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User Manual

Frequency Inverter ST500 Series

Foreword

Thank you for choosing a Sourcetronic ST500 series frequency inverter. This product made by Sourcetronic is based on years of experience in professional production and sale, and designed for a variety of industrial machinery, fan and water pump drive units and IF heavy-duty grinding units.

This manual provides the user with the relevant precautions on installation, operational parameter setting, error diagnosis, routine maintenance and safe use. In order to ensure correct installation and operation of the frequency inverter, please carefully read this manual before installation.

For any problem when using this product, please contact your local seller authorized by Sourcetronic or directly contact Sourcetronic; our professionals are happy to serve you.

The end-users should keep hold of this manual for future maintenance and care, and other application occasions. For any problem within the warranty period, please fill out the warranty card and send it to our authorized seller.

The contents of this manual are subject to change without prior notice. To obtain the latest information, please visit: http://www.sourcetronic.com/.

Sourcetronic

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Contents

1 Inspection and Safety Precautions

Sourcetronic ST500 frequency inverters are subject to strict quality assurance during production. Nevertheless, please check immediately after delivery whether the individual parts match the documents supplied. Report any visible transport damage to the shipping company immediately.

1.1 Inspection After Unpacking

- Check package contents for completeness (one ST500 frequency inverter, this operating manual)
- Compare type plate with your order

1.2 Instructions on Nameplate

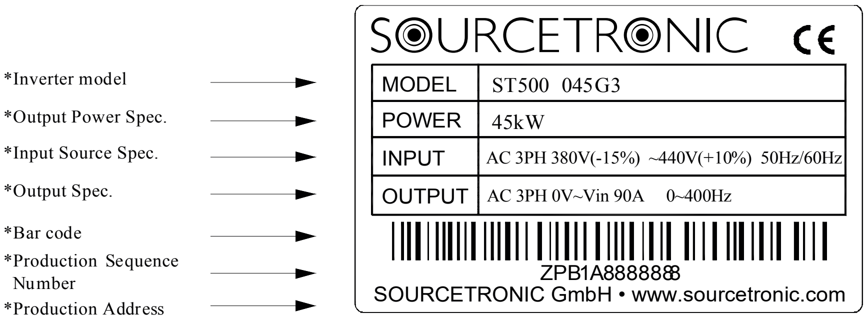


Figure 1-1 Nameplate Description

1.2.1 Model Designation

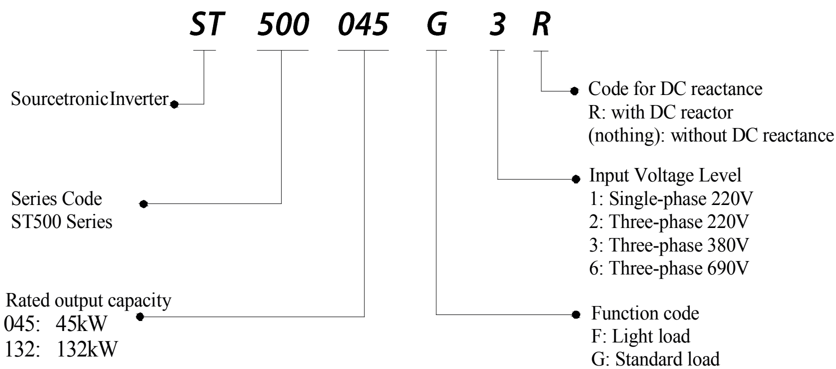


Figure 1-2 Model Description

1.3 Safety Precautions

Safety precautions in this manual are divided into the following two categories:

Danger: Failure to perform these operations may result in serious injury or even death.

Caution: Failure to perform these operations may result in minor to moderate injury injury, or equipment damage.

Process	Type	Description
Before Installation	Danger	• Visual inspection after unpacking: If the frequency inverter or its components are wet, incomplete or damaged, the frequency inverter must not be installed or put into operation! • If the device supplied does not match the device specified on the delivery bill, please contact Sourcetronic GmbH before the inverter is installed or commissioned. • Do not touch the control cards of the frequency inverter directly. This can lead to small damage that may interfere with the operation of the inverter.
When Installing	Danger	Please install the device only on metallic or non-flammable materials.
	Note	• Ensure that no screws, wires, components or similar fall into the inverter during installation. This could damage the inverter! • Choose an installation location that is as vibration-free as possible and not in direct sunlight. • When installing more than two inverters in one control cabinet, ensure good ventilation and observe the installation clearances.
When Wiring	Danger	• The connection/wiring of the frequency inverter should only be carried out by appropriately trained specialist personnel and with the aid of these operating instructions. Damage caused by improper connection is not covered by the warranty. • A line disconnector must be used between the inverter and the mains supply. • When connecting the inverter to a voltage source, make sure that this is switched off. Failure to do so may result in injury from electric shock! • Ensure that the frequency inverter and motor are earthed in accordance with legal standards. • Ensure that the cables used comply with the regional EMC safety guidelines. The recommended cable cross-section for the respective power class can be found in these operating instructions. • Never connect a braking resistor directly to the DC link (terminals + and -). Failure to do so may result in serious damage to the inverter!

		• When using an encoder, a shielded cable should be used that is earthed individually. • Please note that a considerable amount of energy is stored capacitively or inductively both in the frequency inverter DC link and in the motor. The protective effect of an RCD in the supply of an inverter is therefore severely impaired with regard to the inverter output cables. It is therefore essential to ensure that the live parts of the motor, its supply cables and the DC link, including braking units and resistors, are always protected against contact!
Before Powering On	Note	• Please ensure that the supply voltage corresponds to the rated voltage of the frequency inverter. The terminals for the supply voltage are R,S,T (single-phase inverters: phase R, zero T) and the terminals for the output voltage U, V and W. Also check the supply cables to the inverter for a possible short circuit. This can lead to damage to the inverter. • Do not perform withstand voltage tests for any part of the inverter; this product has been tested before leaving the factory. Otherwise it may cause an accident!
	Danger	• Ensure that the cover of the frequency inverter is closed when switching on. Otherwise there is a risk of electric shock! • External elements must be connected to the frequency inverter using these operating instructions.
After Energizing	Danger	• Do not open the cover plate after powering on your device. Otherwise there is a risk of electric shock! • Do not touch the inverter and peripheral circuits with wet hands. Otherwise there is a risk of electric shock! • Do not touch any input and output terminals of the inverter. Otherwise there is a risk of electric shock! • The inverter automatically performs safety testing for the external strong electrical circuit in the early stages of power-on; therefore never touch the inverter terminals (U, V, W) or motor terminals. Otherwise there is a risk of electric shock! • If you need to identify the parameters, please pay attention to the danger of injury during motor rotation. Otherwise it may cause an accident! • Please do not change the inverter manufacturer parameters. Otherwise it may cause damage to this unit!
During Operation	Danger	• Do not touch the fan, heat sink or the discharging or braking resistor during operation to check the temperature. There is a risk of burns! • Only qualified personnel may take measurements on the frequency inverter during operation.

	⚠ Note	• Stop the inverter before disconnecting the mains supply. • Make sure that no parts fall into the inverter during operation to prevent damage to the inverter.
When Maintaining	⚠ Danger	• Do not carry out any maintenance or repair work on the frequency inverter during operation. There is a risk of electric shock! • Maintenance or repair work may only be carried out if the DC link voltage is below 36V DC and the LED on the power board goes out; this is usually the case two minutes after disconnection from the mains. If this is not observed, there is a risk of electric shock due to the residual charge of the DC link capacitors. • Untrained specialist personnel must not carry out any maintenance or repair work on Sourcetronic frequency inverters. Failure to do so will invalidate the warranty!

1.3.1 Precautions

No.	Type	Description
1	Check the Motor Windings	Please carry out an insulation test on the motor windings before initial commissioning or before commissioning a motor that has not been in operation for a longer period of time. This measure is intended to ensure the functionality of the motor and prevent damage to the frequency inverter due to defective motor windings. The motor must not be connected to the inverter during the insulation test. A test voltage of 500V DC is recommended, whereby the insulation resistance to be measured should not be less than 5MΩ.
2	Protection from Motor Overheating	If the rated power of the motor is lower than the rated power of the inverter, care should be taken to adjust the motor protection parameters in the frequency inverter. It may be advisable to install a thermal protection relay.
3	Operation of the Motor Above Rated Frequency	The ST500 series frequency inverters have a maximum output frequency of 3200Hz (in vector control mode, the control quality deteriorates from 300Hz, so operation at more than 400Hz is not recommended). If the motor is operated above its rated frequency, the higher mechanical and electrical load may result in a shorter service life. The inverter must be designed for the resulting increased power. Note that the inverter does not extrapolate the voltage curve beyond the rated voltage if the rated frequency is exceeded. To avoid a drop in torque due to field weakness, it is therefore necessary to enter the increased frequency and a corresponding voltage in the motor data.Take into account that the inverter cannot output more than its input voltage, the motor may therefore have to be reconfigured from star to triangle.

4	Prevent Vibrations on the Motor	The output frequency of the frequency inverter can hit the mechanical resonance frequency of the load during the acceleration process. If this happens and strong vibrations occur at certain frequencies, this frequency can be "skipped" by the inverter to avoid these vibrations.
5	Motor Temperature and Running Noise	Generating the output signal using PWM can lead to increased temperature and more running noise compared to operation without a frequency inverter. This is caused by the harmonics of the PWM.
6	Output-Side Use of Performance-Enhancing Components	The use of piezoresistors or capacitors at the output of the inverter can lead to an overcurrent fault or even damage the inverter!
7	Use of Switching Elements at the Input/Output Terminals	The use of switching elements at the mains input / motor output to start and stop the motor is not recommended. If this is absolutely necessary, the entire frequency inverter must not be switched off more than once an hour. Frequent charging and discharging will significantly shorten the service life of the capacitors inside the frequency inverter. Disconnecting the motor during operation using switching elements should be avoided at all costs, as this can damage the output circuit of the inverter. Therefore, if possible, only stop the inverter using the control panel and terminal functions provided for this purpose and only carry out switching operations at the output when the inverter and motor are stopped!
8	Operation of the Inverter at Greatly Deviated Voltage	The Sourcetronic ST500 frequency inverters are not designed for operation with a voltage outside the voltage range specified in these operating instructions. Operation with a different voltage can lead to damage within the inverter.
9	Do Not Operate a 3-Phase Inverter Using 1-Phase Input Voltage	**Never** operate an inverter designed for a 3-phase supply voltage with a 1-phase supply voltage and vice versa. This can lead to considerable damage within the frequency inverter.
10	Operation of the Inverter at Great Altitudes	If the frequency inverter is used at an altitude of over 1000 m, the output power of the frequency inverter must be adjusted accordingly. The thinner air results in a reduced cooling capacity.
11	Special Applications	If the frequency inverter is to be used for an application that is not listed in these operating instructions, please contact a Sourcetronic technician.
12	Compatible Motor Types	• Three-phase asynchronous motors or permanent magnet synchronous motors. The selection of the correct frequency inverter depends on the rated motor current. • In the case of an asynchronous motor, make sure that its current configuration (star, delta) matches the operating voltage used. • The cooling properties of the above motors are designed for the respective rated frequency. This means that an increased motor temperature is to be

		expected when the motors are operated below the rated frequency. Overheating of the motor can be counteracted with an external fan. • The frequency inverter is supplied with a standard set of parameters. These may need to be adapted to the respective motor. Operating the motor with incorrect parameters can affect the operation and protection of the motor. • If a short circuit in the motor supply cable or in the motor itself leads to a malfunction, please first carry out an insulation test on the motor and the supply cables. • Also observe the safety instructions for your motor. Do not underestimate the forces acting on the axle and motor mountings when accelerating and braking!
13	Other	Ensure that the power supply of the inverter is not connected to the output terminals U,V,W. Ensure that the cover is closed before commissioning the inverter. Observe ESD protection measures before touching internal parts of the inverter. Do not carry out any connection work on the inverter while it is switched on.

1.4 Scope of Applications

- The ST500 frequency inverter is only suitable for three-phase asynchronous motors and permanent magnet synchronous motors.
- The ST500 frequency inverter may only be used in applications specified by Sourcetronic GmbH. If the inverter is used outside of these applications, this can lead to injury, fire or other accidents.
- If the ST500 frequency inverter is to be used for the transportation of people / dangerous goods or in the aviation industry, please contact Sourcetronic GmbH in advance!
- The ST500 frequency inverter may **only** be operated by qualified specialist personnel!
- The specialist personnel must have read these operating instructions carefully before commissioning. The regional and local safety regulations must be observed to ensure safe and correct operation.

2 Standard Specifications

2.1 Technical Specifications

Model	Rated Output Power (kW)	Rated Input Current (A)	Rated Output Current (A)	Adaptive Motor (kW)
AC 1PH 220V (-15%) to 240V (+10%)				
ST500-0R7G1	0.75	8.2	4	0.75
ST500-1R5G1	1.5	14	7	1.5
ST500-2R2G1	2.2	23	10	2.2
ST500-004G1	4	35	16	4.0
ST500-5R5G1	5.5	50	25	5.5
AC 3PH 220V (-15%) to 240V (+10%)				
ST500-0R7G2	0.75	5.3	4	0.75
ST500-1R5G2	1.5	8.0	7	1.5
ST500-2R2G2	2.2	11.8	10	2.2
ST500-004G2	4	18.1	16	4
ST500-5R5G2	5.5	28	25	5.5
ST500-7R5G2	7.5	37.1	32	7.5
ST500-011G2	11	49.8	45	11
ST500-015G2	15	65.4	60	15
ST500-018G2	18.5	81.6	75	18.5
ST500-022G2	22	97.7	90	22
ST500-030G2	30	122.1	110	30
ST500-037G2	37	157.4	152	37
ST500-045G2	45	185.3	176	45
ST500-055G2	55	214	210	55
ST500-075G2	75	307	304	75
ST500-093G2	93	383	380	93
ST500-110G2	110	428	426	110
ST500-132G2	132	467	465	132
ST500-160G2	160	522	520	160
AC 3PH 380V (-15%) to 440V (+10%)				
ST500-0R7G3	0.75	4.3	2.5	0.75

ST500-1R5G3	1.5	5.0	3.8	1.5
ST500-2R2G3	2.2	5.8	5.1	2.2
ST500-004G3	4	10.5	9	4
ST500-5R5G3	5.5	14.6	13	5.5
ST500-7R5G3	7.5	20.5	17	7.5
ST500-011G3	11	26	25	11
ST500-015G3	15	35	32	15
ST500-018G3	18.5	38.5	37	18.5
ST500-022G3	22	46.5	45	22
ST500-030G3	30	62	60	30
ST500-037G3	37	76	75	37
ST500-045G3	45	91	90	45
ST500-055G3	55	112	110	55
ST500-075G3	75	157	150	75
ST500-093G3	93	180	176	93
ST500-110G3	110	214	210	110
ST500-132G3	132	256	253	132
ST500-160G3R	160	307	304	160
ST500-187G3R	187	345	340	187
ST500-200G3R	200	385	380	200
ST500-220G3R	220	430	426	220
ST500-250G3R	250	468	465	250
ST500-280G3R	280	525	520	280
ST500-315G3R	315	590	585	315
ST500-355G3R	355	665	650	355
ST500-400G3R	400	785	725	400
ST500-450G3R	450	883	820	450
ST500-500G3R	500	920	860	500
ST500-560G3R	560	1010	950	560
ST500-630G3R	630	1160	1100	630
ST500-710G3R	710		1250	710
AC 3PH 480V±10%				
ST500-0R7G4	0.75	4.1	2.5	0.75
ST500-1R5G4	1.5	4.9	3.7	1.5

ST500-2R2G4	2.2	5.7	5.0	2.2
ST500-004G4	4.0	9.4	8	4.0
ST500-5R5G4	5.5	12.5	11	5.5
ST500 7R5G4	7.5	18.3	15	7.5
ST500-011G4	11	23.1	22	11
ST500-015G4	15	29.8	27	15
ST500-018G4	18.5	35.7	34	18.5
ST500-022G4	22	41.7	40	22
ST500-030G4	30	57.4	55	30
ST500-037G4	37	66.5	65	37
ST500-045G4	45	81.7	80	45
ST500-055G4	55	101.9	100	55
ST500-075G4	75	137.4	130	75
ST500-093G4	93	151.8	147	93
ST500-110G4	110	185.3	180	110
ST500-132G4	132	220.7	216	132
ST500-160G4R	160	264.2	259	160
ST500-187G4R	187	309.4	300	187
ST500-200G4R	200	334.4	328	200
ST500-220G4R	220	363.9	358	220
ST500-250G4R	250	407.9	400	250
ST500-280G4R	280	457.4	449	280
ST500-315G4R	315	533.2	516	315
ST500-355G4R	355	623.3	570	355
ST500-400G4R	400	706.9	650	400
ST500-450G4R	450		720	450
ST500-500G4R	500		800	500
ST500-560G4R	560		870	560
ST500-630G4R	630		1000	630
ST500-710G4R	710		1120	710
AC 3PH 690V±10%				
ST500-011G6	11	15	12	11
ST500-015G6	15	20	15	15
ST500-018G6	18.5	30	20	18.5

ST500-022G6	22	35	24	22
ST500-030G6	30	45	33	30
ST500-037G6	37	55	41	37
ST500-045G6	45	65	50	45
ST500-055G6	55	70	62	55
ST500-075G6	75	90	85	75
ST500-093G6	93	105	102	93
ST500-110G6	110	130	125	110
ST500-132G6	132	170	150	132
ST500-160G6R	160	200	175	160
ST500-187G6R	187	210	198	187
ST500-200G6R	200	235	215	200
ST500-220G6R	220	247	245	220
ST500-250G6R	250	265	260	250
ST500-280G6R	280	305	299	280
ST500-315G6R	315	350	330	315
ST500-355G6R	355	382	374	355
ST500-400G6R	400	435	410	400
ST500-450G6R	450		465	450
ST500-500G6R	500		550	500
ST500-560G6R	560		590	560
ST500-630G6R	630		680	630
ST500-710G6R	710		750	710
ST500-800G6R	800		850	800

Note:

- The model names ending in "R" indicate an inbuilt DC reactor.
- To ensure you select the correct frequency inverter, please check the following: The inverter rated output current must be more than or equal to the rated current of the motor.
- The difference between the frequency inverter and the rated power of the motor generally is recommended to be no more than two inverter power steps.
- When using a large frequency inverter with a small motor, you must accurately input the motor parameters, so that the inverter’s protection functions can avoid motor overload and damage.

2.2 Specification of the Main Terminal Connection Screws

Model	Screw Type	Tightening Torque [Nm]
ST500-5R5G1	M5	2 to 2.5
ST500-5R5G2	M5	2 to 2.5
ST500-7R5G2	M5	2 to 2.5
ST500-011G2	M5	2 to 2.5
ST500-015G2	M6	4 to 6
ST500-018G2	M6	4 to 6
ST500-022G2	M8	9 to 11
ST500-030G2	M8	9 to 11
ST500-037G2	M8	9 to 11
ST500-045G2	M10	18 to 23
ST500-055G2	M10	18 to 23
ST500-075G2	M10	18 to 23
ST500-093G2	M10	18 to 23
ST500-110G2	M10	18 to 23
ST500-132G2	M12	32 to 40
ST500-160G2	M12	32 to 40
ST500-7R5G3	M5	2 to 2.5
ST500-011G3	M5	2 to 2.5
ST500-015G3	M5	2 to 2.5
ST500-018G3	M5	2 to 2.5
ST500-022G3	M5	2 to 2.5
ST500-030G3	M6	4 to 6
ST500-037G3	M6	4 to 6
ST500-045G3	M8	9 to 11
ST500-055G3	M8	9 to 11
ST500-075G3	M8	9 to 11
ST500-093G3	M10	18 to 23
ST500-110G3	M10	18 to 23
ST500-132G3	M10	18 to 23
ST500-160G3	M10	18 to 23

ST500-187G3	M10	18 to 23
ST500-200G3	M10	18 to 23
ST500-220G3	M10	18 to 23
ST500-250G3	M12	32 to 40
ST500-280G3	M12	32 to 40
ST500-315G3	M12	32 to 40
ST500-355G3	M12	32 to 40
ST500-400G3	M12	32 to 40
ST500-450G3	M12	32 to 40
ST500-500G3	M12	32 to 40
ST500-560G3	M12	32 to 40
ST500-630G3	M12	32 to 40

2.3 General Specifications

<table>
<tr><th colspan="2">Items</th><th colspan="2">Specifications</th></tr>
<tr><td rowspan="4">Power Input</td><td>Rated Voltage</td><td colspan="2">AC 1PH 220V (-15%) to 240V (+10%)
AC 3PH 220V (-15%) to 240V (+10%)
AC 3PH 380V (-15%) to 440V (+10%)
AC 3PH 480V (-10%) to 480V (+10%)
AC 3PH 690V (-10%) to 690V (+10%)</td></tr>
<tr><td>Input Frequency</td><td colspan="2">50Hz/60Hz</td></tr>
<tr><td rowspan="2">Allowing Fluctuations</td><td>Voltage Continued Volatility: ±10%</td><td>Less than 3% of voltage unbalance rate 3%</td></tr>
<tr><td>Input Frequency Fluctuation: ±5%</td><td>Distortion satisfies the IEC61800-2 standard</td></tr>
<tr><td rowspan="5">Control System</td><td>Control System</td><td colspan="2">High performance vector control inverter based on DSP</td></tr>
<tr><td>Control Method</td><td colspan="2">V/f control, vector control W/O PG, vector control W/ PG</td></tr>
<tr><td>Automatic Torque Boost Function</td><td colspan="2">Realize low frequency (1Hz) and large output torque control under the V/f control mode.</td></tr>
<tr><td>Acceleration/ Braking Control</td><td colspan="2">Straight or S-curve mode. Four separate times are available, and the time range is 0.0 to 6500.0s.</td></tr>
<tr><td>V/f Curve Mode</td><td colspan="2">Linear, square root/m-th power, custom V/f curve</td></tr>
</table>

	Overload Capability	G type: Rated current 150% – 1 minute; rated current 180% – 2 seconds F type: Rated current 120% – 1 minute; rated current 150% – 2 seconds
	Maximum Frequency	• Vector control: 0 to 300Hz • V/f control: 0 to 3200Hz
	Carrier Frequency	0.5 to 16kHz; Automatically adjust the carrier frequency according to the load characteristics
	Input Frequency Resolution	Digital setting: 0.01Hz minimum Analog: 0.01Hz.
	Start Torque	G type: 0.5Hz/150% (vector control W/O PG) F type: 0.5Hz/100% (vector control W/O PG)
	Speed Range	1:100 (vector control without PG) 1:1000 (vector control with PG)
	Steady-Speed Precision	Vector control W/O PG: ≤ ± 0.5% (rated synchronous speed) Vector control W/ PG: ≤ ± 0.02% (rated synchronous speed)
	Torque Response	≤ 40ms (vector control without PG)
	Torque Boost	Automatic torque boost; manual torque boost (0.1% to 30.0%)
	DC Braking	DC braking frequency: 0.0Hz to max. frequency; Braking time: 0.0 to 100.0 seconds; Braking current value: 0.0% to 100.0%
	Jogging Control	Jog frequency range: 0.00Hz to max. frequency; Jog acceleration/braking time: 0.0s to 6500.0s
	Multi-Speed Operation	Achieve up to 16-speed operation through the control terminal
	Built-In PID	Easy to realize closed-loop control system for the process control.
	Automatic Voltage Regulation (AVR)	Automatically maintain a constant output voltage when the voltage of electricity grid changes.
	Torque Limit and Control	"Excavator" feature – the torque is automatically limited during the operation to prevent a frequent overcurrent trip; the closed-loop vector mode is used to control the torque.
Personalization Function	Self-Inspection of Peripherals After Power-On	After powering on, the peripheral equipment will perform safety testing, such as ground, short circuit, etc.
	Common DC Bus Function	Multiple inverters can use a common DC bus.

	Quick Current Limiting		The current limiting algorithm is used to reduce the chance of an inverter overcurrent and improve the whole unit's anti-interference capability.
	Timing Control		Timing control function: time setting range (0m to 6500m)
Running	Input Signal	Running Method	Keypad/terminal/communication
		Frequency Setting	10 frequency settings available, including adjustable DC (0 to 10V/ -10V to 10V), adjustable DC (0 to 20mA), panel setting, etc.
		Start Signal	Rotate forward/reverse
		Multi-Step	At most 16-different speed steps can be set (run by using the multi-function terminals or program)
		Emergency Stop	Interrupt controller output
		Wobbulate	Process control run
		Error Reset	When the protection function is active, you can automatically or manually reset the error condition.
		PID Feedback Signal	Including DC (0 to 10V); DC (0 to 20mA)
	Output Signal	Running Status	Motor status display, stop, acceleration/braking, constant speed, program running status.
		Fault Output	Contact capacity: normally closed contact 3A/AC 250V; normally open contact 5A/AC 250V, 1A/DC 30V.
		Analog Output	Two-way analog output. 16 signals can be selected, including frequency, current, voltage and others; output signal range (0 to 10V / 0 to 20mA).
		Output Signal	Max. four-way output; there are 40 signals each way
	Run Function		Frequency limit, skip frequency, frequency compensation, auto-tuning, PID control
	DC Current Braking		Built-in PID regulates the braking current to ensure sufficient braking torque under no overcurrent condition.
	Running Command Channel		Three channels: keypad, control terminals and serial communication port. These can be selected in a variety of ways.
	Frequency Source		Total 10 frequency sources: digital, analog voltage, analog current, multi-speed and serial port. These can be selected in a variety of ways.
	Input Terminals		8 digital input terminals, compatible with active PNP or NPN input mode; one of them can be for high-speed pulse input (0 to 100 kHz square wave) 3 analog input terminals for voltage or current input

	Output Terminals		2 digital output terminals, one of them can be for high-speed pulse output (0 to 100kHz square wave); one relay output terminal 2 analog output terminals respectively for optional range (0 to 20mA or 0 to 10V), They can be used to set frequency, output frequency, speed and other physical parameters.
Protection Function	Inverter Protection		Overvoltage protection, undervoltage protection, overcurrent protection, overload protection, overheat protection, overcurrent stall protection, overvoltage stall protection, losting-phase protection (optional), communication error, PID feedback signal abnormalities, PG failure and short circuit to ground protection.
	IGBT Temperature Display		Displays current temperature IGBT
	Inverter Fan Control		Can be set according to your needs
	Instantaneous Power-Down Restart		< 15 milliseconds: continuous operation. > 15 milliseconds: automatic detection of motor speed, instantaneous power-down restart.
	Speed Start Tracking Method		The inverter automatically tracks the motor speed after it starts
	Parameter Protection Function		Protect the inverter parameters by setting an administrator password
Display	LED/ OLED Display Keypad	Running Information	Monitoring objects include: running frequency, set frequency, bus voltage, output voltage, output current, output power, output torque, input terminal status, output terminal status, analog AI1 value, analog AI2 value, motor actual running speed, PID set value percentage, PID feedback value percentage.
		Error Message	Save up to three error messages. The error type, time, voltage, current, frequency and work status at the time of the error can be queried as needed.
	LED Display		Displays parameters
	OLED Display		Optional, prompts operation content in Chinese/English text
	Copy Parameter		Can upload and download function code information of frequency converter, rapid replication parameters.
	Key Lock and Function Selection		Lock some or all of the keys; define the function scope of some keys to prevent misuse.

Communication	RS485	The optional completely isolated RS485 communication module can communicate with the host computer.
Environment Product Standard	Environment Temperature	-10°C to 40°C (For use at a temperature of 40°C to 50°C, please derate accordingly!)
	Storage Temperature	-20°C to 65°C
	Environment Humidity	Less than 90% R.H, no condensation
	Vibration	Below 5.9m/s² (= 0.6g)
	Application Sites	Indoors, kept out of direct sunlight and away from corrosives, explosive gases, water vapor, dust, flammable substances, oil mist, drip or salt, etc.
	Altitude	No need for derating below 1000m Please derate by 1% for every 100m when the altitude exceeds 3000m
	Pollution Degree	2
	Protection Level	IP20
Product Standard	Product Adopts Safety Standards.	IEC61800-5-1:2007
	Product Adopts EMC Standards.	IEC61800-3:2005
Cooling Method		Forced air cooling

3 Keypad

3.1 Keypad Description

Figure 3-1 Operation Panel Display

3.1.1 Keypad Indicators

<table>
<tr><th colspan="2">LED</th><th>Name / Description</th></tr>
<tr><td rowspan="4">Status LED</td><td>RUN</td><td>• Motor operating status display
• ON: the frequency inverter is in operation.
• OFF: the frequency inverter is in standby mode.</td></tr>
<tr><td>LOCAL/
REMOTE</td><td>• Display of the control source
• ON: the frequency inverter is controlled via the terminals.
• OFF: the frequency inverter is controlled via the control panel.
• FLASHING: the frequency inverter is controlled remotely (RS485, CAN etc.)</td></tr>
<tr><td>FWD/REV</td><td>• Direction of rotation display
• ON: Direction of rotation is forwards.
• OFF: Direction of rotation is backwards.</td></tr>
<tr><td>TUNE/TC</td><td>• Auto detection / error display
• ON: Torque control active
• Slow FLASHING: Auto-detection mode active
• Fast FLASHING: Inverter is in error state</td></tr>
<tr><td>Units Combination Indicator</td><td>HzAV</td><td>

<table>
<tr><td>Hz</td><td>Frequency Unit</td></tr>
<tr><td>A</td><td>Current Unit</td></tr>
<tr><td>V</td><td>Voltage Unit</td></tr>
<tr><td>RPM</td><td>Speed Unit</td></tr>
<tr><td>%</td><td>Percentage</td></tr>
</table></td></tr>
</table>

3.1.2 Description of Operation Panel Keys

Sign	Name	Function
	Parameter Setting/ ESC Key	• Call up parameterization menu • Close parameterization menu • Cancel parameter input without saving
	Shift Key	• Select special functions during operation • Switch through the displayed status parameters • Select the decimal point when selecting function parameters or entering function parameters
	UP Key	Increase parameter or function number, defined by parameter F6.18.
	DOWN Key	Decrease parameter or function number, defined by parameter F6.19.
	RUN Key	Start running (if the device is in keypad control mode)
	Stop/Reset Key	Stops the motor during operation and resets the error status. If the keypad control is not active, the function depends on the setting in F6.00.
	Enter Key	• Confirm settings • Navigate in parameter menus
	QUICK Multifunction Key	This key's function is determined by the setting of the function code F6.21.
	Keypad Rotary Encoder	Enables parameter values to be selected and changed in parameterization mode and can be used for frequency control during operation.

3.1.3 Keypad Display and Corresponding Letters and Numbers

	Display Letters	Corresponding Letters	Display Letters	Corresponding Letters	Display Letters	Corresponding Letters
Digital Display Area	0	0	1	1	2	2
	3	3	4	4	5	5
	6	6	7	7	8	8
	9	9	A	A	b	B

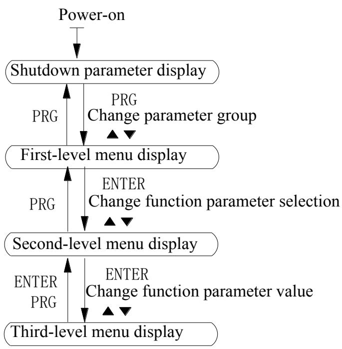
	C	C	d	d	E	E
	F	F	H	H	I	I
	L	L	N	N	n	n
	o	o	P	P	r	r
	S	S	t	t	U	U
	T	T	.	.	-	-
	y	y				

3.2 Examples of Parameter Settings

3.2.1 Instructions on Viewing and Modifying Function Code

The parameter structure of the ST500 frequency inverter basically consists of three levels. The first level contains the parameter groups, the second level contains the individual parameters of the parameter group and the third level contains the associated value for the parameter.

The following schematic diagram illustrates these levels:



3.2.2 Operation Processes

After switching on the frequency inverter, the operating display appears on the upper display. It shows 50.00 for factory settings. This is the target frequency. To configure the inverter, the "PRG" button must be pressed in this state, which will take you to the parameter group level, as shown in the flow chart above.

You can switch between the individual parameter groups by turning the dial or pressing the "Up" and "Down" buttons. To access the parameters in the individual parameter groups, press the "Enter" button or press the adjusting dial.

Press the "PRG" button again to exit the first level and return to the normal operating display of the inverter. You are now in the second level, the function parameters. Navigation within the parameters of a group is again carried out using the "Up" and "Down" buttons or the dial; you can also use the "Shift" and "Quick" buttons to switch the decimal place being edited. The lower display shows the value of the parameter shown in the upper display.

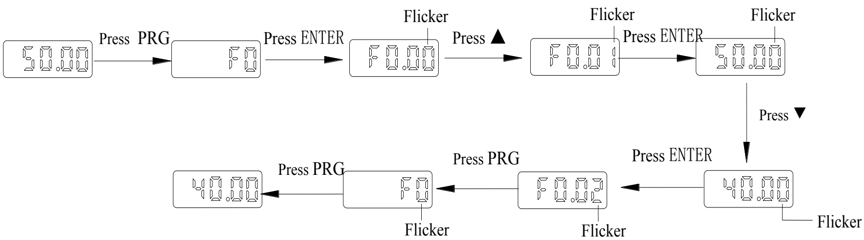
Once you have reached the desired parameter, press the "Enter" button or the adjusting dial again to reach the parameter value; the lower display then shows the parameter number. To return to the second level, the parameters, press the "PRG" button.

If you are in the third level, the parameter value, the upper display should show the currently active decimal point flashing. The value can be set using the "Up" and "Down" buttons or the dial. You can also use the "Shift" and "Quick" buttons to move the active decimal point to the right or left.

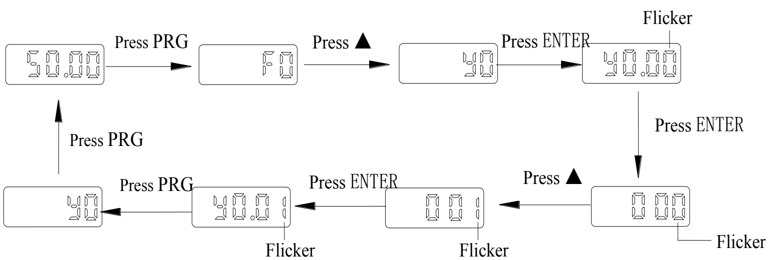
If the changed value is to be saved in the frequency inverter, this is confirmed with the "Enter" button or by pressing the dial. To cancel the process and not save the change, press the "PRG" button. In both cases, you return to the function parameter level, where the function code number is automatically increased by 1 if the entry is saved; this is to make it easier to enter several consecutive values.

Example 1: Changing the Target Frequency

→ Set F0.01 from 50.00Hz to 40.00Hz



Example 2: Restoring Factory Settings



If the parameter value cannot be changed (no decimal place is flashing), this can have the following causes:

- The selected parameter is a locked factory parameter that cannot be adjusted by the user for safety reasons.
- The selected parameter is based on measured values and can therefore only be read.
- The selected parameter cannot be changed while the motor is in operation (indicated by the LED "RUN" being lit). If necessary, stop the motor to be able to change the parameter.

3.2.3 How to View Parameters During Operation or in Standby

Various information can be displayed during operation or at standstill. To switch through the status parameters, press the "SHIFT" button on the control panel of the frequency inverter. Three parameter sets are available. Parameter sets 1 and 2 (F6.01 and F6.02) are parameters that contain information during operation. Parameter set 3 (F6.03) are information parameters that can be displayed when the inverter is stopped.

- Parameter groups 1 and 2 contain a total of 30 information parameters. These include, for example, the current frequency, the target frequency, the DC link voltage, the output voltage, the motor current, etc.
- Parameter group 3 contains a total of 16 information parameters. These include, for example, the target frequency, the DC link voltage, the status of the individual digital input terminals, the voltage applied to the analog terminals, etc.

A complete overview of the functions available in the parameter groups can be found in Chapter 6 – Function Parameters.

3.3 Password Settings

The ST500 frequency inverter can be protected against unauthorized access by setting a password. The password can be set in the corresponding function parameter y0.01.

If this value is not "0", a password has already been entered. If password protection is active, "LoC" is shown on the display and other function parameters can only be edited once the correct password has been entered.

To deactivate the password function, the correct password must first be entered and then the function parameter y0.01 must be set to "0".

As the function code number is automatically incremented after an entry, it can easily happen that a password is inadvertently entered in y0.01 instead of calling another function from y0.00. Therefore, always pay attention to the parameter number displayed!

3.4 Automatic Calibration of Motor Parameters

If the frequency inverter is to be operated with vector control, the motor parameters from the motor rating plate must be entered precisely before operation. In order to achieve the best possible control with vector control, as many parameters as possible should be entered. once the parameters have been entered, the automatic calibration of further motor data can be started as follows:

First set the parameter F0.11=0 or 4 to enable control of the inverter from the control panel.
The following values must then be entered based on your motor:

- b0.00: Type of motor
- b0.01: Rated power of the motor in [kW]
- b0.02: Rated voltage of the motor in [V]
- b0.03: Rated current of the motor in [A]
- b0.04: Rated frequency of the motor in [Hz]
- b0.05: Rated speed of the motor in [rpm].
- (if available) b0.28: Encoder type and b0.29: Encoder pulses per revolution or b0.35: Number of pole pairs of the rotary encoder

To start the automatic measurement of the motor parameters for three-phase asynchronous motors, the function parameter b0.27 must be set to either 1 or 2. If the motor can be calibrated without load, please set b0.27 to 2. If the motor must be calibrated with load, b0.27 should be set to 1. Then press the "RUN" button on the control panel. The frequency inverter starts to determine the following parameters automatically:

- b0.06: Stator resistance
- b0.07: Rotor resistance
- b0.08: Leakage inductance
- b0.09: Mutual inductance

Only without load with b0.27 = 2 the inverter starts the motor and determines:

- b0.10: Motor current at no load
- (if available) b0.31: Phase sequence of the AB encoder
- PI parameters of the vector current control loop F5.12 to F5.15

If a permanently excited synchronous motor is to be operated instead, the use of a position encoder with a suitable PG card and calibration is absolutely essential so that the inverter can determine the pole wheel position. To carry out the calibration, in addition to the parameters b0.00 to b0.05, the parameters b0.28, b0.29 and, if the installed encoder is a rotary transformer, b0.35 must also be entered. If the motor can be calibrated without a load, please set b0.27 to 12. If the motor must be calibrated with a load, b0.27 is set to 11. Then press the "RUN" button. The frequency inverter starts to determine the following parameters automatically:

- b0.11: Stator resistance
- b0.12: Inductance D-axis
- b0.13: Inductance Q-axis
- b0.14: Counter-EMF coefficient
- b0.30: Pole wheel angle

Only without load with b0.27 = 12:

- Depending on encoder type: b0.31: AB phase sequence or b0.32: UVW encoder zero angle
- b0.33: UVW encoder phase sequence
- PI parameters of the vector current control loop F5.12 to F5.15

4 Installation

4.1 Environmental Conditions

- The ambient temperature may be between -10°C and 50°C. At temperatures above 40°C, the performance decreases by 3% per 1°C. It is not recommended to use the frequency inverter at ambient temperatures above 50°C.
- The frequency inverter should only be used in an environment where there is no risk of interference.
- Protect the internal components of the inverter from small parts, dust, moisture and liquids.
- Avoid installing the frequency inverter on highly vibrating surfaces.
- The relative humidity should be less than 90% (non-condensing).
- Do not use the frequency inverter in the vicinity of highly flammable or otherwise hazardous materials!

4.1.1 Installation Instructions

The frequency inverter should be installed in a well-ventilated room. Air is drawn in at the bottom and blown out at the top. When installing, make sure that there is enough free space around the inverter. The following illustration and table show the recommended installation dimensions:

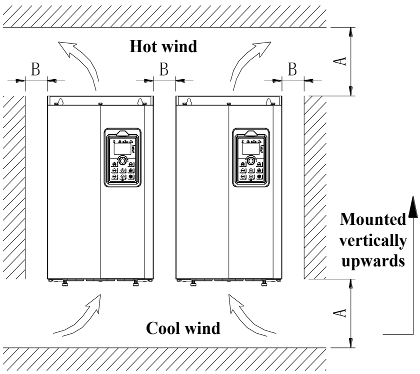


Figure 4-1 Space Requirements

Power Rating	Dimension Requirements
0.75kW to 7.5kW	A≥100mm; B≥10mm
11kW to 22kW	A≥200mm; B≥10mm
30kW to 75kW	A≥200mm; B≥50mm
93kW to 400kW	A≥300mm; B≥50mm

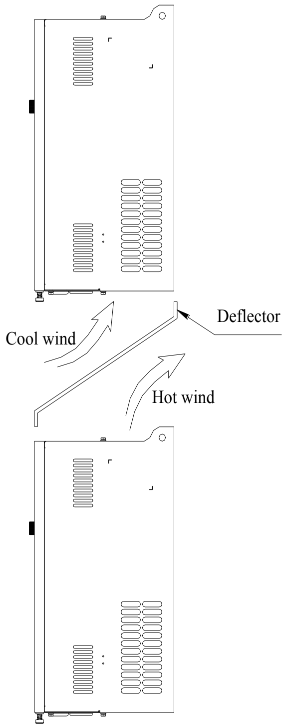


Figure 4-2 Use of Heat Deflector for Inverters Mounted One on Top of the Other

4.2 Wiring

The wiring of the frequency inverter is divided into two parts (supply terminals and control terminals), whereby there are two different but functionally identical control boards for the models in plastic and metal housings. The wiring must be carried out as shown in the following diagrams.

4.2.1 Wiring Diagram

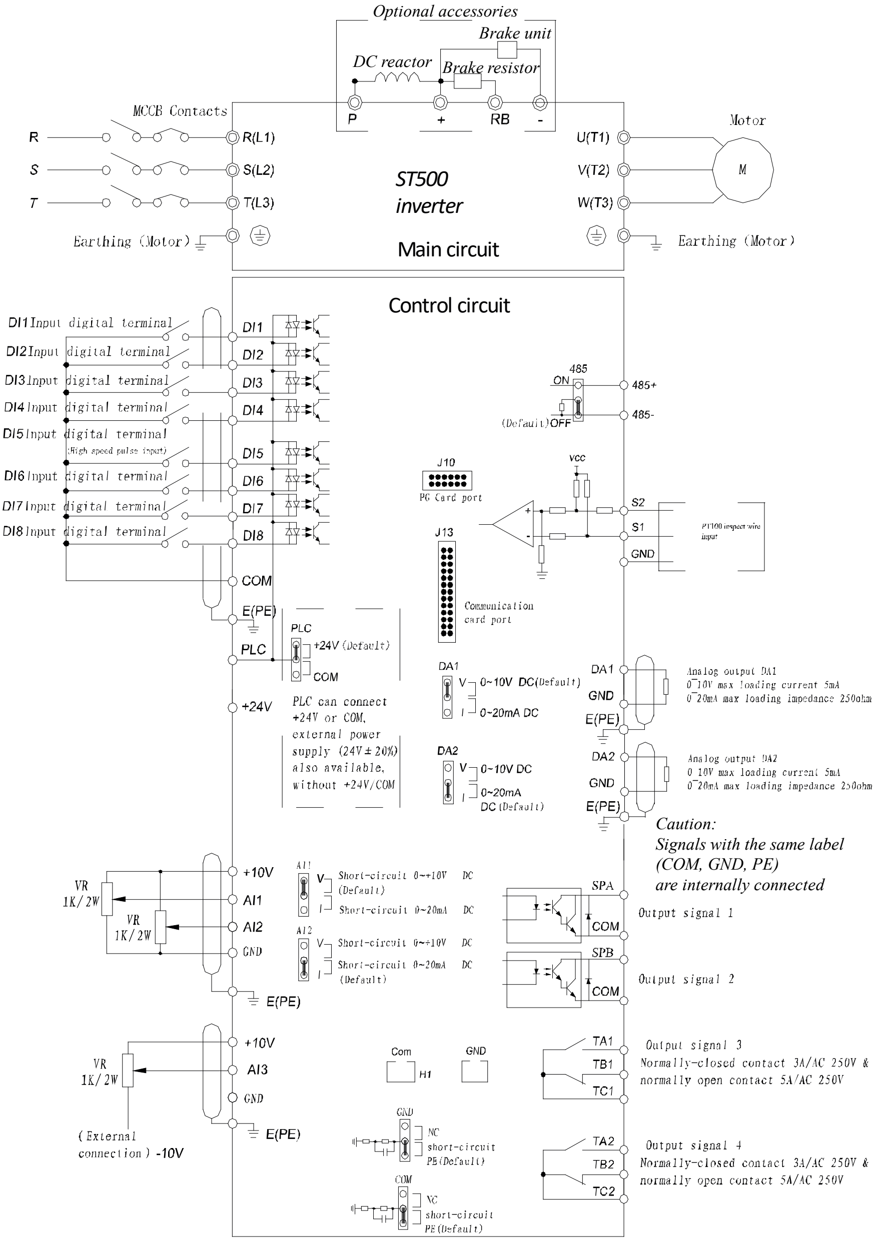
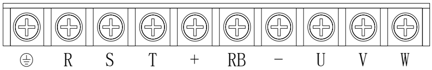


Figure 4-3 Wiring Diagram

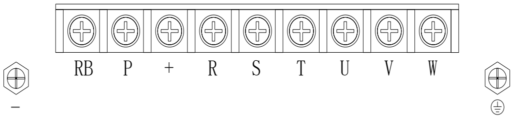
4.3 Main Circuit Terminal

4.3.1 Main Circuit Terminal Arrangement

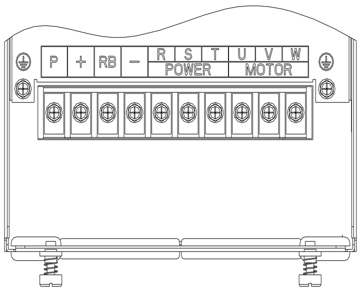
0.75kW to 4kW G3 Main Circuit Terminal:



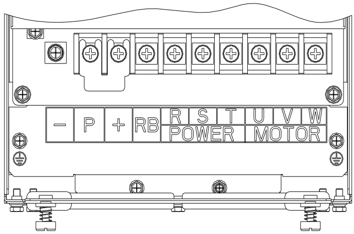
5.5kW to 11kW G3 Main Circuit Terminal:



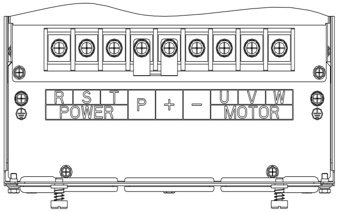
15kW G3 Main Circuit Terminal:



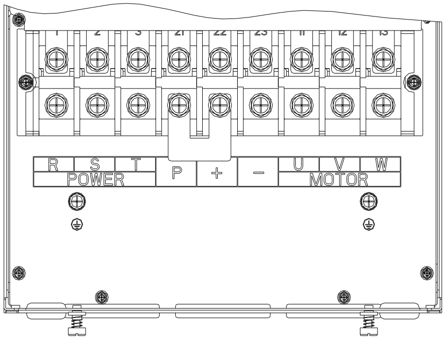
18.5kW to 22kW G3 Main Circuit Terminal:



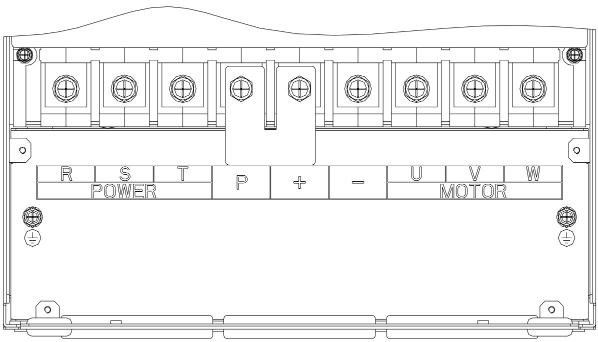
30kW to 37kW G3 Main Circuit Terminal:



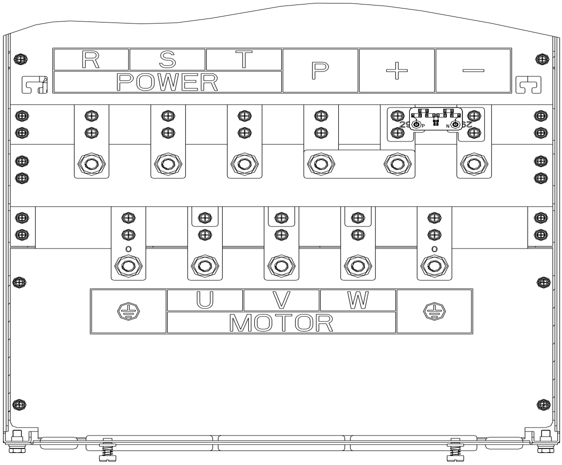
45kW to 75kW G3 Main Circuit Terminal:



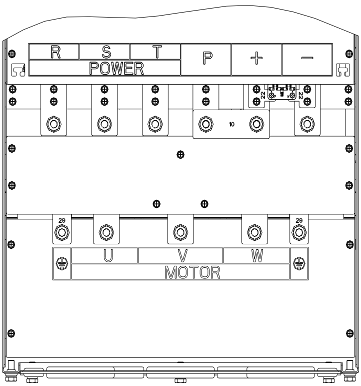
93kW to 110kW G3 Main Circuit Terminal:



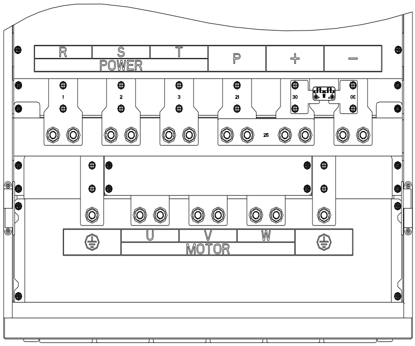
132kW Main Circuit Terminal:



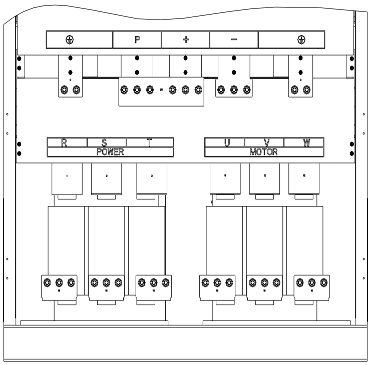
160kW to 220kW G3 Main Circuit Terminal:



250kW to 400kW G3 Main Circuit Terminal:



450kW to 630kW G3 Main Circuit Terminal:



4.3.2 DC Link Bridge and C3 Filter

Normally, a bridge is installed between P and +. The entire input current of the inverter flows through this, so the screw connection must always be securely tightened on both sides. If an intermediate circuit reactor is installed between P and P+, this bridge must be removed and the reactor connected instead!

The models of the G1 series up to 2.2kW and the G3 and G4 series up to 4kW do not provide for the connection of a DC link reactor and therefore neither terminal P nor the jumper mentioned above are present.

The switch for activating the C3 filter on models from 15kW is located in the plate above the supply terminals and is switched off at the factory. It may only be switched on if the supply to the inverter is symmetrical to earth. The filter is always active on G3 models between 5.5 and 11kW.

4.3.3 Functional Description of the Main Circuit Terminals

Terminal	Name	Description
R	Input Terminals	Terminals for connecting the power supply of the frequency inverter. For single-phase models, the screw of terminal S remains unassembled; the two remaining terminals R and T must be used for phase and neutral. Due to the symmetry of the input rectifier, it is irrelevant which of the two or three supply lines is connected to which terminal.
S		
T		
⏚	Ground Terminals	For grounding.
+, RB	Braking Resistor Terminals (up to 22kW G3)	For installing a braking resistor.
U	Output Terminals	Output terminals for connecting a three-phase motor. ⚠ **Single-phase motors must not be connected!**
V		
W		
+, -	DC Link Terminals	For connecting a brake unit.
P, +	DC Reactor Terminals (from 4kW G1/5.5kW G3)	To install a DC link reactor, the bridge between P and + must be removed.
E	PE Terminal	PE connection terminals (protective conductor).

4.4 Control Circuit Terminals

Note: Terminals and screw connections with the same designation (GND, COM) are at the same potential as they are connected internally.

4.4.1 Control Circuit Terminals Arrangement

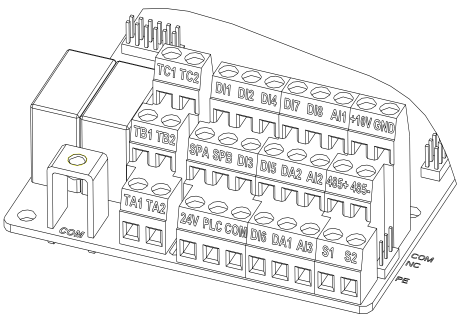


Figure 4-4 Keypad Control Circuit Terminals

4.4.2 Description of Control Circuit Terminals

Category	Symbol	Name	Function
Power Supply	+10V-GND	+10V DC Voltage Source Jumper GND: Interference Suppressor Against Protective Earth PE	+10V voltage source with a maximum output current of 10mA. Usually used as a source for a potentiometer. The total resistance range should be between 1kΩ and 5kΩ.
	+24V-COM	+24V DC Voltage Source, Galvanically Isolated Jumper COM: Interference Suppressor Against Protective Earth PE	+24V voltage source with a maximum output current of 200mA. Can be used to supply external sensors (connect COM and GND, galvanic isolation not required) or the digital input terminals.
	PLC	Input Terminal for External Voltage Source 9-30V for the Digital Inputs	When using an external voltage source, the PLC jumper must be removed. The pole of the source from/to which current is to flow via the optocouplers in the active state must be connected to terminal PLC; accordingly, the inputs must be connected to the other pole of the source in the active state.
Analog Input	AI1 GND	Analog Input AI1	Input voltage range: 0V to 10V DC or 0mA to 20mA DC. Can be switched via jumper AI1 or AI2 on the control board. Input impedance: 22kΩ (0-10V), 500Ω (0-20mA).
	AI2 GND	Analog Input AI2	
	AI3 GND	Analog Input AI3	Input voltage range: -10V to +10V DC.
Digital Input	DI1	Digital Input DI1	Contacts as optocouplers compatible with bipolar input (i.e. can be operated in both current directions). Input impedance: >1.65kΩ (DI5) / >3.3kΩ (all other DI), anti-parallel Zener diode. Voltage range: 19.2V to 28.8V DC. DI1 to DI8 voltage setting by jumper PLC, remove jumper for external source.
	DI2	Digital Input DI2	
	DI3	Digital Input DI3	
	DI4	Digital Input DI4	
	DI5	Digital Input DI5	
	DI6	Digital Input DI6	
	DI7	Digital Input DI7	
	DI8	Digital Input DI8	
	DI5	Digital Pulse Input	DI5 can also be used as a pulse input. Max. Input frequency: 100kHz.

<table>
<tr><td rowspan="2">Analog Output</td><td>DA1 GND</td><td>Analog Output DA1</td><td>Selection of the output signal between 0V to 10V or 0mA to 20mA via jumper DA1.</td></tr>
<tr><td>DA2 GND</td><td>Analog Output DA2</td><td>Selection of the output signal between 0V to 10V or 0mA to 20mA via jumper DA2.</td></tr>
<tr><td rowspan="3">Digital Output</td><td>SPA COM</td><td>Digital Output 1</td><td rowspan="2">Opto-coupler isolation, bipolar open collector output;
Output voltage range: 0V to 24V;
Output current range: 0mA to 50mA</td></tr>
<tr><td>SPB COM</td><td>Digital Output 2</td></tr>
<tr><td>SPB COM</td><td>Pulse Output</td><td>Using function parameter F2.00, SPB can also be configured as a pulse output. The maximum output frequency is 100 kHz.</td></tr>
<tr><td rowspan="2">Relay Output</td><td>TA1/2
TC1/2</td><td>Normally Open Contact</td><td rowspan="2">Maximum switchable power:
250V AC NC contact 3A, NO contact 5A, cosφ = 0.4
30V DC 1A
NC contact relay 2 only available up to V1.05</td></tr>
<tr><td>TB1/2
TC1/2</td><td>Normally Closed Contact</td></tr>
<tr><td>Motor Temperature Sensor</td><td>S1
S2
GND</td><td>PT100/PT1000/PTC</td><td>Connection for a motor temperature sensor.</td></tr>
<tr><td rowspan="3">Interfaces</td><td>J13</td><td>Interface card</td><td>26-pin connection for interface card: CANbus or Profibus DP</td></tr>
<tr><td>J10</td><td>PG interface</td><td>12-pin connection for position encoder</td></tr>
<tr><td>485+
485-</td><td>RS485 interface</td><td>RS485/Modbus interface; not potential-free to GND</td></tr>
</table>

4.5 Circuit Description of the Input Terminals

The digital inputs and outputs are each decoupled from the rest of the control unit via an optocoupler. However, this does not apply to the inputs themselves, as all input circuits of DI1-8 are connected to PLC at the other end.

In the factory setting, all input circuits are connected to +24V via the PLC jumper. Therefore, current flows via the optocouplers when the respective input terminal is connected to COM. The other jumper position connects PLC to COM, in which case current flows when the input terminal is switched to +24V. Current flow is considered "active" in the sense of F1.35, the current direction does not matter, as the bridge rectifier circuit always conducts it in the same direction through the optocoupler.

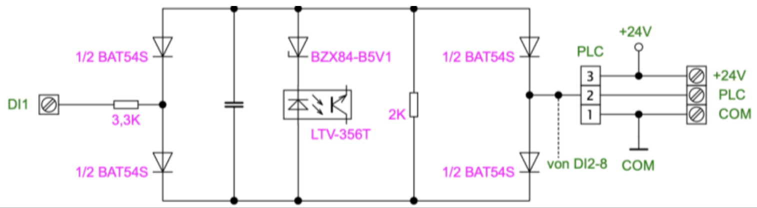
The power supply (+24V/COM) is always potential-free in relation to the rest of the inverter. However, in the factory setting, COM is connected to protective earth PE via the COM jumper and an RC element. If complete potential-free operation is required, the jumper must be changed from "PE" to "NC".

Furthermore, the emitters of the output optocouplers SPA and SPB are connected to COM and are therefore not potential-free in relation to the internal 24V supply. If the 24V are required for sensors at the analog inputs, COM must be connected to GND, whereby the potential separation between digital and analog terminals is completely eliminated.

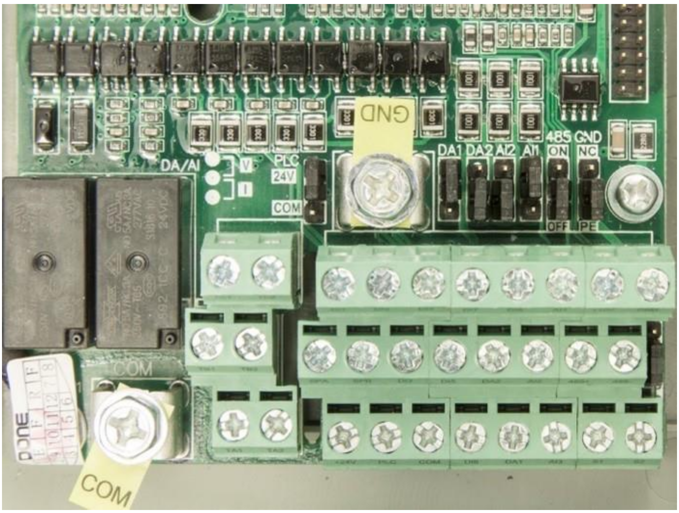
If the inputs are to be controlled with external voltage (and galvanically isolated from the internal 24V supply and thus from the digital outputs), jumper PLC must be removed and the corresponding opposite pole of the external voltage must be connected to terminal PLC. If, for example, a PLC is connected with the output levels 0V/+24V and +24V is to be the active state, terminal PLC must be connected to 0V of the PLC. Conversely, if a level of 0V is to indicate the active state, terminal PLC must be connected to +24V of the external voltage. When wiring, ensure that only PLC and the respective DI are connected to the inverter in order to maintain electrical isolation.

In addition to the 3.3kΩ series resistor, each optocoupler is preceded by a 5.1V zener diode in the blocking direction, which increases the trigger voltage and current for the purpose of interference suppression. A high-speed optocoupler is used for the DI5 pulse input. This requires slightly more current, which is why two parallel-connected resistors are installed in its input circuit instead of one 3.3kΩ resistor, resulting in an effective resistance of 1.65kΩ.

Otherwise, all inputs are equivalent to the DI1 shown here as an example. Input circuit DI1-8:



Jumper on the control board:



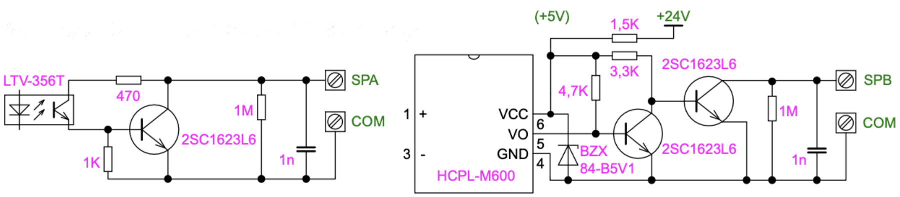
4.6 Circuit Description of the Output Terminals

As already mentioned in the previous section, the SPA and SPB digital outputs are also equipped with optocouplers. A 2SC1623L6 transistor is connected downstream of the LTV-356T-B optocoupler at the SPA output, while the HCPL-M600 high-speed optocoupler requires an auxiliary voltage generated from the 24V source and therefore a further transistor for decoupling. Both outputs are wired in such a way that the maximum load is specified by the transistors used. The maximum permissible operating parameters of the 2SC1623 (at 25°C ambient temperature) are: V_{CEO} 50V, I_C 100mA, P_C 200mW, T_J 150°C.

The reference potential to which both open collector outputs switch in the active state is the COM of the +24V source, which is also the reference potential of the digital inputs in the factory setting. If, for example, a 24V signal lamp is to be controlled, this must therefore be between SPA or SPB and +24V. Furthermore, the outputs cannot be connected in series (for a hard-wired AND function).

If all inputs and outputs are connected to the same PLC, the common reference potential is unproblematic. However, if different devices are involved, potential separation must be carried out if necessary by switching the digital inputs of the ST500 to external supply via the PLC terminal.

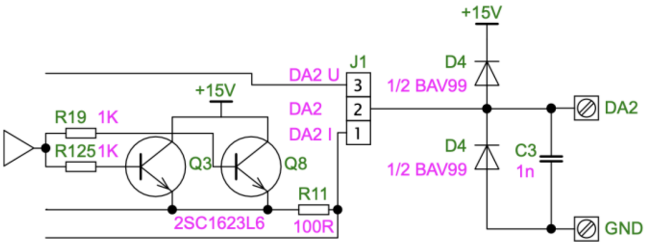
Output circuit SPA (left) / SPB (right):



The analog outputs consist of two circuits for voltage and current output, between which a jumper is used to switch. The voltage output is driven by ¼ TL074 and current-limited by a 100Ω resistor, whereby the OpAmp used would already be permanently short-circuit proof. In the current output branch, this is followed by a further ¼ TL074, which performs the voltage-current conversion with the aid of two parallel-connected 2SC1623. The output is equipped with a BAV99 double diode, which dissipates voltages above 15V or below 0V.

Both outputs DA1 and DA2, as well as the analog inputs AI1, AI2, AI3 and PT100, are referenced to GND of the 10V source. This is always potential-free in relation to the rest of the inverter. However, in the factory setting, GND is connected to protective earth PE via the GND jumper and an RC element. If complete potential-free operation is required, the jumper must be set from "PE" to "NC".

Switching of DA2:



4.7 List of Jumpers

(**Bold/underlined** = default setting)

<table>
<tr><td>DA1</td><td>Analog Output DA1: <u>V</u></td><td rowspan="4">I:
0mA to
20mA

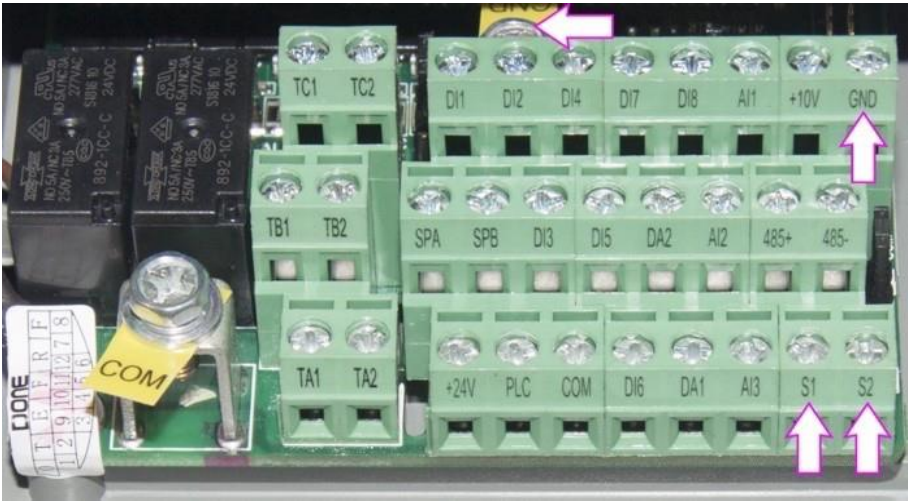
V:
0V to 10V</td><td rowspan="2">PLC</td><td rowspan="2">Reference potential DI1 to 8
COM (high-active) / <u>24V</u> (low-active)
Open: external supply via PLC terminal</td></tr>
<tr><td>DA2</td><td>Analog Output DA2: I</td></tr>
<tr><td>AI1</td><td>Analog Input AI1: <u>V</u></td><td rowspan="2">GND
COM</td><td rowspan="2">Interference suppression/earth reference for COM/GND
Jumper GND, Jumper COM:
NC open / <u>PE</u> RC element to protective earth</td></tr>
<tr><td>AI2</td><td>Analog Input AI2: I</td></tr>
<tr><td>485</td><td colspan="4">Termination RS485 500Ω ON/<u>OFF</u></td></tr>
</table>

4.8 PT100

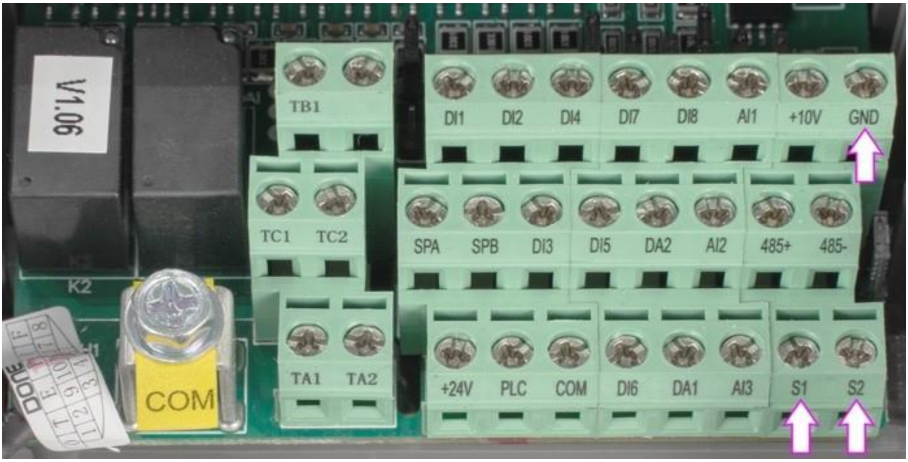
A PT100 motor temperature sensor can be connected to terminals S1, S2 and GND. In this case, one pole is connected to terminal S1 and the other to the two terminals S2 and GND. A PT1000 can also be used; this is then only connected to S1 and GND, in this case terminal S2 remains free. A PTC with step characteristic can usually be connected in the same way as a PT1000, but the temperature cannot then be displayed.

Below you will find a figure of the terminal block.

Terminals S1 and S2 are located at the front right, terminal GND at the top right and also as a terminal bracket behind DI2.



From V1.06 on, the terminal bracket for GND is omitted:



4.9 Wiring Precautions

Danger!

Ensure that the frequency inverter is **switched off** while you are working on it!

Wait until the condensers have **discharged** before working on the DC link. There is an LED on the supply board that indicates the charge in the DC link. If in doubt, measure the terminals to ensure that there is no voltage. T**here is a risk of injury from electric shock!**

Work on the frequency inverter may only be carried out by **trained specialist personnel**!

Also ensure that the frequency inverter is **properly earthed**! Do not remove the earthing until the capacitors have completely discharged.

Please be sure to take <u>all</u> of the following precautions!

- Before commissioning, ensure that the mains voltage corresponds to the supply voltage stated in the specifications of the inverter, as the inverter can be damaged if the voltage applied is too high!
- Make sure that the output voltage of the frequency inverter matches your motor and is configured correctly, otherwise the motor could be damaged!
- **Never** connect the mains supply to the terminals for connecting the motor (U, V, W)! This can cause irreparable damage to the inverter. Damage caused by such an improper connection is not covered by the warranty!
- If you want to use a braking resistor, **never** connect it to the - and + terminals without using a braking unit! This can damage the frequency inverter and the resistor. Only inverters with terminal RB have an integrated brake unit.
- **Do not** connect a phase-shifting capacitor or RC component to the U, V and W terminals of the frequency inverter! This does not apply to special output filters.
- When changing the motor, the frequency inverter **must** be switched off (stopped).
- **Do not** disconnect the motor from the frequency inverter until the RUN lamp has gone out and the frequency inverter no longer supplies voltage at the output.
- **Only** carry out work in the frequency inverter when the LED on the circuit board, which indicates the remaining charge in the DC link, has gone out. To be on the safe side, check whether the voltage between the + and - terminals has fallen below 36V. This is usually the case after about two minutes.
- Ensure that no pieces of cable or other metal objects fall into the inverter during wiring. This can lead to damage to the frequency inverter!
- Pay attention to the different potential references (COM, GND and PE). Only connect the COM and GND circuits if necessary, e.g. if you need the +24V to supply a sensor at one of the analog inputs.
- To minimize electromagnetic interference, it is recommended to install overvoltage protection if a power contactor is connected upstream of the inverter.
- Supply cables should be shielded.
- **Do not** lay control cables close to the supply cables and use shielded cables.
- If the carrier frequency is less than 3kHz, the maximum cable length to the motor should not be longer than 50m. If the carrier frequency is greater than 4kHz, the cable length should be adjusted accordingly.

- If external accessories (EMC filters, reactors, etc.) are connected to the frequency inverter, first check these accessories for insulation with a voltage of 1000V. The measured insulation resistance should not be less than 4MΩ.
- If the motor is to be switched on and off frequently, **do not** do this by switching the entire inverter on and off. Instead, use the digital input terminals, the control panel or the RS485 communication to start and stop the motor in order to avoid premature wear of the rectifier and the DC link capacitors.
- To avoid the risk of electric shock, ensure that the frequency inverter is **earthed** in accordance with the relevant local regulations. The connection to earth (PE) should not exceed a resistance value of 100mΩ.
- The requirements for the cables used should be checked in coordination with national specifications.
- The motor power should be equal to or less than the power of the frequency inverter.
- Please note that a considerable amount of energy is stored capacitively or inductively both in the frequency inverter intermediate circuit and in the motor, and that mechanical energy is converted back into electrical energy during braking. T**he protective effect of an RCD in the supply of an inverter is therefore severely impaired with regard to the inverter output cables. I**t is therefore essential to ensure that the live parts of the motor, the motor supply cables and the DC link, including the connected braking units and braking resistors, are always protected against contact!
- Improper connection voids the warranty. Product liability also does not apply in the event of errors for which the customer is responsible. Furthermore, you may lose your insurance cover. It is therefore essential to ensure the appliance is connected by a **qualified person**, and to **check the wiring very carefully** before commissioning. Frequency inverters can have very high power levels, which can cause considerable damage in the event of an error.
- Please note that incorrect programming can also cause considerable damage. In particular, check the running direction of the motor, the correct input of motor voltage and current, the maximum frequency, the polarity of the PID controller if necessary, and the function of emergency stop switches
- (Only models from 15kW).

4.10 Spare Circuit

If motor operation is no longer possible due to an error in the inverter, longer downtimes can be avoided by bypassing the inverter with a replacement circuit if a three-phase supply is available, provided that the motor can be operated directly from the mains and continued operation is more important than the control function.

Notes:

- **CAUTION: This spare circuit diagram only applies to three-phase variants of the ST500.**
- The functionality and suitability of the replacement circuit should be checked before commissioning!
- Mechanical coupling or other suitable measures must be taken to ensure that MCC1 and MCC2 can never become conductive at the same time!
- Make sure that the motor is configured appropriately for the mains voltage (star, delta). If, for example, you have reconfigured the motor to delta in order to "overclock" it to 87Hz at 400V, operation with 400V mains voltage at 50Hz is no longer possible.
- Substitute operation is only possible for applications in which frequency adjustment and voltage regulation by the inverter are not absolutely necessary or are less critical than a longer standstill.

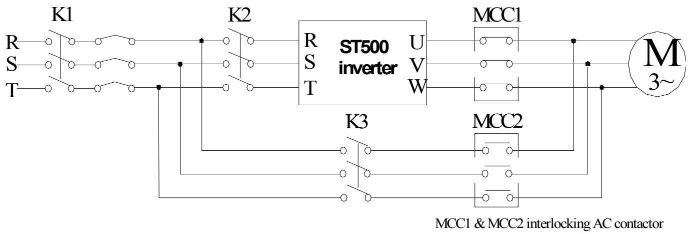
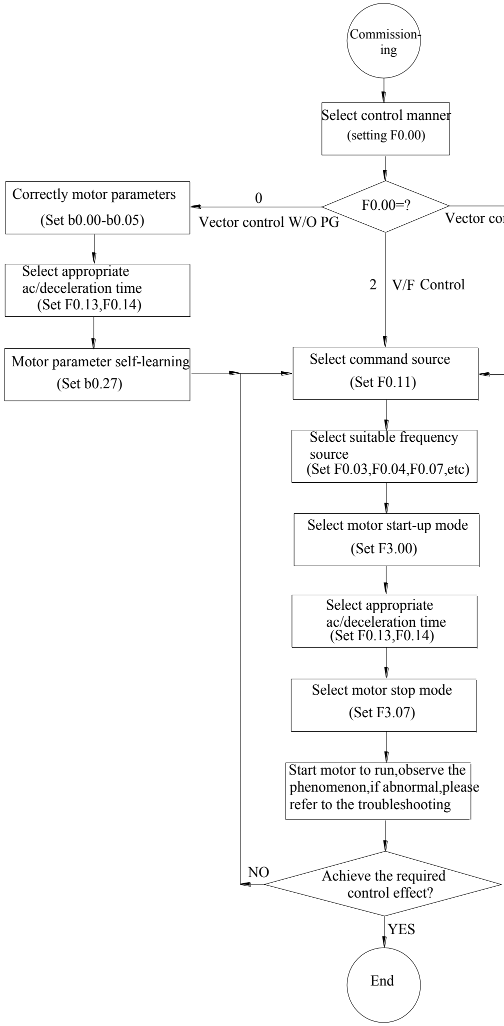


Figure 4-5 Spare Circuit Electrical Diagram

5 Commissioning



1) Firstly confirm that AC input power supply voltage shall be within inverter rated input voltage range before connecting power supply to the inverter.

2) Connect power supply to the R, S and T terminals of the inverter (1-phase only R and T)

3) Connect 3-phase motor to the U, V and W terminals of the inverter.

4) Select the appropriate operation control method.

6 Function Parameters

6.1 Menu Grouping

The column labelled "Mod." refers to whether or not the parameters are modifiable, i.e. can be manually adjusted by the user.

The following symbols will be used:

★ This parameter cannot be modified during operation

● This parameter is part of the actual testing data and thus cannot be modified

☆ This parameter can be modified both during operation and in standby mode;

▲ Factory parameter, not modifiable

_ This is a factory parameter related to power or model. Please check the details in the involved parameter introduction.

The parameter menu is not password-protected in the customized parameters mode!

Code	Group Name	Description
d0	Status Parameters	Setting the displayed status parameters such as target frequency, motor current, etc.
F0	Basic Parameter Group	Setting the target frequency, converter operating mode, acceleration and braking time
F1	Input Terminals	Function settings for the digital and analog inputs
F2	Output Terminals	Function settings for the digital and analog outputs
F3	Start/Stop Parameters	Set the starting and braking behavior of the frequency inverter
F4	V/f Control	Parameters for setting the V/f control
F5	Vector Control	Configuration of the vector control
F6	Control Panel	Assignment of functions on the control panel and display settings
F7	Auxiliary Functions	Jog operating mode, skip frequencies etc.
F8	Errors and Protection	Behavior of the inverter in the event of an error; protective functions
F9	Communication	Settings for communication interfaces
FA	Torque Control	Parameter settings for torque control
Fb	Controller Optimization	Adjustment of the control parameters

FC	Extended Function	Parameters for advanced functions
E0	Pulse Settings	Counting functions of the pulse input
E1	Program Operation	Multiple speeds and PLC functions
E2	PID Parameters	Configuration of the PID controller
E3	Virtual Terminals	Settings for virtual input and output terminals
b0	Motor Parameters	Entering the motor parameters
y0	System Parameters	System settings and password protection
y1	Error Memory	Overview of stored errors

6.1.1 d0 Group – Monitoring Function Group (Read Only)

No.	Code	Designation	Setting Range	Resolution
0.	d0.00	Motor Frequency	Current actual frequency	0.01Hz
1.	d0.01	Target Frequency	Current target frequency	0.01Hz
2.	d0.02	DC Link Voltage	Currently measured DC link voltage	0.1V
3.	d0.03	Output Voltage	Current output voltage	1V
4.	d0.04	Motor Current	Current motor current	0.01A
5.	d0.05	Motor Power	Calculated instantaneous motor power	0.1kW
6.	d0.06	Motor Torque	Current torque at the motor shaft	0.1%
7.	d0.07	Digital Input (DI) Status	Status of the digital inputs	-
8.	d0.08	Digital Output (DO) Status	Status of the digital outputs	-
9.	d0.09	AI1 Voltage	Voltage present at input AI1	0.01V
10.	d0.10	AI2 Voltage	Voltage present at input AI2	0.01V
11.	d0.11	AI3 Voltage	Voltage present at input AI3	0.01V
12.	d0.12	Current Counter Value of the Pulse Input	Current value of the counter at the pulse input	-
13.	d0.13	Length Currently Counted at the Pulse Input	Current counted length (Fct. 27)	-
14.	d0.14	Motor Speed	Current engine speed	-

15.	d0.15	PID Setpoint	Set setpoint of the PID controller in % of the maximum	%
16.	d0.16	PID Feedback	PID feedback signal as a percentage of the maximum value	%
17.	d0.17	PLC Stage	Current PLC program section	-
18.	d0.18	Input Frequency of the Pulse Input DI5	Current input frequency at pulse input DI5 (input fct. 30)	0.01kHz
19.	d0.19	Current Speed from Encoder Card	Returned speed from the encoder input	0.01Hz
20.	d0.20	Remaining Runtime	Remaining operating time in program operating mode	0.1Min
21.	d0.21	Remaining Operating Time with Time Control	Linear speed calculated from the number of pulses per minute and the pulses per meter (E0.07).	1m/Min
22.	d0.22	Current Power-On Time	Time since last power-on	Min
23.	d0.23	Current Runtime	Runtime of the inverter since it was last switched on.	0.1Min
24.	d0.24	Input Frequency of the Pulse Input DI5	Current input frequency at pulse input DI5, high resolution	1Hz
25.	d0.25	Control Value via Remote Control	Frequency, torque or other control values of the communi-cation interface	0.01%
26.	d0.26	Encoder Feedback Speed	Current speed returned by the encoder	0.01Hz
27.	d0.27	Specified Frequency by Parameter F0.03 (Master Frequency)	Current value of the main frequency control source (F0.03)	0.01Hz
28.	d0.28	Specified Frequency by Parameter F0.04 (Additional Frequency)	Current value of the additional frequency control source (F0.04)	0.01Hz
29.	d0.29	Current Specified Torque (%)	Current value of the rotary setting (see FA.01)	0.1%
30.	d0.30	Reserved	–	
31.	d0.31	Synchronous Machine: Position of the Rotor	Position of the rotor of a synchronous motor as an angle	0.0°
32.	d0.32	Rotor Position of the Rotary Transformer at PG Card Position ABZ	Rotor position of the rotary converter	-

33.	d0.33	AB Pulse Count Value from the Current ABZ or UVW Encoder on the PG Card	Calculated position information when an ABZ incremental encoder is used	0
34.	d0.34	Z Signal Counter	Count value of the signals when a Z-phase encoder is used	-
35.	d0.35	Frequency Inverter Status	Displays the individual operating statuses of the inverter.	-
36.	d0.36	Frequency Inverter Type	Displays the respective load type of the inverter. (G or F)	-
37.	d0.37	AI1 Voltage Before Correction	Input voltage at the AI1 terminal before linear correction (see F1.12)	0.001V
38.	d0.38	AI2 Voltage Before Correction	Input voltage at the AI2 terminal before linear correction (see F1.12)	0.001V
39.	d0.39	AI3 Voltage Before Correction	Input voltage at the AI3 terminal before linear correction (see F1.12)	0.001V
40.	d0.40	Reserved	–	
41.	d0.41	Motor Temperature Monitoring	Temperature from the optional temperature sensor	1°C

6.1.2 F0 Group – Basic Function Group

No.	Code	Designation	Setting Range	Default	Mod.
42.	F0.00	Motor Control	0: Vector control without PG 1: Vector control using the pulse generator / rotary encoder 2: V/f control	2	★
43.	F0.01	Target Frequency	0.00Hz to F0.19 (Max frequency)	50.00Hz	☆
44.	F0.02	Frequency Resolution	1: 0.1Hz 2: 0.01Hz	2	★
45.	F0.03	Frequency Control Source	0 to 10	1	★
46.	F0.04	Additional Frequency Control Source	0 to 10	0	★
47.	F0.05	Reference Value for Additional Frequency	0: Relative to the maximum frequency 1: Relative to master frequency source 1 2: Relative to master frequency source 2	0	☆

48.	F0.06	Frequency Range for Additional Frequency	0% to 150%	100%	☆
49.	F0.07	Configuration of Main and Additional Frequency	**Ones Digit:** Selection of the source for the target frequency **Tens Digit:** Choice of arithmetic operation	00	☆
50.	F0.08	Offset for Arithmetic Operation	0.00Hz to F0.19 (maximum frequency)	0.00Hz	☆
51.	F0.09	Memory Setting for Digitally Controlled Frequency	0: Do not save 1: Save	1	☆
52.	F0.10	Reference for UP/DOWN Button During Operation	0: Actual frequency 1: Target frequency	0	★
53.	F0.11	Command Source	0: Control panel (LED off) 1: Terminals (LED on) 2: Communication interface (LED flashes) 3: Control panel + communication interface 4: Control panel + terminals + communication interface	0	☆
54.	F0.12	Linking the Frequency Source and Control Source	**Ones Digit:** Source for control panel **Tens Digit:** Source for terminal **Hundreds Digit:** Source for communication	000	☆
55.	F0.13	Acceleration Time 1	0.00s to 6500s Default settings depend on the power class of the inverter	Depends on Model	☆
56.	F0.14	Braking Time 1	0.00s to 6500s Default settings depend on output	Depends on Model	☆
57.	F0.15	Time Unit for F0.13 and F0.14	0: Seconds 1: Tenths of a second 2: Hundredths of a second	1	★
58.	F0.16	Reference Frequency for Acceleration/Braking Time	0: F0.19 (maximum frequency) 1: Target frequency 2: 100Hz	0	★
59.	F0.17	Carrier Frequency Adjustment for Temperature Changes	0: Inactive 1: Active	0	☆

60.	F0.18	Carrier Frequency	0.5kHz to 16.0kHz	Depends on Model	☆
61.	F0.19	Maximum Output Frequency	50.00Hz to 3200.0Hz	50.00Hz	★
62.	F0.20	Source for Upper Limit Frequency	0: Setting in F0.21 1: AI1 2: AI2 3: Control panel rotary encoder 4: Setting via pulse input 5: Communication interface 6: AI3	0	★
63.	F0.21	Upper Limit Frequency	F0.23 to F0.19	50.00Hz	☆
64.	F0.22	Offset for Upper Limit Frequency	0.00Hz to F0.19	0.00Hz	☆
65.	F0.23	Lower Limit Frequency	0.00Hz to F0.21	0.00Hz	☆
66.	F0.24	Direction of Motor Rotation	0: Default (forward) 1: Reverse (backward)	0	☆
67.	F0.25	Reserved	–		
68.	F0.26	Accuracy of AI Processing	0: 0.01Hz 1: 0.05Hz 2: 0.1Hz 3: 0.5Hz	1	★
69.	F0.27	Inverter Type	1: Type G (standard model) 2: Type F (specialized model)	-	●

6.1.3 F1 Group – Input Terminals Group

No.	Code	Designation	Setting Range	Default	Mod.
70.	F1.00	DI1 Function	0 to 51	1	★
71.	F1.01	DI2 Function		2	★
72.	F1.02	DI3 Function		8	★
73.	F1.03	DI4 Function		9	★
74.	F1.04	DI5 Function		12	★
75.	F1.05	DI6 Function		13	★
76.	F1.06	DI7 Function		14	★
77.	F1.07	DI8 Function		15	★
78.	F1.08	Reserved	–	–	–
79.	F1.09	Reserved	–	–	–
80.	F1.10	Terminal Command Mode	0: Two-wire control 1 1: Two-wire control 2 2: Three-wire control 1 3: Three-wire control 2	0	★
81.	F1.11	Command Frequency Change	0.001Hz/s to 65.535Hz/s	1.000Hz/s	☆
82.	F1.12	Minimum Input Voltage for AI Curve 1	0.00V to F1.14	0.30V	☆
83.	F1.13	Minimum Value for AI Curve 1	-100.0% to +100.0%	0.0%	☆
84.	F1.14	Maximum Input Voltage for AI Curve 1	F1.12 to +10.00V	10.00V	☆
85.	F1.15	Maximum Value for AI Curve 1	-100.0% to +100.0%	100.0%	☆
86.	F1.16	Minimum Input Voltage for AI Curve 2	0.00V to F1.18	0.00V	☆
87.	F1.17	Minimum Value for AI Curve 2	-100.0% to +100.0%	0.0%	☆

88.	F1.18	Maximum Input Voltage for AI Curve 2	F1.16 to +10.00V	10.00V	☆
89.	F1.19	Maximum Value for AI Curve 2	-100.0% to +100.0%	100.0%	☆
90.	F1.20	Minimum Input Voltage for AI Curve 3	-10.00V to F1.22	0.00V	☆
91.	F1.21	Minimum Value for AI Curve 3	-100.0% to +100.0%	0.0%	☆
92.	F1.22	Maximum Input Voltage for AI Curve 3	F1.20 to +10.00V	10.00V	☆
93.	F1.23	Maximum Value for AI Curve 3	-100.0% to +100.0%	100.0%	☆
94.	F1.24	Curve Selection for Analog Input Terminals (AI1 to AI3)	**Ones Digit:** Selection of the curve for AI1 **Tens Digit:** Selection of the curve for AI2 **Hundreds Digit:** Selection of the curve for AI3	H.0321	☆
95.	F1.25	Behavior with Voltage Below Minimum Voltage	**Ones Digit:** Setting for AI1 **Tens Digit:** Setting for AI2 **Hundreds Digit:** Setting for AI3	H.0000	☆
96.	F1.26	HDI Minimum Pulse Frequency	0.00kHz to F1.28	0.00kHz	☆
97.	F1.27	Minimum Value of the Pulse Frequency	-100.0% to +100.0%	0.0%	☆
98.	F1.28	HDI Maximum Pulse Frequency	F1.26 to 100.00kHz	50.00kHz	☆
99.	F1.29	Maximum Value of the Pulse Frequency	-100.0% to +100.0%	100.0%	☆
100.	F1.30	DI Filter Time	0.000s to 1.000s	0.010s	☆
101.	F1.31	AI1 Filter Time	0.00s to 10.00s	0.10s	☆
102.	F1.32	AI2 Filter Time	0.00s to 10.00s	0.10s	☆
103.	F1.33	AI3 Filter Time	0.00s to 10.00s	0.10s	☆
104.	F1.34	Pulse Input Filter Time	0.00s to 10.00s	0.00s	☆

105.	F1.35	DI Level Setting (Terminals 1 to 5)	**Ones Digit:** DI1 0: Positive logic 1: Negative logic **Tens Digit:** DI2 **Hundreds Digit:** DI3 **Thousands Digit:** DI4 **Ten-Thousands Digit:** DI5	00000	★
106.	F1.36	DI Level Setting (Terminals 6 to 10)	**Ones Digit:** DI6 0: Positive logic 1: Negative logic **Tens Digit:** DI7 **Hundreds Digit:** DI8 **Thousands Digit:** DI9 **Ten-Thousands Digit:** DI10	00000	★
107.	F1.37	DI1 Delay Time	0.0s to 3600.0s	0.0s	☆
108.	F1.38	DI2 Delay Time	0.0s to 3600.0s	0.0s	☆
109.	F1.39	DI3 Delay Time	0.0s to 3600.0s	0.0s	☆
110.	F1.40	Function Assignment to Multiple Terminals	0: Do not allow the same function to be assigned to multiple terminals 1: Allow the same function to be assigned to multiple terminals	0	☆
111.	F1.41	Start Value X1 for Control Panel Rotary Encoder	0,00 to 100,00%	0.00%	☆
112.	F1.42	End Value X2 for Control Panel Rotary Encoder	0,00 to 100,00%	0.50%	☆
113.	F1.43	Fixed Value for Control Panel Rotary Encoder	0,00 to 100,00%	0.00%	☆
114.	F1.44	Start Value Y1 for Control Panel Rotary Encoder	-100,00 to 100,00%	0.00%	☆
115.	F1.45	End Value Y2 for Control Panel Rotary Encoder	-100,00 to 100,00%	100.00%	☆
116.	F1.46	Configuration of Control Panel Rotary Encoder	00 to 21	00	☆

6.1.4 F2 Group – Output Terminals Group

No.	Code	Designation	Setting Range	Default	Mod.
117.	F2.00	SPB Output Function	0: Pulse output (F2.06) 1: Switching output (F2.01)	0	☆
118.	F2.01	SPB Output Function (If F2.00=1)	0 to 40	0	☆
119.	F2.02	Relay Output 1 Function (TA1, TB1, TC1)		2	☆
120.	F2.03	Reserved			
121.	F2.04	SPA Output Function		1	☆
122.	F2.05	Relay Output 2 Function (TA2, TC2)		1	☆
123.	F2.06	SPB Pulse Output Function (If F2.00=0)	0 to 17	0	☆
124.	F2.07	DA1 Output Function		2	☆
125.	F2.08	DA2 Output Function		13	☆
126.	F2.09	Maximum Output Frequency for Pulse Output	0.01kHz to 100.00kHz	50.00 kHz	☆
127.	F2.10	SPB Output Delay	0.0s to 3600.0s	0.0s	☆
128.	F2.11	Relay 1 Output Delay	0.0s to 3600.0s	0.0s	☆
129.	F2.12	Expansion Card Digital Output (DO) Delay	0.0s to 3600.0s	0.0s	☆
130.	F2.13	SPA Output Delay	0.0s to 3600.0s	0.0s	☆
131.	F2.14	Relay 2 Output Delay	0.0s to 3600.0s	0.0s	☆
132.	F2.15	Output Terminal Logic for F2.01 to F2.05	**Ones Digit:** SPB 0: Positive logic 1: Negative logic **Tens Digit:** Relay 1 **Hundreds Digit:** Reserved **Thousands Digit:** SPA	00000	☆

			Ten-Thousands Digit: Relay 2		
133.	F2.16	DA1 Zero Bias Coefficient	-100.0% to +100.0%	0.0%	☆
134.	F2.17	DA1 Gain	-10.00 to +10.00	1.00	☆
135.	F2.18	DA2 Zero Bias Coefficient	-100.0% to +100.0%	20.0%	☆
136.	F2.19	DA2 Gain	-10.00 to +10.00	0.80	☆

6.1.5 F3 Group – Start and Stop Control Group

No.	Code	Designation	Setting Range	Default	Mod.
137.	F3.00	Start-Up Mode	0: Direct start-up 1: Rotation-monitored start-up, speed equalization 2: Asynchronous motor pre-excited start	0	☆
138.	F3.01	Speed Equalization	0 to 2: Reserved 3: Hard Speed-Tracking Mode	3	★
139.	F3.02	Value for Speed Equalization	1 to 100	20	☆
140.	F3.03	Start Frequency	0.00Hz to 10.00Hz	0.00Hz	☆
141.	F3.04	Hold Time for Start Frequency	0.0s to 100.0s	0.0s	★
142.	F3.05	DC Holding Current / Pre-Excitation at Start	0% to 100%	0%	★
143.	F3.06	Time for DC Holding Current at Start	0.0s to 100.0s	0.0s	★
144.	F3.07	Stop Mode	0: Active stop 1: Free stop	0	☆
145.	F3.08	DC Braking Frequency	0.00Hz to F0.19	0.00Hz	☆
146.	F3.09	Waiting Time for DC Brake	0.0s to 100.0s	0.0s	☆
147.	F3.10	Output Current with DC Braking Function	0% to 100%	0%	☆
148.	F3.11	Duration of DC Braking Function to Stop	0.0s to 100.0s	0.0s	☆

149.	F3.12	Degree of Utilization of the Braking Function	0% to 100%	100%	☆
150.	F3.13	Acceleration/Braking Mode	0: Linear 1: S-curve A 2: S-curve B	0	★
151.	F3.14	S Curve Start Section	0.0% to (100.0% minus F3.15)	30.0%	★
152.	F3.15	S Curve End Section	0.0% to (100.0% minus F3.14)	30.0%	★

6.1.6 F4 Group – V/f Control Parameters

No.	Code	Designation	Setting Range	Default	Mod.
153.	F4.00	V/f Curve Setting	0 to 11	0	★
154.	F4.01	Torque Boost	0.0% (Automatic) 0.1 to 30% (manual)	0.0%	☆
155.	F4.02	Cut-Off Frequency for Torque Boost	0.00Hz to F0.19	15.00Hz	★
156.	F4.03	V/f Frequency Point f1	0.00Hz to F4.05	0.00Hz	★
157.	F4.04	V/f Voltage Point Y1	0.0% to 100.0%	0.0%	★
158.	F4.05	V/f Frequency Point f2	F4.03 to F4.07	0.00Hz	★
159.	F4.06	V/f Voltage Point Y2	0.0% to 100.0%	0.0%	★
160.	F4.07	V/f Frequency Point f3	F4.05 to b0.04 (rated motor frequency)	0.00Hz	★
161.	F4.08	V/f Voltage Point Y3	0.0% to 100.0%	0.0%	★
162.	F4.09	Slip Compensation	0% to 200.0%	0.0%	☆
163.	F4.10	DC Link Overvoltage Protection	0 to 200	80	☆
164.	F4.11	Oscillation Suppression	0 to 100	0	☆
165.	F4.12	Voltage Control Source	0 to 9	0	☆
166.	F4.13	Control Panel Voltage Setting	0V to rated motor voltage	0V	☆
167.	F4.14	Rise Time V/f Voltage	0.0s to 1000.0s	0.0s	☆

6.1.7 F5 Group – Vector Control Parameters

No.	Code	Designation	Setting Range	Default	Mod.
168.	F5.00	Lower Proportional Component G1	1 to 100	30	☆
169.	F5.01	Lower Integral Time T1	0.01s to 10.00s	0.50s	☆
170.	F5.02	Lower Switching Frequency 1	0.00 to F5.05	5.00Hz	☆
171.	F5.03	Upper Proportional Component G2	0 to 100	20	☆
172.	F5.04	Upper Integral Time T2	0.01s to 10.00s	1.00s	☆
173.	F5.05	Upper Switching Frequency 2	F5.02 to F0.19	10.00Hz	☆
174.	F5.06	Integral Component	0: Active 1: Inactive	0	☆
175.	F5.07	Control Source for Torque Limitation	0 to 7	0	☆
176.	F5.08	Upper Limit for Torque Specification	0.0% to 200.0%	150.0%	☆
177.	F5.09	Differential Gain	50% to 200%	150%	☆
178.	F5.10	Filter Constant	0.000s to 0.100s	0.000s	☆
179.	F5.11	Overvoltage Protection for Vector Control	0 to 200	64	☆
180.	F5.12	P-Component Gain for Voltage Regulation	0 to 60000	2000	☆
181.	F5.13	I-Component Gain for Voltage Regulation	0 to 60000	1300	☆
182.	F5.14	P-Component for Torque Control	0 to 60000	2000	☆
183.	F5.15	I-Component for Torque Control	0 to 60000	1300	☆

6.1.8 F6 Group – Keypad and Display

No.	Code	Designation	Setting Range	Default	Mod.
184.	F6.00	STOP/RESET Key Functions	0: STOP/RESET only active in keypad mode 1: STOP/RESET active in any operation mode	1	☆
185.	F6.01	Status Parameters in Operation 1	0x0000 to 0xFFFF	001F	☆
186.	F6.02	Status Parameters in Operation 2	0x0000 to 0xFFFF	0000	☆
187.	F6.03	Status Parameters in Stop State	0x0000 to 0xFFFF	0033	☆
188.	F6.04	Motor Speed Factor	0.0001 to 6.5000	3.0000	☆
189.	F6.05	Decimal Places for Motor Speed	0: No decimal places 1: One decimal place 2: Two decimal places 3: Three decimal places	1	☆
190.	F6.06	IGBT Temperature	0°C to 100°C	-	●
191.	F6.07	Total Operation Time	0h to 65535h	-	●
192.	F6.08	Total Power-On Time	0h to 65535h	-	●
193.	F6.09	Total Power Consumption	0 to 65535 kWh	-	●
194.	F6.10	Product Model Number		-	●
195.	F6.11	Firmware Version Number		-	●
196.	F6.12 F6.13 F6.14 F6.15	Reserved			
197.	F6.16	Parameter Display 2	Selection from all parameters	d0.04	☆
198.	F6.17	Power Correction Factor	0,00 to 10,00	1.00	☆
199.	F6.18	UP Button Function	0 to 7	0	☆
200.	F6.19	DOWN Button Function	0 to 7	0	☆
201.	F6.20	Key Lock Mode	0 to 3	0	☆
202.	F6.21	QUICK Button Function	0 to 6	0	☆

6.1.9 F7 Group – Auxiliary Function

No.	Code	Designation	Setting Range	Default	Mod.
203.	F7.00	Jog Frequency	0.00Hz to F0.19	6.00Hz	☆
204.	F7.01	Jog Acceleration Time	0.0s to 6500.0s	5.0s	☆
205.	F7.02	Jog Braking Time	0.0s to 6500.0s	5.0s	☆
206.	F7.03	Jog Priority	0: Inactive 1: Active	1	☆
207.	F7.04	Skip Frequency 1	0.00Hz to F0.19 (maximum frequency)	0.00Hz	☆
208.	F7.05	Skip Frequency 2	0.00Hz to F0.19 (maximum frequency)	0.00Hz	☆
209.	F7.06	Skip Frequency Range	0.00Hz to F0.19 (maximum frequency)	0.00Hz	☆
210.	F7.07	Skip Frequency Availability During Braking/Acceleration	0: Inactive 1: Active	0	☆
211.	F7.08	Acceleration Time 2	0.0s to 6500.0s	Depends on Model	☆
212.	F7.09	Braking Time 2	0.0s to 6500.0s	Depends on Model	☆
213.	F7.10	Acceleration Time 3	0.0s to 6500.0s	Depends on Model	☆
214.	F7.11	Braking Time 3	0.0s to 6500.0s	Depends on Model	☆
215.	F7.12	Acceleration Time 4	0.0s to 6500.0s	Depends on Model	☆
216.	F7.13	Braking Time 4	0.0s to 6500.0s	Depends on Model	☆
217.	F7.14	Switching Frequency for Acceleration Time 1 and 2	0.00Hz to F0.19 (maximum frequency)	0.00Hz	☆
218.	F7.15	Switching Frequency for Braking Time 1 and 2	0.00Hz to F0.19 (maximum frequency)	0.00Hz	☆

219.	F7.16	Delay Between Forward and Reverse Operation	0.0s to 3600.0s	0.00s	☆
220.	F7.17	Disable Reverse Operation	0: Reverse operation enabled 1: Reverse operation disabled	0	☆
221.	F7.18	Behavior at Target Frequency < Lower Limit Frequency	0: Operation at lower frequency 1: Stop 2: Operation at 0Hz	0	☆
222.	F7.19	Control Difference Compensation	0.00Hz to 10.00Hz	0.00Hz	☆
223.	F7.20	Time Limit for Power-On Time	0h to 36000h	0h	☆
224.	F7.21	Time Limit for Operating Time	0h to 36000h	0h	☆
225.	F7.22	Start-Up Protection	0: Inactive 1: Active	0	☆
226.	F7.23	Frequency Detection Value (FDT1)	0.00Hz to F0.19 (maximum frequency)	50.00Hz	☆
227.	F7.24	Range for Frequency Detection Value (FDT1)	0.0% to 100.0% (from F7.23)	5.0%	☆
228.	F7.25	Target Frequency Monitoring Range	0.0 to 100.0% (from F0.19)	0.0%	☆
229.	F7.26	Frequency Detection Value (FDT2)	0.00Hz to F0.19 (maximum frequency)	50.00Hz	☆
230.	F7.27	Range for Frequency Detection Value (FDT2)	0.0% to 100.0% (from F7.26)	5.0%	☆
231.	F7.28	Freely Selectable Frequency Value 1	0.00Hz to F0.19	50.00Hz	☆
232.	F7.29	Range for Freely Selectable Frequency Value 1	0.0% to 100.0% (from F0.19)	0.0%	☆
233.	F7.30	Freely Selectable Frequency Value 2	0.00Hz to F0.19	50.00Hz	☆

234.	F7.31	Range for Freely Selectable Frequency Value 2	0.0% to 100.0% (from F0.19)	0.0%	☆
235.	F7.32	Zero Current Limit	0.0% to 300.0% (rated motor current)	5.0%	☆
236.	F7.33	Zero Current Delay Time	0.01s to 360.00s	0.10s	☆
237.	F7.34	Overcurrent Monitoring	0.0% (not active) 0.1% to 300.0% (rated motor current)	200.0%	☆
238.	F7.35	Overcurrent Delay Time	0.00s to 360.00s	0.00s	☆
239.	F7.36	Current Limit 1	0.0% to 300.0% (rated motor current)	-100.0%	☆
240.	F7.37	Monitoring Range for Current Limit 1	0.0% to 300.0% (rated motor current)	0.0%	☆
241.	F7.38	Current Limit 2	0.0% to 300.0% (rated motor current)	-100.0%	☆
242.	F7.39	Monitoring Range for Current Limit 2	0.0% to 300.0% (rated motor current)	0.0%	☆
243.	F7.40	IGBT Temperature Limit	0°C to 100°C	75°C	☆
244.	F7.41	Cooling Fan Control	0: Fan active when inverter in operation 1: Fan always active	0	★
245.	F7.42	Timer Operation	0: Inactive 1: Active	0	★
246.	F7.43	Source for Timer	0: F7.44 1: Analog input AI1 2: Analog input AI2 3: Control panel rotary encoder 100% of the respective input corresponds to the value in F7.44	0	★
247.	F7.44	Operating Time for F7.42	0.0min to 6500.0min	0.0Min	★
248.	F7.45	Current Operating Time Limit	0.0min to 6500.0min	0.0Min	★
249.	F7.46	Wake-Up Frequency	Standby frequency F7.48 to F0.19	0.00Hz	☆

250.	F7.47	Delay for Wake-Up Frequency	0.0s to 6500.0s	0.0s	☆
251.	F7.48	Standby Frequency	0Hz to wake-up frequency F7.46	0.00Hz	☆
252.	F7.49	Delay for Standby Frequency	0.0s to 6500.0s	0.0s	☆
253.	F7.50	AI1 Lower Limit Voltage	0.00V to F7.51	3.10V	☆
254.	F7.51	AI1 Upper Limit Voltage	F7.50 to 10.00V	6.80V	☆
255.	F7.52 F7.53	Reserved			
256.	F7.54	Jog Mode Configuration	**Ones Digit:** Jog Direction 0: Forward 1: Reverse 2: Control via terminals **Tens Digit:** Behavior at Jog End 0: Restore to operating mode before jog mode 1: Stop **Hundreds Digit:** Acceleration/Braking Time 0: Use the time pair active before jog mode 1: Retain acceleration/braking time from jog mode	H.0002	☆

6.1.10 F8 Group – Errors and Protection

No.	Code	Designation	Setting Range	Default	Mod.
257.	F8.00	Overcurrent Protection	0 to 100	20	☆
258.	F8.01	Overcurrent Limit	100% to 200%	-	☆
259.	F8.02	Overload Protection	0: Inactive 1: Active	1	☆
260.	F8.03	Degree of Overload Protection	0.20 to 10.00	1.00	☆
261.	F8.04	Advance Warning of Overload	50% to 100%	80%	☆
262.	F8.05	Overvoltage Protection	0 to 100	0	☆

263.	F8.06	Overvoltage / Braking Voltage	120% to 150%	130%	☆
264.	F8.07	Input Phase Loss Protection	**Ones Digit:** Protection in the event of input phase loss 0: Inactive 1: Active **Tens Digit:** Protection on contactor activation 0: Inactive 1: Active	11	☆
265.	F8.08	Output Phase Loss Protection	0: Inactive 1: Active	1	☆
266.	F8.09	Short-Circuit Protection	0: Inactive 1: Active	1	☆
267.	F8.10	Number of Automatic Error Resets	0 to 32767	0	☆
268.	F8.11	DO Terminals Active with Automatic Error Resets	0: Inactive 1: Active	0	☆
269.	F8.12	Time After Error Until Reset	0.1s to 100.0s	1.0s	☆
270.	F8.13	Motor Overspeed Limit	0.0 to 50.0% (maximum frequency)	20.0%	☆
271.	F8.14	Monitoring Time for Overspeed	0.0 to 60.0s	1.0s	☆
272.	F8.15	Speed Deviation Limit	0.0 to 50.0% (maximum frequency)	20.0%	☆
273.	F8.16	Monitoring Time for Speed Deviation	0.0 to 60.0s	5.0s	☆
274.	F8.17	Behavior in the Event of an Error 1	**Ones Digit:** Motor overload (Err.11) 0: Free stop 1: Stop in selected mode 2: Continue operation **Tens Digit:** Input phase loss (Err.12) **Hundreds Digit:** Output phase loss (Err.13) **Thousands Digit:** External error signal (Err.15) **Ten-Thousands Digit:** Faulty communication (Err.16)	00000	☆

275.	F8.18	Behavior in the Event of an Error 2	**Ones Digit:** Encoder error (Err.20) 0: Free stop 1: Switch to V/f and stop 2: Switch to V/f and continue operation **Tens Digit:** EEPROM error when reading/writing function parameter value (Err.21) 0: Free stop 1: Stop **Hundreds Digit:** Reserved **Thousands Digit:** Motor overheating (Err.45) **Ten-Thousands Digit:** Operating time limit reached (Err.26)	00000	☆
276.	F8.19	Behavior in the Event of an Error 3	**Ones Digit:** User-defined error 1 (Err.27) **Tens Digit:** User-defined error 1 (Err.28) **Hundreds Digit:** Power-on time limit reached (Err.29) **Thousands Digit:** Load loss (Err.30) 0: Free stop 1: Active stop 2: Brake to 7% of the rated motor frequency and continue operation. Automatically reset the target frequency when the load is detected again. **Ten-Thousands Digit:** Loss of PID feedback signal (Err.31)	00000	☆
277.	F8.20	Behavior in the Event of an Error 4	**Ones Digit:** Speed deviation too high (Err.42) **Tens Digit:** Limit value for motor speed exceeded (Err.43) **Hundreds Digit:** Position error / excessive deviation of motor data (Err.51) **Thousands Digit:** Reserved **Ten-Thousands Digit:** Reserved	00000	☆
278.	F8.21 F8.23	Reserved			★
279.	F8.24	Frequency Source for Operation After Error	0: Maintain current frequency 1: Target frequency 2: Upper frequency limit 3: Lower frequency limit	0	☆

			4: Substitute frequency (F8.25)		
280.	F8.25	Substitute Frequency	60.0% to 100.0%	100%	☆
281.	F8.26	Behavior in Case of Short-Term Voltage Loss	0: Continue 1: Generator brake 2: Brake and stop	0	☆
282.	F8.27	Frequency Switching Points for Momentary Power Cut Braking	50.0% to 100.0%	90%	☆
283.	F8.28	Measuring Time for Voltage Loss	0.00s to 100.00s	0	☆
284.	F8.29	Normal Voltage Reference	50.0% to 100.0% (of the standard DC link voltage)	10%	☆
285.	F8.30	Protection in the Event of Load Loss	0: Inactive 1: Active	1	☆
286.	F8.31	Limit for Load Loss	0.0 to 100.0%	10.0%	☆
287.	F8.32	Measuring Time for Load Loss	0.0 to 60.0s	1.0s	☆
288.	F8.33	Temperature Sensor on the Motor	0: Inactive 1: PT100	0	☆
289.	F8.34	Limit Value for Motor Temperature	0°C to 200°C	110	☆
290.	F8.35	Pre-Warning Value for Motor Temperature	0°C to 200°C	90	☆

6.1.11 F9 Group – Communication Parameters

No.	Code	Designation	Setting Range	Default	Mod.
291.	F9.00	Baud Rate	**Ones Digit:** MODBUS **Tens Digit:** Profibus-DP **Hundreds Digit:** Reserved **Thousands Digit:** CANlink 0 to 9, i.e. 300BPS to 115200BPS	6005	☆
292.	F9.01	Data Format	0: (8-N-2) 1: (8-E-1) 2: (8-O-1) 3: (8-N-1)	0	☆
293.	F9.02	Address of the Inverter	1 to 247, 0 for master	1	☆
294.	F9.03	Response Delay	0ms to 20ms	2ms	☆
295.	F9.04	Time Until Time-Out	0.0 (inactive), 0.1s to 60.0s	0.0	☆
296.	F9.05	Data Log	**Ones Digit:** MODBUS 0: Non-standard MODBUS protocol 1: Standardized MODBUS protocol **Tens Digit:** Profibus-DP 0: PP01 format 1: PP02 format 2: PP03 format 3: PP05 format	31	☆
297.	F9.06	Resolution for Current	0: 0.01A 1: 0.1A	0	☆
298.	F9.07	Interface Type	0: Modbus interface (integrated) 1: Profibus expansion card 2: Reserved 3: CANlink expansion card	0	☆

6.1.12 FA Group – Torque Control Parameters

No.	Code	Designation	Setting Range	Default	Mod.
299.	FA.00	Control Mode	0: Speed control 1: Torque control	0	★
300.	FA.01	Source for Torque Setting	0: Control panel (FA.02) 1: AI1 2: AI2 3: Control panel rotary encoder 4: Pulse 5: Communication interface 6: Minimum (AI1, AI2) 7: Maximum (AI1, AI2) 8: AI3	0	★
301.	FA.02	Torque Value Setting	-200.0% to 200.0%	150%	☆
302.	FA.03	Torque Control Acceleration Time	0.00s to 650.00s	0.00s	☆
303.	FA.04	Torque Control Braking Time	0.00s to 650.00s	0.00s	☆
304.	FA.05	Maximum Frequency in Forward Mode	0.00Hz to F0.19 (maximum frequency)	50.00Hz	☆
305.	FA.06	Maximum Frequency in Reverse Mode	0.00Hz to F0.19 (maximum frequency)	50.00Hz	☆
306.	FA.07	Torque Filter Time	0.00s to 10.00s	0.00s	☆

6.1.13 Fb Group – Control Optimization Parameters

No.	Code	Designation	Setting Range	Default	Mod.
307.	Fb.00	Fast Response to Overcurrent	0: Inactive 1: Active	1	☆
308.	Fb.01	Measuring Point for Undervoltage	50.0% to 140.0%	100.0%	☆
309.	Fb.02	Measuring Point for Overvoltage	200.0V to 2500.0V	810V	☆
310.	Fb.03	Dead Zone Compensation	0: Inactive 1: Compensation mode 1 2: Compensation mode 2	1	☆
311.	Fb.04	Current Compensation	0 to 100	5	☆
312.	Fb.05	Vector Optimization Without Encoder	0: Inactive 1: Mode 1 2: Mode 2	1	☆
313.	Fb.06	Frequency for Switching the Pulse Width Modulation (PWM) Stages	0.00Hz to 15.00Hz	12.00Hz	☆
314.	Fb.07	Tyoe of PWM Below 85Hz	0: Asynchronous below 85Hz 1: Synchronous across entire frequency range	0	☆
315.	Fb.08	Random PWM Depth	0: Inactive 1 to 10: Modulation depth	0	☆
316.	Fb.09	Dead Zone Time	100% to 200%	150%	★

6.1.14 FC Group – Extended Function Parameters

No.	Code	Designation	Setting Range	Default	Mod.
317.	FC.00	Reserved			
318.	FC.01	Link Factor	0.00 to 10.00	0	☆
319.	FC.02	PID Start Deviation	0.0 to 100.0	0	☆

6.1.15 E0 Group – Oscillation and Counting Functions

No.	Code	Designation	Setting Range	Default	Mod.
320.	E0.00	Oscillation Mode	0: Relative to the current setpoint frequency 1: Relative to the maximum frequency	0	☆
321.	E0.01	Oscillation Range	0.0% to 100.0%	0.0%	☆
322.	E0.02	Skip Frequency with Oscillation	0.0% to 50.0%	0.0%	☆
323.	E0.03	Duration of an Oscillation Cycle	0.1s to 3000.0s	10.0s	☆
324.	E0.04	Rise Time Coefficient	0.1% to 100.0%	50.0%	☆
325.	E0.05	Target Length	0m to 65535m	1000m	☆
326.	E0.06	Current Length	0m to 65535m	0m	☆
327.	E0.07	Pulse per Meter	0.1 to 6553.5	100.0	☆
328.	E0.08	Upper Limit Count Value	1 to 65535	1000	☆
329.	E0.09	Lower Limit Count Value	1 to 65535	1000	☆
330.	E0.10	Pulse Count Value for Reduced Frequency	0: Inactive 1 to 65535	0	☆
331.	E0.11	Frequency for Reduction	0.00Hz to F0.19 (maximum frequency)	5.00Hz	☆

6.1.16 E1 Group – Multi-Speed / Simple PLC Operation

No.	Code	Designation	Setting Range	Default	Mod.
332.	E1.00	Speed 0X	-100.0% to 100.0%	0.0%	☆
333.	E1.01	Speed 1X	-100.0% to 100.0%	0.0%	☆
334.	E1.02	Speed 2X	-100.0% to 100.0%	0.0%	☆
335.	E1.03	Speed 3X	-100.0% to 100.0%	0.0%	☆
336.	E1.04	Speed 4X	-100.0% to 100.0%	0.0%	☆
337.	E1.05	Speed 5X	-100.0% to 100.0%	0.0%	☆
338.	E1.06	Speed 6X	-100.0% to 100.0%	0.0%	☆
339.	E1.07	Speed 7X	-100.0% to 100.0%	0.0%	☆

340.	E1.08	Speed 8X	-100.0% to 100.0%	0.0%	☆
341.	E1.09	Speed 9X	-100.0% to 100.0%	0.0%	☆
342.	E1.10	Speed 10X	-100.0% to 100.0%	0.0%	☆
343.	E1.11	Speed 11X	-100.0% to 100.0%	0.0%	☆
344.	E1.12	Speed 12X	-100.0% to 100.0%	0.0%	☆
345.	E1.13	Speed 13X	-100.0% to 100.0%	0.0%	☆
346.	E1.14	Speed 14X	-100.0% to 100.0%	0.0%	☆
347.	E1.15	Speed 15X	-100.0% to 100.0%	0.0%	☆
348.	E1.16	PLC Program Operating Mode	0: Stop after running a single program cycle 1: Continue operation after a single program cycle has been completed 2: Repeat program	0	☆
349.	E1.17	Memory Function for Program Operation	**Ones Digit:** Behavior upon Power-Down 0: Power-down without saving 1: Save **Tens Digit:** Behavior upon Stop 0: Stop without saving 1: Save	11	☆
350.	E1.18	Segment Runtime T0 for Segment 0X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
351.	E1.19	Acceleration/Braking Time Group for Segment 0X	0 to 3	0	☆
352.	E1.20	Segment Runtime T1 for Segment 1X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
353.	E1.21	Acceleration/Braking Time Group for Segment 1X	0 to 3	0	☆
354.	E1.22	Segment Runtime T2 for Segment 2X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
355.	E1.23	Acceleration/Braking Time Group for Segment 2X	0 to 3	0	☆
356.	E1.24	Segment Runtime T3 for Segment 3X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆

357.	E1.25	Acceleration/Braking Time Group for Segment 3X	0 to 3	0	☆
358.	E1.26	Segment Runtime T4 for Segment 4X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
359.	E1.27	Acceleration/Braking Time Group for Segment 4X	0 to 3	0	☆
360.	E1.28	Segment Runtime T5 for Segment 5X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
361.	E1.29	Acceleration/Braking Time Group for Segment 5X	0 to 3	0	☆
362.	E1.30	Segment Runtime T6 for Segment 6X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
363.	E1.31	Acceleration/Braking Time Group for Segment 6X	0 to 3	0	☆
364.	E1.32	Segment Runtime T7 for Segment 7X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
365.	E1.33	Acceleration/Braking Time Group for Segment 7X	0 to 3	0	☆
366.	E1.34	Segment Runtime T8 for Segment 8X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
367.	E1.35	Acceleration/Braking Time Group for Segment 8X	0 to 3	0	☆
368.	E1.36	Segment Runtime T9 for Segment 9X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
369.	E1.37	Acceleration/Braking Time Group for Segment 9X	0 to 3	0	☆
370.	E1.38	Segment Runtime T10 for Segment 10X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
371.	E1.39	Acceleration/Braking Time Group for Segment 10X	0 to 3	0	☆
372.	E1.40	Segment Runtime T11 for Segment 11X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆

373.	E1.41	Acceleration/Braking Time Group for Segment 11X	0 to 3	0	☆
374.	E1.42	Segment Runtime T12 for Segment 12X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
375.	E1.43	Acceleration/Braking Time Group for Segment 12X	0 to 3	0	☆
376.	E1.44	Segment Runtime T13 for Segment 13X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
377.	E1.45	Acceleration/Braking Time Group for Segment 13X	0 to 3	0	☆
378.	E1.46	Segment Runtime T14 for Segment 14X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
379.	E1.47	Acceleration/Braking Time Group for Segment 14X	0 to 3	0	☆
380.	E1.48	Segment Runtime T15 for Segment 15X	0.0s (h) to 6500.0s (h)	0.0s (h)	☆
381.	E1.49	Acceleration/Braking Time Group for Segment 15X	0 to 3	0	☆
382.	E1.50	Time Unit of Segment Runtimes	0: S (seconds) 1: H (hours)	0	☆
383.	E1.51	Source for Segment 0X	0: E1.00 1: AI1 2: AI2 3: Control panel rotary encoder 4: High-frequency pulse 5: PID setpoint 6: Target frequency (F0.01) 7. AI3	0	☆

6.1.17 E2 Group – PID Function

No.	Code	Designation	Setting Range	Default	Mod.
384.	E2.00	Source for PID Setpoint	0: E2.01 1: AI1 2: AI2 3: Panel rotary encoder 4: High-frequency pulse 5: Communications interface 6: E1.00 to E1.15 via terminals 7: AI3	0	☆
385.	E2.01	PID Setpoint	0.0% to 100.0%	50.0%	☆
386.	E2.02	Source for PID Feedback Variable	0: AI1 1: AI2 2: Panel rotary encoder 3: AI1 – AI2 reference 4: High-frequency pulse 5: Communications interface 6: AI1 + AI2 reference 7: MAX (|AI1|, |AI2|) reference 8: MIN (|AI1|, |AI2|) reference 9: AI3	0	☆
387.	E2.03	PID Behavior	0: Positive 1: Negative	0	☆
388.	E2.04	PID Value Range	0 to 65535	1000	☆
389.	E2.05	PID Reverse Frequency Limit	0.00 to F0.19	0.00Hz	☆
390.	E2.06	PID Deviation Limit	0.0% to 100.0% See also E2.29.	2.0%	☆
391.	E2.07	PID Differential Component Limit	0.00% to 100.00%	0.10%	☆
392.	E2.08	PID Setting Time	0.00s to 650.00s	0.00s	☆
393.	E2.09	Filter Time Feedback Variable	0.00s to 60.00s	0.00s	☆
394.	E2.10	Filter Time Manipulated Variable	0.00s to 60.00s	0.00s	☆

395.	E2.11	Loss Detection of the PID Feedback Signal	0.0%: No monitoring 0.1% to 100.0%	0.0%	☆
396.	E2.12	Time Until Loss Detection	0.0s to 20.0s	0.0s	☆
397.	E2.13	Proportional Gain KP1	0.0 to 200.0	80.0	☆
398.	E2.14	Integration Time Ti1	0.01s to 10.00s	0.50s	☆
399.	E2.15	Differential Time Td1	0.00s to 10.000s	0.000s	☆
400.	E2.16	Proportional Gain KP2	0.0 to 200.0	20.0	☆
401.	E2.17	Integration Time Ti2	0.01s to 10.00s	2.00s	☆
402.	E2.18	Differential Time Td2	0.00 to 10,000	0.000s	☆
403.	E2.19	Switching PID Parameter Groups	0: No switching 1: Switching via digital input (DI) terminals 2: Automatic switching depending on deviation	0	☆
404.	E2.20	PID Deviation for Group 1	0.0% to E2.21	20.0%	☆
405.	E2.21	PID Deviation for Group 2	E2.20 to 100.0%	80.0%	☆
406.	E2.22	PID Integral Settings	**Ones Digit:** Separation I-Component 0: Inactive 1: Active **Tens Digit:** I-Component stops when maximum/ minimum PID value is reached 0: Inactive 1: Active	00	☆
407.	E2.23	PID Start Value	0.0% to 100.0%	0.0%	☆
408.	E2.24	Waiting Time After Start Value	0.00s to 360.00s	0.00s	☆
409.	E2.25	Maximum Deviation in FWD Mode	0.00% to 100.00%	1.00%	☆
410.	E2.26	Maximum Deviation in REV Mode	0.00% to 100.00%	1.00%	☆
411.	E2.27	Behavior of the PID Controller in Stop State	0: Stop calculation at STOP signal 1: Continue calculation at STOP signal	1	☆
412.	E2.28	Reserved			

413.	E2.29	Automatic Frequency Reduction	0: Inactive 1: Active (recommended: E2.06=0)	1	☆
414.	E2.30	PID Frequency Limit Value	0.00Hz to F0.19	25	☆
415.	E2.31	Time Between Measurements	0s to 3600s	10	☆
416.	E2.32	Number of Measurements	10 to 500	20	☆

6.1.18 E3 Group – Virtual DI, Virtual DI

No.	Code	Designation	Setting Range	Default	Mod.
417.	E3.00	VDI1 Function	0 to 51	0	★
418.	E3.01	VDI2 Function			
419.	E3.02	VDI3 Function			
420.	E3.03	VDI4 Function			
421.	E3.04	VDI5 Function			
422.	E3.05	VDI Toggle	**Ones Digit:** VDI1 **Tens Digit:** VDI2 **Hundreds Digit:** VDI3 **Thousands Digit:** VDI4 **Ten-Thousands Digit:** VDI5 0: Inactive 1: Active	00000	☆
423.	E3.06	VDI Terminal Status Source	**Ones Digit:** VDI1 **Tens Digit:** VDI2 **Hundreds Digit:** VDI3 **Thousands Digit:** VDI4 **Ten-Thousands Digit:** VDI5 0: Determination of status by VDO terminal 1: Determination of status by parameter E3.05	11111	★
424.	E3.07	Assign Analog Input AI1 with DI Function	0 to 51	0	★
425.	E3.08	Assign Analog Input AI2 with DI Function	0 to 51	0	★

426.	E3.09	Assign Analog Input AI3 with DI Function	0 to 51	0	★
427.	E3.10	Switch High-Active/ Low-Active for AI-as-DI Terminals	**Ones Digit:** AI1 0: High-active 1: Low-active **Tens Digit:** AI2 (0 to 1,same as ones digit) **Hundreds Digit:** AI3 (0 to 1; same as ones digit)	000	★
428.	E3.11	VDO1 Function	0 to 40	0	☆
429.	E3.12	VDO2 Function	0 to 40	0	☆
430.	E3.13	VDO3 Function	0 to 40	0	☆
431.	E3.14	VDO4 Function	0 to 40	0	☆
432.	E3.15	VDO5 Function	0 to 40	0	☆
433.	E3.16	Switch High-Active/ Low-Active for VDO Terminals	**Ones Digit:** VDO1 0: Positive logic 1: Negative logic **Tens Digit:** VDO2 (0 to 1, same as above) **Hundreds Digit:** VDO3 (0 to 1, same as above) **Thousands Digit:** VDO4 (0 to 1, see above) **Ten-Thousands Digit:** VDO5 (0 to 1, see above)	00000	☆
434.	E3.17	Delay for VDO1	0.0s to 3600.0s	0.0s	☆
435.	E3.18	Delay for VDO2	0.0s to 3600.0s	0.0s	☆
436.	E3.19	Delay for VDO3	0.0s to 3600.0s	0.0s	☆
437.	E3.20	Delay for VDO4	0.0s to 3600.0s	0.0s	☆
438.	E3.21	Delay for VDO5	0.0s to 3600.0s	0.0s	☆

6.1.19 b0 Group – Motor Parameters

No.	Code	Designation	Setting Range	Default	Mod.
439.	b0.00	Motor Type	0: All common three-phase asynchronous motors 1: Three-phase asynchronous motor especially for frequency inverters 2: Permanently excited synchronous motor (b0.27 to b0.28 required)	0	★
440.	b0.01	Rated Power	0.1 to 1000.0kW	Depends on Model	★
441.	b0.02	Rated Voltage	1 to 2000V	Depends on Model	★
442.	b0.03	Rated Current	0.01 to 655.35A/6553.5A	Depends on Model	★
443.	b0.04	Rated Frequency	0.01Hz to F0.19	Depends on Model	★
444.	b0.05	Rated Speed	1 to 36000 rpm	Depends on Model	★
445.	b0.06	Stator Resistance Asynchronous Motor	0.001 to 65.535Ω (≤55kW) 0.0001 to 6.5535Ω (>55kW)	Depends on Model	★
446.	b0.07	Rotor Resistance Asynchronous Motor	0.001 to 65.535Ω (≤55kW) 0.0001 to 6.5535Ω (>55kW)	Depends on Model	★
447.	b0.08	Leakage Inductance Asynchronous Motor	0.01 to 655.35mH (≤55kW) 0.001 to 65.535mH (>55kW)	Depends on Model	★
448.	b0.09	Counter-Inductance Asynchronous Motor	0.1 to 6553.5mH (≤55kW) 0.01 to 655.35mH (>55kW)	Depends on Model	★
449.	b0.10	No-Load Current Asynchronous Motor	0.01A to b0.03 (≤55kW) 0.1A to b0.03 (>55kW)	Depends on Model	★
450.	b0.11	Stator Resistance Synchronous Motor	0.001 to 65.535Ω (≤55kW) 0.0001 to 6.5535Ω (>55kW)	–	★
451.	b0.12	Inductance D-Axis Synchronous Motor	0.01 to 655.35mH (≤55kW) 0.001 to 65.535mH (>55kW)	–	★

452.	b0.13	Inductance Q-Axis Synchronous Motor	0.01 to 655.35mH (≤55kW) 0.001 to 65.535mH (>55kW)	–	★
453.	b0.14	Counter-EMF Coefficient for Synchronous Motor	0.1 to 6553.5V	–	★
454.	b0.15 to b0.26	Reserved			
455.	b0.27	Automatic Calibration of Motor Parameters	0: Inactive 1: Asynchronous motor with load 2: Asynchronous motor without load 11: Synchronous motor with load 12: Synchronous motor without load	0	★
456.	b0.28	Encoder Type	0: ABZ incremental encoder 1: UVW incremental encoder 2: Rotary transformer 3: Sine and cosine encoder 4: UVW encoder	0	★
457.	b0.29	Number of Pulses per Revolution	1 to 65535	2500	★
458.	b0.30	Pole Wheel Angle	0.0° to 359.9°	0.00	★
459.	b0.31	AB Phase Sequence	0: Forward 1: Reverse	0	★
460.	b0.32	UVW Encoder Zero Angle	0.0° to 359.9°	0.0	★
461.	b0.33	UVW Phase Sequence	0: Forward 1: Backwards	0	★
462.	b0.34	Encoder Signal Monitoring Time Threshold	0.0s: Inactive 0.1s to 10.0s	0.0s	★
463.	b0.35	Number of Pole Pairs of the Rotation Encoder	1 to 65535	1	★

6.1.20 y0 Group – System Parameters

No.	Code	Designation	Setting Range	Default	Mod.
464.	y0.00	Parameter Initialization	0: No function 1: Reset to factory settings (not including motor parameters) 2: Delete runtime data 3: Reset to factory settings (including motor parameters) 4: Save current parameter set 501: Restore user backup parameters 10: Delete the control panel memory 11: Upload current parameter set to control panel memory location 1 12: Upload current parameter set to control panel memory location 2 21: Download parameter set from control panel memory location 1 22: Download parameter set from control panel memory location 2	0	★
465.	y0.01	User Password	0 to 65535	0	☆
466.	y0.02	Display Settings for Function Parameters	**Ones Digit:** Group d 0: Do not display 1: Display **Tens Digit:** Group E **Hundreds Digit:** Group b **Thousands Digit:** Group y1 **Ten-Thousands Digit:** Group L	11111	★
467.	y0.03	Display Settings for User-Defined Parameters	**Ones Digit:** Reserved **Tens Digit:** User Parameters 0: Do not display 1: Display	00	☆
468.	y0.04	Function Parameters Modifiable	0: Modifiable 1: Not modifiable	0	☆

6.1.21 y1 Group – Error Memory

<table>
<tr><th>No.</th><th>Code</th><th>Designation</th><th>Setting Range</th><th>Default</th><th>Mod.</th></tr>
<tr><td>469.</td><td>y1.00</td><td>Error Type in Error Memory 1</td><td rowspan="3">0: No error
1: Inverter protection function
2: Overcurrent during acceleration
3: Overcurrent during braking
4: Overcurrent at constant speed
5: Overvoltage acceleration
6: Overvoltage brake supply
7: Overvoltage at constant speed
8: Control voltage error
9: Undervoltage
10: Inverter overload
11: Motor overload
12: Input phase loss
13: Output phase loss
14: Overheating
15: External error
16: Communication error
17: Contactor error
18: Current measurement error
19: Calibration faulty
20: Error encoder card
21: Parameter memory error
22: Hardware error
23: Short circuit on motor
24/25: Reserved
26: Operating time reached
27: User-defined 1
28: User-defined 2
29: Standby time reached
30: Load loss
31: PID feedback signal loss
40: Current limit
41: Motor changeover
42: Speed dev.
43: Overspeed
45: Motor overheating
51: Position error (start)
COF: Communication error</td><td>–</td><td>●</td></tr>
<tr><td>470.</td><td>y1.01</td><td>Error Type in Error Memory 2</td><td>–</td><td>●</td></tr>
<tr><td>471.</td><td>y1.02</td><td>Error Type in Error Memory 3</td><td>–</td><td>●</td></tr>
</table>

472.	y1.03	Frequency in Error Memory 3 (most recent)	–	–	•
473.	y1.04	Current in Error Memory 3	–	–	•
474.	y1.05	DC Link Voltage in Error Memory 3	–	–	•
475.	y1.06	Input Terminal Status in Error Memory 3	–	–	•
476.	y1.07	Output Terminal Status in Error Memory 3	–	–	•
477.	y1.08	Reserved			
478.	y1.09	Power-On Time in Error Memory 3	–	–	•
479.	y1.10	Operating Time in Error Memory 3	–	–	•
480.	y1.11	Reserved			
481.	y1.12	Reserved			
482.	y1.13	Frequency in Error Memory 2	–	–	•
483.	y1.14	Current in Error Memory 2	–	–	•
484.	y1.15	DC Link Voltage in Error Memory 2	–	–	•
485.	y1.16	Input Terminal Status in Error Memory 2	–	–	•
486.	y1.17	Output Terminal Status in Error Memory 2	–	–	•
487.	y1.18	Reserved			
488.	y1.19	Power-On Time in Error Memory 2	–	–	•
489.	y1.20	Operating Time in Error Memory 2	–	–	•
490.	y1.21	Reserved			

491.	y1.22	Reserved			
492.	y1.23	Frequency in Error Memory 1 (oldest)	–	–	●
493.	y1.24	Current in Error Memory 1	–	–	●
494.	y1.25	DC Link Voltage in Error Memory 1	–	–	●
495.	y1.26	Input Terminal Status in Error Memory 1	–	–	●
496.	y1.27	Output Terminal Status in Error Memory 1	–	–	●
497.	y1.28	Reserved			
498.	y1.29	Power-On Time in Error Memory 1	–	–	●
499.	y1.30	Operating Time in Error Memory 1	–	–	●

6.2 Function Parameter Description

6.2.1 Basic Monitoring Parameters: d0.00 to d0.41

The d0 parameters contain operating information of the frequency inverter such as the current frequency of the motor or the currently set target frequency. The information can be shown on the control panel display during operation or sent to a PC via the communication interface. The following table describes the individual parameters and their units.

Function Code	Name	Unit
d0.00	Motor Frequency (Hz)	0.01Hz
The motor frequency is the actual frequency currently present at the output of the frequency inverter. The resolution depends on the setting in F0.02.		
d0.01	Target Frequency (Hz)	0.01Hz
The target frequency is the currently active target frequency. It can be set in the range between the minimum and maximum frequency.		
d0.02	DC Link Voltage (V)	0.1V
The DC voltage currently measured in the DC link of the inverter is displayed.		

d0.03	Output Voltage (V)	1V

Indicates the effective value of the voltage currently present at the output of the inverter.

d0.04	Output Current (A)	0.01A

Indicates the effective value of the current flowing.

d0.05	Output Power (kW)	0.1kW

Displays the value of the output power calculated from the current and voltage.

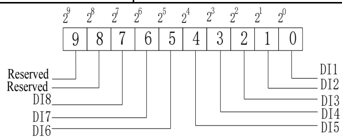
d0.06	Motor Torque (%)	0.1%

The torque currently applied to the motor is displayed as a percentage of the nominal motor torque.

d0.07	Digital Input (DI) Status	–

The digital inputs' status is displayed as a hexadecimal number. The status of each individual digital input can be 0.

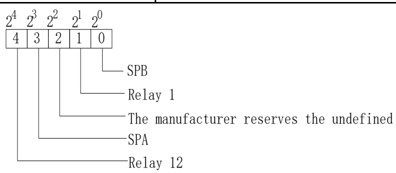
0 to 10 bits	Input terminal status
0	Inactive
1	Active



d0.08	Digital Output (DO) Status	–

The status of the digital outputs is displayed as a hexadecimal number, which is derived from the status of the individual outputs (0 or 1).

0 to 10 bits	Output terminal status
0	Invalid
1	Valid



d0.09	AI1 Voltage (V)	0.01V

Current voltage between terminals AI1 and GND.

d0.10	AI2 Voltage (V)	0.01V
Current voltage between terminals AI2 and GND.		
d0.11	AI3 Voltage (V)	0.01V
Current voltage between terminals AI3 and GND.		
d0.12	Current Counter Value of the Pulse Input	-
–		
d0.13	Length Currently Counted at the Pulse Input	-
d0.13 = E0.06 = (d0.12 × E0.07).		
d0.14	Motor Speed	-
Current calculated speed of the motor, see F6.04.		
d0.15	PID Setpoint	%
Value of the currently set PID setpoint in percent of the maximum value, scaled with E2.04.		
d0.16	PID Feedback	%
Value of the feedback variable in % of the maximum (depending on the external wiring), scaled with E2.04. (Default Setting: E2.04 = 1000 = 100.0%)		
d0.17	PLC Stage	-
Stage display when PID program is running		
d0.18	Input Frequency of the Pulse Input DI5	0.01kHz
Up to max. 100kHz.		
d0.19	Current Speed from Encoder Card	0.1Hz 0.01Hz
Unit depends on F0.02.		
d0.20	Remaining Run Time	0.1Min
Remaining run time display, it is for timing run control		
d0.21	Remaining Operating Time with Time Control	1Min
–		
d0.22	Current Power-On Time	1Min
Total time of current inverter power-on.		

d0.23	Current Runtime	0.1Min
Total time of current run cycle.		
d0.24	Input Frequency of Pulse Input DI5	1Hz
Up to max. 65535Hz.		
d0.25	Control Value via Remote Control	0.01%
For remote control of the frequency inverter via PC or PLC, the percentage of the reference value of the control signal for frequency, torque or other is displayed here.		
d0.26	Encoder Feedback Speed	0.01Hz
PG feedback speed, to an accuracy of 0.01hz		
d0.27	Specified Frequency by Parameter F0.03 (Master Frequency)	0.01Hz
Frequency set by F0.03 master frequency setting source, unit: 0.1Hz/0.01Hz depending on F0.02		
d0.28	Specified Frequency by Parameter F0.04 (Additional Frequency)	0.01Hz
Frequency set by F0.04 auxiliary frequency setting source, unit depending on F0.02 (see above)		
d0.29	Current Specified Torque (%)	0.1%
Display the set target torque under torque control mode		
d0.30	Reserved	
Reserved		
d0.31	Synchronous Machine: Position of the Rotor	0.0°
Current position angle of synchronous motor rotor		
d0.32	Rotor Position of the Rotary Transformer at PG Card Position ABZ	–
Rotor position when rotary transformer is used as a speed feedback. AB pulse count value from the current ABZ or UVW encoder on the PG card.		
d0.33	AB Pulse Count Value from the Current ABZ or UVW Encoder on the PG Card	0
Displays AB phase pulse count of the current ABZ or UVW encoder.		
d0.34	Z Signal Counter	–
Displays Z phase pulse count of the current ABZ or UVW encoder.		
d0.35	Frequency Inverter Status	–
The current operating status of the frequency inverter is displayed. The output format of the data is as follows:		

Bit 1 and Bit 0:
- 00: Stop
- 01: Forward
- 10: Reverse

Bit 3 and Bit 2:
- 00: Constant
- 01: Acceleration
- 10: Braking

Bit 4:
- 0: Bus Voltage Normal
- 1: Undervoltage

d0.36	Inverter Type	–
Displays the type of inverter model (G or F).		
d0.37	AI1 Voltage Before Correction	0.001V
d0.38	AI2 Voltage Before Correction	0.001V
d0.39	AI3 Voltage Before Correction	0.001V
d0.40	Reserved	
d0.41	Motor Temperature Monitoring	1°C
Signal from the optional motor temperature sensor PT100, must be connected to S1/S2.		

6.2.2 Basic Function Group: F0.00 to F0.27

The basic parameter group includes all the main parameters such as the target frequency, operating mode and control modes for frequencies etc.

Code	Parameter Name	Default	Mod.
F0.00	Motor Control	2	★

The frequency inverter offers three different types of motor control. Depending on use case, you can choose between vector control and V/f control: with vector control, the motor must be calibrated using b0.27 and the inverter rated power must not be more than two steps higher or one step lower than the motor rated power, otherwise interference may occur.

Above a frequency of 300Hz, the quality of the vector control decreases; use at more than 400Hz is not recommended.

0: Vector Control Without PG Card (Open Loop)

Vector control without an encoder card (open loop) is suitable for high-performance applications in which the frequency inverter only controls one motor.

1: Vector Control with PG Card (Closed Loop)

To implement vector control with an encoder card, a pulse/position encoder and the appropriate encoder card for the frequency inverter are required (12V or 24V). This is particularly suitable for very precise speed or torque control of the motor. Please note that the inverter can only control one motor.

2: V/f Control

The V/f control mode is somewhat less precise than the two types of vector control. It is suitable for all common three-phase asynchronous motors, pumps and fans. Several motors can be operated on one frequency inverter, but switchovers are not permitted during operation. It is not absolutely necessary to calibrate the motor data using b0.27.

F0.01	Target Frequency	50.00Hz	☆

Range: 0.00Hz to F0.19 (maximum frequency)

If the frequency control of the frequency inverter F0.03/4 is set to the control panel, the desired target frequency can be entered here. It can be set in a range between 0Hz and the maximum frequency F0.19. If a value above 50.00Hz is to be configured here, the maximum output frequency F0.19 and the upper limit frequency F0.21 must first be increased accordingly. Although a value greater than F0.21 can be entered here, this will be capped at d0.01 when it is transferred to the active setpoint memory. With digital control of the frequency and when modifying the frequency with the "Up" and "Down" buttons on the control panel, the frequency set here serves as the starting value.

F0.02	Frequency Resolution	2	★

The frequency resolution is responsible for regulating the setting accuracy for all parameters that contain a frequency. It also affects d0.00 to d0.01, d0.19 and d0.27 to d0.28.

1: 0.1Hz

If 0.1Hz is selected as the resolution, the maximum output frequency of the ST500 frequency inverter is 3200.0Hz

2: 0.01Hz

If 0.01Hz is selected as the resolution, the maximum output frequency is 320.00Hz

Note: If this parameter is changed, **all frequency-related parameters except d0.26** are also changed and shifted accordingly by a power of ten. **Example:** If this parameter is set to the value 1 for a frequency inverter with factory settings, the target frequency in parameter F0.01 changes from 50.00Hz to 500.0Hz.

F0.03	Frequency Control Source	1	★

The frequency inverter offers ten possible settings as a control source for the frequency. for example, the input voltage at the analog terminals or the control panel rotary encoder can be selected as the source. Each value can only be used once in F0.03 or F0.04; the value in the other parameter is skipped during selection. The offset set in function 0 or 1 with the "Up" and "Down" buttons can be reset with input function 19 or function 4 of the QUICK button (F6.21).

0: Control Panel (F0.01), Without Saving After Power-Off

The frequency is specified by the value in parameter F0.01. The "Up" and "Down" buttons on the control panel of the frequency inverter, and the terminal functions 6 and 7 can be used to modify the frequency. After the frequency inverter is powered off, the last set value is not saved but is reset to the value F0.01.

1: Control Panel (F0.01), Saving After Power-Off

Same as above, however, after the frequency inverter is switched off, the last set frequency is used by saving the offset to parameter F0.01. It should be noted here that the term "power-off" refers to disconnecting the frequency inverter from the mains voltage, but not to stopping the motor. To save the offset when the motor is stopped, see F0.09.

2: Analog Input AI1

The analog voltage applied between terminals AI1 and GND is used to set the frequency. The configuration is made in F1.12 to F1.25. This setting should be used if an external potentiometer is to be used for frequency control. The input voltage range here is 0V to 10V or 0mA to 20mA. To switch between voltage and current measurement, the AI1 jumper on the inverter control card must be changed. The analog input is set to voltage measurement at the factory.

3: Analog Input AI2

Essentially the same function as Setting 2, except that the voltage between terminals AI2 and GND is used. The corresponding jumper on the control card of the frequency converter is AI2. This is set to current measurement at the factory.

4: Panel Rotary Encoder

The virtual potentiometer on the control panel of the inverter is used as the frequency source. It should be noted that the "stop" of the digital potentiometer refers to F0.19, but the set value may be limited to F0.21 while the rotary encoder continues to run. This could lead to confusion if the rotary encoder is to be turned back again and does not appear to react at first because the excess must first be reduced, but the acceleration from the digital encoder is only high enough for this after a few revolutions. Therefore, F1.42 is now preset to 0.5%, which results in a step width of 1Hz.

5: High-Frequency Pulse

Here, the frequency is specified by a pulse signal in that its frequency forms a quasi-analog value, which is converted into a percentage value as with the analog inputs. It should be noted that only DI5 can be used as a pulse input (F1.04=30). The input voltage range is 9V to 30V with a frequency range of 0kHz to 100kHz. The settings for the frequency dependence on the pulse can be modified in parameters F1.26 to F1.29.

6: Multi-Speed Operation

When controlling the frequency using multiple speeds, digital inputs can be used to specify different fixed frequencies to the inverter. Up to 16 speeds can be programmed, which can then be selected using combinations of the digital inputs. The frequencies can be defined in parameter group E1. In order for a digital input to be used for multiple speeds, the "Multi-Speed Input" function must be configured for the digital input in parameter group F1.

7: Simple PLC Program

In this mode, the frequency inverter can be programmed with up to 16 different program sections. Acceleration and braking times can be determined individually for each section. The corresponding parameters can be found in parameter group E1.

8: PID Control

In PID control, the output frequency is controlled by the PID process controller of the frequency converter. PID control is usually used for constant pressure control or other "closed loop" processes, whereby an external sensor or similar is used as a feedback variable. The PID parameters are located in parameter group E2.

9: Specification via Remote Control

The frequency inverter supports several types of remote control such as RS485 with MODBUS protocol. To be able to use a different interface, the relevant expansion card must be installed. The communication parameters are stored in parameter group F9.

10: Analog Input AI3

Functions in the same way as AI1/AI2, except that the voltage is used between terminals AI3 and GND. Input AI3 has a voltage range of -10V to +10V.

F0.04	Additional Frequency Control Source	0	★

0: Control Panel (F0.01), Without Saving After Power-Off
1: Control Panel (F0.01), Saving After Power-Off
2: Analog Input AI1
3: Analog Input AI2
4: Control Panel Rotary Encoder
5: High-Frequency Pulse
6: Multi-Speed Operation
7: Simple PLC Program
8: PID Control
9: Specification via Remote Control
10: Analog Input AI3

The additional frequency is a second frequency setting that can be used to control the reference frequency in certain cases, depending on the parameterization. The functions of the possible parameter values are identical to F0.03. The value entered in F0.03 is skipped when F0.04 is selected.

The following points should be observed when using the additional frequency:

- The reference frequency here is **not** the frequency stored in parameter F0.01! for parameter values 1 and 2, pressing the "Up" and "Down" buttons only changes the main frequency, which uses parameter F0.01 as a reference.
- When using the analog inputs (parameter value 2 or 3), the setting range of the additional frequency can be set using parameters F0.05 and F0.06.
- If the source of the additional frequency is configured to the value 5, the behaviour corresponds to the analog inputs.

Note: the sources of the main frequency and the additional frequency cannot be assigned to the same input, as otherwise no clear control of the frequency is possible.

F0.05	Reference Value for Additional Frequency	0	☆

Here you can specify which frequency value should be used as a reference for the additional frequency if an arithmetic operation is set as the source in F0.07. Parameter F0.06 is used to set the frequency range of the additional frequency.

0: Relative to Maximum Frequency

The maximum output frequency F0.19 is used as a reference.

1: Relative to the Master Frequency Source 1

If control source 1 is selected as the reference, the setting range of the additional frequency changes depending on the main frequency, but is smaller than its setting range.

2: Relative to Master Frequency Source 2

Corresponds to parameter value 1 in the event that the setting range of the additional frequency is greater than that of the main frequency.

F0.06	Frequency Range for Additional Frequency	100%	☆

Range: 0% to 150%

The setting range of the additional frequency can be set here as a percentage of the maximum frequency.

F0.07	Configuration of Main and Additional Frequency	00	☆

The configuration of the main and additional frequency contains settings about the relationship between the two frequencies and their dependencies on each other. for example, arithmetic operations between the two frequencies can be used to determine the target frequency. The configuration word consists of two digits that can be configured. Please note that the assignment via F0.12 has priority.

Ones Digit: Selection of the Source for the Target Frequency

0: Main Frequency

The main frequency is selected as the source of the target frequency and the additional frequency is not selected. The control source of the main frequency is described under parameter F0.03.

1: Arithmetic Operation Between Main and Additional Frequency

To determine the target frequency, an arithmetic operation is used, which can be selected with the tens digit of this parameter.

2: Switching Between Main and Additional Frequency

A digital input can be used to switch between the main frequency and the auxiliary frequency. To do this, a digital input must be configured to function 18. If the state of the input is "0" (inactive), the main frequency is used; if the state is "1" (active), the additional frequency is used.

3: Switching Between Main Frequency and Arithmetic Operation

To switch between the two modes, a digital input must also be connected to the radio control unit. If the state of the input is "0", only the main frequency is used. If the state is "1", the arithmetic operation is used, which is set with the tens digit of this parameter.

4: Switching Between Additional Frequency and Arithmetic Operation

With this setting, either the auxiliary frequency or an arithmetic operation is used. If a digital input is configured with function 18, the state "1" of the input uses the arithmetic operation set with the tens digit of this parameter between the main and auxiliary frequency to determine the target frequency.

Tens Digit: Choice of Arithmetic Operation

0: Sum (Main Frequency + Additional Frequency)

The target frequency is determined from the sum of the two frequencies.

1: Difference (Main Frequency – Additional Frequency)

The target frequency is determined from the difference between the two frequencies.

2: MAX (Master and Auxiliary)

The two frequencies are compared with each other and the larger absolute value is used as the target frequency.

3: MIN (Master and Auxiliary)

Here, the lower absolute value of the two frequencies is used as the target frequency.

4: Product (Main Frequency * Additional Frequency / Maximum Frequency)

With this setting, the product of both frequencies is formed and then divided by the maximum frequency F0.19.

F0.08	Offset for Arithmetic Operation	0.00Hz	☆

Range: 0.00Hz to F.019 (maximum frequency)

This function parameter is only valid if an arithmetic operation has been selected to determine the target frequency. This value is added to the result of the arithmetic operation.

F0.09	Memory Setting for Digitally Controlled Frequency	1	☆

0: Do Not Save

After stopping the motor, the frequency is reset to the value in parameter F0.01.

1: Save

After stopping the motor, the last set frequency is retained.

This parameter is only valid for the frequency control source control panel. Here you can select whether the offset to the frequency in F0.01 set using the control panel buttons or terminal functions 6 and 7 should be retained after the motor is stopped or whether it should be reset.

F0.10	Reference for UP/DOWN Button During Operation	0	★

0: Actual Frequency

The current frequency measured at the output of the inverter is used as a reference.

1: Target Frequency

The currently active target frequency is used as a reference.

This parameter is only valid if the frequency is controlled using the control panel (F0.03 or F0.04 is 0 or 1). The parameter determines which frequency is to be used as a reference for frequency changes when the up/down buttons on the control panel or the up/down buttons on the control panel are used. If the actual frequency is the same as the target frequency, there is no difference. There is a difference between the two settings if the actual frequency is not equal to the target frequency. This occurs during braking and acceleration processes.

F0.11	Command Source Selection	0	☆

The parameter determines how various functions of the frequency inverter such as start, stop, forward, reverse etc. are to be controlled.

0: Keypad Control ("LOCAL / REMOTE" LED off)

The control panel (keypad) is used to control the inverter.

1: Terminal Control ("LOCAL / REMOTE" LED on)

Allows the frequency inverter to be controlled via the terminal block.

2: Control via Communication Interface ("LOCAL / REMOTE" LED flashes)

The frequency inverter can be controlled, for example, by a PC or other device using a communication interface.

3: Control Panel + Communication Interface

The frequency inverter accepts commands from both the control panel and the communication interface.

4: Control Panel + Terminals + Communication Interface

Commands are accepted from all three sources.

F0.12	Linking the Frequency Source and Control Source	000	☆

Ones Digit: Selection of the Frequency Source for Keypad Control

0: No link to control source

1: Control Panel (F0.01), Without Saving After Power-Off

2: Analog Input AI1

3: Analog Input AI2

4: Control Panel Rotary Encoder

5: High-Frequency Pulse

6: Multi-Speed Operation

7: Simple PLC Program

8: PID Control

9: Specification via Remote Control

Tens Digit: Selection of the Frequency Source for Terminal Control

0 to 9; same as the ones digit

Hundreds Digit: Selection of the Frequency Source for Communication Interface

0 to 9; same as the ones digit

This parameter can be used to link the frequency sources from parameter F0.03 directly to a control source. The source for the frequency is automatically selected according to which control source is used to start the ST500. The function descriptions of the individual frequency sources are listed in parameter F0.03. This function has priority over the frequency source settings in F0.03/04/07, e.g. F0.07=02 with DI function 18.

F0.13	Acceleration Time 1	-	☆

Range: 0.00s to 6500.00s

The acceleration time specifies the time in seconds that the frequency inverter requires to accelerate from 0Hz to the target frequency. The target frequency to be used for acceleration can be set in parameter F0.16. The ST500 frequency inverter can save a total of four different acceleration times, which can be selected via the digital input functions 16 and 17 or via the multiple speeds. The three other times can be found in parameters F7.08, F7.10 and F7.12.

F0.14	Braking Time 1	-	☆

Range: 0.00s to 6500.00s

The braking time specifies the time required by the frequency inverter to brake from the target frequency to 0Hz. Here too, the reference for the target frequency is set in parameter F0.16. Analogous to the three other acceleration times, the corresponding braking times can be found in parameters F7.09, F7.11 and F7.13.

F0.15	Time Unit for F0.13 and F0.14	1	★

0: 1 second (Range: 0s to 65000s)
1: 0.1 second (Range: 0.0s to 6500.0s)
2: 0.01 second (Range: 0.00s to 650.00s)

The time unit can be adjusted for the various braking and acceleration times in order to be able to set longer times or to set the times even more precisely. When changing this parameter, please note that the display and the times in all braking and acceleration parameters (including F7.08 to F7.13) change automatically.

F0.16	Reference Frequency for Acceleration/Braking Time	0	★

0: Maximum Frequency (F0.19)
The maximum frequency is used as a reference. The actual acceleration and braking times change by the ratio of the target frequency to the maximum frequency.

1: Target Frequency
With this setting, it should be noted that the target frequency can change depending on the defined frequency source. This means that the times are not dependent on the target frequency set by the user, but the forces that occur can vary greatly. Therefore, use this setting with caution.

2: 100Hz
The reference frequency is set to 100Hz fixed.

All acceleration and braking times refer to the reference frequency set in this parameter (i.e. the time required to reach this frequency from zero, or vice versa).

F0.17	Carrier Frequency Adjustment for Temperature Changes	0	☆

0: Inactive
1: Active

The automatic adjustment of the carrier frequency of the PWM of the frequency inverter depending on the temperature of the heat sink is used for heat protection. As the temperature rises, the carrier frequency is automatically reduced to counteract further heating of the frequency inverter. If the temperature drops again, the carrier frequency is also increased again up to the value set in F0.18.

F0.18	Carrier Frequency	-	☆

Range: 0.5kHz to 16.0kHz

The carrier frequency can be adjusted to counteract any noise development or vibration behavior on the motor. A higher carrier frequency produces a higher quality signal at the output of the frequency inverter and thus reduces the noise and vibrations of the motor. on the other hand, the switching losses within the frequency inverter are higher, which reduces the efficiency of the inverter and thus reduces the output power. The EMC load from the inverter also increases with a higher carrier frequency, and the capacitive leakage current is also increased, which can potentially trigger an RCD. The phenomena just described are reversed if the carrier frequency is reduced.

How a motor behaves at different carrier frequencies varies from motor to motor. The optimum setting can be found here in conjunction with the manufacturer and your own tests. However, it can be said that the higher the power of the motor connected to the inverter, the better the results achieved with a lower carrier frequency. The maximum carrier frequency that can be set here is 16 kHz. The following table is intended as an approximate guideline for finding the correct carrier frequency:

Carrier Frequency	Low → High
Motor Noise	Large → Small
Quality of the Output Signal	Poor → Good
Motor Temperature	High → Low
Inverter Temperature	Low → High
Leakage Current	Small → Large
EMC Load	Small → Large

F0.19	Maximum Output Frequency	50.00Hz	★

Range: 50Hz to 3200Hz

The maximum output frequency serves as a reference value for frequency control with analog inputs, digital inputs and multiple speeds, as these always refer to the maximum output frequency as a percentage.

The maximum output frequency can be set up to 3200.0Hz. If very high frequencies are to be set here, it may be necessary to change the parameter F0.02. With F0.02=1, the setting range of this parameter is 50.0Hz to 3200.0Hz and with F0.02=2 it's 50.00Hz to 320.00Hz.

F0.20	Source for Upper Limit Frequency	0	★

Just like the target frequency, the upper cut-off frequency can be varied by external sources such as analog voltages or via remote control using PCs. The values of all external sources represent a proportional share of the setting in F0.21.

0: Use the Frequency Defined by F0.21

1: Analog Input AI1

2: Analog Input AI2
3: Control Panel Rotary Encoder
4: High-Frequency Pulse Input (DI5)
5: Specification via Communication Interface
6: Analog Input AI3

If the frequency is controlled by an analog voltage between AI1, AI2 or AI3 and GND or a pulse frequency at DI5, the frequency in F0.21 is the reference for 100% input voltage or 100% of the maximum pulse frequency. See also F1.12 to F1.29.

F0.21	Upper Limit Frequency	50.00Hz	☆

Range: F0.23 (Lower Limit Frequency) to F0.19 (Maximum Frequency)

The upper limit frequency is set to 50.00Hz at the factory. It should not be confused with the maximum frequency F0.19 and serves as a variable limitation of the motor frequency during operation of the frequency inverter. Sources for controlling the upper limit frequency can be found under parameter F0.20. The limitation does not take place in all operating modes.

F0.22	Offset for Upper Limit Frequency	0.00Hz	☆

Range: 0.00Hz to F0.19 (Maximum Frequency)

If the upper limit frequency F0.21 is controlled by an analog or digital source, an offset can be programmed in this parameter, which is then added to the frequency value specified by the analog or digital source. The resulting frequency is then the upper limit frequency.

F0.23	Lower Limit Frequency	0.00Hz	☆

If the frequency specification is lower than the lower limit frequency, the frequency inverter can stop the motor, continue to operate the motor at the lower limit frequency or at zero speed. This behavior can be specified in parameter F7.18.

F0.24	Direction of Motor Rotation	0	☆

0: Maintain Direction of Rotation
1: Reverse Direction of Rotation

If the motor direction of rotation is incorrect, this parameter can be used to reverse the direction of rotation without having to change the wiring on the motor. To avoid any surprises after resetting to factory settings or changing the inverter, this setting should only be used temporarily for test purposes!

F0.25	Reserved		
F0.26	Accuracy of AI Processing	1	★

0: 0.01Hz
1: 0.05Hz
2: 0.1Hz

3: 0.5Hz

The accuracy with which the frequency input is processed via the analog inputs is set here.

F0.27	Inverter Type	–	●

This parameter is **only** used to provide the user with information and therefore cannot be changed!

1: Type G

Standard version of the frequency inverter, suitable for most applications with constant or only slightly changing load torque.

2: Type F (Special Model)

Specialized version of the frequency inverter for applications such as pumps or fans with highly variable loads, but low starting torque and low overload capacity.

6.2.3 Input Parameter Group: F1.00 to F1.46

The input parameter group includes all parameters that are required to configure and use the available inputs of the ST500 frequency inverter. All ST500 series frequency inverters are equipped with eight freely configurable digital inputs.

Code	Parameter Name	Default	Mod.
F1.00	DI1 Function	1	★
F1.01	DI2 Function	2	
F1.02	DI3 Function	8	
F1.03	DI4 Function	9	
F1.04	DI5 Function	12	
F1.05	DI6 Function	13	
F1.06	DI7 Function	14	
F1.07	DI8 Function	15	

Range: 0 to 51

The eight parameters listed above are used to set the function of the individual digital inputs. Please refer to the circuit diagram in chapter 8 of these operating instructions for correct external wiring of the digital inputs. Each input can be assigned any of the following functions, but please note that F1.40 must be changed from 0 to 1 if you want to assign the same function to several real or virtual inputs (see virtual terminals E3.00 to E3.21).

The possible functions include:

0: No Function

This setting is only used to deactivate the digital input in order to avoid any unintentional activation of a function.

1: Forward Operation

The frequency inverter operates the motor in forward mode.

2: Reverse Operation

The frequency inverter operates the motor in reverse mode.

3: Three-Wire Operation Control

Input is used to control the three-wire operating mode of the frequency inverter, which is described in more detail under parameter F1.10.

4: Forward Jog (FJOG)

Forward operation in JOG mode of the frequency inverter. The JOG frequency and the braking and acceleration times can be set under parameters F7.00, F7.01 and F7.02.

5: Reverse Jog (RJOG)

Reverse operation in JOG mode of the frequency inverter.

6: Increase Frequency (UP)

Increase the frequency with the frequency increment set in F1.11.

7: Decrease Frequency (DOWN)

Decrease the frequency with the frequency increment set in F1.11

8: Free Stop

The inverter switches the output off immediately. The braking process is no longer controlled by the inverter. This is the same function as described under parameter F3.07. Currently not certified for STO (Safe Torque Off).

9: Reset Error State (RESET)

After the inverter has entered the error state, this function can be used to reset the inverter. This is the same function as the RESET button on the control panel.

10: Pause Operation

The inverter brakes the motor and stops. All operating parameters are retained. These can be values of PID parameters, for example. If the digital input is then set back to the "0" state, the inverter continues to operate the motor with the retained parameters.

11: Input for External Error (Normally Open)

If a digital input is configured with this function, the inverter outputs the error code Err.15 when the input is in state "1", changes to the error state and then carries out the error protection measures configured in F8.17. See also function 33.

12: Multi-Speed Input 1

13: Multi-Speed Input 2

14: Multi-Speed Input 3

15: Multi-Speed Input 4

Up to 16 different speeds can be programmed with the multiple speeds. These 16 speeds can be realized with combinations of the 4 multiple speed inputs. Please refer to the following table for more information:

MGE4	MGE3	MGE2	MGE1	Speed Setting	Parameter
0	0	0	0	0X	E1.00
0	0	0	1	1X	E1.01

0	0	1	0	2X	E1.02
0	0	1	1	3X	E1.03
0	1	0	0	4X	E1.04
0	1	0	1	5X	E1.05
0	1	1	0	6X	E1.06
0	1	1	1	7X	E1.07
1	0	0	0	8X	E1.08
1	0	0	1	9X	E1.09
1	0	1	0	10X	E1.10
1	0	1	1	11X	E1.11
1	1	0	0	12X	E1.12
1	1	0	1	13X	E1.13
1	1	1	0	14X	E1.14
1	1	1	1	15X	E1.15

If the multiple speeds are selected as a frequency control method, the speeds configured in parameters E1.00 to E1.15 refer to the maximum frequency configured in F0.19 as a percentage. When using the PID controller, the multiple speeds can also be used to switch between different target variables. for example, you could configure five different target pressures and switch between these pressures using the digital inputs.

16: Input for Variable Acceleration/Braking Time 1

17: Input for Variable Acceleration/Braking Time 2

With the help of two digital inputs, you can choose between four different braking and acceleration time modes. The following table shows the truth matrix with the corresponding parameters for the four different times:

Input 2	Input 1	Acceleration/Braking Time Pair	Parameters Used
0	0	Time Pair 1	F0.13 and F0.14
0	1	Time Pair 2	F7.08 and F7.09
1	0	Time Pair 3	F7.10 and F7.11
1	1	Time Pair 4	F7.12 and F7.13

18: Switching Between Different Frequency Controls (F0.07)

This function is used to switch the frequency control source of the inverter. The terminal can switch between two different control types; to do this, the ones digit of parameter F0.07 must be set to 2, 3 or 4.

19: Reset the Frequency to the Parameter Value in F0.01

A digital input with this function can be used to reset the offset to the frequency control source set by using the "Up" and "Down" buttons or terminals. See also F0.09.

20: Switch Control Source Between F0.11=1 or F0.11=2 and Control Panel

If the control mode of the frequency inverter is F0.11=1, this function can be used to switch between terminal control and keypad control using a digital input, or between remote control and keypad control if F0.11=2.

21: Prevent Braking and Acceleration by External Signals

Blocks the change of the current target frequency by external signals. When the input is set, the current output frequency is retained.

22: Pause PID Control

Pauses the control of the motor by the PID controller and retains the current frequency.

23: Reset PLC Control

If PLC control has been selected as the frequency control method, this function can be used to reset the PLC program sequence to the beginning (E1.00).

24: Pause Oscillation

The oscillation of the frequency (E0.00) pauses the next time the center frequency is reached.

25: Counter for Pulse Input

Input serves as a counter for pulsed signals. See also E0.08.

26: Reset Counter

Resets the counter of the input with function 25.

27: Length Counter for Pulse Input

Input serves as a length counter for pulse signals. The pulses per meter are set in E0.07.

28: Reset Length Counter

29: Prohibit Torque Control

If torque control is disabled, the inverter switches to speed control. See also function 46 and parameter FA.00.

30: Use Input as Pulse Frequency Input

DI5 only, see also F1.26 to F1.29.

31: Reserved

32: Immediate DC Brake

If the input is set to "1", the frequency inverter immediately switches on the DC braking function. Please note that this triggers a jerk that can exert considerable torque on the machine, motor and motor bearings and possibly cause damage. See also F3.08 to F3.11.

33: Input for External Error (Normally Closed, Closed-Circuit Current Loop)

If a digital input is assigned this function, the inverter outputs the error code Err.15 when the input is in the "0" state, changes to the error state and then executes the functions described in F8.17 (error protection measures). See also function 11.

34: Deactivate Frequency Change

When the input is set, the frequency inverter no longer allows a change in frequency as long as the input is in the "1" state.

35: Reverse PID Reaction (E2.03)

If the status of the selected input is "1", the PID behavior (positive or negative) in the parameter is reversed.

36: Stop the Motor with Keypad control

If the control type of the frequency inverter is configured to keypad control, the motor can be stopped with this function. The function is identical to that of the "STOP" button on the control panel of the frequency inverter.

37: Switching Between Terminal and Remote Control

Used to change the control method of the frequency inverter from terminal control (state "0") to control via the communication interface ("1").

38: Pause Integral Component of PID Control

If the input state is "active", the integral component of the PID controller is paused. The proportional and differential components continue to work normally.

39: Set the Main Target Frequency (Master) to F0.01

The target frequency configured using F0.03 is replaced by the frequency in F0.01.

40: Set the Additional Target Frequency (Aux) to F0.01

The target frequency configured using F0.04 is replaced by the frequency in F0.01.

41: Reserved

42: Reserved

43: PID Parameter Set Changeover

If a digital input terminal is used to switch PID parameter sets (E2.19=1), this function must be assigned to an input terminal. If the status of the selected terminal is "0", the parameter set E2.13 to E2.15 is used. If the status is "1", the parameter set E2.16 to E2.18 is used.

44: User-Defined Error 1

45: User-Defined Error 2

If one of the two inputs is switched to "1", the frequency inverter outputs the error codes Err.27 or Err.28 and behaves as defined by parameter F8.19.

46: Switching Between Speed and Torque Control

When using vector control, it is possible to switch between speed and torque control (see also FA.00). If the state of the terminal is "0", control is disabled. Function 29 has priority.

47: Emergency Stop Function (Currently Not Certified for Safe Stop SS1)

If a digital input is assigned the emergency stop function, the motor is braked as quickly as possible by the inverter when the terminal is activated. To do this, the vector control operating mode must be active (F0.00=0 or 1); in V/f operating mode (F0.00=2), only a free stop is triggered as with function 8. Please note that the jerk caused by the sudden braking can lead to considerable forces on the motor bearings and machine and thus to damage to them. The inverter can also be damaged by overloading.

48: External Stop Signal 2

The external stop signal 2 is used to stop the motor. In contrast to function 36, however, this can be used in any control mode; in addition, the braking time of time pair 4 (F7.13) is implicitly switched to.

49: Brake, Then DC Holding Current

The frequency inverter brakes the motor and activates the DC brake once the DC brake starting frequency configured in F3.08 has been reached.

50: Delete the Current Runtime

The current operating time of the inverter is reset to 0. The runtime is the reference for the parameters F7.42 to F7.45.

51: JOG Direction

For switching the JOG direction, see F7.54.

F1.08 F1.09	Reserved Reserved	–	–
F1.10	Terminal Command Mode	0	★

The terminal mode determines the control type of the frequency inverter when controlling via terminals. The input functions required for this can be freely assigned to the existing input terminals DI1 to DI8 in F1.00 to F1.07. In the factory setting, DI1 is already configured to 1 (forward operation) and DI2 to 2 (reverse operation).

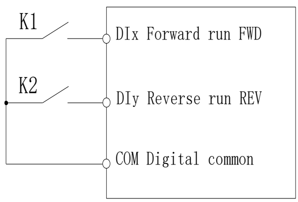
0: Two-Wire Control 1

The factory-configured two-wire control 1 is the most commonly used control type. The forward/reverse operation of the motor is controlled by two separate digital inputs. The terminal functions are as follows:

Terminals	Set Value	Description
DIx	1	Forward run (FWD)
DIy	2	Reverse run (REV)

Here, DIx and DIy are the multi-function input terminals of DI1 to DI10, the level is active.

K1	K2	Run Command
0	0	Stop
0	1	Reverse
1	0	Forward
1	1	Stop



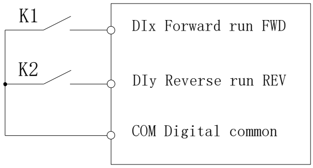
1: Two-Wire Control 2

With this type of control, a digital terminal is used to start and stop the motor. Another terminal can be used to switch the direction of rotation of the motor between forward and reverse:

Terminals	Set Value	Description
DIx	1	Forward run (FWD)
DIy	2	Reverse run (REV)

Here, DIx and DIy are the multi-function input terminals of DI1 to DI10, the level is active.

K1	K2	Run Command
0	0	Stop
0	1	Stop
1	0	Forward
1	1	Reverse

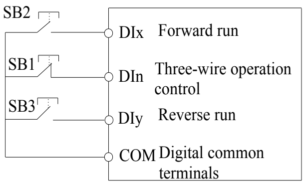


2: Three-Wire Control 1

In three-wire control mode 1, three terminals are used to control the inverter. One of these terminals is used to enable the inverter and the other two are used for forward/reverse switching.

The two terminals for direction control each react to a rising edge. for example, push-buttons can be used to switch between forward and reverse operation. The release of the inverter is level-controlled and can be controlled with a normal switch or a push-button (normally closed contact), for example:

Terminals	Set Value	Description
DIx	1	Forward run (FWD)
DIy	2	Reverse run (REV)
DIn	3	Three-wire operation control

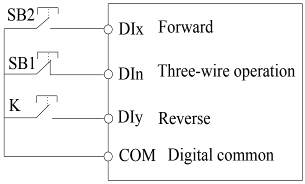


SB1 is used as a start/stop switch or as a stop button (NC contact), SB2 as a forward button and SB3 as a reverse button.

3: Three-Wire Control 2

In three-wire control 2, one terminal is used for enabling, another for starting the motor and the third for controlling the direction of rotation. The enable and direction of rotation are level-controlled and the start is edge-controlled. The function parameters are as follows:

Terminals	Set Value	Description
DIx	1	Forward run (FWD)
DIy	2	Reverse run (REV)
DIn	3	Three-wire operation control



K	Command
0	FWD
1	REV

Here, K is a switch and SB2 is a button, SB1 can be a switch or button (normally closed contact). The motor is started with SB2 in the direction specified by K and stopped again by withdrawing the release controlled by SB1.

F1.11	Command Frequency Change	1.000Hz/s	☆

Range: 0.001Hz/s to 65.535Hz/s

This parameter can be used to set the rate at which the frequency changes per second when the inputs assigned with function 6 and 7 (UP and DOWN) are used.

If the parameter F0.02 is set to 2, the setting range of the parameter is 0.001Hz/s to 65.536Hz/s.

If F0.02 is set to 1, the setting range changes to 0.01Hz/s to 655.36Hz/s.

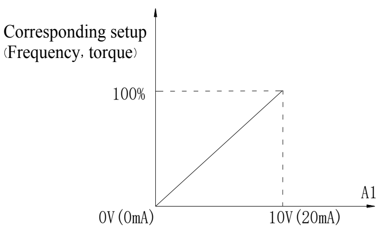
F1.12	Minimum Input Voltage for AI Curve 1	0.30V	☆

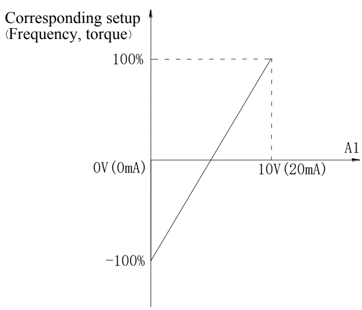
Range: 0.00V to F1.14

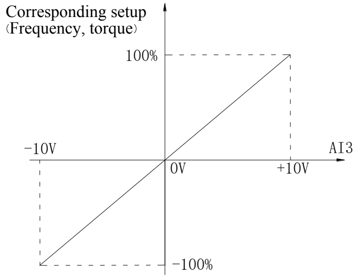
Function parameters F1.12 to F1.24 can be used to determine the behavior of the analog inputs AI. One of three curves is defined in parameter F1.12 to F1.15. The ratio between the input voltage and the final value can be used, for example, to specify a minimum voltage for the frequency inverter. If the analog input is to be used with a current rather than a voltage, 0.5V corresponds exactly to 1mA. The corresponding parameters for AI curves 2 and 3 behave in the same way as their equivalents for AI curve 1.

Example: If the analog input AI1 is to be used with a signal of 4mA to 20mA, the jumper AI1 must first be moved to I. The input must now be set to a minimum value of 4mA. This means that parameter F1.12 must be programmed to 2.00V, as the 500Ω resistor connected via the jumper just drops 2V at 4mA. This curve must be assigned to AI1 in F1.24 (ones digit=1).

The following graphs show the relationship between the input signal and the resulting value using three examples:







F1.13	Minimum Value for AI Curve 1	0.0%	☆
Range: -100.0% to 100.0%			
F1.14	Maximum Input Voltage for AI Curve 1	10.00V	☆
Range: F1.12 to 10.00V			
F1.15	Maximum Value for AI Curve 1	100.0%	☆
Range: -100.0% to 100.0%			
F1.16	Minimum Input Voltage for AI Curve 2	0.00V	☆
Range: 0.00V to F1.18			
F1.17	Minimum Value for AI Curve 2	0.0%	☆
Range: -100.0% to 100.0%			
F1.18	Maximum Input Voltage for AI Curve 2	10.00V	☆
Range: F1.16 to +10.00V			
F1.19	Maximum Value for AI Curve 2	100.0%	☆
Range: -100.0% to 100.0%			
F1.20	Minimum Input Voltage for AI Curve 3	0.00V	☆
Range: 0.00V to F1.22			
F1.21	Minimum Value for AI Curve 3	0.0%	☆
Range: -100.0% to 100.0%			
F1.22	Maximum Input Voltage for AI Curve 3	10.00V	☆
Range: F1.20 to +10.00V			

F1.23	Maximum Value for AI Curve 3	100.0%	☆

Range: -100.0% to 100.0%

F1.24	Curve Selection for Analog Input Terminals (AI1 to AI3)	H.0321	☆

The curves for the analog inputs AI1 to AI3 can be selected in this parameter. Curves 1, 2 and 3 are linear curves that can be set in the preceding F1 parameters F1.12 to F1.23. One type of curve can be assigned to multiple inputs.

Ones Digit: Selection of the Curve for Analog Input AI1

1: Curve 1

Linear, parameters F1.12 to F1.15

2: Curve 2

Linear, parameters F1.16 to F1.19

3: Curve 3

Linear, parameters F1.20 to F1.23

Tens Digit: Selection of the Curve for Analog Input AI2

1 to 3; same as the ones digit

Hundreds Digit: Selection of the Curve for Analog Input AI3

1 to 3; same as the ones digit

F1.25	Behavior with Voltage Below Minimum Voltage	H.0000	☆

If a voltage lower than the set minimum voltage is present at one of the analog inputs, this parameter can be used to define the behavior of the frequency inverter in this case.

Ones Digit: Setting Selection for AI1 Less than Minimum Input

0: Use of the Minimum Value of the Selected Curve (F1.13, F1.17, F1.21)

If the input signal at the analog inputs falls below the minimum voltage, the minimum value set in parameters F1.13, F1.17 and F1.21 is used. This means that the signal cannot fall below this value, regardless of what is present at the respective analog inputs.

1: 0.0%

If the voltage falls below the set minimum voltage at an input configured at this setting, 0.0% is used as the value.

Tens Digit: Setting Selection for AI2 Less than Minimum Input

0 to 1; same as the ones digit

Hundreds Digit: Setting Selection for AI3 less than Minimum Input

0 to 1; same as the ones digit

F1.26	HDI Minimum Pulse Frequency	0.00kHz	☆

Range: 0.00kHz to F1.28

Parameters F1.26 to F1.29 are used to set the digital input used as the pulse input. Only digital input DI5 can be used as a pulse input.

F1.27	Minimum Value of the Pulse Frequency	0.0%	☆

Range: -100.0% to 100.0%

F1.28	HDI Maximum Pulse Frequency	50.00kHz	☆

Range: F1.26 to 100.00kHz

F1.29	Maximum Value of the Pulse Frequency	100.0%	☆

Range: -100.0% to 100.0%

F1.30	DI Filter Time	0.010s	☆

Range: 0.000s to 1.000s

F1.31 F1.32 F1.33	AI1 Filter Time AI2 Filter Time AI3 Filter Time	0.10s	☆

Range: 0.00s to 10.00s

F1.34	Pulse Input Filter Time	0.00s	☆

Range: 0.00s to 10.00s

This parameter can be used to set the filter time on the software side. If interference causes digital inputs or analog inputs to not function correctly, this can be counteracted by increasing the filter time. However, a longer filter time also leads to a longer response time for the inputs.

F1.35 F1.36	DI Level Setting (Terminals 1 to 5) DI Level Setting 2 (Terminals 6 to 10)	00000	★

Parameters F1.35 and F1.36 determine when the digital input terminals change status (active or inactive). by default, the inputs are called "active" if the respective DI terminal is connected to COM, i.e. current is flowing, and "inactive" if the terminal and COM are disconnected. If the parameter is set to "1" for the respective input, the situation is exactly the opposite. The following parameter settings apply to the individual inputs:

Ones Digit: Digital Input DI1 (F1.35) or DI6 (F1.36)

0: Positive Logic

The input is considered active if the input terminal is connected to the corresponding reference potential, i.e. the (relay) contact connected to the input is closed or an open collector transistor output is switched (i.e. if J5/6 are in the factory setting: Input signal low-active, logic ON at low level, wired-OR possible).

1: Negative Logic

The input is considered active if the input terminal is not connected to the reference potential and therefore **no current** flows through the optocoupler at the input (i.e. if J5/6 are in the factory setting: Input signal high-active, logic ON at high level, wired-AND possible).

Tens Digit: Digital Input DI2 (F1.35) or DI7 (F1.36)

0 to 1; same as the ones digit

Hundreds Digit: Digital Input DI3 (F1.35) or DI8 (F1.36)

0 to 1; same as the ones digit

Thousands Digit: Digital Input DI4 (F1.35) or DI9 (F1.36)

0 to 1; same as the ones digit

Ten-Thousands Digit: Digital Input DI5 (F1.35) or DI10 (F1.36)

0 to 1; same as the ones digit

F1.37 F1.38 F1.39	DI1 Delay Time DI2 Delay Time DI3 Delay Time	0.0s	☆

Range: 0.0s to 3600.0s

The above parameter group defines the delay time until the status of the digital terminals DI1 to DI3 is accepted.

F1.40	Function Assignment to Multiple Terminals	0	☆

0: Do not allow the same function to be assigned to multiple terminals
1: Allow the same function to be assigned to multiple terminals

If this parameter is set to "1", several (real or virtual) digital input terminals can be assigned the same function.

F1.41	Start Value X1 for Control Panel Rotary Encoder	0.00%	☆

Range: 0 to 100.00%

The start value of the control panel rotary encoder can be set here when the rotary encoder is in the zero position. The resulting percentage values refer to F0.19 if the encoder is used to set a frequency; for percentage-based settings, they are applied directly.

F1.42	End Value X2 for Control Panel Rotary Encoder	0.50%	☆

Range: 0 to 100.00%

This parameter determines the value of the maximum position of the control panel rotary encoder. The basic resolution of the rotary encoder is 0.01%, therefore the factory setting results in setting steps of 1Hz when selected as a frequency control source, e.g. with F0.03=4.

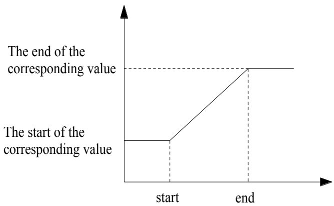
F1.43	Fixed Value for Control Panel Rotary Encoder	-	☆

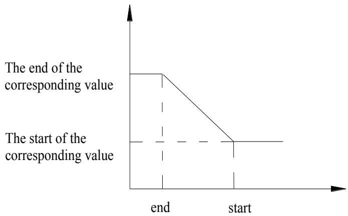
Range: 0 to 100.00%

If the control panel rotary encoder is to be set to a specific value, this value must be saved in this parameter. for example, the control panel encoder can be used as a fixed setpoint for the PID controller. To overwrite the current value of the encoder, the value in this parameter must be changed and then saved. The current value can then be changed with the encoder. See also F1.46.

F1.44 F1.45	Start Value Y1 for Control Panel Rotary Encoder End Value Y2 for Control Panel Rotary Encoder	0.00% 100.00%	☆

Range: -100.00% to +100.00%





Keypad encoder X correspondent value is Y

Setting analogous to the AI configuration in F1.12 to F1.24.

F1.46	Configuration of Control Panel Rotary Encoder	00	☆

The control panel can either save the current setting value of the control panel rotary encoder in F1.43 when the frequency inverter is switched off or delete both values. Similarly, the behaviour can be configured when the frequency inverter receives a stop command.

Ones Digit: Behavior when the Inverter Is Powered Off

0: Save the Settings when the Supply Voltage Is Switched Off

1: Delete the Settings when the Supply Voltage Is Switched Off

After the frequency inverter has been switched off and restarted, the default memory and setting value 0% is used instead of retaining the settings.

Tens Digit: Behavior upon Stop Command

0: Save the Settings when a Stop Command Is Received

1: Delete the Settings when a Stop Command Is Received

Analogous to the behavior on switch-off, the setting value of the control panel rotary encoder and the value stored in F1.43 are deleted and reset to 0%.

2: Delete the Settings on Restart

See above.

6.2.4 Output Parameter Group: F2.00 to F2.19

The output parameter group contains all the parameters required to set both the analog and digital outputs of the frequency inverter. The analog outputs can be used, for example, to output the current motor current as a 0V to 10V or 0mA to 20mA signal. The digital outputs can be used, for example, to switch a relay or control a PLC in the event of a frequency inverter error.

Code	Parameter Name	Default	Mod.
F2.00	SPB Output Function	0	☆

The SPB output terminal can be configured with two different types of function. The output can either be used as a pulse output with a maximum frequency of 100kHz or as a (partially) potential-free switching contact (optocoupler with downstream open-collector probe, but coupled to the COM of the 24V source). The function of the pulse output can be determined using parameter F2.06.

0: Pulse Output
Function can be set with parameter F2.06.

1: Open Collector Switching Contact
Function can be set with parameter F2.01

Code	Parameter Name	Default	Mod.
F2.01	SPB Output Function (Only if F2.00=1)	0	☆

Range: 0 to 40

Code	Parameter Name	Default	Mod.
F2.02	Relay Output 1 Function (TA1, TB1, TC1)	2	☆

Range: 0 to 40

Code	Parameter Name	Default	Mod.
F2.03	Reserved	–	–
F2.04	SPA Output Function	1	☆

Range: 0 to 40

Code	Parameter Name	Default	Mod.
F2.05	Relay Output 2 Function (TA2, TB2, TC2)	1	☆

Range: 0 to 40
The functions of the outputs listed above can be freely selected from the following list for each output:

0: No Function
The output has no function. (In case of inversion (F2.15): supply voltage is present.)

1: Inverter in Operation
The frequency inverter is in operation, even at an output frequency of 0Hz.

2: Error Signal
The inverter has switched off due to an error.

3: Frequency Limit FDT1 Reached

The frequency limit FDT1 can be set using the parameters F7.23 and F7.24.

4: Target Frequency Reached (F7.25)

Output is set to "1" when the target frequency is reached. The valid frequency range can be set in parameters F7.23 and F7.24.

5: Inverter in Operation with Frequency 0Hz, but Not Stopped

Output is activated when the motor is operating at 0Hz. See function 23.

6: Motor Overload Warning (F8.04)

If the frequency inverter detects an imminent overload of the motor, the input is switched to "1". Overload settings are defined in parameters F8.02 to F8.04.

7: Inverter Overload Warning

Output is activated if the frequency inverter detects an overload of internal components. The overload protection is activated 10 seconds after the output is switched (Err.10).

8: User-Defined End Value Reached (E0.08)

If the counter reaches the value entered in parameter E0.08, the output is set to "1".

9: User-Defined Value Reached (E0.09)

When the counter reaches the user-defined value, the output is set to "1".

10: Length Reached (E0.05)

The length exceeds the length specified via parameter E0.05.

11: Run Through PLC cycle

If PLC mode is active, the output is activated briefly when the frequency converter has run through a complete cycle of the set program segments. The pulse output has a width of 250ms.

12: Cumulative Operating Time Reached (F6.07 > F7.21)

If the operating time in parameter F6.07 reaches the value set by the user in F7.21, the output is switched.

13: Frequency Limit Reached / Exceeded

If a frequency limit is activated during operation, the output is switched. This can be either the upper limit frequency or the lower limit frequency.

14: Torque Limit Reached

Analogous to function 13.

15: Inverter Initialized and Ready for Operation

Output is activated if the frequency inverter initializes correctly after the supply voltage is applied and has not generated an error message and is waiting for commands.

16: AI1 > AI2

Output is activated when the signal level at analog input AI1 is higher than the signal level at analog input AI2.

17: Upper Limit Frequency Reached

18: Lower Limit Frequency Reached

Output is activated when the actual frequency is lower than the lower limit frequency, but not when the inverter is stopped. See function 37.

19: Undervoltage

The frequency inverter measures an input voltage that is too low.

20: Communication Setting

A communication error has occurred.

21: Reserved

22: Reserved

23: Inverter Stopped and/or Motor Speed at 0Hz

If the inverter is in the "Stop" state or is operating the motor at a frequency of 0Hz, the output is switched. In case of inversion (F2.15: operation with =/= 0Hz.) See function 5.

24: Standby Time Reached (F6.08 > F7.20)

25: Limit Frequency FDT2 Reached (F7.26 and F7.27)

Settings analogous to parameter value 3.

26: Output Frequency Within Frequency Range 1 (F7.28 and F7.29)

27: Output Frequency Within Frequency Range 2 (F7.30 and F7.31)

28: Output Current Within Current Limits 1 (F7.36 and F7.37)

29: Output Current Within Current Limits 2 (F7.38 and F7.39)

30: Operating Time Reached Timer (F7.42 to F7.44)

Output is activated when the timer function in the parameter and the runtime configured with F7.43 and F7.44 has expired.

31: Signal to AI1 Outside the Limits (F7.50 and F7.51)

Output is switched when the signal level at analog input AI1 exceeds the upper limit set in parameter F7.51 or falls below the lower limit set in parameter F7.50.

32: Load Loss

If the load on the frequency inverter changes quickly, the output is switched.

33: Inverter in Reverse Operation

34: Output Current Is Zero

Output is activated when the current falls below the value set in F7.32 for the duration of the time set in F7.33.

35: IGBT Module Reaches Set Temperature (F7.40)

If the temperature measured in parameter F6.06 reaches the value set in the parameter F7.40, the output is activated.

36: Output Current Measurement Reaches Set Limit (F7.34 and F7.35)

Output is activated when the current exceeds the limit set in F7.34 for the duration of the time set in F7.35.

37: Lower Limit Frequency Reached, Even when Stopped

If the current operating frequency of the motor falls below the set limit frequency or the frequency inverter is in stop mode, the output is activated. See 18.

38: Alarm Signal Output

Input is activated if the frequency inverter switches to error status during operation and continues operation anyway. See also F8.17 to F8.25.

39: Motor Temperature Warning (F8.35)

If the motor temperature exceeds the value set in the parameter F8.35, the output is activated.

40: Runtime Limit Reached (F7.45)

Current operating time exceeds the runtime limit set in F7.45.

F2.06	SPB Pulse Output Function (Only if F2.00=0)	0	☆
F2.07	DA1 Output Function	2	☆
F2.08	DA2 Output Function	13	☆

The output frequency of the pulse output SPB is between 0.01kHz and F2.09, whereby F2.09 can have a maximum value of 100.0kHz. The analog outputs can either output a voltage of 0 - 10V or a current of 0mA to 20mA. The following values can be output via the three outputs, each with full scale = maximum value:

0: Actual Frequency (0Hz to Maximum Output Frequency)
1: Target Frequency (0Hz to Maximum Output Frequency)
2: Output Current (0 to 2 Times the Rated Motor Current)
3: Torque (0 to 2 Times the Rated Motor Torque)
4: Output Power (0 to 2 Times the Rated Motor Power)
5: Output Voltage (0 to 1.2 Times the Rated Motor Voltage)
6: Frequency at the Digital Pulse Input (0.01khz to 100.00khz)
7: Voltage or Current at Analog Input AI 1 (0V to 10V or 0ma to 20ma)
8: Voltage or Current at Analog Input AI 2 (0V to 10V or 0ma to 20ma)
9: Voltage or Current at Analog Input AI 3 (0V to 10V or 0ma to 20ma)
10: Length (0 to Set Maximum Length)
11: Counter Value (0 to Maximum Counter Value)
12: Communication Setting (0 to 100%)
13: Motor Speed (0 to Speed with Max. Frequency)
14: Output Current (0.0A to 100.0A)
15: DC Link Voltage (0.0V to 1000.0V)
16: Reserved
17: Frequency of the Current Frequency Control

F2.09	Maximum Output Frequency for Pulse Output	50.00kHz	☆

Range: 0.01kHz to 100.00kHz

If the SPB terminal is used as a pulse output, the maximum output frequency assigned to the maximum value of the selected output variable can be set here.

F2.10	SPB Output Delay	0.0s	☆

Range: 0.0s to 3600.0s

F2.11	Relay 1 Output Delay	0.0s	☆

Range: 0.0s to 3600.0s

F2.12	Expansion Card Digital Output (DO) Delay	0.0s	☆

Range: 0.0s to 3600.0s

F2.13	SPA Output Delay	0.0s	☆

Range: 0.0s to 3600.0s

F2.14	Relay 2 Output Delay	0.0s	☆

Range: 0.0s to 3600.0s

Parameter group F2.10 to F2.14 can be used to set the (symmetrical) delay until the outputs actually perform a switchover.

F2.15	Output Terminal Logic for F2.01 to F2.05	00000	☆

This parameter can be used to invert the output terminals.

Ones Digit: SPB (F2.01)

0: Positive Logic

The output is considered active when the output terminal is connected to the corresponding ground (low-active).

1: Negative Logic

The output is considered active if the output terminal is open and therefore not connected to the corresponding ground (high-active if ext. pull-up is present).

Tens Digit: Relay 1 (F2.02)

0 to 1; same as the ones digit

Hundreds Digit: Reserved

Thousands Digit: SPA (F2.04)

0 to 1; same as the ones digit

Ten-Thousands Digit: Relay 2 (F2.05)

0 to 1; same as the ones digit

F2.16	DA1 Zero Bias Coefficient	0.0%	☆
Range: -100.0% to +100.0%			
F2.17	DA1 Gain	1.00	☆
Range: -10.00 to +10.00			
F2.18	DA2 Zero Bias Coefficient	20.0%	☆
Range: -100.0% to +100.0%			
F2.19	DA2 Gain	0.80	☆

Range: -10.00 to +10.00

The function parameters F2.16 to F2.19 can be used to correct zero point deviations and inaccuracies in the output amplitude. The parameters can also be used to modify the analog output curves.

The analog output curves are based on the generally known linear equation **Y=kX+b**, where Y is the momentary actual output value, k is the gain, X is the internal reference output value and b is the zero bias.

A 100% zero bias voltage then corresponds to exactly 10V or 20mA. The reference output value can assume values between 0V to 10V or 0mA to 20mA if the zero bias voltage b is 0% and the gain k is 1.00.

The possible output range is of course still limited by the circuitry to 0V to 10V or 0mA to 20mA. If these limits are exceeded or undercut by calculation, the respective limit value is output.

Example 1: If the operating frequency is to be output via an analog output, with 0Hz operating frequency corresponding to 8V output voltage and the maximum operating frequency corresponding to 3V output voltage, the gain must be set to -0.50 and the zero bias voltage to 80.00%.

Example 2: If a value is to be output with "live zero" at 2V or 4mA, the zero bias voltage must be set to 20.00%. To ensure that the full value range continues to be transmitted and is not capped at 10V/20mA from 80%, the gain must be reduced to 0.80.

6.2.5 Start and Stop Control Group: F3.00 to F3.15

The start and stop behavior of the frequency inverter can be set in this parameter group. The function parameters include, for example, settings for the DC braking behavior and the speed measurement at the start of operation.

Code	Parameter Name	Default	Mod.
F3.00	Start-Up Mode	0	☆

0: Direct Start-Up

If the DC braking time is set to 0, the inverter starts directly at the start frequency. If a DC braking time is set, the rotor is first held for this time and only then starts at the starting frequency. Suitable for smaller loads that may rotate when switched on.

1: Rotation-Monitored Start-Up, Speed Equalization

The inverter first checks the speed and direction of the motor and then starts at the measured speed. Suitable for briefly switching off the current for larger loads and inertias. To be able to use the speed-monitored start-up correctly, you must first set the motor parameters in group b0.

2: Asynchronous Motor Pre-Excited Start

This function is only for asynchronous motors in order to generate a magnetic field before the motor starts. This can improve the response behavior of the motor by allowing the squirrel-cage rotor to build up a field. More information can be found under parameters F3.05, F3.06 for the pre-excitation current and the pre-excitation time. If 0 is entered for the pre-excitation time, this function is skipped and started immediately with the start frequency. If a value is entered, pre-excitation is first carried out for this time and then started with the starting frequency.

F3.01	Speed Equalization	3	★

0 to 2: Reserved

3: Hard Speed Tracking Mode

Most frequently used function. In this setting, the inverter automatically finds the speed and starts up again without jerking.

F3.02	Value for Speed Equalization	20	☆

Range: 1 to 100

If revolution monitoring is activated, select the speed at which monitoring is carried out here. The smaller the value, the faster the measurement is completed. However, if the value is too small, this can lead to inaccuracies.

F3.03	Start Frequency	0.00Hz	☆

Range: 0.00Hz to 10.00Hz

F3.04	Hold Time for Start Frequency	0.0s	★

Range: 0.0s to 100.0s

If the motor is started, it is first started at the start frequency until the time in parameter F3.04 has elapsed. The motor is then operated at the set target frequency. The starting frequency in parameter F3.03 is not limited by the lower limit frequency. However, if the target frequency is lower than the set starting frequency, the frequency inverter remains in standby.

The waiting time in parameter F3.04 is not taken into account during a reversal of the direction of rotation and during the departure of the programmed start ramp. However, it is included in the runtime of a cycle in PLC mode.

Example 1:

F0.03＝0	The frequency source is set to digital reference
F0.01＝2.00Hz	The digital set frequency is 2.00Hz

F3.03＝5.00Hz	The start frequency is 5.00Hz
F3.04＝2.0s	The hold time for start frequency is 2.0s, at this time, the inverter will be in the standby state with the output frequency of 0.00Hz.

Example 2:

F0.03＝0	The frequency source is set to digital reference
F0.01＝10.00Hz	The digital set frequency is 10.00Hz
F3.03＝5.00Hz	The start frequency is 5.00Hz
F3.04＝2.0s	The hold time for start frequency is 2.0s

In example 2, the frequency inverter accelerates to 5.00Hz within the specified 2.0s. once the inverter has reached the set start frequency, the motor is accelerated to 10.00Hz with the currently active start ramp.

F3.05	DC Holding Current / Pre-Excitation at Start	0%	★

Range: 0% to 100%

F3.06	Time for DC Holding Current at Start	0.0s	★

Range: 0.0s to 100.0s

The DC holding current before starting the motor is often used if the motor is to be braked and then restarted in a defined manner. This prevents overrunning. Pre-excitation ensures that the magnetic field is built up in the motor before the motor starts, which then improves the motor's response time. F3.00 defines which of the functions is active.

The DC holding current function is only available for a start without speed measurement.

If the holding time is configured to 0.0s, the function is automatically deactivated. As a general rule, the greater the DC holding current, the greater the braking effect. The percentage value in parameter F3.05 refers to the specified rated current of the frequency inverter.

F3.07	Stop Mode	0	☆

If a stop command is issued to the frequency inverter, two different braking behaviors can be selected:

0: Active Stop

The frequency inverter actively brakes the motor by reducing the output frequency in the set braking ramp time.

1: Free Stop

Immediately after receiving the stop command, the frequency inverter switches off the voltage at the output and allows the motor to coast freely.

F3.08	DC Braking Frequency	0.00Hz	☆

Range: 0.00Hz to F0.19 (Maximun Frequency)

F3.09	Waiting Time for DC Brake	0.0s	☆

Range: 0.0s to 100.0s			
F3.10	Output Current with DC Braking Function	0%	☆
Range: 0% to 100%			
F3.11	Duration of DC Braking Function to Stop	0.0s	☆

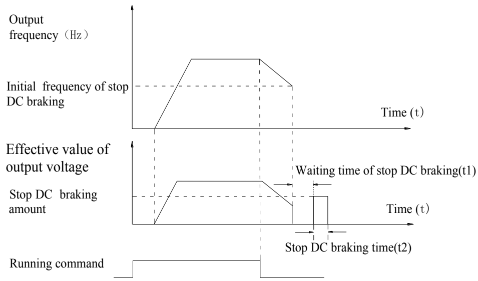
Range: 0.0s to 100.0s

If the actual frequency falls below the DC braking frequency, the inverter switches off the voltage at the output, allows the motor to coast during the waiting time F3.09 in order to counteract any current peaks and activates the DC braking function after this waiting time has elapsed.

The level of the DC braking current can be set in parameter F3.10. The parameter is a percentage of the rated motor current. The higher this current is set, the greater the braking or holding effect. However, this can lead to greater heat development on the motor and frequency inverter and to heavy loads on the motor suspension due to the jerk of the braking.

If the DC braking frequency F3.08 and/or the braking current F3.10 are set too high, the excessive braking torque Err.03 "Overcurrent during braking" or the excessive recuperation Err.06 "Overvoltage during braking" will be triggered. It is therefore recommended to start with low values (a few Hz and below 30%) and to increase these as required.

The duration of the DC brake can be set in parameter F3.11. In the 0.0s setting, the DC brake function is deactivated. The following diagram illustrates the DC brake function:



Schematic Diagram of DC Braking Function

F3.12	Degree of Utilization of the Braking Function	100%	☆

Range: 0% to 100%

This parameter only has an effect on frequency inverters with a built-in brake unit. During the braking process, it may be necessary to dissipate excess energy via the braking unit. This parameter can be used to set the frequency with which the braking unit dissipates energy from the DC link. A high value for this parameter can lead to a high braking effect, but also to a very strongly fluctuating voltage in the DC link. The integrated braking unit is deactivated with the 0% setting. See also F8.05 / F8.06.

F3.13	Acceleration/Braking Mode	0	★

This parameter can be used to select several types of acceleration and braking curves.

0: Linear Acceleration and Braking

The output frequency is reduced or increased linearly during braking and acceleration.

1: S Curve A

The output frequency changes in the form of an S-curve. The S-curve shape is particularly suitable for applications where a very smooth start and stop process is required (lifts, conveyor belts, etc.). The shape of the S-curve can be set using parameters F3.14 and F3.15.

2: S Curve B

With the second S-curve shape, the nominal frequency of the motor is always the reversal point of the S-curve during the start and stop process. Used in applications that require fast acceleration in the range above the rated frequency.

When the frequency is higher than the rated frequency, the acceleration and braking are:

$$t=\left[\frac{4}{9}\times\left(\frac{f}{f_b}\right)^2+\frac{4}{9}\right]\times T$$

The parameter f refers to the setting frequency, fb means the rated frequency. T means the time from 0 to rated frequency (fb).

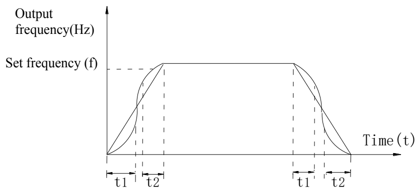
F3.14	Proportion of S Curve Start Section	30.0%	★

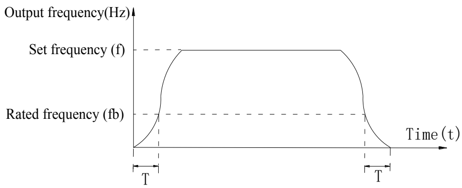
Range: 0.0% to (100.0% to F3.15)

F3.15	Proportion of S Curve End Section	30.0%	★

Range: 0.0% to (100.0% to F3.14)

The function parameters F3.14 and F3.15 determine the properties of the start and end segments of the S-curve a shown in the figure. When parameterizing F3.14 and F3.15, it must be ensured that F3.14 + F3.15 is < 100%. Within the time specified by F3.14, the slope of the curve is gradually increased, while it gradually decreases to 0 within the time specified by F3.15. If a range remains in between, the gradient in this range remains constant, i.e. the curve is linear there.





6.2.6 V/f Control Parameters: F4.00 to F4.14

The parameters in this parameter group are only used if the frequency inverter is in V/f control mode. V/f control is suitable for fans or pumps, for example, and is essential for applications in which one frequency inverter controls several motors.

The V/f curve is not extrapolated beyond the nominal frequency, but remains at the nominal voltage b0.02 at higher frequencies.

Code	Parameter Name	Default	Mod.
F4.00	V/f Curve Setting	0	★

0: Linear V/f Curve

V/f = rated motor voltage / rated motor frequency. Suitable for constant load.

1: Multi-Point V/f Curve

Suitable for centrifuges and other special applications. The points that make up this curve can be set using parameters F4.03 to F4.08.

2: Quadratic V/f Curve

Suitable for fans, pumps and centrifuges.

3: Exponential V/f Curve with Exponent 1.2
4: Exponential V/f Curve with Exponent 1.4
5: Reserved
6: Exponential V/f Curve with Exponent 1.6
7: Reserved
8: Exponential V/f Curve with Exponent 1.8
9: Reserved

10: No Correlation Between V and F

With this curve, there is no relationship between the output voltage V and the output frequency f. The output frequency is still controlled by the source set for it and the voltage by the source specified in parameter F4.12.

11: Proportional Relationship Between V and F

With this curve shape, F is proportional to f. The proportionality factor can be specified in parameter F4.12. This factor is also dependent on the configured rated motor voltage and the rated motor frequency in parameter group b0.

If we assume that the control source defined in F4.12 has the value X[%] (in the range from 0% to 100% of its control voltage range), then the relationship between the output voltage V, the frequency f and the modulation factor of the control voltage X can be expressed as follows:

V/f=2*X*(rated voltage of motor)/(rated frequency of motor)

Code	Parameter Name	Default	Mod.
F4.01	Torque Boost	0.0%	☆

0.0%: Automatic Torque Boost; 0.1% to 30.0%

F4.02	Cut-Off Frequency for Torque Boost	15.00Hz	★

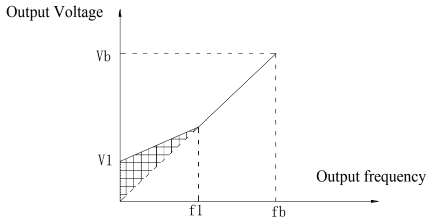
Range: 0.00Hz to F0.19 (maximum frequency)

The main function of the torque boost is to improve the torque characteristics of the motor at low frequencies in V/f operation. The correct setting of the boost depends on the respective application. If the boost is set too low, the motor may have too little torque to set the load in motion due to field weakness despite high currents. If, on the other hand, the boost is set too high, the motor may be overexcited. The motor current, which is then also too high, can reduce the efficiency of the motor and lead to greater heat generation.

It is recommended to increase the torque boost value if the motor has to move a heavy load and has noticeably too little torque. If the boost is set to 0.0%, the frequency inverter automatically calculates the required value from the measured stator resistance parameters.

Note: If the motor is controlled with a frequency that is too low for the motor to start properly, it may happen in individual cases that the automatic boost function tries unsuccessfully to force the motor to start by increasing the voltage instead of increasing the frequency further, causing the inverter to become "stuck" at this frequency. This can result in noise and Err.02. In this case, ensure that no frequencies that are too low are used, deactivate the automatic torque boost by setting it to 0.1%, for example, or use vector control instead of V/f control.

The cut-off frequency can be used to define the frequency up to which the boost is active.



V1: Manual torque boost voltage Vb: Maximum output voltage
f1: Manual torque boost cut-off frequency fb: Rated operating frequency

F4.03	V/f Curve Frequency Point f1	0.00Hz	★

Range: 0.00Hz to F4.05

F4.04	V/f Curve Voltage Point V1	0.0%	★

Range: 0.0% to 100.0%

F4.05	V/f Curve Frequency Point f2	0.00Hz	★

Range: F4.03 to F4.07

F4.06	V/f Curve Voltage Point V2	0.0%	★

Range: 0.0% to 100.0%

F4.07	V/f Curve Frequency Point f3	0.00Hz	★

Range: F4.05 to b0.04 (rated motor frequency)

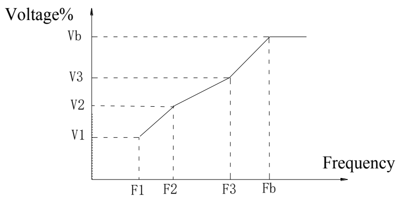
F4.08	V/f Curve Voltage Point V3	0.0%	★

Range: 0.0% to 100.0%

Parameters F4.03 to F4.08 are used to define the user-defined V/f curve. Please note that the following conditions must be met:

X1 < X2 < X3 **and** Y1 < Y2 < Y3

Caution: If the voltage is set too high at low frequencies, the motor may overheat or even be damaged. In this case, the frequency inverter may also switch to error status (e.g. Err.02 or Err.11). The following figure shows the adjustable V/f characteristic curve.



V1-V3: Voltage percentage of stage 1-3 to multi-speed V/F
F1-F3: Frequency percentage of stage 1-3 to multi-speed V/F
Vb: Rated motor voltage
Fb: Rated motor operating frequency

Schematic Diagram of User-Defined V/f Curve

The frequencies X1 to X3 shown in the illustration refer to parameters F4.03, F4.05 and F4.07. The corresponding voltage values Y1 to Y3 in % of V_b can be set in parameters F4.04, F4.06, F4.08.

V_b and f_b stand for the rated motor voltage and rated motor frequency. If f_b is exceeded, V is not increased beyond V_b.

F4.09	Slip Compensation	0.0%	☆

Range: 0% to 200.0%

The slip compensation setting can only be used if a three-phase asynchronous motor is connected to the frequency inverter. With this type of motor, there is a torque-dependent frequency deviation between the rotating field and mechanical rotation, which is called slip. The slip compensation can counteract a change in speed that occurs during a load change. This means that the speed of the motor can be kept almost constant even without PG during a load change.

A setting of 100.0% corresponds to the slip compensation at nominal load, which is calculated from the difference between the rotating field speed (60 × nominal motor frequency / number of pole pairs) and the nominal motor speed entered in b0.05. If there is still a deviation, the value must be fine-tuned manually.

F4.10	DC Link Overvoltage Protection	80	☆

Range: 0 to 200

During the braking process, the DC link protection can prevent or counteract an increase in the DC link voltage and thus avoid an overvoltage fault. The higher the value of this parameter, the more the inverter attempts to prevent an increase in the DC link voltage. If the frequency inverter switches to overvoltage protection very quickly during the braking process, this value should be increased. However, if the value is set too high, this leads to an increased output current, so this setting should be adjusted manually to the respective application.

For applications in which there is only a very small load on the motor, this value can be set to 0, as the mass moment of inertia for small loads is low and only a small amount of energy is fed back to the inverter. If a braking resistor is used, this value can also be configured to 0. See also F8.05.

F4.11	Oscillation Suppression	0	☆

Range: 0 to 100

Oscillation suppression should only be activated if oscillation occurs during motor operation. for this, it is necessary that the values for rated motor current and no-load current in b0.03 and b0.10 are correct. The function is deactivated with the setting 0.

F4.12	Voltage Control Source	0	☆

This parameter is only required if 10 or 11 is configured as the V/f characteristic curve in parameter F4.00. Ten different sources can be set for voltage control.

0: Control Panel (F4.13)
1: Analog Input AI1
2: Analog Input AI2
3: Control Panel Rotary Encoder
4: High-Frequency Pulse (DI5)
5: Multi-Speed Setting
6: Simple PLC
7: PID Control
8: Communication Interface
9: Analog Input AI3

All sources except F4.13 refer to the rated motor voltage b0.02 as a percentage (full control of the respective source corresponds to 100% of b0.02). Note the factor 2 when using F4.00=11, but still the output voltage is always limited to b0.02.

F4.13	Control Panel Voltage Setting	0V	☆

Range: 0V to Rated Motor Voltage

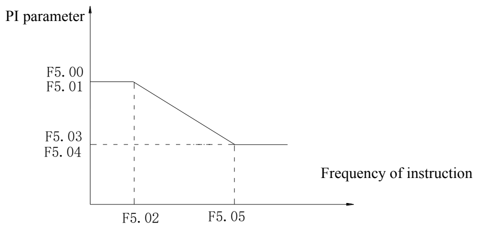
F4.14	Rise Time V/f Voltage	0.0s	☆

Range: 0.0s to 1000.0s

6.2.7 Vector Control Parameters: F5.00 to F5.15

The function parameters in this parameter group are only active if the control mode of the frequency inverter (F0.00) has been configured to vector control. These parameters do not apply when using V/f control.

Code	Parameter Name	Default	Mod.
F5.00	Lower Proportional Component G1	30	☆
Range: 1 to 100			
F5.01	Lower Integral Time T1	0.50s	☆
Range: 0.01s to 10.00s			
F5.02	Lower Switching Frequency 1	5.00Hz	☆
Range: 0.00 to F5.05			
F5.03	Upper Proportional Component G2	20	☆
Range: 1 to 100			
F5.04	Upper Integral Time T2	1.00s	☆
Range: 0.01s to 10.00s			
F5.05	Upper Switching Frequency 2	10.00Hz	☆
Range: F5.02 to F0.19 (max frequency)			



PI Parameter Diagram

Parameters F5.00 to F5.04 allow the PI control for the speed to be set for vector control. If the operating frequency is lower than the lower switching frequency F5.02, the reaction or control is influenced by the two parameters F5.00 and F5.01. If the operating frequency is higher than the upper switching frequency, the control behavior is set with the two parameters F5.03 and F5.04. In the range in between, the effective coefficients are formed by linear interpolation from the upper and lower parameter set.

Excessively high values for the P component and excessively short integration times lead to a tendency to oscillate, while low values for the gain and long integration times lead to a slow response; in addition, if the integration time is too long, the control can overshoot considerably.

F5.06	Integral Component	0	☆

This parameter is used to activate and deactivate the I component of the controller for vector control.

0: Active

1: Inactive

F5.07	Control Source for Torque Limitation	0	☆

For vector control with speed control, the upper limit for the output torque can be set using parameter F5.08. If the torque is not to be specified by input on the control panel but by another control source, this source can be specified in parameter F5.07. If either an analog input, digital pulse or control via the communication interface is selected here as the control source, an input value of 100% results in the value set in parameter F5.08. The value 100% corresponds to the nominal torque of the frequency inverter.

Example: Input AI1 with 5V corresponding to 50%, scaled with 150% in F5.08, results in an upper torque limit of 75%.

0: Control Panel (F5.08)

1: Analog Input AI1

2: Analog Input AI2

3: Control Panel Rotary Encoder

4: High-Frequency Pulse

5: Communication Interface

6: Min (AI1, AI2)

7: Max (AI1, AI2)

8: Analog Input AI3

F5.08	Upper Limit for Torque Specification	150.0%	☆

Range: 0.0% to 200.0%

F5.09	Differential Gain	150%	☆

Range: 50% to 200%

When using sensorless vector control, this parameter can be used to minimize the deviation of the speed control. If the speed is too low under load, this parameter should be increased and vice versa..

F5.10	Filter Constant	0.000s	☆

Range: 0.000s to 0.100s

If the speed varies greatly with vector control of the motor, the filter constant can be increased to enable more stable operation. However, too high a delay can itself cause speed jumps.

F5.11	Overvoltage Protection for Vector Control	64	☆

Range: 0 to 200

Description analogous to parameter F4.10; see there.

F5.12	P-Component Gain for Voltage Regulation	2000	☆

Range: 0 to 60000

F5.13	I-Component Gain for Voltage Regulation	1300	☆

Range: 0 to 60000

F5.14	P-Component Gain for Torque Control	2000	☆

Range: 0 to 60000

F5.15	I-Component Gain for Torque Control	1300	☆

Range: 0 to 60000

The parameters of the excitation voltage and current control loops F5.12 to F5.15 are normally set automatically by the frequency inverter depending on the motor when it is calibrated (see b0.27) and do not normally need to be changed.

Note: the I-component here does not refer to the integral time, but to the amplification factor of the integral component. Values that are too high can lead to oscillation of the entire control loop.

6.2.8 Keypad and Display: F6.00 to F6.19

The control panel (keypad) can be configured in this parameter group. The parameters include display settings, memory settings and information about the frequency inverter.

Code	Parameter Name	Default	Mod.
F6.00	STOP/RESET Key Functions	1	☆

0: STOP/RESET Key Only Active in Keypad Control Mode

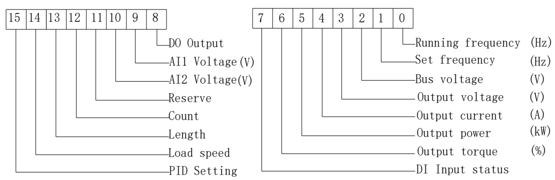
If a control mode other than keypad control is used, the STOP/RESET button is deactivated.

1: STOP/RESET Key Active in Any Operation Mode

STOP/RESET button is always active, regardless of which control mode is selected.

F6.01	Status Parameters in Operation 1	H.001F	☆

Range: 0000 to FFFF



Running Status 1

If one of the parameters shown above is to be displayed during operation, the position of the value in the binary value must first be set to "1". The binary value must then be converted to the hexadecimal number system and saved as a parameter value.

If the currently displayed value is switched off, it will continue to be displayed after returning from parameterization and the switch-off will only take effect after pressing the "Shift" button, as the memory for the last displayed value is not directly affected by this parameter, as it is only taken into account when switching on again. The parameters in F6.01 and F6.02 correspond exactly to parameters d0.00 to d0.31 in terms of meaning, value, scaling and sequence.

At least one display value must always be active during operation and stop:

tag number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
number	0	1	1	1	1	0	1	0	0	1	0	0	1	1	1	1

The data will be divided into 4 groups:

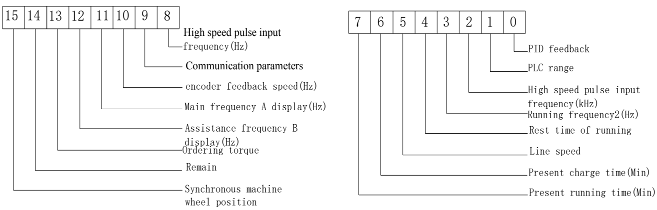
Tag Number	15-12	11-8	7-4	3-0
Number	0111	1010	0100	1111

After checking the comparison of the binary number and the hexadecimal number, the data is 0x7A4F.

Binary	Hexadecimal	Binary	Hexadecimal	Binary	Hexadecimal	Binary	Hexadecimal
0000	0	0100	4	1000	8	1100	C
0001	1	0101	5	1001	9	1101	D
0010	2	0110	6	1010	A	1110	E
0011	3	0111	7	1011	B	1111	F

F6.02	Status Parameters in Operation 2	H.0000	☆

Range: 0x0000 to 0xFFFF



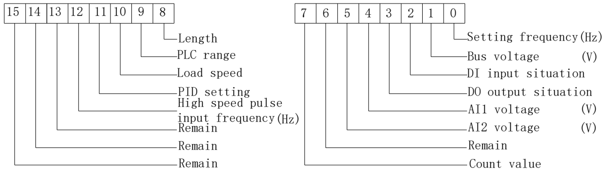
Running Status 2

Function description analogous to F6.01.

Synchronous position indicates the pole wheel angle of the rotor of a synchronous machine.

F6.03	Status Parameters in Stop State	H.0033	☆

Range: 0x0001 to 0xFFFF



Stop Status

Function description analogous to F6.01.

F6.04	Motor Speed Factor	3.0000	☆

Range: 0.0001 to 6.5000

This parameter can be used to adjust the scaling factor with which the motor speed displayed in d0.14 and in F6.01 bit 14 is calculated. for example, if the actual motor frequency is 40.00Hz and this factor is configured to 3.0000, the motor speed is displayed as 1200. In the stop state, the target frequency is used instead of the actual frequency.

Displayed speed [rpm] = 10 × F6.04 × actual frequency, or for calculation from the rated values: F6.04 [rpm/Hz] := rated speed at rated slip / load [rpm] / (10 × rated frequency [Hz])

Example: F6.04 = 1460[rpm] / (10 × 50[Hz]) = 2.92.

Instead of the rated motor speed, the speed can be used behind a gearbox, for example. Please note that the display is based solely on a conversion of the frequency according to the above formula and that there is no slip compensation. The factory setting 3.0000 results in the speed of a four-pole asynchronous motor without any slip.

F6.05	Decimal Places for Motor Speed	1	☆

0: No Decimal Places

1: 1 Decimal Place

2: 2 Decimal Places

3: 3 Decimal Places

F6.06	IGBT Temperature	-	●

Range: 0.0°C to 100.0°C

This parameter shows the temperature of the IGBT module installed in the frequency inverter. The temperature that is considered normal can vary between the different power variants in operation and standby.

F6.07	Total Operation Time	-	●

Range: 0h to 65535h

This parameter displays the total running time of the frequency inverter. This is the operating time during which the motor was also running or the output of the frequency inverter was active. A limit can be set for the runtime in parameter F7.21. If the set limit is reached, error 26 is triggered and a digital output with function 12 is activated.

F6.08	Total Power-On Time	-	●

Range: 0 to 65535h

The power-on time during which the inverter was connected to the mains is included in this parameter.

Analogous to F6.07, a limit for the power-on time can be set in F7.20, resulting in an error 29 and a digital output signal of function 24.

F6.09	Total Power Consumption	-	●

Range: 0 to 6553kWh

The cumulative power consumed by the frequency inverter from the grid over the entire runtime can be read here.

F6.10	Product Model Number	-	●
F6.11	Firmware Version Number	-	●
F6.12 F6.13 F6.14 F6.15	Reserved		
F6.16	Parameter Display 2	d0.04	☆

1Kbit/100bit; 10bit/1bit
Parameter Number; Parameter Series Number

This is where you configure which parameter is displayed in the second line of the control panel. The factory setting is parameter d0.04, motor current.

F6.17	Power Correction Factor	1.00	☆

Range: 0.00 to 10.00

If the output power displayed in parameter d0.05 deviates from the actual power output, this factor can be used to correct the display.

F6.18	Function of the UP Button	0	☆
F6.19	Function of the DOWN Button	0	☆

The function of the two arrow buttons in the middle of the control panel can be defined using these two parameters. Functions 0 to 5 are only valid outside of parameterization mode.

In parameterization mode, you can switch through parameters. When changing a parameter, the value to be configured can be increased with the UP button or decreased with the DOWN button.

Functions 6 and 7 are always valid.

In parameterization mode, the control panel wheel must then be used to select and change parameters.

0: "Up" or "+" Function for UP Button / "Down" or "–" Function for DOWN Button
During operation, this function can be used to increase or decrease the target frequency stored in parameter F0.01. This is the default setting.

1: Free Stop
2: FWD (Forward) Function
3: REV (Reverse) Function
4: FJOG (Forward Jog) Function
5: RJOG (Reverse Jog) Function
6: "UP" Terminal Control Function
7: "DOWN" Terminal Control Function

F6.20	Key Lock Mode	0	☆

This parameter can be used to set which buttons should remain enabled when the key lock function is active. The key lock is switched on and off by pressing PRG and the rotary encoder at the same time.

While the lock is active, "A." is displayed in front in the main display.

0: RUN and STOP Buttons Are Enabled
1: RUN and STOP Buttons and Rotary Encoder Are Enabled
2: RUN, STOP, UP and DOWN Buttons Are Enabled
3: Only STOP Button Is Enabled

F6.21	Function of the QUICK Button	0	☆

This parameter is used to configure the function of the QUICK button outside of programming mode. In programming mode, the QUICK key can be used together with the SHIFT key to select the edited decimal place; the active position is moved to the left with the QUICK key and to the right with the SHIFT key.

0: No Function
1: FJOG
2: Shift Key
3: Change Operation Direction (Forward/Reverse)

4: Reset the Offset to F0.01 Set via UP/DOWN Buttons
This setting corresponds to input function 19. See also F0.03 and F0.09.

5: Free Stop

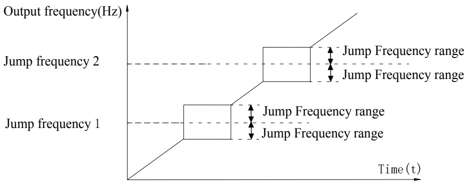
6: Switch Command Control Setting

When this function is activated, the command control source is switched cyclically between the first three setting options of F0.11 each time the button is pressed: Control panel (LOCAL/ REMOTE LED off), terminals (LOCAL/REMOTE LED on), communication interface (LOCAL/ REMOTE LED flashes). If the button is pressed again, it cycles back to the beginning (control panel), etc. See also F0.11.

6.2.9 Auxiliary Functions: F7.00 to F7.54

The auxiliary function parameter group contains parameters for JOG operation, skip frequencies, wake-up function and other additional features.

Code	Parameter Name	Default	Mod.
F7.00	Jog Frequency	6.00Hz	☆
Range: 0.00Hz to F0.19 (maximum frequency)			
F7.01	Jog Acceleration Time	5.0s	☆
Range: 0.0s to 6500.0s			
F7.02	Jog Braking Time	5.0s	☆
Range: 0.0s to 6500.0s Parameters F7.00 to F7.02 determine the basic values in JOG mode. As long as the JOG mode is used, the start mode is automatically and implicitly set to Direct start (parameter F3.00=0) and the stop mode to Active stop (parameter F3.07=0).			
F7.03	Jog Priority	1	☆
0: Inactive **1: Active** This parameter can be used to prioritize the jog function during operation of the frequency inverter or not. If this parameter is set to 1 and the inverter receives the JOG command during operation, the frequency inverter switches to JOG mode.			
F7.04 F7.05 F7.06	Skip Frequency 1 Skip Frequency 2 Skip Frequency Range	0.00Hz	☆
Range: 0.00Hz to F0.19 (maximum frequency) If the frequency inverter reaches one of the two step frequencies during operation, the skip frequency (jump frequency) range is skipped. In this way, frequencies at which resonance oscillations occur on the motor can be avoided. If the two skip frequencies are set to 0Hz, the function is deactivated. The following diagram provides a schematic representation.			



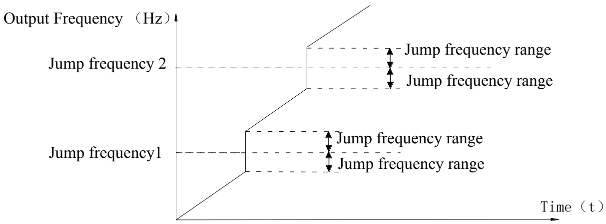
Schematic Diagram of Skip Frequency

F7.07	Skip Frequency Availability During Acceleration/Braking Process	0	☆

0: Inactive

0: Active

The value in this parameter specifies whether or not the skip frequency function should also be active when the motor is accelerating or braking. If the skip frequency function is activated and the operating frequency reaches a limit set by parameters F7.04 and F7.05, the entire skip frequency range is skipped immediately, as shown in the following diagram:



Schematic Diagram of Skip Frequency Availability in the Process of Acceleration or Braking

F7.08 F7.09 F7.10 F7.11 F7.12 F7.13	Acceleration Time 2 Braking Time 2 Acceleration Time 3 Braking Time 3 Acceleration Time 4 Braking Time 4	–	☆

Range: 0.0s to 6500.0s

The ST500 frequency inverter offers four groups with different braking and acceleration times. Various combinations of digital inputs can be used to switch between the groups. The settings for the digital inputs can be found in parameters F1.00 to F1.07, function 16/17.

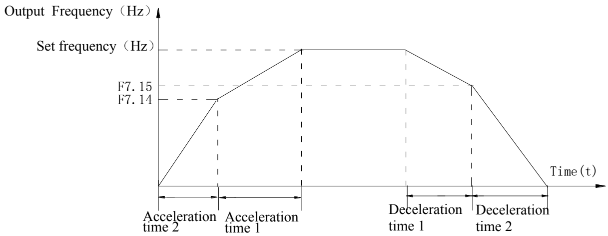
When using PLC program mode, one of the four groups can be selected for each individual program level.

Note: Changing the time resolution F0.15 applies to all four time pairs.

F7.14 F7.15	Switching Frequency for Acceleration Time 1 and 2 Switching Frequency for Braking Time 1 and 2	0.00Hz	☆

Range: 0.00Hz to F0.19 (maximum frequency)

This function is activated if a frequency >0Hz is entered and no digital input is used to switch between the braking and acceleration time groups. Parameters F7.14 and F7.15 are used to automatically switch between two different braking and acceleration times without the use of digital inputs. The switchover is realized using the actual frequency.

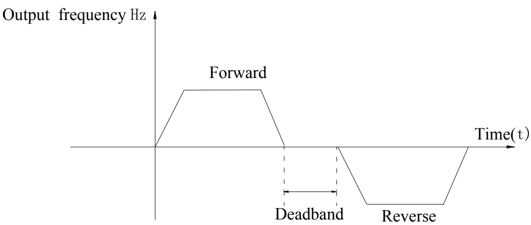


Schematic Diagram of Switching Between Acceleration and Braking

F7.16	Delay Between Forward and Reverse Operation	0.0s	☆

Range: 0.00s to 3600.0s

If the command for reverse operation is given during forward operation of the frequency inverter, the inverter brakes the motor down to 0Hz and then switches to reverse operation. A delay time can be set with this parameter. If the frequency inverter has reached 0Hz and this parameter is not 0.0s, it will wait for the time set in this parameter before the motor is switched to reverse mode. The following diagram shows the course of the frequency with the set delay.



Schematic Diagram of the Deadband of Forward and Reverse

F7.17	Disable Reverse Operation	0	☆

0: Reverse Operation Enabled

1: Reverse Operation Disabled

In various cases, it may be necessary to disable reverse operation of the motor, as otherwise damage may occur. If the parameter is set to 1, the motor is not able to switch to reverse operation, even if the command is given.

F7.18	Behavior at Target Frequency < Lower Limit Frequency	0	☆

In the event that the target frequency falls below the lower cut-off frequency set in F0.23, this parameter can be used to select from three possible behaviors:

0: Operation at Lower Limit Frequency
1: Stop
2: Operation at 0Hz

F7.19	Control Difference Compensation	0.00Hz	☆

Range: 0.00Hz to 10.00Hz

The control difference function is normally used when several motors on separate frequency inverters drive a load together. In the event that the load increases, this function ensures that the frequency is reduced so that the load is distributed evenly across the motors, similar to load control in the power grid.

The set value indicates the frequency reduction at nominal load.

F7.20	Time Limit for Power-On Time	0h	☆

Range: 0h to 36000h

If the power-on time in parameter F6.08 exceeds the power-on time set here, error 29 is triggered and a digital output assigned to function 24 is activated.

F7.21	Time Limit for Operating Time	0h	☆

Range: 0h to 36000h

If the operating time in parameter F6.07 reaches the operating time limit set here, error 26 is triggered and a digital output configured with function 12 is activated.

F7.22	Start-Up Protection	0	☆

0: Inactive
1: Active

If this parameter is set to 1 and, for example, a controller enable signal is present at the digital inputs when the inverter is connected to the power supply, the frequency inverter will not respond to this signal. This protection setting must be disabled first; then the frequency inverter will accept all signals again.

Similarly, if an error occurs during operation, the start-up protection must first be removed before the error can be acknowledged.

F7.23	Frequency Detection Value (FDT1)	50.00Hz	☆

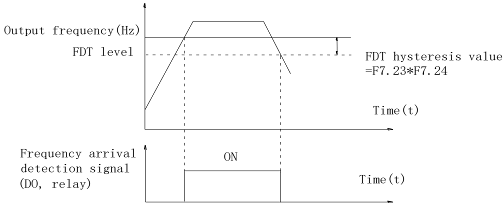
Range: 0.00Hz to F0.19 (maximum frequency)

F7.24	Range for Frequency Detection Value (FDT1)	5.0%	☆

Range: 0.0% to 100.0% (FDT1 level)

Parameters F7.23 and F7.24 can be used to program a frequency value which, when reached or exceeded, sets a digital output configured with function 3 to "1".

The range configured in F7.24 is the hysteresis range of the frequency related to F7.23 as a percentage, within which the digital output should remain switched to "1" during the braking process.

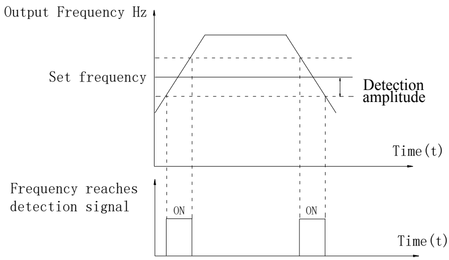


Schematic Diagram of the FDT Value

F7.25	Target Frequency Monitoring Range	0.0%	☆

Range: 0.00 to 100% (maximum frequency)

In contrast to F7.23, this parameter can be used to select a specific frequency range around the target frequency, whereby a digital output configured with function 4 is switched to "1" if the operating frequency is within this set range.



Schematic Diagram of Target Frequency Monitoring Range

F7.26	Frequency Detection Value (FDT2)	50.00Hz	☆

Range: 0.00Hz to F0.19 (maximum frequency)

F7.27	Range for Frequency Detection Value (FDT2)	5.0%	☆

Range: 0.0% to 100.0%(FDT2 level)

Another programmable frequency threshold. Output terminal function 25, otherwise the same as F7.23 and F7.24.

F7.28	Freely Selectable Frequency Value 1	50.00Hz	☆

Range: 0.00Hz to F0.19 (maximum frequency)

F7.29	Range for Freely Selectable Frequency Value 1	0.0%	☆

Range: 0.00% to 100.0% (maximum frequency)

F7.30	Freely Selectable Frequency Value 2	50.00Hz	☆

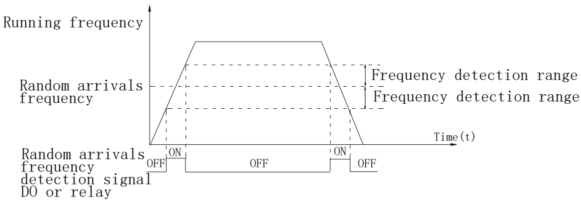
Range: 0.00Hz to F0.19 (maximum frequency)

F7.31	Range for Freely Selectable Frequency Value 2	0.0%	☆

Range: 0.00% to 100.0% (maximum frequency)

During operation, the output frequency changes in the control system. Parameters F7.28 to F7.31 can be used to monitor the output frequency during operation and to activate a digital output if it is within an interval around a specific frequency value F7.28 or F7.30.

Parameters F7.29 and F7.31 can be used to configure the range around the frequency values within which an output is activated with function 26 or 27, analogous to F7.25. The following diagram shows the function of the parameters in simplified form.



Schematic Diagram of Freely Selectable Frequency Values

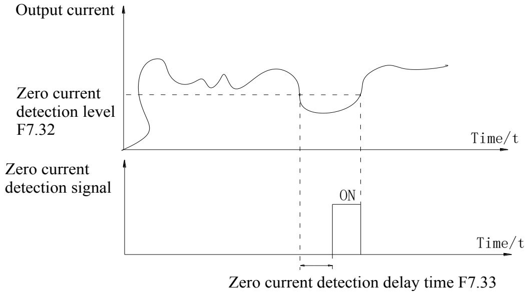
F7.32	Zero Current Limit	5.0%	☆

Range: 0.0% to 300.0% (rated motor current)

F7.33	Zero Current Delay Time	0.10s	☆

Range: 0.01s to 360.00s

If the output current of the frequency inverter falls below the zero current limit in parameter F7.32 and remains below this value for longer than the delay time set in parameter F7.33, a digital output configured with function 34 is switched to "1".



Schematic Diagram of Zero Current Detection

F7.34	Overcurrent Monitoring	200.0%	☆

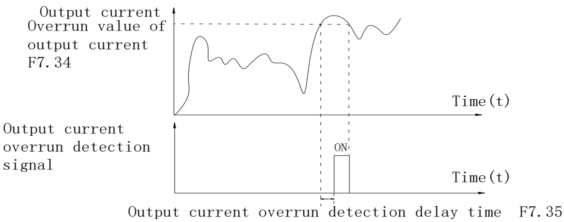
0.0% (not detected)

0.1% to 300.0% (of rated motor current)

F7.35	Overcurrent Delay Time	0.00s	☆

Range: 0.01s to 360.00s

If the output current of the frequency inverter exceeds the value in parameter F7.34 and this lasts longer than the delay time configured in F7.35, a digital output configured with function 36 is switched to "1". If parameter F7.34 is configured to the value 0.0%, overcurrent monitoring is deactivated. The following diagram illustrates the function:



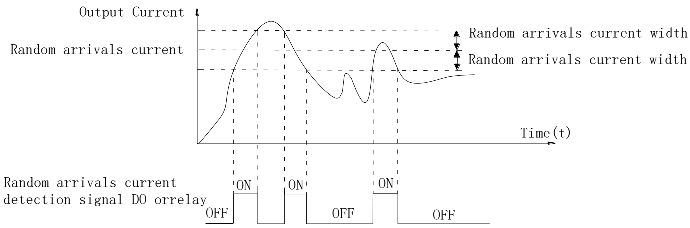
Schematic Diagram of Output Current Overrun Detection Signal

F7.36	Current Limit 1	-100.0%	☆
F7.37	Monitoring Range for Current Limit 1	0.0%	☆
F7.38	Current Limit 2	-100.0%	☆
F7.39	Monitoring Range for Current Limit 2	0.0%	☆

Range: 0.0% to 300.0% (of rated motor current)

Parameters F7.36 to F7.39 can be used to define two values and two ranges for output current monitoring. If the respective range is configured to 0%, only the value itself is monitored.

If the effective output current value is within the set range, a digital output configured with function 28 or 29 is switched to "1", as shown in the following diagram:



Schematic Diagram of Random Arrivals Current Detection

F7.40	IGBT Temperature Limit	75°C	☆

Range: 0°C to 100°C

If the temperature of the IGBT heat sink exceeds the limit set here, a digital output which is assigned function 35 will be activated.

F7.41	Cooling Fan Control	0	★

0: Fan Active when Inverter in Operation

With this setting, the fan on the heat sink is only activated if the inverter is in operation or if the heat sink temperature exceeds 40°C in standby mode.

1: Fan Always Active

The fan on the heat sink is activated both in operation and in standby.

F7.42	Timer Operation	0	★

0: Inactive

1: Active

This parameter activates the timer for the frequency inverter's timer mode. When the frequency inverter is started, the timer also starts from zero. The timer can be reset with input function 50. The remaining operating time can be viewed in parameter d0.20. If the operating time in parameter F7.44 is reached, the frequency inverter switches off automatically and the digital output with function 30 is activated.

This allows a fixed runtime to be realized independently of the duration of the switch-on signal by inverting the real or virtual output with function 30 in three-wire control operating mode (see F1.10) and connecting it to an additional input (this may require F1.40=1).

If the external FWD signal is also connected to an input with function 50, this results in a run-on function. Alternatively, this can be implemented via program mode.

F7.43	Source for Timer	0	★

0: F7.44

1: Analog Input AI1

2: Analog Input AI2

3: Control Panel Rotary Encoder

The control source for setting the runtime of the timer can be selected here. Parameter F7.44 is used directly if the value "0" is configured here. If one of the other values is selected as the control source, its control level is proportional to the value entered in F7.44, i.e. 100% control level of the input results in exactly the value in F7.44.

F7.44	Operating Time for F7.42	0.0 min	★

Range: 0.0 min to 6500.0 min

Configuring the runtime when using the timer mode.

F7.45	Current Operating Time Limit	0.0 min	★

Range: 0.0 min to 6500.0 min

If the current operating time (i.e. since the last start command or the last activity of input function 50) of the frequency inverter reaches this value, a digital output configured with function 40 is switched to "1". This parameter has no connection with parameters F7.20, F7.21 or F7.42 to F7.44. The time set here is only used to activate the output signal and has no further effect.

This can be used to configure a minimum power-on duration by inverting the real or virtual output with function 40 and assigning it to an additional input configured with enabling (this may require F1.40=1).

If the external FWD signal is also connected to an input with function 50, this results in a run-on function, as with F7.42.

F7.46	Wake-Up Frequency	0.00Hz	☆

Range: Standby Frequency (F7.48) to Maximum Frequency (F0.19)

F7.47	Delay for Wake-Up Frequency	0.0s	☆

Range: 0.0s to 6500.0s

F7.48	Standby Frequency	0.00Hz	☆

Range: 0.00Hz to Wake-Up Frequency (F7.46)

F7.49	Delay for Standby Frequency	0.0s	☆

Range: 0.0s to 6500.0s

Parameters F7.46 to F7.49 can be used to configure the lower limit of the operating range in which the frequency inverter operates the motor. The associated hysteresis range is the difference between the wake-up frequency F7.46 and the frequency for the idle state F7.48. To avoid frequent starting and stopping, the hysteresis range should not be too small; a difference of at least 2 Hz between F7.46 and F7.48 is recommended. If, for example, the frequency is controlled via an analog signal, operation at low frequencies can be prevented by defining the lower frequency in parameter F7.48. for use with PID control, see also FC.02.

F7.50	AI1 Lower Limit Voltage	3.10V	☆

Range: 0.00V to F7.51

F7.51	AI1 Upper Limit Voltage	6.80V	☆

Range: F7.50 to 10.00V

Parameters F7.50 and F7.51 are used to monitor the voltage at analog input AI1. If the value of the voltage applied to AI1 is less than F7.50 or greater than F7.51, a digital output configured with function 31 is switched to "1".

If F7.50 is set to e.g. 1V, and J3 is in position 1 or 2 (current), a signal can be triggered at "live zero" (4mA to 20mA) if an input signal is lost.

The triggering threshold should be well below 2V (corresponding to 4mA) in order to avoid false triggering.

F7.52 F7.53	Reserved		
F7.54	Jog Mode Configuration	H.0002	☆

Ones Digit: Jog Direction

0: Forward

1: Reverse

2: Control via Terminals

Tens Digit: Behavior at Jog End

0: Restore to Operating Mode Before Jog Mode

1: Stop

Hundreds Digit: Acceleration/Braking Time at Jog End

0: Use the Time Pair Active Before Jog Mode

1: Retain Acceleration/Braking Time from Jog Mode (F7.01/02)

These times are valid until the state configured in the tens digit is established, i.e. the inverter has accelerated or decelerated to the frequency valid before jog mode or the motor has stopped.

6.2.10 Errors and Protective Functions: F8.00 to F8.35

The behaviour of the frequency inverter in the event of an error and various protective functions can be configured in this parameter group.

Code	Parameter Name	Default	Mod.
F8.00	Overcurrent Protection	20	☆
Range: 0 to 100			
F8.01	Overcurrent Limit	-	☆
Range: 100% to 200% (of rated motor current) When starting an asynchronous motor or during load changes, a significantly higher current can flow than the rated motor current. The frequency is not increased any further or is even reduced until the output current falls below the limit set in F8.01 again. The configured value at F8.00 is the degree of protection. The higher this value is selected, the more aggressively the frequency inverter attempts to minimize the output current, although this slows down the dynamics. If it is known in advance that no high current will occur when the motor starts up, a lower value is more suitable here. If the motor has to move a large load, it is usually better to select a higher value, as higher currents normally occur here. If "0" is configured for F8.00, the overcurrent protection is deactivated.			
F8.02	Overload Protection	1	☆
Parameter F8.02 determines whether the overload protection function is activated or deactivated. **0: Inactive** If the overload protection is deactivated, the motor may be damaged due to overheating. It is recommended to use a thermal protection relay to protect the motor. **1: Active** The frequency inverter decides whether the motor is overloaded or not. This decision is made on the basis of the following formulas: 220% x F8.03 x rated motor current If the motor current is greater than the calculated value for more than 1 second, the frequency inverter immediately switches to overload protection with "Err.11". 150% x F8.03 x rated motor current If the rated motor current is greater than the calculated value for more than 60 seconds, the frequency inverter immediately switches to overload protection with "Err.11"			
F8.03	Degree of Overload Protection	1.00	☆

Range: 0.20 to 10.00

The degree of protection F8.03 should be set in accordance with the overload capacity of the motor. Incorrect settings can result in an unnoticed overload of the motor, which can cause thermal damage to the windings!

F8.04	Advance Warning of Overload	80%	☆

Range: 50% to 100%

This function serves as a pre-warning function before the frequency inverter activates the overload protection. When the configured value relating to the load limit configured in F8.02/03 is reached, it can activate a digital output configured with function 6 and thus, for example, send a signal to a controller or activate a warning LED.

The higher the configured value, the shorter the pre-warning time.

F8.05	Overvoltage Protection	0	☆

Range: 0 (No Overvoltage Stall) to 100

F8.06	Overvoltage / Braking Voltage	130%	☆

Range: 120% to 150%

During the braking process, the DC link voltage may increase. If the DC link voltage is higher than the value configured in F8.06, the frequency inverter interrupts the braking process and maintains the current output frequency until the DC link voltage is reduced.

In the case of an inverter with an integrated brake unit, this is activated unless it was prevented with F3.12=0. The set value of parameter F8.05 influences how quickly the frequency inverter reacts to an overvoltage in the DC link. If no large load is operated, it can be assumed that there will be no overvoltage in the DC link during the braking process. In this case, the parameter value for F8.05 should be set rather low. The parameter value "0" deactivates this overvoltage protection. Please note that the emergency shutdown (errors 5 to 7) is still active. See also Fb.02.

F8.07	Input Phase Loss Protection	11	☆

These functions are only available for ST500 series inverters of type G from 18.5kW or type F from 22kW.

Ones Digit: Protection in the Event of Input Phase Loss (Err. 12)

0: Inactive

1: Active

Tens Digit: Protection on Contactor Activation (Err. 17)

0: Inactive

1: Active

F8.08	Output Phase Loss Protection	1	☆

0: Inactive

1: Active

F8.09	Short-Circuit Protection	1	☆

0: Inactive
0: Active

After the frequency inverter has started up, it applies voltage to the U, V and W terminals for a short time and can thus determine whether the motor has a short circuit to earth or not.

F8.10	Number of Automatic Error Resets	0	☆

Range: 0 to 32767

The number of errors that the frequency inverter should automatically acknowledge can be defined in this parameter. If more errors have occurred during operation than have been configured here, the inverter remains in error status and each additional error must be acknowledged manually. After one hour of error-free operation, the error number is reset.

If the parameter value is greater than or equal to 1, the frequency inverter will automatically resume operation after the input voltage is lost.

F8.11	DO Terminals Active with Automatic Error Resets	0	☆

0: Inactive
1: Active

If the automatic fault reset function is activated for parameter F8.10, this parameter can be used to set the status of the digital output terminals during the fault reset.

F8.12	Time After Error Until Error Reset	1.0s	☆

Range: 0.1s to 100.0s

Setting the waiting time after an error occurs until it is automatically acknowledged. This time should be set so that the cause of the fault is very likely to be resolved during this time (e.g. overheating, overvoltage or undervoltage).

Particularly in the case of longer waiting times, a notice should be attached to the driven machine that it can restart automatically.

F8.13	Motor Overspeed Limit	20.0%	☆

Range: 0.0% to 50.0% (maximum frequency)

F8.14	Monitoring Time for Overspeed	1.0s	☆

Range: 0.0s to 60.0s

Parameters F8.13 and F8.14 are only taken into account if the motor is operated by vector control with speed sensor.

If the frequency inverter detects that the target frequency is exceeded by more than parameter F8.13 and this lasts longer than the set time F8.14, the inverter issues an error "Err. 43" and behaves according to the parameter settings in F8.20.

F8.15	Speed Deviation Limit	20.0%	☆

Range: 0.0% to 50.0% (maximum frequency)

F8.16	Monitoring Time for Speed Deviation	5.0s	☆

Range: 0.0s to 60.0s

Parameters F8.15 and F8.16 are only taken into account if the motor is operated by vector control with speed sensor. If the frequency inverter detects that the actual motor frequency deviates from the target frequency by more than F8.15 and this deviation lasts longer than the time configured in F8.16, the inverter issues an error "Err. 42" and behaves according to the parameter settings in F8.20.

If the measuring time at F8.16 is set to 0.0s, this function is deactivated.

F8.17	Behavior in the Event of an Error 1	00000	☆

These parameters can be used to define the behavior of the frequency inverter for individual fault types. You can choose between the following three types of behavior in the event of a fault:

Ones Digit: Motor Overload (Err.11)

0: Free Stop

If "Free Stop" is selected, the inverter displays "Err.<no.>" and switches off the outputs directly so that the motor coasts to a stop.

1: Stop in Selected Mode

If "Stop in Selected Mode" is selected, the inverter displays "Arr.<no.>", carries out the stop process in the currently selected mode and then displays "Err.<no.>"

2: Continue Operation

If "Continue Operation" is selected, the inverter displays "Arr.<no.>" and continues to run at the frequency defined via F8.24.

Tens Digit: Input Phase Loss (Err.12)

0 to 2; same as the ones digit

Hundreds Digit: Output Phase Loss (Err.13)

0 to 2; same as the ones digit

Thousands Digit: External Error Signal (Err.15)

0 to 2; same as the ones digit

Ten-Thousands Digit: Faulty Communication (Err.16)

0 to 2; same as the ones digit

F8.18	Behavior in the Event of an Error 2	00000	☆

Ones Digit: Encoder Fault (Err.20, encoder signal failed for longer than b0.34)

0: Free Stop

1: Switch to V/f Control and Stop

2: Switch to V/f Control and Continue Operation

Tens Digit: EEPROM Error when Reading/Writing Function Parameter Value (Err.21)

0: Free Stop

1: Stop in Selected Mode

Hundreds Digit: Reserved

Thousands Digit: Motor Overheating (Err.45)

0 to 2; same as F8.17 ones digit

Ten-Thousands Digit: Operating Time Limit Reached (Err.26)

0 to 2; same as F8.17 ones digit

F8.19	Behavior in the Event of an Error 3	00000	☆

Ones Digit: User-Defined Error 1 (Err.27)

0 to 2; same as the F8.17 ones digit

Tens Digit: User-Defined Error 2 (Err.28)

0 to 2; same as the F8.17 ones digit

Hundreds Digit: Power-On Time Limit Reached (Err.29)

0 to 2; same as the F8.17 ones digit

Thousands Digit: Load Loss (Err.30)

0: Free Stop

1: Stop in Select Mode

2: Decelerate to 7% of the Rated Motor Frequency and Continue Operation

Automatically return to the target frequency when the load is detected again.

Ten-Thousands Digit: Loss of PID Feedback Signal (Err.31)

0 to 2; same as the F8.17 ones digit

F8.20	Behavior in the Event of an Error 4	00000	☆

Ones Digit: Speed Deviation Too High (Err.42)

0 to 2; same as the F8.17 ones digit

Tens Digit: Limit Value for Motor Speed Exceeded (Err.43)

0 to 2; same as the F8.17 ones digit

Hundreds Digit: Position Error / Excessive Deviation of Motor Data (Err.51)

0 to 2; same as the F8.17 ones digit

<u>**Thousands Digit: Reserved**</u>

<u>**Ten-Thousands Digit: Reserved**</u>

F8.21 F8.22 F8.23	Reserved		★
F8.24	Frequency Source for Operation After Error	0	☆

If an error occurs during operation of the frequency inverter and the behaviour in the event of an error is configured so that the inverter should continue operation, this parameter can be used to select the frequency for this case.

0: Maintain Current Frequency
1: Operation at Target Frequency
2: Operation at Upper Limit Frequency
3: Operation at Lower Limit Frequency
4: Operation at Substitute Frequency (F8.25)

F8.25	Substitute Frequency in the Event of an Error	100%	☆

Range: 60.0% to 100.0%

If operation with substitute frequency is configured in parameter F8.24, the substitute frequency can be entered in this parameter. The value is a percentage of the maximum frequency (F0.19).

F8.26	Behavior upon Short-Term Voltage Loss	0	☆

Parameters F8.26 to F8.29 can be used to define the behavior in the event of a brief voltage dip. In the event of a voltage dip at the input of the frequency inverter, where the voltage falls below the voltage configured in F8.29, the behaviour can be defined using parameter F8.26. The following settings are available:

0: No Function
The function for compensating a short-term voltage drop is deactivated. If the voltage falls below the minimum voltage Fb.01 Err.09 is triggered.

1: Braking with Recuperation
If a voltage drop occurs, the inverter brakes the motor and thus draws rotational energy from the load in favour of the DC link until the DC link voltage is above the voltage range configured in F8.29 again. If the voltage returns to normal and remains in the normal range for longer than the time configured in F8.28, the motor is accelerated again.

2: Braking to Stop
If a voltage drop occurs, the frequency inverter brakes the motor and stops it.

F8.27	Frequency Switching Points for Momentary Power Cut Braking	90%	☆

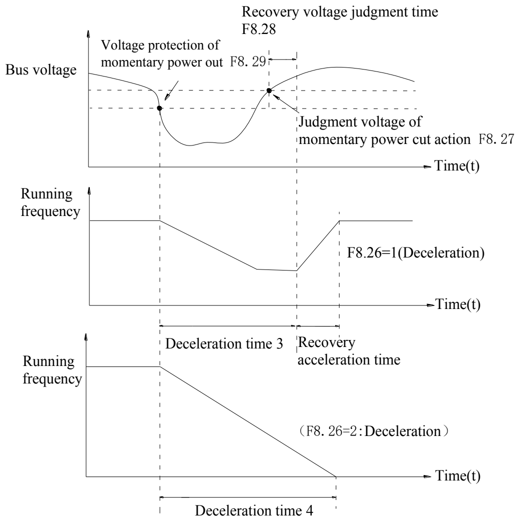
Range: 50.0% to 100.0%

F8.28	Measuring Time for Voltage Loss	0.50s	☆

Range: 0.00s to 100.00s

F8.29	Normal Voltage Reference	80.0%	☆

Range: 50.0% to 100.0% (standard bus voltage)



Schematic Diagram of Momentary Power Cut Action

F8.30	Protection in the Event of Load Loss	0	☆

0: Inactive

1: Active

In the event of a load loss on the motor, the motor current drops. If the protective function is activated with F8.30, the frequency inverter reacts to the reduced motor current and carries out the action configured in the thousands digit of F8.19. The protection is only activated if the motor current is below the limit set in parameter F8.31 and this lasts longer than the time period in F8.32. In the case of F8.19=2, the inverter reduces the frequency to 7% of the rated frequency.

If a normal load is then restored because the connection has been re-established, the inverter automatically returns to normal operation.

F8.31	Limit for Load Loss	10.0%	☆

Range: 0.0% to 100.0% (of rated current)

F8.32	Measuring Time for Load Loss	1.0s	☆

Range: 0.0s to 60.0s

F8.33	Temperature Sensor on Motor	0	☆

0: Inactive

1: Active

If there is a temperature sensor on the motor and it is connected to the terminals on the terminal strip, this parameter must be set to "1" and the following parameters must be adjusted if necessary.

If the temperature sensor is a PT100, it must be connected to terminals S1, S2 and GND; if it is a PT1000 or a PTC with a step characteristic (from <1kΩ to >>1kΩ), it must be connected to terminals S1 and GND; in this case, S2 remains unconnected.

F8.34	Limit Value for Motor Temperature	110	☆

Range: 0 to 200

F8.35	Pre-Warning Value for Motor Temperature	90	☆

Range: 0 to 200

If the motor temperature rises above the value set in parameter F8.34, the frequency inverter switches to the error status "Err.45". In addition, a pre-warning value can be configured in parameter F8.35, above which a digital output configured with function 39 switches to indicate the increased motor temperature at an early stage. If a PTC with step characteristic (from <1kΩ to >>1kΩ) is used, the value set here is irrelevant, as the trigger threshold is always exceeded at the step temperature.

Please note that with such a PTC, no meaningful temperature values can be displayed in d0.41 and thus, the advance warning feature cannot function.

F8.36 F8.37	Reserved	–	★
F8.38	Tolerance Range Below the Setpoint	3%	☆

Range: 0.0% to 100.0%

F8.39	Tolerance Range Above the Setpoint	0%	☆

Parameters F8.38 and F8.39 define the tolerance range around the setpoint for the automatic frequency reduction configured in E2.29 to E2.32. In contrast to E2.06, the percentage specification here refers to the PID setpoint. Please also note the information on FC.02.

Not available for all models!

6.2.11 Communication Parameters: F9.00 to F9.07

This parameter group contains all communication parameters that are required to establish a connection with the inverter via RS485, MODBUS or CANLink. A more detailed description of the communication protocol can be found in the appendix of this manual.

Code	Parameter Name	Default	Mod.
F9.00	Baud Rate	6005	☆

The baud rate for the individual transmission protocols can be set in this parameter. Please note that the susceptibility to interference increases with the baud rate.

Ones Digit: MODBUS

0: 300BPS

1: 600BPS

2: 1200BPS

3: 2400BPS

4: 4800BPS

5: 9600BPS

6: 19200BPS

7: 38400BPS

8: 57600BPS

9: 115200BPS

Tens Digit: Profibus-DP

0: 115200BPS

1: 208300BPS

2: 256000BPS

3: 512000BPS

Hundreds Digit: Reserved

Thousands Digit: CANlink

0: 20

1: 50

2: 100

3: 125

4: 250

5: 500

6: 1M

Code	Parameter Name	Default	Mod.
F9.01	Data Format	0	☆

0: No Parity, 2 Stop Bits (8-N-2)

1: Even Parity, 1 Stop Bit (8-E-1)

The 8-E-1 format must be supported by every MODBUS device, so select this setting if the format cannot be selected on your other MODBUS devices.

2: Odd Parity, 1 Stop Bit (8-O-1)

3: No Parity, 1 Stop Bit (8-N-1)

F9.02	Address of the Frequency Inverter	1	☆

Range: 1 to 250, 0 for master address

The address of the frequency inverter, which is subsequently used for communication, can be defined here. If the frequency inverter is to be used as the master, a "0" can be configured.

F9.03	Response Delay	2ms	☆

Range: 0ms to 20ms

This parameter sets the minimum delay time that must elapse after complete receipt of the received data before the inverter starts sending the response.

F9.04	Time Until Time-Out	0.0	☆

0.0: Inactive

0.1s to 60.0s

If there is no communication for longer than the configured time, error 16 is triggered. A parameter value of 0.0s deactivates this function. Only activate this function if you are really sure that the inverter should stop without constant communication.

F9.05	Data Log	31	☆

Ones Digit: MODBUS

0: Non-Standard MODBUS Protocol

2 bytes for the data length of the response.

1: Standardized MODBUS Protocol

1 byte for the data length of the response.

Tens Digit: Profibus

0: PPO1 Format

1: PPO2 Format

2: PPO3 Format

3: PPO5 Format

F9.06	Resolution for Current	0	☆

0: 0.01A

1: 0.1A

F9.07	Interface Type	0	☆

0: Modbus Interface (integrated)

1: Profibus Expansion Card

2: Reserved

3: CANlink Expansion Card

6.2.12 Torque Control Parameters: FA.00 to FA.07

Code	Parameter Name	Default	Mod.
FA.00	Control Mode (Speed/Torque)	0	★

The ST500 can be switched to torque control. There are two functions of the digital input terminals that are related to torque control:

- Function 29 (disabling torque control, fixed to speed control, has priority over function 46)
- Function 46 (switch between speed and torque control; when the terminal is active, the setting made in FA.00 is inverted)

0: Speed Control (S)

1: Torque Control (T)

FA.01	Source for Torque Setting	0	★

0: Control Panel (FA.02)

1: Analog Input AI1

2: Analog Input AI2

3: Control Panel Rotary Encoder

4: High-Frequency Pulse

5: Communication Interface

6: MIN (AI1, AI2)

7: MAX (AI1, AI2)

8: Analog Input AI3

FA.02	Torque Value Setting	150%	☆

Range: -200.0% to 200.0%

If torque control is used and the control panel is selected as the source of torque control, the desired torque can be entered in this parameter. 100% corresponds to the nominal torque of the frequency inverter.

The setting range is -200% to +200%, negative values mean a reversal of the direction of rotation. If a value of 1 to 8 is entered as the parameter value for FA.01, then 100% of the source refers to the value entered here.

FA.03	Torque Control Acceleration Time	0.00s	☆

FA.04	Torque Control Braking Time		

Range: 0.00s to 650.00s

When using torque control, the difference between the torque output by the motor and the torque absorbed by the load determines the rate of change in speed. This can result in very rapid changes in motor speed, which can lead to noise and high mechanical loads. A slower change in speed can be achieved by setting parameters FA.03 and FA.04.

In use cases that require a fast response, the two parameters should be set as small as possible. Correctly entered motor data is also required.

Example: If two motors are to move the same load, it should be ensured that the load is distributed evenly to both motors. This can be achieved by using one frequency inverter as the "master" with speed control and the second inverter as the "slave" with speed control.

The output torque of the master inverter is then used as the torque source of the second inverter.

FA.05 FA.06	Maximum Frequency in Forward Mode Maximum Frequency in Reverse Mode	50.00 Hz	☆

Range: 0.00Hz to Maximum Frequency (F0.19)

Parameters FA.05 and FA.06 can be used to set the maximum frequency during operation when using torque control. This additional limitation is necessary because with a constant torque, the speed can "run away" very quickly in the event of a sudden load reduction.

FA.07	Torque Filter Time	0.00s	☆

Range: 0.00s to 10.00s

This can be used to adjust the response time if the control is too unsteady.

6.2.13 Control Optimization Parameters: Fb.00 to Fb.09

Code	Parameter Name	Default	Mod.
Fb.00	Fast Response to Overcurrent	1	☆

0: Inactive
1: Active

The frequency inverter's fast response to overcurrent can help to prevent an overcurrent fault during operation and thus ensure smooth operation without interruptions.

If the frequency inverter has to use this function over a longer period of time, the components may overheat. To prevent damage, the protective function of the inverter then intervenes and the inverter switches to the error state with the error ID "Err.40".

Fb.01	Measuring Point for Undervoltage	100.0%	☆

Range: 50.0% to 140.0%

The measuring point at which the inverter switches to the undervoltage error state and the error message "Err.09" appears on the display can be defined here. The 100% factory setting here refers to basic values that depend on the different versions of the ST500 frequency inverters. The different basic DC link voltage values are:

- Single-phase 220V or three-phase 220V: 200V
- Three-phase 380V: 350V
- Three-phase 480V: 450V
- Three-phase 690V: 650V

Fb.02	Measuring Point for Overvoltage	–	★

Range: 200.0V to 2500.0V

This parameter can be used to set the voltage above which the inverter reports an overvoltage in the DC link. If this value is set too low, this can lead to increased operational interruptions.

This parameter should **not** normally be changed by the user. The default setting for 230V models is 400V, for 400V models 810V, for 480V models 890V and for 690V models 1300V DC link voltage.

Note: These are fixed limit values that can only be reduced but not increased with this parameter; values that are higher than the default setting are ignored.

Fb.03	Dead Zone Compensation	1	☆

This parameter does not normally need to be adjusted by the user. Only in special cases where the output signal of the frequency inverter leads to abnormal behavior at the motor (oscillation) can the problem possibly be solved by changing the compensation method. Compensation method 2 is recommended from 45kW power.

0: No Compensation

1: Compensation Mode 1

2: Compensation Mode 2

Fb.04	Current Compensation	5	☆

Range: 0 to 100

This parameter used to set the current measurement of the inverter. A value that is configured too high can have a negative effect on the control behaviour. Normally this does not need to be changed.

Fb.05	Vector Optimization Without Encoder	1	★

0: No Optimization

1: Optimization Mode 1

For use cases that require a linear torque.

2: Optimization Mode 2

For use cases that require stable speed.			
Fb.06	Frequency for Switching the Pulse Width Modulation (PWM) Stages	12.00Hz	☆
Range: 0.00Hz to 15.00Hz			
Fb.07	Type of PWM Below 85Hz	0	☆
0: Asynchronous Pulse Width Modulation Below 85Hz **1: Synchronous Pulse Width Modulation Across Entire Frequency Range** The parameters Fb.06 and Fb.07 are only valid when using V/f control. Below Fb.06, 7-stage PWM is used, above 5-stage PWM. Either synchronous or asynchronous modulation can be used as the type of modulation. When using synchronous pulse width modulation, the carrier frequency changes linearly with the output frequency in order to keep the ratio between useful and noise signal the same. Above 85Hz, the synchronous modulation type is always used. Continuous synchronous modulation should be activated if the output frequency frequently passes the 85Hz mark. If the output frequency always remains below or above 85Hz, a changeover is not necessary.			
Fb.08	Random PWM Depth	0	☆
0: Inactive **1 to 10: PWM Carrier Frequency Random Depth** By activating random pulse width modulation, the EMC load on external components and any whistling noise that may occur on the motor can be minimized. If this parameter is set to "0", random pulse width modulation is deactivated. If a value between 1 and 10 is configured, the depth of the random pulse width modulation changes and can lead to different results.			
Fb.09	Dead Zone Time	150%	★
Range: 100% to 200% This parameter should not be changed. It relates to the switching times of the IGBTs.			

6.2.14 Extended Function Parameters: FC.00 to FC.02

Code	Parameter Name	Default	Mod.
FC.00	Reserved		
FC.01	Link Factor	0	☆

Range: 0.00 to 10.00

When using the link function to connect two inverters, the transmitted value can be multiplied by a factor. If the value "0" is configured here, the link function is deactivated. If the link function is used, the communication address (F9.02) of the master must be set to the value "248" and that of the slave inverter to a value from "1" to "247". The frequency of the slave inverter then results from:

$f_{Slave} = f_{Master}$ x FC.01 ± manual changes using the UP/DOWN buttons

Code	Parameter Name	Default	Mod.
FC.02	PID Start Deviation	0	☆

Range: 0.0 to 100.0

The PID control only activates the inverter when the amount of deviation between the setpoint and actual value is greater than set in this parameter and the wake-up frequency is exceeded. This prevents increased energy consumption due to constant readjustment, which occurs in particular in the form of limit cycles caused by static friction.

To be able to use this function, E2.27 must be set to 1 so that this control deviation is calculated in the stopped state and can wake up the inverter again. This parameter is used together with F7.46 to F7.49.

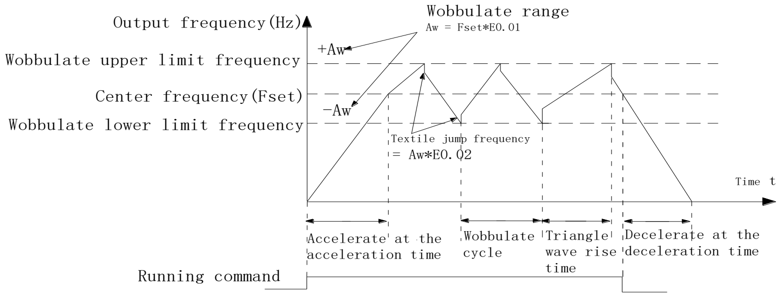
If the inverter is in operation and, for example, in the case of pressure control, the PID feedback is greater than the setpoint, i.e. the control deviation is negative and the output frequency setpoint calculated by the PID controller therefore falls below the value in F7.48, the inverter switches to an idle state after waiting for the amount of time specified in F7.49 and allows the load to coast to a free stop.

If the inverter is in this idle state, the RUN command is still present, the amount of control deviation is greater than configured here and the frequency setpoint calculated by the PID controller is greater than the value in F7.46, the inverter is restarted after the waiting time in F7.47 has elapsed.

Note: If this parameter is used together with the automatic frequency reduction E2.29 to E2.32, the start deviation configured here should be greater than the tolerance range configured in F8.38 and F8.39, as exceeding the PID start deviation can otherwise lead to the inverter waking up prematurely!

6.2.15 Oscillation and Counting Functions: E0.00 to E0.11

The oscillation function and the counting functions can be set in this parameter group.



Schematic Diagram of Oscillation

Code	Parameter Name	Default	Mod.
E0.00	Oscillation Mode	0	☆

The oscillation function can be used for various applications in the textile or chemical industry or other branches of industry. During oscillation, the frequency fluctuates in a configured range around the target frequency. The oscillation amplitude can be set with parameters E0.00 and E0.01. If parameter E0.01 is configured to "0", the oscillation function is deactivated.

The frequency range remains limited by the upper and lower cut-off frequency F0.20 and thus by the maximum frequency F0.19. If the frequency falls below F0.23, the action selected in F7.18 comes into effect and the sleep frequency must also be observed.

0: Relative to Main Frequency (F0.07)

The target frequency is selected as the reference for the width of the oscillation in E0.01 in order to enable a variable target frequency-dependent oscillation in which the same relative frequency deviation is always used.

1: Relative to Maximum Frequency (F0.19)

The maximum frequency is used as a reference so that the sweep frequency range is independent of the target frequency and the same absolute frequency deviation is always used.

Code	Parameter Name	Default	Mod.
E0.01	Oscillation Range	0.0%	☆

Range: 0.0% to 100.0%

This parameter can be used to determine the range around the oscillation center point in which the frequency inverter oscillates.

Code	Parameter Name	Default	Mod.
E0.02	Skip Frequency with Oscillation	0.0%	☆

Range: 0.0% to 50.0%

If a value >0.0% is configured in this parameter, the frequency inverter skips a certain frequency range at the start of each oscillation cycle. This frequency range corresponds to the percentage range set in this parameter. This percentage range relates to the oscillation range set in parameter E0.01 and is therefore also dependent on the setpoint frequency or constant, depending on the setting in E0.00.

E0.03	Duration of an Ocillation Cycle	10.0s	☆

Range: 0.1s to 3000.0s

Parameter E0.03 determines the duration of an entire oscillation cycle.

E0.04	Rise Time Coefficient	50.0%	☆

Range: 0.1% to 100.0%

The proportion of the rise time in the oscillation cycle can be influenced using parameter E0.04, the fall time takes up the rest of the cycle.

E0.05	Target Length	1000m	☆

Range: 0m to 65535m

E0.06	Current Length	0m	☆

Range: 0m to 65535m

E0.07	Pulse per Meter	100.0	☆

Range: 0.1 to 6553.5

The three parameters mentioned above are required to set the length monitoring. A digital input assigned with function 27 "Length counter" serves as the input terminal. The sampled number of pulses is then divided by the value in parameter E0.07. This calculates the current length in parameter E0.06. If the current length (E0.06) is greater than the length set in parameter E0.05, a digital output with function 10 "Length reached" is set to "1".

The digital input DI5 should be used for high pulse frequencies.

The currently counted length in parameter E0.06 can be reset to "0" using a digital input terminal with function 28 "Reset length counter".

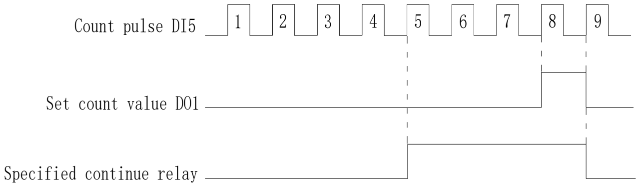
E0.08 E0.09	Upper Limit Count Value Lower Limit Count Value	1000	☆

Range: 1 to 65535

The pulse generator is sampled by one of the digital input terminals. Function 25 must be assigned to this terminal. At higher pulse frequencies, the digital input DI5 should be used for this purpose. If the counted value reaches the value configured in parameter E0.08, a digital output configured with function 8 is set to "1". If the value configured in E0.09 is reached, a digital output configured with function 9 is set to "1" and counting continues until the value in E0.08 is reached. With the following pulse, both outputs are reset and the counter restarts.

The current counter reading d0.12 can be reset to 0 by using a digital input terminal with function 26.

This is shown in the following figure for E0.08=8 and E0.09=4:



Schematic Diagram of the Upper and Lower Limit Count Values

E0.10	Pulse Count Value for Reduced Frequency	0	☆

0: Inactive
1 to 65535

E0.11	Frequency for Reduction	5.00Hz	☆

Range: 0.00Hz to F0.19 (max frequency)

This function is intended to reduce the output frequency shortly before the limit value configured in E0.08 is reached so that, for example, a position can be approached with high precision without overshooting. E0.10 specifies how many pulses before the braking should take place, i.e. the reduction takes place if the count value d0.12 >= E0.08 - E0.10.

If the current counter value d0.12 is above this reduction limit and the inverter is in the stopped state, the inverter cannot be restarted until the counter value is reset to 0 by using a digital input terminal with function 26.

This function is deactivated in the default setting E0.10=0.

6.2.16 Multi-Speed Command and Simple PLC: E1.00 to E1.51

Parameter group E1 contains parameters for 16 multi-speeds and program operation. During operation, the digital input terminals can be used to switch back and forth between individual segments as required.

Code	Parameter Name	Default	Mod.
E1.00 E1.01 E1.02 E1.03 E1.04 E1.05	Speed 0X Speed 1X Speed 2X Speed 3X Speed 4X Speed 5X	0.0%	☆

E1.06	Speed 6X		
E1.07	Speed 7X		
E1.08	Speed 8X		
E1.09	Speed 9X		
E1.10	Speed 10X		
E1.11	Speed 11X		
E1.12	Speed 12X		
E1.13	Speed 13X		
E1.14	Speed 14X		
E1.15	Speed 15X		

Range: -100.0% to 100.0%

The multiple speed levels 0X - 15X can be used as a frequency setting or as a setpoint for PID control. When used as a frequency specification, the value to be configured refers to the maximum frequency as a percentage. When used as a PID setpoint, the value is configured directly.

The way in which the digital inputs must be switched in order to select one of the 16 levels is explained in parameter group F1.

E1.16	PLC Program Operating Mode	0	☆

The schematic diagram below shows the use of program operation.

This is activated by setting the frequency control source in F0.03 or F0.04 to 7 "Simple PLC".

In program mode, the multiple speeds at E1.00 to E1.15 are used as a frequency setting, whereby a negative value reverses the direction of rotation. There are three different types of program operation:

0: Stop After Running a Single Program Cycle

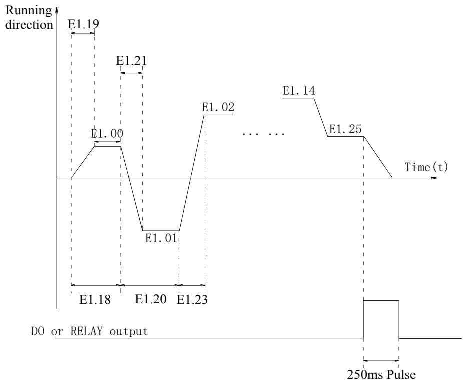
After the frequency inverter has run through all activated program segments, the inverter stops. To restart, the start command must be issued again.

1: Continue Operation After a Single Program Cycle Has Been Completed

After the frequency inverter has run through all activated program segments, operation continues with the frequency and direction of rotation specified by the last program segment.

2: Repeat Program

After the frequency inverter has run through a program cycle, the program sequence is repeated until a stop command is issued.



Schematic Diagram of Simple PLC Mode

E1.17	Memory Function for Program Operation	11	☆

This parameter describes the behavior of the frequency inverter when the inverter is stopped and when the power supply is switched off during program operation.

Ones Digit: Behavior in the Event of Power-Off During Program Operation

0: Do Not Save the Last Program Segment

If the frequency inverter is switched off during program operation, the frequency inverter does not know which program segment was run last.

1: Save the Last Program Segment

When switching off, the last program segment is saved and operation is continued with this segment when switching on again.

Tens Digit: Behavior in the Event of a Stop Command During Program Operation

0: Do Not Save the Last Program Segment

If a stop command is issued during program operation, when the controller is enabled again operation is continued from the beginning of the configured program.

1: Save the Last Program Segment

When the program sequence is stopped, the inverter continues operation with the program segment that was active before the stop command was executed after the controller is enabled again.

E1.18	Segment Runtime T0 for Segment 0X	0.0s (h)	☆

Range: 0.0s (h) to 6500.0s (h)

E1.19	Acceleration/Braking Time Group for Segment 0X	0	☆

Range: 0 to 3

E1.20	Segment Runtime T1 for Segment 1X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.21	Acceleration/Braking Time Group for Segment 1X	0	☆
Range: 0 to 3			
E1.22	Segment Runtime T2 for Segment 2X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.23	Acceleration/Braking Time Group for Segment 2X	0	☆
Range: 0 to 3			
E1.24	Segment Runtime T3 for Segment 3X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.25	Acceleration/Braking Time Group for Segment 3X	0	☆
Range: 0 to 3			
E1.26	Segment Runtime T4 for Segment 4X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.27	Acceleration/Braking Time Group for Segment 4X	0	☆
Range: 0 to 3			
E1.28	Segment Runtime T5 for Segment 5X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.29	Acceleration/Braking Time Group for Segment 5X	0	☆
Range: 0 to 3			
E1.30	Segment Runtime T6 for Segment 6X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.31	Acceleration/Braking Time Group for Segment 6X	0	☆
Range: 0 to 3			
E1.32	Segment Runtime T7 for Segment 7X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.33	Acceleration/Braking Time Group for Segment 7X	0	☆

Range: 0 to 3			
E1.34	Segment Runtime T8 for Segment 8X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.35	Acceleration/Braking Time Group for Segment 8X	0	☆
Range: 0 to 3			
E1.36	Segment Runtime T9 for Segment 9X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.37	Acceleration/Braking Time Group for Segment 9X	0	☆
Range: 0 to 3			
E1.38	Segment Runtime T10 for Segment 10X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.39	Acceleration/Braking Time Group for Segment 10X	0	☆
Range: 0 to 3			
E1.40	Segment Runtime T11 for Segment 11X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.41	Acceleration/Braking Time Group for Segment 11X	0	☆
Range: 0 to 3			
E1.42	Segment Runtime T12 for Segment 12X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.43	Acceleration/Braking Time Group for Segment 12X	0	☆
Range: 0 to 3			
E1.44	Segment Runtime T13 for Segment 13X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			
E1.45	Acceleration/Braking Time Group for Segment 13X	0	☆
Range: 0 to 3			
E1.46	Segment Runtime T14 for Segment 14X	0.0s (h)	☆
Range: 0.0s (h) to 6500.0s (h)			

E1.47	Acceleration/Braking Time Group for Segment 14X	0	☆

Range: 0 to 3

E1.48	Segment Runtime T15 for Segment 15X	0.0s (h)	☆

Range: 0.0s (h) to 6500.0s (h)

E1.49	Acceleration/Braking Time Group for Segment 15X	0	☆

Range: 0 to 3

Parameters E1.18 to E1.49 can be used to define the run times as well as the acceleration and deceleration times of the individual segments in program mode. Segments with a runtime of 0.0 are deactivated. When selecting the braking and acceleration times, four groups are available, which can be found under the following parameters:

- Group 0: F0.13 and F0.14
- Group 1: F7.08 and F7.09
- Group 2: F7.10 and F7.11
- Group 3: F7.12 and F7.13

E1.50	Time Unit of Segment Runtimes	0	☆

0: S (seconds)

The segment runtimes in parameters E1.18, E1.20, E1.22, etc. are specified in seconds.

1: H (hours)

The segment runtimes in parameters E1.18, E1.20, E1.22, etc. are specified in hours.

E1.51	Source for Segment 0X	0	☆

0: E1.00

1: Analog Input AI1

2: Analog Input AI2

3: Control Panel Rotary Encoder

4: High-Frequency Pulse

5: PID Setpoint

The "PID setpoint" selection does not make sense if the multiple speeds themselves exceed the source for the PID setpoint (E2.00=6), as this would result in a recursive assignment.

6: Target Frequency (F0.01)

This can be modified using the UP/DOWN buttons as described in group F0.

7: Analog Input AI3

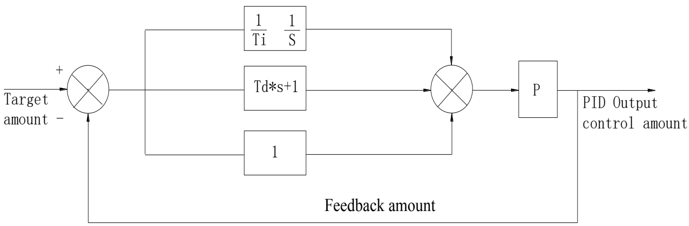
6.2.17 PID Function: E2.00 to E2.32

PID controllers automatically influence the physical variables in a mostly technical process in such a way that a specified setpoint is maintained as well as possible even in the event of interference. for this purpose, the PID controller within a control loop continuously compares the signal of the reference variable (setpoint) with the measured and fed-back control variable (actual value) and determines a manipulated variable from the difference between the two variables – the control deviation (control difference) – which influences the controlled system in such a way that the control deviation is minimized in the steady state.

Because the individual control loop elements have a time response, the controller must amplify the value of the control deviation and at the same time compensate for the time response of the system so that the controlled variable reaches the setpoint in the desired manner – from aperiodic to damped (overshoot).

Incorrectly set controllers make the control loop too slow, lead to a large control deviation or to undamped oscillations of the controlled variable and thus possibly to the destruction of the controlled system. An incorrectly selected feedback variable or incorrectly connected feedback variable or incorrect configuration of E2.03, on the other hand, causes the controller to increase the control deviation instead when attempting to minimize it until the maximum possible values (mechanical stop, limit values, protective circuit) are reached.

The manipulated variable here is the setpoint frequency, as the PID controller serves as a frequency control source for the inverter.



Flow Diagram of Process PID Principle

Code	Parameter Name	Default	Mod.
E2.00	Source for PID Setpoint	0	☆

0: E2.01
1: Analog Input AI1
2: Analog Input AI2
3: Control Panel Rotary Encoder
4: High-Frequency Pulse
5: Communication Interface
6: Multi-Speed Operation
7: Analog Input AI3

Code	Parameter Name	Default	Mod.
E2.01	PID Setpoint	50.0%	☆

Range: 0.0% to 100.0%

The setpoint for the PID control must be configured here if the parameter E2.00=0 has been set. The setting range is specified in [%] and refers to the max possible value of the feedback variable (e.g. configured in F1.12 to F1.24 for AI1/2).

E2.02	Source for PID Feedback Variable	0	☆

The value set in this parameter determines the source for the feedback variable in the PID control loop. This can be, for example, a pressure sensor at an analog input or a fixed variable. The source must be different from the setpoint source.

0: Analog Input AI1
1: Analog Input AI2
2: Control Panel Rotary Encoder
3: AI1 – AI2
4: High-Frequency Pulse
5: Communication Interface
6: AI1 + AI2
7: MAX (|AI1|, |AI2|)
8: MIN (|AI1|, |AI2|)
9: Analog Input AI3

E2.03	PID Behavior	0	☆

Behavior of the controlled system.

0: Positive

An increase in the control variable leads to an increase in the feedback variable, so a positive control deviation (setpoint > actual value) must be compensated for by increasing the control variable. **Examples:** Control of the line tension during winding, pressure, speed and position control.

1: Negative

An increase in the control variable leads to a decrease in the feedback variable, so a positive control deviation must be compensated for by decreasing the control variable. **Examples:** Control of the line tension during unwinding, negative pressure control, level control during pump-down, temperature control via ventilation.

E2.04	PID Value Range	1000	☆

Range: 0 to 65535

The PID value range is a unitless value that is used for scaling the display of the PID setpoint value d0.15 and the feedback signal d0.16. 100% of the feedback signal corresponds to the value range in this parameter. If, for example, the value 2000 is configured here and the setpoint is set to 100%, the value 2000 is shown in the display for parameter d0.15.

E2.05	PID Reverse Frequency Limit	0.00Hz	☆

Range: 0.00 to F0.19 (maximum frequency)

In some cases, the output frequency of the inverter may become negative and the direction of rotation reversed. This parameter can be used to set the upper limit of the frequency in the reverse direction of rotation (See also F7.17).

E2.06	PID Deviation Limit	2.0%	☆

Range: 0.0% to 100.0%

If the deviation between the setpoint and the reset value is smaller than the value configured here (specified in percentage points, i.e. in relation to the value range, not the setpoint), the inverter pauses the PID control and keeps the output frequency stable. This prevents running irregularities due to constant readjustment, which also occurs in particular in the form of limit cycles caused by static friction, and can improve the overshoot behavior. However, a value that is too high can significantly increase overshooting. Implicitly deactivates E2.29.

E2.07	PID Differential Component Limitation	0.10%	☆

Range: 0.00% to 100.00%

A high D component in a PID control leads to more sensitive control, but also increases interference and can lead to oscillation if the D component is set too high. This parameter can be used to set the upper limit for the D component.

E2.08	PID Setting Time	0.00s	☆

Range: 0.00s to 650.00s

The PID setting time is the time required by the frequency inverter to set the effective setpoint to the new value after a change in the setpoint specification from 0% to 100%. If, for example, a time of 5.00s is configured here and the setpoint specification is changed by 10% of the setpoint range using a potentiometer at the analog input, the effective setpoint is not adjusted immediately, but slowly linearly over the time of (10% of 5s = 0.5s), which prevents the controller from overreacting to the setpoint jump.

E2.09 E2.10	Filter Time Feedback Variable Filter Time Manipulated Variable	0.00s	☆

Range: 0.00s to 60.00s

The filter times for the feedback variable and the manipulated variable can be increased in the event of interference in order to enable more stable operation or to dampen abrupt frequency changes, but the higher the two times are set, the slower the control becomes.

E2.11	Loss Detection of PID Feedback Signal	0.0%	☆

0.0%: Monitoring Inactive

Range: 0.1% to 100.0%

E2.12	Time Until Loss Detection	0.0s	☆

Range: 0.0s to 20.0s

Parameters E2.11 and E2.12 can be used to determine whether the feedback signal is completely lost during operation. This is useful, for example, in conjunction with a sensor with "live zero", which supplies a value range of 4 to 20mA; measured values between 0 and 4mA then indicate an error. Please note that a scaling set in F1.12 to F1.25 may have to be adjusted so that the error range can be displayed in the percentage value range. Parameter E2.12 specifies how long the feedback signal may fall below the limit in E2.11 before the inverter detects the loss of the feedback signal and reports error no. 31 "E.PID". At the 0.0% setting, monitoring is deactivated.

E2.13	Proportional Gain KP1	80.0	☆

Range: 0.0 to 200.0

E2.14	Integration Time Ti1	0.50s	☆

Range: 0.01s to 10.00s

E2.15	Differential Time Td1	0.000s	☆

Range: 0.00s to 10.000s

The individual components of the PID controller can be set using parameters E2.13 to E2.15. Here, 100.0 at KP means that the manipulated variable is set to the maximum frequency at 100% deviation between the feedback and setpoint values, while the Ti time indicates how long it takes after a deviation of 100% for the integral component to set the manipulated variable to the maximum frequency, and the Td time indicates the time within which the feedback signal must change by 100% for the differential component to output the maximum manipulated variable. The I component therefore becomes stronger with a shorter Ti, while this is the case for the D component with a longer Td.

E2.16	Proportional Gain KP2	20.0	☆

Range: 0.0 to 200.0

E2.17	Integration Time Ti2	2.00s	☆

Range: 0.01s to 10.00s

E2.18	Differential Time Td2	0.000s	☆

Range: 0.00s to 10.000s

For some applications, a single group of PID settings is not sufficient. If this is the case, an additional group of PID parameters can be defined using parameters E2.16 to E2.18.

E2.19	Switching PID Parameter Groups	0	☆

This parameter can be used to select how to switch between the two different PID parameter groups.

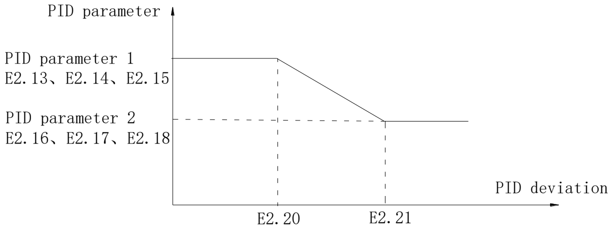
0: No Switching

1: Switching via Digital Input Terminals DI

If digital input terminals are to be used for switching, function 43 must be assigned to one of the digital input terminals. As long as this input is active, the system switches to parameter group 2.

2: Automatic Switching Depending on Deviation

When automatically switching between the two parameter groups, the PID controller decides independently when to switch. The switchover depends on the deviation of the setpoint from the feedback value. The limits at which the switchover takes place can be set with parameters E2.20 and E2.21. Between the two limit values, the effective parameters are formed by linear interpolation from the two parameter sets. The following schematic diagram illustrates the switchover:



PID Parameter Switching

E2.20	PID Deviation for Group 1	20.0%	☆

Range: 0.0% to E2.21

E2.21	PID Deviation for Group 2	80.0%	☆

Range: E2.20 to 100.0%

As shown in the figure under parameter E2.19, parameters E2.20 and E2.21 can be used to set the limits for switching the PID parameters.

E2.22	PID Integral Settings	00	☆

Ones Digit: Separation I Component

0: Inactive

1: Active

To enable the integral component of the PID controller to be paused by a digital input terminal assigned to function 38, the isolation of the I component must be activated.

Tens Digit: I Component Stops when Maximum/Minimum PID Value Is Reached

0: Inactive

1: Active

If the tens digit of this parameter is set to 1, the I component of the PID controller is automatically deactivated when a limit value is reached. Activating this function can counteract any overshooting (wind-up) when the setpoint is reached.

E2.23	PID Start Value	0.0%	☆

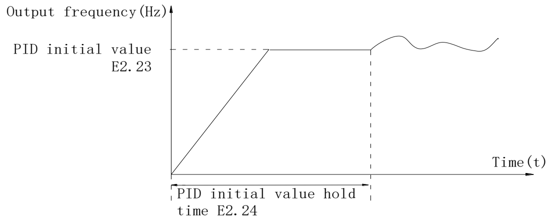
Range: 0.0% to 100.0% (max frequency)

E2.24	Waiting Time After Start Value	0.00s	☆

Range: 0.00s to 360.00s

When the inverter is started, the manipulated variable of the PID controller is first set to the start value E2.23, taking the start ramp into account, and held there for the time specified at E2.24. After this time has elapsed, the PID control starts, taking the feedback variable into account.

The following diagram shows the process with the set start value and waiting time:



Functional Schematic of the PID Start Value

E2.25	Maximum Deviation in FWD Mode	1.00%	☆

Range: 0.00% to 100.00%

E2.26	Maximum Deviation in REV Mode	1.00%	☆

Range: 0.00% to 100.00%

Parameters E2.25 and E2.26 specify the amount of the maximum permissible change in the manipulated variable between two calculation points of the PID controller (every 2 ms) in FWD and REV mode. This suppresses excessively fast changes and stabilizes the control.

E2.27	Behavior of the PID Controller in Stop State	1	☆

This parameter determines whether the PID controller should continue to calculate the controlled variable after a STOP command or not. This is necessary, for example, so that the inverter can wake up again after a stop due to falling below the sleep frequency F7.48 as soon as the control deviation and therefore the calculated output frequency has increased again.

0: Stop Calculation at STOP Signal
1: Continue Calculation at STOP Signal

E2.28	Reserved		
E2.29	Automatic Frequency Reduction	1	☆

0: Inactive
0: Active

E2.30	PID Frequency Limit Value	25Hz	☆

Range: 0Hz to Max Frequency (F0.19)

If the feedback variable (actual value) exactly reaches the reference variable (setpoint) or exceeds it by less than the upper tolerance limit configured in F8.39 (the lower tolerance limit F8.38 is not active at this point), the control value (output frequency) is periodically reduced by this function.

Above the upper tolerance limit, the reduction is left to the PID controller. If the current output frequency reaches the value set in parameter E2.30 or falls below the frequency specified in parameter F7.48 the frequency inverter is set to idle mode. In some situations with indirect dynamic equilibrium, e.g. pressure control of flowing water or temperature control via a ventilation system, this function can ensure more even and stable control if E2.06 is not sufficient or leads to excessive overshooting. Furthermore, this function ensures that the machine runs down slowly after reaching the setpoint instead of remaining in a dynamic equilibrium.

The PID deviation limit function E2.06 is implicitly deactivated when the automatic frequency reduction is triggered, so that the frequency can be reduced, but until then it remains active in the configured range above and below the setpoint. Therefore, when using this function, E2.06 should be configured to 0 so that the two functions do not interfere with each other.

Note: by default, E2.06=2.0.

E2.31	Time Between Measurements	10	☆

Range: 0s to 3600s

Every E2.31 seconds, the system checks whether the actual value is still within the tolerance range around the setpoint value. As soon as the actual value falls below the setpoint minus F8.38 or above the setpoint plus F8.39, the inverter returns to the frequency currently calculated by the PID controller.

Note: the parameter functions F8.38 and F8.39 are not available in all models. If you require these for your application, please contact us.

E2.32	Number of Measurements	20	☆

Range: 1 to 500

If the actual value is still within the tolerance range around the setpoint after this number of individual measurements, the frequency is reduced by 0.5Hz. This process is repeated until either 0Hz is reached, the switch-on frequency E2.30 or F7.48 is undershot, or the actual value leaves the tolerance range around the setpoint.

6.2.18 Virtual DI, Virtual DO: E3.00 to E3.21

Code	Parameter Name	Default	Mod.
E3.00 E3.01 E3.02 E3.03 E3.04	VDI1 Function VDI2 Function VDI3 Function VDI4 Function VDI5 Function	0	★

Range: 0 to 51

The terminal functions of the virtual terminals are identical to the functions of the digital input terminals. A detailed description of the various functions can be found in parameters F1.00 to F1.09.

Code	Parameter Name	Default	Mod.
E3.05	VDI Toggle	00000	☆

This parameter can be used to determine the status of the virtual terminals, provided this is enabled in parameter 3.06. Among other things, this detour also makes it possible to use the input functions from the communication interface.

Ones Digit: VDI1

0: Inactive

0: Active

Tens Digit: VDI2

0 to 1; same as the ones digit

Hundreds Digit: VDI3

0 to 1; same as the ones digit

Thousands Digit: VDI4

0 to 1; same as the ones digit

Ten-Thousands Digit: VDI5

0 to 1; same as the ones digit

Code	Parameter Name	Default	Mod.
E3.06	VDI Status Source	11111	★

In contrast to the real digital inputs DI, the state of the virtual terminals can neither be defined by parameter E3.05 nor determined by the state of the associated virtual output terminal.

Ones Digit: VDI1

0: Determination of Status by VDO Terminal

The state of the virtual input terminal is determined by the state of the corresponding virtual output terminal VDO with the same terminal number.

1: Determination of Status by Parameter E3.05

The status of the virtual input terminal can be determined in parameter E3.05 and is not dependent on the virtual output terminal.

Tens Digit: VDI2

0 to 1; same as the ones digit

Hundreds Digit: VDI3

0 to 1; same as the ones digit

Thousands Digit: VDI4

0 to 1; same as the ones digit

Ten-Thousands Digit: VDI5

0 to 1; same as the ones digit

To better explain the function of the virtual terminals, here are two simple examples:

Example 1

The following function is to be realized: the inverter automatically outputs an error and stops if a frequency higher than the upper limit frequency is specified by a signal at analog input AI1.

The following settings are required for this:

First, the function of the virtual terminal VDI1 must be assigned “User-defined error 1” (E3.00=44). Then the status of VDI1 must be determined by the virtual output terminal VDO1. To do this, the parameter must be set to E3.06=xxxx0, i.e. the ones digit must be set to 0. Now the function of the virtual output terminal VDO1 must be set to “Signal at AI1 lower/greater than lower/upper limit” (E3.11=31).

If the signal at AI1 now exceeds the limit set in F7.51 (do not forget to set the lower limit F7.50 to zero), the virtual terminal VDO1 is set to “1”. As the status of the virtual input terminals VDI1 is determined by VDO1, the inverter now receives the signal for “User-defined error 1” and issues the error message “Err.27”.

Example 2

The following function is to be implemented: the motor starts automatically after the inverter is switched on. The following settings are required for this:

First, F1.40 is set to “1” so that functions can be configured on more than one input terminal. This allows the virtual input terminal VDI1 to be configured with the “Forward operation” function (E3.00=1). The status of the terminal should then be dependent on parameter E3.05. To do this, parameter E3.06=xxxx1, i.e. the ones digit must be set to 1 (factory setting). To switch the virtual terminal VDI1 permanently to “1”, the ones digit of parameter E3.05=xxxx1 must be set. Parameter F0.11 is configured to “1” or “4” so that the inverter accepts the command from the virtual terminal. Finally, check whether the parameter F7.22 is still set to “0” (factory setting) so that the inverter also accepts commands that were already present at the terminals before complete initialization.

After switching on the inverter, the motor should now automatically switch to forward operation.

E3.07 E3.08	Assign Analog Input AI1 with DI Function Assign Analog Input AI2 with DI Function	0	★

E3.09	Assign Analog Input AI3 with DI Function		

Range: 0 to 51

In addition to the analog input functions, the analog inputs of the frequency inverter can also be assigned functions of the digital input terminals. In this case, a voltage greater than 7V corresponds to the high level and a voltage of less than 3V corresponds to the low level. The state in the hysteresis range between 3V and 7V depends on the last clear state.

Note: the reference potential GND of the analog inputs is independent of the reference potential COM of the digital inputs in the as-delivered state. The functions are identical to the functions of the real digital input terminals. Entering a "0" deactivates this function for the respective terminal.

E3.10	Switch High-Active/Low-Active for AI-as-DI Terminals	000	★

This parameter is used to switch the logic for parameters E3.07 to E3.09.

Caution: the logic levels are factory-set exactly the opposite of all other real or virtual inputs and outputs!

Ones Digit: AI1

0: High-Active

The input is considered active if a sufficiently high voltage is present at the input terminal (input signal high-active, logic ON at high level.

1: Low-Active

In particular, the input is considered active if the input terminal is connected to the corresponding ground, i.e. the (relay) contact connected to the input and GND is closed (input signal low-active, logic ON at low level).

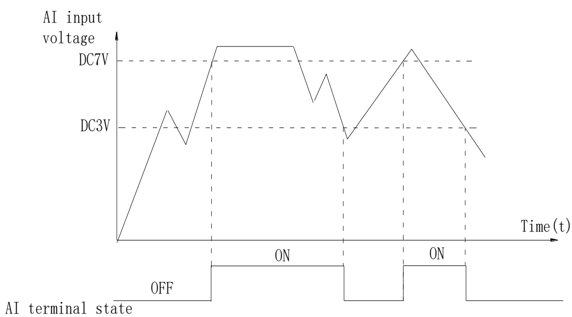
Tens Digit: AI2

0 to 1; same as the ones digit

Hundreds Digit: AI3

0 to 1; same as the ones digit

The following drawing shows the relationship between the voltages at the analog inputs and the logical state of the digital functions:



High-Active/Low-Active State of AI-as-DI Terminals

E3.11 E3.12 E3.13 E3.14 E3.15	VDO1 Output Function VDO2 Output Function VDO3 Output Function VDO4 Output Function VDO5 Output Function	0	☆

Range: 0 to 40

Parameters E3.11 to E3.15 can be used to define the functions of the five virtual output terminals. These are identical to the functions of the real output terminals.

If "0" is configured as a function, the status of the virtual output terminal corresponds to that of the corresponding real DI input terminal with the same number, i.e. a DI is routed to a VDI simultaneously and can thus trigger two input functions at once.

E3.16	Switch High-Active/Low-Active for VDO Terminals	00000	☆

This parameter is used to switch the logic for parameters E3.11 to E3.15.

Ones Digit: VDO1

0: Positive Logic

The output is considered active if the virtual output element (optocoupler) is actively controlled and connects the output terminal to the corresponding ground (output signal low-active).

1: Negative Logic

The output is considered active if the virtual output element (optocoupler) is not activated and the output terminal is not connected to earth (output signal high-active).

Tens Digit: VDO2

0 to 1; same as the ones digit

Hundreds Digit: VDO3

0 to 1; same as the ones digit

Thousands Digit: VDO4

0 to 1; same as the ones digit

Ten-Thousands Digit: VDO5

0 to 1; same as the ones digit

E3.17 E3.18 E3.19 E3.20 E3.21	Delay for VDO1 Delay for VDO2 Delay for VDO3 Delay for VDO4 Delay for VDO5	0.0s	☆

Range: 0.0s to 3600.0s

Delay times of the virtual outputs until the "switching operation" is executed. This is a symmetrical delay corresponding to a shift register, i.e. both switching edges are delayed equally and all switching operations are replicated true to the original after the delay time has elapsed. **Note:** All pending switching operations are deleted as soon as the inverter switches to the STOP state. In particular, a stopped inverter cannot be restarted by a delayed signal. When VDOx output function is "0", output status is decided by DI1 to DI5 input status on the control board, VDOx and Dix one-to-one correspondence. When the output function selection is not "0", VD0x function setting and using method is same as D0 in F2 output parameter, please read F2 group parameter description. The VDOx output valid status can be set by E3.16 setting, select positive or negative logic.

6.2.19 Motor Parameters: b0.00 to b0.35

The motor parameter group contains all the parameters required to enable smooth operation with the frequency inverter.

Code	Parameter Name	Default	Mod.
b0.00	Motor Type	0	★
The type of motor connected to the frequency inverter can be selected here. **0: All Common Three-Phase Asynchronous Motors** **1: Three-Phase Asynchronous Motor Especially for Frequency Inverters** Motors specially designed for operation with variable frequency. **2: Permanently Excited Synchronous Motor** A rotary encoder and its calibration with b0.27=11 or 12 are absolutely necessary!			
b0.01	Rated Power	-	★
Range: 0.1kW to 1000.0kW			
b0.02	Rated Voltage	-	★
Range: 1V to 2000V			
b0.03	Rated Current	-	★
Range: **0.01A to 655.35A (Inverter Power ≤ 55kW)** **0.1A to 6553.5A (Inverter Power > 55kW)**			
b0.04	Rated Frequency	-	★
Range: 0.01Hz to F0.19 (maximum frequency)			

b0.05	Rated Speed	-	★

Range: 1rpm to 36000rpm

Parameters b0.00 to b0.05 are parameters that can be taken from the motor nameplate. The inverter will not output a higher voltage than that entered in b0.02, even if the target frequency exceeds the frequency entered in b0.04, i.e. if a motor is to be operated above its rated frequency with a correspondingly higher voltage, the values for the higher maximum frequency **must** be calculated and entered here.

The rated current of the motor must be between 30% and 100% of the rated current of the frequency inverter, otherwise compliance with the specifications cannot be guaranteed. The rated motor current cannot exceed the rated current of the inverter; any higher value entered will be ignored. by entering the rated motor current, the frequency inverter is able to protect the motor from overload and operate it more effectively.

The other values are required as a basis for automatic calibration. The vector control in particular is dependent on correct motor parameters.

b0.06 b0.07	Asynchronous Motor Stator Resistance Asynchronous Motor Rotor Resistance	-	★

Range:

0.001Ω to 65.535Ω (Inverter Power ≤ 55kW)

0.0001Ω to 6.5535Ω (Inverter Power > 55kW)

b0.08 b0.09	Asynchronous Motor Leakage Inductance Asynchronous Motor Counter-Inductance	-	★

Range:

0.01mH to 655.35mH (Inverter Power ≤ 55kW)

0.001mH to 65.535mH (Inverter Power > 55kW)

b0.10	Asynchronous Motor No-Load Current	-	★

Range:

0.01A to b0.03 (Inverter Power ≤ 55kW)

0.1A to b0.03 (Inverter Power > 55kW)

Parameters b0.06 to b0.10 are only valid when using an asynchronous motor. Normally, these values cannot be found on the nameplate of the motor, but are determined by calculation or automatic calibration by the frequency inverter.

As with b0.03, the number of decimal places depends on the rated inverter power (above/below 55kW). If one of the parameters b0.01 or b0.02 is changed by the user, the frequency inverter automatically calculates and modifies the parameter values of b0.06 to b0.10 on the basis of standard values of an asynchronous motor connected in a star connection.

If the automatic calibration of the parameters does not work, these values can also be requested from the motor manufacturer and entered here.

b0.11	Synchronous Motor Stator Resistance	-	★

Range:
0.001Ω to 65.535Ω (Inverter Power ≤ 55kW)
0.0001Ω to 6.5535Ω (Inverter Power > 55kW)

b0.12 b0.13	Inductance D-Axis Inductance Q-Axis	-	★

Range:
0.01mH to 655.35mH (Inverter Power ≤ 55kW)
0.001mH to 65.535mH (Inverter Power > 55kW)

b0.14	Counter-EMF Coefficient for Synchronous Motor	-	★

Range: 0.1V to 6553.5V

The parameters b0.11 to b0.14 are, analogous to the characteristic values of an asynchronous motor in b0.06 to b0.10, the characteristic values of a synchronous motor.

b0.15 to b0.26	Reserved		
b0.27	Automatic Calibration of Motor Parameters (Auto Tuning)	0	★

Automatic calibration of the motor parameters should, if possible, be carried out without a load on the motor in order to enable more efficient operation by the frequency inverter. If it is not possible to disconnect the load from the motor, automatic calibration of most parameters can also be carried out with a load.

For automatic calibration, the parameters b0.00 - b0.05 must be entered first. The type of automatic calibration is then selected in this parameter. After entering the desired calibration method and confirming with the "ENTER" button, the display shows "RUNE" and "doInG". To start the calibration, the "RUN" button must be pressed. The inverter then performs static auto-tuning; in no load mode this is followed by the dynamic auto-tuning and the engine starts.

Calibration can only be started if the control panel is activated as a controller and the "RUN" button is enabled. The following values can be configured (after execution, the parameter value automatically resets to "0".

0: No Automatic Calibration of Motor Parameters

1: Asynchronous Motor with Load
The parameters b0.00 to b0.05 must be entered correctly before starting the measurement. The measurement then determines the parameters b0.06 to b0.08 automatically.

2: Asynchronous Motor Without Load

When calibrating the parameters without load, the inverter initially measures the same values as when calibrating with load. once the measurement is complete, the frequency inverter accelerates the motor to 80% of the rated motor speed within the time configured in F0.13. The inverter is then stopped within the time configured in F0.14.

Therefore, F0.13 and F0.14 must be set to sensible values that are appropriate for the inertia of the motor. This determines the parameters b0.06 to b0.10 and the PI parameters of the vector current control loop F5.12 to F5.15.

If an encoder card is used, not only the motor data from the rating plate must be entered in b0.00 to b0.05, but also parameters b0.28 and b0.29 or b0.35. The phase sequence b0.31 is then determined automatically.

11: Synchronous Motor with Load

The parameters of the synchronous motor must be entered in b0.00 to b0.05 before starting the measurement. The frequency inverter also determines the pole wheel angle during the measurement.

12: Synchronous Motor Without Load

When measuring without load, the inverter proceeds in the same way as when measuring with load. In addition, the inverter then accelerates the motor to the frequency in F0.01 within the time in parameter F0.13, analogous to the asynchronous motor calibration.

After a certain time, the frequency inverter decelerates the motor within the time configured in F0.14 and stops.

Please note that the parameters b0.28, b0.29 and, if applicable, b0.35 must be entered before starting the calibration. The parameters b0.11 to b0.14 and b0.30 to b0.33 are determined automatically, as are the PI parameters of the vector current control loop F5.12 to F5.15.

b0.28	Encoder Type	0	★

The ST500 frequency inverter supports several types of position encoders and associated pulse generator adapter cards. All five types of encoders can usually be used with a synchronous motor, whereas only an ABZ incremental encoder or a rotary encoder can usually be used with an asynchronous motor. If a PG card is installed, the type must be entered correctly here.

0: ABZ Incremental Encoder
1: UVW Incremental Encoder
2: Rotary Transformer (requires configuration of b0.35)
3: Sine and Cosine Encoder
4: UVW Encoder

b0.29	Number of Pulses per Rotation	2500	★

Range: 1 to 65535

If the motor is operated in vector control mode with pulse generator, this parameter must be set correctly, otherwise malfunctions may occur during operation.

b0.30	Pole Wheel Angle	0.00°	★

Range: 0.00° to 359.90° This parameter is only valid when using synchronous motors.			
b0.31	AB Phase Sequence	0	★
0: Forward **1: Reverse**			
b0.32	UVW Encoder Zero Angle	0.00	★
Range: 0.00 to 359.90			
b0.33	UVW Phase Sequence	0	★
0: Forward **1: Reverse**			
b0.34	Encoder Signal Failure Monitoring Time Threshold	0.0s	★
0.0s: Monitoring Inactive **Range: 0.1s to 10.0s** This parameter is used to set the time threshold for detecting an encoder disconnection. When the inverter detects a disconnection and this lasts longer than the time set here, the inverter will put out an error with the ID: "Err.20".			
b0.35	Number of Pole Pairs of the Rotation Encoder	1	★
Range: 1 to 65535			

6.2.20 System Parameter Group: y0.00 to y0.04

In the system parameter group, the frequency inverter can be reset to factory settings, parameter sets can be transferred to the control panel and back and the parameter display can be modified.

Code	Parameter Name	Default	Mod.
y0.00	Parameter Initialization	0	★
After the function has been executed, the parameter value is automatically reset to "0". **0: No Operation** **1: Reset to Factory Settings (not including motor parameters)** The frequency inverter resets all parameters (except for the motor parameters) to the factory settings. **2: Delete Runtime Data** With this setting, all errors, runtimes (see also F7.20) and consumption data of the frequency inverter are reset.			

3: Reset to Factory Settings (including motor parameters)

4: Save Current Parameter Set

All parameters entered by the user are saved.

501: Restore User Backup Parameters

The parameters saved with function "4" are restored.

10: Delete the Control Panel Memory

The contents of control panel memory locations 1 and 2 are deleted.

11: Upload Current Parameter Set to Control Panel Memory Location 1

All parameters set by the user are uploaded to the control panel in memory location 1.

12: Upload Current Parameter Set to Control Panel Memory Location 2

All parameters set by the user are uploaded to the control panel in memory location 2.

21: Download Parameter Set from Control Panel Memory Location 1

All parameters in control panel memory location 1 are loaded into the inverter.

22: Download Parameter Set from Control Panel Memory Location 2

All parameters in control panel memory location 2 are loaded into the inverter.

y0.01	User Password	0	☆

Range: 0 to 65535

Unless the value "0" is set for this parameter, protection by a user password is active. once a password has been configured, this password must be entered each time the menu is called up. The display then changes to " " and can be changed to the correct password using the UP/DOWN and "SHIFT" buttons or the adjusting dial. Finally, press "ENTER" to access the normal menu. The password lock is then released until the menu is exited.

To reset the password, this parameter must be reset to "0". This also happens when resetting to factory settings using y0.00 function 1 or 3.

Caution: Make sure that you do not accidentally enter a value in y0.01 after changing y0.00 (as the interface will automatically jump to the next parameter)!

y0.02	Display Settings for Function Parameters	11111	★

Ones Digit: Parameter Group d

0: Do Not Display

1: Display

Tens Digit: Parameter Group E

0 to 1; same as the ones digit

Hundreds Digit: Parameter Group b

0 to 1; same as the ones digit

Thousands Digit: Parameter Group y1

0 to 1; same as the ones digit

Ten-Thousands Digit: Parameter Group L

0 to 1; same as the ones digit

y0.03	Display Settings for User Parameters	00	☆

Ones Digit: Reserved

Tens Digit: User Parameter Group

0: Do Not Display

1: Display

y0.04	Function Parameters Modifiable	0	☆

0: Modifiable

1: Not Modifiable

Setting function parameters to not be modifiable can prevent any accidental changes once you have set up the function parameters the way they are needed for your application.

6.2.21 Error Memory: y1.00 to y1.30

This parameter group contains the frequency inverter's fault memory. Both the type of error or the error code and the status data recorded at the time the error occurred can be called up in order to obtain the most detailed error description possible.

Code	Parameter Name	Default	Mod.
y1.00 y1.01 y1.02	Error Type in Error Memory 1 Error Type in Error Memory 2 Error Type in Error Memory 3	–	●

Range: 0 to 51

The parameters y1.00 to y1.02 contain the error number of the last three errors that occurred. Error memory 3 contains the data of the last error that occurred, memory 2 contains the data of the second-last error, and memory 1 contains the data of the third-last error. See the chapter on "Troubleshooting" for further information.

The error codes have the following meanings:

0: No Error

1: Inverter Protection Function

2: Overcurrent During Acceleration

3: Overcurrent During Braking

4: Overcurrent at Constant Speed

5: Overvoltage During Acceleration

6: Overvoltage During Braking

7: Overvoltage at Constant Speed

8: Control Voltage Error

Input voltage outside the specification or auxiliary voltage sources overloaded

9: Undervoltage

Also occurs when the power supply is intentionally disconnected during operation, as the converter cannot recognize that this is done intentionally.

10: Inverter Overload

11: Motor Overload

12: Input Phase Loss

13: Output Phase Loss

14: Overheating of the Inverter IGBT Module

15: External Error

An external error was signaled to the inverter by means of input terminal functions 11 or 33.

16: Communication Error

17: (External) Circuit Breaker Faulty

18: Current Measurement Error

19: Calibration Faulty

20: Encoder Card/Encoder Disk Error, Encoder Signal Longer than b0.34

21: EEPROM Read/Write Error

22: Hardware Error

23: Short Circuit on Motor to Earth

24: Reserved

25: Reserved

26: Operating Time Reached

27: User-Defined Error 1

28: User-Defined Error 2

These two errors are generated by the input terminal functions 44 and 45.

29: Duty Cycle Reached

30: Load Loss

31: PID Feedback Signal Loss

40: Current Limitation

41: Motor Switchover During Operation

42: Speed Deviation Too High

43: Overspeed

45: Motor Overheating

51: Position Error (Start)

The deviation between the entered and actual motor parameters is too large.

COF: Communication with Control Panel Faulty

y1.03	Frequency in Error Memory 3 (most recent)	●
y1.04	Motor Current in Error Memory 3	●
y1.05	DC Link Voltage in Error Memory 3	●
y1.06	Input Terminal Status in Error Memory 3	●

The status of the input terminals is displayed as a decimal number with the following binary coding:

BIT9	BIT8	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
DI0	DI9	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

If the terminal was active, this is displayed as "1" in the binary number.

y1.07	Output Terminal Status in Error Memory 3	●

The status of the output terminals is displayed as a decimal number with the following binary coding:

BIT4	BIT3	BIT2	BIT1	BIT0
REL2	SPA	Reserve	REL1	SPB

If the terminal was active, this is displayed as "1" in the binary number.

y1.08	Reserved	
y1.09	Power-On Time in Error Memory 3	●
y1.10	Operating Time in Error Memory 3	●
y1.11 y1.12	Reserved	
y1.13	Frequency in Error Memory 2	●
y1.14	Motor Current in Error Memory 2	●
y1.15	DC Link Voltage in Error Memory 2	●
y1.16	Input Terminal Status in Error Memory 2	●

The status of the input terminals is displayed as a decimal number with the following binary coding:

BIT9	BIT8	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
DI0	DI9	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

If the terminal was active, this is displayed as "1" in the binary number

y1.17	Output Terminal Status in Error Memory 2	●

The status of the output terminals is displayed as a decimal number with the following binary coding:

BIT4	BIT3	BIT2	BIT1	BIT0
REL2	SPA	Reserve	REL1	SPB

If the terminal was active, this is displayed as "1" in the binary number.

y1.18	Reserved	
y1.19	Power-On Time in Error Memory 2	●
y1.20	Operating Time in Error Memory 2	●
y1.11 y1.12	Reserved	
y1.23	Frequency in Error Memory 1 (oldest)	●
y1.24	Motor Current in Error Memory 1	●
y1.25	DC Link Voltage in Error Memory 1	●
y1.26	Input Terminal Status in Error Memory 1	●

The status of the input terminals is displayed as a decimal number with the following binary coding:

BIT9	BIT8	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
DI0	DI9	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

If the terminal was active, this is displayed as "1" in the binary number

y1.27	Output Terminal Status in Error Memory 1	●

The status of the output terminals is displayed as a decimal number with the following binary coding:

BIT4	BIT3	BIT2	BIT1	BIT0
REL2	SPA	Reserve	REL1	SPB

If the terminal was active, this is displayed as "1" in the binary number.

y1.28	Reserved	
y1.29	Power-On Time in Error Memory 1	●
y1.30	Operating Time in Error Memory 1	●

7 EMC (Electromagnetic Compatibility)

7.1 Definition

Electromagnetic compatibility (EMC) describes the usually desired condition that technical devices do not interfere with each other through unwanted electrical or electromagnetic effects. It deals with technical and legal issues of unwanted mutual interference in electrical engineering.

7.2 EMC Standard

Sourcetronic frequency inverters are tested in accordance with current international standards:

- **IEC/EN61800-3: 2004** (Adjustable speed electrical drives – Part 3: EMC requirements including specific test methods)

These test procedures test the inverter for electromagnetic interference as well as for structural measures against electromagnetic interference.

Electromagnetic interference caused by emission, radiation or induction (or by a combination of emission, radiation or induction) is the result of unwanted energy immission from electrical devices in the vicinity of the inverter.

The test of the structural measures includes the immunity of the inverter itself against the energy from its environment caused by emission, radiation or induction.

7.3 EMC Directives

7.3.1 Harmonic Effect

Higher order harmonics can damage the inverter by degrading the quality of the supply. In such cases, the use of an input choke is recommended.

7.3.2 Electromagnetic Interference and Installation Precautions

A distinction is made between two cases of electromagnetic interference. on the one hand, other electrical devices in the vicinity of the inverter can cause interference in the inverter. on the other hand, the inverter can cause electromagnetic interference in devices in its vicinity.

The following installation precautions can be taken to avoid such interference:

- Ensure that the inverter and other electrical devices are correctly earthed.
- The control cables of the inverter should not be laid parallel to the supply cable or the motor cable.
- It is recommended to use shielded cables for the supply line to the motor. The shield of these cables should be correctly earthed at least at one end.

- If the motor supply line exceeds a length of 30m, an output filter and/or an output reactor should be installed.

7.3.3 Protection of the Inverter Against External Electromagnetic Interference

In most cases, errors within the inverter are caused by contactors, relays, electromagnetic brakes, etc. Installed in the vicinity. In the event of an error, the following measures can provide a remedy:

- Reduce the voltage peaks of the device causing the interference with a surge arrester.
- Install an EMC input filter upstream of the inverter.
- Use shielded cables.

7.3.4 Protection of Other Electrical Devices from EMC Radiation near the Inverter

The inverter can interfere with other devices in two ways. The first is electromagnetic radiation and the second is interference transmitted via the inverter's supply cables. If other electrical devices in the vicinity of the frequency inverter are disturbed, the following measures can prevent interference:

- Measuring devices, sensors and receivers usually work with weaker signals than the frequency inverter. Installing these devices together with a frequency inverter in a control cabinet can therefore lead to interference with these devices. Try to operate these devices as far away from the inverter as possible and do not run control lines in parallel with supply lines. Use shielded cables whose shield is earthed. If this does not eliminate the interference, an EMC output filter must be installed on the inverter.
- If the interfering devices use the same supply source as the inverter, interference may be transmitted via the supply lines. In these cases, an EMC input filter should be installed between the supply source and the inverter.
- Sometimes errors can occur if the inverter and other devices use the same earth. In this case, earthing the inverter separately can eliminate the error. Ensure that no earth loops are created and, if necessary, check the earthing points for equal earth potential.

7.3.5 Remedies for Leakage Current

There are two types of leakage current that can occur when using a frequency inverter. Leakage current can occur between the inverter and its earth and a much smaller leakage current can occur between the cables themselves.

Factors that can lead to increased leakage current:

- The capacitance coating of a conductor leads to a capacitance between the cable and earth, especially with shielded cables. The longer the cables are, the greater the capacitance. A larger capacitance leads to a larger leakage current. Shortening the motor supply cable can therefore lead to a lower leakage current.
- Another factor for a higher leakage current is the carrier frequency of the inverter. The higher the carrier frequency of the inverter, the greater the leakage current. To reduce the leakage current, the carrier frequency can be reduced, but this can also lead to louder motor noises.

- The installation of a motor reactor can also lead to a significant reduction in the leakage current – especially high-frequency leakage current – if the two points mentioned above are not possible.
- If the leakage current is still too high even with the motor reactor and output filter and an upstream RCD trips, the only last resort is a double-shielded motor supply cable in which the inner shield is connected to the neutral conductor. As a result, the majority of the leakage current will flow through the neutral conductor through the RCD to earth and therefore not be recognized as an error current, so that the RCD does not trip. However, double-shielded motor cables are uncommon and therefore expensive.

7.3.6 Information on Installing Input and Output Filters

- Make sure that the filters used match the power class of the frequency converter.
- As filters are products of electrical protection class I, care must be taken to ensure that both the filter and the housing of the inverter are correctly earthed and that the connection to earth does not exceed the value of the earth resistance required by the relevant safety standard. Otherwise there is a risk of electric shock and the effectiveness of the filter will be reduced.
- The frequency inverter and the EMC filter should use a common earth so that the PWM-induced leakage currents are fed back to the inverter via the shortest route, which can also help to avoid tripping an upstream RCD.

8 Troubleshooting

8.1 Error Alarm and Countermeasures

The ST500 frequency inverter offers many protective functions if handled and installed correctly. The errors covered in this chapter can occur during operation of the inverter. In the event of an error, please first refer to the table in this chapter and try to find and eliminate any possible sources of error.

In the event of damage to the frequency inverter or in the event of errors not covered by this chapter, please contact Sourcetronic GmbH.

No.	Error ID	Error Type	Possible Causes	Solutions
1	Err.01	Inverter Unit Protection	Short circuit at the output	Check the wiring.
			Cables too long	Install a motor filter or motor reactor.
			Overheating	Check the fan of the inverter and observe the installation dimensions.
			Wiring error	Check the wiring.
			Control unit faulty	Contact the technical support team.
			Faulty control display	
			IGBT module faulty	
2	Err.02	Overcurrent During Acceleration	Launch ramp too short	Increase the launch ramp time.
			Manual torque increase or V/f not suitable	Reduce the torque increase and adjust the V/f characteristic curve.
			Motor voltage too low	Adapt the motor voltage parameters to the motor.
			Short circuit on the motor	Check the wiring.
			Motor parameters missing in vector control	Input and calibrate the motor parameters.
			Engine in motion even before the start	Activate speed measurement or stop the motor.
			Sudden increase in motor load	Avoid sudden load changes.

			Rated power of the inverter too low	Choose a larger inverter.
			Automatic torque boost attempts to force the engineinto motion, but the frequency is too low for the motor	• Deactivate the torque boost (F4.01). • Increase the starting frequency. • Calibrate the motor and operate in vector mode.
3	Err.03	Overcurrent During Braking	Short circuit at the output of the inverter	Check the motor supply cable.
			Motor parameters missing in vector control	Input and calibrate the motor parameters.
			Braking time too short	Increase the braking time.
			DC braking frequency too high	Reduce F3.08.
			Motor voltage too low	Adapt the motor voltage parameters to the motor.
			Sudden increase in motor load	Avoid sudden load changes.
			No brake unit / brake resistor	Install a brake unit / brake resistor.
4	Err.04	Overcurrent at Constant Speed	Short circuit at the output of the inverter	Check the motor supply cable.
			Motor parameters missing in vector control	Input and calibrate the motor parameters
			Motor voltage too low	Adapt the motor voltage parameters to the motor
			Sudden increase in motor load	Avoid sudden load changes.
			Rated power of the inverter too low	Choose a larger inverter.
5	Err.05	Overvoltage During Acceleration	Input voltage too high	Check the mains voltage.
			External torque accelerates motor	Remove the external torque.
			Launch ramp too short	Increase the ramp time.
6	Err.06	Overvoltage During Braking	Input voltage too high	Check the mains voltage.
			External torque accelerates motor	Remove the external torque or install a brake unit / brake resistor.

			Stop ramp too short	Increase the stop ramp time.
			No brake unit / brake resistor	Install a brake unit / brake resistor.
7	Err.07	Overvoltage at Constant Speed	External torque accelerates motor	Remove the external torque or install a brake unit / brake resistor.
			Input voltage too high	Check the mains voltage.
8	Err.08	Control Voltage Error	Input voltage at the terminals is not within the specified range	Adapt the input voltage to the specified range.
9	Err.09	Undervoltage	Temporary loss of input voltage	Acknowledge the error (e.g. in the case of external power-off)
			Input voltage not in the range of the inverter	Check the mains voltage.
			DC link voltage incorrect	Contact the technical support team.
			Rectifier not working correctly	
			Output circuit not working correctly	
			Control circuit not working correctly	
10	Err.10	Inverter Overload	Inverter power too low	Choose a larger inverter.
			Load on motor too high or motor blocked	Reduce the load and check the motor for mechanical defects.
11	Err.11	Motor Overload	Mains voltage too low, resulting in grid weakness	Check the mains voltage.
			Motor protection parameter (F8.03) incorrect	Check parameter F8.03.
			Load on motor too high or motor blocked	Reduce the load and check the motor for mechanical defects.
12	Err.12	Phase Loss / Phase Asymmetry at the Input (only possible for 18kW and above models)	Mains voltage collapses	Reduce the load on the grid.
			Input circuit not working correctly	Contact the technical support team.
			Control circuit not working correctly	
			Mains voltage quality too low	Install a line reactor.

13	Err.13	Phase Loss at the Output	Motor supply cable not in order	Check the motor supply cable and the connection to the motor terminal board.
			There is no symmetrical load at the output	Check the insulation of the motor windings.
			Output circuit not working correctly	Contact the technical support team.
			IGBT module not working correctly	
14	Err.14	Overheating of the IGBT Module (above 80°C)	Ventilation covered	Ensure sufficient air supply.
			Cooling fan damaged	Replace the cooling fan.
			Ambient temperature too high	Lower the temperature.
			Thermistor damaged	Contact the technical support team.
			IGBT module damaged	
15	Err.15	Error due to External Accessories	External error signal active at DI terminals (function 11 or 33)	Acknowledge (reset) the error signal.
16	Err.16	Communication Error	Communication line disrupted	Check the cable.
			Parameter F9.07 not correct	Correctly select the communication card type.
			Other parameters from F9 for communication configuration not correct	Check the parameters.
			Connected PC sends incorrectly	Check the settings and wiring of the PC.
17	Err.17	Error at the Power Switch	Phase loss / phase asymmetry at the input	Contact the technical support team.
			Contacts in input or output circuit faulty	
18	Err.18	Error in Current Measurement	Current sensor faulty	Contact the technical support team.
19	Err.19	Error when Calibrating Motor Parameters	Motor parameters entered do not match nameplate	• Correct the parameters. • Check the comma position.
			Measurement timeout	Check the connection to the motor.

20	Err.20	Encoder Card Error (Encoder Signal longer than b0.34)	Encoder damaged	Contact the technical support team.
			Encoder card damaged	Replace the encoder card.
			Encoder card not compatible with encoder	Order a compatible card.
			Encoder parameters not correct	Check the parameter settings.
			Connection between encoder card and encoder faulty	Check the connection.
21	Err.21	EEPROM Read / Write Error	EEPROM damaged	Contact the technical support team.
22	Err.22	Hardware Error	Overvoltage	Eliminate the overvoltage.
			Overcurrent	Eliminate the overcurrent.
23	Err.23	Short-Circuit to Earth	Short circuit on the motor	Replace the cable or the motor.
26	Err.26	Operating Time Limit (F7.21) Reached	Configured operating time limit has been reached (monitoring active)	• Increase the time limit. • Reset the operating times with y0.00.
27	Err.27	Custom Error 1	Digital input terminal with function 44 active	Acknowledge (reset) the error signal.
28	Err.28	Custom Error 2	Digital input terminal with function 45 active	Acknowledge (reset) the error signal.
29	Err.29	Power-On Time Limit (F7.20) Reached	Configured power-on time limit has been reached (monitoring active)	• Increase the time limit. • Reset the operating times with y0.00.
30	Err.30	Load Loss	Current drops below the value of F8.31 for the duration set in F8.32	Check parameters F8.31 and F8.32.
31	Err.31	PID Feedback Signal Loss During Operation	PID feedback signal does not exceed E2.11 without interruption for longer than the detection time configured in E2.12	Check the PID feedback signal and wiring or adjust E2.11/E2.12.
40	Err.40	Current Limit Exceeded	Load on motor too high or motor blocked	Reduce the load and check the motor for mechanical damage.
			Inverter power too low	Choose a larger inverter.

41	Err.41	Motor Switchover During Operation	Switched to another motor during operation	Stop the motor and repeat the switchover.
42	Err.42	Speed Deviation Too High	Settings of parameters F8.15/F8.16 incorrect	Adjust the parameters.
			Settings for encoder card incorrect	
			Motor parameter calibration was not successful	Repeat the calibration.
43	Err.43	Motor Speed Too High	Motor parameter calibration was not successful	Repeat the calibration.
			Settings for encoder card incorrect	Adjust the parameters.
			Settings of parameters F8.13/F8.14 not correct	
45	Err.45	Motor Overheating (above F8.34)	Connection to temperature sensor not correct	Check the sensor and the cable.
			Motor temperature too high	Adjust the carrier frequency (parameter F0.18) or improve motor cooling.
51	Err.51	Error During Position Initialization	Deviation between the actual and the entered motor parameters is too high	Check the motor parameters.
–	CoF	Communication Error	Poor connection between inverter and control unit	Check the cable and the control unit.
–	LoC	N/A, see y0.01	Inverter is password-protected	• Enter the password. • Remove the password.

9 Dimensions

9.1 Housing Description

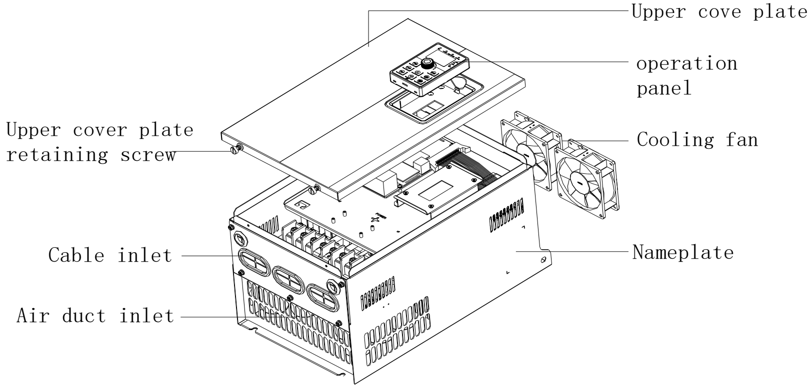


Figure 9-1 Housing Description (Example: 15kW G3)

9.2 Dimensions of Plastic Housing Models

9.2.1 Models 0.4kW to 2.2kW G1/G2 / 0.75kW to 4kW G3/G4

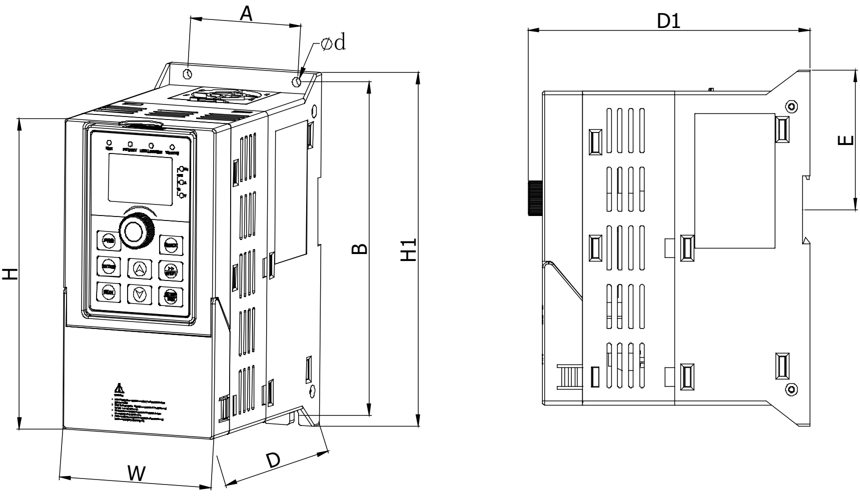


Figure 9-2 0.4kW to 2.2kW G1/G2 / 0.75kW to 4kW G3/G4

These models can be installed on a DIN rail. DIN rail position E: 72.5mm.

<table>
<tr><th>Power [kW]</th><th>Nominal Voltage</th><th>Housing Dimensions [mm] (W x H x D / W x H1 x D1)</th><th>Installation Dimensions [mm] (A x W x d)</th><th>Weight [kg] Net/Gross</th></tr>
<tr><td>0.4 to 0.75</td><td>1-phase 230V</td><td rowspan="4">90 x 163 x 146
90 x 185 x 154</td><td rowspan="8">65 x 174 x 5</td><td rowspan="4">1/1.6</td></tr>
<tr><td>0.4 to 1.5</td><td>3-phase 230V</td></tr>
<tr><td rowspan="2">0.75 to 2.2</td><td>3-phase 400V</td></tr>
<tr><td>3-phase 480V</td></tr>
<tr><td>1.5 to 2.2</td><td>1-phase 230V</td><td rowspan="4">90 x 163 x 166
90 x 185 x 174</td><td rowspan="4">1.5/2</td></tr>
<tr><td>2.2</td><td>3-phase 230V</td></tr>
<tr><td rowspan="2">4.0</td><td>3-phase 400V</td></tr>
<tr><td>3-phase 480V</td></tr>
</table>

9.2.2 Models 4kW G1 / 4kW to 5.5kW G2 / 5.5kW to 11kW G3/G4

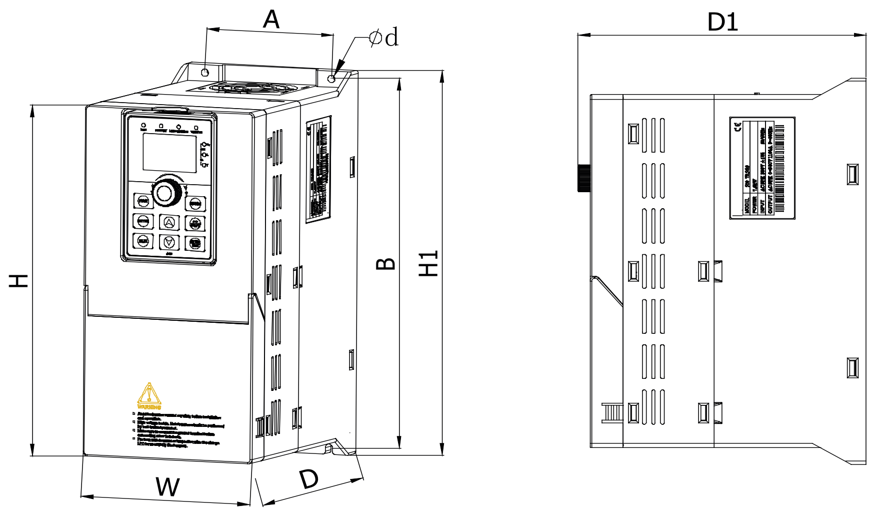


Figure 9-3 4kW G1 / 4kW to 5.5kW G2 / 5.5kW to 11kW G3/G4

Power [kW]	Nominal Voltage	Housing Dimensions [mm] (W x H x D / W x H1 x D1)	Installation Dimensions [mm] (A x W x d)	Weight [kg] Net/Gross
4	1-phase 230V	120 x 238 x 182 120 x 260 x 190	90 x 250 x 5	2.5/3
4 to 5.5	3-phase 230V			
5.5 to 11	3-phase 400V			
	3-phase 480V			

9.3 Dimensions of Metal Housing Models for Wall Mounting

9.3.1 Models 5.5 to 7.5kW G1/7.5 to 110kW G2/15 to 220kW G3/G4 / 11 to 160kW G6

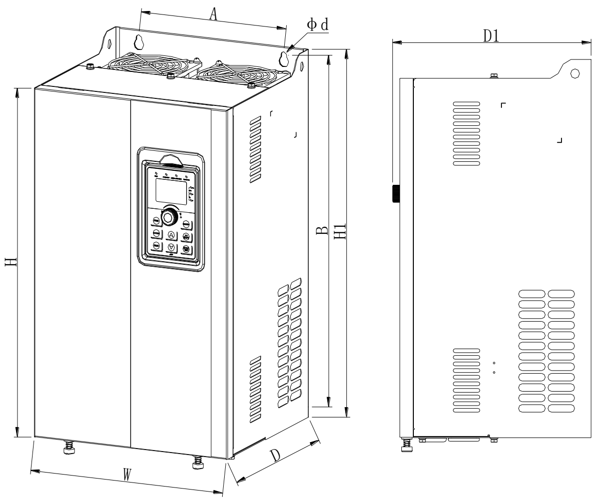


Figure 9-4 5.5 to 7.5kW G1 / 7.5 to 110kW G2 / 15 to 220kW G3/G4 / 11 to 160kW G6

Power [kW]	Nominal Voltage	Housing Dimensions [mm] (W x H x D / W x H1 x D1)	Installation Dimensions [mm] (A x W x d)	Weight [kg] Net/Gross
5.5 to 7.5	1-phase 230V	190 x 280 x 190 190 x 300 x 198	140 x 285 x 6	6/7.2
7.5	3-phase 230V			
15	3-phase 400V			

	3-phase 480V			
	3-phase 690V			
11	3-phase 230V	210 x 330 x 190 210 x 350 x 198	150 x 335 x 6	9/10
18.5 to 22	3-phase 400V			
	3-phase 480V			
	3-phase 690V			
15 to 18.5	3-phase 230V	240 x 380 x 215 240 x 400 x 223	180 x 385 x 7	12/13
30 to 37	3-phase 400V			
	3-phase 480V			
	3-phase 690V			
22 to 37	3-phase 230V	300 x 500 x 275 300 x 520 x 283	220 x 500 x 10	30/42
45 to 75	3-phase 400V			
	3-phase 480V			
	3-phase 690V			
45 to 55	3-phase 230V	355 x 550 x 320 355 x 575 x 328	250 x 555 x 10	44/58
93 to 110	3-phase 400V			
	3-phase 480V			
	3-phase 690V			
75	3-phase 230V	400 x 695 x 360 400 x 720 x 368	300 x 700 x 10	56/73
132	3-phase 400V			
	3-phase 480V			
	3-phase 690V			
93 to 110	3-phase 230V	480 x 790 x 390 480 x 820 x 398	370 x 800 x 11	108/130
160 to 220	3-phase 400V			
	3-phase 480V			
160	3-phase 690V			

9.3.2 Models 250 to 400kW G3/G4 / 187 to 400kW G6

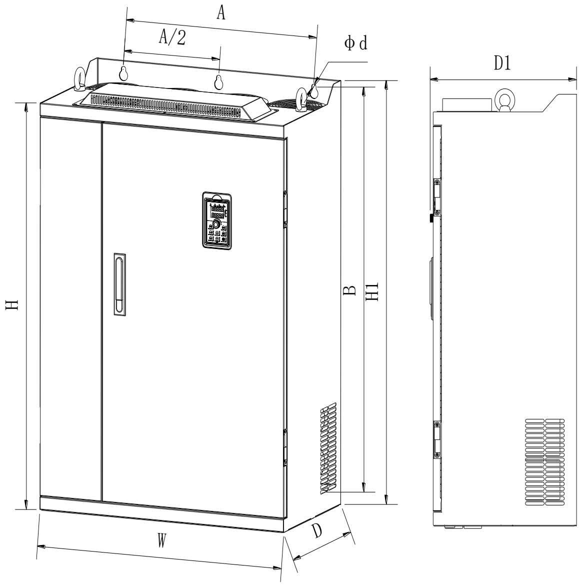


Figure 9-5 250 to 400kW G3/G4 / 187 to 400kW G6

Power [kW]	Nominal Voltage	Housing Dimensions [mm] (W x H x D / W x H1 x D1)	Installation Dimensions [mm] (A x W x d)	Weight [kg]
250 to 280	3-phase 400V	560 x 940 x 410 560 x 980 x 418	415 x 945 x 13	153
	3-phase 480V			
315 to 400	3-phase 400V	705 x 940 x 410 705 x 980 x 418	550 x 945 x 13	190
	3-phase 480V			
187 to 400	3-phase 690V			

9.4 Floor Mounting Dimensions of Metal Housing Models with DC Reactor

9.4.1 Models 132kW G3R/G4R

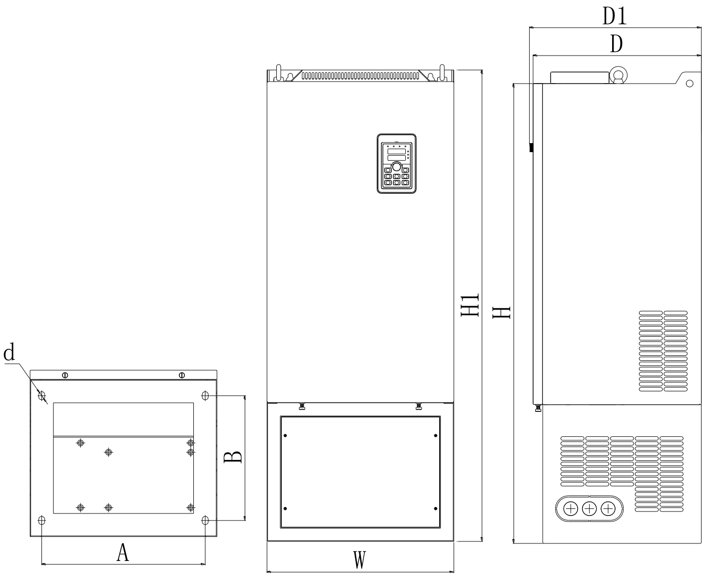


Figure 9-6 132kW G3R/G4R

Power [kW]	Nominal Voltage	Housing Dimensions [mm] (W x H x D / W x H1 x D1)	Installation Dimensions [mm] (A x W x d)	Weight [kg] Net
132	3-phase 400V 3-phase 480V	400 x 995 x 360 400 x 1020 x 368	350 x 270 x 13x18	115

9.4.2 Models 160kW to 220kW G3R/G4R/G6R

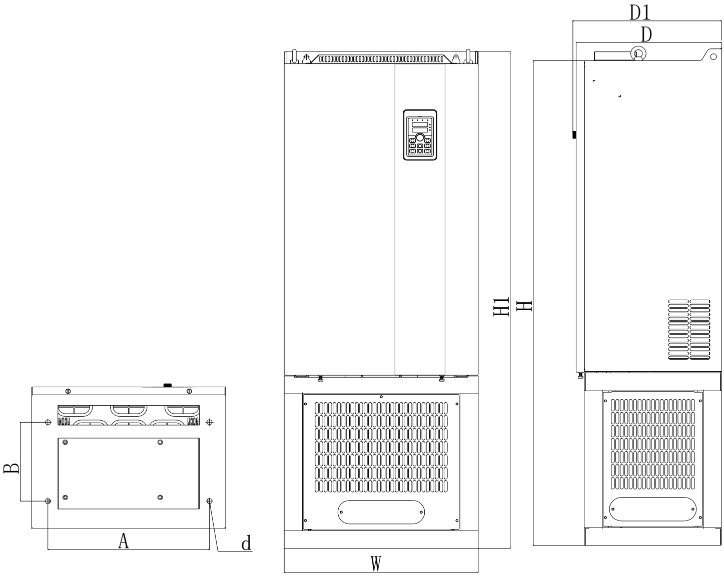


Figure 9-7 160kW to 220kW G3R/G4R/G6R

Power [kW]	Nominal Voltage	Housing Dimensions [mm] (W x H x D / W x H1 x D1)	Installation Dimensions [mm] (A x W x d)	Weight [kg] Net/Gross
160 to 220	3-phase 400V	480 x 1230 x 390 480 x 1260 x 398	400 x 200 x 13	150/180
	3-phase 480V	480 x 1230 x 360 480 x 1260 x 368		
	3-phase 690V	480 x 1230 x 390 480 x 1260 x 398		

9.4.3 Models 250kW to 400kW G3R/G4R/G6R

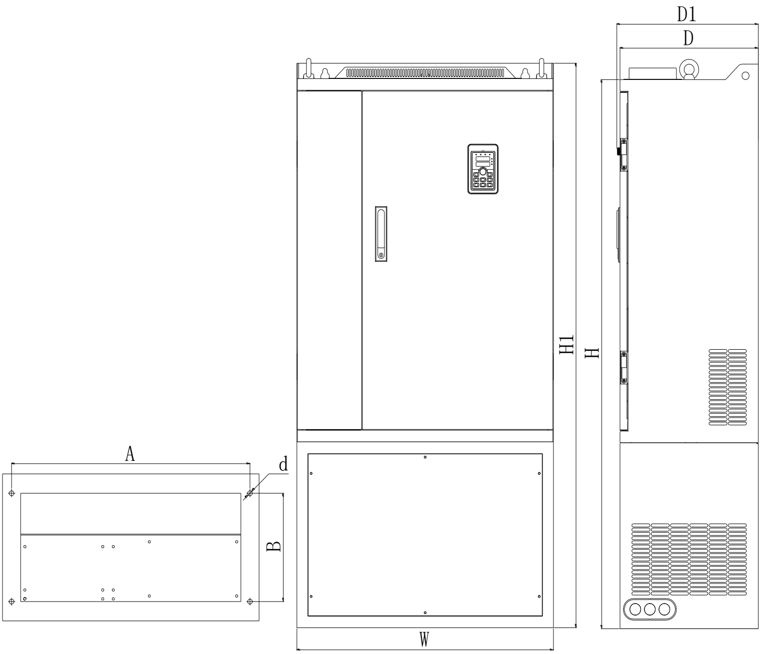


Figure 9-8 250kW to 400kW G3R/G4R/G6R

<table>
<tr><th>Power [kW]</th><th>Nominal Voltage</th><th>Housing Dimensions [mm]
(W x H x D / W x H1 x D1)</th><th>Installation Dimensions
[mm] (A x W x d)</th><th>Weight [kg]
Net/Gross</th></tr>
<tr><td rowspan="2">250 to 280</td><td>3-phase 400V</td><td rowspan="2">560 x 1419 x 410
560 x 1460 x 418</td><td rowspan="2">500 x 310 x 13</td><td rowspan="2">205/240</td></tr>
<tr><td>3-phase 690V</td></tr>
<tr><td rowspan="2">315 to 400</td><td>3-phase 400V</td><td rowspan="2">705 x 1419 x 410
705 x 1460 x 418</td><td rowspan="3">620 x 240 x 13</td><td rowspan="2">250/280</td></tr>
<tr><td>3-phase 690V</td></tr>
<tr><td>250 to 400</td><td>3-phase 480V</td><td>705 x 1419 x 380
705 x 1459 x 388</td><td>230/250</td></tr>
</table>

9.4.4 Models 450kW to 630kW G3R/G4R/G6R

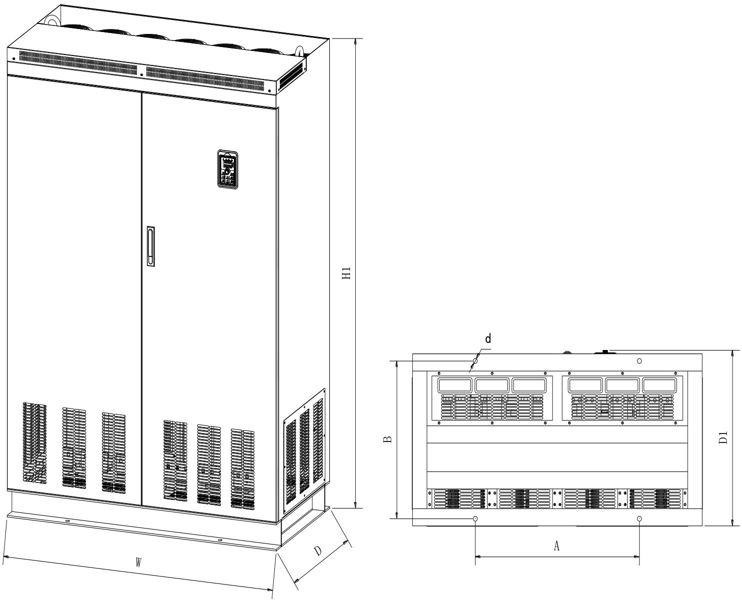


Figure 9-9 450kW to 630kW G3R/G4R/G6R

<table>
<tr><th>Power [kW]</th><th>Nominal Voltage</th><th>Housing Dimensions [mm]
(W x H x D / W x H1 x D1)</th><th>Installation Dimensions
[mm] (A x W x d)</th><th>Weight [kg]
Net/Gross</th></tr>
<tr><td rowspan="2">450 to 710</td><td>3-phase 400V</td><td rowspan="3">1200 x 1700 x 600
1200 x 1700 x 612</td><td rowspan="3">680 x 550 x 17</td><td>300/350</td></tr>
<tr><td>3-phase 480V</td><td>330/350</td></tr>
<tr><td>450 to 800</td><td>3-phase 690V</td><td>300/350</td></tr>
</table>

9.5 Wall Mounting Dimensions of Metal Housing Models with DC Reactor

9.5.1 Models 132kW to 400kW G3R/G4R

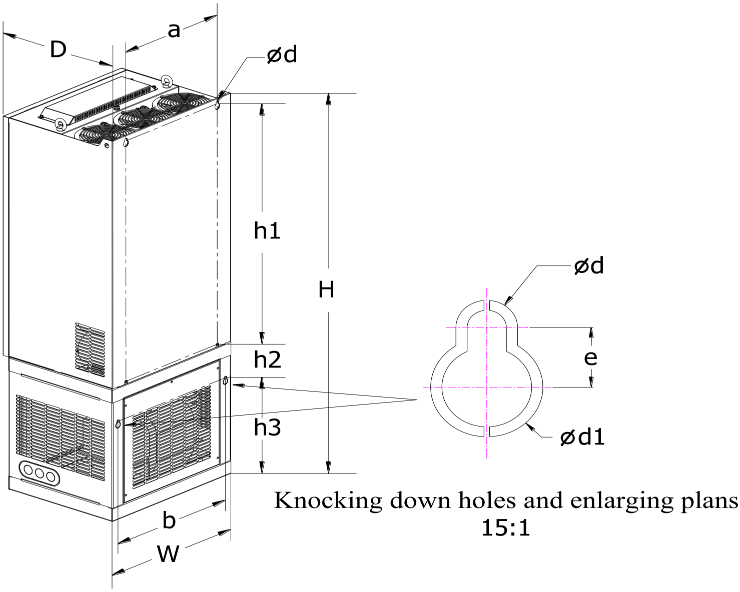


Figure 9-10 132 to 400kW G3 (With DC Reactor and Base) Wall Hanging Dimensions

Power [kW]	Nominal Voltage	External Dimensions [mm] (W x H x d)	Hole Position [mm]							
			h1	h2	h3	a	b	d	d1	e
132	3-phase 400V 3-phase 480V	400 x 1020 x 360	702	89	218	300	370	10	18	11
160 to 220	3-phase 400V 3-phase 480V	480 x 1260 x 390	801	119	325	370	435	11	20	12
250 to 280	3-phase 400V 3-phase 480V	560 x 1460 x 410	947	164	330	208 +208	530	13	24	15
315 to 400	3-phase 400V 3-phase 480V	705 x 1460 x 410	947	94	400	275 +275	675	13	24	15

9.6 Keypad Dimensions

9.6.1 Display Unit

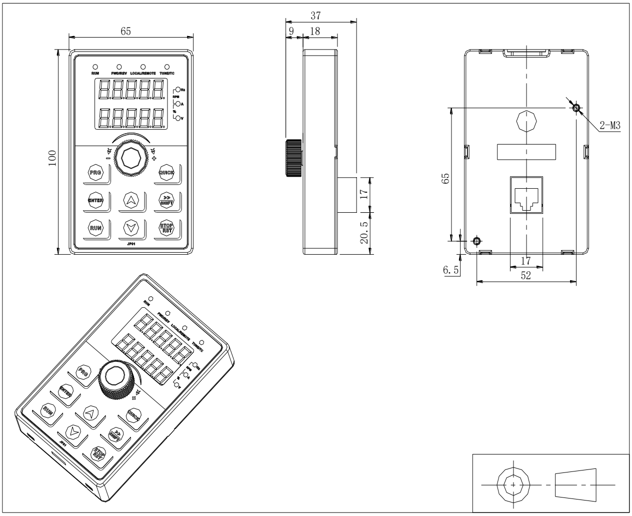


Figure 9-11 ST500 Display Unit Dimensions (in mm)

9.6.2 Mounting Frame

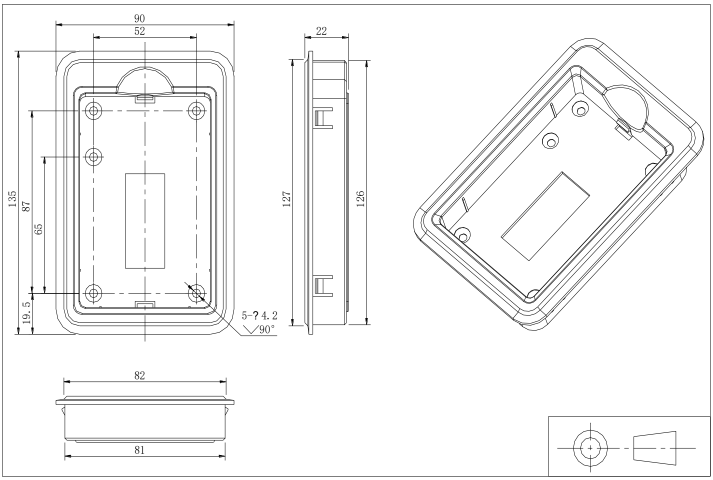


Figure 9-12 ST500 Keypad Mounting Frame Dimensions (in mm)

An opening in the mounting surface is required when installing the mounting frame. Dimensions: (82mm ± 0.1mm)x(126.5mm ± 0.1mm)

9.6.3 Open Inlet for Installation

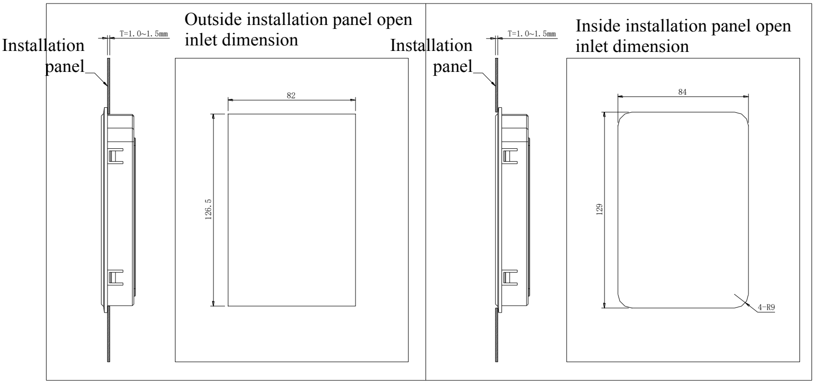


Figure 9-13 ST500 Keypad Installation Open Inlet Dimensions (in mm)

9.6.4 Pin Assignment of the Display Unit

Pin	Connected with Pin	Meaning
1	8	GND
2	7	Vcc
3	5	Data 1
4	6	Data 2
5	3	Data 1
6	4	Data 2
7	2	Vcc
8	1	GND

10 Maintenance and Repair

10.1 Inspection and Maintenance

During the operating time of the frequency inverter, it is necessary to check and maintain certain assemblies and components. The interval between these checks should not be longer than 6 months. The following table provides an overview of the maintenance and checks to be carried out:

Frequency of Inspection		Component	Object	Contents of the Inspection	Procedures
Daily	6 Months				
√		Display	LED Display	Display contents	Visual inspection
√	√	Cooling System	Fan	Unhindered rotation, noise, vibrations	Visual inspection, Hearing test
√		Body	Environmental Conditions	Temperature, humidity, dust, harmful gases	Visual inspection, Hearing test
√		Input/Output Terminals	Voltage	Voltage level	Voltage measurement on R, S, T / U, V, W
	√	Main Circuit	General	Loose fastening parts, signs of overheating, signs of discharge, interfering dust, blocked air ducts	Visual inspection, Fastening, Cleaning
			Electrolyte Condensers	Surface deformation, electrolyte leakage	Visual inspection
			Cables	Fastenings	Visual inspection
			Terminals	Bolts or screws loose	Tighten the screws

Note: The "√" in the table indicates which test should be carried out and when. Do not dismantle any components and do not shake the frequency inverter excessively during the test. This could lead to a malfunction or damage to the inverter.

10.2 Regular Replacement of Components

To ensure smooth and safe operation of the frequency inverter, certain mechanically or electrically stressed components should be replaced after a certain operating time (fans, DC link capacitors, etc.). The following table provides an overview of the components:

Product Component	Replacement Interval
Fan	1 to 3 years
DC Link Capacitors	4 to 5 years
Control Board	5 to 8 years

10.3 Storage

If the frequency inverter is not used immediately after purchase, the following points should be observed during storage:

- The storage location should be sufficiently ventilated. The frequency inverter should not be exposed to moisture, dust or metal dust and the temperature should not be outside the specified storage temperature.
- If the storage time exceeds 1 year, the function of the charging capacitors should be checked before commissioning. In addition, an insulation resistance test should be carried out, in which the measured value should not be less than 4MΩ.

10.4 Capacitors

If the inverter has not been used for a longer period of time, the DC link capacitors must be reformed before they are exposed to the load of active operation again. In order to avoid the more costly reforming with a series transformer, the inverter should be connected to the mains for one hour every two years at the minimum.

Storage Time	Reformation Instruction
Less than 1 Year	Not necessary
1-2 Years	1 hour in standby mode, normally connected to the power supply
2-3 Years	30 min each at 25%, 50%, 75% and 100% of the rated input voltage
More than 3 Years	2h each at 25%, 50%, 75% and 100% of the rated input voltage

10.5 Measuring and Readings

If a commercially available multimeter is used to measure the current at the input of the frequency inverter, a deviation of up to 10% is normal, especially if no true RMS measurement is used. If a deviation of more than 30% occurs, check whether the deviation of the input voltage is more than 5V.

If a commercially available multimeter is used to measure the output voltage or current of the frequency inverter, the multimeter may be disturbed by the carrier frequency of the inverter.

11 Optional Peripheral Accessories

It is possible to connect different types of accessories to the frequency inverter depending on the application and requirements. The following diagram provides an overview of available accessories:

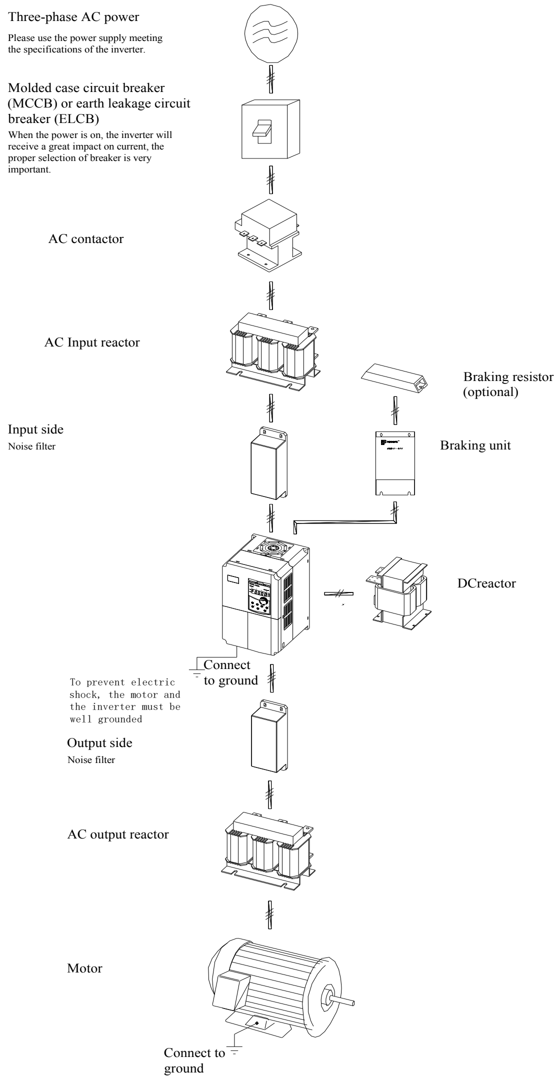


Figure 11-1 Wiring of Optional Accessories

Current information on available accessories and their technical data can always be found on our website at: https://www.sourcetronic.com/shop/en/drive-technology/.

11.1 Expansion Cards

Should you require expansion cards such as a CANbus or PROFIBUS interface or an encoder interface, clarify beforehand which specifications are needed. Please note that an alternative interface card cannot be used at the same time as the integrated RS485.

11.2 Circuit Breakers / RCD

Choose the circuit breaker so that it matches the specifications of the frequency inverter and do not use the power switch to turn the motor on and off – this should always be done via the control functions of the inverter, as repeated mains connection/disconnection reduces the service life of the DC link capacitors.

11.3 Power Contactors

A contactor is used to remotely switch on the entire system at the start of operation and to switch it off after a controlled shutdown of the motor and inverter at the end of operation. A contactor must not be used to regularly switch the motor on and off in short operating cycles; this should always be done via the control functions of the inverter, as repeated mains connection/disconnection unnecessarily impairs the service life of the capacitors in the DC link.

11.4 Line Reactors

A line reactor can eliminate higher order harmonics and thus increase the efficiency of the frequency inverter. The use of a line reactor is recommended in any of the following cases:

- The available power is more than ten times greater than the power of the inverter.
- The voltage fluctuations of the supply grid are greater than 3%.
- Another thyristor load or a power factor compensation device with ON/OFF control is operated on the same power supply.

11.5 EMC Input Filters

An EMC input filter can eliminate both electromagnetic interference caused by the frequency inverter, and protect the frequency inverter against the effects of electromagnetic radiation.

Before using the input filter, make sure that you have a 3-phase mains supply available. The input filter should be installed as close to the inverter as possible.

11.6 Brake Units and Brake Resistors

If too much energy is fed back into the inverter when the motor brakes, this energy can be dissipated using a braking unit in conjunction with a braking resistor.

Care must be taken to ensure that the brake unit and the brake resistor are selected to match the power class of the frequency inverter. The data can be taken from the following table. These are guideline values for regular braking with a maximum duty cycle of 20%. With frequent braking or high inertia of the load, a higher continuous load capacity of the resistor is required.

The single-phase inverter models up to 7.5kW and the three-phase models up to 22kW have an integrated braking unit. Single-phase models from 11kW and three-phase models from 30kW require an external braking unit in order to be able to connect a braking resistor.

Voltage (V)	Inverter Power (kW)	Braking Resistor (Ω)	Power of Braking Resistor kW)
220V 230V	0.75	200	120
	1.5	100	300
	2.2	70	300
	4	40	500
	5.5	30	500
	7.5	20	780
	11	13.6	2000
	15	10	3000
	18	8	4000
	22	6.8	4500
380V 400V	0.75	750	120
	1.5	400	300
	2.2	250	300
	4	150	500
	5.5	100	500
	7.5	75	780
	11	50	1000
	15	40	1500

11.7 EMC Motor Filters

An output filter suppresses interference in the supply line to the motor and minimizes the EMC load for surrounding devices.

11.8 Motor Reactors

If the motor supply cable is longer than 20 meters, the motor reactor minimizes the current that occurs due to the increased capacitance, especially with shielded cables.

11.9 DC Line Reactors

The DC link reactor is used to smooth out the current jumps caused by the rectification. This reduces the load on the power grid and minimizes the EMC effect on other devices. DC link reactors can be used with both three-phase and single-phase inverters, as they are connected to terminals P and P in the DC circuit between the rectifier and capacitor bank; the factory-installed jumper must be removed.

11.10 Information on Circuit Breakers and Cable Cross-Sections

To correctly choose circuit breakers, contactors and cable cross-sections when installing the frequency inverter, please refer to the following table:

Type	Line Protection Switch [A]	Cable Cross-Section (Copper) [mm²]	Rated Contactor Current (380V or 220V)
R40G2	10	1,5	10
R75G2	16	2,5	10
1R5G2	20	2,5	16
2R2G2	32	4	20
004G2	40	6	25
5R5G2	63	6	32
7R5G2	100	10	63
011G2	125	10	95
015G2	160	25	120
018G2	160	25	120
022G2	200	25	170
030G2	200	35	170
037G2	250	35	170
045G2	250	70	230

055G2	315	70	280
R75G3	10	1,5	10
1R5G3	16	1,5	10
2R2G3	16	2,5	10
004G3	25	2,5	16
5R5G3	25	4	16
7R5G3	40	4	25
011G3	63	6	32
015G3	63	6	50
018G3	100	10	63
022G3	100	10	80
030G3	125	16	95
037G3	160	25	120
045G3	200	35	135
055G3	250	35	170
075G3	315	70	230
093G3	400	70	280
110G3	400	95	315
132G3	400	95	380
160G3	630	150	450
187G3	630	185	500
200G3	630	240	580
220G3	800	150x2	630
250G3	800	150x2	700
280G3	1000	185x2	780
315G3	1200	240x2	900
355G3	1280	240x2	960
400G3	1380	185x3	1035
500G3	1720	185x3	1290

12 Warranty

The following warranty conditions apply to this product:

- The warranty period for this product is 1 year.
- Errors or damage caused by the following reasons are not covered by the warranty and will result in a chargeable repair:
  - Improper use of the frequency inverter or unauthorized modifications or repairs.
  - Non-compliance with the standard specifications in these operating instructions.
  - Damage due to improper transportation or falling damage.
  - Damage caused by earthquakes, fire, wind, water, lightning or large voltage fluctuations in the grid.
  - The connection and installation were not carried out by trained electricians
- A credit note, replacement or repair can only be carried out if the defective inverter has been returned to Sourcetronic GmbH.

Appendix A RS485 Communication Protocol

A.1 Introduction

The ST500 series inverters are equipped with an RS485 communication interface. The MODBUS protocol is used for transmission. The user can use a PC or PLC to change the parameters of the inverter, set the frequency, enable or stop operation and read out the operating status..

A.2 Details

A.2.1 Protocol Definition

The serial communication protocol defines the information transmission format including the master/slave broadcast format, the frame encoding, the actual content consisting of function code, data and checksum, and the error messages returned by the slave to the master.

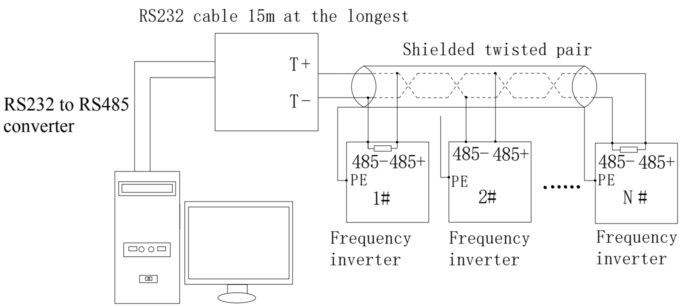
A.2.2 Bus Structure

The inverter is integrated into a "single master/multi-slave" network based on RS485.

The operating mode is asynchronous serial, half-duplex; only one device can send data at any one time. The data is transmitted in the form of message frames.

Each connected device requires a unique address in the range from 1 to 247, which is configured in F9.02 on the ST500. The individual devices are connected to the bus in parallel. At the end of the chain, a 120Ω and at least ¼W temperature control resistor should be connected between T+ and T-. Alternatively, an integrated 500Ω resistor can be connected with the "485" jumper (see below), which is usually sufficient for a short bus with few devices. If only a single inverter is connected directly to a USB or Bluetooth adapter supplied by Sourcetronic, for example, the termination can usually be omitted completely.

All devices on the RS485 bus must use identical communication settings.



A.2.3 Protocol Description

The communication protocol of the ST500 inverter is a serial asynchronous master-slave protocol, where the master is a PC or PLC and the ST500(s) are slaves. In the network, only the master can send commands and requests, the slaves can only respond to communication initiated by the master.

The master can communicate with a single slave or address all slaves at once (broadcast to address 0). No response is sent by the slaves to a broadcast command, as otherwise collisions could occur. Otherwise, the response from the slave repeats the inverter address and command.

Many development environments already contain library functions for MODBUS control. To be able to use these, make sure not to change the ones digit of F9.05 from the factory setting (1, standardized protocol) or – if this is necessary – to use functions that can be configured to the non-standard protocol with two bytes for the response data length.

A.2.4 Communication Data Structure

The ST500 supports the MODBUS protocol in RTU mode (Remote Terminal Unit).

RTU Frame Format:

Message frames are sent with a "silent" interval of at least 3.5 characters. A message frame therefore begins with a 4-character pause. The first data field contains the device address. The connected devices constantly monitor the bus and check whether the first transmitted data field after a 3.5 character pause contains their own or the broadcast address.

The entire message frame must be sent as a continuous data stream without interruption. If an interruption occurs with a length of more than 1.5 characters, the implementation can discard the data packet and interpret the next data byte as a device address field, and conversely, if there is a pause of less than 3.5 characters between two messages, the receiving device can interpret this as a continuation of the previous message frame, as the behavior is not defined for a pause between 1.5 and 3.5 characters in length.

Both lead to an error, as the last two bytes of the transmission are interpreted as a CRC checksum and this no longer matches the packet content.

The 16-bit CRC checksum is transmitted as the only data word with the lower byte first (according to the bit sequence of the serial transmission, which begins with the least significant bit), all other data words with the higher-value byte first. To generate the CRC, the generator polynomial 1x2x15x16 (IBM-CRC-16) is used, usually with the reverse calculation method with the least significant bit first, therefore noted as $A001_{hex}$ (1010 0000 0000 0001[1], the most significant 1 is not noted).

CRC functions are already included in the usual I/O libraries, so an example implementation is not shown here.

Frame Header Start	Time interval of min. 3.5 characters
Slave address aDR	Communication address: 1 to 247
Command code CMD	03: read slave parameters; 06: write slave parameters

Data length (Only included in slave response)	Upper byte	Only if F9.05=0 (non-standard protocol): Upper byte of the number of the following data bytes
	Lower byte	Number of the following data bytes
Data content DATA (N-1)		N data words, corresponding to 2×N data bytes: the actual content of the communication
Data content DATA (N-2)		
………………………		
Data content DATA (0)		
CRC checksum, lower byte		16-bit CRC checksum
CRC checksum, upper byte		
END		Time interval of min. 3.5 characters

Example:

- Inverter address 1
- CMD read command 03_{hex} , read up to 16 words from the start address
- DATA Start address F001, read length 2 (i.e. read parameters F0.01 and F0.02)

Request from the Master	RTU
Message frame START	Time interval of min. 3.5 characters
Slave device address ADDR	01_{hex}
Command code CMD	03_{hex}
Data field 1: Start address upper byte	$F0_{hex}$
Data field 1: Start address lower byte	00_{hex}
Data field 2: Data length upper byte	00_{hex}
Data field 2: Data length lower byte	02_{hex}
CRC16 checksum	16bit CRC, lower byte
	16bit CRC, upper byte
Message frame END	Time interval of min. 3.5 characters

<table>
<tr><th rowspan="2">Response from the Inverter</th><th>RTU
F9.05=0</th><th>RTU
F9.05=1</th></tr>
<tr><td colspan="2">Message frame START</td></tr>
<tr><td>Message frame START</td><td colspan="2">Time interval of min. 3.5 characters</td></tr>
<tr><td>Slave device address ADDR</td><td colspan="2">01_{hex}</td></tr>
<tr><td>Command code CMD</td><td colspan="2">03_{hex}</td></tr>
<tr><td rowspan="2">Length of the response in bytes</td><td>00_{hex}</td><td rowspan="2">04_{hex}</td></tr>
<tr><td>04_{hex}</td></tr>
<tr><td>Data field 1: Answer 1
upper byte</td><td colspan="2">13_{hex}</td></tr>
<tr><td>Data field 1: Answer 1
lower byte</td><td colspan="2">88_{hex}</td></tr>
<tr><td>Data field 2: Answer 2
upper byte</td><td colspan="2">00_{hex}</td></tr>
<tr><td>Data field 2: Answer 2
lower byte</td><td colspan="2">00_{hex}</td></tr>
<tr><td rowspan="2">CRC16 checksum</td><td colspan="2">16bit CRC, lower byte</td></tr>
<tr><td colspan="2">16bit CRC, upper byte</td></tr>
<tr><td>Message frame END</td><td colspan="2">Time interval of min. 3.5 characters</td></tr>
</table>

A.2.5 Definition of the Communication Parameters

The 16-bit addresses are assigned to the communication parameters of the inverter as follows:

The lower byte of the address indicates the number of the individual parameter.

The upper byte of the address specifies the parameter group. There are two different assignments, namely one in which written values only change the volatile memory of the inverter and one in which written values are also stored non-volatilely in the EEPROM. The latter can lead to premature wear of the EEPROM, particularly in the case of complete external control of the inverter with frequent parameter changes, which is why it is recommended to only use this variant if the persistence of the written parameters is required beyond an inverter restart.

Alternatively, the write command 07_{hex} can be used instead of 06_{hex} in conjunction with the addresses for non-volatile storage in order to force volatile storage.

The addresses for volatile storage cannot be used to read out the parameters; the inverter then reports an invalid address.

Some parameters cannot be changed during operation, others such as the entire group d0 can generally only be read.

Parameter Group	Readout / Storage Non-Volatile	Storage Volatile
F0 to FC	F0 to FC:	00 to 0C
E0 to E3	A0 to A3	40 to 43
b0	B0	50
y0 to y1	C0 to C1	60 to 61
d0	70	readable only

There are also parameter groups that replace the control panel. Group 10_{hex} is used to read out status values that correspond to those configurable in F6.01, group 20_{hex} to start and stop, group 30_{hex} to read out the operating status, and group 80_{hex} to read out the errors that have occurred.

Parameter values as percentage values are assigned as follows:

- 10000dec corresponds to +100.00%
- -10000dec corresponds to -100.00%.

Frequencies always refer to F0.19, currents/torque to F5.08.

There are two ways of specifying the target frequency via the communication interface:

1) Set F0.03 to 0 or 1, modify F0.01 via $F001_{hex}$ or 0001_{hex} (volatile).

- Set F0.03 to 9, modify the communication specification in $1000_{hex.}$ The communication specification refers to the maximum frequency in F0.19 or to the maximum torque in F5.08.

Group 10_{hex}: Status parameters (read-only up to 1000_{hex})

Parameter Address	Parameter Description
1000_{hex}	Communication specification (%×100 of F0.19 or F5.08)
1001_{hex}	Actual frequency (as on the display, without decimal point)
1002_{hex}	DC link voltage
1003_{hex}	Output voltage
1004_{hex}	Output current
1005_{hex}	Output power
1006_{hex}	Torque
1007_{hex}	Speed

1008_{hex}	Input status DI
1009_{hex}	Initial status DO
$100A_{hex}$	Value AI1
$100B_{hex}$	Value AI2
$100C_{hex}$	Value AI3
$100D_{hex}$	Counter value
$100E_{hex}$	Length value
$100F_{hex}$	Motor speed [rpm]
1010_{hex}	PID setpoint [%]
1011_{hex}	PID feedback [%]
1012_{hex}	Multi-speed PLC program section
1013_{hex}	Pulse input frequency, resolution 0.01 kHz
1014_{hex}	Encoder speed, resolution 0.01 / 0.1Hz (=d0.19)
1015_{hex}	Remaining term
1016_{hex}	Uncorrected voltage at AI1
1017_{hex}	Uncorrected voltage at AI2
1018_{hex}	Uncorrected voltage at AI3 (from V5)
1019_{hex}	Linear speed [m/min]
$101A_{hex}$	Current switch-on time [min]
$101B_{hex}$	Current operating time [min]
$101C_{hex}$	Pulse input frequency, resolution 1Hz
$101D_{hex}$	Setpoint value set via communication $(=1000)_{hex}$
$101E_{hex}$	Encoder speed, resolution 0.01Hz (=d0.26)
$101F_{hex}$	Master frequency
1020_{hex}	Additional frequency

Group $C0_{hex}$ Parameter 01_{hex}: Password (write-only)

$C001_{hex}$	Enter password, unlock parameters (login)	*****

If the correct password was transmitted in parameter $C001_{hex}$, the inverter responds with 8888_{hex}, after which the inverter is enabled for control.

Group 20_{hex}: Control commands operating status/outputs (write-only)

Parameter Address	Parameter Description
2000_{hex}	0001_{hex}: Forward operation
	0002_{hex}: Reverse operation
	0003_{hex}: Forward operation Jog
	0004_{hex}: Reverse operation Jog
	0005_{hex}: Free stop
	0006_{hex}: Brake and stop
	0007_{hex}: Reset error message
2001_{hex}	Bit 0: SPA Bit 1: Relay 2 Bit 2: Relay 1 Bit 3: Reserved Bit 4: SPB as switching output
2002_{hex}	DA1; 0 to 7FFF correspond to 0% to 100% of the maximum voltage or the maximum current
2003_{hex}	DA2; 0 to 7FFF correspond to 0% to 100% of the maximum voltage or the maximum current
2004_{hex}	SPB as pulse frequency output; 0 to 7FFF correspond to 0% to 100% of the maximum frequency F2.09

Group 30_{hex}: Operating status (read-only)

Parameter Address	Parameter Description
3000_{hex}	0001_{hex}: Forward operation
	0002_{hex}: Reverse operation
	0003_{hex}: Inverter is in standby mode

Group 80$_{hex}$: Error messages

Error Address	Code	Error Description
8000$_{hex}$	0000$_{hex}$	No error
	0001$_{hex}$	Inverter protection function
	0002$_{hex}$	Overcurrent during acceleration
	0003$_{hex}$	Overcurrent during braking
	0004$_{hex}$	Overcurrent at constant speed
	0005$_{hex}$	Overvoltage during acceleration
	0006$_{hex}$	Overvoltage during braking
	0007$_{hex}$	Overvoltage at constant speed
	0008$_{hex}$	Control voltage error
	0009$_{hex}$	Undervoltage in the DC link
	000A$_{hex}$	Inverter overload
	000B$_{hex}$	Motor overload
	000C$_{hex}$	Input phase loss
	000D$_{hex}$	Output phase loss
	000E$_{hex}$	Overheating of the inverter module
	000F$_{hex}$	External error
	0010$_{hex}$	Communication error
	0011$_{hex}$	Contactor error
	0012$_{hex}$	Current measurement error
	0013$_{hex}$	Calibration faulty
	0014$_{hex}$	Encoder/pulse generator card faulty
	0015$_{hex}$	EEPROM error
	0016$_{hex}$	Inverter hardware error
	0017$_{hex}$	Short circuit on motor to earth
	0018$_{hex}$	Reserved

	0019_{hex}	Reserved
	$001A_{hex}$	Operating time achieved
	$001B_{hex}$	User-defined error 1
	$001C_{hex}$	User-defined error 2
	$001D_{hex}$	Duty cycle reached
	$001E_{hex}$	Load loss
	$001F_{hex}$	PID feedback signal loss
	0028_{hex}	Current limit exceeded
	0029_{hex}	Motor switchover during operation
	$002A_{hex}$	Speed deviation too high
	$002B_{hex}$	Overspeed
	$002D_{hex}$	Motor overheating
	$005A_{hex}$	Encoder incorrectly connected
	$005B_{hex}$	Encoder not recognized
	$005C_{hex}$	Position error (start)
	$005E_{hex}$	Error in speed measurement

A.2.6 Communication Errors

Normally, the inverter responds to commands with its own address and the command received so that the master can assign the response.

If an error occurs during communication, the slave signals this by setting the highest bit of the command to 1, e.g. a read command 00000011bin 03_{hex} becomes 10000011bin 83_{hex}. This is followed by a byte that indicates the type of error that has occurred.

Alternatively, the last communication error that occurred can be read out in address 8001_{hex}.

Error Code	Name	Description
01_{hex}	Password Error	The password transmitted with parameter $C001_{hex}$ does not match the password set in y0.01.
02_{hex}	Invalid Function	The transmitted command is not permitted (in this operating state). An attempt may have been made to change a parameter that can only be

		changed in standby mode while the inverter is in operation, or none of the permitted command codes 03_{hex}, 06_{hex} or 07_{hex} were recognized.
03_{hex}	Checksum Error	The transmitted CRC (RTU format) or LRC (ASCII format) does not match the one calculated by the receiver.
04_{hex}	Invalid Data Address	The requested parameter address is not permitted or the combination of address and data length is invalid.
05_{hex}	Invalid Value	The transferred data field contains invalid values. This refers to general invalidity, not to permissible value ranges of specific parameters (see next point).
06_{hex}	Invalid Parameter Change	The parameter values are outside the valid range for this parameter.
07_{hex}	System Locked	The master has issued a read or write command, but the inverter must first be unlocked with the password.
08_{hex}	Device Busy	The inverter is busy writing data to the EEPROM.

Appendix B Profibus-DP Communication Card

B.1 Introduction

The ST500 series inverters can be equipped with a Profibus DP communication interface. The PPO1 protocol is used for transmission. The user can use a PC or PLC to change the parameters of the inverter, set the frequency, enable or stop operation and read out the operating status.

Please note that you cannot use the Modbus RS485 interface integrated in the inverter at the same time as the Profibus interface.

B.2 Installation

B.2.1 Preparation

Ensure that the frequency inverter is completely disconnected from the mains and that the DC link capacitors have discharged to a safe voltage of less than approx. 36V and that the red control LED on the circuit board has gone out. This is usually the case approx. 2 minutes after disconnection from the mains.

First, remove the cover of the frequency inverter to expose the control board. There is a 26-pin pin header labeled "J13" and a 12-pin pin header labeled "J10". Place the plug-in card on the connectors mentioned. Make sure that you have placed the card correctly on the corresponding pins and press the card fully into place so that the two pin headers of the control board are seated as far as they will go in the sockets of the Profibus DP board.

B.2.2 Connecting the Profibus-DP Cable

A type a Profibus DP cable contains two wires in the purple sheath, the green a wire and the red B wire. Connect the Profibus DP cable to the terminals of the Profibus DP card by connecting the green a wire to the TR- terminal and the red B wire to the TR+ terminal.

B.2.3 DIP Switch

There is an eight-way DIP switch on the Profibus DP card. Positions 1 and 2 are used to set the baud rate between the Profibus card and the inverter, positions 3 to 8 are used to set the Profibus address. A switch moved upwards to the ON position is switched on and a switch moved towards the digit is switched off.

Function	DIP Switch Position		Baud Rate
	Bit 1	Bit 2	
Setting the baud rate between Profibus-DP card and frequency Inverter	OFF	OFF	115.2K
	OFF	ON	208.3K
	ON	OFF	256K
	ON	ON	Not allowed

The Profibus address results from the binary coding using the switches at positions 3 to 8. 64 different addresses can therefore be set using the six switches. Position 8 is assigned to the least significant bit 2^0 and position 3 to the most significant bit 2^5. ON corresponds to a 1, OFF to a 0. Profibus address 0 must not be set as this is reserved for broadcast.

B.2.4 Configuration of the Frequency Inverter

Switch on the frequency inverter once the Profibus DP card has been installed and configured. If you have plugged in the card correctly, the green "POW" LED will light up continuously. If this is not the case, switch off the frequency inverter and check that the pin headers are correctly aligned.

To establish a connection between the interface card and the inverter, the following parameters must be changed:

Parameter	Required Value	Description
F0.11 (default: 0)	2	Control via communication interface
	4	Control through all three control types
F0.03 (default: 1)	9	Frequency control via communication interface, with Profibus via PZD2 (optional)
F9.00 (default: 6005)	60X5	X = Baud rate set via DIP switch 1-2:
	6005	115.2kBps
	6015	208.3kBps
	6025	256kBps
F9.04 (V.: 0.0)	0.0s (deactivated)	Time until timeout
F9.05 (V.: 31)	01	Profibus data protocol = PPO1
F9.07 (V.: 0)	1	Interface type Profibus

If the parameters are set correctly, the yellow LED "S2" lights up continuously.

B.2.5 Status LEDs

LED / Color	Function	Description
POW Green	Power supply of the Profibus-DP card	This LED lights up continuously when the Profibus-DP card is correctly supplied with power.
S2 Yellow	Connection between Profibus-DP card and frequency inverter	This LED lights up continuously if you have configured the frequency inverter correctly. If the LED flickers, there is an interruption or error between the frequency converter and the Profibus DP card. If the LED goes out, the connection between the frequency inverter and the

		Profibus-DP card has failed. Check that DIP switches 1-2 match the setting in parameter F9.00 and that the Profibus-DP card is correctly seated on the two pin headers on the control board.
S1 Red	Establishing the Profibus-DP connection	This LED lights up continuously when you have established a successful Profibus connection. If the LED flickers, there is an interruption or interference. If the LED goes out, the Profibus connection has failed. Check the Profibus-DP data cable for correct connection and continuity, the data rate on the Profibus master (between 9600 and 12Mbps, see GSD file) and parameter F9.05.

B.3 Details

B.3.1 Protocol Definition and Communication Data Structure

The serial communication protocol defines the information transmission format including the master/slave broadcast format, the frame encoding, the actual content consisting of function code, data and checksum, and the error messages returned by the slave to the master.

The basic structure of the transmission format, including device addressing on the Profibus, data flow control and CRC check, is identical for every standard-compliant device and is already pre-implemented in all Profibus-capable PLC environments, so that only the GSD file needs to be integrated in your development environment and the device address of the converter and the PPO1 format selected as the high-level protocol. Please refer to the documentation of your PLC development environment for the necessary settings. The GSD file can be found on the CD supplied with the inverter or can be sent to you by Source- tronic by e-mail on request.

Only the content of the already decoded PPO1 packets will be discussed in this manual. These consist of four 16-bit words for the parameter channel (PKW) and two 16-bit words for the process data channel.

Byte	0	1	2	3	4	5	6	7	8	9	10	11
Word	1		2		3		4		5		6	
Field	Parameter identification (PKE)		Subindex (Ind)		Parameter Identification Value (PWE)				Process data 1 (PZD1)		Process data 2 (PZD2)	
Type	Command	Parameters		Reserved			Parameter value		Control word		Main target value	
Example	20_{hex} = Writing (volatile)	F0.00 = $F000_{hex}$ E2.27 = $A21B_{hex}$		00_{hex}	0000_{hex}		100,00 % = 2710_{hex} 50.00 Hz = 1388_{hex}		FWD Run = 0001_{hex} Free stop = 0005_{hex}		45.00 Hz = 1194_{hex} 80.00 % = $1F40_{hex}$	

The first byte of the first word (byte 0) contains the command to the inverter.

The second byte of the first word and the first of the second word (bytes 1 and 2) form a word that specifies the parameter address to which the command sent in byte 0 should apply.

The second byte of the second word and the third word (bytes 3-5) must always be 0.

In the case of a write command, the parameter value to be written is specified in the fourth word (bytes 6 and 7). In the case of a read command, the response from the inverter contains the read value at this point.

In the fifth word (bytes 8 and 9), an operating control command is sent to the inverter. This corresponds exactly to a write access to the parameter address 2000hexduring operation via MODBUS. The inverter responds with a status word containing the current operating status and basically, but not exactly, corresponds to parameter address 3000hex in MODBUS mode. The main setpoint is specified in the sixth word (bytes 10 and 11). This corresponds to parameter address 1000hex , which is used if the setpoint source is set to "Specification by communication interface" (e.g. F0.03=9, FA.01=5, E2.00=5; in %×100 of F0.19, F5.08 or FA.02). This setpoint must therefore be sent with every communication process. The inverter responds at this point with the current actual frequency.

B.3.2 Protocol Description

The communication protocol of the ST500 inverter is a serial asynchronous master-slave protocol, where the master is a PC or PLC and the ST500(s) are slaves. In the network, only the master can send commands and requests, the slaves can only respond to communication initiated by the master. The master can communicate with a single slave or address all slaves at once (broadcast to address 0). No response is sent by the slaves to a broadcast command, as otherwise collisions could occur. Otherwise, the response from the slave repeats the command and returns its result and the current process data.

Many development environments already contain library functions for Profibus DP control. Make sure that you can use these with the PPO1 data format.

B.3.3 Definition of the Communication Parameters

The basic communication parameter addresses, in particular the assignment of the parameter groups to the hexadecimal values to be entered in byte 1, are identical to those already described in the equivalent chapter for control via MODBUS, apart from the exceptions listed below and the changed arrangement in the PPO1 structure, and are therefore not listed again here.

The differences are as follows:

- The command to be sent in the first byte differs from that used for MODBUS. The commands to be used for Profibus can be found in the following table. The same applies to the response from the inverter.
- Only one parameter can be set or queried per PPO1 data packet.
- Control commands are transmitted implicitly during each communication process in word PZD1 (bytes 8 and 9 of the PPO1 structure) instead of explicitly via address 2000hex of the control parameter group. As each command is valid until a new command is received, this field can be set to zero after successful transmission of a control command in further communication until the next control command is required.

- The response from the inverter contains the status word located at MODBUS address 3000hex at position PZD1.
- The setpoint specification transmitted with MODBUS only by explicit access to address 1000hex is also transmitted in each communication process in word PZD2 bytes 10 and 11 of the PPO1 structure. In contrast to PZD1 above, however, the value must be retransmitted in subsequent communication processes, as there is no neutral element here, but setting to zero leads to a change in the target frequency or the target torque, the PID setpoint or the PID feedback to 0Hz or 0. If this is not desired, please use a different frequency control source, e.g. by leaving this at the factory setting of 1 instead of setting F0.03 to 9 and writing the desired frequency directly to parameter F0.01 using command 20hex. The same applies to the other parameters F0.04, F0.20, F4.12, F5.08, FA.01, E2.00 and E2.02, for which the communication interface can be the source.
- The response from the inverter contains the current actual frequency at position PZD2.
- We strongly advise against writing via the parameter channel in address 2000hex or 1000hex, as the behavior of the inverter is not defined for values to be saved that differ from those present in the same PPO1 package at position PZD1 or PZD2 and therefore conflict with them.

Command in parameter channel PKW, byte 0:

Command Number	**Description**
00hex	No action. Is used if only the PZD1 and PZD2 fields of the PPO1 data structure are required, for example to start the inverter or specify a new setpoint.
10hex	Command for reading a parameter value
14hex	Command for changing a parameter value with non-volatile storage in the EEPROM It is recommended to use this command only if permanent storage of the value beyond a restart is absolutely necessary in order to prevent the EEPROM from ageing prematurely due to frequent write operations.
20hex	Command for changing a parameter value with volatile storage in RAM, without saving it persistently in the EEPROM, thus protecting it
Other	Reserved
Inverter Response	**Description**
00hex	No response - response to command 00hex
01hex	Read/write request processed correctly
07hex	Read/write request not processed correctly
(For Response 07hex) Error Type In Byte 7	**Description**

00hex	No error
01hex	Password error: the password transmitted with parameter C001hex does not match the password defined in y0.01.
02_{hex}	Command number error: the command code received is not included in the above list of permitted commands, or the command cannot be executed in the current operating mode (e.g. an attempt was made to write a parameter that may not be changed in the current operating mode).
03_{hex}	Error with CRC checksum
04_{hex}	Error with address: the specified address is not allowed.
05_{hex}	Invalid parameter
06_{hex}	Parameter change invalid because outside the permissible value range
07_{hex}	System is locked: the inverter must be unlocked before access by entering the password in address $C001_{hex}$.
08_{hex}	EEPROM is in operation

The last communication error that occurred can also be read out subsequently at address 8001_{hex}.

Byte 8/9 Process data 1 (PZD1) Control word:

Command of the Master in PZD1	Description
0001_{hex}	Start forward operation (FWD)
0002_{hex}	Start reverse operation (REV)
0003_{hex}	Start forward operation JOG (FJOG)
0004_{hex}	Start reverse operation JOG (RJOG)
0005_{hex}	Free stop
0006_{hex}	Active stop with set braking ramp
0007_{hex}	Acknowledge error

Response of the Inverter in PZD1		
Bit (in byte 9, because big-endian)	**Value**	**Description**
0	0	Inverter in stop state
	1	Inverter in operation

1	0	Inverter in forward operation
	1	Inverter in reverse operation
2	0	No error
	1	Inverter has error
3	0	Target frequency not reached
	1	Target frequency reached

Examples:

Response of the Inverter in PZD1	Description
0000_{hex}	Inverter not in operation
0001_{hex}	Inverter in operation, forward, target frequency not reached
0003_{hex}	Inverter in operation, reverse, target frequency not reached
0004_{hex}	Inverter not in operation, error
0009_{hex}	Inverter in operation, forward, at target frequency
$000B_{hex}$	Inverter in operation, reverse, to target frequency

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