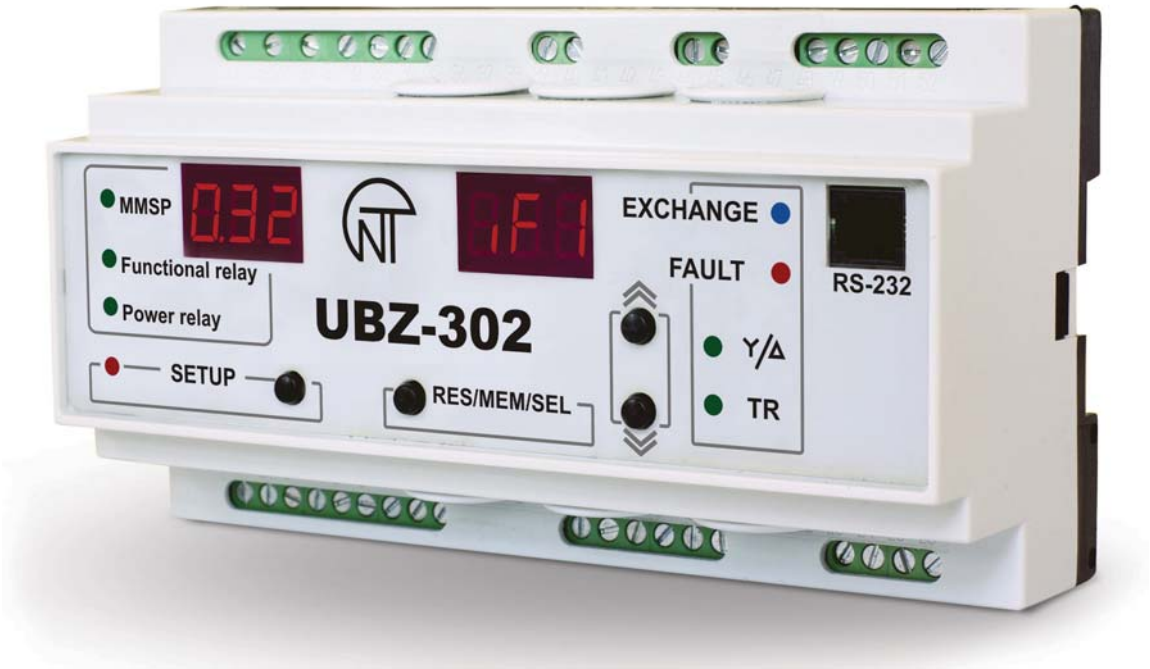
ELECRTIC MOTORS
UNIVERSAL PROTECTION DEVICE

UBZ-302



SERVICE MANUAL

1. GENERAL DESCRIPTION AND OPERATION

1.1 APPLICATION

UBZ-302 is the microprocessor based digital device, reliable and of highest degree of measurement accuracy. It doesn't require the operational external power supply since the controlled voltage at the same time is the power supply for UBZ-302. It has 3 built-in current measurement transformers through which the motor power supply wires are looped for continuous currents monitoring.

Universal electric motor protection device (hereinafter UBZ-302) is designed for the continuous control of the power supply voltage, monitoring of **acting** values of phase/line currents in 3 phase electrical circuits and additionally performs the **resistance test** to check the level of motor coils insulation.

UBZ-302 performs protection of asynchronous electric motors with rated power from 2,5 to 30 kW using built in current transformers. With the use of externally connected current transformers (not supplied together with UBZ-302) is possible to protect motors with rated power up to 315 kW. Moreover UBZ-302 is capable to work in electric circuits with isolated neutral (allows operation in both in 3 and 4 wire electric circuits).

UBZ-302 protects the electric motors in the following alarm situations:

- ✓ Low quality power supply voltage:
  - o not allowable voltage surges and fluctuations, phase loss, wrong phase sequence, phase imbalance of phase/line voltage, phase coincidences;
- ✓ Mechanical overloads (symmetrical overload in phase/line currents);
- ✓ Exceeding the threshold for reverse current sequence;
- ✓ Non-symmetry of the phase currents in the absence of overload which may happen either due to fault of insulation of the motor coils or the power supply cable. UBZ-302 performs comparison of non-symmetry coefficient for reverse sequence current with the non-symmetry coefficient of the voltage on the reverse sequence.
- ✓ Disappearing of the drive torque of the motor shaft (dry stroke for the pumps) – protection on the minimal starting current and/or operation current;
- ✓ Long lasting motor start or blocked rotor;
- ✓ Checking the level of insulation between the stator and motor case before the motor start;
- ✓ Earth leakage protection of stator coils during the motor operation;
- ✓ Thermal overload protection for the motor;
- ✓ Overheating protection for the motor coils. UBZ-302 performs temperature monitoring using built in to the motor temperature sensors or the temperature of the motor case could be measured with the use of external temperature sensors.

For every type of protection mentioned above it's possible to set individually the autoreclosing parameters (allowed or not allowed to start the motor automatically after certain type of fault or alarm situation).

UBZ-302 performs protection of a motor or equipment by operating with the magnetic coil of contactor which in its turn commutates the required power load.

UBZ-302 has 2 output relays: *power load relay* and *functional relay*. Presence of 2 output relays gives the possibility to arrange **DELTA/STAR** switching, turn **ON** with the delayed start (cascade turn **ON** of motors) and remote signalization. UBZ-302 detects the presence of the currents when the *power load relay* contacts are open and when the *functional relay* is in the **DELTA/STAR** mode. If these currents are detected then UBZ-302 indicates the fault of the external contactor that turns motor **ON.** UBZ-302 will keep on indicating this fault until it will not be deenergized (turned **OFF**).

DATA TRANSMISSION

- control operation and data transmission using RS-485 interface in accordance with MODBUS protocol,
- control operation and data transmission using RS-232 interface.

N o t i c e: Simultaneous use of RS-485 and RS-232 is impossible.

For work of the personal computer with UBZ-302 the program "Control panel UBZ-302", is placed on a company site can be used (http://www.novatek-electro.com/production_ubz.htm).

The program "Control panel UBZ-302" is intended for the control of a condition and data gathering from devices UBZ-302, to communication means (RS-232 or RS-485). The program allows to keep to (load) various options UBZ, to conduct data gathering and to keep them for the further researches.

1.1.2 CHARACTERISTICS OF THE BUILT-IN OUTPUT TERMINALS

Basic characteristics of the UBZ-302 output relays are shown in Tables 1.1 and 1.2 shown below

Table 1.1 - Power load relay

	Maximal current at U~250V	**Commutation lifetime x1000**	**Maximal power for commutation**	**Maximal long lasting withstand AC voltage**	**Maximal current at U_{const}=30V (commut.)**
Cos φ = 0,4	2 A	100	1000 VA	460 V	3 A (50000)
Cos φ = 1,0	5 A	100			

Table 1.2 -Functional relay

	Maximal current at U~250V	Commutation lifetime x1000	Maximal power for commutation	Maximal long lasting withstand AC voltage	Maximal current at U_{const}=30V(commut.)
Cos φ = 0,4 Cos φ = 1,0	5 A 16 A	100 100	4000 VA	440/300 V	3 A

1.1.3 Restrictions for the UBZ-302 application and the selection of the parameters

1.1.3.1 The use of built-in current transformers.

It's prohibited to use the UBZ-302 for the protection of the motors with rated power more than 20 kW.

When measuring the currents in the range from 63 A to 300A the measurement error does not exceed 5% value but if the currents are more than 320 A, then the current transformer core saturation happens and this lead to significant decrease of measurement accuracy.

Disregarding the real value of the current the UBZ-302 will not be able to measure the currents more than 400A. The setting of several programmable parameters (maximal current protection, overcrank start and locked rotor or thermal overload) without taking into consideration the saturation of current transformers will lead to disabling of the effective protection.

For example when setting Ind=50 (rated motor current), I>P =0 (current protection with independent time delay), I>5 =9 (multiplication factor for tripping to maximal current faults) maximal current protection must trip when current is 450A. But due to the saturation of current transformer core measured value of current will never exceed 380-400A even there will be a short circuit in the coils of motor and currents more than 1000A – and thus the UBZ-302 will not turn the motor OFF. In this case (Ind=50) the user must set the value for multiplication factor for the maximal current protection and set the value not more than 6.

1.1.3.2 The use of external current transformers.

All the tested samples of standard current transformers the saturation of the core takes place when the measured current value exceed 4-5 fold of rated. Taking this fact into consideration it's necessary to select the external current transformers with such a rated value that it will be at least 2-fold more than the rated motor current or to select the transformer taking into consideration possible saturation of the current transformer core.

1.1.3 LIST OF ABBREVIATIONS USED IN THIS PRESENT MANUAL

AR – automatic reclosing of the output contacts (autoreclosing)

MC – magnetic contactor

PC – personal computer

CT – current transformer

MMSP – mode with minimal number of setting parameters

Itt – rated current for the current transformers. It should be set up in case of using external current transformers (For example **CT** T-0.66 300/5, then **Itt** is 300A)

In – rated current of motor. As a rule it's the value that is shown on the motor shield but depending on the usage conditions it's possible to set some other required value.

1.2 TECHNICAL PARAMETERS

1.2.1 Basic technical parameters are shown below in Table 1.3.

Table 1.3

Rated power supply voltage: three phase	415V 50 Hz
Operational voltage frequency, Hz	48-62
Range of the rated currents when UBZ-302 use built in current transformers, A	5-63
Voltage hysteresis (phase/line), V	10/17
Thermal hysteresis, % of accumulated heat at turn **OFF**	33
Current tripping threshold detection accuracy, not more then, in % of rated	2
Voltage tripping threshold detection accuracy, not more then, V	3
Accuracy for the detection of phase imbalance basing voltage measurements, V, not more then	3
Operational input voltage: -phase voltage, when power supply from one phase and neutral wire connected, not less then, V -line voltage, in case of 3 phase power supply, not more then, B	 180 450
Analog inputs: - 2 analog inputs for the temperature sensors connection (type Pt100, Ni100, Ni120) - analog input for the connection of the sensor with the output 0 – 10V - analog input for the connection of the sensor with the output 4mA (0mA) – 20mA - 3 analog inputs for the connection of current transformers with the output of 5 A (type T-0.66 or similar)	

- input for the connection of the differential current transformer	
Basic outputs: **Power load relay** – 2 groups of changeover contacts to operate with the motor starting contactor - 5A 250V at cosφ=1; **Functional relay** – one group of changeover contacts 16A 250V at cosφ=1 (the application of this relay contact is user defined);	
Temperature sensors measurement accuracy, °C.	1
Consumed power (under the load), not more then, VA	5,0
Protection degree: - case enclosure - contact terminals	IP40 IP20
Operational temperature range, °C	from-35 to +55
Storage temperature, °C	from-45 to +70
Weight, not more then, kg	0,5
Outer dimensions (kindly see Fig.1.1) Nine standard S-modules width Mounting on standard DIN rail 35 mm Mounting position - arbitrary	

1.2.2. The measured and calculated parameters, which values are deduced on the display device*, limits of their measurement and an error are resulted in the Table 1.4.

***Table 1.4* - Measured and Indicated parameters**

Measurements	**Range**	**Accuracy**	**Indication on display (mnemonics)**	**Address**	**Measurement units at data transmission**
Currents					Tenths of ampere
Acting value of phase currents, A	0,5-630	2%	iF1_ iF2_ iF3	100, 101, 102	
Acting value of zero-sequence current, A	0,3-5,0	2%	iF0	103	
Average current value on each of the phase within the time preset by the parameter tS1			iS1_ iS2_ iS3	104, 105, 106	
Maximal value of average current on each phase, obtained from the moment of the last load. To reset all average values press button RES/MEM/SEL – then UBZ-302 will display maximal average current value on corresponding phase and start further measurements (it doesn't reset the initial value to zero after pressing RES/MEM/SEL).	<3 Itt > 3 Itt	2% 10%	in1_ in2_ in3	107, 108, 109	
Starting current of motor (averaged by phases) Overload current (averaged by phases) Starting time, seconds Starting time – is a period of time from the moment when 3 phase currents exceed 1,2×**In** and up to the moment when all those 3 currents will decrease lower then 1,2×**In**. Maximal phase current that was achieved during the startup is considered to be maximal starting current.	<3 Itt > 3 Itt 0,1-600	2% 10%	iPU iPE tPU	110 112 111	Tenths of ampere
Reverse sequence current (imbalance), A	0,2-200	5%	ioP	113	

***** The display device correspond:
- Two three-digit seven-segment indicators on the UBZ face panel;

- PC connected to one of UBZ interfaces (MODBUS, RS-232)

Measurements	**Range**	**Accuracy**	**Indication on display (mnemonics)**	**Address**	**Measurement units at data transmission**
Voltage					Volts
Acting value of phase voltage (measured when the neutral wire is connected to the UBZ-302), V	100-300	3 V	UF 1, UF2, UF3	114,115 116	
Acting value of line voltage, V	100-475	5 V	UL 1, UL2, UL3	117,118 119	
Positive sequence voltage, V	100-300	3 V	UPP	120	
Reverse sequence voltage, V	3 -300	3 V	U P	121	
Zero sequence voltage (vector sum of 3 phase voltages divided by 3), (calcu-lated when neutral wire connected to the UBZ-302), V	3-100	3 V	UnP	122	
Others					
Temperature of the Sensor 1 (type of the sensor is defined according the table 1.6.), ^{0}C *****	from -40^{o}C to +220 ^{o}C	1^{0}C	td 1	123	5000 – sensor is disabled 1000±10 –short circuit of the sensor 2000±10 –sensor is not connected or cut
Temperature of the Sensor 2 (type of the sensor is defined according the table 1.6.), ^{0}C *****	from -40^{o}C to +220 ^{o}C	1^{0}C	td2	124	
Value of current input (4-20) mA, mA	0-25	2%	in 1	125	Hundreds of µA
Voltage value on analog input 0-10 V	0-10 V	2%	inU	126	Tenths of Volt
Running time counter for the machinery, days	0-999		Str	127	
Power supply frequency, Hz	45-65	1%	FFF	128	Tenths of Hz
Remaining time before tripping to overload (shows the remaining time that is left before Turning **OFF** basing the thermal overload para-meter), sec	0-600	1 sec	tOP	129	Seconds
Remaining time to the end of autoreclosing interval, sec******	0-900	1 sec	tAP	130	Seconds
Latency time after overload caused turn **OFF** (shows the latency time which remains to turn ON the motor after the thermal overload fault), sec*******	0-900	1 sec	ttP	131	Seconds
Resistance of the motor insulation, MOhms ****	0-19,9	10%	r id	132	Hundreds of kOhms
Termal balans of the motor Parame-ters only for reading the information using MODBUS or RS-232 protocols	Number 1100 thousand corresponds 100 % of saved up heat at which occurs the engine is "**off**" position at the included protection on a thermal overload (1.2.5.7)			133, 134	
Full Capacity, kVA*****	0-5000	5%	Pot	135, 136	Tens of W
Active power capacity, kW*****	0-5000	5%	PoA	137, 138	
Reactive power capacity, kVAR*****	0-5000	5%	PoJ	139, 140	Tens of W
Cos of the angle between voltage and current on Phase A*1000 This parameter is read-only for the interface RS-232, RS-485	0-1000	5%		141, 142	
Cos of the angle between voltage and current on Phase B*1000 This parameter is read-only for the interface RS-232, RS-485	0-1000	5%		143,144	

Cos of the angle between voltage and current on Phase C*1000 This parameter is read-only for the interface RS-232, RS-485	0-1000	5%		145,146	

* NOTICE. If the temperature value exceed the mentioned limits – then on the indicator will be displayed the alarm code according to the Table 2.6;

** NOTICE. If the autoreclosing is prohibited by the user – then on display will be glowing sing "not";

*** NOTICE. If the time interval before switching to thermal overload fault or the autoreclosing time interval (ttP) is not defined (more then 900 sec), then on the indicator will be displayed code "---". If the protection function is cancelled then the indicator should show sign "not".

**** NOTICE. If the value of the motor insulation is more then 20 MOhms – then indicator shows code " 1. " (one with the decimal point in the lower order).

When the motor is turned ON (power supply is applied to the motor) the insulation resistance is not defined and on the indicator is being displayed the code "---" (if the insulation test measurement circuit is connected).

***** If the power capacity consumed by the load is more than 990 kW (kVA, kVAR) then MW (MVA) will be displayed with dots looking like "n" in the middle decade. For example if the indicator shows "3n4", then it means that 3,4 MW (MVA).

****** NOTES. In the program version 15 when working with external transformers with rated current more than 100A, measured currents and calculated values except the zero-sequence current (earthing current) on the RS-232/RS485 interface are being transmitted the values in Amperes.

1.2.3. Programmed parameters and their respective values are shown in the Table 1.5 below:

***Table 1.5* - Programmable parameters**

Default and readable parameters	Codes of parameters	Min value	Max Value	Default factory setting	Action	Address
Current transformers						
Use of current transformer	tPt	0	1	0	0 - Use of built-in transformers 1-Use of external transformers	150
Rated current for the current transformer, A	tnt	20	800	100	For the external current transformer	151
Others						
Rated current of motor, A	ind	0	630	0	0 - current value is not set: UBZ-302 will not allow to close the output *power relay* (see section 2.3.7.)	152
Time frame for the measurement of average current value, sec	t5 1	10	600	60	Time frame during which the average current value is measured (parameters 151, 152, 153 from Table1.4)	153
Protection from maximal currents						
Type of maximal current protection	1=P	0	5	0	0- protection with the independent time delay; Type of protections with time dependent delays: 1-SIT; 2-VIT (LTI); 3-EIT; 4-UIT; 5-RI	154
Tripping threshold to cut the load basing the detected maximal, current values. User defined multiplication factor	1=5	0,8	9,0	4,0	Multiplication factor value is set up basing the rated current of motor.	155
Tripping time delay for current faults, sec	1=t	0,1	600	10,0		156
ON/OFF mode for this type of protection	1=r	0	2	2	0- protection disabled 1- protection enabled, but autoreclosing after the fault is prohibited 2- protection enabled and autoreclosing is allowed afterwards	157
Tripping sequence of the protection depen-	1=n	0	1	1	0- protection trips the current independently from thermal protection	158

Default and readable parameters	Codes of parameters	Min value	Max Value	Default factory setting	Action	Address
ding on thermal over-load protection					1- if there is no thermal overload then it's indicated on the display but the *power relay* doesn't turn the motor **OFF**	
Earth leakage protection						
Current tripping setting, A	I_S	0,3	5,0	0,5	If this parameter is not included into the list of **MMSP** then the default values are the following: 0,5 at In<=50A; 1,0 at In>50A	159
Tripping time delay for the protection, sec	I_t	0,1	2,0	1,0		160
ON/OFF mode for this type of protection	I_r	0	2	2	0- protection is disabled 1- protection enabled but auto-reclosing after the fault is prohibited 2- protection enabled and auto-reclosing is allowed	161
Reverse current sequence protection						
Tripping threshold, %	I05	5	20	10	Is being set in the % of rated motor current value	162
Tripping time delay,sec	I0t	0,2	10,0	5,0		163
ON/OFF mode for this type of protection	I 0r	0	2	2	0- protection is disabled 1- protection enabled but auto-reclosing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	164
Analysis of the tripping basing the reverse current sequence						
Multiplication factor for the exceeding of 2 coefficients dependen-cy: when the reverse sequence current coef-ficient is devided by reverse sequence voltage coefficient	I05	2	4	2		165
Permission of the analysis	I0r	0	1	1	0- **OFF** 1- **ON**	166
Thermal overload (thermal model of AC motor)						
ON/OFF mode for this type of protection	dtr	0	2	2	0- protection is disabled 1- protection enabled but auto-reclosing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	167
Tripping time in case of 2-times current over-load, sec	dtt	10	120	60		168
Coefficient of the coo-ling time augmentation when the motor was switched of due to thermal overload	dtP	1,0	4,0	1,0	Compensation of the time required for motor cooling after motor turn **OFF** due to the thermal overload	169
Minimal phase current						
Tripping threshold setting, %	I=S	11	90	20	Tripping threshold for the protection to minimal operating current in % of adjusted rated current	170
Tripping time delay for the protection, sec	I=t	1	100	5		171
ON/OFF mode for this type of protection	I=r	0	2	2	0- protection is disabled 1- protection enabled but autoreclo-	172

Default and readable parameters	Codes of parameters	Min value	Max Value	Default factory setting	Action	Address
					sing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	
Long lasting (Overcrank) motor start, blocked rotor fault						
Tripping threshold to current, multiplicity coefficient	PPS	1,5	7,0	5,0	User defined multiplicity coefficient to rated current value	173
Tripping time delay for the protection from long lasting start of the motor, sec	PPt	1	600	10	Time for starting up the motor	174
Tripping time delay in case the blocked rotor detected, sec	Pbt	0,1	300	1.0		175
ON/OFF mode for this type of protection	PPr	0	2	1	0- protection is disabled 1- protection enabled but auto-reclosing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	176
Voltage monitoring and protection						
Minimal line voltage, V	U = S	270	415	320		177
Tripping time delay to minimal voltage fault, s	U = t	5	30	10		178
ON/OFF mode for minimal line voltage level protection	U = r	0	2	2	0- protection is disabled 1- protection enabled but auto-reclosing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	179
Maximal line voltage, V	U = S	330	475	415		180
Tripping time delay to maximal voltage fault, sec	U = t	1	10	2		181
ON/OFF mode for maximal line voltage level protection	U = r	0	1	2	0- protection is disabled 1- protection enabled but auto-reclosing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	182
Line voltage imbalance, V	U n S	15	120	35	Reverse voltage sequence	183
Tripping time delay to line voltage imbalance fault, sec	U n t	1	30	5		184
ON/OFF mode for the protection from line voltage imbalance control	U n r	0	2	2	0- protection is disabled 1- protection enabled but auto-reclosing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	185
ON/OFF mode for the correct phase sequence control	U y r	0	2	1	0- protection is disabled 1- protection enabled but autoreclo-sing after the fault is prohibited 2- protection enabled and autoreclosing is allowed	186
AC motor operation and autoreclosing parameters						
Autoreclosing time after the tripping for minimal current fault, sec	AtA	0	900	600		187
Autoreclosing time setting, sec	Att	0	900	5		188

Default and readable parameters	Codes of parameters	Min value	Max Value	Default factory setting	Action	Address
ON/OFF mode for all type of faults	Arr	0	1	1	0-autoreclosing disabled 1-autoreclosing enabled The action of the Arr parameter is valid for all faults and alarms except the voltage faults. To disable auto-reclosing on the detect of voltage faults it's necessary to use the parameters U⁻r , U_r, Un	189
Permission of motor start after the power supply is given to the input terminals of UBZ-302	APd	0	2	1	0 – motor is started manually 1– motor starts with the user preset autoreclosing time 2 – Motor starts with 2 seconds de-lay after power supply is given to UBZ-302	190
Motor operation using the UBZ-302	ACd	0	3	0	0-disabled 1-motor start allowed 2-alarm motor stop allowed 3-motor start and stop allowed For details kindly see section 2.4.7.	191
Temperature control and monitoring						
ON/OFF mode for the temperature control function and setting the type of the *Sensor 1*	Ir	0	2	0	0 – disabled 1- built-in sensor (protection trips the motor if the sensor resistance exceed 1.7 kOhm) 2 – external PTC sensor (1kOhm at 25^0C)	192
Threshold temperature to turn **OFF** the motor (*sensor 1*), ^{o}C	C 15	0	100	80		193
Correction coefficient for the *Sensor 1*	C 1c	-9	9	0		194
ON/OFF mode for the temperature control function and setting the type of the *Sensor 2*	C2r	0	3	0	0 – disabled 1 –type Pt100 2- type Ni100 3- type Ni120	195
Threshold tempera-ture to turn **OFF** the motor (*sensor 2*), ^{o}C	C25	0	220	180		196
Alarm indication temperature value	C2A	0	220	170		197
Correction coefficient for the *Sensor 2*	C2c	-9	9	0		198
Autoreclosing after the thermal overload fault detected and motor is **OFF**	CPA	1	2	1	1- autoreclosing after the fault prohibited 2- autoreclosing after the fault allowed	199
Action in case the temperature sensor fault detected	r	0	1	0	0- alarm indication and continuous operation of the motor running; 1- alarm indication and motor stop	200
Control of the motor coil insulation level						

Default and readable parameters	Codes of parameters	Min value	Max Value	Default factory setting	Action	Address
Control of the minimal insulation level of the AC motor	rid	0	10	5	0-disabled 5-if the insulation resistance is less then 500 kOhms then motor start is not allowed. Autoreclosing allowed 10- motor is not allowed to start if the resistance of the coils is less then 1000 kOhms. Autoreclosing allowed 15- motor is not allowed to start if the resistance of the coils is less then 500 kOhms. Autoreclosing prohibited 20- motor is not allowed to start if the resistance of the coils is less then 1000 kOhms. Autoreclosing prohibited	201
Other parameters and controls						
Mode with minimal set of user defined para-meters	Sin	0	1	1	0-disabled 1-enabled	202
Indication on the UBZ-302 front panel before the permission to start the motor	SiP	0	2	1	0- line voltage in between lines AB (Uab) 1-Resistance of the insulation rid 2- Countdown of the remaining autoreclosing time	203
Parameter indication mode	SiC	0	1	1	0 – parameter value is being shown continuously 1 – parameter value is shown on display within 15 seconds	204
Operation mode for the functional relay output	rrS	0	2	0	0 – relay is used as a signalization output 1- relay is used like a time delay relay (closes its contacts with the user defined parameter rrt. After the power supply is given to the input of UBZ-302 2- relay is used for the **delta-star** switching	205
Timer setting for the functional relay, sec	rrt	0	300	30	Kindly see line above and parameters of rrS	206
Total running time for UBZ-302, days	tbU	0	999	0	* when information is transmitted using MODBUS/RS-232 interface – then the total running time is transmitted in hours	207
Total motor running time, days	tCO	0	999	0	* when information is transmitted using MODBUS/RS-232 interface – then the total running time is transmitted in hours	208
Users access code	LOC	0	9	0	0 – keys are unblocked 1-9 – user defined password	209
Advanced user access code	PAS	000	999	123	000 – access to the advanced user settings allowed 000-999 – password of the advanced user	210
Reset default factory settings	PPP	0	1	0	After the entry “1” and exit from the settings mode – UBZ-302 returns to factory default settings	211
Serial interface parameters (RS-485/ RS-232)						
Communication address of UBZ-302	rSA	1	247	1		212
Data transmission speed	rSS	0	1	0	0: 9600 symbols per second; 1: 19200 symbols per second;	213

Default and readable parameters	Codes of parameters	Min value	Max Value	Default factory setting	Action	Address
Action of transducer to the loss of connection	rSP	0	3	0	0- continuation of transmission without alarm indication 1- alarm indication and continuation of the operation 2- alarm indication and motor stop with the allowed autoreclosing when the connection resumed 3- alarm indication and motor stop with prohibited autoreclosing even if connection resumed	214
Detection of overexceeding the response time, sec	rS0	0	120	0	0-disabled	215
Permission of the UBZ-302 connection using the serial channel	rPP	0	2	0	0- Connection disabled 1- Connection using RS-232 2- Connection using MODBUS	216
UBZ-302 Version	rEL			10		217
FUNCTIONAL RELAY PARAMETERS – DELTA/STAR SWITCHING MODE						
Switching time, sec	Ftt	0,1	2,0	0,4	Time interval between opening the *power relay* contacts and closing the contacts of the *functional relay*	218
Phase loss with current control function						
Tripping time delay to the phase loss fault, sec	ibt	0,3	10	0,5		219
Activation of the protection	ibr	0	2	1	0-protection disabled 1- protection enabled but after the fault autoreclosing prohibited 2- protection enabled but after the fault autoreclosing allowed	220
Remote start and stop of the motor using RS-232/RS485 interface	dUd	0	2	0	0-remote control prohibited 1-remote control allowed and the motor start after the power supply is given to UBZ-302 2- remote control allowed but the motor will not start after the power supply is given to UBZ-302 until there will not be a command for remote start of the motor	221

1.2.4 Front panel, main controls and outer dimensions are figure 1.1.

1.2.5 Protection functions

1.2.5.1 UBZ-302 protects AC motors in the following alarm situations:

- maximal current protection on phases;
- earth leakage (basing the zero-sequence current);
- protection by monitoring the reverse current sequence;
- analysis of ratio between the coefficient of inverse sequence current and the inverse sequence voltage coefficient;
- Thermal overloads-по тепловой перегрузке;
- Minimal current protection on phases;
- Long lasting start and Blocked rotor;
- Overheating of the AC motor coils;
- Protection by minimal line voltage;
- Protection by maximal line voltage;
- Imbalance of line voltage (reverse sequence voltage);
- Correct phase sequence monitoring;
- Minimal resistance of the AC motor coils.
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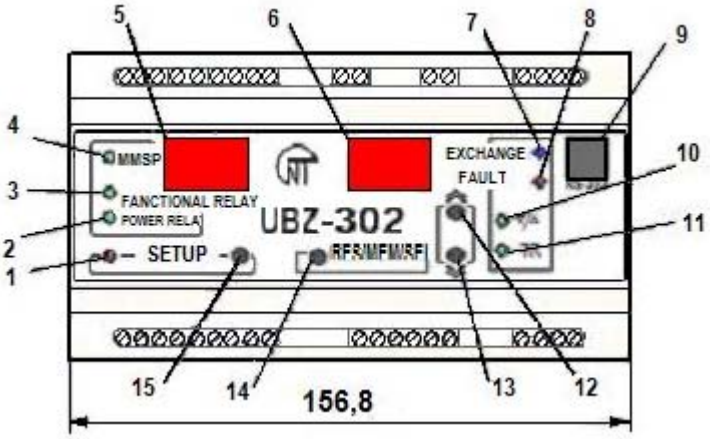
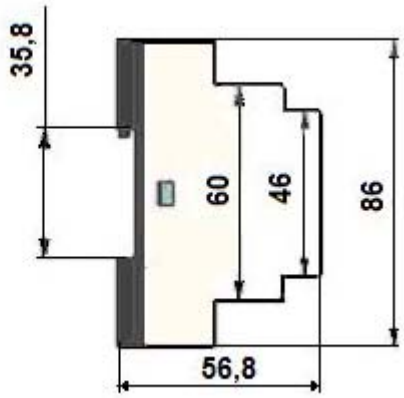




1 – **Green LED "SETUP"** – glows when the relay is in the mode of adjusting the parameters
2 – **Green LED "LOAD"** – glows then the output contacts of *power relay* are closed
3 – **GreenLED "RELAY"** – glows when output contacts of *functional relay* are closed
4 – **Green LED "MMSP"** – glows when UBZ-302 is operating in the mode with minimal number of setting parameters
5 – **3 DIGITS 7-SEGMENT LED INDICATOR**:
- ✓ shows the name of parameter that doesn't belong to the list of minimal number of setting parameters
- ✓ glows then the value of adjusted parameter is protected with the password of advanced user
- ✓ glows when the UBZ-302 is in the advanced user setting mode

6 – **3 DIGITS 7-SEGMENT LED INDICATOR** – shows the value of parameter
7 – **Blue LED "EXCHANGE"** – glows during the data exchange between the UBZ-302 and computer
8 – **Red LED "FAULT"**:
- ✓when power relay contacts are open – it glows then the UBZ-302 when some alarm situation detected (and blinks if after the fault autoreclosing is allowed);
- ✓when power relay contacts are closed – it blinks when the motor is in the condition of the overload to maximal current or the thermal overload condition but the turn **OFF** time not yet came

9 – socket for the connection of the UBZ-302 to computer by RS-232 protocol
10 – **Green LED "Y/Δ"**- glows when *functional relay* works in delta/star switching mode (paragraph 2.4.3.)
11 – **Green LED "TR"** – glows then *functional relay* works in Time relay mode
12 - **Button** ⏫ ⏫ – scrolling to view the parameters values and listing the menus when adjusting the parameters
13 - **Button** ⏬ ⏬ – scrolling to view the parameters values and listing the menus when adjusting the parameters
14 – **Button "RES/MEM/SEL"** – reset of parameter; saving parameter values in setting mode; switching in between the groups of parameters in the view mode
15 – **Button "SET"**– turns **ON** the parameters setting mode

NOTES:

1 - Y/Δ - in text star/delta

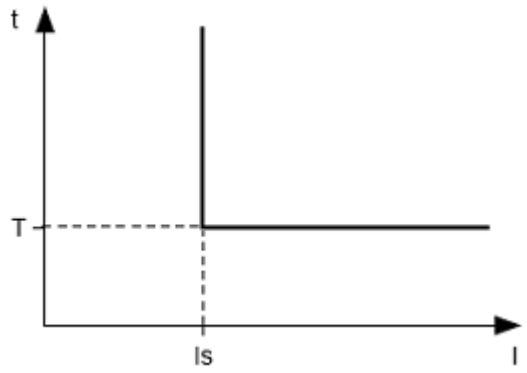
2 – In order to increase the reliability of the UBZ-302 for the input terminals of the power supply the terminals with the step 7,5 mm are being used. Standard numeration of the terminals on the plastic housing of the UBZ-302 case does not fully correspond to the real connection terminals. Thus on the Figure 2.1 some terminals are shown with intermediate values.

Figure 1.1 - Control knobs and outer dimensions of the **UBZ-302**

1.2.5.2. Maximal current protection on phases is 3 phase protection. It trips when one, two or three currents reach some user defined threshold value.

This type of protection has a time delay setting. This time delay could be fixed (some constant value) or have the inverse relation of several types: standard inverse relation - **SIT**; very inverse relation - **VIT** or **LTI**; extreme inverse relation - **EIT**; ultimate inverse relation-**UIT**, delay type **R1**) – dependency curves are shown in APPENDIX 1 (kindly see APPENDIX 1 in the bottom of this manual).

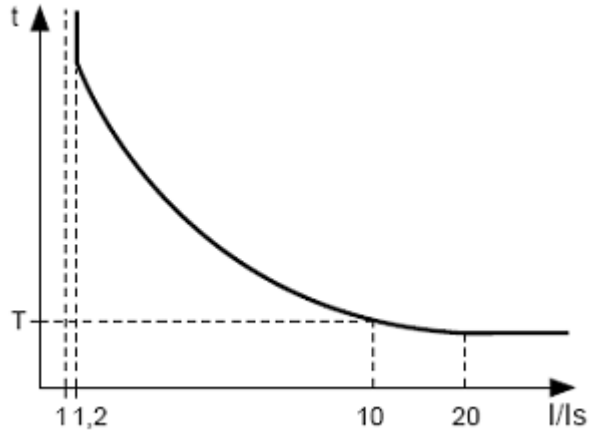
Maximal Current Protection with independent time-delay means that the motor will be switched OFF when the current on one of phases exceed the threshold value. Time-delay is fixed. (Parameter "dEt")



Is corresponds the setting "$I^{=}S$", where T – is fixed time-delay of tripping

Figure 1.2 - Principle of operation of the maximal current protection with independent time-delay

Protection with time-dependent delay corresponds to MEC standards 60255-3 and BS 142



In corresponds the setting "Ind" (rated motor current);
T (parameter "$I^{=}t$" – time constant for protection performance) – corresponds to the tripping time-delay for 10 In).
For very high current values protection has the independent time-delay:

Figure 1.3 - Protection principle for time-dependent maximal current protection.

In APPENDIX 1 there are the graphs for the time constant of 1 sec (parameter "$I^{=}t$"). When setting another value of time constant the tripping time for the protection will change proportionally to time constant value (EXAMPLE if parameter "$I^{=}t$"=10 seconds then the tripping time for the protection will also increase by 10 times).

1.2.5.3 Earth leakage protection:

-trips when the earth leakage current reached the user defined threshold value (parameter "$I_{-}S$");

-AC motor turns OFF if the earth leakage current is more then the user defined value within the time defined by parameter "$I_{-}t$".

1.2.5.4 Inverse current sequence protection (Imbalance). This type of protection turns **ON** when the motor inverse current component exceeds the value defined by parameter "IoS" and turns the motor **OFF** when this exceeding lasts longer then the time defined by parameter "Iot".

If the fault reason analysis mode is active (parameter $I0r$=1), then the tripping of the protection due to exceeding inverse sequence current and not due to the line voltage imbalance (in this case it's considered that the motor has some internal mechanical defects) then the autoreclosing is prohibited (disregarding on the value of parameter "Ior").

Internal AC motor defects are detected basing the exceeding ratio of inverse sequence current coefficient over the inverse sequence voltage coefficient.

1.2.5.5. Minimal phase current protection:

- activates when the current on phase becomes lower than threshold value (defined by parameter "$I_{=}S$") and turns the motor **OFF** when the current is lower than the threshold longer then the time defined by parameter "$I_{=}t$";

- not active when the load current is less than 10% of **In** then it's considered that the motor has been switched **OFF** externally by some other technological equipment (not connected with UBZ-302). (when the decrease of the current caused by turning of the motor by some external control device and not due the decrease of its load);

- has its own independent autoreclosing time-delay adjustment (parameter "Atn").

1.2.5.6. Long lasting motor start and blocked rotor.

Operation principle for the protection in case of long lasting start and blocked rotor shown on Figure 1.4.

Long lasting (overcrank) motor start.

During the motor starting this type of protection trips the motor **OFF** when all phase currents exceed the value of **Is** setting (parameter "PPS") and it lasts longer then the user defined parameter "PPt".

Blocked rotor

At normal motor operation after the start protection trips the motor **OFF** – when all phase currents exceed the setting value within the time more then delay LT (parameter "PbL").

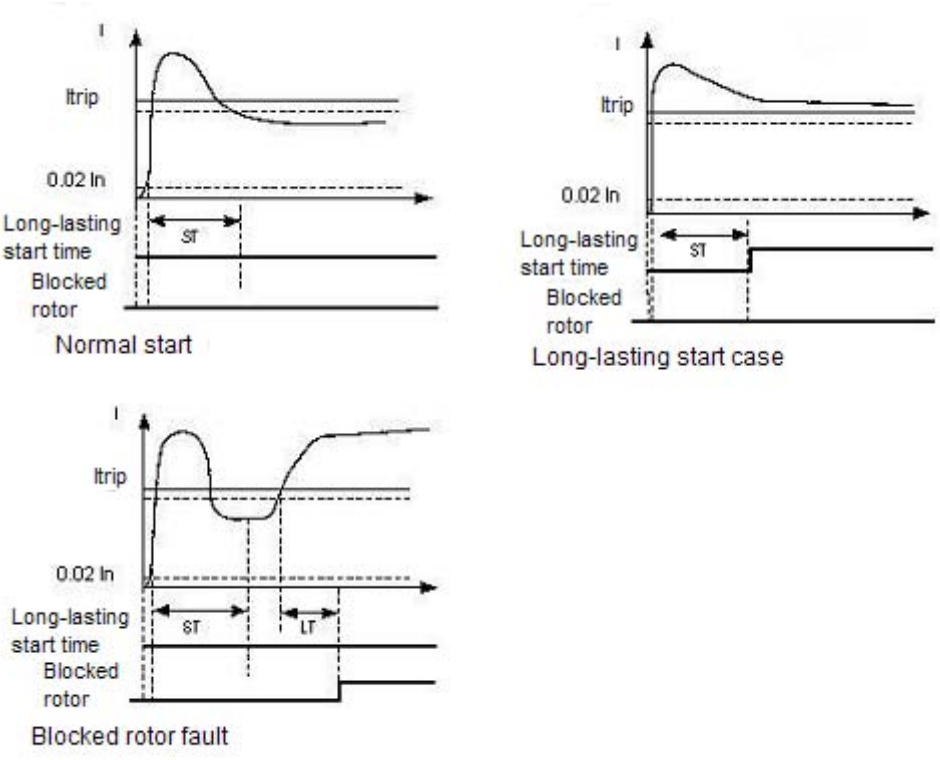


Figure 1.4 - Long lasting motor start and blocked rotor

1.2.5.7. Thermal overload protection

Thermal overload protection is designed basing the calculation of the heating balance equation for the AC motors and takes several assumptions:

- Before the first start motor was in a cold state;
- On motor operation generated heat is proportional to square of current value;
- after turning the motor **OFF** its cooling goes exponentially;

For the correct protection operation it is necessary to set up the tripping time in case of double overload **T2** (parameter "dLt").

Current-time characteristic at different values of T2 is shown on the Figure 1.5.

In Table 1.6 below there is current-time characteristic for the generally recommended value of T2 (60 seconds at 2-times overload).

Table 1.6

I/Irated	1,1	1,2	1,4	1,7	**2**	2,7	3
Tsec	365	247	148	88,6	**60**	36.4	24.6

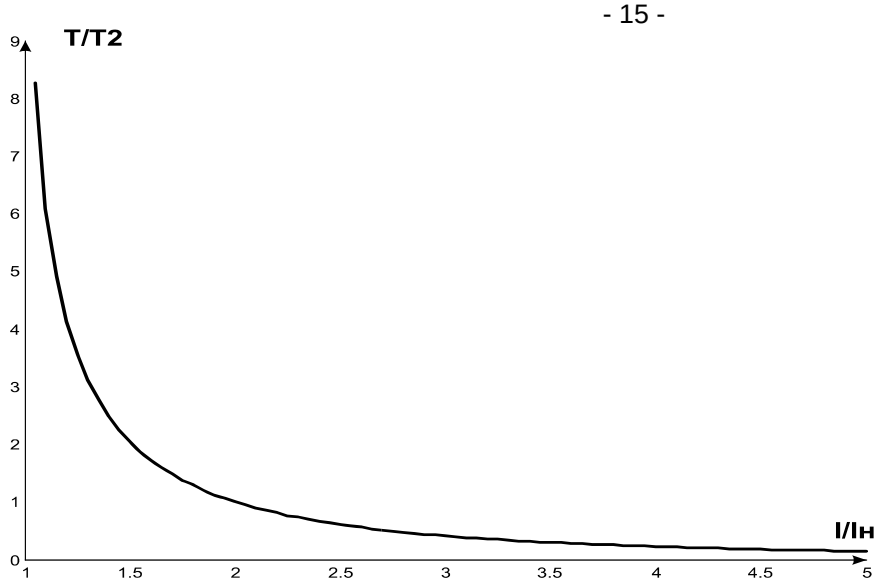
I/Irated	4	5	6	7	8	10	15
Tsec	13.5	8,5	5,9	4,3	3,3	2,1	0,9

For the spinning machines or motors with mechanisms of active heat irradiation cooling is more effective when motor is operating then when the motor is stopped. Taking this fact into consideration it's possible using the parameter dtP to compensate the coefficient of cooling constant when motor is stopped.

After thermal overload detected and motor turned **OFF** by opening the contacts of ***power relay*** the autoreclosing and motor start will only happen with the bigger time of the following 2 cases:

- time required for thermal hysteresis, means that the motor should chill to 33% of the accumulated heat;
- autoreclosing time.

By setting different time intervals for autoreclosing taking into consideration the thermal hysteresis it's possible to make a limitation of number of motor starts within some time frame. Since the UBZ-302 keeps in memory short-time repeated starts and calculates the heat that the motor accumulated during this start.



I/In – multiplication factor for current over the rated value;
T/T2 – actual tripping time basing T2.

Figure 1.5 - Current-time characteristic

1.2.5.8. Protection of motor coils from overheating

Depending on selected settings protection may work on temperature **Channel 1** with the following temperature sensors:

1) built-in to the motor case temperature sensors (C1r=1). In this case settings C1S are disabled and thus short circuit of the sensor and wire-break for the sensor are not controlled. Protection trips the motor when the resistance of the sensor will exceed 1700 Ohm.

2) with the sensors of PTC type (1 kOhm at 25 ^{0}C). Using this type of sensor measured temperature can't exceed 100^{0}C.

On the temperature **Channel 2** protection works using the sensors Pt100 type (Platinum, 100 Ohms at 0^{0}C) or Ni100 (Ni120) (Nickel,100 Ohms (120 Ohms) at 0^{0}C) in accordance with the MEC standards 60751 and DIN 43760.

Protection on **Channel 2**:

- activates when the measured temperature exceeds the threshold value;
- has 2 independent settings: alarm threshold setting and turn **OFF** threshold setting.

Wire-break and short circuits of the temperature sensors are detected in the temperature range from -45 to +220 ^{o}C:

- if the temperature if more than 220 °C then the resistance of the sensor is very high and

UBZ-302 considers it as the wire-break (but in fact the wire could stay intact if the temperature reached such a high temperature);

- if the temperature is less than 45^{o}C the resistance is very low and UBZ-302 considers it as the short circuit fault for the sensor (but in fact the sensor is intact and there is no problem with it).

1.2.5.9 Voltage control and protection

Before starting the motor UBZ-302 performs the measurement of the input voltage and checking the user defined settings. Then it takes the decision whether the motor start is allowed or not. After the motor start UBZ-302 performs continuous control over the voltage parameters, but the decision to turn **OFF** the motor is taken only basing the currents measurements.

VOLTAGE MONITORING PROTECTION:

- by minimal line voltage (trips the load if any of line voltage is lower than the parameter "U_S" within the time defined by parameter "U_t";

- by maximal line voltage (trips the load if any of line voltage is more than the parameter "U^S" within the time defined by parameter "U_t";

- imbalance of line voltages (trips the load if the difference between acting values of line voltages exceed the setting of the parameter "Un S" within the time defined by parameter "Un t");

1.2.5.10 Correct phase sequence control trips the power load if the phase sequence is incorrect and doesn't allow further motor running until the problem is solved;

1.2.5.11 Control of minimal coil insulation resistance level

After the power supply is given to the input terminals of UBZ-302 before closing the output relay contacts it performs the insulation level between the stator coils and the case of the motor.

If parameter rid=5 (15) then the motor is not allowed to start if the resistance is lower than 500±20 kOhms;

If parameter rid=10 (20) then the motor is not allowed to start if the resistance is lower than 1000±50 kOhms.

When rid=5 and rid=10, power load will turn ON after the recovery of the insulation and the expiration of the autoreclosing time delay. When rid=15 и rid=20 autoreclosing will not happen.

1.2.5.12 Phase loss protection will trip and turn the motor OFF if on one of the phases current is more than 10% of rated (parameter "Ind") and on any of other phases it is less than 7% of rated motor current.

1.3 UBZ-302 SET AND COMPONENTS

The set of UBZ-302 motor protection device is shown below in the form of Table 1.7

Table 1.7

Item description	Abbreviation
Motor protection device UBZ-302	UBZ-302
Differential current transformer (zero-sequence current transformer) *	
PC connection cable for RS-232 protocol*	CC-01
Data transmission cable between UBZ-302 and computer by USB *	CC-USB-01
Temperature sensors (types- Pt100, Ni100, Ni120) *	Pt100, Ni100, Ni120
_____ * Supplied on special customers request.	

Differential current transformer supplied with internal diameter 45 or 100 mm.
Manufacturing of transformers of other diameters under the order is possible.

2. APPLICATION AND UTILITY

2.1. SAFETY PRECAUTIONS

All connections must necessarily be performed only on cold state device with maximal care and according with all general safety regulations.

2.2 UBZ-302 OPERATION

2.2.1 UBZ-302 has 5 different modes of operation:

- blocked buttons mode;
- mode with minimal number of setting parameters;
- users mode;
- advanced users mode;
- remote control and operation mode.

In all operation modes is possible to perform following actions:

- to view measured and indicated parameters (see table 1.4). Listing of parameters within each group using **UP** and **DOWN** buttons;
- to view the history of faults (see section 2.4.6.).

2.2.2 **In the blocked buttons mode is not possible to view or change of parameters.**

When this mode is active then pressing "**SET**" button lead to indication "**LOC**" on the front panel display.

To unblock the buttons it's necessary to press again "**SET**" button. Then the green LED "**SET**" start glowing and on digital display starts to blink "0". Using **UP** and **DOWN** buttons user should select the number from 1 to 9 and press "**RES/MEM/SEL**" button. If password is entered correct then the Blocked buttons mode would be disabled and keys will be unblocked. If after the unblocking none of the buttons is pressed within 15 seconds interval then UBZ-302 returns back to the blocked buttons mode.

N o t i c e **–** If one of the sensors is switched **OFF** using the internal UBZ-302 settings – then instead of the temperature value (resistance) on the display will be shown "not".

2.2.3. Mode with minimal number of setting of parameters and other controls:

When the control and setting buttons are unblocked it's possible to work in mode with minimal number of setting parameters and perform several other actions:

- operation with the mode of minimal number of setting parameters;
- View and change the parameters of user mode;
- View the setting parameters of the advanced user mode.

2.2.3.1 Mode with minimal number of setting **(MMSP)** was developed to make the operation easy and user friendly for the majority of ordinary customers.

To switch the UBZ-302 to the MMSP mode it's necessary to set parameter Sin=1 or alternatively to resume the default factory settings (kindly see section 2.2.4). When MMSP mode is active on the front panel of UBZ-302 glow green LED "**MMSP**".

In the MMSP mode for the normal operation and effective protection of AC motor it's necessary to set the following number of parameters:

- type of the current transformer (built-in or external);

- rated current for current transformers (in case of using the external current transformers);
- rated current for the motor (usually written on the motor shield).

The difference between the MMSP mode and *USERS MODE* is that in MMSP mode the other parameters that doesn't belong to list of MMSP mode – they are set as factory default.

ATTENTION!!! Pay special attention that if some of the parameters or settings were changed by the USER or ADVANCED USER but were not included into the list of MMSP – then when activating the MMSP mode they will be automatically set as factory default.

Parameters that were not included into the list of MMSP is not possible to view or change. Work with the parameters that were included into the list of MMSP is the same as with all adjustable parameters.

To include or exclude any of the parameters into the list of MMSP is possible only on the level of *ADVANCED USER*.

When turning the MMSP mode OFF (when setting the parameter SIn=0) the front panel LED "**MMSP**" will turn **OFF**. When working in a USER MODE you can view full list of parameters, but to change or set the value of the parameter it's necessary to select the required parameter using UP and DOWN buttons and then press them simultaneously.

2.2.3.2 To view and modify the parameters of the *USERS MODE* it's necessary to press **"SET"** button, then the LED "**SET**" will start glowing. Listing in between the parameters using **UP** and **DOWN** button. To enter to the parameter for changing press "**SET**" button (value of parameter starts blinking). To change the value of parameter use **UP** and **DOWN** buttons – to save the parameter press "**RES/MEM/SEL**" button. To exit the menu without saving press "**SET**" button. If none of the buttons were pressed within 15 seconds time interval UBZ-302 automatically switch to initial state.

If the parameter is not allowed to change by the *ADVANCED USER* – then in the middle decimal order will glow dot sign. Then it's possible to change the required value only from the *ADVANCED USER* level.

2.2.3.3. Advanced User mode

To enter the *ADVANCED USER* mode it's necessary to press "**SET**" button and keep it pressed within 5 seconds. If this level is protected with a password then on the indicator will be shown "PAS". The LED "**SET**" will start glowing and on the digital display on the front panel will start glowing "000". Using the **UP** and **DOWN** buttons it's necessary to enter one by one all 3 numbers of password. After setting each digit value press "**RES/MEM/SEL**" button.

If password is not correct on the display will be shown "**PAS**" and blinking the value in the maximal digital order and after 15 seconds UBZ-302 will return to it's initial state. If password was entered correctly – then on display will be shown the first parameter of the *ADVANCED USER* menu.

Listing in between the parameters using **UP** and **DOWN** buttons – to enter and change the parameter press "**SET**" button (value will start blinking) – then change the parameter to required value using **UP** and **DOWN** buttons and save it by pressing "**RES/MEM/SEL**", to exit back to the menu without saving press "**SET**" button. If none of the buttons were pressed within 15 seconds time interval UBZ-302 automatically switch to initial state.

When working in the *ADVANCED USER MODE* in the lower digital order of parameter name glows dot sign.

In the *ADVANCED USER MODE* it is possible to allow or cancel the possibility to change some certain parameter on the level of *USER MODE*. This is achieved by simultaneous pressing of "**SET**" and **DOWN** buttons. The indication of the protected parameter is shown as a decimal dot in the middle digital order of the parameter name on the display.

In the *ADVANCED USER MODE* it's possible to include to the MMSP list any of the required parameter. For this it's necessary to perform the following actions:

- using **UP** and **DOWN** buttons to select required parameter which is necessary to include to the list of MMSP;
- press simultaneously buttons **UP** and **DOWN**

If the parameter has been deleted from the list of the MMSP then in the higher order of the parameter name will glow decimal dot.

2.2.4. Resume the default factory setting

There are 2 ways to reset the default factory settings:

1) Set the parameter value PPP=1. After the exit from setting menu all factory settings will be changed to default factory settings (except the password of the *ADVANCED USER*).

2) While keeping the buttons "**SET**" and "**RES/MEM/SEL**" simultaneously pressed to give the power supply to the input terminals of the UBZ-302. In this case absolutely all settings including the *ADVANCED USER* password will be changed to default factory settings (default password of the **advanced user is – 123**).

After the resetting the default factory settings UBZ-302 starts operation from the MMSP mode with the following list of default parameters:

- type of the current transformers (built-in or external), parameter tPt;
- rated current for the current transformers (should be set in case of using external current transformers), parameter tnt;
- rated current of the motor, parameter ind.

2.3. FIRST START UP PREPARATIONS

2.3.1. When using the AC motor with the rated power from 2,5 and up to 30 kW it's allowed to use built-in current transformers. It's necessary to let the wires going to the motor through the corresponding holes in the case of UBZ-302. Each phase wire must go through its individual hole.

When using the motors with another rated power it's necessary to connect (see Figure 2.1) current transformers with the rated output current of 5A. For the correct UBZ-302 operation it's necessary to pay attention to the polarity of the current transformers.

2.3.2. Take all three phase wires and let them go through the differential (zero-sequence transformer) current transformer. Then connect the differential transformer to the corresponding terminals of the UBZ-302.

2.3.3. For the control and measurement the resistance of coil insulation it's necessary to connect the *terminal **25*** to one of the output contacts of magnetic contactor that starts the motor. If the motor case is not grounded or if the motor is being used in the circuits with isolated neutral or the neutral wire is not connected to the UBZ-302 then it's necessary to connect the *terminal **26*** to the case of the motor.

2.3.4. Connect UBZ-302 to the electric circuit in accordance with the scheme shown on Figure 2.1. When using the motor with delta-star switching it is necessary to connect the UBZ-302 as shown in **Appendix 2**.

2.3.5. For the operation with the use of computer connection as a controlling device and with the use of software it's necessary to do the following steps:

- install onto the PC "UBZ-302 control panel" program by starting the installation file **setup_UBZ302.msi**;
- connect one end the cable KC-01 to the front panel of the UBZ-302 and to corresponding slot of the PC using RS-232 protocol. Or alternatively connect to the USB slot of PC with the use of cable KC-USB-01.
- set the parameter "rPP=1".

N o t e s:

1 The program "setup_ UBZ302.msi", is placed on a company site (http://www.novatek-electro.com/production_ubz.htm).

2 KC-01 and KC-USB-01 cables are supplied on special customer request. Perhaps independent manufacturing of cable KC-01 by the user according to fig. 2.2.

3 Use of the programs developed by the user is supposed for working with UBZ.

2.3.6. When using MODBUS protocol connect the data transmission lines to *terminals **33, 34, 35*** of UBZ-302. Set parameter "rPP-2".

2.3.7. Give the power supply to the input terminals of UBZ-302.

N o t i c e **- UBZ-302 is supplied with the factory preset rated current that equals zero. In this case output *power relay* will never close its contact until the rated current is installed. Engine nominal current will be no less 5A.**

The sequence of power relay operation and closing is defined by parameters Att and APd (see section 2.4.1).

2.3.8 Enter the settings menu and set the required values of parameters.

2.3.9 Turn **OFF** the power supply from UBZ-302 input terminals.

2.3.10 According the wiring diagram shown on Figure 2.1 connect magnetic contactor (hereinafter MC) that should afterwards commutate the power load for the AC motor.

N o t i c e **-** When output power relay is in **ON** state – contacts **5-6** and **8-9** are closed, when power relay is in **OFF** state – contacts **4-5** and **7-8** are closed.

2.4. USAGE AND OPERATION

Please kindly pay attention when describing the usage and operation of the UBZ-302 in this section it's considered that all mentioned protections are activated and all necessary sensors are connected.

2.4.1. **UBZ-302 operation before turning the load ON:**

2.4.1.1. UBZ-302 operation after giving the power supply on the input terminals (first startup)

After power supply is given to the input terminals of UBZ-302 on the display indicator is being shown "StA", and then before turning the power load ON it tests the following:

- Level of insulation between the stator coils and the case of the motor (if resistance is less then 500 ± 20 kOhms when parameter rid=5 (1000 ± 50 kOhms when parameter rid=10) motor will not be allowed to take a start);
- Quality of the power supply voltage: full phase power, phase symmetry, and the value of acting line voltage;
- Correct phase sequence and the absence of phase coincidence.

If one of the above mentioned factors detected then output power relay of the UBZ-302 will not close its contacts and will not allow to start the motor. On the front panel indicator will be shown the corresponding fault type code and red color LED "FAULT" will glow.

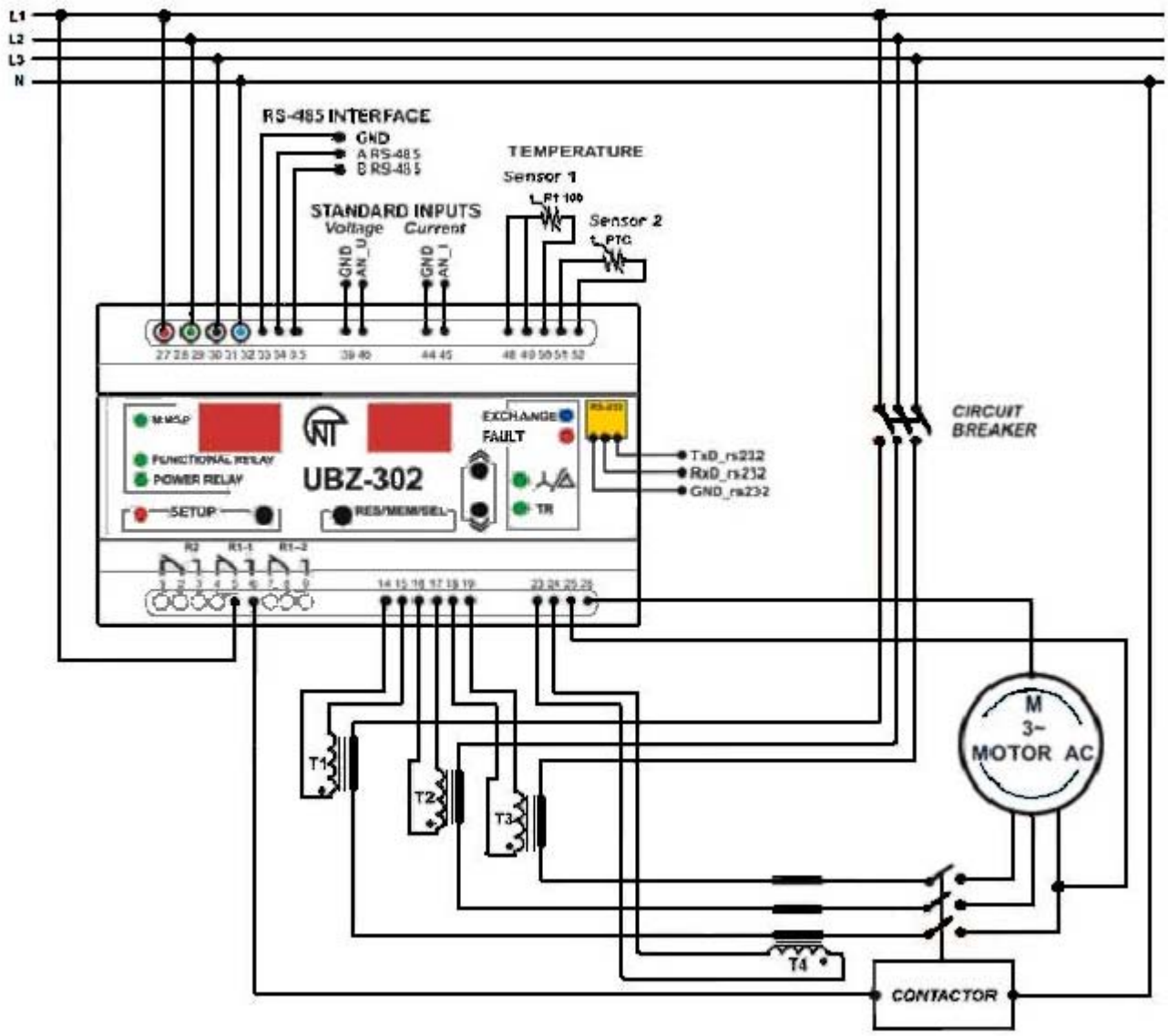


Figure 2.1 - Wiring diagram for the UBZ-302

Depending on the value of parameter SiP on the front panel indicator will be shown:

- line voltage between phases A-B Uab if parameter SiP=0;
- resistance of the insulation (rid) if parameter SiP=1;
- remaining time for the autoreclosing in seconds (Rtt) if parameter SiP=2.

In the absence of factors that allow or prohibit the motor starting further turning **ON** the motor is determined by parameters APd (operation after power supply is given to the input terminals) and parameter Arr (prohibited autoreclosing after all types of fault situations):

1) If APd=0 *power relay* will not close it's output contacts**. In this case to turn ON the power load it's necessary to press simultaneously UP and DOWN buttons.**

2) If APd=1 *power relay* will close contacts and turn **ON** the power load with the user defined autoreclosing time interval.

3) If APd=2 *power relay* will close its contacts 2 seconds after the power supply is given to the input of UBZ-302.

At the same moment of turning **ON** the power load on the front panel LED "**LOAD**" starts glowing.

After the *power relay* closed its contacts and up to the moment of motor start (motor start is con-sidered when the current consumed by the motor will be 1,2 of rated motor current (1,2In) UBZ-302 performs the continuous voltage parameters monitoring. If in this "currentless" interval appeared some faults or voltage interruptions then the *power relay* will turn **OFF** the power load immediately.

Operation of the UBZ-302 when the remote operation and the use of interfaces RS-232/RS-485 (dUd=1, dUd=2) is described in details in paragraph 2.4.4.8.

2.4.1.2. Operation of the UBZ-302 after the turning the power load OFF because of a detected fault

Operation of the UBZ-302 in this case it the same like during the first start-up, but turning the power load **ON** doesn't depend on the value of parameter APd.

If after the fault autoreclosing is prohibited parameter "Arr=0", then turn ON of the motor is not possible until

the UBZ-302 will be completely deenergized. Parameter Arr is active for all type of faults except the voltage faults. To disable the autoreclosing for voltage faults it's necessary to use parameters Ur, U_r, Unr.

2.4.2. UBZ-302 Operation after motor start (when currents exceed 10% of rated motor current).

UBZ-302 performs the continuous monitoring of both voltage and current parameters. Output ***power relay*** opens its contacts when tripping of any of the protections mentioned in Table 2.7 excluding:

- protection by voltage control;
- maximal current protection when parameter "inn" =1 (in this case there is indication about the fault byt the output *power relay* doesn't open the contacts.

On the indicator could be shown current on phase A of the motor or the value of parameter defined by user. User defined parameter value could be displayed constantly (SiC=0) or within 15 seconds and then returns to indication of the current on phase A (SiC=1).

2.4.3. Operation of the functional output relay

Functions that functional relay may perform are defined by parameter rrS:

If rrS =0 then *functional relay* is being used as a signalization output (LEDs Y/Δ and TR doesn't glow). Contacts of the relay close at any detected fault mentioned in the Table 2.7.

If rrS = 1 then *functional relay* is being used as Time relay (LEDs Y/Δ and **TR** glow): it turns **ON** with the time defined by parameter "rrt" after the power relay closes its contacts.

If rrS = 2 then *functional relay* is being used for switching of the coils from star connection to delta (glows LED Y/Δ). In this mode power relay closes its contacts the same way as when the parameter rrS=0, but with the time defined by parameter "rrt" it will open its the contacts. After the time defined by parameter "Ftt" *functional relay* closes its contacts after opening the contacts of *power relay*.

Notice **-** Functional relay is considered to be in ON state then contacts 1-2 open and terminals 2-3 closed.

2.4.4. Operation with the RS-485 interface using MODBUS protocol in RTU mode

UBZ-302 allows to arrange data exchange with externally connected devices using serial interface by MODBUS protocol. During the data exchange by RS-485 or RS-232 on the front panel glows the blue LED "EXCHANGE".

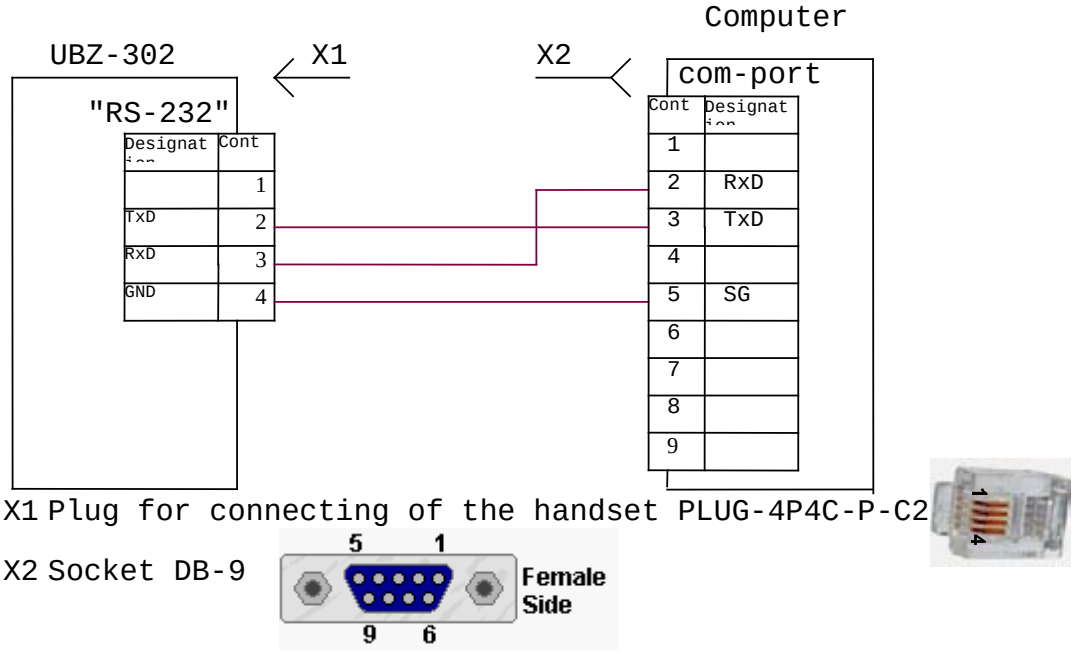
2.4.4.1 Communication parameters:

- address of the device: 1-247 (parameter rSA);
- data transmission speed: 9600 SPS, 19200 SPS (parameter rSS);
- reaction of the device for the loss of connection: alarm signalization and continue the operation; alarm signalization and stopping the motor; continue of operation disregarding the loss of connection and without alarm signalization (parameter rSP);
- detection of the response time delay: 1 sec –120 sec (parameter rS0);
- format of word transmission – 8 bit, without parity control, 2 stop bits.

2.4.4.2 Computer control operation with the UBZ-302

Connection of computer and UBZ-302 is performed using serial interface. Connection scheme is snown on Figure 2.2. Each of the UBZ-302 has its own individual communication address. Computer operates with each of UBZ-302 using this addresses.

UBZ-302 may work in the networks that function in RTU mode.



2.4.4.3. Communication protocol

Exchange between PC and UBZ-302 realized in packet data exchange way. Data packet format is shown in the Table 2.1 below:

Table 2.1

START	Silence interval – more then 2 ms at SPS 9600, or more then 4 ms id the transmission speed is 19200 SPS
ADR	Communication address (8 bit)
CMD	Command code 8 bit
DATA 0	Data content: N*8 bit of data (n<=24)
….	
DATA (n-1)	
CRC CHK low	CRC sum of cyclical control 16 bit
CRC CHK high	
END	Silence interval – more then 2 ms at SPS 9600, or more then 4 ms id the transmission speed is 19200 SPS

2.4.4.4. CMD (command code) and DATA (data symbols)

Format of data symbols depend on command codes.

Command code –0x03, reading n- words.

For example reading 2 words from the initial address 2102H in the UBZ-302 with the communication address 01H (see Table 2.2).

Table 2.2

Command message		**Answer message**	
ADR	0x01	ADR	0x01
CMD	0x03	CMD	0x03
Data starting address	0x21 0x02	Data size in Bytes	0x04
Data size in words	0x00 0x02	Memory address of data	0x17 0x70
CRC CHK low	0x6F	Memory address of data	0x00 0x00
CRC CHK high	0xF7	CRC CHK low	0xFE
		CRC CHK high	0x5C

Command code 0x06, registry – one word

Usage of command line is not recommended since writing of invalid data may result to the malfunction of UBZ-302.

Data entry is possible only to the addresses of programmable parameters (Table 1.5), excluding parameters listed in Table 2.3.

Table 2.3

Setting and reading parameters	**Parameter codes**	**Address**
Total running time of UBZ-302, days	tbU	207
Motor total running time, days	tCO	208
User access code	LOC	209
Advanced user access code	PAS	210
Resuming the default factory settings	PPP	211
UBZ-302 device version	rEL	217

Parameter entry is made disregarding on the *ADVANCED USER* mode settings (when UBZ-302 is connected to computer it has higher priority level than the *ADVANCED USER* mode).

When writing new parameter value that doesn't belong to **MMSP** – then this parameter automatically comes active.

All written parameters must necessarily be in accordance to the multiplication factor shown in Table 1.5.

For example registry 1000 (0x03E8) in register with address 0x00A0 in UBZ-302 with communication address 01H.

Table 2.4

Command message		Answer message	
ADR	0x01	ADR	0x01
CMD	0x06	CMD	0x06
Data starting address	0x00 0xA0	Data starting address	0x00 0xA0
Data	0x03 0xE8	Date	0x03 0xE8
CRC CHK low	0x89	CRC CHK low	0x89
CRC CHK high	0x56	CRC CHK high	0x56

Command code 08h – diagnostics.

Function 08h provides a number of tests to check the connection between the UBZ-302 and the PC and also tests the operation capacity of the UBZ-302.

Function uses sub-functions field to specify the exact parameter testing.

Sub-function 00h – return of the request data.

Data sent to the request field must return to the response field data field.

Example of request and response is shown on Figure 2.3.

Request

Adress	Function	Subfunction HB	Subfunction LB	Data HB	Data LB	CRC LB	CRC HB
01h	08h	00h	00h	A0h	3Ch	98h	1Ah

Answer

Adress	Function	Subfunction HB	Subfunction LB	Data HB	Data LB	CRC LB	CRC HB
01h	08h	00h	00h	A0h	3Ch	98h	1Ah

Figure 2.3 – Example of the request and response for the sub-function 00h – return of the request data.

Sub-function 01h – restart of the connection options.

Peripheral port of UBZ-302 should be initialized and restarted.

Example of request and response is shown on the Figure 2.4.

Request

Adress	Function	Subfunction HB	Subfunction LB	Data HB	Data LB	CRC LB	CRC HB
01h	08h	00h	01h	00h	00h	B1h	CBh

Answer is not returned.

Figure 2.4 – Example of request and response for the sub-function 01h – restart of the connection options.

2.4.4.5 CRC – Code of Cyclic control (cyclic redundancy check)

Control sum (CRC16) is the cyclic redundancy code on the base of polynomial A001h. Transmitting device forms control sum for all byte sent message. Recipient device accordingly forms the sum for all byte received message. Then it is followed by comparison of sent and received sums. In case of disagreement of sums the fault error message forms.

The size of the control sum field is 2 bytes. Control sum in the message is being sent with the low order byte first.

Control sum is being formed using the following algorithm:

1) boot of the CRC registrator (16 bit) with the digits (FFFFh);
2) excluding **OR** is sent with the first 8 bits of the message and with the content of the CRC registrator;
3) shift of the result to one bit to the right;
4) if shifted bit =1, excluding **OR** of the registrator with the value A001h;
5) if shifted bit = 0, then repeat step 3;
6) repeat steps 3, 4, 5 until 8 shifts will not be performed;
7) excluding **OR** with the next 8 bits of the byte message and the content of the CRC registrator;
8) repeat step 3-7 untill all the bytes will not be processed;
9) final content of the registry must contain control sum.

Example of the program CRC code generating with the use of language C.

Function takes 2 arguments:

Unsigned char* data <- a pointer to the message buffer

Unsigned char length <- the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.

```
Unsigned int crc_chk(unsigned char* data, unsigned char length)
{int j;
 unsigned int reg_crc=0xFFFF;
 while(length--)
  {
    reg_crc ^= *data++;
    for(j=0;j<8;j++)
     {
       if(reg_crc & 0x01)   reg_crc=(reg_crc>>1) ^ 0xA001;  // LSB(b0)=1
          else reg_crc=reg_crc>>1;
      }
  }
return reg_crc;
}
```

2.4.4.6. Registry addresses

Registry addresses of measured and calculated parameters for the UBZ-302 are shown in Table 1.4. Adresses of the programmable parameters are shown in Table 1.5. Additional registers and their application are shown in Table 2.5.

Table 2.5

Description	Address	Application		Notes
UBZ-302 state register 240		Bit 0	0- normal (no faults detected) 1-fault (code of the fault in the registry 241)	
		Bit 1	0 – *power relay* is OFF (contacts open) 1 - *power relay* is ON (contacts closed)	
		Bit 2	0 – *functional relay* is OFF 1 - *functional relay* is ON	
		Bit 3	0 – autoreclosing disabled 1 – autoreclosing enabled	
		Bit 5-4	*Functional relay* operation mode 00 – signalization relay 01 – time delay relay 10 – delta/star switching mode	
		Bit 6	0 – MMSP mode is disabled (OFF) 1 – MMSP mode is enabled (ON)	
Fault register 1	241	For more details bits description see *Table 2.7*		0- normal 1-fault
Fault register 2	242	For more details bits description see *Table 2.7*		
Faults history log				
Fault code 1	243	Fault type codes kindly see in *Table 2.7*		
Parameter value 1	244	Parameter values kindly see in *Table 2.7*		
Time of the fault 1	245	High-order 2 bytes		
	246	Low-order 2 bytes		
Fault code 2	247	Alarm codes kindly see in *Table 2.7*		
Parameter value 2	248	Parameter values kindly see in *Table 2.7*		
Time of the fault 2	249	High-order 2 bytes		
	250	Low-order 2 bytes		
Fault code 3	251	Fault type codes kindly see in *Table 2.7*		
Parameter value 3	252	Parameter values kindly see in *Table 2.7*		
Time of the fault 3	253	High-order 2 bytes		
	254	Low-order 2 bytes		
Fault code 4	255	Fault type codes kindly see in *Table 2.7*		
Parameter value 4	256	Parameter values kindly see in *Table 2.7*		
Time of the fault 4	257	High-order 2 bytes		
	258	Low-order 2 bytes		
Fault code 5	259	Fault type codes kindly see in *Table 2.7*		
Parameter value 5	260	Parameter values kindly see in Table 2.7		
Time of the fault 5	261	High-order 2 bytes		
	262	Low-order 2 bytes		

Notes:

1 Fault time – this is the time which passed since the moment of giving the power supply to the input terminals of the **UBZ-302** and till the moment when this fault was detected. It's being measured in minutes.

2 On the purchase of the **UBZ-302** or after setting default factory settings to the LOG file of the faults the code of fault 40 and the value of the parameter 10000 will be written.

2.4.4.7. Connection errors processing

In case of errors in frame receiving (parity error, control sum error, frame error) UBZ-302 doesn't response and doesn't return the reply message.

In case of mistakes in data format or value of transmitted data (not supported function code and etc.) then UBZ-302 receives the request frame and forms a reply with the overrun bit and the code of error. The sign of overrun bit is the high-order bit in the function field. For the error code there is a separate field in the reply. Example of the response is shown on Figure 2.5**.** Error codes are shown in Table 2.6.

Request – 30h function is not supported

Adress	Function	Data	CRC LB	CRC HB
01h	30h		XXh	XXh

Answer

Adress	Function	Error code	CRC LB	CRC HB
01h	B0h	01h	94h	00h

Figure 2.5- Example of the reply after the error

Table 2.6

Error code	Name	Description
01h	ILLEGAL FUNCTION	Received function code can't be processed by the UBZ-302
02h	ILLEGAL DATA ADDRESS	Shown data address is inaccessible for this subordinate
03h	ILLEGAL DATA VALUE	The value in the request field is inacceptable for the UBZ-302
04h	SLAVE DEVICE FAILURE	While the UBZ-302 tried to perform the requested action it happened fatal error
05h	ACKNOWLEDGE	UBZ-302 received the request and processing it, but it requires more time. This response preserves the master from generation timeout error
06h	SLAVE DEVICE BUSY	UBZ-302 is in command processing mode. Master should repeat the message later when the slave will get free
07h	NEGATIVE ACKNOWLEDGE	UBZ-302 can't perform the program function received in request

2.4.4.8 Remote operation with the motor using interface RS-232/RS-485.

Remote control and operation function is defined by parameter ***dUd***.

When ***dUd***=0 remote control of the motor is fully disabled.

When ***dUd***=1 after giving the power supply to the input terminals of the UBZ-302 it keep on working the same way as if the remote control was disabled (normal device operation) but its allows the record of the commands to the register of commands R_COMMAND.

When ***dUd***=2 UBZ-302 will start the motor ON only after the appropriate command will be given by interface RS-232/RS-485.

The value of R_COMMAND is taken into account by UBZ-302 operation algorithm at ***dUd***=1, ***dUd***=2. If ***dUd***=0 and the user sets ***dUd***=1 or ***dUd***=2, then to R_COMMAND will be written the value 0.

The list of potential settings of registry commands is shown in the **Table 2.7** below.

If ***dUd***=1, then after turning the power supply ON to the registry of commands will be automatically written 1 (normal device operation). If ***dUd***=2, then after the power supply is given to the registry of commands will be written the value 0 (motor is switched OFF until the Start command to turn the motor ON).

In case of alarm motor turn OFF by simoultaneous pressing UP and DOWN buttons (when ***ACd***=2,***ACd***=3), command register will be resumed to values 0.

Table 2.7

Command register R_COMMAND Address = 299	**Actions to perform**
0	Turn **OFF** the motor. If the motor is already stopped then it will not start until the remote command for a start will not be given. If the motor is running – then it will be switched **OFF**.
1	Normal operation of the device. If the motor was initially stopped by the remote control command or with simultaneous pressing of UP and DOWN buttons (parameter ACd=3) or any fault or alarm situation was detected – then the motor will turn ON again after the expiration of the autoreclosing time delay and to the register R_COMMAND will be written the value 1.
2	Premature start of the motor. Record 2 will lead to the turn ON of the motor before the expiration of the autoreclosing time delay. After the motor turn ON to R_COMMAND will be written the value 1.

2.4.5. System of alarm states

On detecting the fault or alarm situation UBZ-302 performs the following actions:

- on the front panel digital indicator is being shown the code of an error in accordance with ***Table 2.8*** (kindly see below);
- on the digital indicator is shown the value of parameter that lead to the fault tripping (if this fault doesn't have numeric value then it's shown "---") ;
- starts glowing RED LED "ALARM" if the autoreclosing is prohibited afterwards and blinking in turns if by the end of autoreclosing time delay the UBZ-302 will automatically turn **ON** the power load;
- output power relay close its contacts (turns **OFF**);
- Functional relay close its contacts (turns **ON**) if parameter rr5=0.

If UBZ-302 detects several faults simultaneously then the fault codes and their corresponding values are being shown in turns one by one.

If the autoreclosing is allowed then on the digital indicator are shown the codes of faults and remaining time for autoreclosing (if the remaining time for motor thermal overload is more than the remaining autoreclosing time then on the display is shown the remaining time for cooling after the thermal overload fault).

***Table 2.8* - Error codes**

Fault description	**Display mnemonic**	**Parameter values**	**Registry address for the parameter value**	**Fault code**	**N-bit registry address**
Maximal current fault on phases	Ai=	Maximal current on phase	300	0	241:0
Thermal overload	Adt		301	1	241:1
Earth leakage (based on zero-sequence current measurement)	Ai-	Zero-sequence current	302	2	241:2
Exceeding of coefficient of inverse current sequence over the inverse voltage sequence coefficient	AiO	Inverse sequence coefficient current * 100	303	3	241:3
At the inverse sequence current	Aio	Inverse sequence current	304	4	241:4
Minimal current fault on phases	Ai_		305	5	241:5
Long lasting start	APP		306	6	241:6
Blocked rotor	APb		307	7	241:7
Threshold temperature value on *Sensor 1*	At1	Temperature value,°C	308	8	241:8
Threshold temperature value on *Sensor 2*	At2	Temperature value,°C	309	8	241:9
Phase sequence fault	AU4		310	10	241:10
Contactor fault (Presence of currents while the power relay contacts are open)	ACo	Current value	311	11	241:11
Minimal line voltage fault	AU_	Voltage	312	12	241:12
Maximal line voltage fault	AU=	Voltage	313	13	241:13
Phase imbalance	AU	Imbalance	314	14	241:14

Minimal resistance of the motor coils	Ar ı	Insulation resistance	315	15	241:15
Alarm of the remote control panel	AdU			16	242:0
Alarm motor stop with blocked autoreclosing and prohibited motor start	EAd			17	242:1
Alarm motor stop with allowed autoreclosing by pressing **UP** and **DOWN** buttons simultaneously	EOd			18	242:2
Short circuit of temperature *sensor 1*	EoS			19	242:3
Wire break of temperature *sensor 1*	Eoo			20	242:4
Short circuit of temperature *sensor 2*	EoS			21	242:5
Wire break of temperature *sensor 2*	Eoo			22	242:6
Wire break of phase	E ıU			23	242:7

2.4.6. History Log of alarm situations and faults

On turning OFF the power load in case of the detected fault UBZ-302 keeps in its internal memory the code of the fault, value of faulty parameter and the time when it happened.

N o t i c e **-** Time of the fault situation UBZ-302 measures basing its own internal clocks. Since UBZ-302 doesn't have its own built in or external independent power supply mode – then the time when there was no power supply is not taken into consideration and not taken into account.

Number of faults simultaneously to be kept in the history log – 5. On the occur of the following faults most old one will be erased from memory and rewritten with the new one.

To view the faults history log it's necessary to press button "RES/MEM/SEL".

LED "**SETTING**" will start blinking and on the digital indicators will be shown first line from Table 2.9. Using **UP** and **DOWN** buttons you may list all the fault events.

To exit the history log menu it's necessary to press button "RES/MEM/SEL" or it will happen automatica-lly in 30 seconds if none of the buttons are pressed within this time interval.

Information about faults is shown on the digital displays on the UBZ-302 front panel as shown in Table 2.9.

Table 2.9

Indication of parameter	Value shown on the digital display
"Ad ı"	Number of event in the log (1-last event)
XXX – fault indication code as per Table 2.7	YYY – value of parameter according to the Table 2.7 (if there is no numeric value then display shown "---")
XXX – hours since the fault detection moment	YY – minutes from the fault detection moment

2.4.7. Operation by the motor using the front panel of the UBZ-302

Depending on the value of parameter ACd its possible to operate with the motor using the front panel of UBZ-302 by pressing **UP** and **DOWN** buttons:

ACd=0 – no reaction to simultaneous pressing of **UP** and **DOWN** buttons;

ACd=1 (motor start allowed) – *power relay* will close its contacts (turn the motor **ON**) even if autoreclo-sing time didn't yet expire;

ACd=2 (alarm motor turn **OFF**) - *power relay* will open its contacts (turn the motor **OFF**) and give the alarm code "AAd" on the front panel. Motor restart is possible only after complete deenergizing of the input terminals of the **UBZ-302** and then turning it **ON**;

ACd=3 (allowed to stop and start the motor) – after pressing **UP** and **DOWN** buttons *power relay* turns the motor **OFF** and indicates it with code "AOd". To turn the motor **ON** it's necessary to press again buttons **UP** and **DOWN**.

Attention – when selecting the parameter "APd=0" (after the power supply is given to the input terminals of the UBZ-302 the motor starts manually only by pressing front panel buttons and the parameter "ACd=0" (manual operation with the motor is disabled) the power relay will not turn ON.

3. TECHNIAL MAINTAINANCE

3.1. SAFEGUARDS

When performing technical or service maintenance works UBZ-302 should be disconnected (deenergized) from input power supply.

3.2 ORDER OF THE TECHNICAL MAINTAINANCE

Technical maintenance is recommended to make every 6 months – so that it's necessary to check the tight wire connection to all input and output terminals and make visual inspection to be sure that there are no dents or mechanically caused defects on the plastic case of the UBZ-302.

4. TRANSPORTATION AND STORAGE

UBZ-302 in the manufacturers package should be carefully stored in dry places with ambient temperature from -45 to +75 °C and relative air humidity not more than 80%. Air should not contain any chemically aggressive vapors. When transporting customer should provide suitable packing that would protect the UBZ-302 from any mechanical damages, serious drops and vibrations that may affect the device integrity.

5. MANUFACTURERS WARRANTY AND OPERATION LIFE TIME

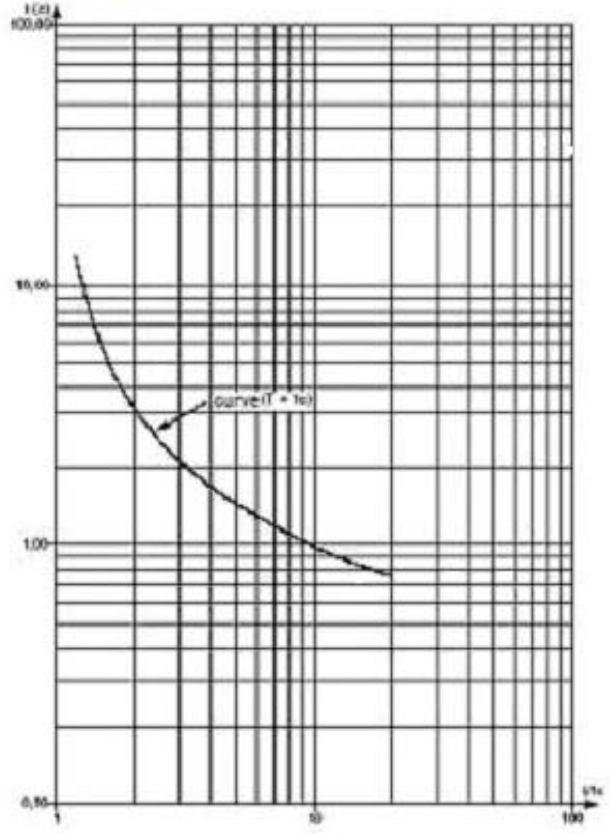
Operational life time of UBZ-302 is 10 years – after the expiration of this period contact to manufacturer.

Manufacturer assures safe and reliable product operation within 3 years since sale on the following conditions:

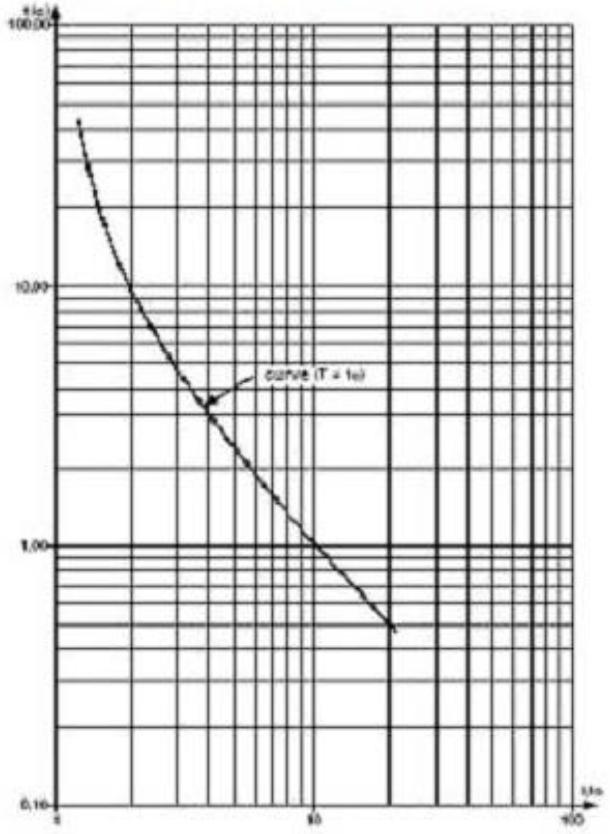
- correct connection of wires;
- integrity of manufacturers plumb of the quality inspection;
- Integrity of case and no traces of the case opening. Absence of dents and mechanical damages on the case.

APPENDIX 1. Current protections with different time-dependent delay

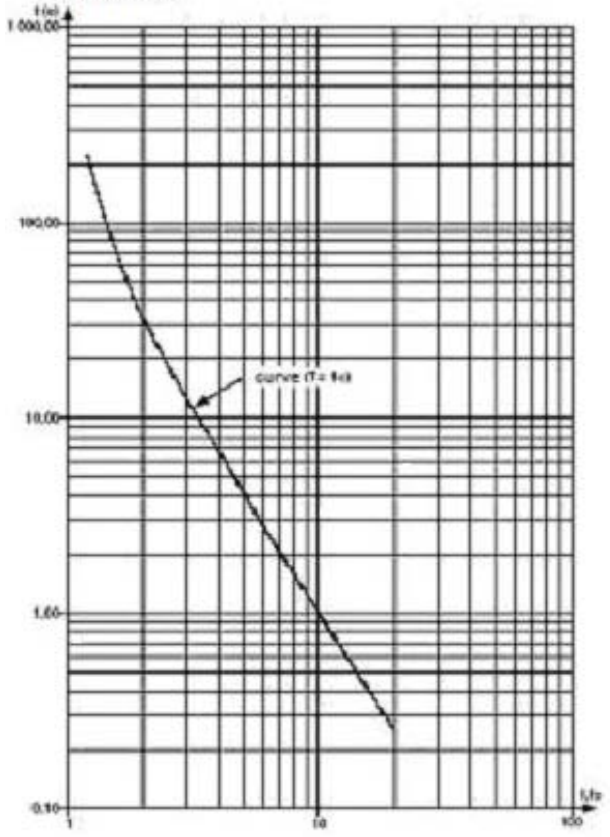
Curve of standard inverse relation of time delay SIT



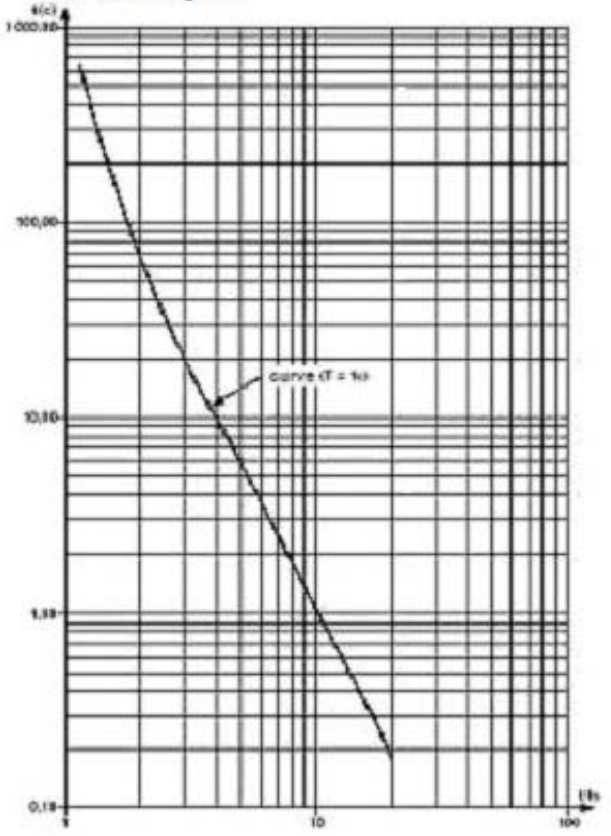
Curve of very inverse relation of time delay VIT or long inverse relation of time delay LTI



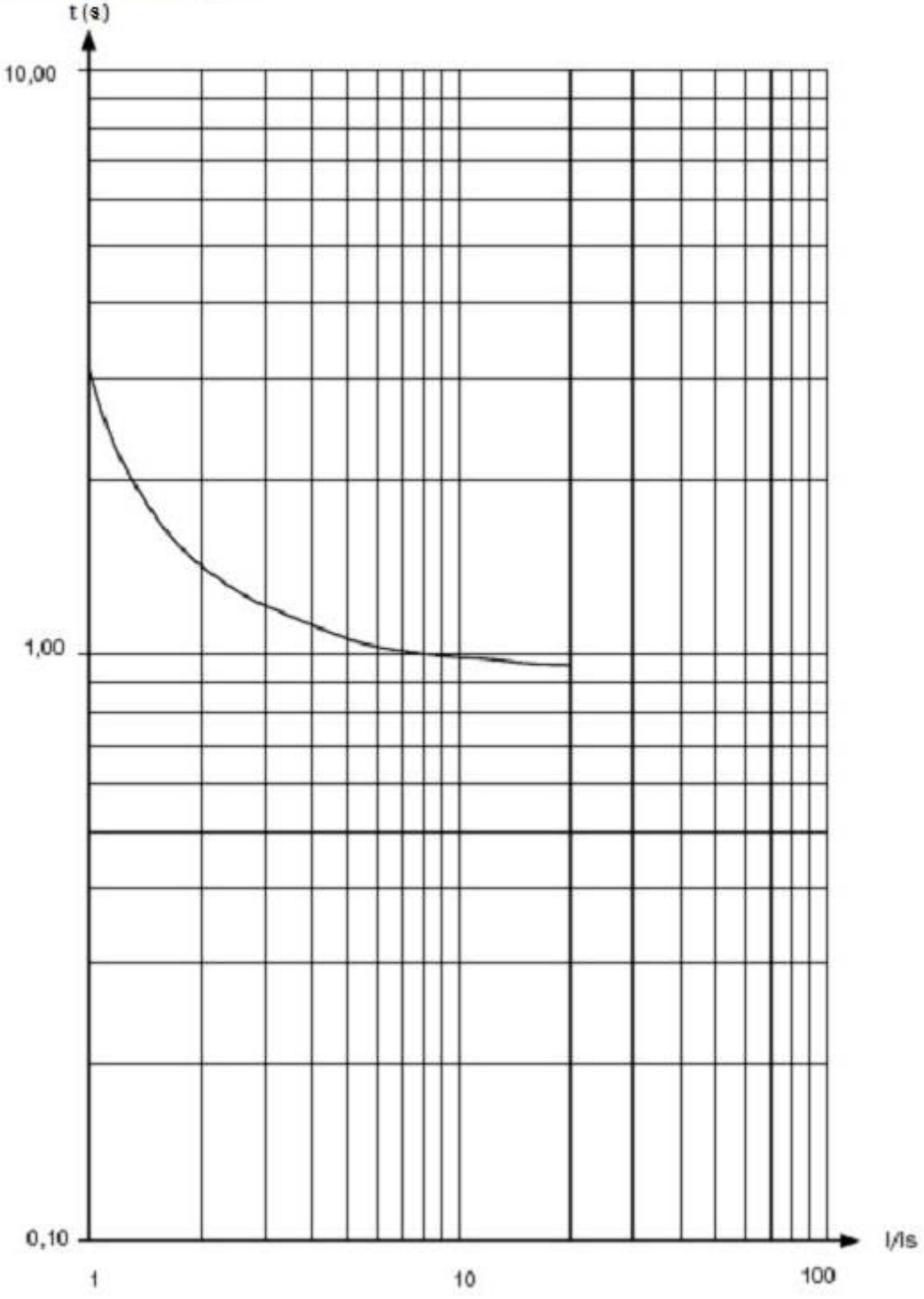
Curve of extreme inverse relation of time delay EIT



Curve of ultimate inverse relation of time delay UIT



Curve of time delay RI



APPENDIX 2 – UBZ-302 operation by the motor in the star/delta switching mode

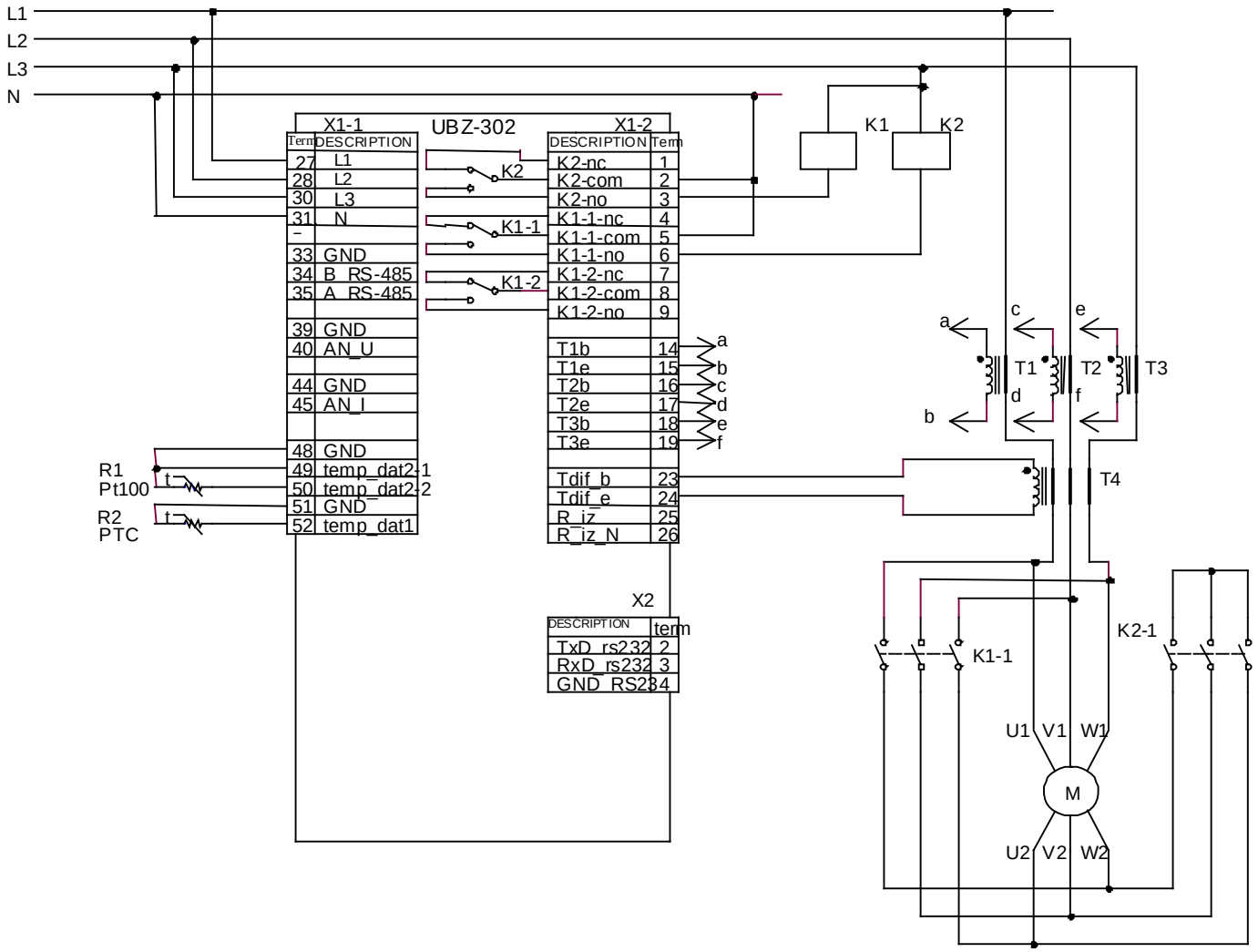
If before the start of the motor it is not necessary to test and check the insulation of the coils to the case of the motor then it's allowed to connect the UBZ-302 according to the simplified scheme shown on **Figure P1** below.

If before the start of the motor it's necessary to test the insulation level of the coils to the motor case then the connection must necessarily be done as shown on **Figure P2**.

When working in the delta/star switching mode the motor could be controlled in a several ways:

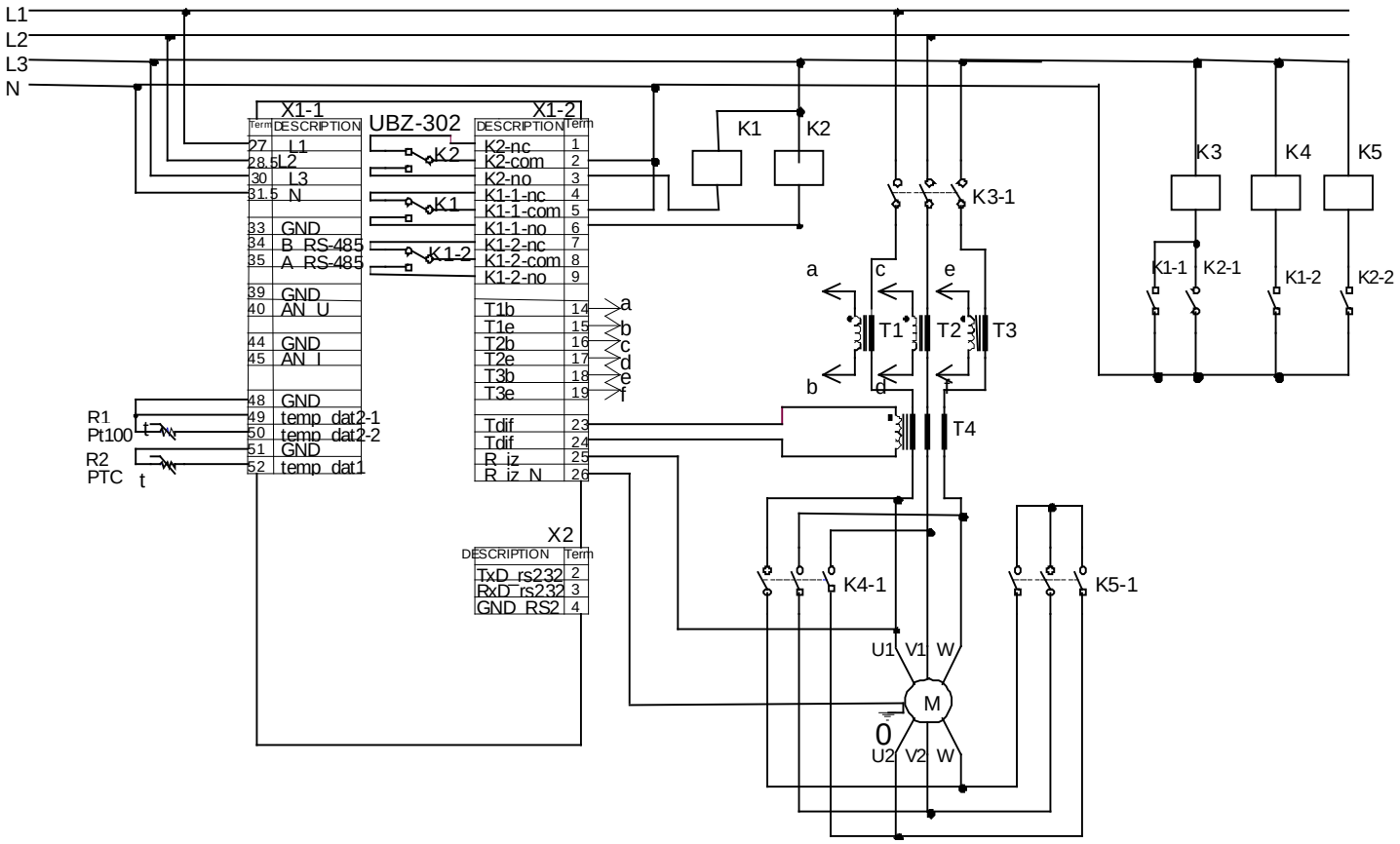
- Turn OFF/ON of the motor by external circuit breaker (contactor) with simultaneous power supply OFF/ON to the input terminals of the **UBZ-302**;
- Operation with the motor from the front panel of the **UBZ-302**;
- Operation with the motor using interface RS-232/RS-485.

ATTENTION!!! It is strictly prohibited to turn OFF the motor by external circuit breaker (contactor) without taking OFF the power supply from the input terminals of the **UBZ-302**. As a very exception it's possible to disconnect first the motor by external breaker (contactor) and then additionally turn the motor OFF from the front panel of the UBZ-302 or alternatively by giving the corresponding remote control command by interface RS-232/RS-485 to avoid the direct start on Delta.



K1 – contactor to turn ON the coils for Delta scheme
K2- contactor to turn ON the coils for Star scheme

Figure P1 - Wiring diagram for the UBZ-302 for star/delta mode of operation without the control of the coils insulation



K1- intermediate relay to turn the coils for Delta
K2 – intermediate relay to turn the coils for Star
K3- main contactor for starting the motor
K4 – contactor to turn the coils for Delta
K5 – contactor to turn the coils for Star

Figure P2 - UBZ-302 Wiring diagram for the Star-Delta operation mode and the control of the coils insulation level