

# Agilent 87405C 100 MHz to 18 GHz Preamplifier

## Technical Overview



## Key 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

## Description

The Agilent 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 Agilent 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



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# Applications

## Low Level Signal Measurement

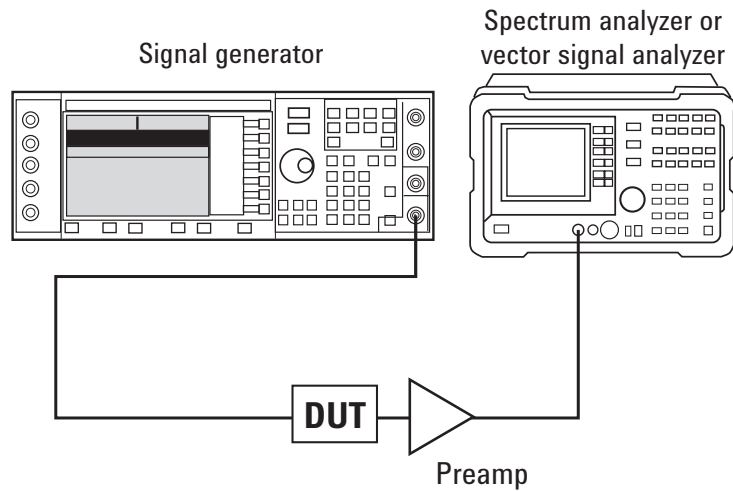


Figure 1. Low level signal measurement test setup

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.

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

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.

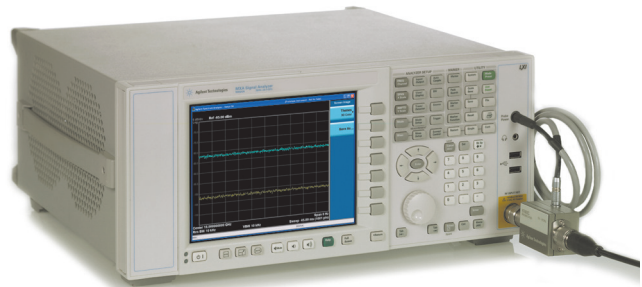


Figure 2. Preamplifier with spectrum analyzer test setup

## 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	6 dB (0.1 – 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 Agilent Technologies' 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 per	1500 G @ 0.5 ms, 3 shock pulses orientation, 18 total per MIL-STD-883F, Method 2002.4, Condition B (modified)
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#### Vibration

Broadband random	50 to 2000 Hz, 7.0 G rms, 15 minutes, per MIL-STD-883F, Method 2026-1 (modified)
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#### Altitude

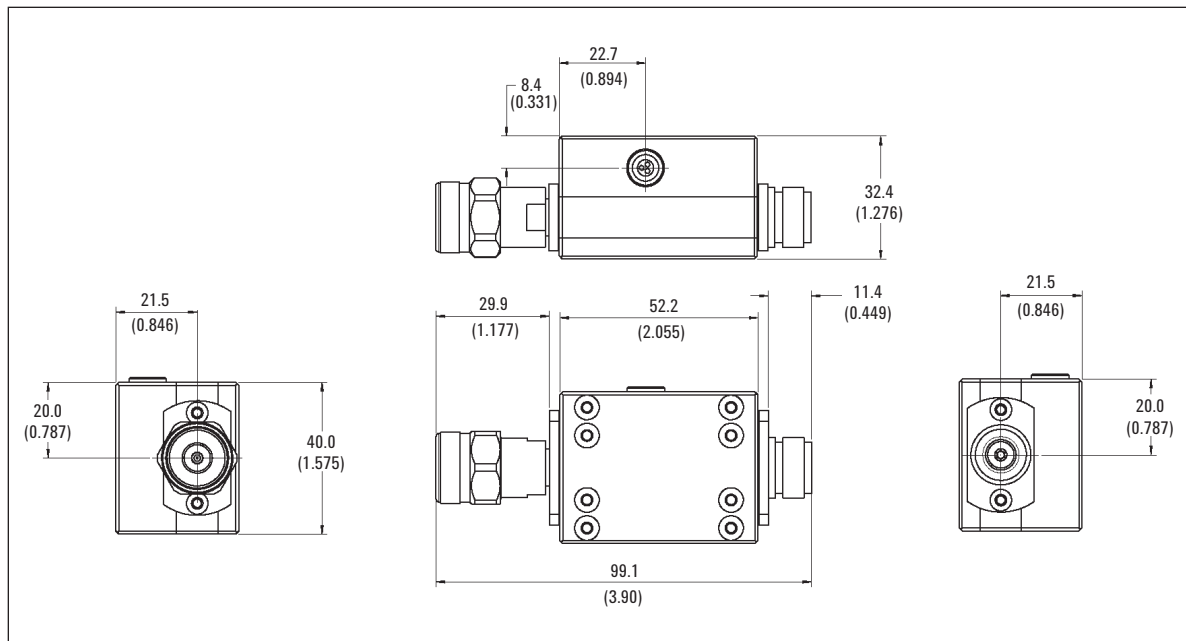
Storage	< 15,300 meters (50,000 feet)
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#### Temperature coefficient

Gain	–0.06 dB/° C
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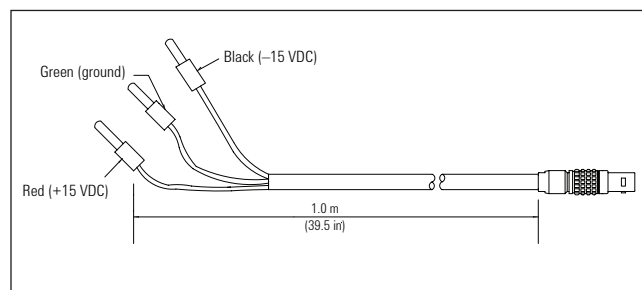
## Mechanical Dimensions

**Weight:** 220 grams (0.485 lbs)

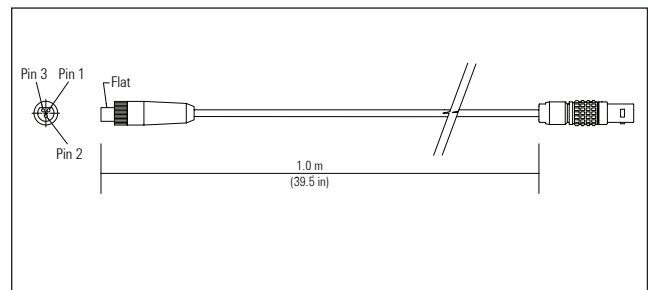


**Figure 3. Mechanical dimension for the 87405C preamplifier**

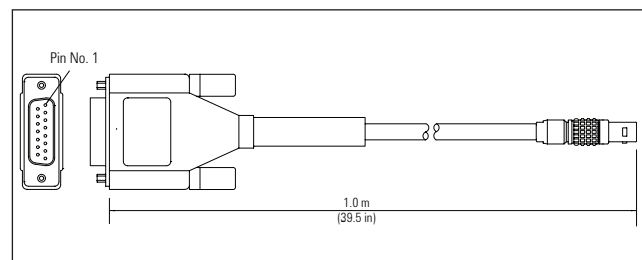
Dimensions are in mm (inches) nominal, unless otherwise specified.



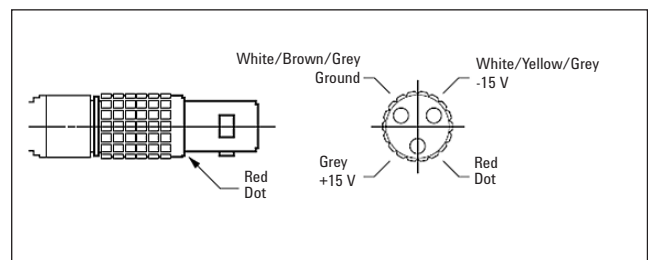
**Figure 4a. Mechanical dimension for cable option with banana plugs (87405C-101)**



**Figure 4b. Mechanical dimension for 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

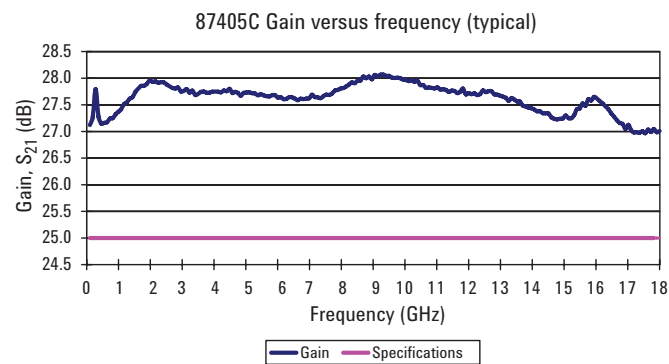


Figure 5. Gain specifications for the 87405C preamplifier

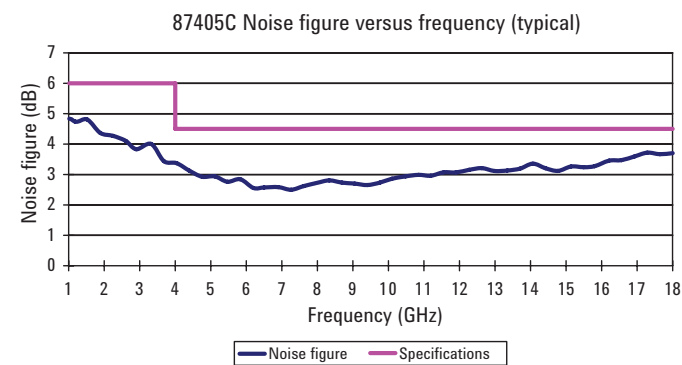


Figure 6. Noise figure specifications for the 87405C preamplifier

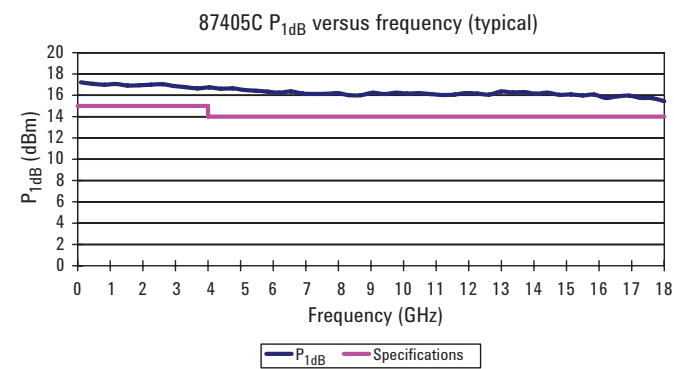


Figure 7.  $P_{1dB}$  specifications for the 87405C preamplifier

## Typical Performance *(continued)*

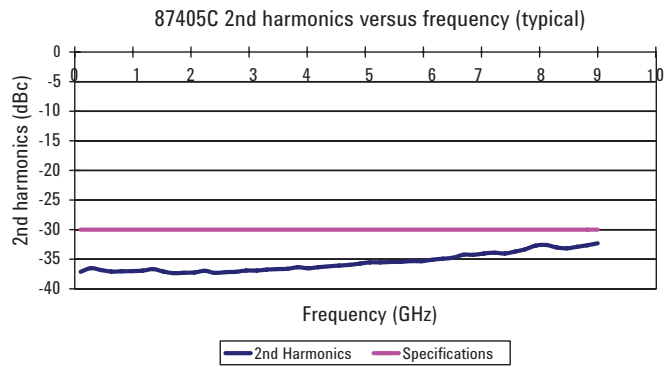


Figure 8. 2nd harmonics specifications for the 87405C preamplifier

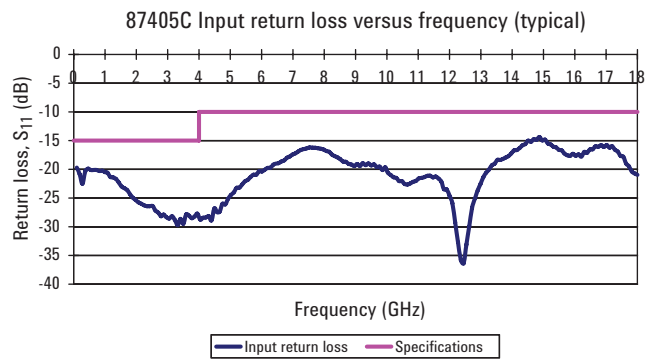


Figure 9. Input return loss specifications for the 87405C preamplifier

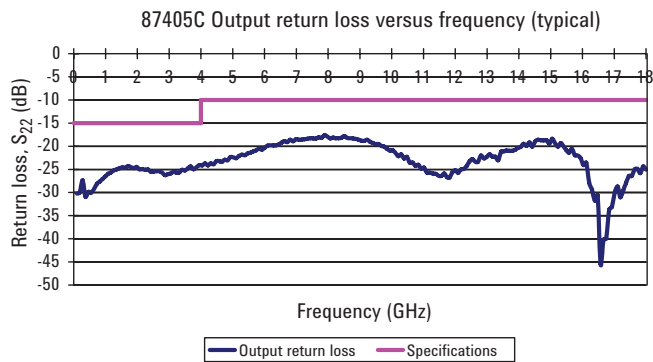


Figure 10. Output return loss specifications for the 87405C preamplifier

## 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 Agilent E3631A power supply.

**87405C-102** Cables - probe power bias  
Probe power bias – to be used when connected to compatible Agilent instruments with port 3-pin probe power.

**87405C-103** Cables - DSUB 15-pin  
15 pin bias – compatible with the Agilent 87422A remotely locatable power supply.

## Web Resources

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

## Related Literature

*Agilent Preamplifiers and System Noise Figure Application Note*, literature number 5989-5742EN

*Agilent 87405C 100 MHz to 18 GHz Preamplifier*, literature number 5989-5741EN



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