

White paper

PR223EF

Zone selectivity with Early Fault Detection and Prevention technology

PR223EF: Zone selectivity with Early Fault Detection and Prevention technology

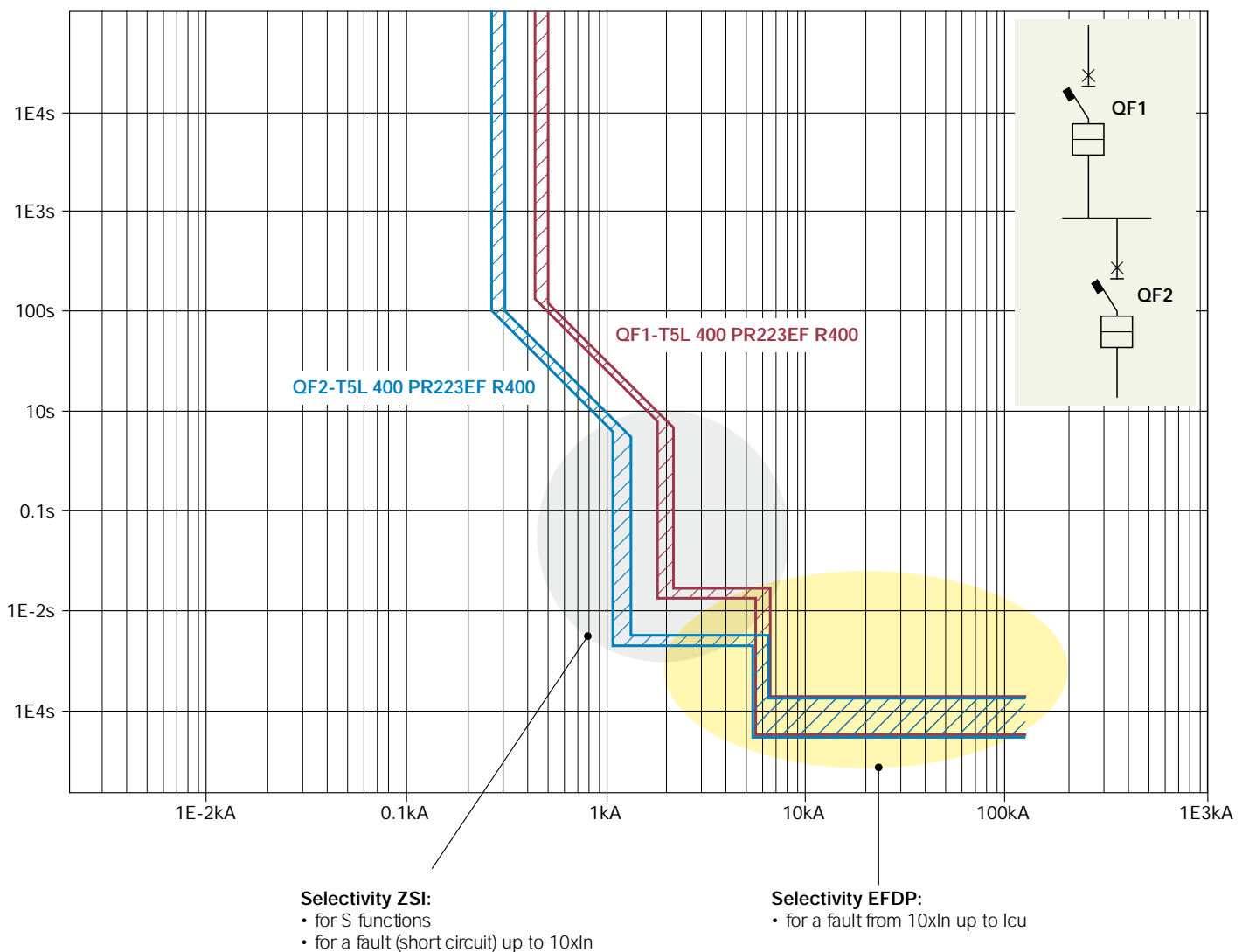
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1. Introduction

The purpose of the present document is giving detailed information about the proper use and the correct configuration of the trip unit type PR223EF so as to exploit its potentials at the best and to obtain the maximum advantages in the installations requiring zone selectivity. The aim of this document is not to explain the selectivity theory; to satisfy this need, please refer to the Technical Application Paper "Low voltage selectivity with ABB circuit-breakers" (QT1).

Besides making available Zone Selectivity Interlocking (ZSI) also for molded-case circuit-breakers, the trip unit PR223EF introduces a new concept of selectivity called Early Fault Detection and Prevention (EFDP). If logical selectivity is operating in the range $1 \dots 10 \times I_n$, EFDP selectivity is usually active approximately in the range from $10 \times I_n$ and the I_{cu} of the circuit-breaker, thus increasing the normal limit of energy selectivity.



Zone selectivity (ZSI): logical selectivity is based on a wired network so as to achieve a more accurate and increased discrimination range

Logical zone selectivity (ZSI) is an evolution of the time-current selectivity and it is based on the communication between electronic trip units. Thanks to the possibility of sending an interlock signal to the circuit-breaker on the supply side, the delay time of the protections is not increased as moving towards the supply source, while keeping the possibility of discriminating the zone affected by the fault. This selectivity technique is applied to S and G protections.

EFDP (Early Fault Detection and Prevention) technology: thanks to a patented algorithm it allows the selectivity limit between two molded-case circuit-breakers to be increased

EFDP selectivity can be considered as an extension of zone selectivity ZSI to those short-circuit current values where energy selectivity was usually active.

The availability of processors with high calculation power and the development of an algorithm capable to detect the fault condition within 100µsec, together with a very fast transmission protocol, makes it possible to obtain very high selectivity values also using molded-case circuit-breakers.

The algorithm for fault detection developed and patented by ABB has a predictive character since, based on short-circuit current parameters during the initial instant of the fault, it

is able to forecast the short-circuit current value before it reaches its maximum.

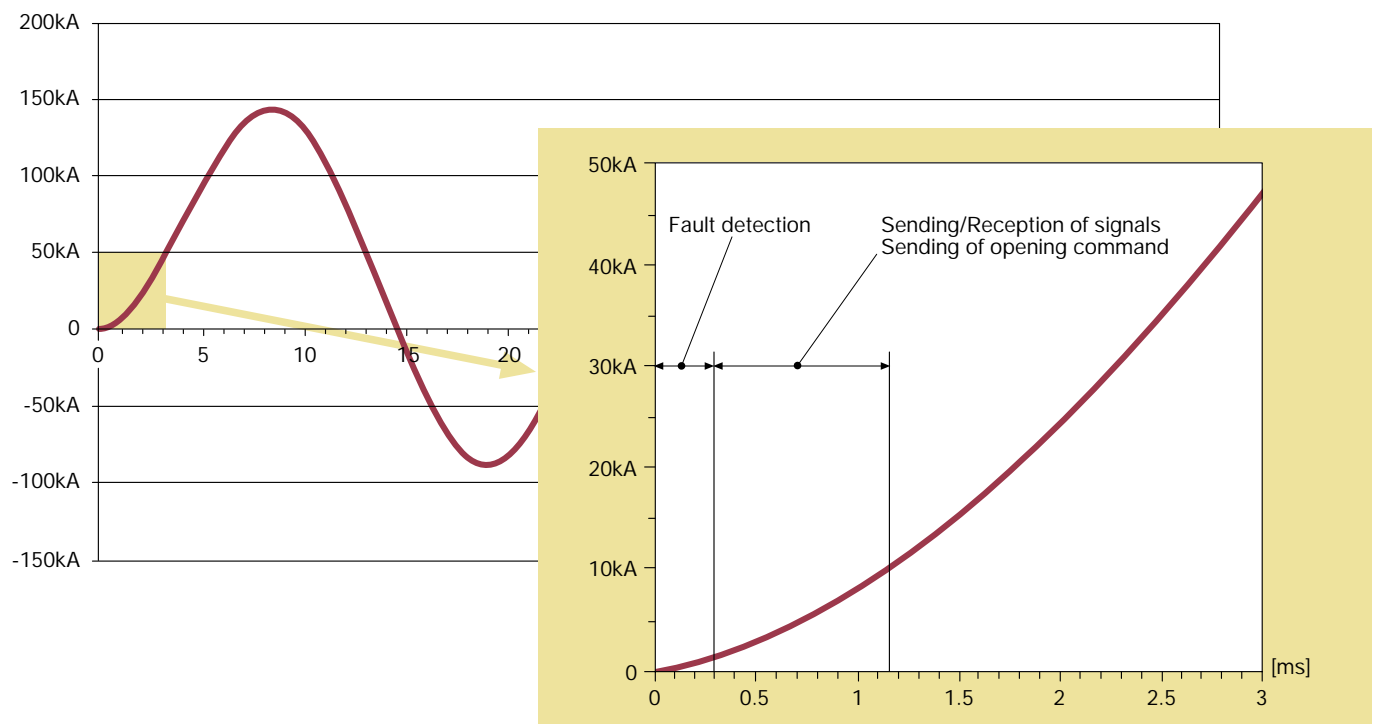
The EFDP system is able to detect the fault, to send a signal to the circuit-breaker on the supply side and to check for a signal coming from the downstream device before starting the contact opening. Thus, the opening of only the circuit-breaker immediately on the supply side of the fault is achieved. In this way we can realize zone selectivity between current-limiting circuit-breakers when fitted with a PR223EF trip unit.

With EFDP zone selectivity, we are able to achieve total selectivity between two circuit-breakers of the same size. On the contrary, when using the traditional method, the upstream circuit-breaker should have been larger in size (thus implying larger overall dimensions) to guarantee selectivity.

EFDP is normally implemented where space is a critical factor, for example in marine applications.

Therefore, Tmax equipped with PR223EF represents a solution to achieve:

- total selectivity between circuit-breakers of the same size
- reduction in the size of the upstream circuit-breakers ensuring selectivity
- total selectivity for rated voltages up to 690V
- circuit-breaker selection only based on rated current








2. PR223EF: new generation electronic protection unit integrated with zone selectivity

The trip unit PR223EF is available for T4-T5-T6 circuit-breakers of breaking capacity version L.

The table below shows the main characteristics of the protection functions and settings.

2.1 Protection and function

Protection functions	
	Not excludable. Active in Vaux and in self-supply I1=0.18...1xIn
	Excludable. Active in Vaux and in self-supply I2=0.6...10xIn
	Active in Vaux*
	Excludable. Active in self-supply* I3=1.5...12xIn
	Excludable. Active in Vaux and in self-supply I4=0.2...1xIn
Logical Interlock	Connection of several PR223EF, by means of shielded twisted pair cable
Zone selectivity interface with Emax	S51/P1 programmable contact
Application range	Molded-case breakers from 160 A to 1000 A sizes
Power supply	24 Vdc (aux) – 0.18 x In (self-supply on one phase)
Operating frequency	45-66 Hz
Operating temperature	-25°C...+80°C
Relative humidity	5%...98%
Electromagnetic compatibility (LF and HF)	IEC 60947-2 Annex F and N

* EFDP zone selectivity function can only be obtained when auxiliary voltage is available. Should the auxiliary voltage fail, the EF protection will switch to I protection if it is not excluded (OFF).

2.2 Configuration method

PR223EF is not provided with dip switches for the manual configuration of the parameters. The user has to take one of the following methods, and accordingly, the accessories:

- PR010/T test and configuration unit
- SD-TestBus supervision software through Modbus communication
- BT030

For further information about the protection unit and the configuration procedure please refer to **1SDH000538R0002 (User manual of protection unit PR223EF)**.

2.3 Measurement function

In addition to the protection functions mentioned and described in the previous page, PR223EF trip unit offers the possibility of measuring the main electrical parameters of the network.

Current measurements

The PR223EF trip unit is capable of providing a measure of the currents in the three phases, the neutral and the earth current. The minimum displayable current is 10% In.

Range	0.4...2xIn
Measurement accuracy	+/-3% +/-1digit

Voltage measurements

For this measurement the Vaux and VM210 module must be present. The measurements given refer to the voltage of the three-phases and to the line to line voltage with distributed neutral.

Range	100...1000V
Measurement accuracy	+/-1% +/-1digit

Frequency measurements

For this measurement too the Vaux and VM210 module must be present. The value of the rated mains frequency is set by the user by configuring the suitable parameter (50 or 60 Hz).

Range	45...66Hz
Measurement accuracy	+/-2% +/-1digit

Module VM210

As already said, to carry out some measurements the module VM210 must be used. The following table shows its main characteristics:

VM210 – Service conditions	Values
Voltage supply	24 V DC ± 20%
Ripple	± 5%
Service temperature T	-25° C...+70° C
Relative humidity	5%...98%
Certifications	
Product Stds.	IEC 60068
EMC Stds.	IEC 61000



2.4 Accessories for measurement display

The measurements can be displayed as follows:

Front display unit FDU

The front display unit FDU, which can operate also with self-supply ($I > 0.35 \times I_n$), is a display unit of the setting currents, alarms and parameters mounted on the front part of the circuit-breakers.



HMI030 display unit

The HMI030 interface is a display unit installed on the front of the switchboard. It consists of a graphic display and navigation push buttons. The HMI unit is connected to the trip unit PR223EF through the system bus. This accessory needs Vaux, and it is an alternative to a supervision system.



PR010/T test and configuration unit

The PR010/T unit is a device which, besides carrying out test and programming functions, allows the reading of the electrical parameters detected by the trip unit. All these functions can be carried out ON BOARD through a connection to the multi-pin connector on the front of the trip unit.



BT030 connection unit

In addition to the possibility of changing the settings and sending commands, this accessory, which can be connected to the trip unit PR223EF through front connector (or via Bluetooth), allows the measurements taken by the trip unit to be displayed on a PC.



Remote supervision system

The values measured by the trip unit PR223EF can be transmitted to communication systems through Modbus RTU protocol (for further references see the Technical Application Paper QT9 "Bus communication with ABB circuit-breakers").

2.5 Trip history

The PR223EF device stores in the memory the data of the last trip it has detected. The information stored in memory is:

- currents (L1, L2, L3, N) which have resulted in opening
- CB/Relay status
- alarms
- trip
- type of protection tripped
- parameters for the protection tripped

2.6 Supply

Auxiliary voltage.

Characteristics	PR223EF
Power supply voltage	24 Vdc \pm 20%
Maximum ripple	5%
Inrush Current @ 24 V	~4 A for 0.5 ms
Start-up Current @ 24 V	~0.5 A for 50 ms
Rated Current @ 24 V	~80 mA
Rated Power @ 24 V	~2 W

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