The **RF** Experts

VECTOR NETWORK ANALYZER
Compact USB 2-Port

BNA100 SERIES

Where Precision
Meets Affordability

The BN100 Series Vector Network Analyzer offers exceptional performance in a compact package, balancing the demands of productivity, budget, and space. Merging affordability with high-end VNA functionalities, the BN100 Series is the perfect tool for those seeking cost-effective solutions without compromising on performance and accuracy.

The series is characterized by its ease of use, making it suitable for educational environments where hands-on RF technology training is crucial. For small businesses and budget-conscious engineers, the BN100 Series offers reliable performance necessary for accurate RF analysis tasks. This series exemplifies Bird's commitment to delivering professional-grade RF technology in a user-friendly and economical package.

Harnessing Bird's 80+ Years of RF Expertise for the Compact USB BN100 Series.

KEY PERFORMANCE SPECIFICATIONS

- 300 kHz to 6.5 GHz or 8.5 GHz frequency range
- Up to 120 dB dynamic range
- Up to +10 dBm output power
- 2 ports
- 0.005dB rms (IFBW = 3 kHz) trace noise
- 68us/point (IFBW = 100 kHz) measurement speed
- User interface software included

APPLICATIONS

- Educational Labs
- Manufacturing Test
- Passive/Active Component Evaluation
- RF & Microwave Product Design
- Filter Design and Testing
- Fault Location
- Antenna Tuning
- Quality Control and Incoming Inspection

Bird®

COMPACT USB VECTOR NETWORK ANALYZER

BNA100 SERIES

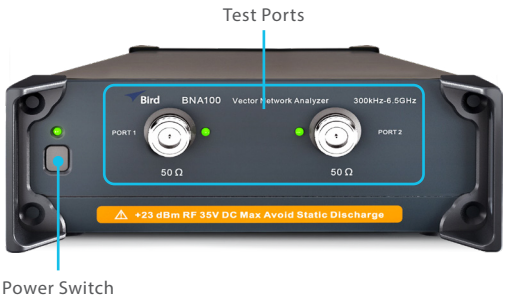
Product Overview

Accurate Measurements Delivered Fast

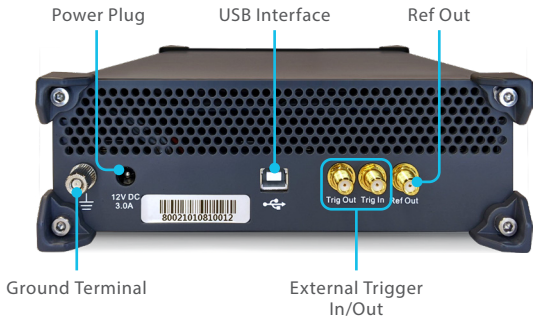
Wide frequency range, high dynamic range and easy-to-use interface.

Bird's BNA100 Series represents a new era in vector network analyzers, offering high performance through an innovative, PC-controlled design. By transferring the complex data processing demands typically found within the instrument to a sophisticated software platform, Bird offers a cost-effective and feature-rich VNA solution suitable for every testing environment. The BNA100 excels in scenarios where high throughput is crucial, seamlessly replacing costly and bulky production test systems while saving space and reducing the total cost of ownership.

FRONT PANEL



BACK PANEL



This product line is accompanied by Bird's intuitive User Interface (UI) software, designed to provide a familiar yet powerful control application for any engineer experienced with contemporary VNA tools. The package also includes an Application Programming Interface (API) and supports a standardized SCPI command-set, facilitating the easy automation of VNA calibrations, measurements, trace displays, and data exports across various programming environments.

To discover the extensive measurement capabilities of the BNA100 series, download the BNA100 software from BirdRF.com and explore its full potential.

WHY CHOOSE BIRD'S COMPACT USB VNA?

- **Enhanced Flexibility -** The compact design and PC-based processing allow for easy customization and future upgrades. Tailor your VNA to meet your specific needs, whether for simple single-port measurements or complex dual-port analyses.
- **Compact and Portable -** The sleek and compact design is ideal for manufacturing facilities, educational labs, space-constrained environments and sharing between locations.
- **Cost-Effective Solution -** Get professional-grade performance at a fraction of the cost. Our PC-controlled BNA100 Series delivers high-quality measurements without a high price tag.
- **Powerful Data Processing -** Offload data processing and calculations to your PC, enabling faster measurement speeds and more complex analyses. Harness the full power of your computer for enhanced performance.

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COMPACT USB VECTOR NETWORK ANALYZER

BNA100 SERIES

Product Overview

When evaluating small form factor vector network analyzers from various vendors, discerning differences can be challenging, especially when their specifications appear similar on paper. Merely presenting figures can be simplistic; therefore, let's dive into some of the critical specifications and why they are important.

Dynamic range, power range, and Intermediate Frequency (IF) bandwidth form a critical trio in the context of noise reduction. The ability to effectively manage these specifications provides a significant advantage in distinguishing your signal from surrounding noise.

HIGH DYNAMIC RANGE

Enables VNAs to accurately measure very weak signals, ensuring that even the smallest signals are accurately captured and analyzed. This aspect is particularly vital in tasks such as filter characterization, where there is a substantial variation between stopband and passband power levels. A broader dynamic range allows for the setting of a wider IF bandwidth, thereby enhancing the efficiency of measurements.

Bird's BNA100 Series has a 120 dB dynamic range across its frequency range (IFBW = 10Hz and no averaging applied).

MEASUREMENT BANDWIDTH

The measurement bandwidth stands as one of the most pivotal parameters in a network analyzer. It enables the balancing act between noise reduction and measurement speed. Depending on the nature of the device under test and the testing environment, the optimal setting can vary significantly. For instance, in a laboratory setting where precision is paramount, a narrower bandwidth might be chosen, while in a production line, speed might take precedence, necessitating a wider bandwidth.

The BNA100 family has measurement bandwidths between 1 Hz to 100 kHz, providing flexibility for laboratory and manufacturing applications.

POWER RANGE

The importance of power range in RF test equipment lies in its ability to provide comprehensive testing capabilities, versatility, and efficiency. An optimal power range is crucial for the characterization of nonlinear devices through power sweeps. It also facilitates testing without the need for an external power amplifier, thereby conserving bench space and reducing the overall cost of testing.

LOW TRACE NOISE

At 0.005 dB rms at IFBW=3 kHz, the BNA100 Series ensures cleaner and more precise signal measurements. Lower trace noise reduces the likelihood of measurement anomalies or inaccuracies, thus enhancing overall precision.

MEASUREMENT SPEED

The 68 µs/point measurement speed at an IFBW of 100 kHz means faster data acquisition with less time for environmental or situational variables to affect the measurement. This speed contributes to consistent and repeatable results.

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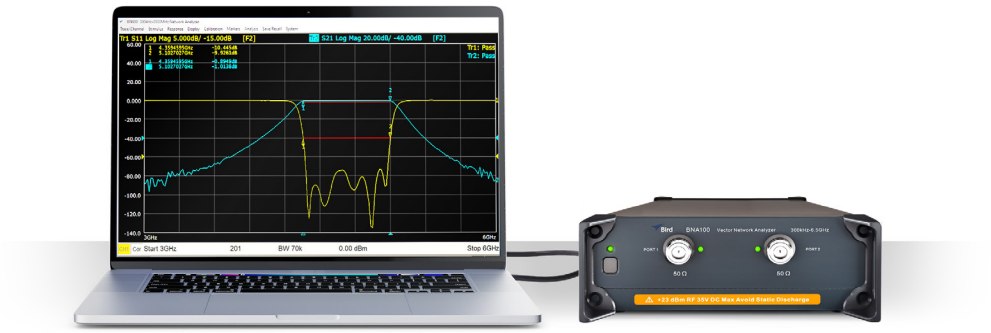
Software



Included with the BNA100 is the user-friendly graphical interface VNA measurement and calibration software. With the BNA100 controlled via USB from an external PC, the software simplifies the testing process with easy navigation and effective data analysis tools, enhancing your workflow efficiency. A comprehensive range of measurements and plot formats can be visualized, supporting various RF testing scenarios and offering a practical and streamlined experience for precise data analysis.

MEASUREMENT AND DISPLAY CAPABILITIES

FULL S-PARAMETERS MEASUREMENTS

- **Independent Measurement Channels:** Up to 16
- **Display Traces per Channel:** Up to 16
- **Markers per Trace:** Up to 16
- **Store Traces for Recall or Trace Math Operations:** Data + Mem, Data - Mem, Data * Mem, Data / Mem
- **Flexible Trace Format Options:** Log Mag, Phase (Deg), Phase (Rad), Group Delay, Lin Mag, SWR, Real, Imaginary, Unwrapped Phase, Positive Phase, Smith, Polar
- **BN100 2-Port Instrument Includes:**
  - Forward and reverse transmission parameters (S12, S21)
  - Reflection parameters (S11, S22)

SWEEP STIMULUS

- **Sweep Type:** Lin Freq, Log Freq, Power, Segmented
- **Sweep Mode:** Normal or Fast
- **Number of points:** Up to 20,001
- **IF Bandwidth:** 1 Hz to 500 kHz
- **Port Power Setting:** -50 dBm to +10 dBm
- **Power Slope Setting:** -2 to +2 dB/GHz

ANALYSIS AND MARKER FUNCTIONS

- **Marker Search:** Max, Min, Peak, Target
- **Marker Function:** Set sweep and scaling settings using markers as reference
- **Limit and Bandwidth Tests:** Integrated Pass/Fail testing for Min/Max, ripple, and bandwidth limits
- **Time Domain Transform:** Lowpass and Bandpass Time Domain transform
- **Time Domain Gating:** Fixture De-Embedding using time domain techniques

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Software

DATA EXPORT OPTIONS

- S-parameter files
- Trace data .csv
- Touchstone file
- Instrument / calibration / data states

CALIBRATION AND CORRECTION CAPABILITIES

- Response calibration
- Enhanced Response calibration
- 1-port SOL
- 2-port SOLT
- Electronic calibration

SOFTWARE DOWNLOAD

- BNA1000 software package and operation manual can be downloaded from BirdRF.com.

MINIMUM PC SYSTEM REQUIREMENTS

	SPECIFICATION
Host PC System Requirements	Windows 7 and above
PC Hardware	CPU frequency of 1.5 GHz, 1 GB RAM minimum
Interface	USB 2.0 or later

AUTOMATION AND CONTROL

- **BNA1000 Test Automation Tools:** The BNA1000 software suite incorporates a SCPI command set and API (application programming interface) which allows custom automation programs to be created for the vector network analyzer. Most common programming environments are supported, including Python, LabVIEW, C# and MatLab.
- **SCPI Control:** BNA1000 supports a comprehensive set of SCPI control commands which should be familiar to anyone that has previously programmed with a VNA. These commands expose the full range of the BNA1000 capabilities, from calibration to display configuration, to measurement, to data processing.
- **API Control From the Host PC:** The host PC has the BNA1000 software package installed and is connected by USB to the BNA1000. The API can be used to create custom automation programs running on the host PC, using SCPI commands to control the BNA1000.
- **API Control From a Remote PC:** The complete BNA1000 system (host PC + BNA1000 software + BNA1000 VNA instrument) can be configured to allow remote control over a network connection. The remote PC connects to the BNA1000 host PC using a TCP/IP connection and then has access to the full range of SCPI commands for BNA1000 control.

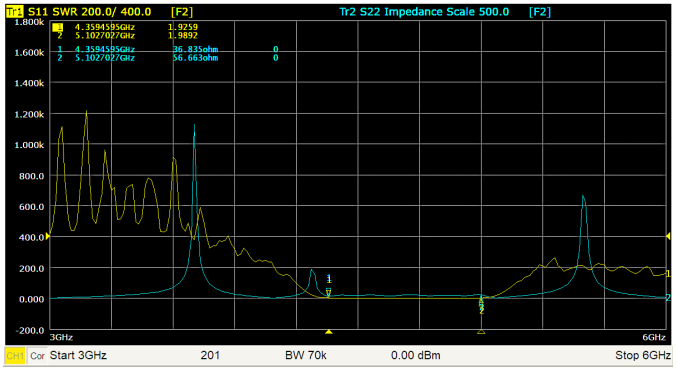
COMPACT USB VECTOR NETWORK ANALYZER

BNA100 SERIES

Time Domain Analysis & Gating

TIME DOMAIN ANALYSIS

This powerful tool, provides detailed insights into the behavior of various electronic components and systems over time. This analysis transforms frequency domain data into time domain information, providing a different and often more insightful perspective on the device under test (DUT).



Time Domain Analysis & Gating

WHAT IS TIME DOMAIN ANALYSIS?

Time Domain Analysis involves converting the measured frequency domain data (S-parameters) into the time domain using mathematical algorithms, typically an Inverse Fourier Transform. The result can be an impulse or a step response, which shows how a device responds over time to a fast transition, offering a time-resolved view of the DUT's behavior.

This analysis can pinpoint the location and nature of discontinuities or faults within a DUT by showing reflections or other signal alterations over time.

WHAT IS TIME DOMAIN GATING?

Time Domain Gating is a powerful feature that enhances the analyzer's ability to focus on specific parts of a DUT, improving the accuracy and relevance of measurements in various complex testing scenarios.

Once the data is in the time domain, Time Domain Gating allows the user to 'gate' or isolate specific time intervals corresponding to certain physical locations or components in the DUT. This enables the analysis of just those parts of the signal path, ignoring others.

This feature is particularly useful in removing the effects of fixtures, cables, or other elements that might introduce reflections or distortions to the measurement of the actual DUT.

APPLICATIONS REQUIRING TIME DOMAIN ANALYSIS AND GATING

- **Fault Location in Cables and Transmission Lines:** Identifying the exact location of faults or breaks in cables and transmission lines is a primary application. Time domain reflectometry (TDR) techniques allow for precise fault localization.
- **PCB Trace Characterization**: Useful to evaluate the characteristics of PCB traces and layers, such as impedance discontinuities, crosstalk issues and defects, which are crucial in high-speed digital circuit design.
- **Material Characterization:** Effective in material science for determining properties like dielectric constant and loss tangent of materials at different frequencies. Gating can examine the properties of different materials by isolating the response from the material itself, separate from the measurement setup.
- **Antenna Design and Testing:** Understand antenna behaviors like bandwidth and radiation patterns over time, which is particularly useful for transient or pulsed signal applications.
- **Radar and Microwave Component Testing:** For components like filters, couplers, or antennas in radar and microwave systems, the Gating feature can help isolate and analyze individual components within a complex system.
- **Filter and Network Analysis:** It allows for the examination of filter responses and network behavior, helping in designing more efficient filters and network components.
- **Quality Control and Manufacturing:** In manufacturing, it's used for quality control, ensuring components and systems meet their specified time domain response criteria.

COMPACT USB VECTOR NETWORK ANALYZER

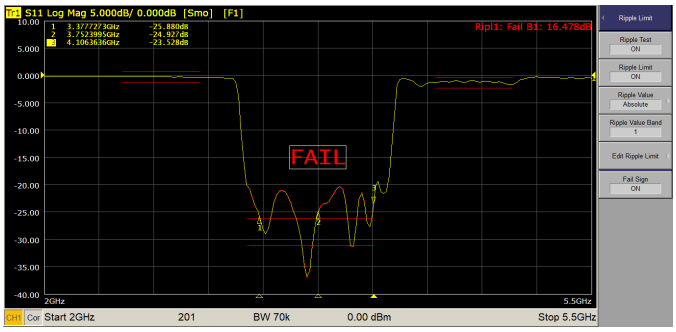
BNA100 SERIES

Limit Testing

LIMIT AND RIPPLE LIMIT TESTING

Both tests are important tools for evaluating the uniformity and stability of a device under test (DUT) across a specified frequency range. While Limit testing offers a broad assessment of a wide range of parameters, Ripple Limit Testing delves into the specifics of passband performance.

The BNA100 series simplifies these tests by providing six limit line segments to be defined for each displayed plot. A visual alarm will be shown when a limit line is crossed.



Ripple Limit Testing

WHAT IS LIMIT TESTING?

The limit testing feature allows users to set specific upper and lower threshold limits for any measurable parameter. Pass/fail criteria is determined whether the DUT meets predefined criteria set by the user. The VNA flags any data point that falls outside of the set limits, indicating a fail condition.

This test can be applied to a wide array of parameters like S-parameters (such as return loss, insertion loss, gain), phase, group delay, and others.

Used in a wide range of applications, including filter performance, antenna testing, cable testing, amplifier testing, and more, wherever specific performance criteria need to be met.

WHAT IS RIPPLE LIMIT TESTING?

Ripple Limit Testing is a more specialized form of limit testing. It specifically measures the variations or 'ripples' in the amplitude response of a device within its passband. This test is particularly focused on evaluating how consistently a device like a filter or amplifier performs within a certain frequency range (usually the passband), checking for uniformity in the amplitude.

Predominantly used in scenarios where uniformity in the passband is critical, such as in filters and RF amplifiers, to ensure consistent signal quality.

KEY FEATURES THAT SIMPLIFY TESTING

- **Automated Testing Procedures:** The VNA can automate the Limit Testing process, rapidly assessing whether a device under test (DUT) meets predefined criteria across a wide frequency range. This automation speeds up testing and reduces the likelihood of human error.
- **Intuitive User Interface:** With a user-friendly interface, the VNA allows for easy setup of limit parameters. Operators can quickly define upper and lower thresholds for various measurements, making the process straightforward even for less experienced users.
- **Fast Data Processing:** The VNA's rapid data processing capabilities mean quicker sweep times and faster analysis of results. This is crucial in high-throughput manufacturing environments where time efficiency is paramount.
- **Integration with Manufacturing Systems:** Its ability to integrate with existing automated manufacturing systems and relay pass/fail results directly aids in streamlining the production process.

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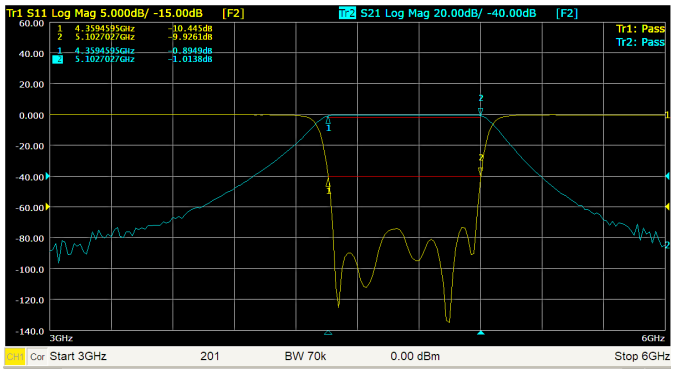
BNA100 SERIES

Component Test

PASSIVE COMPONENT EVALUATION AND TEST

For advanced communications systems, the performance of passive devices like filters, combiners, switches, and transmission lines is critical. These components need to exhibit low ripple and minimal insertion loss within their pass bands, alongside high rejection ratios in their stop bands.

When integrated into balanced circuits with multiple input and output ports, these devices introduce complexities in measurement system setups. The primary challenge in testing these devices lies in obtaining precise data swiftly and efficiently.



Passive Component Evaluation and Test

WHY CHOOSE BIRD'S VNA SOLUTIONS

Time Domain Analysis involves converting the measured frequency domain data (S-parameters) into the time domain using mathematical algorithms, typically an Inverse Fourier Transform. The result can be an impulse or a step response, which shows how a device responds over time to a fast transition, offering a time-resolved view of the DUT's behavior.

This analysis can pinpoint the location and nature of discontinuities or faults within a DUT by showing reflections or other signal alterations over time.

KEY FEATURES THAT SIMPLIFY TESTING

- **Wide Frequency Range:** Passive devices often operate over a wide range of frequencies. A VNA with a broad frequency range can accurately characterize the performance of these devices across all relevant frequencies.
- **High Dynamic Range:** This is crucial for measuring devices with low insertion loss and high rejection ratios. A high dynamic range allows the VNA to accurately measure both strong and weak signals, which is essential for assessing the quality of filters and other passive components.
- **Low Trace Noise:** Minimizing measurement noise is vital for precision. Low trace noise in a VNA ensures the accuracy of measurements, particularly in the passband where ripple and insertion loss are critical parameters.
- **Excellent Directivity and Source Match:** These features improve the accuracy of S-parameter measurements by reducing measurement errors due to reflections.
- **Advanced Calibration Techniques:** Accurate calibration is key to reliable measurements. VNAs with sophisticated calibration capabilities can compensate for systematic errors and ensure the validity of the data collected.
- **Multiple Port Capability:** For devices with multiple input and output ports, such as those used in balanced circuits, a multi-port VNA allows for simultaneous measurement of all ports, simplifying the setup and improving efficiency.
- **Time Domain Analysis:** This feature is useful for locating faults and understanding the behavior of components in the time domain, which can be particularly important for transmission lines and filters.
- **User-Friendly Interface and Software:** An intuitive interface and robust software support efficient testing and analysis, enabling easier setup, measurement, and interpretation of results.
- **Automation and Connectivity Options:** For high-throughput environments, automation capabilities and connectivity options such as GPIB, USB, or LAN can greatly enhance efficiency.

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Education Applications

EDUCATION AND TEACHING LABS

The BNA100 Series is engineered to align with the needs of university laboratories, providing an ideal blend of sophistication and accessibility for educational purposes. Its user-friendly interface ensures ease of use, making it suitable for a variety of teaching and research applications in RF and electronics engineering. The versatility of the BNA100 Series enables its use in a wide range of academic projects, from elementary circuit analysis to more complex RF research endeavors.

Mindful of the typical budgetary and spatial constraints in educational settings, the BNA100 Series is designed to be both cost-effective and compact. This ensures that university labs can incorporate advanced network analysis technology without overextending their resources. The compact nature of the BNA100 Series also addresses the challenge of limited lab space, making it a practical choice for enhancing the educational experience in diverse and active learning environments.

KEY FEATURES THAT SIMPLIFY LEARNING

- **Educational Value:** The BNA100's sophisticated yet user-friendly features allow students to learn and understand complex RF concepts and network analysis techniques. This hands-on experience is invaluable in RF and electronics engineering education.
- **Versatility for Various Applications:** University labs often conduct a wide range of experiments and research. The BNA100's versatility makes it suitable for a variety of applications, from basic circuit analysis to more advanced research projects.
- **Ease of Use and Learning:** With a graphical user interface that is intuitive, the BNA100 makes it easier for students and educators to use and understand the device without extensive training. This ease of use is essential in an educational setting where users may not have advanced technical expertise.
- **Cost-Effectiveness for Educational Budgets:** Budget constraints are a common concern in educational institutions. The BNA100, being cost-effective, fits well within the budgetary limitations of many university labs, providing high-end functionality without a high-end price tag.
- **Compact Design for Lab Space Efficiency:** University labs often have limited space. The BNA100's compact design ensures it doesn't occupy much room, making it an ideal addition to crowded lab environments.

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Specifications

MEASUREMENT

Frequency Range	
BNA100-2P6G5	300 kHz to 6.5 GHz
BNA100-2P8G5	300 kHz to 8.5 GHz
Impedance	50 Ohms
Frequency Accuracy	±5ppm
Frequency Resolution	1 Hz
Measurement Points	2 to 20001
Measurement Bandwidth	1 Hz to 100 kHz
Measurement Time/Point	68 µs
Dynamic Range (IFBW=10Hz)	112 dB
Accuracy of Transmission Measurements (magnitude/phase)	+5 dB to +15 dB (0.2 dB/2°) -50 dB to +5 dB (0.1 dB/1°) -70 dB to -50 dB (0.5 dB/3°) -90 dB to -70 dB (2.5 dB/8°)
Accuracy of Reflection Measurements (magnitude/phase)	-15 dB to 0 dB (0.4 dB/3°) -25 dB to -15 dB (1.0 dB/6°) -35 dB to -25 dB (3.0 dB/20°)
Trace Noise (IFBW=3kHz)	5 mdB rms
Temperature Stability	0.03 dB/°C
Effective Directivity[1]	38 dB
Effective Source Match[1]	35 dB
Effective Load Match[1]	37 dB

TEST PORT OUTPUT

Match	18 dB (W/O system error correction)
Power range (Option-70 to +10dBm)	-20 dBm to +10d Bm
Power Accuracy	±1.5dB
Power Resolution	0.05dB

TEST PORT INPUT

Match	18 dB (W/O system calibration)
Max Input Level	+23 dBm
Max Input Voltage	+35 V
Noise Level	-120 dBm/Hz

[1] Applied over them temperature range of 23°C± 5°C after 40 minutes of warming-up, with less than 1°deviation from the full two-port calibration temperature, at output power of -5dBm and IF bandwidth 10Hz.

CONNECTORS

Connectors	Type N(f)
Test Ports	
BNA100-4P6G5	2-port
BNA100-2P8G5	2-port

ENVIRONMENTAL

Operating Temperature	+5 °C to +40 °C (+41 °F to +104 °F)
Storage Temperature	-45°C to +55 °C (-49 °F to +131 °F)
Humidity	90%, 25 °C (77 °F)

SYSTEM

Power Supply	110/220 VAC, 50 /60 Hz
Recommended Calibration interval	3 years
Warranty	3 years

REGULATORY COMPLIANCE

CE	**Meets the requirements of the following applicable European directives and carries the CE marking accordingly:** – LVD 2014/35 – EMC Directive 2014/30/EU **Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)** – Directive 2011/65/EU
RoHs	Compliant
FC	Complies with part 15 of the FCC Rule

PHYSICAL

Size	6.9 in x 2.6 in x 11.5 in (175 mm x 65 mm x 292 mm)
Weight	5.1 lb (2.3kg)

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COMPACT USB VECTOR NETWORK ANALYZER

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Ordering Information

BNA100 Series
Vector Network Analyzer

MODEL NUMBER

BNA100-2P6G5	300 kHz to 6.5 GHz, 2-port, Type N(f)
BNA100-2P8G5	300 kHz to 8.5 GHz, 2-port, Type N(f)

INCLUDED WITH VNA

(1) VNA 2-port
(1) USB-B to USB-A Cable, 1 m
(1) 1 G USB Flash Drive with software installer
(1) Power Cord, 1 m

OPTIONS

BNA1000-010	Time Domain
BNA1000-1F5	Fixture circuit simulation function

CALIBRATION MODULES

E285A	Electronic calibration module, 2 ports, 100 kHz to 8.5 GHz, 3.5 mm (f)
E285C	Electronic calibration module, 2 ports, 100 kHz to 8.5 GHz, N(f)
SK-CAL-NF-90	Calibration Kit, SOLT, DC to 9 GHz, N(f)
SK-CAL-NM-90	Calibration Kit, SOLT, DC to 9 GHz, N(m)
SK-CAL-SMAF-90	Calibration Kit, SOLT, DC to 9 GHz, SMA(f)
SK-CAL-SMAM-90	Calibration Kit, SOLT, DC to 9 GHz, SMA(m)

RF CABLES

T5-RFCAB-NmNm-90101	Test Cable, 1m, DC to 9 GHz, N(m) to N(m)
T5-RFCAB-NmSMAm-90102	Test Cable, 1m, DC to 9 GHz, N(m) to SMA(m)

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Accessories

Electronic Calibration Modules

SOLT (Short-Open-Load-Through) calibration standards are an essential component for achieving precise and accurate measurements with VNAs. The VNA is able to compensate for directivity, source match, frequency response, and reflection tracking errors, leading to more reliable and consistent measurements.

Bird's electronic calibration modules are designed to simplify the calibration process. The ECM achieves this with just a single connection, streamlining the entire calibration procedure.

MODEL	DESCRIPTION
E285A	Electronic calibration module, 2 ports, 100 kHz to 8.5 GHz, SMA (f-f)
E285C	Electronic calibration module, 2 ports, 100 kHz to 8.5 GHz, Type N (m-m)

Manual Calibration Kits

SOLT (Short-Open-Load-Through) manual calibration standards perform the same function as the Electronic Calibration Module without the automation.

MODEL	DESCRIPTION
SK-CAL-NM-90	Type N(m) mechanical calibration module, DC to 8.5 GHz, Short, Open, Load, Through (SOLT)
SK-CAL-NF-90	Type N(f) mechanical calibration module, DC to 8.5 GHz, Short, Open, Load, Through (SOLT)
SK-CAL-SMAM-90	Type SMA(m) mechanical calibration module, DC to 8.5 GHz, Short, Open, Load, Through (SOLT)
SK-CAL-SMAF-90	Type SMA(f) mechanical calibration module, DC to 8.5 GHz, Short, Open, Load, Through (SOLT)

RF Test Cables

Bird provides a complete series of precision, coaxial RF cables to complete your test solution.

MODEL	DESCRIPTION
T5-RFCAB-NmNm-90101	Type N(m) - male precision cable, 9 GHz
T5-RFCAB-NmSMAm-90102	Type N(m) – SMA male precision cable, 9 GHz

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