

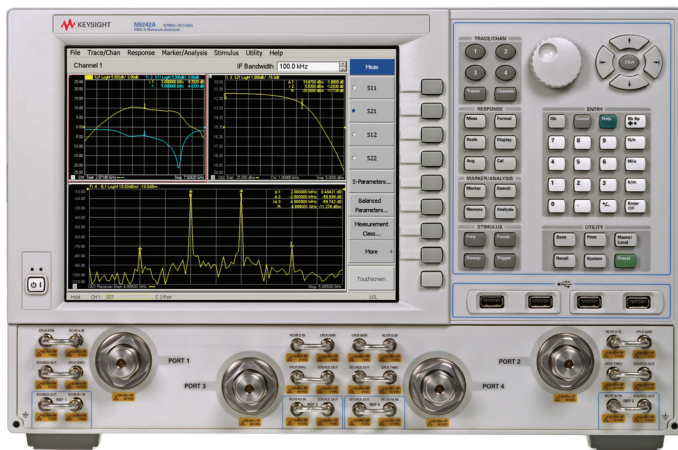
# Keysight Technologies

## PNA Family

### Microwave Network Analyzers

(N522x/3x/4xA)

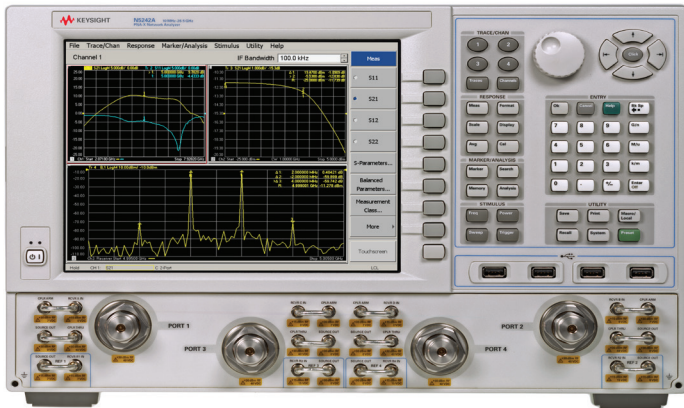
## Configuration Guide



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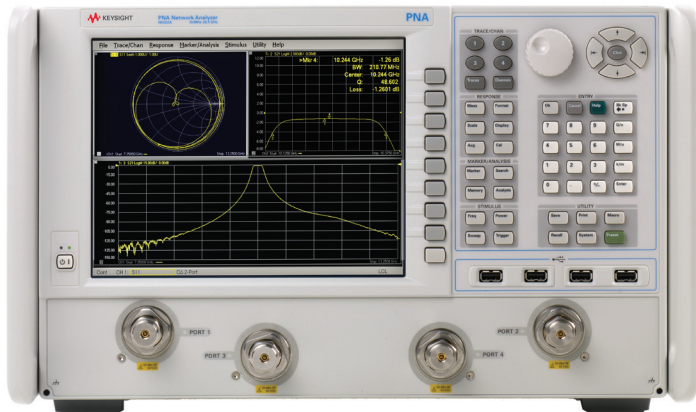
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This configuration guide describes standard configurations, options, accessories, upgrade kits and compatible peripherals for the PNA Family microwave network analyzers. This guide should be used with the Keysight Technologies, Inc. PNA Family data sheets for a complete description of these analyzers.



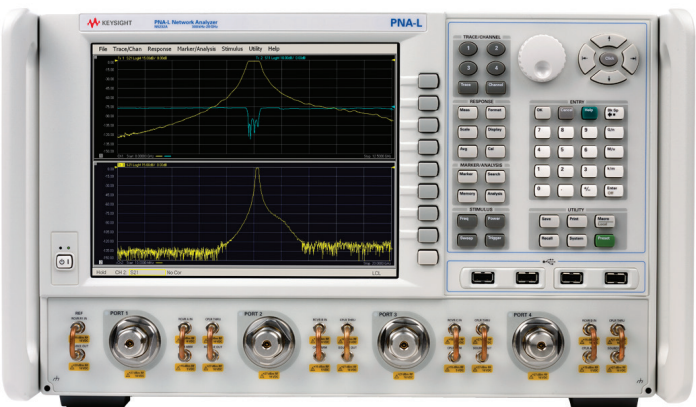
### PNA-X Series

- N5249A 10 MHz to 8.5 GHz
- N5241A 10 MHz to 13.5 GHz
- N5242A 10 MHz to 26.5 GHz
- N5244A 10 MHz to 43.5 GHz
- N5245A 10 MHz to 50 GHz
- N5247A 10 MHz to 67 GHz



### PNA Series

- N5221A 10 MHz to 13.5 GHz
- N5222A 10 MHz to 26.5 GHz
- N5224A 10 MHz to 43.5 GHz
- N5225A 10 MHz to 50 GHz
- N5227A 10 MHz to 67 GHz



### PNA-L Series

- N5239A 300 kHz to 8.5 GHz
- N5231A 300 kHz to 13.5 GHz
- N5232A 300 kHz to 20 GHz
- N5234A 10 MHz to 43.5 GHz
- N5235A 10 MHz to 50 GHz

## Keysight offers the following options for all PNA Family network analyzers

### Certification options

Commercial calibration certification with test data (Option UK6)  
Complete set of measurements which tests unit to manufacturer's published specifications. Includes calibration label, calibration certificate, and data report. Conforms to ISO 9001.

#### ISO 17025 compliant calibration (Option 1A7)

Complete set of measurements which tests unit to manufacturer's published specifications. Includes calibration label, ISO 17025 calibration certificate, and data report, measurement uncertainties and guardbands on all customer specifications. Conforms to ISO 17025 and ISO 9001.

#### ANSI Z540 compliant calibration (Option A6J)

Complete set of measurements which tests unit to manufacturer's published specifications. Includes pre- and post-adjustment data with measurement uncertainty information compliant to the ANSI/NCSS Z540 standard.

### Warranty and service

3- and 5-year warranty and service plans are available at the time of instrument purchase. Standard warranty is 3 years.

### Documentation

The PNA Series instruments are equipped with an Online Help system available within the instrument in English only. All PNA documentation is available on the web:

[www.keysight.com/find/pna](http://www.keysight.com/find/pna)

### Calibration Software Licenses

Perpetual license for built-in performance test software for Keysight inclusive cal (Option 897)

Adds built-in performance testing and calibration software for self-maintainers. Requires additional equipment. See the analyzer's Service Guide for more information on equipment required.

Perpetual license for built-in performance test software for Standards compliant cal (Option 898)

Adds built-in performance testing and calibration software for self-maintainers. Requires additional equipment. See the analyzer's Service Guide for more information on equipment required.

## PNA Family Network Analyzer Configurations

### PNA-X Series

N5249A 10 MHz to 8.5 GHz  
 N5241A 10 MHz to 13.5 GHz  
 N5242A 10 MHz to 26.5 GHz  
 N5244A 10 MHz to 43.5 GHz  
 N5245A 10 MHz to 50 GHz  
 N5247A 10 MHz to 67 GHz

### PNA Series

N5221A 10 MHz to 13.5 GHz  
 N5222A 10 MHz to 26.5 GHz  
 N5224A 10 MHz to 43.5 GHz  
 N5225A 10 MHz to 50 GHz  
 N5227A 10 MHz to 67 GHz

### PNA-L Series

N5239A 300 kHz to 8.5 GHz  
 N5231A 300 kHz to 13.5 GHz  
 N5232A 300 kHz to 20 GHz  
 N5234A 10 MHz to 43.5 GHz  
 N5235A 10 MHz to 50 GHz

## Test set and power configuration options

Choose one test set and power configuration option. Option 2xx indicates two test ports. Option 4xx indicates four test ports. To add options to a product, order the corresponding item number (N52xxA-xxx).

| Description                            | Configurable Test Set | Source Attenuators | Receiver Attenuators | Bias-tees | Internal Second Source | Internal Combiner | Mechanical Switches | Additional Information                                  |
|----------------------------------------|-----------------------|--------------------|----------------------|-----------|------------------------|-------------------|---------------------|---------------------------------------------------------|
| <b>PNA-X Series</b>                    |                       |                    |                      |           |                        |                   |                     |                                                         |
| Option 200                             | •                     |                    |                      |           |                        |                   |                     |                                                         |
| Option 200, H85, 285 <sup>1</sup>      | •                     | •                  | •                    |           |                        |                   |                     | Not available on 67 GHz model                           |
| Option 200, 219                        | •                     | •                  | •                    | •         |                        |                   |                     |                                                         |
| Option 200, H85, 285, 224 <sup>1</sup> | •                     | •                  | •                    |           | •                      | •                 | •                   | Requires Option 080<br>Not available on 67 GHz model    |
| Option 200, 219, 224                   | •                     | •                  | •                    | •         | •                      | •                 | •                   | Requires Option 080                                     |
| Option 400                             | •                     |                    |                      |           | •                      |                   |                     | Option 080 recommended                                  |
| Option 400, H85, 485 <sup>1</sup>      | •                     | •                  | •                    |           | •                      |                   |                     | Option 080 recommended<br>Not available on 67 GHz model |
| Option 400, 419                        | •                     | •                  | •                    | •         | •                      |                   |                     | Option 080 recommended                                  |
| Option 400, H85, 485, 423 <sup>1</sup> | •                     | •                  | •                    |           | •                      | •                 | •                   | Requires Option 080<br>Not available on 67 GHz model    |
| Option 400, 419, 423                   | •                     | •                  | •                    | •         | •                      | •                 | •                   | Requires Option 080                                     |
| <b>PNA Series</b>                      |                       |                    |                      |           |                        |                   |                     |                                                         |
| Option 200                             |                       |                    |                      |           |                        |                   |                     |                                                         |
| Option 201                             | •                     |                    |                      |           |                        |                   |                     |                                                         |
| Option 210                             |                       |                    |                      |           |                        |                   |                     | 2-port metrology option                                 |
| Option 217                             | •                     | •                  | •                    |           |                        |                   |                     | Not available on 67 GHz model                           |
| Option 219                             | •                     | •                  | •                    | •         |                        |                   |                     |                                                         |
| Option 400                             |                       |                    |                      |           | •                      |                   |                     | Option 080 recommended                                  |
| Option 401                             | •                     |                    |                      |           | •                      |                   |                     | Option 080 recommended                                  |
| Option 410                             |                       |                    |                      |           | •                      |                   |                     | 4-port metrology option                                 |
| Option 417                             | •                     | •                  | •                    |           | •                      |                   |                     | Option 080 recommended<br>Not available on 67 GHz model |
| Option 419                             | •                     | •                  | •                    | •         | •                      |                   |                     | Option 080 recommended                                  |
| <b>PNA-L Series</b>                    |                       |                    |                      |           |                        |                   |                     |                                                         |
| Option 200                             |                       |                    |                      |           |                        |                   |                     |                                                         |
| Option 216                             | •                     | •                  |                      |           |                        |                   |                     |                                                         |
| Option 400                             |                       |                    |                      |           |                        |                   |                     | Available on only N5231A/2A                             |
| Option 416 <sup>2</sup>                | •                     | •                  |                      |           |                        |                   |                     | Available on only N5231A/2A                             |

- Order special model N524xAS instead of N524xA. Order N524xA-xxx items for other standard options. Option H85 requires Option 285 or 485 which includes the extended power range of Option 219 or 419; therefore these options cannot be combined.
- Adds one source attenuator to be shared with all test ports.

## PNA Family Network Analyzer Configurations (continued)

| PNA-X Series              | PNA Series                | PNA-L Series               |
|---------------------------|---------------------------|----------------------------|
| N5249A 10 MHz to 8.5 GHz  | N5221A 10 MHz to 13.5 GHz | N5239A 300 kHz to 8.5 GHz  |
| N5241A 10 MHz to 13.5 GHz | N5222A 10 MHz to 26.5 GHz | N5231A 300 kHz to 13.5 GHz |
| N5242A 10 MHz to 26.5 GHz | N5224A 10 MHz to 43.5 GHz | N5232A 300 kHz to 20 GHz   |
| N5244A 10 MHz to 43.5 GHz | N5225A 10 MHz to 50 GHz   | N5234A 10 MHz to 43.5 GHz  |
| N5245A 10 MHz to 50 GHz   | N5227A 10 MHz to 67 GHz   | N5235A 10 MHz to 50 GHz    |
| N5247A 10 MHz to 67 GHz   |                           |                            |

### Application options

To add options to a product, order the corresponding item number (N52xxA-xxx).

| Measurement application                                             | For PNA-X Series        | For PNA Series | For PNA-L Series | Additional Information                                                                                                                                                                                                                               |
|---------------------------------------------------------------------|-------------------------|----------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Automatic fixture removal                                           | N524xA-007              | N522xA-007     | N523xA-007       | Requires Windows 7 OS <sup>8</sup>                                                                                                                                                                                                                   |
| Time-domain measurements                                            | N524xA-010              | N522xA-010     | N523xA-010       |                                                                                                                                                                                                                                                      |
| Noise figure measurements using standard receivers <sup>1</sup>     | N524xA-028              | N522xA-028     | n/a              | Requires Option 080. For measuring frequency converters, requires Option 082 or 083. Not available with N522xA-200, -210, -400 and -410                                                                                                              |
| Fully-corrected noise figure measurements <sup>1</sup>              | N524xA-029              | n/a            | n/a              | Requires Option 080 and for N5241/42/49A, one of Options 219, 224, 419, 423 or H85. For N5244/45/47A, requires Option 224 or 423. On N5247A, noise receivers work up to 50 GHz only. For measuring frequency converters, requires Option 082 or 083. |
| Frequency offset <sup>2</sup>                                       | N524xA-080              | N522xA-080     | N523xA-080       |                                                                                                                                                                                                                                                      |
| Scalar-calibrated converter measurements <sup>3</sup>               | N524xA-082              | N522xA-082     | N523xA-082       | Requires Option 080                                                                                                                                                                                                                                  |
| Vector- and scalar-calibrated converter measurements <sup>3,4</sup> | N524xA-083              | N522xA-083     | n/a              | Requires Option 080                                                                                                                                                                                                                                  |
| Embedded LO measurements                                            | N524xA-084              | N522xA-084     | n/a              | Requires Option 082 or Option 083. Also works with Options 028, 029, 086 and 087                                                                                                                                                                     |
| Gain compression application                                        | N524xA-086              | N522xA-086     | n/a              | For measuring frequency converters, requires Option 082 or 083                                                                                                                                                                                       |
| Intermodulation distortion application <sup>5</sup>                 | N524xA-087              | N522xA-087     | n/a              | Requires Option 080 For measuring frequency converters, requires Option 082 or 083. Not available with N522xA-200, -210, -400 and -410                                                                                                               |
| Source phase control                                                | N524xA-088              | N522xA-088     | n/a              | Not available with N522xA-200 and -210                                                                                                                                                                                                               |
| Differential and I/Q devices application                            | N524xA-089              | N522xA-089     | n/a              | Requires Option 080 and 400, 401, 410, 417, or 419, and Windows 7 OS <sup>8</sup>                                                                                                                                                                    |
| Spectrum analyzer                                                   | N524xA-090              | N522xA-090     | N523xA-090       | Requires Option 080, Windows 7 OS, and DSP version 5 <sup>8</sup> . Test set and power configuration option with receiver attenuators is recommended.                                                                                                |
| Extended spectrum analyzer to 110 GHz <sup>9</sup>                  | N524xA-093              | N522xA-093     | n/a              | Requires Option 090. Not available with N5241/49A or N5221A                                                                                                                                                                                          |
| Extended spectrum analyzer above 110 GHz <sup>9</sup>               | N524xA-094              | N522xA-094     | n/a              | Requires Option 090. Not available with N5241/49A or N5221A                                                                                                                                                                                          |
| Integrated true-mode stimulus application                           | N524xA-460              | N522xA-460     | n/a              | Requires one of Options 400, 401, 410, 417, 419 or 423                                                                                                                                                                                               |
| N-port capabilities <sup>6</sup>                                    | N524xA-551 <sup>7</sup> | N522xA-551     | N523xA-551       | Not available with N522xA-200, -210, -400 and -410, and N523xA-200 and -400                                                                                                                                                                          |

- For N522xA and N5241/42/49A, vector-noise-corrected measurements require an ECal for use as an impedance tuner. For N5244/45/47A with Option 029, an internal tuner is included. For calibration, Option 028 requires a power meter, and Option 029 requires either a power meter or a 346-series noise source (Keysight 346C or 346C-K01 recommended). All options require a power meter for measuring mixers and converters.
- Option 080 is required to configure an external source using External Device Configuration dialog.
- Option 082 is a subset of Option 083; therefore, they cannot be ordered together.
- A configurable test set is required for VMC measurements (to connect a reference mixer) or for SMC+Phase measurements using the comb-generator-based calibration. When ordered with N522xA-200, -210, -400 and -410, Option 083 adds phase and delay measurements only by using SMC+Phase with a calibration mixer.
- Option 087 can be ordered without N524xA-224 or N524xA-423, but may require external equipment such as a signal generator and a combiner. Refer to page 13 for more details.
- When ordering a test set, select an appropriate interface kit. Refer to page 22 Multiport Measurements section for more details.
- When configuring N524xA as a multiport analyzer using Option 551 and a multiport test set, the combiner feature of Option 224 or 423 is temporarily disabled. When configuring N524xA as a standalone analyzer, the combiner feature is enabled.
- The Windows 7 upgrade kit for PNAs containing CPU version 6 is model N8983A. This upgrade kit contains a new solid state drive with all of the necessary software installed. For units with older CPUs, order the N8984A with Option PC7. This upgrade kit contains a new solid state drive and a version 7 CPU. For adding Option 090 to units with DSP version 4, add Option SP5 to the N8983A or N8984A order to get the DSP version 5.
- Option 093 is a subset of 094; therefore they cannot be ordered together.

## PNA Family Network Analyzer Configurations (continued)

### PNA-X Series

N5249A 10 MHz to 8.5 GHz  
 N5241A 10 MHz to 13.5 GHz  
 N5242A 10 MHz to 26.5 GHz  
 N5244A 10 MHz to 43.5 GHz  
 N5245A 10 MHz to 50 GHz  
 N5247A 10 MHz to 67 GHz

### PNA Series

N5221A 10 MHz to 13.5 GHz  
 N5222A 10 MHz to 26.5 GHz  
 N5224A 10 MHz to 43.5 GHz  
 N5225A 10 MHz to 50 GHz  
 N5227A 10 MHz to 67 GHz

### PNA-L Series

N5239A 300 kHz to 8.5 GHz  
 N5231A 300 kHz to 13.5 GHz  
 N5232A 300 kHz to 20 GHz  
 N5234A 10 MHz to 43.5 GHz  
 N5235A 10 MHz to 50 GHz

## Application options (continued)

To add options to a product, order the corresponding item number (N52xxA-xxx).

| Description                                          | For PNA-X Series | For PNA Series | For PNA-L Series | Additional Information                                                       |
|------------------------------------------------------|------------------|----------------|------------------|------------------------------------------------------------------------------|
| <b>Pulse, antenna, mm-wave</b>                       |                  |                |                  |                                                                              |
| Pulsed-RF measurements                               | N524xA-008       | N522xA-008     | n/a              | Requires Option 025                                                          |
| Add IF inputs                                        | N524xA-020       | N522xA-020     | n/a              |                                                                              |
| Add pulse modulator to internal 1st source           | N524xA-021       | N522xA-021     | n/a              |                                                                              |
| Add pulse modulator to internal 2nd source           | N524xA-022       | N522xA-022     | n/a              | Requires one of Option 224, 400, 401, 417, 419, or 423                       |
| Add four internal pulse generators                   | N524xA-025       | N522xA-025     | n/a              |                                                                              |
| Fast CW sweep                                        | N524xA-118       | N522xA-118     | n/a              |                                                                              |
| <b>Nonlinear vector network analysis<sup>1</sup></b> |                  |                |                  |                                                                              |
| Nonlinear component characterization                 | N524xA-510       | n/a            | n/a              | Requires Options 419 and 080, or 400, H85 and 080                            |
| Nonlinear X-parameters <sup>2</sup>                  | N524xA-514       | n/a            | n/a              | Requires Options 423 and 510, requires MXG or PSG except 10 MHz tone-spacing |
| Nonlinear pulse envelope domain                      | N524xA-518       | n/a            | n/a              | Requires Options 021, 025 and 510                                            |
| Arbitrary load-impedance X-parameters                | N524xA-520       | n/a            | n/a              | Requires Option 514, requires MXG or PSG except 10 MHz tone-spacing          |

## Accessories, calibration options

To add options to a product, order the corresponding item number (N52xxA-xxx).

| Description                                                                                              | For PNA-X Series | For PNA Series | For PNA-L Series | Additional Information |
|----------------------------------------------------------------------------------------------------------|------------------|----------------|------------------|------------------------|
| <b>Accessories</b>                                                                                       |                  |                |                  |                        |
| Rack mount kit for use without handles                                                                   | N524xA-1CM       | N522xA-1CM     | N523xA-1CM       |                        |
| Rack mount kit for use with handles                                                                      | N524xA-1CP       | N522xA-1CP     | N523xA-1CP       |                        |
| Pulse I/O adapter                                                                                        | N1966A           | N1966A         | n/a              |                        |
| <b>Calibration software</b>                                                                              |                  |                |                  |                        |
| Perpetual license for built-in performance test software for Keysight inclusive calibration <sup>3</sup> | N524xA-897       | N522xA-897     | N523xA-897       |                        |
| Perpetual license for built-in performance test software for standard compliant calibration <sup>3</sup> | N524xA-898       | N522xA-898     | N523xA-898       |                        |
| <b>Calibration documentation</b>                                                                         |                  |                |                  |                        |
| ISO 17025 compliant calibration                                                                          | N524xA-1A7       | N522xA-1A7     | N523xA-1A7       |                        |
| Commercial calibration certificate with test data                                                        | N524xA-UK6       | N522xA-UK6     | N523xA-UK6       |                        |
| ANSI Z540 compliant calibration                                                                          | N524xA-A6J       | N522xA-A6J     | N523xA-A6J       |                        |

1. To configure NVNA, requires two comb generators with power supplies, Keysight calibration kits (mechanical or ECal), power meter and sensor or USB power sensor. Requires EXG, MXG or PSG for X-parameter extraction (PNA-X 10 MHz reference output can be used for 10 MHz tone-spacing applications).
2. X-parameters is a trademark and registered trademark of Keysight Technologies in the US, EU, JP, and elsewhere. The X-parameters format and underlying equations are open and documented. For more information, visit <http://www.Keysight.com/find/eesof-x-parameters-info>.
3. Additional hardware required. Please refer to the analyzer's Service Guide for required service test equipment.

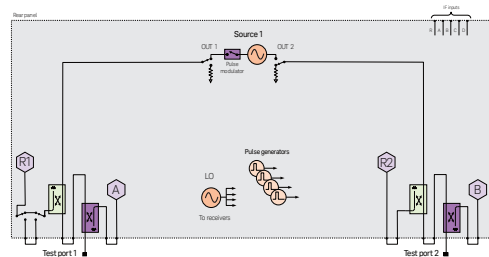
## PNA-X Series test set and power configuration options<sup>1</sup>

The PNA-X is an integrated vector network analyzer featuring a built-in S-parameter test set, one or two synthesized sources used for device stimulus, a solid-state drive, USB interfaces, and a 10.4" LCD touch screen display. The N5241A, N5242A, and N5249A have 50 ohm, ruggedized 3.5 mm (m) test ports. The N5244A and the N5245A have 50 ohm, ruggedized 2.4 mm (m) test ports. The N5247A has 50 ohm, ruggedized 1.85 mm (m) test ports. Included with each instrument is a mouse, keyboard (U.S. style), a 3-year return-to-Keysight service warranty, and one day of on-site productivity assistance (PS-S20-PNA).

A test set and power configuration option is mandatory, choose one of the following:

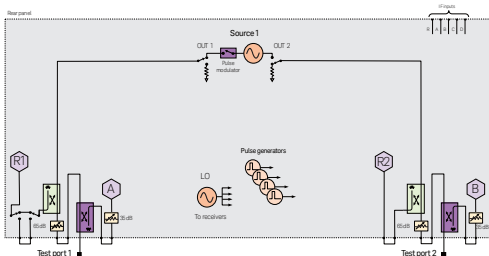
### 2-port standard test set and power range (Option 200)

The standard 2-port test set comes with six front-panel access loops. The loops provide access to the signal path between (a) the source output and the reference receiver, (b) the source output and directional coupler thru arm and (c) the coupled arm of the directional coupler and the port receiver. The standard test set also includes a solid-state internal RF transfer switch in the R1 reference-receiver path.



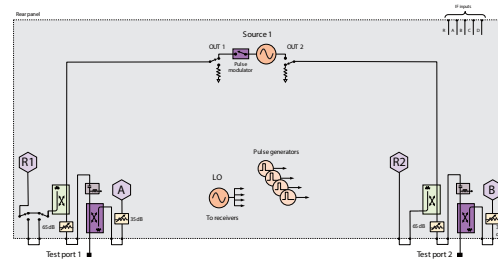
### High-power configurable and extended power range (N524xAS Option H85/285)

With extended power range and bias-tees (Option 219), the internal bias-tees limit the maximum test port input power to +30 dBm. The N524xAS Option H85/285 removes the bias-tees between the source attenuators and the test port couplers. This extends the maximum port power that the analyzer can safely handle to +43 dBm. Selecting Option H85/285 adds internal attenuators and cables. The N524xAS Option H85/285 and Option 219 can not be ordered together. Option H85/285 is not available for the N5247A. When ordering, select N524xAS then add items N524xAS-H85, N524xAS-285 and N524xA-200.



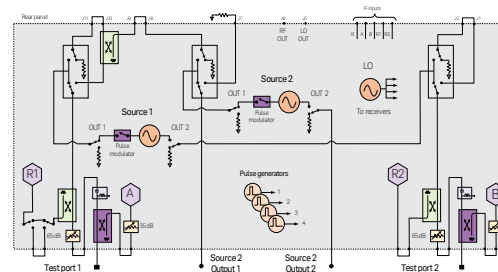
### Extended power range and bias-tees (Option 219)

Adds to the standard test set one 65 dB for N5241/42/49A, 60 dB for N5244/45A, and 50 dB for N5247A source attenuator (settable in 5 dB increments for N5241/42/49A and 10 dB increments for N5244/45/47A), one 35 dB receiver attenuator (settable in 5 dB increments) for N5241/42/44/45/49A and 50 dB receiver attenuator (settable in 10 dB increments) for N5247A, and one bias-tee to each test port. Option 219 requires Option 200.



### Add an internal second source, a combiner and mechanical switches to 2-port analyzer (Option 224)

Available with 2-port model only, this option adds an internal second source, a combiner and mechanical switches. The internal second source provides an additional signal (fixed or swept) for two-tone third-order-intercept (TOI) and intermodulation testing of amplifiers, or it can be used as a fast swept-LO signal for fixed-IF testing of mixers and converters. The mechanical switches provide increased flexibility by having rear panel access (front panel access for N5247A Source 1 and 2 Out 1) to signal paths for advanced applications. Access to the second source is available through two output connectors on the front panel. Requires Options 200, 219 and 080.

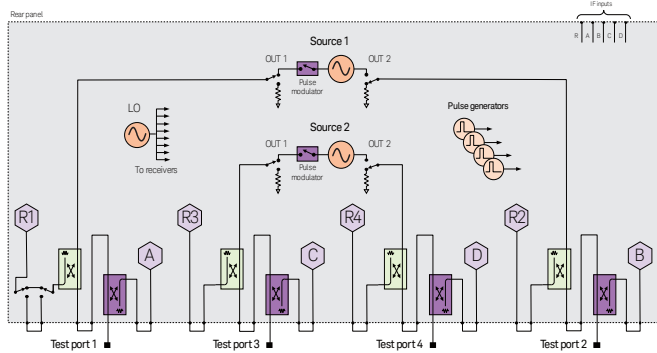


1. The block diagrams shown above include hardware that must be ordered as separate options, such as pulse generators (Option 025), pulse modulators (Options 021 and 022), and IF access (Option 020). In addition, the combiner type and attenuator values vary by model number. Refer to the product data sheet for the correct block diagram for a specific model.

## PNA-X Series test set and power configuration options<sup>1</sup> (continued)

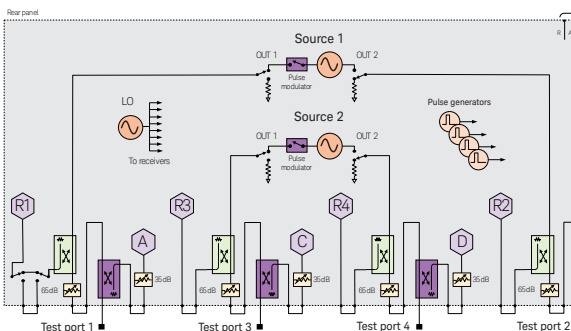
### 4-port standard test set, power range and an internal second source (Option 400)

The standard 4-port test set comes with 12 front-panel access loops and a built-in second source. The loops provide access to the signal path between (a) the source output and the reference receiver, (b) the source output and directional coupler thru arm and (c) the coupled arm of the directional coupler and the port receiver. The internal second source provides an additional signal (fixed or swept) for two-tone third-order-intercept (TOI) and intermodulation testing of amplifiers, or it can be used as a fast swept-LO signal for fixed-IF testing of mixers and converters. With two sources, source 1 is accessible through test ports 1 and 2, and source 2 is accessible through test ports 3 and 4. The standard test set also includes a solid-state internal RF transfer switch in the R1 reference-receiver path. Option 080 is recommended.



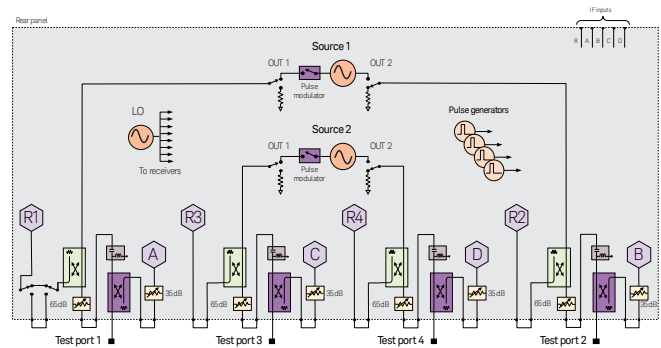
### High-power configurable and extended power range (N524xAS Option H85/485)

With extended power range and bias-tees (Option 419), the internal bias-tees limit the maximum test port input power to +30 dBm. The N524xAS Option H85/485 removes the bias-tees between the source attenuators and the test port couplers. This extends the maximum port power that the analyzer can safely handle to +43 dBm. Selecting Option H85/485 adds internal attenuators and cables. The N524xAS Option H85/485 and Option 419 can not be ordered together. Option H85/485 is not available for the N5247A. When ordering, select N524xAS then add items N524xAS-H85, N524xAS-485 and N524xA-400.



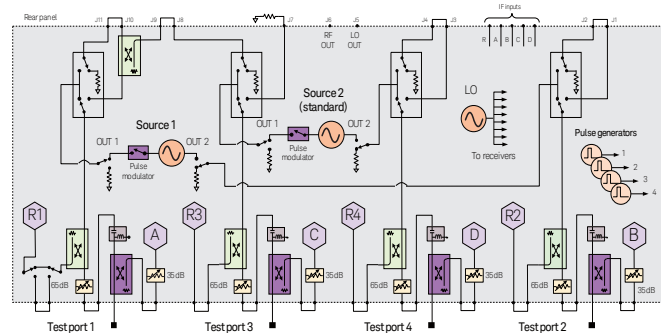
### Extended power range and bias-tees (Option 419)

Adds to the standard test set one 65 dB for N5241/42/49A, 60 dB for N5244/45A, and 50 dB for N5247A source attenuator (settable in 5 dB increments for N5241/42/49A and 10 dB increments for N5244/45/47A), one 35 dB receiver attenuator (settable in 5 dB increments) for N5241/42/44/45/49A and 50 dB receiver attenuator (settable in 10 dB increments) for N5247A, and one bias-tee to each test port. Option 419 requires Option 400.



### Add an internal combiner and mechanical switches to 4-port analyzer (Option 423)

Available with 4-port model only, this option adds a combiner and mechanical switches. The mechanical switches provide increased flexibility by having rear panel access (front panel access for the N5247A Source 1 and 2 Out 1) to signal paths for advanced applications. Requires Options 400, 419 and 080.



1. The block diagrams shown above include hardware that must be ordered as separate options, such as pulse generators (Option 025), pulse modulators (Options 021 and 022), and IF access (Option 020). In addition, the combiner type and attenuator values vary by model number. Refer to the product data sheet for the correct block diagram for a specific model.

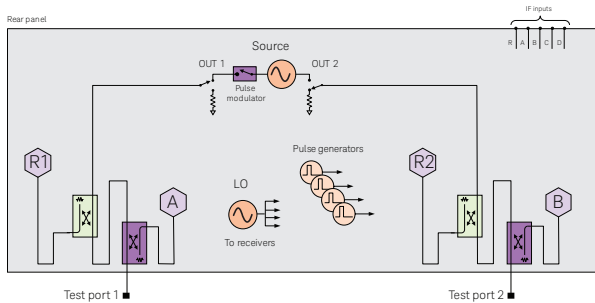
## PNA Series test set and power configuration options<sup>1</sup>

The PNA is an integrated vector network analyzer featuring a built-in S-parameter test set, one or two synthesized sources used for device stimulus, a solid-state drive, USB interfaces, and a 10.4" LCD touch screen display. The N5221A and the N5222A have 50 ohm, ruggedized 3.5 mm (m) test ports. The N5224A and the N5225A have 50 ohm, ruggedized 2.4 mm (m) test ports. The N5227A has a 50 ohm, ruggedized 1.85 mm (m) test ports. Included with each instrument is a mouse, keyboard (U.S. style), a 3-year return-to-Keysight service warranty, and one day of on-site productivity assistance (PS-S20-PNA).

A test set and power configuration option is mandatory, choose one of the following:

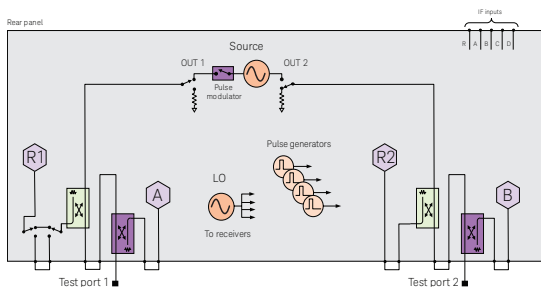
### 2-ports, single source, base configuration (Option 200/210)

The 2-port with base configuration has no front-panel access loops.



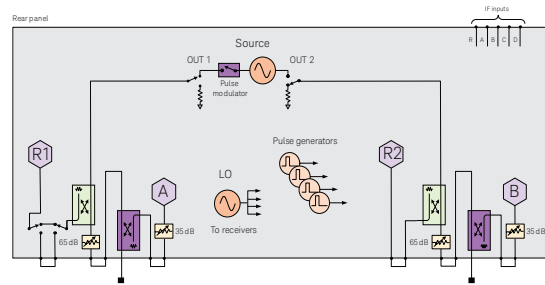
### 2-ports, single source, with configurable test set (Option 201)

The 2-port configurable test set comes with six front-panel access loops. The loops provide access to the signal path between (a) the source output and the reference receiver, (b) the source output and directional coupler thru arm and (c) the coupled arm of the directional coupler and the port receiver at all ports. Also included is a solid-state internal RF transfer switch in the R1 reference-receiver path.



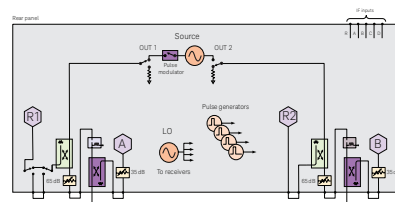
### 2-ports, single source, with extended power range (Option 217)

The 2-port test set with extended power range comes with a configurable test set, source and receiver attenuators at each port. For N5221/22A, the source attenuators are 65 dB in 5 dB steps and the receiver attenuators are 35 dB in 5 dB steps. For N5224/25A, the source attenuators are 60 dB in 10 dB steps and the receiver attenuators are 35 dB in 5 dB steps. Also included is a solid-state internal RF transfer switch in the R1 reference-receiver path. This configuration is not available on N5227A.



### 2-ports, single source, with extended power range and bias-tee (Option 219)

The 2-port test set with extended power range and bias-tee comes with a configurable test set, source and receiver attenuators, and bias-tee at each port. For N5221/22A, the source attenuators are 65 dB in 5 dB steps and the receiver attenuators are 35 dB in 5 dB steps. For N5224/25A, the source attenuators are 60 dB in 10 dB steps and the receiver attenuators are 35 dB in 5 dB steps. For N5227A, both source and receiver attenuators are 50 dB in 10 dB steps. Also included is a solid-state internal RF transfer switch in the R1 reference-receiver path.

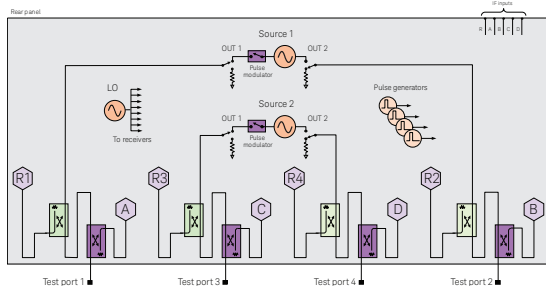


1. The block diagrams shown above include hardware that must be ordered as separate options, such as pulse generators (Option 025), pulse modulators (Options 021 and 022), and IF access (Option 020). In addition, the attenuator values vary by model number. Refer to the product data sheet for the correct block diagram for a specific model.

## PNA Series test set and power configuration options<sup>1</sup> (continued)

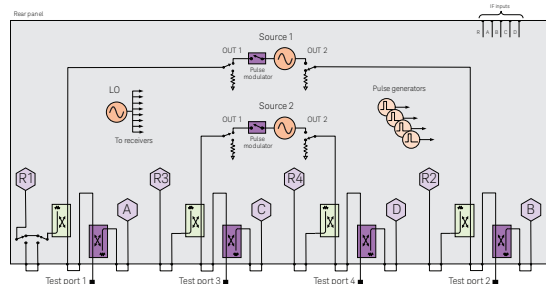
### 4-ports, dual source, base configuration (Option 400/410)

The 4-port with base configuration has no front-panel access loops.



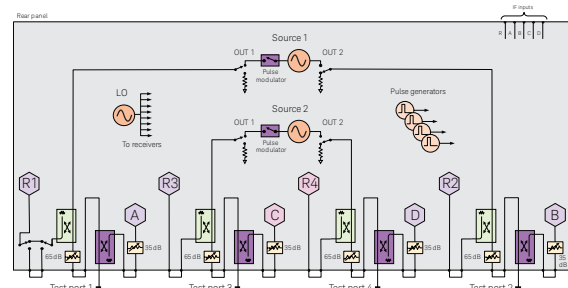
### 4-ports, dual source, with configurable test set (Option 401)

The 4-port configurable test set comes with two internal sources, twelve front-panel access loops. The loops provide access to the signal path between (a) the source output and the reference receiver, (b) the source output and directional coupler thru arm and (c) the coupled arm of the directional coupler and the port receiver at all ports. Also included is a solid-state internal RF transfer switch in the R1 reference-receiver path.



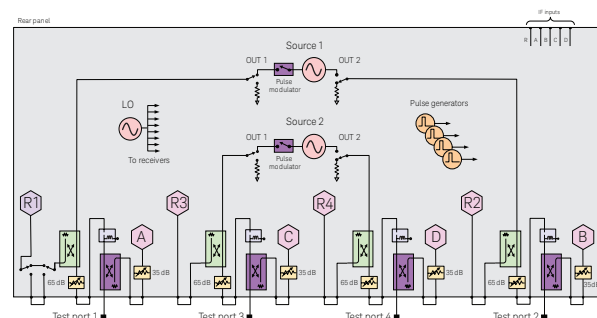
### 4-ports, dual source, with extended power range (Option 417)

The 4-port test set with extended power range comes with two internal sources, configurable test set, source and receiver attenuators at each port. For N5221/22A, the source attenuators are 65 dB in 5 dB steps and the receiver attenuators are 35 dB in 5 dB steps. For N5224/25A, the source attenuators are 60 dB in 10 dB steps and the receiver attenuators are 35 dB in 5 dB steps. Also included is a solid-state internal RF transfer switch in the R1 reference-receiver path. This configuration is not available on N5227A.



### 4-ports dual source, with extended power range and bias-tee (Option 419)

The 4-port test set with extended power range and bias-tee comes with two internal sources, configurable test set, source and receiver attenuators, and bias-tee at each port. For N5221/22A, the source attenuators are 65 dB in 5 dB steps and the receiver attenuators are 35 dB in 5 dB steps. For N5224/25A, the source attenuators are 60 dB in 10 dB steps and the receiver attenuators are 35 dB in 5 dB steps. For N5227A, both source and receiver attenuators are 50 dB in 10 dB steps. Also included is a solid-state internal RF transfer switch in the R1 reference-receiver path.



1. The block diagrams shown above include hardware that must be ordered as separate options, such as pulse generators (Option 025), pulse modulators (Options 021 and 022), and IF access (Option 020). In addition, the attenuator values vary by model number. Refer to the product data sheet for the correct block diagram for a specific model.

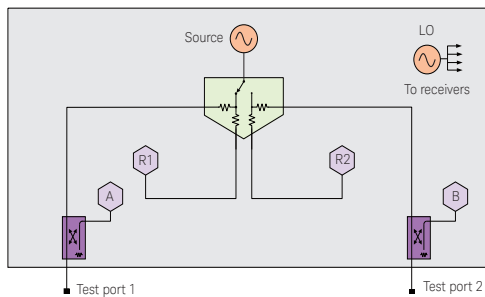
## PNA-L Series test set and power configuration options

The PNA-L is an integrated vector network analyzer featuring a built-in S-parameter test set, one synthesized source used for device stimulus, a solid state drive, USB interfaces, and a 10.4" LCD touch screen display. The N5239A, N5231A and the N5232A have 50 ohm, ruggedized 3.5 mm (m) test ports. The N5234A and N5235A have 50 ohm, ruggedized 2.4 mm (m) test ports. Included with each instrument is a mouse, keyboard (U.S. style), and a 3-year return-to-Keysight service warranty. For one day of on-site productivity assistance (not included with instrument purchase), request quantity 1 each PS-S20-PNA.

A test set and power configuration option is mandatory, choose one of the following:

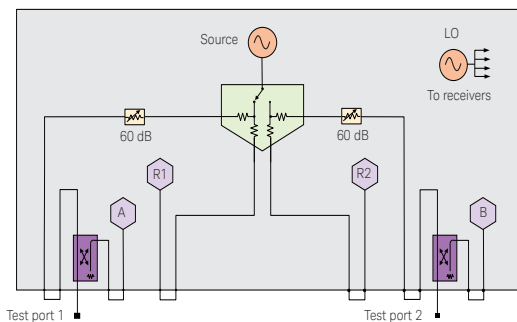
### 2 ports, single source, base configuration (Option 200)

The 2-port with base configuration has no front-panel access loops.



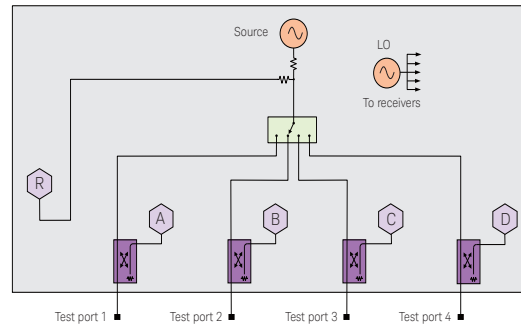
### 2 ports, single source, with configurable test set and source attenuators (Option 216)

The 2-port test set comes with a configurable test set and source attenuator at each port. The configurable test set adds six front-panel access loops. The loops provide access to the signal path between (a) the source output and the reference receiver, (b) the source output and directional coupler thru arm, and (c) the coupled arm of the directional coupler and the port receiver at all ports. The source attenuators are 60 dB in 10 dB steps.



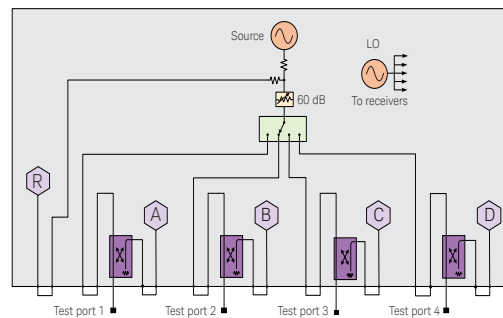
### 4 ports, single source, base configuration (Option 400)

The 4-port base configuration has no front-panel loops, and is available only on the N5231A and N5232A.



### 4 ports, single source, with configurable test set and source attenuator (Option 416)

The 4-port test set comes with a configurable test set and one source attenuator to be shared with all ports. The configurable test set adds nine front-panel access loops. The loops provide access to the signal path between (a) the source output and the reference receiver, (b) the source output and directional coupler thru arm at all ports, and (c) the coupled arm of the directional coupler and the port receiver at all ports. The source attenuator is 60 dB in 10 dB steps. This configuration is available on only N5231A and N5232A.



## PNA Family Application Options

### Measurement applications

Solid black series name indicates the feature is available on that series, while gray series name with strikethrough indicates the feature is not available on that series. For example;

PNA: Available on PNA Series

~~PNA~~: Not available on PNA Series

### Automatic fixture removal (Option 007)

PNA-X PNA ~~PNA-L~~

Many devices do not have coaxial connectors and are put in fixtures in order to measure them in a coaxial environment. Accurately removing the effects of the fixture is required to get a good measurement of the device under test (DUT). This option adds a powerful application wizard to guide you through characterizing a fixture and removing it from the measurement. Devices can be single ended or differential. Files can be saved in a variety of formats for later use in PNA, ADS, and PLTS. Requires Windows 7 OS.

### Time domain (Option 010)

PNA-X PNA ~~PNA-L~~

This option enables the analyzer to view reflection and transmission responses in time or distance. Use time domain to tune filters, gate out the response of fixtures and cables, characterize the impedance of transmission lines and more. If eye-diagram analysis, W-element modeling or high-speed interconnect testing is required, PLTS N1930B software must be used.

### Frequency offset (Option 080)

PNA-X PNA ~~PNA-L~~

This option enables the analyzer to set the source frequency independently from where the receivers are tuned, and is required to configure an external source using External Device Configuration. This ability is important for measuring amplifiers, mixers, and frequency converters.

### Scalar-calibrated converter measurements (Option 082)

PNA-X PNA ~~PNA-L~~

With a simple setup and calibration, this application delivers the highest accuracy for scalar conversion-loss/gain measurements by combining one-port and power-meter calibrations to remove mismatch errors. Option 082 provides an intuitive and easy-to-use user interface for setting up mixer and converter measurements, with single or dual conversion stages. It can control the analyzer's built-in source(s) as well as external signal generators for use as LO signals. Supported external sources include the Keysight ESG, PSG, and MXG Series, as well as other SCPI-controlled signal generators. Option 082 requires Option 080, and cannot be ordered with Option 083. It is compatible with Option 084, which enables measurements of converters with internal LOs.

### Vector- and scalar-calibrated converter measurements (Option 083)

PNA-X PNA ~~PNA-L~~

This application includes the scalar mixer/converter plus phase (SMC+Phase) measurement class that provides fully calibrated conversion gain/loss, relative phase, and absolute group delay measurements of mixers and converters without the need for reference or calibration mixers. Eliminating the calibration mixer requires a U9391C/F/G comb generator and an external DC power supply capable of sourcing +15 V to 300 mA for U9391C/F or 800 mA for U9391G1. A vector mixer/converter measurement (VMC) class is also included for measuring the phase difference between multiple paths or devices, or for measuring phase shifts within a device. Using VMC or the comb-generator-based calibration for SMC+Phase requires an instrument with a configurable test set (i.e., has front-panel RF loops). For units without front-panel loops, SMC+Phase can be used with a calibration mixer supplied by the user. Option 083 provides an intuitive and easy-to-use user interface for setting up mixer and converter measurements, with single or dual conversion stages. It can control the analyzer's built-in source(s) as well as external signal generators for use as LO signals. Supported external sources include the Keysight ESG, PSG, and MXG Series, as well as other SCPI-controlled signal generators. Option 083 requires Option 080, and cannot be ordered with Option 082. It is compatible with Option 084, which enables measurements of converters with internal LOs.

1. When a comb generator is used as a phase reference for calibration and the start frequency of the measurement is less than 55 MHz, a user-supplied calibration mixer is required. For measurements between 50 GHz and 67 GHz, an additional high-pass filter is required (two back-to-back Keysight V281A waveguide-to-coax adapters recommended; must be ordered separately).

## Embedded LO measurements (Option 084)

PNA-X PNA ~~PNA-L~~

This option tunes the analyzer's receivers to the output frequency of the converter under test without the need for access to internal LOs or a common reference signal. For converters with embedded LOs, this option requires Option 082 (enables match-corrected conversion loss/gain measurements) or Option 083 (enable absolute group delay measurements). This option also works with Option 086 gain compression application, Option 087 intermodulation distortion application, and Option 028/029/H29 noise figure applications.

## Gain compression application (Option 086)

PNA-X PNA ~~PNA-L~~

The gain compression application (GCA) provides input power, output power, gain, and phase at the compression point of an amplifier or frequency converter, over a specified frequency range. GCA's SMART Sweep is very fast and easy-to-use. GCA also includes a guided calibration that corrects for absolute power levels, frequency response, and mismatch errors.

## Intermodulation distortion application

(Option 087) PNA-X PNA ~~PNA-L~~

The intermodulation distortion (IMD) application makes it very easy to set up and calibrate swept-IMD measurements of both amplifiers and frequency converters. It controls the frequency and power of internal and external sources and tunes the receivers to the main tones as well as the IMD products in a single measurement channel. The user can sweep either the center frequency of the two stimulus signals, the frequency spacing of the two stimulus signals about a fixed center frequency, or the power of one or both stimulus signals or the power of the LO signal. The analyzer can measure intermodulation distortion products of order 2, 3, 5, 7, or 9, and can display the associated intercept points. In addition, an IM Spectrum mode gives a spectrum-analyzer-like display for confirming or trouble-shooting measurements. Requires Option 080. Not available with PNA Options 200, 210, 400 and 410. When configured with a 2-port PNA or 2-port PNA-X with either Option 200 or 219, an external signal generator and a combiner are required. When configured with a 4-port PNA or 4-port PNA-X with Option 400 or 419, the two internal sources and an unused test port coupler configured as a combiner can be used for two-tone IMD measurements. When configured with PNA-X Option 224 or 423, the two internal sources and internal combiner can be used for two-tone IMD measurements.

## Source phase control (Option 088)

PNA-X PNA ~~PNA-L~~

This option allows users to set calibrated, arbitrary phase differences between two signal sources. The sources can be the analyzer's internal sources or external signal generators routed through the analyzer's test set. The phase difference can be fixed, or swept between two specified phase values. Option 088 also controls the relative power level between the sources using the receiver-leveling feature. Option 088 is targeted for active-load control, where the analyzer provides a precise, electronically settable impedance to the output port of a device, while gain and output power are measured. This capability can be combined with external load-pull software to create traditional load-pull power contours. Not available with PNA Options 200 and 210.

## Differential and I/Q devices application (Option 089)

PNA-X PNA ~~PNA-L~~

This option combines source-phase control of multiple internal or external sources with frequency-offset mode, enabling simplified test of I/Q modulators/converters and differential mixers, and harmonic measurements of differential amplifiers. The phase difference between sources can be fixed (for example, at 90 or 180 degrees), or swept between two specified phase values. Providing accurate control of the relative phase between sources eliminates the need for hybrid couplers and baluns to create quadrature or differential signals. After achieving the desired phase alignment, the instrument's receivers can be tuned to all frequencies needed to characterize the DUT. On an I/Q modulator for example, measurements can be made of both the desired and suppressed conversion bands, along with LO leakage, harmonics and other spurious signals. Phase sweeps can be used to determine a DUT's phase imbalance versus frequency. Users can specify measurements with individual receivers or multiple receivers combined with a wide range of mathematical operators. Power measurements can employ match correction for increased accuracy. Option 089 only works on 4-port PNA or PNA-X models, and requires Option 080 and Windows 7 OS.

## PNA Family Application Options (continued)

### Measurement applications (continued)

Solid black series name indicates the feature is available on that series, while gray series name with strikethrough indicates the feature is not available on that series. For example;

PNA: Available on PNA Series

~~PNA~~: Not available on PNA Series

### Spectrum analyzer (Option 090)

PNA-X PNA ~~PNA-L~~

The spectrum analyzer (SA) option adds high-performance microwave spectrum analysis to the PNA-X, PNA, and PNA-L Series. With fast stepped-FFT sweeps due to optimized data processing, the SA option provides quick spurious searches over broad frequency ranges. Option 090 enables spectrum measurements with the test receiver at each test port, and a reference receiver (two reference receivers for 2-port configuration) simultaneously. This multi-channel SA used with the internal swept-signal generators allows efficient spurious analysis of mixers and converters. The SA option employs source power and receiver response calibration as well as fixture de-embedding, providing in-fixture or on-wafer spectrum measurements with the highest level of accuracy. Requires Option 080, Windows 7 OS, and DSP version 5. It is recommended to use this option on instruments with receiver attenuators to avoid receiver compression when measuring large signals.

### Extended spectrum analyzer to 110 GHz

(Option 093) PNA-X PNA ~~PNA-L~~

This option extends the spectrum analyzer (Option 090) upper frequency to 110 GHz, when the analyzer is configured with broadband or banded millimeter-wave frequency extenders, using a millimeter-wave controller. With this configuration, the analyzer's internal receiver attenuators are not in the receiver paths, so they cannot be used to reduce signal levels. External attenuators may be required to avoid compressing the receivers in the millimeter-wave frequency extenders. Requires Option 090, and either an N5261A or N5262A millimeter-wave controller. Option 093 is a subset of option 094; therefore they cannot be ordered together.

### Extended spectrum analyzer above 110 GHz

(Option 094) PNA-X PNA ~~PNA-L~~

This option extends the spectrum analyzer (Option 090) upper frequency to 110 GHz and beyond, when the analyzer is configured with broadband or banded millimeter-wave frequency extenders, using a millimeter-wave controller. With this configuration, the analyzer's internal receiver attenuators are not in the receiver paths, so they cannot be used to reduce signal levels. External attenuators may be required to avoid compressing the receivers in the millimeter-wave frequency extenders. Requires Option 090, and either an N5261A or N5262A millimeter-wave controller. Option 094 is a superset of option 093; therefore they cannot be ordered together.

### Integrated true-mode stimulus application

(Option 460) PNA-X PNA ~~PNA-L~~

Integrated true-mode stimulus application (iTMSA) provides mis-match-corrected true-mode (true differential mode and true common mode) stimulus and enables accurate balanced measurements under real operating conditions. iTMSA also provides balanced measurements with forward-only sweep, reverse-only sweep, and frequency or power sweep with arbitrary phase and amplitude off-sets. Requires one of Options 400, 401, 410, 417, 419 and 423.

### N-port capabilities (Option 551)<sup>1</sup>

PNA-X PNA ~~PNA-L~~

Adds a multiport analyzer mode, which enables full N-port error correction and measurement capabilities using an external test set. Only standard measurement class is available in the multiport analyzer mode. Not available with PNA Options 200, 210, 400 and 410. For multiport analysis greater than 8 ports, it is highly recommended to use PLTS software N1930B to manage the large data format files that easily grow exponentially (12 port S-parameter files have 144 S-parameter elements).

### Noise figure options

#### Noise figure measurements using standard receivers

(Option 028) PNA-X PNA ~~PNA-L~~

This option adds firmware for high-accuracy noise figure measurements of amplifiers, frequency converters, and mixers using the analyzer's standard receivers, and utilizing Keysight's unique source-correction technique. Using an Keysight ECal module configured as an impedance tuner (N4691B/93A/94A-M0F recommended; must be ordered or supplied separately<sup>2</sup>), the effects of imperfect system-source match are removed, greatly improving the accuracy of the cold-source technique. This approach surpasses the accuracy provided by the Y-factor method and other cold-source implementations. A scalar calibration choice is also available that offers less accuracy but is faster and does not require the external ECal module used as an impedance tuner. For calibration, a power meter and separate ECal module or mechanical calibration kit is required (must be ordered or supplied separately). An external preamplifier and filter(s) is required for devices with < 30 dB of excess noise (gain plus noise figure in dB) up to 20 GHz, < 40 dB up to 50 GHz, or < 45 dB up to 67 GHz. Front panel jumpers provide a convenient spot for adding a preamplifier and filter for low gain, low noise figure devices. Not available with N522xA-200 and -400.

1. When configuring N524xA as a multiport analyzer using Option 551 and a multiport test set, the combiner feature of Option 224 or 423 is temporarily disabled. When configured as a standalone analyzer, the combiner feature is enabled. When ordering a test set, select an appropriate interface kit. Refer to page 22 Multiport Measurements section for more details.
2. Only N4690 Series ECal modules are supported for use as an impedance tuner.

## PNA Family Application Options (continued)

### Noise figure options

Solid black series name indicates the feature is available on that series, while gray series name with strikethrough indicates the feature is not available on that series. For example:

PNA: Available on PNA Series

~~PNA~~: Not available on PNA Series

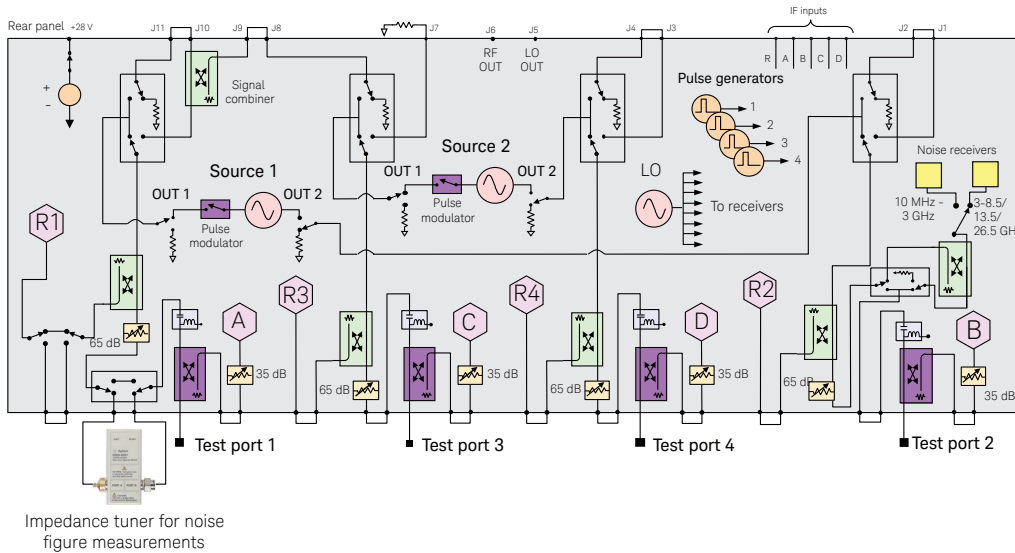
### Fully-corrected noise figure measurements (Option 029) PNA-X ~~PNA~~ ~~PNA-L~~

This option adds a low-noise receiver and firmware to the PNA-X1 for high-accuracy noise figure measurements of amplifiers, frequency converters, and mixers, utilizing Keysight's unique source-correction technique. Using an Keysight ECal module configured as an impedance tuner for N5241/42/49A (3.5 mm N4691B-M0F recommended; must be ordered or supplied separately<sup>2</sup>), or a built-in tuner for N5244/45/47A, the effects of imperfect system-source match are removed, greatly improving the accuracy of the cold-source technique. This approach surpasses the accuracy provided by the Y-factor method and other cold-source implementations. A scalar calibration choice is also available that offers less accuracy but is faster, and for N5241/42/49A, does not require the external ECal module used as an impedance tuner. For calibration of the noise receiver, Option 029 requires a power meter or a 346 series noise source (346C or 346C-K0<sup>1</sup> recommended). For measurements of mixers and converters, a power meter is always required. The noise source and power meters are only used during calibration of the analyzer, and must be ordered or supplied separately. During the S-parameter portion of the noise calibration, a separate ECal module or mechanical calibration kit is required (also must be ordered or supplied separately). Option 029 also allows noise figure measurements using the standard receivers for high-gain (> 60 dB), narrowband devices that might otherwise overload the low-noise receiver, or for noise figure measurements up to 67 GHz on the N5247A<sup>1</sup>.

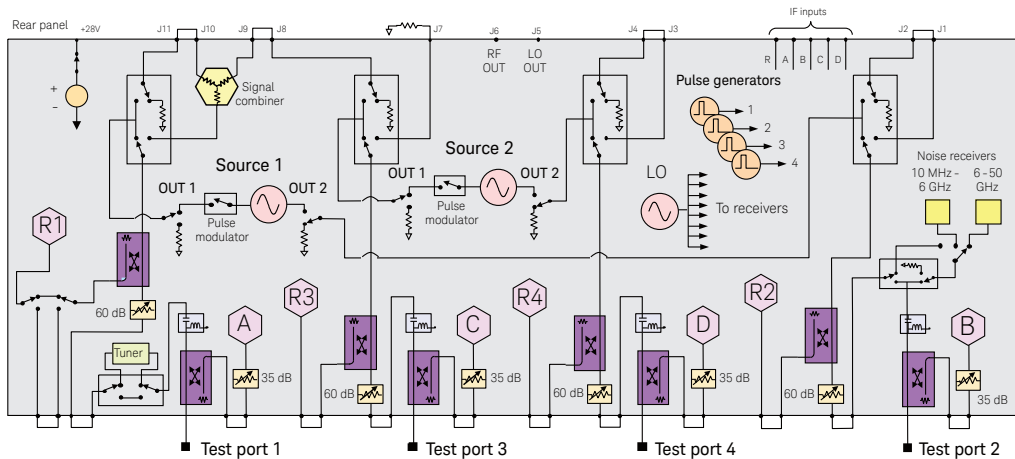
1. For N5247A, the low-noise receiver works up to 50 GHz only  
 2. Only N4690 Series ECal modules are supported for use as an impedance tuner.

## PNA Family Application Options, continued

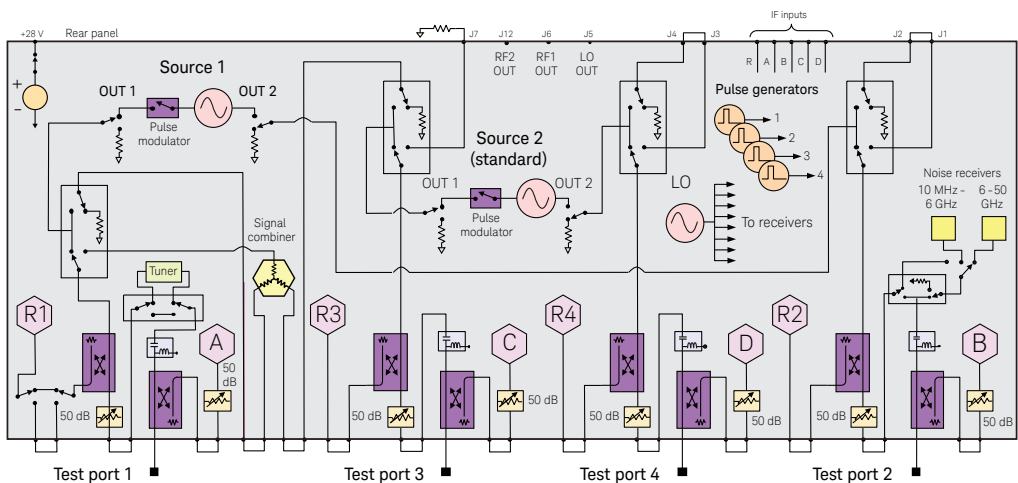
### PNA-X block diagrams with noise figure option



N5241/42/49A 4-port block diagram with noise figure option



N5244/45A 4-port block diagram with noise figure option



N5247A 4-port block diagram with noise figure option

## PNA Family Application Options, continued

### Noise figure options summary

| Overview                                                          | Option 028                                                                                                                                                                                                      | Option 029                                                                                                                                                                |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description                                                       | Noise figure application using standard receivers only, for all PNA / PNA-X models.                                                                                                                             | Noise figure application using standard or low-noise receivers, for all PNA-X models.                                                                                     |
| Required options                                                  | 080, and 082 or 083 for measuring frequency converters. Not available with N522xA-200 and -400.                                                                                                                 | For N5241/42/49A, 080 and either 219, 224, 419, 423, or H85. For N5244/45/47A, 080 and either 224 or 423. For measuring frequency converters, requires Option 082 or 083. |
| Includes low-noise receivers                                      | No                                                                                                                                                                                                              | Yes <sup>1</sup>                                                                                                                                                          |
| Includes filters for LO-harmonic rejection                        | No                                                                                                                                                                                                              | Yes <sup>1</sup>                                                                                                                                                          |
| Includes source tuner bypass switch                               | No                                                                                                                                                                                                              | Yes                                                                                                                                                                       |
| Use standard receivers for noise figure measurements <sup>2</sup> | Yes                                                                                                                                                                                                             | Yes                                                                                                                                                                       |
| Vector noise calibration available using ECal as tuner            | Yes                                                                                                                                                                                                             | Yes                                                                                                                                                                       |
| Vector noise calibration using built-in tuner                     | No                                                                                                                                                                                                              | Yes, for N5244/45/47A                                                                                                                                                     |
| Recommended ECal for vector noise calibration <sup>3</sup>        | 3.5 mm N4691B-M0F (N5221/22/41/42/49A)<br>2.4 mm N4693A-M0F (N5224/25/44/45A)<br>1.85 mm N4694A-M0F (N5227/47A)                                                                                                 | 3.5 mm N4691B-M0F (N5241/42/49A)<br>Built-in for N5244/45/47A                                                                                                             |
| Included tuner accessories for m-f ECal                           | 3.5 mm N5242-20137 cable, 85052-60013 m-f adapter (N5221/22/41/42/49A)<br>2.4 mm N5245-20140 cable, 85056-60007 m-f adapter (N5224/25/44/45A)<br>1.85 mm N5247-20142 cable, 85058-60115 m-f adapter (N5227/47A) | 3.5 mm N5242-20137 cable, 85052-60013 m-f adapter (N5241/42/49A)<br>N/A for N5244/45/47A, due to built-in tuner                                                           |
| Recommended adapter for f-f ECal tuner (N4691B/93A/94A-00F)       | 3.5 mm 85052-60014 m-m adapter (N5221/22/41/42/49A)<br>2.4 mm 85056-60005 m-m adapter (N5224/25/44/45A)<br>1.85 mm 85058-60113 m-m adapter (N5227/47A)                                                          | 3.5 mm 85052-60014 m-m adapter (N5241/42/49A)<br>N/A for N5244/45/47A, due to built-in tuner                                                                              |
| Scalar noise calibration available                                | Yes                                                                                                                                                                                                             | Yes                                                                                                                                                                       |
| S-parameter, conversion gain/loss measurements                    |                                                                                                                                                                                                                 |                                                                                                                                                                           |
| Max freq (GHz)                                                    | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                                                        | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                  |
| NF measurements, amplifiers                                       |                                                                                                                                                                                                                 |                                                                                                                                                                           |
| Max frequency, using low-noise receivers (GHz)                    | N/A                                                                                                                                                                                                             | 8.5/13.5/26.5/43.5/50                                                                                                                                                     |
| Max frequency, using standard receivers (GHz) <sup>2</sup>        | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                                                        | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                  |
| Calibration accessories for low-noise receivers                   | N/A                                                                                                                                                                                                             | Cal kit or ECal, 346C or 346C-K01 noise source or power meter                                                                                                             |
| Calibration accessories for standard receivers                    | Cal kit or ECal, power meter                                                                                                                                                                                    | Cal kit or ECal, power meter                                                                                                                                              |
| NF measurements, converters                                       |                                                                                                                                                                                                                 |                                                                                                                                                                           |
| Max input frequency (GHz)                                         | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                                                        | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                  |
| Max output frequency, using low-noise receivers (GHz)             | N/A                                                                                                                                                                                                             | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                  |
| Max output frequency, using standard receivers (GHz) <sup>2</sup> | 18.5/13.5/26.5/43.5/50/67                                                                                                                                                                                       | 8.5/13.5/26.5/43.5/50/67                                                                                                                                                  |
| Calibration accessories for low-noise receivers                   | N/A                                                                                                                                                                                                             | Cal kit or ECal, power meter, 346C or 346C-K01 noise source (optional)                                                                                                    |
| Calibration accessories for standard receivers                    | Cal kit or ECal, power meter                                                                                                                                                                                    | Cal kit or ECal, power meter                                                                                                                                              |

- For N5247A, the low-noise receiver works up to 50 GHz only.
- External preamplifier and filter(s) required if DUT excess noise (gain plus noise figure) is < 30 dB up to 20 GHz, < 40 dB up to 50 GHz, or < 45 dB up to 67 GHz.
- Only N4690 Series ECal modules are supported for use as an impedance tuner.

## PNA Family Application Options (continued)

### Pulse, antenna, mm-wave

Solid black series name indicates the feature is available on that series, while gray series name with strikethrough indicates the feature is not available on that series. For example;

PNA: Available on PNA Series

~~PNA-L~~: Not available on PNA Series

#### Pulsed-RF measurements (Option 008)

PNA-X PNA ~~PNA-L~~

This option adds narrowband pulse detection mode and extends the pulsed-RF measurement capability to narrower pulse widths below the limit for the standard wideband detection mode. The PNA-X and PNA are complete pulsed-RF solutions with built in pulse generators and modulators, so external test sets and pulse generators are not required. With narrowband detection mode, Option 008 sets the coefficient of the analyzer's digital-IF filters to null out unwanted spectral components, enables the internal receiver IF gates, controls internal pulse generators (Option 025), internal pulse modulators (Option 021 and/or 022), and external pulse modulators, and performs optimization for measurement sensitivity. Option 008 also includes conventional pulsed-RF measurement software (Option H08). Option 025 is required. Option 021 is recommended for forward-only pulsed-RF measurements. Option 021 and 022 are recommended for bi-directional pulsed-RF measurements. The N1966A pulse I/O adapter is recommended if using external pulse generators and/or external pulse modulators

#### Add IF inputs for antenna and millimeter-wave (Option 020) PNA-X PNA ~~PNA-L~~

This option enables external IF inputs on the rear panel of the analyzer for applications such as antenna and millimeter-wave test.

#### Add pulse modulator to internal first source (Option 021) PNA-X PNA ~~PNA-L~~

This option enables the internal pulse modulator on Source1 Out1. Control of the modulator can also be done via pin 8 of the Pulse I/O D-sub connector on the rear panel of the analyzer using an external pulse generator, or by using one of the internal pulse generators (Option 025). The N1966A pulse I/O adapter is recommended if using an external pulse generator.

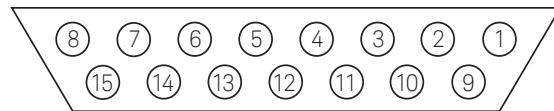
#### Add pulse modulator to internal second source (Option 022) PNA-X PNA ~~PNA-L~~

This option enables the internal pulse modulator on Source2 Out1. Control of the modulator can also be done via pin 8 of the Pulse I/O D-sub connector on the rear panel of the analyzer using an external pulse generator, or by using one of the internal pulse generators (Option 025). The N1966A pulse I/O adapter is recommended if using an external pulse generator. Option 224 or 400 is required for PNA-X, and one of Option 400, 401, 417, or 419 is required for PNA.

#### Add four internal pulse generators (Option 025)

PNA-X PNA ~~PNA-L~~

This option enables four internal pulse generators. These pulse generators can be used to control the internal pulse modulators and internal receiver IF gates, and are also available on pins 10 through 13 of the Pulse I/O D-sub connector on the rear panel of the analyzer to control external modulators and/or gates. The N1966A pulse I/O adapter is recommended if using external pulse modulators.



Pulse I/O D-sub connector (DB-15 female)

#### Fast CW Sweep (Option 118)

PNA-X PNA ~~PNA-L~~

This option uses FIFO (first-in first-out) to allow external point-trigger acquisition of 400,000 data points per second on five measurement receivers. When enabled, there is no display update, no background computation, or other interference from the vector network analyzer application. All the data gathered is placed into a 500 million points FIFO buffer. While the data is going into FIFO it can be read from the FIFO buffer.

#### Nonlinear vector network analysis

Please refer to 5989-8575EN *Nonlinear Vector Network Analyzer Brochure* for more information.

## PNA Family Application Options (continued)

### Accessories

Solid black series name indicates the feature is available on that series, while gray series name with strikethrough indicates the feature is not available on that series. For example;

PNA: Available on PNA Series

~~PNA~~: Not available on PNA Series

#### Rack mount kit without handles (Option 1CM)

PNA-X PNA ~~PNA-L~~

Adds a rack mount flange kit 1CM042A and a rail kit (E3663AC) for use without handles.

#### Rack mount kit with handles (Option 1CP)

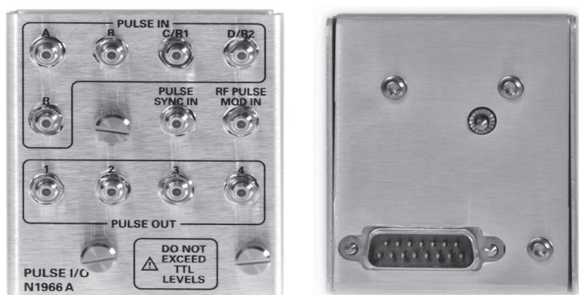
PNA-X PNA ~~PNA-L~~

Adds handles 1CN020A, a rack mount flange kit (5063-9237), and a rail kit (E3663AC) for use with handles.

#### Pulse I/O adapter (N1966A)

PNA-X PNA ~~PNA-L~~

An adapter for connecting between the Pulse I/O connector on the rear panel of the analyzer and the coaxial inputs and outputs of external pulse generators and external pulse modulators. Coaxial connectors are SMB-male. The PULSE IN connectors are for controlling the analyzer's internal IF gates, which are enabled with Option 008 and used with narrowband detection. The PULSE OUT connectors are from the four internal pulse generators, which are enabled with Option 025. The PULSE SYNC IN connector is used to synchronize the internal pulse generators with an external timing pulse. The RF PULSE MOD IN connector controls the internal pulse modulator(s) which are enabled with Options 021 and 022.



Pulse I/O adapter (N1966A) simplifies connections

### Comb Generators

U9391C 10 MHz to 26.5 GHz

U9391F 10 MHz to 50 GHz

U9391G 10 MHz to 67 GHz

PNA-X PNA ~~PNA-L~~

The U9391C/F/G provides precision phase calibration, traceable to the National Institute of Standards and Technology (NIST) standard. It is used for nonlinear measurements with the PNA-X nonlinear vector network analyzer (NVNA). NVNA requires two comb generators, one is connected during measurements and another is used only during calibration. A comb generator is also used to characterize the VNA receivers for delay measurements of frequency converters using PNA-X or PNA with Option 083.



Comb generator enables vector-corrected measurements at fundamental and harmonic frequencies

### CalPod calibration refresh module (8553xB/4xA)

PNA-X PNA ~~PNA-L~~

CalPods allow in-situ calibration refreshes to be performed at the push of a button without removing the DUT or connecting calibration standards. CalPods are useful in any measurement situation where it is desirable to have assurance that a valid calibration is present before recording measurement data. Some of the measurement applications where CalPods have proven useful are as follows:

- Thermal-vacuum testing
- Temperature chamber testing
- Measurement of low-loss devices
- Applications that require frequent re-calibrations
- Applications that have complex and lengthy calibrations, such as multi-port measurements
- Measurement of cables installed in aircraft
- Removing switch matrix repeatability errors
- Removing switch and connector repeatability errors in complex ATE test systems

## PNA Family Network Analyzer Upgrade Kits

### Frequency, test ports, test set and power configurations

Upgrade kits are available to add options after initial purchase. To upgrade the PNA-X/PNA/PNA-L, order the corresponding item number. The model and serial numbers of the instrument to be retrofitted are required as part of the order.

| Description                                                                                                                                     | Required Option           | For PNA-X Series     | For PNA Series | For PNA-L Series | User Installable |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------|----------------|------------------|------------------|
| <b>Frequency upgrade<sup>1</sup></b>                                                                                                            |                           |                      |                |                  |                  |
| Extend analyzer's frequency range to 13.5 GHz                                                                                                   | N5239A or N5249A          | N5249AU-913          | n/a            | N5239AU-613      | No               |
| Extend analyzer's frequency range to 20 GHz                                                                                                     | N5239A or N5231A          | n/a                  | n/a            | N5239AU/31AU-620 | No               |
| Extend analyzer's frequency range to 26.5 GHz                                                                                                   | N5241A, N5249A, or N5221A | N5241AU-960/49AU-960 | N5221AU-626    | n/a              | No               |
| Extend analyzer's frequency range to 50 GHz                                                                                                     | N5244A, N5224A or N5234A  | N5244AU-990          | N5224AU-650    | N5234AU-650      | No               |
| <b>Test ports</b>                                                                                                                               |                           |                      |                |                  |                  |
| Expand 2-ports, single source without configurable test set to 4-ports                                                                          | N522xA-200                | n/a                  | N522xAU-600    | n/a              | No               |
| Expand 2-ports, single source with configurable test set to 4-ports                                                                             | N524xA-200 or N522xA-201  | N524xAU-940          | N522xAU-601    | n/a              | No               |
| Expand 2-ports, single source with configurable test set and extended power range to 4-ports                                                    | N522xA-217                | n/a                  | N522xAU-617    | n/a              | No               |
| Expand 2-ports, single source with configurable test set, extended power range and bias-tees to 4-ports                                         | N524xA-219 or N522xA-219  | N524xAU-942          | N522xAU-619    | n/a              | No               |
| Expand 2-ports, internal second source with configurable test set, extended power range, bias-tees, combiner and mechanical switches to 4-ports | N524xA-224                | N524xAU-944          | n/a            | n/a              | No               |
| <b>Test set and power configuration</b>                                                                                                         |                           |                      |                |                  |                  |
| Add configurable test set, 2-ports                                                                                                              | N522xA-200                | n/a                  | N522xAU-201    | n/a              | No               |
| Add configurable test set and source attenuators, 2-ports                                                                                       | N523xA-200                | n/a                  | n/a            | N523xAU-216      | No               |
| Add extended power range, 2-ports <sup>2</sup>                                                                                                  | N522xA-201                | n/a                  | N522xAU-217    | n/a              | No               |
| Add bias-tees, 2-ports <sup>2</sup>                                                                                                             | N522xA-217                | n/a                  | N522xAU-219    | n/a              | No               |
| Add extended power range and bias-tees, 2-ports                                                                                                 | N524xA-200 or N5227A-201  | N524xAU-921          | N5227AU-219    | n/a              | No               |
| Add internal 2nd source, combiner and mechanical switches, 2-ports                                                                              | N524xA-219 or N522xA-219  | N524xAU-922          | n/a            | n/a              | No               |
| Add high power configurable, 2-ports                                                                                                            | N524xA-219 or 224         | N524xAU-H85          | n/a            | n/a              | No               |
| Add configurable test set, 4-ports                                                                                                              | N522xA-400                | n/a                  | N522xAU-401    | n/a              | No               |
| Add configurable test set and source attenuators, 4-ports                                                                                       | N523xA-400                | n/a                  | n/a            | N523xAU-416      | No               |
| Add extended power range, 4-ports <sup>2</sup>                                                                                                  | N522xA-401                | n/a                  | N522xAU-417    | n/a              | No               |
| Add bias-tees, 4-ports <sup>2</sup>                                                                                                             | N522xA-417                | n/a                  | N522xAU-419    | n/a              | No               |
| Add extended power range and bias-tees, 4-ports                                                                                                 | N524xA-400 or N5227A-401  | N524xAU-926          | N5227AU-419    | n/a              | No               |
| Add internal 2nd source, combiner and mechanical switches, 4-ports                                                                              | N524xA-419 or N522xA-419  | N524xAU-927          | n/a            | n/a              | No               |
| Add high power configurable, 4-ports                                                                                                            | N524xA-419 or 423         | N524xAU-H85          | n/a            | n/a              | No               |

1. Frequency upgrade options from 8.5/13.5/20/26.5 GHz to 43.5/50 GHz and 43.5/50 GHz to 67 GHz are not available. Trade-in is recommended.  
 2. Not available on N5227A.

## PNA Family Network Analyzer Upgrade Kits (continued)

### Application options

Upgrade kits are available to add options after initial purchase. To upgrade the PNA-X/PNA/PNA-L, order the corresponding item number. The model and serial numbers of the instrument to be retrofitted are required as part of the order.

| Description                                                  | Required Option                                                                                                 | For PNA-X Series         | For PNA Series | For PNA-L Series | User Installable |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------|----------------|------------------|------------------|
| <b>Measurement applications</b>                              |                                                                                                                 |                          |                |                  |                  |
| Automatic fixture removal                                    | Windows 7 OS <sup>7</sup> .                                                                                     | N524xAU-007              | N522xAU-007    | N523xAU-007      | Yes              |
| Time-domain measurements                                     |                                                                                                                 | N524xAU-010              | N522xAU-010    | N523xAU-010      | Yes              |
| Noise figure measurements using standard receivers           | Option 080 <sup>1,2</sup>                                                                                       | N524xAU-028              | N522xAU-028    | n/a              | Yes              |
| Fully-corrected noise figure measurements for PNA-X, 2-ports | Option 080 and for N5241/42/49A, one of Options 219, 224 or H85 <sup>1</sup> .<br>For N5244/45/47A, 080 and 224 | N524xAU-924 <sup>3</sup> | n/a            | n/a              | No               |
| Fully-corrected noise figure measurements for PNA-X, 4-ports | Option 080 and for N5241/42/49A, one of Options 419, 423 or H85 <sup>1</sup> .<br>For N5244/45/47A, 080 and 423 | N524xAU-929 <sup>3</sup> | n/a            | n/a              | No               |
| Frequency offset                                             |                                                                                                                 | N524xAU-080              | N522xAU-080    | N523xAU-080      | Yes              |
| Scalar-calibrated converter measurements                     | Option 080                                                                                                      | N524xAU-082              | N522xAU-082    | N523xAU-082      | Yes              |
| Vector- and scalar-calibrated converter measurements         | Option 080 <sup>3</sup>                                                                                         | N524xAU-083              | N522xAU-083    | n/a              | Yes              |
| Embedded LO measurements                                     | Option 082 or 083                                                                                               | N524xAU-084              | N522xAU-084    | n/a              | Yes              |
| Gain compression application                                 | See Footnote 1                                                                                                  | N524xAU-086              | N522xAU-086    | n/a              | Yes              |
| Intermodulation distortion application                       | Option 080 <sup>1,4</sup>                                                                                       | N524xAU-087              | N522xAU-087    | n/a              | Yes              |
| Source phase control                                         | See Footnote 5                                                                                                  | N524xAU-088              | N522xAU-088    | n/a              | Yes              |
| Differential and I/Q devices application                     | Option 080 and 400, 401, 410, 417, or 419, and Windows 7 OS <sup>7</sup>                                        | N524xAU-089              | N522xAU-089    | n/a              | Yes              |
| Spectrum analyzer                                            | Option 080, Windows 7 OS, and DSP version 5 <sup>7,9</sup>                                                      | N524xAU-090              | N522xAU-090    | 523xAU-090       | Yes              |
| Extended spectrum analyzer to 110 GHz <sup>10</sup>          | Option 090. Not available with N5241/49A or N5221A                                                              | N524xAU-093              | N522xAU-093    | n/a              | Yes              |
| Extended spectrum analyzer above 110 GHz <sup>10</sup>       | Option 090. Not available with N5241/49A or N5221A                                                              | N524xAU-094              | N522xAU-094    | n/a              | Yes              |
| Integrated true-mode stimulus application                    | Option 400, 401, 417, 419, or 423                                                                               | N524xAU-460              | N522xAU-460    | n/a              | Yes              |
| N-port capabilities                                          | See Footnote 6                                                                                                  | N524xAU-551              | N522xAU-551    | N523xAU-551      | Yes              |
| <b>Pulse, antenna, mm-wave</b>                               |                                                                                                                 |                          |                |                  |                  |
| Pulsed-RF measurements                                       | Option 025 <sup>1</sup>                                                                                         | N524xAU-008              | N522xAU-008    | n/a              | Yes              |
| Add IF inputs                                                |                                                                                                                 | N524xAU-020              | N522xAU-020    | n/a              | Yes              |
| Add pulse modulator to internal 1st source                   |                                                                                                                 | N524xAU-021              | N522xAU-021    | n/a              | Yes              |
| Add pulse modulator to internal 2nd source                   | Option 224, 400, 401, 417, 419, or 423                                                                          | N524xAU-022              | N522xAU-022    | n/a              | Yes              |
| Add four internal pulse generators                           |                                                                                                                 | N524xAU-025              | N522xAU-025    | n/a              | Yes              |
| Fast CW sweep                                                |                                                                                                                 | N524xAU-118              | N522xAU-118    | n/a              | Yes              |

- For measuring frequency converters, Option 082 or 083 is required.
- Requires configurable test set for signal conditioning of noise figure measurements using standard receivers. Therefore it is not available with N522xA-200, -210, -400 and -410.
- Upgrading N5244A units with noise figure hardware requires serial-number prefixes of 5204 or higher, and upgrading N5245A units requires serial-number prefixes of 5205 or higher. For these two models, units with lower serial-number prefixes can be traded in for credit towards a new unit with the noise figure hardware.
- Two-tone signal must be routed to R1 receiver after an external combiner; therefore it is not available with N522xA-200, -210, -400 and -410.
- When used with an external signal generator, configurable test set is required to access a receiver. Therefore it is not available with N522xA-200 and -210.
- To connect a multipoint test set, configurable test set is required. Therefore it is not available with N522xA-200, -210, -400, -410, and N523xA-200, and -400.
- The Windows 7 upgrade kit for PNAs containing CPU version 6 is model N8983A. This upgrade kit contains a new solid state drive with all of the necessary software installed. For units with older CPUs, order the N8984A with Option PC7. This upgrade kit contains a new solid state drive and a version 7 CPU. For adding Option 090 to units with DSP version 4, add Option SP5 to the N8983A or N8984A order to get the DSP version 5.
- A configurable test set is required for VMC measurements (to connect a reference mixer) or for SMC+Phase measurements using the comb-generator-based calibration. When ordered with N522xA-200, -210, -400 and -410, Option 083 adds phase and delay measurements only by using SMC+Phase with a calibration mixer.
- Optional receiver attenuators are recommended to avoid receiver compression for large-signal measurements.
- Option 093 is a subset of Option 094; therefore they cannot be ordered together.

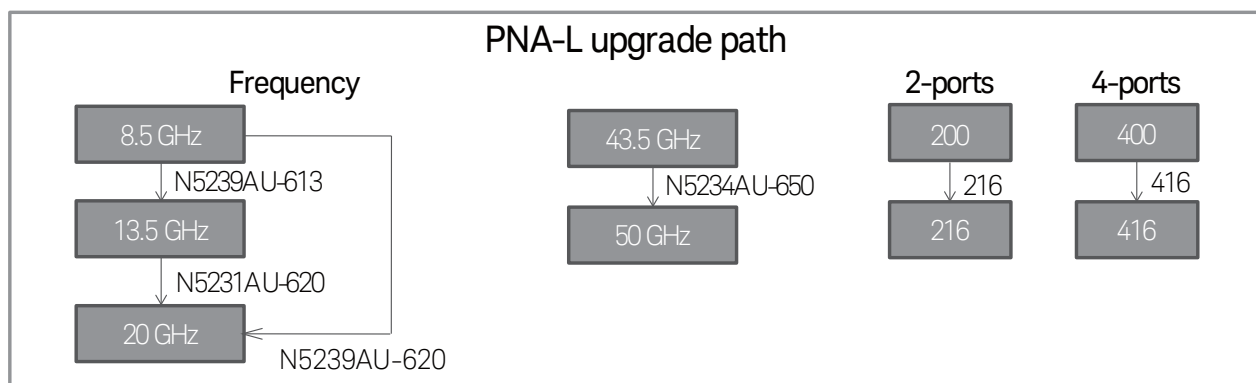
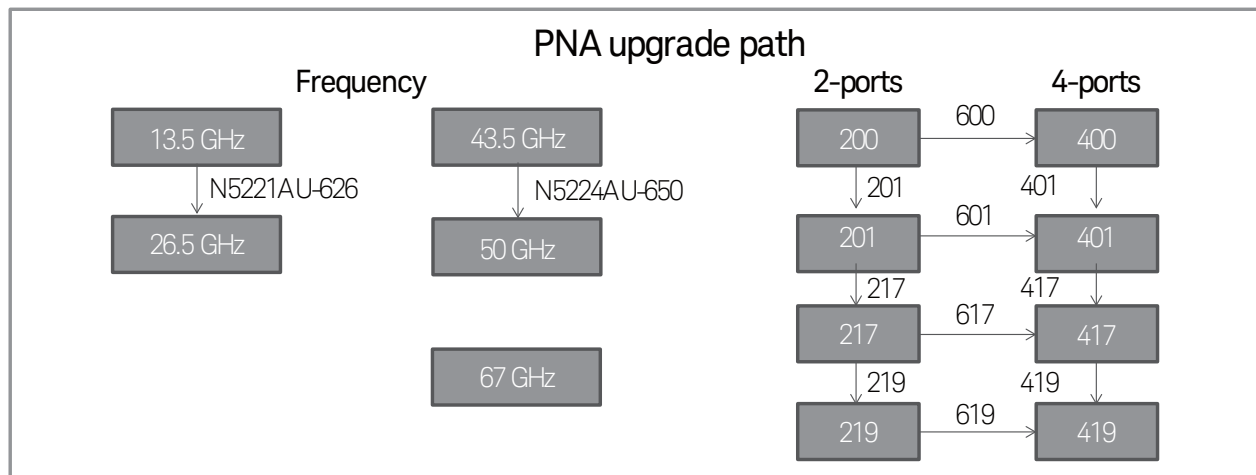
## PNA Family Network Analyzer Upgrade Kits (continued)

### Application options

Upgrade kits are available to add options after initial purchase. To upgrade the PNA-X/PNA/PNA-L, order the corresponding item number. The model and serial numbers of the instrument to be retrofitted are required as part of the order.

| Description                                                                                 | Required Option                                        | For PNA-X Series | For PNA Series | For PNA-L Series | User Installable |
|---------------------------------------------------------------------------------------------|--------------------------------------------------------|------------------|----------------|------------------|------------------|
| <b>Nonlinear vector network analysis</b>                                                    |                                                        |                  |                |                  |                  |
| Nonlinear component characterization                                                        | Options 419 and 080, or 400, H85 and 080               | N524xAU-510      | n/a            | n/a              | Yes              |
| Nonlinear X-parameters                                                                      | Options 423 and 510                                    | N524xAU-514      | n/a            | n/a              | Yes              |
| Nonlinear pulse envelope domain                                                             | Requires Options 021, 025 and either one of 510 or 514 | N524xAU-518      | n/a            | n/a              | Yes              |
| Arbitrary load-impedance X-parameters                                                       | Option 514                                             | N524xAU-520      | n/a            | n/a              | Yes              |
| <b>Calibration software</b>                                                                 |                                                        |                  |                |                  |                  |
| Perpetual license for built-in performance test software for Keysight inclusive calibration |                                                        | N524xAU-897      | N522xAU-897    | N523xAU-897      | Yes              |
| Perpetual license for built-in performance test software for standard compliant calibration |                                                        | N524xAU-898      | N522xAU-898    | N523xAU-898      | Yes              |

## Upgrade paths



1. This upgrade path only available on N5241/42/49A.
2. Upgrading N5244A units with noise figure hardware requires serial-number prefixes of 5204 or higher, and upgrading N5245A units requires serial-number prefixes of 5205 or higher. For these two models, units with lower serial-number prefixes can be traded in for credit towards a new unit with the noise figure hardware.

## Applications

### Material measurements

#### 85070E High-Temperature Dielectric Probe Kit

The 85070E enables measurements of the dielectric properties of materials quickly and conveniently. Measurements made with this probe are nondestructive and require no sample preparation. The dielectric probe is well suited for measurements of liquid, semisolid and flat solid materials. Measurement results can be viewed in a variety of formats ( $\epsilon^r$ ,  $\epsilon^{\prime\prime}$ ,  $\tan \delta$  or Cole-Cole). The supplied software can be run in the PNA analyzer or on a PC.

#### 85071E Materials Measurement Software

The 85071E materials measurement software calculates the permittivity and permeability of material samples placed in a coaxial airline or a rectangular waveguide. The measurement technique works well for solid materials that can be machined to fit precisely inside a transmission line. Measurement results can be viewed in a variety of formats ( $\epsilon^r$ ,  $\epsilon^{\prime\prime}$ ,  $\mu^r$ ,  $\mu^{\prime\prime}$ ,  $\tan \delta$ , or Cole-Cole  $\mu$ ). The software can be run in the PNA analyzer or on a PC.

### Signal integrity measurements

#### N1930B Physical Layer Test System (PLTS) Software

The PLTS software platform has become an industry standard for calibration, measurement and analysis of linear passive interconnects such as cables, connectors, backplanes and printed circuit boards. Utilizing either a vector network analyzer (VNA) or a time domain reflectometer (TDR), fast and accurate measurements can be obtained without in-depth knowledge of microwave measurement techniques. Refer to [www.keysight.com/find/plts](http://www.keysight.com/find/plts) or the technical overview, literature number 5989-6841EN for more details.

### Multiport measurements

Multiport test sets are designed to work with the PNA family of network analyzers to provide network analysis with a single set of connections for devices that have multiple ports. The test sets are configured in a variety of ways, for extension or switching, electro-mechanical or solid-state switches, number of test ports, frequency range, and 2- or 4-ports, depending on your analyzer.

#### Test set types: switching and extension test sets

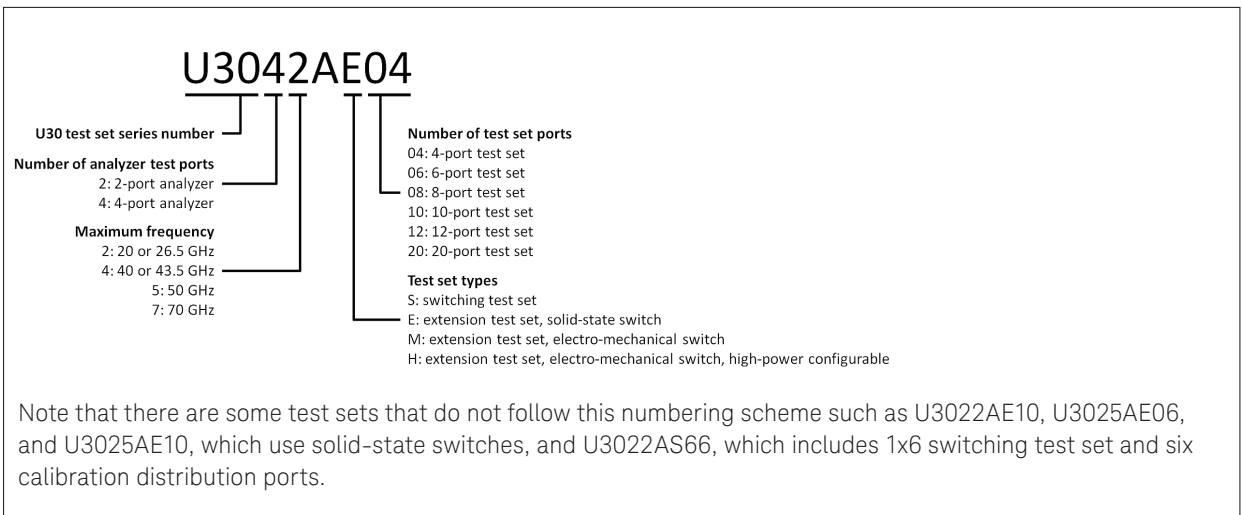
Switching test sets provide an economical solution for RF applications. They are connected directly to the test ports of the VNA, and a group of test ports share the directional couplers and receivers in the VNA. An extension test set is connected to the sources and test receivers through the configurable test set of the VNA. It features a directional coupler for every test port and all switching occurs behind the directional couplers, which provides the ultimate in flexibility, stability, and performance for RF and microwave applications.

#### Switch types: electro-mechanical and solid-state switches

Electro-mechanical switches have less insertion loss, higher power handling, and a more linear response compared to solid-state switches. They are recommended for testing active devices, high-power devices, and devices that require wide dynamic range. However, they have limited switching life (mostly 5 million cycles) and long setting times. In contrast, solid-state switches have unlimited switching life, very fast switching speed and excellent repeatability. Thus, they are often used for high-volume S-parameter measurements of passive devices.

#### Test set model number

Multiport test set model numbers represent the type of test set; note the numbering scheme below.



## Test set options

One of the following test set options must be selected.

### Standard configuration (Option 700)

- The standard configuration is the basic test set configuration, which does not include signal conditioning devices such as amplifiers.

### Add amplifiers for improved dynamic range (Option 001)

- Option 001 adds an amplifier between each test port coupler and the receiver switch to improved system dynamic range. It is primarily offered for the test set with solid-state switches to compensate for the insertion loss.

### Add amplifiers and bias-tees (Option 002)

- Option 002 adds an amplifier between each test port coupler and the receiver switch to improved system dynamic range and bias-tees for all test ports on the test set as well as the analyzer. It is primarily offered for the test set with solid-state switches to compensate for the insertion loss.

## Interface kits

The interface kit includes a set of semi-rigid RF jumper cables and two pairs of rear locking feet that connect and lock the analyzer and the test set together. When ordering a multiport test set, the analyzer that is used with the test set must be specified to add one of the following interface kits. The availability depends on the test set model. There are following three interface kit models based on the jumper connector layouts on the test set. Therefore, only one interface kit model ("PX", "PN", or "PL") is available on each test set. Each interface kit model has one digit suffix indicating the connector type; 1 for 1.85 mm, 2 for 2.4 mm and 3 for 3.5 mm (or SMA).

## Millimeter-wave measurements

### Single sweep solution to 110 GHz

The 67 GHz PNA and PNA-X network analyzers allow extending the maximum frequency to 110 GHz with a 1.0 mm coaxial connector, enabling 10 MHz to 110 GHz single sweep measurements using a millimeter-wave controller and frequency extenders with built-in combiner.

The 10 MHz to 110 GHz broadband millimeter-wave system provides high performance and capabilities including power control, 4-port true-differential, and frequency converter measurements. It is configured with an N5227A PNA with Option 201 (2-ports) or Option 401 (4-ports), or N5247A with Option 200 (2-ports) or Option 400 (4-ports), Option 020 IF access, an N5261A 2-port or an N5262A 4-port millimeter-wave test set controller with 1.85 mm coaxial cables (Option 112 for N5261A, Option 114 for N5262A) and RF/LO/IF/DC cables sets (to select the cable length and quantities), and one (for 2-ports) or two (for 4-ports) each of right and left frequency extenders with required attenuators and bias-tee configurations.

### Waveguide banded solutions to 1.05 THz

The waveguide banded millimeter-wave solution covers waveguide bands from 50 GHz to 1.05 THz. A 2- or 4-port PNA or PNA-X in conjunction with N5261A (for 2-port) or N5262A (for 4-port) configures for the most complete millimeter wave solution. It is configured with a PNA Series with Option 020 IF access, configurable test set (Option 201 or 401), and frequency offset mode (Option 080), or PNA-X Series with 2-port (Option 200) or 4-port (Option 400) and IF access (Option 020). For the millimeter-wave test controller, appropriate RF cable option and RF/LO/IF/DC cable set option for frequency extenders must be selected for the analyzer's connector type, number of test ports, and lengths. Add appropriate frequency extenders with required quantity for the measurements.

For complete list of millimeter-wave products and options, and ordering instructions, please refer to 5989-7620EN *Millimeter-wave Network Analyzers Technical Overview*.

|            |                                                                                                            |
|------------|------------------------------------------------------------------------------------------------------------|
| U3021PXx   | Interface kit for test set with jumper connectors to align with N524xA PNA-X and N522xA PNA                |
| U3021PNx   | Interface kit for test set with jumper connectors to align with E836xB/C PNA and N5230A/C-x25 2-port PNA-L |
| Option 261 | For use with E8361A/C 2-port PNA                                                                           |
| Option 262 | For use with E8362B/C 2-port PNA or N5230A/C-225 2-port PNA-L                                              |
| Option 263 | For use with E8363B/3C/4B/4C 2-port PNA or N5230A/C-425/525 2-port PNA-L                                   |
| Option 430 | For use with N5230A/C-245/246 4-port PNA-L                                                                 |
| Option 242 | For use with N5241/42/49A-2xx 2-port PNA-X or N5221A/2A-2xx 2-port PNA                                     |
| Option 442 | For use with N5241/42/49A-400 4-port PNA-X or N5221A/2A-4xx 4-port PNA                                     |
| Option 245 | For use with N5244A/5A-200 2-port PNA-X or N5224A/5A-2xx 2-port PNA                                        |
| Option 445 | For use with N5244A/5A-400 4-port PNA-X or N5224A/5A-4xx 4-port PNA                                        |
| Option 247 | For use with N5247A-200 2-port PNA-X or N5227A-2xx 2-port PNA                                              |
| Option 447 | For use with N5247A-400 4-port PNA-X or N5227A-4xx 4-port PNA                                              |

When ordering an additional cable set, a spare cable or rear locking feet, refer to the multiport test set user's guide or go to:

[www.keysight.com/find/multiport](http://www.keysight.com/find/multiport)

## Measurement Accessories

A complete list of RF and microwave test accessories is available on our Web site:

[www.keysight.com/find/accessories](http://www.keysight.com/find/accessories)

Accessories are available in these connector types:

50  $\Omega$  Type-N, 3.5 mm, 7 mm, 2.4 mm, 2.92 mm, 1.85 mm, 1.0 mm, and waveguide. Test port cables and a calibration kit should be added for a complete measurement system. A verification kit is used to verify corrected system performance.

### Cables and adapter sets

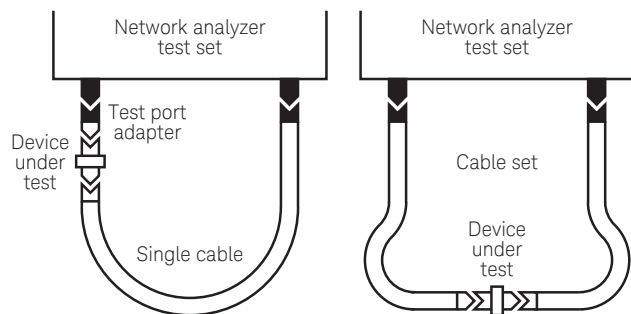
Keysight offers cables in the following types:

- single cables in semi-rigid and flexible
- cable sets in semi-rigid and flexible

There are also adapter sets available that protect the test port and convert the port to the desired connector interface. These kits contain:

- one male adapter
- one female adapter

To attain the best mechanical rigidity for device connection, use a single cable and the appropriate special adapter set. To attain the greatest flexibility for device connection, use a cable set.



## Calibration kits

### Coaxial measurements

Mechanical calibration kits include standards, such as opens, shorts and loads, which are measured by the network analyzer for increased measurement accuracy.

Electronic calibration (ECal) kits replace mechanical calibration standards with one solid-state calibration module that is controlled by the network analyzer via USB, to present many different impedances to the test ports. A full two-port calibration can be performed quickly with a single connection. This technique reduces operator errors and connector wear and abrasion.

Choose a calibration kit for each connector type to be used.

Economy, includes:

- open standards (male and female)
- short standards (male and female)
- fixed-termination standards (male and female)

Standard, includes the devices in the economy kit and adds:

- sliding load standards (male and female) or a series of offset shorts

Precision, includes the devices in the economy kit and adds:

- 50  $\Omega$  airline(s) for TRL calibration
- TRL adapters

### Waveguide measurements

For waveguide measurements, Keysight offers mechanical calibration kits that include:

- waveguide-to-coax adapters (X, P, K, R, Q, U, V)
- precision waveguide section
- flush short circuit
- fixed terminations
- straight section

## For devices with 1.0 mm connectors

### Mechanical calibration/verification kit

85059A DC to 110 GHz precision calibration/verification kit.

Includes:

- 85059-60003 1.00 mm (m) short 2.450 mm
- 85059-60007 1.00 mm (f) short 2.450 mm
- 85059-60004 1.00 mm (m) short 3.000 mm
- 85059-60008 1.00 mm (f) short 3.000 mm
- 85059-60002 1.00 mm (m) short 1.825 mm
- 85059-60006 1.00 mm (f) short 1.825 mm
- 85059-60001 1.00 mm (m) short 1.300 mm
- 85059-60005 1.00 mm (f) short 1.300 mm
- 85059-60009 1.00 mm male open
- 85059-60010 1.00 mm female open
- 85059-60019 1.00 mm male load
- 85059-60020 1.00 mm female load
- 85059-60021 1.00 mm lossy delay line
- 11920-60001 1.00 mm (m) to 1.00 mm (m) adapter
- 11920-60002 1.00 mm (f) to 1.00 mm (f) adapter
- 11920-60003 1.00 mm (m) to 1.00 mm (f) adapter
- 11500-60001 1.00 mm (f) to 1.00 mm (f) 8.8 cm cable
- 85059-60016 1.00 mm mismatch thru adapter for verification
- 85059-60017 1.00 mm matched thru adapter for verification
- 8710-2079 6 mm, 4 in-lb torque wrench
- 8710-2156 6 mm open end wrench

### Cables

- 11500I 1.0 mm (f-f) test port cable (8.8 cm)
- 11500J 1.0 mm (m-f) test port cable (16.0 cm)<sup>1</sup>
- 11500K 1.0 mm (m-f) test port cable (20.0 cm)<sup>1</sup>
- 11500L 1.0 mm (m-f) test port cable (24.0 cm)<sup>1</sup>

### Adapter set

- V281C 1.0 mm(f) to V-band waveguide adapter
- V281D 1.0 mm (m) to V-band waveguide adapter
- W281C 1.0 mm (f) to W-band waveguide adapter
- W281D 1.0 mm (m) to W-band waveguide adapter
- 11920A 1.0 mm (m) to 1.0 mm (m) adapter
- 11920B 1.0 mm (f) to 1.0 mm (f) adapter
- 11920C 1.0 mm (m) to 1.0 mm (f) adapter
- 11921A 1.0 mm (m) to 1.85 mm (m) adapter
- 11921B 1.0 mm (f) to 1.85 mm (f) adapter
- 11921C 1.0 mm (m) to 1.85 mm (f) adapter
- 11921D 1.0 mm (f) to 1.85 mm (m) adapter
- 11922A 1.0 mm (m) to 2.4 mm (m) adapter
- 11922B 1.0 mm (f) to 2.4 mm (f) adapter
- 11922C 1.0 mm (m) to 2.4 mm (f) adapter
- 11922D 1.0 mm (f) to 2.4 mm (m) adapter
- 11923A 1.0 mm (f) connector launch assembly

1. For on-wafer applications, two 11500J/K/L cables are required; one cable for each test port.
2. Special rugged female connector specifically for connecting to the network analyzer test port, but does not mate with a standard male connector.

## For devices with 1.85 mm connectors

### Mechanical calibration kit

85058B standard: DC to 67 GHz. Includes:

- 85058-60101 1.85 mm (m) short 5.4 mm
- 85058-60102 1.85 mm (m) short 6.3 mm
- 85058-60103 1.85 mm (m) short 7.12 mm
- 85058-60104 1.85 mm (m) short 7.6 mm
- 85058-60105 1.85 mm (f) short 5.4 mm
- 85058-60106 1.85 mm (f) short 6.3 mm
- 85058-60107 1.85 mm (f) short 7.12 mm
- 85058-60108 1.85 mm (f) short 7.6 mm
- 85058-60109 1.85 mm male open
- 85058-60110 1.85 mm female open
- 85058-60111 1.85 mm male load
- 85058-60112 1.85 mm female load
- 85058-60113 1.85 mm (m) to 1.85 mm (m) adapter
- 85058-60114 1.85 mm (f) to 1.85 mm (f) adapter
- 85058-60115 1.85 mm (m) to 1.85 mm (f) adapter

85058E economy: DC to 67 GHz. Includes:

- 85058-60101 1.85 mm (m) short 5.4 mm
- 85058-60105 1.85 mm (f) short 5.4 mm
- 85058-60109 1.85 mm male open
- 85058-60110 1.85 mm female open
- 85058-60123 1.85 mm male load
- 85058-60124 1.85 mm female load
- 85058-60113 1.85 mm (m) to 1.85 mm (m) adapter
- 85058-60114 1.85 mm (f) to 1.85 mm (f) adapter
- 85058-60115 1.85 mm (m) to 1.85 mm (f) adapter

### Electronic calibration kits

N4694A Microwave ECal: 10 MHz to 67 GHz, 2-ports Includes:

- Option M0F module with:  
N4694-60001 1.85 mm (f) to 1.85 mm (m) ECal module
- Option 00M module with:  
N4694-60002 1.85 mm (m) to 1.85 mm (m) ECal module
- Option 00F module with:  
N4694-60003 1.85 mm (f) to 1.85 mm (f) ECal module
- Option 00A adds:
  - 85058-60113 1.85 mm (m) to 1.85 mm (m) adapter
  - 85058-60114 1.85 mm (f) to 1.85 mm (f) adapter

### Cables

- N4697E<sup>2</sup> Single, flexible:  
1.85 mm (f) to 1.85 mm (f), 96.5 cm, 38 inches
- N4697F<sup>2</sup> Set, flexible:
  - One 1.85 mm (f) to 1.85 mm (f) cable, 62.2 cm, 24.5 inches, p/n N4697-60100
  - One 1.85 mm (f) to 1.85 mm (m) cable, 62.2 cm, 24.5 inches, p/n N4697-60200
- N4421B-K67 Single, flexible:  
1.85 mm (f) to 1.85 mm (m), 91.4 cm, 36 inches

### Adapter set

- 85130H<sup>2</sup> 1.85 mm to 1.85 mm

## For devices with 2.4 mm connectors

### Mechanical calibration kit

85056A standard: DC to 50 GHz. Includes:

- 00901-60003 2.4 mm (m) fixed broadband load
- 00902-60004 2.4 mm (f) fixed broadband load
- 00915-60003 2.4 mm (m) sliding load
- 00915-60004 2.4 mm (f) sliding load
- 85056-60005 2.4 mm (m) to 2.4 mm (m) adapter
- 85056-60006 2.4 mm (f) to 2.4 mm (f) adapter
- 85056-60007 2.4 mm (m) to 2.4 mm (f) adapter
- 85056-60020 2.4 mm (m) short
- 85056-60021 2.4 mm (f) short
- 85056-60022 2.4 mm (m) open
- 85056-60023 2.4 mm (f) open

85056D economy: DC to 50 GHz. Includes:

- 00901-60003 2.4 mm (m) fixed broadband load
- 00902-60004 2.4 mm (f) fixed broadband load
- 85056-60005 2.4 mm (m) to 2.4 mm (m) adapter
- 85056-60006 2.4 mm (f) to 2.4 mm (f) adapter
- 85056-60007 2.4 mm (m) to 2.4 mm (f) adapter
- 85056-60020 2.4 mm (m) short
- 85056-60021 2.4 mm (f) short
- 85056-60022 2.4 mm (m) open
- 85056-60023 2.4 mm (f) open

### Electronic calibration kits

N4693A Microwave ECal: 10 MHz to 50 GHz, 2-ports.

Includes:

- Option M0F module with:  
N4693-60001 2.4 mm (f) to 2.4 mm (m) ECal module
- Option 00M module with:  
N4693-60002 2.4 mm (m) to 2.4 mm (m) ECal module
- Option 00F module with:  
N4693-60003 2.4 mm (f) to 2.4 mm (f) ECal module
- Option 00A adds:
  - 85056-60005 2.4 mm (m) to 2.4 mm (m) adapter
  - 85056-60006 2.4 mm (f) to 2.4 mm (f) adapter

### Cables

Note: Keysight offers the following 2.4 mm test port cables. Adapters will be necessary when using these cables for 2.92 mm measurements.

- 85133C<sup>1</sup> single, semi-rigid:  
2.4 mm (f) to PSC-2.4 mm (f), 81 cm, 32 inches
- 85133D<sup>1</sup> set, semi-rigid:  
One 2.4 mm (f) to 2.4 mm (m), 53 cm, 21 inches,  
p/n 85133-60001  
One 2.4 mm (f) to 2.4 mm (f), 53 cm, 21 inches,  
p/n 85133-60002
- 85133E<sup>1</sup> single, flexible:  
2.4 mm (f) to PSC-2.4 mm (f), 97 cm, 38 inches

- 85133F<sup>1</sup> set, flexible:  
One 2.4 mm (f) to 2.4 mm (f), 63 cm, 25 inches,  
p/n 85133-60016  
One 2.4 mm (f) to 2.4 mm (m), 63 cm, 25 inches,  
p/n 85133-60017
- 85133H<sup>1</sup> Single, flexible: 2.4 mm (f) to 2.4 mm (m),  
63 cm, 25 inches
- N4421AK20 Single, flexible: 2.4 mm (f) to 2.4 mm (m),  
91.4 cm, 36 inches

### Adapter set

- 85130E 2.4 mm<sup>1</sup> to 7 mm
- 85130F 2.4 mm<sup>1</sup> to 3.5 mm
- 85130G 2.4 mm<sup>1</sup> to 2.4 mm

## For devices with K connectors (2.92 mm)

### Mechanical calibration kits

85056KE01 DC to 40 GHz

For use with user supplied 2.9 mm test port cables. 2.92 mm (K connector) calibration kit with fixed and sliding loads. The Keysight 85056KE01 calibration kit is an ordering convenience to allow the pass through ordering from Keysight for the Maury 8770C47 calibration kit.

85056KE02 DC to 40 GHz

For use with user supplied 2.92 mm test ports cables. 2.92 mm (K connector) calibration kit with fixed loads only. The Keysight 85056KE02 calibration kit is an ordering convenience to allow the pass through ordering from Keysight for the Maury 8770D47 calibration kit.

The 85056KE01 and 85056KE02 contains one NMD 2.4 mm<sup>2</sup> (f) to 2.92 mm (f) and one NMD 2.4 mm<sup>2</sup> (f) to 2.92 mm (m) test port adapter to adapt the 2.4 mm test ports of the PNA to 2.92 mm. It also supplies 2.92 mm to 2.92 mm in-series adapters (3 adapters) and a PNA Cal Coefficients on a USB stick. Users must supply their own 2.92 mm or K-connector test port cables. Also included is a 2.92 mm torque wrench.

Maury Microwave Terms and Conditions for Warranty and Return apply. Maury Microwave Corp. calibration kits are to be returned directly to Maury Microwave for service, repair, or calibration issues and not to Keysight Technologies. For additional information go to [www.maurymicrowave.com](http://www.maurymicrowave.com).

Keysight Technologies does not guarantee the performance of the Maury calibration kits or the system performance when connected to Keysight Microwave PNA Series network analyzers.

1. Special rugged female connector specifically for connecting to the network analyzer test port, but does not mate with a standard male connector.  
2. Special rugged female connector specifically for connecting to the network analyzer test port, but does not mate with standard 2.4 mm male connector

## For devices with K connectors (2.92 mm), continued

### Mechanical calibration kits, continued

#### Electronic calibration kits

N4692A Microwave ECal: 10 MHz to 40 GHz, 2-ports.

Includes:

- Option M0F module with: N4692-60001 2.92 mm (f) to 2.92 mm (m) ECal module
- Option 00M module with: N4692-60002 2.92 mm (m) to 2.92 mm (m) ECal module
- Option 00F module with: N4692-60003 2.92 mm (f) to 2.92 mm (f) ECal module
- Option 00A adds:
  - N4692-60021 2.92 mm (m) to 2.92 mm (m) adapter
  - N4692-60022 2.92 mm (f) to 2.92 mm (f) adapter

### Cables

Note: Keysight offers the following 2.4 mm test port cables. Adapters will be necessary when using these cables for 2.92 mm measurements.

- 85133C<sup>1</sup> single, semi-rigid: 2.4 mm (f) to PSC-2.4 mm (f), 81 cm, 32 inches
- 85133D<sup>1</sup> set, semi-rigid:
  - One 2.4 mm (f) to 2.4 mm (m), 53 cm, 21 inches, p/n 85133-60001
  - One 2.4 mm (f) to 2.4 mm (f), 53 cm, 21 inches, p/n 85133-60002
- 85133E<sup>1</sup> single, flexible: 2.4 mm (f) to PSC-2.4 mm (f), 97 cm, 38 inches
- 85133F<sup>1</sup> set, flexible:
  - One 2.4 mm (f) to 2.4 mm (f), 63 cm, 25 inches, p/n 85133-60016
  - One 2.4 mm (f) to 2.4 mm (m), 63 cm, 25 inches, p/n 85133-60017
- 85133H<sup>1</sup> Single, flexible: 2.4 mm (f) to 2.4 mm (m), 63 cm, 25 inches
- N4421AK20 Single, flexible: 2.4 mm (f) to 2.4 mm (m), 91.4 cm, 36 inches

### Adapters

- 11904A 2.4 mm (m) to 2.92 mm (m)
- 11904B 2.4 mm (f) to 2.92 mm (f)
- 11904C 2.4 mm (m) to 2.92 mm (f)
- 11904D 2.4 mm (f) to 2.92 mm (m)
- 11904S 2.4 mm to 2.92 mm
- Adapter set, contains 4 matched adapters

## For devices with 3.5 mm, SMA, or 2.92 mm connectors

### CalPod calibration refresh modules

CalPod calibration refresh modules allow in-situ calibration refreshes to be performed at the push of a button without removing the DUT or connecting calibration standards. They're useful for removing environmental effects such as cable movement, thermal effects of cables, connectors, and adapters, as well as connector and switch matrix repeatability errors, or whenever it is desirable to ensure a current and valid calibration is present. The modules are especially useful in thermal or thermal-vacuum chamber testing.

- 85530B 20 GHz Ambient temperature CalPod calibration refresh module
- 85531B 20 GHz Temperature-compensated CalPod calibration refresh module
- 85532B 20 GHz Thermal-vacuum compatible CalPod calibration refresh module
- 85540A 40 GHz Ambient temperature CalPod calibration refresh module
- 85541A 40 GHz Temperature-compensated CalPod calibration refresh module
- 85542A 40 GHz Thermal-vacuum compatible CalPod calibration refresh module
- 85523B CalPod controller; Provides control for up to four CalPods
- 85556A CalPod drive cable splitter; Allows control for up to 12 CalPods
- 85554A CalPod drive cable extension; 10 meter extension cable; cascable.

1. Special rugged female connector specifically for connecting to the network analyzer test port, but does not mate with a standard male connector.

## For devices with 3.5 mm or SMA connectors

### Mechanical calibration kits

85052B standard: DC to 26.5 GHz. Includes:

- 00902-60003 3.5 mm (m) fixed load
- 00902-60004 3.5 mm (f) fixed load
- 00911-60019 3.5 mm (m) sliding load
- 00911-60020 3.5 mm (f) sliding load
- 85052-60006 3.5 mm (m) short
- 85052-60007 3.5 mm (f) short
- 85052-60008 3.5 mm (m) open
- 85052-60009 3.5 mm (f) open
- 85052-60012 3.5 mm (f) to 3.5 mm (f) adapter
- 85052-60013 3.5 mm (f) to 3.5 mm (m) adapter
- 85052-60014 3.5 mm (m) to 3.5 mm (m) adapter

85052C precision TRL: DC to 26.5 GHz. Includes:

- 00902-60003 3.5 mm (m) fixed load
- 00902-60004 3.5 mm (f) fixed load
- 85052-60006 3.5 mm (m) short
- 85052-60007 3.5 mm (f) short
- 85052-60008 3.5 mm (m) open
- 85052-60009 3.5 mm (f) open
- 85052-60032 3.5 mm (f) to 3.5 mm (f) adapter
- 85052-60033 3.5 mm (m) to 3.5 mm (m) adapter
- 85052-60034 3.5 mm (f) to 3.5 mm (m) adapter
- 85052-60035 3.5 mm short TRL line
- 85052-60036 3.5 mm long TRL line

85052D economy: DC to 26.5 GHz. Includes:

- 00902-60003 3.5 mm (m) fixed load
- 00902-60004 3.5 mm (f) fixed load
- 85052-60006 3.5 mm (m) short
- 85052-60007 3.5 mm (f) short
- 85052-60008 3.5 mm (m) open
- 85052-60009 3.5 mm (f) open
- 85052-60012 3.5 mm (f) to 3.5 mm (f) adapter
- 85052-60013 3.5 mm (f) to 3.5 mm (m) adapter
- 85052-60014 3.5 mm (m) to 3.5 mm (m) adapter

### Electronic calibration kits

85093C RF ECal: 300 kHz to 9 GHz, 2-ports; Standard module includes:

- Option M0F with: 85093-60008 3.5 mm (f) to 3.5 mm (m) ECal module
- Option 00F module with: 85093-60010 3.5 mm (f) to 3.5 mm (f) ECal module
- Option 00M module with: 85093-60009 3.5 mm (m) to 3.5 mm (m) ECal module
- Option 00A adds:
  - 85052-60012 3.5 mm (f) to 3.5 mm (f) adapter
  - 85052-60014 3.5 mm (m) to 3.5 mm (m) adapter

85093C-xxx mixed-connector options:

| Port A option |     |     | Port B option |     |     |      |     |     |
|---------------|-----|-----|---------------|-----|-----|------|-----|-----|
| Type          | (f) | (m) | Type          | (f) | (m) | Type | (f) | (m) |
| 3.5 mm        | 101 | 102 | Type-N        | 203 | 204 | 7-16 | 205 | 206 |
|               |     |     | 50 ohm        |     |     |      |     |     |

N4431B Microwave ECal: 300 kHz to 13.5 GHz, 4-ports

Includes: Option 010 module with:

N4431-60006 4 x 3.5 mm (f) ECal module

N4431B-xxx mixed-connector options:

| Connector type    | Port A option | Port B option | Port C option | Port D option |
|-------------------|---------------|---------------|---------------|---------------|
| 3.5 mm (f)        | 101           | 201           | 301           | 401           |
| 3.5 mm (m)        | 102           | 202           | 302           | 402           |
| Type-N 50 ohm (f) | 103           | 203           | 303           | 403           |
| Type-N 50 ohm (m) | 104           | 204           | 304           | 404           |
| 7-16 (f)          | 105           | 205           | 305           | 405           |
| 7-16 (m)          | 106           | 206           | 306           | 406           |

N4433A Microwave ECal: 300 kHz to 20 GHz, 4-ports.

Includes: Option 010 module with:

N4433-60003 4 x 3.5 mm (f) ECal module

N4433A-xxx mixed-connector options:

| Connector type | Port A option | Port B option | Port C option | Port D option |
|----------------|---------------|---------------|---------------|---------------|
| 3.5 mm (f)     | 101           | 201           | 301           | 401           |
| 3.5 mm (m)     | 102           | 202           | 302           | 402           |

N4691B Microwave ECal: 300 kHz to 26.5 GHz, 2-ports.

Includes:

- Option M0F module with:
  - N4691-60004 3.5 mm (f) to 3.5 mm (m) ECal module
- Option 00M module with:
  - N4691-60005 3.5 mm (m) to 3.5 mm (m) ECal module
- Option 00F module with:
  - N4691-60006 3.5 mm (f) to 3.5 mm (f) ECal module
- Option 00A adds:
  - 85052-60012 3.5 mm (f) to 3.5 mm (f) adapter
  - 85052-60014 3.5 mm (m) to 3.5 mm (m) adapter

## Cables

- 85131C<sup>1</sup> single, semi-rigid: 3.5 mm (f) to PSC-3.5 mm (f), 81 cm, 32 inches<sup>2</sup>
- 85131D<sup>1</sup> set, semi-rigid:
  - One 3.5 mm (f) to 3.5 mm (m), 53 cm, 21 inches, p/n 85131-60009
  - One 3.5 mm (f) to PSC-3.5 mm (f), 53 cm, 21 inches, p/n 85131-60010
- 85131E<sup>1</sup> single, flexible: 3.5 mm (f) to PSC-3.5 mm (f), 96.5 cm, 38 inches<sup>2</sup>
- 85131F<sup>1</sup> set, flexible:
  - One 3.5 mm (f) to 3.5 mm (m), 62.2 cm, 24.5 inches, p/n 85131-60012
  - One 3.5 mm (f) to PSC-3.5 mm (f), 62.2 cm, 24.5 inches, p/n 85131-60013
- 85131H<sup>1</sup> single, flexible: 3.5 mm (f) to 3.5 mm (m), 62.2 cm, 24.5 inches
- 85134E<sup>1</sup> single, flexible: PSC-3.5 mm (f) to 2.4 mm (f), 96 cm, 38 inches
- 85134F<sup>1</sup> set, flexible:
  - One 2.4 mm (f) to PSC-3.5 mm (f), 53 cm, 21 inches, p/n 85134-60004
  - One 2.4 mm (f) to PSC-3.5 mm (m), 53 cm, 21 inches, p/n 85134-60003
- 85134H<sup>1</sup> single, flexible: 2.4 mm (f) to PSC-3.5 mm (m), 53 cm, 21 inches
- N4419AK20 single, flexible: 3.5 mm (m) to 3.5 mm (f), 91.4 cm, 36 inches
- Z5623A-K20 single, flexible: 3.5 mm (m) to 3.5 mm (m), 91.4 cm, 36 inches

## Adapter sets

- 85130D 3.5 mm<sup>1</sup> to 3.5 mm

1. Special rugged female connector specifically for connecting to the network analyzer test port, but does not mate with a standard male connector.

2. For use with E8362C.

## For devices with Type-N connectors

### Mechanical calibration kits

85054B standard: DC to 18 GHz. Includes:

- 00909-60011 Type-N (m) fixed lowband load
- 00909-60012 Type-N (f) fixed lowband load
- 85054-60025 Type-N (m) short
- 85054-60026 Type-N (f) short
- 85054-60027 Type-N (m) open
- 85054-60028 Type-N (f) open
- 85054-60031 Type-N (f) to 7mm adapter
- 85054-60032 Type-N (m) to 7mm adapter
- 85054-60037 Type-N (f) to Type-N (f) adapter
- 85054-60038 Type-N (m) to Type-N (m) adapter
- 85054-80010 Type-N (f) sliding load
- 85054-80009 Type-N (m) sliding load
- 85054-60050 Type-N (f) connector gage
- 85054-60052 Type-N (f) gage master
- 85054-60051 Type-N (m) connector gage
- 85054-60053 Type-N (m) gage master

85054D economy: DC to 18 GHz. Includes:

- 85054-60025 Type-N (m) short
- 85054-60026 Type-N (f) short
- 85054-60027 Type-N (m) open
- 85054-60028 Type-N (f) open
- 85054-60031 Type-N (f) to 7mm adapter
- 85054-60032 Type-N (m) to 7mm adapter
- 85054-60037 Type-N (f) to Type-N (f) adapter
- 85054-60038 Type-N (m) to Type-N (m) adapter
- 85054-60046 Type-N (m) fixed load
- 85054-60047 Type-N (f) fixed load

### Adapter sets

- 85130C 3.5 mm<sup>2</sup> to Type-N

### Electronic calibration kits

N4431B Microwave ECal: 300 kHz to 13.5 GHz, 4-ports.

Includes:

- Option 020 module with:  
N4431-60007 4 x Type-N (f) ECal module

N4431B-xxx mixed-connector options:

| Connector type        | Port A option | Port B option | Port C option | Port D option |
|-----------------------|---------------|---------------|---------------|---------------|
| 3.5 mm (f)            | 101           | 201           | 301           | 401           |
| 3.5 mm (m)            | 102           | 202           | 302           | 402           |
| Type-N 50 ohm (f)     | 103           | 203           | 303           | 403           |
| Type-N 50 ohm (m)     | 104           | 204           | 304           | 404           |
| 7-16 (f) <sup>1</sup> | 105           | 205           | 305           | 405           |
| 7-16 (m) <sup>1</sup> | 106           | 206           | 306           | 406           |

N4432A Microwave ECal: 300 kHz to 18 GHz, 4-ports. Includes:

- Option 020 module with:  
N4432-60003 4 x Type-N (f) ECal module

N4432A-xxx mixed-connector options:

| Connector type    | Port A option | Port B option | Port C option | Port D option |
|-------------------|---------------|---------------|---------------|---------------|
| 3.5 mm (f)        | 101           | 201           | 301           | 401           |
| 3.5 mm (m)        | 102           | 202           | 302           | 402           |
| Type-N 50 ohm (f) | 103           | 203           | 303           | 403           |
| Type-N 50 ohm (m) | 104           | 204           | 304           | 404           |

N4690B Microwave ECal: 300 kHz to 18 GHz, 2-ports.

Includes:

- Option M0F module with:  
N4690-60004 Type-N (f) to Type-N (m) ECal module
- Option 00M module with:  
N4690-60005 Type-N (m) to Type-N (m) ECal module
- Option 00F module with:  
N4690-60006 Type-N (f) to Type-N (f) ECal module
- Option 00A adds:  
85054-60037 Type-N (f) to Type-N (f) adapter  
85054-60038 Type-N (m) to Type-N (m) adapter

### Cables<sup>2</sup>

Use the test port cables recommended for devices with 7 mm connectors, and 7 mm to Type-N adapters that are from the 85054B/D Type-N calibration kit (see 7 mm connector section).

1. Special rugged female connector specifically for connecting to the network analyzer test port, but does not mate with a standard male connector.  
2. For use with E8362C.

## For devices with 7 mm connectors

### Mechanical calibration kits

85050B standard: DC to 18 GHz. Includes:

- 00909-60008 7 mm coax termination
- 85050-60006 7 mm fixed broadband load
- 85050-80007 7 mm short
- 85050-80010 7 mm open
- 85050-80011 7 mm sliding load

85050C precision TRL: DC to 18 GHz. Includes:

- 00909-60008 7 mm coax termination
- 85050-60003 7 mm to 7 mm airline
- 85050-60005 7 mm to 7 mm TRL adapter
- 85050-60006 7 mm fixed broadband load
- 85050-80008 7 mm short
- 85050-80009 7 mm short collet
- 85050-80010 7 mm open

85050D economy: DC to 18 GHz. Includes:

- 85050-60006 7 mm fixed broadband load
- 85050-80007 7 mm short
- 85050-80010 7 mm open

### Electronic calibration kits

- N4696B Microwave ECal: 300 kHz to 18 GHz, 2-ports, 7 mm to 7 mm Microwave module

### Cables<sup>1</sup>

- 85132E single, flexible: 3.5 mm (f) to 7 mm, 97.2 cm, 38.25 inches<sup>2</sup>
- 85132F set, flexible: two 3.5 mm (f) to 7 mm cables, 62.9 cm each, 24.75 inches each<sup>2</sup>, p/n 85132-60004
- 85133F cable set (set, flexible, 2.4 mm, 53 cm each, 21 inches each)
- 85134F cable set (set, flexible, 2.4 mm (f) to 3.5 mm (f) and (m), 53 cm each, 21 inches each)
- 85135E single, flexible: 2.4 mm (f) to 7 mm, 96 cm, 38 inches
- 85135F set, flexible: two 2.4 mm (f) to 7 mm cables, 53 cm each, 21 inches each, p/n 85135-60002

### Adapter sets

- 85130E 2.4 mm<sup>1</sup> to 7 mm
- R281A adapter (2.4 mm (f) to WR-28 waveguide adapter)
- R281B adapter (2.4 mm (m) to WR-28 waveguide adapter)
- Q281A adapter (2.4 mm (f) to WR-22 waveguide adapter)
- Q281B adapter (2.4 mm (m) to WR-22 waveguide adapter)

## For devices with waveguide

### Mechanical calibration kits

X Band

X11644A standard, WR-90: 8.2 to 12.4 GHz. Includes:

- 00896-60008 X-band standard section
- 00910-60003 X-band termination
- 11644-20018 X-band short
- 11644-20021 X-band shim
- X281C adapter (included in calibration kit): WR-90 to 7 mm

P Band

P11644A standard, WR-62: 12.4 to 18 GHz. Includes:

- 00896-60007 P-band standard section
- 00910-60002 P-band termination
- 11644-20017 P-band short
- 11644-20020 P-band shim
- P281C adapter (included in calibration kit): WR-62 to 7 mm

K Band

K11644A standard, WR-42: 18 to 26.5 GHz. Includes:

- 00896-60006 K-band standard section
- 00910-60001 K-band termination
- 11644-20016 K-band short
- 11644-20019 K-band shim
- K281C adapter (included in calibration kit): WR-42 to 3.5 mm (f) Option 012 WR-42 to 3.5 mm (m)

R Band

R11644A standard, WR-28: 26.5 to 40 GHz. Includes:

- 00914-20028 R-band termination
- 11644-20005 R-band short
- 11644-20003 R-band shim
- 11644-60001 R-band 10 cm straight waveguide
- 11644-60016 R-band 5 cm straight waveguide

1. For use with E8362C.

2. Special rugged female connector specifically for connecting to the network analyzer test port, but does not mate with a standard male connector.

## Q Band

Q11644A standard, WR-22: 33 to 50 GHz. Includes:

- 11644-60005 Q-band termination
- 11644-20004 Q-band short
- 11644-20001 Q-band shim
- 11644-60002 Q-band 10 cm straight waveguide
- 11644-60017 Q-band 5 cm straight waveguide

## U Band

U11644A standard, WR-19: 40 to 60 GHz. Includes:

- 11644-60006 U-band termination
- 11644-20004 U-band short
- 11644-20002 U-band shim
- 11644-60003 U-band 10 cm straight waveguide
- 11644-60018 U-band 5 cm straight waveguide

## V Band

V11644A standard, WR-15: 50 to 75 GHz. Includes:

- 11644-60025 V-band termination
- 11644-20015 V/W-band short
- 11644-20013 V-band shim
- 11644-60012 V-band standard section

## W Band

W11644A standard, WR-10: 75 to 110 GHz. Includes:

- 11643-60026 W-band termination
- 11644-20015 V/W-band short
- 11644-20014 W-band shim
- 11644-60013 W-band standard section

## Verification kits

All Keysight verification kits include:

- precision  $Z_0$  airline or match thru
- mismatched airline or mismatch thru
- fixed attenuators
- traceable measured data and uncertainties

### 85051B 45 MHz to 18 GHz 7 mm kit

Includes attenuators, airline and mismatch airline with data on a 3.5-inch disk for use in confirming accuracy enhanced system measurement performance, traceable to national standards. Test procedure is provided in the service manual.

### 85053B 300 kHz to 26.5 GHz 3.5 mm kit

Includes attenuators, airline and mismatch airline with data on a 3.5-inch disk for use in confirming accuracy enhanced system measurement performance, traceable to national standards. Test procedure is provided in the service manual.

### 85055A 300 kHz to 18 GHz Type-N kit

Includes attenuators, airline and mismatch airline with data on a 3.5-inch disk for use in confirming accuracy enhanced system measurement performance, traceable to national standards. Test procedure is provided in the service manual.

### 85057B 45 MHz to 50 GHz 2.4 mm kit

Includes attenuators, airline and mismatch airline with data on a 3.5-inch disk for use in confirming accuracy enhanced system measurement performance, traceable to national standards. Test procedure is provided in the service manual.

### 85058V 45 MHz to 67 GHz 1.85 mm kit

Includes attenuators, match thru and mismatch thru with data on a 3.5-inch disk for use in confirming accuracy enhanced system measurement performance, traceable to national standards. Test procedure is provided in the service manual.

## General Accessories

### Spare drive<sup>1</sup>

- N5242-60133 spare drive with mounting cradle for all PNA with Windows 7 and 2.2 GHz CPU (version 7)
- N8983A spare drive with mounting cradle for all PNA with Windows 7 and 2.0 GHz i7 or 1.87 GHz CPU (version 6)
- N5242-60044 spare drive with mounting cradle for N524xA with Windows XP and 2.0 GHz Core 2 Duo CPU (version 5)
- N5242-60088 spare drive with mounting cradle for N522xA/4xA with Windows XP and 2.0 GHz i7 CPU (version 6)
- N5235-60060 spare drive with mounting cradle for N523xA with Windows XP and 1.87 GHz CPU (version 6)
- Upgrading to 2.2 GHz CPU is recommended for N5241A/2A with 1.6 GHz CPU by ordering N8984A-PC7
- N8982A spare drive with mounting cradle for E836xC and N5230C
- N8981A spare drive with mounting cradle for E836xA/B and N5230A with 1.1 GHz CPU

1. All spare drives are solid-state drive. For more information, refer to [na.support.keysight.com/pna/hdnumbers.html](http://na.support.keysight.com/pna/hdnumbers.html).

## General Accessories, continued

### Probe

- 85024A high-frequency probe; provides high-impedance in-circuit test capability from 300 kHz to 3 GHz.

### Power meters and sensors<sup>1</sup>

Recommended for self support, adjustments and performance tests to verify proper instrument operation.

#### USB power sensors

- U848x Series USB thermocouple power sensors (A.09.90.08 and later)
- U2020 X-Series USB peak and average power sensors
- U2000 Series USB power sensors
- U2040 X-Series USB and LAN power sensors

#### Power meters

- P Series power meters (N1911A and N1912A) and all supported sensors
- EPM Series power meters (N1913A and N1914A) and all supported sensors
- EPM-P Series power meters (E4416A and E4417A) and all supported sensors
- E Series power meters (E4418 and E4419) and all supported sensors
- HP 437B / 438A power meters

### Comb generators

Two are required for NVNA. Also requires separate power supply.

- U9391C 10 MHz to 26.5 GHz comb generator
- U9391F 10 MHz to 50 GHz comb generator
- U9391G 10 MHz to 67 GHz comb generator

### Amplifiers

- 83006A power amplifier, 10 MHz to 26.5 GHz, 20 dB gain, power out: +18 dBm to 10 GHz or +16 dBm to 20 GHz or +14 dBm to 26.5 GHz
- 83017A power amplifier, 50 MHz to 26.5 GHz, 25 dB gain, power out: +20 dBm to 20 GHz, or +15 dBm to 26.5 GHz
- 83018A power amplifier, 2 to 26.5 GHz, 27 dB gain to 20 GHz or 23 dB to 26.5 GHz, power out: +24 dBm to 20 GHz or +21 dBm to 26.5 GHz
- 83020A power amplifier, 2 to 26.5 GHz, 30 dB gain to 20 GHz or 27 dB to 26.5 GHz, power out: +30 dBm to 20 GHz or +26 dBm to 26.5 GHz
- 83050A power amplifier, 2 to 50 GHz, 23 dB gain, power out: +20 dBm to 40 GHz or +17 dBm to 50 GHz
- 83051A power amplifier, 45 MHz to 50 GHz, 23 dB gain power out: +12 dBm to 45 GHz or +10 dBm to 50 GHz

## Couplers

- 87300B coaxial coupler, 1 to 20 GHz, SMA (f), 10 dB coupling
- 87300C coaxial coupler, 1 to 26.5 GHz, 3.5 mm (f), 10 dB coupling
- 87301B coaxial coupler, 10 to 46 GHz, 2.92 mm (f), 10 dB coupling
- 87301D coaxial coupler, 1 to 40 GHz, 2.4 mm (f) or optional 2.92 mm (f), 13 dB coupling
- 87301E coaxial coupler, 2 to 50 GHz, 2.4 mm (f), 10 dB coupling
- 87310B 90° coaxial coupler, 1 to 18 GHz, SMA (f), 3 dB coupling

## Equipment rack accessories

- E3663AC Rail kit (included with Option 1CM and 1CP)
- 1CM042A Rack mount flange kit, for use without handles (included with Option 1CM)
- 5063-9224 Rack mount flange kit with handles<sup>2</sup>
- 5063-9230 Front handle kit<sup>2</sup>
- 1CN020A Rack mount flange kit, for use with classic handles (included with Option 1CP)<sup>2</sup>

## Monitors

- VGA-compatible monitor

## Interface cables

Choose the appropriate cables to connect each peripheral to the network analyzer.

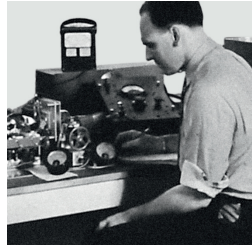
- 10833A GPIB cable, 1.0 m (3.3 ft)
- 10833B GPIB cable, 2.0 m (6.6 ft)
- 10833D GPIB cable, 0.5 m (1.6 ft)
- 82357B GPIB to USB interface

1. For the latest guide to power meters and power sensors, refer to the Keysight web site: [www.keysight.com/find/powermeters](http://www.keysight.com/find/powermeters)

2. 5063-9224 is a complete rack mount kit with handles. N52xxA comes with ruggedized handles, which must be replaced with classic handles shipped with the kit. 1CN020A is a pair of classic handles, and used with 5063-9237 for mounting N52xxA to a rack.

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