MICROWAVE VECTOR NETWORK ANALYZERS
37000D Series
40 MHz to 65 GHz

Ethernet C€ **GPIB**

For Fast and Accurate S-Parameter Measurements

NEW

The Lightning D-Series Vector Network Analyzer (VNAs) are high performance test tools designed to satisfy the growing needs of defense, satellite, radar, broadband communication, and high speed component markets. The new 37000D VNAs improve upon performance while providing a wider set of standard application features to better suit the needs of R&D engineers working on next generation designs. These new features, when combined with the ease of programming through helpful software utilities and faster data transfer over Ethernet, make it an equally valuable tool for manufacturing as well.

The Lightning D-Series consists of two primary configurations built for R&D and Production applications:

Premium Models (37300D)
The Premium series are designed for active and passive device applications, where versatility is the main priority. These are high performance two-port VNAs that include step attenuators, internal bias tees, a gain compression application and wider power range as standard features. They are available in four different frequency ranges; 20 (37347D), 40 (37369D), 50 (37377D) and 65 (37397D) GHz. Each one of them can be configured as an ME7808B millimeter wave VNA by simply adding a broadband test set, two synthesizers and the desired millimeter wave modules. The 37397D is also directly upgradeable to an ME7808B Broadband VNA with single sweep coverage from 40 MHz to 110 GHz.

Economy Models (37200D)
The Economy series are basic two-port VNAs designed for passive applications. They are available in four different frequency ranges; 20 (37247D), 40 (37269D), 50 (37277D) and 65 (37297D) GHz. Each one of them can be configured as an Economy millimeter wave VNA by simply adding a broadband test set, two synthesizers and the desired mmW modules.

The 37300D Premium models include:
● Multiple Source Control and Frequency Offset
● E/O and O/E Application
● Gain Compression Application
● Internal Bias Tees
● Extended Power Range (Source Step Attenuator and Receiver Step Attenuator)
● Rear Panel IF Inputs (for upgrade to Millimeter Wave)
● NxN calibration Utility for Mixer Measurements
● Embed/De-Embed application
● High Stability Frequency Reference
● 1 Hz Frequency Resolution

The 37200D Economy models include:
● Multiple Source Control and Frequency Offset
● E/O and O/E Application
● Rear Panel IF Inputs (for upgrade to Millimeter Wave)
● NxN calibration Utility for Mixer Measurements
● Embed/De-Embed application
● High Stability Frequency Reference
● 1 Hz Frequency Resolution

Features

● **High speed data transfer and control**
For maximum efficiency, an Ethernet connection and dual GPIB ports are standard on every 37000D VNA. Ethernet connection provides high speed data transfers and remote data extraction from the VNA. The same can also be achieved via the standard GPIB interface. The second GPIB port is dedicated to control of peripheral devices such as plotters, power meters, and frequency synthesizers. The 37000D series maximize throughput by combining fast, error-corrected sweeps with high-speed data transfers.

● **Time domain analysis (Option 2A)**
Analyze impedance discontinuities as a function of time or distance with the 37000D's high-speed time domain. Isolate individual reflections in time and evaluate their effects in the frequency domain. Remove the effects of device packages and fixturing with time domain gating to see the actual performance of your designs. Use the independent display channels to view the response of your designs before, during, and after time domain processing.

The software provides four different windowing functions to optimize dynamic range and resolution. The exclusive phasor impulse mode will show you the true impedance characteristics of mismatches in waveguide, microstrip, and other band-limited media.

● **Multiple source control and set-on receiver mode**
The frequency of two sources and a receiver can be controlled without the need for an external controller using this function. Independently specify the sweep ranges and output powers of the sources and the sweep range of the receiver to accommodate mixer, swept IMD, TOI, and harmonic measurements. The 37000D's set-on receiver mode allows it to operate as a tuned receiver by phase locking all of its local oscillators to its internal crystal reference oscillator.

- **Software tools and compatibility**

VNA Utilities, provided with every 37000D, is the ultimate solution for automated test software development. It includes fully functional application programs, re-usable calibration, set-up and data manipulation samples, and software development tools for creating custom applications. VNA Utilities includes applications such as the Capture Utility, which allows the user to extract data from the VNA in any of the supported formats (bitmap, S2P, plotter graphics, etc.).

The Calkit File Maker helps create a custom calibration kit disk from the coefficients entered by the user. And the VNA File Utility manages system software downloads and data file uploads to/from the VNA's hard disk via a PC. VNA Utilities also includes drivers and help tools for various software environments such as Visual Basic®, Labview and others.

- **NxN calibration utility**

This application is used for making error-corrected measurements of frequency translating devices such as mixers. The calibration performed requires a three mixer combination to correct for the components in the measurement path. Any one of the mixers characterized can then be used for the measurement of the DUT mixer. The standard built-in application guides the user through the set up and the calibration.

- **Embedding/De-embedding**

The de-embedding function is used for removal of test fixture contributions and other networks from measurements. The embedding function can be used to simulate matching circuits for optimizing amplifier and other designs.

- **Internally controlled AutoCal®**

One source of potential errors and inaccuracies in any network analyzer system is the calibration of that system. The Anritsu AutoCal automatic calibrator is designed to speed and simplify the calibration of your 37000D VNA. Using the built-in software support and an AutoCal module connected to the serial port on the rear panel of the instrument, you are ready to make fast, accurate, and repeatable calibrations.

- **Built-in mass storage**

Testing devices with multiple setups is now easier. A built-in hard disk drive rapidly stores and recalls frequently used front panel setups and calibrations. Store your complete test setup including limit lines and frequency markers. Create descriptive file names to assist multiple users or device types. The high storage capability of the internal hard disk means there is space for literally hundreds of calibrations, front panel setups, and data traces. In secure environments, the internal hard disk can be removed (Option 4A) and either an external drive on the SCSI port or the internal 1.44 MB floppy drive can be used for uploading proprietary setups.

- **Flexible test set (Option 15)**

All 37000D VNAs can be configured with six front panel loops: four direct receiver access loops and two auxiliary source loops (one for each port). These are useful for measurements of mixers, antennas, as well as integration with external test sets (for example, multiport).

- **Upgradeability**

The 37000D series analyzers are designed to accommodate higher frequency ranges and more powerful features as your requirements grow. Any 37000D series VNA can be upgraded to any other model in the instrument family to fit your changing requirements. In addition, any VNA can also be upgraded to the ME7808B Broadband and Millimeter Wave VNA. This provides a cost-effective approach to satisfying today's needs while providing the flexibility to meet tomorrow's demands. System software upgrades are easily performed by loading software through the floppy drive or GPIB.

- **Three-year factory warranty**

All 37000D series VNAs are backed with a no-questions-asked three-year warranty.

Applications

- **Filters**

The 37000D VNAs have built-in functions that automatically locate filter center frequency, 3 dB bandwidth, max/min insertion loss, Q, and shape factor. The analyzer's improved dynamic range can be used to measure filter rejection and input match on the same display. Sweep speed can be enhanced for tuning filters by using the instrument's tune mode. This unique feature allows users optimize sweep times in one direction for better hand-to-eye tuning while maintaining a 12-term corrected S-parameter display. The analyzer's tune mode maximizes sweep speed and accuracy, simultaneously, by allowing the user to choose when reverse parameters are updated.

Also, passband phase distortions can be measured with the automatic reference plane extension capability. A single key press can help quickly identify filter non-linear phase responses.

- **Swept Power Gain Compression - Amplifiers (37300D models only)**

The Swept Power Gain Compression application (standard on 37300D models) allows the user to easily measure amplifier gain compression vs. input power or frequency. Power meter assisted linearity and flat output power calibration, combined with a receiver port calibration, provides capability to measure output power in dBm. A 1 watt, 70 dB (60 dB on >40 GHz models) step attenuator in the port 1 path, and a 40 dB step attenuator in the port 2 path, coupled with 20 dB ALC range, give complete control to characterize virtually any amplifier. This range is reduced to 12 dB at frequencies >50 GHz. Internal bias tees simplify DC biasing of your active designs.

In addition, a front panel source loop on each port (option 15) allows external amplifier insertion, increasing port power up to 1 Watt maximum for high input power amplifiers.

- **Mixers**

Complex frequency translated device measurements such as error corrected conversion loss, group delay, and port match measurements of mixers and up/downconverters are simplified with the NxN mixer measurement application. The NxN application adjusts the VNA's 12-term calibration for the reference mixer, a Band Pass Filter, and attenuators used in the measurement setup, yielding accurate measurements of the frequency translated DUT.

- **Multiport and Balanced/Differential**

Single-ended and mixed-mode S-parameter measurements with the 37000D series VNA are accomplished using a multiport test set and an external PC running the Navigator™ Multiport software. Multiport components (diplexers, couplers, power dividers, etc.) or balanced/differential components can be easily characterized to frequencies as high as 65 GHz.

- **Microstrip devices**

The 37000D series offers complete substrate measurement solutions for both microstrip and coplanar waveguide (CPW) designs. The 37000D series analyzers accommodate the model 3680 series Universal Test Fixtures (UTF), calibration kits, and verification kits. Guaranteed system specifications provide assurance that your test results are accurate and verifiable. Internal calibration routines such as the Line-Reflect-Line (LRL) and Line-Reflect-Match (LRM) calibration capability help completely characterize connectorless devices with the Lightning VNAs. The four channel design provides true LRL/LRM error-correction yielding the highest performance available for in-fixture measurements. Highly reflective devices, along with well matched ones can also be measured with the same degree of ease. Automatic dispersion compensation improves measurement accuracy to help determine phase distortions for all microstrip designs.

- **E/O and O/E devices**

The 37000D series incorporates an E/O and O/E measurement application that simplifies VNA calibration when measuring E/O and O/E devices. The transfer function, group delay, and return loss of optical modulators (E/O) and photoreceivers (O/E) can be easily characterized using this application. An O/E calibration module (MN4765A) and a laser source are required to complete the test setup. The internal VNA application de-embeds the response of the O/E calibration module to allow direct measurement of the modulator. For O/E measurements, the O/E calibration module is used to characterize a modulator first, which is then used as the characterized reference to measure another photoreceiver.

- **Antennas**

All 37000D VNAs include rear panel IF inputs (<270 MHz) that can be used in remote mixing applications to make antenna measurements. For near field and far field measurements that require direct access to the VNA test and reference channels, Option 15 can be included on any 37000D VNA which adds the four test and reference loops on the front panel to simplify measurements.

In addition the VNAs Fast CW mode enhances data extraction over GPIB to rates of 0.8 ms/point using internal triggering, and 1.2 ms/point with external triggering or 1.5 ms/point with GPIB triggering, allowing for fast data extraction for accurate plotting of near and far field effects.

Specifications

Measurement capabilities	Number of channels	Four measurement channels
	Parameters	S11, S21, S12, S22, or user defined; analog voltage input; complex input and output impedance; complex input and output admittance; complex forward and reverse transmission
	Domains	Frequency domain, CW draw, and optional high speed time domain (Option 2A)
	Formats	Log magnitude, phase, log magnitude and phase, Smith chart (impedance), Smith chart (admittance), linear polar, log polar, group delay, linear magnitude, linear magnitude and phase, real, imaginary, real and imaginary, and SWR
	Data points	1601 maximum. System also accepts an arbitrary set of N discrete data points where 2≤N≤1601. CW mode permits selection of a single point.
	Reference delay	Can be entered in time or in distance. Automatic reference delay adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between the reference and test is accurate and stable since measurement frequencies are always synthesized.
	Reference offset	Magnitude and phase
	Markers	Six independent markers can be used to read out measurement data. In delta-reference mode, any one marker can be selected as the reference for the other five. Markers can automatically find critical filter parameters i.e. 3 dB bandwidth, loss, center frequency, shape factor and Q.
	Marker sweep	Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.
	Limits	Two limit lines per data trace to indicate test limits. Limits can be either single or segmented limits for testing devices pass-fail.
	Measurement dynamic range	Table 1 gives receiver dynamic range as the ratio of typical power at Port 1 and the noise floor.
	Data averaging	Averaging of 1 to 4096 averages per data point can be selected.
	IF bandwidth	Front panel switch selects four levels of IF bandwidth: 10 kHz, 1 kHz, 100 Hz and 10 Hz
Display capabilities	Display channels	1, 2, 3 or 4 channels can be displayed. Each channel can display any S-parameter or user defined parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously.
	Display type	Color LCD, 8.5" diagonally, VGA display. Color of graticule, trace data and text are user definable.
	Trace overlay	Overlays two traces with the same graticule type on the same display
	Trace memory	A separate memory for each channel can be used to store measurement data for later display or subtraction, addition, multiplication or division.
	Scale resolution	Log mag: 0.001 dB, linear mag: 1 pU Phase: 0.01°, group delay: 0.001 ps Time: 0.001 ms, distance: 0.1 mm SWR: 1 pU Power: 0.05 dB
	Autoscale	Automatically sets resolution and offset to display measurement data on the full display
	Reference position	Settable to any graticule line
	Annotation	Type of measurement, vertical and horizontal scale resolution, start and stop frequencies and reference position
Vector error correction	Error correction models	Full 12-term, one-path two-port, reflection only, transmission response
	LRL/LRM	Line-Reflect-Line and Line-Reflect-Match calibration models are available for coaxial, microstrip and waveguide transmission lines.
Signal source capabilities	Source power level	Source power may be set from the 37000D front panel menu.
	Flat power correction	The 37000D corrects for test port power variations using an external power meter. Once the port power has been flattened, the power meter is removed and the signal source power level may be changed within the remaining power adjustment range.

	Multiple source control	Allows a user to separately control the frequency of two sources and receiver without need for an external controller.
		    Source #1: 37000D internal source, or any 68000C, 69000B, or MG3690A synthesizer
		    Source #2: Any 68000C, 69000B, or MG3690A synthesizer
		    Receiver: 37000D internal receiver

	Internal 10 MHz time base stability	Standard (1 Hz resolution)
		    With aging: $<1 \times 10^{-9}$/day
		    With temperature: $<5 \times 10^{-9}$ over 0˚ to 55˚C

Hard copy	Printers	Select full screen, graphical, tabular data, and printer type. Compatible with most HP and Epson printers with a parallel port interface
	GPIB plotters	Compatible with most HP and Tektronix plotters
	Disk file	Bitmap, S2P, text, tabular data, and HPGL
Storage	Internal memory	Ten front panel states (setup) can be stored and recalled from non-volatile memory locations.
	Internal hard disk drive	Store and recall instrument setups, calibration files and trace data files. All files are MS-DOS compatible.
	Internal floppy disk drive	Store and recall instrument setups, calibration files and trace data files from 3.5 inch 1.44 MB floppy disks. All files are MS-DOS compatible.
Remote programming	Interface	GPIB (IEEE 488.2), Ethernet
	Addressing	GPIB address can be set from the front panel and can range from 1 to 30. Static IP address for Ethernet.
	Transfer formats	ASCII, 32-bit floating point and 64-bit floating point
	Speed	150 kB/sec over GPIB, up to 850 kB/sec over Ethernet
	Interface function codes	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DT1, DC0, C0
General	Test ports	GPC-7, 3.5 mm, N-type, K, and V connectors supported
	Power requirements	85 to 240 V, 48 to 63 Hz, 540 VA maximum
	Dimensions	432 (W) x 267 (H) x 585 (D) mm (10.5 x 17 x 23 in)
	Weight	27 kg (60 lbs)
	Temperature	0˚ to 50˚C (operate), −40˚ to 75˚C (storage)

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Table 1. Dynamic Range

Model	Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
37347D	0.04 2 20	10 11 8	−82 −104 −100	92 115 108
37369D	0.04 2 20 40	10 8 3 2	−85 −107 −103 −95	95 115 106 97
37377D	0.04 2 20 40 50	10 5 2 1 −1	−88 −110 −106 −98 −94	98 115 108 99 93
37397D	0.04 2 20 40 50 65	10 5 2 1 −1 −2	−88 −110 −106 −98 −94 −82	98 115 108 99 93 80
37247D	0.04 2 20	10 11 7	−82 −104 −101	92 115 108
37269D	0.04 2 20 40	10 8 2 2	−85 −107 −104 −97	95 115 106 99
37277D	0.04 2 20 40 50	10 5 1 1 −1	−88 −110 −107 −100 −96	98 115 108 101 95
37297D	0.04 2 20 40 50 65	10 5 1 1 −1 −1	−88 −110 −107 −100 −96 −84	98 115 108 101 95 83

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
37247D	Vector Network Analyzer (40 MHz to 20 GHz)
37269D	Vector Network Analyzer (40 MHz to 40 GHz)
37277D	Vector Network Analyzer (40 MHz to 50 GHz)
37297D	Vector Network Analyzer (40 MHz to 65 GHz)
37347D	Vector Network Analyzer (40 MHz to 20 GHz)
37369D	Vector Network Analyzer (40 MHz to 40 GHz)
37377D	Vector Network Analyzer (40 MHz to 50 GHz)
37397D	Vector Network Analyzer (40 MHz to 65 GHz)
	Options
Option 1	Rack mount kit with slides
Option 1A	Rack mount kit with handles
Option 2A	High-speed time (distance) domain capability
Option 4A	External SCSI-2 hard disk drive compatibility (internal HDD removed)
Option 7A	Replaces universal K connector (standard) with universal GPC-7 (37200C/37300C only)
Option 7N	Replaces universal K connector (standard) with universal N-male (37200C/37300C only)
Option 7NF	Replaces universal K connector (standard) with universal N-female (37200C/37300C only)
Option 7S	Replaces universal K connector (standard) with universal 3.5 mm-male (37200C/37300C only)
Option 7K	Replaces universal V connector (standard) with universal K (m) (37277C/37297C/37377C/37397C models only)
Option 15	Flexible Test Set
	Calibration kits
3650	SMA/3.5 mm Calibration Kit
Option 1	Adds sliding terminations
3651	GPC-7 Calibration Kit

Model/Order No.	Name
Option 1	Adds sliding terminations
3652	K Connector Calibration Kit
Option 1	Adds sliding terminations
3653	Type N Calibration Kit
3654B	V Connector Calibration Kit with sliding terminations
36581NNF	AutoCal, N (m) to N (f), 40 MHz to 18 GHz
36581KKF	AutoCal, K (m) to K (f), 40 MHz to 20 GHz
36582KKF	AutoCal, K (m) to K (f), 40 MHz to 40 GHz
	Verification kits
3663	Type N Verification Kit
3666	SMA/3.5 mm Verification Kit
3667	GPC-7 Verification Kit
3668	K Connector Verification Kit
3669B	V Connector Verification Kit
3656	W1 Connector Calibration/Verification Kit
	Test port cables
3670A50-1	GPC-7 semi-rigid cable, 1 foot
3670A50-2	GPC-7 semi-rigid cable, 2 foot
3670K50-1	K connector semi-rigid cable, 1 foot
3670K50-2	K connector semi-rigid cable, 2 foot
3670V50-1	V connector semi-rigid cable, 1 foot
3670V50-2	V connector semi-rigid cable, 2 foot
3671A50-1	GPC-7 flexible cables, 25 in. (1 pair)
3671A50-2	GPC-7 flexible cables, 38 in.
3671S50-1	3.5 mm flexible cables, 25 in. (1 pair)
3671S50-2	3.5 mm flexible cables, 38 in.
3671K50-1	K connector flexible cables, 25 in. (1 pair)
3671K50-2	K connector flexible cables, 38 in.
3671V50-3	V connector flexible cable, 25 in. (1 pair)
3671V50-4	V connector flexible cable, 38 in.