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SIEMENS

Power network telecommunication

PowerLink – technical data

www.siemens.com

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 these 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	PowerLink 50	PowerLink 100
Method		
Modulation	Amplitude modulation with single-sideband transmission, multicarrier modulation (OFDM), single-stage frequency conversion	
HF frequency range	24 kHz 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	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 Balance to ground 60 Hz	> 40 dB > 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 cross talk cancellation AXC	Dynamic adjustment to changes in the line conditions	
Automatic gain control AGC	40 dB dynamic range (AGC range can vary according to operating mode) Stabilization of the VF output level: < ±0.5 dB	
Automatic frequency control AFC	VF frequency variation between transmitter and receiver ≈ 0 Hz	

Analog interface		
	PowerLink 50	**PowerLink 100**
VF interface (general)		
Number of channels	Up to 7	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 V DC < V_{in} < 72 V DC, I_{max} = 7 mA)	
Control wire out	Optocoupler (12 V < V_{out} < 72 V DC, I_{max} = 100 mA depending on V_{out})	
VF telephone channel, 2/4-wire, E & M		
Number of channels	Up to 4	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 2	Up to 3
Impedance	600 Ω	
Feeding current	48 V/max. 40 mA	
Loop resistance	1,500 Ω	
Ringing voltage	96 V_{pp}/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 2	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 2	Up to 2
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 2	Up to 2
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	≤ 10 ms	

Digital interface	PowerLink 50	PowerLink 100
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 8 x asynchronous; 2 x synchronous; 8 x voice; 2 x VF data; 2 x 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 (StationLink) 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 4 via analog VF telephone interface	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 2 VF 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	

	PowerLink 50	PowerLink 100
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 according to IEE 802.3		
Number of ports	2	
Interface	10/100Base-TX; 100Base-FX	
Bandwidth	Max. 320 Kbps; configurable	
Application	Layer-2 bridging; IP routing; VoIP; header compression	

Integrated teleprotection system

	PowerLink 50	PowerLink 100
Properties		
Number of systems	One integrated SWT 3000 in the PowerLink rack	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. 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		
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 Nominal input/threshold 48/60 V Nominal input/threshold 110 V Nominal input/threshold 250 V	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	

	PowerLink 50	PowerLink 100	
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 (< 2.5 ms)	1.5 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/current/ insulation withstand voltage	As IFC-D		
Continuous current	1 A AC/DC		
Transmission time – SWT 3000 integrated into PowerLink[1]			
Broadband modulation: Single-purpose Alternate multipurpose with voice Alternate multipurpose with data pump Simultaneous multipurpose	 $t_0 \leq 10$ ms (F6, CT) $t_0 \leq 15$ ms (F6, CT); F2+AMP $t_0 \leq 19$ ms (F6, CT); DP+AMP $t_0 \leq 10$ 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] 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	PowerLink 50	PowerLink 100
Power supply		
Input voltage DC Input voltage AC	38 V to 72 V; 85 V to 264 V 93 V to 264 V (47 Hz to 63 Hz)	
Power consumption 50-W amplifier Power consumption 100-W amplifier	Max. 320 VA/180 W	Max. 340 VA/200 W Max. 520 VA/360 W
Alarm output ALR		
Contact type	Relay CO; changeover	
Contacts per module	3	
Number of modules	1	2
Switching power	300 W/1,000 VA	
Switching voltage	250 V AC/DC	
Carry current	5 A AC/DC	
Clock synchronization input		
Sync. pulse	Minute/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; tolerance –20% to +15%	
Event recorder		
Events	4,000; nonvolatile; 1 ms resolution	
Trip counter of integrated SWT 3000	Individual counter for each received and transmitted command; size 128	
Element manager		
Interface	Ethernet; RJ45; 100Base-TX; RS 232; DSUB9	
Application	PowerSys	
Operating system	Windows 7	
Network management		
Interface	Ethernet; RJ45; 10/100Base-TX or 100Base-FX	
NMS integration	SNMPv2/3	
Maintenance interfaces		
Service phone	Headset (2 x 3.5-mm telephone jack)	
Expansion port	USB	
Mechanical design		
Dimensions	Height 266 mm; width 482 mm/19 inches; depth 270 mm	Height 578 mm; width 482 mm/19 inches; depth 270 mm
Weight[1]	With 50 W amplifier 16 kg	With 50 W amplifier 21 kg With 100 W amplifier 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)		
	PowerLink 50	PowerLink 100
Immunity IEC 61000-6-2, IEC 61000-6-4, IEC 61000-4-2/3/4/5/6/8/12, IEC 60870-2		
RF disturbance immunity	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 output	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 output	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/m³; 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