Transformer Differential Protection – SIPROTEC 7UT85

ANSI	Function	Abbr.	Available	Application Templates				
				1	2	3	4	5
	Expandable hardware quantity structure	I/O	■					
	Process bus client protocol (hint: PB client requires a separate ETH-BD-2FO plug-in module, from V8.0)	PB client	■					
	IEC61850-9-2 Merging Unit Stream (hint: Each stream requires a separate ETH-BD-2FO plug-in module, from V8.0)	MU	■					
	IEC61850-9-2 Merging Unit Stream 7SS85 CU (hint: Only for communication with a 7SS85 CU. A separate ETH-BD-2FO plug-in module is required starting with V8.40)	MU	■					
21/21N	Distance Protection	Z<, V< /I>/∠(V, I)	■					
21T	Impedance protection for transformers	Z<	■					
24	Overexcitation protection	V/f	■					
25	Synchrocheck, synchronization function	Sync	■					
27	Undervoltage protection: "3-phase" or "positive-sequence system V1" or "universal Vx"	V<	■					■
27R, 59R	Voltage change protection (starting with V8.30)	dV/dt	■					
	Undervoltage-controlled reactive power protection	Q>/V<	■					
32, 37	Power protection active/reactive power	P<>, Q<>	■					
32R	Reverse-power protection	- P<	■					
37	Undercurrent	I<	■					
37	Power-plant disconnection protection	-dP	■					
38	Temperature supervision	θ>	■					
46	Negative-sequence system overcurrent protection	I2>	■					■
46	Unbalanced-load protection (thermal)	$I2^2$ t>	■					
47	Overvoltage protection, negative-sequence system	V2>	■					
47	Overvoltage protection, negative-sequence system/positive-sequence system	V2/V1>	■					
49	Thermal overload protection	θ, I^2t	■	■	■	■	■	■
49	Thermal overload protection, user-defined characteristic curve	θ, I^2t	■					
49H	Hotspot calculation	θh, I^2t	■					
50/51 TD	Overcurrent protection, phases	I>	■	■	■	■	■	■
	Instantaneous tripping at switch onto fault	SOTF	■					
50HS	Instantaneous high-current tripping	I>>>	■					
50/51 TD	Overcurrent protection with positive-sequence current I1 (from V7.9)	I1>	■					
50N/ 51N TD	Overcurrent protection, ground	IN>	■		■			
50N/ 51N TD	Overcurrent protection, 1-phase	IN>	■			■		
50 Ns/ 51Ns	Sensitive ground-fault detection for grounded arc suppression coils and isolated power systems including a) 3I0> b) admittance Y0>, c) 3I0-harm> (from V7.8)	INs>	■					
	Sensitive ground-fault detection via pulse detection; hint: this stage also requires the function 50Ns/51Ns or 67Ns "sensitive ground-fault detection for grounded arc suppression coils and isolated power systems"	IN pulse	■					
	Intermittent ground-fault protection	IIE>	■					
50BF	Circuit-breaker failure protection, 3-pole	CBFP	■		■	■	■	■

ANSI	Function	Abbr.	Available	Application Templates				
				1	2	3	4	5
50EF	End-fault protection (hint: For use only in decentralized busbar protection with a 7SS85 CU starting with V8.40)		■					
50RS	Circuit breaker restrike monitoring	CBRM	■					
51V	Voltage-controlled overcurrent protection	t=f(I, V)	■					
59, 59N	Overvoltage protection: "3-phase" or "zero-sequence system V0" or "positive-sequence system V1" or "universal Vx"	V>	■				■	■
59	Overvoltage protection: "3-phase" or "positive-sequence system V1" or "universal Vx"	V>	■					
60	Voltage-comparison supervision	ΔV>	■					
67	Directional overcurrent protection, phases	I>, ∠(V, I)	■					
67N	Directional overcurrent protection, ground	IN>, ∠(V, I)	■					■
67N	Directional ground-fault protection in grounded power systems	IN>, ∠(V, I)	■					
67 Ns	Sensitive ground-fault detection for grounded arc suppression coils and isolated power systems including a) 3I0> b) V0>, c) cos/sine Phi, d) transient ground fault, e) Phi(V, I), f) admittance		■					
	Directional tripping stage with one harmonic; hint: this stage also requires the function "67Ns sensitive ground-fault detection for grounded arc suppression coils and isolated power systems"	∠(V0h,I0h)	■					
	Directional Intermittent Ground-Fault Protection	IIEdir>	■					
68	Power-swing blocking	ΔZ/Δt	■					
74TC	Trip-circuit supervision		■	■	■	■	■	
74CC	Single circuit monitoring (from V7.9)		■					
79	Automatic reclosing, 3-pole	AREC	■					
81	Frequency protection: "f>" or "f<" or "df/dt"	f<>; df/dt<>	■					■
81 AF	Abnormal frequency protection	fBand	■					
81U	Underfrequency load shedding	f<(ULS)	■					
	Vector-jump protection	Δφ>	■					
85/21	Teleprotection scheme for distance protection		■					
85/27	Weak or no infeed: Echo and tripping		■					
85/67N	Teleprotection scheme for directional ground-fault protection		■					
86	Lockout		■	■	■	■	■	
87T	Transformer Differential Protection	ΔI	■	■	■	■	■	
87T	Differential protection for special transformers	ΔI	■					
87T Node	Differential protection (nodal point protection for auto transformer)	ΔI nodes	■					
87T	Differential protection for phase-angle regulating transformers (single core)	ΔI	■					
87N T	Restricted ground-fault protection	ΔIN	■		■	■		
87M	Differential motor protection	ΔI	■					■
87G	Generator differential protection	ΔI	■					
87L	Line differential protection for 2 line ends for 7UT8 (communication with 7SD82, 85, 86, 7SL86, 87)	ΔI	■					
	Option for line differential protection with charging-current compensation	ΔI	■					
87 STUB	Stub fault differential protection (for breaker-and-a-half layouts)		■					
90 V	Voltage controller for two-winding transformer		■				■	
90 V	Voltage controller for two-winding transformer with parallel control		■					

Transformer Differential Protection – SIPROTEC 7UT85

ANSI	Function	Abbr.	Available	Application Templates				
				1	2	3	4	5
	Number of two-winding transformers with parallel control (hint: only together with the function "voltage controller for two-winding transformer with parallel control")		■					
90 V	Voltage controller for three-winding transformer		■					
90 V	Voltage controller for grid coupling transformer		■					
FL	Fault Locator, single-side	FL-one	■					
FL	Fault Locator Plus (from V7.9)	FL plus	■					
PMU	Synchrophasor measurement	PMU	■					
AFD	Arc protection (only with plug-in module ARC-CD-3FO)		■					
	Measured values, standard		■	■	■	■	■	■
	Measured values, extended: Min, max, average		■					
	Switching statistics counter		■	■	■		■	
	PQ – Basic measured values: THD (Total Harmonic Distortion) and harmonic component (starting with V8.01) and THD voltage average values (starting with V8.40)		■					
	PQ – Basic measured values: Voltage unbalance (starting with V8.40)		■					
	PQ – Basic measured values: Voltage changes – monitoring of voltage dips, overvoltages and voltage interruptions (starting with V8.40)		■					
	PQ – Basic measured values: TDD - Total Demand Distortion (starting with V8.40)		■					
	CFC (standard, control)		■	■	■	■	■	■
	CFC arithmetic		■					
	Circuit-breaker wear monitoring	ΣIx, I²t, 2P	■					
	Switching sequence function		■					
	Inrush-current detection		■	■	■	■	■	
	External trip initiation		■			■		
	Control		■	■	■	■	■	■
PoW	Point-on-wave switching (starting with V7.90)	PoW	■					
	Circuit breaker		■	■	■	■	■	■
	Disconnector/grounding conductor		■					
	Fault recording of analog and binary signals		■	■	■	■	■	■
	Monitoring		■	■	■	■	■	■
	Protection interface, serial		■					
	Frequency group tracking (from V7.8)		■					
	Transformer side 7UT85		■					
	Cyber security: Role-Based Access Control (from V7.8)		■					
	Temperature recording via communication protocol		■					
	Cyber security: Authenticated network access using IEEE 802.1X (starting from V8.3)		■					
Function point class:				0	30	30	175	50
The configuration and function point class for your application can be determined in the SIPROTEC 5 order configurator at *www.siemens.com/siprotec*.								

Table 2.11/4 SIPROTEC 7UT85 – Functions, Application Templates

(1) 2-Winding Transformer Base (DIFF protection)

(2) 2-Winding Transformer (DIFF protection, SVS, REF)

(3) 2-Winding Transformer 1.5 CB (DIFF protection, SVS, REF)

(4) 2-Winding Transformer (DIFF. Protection, Voltage Controller)

(5) Motor (DIFF protection, CBFP, voltage protection)

Standard Variants for SIPROTEC 7UT85		
O1	1/3, 7 BI, 7 BO, 8 I	
	Housing width 1/3 x 19" 7 binary inputs 7 binary outputs (1 life contact, 2 standard, 4 fast) 8 current transformers Contains the following modules: Base module with PS201 and IO203	
O2	1/2, 19 BI, 23 BO, 8 I	
	Housing width 1/2 × 19" 19 binary inputs, 23 binary outputs (1 life contact, 18 standard, 4 fast) 8 current transformers Contains the following modules: Base module with PS201 and IO203 Expansion module IO205	

Table 2.11/5 Standard Variants for Transformer Differential Protection Devices

You can find the technical data in the manual
www.siemens.com/siprotec.

7UT85 Transformer Differential Protection - Overview Function points calculation

(P1F110185)

Functions Free of Charge

ANSI	Function	Abbr.	Included
	Protection functions for 3-pole tripping	3-pole	✓
	Hardware quantity structure expandable	I/O	✓
37	Undercurrent	I<	✓
38	Temperature supervision	θ>	✓
49	Thermal overload protection	θ, I^2t	✓
49	Thermal overload protection, user-defined characteristic	θ, I^2t	✓
50HS	Instantaneous high-current tripping	I>>>	✓
50/51 TD	Overcurrent protection with positive-sequence current I1 (from V7.9)	I1>	20 X ✓
50N/ 51N TD	Overcurrent protection, ground	IN>	✓
50N/ 51N TD	Overcurrent protection, 1-phase	IN>	✓
74TC	Trip-circuit supervision	TCS	✓
74CC	Closed-circuit supervision (from V7.9)	CCS	✓
85/21	Universal teleprotection scheme for distance protection (from V9.20)		✓
85/27	Weak or no infeed: echo and tripping	WI	✓
85/67N	Universal teleprotection scheme for directional ground fault protection (from V9.20)		✓
86	Lockout		✓
87T	Transformer differential protection	ΔI	✓
87T Node	Differential protection (Node protection for auto transformer)	ΔI Node	✓
87M	Motor differential protection	ΔI	✓
AFD	Arc-protection (only with plug-in module ARC-CD-3FO)		✓
	Measured values - standard		✓

	Switching statistic counters		✓
	PQ-Basic measured values: THD (Total Harmonic Distortion) and harmonics (from V8.01) THD voltage aggregation values (from V8.40)		✓
	CFC (Standard, control)		✓
	Inrush current detection		✓
	External trip initiation		✓
	Control		✓
	Protection interface, serial		✓
	Monitoring and supervision		✓
	Fault recording of analog and binary signals		✓
	Frequency-tracking groups (from V7.8)		6 X ✓
	Temperature acquisition via communication protocol		✓

Functions with Costs

ANSI	Function	Abbr.	Included	Quantity	Value	Points
	IEC 61850-9-2 Merging Unit function (Note: Max. 2 streams per MU function, each MU function requires a ETH-BD-2FO plug-in module)	MU		0	200	0
	Process Bus Client function (Note: This function requires a ETH-BD-2FO plug-in module)	PB client		0	100	0
	IEC 61850-9-2 Merging Unit function for 7SS85 CU (Note: Only for communication with a 7SS85 with Significant properties: "CU: ...". This function requires a ETH-BD-2FO plug-in module)	MU (7SS85 CU)		0	295	0
	IEEE 1588v2/PTP Grandmaster Clock (Note: This function requires a ETH-BD-2FO, with V9.20)	GMC		0	200	0
21/21N	Distance protection	Z<, V<		0	100	0
21GT	Impedance protection for transformers	Z<		0	25	0

24	Overexcitation protection	V/f		0	25	0
25	Synchrocheck, synchronization function	Sync		0	50	0
27	Undervoltage protection: "3-phase" or "positive-sequence system V1" or "universal Vx"	V<		0	5	0
27R, 59R	Rate-of-voltage-change protection (from V8.30)	dV/dt		0	5	0
	Undervoltage-controlled reactive power protection	Q>/V<		0	5	0
32, 37	Power protection active/reactive power	P<>, Q<>		0	10	0
32R	Reverse-power protection	- P<	2 X ✓	0	5	0
37	Power-plant disconnection protection	-dP		0	50	0
46	Negative-sequence overcurrent protection	I2>		0	5	0
46	Unbalanced-load protection (thermal)	$I2^2$ t>		0	5	0
46	Negative-sequence overcurrent protection with direction			0	15	0
47	Overvoltage protection, negative-sequence system	V2>		0	5	0
47	Overvoltage protection, negative-sequence/positive-sequence system	V2/V1>		0	5	0
49H	Hot spot calculation	θh, I^2t		0	20	0
50/51 TD	Overcurrent protection, phases	I>	3 X ✓	0	30	0
	Instantaneous tripping at switch onto fault	SOTF		0	10	0
50Ns/ 51Ns	Sensitive ground-current detection for systems with resonant or isolated neutral systems incl. a) 3I0>, b) admittance Y0>, c) 3I0-harm> (from V7.8)	INs>		0	5	0
	Ground-fault detection via pulse pattern detection; Note: this stage additionally requires the function 50Ns/51Ns or 67Ns "Sensitive ground-fault detection for systems with resonant or isolated neutral"	IN-pulse		0	15	0

	Intermittent ground-fault protection	Iie>		0	20	0
50BF	Circuit-breaker failure protection, 3-pole	CBFP		0	5	0
50RS	Circuit-breaker restrike protection	CBRS		0	20	0
50EF	End-fault protection (Note: Only useable for distributed busbar protection with 7SS85 CU with V8.40)			0	5	0
51V	Overcurrent protection, voltage dependent	t=f(I,V)		0	10	0
52PD	Circuit-breaker pole discrepancy	CBPD		0	5	0
59	Overvoltage protection: "3-phase" or "positive-sequence system V1" or "universal Vx"	V>		0	5	0
59, 59N	Overvoltage protection: "3-phase" or "zero-sequence system V0" or "universal Vx"	V>		0	5	0
60	Voltage-comparison supervision	ΔU>		0	5	0
67	Directional overcurrent protection, phases			0	5	0
67N	Directional overcurrent protection, ground			0	15	0
67N	Directional overcurrent protection for ground faults in grounded systems			0	30	0
67Ns	Dir. sensitive ground-fault detection for systems with resonant or isolated neutral incl. a) 3I0>, b) V0>, c) Cos-/SinPhi, d) Transient ground-fault fct., e) Phi(V,I), f) admittance			0	30	0
	Directional stage with a harmonic; Note: this stage additionally requires the function "67Ns Dir. sensitive ground-fault detection for systems with resonant or isolated neutral"			0	10	0
	Directional intermittent ground-fault protection	Iie dir>		0	20	0
68	Power-swing blocking	ΔZ/Δt		0	25	0
79	Automatic reclosing, 3-pole	AR		0	45	0

81	Frequency protection: "f>" or "f<" or "df/dt"	f<>; df/dt<>		0	5	0
81 AF	Abnormal frequency protection	fBand		0	15	0
81U	Underfrequency load-shedding	f<(UFLS)		0	15	0
	Vector-jump protection	Δφ>		0	20	0
87T	Differential protection for special transformers	ΔI		0	150	0
87T	Transformer differential protection for phase angle regulating transformer (single core)	ΔI		0	200	0
87N	Restricted ground-fault protection	ΔIN		0	15	0
87G	Generator differential protection	ΔI		0	50	0
87L	Stages I2, IN, INunrestrained for line differential protection; Note: each stage requires functions points (from V9.30)	ΔI		0	20	0
87L	Differential protection for lines with 2 ends for 7UT8 (communication with 7SD82,86,87 or 7SL82,86,87) (extendable from V8.60)	ΔI		0	170	0
87L	Differential protection for lines for more than 2 ends, per additional end (from V8.60)			0	185	0
	Option for line differential protection charging-current compensation	ΔI		0	40	0
87 STUB	Stub-fault differential protection (for breaker-and-a-half scheme)			0	35	0
90V	Automatic voltage controller for two-winding transformer			0	150	0
90V	Automatic voltage controller for two-winding transformer with parallel operation			0	180	0
	Number of two-winding transformers with parallel operation (Note: only together with the function "Automatic voltage controller for two-winding transformer with parallel operation")		2 X ✓	0	5	0
90V	Automatic voltage controller for three-winding transformer			0	200	0

90V	Automatic voltage controller for grid coupling transformer			0	175	0
FL	Fault locator, single-sided	FL-one		0	25	0
FL	Fault locator plus (from V7.9)	FL plus		0	45	0
PMU	Synchrophasor measurement	PMU		0	40	0
	Measured values - extended: Min, Max, Avg			0	3	0
	PQ-Basic measured values: Voltage unbalance (from V8.40)			0	20	0
	PQ-Basic measured values: Voltage variations - voltage dips, swells and interruptions (from V8.40)			0	30	0
	PQ-Basic measured values: TDD - Total Demand Distortion (from V8.40)			0	10	0
	CFC arithmetic			0	40	0
	Circuit-breaker monitoring (from V9.20)	ΣIx, I^2t, 2P, tO, tC, pole scatter, discepancy		0	10	0
	Disconnector monitoring (from V9.50)	tO, tC		0	5	0
	Switching sequences function			0	5	0
PoW	Point-on-wave switching (from V7.90)	PoW		0	425	0
	Point-on-wave with residual flux estimation (from V9.80)	PoW		0	465	0
	Circuit-breaker		4 X ✓	0	3	0
	Disconnector/Grounding switch		4 X ✓	0	3	0
	Multiplexing of protection interface			0	50	0
SSR	Slow-scan recorder (Mod.: from V8.80, Non-Mod.: from V9.40)	SSR	1 X ✓	0	40	0
CR	Continuous recorder (Mod.: from V9.20, Non-Mod.: from V9.40)	CR	1 X ✓	0	25	0
	PQ-10/12 cycle values for continuous recorder (from V9.20)	CR		0	25	0

TR	Trend recorder (Mod.: from V9.30, Non-Mod.: from V9.40)	TR	1 X ✓	0	25	0
	PQ-Trend value for Trend Recorder (from V9.30)	TR		0	25	0
	PQ-Flicker values for Trend Recorder (from V9.30)	TR		0	25	0
	Transformer side 7UT85		2 X ✓	0	70	0
	Cyber Security: Role-Based Access Control (from V7.8)			0	25	0
	Cyber Security: IEEE 802.1x based network authentication (from V8.3)			0	10	0
Total:						0