MiCOM P63x

Transformer Differential Protection

compact P630C

modular P631, P632, P633, P634

CUSTOMER BENEFITS

- 1A/5A settable via software
- Multiple communication protocols and interfaces, including IEC 61850
- CB Failure protection
- Detachable HMI option

The MiCOM P63x series differential protection devices are intended for the fast and selective short circuit protection of transformers, motors, generators and other installations with two, three or four windings, respectively.

The MiCOM P63x series provides high-speed three system differential protection using a triple-slope characteristic and two high-set differential elements in combination with transformer inrush restraint, overfluxing restraint and through-stabilization. Amplitude and vector group matching is done just by entering the nominal values of transformer windings and associated CTs.

In addition many supplementary protective functions are incorporated in the devices. Protective functions which are available several times are freely assignable to the windings. For ring bus and breaker-and-a-half applications a virtual winding can be defined for which the current measuring inputs are based on the vector sum of currents from two freely selectable windings. P63x provide four setting groups for easy adaptation to varying system operation conditions.

The intuitive user interface as well as the various communication interfaces allow easy and entire device settings and readings from extensive recordings. Numerous integrated communication protocols, including IEC 61850, allow easy interfacing to almost any kind of substation control or SCADA system. Furthermore the integrated protection interface InterMiCOM provides direct end-end communication between two protection devices.

The specially flat compact case of P630C as well as the standard 19'' modular cases of P631, P632, P633 and P634 with variable number of plug-in modules provide a flexible solution for easy integration of the devices into the substation. Both case variants are available for flush mounting and wall-surface mounting and provides the option of detachable HMI.

Schneider Electric

APPLICATION

MiCOM P63x series differential protection devices provide a wide range of protection functions. The device selection depends on the protected object and the required protection scheme:

- P630C: Two-end/winding schemes (two 3 pole CT inputs)
- P631: Two-end/winding schemes (two 3 pole CT inputs)
- P632: Two-end/winding schemes (two 4 pole CT inputs, one VT input)
- P633: Three-end/winding schemes (three 4 pole CT inputs, one VT input)
- P634: Four-end/winding schemes (three 4 pole CT inputs, one 3 pole CT input, one VT input)

The following functions are generally available in all devices:

- Parameter subset selection (4 alternative setting groups)
- Metering
- Operating data recording
- Overload recording incl. overload data acquisition
- Fault recording of all CT/VT inputs and binary events incl. fault measurands

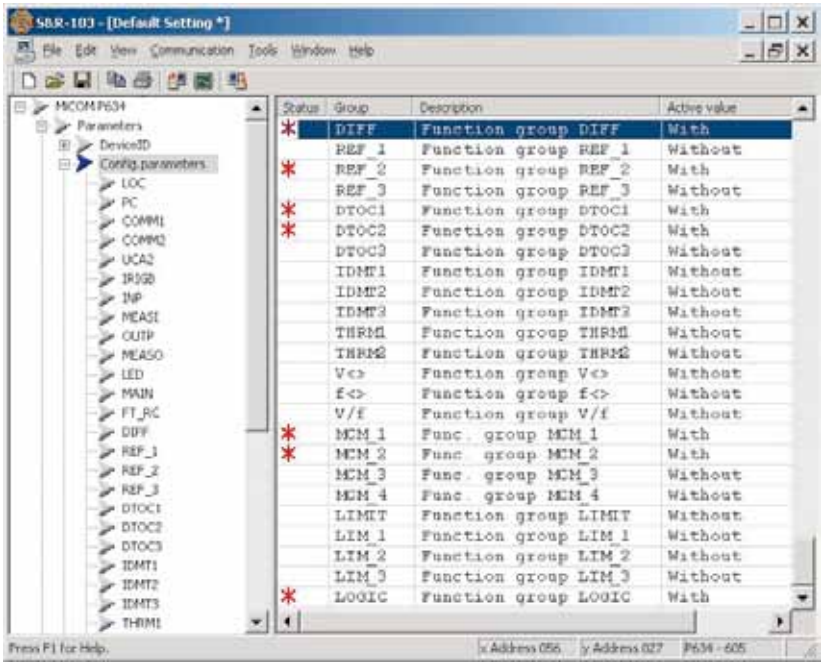
GLOBAL FUNCTIONS

Functions Overview			P630C	P631	P632	P633	P634
87	DIFF	Differential protection	2 wind.	2 wind.	2 wind.	3 wind.	4 wind.
87N	REF_x	Restricted earth fault protection	-	-	2	3	3
50	DTOCx	Definite-time O/C protection	2	2	2	3	3
51	IDMTx	Inverse-time O/C protection	2	2	2	3	3
49	THRMx	Thermal overload protection	1	1	1	2	2
27, 59	V<>	Over/undervoltage protection	-	-	1	1	1
81	f<>	Over/underfrequency protection	-	-	1	1	1
24	V/f	Overexcitation protection	-	-	1	1	1
50BF	CBF_x	Circuit Breaker Failure protection	-	2	2	3	4
	CTS	Current Transformer Supervision	-	1	1	1	1
	MCM_x	Measuring circuit monitoring	2	2	2	3	4
	LIMIT / LIM_x	Limit value monitoring	2	2	2	3	3
	LOGIC	Programmable logic	1	1	1	1	1
		Measuring inputs					
		Phase currents	2 x 3	2 x 3	2 x 3	3 x 3	4 x 3
		Residual current or star-point current	-	-	2	3	3
		Voltage	-	-	1	1	1
	INP / OUTP	Binary inputs and outputs					
		Optical coupler inputs	2	4	4 … 10	4 … 16	4 … 10
		Add. optical coupler inputs	-	-	24	24	24
		Output relays	8	8 … 14	8 … 22	8 … 30	8 … 22
	MEASI/ MEASO	2x 20 mA outputs, 20 mA input, RTD inputs	-	-	1	1	1
	COMM1/2/ IRIG-B	2 rear communication interfaces, IRIG-B	1	1	1	1	1
	COMM3	protection communication interface InterMiCOM	1	-	-	-	-
	IEC	IEC-61850-interface	-	1	1	1	1

MAIN FUNCTIONS

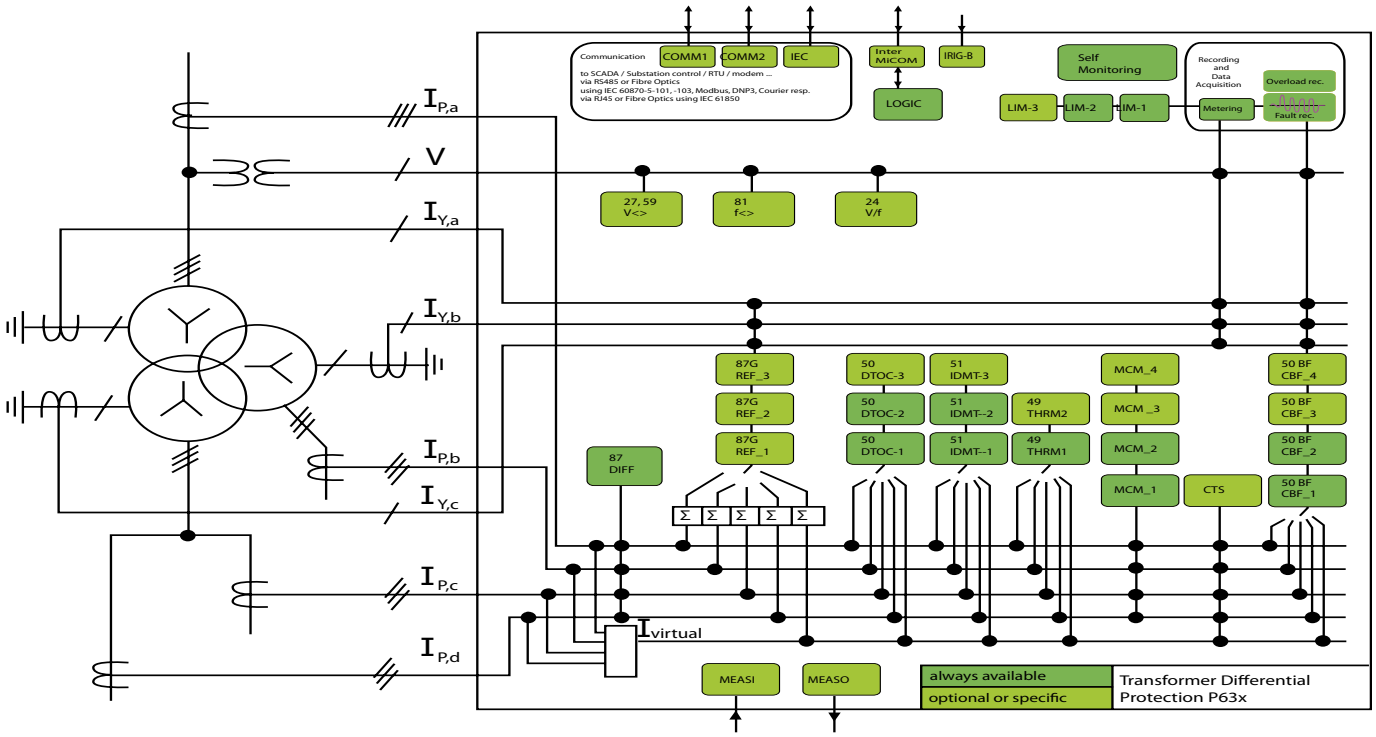
Main functions are autonomous function groups and can be individually configured or disabled to suit a particular application. Function groups that are not required and have been disabled by the user are masked completely (except for the configuration parameter) and functional support is withdrawn from such groups.

This concept permits an extensive scope of functions and universal application of the device in a single design version, while at the same time providing for a clear and straight-forward setting procedure and adaptation to the protection and control task under consideration.



Simple Function Selection by Mouseclick

FUNCTION DIAGRAM



(Description of ANSI code nos. see Function Overview)

MiCOM P63x provides full functionality at your disposal.

DIFFERENTIAL PROTECTION

On the basis of the primary transformer currents, the differential protection devices can be flexibly adapted to the reference currents of the protected object. Amplitude matching is by means of a straight-forward input of the reference power common to all windings plus the nominal voltages and the nominal transformer currents for each winding. The resulting reference currents and matching factors are automatically deduced by the device and checked for compatibility with the internally allowed value ranges.

Matching to the vector group of the protected object is via a straight-forward input of the relevant vector group identification number. The mathematical formula to be applied to the measured values is automatically selected internally according to the relevant vector group.

Zero-sequence filtering may be deactivated separately for each winding in case of an operational grounding within the protected zone

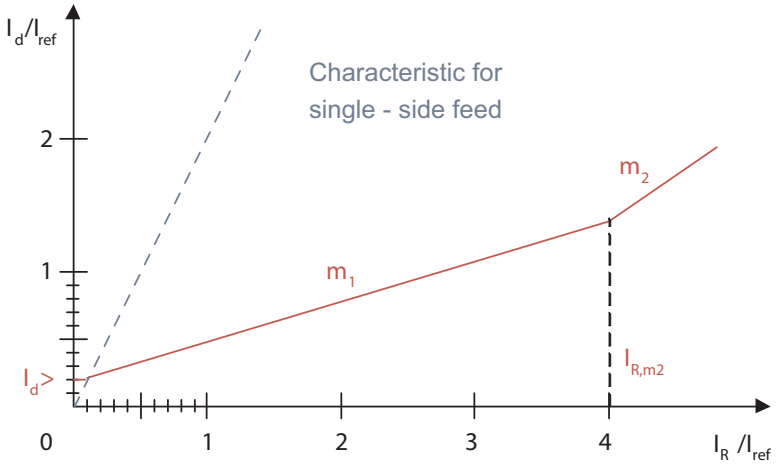
The tripping characteristic of the differential protection device has two knees. The first knee is dependent on the setting of the basic threshold value I_d> and is on the load line for single-side feed. The second knee of the tripping characteristic is defined by a setting. Above the user-selected differential current level I_d>>>, the restraining current is no longer taken into account.

Up to a certain limit, stability in the event of external faults is ensured by means of the bias. Due to the triple-slope tripping characteristic, the stabilization is particularly pronounced for high currents.

However, as an additional safeguard for throughcurrents with transformer saturation, the MiCOM P63x series differential protection devices are provided with a saturation discriminator. Particularly the start-up of directly switched asynchronous motors represents a problem in differential protection due to transient transformer saturation caused by a displacement of the start-up current for relatively high primary time constants. Even under such unfavorable measurement conditions, the MiCOM P63x series differential protection devices perform with excellent stability.

Stabilization under inrush conditions is based on the presence of second harmonic components in the differential currents. The ratio of the second harmonic component to the fundamental wave for the differential current of the measuring systems serves as the criterion. Optionally, tripping is blocked either across all three measuring systems or selectively for one measuring system. However, from a user-selected differential current level I_d>>, the blocking criterion is no longer taken into account. For application as differential protection device for motors or generators, the harmonic restraint can be deactivated.

For stabilization under overfluxing conditions, the ratio of the fifth harmonic to the fundamental wave for the differential current of the measuring systems serves as criterion. Tripping is blocked selectively for each measuring system. For differential current levels of $4 \cdot I_{ref}$ or higher, the blocking criterion is no longer taken into account. The overfluxing restraint function may be deactivated.



Tripping Characteristic of the Differential Protection

RESTRICTED EARTH FAULT PROTECTION

Restricted earth fault protection is based on the principle of comparison of measured variables by comparing residual currents and is applied on transformers in order to detect ground faults on a given winding more sensitively than overall transformer differential protection is able to do. The required through-fault stabilization is provided by two different measuring principles:

- Biased restricted earth fault protection
- High impedance restricted earth fault protection

Compared to the biased restricted earth fault protection high impedance restricted earth fault protection can also be applied to non-grounded objects, especially to delta windings.With biased restricted earth fault protection one of the following operating modes can be chosen:

- Biasing by residual current
- Biasing by maximum phase current

The advantage of ground differential protection resides in the linear dependence of the sensitivity on the distance between the fault and the neutral point.

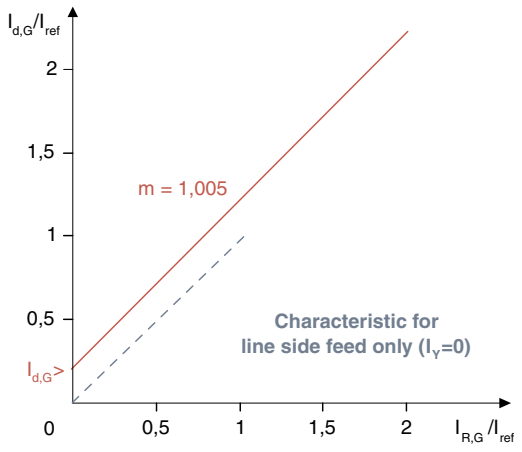
DEFINITE TIME AND INVERSE TIME OVERCURRENT PROTECTION

Both the definite-time and the inverse-time overcurrent protection operate with separate measuring systems for the evaluation of the three phase currents, the negative-sequence current and the residual current.Three stages each are provided for the three measuring systems of the definite-time overcurrent protection. The inverse-time overcurrent protection offers a multitude of tripping characteristics for the individual measuring systems.

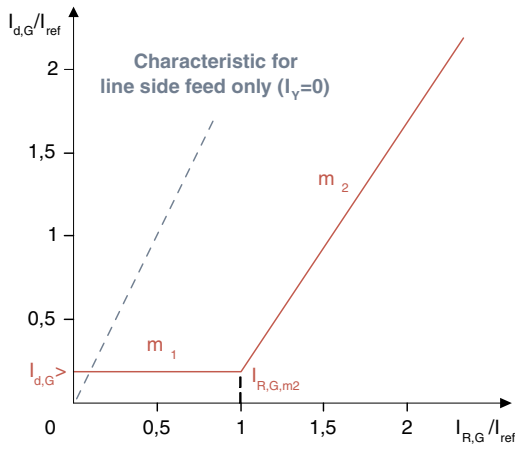
THERMAL OVERLOAD PROTECTION

The highest of the three phase currents serves to track a first-order thermal replica according to IEC 60255-8. The temperature of the cooling medium can be taken into account in the thermal replica using the optional PT-100 input or the 0 to 20 mA input. The user has a choice of using a thermal replica on the basis of either absolute or relative temperature.

A warning signal can be issued in accordance with the set warning level $\Delta\vartheta_{warning}$. As an alternative method of generating a warning, the cyclically updated measured operating value of the predicted time remaining before tripping is monitored to check whether it is falling below a set threshold.



Biasing by Residual Current



Biasing by Maximum Phase Current

Tripping Characteristics of the Restricted Earth Fault Protection

MiCOM P63x offers comprehensive protection for your valuable protective object.

OVER-/UNDERVOLTAGE PROTECTION

The over-/undervoltage protection function evaluates the fundamental component of the voltage by way of two definite-time overvoltage and undervoltage stages each.

OVER-/UNDERFREQUENCY PROTECTION

The four-stage frequency protection can be operated as pure over- and underfrequency monitoring as well as combined with differential frequency gradient monitoring (df/dt) for system decoupling applications or with medium frequency gradient monitoring (Δf/Δt) for load shedding applications.

OVEREXCITATION PROTECTION

Overexcitation protection detects impermissible high magnetic flux densitiy in the iron core of power transformers which can occur in case of increase in voltage and/or decrease in frequency. Flux density above the rated value saturates the iron core which may result in power transformer overheating due to large iron losses.

Overexcitation protection processes the voltage to frequency ratio (V/f) in relation to their nominal values. The inverse time characteristic may be set via 12 value pairs and therefore enables accurate adaptation to power transformer data. In addition a definite-time alarm stage and a definite-time tripping stage are available.

CIRCUIT BREAKER FAILURE PROTECTION

The new Px3x platform Circuit Breaker Failure protection is now also available in modular P63x devices.

Individual protection elements are provided for each end. CB failure operates if the current does not fall below a low set threshold within permitted time. In case of trip conditions with no fault current the CB auxiliary contacts open condition can be monitored additionally. A second (re-)trip command and an upstream CB trip command can be raised.
This CBF provides also trip function in case of downstream CB failure, stub bus protection and pole discrepancy monitoring.

MEASURED DATA INPUT AND OUTPUT

For the acquisition of an externally measured variable or the output of measured data P63x provides optionally one 0 to 20 mA input and two 0 to 20 mA outputs. Settable scaling allows simple adaptation of the input and output ranges resp. (e.g. 0 to 10 mA, 4 to 20 mA). Direct temperature acquisition can be served by the optional PT-100 input.

PROTECTION INTERFACE INTERMiCOM

Optional InterMiCOM allows high performance permissive and blocking type unit protection to be configured, plus transfer of any digital status information between line ends. Intertripping is supported too, with channel health monitoring and cyclic redundancy checks (CRC) on the received data for maximum message security.

InterMiCOM provides eight end-end signal bits, assignable to any function within a MiCOM relay's programmable logic.

Default failsafe states can be set in case of channel outage.

InterMiCOM with Compact Devices

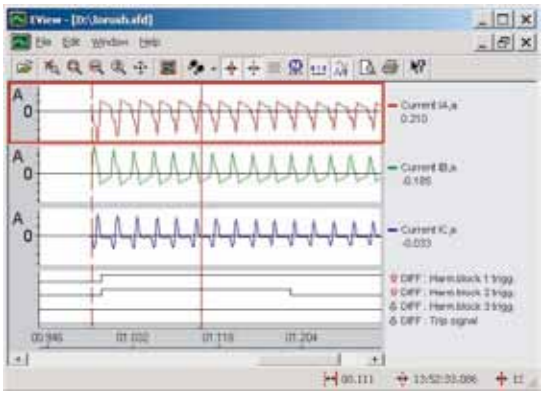
INFORMATION INTERFACES

Information exchange is done via the local control panel, the PC interface and two optional communication interfaces.

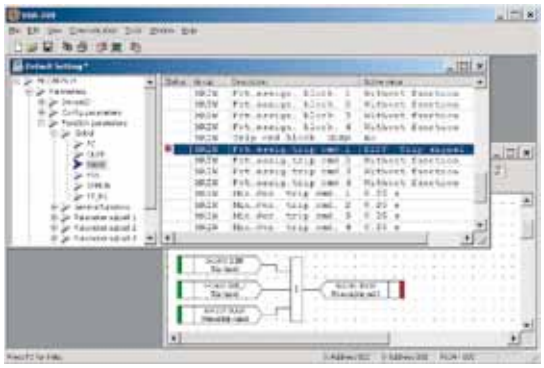
The first communication interface has settable protocols conforming to IEC 60870-5-103, IEC 60870-5-101, DNP 3.0, Modbus and Courier (COMM1) or provides alternatively protocol conforming to IEC 61850 (IEC) and is intended for integration with substation control systems.

The 2nd communication interface (COMM2) conforms to IEC 60870-5-103 and is intended for central settings or remote access.

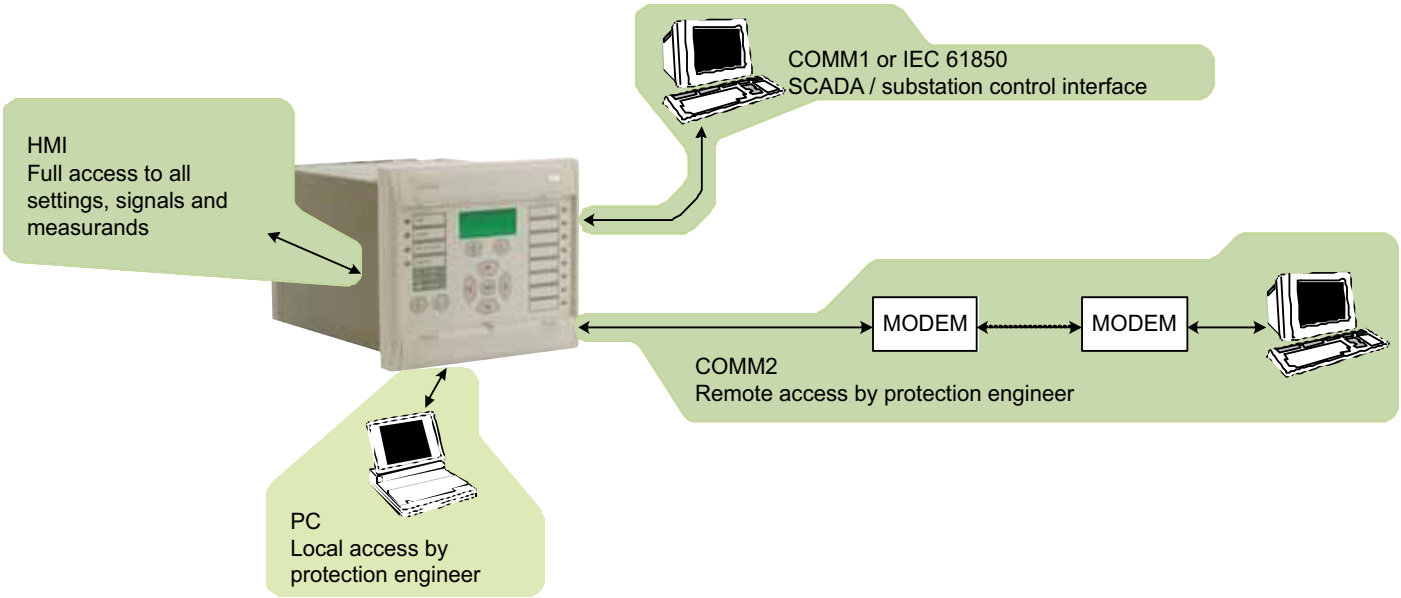
Clock synchronization can be achieved using one of the protocols or using the IRIG-B signal input.



Event Viewer



Just one Setting File



Proven protection with advanced communication and comfortable data handling.

Device Track Record

- PQ 721: First numerical Transformer Differential Protection device, since 1991 more than 2.500 devices
- PQ 731: Compact version of the numerical Transformer Differential Protection device, since 1995 more than 1.200 devices
- Q 7x2: Numerical Transformer Differential Protection devices with extended functionality, launched in 1999, more than 450 devices
- MiCOM P63x: Migration of PQ 7x2 series devices to MiCOM, since 2001 more than 12.000 devices
- 2003: UCA2 protocol implementation in P634
- 2006: IEC 61850 protocol implementation

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