Electrical network protection

Sepam series 20
Sepam series 40

I1 = 165A RMS
I2 = 166A RMS
I3 = 167A RMS

Schneider Electric

Selection table
Sepam series 20

Protection	ANSI code	Substation		Transformer		Motor	Busbar	
		S20	S23	T20	T23	M20	B21 [3]	B22
Phase overcurrent	50/51	4	4	4	4	4		
Earth fault / Sensitive earth fault	50N/51N 50G/51G	4	4	4	4	4		
Breaker failure	50BF		1		1			
Negative sequence / unbalance	46	1	1	1	1	1		
Thermal overload	49RMS			2	2	2		
Phase undercurrent	37					1		
Excessive starting time, locked rotor	48/51LR/14					1		
Starts per hour	66					1		
Positive sequence undervoltage	27D/47						2	2
Remanent undervoltage	27R						1	1
Phase-to-phase undervoltage	27						2	2
Phase-to-neutral undervoltage	27S						1	1
Phase-to-phase overvoltage	59						2	2
Neutral voltage displacement	59N						2	2
Overfrequency	81H						1	1
Underfrequency	81L						2	2
Rate of change of frequency	81R							1
Recloser (4 cycles)	79	□	□					
Thermostat / Buchholz	26/63			□	□			
Temperature monitoring (8 RTDs)	38/49T			□	□	□		
Metering								
Phase current I1, I2, I3 RMS, residual current I0		■	■	■	■	■		
Demand current I1, I2, I3, peak demand current IM1, IM2, IM3		■	■	■	■	■		
Voltage U21, U32, U13, V1, V2, V3, residual voltage V0							■	■
Positive sequence voltage Vd / rotation direction							■	■
Frequency							■	■
Temperature				□	□	□		
Network and machine diagnosis								
Tripping current TripI1, TripI2, TripI3, TripI0		■	■	■	■	■		
Unbalance ratio / negative sequence current Ii		■	■	■	■	■		
Disturbance recording		■	■	■	■	■	■	■
Thermal capacity used				■	■	■		
Remaining operating time before overload tripping				■	■	■		
Waiting time after overload tripping				■	■	■		
Running hours counter / operating time				■	■	■		
Starting current and time						■		
Start inhibit time Number of starts before inhibition						■		
Switchgear diagnosis								
Cumulative breaking current		■	■	■	■	■		
Trip circuit supervision		□	□	□	□	□	□	□
Number of operations, operating time, charging time		□	□	□	□	□		
Control and monitoring	**ANSI code**							
Circuit breaker / contactor control [1]	94/69	□	□	□	□	□	□	□
Latching / acknowledgement	86	■	■	■	■	■	■	■
Logic discrimination	68	□	□	□	□	□		
Switching of groups of settings		■ [2]	■ [2]	■ [2]	■ [2]	■ [2]		
Annunciation	30	■	■	■	■	■	■	■
Additional modules								
8 temperature sensor inputs - MET148-2 module				□	□	□		
1 low level analog output - MSA141 module		□	□	□	□	□	□	□
Logic inputs/outputs - MES114/MES114E/MES114F (10I/4O) module		□	□	□	□	□	□	□
Communication interface - ACE949-2, ACE959, ACE937, ACE969TP or ACE969FO		□	□	□	□	□	□	□

b *standard,* v *according to parameter setting and MES114/MES114E/MES114F or MET148-2 input/output module options.*
(1) For shunt trip unit or undervoltage trip unit.
(2) Exclusive choice between logic discrimination and switching from one 2-relay group of settings to another 2-relay group.
(3) Performs Sepam B20 functions.

Selection table
Sepam series 40

Protection	ANSI code	Substation			Transformer		Motor	Generator
		S40	S41	S42	T40	T42	M41	G40
Phase overcurrent	50/51	4	4	4	4	4	4	4
Voltage-restrained overcurrent	50V/51V							1
Earth fault / Sensitive earth fault	50N/51N 50G/51G	4	4	4	4	4	4	4
Breaker failure	50BF	1	1	1	1	1	1	1
Negative sequence / unbalance	46	2	2	2	2	2	2	2
Directional phase overcurrent	67			2		2		
Directional earth fault	67N/67NC		2	2		2	2	
Directional active overpower	32P		1	1			1	1
Directional reactive overpower	32Q/40						1	1
Thermal overload	49RMS				2	2	2	2
Phase undercurrent	37						1	
Excessive starting time, locked rotor	48/51LR/14						1	
Starts per hour	66						1	
Positive sequence undervoltage	27D						2	
Remanent undervoltage	27R						1	
Undervoltage [3]	27/27S	2	2	2	2	2	2	2
Overvoltage [3]	59	2	2	2	2	2	2	2
Neutral voltage displacement	59N	2	2	2	2	2	2	2
Negative sequence overvoltage	47	1	1	1	1	1	1	1
Overfrequency	81H	2	2	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4	4	4
Recloser (4 cycles)	79	□	□	□				
Temperature monitoring (8 or 16 RTDs)	38/49T				□	□	□	□
Thermostat / Buchholz	26/63				□	□		

Metering

		S40	S41	S42	T40	T42	M41	G40
Phase current I1, I2, I3 RMS, residual current I0		■	■	■	■	■	■	■
Demand current I1, I2, I3, peak demand current IM1, IM2, IM3		■	■	■	■	■	■	■
Voltage U21, U32, U13, V1, V2, V3, residual voltage V0		■	■	■	■	■	■	■
Positive sequence voltage Vd / rotation direction / Negative sequence voltage Vi		■	■	■	■	■	■	■
Frequency		■	■	■	■	■	■	■
Active, reactive and apparent power P, Q, S / Peak demand power PM, QM, power factor		■	■	■	■	■	■	■
Calculated active and reactive energy (W.h, var.h)		■	■	■	■	■	■	■
Active and reactive energy by pulse counting (W.h, .varh)		□	□	□	□	□	□	□
Temperature					□	□	□	□

Network and machine diagnosis

		S40	S41	S42	T40	T42	M41	G40
Tripping context		■	■	■	■	■	■	■
Tripping current TripI1, TripI2, TripI3, TripI0		■	■	■	■	■	■	■
Unbalance ratio / negative sequence current Ii		■	■	■	■	■	■	■
Phase displacement 0, 1, 2, 3		■	■	■	■	■	■	■
Disturbance recording		■	■	■	■	■	■	■
Thermal capacity used					■	■	■	■
Remaining operating time before overload tripping					■	■	■	■
Waiting time after overload tripping					■	■	■	■
Running hours counter / operating time					■	■	■	■
Starting current and time							■	
Start inhibit time, number of starts before inhibition							■	

Switchgear diagnosis

		S40	S41	S42	T40	T42	M41	G40
Cumulative breaking current		■	■	■	■	■	■	■
Trip circuit supervision		□	□	□	□	□	□	□
Number of operations, operating time, charging time		□	□	□	□	□	□	□
CT / VT supervision	60FL	■	■	■	■	■	■	■

Control and monitoring

	ANSI code	S40	S41	S42	T40	T42	M41	G40
Circuit breaker / contactor control [1]	94/69	■	■	■	■	■	■	■
Latching / acknowledgement	86	■	■	■	■	■	■	■
Logic discrimination	68	□	□	□	□	□	□	□
Switching of groups of settings		■	■	■	■	■	■	■
Annunciation	30	■	■	■	■	■	■	■
Logic equation editor		■	■	■	■	■	■	■

Additional modules

		S40	S41	S42	T40	T42	M41	G40
8 temperature sensor inputs - MET148-2 module [2]					□	□	□	□
1 low level analog output - MSA141 module		□	□	□	□	□	□	□
Logic inputs/outputs - MES114/MES114E/MES114F (10I/4O) module		□	□	□	□	□	□	□
Communication interface - ACE949-2, ACE959, ACE937, ACE969TP, ACE969FO or ECI850		□	□	□	□	□	□	□

b *standard*, v *according to parameter setting and MES114/MES114E/MES114F or MET148-2 input/output module options.*
(1) For shunt trip unit or undervoltage trip unit.
(2) 2 modules possible.
(3) Exclusive choice, phase-to-neutral voltage or phase-to-phase voltage for each of the 2 relays.

Schneider Electric

The general settings define the characteristics of the measurement sensors connected to Sepam and determine the performance of the metering and protection functions used. They are accessed via the SFT2841 setting software "General Characteristics", "CT-VT Sensors" and "Particular characteristics" tabs.

General settings		**Selection**	**Sepam series 20**	**Sepam series 40**
In	Rated phase current (sensor primary current)	2 or 3 CT 1 A / 5 A	1 A to 6250 A	1 A to 6250 A
		3 LPCTs	25 A to 3150 A [(1)]	25 A to 3150 A [(1)]
Ib	Base current, according to rated power of equipment		0.4 to 1.3 In	0.4 to 1.3 In
In0	Rated residual current	Sum of 3 phase currents	See In rated phase current	See In rated phase current
		CSH120 or CSH200 core balance CT	2 A or 20 A rating	2 A, 5 A or 20 A rating
		1 A/5 A CT + CSH30 interposing ring CT	1 A to 6250 A	1 A to 6250 A (In0 = In)
		1 A/5 A CT + CSH30 interposing ring CT Sensitivity x10	-	1 A to 6250 A (In0 = In/10)
		Core balance CT + ACE990 (the core balance CT ratio 1/n must be such that 50 y n y 1500)	According to current monitored and use of ACE990	According to current monitored and use of ACE990
Unp	Rated primary phase-to-phase voltage (Vnp: rated primary phase-to-neutral voltage Vnp = Unp/3)		220 V to 250 kV	220 V to 250 kV
Uns	Rated secondary phase-to-phase voltage	3 VTs: V1, V2, V3	100, 110, 115, 120, 200, 230 V	100, 110, 115, 120, 200, 230 V
		2 VTs: U21, U32	100, 110, 115, 120 V	100, 110, 115, 120 V
		1 VT: V1	100, 110, 115, 120 V	100, 110, 115, 120 V
Uns0	Secondary zero sequence voltage for primary zero sequence voltage Unp/3		Uns/3 or Uns/3	Uns/3 or Uns/3
	Rated frequency		50 Hz or 60 Hz	50 Hz or 60 Hz
	Integration period (for demand current and peak demand current and power)		5, 10, 15, 30, 60 mn	5, 10, 15, 30, 60 mn
	Pulse-type accumulated energy meter	Increments active energy	-	0.1 kW.h to 5 MW.h
		Increments reactive energy	-	0.1 kvar.h to 5 Mvar.h

(1) In values for LPCT, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.

Metering and diagnosis
Characteristics

Functions		Measurement range	Accuracy [1] Sepam series 20	Accuracy [1] Sepam series 40		Saving
Metering						
Phase current		0.1 to 40 In [3]	±1 %	±0.5 %	■	
Residual current	Calculated	0.1 to 40 In	±1 %	±1 %	■	
	Measured	0.1 to 20 In0	±1 %	±1 %	■	
Demand current		0.1 to 40 In	±1 %	±0.5 %		
Peak demand current		0.1 to 40 In	±1 %	±0.5 %		□
Phase-to-phase voltage		0.05 to 1.2 Unp	±1 %	±0.5 %	■	
Phase-to-neutral voltage		0.05 to 1.2 Vnp	±1 %	±0.5 %	■	
Residual voltage		0.015 to 3 Vnp	±1 %	±1 %		
Positive sequence voltage		0.05 to 1.2 Vnp	±5 %	±2 %		
Negative sequence voltage		0.05 to 1,2 Vnp	-	±2 %		
Frequency Sepam series 20		50 ±5 Hz or 60 ±5 Hz	±0.05 Hz	-	■	
Frequency Sepam series 40		25 to 65 Hz	-	±0.02 Hz	■	
Active power		0.015 Sn [2] to 999 MW	-	±1 %	■	
Reactive power		0.015 Sn [2] to 999 Mvar	-	±1 %	■	
Apparent power		0.015 Sn [2] to 999 MVA	-	±1 %	■	
Peak demand active power		0.015 Sn [2] to 999 MW	-	±1 %		□
Peak demand reactive power		0.015 Sn [2] to 999 Mvar	-	±1 %		□
Power factor		-1 to +1 (CAP/IND)	-	±1 %		
Calculated active energy		0 to $2.1.10^8$ MW.h	-	±1 % ±1 digit		□
Calculated reactive energy		0 to $2.1.10^8$ Mvar.h	-	±1 % ±1 digit		□
Temperature		-30 to +200 °C or -22 to +392 °F	±1 °C from +20 to +140 °C	±1 °C from +20 to +140 °C	■	
Network diagnosis assistance						
Tripping context						□
Phase tripping current		0.1 to 40 In	±5 %	±5 %		□
Earth fault tripping current		0.1 to 20 In0	±5 %	±5 %		□
Negative sequence / unbalance		10 to 500 % of Ib	±2 %	±2 %		
Phase displacement 0 (between V0 and I0)		0 to 359°	-	±2°		
Phase displacement 1, 2, 3 (between V and I)		0 to 359°	-	±2°		
Machine operating assistance						
Thermal capacity used		0 to 800 % (100 % for I phase = Ib)	±1 %	±1 %	■	□
Remaining operating time before overload tripping		0 to 999 mn	±1 mn	±1 mn		
Waiting time after overload tripping		0 to 999 mn	±1 mn	±1 mn		
Running hours counter / operating time		0 to 65535 hours	±1 % or ±0.5 h	±1 % or ±0.5 h		□
Starting current		1.2 Ib to 24 In	±5 %	±5 %		□
Starting time		0 to 300 s	±300 ms	±300 ms		□
Number of starts before inhibition		0 to 60	1	1		
Start inhibit time		0 to 360 mn	±1 mn	±1 mn		
Cooling time constant		5 to 600 mn	-	±5 mn		
Switchgear diagnosis assistance						
Cumulative breaking current		0 to 65535 kA²	±10 %	±10 %		□
Number of operations		0 to 4.10^9	1	1		□
Operating time		20 to 100 ms	±1 ms	±1 ms		□
Charging time		1 to 20 s	±0.5 s	±0.5 s		□

■ *available on MSA141 analog output module, according to setup.*
□ *saved in the event of auxiliary supply outage.*
(1) Under reference conditions (IEC 60255-6), typical accuracy at In or Unp, cos⬚ > 0.8.
(2) Sn: apparent power, = 3 .Unp.In.
(3) Measurement up to 0.02 In for information purpose.

Protection
Setting ranges

Functions	Settings		Time delays
ANSI 27 - Phase-to-phase undervoltage			
	5 to 100 % of Unp		0.05 s to 300 s
ANSI 27D/47 - Positive sequence undervoltage			
	15 to 60 % of Unp		0.05 s to 300 s
ANSI 27R - Remanent undervoltage			
	5 to 100 % of Unp		0.05 s to 300 s
ANSI 27S - Phase-to-neutral undervoltage			
	5 to 100 % of Vnp		0.05 s to 300 s
ANSI 32P - Directional active overpower			
	1 to 120 % of Sn [3]		0.1 s to 300 s
ANSI 32Q/40 - Directional reactive overpower			
	5 to 120 % of Sn [3]		0.1 s to 300 s
ANSI 37 - Phase undercurrent			
	0.15 to 1 Ib		0.05 s to 300 s
ANSI 38/49T - Temperature monitoring (8 or 16 RTDs)			
Alarm and trip set points	0 to 180 °C (or 32 to 356 °F)		
ANSI 46 - Negative sequence / unbalance			
Definite time	0.1 to 5 Ib		0.1 s to 300 s
IDMT	0.1 to 0.5 Ib (Schneider Electric) 0.1 to 1 Ib (CEI, IEEE)		0.1 s to 1 s
Tripping curve	Schneider Electric		
	CEI: SIT/A, LTI/B, VIT/B, EIT/C [2]		
	IEEE: MI (D), VI (E), EI (F) [2]		
ANSI 47 - Negative sequence overvoltage			
	1 to 50 % of Unp		0.05 s to 300 s
ANSI 48/51LR/14 - Excessive starting time, locked rotor			
	0.5 Ib to 5 Ib	ST starting time	0.5 s to 300 s
		LT and LTS time delays	0.05 s to 300 s
ANSI 49RMS - Thermal overload		**Rate 1 and Rate 2**	
Accounting for negative sequence component		0 - 2,25 - 4,5 - 9	
Time constant	Heating	Sepam serie 20 T1: 1 to 120 mn	
		Sepam serie 40 T1: 1 to 600 mn	
	Cooling	Sepam serie 20 T2: 1 to 600 mn	
		Sepam serie 40 T2: 5 to 600 mn	
Alarm and tripping set points		50 to 300 % of rated thermal capacity	
Cold curve modification factor		0 to 100 %	
Switching of thermal settings conditions		By logic input	
		By Is set point adjustable from 0.25 to 8 Ib	
Maximum equipment temperature		60 to 200 °C (140 °F to 392 °F)	
ANSI 50/51 - Phase overcurrent			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT [1]	DT	
	RI	DT	
	CEI: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.1 to 24 In	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 2.4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
Confirmatio [2]	None		
	By negative sequence overvoltage		
	By phase-to-phase undervoltage		
ANSI 50BF - Breaker failure			
Presence of current	0.2 to 2 In		
Operating time	0.05 s to 300 s		

(1) Tripping as of 1.2 Is.
(2) Sepam series 40 only.
(3) Sn = 3 .In.Unp.

Functions	Settings		Time delays
ANSI 50N/51N or 50G/51G - Earth fault / Sensitive earth fault			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT [1]	DT	
	RI	DT	
	CEI: SIT/A,LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is0 set point	0.1 to 15 In0	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 1 In0	IDMT	0.1 s to 12.5 s at 10 Is0
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
ANSI 50V/51V - Voltage-restrained overcurrent			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT [1]	DT	
	RI	DT	
	CEI: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.5 to 24 In	Definite time	Inst ; 0.05 s to 300 s
	0.5 to 2,4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
ANSI 59 - Overvoltage	**Phase-to-phase**	**Phase-to-neutral [2]**	
	50 to 150 % of Unp	50 to 150 % of Vnp	0.05 s to 300 s
ANSI 59N - Neutral voltage displacement			
	2 to 80 % of Unp		0.05 s to 300 s
ANSI 66 - Starts per hour			
Starts per period	1 to 60	Period	1 to 6 hr
Consecutive starts	1 to 60	Time between starts	0 to 90 mn
ANSI 67 - Directional phase overcurrent			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT [1]	DT	
	RI	DT	
	CEI: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.1 to 24 In	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 2,4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
Characteristic angle	30°, 45°, 60°		

(1) Tripping as of 1.2 Is.
(2) Sepam series 40 only.

Protection
Setting ranges

Functions		Settings		Time delays
ANSI 67N/67NC type 1 - Directional earth fault, according to I0 projection				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
Is0 set point		0.1 to 15 In0	Definite time	Inst ; 0.05 s to 300 s
Vs0 set point		2 to 80 % of Un		
Memory time		T0mem time	0 ; 0.05 s to 300 s	
		V0mem validity set point	0 ; 2 to 80 % of Unp	
ANSI 67N/67NC type 2 - Directional earth fault, according to I0 magnitude with half-plan tripping zone				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
		Tripping time delay	**Timer hold**	
Tripping curve		Definite time	DT	
		SIT, LTI, VIT, EIT, UIT [1]	DT	
		RI	DT	
		CEI: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
		IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
		IAC: I, VI, EI	DT or IDMT	
Is0 set point		0.5 to 15 In0	Definite time	Inst ; 0.05 s to 300 s
		0.5 to 1 In0	IDMT	0.1 s to 12.5 s at 10 Is0
Vs0 set point		2 to 80 % of Unp		
Timer hold		Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
		IDMT (IDMT ; reset time)		0.5 s to 20 s
ANSI 67N/67NC type 3 - Directional earth fault, according to I0 magnitude with angular sector tripping zone				
Angle at start of tripping zone		0° to 359°		
Angle at end of tripping zone		0° to 359°		
Is0 set point	CSH core balance CT (2 A rating)	0.1 A to 30 A	Definite time	Inst ; 0.05 to 300 s
	1 A CT (sensitive, In0 = 0.1 CT In)	0.05 to 15 In0 (min. 0.1 A)		
	Core balance CT + ACE990 (range 1)	0.05 to 15 In0 (min. 0.1 A)		
Vs0 set point		Calculated V0 (sum of 3 voltages)	2 to 80 % of Unp	
		Measured V0 (external VT)	0.6 to 80 % of Unp	
ANSI 81H - Overfrequency				
Sepam series 20		50 to 53 Hz or 60 to 63 Hz		0.1 s to 300 s
Sepam series 40		50 to 55 Hz or 60 to 65 Hz		0.1 s to 300 s
ANSI 81L - Underfrequency				
Sepam series 20		45 to 50 Hz or 55 to 60 Hz		0.1 s to 300 s
Sepam series 40		40 to 50 Hz or 50 to 60 Hz		0.1 s to 300 s
ANSI 81R - Rate of change of frequency				
		0.1 to 10 Hz/s		Inst ; 0.15 s to 300 s

(1) Tripping as of 1.2 Is.

Protection
Tripping curves

IEC curves

Equation	Curve type	Coefficient values		
		k		
$$td(I) = \dfrac{k}{\left(\dfrac{I}{Is}\right)^{\alpha} - 1} \times \dfrac{T}{\beta}$$	Standard inverse / A	0.14	0.02	2.97
	Very inverse / B	13.5	1	1.50
	Long time inverse / B	120	1	13.33
	Extremely inverse / C	80	2	0.808
	Ultra inverse	315.2	2.5	1

RI curve

Equation:
$$td(I) = \dfrac{1}{0,339 - 0,236\left(\dfrac{I}{Is}\right)^{-1}} \times \dfrac{T}{3,1706}$$

IEEE curves

Equation	Curve type	Coefficient values			
		A	B	p	
$$td(I) = \left(\dfrac{A}{\left(\dfrac{I}{Is}\right)^{p} - 1} + B\right) \times \dfrac{T}{\beta}$$	Moderately inverse	0.010	0.023	0.02	0.241
	Very inverse	3.922	0.098	2	0.138
	Extremely inverse	5.64	0.0243	2	0.081

IEEE curves

Equation	Curve type	Coefficient values					
		A	B	C	D	E	
$$td(I) = \left(A + \dfrac{B}{\left(\dfrac{I}{Is} - C\right)} + \dfrac{D}{\left(\dfrac{I}{Is} - C\right)^2} + \dfrac{E}{\left(\dfrac{I}{Is} - C\right)^3}\right) \times \dfrac{T}{\beta}$$	Inverse	0.208	0.863	0.800	-0.418	0.195	0.297
	Very inverse	0.090	0.795	0.100	-1.288	7.958	0.165
	Extremely inverse	0.004	0.638	0.620	1.787	0.246	0.092

Schneider Electric

Standard inverse time SIT curve
Very inverse time VIT or LTI curve
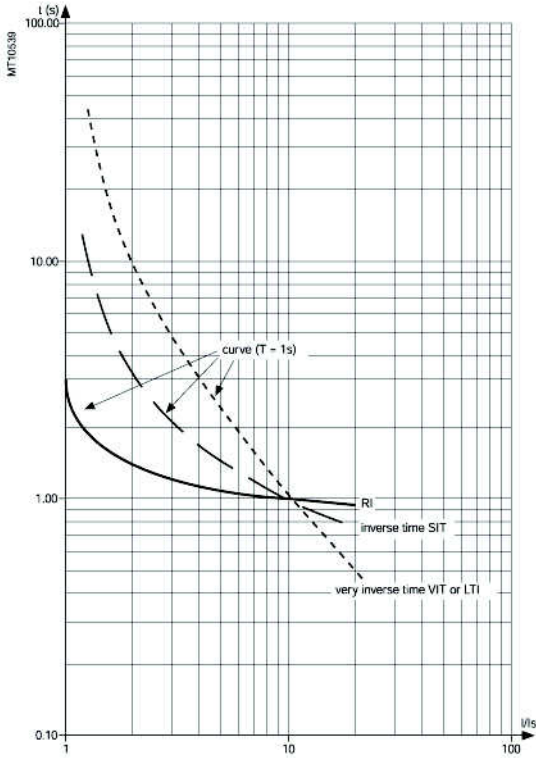
Extremely inverse time EIT curve
Ultra inverse time UIT curve
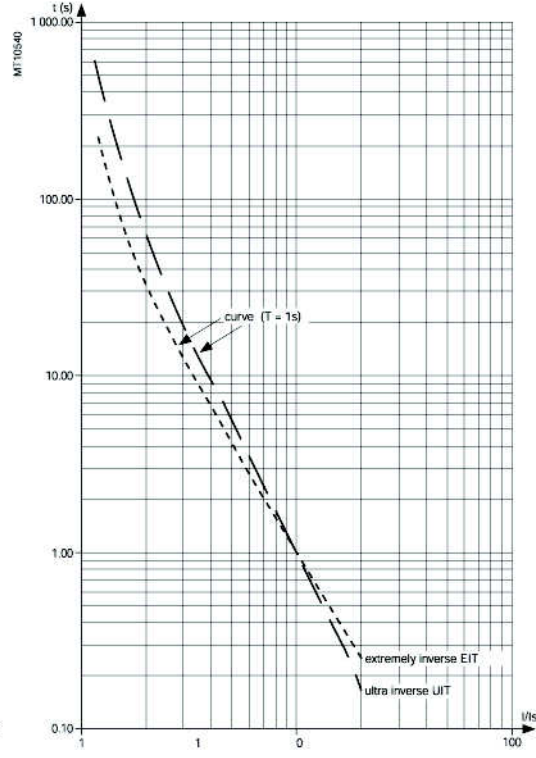
IEEE curves
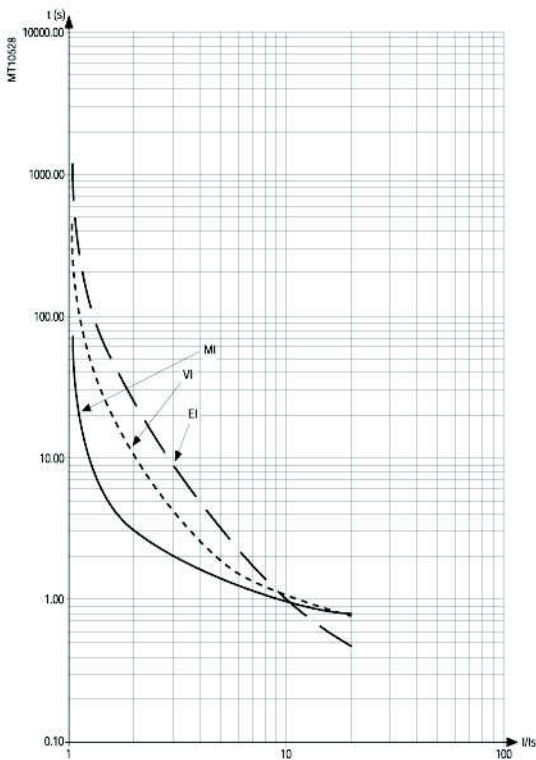
IAC curves
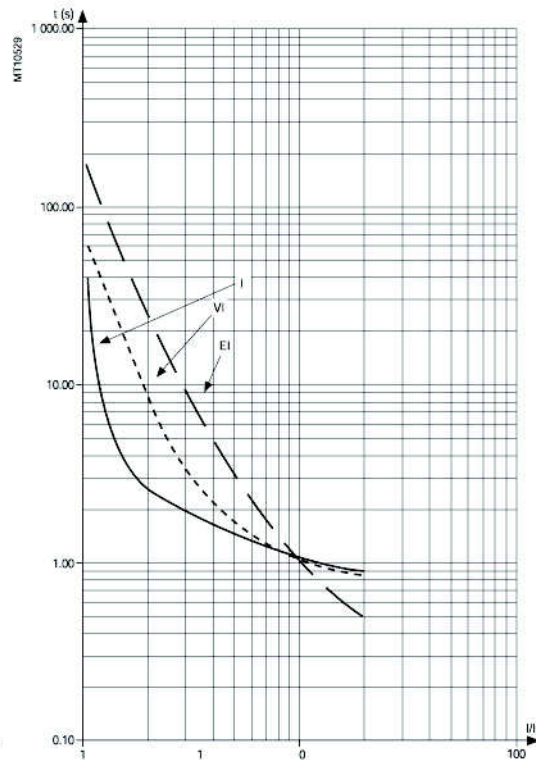
Sepam base unit (series 20 or series 40) with integrated advanced UMI.

Sepam base unit (series 20 or series 40) with basic UMI.

Customized Chinese advanced UMI.

User-Machine Interface

Two types of User-Machine Interfaces (UMI) are available for Sepam base units (series 20 or series 40):
- advanced UMI
- basic UMI.

The advanced UMI can be integrated in the base unit or installed remotely on the cubicle. Integrated and remote advanced UMIs offer the same functions.

A Sepam (series 20 or series 40) with a remote advanced UMI is made up of :
- a base unit with basic UMI, for mounting inside the LV compartment
- a remote advanced UMI (DSM303)
□ for flush mounting on the front panel of the cubicle in the location most suitable for the facility manager
□ for connection to the Sepam base unit using a prefabricated CCA77x cord.
The characteristics of the remote advanced UMI module (DSM303) are presented on page 162.
Sepam series 20 or series 40 are equipped battery for memory saving during power outtage.

Advanced UMI

Comprehensive data for facility managers
All the data required for local equipment operation may be displayed on demand:
- display of all measurement and diagnosis data in numerical format with units and/or in bar graphs
- display of operating and alarm messages, with alarm acknowledgment and Sepam resetting
- display and setting of all the Sepam parameters
- display and setting of all the parameters of each protection function
- display of Sepam and remote module versions
- output testing and logic input status display
- entry of 2 passwords to protect parameter and protection settings.

Ergonomic data presentation
- keypad keys identified by pictograms for intuitive navigation
- menu-guided access to data.
- graphical LCD screen to display any character or symbol
- excellent display quality under all lighting conditions: automatic contrast setting and backlit screen (user activated).

Basic UMI

A Sepam with basic UMI offers an economical solution suited to installations that do not require local operation (managed by a remote monitoring and control system) or to replace electromechanical or analog electronic protections units with no additional operating needs.
The basic UMI includes:
- 2 signal lamps indicating Sepam operating status:
- 9 parameterizable yellow signal lamps equipped with a standard label
- (reset) button for clearing faults and resetting.

Working language

All the texts and messages displayed on the advanced UMI are available in 2 languages:
- english, the default working language
- and a second language, which may be
□ french
□ spanish
□ another "local" language.
Please contact us regarding local language customization.

Setting and operating software

SFT2841 setting and operating software can be used for easy setting of Sepam parameters and protection functions.
A PC containing the SFT2841 software is connected to the communication port on the front of the unit.

Base unit
Presentation

Selection guide

Base unit	With basic UMI	With integrated advanced UMI	With remote advanced UMI

Functions			
Local indication			
Metering and diagnosis data		■	■
Alarms and operating messages		■	■
Sepam parameter setting		■	■
Protection setting		■	■
Version of Sepam and remote modules		■	■
Status of logic inputs		■	■
Local control			
Alarm acknowledgement	■	■	■
Sepam reset	■	■	■
Output testing		■	■
Characteristics			
Screen			
Size		128 x 64 pixels	128 x 64 pixels
Automatic contrast setting		■	■
Backlit screen		■	■
Keypad			
Number of keys	1	9	9
LEDs			
Sepam operating status	2 LEDs on front	2 LEDs on front	■ base unit: 2 LEDs on front ■ remote advanced UMI: 2 LEDs on front
Indication LEDs	9 LEDs on front	9 LEDs on front	9 LEDs on remote advanced UMI
Mounting			
	Flush mounted on front of cubicle	Flush mounted on front of cubicle	■ base unit with basic UMI, mounted at the back of the compartment using the AMT840 mounting plate ■ DSM303 remote advanced UMI module ,flush mounted on the front of the cubicle and connected to the base unit with the CCA77x prefabricated cord

Base unit
Technical characteristics

Weight

Sepam series 20	Minimum weight (base unit with basic UMI and without MES114)	1.2 kg (2.6 lb)
	Maximum weight (base unit with advanced UMI and MES114)	1.7 kg (3.7 lb)
Sepam series 40	Minimum weight (base unit with basic UMI and without MES114)	1.4 kg (3.1 lb)
	Maximum weight (base unit with advanced UMI and MES114)	1.9 kg (4.2 lb)

Analog inputs

Current transformer	Input impedance	< 0.02
1 A or 5 A CT (with CCA630 or CCA634)	Consumption	< 0.02 VA at 1 A
1 A to 6250 A ratings		< 0.5 VA at 5 A
	Rated thermal withstand	4 In
	1-second overload	100 In
Voltage transformer	Input impedance	> 100 k
220 V to 250 kV ratings	Input voltage	100 to 230/ V
	Rated thermal withstand	240 V
	1-second overload	480 V

Temperature sensor input (MET148-2 module)

Type of sensor	Pt 100	Ni 100 / 120
Isolation from earth	None	None
Current injected in sensor	4 mA	4 mA
Maximum distance between sensor and module	1 km (0.62 mi)	

Logic inputs

		MES114	MES114E		MES114F	
Voltage		24 to 250 V DC	110 to 125 V DC	110 V AC	220 to 250 V DC	220 to 240 V AC
Range		19.2 to 275 V DC	88 to 150 V DC	88 to 132 V AC	176 to 275 V DC	176 to 264 V AC
Frequency		-	-	47 to 63 Hz	-	47 to 63 Hz
Typical consumption		3 mA	3 mA	3 mA	3 mA	3 mA
Typical switching threshold		14 V DC	82 V DC	58 V AC	154 V DC	120 V AC
Input limit voltage	At state 1	u 19 V DC	u 88 V DC	u 88 V AC	u 176 V DC	u 176 V AC
	At state 0	y 6 V DC	y 75 V DC	y 22 V AC	y 137 V DC	y 48 V AC
Isolation of inputs in relation to other isolated groups		Enhanced	Enhanced	Enhanced	Enhanced	Enhanced

Relays outputs

Control relay outputs (O1, O2, O3, O11 contacts) [2]

Voltage	DC	24 / 48 V DC	127 V DC	220 V DC		
	AC (47.5 to 63 Hz)	-	-	-	100 to 240 V AC	
Continuous current		8 A	8 A	8 A	8 A	
Breaking capacity	Resistive load	8 / 4 A	0.7 A	0.3 A		
	L/R load < 20 ms	6 / 2 A	0.5 A	0.2 A		
	L/R load < 40 ms	4 / 1 A	0.2 A	0.1 A		
	Resistive load	-	-	-	8 A	
	p.f. load > 0.3	-	-	-	5 A	
Making capacity		< 15 A for 200 ms				
Isolation of outputs in relation to other isolated groups		Enhanced				

Annunciation relay output (O4, O12, O13, O14 contacts)

Voltage	DC	24 / 48 V DC	127 V DC	220 V DC		
	AC (47.5 to 63 Hz)	-	-	-	100 to 240 V AC	
Continuous current		2 A	2 A	2 A	2 A	
Breaking capacity	L/R load < 20 ms	2 / 1 A	0.5 A	0.15 A		
	p.f. load > 0.3	-	-	-	1 A	
Isolation of outputs in relation to other isolated groups		Enhanced				

Power supply

Voltage		24 / 250 V DC	110 / 240 V AC	
Range		-20 % +10 %	-20 % +10 % (47.5 to 63 Hz)	
Deactivated consumption [1]	Sepam series 20	< 4.5 W	< 6 VA	
	Sepam series 40	< 6 W	< 6 VA	
Maximum consumption [1]	Sepam series 20	< 8 W	< 15 VA	
	Sepam series 40	< 11 W	< 25 VA	
Inrush current	Sepam series 20, serie 40	< 10 A for 10 ms, < 28 A for 100 µs	< 15 A for first half-period	
Acceptable momentary outages	Sepam series 20	10 ms	10 ms	
	Sepam series 40	10 ms	10 ms	

Analog output (MSA141 module)

Current	4 - 20 mA, 0 - 20 mA, 0 - 10 mA
Load impedance	< 600 (wiring included)
Accuracy	0.50 %

(1) According to configuration
(2) Relay outputs comply with clause 6.7 of standard C37.90 (30 A, 200 ms, 2000 operations).

Schneider Electric

Base unit
Environmental characteristics

Electromagnetic compatibility	Standard	Level / Class	Value
Emission tests			
Disturbing field emission	IEC 60255-25		
	EN 55022	A	
Conducted disturbance emission	IEC 60255-25		
	EN 55022	B	
Immunity tests – Radiated disturbances			
Immunity to radiated field	IEC 60255-22-3		10 V/m ; 80 MHz - 1 GHz
	IEC 61000-4-3	III	10 V/m ; 80 MHz - 2 GHz
	ANSI C37.90.2 (1995)		35 V/m ; 25 MHz - 1 GHz
Electrostatic discharge	IEC 60255-22-2		8 kV air ; 6 kV contact
	ANSI C37.90.3		8 kV air ; 4 kV contact
Immunity to magnetic fields at network frequency	IEC 61000-4-8	IV	30 A/m (continuous) - 300 A/m (13 s)
Immunity tests – Conducted disturbances			
Immunity to conducted RF disturbances	IEC 60255-22-6		10 V
Fast transient bursts	IEC 60255-22-4	A or B	4 kV ; 2.5 kHz / 2 kV ; 5 kHz
	IEC 61000-4-4	IV	4 kV ; 2.5 kHz
	ANSI C37.90.1		4 kV ; 2.5 kHz
1 MHz damped oscillating wave	IEC 60255-22-1	III	2.5 kV MC ; 1 kV MD
	ANSI C37.90.1		2.5 kV MC and MD
100 kHz damped oscillating wave	IEC 61000-4-12		2.5 kV MC ; 1 kV MD
Surges	IEC 61000-4-5	III	2 kV MC ; 1 kV MD
Voltage interruptions	IEC 60255-11		Series 20: 100 %, 10 ms Series 40: 100 %, 20 ms

Mechanical robustness	Standard	Level / Class	Value
In operation			
Vibrations	IEC 60255-21-1	2	1 Gn ; 10 Hz - 150 Hz
	IEC 60068-2-6	Fc	2 Hz - 13.2 Hz ; a = ±1 mm
Shocks	IEC 60255-21-2	2	10 Gn / 11 ms
Earthquakes	IEC 60255-21-3	2	2 Gn (horizontal axes) 1 Gn (vertical axes)
De-energized			
Vibrations	IEC 60255-21-1	2	2 Gn ; 10 Hz - 150 Hz
Shocks	IEC 60255-21-2	2	30 Gn / 11 ms
Jolts	IEC 60255-21-2	2	20 Gn / 16 ms

Climatic withstand	Standard	Level / Class	Value
In operation			
Exposure to cold	IEC 60068-2-1	Series 20: Ab Series 40: Ad	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Series 20: Bb Series 40: Bd	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-3	Ca	10 days ; 93 % RH ; 40 °C (104 °F)
Temperature variation with specified variation rate	IEC 60068-2-14	Nb	−25 °C to +70 °C (-13 °F to +158 °F) 5 °C/min (41 °F/min)
Salt mist	IEC 60068-2-52	Kb/2	
Influence of corrosion/gaz test 2	IEC 60068-2-60	C	21 days ; 75 % RH ; 25 °C (-13 °F); 0.5 ppm H_2S ; 1 ppm SO_2
Influence of corrosion/gaz test 4	IEC 60068-2-60		21 days ; 75 % RH ; 25 °C ; 0.01 ppm H_2S ; 0.2 ppm SO_2 ; 0.02 ppm NO_2 ; 0.01 ppm Cl_2
In storage [3]			
Exposure to cold	IEC 60068-2-1	Ab	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Bb	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-3	Ca	56 days ; 93 % RH ; 40 °C (104 °F)

Safety	Standard	Level / Class	Value
Enclosure safety tests			
Front panel tightness	IEC 60529	IP52	Other panels closed, except for rear panel IP20
	NEMA	Type 12 with gasket supplied	
Fire withstand	IEC 60695-2-11		650 °C with glow wire (1562 °F)
Electrical safety tests			
1.2/50 µs impulse wave	IEC 60255-5		5 kV [1]
Power frequency dielectric withstand	IEC 60255-5		2 kV 1 mn [2]

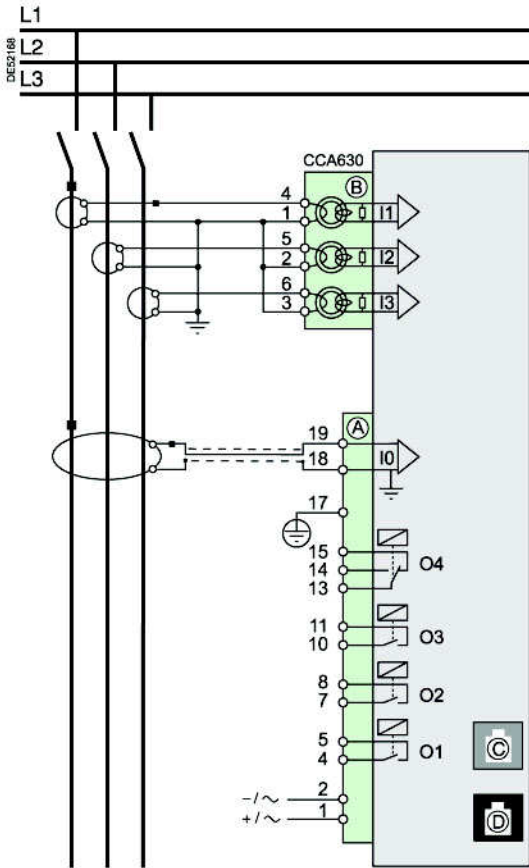| Certificatio			
CE	Harmonized standard: EN 50263	European directives: ■ 89/336/CEE Electromagnetic Comptability (EMC) Directive □ 92/31/CEE Amendment □ 93/68/CEE Amendment ■ 73/23/CEE Low Voltage Directive □ 93/68/CEE Amendment	
UL - ⒸⓊⓁus	UL508 - CSA C22.2 n° 14-95		File E212533
CSA	CSA C22.2 n° 14-95 / n° 94-M91 / n° 0.17-00		File 210625

(1) Except for communication: 3 kV in common mode and 1kV in differential mode
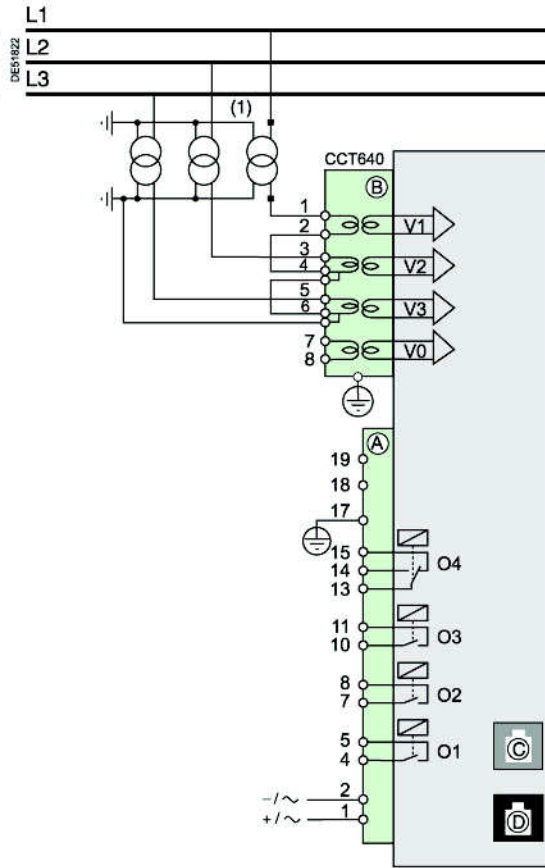*(2) Except for communication: 1 kVrms*
(3) Sepam must be stored in its original packing.

Base unit
Dimensions

Dimensions

Front view of Sepam.

Sepam with advanced UMI and MES114,
flush-mounted in front panel.

|__ __| Clearance for Sepam assembly
and wiring.

Sepam with advanced UMI and MES114,
flush-mounted in front panel.

(1) With basic UMI: 23 mm (0.91 in).

Cut-out

Cut-out accuracy must be complied with to ensure good withstand.

For mounting plate between 1.5 mm (0.059 in) and 3 mm (0.12 in) thick

For mounting plate 3.17 mm (0.125 inch) thick

Assembly with AMT840 mounting plate

Used to mount Sepam with basic UMI at the back of the compartment with access to the connectors on the rear panel.
Mounting associated with the use of the remote advanced UMI (DSM303).

Sepam with basic UMI and MES114, mounted with AMT840 plate.
Mounting plate thickness: 2 mm (0.079 in).

CAUTION

HAZARD OF CUTS
Trim the edges of the cut-out plates to remove any jagged edges.

Failure to follow this instruction can cause serious injury.

AMT840 mounting plate.

Schneider
Electric

Base unit
Sepam series 20

Sepam S20, S23, T20, T23 and M20

Sepam B21 and B22

(1) This type of connection allows the calculation of residual voltage.

Connection

Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.

Connector	Type	Reference	Wiring
	Screw type	CCA620	■ wiring with no fittings □ 1 wire with max. cross-section 0.2 to 2.5 mm² (u AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (u AWG 24-16) □ stripped length: 8 to 10 mm ■ wiring with fittings □ recommended wiring with Telemecanique fittings - DZ5CE015D for 1 x 1.5 mm² wire - DZ5CE025D for 1 x 2.5 mm² wire - AZ5DE010D for 2 x 1 mm² wires □ tube length: 8.2 mm □ stripped length: 8 mm
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4 in) ■ maximum wire cross-section of 0.2 to 2.5 mm² (u AWG 24-12) ■ stripped length: 6 mm ■ use an appropriate tool to crimp the lugs on the wires ■ maximum of 2 ring or spade lugs per terminal ■ tightening torque: 0.7 to 1 Nm
For Sepam S20, S23, T20, T23 and M20	4 mm ring lugs	CCA630, CCA634 for connection of 1 A or 5 A CTs	■ wire cross-section of 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA670, for connection of 3 LPCT sensors	Integrated with LPCT sensor
For Sepam B21 and B22	Screw type	CCT640	Same as wiring for the CCA620
	Green RJ45 plug		CCA612
	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13 ft)

Base unit
Sepam series 40

(1) This type of connection allows the calculation of residual voltage.
(2) Accessory for bridging terminals 3 and 5 supplied with CCA626 and CCA627 connector.

Connection

Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.

Connector	Type	Reference	Wiring
	Screw type	CCA620	■ wiring with no fittings 1 wire with max. cross-section 0.2 to 2.5 mm² (u AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (u AWG 24-16) □ stripped length: 8 to 10 mm ■ wiring with fittings □ recommended wiring with Telemecanique fittings - DZ5CE015D for 1 x 1.5 mm² wire - DZ5CE025D for 1 x 2.5 mm² wire - AZ5DE010D for 2 x 1 mm² wires □ tube length: 8.2 mm □ stripped length: 8 mm
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4 in) ■ maximum wire cross-section of 0.2 to 2.5 mm² (u AWG 24-12) ■ stripped length: 6 mm ■ use an appropriate tool to crimp the lugs on the wires ■ maximum of 2 ring or spade lugs per terminal ■ tightening torque: 0.7 to 1 Nm
	4 mm ring lugs	CCA630, CCA634, for connection of 1 A or 5 A CTs	■ wire cross-section of 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA670, for connection of 3 LPCT sensors	Integrated with LPCT sensor
	Green RJ45 plug		CCA612
	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13 ft)
	Screw type	CCA626	Same as wiring for the CCA620
	6.35 mm ring lugs	CCA627	Same as wiring for the CCA622

Schneider Electric

Variant 1: phase current measurements by 3 x 1 A or 5 A CTs (standard connection)
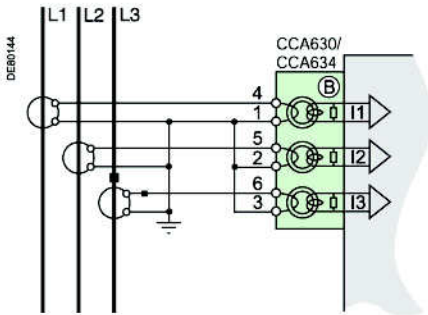
Description

Connection of 3 x 1 A or 5 A sensors to the CCA630 or CCA634 connector.

The measurement of the 3 phase currents allows the calculation of residual current.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	I1, I2, I3
Rated current (In)	1 A to 6250 A

Variant 2: phase current measurement by 2 x 1 A or 5 A CTs
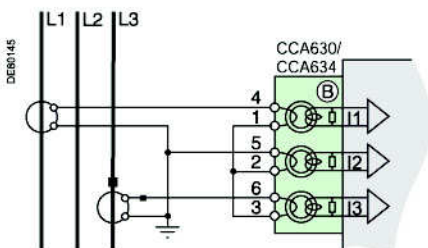
Description

Connection of 2 x 1 A or 5 A sensors to the CCA630 or CCA634 connector.

The measurement of phase currents 1 and 3 is sufficient to ensure all the phase current-based protection functions.
The phase current I2 is only assessed for metering functions, assuming that I0 = 0.

This arrangement does not allow the calculation of residual current.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	I1, I3
Rated current (In)	1 A to 6250 A

Variant 3: phase current measurement by 3 LPCT type sensors
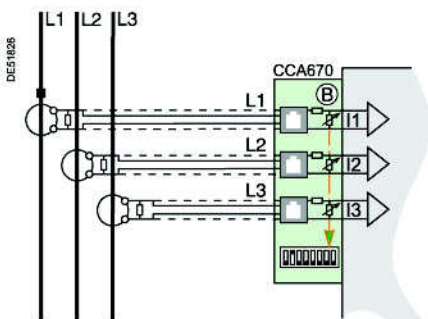
Description

Connection of 3 Low Power Current Transducer (LPCT) type sensors to the CCA670 connector. The connection of only one or two LPCT sensors is not allowed and causes Sepam to go into fail-safe position.

The measurement of the 3 phase currents allows the calculation of residual current.

Parameters

Sensor type	LPCT
Number of CTs	I1, I2, I3
Rated current (In)	25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000 or 3150 A

Note: Parameter In must be set 2 twice:

- *Software parameter setting using the advanced UMI or the SFT2841 software tool*
- *Hardware parameter setting using microswitches on the CCA670 connector*

Base unit
Other residual current input connection schemes

Variant 1: residual current calculation by sum of 3 phase currents

Description

Residual current is calculated by the vector sum of the 3 phase currents I1, I2 and I3, measured by 3 x 1 A or 5 A CTs or by 3 LPCT type sensors.
See current input connection diagrams.

Parameters

Residual current	Rated residual current	Measuring range
Sum of 3 Is	In0 = In, CT primary current	0.1 to 40 In0

Variant 2: residual current measurement by CSH120 or CSH200 core balance CT (standard connection)
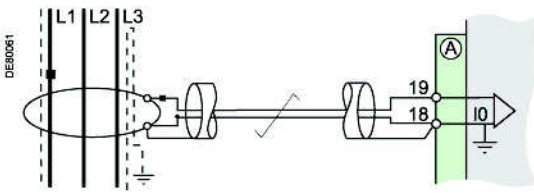
Description

Arrangement recommended for the protection of isolated or compensated neutral systems, in which very low fault currents need to be detected.

Parameters

Residual current	Rated residual current	Measuring range
2 A rating CSH	In0 = 2 A	0.2 to 40 A
5 A rating CSH (Sepam series 40)	In0 = 5 A	0.5 to 100 A
20 A rating CSH	In0 = 20 A	2 to 400 A

Variant 3: residual current measurement by 1 A or 5 A CTs and CCA634
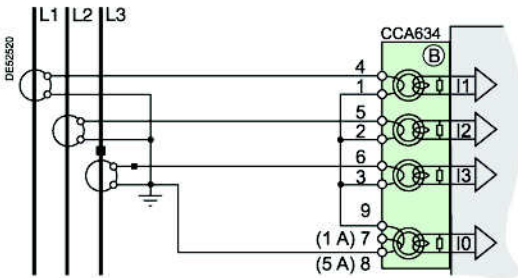
Description

Residual current measurement by 1 A or 5 A CTs.
- Terminal 7: 1 A CT
- Terminal 8: 5 A CT

Parameters

Residual current	Rated residual current	Measuring range
1 A CT	In0 = In, CT primary current	0.1 to 20 In0
1 A CT sensitive	In0 = In/10 (Sepam series 40)	0.1 to 20 In0
5 A CT	In0 = In, CT primary current	0.1 to 20 In0
5 A CT sensitive	In0 = In/10 (Sepam series 40)	0.1 to 20 In0

Schneider Electric

Variant 4: residual current measurement by 1 A or 5 A CTs and CSH30 interposing ring CT

CSH30

19
18
I0

CT 1 A : 2 turns
CT 5 A : 4 turns

CCA630

B

4
1 — I1
5
2 — I2
6
3 — I3

CSH30

A

19
18
I0

CT 1 A : 2 turns
CT 5 A : 4 turns
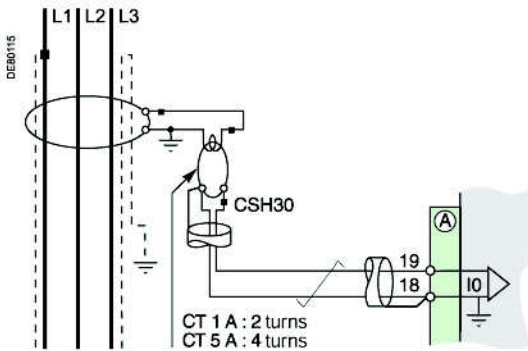
Description

The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:
- connection of CSH30 interposing ring CT to 1 A CT: make 2 turns through CSH primary
- connection of CSH30 interposing ring CT to 5 A CT: make 4 turns through CSH primary.
- for Sepam series 40, the sensitivity can be mulitplied by 10 using the "sensitive" setting with $In0 = In/10$.

Parameters

Residual current	Rated residual current	Measuring range
1 A CT	$In0 = In$, CT primary current	0.1 to 20 In0
1 A CT sensitive	$In0 = In/10$ (Sepam series 40)	0.1 to 20 In0
5 A CT	$In0 = In$, CT primary current	0.1 to 20 In0
5 A CT sensitive	$In0 = In/10$ (Sepam series 40)	0.1 to 20 In0
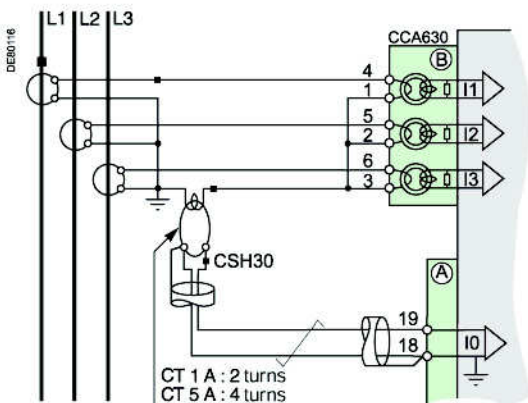
Variant 5: residual current measurement by core balance CT with ratio of 1/n (n between 50 and 1500)

E1 ACE990
E2   S1 19 A
E3   S2 18 I0
E4
E5
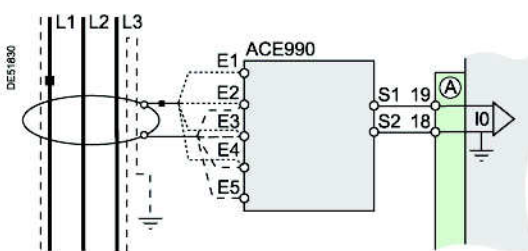
Description

The ACE990 is used as an interface between an MV core balance CT with a ratio of 1/n (50 < n < 1500) and the Sepam residual current input.
This arrangement allows the continued use of existing core balance CTs on the installation.

Parameters

Residual current	Rated residual current	Measuring range
ACE990 - range 1 (0.00578 y k y 0.04)	$In0 = Ik.n^{(1)}$	0.1 to 20 In0
ACE990 - range 2 (0.0578 y k y 0.26316)	$In0 = Ik.n^{(1)}$	0.1 to 20 In0

(1) n = number of core balance CT turns
k = factor to be determined according to ACE990 wiring and setting range used by Sepam

Voltage inputs
Sepam series 20

The phase and residual voltage transformer secondary circuits are connected to the CCT640 connector (item Ⓑ) on Sepam series 20 type B units. The CCT640 connector contains 4 transformers which perform isolation and impedance matching of the VTs and Sepam input circuits.
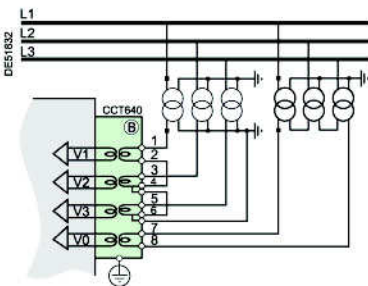
Variant 1: measurement of 3 phase-to-neutral voltages (standard connection)
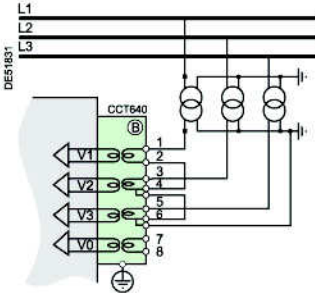
Parameters

Voltages measured by VTs	V1, V2, V3
Residual voltage	Sum of 3Vs

Functions available

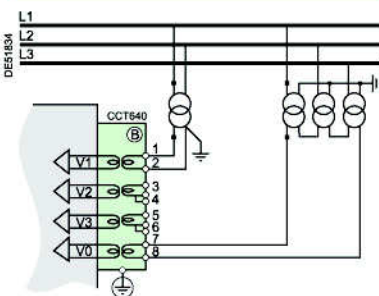|	
Voltages measured	V1, V2, V3
Values calculated	U21, U32, U13, V0, Vd, f
Measurements available	All
Protection functions available (according to type of Sepam)	All

Variant 2: measurement of 3 phase-to-neutral voltages and residual voltage

Parameters

Voltages measured by VTs	V1, V2, V3
Residual voltage	External VT

Functions available

Voltages measured	V1, V2, V3, V0
Values calculated	U21, U32, U13, Vd, f
Measurements available	All
Protection functions available (according to type of Sepam)	All

Variant 3: measurement of 2 phase-to-phase voltages
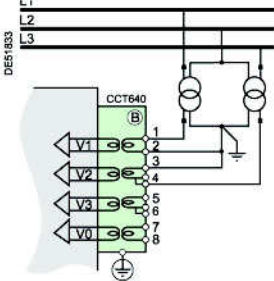
Parameters

Voltages measured by VTs	U21, U32
Residual voltage	None

Functions available

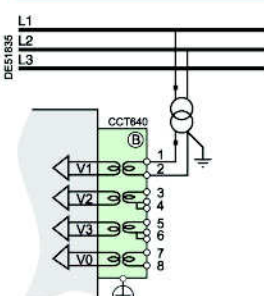|	
Voltages measured	V1, V2, V3
Values calculated	U13, Vd, f
Measurements available	U21, U32, U13, Vd, f
Protection functions available (according to type of Sepam)	All except 59N, 27S

Variant 4: measurement of 1 phase-to-phase voltage and residual voltage

Parameters

Voltages measured by VTs	U21
Residual voltage	External VT

Functions available

Voltages measured	U21, V0
Values calculated	f
Measurements available	U21, V0, f
Protection functions available (according to type of Sepam)	All except 47, 27D, 27S

Variant 5: measurement of 1 phase-to-phase voltage

Parameters

Voltages measured by VTs	U21
Residual voltage	None

Functions available

Voltages measured	U21
Values calculated	f
Measurements available	U21, f
Protection functions available (according to type of Sepam)	All except 47, 27D, 59N, 27S

Schneider Electric

Voltage inputs
Sepam series 40

The phase and residual voltage transformer secondary circuits are connected directly to the connector marked (E).
The 3 impedance matching and isolation transformers are integrated in the Sepam series 40 base unit.

Variant 1: measurement of 3 phase-to-neutral voltages (standard connection)
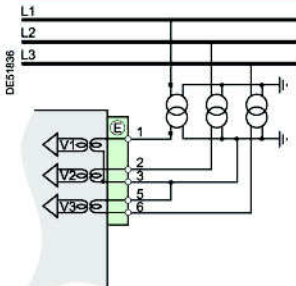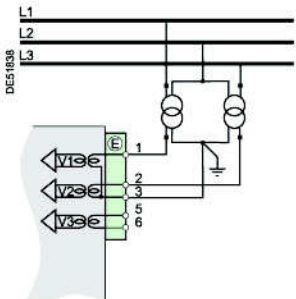
Phase voltage sensor parameter setting	3V
Residual voltage sensor parameter setting	3V sum
Voltages measured	V1, V2, V3
Values calculated	U21, U32, U13, V0, Vd, Vi, f
Measurements unavailable	None
Protection functions unavailable (according to type of Sepam)	None

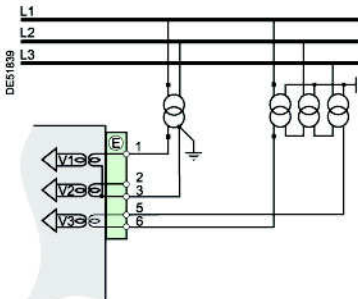### Variant 2: measurement of 2 phase-to-phase voltages and residual voltage
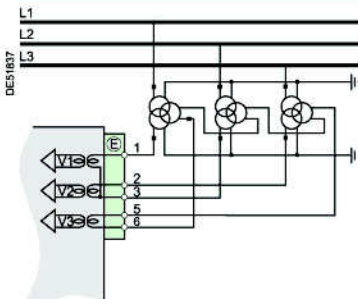
Phase voltage sensor parameter setting	U21, U32
Residual voltage sensor parameter setting	External VT
Voltages measured	U21, U32, V0
Values calculated	U13, V1, V2, V3, Vd, Vi, f
Measurements unavailable	None
Protection functions unavailable (according to type of Sepam)	None

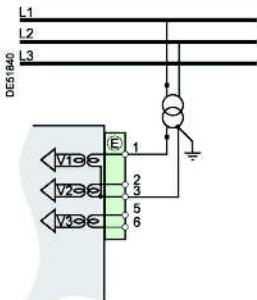### Variant 3: measurement of 2 phase-to-phase voltages

Phase voltage sensor parameter setting	U21, U32
Residual voltage sensor parameter setting	None
Voltages measured	U21, U32
Values calculated	U13, Vd, Vi, f
Measurements unavailable	V1, V2, V3, V0
Protection functions unavailable (according to type of Sepam)	67N/67NC, 59N

### Variant 4: measurement of 1 phase-to-phase voltage and residual voltage

Phase voltage sensor parameter setting	U21
Residual voltage sensor parameter setting	External VT
Voltages measured	U21, V0
Values calculated	f
Measurements unavailable	U32, U13, V1, V2, V3, Vd, Vi
Protection functions unavailable (according to type of Sepam)	67, 47, 27D, 32P, 32Q/40, 27S

Variant 5: measurement of 1 phase-to-phase voltage

Phase voltage sensor parameter setting	U21
Residual voltage sensor parameter setting	None
Voltages measured	U21
Values calculated	f
Measurements unavailable	U32, U13, V1, V2, V3, V0, Vd, Vi
Protection functions unavailable (according to type of Sepam)	67, 47, 27D, 32P, 32Q/40, 67N/67NC, 59N, 27S

Communication interface connection

ACE949-2 — CCA612

C
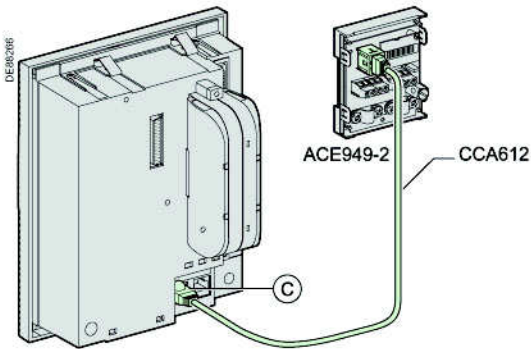
Sepam series 20 and Sepam series 40: 1 communication port.

CCA612 connection cord

Function
The CCA612 prefabricated cord is used to connect ACE942-2, ACE959, ACE937, ACE969TP-2 and ACE969FO-2 communication interfaces:
■ to the white communication port C on a Sepam series 20 or series 40 base unit, or
■ to the white communication port C1 or C2 on a Sepam series 80 base unit.

Characteristics
■ Length = 3 m (9.8 ft)
■ Fitted with 2 green RJ45 plugs.

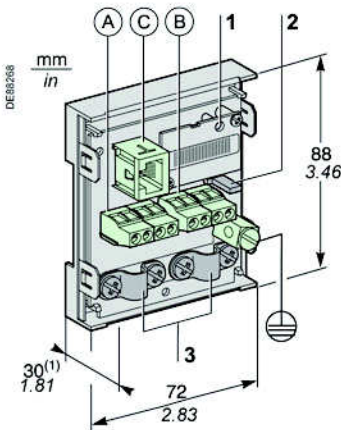## Connection to the communication network

RS485 network for ACE949-2, ACE959 and ACE969TP-2 interfaces

RS 485 network cable	2-wire	2-wire
RS 485 medium	1 shielded twisted pair	2 shielded twisted pairs
Distributed power supply [1]	1 shielded twisted pair	1 shielded twisted pair
Shielding	Tinned copper braid, coverage > 65 %	
Characteristic impedance	120 Ω	
Gauge	AWG 24	
Resistance per unit length	< 100 Ω/km (62.1Ω/mi)	
Capacitance between conductors	< 60 pF/m (18.3 pF/ft)	
Capacitance between conductor and shielding	< 100 pF/m (30.5 pF/ft)	
Maximum length	1300 m (4270 ft)	
Baud rate	4800-38400 Bauds	

Schneider Electric
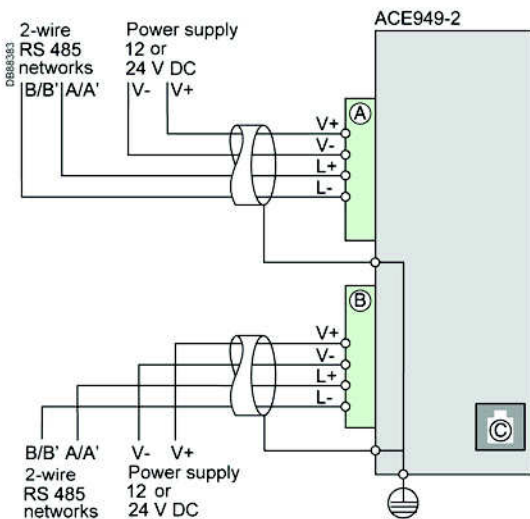
ACE949-2
2-wire RS 485
network interface

ACE949-2 2-wire RS 485 network connection interface.

(1) *70 mm (2.8 in) with CCA612 cord connected.*

Function

The ACE949-2 interface performs 2 functions:
■ Electrical interface between Sepam and a 2-wire RS 485 communication network
■ Main network cable branching box for the connection of a Sepam with a CCA612 cord.

Characteristics

ACE949-2 module	
Weight	0.1 kg (0.22 lb)
Assembly	On symmetrical DIN rail
Operating temperature	-25°C to +70°C (-13°F to +158°F)
Environmental characteristics	Same characteristics as Sepam base units

2-wire RS 485 electrical interface	
Standard	EIA 2-wire RS 485 differential
Distributed power supply	External, 12 V DC or 24 V DC ±10%
Power consumption	16 mA in receiving mode
	40 mA maximum in sending mode

Maximum length of 2-wire RS 485 network with standard cable		
Number of Sepam units	**Maximum length with 12 V DC power supply**	**Maximum length with 24 V DC power supply**
5	320 m (1000 ft)	1000 m (3300 ft)
10	180 m (590 ft)	750 m (2500 ft)
20	160 m (520 ft)	450 m (1500 ft)
25	125 m (410 ft)	375 m (1200 ft)

Description and dimensions

(A) and (B) Terminal blocks for network cable
(C) RJ45 socket to connect the interface to the base unit with a CCA612 cord
(⏚) Grounding/earthing terminal

1 Link activity LED, flashes when communication is active (sending or receiving in progress).
2 Jumper for RS 485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:

  ■ R̶c̶, if the module is not at one end of the network (default position)
  ■ Rc, if the module is at one end of the network.
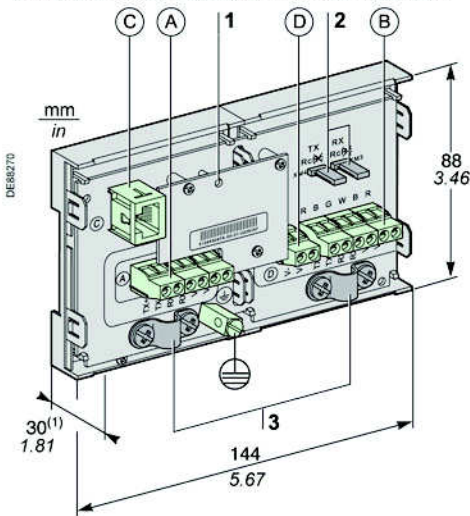**3** Network cable clamps (inner diameter of clamp = 6 mm or 0.24 in).

Connection

■ Connection of network cable to screw-type terminal blocks (A) and (B)
■ Connection of the earthing terminal by tinned copper braid with cross-section ≥ 6 mm² (AWG 10) or cable with cross-section ≥ 2.5 mm² (AWG 12) and length ≤ 200 mm (7.9 in), fitted with a 4 mm (0.16 in) ring lug.
Check the tightness (maximum tightening torque 2.2 Nm or 19.5 lb-in).
■ The interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
  □ the network cable must be stripped
  □ the cable shielding braid must be around and in contact with the clamp
■ The interface is to be connected to connector (C) on the base unit using a CCA612 cord (length = 3 m or 9.8 ft, green fittings)
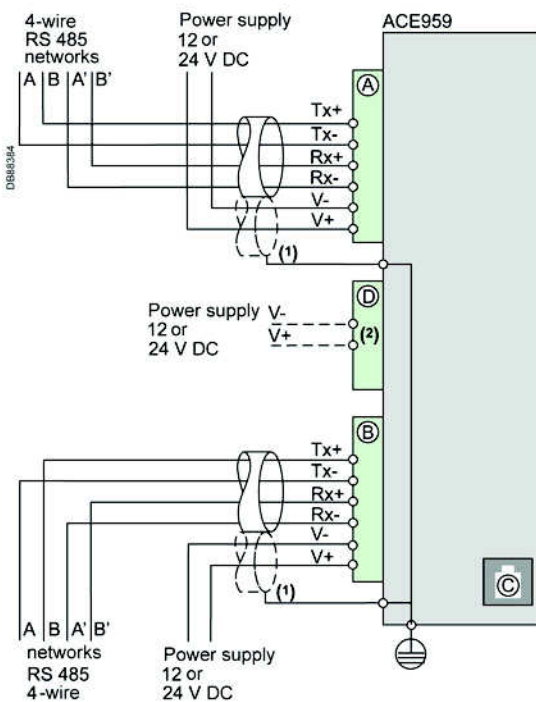■ The interfaces are to be supplied with 12 V DC or 24 V DC.

ACE959
4-wire RS 485
network interface

ACE959 4-wire RS 485 network connection interface.

mm
in

88
3.46

30 (1)
1.81

3

144
5.67

(1) *70 mm (2.8 in) with CCA612 cord connected.*

4-wire RS 485 networks

Power supply 12 or 24 V DC

ACE959

A B A'B'

Tx+
Tx-
Rx+
Rx-
V-
V+

(1)

Power supply 12 or 24 V DC

V-
V+

(2)

Tx+
Tx-
Rx+
Rx-
V-
V+

(1)

A B A'B'
networks RS 485 4-wire

Power supply 12 or 24 V DC

(1) *Distributed power supply with separate wiring or included in the shielded cable (3 pairs).*
(2) *Terminal block for connection of the distributed power supply module.*

Function

The ACE959 interface performs 2 functions:
■ Electrical interface between Sepam and a 4-wire RS 485 communication network
■ Main network cable branching box for the connection of a Sepam with a CCA612 cord.

Characteristics

ACE959 module	
Weight	0.2 kg (0.441 lb)
Assembly	On symmetrical DIN rail
Operating temperature	-25°C to +70°C (-13°F to +158°F)
Environmental characteristics	Same characteristics as Sepam base units

4-wire RS 485 electrical interface	
Standard	EIA 4-wire RS 485 differential
Distributed power supply	External, 12 V DC or 24 V DC ±10%
Power consumption	16 mA in receiving mode
	40 mA maximum in sending mode

Maximum length of 4-wire RS 485 network with standard cable		
Number of Sepam units	Maximum length with 12 V DC power supply	Maximum length with 24 V DC power supply
5	320 m (1000 ft)	1000 m (3300 ft)
10	180 m (590 ft)	750 m (2500 ft)
20	160 m (520 ft)	450 m (1500 ft)
25	125 m (410 ft)	375 m (1200 ft)

Description and dimensions

(A) and (B) Terminal blocks for network cable
(C) RJ45 socket to connect the interface to the base unit with a CCA612 cord
(D) Terminal block for a separate auxiliary power supply (12 V DC or 24 V DC)
(t) Grounding/earthing terminal

1 Link activity LED, flashes when communication is active (sending or receiving in progress).
2 Jumper for 4-wire RS 485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:
   b R̄c̄, if the module is not at one end of the network (default position)
   b Rc, if the module is at one end of the network.
3 Network cable clamps (inner diameter of clamp = 6 mm or 0.24 in).

Connection

■ Connection of network cable to screw-type terminal blocks (A) and (B)
■ Connection of the earthing terminal by tinned copper braid with cross-section ≥ 6 mm² (AWG 10) or cable with cross-section ≥ 2.5 mm² (AWG 12) and length ≤ 200 mm (7.9 in), fitted with a 4 mm (0.16 in) ring lug. Check the tightness (maximum tightening torque 2.2 Nm or 19.5 lb-in).
■ The interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
□ the network cable must be stripped
□ the cable shielding braid must be around and in contact with the clamp
■ The interface is to be connected to connector (C) on the base unit using a CCA612 cord (length = 3 m or 9.8 ft, green fittings)
■ The interfaces are to be supplied with 12 V DC or 24 V DC
■ The ACE959 can be connected to a separate distributed power supply (not included in shielded cable). Terminal block (D) is used to connect the distributed power supply module.

Schneider
Electric