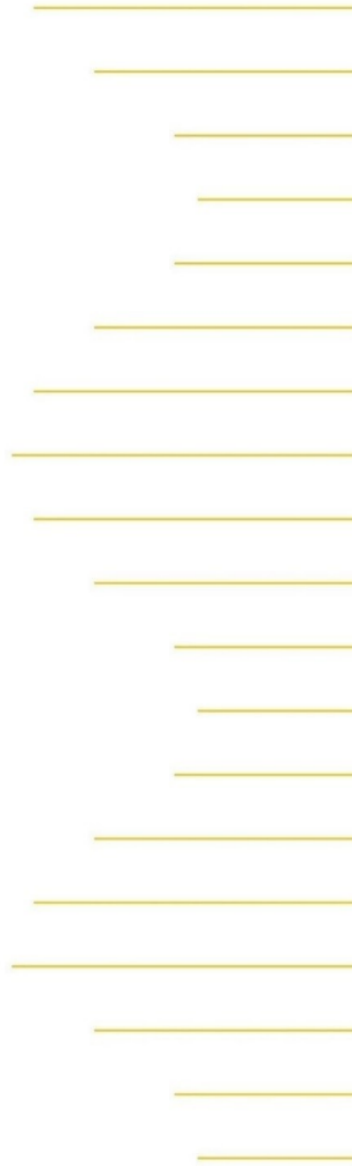




RIGOL

Electronic Calibration Module



Product Manual
2026.03

Guaranty and Declaration

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Software Version

Software upgrade might change or add product features. Please acquire the latest version of the manual from **RIGOL** website or contact **RIGOL** to upgrade the software.

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Product Certification

RIGOL guarantees that this product conforms to the national and industrial standards in China as well as the ISO9001:2015 standard and the ISO14001:2015 standard. Other international standard conformance certifications are in progress.

Contact Us

If you have any problem or requirement when using our products or this manual, please contact **RIGOL**.

E-mail: service@rigol.com

Website: www.rigol.com

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1 Safety Requirement

1.1 General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injury or damage to the instrument and any product connected to it. To prevent potential hazards, please follow the instructions specified in this manual to use the instrument properly.

Use Proper Power Cord.

Only the exclusive power cord designed for the instrument and authorized for use within the destination country could be used.

Ground the Instrument.

The instrument is grounded via the protective ground conductor in the power cable. To avoid electric shock, ensure that the ground terminal of the instrument's power cable is reliably connected to the protective ground before connecting any input or output terminals.

Observe All Terminal Ratings.

To avoid fire or shock hazard, observe all ratings and markers on the instrument and check your manual for more information about ratings before connecting the instrument.

Use Proper Overvoltage Protection.

Ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the operator might be exposed to the danger of an electric shock.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

Avoid Circuit or Wire Exposure.

Do not touch exposed junctions and components when the instrument is powered on.

Do Not Operate with Suspected Failures.

If you suspect that any damage may occur to the instrument, have it inspected by RIGOL authorized personnel before further operations. Any maintenance, adjustment or replacement especially to circuits or accessories must be performed by RIGOL authorized personnel.

Provide Adequate Ventilation.

Inadequate ventilation may cause an increase of temperature in the instrument, which would cause damage to the instrument. So please keep the instrument well ventilated and inspect the air outlet and the fan regularly.

Do Not Operate in Wet Conditions.

To avoid short circuit inside the instrument or electric shock, never operate the

instrument in a humid environment.

Do Not Operate in an Explosive Atmosphere.

To avoid personal injuries or damage to the instrument, never operate the instrument in an explosive atmosphere.

Keep Instrument Surfaces Clean and Dry.

To avoid dust or moisture from affecting the performance of the instrument, keep the surfaces of the instrument clean and dry.

Prevent Electrostatic Impact.

Operate the instrument in an electrostatic discharge protective environment to avoid damage induced by static discharges. Always ground both the internal and external conductors of cables to release static before making connections.

Handle with Caution.

Please handle with care during transportation to avoid damage to keys, knobs, interfaces, and other parts on the panels.

1.2 Safety Notices and Symbols

Safety Notices in this Manual:



WARNING

Indicates a potentially hazardous situation or practice which, if not avoided, will result in serious injury or death.



CAUTION

Indicates a potentially hazardous situation or practice which, if not avoided, could result in damage to the product or loss of important data.

Safety Notices on the Product:

DANGER It calls attention to an operation, if not correctly performed, could result in injury or hazard immediately.

WARNING It calls attention to an operation, if not correctly performed, could result in potential injury or hazard.

CAUTION It calls attention to an operation, if not correctly performed, could result in damage to the product or other devices connected to the product.

Safety Symbols on the Product:



Hazardous
Voltage



Safety
Warning



Protective
Earth Terminal



Chassis
Ground



Test Ground

1.3 Working Environment

Item	Condition	Description
Temperature Range	Operating	+15°C to +35°C
	Save	-20°C to 60°C
	Operating	Relative humidity (RH) up to 75%.
	Non-operating	85% at 65°C, 24 hours
Altitude	Operating	below 2000 m



WARNING

To avoid short circuit inside the instrument or electric shock, never operate the instrument in a humid environment.

Installation (Overvoltage) Category

This product is powered by mains conforming to installation (overvoltage) category II.



WARNING

Ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the operator might be exposed to the danger of an electric shock.

Installation (Overvoltage) Category Definitions

Installation (overvoltage) category I refers to signal level which is applicable to equipment measurement terminals connected to the source circuit. Among these terminals, precautions are done to limit the transient voltage to a low level.

Installation (overvoltage) category II refers to the local power distribution level which is applicable to equipment connected to the AC line (AC power).

1.4 Operating and Safety Precautions

Observe the following guidelines before connecting or operating the ECal module to ensure the instrument safety and measurement accuracy.

- Warm-up Before Calibration

The ECal module must be warmed up before calibration. After connecting the USB cable, the “Wait” indicator lights up red and warm-up begins, allowing the internal temperature to reach the specified stabilized temperature to ensure consistent calibration conditions.

The warm-up time depends on the operating ambient temperature. It is recommended to keep the ambient temperature between 20°C and 28°C. The typical warm-up time is 15–20 minutes for a two-port electronic calibration module and 20–25 minutes for a four-port electronic calibration module. If the ambient temperature is below 20°C, the required warm-up time should be extended accordingly.

- ESD Protection

The ECal module contains sensitive components. Static discharges can cause permanent damage to the unit. To prevent damage from ESD:

- Environment protection: place a grounded antistatic mat in front of your test equipment and wear a grounded wrist strap attached to the mat when handling or operating the ECal module. Wear a heel strap when working in an area with a conductive floor.
- Body grounding: ground yourself by grasping the grounded outer shell of the analyzer test port or cable connector briefly before you clean, inspect, or make a connection to the ECal module.
- Physical protection: avoid touching the center conductor of the test ports to reduce the risk of electrostatic damage.

- Connector Care

Connectors can become defective due to wear during normal use, and all connectors should be inspected and maintained to maximize their service life and ensure measurement accuracy.

- Inspect the mating surface. Metal particles from connector threads often find their way onto the mating surface when a connection is made or disconnected.
- Clean and maintain connectors regularly. Clean dirt and contamination from the connector mating surface and threads. This simple step can extend the service life of the connector and improve the quality of your calibration and measurements.
- Gage connectors periodically. Regularly calibrate the connectors for accuracy, verify the mechanical tolerances and connector performance to detect potential damage risks in advance.

- Torque Operation



CAUTION

ECal modules can be damaged if you apply excessive torque to the connectors.

2 Product Overview

RIGOL's electronic calibration (ECal) modules are available in several models, covering the frequency range from 100 kHz to 26.5 GHz. The RF connector types are 3.5 mm and Type-N. ECal module uses the USB interface for communication and power supply. ECal module is applicable to calibrate and correct errors for vector network analyzers from RIGOL.

- Frequency range: 100 kHz to 26.5 GHz
- Maximum power level: +10 dBm
- Maximum protective DC voltage: ± 10 VDC
- RF connector types: 3.5 mm female connector, Type-N 50 Ω female connector
- Number of ports supported: 2
- Power supply: USB 2.0

ECal module offers easier operation, higher efficiency, and greater reliability than a mechanical calibration module, while requiring fewer connections to complete a calibration. For example, a four-port ECal module calibration requires only six connections, whereas a conventional mechanical module calibration requires eighteen connections. ECal module greatly reduces human-induced errors and cable wear from repeated mate-and-demate cycles, while maintaining equivalent calibration accuracy. ECal module supports multiple connector types and covers most applications of mechanical kits, especially in high-frequency or multi-port testing. ECal module avoids instability introduced by repeated connections and significantly improves calibration efficiency and test reliability.

Product Models

Model	Frequency Range	No. of Ports	Description
ECAL109-NF2	100 kHz to 9 GHz	2	Type-N (F) 50 Ω
ECAL114-NF2	100 kHz to 14 GHz	2	Type-N (F) 50 Ω
ECAL126-35F2	100 kHz to 26.5 GHz	2	3.5 mm (F)

3 Document Overview

This manual introduces the appearance of ECal module, its operating methods, and specifications for each model. ECal module is a high-accuracy, single-connection calibration technology that employs traceable and verifiable electronic standards. Each module contains unique S-parameter data that is used to calculate error terms for vector network analyzers during calibration.

ECal module is applicable to calibrate and correct errors for vector network analyzers from RIGOL. You can download the latest manual for the desired Vector Network Analyzer from RIGOL official website (www.rigol.com).

4 Quick Start

4.1 General Inspection

1 Inspect the packaging

If the packaging has been damaged, do not dispose the damaged packaging or cushioning materials until the shipment has been checked for completeness and has passed both electrical and mechanical tests.

The consigner or carrier shall be liable for the damage to the instrument resulting from shipment. RIGOL would not be responsible for free maintenance/rework or replacement of the instrument.

2 Inspect the instrument

In case of any mechanical damage, missing parts, or failure in passing the electrical and mechanical tests, contact your RIGOL sales representative.

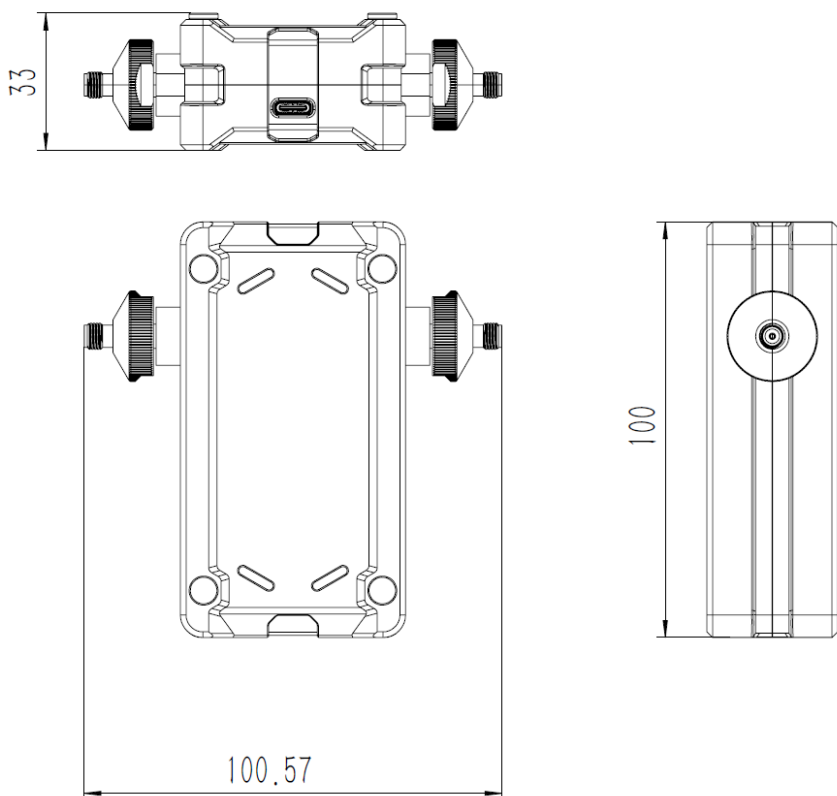
3 Check the accessories

Please check the accessories according to the packing lists. If the accessories are damaged or incomplete, please contact your RIGOL sales representative.

4.2 Appearance and Dimensions



Number	Description
1	Status LED
2	Model and Frequency Range
3	USB Interface
4	Calibration Port



Unit: mm

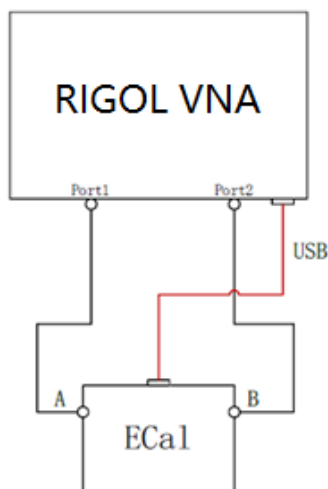
4.3 When to calibrate

- Calibration is required when changes in system error are not negligible (uncorrected leakages, mismatches, system frequency response changes $\geq 10\%$ of the accuracy specifications).
- Calibration is required when a significant environmental change (especially in temperature) occurs between calibration and measurement. The temperature change can alter the physical length of internal and external cables and affect accuracy.
- Calibration is required when the test port connectors and calibration standards become dirty or damaged. If the connectors and calibration standards become dirty or damaged, measurement repeatability and accuracy are affected.
- Calibration is required when the re-measurement calibration standard does not produce repeatable results. You should maintain the test port connector, cable and calibration standards before performing the calibration.
- Periodically remeasure the devices under test or the known devices. Calibration is required when any changes in its corrected response which can be attributed to the test system.

5 Operation Guidance

5.1 To Connect and Disconnect ECal Module

- Connect the ECal module to any of the USB Type-A connectors on the front or rear panel of the vector network analyzer via USB cable (USB Type-C to Type-A). The vector network analyzer can be controlled or powered via a USB cable.
- When connecting an Ecal module to a vector network analyzer, the vector network analyzer automatically identifies the type of calibration module, frequency range, and connector type.



5.2 Function of the Status LED

Status LED	Description
Off	ECal module is not connected to an instrument.
Steady Red	ECal module is warmed up and functioning. (For the warm-up time, please refer to Section 1.4.)
Steady Green	After warm-up, ECal module is connected, functional, and ready for use.
Alternating Red/Green Flashing	ECal module is too hot or too cold and unable to regulate internal temperature to the setpoint.

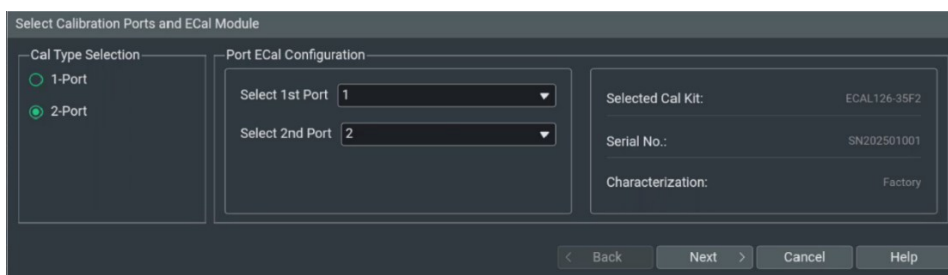
5.3 To Perform an Automatic Calibration

To calibrate with all models of ECal module, please refer to the following procedure:

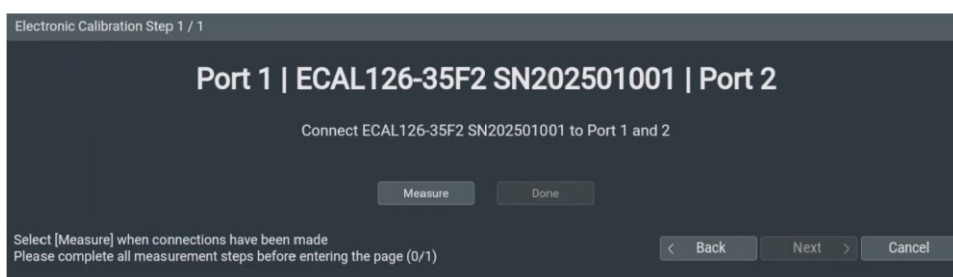
1. Connect an ECal module to a vector network analyzer having the appropriate frequency range and connector type (including the connector under test and the USB connector). Wait until LED turns green.

The warm-up time depends on the operating ambient temperature. It is recommended to keep the ambient temperature between 20°C and 28°C. The typical warm-up time is 15–20 minutes for a two-port electronic calibration module and 20–25 minutes for a four-port electronic calibration module. If the ambient temperature is below 20°C, the required warm-up time should be extended accordingly.

2. Configure parameters of the vector network analyzer, including the frequency range, output power, sweep speed and other stimulus settings. View the uncorrected response and optimize the vector network analyzer settings as needed.
3. On VNA, click or tap Calibration > Main > ECal to enter the following menu.



4. Select "Cal Type Selection" and "Port ECal Configuration" as needed. Then click or tap Next to enter the "Electronic Calibration Step" menu, as shown in the figure below.



5. As prompted, click or tap Measure to complete the calibration and save the calibration information.



6. After the calibration is completed, remove the ECal module. Connect the DUT to the vector network analyzer and then the calibrated measurements are performed.



CAUTION

ECal modules can be damaged if you apply excessive torque to the connectors.

Tip: For optimal results, terminate any unused ECal ports with a 50 Ω load.

6 Technical Specifications

6.1 Performance Specifications

Calibrated System Performance¹

Frequency Range	100 kHz to 10 MHz	10 MHz to 4.5 GHz	4.5 GHz to 9 GHz	9 GHz to 14 GHz	14 GHz to 26.5 GHz
Directivity	48 dB	48 dB	45 dB	40 dB	40 dB
Source Match	30 dB	30 dB	30 dB	28 dB	26 dB
Load Match	45 dB	45 dB	40 dB	35 dB	35 dB
Transmission Tracking	± 0.06 dB	± 0.1 dB	± 0.15 dB	± 0.18 dB	± 0.3 dB
Reflection Tracking	± 0.15 dB	± 0.18 dB	± 0.25 dB	± 0.3 dB	± 0.32 dB

1. The measurement data is calibrated by RIGOL DNA5000 vector network analyzer.

Ecal Module Specifications

Item	Description
Maximum Calibration Input Power	-5 dBm
Maximum Port Power	+10 dBm
Control Port Type	USB
Operating Voltage	DC +5 V 500 mA

6.2 Mechanical Characteristics

Item	Description
Dimensions (W x H x D)	100 mm × 100.57 mm × 33 mm
Weight	350g (package not included)

7 Order Information

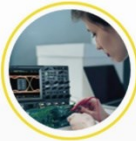
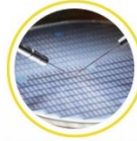
	Description	Order No.
Ecal Module	100 kHz to 9 GHz, 2-Port, Type-N (female) 50 Ω	ECAL109-NF2
	100 kHz to 14 GHz, 2-Port, Type-N (female) 50 Ω	ECAL114-NF2
	100 kHz to 26.5 GHz, 2-Port, 3.5 mm (female)	ECAL126-35F2
Standard	USB2.0 Cable	-
Optional Accessories	Torque wrench, 8 in-lb, 8.1 mm, open-ended, for SMA 3.5 mm connector	TW8-8
	Torque wrench, 12 in-lb, 19.1 mm, open-ended, for Type-N connector	TW812-19

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