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Power network telecommunication

SWT 3000 Teleprotection – technical data

Answers for infrastructure & cities.



Sustainable success for high-voltage power networks

The SWT 3000 Teleprotection system has been the first choice for reliable high-voltage networks for 50 years. The technology is refined on an ongoing basis to offer a high level of system stability and reliable signal transmission. Errors can not only be detected but isolated extremely fast.

The SWT 3000 is known for its high degree of versatility, so it can be used in many different ways in analog and digital networks. In addition, it allows gradual changeover of existing substations to the IEC 61850 communication standard. Operators can enter the new network era step by step – in line with their strategic objectives and available budgets.

Power companies also have many options when it comes to transmission paths. Whether operators want to connect two SWT 3000 devices directly via analog interfaces or Power Line Carrier (PLC), whether the transmission should run via digital PDH, SDH or IP networks, whether different types of fiber-optic connections will be used, or whether SWT 3000 will be completely integrated into a PLC connection: Nearly anything is possible. The existing infrastructure is the decisive factor, and SWT 3000 accommodates its requirements – flexibly, affordably, and without breaking the budget.

Command interface		
Number of commands		
Commands	Analog transmission	Up to 4
	Digital transmission	Up to 8
IEC 61850 command input/output EN 100¹⁾		
	Electrical interface	RJ45; 100 Base-T; max. range 20 m
	Optical interface	1,310 nm; LC connector; max. range 1.5 km
Binary command input IFC-P/IFC-D		
	Input voltage range	24 V – 250 V DC (tolerance –20% to +20%)
	Inputs per module	4
Nominal input/threshold	24 V	Low level $U_{in} < 15$ V; high level $U_{in} > 18$ V
	48/60 V	Low level $U_{in} < 40$ V; high level $U_{in} > 47$ V
	110 V	Low level $U_{in} < 72$ V; high level $U_{in} > 85$ V
	250 V	Low level $U_{in} < 167$ V; high level $U_{in} > 198$ V
	Polarity	Independent
	Pulse suppression	1 ms to 100 ms; programmable in 1-ms steps
	Input current	Max. 2 mA
Binary command output IFC-P for normal contact load		
	Contact type	Relay NO; normal open
	Contacts per module	4
	Switching power	250 W/250 VA
	Switching voltage	250 V AC/DC
	Switching current	1.5 A AC/DC
	Switching current < 2.5 ms	5 A AC/DC
	Continuous current	1.5 A AC/DC
	Insulation withstand voltage	3 kV AC
Binary command output IFC-D for high contact load		
	Contact type	Relay NO; normal open
	Contacts per module	4
	Switching power	150 W/1250 VA
	Switching voltage	250 V AC/DC
	Switching current	5 A AC/DC (30 A \leq 0.5 ms)
	Continuous current	5 A AC/DC
	Insulation withstand voltage	3 kV AC
Binary command output IFC-S for signaling		
	Contact type	Relay CO; changeover with common root
	Contacts per module	8
	Switching power	150 W/1,250 VA
	Switching voltage	250 V AC/DC
	Switching current	5 A AC/DC (30 A \leq 0.5 ms)
	Continuous current	1 A AC/DC
	Insulation withstand voltage	3 kV AC

¹⁾ Not applicable in combination with Ethernet line interface

Transmission line – digital networks	
Digital interface DLE	
64 Kbps	X.21; G703.1
2 Mbps	G703.6 sym. 120 Ω; G703.6 asym. 75 Ω
Path protection (1+1)	Digital and digital line Digital and FO line Digital and analog line Digital and Ethernet line Ethernet and analog line
Digital Ethernet interface EN100 ⁵⁾	
ETH electrical	100TX/100 Base-T; two RJ45 ports; max. range 20 m
ETH optical	100FX/100 Base-FX; two ports; LC connector; SFP transceiver 1,310 nm; max. range 1.5 km
Path protection (1+1)	Ethernet and analog line Ethernet and digital line
Transmission time ¹⁾	
2 Mbps	$t_0 \leq 3$ ms
64 kbps	$t_0 \leq 5$ ms
Security and dependability	
Security	$P_{UC} < 10^{-8}$
Dependability	$P_{MC} < 10^{-4}$ at BER of 10^{-6}
Transmission line – fiber optics	
Fiber-optic interface FOM	
Data rate	64 Kbps and 2 Mbps for direct connection N = 1 to 12 x 64 kbps acc. to IEEE C37.94 for connection to multiplexer
Optical module	SFP transceiver – single-mode; multimode
Connector	LC
Path protection (1+1)	FO line and digital FO and FO line FO and analog line FO and Ethernet line
Long-range single-mode FOL1	
Wavelength	1,550 nm
Optical budget	at 64 Kbps 43 dB at 2 Mbps 33 dB
Range	at 64 Kbps 154 km ²⁾ at 2 Mbps 118 km ²⁾
Short-range single-mode FOS1	
Wavelength	1,310 nm
Optical budget	at 64 Kbps 33 dB at 2 Mbps 17 dB to PowerLink 13 dB
Range	at 64 Kbps 87 km ³⁾ at 2 Mbps 45 km ³⁾ to PowerLink 34 km ³⁾
Short-range multimode FOS2	
Wavelength	850 nm
Optical budget	at 64 Kbps 7 dB at 2 Mbps 7 dB to PowerLink 7 dB
Range	at 64 Kbps 2 km ⁴⁾ at 2 Mbps 2 km ⁴⁾ to PowerLink 2 km ⁴⁾

Short-range multimode FOS3		
	Wavelength	830 nm
Optical budget	for C37.94	7 dB
Range	for C37.94	2 km
Fiber-optic box interface FOB		
Power supply	Input voltage	20 V to 72 V DC/22 V to 60 V AC
	Power consumption	Max. 3.5 W
Alarm output	Contact type	Changeover contact
	Switching power	150 W/300 VA
	Switching voltage	200 V DC/140 V AC
	Continuous current	5 A AC/DC
Mechanical design	Dimensions	230 mm x 110 mm x 60 mm
	Mounting	DIN rail
Insulation withstand voltage	Power supply	3 kV AC
	Alarm outputs	3 kV AC
	Digital I/O G703.6	500 V AC
	Fiber-optic modules (SFP transceiver)	Optical budget and range are identical to FOL1; FOS1; FOS2 as specified for FOM

Transmission line – analog networks		
Analog interface CLE		
	Modulation type	F6 frequency shift keying or CT-coded tripping
Broadband modulation	Trip frequencies	0.3 to 2.03 kHz
	Guard	2.61 or 3.81 kHz
Narrowband modulation	Channel 1	0.63 to 1.26 kHz
	Channel 2	1.64 to 2.27 kHz
	Channel 3	2.65 to 3.28 kHz
	Channel 4	3.16 to 3.79 kHz
Voice frequency interface	Transmitter	Level max. +15 dBm Impedance 600 Ω
	Receiver	Level range –40 dB to +4 dB Impedance 600 Ω or 5 kΩ
	Path protection (1+1)	Analog and digital line Analog and FO line Analog and Ethernet line
Transmission time – SWT 3000 stand-alone ¹⁾		
Broadband modulation	Single-purpose	$t_0 \leq 10$ ms (F6, CT)
	Alternate multipurpose (voice)	$t_0 \leq 15$ ms (F6, CT)
	Narrowband modulation	$t_0 \leq 15$ ms (F6)
Transmission time – SWT 3000 integrated into PowerLink ¹⁾		
Broadband modulation	Single-purpose	$t_0 \leq 10$ ms (F6, CT)
	Alternate multipurpose	$t_0 \leq 15$ ms (F6, CT); F2+AMP
	Alternate multipurpose	$t_0 \leq 19$ ms (F6, CT); DP+AMP
	Simultaneous multipurpose	$t_0 \leq 10$ ms (F6, CT)
	Narrowband modulation	$t_0 \leq 15$ ms (F6)
Security and dependability		
	Security – direct tripping	$P_{UC} < 10^{-6}$
	Dependability – direct tripping	$P_{MC} < 10^{-4}$ at SNR of 6 dB
	Security – blocking/permissive tripping	$P_{UC} < 10^{-4}$
	Dependability – blocking/permissive tripping	$P_{MC} < 10^{-3}$ at SNR of 6 dB

¹⁾ Values are given for the IFC-P module and permissive tripping. If the IFC-D module is used for increased contact load, all specified signal transmission times are prolonged by about 4 ms. For direct tripping schemes the transmission time increases about 5 ms. Ethernet line interface will prolong the digital transmission time about 2ms.

²⁾ Assumed fiber attenuation 0.28 dB/km

³⁾ Assumed fiber attenuation 0.38 dB/km

⁴⁾ Assumed fiber attenuation 3.5 dB/km

⁵⁾ Not applicable in combination with IEC 61850 command interface

Common system data	
Power supply	
Input voltage	24 V to 60 V DC (–20% to +20%) or 110/220/250 V DC (–20% to +20%) and 115/230 V AC (–20% to +10%); 47 Hz to 63 Hz
Power consumption	Approx. 30 W/VA
Alarm output ALR	
Contact type	Relay CO; changeover
Contacts per module	3
Switching power	300 W/1,000 VA
Switching voltage	250 V AC/DC
Carry current	5 A AC/DC
Binary input	
Nominal voltage BI1/ BI2	24 V to 250 V DC, tolerance –20% to +20%
Polarity	Independent
Clock synchronization input	
Sync pulse	Minutes/hour
IRIG-B	B00x, B000, B004
Ethernet	NTP
Nominal voltage binary input	24 V to 250 V DC, tolerance –20% to +20%
Nominal voltage IRIG-B	5 V/12 V/24 V DC
Event recorder	
Events	8,000; nonvolatile; 1 ms time resolution
Trip counter	Individual counter for each received and transmitted command; size 128
Element manager	
Interface	USB; type B; 115 Kbps; local front access RS 232 local/remote; rear Ethernet; RJ45; 100 Base-T local/remote; front
Application	PowerSys
Operating system	Windows XP; Vista; Win7
Network management	
Interface	Ethernet; local; RJ45; 100 Base-T
NMS integration	SNMPv2/3
Mechanical design	
Dimensions	Height 132 mm/3 U Width 482.6 mm/19 inch Depth 240 mm
Weight	Approx. 5 kg
Color	White aluminum; RAL 9006
Maintenance	
Preventive maintenance	not required



SWT 3000 – mechanical design

Standards		
Performance/EMC/Environmental/Safety		
Performance and testing of teleprotection equipment		IEC 60834-1
Electromagnetic compatibility (EMC) directive		IEC 61000-6-2; IEC 61000-6-4; IEC 60870-2; 2004/108/EC (EMC directive)
Environmental conditions		IEC 60721-3; IEC 60870-2
Product safety		IEC 60950-1
NMS integration		SNMPv2/3
Electromagnetic compatibility (EMC)		
Immunity IEC 61000-6-2, IEC 61000-6-4, IEC 61000-4-2/3/4/5/6/8/12, IEC 60870-2		
	Electrostatic discharge	8 kV (contact discharge); 15 kV (air discharge)
	Radiated electromagnetic fields	10 V/m; 80 MHz to 2 GHz
Bursts	Power supply	2 kV
	Data lines	2 kV
Surges	Common mode	2 kV (line to ground)
	Differential mode	1 kV (line to line)
	Direct coupling into shield	2 kV (communication cable)
	Conducted disturbances	10 V AC, 150 kHz to 80 MHz
Damped oscillatory waves	Common mode	2.5 kV (line to ground)
	Differential mode	2.5 kV (line to line)
	Direct coupling into shield	2.5 kV (communication cable)
Emissions IEC 61000-6-4, CISPR 11/22, IEC 60834-1		
	RF disturbance emission radiated	Limit class A; 20 MHz to 1,000 MHz
	Conducted emission	CISPR; power supply and signal cable
	Conducted noise	IEC 60834-1; 3 mV; 0 Hz to 4 kHz
Insulation withstand voltage IEC 60950-1		
	VF input/output	500 V AC
	Power supply	3 kV AC
	Command input/output	3 kV AC
	Alarm outputs	3 kV AC
	G703.1	500 V AC
	G703.6 sym.	500 V AC
Insulation withstand level 1.2/50 μs IEC 60950-1		
	VF input/output	1 kV
	Digital input/output	1 kV
	Power supply	5 kV
	Command input/output	5 kV
	Alarm outputs	5 kV
Ambient conditions		
Climatic IEC 60721-3		
	During operation	-5 °C to +55 °C
	During storage and transport	-40 °C to +70 °C
	Relative humidity	5% to 95%
	Absolute humidity	29 g/m ³ ; no condensation
Mechanical IEC 60721-3-3		
	Degree of protection	IP 20
	Vibration	Stationary use; class 3M3 2 Hz–9 Hz: 1.5 mm amplitude 9 Hz–200 Hz: 0.5 g acceleration
	Shock	Resistance, class 2M1 11 ms pulse duration; 10 g acceleration

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