubleshooting

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate the functions in *2-10 Brake Function*

Increase *14-26 Trip Delay at Inverter Fault*

If the alarm/warning occurs during a power sag the solution is to use kinetic back-up (*14-10 Mains Failure*)

WARNING/ALARM 8, DC under voltage
If the intermediate circuit voltage (DC link) drops below the under voltage limit, the frequency converter checks if a 24 V DC backup supply is connected. If no 24 V DC backup supply is connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

Check that the supply voltage matches the frequency converter voltage.

Perform input voltage test.

Perform soft charge circuit test.

WARNING/ALARM 9, Inverter overload
The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection issues a warning at 98% and trips at 100%, while giving an alarm. The frequency converter *cannot* be reset until the counter is below 90%.
The fault is that the frequency converter has run with more than 100% overload for too long.

Troubleshooting

Compare the output current shown on the LCP with the frequency converter rated current.

Compare the output current shown on the LCP with measured motor current.

Display the Thermal Drive Load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter increases. When running below the frequency converter continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor overload temperature
According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

Check for motor overheating.

Check if the motor is mechanically overloaded

Check that the motor current set in *1-24 Motor Current* is correct.

Ensure that Motor data in parameters 1-20 through 1-25 are set correctly.

If an external fan is in use, check in *1-91 Motor External Fan* that it is selected.

Running AMA in *1-29 Automatic Motor Adaptation (AMA)* tunes the frequency converter to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor thermistor over temp
Check whether the thermistor is disconnected. Select whether the frequency converter issues a warning or an alarm in *1-90 Motor Thermal Protection*.

Troubleshooting

Check for motor overheating.

Check if the motor is mechanically overloaded.

When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check *1-93 Thermistor Source* selects terminal 53 or 54.

When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50. Check *1-93 Thermistor Source* selects terminal 18 or 19.

WARNING/ALARM 12, Torque limit
The torque has exceeded the value in *4-16 Torque Limit Motor Mode* or the value in *4-17 Torque Limit Generator Mode*. *14-25 Trip Delay at Torque Limit* can change this from a warning only condition to a warning followed by an alarm.

Troubleshooting

If the motor torque limit is exceeded during ramp up, extend the ramp up time.

If the generator torque limit is exceeded during ramp down, extend the ramp down time.

If torque limit occurs while running, possibly increase the torque limit. Be sure the system can operate safely at a higher torque.

Check the application for excessive current draw on the motor.

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WARNING/ALARM 13, Over current
The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the frequency converter trips and issues an alarm. This fault may be caused by shock loading or quick acceleration with high inertia loads. It may also appear after kinetic back-up if the acceleration during ramp up is quick. If extended mechanical brake control is selected, trip can be reset externally.

Troubleshooting

Remove power and check if the motor shaft can be turned.

Check that the motor size matches the frequency converter.

Check parameters 1-20 to 1-25 for correct motor data.

ALARM 14, Earth (ground) fault
There is current from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.

Troubleshooting:

Remove power to the frequency converter and repair the earth fault.

Check for earth faults in the motor by measuring the resistance to ground of the motor leads and the motor with a megohmmeter.

ALARM 15, Hardware mismatch
A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact your Danfoss supplier:

15-40 FC Type

15-41 Power Section

15-42 Voltage

15-43 Software Version

15-45 Actual Typecode String

15-49 SW ID Control Card

15-50 SW ID Power Card

15-60 Option Mounted

15-61 Option SW Version (for each option slot)

ALARM 16, Short circuit
There is short-circuiting in the motor or motor wiring.

Remove power to the frequency converter and repair the short circuit.

WARNING/ALARM 17, Control word timeout
There is no communication to the frequency converter. The warning will only be active when *8-04 Control Word Timeout Function* is NOT set to *[0] Off*.
If *8-04 Control Word Timeout Function* is set to *[5] Stop and Trip*, a warning appears and the frequency converter ramps down until it stops then displays an alarm.

Troubleshooting:

Check connections on the serial communication cable.

Increase *8-03 Control Word Timeout Time*

Check the operation of the communication equipment.

Verify a proper installation based on EMC requirements.

ALARM 18, Start failed
The speed has not been able to exceed *1-77 Compressor Start Max Speed [RPM]* during start within the allowed time. (set in *1-79 Compressor Start Max Time to Trip*). This may be caused by a blocked motor.

Warning/ Alarm 19, Discharge Temperature High
Warning:
The discharge temperature exceeds the level programmed in *28-25 Warning Level*.

Alarm:
The discharge temperature exceeds the level programmed in *28-26 Emergency Level*.

WARNING/ALARM 20, Temp. input error
The temperature sensor is not connected.

WARNING/ALARM 21, Parameter error
The parameter is out of range. The parameter number is reported in the LCP. The affected parameter must be set to a valid value.

WARNING/ALARM 22, Hoist mechanical brake
Report value shows what kind it is.
0 = The torque ref. was not reached before timeout.
1 = There was no brake feedback before timeout.

WARNING 23, Internal fan fault
The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 Fan Monitor* (*[0] Disabled*).

For the D, E, and F Frame filters, the regulated voltage to the fans is monitored.

Troubleshooting

Check for proper fan operation.

Cycle power to the frequency converter and check that the fan operates briefly at start up.

Check the sensors on the heatsink and control card.

WARNING 24, External fan fault

The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 Fan Monitor* (*[0] Disabled*).

Troubleshooting

Check for proper fan operation.

Cycle power to the frequency converter and check that the fan operates briefly at start-up.

Check the sensors on the heatsink and control card.

WARNING 25, Brake resistor short circuit

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational but without the brake function. Remove power to the frequency converter and replace the brake resistor (see *2-15 Brake Check*).

WARNING/ALARM 26, Brake resistor power limit

The power transmitted to the brake resistor is calculated as a mean value over the last 120 seconds of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value set in *2-16 AC brake Max. Current*. The warning is active when the dissipated braking is higher than 90% of the brake resistance power. If *[2] Trip* is selected in *2-13 Brake Power Monitoring*, the frequency converter will trip when the dissipated braking power reaches 100%.

WARNING/ALARM 27, Brake chopper fault

The brake transistor is monitored during operation and if a short circuit occurs, the brake function is disabled and a warning is issued. The frequency converter is still operational but, since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.
Remove power to the frequency converter and remove the brake resistor.

WARNING/ALARM 28, Brake check failed

The brake resistor is not connected or not working. Check *2-15 Brake Check*.

ALARM 29, Heatsink temp

The maximum temperature of the heatsink has been exceeded. The temperature fault will not reset until the temperature falls below a defined heatsink temperature. The trip and reset points are different based on the frequency converter power size.

Troubleshooting

Check for the following conditions.

Ambient temperature too high.

Motor cable too long.

Incorrect airflow clearance above and below the frequency converter.

Blocked airflow around the frequency converter.

Damaged heatsink fan.

Dirty heatsink.

ALARM 30, Motor phase U missing

Motor phase U between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing

Motor phase V between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing

Motor phase W between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase W.

ALARM 33, Inrush fault

Too many power-ups have occurred within a short time period. Let the unit cool to operating temperature.

WARNING/ALARM 34, Fieldbus communication fault

The fieldbus on the communication option card is not working.

WARNING/ALARM 35, Option fault

An option alarm is received. The alarm is option specific. The most likely cause is a power-up or a communication fault.

WARNING/ALARM 36, Mains failure

This warning/alarm is only active if the supply voltage to the frequency converter is lost and *14-10 Mains Failure* is NOT set to *[0] No Function*. Check the fuses to the frequency converter and mains power supply to the unit.

ALARM 37, Phase imbalance

There is a current imbalance between the power units

ALARM 38, Internal fault

When an internal fault occurs, a code number defined in *Table 7.4* is displayed.

Troubleshooting

Cycle power

Check that the option is properly installed

Check for loose or missing wiring

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It may be necessary to contact your Danfoss supplier or service department. Note the code number for further troubleshooting directions.

No.	Text
0	Serial port cannot be initialised. Contact your Danfoss supplier or Danfoss Service Department.
256-258	Power EEPROM data is defective or too old
512-519	Internal fault. Contact your Danfoss supplier or Danfoss Service Department.
783	Parameter value outside of min/max limits
1024-1284	Internal fault. Contact your Danfoss supplier or the Danfoss Service Department.
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379-2819	Internal fault. Contact your Danfoss supplier or Danfoss Service Department.
2820	LCP stack overflow
2821	Serial port overflow
2822	USB port overflow
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware
5125	Option in slot C0: Hardware incompatible with control board hardware
5126	Option in slot C1: Hardware incompatible with control board hardware
5376-6231	Internal fault. Contact your Danfoss supplier or Danfoss Service Department.

Table 7.4 Internal Fault Codes

ALARM 39, Heatsink sensor
No feedback from the heatsink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.

WARNING 40, Overload of digital output terminal 27
Check the load connected to terminal 27 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-01 Terminal 27 Mode*.

WARNING 41, Overload of digital output terminal 29
Check the load connected to terminal 29 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-02 Terminal 29 Mode*.

WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7
For X30/6, check the load connected to X30/6 or remove the short-circuit connection. Check *5-32 Term X30/6 Digi Out (MCB 101)*.

For X30/7, check the load connected to X30/7 or remove the short-circuit connection. Check *5-33 Term X30/7 Digi Out (MCB 101)*.

ALARM 43, Ext. supply
MCB 113 Ext. Relay Option is mounted without ext. 24V DC. Either connect an ext. 24V DC supply or specify that no external supply is used via *14-80 Option Supplied by External 24VDC* [0]. A change in *14-80 Option Supplied by External 24VDC* requires a power cycle.

ALARM 45, Earth fault 2
Earth (ground) fault on start up.

Troubleshooting

Check for proper earthing (grounding) and loose connections.

Check for proper wire size.

Check motor cables for short-circuits or leakage currents.

ALARM 46, Power card supply
The supply on the power card is out of range.

There are three power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, ±18 V. When powered with 24 V DC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with three phase mains voltage, all three supplies are monitored.

Troubleshooting

Check for a defective power card.

Check for a defective control card.

Check for a defective option card.

If a 24 V DC power supply is used, verify proper supply power.

WARNING 47, 24 V supply low
The 24 V DC is measured on the control card. The external 24 V DC backup power supply may be overloaded, otherwise contact the Danfoss supplier.

WARNING 48, 1.8 V supply low
The 1.8 V DC supply used on the control card is outside of allowable limits. The power supply is measured on the control card. Check for a defective control card. If an option card is present, check for an overvoltage condition.

WARNING 49, Speed limit
When the speed is not within the specified range in *4-11 Motor Speed Low Limit [RPM]* and *4-13 Motor Speed High Limit [RPM]*, the frequency converter shows a warning. When the speed is below the specified limit in *1-86 Trip Speed Low [RPM]* (except when starting or stopping) the frequency converter will trip.

ALARM 50, AMA calibration failed
Contact your Danfoss supplier or Danfoss Service Department.

ALARM 51, AMA check U_{nom} and I_{nom}
The settings for motor voltage, motor current and motor power are wrong. Check the settings in parameters 1-20 to 1-25.

ALARM 52, AMA low I_{nom}
The motor current is too low. Check the settings.

ALARM 53, AMA motor too big
The motor is too big for the AMA to operate.

ALARM 54, AMA motor too small
The motor is too small for the AMA to operate.

ALARM 55, AMA Parameter out of range
The parameter values of the motor are outside of the acceptable range. AMA will not run.

ALARM 56, AMA interrupted by user
The user has interrupted the AMA.

ALARM 57, AMA internal fault
Try to restart AMA again. Repeated restarts can over heat the motor.

ALARM 58, AMA internal fault
Contact your Danfoss supplier.

WARNING 59, Current limit
The current is higher than the value in *4-18 Current Limit*. Ensure that Motor data in parameters 1-20 to 1-25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

WARNING 60, External interlock
A digital input signal is indicating a fault condition external to the frequency converter. An external interlock has commanded the frequency converter to trip. Clear the external fault condition. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock. Reset the frequency converter.

WARNING/ALARM 61, Feedback error
An error between calculated speed and speed measurement from feedback device. The function Warning/ Alarm/Disabling setting is in *4-30 Motor Feedback Loss Function*. Accepted error setting in *4-31 Motor Feedback Speed Error* and the allowed time the error occur setting in *4-32 Motor Feedback Loss Timeout*. During a commissioning procedure the function may be effective.

WARNING 62, Output frequency at maximum limit
The output frequency has reached the value set in *4-19 Max Output Frequency*. Check the application to determine the cause. Possibly increase the output frequency limit. Be sure the system can operate safely at a higher output frequency. The warning will clear when the output drops below the maximum limit.

ALARM 63, Mechanical brake low
The actual motor current has not exceeded the “release brake” current within the “Start delay” time window.

WARNING/ALARM 65, Control card over temperature
The cutout temperature of the control card is 80 °C.

Troubleshooting

- Check that the ambient operating temperature is within limits
- Check for clogged filters
- Check fan operation
- Check the control card

WARNING 66, Heatsink temperature low
The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module.
Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the frequency converter whenever the motor is stopped by setting *2-00 DC Hold/Preheat Current* at 5% and *1-80 Function at Stop*

ALARM 67, Option module configuration has changed
One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

ALARM 68, Safe Stop activated
Loss of the 24 V DC signal on terminal 37 has caused the filter to trip. To resume normal operation, apply 24 V DC to terminal 37 and reset the filter.

ALARM 69, Power card temperature
The temperature sensor on the power card is either too hot or too cold.

Troubleshooting

Check that the ambient operating temperature is within limits.

Check for clogged filters.

Check fan operation.

Check the power card.

ALARM 70, Illegal frequency converter configuration
The control card and power card are incompatible. Contact your supplier with the type code of the unit from the nameplate and the part numbers of the cards to check compatibility.

ALARM 71, PTC 1 safe stop
Safe Stop has been activated from the MCB 112 PTC Thermistor Card (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T-37 again (when the motor temperature reaches an acceptable level) and when the Digital Input from the MCB 112 is deactivated. When that happens, a reset signal must be is be sent (via Bus, Digital I/O, or by pressing [Reset]).

ALARM 72, Dangerous failure
Safe Stop with Trip Lock. The Dangerous Failure Alarm is issued if the combination of safe stop commands is unexpected. This is the case if the MCB 112 VLT PTC Thermistor Card enables X44/10 but safe stop is somehow

not enabled. Furthermore, if the MCB 112 is the only device using safe stop (specified through selection [4] or [5] in *5-19 Terminal 37 Safe Stop*), an unexpected combination is activation of safe stop without the X44/10 being activated. The following table summarizes the unexpected combinations that lead to Alarm 72. Note that if X44/10 is activated in selection 2 or 3, this signal is ignored! However, the MCB 112 will still be able to activate Safe Stop.

WARNING 73, Safe stop auto restart
Safe stopped. With automatic restart enabled, the motor may start when the fault is cleared.

ALARM 74, PTC Thermistor
Alarm related to the ATEX option. The PTC is not working.

ALARM 75, Illegal profile sel.
Parameter value must not be written while motor is running. Stop motor before writing MCO profile to *8-10 Control Word Profile* for instance.

WARNING 76, Power unit setup
The required number of power units does not match the detected number of active power units.

Troubleshooting:
When replacing an F-frame module, this will occur if the power specific data in the module power card does not match the rest of the frequency converter. Confirm the spare part and its power card are the correct part number.

WARNING 77, Reduced power mode
This warning indicates that the frequency converter is operating in reduced power mode (i.e. less than the allowed number of inverter sections). This warning will be generated on power cycle when the frequency converter is set to run with fewer inverters and will remain on.

ALARM 78, Tracking error
The difference between set point value and actual value has exceeded the value in *4-35 Tracking Error*. Disable the function by *4-34 Tracking Error Function* or select an alarm/warning also in *4-34 Tracking Error Function*. Investigate the mechanics around the load and motor, Check feedback connections from motor – encoder – to frequency converter. Select motor feedback function in *4-30 Motor Feedback Loss Function*. Adjust tracking error band in *4-35 Tracking Error* and *4-37 Tracking Error Ramping*.

ALARM 79, Illegal power section configuration
The scaling card is the incorrect part number or not installed. Also MK102 connector on the power card could not be installed.

ALARM 80, Drive initialised to default value
Parameter settings are initialised to default settings after a manual reset. Reset the unit to clear the alarm.

ALARM 81, CSIV corrupt
CSIV file has syntax errors.

ALARM 82, CSIV parameter error
CSIV failed to init a parameter.

ALARM 83, Illegal option combination
The mounted options are not supported to work together.

ALARM 84, No safety option
The safety option was removed without applying a general reset. Reconnect the safety option.

ALARM 88, Option detection
A change in the option layout has been detected. This alarm occurs when *14-89 Option Detection* is set to [0] *Frozen configuration* and the option layout for some reason has changed. An option layout change has to be enabled in *14-89 Option Detection* before the change is accepted. If the change of configuration is not accepted, it is only possible to reset Alarm 88 (Trip-lock) when the option configuration has been re-established/corrected.

WARNING 89, Mechanical brake sliding
The hoist brake monitor has detected a motor speed > 10 RPM.

ALARM 90, Feedback monitor
Check the connection to encoder/resolver option and eventually replace the MCB 102 or MCB 103.

WARNING/ALARM 104, Mixing fan fault
The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. If the fan is not operating, then the fault is annunciated. The mixing-fan fault can be configured as a warning or an alarm trip by *14-53 Fan Monitor*.

Troubleshooting Cycle power to the frequency converter to determine if the warning/alarm returns.

WARNING 163, ATEX ETR cur.lim.warning
The warning limit of ATEX ETR rated current curve has been reached. The warning is activated at 83% and de-activated at 65% of the permitted thermal overload.

ALARM 164, ATEX ETR cur.lim.alarm
The ATEX ETR permitted thermal overload has been exceeded.

WARNING 165, ATEX ETR freq.lim.warning
The frequency converter is running more than 50 s below the permitted minimum frequency (*1-98 ATEX ETR interpol. points freq.* [0]).

ALARM 166, ATEX ETR freq.lim.alarm
The frequency converter has operated more than 60 s (in a period of 600 s) below the permitted minimum frequency (*1-98 ATEX ETR interpol. points freq.* [0]).

WARNING 250, New spare part
A component in the frequency converter has been replaced. Reset the frequency converter for normal operation.

WARNING 251, New typecode
The power card or other components have been replaced and the typecode changed. Reset to remove the warning and resume normal operation.

8 General Specifications

Mains Supply 3x200 - 240 V AC							
FC 301/FC 302		P15K		P18K		P22K	
High/ Normal Load[1]		HO	NO	HO	NO	HO	NO
	Typical Shaft Output [kW]	15	18.5	18.5	22	22	30
	Enclosure IP20	B4		C3		C3	
	Enclosure IP21	C1		C1		C1	
	Enclosure IP55, IP66	C1		C1		C1	
Output current							
	Continuous (3 x 200-240 V) [A]	59.4	74.8	74.8	88	88	115
	Intermittent (60 s overload) (3 x 200-240 V) [A]	89.1	82.3	112	96.8	132	127
	Continuous kVA (208 V AC) [kVA]	21.4	26.9	26.9	31.7	31.7	41.4
Max. input current							
	Continuous (3 x 200-240 V) [A]	54	68	68	80	80	104
	Intermittent (60 s overload) (3 x 200-240 V) [A]	81	74.8	102	88	120	114
Additional specifications							
	IP20 max. cable cross-section[5] (mains, brake, motor and load sharing)	35 (2)		50 (1)		50 (1)	
	IP21, IP55, IP66 max. cable cross-section[5] (mains, motor) [mm^2 (AWG)] [2]	50 (1)		50 (1)		50 (1)	
	IP21, IP55, IP66 max. cable cross-section[5] (brake, load sharing) [mm^2 (AWG)] [2]	50 (1)		50 (1)		50 (1)	
	Max cable size with mains disconnect [mm^2 (AWG)] [2]	50, 35, 35 (1, 2, 2)					
	Estimated power loss at rated max. load [W] [4]	624	737	740	845	874	1140
	Weight, enclosure IP21, IP55/IP66 [kg]	45		45		45	
	Efficiency[4]	0.96		0.97		0.97	

Table 8.1

For fuse ratings, see 3.4.1 Fuses

1) High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s.

2) American Wire Gauge.

3) Measured using 5 m screened motor cables at rated load and rated frequency.

4) The typical power loss is at nominal load conditions and expected to be within ±15% (tolerence relates to variety in voltage and cable conditions).
Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency will also add to the power loss in the and opposite.
If the switching frequency is increased compared to the default setting, the power losses may rise significantly.
and typical control card power consumptions are included. Further options and customer load may add up to 30W to the losses.
(Though typical only 4 W extra for a fully loaded control card, or options for slot A or slot B, each).

Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (±5%).

5) The three values for the max. cable cross section are for single core, flexible wire and flexible wire with sleeve, respectively.

Mains Supply 3x380 - 500 V AC (FC 302), 3 x 380 - 480V AC (FC 301)							
FC 301/FC 302		P15K		P18K		P22K	
High/ Normal Load[1]		HO	NO	HO	NO	HO	NO
	Typical Shaft output [kW]	15	18.5	18.5	22.0	22.0	30.0
	Enclosure IP20	B3		B4		B4	
	Enclosure IP21	B1		B2		B2	
	Enclosure IP55, IP66	B1		B2		B2	
Output current							
	Continuous (3 x 380-440 V) [A]	32	37.5	37.5	44	44	61
	Intermittent (60 s overload) (3 x 380-440 V) [A]	51.2	41.3	60	48.4	70.4	67.1
	Continuous (3 x 441-500 V) [A]	27	34	34	40	40	52
	Intermittent (60 s overload) (3 x 441-500 V) [A]	43.2	37.4	54.4	44	64	57.2
	Continuous kVA (400 V AC) [kVA]	22.2	26	26	30.5	30.5	42.3
	Continuous kVA (460 V AC) [kVA]		27.1		31.9		41.4
Max. input current							
	Continuous (3 x 380-440 V) [A]	29	34	34	40	40	55
	Intermittent (60 s overload) (3 x 380-440 V) [A]	46.4	37.4	54.4	44	64	60.5
	Continuous (3 x 441-500 V) [A]	25	31	31	36	36	47
	Intermittent (60 s overload) (3 x 441-500 V) [A]	40	34.1	49.6	39.6	57.6	51.7
Additional specifications							
	IP21, IP55, IP66 max. cable cross-section[5] (mains, brake, load sharing) [mm^2 (AWG)] [2]	16, 10, 16 (6, 8, 6)		35,-,-(2,-,-)		35,-,-(2,-,-)	
	IP21, IP55, IP66 max. cable cross-section[5] (motor) [mm^2 (AWG)] [2]	10, 10,- (8, 8,-)		35, 25, 25 (2, 4, 4)		35, 25, 25 (2, 4, 4)	
	IP20 max. cable cross-section[5] (mains, brake, motor and load sharing)	10, 10,- (8, 8,-)		35,-,-(2,-,-)		35,-,-(2,-,-)	
	Max. cable cross-section with Disconnect [mm^2 (AWG)] [2]						
	Estimated power loss at rated max. load [W] [4]	379	465	444	525	547	739
	Weight, enclosure IP20 [kg]	12		23.5		23.5	
	Weight, enclosure IP21, IP55, IP66 [kg]	23		27		27	
	Efficiency[4]	0.98		0.98		0.98	

Table 8.2

For fuse ratings, see 3.4.1 Fuses

1) High overload = 160% torque during 60 s., Normal overload = 110% torque during 60 s.

2) American Wire Gauge.

3) Measured using 5 m screened motor cables at rated load and rated frequency.

4) The typical power loss is at nominal load conditions and expected to be within ±15% (tolerence relates to variety in voltage and cable conditions).
Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency will also add to the power loss in the frequency converter and vice versa.
If the switching frequency is increased compared to the default setting, the power losses may rise significantly.
LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 W to the losses. (Though typical only 4 W extra for a fully loaded control card, or options for slot A or slot B, each).
Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (±5%).

5) The three values for the max. cable cross section are for single core, flexible wire and flexible wire with sleeve, respectively.

Mains Supply 3x525 - 600 V AC							
FC 302		**P15K**		**P18K**		**P22K**	
High/Normal Load[1]		HO	NO	HO	NO	HO	NO
Typical Shaft Output [kW]		15	18.5	18.5	22	22	30
	Enclosure IP21, IP55, IP66	B1		B2		B2	
	Enclosure IP20	B3		B4		B4	
Output current							
	Continuous (3 x 525-550 V) [A]	23	28	28	36	36	43
	Intermittent (3 x 525-550 V) [A]	37	31	45	40	58	47
	Continuous (3 x 525-600 V) [A]	22	27	27	34	34	41
	Intermittent (3 x 525-600 V) [A]	35	30	43	37	54	45
	Continuous kVA (550 V AC) [kVA]	21.9	26.7	26.7	34.3	34.3	41.0
	Continuous kVA (575 V AC) [kVA]	21.9	26.9	26.9	33.9	33.9	40.8
Max. input current							
	Continuous at 550 V [A]	20.9	25.4	25.4	32.7	32.7	39
	Intermittent at 550 V [A]	33	28	41	36	52	43
	Continuous at 575 V [A]	20	24	24	31	31	37
	Intermittent at 575 V [A]	32	27	39	34	50	41
Additional specifications							
	IP21, IP55, IP66 max. cable cross-section[5] (mains, brake, load sharing) [mm² (AWG)] [2]	16, 10, 10 (6, 8, 8)		35,-,-(2,-,-)		35,-,-(2,-,-)	
	IP21, IP55, IP66 max. cable cross-section[5] (motor) [mm² (AWG)] [2]	10, 10,- (8, 8,-)		35, 25, 25 (2, 4, 4)		35, 25, 25 (2, 4, 4)	
	IP20 max. cable cross-section[5] (mains, brake, motor and load sharing)	10, 10,- (8, 8,-)		35,-,-(2,-,-)		35,-,-(2,-,-)	
	Max. cable cross-section with Disconnect [mm² (AWG)] [2]						
	Estimated power loss at rated max. load [W] [4]	285		329		700	
	Weight, enclosure IP21, [kg]	23		27		27	
	Weight, enclosure IP20 [kg]	12		23.5		23.5	
	Efficiency [4]	0.98		0.98		0.98	

Table 8.3

Mains Supply (L1, L2, L3)	
Supply voltage	200-240 V ±10%
Supply voltage	380-480 V ±10%
Supply voltage	525-600 V ±10%
Supply frequency	50/60 Hz
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cos φ) near unity	(> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤ 7.5 kW	Max. 2 times/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ 11 kW	Max. 1 time/min.
Environment according to EN60664-1	Overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100.000 RMS symmetrical Amperes, 240/500/600 V maximum

Motor Compressor Output (U, V, W)	
Output voltage	0-100% of supply voltage
Switching on output	See *14-01 Switching Frequency*
Cable lengths and cross sections	
Max. motor cable length, screened/armoured	150 m
Max. motor cable length, unscreened/unarmoured	300 m
Max. cross section to motor, mains, load sharing and brake *	
Maximum cross section to control terminals, rigid wire	1.5 mm^2/16 AWG (2 x 0.75 mm^2)
Maximum cross section to control terminals, flexible cable	1 mm^2/18 AWG
Maximum cross section to control terminals, cable with enclosed core	0.5 mm^2/20 AWG
Minimum cross section to control terminals	0.25 mm^2

** See Mains Supply tables for more information!*

Digital Inputs	
Voltage level:	0 - 24 V DC
Voltage level, logic.0. PNP	< 5 V DC
Voltage level, logic.1. PNP	> 10 V DC
Voltage level, logic .0. NPN2)	> 19 V DC
Voltage level, logic .1. NPN2)	< 14 V DC
Maximum voltage on input	28 V DC
Input resistance, Ri	approx. 4 kΩ
Safe Stop Terminal 37	
Voltage level	0 - 24 V DC
Voltage level, logic.0. PNP	< 4 V DC
Voltage level, logic.1. PNP	>20 V DC
Nominal input current at 24 V	50 mA rms
Nominal input current at 20 V	60 mA rms
Input capacitance	400 nF

Terminal 37 is fixed PNP logic

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1. Terminals 27 and 29 can also be programmed as output.
2. Except safe stop input Terminal 37.
3. Terminal 37 can only be used as safe stop input.

Terminal 37 is suitable for category 3 installations according to EN 954-1 (safe stop according to category 0 EN 60204-1) as required by the EU Machinery Directive 98/37/EC. Terminal 37 and the Safe Stop function are designed in conformance with EN 60204-1, EN 50178, EN 61800-2, EN 61800-3, and EN 954-1. For correct and safe use of the Safe Stop function follow the related information and instructions in the Application Guidelines.

Analog Inputs	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	-10 to +10 V (scaleable)
Input resistance, Ri: approx	10 kΩ
Max. voltage	± 20 V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, Ri	approx. 200 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Max. error 0.5% of full scale
Bandwidth	100 Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Digital Output	
Programmable digital/pulse outputs	2
Terminal number	27, 29[1)]
Voltage level at digital/frequency output	0-24 V
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 kΩ
Max. capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Max. error: 0.1 % of full scale
Resolution of frequency outputs	12 bit

[1)] Terminal 27 and 29 can also be programmed as input. The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Analog Output	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 to 20 mA
Max. load to common at analog output	500 Ω
Accuracy on analog output	Max. error: 0.5 % of full scale
Resolution on analog output	12 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals

Control Card, 24 V DC Output	
Terminal number	12, 13
Max. load	200 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

Control Card, 10 V DC Output	
Terminal number	50
Output voltage	10.5 V ± 0.5 V
Max. load	15 mA

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals

Control Card, RS-485 Serial Communication	
Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS-485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supplier voltage (PELV).

Control Card, USB Serial Communication	
USB standard	1.1 (Full speed)
USB plug	USB type B device plug

Connection to PC is carried out via a standard host/device USB cable.

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB ground connection is not galvanically isolated from protection earth. Use only isolated laptop as PC connection to the USB connector on the frequency converter drive

Relay Outputs	
Programmable relay outputs	2
Relay 01 Terminal number	1-3 (break),1-2 (make)
Max. terminal load (AC-1)1) on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2 A
Max. terminal load (AC-15)1) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1)1) on 1-2 (NO), 1-3 (NC) (Resistive load)	60 V DC, 1 A
Max. terminal load (DC-13)1) (Inductive load)	24 V DC, 0.1 A
Relay 02 (CDS302 only) Terminal number	4-6 (break), 4-5 (make)
Max. terminal load (AC-1)1) on 4-5 (NO) (Resistive load)	400 V AC, 2 A
Max. terminal load (AC-15)1) on 4-5 (NO) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1)1) on 4-5 (NO) (Resistive load)	80 V DC, 2 A
Surroundings	
Enclosure ≤ enclosure type A	IP20, IP55
Enclosure ≥ enclosure type A, B	IP21, IP55
Enclosure kit available ≤ enclosure type A	IP21/TYPE 1/IP 4X top
Vibration test	1.0 g
Max. relative humidity	5% - 95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 721-3-3), uncoated	class 3C2
Aggressive environment (IEC 721-3-3), coated	class 3C3
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature	Max. 50 °C
Derating for high ambient temperature, see section on special conditions	
Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	- 10 °C
Temperature during storage/transport	-25 - +65/70 °C
Maximum altitude above sea level without derating	1000 m
Maximum altitude above sea level with derating	3000 m
Derating for high altitude, see section on special conditions	
EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3
EMC standards, Immunity	EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

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