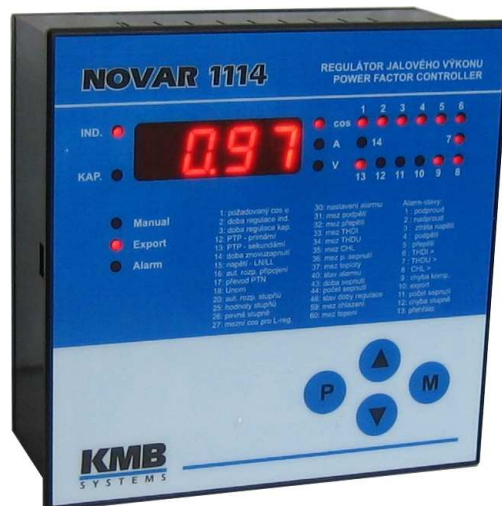


## Remote Controlled Target PF and Remote Controlled Outputs Compensation Systems Based on Novar Line Power Factor Controllers

### NOVAR-1xxx NRC Power Factor Controller NRC 86 Remote Controller

Firmware v. 1.8 (Novar) / 1.0 (NRC86)

*Operating Manual*



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# 1. Application

## 1.1 Remote Controlled Target Power Factor Compensation Systems

When connecting major sources to medium voltage network, a remote control of reactive power is often required. One possibility is to control target power factor using pulse signals from distributor (eg, transmitted via a GPRS modem). Such equipped compensation systems can be implemented using the Novar1xxx NRC power factor controller and the NRC86 remote controller.

## 1.2 Remote Controlled Outputs Compensation Systems

Alternatively, the NRC86 controller in combination with the Novar1xxx NRC power factor controller can be used for remote controlled outputs compensation systems.

In practice, there may be cases where compensation capacitors must be placed at great distance from the measuring current transformer (CT). Since the maximum length of the wires to the CT is limited due to the limited maximum loop impedance, in some cases the power factor controller cannot be installed in a switchboard with capacitors but at the measurement point near the CT. In such cases, it is necessary to install a multi-core power cable connecting the controller with capacitor contactors. If, for technical or other reasons, this solution is impossible and there exists a suitable communication channel (cable or other media) between the points, the NRC86 remote controller can be used for driving the capacitor contactors.

## 1.3 History of Firmware Versions

### Novar 1xxx NRC

version	date of release	note
1.3	10/2010	- basic version
1.4	8/2011	- THDI alarm replaced with adjustable current limit undercurrent alarm ( parameters 30, 40)
1.5	11/2011	- RCC/I/O communication error fixed
1.6	09/2012	- combined RCC and I/O operation and multiple NRC86 units performance support added
1.7	04/2013	- "Alarm by import with adjustable limit and fixed outputs release at export" function added
1.8	10/2013	- PF display error at undercurrent alarm activation correction

### NRC 86

version	date of release	note
0.1	10/2010	- basic version
0.2	01/2011	- „I/O“-mode for two NRC86 units added
0.3	04/2011	- general I/O device feature added
1.0	09/2012	- combined RCC and I/O operation and multiple NRC86 units performance support added

## 1.4 Manual Structure

This *Operating Manual* describes the NRC86 remote controller and the Novar1xxx NRC controller's specific features only. At least basic knowledge of Novar line power factor controllers is necessary for understanding it.

Detailed description of the Novar power factor controllers can be found on the manufacturers website at [www.kmbystems.eu](http://www.kmbystems.eu) .

## 2. The „Novar1xxx NRC“ Special Version Power Factor Controllers

The „NRC“ special version is available for following Novar power factor controller (PFC) models : 1106, 1114, 1206, 1214 ( marking example : Novar1214 NRC). The 1414 and 1312 models can be delivered with limited functionality only – see below.

The PFCs are equipped with a RS-485 communication interface and with the special version firmware „0E“ that allow, in combination with the NRC86 remote controller, either a remote controlled power factor operation mode or a remote controller outputs operation mode .

From point of view of hardware and installation, the „NRC“-version PFCs don't differ from standard PFC models (with exception of models Novar1414 NRC and Novar1312 NRC, see below) and detailed description can be found at the standard Novar1xxx operation manual. The only difference is their firmware – they are equipped with special version firmware „0E“. The PFCs are marked with the „0E“ code :

- on the panel of the controller at initial phase after supply voltage is applied. When the firmware version is displayed the first two characters of displayed string „0E1.3“ stands for special firmware version 0E, and the last two stands for basic firmware version 1.3.
- at firmware window of the product label on the rear panel of the controller. For example marking „1.3/0E“ means basic firmware version 1.3 and the character after a slash mean special version „0E“

The only limitation of this firmware version is that the Modbus communication protocol is not supported. All of other features are the same as the standard version.

The Novar1414 NRC and the Novar 1312 NRC models differ, moreover, from the standard models by not allowing automatic connection detection and automatic sections' powers recognition. Therefore, the type of connection (parameter No. 16) and individual sections' power sizes (parameter No. 25) must be entered manually.

### 2.1 Operation

#### 2.1.1 Remote Controlled Power Factor (Cosinus) Mode – the „RCC“ Mode

The Novar1xxx NRC PFC (or several PFCs) is connected to the NRC86 remote controller through a RS-485 communication link. Using additional parameters of the „0E“ special firmware the PFC can be set up to the *RCC-mode* (Remote Controlled Cosφ). After being set, the PFC periodically reads serial number of remote controlled PF value in range  $1 \div 5$  from the NRC86 unit.

In the PFC it is possible to preset five PF values corresponding to the remote controlled PF serial numbers. Default values are  $-0.95 / -0.97 / 1.00 / 0.97 / 0.95$  , but they can be freely changed. According this setting the PFC keeps preset target PF value that is dynamically controlled by the remote controlled PF serial number from the NRC86 unit ( standard target PF value in parameter 01 has no meaning in this mode).

Simultaneously, other NRC86 units (up to six, i.e. seven units in total) in function of remote controlled outputs (see below) can be connected to the communication link too.

Tab. 2.1 : Novar-1xxx NRC Additional and Affected Parameters

#	name	range	step	default	comment
1 (7)	target PF for metering rate 1 (2)  actual remote controlled target PF	0.80 L ÷ 0.80 C  „EX.XX“ format indicates remote controlled target PF value in the „RCC“-mode	0.01	0.98 L	in the „RCC“-mode (see par. 53), depending on the metering rate 2 parameter setting and state, the actual value of target PF is defined by setting of the „remote controlled target PF“ (par. 80) and by actual state of the „remote controlled PF serial number“ (par. 81)
6	metering rate 2 enable/disable	0 – 1 – E	—	0	when the metering rate 2 parameter enabled (value "1" or "E") and the "RCC"-mode (par. 53) enabled, PF control is carried out by the „remote controlled target PF“ when the metering rate 2 just active only (i. e. when digital input activated or active power export occurs); for metering rate 1, the PF is controlled by the target PF for metering rate 1 (par. 01), regardless to the „remote controlled target PF“ value
30	alarm setting	0 / indication only / actuation only / indication and actuation	—	indication and actuation from undercurrent, voltage signal absence or section error	1... undercurrent ... 14 ... external alarm 15 ... NRC86 connection loss Alarm No. 15 is activated when no response from the NRC86 unit occurs during approx. 20 seconds. The alarm actuation function is intended mainly for the „I/O“-mode.
40	alarm instantaneous condition				„0“ indicates passive state, „1“ indicates active state. Alarm numbering according par. 30.
50	instrument address	1 ÷ 255	1	1	In the „RCC“- and a the „I/O“-mode the preset value has no meaning. The fixed address 200 is used for communication with the NRC86 unit.
51	communication rate	4800 – 9600 – 19200 Bd	—	9600	In the „RCC“- and a the „I/O“-mode the value must correspond to that of the NRC86 unit
52	communication protocol  NRC86 response timeout	KMB(P0)  0 – 1 – 2 – 3 – 8 sec	-	KMB(P0)  0 sec	Modbus-RTU protocol cannot be set. In the „RCC“- and a the „I/O“-mode (par. 53) the parameter defines the NRC86 unit response timeout in seconds.
53	remote control mode	-(=off) / IO / IO. / RCC / RCC. / RCCP	-	-(=off)	- ... remote control mode switched off - comm. interface available for standard remote monitoring (protocol KMB only) - IO ... „I/O“-mode only (with up to 7 NRC86s) - IO. ... „I/O“-mode with actual PFC state broadcast - RCC ... „RCC“-mode with optional simultaneous „I/O“-mode (with up to 6 additional NRC86s) - RCC. ... „RCC“-mode with actual PFC state broadcast - RCCP ... „RCCP“-mode (passive)
80	remote controlled target PF No. 1 ÷ 5 ( in „RCC“-mode )	0.80 L ÷ 0.80 C	0.01	1. = 0.95 C 2. = 0.97 C 3. = 1.00 4. = 0.97 L 5. = 0.95 L	individual remote controlled target PF values EC1+EC5 corresponding to remote controlled PF serial number (par. 81) can be set in a side branch
81	remote controlled PF serial number ( in „RCC“- mode )	1 ÷ 5	1	3	the value is periodically read from the NRC86 unit - slowly flashing dec. point indicates off-line state; the value displayed corresponds to the last read value - slowly flashing dec. point indicates default state 3 ( at long time off-line state )

### 2.1.2 Remote Controlled Outputs – the „I/O“ Mode

The Novar1xxx NRC PFC is connected to the NRC86 remote controller (optionally to more of such controllers) through a RS-485 communication link. Capacitor (or choke) contactors are not connected to the PFC outputs but to corresponding outputs of the NRC86 controller(s).

Using additional parameters of the „0E“ special firmware the PFC can be set up to the *I/O-mode* (Input/Output). Then the PFC output state is periodically transmitted to the NRC86 controller(s) and its outputs state „copies“ the PFC outputs state. The outputs refresh speed is between  $3 \div 10$  times per second if a transparent communication medium ( i.e. a medium with no transmission delay) is used (it depends on preset communication rate and remote control mode). If usual metallic cable is used maximum distance between the PFC and the NRC86 unit is up to 1 km, but it can be nearly unlimited for suitable wireless media.

Up to seven NRC86 units can be connected. At each of the units you can set how many outputs to process (i.e. how many of its outputs are controlled by the PFC outputs); then other outputs of the PFC are processed by other NRC86 units. By this you can control outputs which are spatially spread within reach of the communication line.

Desired remote controlled mode ( either the „RCC“ or the „I/O“ ) can be set using additional parameters according Tab. 2.1°. Essential matters that differ from standard version are bolded.

Significant parameters detailed description follows.

## 2.2 Parameters 01(07) – Target PF for Metering Rate 1(2) / Actual Remote Controlled Target PF

### 2.2.1 Parameter 01

If the remote control mode (par. 53) is switched off or if the metering rate 2 control (par. 06) is enabled, parameter 01 has usual meaning, i.e. preset target PF value ( for metering rate 1).

If any of *RCC-modes* is set and **the metering rate 2 control is disabled simultaneously**, the target PF is remote controlled by external NRC86 unit. In such case an actual value of remote controlled PF with preceding „E“ character is displayed in parameter 01 ( for example **E0.97** ). This value cannot be edited in parameter 01; it is defined by preset value of *remote controlled target PF* in parameter 80, corresponding to actual state of *remote controlled PF serial number*. This serial number ( in range 1 ÷ 5 ) is periodically read from the NRC86 unit and its value can be checked in parameter 81.

Thus the PFC controls PF to one of preset values in parameter 80. Usual value of parameter 01, i.e. standard target PF value for metering rate 1, has no meaning in the *RCC-mode* and it is not displayed.

But, if **the metering rate 2 control** (par. 06) **is enabled**, the parameter 01 has usual meaning - preset target PF value ( for metering rate 1). Then, if the metering rate 2 is inactive actually, the parameter 01 target PF is used for PF control and *the remote controlled target PF value* is ignored.

### 2.2.2 Parameter 07

The standard meaning of this parameter is target PF for metering rate 2 (the second tariff). If the metering rate control (parameter 06) is disabled its value has no meaning.

If the metering rate 2 control is enabled and the *RCC-mode* is off, target PF is defined by the parameter 01 or 07 according actual state of the metering rate 2 control value.



If the **metering rate 2 control is enabled and any of the *RCC-modes* is set simultaneously**, the target PF is remote controlled by external NRC86 unit **only when the metering rate 2 (tariff 2) just active**. In such case, the actual value of *remote controlled PF* with preceding „E“ character is displayed in parameter 07 ( in the same way as in the parameter 01 when the metering rate 2 control disabled). The parameter 01 has in such case its usual meaning, i.e. preset target PF value for tariff 1. Thus, if **the tariff 2 just inactive**, the PF is controlled by the parameter 01 value and *the remote controlled target PF value* is ignored.

The tariff2 value is evaluated in the usual way: either by state dig. input (1) or export (E).

## 2.3 Parameters 30 – Alarm Setting, 40 – Alarm Status

### 2.3.1 Alarm No. 6 – Undercurrent Alarm with Adjustable Limit or Alarm by Import with Adjustable Limit and Fixed Outputs Release at Export

At standard Novar 1xxx controllers, the alarm No. 6 is controlled by THDI value.

At the Novar 1xxx NRC controllers, the alarm is not evaluated. The alarm No. 6 has one of following meanings depending on its setting :

#### 2.3.1.1 Undercurrent Alarm with Adjustable Limit

This is in fact enhanced undercurrent alarm. Behaviour of the alarm corresponds to the alarm No. 1 (thus, it is controlled by *leff* value); furthermore, the undercurrent limit value in “per mille”(ppt, range 0 ÷ 200 ppt) of nominal current (5A/1A according parameter 13 setting) can be set in parameter 33.

For this alarm behaviour, the alarm No. 1 must be set in the same way as the alarm No. 6.

*The limit value setup example* : CT ratio (par. 12,13 ) is set to 500/5A. We intend to set the undercurrent limit to 15A. Nominal current corresponds to the CT primary value, i.e. 500A, one ppt of this is 0.5A. So we set the parametr 33 to  $15 / 0.5 = 30$ .

#### 2.3.1.2 Alarm by Import with Adjustable Limit and Fixed Outputs Release at Export

For this alarm functionality, the actuation function of the alarm No. 1 must be (unlike the function described above) switched off (usual value  $\bar{0}$ ) and the actuation function of the alarm No. 6 must be switched on (usual value  $\bar{2}$ ), simultaneously. Then :

- The alarm No. 6 is triggered as soon as *fifteen-minute average value of the active current lact* is either positive (=import), or it is negative, but its absolute value is below the preset limit in “per mille”(ppt, range 0 ÷ 200 ppt) of nominal current (5A/1A according parameter 13 setting) in parameter 33. During the check a hysteresis of +/-1mA is applied.
- When the actuation is triggered all of the fixed sections are set to their preset states. The controller goes on operation with the remaining ones. If all of the sections are fixed the power factor control is suppressed.
- As soon as *the fifteen-minute average value of the active current lact* gets negative (=export) and its absolute value exceeds the preset limit in the parameter 33, the alarm gets inactive. At the same time, all of the sections preset as fixed ones are released for the control process, i.e. they are considered as standard control sections.
- This alarm function setting is indicated by slowly flashing decimal points at the sections pressed as fixed at the parameter 26, that denotes their conditional behaviour

Note 1 : *The fifteen-minute average value of the active current Iact* is not displayed, you can check the actual value of the active current Iact only. So you must take in mind appropriate delay in the alarm activation and deactivation when checking its behaviour.

Note 2 : When this alarm is set , the undercurrent alarm (No. 1) is, as noted above, switched off, necessarily. Therefore, the controller uses all of the sections but the fixed ones even if the measured current drops to minimum. If you need the controller to set firmly defined combination of all the sections when the alarm is activated, it is necessary to set as fixed all of the sections, not just those that are to be fixed on, but the remaining sections as fixed off, as well.

*The limit value setup example* : Usually, it is necessary to set the current limit according required active power threshold. CT ratio (par. 12,13 ) is set to 500/5A, type of measurement voltage (par. 15) is phase-neutral ( $U=Ln$ ), nominal voltage  $U_{NOM}$  (par. 18) is 230 V. We intend to set the undercurrent limit to correspond to the -5kW (export) of three-phase active power. Corresponding phase power is  $-5 / 3 = -1.67 \text{ kW} = -1670 \text{ W}$ . As nominal voltage is 230V, corresponding phase current is  $1670 / 230 = -7.25 \text{ A}$  (for phase-phase voltage, it must still be divided by  $\sqrt{3}$ ). As one ppt of the current range is (as in previous example) 0.5A, we set the parameter 33 to  $7.25 / 0.5 = \sim 15$ .

### 2.3.2 Alarm No. 15 – Remote Control Failure

For remote control mode state checking, alarm No. 15 was added :

Tab. 2.2 : Remote Control Failure Alarm

#	condition	description	minimum delay of activation / deactivation	actuation
15	remote control failure	loss of connection with the NRC86 unit/units ( some of the unit response is incorrect or missing at all )	20 / 1 seconds	disconnection of all sections

As default, the remote control failure alarm is switched off and it is possible to switch it on if advisable.

If no remote controlled outputs connected the actuation function is not interesting; it is intended especially for emergency disconnection of remote controlled outputs. When temporary interruption of the connection between the PFC and the NRC86 unit/units appears, the situation will look as follows :

1. Approximately after 20 seconds of communication link fault the PFC disconnects all of outputs step by step and it will stay in standby mode until the connection is restored.
2. The NRC86 remote controller(s) in the *I/O-mode* disconnects (simultaneously) all of its outputs after approx. 30 seconds of the communication link fault duration.
3. After the connection is restored, the PFC returns back to to control mode and the NRC86 controller(s) outputs starts to copy the PFCs outputs state to its outputs again.

So it is ensured that no premature switching of more outputs on will occur and the reconnection delay time preset in the PFC will be kept

## 2.4 Parameters 50, 51, 52 – Instrument Address, Communication Rate and Communication Protocol / NRC86 response timeout

Parameter 50 specifies the instrument address for remote control and monitoring of the PFC with the Retis or the Envis program. But this function cannot be used in a remote control mode because the communication link is reserved for connection with the NRC86 unit(s). So the parameter value has no meaning in this mode (the PFC uses fixed addresses 200 and higher for communication with the NRC86(s)).

The communication rate (parameter 51) must be set identically as the communication rate of the NRC86 unit(s). It is recommended to use default value 9.6 kBd or, according local conditions (cable length, interference level, ...), it is possible to increase it if applicable. In the *RCC mode* the set value is not critical, in the *I/O mode* the higher value can bring better performance.

Parameter 52 setting is relevant only when any remote control mode (either the *RCC* or the *I/O*) is activated in parameter 53. In such case it doesn't specify the communication protocol as usual but it defines maximum wait time for response from the NRC86 unit(s). For default value 0 the NRC86 response timeout is approx. 0.3 sec – this setting is suitable for transparent communication links (that have no transmission delay).

For non-transparent communication media (with transmission delay) such like radiomodems, GSM/GPRS modems, LAN etc., it is necessary to set this parameter value to maximum wait time for response from the NRC86 in seconds (in range 1 – 2 – 3 – 5 – 8).

If the remote control mode is switched off the parameter 52 has its usual meaning – the type of communication protocol. But as the „NRC“-version PFCs don't support the Modbus protocol the value is fixed to P0 (= KMB protocol).

## 2.5 Parameter 53 – Remote Control Mode

With this parameter you can activate the so-called *remote control mode*. In this mode, the PFC cooperates with a NRC86 control unit (or more units) interconnected with a serial interface. The interface is used to full capacity during remote control mode and therefore remote monitoring and control of the PFC with the Retis or the Envis program is not possible.

Tab. 2.3 : Parameter 53 – Remote Control Mode Setting Options

setting	description	note
--	remote control mode is switched off	communication interface can be used for PFC remote monitoring & control (Retis, Envis)
.0	<i>I/O-mode</i> only with up to 7 NRC86 units	number of the units connected defined by their setting
.0.	<i>I/O-mode</i> and actual PFC state broadcast	actual PFC state is simultaneously transmitted to the NRC86
rCC	<i>RCC-active mode</i> driven by the 1st NRC86 unit and optional simultaneous <i>I/O-mode</i> with up to 6 additional NRC86 units	to be set at the „master“ PFC only
rCC.	<i>RCC-active mode</i> with actual PFC state broadcast	actual PFC state is simultaneously transmitted to the NRC86
rCCP	<i>RCC-passive mode</i>	to be set at the „slave“ PFCs

In principle, one of two remote control modes can be activated - either the *I/O* or the *RCC mode* :

- *RCC mode*

The *RCC mode* (Remote Controlled Cos $\phi$ ) is designated for remote control of target power factor value. Simultaneously, a remote controlled outputs can be driven by additional NRC86 units.

Basic RCC-mode, so called *active*, must be set at one of PFCs only connected to the NRC86 unit(s); this PFC then behaves as “master”, that means it controls data interchange on the communication link; during this, actual states of the PFC outputs are transferred to additional NRC86 units in case of simultaneous remote outputs control. If more PFCs connected to the NRC86 unit, all of others must be set as „slaves“, that means to *passive* RCC-mode marked as RCCP.

As soon as the mode is set, the master PFC starts to send commands to the NRC86 unit(s). The unit (with address of 200 if more units connected) receives them, processes them and sends confirmation back to the master PFC. The master PFC receives and processes the NRC86 confirmation and this loop is repeated forever. The slave PFCs listen to communication and receives the NRC86(s) answers (confirmations) only.

The (first) NRC86 confirmation contains so called *remote controlled PF serial number* - its value can be checked parameter 81. According this value and *remote controlled target PF* values preset in parameter 80 it evaluates actual target PF, displays it in parameter 01 and controls the PF according its value.

If the first NRC86 unit respectively set and more units (up to six ) connected in “cascade”, the response of the previous unit is always received by the next unit with address higher by one and such units operate as remote controlled outputs as described below.

- *I/O mode*

The *I/O mode* (Inputs/Outputs) is determined for remote controlled outputs only. In this mode, up to seven NRC86 remote controllers can be connected to a single PFC.

The data interchange between the PFC and the NRC86(s) runs in the same way as in the *RCC mode* with one difference only – target power factor is not controlled by the NRC86, but actual state of the PFC outputs is transmitted to the NRC86 unit(s) and so the PFC state outputs are “copied” to the unit outputs.

So called *daisy-chain communication* can be set at the NRC86 unit. If set , the unit passes each command to the next unit with address higher by one after processing it. At the last unit in the cascade the daisy-chain communication must be switched off.

Next, *a number of processed outputs* can be set at each unit. It specifies how many of PFC outputs to be received and “copied” to the unit outputs. At the next unit in the cascade you can set number of processed outputs similarly; then remaining PFC outputs are processed, i.e. those starting from the first PFC output not processed by the previous unit. Maximum number of the units in cascade is 7.

Example : The 1st unit setting : address=200, daisy-chain comm =on, No. of processed outputs=6; the 2nd unit setting : address=201, daisy-chain comm =on, No. of processed outputs=4; the 3rd unit setting : address=202, daisy-chain comm =off, No. of processed outputs=7. Then, at the 1<sup>st</sup> unit 1÷6 outputs, the PFC 1÷6 outputs will appear; the 2<sup>nd</sup> unit 1÷4 outputs will copy the PFC outputs No. 7÷10; and finally, at the outputs 1÷7 of the 3<sup>rd</sup> unit, the PFC outputs No.11 and higher will appear (up to 17, or to the PFC maximum output).

In both of the remote control modes, actual state of the master PFC broadcast can be activated. These options are identified with additional decimal point. When set, the PFC broadcasts its complete actual state (all measured quantities actual values, outputs state etc.) during communication with the NRC86 unit(s). Then, these values can be listed and viewed on the NRC86 unit (the first unit only in case of the unit cascade) display in the same way as on the PFC display. It can be helpful during installation or it can be optionally used for the PFC actual state monitoring by a third-party system (program).

But if not necessary it is recommended to use remote control mode without PFC actual state broadcast during common power factor compensation operation. At this setting, the remote control commands are essentially shorter and due to this the data interchange is faster and more reliable. Then actual PF value and the PFC alarm state only can be checked on the NRC86 display.

## **2.6 Parameters 80,81 – Remote Controlled Target PFs and Remote Controlled PF Serial Number**

These parameters are relevant only when any of the *RCC-mode* is active. Otherwise they are not displayed.

In the *RCC-mode*, so called *serial number of remote controlled PF* is periodically transferred from the (first) NRC86 unit to the PFC (or multiple PFCs). Its range is 1 ÷ 5 and actual value is displayed in parameter 81 with identification string „ECn“; for example, if its value is 2, the **EE<sub>n2</sub>** string is displayed.

If connection between the PFC and the NRC86 unit is interrupted, the PFC keeps last correctly read value from the (first) NRC86 unit for approx. 30 seconds and during this indicates with slowly flashing decimal point that the displayed value is not actual. If the connection is not restored during approx. 1 minute, the serial number of remote controlled PF is set automatically to its default value 3. This state is indicated with quickly (approx. three times per second) flashing decimal point.

The parameter is set to this default value automatically after the PFC startup and keeps it until receives first actual value from the NRC86 unit.

In side branch of parameter 80 you can set five remote controlled target PFs **EE- 1** through **EE- 5**, corresponding to remote controlled PF serial number value. The PF range is the same as parameter 01 has, but it is not possible to set the value in angle degrees. Default values are -0.95 / -0.97 / 1.00 / 0.97 / 0.95 .

According this setting and actual value of remote controlled PF serial number, the PFC selects corresponding PF from preset values **EE- 1** through **EE- 5**, displays it in parameter 01 ( with preceding “E” character) and uses it as actual target PF.

### 3. NRC 86 Remote Controller

The unit is designed for power factor compensation systems either with remote controlled PF or with remote controlled outputs. The unit operates in combination with special version of Novar power factor controller – Novar1xxx NRC.

The unit is available in various modifications. Typical models are :

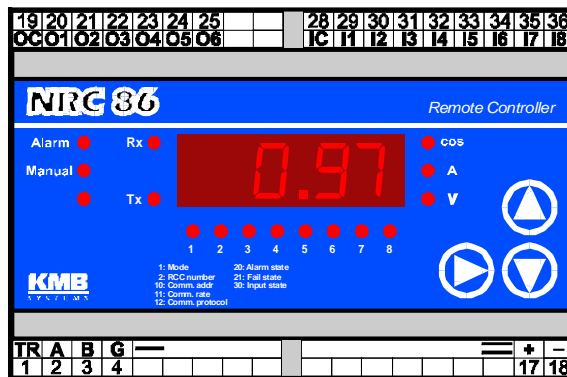
Tab. 3.1 : NRC86 Remote Controller Typical Models

model	configuration	typical use
NRC86-85 24VDC	<ul style="list-style-type: none"> <li>8 inputs 24 V DC</li> <li>5 relay outputs, up to 400 V AC</li> <li>aux. voltage 24 V DC</li> </ul>	remote controlled PF
NRC86-07 230VAC	<ul style="list-style-type: none"> <li>7 relay outputs, up to 400 V AC</li> <li>aux. voltage 100 ÷ 300 V AC</li> </ul>	remote controlled outputs

#### 3.1 Description

The front panel consists of a numeric display, indication LEDs and control keys.

Fig. 3.1 : NRC 86 Remote Controller



The unit design is based on the Novar1007D PFC hardware; therefore indication elements and manipulation is the same or similar. Detailed description can be found at the PFC operating manual.

Indication LED meaning corresponds to the PFC. There are additional LEDs **Rx** and **Tx** indicating receiving and transmitting bytes from / to communication link.

You can list through actual values and unit parameters using the ▲ , ▼ buttons. For into/off a side branch or for parameters editing, use the ► button. Following operations can be made in the same way as with a Novar line PFC :

- actual PF value display, refreshed periodically from connected PFC; if *actual PFC state broadcast* is set, not only the PF value, but all actual values measured by the PFC can be displayed
- listing through parameters and editing them
- disabling or enabling of parameter editing
- manual control of the unit outputs in *Manual mode*

## 3.2 Operation

### 3.2.1 Remote Controlled Power Factor (Cosinus) Mode – the „RCC“ Mode

Up to five pulse signals can be connected to the NRC86 unit. A pulse of correct duration on one of inputs 1÷5 is evaluated as target PF serial number request. The unit saves the number into its memory and confirms by switching of appropriate output on ( this signal is transmitted back to the supervising system for checking ).

The Novar1xxx NRC PFC (or several PFCs) periodically reads the target PF serial number from the unit and uses appropriate preset target PF for compensation.

The instrument address (parameter 10) must be set to 200. If other NRC86 units for remote controlled outputs connected too, the daisy-chain communication option (parameter 6 ) must be set at all of the units in the cascade but the last one. The other units' addresses in the cascade must be increasing by one, i.e. 201, 202 etc.

### 3.2.2 Remote Controlled Outputs – the „I/O“ Mode

For such applications the NRC86-07 unit model is suitable. It has 7 outputs (and no input). For compensation systems with more than 7 outputs, two NRC86-07 units are necessary. Optionally you can use up to 7 units in cascade if you need to spread remote outputs spatially.

The unit is installed in a PF compensation capacitor ( or choke) switchboard. It must be interconnected with distant Novar1xxx NRC PFC using a communication link. The capacitor (or choke) contactors must be connected to the NRC86 unit outputs; the PFC outputs stay unconnected.

The address (parameter 10) of the first unit must be set to 200. If other NRC86 units connected, the daisy-chain communication option (parameter 6 ) must be set at all of the units in the cascade but the last one and their addresses must increase by one, i.e. 201, 202 etc.

With the parameter 5 the number of processed outputs in the unit can be set. The parameter is preset to the maximum number of outputs of the unit, but it can be decreased to "N" – then, the unit outputs **O1 ÷ ON** will follow the PFC outputs' state starting from the first output that is not processed by the previous unit.

Example : The 1<sup>st</sup> unit (address 200) is set to 4 processed outputs; the 2<sup>nd</sup> unit (address=201) is set to 6 processed outputs. Then, at the 1<sup>st</sup> unit **O1÷O4** outputs the PFC 1÷4 outputs will appear and the 2<sup>nd</sup> unit **O1÷O6** outputs will copy the PFC outputs No. 5÷10. The daisy-chain communication must be activated at the 1<sup>st</sup> unit and deactivated at the 2<sup>nd</sup> unit.

### 3.2.3 Manual Mode

In the *Manual* mode, the NRC86 unit goes on receiving commands and answering to them, but the unit outputs stay unchanged - they can be changed manually only in the same way as a Novar PFC outputs.

## 3.3 NRC86 Remote Controller Parameters

### 3.3.1 Parameter 01 – Remote Control Mode

The remote control mode of the NRC86 unit is displayed in the parameter – it can be either **IO** (remote controlled outputs) or **rCC** (remote controlled PF).

The parameter value is controlled and refreshed with each command received from a Novar1xxx NRC PFC, it is not necessary to set it manually. In case of power failure, the last valid value of the parameter is stored in the unit memory and automatically loaded after the power restoration.

For testing purposes, the parameter value can be set manually too. But, for this it is necessary to switch the remote control mode off firstly or simply disconnect the communication link temporarily.

### 3.3.2 Parameter 02 – Remote Controlled PF Serial Number

This parameter is relevant in the *RCC-mode* only. In other modes it is not displayed.

The remote controlled PF serial number can have value in range 1 ÷ 5. If since last unit powerup or the unit initialisation at least one PF control request had come ( i.e. a valid pulse signal had appeared at one of **I1 ÷ I5** inputs ), the decimal point of displayed parameter value is dark.

The last valid parameter value is stored into the unit memory and automatically uploaded after the unit powerup. The fact that the parameter value was reloaded from the unit memory is indicated with flashing decimal point of displayed parameter value. The same indication is activated after manual editing of the parameter value.

The decimal point gets dark as soon as the first valid PF control request on **I1 ÷ I5** inputs appears.

Tab. 3.2 : NRC86 Remote Controller Parameters

#	name	range	step	default	comment
1	remote control mode	I/O / RCC	-	I/O	set by PFC commands; manual setting for testing purposes possible only when cooperating PFC remote control mode is switched off or if communication link is disconnected
2	remote controlled PF serial number ( in „RCC“-mode )	1 ÷ 5	1	3	relevant in the RCC-mode only ; not displayed in the I/O mode
5	outputs processed	0 ÷ MAX	1	MAX	relevant in the I/O mode only; in the RCC mode automatically 0, parameter not displayed
6	daisy-chain communication mode	0 (off) / 1 (on)	-	0	in case of cascade of units must be set on at all of the units but the last one
10	instrument address	1 ÷ 254	1	200	for cooperation with a Novar1xxx NRC PFC in remote control mode must be set to 200 (or higher in case of units cascade)
11	communication rate	4800 – 9600 – 19200 Bd	-	9600 Bd	must correspond to cooperating Novar1xxx NRC PFC setting
12	communication protocol	KMB(P0) / Modbus-RTU(P1)	-	KMB(P0)	for cooperation with a Novar1xxx NRC PFC in remote control mode must be set to P0 (KMB)
20	alarm status	-- / E / C	-	-	set by the NRC86 unit ; indicates type of alarm : E ... external alarm (= indicates cooperating Novar1xxx NRC PFC alarm active state) C ... communication out of order (no Novar1xxx NRC PFC commands received)
21	instrument failure status				indicates E-00 for failure-free state
30	logic inputs status				I1÷I8 logic inputs state : I ... 0 ( passive ) I ... 1 ( active )



### 3.3.3 Parameter 05 – Number of Processed Outputs (in I/O mode)

The parameter is relevant in I/O mode only (it is not displayed in RCC mode). It defines how many of the unit outputs starting from **01** output will be used as remote controlled outputs.

As default, the parameter is preset to the maximum outputs of the unit type. If decreased other outputs will stay unused.

In case of cascade of more units in *the I/O mode*, PFC outputs' states starting from the first output not processed by previous unit are copied to the next unit outputs starting from its output **01**.

### 3.3.4 Parameter 06 – Daisy-Chain Communication Mode („Cascade“)

If more than one NRC86 units connected to a PFC all of the units but the last one must be set to the daisy-chain communication mode (i.e. set to **1**).

This mode must be switched off at the last unit in the cascade, i.e. set to **0**.

### 3.3.5 Parameters 10, 11, 22 – Instrument Address, Communication Rate and Communication Protocol

The address (parameter 10) of the first NRC86 unit cooperating with a Novar1xxx NRC PFC in remote control mode must be set to value 200. In case of more NRC86 units in “cascade” every next unit address must be higher by one than the previous unit address, i.e. 201, 202, etc.

The communication rate (parameter 11) must be set identically as the supervisory Novar1xxx NRC PFC. It is recommended to use default value 9.6 kBd or, according local conditions (cable length, interference level, ...), it is possible to increase it if applicable. In the *RCC mode* the set value is not critical, in the *I/O mode* the higher value can bring better performance.

Parameter 12, i.e. communication protocol, must be set to KMB protocol, i.e. **P0**.

### 3.3.6 Parameter 20 – Alarm Status

This parameter value is driven by a NRC86 unit itself. If the **Alarm** LED-diode flashes, the cause of the alarm can be identified by the parameter value :

- **E** ... indicates supervisory Novar1xxx NRC PFC in alarm state
- **[-** ... indicates missing or incorrect commands from supervisory Novar1xxx NRC PFC (probably communication link failure)

### 3.3.7 Parameter 21 – Instrument Failure Status

The unit carries out self-diagnostic tests in regular intervals during its operation. You can check the diagnostics' results in this parameter.

It shows **E-00** if no errors have occurred. If the value is other than zero, the unit has identified an error. Such a condition does not necessarily mean the unit is out of operation — in such an event the unit supplier must be contacted and told about the identification value of the type of error shown. Using this value, a specialist will then decide about the method of solving the problem.

### 3.3.8 Parameter 30 – Logic Inputs Status

For logic inputs status and functionality checking actual state of all logic inputs **I1 ÷ I8** is displayed in the parameter. The inputs states are displayed in order from left to right (the leftmost is **I1**, the rightmost **I8**). Character representation is as follows :

- 0 ... 0 ( passive )
- 1 ... 1 ( active )

## 3.4 Installation

The NRC86 unit is designed for mounting on a DIN-35 bar. Maximum cross section area of connection wires is 2.5 square millimetres.

Examples of unit wiring are shown below.

### 3.4.1 Power Supply

The unit requires supply voltage in the range as declared in technical specifications table for its operation.

The power supply terminals are galvanically isolated from other unit circuits.

#### 3.4.1.1 24 VDC Power Supply Version

Direct auxiliary voltage connects to terminals 17 (+) and 18 (-). The marked polarity of connection is recommended only, in fact it is free.

Power supply voltage needs to be externally protected ( see chapter **Protection** below ).

#### 3.4.1.2 230 VAC Power Supply Version

Alternating auxiliary voltage connects to terminals 16 (**L**) and 18 (**N**).

Power supply voltage needs to be externally protected ( see chapter **Protection** below ).

#### 3.4.1.3 Protection

Article 6.12.2.1 in the EN 61010-1 standard requires that instrument must have a disconnecting device in the power supply circuit (a switch — see installation diagram). It must be located at the instrument's immediate proximity and easily accessible by the operator. The disconnecting device must be marked as such. A circuit breaker for nominal current of 1 amp makes a suitable disconnecting device, its function and working positions, however, must be clearly marked (symbols "0" for power off and "1" for power on in accordance with EN 61010-1).

### 3.4.2 Logic Outputs

The NRC86 unit can have up to 7 output relays (depending on unit model).

The relays' contacts go to terminals 20 ÷ 26 ( **O1 ÷ O7** ). The relays' common contacts are connected to terminal 19 ( **OC** ).

The relays' output contacts are internally wired with varistors.

### 3.4.3 Logic Inputs

The NRC86 unit can have up to 8 galvanically isolated logic inputs (depending on unit model).

The inputs are passive – a voltage of appropriate level ( specified in technical parameters, see below ) must be applied. For direct voltage inputs the applied voltage polarity is free. The input voltages must be connected to terminals 29 ÷ 36 ( *11* ÷ *18* ), the inputs' common pole to terminal 28 ( *1C* ).

### 3.4.4 Communication Interface

The NRC86 units are equipped with galvanically isolated communication interface in compliance with RS-485 specification for interconnection with supervisory Novar1xxx NRC PFC ( or with other instruments in general use).

Signal-to-pin configuration for RS-485 type line is shown in Tab. 3.2.

Table 3.2: communication line signal configuration

signal	terminal
TR	1
DATA A	2
DATA B	3
GND/C	4

The interface allows connecting up to 32 instruments at a distance up to about 1 kilometre. Recommended cable is shielded twisted metallic double pair. Use one pair for DATA A and DATA B signals and the second pair for GND/C signal interconnection.

RS-485 line requires impedance termination of the final nodes by installing terminating resistors for communication distances of a few tens of metres and longer. Terminating resistors matching the cable's wave impedance are connected between terminals DATA A and DATA B. The unit has a built-in terminating resistor of 330 ohms. It is connected between DATA B-signal (terminal 3) and TR-terminal (1) inside the unit. To install the resistor, simply interconnect terminals DATA A (2) and TR (1).

If the communication cable is hundreds of meters long and in environments with electromagnetic noise it is suitable to use shielded cable. The shielding connects to the PE (protection earth) wire at one end of the cable.

## 4. Putting in Operation

### 4.1 Remote Controlled Target PF Compensation Systems

For remote controlled power factor the NRC86-85 24 VDC remote controller is needed. If remote controlled outputs using additional NRC86 units in cascade necessary too it is better to use the NRC86-07 230 VAC models with 7 outputs each for this task.

One or more (up to 32) Novar1xxx NRC PFCs can be connected to.

Commissioning procedure step-by-step :

1. Install the Novar1xxx NRC PFC (or multiple PFCs) according its *Operation Manual*.
2. Install the NRC86 units according the *Installation* chapter of this manual.
3. Interconnect the NRC86 units and the PFC(s) with a communication link. Install terminating resistors on the link ends. Switch the units' power supply on and set the communication link parameters No. 10, 11 a 12 according the specification above, i.e. the first unit ( which runs in *the RCC mode*) address to 200 and the next units to 201, 202, 203 etc., step-by-step.
4. Set daisy-chain communication mode ( parameter 6 to **1**) at all of the units but the last one and the last unit to **0**.
5. Set number of processed outputs ( parameter 5 ) at all units operating as remote controlled outputs.
6. Power up the PFC (or PFCs). Check communication rate ( p. 51), eventually set to correspond to the NRC86 unit setting. In the parameter 30, clear the section failure alarm ( No. 12 to „0“ ) and set the remote control failure alarm No. 15 to value „S“ or to „2“.
7. In the „master“ PFC, set the *RCC*-mode in parameter 53. The PFC will start transmitting commands and the NRC86 unit should answer. Now set the NRC86 response timeout in parameter 52. For transparent communication links set the value to 0. For non-transparent links set the value (in seconds) that corresponds to maximum transmission delay of the communication loop. Check the remote control function :
  - The **Rx** and **Tx** LED-diodes of the NRC86 units must flashing synchronously to the running communication. In the parameter 01 of the first unit, the **RCC** mode must be displayed, optionally installed other units should indicate the **I/O** mode. At the first unit one of unit outputs **01 ÷ 05** corresponding to serial number of remote controlled PF in parameter 02 must be switched on, optional other units should copy the PFC outputs' states on their outputs. The units should not indicate any alarm, or the external alarm only can be active ( the alarm of supervisory PFC, transmitted to the unit)
  - The PFC(s) should not indicate the remote control failure alarm. In the parameter 81, the serial number of remote controlled PF corresponding to that of the NRC86 unit should be. In parameter 01, appropriate remote controlled target PF value with preceding „E“-character must appear.
8. In case of multiple PFCs connected, all other PFCs but the „master“ one must be set to the *passive remote controlled PF* mode, i.e. the parameter 53 to value **RCCP**. Parameter 52 must be set to the same value as the „master“ PFC is set.

9. Check and optionally change remotely controlled target PF values in parameter 80 of all PFCs.

Finally, it is recommended to check functionality of the whole system : step-by-step apply a pulse on the **I1÷ I5** inputs of the NRC86 and check response of all connected PFCs.

## 4.2 Remote Controlled Outputs Compensation Systems

For these applications, the NRC86-07 230 VAC remote controller with 7 outputs is optimal. Up to 7 of such NRC86 units depending of number of compensation system outputs (contactors) and required spatial spread can be used.

Commissioning procedure step-by-step :

1. Install the Novar1xxx NRC PFC according its *Operation Manual*. Let its outputs unconnected.
2. Install the NRC86 units according the *Installation* chapter of this manual. Connect contactors of steps No. 1 ÷ N1 to the first unit starting with its **O1** output, where N1 is number of processed outputs (parameter 5) in the unit. Similarly at the next and other units, connect contactors of steps No. ( $\Sigma N+1$ ) ÷ ( $\Sigma N +1+NX$ ) to the unit outputs, where  $\Sigma N$  is sum of outputs processed by previous units and NX is number of outputs processed by the unit No. X. The common pole of the unit(s) outputs should be wired via a protection device of suitable rating to the contactors auxiliary voltage.
3. Interconnect the NRC86 unit(s) and the PFC with a communication link. Install terminating resistors on the link ends. Switch the unit(s) power supply on and set the communication link parameters No. 10, 11 a 12 according the specification above – address of the 1<sup>st</sup> unit in cascade must be set to 200 and others to 201, 202, 203 etc., if installed.
4. Set daisy-chain communication mode ( parameter 6 to **1**) at all of the units but the last one and the last unit to **0**.
5. Set number of processed outputs ( parameter 5 ) at all of the units.
6. Now switch the units power supply temporary off.
7. Power up the PFC. Check communication rate ( p. 51), eventually set it to correspond to the NRC86 unit(s) setting. In the parameter 30, clear the section failure alarm ( No. 12 to „0“ ) and set the remote control failure alarm No. 15 to value „2“.
8. In the PFC, set the I/O-mode in parameter 53. The PFC will start transmitting commands to the NRC86 unit(s), but as they are switched off now the PFC will during several seconds start indicating alarm no. 15 ( remote control failure) and will switch all of its outputs off. Now set the NRC86 response timeout in parameter 52. For transparent communication links set the value to 0. For non-transparent links set the value (in seconds) that corresponds to maximum transmission delay of the communication loop.
9. Now switch the NRC86 unit(s) power on. Check the remote control function :
  - The **Rx** and **Tx** LED-diodes of the NRC86 unit(s) must flashing synchronously to the running communication. In the parameter 01, the **IO** –mode must be displayed.
  - The supervisory PFC should stop indicating the remote control failure alarm (No. 15) and should start to compensate normally; the NRC86 unit(s) outputs should follow the PFC outputs state.

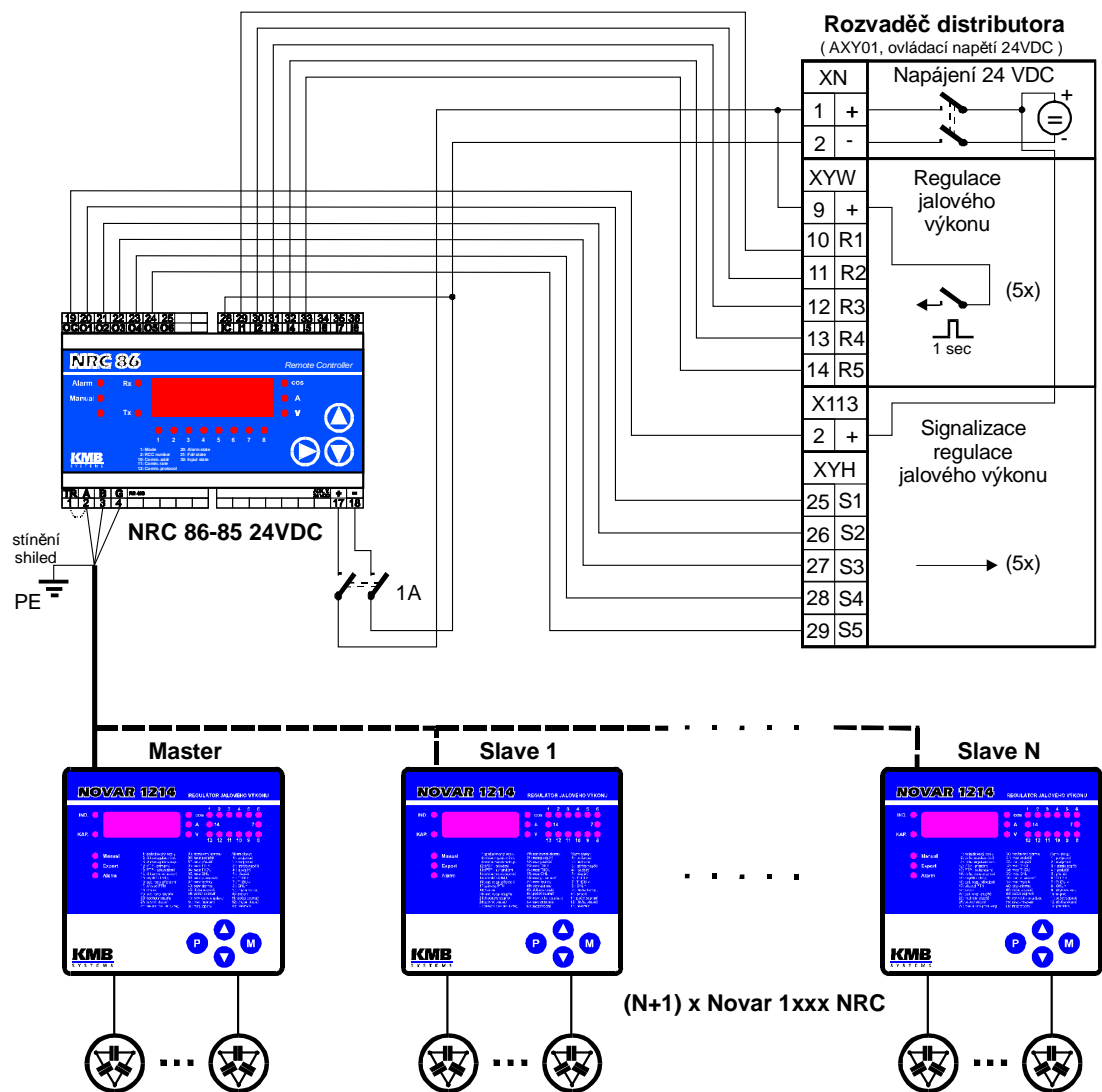
- The NRC86 unit(s) should not indicate any alarm or the external alarm only can be active ( the alarm of supervisory PFC, transmitted to the unit(s))

Finally, it is recommended to check the remote control failure (No. 15) actuation alarm functionality, for example by disconnecting of the communication link or by changing communication rate parameter (No. 51) to any improper value – the PFC must during approx. 20 seconds start indicating the remote control failure alarm and switch all of its outputs off step-by-step. The NRC86 unit(s) must start to indicate the communication link failure alarm during approx. 15 seconds and after 30 seconds to disconnect all of outputs at once.

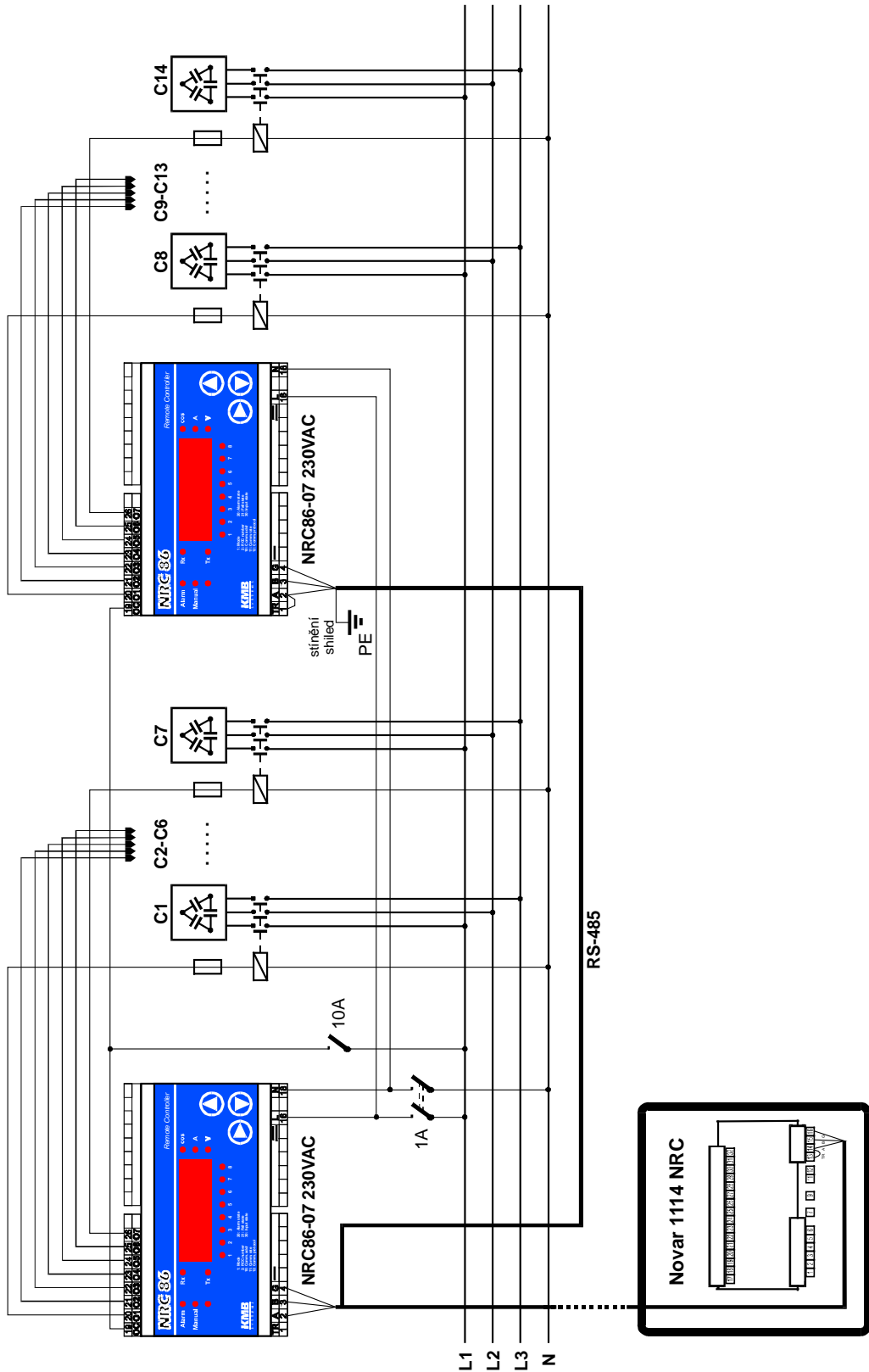
After reconnecting the communication link or setting back the correct parameter value, normal function of the whole systems should restore.

## 5. Connection Examples

### Remote Controlled Target PF Compensation System with NRC86 Remote Controller



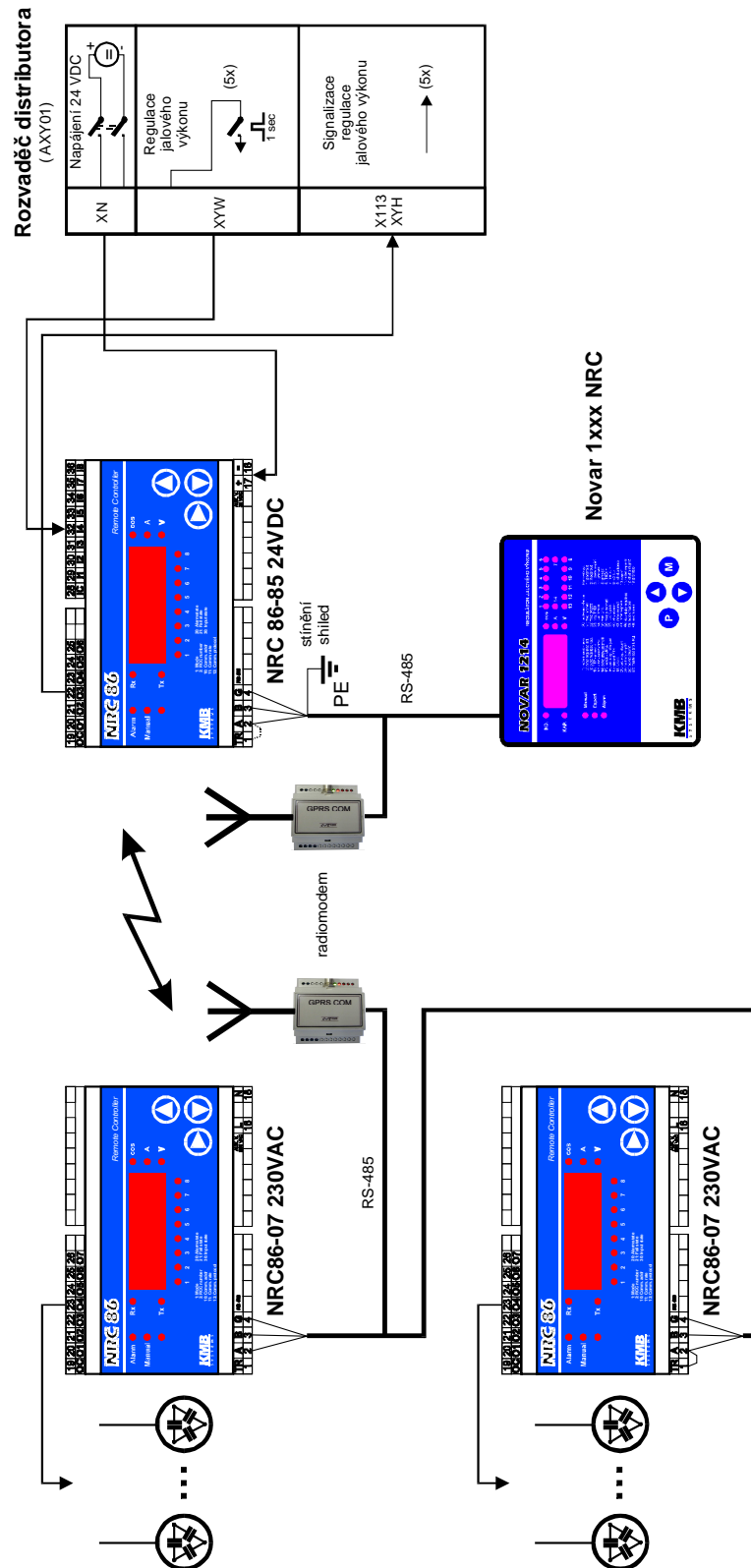
# Remote Controlled Outputs Compensation System with Two NRC86 Remote Controllers





# Combined Remote Controlled Target PF and Remote Controlled Outputs Compensation System with NRC86 Remote Controllers, Wireless Remote Outputs Connection

Block Diagram



## 6. NRC86 Remote Controller Technical Specifications

parameter	NRC86 Model	
	NRC86-85 24VDC	NRC86-07 230VAC
aux. supply voltage, power	18 ÷ 36 V DC, 4W	80 ÷ 275 V AC, 43 ÷ 67 Hz, 5 VA 100 ÷ 300 V DC, 5 W
number of output relays	5	7
output relay load rating	250 V AC / 4 A 110 V DC / 0.3 A	
number of logic inputs	8	0
logic inputs parameters : - character - maximum voltage - impedance - voltage corresponding to „log. 0“ - voltage corresponding to „log. 1“ - serial number of remote controlled PF switchover signal duration („log. 1“, RCC-mode)	galvanically isolated, polarity free 36 V DC ~ 5 kΩ < 4 V DC > 8 V DC > 100 ms	
communication interface - type - transmission rate - protocol - bias voltage impedance - terminating resistor (TR)	RS-485, galvanically isolated 4.8 ÷ 19.2 kBaud KMB / Modbus RTU 2 x 4.7 kΩ 330 Ω	
working environment	class C1 in compliance with IEC 654-1	
operating temperature	-40° ÷ +60°C	
relative humidity	5 to 100 %	
installation overvoltage class / level of pollution	III-2 in compliance with EN 61010-1	
EMC : - noise suppression level - immunity	EN 50081-2; EN 55011, class A; EN 55022, class A; EN 61000-6-2	
enclosure	IP 20	
dimensions	106 x 100 x 58 mm	
mass	max. 0.3 kg	

## 7. MAINTENANCE, TROUBLESHOOTING

NRC86 remote controller does not require any maintenance. For reliable operation you only have to comply with the operating conditions specified and prevent mechanical damage to the instrument.

In the event of the product's breakdown, you have to return it to the supplier at their address.

supplier:

manufacturer:

KMB systems, s.r.o.

559 Dr. M. Horákové

460 06, Liberec 7

Czech Republic

website: [www.kmbsystems.eu](http://www.kmbsystems.eu)

The product must be packed properly to prevent damage in transit. Description of the problem or its symptoms must be sent along with the product. If warranty repair is claimed, the warranty certificate must be sent in too. If after-warranty repair is requested, a written order must be included.

### Warranty Certificate

Warranty period of 24 months from the date of purchase, however no later than within 30 months from the dispatch date from manufacturer's warehouse, is provided for the instrument. Problems in the warranty period, evidently caused by poor workmanship, design or inconvenient material, will be repaired free of charge by the manufacturer or an authorized servicing organization.

The warranty becomes void even within the warranty period if the user makes unauthorized modifications or changes to the instrument, connects it to out-of-range quantities if the instrument is damaged in out-of-specs impacts or from improper handling or if it has been operated in conflict with the technical specifications.

type of product: **NRC 86** .....

serial number .....

date of dispatch: .....

final quality inspection: .....

manufacturer's seal:

date of purchase: .....

supplier's seal: