

# ETL600 R4

## Technical Data

<b>System data</b>		
Operating mode	2-wire frequency duplex	
Modulation	Single Side Band with suppressed carrier (SSB) Multi-carrier modulation with trellis coding and forward error correction Single step frequency conversion with Direct Digital Synthesis (DDS)	
Nominal bandwidth	2, 2.5, 4, 8, 12, 16, 20, 24, 28, 32 kHz (each direction) Edge frequencies at multiples of 500 Hz	
Standards compliance	IEC 60495, IEC 60834-1, IEC 60950-1, IEC 61000-6-2, IEC 61000-6-4 (EN 55022 / CISPR22, Class A)	
Nominal transmit output power (PEP)	ETL600-050: 50 W / +47 dBm ETL600-100: 100 W / +50 dBm The output power may be decreased via user interface program (HMI) in steps of 1 dB	
RF frequency range	24 to 1000 kHz for nominal bandwidth $\geq$ 4 kHz 24 to 500 kHz for 2 kHz nominal bandwidth	
Nominal output impedance	75 $\Omega$ unbalanced (150 $\Omega$ balanced as option)	
Return loss in the transmitter band	$\geq$ 10 dB according to IEC 60495	
Tapping loss	$\leq$ 1.5 dB according to IEC 60495	
Image rejection	$\geq$ 75 dB	
AGC (Automatic Gain Control)	40 dB dynamic range	
Receiver sensitivity	-30 dBm	Pilot level at the RF input
Receiver selectivity	> 65 dB / > 75 dB (for nominal bandwidth > 2 kHz) at 300 Hz / 4 kHz from the band edges > 55 dB / > 65 dB (for nominal bandwidth = 2 kHz) at 300 Hz / 2 kHz from the band edges	
Power supply	-48 VDC +20/-15%	(other on request)
Power consumption	Normal operation @ 75 Ohm	Dual tone modulation PEP @ 75 Ohm
ETL600-050	135 / 145 / 155 W (1 / 2 / 3 APLC channels)	175 / 185 / 195 W (1 / 2 / 3 APLC channels)
ETL600-100	210 / 220 / 230 W (1 / 2 / 3 APLC channels)	280 / 290 / 300 W (1 / 2 / 3 APLC channels)
Alarm relay outputs	Free changeover contacts • System alarm / cabinet alarm • Hardware alarm • Link alarm • Interface alarm • Warning	
Event recording	2600 time-stamped alarm and manipulation events, stored in non-volatile memory Clock synchronizing input for IRIG-B available	
<b>Ambient conditions</b>		
<b>Operation</b>		
Climatic conditions	IEC 60721-3-3, Class 3K5 Temperature range Humidity	Within specification: -5 to +55 °C $\leq$ 95%, < 28 g/m <sup>3</sup> , non-condensing
Mechanical conditions	IEC 60721-3-3, Class 3M1	
Vibration and shock	IEC 60068-2-6, ICE 60068-2-27	
<b>Transport</b>		
Climatic conditions	IEC 60721-3-2, Class 2K4 Temperature range Humidity	-30 to +70 °C $\leq$ 95%, < 28 g/m <sup>3</sup> , non-condensing
Mechanical conditions	IEC 60721-3-2, Class 2M1	
Vibration sinusoidal	IEC 60068-2-6	
Shock and free fall	IEC 60068-2-27, IEC 60068-2-32	0.25 m / equipment is packed
<b>Storage</b>		
Climatic conditions	IEC 60721-3-1, Class 1K5 Temperature range Humidity	-30 to +70 °C $\leq$ 95%, < 28 g/m <sup>3</sup> , non-condensing
Mechanical conditions	IEC 60721-3-1, Class 1M1	

<b>Dimensions and weights</b>					
Equipment subracks	19" wide conforming to standards IEC 60297 and DIN 41494 6 units high, 1 unit per equipment for earth rail and cover plate with label (1 unit = 44.45 mm)				
Dimensions / weight	Height	Width	Depth *	Weight	* without front cable connectors and module ejection handles
ETL600-050-1	308 mm	482 mm	301 mm	13 kg	
ETL600-050-2	575 mm	482 mm	301 mm	16 kg	
ETL600-100-2	575 mm	482 mm	301 mm	20 kg	
<b>Audio frequency services</b>					
Application	Transparent transmission of analog voice-frequency signals such as band limited speech with superimposed teleoperation, VFT-modems, facsimile, external teleprotection				
Number of AF channels	<ul style="list-style-type: none"> <li>• 0, 1, 2 or 3 channels 300 Hz to 3720 Hz in 4 kHz bandwidth each, or</li> <li>• 3 channels of 3.2, 2.4 and 2.4 kHz bandwidth respectively, in 8 kHz total bandwidth</li> <li>• 1 channel of 2.0 kHz or 2.5 kHz bandwidth, for single purpose teleprotection and service telephone</li> <li>• 1 channel of 2 kHz, in conjunction with a 2 kHz or 6 kHz DPLC channel</li> </ul>				
Frequency offset	≈ 0 Hz				
Number of compressed voice channels	Up to 16 (depending on available broadband modem bandwidth and on interface requirements of other services to be deployed in the same terminal)				
<b>Telephony services</b>					
<b>Analog speech</b>					
Telephony services	Depending on configuration either: <ul style="list-style-type: none"> <li>• Point-to-point hotline / 2-wire remote subscriber / 4-wire remote subscriber</li> <li>• 4-wire PAX connection with E&amp;M signaling</li> <li>• 2-/4-wire PAX connection with E&amp;M signaling and hybrid control</li> <li>• Transit mode for E&amp;M wire</li> <li>• Service phone (available once per AF channel)</li> </ul>				
Number of analog speech channels	At most one in each AF channel				
Speech low-pass filter cut-off frequency	<ul style="list-style-type: none"> <li>• 2.0 kHz to 3.4 kHz, programmable in steps of 200 Hz, limited by AF channel bandwidth</li> <li>• 1.6 kHz for nominal bandwidth of 2 kHz (used exclusively for service telephone)</li> </ul>				
Signalization	DTMF-, MFC and Pulse-Code-Dialing				
Speech limiter	+3 dBm0				
Speech compandor	According to ITU-T G.162; configurable to "Off" or "On" (either permanent or enabled/disabled via control input)				
<b>Digital speech</b>					
Telephony services	Depending on configuration either: <ul style="list-style-type: none"> <li>• Point-to-point hotline / 2-wire remote subscriber / 4-wire remote subscriber</li> <li>• 4-wire PAX connection with E&amp;M signaling</li> <li>• Services phone (available once per terminal)</li> </ul>				
Number of digital speech channels	Up to 16 for ETL600-050-2, ETL600-100-2 Up to 12 for ETL600-050-1				
Speech low-pass filter cut-off frequency	2.0 kHz to 3.4 kHz, programmable in steps of 200 Hz				
Signalization	DTMF- and Pulse-Code-Dialing				
Modes	Voice and FAX 4.8 kbps (automatic FAX detection)				
Data rate	5.3 or 6.3 kbps, programmable				
Compression algorithm	MP-MLQ / ACELP according to ITU-T G.723.1				
Echo canceller	According to ITU-T G.168				
<b>Digital transit</b>					
Number of transit connections	Up to 5 (i.e. 6 telephony links in a chain)				
Number of links per substation	Up to 5 (i.e. speech channel can be forwarded in 1 out of 4 possible directions)				
<b>Telephony ports</b>					
<b>4-wire PAX interface with E&amp;M</b>	<b>Analog speech</b>		<b>Digital speech</b>		
Impedance	600 Ω, balanced		600 Ω, balanced		
Input level range	-20 to +4 dBm		-20 to +5 dBm		
Output level range	-20 to +5.5 dBm		-20 to +8 dBm		
<b>2-wire subscriber interface (FXS)</b>	<b>Analog speech</b>		<b>Digital speech</b>		
Impedance	600 Ω, balanced		programmable (resistive and complex)		
Input level range	-17 to +4 dBm		-17 to +4 dBm		
Output level range	-17 to +1 dBm		-17 to +1 dBm		
Ringing frequency	25 or 20 Hz, programmable		16, 20, 25, 50 or 60 Hz, programmable		
Ringing voltage	50 Vrms open circuit; ≥ 36 Vrms across 2.333 kΩ load		50 Vrms open circuit; ≥ 36 Vrms across 2.333 kΩ load		
DC loop voltage	48 VDC ± 15% open loop		48 VDC ± 15% open loop		
<b>2-wire PAX interface (FXO)</b>	<b>Analog speech</b>		<b>Digital speech</b>		
Impedance	600 Ω, balanced		programmable (resistive and complex)		
Input level range	-17 to +4 dBm		-17 to +4 dBm		
Output level range	-17 to +1 dBm		-17 to +1 dBm		
Ringing voltage detection range	20 to 130 Vrms / 17 to 55 Hz		20 to 130 Vrms / 15 to 65 Hz		
<b>Service telephone</b>	<b>Analog speech</b>		<b>Digital speech</b>		
Connector for 2-wire telephone set	RJ11 on front panel		RJ11 on front panel		

<b>Teleoperation</b>									
Number of ports	Up to 20								
Impedance	600 Ω, balanced								
Input level range	-20 to +4 dBm								
Output level range	-20 to +8 dBm								
<b>Transit filters</b>									
Number of filters	Up to 20								
Standard filters	Programmable bandpass filters with cut-off frequencies selectable in steps of 60 Hz								
Group delay equalized filters	<ul style="list-style-type: none"> <li>Bandpass filters for teleoperation band above speech 2000, 2200 or 2400 Hz, or</li> <li>3600 Hz lowpass filter</li> </ul>								
<b>Data services</b>									
<b>Broadband data (MOD600)</b>									
Application	Transmission of high-speed / high-capacity data in bandwidth of 2 kHz, 4 kHz or higher								
Number of broadband modems	1								
Transmission bandwidth	2, 4, 6, 8, 12, 16, 20, 24, 28, 32 kHz								
Programmable data rates	9.6, 11*, 12, 14.4, 16, 19.2, 24, 28.8, 32, 36, 38.4, 40, 48, 56, 64, 72, 76.8, 80, 96, 112, 128, 144, 153.6, 160, 192, 224, 256, 288, 307.2, 320 kbps * available only for DPLC bandwidth 2 kHz								
Efficiency (data rate / bandwidth)	Typically 2 bps / Hz at 15 dB SNR to 10 bps / Hz at 45 dB SNR (for BER = 1E-06)								
Dynamic speed adaptation (DSA)	According to 5 user-selectable data-rates (fallback / fall-forward) Not available for DPLC bandwidth 2 kHz								
<b>Narrowband data (NSK600)</b>									
Application	Data transmission in bandwidth of less than 4 kHz, in point-to-point or point-to-multipoint applications (e.g polling SCADA)								
Number of narrowband modems	≤ 4 for data rates ≤ 4800 bps, or ≤ 3 for data rates ≤ 9600 bps								
<b>Programmable bandwidth and data rates:</b>									
	100 Bd	200 Bd narrow	200 Bd wide	600 Bd	1200 Bd V.23	1200 Bd narrow	2400 bps	4800 bps	9600 bps
Operational data rate [bps]	≤ 150	≤ 225	≤ 300	≤ 600	≤ 1200	≤ 1200	2400	4800	9600
Data format transparent	transparent	transparent	transparent	transparent	transparent	transparent	UART	UART	UART
Nominal bandwidth [Hz] (= channel spacing)	240	360	480	960	2400	1640	840	1680	3360
Center frequency steps [Hz]	60	60	60	60	n.a.	1660	60	60	n.a.
Equalizer	Static APLC channel equalizer						Static or <b>adaptive</b>		
Max. data rates above 2 kHz speech band	1 x 1200 Bd (asynchronous, transparent), or 2 x 2400 bps, or 1 x 4800 bps (asynchronous, UART)								
<b>Multiplexer (MUX600)</b>									
Application	Time-Division Multiplexing of a number of data channels into an aggregate data stream								
Number of channels	10 for data ports / 16 for compressed voice channels								
Multiplexing method	TDM, with data flow control and speed adaptation according to aggregate capacity								
<b>Data ports</b>									
<b>V.11 ports</b>									
Number of V.11/X.21/X.24 ports	1 or 2 (option), depending on configuration								
Data rates	See broadband data								
Clock direction	<ul style="list-style-type: none"> <li>From ETL600</li> <li>Codirectional</li> </ul>								
<b>V.24 ports</b>									
Number of V.24/RS-232 ports	2 or 4 (option), depending on configuration; with optional port sharing and jabber timeout for point-to-multipoint operation								
Data rates	With MOD600: 200, 300, 600, 1200, 2400, 4800, 9600 or 19200 bps With NSK600: according to selected NSK600 channel								
<b>V.24 port sharing device</b>									
Number of shared ports	Up to 4								
Jabber timeout	100 s; can be disabled								
Application	Sharing of one data channel by several RTUs (Remote Terminal Units)								
<b>LAN ports (option)</b>									
Number of LAN ports	3 electrical and 1 optical (with automatic laser shutdown ALS)								
Programmable data rates	See broadband data								
Connector	Electrical: 10/100 BaseT (shielded twisted pair, STP), connector type RJ45 Optical: 100 Mbps (SFP 850 nm MM or 1310 nm SM), connector type LC								
Physical layer	Auto or manual negotiation (full/half duplex and 10/100 Mbps)								
Link layer	Conforms to IEEE 802.3 / Ethernet II								
LAN600 services	4-port switch (layer 2) or IP router (layer 3), SNMP, HMI over LAN VLAN support according to IEEE 802.1q Link Fault Pass-Through (LFPT) Up to 16 static routes, 4 priority queues								
Data compression (configurable)	TCP/IP header compression according to RFC 1144 UDP/IP and RTP/UDP/IP header compression according to RFC 3095								
<b>Digital transit ports (option)</b>									
Number of digital transit ports	2 electrical, connector type RJ45, to daisy-chain up to 5 ETL600 terminals by means of 1:1 Ethernet cables								

<b>Teleprotection (NSD600)</b>	
Application	Transmission of protection commands for line and objects protection
Number of units	1 or 2 integrated NSD600, depending on configuration in AF channels (APLC) and/or broadband channel (DPLC)
Number of commands	4 simultaneous commands, simultaneously transmitted, individually configurable for blocking, permissive or direct tripping; Single purpose teleprotection NSD600 in the 2 kHz APLC channel: 3 independent commands (as above) and 1 prioritized command (for direct tripping)
Secure against	Noise (continuous or impulsive), speech and sweep tones, DTMF (CCITT 48430 or ITU-T Q.23) in-band signaling
Bandwidth requirement	Nil; command signal transmission in-band (alternate purpose, with signal boosting)
Guard signal	ETL-pilot signal, or own guard signal above speech band 2000, 2200, 2400 Hz
Processing of received signal	Adaptive (to prevailing channel condition, always ensuring shortest transmission times)
Number and type of inputs	4 optocoupler per teleprotection interface
Method of tripping	Contact and battery, or dry contact
Voltage ranges	24 to 250 VDC, selectable in 4 ranges
Number and type of outputs	4 solid state relays and 2 mechanical relay contacts per teleprotection interface
Tripping voltage	5 to 250 VDC nominal
Tripping current	≤ 1 A carry / 2 A peak solid state 5 A carry / 20 A peak mechanical relay
HMI configurable	Command and alarm assignments to I/O ports, Command pick-up times, hold times, duration monitoring, State of command outputs during link alarm, Alarm and unblocking level thresholds
Test facilities	Manual or periodic loop test every 1, 3, 6, 12, 24 hours
Event recording	2600 time-stamped command events, stored in non-volatile memory Clock synchronizing input for IIRIG-B available Counters for Tx/Rx commands, unblocking condition and start signal (max. count 1E+09)

<b>Teleprotection performance</b>										
Application		Blocking			Permissive tripping			Direct tripping		
APLC 4 = 4 kHz; APLC 2 = 2 kHz		APLC 4	DPLC	APLC 2	APLC 4	DPLC	APLC 2	APLC 4	DPLC	APLC 2
Nominal transmission time	T0 <sup>1)</sup>	≤ 10 ms	≤ 11 ms	≤ 11 ms	≤ 11 ms	≤ 12 ms	≤ 12 ms	≤ 12 ms	≤ 13 ms	≤ 14 ms
Security	Puc	< 1E-04	< 1E-03	< 1E-03	< 1E-06	< 1E-06	< 1E-06	< 1E-09	< 1E-09	< 1E-09
Dependability	Pmc	< 1E-03	< 1E-03	< 1E-03	< 1E-03	< 1E-03	< 1E-03	< 1E-04	< 1E-04	< 1E-04
(SNR = 6 dB)	Tac <sup>1)</sup>	14 ms	15 ms	17 ms	17 ms	17 ms	19 ms	22 ms	22 ms	30 ms

1) Valid for the solid state command outputs, add 4...8 ms for the relay contact command outputs

<b>User interface program (HMI600)</b>	
Hardware and OS requirements	PC with Windows Vista / 7 / 8 / 10
Port for connection of service PC	RS-232 / 9600, 19200, 57600 bps; USB with optional interface converter; Ethernet port as option

<b>Integrated testing aids</b>	
Channel equalization	Automatic, with graphical display of channel amplitude response
Spectrum analyzer	For graphical display of signal spectra in AF channels
Auxiliary signals generation	For tuning, testing and commissioning

<b>Element management</b>	
	Address range for 65000 terminals; Equipment settings, status monitoring and firmware download locally and remotely via Embedded Operational Channel (EOC) or via LAN600; Alarm polling facility for all terminals in the network, via EOC and all supported communication media (including dial-up telephone modem connection or Intranet/ Internet access using IP with optional direct LAN connection SNMP alarm messages can be collected by a network management system; Support of mixed ETL500 / ETL600 networks