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Power network telecommunication

PowerLink – technical data

Answers for infrastructure & cities.

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First choice for a seamless flow of information between substations

PowerLink offers the energy industry the ability to monitor and protect their networks even in places which have no fiber-optic networks or where they are not economically viable.

Regardless of the situation, PowerLink can be used as a backup system to ensure a continuous flow of information even in the event of a fault. PowerLink can be flexibly integrated into the existing infrastructure. Its compatibility with all relevant transmission solutions and the ability to continue to use existing infrastructure testify to how cost effective this communications technology is. It has proven itself over decades and is continually being refined.

HF transmission	
Method	
Modulation	Amplitude modulation with single-sideband transmission, multicarrier modulation (OFDM), single-stage frequency conversion
HF frequency range	24 to 1,000 kHz
HF bandwidth	2.5; 3.75; 4; 5; 7.5; 8; 12; 16; 24; 32 kHz in each operating direction
TX/RX band	Adjacent, not adjacent
Interface	
Output power	50-W amplifier: max. +47 dBm PEP Software adjustable 20 to 50 W 100-W amplifier: max. +50 dBm PEP Software adjustable 40 to 100 W
Rated output impedance	75 Ω unbalanced 150 Ω balanced
Spurious emission in accordance with IEC 60495	At a distance of: 1 x BN from the transmit frequency band 2 x BN from the transmit frequency band > 2 x BN from the transmit frequency band
	At a transmit power of: > 40 W < 40 W ≥ 60 dB -14 dBm ≥ 70 dB -24 dBm ≥ 80 dB -34 dBm BN = Nominal bandwidth of the transmission channel
Return loss	> 10 dB as per IEC 60495
Tapping loss	≤ 1.5 dB as per IEC 60495
Balance to ground 50 Hz	> 40 dB
Balance to ground 60 Hz	> 40 dB
Properties	
Receiver sensitivity	Minimum receive level for pilot tone: -32 dBm (minimum receive level can differ according to the operating mode)
Receiver selectivity	At distance 1 x BN from the frequency band limits: ≥ 65 dB At distance 2 x BN from the frequency band limits: ≥ 75 dB BN = Nominal bandwidth of the transmission channel
Automatic crosstalk cancellation AXC	Dynamic adjustment to changes in the line conditions
Automatic gain control AGC	40 dB dynamic range (AGC range can vary according to mode) Stabilization of the VF output level: $< \pm 0.5$ dB
Automatic frequency control AFC	VF frequency variation between transmitter and receiver ≈ 0 Hz

Analog interface	
VF interface (general)	
Number of channels	Up to 8
Telephone signaling channel	Pulse distortion < 1.5 ms at 50 Bd
Compander	Compression-expansion ratio $k=2$
Bandwidth	0.3 to 3.84 kHz (frequency range depends on the configuration)
Return loss	> 14 dB
Control wire in	Optocoupler ($7\text{ V DC} < V_{in} < 72\text{ V DC}$, $I_{max} = 7\text{ mA}$)
Control wire out	Optocoupler ($12\text{ V} < V_{out} < 72\text{ V DC}$, $I_{max} = 100\text{ mA}$ depending on V_{out})
VF telephone channel, 2/4-wire, E & M	
Number of channels	Up to 5
Impedance	600 Ω balanced
Input level	4-wire: -26 dBm to +1 dBm 2-wire: -22 dBm to +5 dBm
Output level	4-wire: -7 dBm to +14 dBm 2-wire: -11 dBm to +10 dBm
Control wires	Telephone signaling channel (S2), compander control
VF telephone channel FXS (2-wire)	
Number of channels	Up to 3
Impedance	600 Ω
Feeding current	48 V/max. 40 mA
Loop resistance	1,500 Ω
Ringing voltage	96 Vpp/25, 50, 60 Hz selectable
Input level	-26 dBm to +5 dBm
Output level	-11 dBm to +14 dBm
VF telephone channel FXO (2-wire)	
Number of channels	Up to 3
Impedance	600 Ω
Ringing detection	25, 50 and 60 Hz (> 24 V _{eff})
Loop resistance	< 560 Ω
Loop current	Max. 70 mA
Input level	-26 dBm to +5 dBm
Output level	-11 dBm to +14 dBm
VF data channel (4-wire)	
Number of channels	Up to 3
Impedance	600 Ω balanced
Input level	-26 dBm to +1 dBm
Output level	-7 dBm to +14 dBm
VF distance protection channel (4-wire) for aPLC	
Number of channels	Up to 3
Impedance	600 Ω balanced
Input level	-26 dBm to +1 dBm
Output level	-7 dBm to +14 dBm
Control wire	Boosting of the protection signal (S6)
Transmission time	$\leq 10\text{ ms}$

Digital interface	
Transparent narrowband data for aPLC	
Number of channels	Up to 4, asynchronous
Modulation scheme	FSK (frequency shift keying)
Nominal data rate	50, 100, 200, 600, 1,200, 2,400 bps
Minimum bandwidth	100, 200, 400, 1,000, 1,440, 2,720 Hz
Interface	RS 232 (TxD, RxD)
Broadband data (general) for dPLC	
Number of channels	Up to 8x asynchronous, 2x synchronous, 8x voice, 2x VF data, 2x ETH
Modulation scheme	Multicarrier
DP data rates	9.6 kbps to 64 kbps (adjustable in steps of 0.4 kbps) 64, 80, 96, 128, 144, 160, 192, 224, 256, 288, 320 kbps
Bandwidth	3.5, 3.7, 4, 4.5, 4.7, 5, 5.5, 6.5, 7, 7.5, 11.5, 15.5, 23.5, 31.5 kHz
Versatile multiplexer	For the multiplex transmission of digitized voice and data channels; transfer of digitized voice data (Station-Link) in transition stations without decompression
Fallback mode	Dynamic matching of the data rate in two steps with priority matching
Required minimum signal-to-noise ratio	39 dB for 8.5 bit/s/Hz (e.g. 64 kbps up to 7.5 kHz) 20 dB for 4.2 bit/s/Hz (e.g. 32 kbps up to 7.5 kHz)
Versatile multiplexer/voice compression for dPLC	
Number of voice channels	Up to 8 via E1 interface, up to 5 via analog VF telephone interface
Number of data channels	Up to 14 (synchronous, asynchronous, ETH, VF data)
Voice compression rate	Selectable, 5.3 kbps as per G.723.1; 6.3 kbps as per G.723.1; 8 kbps as per G.729
Voice compression, signaling	DTMF (MFV), S2, MFC on request
Line echo canceller	Selectable
Cross connection switching matrix (StationLink)	Up to 4 PowerLink systems can be connected in an SPS repeater station via a bus; configurable transfer of compressed voice and data signals via a switching matrix (no decompression/compression for optimum quality), point-to-multipoint configuration for asynchronous data (RTU polling)
Analog RTU/modem (rFSK)	Up to 2VF data interfaces for direct connection of analog RTUs/modems
Multiplex method	TDM, for compressed voice and data signals
Transmission capacity	Max. 64 kbps at 8 kHz, max. 256 kbps at 32 kHz
Asynchronous data interface	
Number of channels	Up to 8
Interface	RS 232 (TxD, RxD, RTS, CTS)
Bit rate	1.2; 2.4; 4.8; 9.6; 19.2; 38.4; 57.6; 115.2 kbps
UART mode	8N1, 8N2, 8E1, 8E2, 8O1, 8O2 7N1, 7N2, 7E1, 7E2, 7O1, 7O2
Multiplex method	Statistical, with priority
Transmission capacity	Max. 76.8 kbps at 8 kHz (e.g. 4 x 19.2 kbps) Max. 256 kbps at 32 kHz

Synchronous X.21 data interface	
Number of channels	2
Interface	X.21
Bit rate	9.6 up to 64 kbps (configurable in 0.4-kbps steps) 80, 96, 128, 144, 160, 192, 224, 256, 288, 320 kbps
Synchronous G703.1 data interface	
Number of channels	1
Bit rate	64 kbps
Impedance	120 Ω balanced, G703.1
Clock timing	Contra-directional
Ethernet interface	
Number of ports	2
Interface	10/100Base-TX, 100Base-FX
Bandwidth	Max. 320 kbps, configurable
Application	Layer 2 bridging, IP routing, VoIP
Integrated teleprotection system	
Properties	
Number of systems	Up to 2 SWT 3000 units, integrated in the PowerLink rack or connected via fiber-optic cable (FOM)
Operating modes	Single-purpose (SP), simultaneous multipurpose (MP), alternate multipurpose (AMP), Multicommand mode (MCM)
Number of commands	Max. 4 per system, max. 24 in MCM mode
Modulation	F6 or coded tripping
Broadband frequencies	0.3 to 2.03 kHz, guard 2.61 or 3.81 kHz
Narrowband frequencies	0.63 to 1.26 kHz incl. guard
Transmission on alternative path (1+1)	
Analog	Per VF teleprotection interface, 4-wire
Digital	X.21, G703.1 (64 kbps) G703.6 (2 Mbps)
Security and dependability	
Security	$P_{UC} < 10^{-6}$
Dependability	$P_{MC} < 10^{-4}$ at SNR of 6 dB
Number of commands/modules	
Commands for analog transmission	Up to 4
Binary interface module IFC	Up to 2
IEC 61850 module EN 100	1
IEC 61850 command input/output EN 100 ¹⁾	
Electrical interface	RJ45, 100Base-TX, max. range 20 m
Optical interface	SFP, 100Base-FX, 1,300 nm, LC connector, Max. range 1.5 km
Binary command input IFC-P/IFC-D	
Nominal input voltage	24 V to 250 V DC (tolerance -20% to +20%)
Inputs per module	4
Nominal input/threshold	24 V 48/60 V 110 V 250V
	Low level $U_{in} < 15$ V, high level $U_{in} > 18$ V Low level $U_{in} < 40$ V, high level $U_{in} > 47$ V Low level $U_{in} < 72$ V, high level $U_{in} > 85$ 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/1,250 VA		
Switching voltage	250 V AC/DC		
Switching current	5 A AC/DC (30 A ≤ 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/voltage/insulation	As IFC-D		
Continuous current	1 A AC/DC		
Transmission time – SWT 3000 integrated into PowerLink²⁾			
Broadband modulation	Single-purpose	$t_0 \leq 10$ ms (F6, CT)	
	Alternate multipurpose with voice	$t_0 \leq 15$ ms (F6, CT); F2+AMP	
	Alternate multipurpose with datapump	$t_0 \leq 19$ ms (F6, CT); DP+AMP	
	Simultaneous multipurpose	$t_0 \leq 10$ ms (F6, CT)	
	Narrowband modulation	$t_0 \leq 15$ ms (F6)	
SWT 3000 connection with PowerLink via fiber-optic module FOM			
Module type	FOS1 Short-range Single-mode	FOS2 Short-range Multimode	
Optical module	SFP transceiver		
Connection	Duplex LC connector as per industrial standard		
Wavelength (nm)	1,310	850	
Average output power (dBm)	Max. -8, min. -15	Max. -3, min. -10	
Input power (dBm)	Max. -8, min. -28	Max. 0, min. -17	
Optical budget (dB)	13	7	
Range [km] depending on fiber-optic cable	1,310 nm: 0.38 dB/km, 850 nm: 3.5 dB/km	34	2

¹⁾ Release ≥ P3.5

²⁾ Values are given for the IFC-P module. If the IFC-D module is used for increased contact load, all specified signal transmission times are prolonged by about 4 ms. An optical link between SWT 3000 and PowerLink prolongs the transmission time by ≤ 1 ms.

Common system data		
Power supply		
Input voltage	DC AC	38 V to 72 V, 85 V to 264 V 93 V to 264 V (47 Hz to 63 Hz)
Power consumption	With 50-W amplifier With 100-W amplifier	Max. 250 VA/140 W Max. 520 VA/360 W
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
Clock synchronization input		
	Sync. pulse	Min/hour
	IRIG-B	B00x, B000, B004
	Ethernet	NTP
	Nominal voltage binary input BI	24 V to 250 V DC Tolerance -20% to +15%
	Nominal voltage IRIG-B	5 V/12 V/24 V DC
Event recorder		
	Events	4,000, nonvolatile, 1 ms time resolution; 8,000 for iSWT, nonvolatile 1 ms resolution ²⁾
	Trip counter of integrated SWT 3000	Individual counter for each received and transmitted command, size 128
Element manager		
	Interface	Ethernet 10/100 Base-T, RJ45 RS 232; DSUB9
	Application	PowerSys
	Operating system	Windows XP, Vista, Win7
Network management		
	Interface	Ethernet, RJ45, 10/100Base-TX or 100Base-FX
	NMS integration	SNMPv2
Maintenance interfaces		
	Service phone	Headset (2 x 3.5-mm telephone jack)
	Expansion port	USB
Mechanical design		
	Dimensions	Height 578 mm, width 482 mm/19 inch, depth 270 mm
Weight ¹⁾	With 50-W amplifier With 100-W amplifier	21 kg 26 kg
	Color	White aluminum, RAL 9006
Maintenance		
	Preventive maintenance	not required
Standards		
Performance/EMC/Environmental/Safety		
	Terminals for single-sideband carrier frequency communication via high-voltage lines	IEC 60495
	Power supply and electromagnetic compatibility	IEC 61000-4-2 Electrostatic discharge IEC 61000-4-3 RF immunity test IEC 61000-4-4 Bursts IEC 61000-4-5 Surges IEC 61000-4-6 RF disturbance immunity IEC 61000-6-2 Industrial area IEC 61000-6-4 RF disturbance emission industrial area
	Environmental conditions	IEC 60870-2-2
	Product safety	IEC 60950

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	
Radiated electromagnetic fields	IEC 61000-4-6 10 V AC (0.15 MHz to 80 MHz) IEC 61000-4-3, IEC 61000-6-2 (Industrial area) 10 V/m (80 MHz to 1 GHz) 3 V/m (1.4 GHz to 2 GHz) 1 V/m (2 GHz to 2.7 GHz)
Electrostatic discharge	IEC 61000-4-2 4 kV (contact discharge) 8 kV (direct air discharge)
Bursts	
Power supply	2 kV
HF input/output	2 kV
VF input/output	1 kV
Surges	
Common mode	2 kV (line-to-ground)
Differential mode	1 kV (line-to-line)
Direct coupling into shield	1 kV
Emissions IEC 61000-6-4	
RF disturbance emission radiated	Limit class A, 20 MHz to 1,000 MHz
Insulation withstand voltage IEC 60950-1	
VF input/output	500 V AC
Alarm outputs	2.5 kV AC
Carrier frequency input/output	2.5 kV AC
Power supply	2.5 kV AC
SWT 3000 command input/output	2.5 kV AC
SWT 3000 G703.6 sym.	500 V AC
Insulation withstand level 1.2/50 µs IEC 60950-1	
VF input/output	1 kV
Alarm outputs	5 kV
Carrier frequency input/output	5 kV
Power supply	5 kV
SWT 3000 command input/output	5 kV
Ambient conditions	
Climatic IEC 60721-3	
Operation	0 °C to +55 °C, -5 °C to +55 °C (hot boot)
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 to 9 Hz: 1.5 mm amplitude 9 Hz to 200 Hz: 0.5 g acceleration
Shock	Resistance, class 2M1 11 ms pulse duration, 10 g acceleration

¹⁾ Values including carrier frequency as well as amplifier section

²⁾ Release ≥ P3.5

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