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1 REQUIREMENTS AND BASIC TECHNICAL DATA - REB 551

The operation of a protection measuring function is influenced by distortion, and measures need to be taken in the protection to handle this phenomenon. One source of distortion is current transformer saturation. In this protection terminal, measures are taken to allow for a certain amount of CT saturation with maintained correct operation. This protection terminal can allow relatively heavy current transformer saturation.

Protections are also affected by transients caused by capacitive voltage transformers (CVTs) but this terminal unit has a very effective filter for these transients, the operation is hardly affected at all.

1.1 Requirements on voltage instrument transformers

Magnetic or capacitive voltage transformers can be used.

Capacitive voltage transformers should fulfil the requirements according to IEC 186A, Section 20, with regard to transients. According to the standard, the secondary voltage should drop to less than 10% of the peak value before the short circuit within one cycle. The breaker terminal has an effective filter for this transient, which gives secure and correct operation with CVTs.

1.2 Requirements on current instrument transformers

1.2.1 Choice of current transformers

The current transformers should be of type TPX or TPY with an accuracy class of 5P or better. The characteristic of the linearised current transformer type TPZ is not well defined as far as the phase angle error is concerned, and we therefore recommend that ABB Relays is contacted for confirmation that the type in question can be used.

The current transformer ratio should be selected so that the current to the protection is higher than the minimum operating value for all faults that are to be detected. The minimum operating current for the breaker terminal is 10% of the nominal current.

1.2.2 Conditions for the CT requirements

The requirements for the breaker protection terminal are a result of investigations performed in our network simulator. The tests have been carried out with an analogue current transformer model with a settable core area, core length, air gap and number of primary and secondary turns. The setting of the current transformer model was representative for current transformers of type TPX and TPY. The results are not valid for TPZ.

All testing was made without any remanence flux in the current transformer core. The requirements below are therefore fully valid for a core with no remanence flux. It is difficult to give general recommendations for additional margins for remanence flux. They depend on the reliability and economy requirements.

When current transformers of type TPY are used, practically no additional margin is needed due to the anti-remanence air gap.

For current transformers for type TPX, the small probability of an fully asymmetrical fault, together with maximum remanence flux in the same direction as the flux generated by the fault, has to be kept in mind at the decision of an additional margin. Fully asymmetrical fault current will be achieved when the fault occurs at zero voltage (0°). Investigations have proved that 95% of the faults in the network will occur when the voltage is between 40° and 90°.

1.2.3 Fault current

The current transformer requirements are based on the maximum fault current for faults in different positions. Maximum fault current will occur for three-phase faults or single-phase-to-earth faults. The current for a single phase-to-earth fault will exceed the current for a three-phase fault when the zero sequence impedance in the total fault loop is less than the positive sequence impedance. When calculating the current transformer requirements, maximum fault current should be used and therefore both fault types have to be considered.

1.2.4 REx 5xx current transformer requirements

The current transformer secondary limiting emf (E_{2max}) should meet the requirements below. They assume a maximum dc time constant of 120 ms for the network.

$$E_{2max} > I_{k\ max} \cdot I_{sn} / I_{pn} \cdot a \cdot \left(R_{CT} + R_L + 0,5 / I_R^2 \right)$$

I_{kmax}	maximum primary fundamental frequency component for forward and reverse fault
I_{pn}	primary nominal current
I_R	protection terminal nominal current
R_{CT}	Secondary winding resistance
R_L	CT secondary cable resistance and additional load
a	This factor is a function o the network frequency the time constant for the dc component in the fault current.

1.3 Demands on communication links for remote communication

The optical fibres that can be bought from ABB Relays AB fulfil all the requirements for the communication in the station. Both plastic fibres and glass fibres can be used. For distances up to 30 m, plastic fibres and for distances up to 500 m, glass fibres are suitable. Glass and plastic fibres can be mixed in the same loop.

For communication on longer distances, telephone modems are used. The modems must be Hayes-compatible ones using “AT “commands with automatic answering (AA) capability. The telephone network must comply with the CCITT standards.

For connection of the optical fibre loop to a PC or a telephone modem, an opto / electrical converter is required. The converter uses RS232 and it has a D25 connector on the electrical side. The converter is supplied by ABB Relays AB.

1.4 Demands on PC

The PC shall comply with the following requirements:

- 100% IBM compatible running with DOS 5.0 or higher
- 640 kb RAM or more (at least 450 kb available)
- VGA screen and floppy disk drive 3 1/2” (1,44 Mb)
- 3 Mb disk space required for the local MMI program SM/REx 5xx for communication to the front port
- Additional disk space required depends on the application, see 1MDB11021-EN, SMS 200 or 1MDB11019-EN, SMS 010.

1.5 Technical data

Table 1: Energizing quantities, rated values and limits

Quantity	Rated value	Nominal range	Operative range
Current Burden	I_r = 1 or 5 A <0,25 VA at I_r	(0,2-30) x I_r	(0,2-4) × I_r cont. (0,2-100) × I_r for 1 s *)
Ac voltage Ph-Ph Burden	U_r = 100/110/115/ 120 V <0,2 VA at U_r	(80-120)% of U_r	1,5 × U_r cont. 2,5 × U_r for 1 s
Frequency	f_r = 50/60 Hz	±5%	±10%
Auxiliary dc voltage, EL power consumption basic terminal each I/O-board each output relay	U_r = (48/60) V U_r=(110/125) V U_r=(220/250) V ≤14 W ≤1 W ≤0,1 W	±20% ±20% ±20%	±20% ±20% ±20%
Binary input circuits dc voltage, RL power consumption U_r = (24/30)V U_r = (48/60)V U_r =(110/125)V U_r =(220/250)V	 U_r = (24/30) V U_r = (48/60) V U_r=(110/125) V U_r=(220/250) V max. 0,05 W/input max. 0,1 W/input max. 0,2 W/input max. 0,4 W/input	 ±20% ±20% ±20% ±20%	 ±20% ±20% ±20% ±20%
Ambient temperature	20°C	-5°C to +55°C	-20° C to +70° C
Ripple in dc auxiliary voltage	max. 2%	max. 12%	Full wave recti-fied
Relative humidity	(10-90)%	(10-90)%	(0-95)%

*) max. 350 A for 1 s when COMBIFLEX test switch included together with the product

Table 2: Influencing factors, Permissible influence

Dependence on:	Within nominal range	Within operative range
Ambient temperature	0,01% / 1°C	Correct function
Ripple in auxiliary dc voltage	negligible	Correct function
Interruption in auxiliary dc voltage without resetting correct function restart time	 <50 ms 0 - ∞ <45 s	 <50 ms 0 - ∞ <45 s

Table 3: Electromagnetic compatibility tests

Test	Type test values	Reference standards
1 MHz burst disturbance	2,5 kV	IEC 255-22-1, Class III
Electrostatic discharge	8 kV	IEC 255-22-2, Class III
Fast transient disturbance	4 kV	IEC 255-22-4, Class IV
Radiated electromagnetic field disturbance	10 V/m, (25-1000) MHz	IEC 255-22-3 ANSI C37.90.2

Table 4: Insulation tests

Test	Type test values
Dielectric test - circuit to circuit and circuit to earth	2,0 kV ac 1 min
Impulse voltage test	5 kV, 1,2/50 µs, 0,5 J
Insulation resistance	>100 Mohm at 500 V dc

Table 5: Mechanical tests

Test	Type test values	Reference standards
Vibration	Class I	IEC 255-21-1
Shock and bump	Class I	IEC 255-21-2
Seismic	Class I	IEC 255-21-3

Table 6: Contact data (reference standard: IEC 255)

Function or quantity	Trip and Signal relays	Reed relays
Max system voltage	250 V ac, dc	250 V ac, dc
Test voltage across open contact, 1 min	1,0 kV RMS	800 V dc
Current carrying capacity continuous 1 s	 8 A 10 A	 0,4 A 0,4 A
Making capacity at inductive load with L/R>10 ms 0,2 s 1,0 s	 30 A 10 A	 0,4 A 0,4 A
Breaking capacity for ac, cos φ>0,4	250 V/8,0 A	250 V/8,0 A
Breaking capacity for dc with L/R<40 ms	48 V/1 A 110 V/0,4 A 220 V/0,2 A 250 V/0,15 A	48 V/1 A 110 V/0,4 A 220 V/0,2A 250 V/0,15 A
Maximum capacitive load	-	10 nF

Table 7: Connection system

Connector type	Rated voltage	Maximum square area	Maximum load continuous	Maximum load 1 s
Voltage connectors	250 V ac	2,5 mm^2 2×1 mm^2	10 A	30 A
Current connectors	250 V ac	4,0 mm^2	20 A	500 A

Table 8: Additional general data

Weight approx.	11 kg
Dimensions width height depth	 336 mm 267 mm 245 mm
Storage temperature	-40° C to +70° C