



NA11

FEEDER PROTECTION RELAY

THE BASIC SOLUTION FOR FEEDERS AND TRANSFORMERS
PROTECTION WITH AUTOMATIC RECLOSURE

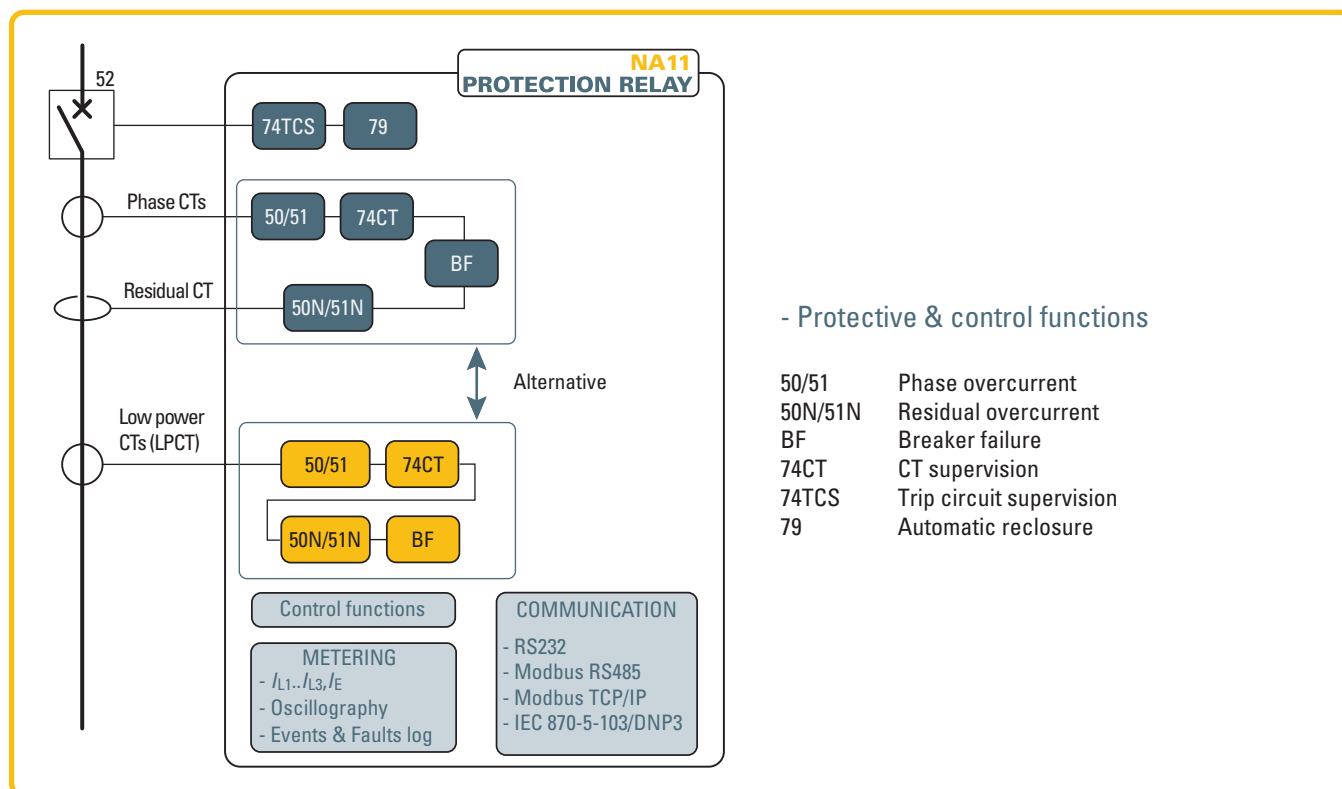
— Application

The relay type NA11 can be used in radial networks as feeder or power transformer protection.

In solidly grounded systems the residual overcurrent protection can be used on feeders of any length, while in ungrounded or Petersen coil and/or resistance grounded systems, the residual overcurrent protection can be used on feeders of small length in order to avoid unwanted trippings due to the capacitive current contribution of the feeder on external ground fault.

Beside to the phase and residual overcurrent protections, the automatic reclosing function is provided.

The NA11 protection relay may be shipped with traditional CTs or low power (LPCT) current inputs.



— Measuring inputs

- Three phase current inputs and one residual current input, with nominal currents independently selectable at 1 A or 5 A through DIP-switches for CTs interface
- Three phase current inputs for low power current sensors (LPCT); the residual current is calculated from the vectorial sum of the three phase currents. This new sensors have reduced cost, reduced weight, reduced wiring cost and best transient performances compared with traditional CTs. Moreover, external shorting devices are not required and safety is highly-improved.

— Firmware updating

The use of flash memory units allows on-site firmware updating.

— Two set point profiles (A,B)

Two independent groups of settings are provided. Switching from profiles may be operated by means of MMI, binary input and communication.

— Construction

According to the hardware configurations, the NA11 protection relay can be shipped in various case styles depending on the required mounting options (flush, projecting mounting, rack or with separate operator panel).

— Binary inputs

Two or five binary inputs are available with programmable active state (active-ON/active-OFF) and programmable timer (active to OFF/ON or ON/OFF transitions).

Several presettable functions can be associated to each input.

— Modular design

In order to extend I/O capability, the NA11 hardware can be customized through external auxiliary modules:

- MRI - Output relays and LEDs
- MID16 - Binary inputs
- MCI - 4...20 mA converters
- MPT - Pt100 probe inputs.



— Blocking input/outputs

One output blocking circuit and one input blocking circuit are provided.

The output blocking circuits of one or several Pro_N relays, shunted together, must be connected to the input blocking circuit of the protection relay, which is installed upwards in the electric plant. The output circuit works as a simple contact, whose condition is detected by the input circuit of the upwards protection relay.

— Output relays

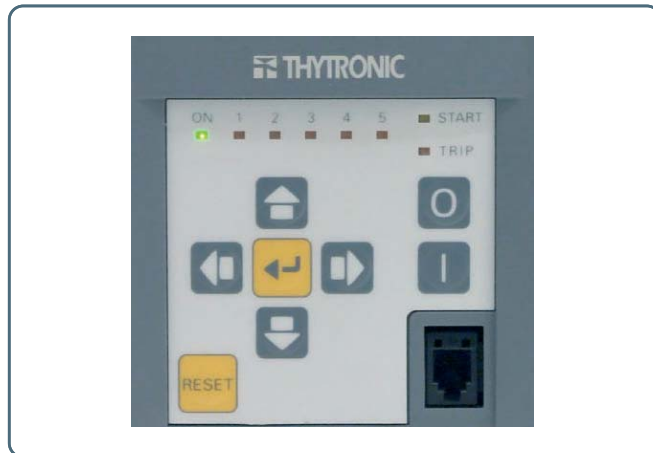
Six output relays are available (two changeover, three make and one break contacts); each relay may be individually programmed as normal state (normally energized, de-energized or pulse) and reset mode (manual or automatic).

A programmable timer is provided for each relay (minimum pulse width). The user may program the function of each relay in accordance with a matrix (tripping matrix) structure.

— MMI (Man Machine Interface)

The user interface comprises a membrane keyboard, a backlight LCD alphanumeric display and eight LEDs.

The green ON LED indicates auxiliary power supply and self diagnostics, two LEDs are dedicated to the Start and Trip (yellow for Start, red for Trip) and five red LEDs are user assignable.



— Communication

Multiple communication interfaces are implemented:

- One RS232 local communication front-end interface for communication with ThySetter setup software
- Two back-end interfaces for communication with remote monitoring and control systems by:
 - RS485 port using ModBus® RTU, IEC 60870-5-103 or DNP3 protocol,
 - Ethernet port (RJ45 or optical fiber) with ModBus/TCP protocol.

— Programming and settings

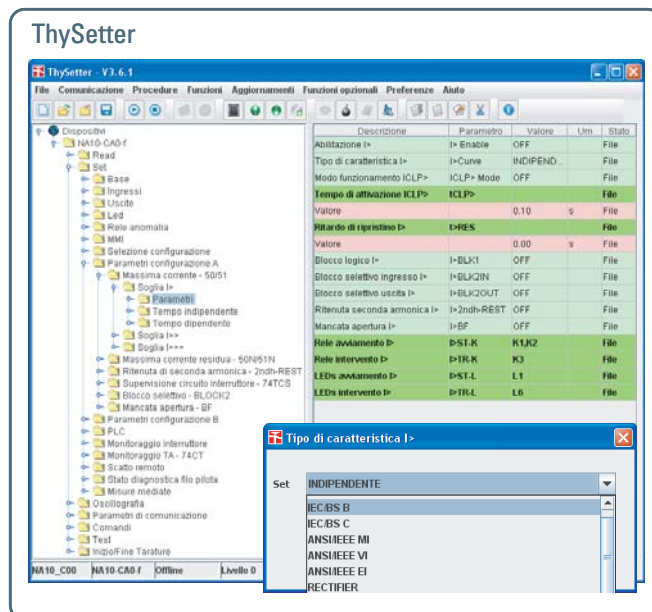
All relay programming and adjustment operations may be performed through MMI (Keyboard and display) or using a Personal Computer with the aid of the ThySetter software.

The same PC setup software is required to set, monitor and configure all Pro_N devices.

Full access to the available data is provided:

- Read status and measures.
- Read/edit settings (on-line or off-line edit).

Two session level (User or Administrator) with password for sensible data access are provided.



— Control and monitoring

Several predefined functions are implemented:

- Activation of two set point profiles
- Phase CTs monitoring (74CT)
- Logic selectivity
- Cold load pickup (CLP) with block or setting change
- Trip circuit supervision (74TCS)
- Second harmonic restraint (inrush)
- Remote tripping
- Synchronization
- Circuit Breaker commands and diagnostic
- Automatic reclosing

Moreover user defined logic must be customized in accordance with IEC 61131-3 protocol by means programmable logic controller (PLC).

Circuit Breaker

Several diagnostic, monitoring and control functions are provided:

- Health thresholds can be set; when the accumulated duty (ΣI or $\Sigma I^2 t$), the number of operations or the opening time exceeds the threshold an alarm is activated
- Breaker failure (BF); breaker status is monitored by means 52a-52b and/or through line current measurements
- Trip circuit supervision (74TCS)
- Breaker control; opening and closing commands can be carried out locally or remotely

Second harmonic restraint

To prevent unwanted tripping of the protective functions on transformer inrush current, the protective elements can be blocked when the ratio between the second harmonic current and the relative fundamental current is larger than a user programmable threshold.

The function can be programmed to switch an output relay so as to cause a blocking protection relays lacking in second harmonic restraint.

Logic selectivity

With the aim of providing a fast selective protection system some protective functions may be blocked (pilot wire accelerated logic). To guarantee maximum fail-safety, the relay performs a run time monitoring for pilot wire continuity and pilot wire shorting. Exactly the output blocking circuit periodically produces a pulse, having a small enough width in order to be ignored as an effective blocking signal by the input blocking circuit of the upstream protection, but suitable to prove the continuity of the pilot wire.

Furthermore a permanent activation (or better, with a duration longer than a preset time) of the blocking signal is identified, as a warning for a possible short circuit in the pilot wire or in the output circuit of the downstream protection.

Automatic reclosing

The automatic reclosure function is well-used on overhead lines (when faults are self-extinguish after tripping of protection relays).

The following sequences may be selected:

- Rapid reclosure,
- Rapid reclosure followed by one slow reclosure,
- Rapid reclosure followed by one slow reclosure and one or more delayed reclosures (1...5).

Starting of the automatic reclosing function can be raised by internal protective elements or externally by means binary input signals (eg: external protection device contacts or operating switches).

The following logics may be set (binary inputs allocation):

- 52a - 52b (Circuit breaker state); the CB position is indispensable for the auto reclosure function.
- Blocking; exclusion command (pulse),
- Enabling; activation command (pulse).
- The following output functions may be coupled to the output relays:
- CB reclosing command;
- Reclosure fail.
- Cycle in progress.

Cold Load Pickup (CLP)

Cold load pickup element prevents unwanted tripping in case of temporary overcurrents produced when a feeder is being connected after an extended outage (e.g. motor starting).

Two different operating modes are provided:

- Each protective element can be blocked for a programmable time
- Each threshold can be increased for a programmable time.

— Self diagnostics

All hardware and software functions are repeatedly checked and any anomalies reported via display messages, communication interfaces, LEDs and output relays.

Anomalies may refer to:

- Hw faults (auxiliary power supply, output relay coil interruptions, MMI board...)
- Sw faults (boot and run time tests for data base, EEPROM memory checksum failure, data BUS,...)
- Pilot wire faults (break or short in the wire)
- Circuit breaker faults.

— Metering

NA11 provides metering values for phase and residual currents, making them available for reading on a display or to communication interfaces.

Input signals are sampled 24 times per period and the RMS value of the fundamental component is measured using the DFT (Discrete Fourier Transform) algorithm and digital filtering.

With DFT the RMS value of 2nd, 3rd, 4th and 5th harmonic of phase current are also measured.

On the base of the direct measurements, the minimum-peak-fixed-rolling demand, mean-minimum-maximum absolute phase currents are processed.

The measured signals can be displayed with reference to nominal values or directly expressed in amperes.

— Event storage

Several useful data are stored for diagnostic purpose; the events are stored into a non volatile memory.

They are graded from the newest to the older after the "Events reading" command (ThySetter) is issued:

- Sequence of Event Recorder (SER)
The event recorder runs continuously capturing in circular mode the last three hundred events upon trigger of binary input/output.
- Sequence of Fault Recorder (SFR)
The event recorder runs continuously capturing in circular mode the last twenty events upon trigger of binary input/output and/or element pickup (start-trip).
- Trip counters

— Digital Fault Recorder (Oscillography)

Upon trigger of tripping/starting of each function or external signals, the relay records in COMTRADE format:

- Oscillography with instantaneous values for transient analysis.
- RMS values for long time periods analysis.
- Logic states (binary inputs and output relays).

Note - A license for Digital Fault Recorder function is required, the records are stored in nonvolatile memory

