TBVNA-6000

0.1 Hz – 6 GHz Vector Network Analyzer

Datasheet

Rev.1.1

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1 Features

The TBVNA-6000 two-port Vector Network Analyzer offers numerous features to allow a detailed analysis of RF devices and components. With a bandwidth ratio of 1 : 6000000000 the instrument covers measurement applications from audio to RF frequencies. Through its fully DC coupled active VSWR bridges, measurements down to 1Hz are possible without sacrificing accuracy. The instrument uses four independent measurement channels simultaneously for accurate and fast two port measurements.

A rich set of software utilities like spectrum analyzer or oscilloscope make this instrument a versatile helper in development or test applications.

- Vector Network Analyzer, 0.1 Hz - 6.0 GHz with 0.1 Hz resolution
- BODE Analyzer, 0.001 Hz – 500 MHz; requires BODE hardware option
- CW Signal generator 0.1 Hz - 6.0 GHz with 0.1 Hz resolution
- Four channel 60 MHz digital oscilloscope with 125 Ms/s and 14 bit resolution.
- 0.1 Hz - 6 GHz spectrum analyzer, with an unambiguous frequency range of DC - 60 MHz and an active sideband suppression for spurious-free signal measurements up to 6 GHz (under certain conditions). Dual channel spectrum analysis with cross correlation
- IQ streaming receiver with file or ethernet streaming capabilities. (GNU radio compatible)
- Power sweep measurements
- RF Wideband Power / Voltage measurements
- THD analyzer
- Phase noise analyzer
- Noise voltage spectral density measurement
- The BODE option adds two additional high impedance inputs with 1Mohm // 15 pF for gain /phase measurements and/or as vector voltmeter.
- The BODE option adds an additional signal output, 0.001 Hz – 500 MHz with an output power of up to + 24 dBm

2 Specifications

VNA specifications

Measured parameters	S_{11}, S_{12}, S_{21}, S_{22}
Measurement channels	Four parallel receiver chains
Data traces	Arbitrary number of traces and diagrams
Memory traces	Four full S-parameter memory slots
Data display formats	Rectangular, polar and smith diagram, over 50 trace functions, including time domain and group delay.
Sweep type	Linear and Logarithmic
Sweep trigger	Continuous, Single, Hold
Measured points per sweep	2 - 100000
Power settings	1 Hz – 500 MHz: -6 dBm to -50 dBm 500 MHz - 4 GHz: - 5 dBm to – 70 dBm 4 GHz – 6 GHz: - 10 dBm to – 70 dBm in 0.25 dB steps
Trace math	Normalization, Magnitude, Phase, Log, Real, Imag, Complex, Delay; Powerful equation editor for user defined measurements
De-embedding	Port Extension with loss, delay and Z_0 adjustment, full de-embedding.
Calibration	SOLT (short, open, load, through), normalization
Calibration types	Simple through, 1-port or full 2-port DC-offset calibration
Measurement bandwidth	0.01 Hz - 400 kHz adjustable
Frequency range	0.1 Hz - 6000 MHz
Frequency step resolution	0.001 Hz
Setups	Arbitrary number of user - defined setups
Output signal amplitude accuracy (typ.)	+/- 1 dB @ -10 dBm to -25 dBm +/- 2 dB @ -25 dBm to -40 dBm +/- 2 dB @ -40 dBm to -80 dBm
Measurement speed (typ.)	250us / frequency point @ 400 kHz RBW unidirectional measurement
Frequency accuracy	+/- 25 ppm
Port 1, Port 2 impedance	50 Ω DC-coupled
RF input return loss	Better -20 dB to 1.5 GHz, better -10 dB to 6 GHz
Port 1, Port 2 connectors	N-Female
Operating temperature	0°C - 40°C ambient
Operating humidity	0% to 80% rel. humidity
Operating voltage	100-120 VAC / 200 - 240 VAC, 50-60 Hz; internal linear power supply with mains voltage selection switch
Power consumption	30 Watt max.
Connection	USB 2.0, Full-Speed

Spectrum analyzer and Phase Noise analyzer utility

Frequency range	0.1 Hz - 6000 MHz
Unambiguous frequency range	0.1 Hz - 60 MHz
Parallel channels	2
Resolution bandwidth	0.1 Hz - 3 MHz
Frequency step resolution	0.1 Hz
Frequency accuracy	+/- 25 ppm
Amplitude accuracy	+/- 1.5 dB typ.
Low spurs technology (sideband suppression)	Multi frequency sampling
Frequency points	Arbitrary
Display functions	RMS, Minimum, Maximum and Average, Correlation
Maximum linear input power	20 dBm (attenuator “on”)
Phase noise (low noise mode) @ 300 MHz	< -90 dBc @ 100 Hz offset
	< -115 dBc @ 1kHz offset
	< -115 dBc @ 10kHz offset
	< -115 dBc @ 100kHz offset
	< -125 dBc @ 1MHz
Input noise voltage	< 30 nV/Sqrt(Hz) @ f > 10 kHz

CW Signal Generator utility

Frequency range	0.001 Hz - 6.0GHz
Frequency step resolution	0.001 Hz
Output power range	-6 dBm to -50 dBm (0.001 Hz to 500 MHz)
	-5 dBm to < -80 dBm (500 MHz to 6 GHz)
Output signal amplitude accuracy (typ.)	+/- 2 dB @ -5 dBm to -25 dBm
	+/-2.5 dB @ -25 dBm to -40 dBm
	+/-3 dB @ -40 dBm to -80 dBm
Phase noise (low noise mode) @ 300 MHz	<-90 dBc @ 100 Hz offset
	< -115 dBc @ 1kHz offset
	< -115 dBc @ 10kHz offset
	< -115 dBc @ 100kHz offset
	< -125 dBc @ 1MHz

Oscilloscope, Voltmeter

Resolution	14 Bit (up to 16Bits with CIC Filter)
Channels	4
Input range	Max. +/- 3V, +/-20V with BODE
Memory	Max. 8192 points
Lowpass Filter	CIC type, adjustable
Sampling range (real)	15 S/s - 125 MS/s
Sampling range (Sin(x)/x)	250 MS/s - 4 GS/s
Bandwidth	60 MHz (Nyquist), 500 MHz (real)
Protocol analyzer	SPI, I2C, RS232
Measurement functions	24 measurement functions like RMS, period..
Trigger Modes	Edge Trigger, Pulse Trigger, Manual, Auto, A->B
Trigger Delay	0 - 1020 samples
Input	50 Ohms single ended , 1 MOhm // 15 pF with Option BODE
Special	Trigger aperture and HF Suppression filters

High impedance inputs

Input Impedance	1 MΩ // 15 pF
Frequency Range	0 - 500 MHz +/- 20V and +/- 5V range, 250 MHz +/- 0.5 V range
Offset	< 1 mV
Voltage ranges	3, +/- 20V, +/- 5V, +/- 0.5 V

Bode Analyzer (requires Bode option)

Measured parameters	Absolute level P_1, P_2, P_A, P_B and all ratios like P_B/P_A, P_2/P_1 etc.
Measurement channels	4 channels P_1, P_2 with 50 Ohms and P_A, P_B with 1 MΩ // 15 pF
Data display formats	Rectangular and polar diagram, over 10 trace functions, including time group delay.
Sweep type	Linear and Logarithmic
Sweep trigger	Continuous, Single, Hold
Measured points per sweep	2 - 100000
Power settings	0.001 Hz – 200 MHz: + 24 dBm to – 17 dBm in 0.1 dB steps 200 MHz – 500 MHz: +10 dBm to – 17 dBm in 0.1 dB steps
Trace math	Normalization, Magnitude, Phase, Log, Real, Imag, Complex, Delay; Powerful equation editor for user defined measurements
Measurement bandwidth	0.001 Hz - 400 kHz adjustable
Frequency range	0.001 Hz - 500 MHz
Frequency step resolution	0.001 Hz
Setups	Arbitrary number of user - defined setups

Measurement speed (max.)	250us / frequency point @ 400 kHz RBW
Frequency accuracy	+/- 25 ppm
Port 1, Port 2 impedance	50 Ω DC-coupled
RF input return loss	< 1 : 1.15 @ 10 … 30dB attenuation < 1 : 1.5@ 0 … 30dB gain
Port 1, Port 2 range	0 dBm max.
Port 1, Port 2 connectors	N-Female
Port A, Port B impedance	1 MΩ // 15 pF , DC-coupled
Port A, Port B voltage range	+/-20V, +/-5V and +/- 0.5V
Port A, Port B connectors	BNC

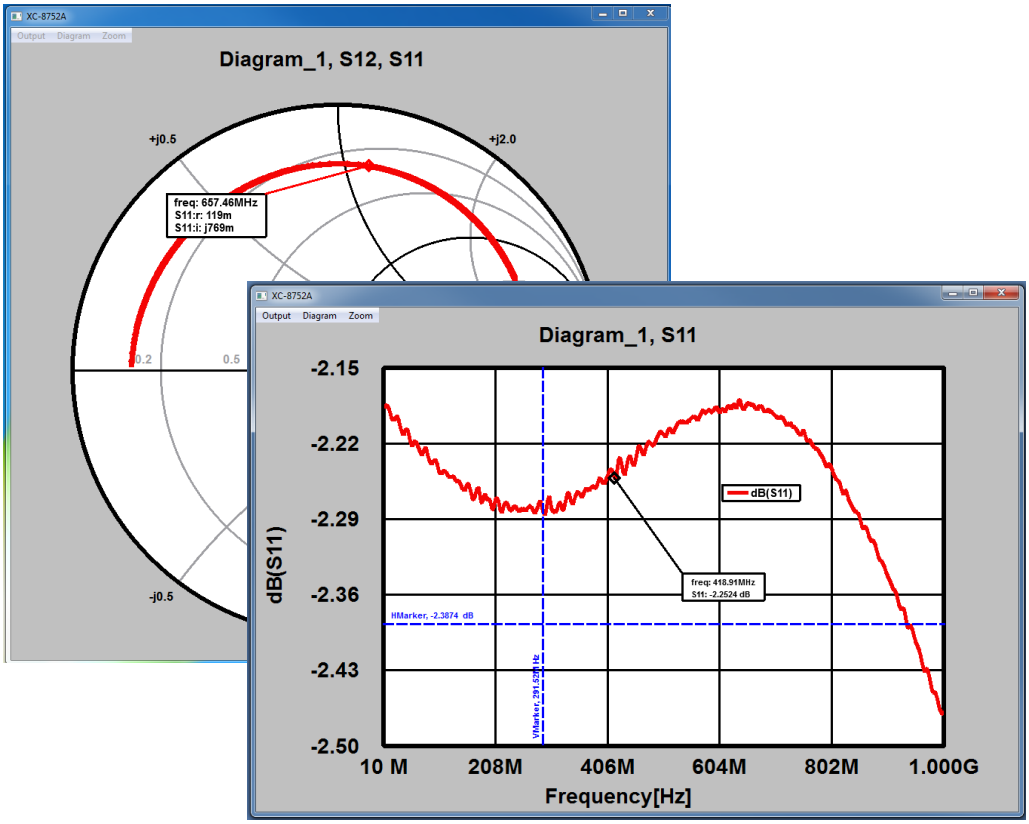
Port 1 & 2 Maximum Input Power Levels

Attenuation [dB]	Absolute Max. Input Level [dBm, dBµV, V]
0	**+5 dBm, 112 dBuV, 0.57V**
20	**+20 dBm, 127 dBuV, 3 V**

Port A & B Maximum Input Voltage Levels

Attenuation [dB]	Absolute Max. Input Level [V]
+/- 20V range	**+/- 25 V**
+/- 5V range	**+/- 7 V**
+/- 0.5V	**+/- 1 V**

3 Software Overview



- Unlimited number of diagrams.
- Over 50 different measurement functions.
- Symbolic equations as trace function.
- Unlimited number of traces per diagram.
- Linear and logarithmic view in horizontal or vertical direction.
- Smith diagram
- Unlimited number of markers
- Delta Markers
- Horizontal line or vertical line marker.
- Many marker functions.
- Single and dual port operation and calibration.
- Printing and Clipboard support.
- Unlimited number of measurement setups.
- Easy loading of setups via direct access.
- Single and continuous measurement.
- Port Extension and full de-embedding.
- Time domain lowpass and bandpass support.
- Selectable measurement bandwidth.
- and much more.

Attenuation [dB]	Absolute Max. Input Level [dBm, dBµV, V]
30	**30 dBm, 137 dBuV, 7 V**
20	**30 dBm, 137 dBuV, 7 V**
10	**25 dBm, 132 dBuV, 4 V**
0	**15 dBm, 122 dBuV, 1.25 V**
-10 (equivalent 10dB gain)	**15 dBm, 122 dBuV, 1.25 V**
-20 (equivalent 20dB gain)	**15 dBm, 122 dBuV, 1.25 V**
-30 (equivalent 30dB gain)	**15 dBm, 122 dBuV, 1.25 V**

4 History

Version	Date	Application software version	Changes
V1.0	31.1.2025	V1.0	Initial document
V1.1	12.4.2025	V1.1.2	Frequency range extended down to 0.1 Hz

The application software version refers to the most recent version available at the time of writing the datasheet.