Compact Drives M21...T

Operating Manual

Safety
Installation
Setup
Accessories

VEM motors Thurm GmbH

Operating Manual

This Operating Manual contains all safety notes for application of Compact Drives and shall enable the user to install the compact drives of type M21 … T and operate them with the works set-up.
Furthermore the various kinds of direct and remote control as well as the related control panels and their connections to the Compact Drives are presented.

When reading through this Operating Manual, you will come across various symbols that require special attention.

The symbols used are the following:

Indicates a general warning.

Indicates something to be noted by the reader.

Indicates a high-voltage warning.

Contents

Safety

All operations must be carried out by appropriately trained personnel.

Use all lifting facilities provided e.g. both lifting points if fitted or single lifting point if fitted.

Vertical lifting - Prevent uncontrolled rotation.

Lift machine - Do not lift other equipment with motor lifting points only.

Before installation check for fan cover damage, shaft damage, foot/mounting damage, and loose fasteners. Check nameplate details.

Ensure level mounting surface, balanced mounting, not misaligned.

Gaskets, and/or sealants, and guards must be correctly fitted.

The voltage on the Compact Drive is dangerous when the motor is connected to mains. Incorrect installation of the Compact Drive may lead to material damage or serious injury, or it may be fatal.

Consequently, the instructions in this manual as well as national and local rules and safety regulations must be complied with.

Touching the electrical parts may be fatal, even after the mains supply has been is connected. Wait at least 4 minutes.

NB!

It is the user's or certified electrician's responsibility to ensure correct earthing and protection in accordance with applicable national and local requirements and standards.

Safety regulations

1. The Compact Drive must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed (4 minutes).
2. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
   At the use of ELCB relays local regulations have to be fulfilled.
   Never use ELCB relays that are not suitable for DC fault currents (type A).
   If ELCB relays are used, they must be:
   - Suitable for protecting equipment with a direct current content (DC) in the fault current (3-phase bridge rectifier)
   - Suitable for power-up with short charging current to earth
   - Suitable for a high leakage current.
3. The earth leakage currents are approximately 7 mA. This means that the Compact Drive requires a fixed, permanent installation as well as reinforced protective earthing.

Warning against unintended start

1. The motor can be brought to a stop by means of digital commands, bus commands, or references, while the frequency converter is connected to mains.
   If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start.
3. A motor that has been stopped may start if faults occur in the electronics of the Compact Drive, or if a temporary overload or a fault in the mains supply ceases.

Tools for installation

1 cross-point screwdriver
1 large screwdriver
1 small screwdriver
Min. 2 glands:

Gland sizes

Types M21 ... T at P= 0.55 ... 3.0 kW	3 x M20x1.5
Types M21 ... T at P= 4.00 ... 7.5 kW	1x M25x1.5, 2 x M20x1.5

Max. cable cross section

Mains supply cable	4.0 mm^2 /10 AWG
Control cable	1.5 mm^2 /16 AWG
Serial communication cable	1.5 mm^2 /16 AWG

1. Mechanical installation

Location

Install the Compact Drive with adequate access for routine maintenance. Adequate space, particularly at the fan inlet (30 mm), is necessary to facilitate airflow.
Where several Compact Drives are installed in close proximity, care must be taken to ensure that there is no recirculation of exhausted warm air.

NB!

Ambient temperature

To avoid the Compact Drive part getting overheated, the ambient temperature is not to exceed 40 °C and the 24-hour average temperature is not to exceed 35 °C. If the ambient temperature is in the range of 40 °C - 55 °C, a reduction of the service life of the Compact Drive part is to be expected. Minimum ambient temperature for operation of the Compact Drive is –10°C even by reduction of load. If the ambient temperature is heavily varying we recommend the application of a membrane gland. If the motor has got a dew you may activate the DC holding voltage (par. 137) for preheating the motor before running.

NB!

Bearings

VEM Compact Drives are provided from works with maintenance-free 2-Z bearings. Nominal service life at maximum load and maximum ambient temperature is 20,000 hours.
In case of normal load and normal environmental conditions, the grease service life is approx. 40,000 operating hours.

Tapping of fitments onto the motor shaft

Tapping of fitments onto the motor shaft, with a hammer or mallet, causes bearing damage. This results in increased bearing noise and a significant reduction in bearing life. For mounting these parts use special tools.

2. Electrical Connections

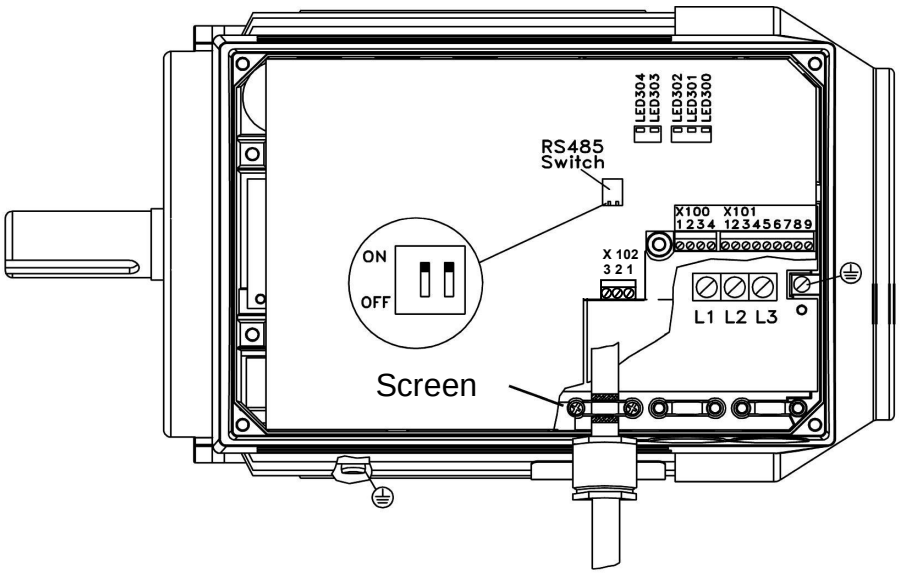


Fig. 1
Remove the inverter box cover, which is held by four screws, to obtain access to the terminals. Remove the detachable terminal plugs from the terminal blocks X100 and X101 to obtain access to the mains terminals (see fig. 1).
Lift only the corner of the black plastic cover by the cable entries to expose the mains terminals L1, L2 and L3.

NB!

Do not lift or remove the entire plastic cover. The voltage on the Compact Drive is dangerous and may lead to material damage, serious injury or it may be fatal.

NB!

Mains terminals L1, L2 and L3:
Make sure that your mains supply corresponds to the voltage required by the Compact Drive (see inverter label), TT and NT mains .

Connect the three mains phases to terminals L1, L2 and L3 and the earth to the separate terminal provided. At powers of the Compact Drives of 0.55 to 4.0 kW use the right gland for connecting the mains supply cable, at powers of 5.5 to 7.5 kW use the left gland (M25x1.5).

Tightening Torques

L1, L2, L3	Types M21R ... T at P = 0.55 ... 4.0 kW	0.5 ... 0.6 Nm
L1, L2, L3	Types M21R ... T at P = 5.50 ... 7.5 kW	1.2 … 1.5 Nm
Earth ground	Types M21R ... T at P = 0.55 … 7.5 kW	3.4 Nm

NB!

You cannot change the rotation direction of the motor by shifting around the phases.
The direction of rotation is clockwise by default.
Another direction of rotation can be programmed (see the Design Guide).
This programming is not necessary if the Compact Drive is controlled by the terminal box (see chapter 3, fig. 2). Clamp 5 of terminal X101 is set-up on reversing the direction of rotation.

Prefuses Max.

Types M21 ... T at P = 0,55 ... 3,0 kW	16 A
Types M21 ... T at P = 4,0 ... 7,5 kW	25 A

Control terminals

For information on terminal blocks X100 and X101, please see **table A and B**.

X100: Terminal block for data communication

Terminal No.	Function	
1	P RS 485	For connection to
2	N RS 485	Bus or PC
3	5 V DC	Supply for
4	0 V DC	RS 485 bus

Table A

X101: Terminal block for analog/digital control signals

Terminal No.	Function	Example
1	Analog input(0 ... 20 mA)	Feedback signal
2	Analog (0 ... 10 V)-/digital input 2	Speed reference
3	Digital input (or pulse) 3	Reset
4	Digital input (or precise stop) 4	Start
5	Digital input (other) 5	Reversing
6	24 V DC supply for digital inputs	(max. 50 mA)
7	10 V DC supply for potentiometer	(max. 15 mA)
8	0 V for terminals 1 ... 7 and 9	
9	Analog (0 ... 20 mA)-/digital output	Fault indication

Table B

X102: Terminal block for relay output

Terminal No.	Function
1 - 2	make (normally open)
1 - 3	braek (normally closed)

Table C

RS 485 switch

For terminating an RS 485 interface serial communication, the bus must be terminated by a resistor network at both ends. This is provided by setting both switches to ON.

LEDs

The Compact Drive has five LEDs which indicate the status of the Compact Drive:

LED 300	red	Fault trip
LED 301	yellow	Warning
LED 302	green	Power on
LED 303-304	green	Communication

EMC-correct installation

The control cables must be screened cables to ensure EMC-correct electrical installation.
Connect the screen to earth at both ends.
Avoid installation with twisted screen ends (pigtails), since this ruins the screening effect at high frequencies. Use cable clamps instead.

3. Start the Compact Drive

Figure 2 shows the factory settings of the VEM Compact Drives. (A summary of the accessories for local and remote control as well as for parameter set-up of the Compact Drive you will find in chapter 4.1 and 4.2)

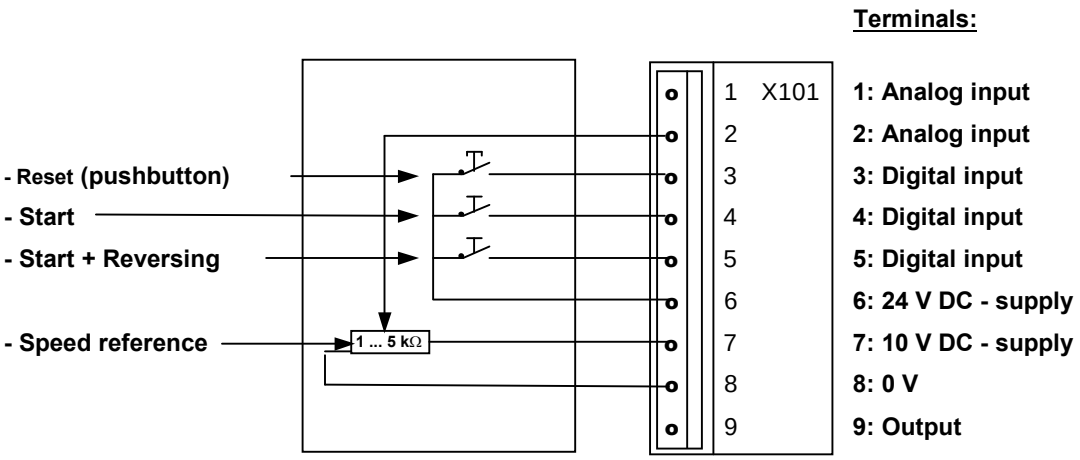


Fig. 2

- ***Reset*** to be closed short time for resetting fault trips
- ***Start*** to be closed for changing to *run mode*
- ***Reversing*** to be closed for reversing the rotation of the motor (counter clockwise)
- ***Speed reference*** (0-10 V) determines speed while in ***run mode***

Connect mains. LED 302 (green) lights up to indicate that the power is on. In Profibus versions, LED 303 will flash. For further information on Profibus, please see the Profibus manual.
Connect terminal 4 and 6 to the start button (see fig. 2).
If necessary connect terminal 5 and 6 for reversing the rotation of the motor.
Connect terminal 2, 7 and 8 to the potentiometer (see fig. 2).
Use the start button to start the Compact Drive and adjust the speed by means of the potentiometer.

The voltage on the Compact Drive is dangerous when the motor is connected to mains. Incorrect installation of the Compact Drive may lead to material damage or serious injury or it may be fatal.

Mount the inverter box cover.

Fastening torque: 2.2 - 2.4 Nm

What if the motor does not start?

- Make sure no parameters have been changed from initial delivery status (factory setting). Use the Local Control Panel or serial port to reset to factory setting.
- Make sure no [STOP]-command have been issued by the optional control panel keyboard (local stop) Control Panel [STOP] can only be restarted by the Control Panel [START]-button.
- Remove lid to check the Light Emitting Diodes visible through a hole in the inside isolation cover, follow Table D.

WARNING:

Extreme care must be taken when operating the unit with open lid.

Green LED 302	Yellow LED 301	Red LED 300	Action
OFF	OFF	OFF	Apply power (see point 2)
ON	OFF	OFF	Apply start and reference signals (see point 3)
ON	OFF	ON	Apply reset signal according to Fig. 2
ON	ON	ON	Switch off power until all LED's have turned off. After power on reset signal is required.

Table D

(For further information see the design guide and/or PROFIBUS manual.)

4. Control of the Compact Drive

4.1. Local Control

• Control panel

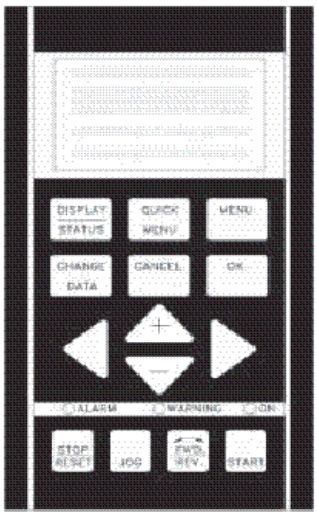
The compact drives optionally features a Local Control Panel - LCP 2 which makes up a complete interface for operation and monitoring of the Compact Drive.

• LCP installation

The LCP 2 is connected to the terminal X100, 1-4.

• LCP functions

The functions of the control panel can be divided into three groups:
- display
- keys for changing program parameters
- keys for local operation



All data are indicated by means of a 4-line alpha-numeric display, which in normal operation is able to show 4 measurements and 3 operating conditions continuously. During programming, all the information required for quick, effective parameter Setup of the compact drive will be displayed. As a supplement to the display, there are three LEDs for voltage, warning and alarm.

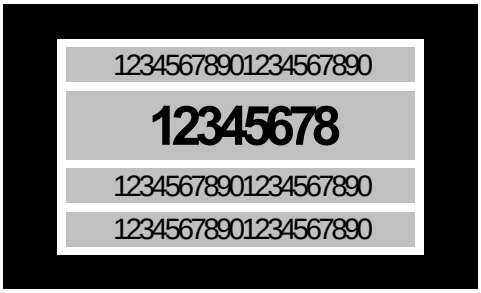
All program parameters of the Compact Drive can be changed immediately from the control panel, unless this function has been blocked via parameter 018.
In the Menu mode the parameters are divided into groups. The following parameter groups are accessible:

Group no.	Parameter group
0	Operation & Display
1	Load & Motor
2	References & Limits
3	Inputs & Outputs
4	Special functions
5	Serial communication
6	Technical functions

Selection of parameter group and parameters is explained under function of operational keys. The complete list of parameters you will find under point 5 of this operational manual.

(For information on parameter group 800 and 900 for PROFIBUS, please see the Profibus manual.)

- **Display**



The LCD-display has rear lighting and a total of 4 alpha-numeric lines together with a box that shows the direction of rotation (arrow) and the chosen Setup as well as the Setup in which programming is taking place if that is the case.

1st line shows up to 3 measurements continuously in normal operating status or a text which explains the 2nd line.

2nd line shows a measurement with related unit continuously, regardless of status (except in the case of alarm/warning).

3rd line is normally blank and is used in the menu code to show the selected parameter number or parameter group number and name.

4th line is used in operating status for showing a status text or in data change mode for showing the value of the selected parameter.

An arrow indicates the direction of rotation of the motor. Furthermore, the Setup which has been selected as the Active Setup in parameter 004 is shown. When programming another Setup than the Active Setup, the number of the Setup which is being programmed will appear to the right. This second Setup number will flash.

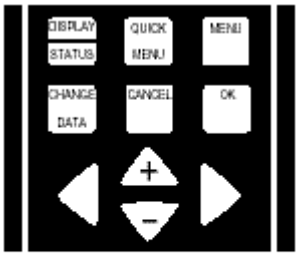
- **LEDs**

At the bottom of the control panel is a red alarm LED and a yellow warning LED, as well as a green voltage LED.

O ALARM	O WARNING	O ON
red	yellow	green

If certain threshold values are exceeded, the alarm and/or warning lamp lights up together with a status and alarm text on the control panel. The voltage LED is activated when the Compact Drive receives voltage; at the same time the rear lighting of the display will be on.

• Control keys



The control keys are divided into functions. This means that the keys between display and indicator LEDs are used for parameter Setup, including choice of display indication during normal operation.

Keys for local control are found under the indicator LEDs.

• Control key functions

[DISPLAY / STATUS] is used for selecting the mode of display or for changing back to Display mode from either the Quick menu mode or the Menu mode.

[QUICK MENU] is used for programming the parameters that belong under the Quick menu mode. It is possible to switch directly between Quick menu mode and Menu mode.

[MENU] is used for programming all parameters. It is possible to switch directly between Menu mode and Quick menu mode.

[CHANGE DATA] is used for changing the parameter selected either in the Menu mode or the Quick menu mode.

[CANCEL] is used if a change of the selected parameter is not to be carried out.

[OK] is used for confirming a change of the parameter selected.

[+/-] is used for selecting parameter and for changing the chosen parameter or for changing the read out in line 2.

[<>] is used for selecting group and to move the cursor when changing numerical parameters.

[STOP / RESET] is used for stopping or for resetting the Compact Drive after a drop-out (trip). Can be selected via parameter 014 to be active or inactive. If stop is activated, line 2 will flash, and [START] must be activated.

NB!

Pressing [STOP/RESET] will prevent motor from running also with disconnected LCP 2. Restarting is only possible via the LCP 2 [START] key.

[JOG] overrides the output frequency to a preset frequency while the key is kept down. Can be selected via parameter 015 to be active or inactive.

[FWD / REV] changes the direction of rotation of the motor, which is indicated by means of the arrow on the display although only in Local. Can be selected via parameter 016 to be active or inactive (parameter 013 must be set to [1] or [3] and parameter 200 set to [1].

[START] is used for starting the Compact Drive after stop via the [STOP] key. Is always active, but cannot override a stop command given via the terminal strip.

NB!

If the keys for local control have been selected as active, they will remain active both when the frequency has been set for *Local Control* and for *Remote Control* via parameter 002, although with the exception of [FWD/REV], which is only active in Local operation.

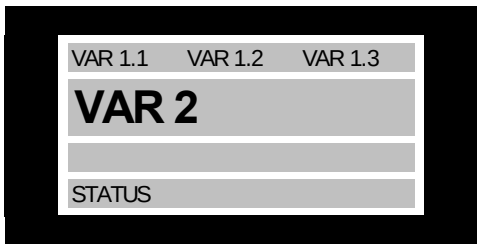
NB!

If no external stop function has been selected and the [STOP] key has been selected as inactive via parameter 014, the Compact Drive can be started and can only be stopped by disconnecting the voltage to the motor.

- **Display read-out state**

The display read-out state can be varied - see the list on page 19 - depending on whether the Compact Drive is in normal operation or is being programmed.

- **Display mode**



In normal operation, up to 4 different operating variables can be indicated continuously: 1,1 and 1,2 and 1,3 and 2, and in line 4 the present operating status or alarms and warnings that have arisen.

- **Display mode - selection of read-out state**

There are three options in connection with the choice of read-out state in the Display mode - I, II and III. The choice of read-out state determines the number of operating variables read out.

Read-out state	I:	II:	III:
Line 1	Description for operating variable in line 2	Data velue for 3 operating variables in line 1	Description for 3 operating variables in line 1

The table below gives the units linked to the variables in the first and second line of the display (see parameter 009).

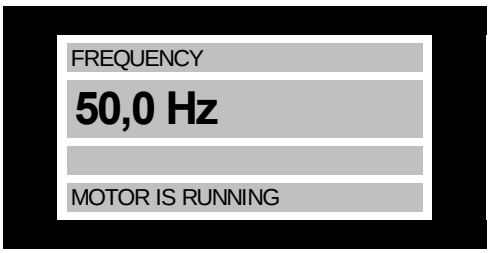
Operating variable	Unit
Reference	[%]
Reference	[Unit]*
Feedback	[Unit]*
Frequency	[Hz]
Frequency x scaling	[-]
Motor current	[A]
Torque	[%]
Power	[kW]
Power	[HP]
Motor voltage	[V]
DC-link voltage	[V]
Inverter thermal	[%]
Hours run	[h]
Input status, dig. Input	[Binary code]
External reference	[%]
Status word	[Hex]
Heat sink temperature	[^{o}C]
Alarm word	[Hex]
Control word	[Hex]
Warning word 1	[Hex]
Warning word 2	[Hex]
Analog input 1	[mA]
Analog input 2	[V]

*) Select in parameter 416. The unit is shown in readout state 1 line 1 otherwise 'U' is shown.

Operating variables 1,1 and 1,2 and 1,3 in the first line, and operating variable 2 in the second line are selected via parameter 009, 010, 011 and 012.

- Read-out state I:

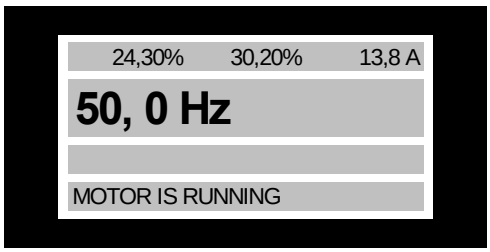
This read-out state is standard after starting up or after initialisation.



Line 2 gives the data value of an operating variable with related unit, and line 1 provides a text which explains line 2, cf. table. In the example, Frequency has been selected as variable via parameter 009. During normal operation another variable can immediately be read out by using the [+/-] keys.

- Read-out state II:

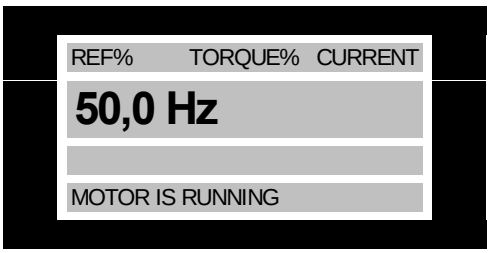
Switching between read-out states I and II is effected by pressing the [DISPLAY / STATUS] key.



In this state, data values for four operating values are shown at the same time, giving the related unit, cf. table. In the example, Reference, Torque, Current and Frequency are selected as variables in the first and second line.

- Read-out state III:

This read-out state can be held as long as the [DISPLAY/STATUS] key is pressed. When the key is released, the system switches back to Read-out state II, unless the key is pressed for less than approx. 1 sec..



This is where parameter names and units for operating variables in the first line are given – operating variable 2 remains unchanged.

- **Quick menu mode versus Menu mode**

The Compact Drive series can be used for practically all assignments, which is why the number of parameters is quite large. Also, this series offers a choice between two programming modes - a Menu mode and a Quick menu mode.

- Quick menu mode

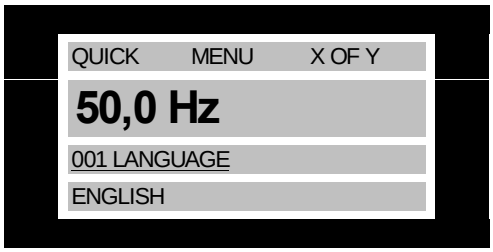
The Quick menu takes the user through a number of parameters that may be enough to get the motor to run nearly optimally, if the factory setting for the other parameters takes the desired control functions into account, as well as the configuration of signal inputs/outputs (control terminals).

- Menu mode

The Menu mode makes it possible to select and change all parameters at the user's option. However, some parameters will be "missing", depending on the choice of configuration (parameter 100), e.g. open loop hides all the PID parameters.
In addition to having a name, each parameter is linked up with a number which is the same regardless of the programming mode. In the Menu mode, the parameters are divided into groups, with the first digit of the parameter number (from the left) indicating the group number of the parameter in question.
Regardless of the mode of programming, a change of a parameter will take effect and be visible both in the Menu mode and in the Quick menu mode.

• Quick Setup via Quick menu

The Quick Setup starts with pressing the [QUICK MENU] key, which brings out the following read-out on the display:



At the bottom of the display, the parameter number and name are given together with the status/value of the first parameter under Quick Setup. The first time the [Quick Menu] key is pressed after the unit has been switched on, the read-outs will always start at pos. 1 - see table below.

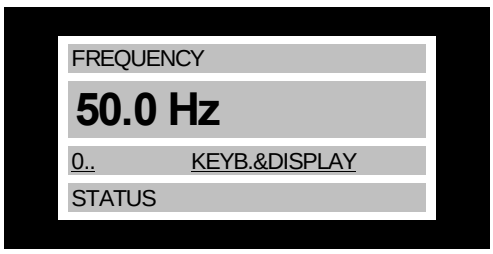
• Parameter selection

The selection of parameter is effected by means of the [+/-] keys. The following parameters are accessible:

Position	No.	Parameter	Unit
1	001	Language	
2	200	Direction of rotation	
3	101	Torque characteristic	
4	204	Min. reference	[Hz]
5	205	Max. reference	[Hz]
6	207	Ramp up time	[s]
7	208	Ramp down time	[s]
8	002	Local/remote control	
9	003	Local reference	
10	500	Bus address	

• Menu mode

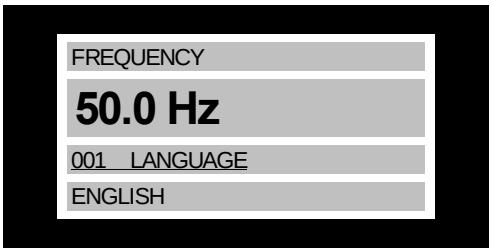
The Menu mode is started by pressing the [MENU] key, which produces the following read-out on the display:



Line 3 on the display shows the parameter group number and name.

• Parameter groups

In the Menu mode the parameters are divided into groups. Selection of parameter group is effected by means of the [<>] keys. When the desired parameter group has been selected, each parameter can be chosen by means of the [+/-] keys.



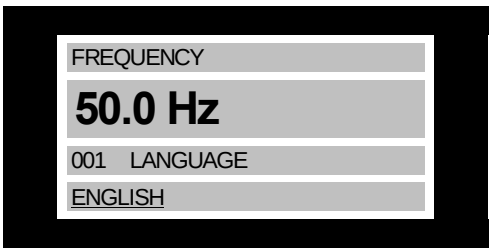
The 3rd line of the display shows the parameter number and name, while the status/value of the selected parameter is shown in line 4.

- **Changing data**

Regardless of whether a parameter has been selected under the Quick menu or the Menu mode, the procedure for changing data is the same. Pressing the [CHANGE DATA] key gives access to changing the selected parameter, following which the underlining in line 4 will flash on the display. The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

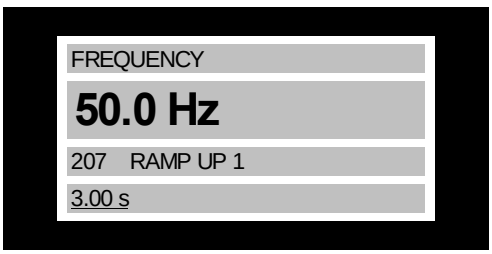
- **Changing a text value**

If the selected parameter is a text value, the text value is changed by means of the [+/-] keys.



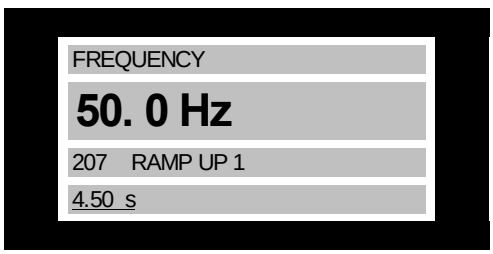
The bottom display line shows the text value that will be entered (saved) when acknowledgement is given [OK].

- **Infinitely variable change of numeric data value**



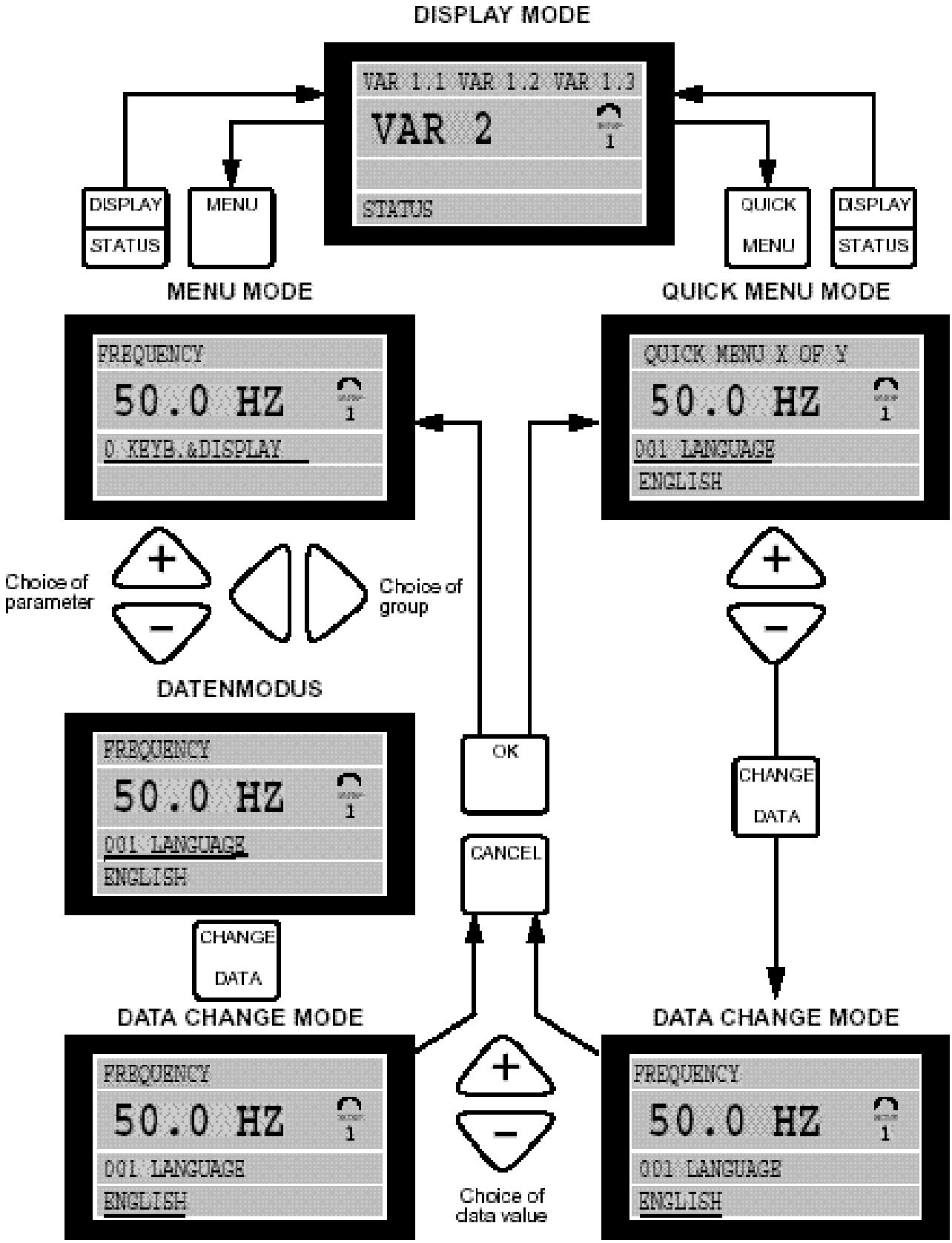
If the chosen parameter represents a numeric data value, a digit is first selected by means of the [<>] keys.

Then the chosen digit is changed infinitely variably by means of the [+/-] keys.



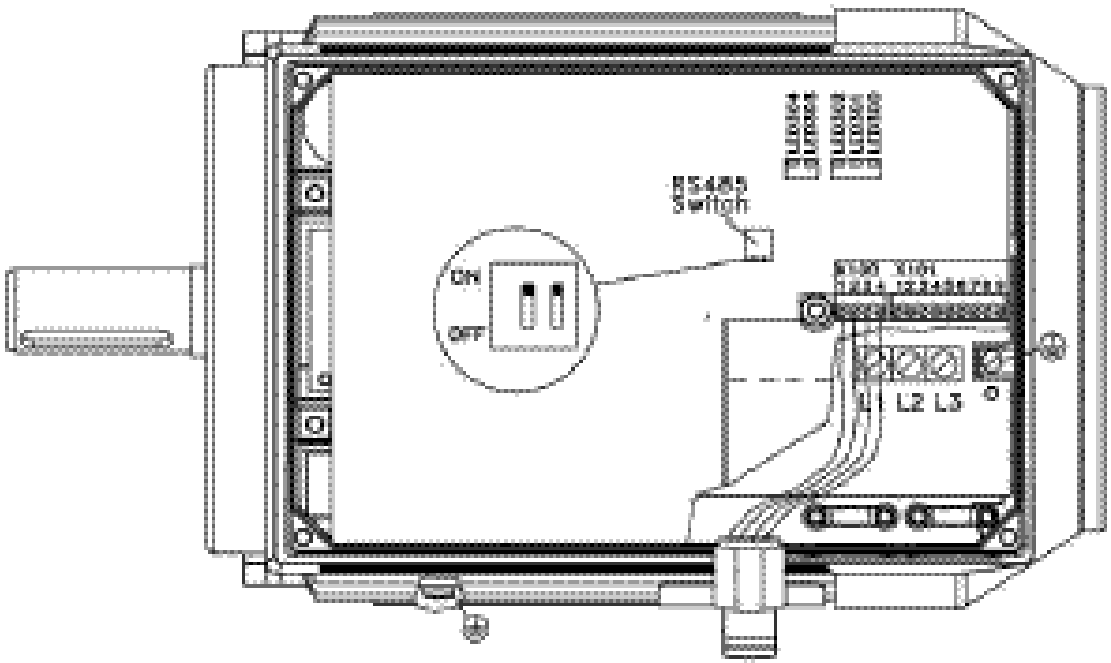
The chosen digit is indicated by the digit flashing. The bottom display line shows the data value that will be entered (saved) when signing off with [OK].

- **Menu structure**



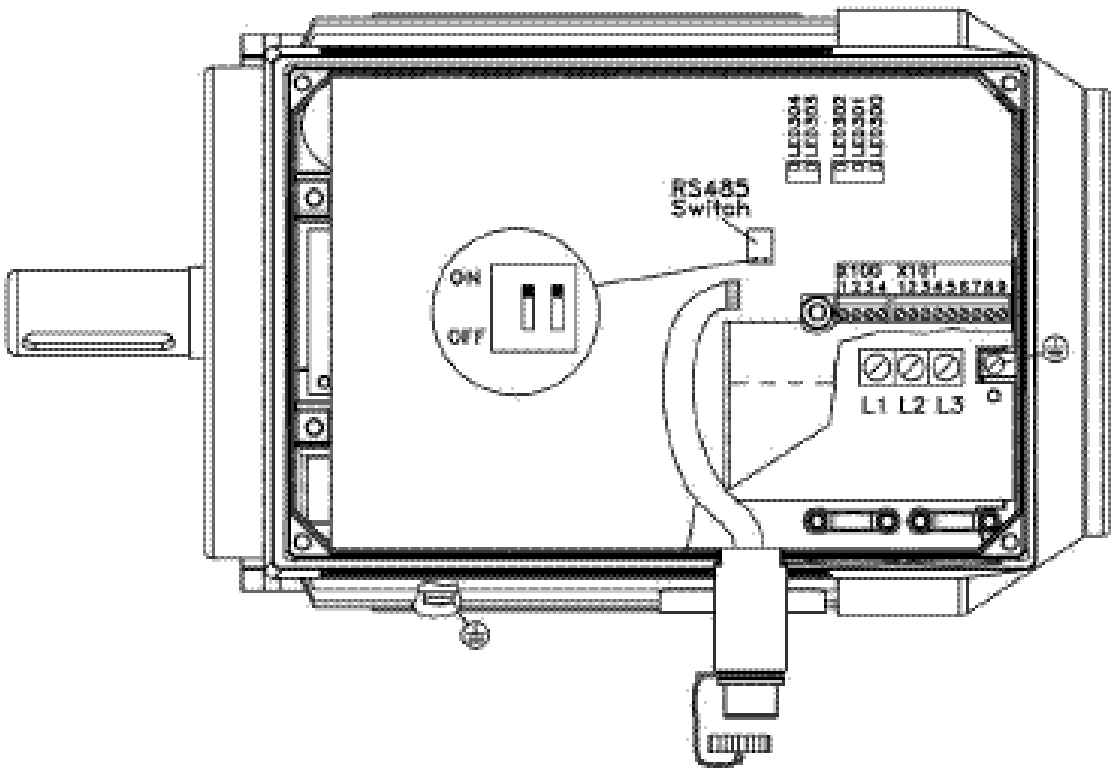
- **Plug kit**

Purpose:
To make a plugable connection between Compact Drive (Terminal X100) and LCP 2.
Used together with cable for plug kit.



- **Service plug kit**

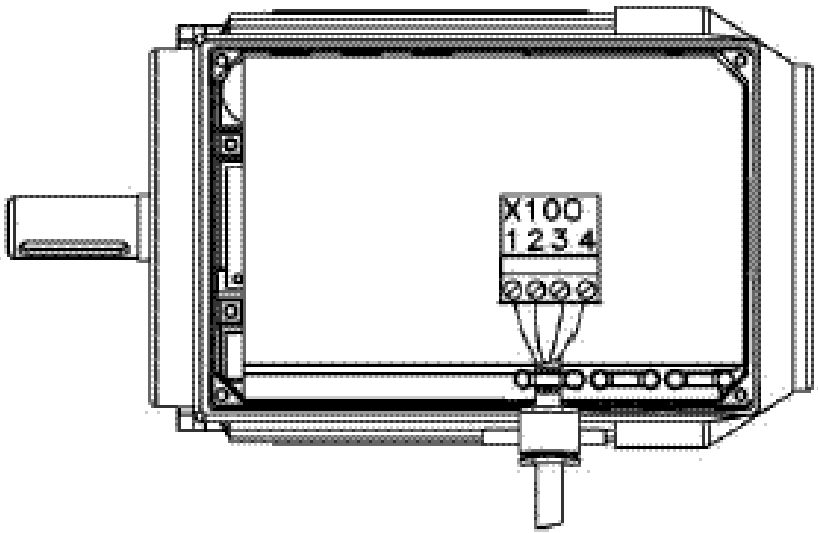
Purpose:
To run LCP2 and PROFIBUS at the same time. Used together with cable for plug kit.

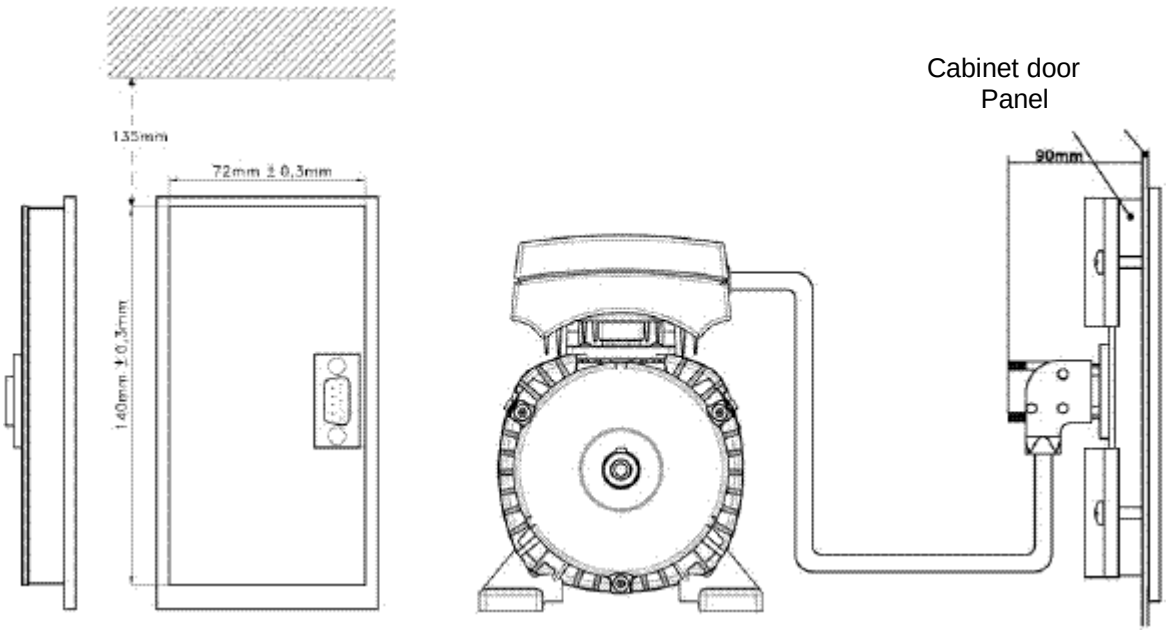


- **Remote mounting kit**

for LCP2 including connection cable (length of about 2m)

Colour of wire	Terminal X100/	D-Sub pin
yellow	1	8
green	2	9
red	3	2
blue	4	3





4.2. Remote Control

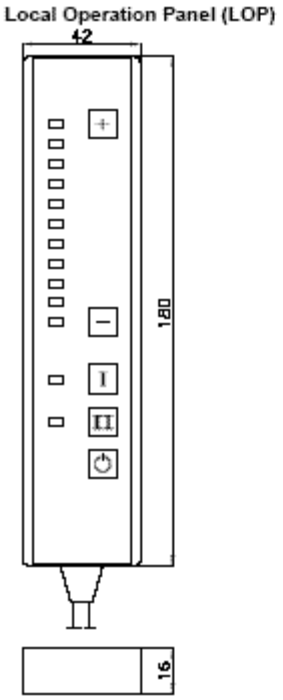
If parameter 002 is set to Remote Control the Compact Drive may be run in the following modes:

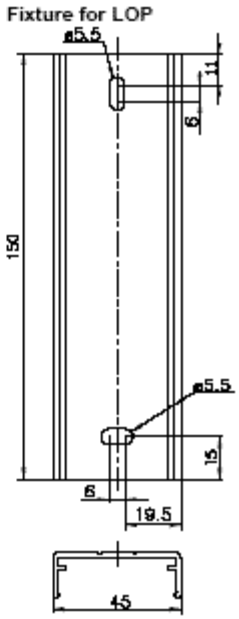
- Via the serial connector by use of the [START]-key. The keys [STOP], [JOG] and [RESET] can also be used for control after setting the parameters 014, 015 and 017 respectively.
- Via the Terminal X101
  - Setting reference of 0 ... 10 V via terminal 2
  - Settino reference via potentiometer. The potentiometer may be screwed into the Compact Drive like a PG16

Wiring:

Colour of wire	Terminal	Function
black	2	Reference
red	7	+10 V
blue	8	Ground

- Setting Reference via the **Local Operation Pad (LOP)**





Wiring of LOP:

Colour of wire	Terminal X101	Function
white	2	Reference
brown	3	RESET
grey/orange	4	See table under key I
green	5	See table under key II
red	6	+24 V
yellow	7	+10 V
blue	8	Ground

Function/Settings	Key I (Start)	Key II (Start)	Key O (Stop)
Default – Dual direction operation ***Connect grey cable*** No changes to factory setting.	Run forward	Run reverse	Stop (and Reset * - if trip)
Function 2 – Dual mode operation ***Connect orange cable*** Select desired modes of operation in Setups 1 and 2 (use parameter 004 – 006) Parameter 335 = 18 (select Setup**)**	Run with Setup 1	Run with Setup 2	Stop (and Reset * - if trip)
Function 3 – Dual speed operation ***Connect orange cable*** Parameter 335 = 13 (Jogging)	Run on set Reference (+/-)	Run on 10 Hz** Jog speed	Stop (and Reset * - if trip)

*If no reset is required, do not connect the brown wire
**or set parameter 213

At power up the unit will always be in stop mode. Set reference will be stored during power down. If permanent start mode is desired, connect terminal 6 to terminal 4 and do not connect purple wire to terminal 4. This means the stop function on LOP is disabled.

5. List of Parameters

Functions to programme, to control, and to monitor via bus (PROFIBUS) or by PC.

	Function	Range/number of settings/value	Factory setting	Parameter No.
Operation and Display	Language	6	English	Parameter 001
	Local/remote control	2	Remote control	Parameter 002
	Local reference	000.000		Parameter 003
	Active Setup	4	Setup 1	Parameter 004
	Programming Setup	4	Active setup	Parameter 005
	Copying of Setups	4	No copying	Parameter 006
	LCP copy	4	No copying	Parameter 007
	Display scaling of motor frequency		100	Parameter 008
	Display line 2	24	Frequency [Hz]	Parameter 009
	Display line 1.1	24	Reference [%]	Parameter 010
	Display line 1.2	24	Motor current [A]	Parameter 011
	Display line 1.3	24	Power [kW]	Parameter 012
	Local control/configaration	5	LCP digital control/par. 100	Parameter 013
	Local stop	2	Possible	Parameter 014
	Local jog	2	Not possible	Parameter 015
	Local reversing	2	Not possible	Parameter 016
	Local reset of trip	2	Possible	Parameter 017
	Lock for data change	2	Not locked	Parameter 018
	Operating state at power up, local control	3	Forced stop, use saved reference	Parameter 019
Load and Motor	Configuration	2	Speed, open loop mode	Parameter 100
	Torque characteristics	4	Constant torque	Parameter 101
	Motor power	XX.XX kW - dep. on unit		Parameter 102
	Motor voltage	XX.XX V - dep. on unit		Parameter 103
	Motor frequency	XX.X Hz - dep. on unit		Parameter 104
	Motor current	XX.XX A - dep. on unit		Parameter 105
	Rated motor speed	XX rpm - dep. on unit		Parameter 106
	Resonance damping	off-100%	off%	Parameter 117
	DC braking time	0.0 (off) - 60.0 sec.	10.0 sec.	Parameter 126
	DC brake cut-in frequency	0.0 Hz - f_{MAX}	0.0 Hz	Parameter 127
	Motor thermal protection	2	Enable	Parameter 128
	DC braking voltage	0 - 100 %	0 %	Parameter 132
	Start voltage	0.00 - 100.00 V	Motor dependent	Parameter 133
	Start compensation	0.0 - 300.0 %	100.0 %	Parameter 134
	U/f ratio	0.00 - 20.00 V/Hz	Motor dependent	Parameter 135
	Slip compensation	-500.0 - +500.0 %	100.0 %	Parameter 136
	DC holding voltage	0 - 100 %	0 %	Parameter 137
	Brake cut out frequency	0.5 - 132 Hz	3.0 Hz	Parameter 138
	Brake cut in frequency	0.5 - 132 Hz	3.0 Hz	Parameter 139
References and limits	Rotation direction	3	Both directions 0 - 132 Hz	Parameter 200
	Min. output frequency (f_{MIN})	0.0 Hz – f_{MAX}	0.0 Hz	Parameter 201
	Max. output frequency (f_{MAX})	f_{MIN} - f_{RANGE}	f_{RANGE} (132 Hz)	Parameter 202
	Reference/feedback range	Min. -max./-max.- +max.	Min. - Max.	Parameter 203
	Minimum reference	-100,000.000 - Ref_{MAX}	0.000	Parameter 204
	Maximum reference	Ref_{MIN} - 100,000.000	50.000	Parameter 205
	Ramp-up time 1	0.05 - 3600.00 sec.	3.00 sec.	Parameter 207
	Ramp-down time 1	0.05 - 3600.00 sec.	3.00 sec.	Parameter 208
	Jog ramp time	0.05 - 3600.00 sec.	3.00 sec.	Parameter 211
	Quick stop ramp-down time	0.05 - 3600.00 sec.	3.00 sec.	Parameter 212
	Jog frequency	0 Hz - f_{MAX}	10.0 Hz	Parameter 213
	Reference function	2	Sum	Parameter 214
	Preset reference 1	-100.00 % - +100.00 %	0.00 %	Parameter 215
	Preset reference 2	-100.00 % - +100.00 %	0.00 %	Parameter 216
	Catch up/slow down value	0.00 - 100.00 %	0.00 %	Parameter 219
	Current limit for motor mode	Min.- max. limit in % of I_{RATED}	Max. limit	Parameter 221
	Frequency bypass, bandwidth	0 (off) - 100 %	0 %	Parameter 229

	Function	Range/number of settings/value	Factory setting	Parameter No.
Inputs and Outputs	Frequency bypass 1	0.0 - 132 Hz	0.0 Hz	Parameter 230
	Frequency bypass 2	0.0 - 132 Hz	0.0 Hz	Parameter 231
	Preset reference 1	-100.00 % - +100.00 %	0.00 %	Parameter 241
	Preset reference 2	-100.00 % - +100.00 %	0.00 %	Parameter 242
	Preset reference 3	-100.00 % - +100.00 %	0.00 %	Parameter 243
	Preset reference 4	-100.00 % - +100.00 %	0.00 %	Parameter 244
	Preset reference 5	-100.00 % - +100.00 %	0.00 %	Parameter 245
	Preset reference 6	-100.00 % - +100.00 %	0.00 %	Parameter 246
	Preset reference 7	-100.00 % - +100.00 %	0.00 %	Parameter 247
	Time out	1 -99 sec.	10 sec.	Parameter 317
	Function after time out	Off/Stop and trip	Off	Parameter 318
	Relay function	13	Unit ready	Parameter 323
	Pulse reference/feedback, max. freq.	100 - 70000 Hz	5000 Hz	Parameter 327
	Terminal 1, analog input current	3	No operation	Parameter 331
	Terminal 2, digital input	25	Reference	Parameter 332
	Terminal 3, digital input	25	Reset	Parameter 333
	Terminal 4, digital input	24	Start	Parameter 334
	Terminal 5, digital input	23	Start + Reversing	Parameter 335
	Terminal 1, min. scaling	0.0 - 20.0 mA	0.0 mA	Parameter 336
	Terminal 1, max. scaling	0.0 - 20.0 mA	20.0 mA	Parameter 337
	Terminal 2, min. scaling	0.0 - 10.0 V	0.0 V	Parameter 338
	Terminal 2, max. scaling	0.0 - 10.0 V	10.0 V	Parameter 339
	Output functions	21	No operation	Parameter 340
Special functions	Brake function	Off/AC braking	Off	Parameter 400
	Sleep mode timer	0 – 300sec.	Off	Parameter 403
	Sleep frequency	f_{Min} – par. 407	0 Hz	Parameter 404
	Reset function	11	Manual reset	Parameter 405
	Boost setup	1 … 200%	100%	Parameter 406
	Wake up frequency	Par. 404 – f_{Max}	50 HZ	Parameter 407
	Switching frequency	1.5 - 14.0 kHz	Unit dependent	Parameter 411
	Variable switching freq.	3	Temp. dep. sw. freq.	Parameter 412
	Overmodulation function	Off/On	On	Parameter 413
	Minimum feedback	-100,000 - F_{BHIGH}	0	Parameter 414
	Maximum feedback	F_{BLOW} - 100,000	1500	Parameter 415
	Reference/feedback unit	42	%	Parameter 416
	Process PID normal/ inverse	ctrl. Normal/inverse	Normal	Parameter 437
	Process PID anti windup	Disable/Enable	Enable	Parameter 438
	Process PID start frequency	f_{MIN} - f_{MAX}	f_{MIN}	Parameter 439
	Process PID proportional gain	0.00 (off) - 10.00	0.01	Parameter 440
	Process PID integral time	0.01 - 9999 sec. (off)	9999 sec.	Parameter 441
	Process PID different. time	0.00 (off) - 10.00 sec.	0.00 sec.	Parameter 442
	Process PID different. gain limit	5 -50	5	Parameter 443
	Process PID lowpass filter Time	0.1 - 10.00 sec.	0.1 sec.	Parameter 444
	Flying start	4	Disable	Parameter 445
	Switching pattern	2	SFAVM	Parameter 446
	Feedback conversion	Linear or square root	Linear	Parameter 461
Serial communication	Bus address	1 - 126	1	Parameter 500
	Baudrate	300 - 9600 Baud/6	9600 Baud	Parameter 501
	Coasting	4	Logic or	Parameter 502
	Quick-stop	4	Logic or	Parameter 503
	DC-brake	4	Logic or	Parameter 504
	Start	4	Logic or	Parameter 505
	Reversing	4	Logic or	Parameter 506
	Selection of setup	4	Logic or	Parameter 507
	Selection of speed	4	Logic or	Parameter 508
	Bus jog 1	0.0 - f_{MAX}	10.0 Hz	Parameter 509
	Bus jog 2	0.0 - f_{MAX}	10.0 Hz	Parameter 510
	Telegram profile	Profidrive/FC Drive	FC Drive	Parameter 512

	Function	Range/number of settings/value	Factory setting	Parameter No.
Serial communication	Bus time interval		1 sec.	Parameter 513
	Bus time interval function	6	Off	Parameter 514
	Data read-out: Reference	XXX.X		Parameter 515
	Data read-out: Refer. unit	Hz/rpm		Parameter 516
	Data read-out: Feedback			Parameter 517
	Data read-out: Frequency	Hz		Parameter 518
	Data read-out: Frequency x scale	Hz		Parameter 519
	Data read-out: Current	A x 100		Parameter 520
	Data read-out: Torque	%		Parameter 521
	Data read-out: Power	kW		Parameter 522
	Data read-out: Power	hp		Parameter 523
	Data read-out: Motor volt.	V		Parameter 524
	Data read-out: DC link volt.	V		Parameter 525
	Data read-out: FC therm.	0 - 100 %		Parameter 527
	Data read-out: Digital input			Parameter 528
	Data read-out: External reference	-200.0 - +200.0 %		Parameter 533
	Data read-out: Status word, binary			Parameter 534
	Data read-out: FC temp.	°C		Parameter 537
	Data read-out: Alarm word, binary			Parameter 538
	Data read-out: Control word, binary			Parameter 539
	Data read-out: Warning word, 1			Parameter 540
	Data read-out: Warning word, 2			Parameter 541
	Data read-out: Terminal 1, analog input	mA x 10		Parameter 542
	Data read-out: Terminal 2, analog input	V x 10		Parameter 543
Technical functions	Operating data: Op. hours	0 - 130,000.0 hours		Parameter 600
	Operating data: Hours run	0 - 130,000.0 hours		Parameter 601
	Operating data: Number of power-up's	0 - 9999		Parameter 603
	Operating data: Number of overtemperature	0 - 9999		Parameter 604
	Operating data: Number of overvoltages	0 - 9999		Parameter 605
	Fault log, read-out: Error code	Index XX - XXX		Parameter 615
	Fault log, read-out: Time	Index XX - XXX		Parameter 616
	Fault log, read-out: Value	Index XX - XXX		Parameter 617
	Reset of hours-run counter	No reset/reset	No reset	Parameter 619
	Operation mode	3	Normal function	Parameter 620
	Nameplate: FC motor type	Depends on unit		Parameter 621
	Nameplate: Software version no.	Depends on unit		Parameter 624
	LCP version	Depends on unit		Parameter 625
	Nameplate: Database identification no.	Depends on unit		Parameter 626
	Nameplate: Application option type			Parameter 628
	Nameplate: Communication option type			Parameter 630
	BMC software identification			Parameter 632
	Motor database identification			Parameter 633
	Unit identification for communication			Parameter 634