Electronic Calibration (ECal) Modules for Vector Network Analyzers

N755xA Series, 2-port Economy ECal Module
N469xD Series, 2-port Microwave ECal Module
8509xD Series, 2-port RF ECal Module
8509xC Series, 2-port RF ECal Module
N443xD Series, 4-port ECal Module
N756xA Series, 6/12/18/24/30/36-ports Multiport ECal

Achieve fast, accurate, and consistent measurement

Keysight Electronic Calibration (ECal) modules bring calibration to your vector network analyzers with just a single connection. The ECal modules are state-of-the-art, solid-state devices with programmable and highly repeatable impedance states which are traceable via the National Metrology Institute. ECal modules are controlled directly from the Keysight network analyzers; no external PC is required. Electronic calibration replaces traditional mechanical standard calibration and provides consistent calibration and eliminates operator error while bringing convenience and simplicity to your calibration routine.

KEYSIGHT

	Model	Description
N755xA Series 2-port Economy ECal Modules		
	N7550A	DC to 4 GHz
	N7551A	DC to 6.5 GHz
	N7552A	DC to 9 GHz
	N7553A	DC to 14 GHz
	N7554A	DC to 18 GHz
	N7555A	DC to 26.5 GHz
8509xD Series 2-ports RF ECal Module		
	85091D	DC/300 kHz to 9 GHz
	85092D	DC/300 kHz to 9 GHz
	85093D	DC/300 kHz to 9 GHz
	85094D	DC/300 kHz to 9 GHz
	85096D	DC/300 kHz to 9 GHz
	85098D	DC/300 kHz to 7.5 GHz
	85099D	DC/300 kHz to 6 GHz
8509xC Series 2-ports RF ECal Module		
	85091C	300 kHz to 9 GHz
	85092C	300 kHz to 9 GHz
	85093C	300 kHz to 9 GHz
	85096C	300 kHz to 3 GHz
	85098C	300 kHz to 7.5 GHz
	85099C	300 kHz to 3 GHz
N469xD Series 2-ports Microwave ECal Module		
	N4690D	DC/300 kHz to 18 GHz
	N4691D	DC/300 kHz to 26.5 GHz
	N4692D	DC/10 MHz to 40 GHz
	N4693D	DC/10 MHz to 50 GHz
	N4694D	DC/10 MHz to 67 GHz
	N4696D	DC/300 kHz to 18 GHz
N443xD Series 4-ports ECal Modules		
	N4431D	DC to 13.5 GHz
	N4432D	DC/300 kHz to 18 GHz
	N4433D	DC /300 kHz to 26.5 GHz
N756xA 6/12/18/24/30/36-ports Multiport ECal		
	N7562A (6-ports)	DC to 9 GHz
	N7562AEP (12/18/24/30/36-ports)	DC to 9 GHz
	N7564A (6-ports)	DC to 20 GHz
	N7564AEP (12/18/24/30/36-ports)	DC to 20 GHz

Key Features

Keysight ECal modules make calibration of vector network analyzers fast, easy and accurate. These features make Keysight ECal modules an ideal solution for calibrating Keysight vector network analyzers such as the PNA, ENA, PXI VNA, FieldFox and USB VNA's.

- Efficient single calibration standard
- Precision, accurate transfer standards
- Broad choice of solutions up to 36-ports
- Frequency coverage down to DC
- Supported by trusted Keysight vector network analyzers
- Custom ECal module using user-characterization

Efficient single calibration standard

Traditional mechanical calibration kits required the user to make numerous connections to the test ports for a single calibration. This increases the user interaction during the calibration process and is prone to errors. A full calibration can be accomplished with a single connection to the ECal module and minimal operator interaction. By reducing the number of connections required for a calibration, you can:

- Calibrate faster, so you save time and make quicker measurements
- Reduce the chance of operator error, for greater repeatability in your calibrations
- Reduce the wear on connectors, for lower repair costs on both the test port connectors and calibration standards

Precision, accurate transfer standards

The ECal modules are transfer standards capable of transferring the factory calibration accuracy to your vector network analyzer. The accuracy of ECal is limited by the measurement accuracy of the original calibration and the test setup used to measure the impedance standards inside the ECal module. Apart from that, the connector repeatability is important which results from great connector care, proper connection and torquing techniques for a quality calibration.

The modules are characterized by Keysight using a precision calibration technique (similar in accuracy to TRL, thus limiting the amount of uncertainty errors) that is traceable via the National Metrology Institute (www. keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement. Each module's unique S-parameter data is stored in the module's memory. During calibration, ECal uses this data to calculate the error terms for your vector network analyzer. All measurements on either insertable or non-insertable devices are traceable to NMI. For greater precision and higher accuracy measurements, consider the N443xD Series and N469xD Series ECal modules.

Broad choice of solutions

Keysight offers a wide range of ECal modules – you may select from maximum frequency, number of ports, number of connector types, and performance versus economy ECal.

While the N755xA Series offers the convenience of an ECal at a lower price point, the N469xD Series provides more accurate calibrations to 67 GHz for PNA-X and PNA. The 4-port N443xD Series is recommended for full 4-port calibration using the PNA, ENA, and PXI VNA. Also, multiport calibrations (n > 4) can be accomplished using any of Keysight's ECal modules.

Most common RF and microwave components have non-insertable connectors, for example, devices with female connectors on both ports. The simplest and fastest non-insertable calibration method uses an ECal module with connectors that match your device. All Keysight 2-port ECal modules support in-family mixed connector options: male-male, female-female and male-female connectors for the same connector type. Simply order your ECal module with connectors that match your device under test – either insertable or non-insertable.

Keysight offers a broad range of connectors to select from: Type-N 50 Ω, Type-N 75 Ω, Type-F 75 Ω, 7-16, 7 mm, 3.5 mm, 2.92 mm, 2.4 mm and 1.85 mm connectors. For measurements of mixed connector devices, you can combine different connector types on the 2-port ECal modules such as the 85092C/D, 85093C/D, 85094D or 85098C/D. The connector combination can be either female or male with Type-N 50 Ω, 3.5 mm or 7-16, Mixed connector options are available for 4-port ECal modules, N443xD. There is a new 4.3-10 connectors option which is only available for N4431D model.

For multiport calibration, the N756xA series provided the world first handy and cascade-able multiport ECal up to 36-ports. The multiport ECal makes it possible to calibrate a wide frequency range without making numerous connections during the calibration process. They come in a smaller footprint which allows the user to share ECal in multiple locations and have the flexibility to scale up your calibration requirements to meet future demand for higher port counts. This is an ideal calibration solution for multiport measurements such as high-volume PA/FEM, massive MIMO or high-speed digital interconnects applications that often come with high test port counts. Available in 2 operating frequencies range from DC to 9/20 GHz where the 9 GHz model comes with a selection of Type-N (f) and 3.5 mm (f) connector type while the 20 GHz model is defaulted to a 3.5 mm (f) connector

Frequency coverage down to DC

For some applications such as broadband device modeling, it is necessary to capture S-parameter data in a wide frequency range. Traditionally, mechanical calibration kits are used to calibrate the low frequency range close to DC. The N755xA comes with starting frequency of DC while the N469xD and N443xD Series ECal offers Option 0DC to extend the calibration frequency range down to DC, which makes it possible to calibrate a wider frequency from DC up to 67 GHz without making numerous connections during the calibration process.

In addition, the DC option for the N469xD and N443xD provides better performance in the low frequency range (below 500 MHz), which is essential for accurate signal integrity measurements in the time domain for high-speed digital applications. The DC option is recommended for calibration with enhanced time domain analysis (TDR) on the Keysight network analyzers.

Supported by trusted Keysight vector network analyzers

The Keysight ECal modules are supported by the latest Keysight vector network analyzers. Simply connect the ECal module to the USB port on an analyzer and the analyzer's firmware will do the rest. The connection of the ECal module is automatically recognized by the firmware and you can control your calibration from the front panel keys of the vector network analyzer. By using the same calibration techniques with all ECal modules, you will achieve consistent measurement results among Keysight vector network analyzers. For more details about ECal support for Keysight VNAs, refer to the VNA compatibility list.

Custom ECal module using user characterization

If you would like to take advantage of the speed and convenience of ECal with a connector option that is not offered by Keysight, user characterization allows re-characterization of your ECal module. Mixed connector, waveguide, and fixture calibrations can all be handled using this feature. User characterization allows you to add an adapter or fixture to the test port of the module and embed the effects into the characterization of the module. The result of the new characterization extends the reference plane from one or more of the module's test ports to those on the adapter or fixture. The process for performing user characterization follows three simple steps:

- Calibrate analyzer for desired connector configuration
- Characterize ECal module impedance standards with adapters if necessary
- Transfer data to the module's flash memory

Can be used on any of Keysight's vector network analyzers. At calibration, you can select the factory characterization (data) or any of the user-defined characterizations stored in the module. Note that the N756xA multiport ECal do not support user characterization at this moment.

Ordering Information

Select an ECal module based on the connector type required and the frequency range of your vector network analyzer.

Model	Connector Types	Frequency Range
N755xA Series 2-port Economy ECal Module		
N7550A	3.5 mm or Type-N 50Ω	DC to 4 GHz
N7551A	3.5 mm or Type-N 50 Ω	DC to 6.5 GHz
N7552A	3.5 mm or Type-N 50 Ω	DC to 9 GHz
N7553A	3.5 mm or Type-N 50 Ω	DC to 14 GHz
N7554A	3.5 mm or Type-N 50 Ω	DC to 18 GHz
N7555A	3.5 mm	DC to 26.5 GHz
8509xD Series 2-ports RF ECal Module		
85091D	7 mm	DC/300 kHz to 9 GHz
85092D	**Port A:** Type-N (f) or Type-N (m) & 4.3-10 (f) or 4.3-10 (m) **Port B:** 3.5 mm (f) or 3.5 mm (m), 4.3-10 (f) or 4.3-10 (m) & 7-16 (f) or 7-16 (m)	DC/300 kHz to 9 GHz
85093D	**Port A:** 3.5 mm (f) or 3.5 mm (m) & 4.3-10 (f) or 4.3-10 (m) **Port B:** Type-N (f) or Type-N (m), 4.3-10 (f) or 4.3-10 (m) & 7-16 (f) or 7-16 (m)	DC/300 kHz to 9 GHz
85094D	**Port A:** 4.3-10 (f) or 4.3-10 (m) **Port B:** Type-N (f) or Type-N (m), 3.5 mm (f) or 3.5 (m) & 7-16 (f) or 7-16 (m)	DC/300 kHz to 9 GHz
85096D	Type-N (75 ohm)	DC/300 kHz to 9 GHz
85098D	**Port A:** 7-16 (f) or 7-16 (m) **Port B:** Type-N (f) or Type-N (m), 3.5 mm (f) or 3.5 (m) & 4.3-10 (f) or 4.3-10 (m)	DC/300 kHz to 7.5 GHz
85099D	Type-F (75 ohm)	DC/300 kHz to 6 GHz
8509xC Series 2-ports RF ECal Module		
85091C	7 mm	300 kHz to 9 GHz
85092C	**Port A:** Type-N 50 Ω **Port B:** Type-N 50 Ω or 3.5 mm or 7-16	300 kHz to 9 GHz or 300 kHz to 7.5 GHz (with 7-16 connector option)
85093C	**Port A:** 3.5 mm **Port B:** 3.5 mm or Type-N 50 Ω or 7-16	300 kHz to 9 GHz or 300 kHz to 7.5 GHz (with 7-16 connector option)
85096C	Type-N 75 Ω	300 kHz to 3 GHz
85098C	**Port A:** 7-16 Port B: 7-16 or 3.5 mm or Type-N 50 Ω	300 kHz to 7.5 GHz
85099C	Type-F 75 Ω	300 kHz to 3 GHz
N469xD Series 2-port Microwave ECal Module		
N4690D	Type-N 50 Ω	DC/300 kHz to 18 GHz
N4691D	3.5 mm	DC/300 kHz to 26.5 GHz
N4692D	2.92 mm	DC/10 MHz to 40 GHz
N4693D	2.4 mm	DC/10 MHz to 50 GHz

N4694D	1.85 mm	DC/10 MHz to 67 GHz
N4696D	7 mm	DC/300 kHz to 18 GHz
N443xD Series 4-port ECal Modules		
N4431D	3.5 mm or Type-N 50 Ω or 7-16 or 4.3-10 or mixed connectors	DC to 13.5 GHz or DC to 7.5 GHz (7-16 connector options) or DC to 12 GHz (4.3-10 connector options)
N4432D	Type-N 50 Ω or 3.5 mm or mixed connectors	DC/300 kHz to 18 GHz
N4433D	3.5 mm	DC /300 kHz to 26.5 GHz
N756xA 6/12/18/24/30/36-ports Multiport ECal		
N7562A (6-ports)	Type-N 50 Ω (f) Ω or 3.5 mm (f)	DC to 9 GHz
N7562AEP (12/18/24/30/36-ports)	Type-N 50 Ω (f) Ω or 3.5 mm (f)	DC to 9 GHz
N7564A (6-ports)	3.5 mm (f)	DC to 20 GHz
N7564AEP (12/18/24/30/36-ports)	3.5 mm (f)	DC to 20 GHz

Connector Options

2-port ECal module (N755xA, 8509xC and N469xD)

All Keysight 2-port ECal modules support in-family mixed connector options - male-male, female-female and male-female for the same connector type.

Description	For N755xA Series	For 8509xC Series	For 8509xC Series	For N469xD Series
1 female & 1 male connector	NMF (Type-N 50 Ω) 3MF (3.5 mm)	M0F	M0F	M0F
Both connectors are female	NFF (Type-N 50 Ω) 3FF (3.5 mm)	00F	00F	F0F
Both connectors are male	NMM (Type-N 50 Ω) 3MM (3.5 mm)	00M	00M	M0M

Additional mixed connector options are available for these 2-ports ECal modules

Model	Connector Type	Port A option (female)	Male	Connector Type	Port B option (female)	Male
85092C	Type-N 50 Ω	103	104	3.5 mm 7-16	201 205	202 206
85093C	3.5 mm	101	102	Type-N 50 Ω 7-16	203 205	204 206
85098C	7-16	105	106	3.5 mm Type-N 50 Ω	201 203	202 204

Model	Connector Type	Port A option (female)	Male	Connector Type	Port B option (female)	Male
85092D	Type-N 50 Ω 4.3-10	103 107	104 108	3.5 mm 7-16 4.3-10	201 205 207	202 206 208
85093D	3.5 mm 4.3-10	101 107	102 108	Type-N 50 Ω 7-16 4.3-10	203 205 207	204 206 208
85094D	4.3-10	107	108	3.5 mm Type-N 50 Ω 7-16	201 203 205	202 204 206
85098D	7-16	105	106	3.5 mm Type-N 50 Ω 4.3-10	201 203 207	202 204 208

4-port ECal module

Keysight 4-port ECal modules support in-family mixed connector options - male-male, female-female and male-female for the same connector type.

N4431D

Description	Port A option	Port B option	Port C option	Port D option
Four 3.5 mm (female)	010			
Four Type-N 50 Ω female	020			
3.5 mm (female)	101	201	301	401
3.5 mm (male)	102	202	302	402
Type-N 50 Ω (female)	103	203	303	403
Type-N 50 Ω (male)	104	204	304	404
7-16 (female)	105	205	305	405
7-16 (male)	106	206	306	406
4.3-10 (female)	107	207	307	407
4.3-10 (male)	108	208	308	408

N4432D

Description	Port A option	Port B option	Port C option	Port D option
Four Type-N 50 Ω female	020			
3.5 mm (female)	101	201	301	401
3.5 mm (male)	102	202	302	402
Type-N 50 Ω (female)	103	203	303	403
Type-N 50 Ω (male)	104	204	304	404

N4433D

Description	Port A option	Port B option	Port C option	Port D option
3.5 mm (female)	101	201	301	401
3.5 mm (male)	102	202	302	402
Four 3.5 mm (female)	010			

Low frequency option

Option	Description	Additional information
Option 0DC	Low frequency starts from DC	Only available for N469xD, 8509xD and N4432/3D
Option 003	Low frequency starts from 300 kHz	Only available for N4690D, N4691D, N4696D, 8509xD N4432D and N4433D
Option 100	Low frequency starts from 10 MHz	Only available for N4692D, N4693D and N4694D

Accessories and calibration options

Select the corresponding option to extend the lower frequency range.

Option	Description	Additional information
Accessories for N756xA multiport ECal		
N7560X		
001	RF semi-rigid cable	Additional accessories for N756xA multiport ECal that can be purchased separately.
002	RF semi-rigid cable for horizontal connection	
003	USB 3.0 cable Type-A and Type-C dual screw locking, 2 m	
150	Plastic storage box	
701	Mounting bracket	
702	Bracket horizontal connection	
703	Stand plate	
704	RF semi-rigid cable guard	
Accessories (For 2/4-port ECal)		
Option 00A	Add male-to-male and female-to-female adapters	Not available for N755xA Series and ECal modules with 7 mm connector (Eg. N4696D)
Calibration documents		
Option 1A7	Calibration + Uncertainties + Guardbanding (Not Accredited)	
Option A6J	ANSI Z540-1-1994 calibration	Not available for N756xA
Option UK6	Commercial calibration certificate with test data	

VNA Compatibility List

1. N755xA Series 2-port Economy ECal Module

VNA Model	N755xA Series	VNA Firmware Revision	Interface Required	Additional information
PNA Series				
N522xB, N523xB, N524xB	Yes	No firmware restriction	USB	
N522xA, N523xA, N524xA	Yes	≥ A.10.49.07	USB	
ENA Series				
E5080B	Yes	No firmware restriction	USB	
E5080A	Yes	≥ A.12.55.05	USB	
E5071C	Yes	≥ B.13.32	USB	
E5072A	Yes	≥ B.02.39	USB	
E5061B	Yes	≥ B.04.86	USB	
E5063A	Yes	≥ A.03.72	USB	
Streamline Series USB VNA				
P937xA	Yes	≥ A.10.55.07	USB	
P937xB, P938xB	Yes	No firmware restriction	USB	
P500xA, P502xA	Yes	No firmware restriction	USB	
P500xB, P502xB	Yes	No firmware restriction	USB	
PXI VNA				
M980xA	Yes	No firmware restriction	USB	
M937xA	Yes	≥ A.03.10	USB	
M9485A	Yes	≥ A.03.10	USB	
FieldFox				
N9912A	No	N/A	N/A	
N99xxA (excluding N9912A)	Yes	≥ A.10.2x with CPU2	USB	
N99xxB	Yes	No firmware restriction	USB	

N755xA supports any USB 2.0 compliant hub. It can communicate at High Speed (480 Mbps) and Full Speed (12 Mbps)

2. 8509xC Series 2-port RF ECal Module

VNA Model	N755xA Series	VNA Firmware Revision	Interface Required	Additional information
PNA Series				
N522xB, N523xB, N524xB	Yes	No firmware restriction	USB	
N522xA, N523xA, N524xA	Yes	No firmware restriction	USB	
ENA Series				
E5080B	Yes	No firmware restriction	USB	
E5080A	Yes	No firmware restriction	USB	
E5071C	Yes	No firmware restriction	USB	
E5072A	Yes	No firmware restriction	USB	
E5061B	Yes	No firmware restriction	USB	
E5063A	Yes	No firmware restriction	USB	
Streamline Series USB VNA				
P937xA	Yes	No firmware restriction	USB	
P937xB, P938xB	Yes	No firmware restriction	USB	
P500xA, P502xA	Yes	No firmware restriction	USB	
P500xB, P502xB	Yes	No firmware restriction	USB	
PXI VNA				
M980xA	Yes	No firmware restriction	USB	
M937xA	Yes	No firmware restriction	USB	
M9485A	Yes	No firmware restriction	USB	
FieldFox				
N9912A	No	N/A	N/A	
N99xxA (excluding N9912A)	Yes	≥ A.10.2x with CPU2 or ≥ A.08.19 with CPU1	USB	
N99xxB	Yes	No firmware restriction	USB	

3. 8509xD Series 2-port RF ECal Module

VNA Model	N755xA Series	VNA Firmware Revision	Interface Required	Additional information
PNA Series				
N522xB, N523xB, N524xB	Yes	No firmware restriction	USB	
N522xA, N523xA, N524xA	Yes	≥ A.10.49.07	USB	
ENA Series				
E5080B	Yes	No firmware restriction	USB	
E5080A	Yes	≥ A.12.60.03	USB	8509xD supports any USB 2.0 compliant hub. It can communicate at High Speed (480 Mbps) and Full Speed (12 Mbps).
E5071C	Yes	≥ B.14.03	USB	
E5072A	Yes	≥ B.02.44	USB	
E5061B	Yes	≥ B.05.02	USB	
E5063A	Yes	≥ A.05.06	USB	
Streamline Series USB VNA				
P937xA	Yes	No firmware restriction	USB	
P937xB, P938xB	Yes	No firmware restriction	USB	
P500xA, P502xA	Yes	No firmware restriction	USB	
P500xB, P502xB	Yes	No firmware restriction	USB	
PXI VNA				
M980xA	Yes	No firmware restriction	USB	
M937xA	Yes	≥ A.12.60.02	USB	
M9485A	Yes	≥ A.12.60.02	USB	
FieldFox				
N9912A	No	N/A	N/A	
N99xxA (excluding N9912A)	Yes	≥ A.10.2x with CPU2	USB	
N99xxB	Yes	No firmware restriction	USB	

4. N469xD Series 2-port Microwave ECal Module

VNA Model	N4690D/ N4691D/ N4692D/ N4696D	VNA Firmware Revision	N4693D / N4694D	VNA Firmware Revision	Interface Required	Additional information
PNA Series						
N522xB, N523xB, N524xB	Yes	≥ A.12.85.00	Yes	≥ A.12.85.00	USB	
N522xA, N523xA, N524xA	Yes	≥ A.10.60.04	Yes	≥ A.10.60.04	USB	
ENA Series						
E5080B	Yes	No firmware restriction	Yes	No firmware restriction	USB	
E5080A	Yes	≥ A.12.60.03	Yes	≥ A.12.60.03	USB	
E5071C	Yes	≥ B.14.03	No	N/A	USB	N469xD supports any USB 2.0 compliant hub. It can communicate at High Speed (480 Mbps) and Full Speed (12 Mbps). N4696D ECal drivers for E5072A must be updated. Contact Keysight Technologies for updating the drivers.
E5072A	Yes	≥ B.02.44	No	N/A	USB	
E5061B	Yes	≥ B.05.02	No	N/A	USB	
E5063A	Yes	≥ A.05.06	No	N/A	USB	
Streamline Series USB VNA						
P937xA	Yes	No firmware restriction	Yes	No firmware restriction	USB	
P937xB, P938xB	Yes	No firmware restriction	Yes	No firmware restriction	USB	
P500xA, P502xA	Yes	No firmware restriction	Yes	No firmware restriction	USB	
P500xB, P502xB	Yes	No firmware restriction	Yes	No firmware restriction	USB	
PXI VNA						
M980xA	Yes	No firmware restriction	Yes	No firmware restriction	USB	
M937xA	Yes	≥ A.12.60.02	Yes	≥ A.12.60.02	USB	
M9485A	Yes	≥ A.12.60.02	Yes	≥ A.12.60.02	USB	
FieldFox						
N9912A	No	N/A	No	N/A	N/A	
N99xxA (excluding N9912A)	Yes	≥ A.10.2x with CPU2	Yes	≥ A.10.2x with CPU2	USB	
N99xxB	Yes	No firmware restriction	Yes	No firmware restriction	USB	

5. N443xD Series 4-port ECal Modules

VNA Model	N4431/2D	VNA Firmware Revision	N4433D	VNA Firmware Revision	Interface Required	Additional information
PNA Series						
N522xB, N523xB, N524xB	Yes	≥ A.12.85.00	Yes	≥ A.12.85.00	USB	
N522xA, N523xA, N524xA	Yes	≥ A.10.60.04	Yes	≥ A.10.60.04	USB	
ENA Series						
E5080B	Yes	No firmware restriction	Yes	No firmware restriction	USB	
E5080A	Yes	≥ A.12.55.05	Yes	≥ A.12.55.05	USB	
E5071C	Yes	≥ B.14.03	No	N/A	USB	
E5072A	Yes	≥ B.02.44	No	N/A	USB	
E5061B	Yes	≥ B.05.02	No	N/A	USB	
E5063A	Yes	≥ B.05.06	No	N/A	USB	
Streamline Series USB VNA						N443xD supports any USB 2.0 compliant hub. It can communicate at High Speed (480 Mbps) and Full Speed (12 Mbps)
P937xA	Yes	No firmware restriction	Yes	No firmware restriction	USB	
P937xB, P938xB	Yes	No firmware restriction	Yes	No firmware restriction	USB	
P500xA, P502xA	Yes	No firmware restriction	Yes	No firmware restriction	USB	
P500xB, P502xB	Yes	No firmware restriction	Yes	No firmware restriction	USB	
PXI VNA						
M980xA	Yes	No firmware restriction	Yes	No firmware restriction	USB	
M937xA	Yes	≥ A.10.55.07	Yes	≥ A.10.55.07	USB	
M9485A	Yes	≥ A.10.55.07	Yes	≥ A.10.55.07	USB	
FieldFox						
N9912A	No	N/A	No	N/A	N/A	
N99xxA (excluding N9912A)	Yes	≥ A.10.2x with CPU2	Yes	≥ A.10.2x with CPU2	USB	
N99xxB	Yes	No firmware restriction	Yes	No firmware restriction	USB	

6. N756xA 6/12/18/24/30/36-ports Multiport ECal

VNA Model	N756xA Series	VNA Firmware Revision	Interface Required	Additional information
PNA Series				
N522xB, N523xB, N524xB	Yes	≥ A.15.60.xx	USB	
N522xA, N523xA, N524xA	No	N/A	N/A	
ENA Series				1. N756xA multiport ECal do not support calibration with external switches 2. N756xA multiport ECal comes with mandatory control software pre-installed in each module 3. N756xA multiport ECal do not support user characterization S94554B: 9 GHz model control software S94555B: 20 GHz model control software
E5080B	Yes	≥ A.15.60.xx	USB	
E5080A	No	N/A	N/A	
E5071C	No	N/A	N/A	
E5072A	No	N/A	N/A	
E5061B	No	N/A	N/A	
E5063A	No	N/A	N/A	
Streamline Series USB VNA				
P937xA	Yes	≥ A.15.60.xx	USB	
P937xB, P938xB	Yes	≥ A.15.60.xx	USB	
P500xA, P502xA	Yes	≥ A.15.60.xx	USB	
P500xB, P502xB	Yes	≥ A.15.60.xx	USB	
PXI VNA				
M980xA	Yes	≥ A.15.60.xx	USB	
M937xA	Yes	≥ A.15.60.xx	USB	
M9485A	No	N/A	N/A	
FieldFox				
N9912A	No	N/A	N/A	
N99xxA (excluding N9912A)	No	N/A	N/A	
N99xxB	No	N/A	N/A	

Input Power Level

Before performing a calibration, make sure the input power and DC levels do not exceed the values indicated in the table below.

Parameter	N755xA	8509xC	8509xD	N469xD	N443xD	N756xA
Typical maximum input power[1, 2]	-15.0 dBm	+9.0 dBm	-5.0 dBm	-5.0 dBm	-7.0 dBm	-10.0 dBm
Typical maximum DC level applied to test port[3]	0 volts	+/- 20 volts	+/- 10 volts	+/- 10 volts	+/- 3 volts	0 volts
Typical damage level[4]	+10.0 dBm	+20.0 dBm	+10.0 dBm	+10.0 dBm	+20.0 dBm	+15.0 dBm

1. If the maximum input power is exceeded when calibrating, compression may occur.
2. When using the PNA-X, the power level can be increased after calibration with minimal impact on measurement accuracy.
3. Maximum DC level applied to test port, where Option 0DC for N469xD and N443xD is set to 0 volts.
4. When applied power exceeds this level, permanent damage to the ECal can occur.

Operating Temperature

The temperature of the ECal module must be within the following temperature range to meet the operating specifications.

- **8509xC Series**: +20 to +30 °C
- **8509xD Series**: +20 °C to +26 °C and up to 95% relative humidity (RH) at 40 °C, non-condensing
- **N443xD Series:** +20 °C to +26 °C and up to 95% relative humidity (RH) at 40 °C, non-condensing.
- **N469x Series:** +20 °C to +26 °C and up to 95% relative humidity (RH) at 40 °C, non-condensing.
- **N755xA Series:** +15 to +35°C and up to 75 % relative humidity (RH)
- **N756xA Series:** +20°C to +30°C and up to 75% relative humidity (RH)

Electrical Specifications

Electrical performance for RF and microwave ECal modules is provided in the following tables, which describe warranted performance that most units exhibit. Ecal modules reflection parameter performance applies to each of the port.

8509xC Series 2-port RF ECal Module

85091C (7 mm)[1]	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	45	52	52	50	45
Source match (dB)	36	45	44	41	34
Reflection tracking (± dB)	0.10	0.04	0.04	0.07	0.10

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.

85092C (Type-N 50 Ω)[1]	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	45	52	52	49	45
Source match (dB)	36	45	44	41	36
Reflection tracking (± dB)	0.10	0.04	0.04	0.06	0.07

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.

85093C (3.5 mm)[1]	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	45	52	52	50	47
Source match (dB)	36	44	44	39	34
Reflection tracking (± dB)	0.10	0.03	0.04	0.05	0.07

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.

85096C (Type-N 75 Ω)[1]	300 kHz to 10 MHz	10 to 300 MHz	300 MHz to 1.3 GHz	1.3 to 3 GHz
Directivity (dB)	45	50	48	43
Source match (dB)	36	48	45	38
Reflection tracking (± dB)	0.10	0.03	0.06	0.10

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.

85098C (7-16)[1]	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 7.5 GHz
Directivity (dB)	45	47	47	46	45
Source match (dB)	36	43	46	38	37
Reflection tracking (± dB)	0.10	0.03	0.03	0.05	0.06

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.

85099C (Type-F)[1]	300 kHz to 10 MHz	10 to 300 MHz	300 MHz to 1.3 GHz	1.3 to 3 GHz
Directivity (dB)	45	50	48	43
Source match (dB)	36	48	45	38
Reflection tracking (± dB)	0.10	0.03	0.07	0.15

1. When mated with male connectors with a 0.77 mm (.030 in) to 0.85 (0.34) pin diameter.

8509xD Series 2-port RF ECal Module

85091D (7 mm)[1]	DC to 10 MHz	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	52	45	52	52	50	45
Source match (dB)	45	36	45	44	41	34
Reflection tracking (± dB)	0.04	0.10	0.04	0.04	0.07	0.10

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.

85092D (Type-N 50 ohm)[1]	DC to 10 MHz	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	52	45	52	52	49	45
Source match (dB)	45	36	45	44	41	36
Reflection tracking (± dB)	0.04	0.10	0.04	0.04	0.06	0.04

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table

85093D (3.5 mm)[1]	DC to 10 MHz	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	52	45	52	52	50	47
Source match (dB)	44	36	44	44	39	34
Reflection tracking (± dB)	0.03	0.10	0.03	0.04	0.05	0.07

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table

85094D (4.3-10)[1]	DC to 10 MHz	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Directivity (dB)	47	45	57	47	44	43
Source match (dB)	43	36	43	43	35	34
Reflection tracking (± dB)	0.03	0.10	0.03	0.03	0.07	0.09

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table

85096D (Type-N 75 ohm)[1]	DC to 10 MHz	300 kHz to 10 MHz	10 to 300 MHz	300 MHz to 1.3 GHz	1.3 to 9 GHz
Directivity (dB)	50	45	50	48	43
Source match (dB)	45	36	48	45	38
Reflection tracking (± dB)	0.03	0.10	0.03	0.06	0.10

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table

85098D (7-16)[1]	DC to 10 MHz	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 7.5 GHz
Directivity (dB)	47	45	47	47	46	45
Source match (dB)	43	36	43	43	38	37
Reflection tracking (± dB)	0.03	0.10	0.03	0.03	0.05	0.06

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table

85099D (Type-F 75 ohm)[1]	DC to 10 MHz	300 kHz to 10 MHz	10 to 300 MHz	300 MHz to 1.3 GHz	1.3 to 3 GHz	3 to 6 GHz
Directivity (dB)	50	45	50	48	43	41
Source match (dB)	45	36	48	45	38	34
Reflection tracking (± dB)	0.03	0.10	0.03	0.07	0.15	0.17

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table

N755xA Series 2-port Economy ECal Module

N755xA Series (3.5 mm)

The electrical specification performance in the following table applies to N755xA Option 3MF, 3MM or 3FF (3.5 mm connectors).

N755xA (3.5 mm)[1]	DC to 500 MHz	500 MHz to 4 GHz	4 to 6.5 GHz	6.5 to 9 GHz	9 to 14 GHz	14 to 18 GHz	18 to 26.5 GHz
Directivity (dB)	42	36	36	36	36	36	36
Source match (dB)	37	30	30	30	28	28	27
Reflection tracking (± dB)	0.13	0.13	0.18	0.18	0.25	0.25	0.30

1. When applied power exceeds −15 dBm, calibration results will be degraded from the performance indicated in this table.

N755xA Series (Type-N 50 Ω)

The electrical specification in the following table applies to N755xA Option NMF, NMM or NFF (Type-N connectors).

N755xA (Type-N 50 Ω)[1]	DC to 500 MHz	500 MHz to 4 GHz	4 to 6.5 GHz	6.5 to 9 GHz	9 to 14 GHz	14 to 18 GHz
Directivity (dB)	42	36	36	36	36	36
Source match (dB)	37	30	30	30	28	28
Reflection tracking (± dB)	0.13	0.13	0.18	0.18	0.25	0.25

1. When applied power exceeds −15 dBm, calibration results will be degraded from the performance indicated in this table.

N469xD Series 2-port Microwave ECal Module

N4690D[1]	DC to 2 MHz[2]	2 to 10 MHz[2]	300 kHz to 2 MHz[3]	2 to 10 MHz[3]	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 18 GHz
Directivity (dB)	45	45	30	40	45	45	40	38
Source match (dB)	40	40	28	35	40	43	40	35
Reflection tracking (± dB)	0.05	0.05	0.12	0.07	0.05	0.03	0.03	0.05

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 003.

N4691D[1]	DC to 2 MHz[2]	2 to 10 MHz[2]	300 kHz to 2 MHz[3]	2 to 10 MHz[3]	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 20 GHz	20 to 26.5 GHz
Directivity (dB)	46	46	31	41	46	47	46	43	41
Source match (dB)	41	41	29	36	41	47	45	42	40
Reflection tracking (± dB)	0.05	0.05	0.11	0.06	0.05	0.02	0.03	0.04	0.05

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 003.

N4692D[1]	DC to 45 MHz[1]	10 to 45 MHZ[3]	45 to 200 MHz	200 MHz to 2 GHz	2 to 20 GHz	20 to 30 GHz	30 to 40 GHz
Directivity (dB)	40	29	41	42	38	35	32
Source match (dB)	38	29	36	36	35	30	29
Reflection tracking (± dB)	0.1	0.18	0.08	0.08	0.10	0.10	0.12

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 003.

N4693D[1]	DC to 45 MHz[2]	10 to 10 45 MHz[3]	45 to 200 MHz	200 MHz to 2 GHz	2 to 10 GHz	10 to 20 GHz	20 to 40 GHz	40 to 50 GHz
Directivity (dB)	40	27	40	46	47	44	38	34
Source match (dB)	38	25	44	46	42	37	35	32
Reflection tracking (± dB)	0.05	0.05	0.05	0.03	0.04	0.05	0.06	0.08

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 003.

N4694D[1]	DC to 45 MHz[2]	10 to 10 45 MHz[3]	45 to 200 MHz	200 MHz to 2 GHz	2 to 20 GHz	20 to 30 GHz	30 to 40 GHz	40 to 50 GHz	50 to 60 GHz	60 to 67 GHz
Directivity (dB)	41	27	41	41	42	41	40	38	35	33
Source match (dB)	38	23	38	38	39	35	34	33	30	26
Reflection tracking (± dB)	0.08	0.08	0.04	0.04	0.04	0.05	0.06	0.08	0.08	0.12

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 003.

N4696D[1]	DC to 2 MHz[2]	2 to 10 MHz[2]	300 kHz to 2 MHz[3]	2 to 10 MHz[3]	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 18 GHz
Directivity (dB)	46	46	30	40	46	45	44	41
Source match (dB)	40	40	28	35	40	40	42	36
Reflection tracking (± dB)	0.05	0.05	0.12	0.07	0.05	0.03	0.03	0.05

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 003.

N443xD Series 4-port ECal Modules

The electrical specification in the following table applies to N4431D Option 010 (3.5 mm female connectors on all ports).

N4431D Option 010[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz
Directivity (dB)	45	53	48	45
Source match (dB)	36	50	45	37
Reflection tracking (± dB)	0.10	0.03	0.04	0.10

The electrical specification in the following table applies to N4431D Option 010 (3.5 mm female connectors on all ports).

N4431D Option 020[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz
Directivity (dB)	45	50	47	45
Source match (dB)	36	47	42	37
Reflection tracking (± dB)	0.10	0.03	0.04	0.10

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.

The electrical specification in the following table applies to N4431D (7-16 female connectors on all ports).

N4431D (7-16 female connector)[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 7.5 GHz
Directivity (dB)	45	50	47
Source match (dB)	36	42	39
Reflection tracking (± dB)	0.10	0.06	0.09

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.

The electrical specification in the following table applies to N4431D (4.3-10 female connectors on all ports).

N4431D (4.3-10 female connector)[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 12 GHz
Directivity (dB)	45	50	47	45
Source match (dB)	36	42	39	37
Reflection tracking (± dB)	0.10	0.06	0.09	0.10

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.

The electrical specification in the following table applies to N4432D Option 020 (Type-N 50 Ω female connectors on all ports).

N4432D Option 020[1]	DC to 10 MHz[2]	300 kHz to 10 MHz[3]	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz	13.5 to 18 GHz
Directivity (dB)	50	45	50	47	41	40
Source match (dB)	41	35	41	37	34	34
Reflection tracking (± dB)	0.06	0.10	0.06	0.10	0.15	0.14

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For option 003.

The electrical performance in the following table applies to N4433D Option 010 (3.5 mm female connectors on all ports).

N4433D Option 010[1]	DC to 10 MHz[2]	300 kHz to 10 MHz[3]	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz	13.5 to 20 GHz	20 to 26.5 GHz
Directivity (dB)	50	45	50	47	45	40	36
Source match (dB)	42	36	42	39	37	31	26
Reflection tracking (± dB)	0.06	0.10	0.06	0.09	0.10	0.18	0.31

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For option 003.

N756xA Series Multiport ECal Modules

N7562A (Type-N 50 Ω female and 3.5 mm female)[1]	DC to 100 kHz	100 kHz to 500 MHz	500 MHz to 4 GHz	4 to 9 GHz
Directivity (dB)	42	42	36	36
Source match (dB)	37	37	30	30
Reflection tracking (± dB)	0.13	0.13	0.13	0.18

1. When applied power exceeds –10 dBm, calibration results will be degraded from the performance indicated in this table.

N7564A (3.5 mm female)[1]	DC to 100 kHz	100 kHz to 500 MHz	500 MHz to 4 GHz	4 to 9 GHz	9 to 14 GHz	14 to 18 GHz	18 to 20 GHz
Directivity (dB)	42	42	36	36	34	32	31
Source match (dB)	37	37	30	30	28	28	27
Reflection tracking (± dB)	0.13	0.13	0.13	0.18	0.25	0.25	0.30

1. When applied power exceeds –10 dBm, calibration results will be degraded from the performance indicated in this table.

Characteristic Performance

Characteristic performance for RF and microwave ECal modules is provided in the following tables, which describe non-warranted performance that most units exhibit.

8509xC Series 2-port RF ECal Module

85091C (7 mm)[1]	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Transmission tracking (± dB)[2]	0.08	0.05	0.05	0.07	0.15
Load match (dB)[2]	40	46	45	43	38

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5231A Option 200.

85092C (Type-N 50 Ω)[1]	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Transmission tracking (± dB)[2]	0.12	0.05	0.06	0.11	0.17
Load match (dB)[2]	36	41	45	40	37

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5231A Option 200.

85093C (3.5 mm)[1]	300 kHz to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 9 GHz
Transmission tracking (± dB)[2]	0.13	0.05	0.05	0.10	0.16
Load match (dB)[2]	36	42	45	42	39

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5231A Option 200.

85096C (Type-N 75 Ω)[1]	300 kHz to 10 MHz	10 to 300 MHz	300 MHz to 1.3 GHz	1.3 to 3 GHz
Transmission tracking (± dB)[2]	0.13	0.05	0.06	0.10
Load match (dB)[2]	36	42	41	37

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer E5061B Option 237.

85098C (7-16)[1]	300 kHz to 10 MHz	10 MHz to1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 7.5 GHz
Transmission tracking (± dB)[2]	0.13	0.06	0.07	0.12	0.14
Load match (dB)[2]	36	40	38	36	34

1. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5231A Option 200.

85099C (Type-F)[1,2]	300 kHz to 10 MHz	10 to 300 MHz	300 MHz to 1.3 GHz	1.3 to 3 GHz
Transmission tracking (± dB)[3]	0.13	0.05	0.07	0.11
Load match (dB)[3]	36	42	41	36

1. When mated with male connectors with a 0.77 mm (.030 in) to 0.85 (0.34) pin diameter.
2. When applied power exceeds +9 dBm, calibration results will be degraded from the performance indicated in this table.
3. Values based on using the network analyzer E5061B Option 237.

N755xA Series 2-port Economy ECal Module

N755xA Series (3.5 mm)

The characteristic performance in the following table applies to N755xA Option 3MF, 3MM or 3FF (3.5 mm connectors).

N755xA (3.5 mm)[1]	DC to 500 MHz	500 MHz to 4 GHz	4 to 6.5 GHz	6.5 to 9 GHz	9 to 14 GHz	14 to 18 GHz	18 to 26.5 GHz
Transmission tracking (± dB)[2]	0.15	0.16	0.22	0.22	0.30	0.30	0.35
Load match (dB)[2]	34	29	28	22	26	26	24

1. When applied power exceeds −15 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5234A Option 200.

N755xA Series (Type-N 50 Ω)

The characteristic performance in the following table applies to N755xA Option NMF, NMM or NFF (Type-N connectors).

N755xA (Type-N 50 Ω)[1]	DC to 500 MHz	500 MHz to 4 GHz	4 to 6.5 GHz	6.5 to 9 GHz	9 to 14 GHz	14 to 18 GHz
Transmission tracking (± dB)[2]	0.15	0.16	0.22	0.22	0.30	0.30
Load match (dB)[2]	34	29	28	22	26	26

1. When applied power exceeds −15 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5234A Option 200.

N469xD Series 2-port Microwave ECal Module

N4690D1	DC to 2 MHz[2]	2 to 10 MHz[2]	300 kHz to 2 MHz[3]	2 to 10 MHz[3]	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 18 GHz
Transmission tracking (± dB)[4, 5]	0.17	0.06	0.37	0.08	0.10	0.04	0.05	0.09
Load match (dB)[4, 5]	36	41	26	37	33	42	39	34

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 010.
4. DC to 10 MHz values based on using the network analyzer N5231B Option 200.
5. 10 MHz to 18 GHz MHz values based on using the network analyzer N5222B Option 200.

N4691D1	DC to 2 MHz[2]	2 to 10 MHz[2]	300 kHz to 2 MHz [3]	2 to 10 MHz[3]	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 20 GHz	20 to 26.5 GHz
Transmission tracking (± dB)[4, 5]	0.21	0.06	0.37	0.08	0.09	0.03	0.04	0.07	0.09
Load match (dB)[4, 5]	34	41	27	37	34	46	43	40	38

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 010.
4. DC to 10 MHz values based on using the network analyzer N5231B Option 200.
5. 10 MHz to 26.5 GHz values based on using the network analyzer N5222B Option 200.

N4692D[1]	DC to 45 MHz[2]	10 to 45 MHZ[3]	45 to 200 MHz	200 MHz to 2 GHz	2 to 20 GHz	20 to 30 GHz	30 to 40 GHz
Transmission tracking (± dB)[4]	0.13	0.28	0.11	0.10	0.14	0.17	0.21
Load match (dB)[4]	35	27	34	35	33	28	27

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 010.
4. Values based on using the network analyzer N5224B Option 200.

N4693D[1]	DC to 45 MHz[2]	10 to 10 45 MHz[3]	45 to 200 MHz	200 MHz to 2 GHz	2 to 10 GHz	10 to 20 GHz	20 to 40 GHz	40 to 50 GHz
Transmission tracking (± dB)[4]	0.08	0.18	0.08	0.04	0.05	0.07	0.11	0.15
Load match (dB)[4]	36	24	41	45	40	35	33	30

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 010.
4. Values based on using the network analyzer N5224B Option 200.

N4694D[1]	DC to 45 MHz[2]	10 to 10 45 MHz[3]	45 to 200 MHz	200 MHz to 2 GHz	2 to 20 GHz	20 to 30 GHz	30 to 40 GHz	40 to 50 GHz	50 to 60 GHz	60 to 67 GHz
Transmission tracking (± dB)[4]	0.12	0.28	0.08	0.08	0.08	0.09	0.11	0.14	0.15	0.22
Load match (dB)[4]	35	22	36	36	37	33	32	31	28	24

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 010.
4. Values based on using the network analyzer N5227B Option 200.

N4696D[1]	DC to 2 MHz[2]	2 to 10 MHz[2]	300 kHz to 2 MHz[3]	2 to 10 MHz[3]	10 to 500 MHz	500 MHz to 2 GHz	2 to 10 GHz	10 to 18 GHz
Transmission tracking (± dB)[4, 5]	0.17	0.05	0.37	0.08	0.10	0.04	0.05	0.08
Load match (dB)[4, 5]	36	41	26	37	33	39	41	34

1. When applied power exceeds −5 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For Option 010.
4. DC to 10 MHz values based on using the network analyzer N5231B Option 200.
5. 10 MHz to 18 GHz values based on using the network analyzer N5222B Option 200.

N443xD Series 4-port ECal Modules

The characteristic performance in the following table applies to N4431D Option 010 (3.5 mm female connectors on all ports).

N4431D Option 010[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz
Transmission tracking (± dB)[2]	0.18	0.08	0.08	0.12
Load match (dB)[2]	35	41	41	38

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5232B 400.

The characteristic performance in the following table applies to N4431D Option 020 (Type-N female connectors on all ports)

N4431D Option 020[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz
Transmission tracking (± dB)[2]	0.18	0.05	0.08	0.12
Load match (dB)[2]	35	43	41	38

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5232B 400.

The characteristic performance in the following table applies to N4431D (7-16 female connectors on all ports).

N4431D (7-16 female connector)[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 7.5 GHz
Transmission tracking (± dB)2	0.18	0.05	0.08
Load match (dB)2	35	42	40

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5232B 400.

The characteristic performance in the following table applies to N4431D (4.3-10 female connectors on all ports).

N4431D (4.3-10 female connector)[1]	DC to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 12 GHz
Transmission tracking (± dB)[2]	0.18	0.05	0.09	0.12
Load match (dB)[2]	35	42	39	32

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer N5232B 400.

The characteristic performance in the following table applies to N4432D Option 020 (Type-N 50 Ω female connectors on all ports).

N4432D Option 020[1]	DC to 10 MHz[2]	300 kHz to 10 MHz[3]	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz	13.5 to 18 GHz
Transmission tracking (± dB)[4]	0.17	0.18	0.05	0.09	0.13	0.19
Load match (dB)[4]	37	35	42	39	35	33

The characteristic performance in the following table applies to N4433D Option 010 (3.5 mm female connectors on all ports).

N4433D Option 010[1]	DC to 10 MHz[2]	300 kHz to 10 MHz[3]	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz	13.5 to 20 GHz	20 to 26.5 GHz
Transmission tracking (± dB)[4]	0.08	0.12	0.08	0.11	0.12	0.22	0.38
Load match (dB)[4]	39	33	39	36	34	28	23

1. When applied power exceeds -7 dBm, calibration results will be degraded from the performance indicated in this table.
2. For Option 0DC.
3. For option 003.
4. Values based on using the network analyzer N5232B 400.

N756xA Series Multiport ECal Modules

N7562A (Type-N 50 Ω female and 3.5 mm female)[1]	DC to 100 kHz	100 kHz to 500 MHz	500 MHz to 4 GHz	4 to 9 GHz
Transmission tracking (± dB)[2]	0.18	0.14	0.17	0.22
Load match (dB)[2]	32	35	29	29

N7564A (3.5 mm female)[1]	DC to 100 kHz	100 kHz to 500 MHz	500 MHz to 4 GHz	4 to 9 GHz	9 to 14 GHz	14 to 18 GHz	18 to 20 GHz
Transmission tracking (± dB)[2]	0.18	0.14	0.17	0.22	0.20	0.33	0.39
Load match (dB)[2]	32	35	29	29	26	26	25

1. When applied power exceeds –10 dBm, calibration results will be degraded from the performance indicated in this table.
2. Values based on using the network analyzer M9804A.