ul. Konstantynowska 79/81
95-200 Pabianice
Phone/fax 42 - 2152383, 2270971
email: biuro@fif.com.pl

Vector control inverter

FA-1LS
FA-3HS

Operating manual

v. 1.0.1

Inverter safety-related information is designated with symbols. All information and recommendations marked with these symbols must be strictly adhered to.

	Electric shock hazard
	A potentially hazardous situation which may pose risk to operating personnel or cause inverter damage.
Information on inverter design, operation and handling	
	Important information, valuable advice
	Practical tip, solution to a problem
	Usage or operation example

Contents

Part 1 Post-unpacking inspection

Before the inverter is installed and commissioned:

1) Check the device for possible transport damage.
2) Consult the device nameplate to check whether the product you received complies with the actual order.

Any damage, missing elements or discrepancies must be immediately reported to the supplier.

Nameplate

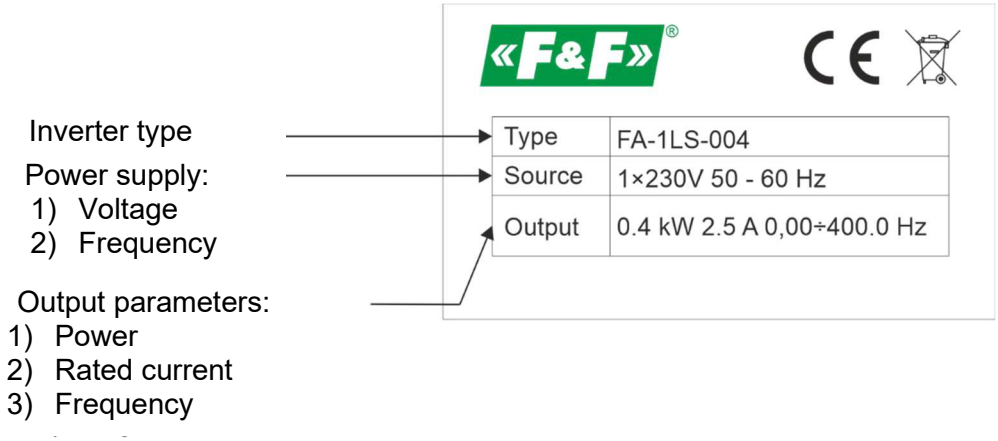


Fig. 1) Inverter nameplate

Inverter type identification

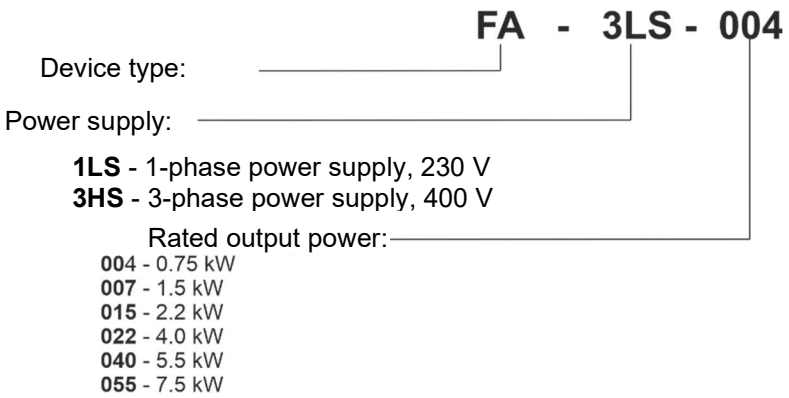


Fig. 2) Inverter type identification

Part 2 Installation

Safety precautions

	**It is forbidden to connect the supply voltage to inverter output terminals. Failure to adhere to this requirement will result in damaging the inverter and may cause a fire hazard.**	
	Prevent foreign bodies, such as pieces of electric wiring or metal filings from control cabinet assembly operations, from penetrating the inverter enclosure.	
	Before powering up the inverter, close the enclosure, paying special attention not to damage any connected electric cables.	
	Do not perform any installation or inspection activities on the inverter after it has been powered up.	
	Do not touch in any way any parts inside the powered up inverter to avoid the electric shock risk.	
	When the supply voltage is off, life-threatening voltage may still be present on inverter internal circuits. To avoid electric shock, wait at least 5 minutes after the power supply and operator panel indicators have been switched off.	
	Electrostatic charges accumulated in the human body can pose a serious danger to inverter electronic circuits. To avoid damaging the inverter, do not touch its PCBs and electronic components inside the enclosure with your hands.	
	Stop the motor before deactivating the inverter power supply.	
	The inverter-motor connection must not be interrupted (e.g. by opening the contactor between the inverter and motor) during motor operation.	
	The inverter neutral terminal must be securely and effectively connected to the control cabinet earthing system and electric installation. **Note: The inverter is designed to operate within type TN-S mains with effective neutralising. Failure to comply with this requirement may result in dangerous potentials occurring on inverter housing metal parts, posing a high risk to both the operator and inverter.**	

Installation

In order to ensure its correct and safe operation, the inverter must be installed in an upright position on a non-flammable wall or mounting plate. In addition, the following installation-related requirements must be met:

1) site ambient temperature ranging from -10 to +40°C;
2) air circulation between the inverter enclosure and the environment ensured;
3) protection against penetration of water droplets, water vapour, dust, iron filings and other foreign bodies;
4) protection against impact exerted by oils, salts, aggressive and explosive gases;
5) adequate space between the inverter and adjacent objects provided as shown in the figure below.

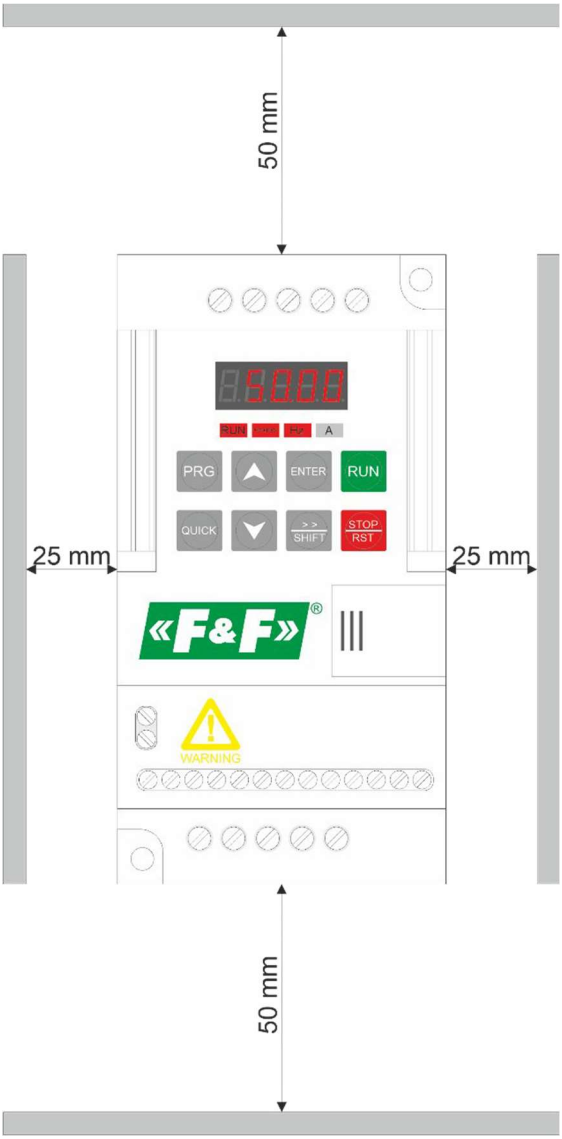


Fig. 3) Correct inverter installation example

Part 3 External connections

Wiring diagram

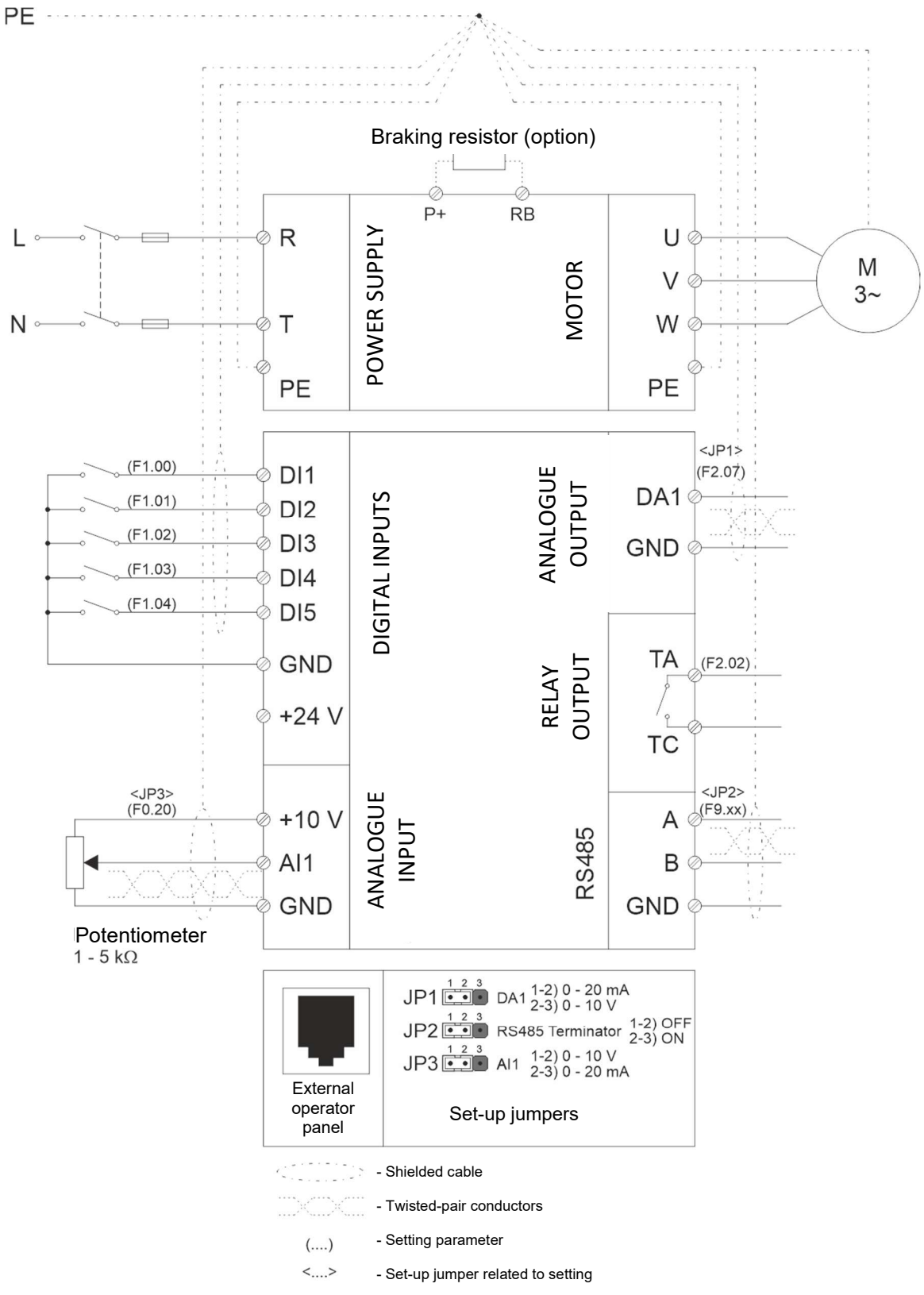


Fig. 4) FA-1LS 1-phase inverter connection diagram

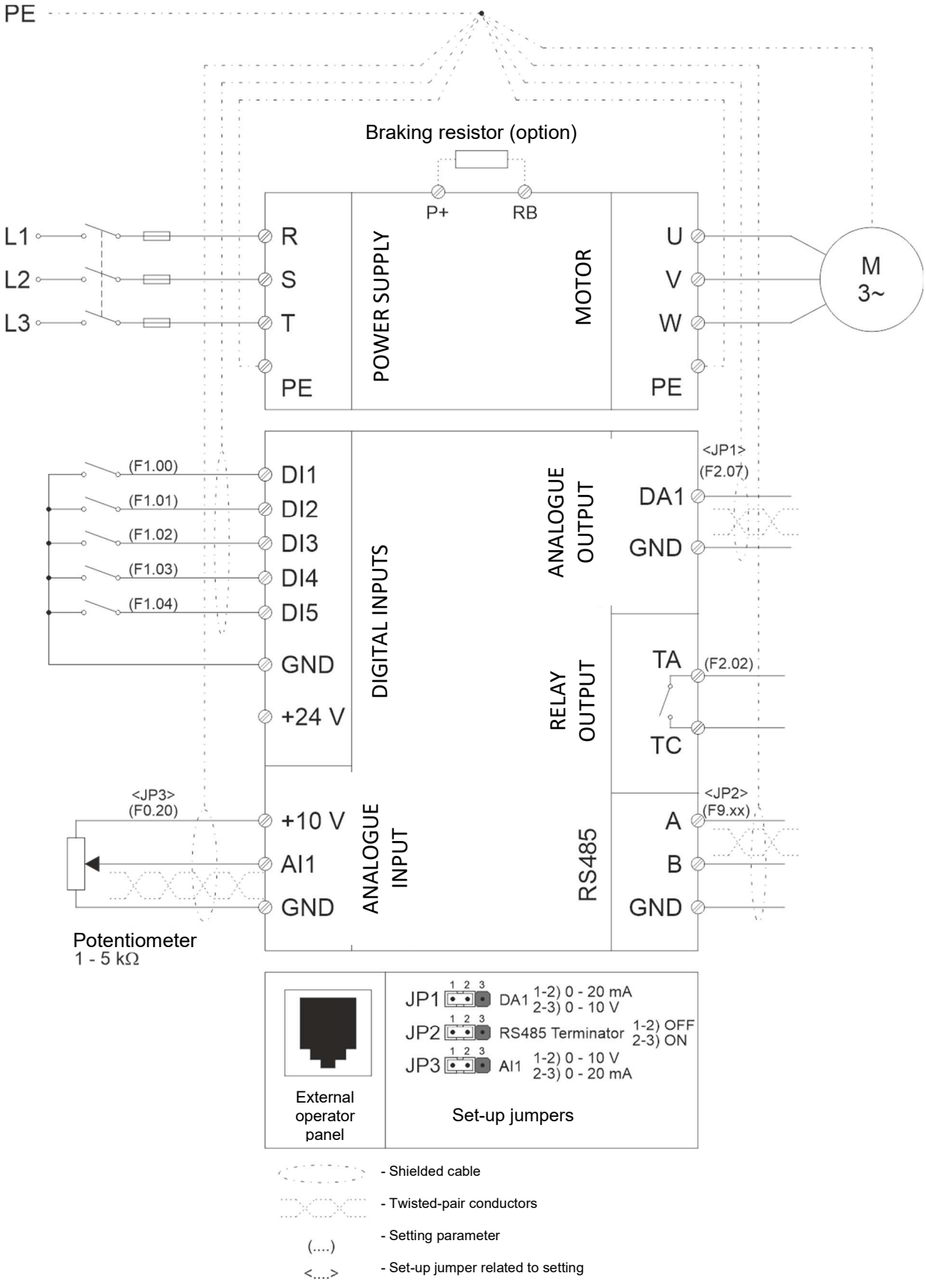
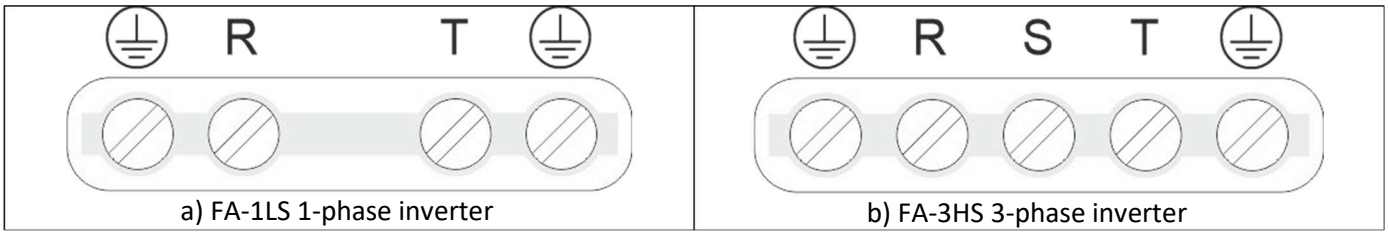


Fig. 5) FA-3HS 3-phase inverter connection diagram

Power circuit connection

⚠	The inverter power supply must be connected in line with all applicable standards. The minimum supply cable diameter must comply with the values specified in the table “Power cable and overcurrent protection device selection”. If long cables are used, increasing their diameter is recommended.	⚠
⚠	If the inverter output switching frequency does not exceed 3 kHz, the maximum length of cabling routed between the inverter and the motor must not exceed 50 m. For higher switching frequencies, this distance may be reduced.	⚠
📄	It is recommended that dedicated shielded motor cables should be routed between the inverter and the motor.	📄



a) FA-1LS 1-phase inverter b) FA-3HS 3-phase inverter

Fig. 6) Inverter power supply connection terminal strip

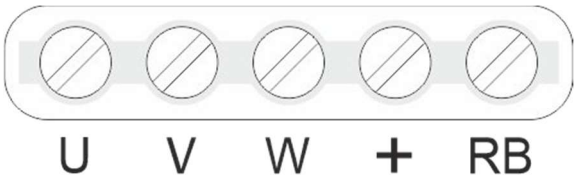


Fig. 7) Motor connection

Terminal	Function	Comments	
R	Inverter power supply	📄	The L1, L2 and L3 phase connection sequence does not affect the inverter operation or motor rotation direction. For the 1-phase inverter, the L-N power supply must be connected to R and T terminals.
S			
T			
+, RB	Braking resistor	Terminals used to connect an external braking resistor	
U	Motor	Terminals used to connect the motor	
V			
W			
⏚/PE	Neutralising	⚠	Effective inverter and motor neutralising must be ensured.

Power cable and overcurrent protection device selection

Inverter type	Input current	Output current	Maximum motor power	Protection	Cable diameter
	A	A	kW	A	mm²
FA-1LS-004	5.4	2.5	**0.4**	10	1.5
FA-1LS-007	8.2	4.0	**0.7**	16	2.5
FA-1LS-015	14.0	7.0	**1.5**	25	2.5
FA-1LS-022	23.0	10.0	**2.2**	40	4.0
FA-3HS-007	4.3	2.5	**0.7**	10	1.5
FA-3HS-015	5.0	3.8	**1.5**	10	1.5
FA-3HS-022	7.1	5.1	**2.2**	16	2.5
FA-3HS-040	10.5	9.0	**4.0**	25	2.5
FA-3HS-055	14.6	13.0	**5.5**	32	4.0

Control circuit connection

	Special attention must be paid to separating the control circuits from power circuits. Any accidental connection of these circuits may cause an electric shock risk to the personnel and/or damage risk to the inverter.	
	Pay attention to the maximum permissible voltage that can be applied to the inverter control inputs and the maximum control output current-carrying capacity rating. Exceeding these values may result in inverter damage.	
	It is recommended that shielded cables should be used for analogue inputs and outputs.	
	If analogue signals are transmitted over longer distances, current signals (0 - 20 mA or 4 - 20 mA) should be used instead of voltage signals, where possible.	

Fig. 8) Control circuit terminal strip

<table>
<tr><th></th><th>Terminal</th><th>Function</th><th>Comments</th></tr>
<tr><td rowspan="3">Power supply</td><td>+10V</td><td rowspan="2">+10 V auxiliary power supply outputs</td><td colspan="2">Auxiliary power supply unit mainly designed to supply potentiometers connected to the inverter analogue inputs</td></tr>
<tr><td>GND</td><td>  </td><td>The maximum permissible load of the +10 V power supply unit is 10 mA. Exceeding this value may result in power supply unit damage.</td></tr>
<tr><td>+24V</td><td>+24V auxiliary power supply outputs</td><td colspan="2">The +24V auxiliary power supply unit can be used, e.g. as a power supply for sensors connected to the inverter.</td></tr>
<tr><td colspan="2"></td><td>  </td><td>The maximum permissible load of the +24V power supply unit is 50 mA. Exceeding this value may result in power supply unit damage.</td></tr>
<tr><td rowspan="5">Digital input</td><td>DI1</td><td>Multi-function digital input 1</td><td colspan="2" rowspan="5">Multi-function input terminals
- galvanically (optically) separated inputs
- inputs triggered with the GND level

Input functions are defined with the following parameters:
F1.00 – DI1 input set-up
F1.01 – DI2 input set-up
F1.02 – DI3 input set-up
F1.03 – DI4 input set-up
F1.04 – DI5 input set-up

Input logic (response to opened or closed contact) set with parameter F1.35.</td></tr>
<tr><td>DI2</td><td>Multi-function digital input 2</td></tr>
<tr><td>DI3</td><td>Multi-function digital input 3</td></tr>
<tr><td>DI4</td><td>Multi-function digital input 4</td></tr>
<tr><td>DI5</td><td>Multi-function digital input 5</td></tr>
<tr><td>Analogue input</td><td>AI1</td><td>Multi-function analogue input AI1</td><td colspan="2">• Operation mode (voltage or current) is selected via jumper J3. Jumper in
○ position 1-2, i.e. 0 - 10 V voltage input (default);
○ position 2-3, i.e. 0 - 20 mA current input.
• Input impedance 22 kΩ for voltage input or 500Ω for current input</td></tr>
<tr><td>Out</td><td>TA</td><td>Relay output - NO contact</td><td colspan="2">Multifunction relay output
Maximum contact current-carrying capacity (NO and NC):</td></tr>
</table>

	Terminal	Function	Comments
Relay output	TC	Relay output - COM contact	**5 A / 250 V AC** **5 A / 30V DC** The relay output function is defined in parameter **F2.02**.
Analogue output	DA1	Multi-function analogue output DA1	Output signal logic set via jumper **J1**: position 1-2, i.e. 0 - 20 mA current output; position 2-3, i.e. 0 - 10 V voltage output The output **DA1 function is set up via parameter F2.07**.
Communication output	485+	RS485 – Line A	Outputs of RS485 communication interface supporting the Modbus RTU protocol Communication parameters are set with **F9** group parameters. Jumper **J1** facilitates the connection of an external resistor terminating the RS485 bus end: position 1-2, i.e. resistor disconnected (default); position 2-3, i.e. resistor activated
	485-	RS485 – Line B	

Part 4 Control panel

Control panel component description

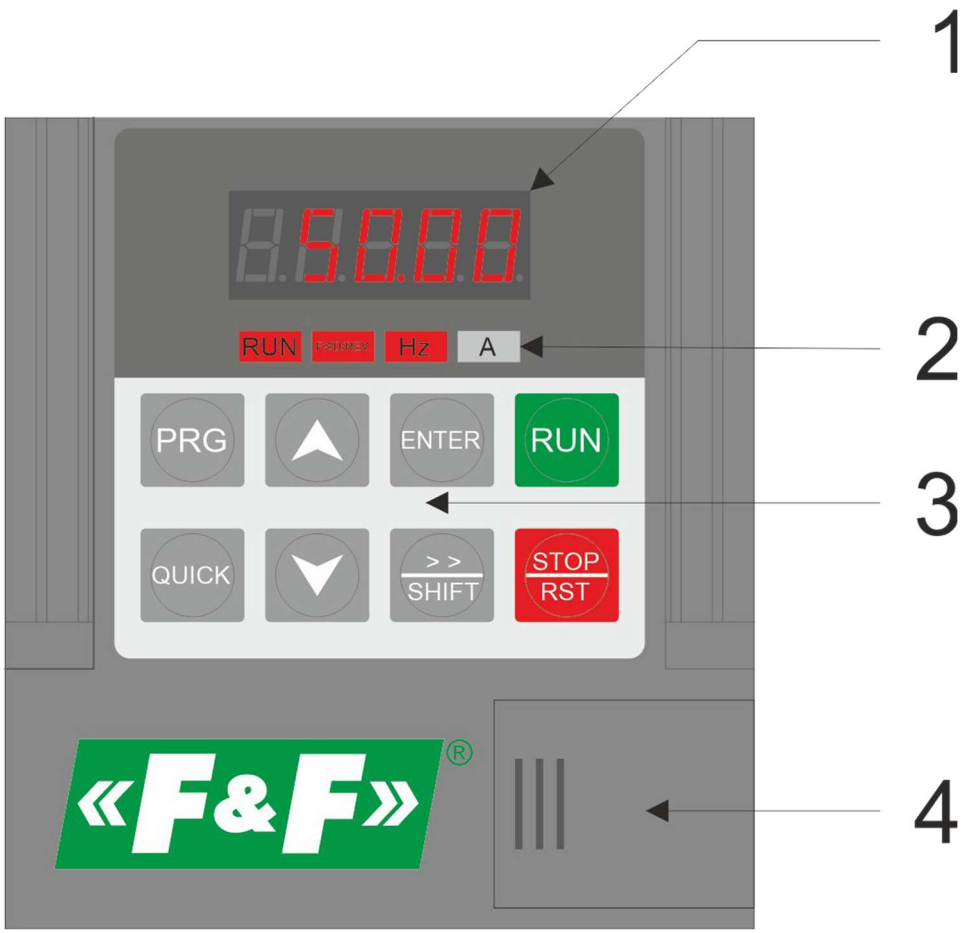


Fig. 9) Inverter control panel

The main inverter control panel elements include:

1) multifunctional 5-character LED display used for inverter operating parameter display and set-up
2) Control indicators

Indicator	Function description
RUN	Operation (motor ON)
FWD/REV	Motor rotation direction indicator. In combination with the activated RUN indicator, it indicates: FWD/REV — **"Forward"** rotations

Indicator	Function description
	FWD/REV **"Reverse"** rotations
Hz	Indicator showing that the display (1) presents frequency values [Hz].
A	Indicator showing that the display (2) presents current values [A].

3) Control buttons

Indicator	Function description
PRG	• In the status display mode - entering the main inverter set-up menu • In the menu display mode - entering a higher-level menu • In the parameter edit mode - exiting the edit mode without saving any changes
>> SHIFT	• In the status display mode - toggling between the status values displayed • In the parameter edit mode - switching to edit the next parameter value digit
▲ ▼	• In the status display mode (when the speed setpoint is set via the operator panel) - motor speed increase/decrease • In the menu display mode - moving between successive parameters within the current parameter group • In the parameter value setting mode, the buttons can be used to increase/decrease the edited parameter value.
ENTER	• Confirms the entered parameter value and exits the parameter edit mode
RUN	• Motor start (if the inverter is set up to be controlled via the operator panel)
STOP RST	• Motor stop (if the inverter is set up to be controlled via the operator panel) • Error conformation and error message deleting
QUICK	• Programmable multi-function button The current button function is set with parameter **F6.21**.

4) The cap under which the socket to connect the external operator panel and the JP1-JP3 jumpers for min. analogue input and output set-up are located.

See Fig. 10 and Fig. 11 for the methods of using inverter control panel and setting necessary parameter values.

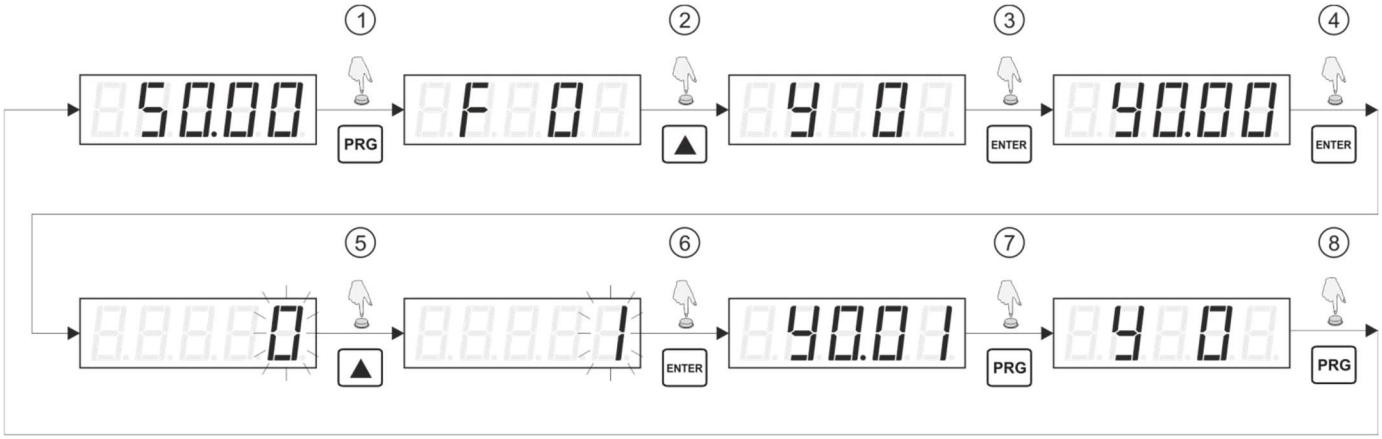


Fig. 10) Procedure example - restoring the default set-up

1. Press **PRG** in the monitor display mode to go to the menu mode and display the symbol for the first parameter group (**F0**).
2. Use the **Up** or **Down** buttons to go to a correct parameter group – here, group **Y0**.
3. Press **ENTER** to enter the selected parameter group and display its first parameter (**Y0.00**).
4. Press **ENTER** to edit a selected parameter (**Y0.00**) and display its value. The value being edited is indicated by the corresponding digit blinking.
5. Use the **Up** or **Down** buttons to set the required parameter value – here, the value is 1.
6. Press **ENTER** to confirm the new parameter value and exit the edit mode. **Note**: Press **PRG** to exit the parameter edit mode without confirming any changes.
7. Press **ENTER** to go to a higher-level menu – **Y0.**
8. Press **ENTER** to go to the status display mode.

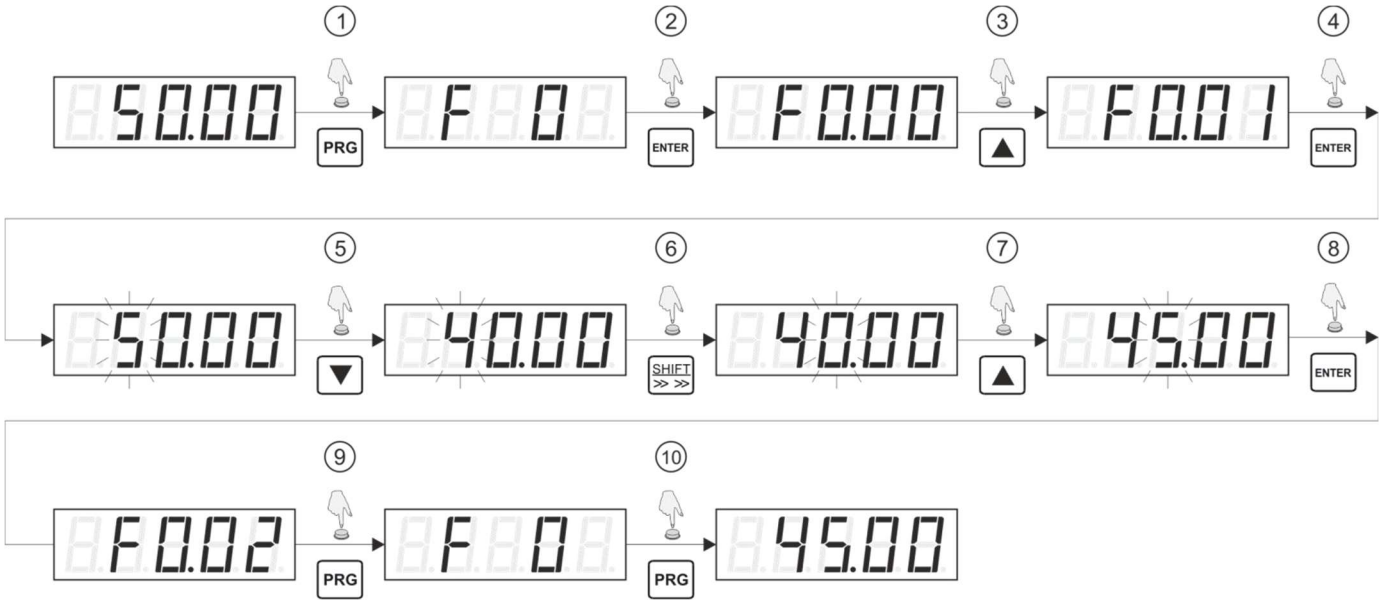


Fig. 11 Procedure example – changing a setpoint

1. Press **PRG** in the monitor display mode to go to the menu mode and display the symbol for the first parameter group (**F0**).
2. Press **ENTER** to enter the selected parameter group and display its first parameter (**F0.00**).
3. Use the **Up** or **Down** buttons to select the required parameter number – here, the number is **F0.01**.
4. Press **ENTER** to edit a selected parameter (**F0.01**) and display its value. The value being edited is indicated by corresponding digit blinking.
5. Use the **Up** or **Down** buttons to set the required parameter value digit being edited.
6. Press **SHIFT** to move to the next edit field position.
7. Use the **Up** or **Down** buttons to set the required value of the digit being edited.
8. Repeat steps 5 and 6, in case further parameter value digits are to be edited. After setting all parameter digits, press **ENTER to confirm the new value. Note**: Press **PRG** to exit the parameter edit mode without confirming any changes.
9. Press **ENTER** to go to a higher-level menu – **F0.**
10. Press **ENTER** to go to the status display mode.

Inverter status

The current inverter status can be monitored via the parameters displayed on the operator panel LED monitor. If the inverter operates in the status display mode (i.e. the inverter menu is not displayed, and it is not in the parameter edit mode), the **SHIFT** button facilitates toggling between the values being displayed. The list of displayed parameters depends on whether the motor is running or has been stopped.

If it running, the values of a total of 26 different parameters can be displayed. They include information regarding the current and set frequency, DC circuit supply voltage, output voltage and current, motor power, (analogue and digital) input and output status, etc.

If it is stopped, the values of a total of 16 different parameters can be displayed. They include information regarding the set frequency, DC circuit supply voltage, output (analogue and digital) input and output status, etc.

	Parameter **F6.01** and **F6.02** can be used to set up the list of parameters to be displayed in the status mode when the motor is running. On the other hand, the list of parameters displayed in the status mode can be set up with parameter **F6.03**.	

Setpoint protection

Inverter setpoints can be protected against unauthorised access. To this end, the parameter **Y0.01** value must differ from zero. The value saved in parameter **Y0.01** (range: 1 - 65535) is a new password granting access to the inverter set-up.

	If a password to prevent making any modifications in the inverter set-up is set, the "-----" message is displayed when the **PRG** button is pressed and somebody attempts to enter the menu. To access the set-up features, enter a valid password value and press **PRG** again to confirm the selection. To deactivate the set-up access protection feature, enter a valid password, go to parameter **Y0.01** and set it to 0.	

	If a password is set, it should not be lost or forgotten, as this may prevent the user from modifying the inverter set-up.	

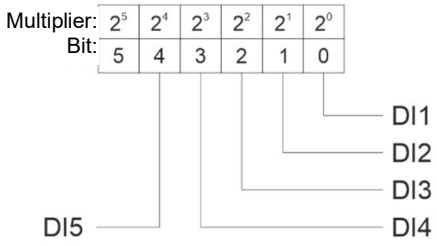
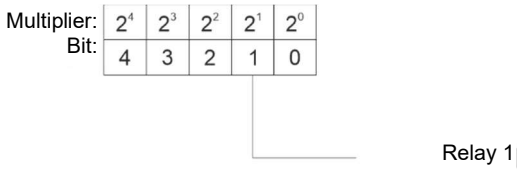
Part 5 Inverter set-up

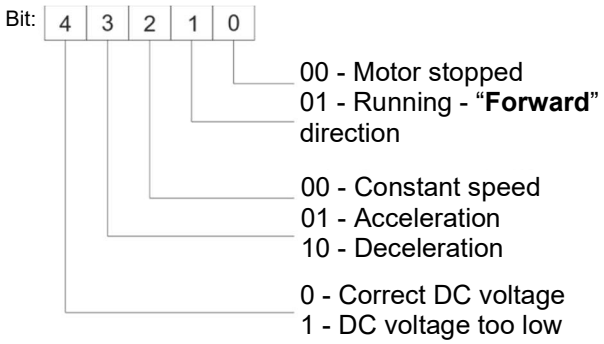
Parameter groups

Code	Group	Description	More on page
d0	Monitoring functions	Parameters responsible for the information displayed on the inverter LED display in the monitoring mode (normal inverter operation).	20
F0	Basic functions	Basic inverter set-up, including: • motor control method specification (U/f or vector control) • drive starting/stopping method • speed setting source • acceleration/deceleration time	22
F1	Input functions	Analogue and digital input set-up	31
F2	Output functions	Analogue and digital output set-up	41
F3	START-STOP functions	Motor starting/stopping parameters, including: • acceleration/deceleration curve • motor stopping method (braking or coasting) • DC braking and braking module set-up	45
F4	U/f characteristics	Parameter group making it possible to customise the U/f control characteristics	49
F5	Vector control	Parameters to set up the drive operation with the vector control mode active	52
F6	Operator panel	Parameters to set up the operator panel operation, including: • **STOP** button function • set-up of parameters displayed in the status mode • operating time, temperature, etc. information	54
F7	Auxiliary parameters	Parameters related to, e.g. JOG mode operation, defining forbidden frequency ranges, permitting rotations in both directions.	57
F8	Safety features	Inverter safety feature set-up	64
F9	Communication	RS485 connection set-up	67
E1	PLC mode	Setting up multi-speed operation parameters and parameters related to simple PLC control implementation.	68
E2	PID controller	Parameters of an on-board PID controller allowing the inverter to be used to create a control system with a feedback loop.	71

Code	Group	Description	More on page
b0	Motor parameters	Set-up of the parameters of the motor connected to the inverter	74
y0	Safety features and default settings	Setting the inverter access code and restoring the default settings	75
y1	Errors	Inverter error log	77

Monitoring functions

Code	Function	Description	Unit
d0.00	Output frequency	Output voltage frequency	Hz
d0.01	Setpoint frequency	Set output voltage frequency	Hz
d0.02	DC voltage	DC voltage value on the intermediate inverter circuit	V
d0.03	Output voltage	Output voltage Rms value	V
d0.04	Output current	Output current Rms value	A
d0.05	Output power	Current value of active power consumed by the motor	kW
d0.06	Output torque	Current drive torque value – value related to the rated value calculated from the connected motor data.	%
d0.07	Digital input status	Digital input status The parameter is programmed as a hexadecimal number with the value from 0x00 to 0x1F, as per the formula below:  One bit of the parameter **d0.07** value corresponds to each output. The value of a given bit equal to **1** indicates an active input, and value equal to **0** indicates an inactive output.	-
d0.08	Digital output status	Digital output status The parameter is programmed as a hexadecimal number with the value from 0x00 to 0x02, as per the formula below:  If the second bit is set (d0.08 = 2), the output is active; 0 = inactive output.	-

Code	Function	Description	Unit
d0.09	Analogue input **AI1**	Voltage value at the analogue input **AI1**	V
d0.12	Pulse counter	Number of pulses counted during operation with pulse inputs	-
d0.14	Motor speed	Actual motor speed converted to rpm	rpm
d0.15	PID - setpoint	PID control system setpoint	%
d0.16	PID - feedback	PID control system feedback value	%
d0.17	PLC - step	In the PLC control mode, parameter **d0.17** indicates the currently performed program step.	-
d0.20	Remaining operation time	If the inverter is programmed for preset operation time (e.g. in the PLC mode), parameter **d0.20** indicates the time left until the working cycle end.	min
d0.22	Activation time	Time from the last inverter activation	min
d0.23	Operation time	Current motor running time (measured since the last activation)	min
d0.25	Set status	Value of the status (frequency, torque, etc.) set to the inverter via a remote communication port	%
d0.27	Set frequency - main source	Frequency set via the main frequency setpoint source **Note:** The main frequency source is selected with parameter **F0.03**.	Hz
d0.28	Set frequency - auxiliary source	Frequency set via the auxiliary frequency setpoint source **Note**: The auxiliary frequency source is selected with parameter **F0.04**.	Hz
d0.35	Current inverter status	Inverter status described using bits. See the figure below for the meaning of individual bits of parameter **d0.35**: 	-
d0.37	Input **AI1** - previous status	Previous voltage value at the analogue input **AI1**	V

Basic functions

Code	Description	Setpoints		Unit	Factory	Change limited
F0.00	Control mode	Sensorless vector control	0	-	2	Y
		Control via U/f curve (scalar control)	2			

0. Sensorless vector control

Drive control based on an accurate electric model of the motor. It ensures significantly improved speed and torque control over a very wide frequency range. Designed for single-motor system operation. Vector control requires accurate motor parameter identification.

2. Control via the U/f curve (scalar control)

Motor control operating via U/f characteristics does not use the powered motor model, and is therefore not recommended for use with drives requiring high dynamic speeds, high drive torque values at low frequencies or short motor acceleration and deceleration times. Instead, it is recommended for applications where the inverter operates as a variable-frequency generator or in multi-motor systems.

F0.01	Frequency set via keyboard	Set motor operation frequency	Hz	50	Y

Parameter **F0.01** can take any value ranging from zero to the maximum frequency value (parameter **F0.19**).
Note: If the multi-step control mode or motopotentiometer mode is set as the frequency setpoint source, parameter **F0.01** facilitates defining the initial frequency value.

F0.02	Frequency step	Step at which frequency can be set	0.1	1	Hz	2	Y
			0.01	2			

Note: Parameter **F0.02** affects the settings of all values related to setting the frequency value.

If **F0.02** is set to **1**, the maximum output frequency may be equal to 3200.0 Hz. If **F0.02** is set to **2** (default setting), the maximum output frequency is 320.00 Hz.

F0.03	Main frequency setpoint source	Keyboard – **Up/Down** buttons, **Up/Down** terminals – value not retained following a power failure.	0	-	0	Y
		Keyboard – **Up/Down** buttons, **Up/Down** terminals – status retained following a power failure.	1			
		Analogue input **AI1**	2			
		Potentiometer on external operator panel	4			
		Multi-step mode	6			
		PLC mode	7			
		PID controller	8			
		Remote control (RS485)	9			

0 – Keyboard – Up/Down buttons, Up/Down terminals – value not retained following a power failure

If 0 is selected, the motor is activated at the frequency value set in parameter **F0.01**. The frequency value can be modified with the **Up/Down** buttons located on the operator panel,

Code	Description	Setpoints	Unit	Factory	Change limited

or via digital outputs to which the **Up/Down** commands are assigned. When the power supply is deactivated, the current frequency setpoint is not retained.

1 – Keyboard – Up/Down buttons, Up/Down terminals - value retained following a power failure

If 0 is selected, the motor is activated at the frequency value set in parameter **F0.01**. The frequency value can be modified with the **Up/Down** buttons located on the operator panel or via digital outputs to which the **Up/Down** commands are assigned. A frequency change results automatically in changing the parameter **F0.01** value, so that after a power failure occurs and the motor is restarted, its start-up takes place from the last set frequency value.

Note: Parameter **F0.09** additionally specifies what happens to the currently set frequency value when the motor is stopped. The parameter **F0.09** setpoint does not affect the value in the event of power failure.

2 - Analogue input AI1

	Analogue output **AI1** is set by default as an auxiliary frequency source (parameter **F0.04**). To enable **AI1** as the main frequency source, first the parameter **F0.04** setpoint must be modified.

4 - Potentiometer on external operator panel

The detailed relationship between the analogue input signal value and output frequency is set up using parameters **F1.12** - **F1.25**.

6 - Multi-step mode

Up to four binary inputs can be programmed for different combinations of the statuses transmitted to these inputs to generate different output frequencies.

When all four inputs are used, sixteen different speed levels can be set. Parameters **E1.00** - **E1.15** make it possible to set up the multi-speed operation in full detail.

7 - PLC mode

In the simple PLC control mode, a user can define up to sixteen different steps (i.e. speed, acceleration and deceleration time, duration) to be performed by the inverter automatically. Parameters from group **E1** make it possible to set up the PLC mode in full detail.

8 - PID controller

The frequency setpoint source is used as a setpoint or feedback source. In order to ensure correct PID controller operation, parameters from group **E2** must be set up additionally.

9 - Remote control

Output frequency is set remotely via commands sent by the RS-485 interface and Modbus RTU protocol.

F0.04	Auxiliary frequency setpoint source	Keyboard – **Up/Down** buttons, **Up/Down** terminals - value not retained following a power failure.	0			
		Keyboard – **Up/Down** buttons, **Up/Down** terminals – value retained following a power failure.	1			

Code	Description	Setpoints		Unit	Factory	Change limited
		Analogue input **AI1**	2			
		Potentiometer on external operator panel	4			
		Multi-step mode	6			
		PLC mode	7			
		PID controller	8			
		Remote control (RS485)	9			
Note: Operation of individual setpoints is the same as operation of parameter **F0.03** setpoints, so it is described in detail in the section describing this parameter.						
F0.05	Selecting the reference frequency for an auxiliary source	Frequency is set via the auxiliary source with reference to the maximum frequency.	0	-	0	N
		Frequency is set via the auxiliary source with reference to the main source frequency.	1			
F0.06	Range of changes for the auxiliary frequency setpoint source	0 - 150%		%	100	N
Parameters **F0.05** and **F0.06** are used if the option to link the main frequency setpoint source with the auxiliary frequency setpoint source is activated (parameter **F0.07** = **1**, **3** or **4**). In this case: • Parameter **F0.05** defines whether the frequency adjustment range for the auxiliary source is between 0 and the maximum frequency value (**F0.05** = **0**), or between 0 and the frequency value defined by the main frequency setpoint source (**F0.05** = **1**). • Parameter **F0.06** defines the range of changes introduced by the auxiliary frequency source. The resultant value of auxiliary frequency setpoint source impact is a combination of the values from parameter **F0.05** and **F0.06**.						
F0.07	Relationship between the main and auxiliary frequency setpoint source	**Ones digit – x<u>X</u>** – Frequency setpoint source selection		-	00	N
		Frequency set using the main source	0			
		The resultant frequency is the result of the arithmetic combination of the signals from the main and auxiliary sources. The action defining the relationship between the main and auxiliary source is defined by the second digit of the parameter.	1			
		Switching between the main and auxiliary frequency setpoint source	2			
		Switching between the main source and the arithmetic combination of signals from the main and auxiliary source	3			
		Switching between the auxiliary source and the arithmetic combination of signals from the main and auxiliary source	4			

Code	Description	Setpoints		Unit	Factory	Change limited
		Tens digit – Xx – relationship between the main and auxiliary frequency setpoint source				
		Main + Auxiliary	0			
		Main - Auxiliary	1			
		Max. (Main, Auxiliary)	2			
		Min. (Main, Auxiliary)	3			

Parameter F0.07 makes it possible to define the relationship between the main and auxiliary frequency setpoint source. The parameter comprises two digits:

1 digit (ones):

0 – Frequency set using the main source

The frequency is set only by means of the main frequency setpoint source (set using parameter **F0.03**).

1 – Arithmetic combination of main and auxiliary source

The resultant frequency is the result of an arithmetic operation (set at the second digit of the parameter) between the main and auxiliary frequency setpoint source.

2 – Switching between primary and secondary source

The choice of whether the frequency is set using the main or auxiliary source is made using one of the digital inputs to which the code 18 function is assigned (frequency setpoint source switching – see the description of parameter **F1.00** - **F1.07** for more details).

If the input to which the source switching function is assigned is inactive, the main source is used to set the frequency. If the source switching input is active, the frequency is set using the auxiliary source.

3 – Switching between the main source and arithmetic combination of the main and auxiliary source

It is the same as for the previous value. If the source switching input is inactive, the frequency is set using the main source. If the source switching input is active, the frequency is defined as a result of an arithmetic operation (set at the second digit of the parameter) between the main and auxiliary source.

4 – Switching between the auxiliary source and arithmetic combination of the main and auxiliary source

It is the same as for the two previous values. If the source switching input is inactive, the frequency is set using the auxiliary source. If the source switching input is active, the frequency is defined as a result of an arithmetic operation (set at the second digit of the parameter) between the main and auxiliary source.

2 digit (tens):

This setting is useful only if the first digit of the parameter forces creating the frequency combination from the main and auxiliary source.

0 – Main + Auxiliary

The resultant frequency is the arithmetic sum of the frequency set using the main and auxiliary source.

1 – Main - Auxiliary

The resultant frequency is the result of subtracting the frequency set by the main source from the frequency set by the auxiliary source.

2 – Max. (Main, Auxiliary)

The frequency is set at the higher of the values which are at a given moment set by the main and auxiliary frequency setpoint source.

3 – Min. (Main, Auxiliary)

Code	Description	Setpoints		Unit	Factory	Change limited
	The frequency is set at the lower of the values which are at a given moment set by the main and auxiliary frequency setpoint source.					
F0.08	Frequency offset	If the frequency setpoint source is set as an arithmetic combination of signals from the main and auxiliary source, parameter **F0.08** allows to force additional offset of the resultant frequency. In such cases, the set frequency is the result of the arithmetic operation between the main and auxiliary source added together with offset **F0.08**. The frequency offset can be set in the range from 0.00 Hz to the maximum value specified by parameter **F0.19**.		Hz	0.00	N
F0.09	Frequency setting memory	Set frequency is not saved when the **STOP button is pressed.**	0	-	1	N
		Set frequency is not saved when the **STOP** button is pressed.	1			

If the frequency is set digitally (e.g. using **Up/Down** buttons/terminals), parameter **F0.09** makes it possible to specify whether the last set frequency value is saved when the motor is stopped.

0 - Frequency value is not saved

When the motor is stopped, the current frequency setting is discarded. The motor will be restarted with the initial frequency value defined in parameter **F0.01**.

1 – Frequency value is saved

When the motor is stopped, the current frequency setting is retained. The motor will be restarted with the frequency value set when the motor was previously stopped.

F0.10	**Up/Down command operation**	Current frequency correction	0	-	0	Y
		Set frequency correction	1			

If the frequency is set digitally (e.g. using **Up/Down** buttons/terminals), parameter F0.10 facilitates specifying whether Up/Down commands affect the current motor frequency or change the frequency setpoint.

	The difference in parameter **F0.10** operation is particularly perceptible during acceleration/deceleration with long coasting and stopping times. In the former case, the Up/Down command affects the current frequency, which causes acceleration/deceleration to occur faster. In the latter case, the difference occurs later, i.e. when the new set frequency is reached.

F0.11	Signal source **START** - **STOP**	Control panel buttons	0	-	0	N
		Control via multi-function digital inputs **DI1** - **DI8**	1			
		Remote control (RS485 and Modbus RTU)	2			

Parameter defining the method of giving starting and stopping commands to the drive (**FWD**, **REV**, **JOG**):

0 - Control panel buttons
Commands are given using inverter control panel buttons.

1 – Control via digital inputs DI1 - DI5
Commands are given using correctly programmed digital inputs **DI1** - **DI5** (input set-up - parameters **F1.00** - **F1.05**).

2 - Remote control
Commands are given using the RS485 communication port and Modbus RTU protocol.

3 – Control panel buttons + remote control
Commands are given using operator panel buttons, RS485 communication port and Modbus RTU protocol.

4 – Control panel buttons + control via digital inputs + remote control
All the above-mentioned sources are used for control purposes.

F0.12	Linking the frequency setpoint source with the **START** - **STOP** signal source	**Ones digit** Linking the frequency sources with **START** - **STOP** commands given via the operator panel			000	N
		No link	0			
		Control panel buttons	1			
		Analogue input **AI1**	2			
		Operator panel potentiometer	4			
		Fast pulse input	5			
		Multi-speed mode	6			
		PLC mode	7			
		PID controller	8			
		Remote control (RS485)	9			
		Tens digit Linking the frequency sources with **START** - **STOP** commands given via the terminal strip (meaning of individual values is the same as for the first digit).				
		Tens digit				

		Linking frequency sources with **START** - **STOP** commands given remotely (meaning of individual values is the same as for the first digit).			

Parameter **F0.12** facilitates defining links between START - STOP command sources and frequency setpoint sources. This feature makes the source switching process more flexible.

Example:
If parameter **F0.12** is set to 24, it means that:
1) If the **START-STOP** command source is set to the operator panel, the frequency is set via an operator panel potentiometer (first digit of parameter **F0.12** set to 4).
2) If the **START-STOP** command source is set to the terminal strip, the frequency is set via an analogue input **AI1** (second digit of parameter **F0.12** set to 2).

The same frequency setpoint source can be linked to various sources used to set the **START** - **STOP** commands. If the sources are linked, parameter **F0.03** - **F0.07** settings are ignored.

F0.13	Acceleration time	0.0 - 6500.0	-	10.0	Y
F0.14	Deceleration time	0.0 - 6500.0	-	10.0	Y

The acceleration time setting (**F0.13**) defines the time during which the inverter accelerates from 0 to the frequency reference value set in parameter **F0.16**. The deceleration time setting (**F0.14**) defines the time during which the inverter decelerates from the frequency value set in **F0.16** to 0. The time unit for parameter **F0.13** and **F0.14** is specified in parameter **F0.15**.

Note:
Excessively short acceleration/deceleration times, especially for drives with a high moment of inertia, impose high loads on motor windings and inverter output circuits. They can also cause tripping of the inverter overvoltage and overcurrent protection features.

FA-3X inverters facilitate defining up to four sets of acceleration/deceleration times and switching between them using signals applied to digital inputs **DI**. Then, these times are set up via the following parameters:

F0.13, **F0.14** – First set
F7.08, **F7.09** – Second set
F7.10, **F7.11** – Third set
F7.12, **F7.13** – Fourth set

F0.15	Acceleration/deceleration time unit	1 second	0	0	N
		0.1 second	1		
		0.01 second	2		

Parameter **F0.15** determines the scale with which acceleration and deceleration times are presented. The selected scale determines the time setting accuracy as well as the maximum acceleration and deceleration times.

0 – 1 second – Time scale 0 - 65000 s
1 – 0.1 second – Time scale 0.0 - 6500.0 s
2 – 0.01 second – Time scale 0.00 - 650.00 s

F0.16	Acceleration/deceleration reference frequency	Maximum frequency (**F0.19**)	0	0	N
		Setpoint frequency	1		
		100 Hz	2		

F0.16 defines reference frequency for acceleration and deceleration times. Depending on the value of **F0.16**, acceleration times are calculated as follows:

- **0 - Maximum frequency (F0.19** – acceleration time from zero to the maximum frequency (saved in parameter **F0.19**).
- **2 - Setpoint frequency** – acceleration time from zero to the setpoint frequency. In this case, the acceleration time is constant regardless of the setpoint frequency. However, the actual motor acceleration changes (the higher the setpoint frequency, the greater the acceleration).
- **3 - 100 Hz** – acceleration time to 100 Hz frequency.

Note:
For 0 and 2, the motor acceleration is constant. If it is assumed that, e.g. the maximum frequency **F0.19** is equal to 50 Hz and the acceleration time is equal to 1 0s, the acceleration time from zero to 25 Hz is:
F0.16 = 0 -> time until 25 Hz is reached = 5 s
F0.16 = 1 -> time until 25 Hz is reached = 10 s
F0.16 = 2 -> time until 25 Hz is reached = 2.5 s

F0.17	Switching frequency change in the temperature function	No	0	1	N
		Yes	1		

When the temperature changes, the inverter can automatically adjust the power output switching frequency so that it decreases at high temperatures and increases at low temperatures. It results in reducing power losses during transistor switching and affects the inverter temperature limit.

F0.18	Switching frequency	0.5 - 16.0	-	8	N

The switching frequency value determines the frequency at which the output power transistors are switched and, simultaneously, the rate at which the PWM output waveform is shaped to power the drive connected to the inverter output. A correct switching frequency has a very significant impact on correct operation of the drive and the level of electromagnetic interferences emitted by the inverter.
If this frequency is high, the sine wave of the voltage supplying the motor is better reproduced, which improves the motor performance (especially at low frequencies) and reduces the noise it generates. However, high frequency generates much higher electromagnetic interferences. It also results in greater power losses inside the inverter, which results in the fact that the inverter emits much more heat, which in turn may even result in inverter damage at high output loads. Other additional problems include current leakage presence on cables routed between the inverter and motor, and between the motor windings and motor housing. This in turn can result in tripping the residual current protection feature integrated with the inverter.

See the table below for an example list of drive characteristics for various switching frequencies:

Switching frequency	Low	High
Motor noise	High	Low
Sinusoidal current reproduction	Poor	Good
Motor temperature	High	Low
Inverter temperature	Low	High
Current leakages	Low	High
Interference (mains and EMC)	Low	High

F0.19	Maximum output frequency	50.00 – 320.00 (3200.0)	Hz	50	Y

Maximum inverter maximum output voltage and current frequency If parameter **F0.02** is set to 2 (default) the maximum output frequency is 320 Hz. If **F0.02** is set to 1, the maximum output frequency may be equal to 3200 Hz.

Parameter **F0.19** is the reference value for the frequency set using the fast pulse input or the digital inputs (multi-speed mode).

F0.20	Upper frequency limit setpoint source	Parameter F0.21	0	-	0	Y
		Analogue input AI1	1			
		Remote control (RS485)	5			

The maximum output frequency can be set permanently via parameter **F0.21**. It is also possible to flexibly limit the maximum frequency via analogue inputs, the fast pulse input or the remote control feature (Modbus RTU communication).

Setting an analogue or pulse input to limit the maximum frequency only makes it possible to limit the maximum frequency set parameter **F0.21**.

In case the set frequency value is higher than the value specified in parameters **F0.20** - **F0.22**, the output frequency is limited to the maximum value set.

F0.21	Upper frequency limit	**F0.23** (lower limit) – **F0.19** (upper limit)	Hz	50	N
F0.22	Upper frequency limit offset	0.00 - F0.19	Hz	0	N

Parameter **F0.21** specifies the maximum frequency value that can be set at the inverter output. The setpoint range extends from the minimum frequency value (set via **F0.23**) to the maximum frequency value (set via **F0.19**).
When the upper frequency limit value (**F0.20**) is set via an analogue or fast pulse input, parameter **F0.22** allows the upper frequency limit threshold offset to be specified (so that, for example, the possibility of setting the maximum frequency equal to 0 is eliminated).

F0.23	Lower frequency limit	0.0 (lower limit) – F0.21 (upper limit)	Hz	0	N

In case the set frequency value is lower than the value set in parameter **F0.23**, the output frequency is limited to the value specified in **F0.23** or the motor is stopped (depending in the parameter **F7.18** setting).

F0.24	Rotation direction	Correct	0	-	0	N
		Reverse	1			

Parameter F0.24 makes it possible to change the motor rotation direction (“forward”). This action is a software-controlled equivalent of changing the rotation direction by altering the sequence of two motor phase wires.

Input functions

Code	Description	Setpoints	Unit	Factory	Change limited
F1.00	Input **DI1** set-up	0 - 50	-	1	Y
F1.01	Input **DI2** set-up	0 - 50	-	2	Y
F1.02	Input **DI3** set-up	0 - 50	-	8	Y
F1.03	Input **DI4** set-up	0 - 50	-	9	Y
F1.04	Input **DI5** set-up	0 - 50	-	12	Y

Inability to set the selected output function may indicate that it has already been assigned to another output. By default, only one function can be assigned to one input **DI**. This limit can be cancelled be setting parameter **F1.40** to 1.

Each binary input **DI1** - **DI5** can be assigned with one out of 50 available functions. See the table below for a list of available functions and their descriptions.

Value	Command	Description
0	None	No function is assigned to the input.
1	Forward	Forward rotation command
2	Reverse	Reverse rotation command
3	Stop	Motor stop command (applies to 3-wire mode control)
4	JOG – forward	Forward test run
5	JOG – reverse	Reverse test run
6	"**Up**" command	Frequency value increase/decrease via digital inputs **DI**.
7	"**Down**" command	
8	Coasting	Motor stop via free coasting function
9	Error reset (**RESET**)	Function designed to acknowledge and clear errors via digital inputs **DI**. It operates analogously to pressing the operator panel **RESET** button.
10	Pause	When the "Pause" command is given, the motor stops while retaining all the motor status parameters from before the pause was activated (e.g. PLC operation step, PID controller status, etc.). When the "Pause" input is deactivated, the motor restarts and its previous status is restored.
11	Alarm	NO (normally-opened) type alarm input When this input is triggered, the inverter is locked and **Err.15** is reported.
12	Multi-step control – Bit 1	Four digital inputs, to which multi-step speed commands are assigned, make it possible to define up to 16 different speeds that can be selected by combining the input signals sent to inputs **DI**.
13	Multi-step control – Bit 2	
14	Multi-step control – Bit 3	
15	Multi-step control – Bit 4	

Code	Description	Setpoints	Unit	Factory	Change limited

See below for a table specifying the speed combinations in the multi-step control input setting function:

Bit 4	Bit 3	Bit 2	Bit 1	Command	Parameter
-	-	-	-	Speed 0	**E1.00**
-	-	-	**ON**	Speed 1	**E1.01**
-	-	**ON**	-	Speed 2	**E1.02**
-	-	**ON**	**ON**	Speed 3	**E1.03**
-	**ON**	-	-	Speed 4	**E1.04**
-	**ON**	-	**ON**	Speed 5	**E1.05**
-	**ON**	**ON**	-	Speed 6	**E1.06**
-	**ON**	**ON**	**ON**	Speed 7	**E1.07**
ON	-	-	-	Speed 8	**E1.08**
ON	-	-	**ON**	Speed 9	**E1.09**
ON	-	**ON**	-	Speed 10	**E1.10**
ON	-	**ON**	**ON**	Speed 11	**E1.11**
ON	**ON**	-	-	Speed 12	**E1.12**
ON	**ON**	-	**ON**	Speed 13	**E1.13**
ON	**ON**	**ON**	-	Speed 14	**E1.14**
ON	**ON**	**ON**	**ON**	Speed 15	**E1.15**

16	Acceleration/ deceleration – Bit 1	The two digital inputs to which the acceleration and deceleration time selection commands are make it possible to select up to four combinations of acceleration and deceleration times via combinations of signals applied to the inputs **DI**. Acceleration and deceleration times associated with the successive steps are defined in the following parameters:, , ,.
17	Acceleration/ deceleration – Bit 2	

See the table below for a list of possible combinations of inputs responsible for acceleration and deceleration plus their corresponding setting.

Bit 2	Bit 1	Command	Parameters
-	-	Set 1	**F01.13** - **F0.14**
-	**ON**	Set 2	**F7.08** - **F7.09**
ON	-	Set 3	**F7.10** - **F7.11**
ON	**ON**	Set 4	**F7.12** - **F7-13**

18	Frequency setpoint source switching	When linked with the parameter **F0.07** setting, input **DI** facilitates switching between two frequency setpoint sources.
19	Up/Down – deleting the setpoint	Triggering the input to which the code 19 function is assigned results in clearing the current frequency value set via **Up** and **Down** buttons and restoring the frequency value set in **F0.01**.
20	**START-STOP** (1) command source switching	Input facilitating START-STOP command source switching If F0.11 is set to 1, this input facilitates switching the source between the operator panel and terminal strip. If F0.12 is set to 2, this input facilitates switching the source between the operator panel and remote control device.

Code	Description	Setpoints	Unit	Factory	Change limited
21	Acceleration/ deceleration lock	Command making it impossible to alter the frequency value (except for the stop motor command)			
22	PID – pause	PID control operation stop Controller status is locked at the current level. Changes to the setpoint and feedback signal do affect the PID controller output.			
23	PLC – reset	In the control mode, the “PLC - reset” command resets the PLC status and restores its initial value.			
25	Counter input	Input for counting pulses appearing at input **DI**			
26	Counter reset	Resetting the counter of pulses counted via the counter input (**DI** - code 25)			
27	Pulse length measurement	Function for determining the length of pulses appearing at input **DI**			
28	Pulse length reset	Resetting the pulse duration determined via the pulse length measurement input (**DI** - code 27).			
29	Torque-controlled lock	If the input is active and the inverter ran in the torque control mode, it is then switched to the speed control mode.			
30	Fast pulse input	The fast (100 kHz) pulse input function can only be assigned to input **DI5**.			
32	DC braking	Input activation switches the inverter to the DC braking mode.			
33	Alarm	NC (normally-closed) type alarm input It the circuit with the input to which the Alarm (NC) function is assigned is interrupted, the inverter is locked and **Err.15** is reported.			
34	Frequency change permission	If the input is triggered, the inverter responds to motor frequency change commands. Otherwise, the frequency is locked at the last set value.			
35	PID controller – run direction	Input making it possible to change the feedback operation direction in the PID control system Note: The default feedback direction is set with parameter **E2.03**.			
36	Braking (1)	This input makes it possible to stop the motor (analogously to pressing the operator panel **STOP** button). For example, this function can be used to operate limit switches.			
37	**START-STOP** (2) command source switching	Input facilitating **START-STOP** command source switching between the terminal strip and remote control device. If the inverter is set up for **START-STOP** control via the terminal strip, triggering this input results in switching the source to the remote control device (and vice versa).			
38	PID – integrating controller stop	If this input is active, operation of the PID controller integrating part is stopped. However, the proportional and integrating sections still operate normally.			
39	Switching between the main frequency source and setpoint	The active input disconnects the main frequency setpoint source and replaces it with the setpoint defined in parameter **F0.01**.			

Code	Description	Setpoints	Unit	Factory	Change limited
40	Switching between the auxiliary frequency setpoint source and setpoint	The active input disconnects the auxiliary frequency setpoint source and replaces it with the setpoint defined in parameter **F0.01**.			
43	PID controller parameter switching	In case the option to switch PID controller parameters via the terminal strip is set (**E2.19** = 1): Input active - PID controller follows the first set of parameters (**E2.13** - **E2.15**). Input Inactive - PID controller follows the second set of parameters (**E2.16** - **E2.18**).			
44	Error (1)	When this input is in activated, the inverter is locked and **Err.27** is reported. Precise response to error occurrence can be defined in parameter **F8.19**.			
45	Error (2)	When this input is in activated, the inverter is locked and **Err.28** is reported. Precise response to error occurrence can be defined in parameter **F8.19**.			
47	Emergency braking	Triggering the input results in stopping the motor as quickly as possible. The braking time is set automatically so that the braking current does not exceed the maximum value and inverter locking can be prevented.			
48	Braking (2)	Triggering the input results in motor deceleration (to a complete stop) as per the braking time set in parameter **F7.13**. Note: The braking command is effective regardless of the selected **START** – **STOP** command mode.			
49	Motor deceleration and stopping with DC	Triggering of the input results in motor deceleration to the initial speed (F0.01) and stopping with the DC braking function.			
50	Running time reset	The input operates in combination with the time control functions (set via parameters **F7.42** – **F7.45**). Activating the input results in resetting the current operating time counter and restarting the countdown.			

F1.10	Terminal strip control mode	Two-wire control - Mode 1	0	-	0	Y
		Two-wire control - Mode 2	1			
		Three-wire control - Mode 1	2			
		Three-wire control - Mode 2	3			

Parameter F1.10 determines the method of processing the **START - STOP** commands given by the inverter terminal strip.

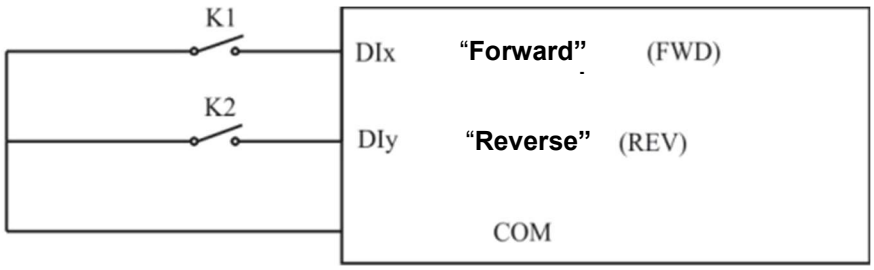
Two-wire control – Mode 1

It is the simplest and most commonly implemented control method. Two digital inputs DI are assigned with forward (FWD) and reverse (REV) run functions.

Input set-up:

Input terminal	Input set-up parameter setpoint	Function description
DIx	1	Run - **Forward** (FWD)
DIy	2	Run - **Reverse** (REV)

Control connection diagram:



Run logic:

K1	K2	Operation
-	-	**STOP**
-	**ON**	Run - **Reverse**
ON	-	Run - **Forward**

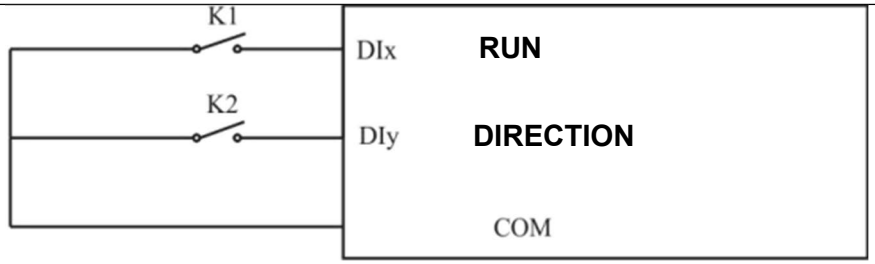
Two-wire control - Mode 2

In this mode, one input (**DIx**) operates as the motor run command, and the other (**DIy**) is used to select the run direction.

Input set-up:

Input terminal	Input set-up parameter setpoint	Function description
DIx	1	Run - **Forward** (FWD)
DIy	2	Run - **Reverse** (REV)

Control connection diagram:



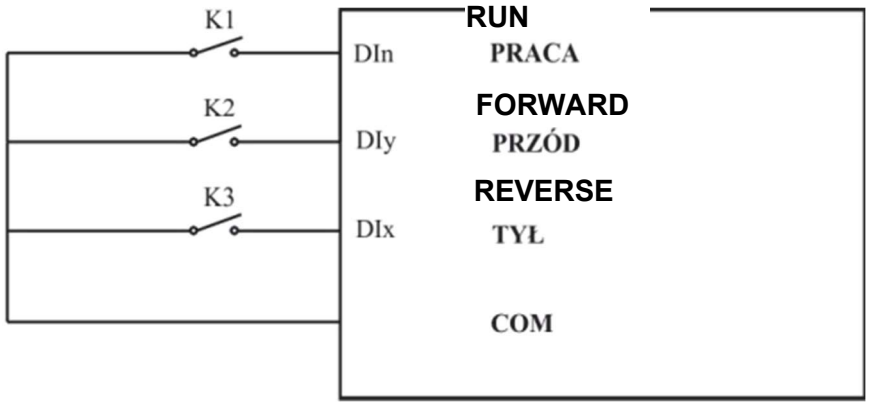
Run logic:

K1	K2	Run
-	-	**STOP**
-	**ON**	STOP
ON	-	Run - **Forward**
ON	**ON**	Run - **Reverse**

Three-wire control - Mode 1

The run permission is obtained by activating input **Din** (level control) to which the code 3 function (three-wire control – run permission) is assigned. The motor run in the specified direction is activated by pressing (pulse control) input **DIx** or **DIy** to which the code 1 and 2 commands are assigned. Deactivate input **Din** to stop the motor.

Input terminal	Input set-up parameter setpoint	Function description
DIy	1	Run - **Forward** (FWD)
DIx	2	Run - **Reverse** (REV)
DIn	3	3-wire control - **STOP/RUN**



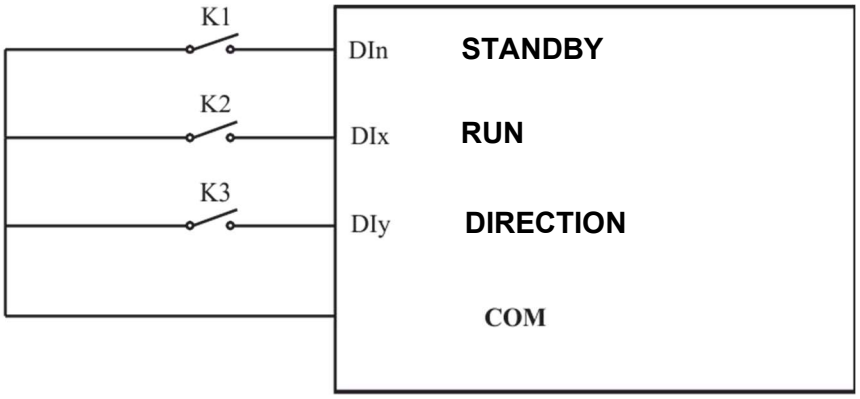
Three-wire control - Mode 2

The run permission is obtained by activating input **Din** (level control) to which the code 3 function (three-wire control – run permission) is assigned. The motor is started with terminal **DIx** (pulse control) to which the code 1 command is assigned. The run direction is specified via input **DIy** (level control) to which the code 2 command is assigned.

Input terminal	Input set-up parameter setpoint	Function description
DIx	1	Run - **Forward** (FWD)
DIy	2	Run - **Reverse** (REV)
DIn	3	3-wire control – **STOP**/**RUN**

Run direction:

DIy	Direction
0	Forward (FWD)
1	Reverse (REV)



F1.11	**Up/Down terminal** - change speed	0.001 - 65.535	Hz/s	1.0	N

When the input terminals are used to operate the **Up**/**Down** function, parameter F1.11 determines how fast the frequency setpoint changes.

Note: If **F0.02** is set to 1, the change speed can be set within the range from 0.01 Hz/s to 655.35 Hz/s. If **F0.02** is set to 2, the change speed can be set within the range from 0.001Hz/s to 65.535 Hz/s.

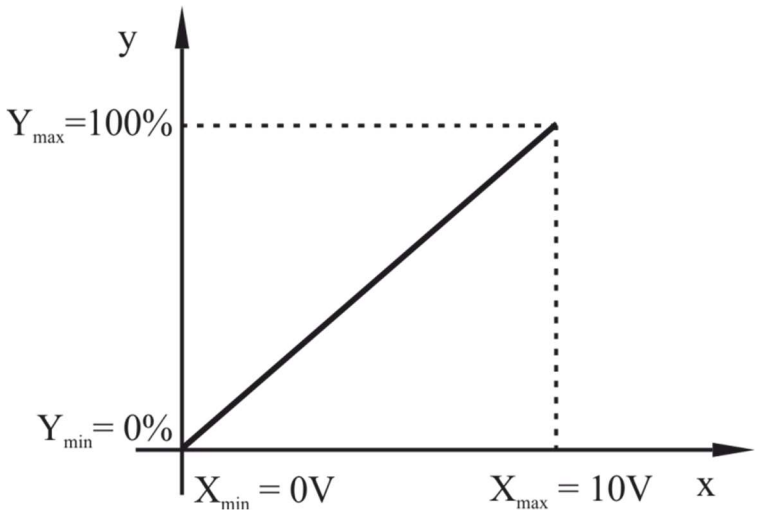
F1.12	First analogue input characteristic	X_{min}	0.00 - **F1.14**	0.00	V	N
F1.13		Y_{min}	-100.00 - 100.00	0.00	%	N
F1.14		X_{max}	F1.12 - 10.00	10.00	V	N
F1.15		Y_{max}	-100.00 - 100.0	100.00	%	N

The inverter makes it possible to define the relationship between the voltage (current) at the analogue input and the setpoint at the analogue transducer output.
If the signal value at the analogue input exceeds $\mathbf{X_{max}}$, the output signal value remains at the $\mathbf{Y_{max}}$ level. If the signal value at the analogue output is below $\mathbf{X_{min}}$, **0** or the $\mathbf{Y_{min}}$ value (depending on the **F1.25** parameter settings) can be set at the output.

See the table below for a few examples of characteristic setpoints:

Example 1

The 0 - 10 V voltage input is set in such a manner that the setpoint equal to 0% corresponds to the input voltage equal to 0 V, and the setpoint equal to 100% corresponds to the input voltage equal to 10 V.

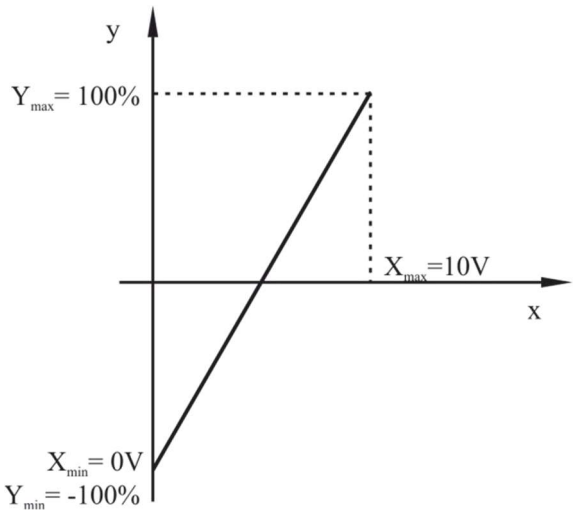


Settings:

F1.12	X_{min}	0.00 V
F1.13	Y_{min}	0.0 %
F1.14	X_{max}	10.00 V
F1.15	Y_{max}	100.0%

Example 2

The 0 - 10 V voltage input is set in such a manner that the setpoint equal to -100% corresponds to the input voltage equal to 0 V, and the setpoint equal to 100% corresponds to the input voltage equal to 10 V. In this case, the setpoint equal to 0% is obtained for the input voltage equal to 5 V.



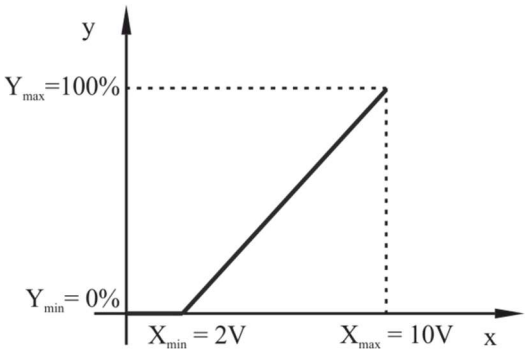
Settings:

F1.12	X_{min}	0.00 V
F1.13	Y_{min}	-100.0 %
F1.14	X_{max}	10.00 V
F1.15	Y_{max}	100.0%

Example 3

The 4 - 20 mA current input is set in such a manner that, for the 4 mA current, the setpoint is 0%, and it is set to 100% for the 20mA current.

Note: When using a current input, the input signal is converted according to the following relationship: 1 mA = 0.5 V



Settings:

F1.12	X_{min}	2.00 V
F1.13	Y_{min}	0.0 %
F1.14	X_{max}	10.00 V
F1.15	Y_{max}	100.0%

F1.25	Signal value lower than the minimum value	**Ones digit** - input **AI1**		-	0	N
		Minimum value	0			
		0.0%	1			

Parameter **F1.25** determines how the analogue signal is processed if its value falls below the minimum level. Here, two responses are possible:

0 – Minimum value

The setpoint remains at the minimum level (parameter **F1.13**) **1 - 0.0%.**
The setpoint is set to 0.0%

F1.30	Filtering	Digital input **DI**	0.000 - 1.000	s	0.01	N
F1.31		Analogue input **AI1**	0.00 - 10.00	s	0.1	N

F1.30 - **F1.31** group parameters make it possible to specify the length of time for which the voltages applied to the analogue and digital inputs are filtered. If disturbances or rapid voltage changes at the inputs occur, the filtering time should be extended to avoid abnormal input operation.

Note: Extending the filtering time results in increasing the input resistance to disturbances, but, simultaneously, it slows down the inverter response to input status changes.

F1.35	**DI1** - **DI5** input logic	**First digit** – input **DI1**		-	0	Y
		Positive logic – active when the contact is closed	0			

		Negative logic - active when the contact is opened	1			
		Second digit – input **DI2**				
		Third digit – input **DI3**				
		Fourth digit – input **DI4**				
		Fifth digit – input **DI5**				

Parameter **F1.35** makes it possible to define the activation method independently for each digital input.

0 – Positive logic

If positive logic is selected, closing the contact between input **DI** and **GND** input is (by default) treated as input activation. An opened contact between **DI** and **GND** is treated as an inactive input.

1 – Negative logic

If negative logic is selected, an opened contact between input **DI** and **GND** input is (by default) treated as input activation. ON the other hand, a closed contact between **DI** and **GND** is treated as an inactive input.

F1.37	**DI1** – deceleration time	0.0 - 3600.0	s	0.0	Y
F1.38	**DI2** – deceleration time	0.0 - 3600.0	s	0.0	Y
F1.39	**DI3** – deceleration time	0.0 - 3600.0	s	0.0	Y

The time from the moment when the digital input status changes to the moment when the function associated with that digital input is activated.

Note: Only inputs **DI1**, **DI2** and **DI3** make it possible to delay the input activation.

F1.40	Doubling the **DI settings**	Parameter determining whether the same function can be assigned to different digital inputs **DI**. 0) Function doubling forbidden 1) Function doubling permitted	-	0	Y

Output functions

Code	Description	Setpoints	Unit	Factory	Change limited
F2.02	Relay output function **T1**	0 - 40	-	2	N

Parameter **F2.02** specifies the relay input function. List of reported events:

Value	Function	Description
0	None	No function is assigned to the output.
1	Standby - frequency equal to 0 Hz	The status is reported when the inverter run command is given and, simultaneously, the output frequency is set to 0 Hz.
2	Error	Error message and inverter emergency stop
3	FDT1 frequency reached	In combination with parameter **F7.23** and **F7.24**, the output informs about reaching and exceeding the frequency setpoint. For more information, see the parameter **F7.23** and **F7.24** descriptions.
4	Set frequency reached	In combination with parameter **F7.25**, the output informs that the set frequency has been reached and the operation is within a defined zone around the setpoint. For more information see the parameter **F7.25** description
5	0 Hz speed	Output is active when 0 Hz frequency is set.
6	Motor overload	Motor overload indication (linked to parameters **F8.02** – **F8.04**)
7	Inverter overload	The output is activated when inverter overload is detected, but ten seconds before the drive emergency stop occurs.
8	Pulse counter overflow	The inverter makes it possible to program the counter (counting the pulses applied to input DI) with a specified maximum and setpoint value. When the setpoint is exceeded, the code 9 output is activated, and when the maximum value is counted down, the 8 code output is also activated. For more information, see the parameter **E0.08** and **E0.09** descriptions.
9	Set pulse number countdown	
10	Set length measurement	If a digital input is used to convert the number of pulses into the material length, the digital output to which the code 10 function is assigned indicates that the set length has been achieved.
11	PLC operation cycle end	When a full PLC operation cycle is completed, the output is activated for 250 ms.
12	Set cumulative operation time reached	The output is activated when the cumulative inverter operation time (parameter **F6.07**) exceeds the limit value defined in parameter **F7.21**.
13	Output frequency limit	The output is active when the set frequency is higher than the maximum value or lower than the minimum value (i.e. when the inverter cannot reach the set frequency value).
14	Output torque limit	The output is active when the drive torque limit is exceeded.
15	Ready to operate	The output is activated when the inverter is ready for operation, i.e. when the power supply is ON, the voltage in the DC circuit is stable and no error messages are displayed.
17	Upper frequency value reached	The output is active when the upper limit frequency value is reached or exceeded.
18	Lower limit frequency value reached	The output is active when the output frequency is equal to or less than the minimum value.

Code	Description	Setpoints	Unit	Factory	Change limited
		Note: When the inverter is stopped (STOP command), this output is deactivated.			
19	Low supply voltage	The output is activated when undervoltage is detected in the inverter DC circuit.			
20	Communication	Output status set by the remote control device (RS485)			
23	0 Hz speed (2)	The output is active when the output frequency is equal to 0 Hz. **Note**: The output is also active when the motor is stopped by the **STOP** command.			
24	Set cumulative inverter activation time reached	The output is activated if the inverter activation time (parameter **F6.08**) reaches the value set in parameter **F7.20**.			
25	FDT2 frequency reached	Signalling the fact that the set frequency FDT2 has been reached and exceeded. For more information, see the parameter **F7.26** and **F7.27** descriptions.			
26	f_1 frequency reached	Indicating that the frequency value set in **F7.28** and **F7.29** has been reached.			
27	f_2 frequency reached	Indicating that the frequency value set in **F7.30** and **F7.31** has been reached.			
28	I_1 current reached	Indicating the I_1 current with the setpoint set in **F7.36** and **F7.37** has been reached.			
29	I_2 current reached	Indicating the I_2 current with the setpoint set in **F7.38** and **F7.39** has been reached.			
30	Current operation time reached	If the current run time counter (parameters **F7.42** - **F7.44**) is programmed, the output is activated when the set motor run time is reached.			
31	Voltage at input **AI1** exceeded	The output is active when the voltage value at analogue input **AI1** is lower than the value set in parameter **F7.50**, or higher than the value set in parameter **F7.51**.			
33	No load	Idle motor operation signalling			
34	Reverse run	The output is active when the motor rotates in the "**Reverse**" direction.			
35	Load current drop	The output is active when the load current value drops below the value defined in the parameter **F7.32** and **F7.33**.			
36	Overtemperature	The output is active when the inverter power module temperature (parameter **F6.06**) exceeds the limit value defined in parameter **F7.40**.			
37	Load current exceeded	The output is active when the load current value rises above the value defined in parameter **F7.34** and **F7.35**.			
38	Minimum frequency	The output is active when the frequency is equal to or less than the minimum value. **Note**: The output is also active when the motor is stopped (**STOP**).			
40	Permissible operation time exceeded	The output is activated when the inverter operation time exceeds the value set in parameter **F7.45**.			
F2.07	Analogue output **DA1 function**	0 - 15	-	0	N
The analogue output operates within the range from 0 to 10 V (voltage output) or from 0 to 20 mA (current output).					

Code	Description	Setpoints	Unit	Factory	Change limited

One of the following functions can be assigned to the analogue output.

Value	Function	Description
0	Current frequency	The output signal value is proportional to the current inverter output frequency. The output signal is scaled within the range from 0 Hz to the maximum output frequency.
1	Set frequency	The output signal value is proportional to the set output frequency. The signal is scaled within the range from 0 Hz to the maximum frequency.
2	Output current	The output signal value is proportional to the output current Rms value. The signal is scaled within the range from 0 to 200% of the motor rated current.
3	Output torque	The output signal value is proportional to driving torque. The signal is scaled within the range from 0 to 200% of the rated torque.
4	Output power	The output signal value is proportional to the current output power. The signal is scaled within the range from 0 to 200% of the rated power.
5	Output voltage	The output signal value is proportional to the voltage Rms value at the inverter output. The signal is scaled within the range from 0 to 120% of the inverter rated voltage.
7	AI1	The signal value is proportional to the voltage value at analogue input **AI1**. The signal is scaled within the range from 0 to 10 V.
10	Length	In length measurement mode, the output signal is proportional to the currently measured length. The signal is scaled within the range from 0 to the set final length (parameter **E0.05**).
11	Counter	In element counting mode, the output signal is proportional to the counter value. The signal is scaled within the range from 0 to the set final counter value (parameter **E0.08**).
13	Rotational speed	The output signal is proportional to the current motor speed. The signal is scaled within the range from 0 Hz to the rotational speed representing the maximum frequency.
14	Output current	The output signal is proportional to the inverter output current value. The signal is scaled within the range from 0 to 100 A.
15	DC voltage	The output signal is proportional to the DC voltage value in the inverter intermediate circuit. The signal is scaled within the range from 0 to 1000 V.

F2.11	Relay output	0.0 - 3600.00	s	0	N

Code	Description	Setpoints	Unit	Factory	Change limited
	delay **T1**				
F2.15	Binary output logic	Second digit (xxx**X**x) - Relay output logic T1			

The second digit of parameter **F2.15** determines the relay output logic.

0 – Positive logic

Positive logic means that if the output is active, the corresponding relay contact is closed.

2 – Negative logic

Negative logic means that if the output is active, the corresponding relay contact is opened.

F2.16	Zero offset for output **DA1**	-100.0 - +100.00	%	0	N
F2.17	Amplification coefficient for output **DA1**	-10.00 - +10.00	-	0	N

Parameters F2.16 - F2.17 are used to offset and scale the analogue output **DA1** characteristics. Offsetting the zero value by 100% results in increasing the output signal characteristic by 10 V (or 20 mA). In this case, the output value equal to 0 V corresponds to +10 V after scaling.

The resulting output signal value can be calculated using the **y = kX + b** formula, where:
k - amplification coefficient;
X - input value of the analogue signal
b - offset of a characteristic
y - scaled and amplified output signal value

Example
If we assume that the output analogue signal is to reproduce the output frequency in such a manner that the frequency of 0 Hz is 8 V, and the maximum frequency is 3 V, then:
k = -0.5
b = 80%

START– STOP functions

Code	Description	Setpoints		Unit	Factory	Change limited
F3.00	Start method	Direct start-up	0	-	0	N
		Start-up with speed tracking	1			
		Start-up with pre-excitation	2			

Parameter F3.00 determines the motor starting method.

0 – Direct start-up
The motor is started at 0 Hz. If the DC braking function is set, first, the motor stopping procedure is performed, and only then the start-up procedure takes place.

1 – Start-up with speed tracking
When the run command is given, the inverter analyses the rotational speed and rotation direction, performs the motor start-up from the current motor speed.

2 – Start-up with pre-excitation
The start-up with pre-excitation is only possible with asynchronous motor control. It consists in pre-magnetising the motor and creating an additional excitation flux. To perform this start-up, parameters **F3.05** and **F3.06** must be set.

F3.01	Speed tracking method	From final speed	0	3	0	Y
		From 0 Hz speed	1			
		From maximum speed	2			
		Intelligent speed tracking	3			

The speed tracking method determines how the inverter searches for the current motor speed. Depending on the standstill duration and the current motor speed, different strategies achieve different speed identification times.

0 - Start from final speed
Tracking starts from the frequency at which the inverter was deactivated downwards (towards the frequency value of 0 Hz). This method makes it possible to quickly determine the motor speed when the breaks between activations were short and the motor torque was low.

1 – Start from 0 Hz speed
The tracking process starts from 0 Hz upwards. This solution is effective when there are long pauses between activations.

2 – Start from maximum speed

3 – Intelligent speed tracking – the inverter identifies how the motor speed changes and adapts the drive start-up method accordingly. It eliminates “jerking” caused by a load when the power is switched on.

F3.02	Tracking speed	1 - 100	-	20	N

Speed tracking system operation speed The higher the value, the faster the system operates. However, an excessive value prevent the inverter from identifying the speed correctly, which results in initiating its start-up from the initial speed value.

F3.03	Start frequency	0.00 - 10.00	Hz	0.00	N
F3.04	Operation time with start frequency	0.0 - 100.0	s	0.0	Y

When the motor is started, firstly, the start frequency (**F3.03**) is set, and is maintained for the time specified in **F3.04.** Next, the motor accelerates to the set frequency. The operation time with start frequency is included in the motor acceleration time. When the direction is switched, the start frequency operation stage is skipped.

Code	Description	Setpoints	Unit	Factory	Change limited

Note: If the set frequency value is lower than the start frequency value, the start frequency operation stage is skipped.

Example 1 – Start frequency value higher than set frequency value F0.01 =
2.00 Hz – Set frequency 2 Hz
F3.03 = 5.00 Hz – Start frequency 5 Hz
F3.04 = 2.0 s - Operation time with start frequency 2 s

As the start frequency is lower than the setpoint, the motor remains stopped for 2 s after the run command is given, after which it accelerates to a speed of 2 Hz.

Example – Start frequency value lower than set frequency value F0.01 =
10.00 Hz – Set frequency 10 Hz
F3.03 = 5.00 Hz – Start frequency 5 Hz
F3.04 = 2.0 s - Operation time with start frequency 2 s

The motor accelerates to 5 Hz and maintains this speed for 2 s. Next, it accelerates to the target speed value, i.e. 10 Hz.

F3.05	Motor start-up	Initial DC braking current, initial excitation flux current	0 - 100	%	0	Y
F3.06		Initial DC braking time, initial motor excitation time	0.0 - 100.0	s	0.0	Y

Parameters **F3.05** and **F3.06** are active when the option of motor initial DC braking before basic start-up is active, or for asynchronous motors, when the option to generate initial excitation current is selected. Parameter **F3.05** determines the braking or excitation current value (specified as inverter rated current percentage). Parameter **F3.06** determines the braking or excitation duration.

F3.07	Stopping method	Braking	0	-	0	N
		Stopping by coasting	1			

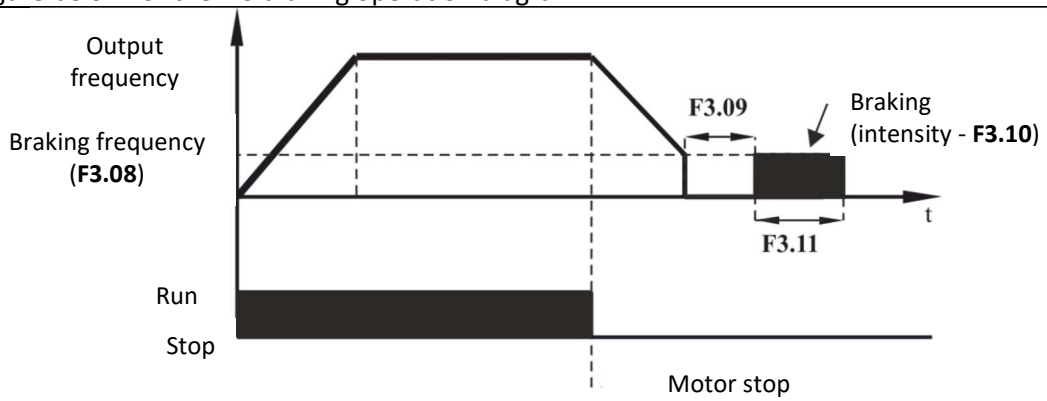
0 – Braking
The motor stop command causes the inverter to gradually reduce the motor speed in line with the time setting in the **Braking time** parameter until the speed reaches 0 Hz.

1 – Stopping by coasting
The motor stop command disconnects the inverter output from the driven motor. As the motor is de-energised, it decelerates by coasting during the time determined by its initial speed and its moment of inertia.

Note
For drives with a high moment of inertia, a sufficiently long braking time must be specified or the motor must also be stopped by coasting. Otherwise, there is a risk that excess energy emitted by a rapidly decelerating motor will be transferred to the inverter, causing a sudden voltage surge in the DC circuit and, as a result, emergency shut-down of the inverter.

Code		Description	Setpoints	Unit	Factory	Change limited
F3.08	Motor stop	DC braking start frequency	0.00 - F0.19 (maximum frequency)	Hz	0	N
F3.09		Time to start DC braking	0.0 - 100.0	s	0	N
F3.10		DC braking current	0 - 100	%	0	N
F3.11		DC braking time	0.0 - 100.0	s	0	N

In the case of DC braking, during the stopping procedure, the inverter decelerates to frequency **F3.08** and de-energises the motor. After time **F3.09** elapses, DC braking starts with will commence with the value specified in **F3.10** (parameter expressed as a percentage of the inverter rated current) and lasts for the time specified in **F3.11**.
See the figure below for the DC braking operation diagram.



F3.12	Braking module performance	0 - 100		%	100	N

It is only used in inverters with an integrated braking unit and a braking resistor installed. High performance allows the excess energy generated during intensive motor braking to be dissipated more efficiently. Conversely, it results in a large amount of heat on the braking resistor and large voltage fluctuations in the DC circuit.

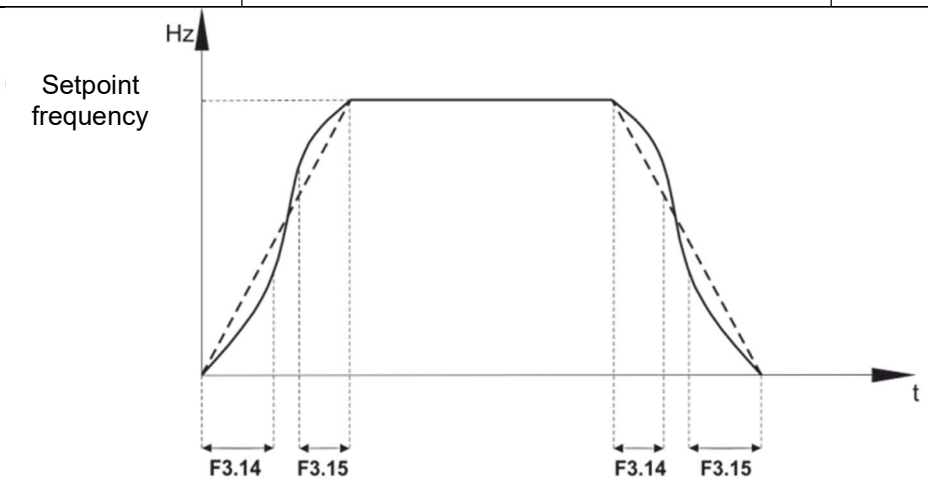
F3.13	Acceleration/deceleration characteristic	Linear characteristic	0	-	0	Y
		Acceleration/deceleration as per the first S-curve	1			
		Acceleration/deceleration as per the second S-curve	2			

0 – Linear characteristic
During acceleration/deceleration the output frequency changes in a linear manner, from the initial to final value.

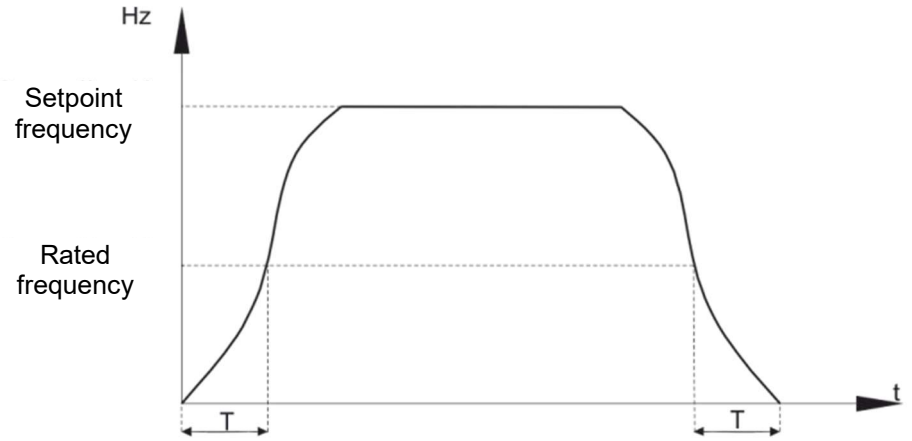
1 – Acceleration/deceleration as per the first S-curve
During acceleration/deceleration the output frequency changes according to an S-shaped characteristic. This solution is suitable for drives in which smooth start-up is required without intensive jerks at the start-up and after reaching the final value. Parameters F3.14 and F3.15 can be used to set the time percentage for individual acceleration curve sections.

2 – Acceleration/deceleration as per the second S-curve
The output frequency changes according to an S-shaped characteristic, but unlike the previous case, the inflection point always corresponds to the rated motor frequency. This solution is suitable for cases in which it is necessary, for example, to obtain frequency areas for which different acceleration times will apply.

F3.14	Acceleration time as per the first S-curve section	0 - 100	%	30	Y
F3.15	Acceleration time as per the second S-curve section	0 - 100	%	30	Y



Acceleration/deceleration characteristic as per the first S-curve



Acceleration/deceleration characteristic as per the second S-curve

Parameters F3.14 and F3.15, respectively, control the sections of the characteristic in which the acceleration value is lower than 0 (concave characteristic) and higher than 0 (convex characteristic). In total, the value of parameters F3.14 and F3.15 must be lower than or equal to 100%.
If F3.14 + F3.15 < 100%, there is a section in the middle of the characteristic where the frequency changes in a linear manner.

U/f characteristic

The parameter group F4 controls the shape of the U/f characteristic. If the vector control functions are used, settings of these parameters are ignored. The U/f function control is primarily used when the inverter drives pumps or fans, to control multiple motors simultaneously or when there is a large imbalance between inverter power and motor power.

Code	Description	Setpoints		Unit	Factory	Change limited
F4.00	U/f control characteristic	Linear – U/f = const	0	-	0	Y
		User-defined	1			
		Square - $U \sim f^2$	2			
		Reduced 1 - $U \sim f^{1.2}$	3			
		Reduced 2 - $U \sim f^{1.4}$	4			
		Reduced 3 - $U \sim f^{1.6}$	6			
		Reduced 4 - $U \sim f^{1.8}$	8			
		Voltage independent from frequency	10			
		Voltage partly independent from frequency	11			

0 – Linear characteristic

The voltage at the inverter output increases in a linear manner together with increase in frequency. The linear characteristic applies to the majority constant-torque drives.

1 – User-defined characteristic

The relationship between the output voltage and frequency can be freely set by a user with the three-point characteristic set up with parameters **F4.03** – **F4.08**.

2 – Square characteristic

The inverter output voltage (and therefore the drive torque) increases up to the squared output frequency value. This characteristic is used in particular to control pumps and fans.

3 - 8 – Reduced characteristics with various degrees of U/f dependency

Intermediate characteristics between linear and square relationship between the output voltage and frequency.

10 – Voltage independent from frequency

The inverter output voltage is totally independent of the output frequency. The frequency value is determined by the frequency setpoint source, while the output voltage value is determined by parameter **F4.12** setting.

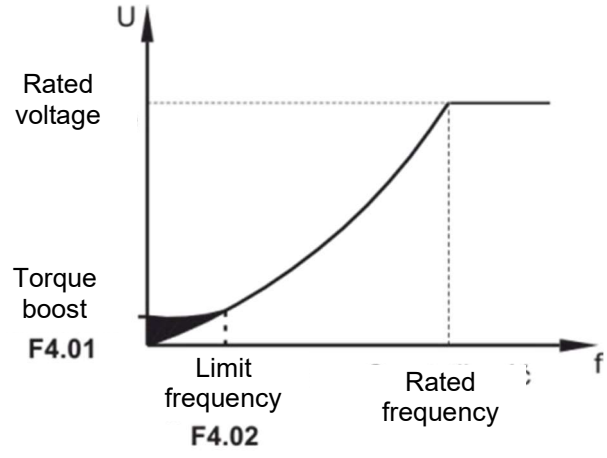
11 – Voltage partly independent from frequency

The inverter output voltage is linked to the output frequency via a coefficient of proportionality defined in parameter **F4.12**. This function facilitates exerting dynamic impact on the control characteristic shape.

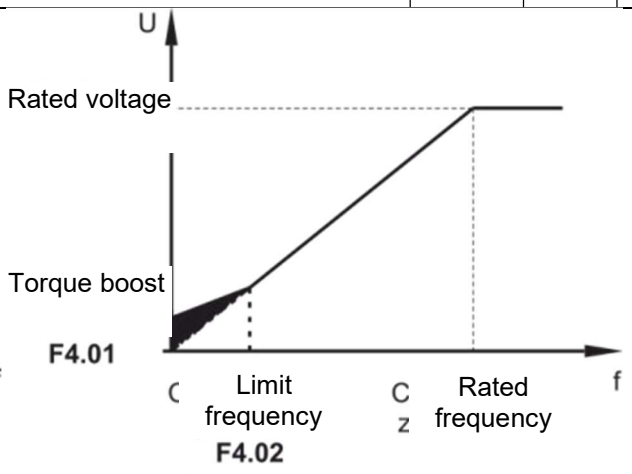
F4.01	Initial torque boost	0.0 - Automatic torque boost 0.1 - 30.0	%	4	Y
F4.02	Drive torque boost limit frequency	0.00 - Maximum frequency (**F0.19**)	Hz	15	Y

The drive torque boost feature is mainly used to improve the drive torque characteristics at low frequencies when controlled in line with the set U/f characteristic. Excessively low drive torque results in the fact that the motor is “weak” at low speeds. Conversely, excessive torque boost poses the risk of motor overexcitation, motor winding overload and drive performance reduction.

Code	Description	Setpoints	Unit	Factory	Change limited



Reduced torque characteristic

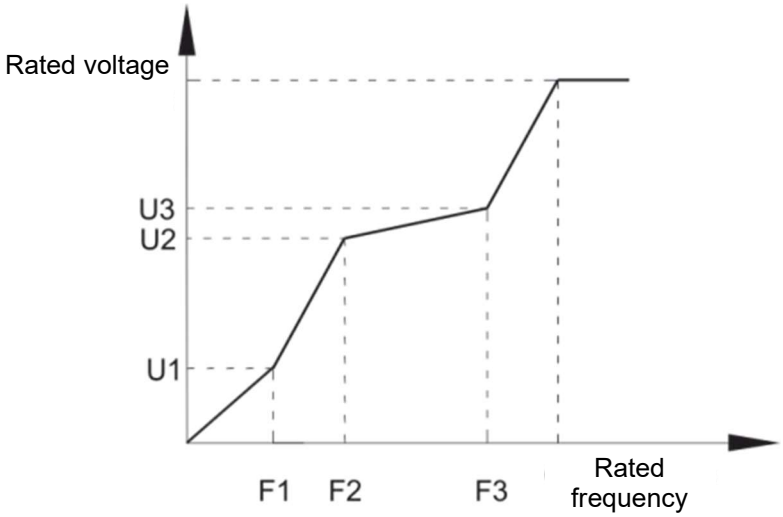


Constant-torque characteristic

It is recommended that higher torque boost should be used for heavy drives where the standard drive torque is insufficient to accelerate them.
When the drive boost feature is set (**F4.01** = 0.0), the inverter uses the rotor resistance value to automatically select the necessary drive torque boost value.

F4.03	User-define U/f characteristic	Point 1 Frequency F1	0.00 - **F4.05**	Hz	0	Y
F4.04		Point 1 Voltage U1	0.0 - 100.0	%	0	Y
F4.05		Point 2 Frequency F2	**F4.03** - **F4.07**	Hz	0	Y
F4.06		Point 2 Voltage U2	0.0 - 100.0	%	0	Y
F4.07		Point 3 Frequency F3	**F4.07** - **b0.04** (motor rated frequency)	Hz	0	Y
F4.08		Point 3 Voltage U3	0.0 - 100.0	%	0	Y

Parameters F4.03 - F4.08 make it possible to define a custom control characteristic optimally adjusted to a given motor and load characteristics.



The following relationship between voltages and frequencies must be maintained while programming the U/f characteristic: **V1** < **V2** < **V3** and **F1**< **F2** < **F3**

Code	Description	Setpoints	Unit	Factory	Change limited
		Note Care must be taken when setting a high voltage value corresponding to a low output frequency. At a low frequency, motor windings demonstrate significantly lower impedance than at the initial frequency, which can result in overheating the windings or overloading the inverter at high voltage.			
F4.09	Slip compensation	0.0 - 200.0	%	0	N
The slip compensation feature is effective only for controlling asynchronous motors in the U/f scalar mode. It facilitates adjusting the motor speed when increase in load results in increase in slip and decrease in the actual speed relative to the setpoint. To ensure correct slip compensation, correct motor parameters (group **b0)** must be entered, i.e. mainly parameter **b0.05** (rated speed) and **b0.03** (rated current). Setting parameter **F4.09** to **100%** results in the fact that, for rated load and rated speed, the slip compensation level is equal to the value resulting from the set motor parameters.					
F4.10	Counter-excitation flux at braking	0.0 - 200.0	-	64	N
When the motor braking feature is used, excess energy dissipated by the motor may cause sudden increase in DC circuit voltage. Excitation control during braking reduces the voltage accumulation and mitigates the risk of inverter locking. The higher the value set in parameter **F4.10**, the stronger the braking effect, however, setting an excessively high parameter **F4.10** value results in high current generation. When the inverter is loaded with a low-inertia drive, or when additional braking resistors are used, it is recommended that parameter **F4.10** should be set to zero.					
F4.11	Oscillation dampening	0 - 100	-	0	N
If scalar U/f control is used, motor speed oscillation can sometimes occur. If this phenomenon is observed, it is necessary to experiment with the parameter **F4.11** value to eliminate this oscillation. If no oscillation is observed during operation, **F4.11 = 0** should be set					
F4.12	Separated U/f characteristic - voltage setting	Parameter **F4.13 setpoint** 0 Analogue input **AI1** 1 Analogue input **AI2** 2 Operator panel potentiometer 3 Fast pulse input **(DI5)** 4 PLC control 6 PID controller 7	-	0	N
If the U/f control characteristic is set to ensure that output voltage is independent from frequency (**F4.00** = 10), parameter **F4.12** selects a source constituting the basis for the output voltage value setting. The rated motor output voltage corresponds to 100% of the setting signal.					
F4.13	Separated U/f characteristic - voltage setpoint	0 - rated motor voltage	V	0	N
The output voltage setpoint in the case when, in the U/f control mode, voltage is independent from frequency (**F4.00** = 0) and the parameter **F4.13** value is set as the voltage setpoint source (**F4.12** = 0)					
F4.14	Separated U/f characteristic - voltage rising time	0.0 - 1000.0	s	0	N
When, in the V/f control mode, the output voltage value is independent from the frequency value (**F4.00** = 0), parameter **F4.00** determines the rate of output voltage rising after the RUN command has been given.					

Vector control

Parameter group **F5** is only active when the vector control operation mode is active (parameter **F0.00** = 0 or 1). To ensure correct operation in the vector control mode, motor parameters (parameter group **b0**) must be defined correctly and motor electric parameters must be identified.

Note

In most cases, the parameter group **F5** values do not need to be changed. Such changes are only justified when the standard vector control settings do not ensure satisfactory results and require extensive expertise related to control systems.

Code	Description		Setpoints		Unit	Factory	Change limited
F5.00	Low-speed controller	Proportional part amplification	1 - 100		-	30	N
F5.01		Integrating part doubling time	0.01 - 10.00		S	0.5	N
F5.02		Limit frequency	0.00 - **F5.05**		Hz	5	N
F5.03	High-speed controller	Proportional part amplification	1 - 100		-	30	N
F5.04		Integrating part amplification	0.01 - 10.00		S	0.5	N
F5.05		Limit frequency	**F5.02** - **F0.19** (maximum frequency)		Hz	5	N
Parameters **F5.00** - **F5.05** set the speed controller operation in the vector control mode.							
F5.07	Torque limit in speed control mode		Parameter **F5.08** value	0	0		
			Analogue input **AI1**	1			
			Remote control (RS485)	5			
F5.08	Upper torque limit in speed control mode		0.0 - 200		%	150	N
To ensure operation in the speed control mode with the vector control feature, parameter **F5.07** determines the source from which the upper value of the drive torque is set. If the limit is set via an analogue input or fast pulse input, the input value equal to 100% corresponds to the torque value set in parameter **F5.08**.							

F5.09	Differential amplification	50 - 200	%	150	N
In the vector control mode, parameter **F5.09** can be used to improve speed stability. If the rotational speed is low, its stability can be improved by increasing the parameter value. If the speed is high, decreasing the value of **F5.09** is a good solution.					
F5.10	Speed filter time constant	0.000 - 0.100	s	0	N
F5.11	Counter-excitation flux at braking	0 - 200	-	64	N
When the motor braking feature is used, excess energy dissipated by the motor may cause sudden increase in DC circuit voltage. Excitation control during braking reduces the voltage accumulation and mitigates the risk of inverter locking. The higher the value set in parameter **F5.11**, the stronger the braking effect, however, setting an excessively high parameter **F5.11** value results in high current generation. When the inverter is loaded with a low-inertia drive, or when additional braking resistors are used, it is recommended that parameter **F4.10** should be set to zero.					
F5.12	Excitation controller – proportional part amplification	0 - 60000	-	2000	N
F5.13	Excitation controller – integrating part amplification	0 - 60000	-	1300	N
F5.14	Torque controller – proportional part amplification	0 - 60000	-	2000	N
F5.15	Torque controller – integrating part amplification		-	1300	N

Note

The parameters characterising the controller determine the amplification coefficients at the proportional and integrating controller parts. For the integrating part, it means that a high amplification value of the integrating part results in stronger impact exerted by the integrating part of the controller.

Operator panel

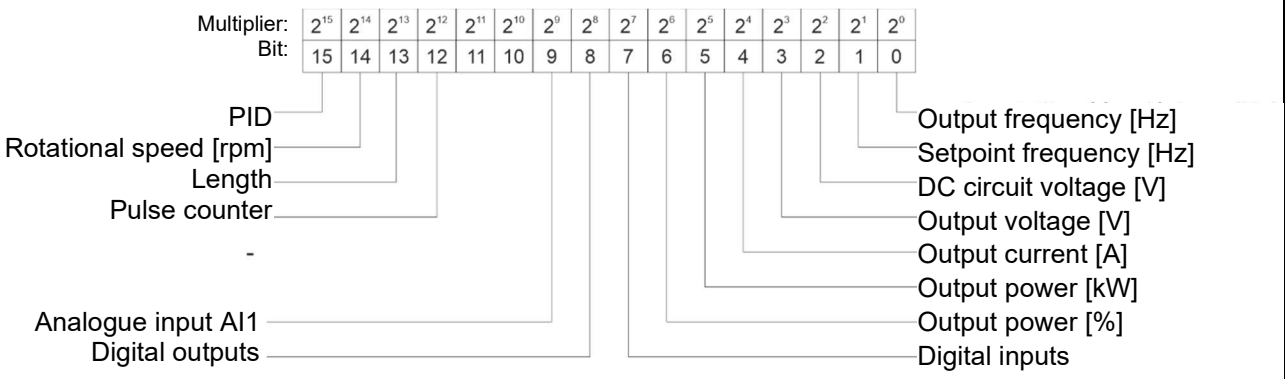
Parameter group **F6** controls the operator panel operation and organises the data displayed on the LCD monitor.

Code	Description	Setpoints		Unit	Factory	Change limited
F6.00	**STOP/RESET** buttons	Active only with operator panel control	0	-	1	N
		Always active	1			

0 – Active only with panel control
The operator panel STOP/RESET button is active only when the inverter is controlled via the operator panel.
1 – Always active
The operator panel STOP/RESET button is active regardless of the control method selected (default and recommended solution).

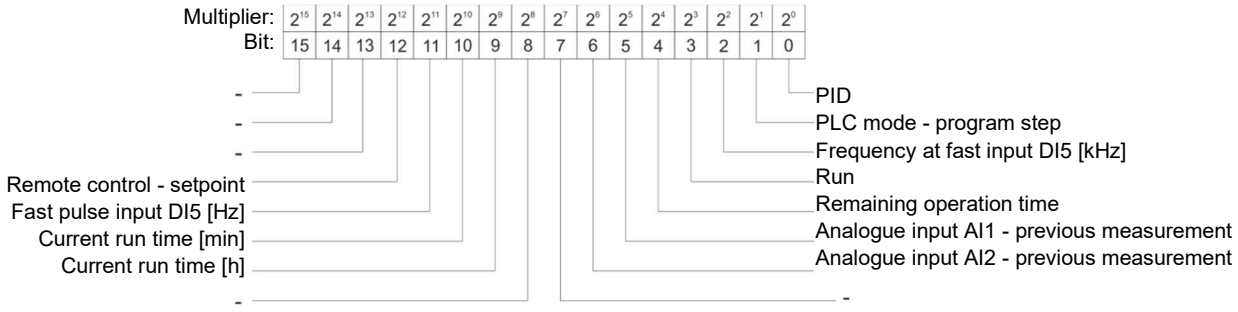
Code	Description	Setpoints	Unit	Factory	Change limited
F6.01	Parameters displayed during operation (1)	0x0000 - 0xFFFF	-	0x1F	N

Parameters **F6.01** and **F6.02** contain an encoded set of values to be displayed when the drive is running.



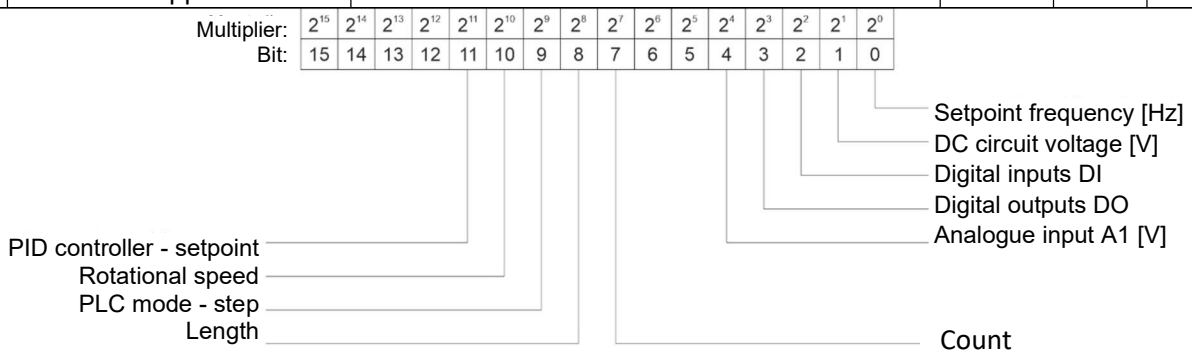
If any of the above-mentioned parameters is to be displayed while the drive is running, set the bit field corresponding to this parameter to 1. Next, convert the whole number to the hexadecimal (HEX) form, and write it to the **F6.01** in this form.

Code	Description	Setpoints	Unit	Factory	Change limited
F6.02	Parameters displayed during operation (2)	0x0000 - 0xFFFF	-	0x0	N



If any of the above-mentioned parameters is to be displayed while the drive is running, set the bit field corresponding to this parameter to 1. Next, convert the whole number to the hexadecimal (HEX) form, and write it to the **F6.02** in this form.

F6.03	Parameters displayed when the drive is stopped	0x0000 - 0xFFFF	-	0x33	N



If any of the above-mentioned parameters is to be displayed while the drive is stopped, set the bit field corresponding to this parameter to 1. Next, convert the whole number to the hexadecimal (HEX) form, and write it to the **F6.03** in this form.

Note: When the motor is stopped, the **Rotational speed** parameter displays the value calculated on the basis of the frequency setpoint.

F6.04	Rotational speed scaling	0.0001 - 6.5000	-	1	N

This parameter converts the current output frequency into the value displayed as on the LCD monitor (Rotational speed).

F6.05	Rotational speed - number of fractional digits	No fractional digits	0	-	0	N
		One fractional digit	1			
		Two fractional digits	2			
		Three fractional digits	3			

Accuracy of the **Rotational speed** parameter value display

Example If **F6.05** = 2 (two fractional digits), **F6.04** = 2.500, at the output frequency equal to 40 Hz, corresponds to the speed value of 40 * 2.5 = 100. Since the result is to be displayed with the accuracy up to two digits, the monitor displays the value of 100.00.

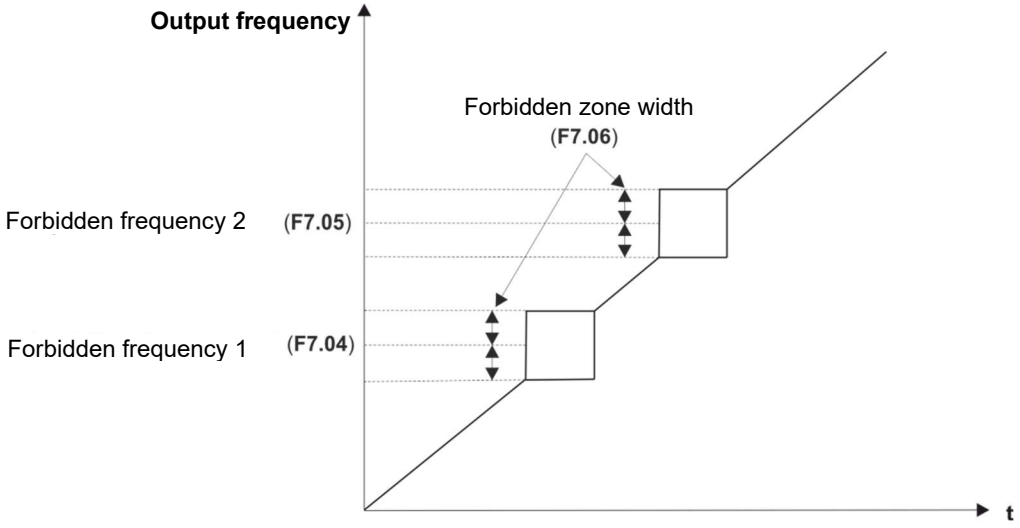
F6.06	Inverter power module temperature	0.0 - 100.0	°C	-	N
F6.07	Total run time	0 - 65535	Hours	-	N
F6.08	Total inverter activation time	0 - 65535	Hours	-	N
F6.09	Total power consumption	0 - 65535	kWh	-	N
F6.13	Exceptions for Modbus RTU1 protocol support	xx**X** – **ones digit** The first digit of the parameter determines how the inverter operates when a Modbus frame with an incorrect checksum is received: 0) the command is processed despite an incorrect CRC sum; 1) the command with an incorrect CRC sum is ignored. x**X**x – **tens digit**	-	11	N

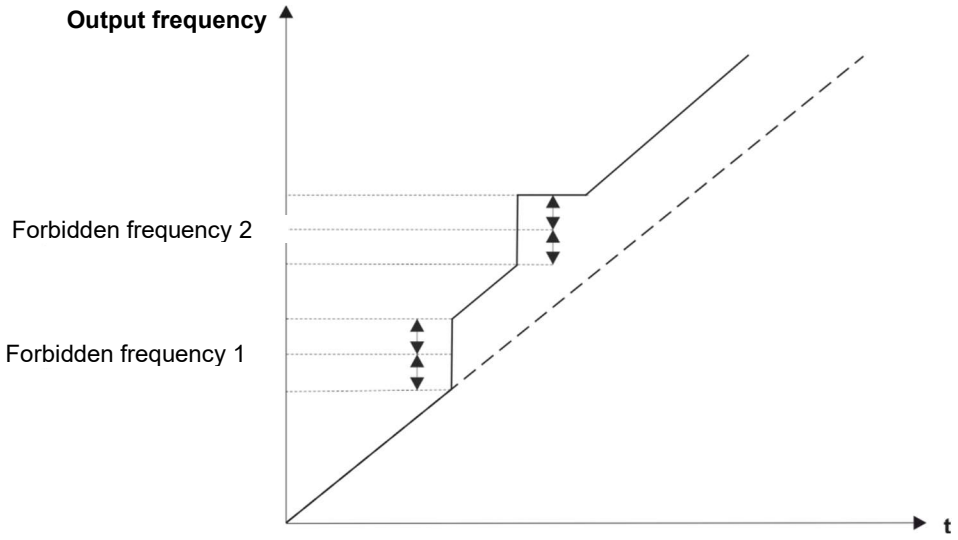
<table>
<tr><td></td><td></td><td>Inverter response to a Broadcast-type command (receiver zero address)
0) Broadcast-type commands are ignored.
1) Broadcast-type commands are processed.</td><td></td><td></td><td></td></tr>
<tr><td>F6.21</td><td>QUICK button function</td><td>A selected function can be assigned to the QUICK button placed on the operator panel.

<table><tr><th>Value</th><th>Function</th></tr><tr><td>0</td><td>None</td></tr><tr><td>1</td><td>Test run (JOG)</td></tr><tr><td>2</td><td>SHIFT button</td></tr><tr><td>3</td><td>Motor rotation direction change</td></tr><tr><td>5</td><td>Motor stop by coasting</td></tr></table></td><td>-</td><td>1</td><td></td></tr>
</table>

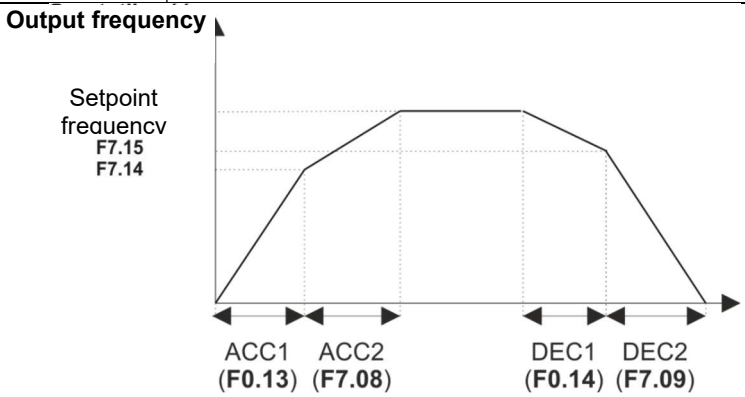
Auxiliary parameters

Code	Description	Setpoints		Unit	Factory	Change limited
F7.00	JOG - frequency	0.00 - **F0.19** (maximum frequency)		Hz	2	N
F7.01	JOG - acceleration time	0.0 - 6500.0		s	20	N
F7.02	JOG - braking time	0.0 - 6500.0		s	20	N
F7.01 - **F7.03** determine inverter operation during a motor test run (JOG). In the JOG mode, the motor is always started in the direct start-up mode (**F3.00** = 0), and it is stopped using the motor braking feature (**F3.07** = 0).						
F7.03	JOG - operation priority	Off	0	-	0	N
		On	1			
If **F7.03** = 1, when the JOG mode operation command is given to the inverter terminal strip, it has priority over the normal operation mode. If **F7.03** = 0, when the Run and JOG commands are given simultaneously, the Run command is executed.						
F7.04	Forbidden frequency 1	0.00 - **F0.19** (maximum frequency)		Hz	0	N
F7.05	Forbidden frequency 2	0.00 - **F0.19** (maximum frequency)		Hz	0	N
F7.06	Forbidden zone width	0.00 - F0.19 (maximum frequency)		Hz	0	N
Two forbidden areas of operation can be defined, i.e. frequency values that cannot be reached during inverter operation. It is particularly useful when resonant frequencies occur in the operating frequency range, which induce vibrations of a given drive. See the figure below for an operation diagram.						
F7.07	Forbidden frequency skipping during acceleration and deceleration	Off	0	-	0	N
		On	1			
If **F7.07 = 0**, the output frequency during motor acceleration and braking can pass through the forbidden frequency zones (smooth frequency change). If **F7.07 = 1**, the forbidden frequency zones are skipped during motor acceleration and braking, the results of which include a sharp frequency surge at the forbidden zone boundary. See the figure below for an operation diagram related to both these cases. The solid line shows the start-up waveform when forbidden frequencies are skipped, and the dashed line depicts the situation in which the frequency can pass through forbidden zones.						



Code	Description	Setpoints	Unit	Factory	Change limited
					
F7.08	Acceleration time - 2	0.0 - 6500	s	-	N
F7.09	Braking time - 2	0.0 - 6500	s	-	N
F7.10	Acceleration time - 3	0.0 - 6500	s	-	N
F7.11	Braking time - 3	0.0 - 6500	s	-	N
F7.12	Acceleration time - 4	0.0 - 6500	s	-	N
F7.13	Braking time - 4	0.0 - 6500	s	-	N
The FA-3X inverter offers four sets of acceleration and braking times defined in the parameters **F0.13**/**F0.14** and **F7.08** – **F7.13**. These sets can be switched over using correct digital input **DI** software (function 16 and 17 codes). The first and second set of times can also be switched over automatically when the set frequency is exceeded (parameter **F7.14** and **F7.15**).					
F7.14	Frequency for switching over the first and second acceleration time	0.00 - **F0.19** (maximum frequency)	Hz	0	N
F7.15	Frequency for switching over Braking first and second braking time	0.00 - **F0.19** (maximum frequency)	Hz	0	N
Functions **F7.14** and **F7.15** are active if the sets of acceleration/braking times are not switched over via the terminal strip at the same time. They facilitate automatic switching over between the first and second set of times after the frequency set here is exceeded. See the figure below for an operation diagram.					

Code	Description	Setpoints		Unit	Factory	Change limited

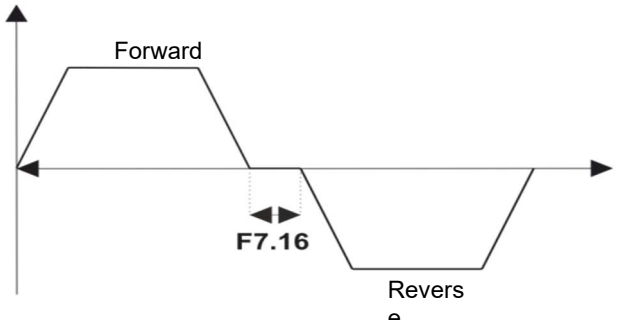


Acceleration – if the frequency value is below the value set in **F7.14**, acceleration is controlled by the time set in **F0.13** (first acceleration time). When the frequency set in **F7.14** is exceeded, the acceleration time is switched to the value set in **F7.08** (second acceleration time).

Braking – if the frequency value is above the value set in **F7.15**, braking is controlled by the time set in **F0.1r** (first braking time). When the frequency set in **F7.15** is exceeded, the braking time is switched to the value set in **F7.09** (second braking time).

F7.16	Pause after motor stop	0.00 - 3600.00		s	0	N

Pause between running in opposite directions. If, for example, the motor is stopped after running in the **Forward** direction, its run in the **Reverse** direction is not restarted until time b has elapsed since the motor was stopped.



F7.17	Motor run in both directions	Permitted	0	-	0	N
		Forbidden	1			

For some drives, running in the direction opposite to the rated direction may result in destroying the drive. In such cases, the possibility of running in the **Reverse** can be eliminated by setting parameter **F7.17** = 1.

F7.18	Operation at frequency lower than rated frequency	Operation at minimum frequency	0	-	0	N
		STOP	1			
		Operation at 0 Hz frequency	2			

If the set frequency is below the permitted minimum value, one of three methods described below can be selected:

0 – Operation at minimum frequency

The output frequency is set to the minimum level.

1 – STOP

The motor is stopped and the output voltage is disconnected.

2 – Operation at 0Hz frequency

The motor is decelerated to the frequency equal to 0 Hz, but the motor power supply is not disconnected (i.e. the inverter can act as an electric brake).

Code	Description	Setpoints		Unit	Factory	Change limited
F7.20	Set inverter activation time	0 - 36000		Hours	0	N
This parameter is used to set e.g. an alarm related to exceeding the set inverter activation time. If the total run time (parameter **F6.08**) exceeds the setpoint specified in **F7.20**, output **DO**, for which the code 24 function has been set, is controlled.						
F7.21	Set drive run time	0 - 36000		Hours	0	N
If the total drive run time (parameter **F6.07**) exceeds the setpoint specified in **F7.21**, output **DO**, for which the code 12 function has been set, is activated.						
F7.22	Command protection **START**	Off	0	-	0	N
		On	1			

The START command protection feature makes it possible to eliminate the possibility of unintended automatic start-up, after power is restored following a failure.

0 – Protection off

If the START command is given to the terminal strip when the inverter power supply is activated, the motor starts automatically without any additional operator's action.

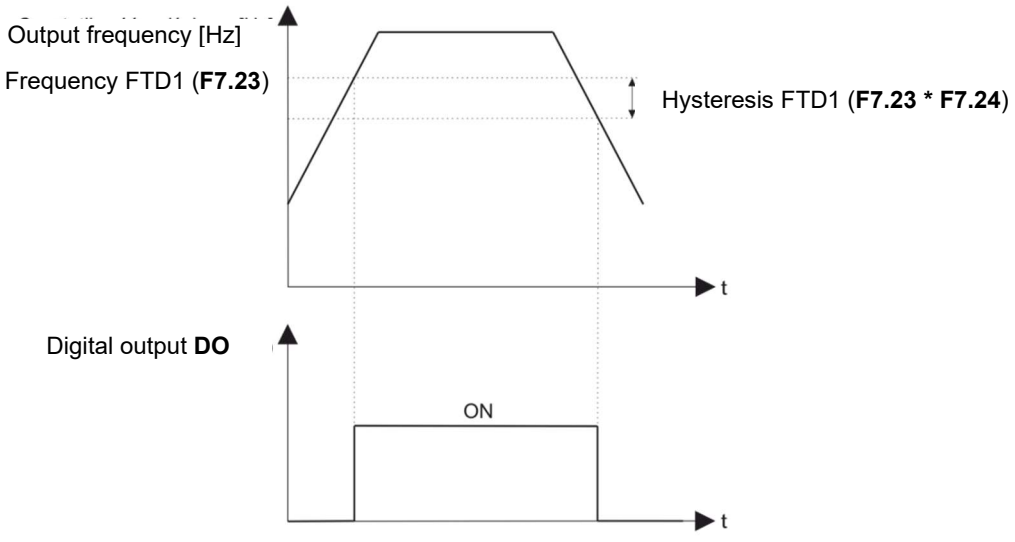
> **NOTE:**
> Exercise extreme caution when working on a drive with the START command protection disabled. Note that sudden power supply restoration and automatic motor start-up can pose a considerable risk to the operator.

1 – Protection on

When this protection feature is on, after the START command is given to the terminal strip when the inverter is activated, the motor does not start automatically. To start the motor, the START signal must first be deactivated and then activated again.

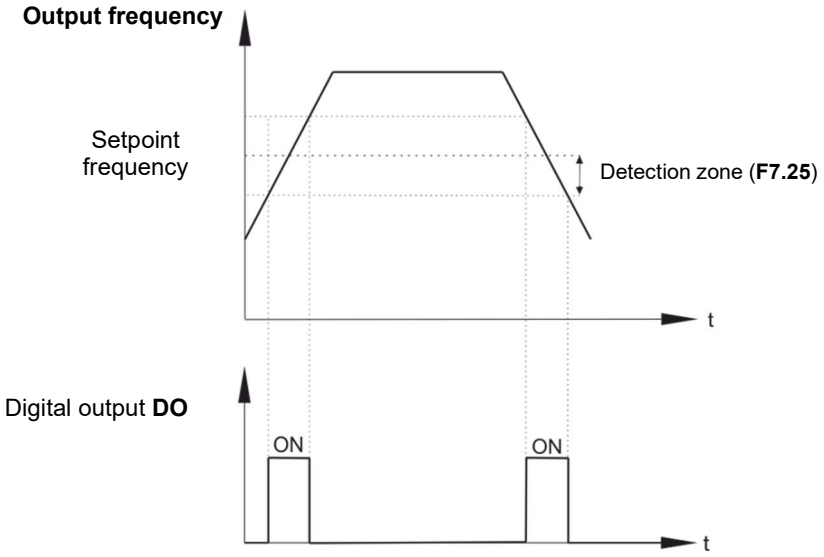
F7.23	**FTD1** frequency exceeded	0.00 - F0.19 (maximum frequency)	Hz	50	N
F7.24	**FTD1** zone hysteresis	0.0 - 100.0	%	4	N

If the set frequency **FTD1** is exceeded, the digital output **DO** to which the code 3 function is assigned, is activated. If the frequency falls below frequency **FTD1** and the set hysteresis zone, the output is deactivated. See the figure below for the function operation diagram:



Code	Description	Setpoints	Unit	Factory	Change limited
F7.25	Set frequency zone	0.00 - 100.00	%	0	N

If the inverter output frequency is within the zone around the set frequency, with the width specified in parameter **F7.25**, the digital output to which the code 4 function is assigned is activated. Parameter **F7.25** is scaled from zero to 100% of the maximum frequency value. See the figure below for an operation diagram:

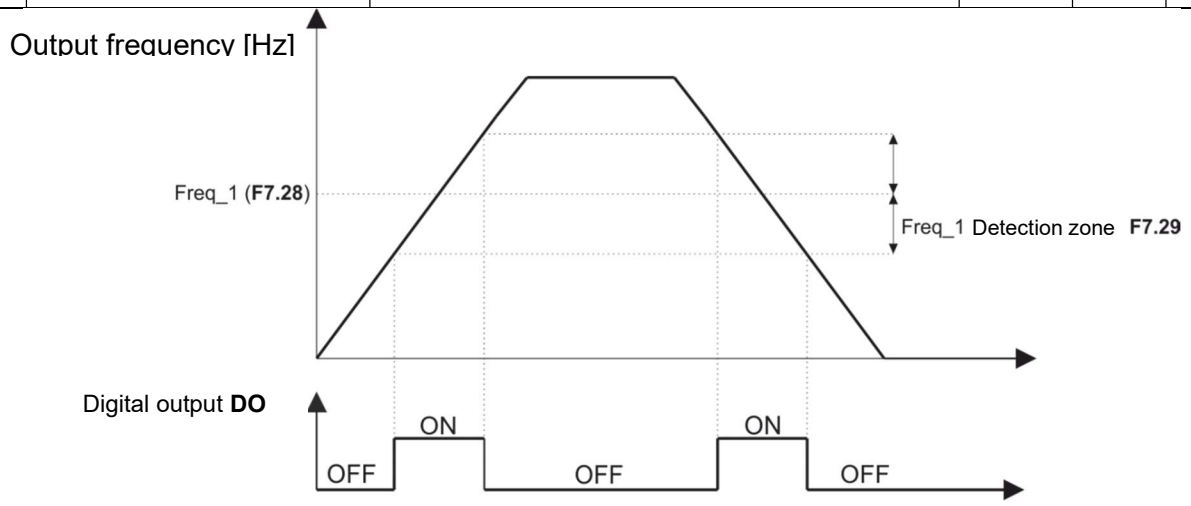
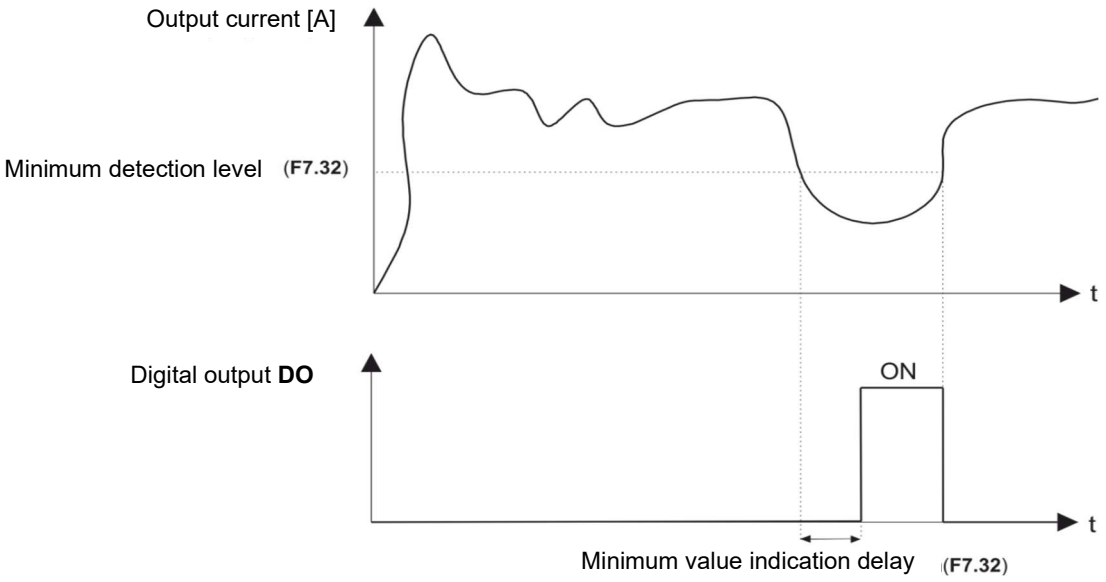


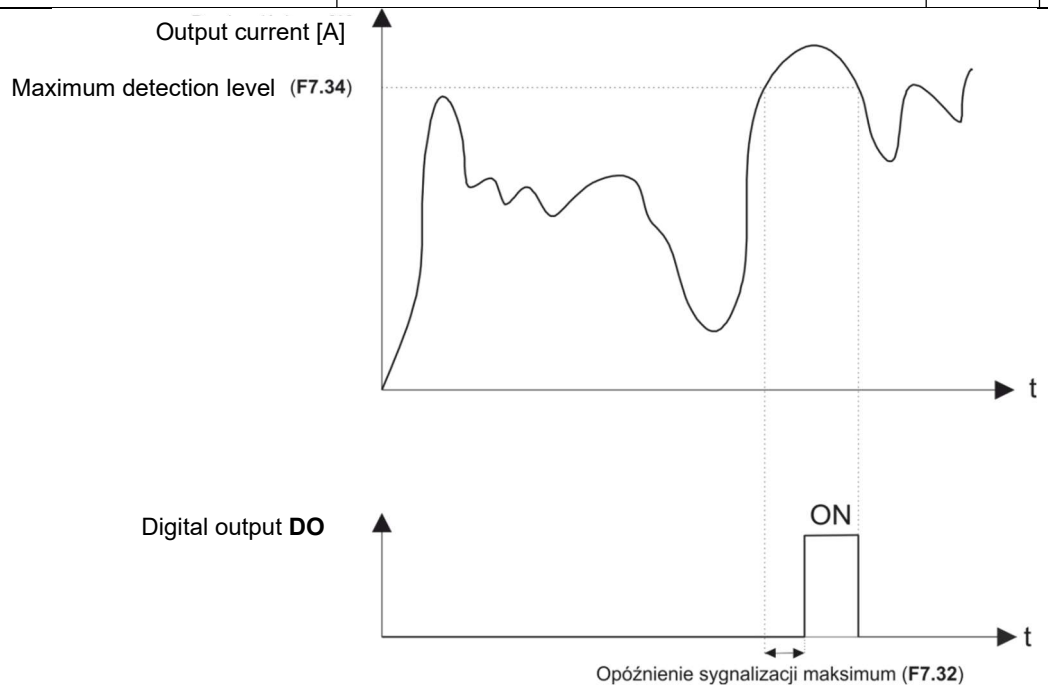
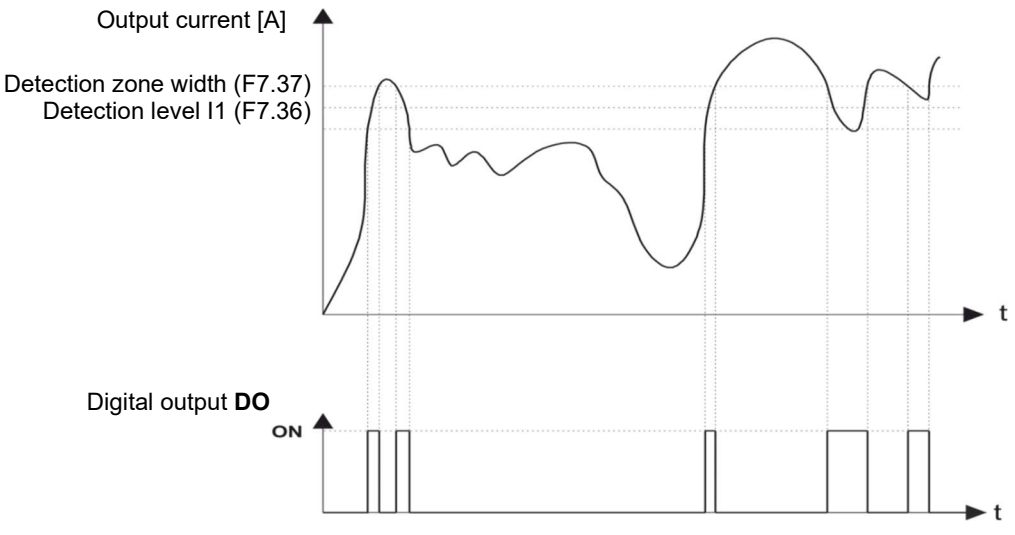
F7.26	**FTD2** frequency exceeded	0.00 - F0.19 (maximum frequency)	Hz	50	N
F7.27	**FTD2** zone hysteresis	0.0 - 100.0 (maximum frequency)	%	4	N

Parameters **F7.26** and **F7.27** operate almost in the same manner as parameters **F7.23** and **F7.24**. The only difference consists in the fact that, in this case, the digital output to which the code 25 function is assigned, is activated.

F7.28	Freq_1 – frequency value reached	0.00 - F0.19 (maximum frequency)	Hz	50	N
F7.29	Freq_1 – detection zone	0.0 - 100.0 (maximum frequency)	%	0	
F7.30	Freq_1 – frequency value reached	0.00 - F0.19 (maximum frequency)	Hz	50	N
F7.31	Freq_2 – detection zone	0.0 - 100.0 (maximum frequency)	%	0	

Parameters **F7.29** - **F7.31** facilitate defining two zones, and the fact of reaching these zones is indicated by digital outputs **DO**. For Freq_1, the digital output to which the code 26 function is assigned, is activated; as for Freq_2, the output to which the code 27 function is assigned, is activated. See the figure below for an operation diagram (the same operation for Freq_2).

Code	Description	Setpoints	Unit	Factory	Change limited
					
F7.32	Minimum current – detection level	0.0 - 300.0 (motor rated current)	%	5	N
F7.33	Minimum current – detection delay	0.01 - 360.00	s	0.1	N
If the motor output current falls below the minimum value (parameter **F7.32**) for a set time (parameter **F7.33**) when the motor is running, a digital output is activated to which the code 34 function will be assigned. See the figure below for the function operation diagram: 					
F7.34	Maximum current – detection level	0.0 - 300.0 (motor rated current)	%	200	N
F7.35	Maximum current – detection delay	0.01 - 360.00	s	0.1	N
If the motor output current rises above the maximum value (parameter **F7.34**) for a set time (parameter **F7.35**) when the motor is running, a digital output is activated to which the code 36 function will be assigned. See the figure below for the function operation diagram:					

Code	Description	Setpoints	Unit	Factory	Change limited
					
F7.36	Current I1 – detection level	0.0 - 300.0 (motor rated current)	%	100	N
F7.37	Current I1 – detection zone width	0.0 - 300.0 (motor rated current)	%	0	N
F7.38	Current I1 – detection level	0.0 - 300.0 (motor rated current)	%	100	N
F7.39	Current I1 – detection zone width	0.0 - 300.0 (motor rated current)	%	0	N
Parameters **F7.36** - **F7.39** facilitate defining two zones, and the fact of reaching these zones is indicated by digital outputs **DO**. For current **I1**, the digital output to which the code 28 function is assigned, is activated; as for **I2**, the output to which the code 29 function is assigned, is activated. See the figure below for an operation diagram. 					
F7.40	Limit temperature	0 - 100	°C	75	N
If the module temperature exceeds the value set in parameter **F7.40**, the digital output to which the code 35 function is assigned, is activated.					

Code	Description	Setpoints		Unit	Factory	Change limited
F7.41	Fan control	Fan ON during drive run	0	-	0	N
		Fan always ON	1			
0 – Fan ON during operation The inverter cooling fan activates when the drive is running. When the drive is stopped, the fan is activated when the power module temperature exceeds 40°C. **1 – Fan always ON** The inverter cooling is always activated.						
F7.42	Time-based control	Off	0	-	0	N
		On	1			
F7.43	Run time setting method	Parameter **F7.44**	0			
		Analogue input **AI1**	1			
		Analogue input **AI2**	2			
		Operator panel potentiometer	3			
100% of the analogue input setpoint corresponds to 100% of the value set in parameter **F7.44**.						
F7.44	Run time	0.0 - 6500.0		min.	0	N
Parameters **F7.42** – **F7.44** make it possible to activate the inverter for a set period of time. If parameter **F7.42** = 1 (time-based control ON), the drive runs, after starting up, for the time specified by parameters **F7.42** – **F7.43**, and then stops automatically. At the end of the cycle (when the motor stops), the digital output to which the code 30 function is assigned, is additionally activated. **Note**: The time left until the end of the run cycle can be checked via parameter **d0.20**.						
F7.45	Set current run time reached	0.0 - 6500.0		min.	0	N
When the current run time (drive activation) exceeds the setpoint specified in **F7.45**, the digital output for which the code 40 function is assigned, is activated.						
F7.50	Input **AI1** - minimum voltage check	0.00 - **F7.51**		V	3.1	N
F7.51	Input AI1 - maximum voltage check	**F7.50** - 10.00		V	6.8	N
If the **AI1** analogue input voltage exceeds the level set in **F7.50** – **F7.51**, the digital output to which the 31 code function is assigned, is activated.						

Safety features

Code	Description	Setpoints	Unit	Factory	Change limited
F8.00	Acceleration and braking current - multiplier	0 - 100	-	20	N
F8.01	Acceleration and braking current - limit level	100 - 200	%	150	N
If, during acceleration or braking, the current exceeds the value set in parameter **F8.01**, the acceleration (braking) process is limited until the current drops below the value specified in **F8.01**. The response speed (acceleration/braking time limit) depends on the parameter **F8.00** setting. The higher the **F8.00** value, the faster and more powerful system response. For low-inertia drives, low F8.00 values are recommended (e.g. equal to the default values).					

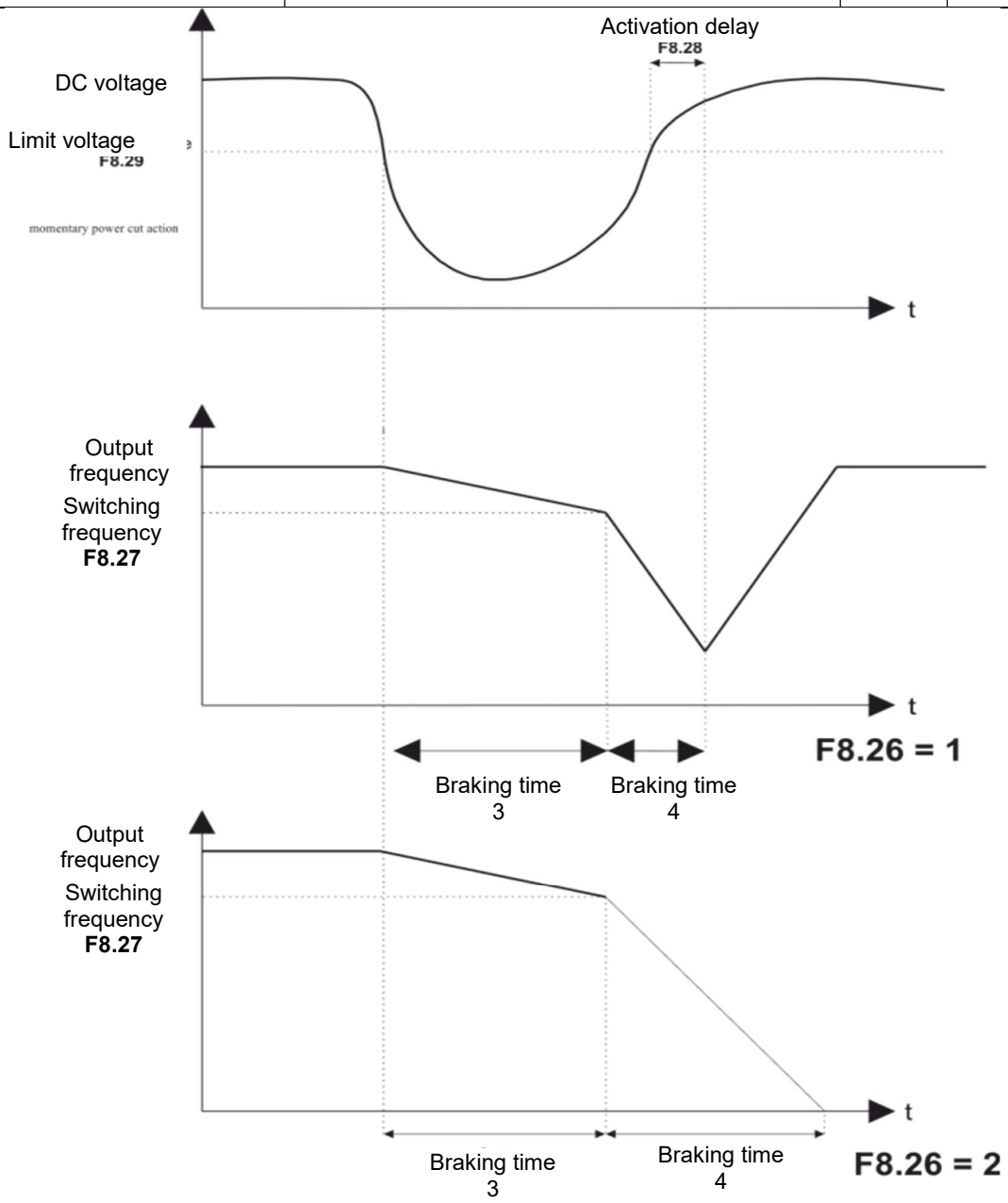
Code	Description	Setpoints		Unit	Factory	Change limited
For high-inertia drives, a higher value should be set. If F8.00 = 0, this acceleration/braking current limit function is disabled.						
F8.02	Over-torque control	Off	0	-	1	N
		On	1			
F8.03	Over-torque control - multiplier	0.20 - 10.00		-	1	N
The over-torque control system protects the motor against overheating caused by running in an overload condition. If the torque control function is activated (**F8.02**), the protection feature tripping level depends on the value and duration of the overload condition. The greater the overload, the shorter the time to error message generation. For example, if the current value exceeds 220% * **F8.03** * of the motor rated current, the motor is deactivated after 1 second. However, if the current value is equal to 150% * **F8.03** * of the motor rated current, the motor is deactivated after 60 seconds. **Note:** The parameter **F8.03** value must be set according to the actual motor overload rating. If an exceedingly high value is set, the protection feature may not respond to overload, which will result in motor damage.						
F8.04	Over-torque control – initial alarm	50 - 100		%	80	N
When the cumulative over-torque level (resulting from the current and time curve set via parameter **F8.03**) exceeds the level set via parameter **F8.04**, the digital output for which the code 16 function is set, is activated.						
F8.05	Over-voltage control - multiplier	0 - 100				
F8.06	Over-voltage control – limit level	120 - 150		%	130	N
The over-voltage control feature protects the binverter from excessive DC circuit voltage resulting from dissipation of the energy generated by the motor in rapid braking conditions. If during the braking operation, the DC circuit voltage exceeds the value set in parameter **F8.06** (measured against the rated DC voltage corresponding to the 3 x 400 V mains supply), the braking intensity is reduced until the DC voltage value returns to a safe level. The braking speed reduction intensity depends on the parameter **F8.05** setting. The higher the value in **F8.05**, the greater the braking speed reduction (recommended for drives with a high moment of inertia).						
F8.07	Input voltage – phase loss control	Off	0	-	1	N
		On	1			
Note: Applies only to FA-3X220 inverters. All inverter supply voltage phases are monitored. If a phase is missing, the inverter is locked (the drive cannot be started and excessive loads cannot be applied to other phases).						
F8.08	Output voltage – phase loss control	Off	0	-	1	N
		On	1			
All inverter output voltage phases are monitored. This option must always be enabled. Missing voltage at the inverter output may indicate a short circuit on the load or inverter damage.						
F8.09	Earth fault control	Off	0	-	1	N
		On	1			
If the earth fault control feature is enabled, the test voltage briefly appears at the inverter output terminals when its power supply activated, to run a check for earth faults present at the inverter output. This option should always be enabled.						

Code	Description	Setpoints		Unit	Factory	Change limited
F8.10	Number of automatic restarts following an error	0 - 20		-	0	N
After setting parameter **F8.10** to a value greater than zero, the inverter restarts automatically, after an error occurs. If the number of restarting operations exceeds the value set in **F8.10**, the inverter is permanently locked.						
F8.11	Alarm output condition during automatic restarting operations	Inactive	0	-	0	N
		Active	1			
If **F8.11 = 0**, the output set up for error reporting purposes is active only when the number of restart attempts exceeds the value set in **F8.10**, and the inverter is permanently locked. If **F8.11** = 1, this output is activated after every error occurrence.						
F8.12	Time to automatic restart	0.1 - 100.0		s	1	N
The time period from error occurrence to the moment at which the inverter automatically sends a reset signal.						
F8.25	Speed limit level	60.0 - 100.0		%	100	N
If an error occurs when the error handling procedure (parameters **F8.17** - **F8.19**) assumes that the drive run must be continued, parameter **F8.24** determines the speed at which the motor rotate after the error occurs. When parameter **F8.24** = 4, the speed limit level is set via parameter **F8.25**. **F8.25** is scaled as a percentage of the maximum speed.						
F8.26	Response to momentary power supply loss	None	0	-	0	N
		Braking	1			
		Braking and stopping	2			
F8.27	Braking time switching frequency at power supply loss	80.0 - 100.0		%	90	N
F8.28	Activation delay after power supply loss	0.00 - 100.00		s	0.5	N
F8.29	Limit value at power supply loss	60.0 - 100.0		%	80	N

Parameters **F8.26** - **F8.29** define the inverter response to a momentary supply voltage loss.

If **F8.26 = 1**, in the case of the voltage loss, when the DC voltage drops the **F8.29** level of the nominal value, the motor starts decelerating as per the braking time 3 (**F7.11**) until the frequency reaches the value specified in **F8.27**. Then the braking time is switched to the **F7.13** value and, according to this time setting, the inverter decelerates until the supply voltage is restored (or the motor stops if the power supply outage lasts too long). When the supply voltage is restored and the DC circuit voltage is higher than the limit value (**F8.29**) for the period of time specified in **F8.28**, the inverter restores the original motor frequency.
If F8.26 = 2, the procedure is the same as above, but the motor is stopped, regardless of whether the voltage is restored or not.
See the figures below for characteristics pertaining to both cases.

Code	Description	Setpoints	Unit	Factory	Change limited



RS485 communication

The parameter group FA sets up the integrated RS485 communication interface.

Code	Description	Setpoints		Unit	Factory	Change limited
F9.00	Baud rate	1200 bps	2	-	5	N
		2400 bps	3			
		4800 bps	4			
		9600 bps	5			
		19200 bps	6			
		38400 bps	7			
		57600 bps	8			

Code	Description	Setpoints		Unit	Factory	Change limited
		115200 bps	9			
F9.01	Data frame format	Parity: **None**, stop bits: **2**	0	-	0	N
		Parity: **Even**, stop bits: **1**	1			
		Parity: **Odd**, stop bits: **1**	2			
		Parity: **None**, stop bits: **1**	3			
F9.02	Modbus network address	1 - 250		-	1	N
F9.03	Response delay	0 - 20		ms	2	N
Additional delay between the time in which the inverter processes a command received via Modbus and the time in which it sends a response.						
F9.04	No communication	0.0 - 60.0		s	0.0	N
Parameter **F9.05** makes it possible to lock the inverter if there is no communication via RS485. If no valid Modbus frame is received within the time period set here, the inverter is locked and **Err.16** is reported.						
		 0 indicates that the communication loss detection function is disabled. In this case, if the inverter is only controlled via RS485 and communication is interrupted, controlling or even stopping the drive is impossible.				
		 If the parameter is set to a value greater than zero, this protection feature is always enabled, regardless of whether the inverter is set to operate in the remote control mode.				
F9.06	Current value readout accuracy	0.01	0	A	0	N
		0.1	1			

PLC mode

A sequence of up to sixteen action steps executed automatically by the inverter can be programmed in the PLC mode. Such parameters as speed, direction, run time, acceleration and braking time can be programmed for each such step.

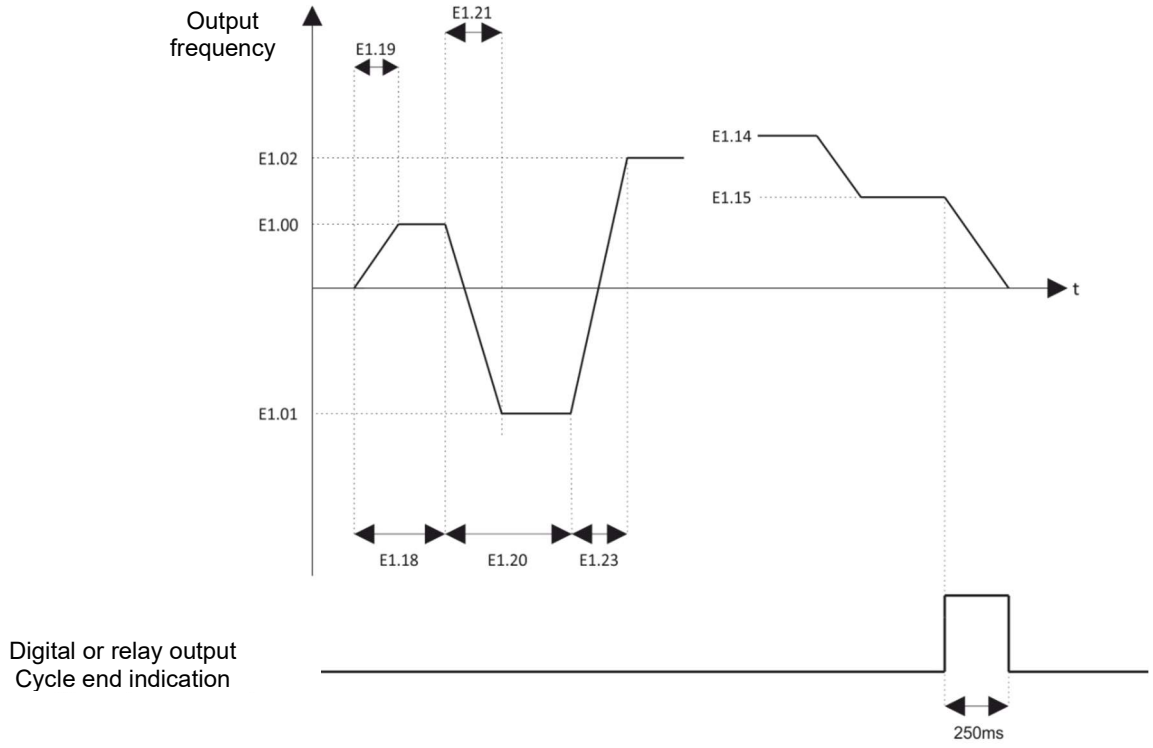
Code	Description	Setpoints	Unit	Factory	Change limited
E1.00	Step 0 - speed	-100.0 - 100.0	%	0	N
E1.01	Step 1 - speed	-100.0 - 100.0	%	0	N
E1.02	Step 2 - speed	-100.0 - 100.0	%	0	N
E1.03	Step 3 - speed	-100.0 - 100.0	%	0	N
E1.04	Step 4 - speed	-100.0 - 100.0	%	0	N
E1.05	Step 5 - speed	-100.0 - 100.0	%	0	N
E1.06	Step 6 - speed	-100.0 - 100.0	%	0	N
E1.07	Step 7 - speed	-100.0 - 100.0	%	0	N
E1.08	Step 8 - speed	-100.0 - 100.0	%	0	N
E1.09	Step 9 - speed	-100.0 - 100.0	%	0	N
E1.10	Step 10 - speed	-100.0 - 100.0	%	0	N
E1.11	Step 11 - speed	-100.0 - 100.0	%	0	N
E1.12	Step 12 - speed	-100.0 - 100.0	%	0	N
E1.13	Step 13 - speed	-100.0 - 100.0	%	0	N
E1.14	Step 14 - speed	-100.0 - 100.0	%	0	N

Code	Description	Setpoints	Unit	Factory	Change limited
E1.15	Step 15 - speed	-100.0 - 100.0	%	0	N

Apart from the PLC mode, parameters **E1.00** – **E1.15** can also be used as a typical frequency setpoint source, and as a source for a PID controller. In the former case, the parameter value is scaled with reference to the maximum frequency. In the latter case, it is done directly as the signal level for the PID controller.
In these cases, individual values are switched over via the digital inputs for which the multi-speed operation mode is assigned (12 - 15 code functions).

E1.16	PLC control mode	Motor stop after program end	0	-	0	N
		Constant speed retained after program end	1			
		Cyclical program repetition	2			

Parameter **E1.16** determines the method of PLC program execution. See the figure below for a diagram depicting single program execution:



There are three possible ways to execute the program:

0 – Motor stop after program end

The motor is stopped at the end of the program execution. The Run command must be given again to start the next program execution.

2 – Constant speed retained after program end

When the last program step is completed, the frequency and direction selected for the last executed program step is retained at the inverter output. The Run command must be given again to start the next program execution.

3 – Cyclical program repetition

As long as the Run signal is active, the program is cyclically executed.

E1.17	PLC - status memory	First digit – x**X** Status retained after power off				
		Off	0			

Code	Description	Setpoints		Unit	Factory	Change limited
		On	1			
		Second digit – **X**x Status retained after the Stop command				
		Off	0			
		On	1			
Status retained after power off – if this option is enabled, the inverter remembers the currently executed PLC program step, and when the power is on again, it continues executing this program. If this option is disabled, after power is restored following a failure, the program is executed from the first step. **Status retained after Stop command** – if this option is enabled, when the Run command is deactivated, the inverter remembers the currently executed PLC program step. After the Run command is given again, the program is executed from the point at which its execution was interrupted. If this option is disabled, the program status is not retained and it is executed from the very start when the motor is restarted.						
E1.18	Step 0 – run time	0.0 - 6500.0		s (h)	0	N
E1.19	Step 0 – acceleration/braking time	0 - 3		-	0	N
E1.20	Step 1 – run time	0.0 - 6500.0		s (h)	0	N
E1.21	Step 1 – acceleration/braking time	0 - 3		-	0	N
E1.22	Step 2 – run time	0.0 - 6500.0		s (h)	0	N
E1.23	Step 2 – acceleration/braking time	0 - 3		-	0	N
E1.24	Step 3 – run time	0.0 - 6500.0		s (h)	0	N
E1.25	Step 3 - acceleration/braking time	0 - 3		-	0	N
E1.26	Step 4 – run time	0.0 - 6500.0		s (h)	0	N
E1.27	Step 4 – acceleration/braking time	0 - 3		-	0	N
E1.28	Step 5 – run time	0.0 - 6500.0		s (h)	0	N
E1.29	Step 5 – acceleration/braking time	0 - 3		-	0	N
E1.30	Step 6 – run time	0.0 - 6500.0		s (h)	0	N
E1.31	Step 6 – acceleration/braking time	0 - 3		-	0	N
E1.32	Step 7 – run time	0.0 - 6500.0		s (h)	0	N
E1.33	Step 7 – acceleration/braking time	0 - 3		-	0	N
E1.34	Step 8 – run time	0.0 - 6500.0		s (h)	0	N
E1.35	Step 8 – acceleration/braking time	0 - 3		-	0	N
E1.36	Step 9 – run time	0.0 - 6500.0		s (h)	0	N
E1.37	Step 9 – acceleration/braking time	0 - 3		-	0	N
E1.38	Step 10 – run time	0.0 - 6500.0		s (h)	0	N
E1.39	Step 10 – acceleration/braking time	0 - 3		-	0	N
E1.40	Step 11 – run time	0.0 - 6500.0		s (h)	0	N
E1.41	Step 11 – acceleration/braking time	0 - 3		-	0	N

Code	Description	Setpoints		Unit	Factory	Change limited
E1.42	Step 12 – run time	0.0 - 6500.0		s (h)	0	N
E1.43	Step 12 – acceleration/braking time	0 - 3		-	0	N
E1.44	Step 13 – run time	0.0 - 6500.0		s (h)	0	N
E1.45	Step 13 – acceleration/braking time	0 - 3		-	0	N
E1.46	Step 14 – run time	0.0 - 6500.0		s (h)	0	N
E1.47	Step 14 – acceleration/braking time	0 - 3		-	0	N
E1.48	Step 15 – run time	0.0 - 6500.0		s (h)	0	N
E1.49	Step 15 – acceleration/braking time	0 - 3		-	0	N
E1.50	Time scale	Seconds (s)	0	-	0	N
		Hours (h)	1			
E1.51	Frequency source for Step 0	Parameter **E1.00**	0	-	0	N
		Analogue input **AI1**	1			
		Analogue input **AI2**	2			
		Operator panel potentiometer	3			
		Fast pulse input **DI5**	4			
		PID setpoint	5			
		Frequency value from parameter **F0.01** (modified via **Up**/**Down** commands.	6			
Parameters **E1.18** - **E1.49** specify the execution time for individual program steps, as well as the acceleration and braking times within a given step. The unit of time for which the step length is calculated is set via parameter **E1.50** – the time can be set in 1 second steps and 1 hour steps.						

PID controller

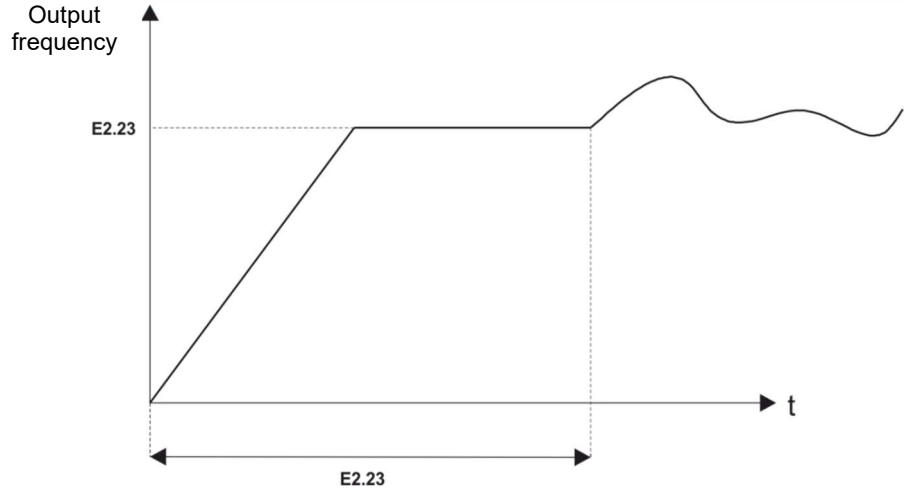
Parameter group **E2** facilitates setting up the integrated PID controller.

	In addition, in order to activate the controller, the PID control option must be selected in the main and auxiliary frequency setpoint source (parameters **F0.03** and **F0.04**).

Code	Description	Setpoints		Unit	Factory	Change limited
E2.00	PID – setpoint source	Parameter **E2.01**	0	-	0	N
		Analogue input **AI1**	1			
		Remote control	5			
		Multi-step control	6			
E2.01	PID – setpoint	0.0 – 100.0		%	50	N
E2.00 determines the PID controller setpoint source. If **E2.00** = 0, the setpoint level is specified in **E2.01**.						
		Setpoint and feedback values are expressed on a relative scale, from 0 to 100%.				
E2.02	PID – feedback	Analogue input **AI1**	0	-	0	N
		Remote control **RS485**	5			
E2.03	PID – feedback type	Positive	0	-	0	N

Code	Description	Setpoints		Unit	Factory	Change limited
		Negative	1			
Positive – if the feedback signal value is smaller than the setpoint value, the output frequency increases. **Negative** – if the feedback signal value is smaller than the setpoint value, the output frequency decreases.						
E2.04	Setpoint and feedback value display scaling	0 - 65535		-	1000	N
E2.04 is a dimensionless multiplier used to scale the PID controller setpoint or feedback value to achieve the format displayed in the parameters **d0.15** and **d0.16**. For example, if the setpoint is 100% and **E2.04** = 2000, parameter **d0.15** displays the setpoint as 2000.						
E2.05	Frequency for reverse direction	0.00 - **F0.19** (maximum frequency)		Hz	2	N
If, as a result of PID controller impact, the rotation direction changes to the direction opposite to the setpoint, **E2.05** makes it possible to specify the maximum output frequency for rotations in the direction opposite to the setpoint.						
E2.06	Minimum deviation	0.0 - 100.0		%	0	N
If the difference between the setpoint and feedback is less than the parameter **E2.06** value, the controller output signal does not change (remains at the previous level).						
E2.07		0.00 - 100.00		%	0.1	N
E2.08	Setpoint filter	0.00 - 650.00		s	0	N
E2.09	Feedback filter	0.00 - 60.00		s	0	N
E2.10	Output value filter	0.00 - 60.00		s	0	N
Parameters **E2.08 - E2.10** are used to filter the setpoint, feedback and controller output values, which facilitates reducing controller sensitivity to sudden value fluctuations caused, for example, by disturbances.						
E2.11	Feedback loss	0 - no control 0.1 - 100.0		%	0	N
E2.12	Feedback loss detection time	0.0 - 20.0		s	0	N
If **E2.11** > 0, when the feedback value is lower than the **E2.11** value for time longer than specified in **E2.12**, error 31 is reported.						
E2.13	Amplification coefficient **KP1**	0.0 - 100.0		-	20	N
E2.14	Doubling time **TI1**	0.01 - 10.00		s	2	N
E2.15	Integration time **TD1**	0.01 - 10.00		s	0	N
E2.16	Amplification coefficient **KP2**	0.0 - 100.0		-	20	N
E2.17	Doubling time **TI2**	0.01 - 10.00		s	2	N
E2.18	Derivative time **TD2**	0.01 - 10.00		s	0	N
E2.19	Controller parameter switching	Off Via digital input **DI** Automatically for the deviation set	0 1 2	-	0	N
E2.20	PID parameter switching – initial deviation	0.0 - **E2.21**		%	20	N
E2.21	PID parameter switching – final deviation	E2.20 - 100.0		%	80	N
The main parameters which characterise PID controller operation include: **Amplification coefficient KP** - this parameter characterises the proportional part of the PID controller.						

Code	Description	Setpoints	Unit	Factory	Change limited
The signal at the regulator output changes proportionally to the deviation value and amplification coefficient **KP**. The higher the **KP** value, the more powerful the controller response. If the amplification coefficient **KP** = 100.0 and control deviation is equal to 100%, the proportional controller output sets the maximum output frequency. **Doubling time TI** – this parameter characterises the integrating part of the PID controller. If the control deviation is constant, integrating regulator response increases in a linear manner together with the speed, depending on the doubling time. The shorter the **TI** value, the faster the controller response. If the control deviation is equal to 100%, integrating controller output changes the frequency in a linear manner, from zero to the maximum frequency in time **TI**. **Derivative time TD** – this parameter characterises the derivative part of the PID controller. The signal at the derivative controller output depends on the control deviation value changes and the set value of parameter **TD**. The higher the **TD** value, the more powerful the controller response to deviation changes. The FA-3X inverter makes it possible to define two sets of PID controller parameters. These parameters can be switched via the parameter **E2.19** setting. If they are switched on the basis of the signal given to the digital input **DI** (**E2.19** = 1), the code 43 function with code must be assigned to the switching input. If they are switched on the basis of the control deviation (**E2.19** = 2): 1. If the control deviation is smaller than the parameter **E2.20** value, the controller follows the first set of parameters (**KP1**, **TI1**, **TD1**). 2. If the control deviation is larger than the parameter **E2.21** value, the controller follows the second set of parameters (**KP2**, **TI2**, **TD2**). 3. If the control deviation is within the **E2.20** - **E2.21** range, controller parameters are calculated as a linear approximation of both sets.					
E2.22	Integrating controller features	First digit – x**X** Integration stopping Off 0 On 1 Second digit – **X**x The integration is stopped after the maximum value is reached. Off 0 On 1	-	0	N
Integration stopping If the digital input DI to which the integral part operation stopping function (function code 38) is assigned is used, the integrating controller operation is blocked when this input is active (the value of the integrating part remains frozen at the current level). **Stopping integration after the maximum value is reached** If the integrating part response reaches 100%, the signal from this part no longer increases if the function is activated.					
E2.23	Original value	0.0 - 100	%	0	N
E2.24	Original value retaining	0.00 - 360.00	s	0	N
When the drive starts up, the original setpoint (**E2.23**) is forced at the controller output, and retained for a certain period of time (**E2.24**). The value at the controller output depends on the control deviation value and controller settings only after the set time lapses. See the figure below for the function operation diagram:					

Code	Description	Setpoints	Unit	Factory	Change limited
					

Motor parameters

Code	Description	Setpoints		Unit	Factory	Change limited
b0.00	Motor type	Asynchronous motor	0	-	0	Y
		Asynchronous motor dedicated to inverter drives	1			
b0.01	Rated power	0.1 - 1000.0		kW	-	Y
b0.02	Rated voltage	1 - 2000		V	-	Y
b0.03	Rated current	0.01 - 655.35		A	-	Y
b0.4	Rated frequency	0.01 - **F0.19** (maximum frequency)		Hz	-	Y
b0.05	Rated speed	1 - 36000		rpm	-	Y

The motor parameters **b0.00** - **b0.05** must be entered precisely from the motor nameplate. It is particularly important when such features as the vector control and automatic motor tuning are used.

Note:
In order to make the best use of the vector control feature, the inverter power should be adjusted to the motor power, so that the rated motor current is between 30 and 100% of the rated inverter current.

b0.06	Asynchronous motor – stator resistance	0.001 - 65.535	Ω	-	Y
b0.07	Asynchronous motor – rotor resistance	0.001 - 65.535	Ω	-	Y
b0.08	Asynchronous motor – dispersion inductance	0.01 - 655.35	mH	-	Y
b0.09	Asynchronous motor – mutual inductance	0.01 - 655.35	mH	-	Y
b0.10	Asynchronous motor – idle current	0.01 - **b0.03**	A	-	Y

<table>
<tr><th>Code</th><th>Description</th><th>Setpoints</th><th>Unit</th><th>Factory</th><th>Change limited</th></tr>
<tr><td colspan="6">Parameters b0.06 – b0.10 are calculated during the automatic motor tuning process and are necessary to ensure correct drive operation in the vector control mode. If the tuning operation is performed on a stopped motor, the inverter only identifies parameters b0.06 - b0.08.

Note:
If the motor auto-tuning procedure cannot be performed, relevant parameters must be obtained from the motor manufacturer and entered in b0.06 - b0.10.</td></tr>
<tr><td colspan="6">Parameters b0.11 - b0.14 are used if a permanent-magnet synchronous motor is connected to the inverter. Parameter values are determined during the motor auto-tuning process.</td></tr>
<tr><td rowspan="3">b0.27</td><td rowspan="3">Motor parameter auto-tuning</td><td>Inactive</td><td>0</td><td rowspan="3">-</td><td rowspan="3">0</td><td rowspan="3">Y</td></tr>
<tr><td>Asynchronous motor – tuning with motor stopped</td><td>1</td></tr>
<tr><td>Asynchronous motor – tuning with motor running</td><td>2</td></tr>
<tr><td colspan="6">Note:
Motor parameter auto-tuning must be performed if the motor is intended to operate in the vector control mode. If, for tuning purposes, load can be detached from the motor shaft, performing the tuning procedure with the motor running is recommended. If it is impossible to start the motor without load, the tuning procedure with the motor stopped must be performed.

Note:
Before the tuning procedure is initiated, enter correct motor data in b0.00 - b0.05.

1 – Asynchronous motor - tuning with motor stopped
If this option is selected, the rotor and stator resistance and dispersion inductance values are measured. These values are then entered in b0.06 - b0.08.

2 – Asynchronous motor - tuning with motor running
The tuning procedure with the motor running consists of two steps. Firstly, the rotor and stator resistance and dispersion inductance are measured with the motor stopped. Secondly, the motor is started and accelerated to 80% of the rated speed in line with the acceleration time set in F0.13, and then decelerated to zero in line with the braking time set in F0.14. It provides the basis for identifying the remaining motor parameters.</td></tr>
</table>

Safety features and default settings

<table>
<tr><th>Code</th><th>Description</th><th>Setpoints</th><th>Unit</th><th>Factory</th><th>Change limited</th></tr>
<tr><td rowspan="3">y0.00</td><td rowspan="3">Parameter initialisation</td><td>No tasks 0</td><td rowspan="3">-</td><td rowspan="3">0</td><td rowspan="3">Y</td></tr>
<tr><td>Restoring default parameters (except for motor set-up) 1</td></tr>
<tr><td>History clearing 2</td></tr>
</table>

Code	Description	Setpoints		Unit	Factory	Change limited
		Restoring default set-up of all parameters	3			
		Saving the current set-up backup	4			
		Restoring the inverter set-up on the basis of the backup saved	5			

1 - Restoring default parameters (except for motor set-up)

If **y0.00** = 1, most of all inverter settings are restored to defaults. Elements not affected by this setting:
- motor set-up (parameters **b0.00** - **b0.14**);
- frequency step (parameter **F0.02**);
- error history;
- activation time, run time, power consumption.

2 - History clearing

The history clearing function deletes information regarding: the error history, inverter activation and run time and power consumption.

3 – Restoring default set-up of all parameters

All inverter parameters are restored to default values.

4 – Saving the current set-up backup

All set-up parameters are saved in an additional backup.

5 – Restoring the set-up from the backup saved

Full inverter set-up is restored from a previously created backup.

y0.01	Password	0 - 65535	-	0	N

If the **y0.01** value is larger than 0, each consecutive access to the inverter set-up requires entering a correct password (set in this parameter).

If a password is set, it should not be lost or forgotten, as this may prevent the user from modifying the inverter set-up.

If y0.01 = 0, the inverter setpoints are not protected.

Errors

Code	Description	Setpoints	Unit	Factory	Change limited
y1.00	First (latest) error code	0 - 31	-	-	Y
y1.01	Second error code	0 - 31	-	-	Y
y1.02	Third (oldest) error code	0 - 31	-	-	Y

Parameters y1.00 – y1.02 store information on the codes of three recently recorded errors. See the table below for the list of errors. For more information on errors and reasons for their occurrence, see the relevant appendix.

Error code	Description
0	No errors
1	General safety feature error
2	Overcurrent during acceleration
3	Overcurrent during braking
4	Overcurrent during constant-speed operation
5	Overvoltage in DC circuit during acceleration
6	Overvoltage in DC circuit during braking
7	Overvoltage in DC circuit during constant-speed operation
9	Power supply voltage too low
10	Inverter overload
11	Motor overload
12	Power supply phase missing
13	Output phase missing
14	Inverter power module limit temperature exceeded
15	External error
16	Communication error
17	Contactor damaged
18	Incorrect current control system operation
19	Motor parameter identification error
21	EEPROM error
22	Faulty inverter circuit operation
23	Earth fault on motor side
26	Set run time reached
27	External error 1
28	External error 2
29	Set inverter activation time reached
30	Load drop
31	No feedback signal in PID controller mode

y1.03		Frequency	Output frequency when the error occurred	Y
y1.04		Current	Output current when the error occurred	Y
y1.05		DC circuit voltage	DC circuit voltage when the error occurred	Y
y1.06		Digital input status	Digital input status when the error occurred	Y

<table>
<tr><th>Code</th><th colspan="2">Description</th><th>Setpoints</th><th>Unit</th><th>Factory</th><th>Change limited</th></tr>
<tr><td></td><td rowspan="4">Error 3</td><td></td><td>If the input was active, the corresponding bit value is set to 1. If the input is inactive, the corresponding bit value is set to 0.
<table><tr><td>Bit</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>DI</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>y1.07</td><td>Digital output status</td><td>Digital output status when the error occurred. If the output was active, the corresponding bit value is set to 1. If the output is inactive, the corresponding bit value is set to 0.
<table><tr><td>Bit</td><td>1</td><td>0</td></tr><tr><td>FOR</td><td>REL1</td><td>-</td></tr></table></td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.09</td><td>Activation time</td><td>Time from inverter activation to error occurrence</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.10</td><td>Run time</td><td>Time from motor activation to error occurrence</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.13</td><td rowspan="7">Error 2</td><td>Frequency</td><td>Output frequency when the error occurred</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.14</td><td>Current</td><td>Output current when the error occurred</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.15</td><td>DC circuit voltage</td><td>DC circuit voltage when the error occurred</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.16</td><td>Digital input status</td><td>Digital input status when the error occurred. If the input was active, the corresponding bit value is set to 1. If the input is inactive, the corresponding bit value is set to 0.
<table><tr><td>Bit</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>DI</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr></table></td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.17</td><td>Digital output status</td><td>Digital output status when the error occurred. If the output was active, the corresponding bit value is set to 1. If the output is inactive, the corresponding bit value is set to 0.
<table><tr><td>Bit</td><td>1</td><td>0</td></tr><tr><td>DO</td><td>REL1</td><td>-</td></tr></table></td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.19</td><td>Activation time</td><td>Time from inverter activation to error occurrence</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.20</td><td>Run time</td><td>Time from motor activation to error occurrence</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.23</td><td></td><td>Frequency</td><td>Output frequency when the error occurred</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.24</td><td></td><td>Current</td><td>Output current when the error occurred</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.25</td><td></td><td>DC circuit voltage</td><td>DC circuit voltage when the error occurred</td><td></td><td></td><td>Y</td></tr>
<tr><td>y1.26</td><td></td><td>Digital input status</td><td>Digital input status when the error occurred. If the input was active, the corresponding bit value is set to 1. If the input is inactive, the corresponding bit value is set to 0.</td><td></td><td></td><td>Y</td></tr>
</table>

Code	Description		Setpoints	Unit	Factory	Change limited
	Error 1		Bit 4 3 2 1 0 DI 5 4 3 2 1			
y1.27		Digital output status	Digital output status when the error occurred. If the output was active, the corresponding bit value is set to 1. If the output is inactive, the corresponding bit value is set to 0. **Bit** 1 0 **DO** REL1 -			Y
y1.29		Activation time	Time from inverter activation to error occurrence			Y
y1.30		Run time	Time from motor activation to error occurrence			Y

Part 6 Error identification

Error code	Problem	Possible cause	Solution
Err.01	General error	1. Inverter output short-circuit 2. Wiring between motor and inverter too long 3. Power module temperature too high 4. Faulty connections inside the inverter 5. Faulty inverter control module 6. Power module damaged 7. Faulty control module operation 8. Faulty power module operation	1. Check connections outside the inverter. 2. Install an additional output filter and/or reduce switching frequency. 3. Check the fan condition. If necessary, clean the fan and gaps between the heatsink fins. 4. Check the operator panel and expansion module connections. 5. Other issues must be reported to the service centre.
Err.02	Overload during acceleration	1. Acceleration time too short 2. Torque boost too high or incorrectly selected U/f characteristic 3. Power supply voltage too low 4. Inverter output short-circuit 5. Vector control mode set without parameter identification 6. Attempt to start a rotating motor 7. Rapid increase in the load at the inverter output 8. Incorrectly sized inverter	1. Extend the acceleration time. 2. Modify the U/f characteristic and torque boost settings. 3. Provide a power supply source with a correct voltage rating. 4. Check connections outside the inverter. 5. Enter correct motor parameters and fine-tune the parameters. 6. Set the speed tracking option. 7. Check the load for sudden variations (e.g. caused by motor locking). 8. Install an inverter with higher power rating.
Err.03	Overload during deceleration	1. Inverter output short-circuit 2. Vector control mode set without parameter identification 3. Deceleration time too short 4. Power supply voltage too low 5. Rapid increase in the load at the inverter output 6. Braking resistor missing	1. Check connections outside the inverter. 2. Enter correct motor parameters and run the auto-tuning function. 3. Extend the deceleration time. 4. Provide a power supply source with a correct voltage rating. 5. Check the load for sudden variations (e.g. caused by motor locking). 6. Install a resistor or braking module.

Err.04	Overload during constant speed operation	1. Inverter output short-circuit 2. Vector control mode set without identification 3. Power supply voltage too low 4. Rapid increase in the load at the inverter output 5. Incorrectly sized inverter	1. Check connections outside the inverter. 2. Enter correct motor parameters and run the auto-tuning function. 3. Provide a power supply source with a correct voltage rating. 4. Check the load for sudden variations (e.g. caused by motor locking). 5. Install an inverter with higher power rating.
Err.05	DC voltage too high during acceleration	1. Power supply voltage too high 2. Additional force drives the motor (e.g. air pushing against the fan blades) 3. Acceleration time too short	1. Provide a power supply source with a correct voltage rating. 2. Eliminate the additional force driving the motor or set the start-up with speed tracking option. 3. Extend the acceleration time.
Err.06	DC voltage too high during deceleration	1. Power supply voltage too high 2. Additional force limits the braking force (e.g. high moment of inertia) 3. Deceleration time too short 4. Braking resistor missing	1. Provide a power supply source with a correct voltage rating. 2. Adjust the deceleration time to the moment of inertia or use a coast-down braking method. 3. Extend the deceleration time. 4. Install a resistor or braking module.
Err.07	DC voltage too high at constant speed	1. Additional force drives the motor (e.g. air pushing against the fan blades) 2. Power supply voltage too high	1. Eliminate the additional forces acting on the motor or install a braking resistor. 2. Provide a power supply source with a correct voltage rating.
Err.09	Voltage loss	1. Momentary power supply failure 2. Input voltage is lower than required 3. Incorrect DC circuit voltage 4. Inverter input circuit damaged 5. Power module damaged 6. Control module damaged	1. Clear the error. 2. Provide a power supply source with a correct voltage rating. 3. Other issues must be reported to the service centre.
Err.10	Inverter overload	1. Incorrectly sized inverter 2. Motor excessively loaded or locked	1. Install an inverter with higher power rating. 2. Reduce the motor load. Perform motor inspection and maintenance activities.
Err.11	Motor overload	1. Incorrectly sized inverter 2. Thermal protection set incorrectly (parameter **F8.03**)	1. Install an inverter with higher power rating. 2. Set **F8.03** to a value adjusted to the connected motor.

		3. Excessively loaded or locked motor	3. Reduce the motor load. Perform motor inspection and maintenance activities.
Err.12	Input voltage phase missing	1. One of input voltage phases not connected 2. Initial current limiting contactor damaged 3. Faulty inverter operation 4. Input module damaged 5. Control board damaged	1. Check for correct connection of the inverter power supply. 2. Other issues must be reported to the service centre.
Err.13	Output voltage phase missing	1. Wiring between the motor and inverter damaged 2. Output voltage imbalance during motor operation 3. Power module damaged 4. Control board damaged	1. Check the wiring between the motor and inverter. 2. Check the winding impedance and motor insulation resistance. 3. Other issues must be reported to the service centre.
Err.14	Module overtemperature	1. Air circulation around the inverter disturbed 2. Ambient temperature too high 3. Fan damaged 4. Temperature sensor damaged 5. Power module damaged	1. Clean the inverter heat sink and clean the fan. 2. Replace the fan. 3. Decrease the ambient temperature (larger control cabinet, improved ventilation of the cabinet in which the inverter is installed). 4. Other issues must be reported to the service centre.
Err.15	External error	External error reported via the digital input to which the 11 or 33 code function is assigned.	Acknowledge and clear the error message.
Err.17	Input contactor damaged	1. One of power supply voltage phases missing 2. Internal input contactor damaged 3. Inverter input circuit damaged	1. Check connections and the inverter power supply. 2. Other issues must be reported to the service centre.
Err.18	Current measurement error	Current measurement system or inverter control board damaged	Report the issue to the service centre.
Err.19	Motor parameter identification error	1. Incorrect motor parameter setting (parameters **b0.00** - **b0.05**) 2. Motor parameter identification timeout	1. Enter the parameters from the nameplate in the inverter system correctly. 2. Check the motor connections, winding impedance and insulation resistance.
Err.21	EEPROM error	The inverter internal memory storing the device set-up is corrupted.	Report the issue to the service centre.
Err.22	Faulty inverter circuit operation	It can be caused by, for example, inverter operation disturbance resulting from rapid power supply voltage fluctuations.	If the error occurs again, report the issue to the service centre.
Err.23	Earth fault on motor side	1. Wiring between the motor and inverter damaged	Check their condition and correctness.

		2. Incorrectly connected motor 3. Motor windings damaged 4. Power module damaged	Check the motor connections and quality of the cable connecting the inverter with the motor. Other issues must be reported to the service centre.
 Do not restart the inverter until the fault reason is identified and rectified. 			
Err.26	Set run time reached	The run time (set in **F7.21**) has been reached.	Clear the inverter history via the function used to restore the inverter set-up to defaults.
Err.27	External error 1	An external error occurred and has been reported to the digital input DI to which the code 44 function is assigned.	Acknowledge and clear the error message.
Err.28	External error 2	An external error occurred and has been reported to the digital input DI to which the code 45 function is assigned.	Acknowledge and clear the error message.
Err.29	Set inverter activation time reached	The inverter activation time (set in **F7.20**) has been reached.	Clear the inverter history via the function used to restore the inverter set-up to defaults.
Err.30	Load drop	The inverter load current is smaller than the value set in **F8.31.**	Check if the error message results from an actual dangerous power drop (e.g. dry run) or the parameter **F8.31** and **F8.32** settings are incorrect.
Err.31	No feedback signal in PID controller mode	The feedback signal value is smaller than the minimum value set in parameter **E2.11**.	Check the operation of the feedback source and parameter **E2.11** settings.

Part 7 Modbus RTU communication

The **FA-1LS/FA-3HS** inverters come with the RS485 communication port supporting transmissions conforming to the Modbus RTU standard. In a communication network, the inverter is a slave device, i.e. it can only respond to and process commands from the master controller.

Parameter readout/saving via RS485

Parameters can be accessed as per the Modbus RTU standard. The inverter supports two main command groups:

- **0x03 – Read Holding Registers**

- **0x06 – Write Single Register**

Remote access to inverter settings

Individual inverter parameters are accessible via registers whose addresses are determined in line with the following scheme: the upper word of the register number is taken from the group number, and the lower word is taken from the parameter number.

Parameter group	Register number		Page
	Hexadecimal	Decimal	
d0	7000_H	28672	20
F0	$F000_H$	61440	22
F1	$F100_H$	61696	31
F2	$F200_H$	61952	41
F3	$F300_H$	62208	45
F4	$F400_H$	62464	49
F5	$F500_H$	62720	52
F6	$F600_H$	62976	54
F7	$F700_H$	63232	57
F8	$F800_H$	63488	64
F9	$F900_H$	63744	67
E1	$E100_H$	57600	68
E2	$E200_H$	57856	71
b0	$B000_H$	45056	74
y0	$C000_H$	49152	75
y1	$C100_H$	49408	77

The Modbus register with the (hexadecimal) value: **$F300_H$** corresponds to the parameter with code **F3.21** (3 in the upper word = parameter group **F3**) + **15_H** (**15_H** in the decimal form is **21**, i.e. parameter number in the group). In total, the address of the register corresponding to parameter **F3.21** is **$F315_H$** (62219 in the decimal form).

Special registers

Additionally, the inverter comes with a group of additional registers facilitating remote control and inverter operation monitoring.

<table>
<tr><th>Command</th><th>Modbus register (hexadecimal)</th><th>Read (R) / Write (W)</th><th>Values</th></tr>
<tr><td>Run</td><td>2000_H</td><td>W</td><td>Drive starting and stopping. For the function to operate, the run command must be given via the RS485 port (F0.11 = 2,3 or 4).

<table><tr><th>Code</th><th>Function</th></tr><tr><td>1</td><td>Forward run (FWD)</td></tr><tr><td>2</td><td>Reverse run (REV)</td></tr><tr><td>3</td><td>Forward test run (FWD JOG)</td></tr><tr><td>4</td><td>Reverse test run (REV JOG)</td></tr><tr><td>5</td><td>Motor stop by coasting</td></tr><tr><td>6</td><td>Motor stop</td></tr><tr><td>7</td><td>Error clearing</td></tr></table></td></tr>
<tr><td>Status</td><td>3000_H</td><td>R</td><td>Quick overview of current inverter contrition

<table><tr><th>Code</th><th>Function</th></tr><tr><td>1</td><td>Forward run</td></tr><tr><td>2</td><td>Reverse run</td></tr><tr><td>3</td><td>Stop</td></tr></table></td></tr>
<tr><td>Errors</td><td>8000_H</td><td>R</td><td>Code of the error reported by the inverter:

<table><tr><td>  </td><td>Error IDs and their causes are described on page 80.</td></tr></table></td></tr>
</table>

The current inverter operation parameters can be read in registers 1000_H – $100E_H$.

<table>
<tr><th colspan="2">Modbus register</th><th rowspan="2">Function</th></tr>
<tr><th>Hexadecimal</th><th>Decimal</th></tr>
<tr><td>1000_H</td><td>4096</td><td>Set frequency

When the speed is set via the RS485 remote control feature, the value entered here sets the motor rotation frequency. A positive value sets the FWD direction; a negative value sets the REV direction.

The setpoint range is from -10000 to +10000.

<table><tr><td>  </td><td>Note:
10000 indicates 100% of the maximum motor speed.</td></tr></table></td></tr>
</table>

1001_H	4097	Output frequency
1002_H	4098	DC circuit voltage
1003_H	4099	Output voltage
1004_H	5000	Output current
1005_H	5001	Output power
1006_H	5002	Output torque
1008_H	5004	Input line **DI** status
1009_H	5005	Output relay **DO** status
$100A_H$	5006	Voltage at analogue input **AI**

Part 8 Inverter specifications

Power supply	Voltage and frequency	FA-1LS	1 x 220 - 240
		FA-3HS	3 x 380 - 415 V, 50/60Hz
	Output voltage	FA-1LS	3 x 220 - 240 V (for 230 V power supply)
		FA-3HS	3 x 380 - 400 V (for 400 V power supply)
	Output frequency	0.00 - 3200 Hz (U/f control) 0.00 - 300.00 Hz (vector control)	
	V/f control characteristic	1) Constant-torque characteristic 2) Reduced-torque characteristics 3) User-defined torque characteristic 4) Vector control (sensorless)	
	Initial torque	150% for 0.50 Hz	
	Speed control dynamic	1: 100 (in vector control mode)	
	Output speed stability	± 0.5% (in vector control mode)	
	Drive torque boost	In V/F control mode – automatic or user-defined	
	Acceleration/braking	Linear characteristic or as per the programmed S-curve Maximum acceleration and braking time – 6500 s	
	Frequency setting accuracy	Digital frequency setting: 0.01Hz(f <= 100Hz), 0.1Hz (> 100Hz); Analogue frequency setting: 1% of maximum frequency	
	Overload capacity	1) 150% of rated current for 1 minute 2) 180% of rated current for 2 seconds	
	Motor slip compensation	In the V/F control mode, automatic slip compensation is possible.	
Safety features	Inverter protection	1) Against over- and under-voltage 2) Against exceeding the maximum current value 3) Against overload 4) Against loss of speed and motor stalling 5) Against current leakage to ground 6) Against inverter overheating 7) In addition, the inverter is protected against communication errors or an incorrect feedback signal.	
	Safety switch	An input or a button can be programmed as a safety switch causing the voltage to be immediately cut off from the inverter outputs.	
	Setpoint protection	Inverter setpoints can be protected against unauthorised access with a PIN number.	
	Error clearing	Both automatic and manual error clearing functions can be set.	
Braking	DC braking and braking with an external braking resistor.		
IO	5 digital inputs	1) Triggering both via a low (COM) and high (+24V) level 2) Extensive function programming flexibility including: forward and reverse run, forward and reverse test run, safety switch, reset, multi-step speed control, motopotentiometer, acceleration and deceleration time change.	
	1 analogue input	1) Can operate both as a voltage input (0 ~ 10 V) and a current input (0 ~ 20mA)	

		(the 4 ~ 20 mA range can also be set via software). 2) The analogue input can be used to set frequency, control the PID controller, etc.
	1 analogue output	1) Can operate both as a voltage output (0 ~ 10 V) and a current output (0 ~ 20mA) 2) Analogue output can be programmed to indicate, e.g. : a. Set and current frequency b. Rotational speed c. Output voltage and current d. DC circuit voltage e. Setpoint monitoring f. Power and output torque g. Motor rotational speed h. Drive torque
	1 relay output	1) Contact current-carrying capacity 5A/250V AC or 5A/30VDC 2) Extensive output function programming flexibility (indication of 40 different inverter statuses), including: a. Run b. Ready to operate c. Failure d. Overload e. Set frequency value reached
Speed adjustment	1) Extensive speed setting flexibility, including various combinations of digital inputs, analogue input, remote control via RS485, control panel buttons 2) Multi-step speed – option to enter 16 different speeds and 8 acceleration/deceleration times. 3) PLC mode – option to define a sequence of 8 steps that are automatically executed by the inverter. For each step, such parameters as the motor speed, acceleration/deceleration time and step duration can be defined. It can also be defined whether the sequence is run once or repeated in a loop.	
PID	On-board PID controller facilitating drive operation adjustment to process requirements. Both a setpoint and feedback signal can be sent from one of the following sources: 1) Control panel 2) Analogue input 3) Digital inputs	
Environmental conditions	Operating temperature	-10°C ~ 40°C. If the temperature exceeds 40°C, the maximum output current decreases by 1% along with each additional °C.
	Storage	-20°C ~+65°C
	Humidity	Below 90%, without condensation
	Altitude	0 ~ 1000 m
	Installation	Installation in an upright position, inside a control cabinet with an effective ventilation system, on a mounting plate made of a non-flammable material. The installation method must also protect the inverter against direct sunlight, dust, humidity and aggressive or explosive gases.

	Installation	Cooling through natural or forced air circulation

Table of types

Inverter type	Input voltage	Input current	Output voltage	Output current	Maximum motor power	Length (L)	Width (W)	Height (H)
	V	A	V	A	**kW**	mm	mm	mm
FA-1LS-004	1 x 230	5.4	3 x 230	2.5	**0.4**	138	72	123.5
FA-1LS-007	1 x 230	8.2	3 x 230	4.0	**0.7**			
FA-1LS-015	1 x 230	14.0	3 x 230	7.0	**1.5**			
FA-1LS-022	1 x 230	23.0	3 x 230	10.0	**2.2**	185		134
FA-3HS-007	3 x 400	4.3	3 x 400	2.5	**0.7**	138		123.5
FA-3HS-015	3 x 400	5.0	3 x 400	3.8	**1.5**			
FA-3HS-022	3 x 400	5.8	3 x 400	5.1	**2.2**			
FA-3HS-040	3 x 400	10.5	3 x 400	9.0	**4.0**	185		134
FA-3HS-055	3 x 400	14.6	3 x 400	13.0	**5.5**			

Assembly drawings

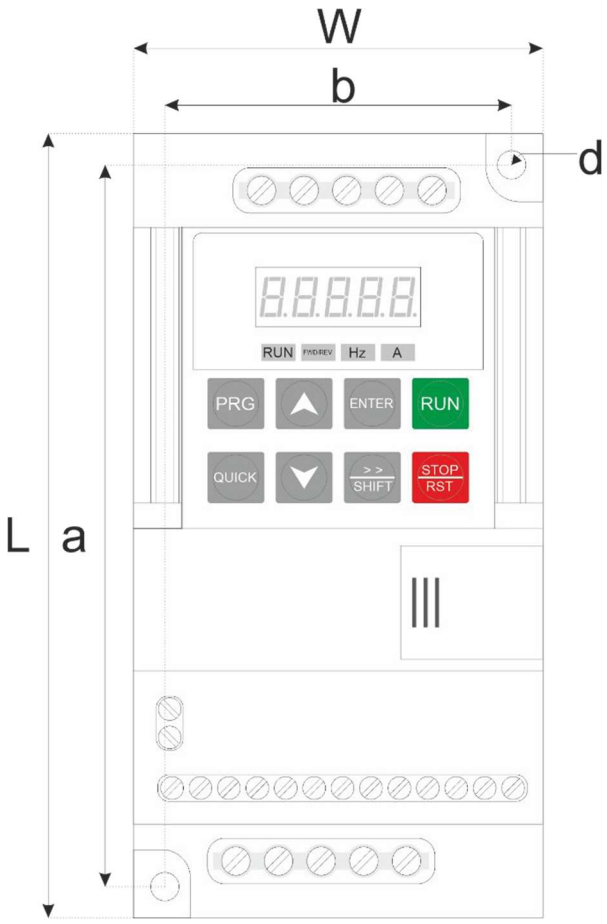


Fig. 12) Inverter dimensions and measurement hole locations

Mounting holes:

Inverter type	Length a	Width b	Diameter d	Weight
	mm	mm	mm	kg
FA-1LS-004	127	61	5	1.1
FA-1LS-007				
FA-1LS-015				
FA-1LS-022	175	45		1.3
FA-3HS-007	127	61		1.1
FA-3HS-015				
FA-3HS-022				
FA-3HS-040	175	45		1.3
FA-3HS-055				

Braking resistor selection

If high braking efficiency is required, additional braking resistors must be used to dissipate the energy transferred from the decelerating drive to the inverter DC link.

It is forbidden to use resistors with resistance or power lower than that shown in the table below under any circumstances. Failure to meet this requirement may result in damaging the inverter and may also present a fire hazard.

Type	Inverter power	Braking resistor resistance	Resistor power
	kW	Ω	W
FA-1LS-004	0.4	250	*100*
FA-1LS-007	0.7	200	*120*
FA-1LS-015	1.5	100	*300*
FA-1LS-022	2.2	70	*300*
FA-3HS-007	0.7	750	*120*
FA-3HS-015	1.5	400	*300*
FA-3HS-022	2.2	400	*300*
FA-3HS-040	4.0	150	*500*
FA-3HS-055	5.5	100	*500*

Revision history

2020.02.25	v.1.0.0	Publishing the first version of the FA-1LS / FA-3HS inverter operating manual.
15.05.2020	v.1.0.1	Editing the parameter F0.00 description. Adding information on the CE declaration of conformity.
14.04.2023	v.1.0.2	• Editing information on the method of digital input DI triggering. • Adding several comments to clarify potential problems related to setting up the digital inputs and the frequency setpoint source.

Warranty

1. This inverter is covered by a 24-month warranty. The warranty period starts from the date of device purchase.
2. The warranty is valid only together with a proof of purchase.
3. Warranty claims must be filed at the sales outlet or directly with the manufacturer:

F&F Filipowski sp. k.
ul. Konstantynowska 79/81
95-200 Pabianice
Phone (42) 227-09 71
email: dztech@fif.com.pl

4. A claim must be supplemented with written information regarding the nature of the fault and the circumstances in which it occurred.
5. The F&F Filipowski sp. j. company undertakes to handle all complaints in line with applicable Polish law regulations.
6. It is up to the manufacturer to decide how to deal with a given complaint, i.e. by replacing faulty goods with defect-free goods or providing repairs or a refund.
7. The warranty does not cover:
    a. mechanical and chemical damage;
    b. damage caused by incorrect operation or use contrary to the instructions provided in the manual;
    c. damage sustained after selling the product as a result of accidents or other events for which neither the manufacturer nor the retailer is responsible, e.g.: damage during transport.
8. The warranty does not cover operations which should be performed by the user in line with the operating manual, e.g.: multimeter installation, electric installation, required electric safety device installation.
9. The warranty does not limit the purchaser's rights resulting from non-conformity of the goods with the contract.

CE declaration

The F&F Filipowski sp. j. company hereby declares that the device conforms to the requirements of the Low-Voltage Equipment (LVD) Directive 2014/35/EU and Electromagnetic Compatibility (EMC) Directive 2014/30/EU.

The CE Declaration of Conformity including references to standards with which conformity is hereby declared is available at: www.fif.com.pl (product subpage).