Diffusion : *Distribution*	Contrôlée *Controlled*	X	Non contrôlée *Uncontrolled*		Disponible sur informatique *Available on computer*	X

Validité document : *Document status*

B.P.I. *F I*		(Information) *(Information)*
B.P.O. *F C*		(Observation) *(Comments)*
B.P.E. *R F E*	X	(Exécution) *(Execution)*
B.P.A. *R P A*		(Application) *(Application)*

Destinataires :

PSJ :	POJ :
COB :	YK :
CEGELEC	

Titre : *Title*

UNDER CAPACITIVE IMPEDANCE FIELD FAILURE RELAY TZG. . . .

04 GTA 001 YE

Type : *Type* FIELD TEST GUIDE

Affaire : *Contract*

Numéro interne à l'affaire *Number specific to the contract*

Identifiant *Name*

Ind *Ind*	Rev *Rev*	Etabli *Prepared*	Vérifié *Checked*	Approuvé *Approved*	Modifications *Modifications*	Folios *Numbers*
	Par/*By*					
	Le/*On*					
	Par/*By*					
	Le/*On*					
B	Par/*By*	MICHELIN	TASCHINI	NIVELLEAU	Up to date	8
	Le/*On*	23/09/90	23/09/90	23/09/90		
A	Par/*By*	SEGONZAC	SIMON	TASCHINI		
	Le/*On*	08/02/88	08/02/88	08/02/88	Edition originale/*Original issue*	

Commission technique/*Technical committe*

Nom/*Name*	Visa/*Visa*	Date/*Date*
VEYRIER		
CHASSAGNE		

CEGELEC

M L V VOLUME 6 TE I 03 H F A B 2 0 0 3

Lieu de création *Place of issue* — Numéro de classement *File number*

2 RELAY CHARACTERISTICS

- Rated values : In = 5A
  Un = 100V 50Hz
- Relay locking : Uv : 0,4 UN
- Impedance setting range Xm : 1,6 to 8 Ω
  o : 8 to 63 Ω
- time lagging range : 0,4 to 4,4 step 0,4
- Auxiliary voltage supply : 125 V ⎓

3 GENERAL INSPECTION

- Wiring conformity in accordance with the following specified drawing(s) :
  - CGE JTR SGTA SD001
  - /
- Check of the module earthing — Correct
- Check of test sockets locate on the input and output circuit
  - . mechanical check — Correct
  - . electrical check — Correct
- Availability and value of auxiliary supply voltage
  U = 125VDC

4 RECEPTION TESTS

4.1 - Checking of the impedance operating values

. Arrangement for test : see the D1067.10 documentation

. Xm + ø = U/(2.I1) Xm = U/(2.I2)

. @ : phase angle between U and I

. U injected = 50 K = 1/2

Setting values			Measured values		Calculated values	
Xm (Ohm)	ø (Ohm)	@ (°)	I1 (A)	I2 (A)	Xm (Ohm)	ø (Ohm)
2	12,5	-45°	/	/	/	/
		-60°	2.22	/	/	/
		-90°	1.74	/	/	/
		-120°	2.03	/	/	/
4	12,5	-45°	/	/	/	/
		-60°	2.20	4.26	/	/
		-90°	1,52	6.1	4,1	12,35
		-120°	1.95	4.90	/	/

4.2 - Checking of the time delay

. Pre-adjust the value of current to be injected at on impedance value located within the operate circle :

$(Xm + o) < U/(2.I) < Xm$

Setting Value t(s)	0.4	1.2	2	2,8	3,6
Measured Value t(s)	0,408	1,221	2,033	2,839	3,648

4.3 Check of the directional property ..... Correct

4.4 Check of the lock-out input voltage

UL = 41,5V

4.5 Check of the test fonction..... Correct

4.6 Check of the output contacts..... Correct

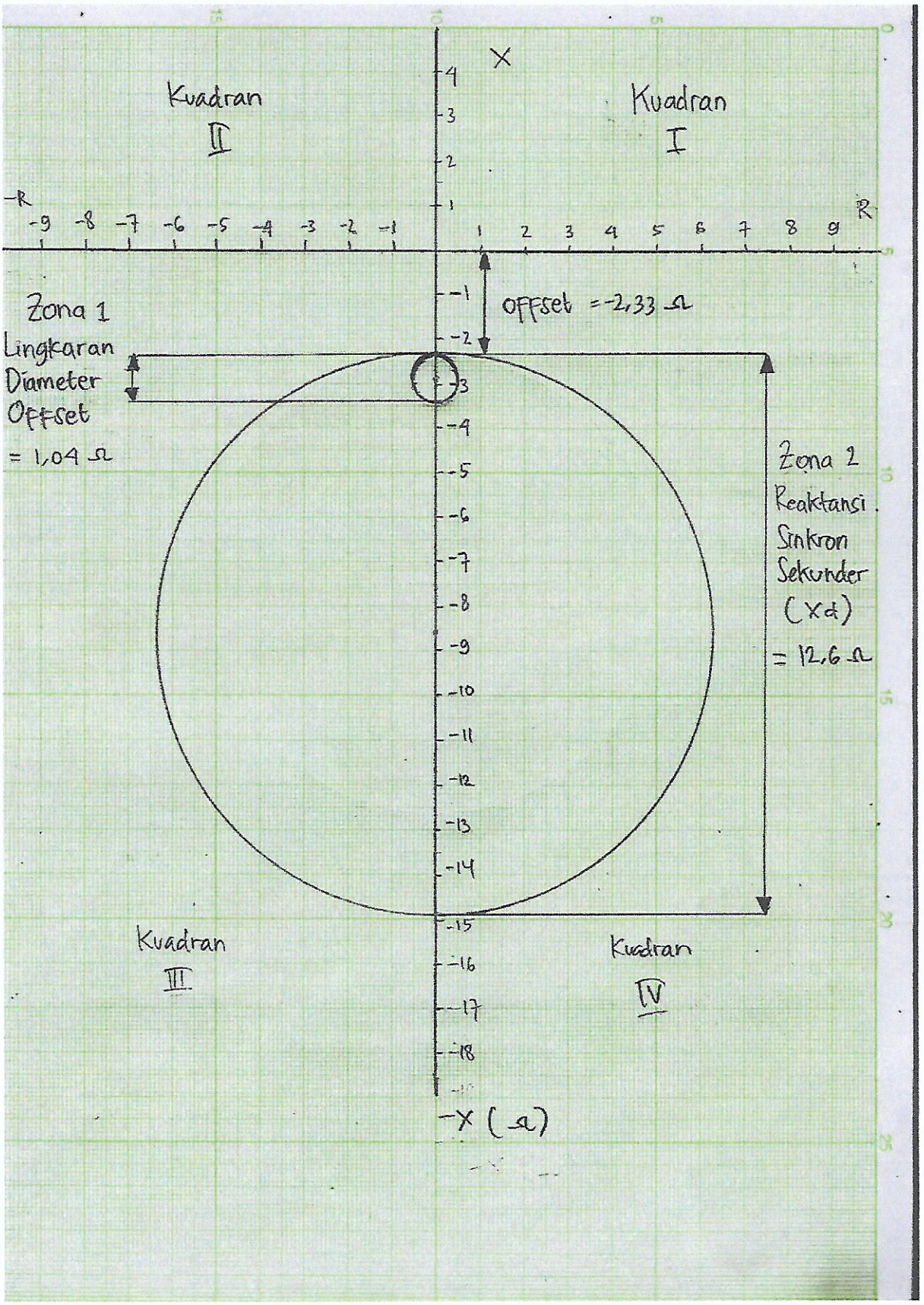
4.7 Check of the output informations..... Correct

4.8 Check of the signalization..... Correct

5 SELECTED VALUES

Xm = 2 ø = 12,5

T1 = 1,2 s



Grafik Karakteristik Rele Hilang Medan Offset Zona 2 Negatif Berdasar Perhitungan

sehingga KW = KVA Cos Ø.

KVAR = KVA Sin Ø.

dengan Ø adalah sudut antara vektor KW dan vektor KVA.

Kemampuan KVA ditentukan oleh kemampuan arus belitan stator.

Kemampuan KW ditentukan oleh kemampuan penggerak mula generator yaitu kemampuan turbin.

Kemampuan KVAR ditentukan oleh kemampuan arus belitan rotor, dan merupakan kemampuan untuk pengaturan tegangan generator / jaringan.

Faktor daya memberikan gambaran tentang :

- Tingkat pemanfaatan kemampuan KVA generator untuk keperluan produksi / pembangkitan daya aktif KW.
- Tingkat ekonomis konstruksi generator.
- Tingkat kemampuan pengatur tegangan generator / jaringan.

GENERATOR SATUAN I s/d V

Kemampuan nominal : 35 MVA, 6300 V ± 10%, 2840 A, 50 Hz, p.f = 0.8, 272,7 RPM.
Runaway speed = 590 RPM.

Impedansi : Xd = 1.0 Xd' = 0.37 Xd" = 0.20 X2 = 0.215
Xq = 0.66 Xq' = 0.66 xq" = 0.23 Xq = 0.09

Short circuit ratio = 1.10 PD^2 = 900 $T.M^2$.

Pendinginan : Oleh udara dengan sirkulasi tertutup : 35 m^3/det.
udara didinginkan oleh air : 39 liter/det.

Kenaikan temperatur : lilitan stator 65° C.
lilitan rotor 70° C, besi 55° C.

Kemampuan MVA sebagai fungsi temperatur air pendingin :

Temp. air	20° C	25° C	30° C	35° C	40° C
MVA	34	33	31	28	25.5

Penguatan generator :
beban nol : 78 V, 340 A
beban penuh p.f 0.8 : 192 V, 630 A
p.f 0.8 : 384 V impulse (> 5 detik)

Rugi-rugi :

Beban	4/4	3/4	2/4	0
p.f = 1.0	600 KW	510 KW	440 KW	385 KW
p.f = 0.8	665 KW	555 KW	470 KW	385 KW

Catatan : - sudah termasuk rugi-rugi angin.
- belum termasuk rugi-rugi mekanis pada bantalan.

Perubahan tegangan bila beban hilang tiba-tiba sedangkan arus penguat dan putaran tetap :

p.f.	0.8	0.9	1.0
V(%)	37 %	33 %	23 %

Temperatur nominal : dianggap - Temp. air pendingin = 30^{o} C
- Temp. udara pendingin $\leq$ 40^{o} C

Lilitan stator : 105^{o} C - diukur dengan pengukur temperatur jenis tahanan
110^{o} C - diukur dengan pengukur tahanan lilitan (cara super posisi).

Lilitan rotor : 110^{o} C - diukur dengan cara perubahan tahanan menggunakan arus searah.

Dengan tegangan = 90% nominal, generator mampu energize trans-line pada beban nol dan menyerap KVAR sebagai berikut :
- menyerap KVAR = 15.000 dengan If = 25% x 340 A
- menyerap KVAR = 20.000 dengan If = 10% x 340 A

Konstruksi :
- Lilitan stator : isolasi kelas B, Transposed Robel Conductor, 2 bar/stot, imbricated type.
- panjang : Ø stator = 4100 mm, Ø rotor = 4056 mm. celah udara = 22, jumlah alur = 270
- lilitan rotor : dilengkapi lilitan peredam.

Bila : 1 fasa putus
2 fasa yang lain dengan arus nominal) maka selama 1 menit mampu memikul tanpa rusak.

Bantalan aksial dan radial
Tipe : melumas sendiri, pendinginan oleh air bersih : 6 liter/detik, tipe Mitchel.

Air pendingin baru boleh berhenti 1/2 jam setelah satuan berhenti.
Kemampuan bantalan tanpa air pendingin :

RPM	272.7	136	590
waktu(lamanya)	40 menit	80 menit	18 menit

Pengereman : - dengan ferrodo yang dikerjakan oleh udara bertekanan
- pengereman mulai RPM = 1/2 Nominal

Dongkrak : - akan menaikkan generator setinggi 20 - 25 mm.

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

47 CFR 15B, Class A

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

UL Listed to U.S. and Canadian safety standards (File E212775, NRGU, NRGU7)

UL Certified for Hazardous Locations to U.S. and Canadian standards (File 4700448)

CE Mark

RCM Mark

General

AC Current Input

Phase and Neutral Currents

I_{NOM} = 1 A or 5 A secondary depending on model

I_{NOM} = 5 A

Continuous Rating:	3 • I_{NOM} @ 85°C, linear to 100 A symmetrical 4 • I_{NOM} @ 55°C, linear to 100 A symmetrical
1-Second Thermal:	500 A
Burden (per Phase):	<0.1 VA @ 5 A

I_{NOM} = 1 A

Continuous Rating:	3 • INOM @ 85°C, linear to 20 A symmetrical 4 • INOM @ 55°C, linear to 20 A symmetrical
1-Second Thermal:	100 A
Burden (per Phase):	<0.01 VA @ 1 A
Measurement Category:	II

AC Voltage Inputs

VNOM (L-L secondary) Range:	20–250 V (if DELTA_Y := DELTA) 20–440 V (if DELTA_Y := WYE)
Rated Continuous Voltage:	300 Vac
10-Second Thermal:	600 Vac
Burden:	<0.1 VA
Input Impedance:	4 MΩ differential (phase-to-phase) 7 MΩ common mode (phase-to-chassis)

Power Supply

Relay Start-Up Time:	Approximately 5–10 seconds (after power is applied until **ENABLED** LED turns on)

125/250 Vdc or 120/240 Vac

Rated Supply Voltage:	110–240 Vac, 50/60 Hz 110–250 Vdc
Input Voltage Range:	85–264 Vac 85–275 Vdc
Power Consumption:	<40 VA (ac) <20 W (dc)
Interruptions:	50 ms @ 125 Vac/Vdc 100 ms @ 250 Vac/Vdc

24/48 Vdc

Rated Supply Voltage:	24–48 Vdc
Input Voltage Range:	19.2–60 Vdc
Power Consumption:	<20 W (dc)
Interruptions:	10 ms @ 24 Vdc 50 ms @ 48 Vdc

Fuse Ratings

LV Power Supply Fuse

Rating:	3.15 A
Maximum Rated Voltage:	300 Vdc, 250 Vac
Breaking Capacity:	1500 A at 250 Vac
Type:	Time-lag T

HV Power Supply Fuse

Rating:	3.15 A
Maximum Rated Voltage:	300 Vdc, 250 Vac
Breaking Capacity:	1500 A at 250 Vac
Type:	Time-lag T
Heater Fuses F2, F3:	5 A, 125 V slow blow 125 Vdc/50 A break rating

Fuses are not serviceable.

Output Contacts

The relay supports Form A, B, and C outputs.

Dielectric Test Voltages:	2500 Vac
Impulse Withstand Voltage (U_{IMP}):	4700 V
Mechanical Durability:	100,000 no-load operations

Standard Contacts

Pickup/Dropout Time:	≤8 ms (coil energization to contact closure)

DC Output Ratings

Rated Operational Voltage:	250 Vdc
Rated Voltage Range:	19.2–275 Vdc
Rated Insulation Voltage:	300 Vdc
Make:	30 A @ 250 Vdc per IEEE C37.90
Continuous Carry:	6 A @ 70°C 4 A @ 85°C
Thermal:	50 A for 1 s
Contact Protection:	360 Vdc, 40 J MOV protection across open contacts

Breaking Capacity (10,000 Operations) per IEC 60255-0-20:1974:

24 Vdc	0.75 A	L/R = 40 ms
48 Vdc	0.50 A	L/R = 40 ms
125 Vdc	0.30 A	L/R = 40 ms
250 Vdc	0.20 A	L/R = 40 ms

Cyclic (2.5 Cycles/Second) per IEC 60255-0-20:1974:

24 Vdc	0.75 A	L/R = 40 ms
48 Vdc	0.50 A	L/R = 40 ms
125 Vdc	0.30 A	L/R = 40 ms
250 Vdc	0.20 A	L/R = 40 ms

AC Output Ratings

Maximum Operational Voltage (U_e) Rating:	240 Vac
Insulation Voltage (U_i) Rating (excluding EN 61010-1):	300 Vac

Contact Rating Designation: B300

B300 (5 A Thermal Current, 300 Vac Max)			
	Maximum Current		Max VA
Voltage	120 Vac	240 Vac	—
Make	30 A	15 A	3600
Break	3 A	1.5 A	360
PF < 0.35, 50–60 Hz			

Utilization Category: AC-15

AC-15		
Operational Voltage (Ue)	120 Vac	240 Vac
Operational Current (Ie)	3 A	1.5 A
Make Current	30 A	15 A
Break Current	3 A	1.5 A
Electromagnetic loads > 72 VA, PF < 0.3, 50–60 Hz		

Voltage Protection Across Open Contacts: 270 Vac, 40 J

Fast Hybrid (High-Speed, High-Current Interrupting)

DC Output Ratings

Rated Operational Voltage: 250 Vdc

Rated Voltage Range: 19.2–275 Vdc

Rated Insulation Voltage: 300 Vdc

Make: 30 A @ 250 Vdc per IEEE C37.90

Continuous Carry: 6 A @ 70°C
4 A @ 85°C

1-Second Rating: 50 A

Open State Leakage Current: <500 µA

MOV Protection (Maximum Voltage): 250 Vac/330 Vdc

Pickup Time: <50 µs, resistive load

Dropout Time: ≤8 ms, resistive load

Break Capacity (10,000 Operations) per IEC 60255-0-20:1974:

48 Vdc	10.0 A	L/R = 40 ms
125 Vdc	10.0 A	L/R = 40 ms
250 Vdc	10.0 A	L/R = 20 ms

Cyclic Capacity (4 cycles in 1 second, followed by 2 minutes idle for thermal dissipation) per IEC 60255-0-20:1974:

48 Vdc	10.0 A	L/R = 40 ms
125 Vdc	10.0 A	L/R = 40 ms
250 Vdc	10.0 A	L/R = 20 ms

AC Output Ratings

See *AC Output Ratings* for *Standard Contacts*.

Optoisolated Control Inputs

When Used With DC Control Signals

250 V: ON for 200–312.5 Vdc
OFF below 150 Vdc

220 V: ON for 176–275 Vdc
OFF below 132 Vdc

125 V: ON for 100–156.2 Vdc
OFF below 75 Vdc

110 V: ON for 88–137.5 Vdc
OFF below 66 Vdc

48 V: ON for 38.4–60 Vdc
OFF below 28.8 Vdc

24 V: ON for 15–30 Vdc
OFF for <5 Vdc

When Used With AC Control Signals

250 V: ON for 170.6–312.5 Vac
OFF below 106 Vac

220 V: ON for 150.2–275 Vac
OFF below 93.3 Vac

125 V: ON for 85–156.2 Vac
OFF below 53 Vac

110 V: ON for 75.1–137.5 Vac
OFF below 46.6 Vac

48 V: ON for 32.8–60 Vac
OFF below 20.3 Vac

24 V: ON for 14–30 Vac
OFF below 5 Vac

Current Draw at Nominal DC Voltage: 2 mA (at 220–250 V)
4 mA (at 48–125 V)
10 mA (at 24 V)

Rated Impulse Withstand Voltage (U_{imp}): 4000 V

Analog Output (Optional)

	1A0	4A0
Current:	4–20 mA	±20 mA
Voltage:	—	±10 V
Load at 1 mA:	—	0–15 kΩ
Load at 20 mA:	0–300 Ω	0–750 Ω
Load at 10 V:	—	>2000 Ω
Refresh Rate:	100 ms	100 ms
% Error, Full Scale, at 25°C:	<±1%	<±0.55%
Select From:	Analog quantities available in the relay	

Analog Input (Optional)

Maximum Input Range: ±20 mA
±10 V
Operational range set by user

Input Impedance: 200 Ω (current mode)
>10 kΩ (voltage mode)

Accuracy at 25°C:

With user calibration: 0.050% of full scale (current mode)
0.025% of full scale (voltage mode)

Without user calibration: Better than 0.5% of full scale at 25°C

Accuracy Variation With Temperature: ±0.015% per °C of full scale (±20 mA or ±10 V)

Frequency and Phase Rotation

System Frequency: 50, 60 Hz

Phase Rotation: ABC, ACB

Frequency Tracking: 15–70 Hz

Time-Code Input

Format: Demodulated IRIG-B

On (1) State: $V_{ih} \geq 2.2$ V

Off (0) State: $V_{il} \leq 0.8$ V

Input Impedance: 2 kΩ

Synchronization Accuracy

Internal Clock: ±1 µs

Synchrophasor Reports (e.g., MET PM): ±10 µs

All Other Reports: ±5 ms

Simple Network Time Protocol (SNTP) Accuracy: ±5 ms

Unsynchronized Clock Drift Relay Powered: 2 minutes per year, typically

Communications Ports

Standard EIA-232 (2 ports)

Location:	Front Panel Rear Panel
Data Speed:	300–38400 bps

EIA-485 Port (Optional)

Location:	Rear Panel
Data Speed:	300–19200 bps

Ethernet Port (Optional)

Single/Dual 10/100BASE-T copper (RJ45 connector)
Single/Dual 100BASE-FX (LC connector)

Standard Multimode Fiber-Optic Port

Location:	Rear Panel
Data Speed:	300–38400 bps

Fiber-Optic Ports Characteristics

Port 1 (or 1A, 1B) Ethernet

Wavelength:	1300 nm
Optical Connector Type:	LC
Fiber Type:	Multimode
Link Budget:	16.1 dB
Typical TX Power:	–15.7 dBm
RX Min. Sensitivity:	–31.8 dBm
Fiber Size:	62.5/125 µm
Approximate Range:	~6.4 km
Data Rate:	100 Mbps
Typical Fiber Attenuation:	–2 dB/km

Port 2 Serial

Wavelength:	820 nm
Optical Connector Type:	ST
Fiber Type:	Multimode
Link Budget:	8 dB
Typical TX Power:	–16 dBm
RX Min. Sensitivity:	–24 dBm
Fiber Size:	62.5/125 µm
Approximate Range:	~1 km
Data Rate:	5 Mbps
Typical Fiber Attenuation:	–4 dB/km

Optional Communications Cards

Option 1:	EIA-232 or EIA-485 communications card
Option 2:	DeviceNet communications card

Communications Protocols

SEL, Modbus, DNP, FTP, TCP/IP, Telnet, SNTP, IEC 61850, MIRRORED BITS, EVMSG, C37.118 (synchrophasors), and DeviceNet

Operating Temperature

IEC Performance Rating:	–40° to +85°C (–40° to +185°F) (per IEC/EN 60068-2-1 and 60068-2-2)

NOTE: Not applicable to UL applications

NOTE: LCD contrast is impaired for temperatures below –20°C and above +70°C

DeviceNet Communications Card Rating:	+60°C (140°F) maximum

Operating Environment

Pollution Degree:	2
Overvoltage Category:	II
Atmospheric Pressure:	80–110 kPa
Relative Humidity:	5–95%, noncondensing
Maximum Altitude:	2000 m

Dimensions

144.0 mm (5.67 in) x 192.0 mm (7.56 in) x 147.4 mm (5.80 in)

Weight

2.0 kg (4.4 lb)

Relay Mounting Screw (#8–32) Tightening Torque

Minimum:	1.4 Nm (12 in-lb)
Maximum:	1.7 Nm (15 in-lb)

Terminal Connections

Terminal Block

Screw Size:	#6
Ring Terminal Width:	0.310 inch maximum

Terminal Block Tightening Torque

Minimum:	0.9 Nm (8 in-lb)
Maximum:	1.4 Nm (12 in-lb)

Compression Plug Tightening Torque

Minimum:	0.5 Nm (4.4 in-lb)
Maximum:	1.0 Nm (8.8 in-lb)

Compression Plug Mounting Ear Screw Tightening Torque

Minimum:	0.18 Nm (1.6 in-lb)
Maximum:	0.25 Nm (2.2 in-lb)

Type Tests

Environmental Tests

Enclosure Protection:	IEC 60529:2001 IP65 enclosed in panel IP20 for terminals IP54 rated terminal dust protection assembly (SEL Part #915900170). 10°C temperature derating applies to the temperature specifications of the relay.
Vibration Resistance:	IEC 60255-21-1:1988, Class 2 Endurance Class 2 Response IEC 60255-21-3:1993, Class 2
Shock Resistance:	IEC 60255-21-2:1988, Class 1 Shock Withstand, Bump Class 2 Shock Response
Cold:	IEC 60068-2-1:2007 –40°C, 16 hours
Damp Heat, Steady State:	IEC 60068-2-78:2001 40°C, 93% relative humidity, 4 days
Damp Heat, Cyclic:	IEC 60068-2-30:2005 25–55°C, 6 cycles, 95% relative humidity
Dry Heat:	IEC 60068-2-2:2007 85°C, 16 hours

Dielectric Strength and Impulse Tests

Dielectric (HiPot):	IEC 60255-5:2000 IEEE C37.90-2005 2.5 kVac on current inputs, voltage inputs, contact I/O 2.0 kVac on analog inputs 1.0 kVac on analog output 2.83 kVdc on power supply
Impulse:	IEC 60255-5:2000 0.5 J, 4.7 kV on power supply, contact I/O, ac current and voltage inputs 0.5 J, 530 V on analog outputs

RFI and Interference Tests

EMC Immunity

Electrostatic Discharge Immunity:	IEC 60255-22-2:2008 IEC 61000-4-2:2008 Severity Level 4 8 kV contact discharge 15 kV air discharge
Radiated RF Immunity:	IEC 60255-22-3:2007 IEC 61000-4-3:2002, 10 V/m IEEE C37.90.2-1995, 35 V/m
Fast Transient, Burst Immunity:	IEC 60255-22-4:2008 IEC 61000-4-4:2004 4 kV @ 2.5 kHz 2 kV @ 5.0 kHz for comm. ports
Surge Immunity:	IEC 60255-22-5:2008 IEC 61000-4-5:2005 2 kV line-to-line 4 kV line-to-earth
Surge Withstand Capability Immunity:	IEC 60255-22-1:1988 2.5 kV common mode 1.0 kV differential mode 1 kV common mode on comm. ports IEEE C37.90.1-2002 2.5 kV oscillatory 4 kV fast transient
Conducted RF Immunity:	IEC 60255-22-6:2001 IEC 61000-4-6:2006, 10 Vrms
Magnetic Field Immunity:	IEC 61000-4-8:2001 1000 A/m for 3 seconds 100 A/m for 1 minute

EMC Emissions

Conducted Emissions:	EN 55011:1998, Class A
Radiated Emissions:	EN 55011:1998, Class A

Electromagnetic Compatibility

Product Specific:	EN 50263:1999

Processing Specifications and Oscillography

AC Voltage and Current Inputs:	32 samples per power system cycle
Analog Inputs:	4 samples per power system cycle
Frequency Tracking Range:	15–70 Hz
Digital Filtering:	One-cycle cosine after low-pass analog filtering. Net filtering (analog plus digital) rejects dc and all harmonics greater than the fundamental.
Protection and Control Processing:	Processing interval is 4 times per power system cycle (except for math variables and analog quantities, which are processed every 100 ms). The protection elements 40, 51, and 78 are processed twice per cycle. Analog quantities for rms data are determined through use of data averaged over the previous 8 cycles.

Oscillography

Length:	15, 64, 180 cycles
Sampling Rate:	32 samples per cycle unfiltered 4 samples per cycle filtered
Trigger:	Programmable with Boolean expression
Format:	ASCII and Compressed ASCII
Time-Stamp Resolution:	1 ms
Time-Stamp Accuracy:	±5 ms

Sequential Events Recorder

Time-Stamp Resolution:	1 ms
Time-Stamp Accuracy (with respect to time source):	±5 ms

Relay Elements

Instantaneous/Definite Time-Overcurrent (50P, 50G, 50N, 50Q)

Pickup Setting Range, A secondary:

5 A models:	0.50–96.00 A, 0.01 A steps
1 A models:	0.10–19.20 A, 0.01 A steps
Accuracy:	±5% of setting plus ±0.02 • I_{NOM} A secondary (steady-state pickup)
Time Delay:	0.00–400.00 seconds, 0.01 seconds steps, ±0.5% plus ±0.25 cycle 0.10–400.00 seconds, 0.01 seconds steps, ±0.5% plus ±0.25 cycle for 50Q
Pickup/Dropout Time:	<1.5 cycles

Inverse Time-Overcurrent (51P, 51G, 51N, 51Q)

Pickup Setting Range, A secondary:

5 A models:	0.50–16.00 A, 0.01 A steps
1 A models:	0.10–3.20 A, 0.01 A steps
Accuracy:	±5% of setting plus ±0.02 • I_{NOM} A secondary (steady-state pickup)
Time Dial:	
US:	0.50–15.00, 0.01 steps
IEC:	0.05–1.00, 0.01 steps
Accuracy:	±1.5 cycles plus ±4% between 2 and 30 multiples of pickup (within rated range of current)

Differential (87)

Unrestrained Pickup Range:	1.0–20.0 in per unit of TAP
Restrained Pickup Range:	0.10–1.00 in per unit of TAP
Pickup Accuracy (A secondary):	
5 A Model:	±5% plus ±0.10 A
1 A Model:	±5% plus ±0.02 A
TAP Range (A secondary):	
5 A Model:	0.5–31.0 A
1 A Model:	0.1–6.2 A

Unrestrained Element

Pickup Time:	0.8/1.0/1.9 cycles (Min/Typ/Max)

Restrained Element (With Harmonic Blocking)

Pickup Time:	1.5/1.6/2.2 cycles (Min/Typ/Max)

Restrained Element (With Harmonic Restraint)

Pickup Time:	2.62/2.72/2.86 cycles (Min/Typ/Max)

Harmonics

Pickup Range (% of fundamental):	5–100%
Pickup Accuracy (A secondary):	
5 A Model:	±5% plus ±0.10 A of harmonic current
1 A Model:	±5% plus ±0.02 A of harmonic current
Time Delay Accuracy:	±0.5% plus ±0.25 cycle

Restricted Earth Fault (REF)

Pickup Range (per unit of INOM of neutral current input, IN):	0.05–3.00 per unit, 0.01 per-unit steps
Pickup Accuracy (A secondary):	
5 A Model:	±5% plus ±0.10 A
1 A Model:	±5% plus ±0.02 A
Timing Accuracy:	
Directional Output:	1.5 ±0.25 cycle
ANSI Extremely Inverse TOC Curve (U4 With 0.5 Time Dial):	±5 cycles plus ±5% between 2 and 30 multiples of pickup (within rated range of current)

Undervoltage (27P, 27PP, 27V1, 27S)

Pickup Range:	Off, 2.0–300.0 V (2.0–520.0 V for phase-to-phase wye connected; 2.0–170.0 V positive-sequence, delta connected)
Accuracy:	±5% of setting plus ±2 V
Pickup/Dropout Time:	<1.5 cycle
Time Delay:	0.00–120.00 seconds, 0.01 second steps
Accuracy:	±0.5% plus ±0.25 cycle

Overvoltage (59P, 59PP, 59V1, 59S, 59Q, 59G)

Pickup Range:	Off, 2.0–300.0 V (2.0–520.0 V for phase-to-phase wye connected; 2.0–170.0 V positive sequence, delta connected)
Pickup Range (59G, 59Q):	Off, 2.0–200.0 V
Accuracy:	±5% of setting plus ±2 V
Pickup/Dropout Time:	<1.5 cycle
Time Delay:	0.00–120.00 seconds, 0.01 second steps
Accuracy:	±0.5% plus ±0.25 cycle

Volts/Hertz (24)

Definite-Time Element

Pickup Range:	100–200%
Steady-State Pickup Accuracy:	±1% of setpoint
Pickup Time:	25 ms @ 60 Hz (Max)
Time-Delay Range:	0.04–400.00 s
Time-Delay Accuracy:	±0.1% plus ±4.2 ms @ 60 Hz
Reset Time Range:	0.00–400.00 s

Inverse-Time Element

Pickup Range:	100–200%
Steady-State Pickup Accuracy:	±1% of setpoint
Pickup Time:	25 ms @ 60 Hz (Max)
Curve:	0.5, 1.0, or 2.0
Factor:	0.1–10.0 s
Timing Accuracy:	±4% plus ±25 ms @ 60 Hz, for V/Hz above 1.2 multiple of pickup setting, and for operating times >4 s
Reset Time Range:	0.00–400.00 s

Composite-Time Element

Combination of Definite-Time and Inverse-Time specifications

User-Definable Curve Element

Pickup Range:	100–200%
Steady-State Pickup Accuracy:	±1% of setpoint
Pickup Time:	25 ms @ 60 Hz (Max)
Reset Time Range:	0.00–400.00 s

Directional Power (32)

Instantaneous/Definite Time, 3 Phase Elements

Type:	+W, –W, +VAR, –VAR
Pickup Settings Range, VA secondary:	
5 A Model:	1.0–6500.0 VA, 0.1 VA steps
1 A Model:	0.2–1300.0 VA, 0.1 VA steps
Accuracy:	±0.10 A • (L-L voltage secondary) and ±5% of setting at unity power factor for power elements and zero power factor for reactive power element (5 A nominal) ±0.02 A • (L-L voltage secondary) and ±5% of setting at unity power factor for power elements and zero power factor for reactive power element (1 A nominal)
Pickup/Dropout Time:	<10 cycles
Time Delay:	0.00–240.00 seconds, 0.01 second steps
Accuracy:	±0.5% plus ±0.25 cycle

Frequency (81)

Setting Range:	Off, 15.0–70.0 Hz
Accuracy:	±0.01 Hz (V1 > 60 V)
Pickup/Dropout Time:	<4 cycles
Time Delay:	0.00–240.00 seconds, 0.01 second steps
Accuracy:	±0.5% plus ±0.25 cycle

RTD Protection

Setting Range:	Off, 1–250°C
Accuracy:	±2°C
RTD Open-Circuit Detection:	>250°C
RTD Short-Circuit Detection:	<–50°C
RTD Types:	PT100, NI100, NI120, CU10
RTD Lead Resistance:	25 ohm max. per lead
Update Rate:	<3 s
Noise Immunity on RTD Inputs:	To 1.4 Vac (peak) at 50 Hz or greater frequency
RTD Trip/Alarm Time Delay:	Approx. 6 s

Distance Element (21)

Two zones of Compensator Distance elements with Load Encroachment block

Reach Pickup Range:	5 A model: 0.1–100.0 ohms 1 A model: 0.5–500.0 ohms
Offset Range:	5 A model: 0.0–10.0 ohms 1 A model: 0.0–50.0 ohms
Steady-State Impedance Accuracy:	5 A model: ±5% plus ±0.1 ohm 1 A mode: ±5% plus ±0.5 ohm
Pickup Time:	33 ms at 60 Hz (Max)

Definite-Time Delay:	0.00–400.00 s
Accuracy:	±0.1% plus ±0.25 cycle
Minimum Phase Current:	5 A model: 0.5 A 1 A model: 0.1 A
Maximum Torque Angle Range:	90–45°, 1° step

Loss-of-Field Element (40)

Two Mho Zones

Zone 1 Offset:	5 A model: –50.0 to 0.0 ohms 1 A model: –250.0 to 0.0 ohms
Zone 2 Offset:	5 A model: –50.0 to 50.0 ohms 1 A model: –250.0 to 250.0 ohms
Zone 1 and Zone 2 Diameter:	5 A model: 0.1–100.0 ohms 1 A model: 0.5–500.0 ohms
Steady-State Impedance Accuracy:	5 A model: ± 0.1 ohm plus ±5% of (offset + diameter) 1 A model: ±0.5 ohm plus ±5% of (offset + diameter)
Minimum Pos.-Seq. Signals:	5 A model: 0.25 V (V1), 0.25 A (I1) 1 A model: 0.25 V (V1), 0.05 A (I1)
Directional Element Angle:	–20.0° to 0.0°
Pickup Time:	3 cycles (Max)
Zone 1 and Zone 2 Definite-Time Delays:	0.00–400.00 s
Accuracy:	±0.1% plus ±1/2 cycle

Voltage-Restrained Phase Time-Overcurrent Element (51V)

Phase Pickup (A secondary):	5 A Model: 2.0–16.0 A 1 A Model: 0.4–3.2 A
Steady-State Pickup Accuracy:	5 A Model: ±5% plus ±0.10 A 1 A Model: ±5% plus ±0.02 A
Time Dials:	US: 0.50–15.00, 0.01 steps IEC: 0.05–1.00, 0.01 steps
Accuracy:	±4% plus ±1.5 cycles for current between 2 and 20 multiples of pickup (within rated range of current)
Linear Voltage Restraint Range:	0.125–1.000 per unit of VNOM

Voltage-Controlled Phase Time-Overcurrent Element (51C)

Phase Pickup (A secondary):	5 A Model: 0.5–16.0 A 1 A Model: 0.1–3.2 A
Steady State Pickup Accuracy:	5 A Model: ±5% plus ±0.10 A 1 A Model: ±5% plus ±0.02 A
Time Dials:	US: 0.50–15.00, 0.01 steps IEC: 0.05–1.00, 0.01 steps
Accuracy:	±4% plus ±1.5 cycles for current between 2 and 20 multiples of pickup (within rated range of current)

100 Percent Stator Ground Protection (64G)

Neutral Fundamental Overvoltage (64G1):	OFF, 0.1–150.0 V
Steady-State Pickup Accuracy:	±5% plus ±0.1 V
Pickup Time:	1.5 cycles (Max)
Definite-Time Delay:	0.00–400.00 s
Accuracy:	±0.1% plus ±0.25 cycle
Third-Harmonic Voltage Differential or Third-Harmonic Neutral Undervoltage Pickup 64G2:	0.1–20.0 V
Steady-State Pickup Accuracy:	±5% plus ±0.1 V
Third-Harmonic Voltage Differential Ratio Setting Range:	0.0 to 5.0
Pickup Time:	3 cycles (Max)
Definite-Time Delay:	0.00–400.00 s
Accuracy:	±0.1% plus ±0.25 cycle

Field Ground Protection (64F) (Requires SEL-2664 Field Ground Module)

Field Ground Protection Element:	0.5–200.0 kilohms, 0.1 kilohm step
Pickup Accuracy:	±5% plus ±500 ohms for 48 ± VF ± 825 Vdc ±5% plus ±20 kilohms for 825 < VF ± 1500 Vdc (VF is the generator field winding excitation dc voltage)
Pickup Time:	2 s if the injection frequency in the SEL-2664 is selected at 1 Hz 8 s if the injection frequency in the SEL-2664 is selected at 0.25 Hz
Definite-Time Delay:	0.0–99.0 s
Maximum Definite-Time Delay Accuracy:	±0.5% plus ±5 ms

Out-of-Step Element (78)

Forward Reach:	5 A model: 0.1–100.0 ohms 1 A model: 0.5–500.0 ohms
Reverse Reach:	5 A model: 0.1–100.0 ohms 1 A model: 0.5–500.0 ohms

Single Blinder

Right Blinder:	5 A model: 0.1–50.0 ohms 1 A model: 0.5–250.0 ohms
Left Blinder:	5 A model: 0.1–50.0 ohms 1 A model: 0.5–250.0 ohms

Double Blinder

Outer Resistance Blinder:	5 A model: 0.2–100.0 ohms 1 A model: 1.0–500.0 ohms
Inner Resistance Blinder:	5 A model: 0.1–50.0 ohms 1 A model: 0.5–250.0 ohms
Steady-State Impedance Accuracy:	5 A model: ±0.1 ohm plus ±5% of diameter 1 A model: ±0.5 ohm plus ±5% of diameter
Pos.-Seq. Current Supervision:	5 A model: 0.25–30.00 A 1 A model: 0.05–6.00 A
Pickup Time:	3 cycles (Max)
Definite Time Delay:	0.00–1.00 s, 0.01 s step
Trip Delay Range:	0.00–1.00 s, 0.01 s step
Trip Duration Range:	0.00–5.00 s, 0.01 s step
Definite-Time Timers:	±0.1% plus ±1/2 cycle

Ground Differential Elements (87N)

Ground Differential Pickup:	5 A Model: 0.10*CTR/CTRN – 15.00 A 1 A Model: 0.02*CTR/CTRN – 3.00 A (Ratio CTR/CTRN must be within 1.0–40.0)
Steady-State Pickup Accuracy:	5 A Model: ±5% plus ±0.10 A 1 A Model: ±5% plus ±0.02 A
Pickup Time:	1.5 cycles (Max)
Time Delay Range:	0.00–5.00 s
Time Delay Accuracy:	±0.5% plus ±1/4 cycle

Negative-Sequence Overcurrent Elements (46)

Definite-Time and Inverse-Time Neg.-Seq. I^2 Pickup:	2%–100% of generator rated secondary current
Generator Rated Secondary Current:	5 A Model: 1.0–10.0 A secondary 1 A Model: 0.2–2.0 A secondary
Steady-State Pickup Accuracy:	5 A Model: ±0.025 A plus ±3% 1 A Model: ±0.005 A plus ±3%
Pickup Time:	50 ms at 60 Hz (Max)
Definite-Time Delay Setting Range:	0.02–999.90 s
Maximum Definite-Time Delay Accuracy:	±0.1% plus ±4.2 ms at 60 Hz
Inverse-Time Element Time Dial:	K = 1 to 100 s
Linear Reset Time:	240 s fixed
Inverse-Time Timing Accuracy:	±4% plus ±50 ms at 60 Hz for $\lvert I_2 \rvert$ above 1.05 multiples of pickup

Rate-of-Change of Frequency (81R)

Pickup Setting Range:	Off, 0.10–15.00 Hz/s
Accuracy:	±100 mHz/s plus ±3.33% of pickup
Trend Setting:	INC, DEC, ABS
Pickup/Dropout Time:	3–30 cycles, depending on pickup setting
Pickup/ Dropout Delay Range:	0.10–60.00/0.00–60.00 s, 01 s increments
Voltage Supervision (Positive Sequence) Pickup Range:	Off, 12.5–300.0 V, 0.1 V increments

Synchronism Check (25Y) for Tie Breaker

Synchronism-Check Voltage Source:	VAY, VBY, VCY, VABY, VBCY, VCAY or angle from VAY or VABY
Voltage Window High Setting Range:	0.00–300.00 V
Voltage Window Low Setting Range:	0.00–300.00 V
Steady-State Voltage Accuracy:	±5% plus ±2.0 V (over the range of 12.5–300 V)
Maximum Percentage Voltage Difference:	1.0–15.0%
Maximum Slip Frequency:	–0.05 Hz to 0.50 Hz
Steady-State Slip Accuracy:	±0.02 Hz
Close Acceptance Angle 1, 2:	0–80°
Breaker Close Delay:	0.001–1.000 s
Steady-State Angle Accuracy:	±2°

Synchronism Check (25X) for Generator Breaker

Synchronism-Check Voltage Source:	VAX, VBX, VCX, VABX, VBCX, VCAX or angle from VAX or VABX
Voltage Window High Setting Range:	0.00–300.00 V
Voltage Window Low Setting Range:	0.00–300.00 V
Steady-State Voltage Accuracy:	±5% plus ±2.0 V (over the range of 12.5–300 V)
Maximum Percentage Voltage Difference:	1.0–15.0%
Minimum Slip Frequency:	–1.00 Hz to 0.99 Hz
Maximum Slip Frequency:	–0.99 Hz to 1.00 Hz
Steady-State Slip Accuracy:	±0.02 Hz
Close Acceptance Angle 1, 2:	0–80°
Target Close Angle:	–15 to 15°
Breaker Close Delay:	0.001–1.000 s
Close Failure Angle:	3–120°
Steady-State Angle Accuracy:	±2°

Generator Thermal Model (49T)

Thermal Overload Trip Pickup Level:	30–250% of full load current (full load current INOM range: 0.2–2.0 • I_{NOM}, where I_{NOM} = 1 A or 5 A)
TCU Alarm Pickup Level:	50–99% Thermal Capacity Used
Time-Constant Range (2):	1–1000 minutes
Time Accuracy Pickup/ Dropout Time:	±(5% + 25 ms) at multiple-of-pickup ≥2, 50/60 Hz (pre-load = 0)

Autosynchronizing

Frequency Matching

Speed (Frequency) Control Outputs:	
Raise:	Digital output, adjustable pulse duration and interval
Lower:	Digital output, adjustable pulse duration and interval
Frequency Synchronism Timer:	5–3600 s, 1 s increments
Frequency Adjustment Rate:	0.01–10.00 Hz/s, 0.01 Hz/s increment
Frequency Pulse Interval:	1–120 s, 1 s increment
Frequency Pulse Minimum:	0.10–60.00 s, 0.01 s increment
Frequency Pulse Maximum:	0.10–60.00 s, 0.01 s increment
Kick Pulse Interval:	1–120 s, 1 s increments
Kick Pulse Minimum:	0.02–2.00 s, 0.01 s increments
Kick Pulse Maximum:	0.02–2.00 s, 0.01 s increments

Voltage Matching

Voltage Control Outputs:	
Raise:	Digital Output, adjustable pulse duration and interval
Lower:	Digital Output, adjustable pulse duration and interval
Voltage Synchronized Timer:	5–3600 s, 1 s increments
Voltage Adjustment Rate (Control System):	0.01–30.00 V/s, 0.01 V/s increment
Voltage Pulse Interval:	1–120 s, 1 s increment
Voltage Control Pulse Minimum:	0.10–60.00 s, 0.01 s increment
Voltage Control Pulse Maximum:	0.10–60.00 s, 0.01 s increment
Timing Accuracy:	±0.5% plus ±1/4 cycle

Metering Accuracy

Accuracies are specified at 20°C, nominal frequency, ac currents within (0.2–20.0) • I_{NOM} A secondary, and ac voltages within 50–250 V secondary unless otherwise noted.

Phase Currents:	±1% of reading, ±1° (±2.5° at 0.2–0.5 A for relays with I_{NOM} = 1 A)
3-Phase Average Current:	±1% of reading
Differential Quantities:	±5% of reading plus ±0.1 A (5 A nominal), ±0.02 A (1 A nominal)
Current Harmonics:	±5% of reading plus ±0.1 A (5 A nominal), ±0.02 A (1 A nominal)
IG (Residual Current):	±2% of reading, ±2° (±5.0° at 0.2–0.5 A for relays with I_{NOM} = 1 A)
IN (Neutral Current):	±1% of reading, ±1° (±2.5° at 0.2–0.5 A for relays with I_{NOM} = 1 A)
3I2 Negative-Sequence Current:	±2% of reading

System Frequency:	±0.01 Hz of reading for frequencies within 20–70 Hz (V1 > 60 V)
Line-to-Line Voltages:	±1% of reading, ±1° for voltages within 24–264 V
3-Phase Average Line-to-Line Voltage:	±1% of reading for voltages within 24–264 V
Line-to-Ground Voltages:	±1% of reading, ±1° for voltages within 24–264 V
3-Phase Average Line-to-Ground Voltages:	±1% of reading for voltages within 24–264 V
Voltage Harmonics:	±5% of reading plus ±0.5 V
3V2 Negative-Sequence Voltage:	±2% of reading for voltages within 24–264 V
Real 3-Phase Power (kW):	±3% of reading for 0.10 < pf < 1.00
Reactive 3-Phase Power (kVAR):	±3% of reading for 0.00 < pf < 0.90
Apparent 3-Phase Power (kVA):	±3% of reading
Power Factor:	±2% of reading
RTD Temperatures:	±2°C

Synchrophasor Accuracy

Maximum Message Rate

Nominal 60 Hz System:	60 messages per second
Nominal 50 Hz System:	50 messages per second

Accuracy for Voltages

Level 1 compliant as specified in IEEE C37.118 under the following conditions for the specified range.

Conditions:

- At maximum message rate
- When phasor has the same frequency as the positive-sequence tracking quantity (see *Table H.10*)
- Frequency-based phasor compensation is enabled (PHCOMP := Y)
- The narrow bandwidth filter is selected (PMAPP := N)

Range:

Frequency:	±5.0 Hz of nominal (50 or 60 Hz)
Magnitude:	30 V–250 V
Phase Angle:	–179.99° to 180°
Out-of-Band Interfering Frequency (Fs):	10 Hz ≤ Fs ≤ (2 • FNOM)

Accuracy for Currents

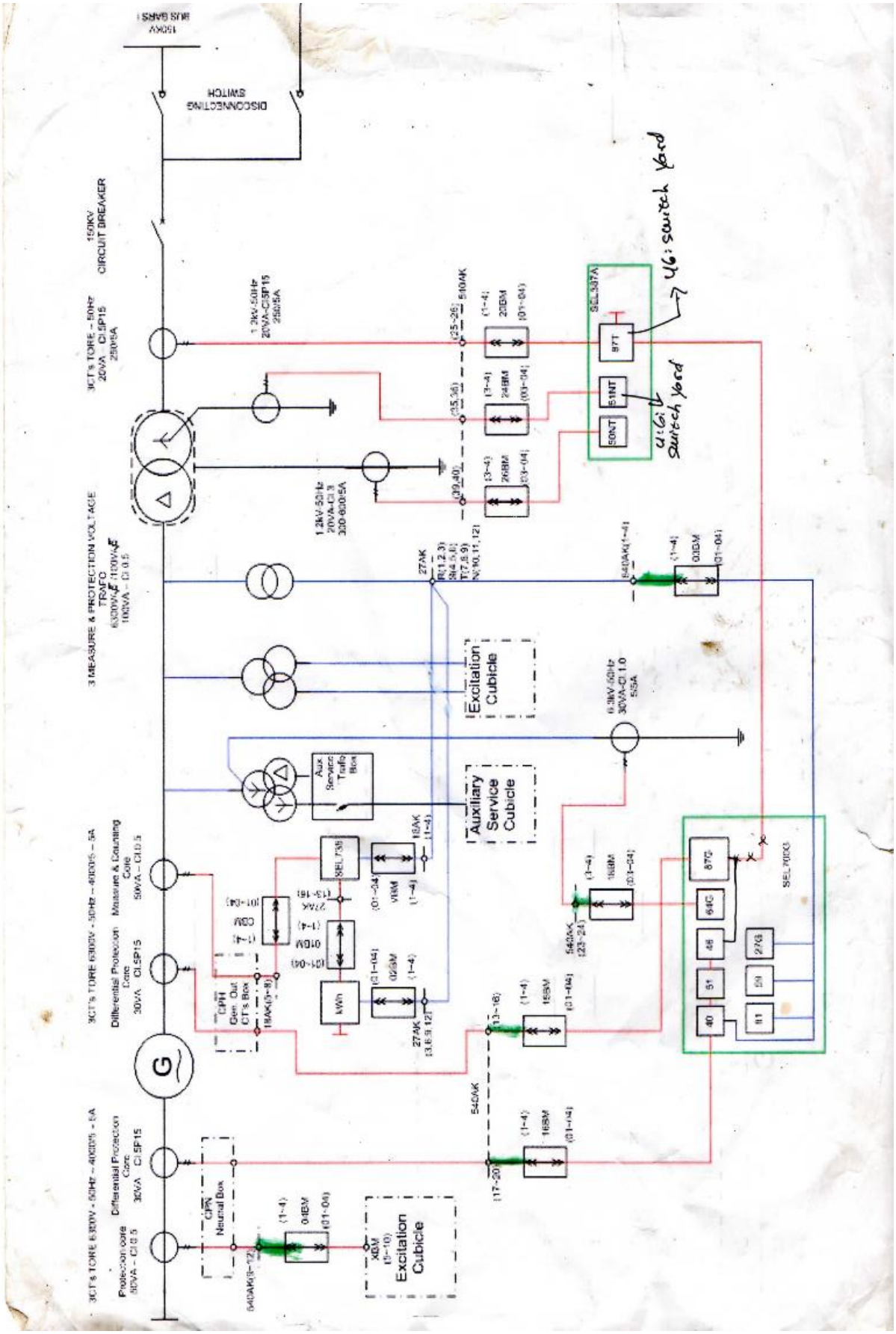
Level 1 compliant as specified in IEEE C37.118 under the following conditions for the specified range.

Conditions:

- At maximum message rate
- When phasor has the same frequency as the positive-sequence tracking quantity (see *Table H.10*)
- Frequency-based phasor compensation is enabled (PHCOMP := Y)
- The narrow bandwidth filter is selected (PMAPP := N)

Range:

Frequency:	±5.0 Hz of nominal (50 or 60 Hz)
Magnitude:	(0.4–2) • I_{NOM} (I_{NOM} = 1 A or 5 A)
Phase Angle:	–179.99 to 180°
Out-of-Band Interfering Frequency (Fs):	10 Hz ≤ Fs ≤ (2 • FNOM)



Single Line Diagram Proteksi PLTA Ir. H. Djuanda Jatiluhur

Lampiran : 3
No. Formulir : F-Pros. 19.03

Kepada Yth,
General Manajer Unit PLTA
Perum Jasa tirta II
di
Jatiluhur

LAPORAN GANGGUAN

I. Gangguan : Hari/ Tanggal : Kamis / 05 Oktober 2017
Pukul : 09.39
Jenis Gangguan : TBB1, Penguatan

II. Indikasi Gangguan :
☐ Di PLC

☑ Di Panel Komando
: TBB1, Penguatan

III. Pemeriksaan dan Perbaikan :
- Pemeriksaan : Pemeriksaan pada P. PLC & P.AVR
- Perbaikan : Pengecekan tegangan di Panel AVR

IV. Sebab Gangguan :
- Eksitasi fault.

IV. Akibat Gangguan :
- Unit 3 tidak beroperasi

IV. Verifikasi Keefektifan Tindakan Perbaikan
- Unit 3 Kembali Beroperasi pada pukul 11.16

Unit PLTA
Manajer Operasional Pembangkitan

H. Ade Suhaedin, ST
NIK. 04078 9270

Lampiran : 3
No. Formulir : F-Pros. 19.03

Kepada Yth,
General Manajer Unit PLTA
Perum Jasa tirta II
di
Jatiluhur

LAPORAN GANGGUAN

I. Gangguan : Hari/ Tanggal : Kamis / 05 Oktober 2017
Pukul : 14.47
Jenis Gangguan : LT1, Penguatan, Trafo35MVA

II. Indikasi Gangguan :
☐ Di PLC

☑ Di Panel Komando
: LT1, Penguatan, Trafo35MVA

III. Pemeriksaan dan Perbaikan :
- Pemeriksaan : Pemeriksaan pada P. PLC & P.AVR
- Perbaikan : Pengecekan Tegangan Eksitasi

IV. Sebab Gangguan :
- Eksitasi fault

IV. Akibat Gangguan :
- Unit 3 tidak beroperasi

IV. Verifikasi Keefektifan Tindakan Perbaikan
- Unit 3 Kembali Beroperasi pada pukul 20.41

Unit PLTA
Manajer Operasional Pembangkitan

H. Ade Suhaedin, ST
NIK. 04078 9270

Lampiran : 3
No. Formulir : F-Pros. 19.03

Kepada Yth,
General Manajer Unit PLTA
Perum Jasa tirta II
di
Jatiluhur

LAPORAN GANGGUAN

I. Gangguan : Hari/ Tanggal : Jum'at / 06 Oktober 2017
Pukul : 03.10
Jenis Gangguan : TBB1, Trafo35MVA, Penguatan

II. Indikasi Gangguan :
☐ Di PLC

☑ Di Panel Komando
: TBB1, Trafo35MVA, Penguatan

III. Pemeriksaan dan Perbaikan :
- Pemeriksaan : Pemeriksaan pada panel PLC dan AVR
- Perbaikan : Pengecekan tegangan Eksitasi

IV. Sebab Gangguan :
- Eksitasi fault

IV. Akibat Gangguan :
- Unit 3 tidak beroperasi

IV. Verifikasi Keefektifan Tindakan Perbaikan
- Unit 3 Kembali Beroperasi pada pukul 09.06

Unit PLTA
Manajer Operasional Pembangkitan

H. Ade Suhaedin, ST
NIK. 04078 9270