

# 96270A 27 GHz Low Phase Noise Reference Source

## Technical Data

### RF calibration just became a lot less complicated

The Fluke Calibration 96270A RF Reference Source is the simplest, most accurate and cost effective single instrument for calibrating spectrum analyzers and RF power sensors and more, up to 27 GHz. Its precision signal level and attenuation, high signal purity and precision low distortion modulation make this reference source clearly superior to the general-purpose signal generators that are often used to calibrate spectrum analyzers, RF power sensors, attenuators, and similar instruments. Its low phase noise provides superior phase noise performance.

Unlike many RF calibration solutions, the 96270A is designed specifically for RF calibration, with a calibration-oriented user interface that makes it easy to learn and operate. The 96270A simplifies and speeds up calibration procedures, reduces opportunities for operator errors, and greatly simplifies RF metrology. At the core of an RF and microwave calibration system, the 96270A covers more than 80 % of the test points required for calibrating almost all spectrum analyzers of any frequency range. For many spectrum analyzer models operating below 27 GHz, you only need a 96270A to perform the entire calibration. You can't simplify much more than that!

Automated with MET/CAL® Plus Calibration Management Software, the 96270A reduces complexity and calibration times, improving efficiency and increasing capacity over manual methods.

#### Key benefits

- Covers a broad range of RF calibration workload
- Reduces the number of instruments and inter-connections required for your RF calibration system
- "Self-characterization" lets you avoid calculating correction factors for each component in the signal delivery system
- "What you set is what you get" accurate signal delivery direct to the UUT input up to 27 GHz
- Integrated 300 MHz frequency counter and dual power meter readout eliminate need for additional instruments



- Calibration-specific interface simplifies technician tasks
- Simplifies uncertainty calculations
- Lowers RF system maintenance costs
- With automation, reduces spectrum analyzer calibration times by as much as 50% over manual methods

#### Cover a broad range of your RF workload with a single instrument

The 96270A calibrates a broad workload of RF calibration devices, including:

- Spectrum analyzers, including higher frequency models
- RF power sensors
- Modulation meters and analyzers
- Measurement receivers
- Frequency counters
- RF attenuators and components
- High frequency oscilloscopes
- ...and more



The metrology associated with calibrating these items becomes simpler because you have fewer error sources and uncertainty contributions to consider than with traditional RF calibration systems.

## More than just an RF calibrator

Many applications in R&D, manufacturing test and ATE need better performance than a general purpose signal generator can offer. If wide frequency coverage, frequency resolution, low harmonics, phase noise and spurious content, signal level and attenuation accuracy, and/or dynamic range are critical parameters, the 96270A is the ideal solution.

## Cut the cost of your RF calibration system in half

As the central instrument in a high performance RF spectrum analyzer calibration system, the 96270A can cut your costs in half or even more. The 96270A replaces all of these parts of a “typical” RF calibration system:

- Up to five signal sources (from audio/ function generators to RF and microwave signal generators and low phase noise sources)
- Power meters
- Power sensors
- Step attenuators
- Filters
- Pads
- Couplers
- 300 MHz frequency counter

The 96270A not only reduces the initial cost and time to purchase, install and configure RF system components, but it also reduces the costs to maintain and calibrate all of that equipment. For many spectrum analyzer models operating below 27 GHz, as well as for most power sensors, you only need a 96270A to perform the entire calibration.

The 96270A is also easier to transport than a heavy rack of equipment and accessories, making it the optimum solution for on-site calibration.

## No need for additional power meters, function generators or counters

The integrated dual power meter readout enables you to use the 96270A as a power meter and perform RF calibrations, without requiring a separate power meter. You can replace the 40 GHz power sensor included with the 96270A/HF model with a different compatible model, for power measurements at frequencies up to 67 GHz.

The 96270A Reference Source’s internal modulation capability makes it suitable for applications that require precision modulation to be applied to the output signal, such as modulation analyzer calibration and spectrum analyzer sweep time testing using an AM signal with more accurate modulation rates. You don’t need additional function generators as a low frequency modulation source—the 96270A delivers it all.

The integrated 300 MHz frequency counter lets you reduce the number of instruments required for RF calibration even further.

## Flexible configurations match your needs and budget

A variety of models, options and accessories enable you to purchase the performance you need, then add items later as your needs change and grow.



The basic **96270A Reference Source** comes with a 50 ohm leveling head. The **96270A/75** includes both the 50 ohm and a 75 ohm head. The leveling head provides leveled, deep attenuation, modulation and low phase noise signals to 4 GHz, covering 80 % of the test points of any frequency spectrum analyzer—including high frequency models—and for linearity calibration of power sensors. Signals at frequencies from 1 mHz to 27 GHz are also available from the 96270A front panel microwave output, at level accuracies comparable with most general purpose signal generators.



The **96270A/HF Reference Source** includes a high frequency leveling kit comprised of a Rohde & Schwarz 40 GHz power sensor and Agilent 11667B splitter, plus a metrology-grade microwave cable and precision APC-3.5 millimeter adapter. This configuration, using the 96270A Microwave output, enables you to calibrate spectrum analyzers, power sensors and high frequency oscilloscope bandwidths in the 1 kHz to 27 GHz range. The power sensor and splitter provide the 96270A with fully automatic feedback that enables it to deliver precision, leveled, high purity signals, just as you set them on the 96270A front panel, at the splitter output port reference plane and UUT input connection.



The **96270A/LL Reference Source with Low Level Microwave Output** extends the microwave output range from -4 dBm at the front panel connector (-10 dBm at the high frequency leveling kit splitter output) down to -100 dBm, for applications that require lower level signals at frequencies up to 27 GHz. This capability is invaluable for calibrating oscilloscopes, as well as for some spectrum analyzer and power sensor tests.

The **96270A/LL/HF** includes both the high frequency leveling kit and the low level microwave output, for the broadest possible workload coverage.

The **9600FLT 1 GHz Wide Offset Phase Noise Filter** accessory is designed specifically for high performance spectrum analyzer wide-offset phase noise testing. Even with the best low phase noise signal generators, technicians occasionally use filters during very high performance spectrum analyzer phase noise tests to reduce noise levels at wide (high) offset frequencies and to improve test margins. The 9600FLT connects easily to the 96270A in either benchtop or rack-mounted applications.



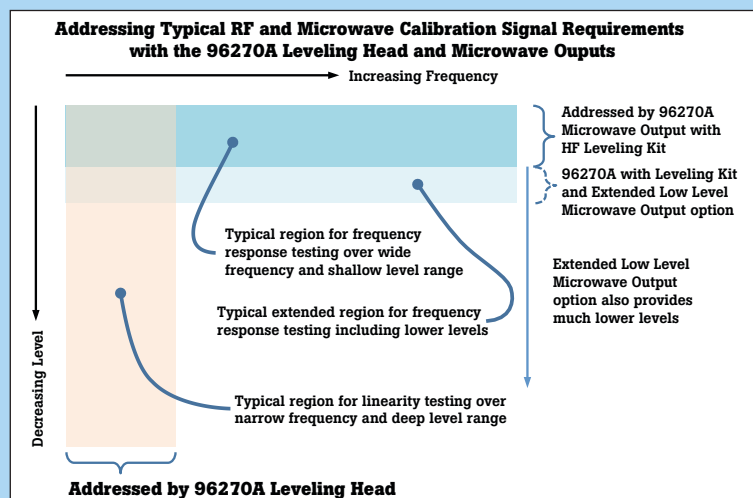
Additional power sensors, rack mount slide kit, an interconnection kit and rugged transit case round out the list of available accessories and make the 96270A easy to set up and transport.

### Designed for RF calibration

Many RF calibration systems are assembled with a mix of general purpose signal generators, power sensors, and other non-calibration-specific instruments. The 96270A, on the other hand, is designed specifically for RF calibration. Its user interface is designed to simplify processes for calibrating items such as spectrum analyzers, RF level meters and receivers. Parameter offset, stepping, relative and UUT/DUT error readout modes allow you to work accurately and efficiently, following familiar calibration procedures. You'll find it easier than ever to determine the performance and tolerances of units under test.

The 96270A front panel is equipped with dedicated function keys, context-sensitive softkeys, and a bright, easy-to-read color display that make

## Typical RF and microwave calibration signal requirements



In general, the signals required in RF and microwave calibration can be split into two ranges: at a relatively narrow range of lower frequencies over a wide amplitude range; and at relatively high amplitudes from low to very high frequencies.

For example, frequency response calibration of spectrum analyzers and power sensors is typically performed throughout the instrument's entire frequency range, requiring low and high frequencies. Usually these signals are only needed at relatively high levels. High frequency oscilloscope bandwidth testing requires high frequency signals, but also includes some lower levels. Linearity (scale fidelity) and attenuator accuracy calibration of spectrum analyzers and linearity testing of power sensors are performed at relatively low frequencies over a very large amplitude range, often a dynamic range of 80 dB or more. Typically the majority (over 80%) of high frequency spectrum analyzer test points are below 4 GHz.

The 96270A is designed to optimally and efficiently address these differing requirements by delivering high purity wide dynamic range accurate level, attenuation and modulation signals via its leveling head at frequencies below 4 GHz; and delivering the higher level high purity signals from below 1 kHz up to 27 GHz via its microwave output. Adding automatic leveling feedback control with the high frequency leveling kit ensures precise signal levels are generated directly at the UUT input. Adding the low level microwave output option extends the dynamic range of the microwave output for applications such as HF oscilloscope bandwidth testing and others that require lower level signals.



it easy to learn and operate. You can set output levels in terms of power (watts or dBm), voltage (RMS or peak to peak) using familiar multipliers and exponent forms. You can move easily between voltage, power and dBm units without losing entered values or accuracy. In error readout mode to adjust the reading, simply rotate the spin wheel and the UUT error is displayed directly in dB, ppm or percent.

The simple, calibration-oriented user interface also makes troubleshooting easier if you encounter an unexpected result or an out-of-tolerance condition while following a manual or automated calibration procedure.

### “What you set is what you get” accuracy and signal purity

The 96270A delivers pure, accurate level signals directly to the UUT input just the way you set them on the front panel. This unique “What you set is what you get” feature helps you avoid losses, mismatch errors, and uncertainty contributions introduced by cables, other devices and interconnections, eliminating complex setups and time consuming methods otherwise required to obtain accurate results.

For low-level signals, use the 96270A with the rugged, precision leveling head in 50 ohm or 75 ohm versions. The head delivers lower frequencies up to 4 GHz directly to the UUT input with deep dynamic range, minimizing losses, noise, interference and mismatch errors, and maintaining the integrity of low-level signals throughout a 154 dB dynamic range, down to the very lowest levels at -130 dBm.

For more shallow level wider frequency range signals up to 27 GHz, use the 96270A with the microwave output with the high frequency leveling kit to realize the “What you set is what you get” signal delivery and accuracy benefits.

### Avoid extensive measurements and calculations with self-characterization

The 96270A can “self-characterize” or profile its output to account for losses and attenuation of system components like cables, attenuators, splitters, and connectors, effectively creating a signal reference plane directly at the connection to the UUT input. This frequency/amplitude level correction profile is saved into 96270A memory, which can store up to 30 profiles for different output and interconnection configurations. Using a profile, the 96270A applies the level correction data automatically and delivers the user’s signal level setting accurately at the reference plane created at the UUT input. As a result, you save time, because you don’t have to measure, calculate and apply correction factors for each component in the signal delivery system.

You can also export or import external profile files from a USB memory stick inserted into the USB port on the 96270A front panel, or via GPIB transfer. This feature gives extra flexibility, which can be useful if you prefer to use device characteristics that have been determined by other measurements, or if you want to use a profile as a way to apply mismatch (Gamma) corrections in a power sensor calibration.

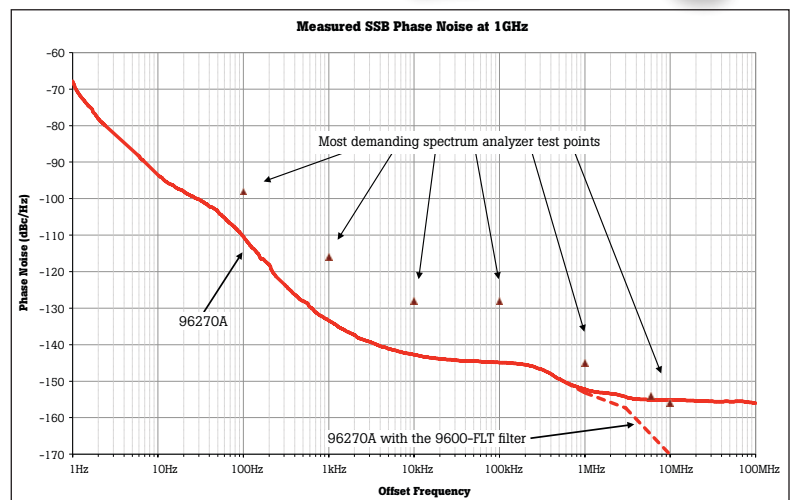
### State-of-the-art phase noise performance

With low phase noise optimized for low and high offset frequencies, and specifications from 1 Hz to 10 MHz offsets, the 96270A offers exceptional phase noise performance beyond that required for today’s high performance workloads.

Phase noise data is included in the 96270A certificate of calibration. Instead of relying only on the more conservative guaranteed specifications, users have actual performance data for their unit.

### Calibrated as a system to assure system performance

The 96270A mainframe and leveling head are calibrated together as a complete system to assure overall system performance. Each 96270A instrument is supplied with a comprehensive ISO 17025 compliant certificate of calibration with data for all key parameters, including level and attenuation, leveling head output VSWR, and phase noise. You can be assured that your 96270A is traceable, plus RF metrology and uncertainty analysis become much simpler and faster. Accredited certification is available for the 96270A and both 50 ohm and 75 ohm heads.



### Selectable frequency reference input/output expands functionality

Selectable external frequency reference input is available as a standard feature on the rear panel of the 96270A. The input allows you to lock the frequency output to an external reference, such as the Fluke Calibration 910R Rubidium Standard, for applications where high clock accuracy or use of a common reference frequency is important. The frequency reference output allows a UUT to be frequency locked to the 96270A internal reference clock. This configuration is often required to reduce frequency offset errors that may occur between the reference source and the UUT.

### Simplify frequency response tests with 96270A sweep functions

RF applications often require a frequency sweep. The 96270A's sweep functions simplify the application of manual legacy spectrum analyzer frequency response testing, as well as filter response measurements.

### Automate with MET/CAL® software for "walk-away" efficiency

In a typical automated RF calibration process, the operator must intervene frequently to change test setups, thus limiting the benefits that can be realized by the automation. Walk-away automation can increase calibration system capacity by 25 percent or more using procedures developed in MET/CAL Calibration Software. Fluke Calibration includes a sample calibration procedure with the 96270A, which you can use as the basis for creating additional RF calibration procedures to handle your unique workload.

MET/CAL procedures created by Fluke Calibration for the 9640A models can also be used by the 96270A.

### Using the 96270A with other automation solutions

The 96270A can be integrated easily into existing automated systems and software. The time savings and efficiency gains offered by the 96270A can be realized by structuring test sequences to take full advantage of its "connect once, test many" capabilities.

Replacing signal generators in automated systems is easy, thanks to the GPIB emulation of many products commonly found in such systems. The 96270A emulates the HP3335A, HP8662/3A, HP 8663A, HP8340A, HP8360 B-Series, Agilent E8257 Series, and the Fluke Calibration 9640A, 9640A-LPN and 9640A-LPNX RF Reference Sources.



## 96270A summary specifications

Key specifications summary. Refer to the 96270A Extended Specifications for detailed specifications, including the 75 ohm output Leveling Head.

|   | Frequency specifications  | Level specifications  |
|---|---|---|
| Frequency/<br>Level Range               | Leveling Head O/P [50 Ω]: 1 mHz to 4 GHz  | -130 to +24 dBm to 125 MHz, +14 dBm at 4 GHz                |
|   | Microwave O/P Direct: 1 mHz to 27 GHz [with LL option]  | -4 [-100] to +24 dBm, >1.4 GHz: +20 dBm, [>20 GHz: +18 dBm] |
|   | Microwave O/P with HF option: 1 kHz to 27 GHz [with LL option]  | -10 [-35] to +18 dBm, >1.4 GHz: +14 dBm, [>20 GHz: +12 dBm] |
| Resolution                              | 10 μHz  | 0.001 dB  |
| Frequency accuracy                      | ± 0.05 ppm ± 5 μHz  |   |
| Level accuracy<br>(into 50 Ω):          | Leveling Head O/P:<br>Down to -48 dBm; ± 0.03 dB to 100 kHz, ± 0.05 dB to 128 MHz, ± 0.3 dB at 4 GHz<br>10 MHz to 128 MHz; ± 0.05 dB to -48 dBm, ± 0.1 dB to -84 dBm, ± 0.7 dB at -130 dBm<br><br>Microwave O/P Direct:<br>Typically ± 0.5 dB to 4 GHz, ± 0.5 dB to 26.5GHz<br><br>Microwave O/P with HF option (after self-characterization):<br>Power flatness uncertainty; ± 0.05 dB at 100 MHz, ± 0.07 dB at 1 GHz, ± 0.1 dB at 12 GHz, ± 0.16 dB at 26.5 GHz<br>% Power (Cal Factor) uncertainty with factory calibration; ± 1.06% at 100 MHz, ± 1.42% at 1 GHz, ± 3.52% at 26.5 GHz<br>% Power (Cal Factor) uncertainty with reference sensor calibrated with typical state-of-the-art uncertainty and vector corrections for mismatches at splitter output port; ± 0.37% at 100 MHz, ± 0.49% at 1 GHz, ± 2.18% at 26.5 GHz |   |
| Attenuation<br>accuracy<br>(into 50 Ω)  | Leveling Head O/P: ± 0.02 dB to 49 dB, ± 0.15 dB at 110 dB<br>Relative to +10 dBm, 10 Hz to 128 MHz   |   |
| VSWR                                    | Leveling Head O/P (50 Ω): ≤ 100 MHz: ≤ 1.05, ≤ 2 GHz: ≤ 1.1, 2 GHz to 4 GHz: ≤ 1.0 + 0.05 x f (GHz)<br>Microwave O/P: direct ≤ 2.0 (typical), HF option splitter device ≤ 1.22  |   |
| Harmonics and<br>sub-harmonics          | Harmonics ≤ 1 GHz: -60 dBc, >1 GHz: -55 dBc; sub-harmonics ≤ 4 GHz: none, >4GHz: -60 dBc  |   |
| Spurious ≥ 3 kHz<br>offset              | ≤ -84 dBc at 500 MHz, ≤ -78 dBc at 1 GHz, ≤ -66 dBc at 4 GHz, ≤ -48 dBc at 27 GHz   |   |
| Phase noise at<br>1 GHz                 | -144 dBc/Hz, typical, at 10 kHz to 100 kHz offset   |   |
| Modulation                              | AM, FM, PM, internal and external to 4 GHz (Leveling Head and Microwave O/P); frequency pull and external leveling  |   |
| Frequency sweep                         | 1 mHz to 4 GHz (Leveling Head); 1 mHz to 27 GHz (Microwave O/P). Linear or logarithmic. Stop-start or center-span   |   |
| Frequency counter                       | Internal 300 MHz frequency counter  |   |
| Power meter<br>readout<br>compatibility | Rhode & Schwarz NRP-Z series thermal sensor models 51, 52, 55.03, 55.04, 56, 57 and 58  |   |
| Temperature                             | Operating: 0 °C to 50 °C, 23 °C ± 5 °C for specified performance<br>Storage: -20 °C to +70 °C   |   |
| Standard interfaces                     | IEEE-488.2 (GPIB)   |   |
| GPIB command<br>emulation               | 9640A, 9640A-LPN, 9640A-LPNX, HP3335, HP8662A, HP8663A, HP8340A, HP8360 B-Series; Agilent E8257 Series  |   |
| Dimensions<br>(HxWxD)                   | 146 mm x 442 mm x 551 mm (5.8 in x 17.4 in x 21.7 in) including handles. Industry-standard 19 in (483 mm) rack mounting when fitted with Y9600 rack mounting kit  |   |
| Weight                                  | 18 kg (40 lb)   |   |

## Ordering information

### Models

**96270A** 96270A 27 GHz RF Reference including 50  $\Omega$  4 GHz Leveling Head

**96270A/75** 96270A 27 GHz RF Reference including 50  $\Omega$  and 75  $\Omega$  4 GHz Leveling Heads

**96270A/LL** 96270A 27 GHz RF Reference with Low Level Microwave O/P

**96270A/HF** 96270A 27 GHz RF Reference with HF Leveling Kit

**96270A/LL/HF** 96270A 27 GHz RF Reference, LL Microwave O/P, HF Leveling Kit

The 75 Ohm Leveling Head is available for all versions.

### Options and Accessories

**9600SNS** Additional Power Sensor

**96270A/HFKIT** Power Sensor, Splitter, Metrology-Grade Microwave Cable and APC-3.5 mm Adapter

**Y9600** Rack Mount Slide Kit

**9600CASE** Rugged Transit Case

**9600CONN** RF Interconnect Kit, Sacrificial RF Adapters, Connector Torque Wrenches

**9600FLT** 1 GHz Wide Offset Phase Noise Filter, including Instrument Mounting Kit

### Upgrades

**96270A > 96270A/LL** Upgrade 96270A to 96270A/LL

**96270A > 96270A/HF** Upgrade 96270A to 96270A/HF

**96270A > 96270A/LL/HF** Upgrade 96270A to 96270A/LL/HF

**96270A/LL > 96270A/LL/HF** Upgrade 96270A/LL to 96270A/LL/HF

**96270A/HF > 96270A/LL/HF** Upgrade 96270A/HF to 96270A/LL/HF

**96040A > 96270A** Upgrade 96040A to 96270A

**96040A > 96270A/HF** Upgrade 96040A to 96270A/HF

**96040A > 96270A/LL** Upgrade 96040A or to 96270A/LL

**96040A > 96270A/LL/HF** Upgrade 96040A to 96270A/LL/HF

Upgrades from the 9640A and 9640A/LPN or 9640A/LPNX are also available. Contact your Fluke Calibration sales representative for information.

### Hardware and Calibration CarePlans

Gold CarePlans are available for the 96270A in one-year, three-year or five-year plans with accredited or standard calibration. Contact your local Fluke Calibration sales office for details or visit [www.flukecal.com](http://www.flukecal.com).

**Fluke Calibration.** *Precision, performance, confidence.™*

|            |    |             |          |      |          |
|------------|----|-------------|----------|------|----------|
| Electrical | RF | Temperature | Pressure | Flow | Software |
|------------|----|-------------|----------|------|----------|

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