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Siemens AG  
Energy Management  
Humboldtstr. 59  
90459 Nuremberg, Germany

For more information, please contact our  
Customer Support Center.

Phone: +49 180/524 84 37

Fax: +49 180/524 24 71

(Charges depending on provider)

E-Mail: [support.energy@siemens.com](mailto:support.energy@siemens.com)

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technical options should therefore be specified  
in the contract.

SIEMENS



# Power network telecommunication

PowerLink – technical data



# 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
<b>Method</b>			
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		
<b>Interface</b>			
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 $\Omega$ unbalanced 150 $\Omega$ balanced		
<b>Spurious emission in accordance with IEC 60495</b>			
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 $\geq 60$ dB $-14$ dBm $\geq 70$ dB $-24$ dBm $\geq 80$ dB $-34$ dBm BN = nominal bandwidth of the transmission channel		
Return loss	> 10 dB as per IEC 60495		
Tapping loss	$\leq 1.5$ dB as per IEC 60495		
Balance to ground 50 Hz Balance to ground 60 Hz	> 40 dB > 40 dB		
<b>Properties</b>			
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: $\geq 65$ dB At distance 2 x BN from the frequency band limits: $\geq 75$ 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: $< \pm 0.5$ dB		
Automatic frequency control AFC	VF frequency variation between transmitter and receiver $\approx 0$ Hz		

Analog interface		
	PowerLink 50	PowerLink 100
<b>VF interface (general)</b>		
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 ( $7\text{ V DC} < V_{in} < 72\text{ V DC}$ , $I_{max} = 7\text{ mA}$ )	
Control wire out	Optocoupler ( $12\text{ V} < V_{out} < 72\text{ V DC}$ , $I_{max} = 100\text{ mA}$ depending on $V_{out}$ )	
<b>VF telephone channel, 2/4-wire, E &amp; M</b>		
Number of channels	Up to 4	Up to 5
Impedance	600 $\Omega$ 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	
<b>VF telephone channel FXS (2-wire)</b>		
Number of channels	Up to 2	Up to 3
Impedance	600 $\Omega$	
Feeding current	48 V/max. 40 mA	
Loop resistance	1,500 $\Omega$	
Ringing voltage	96 $V_{pp}/25$ ; 50; 60 Hz selectable	
Input level	-26 dBm to +5 dBm	
Output level	-11 dBm to +14 dBm	
<b>VF telephone channel FXO (2-wire)</b>		
Number of channels	Up to 2	Up to 3
Impedance	600 $\Omega$	
Ringing detection	25; 50 and 60 Hz (> 24 $V_{eff}$ )	
Loop resistance	< 560 $\Omega$	
Loop current	Max. 70 mA	
Input level	-26 dBm to +5 dBm	
Output level	-11 dBm to +14 dBm	
<b>VF data channel (4-wire)</b>		
Number of channels	Up to 2	Up to 2
Impedance	600 $\Omega$ balanced	
Input level	-26 dBm to +1 dBm	
Output level	-7 dBm to +14 dBm	
<b>VF distance protection channel (4-wire) for aPLC</b>		
Number of channels	Up to 2	Up to 2
Impedance	600 $\Omega$ 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		PowerLink 50	PowerLink 100
<b>Transparent narrowband data for aPLC</b>			
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)		
<b>Broadband data (general) for dPLC</b>			
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)		
<b>Versatile multiplexer/voice compression for dPLC</b>			
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		
<b>Asynchronous data interface</b>			
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		

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<b>Synchronous X.21 data interface</b>			
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	
<b>Synchronous G703.1 data interface</b>			
Number of channels		–	1
Bit rate		–	64 Kbps
Impedance		–	120 Ω balanced, G703.1
Clock timing		–	Contra-directional
<b>Ethernet interface according to IEE 802.3</b>			
Number of ports		2	
Interface		10/100Base-TX; 100Base-FX	
Bandwidth		Max. 320 Kbps; configurable	
Application		Layer-2 bridging; IP routing; VoIP; header compression	
<b>Integrated teleprotection system</b>			
		PowerLink 50	PowerLink 100
<b>Properties</b>			
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	
<b>Transmission on alternative path (1+1)</b>			
Analog		–	Per VF teleprotection interface; 4-wire
Digital		–	X.21, G703.1 (64 Kbps) G703.6 (2 Mbps)
<b>Security and dependability</b>			
Security		$P_{UC} < 10^{-6}$	
Dependability		$P_{MC} < 10^{-4}$ at SNR of 6 dB	
<b>Number of commands/modules</b>			
Commands for analog transmission		Up to 4	
Binary interface module IFC		Up to 2	
IEC 61850 module EN 100		1	
<b>IEC 61850 command input/output EN 100</b>			
Electrical interface		RJ45; 100Base-TX; max. range 20 m	
Optical interface		SFP; 100Base-FX; 1,300 nm; LC connector; Max. range 1.5 km	
<b>Binary command input IFC-P/IFC-D</b>			
Nominal input voltage		24 V to 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	
Nominal input/threshold 48/60 V		Low level $U_{in} < 40$ V, high level $U_{in} > 47$ V	
Nominal input/threshold 110 V		Low level $U_{in} < 72$ V, high level $U_{in} > 85$ V	
Nominal input/threshold 250V		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	
<b>Binary command output IFC-P for normal contact load</b>			
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		
<b>Binary command output IFC-D for high contact load</b>			
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		
<b>Binary command output IFC-S for signaling</b>			
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		
<b>Transmission time – SWT 3000 integrated into PowerLink<sup>1</sup></b>			
Broadband modulation:			
Single-purpose	t <sub>0</sub> ≤ 10 ms (F6, CT)		
Alternate multipurpose with voice	t <sub>0</sub> ≤ 15 ms (F6, CT); F2+AMP		
Alternate multipurpose with data pump	t <sub>0</sub> ≤ 19 ms (F6, CT); DP+AMP		
Simultaneous multipurpose	t <sub>0</sub> ≤ 10 ms (F6, CT)		
Narrowband modulation	t <sub>0</sub> ≤ 15 ms (F6)		
<b>SWT 3000 connection with PowerLink via fiber-optic module FOM</b>			
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

<sup>1</sup> 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
<b>Power supply</b>		
Input voltage DC	38 V to 72 V; 85 V to 264 V	
Input voltage AC	93 V to 264 V (47 Hz to 63 Hz)	
Power consumption 50-W amplifier	Max. 320 VA/180 W	Max. 340 VA/200 W
Power consumption 100-W amplifier		Max. 520 VA/360 W
<b>Alarm output ALR</b>		
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	
<b>Clock synchronization input</b>		
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%	
<b>Event recorder</b>		
Events	4,000; nonvolatile; 1 ms resolution	
Trip counter of integrated SWT 3000	Individual counter for each received and transmitted command; size 128	
<b>Element manager</b>		
Interface	Ethernet; RJ45; 100Base-TX; RS 232; DSUB9	
Application	PowerSys	
Operating system	Windows 7	
<b>Network management</b>		
Interface	Ethernet; RJ45; 10/100Base-TX or 100Base-FX	
NMS integration	SNMPv2/3	
<b>Maintenance interfaces</b>		
Service phone	Headset (2 x 3.5-mm telephone jack)	
Expansion port	USB	
<b>Mechanical design</b>		
Dimensions	Height 266 mm; width 482 mm/19 inches; depth 270 mm	Height 578 mm; width 482 mm/19 inches; depth 270 mm
Weight <sup>1</sup>	With 50 W amplifier 16 kg	With 50 W amplifier 21 kg With 100 W amplifier 26 kg
Color	White aluminum; RAL 9006	
<b>Maintenance</b>		
Preventive maintenance	Not required	
<b>Standards</b>		
<b>Performance/EMC/Environmental/Safety</b>		
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
<b>Immunity IEC 61000-6-2, IEC 61000-6-4, IEC 61000-4-2/3/4/5/6/8/12, IEC 60870-2</b>	
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
<b>Emissions IEC 61000-6-4</b>	
RF disturbance emission radiated	Limit class A; 20 MHz to 1,000 MHz
<b>Insulation withstand voltage IEC 60950-1</b>	
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
<b>Insulation withstand level 1.2/50 µs IEC 60950-1</b>	
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
<b>Ambient conditions</b>	
<b>Climatic IEC 60721-3</b>	
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 <sup>3</sup> ; no condensation
<b>Mechanical IEC 60721-3-3</b>	
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

<sup>1</sup> Values including carrier frequency as well as amplifier section