CURRENT PROTECTION MICROPROCESSOR DEVICE

USER'S MANUAL

CONTENTS

1. APPLICATION

Current protection microprocessor device (electronic starter) is intended to protect electric circuits' elements against overloads. Maximum current of limitation is 20 A for MPT20MK and 200 A for MPT 200MK.

Current protection microprocessor device is also tracks a current ratio between phases and switches off load if ia the value will be exceeded by more than 2 times.

2. BASIC PARAMETERS

| Parameter name		Symbol	MPT 20MK	MPT 200MK
1. Protection minimum current		A	0.5	5
2. Protection maximum current		A	20	200
3. Discreteness of protection current setup		A	0.1	1
4. Measuring maximum current		A	200	2000
5. Input (direct or alternating) control voltage	min	V	10	
	max		30	
6. Input control current		мА	40	
7. Starter control output	alternating voltage	max	V	400	
	current	max	mA	300	
8. Failure relay output	alternating voltage	max	V	400	
	current	max	mA	300	
9. Ability to display the status, parameters change and control of electronic starter via interface RS485				

3. OPERATION CONCEPT
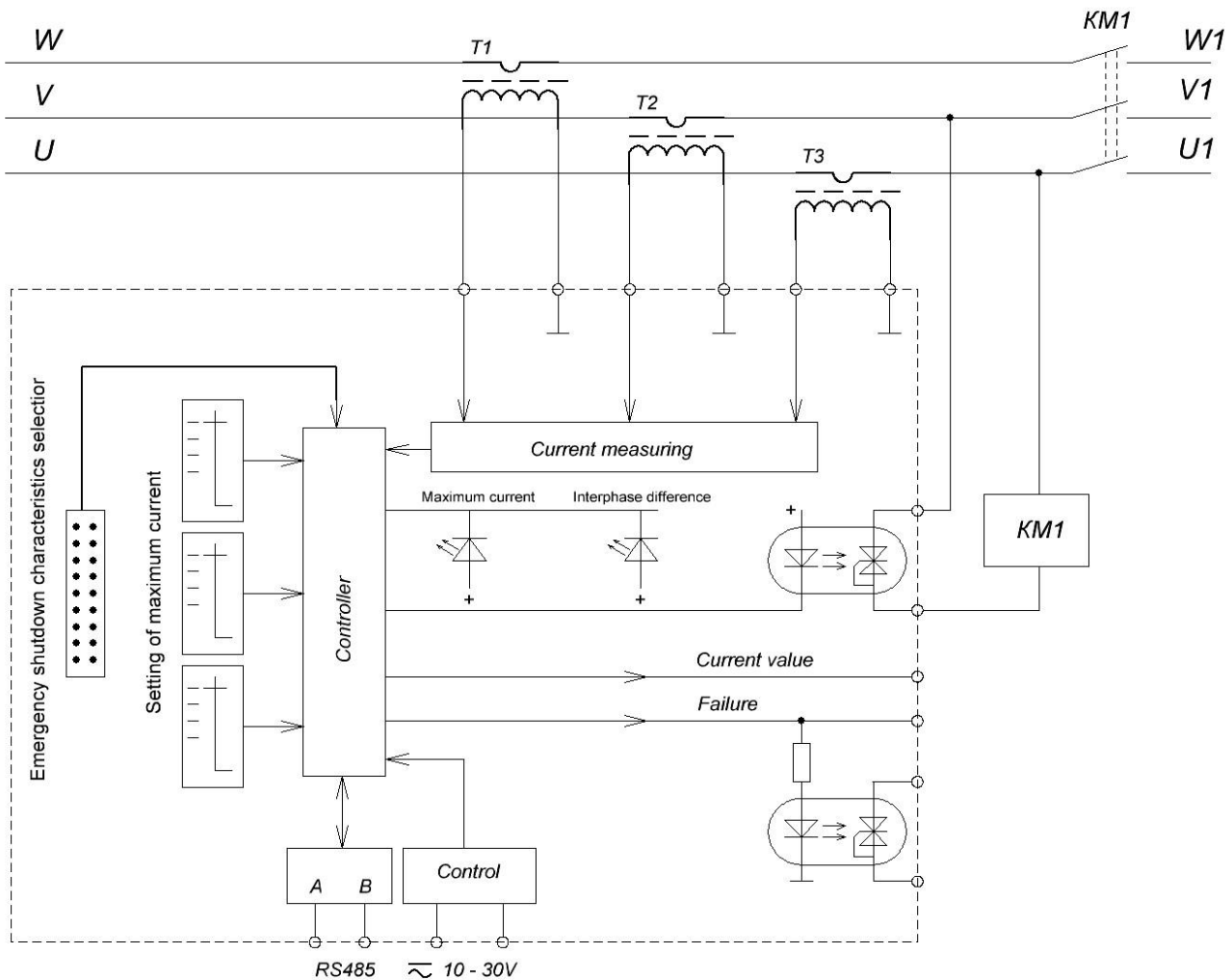
Figure 3.1 Functional circuit

The shown connection circuit MPT XXXMK shows a possibility device application with the use an electromagnetic contactor as a commutating element.

After supplying the controlling voltage the starter KM1 is switched on (Fig. 3.1) and connects the load. The signals from the current sensor are started coming to the controller. Their amplitude is proportional to the current by each phase. When increasing the protection maximum current value or current difference between phases by more than 50% there is switch-off the contactor KM1.

Moment of contactor shutdown at excess the set current protection depends on the selected characteristics of the emergency shutdown.

On Figure 3.2 are represented the characteristics of emergency shutdown available for selection by the consumer.
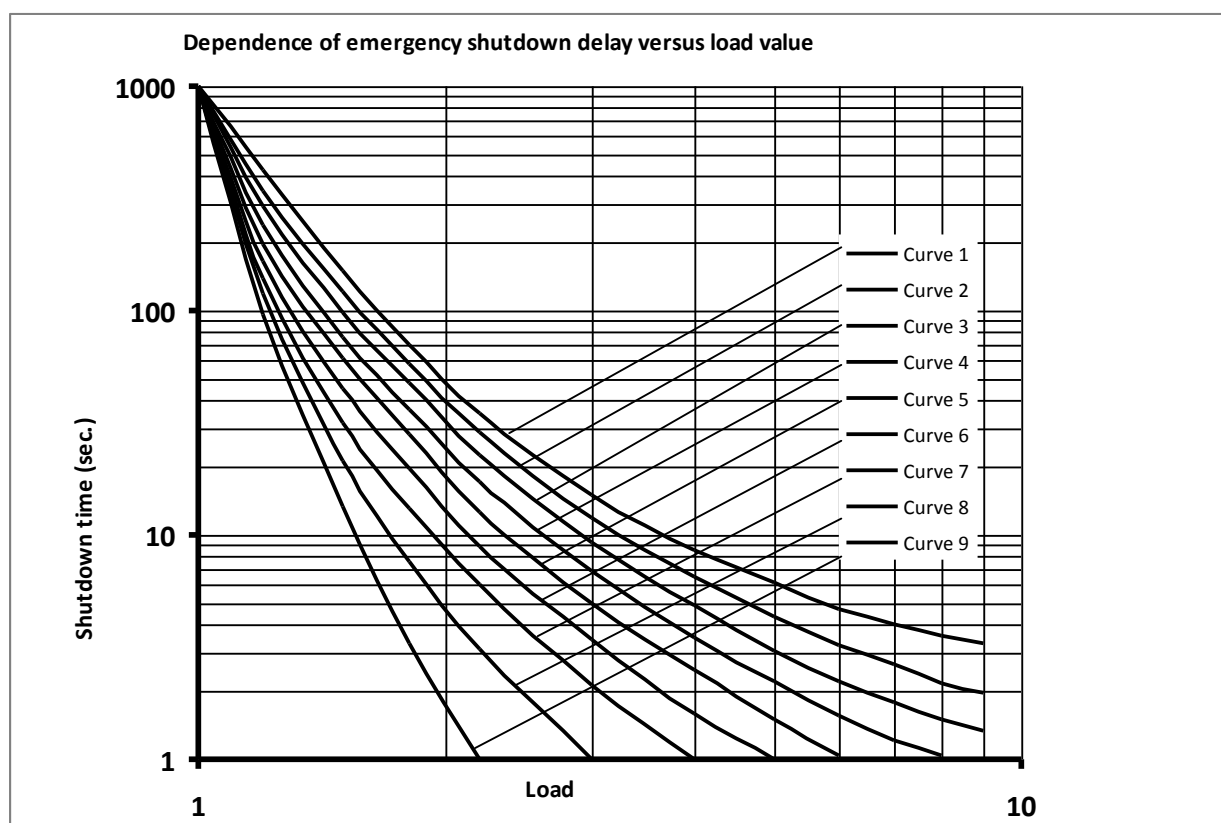
Figure 3.2 Current-time protection

The electronic starter may be used to protect various types of loads such as induction motors and heating elements. For correct operation with these loads should be chosen different from each other characteristics of current-time protection. For example, for electric motor suits the Curve 1 and for active load suits Curve 8 or 9. The curves suggested to select are different the switching off the load time, at increasing the consumed current exceeding the set value. So, when choosing the Curve 1 and at exceeding the set current 2 times the emergency shutdown occurs in 50 seconds. And at the same overload, but with the selected Curve 9, the emergency shutdown will occur in 1.8 seconds. Regardless of the selected Curve if the consumed current will exceed the set value by 10 times, the emergency shutdown will occur in 20 ms.

Switch-off time at current asymmetry is 100 ms. About an emergency shutdown cause alarms a relevant diode that is installed on the front device panel. As current sensors are used external current transformers. MPT 20MK is physically characterized from MPT 200MK in that on the used the current transformers in it is wound by 10 turns more of the wire with necessary section. Now if the protection current is set 155 A then with data development it will be 15.5 A.

4. MPT XXXMK CONSTRUCTION

On Picture 4.1 is shown electric starter appearance.
On the front panel are red LEDs of emergency shutdown cause indication. On the side of the housing there is a socket for current transformers connection. As it was mentioned above – the maximum starter protection current is 200 A. From this it follows that 10-times overload can achieve 2000 A. For measuring such currents as a current transformer used a coil of Rogovsky.

The coil of Rogovsky allows measuring the current linearly all over the current value of the range. Also there is a socket on the side to connect mains supply and control ones. Under the cover of the device are code operated switches for protection current setting and pins to select the required characteristics of an emergency shutdown delay. This is due to the fact that during operation of the electronic starter not necessary to a consumer to change often the values of these parameters, as well as elements protection for parameter setting against external influences. Setting of protection current is set using three coding switches: hundreds, tens and units of amperes. On the housing of switches are plotted the digits, on the movable part is shown an arrow. For current setting it should be combined the arrows with the value of the required current of the relevant switches. On the PCB near to the pins there are numbers from 1 to 9. These numbers correspond to the current-time characteristics shown in Figure 3.2 of the user's manual. To select the required characteristics using the supplied jumper it should be connected the corresponding pair of contacts in the opposite rows. When supplying voltage for MPT-200MK the closed contacts are analyzed and analyzed the choice of the relevant characteristics. The analysis of the closed contacts is made only at switching on the device. If using a jumper to close another pair of contacts when the device is turned on then the change of current-time characteristic does not happen. **The characteristic selection is made only when turning on!**
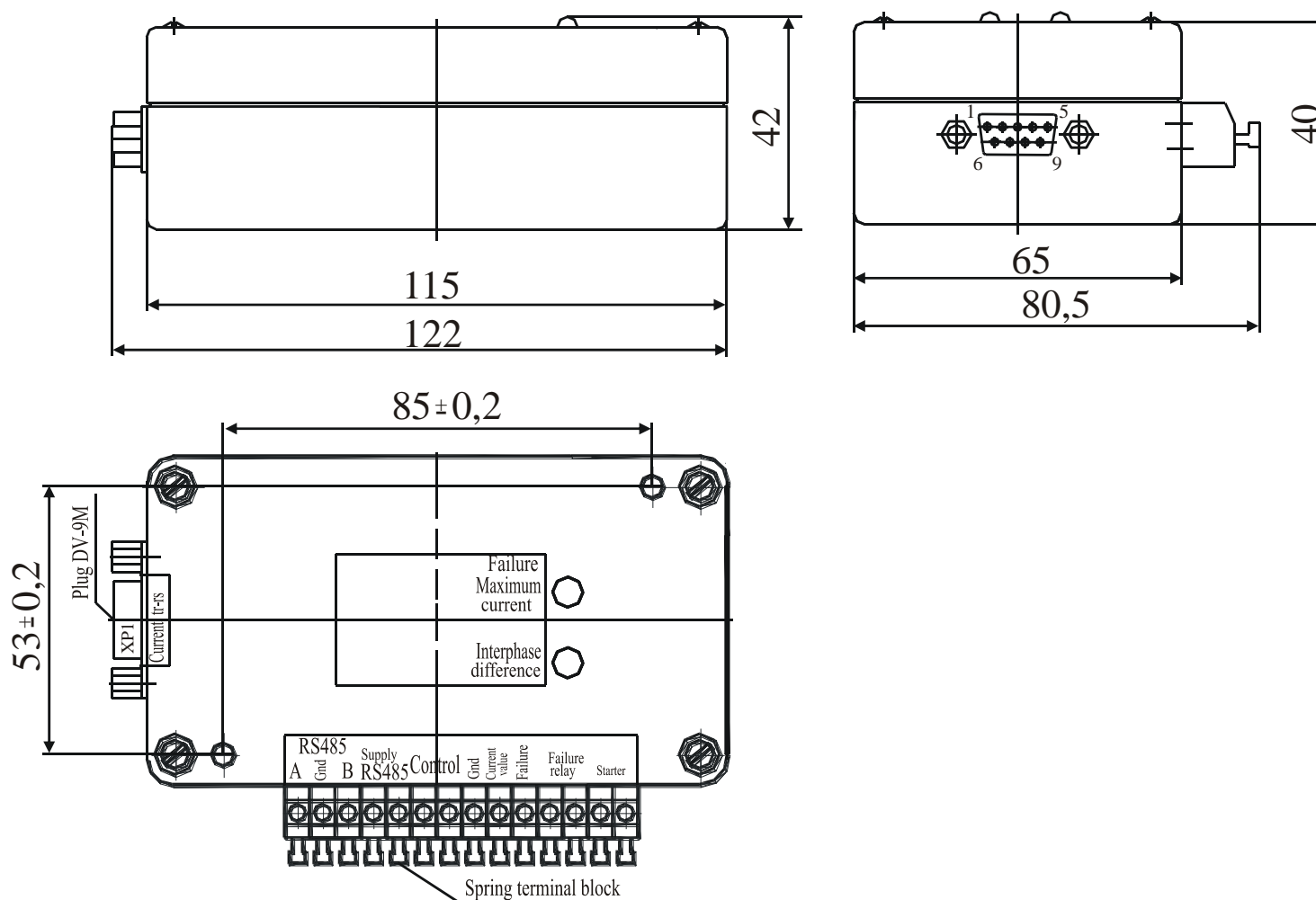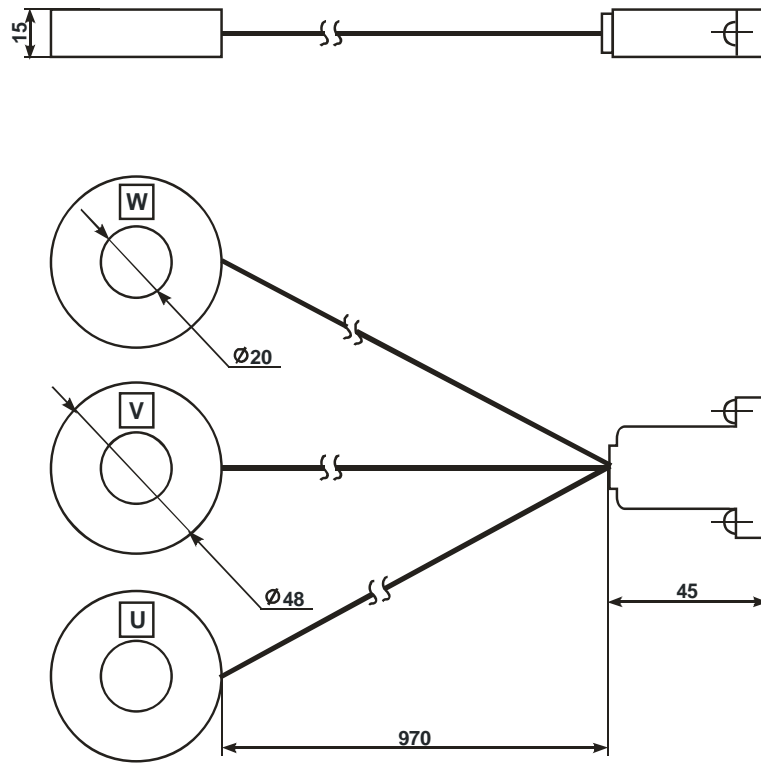

Figure 4.1 Appearance of device

Figure 4.2 Current transformer with connection socket DB9

5. BEFORE USE

First it is necessary to fix the electronic starter in a comfortable location for service. Build the circuit according to the Fig. 5.2.

Connection the socket with current transformer, previously reeved the power wires via the transformer. The current transformer should fix with plastic ties on the power wires. The socket unsoldering scheme with the current transformer is shown on Fig. 5.1.
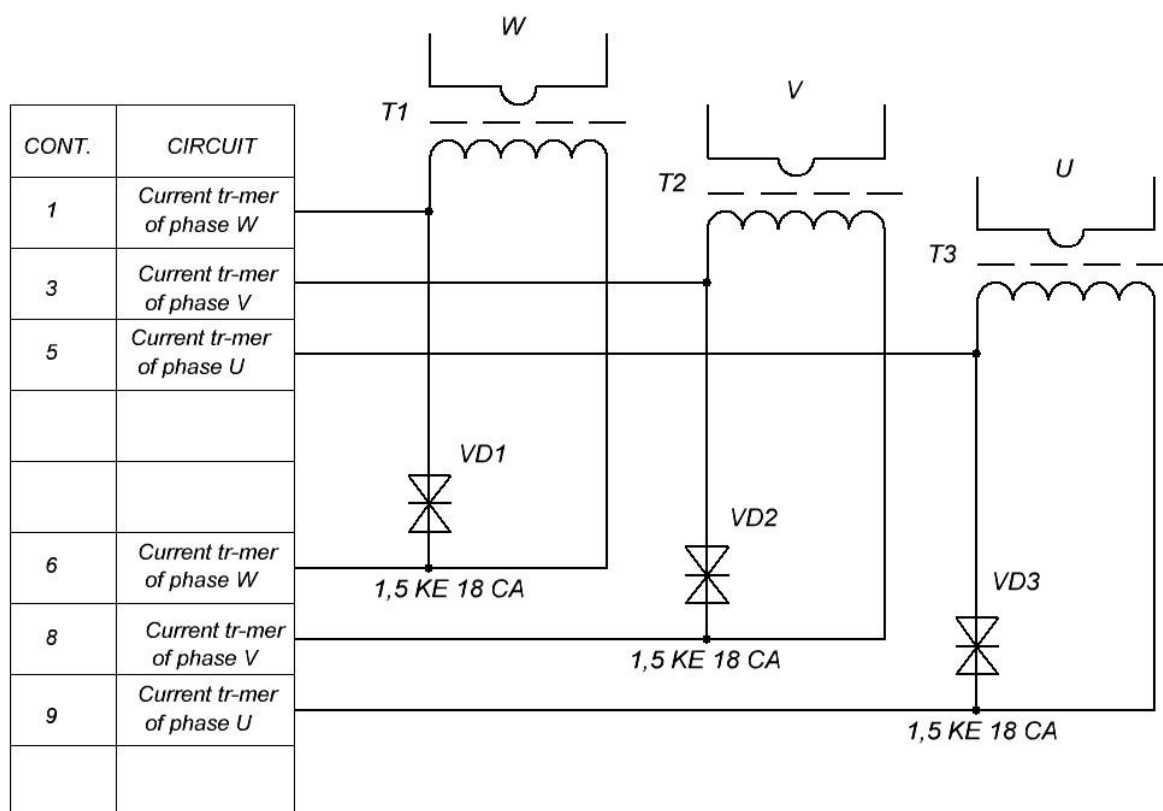

Figure 5.1. Current transformer unsoldering scheme

Because of the complexity of the identity parameters of measurement channels, current transformers are marked and are not changed between each other. Setup of correct measuring is made by the manufacture.

On the Fig. 5.2 is shown connecting scheme MPT XXXMK. On the figure is shown a socket to connect the current transformer and a socket to connect control circuits. To the pins 1, 2 of the control socket is connected a coil of electromagnetic contactor. The electromagnetic contactor may use with a control coil and for alternating voltage 220 V, but in this case in the circuit should be added a neutral wire.

The electronic starter MPT XXXMK also may be used without the electromagnetic contactor, and together with a device of smooth start MO 26MK that manufactures by our enterprise.

In this case when an accident the signal that is read from the pins 3 and 5 control circuits connecting socket will switch off the device MO 26MK and will disconnect the load. If you want to display the load current value between pins 4 and 5 is necessary to install a millivoltmeter with measuring limit 2000 mV. The millivoltmeter will display an average value of the load current. The average value is determined by the formula Current = (current of phase W + current of phase V + current of phase U) / 3. 37A current value will correspond to the reading of 370 mV on the millivoltmeter. 125A current value will correspond to the reading of 1250 mV on the millivoltmeter, etc.

Protection current is installed with the code switches located under the device cover. Protection current value is installed depending on extended protected circuit current consumption.
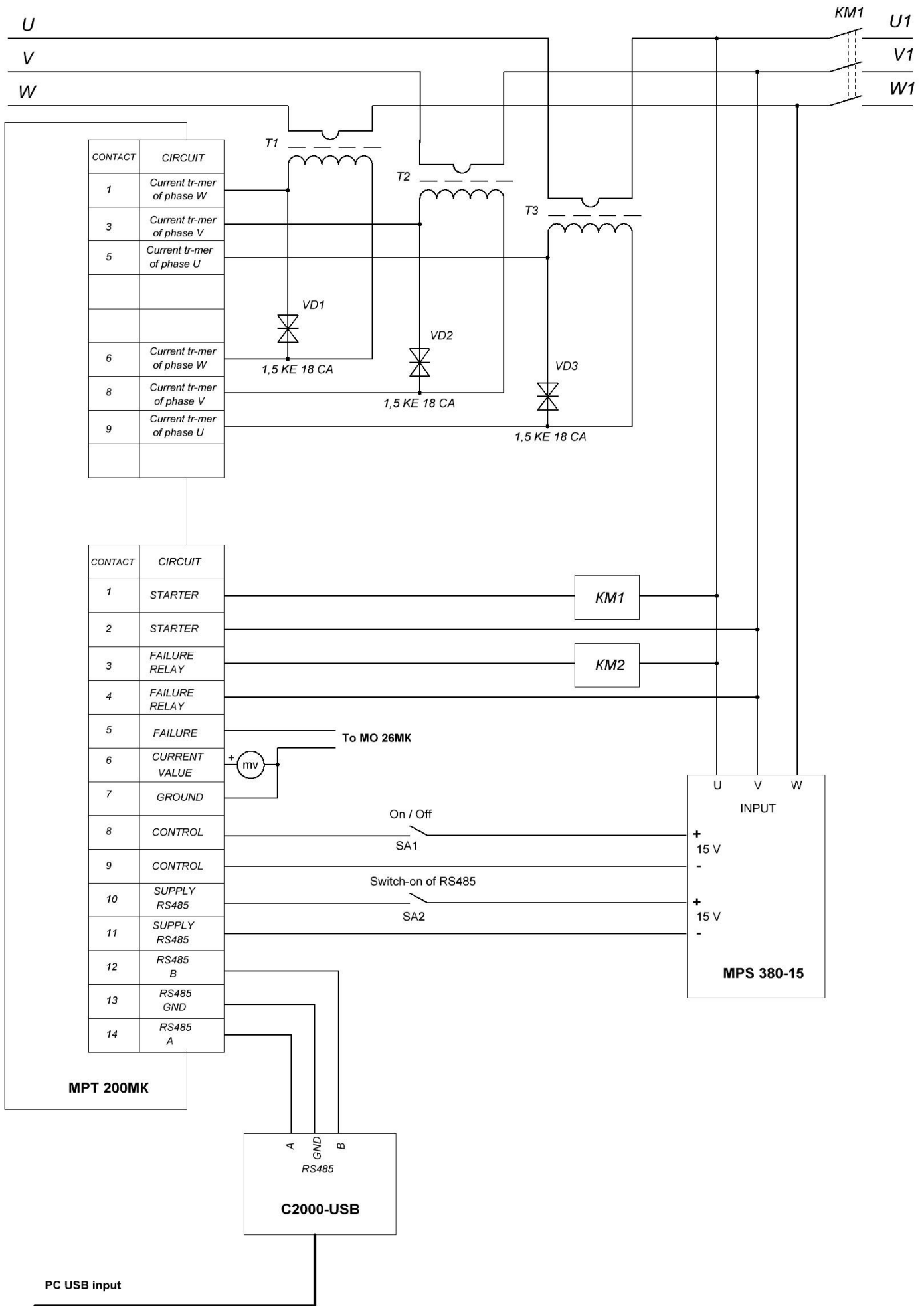
Figure 5.2. Connection circuit of MPT XXXMK

The electronic starter switch-on is performed with control voltage supplying of DC or AC with the value from 10 to 30 V to the pins 6 and 7.

As a voltage source we recommend to use a galvanically isolated two-channel, low-power direct voltage source PSM 380-15 that manufactures by our enterprise. A feature of the source is possibility to form output voltages from three-phase circuit without use the neutral wire. The source can work both from three phases and from two ones of supplying voltage.

To switch off the electronic starter you need to throw off the controlling voltage.
Restart of the MPT200MK at an emergency shutdown is performed by de-energizing control voltage and subsequent its energizing.

6. RS485 INTERFACE

For the visual status display, operational change of settings and control the electronic starter MO26-XXX-12-MK has possibility to contact to the controlling program via RS485 interface.

Before the control program starting is necessary to connect to the control socket regarding to Fig. 5.2. While program debagging we used a converter RS485/USB, product type C2000-USB. The device can also be used from other manufacture, it's up to you.

The software for installing on your computer – according to the information at site www.electrum-av.com in section Information/Software.

Apply voltage (direct or alternating) with a value from 10 to 30 V to the contacts 7 and 8 (Fig. 5.2). It's recommended to use a serial device PSM 380-15 that is produced by our enterprise.

Run the program PMT XXXMK, then you will see the program window of the electric starter control program in accordance with picture 6.1.
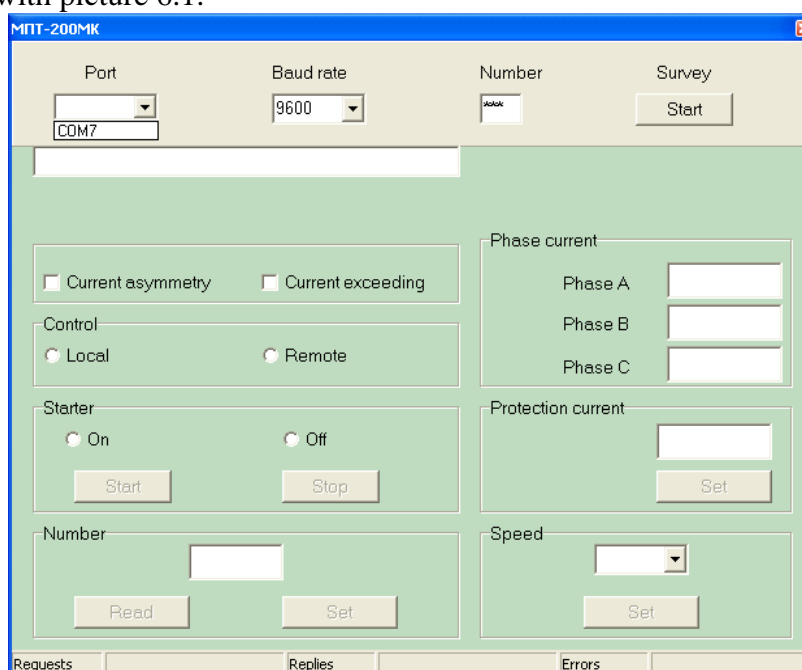

Figure 6.1

In the beginning is necessary to choose a port. To do it, click the left mouse button to arrow with «Port» display. You will see the available ports list. First choose the port which the interface converter is connected to. It is COM7 in our case.

Then it is necessary to set the exchange rate and the device number (MPT XXXMK number which is necessary to be connected to). In the supplied devices MPT XXXMK by default is written – speed 9600 and number 001. During the program description will be listed all possible variants of conversation with the menu.

The device number is written in energy independent memory area and is necessary for marking of concrete device that you want to contact to. At the request there will be an answer from that device which number matches to the number in window «Number». If you forget the device number you can find it out easily.

To do it, choose a port, set a speed and click with the left button of mouse in the field «Number» (in the left low corner of the program) to button «Read». The program will start selecting all possible numbers and send a request to the device. As device number and sent number match, the device will answer and this number will be displayed in the window «Number». During the contact to the menu there will be promptings that are necessary to implement. In this case if the program interrogates all necessary numbers (the device number can have value from 001 to 255) and didn't receive reply from the device, the program will offer you to change the speed of interrogations and read the number one more time. Speed of interrogation can be 2400, 4800, 9600 or 19200.

Also the device cannot answer in case of wrong connection to the interface, in absence of power supply on the contacts 7 and 8 of control jack or at failure of the device itself.

The device responded us at concrete speed and gave us its number. We entered this data in the relevant fields and pressed the «Start» button in the top right corner of the menu window.
If you don't set something, or you set it incorrectly then the program will show you what you need to do. If the entry is correct and in presence of connection with device, on the window of the program, on the Fig. 6.2, is shown the information about state of MPT XXXMK.
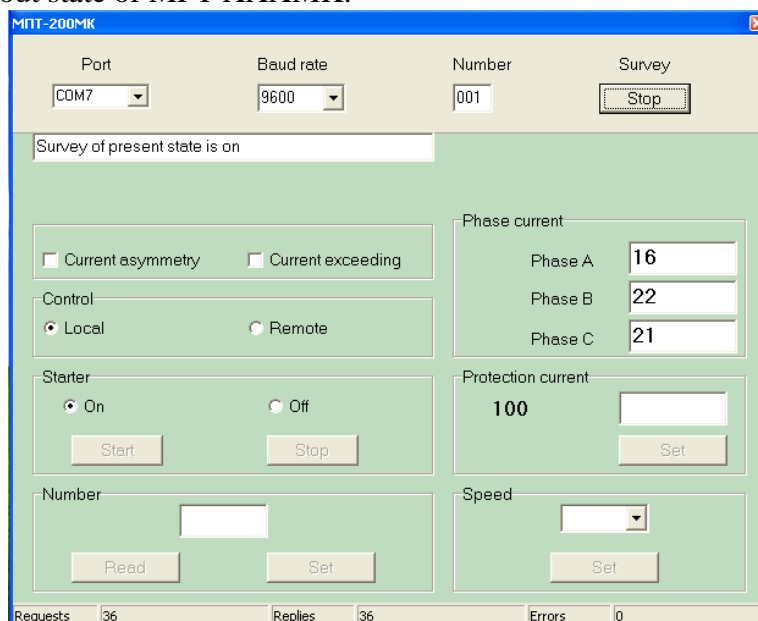

Figure 6.2

In the program window we can see:
1 Survey of current device state is on. The low line shows how many requests were sent to the device and how many answers were received without reply (errors).
2 The starter is on.
3 Protection current that set with the code switches, equal to 100 A in our case.
4 The current value on each phase.
5 Local control.

Pay attention, in this state of electronic starter many buttons of the programs are inactive; their operation in the present moment is forbidden.

Local control forbids turning off the starter and changing protection current. But if stop the survey by pushing the button «Stop», it will be possible to change the device number and exchange rate, Fig. 6.1.

If in the input window type new number and push button «Set», then number of MPT XXXMK will be changed, then click the button «Read» and will appear a new device number in input window. As RS485 interface allows connecting all devices in parallel that are used in technological process; for correct communication with each of them the devices numbers must not match. After changing of the number and after survey renewal by pushing button «Start», device will not respond. It is necessary to input a new changed number of the device in line «Number» in the top window part of the program.

If necessary, one also can be changed the exchange rate by choosing of necessary value in input window of the input area «Speed» and click button «Set». Necessarily in increasing of interface speed appears at big number of connected devices to one line for reduction of common survey time. Reduce the interface speed is necessary at unstable connection with the device because of connection line deterioration or because of significant removal of surveyed devices. Remember that connection to the device will be absent until the new, changed exchange rate is not selected in the line «Speed» in the top part of the program window. If the device doesn't response when there is reference to it then the screen displays the following information – see picture 6.3.
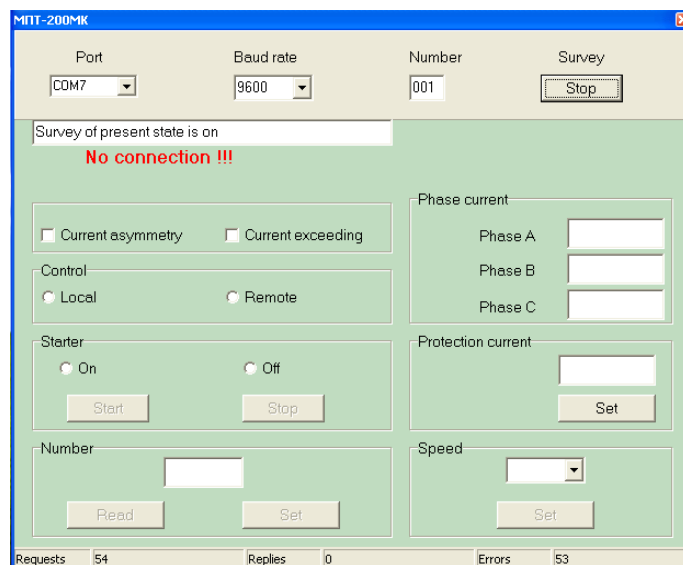

Figure 6.3

Under the state line appears the inscription «No connection» and in the low line requests are in progress and there are no replies from the device. The reasons of such state we observed above.

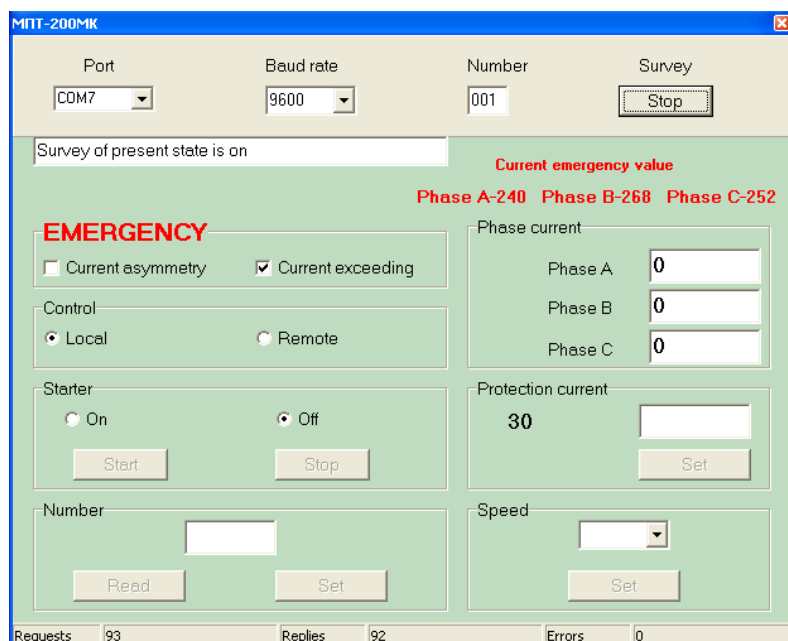On the Fig. 6.4 is shown a view of the program window at emergency turn-off.

Figure 6.4

When exceeding the failure value of the protection current, or when there is current asymmetry among the phases, the contactor will be switched off and on the screen will be displayed an information about the failure cause and current value for each phase at the moment of emergency shutdown. The inscription "FAILURE" periodically flashes for attracting attention. Device operation can be recovered with brief switch-off of control voltage (contacts 6, 7 of controlling socket), **after removing of emergency shutdown cause!**

But the operation of the interface would not be complete if not had the possibility of remote the electric starter switch-on/off. To make this possibility real is necessary to place MPT 200MK in remote control mode. For this is necessary to remove the device cover and set the protection current value by zero. At switching on the program window will have view in accordance with Picture 6.5.
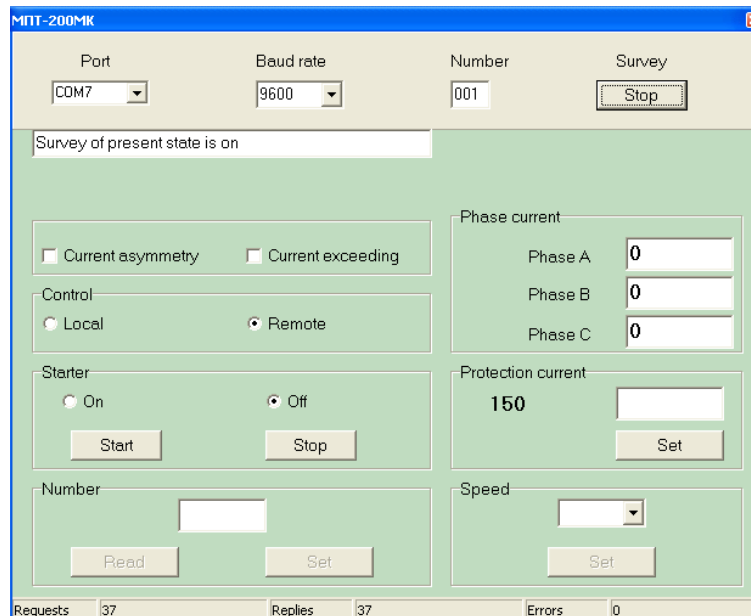

Figure 6.5

To these functions that have been observed earlier, added the possibility of remote protection current changing of the electronic starter.

As before, we choose a port, baud rate, set a number of necessary device (MPT XXXMK) and switch on the survey. The necessary current value type-in in the line "Protection current" and push the button "Set" (the button has become active). The new value is recorded to the device and straight away display in the line "Protection current". The record is made in non-volatile memory and when you switch off the device it stores. As we can see, the buttons of starter control become also active. Now you may switch on the chosen device pushing the button "Start" and switch off pushing the button "Stop".
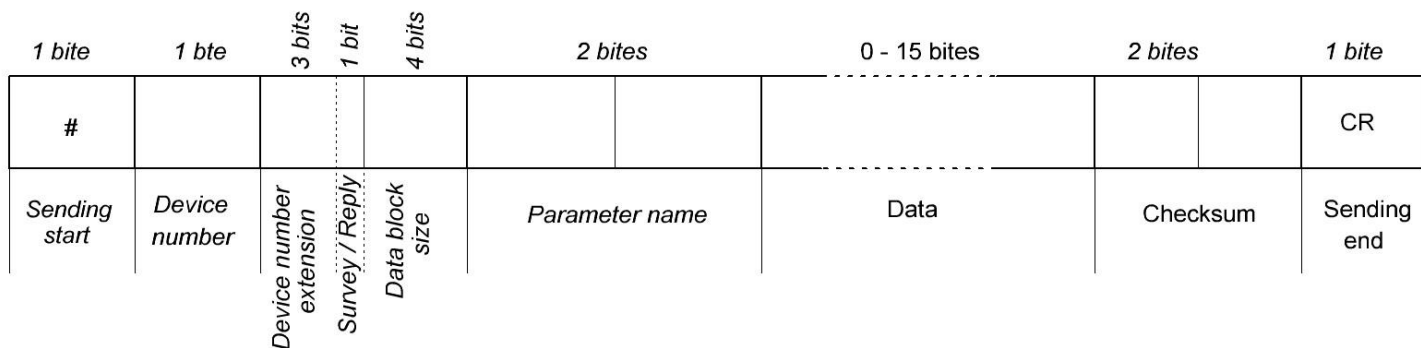
In the algorithm of electric starter operation there is a feature which attention should be paid to. If it is installed the device control as "Local" then when switching off with removing control voltage (contacts 6, 7 of control socket) and the successive switch-on with the supply voltage, the electronic starter will be obligatory switched on. And if the control installed as "Remote", then the electric starter remembers its state on the moment of removing the control voltage and when it supplying the starter will restore this state.

When an emergency the electric starter as well as at the Local control will switch off and on the screen will be displayed the emergency cause and currents by phases on the emergency moment. The buttons for the starter switch-on and switch-off will become inactive till the moment when the device restarts. You can restart the device, as before with switching the control voltage, but also you can do it remotely (**previously sorted out in the cause of the accident!**). For remote restart to the entry line of the protection current is necessary to enter a current value (which were set before or any other one, from 5 to 200) and push the button "Set". In the chosen device will be recorded the protection current value with subsequent restart. As device switch-off happened because of the accident then after restart it will always be in the state "Off".

7. EXCHANGE PROTOCOL

For communicating process structure between the MPT XXXMK and the control program is necessary to use the standard exchange protocol used by the leading manufactures. Fulfilling the condition let the consumer unite products of the different manufactures to a unified control system of the technological process at creating the own controlling programs.

EXCHANGE VIEW

1 bite	1 bte	3 bits	1 bit	4 bits	2 bites		0 - 15 bites	2 bites	1 bite
#									CR
Sending start	Device number	Device number extension	Survey / Reply	Data block size	Parameter name		Data	Checksum	Sending end

Brief description of exchange forming.

Device name – it's a number MPT XXXMK written in non-volatile memory area.
The device name can have a value from 1 to 255.
Survey/ Reply – used low bit of tetrad, 1 – survey / 0 – device reply. Three high bits are not used (an enterprise "Oven" use these bits as high orders of device name).
Data block size – can have value 0 – 15.
Parameter name – two bites with a name of necessary device parameter.
Data – in the area of the line are put the data of chosen device parameter.
Further, from the above data the control total will be counted and added to the line (size of the control totals is 2 bites).

The line with data and checksum are recoded to ASCII code, and to the deceved code are added markers of sending start and end. The formed exchange is transmitted via interface RS485 to the device.

The device, in turn, receives the transmitted exchange, recodes it from ASCII code to a binary code and detects who is transmitted to the exchange, which data want to receive from it. Also, as in the previous example, MPT XXXMK forms a response exchange and transmits to PC.

On Fig.7.1 are shown the lines parameters codes when surveying from PC and replies to surveys from MPT XXXMK. The parameters codes view is represented in the original binary code.

Pay attention that active one is PC, the device replies to its surveys. When an emergency the load will be switched off at once, and on the control program screen the information will be displayed about this after survey only.

PARAMETERS CODES

Parameter name	Sending direction	Device number	Survey / Reply	Block data size	Parameter name	Data
Phase current A	Survey from PC	$01	$01	$00	$0001	
	Device reply		$00	$02		Current of phase A
Phase current B	Survey from PC	$01	$01	$00	$0002	
	Device reply		$00	$02		Current of phase B
Phase current C	Survey from PC	$01	$01	$00	$0003	
	Device reply		$00	$02		Current of phase C
Starter On / Off	Survey from PC	$01	$01	$00	$0004	
	Device reply		$00	$01		Starter condition character $00- off / $01- on
Control Local Remote	Survey from PC	$01	$01	$00	$0005	
	Device reply		$00	$01		Control character $00- local / $01- remote
Failure Interphase difference	Survey from PC	$01	$01	$00	$0006	
	Device reply		$00	$07		Failure character - 1 bite / $01- failure Failure current of Phase-A / Phase-B / Phase-C
Failure Maximum current	Survey from PC	$01	$01	$00	$0007	
	Device reply		$00	$07		Failure character - 1 bite / $01- failure Failure current of Phase-A / Phase-B / Phase-C
Protection current Read	Survey from PC	$01	$01	$00	$0008	
	Device reply		$00	$01		Protection current value
Protection current Set	Survey from PC	$01	$01	$01	$0009	New protection current value
	Device reply	—	—	—	—	No reply
Starter Start	Survey from PC	$01	$01	$00	$000A	
	Device reply	—	—	—	—	No reply
Starter Stop	Survey from PC	$01	$01	$00	$000B	
	Device reply	—	—	—	—	No reply
Read number	Survey from PC	$01	$01	$01	$000C	Numbers from $01 to $FF + 1 after each survey, until device reply
	Device reply		$00	$01		Number of MPT 200MK
Set number	Survey from PC	$01	$01	$01	$000D	New number of MPT 200MK
	Device reply	—	—	—	—	No reply
Change exchange rate	Survey from PC	$01	$01	$02	$000E	Exchange rate code $01DF - 2048/ $00EF - 4800/ $0077 - 9600/ $003B - 19200
	Device reply	—	—	—	—	No reply

Figure 7.1