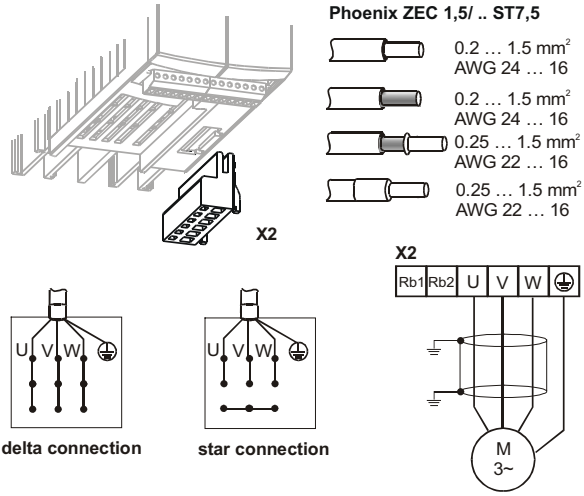
5.4 Motor Connection

The connection to the motor and brake resistor at the frequency inverter is done via plug-in terminals X2. The shielding of the motor cable is to be connected on both sides to earth with good conductivity over a large area. The control, mains supply and motor cables must be laid spatially separated from each other. Note the limit values in accordance with the application, the length of the motor cable and the switching frequency. The general requirements of product standard EN 61800-3 are complied with in the case of a shielded motor cable of up to 50 m in length.

Attention: Frequency inverters ≤ 7.5 kW with a built-in EMC filter comply with the emission limit values of product standard EN 61800-3, for a motor cable length of up to 10 m. Optional filters can be used to meet any customer-specific requirements.

5.4.1 Frequency Inverters (0.55 to 3.0 kW)

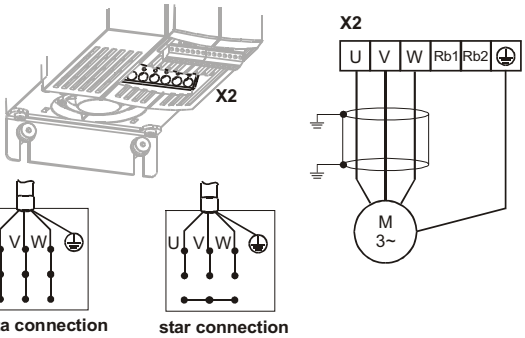
Motor connection 0.55 kW to 3.0 kW



Danger: Plug-in terminal X2, which cannot be connected up with an incorrect polarity, may only be connected when not live and after being disconnected. The motor terminals and the terminals of the brake resistor can still have dangerous voltages even after the frequency inverter has been properly disconnected.
It is essential to wait several minutes before starting the installation work to allow the DC link capacitors time to discharge fully.

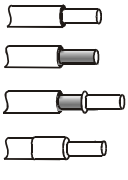
5.4.2 Frequency inverters (4.0 to 18.5 kW)

Motor connection 4.0 kW to 18.5 kW



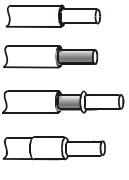
delta connection **star connection**

4.0 kW … 7.5 kW
WAGO Serie 745 / 6qmm / RM7,5



0.2 … 6 mm²
AWG 24 … 10
0.2 … 6 mm²
AWG 24 … 10
0.25 … 4 mm²
AWG 22 … 12
0.25 … 4 mm²
AWG 22 … 16

11 kW … 18.5 kW
WAGO Serie 745 / 16qmm / RM10+15



0.2 … 16 mm²
AWG 24 … 6
0.2 … 16 mm²
AWG 24 … 6
0.25 … 10 mm²
AWG 22 … 8
0.25 … 10 mm²
AWG 22 … 8

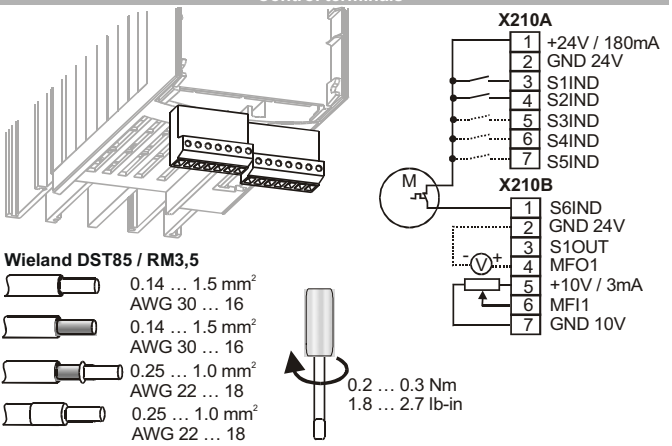
Danger: The terminal X2 may only be connected when not live and after being disconnected. The motor terminals and the terminals of the brake resistor can still have dangerous voltages even after the frequency inverter has been properly disconnected.
It is essential to wait several minutes before starting the installation work to allow the DC link capacitors time to discharge fully.

5.5 Control Terminals

The control and software functionality can be configured as desired for functionally safe and economical operation. The brief instructions describe the factory settings.

Caution: The control inputs and outputs, which cannot be connected up with an incorrect polarity, may only be connected when not live and after being disconnected.

Control terminals



Control terminal X210A

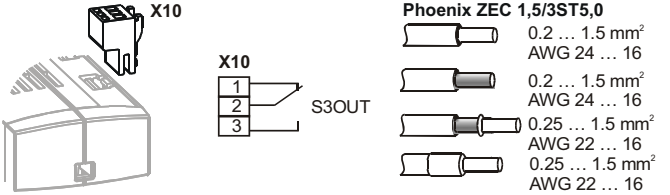
Cl.	Description	Explanation/Use
1	Voltage output 24 V, I_{max} = 180 mA	Supply voltage
2	Ground / GND 24 V	-
3	Digital input S1IND, U_{max} = 30 V, 10 mA at 24 V, PLC-compatible	Controller release / acknowledge fault message
4	Digital input S2IND, U_{max} = 30 V, 10 mA at 24 V, PLC-compatible	Programmable, Start clockwise (factory setting)
5	Digital input S3IND, U_{max} = 30 V, 10 mA at 24 V, PLC-compatible	Programmable, Start anti-clockwise (factory setting)
6	Digital input S4IND, U_{max} = 30 V, 10 mA at 24 V, PLC-compatible	Programmable, Data set change to 1 (factory setting)
7	Digital input S5IND, U_{max} = 30 V, 10 mA at 24 V, PLC-compatible	Programmable, Data set change to 2 (factory setting)

Control terminal X210B

1	Digital input S6IND, U_{max} = 30 V, 10 mA at 24 V, PLC-compatible	Programmable, Motor thermal contact (factory setting)
2	Ground / GND 24 V	-
3	Digital output S1OUT, U = 24 V, I_{max} = 40 mA, overload proof and short-circuit proof	Programmable, Operational message (factory setting)
4	Multifunction output MFO1, U = 24 V, I_{max} = 40 mA, overload proof and short-circuit proof	Programmable, pulse width modulated signal that is proportional to the actual frequency (factory setting)
5	Reference output 10 V, I_{max} = 4 mA	Supply reference value potentiometer
6	Multifunction input MFI1, 12 bit 0 to 10 V, Ri = 70 kΩ	Programmable, Speed reference value (factory setting)
7	Ground / GND 10V	-

The relay output that can be programmed as desired is linked with the monitoring function in the factory setting. Connection of the relay output is not absolutely essential for proper frequency inverter functioning.

Relay output

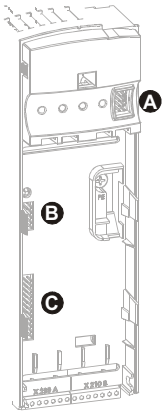


Control terminal X10

Cl.	Description	Explanation/Use
1 to 3	Relay output, changeover contact, Response time approx. 40 ms, floating, 240 V AC / 5 A, 24 V DC / 5 A (ohmic)	Programmable, Without fault message the contact 2 - 3 is closed (factory setting)

These frequency inverters can easily be integrated into an automation concept due to the modular hardware components. These default or customer-specific modules are recognized during initialization and the controller functionality is automatically adapted to suit. The required information for installation and handling of the optional expansions can be found in the relevant documentation.

Hardware modules



A Control unit KP500

Connection of the optional control unit KP500 or an interface adapter KP232.

B Communications module CM

Plug-in section for connection to various communication protocols:

- CM-232, RS232 interface
- CM-485, RS485 interface
- CM-LON, LON interface
- CM-PDP, Profibus-DP interface
- CM-CAN, CANopen interface

C Expansion module EM

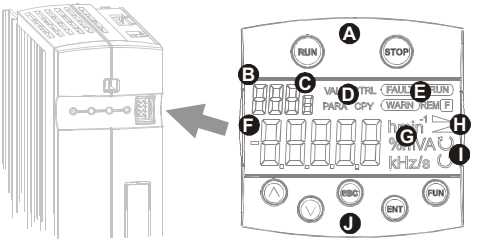
Plug-in section for customer-specific customizing of the control inputs and outputs to various applications:

- Enhanced speed sensor evaluation
- Analog inputs and outputs
- Digital inputs and outputs
- EM-SYS, system bus

Danger: Only carry out installation and dismantling work on the hardware modules once the frequency inverter concerned has been disconnected. It is essential to wait several minutes before starting work to allow the DC link capacitors time to discharge fully.

6 Control Unit KP500

Parameterization, parameter display and control of the frequency inverter can be done via the optional control unit.
The control unit is not absolutely essential for operation of the frequency inverter and can be unplugged if required.

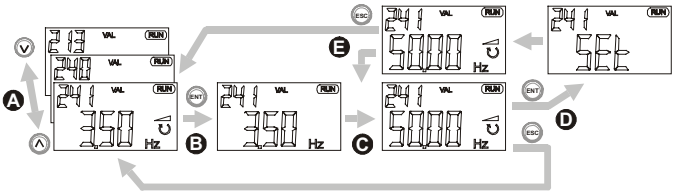


Keys		
A	RUN	Starts the drive unit and changes to the CTRL menu. Press the RUN key to branch to the motor potentiometer function.
	STOP	Changes to the CTRL menu and stops the drive unit. acknowledge fault
J	▲ ▼	Navigation in the menu structure and selection of parameters. Increase and reduce parameter values.
	ENT	Calls up parameters or makes a change within the menu structure. Confirms the selected function or parameter.
	ESC	Quits the parameter or jumps back one level within the within the menu structure. Cancels the functions or resets the parameter value.
	FUN	Changes over the functions of the keys and provides access to special functions.

Display		
B	Three-digit 7-segment display to show the parameter numbers	
C	Single-digit 7-segment display for the active data set, direction of rotation, etc.	
D	Display the selected menu branch:	
	VAL	Display actual values
	PARA	Parameter selection and editing of the parameter values
	CTRL	Selection of functions that can be used via the die control unit: SEtUP for commissioning ctrL Motor potentiometer and jog function tESt Equipment test
E	Status and operational messages:	
	WARN	Warning of critical operational behaviour
	FAULT	Fault switching-off, with the associated message
	RUN	Flashing: ready for operation On continuously: operation and release of the output stage
	REM	Active remote control via the interface connection
	F	Function changeover via the FUN key
F	Five-digit 7-segment display for parameter value and sign	
G	Physical unit of the displayed parameter value	
H	Active acceleration or deceleration ramp	
I	Current direction of rotation of the drive unit	

6.1 Actual Values Menu

The control unit displays a large number of actual values in the VAL menu branch, depending on the selected configuration and installed options. The brief instructions document a selection of parameters and the basic functions of the software. Further information is given in the operating instructions.



A	Use the cursor keys to select the desired number from the actual values shown in numeric order. The number is shown flashing with the active data set in the display.

Keys	
▲ + ▼	Change to the actual value parameter when switching on
FUN , ▲	Display last actual value parameter (highest number)
FUN , ▼	Display first actual value parameter (lowest number)

B	Press the ENT key to select the actual value that is to be displayed with the current parameter value, unit and active data set.

C	It is possible to monitor a specific actual value parameter as part of commissioning and troubleshooting.

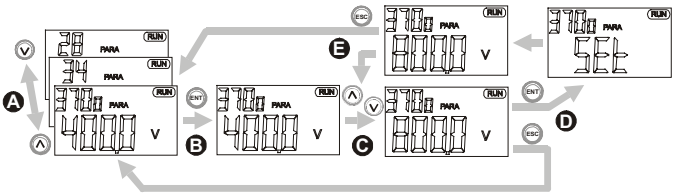
Keys	
FUN , ▲	Maximum actual value is continuously determined and displayed
FUN , ▼	Minimum actual value is continuously determined and displayed
FUN , ENT	Median of the actual value during the monitoring period

D	Press the ENT key to save the selected actual value as a parameter when switching on. The SEt message is displayed briefly with the parameter number. This actual value is automatically displayed in future when switching on the frequency inverter.

E	You can once again monitor and display the value once the parameters have been saved. Press the ESC key to change to the parameter selections in the VAL menu branch.

6.2 Parameters Menu

The parameters that are queried during commissioning are selected from known applications and supplemented by additional settings in the PARA menu branch as required. The brief instructions describe the basic parameters and the basic functions of the software.
Further information is given in the operating instructions.



Ⓐ	Use the cursor keys to select the desired number from the parameters shown in numeric order. The parameter number is shown flashing with the active data set in the display.

Keys	
▲ + ▼	Changes to the last parameter that was modified
FUN , ▲	Display last parameter (highest number)
FUN , ▼	Display first parameter (lowest number)

Ⓑ	Press the ENT key to select the parameter, which is displayed with the parameter value, unit and active data set.

Ⓒ	The cursor keys allow the parameter value to be changed. The value is to be changed or a mode of operation selected, regardless of the parameter.

Keys	
▲ + ▼	Parameter is reset to the factory setting
FUN , ▲	Parameter is set to the highest value
FUN , ▼	Parameter is set to the lowest value
FUN , ENT	Change the data set in the case of switchable parameters

Ⓓ	Press the ENT key to save the parameter value. The SEt message is displayed briefly with the parameter number and data set. Press the ESC key if you wish to quit the parameter without making any changes.

Messages	
Err1: EEPrO	Parameter could not be saved
Err2: StOP	Parameter can only be read during operation
Err3: Error	Other fault

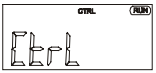
Ⓔ	Once the parameter has been saved, you can change the value again if you wish, or else you should press the ESC key to switch to parameter selection.

6.3 Controlling the Motor via the Control Unit

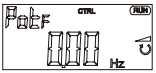
The control unit permits control of the motor parallel with the connected analog and digital control signals.

Attention: Control of the drive unit via the control unit requires the release of the power component via the controller release S1IND digital input. Avoid any risks of severe personal injury or damage to valuable assets by ensuring that only suitably qualified technicians work on the equipment. Qualified persons are those who are familiar with the setting up, installation, commissioning and operation of frequency inverters and have the corresponding qualifications to carry out such work. Carefully read the documentation before starting the work and comply with the safety instructions.

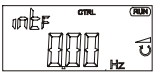
The CTRL menu branch can be reached by navigation within the menu structure. The CtrL function includes sub-functions that are displayed according to the operating point of the frequency inverter.
Press the RUN key to go from any point within the menu structure to motor potentiometer function **Pot** or internal reference value **int** respectively.



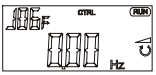
Motor potentiometer function **Pot**
Use the cursor keys to set the output frequency of the frequency inverter from the *minimum frequency* **418** up to the *maximum frequency* **419**. The acceleration corresponds to the factory setting (2 Hz/s) of the parameter *Ramp KP-MPot* **473**. The parameters *Acceleration* **420** and *Deceleration* **421** are considered at lower values of acceleration.



Internal reference value **int**
The drive unit is in operation and the current actual value is displayed. Use the cursor keys to go to motor potentiometer function **Pot**, which causes that the current value for the frequency to be accepted.



JOG frequency **JOG**
Press the FUN key to change from internal reference value **int** or motor potentiometer function **Pot** respectively to the *JOG frequency* **489**. The frequency is set with the aid of the cursor keys.



Key functions	
ENT	Changes over the direction of rotation, regardless of the control signal at the clockwise S2IND or anti-clockwise S3IND terminals.
ESC	Quit the function and go back in the menu structure.
FUN	Press the key to go to JOG frequency and start the drive unit. Releasing the key changes to the sub-function and stops the drive unit.
START	Starts the drive unit; alternative to control signals S2IND or S3IND
STOP	Stops the drive unit; alternative to control signals S2IND or S3IND

Attention: The ENT key produces a **change in direction of rotation** regardless of the signal at the clockwise S2IND or anti-clockwise S3IND terminals.
If the *minimum frequency* **418** has been set to 0 Hz, a change in the sign of the frequency reference value produces a **change in direction of rotation** of the motor.

7 Commissioning the Frequency Inverter

7.1 Turning On the Mains Voltage

Once the installation work has been completed, you should check all control and power connections again before turning on the mains voltage. If all the electrical connections are correct, it is necessary to ensure that you switch off the release of the frequency inverter (control input S1IND open). After the mains is switched on, the frequency inverter carries out a self-test and the relay output (X10) reports "Fault".
The frequency inverter concludes the self-test after a few seconds, and then relay (X10) pulls in and reports "no fault".
Commissioning is called up automatically in the state as delivered and after resetting back to the factory settings. The control unit displays menu item “SEtUP“ from the CTRL menu branch.

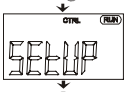
7.2 Setup

The commissioning of the frequency inverter determines all the relevant parameter settings for the desired application. Selection from the available parameters is done from known default applications for the drive unit technology. This makes it easier to select the most important parameters, but it in no way replaces a subsequent check by the user. Once the SETUP routine has been successfully concluded the actual value *Actual frequency* **241** is subsequently displayed from the VAL menu branch in the control unit.

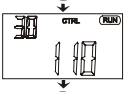
Attention: The commissioning includes a function for parameter identification. The parameters are determined by measurement and set accordingly. The motor should not have been run before starting the measurement, since some of the machine data depends on the operational temperature.

The commissioning appears automatically in the state as delivered. In connection with a successful commissioning, you can select the CTRL sub-menu and call up the function again.

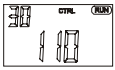
Press the ENT key to go to the CTRL sub-menu. In this sub-menu you can select the “SEtUP“ menu item with the cursor keys and confirm it with the ENT key.



Select the *configuration* **30** parameter with the ENT key and input the numbers **110** or **410** with the cursor keys (see the following section). End the input with the ENT key and switch to the following parameter. The hardware and software functionality is configured if the configuration was changed. Please confirm the desired configuration after initialization.



7.2.1 Configuration

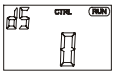


Configuration **30** determines the pin-outs and basic functions of the control and outputs and the software functions. The frequency inverter software offers several configurations to choose from. The configurations primarily differ in the way that the drive unit is controlled. These brief instructions include details on sensor-less control in **Configuration 110** and sensor-less field-oriented control in **Configuration 410**. The speed is input as a frequency reference value via an analog signal. Analog and digital inputs are to be combined and supplemented by the optional communication protocols as an additional source of reference values. The speed of the drive unit is governed down once the set limits are reached so that the latter are not exceeded.

Configuration 110, sensor-less control
Configuration 110 includes the functions for variable speed control of a 3-phase machine in a large number of default applications. The motor speed is derived from the set relationship between the reference frequency and the required voltage.

Configuration 410, sensor-less field-oriented control
Configuration 410 includes the functions for sensor-less control of a 3-phase machine. The current motor speed is determined from the currents and voltages at that moment in combination with the machine parameters. Parallel switching of motors in this configuration is restrictedly possible.

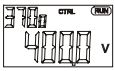
7.2.2 Data Set



The *data set* makes it possible to save parameter settings in four independent data sets. Data sets 1 to 4 are saved with the same parameter values in data set 0. By default the frequency inverter uses data set 1 unless data set switching is used.

Setting	
Parameter dS	**Function**
0	All data sets (DS0) **(factory settings)**
1	Data set 1 (DS1)
2	Data set 2 (DS2)
3	Data set 3 (DS3)
4	Data set 4 (DS4)

7.2.3 Machine Data



The machine data that is input in the following part of the commissioning is to be taken from the rating plate and the data sheet of the motor. The factory settings for the machine parameters relate to the nominal data of the frequency inverter and the associated 3-phase machine. The machine data required for the control and regulation process is calculated in the course of the commissioning from the settings, which have to be checked for plausibility. The rated values used in the factory settings must be checked by the user.

Motor rated values			
Para. No.	**Factory setting**	**Unit**	**Name / Function**
370	U_{FUN}	V	Rated voltage
371	I_{FUN}	A	Rated current
372	FI type	rpm	Rated speed
374	FI type	-	Rated cos phi
375	50,00	Hz	Rated frequency
376	P_{FUN}	kW	Mechanical rated output

7.2.4 Plausibility Check

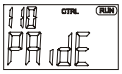
The checking of the machine data should only be skipped by a suitably qualified and experienced user. The configurations include complex control procedures that depend to a large extent on the correct machine parameters being entered. The warning and fault messages displayed during the testing and checking should therefore be noted carefully. If a critical state is detected during the commissioning, this is displayed in the control unit. A warning or fault message is displayed according to the deviation from the expected parameter value.
The warning message can be acknowledged with the ENT key and the commissioning is continued. The parameter values that had been entered can be corrected subsequently by pressing the ESC key.

Warning messages	
Code	**Measures / Remedy**
SA000	There are no warning messages. This message can also be read by an optional communication card.
SA001	The *rated voltage* **370** is outside the FU nominal voltage range. The maximum nominal voltage is given on the rating plate of the frequency inverter.
SA002	The *rated current* **371**, the *rated output* **376** and the *rated voltage* **370** must be checked. The calculated efficiency is within the limits for a 3-phase motor.
SA003	The *rated cos phi* **374** is outside the standard range (0.6 to 0.95).
SA004	The *rated speed* **372** and the *rated frequency* **375** must be checked. The slip is within the limits for a 3-phase motor.

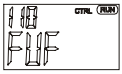
If an fault message appears, check and input again the parameterized rated data. Repeat the commissioning until the rated values have been input without any faults. Only experienced users should terminate the commissioning prematurely by pressing the ESC key, since some of the rated data is not correct.

Fault messages	
Code	**Measures / Remedy**
SF000	There are no fault messages
SF001	The *rated current* **371** that was entered is too low.
SF002	The *rated current* **371** is too high, related to the *rated output* **376** and the *rated voltage* **370**.
SF003	The *rated cos phi* **374** is wrong (more than 1 or less than 0.3).
SF004	The slip frequency calculated from the rated data is negative. The *rated speed* **372** and the *rated frequency* **375** must be checked.
SF005	The *rated speed* **372** and the *rated frequency* **375** that were entered must be checked, since the calculated slip frequency is too large.
SF006	The overall output calculated from the rated data of the drive unit it lower that the figure that was entered for the rated output.
SF007	The configuration that was set is not supported by the commissioning. Configurations 110 and 410 are described in these brief instructions and the unit is to be set accordingly.

7.2.5 Parameter Identification

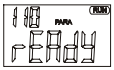


The selected configuration requires the knowledge of additional machine data that is not given on the rating plate of the 3-phase machine. The commissioning can measure the required machine data, supplement or alternative to the data sheet of the manufacturer. The values measured while the drive unit is at a standstill can be entered directly or in connection to a calculation for the parameter. The sequence and duration of the parameter identification varies according to the machine connected and the unit rating. Display PAidE is to be confirmed by pressing the ENT key. The connected load is evaluated in the subsequent course of parameter identification with the displayed signals.



The commissioning changes over to the functions for parameter identification after checking the machine data that had been input. The safety functions of the frequency inverter prevent the release of the power component unless digital input S1IND is wired up. If a signal had already been applied at the start of commissioning, message FUF is not displayed.

Warning: The parameter identification of the frequency inverter requires the release of the power component. Avoid any risks of severe personal injury or damage to valuable assets by ensuring that only suitably qualified technicians work on the equipment. Qualified persons are those who are familiar with the setting up, installation, commissioning and operation of frequency inverters and have the corresponding qualifications to carry out such work. Carefully read the documentation before starting the work and comply with the safety instructions.



The concluding message rEAdY is to be confirmed with the ENT key. Cancelling by pressing the ESC key or by terminating the release of S1IND means that incomplete values are accepted.

7.2.6 Application Data

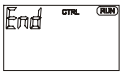
The wide variety of applications for drive units, with the resulting parameter settings, require additional parameters to be checked. The parameters that are queried within the commissioning are selected from known applications and can be supplemented as required in the PARA menu.

Frequency ramps			
Para. No.	**Factory setting**	**Unit**	**Name / Function**
420	5.00	Hz/s	Acceleration
421	5.00	Hz/s	Deceleration

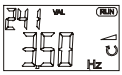
Attention: The deceleration of the drive is monitored in the standard parameter setting *operation mode voltage controller* **670**. The deceleration ramp can be extended during rising DC-link voltage in regenerative operation or braking of the drive.

Multifunction input MFI1 is to be parameterized in the mode of operation that corresponds to the reference value signal. Mode of operation 3 should only be selected by expert users wishing to use drive unit control via *fixed frequency 1* **480** and *fixed frequency 2* **481**.

Reference value signal	
Mode of operation *MFI1* **452**	**Name / Function**
1 **(Factory settings)**	Voltage signal, 0 to 10V
2	Current signal, 0 to 20mA
3	Digital fixed frequency changeover, 0 to 24V



The control unit shows the End message that you should confirm with the ENT key. The commissioning of the frequency inverter is concluded with a reset and initialization of the frequency inverter. Relay output X10 reports an fault during initialization.



The parameter *actual frequency* **241** that is defined in the factory settings is displayed in connection with an fault-free initialization of the frequency inverter. If a signal is applied to digital input 1 and digital input 2 or digital input 3, then the drive unit is accelerated to the set *minimum frequency* **418** (factory setting 3.50 Hz)

The commissioning makes it easier for you to select the main parameters and determines additional rated data for the motor. If the settings for the parameters were determined via the optional operating software or the PARA menu branch of the control unit, display of the selected actual value is to be activated manually. The setup function appears when the frequency inverter is switched on, and you can quit this by pressing the ESC key. Change to the VAL menu branch and select the desired actual value that is to be displayed in future. Press the ENT key to display the value of the parameter and press the ENT key again to select the actual value for a new start.

7.3 Checking the Direction of Rotation

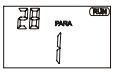
The relationship between the reference value and the actual direction of rotation of the drive unit must be checked. The check should be made as follows. Input a reference value of around 10 % and briefly switch on the release for the inverter (control inputs FUF (S1IND) and STR (S2IND) for clockwise, or FUF (S1IND) and STL (S3IND) for anti-clockwise). Check that the motor shaft is turning in the right direction as the drive unit accelerates. In addition to checking the drive unit, the corresponding actual values and the operational messages can be read with the aid of the control unit. If the direction of rotation is wrong, for example, then swap over two of the motor at the terminals of the frequency inverter, e.g., U and V. The connection of the frequency inverter at the mains has no effect on the direction of rotation of the drive unit.

Note: The commissioning of the frequency inverter is now completed and can now be supplemented by further settings in the PARA menu. The parameters that have been set have been chosen such that they are adequate in most cases concerning commissioning. Testing and checking additional settings that are relevant for the application is to be done on the basis of the operating instructions.

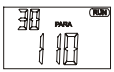
8 Basic Parameters

8.1 Menu Branch PARA

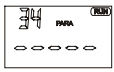
The parameters shown in the PARA menu branch are set within the commissioning to some extent. The parameters documented in the brief instructions are to be supplemented by the information given in the operating instructions.



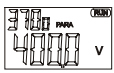
Control level **28** - The brief instructions describe the parameters at control level 1. Control levels 2 or 3 should only be set by expert users. The higher control levels are described in the operating instructions.		
Setting:	1 - 3	



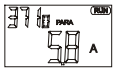
Configuration **30** – The basic functions of the control inputs and outputs and the allocation of the software module is done within the configuration.		
Setting:	110 -	Sensor-less control with v/f-characteristic, for speed control in a wide variety of standard applications.
	410 -	Sensor-less field-oriented control, for applications with a high level of functionality and dynamics



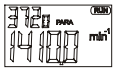
Program(ming) **34** - All the parameters are reset to the factory settings, or a fault message is acknowledged (alternative to the signal at digital input S1IND).		
Setting:	4444	Revert to factory settings
	123	Acknowledge fault



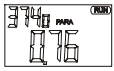
Rated voltage **370** – Set the voltage stated on the rating plate of the 3-phase motor for the selected switching.	
Setting:	60.0 V – 800.0 V



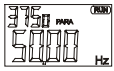
Rated current **371** – Set the rated current stated on the rating plate for the selected switching.	
Setting:	$0.01 \cdot I_{FIN}$ - $10 \cdot o \cdot I_{FIN}$



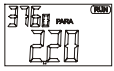
Rated speed **372** - Set the value stated on the rating plate for the motor speed at the rated frequency.	
Setting:	96 rpm - 60,000 rpm



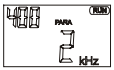
Rated cos phi **374** – Enter the value stated on the rating plate of the 3-phase motor.	
Setting:	0.01 – 1.00



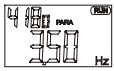
Rated frequency **375** – Set the rated frequency for the parameterized rated speed.	
Setting:	10.00 – 999.99



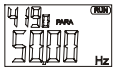
Mech. rated output **376** – Set the output in kilowatts stated on the rating plate of the 3-phase motor in.	
Setting:	$0.1 \cdot P_{FIN}$ - $10 \cdot P_{FIN}$



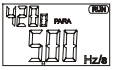
Switching frequency **400** – The nominal rated point of the frequency inverter is defined for a switching frequency of 2 kHz. Higher switching frequencies require a reduction of the output current (see the technical data).	
Setting:	2 kHz, 4 kHz, 8 kHz, 10 kHz, 16 kHz



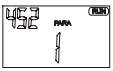
Min. frequency **418** – The start command sent via the control unit or digital inputs S2IND, S3IND brings an acceleration of the drive unit up to the minimum frequency.	
Setting:	0.00 Hz – 999.99 Hz



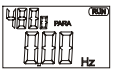
Max. frequency **419** – The speed range of the drive unit is limited by the maximum output frequency of the frequency inverter.	
Setting:	0.00 Hz – 999.99 Hz



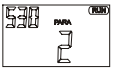
Acceleration **420**, *Deceleration* **421** – The ramps define how quickly the output frequency changes in the event of a reference value change or after a start, stop or braking command.		
Setting:	0.00 Hz/s – 999.99 Hz/s	



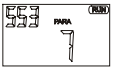
Mode of operation Multifunction input **452** - The reference value input at input MFI1 is to be parameterized in the mode of operation corresponding to the connected signal source.		
Setting:	1 -	Voltage signal, 0 V – 10 V
	2 -	Current signal, 0 mA – 20 mA
	3 -	Digital fixed frequency changeover, digital 0 V – 24 V



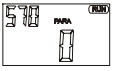
Fixed frequency 1 **480**, *Fixed frequency 2* **481** – Switching between the fixed frequencies is done via the fixed frequency changeover of the MFI1 input. It is possible to select fixed frequency from one of the four data sets via data set changeover S4IND, S5IND. You can parameterize up to 8 fixed frequencies and select them via the controller for the digital inputs an.		
Setting:	0,00 Hz - 999,99 Hz	



Mode of operation Digital output 1 **530**, *Digital output 3* **532** – Various monitoring functions can be allocated to digital output S1OUT and relay output S3OUT.		
Setting:	2 -	Operational message, control signal at S1IND, S2IND or S3IND
	3 -	Fault message
	11 -	Warning
	40 -	Apply the electromechanical brake
	1xx -	Inverted mode of operation (LOW active)

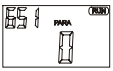


Mode of operation Analog operation MFO1 **553** - output MFO1 supplies a pulse width-modulated signal (0 V - 10 V) that is proportional to an actual value.		
Setting:	7 -	Actual frequency, 0 Hz – *max. Frequency* **418**
	20 -	Active current, 0 A – I_{FIN}
	30 -	Active power P, 0 kW – *Rated mech. Output* **376**
	50 -	Effective current, 0 A – I_{FIN}
	52 -	Machine voltage, 0 V – 1000 V

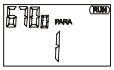


Mode of operation Motor PTC **570** - Monitoring of the motor temperature protects the drive unit system. A suitable sensor is to be connected to digital input S6IND.		
Setting:	0 -	Switched off
	1 -	Warning message
	2 -	Fault switching-off
	3 -	Fault switching-off, after 1 min
	4 -	Fault switching-off, after 5 min
	5 -	Fault switching-off, after 10 min

Mode of operation Synchronization **645** - Synchronization of a rotating drive unit is helpful in a number of applications, such as with pumps and ventilation, or after acknowledging a fault switching-off. If the synchronization of the motor speed is not possible the function is terminated with a fault message.		
Setting:	0 -	Switched off
	10 -	Synchronization switched on



Mode of operation Auto start **651** - Automatic starting up of the drive unit is only permitted as per regulation VDE 0113 (paragraphs 5.4, 5.5), VDE 0100 part 227 and the relevant national regulations. In general, it is necessary to ensure that there is not danger as a result of automatic starting up.		
Setting:	0 -	Switched off, control command S1IND, S2IND or S3IND
	1 -	Auto start, control signal at S1IND, S2IND or S3IND



Mode of operation voltage controller **670** - By regenerative operation or braking the rising DC-link voltage is limited with the voltage controller or with an externally connected brake chopper resistor to prevent the tripping on overvoltage.		
Setting:	0 -	Switched off, external brake resistor connected
	1 -	Overvoltage control, deceleration ramps controlled

The following parameters are displayed in addition to the basic parameters in configuration 410.

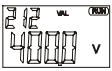
Integral time 1 **722** – The control behaviour of configuration 410 can be adapted by the integral time of the speed controller dependent on the mechanical inertia torque. A lower value results more dynamically behaviour. Proportionally to the lower integral time the oscillation of the system rises.	
Setting:	0 – 60000 ms

Limit current **728** – The speed and the torque can be controlled separately in configuration 410. The torque is limited to the rated torque if the limit current is set to the same as the *rated current* **371** of the motor.	
Setting:	0.0 A – $o \cdot I_{FIN}$

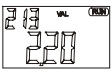
8.2 Menu Branch VAL

The actual values in the VAL menu branch simplify troubleshooting.

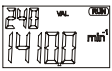
Effective current **211** - Effective output current (motor current) of the frequency inverter calculated from measurement of the three motor phases.	
Display:	0.0 A – $o \cdot I_{FIN}$



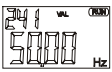
Machine voltage **212** - The modulated output voltage of the frequency inverter, depending on the operational point of the motor.	
Display:	0.0 V – 1000.0 V



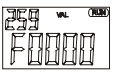
Active power **213** – Calculated output of the 3-phase motor at the operational point as the product of the machine voltage, current and cos phi.	
Display:	0.0 kW – P_{FIN}



Actual speed **240** - The calculated speed of the 3-phase machine determined with the aid of the machine model and the current load point.	
Display:	0.00 rpm – 60,000 rpm

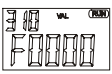


Actual frequency **241** – The current actual output frequency of the frequency inverter, or the actual frequency of the drive unit calculated from the machine model.	
Display:	0.00 Hz – 999.99 Hz



Current fault **259** - The cause for the tripping that occurred is displayed with the corresponding fault code. The current fault is displayed for the fault diagnosis.	
Display:	F0000 ... F9999

Warnings **269** – If a critical state is detected, this is displayed via the WARN field. The warning code is read via parameter 269.	
Display:	A0000 - A9999



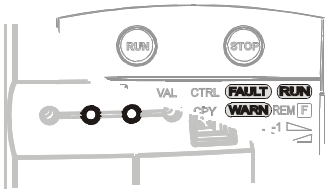
Last fault **310** – The fault message is given immediately after an fault occurs. The frequency inverter attempts to clear some of the faults by itself, or to reset them via digital input S1IND. The last fault code is saved for fault diagnosis.	
Display:	F0000 - F9999

9 Operation and Fault Diagnosis

The operation of the frequency inverter and the connected load is constantly monitored. The troubleshooting details given in the brief instructions can be supplemented by the information given in the operating instructions.

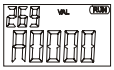
9.1 Status Messages

The red green LED's provide information on the operational point of the frequency inverter. If the control unit is plugged in, status messages are also displayed by display elements RUN, WARN and FAULT.



Status display			
Green LED	**Red LED**	**Display**	**Description**
off	off	-	No power supply
on	an	-	initialization and self-test
flashes	off	RUN flashes	Ready for operation, no output signal
on	off	RUN	Operational message
on	flashes	WARN	Operational message, actual *Warning* **269**
flashes	flashes	WARN	Ready for operation, actual *Warning* **269**
off	flashes	FAULT flashes	Frequency inverter *Fault Message* **310**
off	on	FAULT	*Fault Message* **310,** clear fault

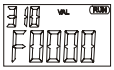
9.2 Warning Messages



The code that is read by the *warnings* **269** parameter can be made up of several different messages. For example, code A0088 is made up of the separate warning messages A0008 + A0080.

Warning messages	
Code	**Meaning**
A0000	No warning messages.
A0001	Frequency inverter overloaded (60 s), warning code A0002 or A0004
A0002	Overloading of the frequency inverter (1 s), check the load behaviour.
A0004	Short-term overload, check the motor and application parameters
A0008	Max. heat sink temperature reached, check the cooling and fan.
A0010	Max. Inside temperature reached, check the cooling and fan.
A0020	Speed reference values are being limited by a controller.
A0080	Max. motor temperature reached, check the motor and sensor.
A0400	Limit frequency reached, The output frequency is limited.
A4000	DC link voltage has reached the minimum limit for that particular type

9.3 Fault Messages



The fault code that is stored in parameter *last Fault* **310** after an fault occurs makes troubleshooting much easier. The fault code is made up of fault group FXX and the following code number XX.
The fault message is cleared via the keys of the control unit and digital input S1IND.

Fault messages		
Code		**Meaning**
F00	00	No fault has occurred
Overload		
F01	02	Frequency inverter overloaded (60 s), check the load behaviour
	03	Short-term overload (1 s), check the motor and application parameters
Heat sink		
F02	00	Heat sink temperature too high, check the cooling and fan
	01	Temperature sensor defective or ambient temperature too low
Inside temperature		
F03	00	Inside temperature too high, check the cooling and fan
	01	Inside temperature too low, check the electrical cabinet heating
Motor connection		
F04	00	Motor temperature too high or sensor defective, check the S6IND connection
	03	Motor phase failure, check the motor and wiring
Output current		
F05	00	Overloaded, check the load relationships and ramps
	03	Short circuit or earth fault, check the motor and wiring
	05	Unsymmetrical motor current, check the motor and wiring
	06	Motor phase current too high, check the motor and wiring
	07	Message from the phase monitoring, check the motor and wiring
DC link voltage		
F07	00	DC link voltage too high, check the deceleration ramps and brake resistor that is connected
	01	DC link voltage too low, check the mains voltage
	02	Mains failure, check the mains voltage and switching
	03	Phase failure, check the mains fuse and voltage
	04	Mains voltage UDC too high when switching on, check the voltage
	05	Mains voltage BC too high when switching on, check the voltage
	06	Mains voltage MC too high when switching on, check the voltage
Electronics voltage		
F08	01	Electronics voltage 24 V too low, check the terminals
	04	Electronics voltage too high, check the wiring of the terminals
Output frequency		
F11	00	Output frequency too high, check the control signals and settings
	01	Max. frequency reached by the controller, check the deceleration ramps and brake resistor that is connected
Motor connection		
F13	00	Earth fault at output, check the motor and wiring
	10	Min. current control, check the motor and wiring
Control connection		
F14	01	Reference value signal at multifunction input 1 missing, check the signal
	07	Overcurrent at multifunction input 1, check the signal

* UNDER PREPARATION

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