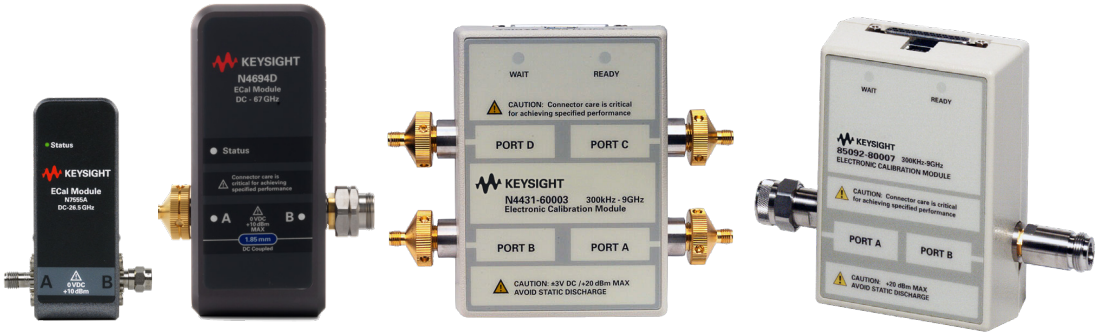
Keysight Technologies
Electronic Calibration (ECal) Modules for Vector Network Analyzers

N755xA Series, 2-port Economy ECal Module
8509xC Series, 2-port RF ECal Module
N469xD Series, 2-port Microwave ECal Module
N443xA/B Series, 4-port ECal Module

Technical Overview



KEYSIGHT TECHNOLOGIES

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Keysight Electronic Calibration (ECal) Modules

This technical overview describes the benefits of electronic calibration (ECal) modules for Keysight vector network analyzers.

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

8509xC Series 2-port RF ECal Modules

- 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-port Microwave ECal Modules

- 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

N443xA/B Series 4-port ECal Modules

- N4431B 9 kHz to 13.5 GHz
- N4432A 300 kHz to 18 GHz
- N4433A 300 kHz to 20 GHz

Keysight Electronic Calibration (ECal) Modules: Achieve fast, accurate, and consistent measurements

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.

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
- 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 only by the measurement accuracy of the original calibration and the test setup used to measure the impedance standards inside the ECal module. 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 N443xA/B 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 N443xA/B 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, 85093C, or 85098C. The connector combination can be either female or male with Type-N 50 Ω, 3.5 mm or 7-16, Mixed connector options are also available for 4-port ECal modules, N4431B or N4432A.

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 N469xD 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 to 67 GHz without making numerous connections during the calibration process.

In addition, the DC option for the N469xD 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.

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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:

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

Once these steps have been completed, the "user-characterized" ECal module can then 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.

Ordering Information

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

ECal modules

Model Number	Connector Types	Frequency Range
N755xA Series 2-port Economy ECal Module		
N7550A	3.5 mm or Type-N 50 Ω	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
8509xC Series 2-port 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
N443xA/B Series 4-port ECal Module		
N4431B	3.5 mm or Type-N 50 Ω or 7-16 or mixed connectors	9 kHz to 13.5 GHz or 9 kHz to 7.5 GHz (with 7-16 connector options)
N4432A	Type-N 50 Ω or 3.5 mm or mixed connectors	300 kHz to 18 GHz
N4433A	3.5 mm	300 kHz to 20 GHz
N469xD Series 2-port Microwave ECal Module		
N4690D	Type-N 50 Ω	DC or 300 kHz to 18 GHz
N4691D	3.5 mm	DC or 300 kHz to 26.5 GHz
N4692D	2.92 mm	DC or 10 MHz to 40 GHz
N4693D	2.4 mm	DC or 10 MHz to 50 GHz
N4694D	1.85 mm	DC or 10 MHz to 67 GHz
N4696D	7 mm	DC or 300 kHz to 18 GHz

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Connector options

2-port ECal module

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

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

Model number	Port A option			Port B option		
	Connector type	Female	Male	Connector type	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

4-port ECal module

N4431B

Connector type	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

N4432A

Connector type	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

N4433A

Connector type	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 options

Select the corresponding option to extend the lower frequency range.

Option number	Description	Additional Information
Accessories		
Option 0DC	Low frequency starts from DC	Only available for N469xD Series ECal modules.
Option 003	Low frequency starts from 300 kHz	Only available for N4690D, N4691D, N4696D ECal modules.
Option 100	Low frequency starts from 10 MHz	Only available for N4692D, N4693D, N4694D ECal modules.

Accessories, calibration options

Option number	Description	Additional Information
Accessories		
Option 00A	Add male-to-male and female-to-female adapters	Not available for N755xA Series and ECal modules with 7 mm connectors (ex. N4696D).
Calibration documents		
Option 1A7	Calibration + Uncertainties + Guardbanding (Not Accredited)	
Option A6J	ANSI Z540-1-1994 calibration	
Option UK6	Commercial calibration certificate with test data	

VNA compatibility list

VNA Series	VNA models	N755xA Series	8509xC Series	N469xD Series	N443xA/B Series	Required VNA firmware revision [1]
PNA Series	N523xB, N522xB, N524xB	Yes	Yes	Yes	Yes	A.12.85.00 or above for the N469xD.
	N523xA, N522xA, N524xA	Yes	Yes	Yes	Yes	A.10.49.07 or above for the N755xA A.10.60.04 or above for the N469xD
ENA Series	E5080A	Yes	Yes	Yes	Yes	A.12.55.05 or above for the N755xA. A.12.60.0x or above for the N469xD.
	E5071C	Yes	Yes [2]	Yes	Yes	B.13.29 or above for the N755xA. B.14.0x or above for the N469xD.
	E5072A	Yes	Yes [2]	Yes	Yes	B.02.39 or above for the N755xA. B.02.4x or above for the N469xD.
	E5061B	Yes	Yes [2]	Yes	Yes	B.04.86 or above for the N755xA. B.05.00 or above for the N469xD.
	E5063A	Yes	Yes [2]	Yes	Yes	A.03.72 or above for the N755XA. A.05.04 or above for the N469xD.
USB VNA	P937xA	Yes	Yes	Yes	Yes	
PXI VNA	M937xA, M9485A	Yes	Yes	Yes	Yes	A.03.10 or above for the N755xA. A.12.60.0x or above for the N469xD.
FieldFox [3]	N9923A/5/6/7/8A N9913/4/5/6/7/8A N9950/51/52A	Yes	Yes	Yes	Yes	Requires a FieldFox with the new CPU (CPU2) for the N755xA and N469xD.

1. There is no restriction with VNA firmware revision for the operation of 8509xC and N443xA/B Series ECal.
2. The N4693D and N4694D are not supported on the E5071C, E5072A, E5061B, and E5063A.
3. The N9912A FieldFox does not support ECal.

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.

Input power limits

	ECal Module Model Number				
Parameter	**8509x**	**N4431x**	**N4432A/N4433A**	**N755xA**	**N469x**
Typical maximum input power	+9.0 dBm	+7.0 dBm	–7.0 dBm	–15 dBm	–5.0 dBm
Typical maximum DC level applied to test port	± 20 volts	± 3 volts	± 3 volts	0 volts	± 10 volts
Typical damage level	+20.0 dBm	+20.0 dBm	+20.0 dBm	+10.0 dBm	+10.0 dBm

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

- 8509x Series: +20 to +30 °C
- N443xA/B Series: +20 to +30 °C
- N469x Series: +20 to +26 °C
- N755xA Series: +15 to +35°C and up to 75 % relative humidity (RH)

Characteristic Performance

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

8509x Series

85091C (7 mm)[1]	Frequency range				
Parameter	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)	0.1	0.04	0.04	0.07	0.1
Transmission tracking (± dB)[2]	0.08	0.05	0.05	0.07	0.15
Load match (dB)[2]	40	46	45	43	38

85092C (Type-N 50 Ω)[1]	Frequency range				
Parameter	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)	0.1	0.04	0.04	0.06	0.07
Transmission tracking (± dB)[2]	0.12	0.05	0.06	0.11	0.17
Load match (dB)[2]	36	41	45	40	37

85093C (3.5 mm)[1]	Frequency range				
Parameter	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)	0.1	0.03	0.04	0.05	0.07
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]	Frequency range			
Parameter	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
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.

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85098C (7-16)[1]	Frequency range				
Parameter	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
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]	Frequency range			
Parameter	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
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.

N4431B (3.5 mm)

The characteristic performance in the following table applies to N4431B Option 010 (3.5 mm female connectors on all ports). The data describes performance when measuring “thru path” A-B, C-D, A-D and B-C.

N4431B Option 010[1]	Frequency range						
Parameter	9 kHz[2] to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 8 GHz	8 to 9 GHz	9 to 13.5 GHz
Directivity (dB)	45	53	52	48	46	44	40
Source match (dB)	36	50	47	45	44	43	32
Reflection tracking (± dB)	0.10	0.03	0.03	0.04	0.04	0.05	0.10
Transmission tracking (± dB)[3]	0.10	0.04	0.06	0.12	0.16	0.17	0.44
Load match (dB)[3]	39	45	45	40	38	36	32

The characteristic performance in the following table applies to N4431B Option 010 (3.5 mm female connectors on all ports). The data describes performance when measuring “thru path” A-C and B-D.

N4431B Option 010[1]	Frequency range						
Parameter	9 kHz[2] to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 8 GHz	8 to 9 GHz	9 to 13.5 GHz
Directivity (dB)	45	53	52	48	46	44	40
Source match (dB)	36	50	47	45	44	43	32
Reflection tracking (± dB)	0.10	0.03	0.03	0.04	0.04	0.05	0.10
Transmission tracking (± dB)[3]	0.10	0.04	0.06	0.11	0.14	0.15	0.30
Load match (dB)[3]	38	45	45	40	38	36	32

1. When applied power exceeds +7 dBm, calibration results will be degraded from the performance indicated in this table.
2. Performance from 9 kHz to 300 kHz is valid only for the E5071C ENA network analyzer with firmware version A.09.10 or higher.
3. Values based on using the network analyzer N5231A Option 400.

N4431B (Type-N 50 Ω)

The characteristic performance in the following table applies to N4431B Option 020 (type-N female connectors on all ports). The data describes performance when measuring "thru path" A-B, C-D, A-D and B-C.

N4431B Option 020[1]	Frequency range						
Parameter	9 kHz[2] to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 8 GHz	8 to 9 GHz	9 to 13.5 GHz
Directivity (dB)	45	53	52	46	44	42	38
Source match (dB)	36	47	43	42	40	39	31
Reflection tracking (± dB)	0.10	0.03	0.04	0.04	0.05	0.06	0.11
Transmission tracking (± dB)[3]	0.10	0.04	0.07	0.12	0.16	0.18	0.45
Load match (dB)[3]	39	45	44	39	37	35	31

The characteristic performance in the following table applies to N4431B Option 020 (type-N female connectors on all ports). The data describes performance when measuring "thru path" A-C and B-D.

N4431B Option 010[1]	Frequency range						
Parameter	9 kHz[2] to 10 MHz	10 MHz to 1 GHz	1 to 3 GHz	3 to 6 GHz	6 to 8 GHz	8 to 9 GHz	9 to 13.5 GHz
Directivity (dB)	45	53	52	46	44	42	38
Source match (dB)	36	47	43	42	40	39	31
Reflection tracking (± dB)	0.10	0.03	0.04	0.04	0.05	0.06	0.11
Transmission tracking (± dB)[3]	0.10	0.04	0.06	0.11	0.14	0.15	0.31
Load match (dB)[3]	39	45	44	39	37	35	31

1. When applied power exceeds +7 dBm, calibration results will be degraded from the performance indicated in this table.
2. Performance from 9 kHz to 300 kHz is valid only for the E5071C ENA network analyzer with firmware version A.09.10 or higher.
3. Values based on using the network analyzer N5231A Option 400.

N4432A (Type-N 50 Ω)

The characteristic performance in the following table applies to N4432A Option 020 (type-N female connectors on all ports).

N4432A Option 020[1]	Frequency range				
Parameter	300 k to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz	13.5 to 18 GHz
Directivity (dB)	45	50	47	41	40
Source match (dB)	35	41	37	34	34
Reflection tracking (± dB)	0.10	0.06	0.10	0.15	0.14
Transmission tracking (± dB)[2]	0.18	0.05	0.10	0.17	0.21
Load match (dB)[2]	35	42	39	35	33

N4433A (3.5 mm)

The characteristic performance in the following table applies to N4433A Option 010 (3.5 mm female connectors on all ports).

N4433A Option 010[1]	Frequency range				
Parameter	300 kHz to 10 MHz	10 MHz to 5 GHz	5 to 9 GHz	9 to 13.5 GHz	13.5 to 20 GHz
Directivity (dB)	45	50	47	45	40
Source match (dB)	36	42	39	37	31
Reflection tracking (± dB)	0.10	0.06	0.09	0.10	0.18
Transmission tracking (± dB)[2]	0.18	0.06	0.09	0.12	0.23
Load match (dB)[2]	35	42	39	38	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 N5232A Option 400.

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]	Frequency range						
Parameter	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 tacking (± dB)	0.13	0.13	0.18	0.18	0.25	0.25	0.30
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

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]	Frequency range					
Parameter	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 tacking (± dB)	0.13	0.13	0.18	0.18	0.25	0.25
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

N4690D	Frequency range							
Parameter	DC to 2 MHz[1]	2 MHz to 10 MHz[1]	300 kHz to 2 MHz[2]	2 MHz to 10 MHz[2]	10 MHz to 500 MHz	500 MHz to 2 GHz	2 GHz to 10 GHz	10 GHz 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
Transmission Tracking (±dB)	0.17[3]	0.06[3]	0.37[3]	0.08[3]	0.10[4]	0.04[4]	0.05[4]	0.09[4]
Load Match (dB)	36[3]	41[3]	26[3]	37[3]	33[4]	42[4]	39[4]	34[4]

1. For Option 0DC
2. For Option 003
3. Values based on using the network analyzer N5231B Option 200
4. Values based on using the network analyzer N5222B Option 200

N4691D	Frequency range								
Parameter	DC to 2 MHz[1]	2 MHz to 10 MHz[1]	300 kHz to 2 MHz[2]	2 MHz to 10 MHz[2]	10 MHz to 500 MHz	500 MHz to 2 GHz	2 GHz to 10 GHz	10 GHz to 18 GHz	20 GHz 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
Transmission Tracking (±dB)	0.21[3]	0.06[3]	0.37[3]	0.08[3]	0.09[4]	0.03[4]	0.04[4]	0.07[4]	0.09[4]
Load Match (dB)	34[3]	41[3]	27[3]	37[3]	34[4]	46[4]	43[4]	40[4]	38[4]

1. For Option 0DC
2. For Option 003
3. Values based on using the network analyzer N5231B Option 200
4. Values based on using the network analyzer N5222B Option 200

N4692D	Frequency range						
Parameter	DC to 45 MHz[1]	10 MHz to 45 MHz[2]	45 MHz to 200 MHz	200 MHz to 2 GHz	2 GHz to 20 GHz	20 GHz to 30 GHz	30 GHz 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	0.1	0.1	0.12
Transmission Tracking (±dB)[3]	0.13	0.28	0.11	0.10	0.14	0.17	0.21
Load Match (dB)[3]	35	27	34	35	33	28	27

1. For Option 0DC
2. For Option 010
3. Values based on using the network analyzer N5224B Option 200

N4693D	Frequency range							
Parameter	DC to 45 MHz[1]	10 MHz to 45 MHz[2]	45 MHz to 200 MHz	200 MHz to 2 GHz	2 GHz to 10 GHz	10 GHz to 20 GHz	20 GHz to 40 GHz	40 GHz 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
Transmission Tracking (±dB)[3]	0.08	0.18	0.08	0.04	0.05	0.07	0.11	0.15
Load Match (dB)[3]	36	24	41	45	40	35	33	30

1. For Option 0DC
2. For Option 010
3. Values based on using the network analyzer N5224B Option 200

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

1. For Option 0DC
2. For Option 010
3. Values based on using the network analyzer N5227B Option 200

N4696D	Frequency range							
Parameter	DC to 2 MHz[1]	2 MHz to 10 MHz[1]	300 kHz to 2 MHz[2]	2 MHz to 10 MHz[2]	10 MHz to 500 MHz	500 MHz to 2 GHz	2 GHz to 10 GHz	10 GHz 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
Transmission Tracking (± dB)	0.17[3]	0.05[3]	0.37[3]	0.08[3]	0.10[4]	0.04[4]	0.05[4]	0.08[4]
Load Match (dB)	36[3]	41[3]	26[3]	37[3]	33[4]	39[4]	41[4]	34[4]

1. For Option 0DC
2. For Option 003
3. Values based on using the network analyzer N5231B Option 200
4. Values based on using the network analyzer N5222B Option 200

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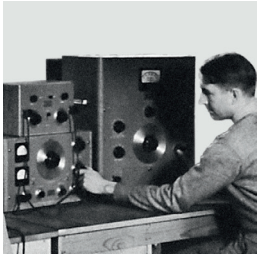

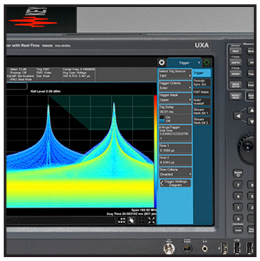

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