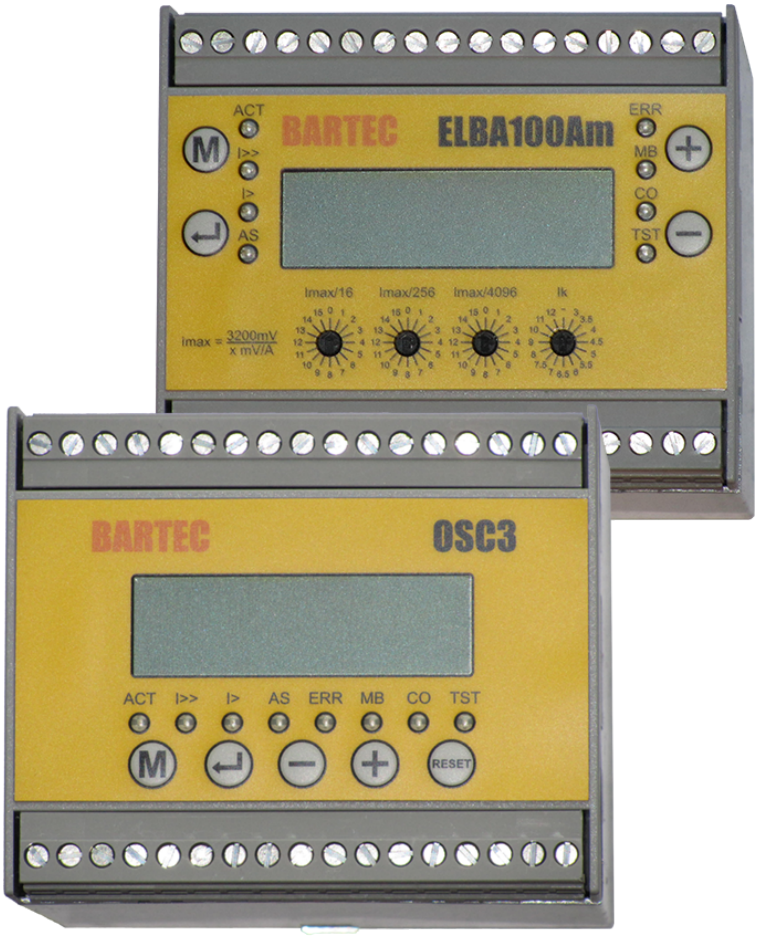
Overload and Short-Circuit protections for 3-phase outlets OSC3 i ELBA100Am type: Modbus communication protocol OSC3 i ELBA100Am

Operation Manual no. BP/IOM/04/09

EXPROTEC



EXPROTEC Sp. z o.o.
43-100 Tychy
ul. Graniczna 26A
tel: +48 32 326 44 00
email: biuro@exprotec.pl

6th May 2022
Edition 1.2.3

Contents

List of Figures

List of Tables

1 Introduction

This Operation Manual specifies the Modbus communication protocol applied in the OSC3 i ELBA1 relay, a protection device for three-phase mains and motors.

The OSC3 i ELBA100Am relays are designed for interfacing with external control and monitoring systems via RS-485 over Modbus. This feature enables reading the operating status, the actual measured valuse, the failure statuses, and the active lockouts of the OSC3 i ELBA100Am. The units of the register values are shown in square brackets.

The operating manual of the OSC3 i ELBA100Am relaye is a separate document titled „Overload and Short-Circuit protections for 3-phase outlets OSC3 i ELBA100Am type", no. BP/IO/16/08.

2 Modbus

The overload and short-circuit protection enables a remote access to the measuring and configuration data through the Modbus protocol, in RTU mode, with using of RS-485 physical interface.

For the technical aspects of the communication protocol outside of this manual, follow the official Modbus protocol documentation available on the official website of the Modbus custodian organisation: http://www.modbus.org.

2.1 Supported commands

- Read Holding Registers (0x03)
- Read Input Registers (0x04)
- Write Single Register (0x06)
- Diagnostics (0x08)
  - Return Query Data (0x00)
  - Restart Communications Option (0x01)
  - Return Diagnostic Register (0x02)
  - Force Listen Only Mode (0x04)
  - Clear Counters and Diagnostic Register (0x0A)
  - Return Bus Message Count (0x0B)
  - Return Bus Communication Error Count (0x0C)
  - Return Bus Exception Error Count (0x0D)
  - Return Slave Message Count (0x0E)
  - Return Slave No Response Count (0x0F)
  - Return Slave NAK Count (0x10)
  - Return Slave Busy Count (0x11)
  - Return Bus Character Overrun Count (0x12)
- Get Comm Event Counter (0x0B)
- Get Comm Event Log (0x0C)
- Write Multiple Registers (0x10)

3 Input data

3.1 Input registers

Table 1: Input registers

Address	Data type	Description
[0:1]	uint 32	Effective value of L1 phase current [mA]
[2:3]	uint 32	Effective value of L2 phase current [mA]
[4:5]	uint 32	Effective value of L3 phase current [mA]
[6:7]	uint 32	Thermal state based on L1 phase overload current [100% • 10^7]
[8:9]	uint 32	Thermal state based on L2 phase overload current [100% • 10^7]
[10:11]	uint 32	Thermal state based on L3 phase overload current [100% • 10^7]
[12]	uint 16	Phase L1 asymmetry[1] [‰]
[13]	uint 16	Phase L2 asymmetry[1] [‰]
[14]	uint 16	Phase L3 asymmetry[1] [‰]
[15]	uint 16	Phase L1 frequency[2] [Hz]
[16]	uint 16	Phase L2 frequency[2] [Hz]
[17]	uint 16	Phase L3 frequency[2] [Hz]
[18]	uint 16	The bits represent the state of digital inputs, starting from the least significant bit. Other bits are reserved.
[19]		Reserved
[20]	uint 16	Main word of the protection state. The bits have the following meanings: Bit 0: L1 phase overload Bit 1: L2 phase overload Bit 2: L3 phase overload Bit 3: L1 phase asymmetry Bit 4: L2 phase asymmetry Bit 5: L3 phase asymmetry Bit 6: L1 phase short-circuit Bit 7: L2 phase short-circuit Bit 8: L3 phase short-circuit Bit 9: Device is in service mode Bit 10: Communication error with the ADC converter Bit 11: Error of calibration data written while checking the device indications Bit 12: Error of device stored settings data Bit 13: Error of data of the protection stages triggering state memory Bit 14: Error of the overload stage triggering state data Bit 15: Data error during writing to EEPROM

[1] The read out asymmetry value should be understood as a per cent by which the current of a given phase differs from the current of this phase in which the momentary current reached the maximal value among all phases.

[2] Proper measuring of the frequency can be impossible in case of runs with small amplitudes (particularly in relation to I^N), with strong interferences or interference from inverters.

Address	Data type	Description
		The state word bits[0:8] are remembered after power loss.
[21]	uint 16	Auxiliary status word. Consecutive bits, starting from the least significant, the states correspond to driven states of the relays. Other bits are reserved.
[22]	uint 16	Bits of this register are flags containing the decoded input: Bit 0: External reset of errors and messages (**Rst**) Bit 1: The start signal (**R**) Bit 2: The stop signal (**H**) Bit 3: The acknowledgment signal (**A**) Bit 4: The signal of the safety switch (**NA**) Bit 5: The signal of a lack of continuity of the protective conductor (**PE**) Bit 6: The signal of blocking earthing module (⏚**B**) Bit 7: The over-temperature signal (**T>**) Bit 8: The signal of central earthing module (⏚**C**) Bit 9: Signal of external activation of 2_{nd} gear (**2**) Other bits are reserved.
[23]	uint 16	Bits of this register are flags containing control signals: Bit 0: Control advance signal (**CA**) Bit 1: Control signal (**C**) / Control signal of 1_{st} gear (**C1**) Bit 2: Control signal of 2_{nd} gear (**C2**) Bit 3: Error of control acknowledgement (**AEr**) Bit 4: Error of control of 2_{nd} gear (**2Er**) Other bits are reserved.
[24:39]		Reserved
[65521]	uint 16	Configuration data version available via Modbus.

3.2 Device ID

The OSC3 i ELBA100Am relay allows reading the device ID saved in ASCII format. The device ID comprises the device type, firmware version, hardware version, and the Modbus register data version. The entries begin with the base address 2048 (0x800). The addresses listed here are offsets from the base address.

Table 2: Device ID

Address	Data type	Description
[0:31]		Device ID

4 Holding Registers

4.1 Device configuration

Table 3: Holding registers

Address	Data type	Description
[40:41]	uint 32	Value of rated current set up with the resolution of 0.01 [A]
[42]	uint 16	Eight less significant bits mean the selected characteristic of the overload stage: 0: Class 2 1: Class 3 2: Class 5 3: Class 10A 4: Class 10 5: Class 15 6: Class 20 7: Class 25 8: Class 30 9: Class 35 10: Class 40 11: Type A 12: Type B 13: Type C 14: Type D 15: Type E 16: Type F 17: User Eight more significant bits are reserved.
[43]	uint 16	Eight more significant bits are the marking of current multiplication for the short-circuit stage with resolution to 0.1. Zero means switching off the short-circuit stage. Other values are reserved.
[44]	uint 16	Response delay for short-circuit stage: 4 – 20ms, 5 – 25ms, 6 – 30ms, np…
[45]	uint 16	Eight less significant bits are the value of allowed phases asymmetry in percent. The value of 100% means that the asymmetry stage is disabled. Other bits are reserved.
[46]	uint 16	Delay time of the asymmetry stage triggering, with the resolution of 0.01 [s]
[47]		Reserved
[48]	uint 16	Preset ratio of the current transformer, with the resolution of 0.1mV/A
[49]	uint 16	Eight more significant bits is the code of preset menu language: 0: Polish 1: English 2: German

Address	Data type	Description
		3: Spanish 4: Czech 5: Russian 6: Turkish Other values are reserved. Eight less significant bits are the value of preset idle time (in minutes), after which the device menu will be quitted automatically.
[50]	uint 16	Four most significant bits [15:12] represent the configuration of serial transmission stop bits. The read out values have the following meanings: 0: 1 stop bit 1: 1,5 stop bits 2: 2 stop bits The next four bits [11:8] represent the configuration of serial transmission data parity. The read out values have the following meanings: 0: Even 1: Odd 2: Zero 3: One 4: None Other values are reserved. Other bits are reserved.
[51]	uint 16	Eight more significant bits are the address at which the device is available in the Modbus protocol. Eight less significant bits mean the rate of data exchange through Modbus protocol. The transmission rates for individual values are as follows: 1: 300 2: 600 3: 1200 4: 1800 5: 2400 6: 3600 7: 4800 8: 7200 9: 9600 10: 14400 11: 19200 12: 28800 13: 38400 14: 57600 15: 115200 Other values are reserved.
[52]	uint 16	Eight less significant bits are the flags having the following meanings: Bit 0: Activity of the overload stage automatic reset function Bit 1: State of LCD display backlight

Address	Data type	Description
		Bit 2: Control stage in pulsed mode Bit 3: Activity of the external errors automatic reset function Bit 4: External reset (**Rst**) works like a stop (**H**) Bit 5: Asymmetry stage active to the triggering Bit 6: Overload stage active to the triggering Bit 7: Short-circuit stage active to the triggering Bit 8: Activation of constant component filter Bit 9: Two-gear operation mode switched on Bit 10: 2_{nd} gear is externally controlled Bit 11: Switching off the 1_{st} gear before activation of the 2_{nd} gear in the two-gear op-eration The state of 5÷7 bits and the way of protection stages activity to the triggering „0" or signalling „1" changes automatically, on the basis of relays configuration. If the asymmetry or short-circuit stage is switched off then the state of bits corresponding to them is of no importance. Other bits are reserved.
[53]	uint 16	Eight less significant bits represent the duration time of the control advance signal, with the resolution of 1[s]. OEight more significant bits represent the waiting time for driving acknowledgment after activation of the control signal, with the resolution of 0.1 [s].
[54]	uint 16	Coefficient „TMS". Resolution 0.01
[55]	uint 16	Coefficient „k". Resolution 0.01.
[56]	uint 16	Coefficient „tr". Resolution 0.01.
[57]	uint 16	Eight less significant bits are „c" coefficient. Resolution 0.01. Eight more significant bits are „a" coefficient. Resolution 0.01.
[58]	uint 16	Current of the 1_{st} gear is expressed as a percent of the 2_{nd} gear current.
[59]	uint 16	Eights less significant bits – threshold of maximum current of the 1_{st} gear, in per-cent of the nominal current of 1_{st} gear at which it is possible to trigger 2_{nd} gear. Zero means switching off. Eight more significant bits – time between switching off the 1_{st} gear and triggering of the 2_{nd} gear with resolution to 0.1s.
[60]	uint 16	Delay of triggering of the 2_{nd} gear with resolution to 0.1s.
[61:75]		Reserved
[76:83]	uint 16	The configuration words of inputs starting from **I0**. Meaning of bits In the words is as follows: Bit 0: External reset of errors and messages (**Rst**) Bit 1: The start signal (**R**) Bit 2: The stop signal (**H**) Bit 3: The acknowledgment signal (**A**) Bit 4: The signal from the safety switch (**NA**) Bit 5: The signal of a lack of continuity of the protective conductor (**PE**) Bit 6: The signal of blocking earthing module (⏚**B**) Bit 7: The over-temperature signal (**T>**) Bit 8: The signal of central earthing module (⏚**C**) Bit 9: Signal of external triggering of the 2_{nd} gear (**2**)

Address	Data type	Description
		Other bits are reserved.
[84:85]		Reserved
[86:87]	uint 32	Configuration and status word of relay **K1**. Meaning of its bits is as follows: Bit 0: Signals that the relay is present in the device[3] Bit 1: Indicates if the relay is fitted with the control of correct operation[3] Bit 2: Signals that incorrect relay operation was detected[3] Bit 3: State of relay control – „1”: ON, „0”: OFF[3] Bit 5: Relay reacts to the asymmetry stage triggering (**As**) Bit 6: Relay reacts to the overload stage triggering (**I>**) Bit 7: Relay reacts to the short-circuit stage triggering (**I>>**) Bit 8: Relay reacts to the reset signal (**Rst**) Bit 9: Relay reacts to the start signal (**R**) Bit 10: Relay reacts to the stop signal (**H**) Bit 11: Relay reacts to the error of control acknowledgment (**A**) Bit 12: Relay reacts to the signal from safety switch (**NA**) Bit 13: Relay reacts to the lack of continuity of the protective conductor signal (**PE**) Bit 14: Relay reacts to the blocking earthing module signal (⏚**B**) Bit 15: Relay reacts to the over-temperature signal (**T>**) Bit 16: Relay reacts to the central earthing module signal (⏚**C**) Bit 24: The control advance signal (**CA**) Bit 25: Control signal (**C**) / control signal of the 1_{st} gear (**C1**) Bit 26: Control signal of the 2_{nd} gear (**C2**) Bit 27: Relay reacts to the error of the control acknowledgment (**AEr**) Bit 28: Relay reacts to the error of the control of the 2_{nd} gear (**2Er**) Other bits are reserved.
[88:89]	uint 32	Configuration and status word of relay K2
[90:91]	uint 32	Configuration and status word of relay K3
[92:93]	uint 32	Configuration and status word of relay K4
[94:95]	uint 32	Configuration and status word of relaya K5
[96:99]	uint 16	Access password to remote change of equipment parameters configuration[4].
[100]	uint 16	Register of instruction for saving of remote configuration of the equipment parameters[4]
[4096]	uint 16	Writing 0xA5C3 value to this register initiates procedure of resetting errors and any triggered stages, which can be reset at a given moment. It is an equivalent of the „RESET” button[4].

[3]Read-only bit.
[4]You can only write data to these registers. Unable to read.

5 Programming the OSC3 i ELBA100Am relay

5.1 Introduction

This section specifies the method for remote programming of the OSC3 i ELBA100Am. relays. It is not recommended do modify any data labelled as „reserved". For bit settings, the unused segments should be filled with zeros or left unmodified. This will prevent erratic and unexpected operation of the product if a newer version introduces new features which use the previously unused data segments.

5.2 Programming

Entering of new data should be started from giving an access password. Password should be entered to 4 registers [96:99] in total, in one operation, in form of ASCII characters. For example to enter password „12345678" user should enter the following values:

address [1]: 0x3231,
address [2]: 0x3433,
address [3]: 0x3635,
address [4]: 0x3837.

Then user should perform operation recording data to the registers. In case of attempt to save incorrect configuration, the error code will be returned.

After saving of correct data user should enter operation code to the register [100] to apply new settings. The followings codes are available:

code [0]: do nothing,
code [1]: test of settings without saving to read-only memory,
code [2]: applying settings and saving in read-only memory,
code [4]: restoring settings from read-only memory,
code [8]: reset to factory settings (without language and communication parameters).

After saving of password and data next operation can be performed only for a short time. In case when address of recorded data is adjacent to address of passwords entering records, then password and data can be save in one operation. Similarly recording of password and instruction can be joined as well as all three operations at the same time. If any abnormalities will be detected during data record – error code will be returned.

6 End notes

EXPROTEC is the manufacturer of this product and reserves the right to changes and modifications as a result of technical progress and to use equivalent replacement parts.

This product has been manufactured in compliance with good engineering practices.

7 Orders and service

The orders should be sent to the following address:

EXPROTEC Sp. z o.o.
43-100 Tychy, ul. Graniczna 26A
Poland
Phone/fax:
+48 32 326 44 00
+48 32 326 44 03
Internet:
biuro@exprotec.pl
www.exprotec.pl

The housing components are replaced by the manufacturer or a company authorized by the manufacturer.

The manufacturer is not responsible for the device quality in case of repairs or components replacement made by the customer itself.

The manufacturer reserves the right to make changes in this specification in any time, without the necessity to inform about it.

EXPROTEC

EXPROTEC company protects people and environment by the safety of its components, systems and devices.

EXPROTEC company develops and produces the innovative components and systems which are controlled in accordance with international standards and are applied in areas endan-gered by explosion as well as in the field of environment pro-tection, radioactive protection and industry.

EXPROTEC Sp. z o.o.