

Keysight Technologies

87405C 100 MHz to 18 GHz
Preamplifier

Technical Overview



Introduction

The Keysight Technologies, Inc. 87405C preamplifier improves overall system performance and helps reduce system errors with reliable gain and low noise figure.

Compact and portable, this preamplifier can be powered directly from the instrument's probe-port which eliminates the need for a separate power supply and makes it an excellent choice for use in the field. The 87405C is designed for use with a variety of Keysight instruments such as the PSA, ESA and MXA spectrum analyzers. The rugged Type-N connectors stand up to the multiple connect and disconnects needed in field applications for reliable, repeatable measurements.

Cable options are provided for stand alone operation, allowing this instrument to be powered up by any triple output DC source. The compact and inexpensive 87422A power supply is a suitable source of DC bias in this and other amplification applications

Features

- Rugged, portable design for ease of use in the field
- Probe-power bias connection eliminates the need for an additional power supply
- Low noise figure of 4.5 dB and high gain of 25 dB helps improve the dynamic range and sensitivity of your test equipment
- High 15 dBm P_{1dB} increases available power from network and spectrum analyzers

Applications

Low Level Signal Measurement

Adding preamplifiers to measurement systems as shown in Figure 1 above can improve sensitivity and reduce the noise floor when measuring low-level signals.

By adding a preamplifier to noise figure measurement systems, the total system noise figure can also be reduced. The noise figure of the system is dominated by the noise figure of the preamplifier.

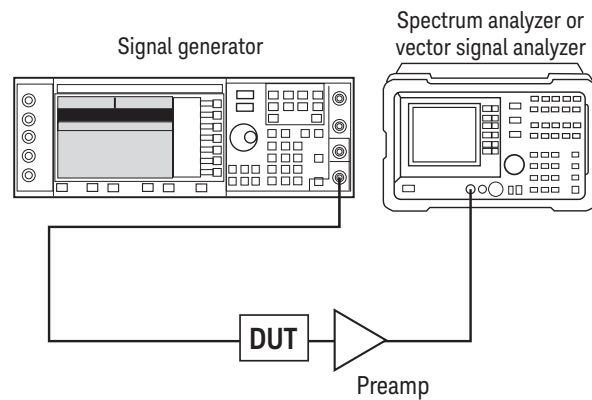


Figure 1. Low level signal measurement test setup

$$F_{new} = F_{pa} + \frac{F_{sys} - 1}{G_{pa}}$$

Where F and G are noise figure and preamplifier gain, both in linear terms.

$$NF_{sys} = 10 \log (F_{sys}) \text{ in dB}$$

For systems with a single preamplifier, where the gain of the preamplifier is greater than or equal to the spectrum analyzer noise figure, the system noise figure is approximately equal to the noise figure of the preamplifier.

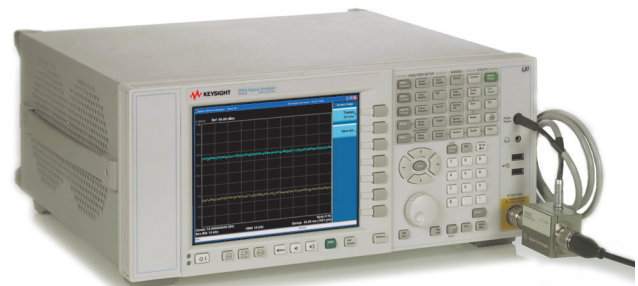


Figure 2. Preamplifier with spectrum analyzer test setup

Specifications

Specifications describe the product's warranted performance. Supplemental and typical characteristics are intended to provide typical but non-warranted performance parameters. These are denoted as "typical", "nominal" or "approximate".

87405C Product Specifications

Specification	87405C
Frequency range	100 MHz – 18 GHz
Gain, S_{21}	25 dB
Flatness (+/-)	1.5 dB
Noise figure	7 dB (0.1 – 0.5 GHz) 6 dB (0.5 – 4 GHz) 4.5 dB (4 – 18 GHz)
Input return loss	15 dB (0.1 – 4 GHz) 10 dB (4 – 18 GHz)
Output return loss	15 dB (0.1 – 4 GHz) 10 dB (4 – 18 GHz)
P_{1dB}	15 dBm (0.1 – 4 GHz) 14 dBm (4 – 18 GHz)
Harmonics (@ +4 dBm output power)	–30 dBc (typical)
Impedance	50 Ohms (typical)
Survival input power (max)	+15 dBm
Reverse isolation	–50 dB (typical)
Power dissipation	2.1 W (typical)
Third Order Intercept (TOI)	23 dBm (typical)

EMC	
IEC	61326:1997
EN	61326:1997
This ISM device complies with Canadian ICES-001.	
Line voltage interrupt (1 cycle, 100%)	IEC/EN 61000-4-11
Surge test (1.2 x 50 us, 0.5/1 kV)	IEC/EN 61000-4-5
Electrical fast transients	IEC/EN 61000-4-4
Radiated emissions	CISPR 11, Class A
Radiated immunity (3 V/m, 80-1000 MHz)	IEC/EN 61000-4-3
Conducted emissions	CISPR 11, Class A
Conducted immunity (3 V, 0.15-80 MHz)	IEC/EN 61000-4-6
ESD (4 kV contact, 8 kV air discharge)	IEC/EN 61000-4-2

Environmental Specifications

87405C preamplifiers are designed to fully comply with Keysight's product operating environment specifications. The following summarizes the environmental specifications for these products.

Temperature	
Operating	–45° C to +55° C
Storage	–65° C to +85° C
Cycling	–65° C to +85° C, 10 cycles @ 20° C per minute, 20 minutes dwell time per MIL-STD-883F, Method 1010.8, Condition C (modified)
Humidity	
Non-operating	90% RH @65C, one 24 hr cycle
Operating	50% to 95% RH @ 40° C, 24 hour cycling, 5 times.
Shock	
Half-sine, smoothed	1500 G @ 0.5 ms, 3 shock pulses per orientation, 18 total per MIL-STD-883F, Method 2002.4, Condition B (modified)
Vibration	
Broadband random	50 to 2000 Hz, 7.0 G rms, 15 minutes, per MIL-STD-883F, Method 2026-1 (modified)
Altitude	
Storage	< 15,300 meters (50,000 feet)
Temperature coefficient	
Gain	–0.06 dB/° C

Mechanical Dimensions

Weight: 220 grams (0.485 lbs)

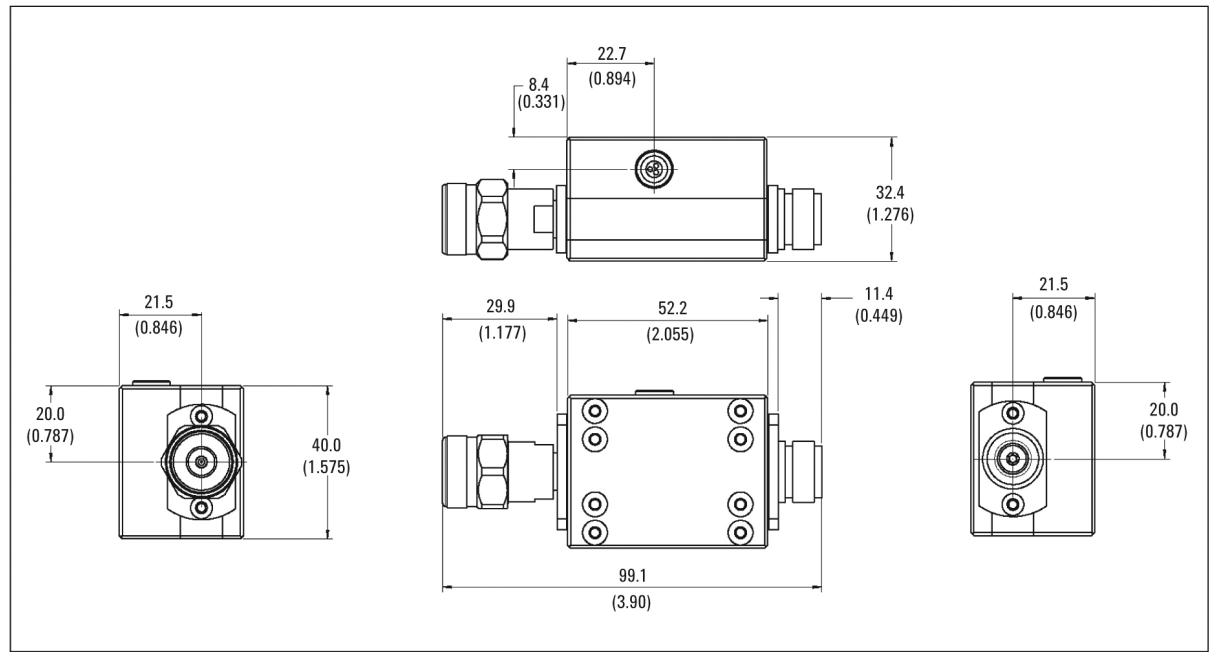


Figure 3. Mechanical dimension for the 87405C preamplifier

Dimensions are in mm (inches) nominal, unless otherwise specified.

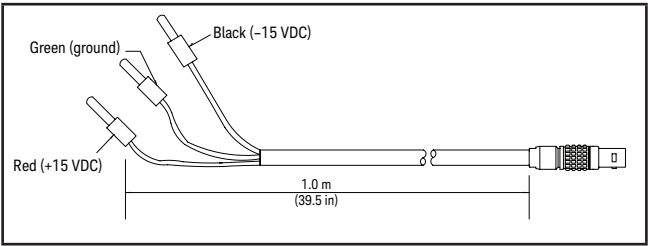


Figure 4a. Mechanical dimension for cable option with banana plugs (87405C-101)

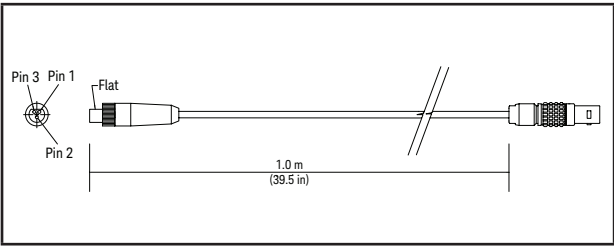


Figure 4b. Mechanical dimension for cable option with power probe bias cable (87405C-102)

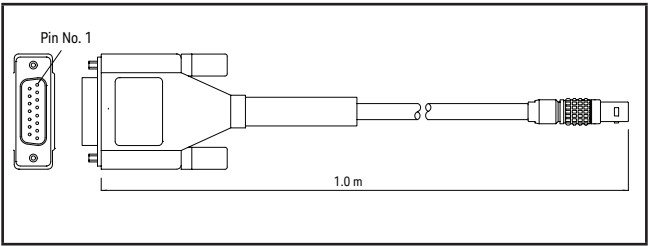


Figure 4c. Mechanical dimension for DSUB 15-pin cable (87405C-103)

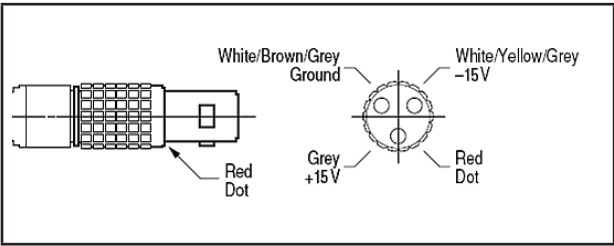


Figure 4d. Pin assignment of connector straight plug 3-pin circular

Typical Performance

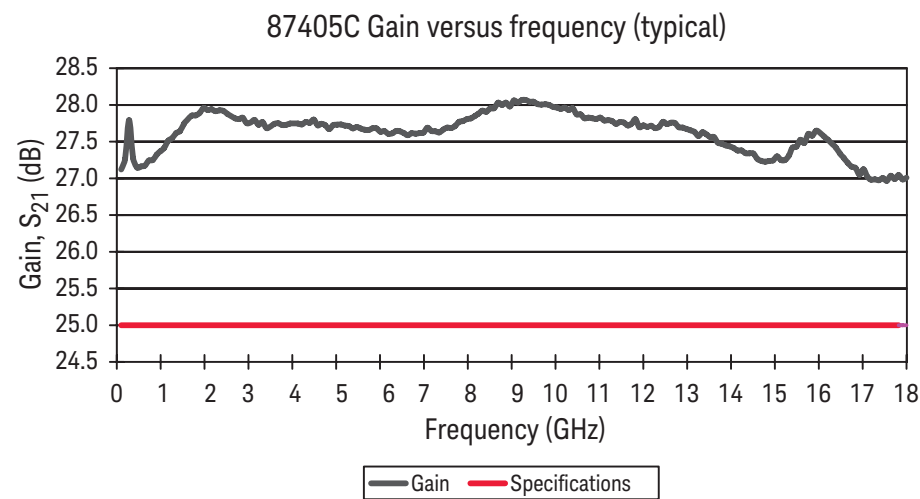


Figure 5. Gain specifications for the 87405C preamplifier

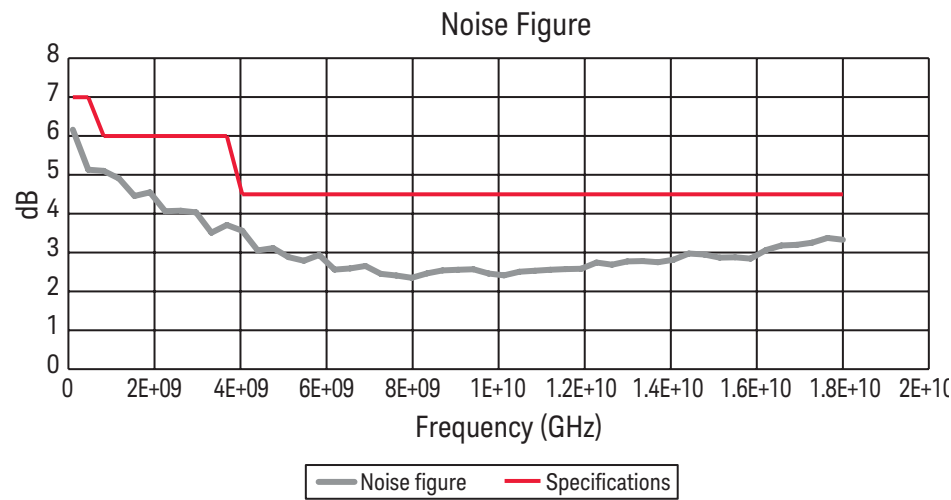


Figure 6. Noise figure specifications for the 87405C preamplifier

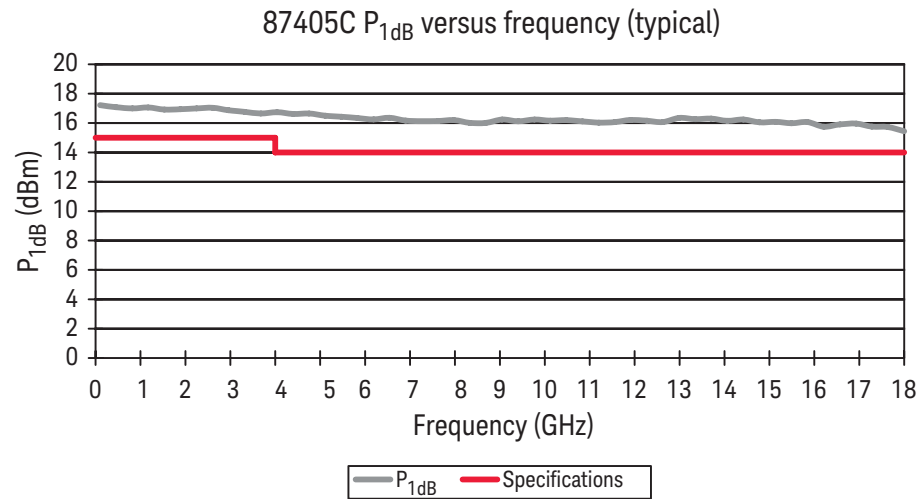


Figure 7. P_{1dB} specifications for the 87405C preamplifier

Typical Performance *(continued)*

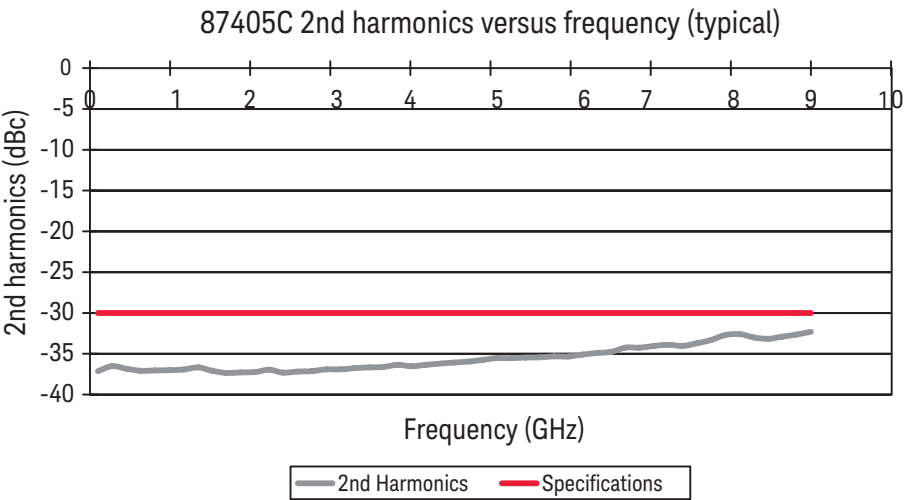


Figure 8. 2nd harmonics specifications for the 87405C preamplifier

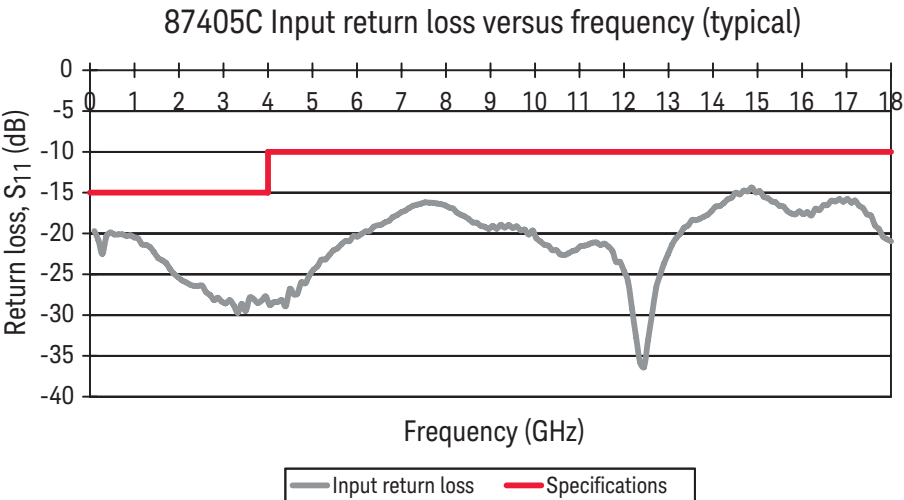


Figure 9. Input return loss specifications for the 87405C preamplifier

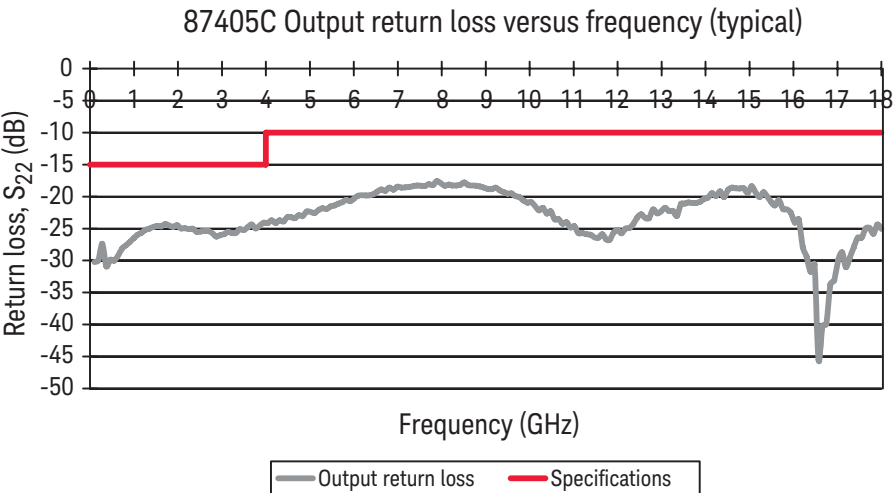


Figure 10. Output return loss specifications for the 87405C preamplifier

Ordering Information

87405C Preamplifier 0.1 to 18 GHz

Cable options (must order one)

87405C-101	Cables – banana plugs Banana plugs – to be used with any triple DC output power supply, compatible with the Keysight E3631A power supply.
87405C-102	Cables – probe power bias Probe power bias – to be used when connected to compatible Keysight instruments with port 3-pin probe power.
87405C-103	Cables – DSUB 15-pin 15 pin bias – compatible with the Keysight 87422A remotely locatable power supply.

Web Resources

<http://www.keysight.com/find/preamp>

Related Literature

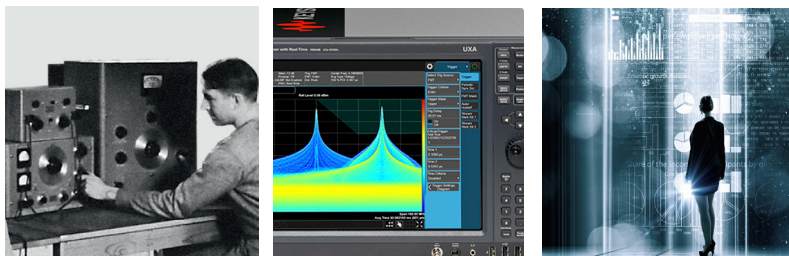
Keysight Preamplifiers and System Noise Figure Application Note,
literature number [5989-5742EN](#)

Keysight 87405C 100 MHz to 18 GHz Preamplifier,
literature number [5989-5741EN](#)

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