RET316*4

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Numerical Transformer Protection

Operating Instructions

6th Edition

Applies for software version V6.3

This document has been carefully prepared and reviewed. Should in spite of this the reader find an error, he is requested to inform us at his earliest convenience.

The data contained herein purport solely to describe the product and are not a warranty of performance or characteristic. It is with the best interest of our customers in mind that we constantly strive to improve our products and keep them abreast of advances in technology. This may, however, lead to discrepancies between a product and its “Technical Description” or “Operating Instructions”.

How to use these Operating Instructions RET316*4 V6.3

What do you wish to know about the device ...	What precisely?	Look in the following Indices (I) / Sections (S):
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1. INTRODUCTION

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1.1. General

The digital transformer protection scheme RET 316*4 is one of the new generation of fully digital protection systems, i.e. the analogue-to-digital conversion of the measured input variables takes place immediately after the input transformers and the resulting digital signals are processed exclusively by programmed micro-processors.

Within the PYRAMID system for integrated control and protection, RET 316*4 serves as a compact transformer protection unit.

Because of its compact design, the use of only a few different hardware units, modular software and continuous self-diagnosis and monitoring functions, the MODURES RET 316*4 scheme optimally fulfils all the demands and expectations of a modern protection scheme with respect to efficient plant management and technical functionality.

AVAILABILITY, i.e. the ratio between mean fault-free operating time and total operational life, is certainly the most important requirement a protection device has to fulfil. As a result of continuous monitoring, this ratio in the case of RET 316*4 is almost unity.

The menu-controlled MMI (man/machine communication) program and the compact construction enable simple operation and connection of the control unit. Absolute FLEXIBILITY, i.e. adaptability to practical applications, already existing control concepts or a control concept to be replaced (retro-fitting), is assured in the case of RET 316*4 by ancillary functions incorporated in the software and by the ability to freely configure inputs and outputs via the MMI.

Broad experience in the field of transformer protection has gone into the development of the RET 316*4 to give it the highest possible degree of RELIABILITY DISCRIMINATION and STABILITY. Digital processing of all the signals means that the ACCURACY and SENSITIVITY of the scheme remain constant throughout its useful life.

The designation “RE. 316*4” is used in the following sections where data applies to the series of devices in general.

1.2. Application

The digital transformer protection RET 316*4 is designed for fast selective protection of two and three-winding power transformers.

It can also be applied to the protection of auto-transformers and generator/transformer units.

The unit detects the following faults on power transformers:

- all phase faults
- earth faults where the power transformer star-point is solidly or low-impedance grounded
- inter-turn faults.

The RET 316*4 places only low requirements on main c.t. performance.

1.3. Main features

RET 316*4 can be supplied with a desired combination of the following protection functions. The functions are selected from the RE. 216/RE. 316*4 library of function modules:

- The transformer differential protection function (Diff-Transf) is one of the most important and provides fast selective protection of all transformers with ratings above a few MVA.
- The thermal overload function (Overtemp) protects the insulation against damage due to excessively high temperatures. It is normally equipped with two independently set operating stages and is used especially where oil temperature monitors are not installed.
- definite time over and undercurrent protection (Current-DT)
  - provision for inrush restraint
- peak value overcurrent protection (Current-Inst)
- inverse time-overcurrent protection (Current-Inv)
- directional definite time overcurrent protection (DirCurrentDT)
- directional inverse time overcurrent protection (DirCurrentInv)
- inverse definite minimum time overcurrent function (I0-Invers)

- definite time over and undervoltage protection (Voltage-DT)
- peak value overvoltage protection (Voltage-Inst)
- power function (Power)
- frequency function (Frequency)
- rate-of-change frequency protection (df/dt)
- definite time overfluxing (Overexcitat)
- inverse time overexcitation (U/F-Inv)
- distance protection (Distance) as backup protection for the power transformer and neighbouring lines
- breaker failure protection (BreakerFailure)
- supplementary logic functions such as
    - supplementary user logic programmed with the aid of CAP316 (function plan programming language FUPLA). This requires systems engineering.
    - logic
    - delay
    - counter (Count)
    - contact bounce filter.

The following measurement and monitoring functions are also provided:

- single-phase measuring function UIfPQ
- three-phase measurement module
- three-phase current plausibility
- three-phase voltage plausibility
- disturbance recorder.

The scheme includes an event memory.

The allocation of the opto-coupler inputs, the LED signals and the auxiliary relay signal outputs, the setting of the various parameters, the configuration of the scheme and the display of the events and system variables are all performed interactively by means of the MMI.

RET 316*4 is equipped with serial interfaces for the connection of a local MMI (PC) and for remote communication with the station control system.

RET 316*4 is also equipped with continuous self-monitoring and self-diagnostic functions. Suitable testing devices (e.g. test set XS92b) are available for quantitative testing.

RET 316*4 can be semi-flush or surface mounted or can be installed in an equipment rack.

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2. DESCRIPTION OF HARDWARE

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2.1. Summary

The hardware of the digital protection scheme RE. 316*4 comprises 4 to 8 plug-in units, a connection unit and the casing:

- Input transformer unit Type 316GW61
- A/D converter unit Type 316EA62
  or Type 316EA63
- Main processor unit Type 316VC61a
  or Type 316VC61b
- 1 up to 4 binary I/O units Type 316DB61
  or Type 316DB62
  or Type 316DB63
- Auxiliary supply unit Type 316NG65
- Connection unit Type 316ML61a
  or Type 316ML62a
- Casing and terminals for analogue signals and connectors for binary signals.

The A/D converter Type 316EA62 or 316EA63 is only used in conjunction with the longitudinal differential protection and includes the optical modems for transferring the measurements to the remote station.

Binary process signals are detected by the binary I/O unit and transferred to the main processor which processes them in relation to the control and protection functions for the specific project and then activates the output relays and LED's accordingly.

The analogue input variables are electrically insulated from the electronic circuits by the screened windings of the transformers in the input transformer unit. The transformers also reduce the signals to a suitable level for processing by the electronic circuits. The input transformer unit provides accommodation for nine transformers.

Essentially the main processor unit 316VC61a or 316VC61b comprises the main processor (80486-based), the A/D converter unit, the communication interface control system and 2 PCMCIA slots.

Binary process signals, signals pre-processed by the control logic, events, analogue variables, disturbance recorder files and device control settings can be transferred via the communication interface to the station control room. In the reverse direction, signals to the control logic and for switching sets of parameter settings are transferred by the station control system to the protection.

RE. 316*4 can be equipped with one up to four binary I/O units.

There are two tripping relays on the units 316DB61 and 316DB62, each with two contacts and according to version either:

8 opto-coupler inputs and 6 signalling relays
or 4 opto-coupler inputs and 10 signalling relays.

The I/O unit 316DB63 is equipped with 14 opto-coupler inputs and 8 signalling relays.

The 16 LED’s on the front are controlled by the 316DB6. units located in slots 1 and 2.

2.2. Mechanical design

2.2.1. Hardware versions

RE. 316*4 is available in a number of different versions which are listed in the data sheet under "Ordering information".

2.2.2. Construction

The RE. 316*4 is 6 U standard units high (U = 44.45 mm) and either 225 mm (Order code N1) or 271 mm wide (Order code N2). The various units are inserted into the casing from the rear (see Fig. 12.3) and then screwed to the cover plate.

2.2.3. Casing and methods of mounting

The casing is suitable for three methods of mounting.

Semi-flush mounting

The casing can be mounted semi-flush in a switch panel with the aid of four fixing brackets. The dimensions of the panel cut-out can be seen from the data sheet. The terminals are located at the rear.

Installation in a 19" rack

A mounting plate with all the appropriate cut-outs is available for fitting the protection into a 19" rack (see Data Sheet). The terminals are located at the rear.

Surface mounting

A hinged frame (see Data Sheet) is available for surface mounting. The terminals are located at the rear.

2.2.4. Front of the protection unit

A front view of the protection and the functions of the frontplate elements can be seen from Fig. 12.2.

A reset button is located behind the frontplate which serves three purposes:

- resetting the tripping relays and where the are configured to latch, also the signalling relays and LED's and deleting the distance protection display when running the control program

- resetting of error messages resulting from defects detected by the self-monitoring or diagnostic functions (short press)
- resetting the entire protection (warm start, press for at least ten seconds) following the detection of a serious defect by the self-monitoring or diagnostic functions.

These control operations can also be executed using the local control unit on the front of the device. Should the latter fail, the reset button can be pressed using a suitable implement through the hole in the frontplate.

2.2.5. PC connection

In order to set the various parameters, read events and measurements of system voltages and currents and also for diagnostic and maintenance purposes, a personal computer (PC) must be connected to the optical serial interface (Fig. 12.2).

2.2.6. Test facilities

A RE. 316*4 protection can be tested using a test set Type XS92b.

2.3. Auxiliary supply unit

The auxiliary supply unit 316NG65 derives all the supply voltages the protection requires from the station battery. Capacitors are provided which are capable of bridging short interruptions (max. 50 ms) of the input voltage. The auxiliary supply unit is protected against changes of polarity.

In the event of loss of auxiliary supply, the auxiliary supply unit also generates all the control signals such as re-initialisation and blocking signals needed by all the other units.

The technical data of the auxiliary supply unit are to be found in the data sheet.

2.4. Input transformer unit

The input transformer unit 316GW61 serves as input interface between the analogue primary system variables such as currents and voltages and the protection. The mounting plate of the unit can accommodate up to nine c.t's and v.t's. The shunts across the secondaries of the c.t's are also mounted in the input transformer unit.

The input transformers provide DC isolation between the primary system and the electronic circuits and also reduce (in the case of the c.t's, with the aid of a shunt) the voltage and current signals to a suitable level for processing by the A/D converters. Thus the input transformer unit produces voltage signals at its outputs for both current and voltage channels.

The c.t's and v.t's actually fitted in the input transformer unit vary according to version. Further information can be obtained from the data sheet.

2.5. Main processor unit

The main processor runs the control and protection algorithms as determined by the particular settings. It receives its data from the A/D converter unit and the I/O unit. The results computed by the algorithms are transferred either directly or after further logical processing to the binary I/O unit.

A 80486-based microprocessor is used in the main processor unit 316VC61a or 316VC61b. The samples taken by the A/D converter are pre-processed by a digital signal processor (DSP). The interfaces for connecting an MMI PC and for communication with the station control system (SPA, IEC60870-5-103) are included. A PCMCIA interface with two slots facilitates connection to other bus systems such as LON and MVB. The flash EPROM's used as program memory enable the software to be downloaded from the PC via the port on the front.

A self-monitoring routine runs in the background on the main processor. The main processor itself (respectively the correct operation of the program) is monitored by a watchdog.

2.6. Binary I/O unit

The binary I/O unit 316DB6. enables binary signals received via opto-couplers from station plant to be read and tripping and other signals to be issued externally.

All the input and output units provide electrical insulation between the external signalling circuits and the internal electronic circuits.

The I/O units in slots 1 and 2 also control the statuses of 8 LED's each on the frontplate via a corresponding buffer memory.

The numbers of inputs and outputs required for the particular version are achieved by fitting from one to four binary I/O units. The relationship between the versions and the number of I/O units is given in the data sheet.

The opto-coupler inputs are adapted to suit the available input voltage range by choice of resistor soldered to soldering posts. This work is normally carried at the works as specified in the order.

The technical data of the opto-coupler inputs and the tripping and signalling outputs can be seen from the data sheet.

2.7. Interconnection unit

The wiring between the various units is established by the interconnecting unit 316ML62a (width 271 mm) or 316ML61a (width 225 mm). It is located inside the housing behind the frontplate and carries the connectors and wiring needed by the individual units.

In addition, the interconnection unit includes the connections to the local control unit, the reset button and 16 LED’s for status signals.