



TWERD ENERGO-PLUS



Vector controlled frequency converter

MFC710 400V

MFC710 500V

MFC710 690V

type

with OP-11 control panel

User Manual

Edition 7.4.1



Vector controlled frequency converter

MFC710 400V

MFC710 500V

MFC710 690V

type

with OP-11 control panel

User Manual

Edition 7.4

Contents

Technical data.....	7
Installation figures.....	10
1. Conditions of safe operation.....	12
1.1 Warnings.....	12
1.2 Basic rules.....	12
1.3. Operation list.....	13
1.4. Environmental conditions.....	13
1.5. Recycle.....	13
1.7. CE marking.....	14
2. Installation of the frequency converter.....	15
2.1. Connection of a power circuits.....	15
2.1.1. Safety rules.....	16
2.1.2. Electromagnetic compatibility (EMC) rules.....	16
2.2. Connection of control circuits.....	18
3. Control panel OP-11.....	20
3.1. General description.....	20
3.2. Basic view.....	21
3.3. Review and change of parameters values.....	22
3.3.1. Parameters overview.....	22
3.3.2. Changing parameters settings.....	23
3.4. Changing the values displayed in the basic view.....	24
3.5. Copying of parameters settings between drives.....	24
3.6. Full pointers.....	24
3.7. Restore factory settings.....	24
3.8. Changing the rotational speed of the motor (output frequency) from the control panel.....	25
3.9. PD access levels and parameters locks.....	25
3.9.1. PD access levels.....	25
3.9.2. Parameters locks.....	26
3.9.3. Change of access codes.....	26
4. Configuration of the frequency converter.....	27
4.1. Setting nominal parameters of the motor.....	27
4.1.1. Preparation for operation in a vector control mode.....	27
4.2. Control.....	27
4.2.1. Structure of control.....	27
4.2.2. Control from the control panel.....	30
4.2.3. Control from terminal connections.....	30
4.2.4. Work with constant speeds.....	31
4.2.5. Motopotentiometer.....	32
4.2.6. Other possibilities of the frequency converter control.....	32
4.2.7. Configuration of digital and analog inputs and outputs.....	33
4.3. Configuration of the drive.....	36
4.3.1. Establishing dynamic characteristics and ways of stopping the motor.....	36
4.3.2. Formation of U/f characteristic.....	36
4.3.3. Elimination of frequencies.....	37
4.3.4. DC (direct current) braking.....	37
4.3.5. Mechanical brake.....	37
4.3.6. Flying start.....	38
4.4. Protection and blocking.....	38
4.4.1. Current, frequency and the torque limitations.....	38
4.4.2. Blocking a direction of electric motor rotation.....	38
4.4.3. Blocking the drive operation.....	38
4.4.4. Thermal protections of the motor.....	39
4.4.5. Autostart blockade.....	41
4.5. Motor drying function.....	42
5. The first start.....	44
5.1. Vector control mode. Identification run.....	44
5.1.1. Stages of identification run.....	44
5.1.2. Switching on identification run.....	44
5.2. Storing and reading of options for 4 different motors.....	45
6. Failures and warnings.....	46
6.1. Messages on failures and warnings on the control panel.....	46
6.2. Deleting failure message. Automatic restarts.....	46
6.2.1. Manual deleting.....	46
6.2.2. Deleting through a digital input of the converter.....	46
6.2.3. Remote deleting through RS link.....	46
6.2.4. Readiness to restart if the reason of failure has not disappeared.....	46
6.2.5. Automatic restarts.....	47
6.3. Codes of failures and warnings.....	47
6.4. Failure and warning log.....	49

7. Sets of factory parameters.....	50
8. PID controller.....	51
8.1. Turning on and a configuration of the PID controller.....	51
8.2. Limitation of saturation and SLEEP function.....	52
9. Reeler calculator.....	52
9.1. Turning on and configuration of RC.....	53
10. Pump Group Controller.....	53
10.1. Parameters of a pump group controller.....	54
10.2. Turning on pump group controller.....	54
10.3. An operating mode with the PID controller and a mode of direct control.....	55
10.4. A configuration of pump amount and operating modes of separate pumps - blocking of pumps.....	55
10.5. Monitoring work of pumps.....	55
10.6. Conditions of switching on/off additional pump.....	56
10.6.1. Priority of switching on/off additional pumps.....	56
10.7. Automatic replacement of pumps.....	57
11. Advanced programming of MFC710.....	58
11.1. Characteristic Points (PCH).....	58
11.2. PCH and the pointers – how does it work.....	58
11.3. Modification of standard control.....	58
11.4. The control panel – defining displayed values.....	59
11.5. The control panel - definition of user referencing-units.....	59
11.6. System of rotation counter.....	60
12. PLC controller.....	61
12.1. Universal functional blocks.....	61
12.2. Sequencer device.....	62
12.3. Multiplexers MUX1 and MUX2.....	62
12.4. Curve shaping unit.....	63
12.5. Constant values.....	63
12.6. Example of PLC use.....	64
13. Control of the frequency converter by means of connection RS.....	65
13.1. Parameters which concern communication through RS.....	65
13.2. Map of registers accessible through RS link.....	65
13.3. Handling of connection errors.....	67
14. Maintenance.....	67
Appendix A – Table of Characteristic Points.....	68
Appendix B - Table of Functions of Universal Blocks.....	73
Appendix C – Table of MFC710 frequency converter's parameters.....	77
GROUP 1 – CONFIGURATION OF THE DRIVE.....	78
GROUP 2 – REFERENCING-UNITS AND CONTROL.....	82
GROUP 3 – FAILURES.....	87
GROUP 4 – PARAMETERS BLOCKING, CONFIGURATION OF: RS, DISPLAYING AND USER REFERENCING-UNITS.....	90
GROUP 5 – PUMP GROUP CONTROLLER, BLOCKS OF PLC CONTROLLER.....	92
GROUP 6 – PLC CONTROLLER – UNIVERSAL BLOCKS.....	95
Appendix D – EU declaration of conformity.....	96

Technical data

This User's manual refers to frequency converters MFC710 type. These frequency converters are made in three different variants of the supply voltage: 3x400V (typical), 3x500V (optional) and 3x690V (optional). Table 0.1 shows the technical data common to the series of frequency converters MFC710.

Table 0.1 – Technical data common for frequency converters of the MFC710 series

Power supply	Voltage U_{in} / freq.	Three-phase power: 400V or 500V ^{*)} or 690V ^{*)} (-15% +10%), 45 ... 66Hz ^{*)} depending on the type of ordered frequency converter; information on the supply voltage is also placed on the nameplate
Output	Output voltage / freq.	0 ... U_{in} [V] / 0,0 ... 400,0 Hz (0,0 ... 200,0 in Vector operation mode)
	Frequency resolution	0,1Hz; 1 rpm (vector operation mode)
	Efficiency	MFC710: up to 97% at nom. power. MFC710/AcR: up to 96% at nom. power.
Control system	Modulator	SVPWM
	Operation mode	U/f (linear, square-law), Vector DTC-SVM without sensor Vector DTC-SVM with sensor of the rotor position
	Switching frequency	2 ... 15kHz, also random carrier
	Rotation speed setting	Analog inputs, control panel, motopotentiometer, PID controller, communication unit RS-232 or RS-485 port and other possibilities. Resolution of 0.1 % for analog inputs or 0.1Hz / 1 rpm for the control panel and RS
Control inputs/outputs	Analog inputs	3 analog inputs: AI0: voltage mode 0(2)..10V, $R_{in} \geq 200k\Omega$ AI1,AI2: voltage mode 0(2)..10V, $R_{in} \geq 100k\Omega$; current mode 0(4)..20mA, $R_{in} = 250\Omega$ Operation mode and polarity are chosen by parameters and switches. Accuracy: 0.5 % of the full range.
	Digital inputs	6 digital galvanic separated inputs 0/(15..24)V, $R_{in} \geq 3k\Omega$
	Analog outputs	2 outputs 0(2)..10V / 0(4)..20mA – configuration by parameters and switches, accuracy 0.5 %
	Digital outputs	3 relays K1, K2 and K3 – breaking capacity: 250V/1A AC, 24V/1A DC, 1 transistor open-collector output 100mA/24V. Fully programmable signal source.
	Encoder interface	Possibility of direct connection of incremental encoder: 5V _{DC} , line driver (RS422), <250kHz. Recommended pulse rate: 1024 ÷ 2048.
Communication	Connectors	RS-232, RS-485 with optoisolation
	Communication protocol	MODBUS RTU. Function 3 (Read Register); Function 6 (Write Register).
	Transmission speed	9600, 19200, 38400 or 57600 bit/s
	Application	Remote operation control and programming of all the parameters.
Special functions	PID controller	Choice of referencing-unit signal source and feedback signal source, the possibility of negating the error signal, SLEEP function and resetting the output to STOP, limiting the output value.
	PLC controller	The possibility of taking control over converter's operation, START / STOP system, direction of rotation and frequency, the possibility of controlling any external process without connecting an external PLC controller. 48 universal functional blocks, 43 functions: simple logic and arithmetic blocks; block of 8-state sequencer, 2 multiplexers with 8 inputs, curve shaping unit, the maximum execution time of the PLC program: 10ms.
	Pump group controller	Up to 5 pumps in a cascade. The operation controlled by the PID controller or by direct reference. Each pump can be programmed individually for operation from a frequency converter or from the mains. The possibility of pump blocking. Automatic replacement of the pump after a preset time of operation.
	Set of Predefined (Factory) Parameters	There are 9 available set of predefined parameters: - Local: control from keyboard, - Remote: control through digital or analog inputs, - Local/Remote: choice between local and remote, - PID: speed regulated by PID controller, - Motopotentiometer: control with "increase/decrease" signals from digital inputs, - Constant frequencies: operation with constant frequencies, switching through digital inputs - Torque regulation: setting the torque by signal from digital input, vector control - Pumps: the control of pump group - Reeler: setting the torque with the reel calculator, vector control
	Additional functions of the panel	Definition of User's values for direct observation of the process variables: selection of a unit of measurement, scale and data source (e.g. from PLC controller) Definition of User's referencing-device for direct changing of the process variables – selection of a unit of measurement and scale. Copying parameter settings between FC (frequency converters)

Technical data

Protections	Short-circuit	Short-circuit on unit output
	Overcurrent	Instantaneous value $3.5 I_n$; effective value $2.5 I_n$
	Overvoltage AC/DC	MFC710 400V: $1,43 U_{in}$ ($U_{in} = 400V$) AC; 750V DC MFC710 500V: $1,32 U_{in}$ ($U_{in} = 500V$) AC; 900V DC MFC710 690V: $1,28 U_{in}$ ($U_{in} = 690V$) AC; 1200V DC
	Undervoltage	$0.65 U_{in}$
	Thermal: device	Heat sink temperature sensor
	Thermal: motor	I^2t limit, motor temperature sensor (PTC type)
	Supervision of communication with control panel	Established permissible time of connection absence
	Supervision of communication through RS	Established permissible time of connection absence
	Control of analog inputs	Check of absence of "living null" in modes 2... 10V and 4... 20mA
	Control of a load symmetry	E.g. a break in one of the motor phases
	Underload	Protection from operating without any load
	Stall	Protection against the stall of a motor

Table 0.2a – Technical data of frequency converters of the **MFC710 400V** series, depending on a type

The type of frequency converter	Constant-torque load (max. overload 1.5)		Variable-torque load (max. overload 1.1 ¹⁾)		I_p [A]	I_z [A]
	P_N [kW]	I_N [A]	P_{N2} [kW]	I_{N2} [A]		
MFC710/0.37kW	0.37	1.5	0.55	2.0	2.25	6.3
MFC710/0.55kW	0.55	2.0	0.75	2.5	3.0	6.3
MFC710/0.75kW	0.75	2.5	1.1	3.5	3.75	6.3
MFC710/1.1kW	1.1	3.5	1.5	4.0	5.25	6.3
MFC710/1.5kW	1.5	4.5	2.2	5.5	6.0	6.3
MFC710/2.2kW	2.2	5.5	3	7.8	8.3	10
MFC710/3kW	3	7.8	4	9.5	11.7	10
MFC710/4kW	4	9.5 ²⁾	4	9.5	15.8	16
MFC710/5.5kW	5.5	12	7.5	16	18	20
MFC710/7.5kW	7,5	17	11	23	25	25
MFC710/11kW	11	24	15	29	36	30
MFC710/15kW	15	30	18	37	45	50
MFC710/18.5kW	18.5	39 ²⁾	18.5	39	60	59
MFC710/22kW	22	45	30	60	68	63
MFC710/30kW	30	60	37	75	90	80
MFC710/37kW	37	75	45	90	112	100
MFC710/45kW	45	90	55	110	135	125
MFC710/55kW	55	110	75	150	165	160
MFC710/75kW	75	150	90	180	225	200
MFC710/90kW	90	180	110	210	270	225
MFC710/110kW	110	210	132	250	315	315
MFC710/132kW	132	250	160	310	375	315
MFC710/160kW	160	310	180	375	465	400
MFC710/200kW	200	375	250	465	570	500
MFC710/250kW	250	465 ²⁾	250	465	690	630
MFC710/315kW	315	585	355	650	850	800
MFC710/355kW	355	650	400	730	940	800
MFC710/400kW	400	730 ²⁾	400	730	1100	800
MFC710/450kW	450	820	500	910	1190	1000
MFC710/500kW	500	910	560	1020	1365	1250

¹⁾ For ambient temperature < 35 °C

²⁾ The permissible overload is lower and amounts to 1,1 I_n

Table 0.2b – Technical data of frequency converters of the MFC710 500V series, depending on a type

The type MFC710/500/...	Constant-torque load (max. overload 1.5)		Variable-torque load (max. overload 1.1 ¹⁾)		I _p [A]	I _z [A]
	P _N [kW]	I _N [A]	P _{N2} [kW]	I _{N2} [A]		
0,37kW	0,37	1,2	0,55	1,6	1,8	6,3
0,55kW	0,55	1,6	0,75	2,0	2,4	6,3
0,75kW	0,75	2,0	1,1	2,8	3,0	6,3
1,1kW	1,1	2,8	1,5	3,6	4,2	6,3
1,5kW	1,5	3,6	2,2	4,4	5,4	6,3
2,2kW	2,2	4,4	3	6,0	6,6	10
3,0kW	3	6,3	4	8,0	9,5	10
4,0kW	4	8,0 ²⁾	4	8,0	12	16
5,5kW	5,5	10	7,5	14	15	20
7,5kW	7,5	14	11	20	21	25
11kW	11	20	15	24	30	30
15kW	15	24	18	32	36	50
18.5kW	18,5	32 ²⁾	18,5	32	48	59
22kW	22	37	30	50	56	63
30kW	30	50	37	60	75	80
37kW	37	60	45	72	90	100
45kW	45	72	55	90	108	125
55kW	55	90	75	120	135	160
75kW	75	120	90	150	180	200
90kW	90	150	110	180	225	225
110kW	110	180	132	200	270	315
132kW	132	200	160	250	300	315
160kW	160	250	180	300	375	400
200kW	200	300	250	380	450	500
250kW	250	380	250	475	570	630
315kW	315	475	355	520	713	800
355kW	355	520	400	584	780	800
400kW	400	584	450	656	876	900
450kW	450	656	500	728	984	1000
500kW	500	728	560	816	1092	1250
560kW	560	816	630	900	1224	1250

¹⁾ For ambient temperature < 35 °C.

²⁾ The permissible overload is lower and amounts to 1,1 I_N.

P_N – nominal output power when the maximum overload current I_p is about 1.5 I_N (constant-torque load).

I_N – nominal output current at P_N.

P_{N2} – nominal output power when the maximum overload current I_p is about 1.1 I_{N2} (pumps, fans).

I_{N2} – nominal output current at P_{N2}.

I_p – overload current: 60 seconds every 10 minutes.

I_z – maximum nominal current of the protection.

Table 0.2c – Technical data of frequency converters of the **MFC710 690V** series, depending on a type

The type MFC710/690/...	Constant-torque load (max. overload 1.5)		Variable-torque load (max. overload 1.1 ¹⁾)		I _p [A]
	P _N [kW]	I _N [A]	P _{N2} [kW]	I _{N2} [A]	
15kW	15	18	18	21	26
18,5kW	18	23	22	26	35
22kW	22	26	30	35	39
30kW	30	36	37	43	52
37kW	37	43	45	52	65
45kW	45	52	55	64	78
55kW	55	64	75	87	95
75kW	75	87	90	104	130
90kW	90	104	110	121	156
110kW	110	121	132	144	182
132kW	132	144	160	179	217
160kW	160	179	180	219	268
180kW	180	202	200	242	300
200kW	200	219	250	266	329
250kW	250	266	315	329	398
315kW	315	329	355	393	491
355kW	355	375	400	420	530
400kW	400	2)	400	420	530
500kW	500	2)	500	500	550
560kW	560	2)	560	560	615
630kW	630	2)	630	650	715
800kW	800	2)	800	800	920

¹⁾ For ambient temperature < 35 °C.

²⁾ For frequency converters at nominal power 400 kW and above, the range of overload is determined in consultation with the Customer.

P_N – nominal output power when the maximum overload current I_p is about 1.5 I_N (constant-torque load).

I_N – nominal output current at P_N.

P_{N2} – nominal output power when the maximum overload current I_p is about 1.1 I_{N2} (pumps, fans).

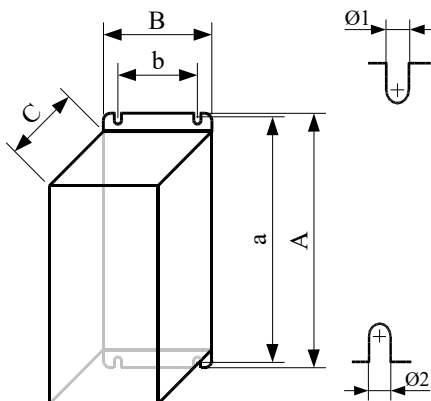
I_{N2} – nominal output current at P_{N2}.

I_p – overload current: 60 seconds every 10 minutes.

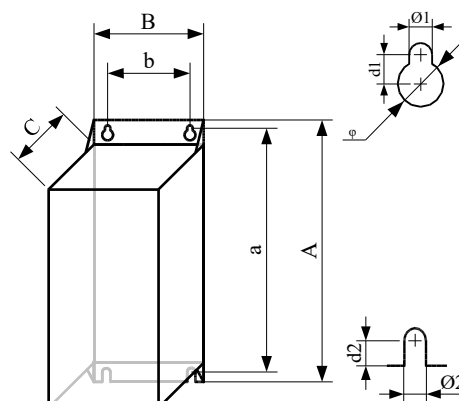
Installation figures

The dimensions of frequency converter, type MFC710.

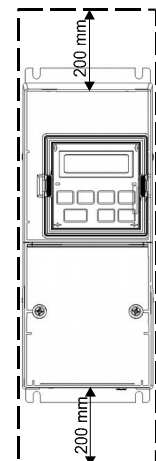
Enclosure type A



Enclosure type B



Free space around the converter



It is necessary to provide some free space around the converter for appropriate air circulation.

Table 0.3a - Mechanical dimensions of the frequency converters **MFC710 400V** and **MFC710 500V** type

Modification	The type of converter: MFC710/... MFC710/500/...	Dimensions [mm]										Weight ¹⁾ [kg]		
		a	A	b	B	C	d1	d2	Ø1	Ø2	φ			
A	0,37 kW	255	267	75	114	154	-	-	7	7	-	3,0		
	0,55 kW											3,0		
	0,75 kW											3,0		
	1,1 kW											3,0		
	1,5 kW											3,0		
	2,2 kW											3,1		
	3,0 kW											3,1		
	4,0 kW											3,1		
	5,5 kW	322	337	90	130	188	-	-	7	7	-	5,6		
	7,5 kW											5,8		
	11 kW	322	337	90	130	223	-	-	7	7	-	7,2		
	15 kW											7,4		
	18,5 kW ²⁾											7,5		
B	22 kW	434	450	160	220	225	6	10	7	7	11	19,0		
	30 kW	585	600	180	225	247	8	8	7	7	14	24		
	37 kW											24		
	45 kW ²⁾	590	615	192	256	266	10	15	8,2	8,2	15	28		
	55 kW ²⁾											29		
	75 kW ²⁾											30		
	90 kW ⁵⁾	838	865	190	283	400	12	15	8,5	8,5	18	60		
	110 kW ⁵⁾											(927)	(955)	(370)
	132 kW ²⁾	875	920	338	460	345	15	25	13	13	22	70 ⁷⁾ (88)		
	160 kW ²⁾											70 ⁷⁾ (88)		
	180 kW ²⁾											72 ⁷⁾ (90)		
	200 kW ²⁾											74 ⁷⁾ (92)		
	250 kW ²⁾											75 ⁷⁾ (93)		
	315 kW ²⁾	875	920	420	640	345	15	25	13	13	22	125		
	355 kW ²⁾											940 ³⁾	558 ⁴⁾	125
	400 kW ²⁾											130		
	450 kW ²⁾	1045	1090	2x317	800	345	15	25	13	13	22	190		
	500 kW ²⁾											1127 ³⁾	190	

Table 0.3b - Mechanical dimensions of the frequency converters **MFC710 690V** type

Modification	The type of converter ⁶⁾ : MFC710/690/...	Dimensions [mm]										Weight ¹⁾ [kg]										
		a	A	b	B	C	d1	d2	Ø1	Ø2	φ											
B	75 kW ⁵⁾	838	865	190	283	400	12	15	8,5	8,5	18	65										
	90 kW ⁵⁾											65										
	110 kW ⁵⁾											(927)	(955)	(370)	(434)	(272)	(14)	(9,5)	(9,4)	(9)	(18,2)	65
	132 kW ⁵⁾											65										
	160 kW	875	920	338	460	345	15	25	13	13	22	90										
	200 kW											90										
	250 kW											95										
	315 kW											95										
	355 kW											125										
	400 kW	875	920	420	640	345	15	25	13	13	22	125										
	450 kW											130										
	500 kW											130										
	560 kW	1045	1090	2x317	800	345	15	25	13	13	22	200										
	630 kW											1127 ³⁾	200									
	800 kW											200										

1) Approximate weight of the frequency converter, may vary depending on the construction.

2) Version launched in 2012.

3) Height of the frequency converter increased due to the power terminals blocks.

4) Bottom mounting hole spacing.

5) Version launched in 2013, the previous dimensions are in brackets.

6) For units of smaller power ratings (< 75 kW), casings are chosen according to the individual requirements.

7) Applies to converters from June 2022, previous weight is given in brackets.

We also offer a frequency converters built in electric cabinets at different IP protection levels.

The IP protection class is given in chapter 2.1.1.e.

1. Conditions of safe operation



This manual contains notices intended to ensure personal safety, as well as to protect the products and connected equipment against damage so read it carefully before using the drive. Not knowing or ignorance of the information contained in it can cause physical injury, death or damage to the frequency converter and connected equipment. *In the further part of this User manual, the frequency converter, to which this instruction applies, will be also referred to as the FC, drive or converter.*

1.1 Warnings

Incorrect installation, usage, and maintenance of the drive can cause physical injury, death, or damage to the device and connected equipment.



RISK OF ELECTRIC SHOCK!
The dangerous voltage is still present after disconnecting the power supply

- Installation, usage, and maintenance of the drive must be performed only by qualified personnel.
- Before switching on the voltage, make sure the drive has been correctly installed and all housing elements have been properly assembled.
- It is forbidden to touch the drive's voltage terminals if it is connected to the power supply.
- After connecting the drive to the supply voltage, its internal components (without the control terminals) are on the power supply potential. Touching these components can cause an electric shock.
- When the drive is connected to the supply voltage, dangerous voltage appears at its output terminals U, V, W even when the motor is not running.
- Externally supplied control circuits may carry dangerous voltage even when the input power of the frequency converter is switched off.
- The drive contains DC link circuit capacitors that remain charged even when the drive is not powered. It can cause an electric shock. The time required for self-discharge of capacitors in an undamaged drive is usually between 5÷15 minutes (a higher power rating of the frequency converter means the longer time).

Before starting any installation works, wait at least 5 minutes after disconnecting all power supplies sources and make sure that voltage on clamps is not present.

CAUTION! The lack of voltage at the connection terminals is not synonymous with the lack of dangerous voltage in the internal DC circuit of a drive.

- Don't make any connections changes when the drive is connected to the power supply.
- Do not install and use the frequency converter in flammable or explosive atmosphere because it could cause fire or explosion.

1.2 Basic rules



- Don't connect mains voltage to output terminals U, V, W.
- Don't measure the voltage endurance of any unit drives.
- To measure the cables insulation it is necessary to disconnect them from the drive.
- Do not repair the unit yourself. Any repairs must be performed only by authorized service.
 Any modifications or self-repairs of the drive can cause physical injury or death, or damage to the drive and connected equipment. Any attempt at unauthorised repairs will void any warranty.
- Don't touch integrated circuits and any other parts on the drive's electronic board, as they can be damaged by electrostatic discharge.
- Don't connect any capacitors to motor wires (e.g. intended for improvement of power factor).
- Don't measure output voltage of converter using digital voltmeters without low-pass filter. The voltage can be measured correctly using an electromagnetic voltmeter.
- The drive is not designed to operate with periodically switched on/off supply voltage. After turn off supply voltage wait 5 minutes before turn on it again.
- If the electric motor runs at low speed (below 25 Hz), additional cooling of the motor is necessary.

1.3. Operation list

<i>The operations applied at installation and the first start-up of the drive</i>	
1	After unpacking the converter, it is necessary to check up visually the presence of damages which could arise during transport.
2	Check up the correspondence between the delivered frequency converter and the order - check up the ratings plate on the case. Delivery includes: <ul style="list-style-type: none"> the frequency converter with the User Manual, a choke – if it was ordered, recommended for rated power 5.5 kW and above, a ferrite ring or RFI filter - depending on the order.
3	Check up the correspondence between the conditions in which the converter will be used and conditions of an environment for which it is designed (section 1.4).
4	Installation of the frequency converter should be made due to the principles of safety and EMC rules, listed in section 2.
5	Perform the configuration of the converter in accordance with the chapters of this manual.

1.4. Environmental conditions

Degree of pollution

The second degree of pollution has been assumed during the design, at which there are normally only non-conducting pollution. However, there is a probability of temporary conductivity caused by a condensation, when the converter is disconnected from the voltage source.

In case the environment in which the frequency converter will work contains pollution, which can influence its safety, it is necessary to apply appropriate counteraction, using, for example, additional cases, air channels, filters etc.

Climatic conditions

	<i>Installation site</i>	<i>During warehousing</i>	<i>During transport</i>
Temperature	from -10°C to +55°C ¹	from -25°C to +55°C	from -25°C to +70°C
		Protective packing	
Relative humidity	from 5% to 95%	from 5% to 95%	Max 95%
	Short-term, insignificant condensation on the external side of the converter case is permitted only when the converter is disconnected from the voltage source.		
Air pressure	from 86 kPa to 106 kPa	from 86 kPa to 106 kPa	from 70 kPa to 106 kPa

1.5. Recycle

Equipment containing electrical and electronic components can not be removed into municipal waste containers. Such equipment must be separated from other wastes and attached to electrical and electronic waste in accordance with applicable local regulations.

This way you help to prevent uncontrolled waste disposal and promote the recycling of materials.



1.6. Limits of responsibility

Despite all the efforts and due diligence of TWERD ENERGO-PLUS does not guarantee that the published data is error-free.

The User is obliged to read the information contained in this Manual before using the device. The TWERD ENERGO-PLUS is not responsible for any consequences of incorrect use of information contained in this Manual or any infringement of patents or other rights of third parties that may arise from their use.

TWERD ENERGO-PLUS products are not authorized for use as critical components in life support devices or systems without the written consent of TWERD ENERGO-PLUS. Furthermore, TWERD ENERGO-PLUS are not responsible for any damages resulting from the use of converters outside its intended purpose.

The information contained in this manual is subject to change without notice, and it supersedes and supplements the information previously provided.

TWERD logo is a trademark of TWERD ENERGO-PLUS. All trademarks used are the property of their respective owners.

For more information contact our technical support at: twerd@twerd.pl

1) For nominal load temperature 40°C was assumed; however, for lower loads higher temperatures are acceptable.

1.7. CE marking

Frequency converters of MFC710 fulfill the fundamental requirements of following instructions of the new approach:

- the Instruction low-voltage LVD 2014/35/EU,
- the Instruction EMC 2014/30/EU.

Mentioned above instructions are fulfilled only after installation of the frequency converter and configuration of the drive according to the instructions of installation principles and the principles of safety resulted below. User is obliged to fulfill these requirements.

The Declaration of Conformity is in the end of this User's manual.

Safety	
IEC/EN 50178:2003	Electronic products which are used in installations of the high power.
IEC/EN 61800-5-1:2007+A1:2017	Adjustable speed electrical power drive systems — Part 5-1: Safety requirements — Electrical, thermal and energy.

Electromagnetic compatibility		
IEC/EN 61800-3:2008+A1:2012	Electric power drives with regulated speed. Electromagnetic compatibility (EMC) in consideration of special methods of research	
Conducted emission	IEC/EN 61800-3:2008 first environment	
	Class C1 The drive up to 18.5kW inclusive with the use of assembly principles (section 2.1.2) and EMC equipment (Section 2.1.2 without the item f.5).	Class C2 The drive up to 18.5kW inclusive with the use of assembly principles (section 2.1.2) and EMC equipment (Section 2.1.2 without items f.4 and f.5).
	IEC/EN 61800-3:2008 second environment	
Radiation emission	IEC/EN 61800-3:2008 first environment	
	Class C2 The drive up to 18.5kW inclusive with the use of assembly principles (section 2.1.2) and EMC equipment (Section 2.1.2 without the item f.5).	Class C3 The drive with the power above 18.5 kW with the use of assembly principles (section 2.1.2) and the equipment (section 2.1.2 without items f.4 and f.5).
	IEC/EN 61800-3:2008 second environment	
Resistance	IEC/EN 61800-3:2008 first and second environments	

The converter power up to 18.5 kW set up in the first environment without external RFI filter does not exceed the emissions admissible for class C2, however, the limits of emission value valid for the class C1 can be exceeded.



Systems with the capacity up to 18.5 kW inclusive in a residential environment may cause radio interference, and in this case, some additional suppression measures may be necessary.

The above warning applies to systems that do not meet the requirements of class C1

In a converter with the power more than 18.5 kW, in which RFI filtering is not required to meet the emission requirements for class C3, the possibility of radio interference may be expected.



Systems with the capacity more than 18,5 kW are not intended for use in the public low-voltage network, which supplies residential units. Operation in such a network is expected to cause radio-frequency interference.

The above warning applies to systems that do not meet the requirements of classes C1 and C2

The converters are not factory-configured for the use in IT-type networks because the asymmetric high-frequency filters used in the converter (Y-type capacitors) reduce the noise emission, disrupt the concept of an isolated distribution network from the ground. Additional grounded impedances can become safety threat in such systems.

Before buying the converter intended for use in the IT network, please contact us to arrange the individual implementation of the system.

For technical reasons, in some applications (current > 400A or voltage ≥ 1000V) fulfilling requirements of EMC is not possible. In such cases, a user and a manufacturer should decide on ways of satisfying EMC requirements in the particular application.

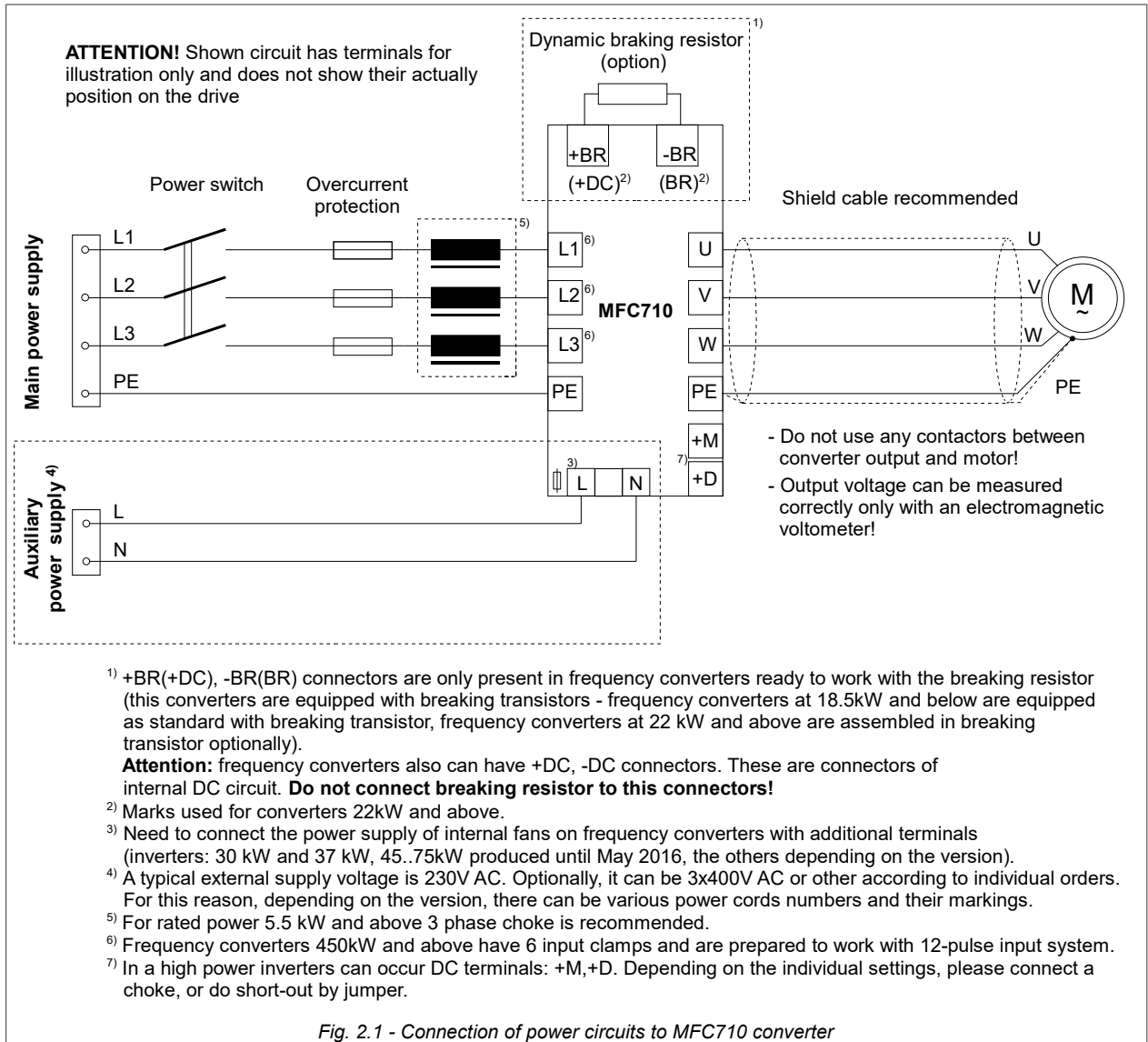
2. Installation of the frequency converter

2.1. Connection of a power circuits

The frequency converters of the MFC710 type are electrical devices intended for control rotational speed of asynchronous motors. This adjustment is made by changing the frequency and amplitude voltage at the output of the converter.

The MFC710 converter is supplied from the three-phase network through terminals L1, L2, L3. In some implementations there is a need to connect an auxiliary power supply intended to supply internal fans.

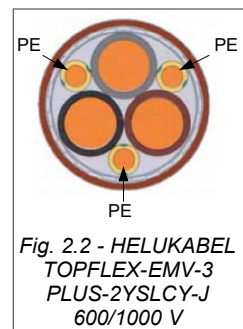
Fig. 2.1 shows a diagram of power circuits connections.



The cross-sections of the cables and the type of the line choke should be selected depending on the load current. The required fuses are shown in Table 0.2, the required cross-section values are presented in the table 2.1.

Table 2.1 - Long-term current load of copper wires with PVC insulation in temperature +40°C on the example of the cable HELUKABEL TOPFLEX-EMV-3 PLUS-2YSLCY-J 600/1000 V

No. cores x cross-sec. [mm ²]	Power ratings with 3 loaded cores ^{*)} [A]	No. cores x cross-sec. [mm ²]	Power ratings with 3 loaded cores ^{*)} [A]
3x1.5 + 3G 0.25	15	3x50 + 3G 10	146
3x2.5 + 3G 0.5	22	3x70 + 3G 10	180
3x4 + 3G 0.75	29	3x95 + 3G 16	217
3x6 + 3G 1	38	3x120 + 3G 16	254
3x10 + 3G 1.5	53	3x150 + 3G 25	291
3x16 + 3G 2.5	71	3x185 + 3G 35	332
3x25 + 3G 4	93	3x240 + 3G 42.5	394
3x35 + 3G 6	117		



3G — yellow-green PE protective conductor (PE protective conductor is divided into 3 conductors — figure 2.2)

*) Load capacity converted for ambient air temperature + 40°C (coefficient of 0.87).

The frequency converter is equipped with connection terminals, protected from corrosion, dedicated to make appropriate connections. Additional information about external connections can be found in section 2.1.1 under the "Equipotential connections" and in section 2.1.2. In order to comply with EU directives of electromagnetic compatibility (EMC), application of a four-wire shielded cable (three phases + earth wire) is recommended to power the motor. The type of line chokes and protections are available at the manufacturer's representative. Do not use any circuit breakers or contactors on the output side of the converter that would disconnect the system during its operation - see section 2.3.

2.1.1. Safety rules

a. Equipotential connections

The protection against indirect touching live parts consists of automatic switching off by special short-circuit protection (or differential-current protection) or voltage limitation to a level not exceeding acceptable values, in case of an insulation failure.

The short circuit to ground at the frequency converter output can be not detected by short-circuit protection, devices due to DC-link circuit. The protection against phase-to-phase and phase-to-ground short-circuit on the output of the converter is provided. However this protection is based on IGBT transistors blocking, what does not conform to the requirements of fire-prevention protection. Due to that, for safety of staff, it is necessary to make local equipotential connections.

In the frequency converter there are provided appropriate terminals, properly marked, protected from corrosion to make equipotential connections.

b. Protection

The maximum values of input wire short-circuit protection are presented in the table 0.2. It is allowed to use gG or aM fuses, however taking into account necessity of protection of the rectifier bridge of the frequency converter, the best solution is gR or aR fuses. You can use overcurrent protection, but the response time of such devices is longer than properly chosen fuse.

Frequency converter is protected from: drive overloading, motor overheating, under- and overvoltage in an DC link circuit of the converter, a short-circuit at the converter output (it protects converter only!).

The usage of differential-current protection due to electrical shock prevention can appear unfavourable since it can trigger due to temporary or constant leakage current of the power drive system, working in normal conditions. In case of usage of the differential-current protection devices you may use only circuit breakers of a B type, due to different nature of a differential current.

c. Disconnecting device

In order to comply with EU directives, according to IEC/EN 60204-1:2010, power drive, which consists of a frequency converter and electrical machine should be supplied with a device for disconnecting power supply. This device should be one of listed below:

- separator (with or without fuses), category of usage AC-23B fulfilling the requirements EN 60947-3,
- disconnector (with fuses or without), disconnecting a load circuit before opening main contacts, conforming the EN 60947-3 requirements,
- tripper conforming the EN 60947-2 requirements.

The installer is responsible for meeting this requirement.

d. Emergency stop

In order to comply with EU directives and IEC/EN 60204-1:2010 and for personnel safety and equipment, it is necessary to use an emergency stop switch, which has higher priority than other functions, irrespective of operating mode. The key STOP on operator panel cannot be treated as the switch of abnormal break, because it doesn't disconnect a frequency converter from power supply. The installer is responsible for meeting the requirement.

e. Casing

Cases of converters with a power 37 kW and below meet the requirements of the protection class IP20. The housings of converters with a power of 45 kW and above have the protection class IP00. In case of individual implementation, the degree of protection may be different. The surface, on which the operator's control panel is located, meets the requirements of an IP40 protection degree. The casing has been designed so that it cannot be removed without the use of tools.

f. Capacitors discharging

In a DC link circuit of a frequency converter there is a capacitor battery with relatively high capacity. After turning off of a supply voltage in its clamps dangerous voltage is present for a certain time. It is necessary to wait for 5÷15 minutes (a higher power rating of the frequency converter means the longer time) before making connections on clamps of power terminal strip of a frequency converter. Before starting any installation works make sure that a voltage on a clamps is not present. The information about danger of such voltage is placed also on terminal strip cover.

2.1.2. Electromagnetic compatibility (EMC) rules

The installation principles reducing EMC problems are divided into four groups. You can achieve the full effect by applying all the principles listed below. Not applying any of the rules undermines the effectiveness of the others:

- separation,
- equipotential bonding,
- shielding,
- filtration.

The basic way of connecting the filter, the frequency converter and the motor is presented in the figure 2.3.

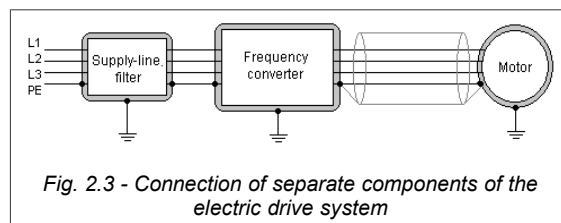


Fig. 2.3 - Connection of separate components of the electric drive system

a. Separation

Power cables (supplying, motor's) must be separated from signal wires. It is necessary to avoid parallel leading of power and signal wires in the common wire channels, and especially in group of cables. The crossing of power cables and signal cables under a right angle is allowed.

b. Equipotential connections

The frequency converter and the filter should be mounted as close as possible, preferably on a common metal plate which acts as a ground. For this purpose, for example, the back wall or a mounting plate of a case can be used. The housing of the frequency converter, the filter and the metal plate shouldn't be coated with any insulation materials. It is necessary to pay attention to an opportunity of oxidation of a surface that results in deterioration of contact. To limit the level of asymmetric disturbances, a multipoint connection of the cable shield with ground is preferred.

Additional information about equipotential connections can be found in section 2.1.1.

c. Shielding

Wires between the mains filter and the frequency converter are not necessary for shielding, if their length doesn't exceed 300mm. In case the length of conductors exceeds 300mm it is necessary to use the shielded wires. Completely shielded cable is a cable which fully complies with requirements of interference radiation according to EN 55011 norms. Such cable should have the screen consisting of spiral metallized aluminium foil and tinned copper plait with a puls-duty factor of not less than 85%, not separated galvanically.

Connection of the cable ends to ground is obligatory. It is necessary to use grounding of the cable shielding on whole section of a cable, on both ends. For this purpose a special EMC grommets are used. They provide valid contact of cable shielding to the case of the equipment. In addition it is necessary to use special cable clips to connect it to back wall of a case for example. It is necessary to pay attention that the unshielded cables, are as short as possible. Junctions of the shielding with a ground should be free from insulating coat on a whole section. Be careful not to damage the shielding. It is not recommended to weave the copper plait in one point (without using EMC grommet) in order to realize grounding.

In case of need control signal wires should also be shielded using the same principles.

d. Filtration

The use of the EMC filter limits noises spreading from electric drive system to the mains. The principles of filter installation are described at the description of equipotential bonding and shielding.

e. Ferrite rings

Fulfilling the requirements, concerning interference emission in the first environment and limited distribution, can be realized by using of ferrite rings instead of additional RFI filter (in converters with rated power 7.5kW and below). It is necessary to remember the warning placed in section 1.7. "CE marking".

The ferrite ring should be placed on a supply cable of the frequency converter, as on the figure 2.4.

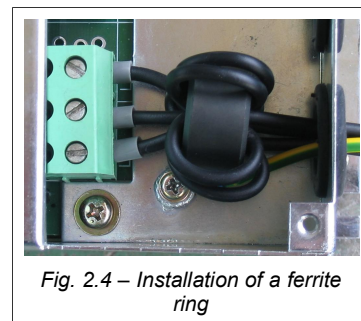


Fig. 2.4 – Installation of a ferrite ring

f. The list of the equipment reducing EMC problems

The list contains devices that can be added to the drive system to improve resistance to interference and reduce the emissivity of the drive system installed in the intended environment of operation:

- 1) completely shielded cables - we recommend cables TOPFLEX EMV and TOPFLEX EMV 3 PLUS (HELUKABEL),
- 2) EMC grommets (throttles),
- 3) ferrite rings,
- 4) RFI filter (EPCOS, REO, SCHAFFNER),
- 5) EMC cabinet — optional, not required to comply with the EMC instructions.

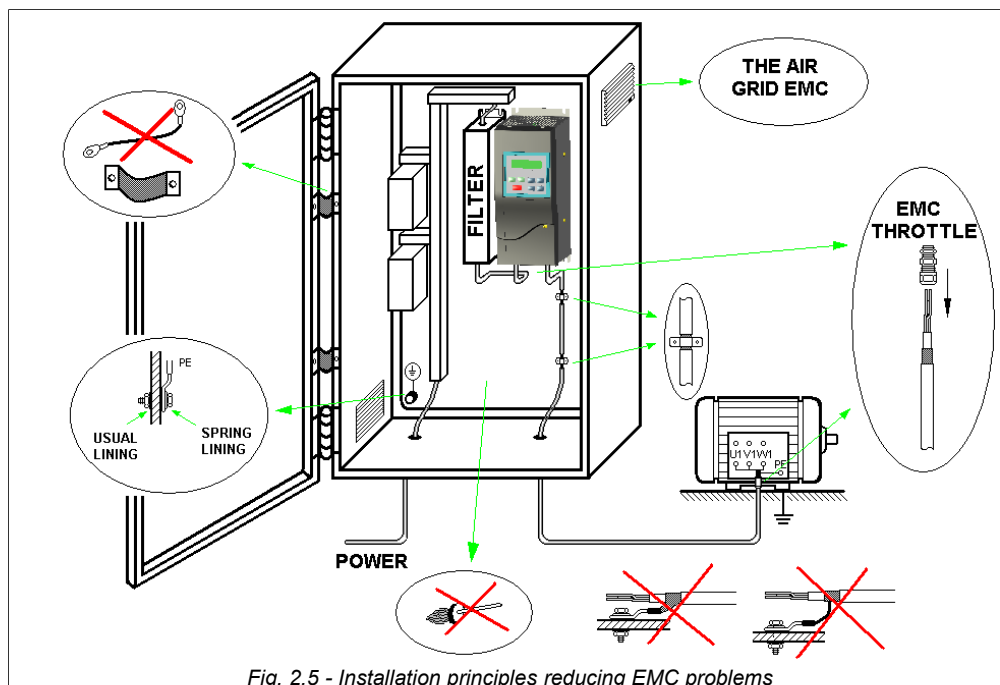
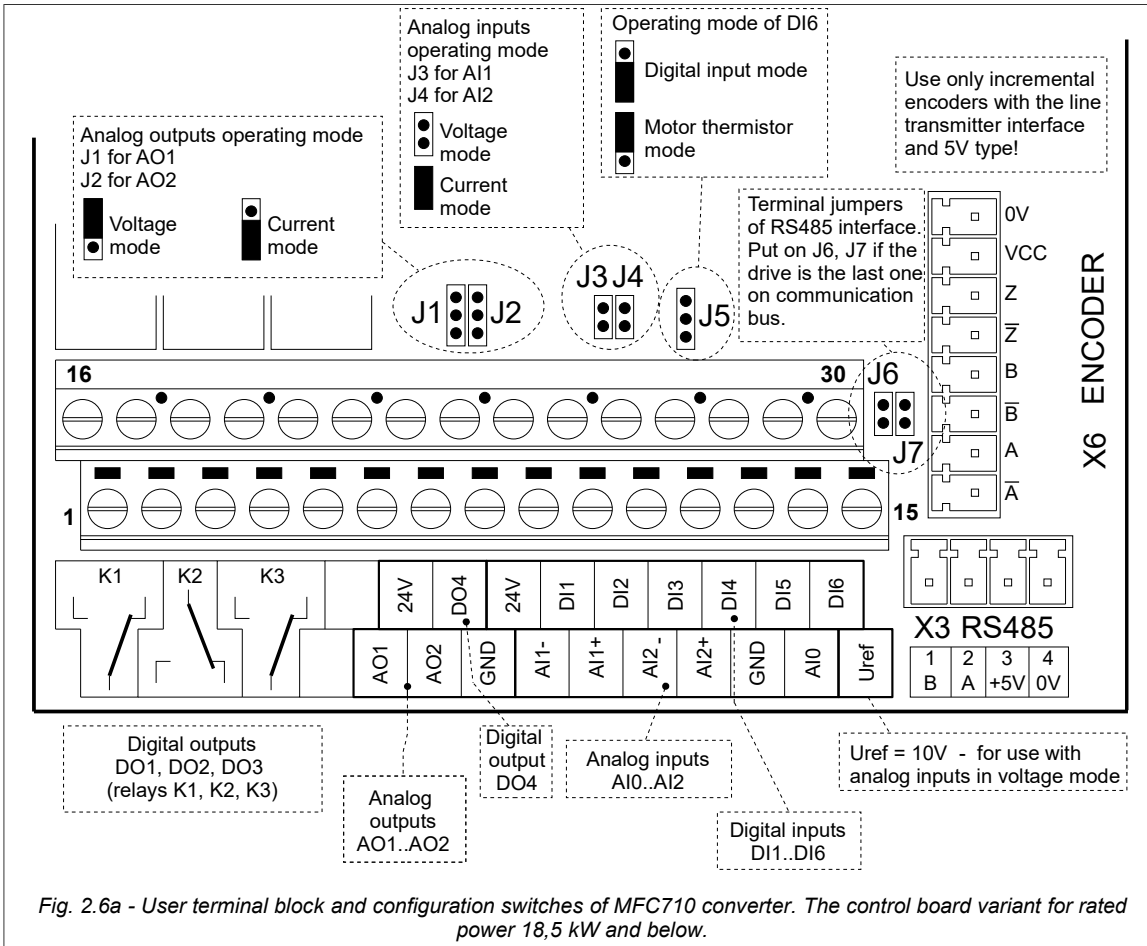


Fig. 2.5 - Installation principles reducing EMC problems

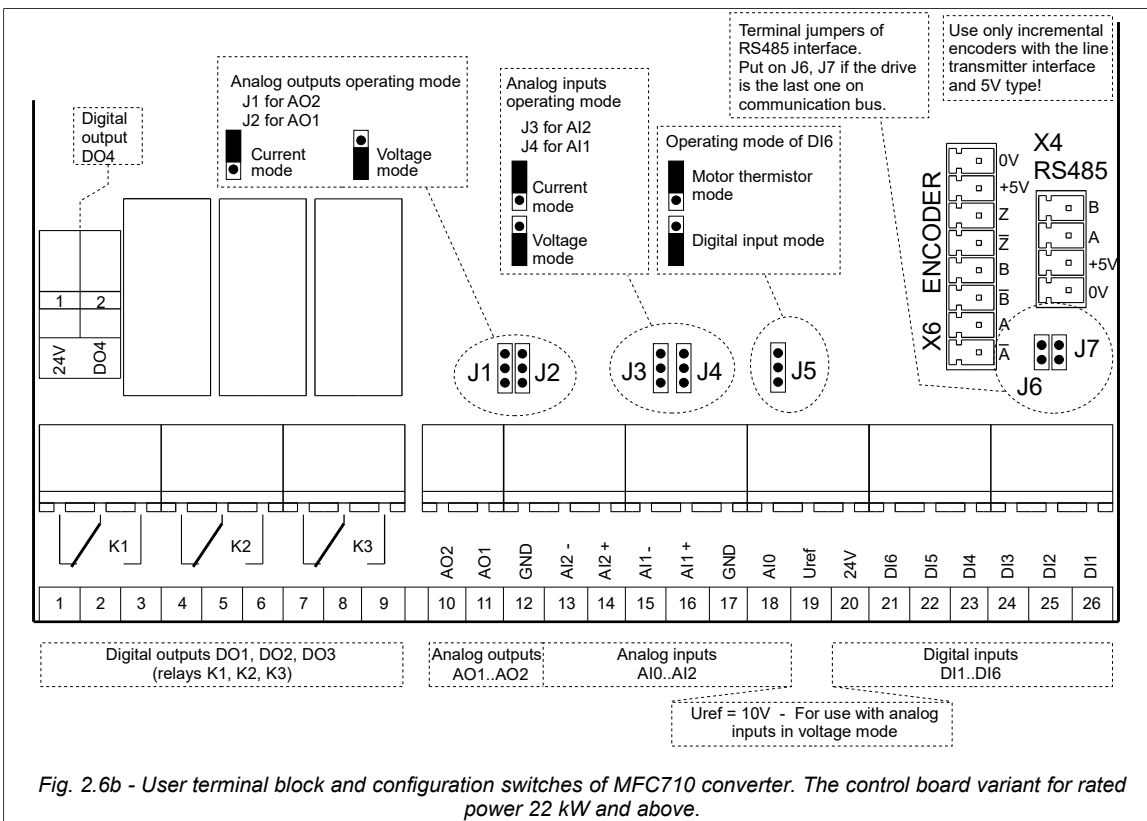
2.2. Connection of control circuits

The figures below show the two variants of the control electronics board used in the MFC710 converters.

a. Frequency converters of rated power 18,5kW and below:

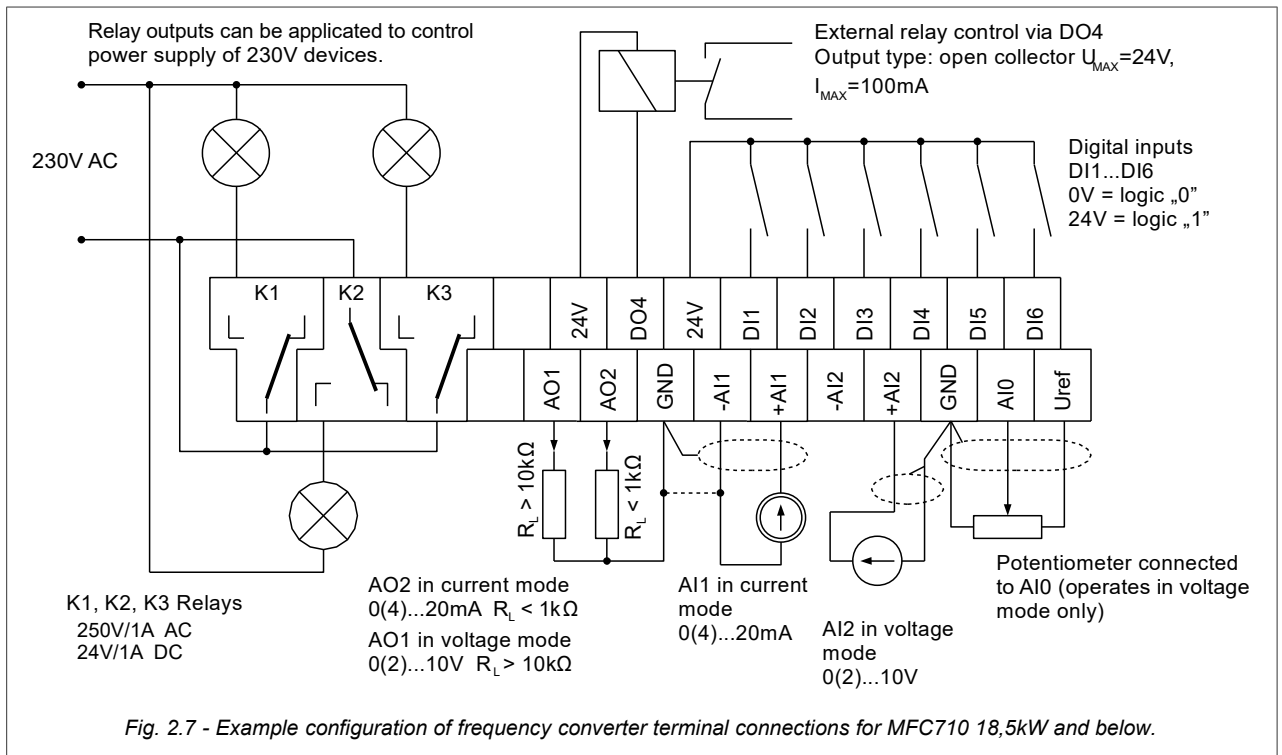


b. Frequency converters of rated power 22kW and above:



2. Installation of the frequency converter

Fig. 2.7 shows an exemplary configuration of control circuit connections, based on the example of a terminal strip of converters with a power of up to 18.5kW inclusive.



$U_{ref} = 10 \text{ Vdc}$, max 10 mA.

2.3. Using contactors between the frequency converter and the electric motor

If there is a need to use contactors between the drive and the electric motor, make sure to switch the contactor in the voltageless state on the output terminals, when the drive is stopped (STOP status). Otherwise there is a high probability of damaging the converter.

Attention: Just issuing the STOP command is not sufficient, because there is a possibility of programmatic delay of the response to the STOP command (par. 1.34) and the possibility of setting a stop on a ramp (par. 1.64).

For this reason, in order to avoid damage to the converter, it is necessary to control the OPERATING status of the converter (PCH.61), e.g. by using one of the relays. The default setting of the K2 relay (par. 2.92, 2.93) is suitable for this purpose.

3. Control panel OP-11

3.1. General description

The control panel (fig. 3.1) is used for:




- monitoring the motor current, voltage, torque, referencing and output frequency as well as other variables available in the group "0 Preview";
- drive operation control: start, stop, change of the electric motor rotation direction, failure resetting;
- changing the settings of the drive: entering the motor's rated data, start the identification run, selecting the place of control, etc.

The entered data is stored in the internal memory of the drive, and the control panel only mediates their reading / writing. This makes it possible to replace panels between converters of the same type regardless of their rated power.

The control panel is removable and can also be mounted outside the drive enclosure, e.g. on the control cabinet door. To do this, use a suitable cable available from the drive manufacturer.

An additional option of the control panel is the ability to copy parameter settings between the drives. See section "3.5. Copying of parameter settings between drives."

Parts of the control panel (fig. 3.1)

- ① Display
- ② Led indicators of drive state – see table 3.1
- ③ Keys: navigation keys „←“ „→“ „↑“ „↓“, Enter key „↵“, ESC, additional Function key “F”
- ④ „Start left“  and „start right“  keys
Note: the electric motor rotation direction depends on the order of the wire connections at the terminals U, V, W.
- ⑤ „Stop/Reset“  key

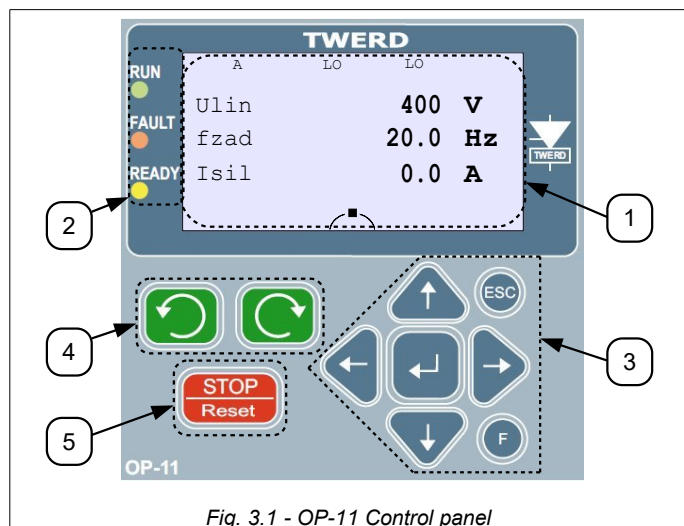


Fig. 3.1 - OP-11 Control panel

The navigation keys ③ are used to navigate the menu of the drive and are always active - pressing them causes a reaction regardless of whether the control operation of the drive takes place from the control panel, through analog / digital inputs, or otherwise.

Keys ④ and ⑤ are used to control the operation of the drive ("start left", "start right", "stop") and are active only when the control is set from the control panel - see table 3.2 and chapter 4.2.2 "Control from the control panel".

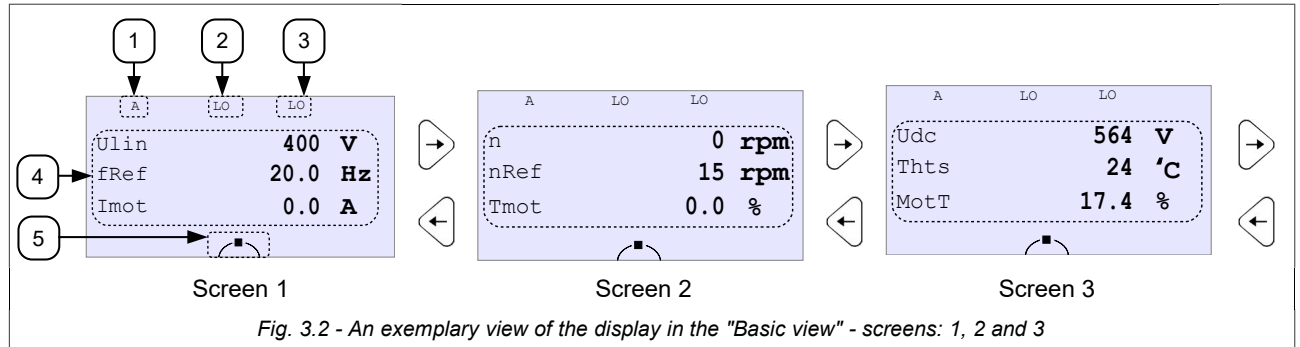
The "Stop / Reset" key is also used to delete the faults message – if it is pressed for more than 2 seconds.

Table 3.1 - Led indicators of FC state

Led colour	Lighting type	Description
Green „RUN“	On	Drive is working
Red „FAULT“	On	Drive is in the failure state – see chapter 6 "Failures and warnings".
	Flashing	Drive is in the warning state – see chapter 6 "Failures and warnings".
Yellow „READY“	On	Drive is in ready state
	Off	Drive is in the blocking state – see chapter 4.4.3
Red „FAULT“ Yellow „READY“	On Flashing	Drive is in the failure state. After removing the cause of the failure, the drive will continue the work <u>automatically</u> .

3.2. Basic view

After connecting the drive to the power supply, the control panel turns on in the "Basic View" (screen 1) as shown in fig. 3.2.



There are three screens in the "Basic View". You can switch between them by pressing the „←“ „→“ keys on the control panel.

On each screen, information is displayed in 5 segments: ① - ⑤ (fig. 3.2 - screen 1). The individual screens differ only in the information displayed in the segment ④. Information displayed in this segment is used to monitor 3 selected values (separately for each screen) – eg. supply voltage Ulin, set frequency fRef, process speed nPro, etc. Any parameter from the "0 Preview" group can be displayed. Additionally, for the first two lines of screen 1, two different monitored values can be set - separately for Run and Stop status of the drive. A detailed description of changing the displayed values is provided in section 3.4 "Changing the values displayed in the basic view". Fig. 3.2 shows the default displayed values.

The remaining segments ① - ③, ⑤ inform about the method of controlling the converter and its operating status. The description of individual display segments is presented in table 3.2.

Table 3.2 - Description of the individual display segments

① Control place	③ Start / Stop signal source																														
<table border="1"> <thead> <tr> <th>Displayed symbol</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Control place A</td> </tr> <tr> <td>B</td> <td>Control place B</td> </tr> </tbody> </table>	Displayed symbol	Meaning	A	Control place A	B	Control place B	<table border="1"> <thead> <tr> <th>Displayed symbol</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>Control Panel</td> </tr> <tr> <td>Di</td> <td>Digital inputs</td> </tr> <tr> <td>Fu</td> <td>START / STOP advanced user reference-unit (PLC). Also, when Start with RS was selected as Start A or B, and there is no permission to work with RS. The drive is stopped.</td> </tr> </tbody> </table>	Displayed symbol	Meaning	LO	Control Panel	Di	Digital inputs	Fu	START / STOP advanced user reference-unit (PLC). Also, when Start with RS was selected as Start A or B, and there is no permission to work with RS. The drive is stopped.																
Displayed symbol	Meaning																														
A	Control place A																														
B	Control place B																														
Displayed symbol	Meaning																														
LO	Control Panel																														
Di	Digital inputs																														
Fu	START / STOP advanced user reference-unit (PLC). Also, when Start with RS was selected as Start A or B, and there is no permission to work with RS. The drive is stopped.																														
<p>② Source of the set frequency</p> <table border="1"> <thead> <tr> <th>Displayed symbol</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>Control Panel</td> </tr> <tr> <td>A0</td> <td>Analog input 0</td> </tr> <tr> <td>A1</td> <td>Analog input 1</td> </tr> <tr> <td>A2</td> <td>Analog input 2</td> </tr> <tr> <td>PI</td> <td>PID controller</td> </tr> <tr> <td>Aw</td> <td>Emergency reference-unit</td> </tr> <tr> <td>Fu</td> <td>User advanced reference-unit (PLC). Also, when the RS reference has been selected as A or B but there is no permission to work with RS. Reference-unit value = 0 Hz.</td> </tr> <tr> <td>RS</td> <td>Reference-unit via the RS</td> </tr> <tr> <td>Fc</td> <td>Constant frequency</td> </tr> <tr> <td>mP</td> <td>Motopotentiometer</td> </tr> </tbody> </table>	Displayed symbol	Meaning	LO	Control Panel	A0	Analog input 0	A1	Analog input 1	A2	Analog input 2	PI	PID controller	Aw	Emergency reference-unit	Fu	User advanced reference-unit (PLC). Also, when the RS reference has been selected as A or B but there is no permission to work with RS. Reference-unit value = 0 Hz.	RS	Reference-unit via the RS	Fc	Constant frequency	mP	Motopotentiometer	<p>④ Monitoring of selected values</p> <p>Any parameter from the "0 Preview" group can be monitored on the screen in the "basic view" - see section 3.4. "Changing the values displayed in the basic view".</p> <p>⑤ Symbol of the converter operation status</p> <table border="1"> <thead> <tr> <th>Displayed symbol</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>■</td> <td>Drive stopped (Stop)</td> </tr> <tr> <td>> (flashing)</td> <td>The converter works (Start) - conventional direction of rotation "clockwise"</td> </tr> <tr> <td>< (flashing)</td> <td>The converter works (Start) - conventional direction of rotation "counterclockwise"</td> </tr> </tbody> </table>	Displayed symbol	Meaning	■	Drive stopped (Stop)	> (flashing)	The converter works (Start) - conventional direction of rotation "clockwise"	< (flashing)	The converter works (Start) - conventional direction of rotation "counterclockwise"
Displayed symbol	Meaning																														
LO	Control Panel																														
A0	Analog input 0																														
A1	Analog input 1																														
A2	Analog input 2																														
PI	PID controller																														
Aw	Emergency reference-unit																														
Fu	User advanced reference-unit (PLC). Also, when the RS reference has been selected as A or B but there is no permission to work with RS. Reference-unit value = 0 Hz.																														
RS	Reference-unit via the RS																														
Fc	Constant frequency																														
mP	Motopotentiometer																														
Displayed symbol	Meaning																														
■	Drive stopped (Stop)																														
> (flashing)	The converter works (Start) - conventional direction of rotation "clockwise"																														
< (flashing)	The converter works (Start) - conventional direction of rotation "counterclockwise"																														

3.3. Review and change of parameters values

3.3.1. Parameters overview

Press the Enter key „↵” to go from the “basic view” to the “parameter overview”. To change the group being viewed, use the up / down arrow keys „↑” „↓”. You can move within a given group with the left / right arrow keys „←” „→”. Return to the "basic view" - ESC key. The diagram of the control panel operation is presented in fig. 3.3.

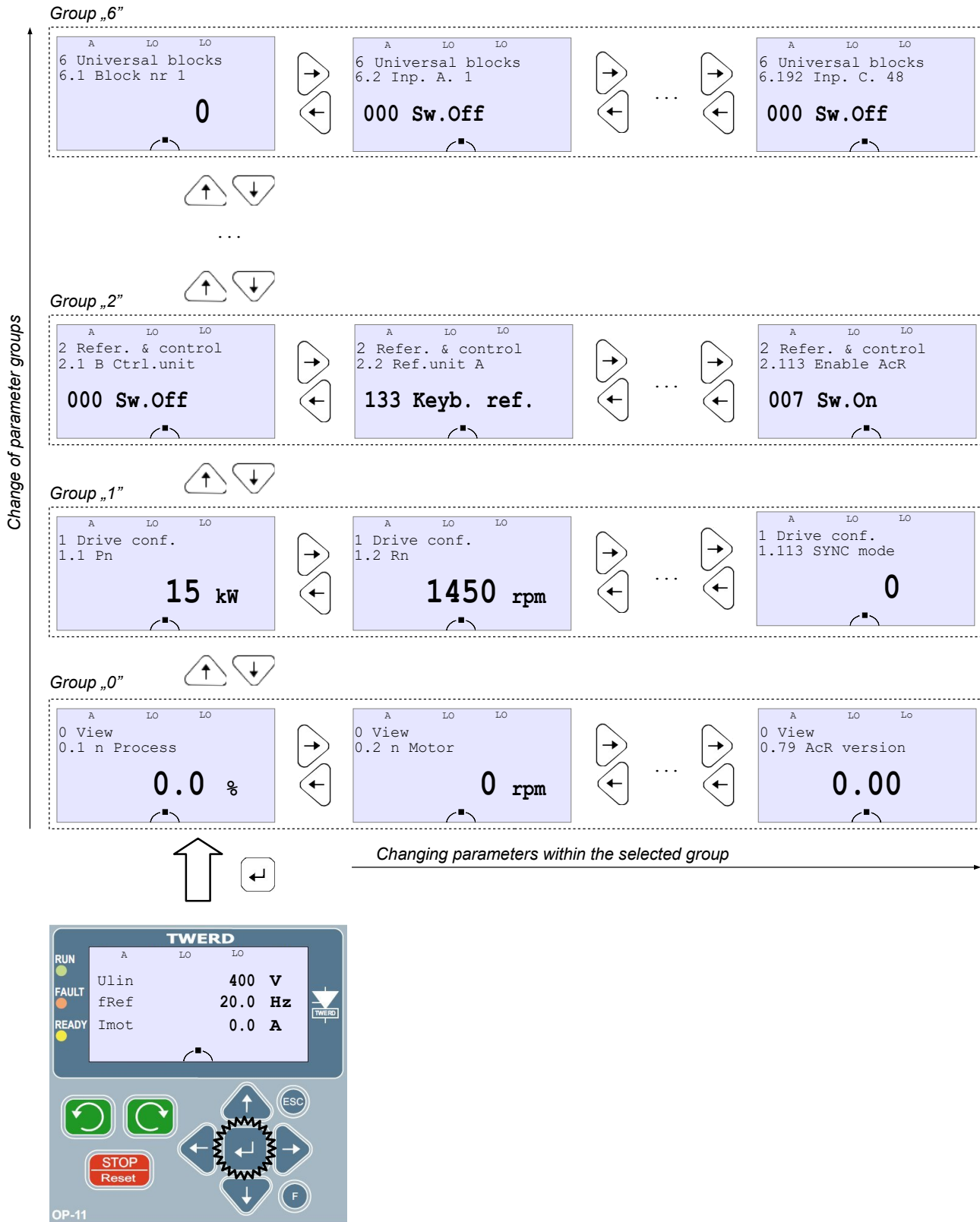


Fig. 3.3 - Scheme of OP-11 control panel operation

3.3.2. Changing parameters settings

The change of parameters settings is shown on the example of the parameter "1.3 In" (fig. 3.4). It is necessary to:

- select the parameter to be changed in the "parameter overview", in this case par. "1.3 In",
- press the Enter key „↵”,
- enter a new value using the up / down „↑” „↓” and left / right „←” „→” keys,
- confirm the change with the Enter key „↵” or cancel with the ESC key.

Graphic illustration of changing the parameter "1.3 In"

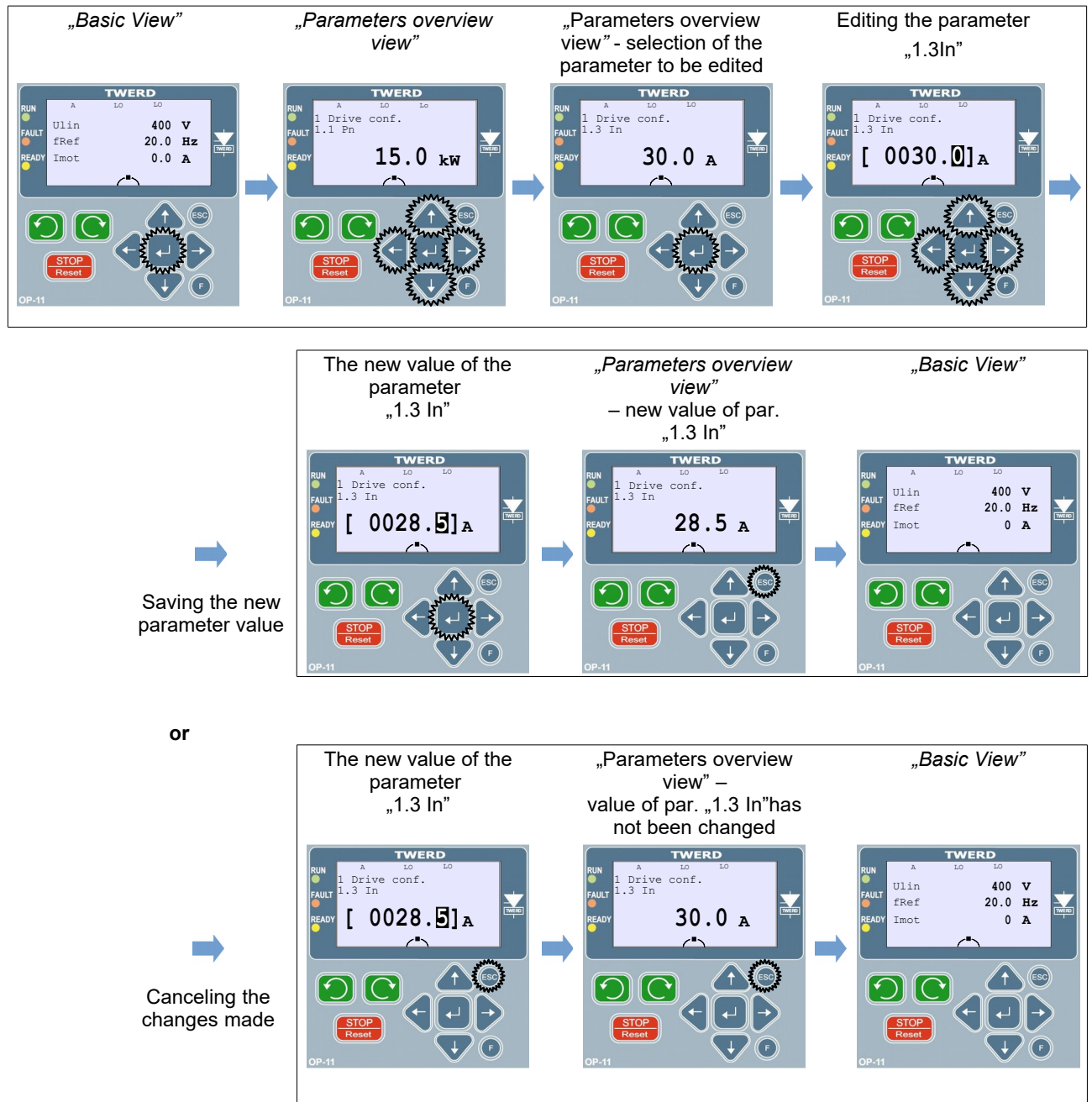


Fig. 3.4 - Graphic illustration of changing the parameter „1.3 In”

3.4. Changing the values displayed in the basic view

The parameters displayed in the "basic view" (screens: 1, 2 and 3 on fig 3.2) are selected from the parameters in the "0 Preview" group. It is possible to change the factory settings and assign any parameter from this group to each line. Table 3.3 lists the parameters determining the displayed value.

Table 3.3 - Setting the parameters displayed in the basic view

Parameter	Description
4.10	Number of the parameter from group 0 displayed in the first line of the first screen in the "basic view" when the electric drive does not operate (STOP)
4.11	Number of the parameter from group 0 displayed in the second line of the first screen in the "basic view" when the electric drive does not operate (STOP)
4.12	Number of the parameter from group 0 displayed in the first line of the first screen in the "basic view" when the electric drive works (START)
4.13	Number of the parameter from group 0 displayed in the second line of the first screen in the "basic view" when the electric drive works (START)
4.14	Number of the parameter from group 0 displayed in the third line of the first screen in the "Basic view".
4.15	Number of the parameter from group 0 displayed in the first line of the second screen in the "Basic view".
4.16	Number of the parameter from group 0 displayed in the second line of the second screen in the "Basic view".
4.17	Number of the parameter from group 0 displayed in the third line of the second screen in the "Basic view".
4.18	Number of the parameter from group 0 displayed in the first line of the third screen in the "Basic view".
4.19	Number of the parameter from group 0 displayed in the second line of the third screen in the "Basic view".
4.20	Number of the parameter from group 0 displayed in the third line of the third screen in the "Basic view".

3.5. Copying of parameters settings between drives

The control panel allows you to store 3 sets (SET 1, SET 2, SET 3) of all parameters of the converter for later upload to the same or another converter of the same type.

Copying parameters from the converter to the control panel:

- press and hold the „F” function key for 5 seconds - (4) on fig. 3.1,
- select „**Copying parameters**” and confirm with the Enter key „↵”,
- select „**Read from inverter**” and confirm with the Enter key „↵”,
- choose one of the 3 sets of SET 1, SET 2, SET 3 to which the parameters will be saved and confirm with the Enter key „↵”.

The copying process takes approximately 5 minutes.

Copying parameters from the control panel to the converter:

Attention:

1. The inverter must be stopped (STOP) when uploading the parameter settings.
2. Before starting the upload, make sure that the START command is not given from the terminal strip or through one of the communication protocols.

In order to save the set of parameters to the converter, do the following:

- press and hold the „F” function key for 5 seconds - (4) on fig. 3.1,
- select „**Copying parameters**” and confirm with the Enter key „↵”,
- select „**Save to inverter**” and confirm with the Enter key „↵”,
- select one of the 3 sets of SET 1, SET 2, SET 3 from which, the previously saved parameters, will be downloaded and confirm with the Enter key „↵”.

The copying process takes approximately 2 minutes.

3.6. Full pointers

Setting a parameter which is a pointer from outside the available range (e.g. setting par. 2.2 as “256 BL1”) is allowed when function of full pointers is turned on (par.4.6 = 001 YES).

3.7. Restore factory settings

Factory settings can be restored only on the second PD access level 2. For this purpose, in the "4.2 Level/CODE" parameter, enter the code corresponding to the second PD level 2 (default is 1). Then in par. "4.4 Fact.set." select one of the predefined factory sets (see section 7 "Sets of factory parameters").

The drive usually comes with factory set no. 1.

Note: After loading any set of factory settings, the converter is automatically restarted, during which communication with the keyboard is lost, and the following message appears on the display "Communication failure. Please wait...".

3.8. Changing the rotational speed of the motor (output frequency) from the control panel

The motor speed can be easily changed from the control panel, provided that at least one of the following conditions is met:

- the source of the motor speed is the control panel (par. 2.2 = „133 Keyb. ref.”),
- The PID controller reference-unit was set to be controlled from the control panel (par. 2.60 = „143 Keyb.P”),
- one of the four user’s referencing-units is active (see chapter 11.5).

Then, in the "Basic view", using the up / down „↑” „↓” arrow keys you can change the motor speed - fig. 3.5. You can return to the "basic view" by pressing the ESC key.

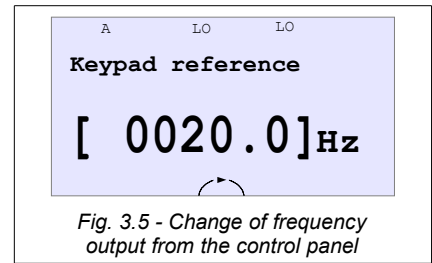


Fig. 3.5 - Change of frequency output from the control panel

Note: Only one (or none) of the above-mentioned referencing-unit can be active at a time.

3.9. PD access levels and parameters locks

If there is a padlock symbol on the left side of the parameter, it means that it is locked and it is impossible to change its value. Possible causes of parameter editing lock:

- some parameters can be changed only when the converter is not running (the motor is stopped),
- the active access level does not allow the parameter to be modified.

Table 3.3 - Parameters responsible for locks and access levels

Parameter	Description
4.1	Switching On the parameter change lock. When set to "001 YES", it will not be possible to change parameters (except for "4.1 Par. block." and "4.2 Level/CODE"). The lock has two variants, depending on whether the code to access level 1 (PD 1) is set to 0 (default value) or to a different number - see section 3.9.2 "Parameter locks".
4.2	Active PD access level (reading), entering the access code (writing).
4.3	Changing the access code for the active level (see par. 4.2).
4.4	Load a set of factory settings of the drive
4.5	Lock of physical parameter writing to EEPROM memory. Service parameter - do not use. <i>Setting this parameter to "000 NO" causes that all changes made to parameter settings are saved only in the temporary memory and will be lost after power off or reset of the converter.</i>

3.9.1. PD access levels

In order to protect the converter settings against unauthorized changing, 3 levels of PD access to parameters are available:

- **PD 0 (level 0 - lowest)** – parameters cannot be changed. Parameter "4.1 Par. block." always has the value "001 YES" and it cannot be changed.
- **PD 1 (level 1 - default)** – it is possible to edit parameters (except for "4.4 Fact. set." and "4.5 En. EEPROM").
- **PD 2 (level 2 - highest)** – designed to load factory parameters – see chapter 3.7 "Restore factory settings".

Each PD access level has its own number (code) assigned, which is a number from 0 to 9999. The change of the PD access level is done indirectly by entering par. "4.2 Level/CODE" of the corresponding code number as shown in table 3.4.

If a code not assigned to any of the PD access levels is entered, then after confirming the entered value with the Enter key, the PD access level will not be changed.

Table 3.4 - Default code values assigned to PD access levels

PD access level	Code (default)
1	0
2	1

A user can assign a different code to a given access level - see section 3.9.3 "Change of access codes".

Example of changing the access level to PD 2

By default, the access level PD 2 is assigned a code with the value 1. This value should be entered in par. "4.2 Level/CODE" and confirmed with the Enter key „↵”. The screen changes to fig. 3.6.

Note 1: The PD 2 access level is intended for loading predefined factory settings - section 3.7 "Restore factory settings".

Note 2: After power off or reset of the converter (caused by e.g. loading of factory settings) the PD access level will automatically return to the PD 1 level.

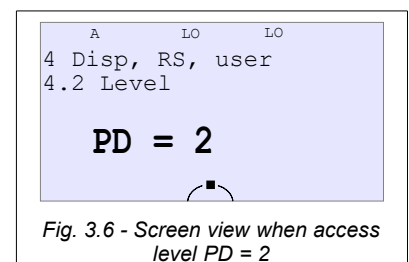


Fig. 3.6 - Screen view when access level PD = 2

3.9.2. Parameters locks

There are two ways to lock parameters editing: temporary and permanent.

Temporary lock - without access code

Temporary lock consists in changing the value of par. "4.1 Par. block." to "001 YES" without changing the PD access level to 0. This will temporarily lock (padlock symbol) all parameters (except "4.1 Par. block." and "4.2 Level/CODE") and their values cannot be changed. Changing the value of par. "4.1 Par. block." on "000 NO" will enable the possibility of editing parameters. *After power off or reset of the inverter, parameters are automatically unlocked according to PD 1 access level.*

Note: temporary locking is possible only when the code for the PD 1 access level is set to 0. Otherwise, changing the parameter "4.1 Par. block." to "001 YES" will automatically change the PD access level to 0 - permanent lock.

Permanent lock - with access code

The permanent lock of parameters consists in changing the default code (zero) assigned to the PD 1 access level to a value other than zero (see section 3.9.3. "Change of access codes"), and then changing the value of par. "4.1 Par. block." to "001 YES". This will activate the PD 0 access level and permanently lock the possibility of modifying all parameters (padlock symbol) except for "4.1 Par. block." and "4.2 Level/CODE".

The parameters will also remain locked after the drive is powered down or reset.

In order to unlock the possibility of changing other parameters, the access level should be changed to PD 1 or PD 2 by entering the corresponding code in the "4.2 Level/CODE" parameter. The return to the temporary lock is done by changing the code to the PD 1 access level to 0.

An example of using an access lock

After power-up, the converter defaults to PD 1 access level (par. "4.2 Level/CODE = 1" and par. "4.1 Par. block" is set to "000 NO"). This enables the change of all parameters of the converter, except for restoring the factory settings (par. "4.4 Fact. set.") and changing the lock of physical parameter writing to the EEPROM of the converter (par. "4.5 En. EEPROM").

Temporary lock	To activate a temporary parameter lock, par. "4.1 Par. block." should be set to "001 YES".
Permanent lock	In order to activate permanent lock of parameters, first change the code assigned to the PD 1 level to a value other than zero (eg 5), and then par. "4.1 Par. block." set to "001 YES". This will change the current access level to 0, which will be seen in par. "4.2 Level/CODE".

After activating the lock, a padlock symbol will appear next to all locked parameters.

Disabling permanent access lock

In order to disable permanent access lock:

- activate access level PD1 → in par. "4.2 Level/CODE", enter the code that was assigned to PD1 during the activation of the permanent lock,
- change the PD1 code to "0" → in par. "4.3 New CODE", enter the value "0" (see section 3.9.3. "Change of access codes").

3.9.3. Change of access codes

The access codes to the PD 1 level and PD 2 level are changed by par. "4.3 New CODE". The change will affect the current PD access level.

In order to change the code:

- check that the PD access level displayed in par. "4.2 Level/CODE" is the level to which we want to assign a new code,
- in par. "4.3 New CODE" enter a new code,
It is recommended to save the new code to prevent its loss,
- repeat entering the new code in par. "4.3 New CODE".

From now switching to the access level for which the code has been changed will take place after entering this new code in par. "4.2 Level/CODE". Access level 0 has no code.

4. Configuration of the frequency converter

4.1. Setting nominal parameters of the motor

Before the first run of the frequency converter it is necessary to determine the nominal parameters of the electric motor. Appropriate data can be read from the rating plate. It is necessary to enter the following parameters:

Par. 1.1 - nominal power of the motor P_n [kW]	Par. 1.4 - nominal motor voltage [V]
Par. 1.2 - nominal motor speed (rpm)	Par. 1.5 - nominal motor frequency [Hz]
Par. 1.3 - nominal motor current [A]	Par. 1.6 - nominal $\cos\phi$ of the motor

In the U/f scalar operation modes these data are sufficient to start the frequency converter.

4.1.1. Preparation for operation in a vector control mode

If you want to work in vector mode (with or without an encoder), then the drive must have additional information about the motor parameters, so-called electric motor equivalent circuit diagram parameters (fig. 4.1):

- Parameter 1.11 - resistance of stator windings R_s [Ohm]
- Parameter 1.12 - resistance of rotor windings R_r [Ohm] (the parameter 1.12 is defined automatically by converter MFC710 on basis of other motor parameters - it is impossible to change)
- Parameter 1.13 - main inductance L_m [mH]
- Parameter 1.14 - inductance of a stator $L_s + L_m$ [mH]
- Parameter 1.15 - inductance of a rotor $L_r + L_m$ [mH]
- Parameter 1.16 - additional inductance - connecting wires, choke if connected in series with the motor.

In order to determine the values of these parameters, use the built-in function of the IDENTIFICATION RUN described in chapter 5.1 "Vector mode. Identification run". It is also possible to enter them manually (or to adjust the values obtained from the identification run).

Without the correct determination of these parameters, the operation in the vector mode is not possible. Setting of incorrect values will result in the malfunction of the system. These parameters correspond to the motor in the star connection (U_s is the phase voltage).

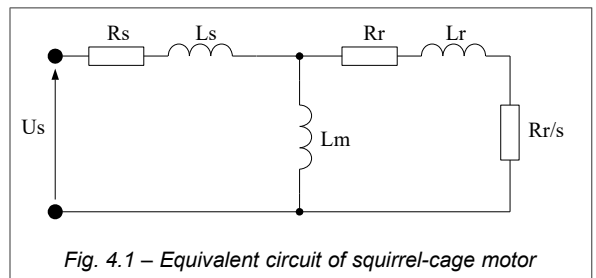


Fig. 4.1 – Equivalent circuit of squirrel-cage motor

After performing the IDENTIFICATION RUN procedure

or manually entering these parameters, the parameter 1.20 "OPERATING MODE" should be set to:

- Vector1 – sensorless mode – does not require an encoder, but it is less accurate,
- Vector2 – operation mode with a position sensor (encoder) - the encoder resolution is determined by the parameter 1.80; this operation mode is especially recommended for operation at low speeds (below 2.0 Hz).

4.2. Control

Main possibilities of converter control – referencing output frequency (rotation rate) and configuration of control with a START / STOP signal - are described below with additional information about configuration of output relays of a converter. More detailed information is in „parameter list” - Appendix C. The control possibilities of the converter result from the analysis of a structure of the control system - fig. 4.2b/4.2c.

4.2.1. Structure of control

The control system of the converter MFC710 uses the structure of two independent „control places” A and B, that allows to change whole structure of the converter control (sources of START and STOP signals and sources of frequency for drive operation) by changing only one parameter – 2.1. In fig. 4.2a there is simple diagram and in fig. 4.2b and 4.2c there are developed diagrams of the converter control.

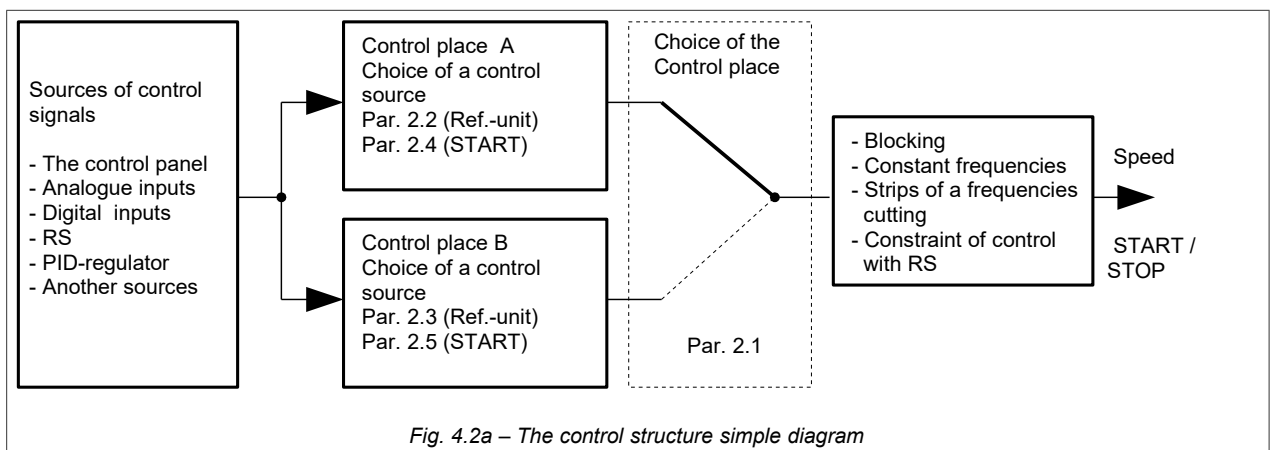


Fig. 4.2a – The control structure simple diagram

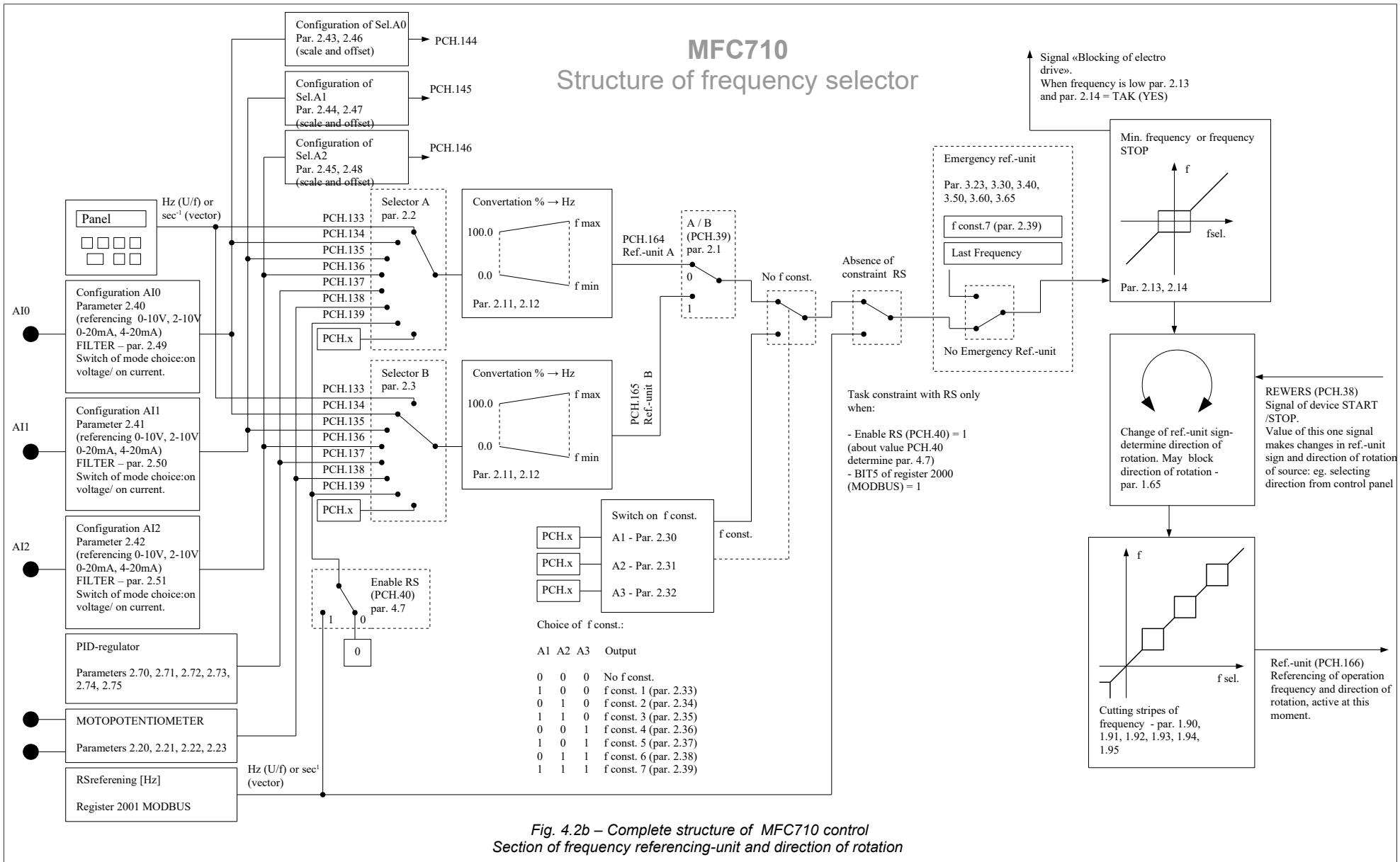
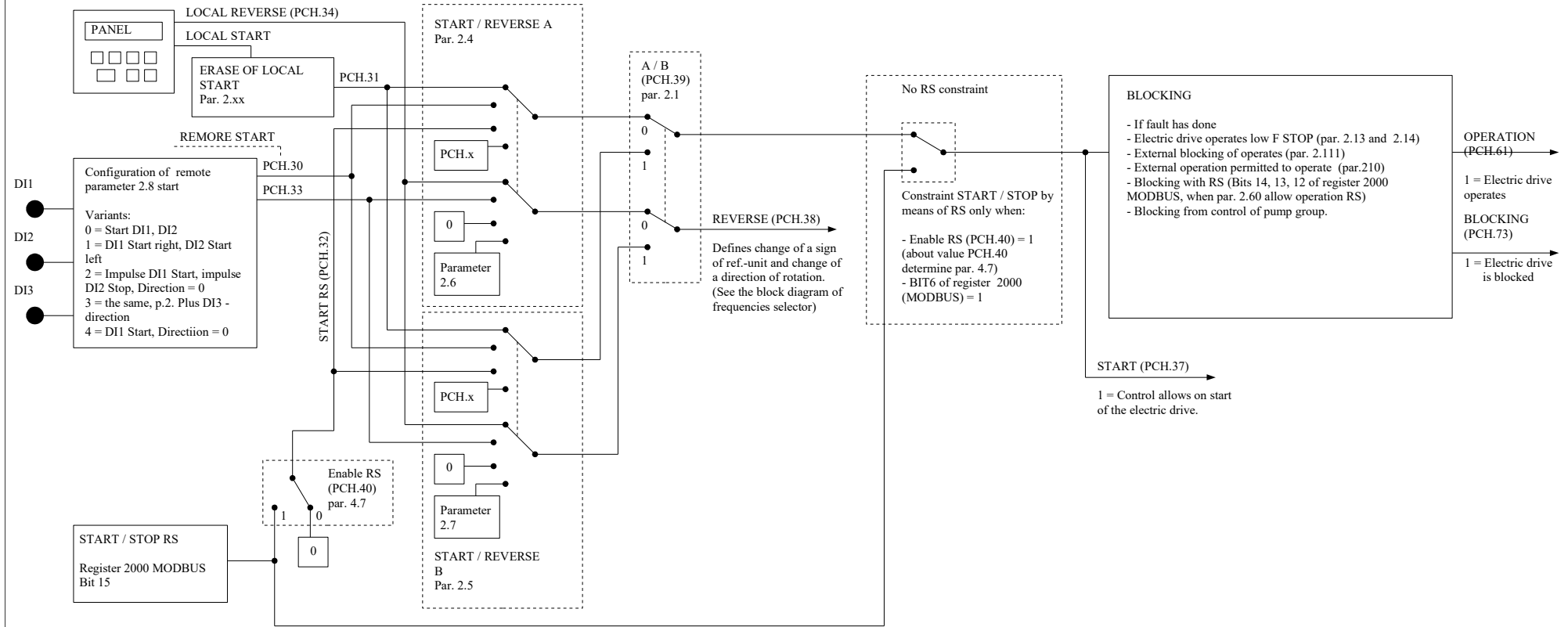


Fig. 4.2b – Complete structure of MFC710 control
Section of frequency referencing-unit and direction of rotation

MFC710

Structure of control START / STOP



*Fig. 4.2c – Complete structure of MFC710 control
Section of signal START/ STOP and operation blocking*

4.2.2. Control from the control panel

In order to control the drive from the control panel it is necessary to set up:

- „Control place” A or B by par. 2.1
- Parameter 2.2 (for A) or 2.3 (for B) should be set to **“133 Keyb ref.”**
- Parameter 2.4 (for A) or 2.5 (for B) should be set to **„031 Keyboard St.”**
- Make sure that the constant speed selection is not active, i.e. the parameters: 2.30, 2.31, 2.32 should be set to **„000 Sw.Off”**.

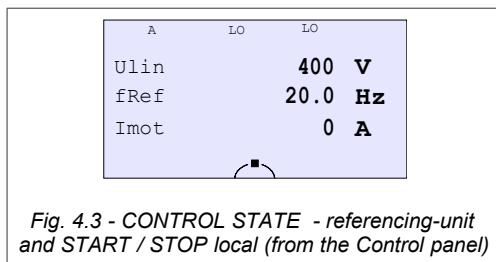


Fig. 4.3 - CONTROL STATE - referencing-unit and START / STOP local (from the Control panel)

With this configuration, the changes in the system frequency value (or rotation speed in vector mode) are made using the keys . The motor is started and stopped from the Panel with the LEFT / RIGHT and STOP keys.

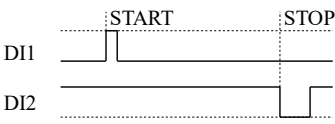
4.2.3. Control from terminal connections

In order to control the drive from the terminal block (e.g. START STOP through digital inputs DI and regulation of rotation speed using a potentiometer) it is necessary to:

In order to control the drive from terminal connections form “control place B” (control place B is default for remote control, control place A can also be used), e.g. START / STOP through digital inputs DI and regulation of rotation speed using a potentiometer, it is necessary to:

- Set up the „control place” A or B by parameter 2.1 (control place B is default for remote control and it is not recommended to modify the existing A control place, which is assigned to the Control Panel by default).
- Define the signal source of the converter output frequency reference by par. 2.2 (“control place” A) or par. 2.3 (“control place” B):
 - **“134 In.A0”** for an analog input AI0
 - **“135 In.A1”** for an analog input AI1
 - **“136 In.A2”** for an analog input AI2
- Set up the source of START/STOP signal by par. 2.4 (“control place” A) or 2.5 (“control place” B) to **“030 Dig.Inp. St”**
- Make sure that the constant speed selection is not active, i.e. the parameters: 2.30, 2.31, 2.32 should be set to **„000 Sw.Off”**.
- set up the parameter **2.8 “Remote start”** - it defines functions of control digital inputs as at the tab. 4.1.

Table 4.1 - possible configuration variants of remote start (START)

Value of par. 2.8 „Remote start”	Notation	Function
0	DI1 = START/STOP DI2 = DIRECTION	Voltage feeding into digital input DI1 results in the drive start, while voltage removal – in the drive stop. The condition of a digital input DI2 defines determines the change of the motor rotation direction.
1	DI1 = START RIGHT DI2 = START LEFT	Voltage feeding into digital input DI1 results in the start of motor. Voltage feeding into digital input DI2 results in the motor start in opposite direction.
2	DI1 = PULSE START DI2 = PULSE STOP	If a voltage pulse is applied to input 1 at high input 2, the motor will start. Removing the voltage from Input 2 will stop the motor. The direction of rotation is determined only by the reference sign. 
3	DI1 = PULSE START DI2 = PULSE STOP DI3 = DIRECTION	As the same as above. Additionally direction of rotation can be change using digital input DI3.
4	DI1 = START/STOP	Voltage feeding to digital input 1 results in the drive start, while voltage removal – in the drive stop. The direction of rotation is determined only by sign of referencing-unit.

Note: Digital input DI3 is default using as a source of external fail 1 (par. 3.10 = In.C3), so before using DI3 to change direction please move a source of external fail 1 to another digital input DI or just turn it off.

An example of the screen view for the following settings is shown in fig. 4.4:

- referencing-unit from analog input 1
- START / STOP from digital inputs.

Regulation of output frequency of the drive and rotation speed of the motor is carried out through selected analog input (e.g. using a potentiometer).

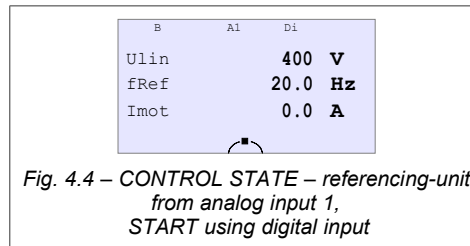


Fig. 4.4 – CONTROL STATE – referencing-unit from analog input 1, START using digital input

4.2.4. Work with constant speeds

The system can work with one of seven constant speeds. The choice of constant speed is made by digital inputs determined by parameters 2.30, 2.31 and 2.32 - an example in table 4.2. Values of constant speeds are defined by parameters:

- par. 2.33 – constant speed number 1 [Hz]
- par. 2.34 – constant speed number 2 [Hz]
- par. 2.35 – constant speed number 3 [Hz]
- par. 2.36 – constant speed number 4 [Hz]
- par. 2.37 – constant speed number 5 [Hz]
- par. 2.38 – constant speed number 6 [Hz]
- par. 2.39 – constant speed number 7 [Hz]

Table 4.2 – suggested configuration of constant speed control

Parameters	Example	Notation
2.30 W1	005 In.C5	Signal of constant speed selection W1 comes from digital input DI5 (W1 = DI5)
2.31 W2	006 In.C6	Signal of constant speed selection W2 comes from digital input DI6 (W2 = DI6)
2.32 W3	000 Sw.Off.	W3 = 0
!!! ATTENTION!!! - see structural circuit of frequency referencing-unit - section 4.2.1		

As a result of choice of such parameter configuration it is possible to choice between 3 available constants through digital inputs DI5 and DI6:

State DI5	State DI6	Effect
0	0	Drive does not operate with constant speed. At this time another referencing-unit is operating. (See structural circuit of frequency referencing-unit - section 4.2.1)
1	0	Constant speed no. 1 (value as par. 2.33)
0	1	Constant speed no. 2 (value as par. 2.34)
1	1	Constant speed no. 3 (value as par. 2.35)

Note 1: Digital input DI4 is default using as a source of external reset, so before using DI4 please move a source of external reset to another digital input DI or just turn it off (par. 3.70).

Note 2: Please make sure that DI6 works in digital input mode (fig. 2.6, jumper J5).

When constant speed referencing-unit is active display looks like it is shown in fig. 4.5. Fc – Referencing-unit: constant frequency (speed), Di – START through digital input.

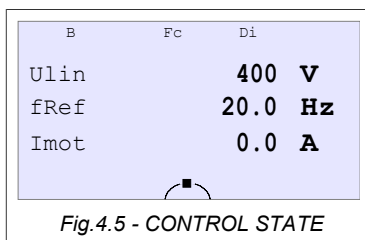
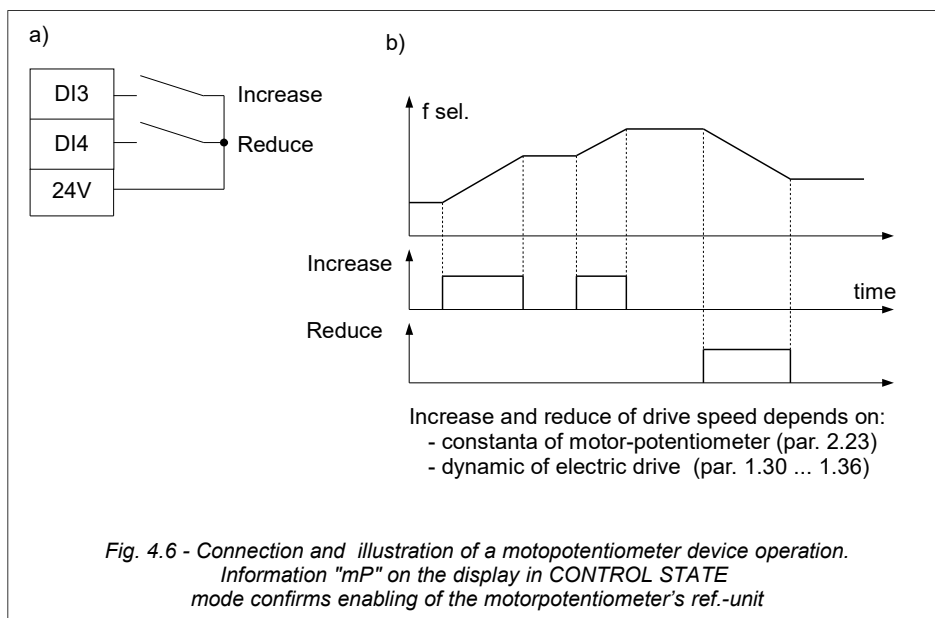


Fig. 4.5 - CONTROL STATE

4.2.5. Motopentiometer

Motopentiometer is designed to "increase/decrease" drive speed by two buttons. An exemplary way of connecting the "Increase" and "Decrease" keys to the drive is shown in fig. 4.6a. In this example, the digital inputs DI3 and DI4 are used. Fig. 4.6b. shows action of the device.



To set the output frequency of the drive using a motopentiometer, set the output frequency of the drive in the selected parameter responsible for the source of the reference signal 2.2 (for "control place" A) or 2.3 (for "control place" B) to "**138 MotPot**". Fig. 4.6a corresponds to a situation when par. 2.20 = "**003 In.C3**" and par. 2.21 = "**004 In.C4**".

Note: Digital input DI3 is default using as a source of external fail 1 (par. 3.10 = "**003 In.C3**"), so before using DI3 please move a source of external fail 1 to another digital input DI or just turn it off. Similar situation occurs with digital input DI4. Digital input DI4 is default using as a source of external reset, so before using DI4 please move a source of external reset to another digital input DI or just turn it off (par. 3.70).

There are four available modes of motopentiometer operation: **0**, **1**, **2** and **3**.

Modes 0, 1 and 2 should be used only when current referencing-unit (par. 2.2/par. 2.3) is set on "**004 MotPot**".

Mode 3 can be used regardless of setting of current referencing-unit.

- Stopping the converter In mode **0** will cause reset of motopentiometer settings.
- In mode **1** settings of motopentiometer will be stored and there is no possibility of changing it while the drive is stopped.
- In mode **2** settings of current referencing-unit are traced by motopentiometer so switching from current referencing-unit to motopentiometer's referencing is made very easily.
- In mode **3** configuration of motopentiometer is stored and there is possibility of changing it while the drive is stopped.

4.2.6. Other possibilities of the frequency converter control

Other possibilities arise from the analysis of the block diagram of control (see section 4.2.1). From the major options it is possible to allocate

- Change of control place A / B e.g. using a digital input - par. 2.1
- Mixed control – e.g. referencing frequency from the control panel and a START / STOP signal from digital inputs,
- Control through RS232/RS485 connection (see section 13),
- Referencing frequency from an output of the PID controller (see section 8),
- Advanced functionalities related to the use of built-in PLC or a control system of group of pumps (see section 10 and the following sections).

4.2.7. Configuration of digital and analog inputs and outputs

• Digital inputs

Frequency converter has 6 digital inputs designated DI1...DI6 (in the control panel they are named In.C1...In.C6). Applying 24V voltage on any digital input (terminal strip – fig. 2.6) sets it in a logic state 1. Current state of digital inputs can be read on parameter 0.48 (fig. 4.7a - "110000" means that voltage 24V is sent on DI1 and DI2).

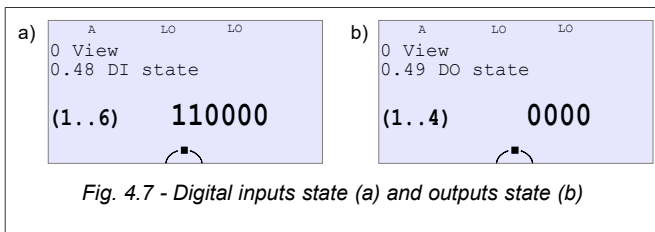


Fig. 4.7 - Digital inputs state (a) and outputs state (b)

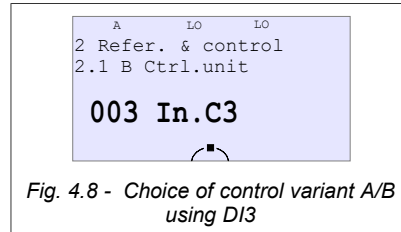


Fig. 4.8 - Choice of control variant A/B using DI3

Digital inputs have no parameters which define their function. Such function is determined only for “remote start” (see table 4.1) and also “thermal blocking” for DI6 - see section 4.4.4.2. In other cases the digital input "is selected" for using the certain functions using parameters which are connected to the given function of the frequency converter. An example to choose control variant A or B using DI3 it is necessary to set up par. 2.1 (which makes choice of control variant) on value “003 In.C3” as it is shown in fig. 4.8. It means that there is a possibility of giving to this digital input simultaneously more than one function. (Other parameter can be set up also on value “003 In.C3”).

• Analog inputs

Frequency converter has three analog inputs AI0, AI1 and AI2 (in the control panel they are named In.A0, In.A1 and In.A2). Two of them (AI1 and AI2) can operate both in voltage mode 0(2)..10V and in current mode 0(4)..20mA. The choice of an operating mode for these inputs is carried out by switches J3 i J4. Input AI0 can work only in voltage mode. It is possible to connect directly a potentiometer or a voltage (current) source to analog inputs - see fig. 2.7. Table 4.3 compares the parameters responsible for a configuration of the analog inputs. By analogy to digital inputs, analog inputs have no parameters which define their function in the system. Inputs are selected by control configuration parameters to perform certain actions (fig. 4.9).

Note: in order to set the configuration shown in Fig. 4.9b, it is necessary to activate the “full pointers” - see chapter 11.3 “Modifying the standard control”.

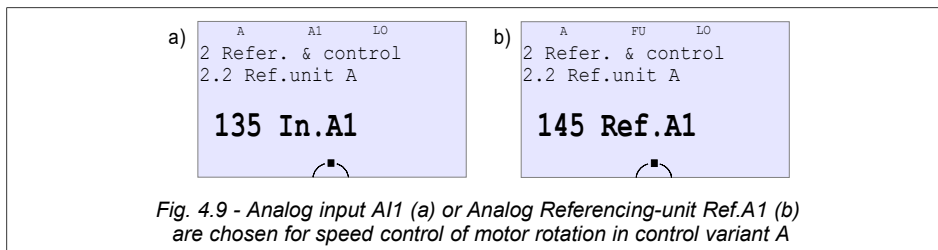


Fig. 4.9 - Analog input AI1 (a) or Analog Referencing-unit Ref.A1 (b) are chosen for speed control of motor rotation in control variant A

Table 4.3 - Parameters defining a configuration of analog inputs

Parameter	Function	Description
2.40	Configuration of AI0 range	Choice of range for input value 0...10V, 2...10V, 10...0V (inversion), 10...2V.
2.41	Configuration of AI1 range	Voltage/current mode: 0-10V / 0-20mA, 10-0V / 20-0mA, 2-10V / 4-20mA, 10-2V / 20-4mA Voltage/current mode selection is done by J3 and J4 jumpers (fig. 2.6). The range configuration is done by software settings (par. 2.41 and 2.42). Displayed marks 0-10V, 10-0V, 2-10V and 10-2V are common for both modes, it means that after changing the jumper setting to current mode, displayed 0-10V means 0-20mA, 10-0V means 20-0mA, 2-10V means 4-20mA and 10-2V means 20-4mA.
2.42	Configuration of AI2 range	Example: to set the AI1 in current mode with 4-20mA range you need: 1. Set the mode selection jumper (fig. 2.6). 2. Set the 2-10V in par. 2.41.
2.49	Constant of time for lowpass filter AI0	
2.50	Constant of time for lowpass filter AI1	
2.51	Constant of time for lowpass filter AI2	
0.40	Value AI0 [%]	READ ONLY. Value AI0 in [%], e.g. for range 0..10V voltage 5V corresponds par. 0.40=50.0 %
0.41	Value AI1 [%]	READ ONLY. Value AI1 in [%], e.g. for range 0..10V voltage 5V corresponds par. 0.41 =50.0%
0.42	Value AI2 [%]	READ ONLY. Value AI2 in [%], e.g. for range 0..10V voltage 5V corresponds par. 0.42 =50.0%
3.23	Reaction to signal absence at the Analog Input	In operating modes 2..10V, 10..2V, 4..20mA and 20..4mA it is possible to define behavior of the drive when value of voltage falls below 1V or value of a current falls below 2mA (see Appendix C - par. 3.23).

In structure of the drive **Analog Referencing-units** are also provided. Analog referencing-units are strictly connected to Analog Inputs, from which they differ, that they have parameters carrying the information on value of their offset and scale. Usually analog referencing-units are used only as inputs for the PID controller, however they can be used as inputs for PLC controller or after expansion of parameters range(see section 11.3) as control signals in any point of the structural diagram of control (e.g. fig. 4.9b). In the table 4.4 there are parameters which define a configuration of Analog Referencing-units and dependence of value Ref.A from AI.

Table 4.4 – Analog Referencing-units

Parameter	Function	Description
2.43	Ref.A0 scale	Value in [%] : -500.0 ... 500.0 %
2.44	Ref.A1 scale	Value in [%] : -500.0 ... 500.0 %
2.45	Ref.A2 scale	Value in [%] : -500.0 ... 500.0 %
2.46	Ref.A0 offset	Value in [%] : -500.0 ... 500.0 %
2.47	Ref.A0 offset	Value in [%] : -500.0 ... 500.0 %
2.48	Ref.A0 offset	Value in [%] : -500.0 ... 500.0 %
0.45	Ref.A0 value [%]	READ ONLY. Value Ref.A0 in [%]. Ref.A0 = (par. 2.46 + par. 2.43 * AI0 / 100.0%) E.g: if par. 2.46 = 20.0%, par. 2.43 = 50.% and AI0 = 30.0% then: Ref.A0 = 20.0% + 50.0% * 30.0% / 100.0% = 35.0%
0.46	Ref.A1 value [%]	READ ONLY. Value Ref.A1 in [%]. Ref.A1 = (par. 2.47 + par. 2.44 * AI1 / 100.0%)
0.47	Ref.A2 value [%]	READ ONLY. Value Ref.A2 in [%]. Ref.A2 = (par. 2.48 + par. 2.45 * AI2 / 100.0%)

• Digital outputs (relays)

In the converter there are 4 digital outputs:

- 3 relay outputs which are called K1, K2 i K3 (or DO1, DO2 and DO3)
- 1 transistor open-collector output marked DO4.

Each digital output can simultaneously realize up to two programmed functions. In table 4.5 there are parameters which serve for a choice of functions of digital outputs.

Table 4.5 – parameters configuring digital outputs

Parameter	Digital output	Value	Note
2.90	Relay K1 (DO1)	Choice of function 1	State of digital output corresponds to the logic sum of values of both functions according to the table
2.91		Choice of function 2	
2.92	Relay K2 (DO2)	Choice of function 1	Function 1 Function 2 State of output
2.93		Choice of function 2	0 0 0
2.94	Relay K3 (DO3)	Choice of function 1	1 0 1
2.95		Choice of function 2	0 1 1
2.96	Open-collector (DO4)	Choice of function 1	1 1 1
2.97		Choice of function 2	

The list of possible functions is in the description of parameters - Appendix C.

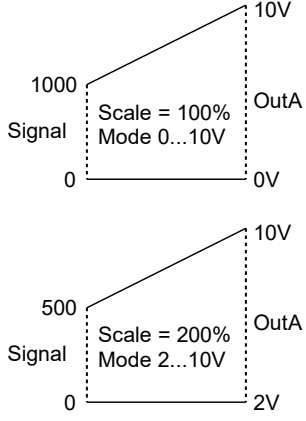
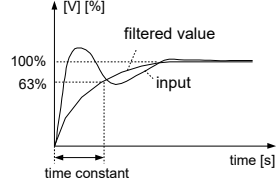
By changing parameters from table 4.5 it is possible to choose advanced functions, which allows to control relay outputs using the built-in control system PLC. In Pumps control variant configuration of digital outputs are responsible for control of contactor group which enable separate pumps.

• Analog outputs

Table 4.6 presents parameters which concern configuration of two analog outputs AO1 and AO2 (in the control panel they are named Out.A1 and Out.A2). Both outputs can operate in a voltage mode 0-10V (2-10V) or in a current mode 0-20mA (4-20mA). The choice of an operating mode is carried out by switches J1 and J2 (see fig. 2.6).

Note: Analog outputs in voltage mode should be loaded by impedance in value not less then 10kOm.

Table 4.6 – Parameters configuring analog outputs

Parameter	Function	Description
2.80	Choice of signal for AO1	Details in Appendix C
2.81	Choice of signal for AO2	Details in Appendix C
2.82	Configuration of range AO1	Voltage/current mode: 0-10V / 0-20mA, 10-0V / 20-0mA, 2-10V / 4-20mA, 10-2V / 20-4mA Voltage/current mode selection is done by J1 and J2 jumpers (fig. 2.6). The range configuration is done by software settings (par. 2.82 and 2.83). Displayed marks 0-10V, 10-0V, 2-10V and 10-2V are common for both modes, it means that after changing the jumper setting to current mode, 0-10V means 0-20mA, 10-0V means 20-0mA, 2-10V means 4-20mA and 10-2V means 20-4mA.
2.83	Configuration of range AO2	<i>Example:</i> to set the AO1 in current mode with 4-20mA range you need: 1. Set the mode selection jumper 2. Set the 2-10V in par. 2.82
2.84	A1 scale (Out.A1 Scal) 	0 ... 500.0 %. Typically 100.0 % For a configuration 0-10V signal value 1000 at a scale established on 100.0 % corresponds to voltage value 10V. For a scale established on 50.0% to receive 10V of output voltage the signal value should be 2000. Similarly for a scale established on 200.0% to receive 10V of output voltage the signal value should be 500. Value of a signal corresponds to value of the selected size without a decimal point, e.g.: 12.5 % = 125 2.43 A = 243 375 B = 375 e.g., if signal (value of current) is 11.7 A it corresponds to 117 number. In this case: voltage = scale * signal / 1000 voltage = 100.0% * 117 /1000 = 11.7 %(0...10V) = 1.17 V
2.85	AO2 scale (Out.A2 Scal)	0 ... 500.0 %. Typically 100.0 %, (see above).
2.86	Constant of time for the lowpass filter of AO1	Filter of analog output AO1 – see Appendix C for more details 
2.87	Constant of time for the lowpass filter of AO2	Filter of analog output AO2 – see Appendix C for more details
0.43	Out.A1 Value of analog output 1	0...100.0% READ ONLY Out.A1 = Absolute value (signal * AO1 scale / 1000)
0.44	Out.A2 Value of analog output 2	0...100.0% READ ONLY. Out.A2 = Absolute value (signal * AO2 scale / 1000)

4.3. Configuration of the drive

4.3.1. Establishing dynamic characteristics and ways of stopping the motor

Dynamics decides about changing rate of the electric motor rotation speed - start and stopping, reverse speed. In MFC710 converter you can choose dynamics from two accessible variants which are named DYNAMICS1 and DYNAMICS2.

The times set in parameters 1.30 ... 1.33 relate to the acceleration after the START command and reverse (deceleration + acceleration) after the REVERSE command. Time set in parameter 1.34 refers to the deceleration time after the STOP command. When parameter 1.34 is set to 0.0 then the deceleration time set in parameters 1.31 (1.33) is also a deceleration time after the STOP command.

- Parameter 1.30 - Acceleration 1 - time of acceleration from 0Hz to 50Hz (Dynamics 1)
- Parameter 1.31 – Deceleration 1 - time of deceleration from 50Hz to 0Hz (Dynamics 1)
- Parameter 1.32 - Acceleration 2 - time of acceleration from 0Hz to 50Hz (Dynamics 2)
- Parameter 1.33 – Deceleration 2 - time of deceleration from 50Hz to 0 Hz (Dynamics 2)
- Parameter 1.34 – Stopping time:
 - when a value of parameter is >0 then this value means time of deceleration from 50Hz to 0Hz after sending a STOP signal (from control panel, digital inputs, internal PLC, RS communication, etc.),
 - when a value of parameter is "0.0" then this parameter is inactive, time of deceleration depends of time set in active dynamics (par. 1.31 or par. 1.33).
- Parameter 1.35 - S Curve - allows to realize the smooth beginning and end of acceleration and deceleration.
- Parameter 1.36 - Choice of DYNAMICS - allows to set up dynamics variant 1 or 2. You can also decide, that the choice of dynamics will be carried out through one of digital inputs.

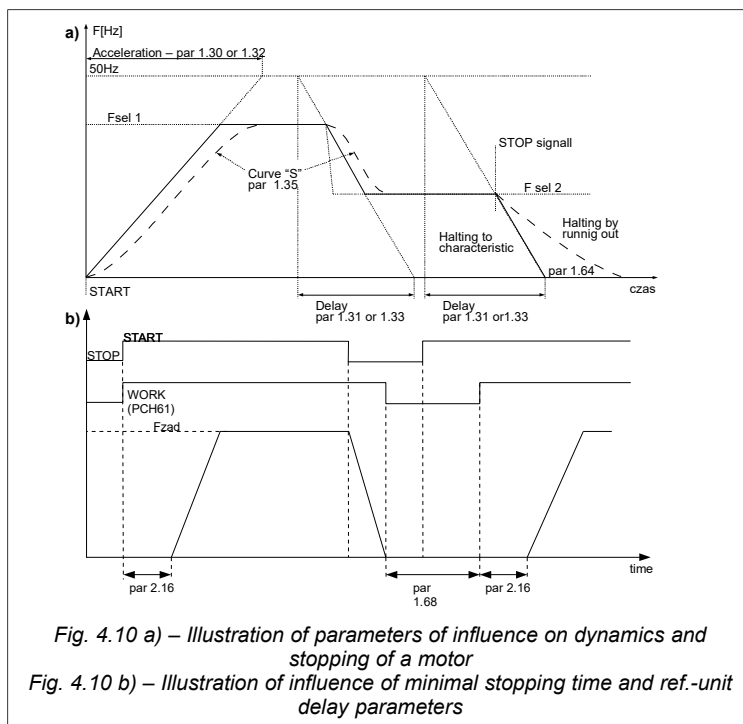


Fig. 4.10 a) – Illustration of parameters of influence on dynamics and stopping of a motor
 Fig. 4.10 b) – Illustration of influence of minimal stopping time and ref.-unit delay parameters

ATTENTION: setting up too small time of acceleration can result in occurrence of „high current” failures during the start-up, especially at significant loading of the motor.

There is a possibility of determining minimal time of halting and referencing-unit delay (fig. 4.10b)

par 1.68 – min t. Stop – minimal time needed to restart electric motor after stopping it,

par 2.16 – Ref. Delay – time needed by referencing-unit to run.

4.3.2. Formation of U/f characteristic

In modes of scalar control U/f there is a possibility of influence on type of the characteristic - see fig. 4.11. In modes of vector control (Vector 1 and Vector 2) parameters of U/f characteristic formation are not relevant.

The main parameter which influences on form of the drive characteristic is par. 1.20 "Operating mode":

- Mode U/f linear. It is used if there exists a constant torque of loading which does not depend on speed.
- Mode U/f exponential. It is used if the torque of loading grows under the exponential from speed (e.g. the drive of the fan). Use of exponential characteristic U/f cause reduction of noise and decrease of losses in the motor.

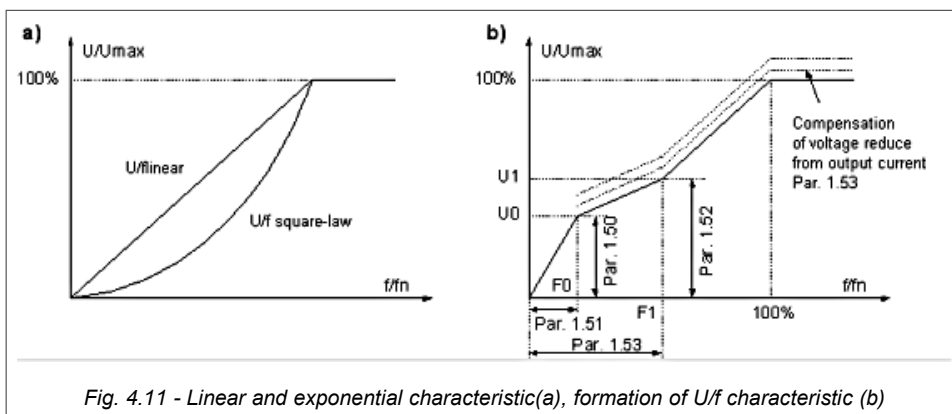


Fig. 4.11 - Linear and exponential characteristic (a), formation of U/f characteristic (b)

4.3.3. Elimination of frequencies

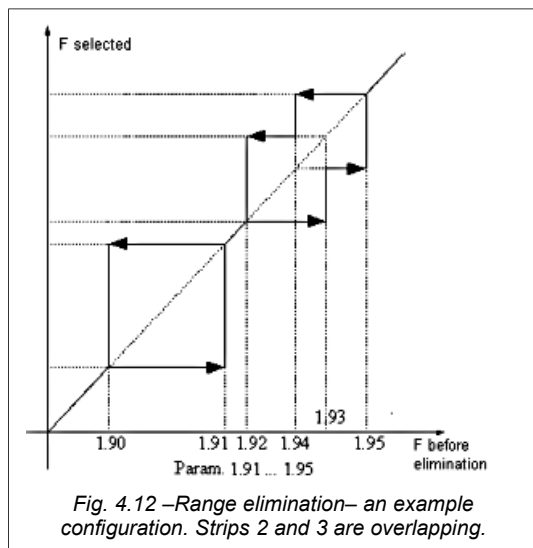
With purpose of elimination of undesirable output frequencies which can result in the resonant phenomena of the motor, it is possible to determine 3 ranges called "ranges of elimination". Their options can be set up by parameters:

- Par. 1.90 - bottom frequency of elimination range 1 [Hz]
- Par. 1.91 - top frequency of elimination range 1 [Hz]
- Par. 1.92 - bottom frequency of elimination range 2 [Hz]
- Par. 1.93 - top frequency of elimination range 2 [Hz]
- Par. 1.94 - bottom frequency of elimination range 3 [Hz]
- Par. 1.95 - top frequency of elimination range 3 [Hz]

Referencing-unit of the drive will "bypass" frequencies which are chosen by the parameters above mentioned.

Fig. 4.12 shows influence of range elimination procedure on output frequency of referencing-unit.

Note. The elimination of frequencies applies f_{Ref} and does not affect at the operation of acceleration and deceleration.



4.3.4. DC (direct current) braking

Parameters 1.66 and 1.67 allow to define voltage (in % U_n of the motor) and also time (in seconds) of braking the electric motor by a direct current. In case time of braking is set up on 0 sec this function is switched off.

4.3.5. Mechanical brake

!!! CAUTION !!! In case when generation of full torque is required at zero speed of a motor, it is recommended to use vector mode of control – par. 1.20 "Vector 2" and to apply encoder.

MFC710 allows to cooperate with mechanical brake of a power transmission system. An example of connecting the brake is shown in fig. 4.13. Braking control is made by appropriate configuration of relay input (appropriate parameter 2.90 ... 2.96 set on "Brake"(Br.)). Functioning of mechanical brake control is shown in fig. 4.14. In table 4.7 configuration parameters are compared.

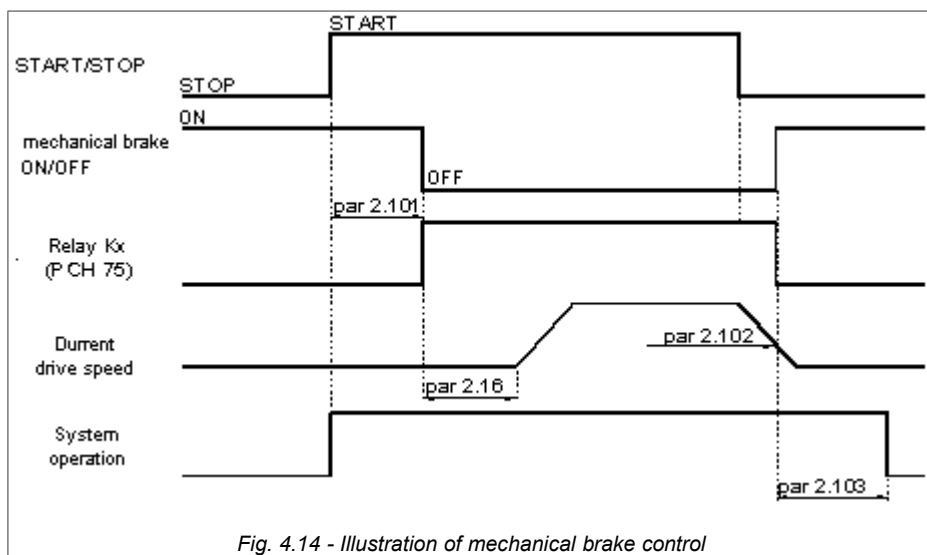
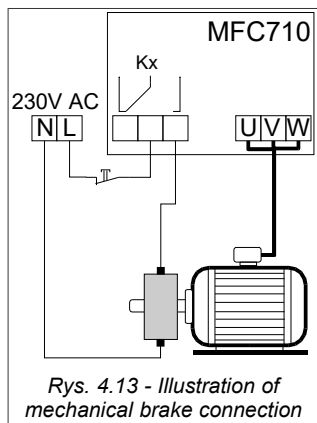


Table 4.7 – Configuration parameters of mechanical brake control

Parameter	Name	Description
2.16	Ref. delay	Referencing-unit start-up delay [s].
2.101	Br. re. delay	Brake release delay [s] – time needed to magnetize the motor (not magnetized motor is unable to create torque).
2.102	Br. close n	Below this speed a command to close the mechanical brake is sent. [rpm]
2.103	Br. close t.	Time of work after closing command is sent [s] – time needed for complete locking of mechanical brake.

4.3.6. Flying start

Flying start enables valid start-up of the motor in case initial speed of a shaft of the motor differs from zero. Five modes of **par 1.61** are possible:

- 0 - function is switched off.
- 1 - search in one direction, search frequency from Fref or Fmax.
- 2 - search in two directions, search frequency from Fref or Fmax.
- 3 - search in one direction, search frequency from Fmax.
- 4 - search in two directions, search frequency from Fmax.

Search in one direction should be used for drive systems in which in case of switching off voltage powering the motor, loading will not result in change of a direction of the device.

Search in two directions should be used for drive systems in which in case of switching off voltage powering the motor, loading can result in change of a direction of the device.

In case of modes 1 and 2 search of frequency can begin from the referenced frequency Fref. or from the maximal frequency Fmax. It depends on whether the repeated start begins:

- After pressing a key STOP (search from Fref),
- After restart of frequency converter (search from Fmax).

For search in one direction it is recommended to set up **par 1.61** on 1. In case of search in two directions it is necessary to set up **par 1.61** on 2.

4.4. Protection and blocking

4.4.1. Current, frequency and the torque limitations

- **Current limit:** In order to prevent overloading of the drive or the motor you can limit maximal permissible output current of the drive – Parameters 1.41 and 1.42 with factory options are set up to value 150 % of nominal current of the drive. System will not allow current to increase higher then this limit.
- **Torque limit:** In order to exclude mechanical impacts of the motor and all drive system the permissible torque on a motor shaft is set up by means of parameters 1.43 and 1.44. Standard option is 150 % from rating value of the torque.
- **Output frequency limit:** In order to exclude possibility of setting frequency which considerably exceeds nominal frequency of the motor, parameter 1.40 allows to limit the top limit of output frequency of the drive. Standard option is 50 Hz. Maximal value in Vector1/vector2 operating mode is 200 Hz - **it is the absolute maximum of output frequency in Vector mode!**

4.4.2. Blocking a direction of electric motor rotation

There is a possibility of partial blocking of the drive with permission of operation only in one direction. In this case irrespective of control signals the drive will rotate the motor only in one direction. Parameter 1.65 allows to define this option:

- "000 Reverse" - operation in two directions (option relative)
- "001 Right" - operation in one direction
- "002 Left" - operation in one direction

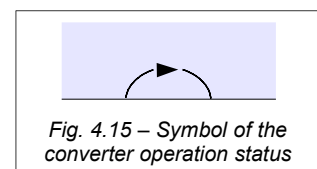


Fig. 4.15 – Symbol of the converter operation status

The symbolic direction of rotation is shown in the lower part of the display – fig. 4.15 and fig. 3.2.

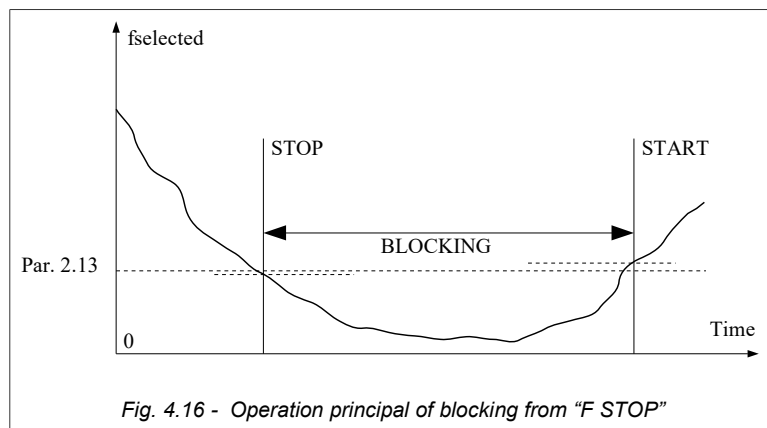
4.4.3. Blocking the drive operation

Switching on one of the arbitrary blocking described below results in electric motor stopping and makes it impossible to start until the time of taking down blocking signal (blocking cause).

Blocking state is indicated by the going off yellow diode READY on the control panel.

- **External permission and blocking of operation:** Two parameters allow to define digital input which will serve as an external signal source for permission and blocking of operation:
 - par. 2.111 – Blocking of operation – value „Sw.Off” (default) switches off external blocking of operation. (possible options: Sw.Off, In.C1...In.C6),
 - par. 2.110 – Permission of operation - value „Sw.On” (default) permits operation in spite of state of digital inputs (possible options: **Sw.On, In.C1...In.C6**).
- **Blocking from thermorelay or thermistor in the motor:** parameter 3.1 permits to switch on thermorelay blocking(see section 4.4.4.2).
- **External emergency stop:** instant stop of the drive in “coast” mode (see par. 2.112 – possible options: **Sw.Off, In.C1...In.C6**). „Sw.Off” by default – function does not operate.
- **Blocking from „F STOP”:** There is a built-in blockade in referencing-unit structure. It is switched on by parameter 2.14. If it is set on "No" par. 2.13 determines the minimal frequency value, below which frequency will not decrease (by

default 0.5 Hz). If par. 2.14 is set up on value "YES" par. 2.13 determines the blocking frequency. If value of frequency decrease under level from parameter 2.13 blockade is activated (STOP). If frequency increases above the limitation set with par. 2.13 will result in repeated start of a drive. The mode of switch on / off will be coordinated due to the characteristic such as "loop of hysteresis" (see fig. 4.16).



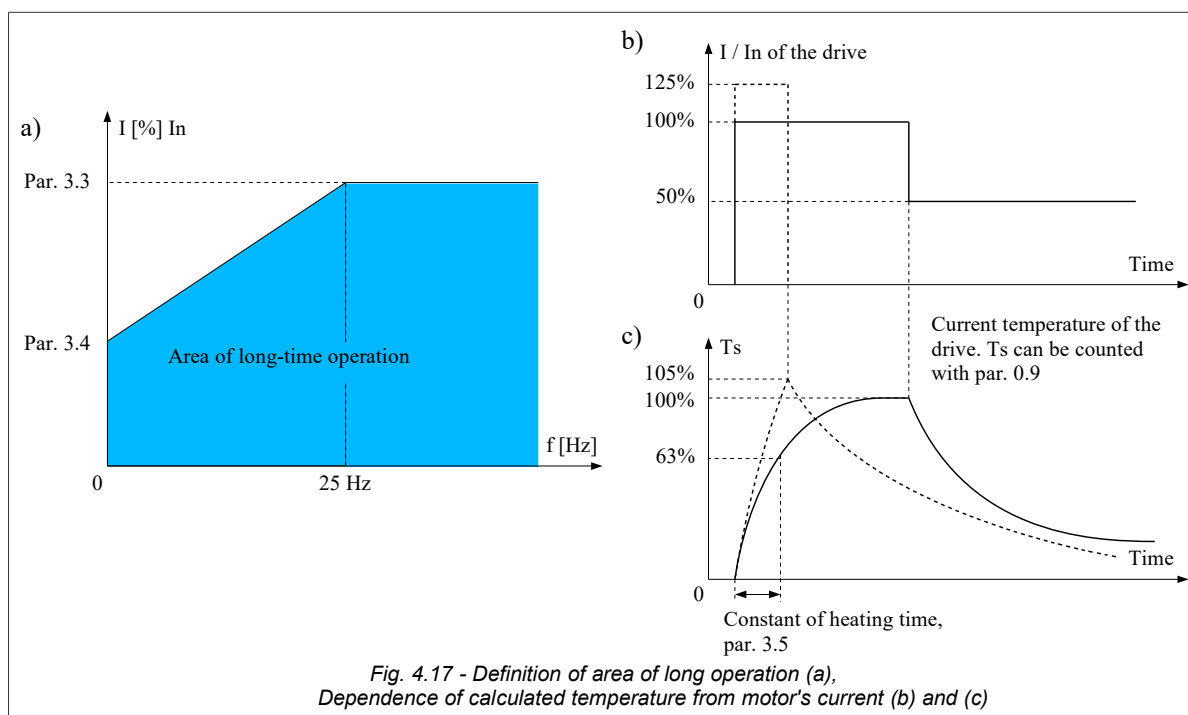
- SLEEP blocking of PID controller – see section 8.

4.4.4. Thermal protections of the motor

4.4.4.1. Protection limit I^2t

The built-in thermal model of the motor enables to calculate temperature of the motor in the theoretical way. The Model is developed on the basis of the following assumptions:

- the temperature of windings changes according to exponential law,
- the electric motor achieves the maximal temperature for continuous work at a rated current
- change of temperature depends on a ratio $(I/I_n)^2$,
- the constant of time of cooling for stopped electric motor is four times more than a constant of time of heating during operation



Relative **long-term motor current** value for frequency higher than 25 Hz is determined by **parameter 3.3**. For frequency lower than 25 Hz long-term current is lower (smaller efficiency of the cooling fan which is placed on a motor shaft) and it is determined by **parameter 3.4**. These parameters are determined in comparison with rating value of a motor current (for 100.0 % = I_n). Thus the **area of long-term work** (fig. 4.17a) is defined.

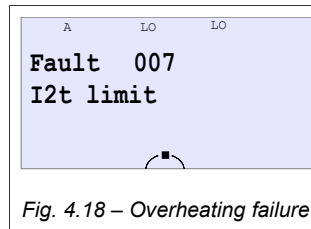


Fig. 4.18 – Overheating failure

When cooling the motor without additional ventilation (only with the internal fan) par. 3.4 is necessary to set up on value of 35 % of rated motor current. If additional ventilation of the motor is used value of par. 3.4 can be set up to 75 %. If the motor current is outside of defined area of long-term operation the calculated temperature will increase above 100 %. **When the calculated temperature achieves value of 105 % drive will stop** (the message of failure will appear (fig. 4.18)). Such situation is represented in fig. 4.17c for a increase in temperature marked by a dotted line.

Speed of increase in calculated temperature is determined by **parameter 3.5** - a constant of time of motor heating. It equals time after which the temperature of the motor will achieve 63 % from value of a final gain. In practice it is possible to accept option:

$$\text{Par. 3.5} = 120 \cdot t_6 [\text{min}], \text{ where } t_6 [\text{s}] \text{ is provided by motor manufacturer}$$

Demonstration values of constants of time are resulted in table 4.8.

Table 4.8 – Constants of time of heating

Nominal power of the motor P _n [kW]	Quantity of poles		
	2	4	6
	Constant of time of motor heating [min] (par. 3.5)		
2.2	11	17	24
3.0	12	18	26
4.0	13	19	29
5.5	15	21	29
7.5	16	23	31
11	19	26	34
15	20	29	39

4.4.4.2. Protection using thermorelay fuse or thermistor built-in the motor

With purpose of protection from overheating it is possible to use PTC thermistor or thermorelay built-in the electric motor. The digital input 6 We.C6 (DI6) is used for connecting signal to the converter. Protecting function is activated by the par. 3.1. It is necessary to set up a switch J5 depending on type of the sensor (fig. 2.6 and fig. 4.19).

Note. Digital input We.C6 (DI6) is default assigned to function “constant speeds”. It is necessary to move this signal to another digital input beforehand or just turn it off by par. 2.31.

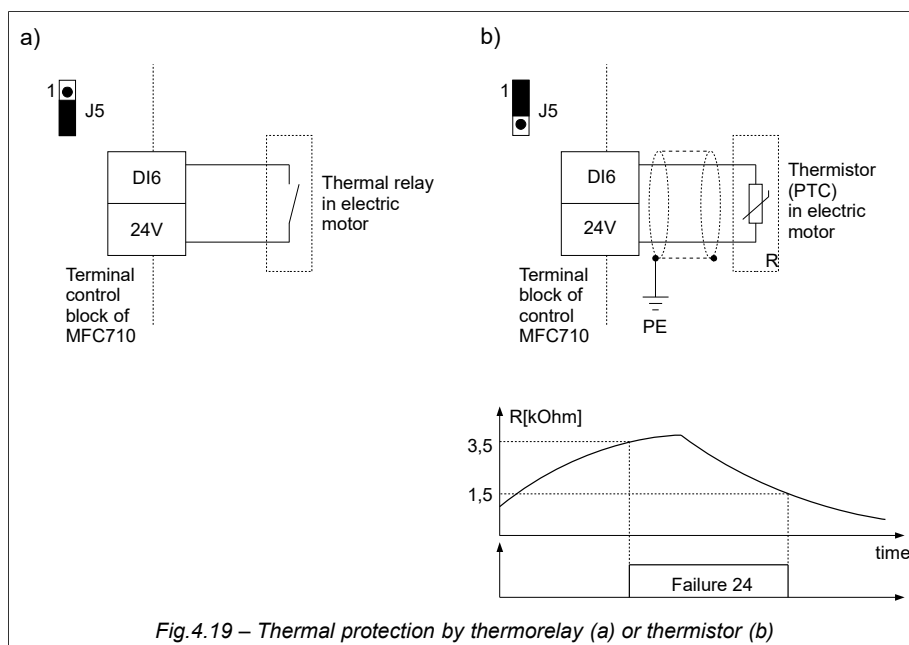


Fig.4.19 – Thermal protection by thermorelay (a) or thermistor (b)

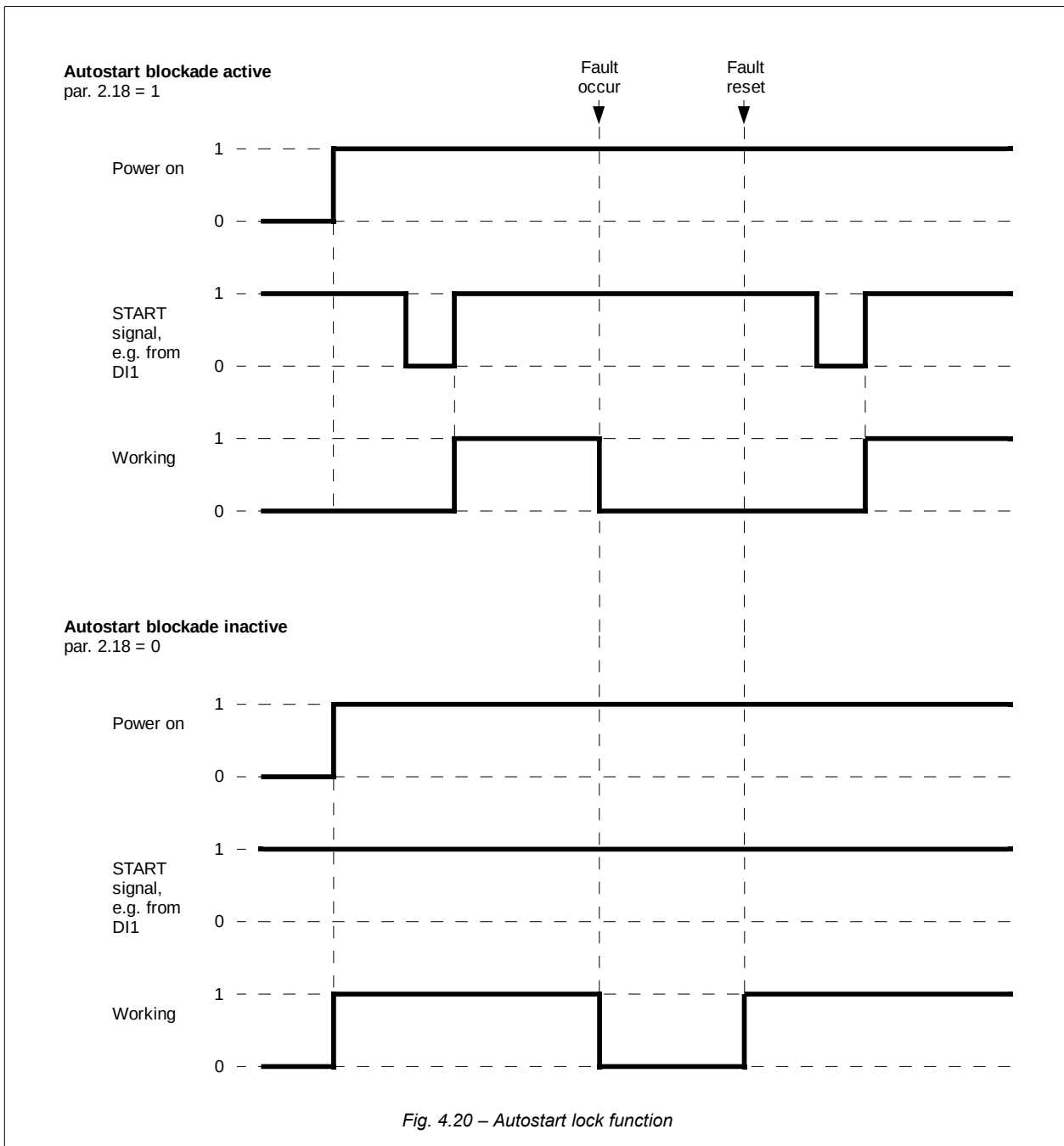
4.4.5. Autostart blockade

Applies to devices with software version 12.63 and above.
 The software version can be checked in parameter 0.51.

Par. 2.18 makes it possible to blockade the converter autostart function, which is triggered in below situations:

- power failure,
- removing the cause and cancelling the fault.

When the blockade of autostart is disabled, then an active start signal is a necessary for the converter autostart (e.g. high state of digital input DI1). Fig. 12.8 shows the difference in converter operation with and without active autostart blockade.



4.5. Motor drying function

Applies to devices with software version 12.63 and above.
The software version can be checked in parameter 0.51.

The motor drying function is used to heat the motor windings when stopped. Keeps the engine warm, dehumidifies from possible moisture and prevents condensation.

The motor is heated by forcing a direct current to flow through the motor windings. The value of this current is set in **par. 1.97** and can be in the range from 0% to 60% of the current rated motor (the rated motor current is given in par. 1.3).

The drying function can only be activated when the motor is stopped. Starting the converter frequency stops the drying function and resets the time remaining until the end of drying (**par. 0.38**). When restarting the drying function, the countdown of time will start from the value stored in **par. 1.99**.

The ongoing process of drying the motor is signaled by the flashing green led RUN.

Note 1: Using the motor drying function without monitoring the temperature of the motor windings may result to windings overheating and motor damage.

Note 2: Setting the maximum drying time in **par. 1.99** at 200.0 h means, disabling the automatic end of drying function - the timer will count down from 200.0 h to 0 h, but after it has expired will not finish the drying process. The drying process will only be finished when one of the following conditions occurs:

- "start converter" command,
- no signal that allows the drying process - **par. 1.96**,
- operation blocking or converter failure.

Parameters responsible for the motor drying function:

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
0.38 Dry end time	Time to the end of the drying process [min.]	---	---	---
1.96 DC dry enable	Switching On the drying process	000 Sw.Off – Switch off 001 In.C1 ... In.C6 – switch on when on DI1..6 is given a voltage 007 Sw.On – Switch on <i>The drying process is switched on with the rising edge – fig. 4.21</i>	000 Sw.Off	Yes
1.97 DC dry max I	Drying current limit	0..60.0% <i>Note: this is the limit of the average value of the current from the three phases. In one of the motor phases, the current value will be higher and may be up to 1.5 times the current value set in parameter 1.97.</i>	20.0 %	Yes
1.98 DC dry max U	Drying voltage limit	0..40.0%	5.0 %	Yes
1.99 DC dry time	Maximum drying time	0.1..200.0 h <i>Note: the value of 200.0 h means that the automatic end of drying function is turned off - the timer will count down the time from 200.0 h to 0 h, but after it finish, it will not end the drying process.</i>	0.1 h	Yes

The state of the motor drying process can be read in register 2007, bit 1 - see chapter 13.2 *Map of registers available through the RS interface.*

The address of the registers (decimal)	Description (meaning)	Mode
2007	bit 1 = 1 - the motor drying process is in progress	Read only

Start the engine drying process

When the drive is stopped and a signal is given in accordance with the setting of parameter **1.96 DC dry enable**, the process of drying the motor windings will be started. The drying process will continue for the time specified in par. **1.99 DC dry time** or less if interrupted by one from the following:

- "start inverter" command,
- no signal that allows the drying process - par 1.96,
- operation lock, inverter failure.

PCH	PCH name	Function / value / note
67	Drying status	H = drying process is active
195	Time until the end of drying process	Time remaining until the end of the drying process [in minutes] - equivalent to par. 0.38

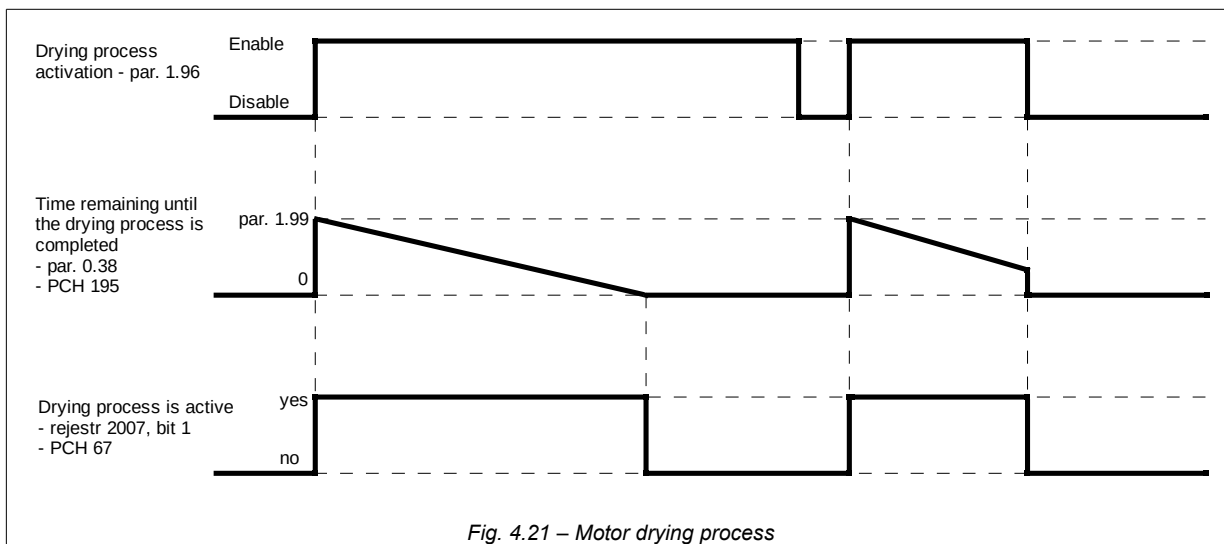


Fig. 4.21 – Motor drying process

Example 1

The start of the drying process is to be activated by digital input 1 (DI1) and should last for 1 hour. Drying current limit: 20% In. Drying voltage limit: 5%.

The following parameters must be set:

- par. 1.96 = 001 We.C1 (DI1),
- par. 1.97 = 20.0%,
- par. 1.98 = 5.0%,
- par. 1.99 = 1.0 h.

Example 2

The start of the drying process is to be activated by digital input 1 (DI1) and should last until the signal changes on this input.

Drying current limit: 20% In. Drying voltage limit: 5%.

The following parameters must be set:

- par. 1.96 = 001 We.C1 (DI1),
- par. 1.97 = 20.0%,
- par. 1.98 = 5.0%,
- par. 1.99 = 200.0 h.

Note: Using the motor drying function without monitoring the temperature of the motor windings may overheat these windings and damage the motor.

5. The first start

Before first start of the converter MFC 710 it is necessary to check section 4 “Configuration of frequency converter”. The structural circuit of control MFC 710 and Appendix C – table of parameters of MFC710 are also very important.

Main options:

- nominal parameters of the motor (see section 4.1)
- “control place” A or B
 - parameter 2.1 “Control B”
 - “Sw.Off” = Control A
 - “In.C1” = Choice A/B using digital input DI1
 - ...
 - “In.C6” = Choice A/B using digital input DI6
 - “Sw.On” = Control B
- Source of signal START/STOP (local from control panel, remote from digital inputs, remote from RS or others):
 - parameter 2.4 “START A” - source of signal START for control A
 - parameter 2.5 “START B” - source of signal START for control B
- method of referencing frequency or rotation speed of the motor (local from control panel, remote from analog input, through link RS, motopotentiometer, from PID controller or others):
 - parameter 2.2 “START A” - source of referencing-unit for control A
 - parameter 2.3 “START B” - source of referencing-unit for control B

5.1. Vector control mode. Identification run

In order to operate drive in a mode of vector control, except for switching on mode **Vector1** (with encoder) or **Vector 2** (without the sensor of rotor position) by parameter 1.20, it is necessary to enter parameters of an equivalent circuit of the motor (see section 4.1). If these parameters are not known it is possible to use the built-in procedure of **parameters identification**. After its switching on the frequency converter will made 2 or 3 tests of the motor during which attempt of determination of equivalent circuit parameters will be carried out.

5.1.1. Stages of identification run

Identification of parameters is divided into three stages:

- Stage 1: DC probing. The motor is stopped, the device defines active resistance of stator R_s ,
- Stage 2: AC probing. The motor is stopped, the device defines active resistance of rotor R_r , inductance of stator L_s and rotor L_r ,
- Stage 3: Experiment with rotation at 50 Hz or 25 Hz. The motor rotates powered by voltage with frequency of 50 or 25 Hz - the device defines inductance L_m .

5.1.2. Switching on identification run

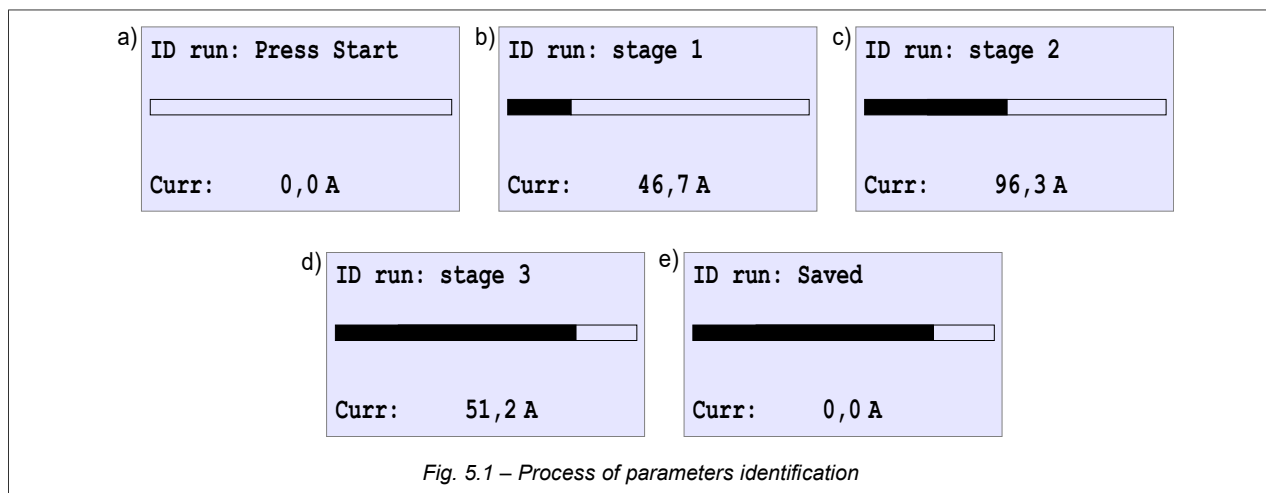
!!! CAUTION!!!

1. Before switching on of parameters identification mode it is necessary to enter nominal parameters of the motor which are described in section 4.1 (nominal power, current, voltage, frequency and speed) - entering erroneous parameters can result in damage of the motor and the frequency converter.
2. During the “ID run” blocking direction rotation of the motor (par. 1.65) is not active.
3. Motor should be disconnected from the load due to stage 3, during which the motor is accelerated to the speed corresponding to a frequency of 50 Hz or 25 Hz (depending on the mode selected in par. 1.10). When it is impossible to disconnect the load, the option “Dont run” in par. 1.10 should be chosen.

To start procedure of parameters identification it is necessary to set up parameter 1.10 “Identification run” on one of values:

- **Run fn** - all 3 stages of identification are carried out, stage 3 at 50 Hz.
- **Run fn/2** - all 3 stages of identification are carried out, stage 3 at 25 Hz.
- **Dont run** - 3rd stage of parameters identification isn't carried out (in the event that the 3rd stage of the “ID run” test cannot be carried out due to the connected driven machine).

After setting parameter 1.10 on one of the options above mentioned the display of the control panel will look as it is shown in fig. 5.1a. After pressing one of keys START (left arrow or right arrow) procedure of parameters identification begins - fig. 5.1b, 5.1c and 5.1d. Depending on parameters of the motor stages 1 and 2 can last from several seconds up to several dozen seconds. The stage 3 lasts about 20 sec. After completing all tests calculated parameters are written to EEPROM memory of the frequency converter (fig. 5.1e). Then STOP button should be pressed to restart the converter. It is possible to interrupt procedure of testing in the same way at any time. At the end the vector mode is set using parameter 1.20: Vector1 or Vector2.



Note 1: During the reset of the system (after pressing STOP) occurs a loss of communication with the keyboard, which results in displaying the message "Fail. Keyb. RS".

Note 2: In case of interruption of identification process by a STOP button before its ending the new parameters of the motor will not be stored.

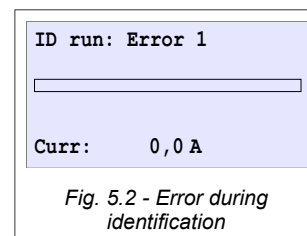
Note 3: In case of the third option (**No run**) parameter L_m is estimated on the basis of other nominal parameters of the motor. Because of that par. L_m can be erroneous.

Note 4: Parameter R_r is estimated on the basis of nominal parameters of the motor. The rated speed of the motor (par 1.2) has the greatest influence on parameter R_r . In case of observing that speed of the motor increases / reduces after its loading it is necessary to accordingly increase / reduce, par 1.2 (it will cause similar reduction / increase of R_r).

Note 5: In case of full identification procedure (three stages) which is carried out when encoder is connected, there is no necessity to carry out change in par 1.81 (Enc. Reverser) because the direction of encoder pulses count is simultaneously identified and correction of par 1.81 is carried automatically out.

The error during parameter identification of the motor (fig. 5.2) can occur if:

- the motor is not connected to the frequency converter,
- the motor has damages,
- the current during identification has exceeded 170 % of rated current of the motor,
- there is no possibility to define parameters for this motor.



After setting up parameters of the motor and control the drive is ready to operate.

5.2. Storing and reading of options for 4 different motors

There is an possibility of storing in memory EEPROM four groups of the parameters connected with different motors. It enables to use one frequency converter to operate with four motors. Thus there is no necessity to change option of parameters manually. The structure of parameters set consists of:

- rated motor power (par 1.1),
- rated motor speed (par 1.2),
- rated motor current (par 1.3),
- rated motor voltage (par 1.4),
- nominal motor frequency (par 1.5),
- nominal motor $\cos\phi_n$ (par 1.6),
- active resistance of stator (par 1.11),
- the main inductance (par 1.13),
- inductance of stator (par 1.14),
- inductance of rotor (par 1.15),
- speed regulator amplification (par 1.70),
- constant of integration of speed regulator (par 1.71),
- torque regulator amplification (par 1.72),
- constant of integration of torque regulator (.1.73),
- stream regulator torque (par 1.74),
- constant of integration of steam regulator (par 1.75),
- quantity of encoder's pulses (par 1.80);
- counter of encoder's pulses reverser (par 1.81),
- current setting of the motor thermal protection (par 3.3),
- thermorelay's setting for stopped motor (par 3.4),
- constant of time of motor heating (par 3.5).

STORING

To store the parameters mentioned above it is necessary to choose number of the memory buffer in par. 1.18 (from 1 up to 4) which will store parameters and to confirm record. The choice of buffer "0" will result in records deleting.

RESTORING

To restore the parameters which have been recorded earlier it is necessary to choose the memory buffer in par 1.19 (from 1 up to 4) in which parameters have been stored and to confirm reading. Reading empty buffer or buffer "0" will not result in changing current parameters.

ATTENTION. Procedure of record / reading can be made only when the motor is stopped.

6. Failures and warnings

6.1. Messages on failures and warnings on the control panel

The **failure status** is signaled by the lighting of the red LED and by the message on the display (Fig. 6.1). The converter is stopped. In order to be able to restart, it is necessary to remove the failure reason cause and cancel the failure state. In case of some failures, an automatic restart (deletion of the notification) is possible after the cause of the failure has disappeared.

The **warning** state is signaled during the inverter operation without stopping it by an appropriate message on the display and by the flashing of the red LED (Fig. 6.2). The warning will be automatically cleared when the motor is stopped.

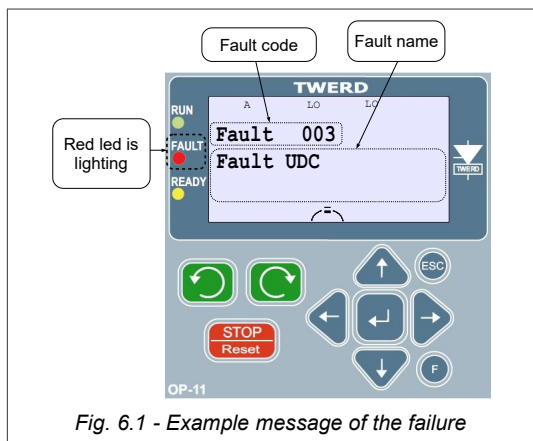


Fig. 6.1 - Example message of the failure

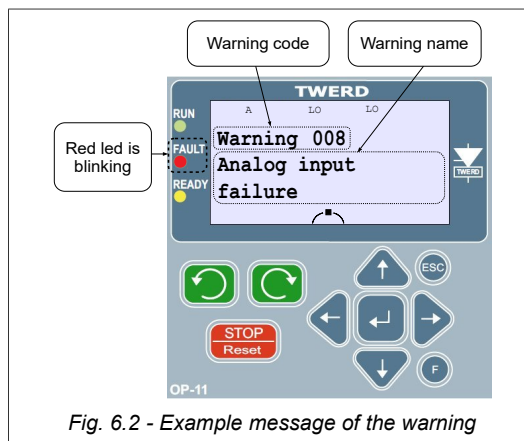
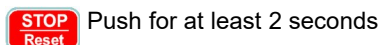


Fig. 6.2 - Example message of the warning

In both cases, the operation of the panel is continued, i.e. all parameters of the converter can be viewed and changed without any problems. The failure or warning message appears as the fourth screen in the Basic View (Fig. 3.2). To return to it, go to the basic view and select the appropriate screen with the „←“ „→“ keys.

6.2. Deleting failure message. Automatic restarts.

6.2.1. Manual deleting



6.2.2. Deleting through a digital input of the converter

The parameter 3.70 allows to choose a digital input which will serve for deleting message of failure.

6.2.3. Remote deleting through RS link

If parameter setting 4.7 allows to operate with RS control mode, sequence of 2 next records in the register 2000 (MODBUS) deletes failure message. The detailed description of separate bits and methods of deleting can be found in the description of the register 2000 - Section 13.

6.2.4. Readiness to restart if the reason of failure has not disappeared

If one of the methods mentioned in sections 6.2.1...6.2.3 deleted the message of failure and the failure reason has not disappeared, the drive will be stopped in „ready to restart“ state (fig. 6.3).

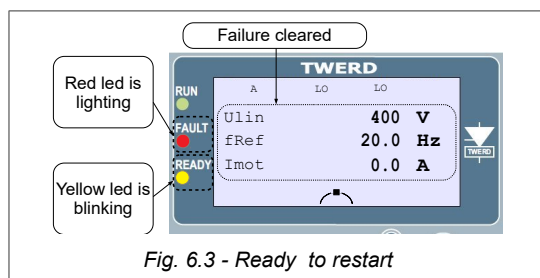


Fig. 6.3 - Ready to restart

When the reason of failure will disappear, automatic restart of the drive will begin.

6.2.5. Automatic restarts

If the drive stops after failure there is a possibility of automatic operation restart after reason of system failure disappears. The parameter 3.71 (amount of automatic restarts) restricts allowable quantity of automatic restarts in a time period defined by parameter 3.72. Restart delay from the time of failure reason disappearance is defined by parameter 3.73 (fig. 6.4).

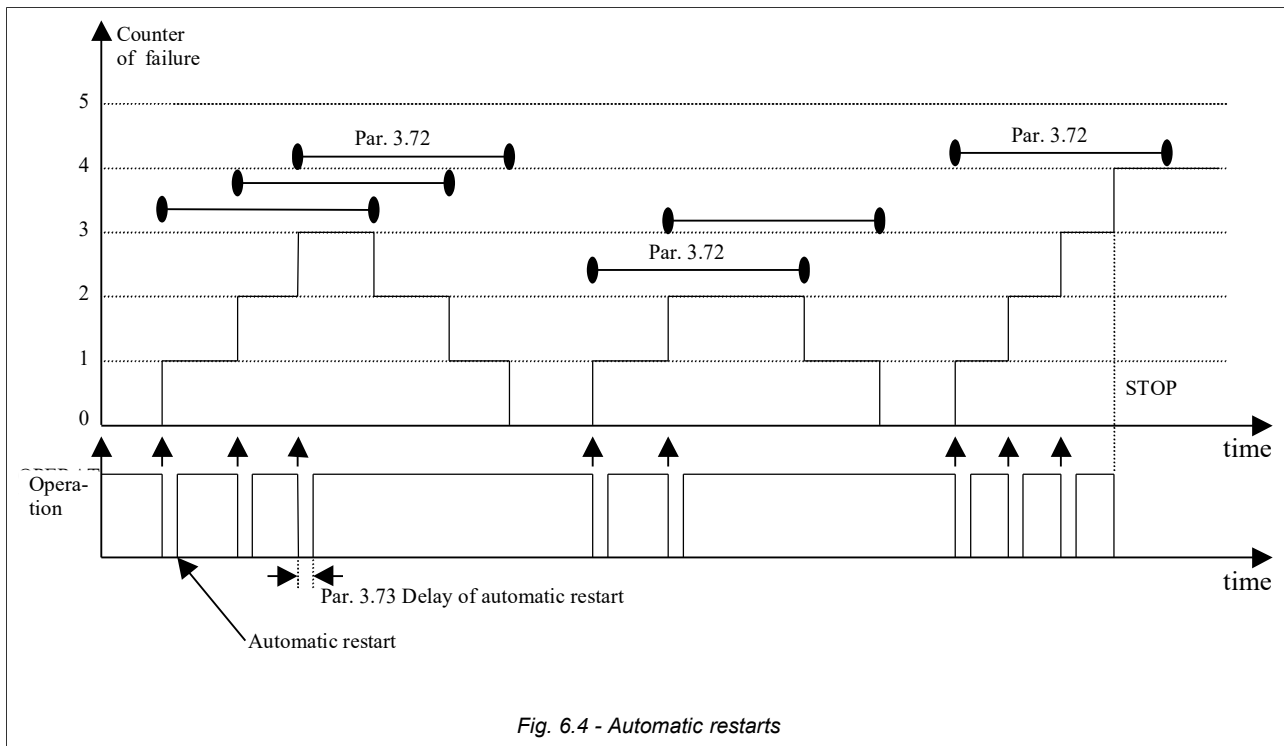


Fig. 6.4 - Automatic restarts

The drive will not restart operation automatically if the internal counter of failure will achieve the value limited by parameter 3.71 in time period determined by parameter 3.72. In this case operation restart will be possible only after deleting failure message by one of methods mentioned in sections 6.2.1...6.2.3

The permission on automatic restarts is possible after setting value "YES" to parameters:

- par. 3.74 (for failure Low Udc)
- par. 3.75 (for failure High Udc)
- par. 3.76 (for failure High current)
- par. 3.77 (for failure High temperature of a heatsink)
- par. 3.78 (for failure Failure of an analog input)

6.3. Codes of failures and warnings

Table 6.1 - List of failure and warnings codes

Failure codes F/W/M ¹⁾	Displayed name	Description	Possible reason	Counteraction
1 (F, W)	High temperature	Fault: Heat sink temperature too high Warning: 5°C before failure a warning appears.	The air course through the converter is complicated, too high temperature of environment.	Check efficiency of ventilation (efficiency of the ventilating fan and pollution of a heat sink).
2 (F – par. 3.35)	Earthing	The sum of motor currents is not equal to null. <i>Note: This failure is only for selected devices.</i>	Damaged motor windings insulation or connecting wires.	Check isolation resistance of the wires connecting the motor and the converter and isolation resistance of windings of the motor.
3 (F)	High Udc	High voltage in circuit DC	Too high voltage in the circuit, intensive braking of the motor	Test the mains Increase a time of braking Par 1.31 or 1.33
4 (F)	Low Udc	Low voltage in circuit DC	Low voltage in circuit, absence of one phase of a supply voltage	Check connecting cables and a level of a feeding voltage
5 (F)	Short circuit	Short circuit on output of the converter or failure of power module	Short circuit in the motor or in the wires feeding the motor	Disconnect the motor and test presence of a short circuit, if present call service to repair drive, and if is not present test isolation of wires and windings of the motor
6 (F)	High current	The current of the motor is to high	Too high intensity of acceleration, a sudden change of motor loading	Increase acceleration time of the motor

Section 6. Failures and warnings

Failure codes F/W/M ¹⁾	Displayed name	Description	Possible reason	Counteraction
7 (F – par.3.2)	I2t limit	Overheating of the motor	Overheating of the motor or operation with high loading at small speeds	Check loading of the motor (current of the motor); check parameters of thermal motor model
8 (F/W – par. 3.23)	InA damage	Damage of the analog input	At input option with „living zero” (2-10V or 4-20mA) value of a signal is lower than 1V	Check a configuration of analog inputs, test system of connection (damage of a cable, etc.)
9 (F/W – par. 3.56)	R brake ovflo.	Braking resistor overload – operational time of braking resistor exceeded the time set in par. 3.55	Deceleration time is too short. Maximum operate resistor's time in DC voltage is too short	Increase the deceleration time (par. 1.31 or 1.33 or 1.34). Increase the maximum operate resistor's time in DC voltage
10 (F)	DC charging	Failure of charging circuit of capacitor bank.	Damage of the relay/contactor (nom. power up to 55kW), thyristor module (nom. power 75kW and above) or pre-charge control circuit	Check connections (wire, plugs, etc.)
11 (F)	Absence of temp. sensor	Failure of the temperature sensor	Failure of the temperature sensor or of connecting wires	Call service
12 (F)	Short cir. of temp. sensor	Short-circuit of temperature sensor	Failure of the temperature sensor or of connecting wires	Call service
13 (F)	Low temperature	Temperature of the heatsink is lower than -10°C	Temperature of converter's environment is too low.	Check efficiency of heating
14 ²⁾ (F/W – par. 3.57)	AcR Fault	ACR module failure - Error code can be read in parameter 0.78	According to the MFC710/AcR user manual.	According to the MFC710/AcR user manual
15 ²⁾ (F/W – par. 3.57)	AcR Comm. Fault	ACR module communication failure	Failure of AcR module or connecting wire	Call service
19 (F/W – par. 3.45)	Spd. control	Error of output speed - difference between reference and output speed exceed acceptable difference (par. 3.46) or time (par. 3.47).	Incorrect setting the dynamics of the drive; output values of frequency converter reached operational limits of: current, torque and/or voltage	Check the drive system, the motor load. Change the parameters 3.45, 3.46, 3.47
20 (F/W – par. 3.30)	Output Symmetry	Asymmetrical loading	The motor failure or absence of output phase (damage of a wire)	Check connections of the drive-motor, check resistance of motor windings, replace the motor.
21 (F/W – par. 3.50)	Underload	Operation with loading which is much lower than nominal	Parameters of a underload are incorrectly determined	Check and correct parameter settings which refer to underload of the converter
22 (F – par. 3.10)	External 1	The signal of external failure is active		Check a signal at digital input DI3 which is chosen as an external failure
23 (F – par. 3.11)	External 2	The signal of external failure is active		Check the signal at digital input DI4 which is chosen as an external failure.
24 (F/W – par. 3.1)	Thermorelay	Overheating of the electric motor or failure of the electric motor's external temperature sensor connected to WeC6 (DI6) Fault: the occurrence of an event during the work of the converter (RUN). Warning: the occurrence of an event during stop of the converter (READY).	Overheating (overloading) of the electric motor or operation with high loading at small speeds. Failure of the temperature sensor or of the connecting wire.	Check loading of the motor (current of the motor). Check connections (wires, plugs, etc.)
25 (F/W – par. 3.40)	Stall	The motor has stopped under act of too high loading	Too high anti-torque, failure of the operating device, to low power of the converter	Check operating device (jam), increase voltage of the frequency converter
26 (F/W – par. 3.65)	Absence of keyboard	Exceeded time of waiting for control panel transmission.	Interferences or damage of a cable connecting a control board with the converter	Check connections (wires, plugs, etc.)
27 (F/W – par. 3.60)	RS time	Waiting time on a signal from RS is exceeded	Failure of a cable, parameters of the transmission are incorrectly set up	Check external connections and validity of RS parameters
28 (F)	U mains	Voltage oscillations of circuit DC are higher than allowable	Voltage oscillation of power source	

Failure codes F/W/M ¹⁾	Displayed name	Description	Possible reason	Counteraction
29 (F)	f > fmax	Output frequency of the frequency converter is higher than the maximum frequency (par. 1.40)	Operation device rolls the motor up or there is a big readjustment of the speed regulator	Modify the speed regulator option
30 (F)	Encoder error	Failure of encoder	Failure of encoder or connecting wires	Check connections (wires, plugs, etc.)
M	Fail. Keyb. RS	A loss of communication between internal processor and keyboard.	Loading factory parameters, identification run and others events causing the restart of frequency converter	It is typical message in the case of restart of the frequency converter. It should appear only for few seconds during the restart.

1) F=fault, W=warning, M=message

2) Applies only to regenerative frequency (Active Front End) converters AcR type.

If you have difficulty removing the fault, please contact the TWERD service.

6.4. Failure and warning log

Parameters 3.80...3.111 form the Failures and warning log allows to display a history of at least the last 16 incidents. Each record in the log consists of two parameters 3.80÷3.81, 3.82÷3.83, ..., 3.110÷3.111, the first (3.80) contains:

- the name of the incident (Fig. 6.5a),
- type of incident (Warn. = warning, Fault = failure) and the number of the incidents in a one working hour (Fig. 6.5b).

It is possible to obtain additional information about the following frequency converter conditions during the time of incident:

- time the incident occurred - a relative time related to the total number of operating hours of the converter - par. 0.35;
e.g. 95 h means that the event occurred in 95 hours of the converter operation, calculated from the first connection to the mains,
- output frequency f_{out},
- RMS current of the electric motor (average from three phases) I_{sil}
- voltage of the DC intermediaries circuit of the converter U_{dc}
- heatsink temperature Trad
- operating status of the converter S

Switching between the above entries is done by pressing the Enter key "↵".

The second parameter (eg. 3.81) contains the relative time of the Fault or the Warning occurrence (Fig. 6.5c). Parameter pair 3.80 - 3.81 contain the most recent Fault or Warning and data parameter pair 3.110 - 3.111 contain the oldest.

In a time of one hour of the converter operation the same incident can take place many times. In order to prevent overflow of the Failure and warning log, only the quantity of incidents which occurred in last operating hour is increased. Thanks to this the real quantity of failures which can be stored in the Failure and warning log increases.

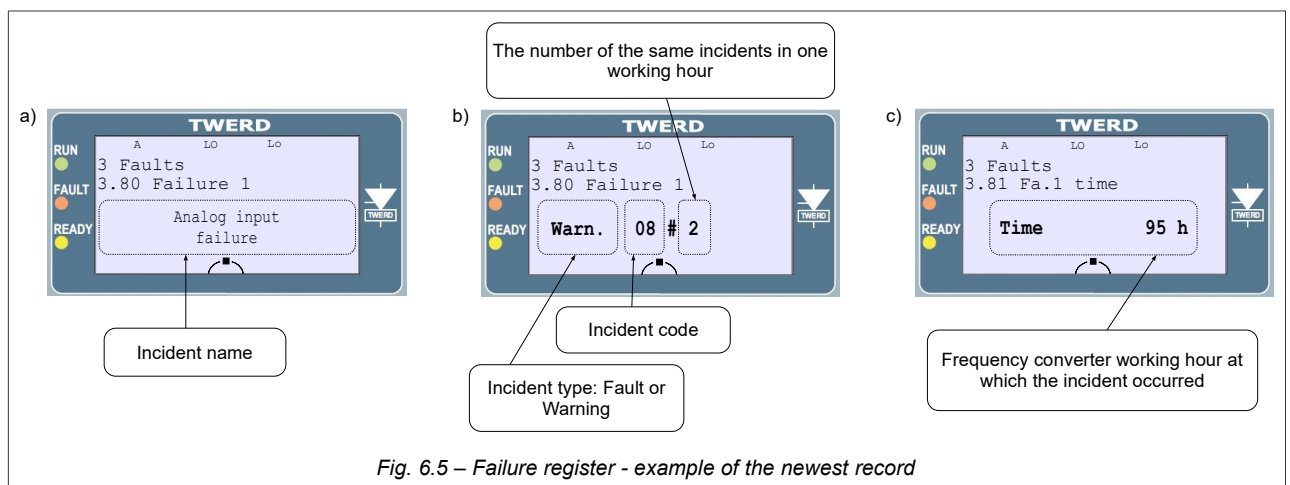


Fig. 6.5 – Failure register - example of the newest record

7. Sets of factory parameters

The way of loading factory parameters in the converter is shown in section 3.7. There are 9 various sets of factory parameters (table 7.1) intended for loading standard, most used control programs.

Frequently in the beginning it is better to load one of the instanced standard sets of parameters, than manually change a lot of parameters of the frequency converter. After loading factory settings it is necessary to change only those options which should be changed to adapt operation of the converter for specific conditions.

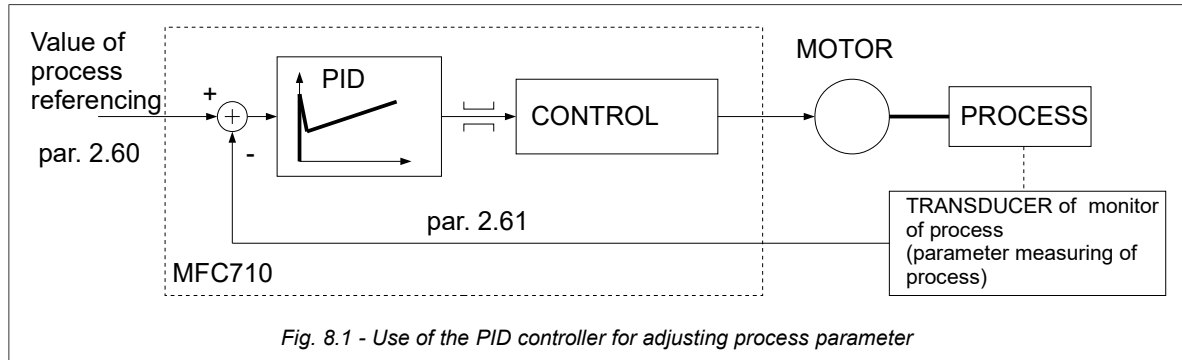
It is important to remember that after loading any set of factory parameters, it is necessary to define factory parameters of the connected motor and in case of using vector mode to carry out motor identification (see section 4.1 and 5.1).

Table 7.1 - Sets of factory parameters

Parameter №	1 Base	2 Remote	3 Local/ Remote	4 PID	5 Motopotentiometer	6 Constant Frequency	7 Regulated torque	8 Pumps	9 Winding
1.20	U/f lin.	U/f lin.	U/f lin.	U/f lin.	U/f lin.	U/f lin.	Vector 1	U/f lin.	Vector 1
1.65	Reverse	Reverse	Reverse	Reverse	Reverse	Reverse	Reverse	Right	Reverse
2.1	Sw.Off	Sw.On	In.C3	In.C3	Sw.Off	Sw.Off	Sw.Off	Sw.Off	Sw.Off
2.2	Keyb.r	Keyb.r	Keyb.r	OutPID	MotPot	Keyb.r	100.0%	OutPID	100.0%
2.3	In.A0	In.A0	In.A0	In.A0	Keyb.r	In.A0	In.A0	In.A0	In.A0
2.4	Keyb.	Keyb.	Keyb.	Dig.In	Dig.In	Keyb.	Keyb.	Keyb.	Keyb.
2.5	Dig.In	Dig.In	Dig.In	Dig.In	Keyb.	Dig.In	Dig.In	Dig.In	Dig.In
2.6	Keyb.	Keyb.	Keyb.	Keyb.	Dig.In	Keyb.	Keyb.	Keyb.	Keyb.
2.7	Dig.In	Dig.In	Dig.In	Dig.In	Keyb.	Dig.In	Dig.In	Dig.In	Dig.In
2.9	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	Ref.A0	100.0%	Ref.RC
2.10	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	Ref.A0	100.0%	Ref.A1
2.20	Sw.Off	Sw.Off	Sw.Off	Sw.Off	In.C6	Sw.Off	Sw.Off	Sw.Off	Sw.Off
2.21	Sw.Off	Sw.Off	Sw.Off	Sw.Off	In.C5	Sw.Off	Sw.Off	Sw.Off	Sw.Off
2.22	1	1	1	1	0	1	1	1	1
2.23	10.0 s	10.0 s	10.0 s	10.0 s	5.0 s	10.0 s	10.0 s	10.0 s	10.0 s
2.30	In.C5	In.C5	In.C5	Sw.Off	Sw.Off	In.C4	In.C4	In.C5	Sw.Off
2.31	In.C6	In.C6	In.C6	Sw.Off	Sw.Off	In.C5	In.C5	In.C6	Sw.Off
2.32	Sw.Off	Sw.Off	Sw.Off	Sw.Off	Sw.Off	In.C6	In.C6	Sw.Off	Sw.Off
2.68	2	2	2	0	2	2	2	1	2
2.70	0 s	0 s	0 s	0 s	0 s	0 s	0 s	60 s	0 s
3.10	In.C3	In.C3	Sw.Off	Sw.Off	In.C3	Sw.Off	Sw.Off	Sw.Off	Sw.Off
3.70	In.C4	In.C4	In.C4	In.C4	In.C4	Sw.Off	Sw.Off	Sw.Off	Sw.Off
4.10	Par. 0.11	Par. 0.11	Par. 0.11	Par. 0.31	Par. 0.11	Par. 0.11	Par. 0.11	Par. 0.11	Par. 0.11
4.11	Par. 0.5	Par. 0.5	Par. 0.5	Par. 0.30	Par. 0.5	Par. 0.5	Par. 0.5	Par. 0.34	Par. 0.5
4.12	Par. 0.4	Par. 0.4	Par. 0.4	Par. 0.31	Par. 0.4	Par. 0.4	Par. 0.4	Par. 0.4	Par. 0.4
4.13	Par. 0.7	Par. 0.7	Par. 0.7	Par. 0.2	Par. 0.7	Par. 0.7	Par. 0.7	Par. 0.34	Par. 0.7
4.14	Par. 0.1	Par. 0.1	Par. 0.1	Par. 0.30	Par. 0.1	Par. 0.1	Par. 0.1	Par. 0.1	Par. 0.1
4.15	Par. 0.2	Par. 0.2	Par. 0.2	Par. 0.4	Par. 0.2	Par. 0.2	Par. 0.2	Par. 0.2	Par. 0.2
4.16	Par. 0.3	Par. 0.3	Par. 0.3	Par. 0.6	Par. 0.3	Par. 0.3	Par. 0.3	Par. 0.3	Par. 0.3
4.17	Par. 0.4	Par. 0.4	Par. 0.4	Par. 0.7	Par. 0.4	Par. 0.4	Par. 0.4	Par. 0.4	Par. 0.4
4.18	Par. 0.5	Par. 0.5	Par. 0.5	Par. 0.8	Par. 0.5	Par. 0.5	Par. 0.5	Par. 0.5	Par. 0.5
4.19	Par. 0.6	Par. 0.6	Par. 0.6	Par. 0.10	Par. 0.6	Par. 0.6	Par. 0.6	Par. 0.6	Par. 0.6
4.20	Par. 0.7	Par. 0.7	Par. 0.7	Par. 0.20	Par. 0.7	Par. 0.7	Par. 0.7	Par. 0.7	Par. 0.7
5.1	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0
5.10	NO	NO	NO	NO	NO	NO	NO	YES	NO
5.27	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0	Ref.A0	RefPID	Ref.A0

8. PID controller

Frequency converter has a PID controller (Proportional - Integral - Differential). The controller can be used for stabilization of any parameters at fixed level (fig. 8.1).



8.1. Turning on and a configuration of the PID controller

To enable PID controller as a source of referenced frequency it is necessary to set up par. 2.2 (for control A) or 2.3 (for control B) on value "137 OutPID" (fig. 8.2).

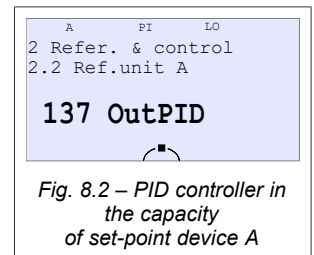


Table 8.1 - Control and information parameters of the PID controller

Parameter	Name	Description
2.60	PID Ref.Src	Source of ref.-unit for PID controller. It serves for setting process referenced value. Possible values: Keyb.P – referencing PID from control board Ref.A0, Ref.A1, Ref.A2 – analog referencing-units from analog inputs RS PID – analog referencing-units from communication module RS232/485 (Modbus) MP-PID – motopotentiometer PID
2.61	PID Inp.Src	Signal source of feedback PID controller. Ref.A0, Ref.A1, Ref.A2 – feedback is connected to one of the analog inputs.
2.62	Error inversion	Error inversion (difference between tasked value and feedback signal) NO / YES
2.63	P amplification (Kp)	Amplification of proportional component of PID controller. The bigger amplification, the faster reaction to speed error
2.64	I Const (Ki)	So called time of PID controller doubling. 0.01 ... 320.00s (0.01 ... 320.00 s)
2.65	D Amp. (Kd)	Amplification of differential component of PID controller.
2.66	Max.Out.PID	Max value which output signal of PID controller can achieve (limitation of saturation) 0.0 3000.0 %
2.67	Min.Out.PID	Min value which output signal of PID controller can achieve (limitation of saturation) 0.0 3000.0 %
2.68	PID Out.res	Resetting PID output when device is stopped: 0,1,2
2.69	PID type	0 / 1 Choice of regulator's algorithm operation. Recommended setting is 0.
2.70	SLEEP time	Time after which SLEEP blockade will activate, when the regulator output maintain on minimal value determined by par. 2.67 0 ... 32000 s , 0 = SLEEP function is not active
2.71	SLEEP threshold	The program of shut down of SLEEP blockade 0.0...100.0 % Blocking will be switched off, when: the output of the regulator will achieve value above than (par. 2.67 + par. 2.71) or error will be higher, than par. 2.71
0.30	RefPID	Value of current PID referencing-unit. READ ONLY.
0.31	InPID	Current value of PID controller input. READ ONLY
0.32	PID error	Value of current regulator error par 0.32 = par 0.30 – par 0.31 READ ONLY
0.33	OutPID	Current value of PID controller output. READ ONLY

8.2. Limitation of saturation and SLEEP function

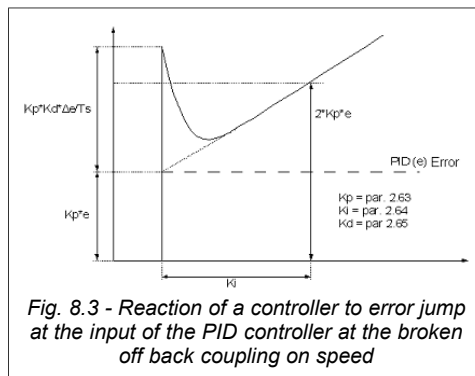
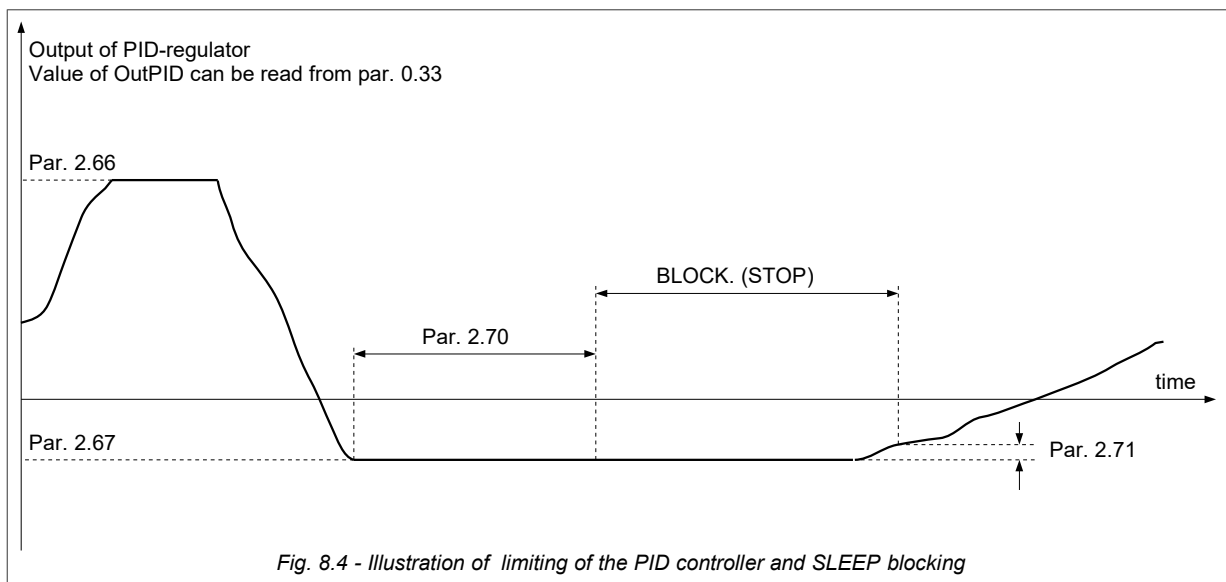
When the positive or negative error of regulating is kept some time it can result in saturation of the PID controller. To prevent this phenomenon, it is necessary to limit output value of the controller:

- the lowest output value - par. 2.67 (by default 0.0 %)
- the highest output value - par. 2.66 (by default 100.0 %)

Function SLEEP of the PID controller enables to shut down automatically the motor when output value of the PID controller which is simultaneously the reference of frequency is kept on minimum determined by par. 2.67, during a time determined by par. 2.70. The drive will be blocked in this case. Unblocking will occur automatically when one from below conditions will be fulfilled:

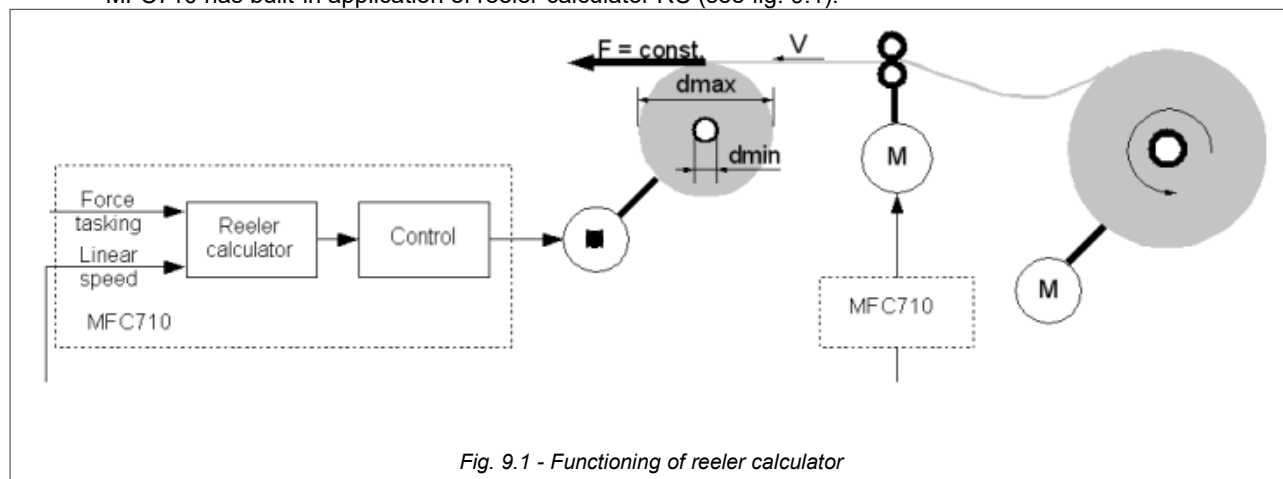
- the output of a controller will achieve value higher than value par. 2.67 + par. 2.71
- the error will be higher than par. 2.71

Functioning of limitation and SLEEP blocking is shown in fig. 8.4.



9. Reeler calculator

MFC710 has built-in application of reeler calculator RC (see fig. 9.1).



Application adapts motor's torque to current roller diameter, so that rolling up could be performed with constant force. For determining current diameter of a roller there is necessary an information about linear speed of rolled medium. In presented example linear speed signal is obtained from frequency converter which cooperates simultaneously in production line.

9.1. Turning on and configuration of RC

To activate RC you should set par. 2.9 (for A control) or par 2.10 (for B control) on „Ref.RC” (fig. 9.2).

CAUTION: RC application works only with vector control (par 1.20 „Vector 1” or „Vector 2”).

CAUTION: Instead of configuring all parameters of Application separately it is better idea to load factory settings number 9 and then modify only some parameters. This set is especially intended for Reeler Calculator Application. Description of loading factory settings can be found in section 3.7.

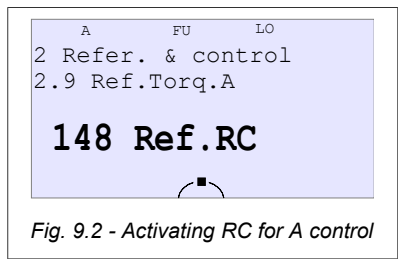


Fig. 9.2 - Activating RC for A control

Table 9.1 – Parameters of reeler calculator

Parameter	Name	Description
5.1	In.V	Source of linear speed signal of rolled medium. Possible values: Ref.A0, Ref.A1, Ref.A2 – analog referencing-units from analog inputs
5.2	In.F	Source of force referencing-unit signal. It serves for determining of force used to roll medium. Possible values: Ref.A0, Ref.A1, Ref.A2 – analog referencing-units from analog inputs
5.3	Vmax	Maximum linear speed of rolled medium. This speed corresponds to 100% of signal value of linear speed referencing-unit (par. 5.1) 0.00 ... 320.00m/s
5.4	dmin	Minimum diameter of roller (see fig.. 9.1). Basing on this value application determines minimum torque 0.0 ... 32000mm
5.5	dmax	Maximum diameter of roller (see fig. 9.1). Basing on this value application determines maximum torque 0.0 ... 32000mm
5.6	Mo	Friction torque set in %

10. Pump Group Controller

The MFC710 built-in control system of pump group (or ventilating fans) enables to control group of maximum 6 pumps (or ventilating fans). Standard frequency converter MFC710 has 4 digital outputs and can serve 4 pumps. The fifth and sixth pump can be connected using the optional expansion module. One of controlled pumps is the pump with an adjustable speed of twirl (it is connected to the frequency converter), and other pumps are connected automatically to work from a mains when needed. Working frequency (pressure) and also quantity of working pumps are adjusted in feedback using PID controller of the converter or directly from any referencing-unit.

One pump works with a rotational speed which is adjusted by frequency converter MFC710, it is “**the leading pump**”. Other pumps are switched on/switched off depending on necessity and powered directly from supply grid (these are **additional pumps**). The frequency converter decides which of pumps is the leading one and also automatically replaces the leading pump and turns on/shuts down additional pumps.

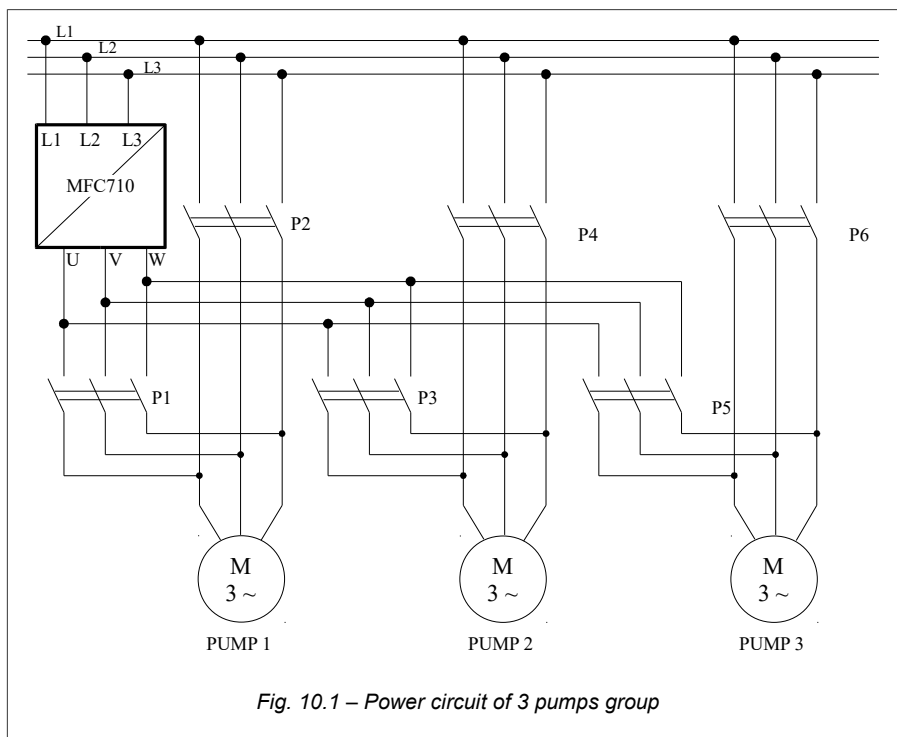
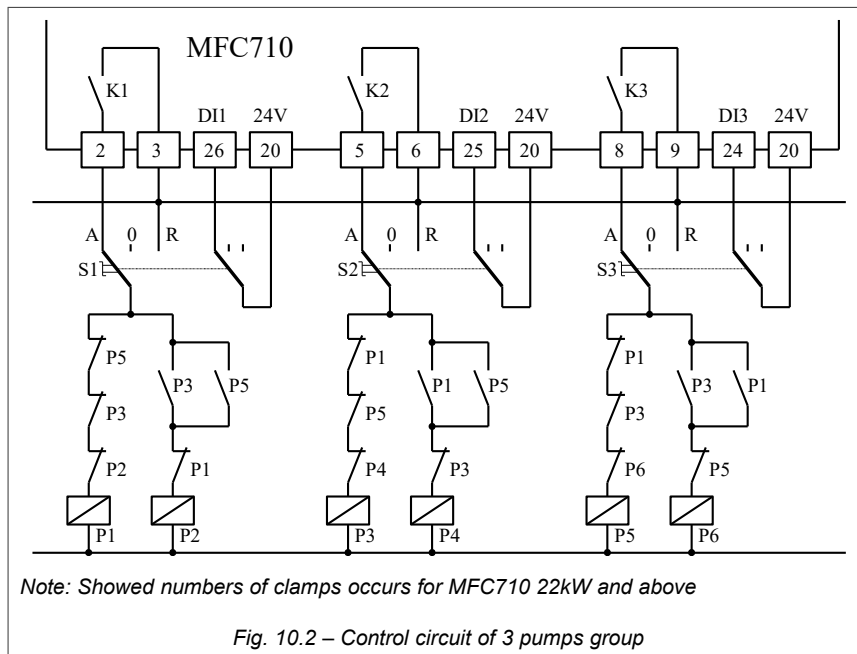


Fig. 10.1 – Power circuit of 3 pumps group

System with control of group of 3 pumps is shown in fig. 10.1. If the operating mode with pump control is chosen (the parameter 5.10 "Switch on pumps" is set on "YES") to each pump will be allocated one digital output of the frequency converter:

- Pump 1 - an output (relay) K1
- Pump 2 - an output (relay) K2
- Pump 3 - an output (relay) K3
- Pump 4 - digital output DO4 (an open-collector)
- Pump 5 and 6 - option.

To provide safe work of pump group shown in fig. 10.1 it is necessary to mount the circuit of control of pump group as in fig. 10.2. Switches S1, S2 and S3 enable to change a configuration of pump as switched off (0) / switched on directly from a grid (R) / controlled automatically by the frequency converter (A).



In fig. 10.2 there is an assumption that inputs that allow/block the pump operation with parameters 5.16, 5.17 and 5.18. are established on control from digital inputs DI1, DI2 and DI3 of the frequency converter (as it is in a set of factory parameters no. 2) and also, that digital outputs of converter K1, K2 i K3 are control signals of turning on pumps (par. 2.90 = „76 pump1“, par. 2.92 = „77 pump2“, par 2.94 = „78 pump3“).

10.1. Parameters of a pump group controller

The description of pumps group controller parameter can be found in Appendix C - see parameters from 5.10 to 5.28.

ATTENTION: Instead of setting all parameters of the Control system separately, it is better to load a set of factory parameters number 8. This set is specially intended for a configuration of the Control system of pump group. The description of loading of factory parameters is in section 3.7.

After loading this set of factory parameters it is possible to change some of them to adapt work of a control system of pumps for this concrete case.

10.2. Turning on pump group controller

Switching on pump group controller activates after setting up parameter 5.10 on value "YES". Besides the configuration of the parameters 5.11...5.28 is responsible for functioning of a pump group controller and also 2.90, 2.92 and 2.94 assign digital outputs function of switching the pumps on . The parameter 2.2 (or 2.3) is necessary to be set up on value „137 OutPID“ or „161 R.Pump“. For operation with the PID controller it is necessary to determine parameters of a controller - especially a signal source of pressure and the pressure referencing-unit - par. 2.60 and 2.61. In addition parameters restricting a range of controller's output - par. 2.66 and 2.67 should be set up on values 100% and 0 % respectively.

Simpler way of setting up parameters is loading of factory parameters, set number 8 which is especially prepared for a pump group controller group, with subsequent changing only some options.

10.3. An operating mode with the PID controller and a mode of direct control

The pump group controller can operate in two modes::

- standard - when pressure control is adjusted by means of the PID controller of the frequency converter (when **par. 5.27 = „158 RefPID”**),
- direct - when the referenced signal decides directly (without PID) about quantity of operating pumps.

In most cases operation in a standard mode, when **par. 5.27 "Ref. choice"** is set up on „**158 Ref. PID**”, is recommended. Any other setting of this parameter will result that the control system will operate in a direct mode - in this case quantity of operating pumps and also speed of twirl of the leading (adjustable) pump will be set up directly by chosen with **par. 5.27** source in limits from 0 to 100 %. For 50 % half of pumps operates, for 0 % one pump operates on the lowest speed, for 100 % all pumps operate.

In a standard mode the quantity of operating pumps and speed of the leading pump is determined by the PID controller on the basis of current referenced value (desirable pressure) and also value of current process (current pressure). Signal of referencing-unit's pressure is set up by parameter **2.60 "PID Ref.Src"** and the signal of current pressure is set up by parameter **2.61 "PID Inp.Src"**. It is possible to set up, for example, that the referenced signal from a control panel and a signal of actual pressure from an analog input of the frequency converter. In addition the PID controller can control rotation speed of leading pump if the parameter 2.2 (frequency referencing-unit for control A) is set on value „**137 Out.PID**”.

In a mode of direct control the parameter 2.2 (frequency referencing-unit for control A) must be set on value „**161 R.Pump**”. This option is outside of standard range of parameter's 2.2 options. In order to make such option of par. 2.2 available, it is necessary to set up **par. 4.6 "Full pointers"** on value "YES".

10.4. A configuration of pump amount and operating modes of separate pumps - blocking of pumps

Maximum quantity of pumps which are switched on simultaneously is set up by parameter 5.28. For example, if a group of 4 pumps which are active (can operate under control from pump group controller) but we want only 3 of them to work **SIMULTANEOUSLY**. For this purpose **par. 5.28** should be set on "3".

Parameters **5.16** (for the Pump 1) ... to **5.20** (for the Pump 5) define signals activating each pump. Value „**000 Sw.Off**” means that the pump will be always in inactive mode (the control system will not use it). Value from „**001 In.C1**” up to „**006 In.C6**” means that this pump will be activated/deactivated by the corresponding digital input DI1..DI6 of the converter (if the pump is in an active mode and operates and will be deactivated, its immediate shutdown will occur). Value „**007 Sw.On**” means that the pump will be constantly active - there will be no opportunity to block its operation. **The pump in an inactive mode cannot be switched on in operation neither as leading nor as additional.**

Parameters 5.11 to 5.15 determines operating modes for each pump. There are two opportunities:

- MFC / MAINS
- MAINS ONLY

MFC / MAINS - the pump can be the pump with regulated by converter speed of a rotation (the main pump) and also can operate as an additional pump powered directly from the grid,

MAINS ONLY - the pump can operate only as an additional pump powered directly from the grid.

10.5. Monitoring work of pumps

It is possible to monitor state of pump group controller by means of par. 0.34. (fig. 10.3). The information about state of the Control system of pumps group can be highlighted on the main display of the panel (fig. 10.4) during drive operation.

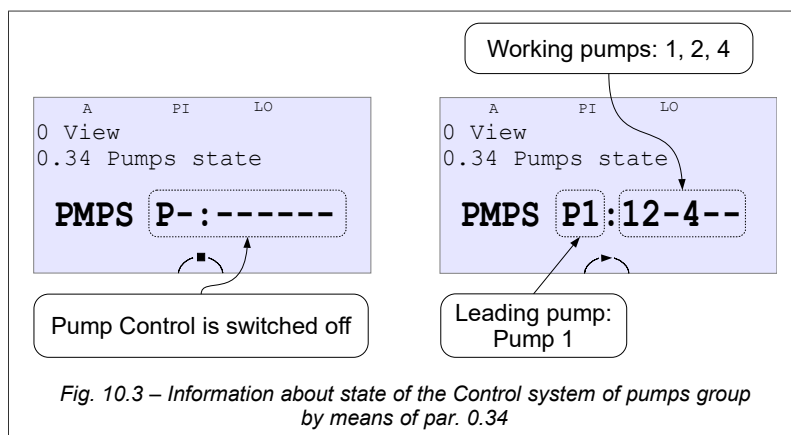


Fig. 10.3 – Information about state of the Control system of pumps group by means of par. 0.34

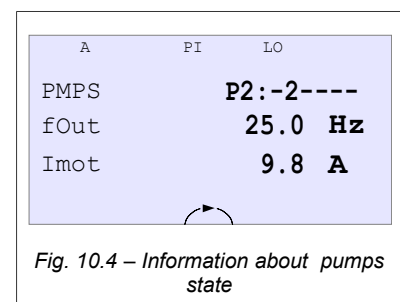


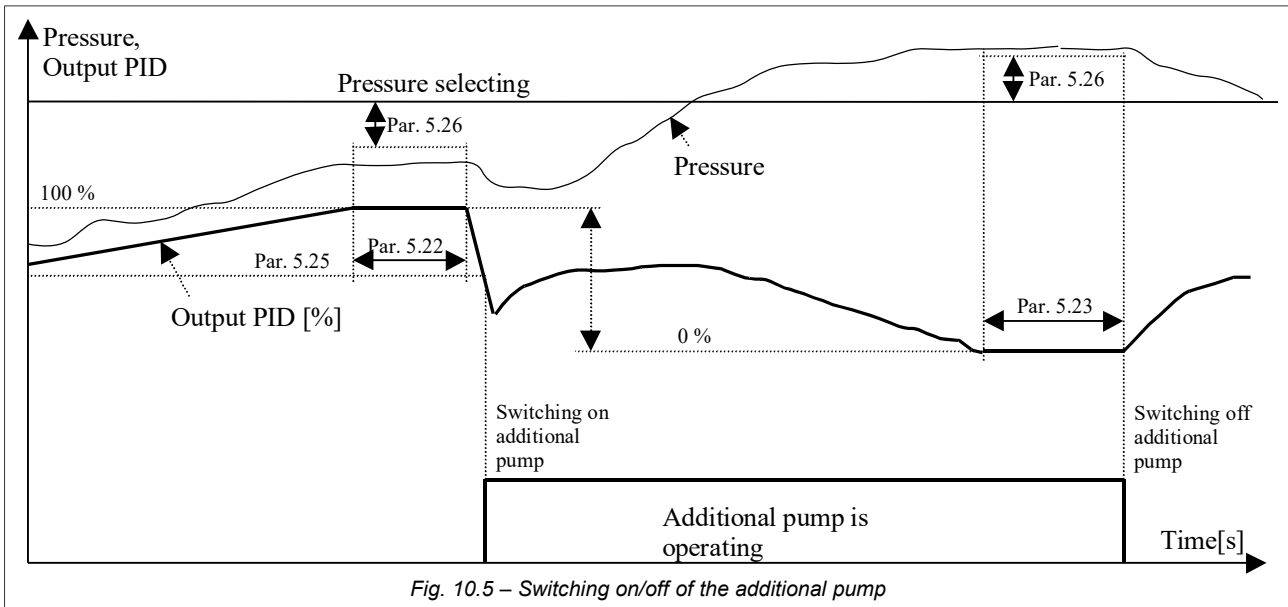
Fig. 10.4 – Information about pumps state

10.6. Conditions of switching on/off additional pump

The additional pump is switched on under conditions:

- output signal of the PID controller attains value of 100%,
- the level of pressure signal is less than referenced pressure by value of parameter 5.26 (or more),
- two previous conditions are carried out through a time which is set up by parameter 5.22.

After fulfilling the conditions mentioned above the leading pump reduces a rotational speed up to value determined by parameter 5.25. When the pump achieves this rotational speed, additional pump is switched on. As a result of switching the pressure in system increases. If pressure will stay in range <Selected Pressure +/-par. 5.26> the control system will continue operation without changes. If pressure again reduce - the next additional pump (if it is active - ready to switching on) will be switched on. Otherwise, when pressure will still increase the last additional pump will be switched off.



The additional pump will be switched off under conditions:

- the PID controller output has reduced up to 0%,
- the level of pressure signal is higher than referenced pressure by value of parameter 5.26 (or more),
- two previous conditions are carried out through a time determined by value of parameter 5.23.

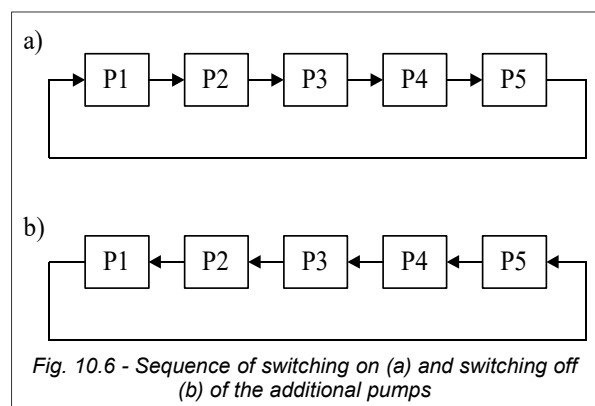
After fulfilling the conditions mentioned above the last additional pump is immediately shut down.

10.6.1. Priority of switching on/off additional pumps

First additional pump that will be switched on, is the pump with number next to the number of the leading pump - according to a sequence shown in fig. 10.6).

When the control system makes a decision to switch on the additional pump, the first pump of sequence, which isn't blocked and is not running, is switched on (see fig 10.6a). The first checked pump is the following pump from sequence after the main pump (e.g. when the main pump is P2 the first according to sequence is P3).

When the control system makes a decision to switch off the additional pump, the first pump of sequence (see fig 10.6b), which is currently working, is switched off. The first checked pump is the pump which is located in sequence on the previous position to the main pump (e.g. when the main pump is P2 the first in sequence is P1).



Example 1:

If the main pump is 2, switching on sequence of additional pumps is following:

P3 → P4 → P5 → P1

switching off sequence:

P1 → P5 → P4 → P3

Condition: the maximum quantity of pumps is set up on 5, all pumps are not blocked.

Example 2:

If pumps P2 P4 are blocked and the main pump is P1 in this case switching on sequence is following:

P3 → P5

switching off sequence:

P5 → P3

If working pump will be blocked, it will be immediately switched off. Thus, when after certain time if conditions of the switching on the additional pump are satisfied, first ready to operate pump from sequence (see fig. 10.6a) will be switched on.

If during operating time the main pump is blocked, all pumps (main and additional) are immediately switched off.

When the quantity of operating pumps (including main) is equal to value of parameter P limit (5.28), even if conditions of switching on are fulfilled and there is not blocked pump ready to run – not any more pump will be switched on.

10.7. Automatic replacement of pumps

After time of leading pump operation (determined in hours by parameter 5.2) expires Pump Control switches off the leading pump and replaces it by other accessible pump and starts counting operation time of new leading pump.

Replacement of the leading pump allows to distribute an operating time of each pump in system.

For automatic pump replacement the following conditions must be satisfied:

- the pump operating at present has worked the quantity of hours determined in parameter 5.21,
- the tasked pressure is less or is equal to a threshold determined in parameter 5.24 (blocking of replacement at high loading of grid),
- there is accessible at least one pump (except leading pump) which is not blocked and its configuration allows to operate as leading pump (MFC/MAINS),
- parameter P limit (5.28) is set up on value 2 or more.

When mentioned above conditions are satisfied the system passes to consecutive replacement of the leading pump. With this purpose:

- in series of 2-seconds intervals all operating additional pumps are switched off according to sequence at the fig. 10.6b;
- in two next seconds the leading pump is switched off;
- through following two seconds the new pump is switched on. It is picked out of unblocked and ready to operate (with signal from the frequency converter) pumps. It is the next pump in sequence (see fig 10.6a) after last used leading pump;
- the system will begin a normal operation and in case of need it will switch on the additional pumps.

REMARK

If the system has been switched off from a supply grid, after switching on power the same pump will be switched on as a leading pump, as before. The amount of operating hours before switching off power is remembered and taken into account at the subsequent switching on.

If the main pump is blocked, other pumps are immediately switched off. After that the system will switch on next (according to a sequence from fig. 9.6a) main pump provided that it is not blocked and can operate from the frequency converter.

By temporarily blocking of main pump operation you can force replacement (accelerated) of this pump.

11. Advanced programming of MFC710

In order to use completely the frequency converter possibilities and to seize art of its programming it is necessary to familiarize with some concepts:

Characteristic point (abbreviation: PCH) - any from accessible 512 values which characterize current state of the converter's operation, for example, there are characteristic points which are responsible for a state of digital input and outputs, values of referencing-unit's signals and also points which are outputs of control unit PLC, etc. (see section 11.1)

Pointer - parameter which decides about what among disposable 512 characteristic points (PCH) will be taken as input value in certain place of process (see sections 11.1 and 11.2). Many of the standard parameters determining operation of MFC710 are, in essence, pointers that makes possible, for example, to control the drive operation using built - in control system PLC.

11.1. Characteristic Points (PCH)

Each of 512 Characteristic Points is a 16-bit number and can accept a numerical value from range 0 up to 65536 for unsigned numbers, or from -32768 up to 32767 for numbers with a sign. If this PCH is treated as digital value (logic 0 or 1) in this case value "logic 0" corresponds to value PCH = 0, and value "logic 1" corresponds each arbitrary value PCH ≠ 0. PCH are numbered from 0 to 511. Some of them are named in order to display their function on LCD or LED of control panel. Part of PCH remains not used and is intended for future use. In table 11.1 general classification of PCH is presented. The detailed description of every PCH can be found in Appendix A "Characteristic Points".

Table 11.1 - General classification of PCH

PCH number	Value	PCH number	Value
0...127	Digital variables of process (e.g. Digital inputs)	384...447	PCH, accessible for record by means of RS connection
128...255	Analog variables of process (e.g. Analog inputs)	448...511	PCH, connected with optional module of expansions
256...383	PCH, connected with units of internal control PLC		

11.2. PCH and the pointers – how does it work

Pointers and PCH are strictly connected: Value of the pointer (in range 0...511) decides which PCH will be picked - value of this PCH is output value (see fig. 11.1).

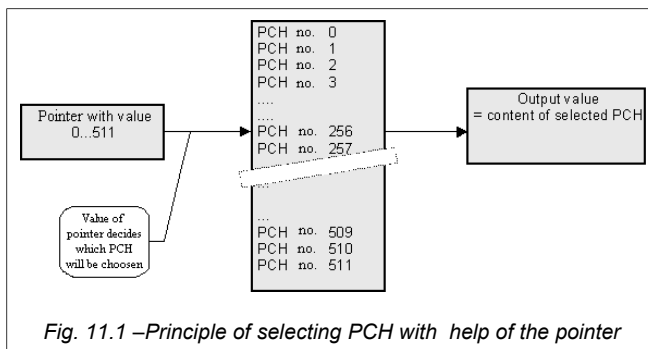


Fig. 11.1 –Principle of selecting PCH with help of the pointer

11.3. Modification of standard control

Part of parameters in the frequency converter MFC710 are defined as pointers (fig. 11.2). Due to this it is possible to change a standard way of controlling the frequency converter by connecting others PCH by means of these parameters. This PCH can be, for example, outputs of control system PLC which implements any control algorithm. There is an example in fig. 11.2. The parameter 2.2 is the pointer which is set up in PCH no.133 that is the Ref.-unit of Panel (Keyboard). It means: Value of the Referencing-unit A will be taken from the control panel (a). After modification value of the Referencing-unit A can be taken, for example, from an output of unit number 2 of control systems PLC (b).

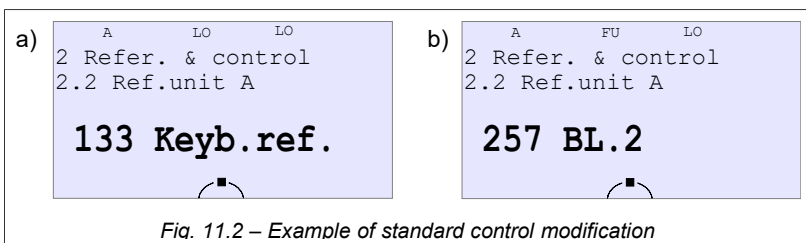


Fig. 11.2 – Example of standard control modification

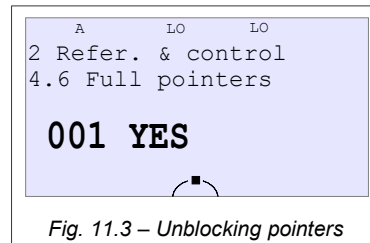


Fig. 11.3 – Unlocking pointers

For security reasons parameters which are pointers and concern operation of the frequency converter have restricted range of selecting PCH. They are reduced to the several standard values. For example for referencing-unit A and B it is possible to choose standard PCH starting from no. 133 to 139 (respectively: referencing-unit of the panel, referencing-unit of analog inputs 0, 1, 2, an output of the PID controller, a motor-potentiometer and RS referencing-unit). It secures, that the unexperienced user will not change this parameter to unspecified value. If however the designed application of system demands different from standard setting of the pointer (e.g. in case when for control of the converter it is necessary to use built-in PLC system or a control system of pumps group), in this case parameter 4.6 ("Full pointers") should be set up on value YES (fig. 11.3).

Operation sequence at change of standard control:

1. Unblock possibility of parameters changing (see a way in section 3.9),
2. Set Parameter 4.6 on value "001 YES",
3. Change appropriate parameter of the frequency converter (the)
4. If it is necessary block possibility of parameters changing.

11.4. The control panel – defining displayed values

Among parameters from group 0 there are 4 “read only” parameters which can be projected on display in a way defined by a user. Each of these parameters can include value of any PCH. You can define also: measurement unit and quantity of decimal digits. Table 11.2 presents configuration parameters.

Table 11.2 - Configuration of own displayed values

Defined parameter in group 0	Parameters determining configuration	Value
0.54 (Usr1)	Par. 4.60	The pointer to PCH which contains value displayed as par 0.54
	Par. 4.61	The displayed unit of measurement of par. 0.54 (see table 11.3)
	Par. 4.62	Number of decimal places 0.54 (0...3)
0.55 (Usr2)	Par. 4.63	The pointer to PCH which contains value presented as par 0.55
	Par. 4.64	The highlighting value of measurement of par. 0.55 (see table 11.3)
	Par. 4.65	Quantity of decimal places of par. 0.55 (0...3)
0.56 (Usr3)	Par. 4.66	The pointer to PCH which contains value displayed as par 0.56
	Par. 4.67	The displayed unit of measurement of par. 0.56 (see table 11.3)
	Par. 4.68	Number of decimal places 0.56 (0...3)
0.57 (Usr4)	Par. 4.69	The pointer to PCH which contains value displayed as par 0.57
	Par. 4.70	The displayed unit of measurement of par. 0.57(see table 11.3)
	Par. 4.71	Number of decimal places 0.57 (0...3)

Because parameters 0.54, 0.55, 0.56 and 0.57 belong to group 0 of parameters, they can be presented on the display of the control panel in a basic mode or in mode of fast review (see section 3.4) and due to this to receive effect as it is shown in fig. 11.4b.

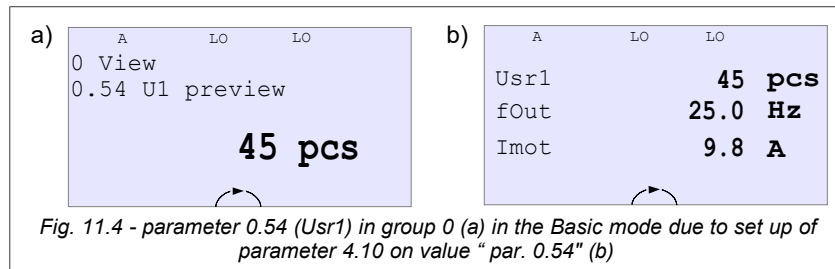


Table 11.3 - predefined measurement units

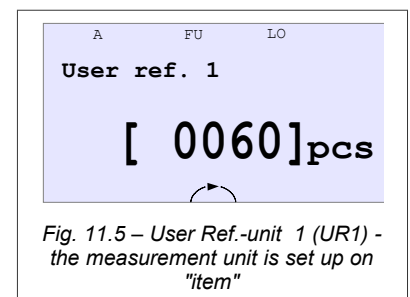
No.	Unit	No.	Unit	No.	Unit	No.	Unit	No.	Unit	No.	Unit
0		5	%	10	Nm	15	ms	20	hPa	25	Wb
1	V	6	Ohm	11	kWh	16	mOhm	21	Bar	26	MWh
2	A	7	kHz	12	mH	17	m/s	22	m	27	kVar
3	Hz	8	°C	13	s	18	szt	23	mm	28	min
4	rpm	9	kW	14	h	19	imp	24	m/m		

11.5. The control panel - definition of user referencing-units

Directly through Control panel with keys it is possible to change value of referencing-units: of frequency (rotation speeds), of the PID controller and also of one of four User Referencing-units (UR1, UR2, UR3 or UR4). The User Referencing-unit can be used, for example, for quick control of process in connection with built-in control system PLC (for example, referencing of quantity of converted pieces of products, selecting time intervals, etc.)

There is an access to the User Referencing-unit only when these conditions are satisfied:

- current control (A or B) is not set up on frequency referencing (rotation speed) from the Panel (par. 2.2 for control A and par. 2.3 for control B),
- the Referencing-unit of the PID controller (par. 2.60) it is not set up on the referencing from the Panel,
- parameter 4.30 (Choice User Referencing-unit) is set up on value 1 (for UR1), 2 (for UR2), 3 (for UR3) or 4 (for UR4). Value defines choice of active referencing-unit. In fig. 11.5 change of the Referencing-unit for par 4.30 = 1 is shown.



Each of four User Referencing-units (UR1, UR2, UR3 and UR4) has parameters which define:

- an allowable range of referencing-unit,
- displayed measurement unit (as in Table 11.3),
- quantity of decimal places.

The detailed description of parameters about user referencing-unit can be found in the Appendix C - see parameters from 4.30 to 4.51. Parameters 4.32...4.35 enable changes of the referencing-unit even when there is no direct access to it from the Control panel. In order to connect value the User Referencing-unit with structure of control of the frequency converter, four PCH are provided which keep current values of SU1... SU4:

PCH.178 = UR1

PCH.179 = UR2

PCH.180 = UR3

PCH.181 = UR4

11.6. System of rotation counter

System of rotations counter serves for measuring the amount of rotations of connected to converter encoder. Parameter 4.28 (Scale) determines the quantity of units that correspond to one rotation of encoder. Thus it is possible to scale any quantity connected with performing the rotation. For example, it can be an amount of mm corresponding to one rotation, amount of rotations in appropriate scale..

Counter can be erased by any PCH. Parameter **4.29 "n.rot.reset"** defines PCH, which erases the counter. Setting 1 erases and switches off the counter..

Counter counts „up” or „down” in range -32000 ... 32000. Current value of counter is placed in PCH.177.

System of rotations counter used in structure of PLC control can serve, for example, to set programmed quantity of rotations of drive's shaft.

12. PLC controller

In standard variant the frequency converter is equipped with built-in PLC controller which can serve for the control of converter's work or control of any process. PLC controller is switched on when the parameter 5.144 is set up on value YES.

The basic characteristics of control system PLC:

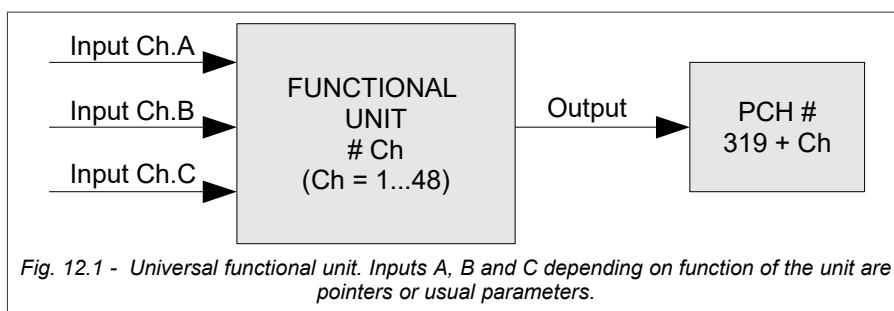
- 48 universal 3-input units from which each can implement one of 43 logical, arithmetical or time-counting functions,
- the sequencer unit with a possibility to program a sequence which will consist of maximum 8 states - each with individually programmed time of operation and a possibility changing state by external signal,
- two 8-input multiplexers which connect to an output one of eight input values depending on control signal,
- 5-point formation unit of curve X→Y which can be used, for example, as the referencing-unit with the certain characteristic,
- 24 programmed constants accessible also as PCH (can be used as factors in calculations),
- time of PLC program execution is less or equal to 10 ms.

Outputs of each PLC units are Characteristic Points, inputs are pointers and that's why it is possible to connect units among themselves and with parameters of the frequency converter, forming thus structure of a control system.

12.1. Universal functional blocks

There are 48 functional units which don't have precisely limited purpose. Therefore with their help it is possible to implement many control algorithms. Each of these units can perform one of 43 possible logical, arithmetical, time-

counting sequencer, multiplexer, curve shaping functions (see appendix B). Each of these units has 3 inputs which have been marked A, B and C and are (depending on the selected function) pointers or constant parameters. Each unit has one output which is a Characteristic Point. OUT of unit 1 has number 256, OUT unit 2 has number 257. and so on, up to OUT of unit 48 which has number 303 (fig. 12.1 and appendix A).



Each of 48 Functional units has constantly assigned 4 parameters in 6 group of parameters, for example the Unit 1 has parameters:

- Par. 6.1 - function of the unit 1 (see Appendix B)
- Par. 6.2 - input A of the unit 1
- Par. 6.3 - input B of the unit 1
- Par. 6.4 - input C of the unit 1

Accordingly, parameters 6.5 up to 6.8 concern the Unit 2, parameters from 6.9 to 6.12 concern the Unit 3 and so on up to the Unit 48.

During PLC operation functions determined by Units are carried out in sequence from 1 up to 48 (always the unit with the lowest number is carried out before the unit with the highest number).

The full operation time of PLC sequence depends on amount of blocks used in program, determined by par. 5.145. This time is equal to $T = \text{par. 5.145} \times 0.2\text{ms}$. By default, parameter is set to 50 what limits time of execution to 10 ms.

NOTE 1. Units with numbers higher than par. 5.145 are not executed!

NOTE 2. The sequencer device, Multiplexers and Curve shaping unit should be placed in one of the function blocks to activate them.

12.2. Sequencer device

The sequencer (fig. 12.2) allows programming up to 8 cyclically repeating operation modes of the converter with the determined times of duration of separate modes. Inputs marked out by arrows are pointers - they take the data from PCH determined by the specified parameter. Input LEN is an ordinary parameter.

In case of defining sequencer as functional unit corresponding inputs A, B and C aren't active. To output of sequencer (which is appropriate PCH of such unit) number of sequence is passed. Number of sequence can be also found in PCH 312.

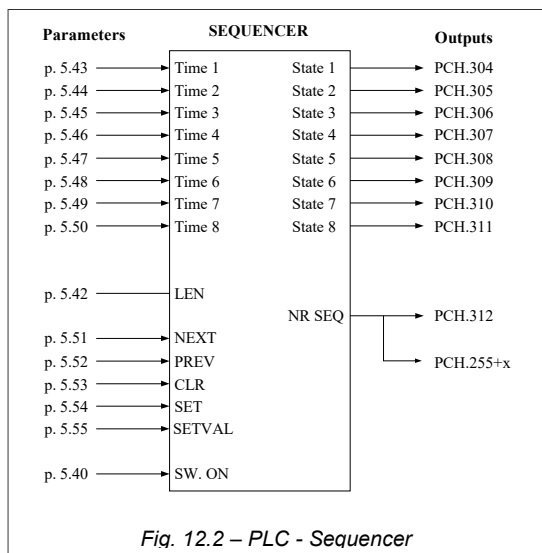


Fig. 12.2 – PLC - Sequencer

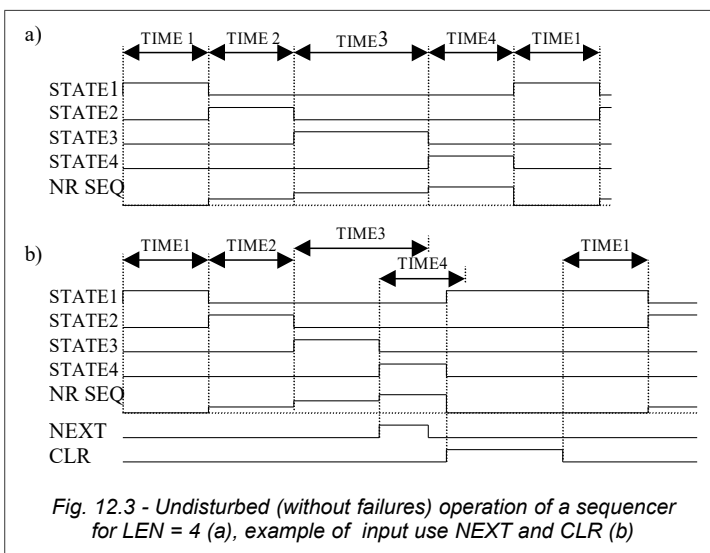


Fig. 12.3 - Undisturbed (without failures) operation of a sequencer for LEN = 4 (a), example of input use NEXT and CLR (b)

Input/output names	Meaning
SW. ON	The pointer to PCH switching on the unit of a sequencer. When SW. ON = 0 all outputs of the device are set on value 0. The sequencer is ready to the beginning of STATE 1 after unblocking this input
LEN	Quantity of sequences. Range from 2 up to 8 allows to organize quantity of sequences. After execution of last sequence first is automatically carried out ("looping").
TIME 1 ... TIME 8	Pointers for PCH which define duration of separate sequences. A range of a time 0.1sec ... 6553.5 sec (interval 0.1 sec). Constant Values (see section 12.5) can be, for example, this PCH.
NEXT	Force switching into following state (forward). The input operates at down-up transition of a signal.
PREV	Force switching into previous state (backward). The input operates at down-up transition of a signal..
CLR	Force transition into STATE 1 when CLR = H (differs from 0).
SET	Force transition into a STATE determined by input SETVAL when SET = H (the priority is lower, than CLR).
SETVAL	STATE to which the frequency converter passes after supply of signal SET (a range 0...7, there are only 3 youngest bits).
STATE 1 ...STATE 8	Outputs which correspond to current state of a sequencer. At the same time only one of outputs STAT1... STAT8 have value other than zero.
NR SEQ	An output - value 0...7. Number of a current state minus 1.

12.3. Multiplexers MUX1 and MUX2

These are two units which implement the selecting function "1 from 8". Depending on the input state of SELECT (values 0...7, only 3 youngest bits are important) on the output of the multiplexer (PCH number 313 or 314) value from an appropriate input (from In0 up to In7) is transferred. It is possible to switch off the multiplexer (input Sw.on) then input value of DVAL input is transferred to the output. Parameter PRIOR can adopt a value from 1 (the most high priority) up to 48 (see the description of a sequencer operation - section 12.2).

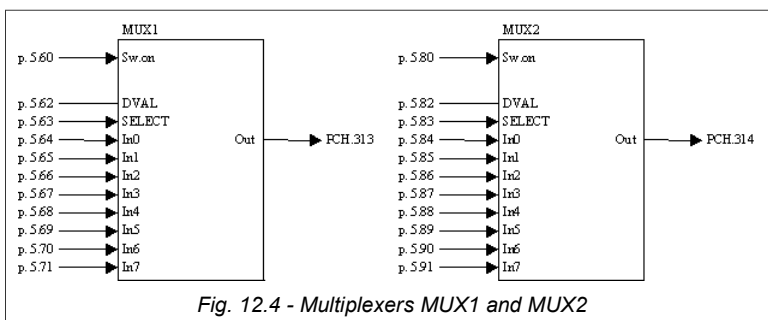
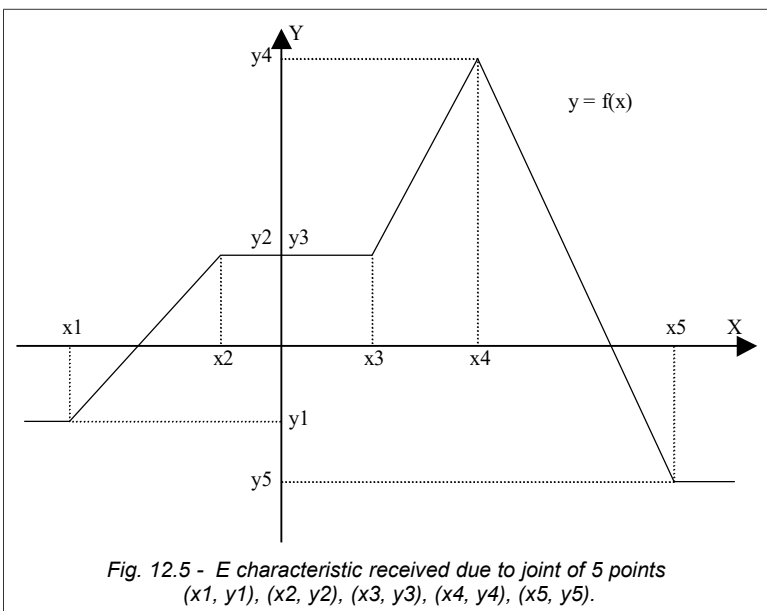


Fig. 12.4 - Multiplexers MUX1 and MUX2

As in sequencer most parameters (inputs) are pointers. They are presented in fig. 12.4.

12.4. Curve shaping unit

PLC controller contain Curve Shaping Unit (CSU) which can serve, for example, for formation of the characteristic of the speed referencing - changing the characteristic from linear to determined broken curve. CSU is the functional converter of any input value X into output value Y, which depends on the form of a curve which is defined with help of 5 points (X, Y) (see fig. 12.5). These points are determined as parameters of CSU. Input value X is chosen by parameter 5.101. Output value Y is in PCH.315.



Parameter	Description	Parameter	Description
5.101	The pointer for an input (a source of value of the X-input)	5.107	Y3 - parameter y points 3. range-32000...32000
5.102	X1 - parameter x points 1. range-32000...32000	5.108	X4 - parameter x points 4. range-32000...32000
5.103	Y1 - parameter y points 1. range-32000...32000	5.109	Y4 - parameter y points 4. range-32000...32000
5.104	X2 - parameter x points 2. range-32000...32000	5.110	X5 - parameter x points 5. range-32000...32000
5.105	Y2 - parameter y points 2. range-32000...32000	5.111	Y5 - parameter y points 5. range-32000...32000
5.106	X3 - parameter x points 3. range-32000...32000		

CAUTION: conditions $X1 \leq X2 \leq X3 \leq X4 \leq X5$ should be satisfied.

12.5. Constant values

In cases, when we want to determine a constant value as an input of any PLC block, we can use one of 24 constant values accessible as PCH with number from 320 to 343. These values can be set in range from -32000 to 32000 by means of parameters 5.120 do 5.143.

Example when there is a necessity to use a constant.

*It is necessary to execute operation $Y = 5 * X$ where X is an input value and Y is output value. Using universal units PLC, we can execute operation $(A * B / C)$ This is function number 2 (see. Appendix B). We assume $A = X$, $B = 5$ and also $C = 1$, in result we have function Y (an output of the universal unit) = $X * 5 / 1$*

How shall we do it?

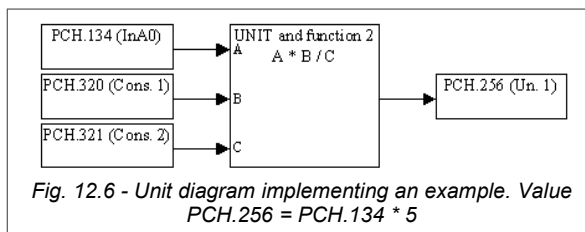
With parameter 5.120 we set value of Constant 1 to 5,

- parameter 5.120 sets up value of the Constant number 1 on 5,
- parameter 5.121 sets up value of the Constant number 2 on 1,
- parameter 6.1 (function of the unit 1) is set up on value 2 (function 2, that is $A * B / C$),
- parameter 6.2 (input A of the unit 1) is set up on a signal source X, for example, the analog input 0 = PCH.134),
- parameter 6.3 (input B of the unit 1) is set up on the Constant number 1 = PCH.320,
- parameter 6.4 (input C of the unit 1) is set up on the Constant number 2 = PCH.321.

In this connection inputs B and C of functions 2 are pointers, instead of parameters, so they cannot be assigned a constant values. It is necessary to choose the Constant number 1 (PCH.320) from among characteristic points for input B and the Constant number 2 (PCH.321) for input C.

The parameter 5.144 "Switching on PLC" is set up on YES.

Since this time PCH.256 (the output of the unit number 1) is the value corresponding to result of operation $X * 5$, that in our case corresponds to value of an analog input 0 increased 5 times, which means it changes in limits from 0 to 5000 (0.0...500.0 %) (fig. 12.6).



12.6. Example of PLC use

An example presented in this section describes how to control such quantities as output speed and time of motor acceleration by means of built-in PLC.

TASK: To modify the process of motor start-up in such way, that the speed characteristics of a motor would look just like it is shown in fig. 12.7.

In fig. 12.7 it is possible to distinct three zones: the First zone - slow acceleration - (Dynamics 1), II zone - the established speed, and also III zone – fast acceleration (Dynamics 2).

Frequency converter MFC710 allows to set up 2 different rates of acceleration and braking: Dynamics 1 and Dynamics 2. These rates are determined by parameters 1.30, 1.31, 1.32, 1.33. Parameter 1.36 decides which dynamic is currently active. The parameter 1.36 is a pointer and consequently it can be set up so that one of PLC units decides about dynamics.

In fig. 12.7 it is shown, that after the motor acceleration (with dynamics1) to speed N1 it is necessary to make time limit T and then to accelerate the motor (with dynamics 2) to speed N2. It is necessary to modify parameter 2.2 (Referencing-unit A) so that one of PLC units define an relative level of speed up to which the motor should be accelerated (this level corresponds to the nominal frequency of the motor).

In fig. 12.8 the structure which implements a given task it presented. The unit 1 is the comparator which reacts to the value of first speed. In the observed case acceleration with dynamics 1 is implemented to speed of 20.0% (ST1) of nominal speed. The signal which informs about achievement of the first value of speed enables Unit 3. The Unit 3 is the counter which counts downwards from value 5 (ST3) every 1 second (constant speed for 5s). The output signal of the Unit 3 enables the Unit 4 and switches type of dynamics (Dynamics 1 or Dynamics 2). The unit 4 is a switch which, depending on a signal on input, passes to the referencing-unit A the first or second value of speed (ST1/ST2). Value of balance time (ST3), first (ST1) and second (ST2) speed can be modified by connecting in proper place, for example, an analog input or one of user referencing-units. Condition: $ST2 > ST1$ must be fulfilled.

To realize such structure it is necessary to:

1. define the Unit 1 (par. 6.1 = 12, par. 6.2 = PCH.176, par. 6.3 = PCH.320, par. 6.4 = 0),
2. define the Unit 2 (par. 6.5 = 23, par. 6.6 = PCH.256),
3. define the Unit 3 (par. 6.9 = 27, par. 6.10 = PCH.91, par. 6.11 = PCH.257, par. 6.12 = PCH.322),
4. define the Unit 4 (par. 6.13 = 9, par. 6.14 = PCH.321, par. 6.15 = PCH.320, par. 6.16 = PCH.256),
5. define the Unit 5 (par. 6.17 = 23, par. 6.18 = PCH.258),
6. set up parameter 2.2 (Referencing-unit, A) on PCH.259 as it described in section 3.2.1, 3.2.8,
7. set up parameter 1.36 (Choice of dynamics) on PCH.260,
8. switch on PLC setting up parameter 5.144 on YES.

In above mentioned example the parameter 5.120 will define a threshold of speed N1 [resolution 0.1 %, that is 1000 = 100.0 %], the parameter 5.121 will define a threshold of speed N2 [resolution 0.1 %, that is 1000 = 100.0 %], a parameter 5.122 time T with resolution of one second.

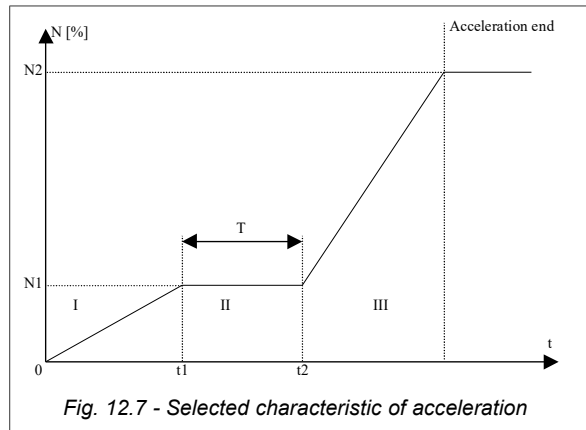


Fig. 12.7 - Selected characteristic of acceleration

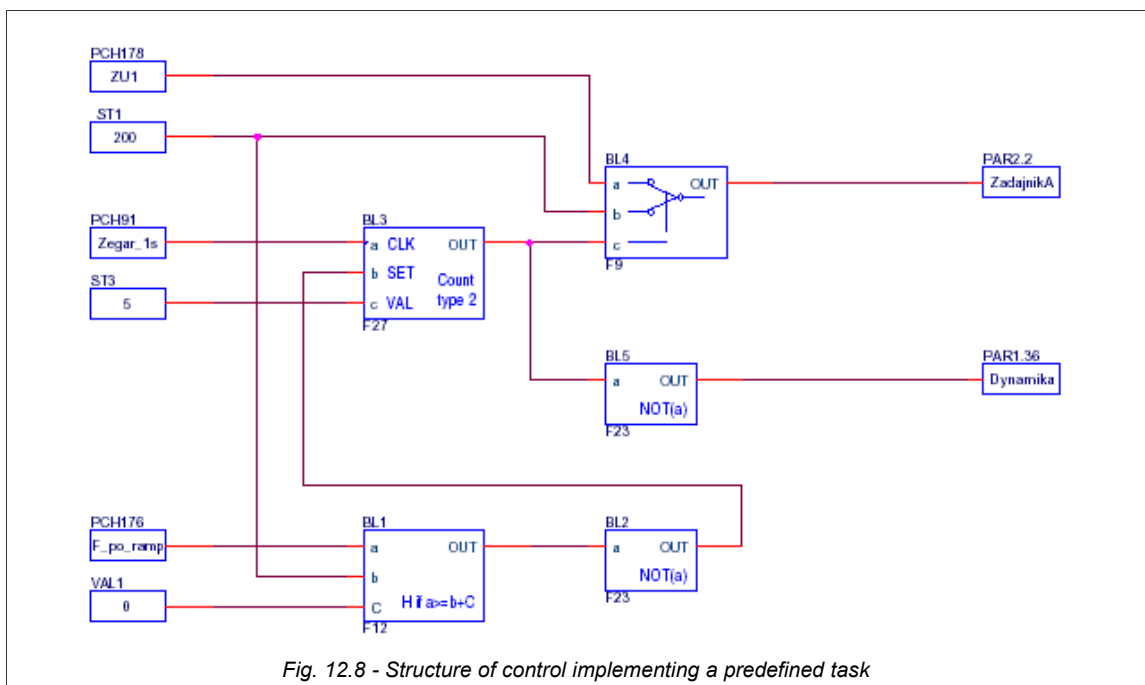


Fig. 12.8 - Structure of control implementing a predefined task

13. Control of the frequency converter by means of connection RS

Frequency converter MFC710 is equipped with RS232 communication link and/or RS485 (depending on variant). It enables to control work of device with help of a computer or an external controller. The basic characteristics and possibilities of the RS link of the frequency converter:

- operation with speed 9600, 19200, 38400 or 57600 bits per second,
- a format of a character: 8 data bits, lack of parity control, 2 stop bits,
- transfer protocol: MODBUS mode RTU,
- check of transfer validity with use of CRC sum,
- unit number (converter) set up with help of parameter (typically 12),
- support of MODBUS commands: command 3 - "read the register" - allows to read individual registers from the converter or block of up to 127 registers. command 6 - "register write" - write to individual register in the converter,
- possibility of reading of an operating mode, control start/stop, reading and writing of referencing-units,
- possibility of reading and writing of all parameters of the converter just as by means of a control panel,
- possibility of reading all 512 PCH and writing 64 of them, which are intended for writing through RS connection.

All operations are based on two basic commands of MODBUS RTU protocol - 3 and 6 which are described in publications concerning MODBUS.

13.1. Parameters which concern communication through RS

Table 13.1 - Parameters which refer to communication

Parameter	Description
2.2	Referencing-unit A - it is possible to set up a source "RS"
2.3	Referencing-unit B - it is possible to set up a source "RS"
2.4	Start A - it is possible to set up a source "RS"
2.5	Start B - it is possible to set up a source "RS"
4.7	RS permission – it is possible to enable permanent permission to control from RS, disable permanent permission or, for example, set enabling/disabling RS permission from a digital input. The permission concerns referencing frequency through RS, RS PID referencing-unit, and a START / STOP/BLOCKING signal from RS (see table 13.2 - registers 2000, 2001 and 2002).
4.8	RS speed - possible options is 9600, 19200, 38400, 57600 bits per second.
4.9	Number of device (converter) in MODBUS protocol (possibility of connecting several converters through one communication channel RS 485).

CAUTION: If control RS blocked (par. 4.7), and parameters 2.2, 2.3, 2.4 or 2.5 define control as "RS" in this case the frequency converter remains in STOP mode or the referencing-unit of frequency will assume value 0.

13.2. Map of registers accessible through RS link

All registers are 16-bit numbers. Addresses which are omitted in the table are not supported.

Table 13.2 - Registers

The address of the registers (decimal)	Description (meaning)	Mode
PCH REGISTERS		
1000 ... 1383	PCH from number 0 up to number 383 (see. Appendix A)	Read only
1384 ... 1447	PCH from number 384 up to number 447 - intended for writing through RS (see. Appendix A)	Read / write
1448 ... 1511	PCH from number 448 up to number 511 (see. Appendix A)	Read only
REGISTERS OF OPERATING MODES		
2000	<p>The register RS CONTROL. The data is valuable only when the parameter 4.7 (RS permission) allows control of the device with RS. Bits meaning:</p> <ul style="list-style-type: none"> bits 0 - not used bits 1 - the sequence 0 → 1 → 0 erases the message on failure bits 2,3 - not used bits 4 - 1 = force referencing PID from RS (the register 2002) bits 5 - 1 = force referencing frequency from RS (the register 2001) bits 6 - 1 = force START/STOP Control from RS bits 7,8,9,10,11 - not used bits 12 - 1 = BLOCKING of OPERATION shut down according to Parameter bits 13 - 1 = BLOCKING of OPERATION shut down RAMP bits 14 - 1 = BLOCKING of OPERATION shut down RUN OUT bits 15 - 1 = START 0 = STOP <p>Bits 4,5,6 allow to force control of the drive through communication channel RS even if referencing-units or source of START / STOP signal is set up on value which differs from RS. If, for example, the referencing-units A is set up on value "RS" , to set frequency with RS, there is no necessity to set up bit 5. Forcing of control with RS by means of bits 4,5,6 results in switching off a source of the control established with parameters.</p> <p>Bits 12,13,14 block operation of the drive irrespective of the established type of control (also when, for example, there is control through RS and bits 15 = 1).</p>	<p>Read / write</p> <p>The last value written down in this register can be read.</p>

Section 13. Control of the frequency converter by means of connection RS

2001	The RS frequency referencing-unit operates only if the parameter 4,7 (RS permission) allows operation with RS. Resolution 0,1Hz (see. CAUTION), a range - 5000....5000. e.g. 250 = 25.0 Hz clockwise rotation e.g.-122 = 12.2 Hz anti-clockwise rotation CAUTION. For a mode of vector control (the Vector 1 and Vector2) value is in rotations per one minute (rpm) instead of in Hz.	Read / write
2002	The referencing-unit of the PID controller operates only if the parameter 4.7 (RS permission) allows operation with RS. Resolution 0,1 %, a range 0....1000. e.g. 445 = 44,5 %	Read / write
2003	Forcing state of digital inputs. The register intended for testing. If bits 15 of this register is set up, bits 0....5 determine a state of a digital input 1....6 of electric drives (state on a real digital input is ignored)	Read / write
2004	STATE OF CONTROL The register which informs from where current START/STOP signal and current frequency referencing-unit is coming. bits 0 - 1 = control A active bits 1 - 1 = control B active bits 2 - 1 = the referencing-unit from an analog input 0 bits 3 - 1 = the referencing-unit from an analog input 1 bits 4 - 1 = the referencing-unit from an analog input 2 bits 5 - 1 = the referencing-unit from a motor-potentiometer bits 6 - 1 = the referencing-unit from an output of the PID controller bits 7 - 1 = the referencing-unit from a control panel bits 8 - 1 = the referencing-unit with another PCH (advanced) bits 9 - 1 = START / STOP from digital inputs (remote) bits 10 - 1 = START / STOP from a control panel (local) bits 11 - 1 = START / STOP with another PCH (advanced) bits 12 - 1 = START / STOP set through RS connection bits 13 - 1 = the referencing-unit of frequency from communication channel RS bits 14 - 1 = active frequency is CONSTANT (f c) its 15 - 1 = the emergency referencing-unit is switched on (can be connected to other bits determining a source of the referencing-unit)	Read only
2005	PID controller state This register informs from where current referencing-unit and input signal of PID controller is coming and also whether SLEEP is switched on. bits 0 - 1 = PID referencing-unit from an analog input 0 bits 1 - 1 = PID referencing-unit from an analog input 1 bits 2 - 1 = PID referencing-unit from an analog input 2 bits 3 - 1 = PID referencing-unit from a control panel bits 4 - 1 = PID referencing-unit from communication channel RS bits 5 - 1 = PID referencing-unit comes from PCH (advanced) bits 6 - 1 = PID input from an analog input 0 bits 7 - 1 = PID input from an analog input 1 bits 8 - 1 = PID input from an analog input 2 bits 9 - 1 = PID input comes from PCH (advanced) bits 10 - 1 = SLEEP blockade of PID controller is active bits 11,12,13,14,15 - not used (= 0)	Read only
2006	OPERATION STATE Value of this register serves for identification of the device's state: bits 0 - 1 = the drive operates bits 1 - 1 = one of referencing-units of a control panel (frequency, the PID controller or the user's referencing-unit) is switched on bits 2 - 1 = device is blocked bits 3 - 1 = ready to restart (failure message was erased, but reason has not disappeared) bits 4,5,6 - number of automatic restart/number of a stage of identification bits 7 - CRC error in EEPROM bits 8,9,10,11,12 - a failure code or warning (0 - absence of failure) bits 13 - value of a failure code: 0 = failure, 1 – warning) bits 14 - a direction of operation (0 = to the right, 1 = to the left). bits 15 - 1 = identification (it is started by par. 1.10)	Read only
2007	bits 1 - 1 = during the drying process of the electric motor	
THE REGISTERS CONNECTED TO PARAMETERS		
40xxx	Parameters from group 0. They are analogous with parameters on the control panel, e.g. the register 40003 corresponds to parameter 0.3	Read only
41xxx	Parameters from group 1. They are similar with parameters on the control panel, e.g. the register 41020 corresponds to parameter 1.20. CAUTION: Changes of parameters are subjected to the same rules, as in case of operating from a control panel. There can be necessary to disable blocking of parameters change (parameter 4.1 = the register 44001) or entering of the corresponding code of access (parameter 4.2 = the register 44002). Some parameters of the device can be changed only in a case when it does not operate. Details: section 3.2 and following.	Read / write
42xxx	Parameters from group 2. They are similar with parameters on the control panel, e.g. the register 42001 corresponds to parameter 2.1. CAUTION: the same as item 41xxx.	Read / write

43xxx	Parameters from group 3. CAUTION: the same as item 41xxx	Read / write
44xxx	Parameters from group 4. CAUTION: the same as item 41xxx	Read / write
45xxx	Parameters from group 5. CAUTION: the same as item 41xxx	Read / write
46xxx	Parameters from group 6. CAUTION: the same as item 41xxx	Read / write

13.3. Handling of connection errors

If connection errors appear or if the command with improper parameter is sent, response of the device is described by MODBUS standard. Possible return error codes are:

- 1 = unknown command - when the command other than 3 or 6 is sent,
- 2 = wrong address - the address of the register is not supported by the drive (there is no such register),
- 3 = wrong value - command 6 tried to send value which is out of range of specified register

In case of wrong transfer (e.g. CRC error) device does not send answers to commands.

14. Maintenance

When installed, the use of the converter in accordance with its specifications is not often required periodic service. The cleanliness of the heatsink and fan as well as the condition of the cable connections require attention electrical wiring, in particular the PE protective conductor. The drive inspection schedule is shown in table 14.1.

Before starting maintenance work it is obligatory:

- disconnect the converter from all supply voltage sources (supply circuit, control circuits),
- make sure that there are no dangerous voltages on the connection terminals,
- wait 30 minutes (this is the time needed for the internal DC link capacitors to discharge and the inverter has cooled down).

If maintenance work requires the housing to be disassembled, make sure it is not present voltage in the internal DC circuit.

Table 14.1. Frequency converter maintenance schedule

Maintenance place	Purpose of the Maintenance	Maintenance frequency
Heatsink	A large amount of dirt deposited on the heat sink weakens heat dissipation and may trigger operation thermal protection of the converter. Cleaning the heat sink can be carried out with compressed, clean and dry air additionally using a vacuum cleaner that catches dirt.	Not less than 12 months ¹⁾
Fan	Increased fan noise and reduced performance work proves the need to replace it. Replacement fans are available from ZE TWERD. Do not use any spare parts other than those recommended by ZE TWERD.	
Condition of electrical connections	Checking the condition of the power circuit connections and control circuits. Check the tightness of the cable clamps and whether it is not present corrosion. Particular attention should be paid to the PE conductor.	

¹⁾ Maintenance should be performed regularly with a frequency depending on the degree of use of the converter and environmental conditions (e.g. dust, vibration).

Terms of warranty

The frequency converter is covered by the warranty in accordance with the information contained in the warranty card. The manufacturer is not responsible liability for defects caused by transport, improper use, faulty installation, inappropriate environmental conditions (e.g. temperature, humidity, presence of corrosive agents) and as a result of exceeding rated parameters.

Appendix A – Table of Characteristic Points

Caution: In these PCH which are interpreted as logical values (0/1 or NO/YES), there is abbreviation «H» used to refer to value different from zero (logical 1). For definition of value "logical 0" abbreviation «L» is used.

<i>PCH</i>	<i>PCH name</i>	<i>Function / value / note</i>
000	Switch Off	Value always = L (logical 0)
001	In.C1	State of digital input DI1; L = 0V, H = 24V
002	In.C2	State of digital input DI2; L = 0V, H = 24V
003	In.C3	State of digital input DI3; L = 0V, H = 24V
004	In.C4	State of digital input DI4; L = 0V, H = 24V
005	In.C5	State of digital input DI5; L = 0V, H = 24V
006	In.C6	State of digital input DI6; L = 0V, H = 24V
007	Switch on	Value always = H (logical 1)
008	F1	Key F1 (for future use) Value = always 0
009	F2	Key F2 (for future use) Value = always 0
010	F3	Key F3 (for future use) Value = always 0
011...019		Reserve. Value = always 0
020	Failure AI0	H = absence of "living zero" at the Analog Input 0 (mode 2...10V, 4...20mA).
21	Failure AI1	H = absence of "living zero" at the Analog Input 1 (mode 2...10V, 4...20mA)
22	Failure AI2	H = absence of "living zero" at the Analog Input 2 (mode 2...10V, 4...20mA)
23...29		Reserve. Value = always 0
030	Remote start	H = Remote Control (digital inputs) permits START This PCH operates also when remote control is not chosen, but the converter ignores it when the control differs from remote.
031	Local start	H = Local Control (Panel) permits START This PCH operates also when local control is not chosen,
032	RS start	H = Control through the connection RS allows START. This PCH operates also when RS control is not chosen.
033	Remote reverse	Direction of operation with Remote Control. L = determined with sign of referencing-unit, H = opposite (depends on state of digital inputs and mode of Remote Start - par. 2.8). This PCH operates even if the chosen control is different from remote.
034	Local reverse	Direction of operation with Local Control. 0 = determined with sign of referencing-unit, H = opposite (depends on pressing the key "Left" or "Right" on the control panel). This PCH operates even if the chosen control is different from local.
035	Ref.-unit sign	Ref.-unit sign . (L = positive ref.-unit, H = negative ref.-unit)
036	Below f_stop	H = the converter is blocked because frequency referencing-unit is lower then STOP frequency. It is determined with par. 2.13. This function will be switched on only in case of par. 2.14 = YES
037	START	H = currently active control allows to START the drive. But it doesn't always mean that the drive operates! One of the several blocking types may be switched on or the drive be running out after braking (directly before stopping)
038	Reverse	Operating direction at currently chosen control. L = is determined with a sign of referencing-unit, H = opposite. Equal to PCH.33 for remote control, PCH.34 for local control, L for RS control. At other control modes (defined by parameters / pointers 2.4 or 2.5) it is a copy of value PCH chosen by parameter / pointer 2.6 or 2.7.
039	A/B control	L = Control A active, H = Control B active
040	Enable RS	0 = general absence of permission to control the converter with RS, H = permission to control the converter with RS. Value of PCH is a copy of PCH which is set by parameter/pointer 4.7. If control through RS is selected (par. 2.4 or 2.5) and PCH.40 = L, then the referencing-unit (value - PCH.166) and also PCH.37 and PCH.38 are set on value zero. If control is chosen with par.2.4 or 2.5 and it differs from RS and PCH.40 = H, in this case it is possible to force externally control through RS (see section 13).
041	Operation permission	L = general lack of permission to work, H = permission to work
042	Fconst is active	H when referencing-unit of constant frequency is switched on. Depends from PCH, defined in the parameters 2.30,2.31,2.32.
043...058		Reserve. Value = always 0
059	PUMP 6	Pump system control. H = pump 6 operates
060	K_ZERO	Value = always 0
061	OPERATION	H when drive operates

Appendix A – Table of Characteristic Points

PCH	PCH name	Function / value / note
062	READY	H when the drive is ready to work (there are no failures)
063	FAILURE	H when there was a failure
064	NOT FAILURE	H when there is no failure
065	WARNING	H when any warning is switch on
066	FAIL. or WARN.	H if failure occurred or warning is active
067	Motor windings drying	H = Motor windings drying is going
068	Threshold 1	H = The frequency defined in parameter 2.98 is exceeded
069	Threshold 2	H = The frequency defined in parameter 2.99 is exceeded
070	Fref reached	H when the drive will reach the referenced frequency
071	Temperature threshold	H = The temperature of the drive has exceeded a threshold defined by parameter 2.100
072	Warning. Lack of the "living zero".	H = the prevention of absence of a signal on analog inputs is switch on in mode 2...10V 4...20mA
073	BLOCKING	H = the drive is blocked and isn't operating.
074	Limitation of current	H = The drive is in a mode of the output current limitation
075	Brake	H = mechanical brake released
076	PUMP 1	Pump system control. H = pump 1 operates
077	PUMP 2	Pump system control. H = pump 2 operates
078	PUMP 3	Pump system control. H = pump 3 operates
079	PUMP 4	Pump system control. H = pump 4 operates
080	PUMP 5	Pump system control. H = pump 5 operates
081	Relay 1	State of relay (digital output) number 1. H = it is switched on
082	Relay 2	State of relay (digital output) number 2. H = it is switched on
083	Relay 3	State of relay (digital output) number 3. H = it is switched on
084	Relay 4	State of relay (digital output) number 4. H = it is switched on
085...089		Reserve. Value = always 0
090	Timer 50 ms	Signal of timer with 50ms period and 50% filling
091	Timer 1s	Signal of timer with 1s period and 50% filling.
092	Timer 1min	Signal of timer with 1min period and 50% filling.
093	Timer 1 hour (t.1hour)	Signal of timer with 1 hour period and 50% filling
094...124		Reserve. Value = always 0
125	RSTout	Value corresponding to timeouf of the communication through RS
126	NULL	Value always = L
127	NOT NULL	Value always = H
128...132		Reserve. Value = always 0
133	Keyboard ref.-unit	Value of the local referencing-unit (keyboard). resolution 0.1 Hz. e.g. 500 = 50.0 Hz, range is determined by parameters 2.11 and 2.12
134	Input A0	Value corresponding to voltage (current) of analog input 0. resolution 0.1 Hz, range 0...1000 = 0.0...100.0 %. It depends on parameter 2.40
135	Input A1	Value corresponding to voltage (current) of analog input 0. resolution 0.1 Hz, range 0...1000 = 0.0...100.0 %. It depends on parameter 2.41
136	Input A2	Value corresponding to voltage (current) of analog input 0. resolution 0.1 Hz, range 0...1000 = 0.0...100.0 %. It depends on parameter 2.42
137	PID Output	Output of PID controller. resolution 0.1 %, range is determined by parameters 2.66 and 2.67
138	Motopotentiometer	Ref.-unit of the motopotentiometer. resolution 0.1 %, range 0...1000 = 0.0...100.0 %
139	RS ref.-unit	Value of the frequency ref.-unit which is transmitted through RS connection. resolution 0.1 Hz. Sign determines direction of the motor rotation
140	Additional motopot.	Additional motopotentiometer. Resolution 0.1%, range 0...1000 = 0.0...100.0%
141	PID motopot.	Referencing-unit of motopotentiometer for PID controller.
142	RS PID ref.-unit	Value of PID controller ref.-unit which is transmitted through RS connection. resolution 0.1 %.
143	PID keyboard	Value of PID controller referencing-unit from control panel. Interval is 0.1 %.
144	Value A0	Value of analog input 0 multiplied by parameter of scale 2.43 and added offset – parameter 2.46
145	Value A1	Value of analog input 0 multiplied by parameter of scale 2.44 and added offset – parameter 2.47

Appendix A – Table of Characteristic Points

PCH	PCH name	Function / value / note
146	Value A2	Value of analog input 0 multiplied by parameter of scale 2.45 and added offset – parameter 2.48
147	100%	In all cases value 1000 corresponds to 100.0 % of referencing-units
148	RC Output	Output of reeler calculator device, it serves for torque referencing. Resolution 0.1 %, range 0.0...100.0 %
149	ABS rotations percent	Relative value which corresponds to current rotational motor speed compared to the rated motor rotation speed. Resolution 0.1 %. Value without a sign, it doesn't depend on direction of rotation.
150	Rotations percent	The same but with sign depending on direction of rotation -1000 = -Nn, 0 = 0 rpm, 1000 = Nn
151	Frequency percent	Relative value which corresponds to current output frequency of the drive compared to the rated motor frequency. Resolution 0.1 %. Value without a sign, it doesn't depend on direction of rotation.
152	Current percent	Relative value which corresponds to present output current compared to rated current of the motor. Resolution 0.1 %.
153	ABS torque percent	Relative value which corresponds to current torque of the motor compared to the rated torque. Resolution 0.1 %. Value without a sign (always positive).
154	Torque percent	Relative value which corresponds to current torque of the motor compared to rated torque. Resolution 0.1 %. Value with positive sign means that the drive gives the electric energy to the motor, negative - the drives brakes the motor (gets el. energy from the motor).
155	Power percent	Relative value which corresponds to current output power of the drive compared to rated power of the motor. Resolution 0.1 %. Value with positive sign means that the drive rotates the motor, negative - the drive breaks the motor.
156	Motor voltage percent	Relative value which corresponds to current output voltage of the drive compared to rated voltage of the motor. Resolution 0.1 %. Value without a sign (always positive).
157	PID error	Value of present error of PID controller (error = PID input – PID ref.-unit). Resolution 0.1 %
158	PID ref.-unit	Value of the PID controller referencing-unit – copy of PCH.142 for referencing-units PID with RS or PCH.143 for referencing-units PID from the panel, or copy of the other PCH. It depends on parameter 2.70
159	Motor temperature	Estimated motor temperature in %, resolution 0.1 %.
160	PID Input	Value of PID controller input. It serves for connection of regulated process signal. This is a copy of PCH, determined with parameter 2.61
161	FR ref.-unit	Output of pump control system ref.-unit. Value of this PCH should be chosen as a main ref.-unit of the drive in Fast Review operation mode without PID controller (parameter 2.2 or 2.3)
162	N of the process	Speed of the process. Value of this PCH is a result of current rotation speed of the motor and scale factor determined with parameter 4.25. It serves for converting rotation speed to output value (e.g. m/s).
163	Torque ref.-unit	Value of the torque referencing-unit. Copy of PCH determined by parameters 2.9 or 2.10. Resolution 0.1 %, range 0.0...100.0 %.
164	Ref.-unit A	Value of ref.-unit A chosen with parameter 2.2. Resolution 0.1 Hz, value with sign.
165	Ref.-unit B	Value of ref.-unit B chosen with parameter 2.3. Resolution 0.1 Hz, value with sign.
166	Ref.-unit	Output of control unit – the final value of the frequency converter, value with a sign determining the direction of rotation (plus = to the right, minus = to the left). Resolution 0.1 Hz.
167	ABS ref.-unit	Output of the control unit – the final value of the frequency ref.-unit, value without a sign(always positive). Resolution 0.1 Hz.
168	Fconst 1	Constant frequency number 1, Copy of parameter 2.33
169	Fconst 2	Constant frequency number 2, Copy of parameter 2.34
170	Fconst 3	Constant frequency number 3, Copy of parameter 2.35
171	Fconst 4	Constant frequency number 4, Copy of parameter 2.36
172	Fconst 5	Constant frequency number 5, Copy of parameter 2.37
173	Fconst 6	Constant frequency number 6, Copy of parameter 2.38
174	Fconst 7	Constant frequency number 7, Copy of parameter 2.39
175	Freq Last	Average frequency
176	f Ramp ABS percent	Value PCH.166 converted to % compared to rated motor frequency taking into account the procedures of acceleration/braking (ramp). Interval is 0.1 %. For operating mode U/f value of this PCH corresponds to current output frequency of the drive. Value without sign (doesn't depend on direction of rotation).
177	Lrot	Value of rotation counter.
178	UR1	Value of the user referencing-unit number 1.
179	UR2	Value of the user referencing-unit number 2.
180	UR3	Value of the user referencing-unit number 3.
181	UR4	Value of the user referencing-unit number 4.

Appendix A – Table of Characteristic Points

PCH	PCH name	Function / value / note
182	fzA_percent	Value corresponds to PCH.164 (referencing-unit A) converted to relative value (compared to rated motor frequency). Value without a sign, resolution 0.1 %.
183	fzB_percent	Value corresponds to PCH.165 (referencing-unit A) converted to relative value (compared to rated motor frequency). Value without a sign, resolution 0.1 %.
184	fz_percent	Value corresponds to PCH.166 (referencing-unit) converted to relative value (compared to rated motor frequency). Value without a sign, resolution 0.1 %.
185	f Ramp	The same as PCH.176 but presented in Hz and with sign depending on direction of rotation.
186	fz%(1)	Value corresponds to PCH.166 (referencing-unit) converted considering Fmin and Fmax. Value with a sign, resolution 0.1%.
187	Fz%(2)	as above with the difference that value doesn't take into consideration direction of rotation. Resolution 0.1%.
188	Fmin of the ref.-unit	Min value of the frequency referencing-unit – a copy of parameter 2.11. Resolution 0.1 Hz. Value of the referencing-unit (in %) is determined by parameter 2.2 or 2.3, converted to resolution 0.1 Hz considering Fmin and Fmax. 0.0 % = Fmin, 100.0 % = Fmax
189	Fmax of the ref.-unit	Max value of the frequency referencing-unit – copy of parameter 2.11. Resolution 0.1 Hz. Value of the referencing-unit (in %) is determined by parameter 2.2 or 2.3, converted to resolution 0.1 Hz considering Fmin and Fmax. 0.0 % = Fmin, 100.0 % = Fmax
190	RTCmin	Value corresponding to current minute of the day. Range 0 ... 1439 (only in systems equipped with the optional RTC module).
191	RTCdoy	Value corresponding to current day of the year. Range 0 ... 365 (only in systems equipped with the optional RTC module).
192	RTCdom	Value corresponding to current day of the month. Range 0 ... 31 (only in systems equipped with the optional RTC module).
193	pump	Value corresponding to currently working pump. Range 0 ... 4.
194	motor	Value corresponding to currently working motor. Range 0 ... 4.
195	motor windings drying timer	Time remaining until the end of motor windings drying process [in minutes] – equivalent to par. 0.38
196..197		Reserve. Value = always 0
198	r.n%	Relative value which corresponds to current speed reference compared to rated speed
199	z n%	Relative value which corresponds to current speed reference compared to rated speed. Value without a sign (always positive)
200..205		Reserve. Value = always 0
206	f.code	Value corresponds to the failure code
207	w.code	Value corresponds to the warning code
208..217		Reserve. Value = always 0
218	d wind	Value corresponds to the current reeling diameter
219..221		Reserve. Value = always 0
222	f InC3	Value corresponds to the frequency on the Digital Input DI3
223	f InC4	Value corresponds to the frequency on the Digital Input DI4
224	f InC5	Value corresponds to the frequency on the Digital Input DI5
225	f InC6	Value corresponds to the frequency on the Digital Input DI6
226..227		Reserve. Value = always 0
228	outPIin	Output value of speed regulator
229	T ref	Input value of torque regulator
230..237		Reserve. Value = always 0
238	ENCpos	Value corresponds to the current encoder position
239	ENCref	Value corresponds to the reference encoder position
240	ENCdif	Value corresponds to the difference between current and reference encoder position
241..255		Reserve. Value = always 0
PCH of built-in PLC controller		
256	UNIT number 1	PLC controller. Output of the universal unit number 1. Depends on unit function. Value can be set from 0 to 65535.
257	UNIT number 2	PLC controller. Output of the universal unit number 2. Depends on unit function. Value can be set from 0 to 65535.
258...303	UNIT number 3...48	PLC controller. Output of the universal unit number 3...48. Depends on unit function. Value can be set from 0 to 65535.
304	SEQUENSER STATE 1	PLC controller. Sequencer system. Value H = active mode 1 (only one of the PCH.304...311 can assume value H at the same time and only if the sequencer is switched on)

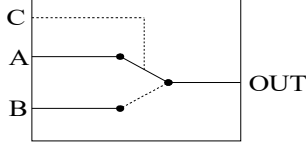
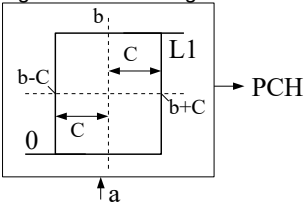
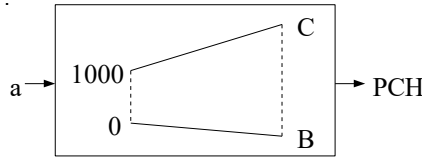
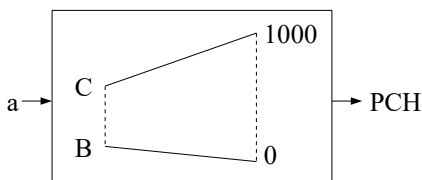
Appendix A – Table of Characteristic Points

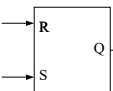
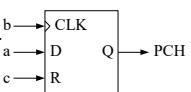
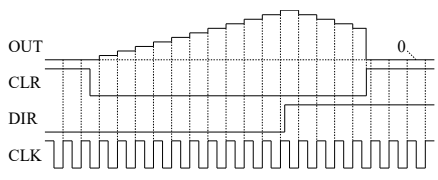
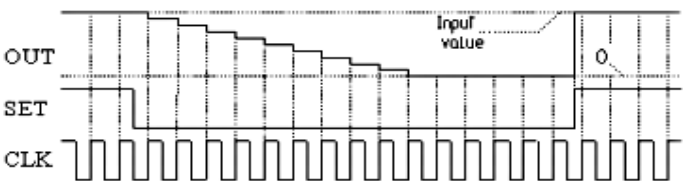
PCH	PCH name	Function / value / note
305	SEQUENSER STATE. 2	PLC controller. Sequencer system. Value H = active mode 2
306...311	SEQUENSER STATE. 3...8	PLC controller. Sequencer system. Value H = active mode 3...8
312	SEQUENSER NUMBER SEQUEN.	PLC controller. Sequencer system. Number of active mode. Value of this PCH can assume value 0...7.(0 = STATE 1...7 = STATE 8)
313	MULTIPLEXER 1	PLC controller. Output of Multiplexer 1 Value = L, when Multiplexer 1 is switched off.
314	MULTIPLEXER 2	PLC controller. Output of Multiplexer 2. 1Value= L, when Multiplexer 2 is switched off.
315	Output CSU	PLC controller. Output Y of Curve Shaping Unit (CSU) X→Y
316...319		Reserve. Value = always 0
320	CONST. 1	Constant number 1. Can be used as a factor in calculations made with help of Universal Block. It is a copy of parameter 5.120
321	CONST. 2	Constant number 1. Can be used as a factor in calculations made with help of Universal Block. It is a copy of parameter 5.121
322...343	CONT. 3...24	Constant number 3...24. Can be used as a factor in calculations made with help of Universal Block. It is a copy of parameter 5.122...5.143
344...383		Reserve. Value = always 0
384...447	PCH RS 1...64	PCH accessible for writing using a connection RS. There is a possibility of an external control of a process which takes values from these PCH
448...511	PCH EXT 1...64	PCH intended for service by means of optional extension module (additional inputs/outputs – analog, digital, etc.)

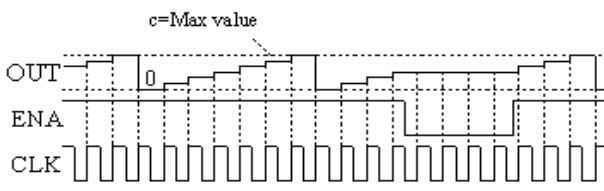
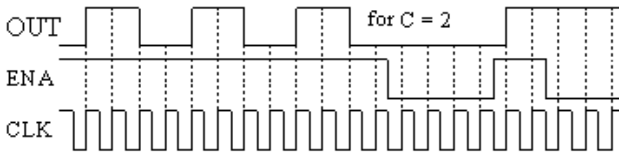
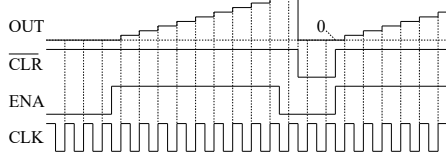
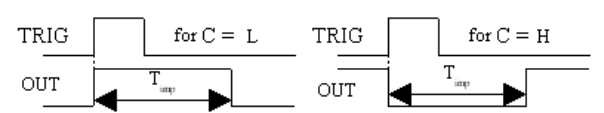
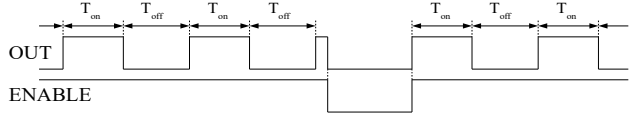
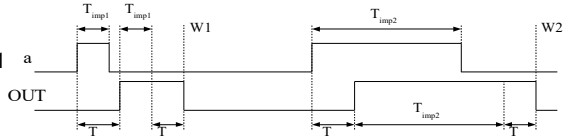
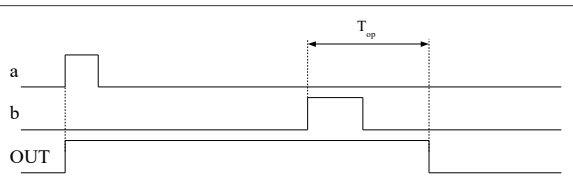
Appendix B - Table of Functions of Universal Blocks

Each Universal Block has 3 inputs which have been marked out A, B and C. These inputs can be pointers or parameters. In the table below following convention of type denoting is used: A (big letter A) means that input **A** is parameter (value is assigned directly to it), but **a** (the small letter a) means that the input **a** is a pointer (it points PCH which contains input value). Inputs B and C are marked in the same way.

Caution: In OUT which is interpreted as logic value (0/1 or not/yes) abbreviation **H** is used for definition of any value different from zero (logic 1). For definition of «logic 0» value character **L** is used.

Function number	Output (OUT of the block)	Description
0	a	Output OUT assumes a value which is defined by an input a . It serves for storing values which are quickly changed – for 10 ms after execution of this block, value of output PCH will not change even if input value changes.
1	$a + b + c$	Value OUT of the unit is the sum of three pointers a , b and c
2	$a * b / c$	Product a * b divided by value c
3	$(a + b)$	OUT of the unit is $-(a + b)$ (negation the sum)
4	ABS (a + b)	OUT of the unit = an absolute value of $(a + b)$
5	$a + b - c$	OUT of the unit = $a + b - c$
6	$b \leq a \leq c$	Limitation of an output range. Output signal of the unit is between b (minimum) and c (maximum) according to rules described below: If $(a < b) \rightarrow \text{OUT} = b$ If $(a \geq b)$ or $(a \leq c) \rightarrow \text{OUT} = a$ If $(a > c) \rightarrow \text{OUT} = c$
7	$B \leq a \leq C$	The same as item 6 but B and C are constant parameters
8	$a + B$	OUT = $a + B$, B is a parameter (e.g. addition of a constant offset)
9	If $c = H$, OUT = b If $c = L$, OUT = a	The multiplexer 1 from 2. Logic state of an input decides about output value a or b . 
10	If $(a \geq B)$, OUT = a If $(a < B)$, OUT = c	If value of an input a is equal or higher than a threshold determined by input B an output value a will be assumed. If value of an input a is less than threshold determined by input B an output value c will be assumed.
11	$a \geq (b * C)$	OUT = H when the inequality is carried out, OUT = L in all other cases
12	$a \geq (b + C)$	OUT = H when the inequality is carried out, OUT = L in all other cases
13	$a = (b +/- C)$	OUT = H when value is in the limits $<b-C... b+C>$, OUT = L in all other cases
14	If $(a < b - C)$, OUT = L If $(a > b + C)$, OUT = H	A hysteresis. The output signal doesn't change for a which is in limits $<b-C... b+C>$ 
15	$B + a * (C - B) / 1000$	Graduation. The input value a will be transformed from a range 0...1000 (0.0...100.0 %) to a range determined by parameters B and C 
16	$(a - B) * 1000 / (C - B)$	Graduation. The input value a will be transformed from a range determined by parameters B and C to a range 0...1000 (0.0...100.0 %) 

Function number	Output (OUT of the block)	Description																																				
17	If (a = H) OUT = b. If (a = L) OUT remains without changes.	Value OUT of the unit changes only if there is value H on an a input.																																				
18	a OR b OR c	OUT of the unit is logical sum of values of input a , b and c . CAUTION: it is not an operation on bits! (0 means an input = 0, 1 means an input ≠ 0).																																				
		<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>c</th> <th>OUT</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table>	a	b	c	OUT	0	0	0	0	0	0	1	1	0	1	0	1	0	1	1	1	1	0	0	1	1	0	1	1	1	1	0	1	1	1	1	1
		a	b	c	OUT																																	
		0	0	0	0																																	
		0	0	1	1																																	
		0	1	0	1																																	
		0	1	1	1																																	
		1	0	0	1																																	
		1	0	1	1																																	
1	1	0	1																																			
1	1	1	1																																			
19	a AND b AND c	OUT of the unit is logic product of values of inputs a , b and c																																				
		<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>c</th> <th>OUT</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table>	a	b	c	OUT	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	0	1	0	1	0	1	1	0	0	1	1	1	1
		a	b	c	OUT																																	
		0	0	0	0																																	
		0	0	1	0																																	
		0	1	0	0																																	
		0	1	1	0																																	
		1	0	0	0																																	
		1	0	1	0																																	
1	1	0	0																																			
1	1	1	1																																			
20	a XOR b	OUT of the unit is a result of operation XOR (exclusive OR) on inputs a and b																																				
		<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>OUT</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td></tr> </tbody> </table>	a	b	OUT	0	0	0	0	1	1	1	0	1	1	1	0																					
		a	b	OUT																																		
		0	0	0																																		
		0	1	1																																		
1	0	1																																				
1	1	0																																				
21	NOT (a OR b OR c)	OUT of the unit is inversion of logical sum of values a , b and c . (NOR)																																				
22	NOT (a AND b AND c)	OUT of the unit is inversion of logical product of values a , b and c . (NAND).																																				
23	NOT (a)	Logic inversion of an input value a .																																				
24	According to Truth Table a = R, b = S	Trigger RS. Input R has the priority.  <table border="1"> <thead> <tr> <th>R</th> <th>S</th> <th>OUT</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>n-1</td></tr> <tr><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>0</td></tr> </tbody> </table>	R	S	OUT	0	0	n-1	0	1	1	1	0	0	1	1	0																					
R	S	OUT																																				
0	0	n-1																																				
0	1	1																																				
1	0	0																																				
1	1	0																																				
25	According to Truth Table a = D, b = CLK, c = R	Trigger D (Latch).  <table border="1"> <thead> <tr> <th>R</th> <th>D</th> <th>CLK</th> <th>OUT</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>n-1</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>n-1</td></tr> <tr><td>0</td><td>0</td><td>∅</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>∅</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>n-1</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>n-1</td></tr> <tr><td>1</td><td>X</td><td>X</td><td>0</td></tr> </tbody> </table>	R	D	CLK	OUT	0	0	0	n-1	0	0	1	n-1	0	0	∅	0	0	1	∅	1	0	1	0	n-1	0	1	1	n-1	1	X	X	0				
R	D	CLK	OUT																																			
0	0	0	n-1																																			
0	0	1	n-1																																			
0	0	∅	0																																			
0	1	∅	1																																			
0	1	0	n-1																																			
0	1	1	n-1																																			
1	X	X	0																																			
26	Current value of the counter a = CLK, b = CLR, c = DIR Caution: the output of this counter can assume positive and negative values in range. <-32768...32767>.	The counter with reset and direction inputs. The minimal period for CLK is 20ms. It concerns all counters. 																																				
27	Current value of the counter: a = CLK, b = SET, c = initial value	"One shot" counter type, counting down with an input setting on initial value (SET) and an input of initial value. 																																				

Function number	Output (OUT of the block)	Description																																				
28	Current value of the counter a = CLK, b = ENABLE, c = max value	The modulo «up» counter with an input of max value and with an input of the account permission ENABLES. 																																				
29	$f_{out} = f_{in} / (2^C)$; a = f_{in} , b = ENABLE, C = the divider	The divider of frequency with ENABLE input. 																																				
30	Current value of the counter a = CLK, b = ENABLE, c = NOT (CLR)	The counter "up" with an input of permission ENABLE and resetting by inverting. Caution: after overflow (max = 65535) the counter starts with null. 																																				
31	0...7 depends on state of inputs a, b, c	The binary decoder. It replaces binary coded number with a decimal number in a band <0...7> according to the table. <table border="1" data-bbox="606 918 1468 1209"> <thead> <tr> <th>a</th> <th>b</th> <th>c</th> <th>OUT</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>2</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>3</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>4</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>5</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>6</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>7</td></tr> </tbody> </table>	a	b	c	OUT	0	0	0	0	1	0	0	1	0	1	0	2	1	1	0	3	0	0	1	4	1	0	1	5	0	1	1	6	1	1	1	7
a	b	c	OUT																																			
0	0	0	0																																			
1	0	0	1																																			
0	1	0	2																																			
1	1	0	3																																			
0	0	1	4																																			
1	0	1	5																																			
0	1	1	6																																			
1	1	1	7																																			
32	Positive or negative impulse a = TRIG (down-up transition), $T_{imp} = B * 5 * T + T$, C = polarity	Caution: the minimal duration of triggering impulse TRIG is $1 * T^*$. Impulse on OUT is maximally $1 * T^*$ delayed in comparison with TRIG signal. Next use of generator isn't possible until termination of current impulse. 																																				
33	Pulse is positive or negative	It is analogous to function 32. Difference: inputs b and c are pointers - it is possible to change a pulse duration and its polarity in PLC operating mode.																																				
34	Generator signal a = ENABLE, B, C – times (periods)	$T_{on} = B * T^*$, $T_{off} = C * T^*$ 																																				
35	Impulse delayed a = input impulse, B, C – delay times-	$T_{op1} = B * T^*$, $T_{op2} = C * T^*$ Detection of the next pulse begins in points W1 and W2. 																																				
36	Switch on / switch off function with delayed shut down a = switching on impulse (leading edge) b = switching off impulse (leading edge) C = delay on shut down	$T_{op} = C * T^*$ 																																				

*T = par 5.145 x 0.2 ms

Function number	Output (OUT of the block)	Description
37	Switch on / switch off function with delayed switching on a = switching on impulse (leading edge) b = switching off impulse (leading edge) C = delay on switching on	<p>$T_{op} = C * T^*$. If the pulse b appears in time T_{op}, switching on will not take place.</p>
38	The filter of analog signals a, b - inputs of the filter C - the constant of the filter	<p>Sum (a+b) is taken as input value of the filter. $T_f = C * T^*$</p>
39	Fast counter a - quantity of impulses for counting B - a multiplier c - restart	<p>The counter converts pulses from digital input DI5. The maximum frequency of converted impulses is 2 kHz. The unit can be used only once in structure of the program.</p> <p>If $i_j < (a * B) \rightarrow OUT = L$ If $i_j \geq (a * B) \rightarrow OUT = H$ If $c \neq 0 \rightarrow OUT = H$ i_j - quantity of the impulses counted from input DI5. Update of the OUT output each T period.</p>
40	Sequencer inputs – not active	Look at sequencer description – section 12.2
41	Multiplexer 1 inputs – not active	Look at multiplexer description – section 12.3
42	Multiplexer 2 inputs – not active	Look at multiplexer description – section 12.3
43	Unit of curve formation	Look at description of the unit of curve formation – section 12.4
45	Reading drive parameters A – group number B – register address	OUT of the unit equal the value of any parameter from group 0÷6
46	Modbus reading A – drive number B – register address	<p>OUT of the unit equal the value reading by Modbus from “A” drive number, from “B” address – see tab. 13.2.</p> <p>Note: reading can be done only by master drive (drive number = 0)</p>
47	Modbus writing A – drive number B – register address c – PCH	<p>The value from PCH number “c” is writing by Modbus to “A” drive, “B” address – see tab. 13.2.</p> <p>Note: reading can be done only by master drive (drive number = 0)</p>
48	CAN reading A – drive number B – register address	<p>OUT of the unit equal the value reading by CAN from “A” drive number, “B” address – see tab. 13.2.</p> <p>Note: reading can be done only by master drive (drive number = 0)</p>
49	CAN writing A – drive number B – register address c – PCH	<p>The value from PCH number “c” is writing by CAN to “A” drive, “B” address – see tab. 13.2.</p> <p>Note: reading can be done only by master drive (drive number = 0)</p>

Appendix C – Table of MFC710 frequency converter's parameters

Numbers of parameters which are instanced in the appendix are numbers presented on the display of the control panel. In case of reading/writing by means of RS connection, each parameter is read/written using the specified register. For example the register 42002 corresponds to parameter 2.2 there, the register 44030 corresponds to parameter 4.30, etc.

Parameters of GROUP 0. Variables of process - only for reading. It is possible to set the control panel to display value of any of these parameters without need to enter mode of parameters viewing (section 3).

Parameters in group 0	Name	Description
0.1	n Process	Speed of process. It depends on current rotation speed of the motor. It is possible to set up scale, measurement unit and number of decimal places for this parameter using parameters 4.25, 4.26 and 4.27.
0.2	n Motor	Current rotation speed of the motor in rotations per one minute [rpm]
0.3	n Ref.	Value of the referenced rotation speed [rpm]
0.4	f Out	Current output frequency of the converter [Hz]
0.5	f Ref.	Referenced frequency [Hz].
0.6	Mot. torque	The torque of the motor compared to the nominal torque [%]
0.7	Mot. cur.	Average value of current in windings of the motor [A]
0.8	Mot. volt.	An output voltage AC of the converter [V] (voltage of the motor) – interfacial voltage
0.9	Mot. temp.	Calculated relative temperature of the motor [%]
0.10	DC volt.	Voltage of the DC intermediaries circuit of the converter [V]
0.11	Mains volt.	Interfacial AC voltage the supply grid powering the converter [V] - calculated from Udc
0.12	Out. pow.	Current output power of the converter at [kW]
0.13	Energy	Value of energy which has been transferred to the motor from the time of switching on the converter or from the time of a cancellation of parameter 3.6 [kWh].
0.14	Ia cur.	RMS current of a phase A of the motor [A]
0.15	Ib cur.	RMS current of a phase B of the motor [A]
0.16	Ic cur.	RMS current of a phase C of the motor [A]
0.17	Pow. fact.	Output power factor
0.18	Psi st.	Stator stream [Wb]
0.19	Encoder n	Encoder speed [rpm]
0.20	Hts.1 temp.	Temperature of separate parts of the converter's heatsink (if it is divided) [°C]
0.21	Hts.2 temp.	
0.22	Hts.3 temp.	
0.23	Hts. temp.	Maximum of parameters 0.20, 0.21, 0.22 [°C]
0.30	PID ref.	Value of current referencing-unit of the PID controller [%]
0.31	<i>PID In.</i>	Current input value of the PID controller [%]
0.32	<i>PID error</i>	Error of the PID controller [%]
0.33	PID out.	Current output value of the PID controller [%]
0.34	Pumps state	State of operation the Control unit of Pumps Group
0.35	ON time	Quantity of hours of converter's operation [h].
0.36	<i>Y.M.D date</i>	Current date – only drives with optional RTC clock
0.37	<i>h:m time</i>	Current time – only drives with optional RTC clock
0.38	Dry end time	Time remaining until the end of motor windings drying process [in minutes] ¹⁾
0.40	In.A0	Value of an analog input 0 [%]
0.41	In.A1	Value of an analog input 1 [%]
0.42	In.A2	Value of an analog input 2 [%]
0.43	Out A1	Value of an analog output 1 [%]
0.44	Out A2	Value of an analog output 2 [%]
0.45	Ref. A0	Value of the analog referencing-unit 0 [%]
0.46	Ref. A1	Value of the analog referencing-unit 1 [%]
0.47	Ref. A2	Value of the analog referencing-unit 2 [%]

1) Parameter is available from software version 12.63

Appendix C – Table of MFC710 frequency converter's parameters

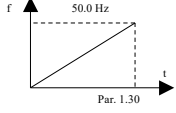
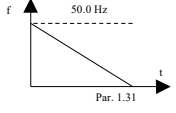
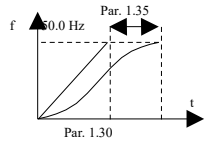
Parameters in group 0	Name	Description
0.48	DI state	State of all six digital inputs (for RS six youngest bits of the register)
0.49	DO state	State of all four digital output (for RS four youngest bits of the register)
0.50	RS1 state	Corresponds to the value written into the register 2000 through RS connection
0.51	Version	Version of the frequency converter software
0.52	RS ref.	RS referencing-unit. Corresponds to the value written into the register 2001 through RS [Hz] or [rpm].
0.53	RS PID ref.	RS PID Ref.-unit. Corresponds to the value written into the register 2002 through RS [%]
0.54	U1 preview	Programmable User value number 1 (see section 11.4)
0.55	U2 preview	Programmable User value number 2 (see section 11.4)
0.56	U3 preview	Programmable User value number 3 (see section 11.4)
0.57	U4 preview	Programmable User value number 4 (see section 11.4)
0.60	Curr.Motor	Number of active motor
Parameters 0.70 ÷ 0.79 are active only in regenerative frequency inverters MFC710AcR		
0.70	AcR I L1	Current of a phase L1 of the line [A]
0.71	AcR I L2	Current of a phase L2 of the line [A]
0.72	AcR I L3	Current of a phase L3 of the line [A]
0.73	AcR Ip	Active current of the line [A]
0.74	AcR Iq	Reactive current of the line [A]
0.75	AcR UL	Interfacial AC voltage the supply grid powering the converter [V]
0.76	AcR Temp1	Temperature of the active rectifier IGBT modules [°C]
0.77	AcR Temp2	Temperature of the active rectifier IGBT modules [°C]
0.78	AcR Fault code	AcR error code
0.79	AcR version	AcR software version

Parameters in group 1 ÷ 6

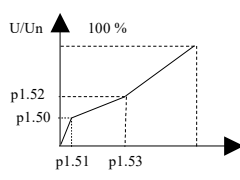
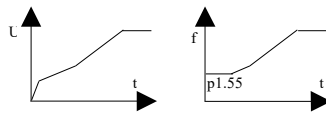
Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
GROUP 1 – CONFIGURATION OF THE DRIVE				
1.1 Pn	Nominal power of the motor	0.0 ... 2 x [Nominal power of the freq. converter] kW	Nominal power of the frequency converter	NO
1.2 Rn	Nominal motor speed	0 ... 30000 rpm	1450 rpm	NO
1.3 In	Nominal motor current	0.00 ... 2 x [Nominal current of the freq. converter] A	Nominal current of the frequency converter	NO
1.4 Un	Nominal motor voltage	0 ... 1000 V	Nominal voltage of the frequency converter	NO
1.5 fn	Nominal motor frequency	0.0 ... 550.0 Hz	50.0 Hz	NO
1.6 PF nom.	Nominal $\cos \varphi_n$ of the motor	0.50 ... 1.00	0.80	NO
1.10 ID run	Identification of motor's equivalent circuit parameters	000 --- – without identification 001 Don't run – only for stopped motor 002 Run 25Hz – test at 25 Hz 003 Run 50Hz - test at 50 Hz	000 ---	NO
1.11 Rs	Resistance stator windings	0 ... 32.000 ¹⁾ Ohm	0.000 Ohm	NO
1.12 Rr	Resistance of rotor windings	0 ... 32.000 ¹⁾ Ohm – read only	0.000 Ohm	NO
1.13 Lm	Main inductance Lm	0.0 ... 3200.0 ¹⁾ mH	0.0 mH	NO
1.14 Ls	Stator inductance Ls	0.0 ... 3200.0 ¹⁾ mH	0.0 mH	NO
1.15 Lr	Rotor inductance Lr	0.0 ... 3200.0 ¹⁾ mH	0.0 mH	NO

1) The number of decimal places depends on the nominal power of frequency converter

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
1.16 Add. L	Additional inductance in stator's circuit (inductance of wires)	<i>service parameter</i>		
1.18 Store mot.	Storing specified parameters	000 --- – resignation from writing 002 Motor 1 ... 005 Motor 4 – memory buffers designed for writing		NO
1.19 Read mot.	Reading specified parameters	000 --- – resignation from reading 002 Motor 1 ... 005 Motor 4 – memory buffers designed for reading		NO
1.20 Oper. mode	Device operating mode	000 U/f linear – operation in scalar mode (linear characteristic) 001 U/f squared – as above (exponential characteristic) 002 Vector1 w/o en – vector mode without sensors 003 Vector2 enc. – vector mode with encoder T4, T5 – service parameters	000 U/f linear	NO
1.21 f carr	Switching frequency of the converter (IGBT modules)	2.0 ... 16.0 kHz Note: The setting range depends on the converter's nominal power.	depends on the nominal power of the converter	NO
1.22 f rand	Random modulation – percent of changes in carrier frequency	0 ... 100%	0 %	NO
1.25 Mot.choice	The choice of active motor	000 Motor 0 ... 004 Motor 4 – the choice of active motor 005 Par.1.26 – the choice of active motor by par. 1.26 NOTE: Motor 0 store actual motor's parameters	Motor 0	NO
1.26 Mot.choice PCH	Set PCH to choice the active motor	000 (PCH.0) ... 511 (PCH.511) NOTE: If logical variable is selected, the choice of the active motor is between Motor 0 and Motor 1.	000 Sw.Off (PCH.0)	NO
1.30 Accel. 1	Acceleration DYNAMICS 1	0.0 ... 600.0 s 	1.0 ÷ 20.0 s depends on the nominal power of the converter	YES
1.31 Decel. 1	Deceleration DYNAMICS 1	0.0 ... 600.0 s 	1.0 ÷ 20.0 s depends on the nominal power of the converter	YES
1.32 Accel. 2	Acceleration DYNAMICS 2	0.0 ... 600.0 s	20 s	YES
1.33 Decel. 2	Deceleration DYNAMICS 2	0.0 ... 600.0 s	20 s	YES
1.34 Stop Delay	Set stopping time of the motor, see section 4.3.1	0.0 ... 600.0 s	0.0 s	YES
1.35 S Curve	S Curve	0 ... 300 % 	0,00 %	YES
1.36 Dyn. choice	Enabling DYNAMICS 1 or DYNAMICS 2	000 Sw.Off – Dynamics 1 active (accel. and delay 1) 001 In.C1...006 In.C6 – switching on Dynamics 2 by means of digital input DI1...DI6 007 Sw.On – Dynamics 2 active (acceleration 2 i delay 2)	000 Sw.Off	YES
1.40 f max	Maximum output frequency	0.0 ... 600.0 Hz NOTE: see also par. 2.12	55.0 Hz	YES
1.41 I limit M	Current limitation at motor operation	0.0 ... 180.0 % motor In	150.0 %	YES
1.42 I limit G	Current limitation at generator operation	0.0 ... 180.0 % motor In	150.0 %	YES
1.43 T limit M	Torque limitation at motor operation	0.0 ... 180.0 % motor Mn	150.0 %	YES
1.44 T limit G	Torque limitation at generator operation	0.0 ... 180.0 % motor Mn	150.0 %	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
1.45 Sel. Torq.	Direct torque set	Source of direct torque set	228 outPIIn	YES
1.50 U0	Voltage for output frequency F0 (par 1.51)	0.0 ... 40.0 % motor Un 	0.3+2.0 % depends on the nominal power of the converter	YES
1.51 F0	F0 frequency	0.0 ... 20.0 %	0.0 %	YES
1.52 U1	Voltage for output frequency F1 (par 1.53)	0.0 ... 100.0 %	50.0 %	YES
1.53 F1	F1 frequency	0.0 ... 100.0 %	50.0 %	YES
1.54 dU at In	Compensation of a voltage drop from output current	0.0 ... 40.0 % Un see Fig. 4.11, chapter 4.3.2	0.0 %	YES
1.55 f Start	Minimal output frequency for U/f operation modes	0.0 ... 40.0 Hz 	0.0 Hz	YES
1.60 Slip comp.	Slip compensation	000 NO – disabled 001 YES – slip compensation enabled	000 NO	YES
1.61 Flying Start	Running the frequency converter when motor is spinning	0 – function disabled 1 – search in one direction, searched frequencies: from Fref or Fmax 2 – search in both directions, searched frequencies: from Fref or Fmax 3 – search in one direction, searched frequencies: from Fmax 4 – search in both directions, searched frequencies: from Fmax	0	YES
1.62 Reg.Hi.Udc	Vdc high voltage control	000 NO / 001 YES: Limiting the dynamics of stopping or decreasing the speed in order to not exceed the permissible Udc voltage value.	YES	YES
1.63 Reg.Low Udc		<i>Service parameter</i>	NO	YES
1.64 Stop mode	Stopping by coast or according to characteristic	001 Coast – stopping by running out after STOP command (voltage taken off immediately) 000 Ramp – deceleration to 0 Hz at first, then shutting down	000 Ramp	YES
1.65 Dir. Block	Blocking direction of rotation	000 Reverse – bidirectional 001 Right – right 002 Left – left <i>Note: the real motor rotation direction depends on the wire order connection of the motor.</i>	000 Reverse	YES
1.66 U DC br.	Voltage of DC braking	<u>Software version: 12.62 and below</u> 0.1 ... 40.0 % motor's Un, direct current braking <u>Software version: 12.63 and upper</u> 0.0 ... 40.0 % motor's Un, direct current braking	0.1 %	YES
1.67 DC br. time	Braking time	0.0 ... 320.0 s <u>Software version 2.63 and upper</u> The setting 320.0 seconds means continuous braking - after giving the STOP command, the DC voltage is applied to the motor windings all the time until the next START command. Note: After connecting the inverter to the power grid, activation for continuous braking takes place only after the first STOP command. During DC braking, the current limitation is active - par. 1.41.	0.0 s	YES
1.68 Min t Stop	Minimal time of stopping	0.00 ... 10.00 s	0.02 s	YES
1.69 DC Brake Sett.	DC brake setting	Software version 12.63 and upper 000 Sw.Off – disabled 001 In.C1... 006 In.C6 – enabled when voltage is applied to digital input 1 ... 6 007 Sw.On - enabled	000 Sw.Off	YES
1.70 Amp. reg.n	Speed regulator gain	<i>Service parameter for Vector modes</i>	20	YES

Appendix C – Table of MFC710 frequency converter's parameters

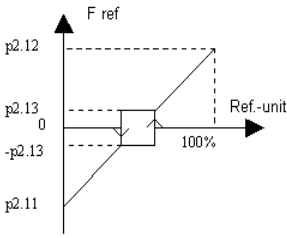
Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
1.71 Ki of reg.n	Integration time of speed regulator	<i>Service parameter for Vector modes</i>	2.00 s	YES
1.72 Amp. reg.M	Torque regulator gain	<i>Service parameter for Vector modes</i>	0.60	YES
1.73 Ki of reg.M	Integration time of Torque regulator	<i>Service parameter for Vector modes</i>	1.00	YES
1.74 Amp. reg.S	Motor stream regulator gain	<i>Service parameter for Vector modes</i>	650	YES
1.75 Ki of reg.S	Integration time of motor stream regulator	<i>Service parameter for Vector modes</i>	0.003	YES
1.80 Enc.imp/rot	Amount of pulses per encoder rotation	1 ... 9999 DEPENDS ON ENCODER TYPE!	1024	NO
1.81 Enc. revers	Reverse direction of rotations of encoder	000 NO / 001 YES – disabled or enabled. It depends on a way of encoder installation on the shaft of the motor. For correct operation of the drive in Vector2 mode detected direction of rotation must be the same as actual direction	000 NO	NO
1.82 Enc. offset		<i>Service parameter</i>		
1.83 Enc. set 0		<i>Service parameter</i>		
1.85 U flying	Initial voltage for a Flying Start	0.0...50.0% <i>Service parameter: available from software version 12v15, unavailable from Control Panel</i>	depends on the nominal power of the converter	YES
1.86 t flying	Dynamic of Flying Start	1.0...50.0s <i>Service parameter: available from software version 12v15, unavailable from Control Panel</i>	depends on the nominal power of the converter	YES
1.90 f elim1 min	Minimum frequency of frequency elimination range number 1	0.0 ... 550 Hz <i>See chapter 4.3.3 "Elimination of frequencies"</i>	0.0 Hz	YES
1.91 f elim1 max	Maximum frequency of frequency elimination range number 1	0.0 ... 550.0 Hz <i>See chapter 4.3.3 "Elimination of frequencies"</i>	0.0 Hz	YES
1.92 f elim2 min	Minimum frequency of frequency elimination range number 2	0.0 ... 550.0 Hz <i>See chapter 4.3.3 "Elimination of frequencies"</i>	0.0 Hz	YES
1.93 f elim2 max	Maximum frequency of frequency elimination range number 2	0.0 ... 550.0 Hz <i>See chapter 4.3.3 "Elimination of frequencies"</i>	0.0 Hz	YES
1.94 f elim3 min	Minimum frequency of frequency elimination range number 3	0.0 ... 550.0 Hz <i>See chapter 4.3.3 "Elimination of frequencies"</i>	0.0 Hz	YES
1.95 f elim3 max	Maximum frequency of frequency elimination range number 3	0.0 ... 550.0 Hz <i>See chapter 4.3.3 "Elimination of frequencies"</i>	0.0 Hz	YES
1.96 DC dry enable ¹⁾	Switching on the drying process	000 Sw.Off – Switch OFF 001 In.C1 ... 006 In.C6 – switch on by digital input DI1...DI6 007 Sw.On – Switch ON <i>Switching on occurs on the leading edge</i>	000 Sw.Off	YES
1.97 DC dry max I ¹⁾	Drying process current limit	0 ... 60% Note: <i>This is the limit of the average value of the current from the three phases. In one of the motor phases, the current value can be higher and may be up to 1.5 times the current value set in par. 1.97.</i>	20%	YES
1.98 DC dry max U ¹⁾	Drying process voltage limit	0 ... 40%	5%	YES
1.99 DC dry time ¹⁾	Maximum time of drying process	0.1 ... 200.0 h Note: <i>the value of 200.0 h means that the automatic end of drying function is turned off - the timer will count down the time from 200.0 h to 0 h, but after it reach the 0 h, the drying process will still going on.</i>	0.1 h	YES

1) Параметр доступен с версией программного обеспечения 12.63

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
<i>Parameters 1.100 – 1.113 are active only in a regenerative frequency inverter MFC710AcR</i>				
1.100 AcR mode	Active Rectifier mode	<p>0 - AcR off 1 - AcR on when „ready” mode (a) 2 - AcR on when „run” mode (b) 3 - AcR on when „run” mode (b), motor starts after the AcR started (c)</p> <p>a) - par. 1.100 = 1 b) - par. 1.100 = 2; 3 c) par. 1.100 = 1; 2 par. 1.100 = 3</p>	3	NO
1.101 Udc ref.	Udc reference voltage	<p>500 ... 744 V for MFC710 3 x 400V 500 ... 894 V for MFC710 3 x 500V 500 ... 1418 V for MFC710 3 x 690V</p>	620 V 750 V 1025 V	YES
1.102 Iq ref.	Iq reference current	-30.0 ... 30.0 % (100.0% = In)	0.0 %	YES
1.103 AcR limit	Active rectifier current limit	1.0 ... 150.0 % (100.0%=In)	150.0 %	YES
1.104 L mains	Inductance of the chokes used in the LCL filter from the power grid side	<p>0.000 ... 32.767 mH</p> <p>The values read from the rating plate of the chokes from the power grid side should be added up.</p>	depends on the nominal power of the freq. conv.	YES
1.105 kp Udc	kp and ki coefficients of the PI Udc voltage controller	0 ... 32767	185	YES
1.106 ki Udc		0 ... 32767	105	YES
1.107 kp Id	kp and ki coefficients of the PI id current controller	0 ... 32767	100	YES
1.108 ki Id		0 ... 32767	115	YES
1.109 kp Iq	kp and ki coefficients of the PI iq current controller	0 ... 32767	100	YES
1.110 ki Iq		0 ... 32767	115	YES
1.112 df carr.AcR	Service parameter	0 ... 10 Hz	0 Hz	YES
1.113 SYNC mode	Service parameter	0, 1, 2, 3	0	YES
GROUP 2 – REFERENCING-UNITS AND CONTROL				
2.1 B Ctrl.unit	Switching on variant A or B of control	<p>000 Sw.Off – Control A 001 In.C1 ... 006 In.C6 – A/B choice by means of digital input DI1...DI6 007 Sw.On – Control B</p>	000 Sw.Off (Control A enabled)	YES
2.2 Ref.unit A	Choice of a referencing-unit for Control A	<p>133 Keyb. ref. – frequency ref.-unit from the control panel 134 In.A0 ... 136 In.A2 – referencing frequency by signal from analog input AI0...AI2 137 OutPID – referencing frequency by PID controller 138 MotPot – referencing by increase/decrease signals from motopotentiometer 139 RS ref. – referencing through RS232 or RS485 connection (Modbus)</p>	133 Keyb. ref	YES
2.3 Ref.unit B	Choice of a referencing-unit for Control B	as above	In.A0	YES
2.4 Start A	Choice of a source of START / STOP signal for Control A	<p>030 Dig. Inp. St – remote START/STOP control (from device's Digital Inputs – see par. 2.8) 031 Keyboard St. – local START/STOP control from the control panel 032 RS St. – START/STOP control through RS232 or RS485 (Modbus)</p>	031 Keyboard St.	YES
2.5 Start B	Choice of a source of START / STOP signal for Control B	as above	030 Dig.In	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
2.6 Dir. A	Choice of signal of direction control for Control A	033 Dig.Inp. Dir. – remote direction of rotation control (from device's Digital Inputs - see par. 2.8) 034 Keyb. Dir. – local direction of rotation control from the control panel	034 Keyb.	YES
2.7 Dir. B	Choice of signal of direction control for Control B	as above	033 Dig.Inp. Dir	YES
2.8 Remote Start	Variant of START/STOP remote control	0 – DI1 = START/STOP, DI2 = direction 1 – DI1 = START RIGHT, DI2 = START LEFT 2 – rising edge DI1 = START, falling edge DI2 = STOP 3 – same as above, additionally DI3 = direction 4 – DI1 = START/STOP See table 4.1 in section 4.2.3	0	YES
2.9 Ref.Torq.A	Torque referencing-unit for Control A	144 Reference A0 ... 146 Reference A2 – referencing maximum torque by a signal from analog input 147 100.0% - maximum torque 100% 148 Reference RC – torque calculated by internal reeler calculator See also par. 1.43 and par. 1.44	147 100.0 %	YES
2.10 Ref.Torq.B	Torque referencing-unit for Control B	as above	100.0 %	YES
2.11 Ref. min	Referenced frequency which corresponds to 0% of the referencing-unit	- 550.0 ... 550.0 Hz 	0.0 Hz	YES
2.12 Ref. max	Ref. frequency which corresponds to 100% of the referencing-unit	0 ... 550.0 Hz Note: see also par. 1.40	50.0 Hz	YES
2.13 f stop	Minimal absolute value of referenced frequency	0.0 ... 550.0 Hz	0.5 Hz	YES
2.14 Use f stop	Stopping when $f <$ par 2.13	YES – device will stop, if referenced f is lower than minimum determined by par 2.13 NO – device will only limit frequency to par 2.13	NO	YES
2.15 Start LoRST	Deleting Signal of Local Start	YES – after switching control to local (from panel) device will stay stopped (or will stop) independently of whether the key START has been pressed before NO – device remembers pressing of START button and will start immediately after changing control to local	YES	YES
2.16 Ref. delay	Ref-unit switching on delay	0.0 ... 12.0 s	0.0 s	YES
2.18 Autostart block	Blockade of autostart	Makes it possible to blockade the frequency converter autostart function: 000 No – blockade of autostart is inactive 001 Yes – blockade of autostart is active <i>The parameter is available from software version 12.63.</i>	000 No	YES
2.20 Motopot.up	Source of “increase” signal for motopotentiometer referencing-unit	000 Sw.Off – disabled 001 In.C1 ... 006 In.C6 – increase ref.-unit, when there is a voltage supplied on digital input DI1...DI6	000 Sw.Off	YES
2.21 Motopot.dwn	Source of “decrease” signal for motopotentiometer ref.-unit	000 Sw.Off – disabled 001 In.C1 ... 006 In.C6 – decrease ref.-unit, when there is a voltage supplied on digital input DI1...DI6	000 Sw.Off	YES

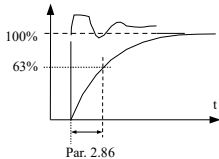
Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation																							
2.22 Motop. mode	Motopotentiometer mode	<p>0 – sending STOP signal (by pushing STOP button, through RS or other possibilities) causes resetting of motopotentiometer settings</p> <p>1 – value of motopotentiometer setting is stored in memory. There is no possibility of changing this setting during stoppage.</p> <p>2 – value of current referencing-unit setting traced by motopotentiometer. Applied for gentle transmission from current ref.-unit to motopotentiometer</p> <p>3 – value of motopotentiometer setting stored in the memory. There is a possibility of changing this setting during stoppage.</p> <p>Note: 0, 1, 2: modes applied when current ref.-unit (par. 2.2 or par. 2.3) is set on MotPot. 3: mode independent of current ref.-unit choice.</p>	1	YES																							
2.23 Motop. time	Time of increase/decrease of motopotentiometer ref.-unit	0.1 ... 320.0 s	10.0 s	YES																							
2.30 fConst0 src	Source of W1 signal for referencing constant speeds	<p>000 Sw.Off – W1 = 0</p> <p>001 In.C1 ... 006 In.C6 – W1 = 1 when there is voltage supplied on digital input DI1..DI6</p> <p>007 Sw.On – W1 = 1</p> <p>See section 4.2.4</p>	005 In.C5	YES																							
2.31 fConst1 src	Source of W2 signal for referencing constant speeds	as above	006 In.C6	YES																							
2.32 fConst2 src	Source of W3 signal for referencing constant speeds	as above	000 Sw.Off	YES																							
2.33 f Const 1	Constant frequency 1	-550.0 ... 550.0 Hz	10.0 Hz	YES																							
2.34 f Const 2	Constant frequency 2	-550.0 ... 550.0 Hz	20.0 Hz	YES																							
2.35 f Const 3	Constant frequency 3	-550.0 ... 550.0 Hz	25.0 Hz	YES																							
2.36 f Const 4	Constant frequency 4	-550.0 ... 550.0 Hz	30.0 Hz	YES																							
2.37 f Const 5	Constant frequency 5	-550.0 ... 550.0 Hz	40.0 Hz	YES																							
2.38 f Const 6	Constant frequency 6	-550.0 ... 550.0 Hz	45.0 Hz	YES																							
2.39 f Const 7	Constant frequency 7	-550.0 ... 550.0 Hz	50.0 Hz	YES																							
2.40 Cfg. In.A0	Configuration of analog input AI0	<table border="1"> <tbody> <tr> <td rowspan="2">0-10 V</td> <td>0 V = 0.0 %</td> <td rowspan="2">AI0 operates only in voltage mode.</td> </tr> <tr> <td>10 V = 100.0 %</td> </tr> <tr> <td rowspan="2">10-0 V</td> <td>0 V = 100.0 %</td> <td rowspan="2"></td> </tr> <tr> <td>10 V = 0.0 %</td> </tr> <tr> <td rowspan="2">2-10 V</td> <td>2 V = 0.0 %</td> <td rowspan="2"></td> </tr> <tr> <td>10 V = 100.0 %</td> </tr> <tr> <td rowspan="2">10-2 V</td> <td>2 V = 100.0 %</td> <td rowspan="2"></td> </tr> <tr> <td>10 V = 0.0 %</td> </tr> </tbody> </table>	0-10 V	0 V = 0.0 %	AI0 operates only in voltage mode.	10 V = 100.0 %	10-0 V	0 V = 100.0 %		10 V = 0.0 %	2-10 V	2 V = 0.0 %		10 V = 100.0 %	10-2 V	2 V = 100.0 %		10 V = 0.0 %	0-10 V	YES							
0-10 V	0 V = 0.0 %	AI0 operates only in voltage mode.																									
	10 V = 100.0 %																										
10-0 V	0 V = 100.0 %																										
	10 V = 0.0 %																										
2-10 V	2 V = 0.0 %																										
	10 V = 100.0 %																										
10-2 V	2 V = 100.0 %																										
	10 V = 0.0 %																										
2.41 Cfg. In.A1	Configuration of analog input AI1	<table border="1"> <thead> <tr> <th></th> <th>Voltage mode</th> <th>Current mode</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0-10 V</td> <td>0 V = 0.0 %</td> <td>0 mA = 0.0 %</td> </tr> <tr> <td>10 V = 100.0 %</td> <td>20 mA = 100.0 %</td> </tr> <tr> <td rowspan="2">10-0 V</td> <td>0 V = 100.0 %</td> <td>0 mA = 100.0 %</td> </tr> <tr> <td>10 V = 0.0 %</td> <td>20 mA = 0.0 %</td> </tr> <tr> <td rowspan="2">2-10 V</td> <td>2 V = 0.0 %</td> <td>4 mA = 0.0 %</td> </tr> <tr> <td>10 V = 100.0 %</td> <td>20 mA = 100.0 %</td> </tr> <tr> <td rowspan="2">10-2 V</td> <td>2 V = 100.0 %</td> <td>4 mA = 100.0 %</td> </tr> <tr> <td>10 V = 0.0 %</td> <td>20 mA = 0.0 %</td> </tr> </tbody> </table> <p>Note: switching between current/voltage mode is done by a jumper – see section 2.2. Example: "0-10" on the display indicates that the analog output mode is 0-10V or 0-20mA - depending on the jumper settings.</p>		Voltage mode	Current mode	0-10 V	0 V = 0.0 %	0 mA = 0.0 %	10 V = 100.0 %	20 mA = 100.0 %	10-0 V	0 V = 100.0 %	0 mA = 100.0 %	10 V = 0.0 %	20 mA = 0.0 %	2-10 V	2 V = 0.0 %	4 mA = 0.0 %	10 V = 100.0 %	20 mA = 100.0 %	10-2 V	2 V = 100.0 %	4 mA = 100.0 %	10 V = 0.0 %	20 mA = 0.0 %	0-10 V	TAK
	Voltage mode	Current mode																									
0-10 V	0 V = 0.0 %	0 mA = 0.0 %																									
	10 V = 100.0 %	20 mA = 100.0 %																									
10-0 V	0 V = 100.0 %	0 mA = 100.0 %																									
	10 V = 0.0 %	20 mA = 0.0 %																									
2-10 V	2 V = 0.0 %	4 mA = 0.0 %																									
	10 V = 100.0 %	20 mA = 100.0 %																									
10-2 V	2 V = 100.0 %	4 mA = 100.0 %																									
	10 V = 0.0 %	20 mA = 0.0 %																									
2.42 Cfg. In.A2	Configuration of analog input AI2	as above	0-10 V	YES																							
2.43 In.A0 Scale	Scale of analog referencing-unit RefA0	-500.0 ... 500.0 %	100.0%	YES																							
2.44 In.A1 Scale	Scale of analog referencing-unit RefA1	-500.0 ... 500.0 %	100.0%	YES																							

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
2.45 In.A2 Scale	Scale of analog referencing-unit RefA2	-500.0 ... 500.0 %	100.0%	YES
2.46 In.A0 Offs.	Offset of analog referencing-unit RefA0	-500.0 ... 500.0 %	0.0%	YES
2.47 In.A1 Offs.	Offset of analog referencing-unit RefA1	-500.0 ... 500.0 %	0.0%	YES
2.48 In.A2 Offs.	Offset of analog referencing-unit RefA2	-500.0 ... 500.0 %	0.0%	YES
2.49 In.A0 Fltr.	Constant of time of lowpass filter AI0	0.01 ... 50.00 s	0.10 s	YES
2.50 In.A1 Fltr.	Constant of time of lowpass filter AI1	0.01 ... 50.00 s	0.10s	YES
2.51 In.A2 Fltr.	Constant of time of lowpass filter AI2	0.01 ... 50.00 s	0.10 s	YES
2.60 PID Ref.Src	Choice of PID controller referencing-unit	141 MP-PID – motopotentiometer PID 142 RS PID – referencing through RS232 or RS485 143 Keyb.P – referencing frequency from panel 144 Ref.A0 – referencing frequency by signal from analog input AI0 145 Ref.A1 – referencing frequency by signal from analog input AI1 146 Ref.A2 – referencing frequency by signal from analog input AI2	143 Keyb.P	YES
2.61 PID Inp.Src	Choice of regulated value of PID controller	144 Ref.A0 – referencing regulated value from analog referencing-unit Ref.A0 145 Ref.A1 – referencing regulated value from analog referencing-unit Ref.A1 146 Ref.A2 – referencing regulated value from analog referencing-unit Ref.A2	145 Ref.A1	YES
2.62 Error inv.	Negation of controller's error	000 NO 001 YES	000 NO	YES
2.63 P Amp.	Amplification of proportional element of PID controller	1 ... 3000 %	1000 %	YES
2.64 I Const.	Constant of time I of the PID controller	0.01 ... 320.00 s	1.00 s	YES
2.65 D Amp.	Amplification of differential element D	0 ... 500 %	0 %	YES
2.66 max.Out.PID	Upper limitation of PID controller output value	0 ... 3000.0 %	100.0 %	YES
2.67 min.Out.PID	Lower limitation of PID controller output value	-3000.0 ... 0 %	0.0 %	YES
2.68 PID Out.res	Resetting PID output when device is stopped	0 – reset on STOP 1 – PID controller continuously active 2 – when the PID controller is not active PID's output tracks the actual reference frequency (only for the case of direct use of the PID controller via par. 2.2 "Ref.unit A" or par. 2.3 "Ref.unit B"). Note: When the PID controller is used via PLC function blocks, this parameter should be set to 0 or 1	2	YES
2.69 PID type	PID algorithm	Service parameter	0	YES
2.70 SLEEP time	Time before activating Sleep function when the output remains on a minimum (par. 2.67)	0 ... 32000 s 0 s = SLEEP function disabled	0 s	YES
2.71 SLEEP thr	A threshold of "wakening" from SLEEP state	0.0 ... 100.0 % Waking up when: (Error > par 2.71) or (PID output > par 2.71)	5.0 %	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation															
2.80 Out.A1 Src	Choice of signal for analog output AO1	133 Keyb. ref 134 In.A0 ... 136 In.A2 137 OutPID 138 MotPot 139 RS ref 140 MP-AUX 141 MP-PID 142 RS PID 143 Keyb.P 144 Ref.A0..146Ref.A2 147 100% 148 Ref.RC 149 rpm – speed without a sign: 0% = 0, 100% = Nn 150 rpm – speed with a sign: 0.0% = -Nn, 50.0% = 0, 100.0% = Nn 151 f output – output frequency: 100.0% = Fn 152 Current – output current: 100.0% = In 153 Torque – load without a sign: 100.0 % = 2 Mn 154 Torque – load with a sign: 100% = 2 Mn, 50% = 0, 0% = -2 Mn 156 U.Motor – output voltage: 100.0% = Un See Appendix A – Table of PCH	151 f output	YES															
2.81 Out.A2 Src.	Choice of signal for analog output AO2	as above	152 Current	YES															
2.82 Out.A1 Cfg.	Configuration of analog output AO1	<table border="1"> <thead> <tr> <th></th> <th>Tryb napięciowy</th> <th>Tryb prądowy</th> </tr> </thead> <tbody> <tr> <td>0-10 V</td> <td>0 V = 0.0 % 10 V = 100.0%</td> <td>0 mA = 0.0 % 20 mA = 100.0%</td> </tr> <tr> <td>10-0 V</td> <td>0 V = 100.0 % 10 V = 0.0 %</td> <td>0 mA = 100.0 % 20 mA = 0.0 %</td> </tr> <tr> <td>2-10 V</td> <td>2 V = 0.0 % 10 V = 100.0 %</td> <td>4 mA = 0.0 % 20 mA = 100.0 %</td> </tr> <tr> <td>10-2 V</td> <td>2 V = 100.0 % 10 V = 0.0 %</td> <td>4 mA = 100.0 % 20 mA = 0.0 %</td> </tr> </tbody> </table> <p>Note: switching between current/voltage mode is done by a jumper – see section 2.2. Example: "0-10" on the display indicates that the analog output mode is 0-10V or 0-20mA - depending on the jumper settings.</p>		Tryb napięciowy	Tryb prądowy	0-10 V	0 V = 0.0 % 10 V = 100.0%	0 mA = 0.0 % 20 mA = 100.0%	10-0 V	0 V = 100.0 % 10 V = 0.0 %	0 mA = 100.0 % 20 mA = 0.0 %	2-10 V	2 V = 0.0 % 10 V = 100.0 %	4 mA = 0.0 % 20 mA = 100.0 %	10-2 V	2 V = 100.0 % 10 V = 0.0 %	4 mA = 100.0 % 20 mA = 0.0 %	0-10 V	YES
	Tryb napięciowy	Tryb prądowy																	
0-10 V	0 V = 0.0 % 10 V = 100.0%	0 mA = 0.0 % 20 mA = 100.0%																	
10-0 V	0 V = 100.0 % 10 V = 0.0 %	0 mA = 100.0 % 20 mA = 0.0 %																	
2-10 V	2 V = 0.0 % 10 V = 100.0 %	4 mA = 0.0 % 20 mA = 100.0 %																	
10-2 V	2 V = 100.0 % 10 V = 0.0 %	4 mA = 100.0 % 20 mA = 0.0 %																	
2.83 Out.A2 Cfg.	Configuration of analog output AO2	as above	0-10 V	YES															
2.84 Out.A1 Scal	Scale of analog output AO1	0 ... 500.0%	100.0%	YES															
2.85 Out.A2 Scal	Scale of analog output AO2	0 ... 500.0%	100.0%	YES															
2.86 Out.A1 Fltr	Constant of time of lowpass filter AO1	0.01 ... 50.00 s 	0.10 s	YES															
2.87 Out.A2 Fltr	Constant of time of lowpass filter AO2	as above	0.10 s	YES															

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
2.90 K1 funct. 1	Function 1 of K1 relay	059 Pump 6 – pump 6 is working 060 K_zero – relay not active 061 Run – active when there is voltage supplied to motor 062 Ready – device is ready to work 063 Failure – a failure has occurred 064 NO Failure – not failure 065 Warning – a warning has occurred 066 Warn+Fail. – a failure or warning has occurred 068 Freq. thrs.1 – threshold 1 frequency exceeded 069 Freq. thrs.2 – threshold 2 frequency exceeded 070 Freq. ref. – referenced frequency reached 071 Temp. thrs. – warning of exceeding programmed threshold of heatsink temperature 072 Warn. Analog. In. – warning: error of analog input signal (lack of "living null" - signal lower than 2 V or 4 mA) 073 Block – any operation is blocked 074 I limit – current = current of limitation 075 Brake – brake control 076 Pump 1 ... 080 Pump 5 – pump 1..5 is working <i>See Appendix A – Table of PCH</i>	062 Ready	YES
2.91 K1 funct. 2	Function 2 of K1 relay	as above	060 K_zero	YES
2.92 K2 funct. 1	Function 1 of K2 relay	as above	061 Run	YES
2.93 K2 funct. 2	Function 2 of K2 relay	as above	060 K_zero	YES
2.94 K3 funct. 1	Function 1 of K3 relay	as above	063 Failure	YES
2.95 K3 funct. 2	Function 2 of K3 relay	as above	060 K_zero	YES
2.96 K4 funct. 1	Function 1 of DO4 (open-collector output)	as above	065 Warning	YES
2.97 K4 funct. 2	Function 2 of DO4 (open-collector output)	as above	060 K_zero	YES
2.98 f thresh. 1	Threshold frequency 1	0.0 ... 550.0 Hz	25.0 Hz	YES
2.99 f thresh. 2	Threshold frequency 2	0.0 ... 550.0 Hz	45.0 Hz	YES
2.100 Thresh.temp.	Threshold of the heatsink overheat warning, PCH 71	0 ... 80 °C	70 °C	YES
2.101 BrRel.del.	Delay of releasing external brake	0.0 ... 12.0 s	0.0 s	YES
2.102 Br.close n	Speed above which brake is being closed	0 ... 10000 rpm	100 rpm	YES
2.103 Br.close t	Device operation time (giving torque) after which command to close the brake is send	0.0 ... 12.0 s	0.0 s	YES
2.110 Op. Perm.	External operation permission	001 In.C1 ... 006 In.C6 – operation allowed, when there is voltage supplied on digital input DI1..DI6 007 Sw.On – operation allowed	007 Sw.On	YES
2.111 Op. Block.	External operation blocking	000 Sw.Off – without operation blocking 001 In.C1 ... 006 In.C6 – blocking active, when there is voltage supplied on digital input DI1..DI6	000 Sw.Off.	YES
2.112 Em. Stop	Emergency Stop	000 Sw.Off – no possibility of emergency stopping 001 In.C1 ... 006 In.C6 – emergency stop by means of one of digital inputs DI1..DI6	000 Sw.Off.	YES
<i>Parameter 2.113 is active only in a regenerative frequency inverter MFC710AcR</i>				
2.113 Enable AcR	Enable active rectifier AcR	Sw.Off – Disabled In.C1 ... In.C6 – enabled when there is voltage supplied on digital input DI1...DI6 007 Sw.On – operation allowed	007 Sw.On	YES
GROUP 3 – FAILURES				
3.1 Sw.on therm.	Switching on blocking from the thermistor built in the motor	000 NO – disabled 001 YES – enabled	000 NO	YES
3.2 i2t Block.	Switching on blocking from thermal overload	000 NO – disabled 001 YES – enabled	001 YES	YES
3.3 I therm.	Setting of motor thermal protection current	0.0 ... 200.0 %	100.0 %	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
3.4 I therm.0	Setting of thermorelay for stopped motor	0.0 ... 200.0 %	50.0 %	YES
3.5 therm.Const	Constant of motor heating	0 ... 200 min.	depends on the nominal power of the converter	YES
3.6 Energy Reset	Resetting energy counter	000 NO – not active 001 YES – reset energy counter (par. 0.13)	000 NO	YES
3.10 Ext. fail.1	Choice of external failure source 1	000 Sw.Off – disabled 001 In.C1 ... 006 In.C6 – reporting external failure 1, when there is voltage supplied on digital input DI1..DI6	003 In.C3	YES
3.11 Ext. fail.2	Choice of external failure source 2	000 Sw.Off – disabled 001 In.C1 ... 006 In.C6 – reporting external failure 2, when there is voltage supplied on digital input DI1..DI6	000 Sw.Off	YES
3.12 Level Ext. 1	Determination of the state that activates an external failure 1 (par. 3.10)	0 - low state of selected digital input in parameter 3.10 activates external failure 1 1 - high state of selected digital input in parameter 3.10 activates fault external 1 <i>The parameter is available from software version 12.63.</i>	1	YES
3.13 Level Ext. 2	Determination of the state that activates an external failure 2 (par. 3.11)	0 - low state of selected digital input in parameter 3.11 activates external failure 2 1 - high state of selected digital input in parameter 3.11 activates fault external 2 <i>The parameter is available from software version 12.63.</i>	1	YES
3.20 Sw.on In.A	Reporting failure of lack of signal (<2V) when AI doesn't serve as referencing-unit	000 Sw.Off – don't report failures 001 In.C1 ... 006 In.C6 – reporting failures, when there is voltage supplied on digital input DI1..DI6 007 Sw.On – always report failures	000 Sw.Off	YES
3.23 Re.4mA lack	Reaction to lack of analog signal (level <2V (4mA))	000 None – no reaction 001 Warning – a warning will be displayed 002 Failure – device will stop and message will be displayed 003 Last freq. – a warning will be displayed, frequency will stay on an average level from last 10 s 004 Const freq. 7 – device keeps working with frequency f const 7 (par. 2.39)	001 Warning	YES
3.30 Re.Sym. lack	Reaction to asymmetry of the load	000 None – no reaction 001 Warning – a warning will be displayed 002 Failure – device will stop and message will be displayed	002 Failure	YES
3.35 I ground	Value of leakage current at which device will be shut down	0.0 ... 100.0 % In of the motor	25.0 %	YES
3.40 Stall Re.	Reaction to stall of the motor	000 None – no reaction 001 Warning – a warning will be displayed 002 Failure – device will stop and message will be displayed	000 None	YES
3.41 f Stall	Stall frequency	0.0 ... 50.0 Hz	10.0 Hz	YES
3.42 Stall time	Stall time	0 ... 600 s	120s	YES
3.45 Spd. err Re.	Reaction to error of output speed	000 None – no reaction 001 Warning – a warning will be displayed 002 Failure – device will stop and message will be displayed	000 None	YES
3.46 Delta n-nz	Acceptable difference between referenced speed and speed of the motor.	0 ... 1000 rpm	200 rpm	YES
3.47 D time max.	Maximum time of acceptable error	0.0 ... 12.0 s	0.1 s	YES
3.50 Re. Underl.	Reaction to underload	000 None – no reaction 001 Warning – a warning will be displayed 002 Failure – device will stop and message will be displayed	000 None	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
3.51 Underl. time	Time of underload	0 ... 1200 s	120 s	YES
3.52 Underl. torq	Torque of underload	0.0 ... 100.0 %	70.0 %	YES
3.55 R breaking Time	Maximum operate resistor's time in DC voltage	0...600 s	10 s	YES
3.56 Re. R brake	Reaction to the excess braking time	000 None – no reaction 001 Warning – a warning will be displayed 002 Failure – device will stop and message will be displayed	000 None	YES
3.57 AcR fail.Re	Reaction to lack of communication with AcR module or failure AcR device	000 None – no reaction 001 Warning – a warning will be displayed, device keeps working with set frequency 002 Failure – device will stop and message will be displayed <i>Warning or failure code is stored in par. 0.78</i>	000 None	YES
3.60 Re. RS lack	Reaction to lack of communication through RS link	000 None – no reaction 001 Warning – a warning will be displayed, device will keep working with referenced frequency 002 Failure – the drive will stop and the message will be displayed 003 Last freq. – a warning will be displayed, frequency will stay on an average level from last 10 s 004 Const freq. 7 – device keeps working with frequency f const 7 (par. 2.39)	000 None	YES
3.61 RS timeout	Acceptable time of lack of communication through RS link	0 ... 600 s	30 s	YES
3.65 Re.key lack	Reaction to lack of keyboard (only for referencing from keyboard)	000 None – no reaction 001 Warning – a warning will be displayed, device will keep working with referenced frequency 002 Failure – the drive will stop and the message will be displayed 003 Last freq. – a warning will be displayed, frequency will stay on an average level from last 10 s 004 Const freq. 7 – device keeps working with frequency f const 7 (par. 2.39)	002 Failure	YES
3.66 Keyb. timeout	Acceptable time of lack of keyboard	0 ... 300 s	30 s	YES
3.70 Ext. reset	Source of external reset	000 Sw.Off – no possibility of external erasing a failure message 001 In.C1 ... 006 In.C6 – erasing a failure by digital input DI1..DI6	004 In.C4	YES
3.71 AR.number	Max number of automatic restarts	0 – no restarts 1 ... 6 – number of restarts in time determined by par. 3.72	0	YES
3.72 AR.time	Time of restarts	0 ... 1200.0 s	60 s	YES
3.73 AR.delay	Restart delay	0.0 ... 10.0 s	1.0 s	YES
3.74 AR.low.Udc	Automatic restart after Low Udc failure	000 NO 001 YES	000 NO	YES
3.75 AR.hi.Udc	Automatic restart after High Udc failure	000 NO 001 YES	000 NO	YES
3.76 AR.hi.I	Automatic restart after High Current failure	000 NO 001 YES	000 NO	YES
3.77 AR.hi.temp.	Automatic restart after High temperature of the heatsink failure	000 NO 001 YES	000 NO	YES
3.78 AR. In.A	Automatic restart after Error of analog input failure	000 NO 001 YES	000 NO	YES
3.80 Failure 1	Failure Register 1 (the last record)	Failure name (read only)		Read only
3.81 Fa.1 time	Register of time of occurrence of failure from Failure Register 1	Time [h] (read only)		Read only
...
3.110 Failure 16	Failure Register 1 (the oldest record)	Failure name (read only)		Read only

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
3.111 Fa.16 time	Register of time of occurrence of failure from Failure Register 16	Time [h] (read only)		Read only
GROUP 4 – PARAMETERS BLOCKING, CONFIGURATION OF: RS, DISPLAYING AND USER REFERENCING-UNITS				
4.1 Par. block.	Parameters blocking	000 NO – modification of parameters is unblocked 001 YES – modification of parameters is blocked	Do not apply	YES
4.2 Level/CODE	Access level (reading) Access code (writing)	Access level AL0 ... AL2 Access code 0 ... 9999	Do not apply	YES
4.3 New CODE	Change of access code to current access level	New access code 0 ... 9999	Do not apply	YES
4.4 Fact. set.	Loading factory settings	<i>Access level AL2 required</i>	Do not apply	NO
4.5 En. EEPROM	Access to save changes in EEPROM memory	000 NO - Switching on blocking of writing to EEPROM memory (parameters can be changed, however they won't be remembered after shut down of power) 001 YES – parameters are normally written to EEPROM (the access level AL2 is necessary)	001 YES	YES
4.6 Full ptrs.	Full pointers	000 NO / 001 YES – values of parameters which are pointers (e.g. par. 4.7) are possible to change in full range PCH.0 ... PCH.511	000 NO	YES
4.7 RS perm.	Permission to work through RS	000 Sw.Off – operation through RS prohibited 001 In.C1 ... 007 In.C6 – enabling RS permission by digital input DI1...DI6 007 Sw.On – operation through RS permitted	000 Sw.Off	YES
4.8 RS baudrate	Transmission speed	Transmission speed [bps]: 000 38400 001 57600 002 9600 003 19200 <i>Note: restart the converter is necessary to activate the changes</i>	002 9600	YES
4.9 Unit no.	Identification number of Modbus device	1 ... 247 0 – Modbus Master mode: internal communication between MFC frequency converters	12	YES
4.10 L1 at STOP	Value displayed in upper line when device is not working (see section 3.3)	par. 0.1 ... par. 0.57	Par. 00.11	YES
4.11 L2 at STOP	Value displayed in lower line when device is not working (see section 3.3)	par. 0.1 ... par. 0.57	Par. 00.05	YES
4.12 L1 at RUN	Value displayed in upper line when device is working (see section 3.3)	par. 0.1 ... par. 0.57	Par. 00.04	YES
4.13 L2 at RUN	Value displayed in lower line when device not working (see section 3.3)	par. 0.1 ... par. 0.57	Par. 00.05	YES
4.14 Preview 1	Value SP1(section 3.3)	par. 0.1 ... par. 0.57	Par. 00.07	YES
4.15 Preview 2	Value SP2(section 3.3)	par. 0.1 ... par. 0.57	Par. 00.02	YES
4.16 Preview 3	Value SP3(section 3.3)	par. 0.1 ... par. 0.57	Par. 00.03	YES
4.17 Preview 4	Value SP4(section 3.3)	par. 0.1 ... par. 0.57	Par. 00.06	YES
4.18 Preview 5	Value SP5(section 3.3)	par. 0.1 ... par. 0.57	Par. 00.10	YES
4.19 Preview 6	Value SP6(section 3.3)	par. 0.1 ... par. 0.57	Par. 00.23	YES
4.20 Preview 7	Value SP7(section 3.3)	par. 0.1 ... par. 0.57	Par. 00.09	YES
4.21 LCD contr.	Adjusting contrast of LCD	0..19 <i>Only OP-01 control panels. Parameter is inactive in OP-11 control panels - they do not have possibility of contrast adjustment.</i>	10	YES
4.22 RTC set.	RTC setting	Option – requires additional RTC module 1: year 2: month 3: day of month 4: day of week 5: hour 6: minute		YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
4.23. Language	Language of the Control Panel	000 Polski 001 English	000 Polski	YES
4.25 nP Scale	Scale of Precess N	Multiplier of speed displayed as parameter 0.1 – (Process N) 0.0 .. 500.0 %	100.0 %	YES
4.26 nP Unit	Process N unit	Unit of measurement displayed for par 0.1. See table 11.3	" % "	YES
4.27 nP dec.p.	Number of decimal places of Process N	Number of decimal places for par 0.1 0..3	1	YES
4.28 n.rot.Scale	Scale of rotation counter	Amount of units that correspond to one encoder rotation	1	YES
4.29 n.rot.reset	Resetting rotation counter	PCH.000 ... PCH.511 Source of signal resetting the rotation counter	000 Sw.Off	YES
4.30 UR choice	Choice of User Referencing-unit (UR)	0 – user referencing-unit not active 1 ... 4 = ZU1 ... ZU4	0	YES
4.31 nu	Numbers of active user Ref.-units	0 ... 4	1	YES
4.32 Ref. UR1	Ref.-unit Value	-32000 ... 32000	0.0 %	YES
4.33 Ref. UR2	Ref.-unit Value	-32000 ... 32000	0.0 %	YES
4.34 Ref. UR3	Ref.-unit Value	-32000 ... 32000	0.0 %	YES
4.35 Ref. UR4	Ref.-unit Value	-32000 ... 32000	0.0 %	YES
4.36 min UR1	Minimum	-5000 ... 5000	0	YES
4.37 max UR1	Maximum	-5000 ... 5000	1000	YES
4.38 UR1 Unit	Unit of ref.-unit US1	Displayed unit. See table 11.3	005 %	YES
4.39 UR1 dec.p.	Number of decimal places	Number of decimal places for US1 ref.-unit 0 ... 3	1	YES
4.40 min UR2	Minimum	-5000 ... 5000	0	YES
4.41 max UR2	Maximum	-5000 ... 5000	1000	YES
4.42 UR2 Unit	Unit of ref.-unit US2	Displayed unit. See table 11.3	005 %	YES
4.43 UR2 dec.p.	Number of decimal places	Number of decimal places for US2 ref.-unit 0 ... 3	1	YES
4.44 min UR3	Minimum	-5000 ... 5000	0	YES
4.45 max UR3	Maximum	-5000 ... 5000	1000	YES
4.46 UR3 Unit	Unit of ref.-unit US3	Displayed unit. See table 11.3	005 %	YES
4.47 UR3 dec.p.	Number of decimal places	Number of decimal places for US3 ref.-unit 0 ... 3	1	YES
4.48 min UR4	Minimum	-5000 ... 5000	0	YES
4.49 max UR4	Maximum	-5000 ... 5000	1000	YES
4.50 UR4 Unit	Unit of ref.-unit US4	Displayed unit. See table 11.3	005 %	YES
4.51 UR4 dec.p.	Number of decimal places	Number of decimal places for US4 ref.-unit 0 ... 3	1	YES
4.60 Usr1 choice	Selection of source for User Value Usr1	Source of data displayed as par. 0.54 (Usr1): PCH.000 ... PCH.511. See section 11.4	000 Sw.Off (PCH.000)	YES
4.61 Usr1 Unit	Unit of Usr1 (par. 0.54)	Displayed unit of par. 0.54 (Usr1). See table 11.3	005 %	YES
4.62 Usr1 dec.p.	Number of decimal places	Number of decimal places for par. 0.54 (Usr1): 0 ... 3	1	YES
4.63 Usr2 choice	Selection of source for User Value Usr2	Source of data displayed as par. 0.55 (Usr2): PCH.000 ... PCH.511. See section 11.4	000 Sw.Off (PCH.000)	YES
4.64 Usr2 Unit	Unit of Usr2 (par. 0.55)	Displayed unit of par. 0.55 (Usr2). See table 11.3	005 %	YES
4.65 Usr2 dec.p.	Number of decimal places	Number of decimal places for par. 0.55 (Usr2): 0 ... 3	1	YES
4.66 Usr3 choice	Selection of source for User Value 3 Usr3	Source of data displayed as par 0.56 (Usr3): PCH.000 ... PCH.511. See section 11.4	000 Sw.Off (PCH.000)	YES
4.67 Usr3 Unit	Unit of Usr3 (par. 0.56)	Displayed unit of par. 0.56 (Usr3). See table 11.3	005 %	YES
4.68 Usr3 dec.p.	Number of decimal places	Number of decimal places for par. 0.56 (Usr3): 0 ... 3	1	YES
4.69 Usr4 choice	Selection of source for User Value 4 Usr4	Source of data displayed as par 0.57 (Usr4): PCH.000 ... PCH.511. See section 11.4	000 Sw.Off (PCH.000)	YES
4.70 Usr4 Unit	Unit of Usr4 (par. 0.57)	Displayed unit of par. 0.57 (Usr4). See table 11.3	005 %	YES
4.71 Usr4 dec.p.	Number of decimal places	Number of decimal places for par. 0.57 (Usr4): 0 ... 3	1	YES

Appendix C – Table of MFC710 frequency converter's parameters

<i>Parameter / Name</i>	<i>Function</i>	<i>Available options / measurement unit</i>	<i>Factory setting</i>	<i>Change during operation</i>
4.72 CAN bdrate	CAN bandwidth rate	0 = 62.5 kbit 1 = 125 kbit 3 = 250 kbit 5 = 500 kbit 7 = 1 Mbit	3	YES
4.73 CAN MTo	<i>Service parameter</i>	10 ms ... 500 ms	30 ms	YES
4.74 CAN STo	<i>Service parameter</i>	0.2 s ... 60.0 s	5.0 s	YES
4.75 CAN dst.num	CAN destination unit number	0 ... 31	0	YES
4.80 ACT sel.1	Current value of any selected parameter or characteristic point PCH available through RS	Par. 0.001 ... Par. 6.255 PCH. 000 ... PCH. 511 <i>Note: "Par. 0.001" means "Par. 0.1"</i> <i>"Par. 0.010" means "Par. 0.10"</i> <i>"Par. 1.001" means "Par. 1.1"</i>	Par. 0.001	YES
4.81 ACT sel.2	Same as above	Same as above	Par. 0.001	YES
4.82 ACT sel.3	Same as above	Same as above	Par. 0.001	YES
4.83 ACT sel.4	Same as above	Same as above	Par. 0.001	YES
4.84 ACT sel.5	Same as above	Same as above	Par. 0.001	YES
4.85 ACT sel.6	Same as above	Same as above	Par. 0.001	YES
4.86 ACT sel.7	Same as above	Same as above	Par. 0.001	YES
4.87 ACT sel.8	Same as above	Same as above	Par. 0.001	YES
GROUP 5 – PUMP GROUP CONTROLLER, BLOCKS OF PLC CONTROLLER				
5.1 In. v	Selection of source of linear speed	Source of linear speed: 144 Ref.A0 – from analog referencing-unit 1 145 Ref.A1 – from analog referencing-unit 2 146 Ref.A2 – from analog referencing-unit 3	144 Ref.A0	YES
5.2 In. F	Selection of force referencing-unit	Source of force referencing-unit: 144 Ref.A0 – from analog referencing-unit 1 145 Ref.A1 – from analog referencing-unit 2 146 Ref.A2 – from analog referencing-unit 3 147 100.0%	147 100.0%	YES
5.3 v max	Max linear speed	Linear speed which correspond to 100.0% of linear speed signal: 0.00 ... 320.00 [m/s]	10.00 m/s	YES
5.4 d min	Minimum diameter of a roller	Determines minimum diameter of a roller: 0.0 ... 3200.0 [mm]	100.0 mm	YES
5.5 dmax	Maximum diameter of a roller	Determines maximum diameter of a roller: 0.0 ... 3200.0 [mm]	500.0 mm	YES
5.6 Mo	Friction torque	0.0 ... 100.0%	10.0 %	YES
PUMPS controller – factory setting concerning set of factory settings number 8				
5.10 Pumps Mode	Activation of Pump Group Control System	Enabling pumps group controller 000 NO – controller disabled 001 YES – controller enabled	000 NO	NO
5.11 Cfg. P1	Pump 1 configuration	000 Mains – operation only from mains 001 MFC/Mains – operation from converter or mains	001 MFC/Mains	YES
5.12 Cfg. P2	Pump 2 configuration	000 Mains – operation only from mains 001 MFC/Mains – operation from converter or mains	001 MFC/Mains	YES
5.13 Cfg. P3	Pump 3 configuration	000 Mains – operation only from mains 001 MFC/Mains – operation from converter or mains	001 MFC/Mains	YES
5.14 Cfg. P4	Pump 4 configuration	000 Mains – operation only from mains 001 MFC/Mains – operation from converter or mains	001 MFC/Mains	YES
5.15 Cfg. P5	Pump 5 configuration	000 Mains – operation only from mains 001 MFC/Mains – operation from converter or mains	001 MFC/Mains	YES
5.16 P1 active	Pump 1 activation	000 Sw.Off – pump disabled 001 In.C1 ... 006 In.C6 – pump enabled by one of digital inputs DI1 ... DI6 007 Sw.On – pump enabled	001 In.C1	YES
5.17 P2 active	Pump 2 activation	000 Sw.Off – pump disabled 001 In.C1 ... 006 In.C6 – pump enabled by one of digital inputs DI1 ... DI6 007 Sw.On – pump enabled	002 In.C2	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
5.18 P3 active	Pump 3 activation	000 Sw.Off – pump disabled 001 In.C1 ... 006 In.C6 – pump enabled by one of digital inputs DI1 ... DI6 007 Sw.On – pump enabled	003 In.C3	YES
5.19 P4 active	Pump 4 activation	000 Sw.Off – pump disabled 001 In.C1 ... 006 In.C6 – pump enabled by one of digital inputs DI1 ... DI6 007 Sw.On – pump enabled	004 In.C4	YES
5.20 P5 active	Pump 5 activation	000 Sw.Off – pump disabled 001 In.C1 ... 006 In.C6 – pump enabled by one of digital inputs DI1 ... DI6 007 Sw.On – pump enabled	005 In.C5	YES
5.21 Rep. time	Time of automatic replacement of leading pump	1 ... 32000 h	24 h	YES
5.22 ON delay	Delay of switching on	A time limit before switching on the additional pump 0.0 ... 60.0 sec	10.0 s	YES
5.23 OFF delay	Delay of switching off	A time limit before switching of the additional pump 0.0 ... 60.0 sec	10.0 s	YES
5.24 Rep. Block.	Postponing automatic change of leading pump at high load	PCH.000 ... PCH.511. When referencing-unit of Pump Controller stays above this value, then automatic change will be postponed till decrease of the pressure.	100.0 % (PCH 147)	YES
5.25 f thresh.	F threshold	Frequency of enabling additional pump: 0.0...50.0 Hz	25.0 Hz	YES
5.26 Insensiv.	Insensibility	Insensibility of enabling / disabling additional pump: 0.0...20.0 %	5.0 %	YES
5.27 Ref. choice	Selection of referencing-unit for pumps control	Source of pressure signal: 144 Ref.A0 ... 146 Ref.A2 – from analog referencing-units (direct control of pumps group) 158 RefPID – from PID controller output (most common setting) <i>Note: parameters 147 100% ... 157 PIDerr are service parameters and should not be used!</i>	144 Ref.A0	YES
5.28 P limit	Max number of simultaneously operating pumps	1 ... 5	4	YES
5.29 P6 active	Pump 6 activation	000 Sw.Off – pump disabled 001 In.C1 ... 006 In.C6 – pump enabled by one of digital inputs DI1 ... DI6 007 Sw.On – pump enabled	000 Sw.Off	YES
5.30 Block time	Minimum break time operation of the pump	0 ... 32000	0 s	YES
5.40 Sw. Seq ON	Enable Sequencer	Signal of enabling PLC sequencer block: PCH.000 Sw.Off ... PCH.511 <i>PCH.000 = SEQ disabled</i>	000 Sw.Off	YES
5.41 nu		Service parameter		
5.42 Seq max	Number of sequencer states	2 ... 8	8	YES
5.43 Seq time 1	Time of 1st state duration	PCH.000 Sw.Off ... PCH.511	PCH.320 Constant.1	YES
5.44 Seq time 2	Time of 2nd state duration	PCH.000 Sw.Off ... PCH.511	PCH.321 Constant. 2	YES
5.45 Seq time 3	Time of 3rd state duration	PCH.000 Sw.Off ... PCH.511	PCH.322 Constant.3	YES
5.46 Seq time 4	Time of 4th state duration	PCH.000 Sw.Off ... PCH.511	PCH.323 Constant.4	YES
5.47 Seq time 5	Time of 5th state duration	PCH.000 Sw.Off ... PCH.511	PCH.324 Constant.5	YES
5.48 Seq time 6	Time of 6th state duration	PCH.000 Sw.Off ... PCH.511	PCH.325 Constant.6	YES
5.49 Seq time 7	Time of 7th state duration	PCH.000 Sw.Off ... PCH.511	PCH.326 Constant.7	YES
5.50 Seq time 8	Time of 8th state duration	PCH.000 Sw.Off ... PCH.511	PCH.327 Constant.8	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
5.51 Seq Nxt	Source of "next state" signal	PCH.000 Sw.Off (disabled) ... PCH.511	PCH.000 Sw.Off	YES
5.52 Seq Prv	Source of "previous state" signal	PCH.000 Sw.Off (disabled) ... PCH.511	PCH.000 Sw.Off	YES
5.53 Seq Clr	Source of "sequencer restart" signal	PCH.000 Sw.Off (disabled) ... PCH.511	PCH.000 Sw.Off	YES
5.54 Seq Set	Source of "sequencer setting" signal	PCH.000 Sw.Off (disabled) ... PCH.511	PCH.000 Sw.Off	YES
5.55 Seq SV	Sequence to which sequencer block will be set after "Seq Set" signal	PCH.000 Sw.Off (disabled) ... PCH.511 (value 0 = sequencer 0)	PCH.000 Sw.Off	YES
5.60 En. Mux1	Signal of switching on MUX1 PLC block	PCH.000 Sw.Off (disabled) ... PCH.511 <i>PCH.000 = MUX1 disabled</i>	PCH.000 Sw.Off	YES
5.61 nu		Service parameter		
5.62 Mux1 DV	Value of MUX1 output (PCH.313) when MUX1 is disabled (par. 5.60)	-32000 ... 32000	0	YES
5.63 Mux1 Sel	Source of MUX1 input selection	PCH.000 ... PCH.511	PCH.000	YES
5.64 Mux1 In.1	Value of input 1 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.65 Mux1 In.2	Value of input 2 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.66 Mux1 In.3	Value of input 3 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.67 Mux1 In.4	Value of input 4 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.68 Mux1 In.5	Value of input 5 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.69 Mux1 In.6	Value of input 6 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.70 Mux1 In.7	Value of input 7 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.71 Mux1 In.8	Value of input 8 MUX1	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.80 En. Mux2	Signal of switching on MUX2 PLC block	PCH.000 ... PCH.511 <i>PCH.000 = MUX2 disabled</i>	PCH.000 Sw.Off	YES
5.81 nu		Service parameter		
5.82 Mux2 DV	Value of MUX2 output (PCH.314) when MUX2 is disabled (par. 5.80)	-32000 ... 32000	0	YES
5.83 Mux2 Sel	Source of MUX2 input selection	PCH.000 ... PCH.511	PCH.000	YES
5.84 Mux2 In.1	Value of input 1 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.85 Mux2 In.2	Value of input 2 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.86 Mux2 In.3	Value of input 3 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.87 Mux2 In.4	Value of input 4 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.88 Mux2 In.5	Value of input 5 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.89 Mux2 In.6	Value of input 6 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.90 Mux2 In.7	Value of input 7 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.91 Mux2 In.8	Value of input 8 MUX2	PCH.000 ... PCH.511	PCH.000 (=0)	YES
5.100 nu		Service parameter		
5.101 CSU In.	CSU Input (X)	PCH.000 (Sw.Off) ... PCH.511	PCH.000	YES
5.102 CSU X1	Point 1, value X	-32000 ... 32000 (see CSU description)	0	YES
5.103 CSU Y1	Point 1, value Y	-32000 ... 32000	0	YES
5.104 CSU X2	Point 2, value X	-32000 ... 32000	0	YES
5.105 CSU Y2	Point 2, value Y	-32000 ... 32000	0	YES
5.106 CSU X3	Point 3, value X	-32000 ... 32000	0	YES
5.107 CSU Y3	Point 3, value Y	-32000 ... 32000	0	YES
5.108 CSU X4	Point 4, value X	-32000 ... 32000	0	YES
5.109 CSU Y4	Point 4, value Y	-32000 ... 32000	0	YES
5.110 CSU X5	Point 5, value X	-32000 ... 32000	0	YES
5.111 CSU Y5	Point 5, value Y	-32000 ... 32000	0	YES

Appendix C – Table of MFC710 frequency converter's parameters

Parameter / Name	Function	Available options / measurement unit	Factory setting	Change during operation
5.120 Const 1	CONSTANT 1	-32000 ... 32000. Copied to PCH.320	0	YES
5.121 Const 2	CONSTANT 2	-32000 ... 32000. Copied to PCH.321	0	YES
5.122 ... 5.141	Analogically as above	as above	as above	as above
5.142 Const 23	CONSTANT 23	-32000 ... 32000. Copied to PCH.342	0	YES
5.143 Const 24	CONSTANT 24	-32000 ... 32000. Copied to PCH.343	0	YES
5.144 Enable PLC	Enable build-in PLC	Enabling PLC controller 000 NO – none of PLC block is active 001 YES – PLC enabled	000 NO	NO
5.145 Blocks numb.	Number of blocks	1 ... 50 - number of blocks executed by PLC	50	YES
GROUP 6 – PLC CONTROLLER – UNIVERSAL BLOCKS				
6.1 Block no. 1	Function of block 1	0 ... 39 – see Appendix B	0	NO
6.2 Inp. A. 1	Input A of block 1	PCH.000 Sw.Off ... PCH.511	PCH.000 Sw.Off	NO
6.3 Inp. B. 1	Input B of block 1	PCH.000 ... PCH.511. Parameter is accessible or not, depending on function of block (par. 6.1)	PCH.000 Sw.Off	NO
6.4 Inp. C. 1	Input C of block 1	PCH.0 ... PCH.511 Parameter is accessible or not, depending on function of block (par 6.1)	PCH.0	NO
6.5 Block no. 2	Function of block 2	0 ... 39 – see Appendix B	0	NO
6.6 Inp. A. 2	Input A of block 2	PCH.000 Sw.Off ... PCH.511	PCH.000 Sw.Off	NO
6.7 Inp. B. 2	Input B of block 2	PCH.000 ... PCH.511. Parameter is accessible or not, depending on function of block (par. 6.5)	PCH.000 Sw.Off	NO
6.8 Inp. C. 2	Input C of block 2	PCH.0 ... PCH.511 Parameter is accessible or not, depending on function of block (par 6.5)	PCH.000 Sw.Off	NO
6.9 ... 6.188	<i>as above</i>	<i>as above</i>	<i>as above</i>	<i>as above</i>
6.189 Block no. 48	Function of block 48	0 ... 39 – see Appendix B	0	NO
6.190 Inp. A. 48	Input A of block 48	PCH.000 Sw.Off ... PCH.511	PCH.000 Sw.Off	NO
6.191 Inp. B. 48	Input B of block 48	PCH.000 ... PCH.511. Parameter is accessible or not, depending on function of block (par. 6.189)	PCH.000 Sw.Off	NO
6.192 Inp. C. 48	Input C of block 48	PCH.0 ... PCH.511 Parameter is accessible or not, depending on function of block (par 6.189)	PCH.000 Sw.Off	NO

Appendix D – EU declaration of conformity



EU DECLARATION OF CONFORMITY



We:

Manufacturer's name: **TWERD ENERGO-PLUS Sp. z o.o.**
 Manufacturer's address: **Aleksandrowska 28-30
 87-100 Toruń, Poland**
 Phone: **+48 56 654-60-91, +48 515-152-382**
 WWW, e-mail: **www.twerd.pl twerd@twerd.pl**

Declare at our own responsibility, that product:

Product name: **Frequency converter**
 Type: **MFC710**
 Power range: **0,37 kW ÷ 800 kW**

installed and used according to *User's Manual* recommendations meets the requirements of Polish Standards:

PN-EN IEC 61800-3:2019-02

Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods

PN-EN 61800-5-1:2007 + A1:2017

Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy

PN-EN 50178:2003

Electronic equipment for use in power installations

which are equivalent to European Standards, harmonized with directives:

2014/35/EU Low Voltage Devices (LVD)**2014/30/EU Electromagnetic Compatibility (EMC)**

TWERD ENERGO-PLUS Sp. z o.o.

Justyna Jątczak
Dyrektor Zarządzający/Członek Zarządu

Justyna Jątczak
Managing Director / Member of the Board

TWERD ENERGO-PLUS
 z ograniczoną odpowiedzialnością
 87-100 Toruń, ul. Aleksandrowska 28-30
 tel. 56 654 60 91
 NIP 9562337873 REGON 380968365
 KRS 0000743645

Date: 2023-09-19

TWERD ENERGO-PLUS Sp. z o.o.

ul. Aleksandrowska 28-30
87-100 Toruń, Poland

tel. +48 56 654-60-91

e-mail: twerd@twerd.pl

