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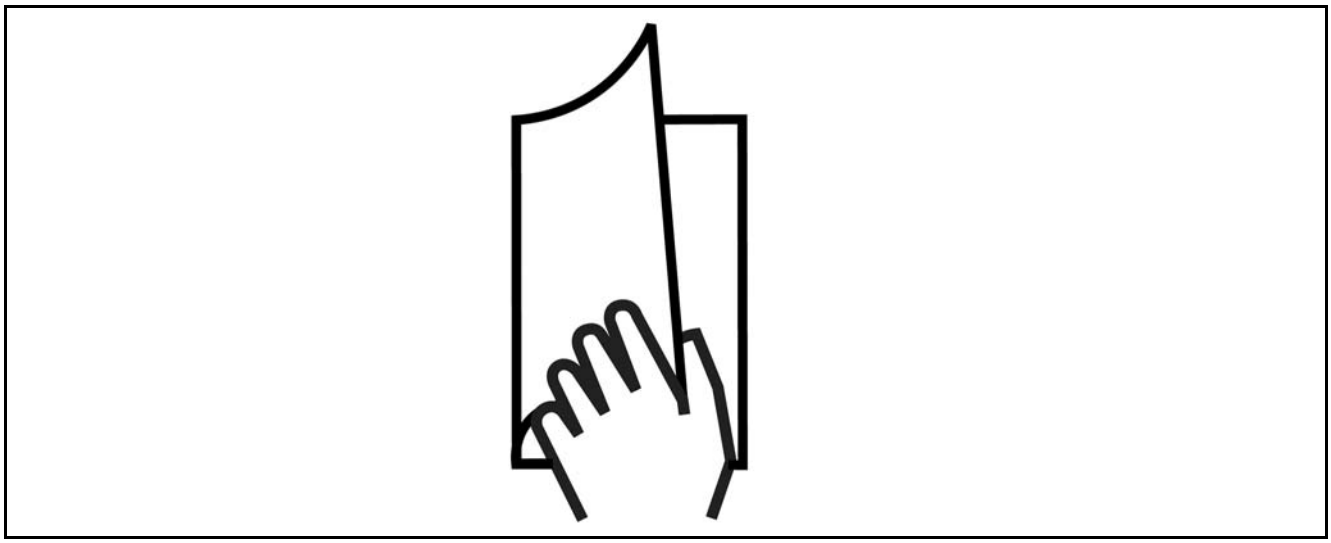
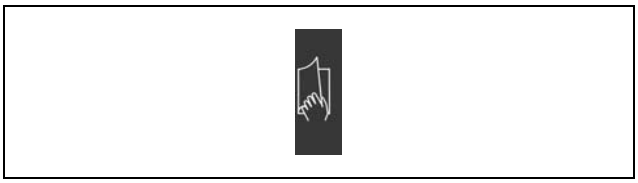
How to Read this Design Guide



□ **How to Read this Design Guide**
This Design Guide will introduce all aspects of your FC 300.

Chapter 1, **How to Read this Design Guide**, introduces the design guide and informs you about the approvals, symbols, and abbreviations used in this manual.



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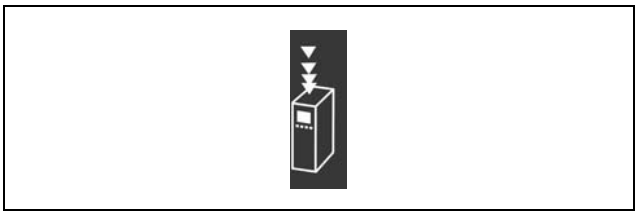
Chapter 2, **Introduction to FC 300**, informs you about available features and instructions on how to handle the FC 300 correctly.



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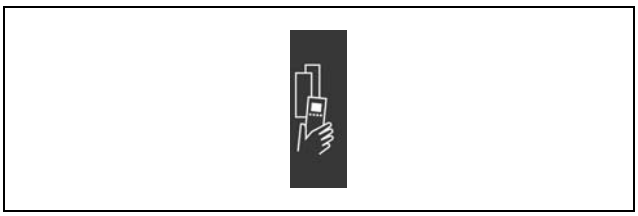
Chapter 3, **How to Select Your VLT**, shows you how to select the right FC 300 model for your plant.



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How to Read this Design Guide

Chapter 4, **How to Order**, supplies the information needed for ordering your FC 300.

Page divider for How to Order.

Chapter 5, **How to Install**, guides you through mechanical and electrical installation.

Page divider for How to Install

Chapter 6, **How to Programme**, shows you how to operate and programme the FC 300 via the Local Control Panel.

Page divider for How to Programme.

Chapter 7, **Troubleshooting**, assists you in solving problems that may occur when using FC 300.

Page divider for Troubleshooting.

Available literature for FC 300

- The VLT® AutomationDrive FC 300 Operating Instructions MG.33.AX.YY provide the neccessary information for getting the drive up and running.
- The VLT® AutomationDrive FC 300 Design Guide MG.33.BX.YY entails all technical information about the drive and customer design and applications.
- The VLT® AutomationDrive FC 300 Profibus Operating Instructions MG.33.CX.YY provide the information required for controlling, monitoring and programming the drive via a Profibus fieldbus.
- The VLT® AutomationDrive FC 300 DeviceNet Operating Instructions MG.33.DX.YY provide the information required for controlling, monitoring and programming the drive via a DeviceNet fieldbus.

Danfoss Drives technical literature is also available online at www.danfoss.com/drives.

How to Read this Design Guide

□ Approvals

□ Symbols

Symbols used in this Design Guide.

NB!:
Indicates something to be noted by the reader.

Indicates a general warning.

Indicates a high-voltage warning.

* Indicates default setting

□ Abbreviations

Alternating current	AC
American wire gauge	AWG
Ampere/AMP	A
Automatic Motor Adaptation	AMA
Current limit	I_{LIM}
Degrees celcius	°C
Direct current	DC
Drive Dependent	D-TYPE
Electronic Thermistor Relay	ETR
Frequency Converter	FC
Gram	g
Hertz	Hz
Kilohertz	kHz
Local Control Panel	LCP
Meter	m
Milliampere	mA
Millisecond	ms
Minute	min
Motion Control Tool	MCT
Motor Type Dependent	M-TYPE
Nanofarad	nF
Newton Meters	Nm
Nominal motor current	$I_{M,N}$
Nominal motor frequency	$f_{M,N}$
Nominal motor power	$P_{M,N}$
Nominal motor voltage	$U_{M,N}$
Parameter	par.
Rated Inverter Output Current	I_{INV}
Revolutions Per Minute	RPM
Second	s
Torque limit	T_{LIM}
Volts	V

□ Definitions

Drive:

D-TYPE

Size and type of the connected drive (dependencies).

$I_{VLT,MAX}$

The maximum output current.

$I_{VLT,N}$

The rated output current supplied by the frequency converter.

$U_{VLT\ MAX}$

The maximum output voltage.

How to Read this Design Guide

Input:

Control command
You can start and stop the connected motor by means of LCP and the digital inputs.
Functions are divided into two groups.

Functions in group 1 have higher priority than functions in group 2.

Group 1	Reset, Coasting stop, Reset and Coasting stop, Quick-stop, DC braking, Stop and the "Off" key.
Group 2	Start, Pulse start, Reversing, Start reversing, Jog and Freeze output

Motor:

f_{JOG}
The motor frequency when the jog function is activated (via digital terminals).

f_M
The motor frequency.

f_{MAX}
The maximum motor frequency.

f_{MIN}
The minimum motor frequency.

$f_{M,N}$
The rated motor frequency (nameplate data).

I_M
The motor current.

$I_{M,N}$
The rated motor current (nameplate data).

M-TYPE
Size and type of the connected motor (dependencies).

$n_{M,N}$
The rated motor speed (nameplate data).

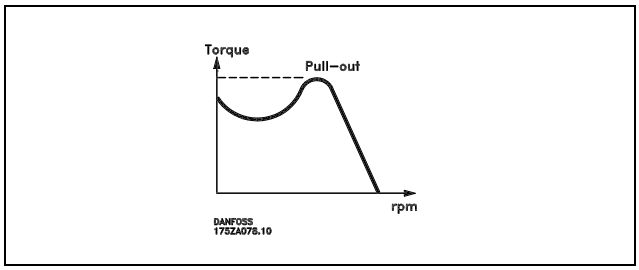
$P_{M,N}$
The rated motor power (nameplate data).

$T_{M,N}$
The rated torque (motor).

U_M
The instantaneous motor voltage.

$U_{M,N}$
The rated motor voltage (nameplate data).

Break-away torque



η_{VLT}
The efficiency of the frequency converter is defined as the ratio between the power output and the power input.

Start-disable command
A stop command belonging to the group 1 control commands - see this group.

Stop command
See Control commands.

References:

Analog Reference
A signal transmitted to the analog inputs 53 or 54, can be voltage or current.

Binary Reference
A signal transmitted to the serial communication port.

Preset Reference
A defined preset reference to be set from -100% to +100% of the reference range. Selection of eight preset references via the digital terminals.

Pulse Reference
A pulse frequency signal transmitted to the digital inputs (terminal 29 or 33).

Ref_{MAX}
Determines the relationship between the reference input at 100% full scale value (typically 10 V, 20mA) and the resulting reference. The maximum reference value set in par. 3-03.

Ref_{MIN}
Determines the relationship between the reference input at 0% value (typically 0V, 0mA, 4mA) and the resulting reference. The minimum reference value set in par. 3-02.

Miscellaneous:

Analog Inputs
The analog inputs are used for controlling various functions of the frequency converter.
There are two types of analog inputs:
Current input, 0-20 mA
Voltage input, 0-10 V DC.

Analog Outputs
The analog outputs can supply a signal of 0-20 mA, 4-20 mA, or a digital signal.

Automatic Motor Adaptation, AMA
AMA algorithm determines the electrical parameters for the connected motor at standstill.

Brake Resistor
The brake resistor is a module capable of absorbing the brake power generated in regenerative braking. This regenerative braking power increases the intermediate circuit voltage and a brake chopper ensures that the power is transmitted to the brake resistor.

CT Characteristics
Constant torque characteristics used for all applications such as conveyor belts and cranes.

Digital Inputs
The digital inputs can be used for controlling various functions of the frequency converter.

Digital Outputs
The drive featyres two Solid State outputs that can supply a 24 V DC (max. 40 mA) signal.

DSP
Digital Signal Processor.

Relay Outputs:
The drive features two programmable Relay Outputs.

ETR
Electronic Thermal Relay is a thermal load calculation based on present load and time.
Its purpose is to estimate the motor temperature.

Hiperface®
Hiperface® is a registered trademark by Stegmann.

Initialising
If initialising is carried out (par. 14-22), the frequency converter returns to the default setting.

Intermittent Duty Cycle
An intermittent duty rating refers to a sequence of duty cycles. Each cycle consists of an on-load and an off-load period. The operation can be either periodic duty or none-periodic duty.

LCP
The Local Control Panel (LCP) makes up a complete interface for control and programming of the FC 300 Series. The control panel is detachable and can be installed up to 3 metres from the frequency converter, i.e. in a front panel by means of the installation kit option.

lsb
Least significant bit.

MCM
Short for Mille Circular Mil, an American measuring unit for cable cross-section. 1 MCM ≡ 0.5067 mm^2.

msb
Most significant bit.

On-line/Off-line Parameters
Changes to on-line parameters are activated immediately after the data value is changed. Changes to off-line parameters are not activated until you enter [OK] on the LCP.

Process PID
The PID regulator maintains the desired speed, pressure, temperature, etc. by adjusting the output frequency to match the varying load.

Pulse Input/Incremental Encoder
An external, digital pulse transmitter used for feeding back information on motor speed. The encoder is used in applications where great accuracy in speed control is required.

RCD
Residual Current Device.

Set-up
You can save parameter settings in four Set-ups. Change between the four parameter Set-ups and edit one Set-up, while another Set-up is active.

SFAVM
Switching pattern called S tator F lux oriented A synchronous V ector M odulation (par. 14-00).

Slip Compensation
The frequency converter compensates for the motor slip by giving the frequency a supplement that follows the measured motor load.

Smart Logic Control (SLC)
The SLC is a sequence of user defined actions executed when the associated user defined events are evaluated as true by the SLC.

Thermistor:
A temperature-dependent resistor placed where the temperature is to be monitored (frequency converter or motor).

Trip
A state entered in fault situations, e.g. if the frequency converter is subject to an over-temperature. Restart is prevented until the cause of the fault has disappeared and the trip state is cancelled by activating reset or, in some cases, by being programmed to reset automatically. Trip may not be used for personal safety.

Trip Locked
A state entered in fault situations requiring physical intervention, e.g. if the frequency converter is subject to a short circuit on the output. A locked trip can be cancelled by cutting off mains, removing the cause of the fault, and reconnecting the frequency converter. Restart is prevented until the trip state is cancelled by activating reset or, in some cases, by being programmed to reset automatically. Trip may not be used for personal safety.

VT Characteristics
Variable torque characteristics used for pumps and fans.

VVC^{plus}
If compared with standard voltage/frequency ratio control, Voltage Vector Control (VVC^{plus}) improves the dynamics and the stability, both when the speed reference is changed and in relation to the load torque.

60° AVM
Switching pattern called 60° A synchronous V ector M odulation (par. 14-00).

How to Read this Design Guide

□ Power Factor

The power factor is the relation between I_1 and I_{RMS}.

$$\text{Power factor} = \frac{\sqrt{3} \times U \times I1 \times \cos\varphi}{\sqrt{3} \times U \times I_{RMS}}$$

The power factor for 3-phase control:

$$= \frac{I_1 \times \cos\varphi 1}{I_{RMS}} = \frac{I_1}{I_{RMS}} \text{ since } \cos\varphi_1 = 1$$

The power factor indicates to which extent the frequency converter imposes a load on the mains supply.
The lower the power factor, the higher the I_{RMS} for the same kW performance.

$$I_{RMS} = \sqrt{I_1^2 + I_5^2 + I_7^2 + .. + I_n^2}$$

In addition, a high power factor indicates that the different harmonic currents are low.
The FC 300 frequency converters' built-in DC coils produce a high power factor, which minimises the imposed load on the mains supply.

How to Read this Design Guide

Introduction to FC 300

130BA140.10

FC 300

Design Guide
Software version: 2.0x

This Design Guide can be used for all FC 300 frequency converters with software version 2.0x.
The software version number can be seen from parameter 15-43.

□ CE Conformity and Labelling

What is CE Conformity and Labelling?

The purpose of CE labelling is to avoid technical trade obstacles within EFTA and the EU. The EU has introduced the CE label as a simple way of showing whether a product complies with the relevant EU directives. The CE label says nothing about the specifications or quality of the product. Frequency converters are regulated by three EU directives:

The machinery directive (98/37/EEC)

All machines with critical moving parts are covered by the machinery directive of January 1, 1995. Since a frequency converter is largely electrical, it does not fall under the machinery directive. However, if a frequency converter is supplied for use in a machine, we provide information on safety aspects relating to the frequency converter. We do this by means of a manufacturer's declaration.

The low-voltage directive (73/23/EEC)

Frequency converters must be CE labelled in accordance with the low-voltage directive of January 1, 1997. The directive applies to all electrical equipment and appliances used in the 50 - 1000 V AC and the 75 - 1500 V DC voltage ranges. Danfoss CE-labels in accordance with the directive and issues a declaration of conformity upon request.

The EMC directive (89/336/EEC)

EMC is short for electromagnetic compatibility. The presence of electromagnetic compatibility means that the mutual interference between different components/appliances does not affect the way the appliances work. The EMC directive came into effect January 1, 1996. Danfoss CE-labels in accordance with the directive and issues a declaration of conformity upon request. To carry out EMC-correct installation, see the instructions in this Design Guide. In addition, we specify which standards our products comply with. We offer the filters presented in the specifications and provide other types of assistance to ensure the optimum EMC result.

The frequency converter is most often used by professionals of the trade as a complex component forming part of a larger appliance, system or installation. It must be noted that the responsibility for the final EMC properties of the appliance, system or installation rests with the installer.

□ What Is Covered

The EU "Guidelines on the Application of Council Directive 89/336/EEC" outline three typical situations of using a frequency converter. See below for EMC coverage and CE labelling.

1. The frequency converter is sold directly to the end-consumer. The frequency converter is for example sold to a DIY market. The end-consumer is a layman. He installs the frequency converter himself for use with a hobby machine, a kitchen appliance, etc. For such applications, the frequency converter must be CE labelled in accordance with the EMC directive.
2. The frequency converter is sold for installation in a plant. The plant is built up by professionals of the trade. It could be a production plant or a heating/ventilation plant designed and installed by professionals of the trade. Neither the frequency converter nor the finished plant has to be CE labelled under the EMC directive. However, the unit must comply with the basic EMC requirements of the directive. This is ensured by using components, appliances, and systems that are CE labelled under the EMC directive.
3. The frequency converter is sold as part of a complete system. The system is being marketed as complete and could e.g. be an air-conditioning system. The complete system must be CE labelled in accordance with the EMC directive. The manufacturer can ensure CE labelling under the EMC directive either by using CE labelled components or by testing the EMC of the system. If he chooses to use only CE labelled components, he does not have to test the entire system.

□ Danfoss VLT Frequency Converter and CE Labelling

CE labelling is a positive feature when used for its original purpose, i.e. to facilitate trade within the EU and EFTA.

However, CE labelling may cover many different specifications. Thus, you have to check what a given CE label specifically covers.

The covered specifications can be very different and a CE label may therefore give the installer a false feeling of security when using a frequency converter as a component in a system or an appliance.

Danfoss CE labels the frequency converters in accordance with the low-voltage directive. This means that if the frequency converter is installed correctly, we guarantee compliance with the low-voltage directive. Danfoss issues a declaration of conformity that confirms our CE labelling in accordance with the low-voltage directive.

The CE label also applies to the EMC directive provided that the instructions for EMC-correct installation and filtering are followed. On this basis, a declaration of conformity in accordance with the EMC directive is issued.

The Design Guide offers detailed instructions for installation to ensure EMC-correct installation. Furthermore, Danfoss specifies which our different products comply with.

Danfoss gladly provides other types of assistance that can help you obtain the best EMC result.

□ **Compliance with EMC Directive 89/336/EEC**

As mentioned, the frequency converter is mostly used by professionals of the trade as a complex component forming part of a larger appliance, system, or installation. It must be noted that the responsibility for the final EMC properties of the appliance, system or installation rests with the installer. As an aid to the installer, Danfoss has prepared EMC installation guidelines for the Power Drive System. The standards and test levels stated for Power Drive Systems are complied with, provided that the EMC-correct instructions for installation are followed, see section *Electrical Installation*.

□ **Mechanical Build-Up**

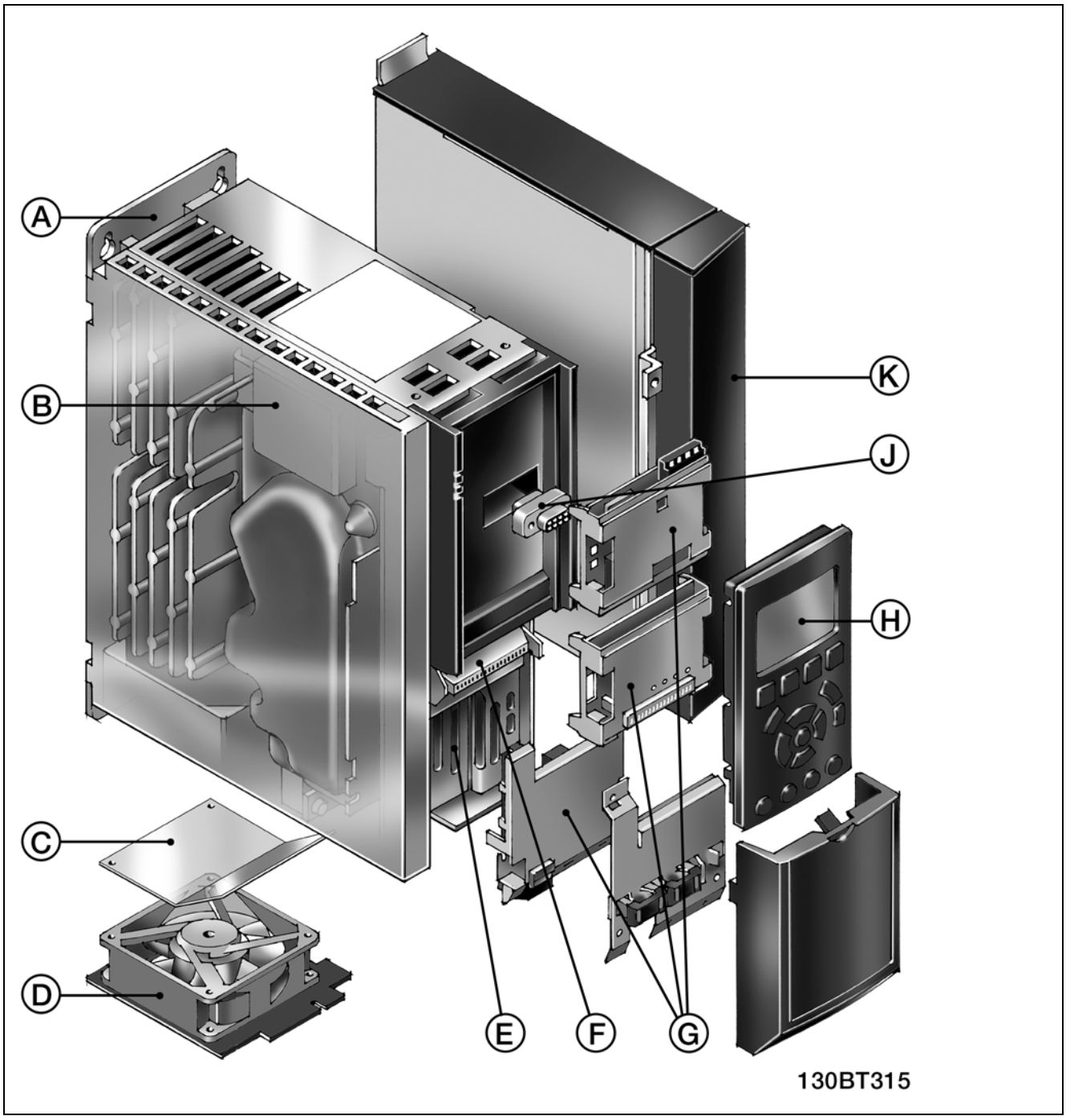


Illustration of the mechanical build-up of FC 300. The exact unit dimensions are listed in chapter *How to Install*.

A	**Cold plate technology** The frequency converter is built upon a very stable aluminium base integrated with the back panel. This provides high mechanical stability, efficient cooling and the possibility of cold plate operation. The cold plate serves as a flat cooling surface on the frequency converter, where a majority of the heat losses dissipates from the electronics to an external cooling surface.
B	**DC coil** The built-in DC coil ensures low harmonic disturbance of the power supply according to IEC-1000-3-2.
C	**Air guiding screen** The screen allows cold air to pass by the electronics only. The plastic air guide screen is enclosed in the package and is easily snapped in place. If the frequency converter is to operate as a cold plate drive, the air guiding screen is inserted in the cooling channel through the bottom of the drive if it is snapped unto the fan. Thus, the amount of heat transferred to the surroundings via the cooling air from the fan is reduced.
D	**Snap off the fan** Like most of the elements, the fan can easily be removed for easy cleaning and remounted.
E	**Safe Stop** The frequency converter comes standard with the safe stop functionality for stop category 0 (EN 60204-1) with safety category 3 (EN 954-1) installations. This feature prevents the drive from starting unintended.
F	**Control signals** Spring-loaded cage clamps add to reliability and facilitate easy commissioning and service.
G	**Options** Options for bus communication, I/O extension etc. can be delivered or ordered built-in from the factory. Options mounted under the LCP is referred to as option Slot A (top) and option Slot B (bottom). Option C (see under K *Free programmable option* is mounted on the side of the drive, while option D is mounted underneath the control cable decoupling clamps.
H	**Local Control Panel** The LCP 102 has a graphical user-interface. Choose between six built-in languages (including Chinese) or have it customised with your own languages and phrases. Two of the languages can be changed by the user. Additionally a simple version, LCP 101, is available with an alpha- numeric display. A complete programming of FC 302 can be handled by both LCP's.
J	**Hot plugable LCP** The LCP can be plugged in or out during operation. Settings are easily transferred via the control panel from one drive to another or from a PC with the MCT-10 set-up software.

□ Air Humidity

The frequency converter has been designed to meet the IEC/EN 60068-2-3 standard, EN 50178 pkt. 9.4.2.2 at 50°C.

□ Aggressive Environments

A frequency converter contains a large number of mechanical and electronic components. All are to some extent vulnerable to environmental effects.

Introduction to FC 300

The frequency converter should not be installed in environments with airborne liquids, particles, or gases capable of affecting and damaging the electronic components. Failure to take the necessary protective measures increases the risk of stoppages, thus reducing the life of the frequency converter.

Liquids can be carried through the air and condense in the frequency converter and may cause corrosion of components and metal parts. Steam, oil, and salt water may cause corrosion of components and metal parts. In such environments, use equipment with enclosure rating IP 55. As an extra protection, coated printet circuit boads can be orded as an option.

Airborne Particles such as dust may cause mechanical, electrical, or thermal failure in the frequency converter. A typical indicator of excessive levels of airborne particles is dust particles around the frequency converter fan. In very dusty environments, use equipment with enclosure rating IP 55 or a cabinet for IP 00/IP 20/TYPE 1 equipment.

In environments with high temperatures and humidity, corrosive gases such as sulphur, nitrogen, and chlorine compounds will cause chemical processes on the frequency converter components.

Such chemical reactions will rapidly affect and damage the electronic components. In such environments, mount the equipment in a cabinet with fresh air ventilation, keeping aggressive gases away from the frequency converter.
An extra protection in such areas is a coating of the printed circuit boards, which can be ordered as an option.

NB!:
Mounting frequency converters in aggressive environments increases the risk of stoppages and considerably reduces the life of the converter.

Before installing the frequency converter, check the ambient air for liquids, particles, and gases. This is done by observing existing installations in this environment. Typical indicators of harmful airborne liquids are water or oil on metal parts, or corrosion of metal parts.

Excessive dust particle levels are often found on installation cabinets and existing electrical installations. One indicator of aggressive airborne gases is blackening of copper rails and cable ends on existing installations.

□ **Vibration and Shock**
The frequency converter has been tested according to a procedure based on the shown standards:

The frequency converter complies with requirements that exist for units mounted on the walls and floors of production premises, as well as in panels bolted to walls or floors.

IEC/EN 60068-2-6:	Vibration (sinusoidal) - 1970
IEC/EN 60068-2-64:	Vibration, broad-band random

□ **Control Principle**
A frequency converter rectifies AC voltage from mains into DC voltage, after which this DC voltage is converted into a AC current with a variable amplitude and frequency.

The motor is supplied with variable voltage / current and frequency, which enables infinitely variable speed control of three-phased, standard AC motors and permanent magnet synchronous motors.

□ **FC 300 Controls**
The frequency converter is capable of controlling either the speed or the torque on the motor shaft. Setting par. 1-00 determines the type of control.

Speed control:
There are two types of speed control:

- Speed open loop control which does not require any feedback.
- Speed closed loop control in the form of a PID control that requires a speed feedback to an input. A properly optimised speed closed loop control will have higher accuracy than a speed open loop control.

Selects which terminal to use as speed PID feedback in par. 7-00.

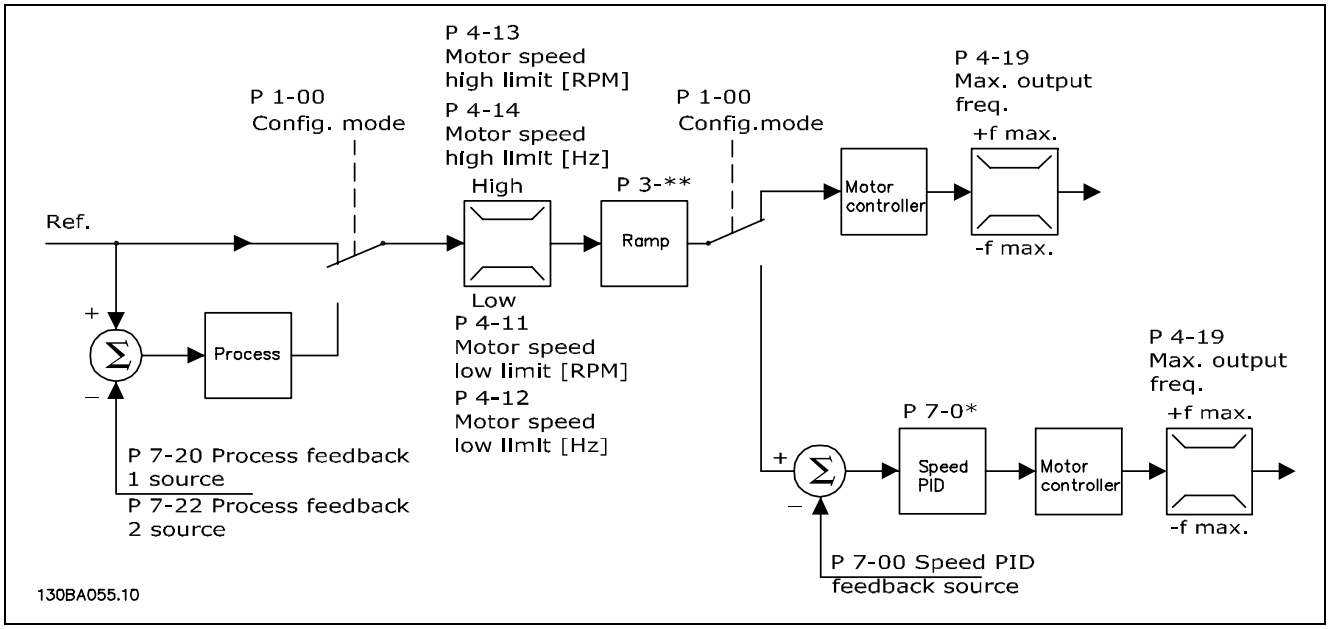
Torque control:
Torque control is part of the motor control and correct settings of motor parameters are very important. The accuracy and settling time of the torque control are determined from *Flux with motor feedback* (par. 1-01 *Motor Control Principle*).

- Flux sensorless offers superior performance in all four quadrants at motor frequencies above 10 Hz.
- Flux with encoder feedback offers superior performance in all four quadrants and at all motor speeds.

The "Flux with encoder feedb" mode requires that an encoder speed feedback signal is present. Select which terminal to use in par. 1-02.

Speed / torque reference:
The reference to these controls can either be a single refrence or be the sum of various references including relatively scaled references. The handling of references is explained in detail later in this section.

□ **Control Structure in VVC^{plus}**
Control structure in VVC^{plus} open loop and closed loop configurations:



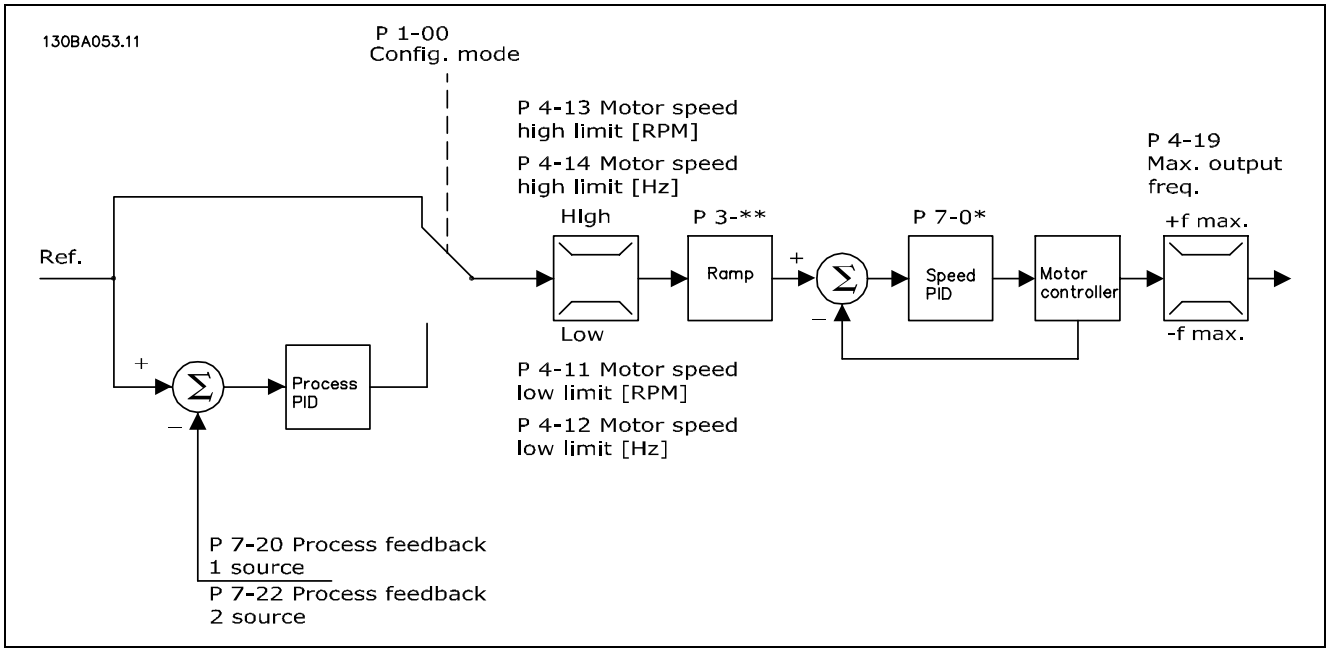
In the configuration shown in the illustration above, par. 1-01 *Motor Control Principle* is set to "VVC^{plus} [1]" and par. 1-00 is set to "Speed open loop [0]". The resulting reference from the reference handling system is received and fed through the ramp limitation and speed limitation before being sent to the motor control. The output of the motor control is then limited by the maximum frequency limit.

If par. 1-00 is set to "Speed closed loop [1]" the resulting reference will be passed from the ramp limitation and speed limitation into a speed PID control. The Speed PID control parameters are located in the par. group 7-0*. The resulting reference from the Speed PID control is sent to the motor control limited by the frequency limit.

Select "Process [3]" in par. 1-00 to use the process PID control for closed loop control of e.g. speed or pressure in the controlled application. The Process PID parameters are located in par. group 7-2* and 7-3*. *Process PID is not available in this software release.*

□ **Control Structure in Flux Sensorless**

Control structure in Flux sensorless open loop and closed loop configurations. (Only available in FC 302):



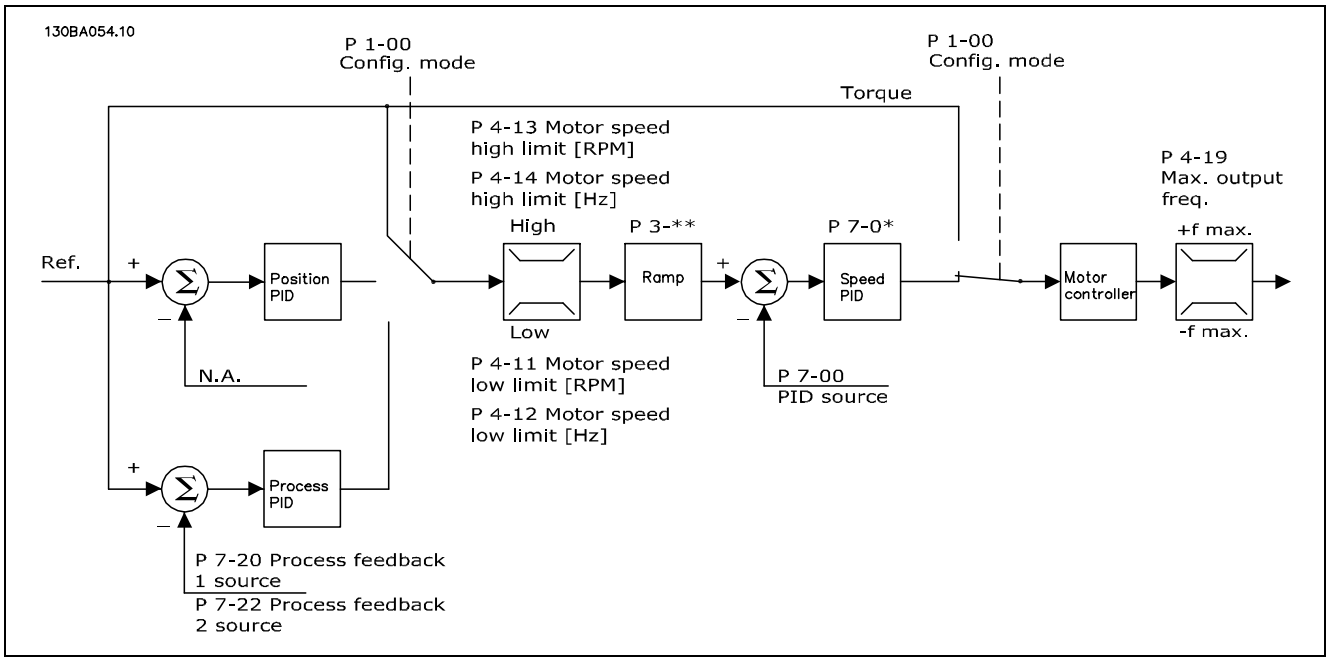
In the shown configuration, par. 1-01 *Motor Control Principle* is set to "Flux sensorless [2]" and par. 1-00 is set to "Speed open loop [0]". The resulting reference from the reference handling system is fed through the ramp and speed limitations as determined by the parameter settings indicated.

An estimated speed feedback is generated to the Speed PID to control the output frequency. The Speed PID must be set with its P,I, and D parameters (par. group 7-0*).

Select "Process [3]" in par. 1-00 to use the process PID control for closed loop control of i.e. speed or pressure in the controlled application. The Process PID parameters are found in par. group 7-2* and 7-3*. *Process PID is not available in this software release*.

□ Control Structure in Flux with Motor Feedback

Control structure in Flux with motor feedback configuration (only available in FC 302):



In the shown configuration, par. 1-01 *Motor Control Principle* is set to "Flux w encoder feedb [3]" and par. 1-00 is set to "Speed closed loop [1]".

The motor control in this configuration relies on a feedback signal from an encoder mounted directly on the motor (set in par. 1-02 *Motor Shaft Encoder Source*).

Select "Speed closed loop [1]" in par. 1-00 to use the resulting reference as an input for the Speed PID control. The Speed PID control parameters are located in par. group 7-0*.

Select "Torque [2]" in par. 1-00 to use the resulting reference directly as a torque reference. Torque control can only be selected in the *Flux with motor feedback* (par. 1-01 *Motor Control Principle*) configuration. When this mode has been selected, the reference will use the Nm unit. It requires no torque feedback, since the torque is calculated on the basis of the current measurement of the frequency converter. All parameters are selected automatically on the basis of the set motor parameters in connection with torque control.

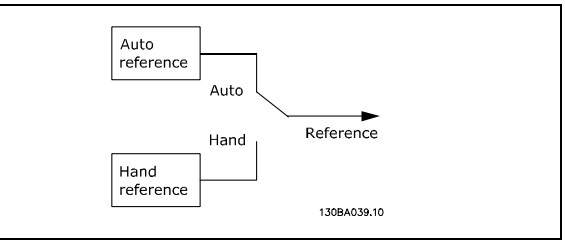
Select "Process [3]" in par. 1-00 to use the process PID control for closed loop control of e.g. speed or a process variable in the controlled application.

Local (Hand On) and Remote (Auto On) Control

The frequency converter can be operated manually via the local control panel (LCP) or remotely via analog and digital inputs and serial bus.

If allowed in par. 0-40, 0-41, 0-42, and 0-43, it is possible to start and stop the frequency converter via the LCP using the [Off] and [Hand] keys. Alarms can be reset via the [RESET] key. After pressing [Hand On] key, the frequency converter goes into Hand mode and follows the Local reference that can be set using arrow key on the LCP.

After pressing the [Auto On] key, the frequency converter goes into Auto mode and follows the Remote reference. In this mode, it is possible to control the frequency converter via the digital inputs and various serial interfaces (RS-485, USB, or an optional fieldbus). See more about starting, stopping, changing ramps and parameter set-ups etc. in par. group 5-1* (digital inputs) or par. group 8-5* (serial communication).



In par. 3-13 *Reference Site* can be choosen to always select either *Local* (Hand) [2] or *Remote* (Auto) [1] reference regardless of whether the frequency converter is in *Auto mode* or in *Hand mode*.

(Hand On) and Remote (Auto On) Control

Hand Off **Auto** **LCP Keys**	**Reference Site** **Par. 3-13**	**Active Reference**
Hand	Linked to Hand / Auto	Local
Hand -> Off	Linked to Hand / Auto	Local
Auto	Linked to Hand / Auto	Remote
Auto -> Off	Linked to Hand / Auto	Remote
All keys	Local	Local
All keys	Remote	Remote

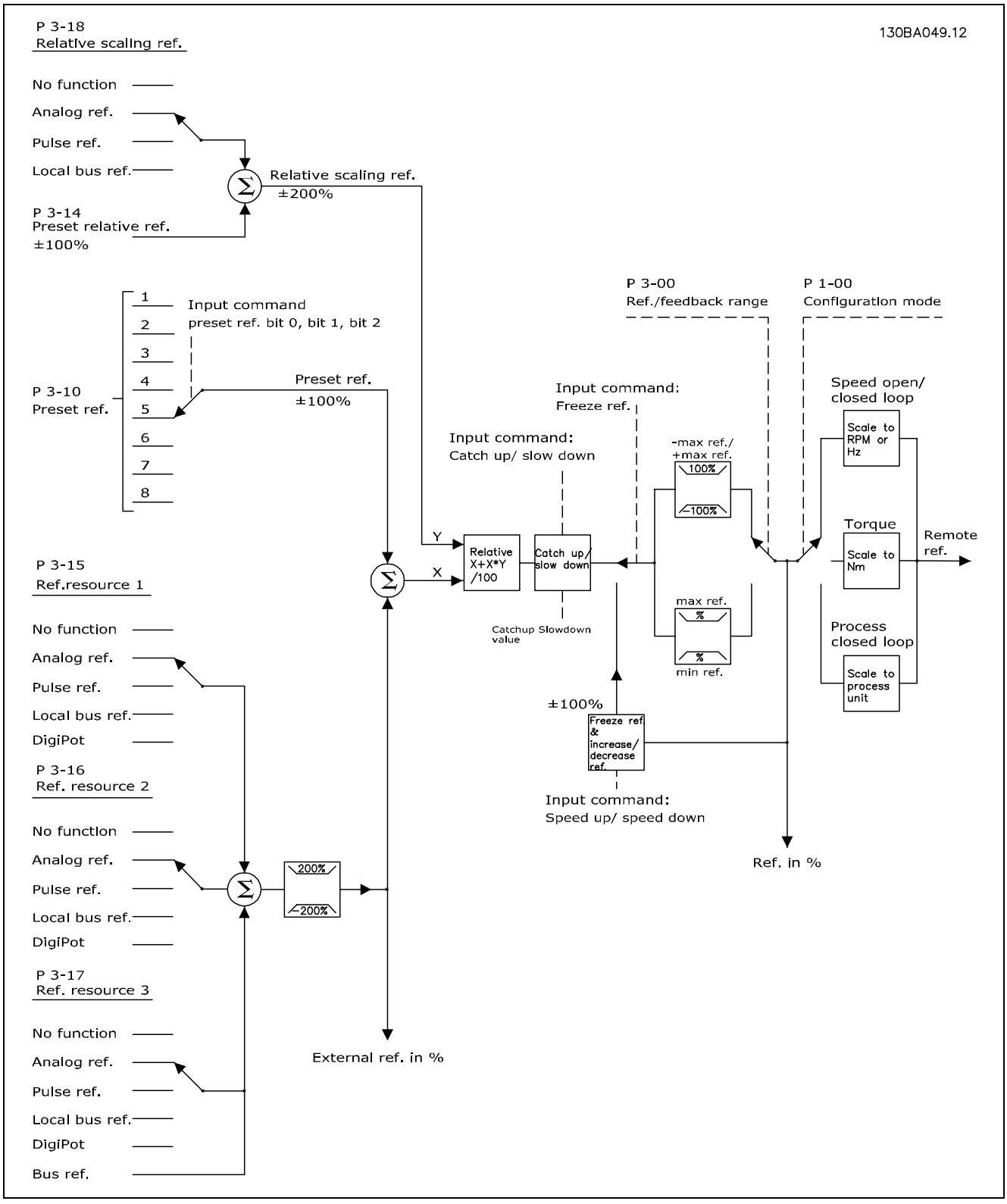
The table shows under which conditions either the Local reference or the Remote reference is active. One of them is always active, but both can not be active at the same time.

Par. 1-00 *Configuration Mode* determines what kind of application control principle (i.e. Speed, Torque or Process Control) is used when the Remote reference is active (see table above for the conditions).

Par. 1-05 *Local Mode Configuration* determines the kind of application control principle that is used when the Local reference is made activate.

Reference handling

The reference handling system for calculating the Remote reference is shown in the illustration below.



The Remote reference is calculated once every scan interval and initally consists of two parts:

1. X (the external reference) : A sum of up to four externally selected references, comprising any combination (determined by the setting of par. 3-15, 3-16 and 3-17) of a fixed preset reference (par. 3-10), variable analog references, variable digital pulse references, and various serial bus references in whatever unit frequency converter are controlled ([Hz], [RPM], [Nm] etc.).
2. Y- (the relative reference): A sum of one fixed preset reference (par. 3-14) and one variable analog reference (par. 3-18) in [%].

The two parts are combined in the following calculation: Auto reference = X + X * Y / 100%. The *catch up / slow down* function and the *freeze reference* function can both be activated by digital inputs on the frequency converter. They are described in par. group 5-1*.
The scaling of analog references are described in par. groups 6-1* and 6-2*, and the scaling of digital pulse references are described in par. group 5-5*.
Reference limits and ranges are set in par. group 3-0*.

References and feedback can be scaled in physical units (i.e. RPM, Hz, °C) or simply in % relating to the values of par. 3-02 *Minimum Reference* and par. 3-03 *Maximum Reference*.

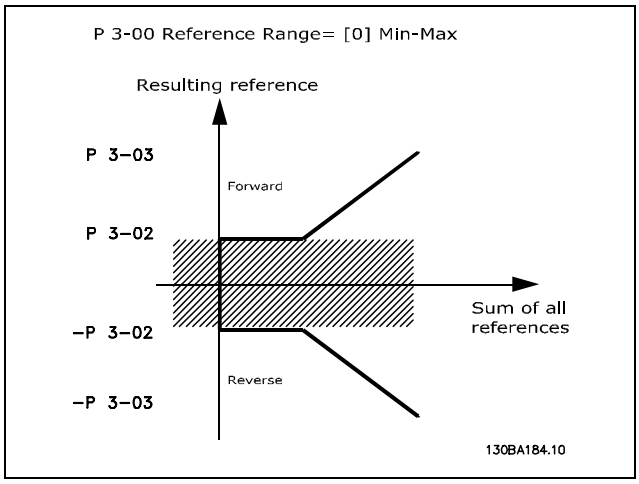
In that case all analog and pulse inputs are scaled according to the following rules:

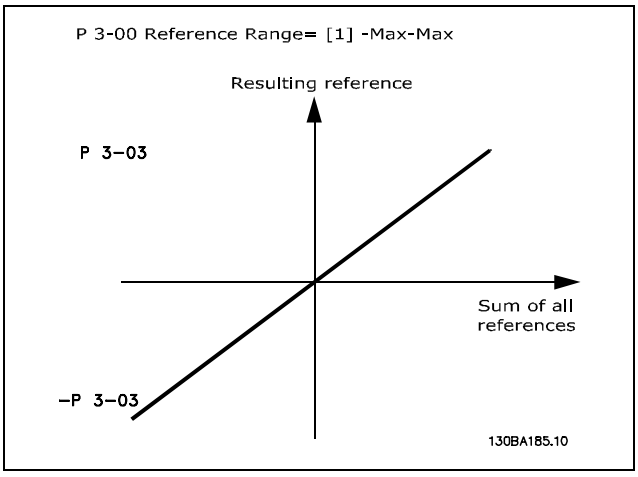
- When par. 3-00 *Reference Range* is [0] Min - Max 0% reference equals 0 [unit] where unit can be any unit e.g. rpm, m/s, bar etc 100% reference equals the Max (abs (par. 3-03 *Maximum Reference*), abs (par. 3-02 *Minimum Reference*).
- When par. 3-00 *Reference Range*: [1] -Max - +Max 0% reference equals 0 [unit] -100% reference equals -Max Reference 100% reference equals Max Reference.

Bus references are scaled according to the following rules:

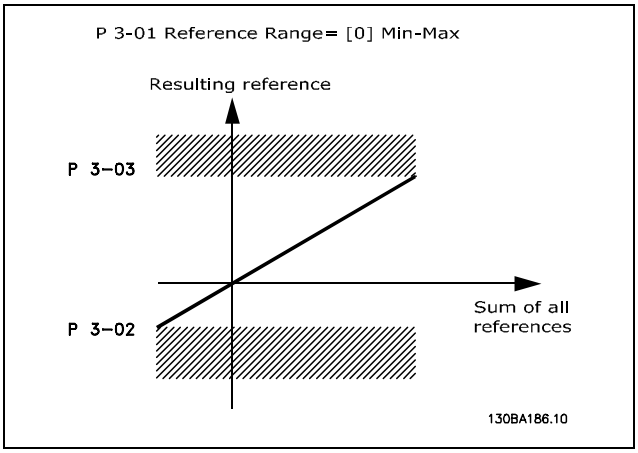
- When par. 3-00 *Reference Range* is [0] Min - Max. To obtain max resolution on the bus reference the scaling on the bus is: 0% reference equals Min Reference 100% reference equals Max reference.
- When par. 3-00 *Reference Range*: [1] -Max - +Max -100% reference equals -Max Reference 100% reference equals Max Reference.

Par. 3-00 *Reference Range*, 3-02 *Minimum Reference* and 3-03 *Maximum Reference* together defines the allowed range of the sum of all references. The sum of all references are clamped when necessary. The relation between the resulting reference (after clamping) and the sum of all references is shown below.

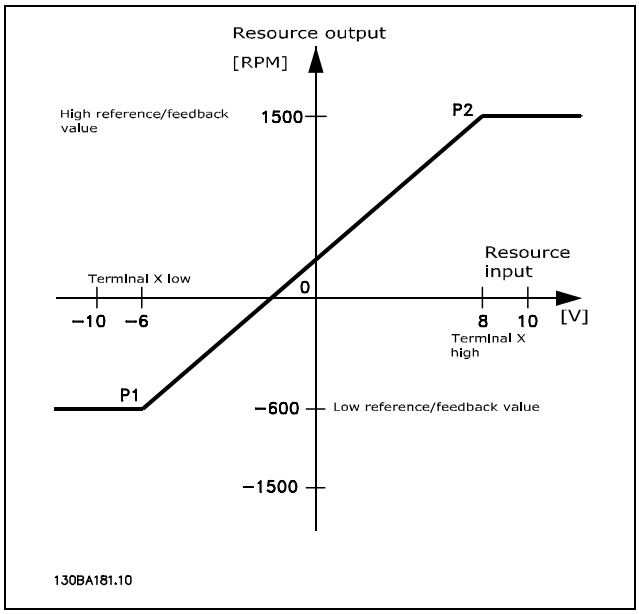


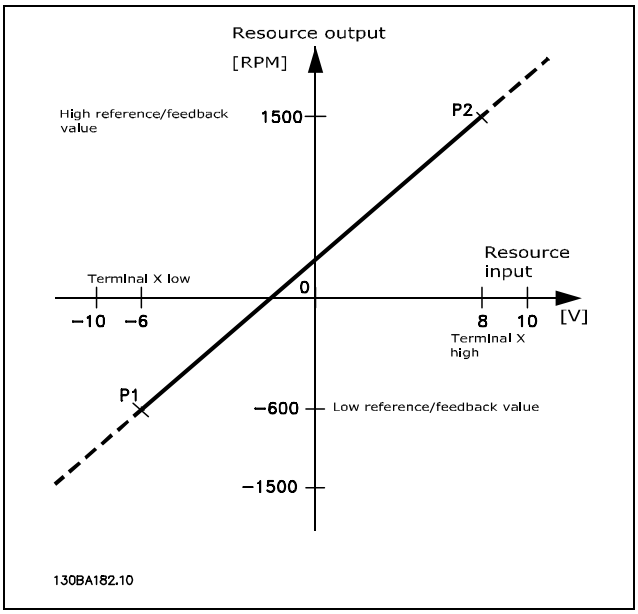


The value of par. 3-02 *Minimum Reference* can not be set to less than 0, unless the par. 1-00 *Configuration Mode* is set to [3] Process. In that case the following relations between the resulting reference (after clamping) and the sum of all references is as shown to the right.



References and feedback are scaled from analog and pulse inputs in the same way. The only difference is that a reference above or below the specified minimum and maximum "endpoints" (P1 and P2 in the graph below) are clamped whereas a feedback above or below are not.





The endpoints P1 and P2 are defined by the following parameters depending on which analog or pulse input is used

	Analog 53 S201=OFF	Analog 53 S201=ON	Analog 54 S202=OFF	Analog 54 S202=ON	Pulse Input 29	Pulse Input 33
P1 = (Minimum input value, Minimum reference value)						
Minimum reference value	Par. 6-14	Par. 6-14	Par. 6-24	Par. 6-24	Par. 5-52	Par. 5-57
Minimum input value	Par. 6-10 [V]	Par. 6-12 [mA]	Par. 6-20 [V]	Par. 6-22 [mA]	Par. 5-50 [Hz]	Par. 5-55 [Hz]
P2 = (Maximum input value, Maximum reference value)						
Maximum reference value	Par. 6-15	Par. 6-15	Par. 6-25	Par. 6-25	Par. 5-53	Par. 5-58
Maximum input value	Par. 6-11 [V]	Par. 6-13 [mA]	Par. 6-21 [V]	Par. 6-23 [mA]	Par. 5-51 [Hz]	Par. 5-56 [Hz]

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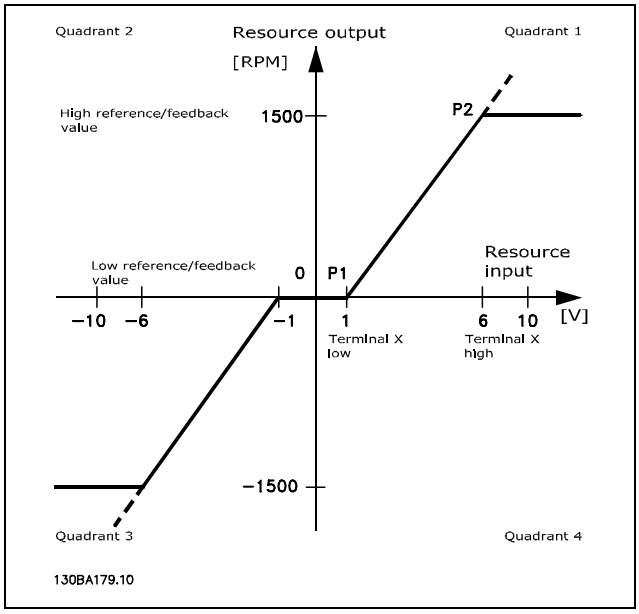
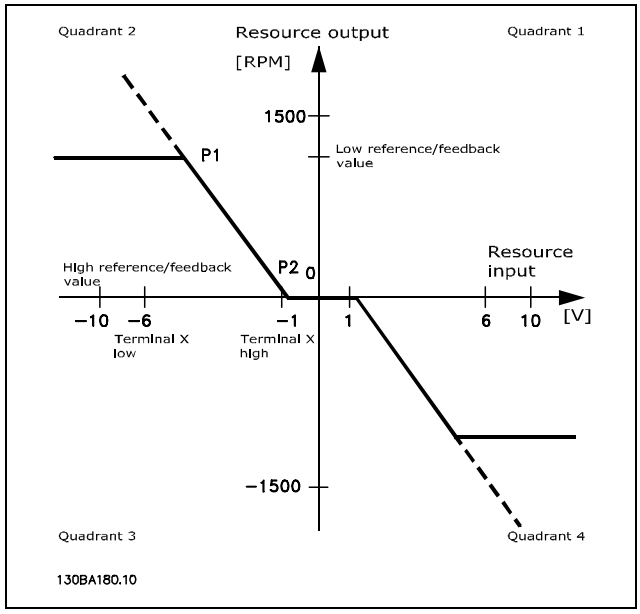
In some cases the reference (in rare cases also the feedback) should have a Dead Band around zero (i.e. to make sure the machine is stopped when the reference is "near zero"). To make the dead band active and to set the amount of dead band, the following settings must be done:

- Either Minimum Reference Value (see table above for relevant parameter) or Maximum Reference Value must be zero. In other words; Either P1 or P2 must be on the X-axis in the graph below.
- And both points defining the scaling graph are in the same quadrant.

The size of the Dead Band is defined by either P1 or P2 as shown in the graph below.

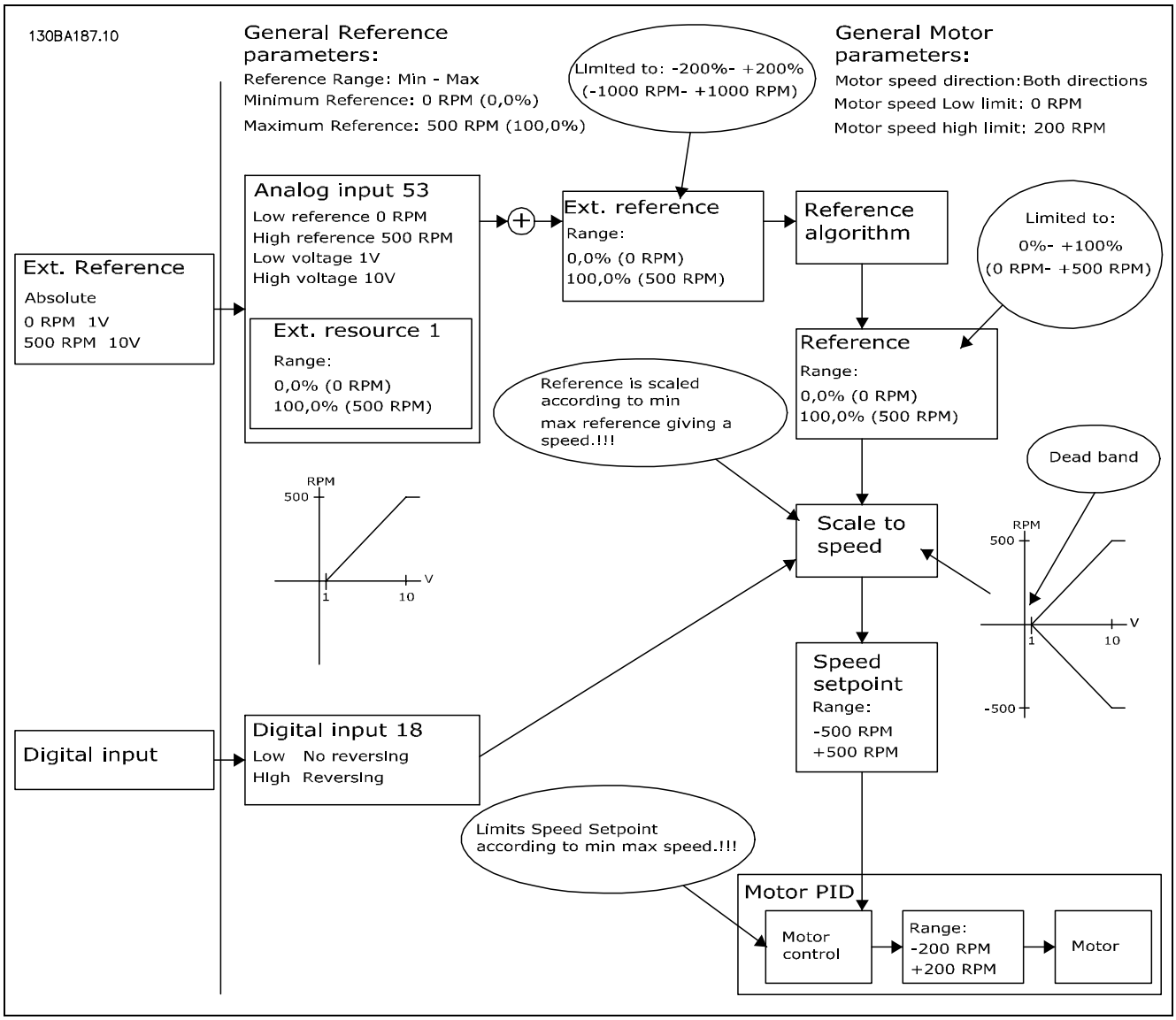




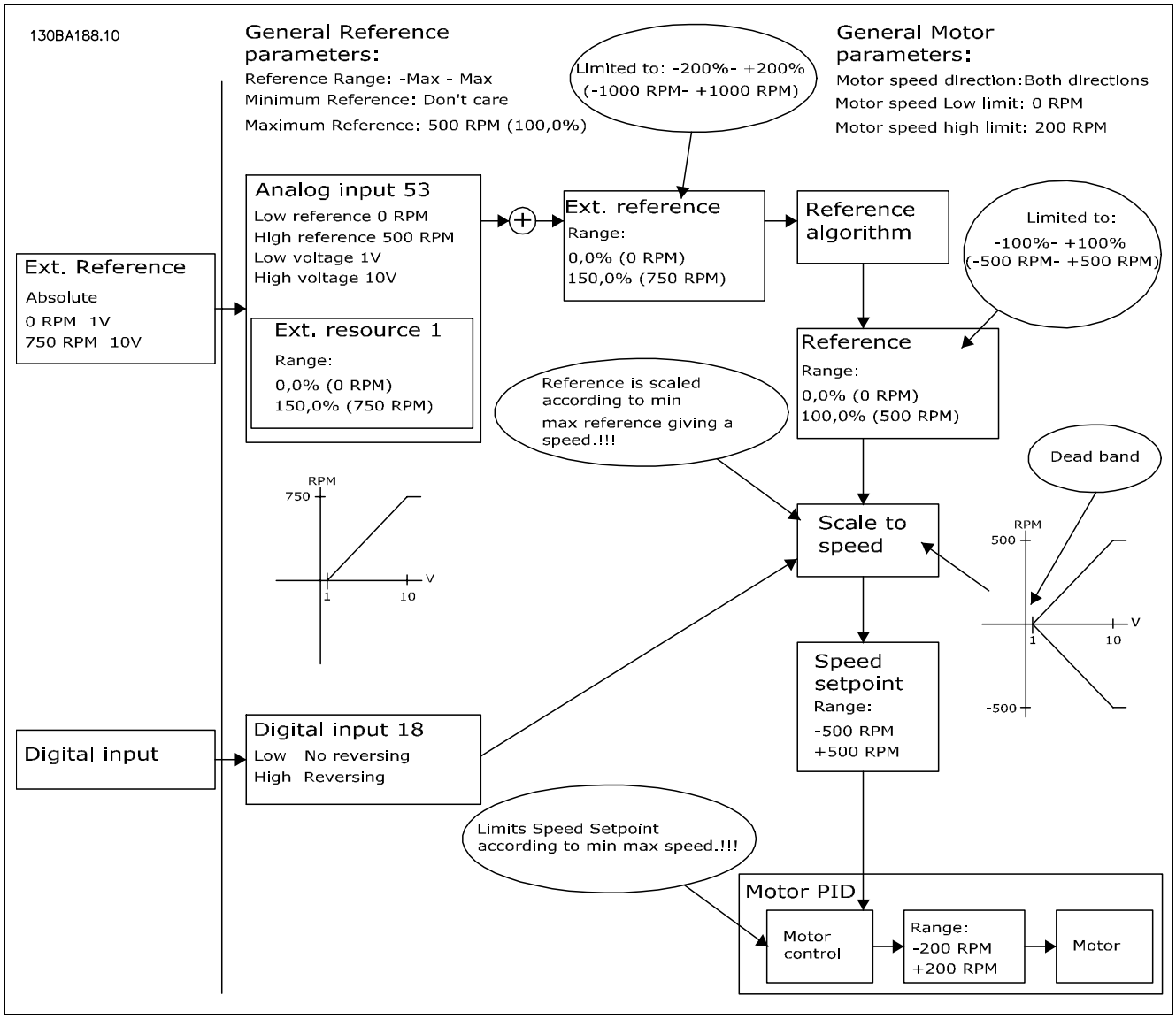
Thus a reference endpoint of P1 = (0 V, 0 RPM) will not result in any dead band.

Case 1: Positive Reference with Dead band, Digital input to trigger reverse

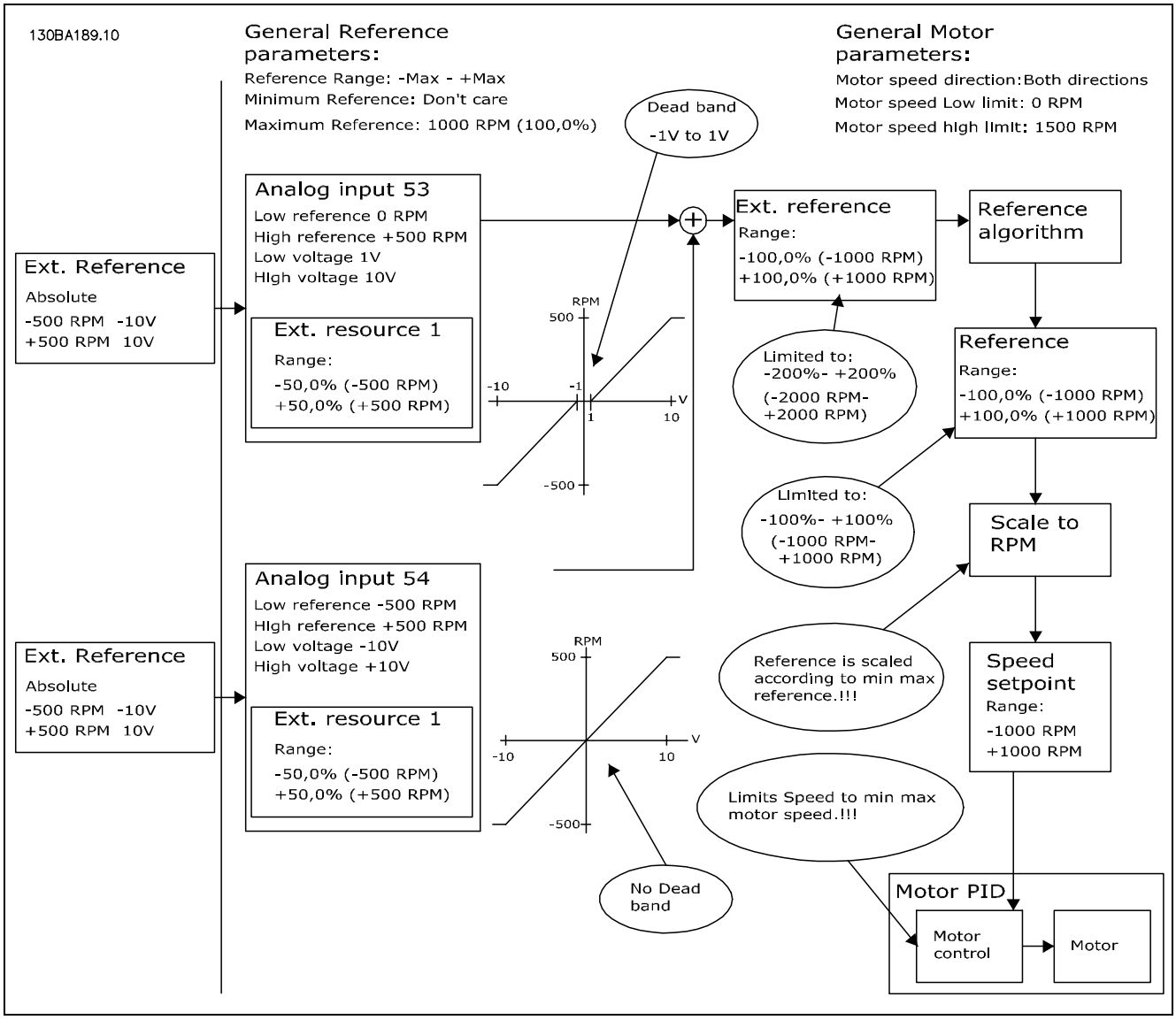
This Use Case shows how Reference input with limits inside Min – Max limits clamps.



Use Case 2: Positive Reference with Dead band, Digital input to trigger reverse. Clamping rules.
This Use Case shows how Reference input with limits outside -Max – +Max limits clamps to the inputs low and high limits before addition to External reference. And how the External reference is clamped to -Max – +Max by the Reference algorithm.

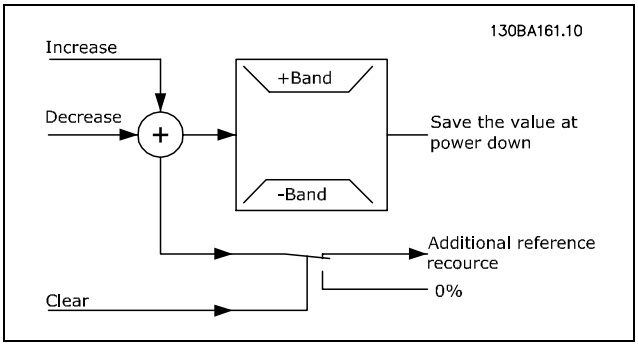


Use Case 3: Negative to positive reference with dead band, Sign determines the direction, -Max – +Max



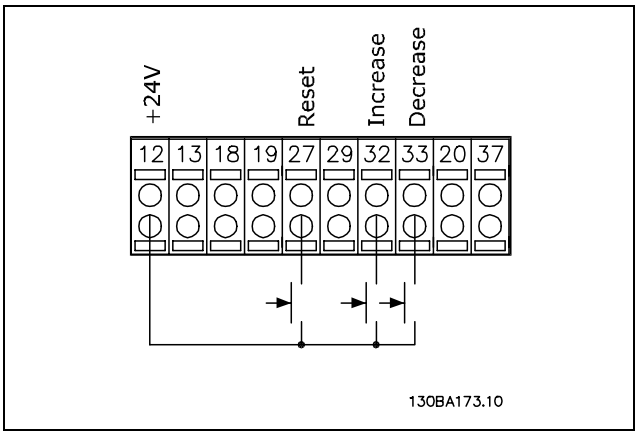
□ DigiPot Function

The DigiPot function is an additional reference source for gradually increasing or decreasing the speed reference i.e. catching up or slowing down the speed.



Connection example:

Par. 5-12 (DI 27) DigiPot Clear [57]
Par. 5-14 (DI 32) DigiPot Increase [55]
Par. 5-15 (DI 33) DigiPot Decrease [56]
Par. 3-90 Step Size 1%
Par. 3-91 Ramp Time 1 sec
Par. 3-92 Power Restore off



□ Automatic Motor Adaptation (AMA)

AMA is an algorithm to measure the electrical motor parameters on a motor at standstill.
This means that AMA itself does not supply any torque.
AMA is useful when commissioning systems and optimising the adjustment of the frequency converter to the applied motor. This feature is particularly used where the default setting does not apply to the connected motor.
Par. 1-29 allows a choice of complete AMA with determination of all electrical motor parameters or reduced AMA with determination of the stator resistance Rs only.
The duration of a total AMA varies from a few minutes on small motors to more than 15 minutes on large motors.

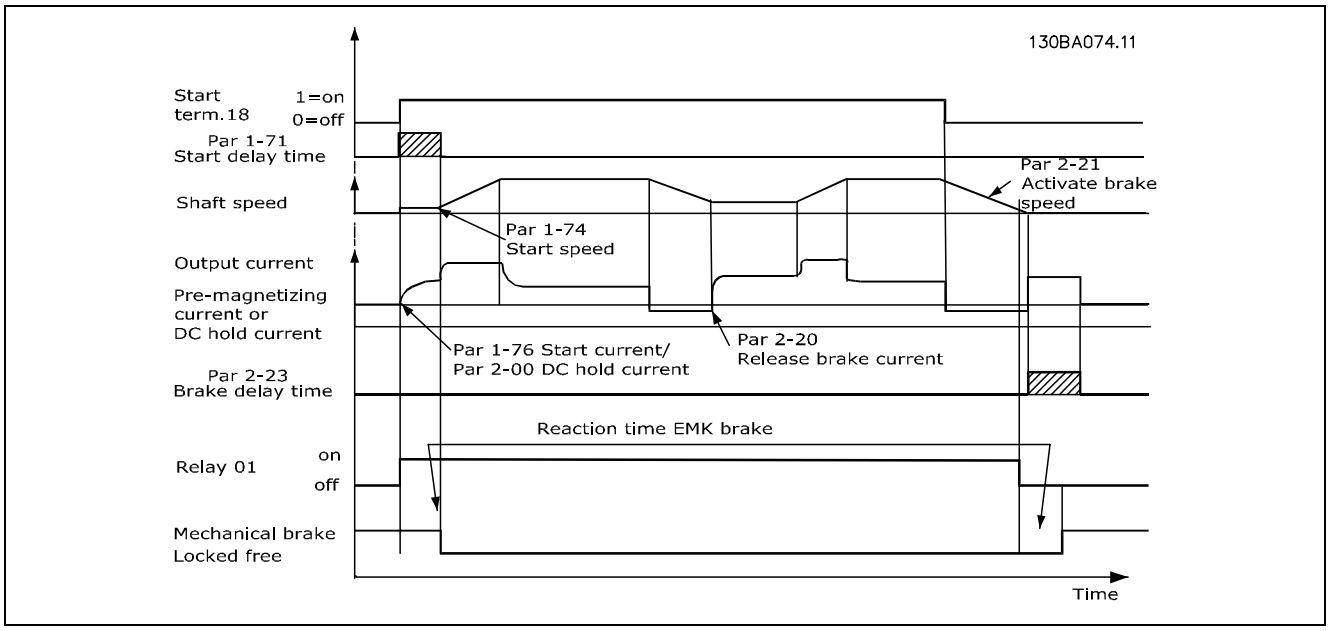
Limitations and preconditions:

- For the AMA to determine the motor parameters optimally, enter the correct motor nameplate data in par. 1-20 to 1-26.
- For the best adjustment of the frequency converter, carry out AMA on a cold motor. Repeated AMA runs may lead to a heating of the motor, which results in an increase of the stator resistance, Rs. Normally, this is not critical.
- AMA can only be carried out if the rated motor current is minimum 35% of the rated output current of the frequency converter. AMA can be carried out on up to one oversize motor.
- It is possible to carry out a reduced AMA test with an LC filter installed. Avoid carrying out a complete AMA with an LC filter. If an overall setting is required, remove the LC filter while running a total AMA. After completion of the AMA, reinsert the LC filter.
- If motors are coupled in parallel, use only reduced AMA if any.
- Avoid running a complete AMA when using synchronous motors. If synchronous motors are applied, run a reduced AMA and manually set the extended motor data. The AMA function does not apply to permanent magnet motors.
- The frequency converter does not produce motor torque during an AMA. During an AMA, it is imperative that the application does not force the motor shaft to run, which is known to happen with e.g. wind milling in ventilation systems. This disturbs the AMA function.

□ Control of Mechanical Brake

For hoisting applications, it is necessary to be able to control an electro-magnetic brake. For controlling the brake, a relay output (relay1 or relay2) or a programmed digital output (terminal 27 or 29) is required. Normally, this output must be closed for as long as the frequency converter is unable to 'hold' the motor, e.g. because of too big load. In par. 5-40 (Array parameter), par. 5-30, or par. 5-31 (digital output 27 or 29), select *mechanical brake control* [32] for applications with an electro-magnetic brake.

When *mechanical brake control* [32] is selected, the mechanical brake relay is closed during start until the output current is above the level selected in par. 2-20 *Release Brake Current*. During stop, the mechanical brake will close when the speed is below the level selected in par. 2-21 *Activate Brake Speed [RPM]*. If the frequency converter is brought into an alarm condition, an over-current, or over-voltage situation, the mechanical brake immediately cuts in. This is also the case during safe stop.



□ **Speed PID Control**

The table shows the control configurations where the Speed Control is active. To see where the Speed Control is active, please refer to the section about the Control Structure.

Par. 1-00 Configuration Mode	Par. 1-01 Motor Control Principle			
	U/f	VVCplus	Flux Sensorless	Flux w/ enc. feedb
[0] Speed open loop	Not Active	Not Active	ACTIVE	N.A.
[1] Speed closed loop	N.A.	**ACTIVE**	N.A.	ACTIVE
[2] Torque	N.A.	N.A.	N.A.	Not Active
[3] Process	N.A.	Not Active	**ACTIVE**	**ACTIVE**

Note: "N.A." means that the specific mode is not available at all. "Not Active" means that the specific mode is available but the Speed Control is not active in that mode.

Note: The Speed Control PID will work under the default parameter setting, but tuning the parameters is highly recommended to optimize the motor control performance. The two Flux motor control principles are specially dependant on proper tuning to yield their full potential.

The following parameters are relevant for the Speed Control:

Parameter	**Description of function**
Feedback Resource Par. 7-00	Select from which resource (i.e. analog or pulse input) the Speed PID should get its feedback
Proportional Gain Par. 7-02	The higher the value - the quicker the control. However too high value may lead to oscillations.
Integral Time Par. 7-03	Eliminates steady state speed error. Lower value means quick reaction. However too low value may lead to oscillations.
Differentiation Time Par. 7-04	Provides a gain proportional to the rate of change of the feedback. A setting of zero disables the differentiator.
Differentiator Gain Limit Par. 7-05	If there are quick changes in reference or feedback in a given application - which means that the error changes swiftly - the differentiator may soon become too dominant. This is because it reacts to changes in the error. The quicker the error changes, the stronger the differentiator gain is. The differentiator gain can thus be limited to allow setting of the reasonable differentiation time for slow changes and a suitably quick gain for quick changes.
Lowpass Filter Time Par. 7-06	A low-pass filter that dampens oscillations on the feedback signal and improves steady state performance. However too large filter time will deteriorate the dynamic performance of the Speed PID control.

Introduction to FC 300

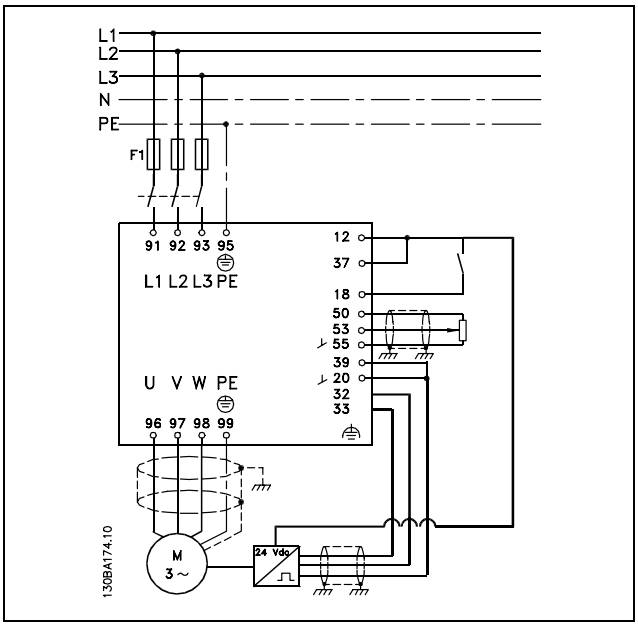
Below is given an example of how to programme the Speed Control:

In this case the Speed PID Control is used to maintain a constant motor speed regardless of the changing load on the motor.

The required motor speed is set via a potentiometer connected to terminal 53. The speed range is 0 - 1500 RPM corresponding to 0 - 10V over the potentiometer.

Starting and stopping is controlled by a switch connected to terminal 18.

The Speed PID monitors the actual RPM of the motor by using a 24V (HTL) incremental encoder as feedback. The feedback sensor is an encoder (1024 pulses per. revolution) connected to terminals 32 and 33.



In the parameter list below it is assumed that all other parameters and switches remain at their default setting.

The following must be programmed in order shown - see explanation of settings in the section "How to programme".

Function	Par. no.	Setting
1) Make sure the motor runs properly. Do the following:		
Set the motor parameters using name plate data	1-2*	As specified by motor name plate
Have the VLT make an Automatic Motor Adaptation	1-29	[1] Enable complete AMA
2) Check the motor is running and the encoder is attached properly. Do the following:		
Press the "Hand On" LCP key. Check that motor runs and note in which direction it is turning (henceforth referred to as the "positive direction").		Set a positive reference.
Go to par. 16-20. Turn the motor slowly in the positive direction. It must be turned so slowly (only a few RPM) that it can be determined if the value in par. 16-20 is increasing or decreasing.	16-20	N.A. (read-only parameter) Note: An increasing value overflows at 65535 and starts again at 0.
If par. 16-20 is decreasing then change the encoder direction in par. 5-71.	5-71	[1] Counter clockwise (if par. 16-20 is decreasing)
3) Make sure the drive limits are set to safe values		
Set acceptable limits for the references.	3-02 3-03	0 RPM (default) 1500 RPM (default)
Check that the ramp settings are within drive capabilities and allowed application operating specifications.	3-41 3-42	3 sec. (default) 3 sec. (default)
Set acceptable limits for the motor speed and frequency.	4-11 4-13 4-19	0 RPM (default) 1500 RPM (default) 60 Hz (default 132 Hz)
4) Configure the Speed Control and select the Motor Control principle		
Activation of Speed Control	1-00	[1] Speed closed loop
Selection of Motor Control Principle	1-01	[3] Flux w motor feedb
5) Configure and scale the reference to the Speed Control		
Set up Analog Input 53 as a reference resource	3-15	Not necessary (default)
Scale Analog Input 53 0 RPM (0 V) to 1500 RPM (10V)	6-1*	Not necessary (default)
6) Configure the 24V HTL encoder signal as feedback for the Motor Control and the Speed Control		
Set up digital input 32 and 33 as encoder inputs	5-14 5-15	[0] No operation (default)
Choose terminal 32/33 as motor feedback	1-02	Not necessary (default)
Choose terminal 32/33 as Speed PID feedback	7-00	Not necessary (default)
7) Tune the Speed Control PID parameters		
Use the tuning guidelines when relevant or tune manually	7-0*	See the guidelines below
8) Finished!		
Save the parameter setting to the LCP for safe keeping	0-50	[1] All to LCP

The following tuning guidelines are relevant when using one of the Flux motor control principles in applications where the load is mainly inertial (with a low amount of friction).

The value of par. 7-02 Proportional Gain is dependent on the combined inertia of the motor and load, and the selected bandwidth can be calculated using the following formula:

$$Par.7{-}02 = \frac{Total\ inertia\ \left[kgm^2\right]\ x\ Par.1-25}{Par.\ 1-20\ x\ 9550} x Bandwidth\,[rad/s]$$

Note: Par. 1-20 is the motor power in [kW] (i.e. enter '4' kW instead of '4000' W in the formula). A practical value for the Bandwith is 20 rad/s. Check the result of the par. 7-02 calculation against the following formula (not required if you are using a high resolution feedback such as a SinCos or Resolver feedback):

$$Par.7{-}02_{MAXIMUM} = \frac{0.01\ x\ 4\ x\ Encoder\ Resolution\ x\ par.\ 7-06}{2 * \pi} x MaxTorqueRipple\,[\%]$$

A good start value for par. 7-06 *Speed Filter Time* is 5 ms (lower encoder resolution calls for a higher filter value). Typically a MaxTorqueRipple of 3 % is acceptable. For incremental encoders the Encoder Resolution is found in either par. 5-70 (24V HTL on standard drive) or par. 17-11 (5V TTL on MCB102 Option).

Generally the practical maximum limit of par. 7-02 is determined by the encoder resolution and the feedback filter time but other factors in the application might limit the par. 7-02 *Proportional Gain* to a lower value.

To minimize the overshoot, par. 7-03 *Integral Time* could be set to approx. 2.5 s (varies with the application).

Par. 7-04 *Differential Time* should be set to 0 until everything else is tuned. If necessary finish the tuning by experimenting with small increments of this setting.

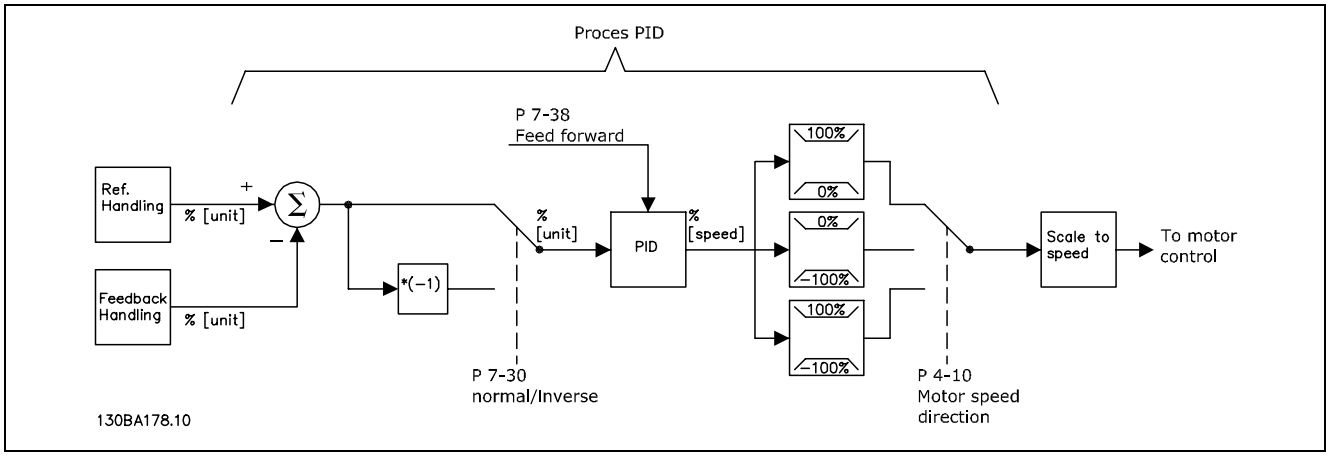
□ **Process PID Control**

The Process PID Control can be used to control application parameters that can be measured by a sensor (i.e. pressure, temperature, flow) and be affected by the connected motor through a pump, fan or otherwise.

The table shows the control configurations where the Process Control is possible. When a Flux Vector motor control principle is used, take care also to tune the Speed Control PID parameters. Refer to the section about the Control Structure to see where the Speed Control is active.

Par. 1-00 Configuration Mode	Par. 1-01 Motor Control Principle			
	U/f	VVCplus	Flux Sensorless	Flux w/ enc. feedb
[3] Process	N.A.	Process	Process & Speed	Process & Speed

Note: The Process Control PID will work under the default parameter setting, but tuning the parameters is highly recommended to optimise the application control performance. The two Flux motor control principles are specially dependant on proper Speed Control PID tuning (prior to tuning the Process Control PID) to yield their full potential.



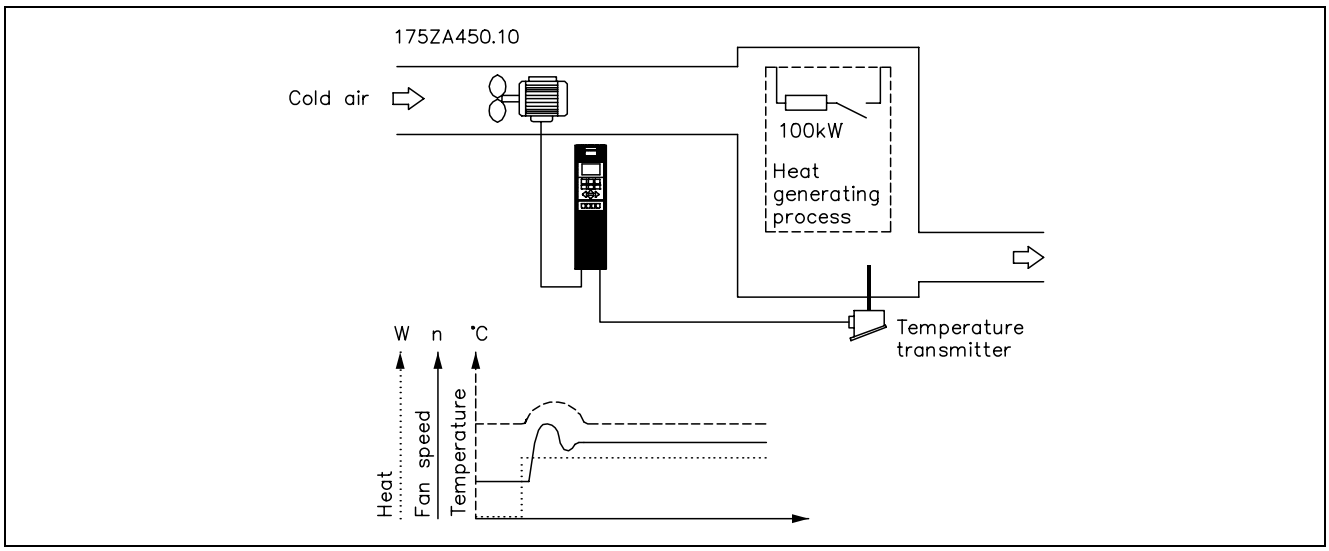
Process PID Control diagram

The following parameters are relevant for the Process Control

Parameter	Description of function
Feedback 1 Resource Par. 7-20	Select from which resource (i.e. analog or pulse input) the Process PID should get its feedback
Feedback 2 Resource Par. 7-22	Optional: Determine if (and from where) the Process PID should get an additional feedback signal. If an additional feedback source is selected the two feedback signals will be added together before being used in the Process PID Control.
Normal/inverse control Par. 7-30	Under [0] Normal operation the Process Control will respond with an increase of the motor speed if the feedback is getting lower than the reference. In the same situation, but under [1] Inverse operation, the Process Control will respond with a decreasing motor speed instead.
Anti Windup Par. 7-31	The anti windup function ensures that when either a frequency limit or a torque limit is reached, the integrator will be set to a gain that corresponds to the actual frequency. This avoids integrating on an error that cannot in any case be compensated for by means of a speed change. This function can be disabled by selecting [0] "Off".
Control Start Value Par. 7-32	In some applications, optimum setting of the process regulator will mean that it takes an excessive time for the desired process value to be reached. In such applications it might be an advantage to fix a motor frequency to which the frequency converter is to bring the motor before the process regulator is activated. This is done by programming a Process PID Start Value (frequency) in this parameter.
Proportional Gain Par. 7-33	The higher the value - the quicker the control. However too large value may lead to oscillations.
Integral Time Par. 7-34	Eliminates steady state speed error. Lower value means quick reaction. However too small value may lead to oscillations.
Differentiation Time Par. 7-35	Provides a gain proportional to the rate of change of the feedback. A setting of zero disables the differentiator.
Differentiator Gain Limit Par. 7-36	If there are quick changes in reference or feedback in a given application - which means that the error changes swiftly - the differentiator may soon become too dominant. This is because it reacts to changes in the error. The quicker the error changes, the stronger the differentiator gain is. The differentiator gain can thus be limited to allow setting of the reasonable differentiation time for slow changes.
Feed Forward Factor Par. 7-38	In application where there is a good (and approximately linear) correlation between the process reference and the motor speed necessary for obtaining that reference, the Feed Forward Factor can be used to achieve at better dynamic performance of the Process PID Control.
Lowpass Filter Time Par. 5-54 (Pulse term. 29), Par. 5-59 (Pulse term. 33), Par. 6-16 (Analog term 53), Par. 6-26 (Analog term. 54)	If there are oscillations of the current/voltage feedback signal, these can be dampened by means of a lowpass filter. This time constant represents the frequency limit of the ripples occurring on the feedback signal. Example: If the lowpass filter has been set to 0.1s, the limit frequency will be 10 RAD/sec. (the reciprocal of 0.1 s), corresponding to (10/(2 x π)) = 1.6 Hz. This will mean that all currents/voltages that vary by more than 1.6 oscillations per second will be removed by the filter. In other words, control will only be carried out on a feedback signal that varies by a frequency of less than 1.6 Hz. In other words; The low-pass filter improves steady state performance but selecting a too large filter time will deteriorate the dynamic performance of the Process PID Control.

Introduction to FC 300

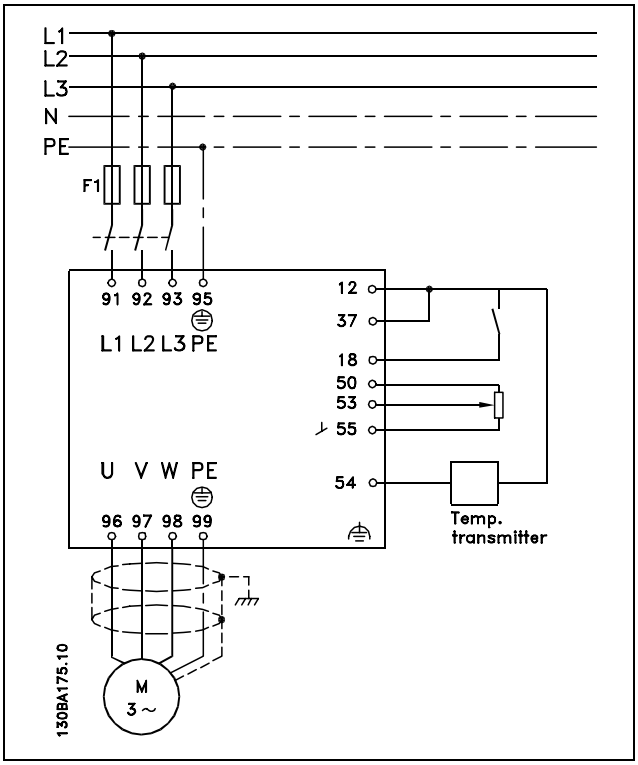
The following is an example of a Process PID Control used in a ventilation system:



In a ventilation system, the temperature is to be settable from - 5 - 35°C with a potentiometer of 0-10 Volt. The set temperature must be kept constant, for which purpose the Process Control is to be used.

The control is of the inverse type, which means that when the temperature increases, the ventilation speed is increased as well, so as to generate more air. When the temperature drops, the speed is reduced. The transmitter used is a temperature sensor with a working range of -10-40°C, 4-20 mA. Min. / Max. speed 300 / 1500 RPM.

NB!:
The example shows a two-wire transmitter.



1. Start/Stop via switch connected to terminal 18.
2. Temperature reference via potentiometer (-5-35°C, 0-10 VDC) connected to terminal 53.
3. Temperature feedback via transmitter (-10-40°C, 4-20 mA) connected to terminal 54. Switch S202 set to ON (current input).

Function	Par. no.	Setting
1) Make sure the motor runs properly. Do the following:		
Set the motor parameters using name plate data	1-2*	As specified by motor name plate
Have the frequency converter make an Automatic Motor Adaptation	1-29	[1] Enable complete AMA
2) Check that the motor is running in the right direction.		
Press the "Hand On" LCP key. Check that the motor runs and note in which direction it is turning.		Set a positive reference.
If the motor was turning in the wrong direction, remove the motor plug and switch two of the motor phases.		
3) Make sure the frequency converter limits are set to safe values		
Check that the ramp settings are within capabilities of the frequency converter and allowed application operating specifications.	3-41 3-42	3 sec. (default) 3 sec. (default)
Prohibit the motor from reversing if necessary	4-10	[0] Clockwise
Set acceptable limits for the motor speed and frequency	4-11 4-13 4-19	300 RPM 1500 RPM (default) 60 Hz (default 132 Hz)
4) Configure the reference to the Process Control		
Allow for an "asymmetrical" reference range by selecting the "Min - Max" Reference Range	3-00	[0] Min - Max
Select the appropriate reference unit	3-01	[13] °C
Set acceptable limits for the sum of all references	3-02 3-03	-5 °C 35 °C
Set up Analog Input 53 as a reference resource	3-15	Not necessary (default)
5) Scale the analog inputs used for reference and feedback		
Scale the Analog Input 1 (terminal 53) that is used for the temperature reference via potentiometer (-5-35°C, 0-10 VDC).	6-10 6-11 6-14 6-15	0 VDC 10 VDC -5 °C 35 °C
Scale the Analog Input 2 (terminal 54) that is used for the temperature feedback via transmitter (-10-40°C, 4-20 mA)	6-22 6-23 6-24 6-25 6-26	4 mA 20 mA -10 °C 40 °C 0.001 s. (default)
6) Configure the feedback to the Process Control		
Set up Analog Input 54 as a feedback resource	7-20	[2] Analog input 54
7) Tune the Process Control PID parameters		
Select inverse control.	7-30	[1] Inverse
Use the tuning guidelines when relevant or tune manually	7-3*	See the guidelines below
8) Finished!		
Save the parameter setting to the LCP for safe keeping	0-50	[1] All to LCP

Optimisation of the process regulator

The basic settings have now been made; all that needs to be done is to optimise the proportional gain, the integration time and the differentiation time (par. 7-33, 7-34, 7-35). In most processes, this can be done by following the guidelines given below.

1. Start the motor
2. Set par. 7-33 (*Proportional Gain*) to 0.3 and increase it until the feedback signal again begins to vary continuously. Then reduce the value until the feedback signal has stabilised. Now lower the proportional gain by 40-60%.
3. Set par. 7-34 (Integration Time) to 20 sec. and reduce the value until the feedback signal again begins to vary continuously. Increase the integration time until the feedback signal stabilises, followed by an increase of 15-50%.
4. Only use par. 7-35 for very fast-acting systems only (differentiation time). The typical value is four times the set integration time. The differentiator should only be used when the setting of the proportional gain and the integration time has been fully optimised. Make sure that oscillations on the feedback signal is sufficiently dampened by the lowpass filter on the feedback signal.

NB!:
If necessary, start/stop can be activated a number of times in order to provoke a variation of the feedback signal.

□ **Ziegler Nichols Tuning Method**

In order to tune the PID controls of the frequency converter, several tuning methods can be used. One approach is to use a technique which was developed in the 1950's but which has stood the test of time and is still used today. This method is known as the Ziegler Nichols tuning method and it can be considered quick and dirty.

NB!:
The method described must not be used on applications that could be damaged by the oscillations created by marginally stable control settings.

The criteria for adjusting the parameters are based on evaluating the system at the limit of stability rather than on taking a step response. We increase the proportional gain until we observe continuous oscillations (as measured on the feedback), that is, until the system becomes marginally stable. The corresponding gain (called the ultimate gain) and the period of the oscillation (also called the ultimate period) are determined as shown in Figure 1.

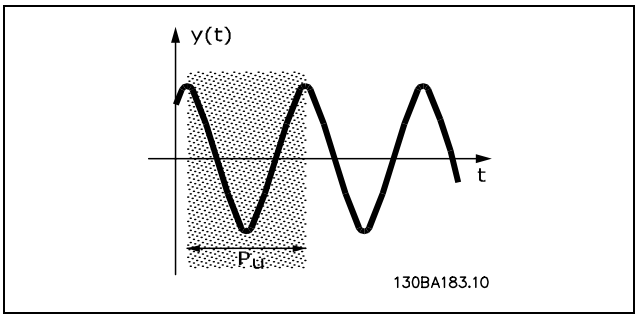


Figure 1: Marginally stable system

P_u should be measured when the amplitude of oscillation is quite small. Then we "back off" from this gain again, as shown in Table 1.

Type of Control	Proportional Gain	Integral Time	Differentiation Time
PI-control	0.45 * K_u	0.833 * P_u	-
PID tight control	0.6 * K_u	0.5 * P_u	0.125 * P_u
PID some overshoot	0.33 * K_u	0.5 * P_u	0.33 * P_u

Table 1: Ziegler Nichols tuning for regulator, based on a stability boundary.

Experience has shown that the control setting according to Ziegler Nichols rule provides a good closed loop response for many systems. The process operator can do the final tuning of the control iteratively to yield satisfactory control.

Step-by-step:

Step 1: Select only Proportional Control, meaning that the Integral time is selected to the maximum value, while the differentiation time is selected to zero.

Step 2: Increase the value of the proportional gain until the point of instability is reached (sustained oscillations) the critical value of gain, K_u, is reached.

Step 3: Measure the period of oscillation to obtain the critical time constant, P_u.

Step 4: Use the table above to calculate the necessary PID control parameters.

□ **Internal Current Regulator**

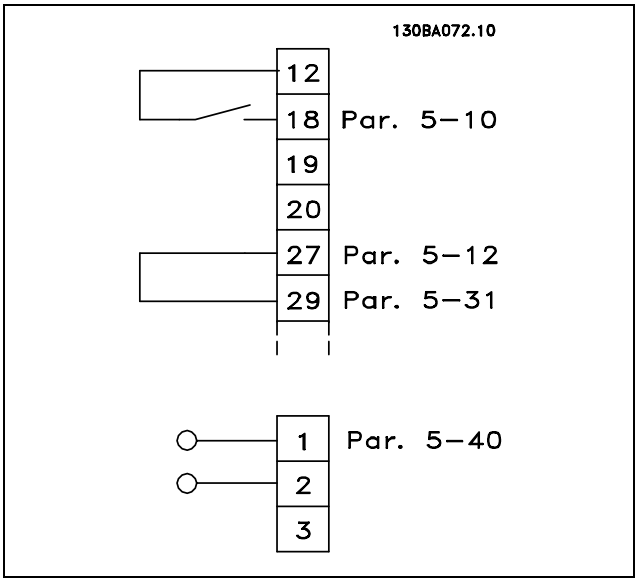
The frequency converter features an integral current limit regulator which is activated when the motor current, and thus the torque, is higher than the torque limits set in par. 4-16 and 4-17.
When frequency converter is at the current limit during motor operation or regenerative operation, the frequency converter will try to get below the preset torque limits as quickly as possible without losing control of the motor.
While the current regulator is active, the frequency converter can *only* be stopped by means of a digital terminal if set to *Coast, inverse* [2] or *Coast and Reset, inverse* [3]. Other signals on terminals 18-33 will *not* be active until the frequency converter is no longer near the current limit.

□ **Programming of Torque Limit and Stop**

In applications with an external electro-mechanical brake, such as hoisting applications, it is possible to stop the frequency converter via a 'standard' stop command and simultaneously activate the external electro-mechanical brake.
The example given below illustrates the programming of frequency converter connections.
The external brake can be connected to relay 1 or 2, see paragraph *Control of Mechanical Brake*.
Program terminal 27 to Coast, inverse [2] or Coast and Reset, inverse [3], and program terminal 29 to Terminal mode 29 Output [1] and Torque limit & stop [27].

Description:
If a stop command is active via terminal 18 and the frequency converter is not at the torque limit, the motor ramps down to 0 Hz.
If the frequency converter is at the torque limit and a stop command is activated, terminal 29 Output (programmed to Torque limit and stop [27]) is activated. The signal to terminal 27 l changes from 'logic 1' to 'logic 0', and the motor start to coast, thereby ensuring that the hoist stops even if the frequency converter itself cannot handle the required torque (i.e. due to excessive overload).

- Start/stop via terminal 18
  Par. 5-10 Start [8]
- Quickstop via terminal 27
  Par. 5-12 Coasting Stop, Inverse [2]
- Terminal 29 Output
  Par. 5-02 Terminal 29 Mode Output [1]
  Par. 5-31 Torque Limit & Stop [27]
- Relay output [0] (Relay 1)
  Par. 5-40 Mechanical Brake Control [32]



□ **Parameter Download**

Parameter download is possible via the following:

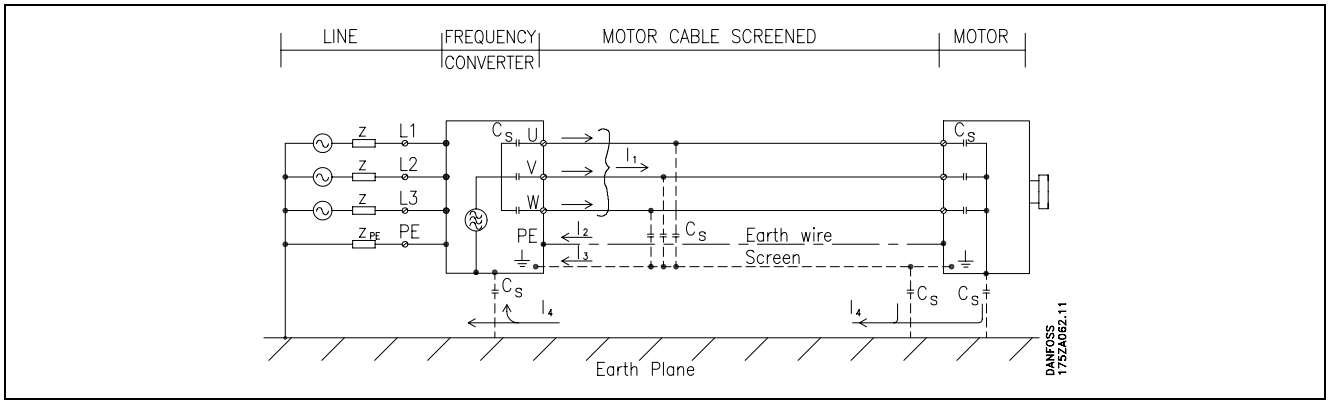
- PC Software MCT 10 tool - see how in *FC 300 PC Software Operating Instructions*.
- Fieldbus options - see how in *FC 300 Profibus Operating Instructions* or *FC 300 DeviceNet Operating Instructions*.
- LCP up- and download as described in par. group 0-5∗.

□ **General Aspects of EMC Emissions**

Electrical interference is usually conducted at frequences in the range 150 kHz to 30 MHz. Airborne interference from the drive system in the range 30 MHz to 1 GHz is generated from the inverter, the motor cable, and the motor.
As shown in the illustration below, capacitive currents in the motor cable coupled with a high dV/dt from the motor voltage generate leakage currents.
The use of a screened motor cable increases the leakage current (see illustration below) because screened cables have higher capacitance to earth than unscreened cables. If the leakage current is not filtered, it will cause greater interference on the mains in the radio frequency range below approx. 5 MHz. Since the leakage current (I_1) is carried back to the unit through the screen (I_3), there will in principle only be a small electro-magnetic field (I_4) from the screened motor cable according to the below figure.

The screen reduces the radiated interference but increases the low-frequency interference on the mains. The motor cable screen must be connected to the frequency converter enclosure as well as on the motor enclosure. This is best done by using integrated screen clamps so as to avoid twisted screen ends (pigtails). These increase the screen impedance at higher frequencies, which reduces the screen effect and increases the leakage current (I_4).
If a screened cable is used for Profibus, standard bus, relay, control cable, signal interface, and brake, the screen must be mounted on the enclosure at both ends. In some situations, however, it will be necessary to break the screen to avoid current loops.

Introduction to FC 300



If the screen is to be placed on a mounting plate for the requency converter, the mounting plate must be made of metal, because the screen currents have to be conveyed back to the unit. Moreover, ensure good electrical contact from the mounting plate through the mounting screws to the frequency converter chassis. With respect to installation, it is generally less complicated to use unscreened cables than screened ones.

NB!:
When unscreened cables are used, some emission requirements are not complied with, although the immunity requirements are observed.

In order to reduce the interference level from the entire system (unit + installation), make motor and brake cables as short as possible. Avoid placing cables with a sensitive signal level alongside motor and brake cables. Radio interference higher than 50 MHz (airborne) is especially generated by the control electronics.

EMC Test Results (Emission, Immunity)

The following test results have been obtained using a system with a frequency converter (with options if relevant), a screened control cable, a control box with potentiometer, as well as a motor and motor cable.

FC 301/FC 302 200-240 V 380-500 V		Conducted emission			Radiated emission	
	Environment	Industrial environment		Housing, trades and light industries	Industrial environment	Housing, trades and light industries
	Basic standard	EN 55011 Class A2	EN 55011 Class A1	EN 55011 Class B	EN 55011 Class A1	EN 55011 Class B
Setup	Motor cable					
FC 301/FC 302 A2 0-3.7 kW 200-240 V 0-7.5 kW 380-500 V	5 m screened/armoured	Yes	No	No	No	No
FC 301 with integrated filter 0-3.7 kW 200-240 V 0-7.5 kW 380-500 V	10 m screened/armoured	Yes	Yes	Yes	Yes	No
	40 m screened/armoured	Yes	Yes	No	Yes	No
	150 m unscreened/unarmoured	No	No	No	No	No
FC 302 with integrated filter 0-3.7 kW 200-240 V 0-7.5 kW 380-500 V	40 m screened/armoured	Yes	Yes	Yes	Yes	No
	150 m screened/armoured	Yes	Yes	No	Yes	No
	300 m unscreened/unarmoured	No	No	No	No	No

□ Required Compliance Levels

Standard / environment	Housing, trades, and light industries		Industrial environment	
	Conducted	Radiated	Conducted	Radiated
IEC 61000-6-3	Class B	Class B		
IEC 61000-6-4			Class A-1	Class A-1
EN 61800-3 (restricted)	Class B	Class B	Class A-2	Class A-2
EN 61800-3 (unrestricted)	Class A-1	Class A-1	Class A-2	Class A-2

EN 55011: Threshold values and measuring methods for radio interference from industrial, scientific and medical (ISM) high-frequency equipment.
Class A-1: Equipment used in an industrial environment.
Class A-2: Equipment used in an industrial environment.
Class B-1: Equipment used in areas with a public supply network (dwellings, commerce, and light industries).

□ EMC Immunity

In order to document immunity against electrical interference from electrical phenomena, the following immunity tests have been made on a system consisting of a frequency converter (with options, if relevant), a screened control cable, and a control box with potentiometer, motor cable, and motor.

The tests were performed in accordance with the following basic standards:

- **EN 61000-4-2 (IEC 61000-4-2): Electrostatic discharges (ESD)**
  Simulation of electrostatic discharges from human beings.
- **EN 61000-4-3 (IEC 61000-4-3): Incoming electromagnetic field radiation, amplitude modulated**
  Simulation of the effects of radar and radio communication equipment as well as mobile communications.
- **EN 61000-4-4 (IEC 61000-4-4): Burst transients**
  Simulation of interference brought about by switching with a contactor, relays, or similar devices.
- **EN 61000-4-5 (IEC 61000-4-5): Surge transients**
  Simulation of transients brouht e.g. by lightning that strikes near installations.
- **EN 61000-4-6 (IEC 61000-4-6): RF Common mode**
  Simulation of the effect from radio-transmitting equipment connected to connection cables.

See following EMC immunity form.

Immunity continued

FC 301/FC 302; 200-240 V, 380-500 V

Basic standard	Burst IEC 61000-4-4	Surge IEC 61000-4-5	ESD IEC 61000-4-2	Radiated electromagnetic field IEC 61000-4-3	RF common mode voltage IEC 61000-4-6
Acceptance criterion	B	B	B	A	A
Line	4 kV CM	2 kV/2 Ω DM 4 kV/12 Ω CM	—	—	10 V_{RMS}
Motor	4 kV CM	4 kV/2 Ω[1)]	—	—	10 V_{RMS}
Brake	4 kV CM	4 kV/2 Ω[1)]	—	—	10 V_{RMS}
Load sharing	4 kV CM	4 kV/2 Ω[1)]	—	—	10 V_{RMS}
Control lines	2 kV CM	2 kV/2 Ω[1)]	—	—	10 V_{RMS}
Standard bus	2 kV CM	2 kV/2 Ω[1)]	—	—	10 V_{RMS}
Relay lines	2 kV CM	2 kV/2 Ω[1)]	—	—	10 V_{RMS}
Application and Fieldbus options	2 kV CM	2 kV/2 Ω[1)]	—	—	10 V_{RMS}
LCP cable	2 kV CM	2 kV/2 Ω[1)]	—	—	10 V_{RMS}
External 24 V DC	2 kV CM	0.5 kV/2 Ω DM 1 kV/12 Ω CM	—	—	10 V_{RMS}
Enclosure	—	—	8 kV AD 6 kV CD	10 V/m	—

AD: Air Discharge

CD: Contact Discharge

CM: Common mode

DM: Differential mode

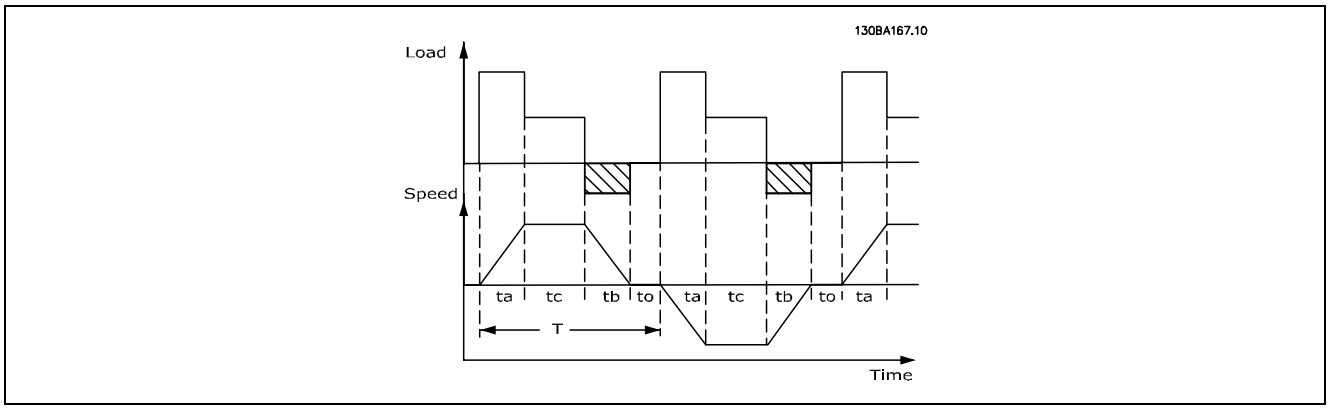
1. Injection on cable shield.

□ Selection of Brake Resistor

To select the right brake resistor, it is necessary to know how often to brake and by how much the power braking is effected.

The resistor intermittent duty (S5), which is often used by motor suppliers when stating the permissible load, is an indication of the duty cycle at which the resistor is working.

The intermittent duty cycle for the resistor is calculated as follows, in which T = cycle time in seconds and t_b is the braking time in seconds (of the cycle time): The max. permissible load on the brake resistor is stated as a peak power at a given intermittent duty cycle. Therefore, determine the peak power for the brake resistor and the resistor value.



Dutycycle = T_b/T

The max. permissible load on the brake resistor is stated as a peak power at a given ED. Therefore, determine the peak power for the brake resistor and the resistor value.

The shown example and formula apply to FC 302. $P_{PEAK} = P_{MOTOR} \times M_{BR(\%)} \times \eta_{MOTOR} \times \eta_{VLT}$ [W]

The brake resistance is calculated as shown: $R_{REC} = U^2_{DC}/P_{PEAK}$

As can be seen, the brake resistance depends on the intermediate circuit voltage (UDC).
With FC 302 frequency converters with a mains voltage of 3 x 200-240 V, the brake will be active at 390 V (UDC). If the frequency converter has a mains voltage of 3 x 380-500 V, the brake will be active at 810 V (UDC), and if the frequency converter has a mains voltage of 3 x 525-600 V, the brake will be active at 943 V (UDC).

NB!:
Check that the brake resistor can cope with a voltage of 430 V, 850 V or 930 V - unless Danfoss brake resistors are used.

Danfoss recommends the brake resistance R_{REC}, i.e. one that guarantees that the frequency converter is able to brake at the highest braking torque (M_{br}) of 160%.
η_{motor} is typically at 0.90, while η_{VLT} is typically at 0.98.
For 200 V, 500 V, and 600 V frequency converters, R_{REC} at 160% braking torque is written as:

$$200\text{V}: \text{R}_{\text{REC}} = \frac{107780}{P_{MOTOR}} \quad [\Omega]$$

$$500\text{ V}: \text{R}_{\text{REC}} = \frac{464923}{P_{MOTOR}} \quad [\Omega]$$

$$600\text{ V}: \text{R}_{\text{REC}} = \frac{630137}{P_{MOTOR}} \quad [\Omega]$$

NB!:
The resistor brake circuit resistance selected should not be higher than that recommended by Danfoss. If a brake resistor with a higher ohmic value is selected, the 160% braking torque mayl not be achieved because there is a risk that the frequency converter cuts out for safety reasons.

NB!:
If a short circuit in the brake transistor occurs, power dissipation in the brake resistor is only prevented by using a mains switch or contactor to disconnect the mains for the frequency converter. (The contactor can be controlled by the frequency converter).

□ **Control with Brake Function**
The brake is to limit the voltage in the intermediate circuit when the motor acts as a generator. This occurs, for example, when the load drives the motor and the power accumulates on the DC link. The brake is built up as a chopper circuit with the connection of an external brake resistor. Placing the brake resistor externally offers the following advantages:

- The brake resistor can be selected on the basis of the application in question.
- The brake energy is dissipated outside the control panel, i.e. where the energy can be utilized.
- The electronics of the frequency converter will not be overheated if the brake resistor is overloaded.

The brake is protected against short-circuiting of the brake resistor, and the brake transistor is monitored to ensure that short-circuiting of the transistor is detected. A relay/digital output can be used for protecting the brake resistor against overloading in connection with a fault in the frequency converter.
In addition, the brake makes it possible to read out the momentary power and the mean power for the latest 120 seconds. The brake can also monitor the power energizing and make sure it does not exceed a limit selected in par. 2-12. In par. 2-13, select the function to carry out when the power transmitted to the brake resistor exceeds the limit set in par. 2-12.

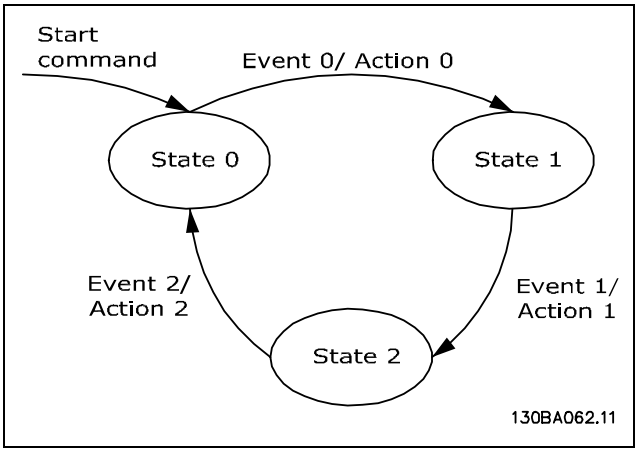
Over voltage control (OVC) (excl. brake resistor) can be selected as an alternative brake function in par. 2-17. This function is active for all units. The function ensures that a trip can be avoided if the DC link voltage increases. This is done by increasing the output frequency to limit the voltage from the DC link. It is a very useful function, e.g. if the ramp-down time is too short since tripping of the frequency converter is avoided. In this situation the ramp-down time is extended.

NB!:
Monitoring the brake power is not a safety function; a thermal switch is required for that purpose. The brake resistor circuit is not earth leakage protected.

□ **Smart Logic Control**
Smart Logic Control The Smart Logic Control (SLC) is essentially a sequence of user defined actions (see par. 13-52) executed by the SLC when the associated user defined *event* (see par. 13-51) is evaluated as TRUE by the SLC.
Events and *actions* are each numbered and are linked together in pairs. 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. Events and actions are placed in array parameters.

Only one *event* will be evaluated at any time. If an *event* is evaluated as FALSE, nothing happens (in the SLC) during the present 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, the SLC executes *action [0]* and starts evaluating *event [1]*.

It is possible to program from 0 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 *events / actions*:



Starting and stopping the SLC:
Starting and stopping the SLC can be done by selecting "On [1]" or "Off [0]" in par. 13-00. The SLC always starts in state 0 (where it evalutes *event [0]*). If the drive is stopped or coasted by any means (either via digital input, field bus or other), the SLC automatically stops. If the drive is started by any means (either via digital input, field bus or other), the SLC also starts (provided that "On [1]" is selected in par. 13-00).

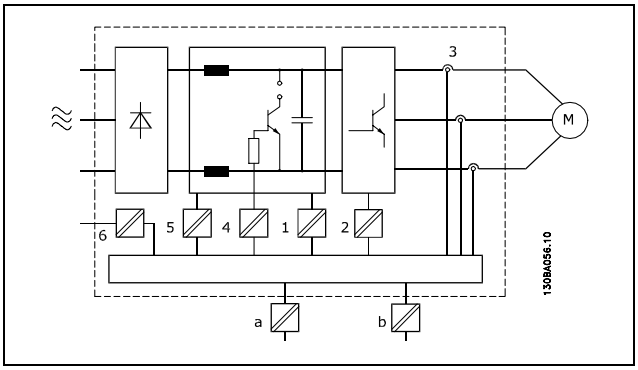
□ **Galvanic Isolation (PELV)**
PELV offers protection by way of extra low voltage. Protection against electric shock is ensured when the electrical supply is of the PELV type and the installation is made as described in local/national regulations on PELV supplies.

All control terminals and relay terminals 01-03/04-06 comply with PELV (Protective Extra Low Voltage) (Does not apply to 525-600 V units and at grounded Delta leg above 300 V).

Galvanic (ensured) isolation is obtained by fulfilling requirements for higher isolation and by providing the relevant creapage/clearance distances. These requirements are described in the EN 61800-5-1 standard.

The components that make up the electrical isolation, as described below, also comply with the requirements for higher isolation and the relevant test as described in EN 61800-5-1.
The PELV galvanic isolation can be shown in six locations (see illustration):

1. Power supply (SMPS) incl. signal isolation of U_{DC}, indicating the intermediate current voltage.
2. Gate drive that runs the IGBTs (trigger transformers/opto-couplers).
3. Current transducers.
4. Opto-coupler, brake module.
5. Internal inrush, RFI, and temperature measurement circuits.
6. Custom relays.



Galvanic isolation

The functional galvanic isolation (a and b on drawing) is for the 24 V back-up option and for the RS 485 standard bus interface.

□ Earth Leakage Current

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), as well as the motor connection for kinetic back-up.
Using VLT AutomationDrive FC 300 (at and below 7.5 kW):
wait at least 2 minutes.

Leakage Current
The earth leakage current from the FC 300 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 mm^2 or 2 rated earth wires terminated separately.

Residual Current Device
This product can cause a d.c. 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 MN.90.GX.02.
Protective earthing of the frequency converter and the use of RCD's must always follow national and local regulations.

□ Extreme Running Conditions

Short Circuit

The frequency converter is protected against short circuits by means of current measurement in each of the three motor phases. A short circuit between two output phases will cause an overcurrent in the inverter. However, each transistor of the inverter will be turned off individually when the short circuit current exceeds the permitted value.
To protect the drive against a short circuit at the load sharing and brake outputs please see the design guidelines for these ports.

After 5-10 µs the gate driver turns off the inverter and the frequency converter displays a fault code, depending on impedance and motor frequency.

Earth Fault

The inverter cuts out within a few µs in case of an earth fault on a motor phase, depending on impedance and motor frequency.

Switching on the Output

Switching on the output between the motor and the frequency converter is fully permitted. You cannot damage the frequency converter in any way by switching on the output. However, fault messages may appear.

Motor-generated Overvoltage

The voltage in the intermediate circuit is increased when the motor acts as a generator. This occurs in two cases:

1. The load drives the motor (at constant output frequency from the frequency converter), ie. the load generates energy.
2. During deceleration ("ramp-down") if the moment of inertia is high, the load is low and the ramp-down time is too short for the energy to be dissipated as a loss in the requency converter, the motor and the installation.

The control unit attempts to correct the ramp if possible.
The inverter turns off to protect the transistors and the intermediate circuit capacitors when a certain voltage level is reached.
See par. 2-10 and par. 2-17 to select the method used for controlling the intermediate circuit voltage level.

Mains Drop-out

During a mains drop-out, the frequency converter keeps running until the intermediate circuit voltage drops below the minimum stop level, which is typically 15% below the frequency converter's lowest rated supply voltage.

The mains voltage before the drop-out and the motor load determines how long it takes for the inverter to coast.

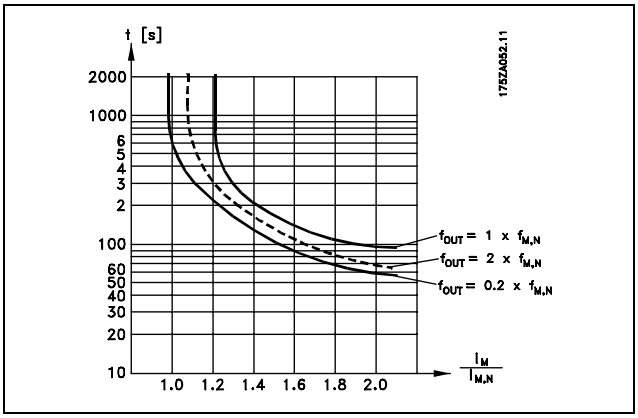
Static Overload in VVC^{plus} mode

When the frequency converter is overloaded (the torque limit in par. 4-16/4-17 is reached), the controls reduces the output frequency to reduce the load.
If the overload is excessive, a current may occur that makes the frequency converter cut out after approx. 5-10 s.

Operation within the torque limit is limited in time (0-60 s) in par. 14-25.

□ **Motor Thermal Protection**

The motor temperature is calculated on the basis of motor current, output frequency, and time. See par. 1-90 in the chapter *How to Programme*.



□ **Acoustic Noise**

The acoustic interference from the frequency converter comes from three sources:

1. DC intermediate circuit coils.
2. Integral fan.
3. RFI components.

The typical values measured at a distance of 1 m from the unit:

FC 301/ FC 302	
PK25-P7K5: 200-240 V, 380-500 V, 525-600V	IP20/IP21/IP4Xtop/Type 1
Reduced fan speed	51 dB(A)
Full fan speed	60 dB(A)

Safe Stop of FC 302

The FC 302 can perform the Designated Safety Function "Uncontrolled Stopping by removal of power" (as defined by draft IEC 61800-5-2) or Stop Category 0 (as defined in EN 60204-1).
It is designed and approved suitable for the requirements of Safety Category 3 in EN 954-1. This functionality is called Safe Stop.
The Safe Stop 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 of FC 302 can be used for asynchronous and synchronous motors.

Safe Stop activation (i.e. removal of 24 V DC voltage supply to terminal 37) does not provide electrical safety.

Safe Stop Operation

1. Activate the Safe Stop function by removing the 24 V DC voltage supply to the terminal 37.
2. After activation of Safe Stop, the frequency converter coasts (stops creating a rotational field in the motor).

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).

After activation of Safe Stop, the FC 302 display will show the text "Safe Stop activated". The associated help text says "Safe Stop has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send Reset signal (via Bus, Digital I/O, or the [Reset] key)." This means that the Safe Stop has been activated, or that normal operation has not been resumed yet after a Safe Stop activation. NB: The requirements of EN 945-1 Category 3 are only fulfilled while 24 V DC supply to terminal 37 is removed or low.

In order to resume operation after activation of Safe Stop, first 24 V DC voltage must be reapplied to terminal 37 (text "Safe Stop activated" is still displayed), second a Reset signal must be created (via bus, Digital I/O, or [Reset] key on inverter).

NB!:
The Safe Stop function of FC 302 can be used for asynchronous and synchronous motors. It may happen that two faults occur in the frequency converters power semiconductor. When using synchronous motors this may cause a residual rotation. The rotation can be calculated to Angle=360/(Number of Poles). The application using synchronous motors must take this into consideration and ensure that this is not a safety critical issue. This situation is not relevant for asynchronous motors.

NB!:
In order to use the Safe Stop functionality in conformance with the requirements of EN-954-1 Category 3, a number of conditions must be fulfilled by the installation of Safe Stop. Please see section *Safe Stop Installation* for further information.

NB!:
The frequency converter does not provide a safety-related protection against unintended or malicious voltage supply to terminal 37 and subsequent reset. Provide this protection via the interrupt device, on application level, or organisational level.
For more information - see section *Safe Stop Installation*.

General Specifications

Protection and Features:

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches 95 °C ± 5°C. An overload temperature cannot be reset until the temperature of the heatsink is below 70 °C ± 5°C.
- The frequency converter is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning.
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.
- The frequency converter is protected against earth faults on motor terminals U, V, W.

Mains supply (L1, L2, L3):

Supply voltage ..... 200-240 V ±10%
Supply voltage ..... FC 301: 380-480 V / FC 302: 380-500 V ±10%
Supply voltage ..... FC 302: 525-600 V ±10%
Supply frequency ..... 50/60 Hz
Max. imbalance between mains phases ..... ± 3.0 % of rated supply voltage
True Power Factor (λ) ..... 0.92 nominal at rated load
Displacement Power Factor (cos φ) near unity ..... (> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ..... maximum 2 times/min.
Environment according to EN60664-1 ..... overvoltage category 111/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 output (U, V, W):

Output voltage ..... 0 - 100% of supply voltage
Output frequency ..... FC 301: 0.2 - 1000 Hz / FC 302: 0 - 1000 Hz
Switching on output ..... Unlimited
Ramp times ..... 0.01 - 3600 sec.

Torque characteristics:

Starting torque (Constant torque) ..... maximum 160% for 1 min.*
Starting torque (par. 1-70 *High Starting Torque Time*) ..... maximum 180% up to 0.5 sec.*
Overload current (Constant torque) ..... maximum 160% for 1 min.*
**Percentage relates to FC 300's nominal current.*

Cable lengths and cross sections:

Max. motor cable length, screened/armoured ..... FC 301: 50 m / FC 302: 150 m
Max. motor cable length, unscreened/unarmoured ..... FC 301: 75 m / FC 302: 300 m
Max. cross section to motor, mains, load sharing and brake (see section Electrical Data in the FC 300 Design Guide MG.33.BX.YY for more information), (0.25 kW - 7.5 kW) ..... 4 mm^2 / 10 AWG
Maximum cross section to control wires, rigid wire ..... 1.5 mm^2/16 AWG (2 x 0.75 mm^2)
Maximum cross section to control cables, flexible cable ..... 1 mm^2/18 AWG
Maximum cross section to control cables, cable with enclosed core ..... 0.5 mm^2/20 AWG
Minimum cross section to control wires ..... 0.25 mm^2

Cable lengths and RFI performance			
FC 30x	Filter	Supply voltage	RFI compliance at max. motor cable lengths
FC 301 FC 302	With A2 filter	200 - 240 V / 380 - 500 V / 380 - 480 V	<5 m. EN 55011 Group A2
FC 301	With A1/B	200 - 240 V / 380 - 480 V	<40 m. EN 55011 Group A1 <10 m. EN 55011 Group B
FC 302	With A1/B	200 - 240 V / 380 - 500 V	<150 m. EN 55011 Group A1 <40 m. EN 55011 Group B
FC 302	No RFI filter	550 - 600 V	Not compliant with EN 55011

In certain instances, shorten the motor cable to comply with EN 55011 A1 and EN 55011 B.
Copper (60/75°C) conductors recommended.

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.

Digital inputs:

Programmable digital inputs ..... FC 301: 4 (5) / FC 302: 4 (6)
Terminal number ..... 18, 19, 27 [1)], 29 [1)], 32, 33,
Logic ..... PNP or NPN
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' NPN[2)] ..... > 19 V DC
Voltage level, logic '1' NPN[2)] ..... < 14 V DC
Maximum voltage on input ..... 28 V DC
Input resistance, R_i ..... approx. 4 kΩ

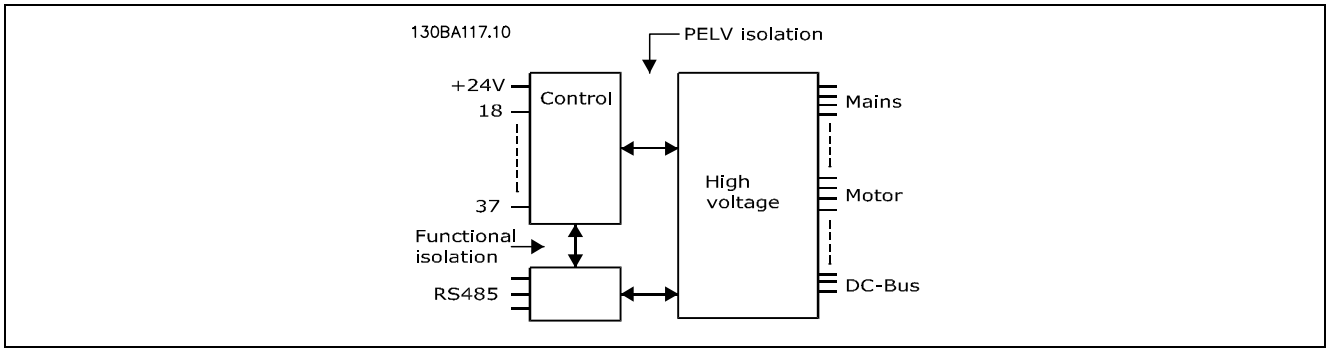
Safe stop Terminal 37[2)]:
Terminal 37 is fixed PNP logic

Voltage level ..... 0 - 24 V DC
Voltage level, logic'0' PNP ..... < 4 V DC
Voltage level, logic'1' PNP ..... >15 V DC
Nominal input current at 24 V ..... 50 mA rms
Nominal input current at 15 V ..... 80 mA rms
Input capacitance ..... 400 nF
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 is only available in FC 302. It 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 Design Guide.

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	FC 301: 0 to + 10 / FC 302: -10 to +10 V (scaleable)
Input resistance, R_i	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, R_i	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	FC 301: 20 Hz / FC 302: 100 Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.



Pulse/encoder inputs:

Programmable pulse/encoder inputs	2/1
Terminal number pulse/encoder	29, 33[1] / 18, 32, 33[2]
Max. frequency at terminal 18, 29, 32, 33	110 kHz (Push-pull driven)
Max. frequency at terminal 18, 29, 32, 33	5 kHz (open collector)
Min. frequency at terminal 18, 29, 32, 33	4 Hz
Voltage level	see section on Digital input
Maximum voltage on input	28 V DC
Input resistance, R_i	approx. 4 kΩ
Pulse input accuracy (0.1 - 1 kHz)	Max. error: 0.1% of full scale
Encoder input accuracy (1 - 110 kHz)	Max. error: 0.05 % of full scale

The pulse and encoder inputs (terminals 18, 29, 32, 33) are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1) Pulse inputs are 29 and 33

2) Encoder inputs: 18 = Z, 32 = A, and 33 = B

Analog output:

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 - 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, 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).

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.

Control card, 24 V DC output:

Terminal number 12, 13
Max. load ..... FC 301: 130 mA / FC 302: 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.

Relay outputs:

Programmable relay outputs ..... FC 301: 1 / FC 302: 2
Relay 01 Terminal number ..... 1-3 (break), 1-2 (make)
Max. terminal load (AC) on 1-3 (NC), 1-2 (NO) ..... 240 V AC, 2 A
Max. terminal load (DC) on 1-2 (NO), 1-3 (NC) ..... 60 V DC, 1A
Relay 02 (FC 302 only) Terminal number ..... 4-6 (break), 4-5 (make)
Max. terminal load (AC) on 4-5 (NO) ..... 400 V AC, 2 A
Max. terminal load (DC) on 4-5 (NC) ..... 80 V DC, 2 A
Max. terminal load (DC) on 4-6 (NC) ..... 50 V DC, 2 A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO) ..... 24 V DC 10 mA, 24 V AC 100 mA
Environment according to EN 60664-1 ..... overvoltage category III/pollution degree 2
The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (SELV).

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 characteristics:

Resolution of output frequency at 0 - 1000 Hz ..... FC 301: +/- 0.013 Hz / FC 302: +/- 0.003 Hz
Repeat accuracy of *Precise start/stop* (terminals 18, 19) ..... FC 301: ≤ ± 1ms / FC 302: ≤ ± 0.1 msec
System response time (terminals 18, 19, 27, 29, 32, 33) ..... FC 301: ≤ 20 ms / FC 302: ≤ 2 ms
Speed control range (open loop) ..... 1:100 of synchronous speed
Speed control range (closed loop) ..... 1:1000 of synchronous speed

Speed accuracy (open loop) ..... 30 - 4000 rpm: Maximum error of ±8 rpm
Speed accuracy (closed loop) ..... 0 - 6000 rpm: Maximum error of ±0.15 rpm
All control characteristics are based on a 4-pole asynchronous motor

Surroundings:

Enclosure ..... IP 20
Enclosure kit available ..... 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
Ambient temperature ..... Max. 50 °C (24-hour average maximum 45 °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 ..... 1000 m
Derating for high altitude, see section on special conditions
EMC standards, Emission ..... EN 61800-3, EN 61000-6-3/4, EN 55011, (EN 50081-1/2)
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, (EN 50082-1/2)
See section on special conditions

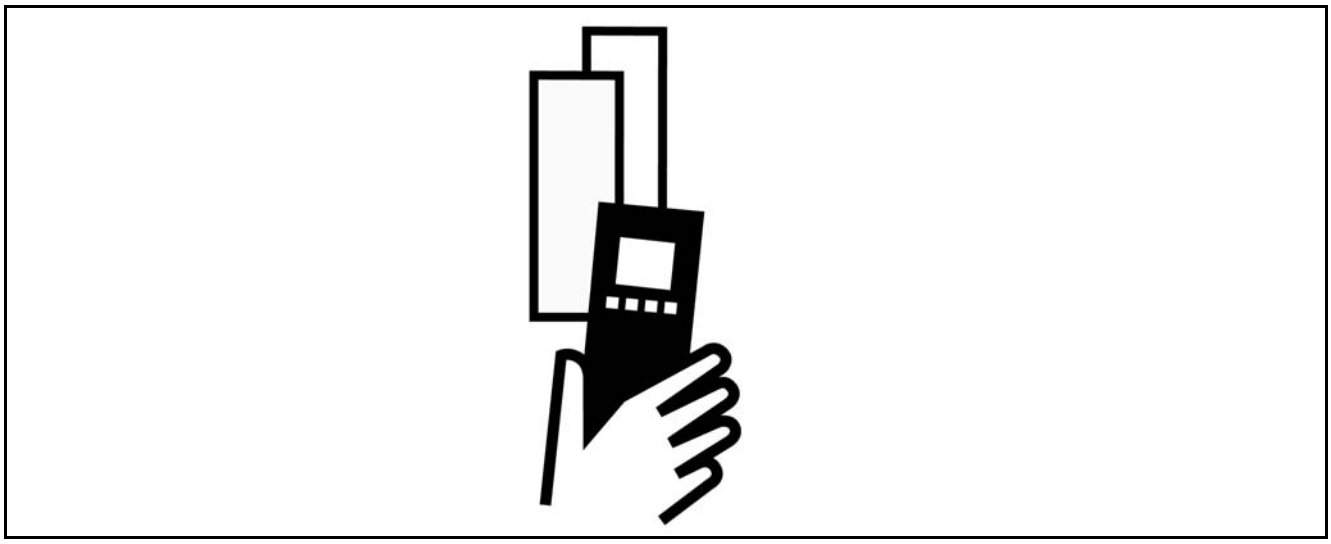
Control card performance:

Scan interval ..... FC 301: 10 mS / FC 302: 1 ms

Control card, USB serial communication:

USB standard ..... 2.0 (low 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.

How to Select Your VLT



□ Peak Voltage on Motor

When a transistor in the inverter is opened, the voltage across the motor increases by a dV/dt ratio depending on:

- the motor cable (type, cross-section, length screened or unscreened)
- inductance

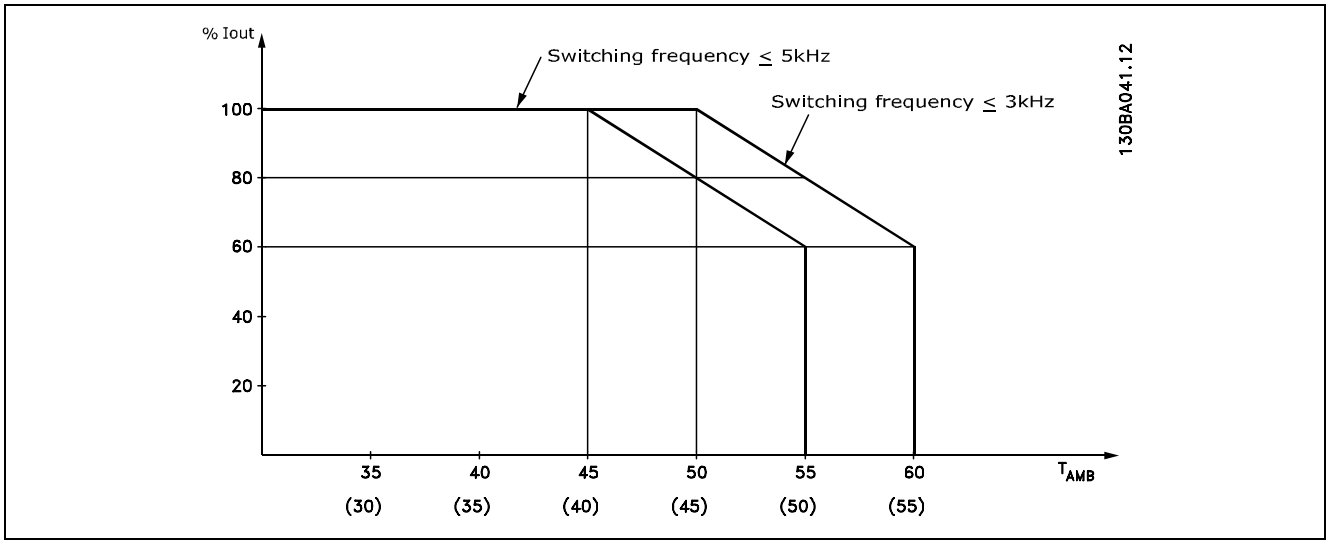
The natural induction causes an overshot U_{PEAK} in the motor voltage before it stabilises itself at a level depending on the voltage in the intermediate circuit. The rise time and the peak voltage U_{PEAK} affect the service life of the motor. If the peak voltage is too high, especially motors without phase coil insulation are affected. If the motor cable is short (a few metres), the rise time and peak voltage are lower.
If the motor cable is long (100 m), the rise time and peak voltage increases.

If very small motors are used without phase coil insulation, connect an LC filter to the frequency converter.

□ Special Conditions

□ Derating for Ambient Temperature

The ambient temperature ($T_{AMB,MAX}$) is the maximum temperature allowed. The average ($T_{AMB,AVG}$) measured over 24 hours must be at least 5 ºC lower.
If the frequency converter is operated at temperatures above 50 ºC, a derating of the continuous output current is necessary.

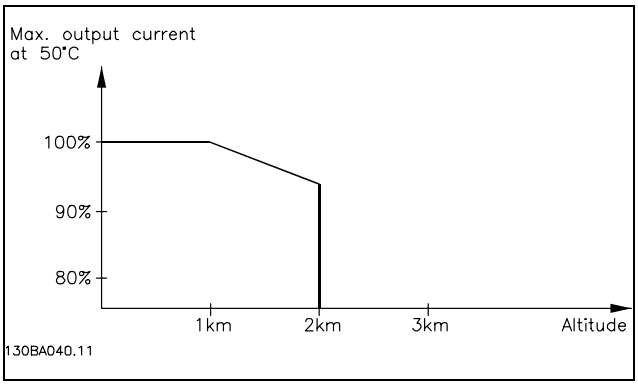


□ **Derating for Air Pressure**

Below 1000 m altitude no derating is necessary.

Above 1000 m the ambient temperature (T_{AMB}) or max. output current ($I_{VLT,MAX}$) must be derated in accordance with the shown diagram:

1. Derating of output current versus altitude at T_{AMB} = max. 50°C
2. Derating of max. T_{AMB} versus altitude at 100% output current.



□ **Derating for Running at Low Speed**

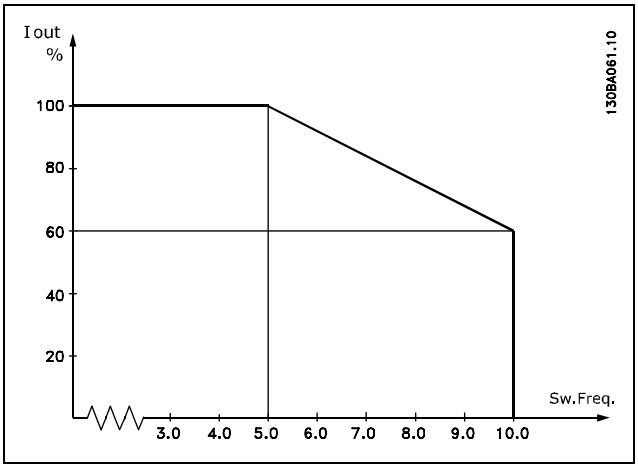
When a motor is connected to a frequency converter, it is necessary to check that the cooling of the motor is adequate.
At low RPM values, the motor fan is not able to supply the required volume of air for cooling. This problem occurs when the load torque is constant (e.g. a conveyor belt) across the regulating range. The reduced ventilation available determines the size of the torque that can be permitted under a continuous load.
If the motor is to run continuously at an RPM value lower than half the rated value, the motor must be supplied with additional air for cooling (or use a motor designed for this type of operation).
Instead of such extra cooling, the load level of the motor can be reduced e.g. by choosing a bigger motor. However, the design of the frequency converter sets a limit to the motor size.

□ **Derating for Installing Long Motor Cables or Cables with Larger Cross-Section**

The frequency converter has been tested using 300 m unscreened cable and 150 m screened cable.

The frequency converter has been designed to work using a motor cable with a rated cross-section. If a cable with a larger cross-section is used, reduce the output current by 5% for every step the cross-section is increased.
(Increased cable cross-section leads to increased capacity to earth, and thus an increased earth leakage current).

□ **Temperature-Dependent Switch Frequency**
This function ensures the highest possible switch frequency without causing a thermal overload of the frequency converter. The internal temperature indicates whether the switch frequency can be based on the load, the ambient temperature, the supply voltage, or the cable length.
The switch frequency is set in par. 14-01.



□ Options and Accessories

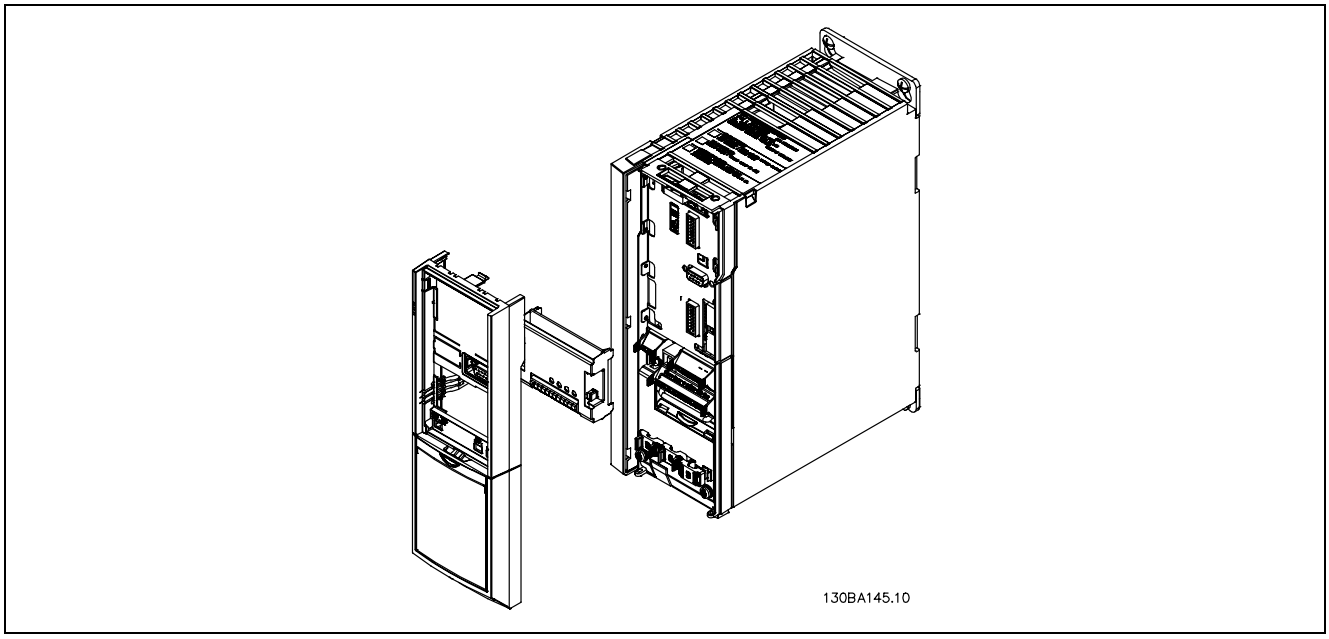
Danfoss offers a wide range of options and accessories for VLT AutomationDrive FC 300 Series.

□ **Encoder Option MCB 102**
The encoder module is used for interfacing feedback from motor or process. Parameter settings in group 17-xx

Used for:
- VVC plus closed loop
- Flux Vector Speed control
- Flux Vector Torque control
- Permanent magnet motor with SinCos feedback (Hiperface®)

Incremental encoder: 5 V TTL type
SinCos Encoder: Stegmann/SICK (Hiperface®)

Selection of parameters in par. 17-1* and par. 1-02

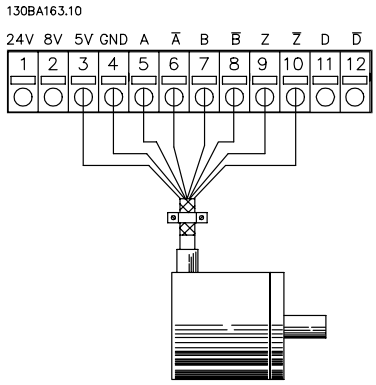


How to Select Your VLT

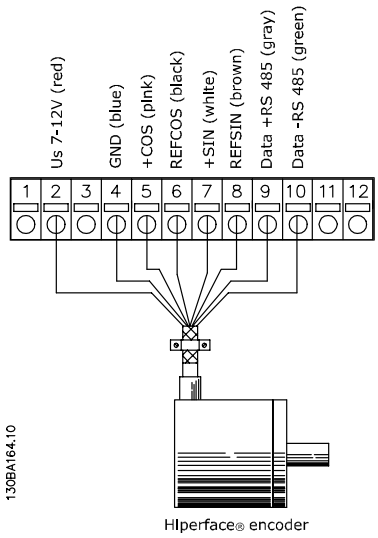
- The power to the frequency converter must be disconnected.
- Remove the LCP, the terminal cover and the cradle from the FC 30x.
- Fit the MCB 102 option in slot B.
- Connect the control cables and relief the cables by the clamp to chassis.
- Fit the extended cradle and terminal cover.
- Replace the LCP.
- Connect the power to the frequency converter.
- Select the encoder functions in par. 17-*.

Connector Designation X31	Incremental Encoder	SinCos Encoder Hyperface	Description
1	NC		24 V Output
2	NC		8 V Output
3	5 VCC		5 V Output
4	GND		GND
5	A input	+COS	A input
6	A inv input	REFCOS	A inv input
7	B input	+SIN	B input
8	B inv input	REFSIN	B inv input
9	Z input	+Data RS485	Z input OR +Data RS485
10	Z inv input	-Data RS485	Z input OR -Data RS485
11	NC	NC	Future use
12	NC	NC	Future use

Max. 5V on X31.5-12



5V incremental encoder



HIperface® encoder

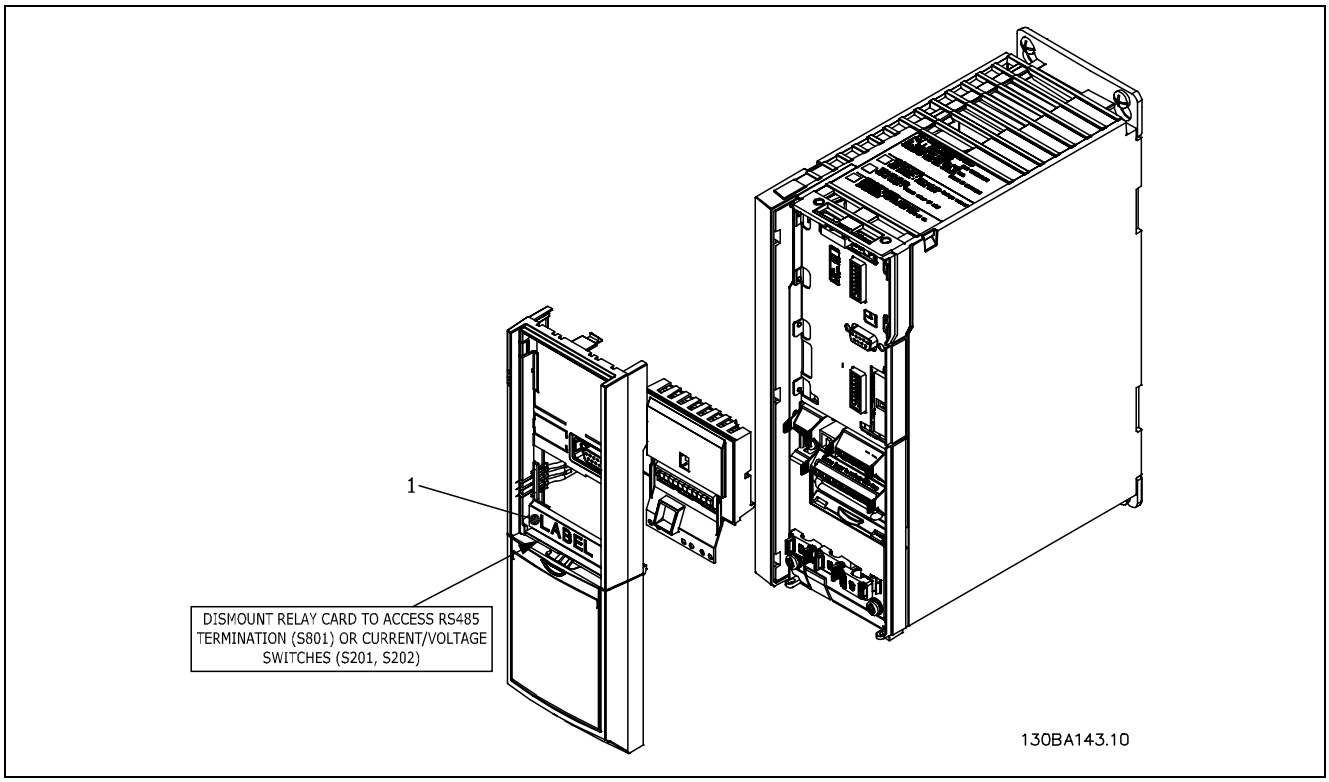
□ **Relay Option MCB 105**

The MCB 105 option includes 3 pieces of change over contacts and can be fitted into option slot B.

Electrical Data:

Max terminal load (AC)	240 V AC 2A
Max terminal load (DC)	24 V DC 1 A
Min terminal load (DC)	5 V 10 mA
Max switching rate at rated load/min load	6 min^{-1}/20 sec^{-1}

How to add the MCB 105 option:



Warning Dual supply

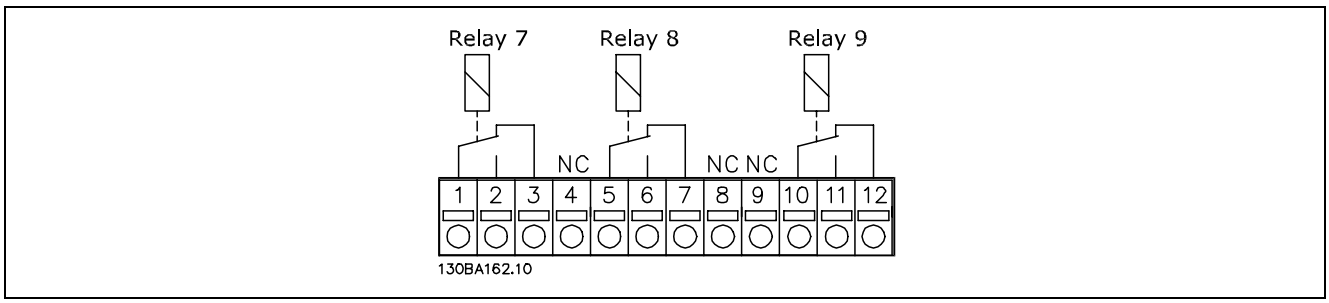
IMPORTANT

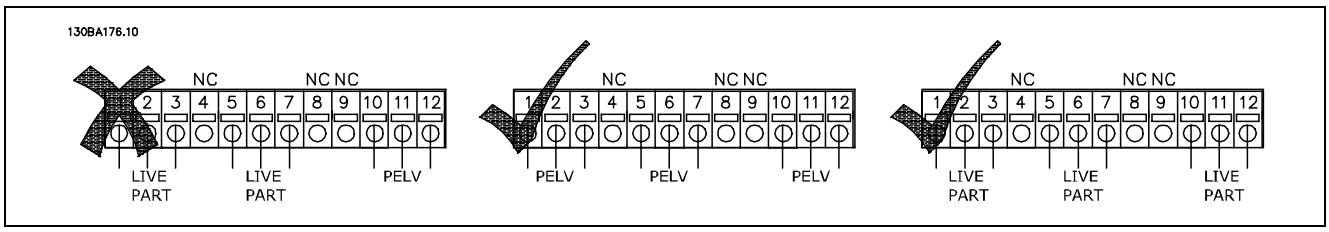
1. The label MUST be placed on the LCP frame as shown (UL approved).

How to Select Your VLT

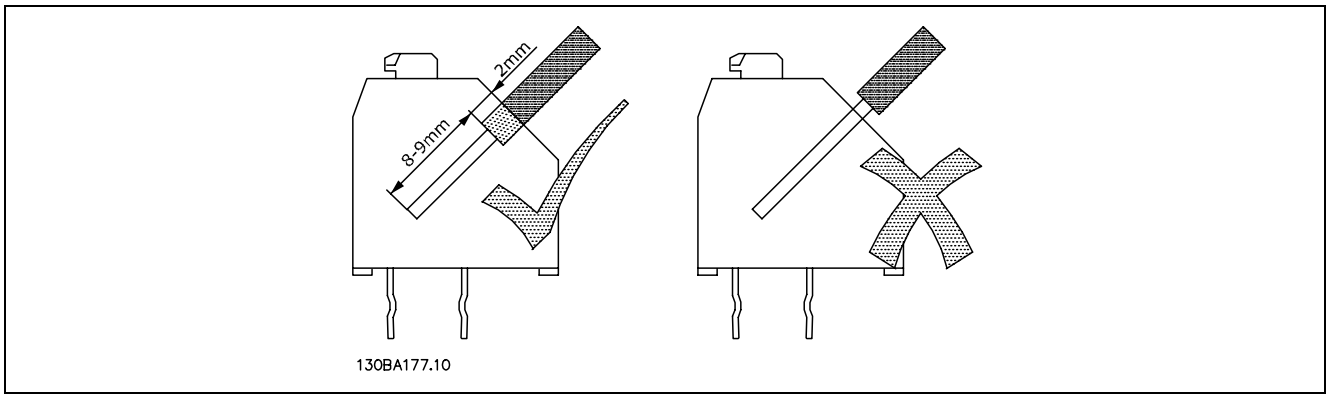
- The power to the frequency converter must be disconnected.
- The power to the livepart connections on relay terminals must be disconnected.
- Remove the LCP, the terminal cover and the cradle from the FC 30x.
- Fit the MCB 105 option in slot B.
- Connect the control cables and relief the cables by the enclosed cable strips.
- Various systems must not be mixed.
- Fit the extended cradle and terminal cover.
- Replace the LCP.
- Connect power to the frequency converter.
- Select the relay functions in par. 5-40 [6-8], 5-41 [6-8] and 5-42 [6-8].

NB (Array [6] is relay 7, array [7] is relay 8, and array [8] is relay 9)





Do not combine liveparts and PELV systems.



Correct wire inserting

□ 24 V Back-Up Option (Option D)

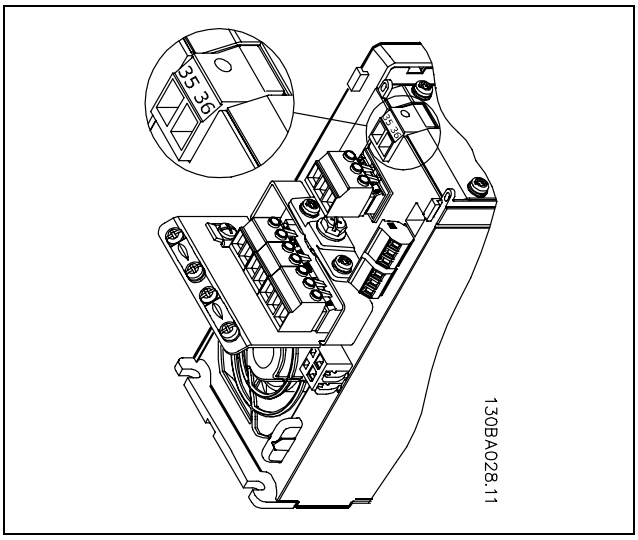
External 24 V DC Supply

An external 24 V DC supply can be installed for low-voltage supply to the control card and any option card installed. This enables full operation of the LCP (including the parameter setting) without connection to mains.

External 24 V DC supply specification:

Input voltage range	24 V DC +15 % (max. 37 V in 10 s)
Max. input current	2.2 A
Max cable length	75 m
Input capacitance load	< 10 uF
Power-up delay	< 0.6 s

The inputs are protected.



Connection to 24 V back-up supplier.

Terminal numbers:

Terminal 35: - external 24 V DC supply.
Terminal 36: + external 24 V DC supply.

Follow these steps:

1. Remove the LCP (F) or Blind Cover
2. Remove the Terminal Cover (G)
3. Remove the Cable Decoupling Plate (H) and the plastic cover underneath
4. Insert the 24 V DC Back-up External Supply Option (D) in the Option Slot (E)
5. Mount the Cable Decoupling Plate (H)
6. Attach the Terminal Cover (G) and the LCP (F) or Blind Cover.

□ Brake Resistors

Brake resistors are used in applications where high dynamics are needed or a high inertia load has to be stopped. The brake resistor is used to remove the energy from the DC link in the frequency converter.

□ **Remote mounting Kits for LCP**

The remote kit option makes it possible to move the display from the frequency converter e.g. to the front panel of an integrated cabinet.

Technical data	
Enclosure:	IP 65 front
Max. cable length between VLT and unit:	3 m
Communication std:	RS 485

□ **External 24 V DC Supply**

The external 24 V DC supply can be used as low-voltage supply to the control card or any option card installed. This enables full operation of the LCP (including the parameter setting) without connection to mains.

External 24 V DC supply specification	
Input voltage range:	24 V DC ±15 % (max. 37 V in 10 s)
Max. input current:	2.2 A
Max. cable length:	75 m
Input capacitance load:	≤ 10 uF
Power-up delay:	≤ 0.6 s

□ **IP 21/IP 4X/ TYPE 1 Enclosure Kit**

IP 20/IP 4X top/ TYPE 1 is an optional enclosure element available for IP 20 Compact units.
If the enclosure kit is used, an IP 20 unit is upgraded to comply with enclosure IP 21/ 4X top/TYPE 1.

The IP 4X top can be applied to all standard IP 20 FC 30X variants.

For more information, see chapter *How to Install*.

□ **LC Filters**

When a motor is controlled by a frequency converter, resonance noise will be heard from the motor. This noise, which is the result of the design of the motor, arises every time an inverter switch in the frequency converter is activated. The frequency of the resonance noise thus corresponds to the switching frequency of the frequency converter.

For the FC 300 Series, Danfoss can supply an LC filter to dampen the acoustic motor noise.

The filter reduces the ramp-up time of the voltage, the peak load voltage U_{PEAK} and the ripple current ΔI to the motor, which means that current and voltage become almost sinusoidal. Consequently, the acoustic motor noise is reduced to a minimum.

The ripple current in the coils, will also cause some noise. Solve the problem by integrating the filter in a cabinet or similar.

□ Ordering Numbers

□ Ordering Numbers: Options and Accessories

Type	Description	Ordering no.	
Miscellaneous hardware			
IP 4X top/TYPE 1 kit	Enclosure, frame size A2: IP21/IP 4X Top/TYPE 1	130B1110	
IP 4X top/TYPE 1 kit	Enclosure, frame size A3: IP21/IP 4X Top/TYPE 1	130B1111	
IP 20 low	Top-frame, frame size A2/A3 (w/o options space)	130B1007	
IP 20 high	Top-frame, frame size A2/A3 (w/ options space)	130B1008	
Fan B	Fan, frame size A2	130B1009	
Fan C	Fan, frame size A3	130B1010	
IP 20 terminal cover low	Control terminal cover, frame size A2/A3 (w/o options space)	130B1011	
IP 20 terminal cover high	Control terminal cover, frame size A2/A3 (w/ options space)	130B1012	
Encoder converter	5 V TTL Linedriver / 24 V DC	175Z1929	
Accessory bag B	Accessory bag, frame size A2	130B0509	
Accessory bag C	Accessory bag, frame size A3	130B0510	
Profibus D-Sub 9	Connector kit for IP20	130B1112	
Profibus top entry kit	Top entry kit for Profibus connection	130B0524	
LCP			
LCP option	Graphical Local Control Panel (LCP)	130B1107	
LCP cable	Separate LCP cable, 3 m	175Z0929	
LCP kit	Panel mounting kit for Full Graphic LCP	130B1113	
LCP kit	Panel mounting kit for numerical LCP	130B1114	
Options for Slot A		**Uncoated**	**Coated**
Profibus option DP V0/V1		130B1100	130B1200
DeviceNet option		130B1102	130B1202
Option for Slot D			
24 VDC back-up		130B1108	130B1208

Options can be ordered as factory built-in options, see ordering information.
For information on fieldbus and application option combatibility with older software versions, please contact your Danfoss supplier.

□ Ordering Numbers: Brake Resistors, 200-240 VAC

Standard brake resistors	10% duty cycle			40% duty cycle		
FC 301/ FC 302	Resistance, [ohm]	Power, [kW]	Code No.	Resistance, [ohm]	Power, [kW]	Code No.
PK25	-	-	-	-	-	-
PK37	-	-	-	-	-	-
PK55	-	-	-	-	-	-
PK75	145	0.065	175U1820	145	0.260	175U1920
P1K1	90	0.095	175U1821	90	0.430	175U1921
P1K5	65	0.250	175U1822	65	0.80	175U1922
P2K2	50	0.285	175U1823	50	1.00	175U1923
P3K0	35	0.430	175U1824	35	1.35	175U1924
P3K7	25	0.8	175U1825	25	3.00	175U1925

Flatpack brake resistors					
FC 301/ FC 302	Size	Motor [kW]	Resistor [ohm]	Order number	Max. duty cycle [%]
PK25	-	-	-	-	-
PK37	-	-	-	-	-
PK55	-	-	-	-	-
PK75	0.75	150	150 Ω 100 W	175U1005	14.0
PK75	0.75	150	150 Ω 200 W	175U0989	40.0
P1K1	1.1	100	100 Ω 100 W	175U1006	8.0
P1K1	1.1	100	100 Ω 200 W	175U0991	20.0
P1K5	1.5	72	72 Ω 200 W	175U0992	16.0
P2K2	2.2	47	50 Ω 200 W	175U0993	9.0
P3K0	3	35	35 Ω 200 W	175U0994	5.5
P3K0	3	35	72 Ω 200 W	2 x 175U0992[1]	12.0
P3K7	4	25	50 Ω 200 W	2 x 175U0993[1]	11.0

1. Order 2 pieces.

Mounting angle for flatpack resistor 100 W 175U0011
Mounting angle for flatpack resistor 200 W 175U0009

□ **Ordering Numbers: Brake Resistors, 380-500 VAC**

Standard brake resistors						
	10% duty cycle			40% duty cycle		
FC 301/ FC 302	Resistance, [ohm]	Power, [kW]	Code No.	Resistance, [ohm]	Power, [kW]	Code No.
PK37	-	-	-	-	-	-
PK55	-	-	-	-	-	-
PK75	620	0.065	175U1840	620	0.260	175U1940
P1K1	425	0.095	175U1841	425	0.430	175U1941
P1K5	310	0.250	175U1842	310	0.80	175U1942
P2K2	210	0.285	175U1843	210	1.35	175U1943
P3K0	150	0.430	175U1844	150	2.0	175U1944
P4K0	110	0.60	175U1845	110	2.4	175U1945
P5K5	80	0.85	175U1846	80	3.0	175U1946
P7K5	65	1.0	175U1847	65	4.5	175U1947

1. Order 2 pieces.

Flatpack brake resistors					
FC 301/ FC 302	Motor [kW]	Resistor, [ohm]	Size	Order number	Max. duty cycle, [%]
PK37	-	-	-	-	-
PK75	-	-	-	-	-
PK75	0.75	630	620 Ω 100 W	175U1001	14.0
PK75	0.75	630	620 Ω 200 W	175U0982	40.0
P1K1	1.1	430	430 Ω 100 W	175U1002	8.0
P1K1	1.1	430	430 Ω 200 W	175U0983	20.0
P1K5	1.5	320	310 Ω 200 W	175U0984	16.0
P2K2	2.2	215	210 Ω 200 W	175U0987	9.0
P3K0	3	150	150 Ω 200 W	175U0989	5.5
P3K0	3	150	300 Ω 200 W	2 x 175U0985[1]	12.0
P5K5	4	120	240 Ω 200 W	2 x 175U0986[1]	11.0
P5K5	5.5	82	160 Ω 200 W	2 x 175U0988[1]	6.5
P7K5	7.5	65	130 Ω 200 W	2 x 175U0990[1]	4.0

1. Order 2 pieces.

Mounting angle for flatpack resistor 100 W 175U0011
Mounting angle for flatpack resistor 200 W 175U0009

□ **Ordering Numbers: Harmonic Filters**

Harmonic filters are used to reduce mains harmonics.

- AHF 010: 10% current distortion
- AHF 005: 5% current distortion

380-415V, 50Hz				
$I_{AHF,N}$	Typical Motor Used [kW]	Danfoss ordering number		FC 301/ FC 302
		AHF 005	AHF 010	
10 A	4, 5.5	175G6600	175G6622	P4K0, P5K5
19 A	7.5	175G6601	175G6623	P7K5

440-480V, 60Hz				
$I_{AHF,N}$	Typical Motor Used [HP]	Danfoss ordering number		FC 301/ FC 302
		AHF 005	AHF 010	
19 A	10, 15	175G6612	175G6634	P7K5

Matching the frequency converter and filter is pre-calculated based on 400V/480V and on a typical motor load (4 pole) and 160 % torque.

□ **Ordering Numbers: LC Filter Modules, 200-240 VAC**

Mains supply 3 x 200-240 V					
FC 301/ FC 302	LC filter enclosure	Rated current at 200 V	Max. torque at CT/VT	Max. output frequency	Ordering no.
PK25 - P1K5	Bookstyle IP 20	7.8 A	160%	120 Hz	175Z0825
P2K2 - P3K7	Bookstyle IP 20	15.2 A	160%	120 Hz	175Z0826
PK25 - P3K7	Compact IP 20	15.2 A	160%	120 Hz	175Z0832

NB!:
When using LC filters, the switching frequency must be minimum 4.5 kHz (see par. 14-01).

□ Ordering Numbers: LC Filter Modules, 380-500 VAC

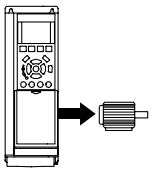
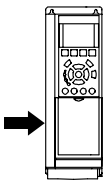
Mains supply 3 x 380 - 500 V					
FC 301/ FC 302	LC filter enclosure	Rated current at 400/500 V	Max. torque at CT/VT	Max. output frequency	Ordering no.
PK37-P3K0	Bookstyle IP 20	7.2 A / 6.3 A	160%	120 Hz	175Z0825
P4K0	Bookstyle IP 20	16 A / 14.5 A	160%	120 Hz	175Z0826
PK37-P7K5	Compact IP 20	16 A / 14.5 A	160%	120 Hz	175Z0832

LC filters for FC 300, 525 - 600 V, please contact Danfoss.

NB!:
When using LC filters, the switching frequency must be minimum 4.5 kHz (see par. 14-01).

□ Electrical Data

□ Mains Supply 3 x 200 - 240 VAC

FC 301/FC 302 Typical Shaft Output [kW]		0.25	0.37	0.55	0.75	1.1	1.5	2.2	3	3.7	4	5.5	7.5
Output current													
	Continuous (3 x 200-240 V) [A]	1.8	2.4	3.5	4.6	6.6	7.5	10.6	12.5	16.7	-	-	-
	Intermittent (3 x 200-240 V) [A]	2.9	3.8	5.6	7.4	10.6	12.0	17.0	20.0	26.7	-	-	-
	Continuous KVA (208 V AC) [KVA]	0.65	0.86	1.26	1.66	2.38	2.70	3.82	4.50	6.00	-	-	-
	Max. cable size (mains, motor, brake) [AWG] [2] [mm²]	24 - 10 AWG 0.2 - 4 mm²									-	-	-
Max. input current													
	Continuous (3 x 200-240 V) [A]	1.6	2.2	3.2	4.1	5.9	6.8	9.5	11.3	15.0	-	-	-
	Intermittent (3 x 200-240 V) [A]	2.6	3.5	5.1	6.6	9.4	10.9	15.2	18.1	24.0	-	-	-
	Max. pre-fuses[1] [A]	10	10	10	10	20	20	20	32	32	-	-	-
	Environment												
	Estimated power loss at rated max. load [W]	58	66	79	94	119	147	178	228	274	-	-	-
	Enclosure IP 20												
	Weight, enclosure IP20 [kg]	4.7	4.7	4.8	4.8	4.9	4.9	4.9	6.6	6.6	-	-	-
	Efficiency	0.94	0.94	0.94	0.94	0.94	0.94	0.95	0.95	0.95	-	-	-

1. For type of fuse see section *Fuses.*
2. American Wire Gauge.
3. Measured using 5 m screened motor cables at rated load and rated frequency.

□ **Mains Supply 3 x 380 - 500 VAC**

FC 301/FC 302 Typical Shaft Output [kW]		0,25	0.37	0.55	0.75	1.1	1.5	2.2	3	3.7	4	5.5	7.5
Output current													
	Continuous (3 x 380-440 V) [A]	-	1.3	1.8	2.4	3	4.1	5.6	7.2	-	10	13	16
	Intermittent (3 x 380-440 V) [A]	-	2.1	2.9	3.8	4.8	6.6	9.0	11.5	-	16	20.8	25.6
	Continuous (3 x 440-500 V) [A]	-	1.2	1.6	2.1	2.7	3.4	4.8	6.3	-	8.2	11	14.5
	Intermittent (3 x 440-500 V) [A]	-	1.9	2.6	3.4	4.3	5.4	7.7	10.1	-	13.1	17.6	23.2
	Continuous KVA (400 V AC) [KVA]	-	0.9	1.3	1.7	2.1	2.8	3.9	5.0	-	6.9	9.0	11.0
	Continuous KVA (460 V AC) [KVA]	-	0.9	1.3	1.7	2.4	2.7	3.8	5.0	-	6.5	8.8	11.6
	Max. cable size (mains, motor, brake) [AWG] [2] [mm²]	-			24 - 10 AWG 0.2 - 4 mm²					-	24 - 10 AWG 0.2 - 4 mm²		
Max. input current													
	Continuous (3 x 380-440 V) [A]	-	1.2	1.6	2.2	2.7	3.7	5.0	6.5	-	9.0	11.7	14.4
	Intermittent (3 x 380-440 V) [A]	-	1.9	2.6	3.5	4.3	5.9	8.0	10.4	-	14.4	18.7	23.0
	Continuous (3 x 440-500 V) [A]	-	1.0	1.4	1.9	2.7	3.1	4.3	5.7	-	7.4	9.9	13.0
	Intermittent (3 x 440-500 V) [A]	-	1.6	2.2	3.0	4.3	5.0	6.9	9.1	-	11.8	15.8	20.8
	Max. pre-fuses[1][A]	-	10	10	10	10	10	20	20	-	20	32	32
	Environment												
	Estimated power loss at rated max. load [W]	-	56	64	72	87	104	123	153	-	190	246	321
	Enclosure IP 20												
	Weight, enclosure IP20 [kg]	-	4.7	4.7	4.8	4.8	4.9	4.9	4.9	-	4.9	6.6	6.6
	Efficiency	-	0.96	0.96	0.96	0.96	0.96	0.97	0.97	-	0.97	0.97	0.97

1. For type of fuse see section *Fuses.*
2. American Wire Gauge.
3. Measured using 5 m screened motor cables at rated load and rated frequency.

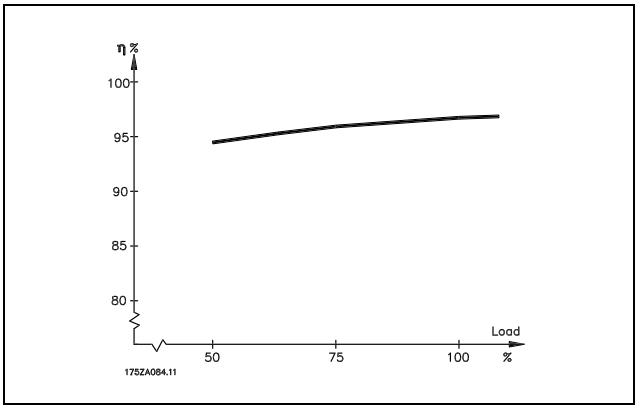
□ Mains Supply 3 x 525 - 600 VAC

FC 302 Typical Shaft Output [kW]	0.25	0.37	0.55	0.75	1.1	1.5	2.2	3	3.7	4	5.5	7.5
Output current												
Continuous (3 x 525-550 V) [A]	-	-	-	1.8	2.6	2.9	4.1	5.2	-	6.4	9.5	11.5
Intermittent (3 x 525-550 V) [A]	-	-	-	2.9	4.2	4.6	6.6	8.3	-	10.2	15.2	18.4
Continuous (3 x 525-600 V) [A]	-	-	-	1.7	2.4	2.7	3.9	4.9	-	6.1	9.0	11.0
Intermittent (3 x 525-600 V) [A]	-	-	-	2.7	3.8	4.3	6.2	7.8	-	9.8	14.4	17.6
Continuous KVA (525 V AC) [KVA]	-	-	-	1.7	2.5	2.8	3.9	5.0	-	6.1	9.0	11.0
Continuous KVA (575 V AC) [KVA]	-	-	-	1.7	2.4	2.7	3.9	4.9	-	6.1	9.0	11.0
Max. cable size (mains, motor, brake) [AWG] [2] [mm²]	-	-	-	24 - 10 AWG 0.2 - 4 mm²					-	24 - 10 AWG 0.2 - 4 mm²		
Max. input current												
Continuous (3 x 525-600 V) [A]	-	-	-	1.7	2.4	2.7	4.1	5.2	-	5.8	8.6	10.4
Intermittent (3 x 525-600 V) [A]	-	-	-	2.7	3.8	4.3	6.6	8.3	-	9.3	13.8	16.6
Max. pre-fuses[1] [A]	-	-	-	10	10	10	20	20	-	20	32	32
Environment												
Estimated power loss at rated max. load [W]	-	-	-	72	87	104	123	153	-	190	246	321
Enclosure IP 20												
Weight, enclosure IP20 [kg]	-	-	-	6.5	6.5	6.5	6.5	6.5	-	6.5	6.6	6.6
Efficiency	-	-	-	0.96	0.96	0.96	0.97	0.97	-	0.97	0.97	0.97

1. For type of fuse see section *Fuses.*
2. American Wire Gauge.
3. Measured using 5 m screened motor cables at rated load and rated frequency.

□ **Efficiency**

To reduce energy consumption it is very important to optimize the efficiency of a system. The efficiency of each single element in the system should be as high as possible.



Efficiency of FC 300 Series (η_{VLT})

The load on the frequency converter has little effect on its efficiency. In general, the efficiency is the same at the rated motor frequency $f_{M,N}$, even if the motor supplies 100% of the rated shaft torque or only 75%, i.e. in case of part loads.

This also means that the efficiency of the frequency converter does not change even if other U/f characteristics are chosen.
However, the U/f characteristics influence the efficiency of the motor.

The efficiency declines a little when the switching frequency is set to a value of above 5 kHz. The efficiency will also be slightly reduced if the mains voltage is 500 V, or if the motor cable is longer than 30 m.

Efficiency of the motor (η_{MOTOR})

The efficiency of a motor connected to the frequency converter depends on magnetising level. In general, the efficiency is just as good as with mains operation. The efficiency of the motor depends on the type of motor.

In the range of 75-100% of the rated torque, the efficiency of the motor is practically constant, both when it is controlled by the frequency converter and when it runs directly on mains.

In small motors, the influence from the U/f characteristic on efficiency is marginal. However, in motors from 11 kW and up, the advantages are significant.

In general, the switching frequency does not affect the efficiency of small motors. Motors from 11 kW and up have their efficiency improved (1-2%). This is because the sine shape of the motor current is almost perfect at high switching frequency.

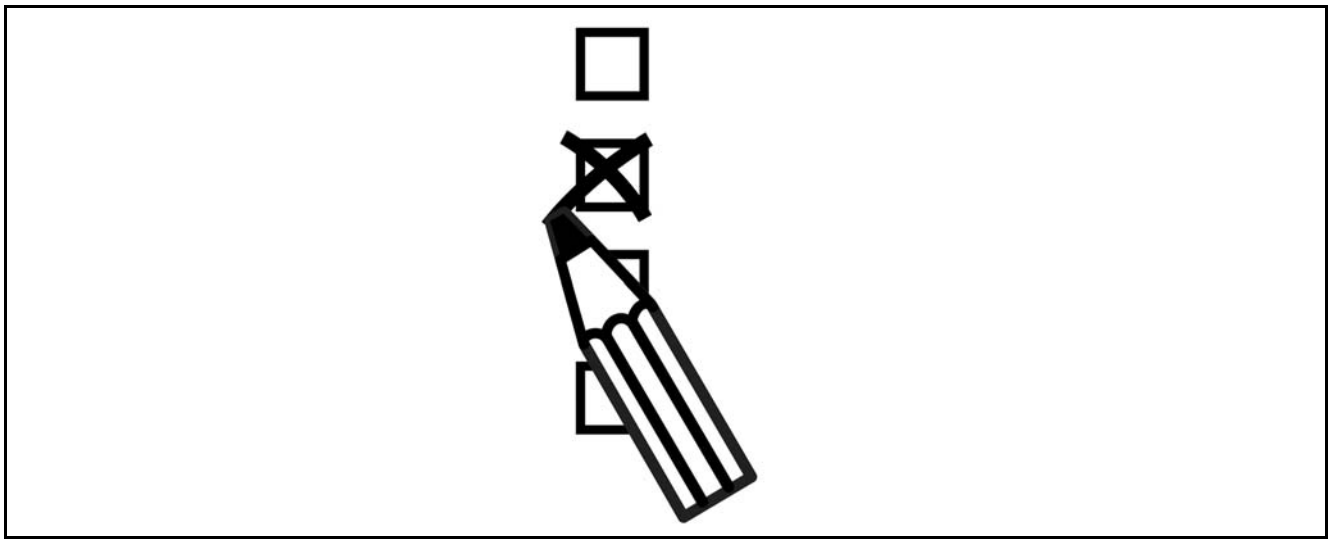
Efficiency of the system (η_{SYSTEM})

To calculate the system efficiency, the efficiency of FC 300 Series (η_{VLT}) is multiplied by the efficiency of the motor (η_{MOTOR}):

$\eta_{SYSTEM}) = \eta_{VLT} \times \eta_{MOTOR}$

Calculate the efficiency of the system at different loads based on the graph above.

How to Order



□ **Drive Configurator**

It is possible to design an FC 300 frequency converter by using the ordering number system.

For the FC 300 Series, you can order standard and with integral options by sending a type code string describing the product a to the local Danfoss sales office, i.e.:

FC-302PK75T5E20H1BGCXXXSXXXXA0BXCXXXXD0

The meaning of the characters in the string can be located in the pages containing the ordering numbers in the chapter *How to Select Your VLT*. In the example above, a Profibus DP V1 and a 24 V back-up option is included in the drive.

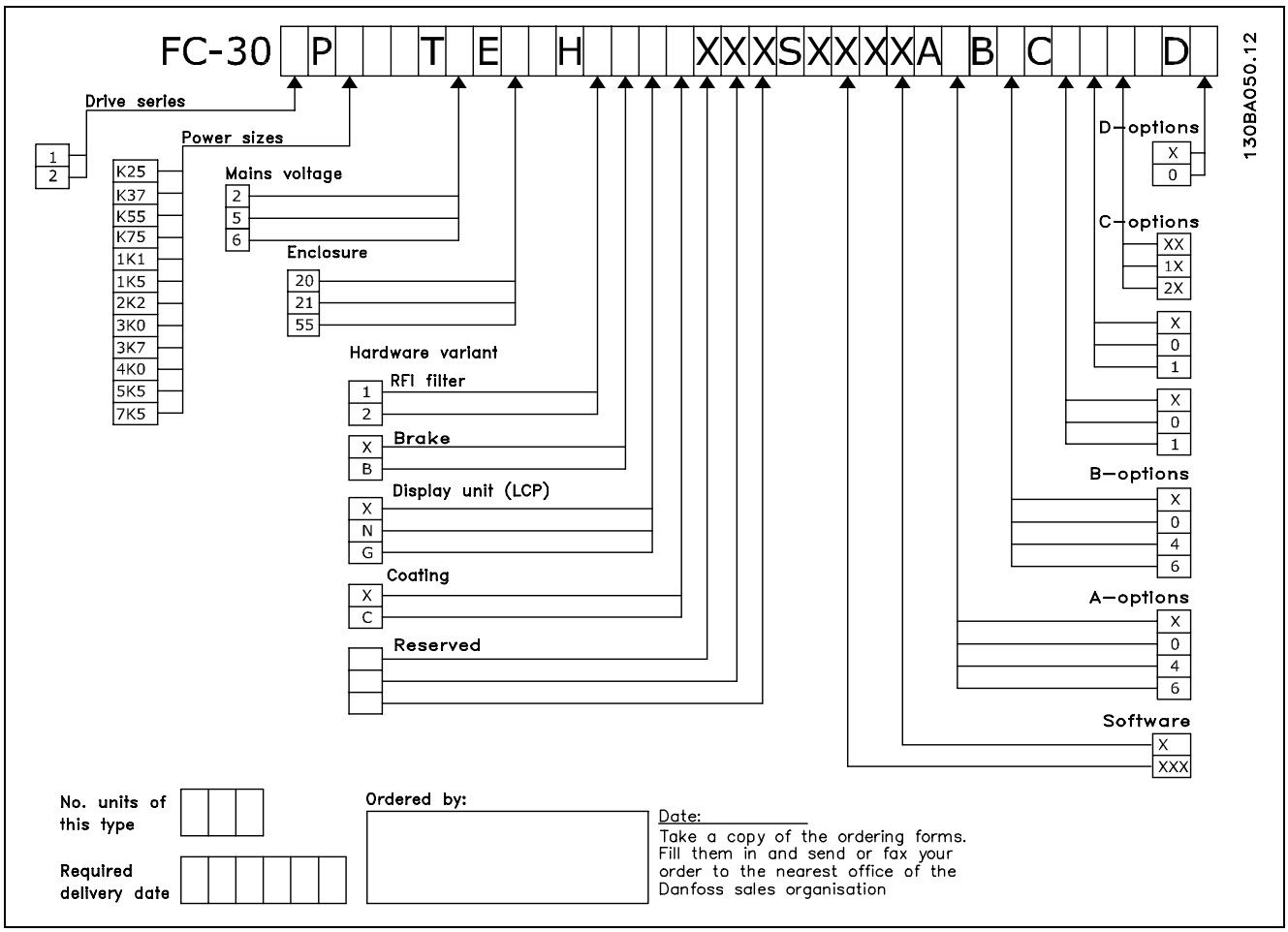
Ordering numbers for FC 300 standard variants can also be located in the chapter *How to Select Your VLT*.

From the Internet based product configurator, the Drive Configurator, you can configure the right drive for the right application and generate the type code string. If the variant has been ordered once before, the configurator will automatically generate an eight-digit sales number. The sales number can be delivered to your local sales office.
Furthermore, you can establish a project list with several products and send it to a Danfoss sales representative.

The Drive Configurator can be found on the global Internet site: www.danfoss.com/drives.

How to Order

□ Ordering Form Type Code

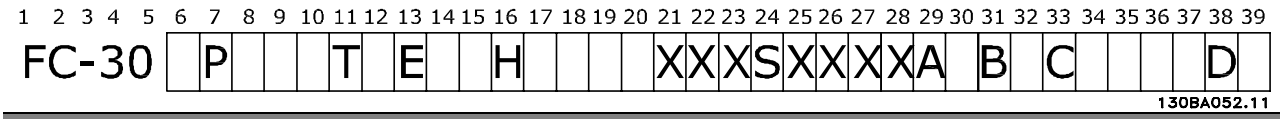


1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
FC-30		P				T		E			H									X	X	X	S	X	X	X	X	A		B		C					D	

130BA052.11

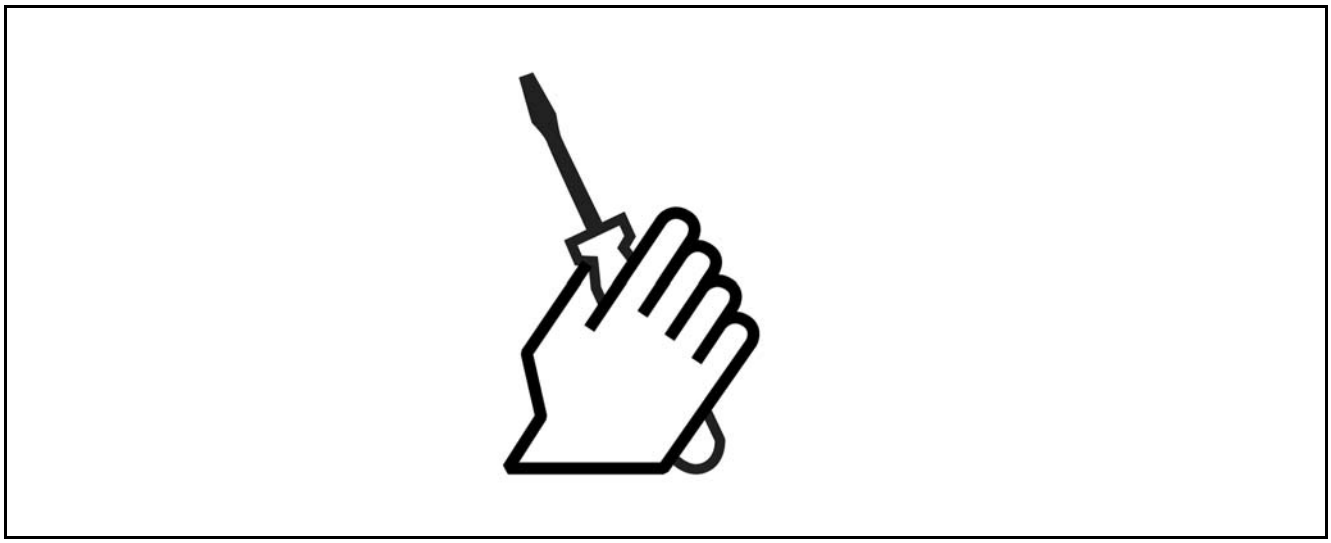
	200-240V 3-phased	380-500V 3-phased	525-600V 3-phased	IP20 / Chassis	IP21/ Type 1	No RFI	RFI A1/B1	RFI (A2)	No brake chopper	Brake chopper	No LCP	Graphical LCP 102	Not coated PCB	Coated PCB	No mains option	Resv.	Resv.
Typecode	T2	T5	T6	E20	E21	HX	H1	H2	X	B	X	G	X	C	X	X	X
Position	7-12	7-12	7-12	13-15	13-15	16-17	16-17	16-17	18	18	19	19	20	20	21	22	23
0.25kW/ 0.33HP	PK25			X	X		X	X	X	X	X	X	X	X	X	X	X
0.37kW/ 0.50HP	PK37	PK37		X	X		X	X	X	X	X	X	X	X	X	X	X
0.55kW/ 0.75HP	PK55	PK55		X	X		X	X	X	X	X	X	X	X	X	X	X
0.75kW/ 1.0HP	PK75	PK75		X	X		X	X	X	X	X	X	X	X	X	X	X
1.1kW/ 1.5HP	P1K1	P1K1		X	X		X	X	X	X	X	X	X	X	X	X	X
1.5kW/ 2.0HP	P1K5	P1K5		X	X		X	X	X	X	X	X	X	X	X	X	X
2.2kW/ 3.0HP	P2K2	P2K2		X	X		X	X	X	X	X	X	X	X	X	X	X
3.0kW/ 4.0HP	P3K0	P3K0		X	X		X	X	X	X	X	X	X	X	X	X	X
3.7kW/ 5.0HP	P3K7			X	X		X	X	X	X	X	X	X	X	X	X	X
4.0kW/ 5.5HP		P4K0		X	X		X	X	X	X	X	X	X	X	X	X	X
5.5kW/ 7.5HP		P5K5		X	X		X	X	X	X	X	X	X	X	X	X	X
7.5kW/ 10HP		P7K5		X	X		X	X	X	X	X	X	X	X	X	X	X
0.75kW/ 1.0HP			PK75	X	X	X			X	X	X	X	X	X	X	X	X
1.1kW/ 1.5HP			P1K1	X	X	X			X	X	X	X	X	X	X	X	X
1.5kW/ 2.0HP			P1K5	X	X	X			X	X	X	X	X	X	X	X	X
2.2kW/ 3.0HP			P2K2	X	X	X			X	X	X	X	X	X	X	X	X
3.0kW/ 4.0HP			P3K0	X	X	X			X	X	X	X	X	X	X	X	X
4.0kW/ 5.5HP			P4K0	X	X	X			X	X	X	X	X	X	X	X	X
5.5kW/ 7.5HP			P5K5	X	X	X			X	X	X	X	X	X	X	X	X
7.5kW/ 10HP			P7K5	X	X	X			X	X	X	X	X	X	X	X	X

How to Order



Optional selections, 200-600 V		
Software:		Position: 24-27
SXXX	Latest release - standard software	
Languages:		Position: 28
X	Standard language pack	
A-options		Position: 29-30
AX	No options	
A0	Profibus DP V1	
A4	DeviceNet	
B-options		Position: 31-32
BX	No options	
B2	Encoder Option Module	
B5	Relay Option Module	
C1-options		Position: 33-34
CX	No options	
C2-options		Position: 35
X	No options	
C option software		Position: 36-37
XX	Standard software	
D-options		Position: 38-39
DX	No option	
D0	24V DC back-up	

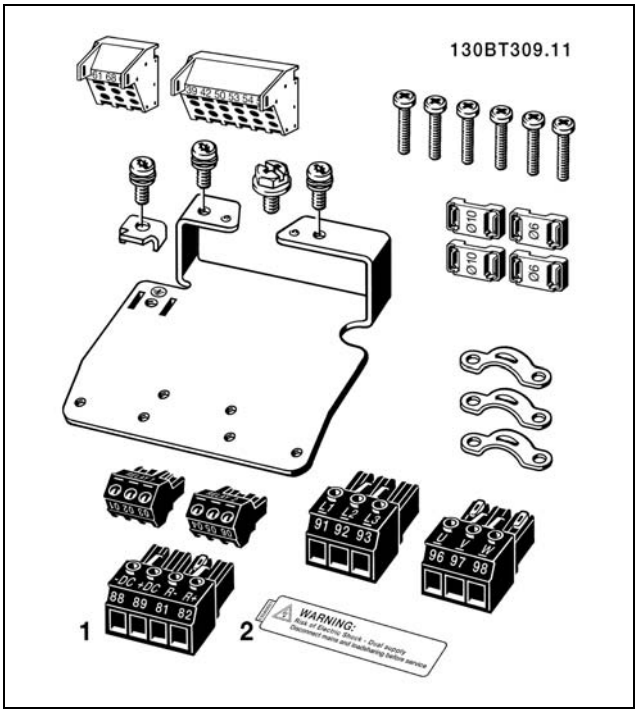
How to Install



□ Mechanical Installation

□ Accessory Bag

Find the following parts included in the FC 300 Accessory Bag.



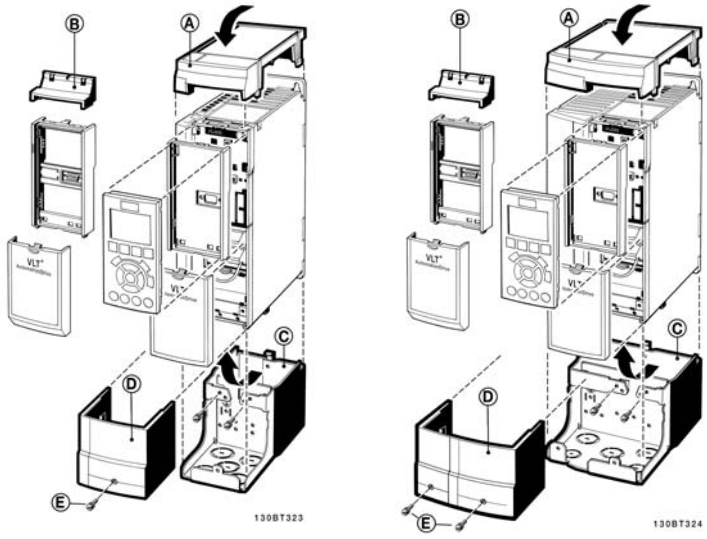
1 + 2 only available in units with brake chopper.

□ IP 21/Type 1 Enclosure Kit

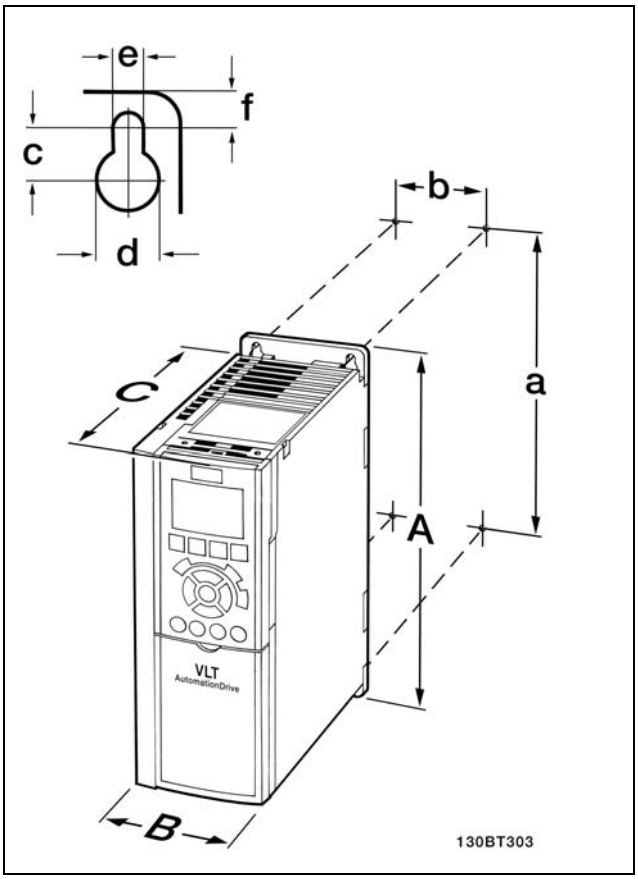
A – Top cover
B – Brim
C – Base part
D – Base cover
E – Screw(s)

Place the top cover as shown. If an A or B option is used the brim must be fitted to cover the top inlet. Place the base part C at the button of the drive and use the clamps from the accessory bag for correct relieving the cables. Holes for cable glands:

Size A2: 2x PG16 (½") 3xPG21 (3/4")
Size A3: 3xPG16 (½") 3xPG21 (3/4")



Mechanical dimensions			
		Frame size A2 0.25-2.2 kW (200-240 V) 0.37-4.0 kW (380-500 V)	Frame size A3 3.0-3.7 kW (200-240 V) 5.5-7.5 kW (380-500 V) 0.75-7.5 kW (550-600 V)
Height			
Height of back plate	A	268 mm	268 mm
Distance between mounting holes	a	257 mm	257 mm
Width			
Width of back plate	B	90 mm	130 mm
Distance between mounting holes	b	70 mm	110 mm
Depth			
From back plate to front	C	220 mm	220 mm
With option A/B		220 mm	220 mm
Without options		205 mm	205 mm
Screw holes			
	c	8.0 mm	8.0 mm
	d	ø 11 mm	ø 11 mm
	e	ø 5.5 mm	ø 5.5 mm
	f	6.5 mm	6.5 mm
Max weight		4.9 kg	6.6 kg

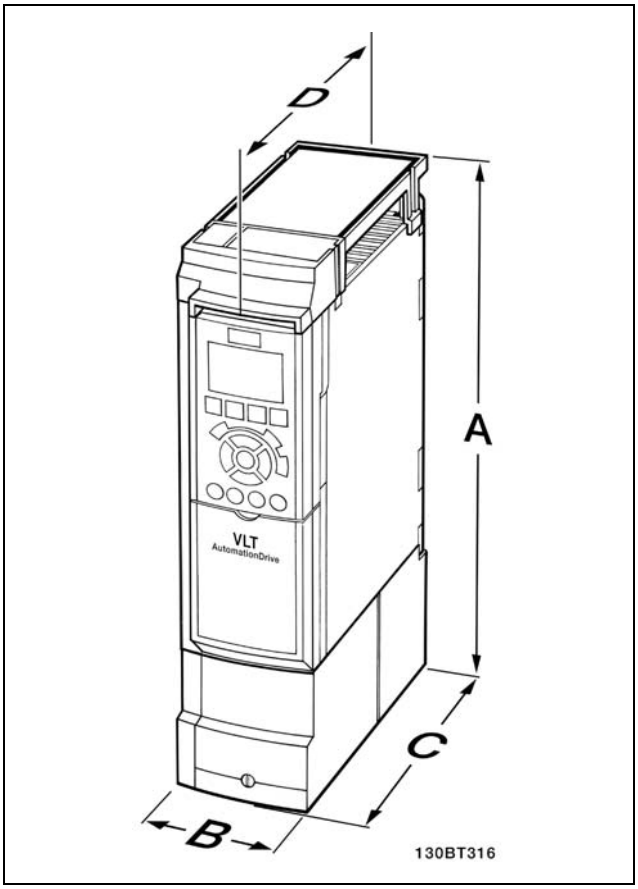


FC 300 IP20 - see table for mechanical dimensions.

IP 21/IP 4X/ TYPE 1 Enclosure Kit

The IP 21/IP 4X/ TYPE 1 enclosure kit consists of a sheet metal part and a plastic part. The sheet metal part serves as bonding plate for conduits and is attached to the bottom of the heat sink. The plastic part serves as protection from live parts on power plugs.

Mechanical dimensions		Frame size A2	Frame size A3
Height	A	375 mm	375 mm
Width	B	90 mm	130 mm
Bottom depth from back plate to front	C	202 mm	202 mm
Top depth from back plate to front (w/o option)	D	207 mm	207 mm
Top depth from back plate to front (w/ option)	D	222 mm	222 mm



Mechanical dimensions of the IP 21/IP 4x/ TYPE 1 enclosure kit

For installation of IP 21/IP 4X/ TYPE 1 top and bottom - see the *Option Guide* enclosed with the FC 300.

1. Drill holes in accordance with the measurements given.
2. You must provide screws suitable for the surface on which you want to mount the FC 300. Retighten all four screws.

FC 300 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 FC 300.

□ Safety Requirements of Mechanical Installation

Pay attention to the requirements that apply to integration and field mounting kit. Observe the information in the list to avoid serious damage or injury, especially when installing large units.

The frequency converter is cooled by means of air circulation.
To protect the unit from overheating, it must be ensured that the ambient temperature *does not exceed the maximum temperature stated for the frequency converter* and that the 24-hour average temperature *is not exceeded*. Locate the maximum temperature and 24-hour average in the paragraph *Derating for Ambient Temperature*.
If the ambient temperature is in the range of 45 °C - 55 ° C, derating of the frequency converter will become relevant, see *Derating for Ambient Temperature*.
The service life of the frequency converter is reduced if derating for ambient temperature is not taken into account.

□ Field Mounting

Field mounting is only possible with IP 21/IP 4X top/TYPE 1 kits part installed.

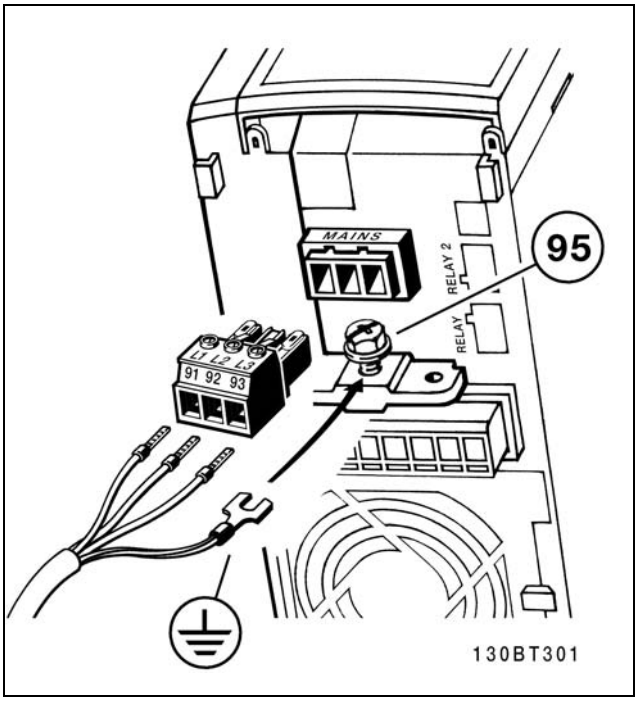
□ Electrical Installation

□ Connection to Mains and Earthing

NB!:
The plug connector for power can be removed.

1. Make sure the FC 300 is properly earthed. Connect to earth connection (terminal 95). Use screw from the accessory bag.
2. Place plug connector 91, 92, 93 from the accessory bag onto the terminals labelled MAINS at the bottom of FC 300.
3. Connect mains wires to the mains plug connector.

The earth connection cable cross section must be at least 10 mm^2 or 2 rated mains wires terminated separately.

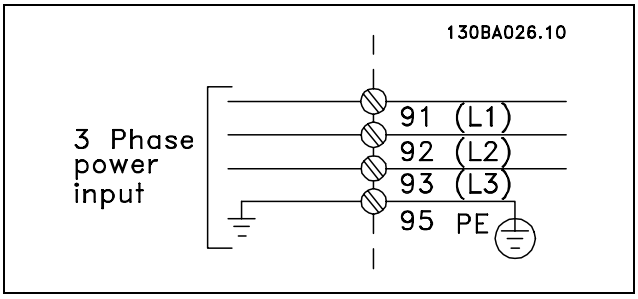


How to connect to mains and earthing.

How to Install

NB!:
Check that mains voltage corresponds to the mains voltage of the FC 300 name plate.

IT Mains
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.

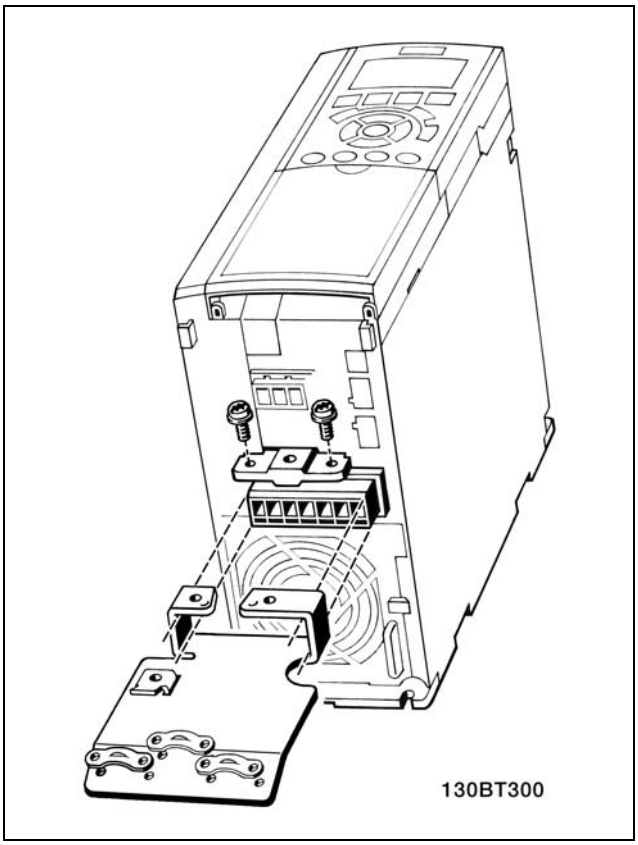


Terminals for mains and earthing.

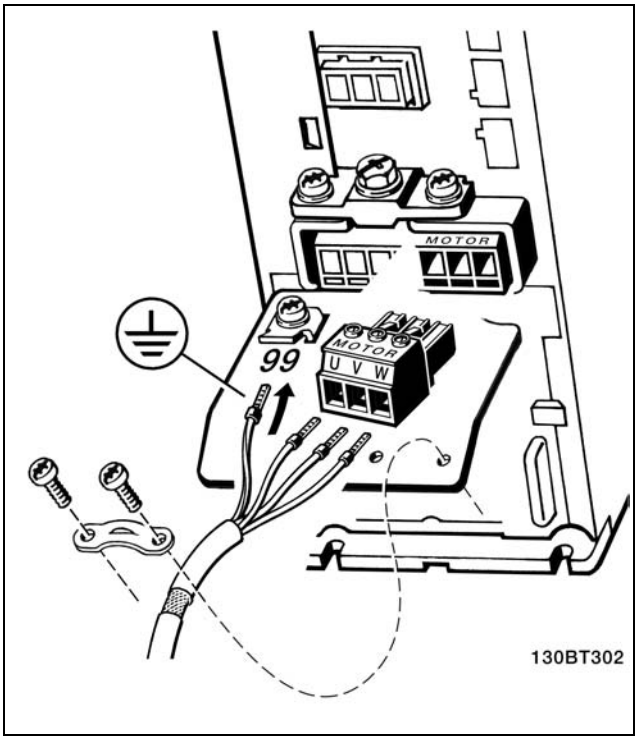
□ Motor Connection

NB!:
Motor cable must be screened/armoured. If an unscreened/unarmoured cable is used, some EMC requirements are not complied with. For more information, see *EMC specifications*.

1. Fasten decoupling plate to the bottom of FC 300 with screws and washers from the accessory bag.

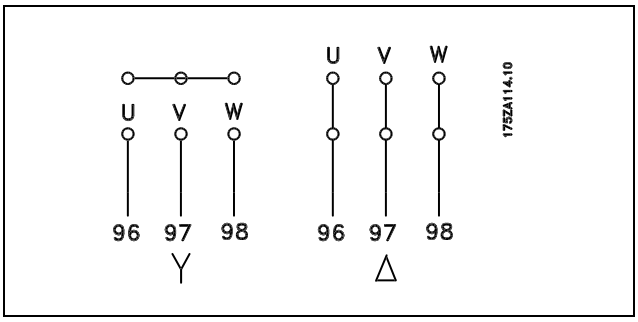


2. Attach motor cable to terminals 96 (U), 97 (V), 98 (W).
3. Connect to earth connection (terminal 99) on decoupling plate with screws from the accessory bag.
4. Insert terminals 96 (U), 97 (V), 98 (W) and motor cable to terminals labelled MOTOR.
5. Fasten screened cable to decoupling plate with screws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



No.	96	97	98	Motor voltage 0-100% of mains voltage. 3 wires out of motor
	U	V	W	
	U1 W2	V1 U2	W1 V2	6 wires out of motor, Delta-connected
	U1	V1	W1	6 wires out of motor, Star-connected U2, V2, W2 to be interconnected separately (optional terminal block)
No.	99			Earth connection
	PE			

All types of three-phase asynchronous standard motors can be connected to the FC 300. Normally, small motors are star-connected (230/400 V, D/Y). Large motors are delta-connected (400/690 V, D/Y). Refer to the motor name plate for correct connection mode and voltage.



NB!:
In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as a frequency converter), fit an LC filter on the output of the FC 300.

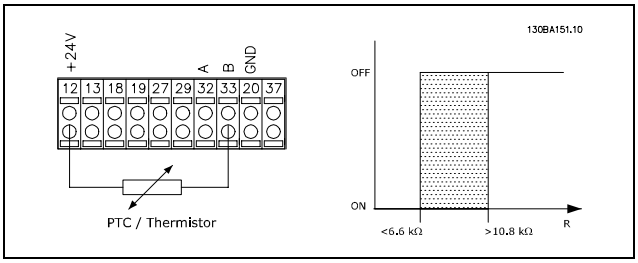
□ **Motor Cables**
See section *General Specifications* for correct dimensioning of motor cable cross-section and length. Always comply with national and local regulations on cable cross-section.

- Use a screened/armoured motor cable to comply with EMC emission specifications unless otherwise stated for the RFI filter used.
- Keep the motor cable as short as possible to reduce the noise level and leakage currents.
- Connect the motor cable screen to the decoupling plate of the FC 300 and to the metal cabinet of the motor.
- Make the screen connections with the largest possible surface area (cable clamp). This is done by using the supplied installation devices in the FC 300.
- Avoid mounting with twisted screen ends (pigtails), which will spoil high frequency screening effects.
- If it is necessary to split the screen to install a motor isolator or motor relay, the screen must be continued with the lowest possible HF impedance.

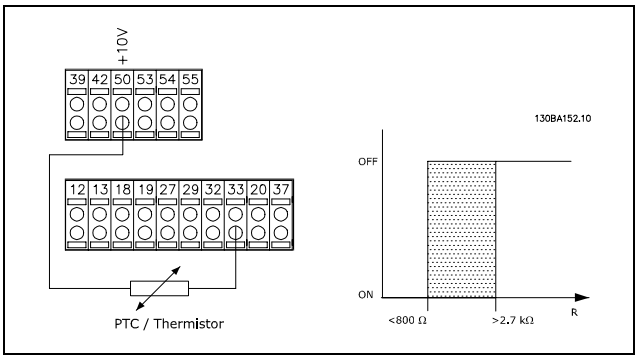
□ Thermal Motor Protection

Connection of thermal motor protection device (PTC or 'Klixon' NC switch):

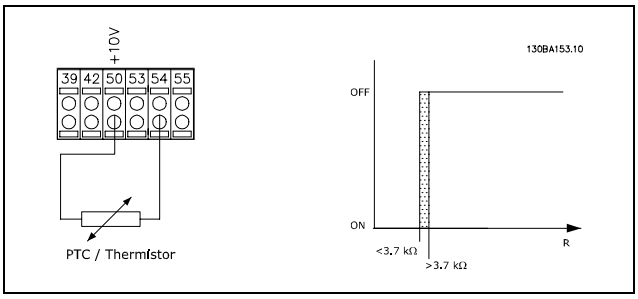
Using a digital input and 24 V as power supply:
Example: Frequency converter trips when motor temperature too high
Parameter set-up:
Par. 1-90 Thermistor Trip [2]
Par. 1-93 Digital Input [6]



Using a digital input and 10 V as power supply:
Example: Frequency converter trips when motor temperature too high
Parameter set-up:
Par. 1-90 Thermistor Trip [2]
Par. 1-93 Digital Input [6]



Using an analog input and 10 V as power supply:
Example: Frequency converter trips when motor temperature too high
Parameter set-up:
Par. 1-90 Thermistor Trip [2]
Par. 1-93 Analog Input 54 [2]
(No reference source must be selected)



□ Electrical Installation of Motor Cables

NB!:
If an unscreened cable is used, some EMC requirements are not complied with.
The motor cable must be screened in order to comply with the EMC specifications regarding emission, unless otherwise stated for the RFI filter. Keep the motor cable as short as possible to reduce the noise level and leakage currents to a minimum.
Connect the motor cable screen to the metal cabinet of the frequency converter and to the metal cabinet of the motor. Make the screen connections with the biggest possible surface (cable clamp). This is done by using different installation devices in the various frequency converters.

Screening of cables

Avoid installation with twisted screen ends (pigtails). They spoil the screening effect at higher frequencies. If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.

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 - increases, and the cable length must be reduced correspondingly.

Switching frequency
When frequency converters are used together with LC filters to reduce the acoustic noise from a motor, the switching frequency must be set according to the LC filter instruction in *Par. 14-01.*

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.

□ Fuses

Branch circuit protection:
In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be shortcircuit and overcurrent protected according to the national/international regulations.

Short circuit protection:
The frequency converter must be protected against short-circuit to avoid electrical or fire hazard. Danfoss recommends using the fuses mentioned below to protect service personnel or other equipment in case of an internal failure in the drive. The frequency converter provides full short circuit protection in case of a short-circuit on the motor output.

Over current protection:
Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. The frequency converter is equipped with an internal over current protection that can be used for upstream overload protection (UL-applications excluded). See par. 4-18. Moreover, fuses or circuit breakers can be used to provide the over current protection in the installation. Over current protection must always be carried out according to national regulations.

To comply with UL/cUL approvals, use pre-fuses according to the tables below.

200-240 V

FC 30X	Bussmann	Bussmann	Bussmann	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
	Type RK1	Type J	Type T	Type RK1	Type RK1	Type CC	Type RK1
K2-K75	KTN-R10	JKS-10	JJN-10	5017906-010	KLN-R10	ATM-R10	A2K-10R
1K1-2K2	KTN-R20	JKS-20	JJN-20	5017906-020	KLN-R20	ATM-R20	A2K-20R
3K0-3K7	KTN-R30	JKS-30	JJN-30	5012406-032	KLN-R30	ATM-R30	A2K-30R

380-500 V, 525-600 V

FC 30X	Bussmann	Bussmann	Bussmann	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
	Type RK1	Type J	Type T	Type RK1	Type RK1	Type CC	Type RK1
K37-1K5	KTS-R10	JKS-10	JJS-10	5017906-010	KLS-R10	ATM-R10	A6K-10R
2K2-4K0	KTS-R20	JKS-20	JJS-20	5017906-020	KLS-R20	ATM-R20	A6K-20R
5K5-7K5	KTS-R30	JKS-30	JJS-30	5012406-032	KLS-R30	ATM-R30	A6K-30R

KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.
FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.
KLSR fuses from LITTEL FUSE may substitute KLNR fuses for 240 V frequency converters.
L50S fuses from LITTEL FUSE may substitute L50S fuses for 240 V frequency converters.
A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V frequency converters.
A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V frequency converters.

Non UL compliance

If UL/cUL is not to be complied with, we recommend using the following fuses, which will ensure compliance with EN50178:
In case of malfunction, not following the recommendation may result in unnecessary damage of the frequency converter. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 A_{rms} (symmetrical), 500 V maximum.

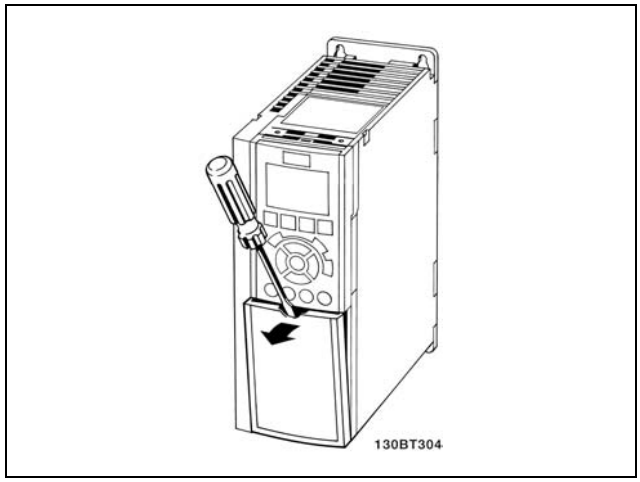
FC 30X	Max. fuse size	Voltage	Type
K25-K75	10A[1)]	200-240 V	type gG
1K1-2K2	20A[1)]	200-240 V	type gG
3K0-3K7	32A[1)]	200-240 V	type gG
K37-1K5	10A[1)]	380-500V	type gG
2K2-4K0	20A[1)]	380-500V	type gG
5K5-7K5	32A[1)]	380-500V	type gG

1) Max. fuses - see national/international regulations for selecting an applicable fuse size.

How to Install

Access to Control Terminals

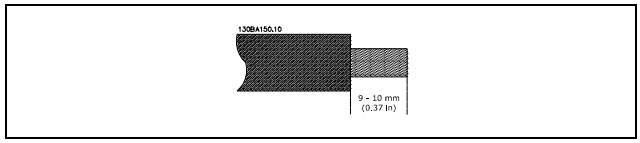
All terminals to the control cables are located underneath the terminal cover on the front of the frequency converter. Remove the terminal cover by means of a screwdriver (see illustration).

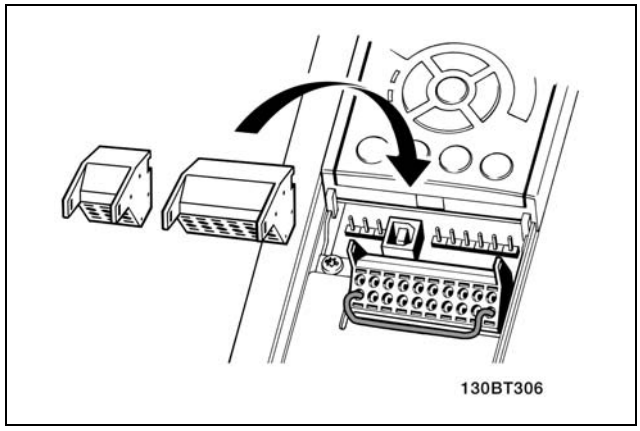


Electrical Installation, Control Terminals

1. Mount terminals from the accessory bag to the front of the FC 300.
2. Connect terminals 18, 27, and 37 to +24 V (terminal 12/13) with the control cable.

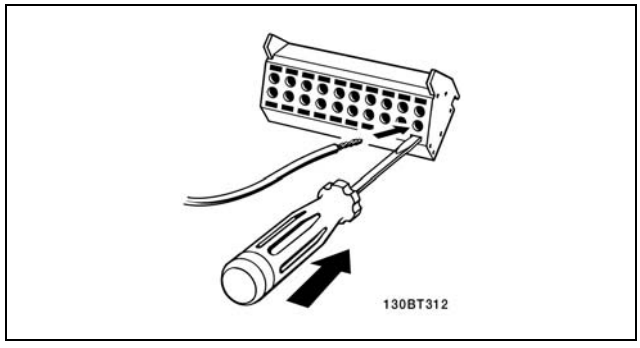
Default settings:
18 = start
27 = coast inverse
37 = safe stop inverse





NB!:
To mount the cable to the terminal:

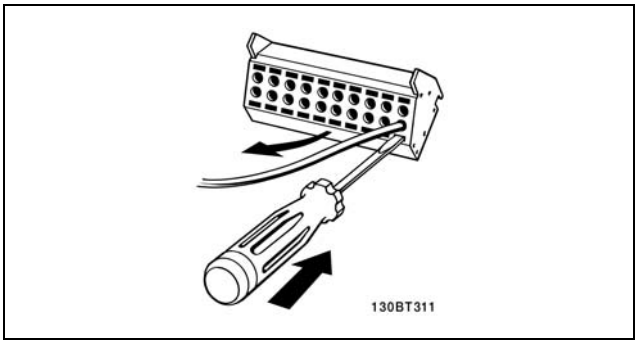
1. Strip isolation of 9-10 mm
2. Insert a screw driver in the square hole.
3. Insert the cable in the adjacent circular hole.
4. Remove the screw driver. The cable is now mounted to the terminal.



How to Install

NB!:
To remove the cable from the terminal:

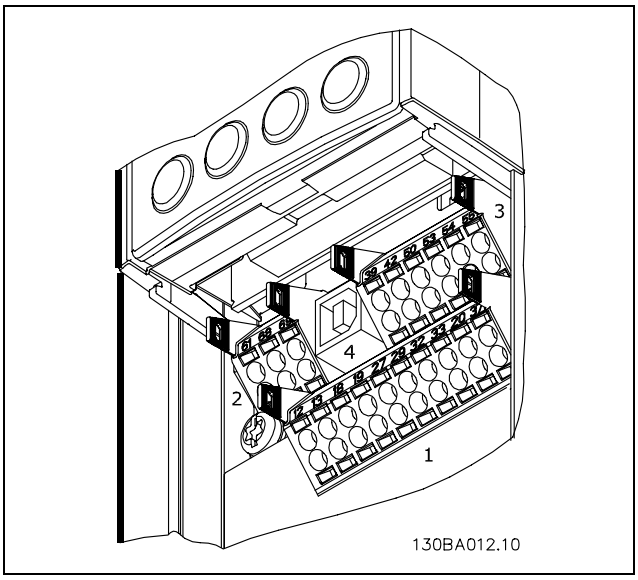
1. Insert a screw driver in the square hole.
2. Pull out the cable.



□ Control Terminals

Drawing reference numbers:

1. 10 pole plug digital I/O.
2. 3 pole plug RS485 Bus.
3. 6 pole analog I/O.
4. USB Connection.



Control terminals

□ Electrical Installation, Control Cables

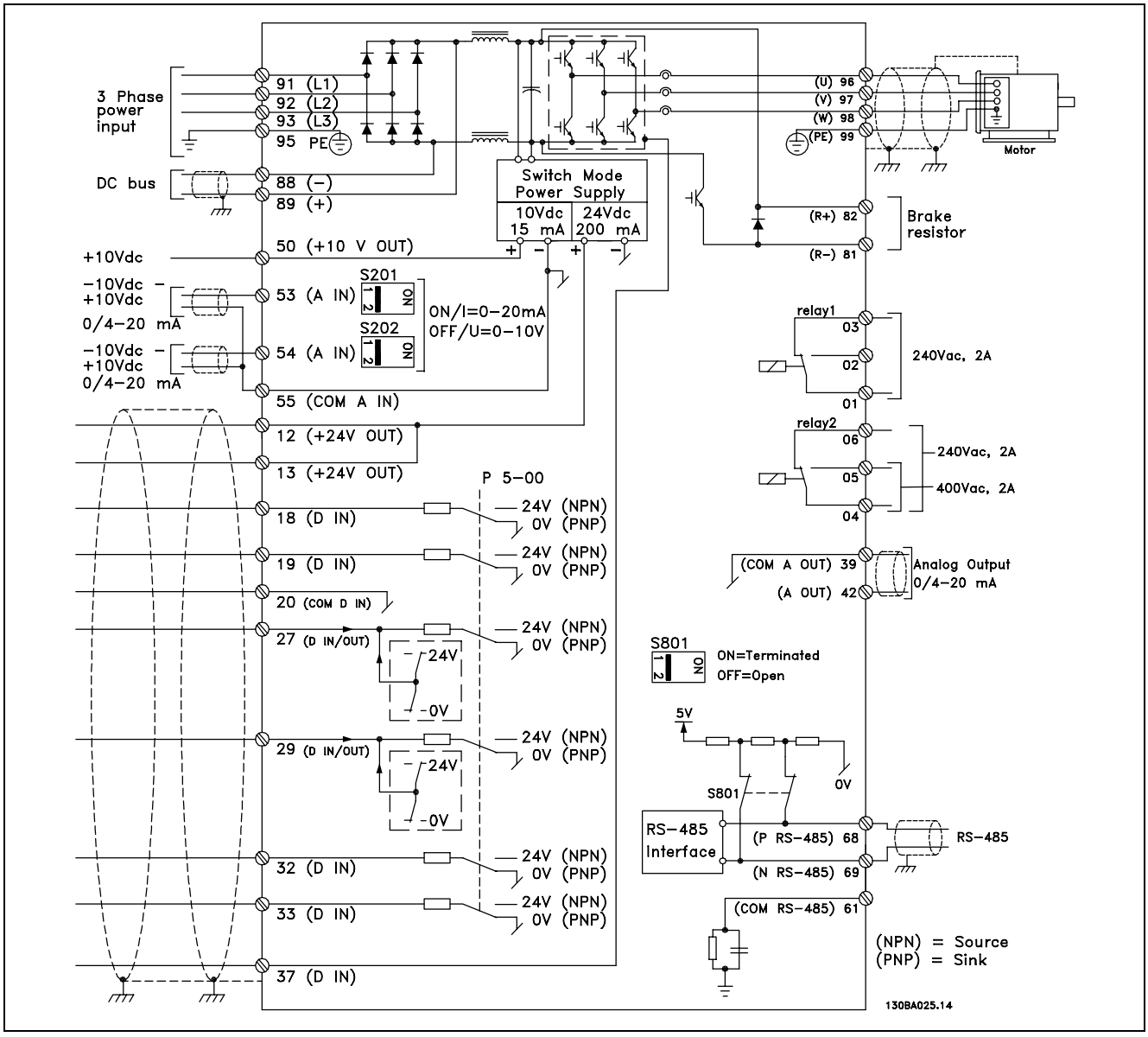


Diagram showing all electrical terminals. Terminal 37 is not included in FC 301.

Very long control cables 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, you may have to break the screen or insert a 100 nF capacitor between screen and chassis.

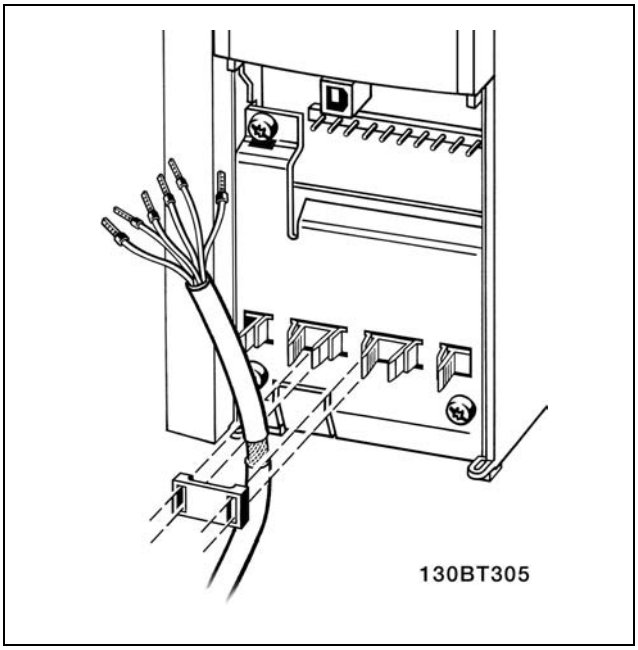
The digital and analog in- and outputs must be connected separately to the FC 300 common inputs (terminal 20, 55, 39) to avoid ground currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

How to Install

NB!:
Control cables must be screened/armoured.

1. Use a clamp from the accessory bag to connect the screen to the FC 300 decoupling plate for control cables.

See section entitled *Earthing of Screened/Armoured Control Cables* for the correct termination of control cables.



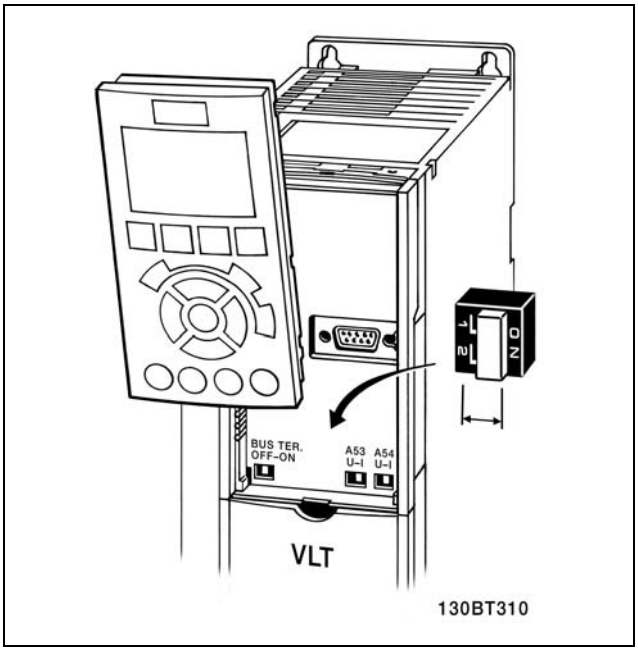
□ **Switches S201, S202, and S801**
Switches S201 (A53) and S202 (A54) are used to select a current (0-20 mA) or a voltage (-10 to 10 V) configuration of the analog input terminals 53 and 54 respectively.

Switch S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

See drawing *Diagram showing all electrical terminals* in section *Electrical Installation.*

Default setting:

S201 (A53) = OFF (voltage input)
S202 (A54) = OFF (voltage input)
S801 (Bus termination) = OFF



□ **Tightening Torques**
Tighten connected terminals with the following torques:

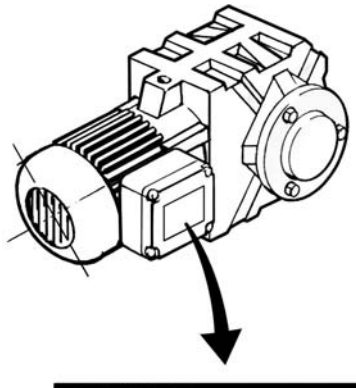
FC 300	Connections	Torque (Nm)
	Motor, mains, brake, DC Bus, Decoupling Plate screws	2-3
	Earth, 24 V DC	2-3
	Relay	0.5-0.6

□ Final Set-Up and Test

To test the set-up and ensure that the frequency converter is running, follow these steps.

Step 1. Locate the motor name plate.

NB!:
The motor is either star- (Y) or delta-connected (Δ). This information is located on the motor name plate data.



BAUER D-73734 ESLINGEN				
3~ MOTOR NR. 1827421				2003
BFSO-04/009LA4				
S/E005A9				
	1,5	kW		
31,5	/min.	400	Y	V
1400	/min.		50	Hz
0,60			3,6	A
1,7L				
B	IP 65	H1/1A		

130BT307

Step 2. Enter the motor name plate data in this parameter list.
To access this list first press the [QUICK MENU] key then select "Q2 Quick Setup".

1.	Motor Power [kW]	par. 1-20
	or Motor Power [HP]	par. 1-21
2.	Motor Voltage	par. 1-22
3.	Motor Frequency	par. 1-23
4.	Motor Current	par. 1-24
5.	Motor Nominal Speed	par. 1-25

Step 3. Activate the Automatic Motor Adaptation (AMA)
Performing an AMA will ensure optimum performance. The AMA measures the values from the motor model equivalent diagram.

1. Connect terminal 37 to terminal 12.
2. Start the frequency converter and activate the AMA par. 1-29.
3. Choose between complete or reduced AMA. If an LC filter is mounted, run only the reduced AMA, or remove the LC filter during the AMA procedure.
4. Press the [OK] key. The display shows "Press hand to start".
5. Press the [Hand on] key. A progress bar indicates if the AMA is in progress.

Stop the AMA during operation

1. Press the [OFF] key - the frequency converter enters into alarm mode and the display shows that the AMA was terminated by the user.

Successful AMA

1. The display shows "Press [OK] to finish AMA".
2. Press the [OK] key to exit the AMA state.

Unsuccessful AMA

1. The frequency converter enters into alarm mode. A description of the alarm can be found in the *Troubleshooting* section.
2. "Report Value" in the [Alarm Log] shows the last measuring sequence carried out by the AMA, before the frequency converter entered alarm mode. This number along with the description of the alarm will assist you in troubleshooting. If you contact Danfoss Service, make sure to mention number and alarm description.

NB!:
Unsuccessful AMA is often caused by incorrectly registered motor name plate data.

Step 4. Set speed limit and ramp time

Set up the desired limits for speed and ramp time.

Minimum Reference	par. 3-02
Maximum Reference	par. 3-03

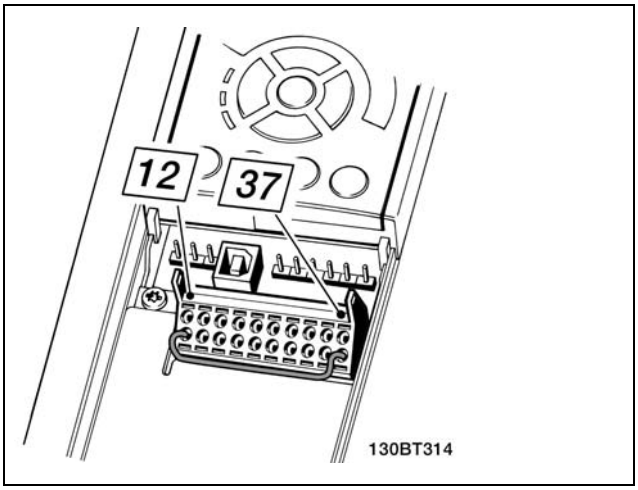
Motor Speed Low Limit	par. 4-11 or 4-12
Motor Speed High Limit	par. 4-13 or 4-14

Ramp-up Time 1 [s]	par. 3-41
Ramp-down Time 1 [s]	par. 3-42

□ **Safe Stop Installation**

To carry out an installation of a Category 0 Stop (EN60204) in conformance with Safety Category 3 (EN954-1), follow these instructions:

1. The bridge (jumper) between Terminal 37 and 24 V DC of FC 302 must be removed. Cutting or breaking the jumper is not sufficient. Remove it entirely to avoid short-circuiting. See jumper on illustration.
2. Connect terminal 37 to 24 V DC by a short-circuit protected cable. The 24 V DC voltage supply must be interruptible by a EN954-1 Category 3 circuit interrupt device. If the interrupt device and the frequency converter are placed in the same installation panel, you can use a regular cable instead of a protected one.
3. The FC 302 must be placed in an IP 54 enclosure.



Bridge jumper between terminal 37 and 24 VDC.

The illustration below shows a Stopping Category 0 (EN 60204-1) with safety Cat. 3 (EN 954-1). The circuit interrupt is caused by an opening door contact. The illustration also shows how to connect a non-safety related hardware coast.

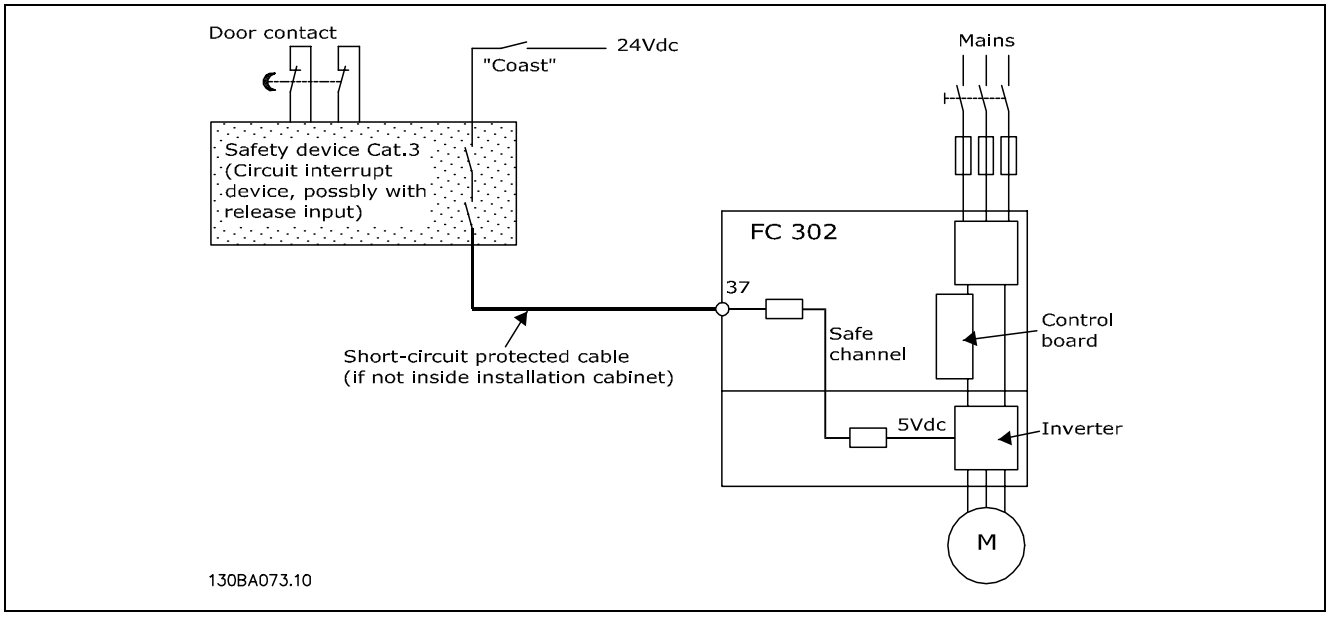


Illustration of the essential aspects of an installation to achieve a Stopping Category 0 (EN 60204-1) with safety Cat. 3 (EN 954-1).

□ **Safe Stop Commissioning Test**

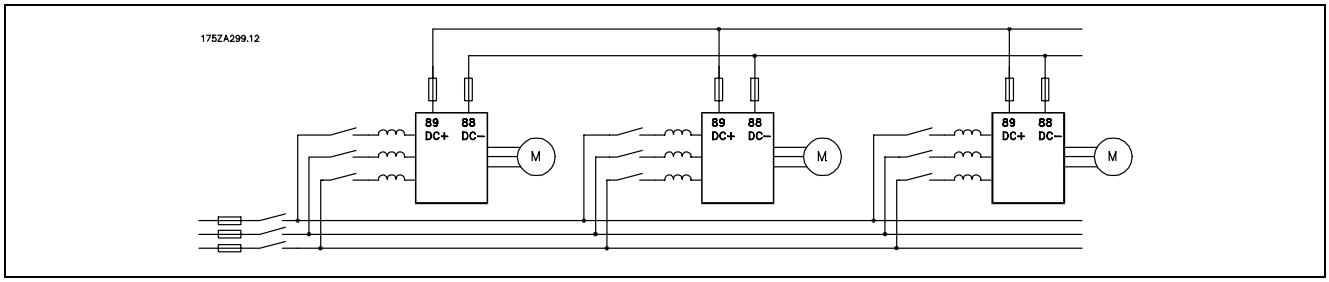
After installation and before first operation, perform a commissioning test of an installation or application making use of FC 300 Safe Stop.
Moreover, perform the test after each modification of the installation or application, which the FC 300 Safe Stop is part of.
The commissioning test:

1. Remove the 24 V DC voltage supply to terminal 37 by the interrupt device while the motor is driven by the FC 302 (i.e. mains supply is not interrupted). The test step is passed if the motor reacts with a coast and the mechanical brake (if connected) is activated.
2. Then 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.
3. Then 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.
4. Then send Reset signal (via Bus, Digital I/O, or [Reset] key). The test step is passed if the motor gets operational again.
5. The commissioning test is passed if all four test steps are passed.

□ Additional Connections

□ Load Sharing

With load sharing you can connect several frequency converter's DC intermediate circuits if you extend the installation using extra fuses and AC coils (see illustration).



NB!:
Load sharing cables must be screened/armoured. If an unscreened/unarmoured cable is used, some EMC requirements are not complied with.

Voltage levels of up to 975 V DC may occur between terminals 88 and 89.

No.	88	89	Loadsharing
	DC -	DC +	

□ Installation of Loadsharing

The connection cable must be screened and the max. length from the frequency converter to the DC bar is 25 metres.

NB!:
Load sharing calls for extra equipment. For further information, see Load-sharing Instructions MI.50.NX.YY.

□ Brake Connection Option

The connection cable to the brake resistor must be screened/armoured.

No.	81	82	Brake resistor
	R-	R+	terminals

1. Use cable clamps to connect the screen to the metal cabinet of the frequency converter and to the decoupling plate of the brake resistor.
2. Dimension the cross-section of the brake cable to match the brake current.

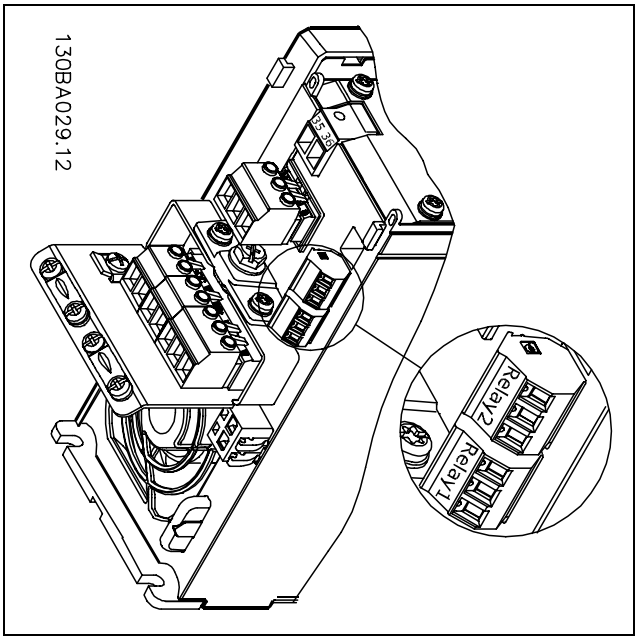
NB!:
Voltages up to 975 V DC (@ 600 V AC) may occur between the terminals.

How to Install

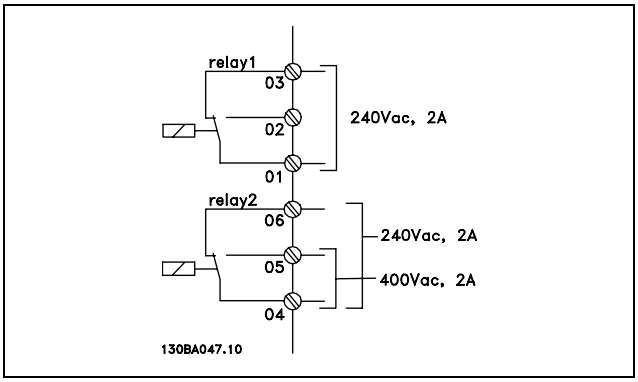
NB!:
If a short circuit in the brake resistor occurs, prevent power dissipation in the brake resistor by using a mains switch or contactor to disconnect the mains for the frequency converter. Only the frequency converter can control the contactor.

□ **Relay Connection**
To set relay output, see par. group 5-4* Relays.

No.		
	01 - 02	make (normally open)
	01 - 03	break (normally closed)
	04 - 05	make (normally open)
	04 - 06	break (normally closed)



Terminals for relay connection.



□ **Relay Output**

Relay 1

- Terminal 01: common
- Terminal 02: normal open 240 V AC
- Terminal 03: normal closed 240 V AC

Relay 2

- Terminal 04: common
- Terminal 05: normal open 400 V AC
- Terminal 06: normal closed 240 V AC

Relay 1 and relay 2 are programmed in par. 5-40, 5-41, and 5-42.

Additional relay outputs by using option module MCB 105.

□ **Control of Mechanical Brake**

In hoisting/lowering applications, you need to be able to control an electro-mechanical brake.

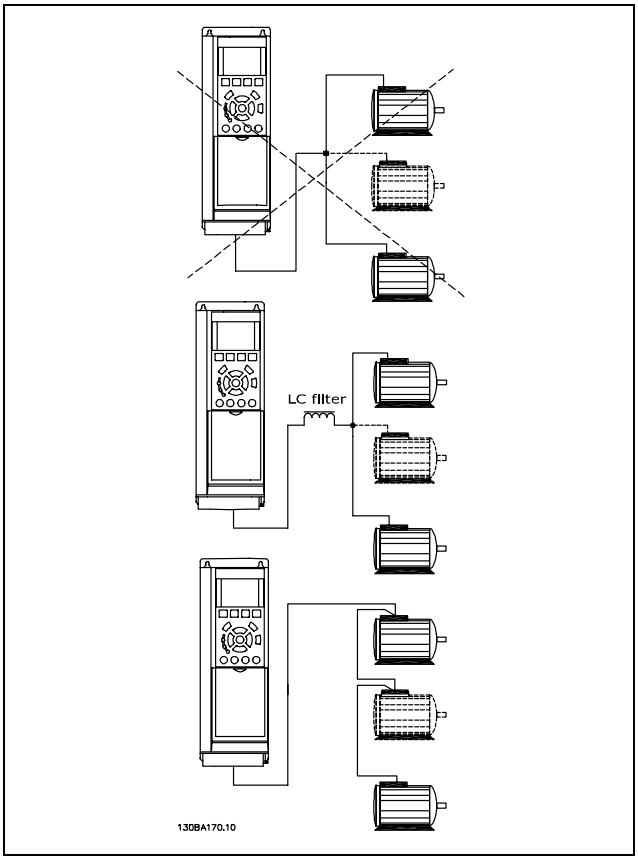
- Control the brake using any relay output or digital output (terminal 27 or 29).
- Keep the output closed (voltage-free) as long as the frequency converter is unable to 'support' the motor, for example due to the load being too heavy.
- Select *Mechanical brake control* [32] in par. 5-4* for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in par. 2-20.
- The brake is engaged when the output frequency is less than the frequency set in par. 2-21 or 2-22, and only if the frequency converter carries out a stop command.

If the frequency converter is in alarm mode or in an overvoltage situation, the mechanical immediately brake cuts in.

□ **Parallel Connection of Motors**

The frequency converter can control several parallel-connected motors. The total current consumption of the motors must not exceed the rated output current I_{INV} for the frequency converter. This is only recommended when U/f is selected in par. 1-01.

NB!:
When motors are connected in parallel, par. 1-02 *Automatic Motor Adaptation (AMA)* cannot be used, and par. 1-01 *Motor Control Principle* must be set to *Special motor characteristics (U/f)*.



Problems may arise at start and at low RPM values if motor sizes are widely different because small motors' relatively high ohmic resistance in the stator calls for a higher voltage at start and at low RPM values.

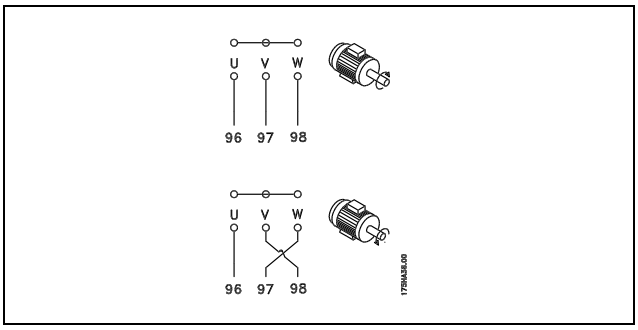
The electronic thermal relay (ETR) of the frequency converter cannot be used as motor protection for the individual motor of systems with parallel-connected motors. Provide further motor protection by e.g. thermistors in each motor or individual thermal relays. (Circuit breakers are not suitable as protection).

□ **Direction of Motor Rotation**

The default setting is clockwise rotation with the frequency converter output connected as follows.

Terminal 96 connected to U-phase
Terminal 97 connected to V-phase
Terminal 98 connected to W-phase

The direction of motor rotation is changed by switching two phases in the motor cable.



□ **Motor Thermal Protection**

The electronic thermal relay in FC 300 has received the UL-approval for single motor protection, when par. 1-90 *Motor Thermal Protection* is set for *ETR Trip* and par. 1-24 *Motor current, $I_{M,N}$* is set to the rated motor current (see motor name plate).

□ **Installation of Brake Cable**

(Only for frequency converters ordered with brake chopper option).

The connection cable to the brake resistor must be screened.

1. Connect the screen by means of cable clamps to the conductive back plate on the frequency converter and to the metal cabinet of the brake resistor.
2. Size the brake cable cross-section to match the brake torque.

No.	Function
81, 82	Brake resistor terminals

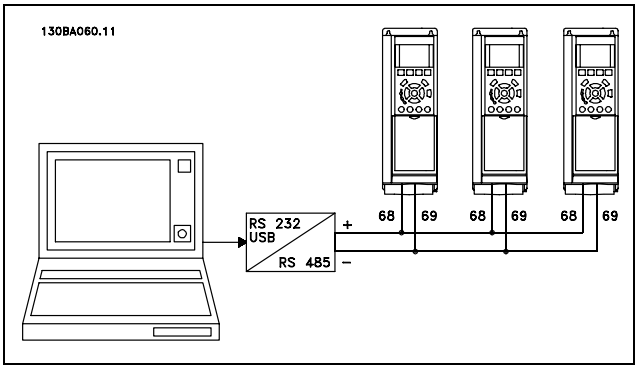
See Brake instructions, MI.90.FX.YY and MI.50.SX.YY for more information about safe installation.

NB!:
Voltages up to 960 V DC, depending on the supply voltage, may occur on the terminals.

□ **Bus Connection**

One or more frequency converters can be connected to a control (or master) using the RS485 standardized interface. Terminal 68 is connected to the P signal (TX+, RX+), while terminal 69 is connected to the N signal (TX-,RX-).

If more than one frequency converter is connected to a master, use parallel connections.



In order to avoid potential equalizing currents in the screen, earth the cable screen via terminal 61, which is connected to the frame via an RC-link.

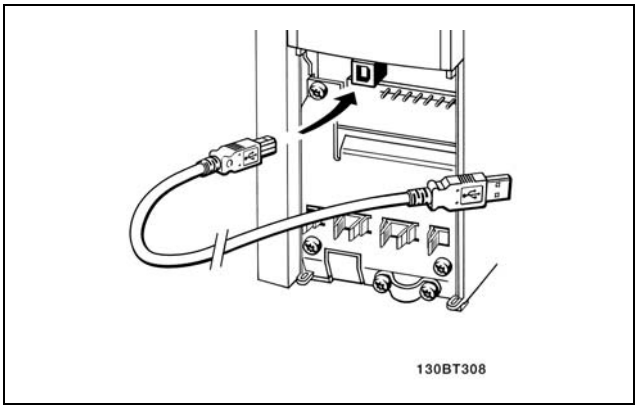
Bus termination

The RS485 bus must be terminated by a resistor network at both ends. For this purpose, set switch S801 on the control card for "ON".
For more information, see the paragraph *Switches S201, S202, and S801*.

How to Install

How to Connect a PC to the FC 300

To control the frequency converter from a PC, install the MCT 10 Set-up Software.
The PC is connected via a standard (host/device) USB cable, or via the RS485 interface as shown in the section *Bus Connection* in the chapter *How to Programme*.



USB connection.

NB!:
The earth terminal to motor and shield on the USB connector do NOT have the same potential. Use isolated laptops in conjunction with the USB port.

The FC 300 Software Dialogue

Data storage in PC via MCT 10 Set-Up Software:

1. Connect a PC to the unit via USB com port
2. Open MCT 10 Set-up Software
3. Choose "Read from drive"
4. Choose "Save as"

All parameters are now stored.

Data transfer from PC to drive via MCT 10 Set-Up Software:

1. Connect a PC to the unit via USB com port
2. Open MCT 10 Set-up software
3. Choose "Open" – stored files will be shown
4. Open the appropriate file
5. Choose "Write to drive"

All parameters are now transferred to the drive.

A separate manual for MCT 10 Set-up Software is available.

□ **High Voltage Test**

Carry out a high voltage test by short-circuiting terminals U, V, W, L_1, L_2 and L_3. Energize by max. 2.15 kV DC for one second between this short-circuit and the chassis.

NB!:
When running high voltage tests of the entire installation, interrupt the mains and motor connection if the leakage currents are too high.

□ **Safety Earthing**

The frequency converter has a high leakage current and must be earthed appropriately for safety reasons.

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 mm2 or 2 rated earth wires terminated separately.

□ **Electrical Installation - EMC Precautions**

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. See also paragraphs *CE Labelling, General Aspects of EMC Emission* and *EMC Test Results*.

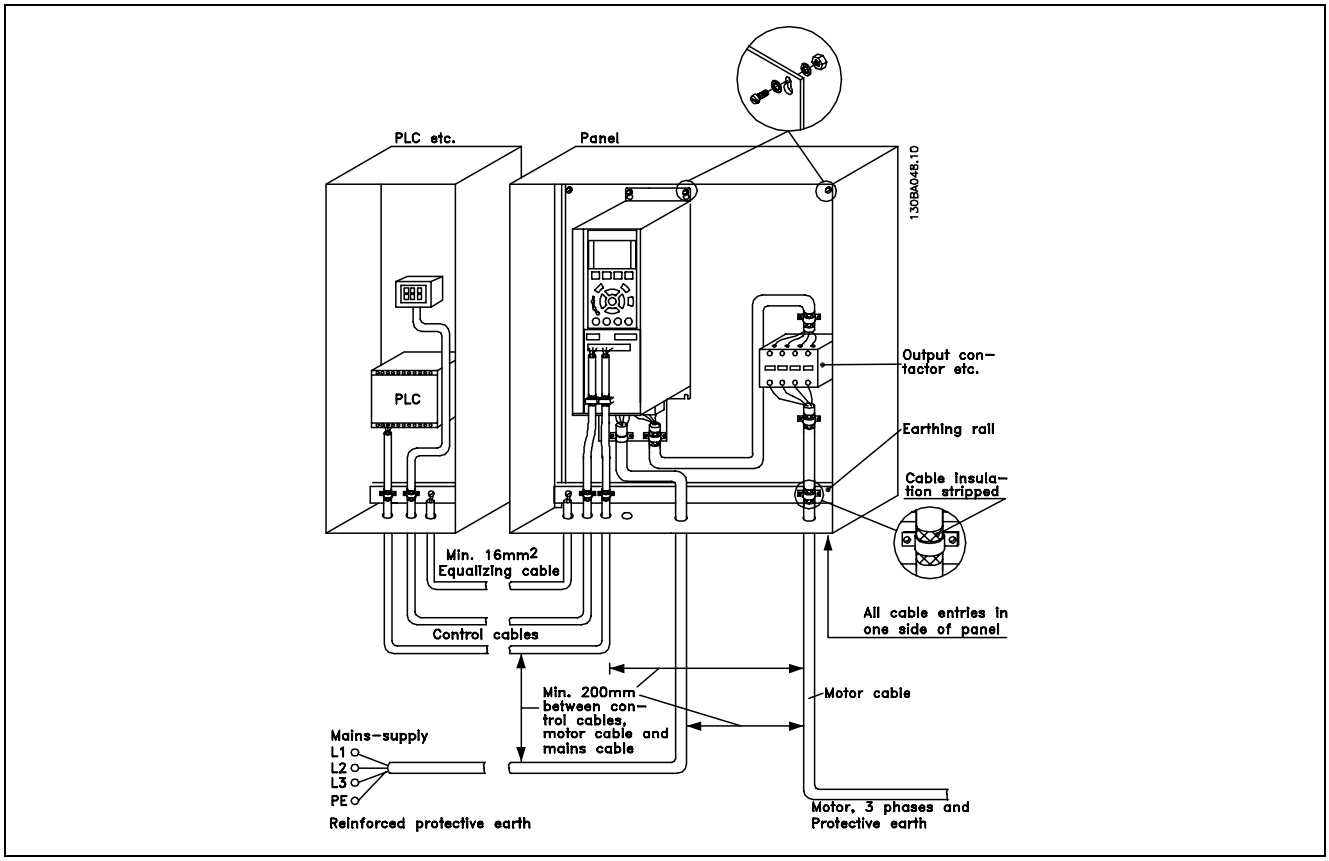
Good engineering practice to ensure EMC-correct electrical installation:

- Use only braided screened/armoured motor 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 cable must be installed in conduit separate from the control and mains cables. Full connection of the conduit from the drive to the motor 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 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 *Earthing of Braided Screened/Armoured 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 or control cables inside cabinets housing the drive(s), whenever this can be avoided.

Leave the screen as close to the connectors as possible.

The illustration 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.

I 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 *EMC test results*.



EMC-correct electrical installation of an IP20 frequency converter.

□ **Use of EMC-Correct Cables**

Danfoss recommends braided screened/armoured cables to optimise EMC immunity of the control cables and the EMC emission from the motor cables.

The ability of a cable to reduce the in- and outgoing radiation of electric noise depends on the transfer impedance (Z_T). The screen of a cable is normally designed to reduce the transfer of electric noise; however, a screen with a lower transfer impedance (Z_T) value is more effective than a screen with a higher transfer impedance (Z_T).

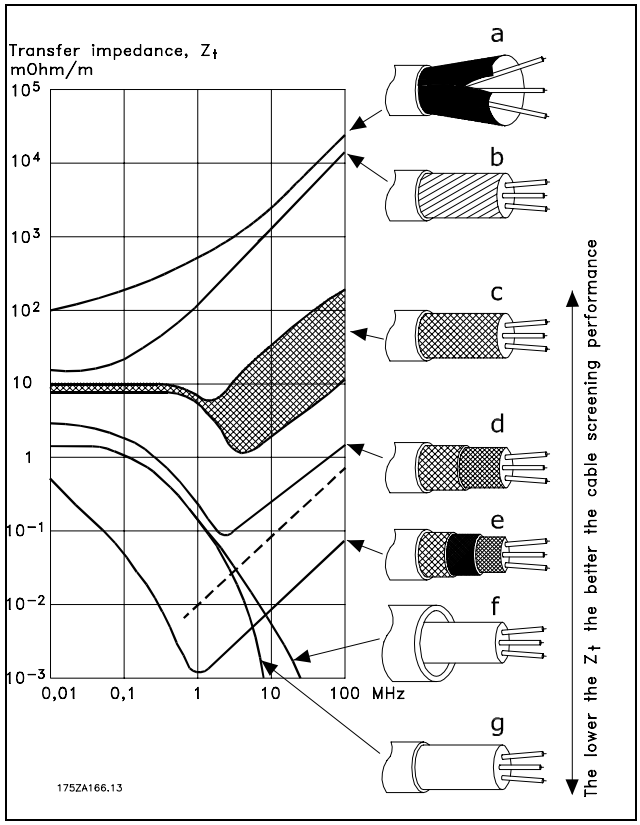
Transfer impedance (Z_T) is rarely stated by cable manufacturers but it is often possible to estimate transfer impedance (Z_T) by assessing the physical design of the cable.

Transfer impedance (Z_T) can be assessed on the basis of the following factors:

- The conductibility of the screen material.
- The contact resistance between the individual screen conductors.
- The screen coverage, i.e. the physical area of the cable covered by the screen - often stated as a percentage value.
- Screen type, i.e. braided or twisted pattern.

How to Install

a. Aluminium-clad with copper wire.
b. Twisted copper wire or armoured steel wire cable.
c. Single-layer braided copper wire with varying percentage screen coverage.
   This is the typical Danfoss reference cable.
d. Double-layer braided copper wire.
e. Twin layer of braided copper wire with a magnetic, screened/armoured intermediate layer.
f. Cable that runs in copper tube or steel tube.
g. Lead cable with 1.1 mm wall thickness.



□ **Earthing of Screened/Armoured Control Cables**

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 below indicates how correct earthing is carried out and what to do if in doubt.

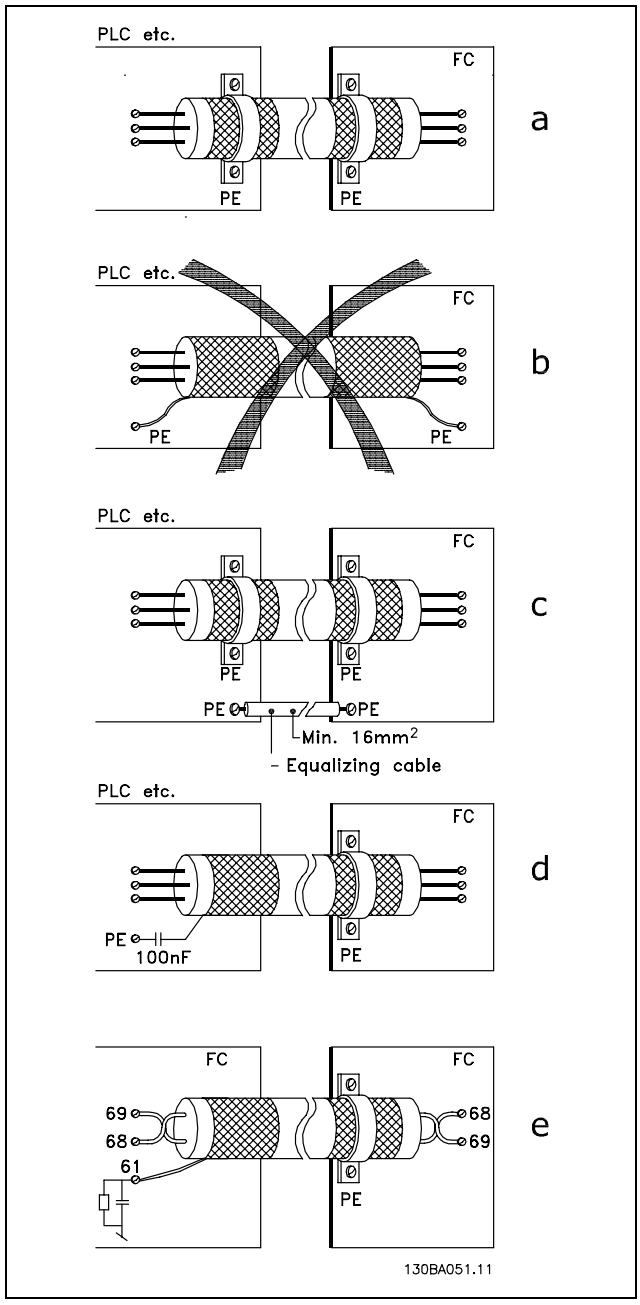
a. **Correct earthing**
Control cables and cables for serial communication must be fitted with cable clamps at both ends to ensure the best possible electrical contact.

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 and VLT**
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 100nF 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.

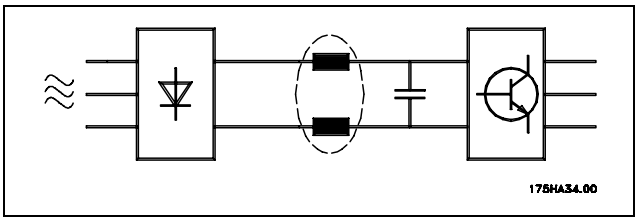


□ **Mains Supply Interference/Harmonics**

A frequency converter takes up a non-sinusoidal current from mains, which increases the input current I_{RMS}. A non-sinusoidal current is transformed by means of a Fourier analysis and split up into sine wave currents with different frequencies, i.e. different harmonic currents I_N with 50 Hz as the basic frequency:

Harmonic currents	I_1	I_5	I_7
Hz	50 Hz	250 Hz	350 Hz

The harmonics do not affect the power consumption directly but increase the heat losses in the installation (transformer, cables). Consequently, in plants with a high percentage of rectifier load, maintain harmonic currents at a low level to avoid overload of the transformer and high temperature in the cables.



NB!:
Some of the harmonic currents might disturb communication equipment connected to the same transformer or cause resonance in connection with power-factor correction batteries.

Harmonic currents compared to the RMS input current:

	Input current
I_{RMS}	1.0
I_1	0.9
I_5	0.4
I_7	0.2
I_{11-49}	< 0.1

To ensure low harmonic currents, the frequency converter is equipped with intermediate circuit coils as standard. This normally reduces the input current I_{RMS} by 40%.

The voltage distortion on the mains supply depends on the size of the harmonic currents multiplied by the mains impedance for the frequency in question. The total voltage distortion THD is calculated on the basis of the individual voltage harmonics using this formula:

$$THD\% = \sqrt{U_5^2 + U_7^2 + \ldots + U_N^2} \quad \left(U_N \% of\ U\right)$$

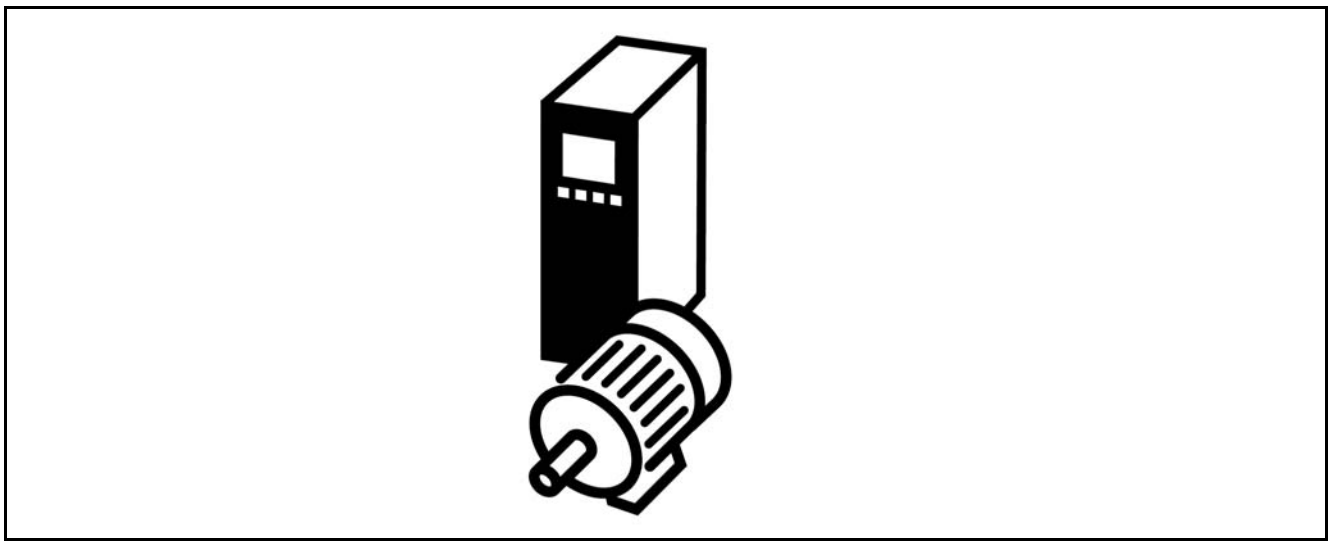
□ **Residual Current Device**

You can use RCD relays, multiple protective earthing or earthing as extra protection, provided that local safety regulations are complied with.

If an earth fault appears, a DC content may develop in the faulty current.

If RCD relays are used, you must observe local regulations. Relays must be suitable for protection of 3-phase equipment with a bridge rectifier and for a brief discharge on power-up see section *Earth Leakage Current* for further information.

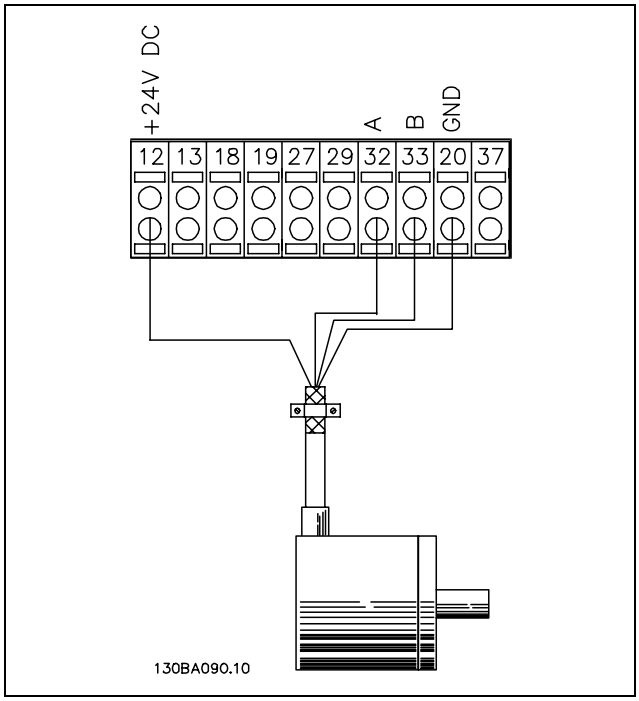
Application Examples

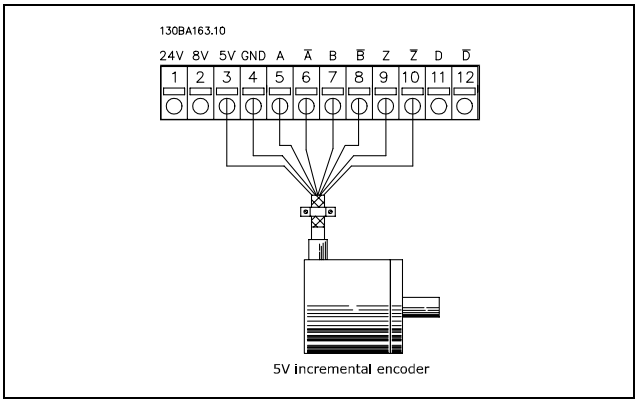


□ Encoder Connection

The purpose of this guideline is to ease the set-up of encoder connection to FC 302. Before setting up the encoder the basic settings for a closed loop speed control system will be shown.

Encoder Connection to FC 302

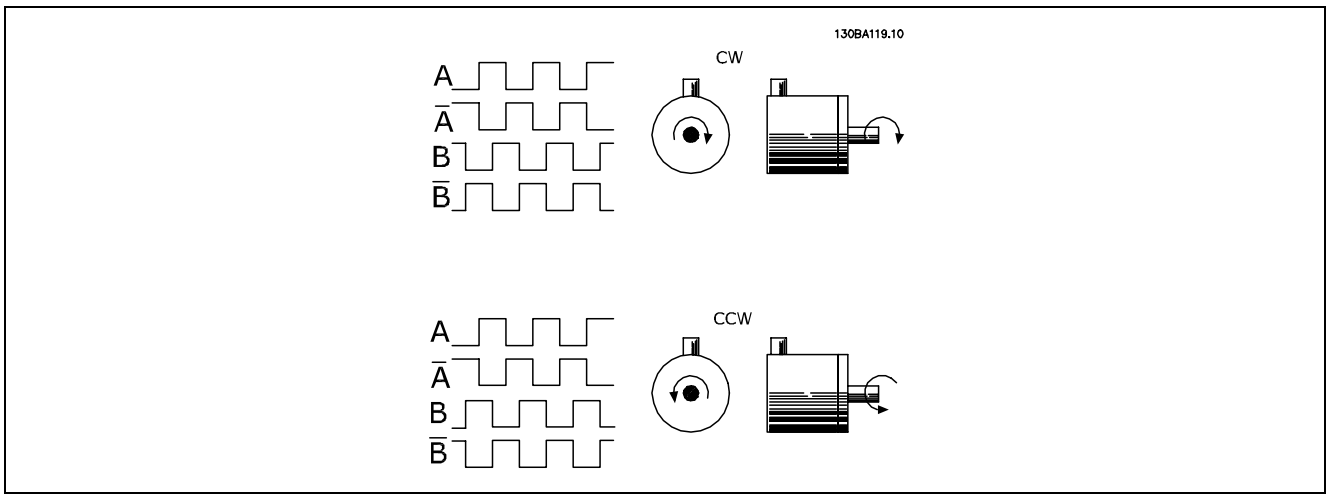




Application Examples

□ Encoder Direction

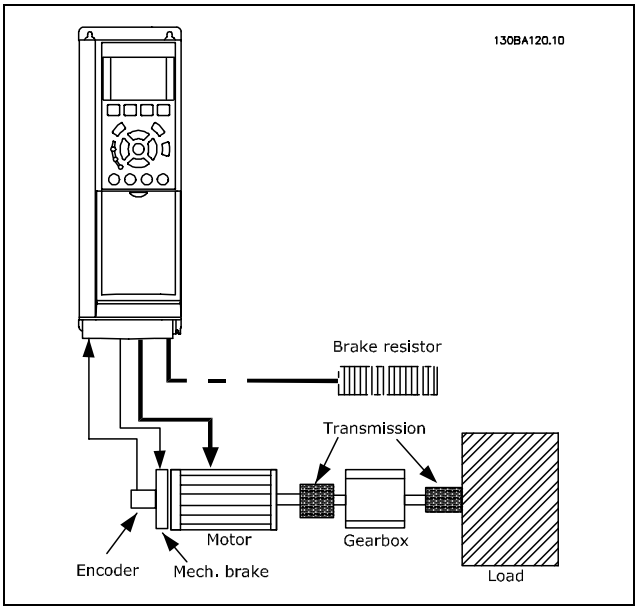
The direction of encoder is determined by which order the pulses are entering the drive.
Clockwise direction means channel A is 90 electrical degrees before channel B.
Counter Clockwise direction means channel B is 90 electrical degrees before A.
The direction determined by looking into the shaft end.



□ Closed Loop Drive System

A drive system consist usually of more elements as:

- Motor
- Add
  (Gearbox)
  (Mechanical Brake)
- FC 302 AutomationDrive
- Encoder as feed-back system
- Brake resistor for dynamic braking
- Transmission
- Load



Basic Set-up for FC 302 Closed Loop Speed Control

Applications demanding mechanical brake control will usually need a brake resistor.

Application Examples

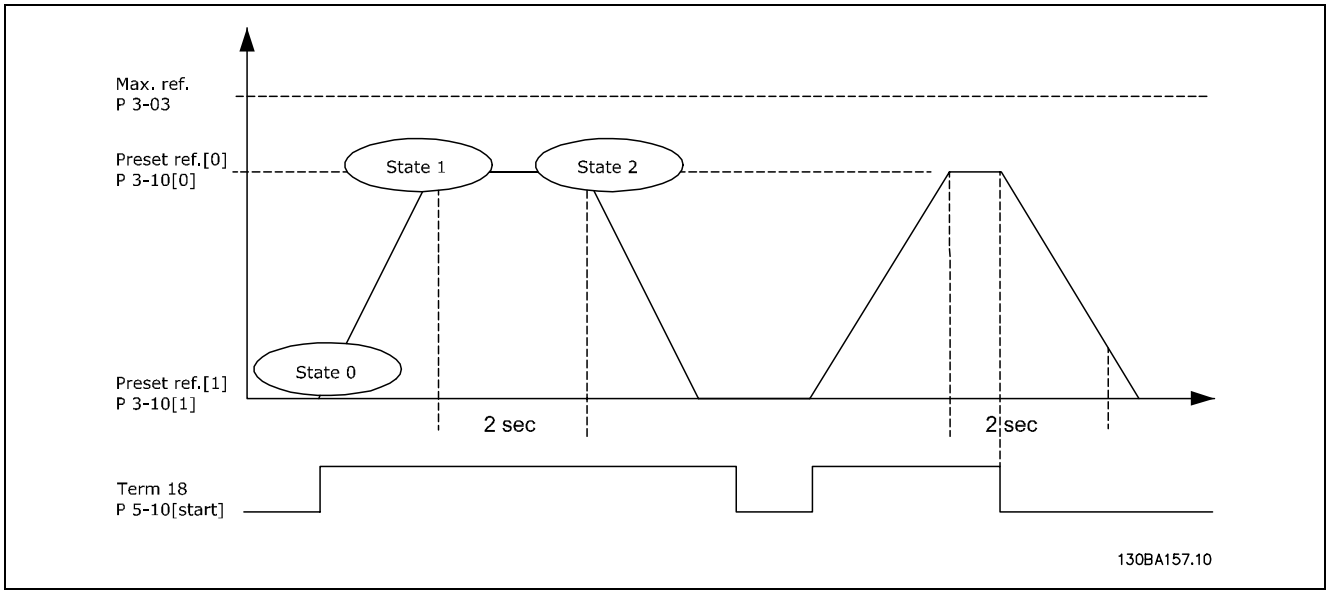
□ **Connection of Mechanical Brake - FC 300 Programming 01**

□ **Smart Logic Control**

New useful facility in FC 302 is the Smart Logic Control (SLC).
In applications where a PLC is generation a simple sequence the SLC may take over elementary tasks from the main control.
SLC is designed to act from event send to or generated in the FC 302. The frequency converter will then perform the pre-programmed action.

□ **SLC Application Example**

One sequence 1:
Start – ramp up – run at reference speed 2 sec – ramp down and hold shaft until stop.



Set the ramping times in par. 3-41 and 3-42 to the wanted times

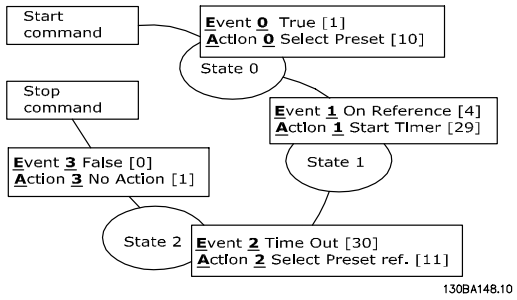
$$t_{ramp} = \frac{t_{acc} * n_{norm}[par.1-25]}{\triangle ref[RPM]}$$

Set term 27 to *No Operation* (par. 5-12)
Set Preset reference 0 to first preset speed (par. 3-10 [0]) in percentage of Max reference speed (par. 3-03). Ex.: 60%
Set preset reference 1 to second preset speed (par. 1-10 [1] Ex.: 0 % (zero).
Set the timer 0 for constant running speed in par. 13-20 [0]. Ex.: 2 sec.

Set Event 0 in par. 13-51 [0] to *True* [1]
Set Event 1 in par. 13-51 [1] to *On Reference* [4]
Set Event 2 in par. 13-51 [2] to *Time Out 0* [30]
Set Event 3 in par. 13-51 [3] to *False* [0]

Set Action 0 in par. 13-52 [0] to *Select preset 0* [10]
Set Action 1 in par. 13-52 [1] to *Start Timer 0* [29]
Set Action 2 in par. 13-52 [2] to *Select preset 1* [11]
Set Action 3 in par. 13-52 [3] to *No Action* [1]

Application Examples



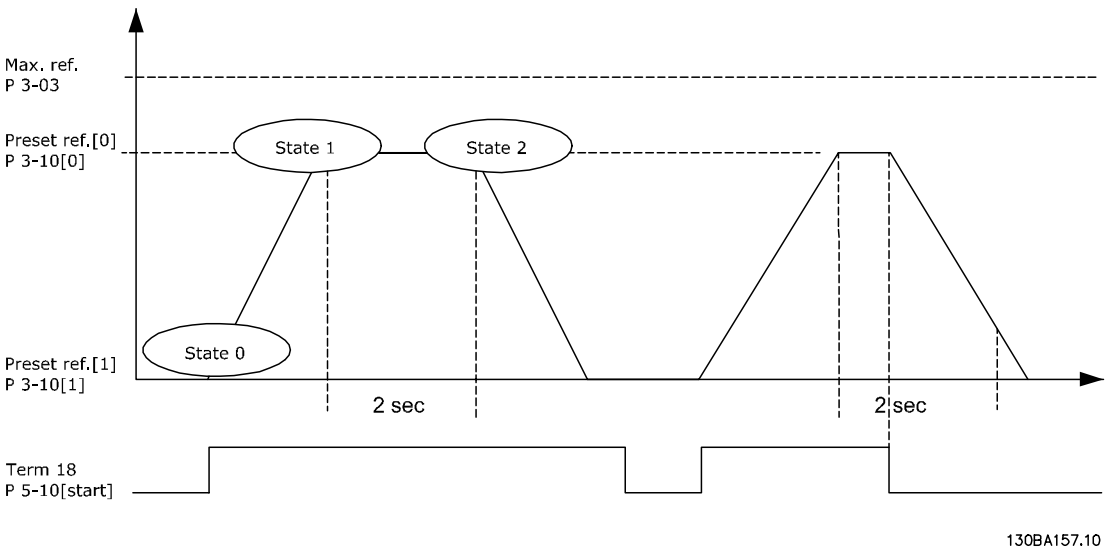
Set the Smart Logic Control in par. 13-00 to ON.

Start / stop command is applied on terminal 18. If stop signal is applied the frequency converter will ramp down and go into free mode.

□ **Application Example**

Continuously sequencing 2:

Start – ramp up – run at reference speed 0 in 2 sec – ramp down to reference speed 1 – run at reference speed 1 in 3 sec – ramp up to reference speed 0 and then continue sequencing until stop is applied.



Preparing for set-up:

Set the ramping times in par. 3-41 and 3-42 to the wanted times

$t_{ramp} = \frac{t_{acc} * n_{norm}[par.1-25]}{\triangle ref[RPM]}$

Set term 27 to *No Operation* (par. 5-12)

Set Preset reference 0 to first preset speed (par. 3-10 [0]) in percentage of Max reference speed (par. 3-03). Ex.: 60%

Set Preset reference 1 to first preset speed (par. 3-10 [1]) in percentage of Max reference speed (par. 3-03). Ex.: 10%

Set preset reference 1 to second preset speed (par. 1-10 [1] Ex.: 10 % (zero).

Set the timer 0 for constant running speed in par. 13-20 [0]. Ex.: 2 sec.

Set the timer 1 for constant running speed in par. 13-20 [1]. Ex.: 3 sec.

Set Event 0 in par. 13-51 [0] to *True* [1]

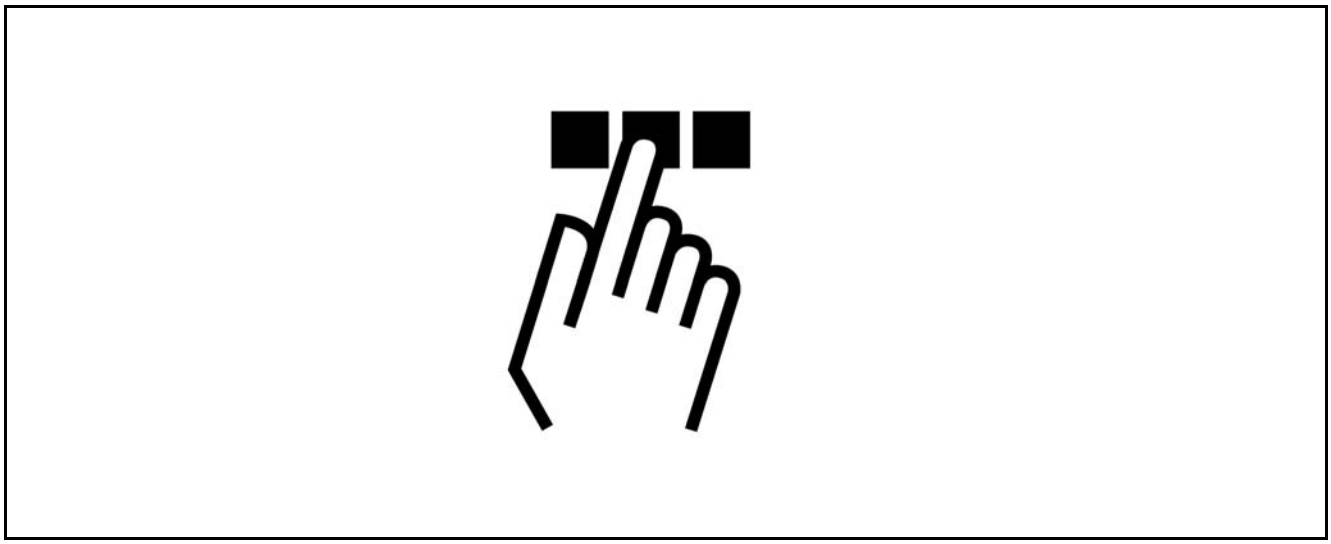
Application Examples

Set Event 1 in par. 13-51 [1] to *On Reference* [4]
Set Event 2 in par. 13-51 [2] to *Time Out* 0 [30]
Set Event 3 in par. 13-51 [3] to *On Reference* [4]
Set Event 4 in par. 13-51 [4] to *Time Out* [30]

Set Action 0 in par. 13-52 [0] to *Select preset* 0 [10]
Set Action 1 in par. 13-52 [1] to *Start Timer 0* [29]
Set Action 2 in par. 13-52 [2] to *Select preset 1* [11]
Set Action 3 in par. 13-52 [3] to *Start Timer 1* [30]
Set Action 4 in par. 13-52 [4] to *No Action* [1]

Application Examples

How to Programme



The FC 300 Local Control Panel

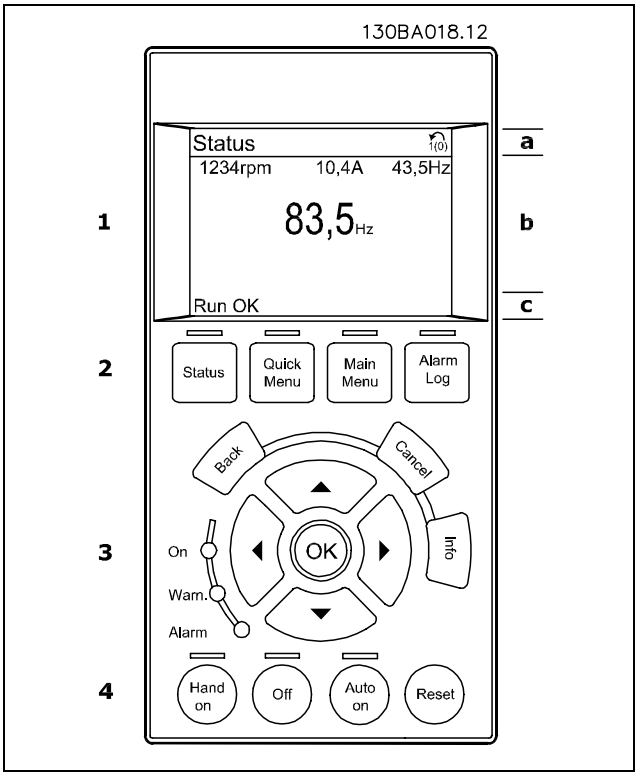
How to Programme on the Local Control Panel

In the following instructions we assume you have a graphical LCP (LCP 102):

The control panel is divided into four functional groups:

1. Graphical display with Status lines.
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).

All data is displayed in a graphical LCP display, which can show up to five items of operating data while displaying [Status].



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.

Display Contrast Adjustment

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

Indicator lights (LEDs):

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

Most FC 300 parameter set-ups can be changed immediately via the control panel, unless a password has been created via par. 0-60 *Main Menu Password* or via par. 0-65 *Quick Menu Password*.

LCP keys

[Status] indicates the status of the frequency converter or the motor. You can choose between 3 different read-outs by pressing the [Status] key:
5 line readouts, 4 line readouts or Smart Logic Control.

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

- My Personal Menu
- Quick Set-up
- Changes Made
- Loggings

[Main Menu] is used for programming all parameters.

[Alarm Log] displays an Alarm list of the five latest alarms (numbered A1-A5). To obtain additional details about an alarm, use the arrow keys to manoeuvre to the alarm number and press [OK]. You will now receive information about the condition of your frequency converter right before entering the alarm mode.

[Back] takes you to the previous step or layer in the navigation structure.

[Cancel] annuls your last change or command as long as the display has not been changed.

[Info] supplies information about a command, parameter, or function in any display window.
Exit info mode by pressing either [Info], [Back], or [Cancel].

[OK] is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.

[Hand On] enables control of the frequency converter via the LCP. [Hand on] also starts the motor, and it is now possible to enter the motor speed data by means of the arrow keys. The key can be selected as Enable [1] or Disable [0] via par. *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 given via the LCP.

[Off] is used for stopping the connected motor. The key can be selected as Enable [1] or Disable [0] via par. *0-41 [Off] key on LCP.*

[Auto On] is used if 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 Enable [1] or Disable [0] via par. *0-42 [Auto on] key on LCP.*

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

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

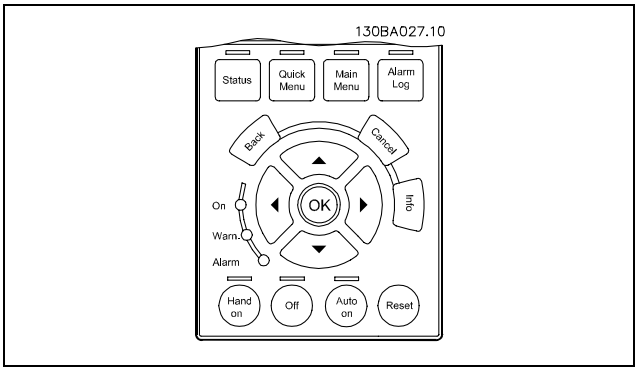
Arrow keys are used for manoeuvring between commands and within parameters.

How to Programme

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.

□ Quick Transfer of Parameter Settings

Once the set-up of a drive is complete, we recommend that you store the data in the LCP or on a PC via MCT 10 Set-up Software Tool.



Data storage in LCP:

1. Go to par. 0-50 *LCP Copy*
2. Press the [OK] key
3. Select "All to LCP"
4. Press the [OK] key

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

NB!:
Stop the unit before performing this operation.

You can now connect the LCP to another frequency converter and copy the parameter settings to this frequency converter as well.

Data transfer from LCP to drive:

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

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

NB!:
Stop the unit before performing this operation.

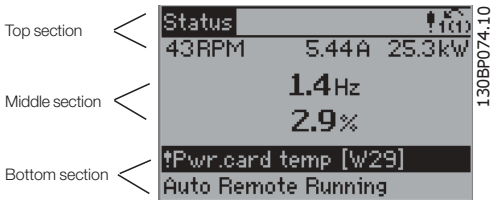
□ Control Panel - Display

The LCD-display has back light and a total of 6 alpha-numeric lines. The display lines show the direction of rotation (arrow), the chosen Set-up as well as the programming Set-up. The display is divided into 3 sections:

Top section shows up to 2 measurements in normal operating status.

The top line in the **Middle section** shows up to 5 measurements with related unit, regardless of status (except in the case of alarm/warning).

Bottom section always shows the state of the frequency converter in Status mode.



The Active Set-up (selected as the Active Set-up in par. 0-10) is shown. When programming another Set-up than the Active Set-up, the number of the programmed Set-up appears to the right.

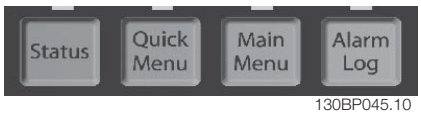
□ Control Panel - LEDs

In the lower left corner of the control panel three LEDs are located: A red alarm LED, a yellow warning LED, and a green voltage LED.

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 voltage LED is activated when the frequency converter receives voltage or 24 V external supply. At the same time, the back light is on.

□ Control Panel - Control Keys

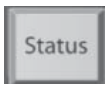
The control keys are divided into functions. The keys below the display and indicator lamps are used for parameter Set-up, including choice of display indication during normal operation.



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

□ Control Key Functions

Use **[Status]** for selecting the mode of display or for changing back to Display mode from either the Quick Menu mode, the Main Menu mode or Alarm mode. Also use the [Status] key to toggle single or double read-out mode.
To adjust the display contrast, hold down the **[Status]** key and use the up or down navigation arrows.



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.

Use **[Main Menu]** for programming all parameters. It is possible to switch directly between Main Menu mode and Quick Menu mode. Parameter shortcut can be carried out by pressing down the [Main Menu] key for 3 seconds. The parameter shortcut allows direct access to any parameter.

[Alarm log] supplies detailed information about the last five alarms.

Use **[Back]** for stepping backwards.

Use **[Cancel]** if you do not wish to carry out a change in the selected parameter.

Use **[Info]** to obtain additional information on the different display states. [INFO] provides detailed information whenever help is needed.

Use these four navigation arrows to navigate between the different choices available in **[Quick Menu]**, **[Main Menu]** and **[Alarm log]**. Use the keys to move the curser.

[OK] confirms a change of a parameter or chooses the cursor selected funtion.

□ Local Control Key Functions

[Hand on] controls the frequency converter via the control unit. Moreover, [Hand on] starts the motor.
On the control terminals, 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 - Set-up select msb
Stop command from serial communication
Quick stop
DC brake

[Off] stops the connected motor. Selected *Enable*[1] or *Disable*[0] via par. 0-13. If the [Off] function is activated, the [Off LED] lights up and the display indicates Off.
If no external stop function is selected and the [Off] key is inactive, you can start the motor by disconnecting the voltage.

[Auto on] controls the frequency converter via the control terminals and/or serial communication. An active start signal on the control terminals and/or the bus starts the frequency converter.
NB!:
An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand on] and [Auto on].

[Reset] resets the frequency converter after an alarm (trip). Select *Enable*[1] or *Disable*[0] via par. 0-15 *Reset on LCP*.

How to Programme

Display Mode

In normal operation, up to 5 different operating variables can be indicated continuously in the middle section: 1.1, 1.2, and 1.3 as well as 2 and 3.

Display Mode - Selection of Read-Outs

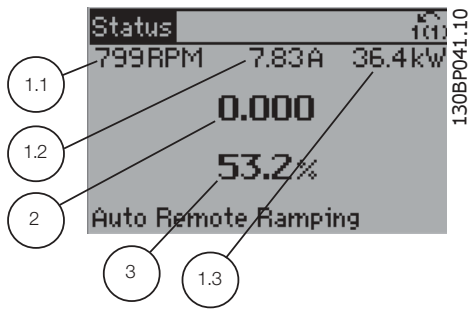
It is possible to toggle between three status read-out screens by pressing the [Status] key. Operating variables with different formatting are shown in each status screen - see below.

The table shows the measurements you can link to each of the operating variables. Define the links via par. 0-20, 0-21, 0-22, 0-23, and 0-24.

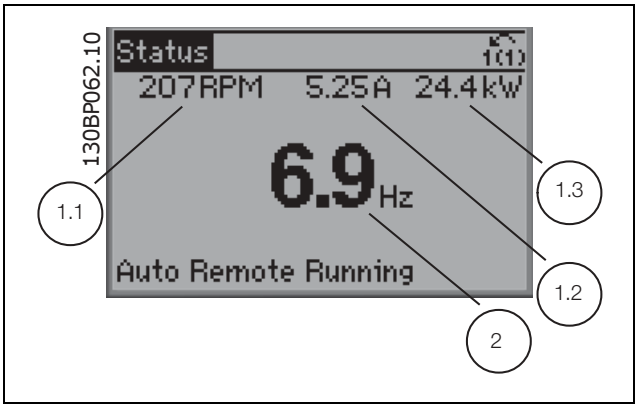
Each readout parameter selected in par. 0-20 to par. 0-24 has its own scale and digits after a possible decimal point. By larger numeric value of a parameter fewer digits are displayed after the decimal point.
Ex.: Current readout
5.25 A; 15.2 A 105 A.

Operating variable:	Unit:
Par. 16-00 Control Word	hex
Par. 16-01 Reference	[unit]
Par. 16-02 Reference	%
Par. 16-03 Status Word	hex
Par. 16-05 Main Actual Value	%
Par. 16-10 Power	[kW]
Par. 16-11 Power	[HP]
Par. 16-12 Motor Voltage	[V]
Par. 16-13 Frequency	[Hz]
Par. 16-14 Motor Current	[A]
Par. 16-16 Torque	Nm
Par. 16-17 Speed	[RPM]
Par. 16-18 Motor Thermal	%
Par. 16-20 Motor Angle	
Par. 16-30 DC Link Voltage	V
Par. 16-32 Brake Energy / s	kW
Par. 16-33 Brake Energy / 2 min	kW
Par. 16-34 Heatsink Temp.	C
Par. 16-35 Inverter Thermal	%
Par. 16-36 Inv. Nom. Current	A
Par. 16-37 Inv. Max. Current	A
Par. 16-38 SL Control State	
Par. 16-39 Control Card Temp.	C
Par. 16-40 Logging Buffer Full	
Par. 16-50 External Reference	
Par. 16-51 Pulse Reference	
Par. 16-52 Feedback	[Unit]
Par. 16-53 Digi Pot Reference	
Par. 16-60 Digital Input	bin
Par. 16-61 Terminal 53 Switch Setting	V
Par. 16-62 Analog Input 53	
Par. 16-63 Terminal 54 Switch Setting	V
Par. 16-64 Analog Input 54	
Par. 16-65 Analog Output 42	[mA]
Par. 16-66 Digital Output	[bin]
Par. 16-67 Freq. Input #29	[Hz]
Par. 16-68 Freq. Input #33	[Hz]
Par. 16-69 Pulse Output #27	[Hz]
Par. 16-70 Pulse Output #29	[Hz]
Par. 16-71 Relay Output	
Par. 16-72 Counter A	
Par. 16-73 Counter B	
Par. 16-80 Fieldbus CTW	hex
Par. 16-82 Fieldbus REF 1	hex
Par. 16-84 Comm. Option STW	hex
Par. 16-85 FC Port CTW 1	hex
Par. 16-86 FC Port REF 1	hex
Par. 16-90 Alarm Word	
Par. 16-92 Warning Word	
Par. 16-94 Ext. Status Word	

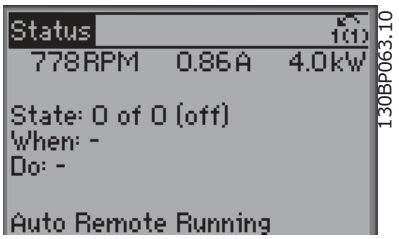
Status screen I:
This read-out state is standard after start-up or initialization.
Use [INFO] to obtain information about the measurement links to the displayed operating variables /1.1, 1.2, 1.3, 2, and 3).
See the operating variables shown in the screen in this illustration.



Status screen II:
See the operating variables (1.1, 1.2, 1.3, and 2) shown in the screen in this illustration.
In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second.

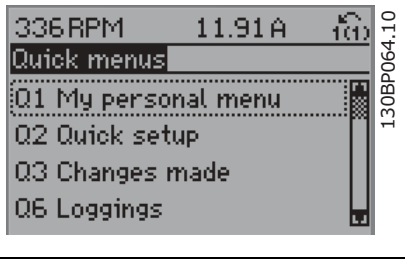


Status screen III:
This state displays the event and action of the Smart Logic Control. For further information, see section *Smart Logic Control*.



□ **Parameter Set-Up**
The FC 300 Series can be used for practically all assignments, which is why the number of parameters is quite large. The series offers a choice between two programming modes - a Main Menu and a Quick Menu mode. The former provides access to all parameters. The latter takes the user through a few parameters making it possible to start operating the frequency converter.
Regardless of the mode of programming, you can change a parameter both in the Main Menu mode and in the Quick Menu mode.

□ **Quick Menu Key Functions**
Pressing [Quick Menus] brings out this read-out on the display. The list indicates the different areas contained in the Quick menu.
Select *My Personal Menu* to display the chosen personal parameters. Select these parameters are selected par. 0-25 *Personal Menu*. You can add up to 20 different parameters in this menu.



Select *Quick setup* to go through a limited amount of parameters to get the motor running almost optimally. The default setting for the other parameters considers the desired control functions and the configuration of signal inputs/outputs (control terminals).

The selection of parameter is effected by means of the arrow keys. The parameters in the table to the right are accessible.

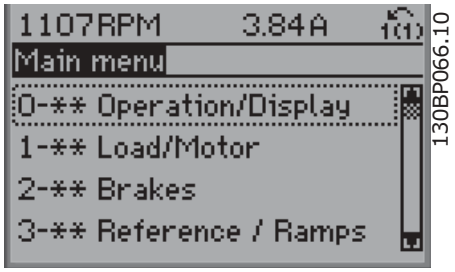
Pos.:	No.:	Parameter:	Unit:
1	0-01	Language	
2	1-20	Motor power	[kW]
3	1-22	Motor voltage	[V]
4	1-23	Motor frequency	[Hz]
5	1-24	Motor current	[A]
6	3-02	Minimum reference	[rpm]
7	3-03	Maximum reference	[rpm]
8	3-41	Ramp 1 ramp up time	[sec.]
9	3-42	Ramp 1 ramp down time	[sec.]
10	3-13	Reference site	

Select *Changes made* to get information about:

- the last 10 changes. Use the up/down navigation keys to scroll between the last 10 changed parameters.
- the changes made since default setting.

Select *Loggins* to get information about the display line read-outs. Display *Speed, Motor current, Power, Frequency* and *Reference* as curves. You can store up to 120 samples in the memory for later reference.

□ **Main Menu Mode**
Start the Main Menu mode is by pressing the [Main Menu] key. The read-out shown to the right appears on the display.
The middle and bottom sections on the display show a list of parameter groups which can be chosen by toggling the up and down buttons.



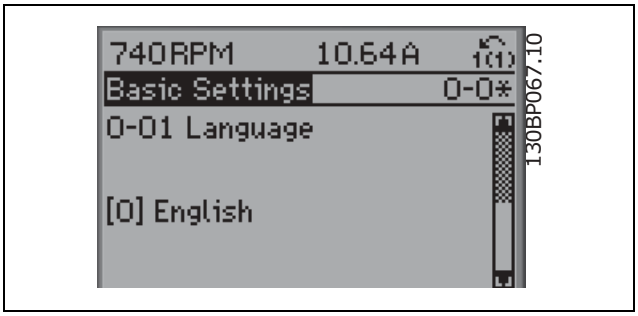
Each parameter has a name and number which remain the same regardless of the programming mode. In the Main Menu mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number.

All parameters can be changed in the Main Menu. However, depending on the choice of configuration (par. 1-00), some parameters can be "missing". E.g. open loop hides all the PID parameters, and other enabled options make more parameter groups visible.

□ **Parameter Selection**
In the Main menu mode, the parameters are divided into groups. You select a parameter group by means of the navigation keys.
The following parameter groups are accessible:

Group no.	Parameter group:
0	Operation/Display
1	Load/Motor
2	Brakes
3	References/Ramps
4	Limits/Warnings
5	Digital In/Out
6	Analog In/Out
7	Controls
8	Comm. and options
9	Profibus
10	CAN fieldbus
11	Reserved com. 1
12	Reserved com. 2
13	Prog. Features
14	Special functions
15	Drive information
16	Data readouts

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



□ **Changing Data**

The procedure for changing data is the same whether you select a parameter in the Quick menu or the Main menu mode. Press [OK] to change the selected parameter.

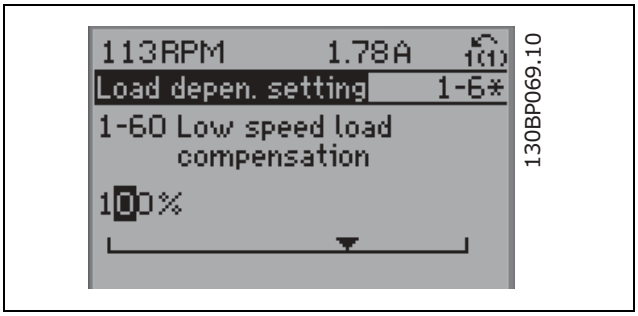
The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

□ **Changing a Text Value**

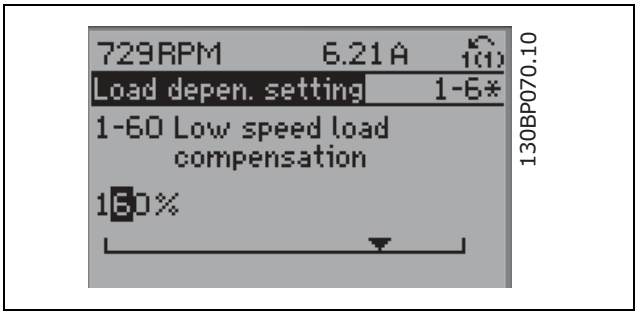
If the selected parameter is a text value, change the text value by means of the up/down navigation keys. The up key increases the value, and the down key decreases the value. Place the cursor on the value you want to save and press [OK].

□ **Changing a Group of Numeric Data Values**

If the chosen parameter represents a numeric data value, change the chosen data value by means of the <> navigation keys as well as the up/down navigation keys. Use the <> navigation keys to move the cursor horizontally.



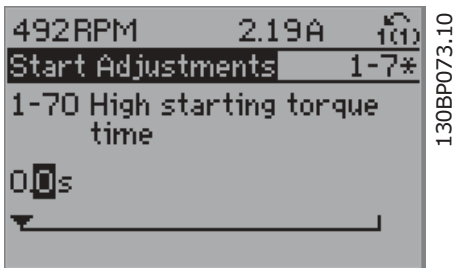
Use the up/down navigation keys to change the data value. The up key enlarges the data value, and the down key reduces the data value. Place the cursor on the value you want to save and press [OK].



How to Programme

□ Infinitely Variable Change of Numeric Data Value

If the chosen parameter represents a numeric data value, select a digit by means of the <> navigation keys.



Change the selected digit infinitely variably by means of the up/down navigation keys.
The chosen digit is indicated by the cursor. Place the cursor on the digit you want to save and press [OK].

□ Changing of Data Value, Step-by-Step

Certain parameters can be changed step by step or infinitely variably. This applies to *Motor Power* (par. 1-20), *Motor Voltage* (par. 1-22) and *Motor Frequency* (par. 1-23).
The parameters are changed both as a group of numeric data values and as numeric data values infinitely variably.

□ Read-out and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack.
Par. 15-30 to 15-32 contain a fault log which can be read out. Choose a parameter, press [OK], and use the up/down navigation keys to scroll through the value log.

Use par. 3-10 as another example:
Choose the parameter, press [OK], and use the up/down navigation keys keys to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. Change the value by using the up/down keys. Press [OK] to accept the new setting. Press [CANCEL] to abort. Press [Back] to leave the parameter.

□ Initialisation to Default Settings

Initialise the frequency converter to default settings in two ways:

Recommended initialisation (via par. 14-22)

1. Select par. 14-22
2. Press [OK]
3. Select "Initialisation"
4. Press [OK]
5. Cut off the mains supply and wait until the display turns off.
6. Reconnect the mains supply - the frequency converter is now reset.

Par. 14-22 initialises all except:	
14-50	*RFI 1*
8-30	*Protocol*
8-31	*Address*
8-32	*Baud Rate*
8-35	*Minimum Response Delay*
8-36	*Max Response Delay*
8-37	*Max Inter-char Delay*
15-00 to 15-05	Operating data
15-20 to 15-22	Historic log
15-30 to 15-32	Fault log

Manual initialisation

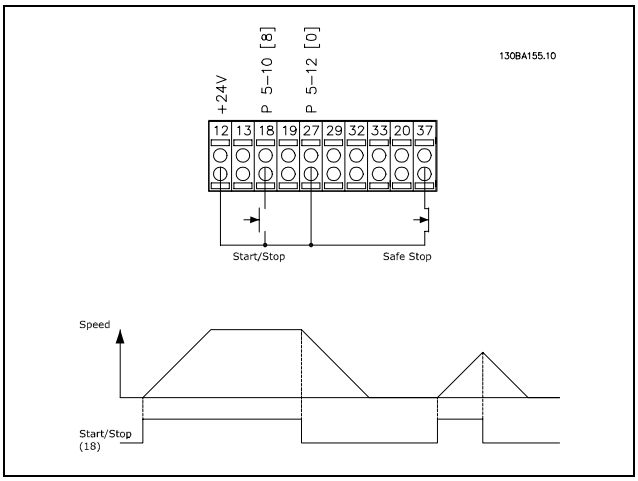
1. Disconnect from mains and wait until the display turns off.
2. Press [Status] - [Main Menu] - [OK] at the same time:
3. Reconnect mains supply while pressing the keys.
4. Release the keys after 5 s.
5. The frequency converter is now programmed according to default settings.

This parameter initialises all except:	
15-00	*Operating Hours*
15-03	*Power-up's*
15-04	*Over temp's*
15-05	*Over volt's*

NB!:
When you carry out manual initialisation, you also reset serial communication and fault log settings.

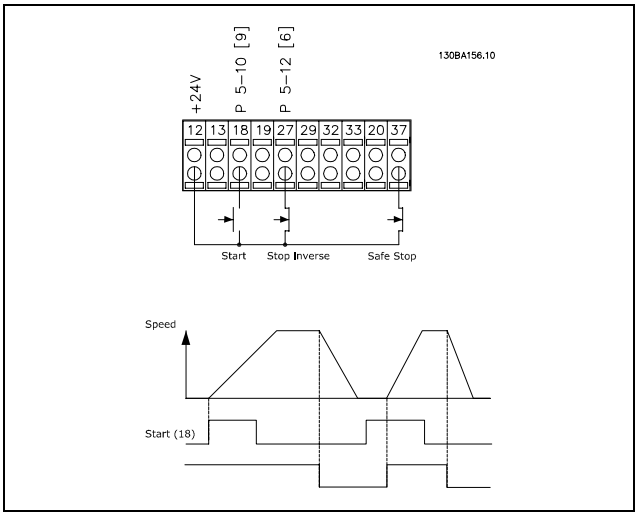
□ **Start/Stop**
Terminal 18 = start/stop par. 5-10 [8] *Start*
Terminal 27 = No operation par. 5-12 [0] *No operation* (Default *coast inverse*
Terminal 37 = coasting stop (safe)

Par. 5-10 *Digital Input* = *Start* (default)
Par. 5-12 *Digital Input* = *coast inverse* (default)



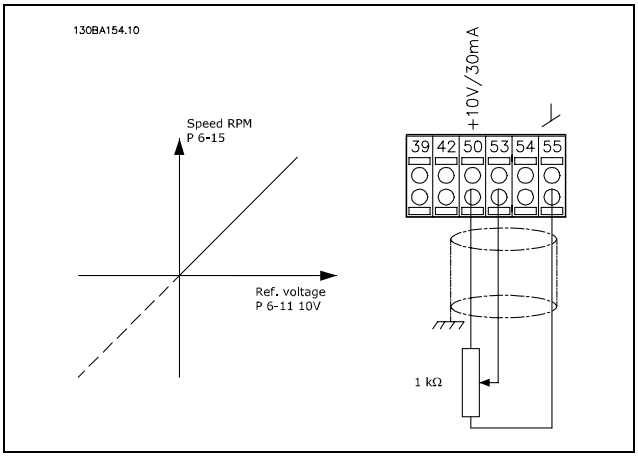
□ **Pulse Start/Stop**
Terminal 18 = start/stop par. 5-10 [9] *Latched start*
Terminal 27= No operation par. 5-12 [6] *Stop inverse*
Terminal 37 = Coasting stop (safe)

Par. 5-10 *Digital Input* = *Latched start*
Par. 5-12 *Digital Input* = *Stop inverse*

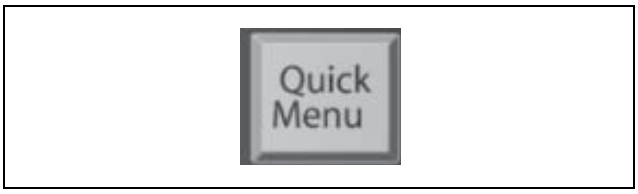


□ **Potentiometer Reference**
Voltage reference via a potentiometer.

Par. 3-15 *Reference Resource 1* [1]
= Analog Input 53
Par. 6-10 *Terminal 53, Low Voltage* = 0 Volt
Par. 6-11 *Terminal 53, High Voltage* = 10 Volt
Par. 6-14 *Terminal 53, Low Ref./Feedb. Value* = 0 RPM
Par. 6-15 *Terminal 53, High Ref./Feedb. Value* = 1.500 RPM
Switch S201 = OFF (U)



□ **Setting up FC 302**
Set basic motor parameters by using Quick Menu → 02 Quick Setup:



Parameter	Designation	Setting
0-01	Language	
1-20	Motor Power	
1-22	Motor Voltage	
1-23	Motor Frequency	
1-24	Motor Current	
1-25	Motor Nominal Speed	
5-12	Terminal 27 Digital Input	
3-02	Min Reference	
3-03	Max Reference	
3-41	Ramp 1 Ramp-up Time	
3-42	Ramp 1 Ramp-down Time	
3-13	Reference Site	
1-29	Automatic Motor Adaptation (AMA)	[1] Enable complete AMA

Select application parameters as following by:

1-0x (General Settings)	→	1-00 (Configuration Mode)	→ [1] Speed closed loop
1-01 (Motor Control Principle)	→	[1] VVC^{plus} or	
		[3] Flux w/ encoder feedback	
		(The Flux principle is recommended by vertical movements)	
5-7x		24 V encoder input	
5-70 Term 32/33 Encoder Resolution		Set the pulse per revolution value (PP)	
5-71 Term 32/33 Encoder Direction		Set the direction following the rotating field in the motor	

The frequency converter is now ready for running.

□ Quick Menu Parameters

Q1 My Personal Menu

Function:

This parameter group displays the parameters specified in par. 0-25 *My Personal Menu*. This allows you to focus on those parameters which are important in the application.

Q2 Quick Set-up

Function:

This parameter group covers all the settings that are required in most applications.

Q3 Changes Made

Function:

These functions allows you to see and track the parameters which have been changed.

Q4 Last 10 Changes

Function:

This parameter group displays a list of the 10 last changes made to parameters in the present parameter setup. This allows you to easily find and correct last-minute changes.

Q5 Since Factory Setting

Function:

This parameter group shows you which parameters have been changed from their default value. This allows you to easily find and fine-tune only the parameters that are relevant in this application.

Q6 Loggings

Function:

Select a display parameter from the list to get a graphical view of its values. Only display parameters selected in par 0-20 to par 0-24 can be viewed.

□ Parameters: Operation and Display

□ 0-0* Basic Settings

0-01 Language

Option:

✱English (ENGLISH)	[0]
German (DEUTSCH)	[1]
French (FRANCAIS)	[2]
Danish (DANSK)	[3]
Spanish (ESPANOL)	[4]
Italian (ITALIANO)	[5]
Chinese (CHINESE)	[10]
Finnish (FINNISH)	[20]
English US (ENGLISH US)	[22]
Greek (GREEK)	[27]
Portuguese (PORTUGUESE)	[28]
Slovenian (SLOVENIAN)	[36]
Korean (KOREAN)	[39]
Japanese (JAPANESE)	[40]
Turkish (TURKISH)	[41]
Traditional Chinese	[42]
Bulgarian	[43]
Serbian	[44]
Romanian (ROMANIAN)	[45]
Hungarian (HUNGARIAN)	[46]
Czech	[47]
Polish (POLISH)	[48]
Russian	[49]
Thai	[50]
Bahasa Indonesian (BAHASA INDONESIAN)	[51]

Function:

Defines the language to be used in display.

The frequency converter can be delivered with 4 various language packages. English and German are included in all packages. English cannot be erased or manipulated.

0-02 Motor Speed Unit

Option:

✱RPM	[0]
Hz	[1]

Function:

Defines the parameters for motor speed (i.e. references, feedbacks, limits) displayed in terms of shaft speed (in RPM) or the output frequency to the motor (Hz). This parameter cannot be adjusted while the motor is running.

0-03 Regional Settings

Option:

✱International	[0]
US	[1]

Function:

Select *International* [0] to set the unit of par.1-20 *Motor Power* in kW and the default setting of par. 1-23 to 50 Hz. Select "[1] US" to set the unit of par. 1-21 Motor Power in HP and the default value of par. 1-23 to 60 Hz. Par. 0-03 cannot be adjusted while the motor is running.

0-04 Operating State at Power-Up

Option:

Resume	[0]
✱Forced stop, ref=old	[1]
Forced stop, ref = 0	[2]

Function:

Sets the operating mode when mains voltage is reconnected after power down in Hand (local) operation.

Select *Resume* [0] start up the drive with the same local reference and the same start/stop conditions (applied by [START/STOP]) as before the drive was switched off.
Use *Forced stop, use saved reference* [1] to stop the drive until mains voltage reappears and until you press [START]. After the start command, the saved local ref. will be set automatically.
Select *Forced stop, set reference to 0* [2] to stop the drive until mains voltage reappears. Local reference is reset.

□ 0-1* Set-Up Handling

Parameters to select and control the individual parameter set-ups.

0-10 Active Set-up

Option:

Factory setup	[0]
✱Set-up 1	[1]
Set-up 2	[2]
Set-up 3	[3]
Set-up 4	[4]
Multi set-up	[9]

Function:

Defines the Set-up number to control the functions of the drive.

All parameters are programmed in four individual parameter Set-ups, Set-up 1 - Set-up 4. Open loop and closed loop function can only be changed with a stop signal applied. The Factory Set-up cannot be modified.
Factory Set-up [0] contains the data set at Danfoss. Can be used as a data source if the other Set-ups are to be returned to a known state. Par. 0-51 allows copying from one Set-up to another or to all the other Set-ups. *Set-ups 1-4* are individual Set-ups, which can be selected individually. *Multi Set-up* [9] is used by remote-selection between Set-ups. Use digital inputs and the serial communication port for switching between Set-ups.

Apply a stop signal when switching between Set-ups where parameters marked as "not changeable during operation" have different values. To make sure that parameters marked as "not changeable during operation" are never set differently in two Set-ups, you should link the two Set-ups together via par. 0-12. Parameters that are "not changeable during operation" are marked FALSE in the parameter lists in the section *Parameter Lists*.

0-11 Edit Set-Up

Option:

Factory setup	[0]
✱Set-up 1	[1]
Set-up 2	[2]
Set-up 3	[3]
Set-up 4	[4]
Active Set-up	[9]

Function:

Selects *Editing Set-up*. Editing is done via the active Set-up or one of the inactive Set-ups. Selects the Set-up in which to programme (change of data) during operation (applies both via the control panel and via the serial communication port). You can programme the 4 Set-ups independently of the active Set-up (selected in par. 0-10). *Factory Set-up* [0] contains default data and can be used as a data source to return the other Set-ups to a known state. *Set-ups 1-4* are individual Set-ups and can be used as required. They can be programmed freely, regardless of the active Set-up.

0-12 This Set-Up Linked to

Option:

✱Set-up 1	[1]
Set-up 2	[2]
Set-up 3	[3]
Set-up 4	[4]

Function:

Apply a stop signal when switching between set-ups where parameters marked as "not changeable during operation" have different values. To make sure that parameters marked as "not change able during operation" are never set differently in two set-ups, link the two set-ups together. The frequency converter will automatically synchonize the parameter values. Parameters that are not changeable during operation are marked FALSE in the section *Parameter Lists*.

0-13 Readout: Linked Set-ups

Array [5]

Range:

0 - 255 N/A ✱0 N/A

Function:

A read-out of all the set-ups linked together by means of par. 0-12. The parameter has one index for each parameter set-up. Each set-up shows the set-up bitset linked to that particular set-up.

Example where set-up 1 and 2 are linked:

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

0-14 Readout: Edit Set-ups / Channel

Range:

0 - FFF.FFF.FFF ✱AAA.AAA.AAA

Function:

This parameter shows the setting of par. 0-11, as set by the different communication channels. When the number is read out in hex, as it is in the LCP, each number represents one channel. Numbers 1-4 represents a setup number, 'F' means factory setting, and 'A' means active setup. The channels are, from right to left, LCP, FC-bus, USB, HPFB1-5. Example: The number AAAAAA21h means, that the FC bus selected setup 2 in par. 0-11, the LCP selected setup 1, and all others uses the active setup.

□ **0-2* LCP Display**

Parameter group for setting the display in the Graphical Logic Control Panel. Following options are available:

0-20 Display Line 1.1 Small

None	[0]
Profibus Warning Word	[953]
Readout Transmit Error Counter	[1005]
Readout Receive Error Counter	[1006]
Readout Bus Off Counter	[1007]
Warning Parameter	[1013]
Running Hours	[1501]
kWh Counter	[1502]
Control Word	[1600]
Reference [Unit]	[1601]
Reference %	[1602]
Status Word	[1603]
Main Actual Value [Unit]	[1604]
Main Actual Value [Unit]	[1605]
Custom Readout	[1609]
Power [kW]	[1610]
Power [hp]	[1611]
Motor Voltage	[1612]
Frequency	[1613]
Motor Current	[1614]
Frequency [%]	[1615]
Torque	[1616]
* Speed [RPM]	[1617]
Motor Thermal	[1618]
KTY Sensor Temperature	[1619]
Motor Angle	[1620]
Phase Angle	[1621]
DC Link Voltage	[1630]
BrakeEnergy/s	[1632]
BrakeEnergy/2 min	[1633]
Heatsink Temp.	[1634]
Inverter Thermal	[1635]
Inv. Nom. Current	[1636]
Inv. Max. Current	[1637]
SL Control State	[1638]
Control Card Temp.	[1639]
External Reference	[1650]
Pulse Reference	[1651]
Feedback [Unit]	[1652]
Digi Pot Reference	[1653]
Digital Input	[1660]
Terminal 53 Switch Setting	[1661]
Analog Input 53	[1662]
Terminal 54 Switch Setting	[1663]
Analog Input 54	[1664]
Analog Output 42 [mA]	[1665]
Digital Output [bin]	[1666]
Freq. Input #29 [Hz]	[1667]
Freq. Input #33 [Hz]	[1668]
Pulse Output #27 [Hz]	[1669]
Pulse Output #29 [Hz]	[1670]
Relay Output [bin]	[1671]
Counter A	[1672]
Counter B	[1673]
Fieldbus CTW 1	[1680]
Fieldbus REF 1	[1682]
Comm. Option STW	[1684]
FC Port CTW 1	[1685]
FC Port REF 1	[1686]
Alarm Word	[1690]
Alarm Word 2	[1691]
Warning Word	[1692]
Warning Word 2	[1693]
Ext. Status Word	[1694]
Ext. Status Word 2	[1695]
PCD 1 Write to MCO	[3401]
PCD 2 Write to MCO	[3402]
PCD 3 Write to MCO	[3403]
PCD 4 Write to MCO	[3404]
PCD 5 Write to MCO	[3405]
PCD 6 Write to MCO	[3406]
PCD 7 Write to MCO	[3407]
PCD 8 Write to MCO	[3408]
PCD 9 Write to MCO	[3409]
PCD 10 Write to MCO	[3410]
PCD 1 Read to MCO	[3421]
PCD 2 Read to MCO	[3422]
PCD 3 Read to MCO	[3423]
PCD 4 Read to MCO	[3424]
PCD 5 Read to MCO	[3425]
PCD 6 Read to MCO	[3426]
PCD 7 Read to MCO	[3427]
PCD 8 Read to MCO	[3428]
PCD 9 Read to MCO	[3429]
PCD 10 Read to MCO	[3430]
Digital Inputs	[3440]
Digital Outputs	[3441]
Actual Position	[3450]
Commanded Position	[3451]
Actual Master Position	[3452]
Slave Index Position	[3453]
Master Index Position	[3454]
Curve Position	[3455]
Track Error	[3456]
Synchronizing Error	[3457]
Actual Velocity	[3458]
Actual Master Velocity	[3459]
Synchronizing Status	[3460]
Axis Status	[3461]
Program Status	[3462]
Idle Time	[9913]
Paramdb Requests in Queue	[9914]

Function:

None [0] No display value chosen

Control Word [1600] Displays the present control word

Reference [Unit] [1601] displays the status value of terminals 53 or 54 using the unit stated on the basis of configuration in P.1-00 (RPM or Nm).

Reference % [1602] displays the total reference (sum of digital/analog/preset/bus/freeze ref./catch-up and slow-down).

Status Word [binary] [1603] Displays the present status word

Alarm Word [1604] indicates one or several alarms in a Hex code.

∗ default setting **( )** display text **[ ]** value for use in communication via serial communication port

Warning Word [1605] indicates one or more warnings in a Hex code.
Extended Status Word [1606] [Hex] indicates one or more status states in a Hex code.
Power [kW] [1610] states the actual power consumed by the motor in kW.
Power [hp] [1611] states the actual power consumed by the motor in HP.
Motor Voltage [V] [1612] states the voltage supplied to the motor.
Frequency [Hz] [1613] gives the motor frequency, i.e. the output frequency from the frequency converter.
Motor Current [A] [1614] states the phase current of the motor measured as effective value.
Torque [%] [1616] gives the current motor load in relation to the rated motor torque.
Speed [RPM] [1617] Display the speed in RPM (Rounds per Minute) i.e. the motor shaft speed in closed loop.
Motor thermal [1618] states the calculated/estimated thermal load on the motor.
DC Link Voltage [V] [1630] states the intermediate circuit voltage in the frequency converter.
BrakeEnergy/s [1632] states the present brake power transferred to an external brake resistor. Stated as an instantaneous value.
BrakeEnergy/2 min [1633] states the brake power transferred to an external brake resistor. The mean power is calculated continuously for the latest 120 seconds.
Heatsink Temperature [°C] [1634] states the present heat sink temperature of the frequency converter. The cut-out limit is 95 ± 5°C; cutting back in occurs at 70 ± 5°C.
Inverter thermal [1635] returns the percentage load of the inverters.
InomVLT [1636] The nominal current of the frequency converter.
ImaxVLT [1637] The maximum current of the frequency converter.
Condition control state [1638] returns the state of the event executed by the control.
Data read-out: Control Card Temperature [1639] returns the temperature on control card.
External Reference [1650] [%] gives the sum of the external reference as a percentage (the sum of analog/pulse/bus).
Pulse Reference [1651] [Hz] states the frequency in Hz connected to the programmed digital inputs (18, 19 or 32, 33).
Feedback [Unit] [1652] returns the reference value from programmed digital input(s).
Digital Input [1660] states the signal states from the 6 digital terminals (18, 19, 27, 29, 32 and 33) Input 18 corresponds to the bit at the far left. '0' = signal low; '1' = signal high.
Terminal 53 Switch Setting [1661] returns the setting of input terminal 53. Current = 0; Voltage = 1.
Analog Input 53 [1662] returns the actual value on input 53 either as reference or protection value.
Terminal 54 Switch Setting [1663] returns the setting of input terminal 54. Current = 0; Voltage = 1.
Analog Input 54 [1664] returns the actual value on input 54 either as reference or protection value.
Analog Output 42 [mA] [1665] returns the actual value in mA on output 42. Selection of shown value is set in par. 6-50.
Digital Output [bin] [1666] returns the bin value of all digital outputs.
Frequency input #29 [Hz] [1667] returns the actual value of the frequency applied on terminal 29 as an impulse input.
Frequency input #33 [Hz] [1668] returns the actual value of the frequency applied on terminal 33 as an impulse input.
Pulse output #27 [Hz] [1669] returns the actual value of impulses applied to terminal 27 in digital output mode.
Pulse output #29 [Hz] [1670] returns the actual value of impulses applied to terminal 29 in digital output mode.
Fieldbus control word1 signal [1680] Control word (CTW) received from the Bus-Master.
Fieldbus status word1 signal [1681] Status word (STW) sent to the Bus-Master.
Fieldbus speed set-point A signal [1682] Main reference value sent with control word form the Bus-Master.
Fieldbus speed actual value A signal [1683] Main actual value send with the Status word to the Bus Master.
Communication Option Status Word [binary] [1684] Extended fieldbus comm. option status word.
FC port control word1 signal [1685] Control word (CTW) received from the Bus-Master.
FC port speed set-point A signal [1686] Status word (STW) sent to the Bus-Master.

0-21 Display Line 1.2 Small

Option:

✱Motor Current [A] [1614]

Options are the same as in par. 0-20.

✱ default setting **( )** display text **[ ]** value for use in communication via serial communication port

0-22 Display Line 1.3 Small

Option:

*Power [kW] [1610]

Options are the same as in par. 0-20.

0-23 Display Line 2 Large

Option:

*Frequency [Hz] [1613]

Options are the same as in par. 0-20.

0-24 Display Line 3 Large

Option:

*Reference [%] [1602]

Options are the same as in par. 0-20.

0-25 My Personal Menu

Array [20]

Range:

0 - 9999

Function:

Defines the parameters to include in the Q1 Personal Menu accessible via [Quick Menu] on the LCP. Add up to 20 parameters in the Q1 Personal Menu. The parameters are listed in the Q1 Personal Menu in the order programmed in this array parameter. Delete parameters by setting the value to "0000".

□ **0-4* LCP Keypad**

These parameters make it possible to enable/disable individual keys on the LCP keypad.

0-40 [Hand on] Key on LCP

Option:

Disabled	[0]
*Enabled	[1]
Password	[2]

Function:

Select *Disabled* [0] to avoid accidental start of the drive in Hand mode. Select *Password* [2] to avoid unauthorised start in Hand mode. Set the password in par. 0-62 or par. 0-64 if par. 0-40 is in included in the Quick menu.

0-41 [Off] Key on LCP

Option:

Disabled	[0]
*Enabled	[1]
Password	[2]

Function:

Press [Off] and select *Disabled [0]* to avoid accidental drive stop. Press [Off] and select *Password [2]* to avoid unauthorised stop. Set the password in par. 0-62 or par. 0-64 if par. 0-40 is in included in the Quick menu.

0-42 [Auto on] Key on LCP

Option:

Disabled	[0]
*Enabled	[1]
Password	[2]

Function:

Press [Auto on] and select *Disabled [0]* to avoid accidental drive start in Auto mode. Press [Auto on] and select *Password [2]* to avoid unauthorised start in Auto mode. Set the password in par. 0-62 or par. 0-64 if par. 0-40 is in included in the Quick menu.

0-43 [Reset] Key on LCP

Option:

Disabled	[0]
*Enabled	[1]
Password	[2]

Function:

Press [Reset] and select *Disabled* [0] to avoid accidental alarm reset. Press [Reset] and select *Password [2]* to avoid unauthorised resetting. Set the password in par. 0-62 or par. 0-64 if par. 0-40 is in included in the Quick menu.

□ **0-5* Copy / Save**

Parameters for copying parameter settings between set-ups and to/from the LCP.

0-50 LCP Copy

Option:

*No copy	[0]
All to LCP	[1]
All from LCP	[2]
Size indep. from LCP	[3]
File from MCO to LCP	[4]
File from LCP to MCO	[5]

Function:

Select Transfer to LCP all parameters [1] to copy all parameters in all set-ups from the drive memory to the LCP memory. Select Transfer from LCP all parameters [2] to copy all parameters in all set-ups from the LCP memory to the drive memory. Select Transfer from LCP size indep. parameters [3] to copy only the parameters that are independent of

the motor size. The latter selection can be used to program several drives with the same function without disturbing motor data which are already set. Par. 0-50 cannot be adjusted while motor is running.

0-51 Set-up Copy

Option:

*No copy	[0]
Copy to set-up 1	[1]
Copy to set-up 2	[2]
Copy to set-up 3	[3]
Copy to set-up 4	[4]
Copy to all	[9]

Function:

Select Copy to set-up 1 [1] to copy all parameters in the current edit set-up (set in par. 0-11) to set-up 1. Make the same choice in the other parameters. Select Copy to all [9] to make all parameters in all set-ups to the parameters in the current edit set-up.

□ **0-6* Password**

This group contains the parameters that control the password functionality.

0-60 Main Menu Password

Range:

0 - 999	*100

Function:

Defines the password used for accessing the Main Menu. If par. 0-61 is set to *Full access* [0], this parameter is ignored.

0-61 Access to Ext. Menu w/o Password

Option:

*Full access	[0]
Read only	[1]
No access	[2]

Function:

Select *Full access* [0] to disable the password in par. 0-60. Select *Read only* [1] to block unauthorized editing of Main Menu parameters. Select *No access* [2] to block unauthorised viewing and editing of Main Menu parameters.
If [0] *Full access* is selected then par. 0-66 is ignored.

0-65 Quick Menu Password

Range:

0 - 999	*200

Function:

Defines the password be used to access the Quick Menu. If par. 0-66 is set to *Full access* [0], this parameter is ignored.

0-66 Access to Quick Menu w/o Password

Option:

*Full access	[0]
Read only	[1]
No access	[2]

Function:

Select *Full access* [0] to disable the password in par. 0-65. Select *Read only* [1] to block unauthorised editing of Quick Menu parameters. Select *No access* [2] to block unauthorised viewing and editing of Quick Menu parameters.
This parameter is ignored if par. 0-61 is set to [0] *Full access*.

□ Parameters: Load and Motor

□ 1-0* General Settings

Determines whether the frequency converter should be in speed mode or torque mode. Also whether the internal PID control should be active or not.

1-00 Configuration Mode

Option:

✱Speed open loop	[0]
Speed closed loop	[1]
Torque	[2]
Process	[3]

Function:

Speed open loop[0]: Enables speed control (without feedback signal from motor) with automatic slip compensation for almost constant speed at varying loads. Compensations are active, but can be disabled in the *Load / Motor* parameter group.
Speed closed loop[1]: Enables encoder feedback from motor. Obtain full holding torque at 0 RPM.
Increased speed accuracy: Provide a feedback signal and set the speed PID control.
Torque [2]: Connect the encoder speed feedback signal to the encoder input.
Only possible with "Flux with encoder feedback", par. 1-01.
Process [3]: Enables the use of process control in the frequency converter. The process control parameters are set in par. groups 7-2* and 7-3*.
Par. 1-00 cannot be adjusted while the motor is running.

1-01 Motor Control Principle

Option:

U/f	[0]
✱VVC^{plus}	[1]
Flux sensorless	[2]
Flux w/ motor feedback	[3]

Function:

Determines which motor control principle to employ. [0] U/f is special motor mode. Used for special motor applications as parallel connected motors. Generally, the best shaft performance is obtained in the two Flux Vector control modes Flux w/ encoder feedback [3] and Flux sensorless [2]. Most applications, however, are easily handled using a Voltage Vector control mode VVC^{plus} [1]. The main benefit of VVC^{plus} operation is a simpler motor model.
Par. 1-01 cannot be adjusted while the motor is running.

1-02 Flux Motor Feedback Source

Option:

✱24 V encoder	[1]
MCB 102	[2]

Function:

24 V encoder [1] is a A and B channel encoder. The encoder can be connected to the digital inputs terminals 32/33 only.
MCB 102 [2] is selection of encoder module.
Par. 1-02 cannot be adjusted while the motor is running.

1-03 Torque Characteristics

Option:

✱Constant torque	[0]
Variable torque	[1]
Auto energy optim.	[2]

Function:

Select the demanded torque characteristic. AEO and VT are different kinds of energy saving operation.

Constant torque [0]: The motor shaft output will provide constant torque by variable speed control.
Variable Torque [1]: The motor shaft output will provide a variable torque by variable speed control. Set variable torque level in par. 14-40.
Automatic Energy Optimizing function [2]: Automatically adjusts the optimized energy consumption by setting par. 14-41 and par. 14-42

1-05 Local Mode Configuration

Option:

Speed open loop	[0]
Speed closed loop	[1]
✱As conf. mode par. 1-00	[2]

Function:

Select which application configuration mode (par. 1-00) to use when a Local (LCP) Reference is active. A Local Reference can only be active if par. 3-13 is [0] or [2]. By default the Local Reference is only active in Hand Mode.

□ 1-1*

1-10 Motor Construction

Option:

✱Asynchron	[0]
PM, non salient SPM	[1]

Function:

Motor construction can either be asynchronous or permanent magnet (PM) motor.

□ 1-2* Motor Data

Parameter group 1-2* is input data for nameplate data on the connected motor.

Parameters in parameter group 1-2* cannot be changed while the motor is running.

NB!:
Changing the value in this parameter affects the setting of other parameters.

1-20 Motor Power [kW]

Range:

0.37-7.5 kW [M-TYPE]

Function:

The value should equal the nameplate data on the connected motor. The default value corresponds to the nominal rated output of the unit.

1-21 Motor power [HP]

Range:

0.5-10 HP [M-TYPE]

Function:

The value should equal the nameplate data on the connected motor. The default setting corresponds to the nominal rated output of the unit.

1-22 Motor Voltage

Range:

200-600 V [M-TYPE]

Function:

The value should equal the nameplate data on the connected motor. The default value corresponds to the nominal rated output of the unit.

1-23 Motor Frequency

Option:

✱50 Hz (50 HZ)	[50]
60 Hz (60 HZ)	[60]

Min - Max motor frequency: 20 - 300 Hz

Function:

Select the stated value from the motor name plate. Alternatively, set the value for motor frequency to be infinitely variable. If a value different from 50 Hz or 60 Hz is selected, it is necessary to correct par. 1-50 to 1-53. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt par. 4-13 *Motor Speed High Limit [RPM)* and par. 3-03 *Maximum Reference* to the 87 Hz application.

1-24 Motor current

Range:

Motor type dependent.

Function:

The value should equal the nameplate data on the connected motor. Data is used for calculating torque, motor protection etc.

1-25 Motor nominal speed

Range:

100 - 60000 RPM ✱ RPM

Function:

The value should equal the name plate data on the connected motor. The data is used for calculating motor compensations.

1-26 Motor Cont. Rated Torque

Range:

1.0 - 10000.0 Nm ✱5.0 Nm

Function:

Parameter open when par. 1-10 = [1] *PM, non salient SPM*.

The value should equal the nameplate data on the connected motor. The default value corresponds to the nominal rated output of the unit.
Par. 1-26 cannot be adjusted while the motor is running.

1-29 Automatic Motor Adaptation, (AMA)

Option:

✱OFF	[0]
Enable complete AMA	[1]
Enable reduced AMA	[2]

Function:

If the AMA function is used, the frequency converter automatically sets the necessary motor parameters (par. 1-30 to par. 1-35) with the motor stationary. AMA ensures optimum use of the motor. For the best adaptation of the frequency converter, run AMA on a cold motor.
Select *Enable complete AMA*, if the frequency converter is to carry out AMA of the stator resistance R_S, the rotor resistance R_r, the stator leakage reactance x_1, the rotor leakage reactance X_2 and the main reactance X_h.

Select *Reduced AMA* if a reduced test is to be carried out, in which only the stator resistance R_s in the system is determined.
AMA cannot be carried out while the motor is running.

AMA cannot be carried out on permanent magnet motors.

Activate the AMA function by pressing [Hand on] after selecting [1] or [2]. See also section *Automatic Motor Adaptation*. After a normal sequence, the display will read, "Press [OK] to finish AMA". After pressing the [OK] key the frequency converter is now ready for operation.

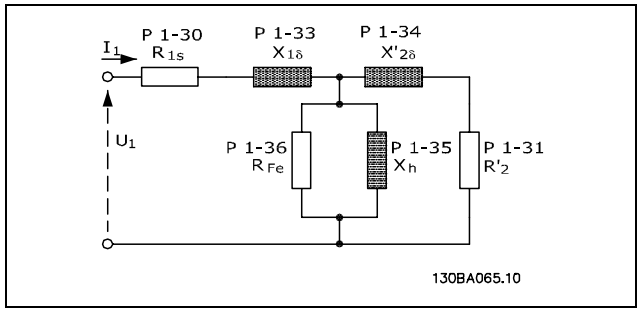
NB!:
It is important to set motor par. 1-2* correctly, since these form part of the AMA algorithm. For optimum dynamic motor performance, an AMA must be carried out. It may take up to 10 min, depending on the power rating of the motor.

NB!:
Avoid externally generating torque during AMA.

NB!:
If one of the settings in par. 1-2* is changed, par. 1-30 to 1-39 will return to default setting.

□ **1-3* Adv. Motor Data**
The motor data in par. 1-30 - par. 1-39 must be matching the specific motor, in order for the motor to run properly. Default settings are figures based on common motor parameter values from normal standard motors. If the motor parameters are not set correctly, it may cause a malfunction of the drive system.
If the motor data is not known it is recommended to perform an AMA (Automatic Motor Adaptation). See section *Automatic Motor Adaptation*. The AMA sequence will adjust all motor parameters except the moment of inertia of the rotor and the iron loss resistance (par. 1-36).

Parameters 1-3* and 1-4* cannot be changed while the motor is running.



Motor equivalent diagram for an asynchronous motor

1-30 Stator Resistance (RS)

Option:

Ohm — Depending on motor data.

Function:

Sets the stator resistance value for the motor control.

1-31 Rotor Resistance (Rr)

Option:

Ohm — Depending on motor data.

Function:

A manually entered Rotor resistance, R_r must apply to a cold motor. Improve shaft performance by fine-tuning R_r.

R_r can be set as follows:

1. AMA: The frequency converter measures the value on the motor. All compensations are reset to 100%.
2. The motor supplier states the value.
3. The default settings of R_r are used. The frequency converter selects the setting on the basis of the motor nameplate data.

1-33 Stator Leakage Reactance (X1)

Option:

Ohm — Depending on motor data.

Function:

Sets the stator leakage reactance of the motor.

X1 can be set as follows:

1. AMA: The frequency converter measures the value on the motor.
2. The motor supplier states the value.
3. The default setting of X1 is used. The frequency converter selects the setting on the basis of the motor name plate data.

1-34 Rotor Leakage Reactance (X2)

Option:

Ohm — Depending on motor data.

Function:

Sets the rotor leakage reactance of the motor.

X2 can be set as follows:

1. AMA: The frequency converter determines the value on the motor to determine.
2. The motor supplier states the value.
3. The default setting of X2 is used. The frequency converter selects the setting on the basis of the motor nameplate data.

1-35 Main Reactance (Xh)

Option:

Ohm — Depending on motor data.

Function:

Sets the main reactance of the motor.

Xh can be set as follows:

1. AMA: The frequency converter measures the value on the motor.
2. The motor supplier states the value.
3. The default setting of Xh is used. The frequency converter selects the setting on the basis of the motor nameplate data.

1-36 Iron Loss Resistance (Rfe)

Range:

1 - 10.000 Ω — ✱M-TYPE

Function:

Sets the equivalent of the R_{Fe} to compensate for iron losses in the motor.
The Iron Loss Resistance will not be found by an AMA procedure.
The iron loss parameter is especially important in torque control applications. If R_{Fe} is unknown, leave par. 1-36 on default setting.

1-37 d-axis Inductance (Ld)

Range:

0.0 - 1000.0 mH — ✱0.0 mH

Function:

Set the value of the d-axis inductance. This parameter is only active when par. 1-10 has the value *[1] PM motor* (Permanent Magnet Motor). See the permanent magnet motor data sheet.

1-39 Motor Poles

Option:

Depends on motor type
Value 2 - 100 poles — ✱4-pole motor

Function:

Sets the motor pole number.

Poles	~n_n@ 50 Hz	~n_n@60 Hz
2	2700 - 2880	3250 - 3460
4	1350 - 1450	1625 - 1730
6	700 - 960	840 - 1153

The table shows the normal speed range for various motor types. Define motors designed for other frequencies separately. The stated value must be, even as the figure refers to the motor's number of poles (not a pair of poles). The frequency converter carries out the initial setting of par. 1-39 based on par. 1-23 and par. 1-25.

1-40 Back EMF at 1000 RPM

Range:

10 - 1000 V — ✱500 V

Function:

Set the nominal back EMF for the motor running at 1000 RPM.

This parameter is only active when par. 1-10 has the value *[1] PM motor* (Permanent Magnet Motor).

1-41 Motor Angle Offset

Range:

0 - 65535 N/A — ✱0 N/A

Function:

Enter the correct offset angle between the PM motor and the index position (single-turn) of the attached encoder / resolver. The value range of 0 - 65535 corresponds to 0 - 2 * pi (radians). Hint: After drive start-up apply DC-hold and enter the value of par. 16-20 *Motor Angle* in this parameter.

This parameter is only active when par. 1-10 has the value *[1] PM motor* (Permanent Magnet Motor).

□ **1-5* Load Indep. Setting**

Parameters for setting the load independent setting of the motor.

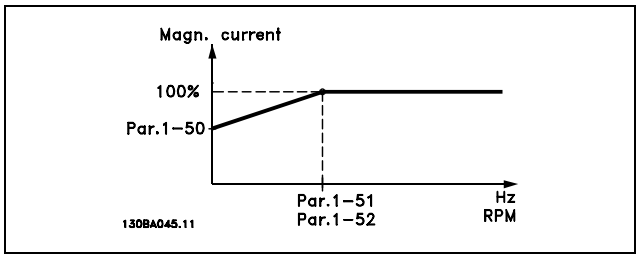
1-50 Motor Magnetizing at Zero Speed

Range:

0 - 300 % — ✱100 %

Function:

Is used along with par. 1-51 to obtain a different thermal load on the motor when running at low speed. Enter a value which is a percentage of the rated magnetizing current. A setting too low may cause a reduced torque on the motor shaft.



1-51 Min Speed Normal Magnetising (RPM)

Range:

10 - 300 RPM ✱15 RPM

Function:

Is used along with par. 1-50. See drawing in par. 1-50. Set the required speed (for normal magnetising current). If the speed is set lower than the motor slip speed, par. 1-50 and par. 1-51 are of no significance.

1-52 Min. Speed Normal Magnetising [Hz]

Range:

0 - 10 Hz ✱0 Hz

Function:

Is used along with par. 1-50. See drawing in par. 1-50. Set the required frequency (for normal magnetising current). If the frequency is set lower than the motor slip frequency, par. 1-50 and par. 1-51 are inactive.

1-53 Model Shift Frequency

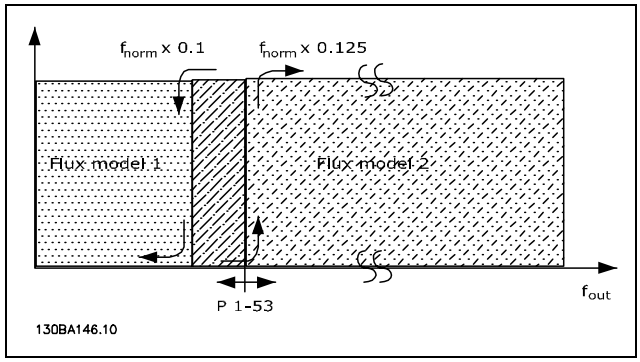
Range:

4.0 - 50.0 Hz ✱6.7 Hz

Function:

Flux Model shift

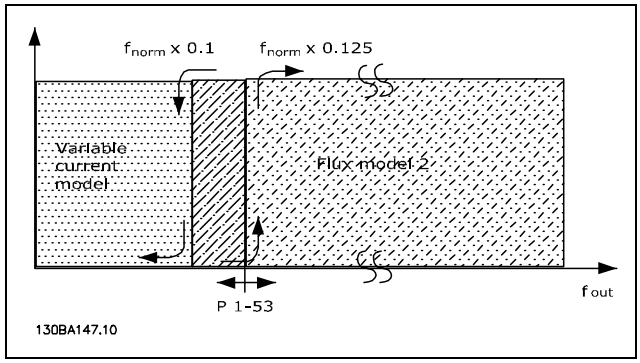
With this parameter it is possible to make an adjustment of the shifting point where FC 302 changes the FLUX model. Useful in some sensitive speed and torque control applications.



Speed closed loop or Torque par. 1-00 = [1] or [2] and Flux w/motor feedback par. 1-01 = [3]

Function Variable current – Flux mode –Sensorless

Par. 1-00 *Speed Open Loop mode* [0] and par. 1-01 *Flux Sensorless* [2]: In speed open loop in flux mode, the speed must be determined from the current measurement. Below n_{norm} x 0.1, the drive is working from a variable current model. Above n_{norm} x 0.125 the drive is working from the FLUX model in the frequency converter.



Speed Open Loop par. 1-00 = [0] Flux Sensorless par. 1-01 = [2]

Par. 1-53 cannot be adjusted while the motor is running.

1-55 U/f Characteristic - U

Range:

0.0 - max. motor voltage ✱Expression limit V

Function:

This parameter is an array parameter [0-5] and is only accessible when par. 1-01 is set to *U/f* [0]. Set the voltage at each frequency point to manually form a U/f-characteristic matching the motor. The frequency points are defined in par 1-56.

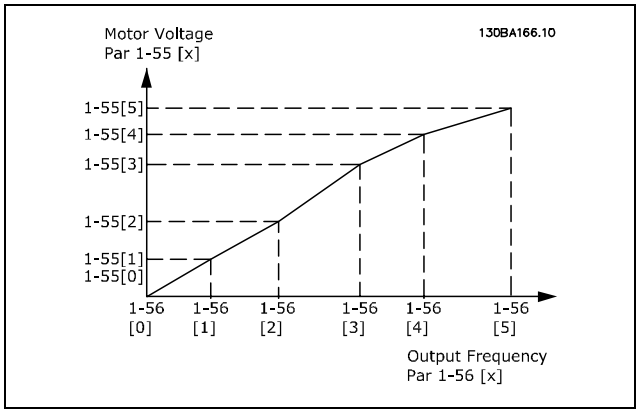
1-56 U/f Characteristic - F

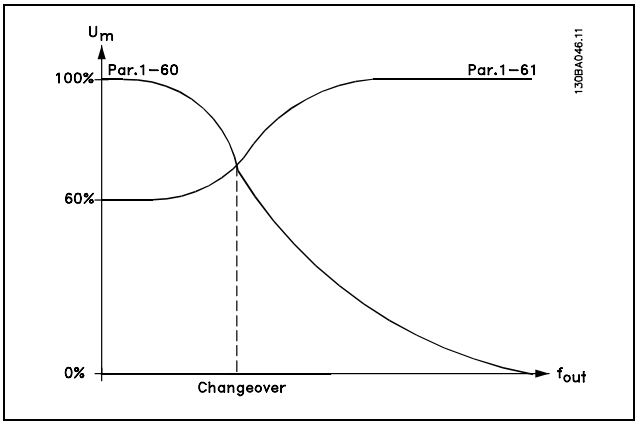
Range:

0.0 - max. motor frequenc* Expression limit Hz

Function:

This parameter is an array parameter [0-5] and is only accessible when par. 1-01 is set to *U/f* [0]. Set the frequency points to manually form a U/f-characteristic matching the motor. The voltage at each point is defined in par. 1-55.





1-61 High Speed Load Compensation

Range:

-300 - 300% *100%

Function:

Enables compensation of voltage in relation to load when the motor is running at high speed. Optimum U/f characteristic is obtained. The frequency range within which this parameter is active, depends on the motor size.

Motor size	Change-over
0.25 kW - 7.5 kW	> 10 Hz

1-62 Slip Compensation

Range:

-500 - 500 % *100 %

Function:

Slip compensation is calculated automatically, i.e. on the basis of the rated motor speed $n_{M,N}$. In par. 1-62, slip compensation is adjusted in detail, which compensates for tolerances in the value of $n_{M,N}$. This function is not active along with *Torque Characteristics* (par. 1-03), *Speed closed loop*, *Torque control*, *Speed feedback* and, *Special motor characteristics*.
Enter a %-value of the rated motor frequency (par. 1-23).

1-63 Slip Compensation Time Constant

Range:

0.05 - 5.00 s *0.10 s

Function:

Determines the slip compensation reaction speed. A high value results in slow reaction. On the other hand, a low value results in quick reaction. If you

□ 1-6* Load Depend. Setting

Parameters for setting the load dependent parameters for the motor.

1-60 Low Speed Load Compensation

Range:

-300 - 300% *100 %

Function:

Enables compensation of voltage in relation to load when the motor is running at low speed. Optimum U/f characteristic is obtained. The frequency range within which this parameter is active, depends on the motor size.

Motor size: 0.25 kW - 7.5 kW Change over: < 10 Hz

encounter low-frequency resonance problems, the set time must be longer.

1-64 Resonance Dampening

Range:

0 - 500 % ✱100%

Function:

Setting par. 1-64 and par. 1-65 can eliminate high-frequency resonance problems. For less resonance oscillation, the value of par. 1-64 must be increased.

1-65 Resonance Dampening Time Constant

Range:

5 - 50 msec. ✱5 msec.

Function:

Setting par. 1-64 and par. 1-65 can eliminate high-frequency resonance problems. Choose the time constant that provides the best dampening.

1-66 Min. Current at Low Speed

Range:

0 - Variable Limit % ✱100 %

Function:

Is enabled when par. 1-00 = *SPEED OPEN LOOP* only. The drive runs with constant current through motor below 10 Hz.
When speed is above 10 Hz, the motor flux model in the drive controls the motor. Par. 4-16 and / or par. 4-17 automatically adjusts par. 1-66. The parameter with the highest value adjusts par. 1-66. The current setting in par. 1-66 is composed of the torque generating current and the magnetizing current.

Example: Par. 4-16 *Torque Limit for Motor Mode* is set to 100% and par. 4-17 *Torque Limit for Generating Mode* is set to 60%. Par. 1-66 automatically sets to about 127%, depending on the motor size.

1-67 Load Type

Option:

✱Passive load	[0]
Active load	[1]

Function:

Select *passive load* [0] for conveyers, fan and pump applications. Select *active load* [1] for hoisting application. When *active load* [1] is selected, set min. current at low speed (par. 1-66) to a level which corresponds to maximum torque.

1-68 Minimum Inertia

Range:

0 - Variable Limit ✱Depending on motor data

Function:

Set the minimum moment of inertia of the mechanical system.

Par. 1-68 and par. 1-69 are used for pre-adjustment of the Proportional Gain in the speed control (par. 7-02).

1-69 Maximum Inertia

Range:

0 - Variable Limit ✱Depending on motor data

Function:

Set the maximum moment of inertia of the mechanical system.

□ **1-7* Start Adjustments**

Parameters for setting special start features for the motor.

1-71 Start Delay

Range:

0.0 - 10.0 s ✱0.0 s

Function:

Enables a delay of the starting time. The frequency converter begins with the start function selected in par. 1-72. Set the start delay time until acceleration is to begin.

1-72 Start Function

Option:

DC hold/delay time	[0]
DC Brake/delay time	[1]
✱Coast/delay time	[2]
Start speed/ current clockwise operation	[3]
Horizontal operation	[4]
VVC^{plus}/Flux clockwise	[5]

Function:

Selects the start function during start delay (par. 1-71).
Select *DC hold/delay time* [0] to energize the motor with a DC holding current (par. 2-00) in the start delay time.
Select *DC brake/delay time* [1] to energize the motor with a DC braking current (par. 2-01) during start delay time.

Select *Coast/delay time* [2] to release the shaft coasted converter during the start delay time (inverter off).
Select *Start speed/current clockwise* [3] to connect the function described in par. 1-74 and par. 1-76 in the start delay time.
Regardless of the value applied by the reference signal, the output speed applies the setting of the start speed in par 1-74 or par. 1-75 and the output current corresponds to the setting of the start current in par. 1-76. This function is typically used in hoisting applications without counterweight and especially in applications with a Cone-motor, where the start is clockwise, followed by rotation in the reference direction
Select *Horizontal operation* [4] to obtain the function described in par. 1-74 and par. 1-76 during the start delay time. The motor rotates in the reference direction. If the reference signal equals zero (0), par. 1-74 *Start speed* is ignored and the output speed equals zero (0). The output current corresponds to the setting of the start current in par. 1-76 *Start current*.
Select *VVC^{plus}/Flux clockwise* [5] for the function described in par. 1-74 only (*Start speed in the start delay time*). The start current is automatically calculated.
This function only uses the start speed in the start delay time. Regardless of the value set by the reference signal, the output speed equals the setting of the start speed in par. 1-74. *Start speed/current clockwise* [3] and *VVC^{plus}/Flux clockwise* [5] are typically used in hoisting applications. *Start speed/current in reference direction* [4] is particularly used in applications with counterweight and horizontal movement.

1-74 Start Speed [RPM]

Range:

0 - 600 RPM ✱0 RPM

Function:

Sets the desired motor start speed.
The motor output speed adjusts to the set value. This parameter can be used e.g. for hoist applications (cone armature motors). Set the start function in par. 1-72 to [3], [4] or [5], and set a start delay time in par. 1-71. A reference signal must be present.

1-75 Start Speed [Hz]

Range:

0 - 500 Hz ✱0 Hz

Function:

Sets a start speed.
After the start signel the output speed adjusts to the set value. This parameter can be used e.g. for hoist applications (cone rotor motors). Set the start function in par. 1-72 to [3], [4] or [5], and set a start delay time in par. 1-71. A reference signal must be present.

1-76 Start Current

Range:

0.00 - par. 1-24 A ✱0.00 A

Function:

Some motors, such as cone rotor motors, need extra current/starting speed (boost) to disengage the mechanical brake. For this purpose use par. 1-74 and par. 1-76. Set the required value to disengage the mechanical brake. Set the start function in par. 1-72 to [3] or [4], and set a start delay time in par. 1-71. A reference signal must be present.

□ 1-8* Stop Adjustments

Parameters for setting special stop features for the motor.

1-80 Function at Stop

Option:

✱Coast	[0]
DC hold	[1]
Motor check	[2]
Pre-magnetizing	[3]
DC Voltage U0	[4]

Function:

Selects the drive function after a stop command or after the speed is ramped down to the settings in par. 1-81.
Select *Coasting* [0] to leave the motor in free mode. Activate *DC hold* [1] DC holding current (par. 2-00). Select *Motor check* [2] to check if a motor is been connected.
Select *Pre-magnetizing* [3] to build up a magnetic field while the motor is stopped. The motor can now produce a quick torque build-up at start.

1-81 Min. Speed for Function at Stop [RPM]

Range:

0 - 600 RPM ✱1 RPM

Function:

Sets the speed at which to activate *Function at stop* (par. 1-80).

1-82 Min. Speed for Function at Stop [Hz]

Range:

0.0 - 500 Hz *0.0 Hz

Function:

Set the frequency at which the function to activate function at stop is elected in par. 1-80.

□ **1-9* Motor Temperature**

Parameters for setting the temperature protection features for the motor.

1-90 Motor Thermal Protection

Option:

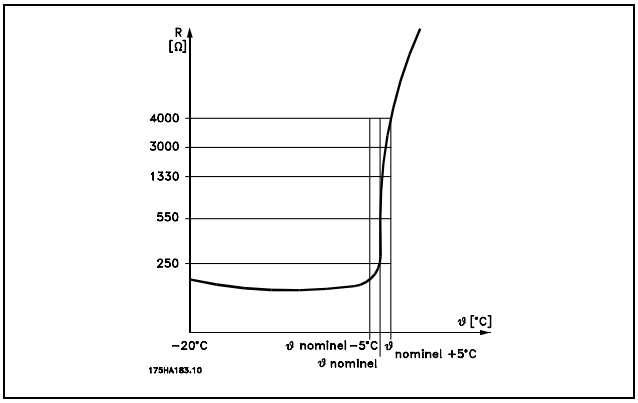
*No protection	[0]
Thermistor warning	[1]
Thermistor trip	[2]
ETR warning 1	[3]
ETR trip 1	[4]
ETR warning 2	[5]
ETR trip 2	[6]
ETR warning 3	[7]
ETR trip 3	[8]
ETR warning 4	[9]
ETR trip 4	[10]

Function:

The frequency converter determines the motor temperature for motor protection in two different ways:

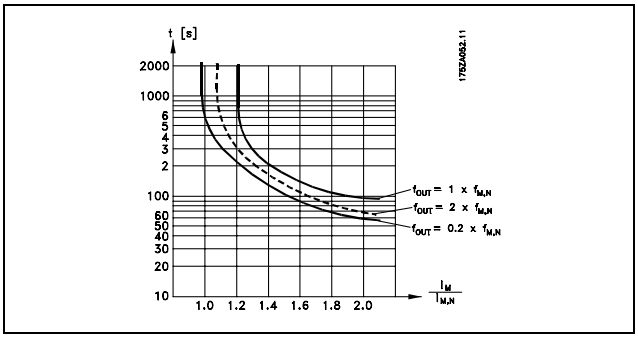
- Via a thermistor sensor connected to one of the analog or digital inputs (par. 1-93).
- Via calculation of the thermal load, based on the actual load and time. The calculation is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. The calculations estimate the need for a lower load at lower speed due to less cooling from the incorporated fan in the motor.

If the motor is continously overloaded, select *No protection* if no warning or trip of drive is required. Select *Thermistor warning* if you want a warning when the connected thermistor in the motor switches off. Select *Thermistor trip* if you want the frequency converter to cut out (trip) when the connected thermistor in the motor switches off. Select thermistor (PTC sensor) if you want a thermistor integrated in the motor (for winding protection) to stop the frequency converter in case of motor over-temperature. The cut-out value is > 3 k.



Input Digital/analog	Supply Voltage Volt	Threshold Cut-out Values
Digital	24 V	< 6.6 kΩ - > 10.8 kΩ
Digital	10 V	< 800Ω - > 2.7 kΩ
Analog	10 V	< 3.7 kΩ - > 3.7 kΩ

Select *ETR Warning 1-4*, if you want a warning on the display when the motor is overloaded. Select *ETR Trip 1-4* if you want the frequency converter to trip when the motor is overloaded. You can programme a warning signal via one of the digital outputs. The signal appears in case of a warning and if the frequency converter trips (thermal warning). ETR (Electronic Terminal Relay) functions 1-4 will not calculate the load until you switch to the set-up where they were selected. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.



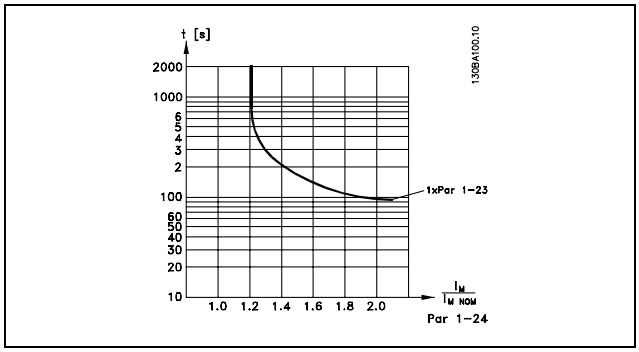
1-91 Motor External Fan

Option:

*No	[0]
Yes	[1]

Function:

Select whether to apply an external motor fan (external ventilation), indicating unnecessary derating at low speed.
If you select *Yes* [1], the graph below is followed if the motor speed is lower. If the motor speed is higher, the time still derates as if no fan is installed.



You cannot change par. 1-91 while the motor is running.

1-93 Thermistor Source

Option:

*None	[0]
Analog input 53	[1]
Analog input 54	[2]
Digital input 18	[3]
Digital input 19	[4]
Digital input 32	[5]
Digital input 33	[6]

Function:

Selects the analog input used for connecting the Thermistor (PTC sensor). An analog input cannot be selected if the analog input is already in use as a reference resource (selected in par. 3-15, 3-16 or 3-17).
Par. 1-93 cannot be adjusted while the motor is running.

□ Parameters: Brakes

□ 2-0* DC-Brakes

Parameter group for setting brake features in the frequency converter.

2-00 DC Hold Current

Range:

0 - 100% ✱50 %

Function:

Holds the motor function (holding torque) or pre-heats the motor. You cannot use this parameter if *DC hold* is selected in par. 1-72 [0] or par. 1-80 [1]. Set the *Holding current* as a percentage value in relation to the rated motor current $I_{M,N}$ (par. 1-24). 100% DC holding current corresponds to $I_{M,N}$.

$$(OFF) - \frac{I_{FC302.norm}}{I_{motor.norm}} * 100\%$$

NB!:
The maximum value depends on the rated motor current.

Avoid 100 % current for too long. It may damage the motor.

2-01 DC Brake Current

Range:

0 - 100 % ✱50%

Function:

Applies DC brake current on a stop command. Activate the function by reaching the set speed in par. 2-03, by activating the DC Brake Inverse function on one of digital inputs, or via the serial communication port. The braking current is active during the time period set in par. 2-02. Set the current as a percentage value of the rated motor current $I_{M,N}$ (par. 1-24). 100% DC braking current corresponds to $I_{M,N}$.

$$(OFF) - \frac{I_{FC302.norm}}{I_{motor.norm}} * 100\,\%$$

NB!:
The maximum value depends on the rated motor current.

Avoid 100 % current for too long. It can damage the motor.

2-02 DC Braking Time

Range:

0.0 - 60.0 s. ✱10.0 s.

Function:

Sets the active DC braking time for the DC braking current (par. 2-01).

2-03 DC Brake Cut-in Speed

Range:

0 - par. 4-13 RPM ✱0 RPM

Function:

Sets the active brake cut-in speed for the DC braking current (par. 2-01) in connection with a stop command.

□ 2-1* Brake Energy Funct.

2-10 Brake and Over-voltage Functions

Option:

✱Off	[0]
Resistor brake	[1]

Function:

The default setting is *Off* [0].
Use *Resistor brake* [1] to programme the frequency converter for connecting a brake resistor. Connecting a brake resistor allows a higher DC link voltage during braking (generating operation). The *Resistor brake* [1] function is only active in frequency converters with an integral dynamic brake.

Select *Resistor brake* [1] if a brake resistor is part of the system.

2-11 Brake Resistor (ohm)

Option:

Ohm Depends on unit size.

Function:

This parameter is only active in frequency converters with an integral dynamic brake.

Set the brake resistor value in ohm. This value is used for monitoring the power to the brake resistor. Select this function in par. 2-13.

2-12 Brake Power Limit (kW)

Range:

0.001 - Variable Limit kW ✱kW

Function:

This parameter is only active in frequency converters with an integral dynamic brake.

The monitoring limit is a product of the maximum duty cycle (120 sec.) and the maximum power of the brake resistor at that duty cycle. See the formula below.

For 200 - 240 V units: $P_{resistor} = \frac{397^2 * dutytime}{R * 120}$

For 380 - 500 V units $P_{resistor} = \frac{822^2 * dutytime}{R * 120}$

For 575 - 600 V units $P_{resistor} = \frac{985^2 * dutytime}{R * 120}$

2-13 Brake Power Monitoring

Option:

*Off	[0]
Warning	[1]
Trip	[2]
Warning and Trip	[3]

Function:

This parameter is only active in frequency converters with an integral dynamic brake.

Allows monitoring of the power to the brake resistor. The power is calculated on the basis of the resistor ohm value (par. 2-11), the DC link voltage, and the resistor duty time. If the power transmitted over 120 s exceeds 100% of the monitoring limit (par. 2-12) and *Warning* [1] is selected, a warning appears on the display. The warning disappears if the power goes below 80%. If the calculated power exceeds 100% of the monitoring limit and *Trip* [2] is selected in par. 2-13 *Power Monitoring*, the frequency converter trips and displays an alarm. If power monitoring is set to *Off* [0] or *Warning* [1], the brake function remains active, even if the monitoring limit is exceeded. This may lead to thermal overload of the resistor. It is also possible to have a warning via a relay/digital outputs. The measuring accuracy of the power monitoring depends on the accuracy of the resistance of the resistor (better than ± 20%).

2-15 Brake Check

Option:

*Off	[0]
Warning	[1]
Trip	[2]
Stop and Trip	[3]

Function:

This parameter is only active in frequency converters with an integral dynamic brake.

Enables the intergration of a test and monitor function, which displays a warning or an alarm. On power-up, the functions is tested for disconnection of the brake resistor. The test is carried out during braking. Testing for disconnection of the IGBT, however, is carried out when there is no braking. A warning or trip disconnects the brake function. The testing sequence is as follows:

1. The DC link ripple amplitude is measured for 300 ms without braking.
2. The DC link ripple amplitude is measured for 300 ms with the brake turned on.
3. If the DC link ripple amplitude while braking is lower than the DC link ripple amplitude before braking + 1 %. Brake check failed, return a warning or alarm.
4. If the DC link ripple amplitude while braking is higher than the DC link ripple amplitude before braking + 1 %. Brake check OK

Select *Off* [0]. This function still monitors whether the brake resistor and the brake IGBT short-circuit during operation. If so, a warning appears. Select *Warning* [1] to monitor the brake resistor and brake IGBT for to short-circuiting. During power-up disconnection of the brake resistor is checked.

NB!:
Remove a warning arisen in connection with *Off* [0] or *Warning* [1] by cycling the mains supply. The fault must be corrected first. With *Off* [0] or *Warning* [1], the frequency converter keeps running even if a fault is located. In the case of *Trip* [2], the frequency converter cuts out while displaying an alarm (trip locked). This happens if the brake resistor is short-circuited, is disconnected, or if the brake IGBT is short-circuited.

2-17 Over-voltage Control

Option:

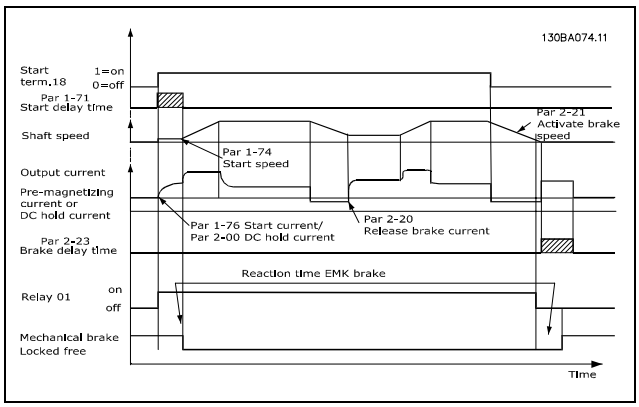
*Disabled	[0]
Enabled (not at stop)	[1]
Enabled	[2]

Function:

The Over-voltage Control is selected to reduce the risk for the drive to trip by an over voltage on the DC link caused by generative power from the load. *Enabled (not at stop)*, means that OVC is active except when stopping with a stop signal applied.

□ 2-2* Mechanical Brake

For hoisting applications, you must control an electro-magnetic brake. To control the brake, a relay output (relay 01 or relay 02) or a programmed digital output (terminal 27 or 29) is required. Normally, this output must be closed during the time when the drive is unable to 'hold' the motor, e.g. because of too high load.
Select *Mechanical Brake Control* [32] for applications with an electro-magnetic brake in par. 5-40 (Array parameter), par. 5-30, or par. 5-31 (digital output 27 or 29). When selecting *Mechanical brake control* [32], the mechanical brake is closed during start until the output current is above the level selected in par. 2-20 *Release Brake Current*. During stop, the mechanical brake activates when the speed is below the level selected in par. 2-21 *Activate Brake Speed [RPM].* If the frequency converter enters into an alarm condition or an over-current or over-voltage situation, the mechanical brake immediately cuts in. This is also the case during safe stop.



2-20 Release Brake Current

Range:

0.00 - par. 16-37 A ✱ 0.00 A

Function:

Set the motor current for release of the mechanical brake, if a start condition is present.

2-21 Activate Brake Speed [RPM]

Range:

0 - par. 4-53 RPM ✱0 RPM

Function:

Set the motor speed for activating the mechanical brake, if a stop condition is present.

2-22 Activate Brake Speed [Hz]

Range:

0 - Max. speed ✱0 Hz

Function:

Set the motor frequency for activating the mechanical brake, if a stop condition is present.

2-23 Activate Brake Delay

Range:

0.0 - 5.0 s ✱0.0 s

Function:

Sets the brake delay time of the coast after ramp-down time. The shaft is held at zero speed with full holding torque. Ensure that the mechanical brake has locked the load before the motor enters coast mode. See section *Mechanical Brake.*

Parameters: Reference/Ramps

3-0* Reference Limits

Parameters for setting the reference unit, limits and ranges.

3-00 Reference Range

Option:

*Min. - Max	[0]
-Max - +Max	[1]

Function:

Settings for the reference signal and the feedback signal. They can both be positive or positive and negative. The minimum limit may have a negative value, unless *Speed control, closed loop* is selected (par. 1-00).

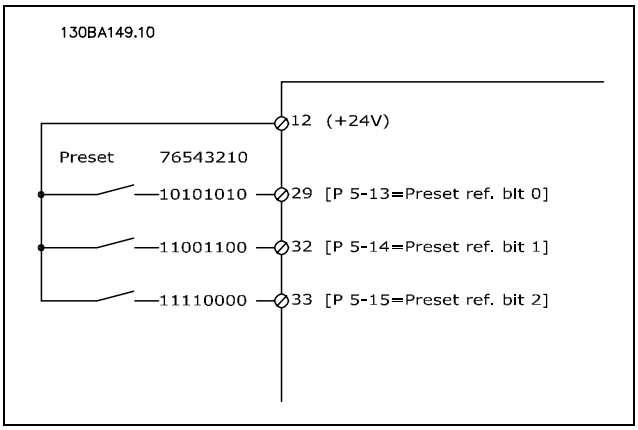
3-01 Reference/Feedback Unit

Option:

None	[0]
*%	[1]
RPM	[2]
Hz	[3]
Nm	[4]
bar	[5]
Pa	[6]
PPM	[7]
CYCLE/min	[8]
PULSE/s	[9]
UNITS/s	[10]
UNITS/min	[11]
UNITS/h	[12]
°C	[13]
F	[14]
m^3/s	[15]
m^3/min	[16]
m^3/h	[17]
t/min	[23]
t/h	[24]
m	[25]
m/s	[26]
m/min	[27]
in wg	[29]
gal/s	[30]
gal/min	[31]
gal/h	[32]
lb/s	[36]
lb/min	[37]
lb/h	[38]
lb ft	[39]
ft/s	[40]
ft/min	[41]
l/s	[45]
l/min	[46]
l/h	[47]
kg/s	[50]
kg/min	[51]
kg/h	[52]
ft^3/s	[55]
ft^s/min	[56]
ft^3/h	[57]

Function:

Select one of the units in par. 3-01 used in the Process PID Control.



3-02 Minimum Reference

Range:

-100000.000 – par. 3-03 *0.000 Unit

Function:

The Minimum Reference gives the minimum value obtained by the sum of all references. Minimum Reference is only active when par. 3-00 is set to *Min. – Max* [0].
Speed control, closed loop: RPM
Torque control, speed feedback: Nm.
Process control unit in par. 3-01.

3-03 Maximum Reference

Range:

Par. 3-02 - 100000.000 *1500.000 Unit

Function:

The *Maximum reference* is the highest value obtained by the sum of all references. The unit follows the choice of configuration in par. 1-00.
Speed control, closed loop: RPM
Torque control, speed feedback: Nm.

□ 3-1* References

Parameters for setting up the reference resources.

Select preset reference(s) you want to obtain when using the preset references. Select Preset ref. enable on the corresponding digital inputs.

3-10 Preset Reference

Array [8]

Range:

-100.00 - 100.00 % ✱0.00 %

Function:

Eight different preset references (0-7) can be programmed via array programming. The preset reference is stated as a percentage of the value Ref_{MAX} (par. 3-03) or as a percentage of the other external references. If a Ref_{MIN} 0 (Par. 3-02) is programmed, the preset reference as a percentage is calculated on the basis of the difference between Ref_{MAX} and Ref_{MIN}. Afterwards, the value is added to Ref_{MIN}. Select *Preset ref enable* on the matching digital inputs when using preset references.

3-12 Catch-up/Slow-down Value

Range:

0.00 - 100.00% ✱0.00%

Function:

Enables entering a percentage value (relative) which is either added to or deducted from the actual reference. If *Catch up* is selected via one of the digital inputs (par. 5-10 to par. 5-15), the percentage (relative) value is added to the total reference. If *Slow down* is selected via one of the digital inputs (par. 5-10 to par. 5-15), the percentage (relative) value is deducted from the total reference.
Extended functionality can be obtained with the DigiPot function. See parameter group 3-9*.

3-13 Reference Site

Option:

✱Linked to Hand / Auto	[0]
Remote	[1]
Local	[2]

Function:

Decides which resulting reference is active. If *Linked to Hand / Auto* [0] is selected, the resulting reference depends on whether the drive is in Hand or Auto mode. In Hand mode the local reference is used, and in Auto mode the remote reference is used. Select *Remote* [1] to use the remote reference in both Hand mode and Auto mode. Select *Local* [2] to use the local reference in both Hand mode and Auto mode (par. 3-14) Preset Relative Reference.

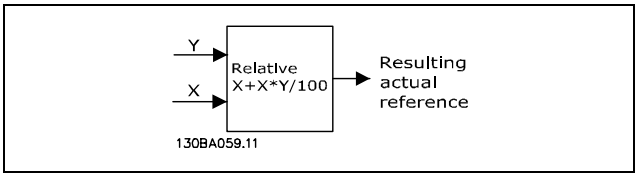
3-14 Preset Relative Reference

Range:

-100.00 - 100.00 % ✱ 0.00 %

Function:

Defines a fixed value (in %) added to the variable value (defined in par. 3-18 and called Y in the illustration below). This sum (Y) is multiplied with the actual reference (called X in the illustration below) and the result is added to the actual reference (X+X*Y/100).



3-15 Reference Resource 1

Option:

No function	[0]
✱Analog input 53	[1]
Analog input 54	[2]
Frequency input 29	[7]
Frequency input 33	[8]
Local bus reference	[11]
Digital pot.meter	[20]

Function:

Adding up to three different reference signals to compose the actual reference.
Defines what reference input should be treated as the source of the first reference signal.
Par. 3-15 cannot be adjusted while the motor is running.

3-16 Reference Resource 2

Option:

No function	[0]
Analog input 53	[1]
Analog input 54	[2]
Frequency input 29	[7]
Frequency input 33	[8]
Local bus reference	[11]
✱Digital pot.meter	[20]

Function:

Up to three different reference signals can be added to compose the actual reference.
Defines what reference input should be treated as the source of the second reference signal.
Par. 3-16 cannot be adjusted while the motor is running.

3-17 Reference Resource 3

Option:

No function	[0]
Analog input 53	[1]
Analog input 54	[2]
Frequency input 29	[7]
Frequency input 33	[8]
*Local bus reference	[11]
Digital pot.meter	[20]

Function:

Up to three different reference signals can be added to compose the actual reference.
Defines what reference input should be treated as the source of the third reference signal.
Par. 3-17 cannot be adjusted while the motor is running.

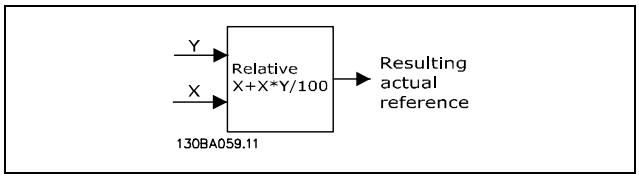
3-18 Relative Scaling Reference Resource

Option:

*No function	[0]
Analog input 53	[1]
Analog input 54	[2]
Frequency input 29	[7]
Frequency input 33	[8]
Local bus reference	[11]
Digital pot.meter	[20]

Function:

Defines that the input is treated as the source of the relative reference. This reference (in %) is added to the fixed value from par. 3-14. The sum (called Y in the illustration below) is multiplied with the actual reference (called X below) and the result is added to the actual reference (X+X*Y/100).



Par. 3-18 cannot be adjusted while the motor is running.

3-19 Jog Speed [RPM]

Range:

0 - par. 4-13 RPM *150 RPM

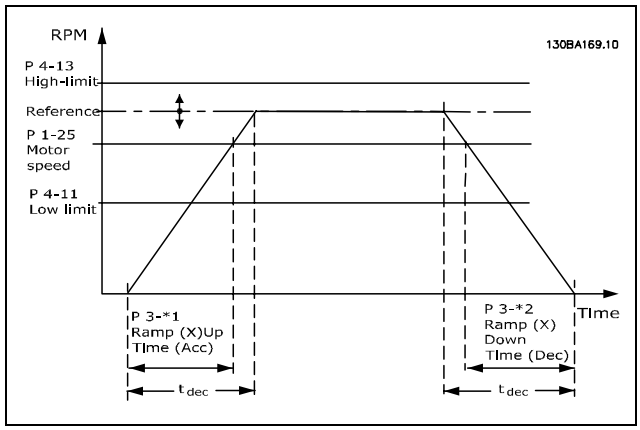
Function:

The jog speed n_{JOG} is a fixed output speed. The frequency converter runs at this speed when the jog function is active.

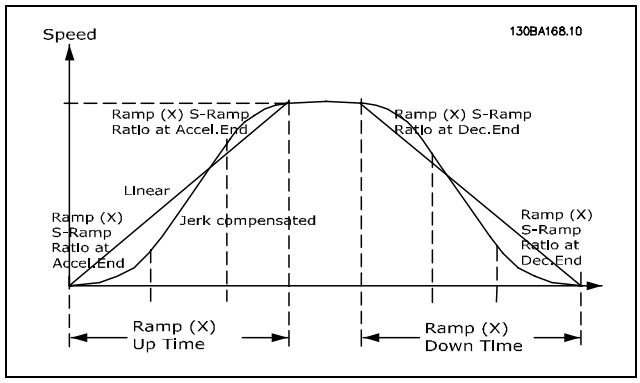
□ Ramps

3-4* Ramp 1

Selection of ramp type, ramping times (acceleration times and deceleration times) and setting of percentage of jerk parts of S ramps.
Start by setting the linear ramping times corresponding to figure and formulas.



If S-ramps are chosen then set the percentage of the jerking part of acceleration and deceleration ramps.



3-40 Ramp 1 Type

Option:

*Linear	[0]
S-ramp	[1]

Function:

Selects the desired ramp type, depending on requirements for acceleration/deceleration. Linear acceleration will have constant acceleration during ramping.
The S-ramp will compensate for jerk in the application. The settings are done by a percentage of the actual ramp time.

3-41 Ramp 1 Ramp-up Time

Range:

0.01 - 3600.00 s ✱ s

Function:

The ramp-up time is the acceleration time from 0 RPM to the rated motor speed nM,N (par. 1-25), provided that the output current does not reach the torque limit (set in par. 4-16). The value 0.00 corresponds to 0.01 s in speed mode.

$$Par.3-41 = \frac{t_{acc} * n_{norm}\ [\,par.1-25\,]}{\triangle ref\ [RPM]}\ [s]$$

3-42 Ramp 1 Ramp-Down Time

Range:

0.01 - 3600.00 s ✱ s

Function:

The ramp-down time is the deceleration time from the rated motor speed $n_{M,N}$ (par. 1-25) to 0 RPM, provided that there is no over-voltage in the inverter due to regenerative operation of the motor, or if the generated current reaches the torque limit (set in par. 4-17). The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in par. 3-41.

$$Par.3-42 = \frac{t_{acc} * n_{norm}\ [\,par.1-25\,]}{\triangle ref\ [RPM]}\ [s]$$

3-45 Ramp 1 S-ramp Ratio at Accel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-41) where the acceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-46 Ramp 1 S-ramp Ratio at Accel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-41) where the acceleration torque is declining smoothly. A large percentage minimises torque jerks.

3-47 Ramp 1 S-ramp Ratio at Decel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-42) where the deceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-48 Ramp 1 S-ramp Ratio at Decel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-42) where the deceleration torque is declining smoothly. A large percentage minimises torque jerks.

□ 3-5* Ramp 2

Choosing ramp parameters, see 3-4*.

3-50 Ramp 2 Type

Option:

✱Linear	[0]
S-ramp	[1]

Function:

Selects the desired ramp type, depending on requirements for acceleration/deceleration.

3-51 Ramp 2 Ramp-up Time

Range:

0.01 - 3600.00 s ✱s

Function:

The ramp-up time is the acceleration time from 0 RPM to the rated motor speed $n_{M,N}$ (par. 1-25). The output current must not reach the torque limit (set in par. 4-16). The value 0.00 corresponds to 0.01 sec. in speed mode.

$$Par.3-51 = \frac{t_{acc} * n_{norm}\ [\,par.1-25\,]}{\triangle ref\ [RPM]}\ [sec]$$

3-52 Ramp 2 Ramp-down Time

Range:

0.01 - 3600.00 s. ✱s

Function:

The ramp-down time is the deceleration time from the rated motor speed $n_{M,N}$ (par. 1-25) to 0 RPM. There must be no over-voltage in the inverter because of regenerative operation of the motor, nor can the generated current reach the torque limit (set in par. 4-17). The value 0.00 corresponds to 0.01 s in speed mode. See ramp in par. 3-51.

$$Par.3-52 = \frac{t_{dec} * n_{norm}\ [\,par.1-25\,]}{\triangle\, ref\ [RPM]}\ [sec]$$

3-55 Ramp 2 S-ramp Ratio at Accel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-51) where the acceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-56 Ramp 2 S-ramp Ratio at Accel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-51) where the acceleration torque is declining smoothly. A large percentage minimises torque jerks.

3-57 Ramp 2 S-ramp Ratio at Decel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-52) where the deceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-58 Ramp 2 S-ramp Ratio at Decel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-52) where the deceleration torque is declining smoothly. A large percentage minimises torque jerks.

□ 3-6* Ramp 3

Choosing ramp parameters, see 3-4*.

3-60 Ramp 3 Type

Option:

✱Linear [0]
S-ramp [1]

Function:

Selects the desired ramp type, depending on requirements for acceleration/deceleration.

3-61 Ramp 3 Ramp-up Time

Range:

0.01 - 3600.00 s ✱s

Function:

The ramp-up time is the acceleration time from 0 RPM to the rated motor speed $n_{M,N}$ (par. 1-25). The output current cannot reach the torque limit (set in par. 4-16). The value 0.00 corresponds to 0.01 s in speed mode.

$$Par.3-61 = \frac{t_{acc} * n_{norm}\ [\,par.1-25\,]}{\triangle\, ref\ [RPM]}\ [sec]$$

3-62 Ramp 3 Ramp-down Time

Range:

0.01 - 3600.00 s ✱s

Function:

The ramp-down time is the deceleration time from the rated motor speed $n_{M,N}$ (par. 1-25) to 0 RPM. There can be no over-voltage in the inverter due to regenerative operation of the motor. Nor can the generated current reach the torque limit (set in par. 4-17). The value 0.00 corresponds to 0.01 s in speed mode. See ramp in par. 3-61.

$$Par.3-62 = \frac{t_{dec} * n_{norm}\ [\,par.1-25\,]}{\triangle\, ref\ [RPM]}\ [sec]$$

3-65 Ramp 3 S-ramp Ratio at Accel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-61) where the acceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-66 Ramp 3 S-ramp Ratio at Accel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-61) where the acceleration torque is declining smoothly. A large percentage minimises torque jerks.

3-67 Ramp 3 S-ramp Ratio at Decel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-62) where the deceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-68 Ramp 3 S-ramp Ratio at Decel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-62) where the deceleration torque is declining smoothly. A large percentage minimises torque jerks.

□ 3-7* Ramp 4

Choosing ramp parameters, see 3-4*.

3-70 Ramp 4 Type

Option:

✱Linear [0]
S-ramp [1]

Function:

Selects the desired ramp type, depending on requirements for acceleration/deceleration.

3-71 Ramp 4 Ramp-up Time

Range:

0.01 - 3600.00 s ✱s

Function:

The ramp-up time is the acceleration time from 0 RPM to the rated motor speed $n_{M,N}$ (par. 1-25). The output current cannot reach the torque limit (set in par. 4-16). The value 0.00 corresponds to 0.01 s in speed mode.

$$Par.3-71 = \frac{t_{acc} * n_{norm}\ [\,par.1-25\,]}{\triangle ref\ [RPM]}\ [sec]$$

3-72 Ramp 4 Ramp-up Time

Range:

0.01 - 3600.00 s ✱s

Function:

The ramp-down time is the deceleration time from the rated motor speed $n_{M,N}$ (par. 1-25) to 0 RPM. There can be no over-voltage in the inverter due to regenerative operation of the motor. Nor can the generated current reach the torque limit (set in par. 4-17). The value 0.00 corresponds to 0.01 s in speed mode. See ramp in par. 3-71.

$$Par.3-72 = \frac{t_{dec} * n_{norm}\ [\,par.1-25\,]}{\triangle ref\ [RPM]}\ [sec]$$

3-75 Ramp 4 S-ramp Ratio at Accel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-71) where the acceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-76 Ramp 4 S-ramp Ratio at Accel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp up time (par. 3-71) where the acceleration torque is declining smoothly. A large percentage minimises torque jerks.

3-77 Ramp 4 S-ramp Ratio at Decel. Start

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-72) where the deceleration torque is growing smoothly. A large percentage minimises torque jerks.

3-78 Ramp 4 S-ramp Ratio at Decel. End

Range:

1 - 99% ✱50%

Function:

Set the period of the total ramp down time (par. 3-72) where the deceleration torque is declining smoothly. A large percentage minimises torque jerks.

□ 3-8* Other Ramps

Parameters for configuring special ramps e.g. Jog or Quick Stop.

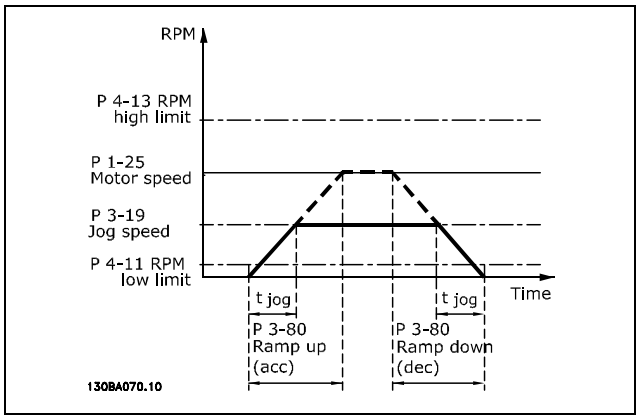
3-80 Jog Ramp Time

Range:

0.01 - 3600.00 s ✱s

Function:

The jog ramp time is the acceleration/deceleration time from 0 RPM to the rated motor frequency $n_{M,N}$ par. 1-25. The output current cannot be higher than the torque limit (set in par. 4-16). The jog ramp time starts when you activate a jog signal via the control panel, a programmed digital input, or the serial communication port.



$$Par.3-80 = \frac{t_{jog} * n_{norm}\ [par.1-25\,]}{\triangle\, jog\ \ speed\ [par.3-19]}\ [sec]$$

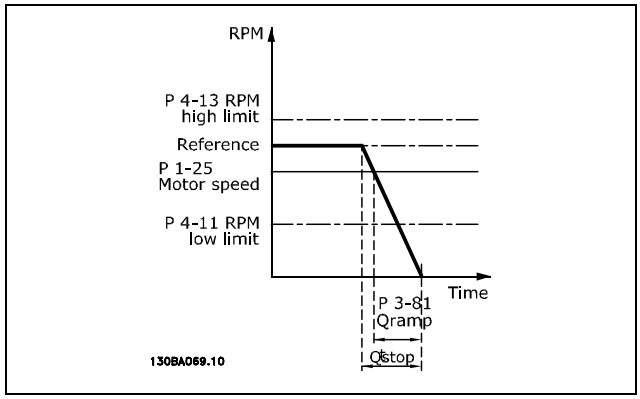
3-81 Quick Stop Ramp Time

Range:

0.01 - 3600.00 s ✱3 s

Function:

The ramp-down time is the deceleration time from the rated motor speed to 0 RPM. No over-voltage can arise in the inverter due to generating operation of the motor. Nor can the generated current be higher than the torque limit (set in par. 4-17). Quick-stop is activated by means of a signal on a programmed digital input, or via the serial communication port.



$$Par.3-81 = \frac{t_{Qstop} * n_{norm}\ [par.1-25\,]}{\triangle\, jog\ \ ref\ [RPM]}\ [sec]$$

□ 3-9* Digital Pot.Meter

This function allows the user to increase or decrease the resulting reference by activating digital inputs setup as either INCREASE, DECREASE or CLEAR. Minimum one input must be set up as INCREASE respectively DECREASE to make it active.

3-90 Step Size

Range:

0.01 - 200.00% ✱0.10%

Function:

If INCREASE / DECREASE is activated the resulting reference will be increased / decreased by the amount set in this parameter.

3-91 Ramp Time

Range:

0.001 - 3600.00 s ✱1.00 s

Function:

If INCREASE / DECREASE is activated longer than specified in par. 3-95 the resulting reference will be ramped up / down according to this ramp time. The ramp time is defined as the time to change the resulting reference from 0% to 100%.

3-92 Power Restore

Option:

✱Off	[0]
On	[1]

Function:

When set to Off [0] the Digital Potentiometer reference will be reset to 0% after power up. If set to On [1] the last Digital Potentiometer reference will be restored at power up.

3-93 Limit

Range:

-200 - 200 % ✱100 %

Function:

Set the maximum value that the Digital Potentiometer reference is allowed to attain. This is advisable if the Digital Potentiometer is only meant for fine tuning of the resulting reference.

3-94 Minimum Limit

Range:

-200 - 200 % ✱-100 %

Function:

Set the minimum value that the Digital Potentiometer reference is allowed to attain. This is advisable if the Digital Potentiometer is only meant for fine tuning of the resulting reference.

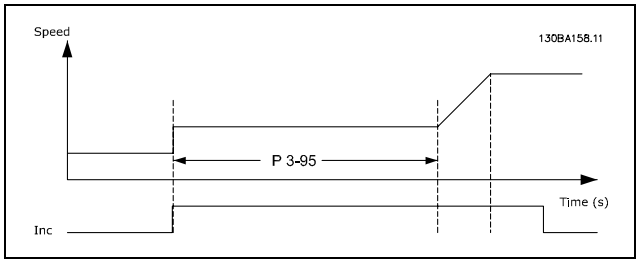
3-95 Ramp Delay

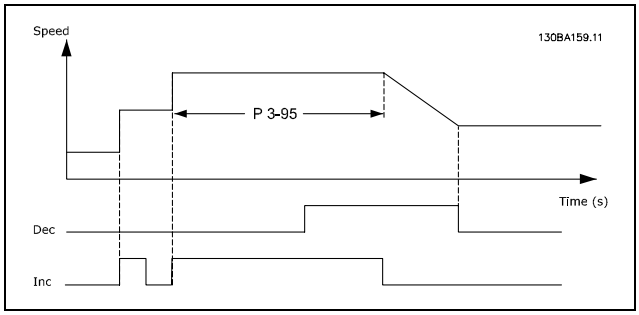
Range:

0.000 - 3600.00 s ✱1.000 s

Function:

Adjust the delay before the frequency converter starts to ramp the reference. With a delay of 0 ms, the reference starts to ramp as soon as the INCREASE / DECREASE goes high.





Parameters: Limits/Warnings

4-1* Motor Limits

Define torque, current and speed limits for the motor.

4-10 Motor Speed Direction

Option:

Clockwise	[0]
Counter clockwise	[1]
Both directions	[2]

Function:

Prevents unwanted reversing. Furthermore, the maximum output speed is selected regardless of other parameter settings. You cannot set his parameter while the motor is running.

4-11 Motor Speed Low Limit [RPM]

Range:

0 - par. 4-13 RPM ✱ 0 RPM

Function:

It is possible to choose to have the *Minimum Motor Speed Limit* correspond to the minimum motor speed. Minimum speed cannot exceed the maximum speed in par. 4-13.

4-13 Motor Speed High Limit [RPM]

Range:

Par. 4-11 - Variable Limit RPM ✱3600. RPM

Function:

You can choose to have the maximum motor speed correspond to the highest motor speed.

NB!:
The output frequency value of the frequency converter can never be a value higher than 1/10 of the switching frequency.

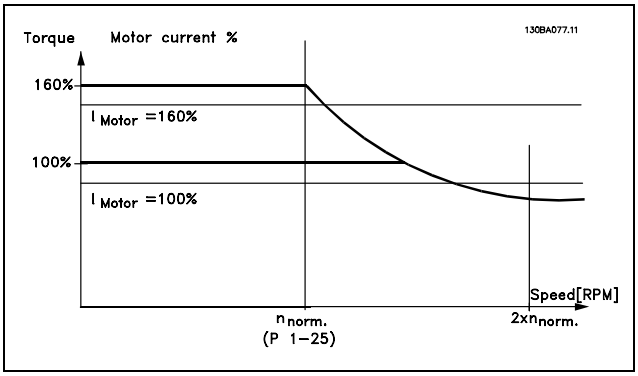
4-16 Torque Limit Motor Mode

Range:

0.0 - Variable Limit % ✱160.0 %

Function:

Sets the torque limit for motor operation. The torque limit is active in the speed range up to the rated motor speed (par. 1-25). To protect the motor from reaching the stalling torque, the default setting is 1.6 x the rated motor torque (calculated value). If a setting in par. 1-00 to par. 1-26 is changed, par. 4-16 to 4-18 are not automatically reset to the default settings.



Changing par. 4-16 *Torque Limit Motor Mode* when par. 1-00 is set to *Speed open loop* [0], par. 1-66 *Min Current at Low Speed* is automatically readjusted.

4-17 Torque Limit Generator Mode

Range:

0.0 - Variable Limit % ✱160.0 %

Function:

Sets the torque limit for generator mode operation. The torque limit is active in the speed range up to the rated motor speed (par. 1-25). See illustration for par. 4-16 as well as par. 14-25 for further details.

4-18 Current Limit

Range:

0.0 - Variable Limit % ✱160.0 %

Function:

Sets the current limit for motor operation. To protect the motor from reaching the stalling torque, the default setting is 1.6 x the rated motor torque (calculated value). If a setting in par. 1-00 to par. 1-26 is changed, par. 4-16 to par. 4-18 are not automatically reset to the default settings.

4-19 Max Output Frequency

Range:

0.0 - 1000.0 Hz ✱132.0 Hz

Function:

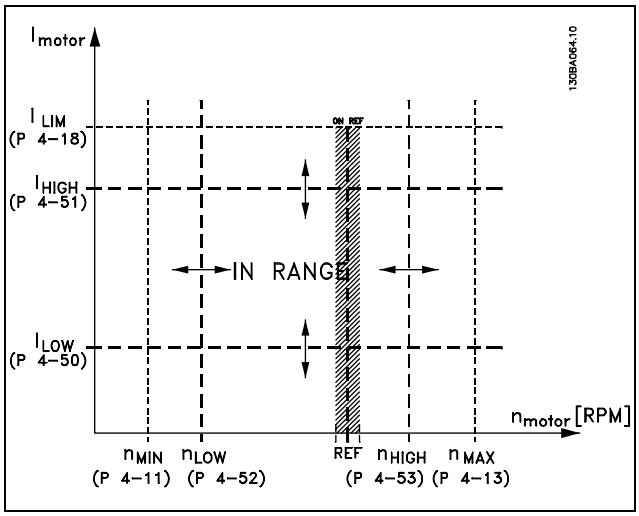
Provides a final limit on the drive output frequency for improved safety in applications where you want to avoid accidental overspeeding. This limit is final in all configurations (independent of the setting in par. 1-00).
Par. 4-19 cannot be adjusted while the motor is running.

4-5* Adj. Warnings

Adjustable warning limits for current, speed, reference and feedback.

✱ default setting ( ) display text [ ] value for use in communication via serial communication port

Warnings are shown on display, programmed output or serial bus.



4-50 Warning Current Low

Range:

0.00 - par. 4-51 A ✱0.00 A

Function:

When the motor current is below this limit, I_{LOW}, the display reads CURRENT LOW. You can programme the signal outputs to produce a status signal on terminal 27 or 29 as well as on relay output 01 or 02.

4-51 Warning Current High

Range:

Par. 4-50 - par. 16-37 A ✱par. 16-37 A

Function:

If the motor current exceeds this limit (I_{HIGH}), the display reads CURRENT HIGH. You can programme the signal outputs to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-52 Warning Speed Low

Range:

0 - par. 4-53 RPM ✱0 RPM

Function:

When the motor speed is below the limit, n_{LOW} the display reads SPEED LOW. You can programme the signal outputs to produce a status signal on terminal 27 or 29 and on relay output 01 or 02. Program the lower signal limit of the motor speed, n_{LOW}, within the normal working range of the frequency converter. See drawing.

4-53 Warning Speed High

Range:

Par. 4-52 - par. 4-13 RPM ✱ par. 4-13 RPM

Function:

When the motor speed is above the limit, n_{HIGH}, the display reads SPEED HIGH. You can programme the signal outputs to produce a status signal on terminal 27 or 29 and on relay output 01 or 02. Program the upper signal limit of the motor speed, n_{HIGH}, within the normal working range of the frequency converter.

4-54 Warning Reference Low

Range:

-999999.999 - 999999.999 ✱ -999999.999

Function:

If the actual reference is below this limit, the display indicates Ref Low. The signal outputs can be programmed to produce a status signal on the digital outputs and the relay outputs.

4-55 Warning Reference High

Range:

-999999.999 - 999999.999 ✱ 999999.999

Function:

If the actual reference exceeds this limit, the display indicates Ref High. The signal outputs can be programmed to produce a status signal on the digital outputs and the relay outputs.

4-56 Warning Feedback Low

Range:

-999999.999 - 999999.999 ✱ -999999.999

Function:

If the feedback is below this limit, the display indicates Feedb Low. The signal outputs can be programmed to produce a status signal on the digital outputs and the relay outputs.

4-57 Warning Feedback High

Range:

-999999.999 - 999999.999 ✱ 999999.999

Function:

If the feedback exceeds this limit, the display indicates Feedb High. The signal outputs can be programmed to produce a status signal on the digital outputs and the relay outputs.

4-58 Missing Motor Phase Function

Option:

Off	[0]
*On	[1]

Function:

Selects monitoring of the motor phases. If you select *On*, the frequency converter reacts on a missing motor phase and displays an alarm. If you select *Off*, no alarm is returned if a motor phase is missing. If the motor runs on only two phases, it can be damaged/overheated. Thus, do not change the missing motor phase function *On*. You cannot set this parameter while the motor is running.

□ **4-6* Speed Bypass**

Parameters for setting the Speed Bypass areas for the ramps.

4-60 Bypass Speed From [RPM]

Array [4]

Range:

0 - par. 4-13 RPM	* 0 RPM

Function:

Some systems call for avoiding certain output frequencies / speed due to resonance problems in the system. Enter the frequencies / speed you want to avoid.

4-62 Bypass Speed to [RPM]

Array [4]

Range:

0 - par. 4-13 RPM	*0 RPM

Function:

Some systems call for avoiding certain output frequencies / speed due to resonance problems in the system. Enter the frequencies / speed you want to avoid.

□ Parameters: Digital In/Out

□ 5-0* Digital I/O Mode

Parameters for configuring the IO mode. NPN/PNP and setting up IO to Input or Output.

5-00 Digital I/O Mode

Option:

✱PNP	[0]
NPN	[1]

Function:

The digital inputs and programmed digital outputs are pre-programmable for operation either in PNP or NPN systems.
PNP systems are pulled down to GND. Action is on positive going pulses (↑).
NPN systems are pulled up to + 24 V (internal in the drive). Action is on negative going pulse (↓).
You cannot set the parameter while the motor is running.

5-01 Terminal 27 Mode

Option:

✱Input	[0]
Output	[1]

Function:

Selects terminal 27 as either a digital input or output. Default setting is the Input function. You cannot set this parameter while the motor is running.

5-02 Terminal 29 Mode

Option:

✱Input	[0]
Output	[1]

Function:

Selects terminal 29 as either a digital input or output. Default setting is the Input function. You cannot set the parameter while the motor is running.

□ 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:

No operation	[0]
Reset	[1]
Coast inverse	[2]
Coast and reset inverse	[3]
Quick stop inverse	[4]
DC-brake inverse	[5]
Stop inverse	[6]
Start	[8]
Latched start	[9]
Reversing	[10]
Start reversing	[11]
Enable start forward	[12]
Enable start reverse	[13]
Jog	[14]
Preset ref bit 0	[16]
Preset ref bit 1	[17]
Preset ref bit 2	[18]
Freeze reference	[19]
Freeze output	[20]
Speed up	[21]
Speed down	[22]
Set-up select bit 0	[23]
Set-up select bit 1	[24]
Catch up	[28]
Slow down	[29]
Pulse input	[32]
Ramp bit 0	[34]
Ramp bit 1	[35]
Mains failure inverse	[36]
DigiPot Increase	[55]
DigiPot Decrease	[56]
DigiPot Clear	[57]
Reset Counter A	[62]
Reset Counter B	[65]

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

You can programme all digital inputs to these functions:

- **No operation [0]**: The frequency converter does not react on signals transmitted to the terminal.
- **Reset [1]**: Resets the frequency converter after a TRIP/ALARM. Not all alarms can be reset.
- **Coast inverse [2]** (Default Digital input 27): Coasting stop, inverted input (NC). The frequency converter leaves the motor in free mode. Logic '0' => coasting stop.
- **Coast and reset inverse [3]**: Reset and coasting stop Inverted input (NC). The frequency converter leaves the motor in free mode and resets the drive. Logic '0' => coasting stop and reset
- **Quick stop inverse [4]**: Inverted input (NC). Generates a stop in accordance with the quick-stop ramp time (par. 3-81). When the motor stops, the shaft is in free mode. Logic '0' => Quick-stop.

- **DC-brake inverse [5]**: Inverted input for DC braking (NC). Stops the motor by energizing it with a DC for a certain time period. See par. 2-01 to par. 2-03. The function is only active when the value in par. 2-02 is different from 0. Logic '0' => DC braking.
- **Stop inverse [6]**: 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 (par. 3-42, par. 3-52, par. 3-62, par. 3-72).

NB!:
When the frequency converter is at the torque limit and has received a stop command, it may not stop by it self. To ensure that the frequency converter stops configure a digital output to "Torque limit & stop [27]" and connect this digital output to a digital input that is configured as coast.

- **Start [8]** (Default Digital input 18): Select start for a start/stop command. Logic '1' = start, logic '0' = stop.
- **Latched start [9]**: The motor starts, if a pulse is applied for min. 2 ms. The motor stops if you activate Stop inverse.
- **Reversing [10]**: (Default Digital input 19). Changes 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 par. 4-10. The function is not active in Torque control, speed feedback.
- **Start reversing [11]**: Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
- **Enable start forward [12]**: Is used if the motor shaft is only to rotate clockwise at start.
- **Enable start reverse [13]**: Is used if the motor shaft is only to rotate anti-clockwise at start.
- **Jog [14]** (Default Digital input 29): Is used for shifting between external reference and preset reference. You must select External/preset [2] in par. 2-14. Logic '0* = external references active; Logic '1' = one of the four references is active according to the table below
- **Preset ref bit 0 [16]**: Preset ref. bit 0,1, and 2 enables a choice between one of the eight preset references according to the table below.
- **Preset ref bit 1 [17]**: Same as Preset ref bit 0 [16].
- **Out of feedback range [18]**: The feedback range is set in par. Xxxx

Present 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

- **Freeze ref [19]**: Freezes the actual reference. The frozen reference 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 (par. 3-51 and 3-52) in the range 0 - par. 3-03.
- **Freeze output [20]**: Freezes the actual motor frequency (Hz). The frozen motor frequency 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 (par. 3-51 and 3-52) in the range 0 - par. 1-23.

NB!:
If Freeze output is active, you cannot stop the frequency converter via a low "start [13]" signal. Stop the frequency converter via a terminal programmed for Coasting inverse [2] or Coast and reset, inverse.

- **Speed up [21]**: 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 is activated for less than 400 msec. the resulting reference will be increased by 0.1 %. If Speed up is activated for more than 400 msec. the resulting reference will ramp you according to Ramp 2 (par. 3-41).

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

- **Slow down [29]**: Same as Catch up [28].
- **Pulse input [32]**: Select Pulse input if you use a pulse sequence as either reference or feedback. Scaling is done in par. group 5-5*.
- **Ramp bit 0 [34]**

- **Ramp bit 1 [35]**
- **Mains failure inverse [36]**: Is selected to activate par. 14-10 *Mains Failure*. Mains failure inverse is active in the Logic '0' situation.
- **DigiPot Increase [55]**: Uses the input as an INCREASE signal to the Digital Potientiometer function described in parameter group 3-9*
- **DigiPot Decrease [56]**: Uses the input as a DECREASE signal to the Digital Potentiometer function described in parameter group 3-9*
- **DigiPot Clear [57]**: Uses the input to CLEAR the Digital Potentiometer reference described in parameter group 3-9*
- **Counter A [60]**: (Terminal 29 only) Input for increment counting in the SLC counter.
- **Counter A [61]**: (Terminal 29 only) Input for decrement counting in the SLC counter.
- **Reset Counter A [62]**: Input for reset of counter A.
- **Counter B [63]**: (Terminal 29 only) Input for increment counting in the SLC counter.
- **Counter B [64]**: (Terminal 29 only) Input for decrement counting in the SLC counter.
- **Reset Counter B [65]**: Input for reset of counter B.

- **Speed down [22]**: Same as Speed up [21].
- **Set-up select bit 0 [23]** : Selection of Set-up, bit 0 and bit 1 allows you to choose between one of the four set-ups. You must set par. 0-10 to Multi Set-up.
- **Set-up select bit 1 [24]** (Default Digital input 32): Same as Set-up select bit 0 [23].
- **Catch up [28]**: Select Catch up/Slow down to increase or reduce the reference value (set in par. 3-12).

5-10 Terminal 18 Digital Input

✱Start [8]

Function:

5-11 Terminal 19 Digital Input

✱Reversing [10]

5-12 Terminal 27 Digital Input

✱Coast inverse [2]

5-13 Terminal 29 Digital Input

Option:

✱Jog	[14]
Counter A (up)	[60]
Counter A (down)	[61]
Counter B (up)	[63]
Counter B (down)	[64]

Function:

Options [60], [61], [63] and [64] are additional functions. Counter function is used in Smart Logic Control functions.

5-14 Terminal 32 Digital Input

✱No operation [0]

5-15 Terminal 33 Digital Input

✱No operation [0]

□ **5-3* Digital Outputs**

The 2 solid-state digital outputs are common for terminals 27 and 29. Set the I/O function for terminal 27 in par. 5-01, and set the I/O function for terminal 29 in par. 5-02.
These parameters cannot be set while running.

No operation	[0]
Control ready	[1]
Drive ready	[2]
Drive ready / remote control	[3]
Enable / no warning	[4]
VLT running	[5]
Running / no warning	[6]
Run in range / no warning	[7]
Run on reference / no warning	[8]
Alarm	[9]
Alarm or warning	[10]
At torque limit	[11]
Out of current range	[12]
Below current, low	[13]
Above current, high	[14]
Out of range	[15]
Below speed, low	[16]
Above speed, high	[17]
Thermal warning	[21]
Ready, no thermal warning	[22]
Remote, ready, no thermal warning	[23]
Ready, no over-/ under voltage	[24]
Reverse	[25]
Bus OK	[26]
Torque limit and stop	[27]
Brake, no brake warning	[28]
Brake ready, no fault	[29]
Brake fault (IGBT)	[30]
Relay 123	[31]
Mechanical brake control	[32]
Safe stop activated	[33]
MCO controlled	[51]
Comparator 0	[60]
Comparator 1	[61]
Comparator 2	[62]
Comparator 3	[63]
Logic Rule 0	[70]
Logic Rule 1	[71]

✱ default setting **( )** display text **[ ]** value for use in communication via serial communication port

Logic Rule 2	[72]
Logic Rule 3	[73]
SL Digital Output A	[80]
SL Digital Output B	[81]
SL Digital Output C	[82]
SL Digital Output D	[83]
SL Digital Output E	[84]
SL Digital Output F	[85]
Local reference active	[120]
Remote reference active	[121]
No alarm	[122]
Start command active	[123]
Running reverse	[124]
Drive in hand mode	[125]
Drive in auto mode	[126]

You can programme the digital outputs to these functions:

- **No operation [0]**: *Default for all digital outputs and relay outputs*
- **Control ready [1]**: The control board receives supply voltage.
- **Drive ready [2]**: The frequency converter is ready for operation and applies a supply signal on the control board.
- **Drive ready / remote control [3]**: The frequency converter is ready for operation and is in Auto On mode.
- **Enable / no warning [4]**: The frequency converter is ready for use. No start or stop command is been given (start/disable). There are no warnings.
- **VLT running [5]**: The motor is running.
- **Running / no warning [6]**: The output speed is higher than the speed set in par. 1-81.The motor is running and there are no warnings.
- **Run in range / no warning [7]**: Runs within the programmed current/speed ranges set in par. 4-50 to par. 4-53.
- **Run on reference / no warning [8]**: Mechanical speed according to reference.
- **Alarm [9]**: An alarm activates the output.
- **Alarm or warning [10]**: An alarm or a warning activates the output.
- **At torque limit [11]**: The torque limit set in par. 4-16 or par. 1-17 is exceeded.
- **Out of current range [12]**: The motor current is outside the range set in par. 4-18.
- **Below current, low [13]**: The motor current is lower than set in par. 4-50.
- **Above current, high [14]**: The motor current is higher than set in par. 4-51.
- **Out of range [15]**
- **Below speed, low[16]**: The output speed is lower than set in par. 4-52.
- **Above speed, high [17]**: The output speed is higher set in par. 4-53.
- **Thermal warning [21]**: Thermal warning is on when the temperature is above limit in the motor, the frequency converter, the brake resistor, or the thermistor.
- **Ready, no thermal warning [22]**: The frequency converter is ready for operation and there is no over-temperature warning.
- **Remote, ready, no thermal warning [23]**: The frequency converter is ready for operation and is in Auto On mode. There is no over-temperature warning.
- **Ready, no over-/ under voltage [24]**: The frequency converter is ready for operation and the mains voltage is within the specified voltage range (see section *General Specifications*).
- **Reverse [25]**: *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.
- **Bus OK [26]**: Active communication (no time-out) via the serial communication port.
- **Torque limit & stop [27]**: Is used when 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'.
- **Brake, no brake warning [28]**: The brake is active and there are no warnings.
- **Brake ready, no fault [29]**: The brake is ready for operation and there are no faults.
- **Brake fault (IGBT) [30]**: 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.
- **Relay 123 [31]**: If Fieldbus profile [0] is selected in par. 5-12, the relay is activate. If OFF1, OFF2 or OFF3 (bit in the control word) is Logic '1'.
- **Mechanical brake control [32]**: Enables control of an external mechanical brake, see description in the section *Control of Mechanical Brake*, and par. group 2-2*
- **Safe stop activated [33]**: Indicates that the safe stop on terminal 37 has been activated.
- **MCO Controlled [51]**
- **Comparator 0 [60]**: See par. group 13-1*. If Comparator 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.

- **Comparator 1 [61]**: See par. group 13-1*. If Comparator 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
- **Comparator 2 [62]**: See par. group 13-1*. If Comparator 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
- **Comparator 3 [63]**: See par. group 13-1*. If Comparator 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
- **Logic Rule 0 [70]**: See par. group 13-4*. If Logic Rule 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
- **Logic Rule 1 [71]**: See par. group 13-4*. If Logic Rule 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
- **Logic Rule 2 [72]**: See par. group 13-4*. If Logic Rule 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
- **Logic Rule 3 [73]**: See par. group 13-4*. If Logic Rule 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
- **SL Digital Output A [80]**: See par. 13-52 *SL Control 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.
- **SL Digital Output B [81]**: See par. 13-52 *SL Control 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.
- **SL Digital Output C [82]**: See par. 13-52 *SL Control 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.
- **SL Digital Output D [83]**: See par. 13-52 *SL Control 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.
- **SL Digital Output E [84]**: See par. 13-52 *SL Control 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.
- **SL Digital Output F [85]**: See par. 13-52 *SL Control 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.
- **Local reference active [120]**: The output will be high if par. 3-13 *Reference Site* = [2] "Local" or when par. 3-13 *Reference Site* = [0] "Linked to hand auto" at the same time the LCP is in Hand on mode.
- **Remote reference active [121]**: The output will be high if par. 3-13 *Reference Site* = [1] "Remote" or when par. 3-13 *Reference Site* = [0] Linked to hand auto at the same time the LCP is in Auto on mode.
- **No alarm [122]**: The output goes high when no alarm is present.
- **Start command active [123]**: The output goes high whenever 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.
- **Running reverse [124]**: The output is high whenever the drive is running counter clockwise (the logical product of the status bits "running" AND "reverse").
- **Drive in hand mode [125]**: The output goes high whenever the drive is in Hand on mode (as indicated by the LED light above [Hand on].
- **Drive in auto mode [126]**: The output goes high whenever the drive is in Hand on mode (as indicated by the LED light above [Auto on].

5-30 Terminal 27 Digital Output

✱ No operation	[0]

5-31 Terminal 29 Digital Output

✱ No operation	[0]

□ **5-4* Relays**

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

5-40 Function Relay

Array [8]	(Relay 1 [0], Relay 2 [1])
Control word bit 11	[36]
Control word bit 12	[37]

Par. 5-40 holds the same options as par. 5-30 including option 36 and 37.

Function:

- **Control word bit 11 [36]**: Bit 11 in the control word controls relay 01. See section

Control Word According to FC Profile (CTW). This option only applies for par. 5-40.

- **Control word bit 12 [37]**: Bit 12 in the control word controls relay 02. See section *Control Word According to FC Profile (CTW)*.

Selecting between 2 internal mechanical relays is an array function.

Ex. par. 5-4* → 'OK' → Function Relay → 'OK' → [0] → 'OK' → *select function*

Relay no. 1 has array no [0]. Relay no. 2 has array no [1].
When relay option MCB 105 is fitted in the drive following selection of relays take place:
Relay 7 -> Par. 5-40 [6]
Relay 8 -> Par. 5-40 [7]
Relay 9 -> Par. 5-40 [8]
Relay functions are selected from the same list as for solid state output functions. See par. 5-3*.

5-41 On Delay, Relay

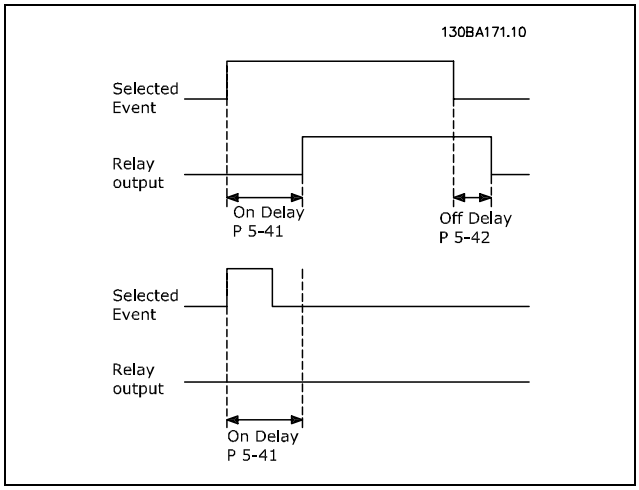
Array [8]	(Relay 1 [0], Relay 2 [1], Relay 7 [6], Relay 8 [7], Relay 9 [8])

Range:

0.01 - 600.00 s	✱0.01 s

Function:

Allows a delay of the cut-in time of the relays. Select between 2 internal mechanical relays and MCO 105 in an array function. See par. 5-40.



5-42 Off Delay, Relay

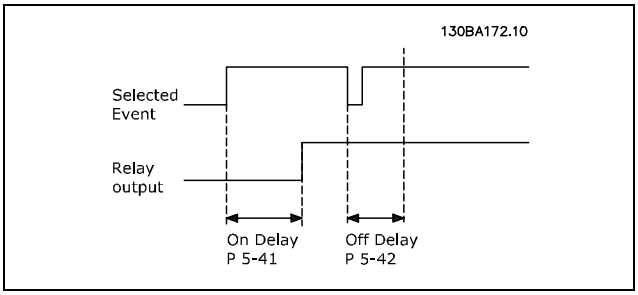
Array [8]	(Relay 1 [0], Relay 2 [1], Relay 7 [6], Relay 8 [7], Relay 9 [8])

Range:

0.01 - 600.00 s.	✱0.01 s

Function:

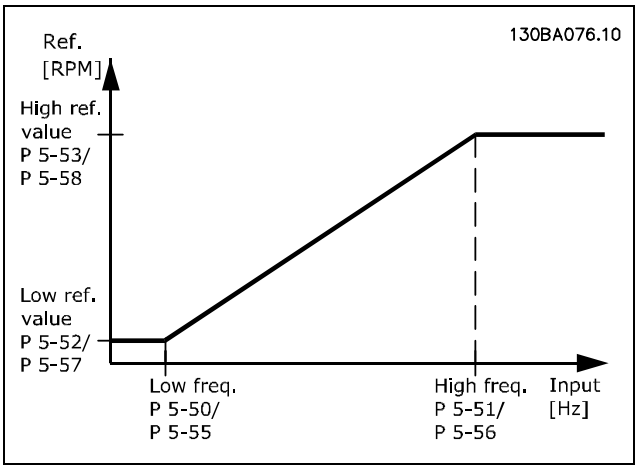
Enables a delay of the relay cut-out time. Select between 2 internal mechanical relays and MCO 105 in an array function. See par. 5-40.



If the Selected Event condition changes before the on- or off delay timer expires, the relay output is not effected.

□ 5-5* Pulse Input

The pulse input parameters are used to select an appropriate window for impulse reference area. Input terminals 29 or 33 are acting as frequency reference inputs. Set par. 5-13 or par 5-15 to 'Pulse input' [32]. If terminal 29 is used as input, par. 5-01 must be selected to 'Input' [0].



5-50 Terminal 29 Low Frequency

Range:

100 - 110000 Hz ✱100 Hz

Function:

Sets the low frequency referring to low reference value in par. 5-52 to correspond to the motor shaft speed.

5-51 Terminal 29 High Frequency

Range:

100 - 110000 Hz ✱100 Hz

Function:

Set the high frequency referring to high reference value in par. 5-53 to correspond to the motor shaft speed.

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

Range:

-1000000.000 - par. 5-53 ✱ 0.000

Function:

Sets the lowest reference value [RPM] for the motor shaft speed and the lowest feedback value. Select terminal 29 as a digital output (par. 5-02 ='Output' [1] and par. 5-13 = applicable value).

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

Range:

Par. 5-52 - 1000000.000 ✱1500.000

Function:

Sets the highest reference value [RPM] for the motor shaft speed and the highest feedback value. Select terminal 29 as a digital output (par. 5-02 ='Output' [1] and par. 5-13 = applicable value)

5-54 Pulse Filter Time Constant #29

Range:

1 - 1000 ms ✱100 ms

Function:

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 on the system. You cannot set this parameter while the motor is running.

5-55 Term. 33 Low Frequency

Range:

100 - 110000 Hz ✱100 Hz

Function:

Sets the low frequency referring to low reference value in par. 5-57 to correspond to the motor shaft speed.

5-56 Term. 33 High Frequency

Range:

100 - 110000 Hz ✱100 Hz

Function:

Sets the high frequency referring to high reference value in par. 5-58 to correspond to the motor shaft speed.

5-57 Term. 33 Low Ref./Feedb. Value

Range:

-100000.000 – par. 5-58) ✱0.000

Function:

Sets the lowest reference value [RPM] for the motor shaft speed.

5-58 Term. 33 High Ref./Feedb. Value

Range:

Par. 5-57 - 100000.000 ✱1500.000

Function:

Sets the highest reference value [RPM] for the motor shaft speed.

5-59 Pulse Filter Time Constant #33

Range:

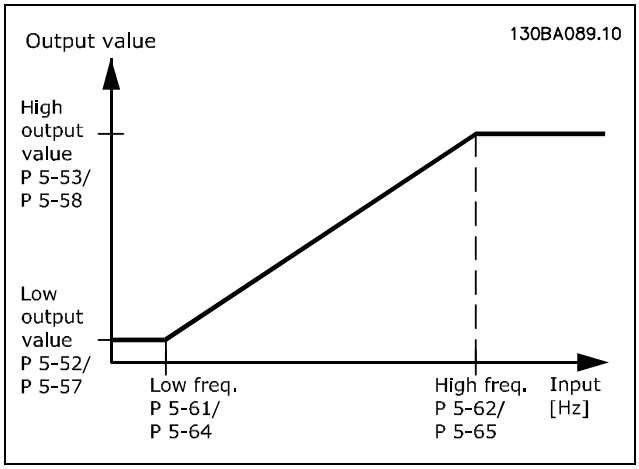
1 - 1000 ms ✱ 100 ms

Function:

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 on the system. You cannot set this parameter while the motor is running.

□ **5-6* Pulse Outputs**

The pulse outputs are designated to terminals 27 or 29. Select terminal 27 in par. 5-01 and terminal 29 in par. 5-02.



5-60 Terminal 27 Pulse Output Variable

Option:

*No operation	[0]
MCO controlled	[51]
Output frequency	[100]
Reference	[101]
Feedback	[102]
Motor current	[103]
Torque relative to limit	[104]
Torque relativ to rated	[105]
Power	[106]
Speed	[107]
Torque	[108]

Function:

Selects the variable for the chosen read-out on terminal 27. You cannot set the parameter while the motor is running.

5-62 Pulse Output Maximum Frequency #27

Range:

0 - 32000 Hz *5000 Hz

Function:

Sets the maximum frequency on terminal 27 referring to output variable in par. 5-60. You cannot set the parameter while the motor is running.

5-63 Terminal 29 Pulse Output Variable

Option:

*No operation	[0]
MCO controlled	[51]
Output frequency	[100]
Reference	[101]
Feedback	[102]
Motor current	[103]
Torque relative to limit	[104]
Torque relativ to rated	[105]
Power	[106]
Speed	[107]
Torque	[108]

Function:

Selects the variable for the chosen read-out on terminal 29. You cannot set the parameter while the motor is running.

5-65 Pulse Output Maximum Frequency #29

Range:

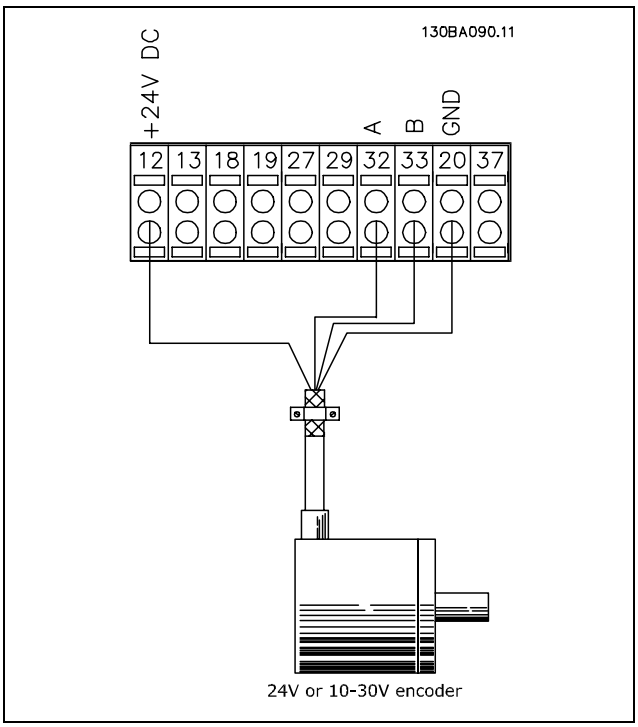
0 - 32000 Hz *5000 Hz

Function:

Sets the maximum frequency on terminal 29 referring to output variable in par. 5-63. You cannot set the parameter while the motor is running.

□ 5-7* 24 V Encoder Input

Connect a 24 V encoder to terminal 12 (24 V DC supply), terminal 32 (Channel A), terminal 33 (Channel B), and terminal 20 (GND). The digital inputs 32/33 are active for encoder inputs when 24V encoder (par. 1-02) or 24 V encoder (par. 7-00) is selected The encoder used is a dual channel (A and B) 24 V type.
Max input frequency: 110 kHz.



5-70 Term 32/33 Pulses per Revolution

Range:

128 - 4096 PPR *1024 PPR

* default setting ( ) display text [ ] value for use in communication via serial communication port

Function:

Sets the encoder pulses per revolution on the motor shaft. Read the correct value from the encoder. You cannot set the parameter while the motor is running.

5-71 Term 32/33 Encoder Direction

Option:

*Clockwise	[0]
Counter clockwise	[1]

Function:

Changes the detected encoder direction (revolution) without changing the wires to the encoder. Select Clockwise when A channel is 90° (electrical degrees) before channel B by clockwise rotation of the encoder shaft. Select Counter clockwise when A channel is 90° (electrical degrees) after channel B by clockwise rotation of the encoder shaft. You cannot set the parameter while the motor is running.

5-72 Term 32/33 Gear Numerator

Range:

1.0 - 60000 N/A	*1 N/A

Function:

Sets the nominator value for a gear ratio between encoder and driving shaft. The nominator is related to the encoder shaft and the denominator is related to the driving shaft.
Example: Speed on the encoder shaft = 1000 RPM and speed on the driving shaft is 3000 RPM:
Par. 5-72 = 1000 and par. 5-73 = 3000, or par. 5-72 = 1 and par. 5-73 = 3.
Par 5-72 cannot be adjusted while the motor is running.
If the motor control principle is 'Flux w encoder feedback' (par. 1-01 [3]), the gear ratio between motor and encoder must be 1:1. (No gear).

5-73 Term 32/33 Gear Denominator

Range:

1.0 - 60000 N/A	*1 N/A

Function:

Sets the denominator value for a gear ratio between encoder and driving shaft. The denominator is related to the driving shaft. See also par. 5-72.
Par. 5-73 cannot be adjusted while the motor is running.

□ Parameters: Analog In/Out

□ 6-0* Analog I/O Mode

FC 300 is equipped with 2 analog inputs: Terminal 53 and 54. The analog inputs on FC 302 are designed to free selection for either voltage (–10V - +10V) or current input (0/4 – 20 mA).

NB!:
Thermistors are connected either to an analog or a digital input.

6-00 Live Zero Timeout Time

Range:

1 - 99 s ✱ 10 s

Function:

Is active when A53 (SW201) and /or A54 (SW202) is/are in the position ON (the analog inputs are selected to current inputs). If the reference signal value connected to the selected current input falls below 50% of the value set in par. 6-12 or par. 6-22 for a period longer than the time set in par. 6-00, the function selected in par. 6-01 is activated.

6-01 Live Zero Timeout Function

Option:

✱Off	[0]
Freeze Output	[1]
Stop	[2]
Jogging	[3]
Max. speed	[4]
Stop and trip	[5]

Function:

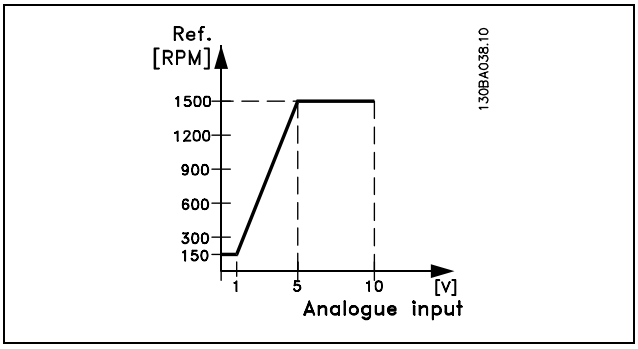
The function set in par. 6-01 will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10, par. 6-12, par. 6-20 or par. 6-22 for a time period defined in par. 6-00. If more time-outs occur at the same time, the frequency converter makes the following priority of the time-out function:

1. *Live Zero Time-out Function* par. 6-01
2. *Encoder Loss Function* par. 5-74
3. *Control-word Time-out Function* par. 8-04.
   The output frequency of the frequency converter can be:

- frozen at the present value
- overruled to jog speed
- overruled to max. speed
- overruled to stop with subsequent trip
- Par. 6-01 cannot be adjusted while the motor is running.

□ 6-1* Analog Input 1

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



6-10 Terminal 53 Low Voltage

Range:

-10.0 - par. 6-11 ✱ 0.07 V

Function:

Sets the analog input scaling value to correspond to the minimum reference value (set in par. 3-02).

6-11 Terminal 53 High Voltage

Range:

Par. 6-10 to 10.0 V ✱ 10.0 V

Function:

Sets the analog input scaling value to correspond to the maximum reference value (set in par. 3-03).

6-12 Terminal 53 Low Current

Range:

0.0 to par. 6-13 mA ✱0.14 mA

Function:

Determines the value of the reference signal to correspond to the minimum reference value (set in par. 3-02). If the Time-out function of par. 6-01 is activated, the value must be set at >2 mA.

6-13 Terminal 53 High Current

Range:

Par. 6-12 to - 20.0 mA ✱ 20.0 mA

Function:

Sets the value of the reference signal to correspond to the maximum reference value (set in par. 3-03).

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

Range:

-1000000.000 to par. 6-15 ✱ 0.000 Unit

Function:
Sets the analog input scaling to correspond to the minimum reference feedback value (set in par. 3-02).

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

Range:
Par. 6-14 to 1000000.000 * 1500.000 Unit

Function:
Sets the analog input scaling value to correspond to the maximum reference feedback value (set in par. 3-03).

6-16 Terminal 53 Filter Time Constant

Range:
0.001 - 10.000 s *0.001 s

Function:
A 1st order digital low pass filter time constant for suppressing electrical noise on terminal 53. You cannot set the parameter while the motor is running.

□ **6-2* Analog Input 2**
Parameters for configuring the scaling and limits for analog input 2 (terminal 54).

6-20 Terminal 54 Low Voltage

Range:
-10.0 – par. 6-21 *0.07 V

Function:
Sets the analog input scaling value to correspond to the minimum reference value (set in par. 3-02). See also section *Reference Handling*.

6-21 Terminal 54 High Voltage

Range:
Par. 6-20 to 10.0 V *10.0 V

Function:
Sets the analog input scaling value to correspond to the maximum reference value (set in par. 3-03).

6-22 Terminal 54 Low Current

Range:
0.0 to par. 6-23 mA *0.14 mA

Function:
Determines the value of the reference signal to correspond to the minimum reference value (set in par. 3-02). If the Time-out function of par. 6-01 is activated, set the value at >2 mA.

6-23 Terminal 54 High Current

Range:
Par. 6-22 to - 20.0 mA *20.0 mA

Function:
Sets the value of the reference signal to correspond to the maximum reference value (set in par. 3-03).

6-24 Terminal 54 Low Ref./Feedb. Value

Range:
-1000000.000 to par. 6-25 * 0.000 Unit

Function:
Sets the analog input scaling value to correspond to the minimum reference feedback value (set in par. 3-02).

6-25 Terminal 54 high ref./feedb. value

Range:
Par. 6-24 to 1000000.000 *1500.000 Unit

Function:
Sets the analog input scaling value to correspond to the maximum reference feedback value (set in par. 3-03).

6-26 Terminal 54 Filter Time Constant

Range:
0.001 - 10.000 s * 0.001 s

Function:
A 1st order digital low pass filter time constant for suppressing electrical noise on terminal 53. You cannot set the parameter while the motor is running.

□ **6-5* Analog Output 1**
Analog outputs are current outputs: 0/4 - 20 mA. Common terminal (terminal 39) is the same terminal and electrical potential for analog common and digital common connection. Resolution on analog output is 12 bit.

6-50 Terminal 42 Output

Option:

No operation	[0]
MCO controlled	[51]
Output frequency (0 – 1000 Hz), 0…20 mA	[100]
Output frequency (0 – 1000 Hz), 4…20 mA	
Reference (Ref min-max), 0…20 mA	[101]

* default setting ( ) display text [ ] value for use in communication via serial communication port

Reference (Ref min-max), 4…20 mA
Feedback (FB min-max), 0…20 mA [102]
Feedback (FB min-max), 4…20 mA
Motor current (0-Imax), 0…20 mA [103]
Motor current (0-Imax), 4…20 mA
Torque relative to limit 0-Tlim, 0…20 mA [104]
Torque relative to limit 0-Tlim, 4…20 mA
Torque relative to rated 0-Tnom, 0…20 mA [105]
Torque relative to rated 0-Tnom, 4…20 mA
Power (0-Pnom), 0…20 mA [106]
Power (0-Pnom), 4…20 mA
Speed (0-Speedmax), 0…20 mA [107]
Speed (0-Speedmax), 4…20 mA
Torque (+/-160% torque), 0-20 mA [108]
Torque (+/-160% torque), 4-20 mA
Output freq. 4-20mA [130]
Reference 4-20mA [131]
Feedback 4-20mA [132]
Motor cur. 4-20mA [133]
Torque % lim. 4-20mA [134]
Torque % nom 4-20mA [135]
Power 4-20mA [136]
Speed 4-20mA [137]
Torque 4-20mA [138]

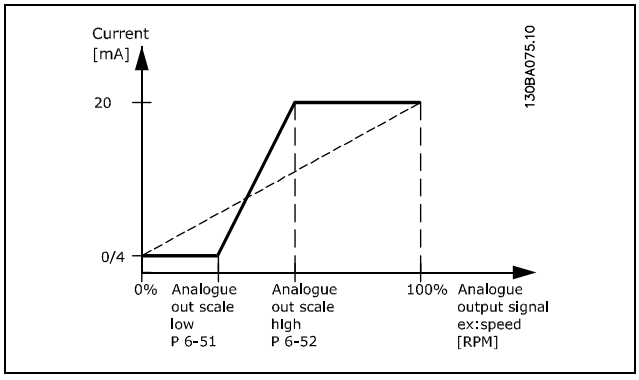
6-51 Terminal 42 Output Min Scale

Range:

0.00 – 200% *0%

Function:

Scales the minimum output of the selected analog signal on terminal 42. Scale the minimum value as a percentage of the maximum signal value, i.e. 0mA (or 0 Hz) is desired at 25% of the maximum output value, and 25% is programmed. The value can never be higher than the corresponding setting in par. 6-52 if value is below 100%.



6-52 Terminal 42 Output Max Scale

Range:

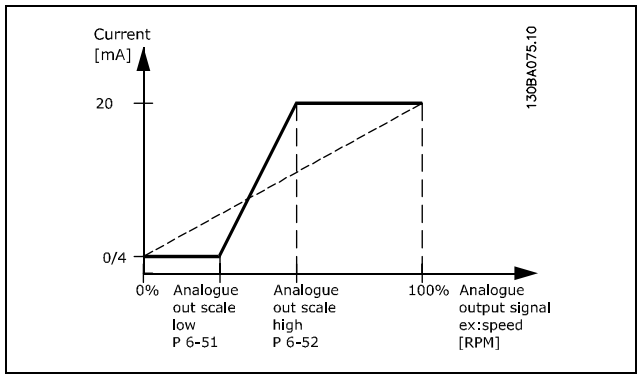
000 – 200% *100%

Function:

Scales the maximum output of the selected analog signal on terminal 42. Set the value to the desired maximum value of the current signal output. Scale the output to give a lower current 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, program 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:

$$20\,mA/desired\,maximum\,current\,*\,100\%$$

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



□ Parameters: Controllers

□ 7-0* Speed PID Ctrl.

7-00 Speed PID Feedback Source

Option:

✱Motor feedb. p.1-02	[0]
24V encoder	[1]
MCB 102	[2]

Function:

Selection of encoder for closed loop feedback. Par. 7-00 cannot be adjusted while the motor is running.

7-02 Speed PID Proportional Gain

Range:

0.000 - 1.000 ✱ 0.015

Function:

Indicates how many times to amplify the error (deviation between the feedback signal and the set-point). It is used with *Speed closed loop*, and *Speed open loop* (par. 1-00). Quick control is obtained at high amplification. If the amplification is too high, the process may become unstable.

7-03 Speed PID Integral Time

Range:

2.0 - 20000.0 ms ✱8.0 ms

Function:

Determines how long the internal PID control takes to correct the error. The greater the error, the quicker the gain increases. The integral time causes a delay of the signal and therefore a dampening effect. It is used together with *Speed closed loop* and *Speed open loop* (par. 1-00).
Obtain quick control through a short integral time. However, if this time is too short, the process becomes unstable. If the integral time is long, major deviations from the required reference may occur, since the process regulator takes long to regulate if an error has occurred.

7-04 Speed PID Differentiation Time

Range:

0.0 - 200.0 ms ✱30.0 ms

Function:

The differentiator does not react to a constant error. It only provides a gain if the error changes. The quicker the error changes, the stronger the gain from the differentiator. The gain is proportional with the speed at which errors change. It is used together with *Speed closed loop* (par. 1-00).

7-05 Speed PID Diff Gain Limit

Range:

1.000 - 20.000 ✱5.000

Function:

It is possible to set a limit for the gain provided by the differentiator. Since the D-gain increases at higher frequencies, limiting the gain may be useful. Thus you can obtain a pure D-link at low frequencies and a constant D-link at higher frequencies. It is used with *Speed Control, Closed Loop* (par. 1-00).

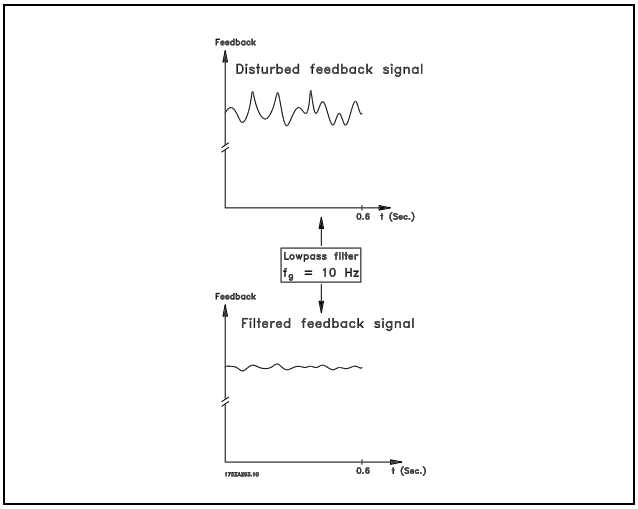
7-06 Speed PID Lowpass Filter Time

Range:

1.0 - 100.0 ms ✱ 10.0 ms

Function:

The low-pass filter reduces the influence on control and dampens oscillations on the feedback signal. This is an advantage, e.g. if there is a great amount on noise on the system. See illustration.
It is used with *Speed control, closed loop* and *Torque control, speed feedback* (par. 1-00). If a time constant (τ) e.g. of 100 ms is programmed, the cut-off frequency for the low-pass filter will be 1/0.1= 10 RAD/sec., corresponding to (10/2 x p) = 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.



□ 7-2* Process Ctrl. Feedb.

Select which resources should be used for feedback to the Process PID Control and how his feedback should be handled.

7-20 Process CL Feedback 1 Resource

Option:

*No function	[0]
Analog input 53	[1]
Analog input 54	[2]
Frequency input 29	[3]
Frequency input 33	[4]

Function:

It is possible to add up to two different feedback signals to compose the actual feedback. This parameter defines which input on the frequency converter should be treated as the source of the first feedback signal.

7-22 Process CL Feedback 2 Resource

Option:

*No function	[0]
Analog input 53	[1]
Analog input 54	[2]
Frequency input 29	[3]
Frequency input 33	[4]

Function:

It is possible to add up to two different feedback signals to compose the actual feedback. This parameter defines which input on the frequency converter should be treated as the source of the first feedback signal.

□ 7-3* Process PID Ctrl.

Parameters for configuring the Process PID control.

7-30 Process PID Normal/Inverse Control

Option:

*Normal	[0]
Inverse	[1]

Function:

It is possible to choose whether the process control is to increase/reduce the output frequency. This is done by having a difference between the reference signal and the feedback signal.

7-31 Process PID Anti Windup

Option:

*Off	[0]
On	[1]

Function:

It is possible to select whether the process control is to continue regulating on an error even if it is not possible to increase/reduce the output frequency.

7-32 Process PID Start Speed

Range:

0 - 6000 RPM	*0 RPM

Function:

When the start signal is given the frequency converter will react with a *Speed control, open loop* following the ramp. Only when the programmed start speed has been obtained it will change to *Process control*.

7-33 Process PID Proportional Gain

Range:

0.00 - 10.00 N/A	*0.01 N/A

Function:

The proportional gain indicates the number of times the error between the set point and the feedback signal is to be applied.

7-34 Process PID Integral Time

Range:

0.01 - 10000.00	*10000.00 s

Function:

The integrator provides an increasing gain at a constant error between the set point and the feedback signal. The integral time needed by the integrator to reach the same gain as the proportional gain.

7-35 Process PID Differentiation Time

Range:

0.00 - 10.00 s	*0.00 s

Function:

The differentiator does not react to a constant error. It only provides a gain when the error changes. The quicker the error changes, the stronger the gain from the differentiator.

7-36 Process PID Diff. Gain Limit

Range:

1.0 - 50.0 N/A	*5.0 N/A

Function:

Set a limit for the differentiator gain (DG). The DG will increase if there are fast changes. Limit the DG to obtain a pure differentiator gain

at slow changes and a constant differentiator gain where quick changes occur.

7-38 Process PID Feed Forward Factor

Range:

0 - 500% *0%

Function:

The FF factor sends a large or small part of the reference signal around the PID control. In that way the PID control only affects part of the control signal.

7-39 On Reference Bandwidth

Range:

0 - 200% *5%

Function:

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 (1).

Parameters: Communications and Options

8-0* General Settings

8-01 Control Site

Option:

*Digital and ctrl. word	[0]
Digital only	[1]
Control word only	[2]

Function:

Specifies the control as either *Digital* inputs, *Control* word, or both. This parameter overrules the settings in par. 8-50 to 8-56.

8-02 Control Word Source

Option:

None	[0]
FC RS485	[1]
FC USB	[2]
Option A	[3]
Option B	[4]
Option C0	[5]
Option C1	[6]

Function:

Specifies the source of the control word, serial interface, or installed option. During initial power-up, the frequency converter automatically sets this parameter to *Option A* if it detects a valid bus option installed in this slot. If the option is removed, the frequency converter detects a change in the configuration and sets par. 8-02 back to default setting *FC RS485*. The frequency converter trips. If an option is installed after initial power-up, the setting of par. 8-02 does not changed but the drive will be tripped and display: Alarm 67 *Option Changed*.
Par. 8-02 cannot be changed while the motor is running.

8-03 Control Word Time-out Time

Range:

0.1 - 18000.0 s	*1.0 s

Function:

Sets 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 par. 8-04 will then be carried out.

8-04 Control Word Time-out Function

Option:

*Off	[0]
Freeze Output	[1]
Stop	[2]
Jogging	[3]
Max. Speed	[4]
Stop and trip	[5]
Select set-up 1	[7]
Select set-up 2	[8]
Select set-up 3	[9]
Select set-up 4	[10]

Function:

A valid control word triggers the time-out counter. Acyclic DP V1 does not trigger the time-out counter. The *time-out* function is activated if the control word is not updated within the time specified in par. 8-03 *Control Word Time-out Time*.

- *Off:* Control via serial bus (Fieldbus or standard) is resumes and uses the most recent control word.
- *Freeze output frequency:* Freeze output frequency until communication resumes.
- *Stop with auto restart:* Stop with auto restart when communication resumes.
- *Output frequency = JOG freq.:* The motor runs at JOG frequency until communication resumes.
- *Output frequency = Max. freq..* The motor runs at maximum frequency until communication resumes.
- *Stop with trip:* The motor stops. You need to reset the frequency converter, see explanation above.

Select set-up x:
This type of time-out function is used for changing set-up on a control word time-out. If communcation resumes causing the time-out situation to disappear, par. 8-05 *End-of-time-out Function* defines whether to resume the set-up used before the time-out or to hold the set-up endorsed by the time-out function.

Note that the following parameters have to be configured for the set-up change to occur on a time-out. Par. 0-10 *Active set-up* has to be set to *Multi set-up* along with the relevant linking set in par. 0-12 *This Set-up Linked To*.

8-05 End-of-time-out Function

Option:

*Hold set-up	[0]
Resume set-up	[1]

Function:

Defines the action after receiving a valid control word upon a time-out. This only applies if set-up 1-4 is been selected in par. 8-04.
Hold: The drive holds the set-up selected in par. 8-04 and displays a warning, until par. 8-06 toggles. Then the drive resumes its original set-up.
Resume: The drive resumes to the original set-up.

8-06 Reset Control Word Time-out

Option:

✱Do not reset	[0]
Do reset	[1]

Function:

Used for returning the drive to the original set-up after a Control word time-out. When setting the value to *"Do Reset"* [1], it returns to *"Do not reset"* [0].

8-07 Diagnosis Trigger

Option:

✱Disable	[0]
Trigger on alarms	[1]
Trigger alarms/warn.	[2]

Function:

Enables and controls the drive diagnosis function and permits expansion of the diagnosis data to 24 byte.

- *Disable:* Extended diagnosis data are not sent even if they appear in the frequency converter.
- *Trigger on alarms:* Extended diagnosis data are sent when one or more alarms appear in alarm par. 16-04 or 9-53.
- *Trigger alarms/warn:* Extended diagnosis data are sent if one or more alarms/warnings appear in alarm par. 16-04, 9-53, or warning par. 16-05.

The content of the extended diagnosis frame is as follows:		
Byte	Content	Description
0 - 5	Standard DP Diagnose Data	Standard DP Diagnose Data
6	PDU length xx	Header of extended diagnostic data
7	Status type = 0x81	Header of extended diagnostic data
8	Slot = 0	Header of extended diagnostic data
9	Status info = 0	Header of extended diagnostic data
10 - 13	VLT par. 16-05	VLT warning word
14 - 17	VLT par. 16-06	VLT status word
18 - 21	VLT par. 16-04	VLT alarm word
22 - 23	VLT par. 9-53	Communication warning word (Profibus)

Enabling diagnosis may cause increased bus traffic. Diagnosis functions are not supported by all fieldbus types.

□ 8-1* Ctrl. Word Settings

Parameters for configuring the option control word profile.

8-10 Control Word Profile

Option:

✱FC profile	[0]
PROFIdrive profile	[1]
ODVA	[5]
CANopen	[7]

Function:

Selects the interpretation of the control and status words. The installed option in slot A determines the valid selection.

□ 8-3* FC Port Settings

Parameters for configuring the FC Port.

8-30 Protocol

Option:

✱FC	[0]
FC MC	[1]

Function:

Protocol selection for the FC (standard) port.

8-31 Address

Range:

1 - 126 ✱1

Function:

Address selection for the FC (standard) port.
Valid range: 1 - 126.

8-32 FC Port Baud Rate

Option:

2400 Baud	[0]
4800 Baud	[1]
✱9600 Baud	[2]
19200 Baud	[3]
38400 Baud	[4]
115200 Baud	[7]

Function:

Baud rate selection for the FC (standard) port.

8-35 Minimum Response Delay

Range:

1 - 500 ms ✱10 ms

Function:

Specifies a 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:

1 - 10000 ms ✱5000 ms

Function:

Specifies a maximum allowed delay-time between transmitting a request and expecting a response. Exceeding this delay causes control word time-out.

8-37 Max Inter-char Delay

Range:

0 - 30 ms ✱25 ms

Function:

Maximum waiting time between two received bytes. It ensures time-out, if transmission is interrupted.

Note: This is only enforced when the FC MC protocol is selected in par. 8-30.

□ **8-5* Digital/Bus**

Parameters for configuring the control word Digital/Bus merging.

8-50 Coasting Select

Option:

Digital input	[0]
Bus	[1]
Logic AND	[2]
✱Logic OR	[3]

Function:

Allows a choice between controlling the coasting function via the terminals (digital input) and/or via the bus.

NB!:
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-51 Quick Stop Select

Option:

Digital input	[0]
Bus	[1]
Logic AND	[2]
✱Logic OR	[3]

Function:

Allows a choice between controlling the Quick stop function via the terminals (digital input) and/or via the bus.

NB!:
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-52 DC Brake Select

Option:

Digital input	[0]
Bus	[1]
Logic AND	[2]
✱Logic OR	[3]

Function:

Allows a choice between controlling the DC brake via the terminals (digital input) and/or via the bus.

NB!:
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-53 Start Select

Option:

Digital input	[0]
Bus	[1]
Logic AND	[2]
✱Logic OR	[3]

Function:

Choose between controlling the drive via the terminals (digital input) and/or via the bus. If you select *Bus*, you can only activate the Start command if it is transmitted via the serial communication port or fieldbus option. If you select *Logic AND*, you must also activate the command via one of the digital inputs. If you select *Logic OR*, you can also activate the Start command via one of the digital inputs.

NB!:
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-54 Reversing Select

Option:

Digital input	[0]
Bus	[1]

✱ default setting **( )** display text **[ ]** value for use in communication via serial communication port

Logic AND	[2]
*Logic OR	[3]

Function:

Choose between controlling the drive via the terminals (digital input) and/or via the bus.
If you select *Bus*, you can only activate the Reversing command if it is transmitted via the serial communication port or fieldbus option. If you select *Logic AND*, you must also activate the command via one of the digital inputs. If you select *Logic OR*, you can also activate the Reversing command via one of the digital inputs.

NB!:
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-55 Set-up Select

Option:

Digital input	[0]
Bus	[1]
Logic AND	[2]
*Logic OR	[3]

Function:

Choose between controlling the drive via the terminals (digital input) and/or via the bus.
If you select *Bus*, you can only activate Selection of Setup if it is transmitted via the serial communication port or fieldbus option. If you select *Logic AND*, you must also activate the command via one of the digital inputs. If you select *Logic OR*, you can also activate the Set-up command via one of the digital inputs.

NB!:
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-56 Preset Reference Select

Option:

Digital input	[0]
Bus	[1]
Logic AND	[2]
*Logic OR	[3]

Function:

Choose between controlling the drive via the terminals (digital input) and/or via the bus.
If you select *Bus*, you can only activate the Preset Reference command if it is transmitted via the serial communication port or fieldbus option. If you select *Logic AND*, you must also activate the command via one of the digital inputs. If you select *Logic OR*, you can also activate the Preset Reference command via one of the digital inputs.

NB!:
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

□ 8-9* Bus Jog

8-90 Bus Jog 1 Speed

Range:

0 - par. 4-13 RPM	*100 RPM

Function:

Sets a fixed speed (jog) activated via the serial port or bus option.

8-91 Bus Jog 2 Speed

Range:

0 - par. 4-13 RPM	*200 RPM

Function:

Sets a fixed speed (jog) is activated via the serial port or bus option

Parameters: Profibus

9-00 Setpoint

Range:

0 - 65535 *0

No LCP access

Function:

Receives reference from a Master Class 2. If the control priority is set to Master Class 2, the drive reference is taken from this parameter, whereas the cyclical reference will be ignored.

9-07 Actual Value

Range:

0 - 65535 * 0

No LCP access

Function:

Delivers the MAV for a Master Class 2. The parameter is only valid if the control priority is set to Master Class 2.

9-15 PCD Write Configuration

Array [10]

Option:

None
3-02 Minimum Reference
3-03 Maximum Reference
3-12 Catch Up/Slow Down Value
3-41 Ramp 1 Ramp Up Time
3-42 Ramp 1 Ramp Down Time
3-51 Ramp 2 Ramp Up Time
3-52 Ramp 2 Ramp Down Time
3-80 Jog Ramp Time
3-81 Quick Stop Ramp Time
4-11 Motor Speed Low Limit [RPM]
4-13 Motor Speed High Limit [RPM]
4-16 Torque Limit Motor Mode
4-17 Torque Limit Generator Mode
7-28 Minimum Feedback
7-29 Maximum Feedback
8-90 Bus Jog 1 Speed
8-91 Bus Jog 2 Speed
16-80 Fieldbus CTW 1
16-82 Fieldbus REF 1
34-01 PCD 1 Write to MCO
34-02 PCD 2 Write to MCO
34-03 PCD 3 Write to MCO
34-04 PCD 4 Write to MCO
34-05 PCD 5 Write to MCO
34-06 PCD 6 Write to MCO
34-07 PCD 7 Write to MCO
34-08 PCD 8 Write to MCO
34-09 PCD 9 Write to MCO
34-10 PCD 10 Write to MCO

Function:

Assigns different parameters to PCD 3 to 10 of the PPO's (the number of PCD's depends on the PPO type). The values in PCD 3 to 10 are written to the selected parameters as data values.

9-16 PCD Read Configuration

Array [10]

Option:

None
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference %
16-03 Status Word
16-04 Main Actual Value [Unit]
16-05 Main Actual Value [%]
16-09 Custom Readout
16-10 Power [kW]
16-11 Power [hp]
16-12 Motor Voltage
16-13 Frequency
16-14 Motor Current
16-16 Torque
16-17 Speed [RPM]
16-18 Motor Thermal
16-19 KTY Sensor Temperature
16-21 Phase Angle
16-30 DC Link Voltage
16-32 Brake Energy / s
16-33 Brake Energy / 2 min
16-34 Heatsink Temp.
16-35 Inverter Thermal
16-38 SL Control State
16-39 Control Card Temp.
16-50 External Reference
16-51 Pulse Reference
16-52 Feedback [Unit]
16-53 Digi Pot Reference
16-60 Digital Input
16-61 Terminal 53 Switch Setting
16-62 Analog Input 53
16-63 Terminal 54 Switch Setting
16-64 Analog Input 54
16-65 Analog Output 42 [mA]
16-66 Digital Output [bin]
16-67 Freq. Input #29 [Hz]
16-68 Freq. Input #33 [Hz]

16-69 Pulse Output #27 [Hz]
16-70 Pulse Output #29 [Hz]
16-71 Pulse Output [bin]
16-84 Comm Option STW [Binary]
16-85 FC port CTW 1 Signal
16-90 Alarm Word
16-91 Alarm Word 2
16-92 Warning Word
16-93 Warning Word 2
16-94 Extended Status Word
16-95 Extended Status Word 2
34-21 PCD 1 Read from MCO
34-22 PCD 2 Read from MCO
34-23 PCD 3 Read from MCO
34-24 PCD 4 Read from MCO
34-25 PCD 5 Read from MCO
34-26 PCD 6 Read from MCO
34-27 PCD 7 Read from MCO
34-28 PCD 8 Read from MCO
34-29 PCD 9 Read from MCO
34-30 PCD 10 Read from MCO
34-40 Digital Inputs
34-41 Digital Outputs
34-50 Actual Position
34-51 Commanded Position
34-52 Actual Master Position
34-53 Slave Index Position
34-54 Master Index Position
34-55 Curve Position
34-56 Track Error
34-57 Synchronizing Error
34-58 Actual Velocity
34-59 Actual Master Velocity
34-60 Synchronizin Status
34-61 Axis Status
34-62 Program Status

Function:

Assigns different parameters to PCD 3 to 10 of the PPO's (the number of PCD's depends on the PPO type). PCD 3 to 10 holds the actual data value of the selected parameters.

9-18 Node Address

Range:

0 - 126 ✱126

Function:

Sets the station address. You can also set it on a hardware switch. You can set the address in par. 9-18 only if the hardware switch is set to 126 or 127. The parameter displays the actual setting of the switch when setting the hardware switch to >0 and <126. Power-up or updating par. 9-72 changes par. 9-18.

9-22 Telegram Selection

Option:

Standard telegram 1	[1]
PPO 1	[101]
PPO 2	[102]
PPO 3	[103]
PPO 4	[104]
PPO 5	[105]
PPO 6	[106]
PPO 7	[107]
✱PPO 8	[108]

Function:

Instead of using par. 9-15 and 9-16 to define profibus telegrams freely, you can use standard telegrams defined by the profibus profile. Standard Telegram 1 equals to PPO type 3. This parameter is automatically set to the according value (PPO type) when the drive is configured by a PLC.

9-23 Parameters for Signals

Array [1000]

Option:

None
3-02 Minimum Reference
3-03 Maximum Reference
3-12 Catch Up/Slow Down Value
3-41 Ramp 1 Ramp Up Time
3-42 Ramp 1 Ramp Down Time
3-51 Ramp 2 Ramp Up Time
3-52 Ramp 2 Ramp Down Time
3-80 Jog Ramp Time
3-81 Quick Stop Ramp Rime
4-11 Motor Speed Low Limit
4-13 Motor Speed High Limit
4-16 Torque Limit Motor Mode
4-17 Torque Limit Generator Mode
7-28 Minimum Feedback
7-29 Maximum Feedback
8-90 Bus Jog 1 Speed
8-91 Bus Jog 2 Speed
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference %
16-03 Status Word
16-04 Main Actual Value [Unit]
16-05 Main Actual Value [%]
16-10 Power [kW]

16-11 Power [hp]
16-12 Motor Voltage
16-13 Frequency
16-14 Motor Current
16-16 Torque
16-17 Speed [RPM]
16-18 Motor Thermal
16-19 KTY Sensor Temperature
16-21 Phase Angle
16-30 DC Link Voltage
16-32 Brake Energy / s
16-33 Brake Energy / 2 Min
16-34 Heatsink Temp.
16-35 Inverter Thermal
16-38 SL Control State
16-39 Controlcard Temp.
16-50 External Reference
16-51 Pulse Reference
16-52 Feedback [Unit]
16-53 Digi Pot Reference
16-60 Digital Input
16-61 Terminal 53 Switch Setting
16-62 Analog Input 53
16-63 Terminal 53 Switch Setting
16-64 Analog Input 54
16-65 Analog Output 42 [mA]
16-66 Digital Output [bin]
16-67 Freq. Input #29 [Hz]
16-68 Freq. Input #33 [Hz]
16-69 Pulse Output #27 [Hz]
16-70 Pulse Output #29 [Hz]
16-80 Fieldbus CTW 1
16-82 Fieldbus REF 1
16-84 Comm Option STW
16-85 FC Port CTW 1
16-90 Alarm Word
16-91 Alarm Word 2
16-92 Warning Word
16-93 Warning Word 2
16-94 Extended Status Word
16-95 Extended Status Word 2
34-01 PCD 1 Write to MCO
34-02 PCD 2 Write to MCO
34-03 PCD 3 Write to MCO
34-04 PCD 4 Write to MCO
34-05 PCD 5 Write to MCO
34-06 PCD 6 Write to MCO
34-07 PCD 7 Write to MCO
34-08 PCD 8 Write to MCO
34-09 PCD 9 Write to MCO
34-10 PCD 10 Write to MCO
34-21 PCD 1 Read from MCO
34-22 PCD 2 Read from MCO
34-23 PCD 3 Read from MCO
34-24 PCD 4 Read from MCO
34-25 PCD 5 Read from MCO
34-26 PCD 6 Read from MCO
34-27 PCD 7 Read from MCO
34-28 PCD 8 Read from MCO
34-29 PCD 9 Read from MCO
34-30 PCD 10 Read from MCO
34-40 Digital Inputs
34-41 Digital Outputs
34-50 Actual Position
34-51 Commanded Position
34-52 Actual Master Position
34-53 Slave Index Position
34-54 Master Index Position
34-55 Curve Position
34-56 Track Error
34-57 Synchronizing Error
34-58 Actual Velocity
34-59 Actual Master Velocity
34-60 Synchronizing Status
34-61 Axis Status
34-62 Program Status

Function:

Contains a list of signals you can enter in par. 9-15 and 9-16. Furthermore, it automatically sets the parameters to meet the most common requirements.

9-27 Parameter Edit

Option:

Disabled	[0]
✱ Enabled	[1]

Function:

It is possible to edit parameters via Profibus, the standard Interface, or the LCP. Disable editing via Profibus with this parameter.

9-28 Process Control

Option:

Disable	[0]
✱ Enable cyclic master	[1]

Function:

Process control (setting of Control Word, speed reference, and process data) is possible via either Profibus or the standard RS485 Interface but not both at the same time. Local control is always possible via the LCP. Control via process control is possible with either terminals or bus depending on the setting of par. 8-50 to 8-56.
- Disable: Disables process control via Profibus, and enables process control via standard RS485.

- Enable cyclic master: Enables process control via Profibus Master Class 1, and disables process control via standard RS485 bus or Master class 2.

9-44 Fault Message Counter

Range:

0 - 65535 N/A ✱0 N/A

Function:

Indicates the number of alarms presently stored in par. 9-47. The buffer capacity is maximum eight error events.

9-45 Fault Code

Range:

0 - 0 N/A ✱0 N/A

Function:

This parameter contains the alarm word from all alarm messages occured.
The buffer capacity is maximum eight error events.

9-47 Fault Number

Range:

0 - 0 N/A ✱0 N/A

Function:

This parameter contains the alarm number (e.g. 2 for live zero error, 4 for mains phase loss) that occurs for an event.
The buffer capacity is maximum eight error events.

9-52 Fault Situation Counter

Range:

0 - 1000 N/A ✱0 N/A

Function:

This parameter contains the amount of events presently stored since last reset/power up. Par. 9-52 is incremented for every event (by AOC or Profibus option).

9-53 Profibus Warning Word

Option:

Bit:	Meaning:
0	Connection with DP-master is not
1	Timeout action active
2	FDL (Field-bus Data link Layer) is not ok
3	Clear data command received
4	Actual value is not updated
5	Baudrate search
6	PROFIBUS ASIC is not transmitting
7	Initializing of PROFIBUS is not ok
8	Drive is tripped
9	Internal CAN error
10	Wrong ID sent by PLC
11	Internal error occured
12	Not configured
13	Clear command received
14	Warning 34 active

Function:

Displays Profibus communication warnings.

9-63 Actual Baud Rate

Option:

Read only

9.6 kbit/s	[0]
19.2 kbit/s	[1]
93.75 kbit/s	[2]
187.5 kbit/s	[3]
500 kbit/s	[4]
1500 kbit/s	[6]
3000 kbit/s	[7]
6000 kbit/s	[8]
12000 kbit/s	[9]
31.25 kbit/s	[10]
45.45 kbit/s	[11]
No baud rate found	[255]

Function:

Displays the actual PROFIBUS baud rate. The Profibus Master automatically sets the baud rate.

9-64 Device Identification

Array [10]

Option:

Read only

Array	[10]

Index	Content	Value
[0]	Manufacturer	128 (for Danfoss)
[1]	Device type	1
[2]	Version	xxyy
[3]	Firmware date year	yyyy
[4]	Firmware date month	ddmm
[5]	No. of axes	variable
[6]	Vendor specific: PB Version	xxyy
[7]	Vendor specific: Database Version	xxyy
[8]	Vendor specific: AOC Version	xxyy
[9]	Vendor specific: MOC Version	xxyy

Function:

The device identification parameter. The data type is "Array[n] of Unsigned16". The assignment of the first subindexes is defined and shown in the table above.

9-65 Profile Number

Option:

Read only

0 - 0 * 0

Function:

Contains the profile identification. Byte 1 contains the profile number and byte 2 the version number of the profile.

9-67 Control Word 1

Range:

Read only

No LCP access

0 - 65535 *0

Function:

Accepts the Control word from a Master Class 2 in the same format as PCD 1. If control priority is set to Master Class 2, the Control word for the drive is taken from this parameter, whereas cyclical and acyclic reference from a Master Class 2 is ignored. This parameter is only visible for Profibus Master Class 2, not for Master Class 1, standard bus or LCP.

9-68 Status Word 1

Range:

Read only

No LCP access

0 - 65535 *0

Function:

Delivers the Status word for a Master Class 2 in the same format as PCD 2. The value of this parameter is only valid if the control priority is set to Master Class 2. This parameter is only visible for Profibus Master Class 2, not for Master Class 1, standard bus, or LCP.

9-71 Profibus Save Data Values

Option:

*Off	[0]
Store edit setup	[1]
Store all set-ups	[2]

Function:

Parameter values changed via Profibus are not automatically stored into non-volatile memory. Use this parameter to activate a function that stores all parameter values in the EEPROM. Thus, you retain changed parameter values at power-down.

- [0] Off: The store function is inactive.
- [1] Store edit set-up: All parameter values in the set-up selected in par. 9-70 are stored in the EEPROM.

The value returns to [0] Off when all values are stored.

-[2] Store all set-ups: All parameter values for all set-ups are stored in the EEPROM. The value returns to [0] Off when all parameter values are stored.

9-70 Edit Set-up

Option:

Factory setup	[0]
*Setup 1	[1]
*Setup 2	[2]
*Setup 3	[3]
*Setup 4	[4]
Active setup	[9]

Function:

Edit set-up. Editing can either follow the active set-up selection (par. 0-10) or be fixed at a set-up number. This parameter is unique for LCP and buses.

9-72 ProfibusDriveReset

Option:

*No action	[0]
Power-on reset	[1]
Comm. option reset	[3]

Function:

Resets the drive (as for power-cycle). The drive disappears from the bus, which might cause a communication error from the master.

9-80 Defined Parameters (1)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the defined drive parameters available for Profibus.

9-81 Defined Parameters (2)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the defined drive parameters available for Profibus.

9-82 Defined Parameters (3)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the defined drive parameters available for Profibus.

9-83 Defined Parameters (4)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the defined drive parameters available for Profibus.

9-90 Changed Parameters (1)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the drive parameters deviating from default setting.

9-91 Changed Parameters (2)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the drive parameters deviating from default setting.

9-92 Changed Parameters (3)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the drive parameters deviating from default setting.

9-93 Changed Parameters (4)

Array [116]

Option:

No LCP access
Read only
0 - 115 *0

Function:

Holds a list of all the drive parameters deviating from default setting.

Parameters: DeviceNet CAN Fieldbus

10-0* Common Settings

10-00 Can Protocol

Option:

*DeviceNet	[1]

Function:

Selection of CAN protocol.

10-01 Baud Rate Select

Option:

*125 Kbps	[20]
250 Kbps	[21]
500 Kbps	[22]

Function:

Selection of the DeviceNet transmission speed. The selection must correspond to the transmission speed of the master and the other DeviceNet nodes.

10-02 MAC ID

Option:

0 - 127 N/A	*63 N/A

Function:

Selection of station address. Every station connected to the same DeviceNet network must have an unambiguous address.

10-05 Read-out Transmit Error Counter

Range:

0 - 255	*0

Function:

A read-out of the Transmit Error Counter of the CAN control since the last power-up.

10-06 Read-out Receive Error Counter

Range:

0 - 255	*0

Function:

Displays the Receive Error Counter of the CAN control since the last power-up.

10-07 Read-out Bus Off Counter

Range:

0 - 255 N/A	*0 N/A

Function:

Displays the number of Bus Off events since the last power-up.

10-1* DeviceNet

Parameter group for DeviceNet specific parameters.

10-10 Process Data Type Selection

Option:

Instance 100/150	[0]
Instance 101/151	[1]
Instance 20/70	[2]
Instance 21/71	[3]

Function:

This parameter permits selection between four different Instances for data transmission, depending upon the setting of par. 8-10 *Control Word Profile.*
When par. 8-10 is set to [0] *FC profile*, par. 10-10 options [0] and [1] are available.
When par. 8-10 is set to [5] *ODVA*, par. 10-10 options [2] and [3] are available.
- Instances 100/150 and 101/151 are Danfoss-specific.
Instances 20/70 and 21/71 are ODVA-specific AC Drive profiles.
Note that a change to this parameter will be executed immediately.

10-11 Process Data Config Write

Option:

*0 None
3-02 Minimum reference
3-03 Maximum reference
3-12 Catch up/slow down value
3-41 Ramp 1 ramp up time
3-42 Ramp 1 ramp down time
3-51 Ramp 2 ramp up time
3-52 Ramp 2 ramp down time
3-80 Jog ramp time
3-81 Quick stop ramp time
4-11 Motor speed low limit (RPM)
4-13 Motor speed high limit (RPM)
4-16 Torque limit motor mode
4-17 Torque limit generator mode
7-28 Minimum Feedback
7-29 Maximum Feedback
8-90 Bus Jog 1 Speed
8-91 Bus Jog 2 Speed
16-80 Fieldbus CTW 1 (Fixed)
16-82 Fieldbus REF 1 (Fixed)
34-01 PCD 1 Write to MCO
34-02 PCD 2 Write to MCO
34-03 PCD 3 Write to MCO
34-04 PCD 4 Write to MCO
34-05 PCD 5 Write to MCO
34-06 PCD 6 Write to MCO

34-07 PCD 7 Write to MCO
34-08 PCD 8 Write to MCO
34-09 PCD 9 Write to MCO
34-10 PCD 10 Write to MCO

Function:

This parameter is used for I/O assembly Instances 101/151.
Only elements [2] and [3] of this array can be selected ([0] and [1] are fixed).
This parameter can be used only for Instance 101/151.

10-12 Process Data Config Read

Option:

*None
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference %
16-03 Status Word (Fixed)
16-04 Main Actual Value [Unit]
16-05 Main Actual Value (%) (Fixed)
16-10 Power [kW]
16-11 Power [hp]
16-12 Motor Voltage
16-13 Frequency
16-14 Motor Current
16-16 Torque
16-17 Speed [RPM]
16-18 Motor Thermal
16-19 KTY Sensor Temperature
16-21 Phase Angle
16-30 DC Link Voltage
16-32 BrakeEnergy/s
16-33 BrakeEnergy/2 min
16-34 Heatsink Temp.
16-35 Inverter Thermal
16-38 SL Control State
16-39 Controlcard Temp.
16-50 External Reference
16-51 Pulse Reference
16-52 Feedback [Unit]
16-53 Digi Pot Reference
16-60 Digital Input
16-61 Terminal 53 Switch Setting
16-62 Analog Input 53
16-63 Terminal 54 Switch Setting
16-64 Analog Input 54
16-65 Analog Output 42 [mA]
16-66 Digital Output [bin]
16-67 Freq. Input #29 [Hz]
16-68 Freq. Input #33 [Hz]
16-69 Pulse Output #27 [Hz]
16-70 Pulse Output #29 [Hz]
16-71 Relay Output [bin]
16-84 Comm Option STW
16-85 FC Port CTW 1
16-90 Alarm Word
16-91 Alarm Word 2
16-92 Warning Word
16-93 Warning Word 2
16-94 Extended Status Word
16-95 Extended Status Word 2
34-21 PCD 1 Read from MCO
34-22 PCD 2 Read from MCO
34-23 PCD 3 Read from MCO
34-24 PCD 4 Read from MCO
34-25 PCD 5 Read from MCO
34-26 PCD 6 Read from MCO
34-27 PCD 7 Read from MCO
34-28 PCD 8 Read from MCO
34-29 PCD 9 Read from MCO
34-30 PCD 10 Read from MCO
34-40 Digital Inputs
34-41 Digital Outputs
34-50 Actual Position
34-51 Commanded Position
34-52 Actual Master Position
34-53 Slave Index Position
34-54 Master Index Position
34-55 Curve Position
34-56 Track Error
34-57 Synchronizing Error
34-58 Actual Velocity
34-59 Actual Master Velocity
34-60 Synchronizing Status
34-61 Axis Status
34-62 Program Status

Function:

This parameter is used for I/O assembly Instances 101/151.
Only elements [2] and [3] of this array can be selected ([0] and [1] are fixed).
This parameter can be used only for Instance 101/151.

10-13 Warning Parameter

Range:

0 - 65535 N/A — *0 N/A

Function:

Reads out warning messages via standard bus or DeviceNet. This parameter is not available via LCP but you can see the warning message by choosing Com warning word as display readout. One bit is assigned to every warning (see manual for list).

Bit:	Meaning:
0	Bus not active
1	Explicit connection timeout
2	I/O connection
3	Retry limit reached
4	Actual is not updated
5	CAN bus off
6	I/O send error
7	Initialization error
8	No bus supply
9	Bus off
10	Error passive
11	Error warning
12	Duplicate MAC ID Error
13	RX queue overrun
14	TX queue overrun
15	CAN overrun

10-14 Net Reference

Option:

Read only from LCP.

*Off	[0]
On	[1]

Function:

Enables selection of reference source in Instance 21/71 and 20/70.
- Off: Enables reference via analog/digital inputs.
- On: Enables reference via the bus.

10-15 Net Control

Option:

Read only from LCP.

*Off	[0]
On	[1]

Function:

Enables selection of control source in Instance 21/71 and 20-70.
- Off: Enables control via analog/digital inputs.
- On: Enables control via the bus.

□ **10-2* COS Filters**

10-20 COS Filter 1

Range:

0 - 65535 *65535

Function:

Sets up the filter mask for the status word. When operating in COS (Change-Of-State), you can filter out bits in the status word that should not be sent if they change.

10-21 COS Filter 2

Range:

0 - 65535 *65535

Function:

Sets up the filter mask for the Main Actual Value. When operating in COS (Change-Of-State), you can filter out bits in the Main actual value that should not be sent if they change.

10-22 COS Filter 3

Range:

0 - 65535 *65535

Function:

Sets up the filter mask for PCD 3. When operating in COS (Change-Of-State), you can filter out bits in PCD 3 that should not be sent if they change.

10-23 COS Filter 4

Range:

0 - 65535 *65535

Function:

Sets up the filter mask for PCD 4. When operating in COS (Change-Of-State), you can filter out bits in PCD 4 that should not be sent if they change.

□ **10-3* Parameter Access**

Parameter group providing access to indexed parameters and defining programming set-up.

10-30 Array Index

Range:

0 - 255 N/A *0 N/A

Function:

This parameter is used for accessing indexed parameters.

10-31 Store Data Values

Option:

*Off	[0]
Store edit setup	[1]
Store all setups	[2]

Function:

Par. 10-31 is used to activate storing of data in non-volatile memory.

10-32 DeviceNet Revision

Range:

0 - 65535 N/A *0 N/A

Function:

Par. 10-32 is used for EDS file creation.

10-33 Store Always

Option:

*Off	[0]
On	[1]

Function:

This parameter selects if data parameters received on DeviceNet should be stored in EEPROM as default.

10-39 Devicenet F Parameters

Array [1000]

Option:

No LCP access

0 - 0	*0

Function:

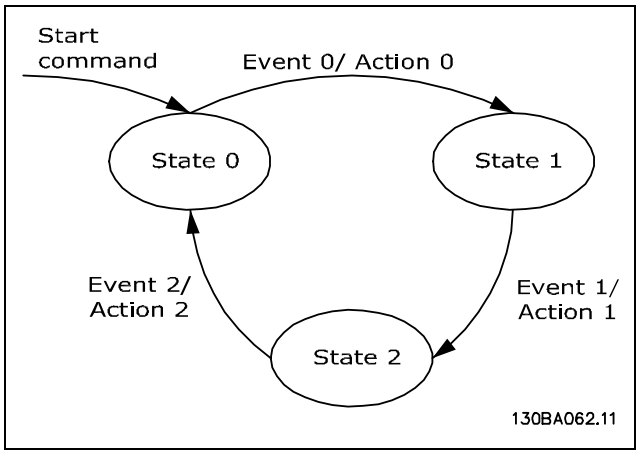
This parameter is used to configure the drive via Devicenet and build the EDS-file.

Parameters: Smart Logic Control

13-** Prog. Features

The Smart Logic Control (SLC) is essentially a sequence of user defined actions (see par. 13-52 [x]) executed by the SLC when the associated user defined *event* (see par. 13-51 [x]) is evaluated as TRUE by the SLC.
Events and *actions* are each numbered and linked together in pairs. 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, the SLC executes *action [0]* and start evaluating *event [1]*. It is possible to program 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 :



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

13-0* SLC Settings

The settings are used for activating, deactivating and resetting the Smart Logic Control.

13-00 SL Control Mode

Option:

*Off	[0]
On	[1]

Function:

Select *On* [1] to enable the Smart Logic Control to start when a start command is present (i.e. via a digital input).

13-01 Start Event

Option:

False	[0]
True	[1]
Running	[2]
In range	[3]
On reference	[4]
Torque limit	[5]
Current limit	[6]
Out of current range	[7]
Below I low	[8]
Above I high	[9]
Below speed low	[11]
Above speed high	[12]
Out of feedb. range	[13]
Below feedb. low	[14]
Above feedb. high	[15]
Thermal warning	[16]
Mains out of range	[17]
Reversing	[18]
Warning	[19]
Alarm (trip)	[20]
Alarm (trip lock)	[21]
Comparator 0	[22]
Comparator 1	[23]
Comparator 2	[24]
Comparator 3	[25]
Logic rule 0	[26]
Logic rule 1	[27]
Logic rule 2	[28]
Logic rule 3	[29]
Digital input DI18	[33]
Digital input DI19	[34]
Digital input DI27	[35]
Digital input DI29	[36]
Digital input DI32	[37]

Digital input DI33	[38]
Start command	[39]
Drive stopped	[40]

Function:

The list describes the available boolean (TRUE or FALSE) input for use in the selected logic rule.

- *False [0] (default setting) – enters the fixed value of FALSE in the logic rule.
- True [1] – enters the fixed value TRUE in the logic rule.
- Running [2] - see par. 5-13 for further description.
- In range [3] - see par. 5-31 for further description.
- On reference [4] - see par. 5-31 for further description.
- Torque limit [5] - see par. 5-31 for further description.
- Current limit [6] - see par. 5-31 for further description.
- Out of current range [7] - see par. 5-31 for further description.
- Below I low [8] - see par. 5-31 for further description.
- Above I high [9] - see par. 5-31 for further description.
- Below frequency low [11] - see par. 5-31 for further description.
- Above frequency high [12] - see par. 5-31 for further description.
- Thermal warning [16] - see par. 5-31 for further description.
- Mains voltage out of range [17] - see par. 5-31 for further description.
- Reversing [18] - see par. 5-31 for further description.
- Warning [19] - see par. 5-31 for further description.
- Alarm (trip) [20] - see par. 5-31 for further description.
- Alarm (trip lock) [21] - see par. 5-31 for further description.
- Comparator 0 [22] – use the result of comparator 0 in the logic rule.
- Comparator 1 [23] – use the result of comparator 1 in the logic rule.
- Comparator 2 [24] – use the result of comparator 2 in the logic rule.
- Comparator 3 [25] – use the result of comparator 3 in the logic rule.
- Logic rule 0 [26] – use the result of logic rule 0 in the logic rule.
- Logic rule 1 [27] – use the result of logic rule 1 in the logic rule.
- Logic rule 2 [28] – use the result of logic rule 2 in the logic rule.
- Logic rule 3 [29] – use the result of logic rule 3 in the logic rule.
- Digital input DI18 [33] – use the value of DI18 in the logic rule (High = TRUE).
- Digital input DI19 [34] – use the value of DI19 in the logic rule (High = TRUE).
- Digital input DI27 [35] – use the value of DI27 in the logic rule (High = TRUE).
- Digital input DI29 [36] – use the value of DI29 in the logic rule (High = TRUE).
- Digital input DI32 [37] – use the value of DI32 in the logic rule (High = TRUE).
- Digital input DI33 [38] – use the value of DI33 in the logic rule (High = TRUE).

13-02 Stop Event

Option:

False	[0]
True	[1]
Running	[2]
In range	[3]
On reference	[4]
Torque limit	[5]
Current limit	[6]
Out of current range	[7]
Below I low	[8]
Above I high	[9]
Below speed low	[11]
Above speed high	[12]
Out of feedb. range	[13]
Below feedb. low	[14]
Above feedb. high	[15]
Thermal warning	[16]
Mains out of range	[17]
Reversing	[18]
Warning	[19]
Alarm (trip)	[20]
Alarm (trip lock)	[21]
Comparator 0	[22]
Comparator 1	[23]
Comparator 2	[24]
Comparator 3	[25]
Logic rule 0	[26]
Logic rule 1	[27]
Logic rule 2	[28]
Logic rule 3	[29]
SL Time-out 0	[30]
SL Time-out 1	[31]
SL Time-out 2	[32]

Digital input DI18	[33]
Digital input DI19	[34]
Digital input DI27	[35]
Digital input DI29	[36]
Digital input DI32	[37]
Digital input DI33	[38]
Start command	[39]
Drive stopped	[40]

Function:

The list describes which boolean input is to define to stop/deactivate the Smart Logic Control.

- *False [0] (default setting) – enters the fixed value of FALSE in the logic rule.
- True [1] – enters the fixed value TRUE in the logic rule.
- Running [2] - see par. 5-13 for further description.
- In range [3] - see par. 5-31 for further description.
- On reference [4] - see par. 5-31 for further description.
- Torque limit [5] - see par. 5-31 for further description.
- Current limit [6] - see par. 5-31 for further description.
- Out of current range [7] - see par. 5-31 for further description.
- Below I low [8] - see par. 5-31 for further description.
- Above I high [9] - see par. 5-31 for further description.
- Below frequency low [11] - see par. 5-31 for further description.
- Above frequency high [12] - see par. 5-31 for further description.
- Thermal warning [16] - see par. 5-31 for further description.
- Mains voltage out of range [17] - see par. 5-31 for further description.
- Reversing [18] - see par. 5-31 for further description.
- Warning [19] - see par. 5-31 for further description.
- Alarm (trip) [20] - see par. 5-31 for further description.
- Alarm (trip lock) [21] - see par. 5-31 for further description.
- Comparator 0 [22] – use the result of comparator 0 in the logic rule.
- Comparator 1 [23] – use the result of comparator 1 in the logic rule.
- Comparator 2 [24] – use the result of comparator 2 in the logic rule.
- Comparator 3 [25] – use the result of comparator 3 in the logic rule.
- Logic rule 0 [26] – use the result of logic rule 0 in the logic rule.
- Logic rule 1 [27] – use the result of logic rule 1 in the logic rule.
- Logic rule 2 [28] – use the result of logic rule 2 in the logic rule.
- Logic rule 3 [29] – use the result of logic rule 3 in the logic rule.
- Digital input DI18 [33] – use the value of DI18 in the logic rule (High = TRUE).
- Digital input DI19 [34] – use the value of DI19 in the logic rule (High = TRUE).
- Digital input DI27 [35] – use the value of DI27 in the logic rule (High = TRUE).
- Digital input DI29 [36] – use the value of DI29 in the logic rule (High = TRUE).
- Digital input DI32 [37] – use the value of DI32 in the logic rule (High = TRUE).
- Digital input DI33 [38] – use the value of DI33 in the logic rule (High = TRUE).

13-03 Reset SLC

Option:

*Do not reset SLC	[0]
Reset SLC	[1]

Function:

Par. 13-03 resets all group 13 parameters (13-*) to default settings.

□ 13-1* Comparators

Used for comparing continuous variables (i.e. output frequency, output current, analog input etc.) with a fixed preset value. Comparators are evaluated once in each scan interval. You can use the result (TRUE or FALSE) directly to define an event (see par. 13-51), or as boolean input in a logic rule (see par. 13-40, 13-42, or 13-44). All parameters in this parameter group are array parameters with index 0-3. Select index 0 to program Comparator 0, select index 1 to program Comparator 1, and so on.

13-10 Comparator Operand

Array [4]

Option:

*DISABLED	[0]
Reference	[1]

Feedback	[2]
Motor speed	[3]
Motor current	[4]
Motor torque	[5]
Motor power	[6]
Motor voltage	[7]
DC-link voltage	[8]
Motor thermal	[9]
VLT thermal	[10]
Heat sink temp.	[11]
Analog input AI53	[12]
Analog input AI54	[13]
Analog input AIFB10	[14]
Analog input AIS24V	[15]
Analog input AICCT	[17]
Pulse input FI29	[18]
Pulse input FI33	[19]
Alarm number	[20]
Counter A	[30]
Counter B	[31]

Function:

Selects the variable monitored by the comparator. The available selection below:

- *DISABLED [0] (factory setting) - the output from the comparator is always FALSE.
- Reference [1] - see par. 16-01 for further description.
- Feedback [2] - see par. 16-52 for further description.
- Motor speed [3] - see par. 16-17 for further description.
- Motor current [4] - see par. 16-14 for further description.
- Motor torque [5] - see par. 16-16 for further description.
- Motor power [6] - see par. 16-10 for further description.
- Motor voltage [7] - see par. 16-12 for further description.
- DC-link voltage [8] - see par. 16-30 for further description.
- Motor thermal [9] - see par. 16-18 for further description.
- VLT thermal [10] - see par. 16-35 for further description.
- Heat sink temperature [11] - see par. 16-34 for further description.
- Analog input AI53 [12] - see par. 16-62 for further description.
- Analog input AI54 [13] - see par. 16-64 for further description.
- Analog input AIFB10 [14] - value of internal 10V supply [V].
- Analog input AIS24V [15] – value of internal 24V supply [V]
- Analog input AICCT [17] – control card temperature [°C].
- Pulse input FI29 [18] - see par. 16-67 for further description.
- Pulse input FI33 [19] - see par. 16-68 for further description.
- Alarm number [20]
- Counter A [30] - see par. 16-72 for further description.
- Counter B [31] - see par. 16-73 for further description.

13-11 Comparator Operator

Array [4]

Option:

<	[0]
✱ ≈	[1]
>	[2]

Function:

Selects the operator used in the comparison. If you select < [0], the result of the evaluation is TRUE, if the variable selected in par. 13-10 is smaller than the fixed value in par. 13-12. The result is FALSE, if the variable selected in par. 13-10 is greater than the fixed value in par. 13-12. If you select > [2] instead, the logic is inverted. If you select ≈ [1], the evaluation is TRUE, if the variable selected in par. 13-10 is approximately equal to the fixed value in par. 13-12.

13-12 Comparator Value

Array [4]

Range:

-100000.000 - 100000.000 ✱0.000

Function:

Selects the "trigger level" for the variable monitored by this comparator.

□ 13-2* Timers

You can use the result (TRUE or FALSE) from *timers* directly to define an *event* (see par. 13-51), or as boolean input in a *logic rule* (see par. 13-40, 13-42 or 13-44). A timer is only FALSE when started

by an action (i.e. "Start timer 1 [29]") 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 0-2. Select index 0 to program Timer 0, select index 1 to program Timer 1, and so on.

13-20 SL Control Timer

Array [3]

Range:

0.00 - 3600.00 s ✱0.00 s

Function:

The value defines 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 entered timer value is elapsed.

□ **13-4* Logic Rules**

Combines up to three boolean inputs (TRUE / FALSE inputs) from timers, comparators, digital inputs, status bits and events using AND, OR, NOT logic operators. Select boolean inputs for the calculation in par. 13-40, 13-42, and 13-44. Define the operators used to logically combine the selected inputs in par. 13-41 and 13-43.

Priority of calculation

The results of par. 13-40, 13-41, and 13-42 are calculated first. The outcome (TRUE / FALSE) of this calculation is combined with the settings of par. 13-43 and 13-44, yielding the final result (TRUE / FALSE) of the logical rule.

13-40 Logic Rule Boolean

Array [4]

Option:

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

Function:

The list describes the available boolean (TRUE or FALSE) input for use in the selected logic rule.

- *False [0] (default setting) – enters the fixed value of FALSE in the logic rule.
- True [1] – enters the fixed value TRUE in the logic rule.
- Running [2] - see par. 5-13 for further description.
- In range [3] - see par. 5-31 for further description.
- On reference [4] - see par. 5-31 for further description.
- Torque limit [5] - see par. 5-31 for further description.
- Current limit [6] - see par. 5-31 for further description.
- Out of current range [7] - see par. 5-31 for further description.
- Below I low [8] - see par. 5-31 for further description.
- Above I high [9] - see par. 5-31 for further description.
- Out of speed range [10] - see par. 5-31 for further description.

- Below frequency low [11] - see par. 5-31 for further description.
- Above frequency high [12] - see par. 5-31 for further description.
- Out of feedback range [13] - see par. 5-31 for further description.
- Below feedback low [14] - see par. 5-31 for further description.
- Above feedback high [15] - see par. 5-31 for further description.
- Thermal warning [16] - see par. 5-31 for further description.
- Mains voltage out of range [17] - see par. 5-31 for further description.
- Reversing [18] - see par. 5-31 for further description.
- Warning [19] - see par. 5-31 for further description.
- Alarm (trip) [20] - see par. 5-31 for further description.
- Alarm (trip lock) [21] - see par. 5-31 for further description.
- Comparator 0 [22] – use the result of comparator 0 in the logic rule.
- Comparator 1 [23] – use the result of comparator 1 in the logic rule.
- Comparator 2 [24] – use the result of comparator 2 in the logic rule.
- Comparator 3 [25] – use the result of comparator 3 in the logic rule.
- Logic rule 0 [26] – use the result of logic rule 0 in the logic rule.
- Logic rule 1 [27] – use the result of logic rule 1 in the logic rule.
- Logic rule 2 [28] – use the result of logic rule 2 in the logic rule.
- Logic rule 3 [29] – use the result of logic rule 3 in the logic rule.
- Time-out 0 [30] – use the result of timer 0 in the logic rule.
- Time-out 1 [31] – use the result of timer 1 in the logic rule.
- Time-out 2 [32] – use the result of timer 2 in the logic rule.
- Digital input DI18 [33] – use the value of DI18 in the logic rule (High = TRUE).
- Digital input DI19 [34] – use the value of DI19 in the logic rule (High = TRUE).
- Digital input DI27 [35] – use the value of DI27 in the logic rule (High = TRUE).
- Digital input DI29 [36] – use the value of DI29 in the logic rule (High = TRUE).
- Digital input DI32 [37] – use the value of DI32 in the logic rule (High = TRUE).
- Digital input DI33 [38] – use the value of DI33 in the logic rule (High = TRUE).

13-41 Logic Rule Operator 1

Array [4]

Option:

✱Disabled	[0]
And	[1]
Or	[2]
And not	[3]
Or not	[4]
Not and	[5]
Not or	[6]
Not and not	[7]
Not or not	[8]

Function:

Selects the logical operator to use on the boolean inputs from par. 13-40 and 13-42.
[13 -XX] signifies the boolean input of par. 13-*.

- DISABLED [0] - select this option to ignore par. 13-42, 13-43, and 13-44.
- AND [1] - evaluates the expression [13-40] AND [13-42].
- OR [2] - evaluates the expression [13-40] OR [13-42].
- AND NOT [3] - evaluates the expression [13-40] AND NOT [13-42].
- OR NOT [4] - evaluates the expression [13-40] OR NOT [13-42].
- NOT AND [5] - evaluates the expression NOT [13-40] AND [13-42].
- NOT OR [6] - evaluates the expression NOT [13-40] OR [13-42].
- NOT AND NOT [7] - evaluates the expression NOT [13-40] AND NOT [13-42].
- NOT OR NOT [8] - evaluates the expression NOT [13-40] OR NOT [13-42].

13-42 Logic Rule Boolean

Array [4]

Option:

*False	[0]
True	[1]
Running	[2]
In range	[3]
On reference	[4]
Torque limit	[5]
Current limit	[6]
Out of current range	[7]

✱ default setting **( )** display text **[ ]** value for use in communication via serial communication port

Below I low	[8]
Above I high	[9]
Out of speed range	[10]
Below speed low	[11]
Above speed high	[12]
Out of feedb. range	[13]
Below feedb. low	[14]
Above feedb. high	[15]
Thermal warning	[16]
Mains voltage out of range	[17]
Reversing	[18]
Warning	[19]
Alarm (trip)	[20]
Alarm (trip lock)	[21]
Comporator 0	[22]
Comporator 1	[23]
Comporator 2	[24]
Comporator 3	[25]
Logic rule 0	[26]
Logic rule 1	[27]
Logic rule 2	[28]
Logic rule 3	[29]
Time-out 0	[30]
Time-out 1	[31]
Time-out 2	[32]
Digital input DI18	[33]
Digital input DI19	[34]
Digital input DI27	[35]
Digital input DI29	[36]
Digital input DI32	[37]
Digital input DI33	[38]
Start command	[39]
Drive stopped	[40]

Function:

Same as in par. 13-40.

13-43 Logic Rule Operator 2

Array [4]

Option:

*Disabled	[0]
And	[1]
Or	[2]
And not	[3]
Or not	[4]
Not and	[5]
Not or	[6]
Not and not	[7]
Not or not	[8]

Function:

Selects the logical to be use on the boolean input calculated in par. 13-40, 13-41, and 13-42, and the boolean input coming from par. 13-42.

- [13-44] signifies the boolean input of par. 13-44.
- [13-40/13-42] signifies the boolean input calculated in par. 13-40, 13-41, and 13-42.
- *DISABLED* [0] (factory setting) – select this option to ignore par. 13-44.
- *AND* [1] – evaluates the expression [13-40/13-42] AND [13-44].
- *OR* [2] – evaluates the expression [13-40/13-42] OR [13-44].
- *AND NOT* [3] – evaluates the expression [13-40/13-42] AND NOT [13-44].
- *OR NOT* [4] – evaluates the expression [13-40/13-42] OR NOT [13-44].
- *NOT AND* [5] – evaluates the expression NOT [13-40/13-42] AND [13-44].
- *NOT OR* [6] – evaluates the expression NOT [13-40/13-42] OR [13-44].
- *NOT AND NOT* [7] – evaluates the expression NOT [13-40/13-42].
- evaluates *AND NOT* [13-44].
- *NOT OR NOT* [8] – evaluates the expression NOT [13-40/13-42] OR NOT [13-44].

13-44 Logic Rule Boolean 3

Array [4]

Option:

*False	[0]
True	[1]
Running	[2]
In range	[3]
On reference	[4]
Torque limit	[5]
Current limit	[6]
Out of current range	[7]
Below I low	[8]
Above I high	[9]
Out of speed range	[10]
Below speed low	[11]
Above speed high	[12]
Out of feedb. range	[13]
Below feedb. low	[14]
Above feedb. high	[15]
Thermal warning	[16]
Mains voltage out of range	[17]
Reversing	[18]
Warning	[19]

Alarm (trip)	[20]
Alarm (trip lock)	[21]
Comporator 0	[22]
Comporator 1	[23]
Comporator 2	[24]
Comporator 3	[25]
Logic rule 0	[26]
Logic rule 1	[27]
Logic rule 2	[28]
Logic rule 3	[29]
Time-out 0	[30]
Time-out 1	[31]
Time-out 2	[32]
Digital input DI18	[33]
Digital input DI19	[34]
Digital input DI27	[35]
Digital input DI29	[36]
Digital input DI32	[37]
Digital input DI33	[38]
Start command	[39]
Drive stopped	[40]

Function:

Same as in par. 13-40.

□ **13-5* States**

13-51 SL Control Event

Array [20]

Option:

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

Function:

Selects the boolean input (TRUE or FALSE) to define this event.

- *False [0] - enters the fixed value FALSE in the event.
- True [1] - enters the fixed value TRUE in the event.
- Running [2] - see par. 5-31 for further description.
- In range [3] - see par. 5-31 for further description.
- On reference [4] - see par. 5-31 for further description.
- Torque limit [5] - see par. 5-31 for further description.
- Current limit [6] - see par. 5-31 for further description.
- Out of current range [7] - see par. 5-31 for further description.
- Above I low [8] - see par. 5-31 for further description.
- Below I high [9] - see par. 5-31 for further description.
- Out of speed range [10] - see par. 5-31 for further description.
- Above frequency low [11] - see par. 5-31 for further description.
- Below frequency high [12] - see par. 5-31 for further description.
- Out of feedback range [13] - see par. 5-31 for further description.
- Below feedback low [14] - see par. 5-31 for further description.
- Above feedback high [15] - see par. 5-31 for further description.

- Thermal warning [16] - see par. 5-31 for further description.
- Mains voltage out of range [17] - see par. 5-31 for further description.
- Reversing [18] - see par. 5-31 for further description.
- Warning [19] - see par. 5-31 for further description.
- Alarm (trip) [20] - see par. 5-31 for further description.
- Alarm (trip lock) [21] - see par. 5-31 for further description.
- Comparator 0 [22] - use the result of comparator 0 in the event.
- Comparator 1 [23] - use the result of comparator 1 in the event.
- Comparator 2 [24] - use the result of comparator 2 in the event.
- Comparator 3 [25] - use the result of comparator 3 in the event.
- Logic rule 0 [26] - use the result of logic rule 0 in the event.
- Logic rule 1 [27] - use the result of logic rule 1 in the event.
- Logic rule 2 [28] - use the result of logic rule 2 in the event.
- Logic rule 3 [29] - use the result of logic rule 3 in the event.
- Time-out 0 [30] - use the result of timer 0 in the event.
- Time-out 1 [31] - use the result of timer 1 in the event.
- Time-out 2 [32] - use the result of timer 2 in the event.
- Digital input DI18 [33] - use the value of DI18 in the event (High = TRUE).
- Digital input DI19 [34] - use the value of DI19 in the event (High = TRUE)
- Digital input DI27 [35] - use the value of DI27 in the event (High = TRUE).
- Digital input DI29 [36] - use the value of DI29 in the event (High = TRUE).
- Digital input DI32 [37] - use the value of DI32 in the event (High = TRUE).
- Digital input DI33 [38] - use the value of DI33 in the event (High = TRUE).
- Start command [39] - this event is TRUE if the frequency converter is started by any means (either via digital input, field bus or other).
- Drive stopped [40] - this event is TRUE if the frequency converter is stopped or coasted by any means (either via digital input, fieldbus or other).

13-52 SL Control Action

Array [20]

Option:

*	Disabled	[0]
	No action	[1]
	Select set-up 0	[2]
	Select set-up 1	[3]
	Select set-up 2	[4]
	Select set-up 3	[5]
	Select preset reference 0	[10]
	Select preset reference 1	[11]
	Select preset reference 2	[12]
	Select preset reference 3	[13]
	Select preset reference 4	[14]
	Select preset reference 5	[15]
	Select preset reference 6	[16]
	Select preset reference 7	[17]
	Select ramp 1	[18]
	Select ramp 2	[19]
	Select ramp 3	[20]
	Select ramp 4	[21]
	Run	[22]
	Run reverse	[23]
	Stop	[24]
	Qstop	[25]
	Dcstop	[26]
	Coast	[27]
	Freeze output	[28]
	Start timer 0	[29]
	Start timer 1	[30]
	Start timer 2	[31]
	Set digital output A low	[32]
	Set digital output B low	[33]
	Set digital output C low	[34]
	Set digital output D low	[35]
	Set digital output E low	[36]
	Set digital output F low	[37]
	Set digital output A high	[38]
	Set digital output B high	[39]
	Set digital output C high	[40]
	Set digital output D high	[41]
	Set digital output E high	[42]
	Set digital output F high	[43]
	Reset Counter A	[60]
	Reset Counter B	[61]

Function:

Actions are executed when the corresponding event (defined in par. 13-51) is evaluated as true. The following list of actions are available for selection.

- **DISABLED* [0]
- *No action* [1]
- Select *set-up 1* [2] - changes the active set-up (par. 0-10) to "1".
- Select *set-up 2* [3] - changes the active set-up (par. 0-10) to "2".
- Select *set-up 3* [4] - changes the active set-up (par. 0-10) to "3".
- Select *set-up 4* [5] - changes the active set-up (par. 0-10) to "4". If you change the set-up, it will merge with other set-up commands coming from either the digital inputs or via a fieldbus.
- Select *preset reference* 0 [10] - selects preset reference 0.
- Select *preset reference 1* [11] - selects preset reference 1.
- Select *preset reference 2* [12] - selects preset reference 2.
- Select *preset reference 3* [13] - selects preset reference 3.
- Select *preset reference 4* [14] - selects preset reference 4.
- Select *preset reference 5* [15] - selects preset reference 5.
- Select *preset reference 6* [16] - selects preset reference 6.
- Select *preset reference 7* [17] - selects preset reference 7. If you change the active preset refence, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
- Select *ramp 1* [18] - selects ramp 1.
- Select *ramp 2* [19] - selects ramp 2.
- Select *ramp 3* [20] - selects ramp 3.
- Select *ramp 4* [21] - selects ramp 4.
- *Run* [22] - issues a start command to the drive.
- *Run reverse* [23] - issues a start reverse command to the drive.
- *Stop* [24] - issues a stop command to the drive.
- *Qstop* [25] - issues a quick stop command to the drive.
- *Dcstop* [26] - issues a DC stop command to the drive.
- *Coast* [27] - the drive coasts immediately. All stop commands including the coast command stops the SLC.
- *Freeze output* [28] - freezes the output frequency of the drive.
- *Start timer 0* [29] - starts timer 0, see par. 13-20 for further description.
- *Start timer 1* [30] - starts timer 1, see par. 13-20 for further description.
- *Start timer 2* [31] - starts timer 2, see par. 13-20 for further description.
- Set *digital output A low* [32] - any output with "digtal output 1" selected is low (open).
- Set *digital output B low* [33] - any output with "digtal output 2" selected is low (off).
- Set *digital output C low* [34] - any output with "digtal output 3" selected is low (off).
- Set *digital output D low* [35] - any output with "digtal output 4" selected is low (off).
- Set *digital output E low* [36] - any output with "digtal output 5" selected is low (off).
- Set *digital output F low* [37] - any output with "digtal output 6" selected is low (off).
- Set *digital output A high* [38] - any output with "digtal output 1" selected is high (closed).
- Set *digital output B high* [39] - any output with "digtal output 2" selected is high (closed).
- Set *digital output C high* [40] - any output with "digtal output 3" selected is high (closed).
- Set *digital output D high* [41] - any output with "digtal output 4" selected is high (closed).
- Set *digital output E high* [42] - any output with "digtal output 5" selected is high (closed).
- Set *digital output F high* [43] - any output with "digtal output 6" selected is high (closed).
- *Reset Counter A* [60] - resets Counter A to zero.
- *Reset Counter B* [61] - resets Counter B to zero.

Parameters: Special Functions

14-0* Inverter Switching

14-00 Switching Pattern

Option:

60 AVM	[0]
*SFAVM	[1]

Function:

Choose between two different switching patterns: 60° AVM and SFAVM.

14-01 Switching Frequency

Option:

2.0 kHz	[0]
2.5 kHz	[1]
3.0 kHz	[2]
3.5 kHz	[3]
4.0 kHz	[4]
*5.0 kHz	[5]
6.0 kHz	[6]
7.0 kHz	[7]
8.0 kHz	[8]
10.0 kHz	[9]
12.0 kHz	[10]
14.0 kHz	[11]
16.0 kHz	[12]

Function:

Determines the inverter switching frequency. If the switching frequency is changed, acoustic noise from the motor will be minimised.

NB!:
The output frequency value of the frequency converter can never be a value higher than 1/10 of the switching frequency.

When the motor is running, adjust the switching frequency in par. 4-11 until the motor is as noiseless as possible. See also par. 14-00 and the section *Derating*.

NB!:
Switching frequencies higher than 5.0 kHz lead to automatic derating of the maximum output of the frequency converter.

14-03 Overmodulation

Option:

Off	[0]
*On	[1]

Function:

Allows connection of the overmodulation function for the output voltage.
Off means no overmodulation of the output voltage, and means that torque ripple on the motor shaft is avoided. This feature may be useful e.g. on grinding machines.
On means you can obtain an output voltage greater than the mains voltage (up to 15%).

14-04 PWM Random

Option:

*Off	[0]
On	[1]

Function:

You can transform the audible switching motor noise from a clear ring tone into a less discernable "white" noise, by slightly altering (at random) the synchronism of the pulse width modulated output phases.

14-1* Mains On/Off

Parameters for configuring mains failure monitoring/handling.

14-10 Mains Failure

Option:

*No function	[0]
Controlled alarm suppression	[5]

Function:

Informs the unit of what to do if mains voltage drops below the limit set in par. 14-11.
Select **No function* [0] (default setting) if the function is not required.

Controlled alarm suppression [5] - suppress the "undervoltage alarm" and "undervoltage warning"

14-11 Mains Voltage at Mains Fault

Range:

180 - 600 V	*342 V

Function:

Defines the AC voltage level of the selected function in par. 14-10.

14-12 Function at Mains Imbalance

Option:

*Trip	[0]
Warning	[1]
Disabled	[2]

Function:

Select to trip the drive or issue a warning if the drive detects a severe mains imbalance. Operation under severe main imbalance conditions reduces the life time of the unit. It is severe if the drive is operated continously near nominal load (i.e. running a pump or fan near full speed).

□ 14-2* Trip Reset

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

14-20 Reset Mode

Option:

✱Manual reset	[0]
Automatic reset x 1	[1]
Automatic reset x 2	[2]
Automatic reset x 3	[3]
Automatic reset x 4	[4]
Automatic reset x 5	[5]
Automatic reset x 6	[6]
Automatic reset x 7	[7]
Automatic reset x 8	[8]
Automatic reset x 9	[9]
Automatic reset x 10	[10]
Automatic reset x 15	[11]
Automatic reset x 20	[12]
Infinite Automatic Reset	[13]

Function:

Selects the reset function after tripping. Upon reset, you can restart the frequency converter.
If you select *Manual reset* [0], carry out reset via [RESET] or via the digital inputs. If you want the frequency converter to carry out an automatic reset (1-10 times) after tripping, select *data value* [1]-[10].

NB!:
If the number of AUTOMATIC RESETs is reached within 10 minutes, the frequency converter enters *Manual reset* [0] mode. When a *Manual reset* is performed, the parameter setting is back in force. If the number of AUTOMATIC RESETs is *not* reached within 10 minutes, the internal AUTOMATIC RESET counter is reset. Also, if a *Manual reset* is performed, the internal AUTOMATIC RESET counter is reset.

The motor may start without a warning.

14-21 Automatic Restart Time

Range:

0 - 600 s ✱10 s

Function:

Sets the time from tripping until the automatic reset function begins. Select automatic reset in par. 14-20 to program the parameter.
Set the desired time.

14-22 Operation Mode

Option:

✱Normal operation	[0]
Control card test	[1]
Initialisation	[2]

Function:

Used for two different tests in addition to its normal function. You can also initialise all parameters (except par. 15-03, 15-04 and 15-05). This function is not active until you turn off mains supply to the frequency converter and then turn it on again.
Select *Normal operation* [0] for normal operation with the motor in the selected application.
Select *Control card test* [1] to test 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:

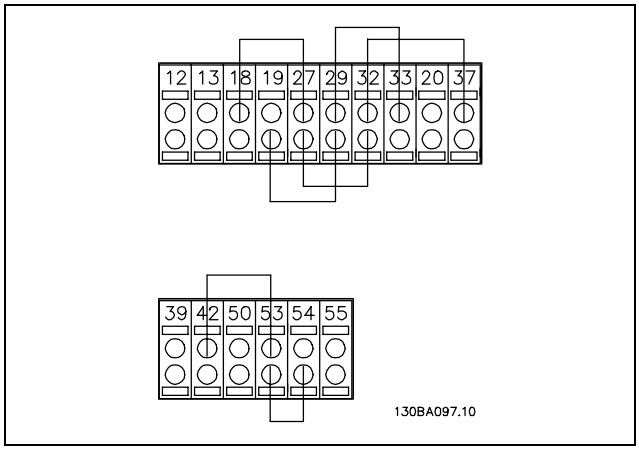
1. Select Control card test.
2. Cut off the mains supply and wait for the light in the display to go out.
3. Set switches S201 (A53) and S202 (A54) = "ON" / I.
4. Insert the test plug (see below).
5. Connect to mains.
6. Carry out various tests.
7. The result is written on the LCP and the drive moves into an infinite loop.
8. Par. 14-22 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.
Cut of mains supply and remove the test plug. The green LED on the Control Card is turned on.

If the test fails:
LCP read-out:
Control Card I/O failure. Replace the unit 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



Select *Initialization* [2] to reset all parameter values to default setting, (except par. 15-03, 15-04, and 15-05). The drive resets during the next power-up. The parameter also resets to default setting *Normal operation* [0].

14-25 Trip Delay at Torque Limit

Option:

0 - 60 s ✱ 60 s

Function:

When the frequency converter registers that the output torque has reached the torque limits (par. 4-16 and 4-17) a warning is shown. If this warning is continuously present as long as specified in this parameter, the frequency converter trips. The feature is disabled by setting the parameter to 60 s = OFF. However, the thermal VLT monitoring is still active.

□ **14-3* Current Limit Control**

The FC 300 Series features an integral current limit control which is activated when the motor current, and thus the torque, is higher than the torque limits set in par. 4-16 and 4-17. When the drive is at the current limit during motor operation or regenerative operation, the frequency converter will try to get below the preset torque limits as quickly as possible without losing control of the motor. While the current control is active, the frequency converter can only be stopped using any digital input set to *Coast inverse* [2] or *Coast and reset inv.* [3]. Any signal on terminals 18 to 33 is not be active until the frequency converter is no longer near the current limit.
By using a digital input set to *Coast inverse* [2] or *Coast and reset inv.* [3], the motor does not use the ramp-down time, since the drive is coasted. If a quick stop is neccesary, use the mechanical brake control function along with an external electro-mechanical brake attached to the application.

14-30 Current Lim Cont, Proportional Gain

Option:

0 - 500 % ✱100 %

Function:

Controls the proportional gain of the current limit control. Setting it to a higher value makes it react faster. A setting too high leads to control instabillity.

14-31 Current Lim Contr, Integration Time

Option:

0.002 - 2.000 s ✱0.020 s

Function:

Controls the current limit control integration time. Setting it to a lower value makes it react faster. A setting too low leads to control instabillity.

□ **14-4* Energy Optimising**

This group contains parameters for adjusting the energy optimisation level in both Variable Torque (VT) and Automatic Energy Optimization (AEO) mode.

14-40 VT Level

Range:

40 - 90% ✱66%

Function:

Sets the level of motor magnetisation at low speed. A low value results in less energy losses in the motor. Note that the consequence is reduced load capability. Par. 14-40 cannot be adjusted while the motor is running.

14-41 Minimum Magnetisation

Range:

40 - 75% ✱40%

Function:

Sets the minimum allowable magnetisation for AEO. A low value results in less energy losses in the

motor. Note that the consequence can be reduced resistance against sudden load changes.

14-42 Minimum AEO Frequency

Range:

5 - 40 Hz *10 Hz

Function:

Sets the minimum frequency at which the Automatic Energy Optimisation (AEO) is active.

14-43 Motor Cosphi

Range:

0.40 - 0.95 N/A *0.66 N/A

Function:

The Cos(phi) setpoint is automatically set for optimum AEO performance. This parameter should normally not be altered, however, it may in some situations be necessay to fine-tune.

□ **14-5* Environment**

If the frequency converter is supplied from an isolated mains source (IT mains) select *Off* [0]. These parameters must be set to *On* [1] for the frequency converter to comply with the EMC standards.

14-50 RFI

Option:

Off	[0]
*On	[1]

Function:

If the drive is supplied from an isolated mains source (IT mains), select *Off* [0]. In this mode, the internal RFI capacities (filter capacitors) between chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the earth capacity currents (according to IEC 61800-3). Select *On* [1], if you want the drive to comply with EMC standards.

14-52 Fan Control

Option:

*Auto	[0]
On 50%	[1]
On 75%	[2]
On 100%	[3]

Function:

Sets the desired continously speed of internal fan.

Parameters: Drive Information

15-0* Operating Data

Parameter group containing operating data e.g. Operating Hours, kWh counters, Power Ups etc.

15-00 Operating Hours

Range:

0 - 2147483647 h ✱0 h

Function:

Indicates how long the frequency converter has run. The value is saved when the unit is turned off.

15-01 Running Hours

Range:

0 - 2147483647 h ✱ 0 h

Function:

Indicates how many hours the motor has run. Reset counter in par. 15-07. The value is saved when the unit is turned off.

15-02 kWh Counter

Range:

0 - 2147483647 kWh ✱ 0 kWh

Function:

States the power consumption from mains in kWh as a mean value over one hour. Reset counter: Par. 15-06.

15-03 Power-ups

Range:

0 - 2147483647 ✱0

Function:

States the number of power-ups to the frequency converter.

15-04 Over Temps

Range:

0 - 65535 ✱0

Function:

States the number of temperature faults on the frequency converter.

15-05 Over Volt's

Range:

0 - 65535 ✱0

Function:

States the number of overvoltages on the frequency converter.

15-06 Reset kWh Counter

Option:

*Do not reset	[0]
Reset counter	[1]

Function:

Reset to zero of kWh hour counter (par. 15-02). Reset the kWh counter by selecting *Reset* [1] and pressing [OK]. You cannot select this parameter via the serial port, RS 485.

NB!:
The reset is carried out by pressing [OK].

15-07 Reset Running Hours Counter

Option:

✱Do not reset	[0]
Reset counter	[1]

Function:

Resets the running hours counter to zero (par. 15-01).
Reset the running hours counter by selecting *Reset* [1] and pressing [OK]. You cannot select this parameter via the serial port, RS 485.

15-1* Data Log Settings

The Data Log enables continuous logging of up to 4 data sources (par. 15-10) at individual rates (par. 15-11). A trigger event (par. 15-12) and window (par. 15-14) are used to start and stop the logging conditionally.

15-10 Logging Source

Array [4]

Option:

None
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference %
16-03 Status Word
16-10 Power [kW]
16-11 Power [hp]
16-12 Motor Voltage
16-13 Frequency
16-14 Motor Current
16-16 Torque
16-17 Speed [RPM]

16-18 Motor Thermal
16-30 DC Link Voltage
16-32 Brake Energy / s
16-33 Brake Energy / 2 min
16-34 Heatsink Temp.
16-35 Inverter Thermal
16-50 External Reference
16-51 Pulse Reference
16-52 Feedback [Unit]
16-60 Digital Input
16-62 Analog Input 53
16-64 Analog Input 54
16-65 Analog Output 42 [mA]
16-66 Digital Output [bin]
16-90 Alarm Word
16-92 Warning Word
16-94 Extended Status Word

Function:

This parameter selects which variable is logged.

15-11 Logging Interval

Range:

1 - 86400000 ms	*1 ms

Function:

Select the interval in milliseconds between each sampling of the variable.

15-12 Trigger Event

Option:

*False	[0]
True	[1]
Running	[2]
In range	[3]
On reference	[4]
Torque limit	[5]
Current limit	[6]
Out of current range	[7]
Below I low	[8]
Above I high	[9]
Out of speed range	[10]
Below speed low	[11]
Above speed high	[12]
Out of feedb. range	[13]
Below feedb. low	[14]
Above feedb. high	[15]
Thermal warning	[16]
Mains voltage out of range	[17]
Reversing	[18]
Warning	[19]
Alarm (trip)	[20]
Alarm (trip lock)	[21]
Comporator 0	[22]
Comporator 1	[23]
Comporator 2	[24]
Comporator 3	[25]
Logic rule 0	[26]
Logic rule 1	[27]
Logic rule 2	[28]
Logic rule 3	[29]
Digital input DI18	[33]
Digital input DI19	[34]
Digital input DI27	[35]
Digital input DI29	[36]
Digital input DI32	[37]
Digital input DI33	[38]

Function:

Select the trigger event. If the event occurs a window is applied to freeze the log. After that it contains a specified amount of samples before and after the occurence of the trigger event (par. 15-14).

15-13 Logging Mode

Option:

*Log always	[0]
Log once on trigger	[1]

Function:

Select if the logging is continuous (Log always) or conditionally started and stopped (Log once on trigger event) (par. 15-12 and 15-14).

15-14 Samples Before Trigger

Range:

0 - 100 N/A	*50 N/A

Function:

Specify the percentage of all samples that are logged before the trigger event.

□ 15-2* Historic Log

It is possible to view up to 50 data logs, via these array parameters. [0] is the latest log and [49] the oldest. A data-log is made every time an *event* occurs (not to be confused with SLC events). *Events* in this context are defined as a change in one of the following areas:

1. Digtal input
2. Digital outputs (not monitored in this SW release)
3. Warning word
4. Alarm word
5. Status word
6. Control word
7. Extended status word

Events are logged with value, and time stamp in msec. The time interval between two events depends on how often *events* occur (maximum once every scan time).
Data logging is continuous but if an alarm occurs, the log is saved and the values are available on the display. This is useful, e.g. when carrying out service after a trip. You can read out this parameter via the serial communication port or via the display.

15-20 Historic Log: Event

Array [50]

Range:

0 - 255 *0

Function:

Shows the occurred type of event.

15-21 Hist. Log: Value

Array [50]

Range:

0 - 2147483647 * 0

Function:

Shows the value of the logged event. Interpret the event values according to this table:

Digtal input	Decimal value. See par. 16-60 for description after converting to binary value.
Digital outputs (not monitored in this SW release)	Decimal value. See par. 16-66 for description after converting to binary value.
Warning word	Decimal value. See par. 16-05 for description.
Alarm word	Decimal value. See par. 16-04 for description.
Status word	Decimal value. See par. 16-03 for description after converting to binary value.
Control word	Decimal value. See par. 16-00 for description.
Extended status word	Decimal value. See par. 16-94 for description.

15-22 Hist. Log: Time

Array [50]

Range:

0 - 2147483647 *0

Function:

Shows when the logged event occurred. Time is measured in ms.

□ **15-3* Fault Log**

Array parameters: See up to 10 fault logs via these parameters. [0] is the latest log and [9] the oldest. The error codes, values, and time stamp are available.

15-30 Fault Log: Error code

Array [10]

Range:

0 - 255 * 0

Function:

Locate the meaning of the error code in section *Troubleshooting*.

15-31 Fault Log: Value

Array [10]

Range:

-32767 - 32767 * 0

Function:

Describes the error and is mostly used in combination with alarm 38 "internal fault".

15-32 Fault Log: Time

Array [10]

Range:

0 - 2147483647 *0

Function:

Shows when the logged event occurred. Time is measured in s.

□ **15-4* Drive Identification**

Parameters containing information about the hardware and software configuration of the frequency converter.

15-40 FC Type

Function:

FC type. The read-out is equal to the FC 300 Series power field of the type code definition (characters 1-6).

15-41 Power Section

Function:
FC type. The read-out equals the FC 300 Series power field of the type code definition (characters 7-10).

15-42 Voltage

Function:
FC type. The read-out equals the FC 300 Series power field of the type code definition (characters 11-12).

15-43 SW Version

Function:
Displays the combined SW version (or "package version") consisting of power SW and control SW.

15-44 Ordered Type Code String

Function:
Shows the type code string used for re-ordering the drive in its original configuration.

15-45 Actual Typecode String

Function:
Shows the actual typecode string.

15-46 Drive Ordering Number

Function:
Shows the 8-digit ordering number used for re-ordering the drive in its original configuration.

15-47 Power Card Ordering No.

Function:
Shows the power card ordering number.

15-48 LCP ID No.

Function:
Shows the LCP ID number.

15-49 SW ID Control Card

Function:
Shows the control card software version number.

15-50 SW ID Power Card

Function:
Shows the power card software version number.

15-51 Drive Serial No.

Function:
Shows the drive serial number.

15-53 Power Card Serial No.

Function:
Shows the power card serial number.

□ **15-6* Option Ident.**
Parameters containing information about the hardware and software configuration of the mounted options.

15-60 Option Mounted

Function:
Shows the type of the installed option.

15-61 Option SW Version

Function:
Shows the software version for the installed options.

15-62 Option Ordering No

Function:
Shows the ordering number for the installed options.

15-63 Option Serial No

Function:
Shows the serial number for the installed options.

15-70 Option in Slot A

Function:
Shows the typecode string for the options (AX if no option) and the translation i.e. "No option".

15-71 Slot A Option SW Version

Function:
Software version for the installed option in slot A.

15-72 Option in Slot B

Function:
Shows the typecode string for the option (BX if no option) and the translation i.e. *No option*.

15-73 Slot B Option SW Version

Function:
Software version for the installed option in slot B.

15-74 Option in Slot C

Function:

Shows the typecode string for the options (CXXXX if no option) and the translation i.e. *No option*.

15-75 Slot C Option SW Version

Function:

Software version for the installed option in option slot C.

□ **15-9* Parameter Info**

15-92 Defined Parameters

Array [1000]

Range:

0 - 9999 *0

Function:

Contains a list of all defined parameters in the drive. The list ends with 0.

15-93 Modified Parameters

Array [1000]

Range:

0 - 9999 *0

Function:

Contains a list of the parameters that are changed compared to default setting. The list ends with 0. The list is updated regularly, so a change might not be reflected until after 30s.

15-99 Parameter Meta Data

Array [23]

Option:

0 - 9999 *0

Function:

For use by MCT10.

□ Parameters: Data Read-outs

□ 16-0* General Status

Parameters for reporting the general status e.g. the calculated reference, the active control word and status etc.

16-00 Control Word

Range:

0 - 65535 ✱0

Function:

Gives the present reference value applied on impulse or analog basis in the unit resulting from the choice of configuration in par. 1-00 (Hz, Nm or RPM).

16-01 Reference [Unit]

Range:

-999999.000 - 999999.000 ✱0.000

Function:

Shows the present value of reference value applied on impulse or analog basis in the unit as a result of the configuration made in par. 01-00 (Hz, Nm or RPM).

16-02 Reference %

Range:

-200.0 - 200.0 % ✱0.0 %

Function:

The value shown corresponds to the total reference (sum of digital/analog/preset/bus/freeze ref./catch-up and slow-down).

16-03 Status Word [Binary]

Range:

0 - 65535 ✱0

Function:

Returns the status word sent from the drive via the serial communication port in hex code.

16-05 Main actual value [%]

Option:

0 - 0 N/A ✱N/A

Function:

Two-byte word sent with the Status word to the bus Master reporting the main actual value. Please refer to to the VLT® AutomationDrive FC 300 Profibus Operating Instructions MG.33.CX.YY for detailed description.

□ 16-1* Motor Status

Parameters for reporting the motor status values.

16-10 Power [kW]

Range:

0.0 - 1000.0 kW ✱0.0 kW

Function:

The value shown is calculated on the basis of the actual motor voltage and motor current. The value is filtered. Thus, approx. 1.3 s may pass from an input value changes until the data read-out values change.

16-11 Power [hp]

Range:

0.00 - 1000.00 hp ✱0.00 hp

Function:

The value shown is calculated on the basis of the actual motor voltage and motor current. The value is indicated in the unit of Horse Power. The value is filtered. Thus, approx. 1.3 seconds may pass from an input value changes until the data read-out changes values.

16-12 Motor Voltage

Range:

0.0 - 6000.0 V ✱0.0 V

Function:

A calculated value used for controlling the motor.

16-13 Frequency

Range:

0.0 - 6500.0 Hz ✱0.0 Hz

Function:

The shown value corresponds to the actual motor frequency (without resonance dampening).

16-14 Motor Current

Range:

0.00 - 0.00 A ✱0.00 A

Function:

The shown value corresponds to the given motor current measured as a mean value IRMS. The value is filtered. Thus, approx. 1.3 s may pass from an input value changes until the data read-out values change.

16-15 Frequency %

Range:

0.00 - 0.00 % ✱0.00 %

Function:

A two-byte word reporting the actual motor frequency (without resonance dampening) as a percentage (scale 0000-4000 Hex) of par. 4-19 *Max. Output Frequency*. Set par. 9-16 index 1 to have it sent with the Status Word instead of the MAV.

16-16 Torque

Range:

-3000.0 - 3000.0 Nm ✱0.0 Nm

Function:

Shows the torque value with sign, applied to the motor shaft. There is not exact linearity between 160% motor current and torque in relation to the rated torque. Some motors supply more torque than that. Consequently, the min. value and the max value will depend on the max. motor current as well as the motor used. The value is filtered. Thus, approx. 1.3 seconds may pass from an input changes value until the data read-out values change.

16-17 Speed [RPM]

Range:

0 - 0 RPM ✱0 RPM

Function:

The value corresponds to the actual motor RPM. The motor RPM is estimated in open loop or closed loop process control. It is measured in speed closed loop modes.

16-18 Motor Thermal

Range:

0 - 0 % ✱0 %

Function:

States the calculated/estimated thermal load on the motor. The cut-out limit is 100%. The basis is ETR function (set in par.1-40).

16-20 Motor Angle

Range:

0 - 65535 ✱0

Function:

The current encoder/resolver angle offset relative to the index position. The value range of 0-65535 corresponds to 0-2*pi (radians).

□ 16-3* Drive Status

Parameters for reporting the Drive status.

16-30 DC Link Voltage

Range:

0 - 10000 V ✱0 V

Function:

Shows a measured value. The value is filtered. Thus, approx. 1.3 s may pass from an input value changes until the data read-out changes values.

16-32 Brake Energy/s

Range:

0.000 - 0.000 kW ✱0.000 kW

Function:

Returns the brake power transmitted to an external brake resistor. Stated as an instantaneous value.

16-33 Brake Energy/2 min

Range:

0.000 - 500.000 kW ✱0.000 kW

Function:

Returns the brake power transmitted to an external brake resistor. The mean power is calculated on an average basis for the latest 120 s.

16-34 Heatsink Temperature

Range:

0 - 255 °C ✱0 °C

Function:

States the drive heatsink temperature. The cut-out limit is 90 ± 5 °C, while the unit cuts back in at 60 ± 5 °C.

16-35 Inverter Thermal

Range:

0 - 0 % ✱0 %

Function:

Returns the percentage load of the inverters.

16-36 Inv. Nom. Current

Range:

0.01 - 10000.00 A ✱ A

Function:

The value should equal the nameplate data on the connected motor. The data is used for calculation of torque, motor protection etc.

Changing the value in this parameter affects the setting of other parameters.

16-37 Inv. Max. Current

Range:

0.01 - 10000.00 A ✱A

Function:

The value should equal the nameplate data on the connected motor. The data is used for calculation of torque, motor protection etc. Changing the value in this parameter affects the setting of other parameters.

16-38 SL Control State

Range:

0 - 0 ✱0

Function:

Returns the state of which event the control is going to execute.

16-39 Control Card Temp.

Range:

0 - 100 °C ✱0 °C

Function:

Returns the temperature on the control card to degree °C.

16-40 Logging Buffer Full

Option:

✱No	[0]
Yes	[1]

Function:

Returns if the Data Log is full (see par. 15-1). The log will never fill when Loging Mode (see par. 15-13) is set to Log always.

□ **16-5* Ref. & Feedb.**

Parameters for reporting the reference and feedback input.

16-50 External Reference

Range:

0.0 - 0.0 ✱0.0

Function:

Returns the total reference sum of digital/analog/preset/bus/freeze ref./catch-up and slow-down.

16-51 Pulse Reference

Range:

0.0 - 0.0 ✱0.0

Function:

Returns the reference value from programmed digital input(s). The read-out can also be the impulses from an incremental encoder.

16-52 Feedback [Unit]

Range:

0.0 - 0.0 ✱0.0

Function:

Gives the resulting feedback value by means of the unit/scaling selected in par. 3-00, 3-01, 3-02 and 3-03.

16-53 Digi Pot Reference

Range:

0.0 - 0.0 ✱0.0

Function:

The contribution of the Digital Potentiometer to the actual reference.

□ **16-6* Inputs and Outputs**

Parameters for reporting the digital and analog IO ports.

16-60 Digital Input

Range:

0 - 63 ✱0

Function:

Returns the signal states from the active digital inputs. Input 18 corresponds to the bit at the far left. '0' = no signal, '1' = connected signal.

16-61 Terminal 53 Switch Setting

Option:

✱Current	[0]
Voltage	[1]

Function:

Returns the setting of input terminal 53. Current = 0; Voltage = 1.

16-62 Analog Input 53

Range:

0.000 - 0.000 ✱0.000

Function:

Returns the actual value on input 53 either as reference or protection value.

✱ default setting **( )** display text **[ ]** value for use in communication via serial communication port

16-63 Terminal 54 Switch Setting

Option:

*Current	[0]
Voltage	[1]

Function:

Returns the setting of input terminal 54.
Current = 0; Voltage = 1.

16-64 Analog Input 54

Range:

0.000 - 0.000 *0.000

Function:

Returns the actual value on input 54 either as reference or protection value.

16-65 Analog Output 42 [mA]

Range:

0.000 - 0.000 *0.000

Function:

Returns the actual value in mA on output 42.
Select the shown value in par. 06-50.

16-66 Digital Output [Bin]

Range:

0 - 3 *0

Function:

Returns the bin value of all digital outputs.

16-67 Frequency Input #29 [Hz]

Range:

0 - 0 *0

Function:

Returns the actual frequency rate on terminal 29.

16-68 Frequency Input #33 [Hz]

Range:

0 - 0 *0

Function:

Returns the actual value of the frequency applied on terminal 29 as an impulse input.

16-69 Pulse Output #27 [Hz]

Range:

0 - 0 *0

Function:

Returns the actual value of impulses applied to terminal 27 in digital output mode.

16-70 Pulse Output #29 [Hz]

Range:

0 - 0 *0

Function:

Returns the actual value of impulses applied to terminal 29 in digital output mode.

16-71 Relay Output [bin]

Range:

0 - 31 *0

Function:

Set out the setting of all relays.

16-72 Counter A

Range:

0 - 0 *0

Function:

The present value of Counter A. Counters are useful as a comparator operand (par. 13-10).
The value can be reset or changed either via digital inputs (parameter group 5-1*) or by using a SLC action (par. 13-52).

16-73 Counter B

Range:

0 - 0 *0

Function:

The present value of Counter B. Counters are useful as a comparator operand (par. 13-10).
The value can be reset or changed either via digital inputs (parameter group 5-1*) or by using a SLC action (par. 13-52).

□ **16-8* Fieldbus & FC Port**

Parameters for reporting the BUS references and control words.

16-80 Fieldbus CTW 1

Range:

0 - 65535 *0

Function:

Two-byte Control word (CTW) received from the Bus-Master. Interpretation of the control word depends on the installed bus option and the chosen control word profile (par. 8-10). For more information - see specific fieldbus manual.

16-82 Fieldbus REF 1

Function:

Two-byte word sent with the control word form the Bus-Master to set the reference value. For more inforation - see specific fieldbus manual.

16-84 Comm. Option STW

Range:

0 - 65535 *0

Function:

Extended fieldbus comm. option status word. For more information - see specific fieldbus manual.

16-85 FC Port CTW 1

Range:

0 - 65535 *0

Function:

Two-byte Control word (CTW) received from the Bus-Master. Interpretation of the control word depends on the installed bus option and the chosen control word profile (par. 8-10).

16-86 FC Port REF 1

Range:

0 - 0 *0

Function:

Two-byte status word (STW) sent to the Bus-Master. Interpretation of the status word depends on the installed bus option and chosen control word profile (par. 8-10).

□ **16-9* Diagnosis Read-Out**

Alarm, warning and extended status words.

16-90 Alarm Word

Range:

0 - 4294967295 *0

Function:

Returns the alarm word sent via the serial communication port in hex code.

16-92 Warning Word

Range:

0 - 4294967295 *0

Function:

Returns the warning word sent via the serial communication port in hex code.

Parameters: EncoderInput

17-** Motor Feedb. Option

Additional parameters to configure the Encoder (MCB102) or the Resolver (MCB103) Feedback Option.

17-1* Inc. Enc. Interface

Configures the incremental interface of the MCB102 option. Note that both the incremental and absolute interfaces are active at the same time.

17-10 Signal Type

Option:

*RS422 (5V TTL/linedrv.)	[1]
Sinusoidal 1Vpp	[2]

Function:

Select the type of the incremental track (A/B channels) of the encoder in use. Consult your encoder data sheet. Select *None* if the encoder is absolute only.
Par. 17-10 cannot be adjusted while the motor is running.

17-11 Resolution (PPR)

Range:

10 - 10000	*1024

Function:

Set the resolution of the incremental track, i.e. the number of pulses or periods per revolution.
Par. 17-11 cannot be adjusted while the motor is running.

17-2* Abs. Enc. Interface

Configures the absolute interface of the MCB102 option. Note that both the incremental and absolute interfaces are active at the same time.

17-20 Protocol Selection

Option:

*None	[0]
HIPERFACE	[1]

Function:

Select the absolute encoder data interface. Select *None* if the encoder is incremental only.
Par. 17-20 cannot be adjusted while the motor is running.

17-21 Resolution (Positions/Rev)

Option:

512	[512]
1024	[1024]
2048	[2048]
4096	[4096]
8192	[8192]
16384	[16384]
*32768	[32768]

Function:

Set the resolution of the absolute encoder, i.e. the number of counts per revolution.
Par. 17-21 cannot be adjusted while the motor is running.

17-34 HIPERFACE Baudrate

Option:

600	[0]
1200	[1]
2400	[2]
4800	[3]
*9600	[4]
19200	[5]
38400	[6]

Function:

Enter the baudrate of the attached encoder.
Par. 17-34 cannot be adjusted while the motor is running.

17-60 Encoder Positive Direction

Option:

*Clockwise	[0]
Counter clockwise	[1]

Function:

Changes the detected encoder direction (revolution) without changing the wires to the encoder. Select Clockwise when A channel is 90° (electrical degrees) before channel B by clockwise rotation of the encoder shaft. Select Counter clockwise when A channel is 90° (electrical degrees) after channel B by clockwise rotation of the encoder shaft. Par. 17-60 cannot be changed while the motor is running.

□ Parameter Lists

Changes during operation

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

4-Set-up

'All set-up': 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.

Conversion index

This number refers to a conversion figure used when writing or reading by means of a frequency converter.

Conv. index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

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

□ 0-** Operation/Display

Par. No. #	Parameter description	Default setting	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	[0] RPM	1 set-up	FALSE	-	Uint8
0-03	Regional Settings	[0] International	1 set-up	FALSE	-	Uint8
0-04	Operating State at Power-up (Hand)	[1] Forced stop, ref=old	All set-ups	FALSE	-	Uint8
0-1* Set-up Handling						
0-10	Active Set-up	[1] Setup 1	1 set-up	FALSE	-	Uint8
0-11	Edit Set-up	[1] Setup 1	All set-ups	FALSE	-	Uint8
0-12	This Set-up Linked to	[1] Setup 1	All set-ups	FALSE	-	Uint8
0-13	Readout: Linked Set-ups	0 N/A	All set-ups	FALSE	0	Uint16
0-14	Readout: Edit Set-ups / Channel	0 N/A	All set-ups	FALSE	0	Int32
0-2* LCP Display						
0-20	Display Line 1.1 Small	1617	All set-ups	FALSE	-	Uint16
0-21	Display Line 1.2 Small	1614	All set-ups	FALSE	-	Uint16
0-22	Display Line 1.3 Small	1610	All set-ups	FALSE	-	Uint16
0-23	Display Line 2 Large	1613	All set-ups	FALSE	-	Uint16
0-24	Display Line 3 Large	1602	All set-ups	FALSE	-	Uint16
0-25	My Personal Menu	ExpressionLimit	1 set-up	FALSE	0	Uint16
0-4* LCP Keypad						
0-40	[Hand on] Key on LCP	[1] Enabled	All set-ups	FALSE	-	Uint8
0-41	[Off] Key on LCP	[1] Enabled	All set-ups	FALSE	-	Uint8
0-42	[Auto on] Key on LCP	[1] Enabled	All set-ups	FALSE	-	Uint8
0-43	[Reset] Key on LCP	[1] Enabled	All set-ups	FALSE	-	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	FALSE	0	Uint16
0-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	FALSE	-	Uint8
0-65	Quick Menu Password	200 N/A	1 set-up	FALSE	0	Uint16
0-66	Access to Quick Menu w/o Password	[0] Full access	1 set-up	FALSE	-	Uint8

□ 1-** Load/Motor

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conver-sion index	Type
1-0* General Settings						
1-00	Configuration Mode	null	All set-ups	FALSE	-	Uint8
1-01	Motor Control Principle	null	All set-ups	FALSE	-	Uint8
1-02	Flux Motor Feedback Source	[1] 24V encoder	All set-ups	FALSE	-	Uint8
1-03	Torque Characteristics	[0] Constant torque	All set-ups	FALSE	-	Uint8
1-05	Local Mode Configuration	[2] As conf. mode P.1-00	All set-ups	FALSE	-	Uint8
1-1* Motor Selection						
1-10	Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8
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
1-29	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
1-33	Stator Leakage Reactance (X1)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-34	Rotor Leakage Reactance (X2)	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	-4	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
1-41	Motor Angle Offset	0 N/A	All set-ups	TRUE	0	Int16
1-5* Load Indep. Setting						
1-50	Motor Magnetisation at Zero Speed	100 %	All set-ups	FALSE	0	Uint16
1-51	Min Speed Normal Magnetising [RPM]	ExpressionLimit	All set-ups	FALSE	67	Uint16
1-52	Min Speed Normal Magnetising [Hz]	ExpressionLimit	All set-ups	FALSE	-1	Uint16
1-53	Model Shift Frequency	6.7 Hz	All set-ups	FALSE	-1	Uint16
1-55	U/f Characteristic - U	ExpressionLimit	All set-ups	FALSE	-1	Uint16
1-56	U/f Characteristic - F	ExpressionLimit	All set-ups	FALSE	-1	Uint16
1-6* Load Depen. Setting						
1-60	Low Speed Load Compensation	100 %	All set-ups	FALSE	0	Int16
1-61	High Speed Load Compensation	100 %	All set-ups	FALSE	0	Int16
1-62	Slip Compensation	100 %	All set-ups	FALSE	0	Int16
1-63	Slip Compensation Time Constant	0.10 s	All set-ups	FALSE	-2	Uint16
1-64	Resonance Dampening	100 %	All set-ups	FALSE	0	Uint16
1-65	Resonance Dampening Time Constant	5 ms	All set-ups	FALSE	-3	Uint8
1-66	Min. Current at Low Speed	100 %	All set-ups	FALSE	0	Uint8
1-67	Load Type	[0] Passive load	All set-ups	FALSE	-	Uint8
1-68	Minimum Inertia	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-69	Maximum Inertia	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-7* Start Adjustments						
1-71	Start Delay	0.0 s	All set-ups	FALSE	-1	Uint8
1-72	Start Function	[2] Coast/delay time	All set-ups	FALSE	-	Uint8
1-74	Start Speed [RPM]	ExpressionLimit	All set-ups	FALSE	67	Uint16
1-75	Start Speed [Hz]	ExpressionLimit	All set-ups	FALSE	-1	Uint16
1-76	Start Current	0.00 A	All set-ups	FALSE	-2	Uint32
1-8* Stop Adjustments						
1-80	Function at Stop	[0] Coast	All set-ups	FALSE	-	Uint8
1-81	Min Speed for Function at Stop [RPM]	ExpressionLimit	All set-ups	FALSE	67	Uint16
1-82	Min Speed for Function at Stop [Hz]	ExpressionLimit	All set-ups	FALSE	-1	Uint16
1-9* Motor Temperature						
1-90	Motor Thermal Protection	[0] No protection	All set-ups	FALSE	-	Uint8
1-91	Motor External Fan	[0] No	All set-ups	FALSE	-	Uint16
1-93	Thermistor Resource	[0] None	All set-ups	FALSE	-	Uint8

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□ 2-** Brakes

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conver-sion index	Type
2-0* DC-Brake						
2-00	DC Hold Current	50 %	All set-ups	FALSE	0	Uint8
2-01	DC Brake Current	50 %	All set-ups	FALSE	0	Uint16
2-02	DC Braking Time	10.0 s	All set-ups	FALSE	-1	Uint16
2-03	DC Brake Cut In Speed	0 RPM	All set-ups	FALSE	67	Uint16
2-1* Brake Energy Funct.						
2-10	Brake Function	null	All set-ups	FALSE	-	Uint8
2-11	Brake Resistor (ohm)	ExpressionLimit	All set-ups	FALSE	0	Uint16
2-12	Brake Power Limit (kW)	ExpressionLimit	All set-ups	FALSE	0	Uint32
2-13	Brake Power Monitoring	[0] Off	All set-ups	FALSE	-	Uint8
2-15	Brake Check	[0] Off	All set-ups	FALSE	-	Uint8
2-17	Over-voltage Control	[0] Disabled	All set-ups	FALSE	-	Uint8
2-2* Mechanical Brake						
2-20	Release Brake Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
2-21	Activate Brake Speed [RPM]	ExpressionLimit	All set-ups	FALSE	67	Uint16
2-22	Activate Brake Speed [Hz]	ExpressionLimit	All set-ups	FALSE	-1	Uint16
2-23	Activate Brake Delay	0.0 s	All set-ups	FALSE	-1	Uint8

□ 3-** Reference / Ramps

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conversion index	Type
3-0* Reference Limits						
3-00	Reference Range	null	All set-ups	FALSE	-	Uint8
3-01	Reference/Feedback Unit	null	All set-ups	FALSE	-	Uint8
3-02	Minimum Reference	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
3-03	Maximum Reference	1500.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
3-1* References						
3-10	Preset Reference	0.00 %	All set-ups	TRUE	-2	Int16
3-12	Catch up/slow Down Value	0.00 %	All set-ups	TRUE	-2	Int16
3-13	Reference Site	[0] Linked to Hand / Auto	All set-ups	FALSE	-	Uint8
3-14	Preset Relative Reference	0.00 %	All set-ups	TRUE	-2	Int32
3-15	Reference Resource 1	[1] Analog input 53	All set-ups	FALSE	-	Uint8
3-16	Reference Resource 2	[20] Digital pot.meter	All set-ups	FALSE	-	Uint8
3-17	Reference Resource 3	[11] Local bus reference	All set-ups	FALSE	-	Uint8
3-18	Relative Scaling Reference Resource	[0] No function	All set-ups	FALSE	-	Uint8
3-19	Jog Speed [RPM]	150 RPM	All set-ups	TRUE	67	Uint16
3-4* Ramp 1						
3-40	Ramp 1 Type	[0] Linear	All set-ups	FALSE	-	Uint8
3-41	Ramp 1 Ramp up Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-42	Ramp 1 Ramp Down Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-45	Ramp 1 S-ramp Ratio at Accel. Start	50 %	All set-ups	FALSE	0	Uint8
3-46	Ramp 1 S-ramp Ratio at Accel. End	50 %	All set-ups	FALSE	0	Uint8
3-47	Ramp 1 S-ramp Ratio at Decel. Start	50 %	All set-ups	FALSE	0	Uint8
3-48	Ramp 1 S-ramp Ratio at Decel. End	50 %	All set-ups	FALSE	0	Uint8
3-5* Ramp 2						
3-50	Ramp 2 Type	[0] Linear	All set-ups	FALSE	-	Uint8
3-51	Ramp 2 Ramp up Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-52	Ramp 2 Ramp down Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-55	Ramp 2 S-ramp Ratio at Accel. Start	50 %	All set-ups	FALSE	0	Uint8
3-56	Ramp 2 S-ramp Ratio at Accel. End	50 %	All set-ups	FALSE	0	Uint8
3-57	Ramp 2 S-ramp Ratio at Decel. Start	50 %	All set-ups	FALSE	0	Uint8
3-58	Ramp 2 S-ramp Ratio at Decel. End	50 %	All set-ups	FALSE	0	Uint8
3-6* Ramp 3						
3-60	Ramp 3 Type	[0] Linear	All set-ups	FALSE	-	Uint8
3-61	Ramp 3 Ramp up Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-62	Ramp 3 Ramp down Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-65	Ramp 3 S-ramp Ratio at Accel. Start	50 %	All set-ups	FALSE	0	Uint8
3-66	Ramp 3 S-ramp Ratio at Accel. End	50 %	All set-ups	FALSE	0	Uint8
3-67	Ramp 3 S-ramp Ratio at Decel. Start	50 %	All set-ups	FALSE	0	Uint8
3-68	Ramp 3 S-ramp Ratio at Decel. End	50 %	All set-ups	FALSE	0	Uint8
3-7* Ramp 4						
3-70	Ramp 4 Type	[0] Linear	All set-ups	FALSE	-	Uint8
3-71	Ramp 4 Ramp up Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-72	Ramp 4 Ramp Down Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-75	Ramp 4 S-ramp Ratio at Accel. Start	50 %	All set-ups	FALSE	0	Uint8
3-76	Ramp 4 S-ramp Ratio at Accel. End	50 %	All set-ups	FALSE	0	Uint8
3-77	Ramp 4 S-ramp Ratio at Decel. Start	50 %	All set-ups	FALSE	0	Uint8
3-78	Ramp 4 S-ramp Ratio at Decel. End	50 %	All set-ups	FALSE	0	Uint8
3-8* Other Ramps						
3-80	Jog Ramp Time	ExpressionLimit	All set-ups	FALSE	-2	Uint32
3-81	Quick Stop Ramp Time	ExpressionLimit	2 set-ups	FALSE	-2	Uint32
3-9* Digital Pot.Meter						
3-90	Step Size	0.10 %	All set-ups	FALSE	-2	Uint16
3-91	Ramp Time	1.00 s	All set-ups	FALSE	-2	Uint32
3-92	Power Restore	[0] Off	All set-ups	FALSE	-	Uint8
3-93	Maximum Limit	100 %	All set-ups	FALSE	0	Int16
3-94	Minimum Limit	-100 %	All set-ups	FALSE	0	Int16
3-95	Ramp Delay	1.000 s	All set-ups	FALSE	-3	TimD

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□ 4-** Limits / Warnings

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conver-sion index	Type
4-1* Motor Limits						
4-10	Motor Speed Direction	[2] Both directions	All set-ups	FALSE	-	Uint8
4-11	Motor Speed Low Limit [RPM]	0 RPM	All set-ups	FALSE	67	Uint16
4-13	Motor Speed High Limit [RPM]	ExpressionLimit	All set-ups	FALSE	67	Uint16
4-16	Torque Limit Motor Mode	160.0 %	All set-ups	FALSE	-1	Uint16
4-17	Torque Limit Generator Mode	160.0 %	All set-ups	FALSE	-1	Uint16
4-18	Current Limit	ExpressionLimit	All set-ups	FALSE	-1	Uint32
4-19	Max Output Frequency	132.0 Hz	All set-ups	FALSE	-1	Uint16
4-5* Adj. Warnings						
4-50	Warning Current Low	0.00 A	All set-ups	FALSE	-2	Uint32
4-51	Warning Current High	ImaxVLT (P1637)	All set-ups	FALSE	-2	Uint32
4-52	Warning Speed Low	0 RPM	All set-ups	FALSE	67	Uint16
4-53	Warning Speed High	outputSpeedHighLimit (P413)	All set-ups	FALSE	67	Uint16
4-54	Warning Reference Low	-999999.999 N/A	All set-ups	FALSE	-3	Int32
4-55	Warning Reference High	999999.999 N/A	All set-ups	FALSE	-3	Int32
4-56	Warning Feedback Low	-999999.999 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
4-57	Warning Feedback High	999999.999 Reference-FeedbackUnit	All set-ups	FALSE	-3	Int32
4-58	Missing Motor Phase Function	[1] On	All set-ups	FALSE	-	Uint8
4-6* Speed Bypass						
4-60	Bypass Speed From [RPM]	0 RPM	All set-ups	FALSE	67	Uint16
4-62	Bypass Speed To [RPM]	0 RPM	All set-ups	FALSE	67	Uint16

□ 5-** Digital In/Out

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conversion index	Type
5-0* Digital I/O mode						
5-00	Digital I/O Mode	[0] PNP	All set-ups	FALSE	-	Uint8
5-01	Terminal 27 Mode	[0] Input	All set-ups	FALSE	-	Uint8
5-02	Terminal 29 Mode	[0] Input	All set-ups	FALSE	-	Uint8
5-1* Digital Inputs						
5-10	Terminal 18 Digital Input	[8] Start	All set-ups	FALSE	-	Uint8
5-11	Terminal 19 Digital Input	[10] Reversing	All set-ups	FALSE	-	Uint8
5-12	Terminal 27 Digital Input	[2] Coast inverse	All set-ups	FALSE	-	Uint8
5-13	Terminal 29 Digital Input	[14] Jog	All set-ups	FALSE	-	Uint8
5-14	Terminal 32 Digital Input	[0] No operation	All set-ups	FALSE	-	Uint8
5-15	Terminal 33 Digital Input	[0] No operation	All set-ups	FALSE	-	Uint8
5-3* Digital Outputs						
5-30	Terminal 27 Digital Output	[0] No operation	All set-ups	FALSE	-	Uint8
5-31	Terminal 29 Digital Output	[0] No operation	All set-ups	FALSE	-	Uint8
5-4* Relays						
5-40	Function Relay	[0] No operation	All set-ups	FALSE	-	Uint8
5-41	On Delay, Relay	0.01 s	All set-ups	FALSE	-2	Uint16
5-42	Off Delay, Relay	0.01 s	All set-ups	FALSE	-2	Uint16
5-5* Pulse Input						
5-50	Term. 29 Low Frequency	100 Hz	All set-ups	FALSE	0	Uint32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	FALSE	0	Uint32
5-52	Term. 29 Low Ref./Feedb. Value	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
5-53	Term. 29 High Ref./Feedb. Value	1500.000 ReferenceFeedbackUnit	All set-ups	FALSE	-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	FALSE	0	Uint32
5-56	Term. 33 High Frequency	100 Hz	All set-ups	FALSE	0	Uint32
5-57	Term. 33 Low Ref./Feedb. Value	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
5-58	Term. 33 High Ref./Feedb. Value	1500.000 ReferenceFeedbackUnit	All set-ups	FALSE	-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	FALSE	-	Uint8
5-62	Pulse Output Maximum Frequency #27	5000 Hz	All set-ups	FALSE	0	Uint32
5-63	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	FALSE	-	Uint8
5-65	Pulse Output Maximum Frequency #29	5000 Hz	All set-ups	FALSE	0	Uint32
5-7* 24V Encoder Input						
5-70	Term 32/33 Pulses per Revolution	1024 N/A	All set-ups	FALSE	0	Uint16
5-71	Term 32/33 Encoder Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8
5-72	Term 32/33 Gear Numerator	1 N/A	All set-ups	FALSE	0	Uint16
5-73	Term 32/33 Gear Denominator	1 N/A	All set-ups	FALSE	0	Uint16

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□ 6-** Analog In/Out

Par. No. #	Parameter description	Default setting	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	FALSE	0	Uint8
6-01	Live Zero Timeout Function	[0] Off	All set-ups	FALSE	-	Uint8
6-1* Analog Input 1						
6-10	Terminal 53 Low Voltage	0.07 V	All set-ups	FALSE	-2	Int16
6-11	Terminal 53 High Voltage	10.00 V	All set-ups	FALSE	-2	Int16
6-12	Terminal 53 Low Current	0.14 mA	All set-ups	FALSE	-5	Int16
6-13	Terminal 53 High Current	20.00 mA	All set-ups	FALSE	-5	Int16
6-14	Terminal 53 Low Ref./Feedb. Value	0.000 ReferenceFeed-backUnit	All set-ups	FALSE	-3	Int32
6-15	Terminal 53 High Ref./Feedb. Value	1500.000 Reference-FeedbackUnit	All set-ups	FALSE	-3	Int32
6-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	FALSE	-3	Uint16
6-2* Analog Input 2						
6-20	Terminal 54 Low Voltage	0.07 V	All set-ups	FALSE	-2	Int16
6-21	Terminal 54 High Voltage	10.00 V	All set-ups	FALSE	-2	Int16
6-22	Terminal 54 Low Current	0.14 mA	All set-ups	FALSE	-5	Int16
6-23	Terminal 54 High Current	20.00 mA	All set-ups	FALSE	-5	Int16
6-24	Terminal 54 Low Ref./Feedb. Value	0.000 ReferenceFeed-backUnit	All set-ups	FALSE	-3	Int32
6-25	Terminal 54 High Ref./Feedb. Value	1500.000 Reference-FeedbackUnit	All set-ups	FALSE	-3	Int32
6-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	FALSE	-3	Uint16
6-5* Analog Output 1						
6-50	Terminal 42 Output	[0] No operation	All set-ups	FALSE	-	Uint8
6-51	Terminal 42 Output Min Scale	0.00 %	All set-ups	FALSE	-2	Int16
6-52	Terminal 42 Output Max Scale	100.00 %	All set-ups	FALSE	-2	Int16

□ 7-** Controls

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conver-sion index	Type
7-0* Speed PID Ctrl.						
7-00	Speed PID Feedback Source	[0] Motor feedb. P1-02	All set-ups	FALSE	-	Uint8
7-02	Speed PID Proportional Gain	0.015 N/A	All set-ups	FALSE	-3	Uint16
7-03	Speed PID Integral Time	ExpressionLimit	All set-ups	FALSE	-4	Uint32
7-04	Speed PID Differentiation Time	ExpressionLimit	All set-ups	FALSE	-4	Uint16
7-05	Speed PID Diff. Gain Limit	5.0 N/A	All set-ups	FALSE	-1	Uint16
7-06	Speed PID Lowpass Filter Time	10.0 ms	All set-ups	FALSE	-4	Uint16
7-2* Process Ctrl. Feedb						
7-20	Process CL Feedback 1 Resource	[0] No function	All set-ups	FALSE	-	Uint8
7-22	Process CL Feedback 2 Resource	[0] No function	All set-ups	FALSE	-	Uint8
7-3* Process PID Ctrl.						
7-30	Process PID Normal/ Inverse Control	[0] Normal	All set-ups	FALSE	-	Uint8
7-31	Process PID Anti Windup	[1] On	All set-ups	FALSE	-	Uint8
7-32	Process PID Start Speed	0 RPM	All set-ups	FALSE	67	Uint16
7-33	Process PID Proportional Gain	0.01 N/A	All set-ups	FALSE	-2	Uint16
7-34	Process PID Integral Time	10000.00 s	All set-ups	FALSE	-2	Uint32
7-35	Process PID Differentiation Time	0.00 s	All set-ups	FALSE	-2	Uint16
7-36	Process PID Diff. Gain Limit	5.0 N/A	All set-ups	FALSE	-1	Uint16
7-38	Process PID Feed Forward Factor	0 %	All set-ups	FALSE	0	Uint16
7-39	On Reference Bandwidth	5 %	All set-ups	FALSE	0	Uint8

□ 8-** Comm. and Options

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conversion index	Type
8-0* General Settings						
8-01	Control Site	[0] Digital and ctrl.word	All set-ups	FALSE	-	Uint8
8-02	Control Word Source	null	All set-ups	FALSE	-	Uint8
8-03	Control Word Timeout Time	1.0 s	1 set-up	FALSE	-1	Uint32
8-04	Control Word Timeout Function	[0] Off	1 set-up	FALSE	-	Uint8
8-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	FALSE	-	Uint8
8-06	Reset Control Word Timeout	[0] Do not reset	All set-ups	FALSE	-	Uint8
8-07	Diagnosis Trigger	[0] Disable	2 set-ups	FALSE	-	Uint8
8-1* Ctrl. Word Settings						
8-10	Control Word Profile	[0] FC profile	All set-ups	FALSE	-	Uint8
8-3* FC Port Settings						
8-30	Protocol	[0] FC	1 set-up	FALSE	-	Uint8
8-31	Address	1 N/A	1 set-up	FALSE	0	Uint8
8-32	FC Port Baud Rate	[2] 9600 Baud	1 set-up	FALSE	-	Uint8
8-35	Minimum Response Delay	10 ms	All set-ups	FALSE	-3	Uint16
8-36	Max Response Delay	5000 ms	1 set-up	FALSE	-3	Uint16
8-37	Max Inter-Char Delay	25 ms	1 set-up	FALSE	-3	Uint16
8-5* Digital/Bus						
8-50	Coasting Select	[3] Logic OR	All set-ups	FALSE	-	Uint8
8-51	Quick Stop Select	[3] Logic OR	All set-ups	FALSE	-	Uint8
8-52	DC Brake Select	[3] Logic OR	All set-ups	FALSE	-	Uint8
8-53	Start Select	[3] Logic OR	All set-ups	FALSE	-	Uint8
8-54	Reversing Select	[3] Logic OR	All set-ups	FALSE	-	Uint8
8-55	Set-up Select	[3] Logic OR	All set-ups	FALSE	-	Uint8
8-56	Preset Reference Select	[3] Logic OR	All set-ups	FALSE	-	Uint8
8-9* Bus Jog						
8-90	Bus Jog 1 Speed	100 RPM	All set-ups	FALSE	67	Uint16
8-91	Bus Jog 2 Speed	200 RPM	All set-ups	FALSE	67	Uint16

□ 9-** Profibus

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conversion index	Type
9-00	Setpoint	0 N/A	All set-ups	FALSE	0	Uint16
9-07	Actual Value	0 N/A	All set-ups	FALSE	0	Uint16
9-15	PCD Write Configuration	ExpressionLimit	2 set-ups	FALSE	-	Uint16
9-16	PCD Read Configuration	ExpressionLimit	2 set-ups	FALSE	-	Uint16
9-18	Node Address	126 N/A	1 set-up	FALSE	0	Uint8
9-22	Telegram Selection	[108] PPO 8	1 set-up	FALSE	-	Uint8
9-23	Parameters for Signals	0	All set-ups	FALSE	-	Uint16
9-27	Parameter Edit	[1] Enabled	2 set-ups	FALSE	-	Uint16
9-28	Process Control	[1] Enable cyclic master	2 set-ups	FALSE	-	Uint8
9-44	Fault Message Counter	0 N/A	All set-ups	FALSE	0	Uint16
9-45	Fault Code	0 N/A	All set-ups	FALSE	0	Uint16
9-47	Fault Number	0 N/A	All set-ups	FALSE	0	Uint16
9-52	Fault Situation Counter	0 N/A	All set-ups	FALSE	0	Uint16
9-53	Profibus Warning Word	0 N/A	All set-ups	FALSE	0	V2
9-63	Actual Baud Rate	[255] No baudrate found	All set-ups	FALSE	-	Uint8
9-64	Device Identification	0 N/A	All set-ups	FALSE	0	Uint16
9-65	Profile Number	0 N/A	All set-ups	FALSE	0	Oct-Str[2]
9-67	Control Word 1	0 N/A	All set-ups	FALSE	0	V2
9-68	Status Word 1	0 N/A	All set-ups	FALSE	0	V2
9-71	Save Data Values	[0] Off	All set-ups	FALSE	-	Uint8
9-72	Drive Reset	[0] No action	1 set-up	FALSE	-	Uint8
9-80	Defined Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
9-81	Defined Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
9-82	Defined Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
9-83	Defined Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
9-90	Changed Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
9-91	Changed Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
9-92	Changed Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
9-93	Changed parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16

□ 10-** CAN Fieldbus

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conver-sion index	Type
10-0* Common Settings						
10-00	CAN Protocol	[1] Device Net	2 set-ups	FALSE	-	Uint8
10-01	Baud Rate Select	[20] 125 Kbps	2 set-ups	FALSE	-	Uint8
10-02	MAC ID	63 N/A	2 set-ups	FALSE	0	Uint8
10-05	Readout Transmit Error Counter	0 N/A	All set-ups	FALSE	0	Uint8
10-06	Readout Receive Error Counter	0 N/A	All set-ups	FALSE	0	Uint8
10-07	Readout Bus Off Counter	0 N/A	All set-ups	FALSE	0	Uint8
10-1* DeviceNet						
10-10	Process Data Type Selection	null	All set-ups	FALSE	-	Uint8
10-11	Process Data Config Write	ExpressionLimit	2 set-ups	FALSE	-	Uint16
10-12	Process Data Config Read	ExpressionLimit	2 set-ups	FALSE	-	Uint16
10-13	Warning Parameter	0 N/A	All set-ups	FALSE	0	Uint16
10-14	Net Reference	[0] Off	2 set-ups	FALSE	-	Uint8
10-15	Net Control	[0] Off	2 set-ups	FALSE	-	Uint8
10-2* COS Filters						
10-20	COS Filter 1	0 N/A	All set-ups	FALSE	0	Uint16
10-21	COS Filter 2	0 N/A	All set-ups	FALSE	0	Uint16
10-22	COS Filter 3	0 N/A	All set-ups	FALSE	0	Uint16
10-23	COS Filter 4	0 N/A	All set-ups	FALSE	0	Uint16
10-3* Parameter Access						
10-30	Array Index	0 N/A	2 set-ups	FALSE	0	Uint8
10-31	Store Data Values	[0] Off	All set-ups	FALSE	-	Uint8
10-32	Devicenet Revision	ExpressionLimit	All set-ups	FALSE	0	Uint16
10-33	Store Always	[0] Off	1 set-up	FALSE	-	Uint8
10-39	Devicenet F Parameters	0 N/A	All set-ups	FALSE	0	Uint32

□ 13-** Smart Logic

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conver-sion index	Type
13-0* SLC Settings						
13-00	SL Control Mode	null	2 set-ups	FALSE	-	Uint8
13-01	Start Event	null	2 set-ups	FALSE	-	Uint8
13-02	Stop Event	null	2 set-ups	FALSE	-	Uint8
13-03	Reset SLC	[0] Do not reset SLC	All set-ups	FALSE	-	Uint8
13-1* Comparators						
13-10	Comparator Operand	null	2 set-ups	FALSE	-	Uint8
13-11	Comparator Operator	null	2 set-ups	FALSE	-	Uint8
13-12	Comparator Value	ExpressionLimit	2 set-ups	FALSE	-3	Int32
13-2* Timers						
13-20	SL Control Timer	ExpressionLimit	1 set-up	FALSE	-3	TimD
13-4* Logic Rules						
13-40	Logic Rule Boolean 1	null	2 set-ups	FALSE	-	Uint8
13-41	Logic Rule Operator 1	null	2 set-ups	FALSE	-	Uint8
13-42	Logic Rule Boolean 2	null	2 set-ups	FALSE	-	Uint8
13-43	Logic Rule Operator 2	null	2 set-ups	FALSE	-	Uint8
13-44	Logic Rule Boolean 3	null	2 set-ups	FALSE	-	Uint8
13-5* States						
13-51	SL Control Event	null	2 set-ups	FALSE	-	Uint8
13-52	SL Control Action	null	2 set-ups	FALSE	-	Uint8

□ 14-** Special Functions

Par. No. #	Parameter description	Default setting	4-set-up	Change during operation	Conver-sion index	Type
14-0* Inverter Switching						
14-00	Switching Pattern	[1] SFAVM	All set-ups	FALSE	-	Uint8
14-01	Switching Frequency	null	All set-ups	FALSE	-	Uint8
14-03	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
14-04	PWM Random	[0] Off	All set-ups	FALSE	-	Uint8
14-1* Mains On/Off						
14-10	Mains Failure	[0] No function	All set-ups	FALSE	-	Uint8
14-11	Mains Voltage at Mains Fault	342 V	All set-ups	FALSE	0	Uint16
14-12	Function at Mains Imbalance	[0] Trip	All set-ups	FALSE	-	Uint8
14-2* Trip Reset						
14-20	Reset Mode	[0] Manual reset	All set-ups	FALSE	-	Uint8
14-21	Automatic Restart Time	10 s	All set-ups	FALSE	0	Uint16
14-22	Operation Mode	[0] Normal operation	All set-ups	FALSE	-	Uint8
14-25	Trip Delay at Torque Limit	60 s	All set-ups	FALSE	0	Uint8
14-28	Production Settings	[0] No action	All set-ups	FALSE	-	Uint8
14-29	Service Code	0 N/A	All set-ups	FALSE	0	Int32
14-3* Current Limit Ctrl.						
14-30	Current Lim Cont, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
14-31	Current Lim Contr, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16
14-4* Energy Optimising						
14-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
14-41	AEO Minimum Magnetisation	40 %	All set-ups	FALSE	0	Uint8
14-42	Minimum AEO Frequency	10 Hz	All set-ups	FALSE	0	Uint8
14-43	Motor Cosphi	ExpressionLimit	1 set-up	FALSE	-2	Uint16
14-5* Environment						
14-50	RFI 1	[1] On	1 set-up	FALSE	-	Uint8
14-52	Fan Control	[0] Auto	All set-ups	FALSE	-	Uint8

∗ default setting **( )** display text **[ ]** value for use in communication via serial communication port

□ 15-** Drive Information

Par. No. #	Parameter description	Default settings	4-set-up	Change during operation	Conver-sion 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	FALSE	-	Uint8
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	FALSE	-	Uint8
15-1* Data Log Settings						
15-10	Logging Source	0	2 set-ups	FALSE	-	Uint16
15-11	Logging Interval	1 ms	2 set-ups	FALSE	-3	TimD
15-12	Trigger Event	[0] False	1 set-up	FALSE	-	Uint8
15-13	Logging Mode	[0] Log always	2 set-ups	FALSE	-	Uint8
15-14	Samples Before Trigger	50 N/A	2 set-ups	FALSE	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
15-3* Fault Log						
15-30	Fault Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint8
15-31	Fault Log: Value	0 N/A	All set-ups	FALSE	0	Int16
15-32	Fault Log: Time	0 s	All set-ups	FALSE	0	Uint32
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]
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 C	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-75	Slot C 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

□ 16-** Data Readouts

Par. No. #	Parameter description	Default settings	4-set-up	Change during operation	Conver-sion index	Type
16-0* General Status						
16-00	Control Word	0 N/A	All set-ups	FALSE	0	V2
16-01	Reference [Unit]	0.000 ReferenceFeed-backUnit	All set-ups	FALSE	-3	Int32
16-02	Reference %	0.0 %	All set-ups	FALSE	-1	Int16
16-03	Status Word	0 N/A	All set-ups	FALSE	0	V2
16-05	Main Actual Value [%]	0.00 %	All set-ups	FALSE	-2	N2
16-1* Motor Status						
16-10	Power [kW]	0.0 kW	All set-ups	FALSE	2	Int32
16-11	Power [hp]	0.00 hp	All set-ups	FALSE	-2	Int32
16-12	Motor Voltage	0.0 V	All set-ups	FALSE	-1	Uint16
16-13	Frequency	0.0 Hz	All set-ups	FALSE	-1	Uint16
16-14	Motor Current	0.00 A	All set-ups	FALSE	-2	Int32
16-15	Frequency [%]	0.00 %	All set-ups	FALSE	-2	N2
16-16	Torque	0.0 Nm	All set-ups	FALSE	-1	Int16
16-17	Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32
16-18	Motor Thermal	0 %	All set-ups	FALSE	0	Uint8
16-20	Motor Angle	0 N/A	All set-ups	FALSE	0	Uint16
16-3* Drive Status						
16-30	DC Link Voltage	0 V	All set-ups	FALSE	0	Uint16
16-32	Brake Energy /s	0.000 kW	All set-ups	FALSE	0	Uint32
16-33	Brake Energy /2 min	0.000 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 Control 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	FALSE	-	Uint8
16-5* Ref. & Feedb.						
16-50	External Reference	0.0 N/A	All set-ups	FALSE	-1	Int16
16-51	Pulse Reference	0.0 N/A	All set-ups	FALSE	-1	Uint32
16-52	Feedback [Unit]	0.000 ReferenceFeed-backUnit	All set-ups	FALSE	-3	Int32
16-53	Digi Pot Reference	0.00 N/A	All set-ups	FALSE	-2	Int16
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	0.000 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	0.000 N/A	All set-ups	FALSE	-3	Int32
16-65	Analog Output 42 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16
16-66	Digital Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
16-67	Freq. Input #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-68	Freq. 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
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	FALSE	0	Int32
16-73	Counter B	0 N/A	All set-ups	FALSE	0	Int32
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
16-92	Warning Word	0 N/A	All set-ups	FALSE	0	Uint32
16-94	Ext. Status Word	0 N/A	All set-ups	FALSE	0	Uint32

∗ default setting **( )** display text **[ ]** value for use in communication via serial communication port

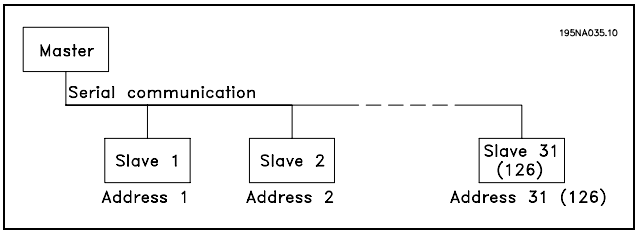
□ **17-** Motor Feedb.Option**

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
17-1* Inc. Enc. Interface						
17-10	Signal Type	[1] RS422 (5V TTL/linedrv.)	All set-ups	FALSE	-	Uint8
17-11	Resolution (PPR)	1024 N/A	All set-ups	FALSE	0	Uint16
17-2* Abs. Enc. Interface						
17-20	Protocol Selection	[0] None	All set-ups	FALSE	-	Uint8
17-21	Resolution (Positions/Rev)	[32768] 32768	All set-ups	FALSE	-	Uint16
17-34	HIPERFACE Baudrate	[4] 9600	All set-ups	FALSE	-	Uint8
17-6* Monitoring and App.						
17-60	Encoder Positive Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8

Serial communication via RS 485 Interface

Protocols

Master-slave communication.



Telegram Traffic

Control and response telegrams

The master controls telegram traffic in a master-slave system. You can connect a maximum of 31 slaves to a master unless you use repeaters. If so, you can connect a maximum of 126 slaves to a master.

The master constantly sends telegrams addressed to the slaves and waits for their response telegrams. The slave response time is maximum 50 ms.

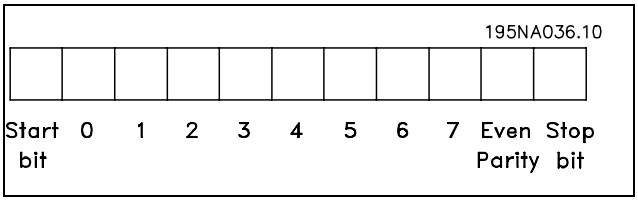
A slave can only send a response telegram if it has received an error-free telegram addressed to itself.

Broadcast

A master can send the same telegram simultaneously to all slaves connected to the bus. During this broadcast communication the slave does not send any response telegrams to the master on whether the telegram is correctly received. Broadcast communication is set up in address format (ADR), see *Telegram structure*.

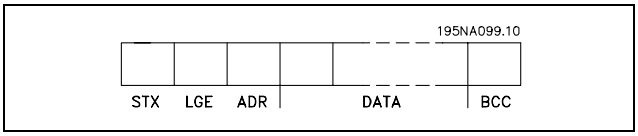
Content of a character (byte)

Each character transferred begins with a start bit. Then 8 data bits are transferred, corresponding to a byte. Each character is secured via a parity bit, which is set at "1" when it reaches parity (i.e. when there is an equal number of 1's in the 8 data bits and the parity bit in total). A character is completed by a stop bit, thus consisting of 11 bits in all.



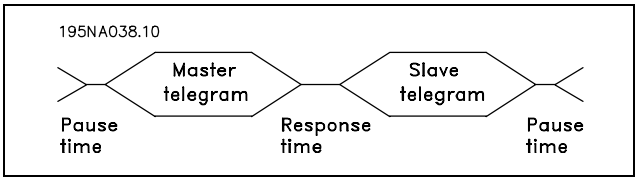
Telegram Structure

Each telegram begins with a start character (STX) = 02 Hex, followed by a byte denoting the telegram length (LGE) and a byte denoting the frequency converter address (ADR). A number of data bytes (variable, depending on the type of telegram) follows. The telegram is completed by a data control byte (BCC).



Telegram timing

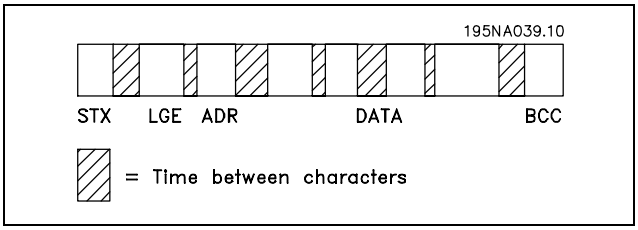
The communication speed between a master and a slave depends on the baud rate. The frequency converter's baud rate must be the same as the master's baud rate (selected in par. 8-32 *FC Port Baud Rate*.



After a response telegram from the slave, make sure there is a pause of at least 2 characters (22 bits) before the master sends a new telegram. At a baud rate of 9600 baud, make sure there is a pause of at least 2.3 ms. When the master has completed the telegram, the slave's response time to the master is maximum of 20 ms. There is a pause of at least 2 characters.

- Pause time, min: 2 characters
- Response time, min: 2 characters
- Response time, max: 20 ms

The time between the individual characters in a telegram may not exceed 2 characters, and the telegram must be completed within 1.5 x nominal telegram time. At a baud rate of 9600 baud and a telegram length of 16 bytes, the telegram is completed after 27.5 ms.



Telegram length (LGE)

The telegram length is the number of data bytes plus the address byte ADR and the data control byte BCC.

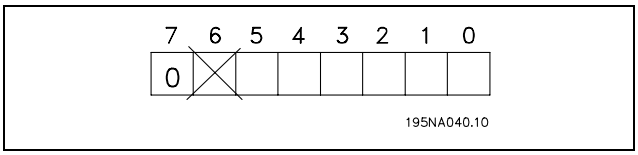
The length of telegrams with 4 data bytes is: LGE = 4 + 1 + 1 = 6 bytes
The length of telegrams with 12 data bytes is: LGE = 12 + 1 + 1 = 14 bytes
The length of telegrams containing texts is 10+n bytes. 10 represents the fixed characters, while the 'n' is variable (depending on the length of the text).

Frequency converter address (ADR)

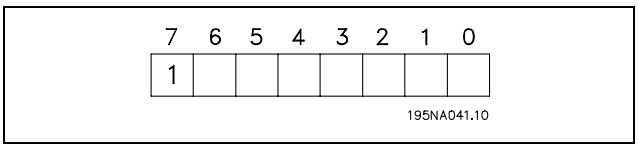
Two different address formats are used. The frequency converter's address range is either 1-31 or 1-126.

1. Address format 1-31

The byte for address range 1-31 has the shown profile:
Bit 7 = 0 (address format 1-31 active)
Bit 6 is not used
Bit 5 = 1: Broadcast, address bits (0-4) are not used
Bit 5 = 0: No Broadcast
Bit 0-4 = Frequency converter address 1-31



2. Address format 1-126

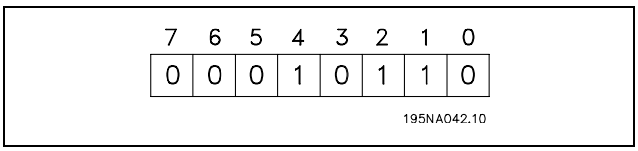


The byte for address range 1 - 126 has the shown profile:
Bit 7 = 1 (address format 1-126 active)
Bit 0-6 = Frequency converter address 1-126
Bit 0-6 = 0 Broadcast

The slave returns the address byte unchanged to the master in the response telegram.

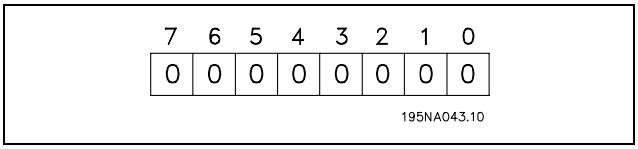
Example:

Writing to frequency converter address 22 (16H) with address format 1-31:



Data control byte (BCC)

The data control byte is explained in this example:
Before the first byte in the telegram is received, the Calculated CheckSum (BCS) is 0.



When the first byte (02H) is received:

BCS = BCC EXOR "first byte"
(EXOR = exclusive-or)

BCS	= 0 0 0 0 0 0 0 0 (00 H)
	EXOR
1. byte	= 0 0 0 0 0 0 1 0 (02H)
BCC	= 0 0 0 0 0 0 1 0 (02H)

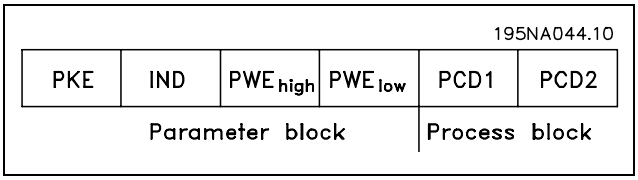
Each subsequent byte gates with BCS EXOR and produces a new BCC, e.g.:

BCS	= 0 0 0 0 0 0 1 0 (02H)
	EXOR
2nd byte	= 1 1 0 1 0 1 1 0 (D6H)
BCC	= 1 1 0 1 0 1 0 0 (D4H)

□ **Data Character (byte)**

The structure of data blocks depends on the type of telegram. There are three telegram types, and the type applies for both control telegrams (master=>slave) and response telegrams (slave=>master). The three types of telegram are:

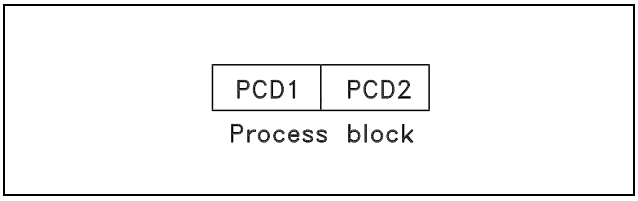
Parameter block: Used to transfer parameters between master and slave. The data block is made up of 12 bytes (6 words) and also contains the process block.



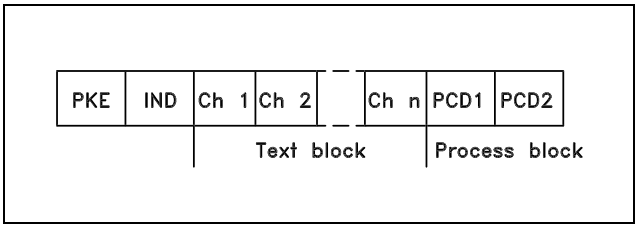
How to Programme

Process block: Made up of a data block of four bytes (2 words) and contains:

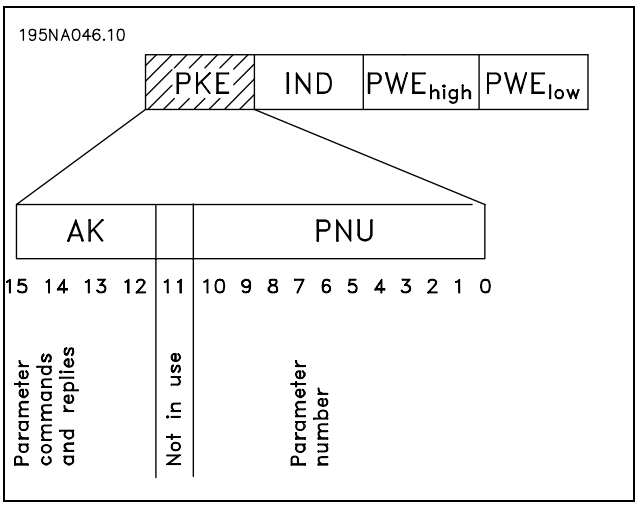
- Control word and reference value (from master to slave)
- Status word and present output frequency (from slave to master)



Text block is used to read or write texts via the data block.



Parameter commands and responses (AK)



Bits no. 12-15 transfers parameter commands from master to slave and returns processed slave responses to the master.

Parameter commands master=>slave				
Bit no.				Parameter command
15	14	13	12	
0	0	0	0	No command
0	0	0	1	Read parameter value
0	0	1	0	Write parameter value in RAM (word)
0	0	1	1	Write parameter value in RAM (double word)
1	1	0	1	Write parameter value in RAM and EEprom (double word)
1	1	1	0	Write parameter value in RAM and EEprom (word)
1	1	1	1	Read/write text

Response slave=>master				
Bit no.				Response
15	14	13	12	
0	0	0	0	No response
0	0	0	1	Parameter value transferred (word)
0	0	1	0	Parameter value transferred (double word)
0	1	1	1	Command cannot be performed
1	1	1	1	Text transferred

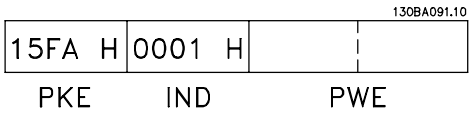
If the command cannot be performed, the slave sends this response: 0111 *Command cannot be performed* and issues the following fault report in the parameter value (PWE):

Response (0111)	Fault Report
0	The parameter number used does not exist
1	There is no write access to the defined parameter
2	Data value exceeds the parameter's limits
3	The sub index used does not exist
4	The parameter is not the array type
5	The data type does not match the defined parameter
17	Data change in the defined parameter is not possible in the frequency converter's present mode. Certain parameters can only be changed when the motor is turned off
130	There is no bus access to the defined parameter
131	Data change is not possible because factory Setup is selected

Parameter number (PNU)
Bits no. 0-10 transfers parameter numbers. The relevant parameter's function is defined in the parameter description in the chapter *How to Programme*.

Index
Index is used together with the parameter number to read/write-access parameters with an index, e.g. par. 15-30 *Error Code*. The index consists of 2 bytes - one lowbyte and one highbyte. Only the lowbyte is used as an index.

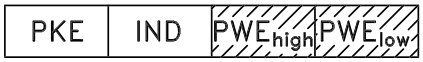
Example - Index:
The first error code (index [1]) in par. 15-30 *Error Code* must be read.
PKE = 15 FA Hex (read par. 15-30 *Error Code*.)
IND = 0001 Hex - Index no. 1.
The frequency converter responds in the parameter value block (PWE) with a fault code value from 1 - 99. See *Summary of Warnings and Alarms* to identify the fault code.



How to Programme

Parameter value (PWE)

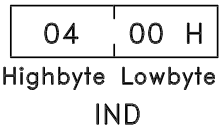
The parameter value block consists of 2 words (4 bytes), and the value depends on the defined command (AK). If the master prompts for a parameter value, the PWE block does not contain a value.



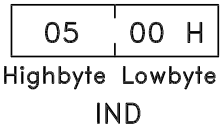
If you want the master to change a parameter value (write), the new value is written in the PWE block and sent to the slave.
If the slave responds to a parameter request (read command), the present parameter value in the PWE block is transferred and returned to the master.
If a parameter contains not a numerical value but several data options, e.g. par. 0-01 *Language* where [0] corresponds to *English*, and [4] corresponds to *Danish*, select the data value by entering the value in the PWE block. See *Example - Selecting a data value*.

Via serial communication it is only possible to read parameters that have data type 9 (text string). Par. 15-40 to 15-33 *Drive Identification* is data type 9. For example, you can read the unit size and mains voltage range in par. 15-40 *FC Type*.
When a text string is transferred (read), the length of the telegram is variable, and the texts are of different lengths. The telegram length is defined in the telegram's second byte, known as LGE.
To read a text via the PWE block, set the parameter command (AK) to 'F' Hex.

The index character indicates if the command is read or write. In a read command, the index must have the shown format:



Some frequency converters have parameters in which you can write a text. To write a text via the PWE block, set the parameter command (AK) to 'F' Hex. For a write command the text must have the shown format:



Data types supported by frequency converter:

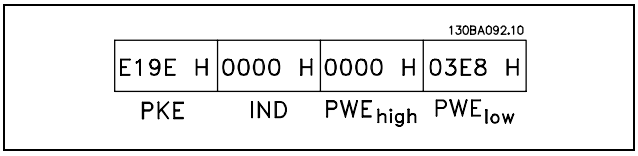
Unsigned means that there is no operational sign in the telegram.

Data types	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string
10	Byte string
13	Time difference
33	Reserved
35	Bit sequence

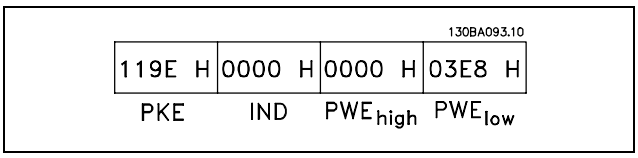
How to Programme

Example - Write a parameter value:
Change par. 4-14 *Motor Speed High Limit* to 100 Hz. After a mains failure, recall the value to write it in EEPROM.

PKE = E19E Hex - Write for par. 4-14 *Motor Speed High Limit*
IND = 0000 Hex
PWE_{HIGH} = 0000 Hex
PWE_{LOW} = 03E8 Hex - Data value 1000, corresponding to 100 Hz, see conversion.

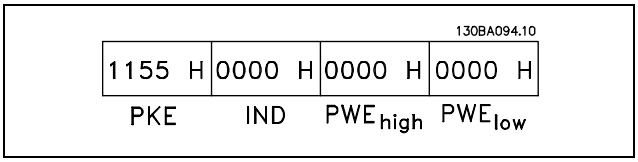


The response from the slave to the master will be:

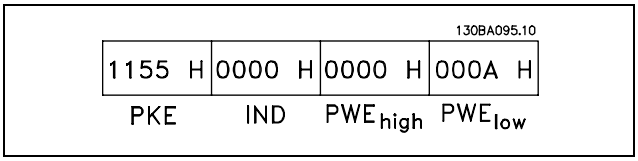


Example - Reading a parameter value:
Requires a value in par. 3-41 *Ramp 1 Up Time*. The master sends the following request:

PKE = 1155 Hex - read par. 3-41 *Ramp 1 Up Time*
IND = 0000 Hex
PWE_{HIGH} = 0000 Hex
PWE_{LOW} = 0000 Hex



If the value in par. 3-41 *Ramp 1 Up Time* is 10 s, the response from the slave to the master is:



Conversion:
The various attributes of each parameter are displayed in section *Factory Settings*. A parameter value is only transferred as a whole number. Thus, use a conversion factor to transfer decimals.

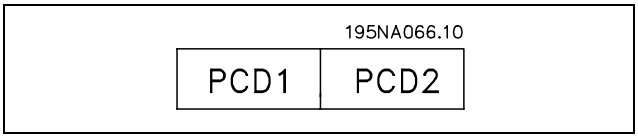
Example:
Par. 4-12 *Motor Speed, Low Limit* has a conversion factor of 0.1. If you wish to preset the minimum frequency to 10 Hz, transfer the value 100. A conversion factor of 0.1 means that the value transferred is multiplied by 0.1. The value 100 is thus perceived as 10.0.

Conversion table

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001
-5	0.00001

□ Process Words

The block of process words is divided into two blocks of 16 bits, which always occur in the defined sequence.



	PCD 1	PCD 2
Control telegram (master=>slave)	Control word	Reference-value
Control telegram (slave=>master)	Status word	Present outp.frequency

□ Control Word According to FC Profile (CTW)

To select FC protocol in the control word, set par. 8-10 Control word rofile to FC protocol [0]. The control sends commands from a master (PLC or PC) to a slave (frequency converter).

Master => slave				
1	2	3	.....	10
CTW	MRV	PCD	.....	PCD
		PCD read/write		

Explanation of the Control Bits

Bit	Bit value = 0	Bit value = 1
00	Reference value	external selection lsb
01	Reference value	external selection msb
02	DC brake	Ramp
03	Coasting	No coasting
04	Quick stop	Ramp
05	Freeze output	use ramp
06	Ramp stop	Start
07	No function	Reset
08	No function	Jog
09	Ramp 1	Ramp 2
10	Data not valid	Data valid
11	Relay 01 open	Relay 01 active
12	Relay 02 open	Relay 02 active
13	Parameter set-up	selection lsb
14	Parameter set-up	selection msb
15	No function	Reverse

Bits 00/01

Use bits 00 and 01 to choose between the four reference values, which are pre-programmed in par. 3-10 *Preset Reference* according to the shown table:

NB!:
Make a selection in par. 8-56 *Preset Reference Select* to define how Bit 00/01 gates with the corresponding function on the digital inputs.

Programmed ref. value	Par.	Bit 01	Bit 00
1	3-10 [0]	0	0
2	3-10 [1]	0	1
3	3-10 [2]	1	0
4	3-10 [3]	1	1

Bit 02, DC brake:
Bit 02 = '0': DC braking and stop. Set braking current and duration in par. 2-01 *DC Brake Current* and 2-02 *DC Braking Time*. Bit 02 = '1' leads to ramping.

Bit 03, Coasting:
Bit 03 = '0': The frequency converter immediately "lets go" of the motor, (the output transistors are "shut off") and it coasts to a standstill. Bit 03 = '1': The frequency converter starts the motor if the other starting conditions are met.

NB!:
Make a selection in par. 8-50 *Coasting Select* to define how Bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick stop:
Bit 04 = '0': Makes the motor speed ramp down to stop (set in par. 3-81 *Quick Stop Ramp Time*.

Bit 05, Freeze output frequency:
Bit 05 = '0': The present output frequency (in Hz) freezes. Change the frozen output frequency only by means of the digital inputs (par. 5-10 to 5-15) programmed to Speed up and Speed down.

NB!:
If Freeze output is active, the frequency converter can only be stopped by the following:

- Bit 03 Coasting stop
- Bit 02 DC braking
- Digital input (par. 5-10 to 5-15) programmed to DC braking, Coasting stop, or Reset and coasting stop.

Bit 06, Ramp stop/start:
Bit 06 = '0': Causes a stop and makes the motor speed ramp down to stop via the selected ramp down par.
Bit 06 = '1': Permits the frequency converter to start the motor, if the other starting conditions are met.

NB!:
Make a selection in par. 8-53 *Start Select* to define how Bit 06 Ramp stop/start gates with the corresponding function on a digital input.

Bit 07, Reset: Bit 07 = '0': No reset. Bit 07 = '1': Resets a trip. Reset is activated on the signal's leading edge, i.e. when changing from logic '0' to logic '1'.

Bit 08, Jog:
Bit 08 = '1': The output frequency is determined by par. 3-19 *Jog Speed*.

Bit 09, Selection of ramp 1/2:
Bit 09 = "0": Ramp 1 is active (par. 3-40 to 3-47). Bit 09 = "1": Ramp 2 (par. 3-50 to 3-57) is active.

Bit 10, Data not valid/Data valid:
Tell the frequency converter whether to use or ignore the control word. Bit 10 = '0': The control word is ignored. Bit 10 = '1': The control word is used. This function is relevant because the telegram always contains the control word, regardless of the telegram type. Thus, you can turn off the control word if you do not want to use it when updating or reading parameters.

Bit 11, Relay 01:
Bit 11 = "0": Relay not activated. Bit 11 = "1": Relay 01 activated provided that Control word bit 11 is chosen in par. 5-40.

Bit 12, Relay 02:
Bit 12 = "0": Relay 2is not activated. Bit 12 = "1": Relay 02 is activated provided that Control word bit 12 is chosen in par. 5-40.

Bit 13/14, Selection of set-up:

Use bits 13 and 14 to choose from the four menu set-ups according to the shown table. The function is only possible when Multi Set-Ups is selected in par. 0-10 *Active Set-Up*.

Set-up	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

NB!:
Make a selection in par. 8-55 *Set-up select* to define how Bit 13/14 gates with the corresponding function on the digital inputs.

Bit 15 Reverse:
Bit 15 = '0': No reversing. Bit 15 = '1': Reversing. In the default setting, reversing is set to digital in par. 8-54 *Reversing Select*. Bit 15 causes reversing only when Ser. communication, Logic or or Logic and is selected.

Status Word According to FC Profile (STW)
The status word informs the master (e.g. a PC) of the slave (frequency converter) operation mode.

Slave => master				
1	2	3	.....	10
STW	MAV	PCD	.....	PCD
		PCD read/write		

Explanation of the Status Bits

Bit	Bit value = 0	Bit value = 1
00	Control not ready	Control ready
01	Drive not ready	Drive ready
02	Coasting	Enable
03	No error	Trip
04	Reserved	-
05	Reserved	-
06	No error	Triplock
07	No warning	Warning
08	Speed ≠ reference	Speed = reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit OK
11	No operation	In operation
12	Drive OK	True if brake Warning/Failure
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

Bit 00, Control not ready/ready:
Bit 00 = '0': The frequency converter trips. Bit 00 = '1': The frequency converter controls are ready but the power component does not necessarily receive any power supply (in case of external 24 V supply to controls).

Bit 01, Drive ready:
Bit 01 = '1': The frequency converter is ready for operation but the coasting command is active via the digital inputs or via serial communication.

Bit 02, Coasting stop:
Bit 02 = '0': The frequency converter releases the motor. Bit 02 = '1': The frequency converter starts the motor with a start command.

Bit 03, No error/trip:
Bit 03 = '0' : The frequency converter is not in fault mode. Bit 03 = '1': The frequency converter trips. To re-establish operation, enter [Reset].

Bit 04, No error/error (no trip):
Bit 04 = '0': The frequency converter is not in fault mode. Bit 04 = "1": The frequency converter shows am error but does not trip.

Bit 05, Not used:
Bit 05 is not used in the status word.

Bit 06, No error / triplock:
Bit 06 = '0': The frequency converter is not in fault mode. Bit 06 = "1": The frequency converter is tripped and locked.

Bit 07, No warning/warning:
Bit 07 = '0': There are no warnings. Bit 07 = '1': Awarning has occurred.

Bit 08, Speed≠ reference/speed = reference:
Bit 08 = '0': The motor is running but the present speed is different from the preset speed reference. It might e.g. be the case when the speed ramps up/down during start/stop. Bit 08 = '1': The motor speed matches the preset speed reference.

Bit 09, Local operation/bus control:
Bit 09 = '0': [STOP/RESET] is activate on the control unit or Local control in par. 3-13 *Reference Site* is selected. You cannot control the frequency converter via serial communication. Bit 09 = '1' It is possible to control the frequency converter via the fieldbus/ serial communication.

Bit 10, Out of frequency limit:
Bit 10 = '0': The output frequency has reached the value in par. 4-11 *Motor Speed Low Limit* or par. 4-13 *Motor Speed High Limit*. Bit 10 = "1": The output frequency is within the defined limits.

Bit 11, No operation/in operation:
Bit 11 = '0': The motor is not running. Bit 11 = '1': The frequency converter has a start signal or the output frequency is greater than 0 Hz.

Bit 12, Drive OK/stopped, autostart:
Bit 12 = '0': There is no temporary over temperature on the inverter. Bit 12 = '1': The inverter stops because of over temperature but the unit does not trip and will resume operation once the over temperature stops.

Bit 13, Voltage OK/limit exceeded:
Bit 13 = '0': There are no voltage warnings. Bit 13 = '1': The DC voltage in the frequency converter's intermediate circuit is too low or too high.

Bit 14, Torque OK/limit exceeded:
Bit 14 = '0': The motor current is lower than the torque limit selected in par. 4-18 *Current Limit*.
Bit 14 = '1': The torque limit in par. 4-18 *Current Limit* is exceeded.

Bit 15, Timer OK/limit exceeded:
Bit 15 = '0': The timers for motor thermal protection and VLT thermal protection are not exceeded 100%. Bit 15 = '1': One of the timers exceeds 100%.

□ **Control Word according to PROFIdrive Profile (CTW)**

The Control word is used to send commands from a master (e.g. a PC) to a slave.

Master => slave				
1	2	3	.....	10
CTW	MRV	PCD	.....	PCD
		PCD read/write		

Explanation of the Control Bits

Bit	Bit value = 0	Bit value = 1
00	OFF 1	ON 1
01	OFF 2	ON 2
02	OFF 3	ON 3
03	Coasting	No coasting
04	Quick stop	Ramp
05	Hold frequency output.	Use ramp
06	Ramp stop	Start
07	No function	Reset
08	Jog 1 OFF	Jog 1 ON
09	Jog 2 OFF	Jog 2 ON
10	Data invalid	Data valid
11	No function	Slow down
12	No function	Catch up
13	Parameter set-up 1	Selection lsb
14	Parameter set-up 2	Selection msb
15	No function	Reverse

Bit 00, OFF 1/ON 1:
Normal ramp stop uses the ramp times of the actual selected ramp. Bit 00 = "0": Stops and activates the output relay 1 or 2, if the output frequency is 0 Hz and if Relay 123 is selected in par. 5-40. Bit 00 = "1": The frequency converter starts if the other start conditions are met.

Bit 01, OFF 2/ON 2
Bit 01 = "0": Coasting stop and activation of the output relay 1 or 2 occurs if the output frequency is 0 Hz and if Relay 123 is selected in par. 5-40. Bit 01 = "1": The frequency converter starts if the other start conditions are met.

Bit 02, OFF 3/ON 3
A quick stop uses the ramp time of par. 2-12. Bit 02 = "0": A quick stop and activation of the output relay 1 or 2 occurs if the output frequency is 0 Hz and if Relay 123 is selected in par. 5-40. Bit 02 = "1": The frequency converter starts if the other start conditions are met.

Bit 03, Coasting/No coasting
Bit 03 = "0": Leads to a stop. Bit 03 = "1": The frequency converter starts if the other start conditions are met.

NB!:
The selection in par. 8-50 *Coasting Select* determines how bit 03 links with the corresponding function of the digital inputs.

Bit 04, Quick stop/Ramp
Quick stop uses the ramp time of par. 3-81. Bit 04 = "0": A quick stop occurs. Bit 04 = "1": The frequency converter starts if the other start conditions are met.

NB!:
The selection in par. 5-51 *Quick Stop Select* determines how bit 04 links with the corresponding function of the digital inputs.

Bit 05, Hold frequency output/Use ramp
Bit 05 = "0": Maintains the current output frequency even if the reference value is modified. Bit 05 = "1": The frequency converter performs its regulating function again. Operation occurs according to the respective reference value.

Bit 06, Ramp stop/Start
Normal ramp stop uses the selected ramp times of the actual ramp. In addition, activation of the output relay 01 or 04 if the output frequency is 0 Hz if Relay 123 is selected in par. 5-40. Bit 06 = "0": Leads to a stop. Bit 06 = "1": The frequency converter starts if the other start conditions are met.

NB!:
The selection in par. 8-53 determines how bit 06 links with the corresponding function of the digital inputs.

Bit 07, No function/Reset
Reset after switching off. Acknowledges event in fault buffer. Bit 07 = "0": No reset occurs. A reset occurs after switching off, when there is a slope change of bit 07 to "1".

Bit 08, Jog 1 OFF/ON
Activation of the pre-programmed speed in par. 8-90 *Bus Jog 1 Speed*. JOG 1 is only possible if bit 04 = "0" and bit 00 - 03 = "1".

Bit 09, Jog 2 OFF/ON
Activation of the pre-programmed speed in par. 8-91 *Bus Jog 2 Speed*. JOG 2 is only possible if bit 04 = "0" and bit 00 - 03 = "1". If both JOG 1 and JOG 2 are activate (bit 08 and 09 = "1"), JOG 3 is selected. Thus, the speed (set in par. 8-92) is used.

Bit 10, Data invalid/valid
Notifies the frequency converter if the process data channel (PCD) should respond to modifications by the master (bit 10 = 1) or not.

Bit 11, No function/Slow down
Reduces the speed reference value by the amount given in par. 3-12 *Catch Up/Slow Down Value*. Bit 11 = "0": The reference value is not modified. Bit 11 = "1": The reference value is reduced.

Bit 12, No function/Catch up
Increases the speed reference value by the amount given in par. 3-12 *Catch Up/Slow Down Value*. Bit 12 = "0": The reference value is not modified. Bit 12 = "1": The reference value is increased. If both slowing down and accelerating are activate (bit 11 and 12 = "1"), slowing down has priority. Thus, the speed reference value is reduced.

Bits 13/14, Set-up selection

Choose between the four parameter set-ups via bits 13 and 14 according to the shown table: The function is only possible if you choose Multi Set-up in par. 0-10. The selection in par. 8-55 *Set-up Select* determines how bits 13 and 14 links with the corresponding function of the digital inputs. When the motor is running, you can only change the set-up if it is linked.

Set-up	Bit 13	Bit 14
1	0	0
2	1	0
3	0	1
4	1	1

Bit 15, No function/Reverse

Reversion of the motor rotational direction. Bit 15 = "0": No reversion. Bit 15 = "1": Reversion. The reversion in the default setting in par. 8-54 *Reversing Select* is "Logic OR". Bit 15 causes a reversion only when "Bus", "Logic OR", or "Logic AND" is selected ("Logic AND" only in connection with terminal 9, however).

NB!:
Unless otherwise indicated, the control word bit links with the corresponding digital input function as a logic "OR".

□ Status Word According to PROFIdrive Profile (STW)

The Status word is used to notify a master (e.g. a PC) about the status of a slave.

Slave => master				
1	2	3	.....	10
STW	MAV	PCD	.....	PCD
		PCD read/write		

Explanation of the Status Bits

Bit	Bit value = 0	Bit value = 1
00	Control not ready	Control ready
01	Drive not ready	Drive ready
02	Coasting	Enable
03	No error	Trip
04	OFF 2	ON 2
05	OFF 3	ON 3
06	Start possible	Start not possible
07	No warning	Warning
08	Speed ≠ reference	Speed = reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit
11	No operation	In operation
12	Drive OK	Stopped, autostart
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

Bit 00, Control not ready/ready
Bit 00 = "0": Bit 00, 01, or 02 of the Control word is "0" (OFF 1, OFF 2 or OFF 3) - or the frequency converter switches off (trips). Bit 00 = "1": The frequency converter control is ready but there is not necessarily a power supply (in the event of external 24 V supply of the control system).

Bit 01, VLT not ready/ready
Same significance as bit 00 but with power unit supply. The frequency converter is ready when it receives the necessary start signals.

Bit 02, Coasting/Enable
Bit 02 = "0": Bit 00, 01, or 02 of the Control word is "0" (OFF 1, OFF 2, or OFF 3 or coasting) - or the frequency converter switches off (trips). Bit 02 = "1": Bit 00, 01, or 02 of the Control word is "1" - the frequency converter does not trip.

Bit 03, No error/Trip
Bit 03 = "0": No error in the frequency converter. Bit 03 = "1": The frequency converter trips and requires. Press [Reset] to restart.

Bit 04, ON 2/OFF 2
Bit 04 = "0": Bit 01 of the Control word is "0". Bit 04 = "1": Bit 01 of the Control word is "1".

Bit 05, ON 3/OFF 3
Bit 05 = "0": Bit 02 of the Control word is "0". Bit 05 = "1": Bit 02 of the Control word is "1".

Bit 06, Start possible/Start not possible
Bit 06 is always "0" if you select FC Drive in par. 8-10. If you select PROFIdrive in par. 8-10, bit 06 is "1" after a switch-off acknowledgement, after activation of OFF2 or OFF3, and after switching on mains voltage. Start is not possible. The frequency converter is reset with bit 00 of the Control word set to "0" and bit 01, 02, and 10 set to "1".

Bit 07, No warning/Warning
Bit 07 = "0": No unusual situation.Bit 07 = "1": There is an unusual status in the frequency converter. For more information about warnings - see the *FC 300 Profibus Operating Instructions*.

Bit 08, Speed ≠ reference / Speed = reference:
Bit 08 = "0": The motor speed deviates from the set speed reference value. This occurs e.g. when the speed is changed during start/stop through ramp up/down. Bit 08 = "1": The motor speed corresponds to the set speed reference value.

Bit 09, Local operation/Bus control
Bit 09 = "0": Indicates that the frequency converter is stopped via [Stop] or that Local is selected in par. 0-02. Bit 09 = "1": The frequency converter is controlled through the serial interface.

Bit 10, Out of frequency limit/Frequency limit OK
Bit 10 = "0": The output frequency is outside the limits set in par. 4-11 and par. 4-13 (Warnings: Motor speed low or high limit). Bit 10 = "1": The output frequency is within the indicated limits.

Bit 11, No operation/Operation
Bit 11 = "0": The motor is not running. Bit 11 = "1": A start signal is active or the output frequency is higher than 0 Hz.

Bit 12, Drive OK/Stopped, autostart
Bit 12 = "0": No temporary overloading of the inverter. Bit 12 = "1": The inverter stops due to overload. However, the frequency converter is not switched off (trip) and will restart after the overloading stops.

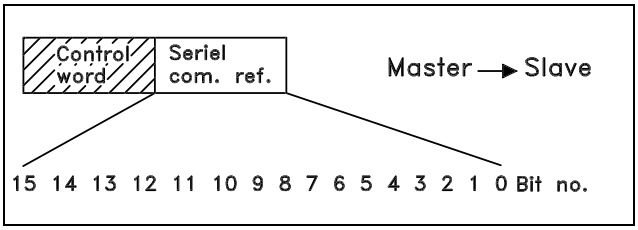
Bit 13, Voltage OK/Voltage exceeded
Bit 13 = "0": The frequency converter voltage limits are not exceeded. Bit 13 = "1": The direct voltage in the drive intermediate circuit is too low or too high.

Bit 14, Torque OK/Torque exceeded
Bit 14 = "0": The motor current is below the moment limit selected in par. 4-18. Bit 14 = "1": The torque limit selected in par. 4-18 is exceeded.

Bit 15, Timer OK/Timer exceeded
Bit 15 = "0": The timers for the thermal motor protection and thermal frequency converter protection have not exceeded 100%. Bit 15 = "1": One of the timers has exceeded 100%.

□ **Serial Communication Reference**

The serial communication reference is transferred to the frequency converter as a 16-bit word. The value is transferred in whole numbers 0 - ±32767 (±200%). 16384 (4000 Hex) corresponds to 100%.

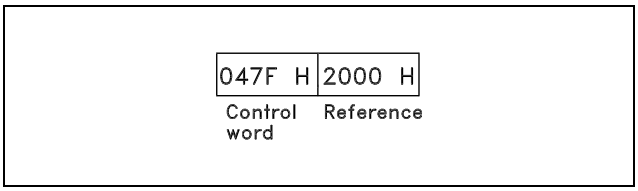


The serial communication reference has the following format: 0-16384 (4000 Hex) ≅ 0-100% (par. 3-02 *Minimum Ref.* to par. 3-03*Maximum Ref.*).

It is possible to change the direction of rotation via the serial reference. This is done by converting the binary reference value to 2' complement. See example.

Example - Control word and serial communication ref.:

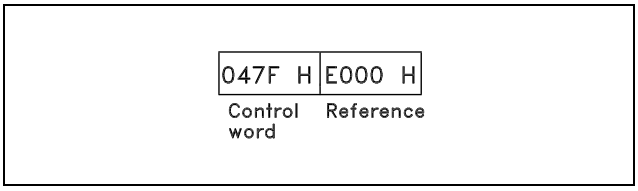
The frequency converter receives a start command and the reference is set to 50% (2000 Hex) of the reference range.
Control word = 047F Hex => Start command.
Reference = 2000 Hex => 50% reference.



The frequency converter receives a start command and the reference is set to -50% (-2000 Hex) of the reference range.
The reference value is first converted to 1' complement, and then 1 is added binarily to obtain 2' complement:

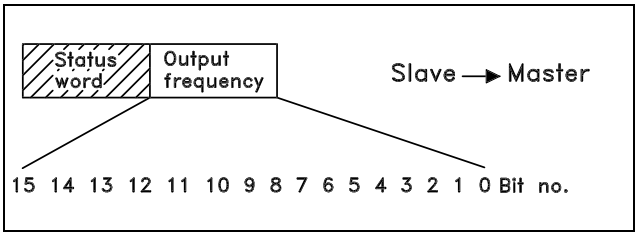
2000 Hex	0010 0000 0000 0000 0000
1' complement	1101 1111 1111 1111 1111
	+ 1
2' complement	1110 0000 0000 0000 0000

Control word = 047F Hex => Start command.
Reference = E000 Hex => -50% reference.



□ **Present Output Frequency**

The value of the frequency converter's present output frequency is transferred as a 16-bit word. The value is transferred as whole numbers 0 - ±32767 (±200%).
16384 (4000 Hex) corresponds to 100%.

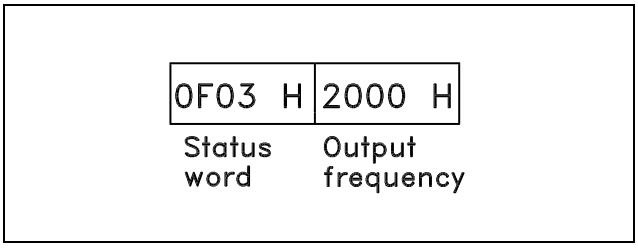


Output frequency has this format:
0-16384 (4000 Hex) ≅ 0-100% (Par. 4-12 *Motor Speed Low Limit* - par. 4-14 *Motor Speed High Limit*).

Example - Status word and current output frequency:

The frequency converter informs the master that the current output frequency is 50% of the output frequency range.
Par. 4-12*Motor Speed Low Limit* = 0 Hz
Par. 4-14*Motor Speed High Limit* = 50 Hz

Status word = 0F03 Hex.
Output frequency= 2000 Hex => 50% of the frequency range, corresponding to 25 Hz.



□ **Example 1: For Controlling the Drive and Reading Parameters**

This telegram reads par. 16-14 *Motor Current*.

Telegram to the frequency converter:

stx	lge	adr	pke	ind	pwe, high	pwe, low	pcd 1	pcd 2	bcc
02	0E	01	6 4E	00 00	00 00	00 00	00 00	00 00	45

All numbers are in hex format.

The response from the frequency converter corresponds to the command above but *pwe,high* and *pwe,low* contains the actual value of par. 16-14 multiplied by 100. If the actual output current is 5.24 A, the value from the frequency converter is 524.

Response from the frequency converter:

stx	lge	adr	pke	ind	pwe, high	pwe, low	pcd 1	pcd 2	bcc
02	0E	01	6 4E	00 00	00 00	02 0C	06 07	00 00	4A

All numbers are in hex format.

Pcd 1 and *pcd 2* from example 2 can be used and added to the example. Thus, t it is possible to control the drive and read the current at the same time.

□ **Example 2: Only for Controlling the Drive**
This telegram sets the control word to 047C Hex (Start command) with a speed reference of 2000 Hex (50%).

NB!:
Par. 8-10 is set to FC Profile.

Telegram to the frequency converter:
All numbers are in hex format.

stx	lge	adr	pcd 1		pcd 2		bcc
02	06	04	04	7C	20	00	58

The frequency converter supplies information about the drive status after receiving the command. By resending the command, the *pcd1* changes to a new status.

Response from the frequency converter:

All numbers are in hex format.

stx	lge	adr	pcd 1		pcd 2		bcc
02	06	04	06	07	00	00	01

□ **Read Parameter Description Elements**
Read the characteristics of a parameter (eg. *Name, Default value, conversion,* etc.) with *Read Parameter Description Elements*.

The table hows the available parameter description elements:

Index	Description
1	Basic characteristics
2	No of elements (array types)
4	Unit of measure
6	Name
7	Lower limit
8	Upper limit
20	Default value
21	Additional characteristics

In the following example *Read Parameter Description Elements* is chosen in par. 0-01 *Language*, and the requested element is index 1 *Basic characteristics*.

Basis characteristics (index 1):
The Basic characteristics command is split up in two parts representing basic behaviour and datatype.
The Basic characteristics return a 16 bit value to the master in PWE_{LOW}.
The basic behaviour indicates whether eg. text is available or the parameter is an array as single bit information in the high byte of PWE_{LOW}.
The datatype part indicates if a parameter is signed 16, unsigned 32 in the low byte of PWE_{LOW}.

PWE high basic behaviour:

Bit	Description
15	Active parameter
14	Array
13	Parameter value can only be reset
12	Parameter value different from factory setting
11	Text available
10	Additional text available
9	Read only
8	Upper and lower limit not relevant
0-7	Data type

Active parameter is only active when communicating through Profibus.
Array means that the parameter is an array.
If bit 13 is true, the parameter can only be reset, not written to.
If bit 12 is true, the parameter value is different from the factory setting.
Bit 11 indicates that text is available.
Bit 10 indicates that additional text is available. Eg. par. 0-01, *Language*, contains text for index field 0, *English*, and for index field 1, *German*.
If bit 9 is true, the parameter value is read-only and cannot be changed.
If bit 8 is true, upper and lower limits of the parameter value are not relevant.

PWE_{LOW} datatype

Dec.	Data type
3	Signed 16
4	Signed 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Visible string
10	Byte string
13	Time difference
33	Reserved
35	Bit sequence

Example
In this example, the master reads the Basic characteristics of par. 0-01, *Language.* The following telegram must be sent to the frequency converter:

STX	LGE	ADR	PKE	IND	PWE_{HIGH}	PWE_{LOW}	PCD1	PCD2	BCC
02	0E	01	40 01	00 01	00 00	00 00	XX XX	XX XX	XX

STX = 02 Start byte
LGE = 0E Length of remaining telegram
ADR = Sends the frequency converter on Address 1, Danfoss format
PKE = 4001; 4 in the PKE field indicates a *Read Parameter Description* and 01 indicates par. 0-01, *Language*
IND = 0001; 1 indicates that *Basic characteristics* are required.

The response from the frequency converter is:

STX	LGE	ADR	PKE	IND	PWE_{HIGH}	PWE_{LOW}	PCD1	PCD2	BCC
02	0E	01	30 01	00 01	00 00	04 05	XX XX	XX XX	XX

STX= 02 Start byte
IND = 0001; 1 indicates that *Basic characteristics* are sent
PKE = 3001: 3 in the PKE field indicates *Parameter Description Element Transferred*, 01 indicates par. 0-01.
PWE_{LOW} = 0405; 04 indicates that Basic behaviour as bit 10 corresponds to *Additional text*. 05 is the datatype which corresponds to *Unsigned 8*.

No of elements (index 2):
This function indicates the Number of elements (array) of a parameter. The answer to the master will be in PWE_{LOW}.

Conversion and Unit of measurement (index 4):
The Conversion and unit of measurement command indicates the conversion of a parameter and the unit of measurement. The answer to the master is in PWE_{LOW}. The conversion index is in the high byte of PWE_{LOW} and the unit index is in the low byte of PWE_{LOW}. Conversion index is signed 8 and unit index is unsigned 8, see the tables.

Conversion index	Conversion factor
0	1
1	10
2	100
3	1000
-1	0.1
-2	0.01
-3	0.001
67	1/60
74	3600
75	3600000
100	1

The unit index defines the "Unit of measure". The conversion index defines how the value should be scaled to get the basic representation of the "Unit of measure". Basic representation is where conversion index equals "0".

Example:
A parameter has a "unit index" of 9 and a "conversion index" of 2. The raw (integer) value read is 23. This means that we have a parameter of the unit "Power" and the raw value should be multiplied by 10 to the power of 2 and the unit is W. 23 x 10^2 = 2300 W

Unit index	Unit of measure	Designation	Conversion index
0	Dimension less		0
4	Time	s	0
		h	74
8	Energy	j	0
		kWh	
9	Power	W	0
		kW	3
11	Speed	1/s	0
		1/min (RPM)	67
16	Torque	Nm	0
17	Temperature	K	0
		°C	100
21	Voltage	V	0
22	Current	A	0
24	Ratio	%	0
27	Relative change	%	0
28	Frequency	Hz	0
54	Time difference w/o date indication	ms	1*

*

Bit	8	7	6	5	4	3	2	1	
Byte 1	2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}	ms
Byte 2	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}	
Byte 3	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	
Byte 4	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}	

Name (index 6):
The Name returns a string value in ASCII format, containing the name of the parameter.

Example:
In this example the master reads the name of par. 0-01, *Language*.

The following telegram must be sent to the frequency converter:

STX	LGE	ADR	PKE	IND	PWE_{HIGH}	PWE_{LOW}	PCD1	PCD2	BCC
02	0E	01	40 01	00 06	00 00	00 00	XX XX	XX XX	XX

STX = 02 Start byte
LGE = 0E Length of remaining telegram
ADR = Sends the frequency converter on Address 1, Danfoss format
PKE = 4001; 4 in the PKE field indicates a *Read Parameter Description* and 01 indicates par. 0-01, *Language*
IND = 0006; 6 indicates that *Names* is required.

The response from the frequency converter will be:

STX	LGE	ADR	PKE	IND	PVA	PCD1	PCD2	BCC
02	12	01	30 01	00 06	4C41 4E47 5541 4745	XXXX	XXXX	XX

PKE = 3001; 3 are the response for *Name* and 01 indicates the par. 0-01, *Language*
IND = 00 06; 06 indicates that *Name* is sent.
PVA = 4C 41 4E 47 55 41 47 45
L A N G U A G E

The parameter value channel is now set up to a visible string which returns an ASCII character for each letter in the parameter name.

Lower limit (index 7):
The Lower limit returns the minimum allowed value of a parameter. The data type of Lower limit is the same as for the parameter itself.

Upper limit (index 8):
The Upper limit returns the maximum allowed value of a parameter. The data type of Upper limit is the same is for the parameter itself.

Default value (index 20):
The Default value returns the default value of a parameter, which is the factory setting. The data type of Default value is the same as for the parameter itself.

Additional characteristics (index 21):
The command can be used for getting additional information on a parameter, eg. *No bus Access, Power Unit dependency, etc.*. The Additional characteristics returns an answer in PWE_{LOW}. If a bit is logic '1', the condition is true according to the table below:

Bit	Description
0	Special Default Value
1	Special Upper Limit
2	Special Lower Limit
7	LCP Access LSB
8	LCP Access MSB
9	NoBusAccess
10	Std Bus Read Only
11	Profibus Read Only
13	ChangeRunning
15	PowerUnitDependency

If one of bit 0 *Special Default Value*, bit 1 *Special Upper Limit* and bit 2 *Special Lower Limit* are true, the parameter has power unit depending values.

Bit 7 and 8 indicates the attributes for the LCP access, see table.

Bit 8	Bit 7	Description
0	0	No access
0	1	Read only
1	0	Read/write
1	1	Write with lock

Bit 9 indicates *No bus Access*.
Bits 10 and 11 indicates that this parameter can only be read over the bus.

If bit 13 is true, the parameter cannot be changed while running.
If bit 15 is true, the parameter is depending on the power unit.

□ **Additional Text**

With this feature it is possible to read additional text if bit 10, *Additional text available*, is true in Basic characteristics.

To read out additional text, the parameter command (PKE) must be set to F hex, see *Databytes*.

The index-field is used for pointing out which element to read. Valid indexes are in the range of 1 through 254. The index must be calculated after the following equation:
Index = Parameter value + 1 (see table below).

Value	Index	Text
0	1	English
1	2	Deutsch
2	3	Français
3	4	Dansk
4	5	Espanol
5	6	Italiano

Example:

In this example, the Master reads additional text in par. 0-01, *Language*. The telegram is set up to read data value [0] (*English*). You must send the following telegram to the frequency converter:

STX	LGE	ADR	PKE	IND	PWE_{HIGH}	PWE_{LOW}	PCD1	PCD2	BCC
02	0E	01	F0 01	00 01	00 00	00 00	XX XX	XX XX	XX

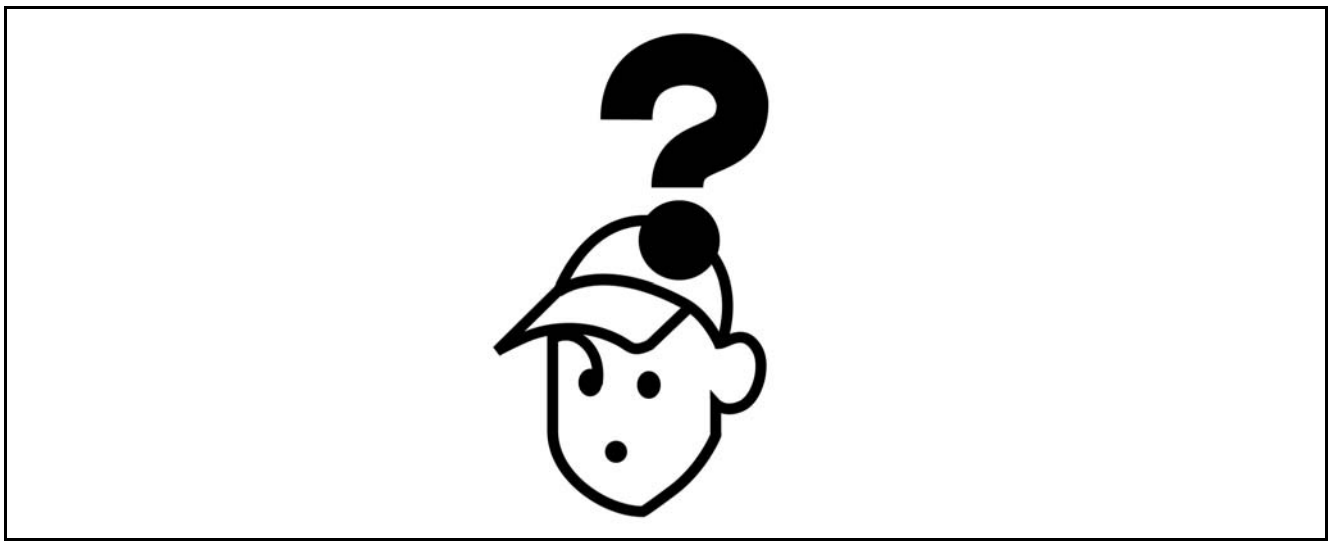
STX = 02 Start byte
LGE = 0E Length of the remaining telegram
ADR = Send the VLT frequency converter on Address 1, Danfoss format
PKE = F001; F in the PKE field indicates a *Read text* and 01 indicates par. 0-01, *Language*.
IND = 0001; 1 indicates that text to parameter value [0] is required

The response from the frequency converter is:

STX	LGE	ADR	PKE	IND	PVA	PCD1	PCD2	BCC
02	11	01	F0 01	00 01	454E 474C 4953 48	XX XX	XX XX	XX

PKE = F001; F is the response for *Text transfer* and 01 indicates par. 0-01, *Language*.
IND = 0001; 1 indicates that index [1] is sent
PVA = 45 4E 47 4C 49 53 48
E N G L I S H

The parameter value channel is now set up to a visible string, which returns an ASCII character for each letter in the index name.



□ **Warnings/Alarm Messages**

A warning or an alarm icon appears in the display as well as a text string describing the problem. A warning is shown on the display until the fault has been corrected, while an alarm will continue to flash on the LED until you activate the [RESET] key. The table (next page) shows the various warnings and alarms, and whether the fault locks the FC 300. After an *Alarm/Trip locked*, cut off the mains supply and correct the fault. Reconnect mains supply. The FC 300 is now unlocked. The *Alarm/Trip* can be reset manually in three ways:

1. Via the operating key [RESET].
2. Via a digital input.
3. Via serial communication.

You can also choose an automatic reset in par. 14-20 *Reset Mode*. When an X appears in both warning and alarm, it means that either a warning comes before an alarm or that you can define whether a warning or an alarm appears for a given fault. For example, this is possible in par. 1-90 *Motor Thermal Protection*. After an alarm/trip, the motor will remain coasted, and alarm and warning will flash on the FC 300. If the fault disappears, only the alarm will flash.

Troubleshooting

No.	Description	Warning	Alarm/Trip	Alarm/Trip locked
1	10 Volts low	X		
2	Live zero error	(X)	(X)	
3	No motor	X		
4	Mains phase loss	X	X	X
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	
11	Motor thermistor over temperature	X	X	
12	Torque limit	X	X	
13	Over Current	X	X	X
14	Earth fault	X	X	X
16	Short Circuit		X	X
17	Control word timeout	(X)	(X)	
25	Brake resistor short-circuited	X		
26	Brake resistor power limit	X	X	
27	Brake chopper fault	X	X	
28	Brake check	X	X	
29	Power card over temp	X	X	X
30	Motor phase U missing		X	X
31	Motor phase V missing		X	X
32	Motor phase W missing		X	X
33	Inrush fault		X	X
34	Fieldbus communication fault	X	X	
38	Internal fault		X	X
47	24 V supply low	X	X	X
48	1.8V supply low		X	X
49	Speed limit	X		
50	AMA calibration failed		X	
51	AMA check Unom and Inom		X	
52	AMA low Inom		X	
53	AMA motor too big		X	
54	AMA motor too small		X	
55	AMA parameter out of range		X	
56	AMA interrupted by user		X	
57	AMA timeout		X	
58	AMA internal fault	X	X	
59	Current limit	X		
61	Encoder loss	(X)	(X)	
62	Output Frequency at Maximum Limit	X		
63	Mechanical Brake Low		X	
64	Voltage Limit	X		
65	Control Card Overtemperature	X	X	X
66	Heatsink Temperature Low	X		
67	Option Configuration has Changed		X	
68	Safe Stop Activated		X	
80	Drive Initialised to Default Value		X	
(X)	Dependent on parameter			

LED indication	
Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Troubleshooting

Alarm Word Extended Status Word					
Bit	**Hex**	**Dec**	**AlarmWord**	**WarningWord**	**ExtendedStatusWord**
0	00000001	1	Brale Check	Brale Check	Ramping
1	00000002	2	Pwr. Card Temp	Pwr. Card Temp	AMA Running
2	00000004	4	Earth Fault	Earth Fault	Start CW/CCW
3	00000008	8	Ctrl.Card Temp	Ctrl.Card Temp	Slow Down
4	00000010	16	Ctrl. Word TO	Ctrl. Word TO	Catch Up
5	00000020	32	Over Current	Over Current	Feedback High
6	00000040	64	Torque Limit	Torque Limit	Feedback Low
7	00000080	128	Motor Th Over	Motor Th Over	Output Current High
8	00000100	256	Motor ETR Over	Motor ETR Over	Output Current Low
9	00000200	512	Inverter Overld.	Inverter Overld.	Output Freq High
10	00000400	1024	DC under Volt	DC under Volt	Output Freq Low
11	00000800	2048	DC over Volt	DC over Volt	Brake Check OK
12	00001000	4096	Short Circuit	DC Voltage Low	Braking Max
13	00002000	8192	Inrush Fault	DC Voltage High	Braking
14	00004000	16384	Mains ph. Loss	Mains ph. Loss	Out of Speed Range
15	00008000	32768	AMA Not OK	No Motor	OVC Active
16	00010000	65536	Live Zero Error	Live Zero Error	
17	00020000	131072	Internal Fault	10V Low	
18	00040000	262144	Brake Overload	Brake Overload	
19	00080000	524288	U phase Loss	Brake Resistor	
20	00100000	1048576	V phase Loss	Brake IGBT	
21	00200000	2097152	W phase Loss	Speed Limit	
22	00400000	4194304	Fieldbus Fault	Fieldbus Fauld	
23	00800000	8388608	24 V Supply Low	24V Supply Low	
24	01000000	16777216	Mains Failure	Mains Failure	
25	02000000	33554432	1.8V Supply Low	Current Limit	
26	04000000	67108864	Brake Resistor	Low Temp	
27	08000000	134217728	Brake IGBT	Voltage Limit	
28	10000000	268435456	Option Change	Unused	
29	20000000	536870912	Drive Initialised	Unused	
30	40000000	1073741824	Safe Stop	Unused	
31	80000000	2147483648	Mech. brake low	Warning Word 2 (Extended Status Word)	

WARNING 1
10 Volts low:
The 10 V voltage from terminal 50 on the control card is below 10 V.
Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

WARNING/ALARM 2
Live zero error:
The signal on terminal 53 or 54 is less than 50% of the value set in par. 6-10, 6-12, 6-20, or 6-22 respectively.

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 in case of a fault in the input rectifier on the frequency converter.
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 overvoltage limit of the control system. The frequency converter is still active.

WARNING 6:
DC link voltage low
The intermediate circuit voltage (DC) is below the undervoltage limit of the control system. The frequency converter is still active.

WARNING/ALARM 7
DC over voltage:
If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.
Possible corrections:

Connect a brake resistor
Extend the ramp time
Activate functions in par. 2-10
Increase par. 14-26

Connect a brake resistor. Extend the ramp time

Alarm/warning limits:			
FC 300 Series	3 x 200 - 240 V [VDC]	3 x 380 - 500 V [VDC]	3 x 525 - 600 V [VDC]
Undervoltage	185	373	532
Voltage warning low	205	410	585
Voltage warning high (w/o brake - w/brake)	390/405	810/840	943/965
Overvoltage	410	855	975

The voltages stated are the intermediate circuit voltage of the FC 300 with a tolerance of ± 5 %. The corresponding mains voltage is the intermediate circuit voltage (DC-link) divided by 1.35

WARNING/ALARM 8
DC under voltage:
If the intermediate circuit voltage (DC) drops below the "voltage warning low" limit (see table above), the frequency converter checks if 24 V backup supply is connected.
If no 24 V backup supply is connected, the frequency converter trips after a given time depending on the unit.
To check whether the supply voltage matches the frequency converter, see *General Specifications*.

WARNING/ALARM 9
Inverter overloaded:
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 gives a warning at 98% and trips at 100%, while giving an alarm. You cannot reset the frequency converter until the counter is below 90%.
The fault is that the frequency converter is overloaded by more than 100% for too long.

WARNING/ALARM 10
Motor ETR over temperature:
According to the electronic thermal protection (ETR), the motor is too hot. You can choose if you want the frequency converter to give a warning or an alarm when the counter reaches 100% in par. 1-90. The fault is that the motor is overloaded by more than 100% for too long. Check that the motor par. 1-24 is set correctly.

WARNING/ALARM 11
Motor thermistor over temp:
The thermistor or the thermistor connection is disconnected. You can choose if you want the frequency converter to give a warning or an alarm when the counter reaches 100% in par. 1-90. Check that the thermistor is connected correctly between terminal 53 or 54 (analog voltage input) and terminal 50 (+ 10 Volts supply), or between terminal 18 or 19 (digital input PNP only) and terminal 50. If a KTY sensor is used, check for correct connection between terminal 54 and 55.

WARNING/ALARM 12
Torque limit:
The torque is higher than the value in par. 4-16 (in motor operation) or the torque is higher than the value in par. 4-17 (in regenerative operation).

WARNING/ALARM 13
Over Current:
The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning will last approx. 8-12 sec., then the frequency converter trips and issues an alarm. Turn off the frequency converter and check if the motor shaft can be turned and if the motor size matches the frequency converter.
If extended mechanical brake control is selected, trip can be reset externally.

ALARM: 14
Earth fault:
There is a discharge from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.
Turn off the frequency converter and remove the earth fault.

ALARM: 16
Short-circuit:
There is short-circuiting in the motor or on the motor terminals.
Turn off the frequency converter and remove the short-circuit.

WARNING/ALARM 17
Control word timeout:
There is no communication to the frequency converter.
The warning will only be active when par. 8-04 is NOT set to *OFF*.
If par. 8-04 is set to *Stop* and *Trip*, a warning appears and the frequency converter ramps down until it trips, while giving an alarm.
Par. 8-03 *Control Word Timeout Time* could possibly be increased.

WARNING 25
Brake resistor short-circuited:
The brake resistor is monitored during operation. If it short-circuits, the brake function is disconnected and the warning appears. The frequency converter still works, but without the brake function. Turn off the frequency converter and replace the brake resistor (see par. 2-15 *Brake Check*).

ALARM/WARNING 26
Brake resistor power limit:
The power transmitted to the brake resistor is calculated as a percentage, as a mean value over the last 120 s, on the basis of the resistance value of the brake resistor (par. 2-11) and the intermediate circuit voltage. The warning is active when the dissipated braking power is higher than 90%. If *Trip* [2] has been selected in par. 2-13, the frequency converter cuts out and issues this alarm, when the dissipated braking power is higher than 100%.

WARNING 27
Brake chopper fault:
The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and the warning comes up. The frequency converter is still able to run, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.
Turn off the frequency converter and remove the brake resistor.

Warning: There is a risk of substantial power being transmitted to the brake resistor if the brake transistor is short-circuited.

ALARM/WARNING 28
Brake check failed:
Brake resistor fault: the brake resistor is not connected/working.

ALARM 29
Drive over temperature:
If the enclosure is IP 20 or IP 21/TYPE 1, the cut-out temperature of the heat-sink is 95 °C ±5 °C. The temperature fault cannot be reset, until the temperature of the heatsink is below 70 °C.
The fault could be:

- Ambient temperature too high
- Too long motor cable

ALARM 30
Motor phase U missing:
Motor phase U between the frequency converter and the motor is missing.
Turn off 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.
Turn off 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.
Turn off the frequency converter and check motor phase W.

ALARM: 33
Inrush fault:
Too many powerups have occured within a short time period. See the chapter *General Specifications* for the allowed number of powerups within one minute.

WARNING/ALARM 34
Fieldbus communication fault:
The fieldbus on the communication option card is not working.

WARNING 35
Out of frequency range:
This warning is active if the output frequency has reached its *Warning speed low* (par. 4-52) or *Warning Speed High* (par. 4-53). If the frequency converter is in *Process Control, Closed Loop* (par. 1-00), the warning is active in the display. If the frequency converter is not in this mode bit 008000 Out of *frequency range* in extended status word is active but there is no warning in the display.

ALARM 38
Internal fault:
Contact your Danfoss supplier.

WARNING 47
24 V supply low:
The external 24 V DC backup power supply may be overloaded, otherwise contact your Danfoss supplier.

WARNING 48
1.8 V supply low:
Contact your Danfoss supplier.

WARNING 49
Speed limit:
The speed is not within the specified range in par. 4-11 and par. 4-12

ALARM 50
AMA calibration failed:
Contact your Danfoss supplier.

ALARM 51
AMA check Unom and Inom:
The setting of motor voltage, motor current, and motor power is presumably wrong. Check the settings.

ALARM 52
AMA low Inom:
The motor current is too low. Check the settings.

ALARM 53
AMA motor too big:
The motor is too big for the AMA to be carried out.

ALARM 54
AMA motor too small:
The motor is too small for the AMA to be carried out.

ALARM 55
AMA par. out of range:
The par. values found from the motor are outside acceptable range.

ALARM 56
AMA interrupted by user:
The AMA has been interrupted by the user.

ALARM 57
AMA timeout:
Try to start the AMA again a number of times, until the AMA is carried out. Please note that repeated runs may heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical.

ALARM 58
AMA internal fault:
Contact your Danfoss supplier.
Some typical alarm messages:
1299 - OptionSW in slot A is too old
1300 - OptionSW in slot B is too old
1301 - OptionSW in slot C0 is too old
1302 - OptionSW 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)
1317 - Option SW in slot C0 is not supported (not allowed)
1318 - Option SW in slot C1 is not supported (not allowed)
2315 - Missing SW version from power unit.

WARNING 59
Current limit:
The current is higher than the value in par. 4-18.

WARNING 61
Encoder loss:
Contact your Danfoss supplier.

WARNING 62
Output Frequency at Maximum Limit:
The output frequency is higher than the value set in par. 4-19

ALARM 63
Mechanical Brake Low:
The actual motor current has not exceeded the "release brake" current within the "Start delay" time window.

WARNING 64
Voltage Limit:
The load and speed combination demands a motor voltage higher than the actual DC link voltage.

WARNING/ALARM/TRIP 65
Control Card Over Temperature:
Control card over temperature: The cut-out temperature of the control card is 80° C.

WARNING 66
Heatsink Temperature Low:
The heat sink temperature is measured as 0° C. This could indicate that the temperature sensor is defect and thus the fan speed is increased to the maximum in case the power part or control card is very hot.

ALARM 67
Option Configuration has Changed:
One or more options has either been added or removed since the last power-down.

ALARM 68
Safe Stop Activated:
Safe Stop has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via Bus, Digital I/O, or by pressing [RESET]).

ALARM 80
Drive Initialised to Default Value:
Parameter settings are initialised to default setting after a manual (three-finger) reset.

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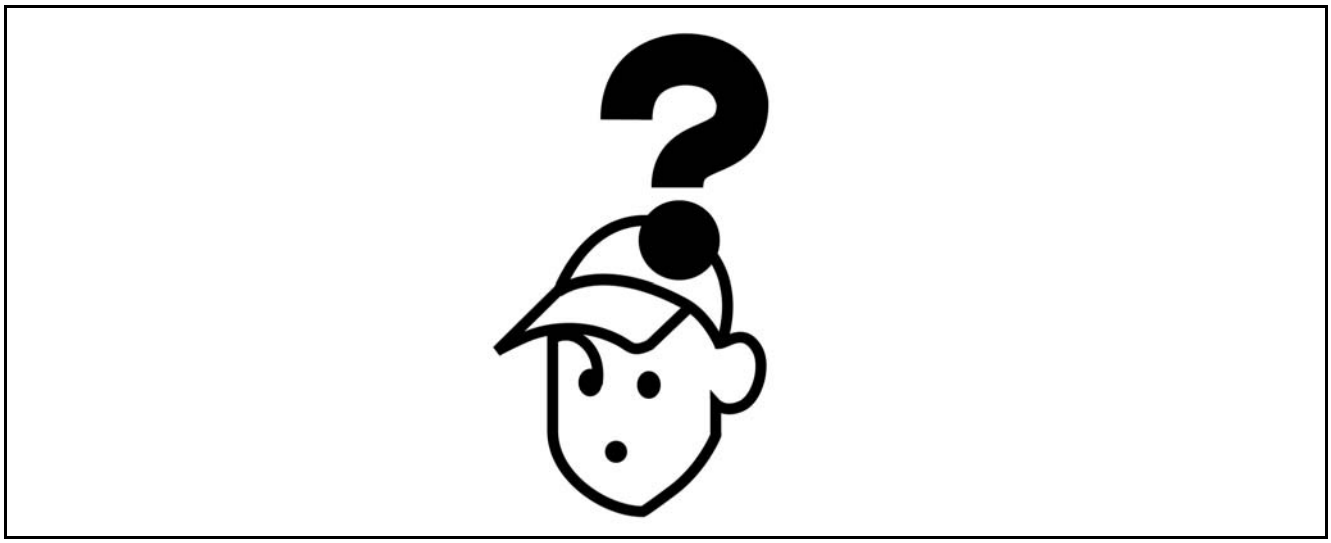

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