



## NPR - Capacitor bank protection relay

The capacitor bank protection relay (NPR) is used for supervision of 3-phase capacitor stages in reactive power compensation systems. It is able to recognize different situations which could be hazardous for the capacitors:

- overload by over-current
- over-voltage
- unsymmetrical load in double-star connection
- overload by harmonics

### Connection

The device needs the following connections:

- AC voltage 115V / 230V or DC voltage 110V / 48V / 24V for internal power supply (depends on ordered type)
- Voltage measurement L1, L2, L3, (N). If neutral N is not connected, it will be artificially generated in the NPR from the voltages L1/L2/L3.
- Current measurement via current measurement transformers. The NPR can be ordered with either 5A or 1A current inputs for use with xxxA/5A or xxxA/1A current transformers. A maximum of 4 current channels is available.

### optional connections:

The NPR can be equipped with output relays in different combinations from the following list:

- 2 volt free change over contacts
- 4 volt free closing contacts
- or 6 closing contacts with common root contact

### Measurement functions

The NPR measurement system acquires amplitudes and waveforms of the currents and voltages which are connected to the measurement inputs. The signal processor calculates different values from that information:

- **T:** ambient temperature
- **ULN:** TRMS voltages L1-N, L2-N, L3-N
- **ULL:** TRMS voltages L1-L2, L2-L3, L3-L1
- **I:** TRMS currents 1-4
- **If:** RMS values for fundamental waves of the currents (without harmonics!)
- harmonics (order 2-63) for currents and voltages
- **THD:** THD - factors for voltages L-N and all 4 currents
- **Ith:** exponentially damped current values to simulate thermal measurement

### Other functions

- 6 relay outputs for alarms with programmable inversion and hold-function
- 32 individually programmable alarms with delay timers

### Alarm system

The NPR allows the programming of the output relays to produce alarms. The alarm system works with two separate facilities:

- The output relays can be programmed separately. Each relay implements an inversion feature as well as a hold state in which the user must manually reset the relay after the activating alarm has become inactive again. The relays receive signals to "activate themselves" from one or more of the 32 configurable alarms. Depending on its inversion setting, the relay closes or opens on activation.
- A maximum of 32 alarms can be assigned. Each of them continuously compares a value to an assigned limit. If a selectable alarm

condition is true (value>limit or value<limit), a delay timer is started. After the selected delay time is over, the alarm sends the activation signals to all output relays, which are programmed as "targets" for this alarm. A second, configurable timeout delay can be set for the time between the reset of the alarm condition and the transmission of the deactivation signals to the output relays. A graphical display message can be used to show the alarms in the LCD of the device. The alarm display message is treated as if it was another output relay (so it can simply be selected as target for an alarm). This display message saves the causing minimum or maximum value and it has to be quitted.

The high flexibility of this alarm system is achieved due to the following points:

1. One alarm can cause the activation of one or more output relays.
2. One relay can be activated from more than one alarm. If two or more alarms use the same relay as output, a logical OR condition is used: one active alarm suffices to cause the relay to switch.
3. Both, relays and alarms, are invertible in their function.

### Usage

The device provides 4 keys to the user to accept any inputs. The keys are numbered key 1... key 4 from left to right. The actual function of a certain key changes due to the actual context. The keys function is indicated by small pictograms in the bottom line of the display.

After turning the supply power on, a welcome message will be displayed after some seconds.

The keys, which are labelled with capital letters „M“ can be used to switch to the main menu.

### Main menu

In the main menu, one can choose between the following possibilities:

- measurement = display measured values
- auto-roll = display measured values with automatic value rotation
- harmonics = display harmonics
- setup = device setup sub-menu
- device info = display device information
- reset min/max = reset of minimum/maximum values

Use the keys „↑“ and „↓“ to place the desired entry next to the tiny arrow („>“) on the left side. Press the „→“ - key to activate the selected entry.

### “measurement”

This menu holds nearly all the measured values. Each value is displayed together with its name (ULN, Ith,... ) and its origin (L1, L2, L3, sum, N). The units, together with appropriate unit-prefixes, are also available. Use keys „↑“ and „↓“ to select from the variety of measured values.

The NPR stores the maxima and minima for each value. The display can be switched to show them instead of the actual value. The right key is labelled "min", "max" or "val", according to the selected value. Press it to change between them.

In the top line, the set of relays (if they are assembled in the device) is shown. A dark number on bright ground represents an inactive relay. Inverse display (bright number on dark ground) indicates an activated relay.

The „M“ - key switches back to the main menu.

### „auto-roll“

This menu contains nearly the same set of values as the „measurement“ menu, but it features an automatic, timer controlled, switch function to the next value.

### “harmonics”

All harmonics are normalized to 100% of the fundamental harmonic. Key “<->” selects the data source (voltages, currents), “↑“ and “↓“ move the display to higher and lower harmonics. The index, which is shown with each harmonic, specifies its order. The fundamental harmonic (index 01) is not shown as it is always 100%.

### „setup“

The „setup“-menu is protected from unauthorised usage by means of a password. The password is fixed („2402“). Because of the huge amount of setup possibilities, a set of submenus is used.

At certain points the user will be confronted with the need to enter numeric values. The NPR will prompt with the old or a default value. One digit of this value will be marked with a “-“ below it. Now this digit can be changed with the „+“ and „-“ keys. „→“ will switch to the next digit which can then be altered as described. After you have reached the last digit, press the right button once more and the new value will be used by the device.

### „setup→parameter“

System parameters:

- „vt ratio“ - ratio of a VT
- „ct-1123 ratio“ - ratio of CT for L1, L2 L3
- „ct-l4 ratio“ - ratio of a CT for current 4
- „thermic tau“ - time constant for calculation of Pth and Ith
- „display contrast“ - display contrast setting

### „setup→relay“

Setup for the relays:

- „normally open ↔ normally closed“ - this selects the relay inversion. If one chooses „normally open“, the relay will be open in inactive state and it will close on activation. „normally closed“ inverts this behaviour.
- „automatic reset ↔ manual reset“ - If a relay is set to “manual reset”, it will stay activated once it has been triggered by an alarm, even if the alarm is inactive again (hold state). If “automatic reset” is used, the relay will fall back to inactive state automatically once the activating alarms have become inactive again.

### „setup→alarm“

This menu contains different settings:

- SOURCE : this selects the data source
- TRIGGER : trigger condition:
- LIMIT : selection of the limit value
- T-ON : turn-on delay time
- T-OFF : turn-off delay time
- OUTPUT : selection of the relays, which shall be activated if alarm condition is true and after T-ON is over. The alarm display feature can be selected here, too, as if it was another relay output.

### „setup→load defaults“

This resets all relay settings, parameters and alarm settings to standard values.

### „setup→reset relays“

This resets all relays, which are configured with the “manual reset” setting. By selection of this menu entry, the relays are set back to inactive state. A new alarm will re-activate the hold state for the relay.

### „device info“

This menu shows information about the device :

- SW = software version
- HW = hardware revision number
- SN = serial number of the device

- FLAGS = options of the device

The „M“ - key will switch back to the main menu.

### „reset min/max“

This resets the minimum and maximum values.

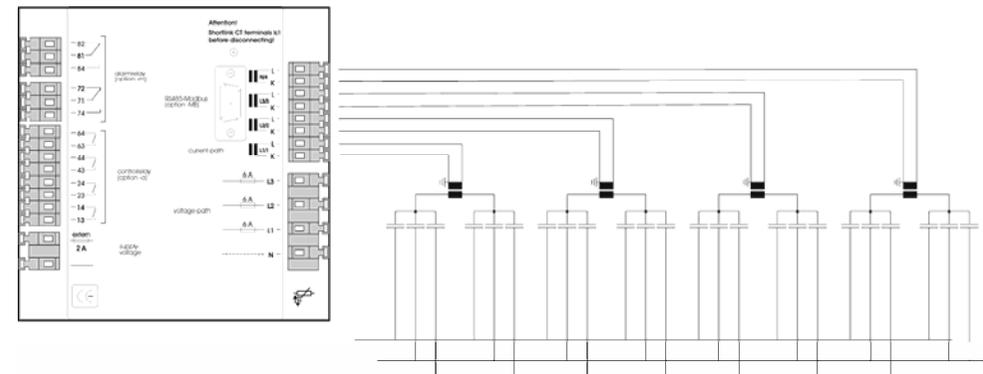
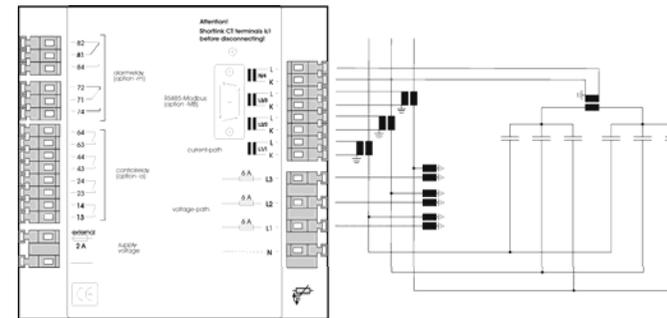
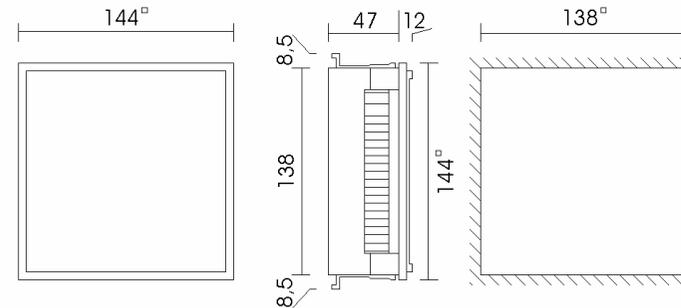
## Important :

The NPR needs a certain minimum voltage at input L1-N for synchronisation. If the voltage is too small, the data acquisition system will assume 50Hz and continue data acquisition with this value.

If, after turning on the device supply, no display contents are visible after some seconds, a wrong display contrast setting may be the cause. In this situation, it would be very difficult to find the correct menu for the display contrast settings because of the missing display content. So, a second possibility to adjust the contrast is included in the welcome screen of the device (after power is turned on) by pressing keys 2 (brighter) or 3 (darker) repeatedly.

Due to security reasons, the device may only be used in conjunction with current measurement transformers. Never connect the current measurement terminals directly to any wire which is running on high voltage for direct measurement of the current !

If the used current transformers are grounded, you have to ensure that they all have exactly got the same potential. Otherwise this can cause failures in the measurement!



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