CZAZ-G/GT/GTM

PROTECTION FUNCTION LIBRARY

POWER SYSTEM
PROTECTION EQUIPMENT

TABLE OF CONTENTS

The configuration file for CZAZ-type multifunction relays is created and uploaded into the device using dedicated software based on functions accessible in protection, logic and measurement libraries.

By uploading the file into CZAZ relay the parameters of all its modules become programmed thus making the device ready to operate in accordance with its brief foredesign. Thanks to it, the relay can be adapted to individual requirements of the protected object.

I. Relay function library

The library contains a set of relay functions accessible in the CZAZ-GT-type multifunction relay. The protection functions are configured on the basis of these functions. The basic parameters of particular functions are set forth below.

F1 – Stabilized differential current protection (87G)

1. Application

   This function represents a differential protection of the generator dedicated to detecting phase-to-phase faults occurring within the zone covered by its operation in a selective way.

2. Description

   The energizing values of this function are amplitudes of fundamental components of differential and restrain currents. Its operating characteristic presented on Fig. 1 is determined by the following relationship:

$$I_r > \sqrt{(I_{ro})^2 + (k_h I_h)^2}$$

where: I_r - fundamental component of differential current
I_{ro} – initial starting (differential) current
I_h – fundamental component of restrain current
k_h – stabilization coefficient determining the angle of operating characteristic

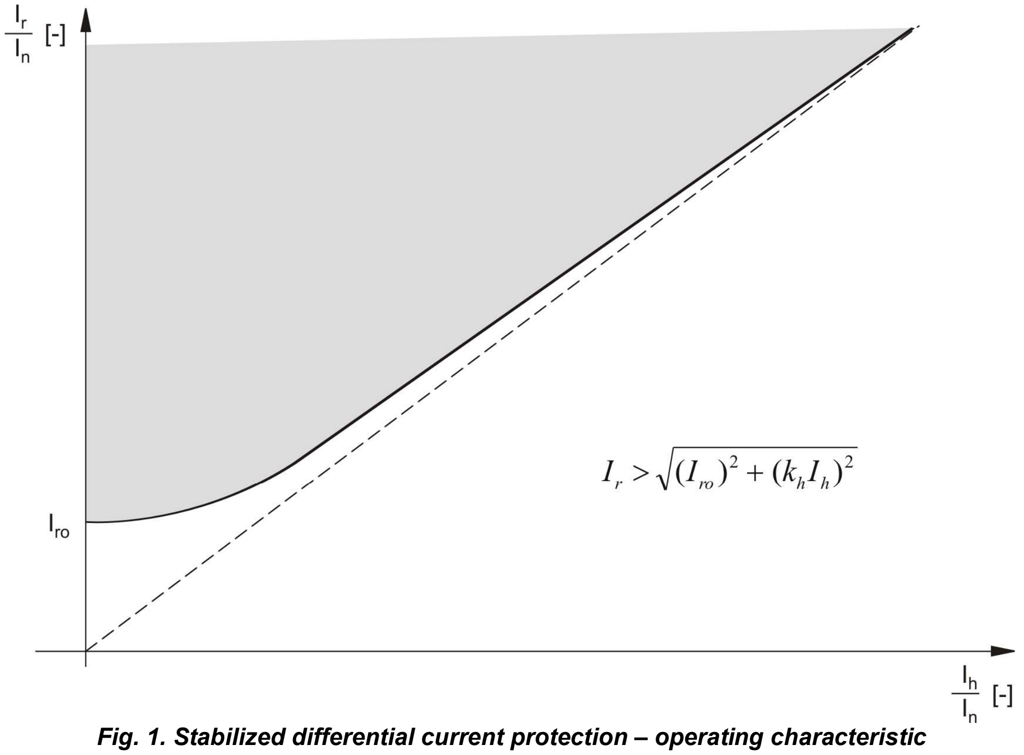


Fig. 1. Stabilized differential current protection – operating characteristic

Setting ranges:

Initial starting current	$I_{ro} = (0.10 \div 1.00)I_n$	in step of $0.05I_n$
Stabilization coefficient	$k_h = 0.00 \div 0.50$	in step of 0.05
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 5ms$	for $I_r > 10I_n$
	$t_w < 30ms$	for $I_r \le 10I_n$
Admissible error	$\Delta\% = \pm10\%$	

F2 – Stabilized differential current restrained by the second harmonic (87B, 87TB, 87TO)

1. Application

This function represents a protection dedicated to detect phase-to-phase fault occurring within the zone covered by its operation, immune to magnetizing current surges, in particular:

- differential protection of two- and three-winding transformers,
- differential protection of generator-transformer units

2. Description

The energizing values of this function are amplitudes of fundamental component of differential and restrain currents as well as amplitude of second harmonic of differential current. Its operating characteristic presented on Fig.2. is determined by the following relationship :

$$dla\ I_h \le I_{hg} \quad I_r > \sqrt{(I_{ro})^2 + (k_h I_h)^2}$$

$$dla\ I_h > I_{hg} \quad I_r > \sqrt{(I_{ro})^2 + (k_h I_{hg})^2}$$

where: I_r - fundamental component of differential current
I_{2r} - second harmonic of the differential current
I_{ro} - initial starting (differential) current
I_{rg} - starting (differential) current high level
I_h - fundamental component of restrain current
I_{hg} - stabilizing (restrain) current limit
k_h - stabilization coefficient determining slope of the starting curve to the X-axis

If the second harmonic value in relation to the differential current basic component exceeds the preset value of interlocking coefficient (kb), the operation of this protection is blocked.

Condition of restrain by the second harmonic is determined by the following relationship: $\frac{I_{2r}}{I_r} > k_b$

In case the fundamental component of differential current reach its high level value I_{rg}, the function trips immediately. It means, not according to restrain characterstic and without second harmonic blocking mode.

Operation condition of the protection is $I_r > I_{rg}$
(independent from the restrain current fundamental component and the second harmonic of differential current).

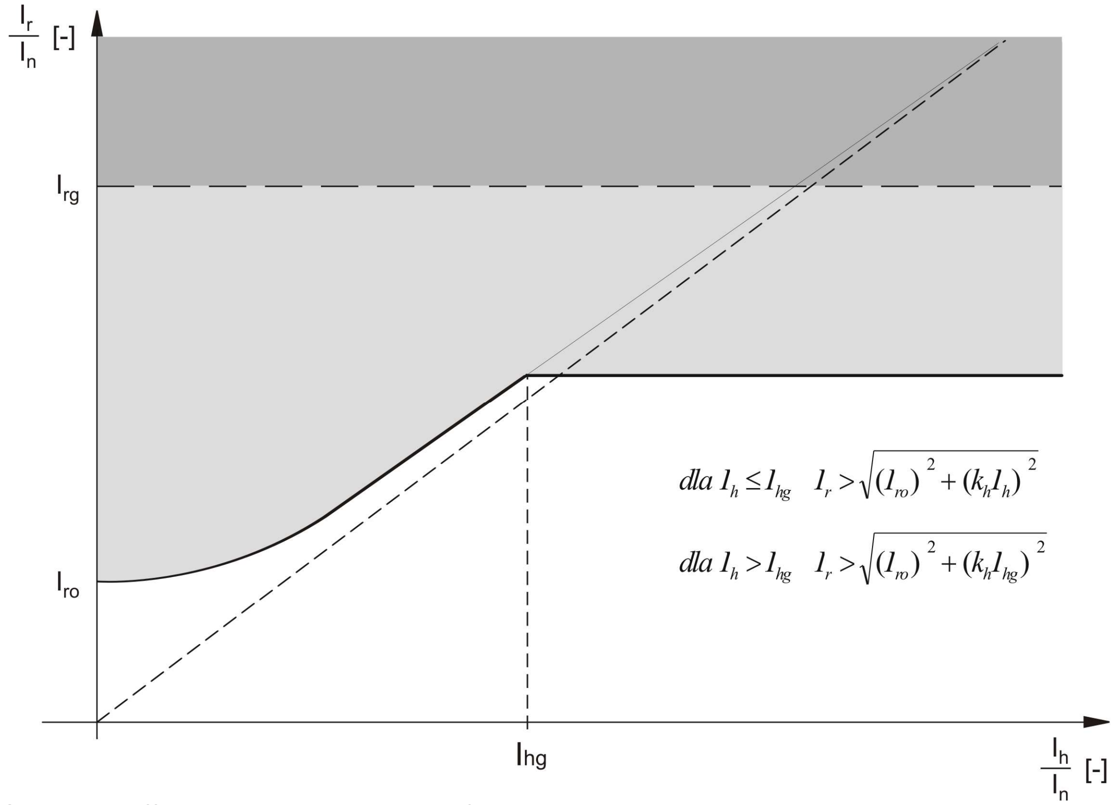


Fig. 2. Stabilized differential current protection featuring restrain by second harmonic – operating characteristic

Setting ranges:

Initial starting current	$I_{ro} = (0.10 \div 1.00)I_n$	in step of $0.05I_n$
Stabilizing current limit	$I_{hg} = (5 \div 15)I_n$	in step of $1I_n$
Differential current limit	$I_{rg} = (5 \div 15)I_n$	in step of $1I_n$
Restrain coefficient 2h	$k_b = 0.01 \div 0.50$	in step of 0.01
Stabilization coefficient	$k_h = 0.2 \div 0.8$	in step of 0.1
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 5ms$	for $I_r > 10I_n$
	$t_w < 30ms$	for $I_r \le 10I_n$
Admissible error	$\Delta\% = \pm10\%$	

F3 – Definite or inverse time overcurrent protection (50, 51)

1. Application

This function represents a protection reacting to current rise, in particular:

- generator stator overload protection,
- step-up transformer fault, overcurrent and overload protection,
- ground-fault protection,
- protection against phase-to-phase faults within the stator winding

2. Description

The energizing value of this function is amplitude of the current fundamental component.

Setting ranges:

Starting current	$I_r = (0.02 \div 20.00)I_n$	in step of $0.01I_n$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30ms$
Admissible error	$\Delta\% = \pm 5\%$

F4 – Definite time negative-sequence overcurrent protection (46.1)

1. Application

This function represents a generator load unbalance protection (signalling unit) reacting in case of exceeding of permanently admitted load unbalance value.

2. Description

The energizing value of this function is amplitude of negative-sequence current:

$$I_2 > I_{2r}$$

where: $I_{2r} = k_2 I_{nG}$
I_2 – negative-sequence current
k_2 – a coefficient (defined by the generator manufacturer) constituting the admitted permanent load unbalance
I_{nG} – generator rated current

Setting ranges:

Starting current	$I_r = (0.02 \div 0.50)I_n$	in step of $0.01I_n$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30ms$
Admissible error	$\Delta\% = \pm 5\%$

F5 – Inverse-time thermal overcurrent protection (1) (49R)

1. Application

   This function represents a generator rotor winding protection against thermal effects of operating overloads.

2. Description

   The aim of this function is to detect rms value rise of current summed up from all three phases and thus – to realize criterion of admissible momentary overload ability defined by the generator manufacturer.

Its operating characteristic is presented on Fig. 3 below.

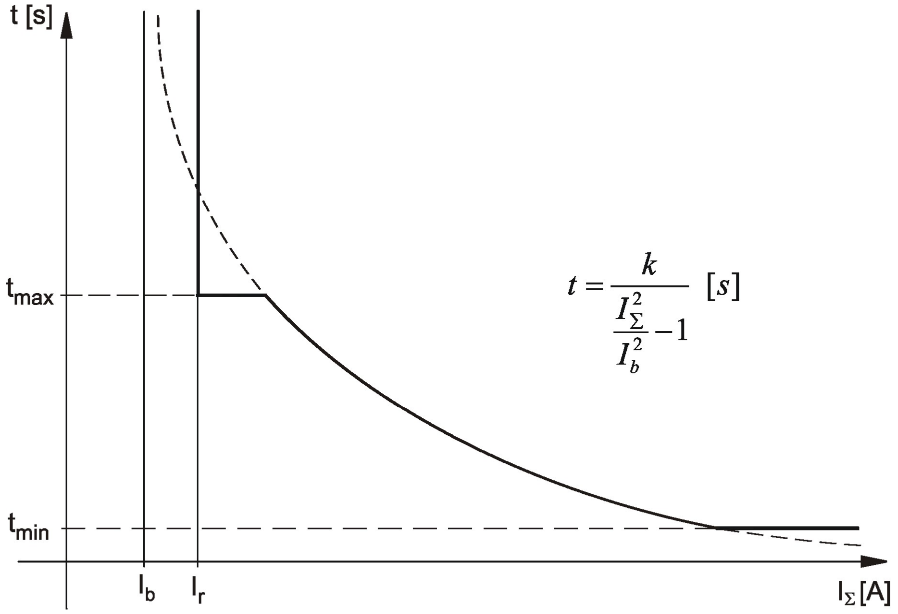


Fig. 3. Inverse-time thermal overcurrent protection – operating characteristic

The operating time of this protection is determined by the following relationship:

$$t = \frac{k}{\frac{I_\Sigma^2}{I_b^2} - 1}\ [s] \quad \text{, where: } I_\Sigma^2 = \frac{I_{L1}^2 + I_{L2}^2 + I_{L3}^2}{3}$$

where: k – a coefficient (defined by the generator manufacturer) constituting the admitted momentary overload of the generator rotor

I_{L1}. I_{L2}. I_{L3} – rms values of current in particular three phases

I_b – base current (generator rotor rated current)

Setting ranges:

Starting current	I_r = (0.50 ÷ 1.50)I_b	in step of 0.01I_b
Base current	I_b = (0.10 ÷ 2.50)I_n	in step of 0.01I_n
Coefficient	k = (1.0 ÷ 99,9)s	in step of 0.1s
Minimum overload duration	t_{min} = (1.0 ÷ 100.0)s	in step of 0.1s
Maximum overload duration	t_{max} = (100 ÷ 2000)s	in step of 10s
Reset time	t_{res} = (5 ÷ 1000)s	in step of 5s
Reset coefficient	k_p = 0.80 ÷ 0.99	in step of 0.01

Parameters:

Admissible error	Δ% = ± 10 %

F6 – Inverse-time over-current protection (2)

1. Application

   This function enables realizing any curve determined by formula.

2. Description

   The aim of this function is to detect amplitude rise of fundamental component of current and thus – to realize inverse-time criterion in accordance with the following formula:

$$t = \frac{k}{\left(\frac{I_1}{I_b}\right)^c - 1} \quad [s]$$

where: k – time dimension coefficient
c – power exponent
I_1 – amplitude of fundamental component of current
I_b – amplitude of base current

Setting ranges:

Starting current	I_r = (1.00 ÷ 2.00)I_B	in step of 0.01I_B
Base current	I_B = (0.20 ÷ 2.50)I_n	in step of 0.01I_n
Coefficient	k = (0.01 ÷ 200.00)s	in step of 0.01s
Power exponent	c = 0.02 ÷ 2.00	in step of 0.02
Minimum duration	t_{min} = (0.0 ÷ 10.0)s	in step of 0.1s
Reset coefficient	k_p = 0.80 ÷ 0.99	in step of 0.01

Parameters:

Admissible error	Δ% = ± 10 %

F7 – Inverse-time negative-sequence thermal overcurrent protection (46.2)

1. Application

This function represents a generator load unbalance protection (tripping unit) reacting to exceeding of admissible duration of momentary load asymmetry condition.

2. Description

   The aim of this function is to detect amplitude rise of negative-sequence current and thus – to realize criterion of admissible duration of momentary load unbalance condition. Its operating characteristic is presented on Fig. 4 below.

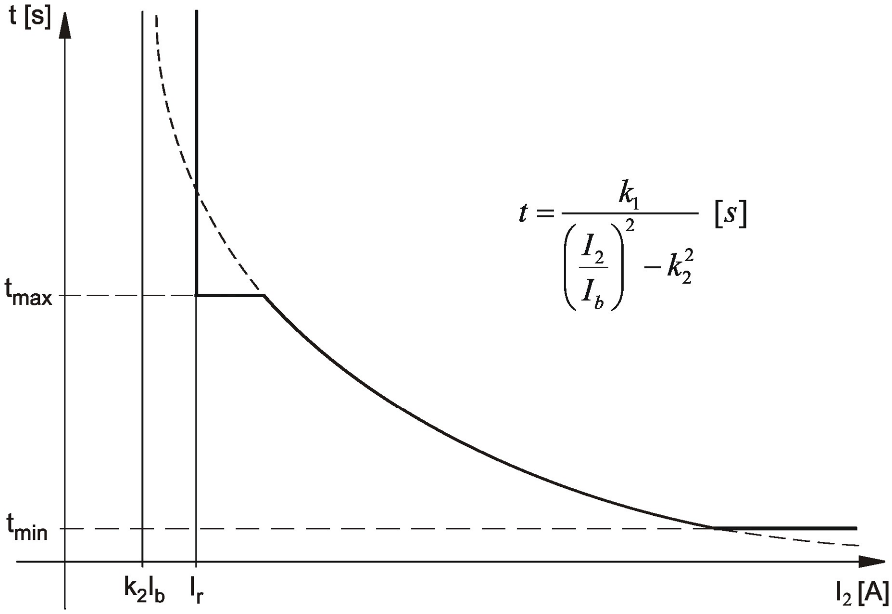


Fig. 4. Inverse-time negative-sequence over-current and temperature protection – operating characteristic

The admissible duration of load asymmetry condition is determined by the following formula:

$$t = \frac{k_1}{\left(\frac{I_2}{I_b}\right)^2 - k_2^2} \; [s]$$

where: k_1 – coefficient (defined by the generator manufacturer) constituting the admitted momentary load unbalance condition
k_2 – coefficient (defined by the generator manufacturer) constituting admitted permanent load unbalance condition
I_2 – negative-sequence current
I_b – base current

Setting ranges:

Starting current	$I_r = (0.02 \div 0.50)I_n$	in step of $0.01I_n$
Base current	$I_b = (0.50 \div 2.50)I_n$	in step of $0.01I_n$
Coefficient	$k_1 = (1.0 \div 50.0)$s	in step of 0.1s
Coefficient	$k_2 = 0.01 \div 1.00$	in step of 0.01
Minimum duration	$t_{min} = (1.0 \div 120.0)$s	in step of 0.1s
Maximum duration	$t_{max} = (100 \div 2000)$s	in step of 1s
Reset time	$t_{powr} = (5 \div 2000)$s	in step of 1s
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Admissible error	$\Delta\% = \pm 10\%$

F8 – Peak value overcurrent protection

1. Application

This function enables control over the value of current independently on measuring signal frequency value, e.g. in frequency controlled start-up systems.

2. Description

The energizing value of this function is rms value of current of variable frequency.

Setting ranges:

Starting current	$I_r = (0.1 \div 20.0)I_n$	in step of $0.1I_n$
Minimum frequency	$f_{min} = (0.04 \div 1.00)f_n$	in step of $0.01f_n$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	dependent on frequency of the current
Admissible error	$\Delta\% = \pm 5\%$

F9a – Overimpedance protection featuring correction mode (64R.3)

1. Application

This function represents protection against loss of supervision of generator rotor insulation condition (i.e. break within measuring circuits).

2. Description

The energizing values of this function are the resistance (R) and reactance (X) of rotor impedance.

Setting ranges:

Impedance limit	$Z_{gr} = (20 \div 100)k\Omega$	in step of $5k\Omega$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30ms$
Admissible error	$\Delta\% = \pm 5\%$

F10 – Definite-time undervoltage protection (27)

1. Application

This function represents protection reacting to voltage drop, thus realizing e.g. voltage criterion of protection against generator excitation loss.

2. Description

The energizing value of this function is amplitude of voltage fundamental component.

Setting ranges:

Starting voltage	$U_r = (0.020 \div 2.000)U_n$	in step of $0.001U_n$
Reset coefficient	$k_p = 1.01 \div 1.10$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30$ ms
Admissible error	$\Delta\% = \pm 5\%$

F11 – Definite-time overvoltage protection (59)

1. Application

   This function represents protection of the generator and unit transformer against effects of excessive voltage rise.

2. Description

   The energizing value of this function is amplitude of fundamental component voltage.

Setting ranges:

Starting voltage	$U_r = (0.020 \div 2.000)U_n$	in step of $0.001U_n$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$_w < 30$ms
Admissible error	$\Delta\% = \pm 5\%$

F12 – Third harmonic overvoltage protection (64S)

1. Application

   This function represents a generator protection against ground-faults within the generator stator windings near the generator star point (100%).

2. Description

   The energizing value of this function is amplitude of third-harmonic of voltage.

Setting ranges:

Starting voltage	$U_r = (0.001 \div 0.200)U_n$	in step of $0.001U_n$
Reset voltage	$U_z = (0.000 \div 0.200)U_n$	in step of $0.001U_n$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30$ms
Admissible error	$\Delta\% = \pm 5\%$

F13 – Peak overvoltage protection

1. Application

This function enables control over the voltage value independently on measuring signal frequency value, e.g. in frequency controlled start system.

2. Description

   The energizing value of this function is rms value of voltage of variable frequency.

Setting ranges:

Starting voltage	$U_r = (0.020 \div 2.000)U_n$	in step of $0.001U_n$
Minimum frequency	$f_{min} = (0.04 \div 1.00)f_n$	in step of $0.01f_n$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	dependent on frequency of the voltage
Admissible error	$\Delta\% = \pm 5\%$

F14 – Full-impedance circular protection (21)

1. Application

This function represents protection reacting to uncleared phase-to-phase faults occurring within the generator or unit and bus-bars.

2. Description

The energizing values of this function are the resistance (R) and reactance (X) of impedance vector. Its operation characteristics is presented on Fig.5. Following formula determines its characteristics:

$$R^2 + X^2 < Z_r^2$$

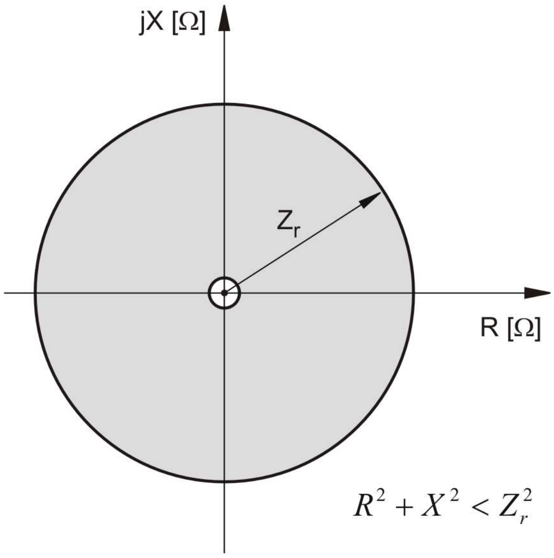


Fig. 5. Full-impedance circular protection – operating characteristic

The starting current value is also determined (by measuring amplitude of the generator fundamental component of current) at residual voltage value within the measuring circuit ($I_r = I_{bl}$).

Setting ranges:

Circle radius	$Z_r = (0.10 \div 150.00)\Omega$	in step of 0.02Ω
Blocking current	$I_{bl} = (0.08 \div 0.10)I_n$	in step of $0.01I_n$
Reset coefficient	$k_p = 1.01 \div 1.10$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30ms$
Admissible error	$\Delta\% = \pm 5\%$

F15 – Conductance-based protection (64R.1. 64R.2)

1. Application

   This function represents protection reacting either to insulation resistance drops or to particular ground faults occurring within excitation circuits.

2. Description

This function is described by circular curve determined by the following relationship:

$$\left(R-\frac{R_1+R_2}{2}\right)^2+X^2<\left(\frac{R_1-R_2}{2}\right)^2$$

As in R/X plane, the curve constitutes a circle symmetrical to the R axis having two characteristic points: R_1 and R_2, There are two curves presented on Fig.6: 1 – signalling stage; 2 – tripping stage.

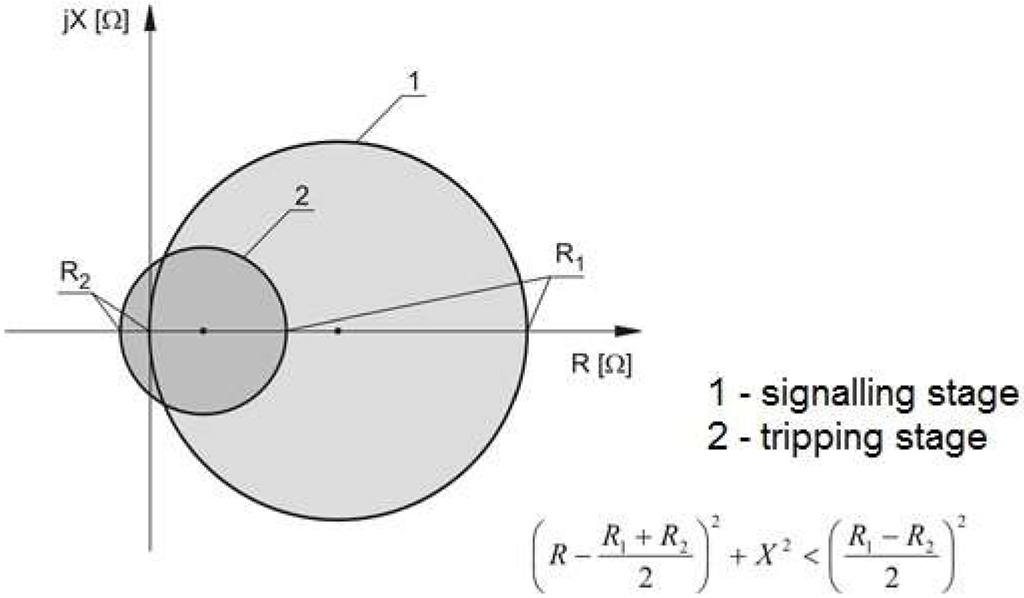


Fig. 6. Conductance-based protection – operating characteristic

Setting ranges:

Right-side resistance limit	$R_1 = (0 \div 15000)\Omega$	in step of 1Ω
Left-side resistance limit	$R_2 = (-1000.0 \div 0.0)\Omega$	in step of 0.1Ω
Reset coefficient	$k_p = 1.01 \div 1.10$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30ms$
Admissible error	$\Delta\% = \pm 5\%$

F16 – Reactance-based protection featuring straight-line cut-off mode (40)

1. Application

   This function represents generator protection against asynchronous operation condition and effects of unstable co-operation with the network caused by full or partial excitation loss.

2. Description

   The energizing values of this function are the R and X components of impedance vector. Measurement of operating impedance (as seen from the side of generator terminals) allows to detect excitation loss condition. During excitation loss, the end of operating impedance vector is inside the circle. The straight line cutting off part of the circle has to be adjusted in the way that, the protection does not operate in case of faults occurring within the main circuits of the protected power unit.
   The operating characteristic of the present function as shown on Fig. 7 is determined by the following relationships:

$$R^2 + \left(X - \frac{X_1 + X_3}{2} \right)^2 < \left(\frac{X_1 - X_3}{2} \right)^2 \wedge X < X_2$$

where: X_1 - top-side reactance limit ($X_1 = X_T$)

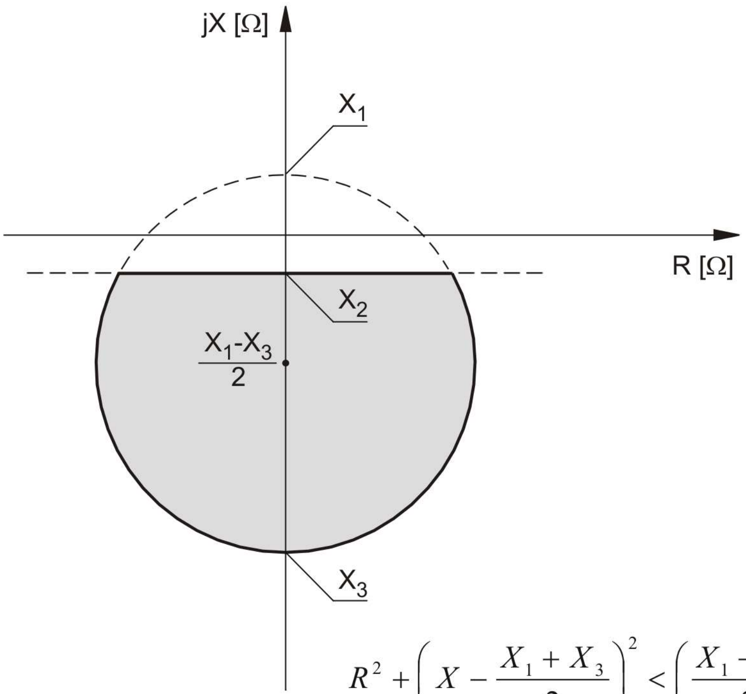
X_2 - cut-off reactance ($X_2 = \frac{-X_d^{'}}{2}$)

X_3 - bottom-side reactance limit ($X_3 = -X_d$)

X_d - synchronous reactance of the generator in the longitudinal (R-) axis

X_T - reactance of the unit transformer

$X_d^{'}$ - transient reactance of the generator



$$R^2 + \left(X - \frac{X_1 + X_3}{2} \right)^2 < \left(\frac{X_1 - X_3}{2} \right)^2 \wedge X < X_2$$

Fig. 7. Reactance-based protection featuring straight-line cut-off mode – operating characteristic.

The starting current value is also determined (by measuring amplitude of the generator fundamental component of current) at residual voltage value within the measuring circuit ($I_r = I_{bl}$).

Setting ranges:

Blocking current	$I_{bl}= (0.08 \div 0.10)I_n$	in step of $0.01I_n$
Top-side reactance	$X_1= (-50.00 \div 50.00)\Omega$	in step of 0.02Ω
Cut-off reactance	$X_2= (-50.00 \div 50.00)\Omega$	in step of 0.02Ω
Bottom-side reactance	$X_3= (-150.00 \div 0.00)\Omega$	in step of 0.02Ω
Reset coefficient	$k_p = 1.01 \div 1.10$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30ms$
Admissible error	$\Delta\% = \pm10\%$

F17i – Underfrequency protection featuring current restrain mode (81L)

1. Application

This function represents an underfrequency protection featuring current restrain mode.

2. Description

The energizing values of this function are: amplitude of the fundamental component of current as well as frequency.

Setting ranges:

Starting frequency	$f_r = (0.8000 \div 1.0000)f_n$	in step of $0.0002f_n$
Blocking current	$I_{bl} = (0.1 \div 0.5)I_n$	in step of $0.1I_n$
Reset coefficient	$k_p = 1.0001 \div 1.1000$	in step of 0.0001

Parameters:

Pick-up & drop-out time	$t_w < 100ms$
Admissible error	$\Delta\% = \pm$ 5mHz

F17u – Underfrequency protection featuring voltage restrain mode (81L)

1. Application

This function represents an underfrequency protection featuring voltage restrain mode.

2. Description

The energizing values of this function are: amplitude of the fundamental component of voltage as well as frequency.

Setting ranges:

Starting frequency	$f_r = (0.8000 \div 1.0000)f_n$	in step of $0.0002f_n$
Blocking voltage	$U_{bl} = (0.2 \div 0.8)U_n$	in step of $0.1U_n$
Reset coefficient	$k_p = 1.0001 \div 1.1000$	in step of 0.0001

Parameters:

Pick-up & drop-out time	$t_w < 100ms$
Admissible error	$\Delta\% = \pm$ 5mHz

F18i – Overfrequency protection featuring current restrain mode (81H)

1. Application

This function represents an over-frequency protection featuring current restrain mode.

2. Description

The energizing values of this function are: amplitude of the fundamental component of current as well as frequency.

Setting ranges:

Starting frequency	$f_r = (1.0000 \div 1.3000)f_n$	in step of $0.0002f_n$
Blocking current	$I_{bl} = (0.1 \div 0.5)I_n$	in step of $0.1I_n$
Reset coefficient	$k_p = 0.9600 \div 1.0000$	in step of 0.0001

Parameters:

Pick-up & drop-out time	$t_w < 100$ms
Admissible error	$\Delta\% = \pm$ 5mHz

F18u – Overfrequency protection featuring voltage restrain mode (81H)

1. Application

This function represents an over-frequency protection featuring voltage restrain mode.

2. Description

The energizing values of this function are: amplitude of the fundamental component of voltage as well as frequency.

Setting ranges:

Starting frequency	$f_r = (1.0000 \div 1.3000)f_n$	in step of $0.0002f_n$
Interlocking voltage	$U_{bl} = (0.2 \div 0.8)U_n$	in step of $0.1U_n$
Reset coefficient	$k_p = 0.9600 \div 1.0000$	in step of 0.0001

Parameters:

Pick-up & drop-out time	$t_w < 100$ms
Admissible error	$\Delta\% = \pm$ 5mHz

F19 – Volt per Hertz protection (24)

1. Application

   The aim of this function is to protect transformers (co-operating within the generator-transformer unit with a generator static excitation system) against excessive rise of magnetic induction.

2. Description

   The energizing values of this function are: amplitude of the voltage as well as frequency. The measuring algorithm of the protection determines the relation of voltage to frequency, which is the measure of induction arisen in iron.

$$B = c\frac{U}{f}$$

The transformer overexcitation coefficient, i.e. relative value of this quotient, is assumed as the operating criterion of the protection. The operating characteristic of the present function as shown on Fig. 8 is determined by the following relationships

$$\frac{U}{f}\frac{f_n}{U_n} > k_r$$

where: U_n – transformer rated voltage
f_n – rated frequency

Minimum values of voltage and frequency (values blocking function operation):

Blocking voltage	$U_{bl}= 0.2U_n$
Blocking frequency	$f_{bl}= 0.4f_n$

Setting ranges:

Starting over-excitation coefficient	$(U/f)_r = (0.20 \div 2.00)U_n/f_n$	in step of $0.01U_n/f_n$
Reset coefficient	$k_p = 0.80 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 50ms$
Admissible error	$\Delta\% = \pm10\%$

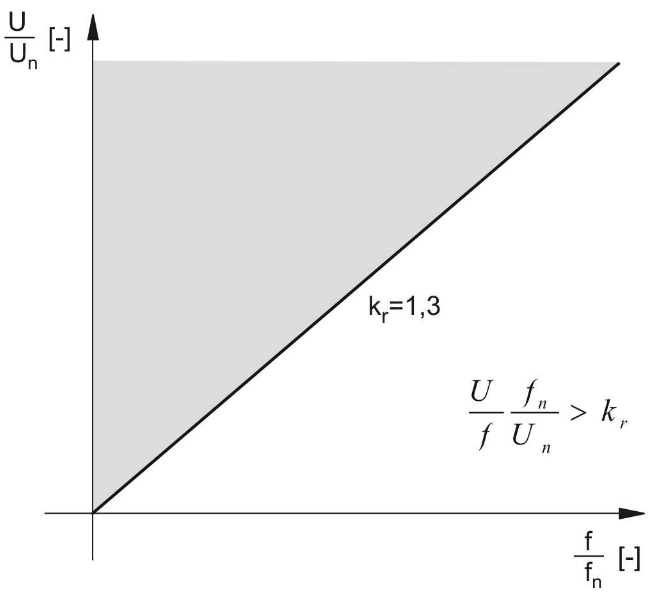


Fig. 8. Function of frequency and voltage protection – operating characteristic

F20 / F20a – Function of reverse power (overload) protection (32R)

1. Application

This function represents protection reacting to reverse power flow, thus protecting the generator against effects of motor operation condition, where:

F20 – single-phase protection mode
F20a – three-phase protection mode

2. Description

The energizing values of this function are active and reactive power of the generator. The operation characteristic of the function is shown on Fig.9.

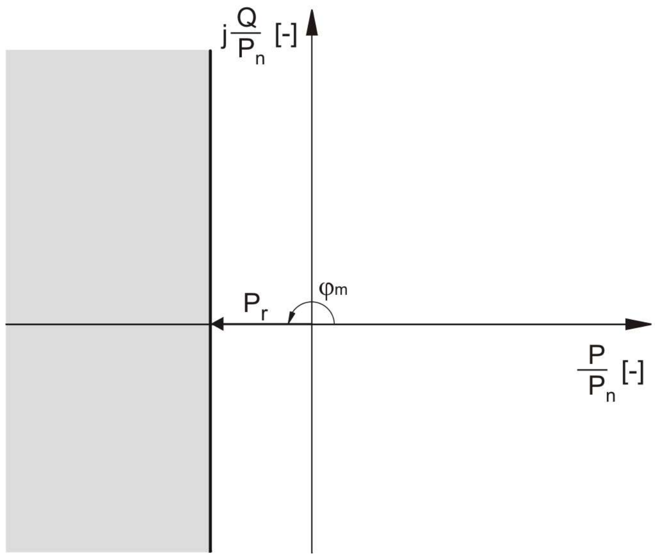


Fig. 9. Function of reverse power protection – operating characteristic

Setting ranges:

Starting power	$P_r = (0.000 \div 1.200)P_n$	in step of $0.005P_n$
Max. sensitivity angle	$\varphi_m = (0.0 \div 360.0)°$	in step of 0.1°
Reset coefficient	$k_p = 0.60 \div 0.99$	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30ms$
Admissible error	$\Delta\% = \pm 10\%$

F21 / F21a – Function of active power (under-load) protection (32L)

1. Application

This function represents protection against power drop, where:

F21 – single-phase protection mode
F21a – three-phase protection mode

2. Description

The energizing values of this function are active and reactive power of the generator.

Setting ranges:

Starting power	P_r = (0.000 ÷ 1.200)P_n	in step of 0.005P_n
Max. sensitivity angle	φ_m = (0.0 ÷ 360.0)°	in step of 0.1°
Reset coefficient	k_p = 1.01 ÷ 1.10	in step of 0.01

Parameters:

Pick-up & drop-out time	t_w < 30ms
Admissible error	Δ% = ± 10%

F22 – Function of slipping pole protection (78)

F22S1 - function of slipping pole protection, impedance stage S1

F22S2 - function of slipping pole protection, impedance stage S2

F22W - function of slipping pole protection, impedance tripping stage W

F22K - function of slipping pole protection, directional stage K

F22Z - function of slipping pole protection, directional stage Z

1. Application

The present function is meant for detecting condition where the power network source voltages are not synchronized with generator voltages. It allows to define condition and nature of power swinging (i.e. rise of the generator rotor angle, slipping pole, position of the power swinging center within or beyond the block).

2. Description

The energizing values of this function are the R and X components of impedance vector as well as amplitude of the generator fundamental component of phase current. The operating characteristic of the function is shown on Fig.10.

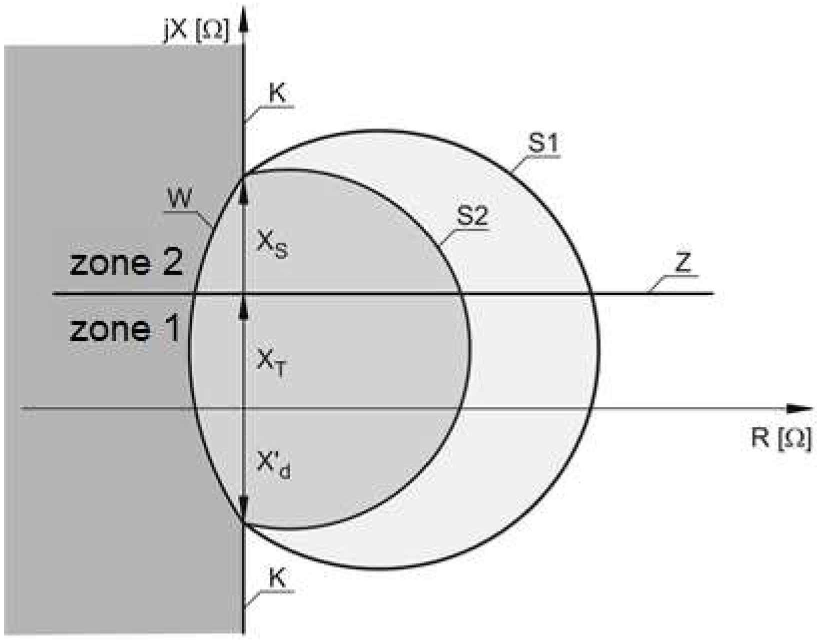


Fig. 10. Function of slipping pole protection – operating characteristic

Setting ranges:

Reactance of unit transformer	X_T= (0.0 ÷ 100.0)Ω	in step of 0.2Ω
Transfer reactance of the system	X_S= (0.0 ÷ 100.0)Ω	in step of 0.2Ω
Transfer reactance of the generator	X_d= (2.0 ÷ 150.0)Ω	in step of 0.2Ω

Angle (δ) between source voltages of the power network and the generator:

- for the S1stage	δ_{S1}= (0 ÷ 180)°	in step of 5°
- for the S2 stage	δ_{S2}= (0 ÷ 180)°	in step of 5°
- for the W stage	δ_W= (0 ÷ 180)°	in step of 5°
Reset coefficient	k_p = 1.01 ÷ 1.10	in step of 0.01

Parameters:

Pick-up & drop-out time	$t_w < 30$ms
Admissible error	Δ% = ± 5 %

II.Logic operators library

The logic operators library includes logic, timers and special functions to be freely used for creation of the multifunction relay configuration part determining interrelationships between signals, time dependencies, emergency control mode, signalling mode and co-operation of the relay with its internal recorder of events and disturbances. The configuration file can be created using logic functions selected from these set forth below.

BUF – input buffer

- single-input function
- single output
- performs repetition or negation of the current state of input
- allows to increase addressing range and negate input of any other function

XOR – symmetric difference

- double-input function
- single output
- performs symmetric logical difference

OR2 – double-input logical sum

- double-input function
- single output
- performs logical sum of two input signals

AND2 – double-input logical product

- double-input function
- single output
- performs logical product of two input signals

OR3 – triple-input logical sum

- triple-input function
- single output
- performs logical sum of three input signals

AND3 – triple-input logical product

- triple-input function
- single output
- performs logical product of three input signals

STN – derivation of follow-up mode

- single-input function,

- single output,
- sets active state of output whilst the input is in active state

STN3 – multiplied derivation of follow-up mode

- single-input function,
- three outputs,
- sets active state of output whilst the input is in active state

REJ – derivation of edge state

- single-input function,
- single output,
- records ascending edge of the input
- sets active state of output when the input is triggered from inactive to active state

REJ4 – multiplied derivation of edge state

- single-input function,
- four inputs,
- reacts to signal edge,
- records ascending edge of the input at the first three outputs
- records descending edge of the input at the fourth output

STP – derivation of sustained state

- double-input function (input, reseting input),
- single output,
- reacts to input signal level
- when the input is in the active state, the function sets the active output state sustained until the reseting input is activated

WYJ7 – multiplied output of signal

- single-input function,
- combines operation of the **STN3** and **REJ4** functions (7 outputs)

ICOM – detection of operation counter threshold

- double-input function (input, the controlled counter)
- single output
- reacts to ascending edge of the input signal
- preset value – the counter threshold (0÷65535)
- operation – when the active state appears at the input the former counter value becomes incremented and the new value is compared with the preset threshold value. If the counter value is less than the preset value, the function output is inactive. Otherwise the function output is active.

CST – state setting

- no-input function
- single output
- setting – state 0 or 1.
- operation – function output is active for setting „1” and inactive for setting „0”.

FT0 – Drop-out delay

- single-input function,
- single output,
- timer adjustable within the range (0.00÷320.00)s in step of 0.01 s with accuracy of ±1% ±0.005s,
- operation – the active state is sustained (after its disappearance at the input) during the preset time period

FT1 – operation delay

- single-input function
- single output
- time function adjustable within the range (0.00÷320.00)s in step of 0.01 s with accuracy of ±1% ±0.005s
- operation – repetition of the input state under a time-delay determined by setting of the function

FTi – pulse

- single-input function
- single output
- time function adjustable within the range (0.00÷320.00)s in step of 0.01 s with accuracy of ±1% ±0.005s
- operation – the functions enforces the active state (a pulse) of the preset duration commencing from the appearance moment of the input active state. The reappearance of high state of input during the pulse does not extend the pulse duration

FTp – limitation of pause duration

- single-input function,
- single output,
- time function adjustable within the range (0.00÷320.00)s in step of 0.01 s with accuracy of ±1% ±0.005s
- operation – in case the input remains in an inactive state during a time period longer than the preset time the function becomes active. If the active state appears at the input, the function is triggered to the inactive state extended by the function setting (a pulse after disappearance of the active state at the input). Reappearance of the active state at the input causes recount of the state from the beginning.

FTs – pulse adder

- double-input function (input, resetting input)
- single output,
- time function adjustable within the range (0.00÷320.00)s in step of 0.01 s with accuracy of ±1% ±0.005s
- operation – the function becomes active if the total duration of active state occurring at the input reaches the value determined by the setting. Active state of the resetting input causes reset of the adder – the time is recounted in this case from zero.

WWA – trip outputs

- double-input function (set and reset input),
- eight outputs (of the type W/Sg),
- operation – activation of up to eight trip outputs

III.Measurement function library

The measurement function library includes measuring algorithms to be freely used for processing preset value of the controlled quantity. The following set of measuring functions is available:

P1 – measurement of rms current value

- single-input function

P2 – measurement of rms voltage value

- single-input function

P3 – frequency measurement

- single-input function

P4 – phase shift measurement

- double-input function

P5 – measurement of active power

- double-input function (voltage and current of one phase)

P5a – measurement of three-phase active power

- six-input function (voltages and currents of three phases)

P6 – measurement of reactive power

- double-input function (voltage and current of one phase)

P6a – measurement of three-phase reactive power

- six-input function (voltages and currents of three phases)

P7 – impedance measurement

- double-input function (voltage and current of one phase).

P7a – impedance measurement featuring correction mode

- double-input function (voltage and current of one phase),
- impedance value correction mode considering non-linearity of the curve of the generator rotor ground-fault protection

P8 – resistance measurement

- double-input function (voltage and current of one phase).

P9 – reactance measurement

- double-input function (voltage and current of one phase).

P10 – value measurement [s]

- single-input function,
- dependent protection state indicator expressed in seconds

P11 – value measurement [%]

- single-input function,
- dependent protection state indicator expressed in seconds

Notes on the functioning of the CZAZ-G / GT / GTM devices, SmiS software and this description please report to the manufacturer:

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