

TRANSFORMER PROTECTION SYSTEM

High-speed, draw-out transformer protection and management

Key Benefits

- Easy to use Transformer Protection System supported by industry leading suite of software tools to optimize transformer performance and to extend life expectancy
- Improved security for transformer energization using superior Adaptive 2nd Harmonic Restraint algorithm
- Accurate built-in metering functions - Eliminates auxiliary metering devices and reduces cost
- Advanced automation capabilities using FlexLogic to provide customized protection and control solutions
- Fast, flexible and reliable communications - Embedded 10BaseT Ethernet capability provides faster data transfer for improved system performance
- Minimize replacement time - Draw-out construction ideal in industrial environments
- Reduce troubleshooting time and maintenance costs - IRIG-B time synchronization, event reports, waveform capture, data logger
- Simplified testing - Built in simulation features for setpoint verification including waveform playback for relay setting verification
- Cost effective access to information - Modbus and DNP 3.0 Level 2 protocols through embedded Ethernet, standard RS232, RS485 & RS422 serial ports.
- Globally accepted - Member of the most renowned product family in the market.
- Extended life - Optional conformal coating for chemically corrosive and humid environments
- Fast and easy troubleshooting, improved maintenance procedures and increased device security - Security Audit Trail provides detailed traceability for system configuration changes

Applications

- Primary and back-up protection and management of small, medium and larger power transformers, autotransformers and reactors
- Transformer asset monitoring using Hottest Spot, Loss-of-Life and Aging Factor
- Stand-alone or component in automated substation control system

Features

Protection and control

- Variable dual-slope percent differential protection
- Magnetizing inrush and overexcitation blocking
- Phase & ground overcurrent elements
- Adaptive time overcurrent using FlexCurves elements
- Underfrequency/Overfrequency Protection
- Frequency rate-of-change Detection

GE VERNOVA

745 Transformer Protection System

- Overexcitation (V/Hz) Protection
- Restricted Ground Fault Protection
- Transformer overload protection

Communications

- Networking interfaces - 10Mbps Ethernet, RS232, RS485 and RS422 ports
- Ethernet port, 10Mbps
- Multiple protocols - ModBus™ RTU, ModBus™ RTU TCP/IP, DNP 3.0 Level 2

Monitoring and Metering

- Metering - current, voltage, sequence components per winding, power, energy, voltage
- THD and harmonics up to the 21st
- Event recording - 128 time tagged events
- Tap position up to 50 tap positions
- Ambient temperature /analog transducer input
- Analog transducer input
- Oscillography & Data Logger - 10 records up to 32 power cycles
- Simulation mode and playback capability.

EnerVista™ Software

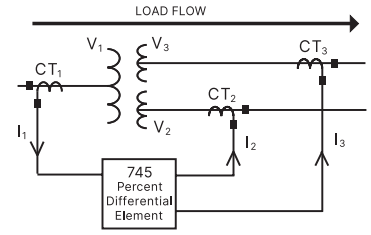
- Sophisticated software for configuration and commissioning
- Graphical Logic Designer and Logic Monitor to simplify designing and testing procedures
- Document and software archiving toolset
- EnerVista™ Integrator providing easy integration of data in the 745 into new or existing monitoring and control systems

Protection and Control

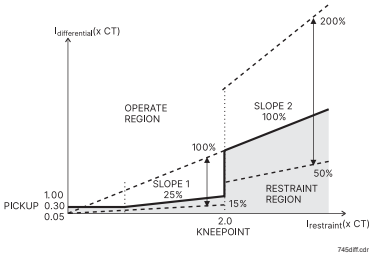
The 745 Transformer Protection System is a full featured transformer protection relay, suitable for application on small, medium, and large power transformers. The 745 can be applied on two-winding and three-winding transformers, and can be applied on transformers with breaker-and-a-half source terminals. Multiple current and voltage inputs are used to provide primary protection, control and back-up protection of transformers, including current differential, Restricted Ground Fault neutral, and ground overcurrent, over-fluxing, and on-load tap changer. The 745 also has specific features for industrial environments, including a drawout case to limit downtime during maintenance and conformal coating for harsh environments. The 745 also includes analog inputs and outputs, while incorporating advanced features such as transformer loss of life monitoring.

Percent differential protection

The 745 features the equivalent of three single-phase differential current relays. Dual-slope percent differential with 2nd or/and 5th harmonic restraints to protect against maloperation due to magnetizing inrush current during transformer energization and overexcitation. Each differential element has programmable dual-slope percentage restraint with adjustable slope breakpoint. Maximum winding current is used as a restraining signal for better through fault stability under CT saturation conditions.



Differential vs. Restraint Characteristic (Id vs.Ir)



The settings for the dual-slope, dual-breakpoint curve provides higher flexibility for shaping up the characteristic and achieve better sensitivity and security

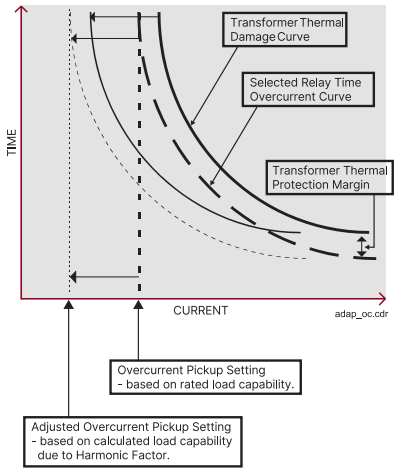
Harmonic Inrush /Overexcitation Inhibit

The 745 offers great performance in dealing with magnetizing current inrush, by providing three programmable restraint methods, each of which can be enabled or disabled by the user.

An increase in transformer voltage or decrease in system frequency may result in overexcitation of the transformer. It is often desirable to prevent operation of the percent differential element in these cases therefore a fifth harmonic inhibit is integrated into the percent differential element to cater for overexcitation conditions resulting from an increased V/Hz ratio.

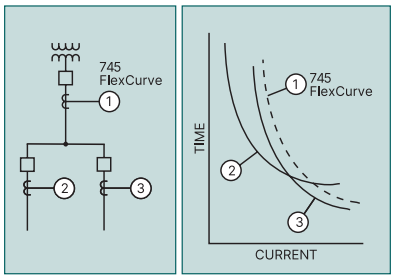
- Harmonic inhibit allows the user to set a harmonic restraint level of second or second plus fifth which, if enabled, remains active all the time
- An independent fifth harmonic inhibit allows restraint for systems permitting intentional overexcitation (overfluxing) during energization
- Energization inhibit allows the user to define a temporary lower restraint level which will be automatically enabled upon detection of transformer deenergization or parallel transformer energization

Each of the restraint methods features user-defined harmonic averaging.



FlexCurves to coordinate with adjacent protections (including fuses) as well as transformer damage curves and thermal/damage curves for downstream equipment

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Unrestrained Differential

An unrestrained differential element current magnitude is provided for fast tripping on heavy internal faults to limit catastrophic damage to the transformer and minimize risks to the remainder of the power system.

Overcurrent Elements

745 can be used to provide back up protection for transformer and adjacent power system equipment. Instantaneous overcurrent (IOC) elements can be used for fast clearing of severe internal and external (through) faults. Time overcurrent protection (TOC) elements per winding allow to coordinate with the adjacent protection zones and act as backup protection.

- TOC protection functions are provided for phase, and ground currents. A variety of standard time curves including IEEE, IEC, GE Vernova IAC, I2t, definite time are provided.
- FlexCurves to coordinate with adjacent protections (including fuses) as well as transformer damage curves and thermal/damage curves for downstream equipment

ANSI	Extremely Inverse Very Inverse Normally Inverse Moderately Inverse Definite Time
IEC (BS142)	Curve A Curve B Curve C Short Inverse
IAC	Extremely Inverse Very Inverse Inverse Short Inverse
Custom	FlexCurve™ A FlexCurve™ B FlexCurve™ C

Curve shapes - Typical application of 745 FlexCurves.

Negative Sequence Overcurrent

For Delta/Wye impedance grounded transformers, overcurrent protection is particularly difficult to set. A negative sequence based overcurrent element provides the required sensitivity phase faults. Each winding is given its own element with the same programmable characteristics as the phase and neutral TOC elements.

Over / Under Frequency Protection

The 745 calculates and maintains a running average of the system frequency and the frequency rate-of-change (df/dt). Two underfrequency and four rate-of-change elements are provided to implement traditional and advanced load shedding schemes. Additionally, an overfrequency element can be used to trigger a generator rampdown.

Restricted Ground Fault

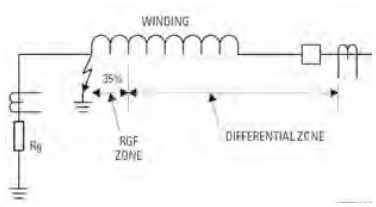
Conventional overcurrent protection fails to provide adequate protection for star connected windings whose neutral is impedance earthed. Faults close to the neutral do not generate adequate fault current. RGF (also known as zero sequence differential) provides sensitive ground fault detection for low-magnitude fault currents.

Loss-of-Life

This feature provides an estimate of how much of the transformer's total insulation life has elapsed (based on IEEE Standards C57.91-1995, "IEEE Guide for Loading Mineral-Oil-Immersed Transformers," and C57.96-1989, "IEEE Guide for Loading Dry-Type Distribution and Power Trans- formers").

Analog Outputs (Optional)

Seven transducer output channels allow individually programmed outputs for ranges of 0 to 1 mA, 0-to-5-mA, 1 to 10 mA, 0 to 20 mA and 4-to-20 mA. Channels are assignable to any measured parameter.



Faults close to the neutral point of a wye-connected winding does not generate adequate fault current for differential element to pick up. Restricted Ground Fault protection provides sensitive ground fault detection for low-magnitude fault currents.

Multiple Settings Groups

The four user defined setpoint groups are available for different power system configurations. Selection is done via the Logic (digital) inputs, front panel or communications port.

Automation

The 745 incorporates advanced automation features including powerful FlexLogic™ programmable logic, communication, and SCADA capabilities that far surpass what is found in the average line relay. The 745 integrates seamlessly with other relays for complete system protection.

FlexLogic™

FlexLogic™ is the powerful programming logic engine that provides the ability of creating customized protection and control schemes thereby minimizing the need, and the associated costs, of auxiliary components and wiring. Using FlexLogic™, the 745 can be programmed to provide required tripping logic along with custom scheme logic including interlocking dynamic setting group changes.

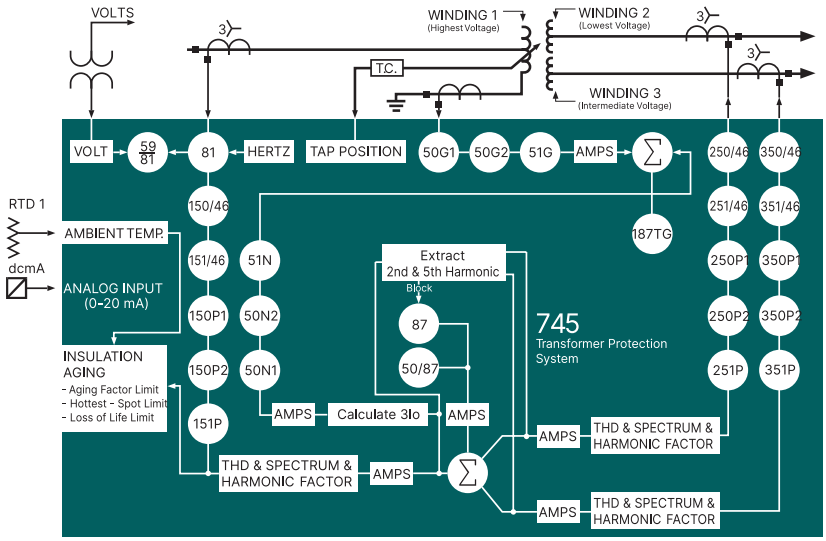
Output Relays

One high-speed solid state electronic output can be activated by any protection element through user-defined FlexLogic™ equations or directly assigned from a protection element . Seven of the eight electro-mechanical relay outputs can be activated by the protection elements according to FlexLogic™ equations or directly assigned from a protection element. One output is factory set as an internal self-test failure alarm relay.

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Functional Block Diagram



Monitoring and Metering

The 745 features advanced metering functions including:

Currents

The 745 accurately measures the following currents:

- Phase A, B, C, residual ($3I_0$) and ground currents
- Instantaneous and maximum current demand on each phase of each winding
- Positive, negative, and zero sequence currents and phase angles for all windings.
- Differential and restraint currents for all phases
- Ground differential currents

All current inputs feature harmonic level detectors. A sampling rate of 64 times the power cycle allows recovery up to the 21st harmonic. Total Harmonic Distortion (IEEE.519-1986) or Harmonic Derating Factor (as per ANSI/IEEE C57.110-1986) are calculated for each winding and compared against user-adjustable setpoints.

Asset Monitoring

745 can monitor, calculate and log hottest -spot temperature, aging factor and lost of life data over a long period. These data combined with economic analysis, allows criteria to be developed regarding the best time at which to replace a power transformer due to load growth, i.e. to minimize the cost without significantly increasing the risk.

Event Recording

The last 128 events are captured and stored, recording the time, date, cause, and system parameters of each event. This information is easily accessible by computer via communication port or the front panel display.

Tap Position, Ambient Temperature, Analog Transducer-Input

The 745 monitors and displays tap position and ambient temperature. An optional general purpose transducer input allows a user-defined quantity to be monitored and used as part of the protection as defined by FlexLogic™.

Simulation Mode

Simulation Mode allows testing the functionality of the relay by simply feeding arbitrary waveform data into the relays simulation buffer for playback as sampled current input signals.

Fault Recording (Oscillography)

System input signals are sampled at a rate of 64 times the power cycle. Because all the signals are sampled at the same instant in time the magnitude and phase relationship of each can be compared. A combination of 16 pre and post-trigger cycles can be saved.

The advanced disturbance (Data logger & Waveform Capture) and event recording features within the 745 can significantly reduce the time needed for postmortem analysis of power system events and creation of regulatory reports.

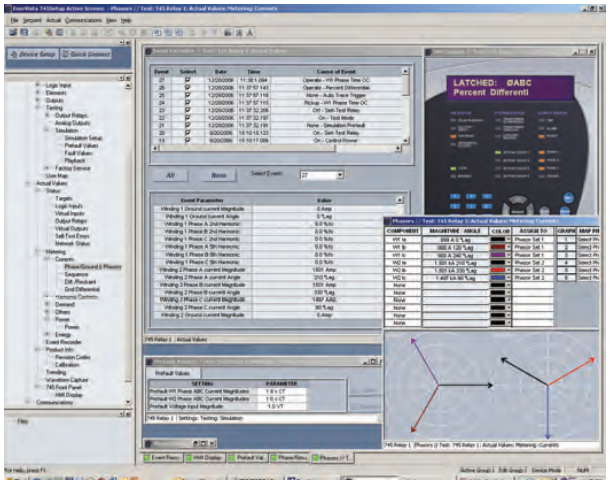
ANSI Device Numbers & Functions

Device Number	Function
50/67	Negative Sequence IOC
50/87	Instantaneous Differential
50G	Ground IOC
50N	Neutral (3I0) IOC
50P	Phase IOC
51/67	Negative Sequence TOC
51G	Ground TOC
51N	Neutral (3I0) TOC
51P	Phase TOC
59/81	Volts-Per-Hertz
81-H5	Fifth Harmonic Level
81O	Overfrequency
81U	Underfrequency
81U-R	Frequency Decay Rate
87	Differential (Percentage)
87TG	Ground Differential
AD	Current Demand
AN-1	Analog Input Level 1
AN-2	Analog Input Level 2 Insulation Aging – Aging Factor Limit – Hottest-Spot Limit – Loss of Life Limit Tap Changer Failure
THD	Total Harmonic Distortion Level

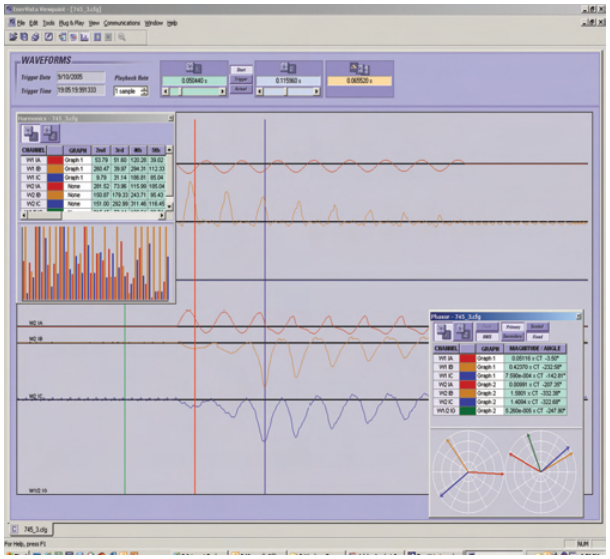
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Power System Troubleshooting

The 745 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.



Record the operation of the internal 745 elements and external connected devices with 1ms time-stamped accuracy to identify the Sequence of Operation of station devices during transformer faults and disturbances.



Analyze transformer faults using both analog and digital power system quantities that are measured and recorded up to a rate of 12 samples per cycle.

Additional Features

The 745 offers additional features designed for ease of use:

Auto CT Configuration

All CTs are connected in a wye configuration for simplicity. All phase and magnitude corrections as well as zero-sequence current compensation are performed automatically based on a choice of over 100 transformer types.

Dynamic CT Ratio Mismatch Correction

Variances in on-load tap position output are monitored and corrected. In addition, external compensation CT's are not required.

Field Upgradable Option

An optional pass-code key may be purchased to allow field upgrades. Field upgradable options ensure operators are able to add features and functionality when it is required.

User Interfaces

Various user interfaces facilitate operation of the 745.

Display

A 40 character display allows access to setpoints, actual values, and diagnostic messages generated by a trip or alarm condition. The 745 can display 30 user-selected messages during keypad inactivity.

Indicators

Twenty LEDs indicate relay status, system status, and trip and alarm conditions.

IRIG-B Input

This feature provides time synchronization via standard GPS clock inputs.

Communications

The 745 is equipped with three standard serial communications ports, one RS232 located in the front panel, and two RS485/ RS422 in the rear of the relay. One optional Ethernet port is available at the rear of the relay. The front panel port allows easy local computer access. The rear ports provide remote communications or connection to a DCS, SCADA, or PLC. The baud rate of all the ports is variable from 300 to 19,200 bps. The optional Ethernet port can be used to connect the 745 to 10 Mbps Ethernet networks. The 745 supports ModBus® RTU, DNP3.0 Level 2, and ModBus® RTU TCP/IP protocols.

The three serial ports support ModBus® RTU protocol, while either of the two rear ports can be configured to support DNP 3.0 Level 2. The optional Ethernet port supports ModBus® RTU via TCP/IP protocol. The communication system of the 745 is designed to allow simultaneous communication via all ports.

Using Ethernet as the physical media to integrate the 745 to Local or Wide Area Networks, replaces a multidrop-wired network (e.g., serial Modbus®), and eliminates expensive leased or dial-up connections, reducing monthly operating costs.

EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the 745 relay. The EnerVista™ suite provides all the tools to monitor the status of the transformer, maintain the relay, and integrate information measured by the 745 into DCS or SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of the 745 Setup software included with every 745 relay, to carry out postmortem event analysis to ensure proper protection system operation.

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EnerVista™ Launchpad

EnerVista™ Launchpad is a powerful software package that provides users with all of the setup and support tools needed for configuring and maintaining GE Vernova Multilin products. The setup software within Launchpad allows configuring devices in real-time by communicating using serial, Ethernet , or modem connections, or offline by creating setting files to be sent to devices at a later time.

Included in Launchpad is a document archiving and management system that ensures critical documentation is up-to-date and available when needed.

Documents made available include:

- Manuals
- Application Notes
- Guideform Specifications
- Brochures
- Wiring Diagrams
- FAQ's
- Service Bulletins

Viewpoint Monitoring

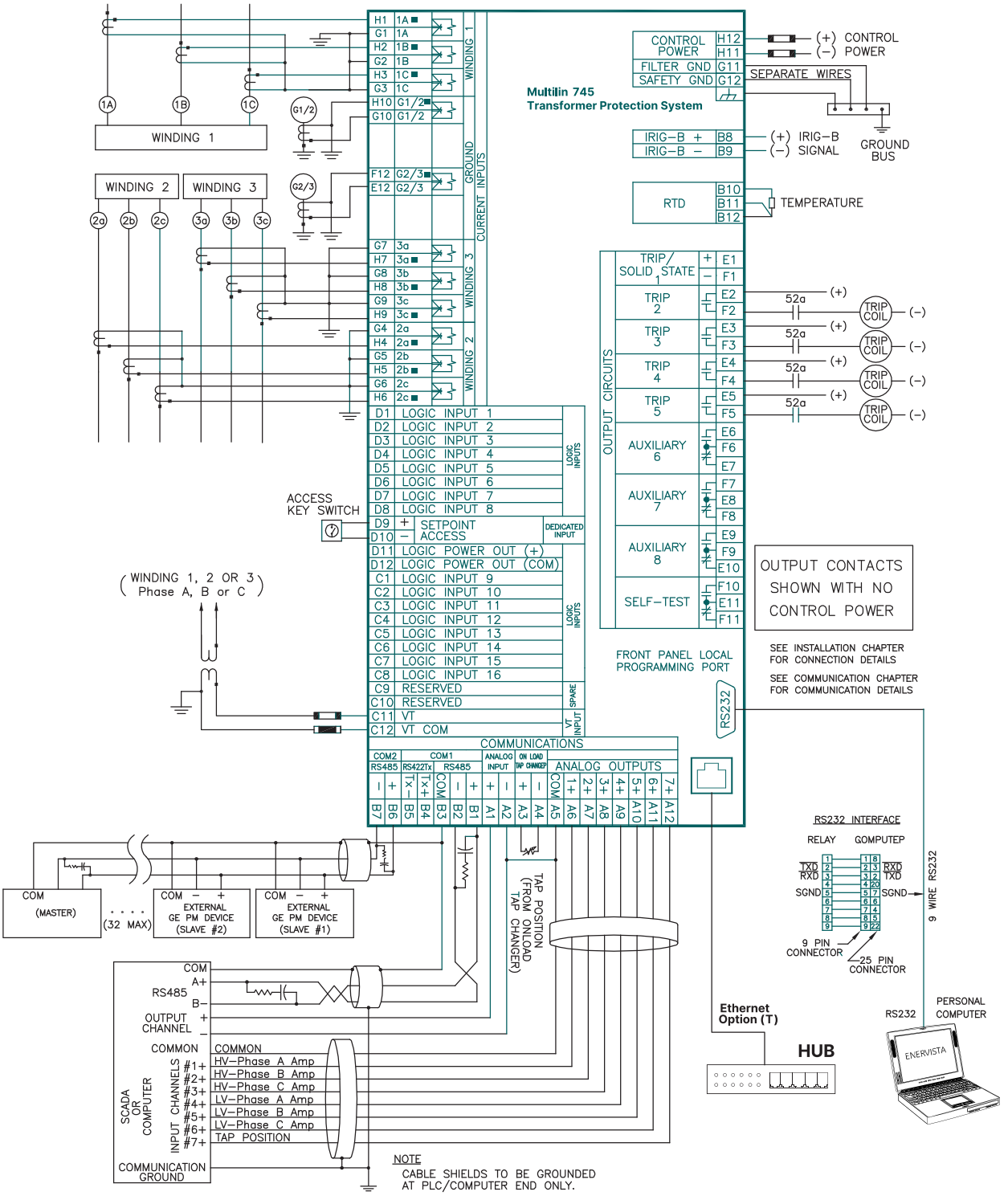
Viewpoint Monitoring is a simple-to-use and full-featured monitoring and data recording software package for small systems. Viewpoint Monitoring provides a complete HMI package with the following

- Plug-&-Play Device Monitoring
- System Single-Line Monitoring & Control
- Annunciator Alarm Screens
- Trending Reports
- Automatic Event Retrieval
- Automatic Waveform Retrieval

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Typical Wiring



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Technical Specifications

PROTECTION

Note: [x] indicate 1 A secondary CT specifications, other values are for 5 A secondary

PERCENT DIFFERENTIAL PROTECTION

Operating current pu:	0.05 – 1.00 in steps of 0.01 x CT
Dropout level:	97% – 98% of pickup
SLOPE-1 range:	15% – 100% in steps of 1
SLOPE-2 range:	50% – 100% in steps of 1
KP (SLOPE-1 kneepoint):	1.0 – 20.0 in steps of 0.1 x CT
Harmonic restraint:	0.1% – 65.0% in steps of 0.1
Operate time:	
Solid state output:	Pickup <1 x CT: 42 – 52 ms 1 x CT < Pickup <1.1 x kneepoint: 34 – 44 ms Pickup >1.1 x kneepoint: 26–36 ms
Relay outputs 2 – 5:	Pickup <1 x CT: 46 – 56 ms1 x CT <pickup <1.1x. kneepoint: 38–48ms Pickup>1.1 x kneepoint: 30–40ms

INSTANTANEOUS DIFFERENTIAL OVERCURRENT

Pickup level:	3.00 – 20.00 in steps of 0.01 x CT
Dropout level:	97% – 98% of pickup
Level accuracy:	Per current input
Operate time:	
Solid state output:	@ 1.2 x pickup: 22 – 30 ms @ 2.0 x pickup: 18 – 26 ms @ 4.0 x pickup: 11 – 19 ms
Relay outputs 2 – 5:	@ 1.2 x pickup: 28 – 36 ms @ 2.0 x pickup: 24 – 32 ms @ 4.0 x pickup: 17 – 25 ms

PHASE/NEUTRAL ($3I_0$)/GROUND/NEGATIVE SEQUENCE TIME OVERCURRENT

Pickup level:	0.05 – 20.00 in steps of 0.01 x CT
Dropout level:	97% – 98% of pickup
Curve shape:	(see curve shapes)
Curve multiplier (time dial):	0.5 – 30 for ANSI, IAC and FlexCurve™ in steps of 0.1 0.05 – 1.00 for IEC curves in steps of 0.01
Reset type:	Instantaneous or linear
Level accuracy:	Per current input
Timing accuracy:	at 1.03 x pickup: ±3% of trip time or ±20 ms (whichever is greater)

PHASE/GROUND/NEUTRAL ($3I_0$)/NEGATIVE SEQUENCE INSTANTANEOUS OVERCURRENT ±

Pickup level:	0.05 – 20.00 in steps of 0.01 x CT
Dropout level:	97% – 98% of pickup
Time delay:	0 – 60,000 in steps of 1 ms
Level accuracy:	Per current input
Operate time:	
Solid state output:	@ 1.2 x pickup: 22 – 30 ms @ 2.0 x pickup: 18 – 26 ms @ 4.0 x pickup: 11 – 19 ms
Relay outputs 2 – 5:	@ 1.2 x pickup: 28 – 36 ms @ 2.0 x pickup: 24 – 32 ms @ 4.0 x pickup: 17 – 25 ms

PROTECTION

UNDERFREQUENCY (2 ELEMENTS)

Operating current pickup:	0.05 – 1.00 in steps of 0.01 x CT
Operating voltage pickup:	0.10 – 0.99 in steps of 0.01 x VT
Pickup level:	45.00–59.99 Hz in steps of 0.01 Hz
Dropout level:	Pickup + 0.03 Hz
Time delay:	0.00–600.00 sec in steps of 0.01 sec
Signal source:	Winding 1 Phase A current/ voltage
Level accuracy:	±0.02 Hz
Operate time (delay set to 0.0 sec):	
Solid state output:	@ 3% beyond pickup: 120–150 ms
Relay outputs 2 – 5:	@ 3% beyond pickup: 125–155ms

RESTRICTED GROUND FAULT

Number of elements:	2
Minimum pickup:	0.02 to 20.00×CT in steps of 0.01
Dropout level:	97 to 98% of Pickup
Slope range:	0 to 100% in steps of 1
Pickup delay:	0.00 to 600.00s in steps of 0.01
Operating time:	at 1.1 × pickup: 30 to 40 ms at 10 × pickup: 20 to 30 ms

FREQUENCY RATE OF CHANGE (4 ELEMENTS)

Operating current pickup:	0.05 – 1.00 in steps of 0.01 x CT
Operating voltage pickup:	0.10 – 0.99 in steps of 0.01 x V
Pickup level:	45.00 – 59.99 in steps of 0.01 Hz
Dropout level:	Pickup + 0.03 Hz
Rate 1/2/3/4:	0.1 – 5.0 in steps of 0.1 Hz/sec
Dropout level:	Pickup + 0.07 Hz/sec
Signal source:	Winding 1 Phase A current/ voltage
Level accuracy:	±0.02 Hz
Operate time:	The operate time of the frequency trend element is variable and is dependent on the decay rate setting and-the supervision frequency level.
Operating current pickup:	0.05 – 1.00 in steps of 0.01 x CT
Operating voltage pickup:	0.10 – 0.99 in steps of 0.01 x VT
Pickup level:	50.01 – 65.00 in steps of 0.01 Hz
Dropout level:	Pickup - 0.03 Hz
Time delay:	0.00 – 600.00 sec in steps of 0.01 sec
Signal source:	Winding 1 Phase A current/ voltage
Level accuracy:	±0.02 Hz
Operate time (delay set to 0.0 sec):	
Solid state output:	@3% beyond pickup: 120–150ms
Relay outputs 2 – 5:	@ 3% beyond pickup: 125–155ms

PROTECTION

OVEREXCITATION ON 5TH HARMONIC LEVEL

Definite time element:	
Operating current pickup:	0.03 – 1.00 in steps of 0.01x CT
Pickup level:	0.1 – 99.9 in steps of 0.1%
Dropout:	95% of pickup
Time delay:	0 – 60,000 sec in steps of 1 sec
Signal source:	All phase currents
Operate time (delay set to 0.0 sec):	
Solid state output:	@ 1.10 x pickup: 20 – 120 ms
Relay outputs 2 – 5:	@ 1.10 x pickup: 25 – 125 ms

OVEREXCITATION ON V/HZ (2 ELEMENTS)

Operating voltage pickup:	0.10 – 0.99 in steps of 0.01x VT
Pickup level:	1.00 – 4.00 in steps of 0.01 V/Hz
Curve shape:	Definite time (0.1 sec base curve) IEC curve A/B/C
Time delay:	0.00 – 600.00 sec in steps of 0.01 sec
Reset delay:	0.0 – 6000.0 sec in steps of 0.1 sec
Signal source:	Voltage
Range:	10 – 65 Hz
Level accuracy:	±0.02 V/Hz
Operate time (delay set to 0.0 sec):	
Solid state output:	@ 1.10 x pickup: 165 – 195ms
Relay outputs 2 – 5:	@ 1.10 x pickup: 170 – 200ms

INSULATION AGING/HOTTEST-SPOT LIMIT

Pickup level:	50 – 300 in steps of 1° C
Delay:	0 – 60,000 in steps of 1 min

INSULATION AGING/AGING FACTOR LIMIT

Pickup level:	1.1 – 10.0 in steps of 0.1
Delay:	0 – 60,000 in steps of 1 min

INSULATION AGING/LOSS OF LIFE LIMIT

Pickup level:	0 – 20,000 in steps of 1 x 10 hrs.

INPUTS

PHASE AND GROUND CURRENT INPUT CIRCUITS

Source CT:	1 – 50,000 A/1 or 5 A
Relay input:	1 A or 5 A (specified when ordering)
Burden:	Less than 0.2 VA @ rated load
Conversion range:	0.02 – 46 x CT
Accuracy:	at <4 x CT: ±0.25% of 4 x CT(± 0.01 ×CT) at 4 x CT: ±0.5% of 46 x CT (± 0.02 ×CT)
Overload withstand:	1 sec @ 80 x rated current 2 sec @ 40 x rated current continuous @ 3 x rated current

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INPUTS

ANALOG INPUTS (4)

General purpose input:

Type:	dcmA
Ranges:	0 – 1, 0 – 5, 0 – 10, 0 – 20 or 4–-20 mA (programmable)
Input impedance:	375 Ω ± 10%
Conversion range:	0–21 mA
Accuracy:	±1% of full scale (based on input range)

Tap Position Input:

Type:	resistance (Ω)
Ranges:	0 – 500 or 0.5 – 5 k Ω (programmable
Bias current:	1 mA or 10 mA (based on input range
Accuracy:	±1% of full scale (based on input range)

RTD Input:

Type: 3-wire:	100 Ω Platinum (DIN.43760) 100 Ω and 120 Ω Nickel
Sensing current:	5 mA
Range	-50 to +250°C
Accuracy:	±2°C

IRIG-B Input:

Amplitude modulated:	1.0 – 10 Vpp
DC shift:	TTL

LOGIC (SWITCH) INPUT CONTACTS (16)

Dry contacts:	1000 Ω maximum "ON" resistance 32 VDC @ 2 mA provided by 745
Wet contacts:	Inputs 1 – 16: 30 – 300 VDC @ 1.5 mA

VOLTAGE INPUT CIRCUIT

Source VT:	2 – 600 kV/60 – 120 V
Source VT ratio:	1 – 5000:1 in steps of 1
Relay input:	60 – 120 V phase-neutra
Burden:	Less than 0.025 VA at 120 V
Max continuous:	273 V phase-neutral (F.S.)
Accuracy:	±1% of 2 x VT

OUTPUTS

ANALOG OUTPUTS (7)

Output range:	0 – 1, 0 – 5, 0 – 10, 0 – 20 or 4–-20 mA
Maximum load:	10 Ω at 0 to 1 mA 600 Ω at 4 to 20 mA
Isolation:	fully isolated
Accuracy:	±1% of full scale

OUTPUTS (1 SOLID STATE)

Max ratings:	Make and carry 15 A @ 250 VDC for 500 ms

OUTPUT RELAYS

2 – 5 trip:	Form A (breaker TRIP rated)
6 – 8 auxiliary:	Form C
9 self-test:	Form C
Contact material:	silver alloy
Max ratings:	300 VAC, 250 VDC, 15 A, 1500 VA

OUTPUTS

RELAYS: 2-5 TRIP

VOLTAGE		M/C CONT.	M/C 0.2S	BREAK	MAX LOAD
DC Resistive	30 VDC	20 A	40 A	10 A	300 W
	125 VDC	20 A	40 A	0.8 A	300 W
	250 VDC	20 A	40 A	0.4 A	300 W
DC Inductive L/R=40ms	30 VDC	20 A	40 A	5 A	150 W
	125 VDC	20 A	40 A	0.3 A	150 W
	250 VDC	20 A	40 A	0.2 A	150 W
AC Resistive	120 VDC	20 A	80 A	20 A	5000 VA
	240 VDC	20 A	80 A	20 A	5000 VA
AC Inductive PF=0.4	120 VAC	20 A	80 A	8 A	5000 VA
	250 VAC	20 A	80 A	7 A	5000 VA

RELAYS: 6-8 AUXILIARY, 9 SELF-TEST

VOLTAGE		M/C CONT.	M/C 0.2S	BREAK	MAX LOAD
DC Resistive	30 VDC	10 A	30 A	10 A	300 W
	125 VDC	10 A	30 A	0.5 A	62.5 W
	250 VDC	10 A	30 A	0.3 A	75 W
DC Inductive L/R=40ms	30 VDC	10 A	30 A	5 A	150 W
	125 VDC	10 A	30 A	0.25 A	31.3 W
	250 VDC	10 A	30 A	0.15 A	37.5 W
AC Resistive	120 VDC	10 A	30 A	10 A	2770 VA
	240 VDC	10 A	30 A	10 A	2770 VA
AC Inductive PF=0.4	120 VAC	10 A	30 A	4 A	480 VA
	250 VAC	10 A	30 A	3 A	750 VA

METERING

HARMONICS

Individual: Range:	0.00 – 99.9%
Accuracy:	±1% of Full Scale @ 0.5 x CT
THD: Range:	0.00 – 99.9%
Accuracy:	±1% of Full Scale @ 0.5 x CT

COMMUNICATIONS

Serial ports:	Front: RS232; Rear: RS485
Baud Rate:	300 to 19200 baud,programmable parity
Protocols:	Modbus RTU, DNP 3.0 Level 2
Ethernet Port:	Optional, 10BaseT
Baud Rate:	Suitable for 10 Mbs networks
Protocol:	Modbus RTU over TCP/IP

POWER SUPPLY

Options:	LO/HI (specified when ordering)
LO range:	DC = 20 – 60 V; AC = 20 – 48 V @ 48 – 62 Hz
HI range:	DC=90–300V;AC=70–265V@48–62Hz
Power:	30 VA nominal, 40 VA maximum
Fuse:(not accessible)	Current Rating: 3.15 A Type: 5 × 20 mm Slow-Blow Littelfuse, High Breaking Capacity; Model # 2153.15

PRODUCTION TESTS

Dielectric strength:	IEC 255-5 & ANSI/IEEE C37.90 (2kV @ 60Hz for 1 min)

ENVIRONMENTAL

Operating temperature range:	-20° C to +60° C
Ambient storage temperature:	-40° C to +90° C
Humidity (non-condensing):	Up to 90% (non condensing)

**Specifications subject to change without notice.*

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745 Transformer Protection System

Technical Specifications (con't)

TYPE TESTS	
Dielectric voltage withstand:	EN60255-5
Impulse voltage withstand:	EN60255-5
Damped Oscillatory:	IEC61000-4-18/ IEC60255-22-1
Electrostatic Discharge:	EN61000-4-2 / IEC60255-22-2
RF immunity:	EN61000-4-3 / IEC60255-22-3
Fast Transient Disturbance:	EN61000-4-4 / IEC60255-22-4
Surge Immunity:	EN61000-4-5 / IEC60255-22-5
Conducted RF Immunity:	EN61000-4-6/ IEC60255-22-6
Radiated & Conducted Emissions:	CISPR11 / CISPR22 / IEC60255-25
Sinusoidal Vibration:	IEC60255-21-1
Power magnetic Immunity:	IEC61000-4-8
Pulse Magnetic Immunity:	IEC61000-4-9
Voltage Dip & interruption:	IEC61000-4-11
Ingress Protection:	IEC60529

TYPE TESTS	
Relative Humidity Cyclic:	IEC60068-2-30
Environmental (Cold):	IEC60068-2-1
Environmental (Dry heat):	IEC60068-2-2
Damped Oscillatrory:	IEEE/ANSI C37.90.1
Safety:	UL508 / UL C22.2-14 / UL1053

CASE	
Fully drawout unit (automatic CT shorts)	
Seal provision	
Dust tight door	
Weight (case and relay):	18 lbs, 6 oz

APPROVALS	
cULus:	UL508, UL1053, C22.2.No 14
ISO:	Manufactured under the ISO90001 quality program:
CE	according to EN60255-5, EN50263

Please refer to Multilin 745 Instruction Manual for complete technical specifications

Ordering

745	*	*	*	*	*	*	*	*	*	*	
745											Base unit Transformer Protection System
Phase Current Input Rating	W2										2 windings per phase
	W3										3 windings per phase
Phase Current Input Rating		P1									1 A for all windings
		P5									5 A for all windings
		P15									1 A for winding 1, 5 A for winding 2
		P51									5 A for winding 1, 1 A for winding 2
		P115									1 A for winding 1, 1 A for winding 2, 5 A for winding 3
		P151									1 A for winding 1, 5 A for winding 2, 1 A for winding 3
		P155									1 A for winding 1, 5 A for winding 2, 5 A for winding 3
		P511									5 A for winding 1, 1 A for winding 2, 1 A for winding 3
		P515									5 A for winding 1, 1 A for winding 2, 5 A for winding 3
		P551									5 A for winding 1, 5 A for winding 2, 1 A for winding 3
Ground Current Input Rating			G1								1 A for windings 1 and 2, 1 A for windings 2 and 3
			G5								5 A for windings 1 and 2, 5 A for windings 2 and 3
			G15								1 A for windings 1 and 2, 5 A for windings 2 and 3
			G51								5 A for windings 1 and 2, 1 A for windings 2 and 3
Power Supply Options				LO							20 – 60 VDC, 20 – 48 VAC @ 48 – 62 Hz
				HI							90 – 300 VDC, 70 – 265 VAC @ 48 – 62 Hz
Enhancements					A						Analog input/outputs option
						L					Loss of Life
							R				Restricted ground fault option
								E			Enhanced display, larger LCD, improved keypad
									T		Enhanced display, larger LCD, improved keypad plus 10BaseT Ethernet Port
Environmental Protection										H	Harsh (Chemical) Environment Conformal Coating

Accessories

Dual mounting available with the 19-2 Panel

NOTE: For dimensions see SR Family brochure.

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PRODUCT: 745-W3-P5-G5-HI-A-L-R-E-H / MULTILIN 745 THREE-WINDING TRANSFORMER PROTECTION SYSTEM

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