



**"Results You Can Count On"**

## **Model 4902 Universal G.fast Noise Generator**



### **20 kHz to 120 MHz Noise Generator for Realistic G.fast Testing**

G.fast technology promises to bring a wealth of new opportunities to Service Providers as well as manufacturers of DPUs, CPE Modems and Chipsets. This exciting new technology allows for a more efficient use of existing copper infrastructure by utilizing the spectrum above 30 MHz and by cancelling the crosstalk between pairs within a cable. This increases data rates far beyond current levels, making bandwidth-intensive applications such as IPTV and Triple Play available in many areas where it was not possible before.

The Model 4902 Universal G.fast Noise Generator is available in two versions – portable and rack-mountable. The portable unit provides 2 to 16 independent Arbitrary Waveform Generator (AWG) outputs and includes a keyboard and built-in display. The higher-density version is rack-mountable and may be configured for 2 to 24 independent AWG outputs.

User-friendly configuration software allows the user to select and build impairment models common to DSL network implementations using ADSL2+, VDSL2, VDSL2 vectoring and G.fast. A generous assortment of custom crosstalk as well as impulse noises (e.g., REIN, SHINE and PEIN) can be created. It can also generate a wide variety of interferences above 30 MHz that may impact G.fast deployments. These include background Gaussian noise, high frequency impulse noise (PEIN, SHINE), FM radio, Broadcast TV, Spark Plug Ignition noise, PLC noise, Reverse Power Feed noise and more. In addition, user-defined files in several formats (such as MATLAB, CSV and Excel) may be imported. Optional noise modules automatically setup standards-based testing for TR-114, TR-105, TR-115, TR-100 and more.

The 4902 also works with an optional stand-alone noise injector, the Model 4902-D4-120 for injecting independent differential mode noise on 4 channels of the CO (or CPE) side of the loop or the VxT-N48 for injecting noises up to 30 MHz over 48 channels (independent or distributed).

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## Highlights

- Bandwidth 20 kHz to 120 MHz
- Suitable for wide range of applications including VDSL2 Vectoring and G.fast testing
- Output power -9.21 dBm
- Crest Factor greater than 5
- High degree of accuracy
- Noise Floor less than -153 dBm/Hz (as measured at the output of the noise injector)
- Expandable, modular design
  - High-density version holds up to 6 (2 or 4-port) AWG cards for a maximum of 24 AWG outputs
  - Portable version holds up to 4 (2 or 4-port) AWG cards for a maximum of 16 AWG outputs
- Inject crosstalk and impulse noise combined
- Independent control of each AWG output
- Select from common crosstalk types such as ADSL, VDSL2, and G.fast
- Impulse noises such as REIN, SHINE, PEIN, and Switching Power Supply noise
- Specify NEXT, FEXT and number of disturbers
- Add in RFI and AWGN (at variable levels)
- Specify impedance, sampling rate and DUT location
- Optional Noise Modules setup and run all tests in standard automatically
- Design custom loops with Loop Configuration Editor
- Save custom noise files or entire configurations to repeat tests with ease and accuracy
- Import MATLAB (.mat), CSV, or Excel (.xls) noise files
- Remote control via Ethernet
- Adjust Amplitude of Crosstalk and Impulse noise
- G.fast Specific Noise
  - Background Gaussian Noise (Piecewise Flat, Colored)
  - High Frequency Impulse Noise (PEIN, SHINE)
  - PLC Noise
  - RFI (FM, Broadcast TV)
  - Spark Plug Ignition Noise
  - Reverse Power Feed Noise

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## Ordering Information

Model Number	Description
<b>4902-Portable</b>	<ul style="list-style-type: none"> <li>• Telebyte Portable computer w/built-in display &amp; keyboard.</li> <li>• Includes Noise Generation Software.</li> <li>• Accepts 1-4, 4902-AWGx cards.</li> </ul>
<b>4902-HD</b>	<ul style="list-style-type: none"> <li>• Telebyte High-Density, rack-mountable computer.</li> <li>• Includes Noise Generation Software.</li> <li>• Accepts 1-6, 4902-AWGx cards.</li> </ul>
<b>4902-AWG2-300</b>	2-Port AWG Card - 600 MS/s, supports 1 kHz to 300MHZ
<b>4902-AWG4-300</b>	4-Port AWG Card - 600 MS/s, supports 1 kHz to 300MHZ
<b>4902-AWG2-30</b>	2-Port AWG Card – 60 MS/s, supports 1 kHz to 30 MHz
<b>4902-AWG4-30</b>	4-Port AWG Card – 60 MS/s, supports 1 kHz to 30 MHz
<b>4902-D4-120</b>	4-Channel Differential Mode Noise Injector (20 kHz to 120 MHz) Plus Micro Interrupts and Distributed Noise
<b>4902-PC-2-1-60</b>	2-1 Power Combiner (2 kHz to 60 MHz)
<b>4902-PC-2-1-400</b>	2-1 Power Combiner (100 kHz to 400 MHz)
<b>4901-D1-30</b>	1-Channel Differential Mode Noise Injector (1 kHz to 30 MHz) Plus Micro Interrupts
<b>VxT-N48*</b>	48-Channel AWGN Generator/Injector (20 kHz to 30 MHz)
<b>4902-N6</b>	Optional Noise Module for TR-067
<b>4902-N10</b>	Optional Noise Module for TR-100
<b>4902-N11</b>	Optional Noise Module for TR-114
<b>4902-N12</b>	Optional Japanese Noise Library – Including TCM-ISDN Noise Files, SHDSL NTT Noise Files; Half, Single & Double ADSL Disturbers NTT Noise Files; 3-Band, 4-Band & 6-Band VDSL NTT Noise Files
<b>4902-N16</b>	Optional Noise Module for TR-105
<b>4902-N17</b>	Optional Noise Module for TR-115
<b>4902-N18</b>	Optional Noise Module for G.shdsl
<b>4902-N20</b>	Optional Noise Module for VDSL2 vectoring
<b>4902-N21</b>	Optional Noise Module for G.fast ID-337

Impulse and crosstalk noises must be carried out on two different AWG cards. 4902-AWGx card types may be combined on one 4902 computer. Please consult a Telebyte sales representative for more information.

\*See separate Model VxT-N48 datasheet for more information.



The Model 4902-D4-120 provides four channels of independent differential mode noise injection.



## Model 4902 Universal G.fast Noise Generator (continued)

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### Specifications

4902-Portable Specifications	
Remote Commands	Telnet
Included Software	Telebyte Universal G.fast Noise Generator Software
Power supply	AC 90 V to 264 V, 47 to 63 Hz
Operating Temperature Range	0 to 50 ° C
Operating Relative Humidity	5% - 95% non-condensing
Mechanical Dimensions	DxWxH: 9.5" D x 13.5" W x 17.5" H
Weight	32 lbs
Connectors	10 USB 3.0 Ports, 4 USB 2.0 Ports (2 front), 2 RJ-45 Gigabit LAN
Display	Integrated 17.3-in WUXGA+ (1920 x 1080) display

4902-HD Specifications	
Remote Commands	Telnet
Included Software	Telebyte Universal G.fast Noise Generator Software
Power supply	AC 90 V to 264 V, 47 to 63 Hz
Operating Temperature Range	0 to 50 ° C
Operating Relative Humidity	5% - 95% non-condensing
Mechanical Dimensions	DxWxH: 19.5" D x 16.8" W x 7.0" H
Weight	32 lbs
Connectors	10 USB 3.0 Ports, 2 eSATA Ports, 2 RJ-45 Gigabit LAN

4902-AWGx-30 Specifications	
Bandwidth	1 kHz to 30 MHz
Noise Outputs	4902-AWG2-30: 2 4902-AWG4-30: 4
Interference Profile Accuracy	≤ 0.5 dB mean absolute error (MAE) for Crosstalk PSD
AWGN Crest Factor	> 5
AWGN Gap	< 10%
Output Impedance	50Ω unbalanced
SMB Connectors	4902-AWG2-30: 2 4902-AWG4-30: 4

4902-AWGx-300 Specifications	
Bandwidth	1 kHz to 300 MHz
Noise Outputs	4902-AWG2-300: 2 4902-AWG4-300: 4
Interference Profile Accuracy	≤ 0.5 dB mean absolute error (MAE) for Crosstalk PSD
AWGN Crest Factor	> 5
AWGN Gap	< 10%
Output Impedance	50Ω unbalanced
SMA Connectors	4902-AWG2-300: 2 4902-AWG4-300: 4



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(continued)**

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**Specifications (continued)**

<b>4902-D4-120 Noise Injector Specifications</b>	
<b>Bandwidth</b>	20 kHz to 120 MHz continuous frequency response of signal path
<b>Injection Type</b>	Differential Mode
<b>Output Impedance</b>	Differential Mode > 4 k Ω
<b>Insertion Loss of Noise Injection Path</b>	Differential Mode 0/20 dB ± 0.5dB
<b>Maximum RMS Output</b>	+5 dBm into 50 Ω
<b>Crest Factor</b>	Greater than 5
<b>Noise Floor</b>	Below -153 dBm/Hz as measured at the output of the noise injector
<b>Connectors</b>	<ul style="list-style-type: none"> <li>• SMA: (2) Female Connectors per channel for Independent Differential Mode noise from 4902-Portable or 4902-HD; (2) for distributed noise</li> <li>• 8 Cat6 RJ-45 Connectors on front (2 Input/Outputs for each channel)</li> </ul>
<b>Micro Interruptions</b>	<ul style="list-style-type: none"> <li>• Location: On any single channel</li> <li>• Method: Type-1, Type-2, or Type-3 as defined in TR-249 Issue 1</li> <li>• Interrupt Time: 5ms to 100ms in 1-ms increments</li> </ul>

<b>4901-D1-30 Specifications</b>	
<b>Bandwidth</b>	1 kHz to 30 MHz
<b>Output Impedance</b>	4kΩ Minimum (1 kHz to 30 MHz)
<b>Input Impedance</b>	50Ω unbalanced (100Ω unbalanced*)
<b>Output Mode</b>	Differential, balanced
<b>Noise Floor</b>	Below -145 dBm/Hz as measured at the output of the noise injector
<b>Insertion Loss</b>	13.0/35 dB ± 0.5 dB
<b>Connectors</b>	SMB Female Connector for 4902-Portable or 4902-HD, RJ45 (2) Female Connectors for Loop Simulator (external cable provided) and for the modem.
<b>Micro Interruptions</b>	<ul style="list-style-type: none"> <li>• Method: Type-1 as defined in TR-249 Issue 1</li> <li>• Interrupt Time: 1ms to 250ms in 1-ms increments</li> </ul>



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(continued)**

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**Specifications (continued)**

<b>Vxt-N48 AWGN 48-Channel Generator/Injector Specifications</b>	
<b>Built-In AWGN Generator Specifications</b>	
<b>Simulation</b>	<b>Additive White Gaussian Noise (AWGN)</b>
<b>Bandwidth</b>	<b>Flat Power Spectral Density (PSD) over bandwidths from 20 kHz to 30 MHz</b>
<b>AWGN Crest Factor</b>	<b>≥ 5</b>
<b>Output Impedance</b>	<b>4kΩ Minimum (20 kHz to 30 MHz)</b>
<b>White Noise (AWGN) Generator</b>	<b>-90 dBm/Hz to -143 dBm/Hz in 1 dBm increments</b>
<b>Maximum Voltage Tip-Ring</b>	<b>200 V</b>
<b>Output Mode</b>	<ul style="list-style-type: none"> <li>• <b>Differential, balanced</b></li> <li>• <b>48 individually controllable, uncorrelated outputs</b></li> </ul>
<b>Differential Mode Noise Injection Specifications</b>	
<b>Bandwidth</b>	20 kHz to 30 MHz
<b>Output Impedance</b>	4kΩ Minimum at point of injection (20 kHz to 30 MHz)
<b>Input Impedance</b>	50Ω unbalanced
<b>Output Mode</b>	Differential, balanced
<b>Noise Floor</b>	Below -143 dBm/Hz as measured at the output of the noise injector
<b>Insertion Loss</b>	13.0 dB
<b>System Specifications</b>	
<b>Remote Control</b>	Ethernet, RS-232 and GPIB
<b>Front Panel Control</b>	LCD Display and keypad for setting AWGN levels and the IEEE-488 address, RS-232 or Ethernet communication parameters
<b>Size</b>	[2U] 19 in W x 22 in D x 3.47 in H (482.6 mm W x 558.8 mm D x 88.1 mm H)
<b>Connectors</b>	<ul style="list-style-type: none"> <li>• Uncorrelated Noise: 96 SMBs (2 per channel)</li> <li>• Correlated Noise: 2 SMBs for all channels</li> <li>• Modem/Crosstalk Emulator: 24 quad-channel high-speed CAT7 TERA connectors</li> </ul>
<b>Power Supply</b>	AC 90 V to 264 V, 47 to 63 Hz, 100 W
<b>Environmental</b>	Operating: +32 F to +122 F (0 to +50 degrees C) Storage: 0 to 95% relative humidity (non-condensing)

Specifications are subject to change without notice. Made in USA.

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## Additional Features Included in Base System

### Crosstalk

Standard	Bandplans/Protocols
ADSL, ADSL2, ADSL2+	G.992.3 Annex A, B, I, J, L, M G.992.4 Annex A, I G.992.5 Annex A, B, I, J, M
VDSL2	G.993.2 Annex A (POTS) G.993.2 Annex A (ADL) G.993.2 Annex B7 (1-10), B8 (1-16)

### Alien Crosstalk

Reference	Test System	Models
ETSI TS 101 388 §5.3.4.1.1	EC ADSL (POTS)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.2	EC ADSL (ISDN)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.3	FDD ADSL (POTS)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.4	FDD ADSL (ISDN)	FA, FB, FC, FD
TR-100 Annex D.1	ADSL2 (TR-100 A.2)	FA, FB, FC, FD
TR-100 Annex D.1	ADSL2+ (TR-100 A.2)	FA, FB, FD, FD19
TR-100 Annex D.2	ADSL2+ (TR-100 A.3)	CAL=12, CAL=36, CAL=52
TR-100 Annex D.3	ADSL2+ (TR-100 B.3)	FA, FB, FD
TR-114 Appendix A	VDSL2	MD_EX, MD_CAB27, MD_CAB72

#### Other Crosstalk Features

- Fluctuating Crosstalk
- VDSL Power Back-Off
- Dynamic Noise Levels
- Variable AWGN
- RFI Tones
- Pre-Defined Spectra
  - ETSI A, ETSI B, EUROK
- Batch conversion of user-defined Crosstalk files for easy import

#### Impulse Noise

- High Frequency
- Low Frequency
- Single Shot
- Burst Pattern

#### Other

- Loop Editor
- Preconfigured Loops

#### G.fast Specific Noise

- Background Gaussian Noise (Piecewise Flat, Colored)
- High Frequency Impulse Noise (PEIN, SHINE)
- PLC Noise
- RFI (FM, Broadcast TV)
- Spark Plug Ignition Noise
- Reverse Power Feed Noise