1.1.1 DESCRIPTION

NOTE

These instructions do not purport to cover all details or variations in equipment nor provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE, and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

The 745 Transformer Management Relay™ is a high speed, multi-processor based, three-phase, two or three winding, transformer management relay intended for the primary protection and management of small, medium and large power transformers. The 745 combines Percent Differential, Overcurrent, Frequency, and Overexcitation protection elements along with monitoring of individual harmonics, and THD in one economical package.

The relay provides a variety of adaptive relaying features:

- Adaptive Harmonic Restraint which addresses the problem of false tripping during inrush
- Adaptive Time Overcurrent Elements which will adjust their pickup settings based on the calculated transformer capability when supplying load currents with high harmonic content
- Multiple Setpoint Groups which allow the user to enter and dynamically select from up to four groups of relay settings to address the protection requirements of different power system configurations
- Dynamic CT Ratio Mismatch Correction which monitors the on-load tap position and automatically corrects for CT ratio mismatch
- FlexLogic™ which allows PLC style equations based on logic inputs and protection elements to be assigned to any of the 745 outputs.

The 745 also includes a powerful testing and simulation feature. This allows the protection engineer the ability to test the relay operation based on captured or computer generated waveform data which can be converted to a digitized format and downloaded into the 745's simulation buffer for "playback". A Waveform Capture function that records waveform data for fault, inrush, or alarm conditions is also provided.

The Auto-Configuration function eliminates the need for any special CT connections by having all CTs connected in wye.

1.1.2 PROTECTION FEATURES SUMMARY

SYMBOL	COMMON PROTECTION ELEMENT
59/81-1	Volts-Per-Hertz 1
59/81-2	Volts-Per-Hertz 2
81U-1	Underfrequency 1
81U-2	Underfrequency 2
81U-R1	Frequency Decay Rate 1
81U-R2	Frequency Decay Rate 2
81U-R3	Frequency Decay Rate 3
81U-R4	Frequency Decay Rate 4
81-H5	5th Harmonic Level
81O	Overfrequency
87	Differential (Percent)
50/87	Instantaneous Differential
AN-1	Analog Input Level 1
AN-2	Analog Input Level 2
	Insulation Aging: • Aging Factor • Hottest Spot Limit • Total Accumulated Life
	Tap Changer Monitor

SYMBOL	WINDING 1 PROTECTION ELEMENT
150/46	Negative Sequence Instantaneous Overcurrent
151/46	Negative Sequence Time Overcurrent
150P1	Phase Instantaneous Overcurrent 1
150P2	Phase Instantaneous Overcurrent 2
150N1	Neutral ($3I_0$) Instantaneous Overcurrent 1
150N2	Neutral ($3I_0$) Instantaneous Overcurrent 2
150G1	Ground Instantaneous Overcurrent 1
150G2	Ground Instantaneous Overcurrent 2
151P	Phase Time Overcurrent
151N	Neutral ($3I_0$) Time Overcurrent
151G	Ground Time Overcurrent
187TG	Ground Differential (Restricted Ground Fault)
1THD	Total Harmonic Distortion Level
1AD	Current Demand

1.2.4 OUTPUTS

ANALOG OUTPUTS

Number of Outputs: 7

Output Range: 0-1 mA, 0-5 mA, 0-10 mA, 0-20 mA, or 4-20 mA

Maximum Load: 10 kΩ at 0 to 1 mA
600 Ω at 4 to 20 mA

Isolation: Fully isolated

Accuracy: ±1% of full scale

SOLID STATE OUTPUT

Maximum Ratings: Make & Carry 15 A at 250 V DC for 500 ms

TRIP RELAYS 2 TO 5

Configuration: Form A (breaker trip rated)

Contact Material: silver alloy

Max Ratings: 300 V AC, 250 V DC, 15 A, 1500 VA

RELAYS: 2-5 TRIP					
VOLTAGE		MAKE/CARRY CONTINUOUS	MAKE/ CARRY 0.2S	BREAK	MAX LOAD
DC Resistive	30 V DC	20 A	40 A	10 A	300 W
	125 V DC	20 A	40 A	0.8 A	300 W
	250 V DC	20 A	40 A	0.4 A	300 W
DC Inductive L/R = 40 ms	30 V DC	20 A	40 A	5 A	150 W
	125 V DC	20 A	40 A	0.3 A	150 W
	250 V DC	20 A	40 A	0.2 A	150 W
AC Resistive	120 V AC	20 A	80 A	20 A	5000 VA
	240 V AC	20 A	80 A	20 A	5000 VA
AC Inductive PF = 0.4	120 V AC	20 A	80 A	8 A	5000 VA
	240 V AC	20 A	80 A	7 A	5000 VA

AUXILIARY 6 TO 8 RELAYS, SELF-TEST RELAY 9

Configuration: Form C

Contact Material: silver alloy

Max Ratings: 300 V AC, 250 V DC, 15 A, 1500 VA

RELAYS: 6-8 AUXILIARY, 9 SELF-TEST					
VOLTAGE		MAKE/CARRY CONTINUOUS	MAKE/ CARRY 0.2S	BREAK	MAX LOAD
DC Resistive	30 V DC	10 A	30 A	10 A	300 W
	125 V DC	10 A	30 A	0.5 A	62.5 W
	250 V DC	10 A	30 A	0.3 A	75 W
DC Inductive L/R = 40 ms	30 V DC	10 A	30 A	5 A	150 W
	125 V DC	10 A	30 A	0.25 A	31.3 W
	250 V DC	10 A	30 A	0.15 A	37.5 W
AC Resistive	120 V AC	10 A	30 A	10 A	2770 VA
	240 V AC	10 A	30 A	10 A	2770 VA
AC Inductive PF = 0.4	120 V AC	10 A	30 A	4 A	480 VA
	240 V AC	10 A	30 A	3 A	750 VA

1.2.5 MISCELLANEOUS

COMMUNICATIONS

All Ports: 300 to 19200 baud, programmable parity, Modbus RTU protocol, DNP

CLOCK

Resolution: 1 ms

Accuracy ±1 ms with IRIG-B
±1 minute/month without IRIG-B

Backup Battery Life: 10 years continuous use

HARMONICS

Range: 0.00 to 99.9%

Accuracy: ±1% of Full Scale at 0.5 × CT

THD

Range: 0.00 to 99.9%

Accuracy: ±1% of Full Scale at 0.5 × CT

OPERATING ENVIRONMENT

Operating Temperature: –40°C to +60°C

Storage Temperature: –40°C to +80°C ambient

Humidity: up to 90% non-condensing

Altitude: 2000 m

Pollution degree: II

CASE

Drawout: Fully drawout unit (automatic CT shorts)

Seal: Seal provision

Door: Dust tight door

Panel: Panel or 19" rack mount

Weight (case and relay): 18 lbs., 6 oz.

IP class: X0

PRODUCTION TESTS

Thermal: Operational test at ambient then increasing to 60°C

Dielectric Strength: Per IEC 255-5 and ANSI/IEEE C37.90
On CT inputs, VT inputs, Control Power inputs, Switch inputs, and Relay outputs
(2 kV for 1 second)

TYPE WITHSTAND TESTS

Fast Transient:	per ANSI/IEEE C37.90.1 (5 kV) per IEC 255-22-4 (4 kV)
Insulation Resistance:	per IEC 255-5 (500 V DC, 2000 MΩ)
Dielectric Strength:	per IEC 255-5 and ANSI/IEEE C37.90 (2 kV at 60 Hz for 1 minute)
Surge Immunity:	per EN 61000-4-5 (common mode 4 kV, differential modes 2 kV) per ANSI/IEEE C37.90.1, IEC 255-22-1, and Ontario Hydro A-28M-82
Voltage Dips:	per IEC 1000-4-1 (0%, 40%)
Electrostatic Discharge:	per IEC 255-22-2 (8/15 kV)
Power Frequency/ Magnetic Field Immunity:	per EN 61000-4-8
Damp Heat (Cyclic Humidity):	per IEC 68-2-30 (6 days)
Temperature Cycle:	–40°C, +60°C
Mechanical Stress	2 g
Make and Carry Rating	30 A
Current Withstand:	per ANSI/IEEE C37.90 (40 × rated A for 2 seconds, 80 × rated A for 1 second)
RFI Radiated Immunity:	per IEC 255-22-3 (160 MHz, 460 MHz) per EN 61000-4-3 (10 V/m)
RFI Conducted Immunity:	per EN 61000-4-6 (10 V)
RFI Conducted/Radiated Emission:	per EN 55011 / CISPR 11 FCC Part 15

APPROVALS

CE:	Conforms to IEC 1010-1 / EN 50082-2
UL:	UL listed for the USA and Canada
ISO:	Manufactured under ISO9001 registered program

NOTE **It is recommended that all 745 relays be powered up at least once per year to avoid deterioration of electrolytic capacitors in the power supply.**

Specifications subject to change without notice.