Keysight 87405C Pre-amplifier

KEYSIGHT TECHNOLOGIES

Operating and Service Manual

Notices

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A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Compliance Notices and Regulatory Information

Compliance with Electromagnetic Compatibility (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 μs, 0.5 kV line-line, 1 kV line-ground)	IEC/EN 61000-4-5
Electrical fast transients (0.5 kV signal lines, 1 kV power lines)	IEC/EN 61000-4-4
Radiated emissions	CISPR 11, Class A EN55011
Radiated immunity (3 V/m, 80 - 1000 MHz)	IEC/EN 61000-4-3
Conducted emissions	CISPR 11, Class A EN55011
Conducted immunity (3 V, 0.15 - 80 MHz)	IEC/EN 61000-4-6
ESD (4 kV contact discharge, 8 kV air discharge)	IEC/EN 61000-4-2

Regulatory markings

CE	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.	40	This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.
	This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.	KCC-REM-ATi-WN87405C	This instrument is Class A suitable for professional use and is for use in electromagnetic environments outside of the home. A급 기기 (업무용 방송통신기자재) 이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/amplifiers
  (product-specific information and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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List of Tables

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1 Introduction

This chapter provides an overview of the Keysight 87405C Pre-amplifier.

Product Overview

The Keysight 87405C pre-amplifier offers reliable gain and low noise figure to measurement systems, thus improve overall system performance and reduce systematic errors. With the ability to be powered directly from the instrument probe-port, it eliminates the need for a separate power supply.

The 87405C is ideal for use as the front end pre-amplifier for a variety of Keysight instruments such as PSA, ESA as well as the MXA series of spectrum analyzer. The rugged Type-N connectors make the 87405C well suited for various field applications.

Figure 1-1 87405C pre-amplifier

Table 1-1 shows the general information of the 87405C pre-amplifier.

Table 1-1 General information of the 87405C pre-amplifier

Model	Frequency range	Small signal gain	Connector type
87405C	100 MHz to 18 GHz	25 dB	Type N (m), (f)

Key features of the 87405C pre-amplifier

- DC bias via probe-power port on Keysight instruments eliminates the need for additional power supply
- Low noise figure of 4.5 dB and high gain of 25 dB reduce total system noise figure for better equipment dynamic range and sensitivity
- Compact design and portability allows usage in the field (installation and maintenance applications)
- High P1dB of 15 dBm increases available power from network analyzer and signal source

Application

Low level signal measurement

In low level signal measurement, the sensitivity of the measurement system can be improved by adding a pre-amplifier into the system as illustrated in Figure 1-2.

Total noise figure of the system can also be reduced using a pre-amplifier as the noise figure of the system is dominated by the noise figure of the pre-amplifier.

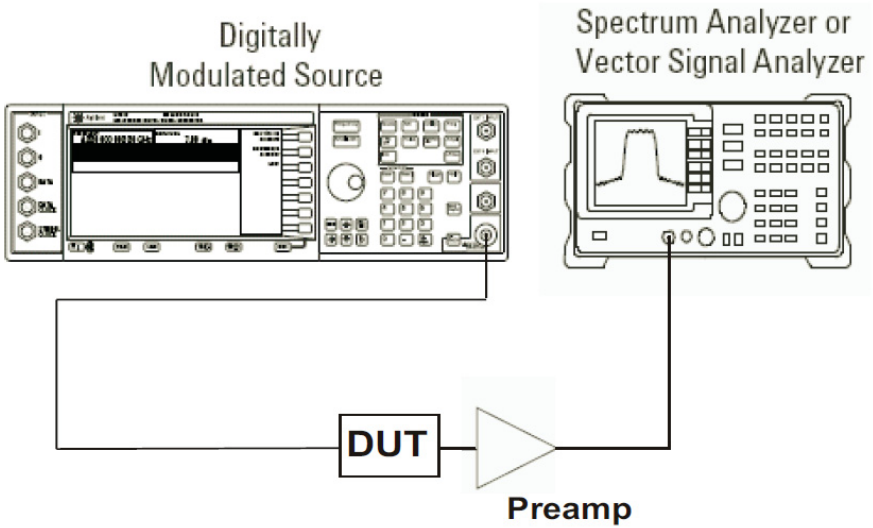

Figure 1-2 Low level signal measurement test setup

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2 Specifications

This chapter provides the specifications of the 87405C pre-amplifier.

General Specifications

Specifications

Specifications refer to the performance standards or limits against which the 87405C is tested.

Typical characteristics are included for additional information only and they are not specifications. These are denoted as "typical", "nominal", or "approximate", and are printed in italic.

Table 2-1 87405C specifications

Specification	87405C	
Frequency range	100 MHz to 4 GHz	4 GHz to 18 GHz
Gain, S_{21}	25 dB	
Flatness	±1.5 dB	
P1dB	15 dBm	14 dBm
Noise figure: – 100 MHz to 500 MHz – 500 MHz to 4 GHz – 4 GHz to 18 GHz	 7 dB 6 dB 4.5 dB	
Survival input power	+15 dBm	
Return loss S_{11}	15 dB	10 dB
Return loss S_{22}	15 dB	10 dB
Harmonics (at +4 dBm output power)	*30 dBc typical*	
Impedance	*50 Ω nominal*	
Reverse isolation	*50 dB typical*	
Third Order Intercept (TOI)	*+23 dBm typical*	
Power dissipation	*2.1 W typical*	

Table 2-1 87405C specifications (continued)

Specification	87405C
Bias voltage	*+15V ±6% Vdc at 140 mA nominal* *–15V ±6% Vdc at 3 mA nominal*
Connectors:	
– RF	Type N(f) in, N(m) out
– DC	Probe power connector (f)

Physical specifications

Table 2-2 87405C physical specifications

Weight	0.22 kg (0.485 lb)
Dimensions:	
– Length	98.3 mm (0.709 inch)
– Height	40.3 mm (1.587 inch)

Environmental Specifications

The 87405C is designed to fully comply with Keysight Technologies's product operating environment specifications. The following table shows the summarized environmental specifications for this product.

Table 2-3 87405C environmental specifications

Temperature	
– Operating	–45 °C to +55 °C
– Storage	–65 °C to +85 °C
– Cycling	–65 °C to +85 °C, 10 cycles at 20 °C per minute, 20 minutes dwell time per MIL-STD-883F, Method 1010.8, Condition C (modified)
Vibration	
– Broadband	50 to 2000 Hz, 7.0 G rms, 15 minutes, per MIL-STD-883F, Method 2026-1 (modified)
– Random	
Shock	
– Half-sine	1500 G @ 0.5 ms, 3 shock pulses per orientation, 18 total per MIL-STD-883F, Method 2002.4, Condition B (modified)
– Smoothed	
Humidity	
– Operating	50% to 95% Relative Humidity (RH) at 40 °C, 24 hour cycling, repeated 5 times
– Storage	90% RH at 65 °C, one 24 hour cycle
Altitude	
– Storage	<15300 m (50000 ft)
Temperature coefficient	
– Gain	–0.06 dB/°C

3 Operating Guides

This chapter provides simple quick-check instructions to verify the 87405C pre-amplifier functionality prior to usage.

Installation

Initial inspection

1. Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment. If the shipping container or cushioning material is damaged, the contents should be checked both mechanically and electrically.
   - Check for mechanical damage such as scratches or dents.
   - Procedures for checking electrical performance are given under "Operator's check" on page 21 or "Performance Tests" on page 22.
2. If the contents are damaged or defective, contact your nearest Keysight Technologies Service and Support Office. Refer to "Sales and Technical Support" on page 4 of this manual. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier's inspection.
3. If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and material or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to "Sales and Technical Support" on page 4 of this manual for the Keysight Technologies nearest to you. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container ***FRAGILE*** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Operating Instructions

Operator’s check

The operator's check is supplied to allow the operator to make a quick check of the 87405C prior to usage or if a failure is suspected.

Operator's check for the S-parameter test

All four S-parameters of the pre-amplifier are measured using a network analyzer calibrated with the necessary settings applied. The equipment setup is as illustrated in Figure 3-1.

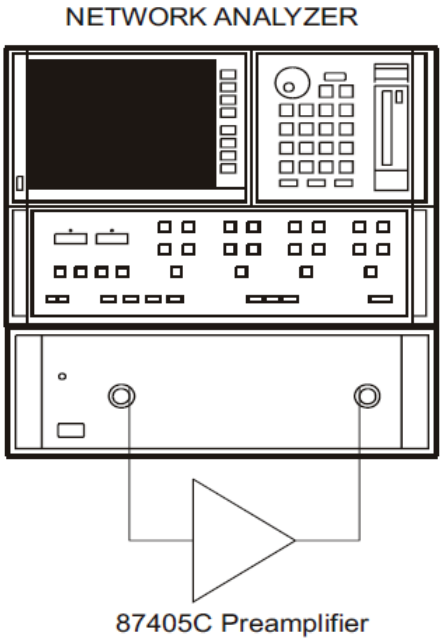

Figure 3-1 Equipment setup using network analyzer

Quick-check procedure

1. Calibrate the network analyzer using appropriate settings and setup if necessary.
2. Connect the input of the pre-amplifier to port 1 of the network analyzer and the output to port 2.
3. Turn on biasing to the pre-amplifier by connecting to a power supply, ±15 V, 0.2 A.
4. Measure the S11 (input return loss), S22 (output return loss), and S21 (gain). Gain flatness is the difference between maximum and minimum gain values.
5. Compare the measurement results with the specifications in Table 2-1.

Performance Tests

The pre-amplifier can be tested to the accuracy of the specifications with a network analyzer or equivalent equipment of suitable accuracy. If a network analyzer is available, test the pre-amplifier using the procedure in the analyzer's operating manual.

Service and Maintenance

Service

The 87405C does not have internal adjustments and should not be opened; it should only be repaired by service-trained personnel. Should it become necessary to return the 87405C for repair or service, contact your nearest Keysight Sales and Service Center.

Maintenance

The connectors of the 87405C, particularly the connector faces must be kept clean. Keysight recommends that the connectors be periodically inspected and cleaned if necessary. For instructions on the connection and maintenance of your connectors, refer to the Connector Care Quick Reference Card (08510-90360).

Replaceable Parts

Table 3-1 lists the replaceable parts for the 87405C pre-amplifier.

Table 3-1 Replaceable parts for the 87405C

Description	Keysight part number	Quantity
Cable assembly – banana plug	87405-20006	1
Cable assembly – probe power cable	87405-20007	1
Cable assembly – 15-pin	87405-20010	1

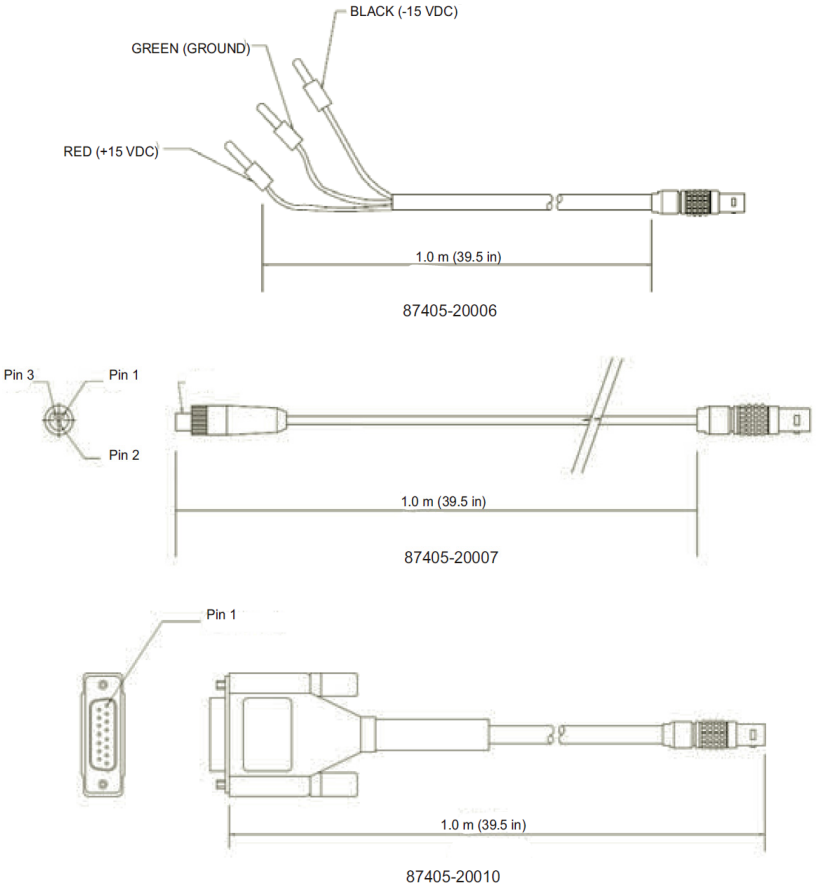

Figure 3-2 Drawings of replaceable parts for the 87405C

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