


Transformer Protection – Selector Guide

Transformer Protection

Features	Device	345	745	845	P642
APPLICATIONS & FUNCTIONALITY					
Low to Medium size LV and MV Transformers		•	•	•	•
Medium to Large size MV-HV Transformers		•		•	
Auto-transformers			•	•	•
Non-Standard Transformers					
Two windings		•	•	•	•
Three windings			•	•	
More than three windings					
3-phase Voltage inputs				•	
Advanced M&D features				•	
PROTECTION & CONTROL					
Transformer Differential	87T	•	•	•	•
Switchgear Control and Configurable SLD				•	
Maximum Number of Windings/Restraint Inputs		2	3	3	2
Harmonic Restraint		•	•	•	•
Internal Winding Standard Phase Shift Compensation		•	•	•	•
Internal Winding Non-standard Phase Shift Compensation					
Dynamic CT Ratio-Matching		•	•	•	•
CT Mismatch Range		16/1	16/1	20/1	15/1
Restricted Ground Fault - RGF/REF	87G	•	•	•	•
Over-excitation (Voltz Per Hertz)	24		•	•	•
Phase Undervoltage	27P			•	
IOC, Ground/Neutral/Phase	50G/N/P	G/N/P	G/N/P	G/N/P	G/N/P
TOC, Ground/Neutral/Phase	51G/N/P	G/N/P	G/N/P	G/N/P	G/N/P
Negative Phase Sequence Overcurrent	46	•	•	•	•
Custom programmable overcurrent curves		x	•	•	
Overvoltage - Phase	59P			•	
Overvoltage - Neutral	59N			•	
Overvoltage - Auxiliary	59X			•	
Overvoltage - Negative Sequence	59_2			•	
Current Directional, Neutral/Phase.	67 N/P			P/N	
Voltage Transformer Fuse Failure	VTFF/VTS			•	•
Current Transformer Supervision	CTS				•
Under/Overfrequency	81U/O		•	•	•
Synchrocheck	25			•	
Synchrophasor					
Thermal Overload	49	x	•	•	•
Power Swing Blocking	68				
Out of Step	78				
Backup Distance Protection	21				
Voltage Dependent Overcurrent (VCO/VRO)	51V			•	•
Transformer Hottest-spot Temperature			•	•	•
Transformer Aging factor			•	•	•
Transformer Loss of Life			•	•	•
Lockout	86			•	•
Tap Changer Monitoring			•	•	
Breaker Failure	50BF	•		•	•
Arc Flash Detection				•	
Graphical Display with Bay Control & Monitoring				•	
Display/Control of Swg. Elements from HMI				10/8	
Temperature Monitoring (RTD)		•		•	•
Phasor/Harmonic measurement graphical display				•	

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Features	Device	345	745	845	P642
AUTOMATION					
Settings Groups		2	4	6	4
Setting mode- Simple/Regular				•	
Contact Inputs (max)		10	16	14	12
Contact Outputs (max)		7	8	10	12
Non-volatile latch		•		•	•
Programmable Logic		•	•	•	•
User Definable Protection (Flexible Protection, Customized Functions)				8	
Virtual Inputs/Outputs		32	16/16	64/96	64/32
Direct Inputs/Outputs					
Programmable Pushbuttons		x		3	10
Trip/Close Coil Supervision		Trip	Trip	•	Trip
User-Programmable LEDs		Optional		15	18
User-Programmable Self Test				•	
Selector Switch				•	
Digital Counters				•	
Digital Elements		16			
Transducer Analog Inputs/outputs (max)			1	4/7	4/4
RTD Inputs (max)		Optional	1	12	10
Field swappable power supply				•	
Maintenance/Simulation mode (test/commission facilities)				•	
GOOSE Remote inputs				8 sets of 64	
GOOSE Remote outputs				3 sets of 64	
MONITORING & METERING					
Power Factor			•	•	
Current – RMS		•	•	•	•
Current – Phasor				•	•
Current – Demand		•	•	•	
Current - Unbalance			•	•	•
Voltage			•	•	•
Power - Apparent, Real, Reactive			•	•	•
MW, MVA, Mvar Demand				•	•
Breaker Arc Current				•	
Environmental monitoring				•	
Energy			•	•	•
Frequency			•	•	•
Current Harmonics (max)		5	21	25	
Loss of Life Calculations			•	•	•
Fault Report		x	•	•	•
User Programmable Trip Reports				•	
Event Recorder - Number of Events		256	40	1024	512
Oscillography/Transient Recorder - Sampling Rate		32	12	128	24
Trip Counters				•	
Data Logger / Trend Recording		•	•	•	
Simulation Mode			•		
COMMUNICATIONS INTERFACES					
Front Port Local Access		x	x	x	x
Rear Communications (RS232/RS422)			•		•
Rear Communications (G.703, C37.94)					•
Rear Communications (RS485)				•	•
Ethernet (copper)		•	•	•	•
Ethernet (fiber)		1		2	2
USB Front Port				•	
PROTOCOLS					
Courier					•
ModBus RTU		•	•	•	•
ModBus TCP/IP		•			
DNP3 Serial		•	•	•	•
EGD Protocol					
IEC61850		•		•	•
IEC 60870-5-104		•		•	
IEC 60870-5-103		•		•	•
Simple Network Time Protocol		x		•	•
PRP (IEC 62439-3 Clause 4)				•	•
HSR (IEC 62439-3 Clause 5)					•
IRIG-B Input		•	•	•	
Process Bus (IEC 61850-9-2)					

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Features	Device	P643	P645	T35	T60
APPLICATIONS & FUNCTIONALITY					
Low to Medium size LV and MV Transformers		•		•	
Medium to Large size MV-HV Transformers		•	•		•
Auto-transformers		•	•	•	•
Non-Standard Transformers				•	•
Two windings		•	•	•	•
Three windings		•	•	•	•
More than three windings			•	•	•
3-phase Voltage inputs		•	•	•	•
Advanced M&D features					
PROTECTION & CONTROL					
Transformer Differential	87T	•	•	•	•
Switchgear Control and Configurable SLD				•	•
Maximum Number of Windings/Restraint Inputs		3	5	6	6
Harmonic Restraint		•	•	•	•
Internal Winding Standard Phase Shift Compensation		•	•	•	•
Internal Winding Non-standard Phase Shift Compensation				•	•
Dynamic CT Ratio-Matching		•	•	•	•
CT Mismatch Range		20/1 optional	20/1 optional	32/1	32/1
Restricted Ground Fault - RGF/REF	87G	•	•		•
Over-excitation (Voltz Per Hertz)	24	•	•		•
Phase Undervoltage	27P	•	•		•
IOC, Ground/Neutral/Phase	50G/N/P	G/N/P	G/N/P		G/N/P
TOC, Ground/Neutral/Phase	51G/N/P	G/N/P	G/N/P	G/P	G/N/P
Negative Phase Sequence Overcurrent	46	•	•		
Custom programmable overcurrent curves				•	•
Overvoltage - Phase	59P	•	•		•
Overvoltage - Neutral	59N	•	•		•
Overvoltage - Auxiliary	59X				•
Overvoltage - Negative Sequence	59_2	•	•		•
Current Directional, Neutral/Phase.	67 N/P	P/N	P/N		P/N
Voltage Transformer Fuse Failure	VTFF/VTS	•	•		•
Current Transformer Supervision	CTS	•	•	•	•
Under/Overfrequency	81U/O	•	•		•
Synchrocheck	25				•
Synchrophasor					•
Thermal Overload	49	•	•	•	•
Power Swing Blocking	68				•
Out of Step	78				•
Backup Distance Protection	21				•
Voltage Dependent Overcurrent (VCO/VRO)	51V	•	•		VRO
Transformer Hottest-spot Temperature		•	•		•
Transformer Aging factor		•	•	•	•
Transformer Loss of Life		•	•		•
Lockout	86	•	•	•	•
Tap Changer Monitoring					•
Breaker Failure	50BF	•	•		•
Arc Flash Detection					•
Graphical Display with Bay Control & Monitoring				•	•
Display/Control of Swg. Elements from HMI					•
Temperature Monitoring (RTD)		•	•	•	•
Phasor/Harmonic measurement graphical display					•

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Features	Device	P643	P645	T35	T60
AUTOMATION					
Settings Groups		4	4	6	6
Setting mode- Simple/Regular					
Contact Inputs (max)		40	40	96	96
Contact Outputs (max)		24	24	64	64
Non-volatile latch		•	•	•	•
Programmable Logic		•	•	•	•
User Definable Protection (Flexible Protection, Customized Functions)				•	•
Virtual Inputs/Outputs		64/32	64/32	64/96	64/96
Direct Inputs/Outputs				32/32	32/32
Programmable Pushbuttons		10	10	12	12
Trip/Close Coil Supervision		Trip	Trip	Trip/Close	Trip/Close
User-Programmable LEDs		18	18	48	48
User-Programmable Self Test				•	•
Selector Switch				•	•
Digital Counters				•	•
Digital Elements				•	•
Transducer Analog Inputs/outputs (max)		4/4	4/4	24/12	24/12
RTD Inputs (max)		10	10	24	24
Field swappable power supply					
Maintenance/Simulation mode (test/commission facilities)					
GOOSE Remote inputs					
GOOSE Remote outputs					
MONITORING & METERING					
Power Factor		•	•	•	•
Current – RMS		•	•	•	•
Current – Phasor		•	•	•	•
Current – Demand					•
Current - Unbalance		•	•		
Voltage		•	•	•	•
Power - Apparent, Real, Reactive		•	•	•	•
MW, MVA, Mvar Demand		•	•		•
Breaker Arc Current				•	•
Environmental monitoring					
Energy		•	•	•	•
Frequency		•	•	•	•
Current Harmonics (max)					25
Loss of Life Calculations		•	•		•
Fault Report		•	•	•	•
User Programmable Trip Reports				•	•
Event Recorder - Number of Events		512	512	1024	1024
Oscillography/Transient Recorder - Sampling Rate		24	24	64	64
Trip Counters				•	•
Data Logger / Trend Recording				•	•
Simulation Mode					
COMMUNICATIONS INTERFACES					
Front Port Local Access		x	x	x	x
Rear Communications (RS232/RS422)		•	•	•	•
Rear Communications (G.703, C37.94)		•	•	•	•
Rear Communications (RS485)		•	•		
Ethernet (copper)		•	•	•	•
Ethernet (fiber)		2	3	3	3
USB Front Port					
PROTOCOLS					
Courier		•	•		
ModBus RTU		•	•	•	•
ModBus TCP/IP					
DNP3 Serial		•	•	•	•
EGD Protocol				•	•
IEC61850		•	•	•	•
IEC 60870-5-104				•	•
IEC 60870-5-103		•	•	•	•
Simple Network Time Protocol		•	•	•	•
PRP (IEC 62439-3 Clause 4)		•	•	•	•
HSR (IEC 62439-3 Clause 5)		•	•		
IRIG-B Input				•	•
Process Bus (IEC 61850-9-2)			•	•	•