

## Microwave System Amplifiers

**HP 83006A** 10 MHz to 26.5 GHz

**HP 83017A** 500 MHz to 26.5 GHz

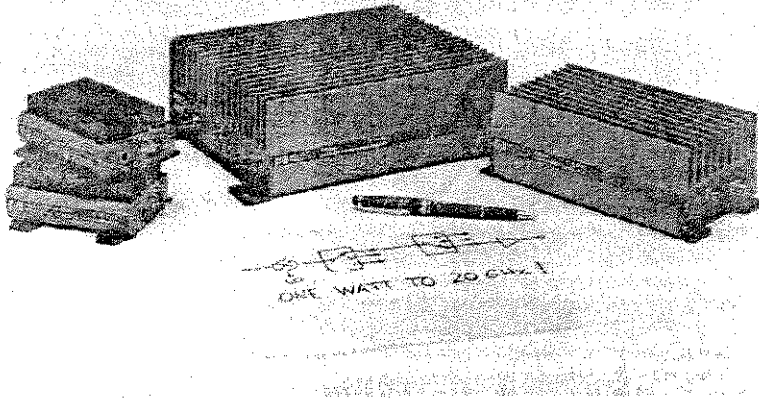
**HP 83018A** 2 to 26.5 GHz

**HP 83020A** 2 to 26.5 GHz

**HP 83050A** 2 to 50 GHz

**HP 83051A** 45 MHz to 50 GHz

### Product Overview



The HP microwave system amplifiers are compact, off-the-shelf amplifiers designed for systems designers and integrators. This family of amplifiers provides power where you need it to recover system losses and to boost available power in RF and microwave ATE systems. The ultrabroad bandwidth from 10 MHz to 50 GHz allows the designer to replace several narrow bandwidth amplifiers with a single HP amplifier, eliminating the need for crossover networks or multiple bias supplies. The HP 83050A power amplifier and HP 83051A preamplifier expand frequency performance

to 50 GHz, while the 1 Watt HP 83020A offers broadband power to 26 GHz. The small amplifier footprint allows for simple in-line insertion to existing system blocks that require amplification. The standard HP 83017A, 83018A, and 83020A include internal directional detectors for external leveling applications. The HP 83020A and 83018A are optionally available without the coupler-detector providing up to +30 dBm and +25 dBm, respectively. With excellent noise figure relative to their broad bandwidth and high gain, these amps significantly improve system noise figure and dynamic

### Features

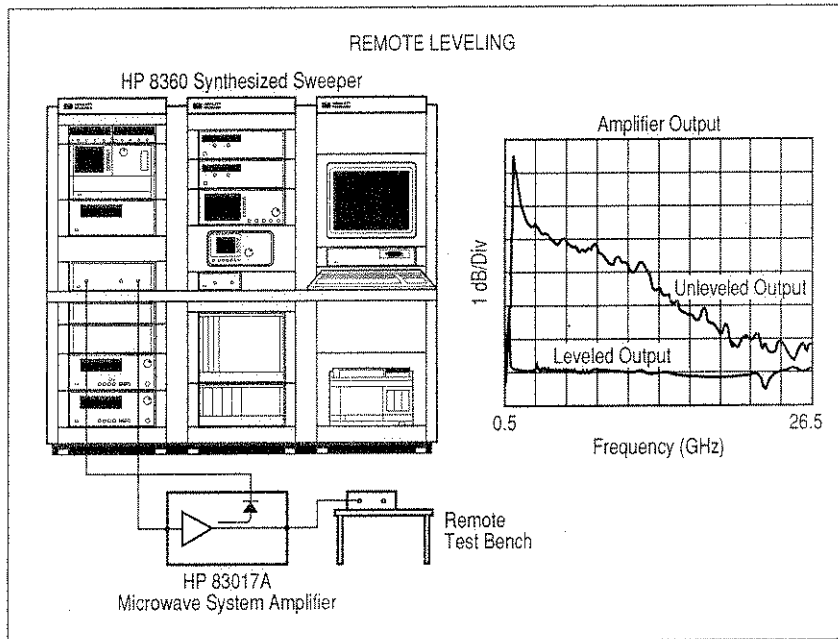
- Ultra broadband to 50 GHz
- Up to 1 watt output power
- Compact size

HP Model	Frequency (GHz)	Gain (dB)	P <sub>out</sub> (dBm)
83006A	0.01-26.5	20	13
83017A	0.5-26.5	25	18
83018A	2-26.5	27	24
83020A	2-26.5	30	30
83050A	2-50	21	18
83051A	0.045-50	23	12*

\* 10 dbm 45-50 GHz

range. These products come equipped with a low profile heat sink, an integral mounting bracket, and a two-meter DC power supply cable. Thermal and power supply design allows fast, easy integration into most measurement systems. See the ordering guide for the recommended remote power supply.

# Applications



Small envelope size makes the Hewlett-Packard family of microwave system amplifiers ideal for automated test and benchtop applications, offering the flexibility to place power where you need it.

## Boost Source Output Power

Increase output power from microwave sources to increase test system dynamic range. Drive high input power devices such as TWTs, mixers, power amps, or optical modulators. Drive test devices into compression for device characterization.

## Recover Systematic Losses

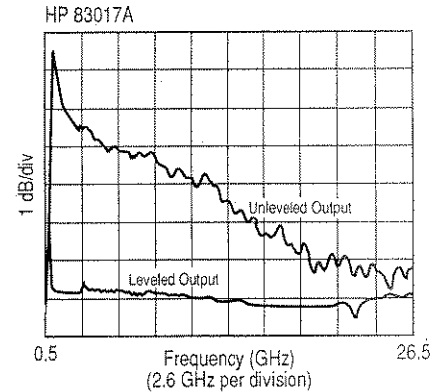
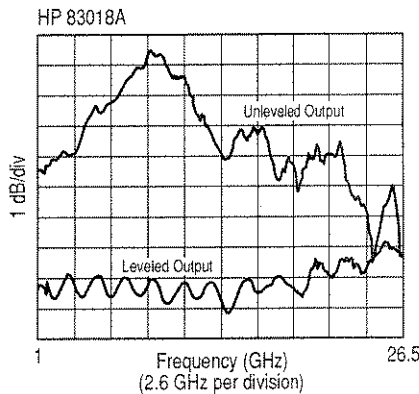
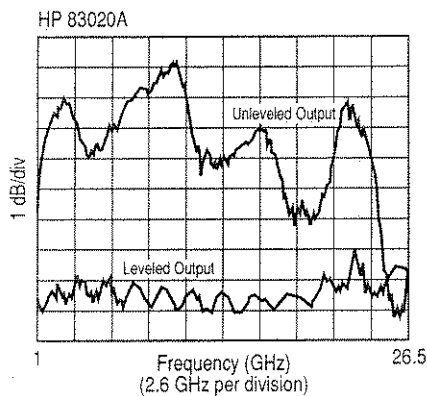
The HP microwave system amplifiers help solve the power loss from connectors, cables, switches, and signal routing components which consume valuable source power. Long transmission paths, common in antenna applications, are particularly susceptible to such losses.

## Level Source Power

By using feedback to an external source ALC input, system designers can level output power at the test port, negating the effects of post-sweeper reflections and losses.

Simply route the directional detector output to the source external ALC input connector. The figures below show typical results.

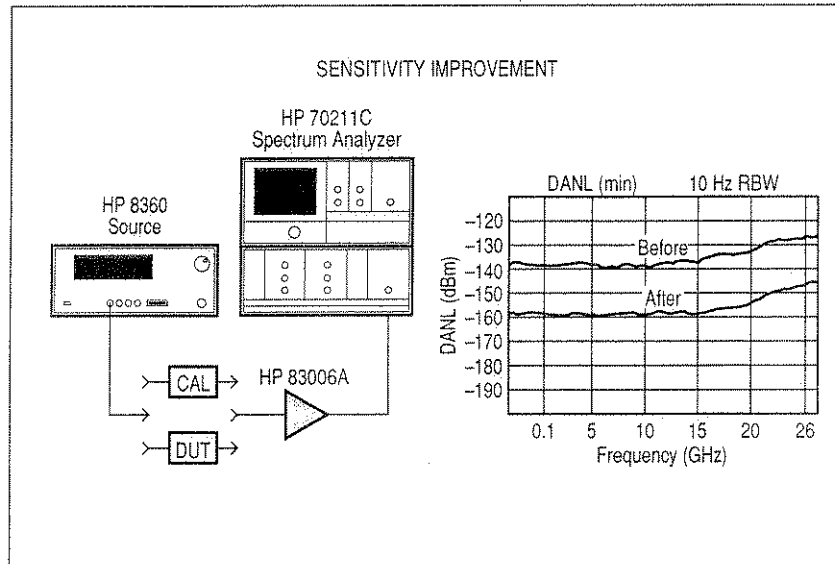
The HP 83020A, 83018A and 83017A feature an integral directional detector to supply feedback. To level an HP 83006A amplifier, use the 0.01–26.5 GHz HP 83036C directional detector or the 1 to 26.5 GHz HP 87300C coupler with an HP 8474C detector.



## Improve Measurements

The HP 83006A, 83017A and 83051A preamplifiers increase the sensitivity and dynamic range of spectrum analyzers. Add a preamplifier to noise figure measurement systems to significantly lower system noise figure. The

table below shows typical system noise figure reduction achievable with these amplifiers. Note that the reduced system noise figure is dominated by the preamplifier noise figure. See Application Note 57-2, literature number 5952-3706.



### Benchtop Gain Block

Benchtop microwave design tasks often require amplification to measure low level output characteristics, improve system dynamic range, perform saturation tests or boost power levels. The HP family of system amplifiers offers small size, immediate, off-the-shelf solutions to microwave design, production, or test engineers.

### Pulse Parameter Measurements

Fast rise time and multi-octave bandwidth make these amplifiers attractive for fast pulse parameter measurements. The 0.01, 0.5, and 2 GHz cutoff frequencies make them more useful for RF or impulse measurements with low duration times.

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

All terms linear

### Typical Noise Figure Improvement

Amp Model	Freq (GHz)	Max NF(dB)	Min Gain(dB)	System Noise Figure ( $F_{\text{sys}}$ ) without preamp (dB)						
				13	15	18	20	23	25	30
HP 83006A	0.01-0.2	13	20	—	13.1	13.1	13.2	13.4	13.6	14.8
	0.2-18	8	—	8.1	8.2	8.4	8.6	9.2	9.8	12.1
	18-26.5	13	—	—	13.1	13.1	13.2	13.4	13.6	14.8
HP 83017A	0.5-18	8	25	8.0	8.1	8.1	8.2	8.4	8.6	9.8
	18-26.5	13	—	—	13.0	13.0	13.1	13.1	13.2	13.6
HP 83018A	1-2	10	23	10.0	10.1	10.1	10.2	10.4	10.6	11.8
	2-20	10	27	10.0	10.0	10.1	10.1	10.2	10.3	10.8
	20-26.5	13	23	—	13.0	13.1	13.1	13.2	13.3	14.0
HP 83020A	1-20	10	30	10.0	10.0	10.0	10.0	10.1	10.1	10.4
	20-26.5	13	27	—	13.0	13.1	13.1	13.1	13.1	13.4
HP 85050A	2-26.5	6	21	6.1	6.2	6.3	6.5	7.0	7.5	9.5
	26.5-50	10	—	10.0	10.1	10.1	10.2	10.4	10.6	11.8
HP 83051A	0.045-2	12	23	12.0	12.0	12.1	12.1	12.3	12.4	13.2
	2-26.5	6	—	6.1	6.2	6.3	6.5	7.0	7.5	9.5
	26.5-50	10	—	10.0	10.1	10.1	10.2	10.4	10.6	11.8

# Product Specifications

Model Number	HP 83006A	HP 83017A	HP 83018A
Frequency Range	10 MHz–26.5 GHz	0.5–26.5 GHz	2–26.5 GHz
Small Signal Gain	20 dB min	25 dB min	23 dB typ 1–2 GHz 27 dB min 2–20 GHz 23 dB min 20–26.5 GHz
Small Signal Gain Flatness	±5 dB max 0.01–5 GHz ±3 dB max 5–26.5 GHz	±5 dB max 0.5–2 GHz ±5 dB max 2–26.5 GHz	±5 dB typ
Output Power (At P <sub>max</sub> )	+18 dBm typ 0.01–10 GHz +16 dBm typ 10–20 GHz +14 dBm typ 20–26.5 GHz	+20 dBm typ 0.5–20 GHz +15 dBm typ 20–26.5 GHz	+23 dBm typ 1–2 GHz <sup>4</sup> +24 dBm min 2–20 GHz <sup>4,5</sup> +21 dBm min 20–26.5 GHz <sup>4,5</sup>
(At 1 dB compression)	+13 dBm min 0.01–20 GHz +10 dBm min 20–26.5 GHz	+18 dBm min 0.5–20 GHz +18 dBm–0.75 dB/GHz (20<l<26.5 GHz)	+22 dBm typ 1–2 GHz +22 dBm min 2–20 GHz +17 dBm min 20–26.5 GHz
Leveled Output Power Flatness <sup>1</sup>	N/A	±1.1 dB 0.5–26.5 GHz at 12 dBm ±1.5 dB 0.5–20 GHz at 18 dBm	±1.5 dB 1–26.5 GHz at 17 dBm
Noise Figure	<13 dB typ 0.01–0.1 GHz <8 dB typ 0.1–18 GHz <13 dB typ 18–26.5 GHz	<8 dB typ 0.5–20 GHz <13 dB typ 20–26.5 GHz	<10 dB typ 1–20 GHz <13 dB typ 20–26.5 GHz
Harmonics (At spec'd value of P <sub>1</sub> dBC)	–25 dBc 0.01–11 GHz –25 dBc typ 11–13.25 GHz	–20 dBc 0.5–11 GHz –20 dBc typ 11–13.25 GHz	–22 dBc typ 1–2 GHz –19 dBc 2–11 GHz –19 dBc typ 11–13.25 GHz
Harmonics (At spec'd max power)	N/A	N/A	–20 dBc typ 1–2 GHz –17 dBc typ 2–11 GHz –17 dBc typ 11–13.25 GHz
Input SWR	2.6:1	2.6:1	3:1 typ 1–2 GHz 3:1 2–26.5 GHz
Output SWR	2.8:1 0.01–18 GHz 3.2:1 18–26.5 GHz	2.6:1	7.0:1 typ 1–2 GHz 4.5:1 2–10 GHz 2.2:1 10–26.5 GHz
Non-Harmonically Related Spurious	–65 dBc typ	–65 dBc typ	–65 dBc typ
Rise Time	400 ps typ	310 ps typ	275 ps typ
Third Order Intercept (TOI)	30 dBm typ at 2 GHz 20 dBm typ at 26.5 GHz	30 dBm typ at 2 GHz 20 dBm typ at 26.5 GHz	36 dBm typ 2–20 GHz 31 dBm typ 20–26.5 GHz
Impedance	50Ω typ	50Ω typ	50Ω typ
Reverse Isolation (typ)	–65 dB	–65 dB	–55 dB at 1 GHz +0.95 dB/GHz
Survival Input Power	+23 dBm max	+23 dBm max	+23 dBm max
Power Dissipation	6 W	9 W	24 W

<sup>1</sup> At min specified P<sub>1</sub> dBC within given frequency band

<sup>2</sup> P<sub>max</sub> measured with +5 dBm input

<sup>3</sup> Option 001 deletes detected output, for P<sub>max</sub> add 0.5 dBm 1–26.5 GHz

<sup>4</sup> P<sub>max</sub> measured with 0 dBm input

<sup>5</sup> Option 001 P<sub>max</sub> +25 dBm 2–20 GHz, +22 dBm 20–26.5 GHz

Model Number	HP 83020A	HP 83050A	HP 83051A
Frequency Range	2–26.5 GHz	2–50 GHz	45 MHz–50 GHz
Small Signal Gain	30 dB typ 1–2 GHz 30 dB min 2–20 GHz 27 dB min 20–26.5 GHz	21 dB min	23 dB min
Small Signal Gain Flatness	±5 dB typ	±3.5 dB max	±3.5 dB max
Output Power (At P max)	+30 dBm typ 1–2 GHz <sup>2</sup> +30 dBm min 2–20 GHz <sup>2,3</sup> +30 dBm –0.7 dB/GHz <sup>2,3</sup> (20<f<26.5 GHz)	+20 dBm 2–40 GHz +19 dBm–0.2 dB/GHz (40<f<50 GHz)	+12 dBm to 45 GHz +10 dBm 45–50 GHz
(At 1 dB compression)	+28 dBm typ 1–2 GHz +28 dBm min 2–20 GHz +28 dBm–0.7 dB/GHz (20<f<26.5 GHz)	+15 dBm 2–40 GHz +13 dBm 40–50 GHz	+8 dBm 45 MHz–45 GHz +6 dBm 45–50 GHz
Leveled Output Power Flatness <sup>1</sup>	±1.5 dB typ 1–26.5 GHz At 23 dBm	N/A	N/A
Noise Figure	<10 dB typ 1–20 GHz <13 dB typ 20–26.5 GHz	<6 dB typ 2–26.5 GHz <10 dB typ 26.5–50 GHz	<12 dB typ 45 MHz–2 GHz <6 dB typ 2–26.5 GHz <10 dB typ 26.5–50 GHz
Harmonics (At Spec'd value of P1 dBc)	–22 dBc typ 1–2 GHz –20 dBc typ 2–11 GHz –17 dBc typ 11–13.25 GHz	–20 dBc typ 2–18 GHz –18 dBc typ 18–25 GHz	–20 dBc typ 45 MHz–18 GHz –18 dBc typ 18–25 GHz
Harmonics (At Spec'd max power)	–20 dBc typ 1–2 GHz –17 dBc typ 2–11 GHz –17 dBc typ 11–13.25 GHz	N/A	N/A
Input SWR	3:1 typ 1–26.5 GHz	2.1 max	2.1 max
Output SWR	7.0:1 typ 1–2 GHz 4.5:1 2–10 GHz 2.2:1 10–26.5 GHz	2.8 max 2–18 GHz 2.1 max 18–50 GHz	2.2 max
Non-Harmonically Related Spurious	–65 dBc typ	–50 dBc typ	–50 dBc typ
Rise Time	375 ps typ	250 ps typ	225 ps typ
Third Order Intercept (TOI)	38 dBm typ 2–20 GHz 33 dBm typ 20–26.5 GHz	27 dBm typ	27 dBm typ
Impedance	50Ω typ	50Ω typ	50Ω typ
Reverse Isolation (typ)	–55 dB	–50 dB typ	–50 dB typ
Survival Input Power	+23 dBm max	+23 dBm max	+23 dBm max
Power Dissipation	48 W	11 W	5 W

**Special Applications**  
Higher performance models available upon request (i.e., higher power, etc.).

# General Specifications

Model Number	HP 83006A	HP 83017A	HP 83018A
Bias Voltage and Current (nominal)	12 $\pm$ 1 Vdc at 450 mA -12 $\pm$ 1 Vdc at 50 mA	12 $\pm$ 1 Vdc at 700 mA -12 $\pm$ 1 Vdc at 50 mA	12 $\pm$ 1 Vdc at 2A -12 $\pm$ 1 Vdc at 50 mA
RF Connectors	3.5 mm (f)	3.5 mm (f)	3.5 mm (f)
Detector Output	N/A	BNC (f)	BNC (f)
Detector Sensitivity	N/A	15 $\mu$ V/ $\mu$ W	4 $\mu$ V/ $\mu$ W
Detector Polarity	N/A	Negative	Negative
Weight: net shipping	0.64 kg (1.4 lb) 1.32 kg (2.9 lb)	0.64 kg (1.4 lb) 1.32 kg (2.9 lb)	1.8 kg (4.0 lb) 2.9 kg (6.4 lb)

## Environmental Specifications

Temperature Coefficient of Gain	-0.07 dB/ $^{\circ}$ C	-0.1 dB/ $^{\circ}$ C	-0.13 dB/ $^{\circ}$ C
Operating Temperature	0 to +55 $^{\circ}$ C	0 to +55 $^{\circ}$ C	0 to +55 $^{\circ}$ C
Storage Temperature	0 to +55 $^{\circ}$ C	0 to +55 $^{\circ}$ C	-40 to +70 $^{\circ}$ C

## Other Environmental Information

EMC	VDE 0871 CISPR-11/1990	VDE 0871 CISPR-11/1990	IEC 801-2/1991 IEC 801-3/1984 IEC 801-4/1988 CISPR-11/1990
Moisture Resistance	65 $^{\circ}$ C at 95% RH for 10 days per Mil-Std-883C method 1004.5		
Random Vibration	5.2 G (rms) to 2000 Hz per Mil-Std-883C method 2026 test condition 11A		
Shock	1500 G (peak), 0.5 ms per Mil-Std-883C method 2002.3 test condition B		
Altitude, non-operating	15,000 m per Mil-Std-883C method 1001 test condition C		

Model Number	HP 83020A	HP 83050A	HP 83051A
Bias Voltage and Current (nominal)	15 ±1.5 Vdc at 3.2A -15 ±0.5 Vdc at 40 mA	12 ±1 Vdc at 830 mA 12 ±1 Vdc at 50 mA	12 ±1 Vdc at 425 mA 12 ±1 Vdc at 50 mA
RF Connectors	3.5 mm (f)	2.4 mm (f)	2.4 mm (f)
Detector Output	BNC (f)	N/A	N/A
Detector Sensitivity	1 µV/µW	N/A	N/A
Detector Polarity	Negative	N/A	N/A
Weight: net shipping	3.9 kg (8.5 lb) 5.0 kg (11 lb)	0.64 kg (1.4 lb) 1.32 kg (2.9 lb)	0.64 kg (1.4 lb) 1.32 kg (2.9 lb)

## Environmental Specifications

Temperature Coefficient of Gain	-0.19 dB/°C	-0.09 dB/°C	-0.09 dB/°C
Operating Temperature	0 to +55°C	0 to +55°C	0 to +55°C
Storage Temperature	-40 to +70°C	-40 to +70°C	-40 to +70°C

## Other Environmental Information

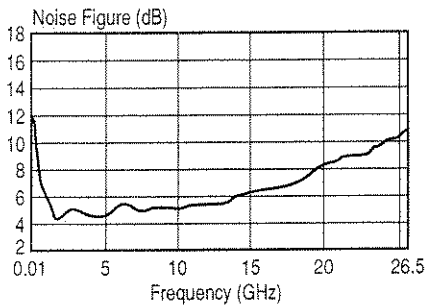
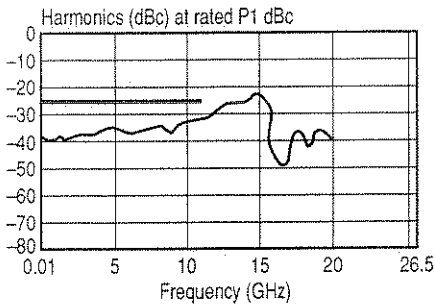
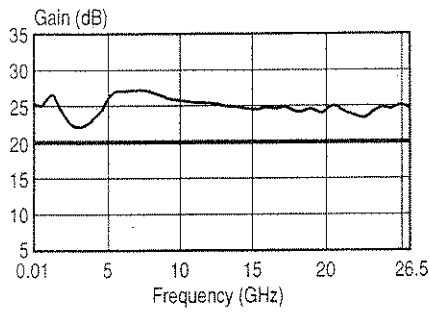
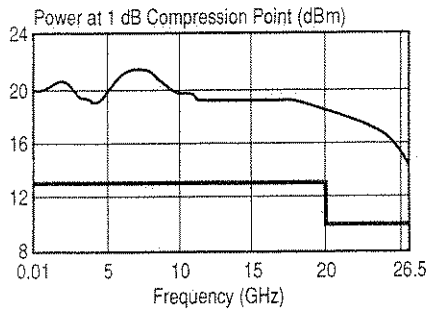
EMC	IEC 801-2/1991 IEC 801-3/1984 IEC 801-4/1988 CISPR-11/1990	IEC 801-2/1991 IEC 801-3/1984 IEC 801-4/1988 CISPR-11/1990	IEC 801-2/1991 IEC 801-3/1984 IEC 801-4/1988 CISPR-11/1990
Moisture Resistance	65°C at 95% RH for 10 days per Mil-Std-883C method 1004.5		
Random Vibration	5.2 G (rms) to 2000 Hz per Mil-Std-883C method 2026 test condition 11A		
Shock	1500 G (peak), 0.5 ms per Mil-Std-883C method 2002.3 test condition B		
Altitude, non-operating	15,000 m per Mil-Std-883C method 1001 test condition C		

Specifications describe the instrument's warranted performance over the temperature range +20°C to +30°C (unless otherwise noted). All specifications apply after the instrument's temperature has been stabilized after one hour continuous operation. Typical characteristics are intended to provide information useful in applying the instrument by giving typical but nonwarranted performance parameters. These are denoted as "typical" or "nominal" and apply over the temperature range +20°C to +30°C.

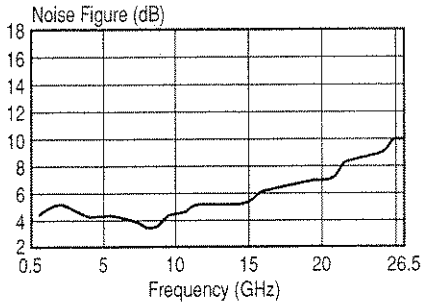
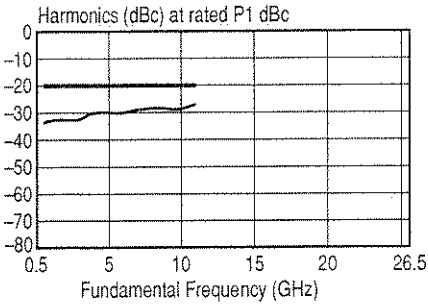
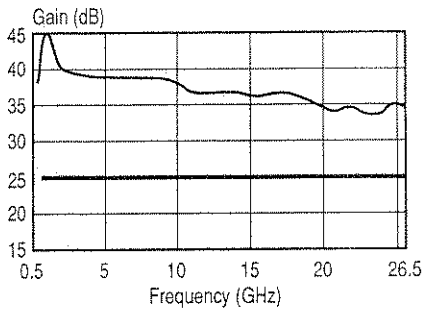
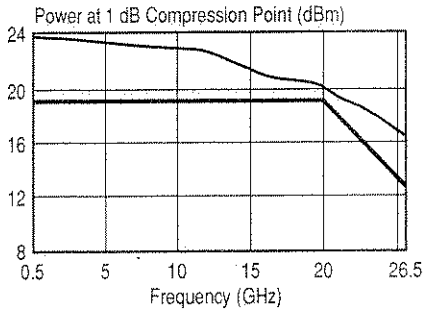
**Caution on Electrostatic Discharge.** Electrostatic discharge (ESD) can damage or destroy electronic components. It is recommended that these amplifiers, like other electronic components, be installed and operated at a static-free workstation or in an environment where precautions against ESD have been implemented.

# Graphical Performance Data

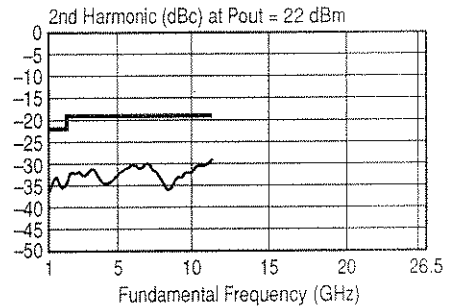
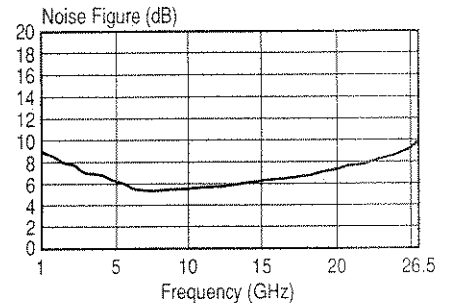
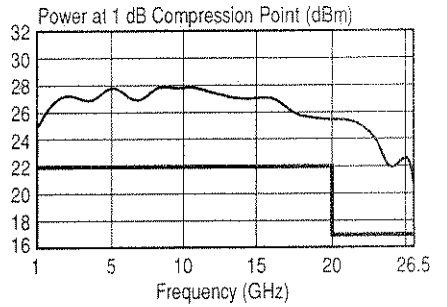
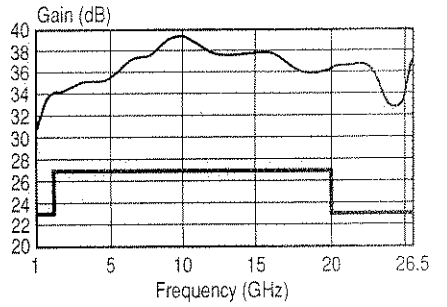
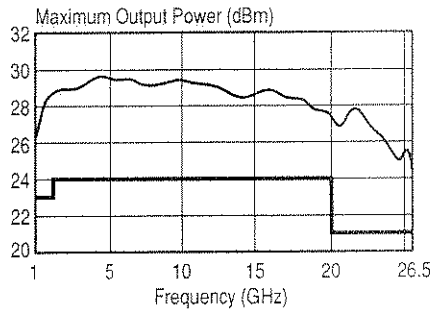
## HP 83006A Amplifier



## HP 83017A Amplifier



## HP 83018A Amplifier

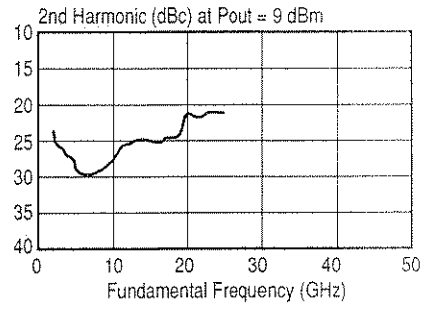
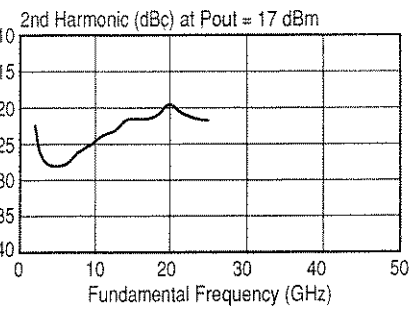
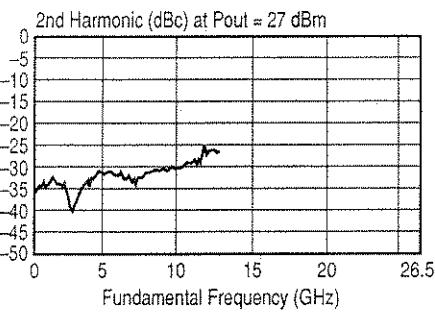
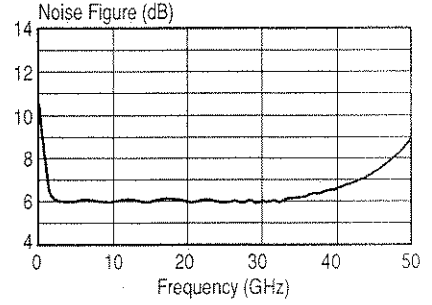
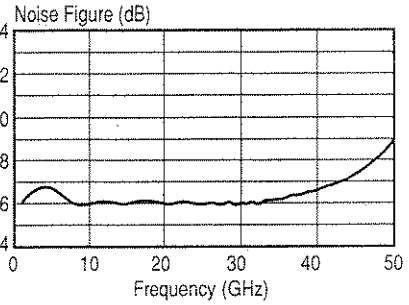
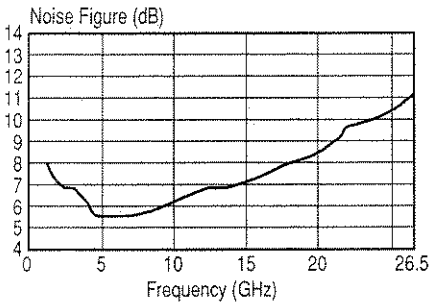
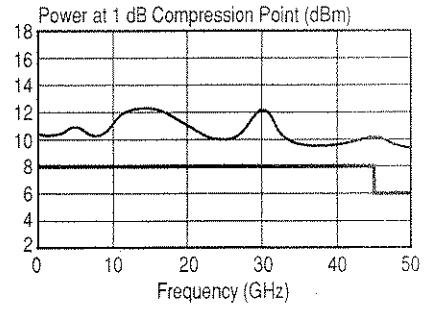
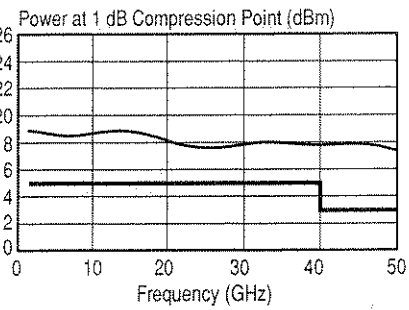
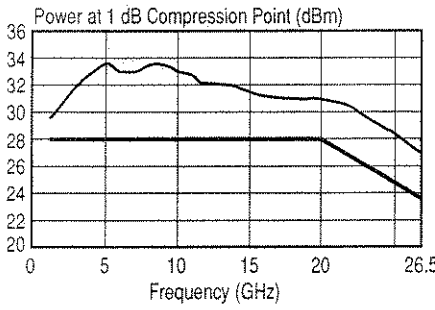
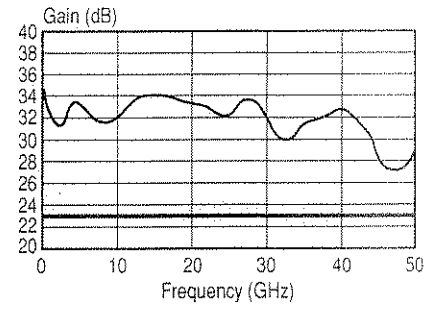
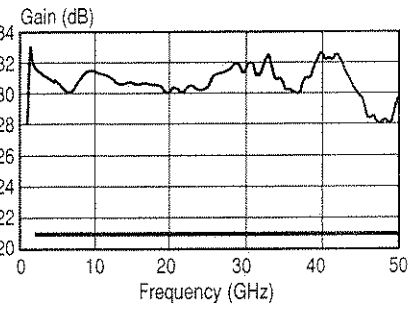
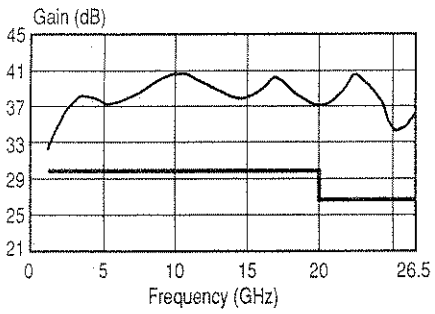
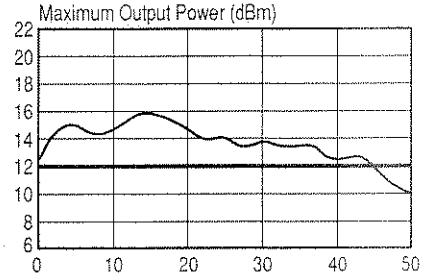
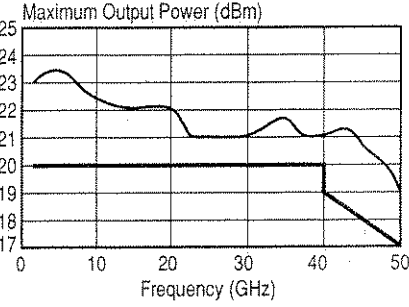
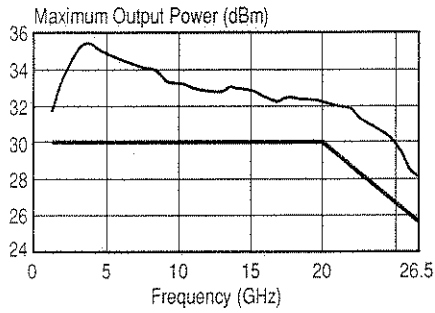




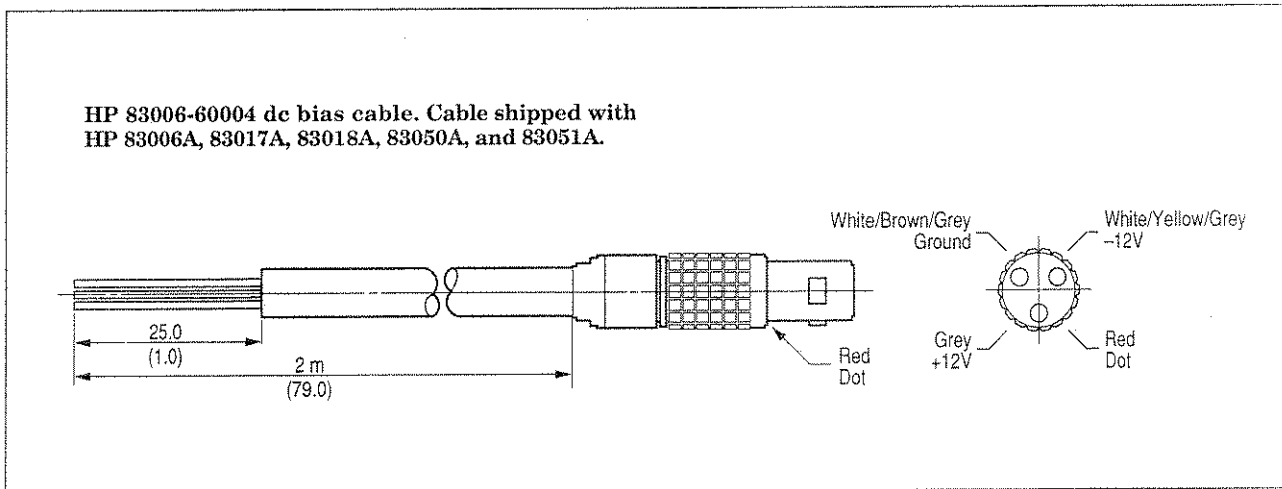
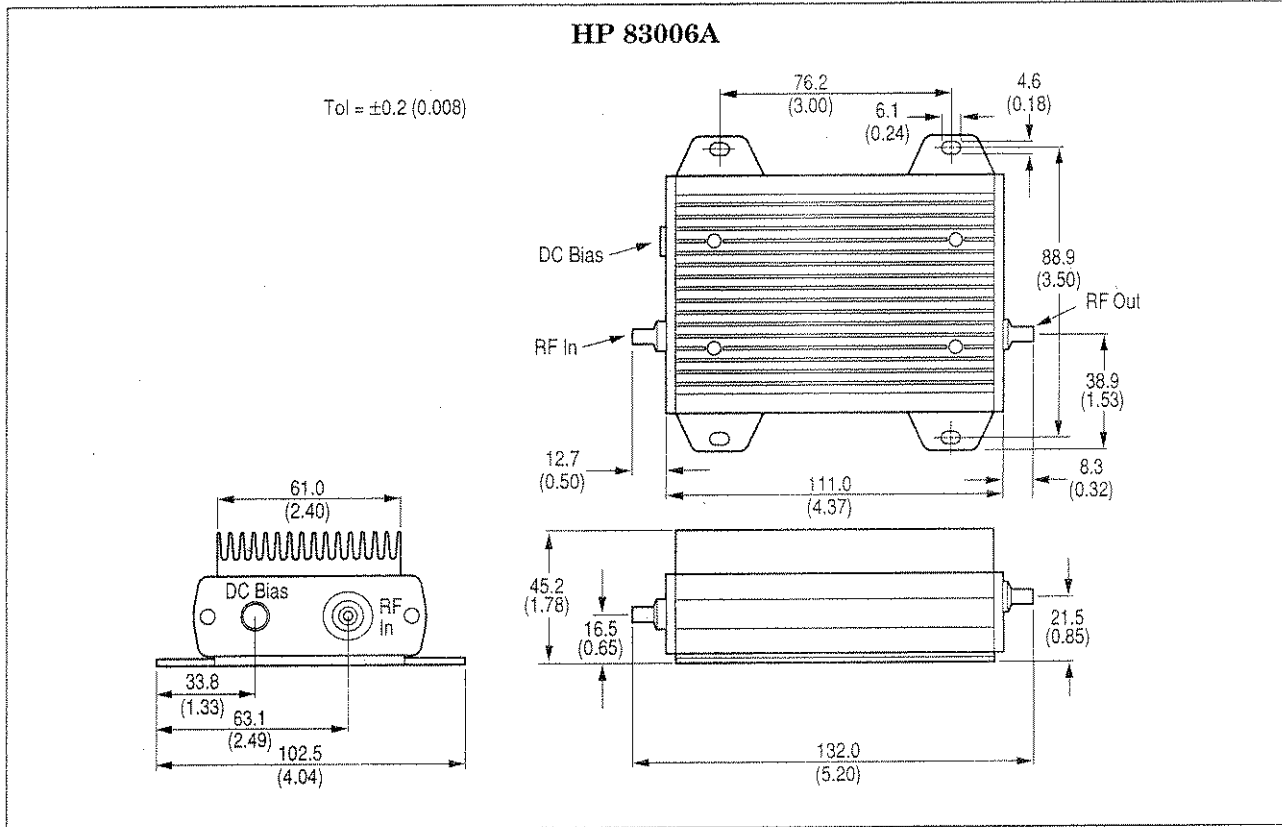
### HP 83020A Amplifier

### HP 83050A Amplifier

### HP 83051A Amplifier

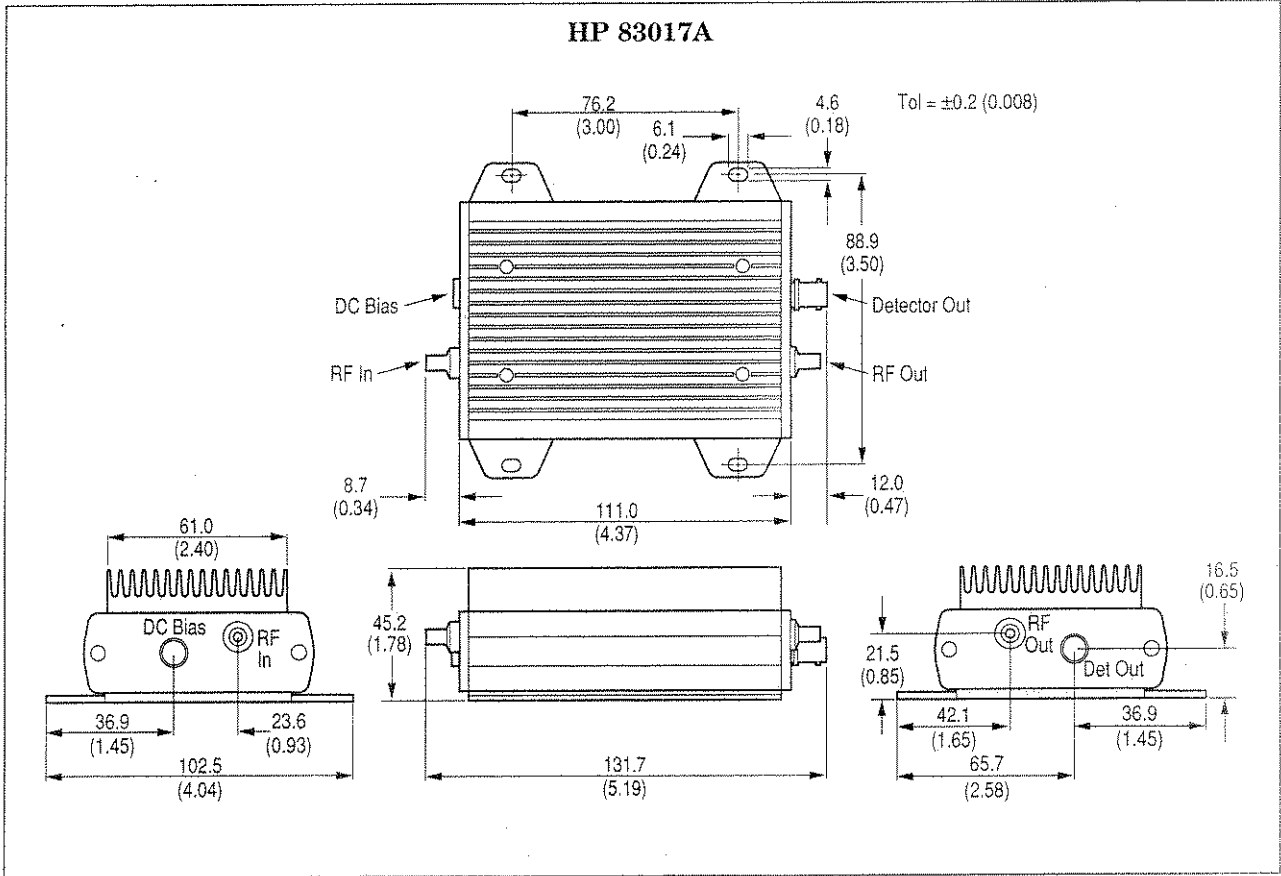


# Amplifier Outline Drawings<sup>1</sup>

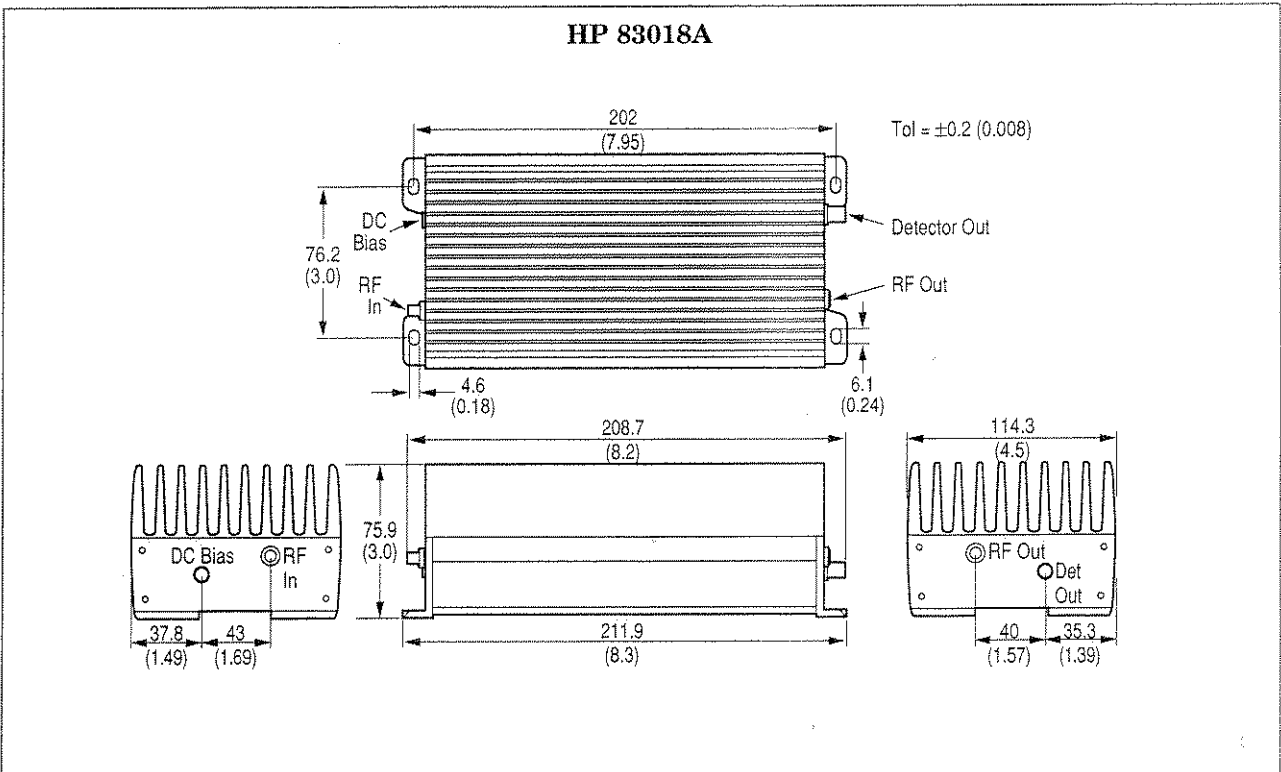


<sup>1</sup> Dimensions in millimeters and (inches).

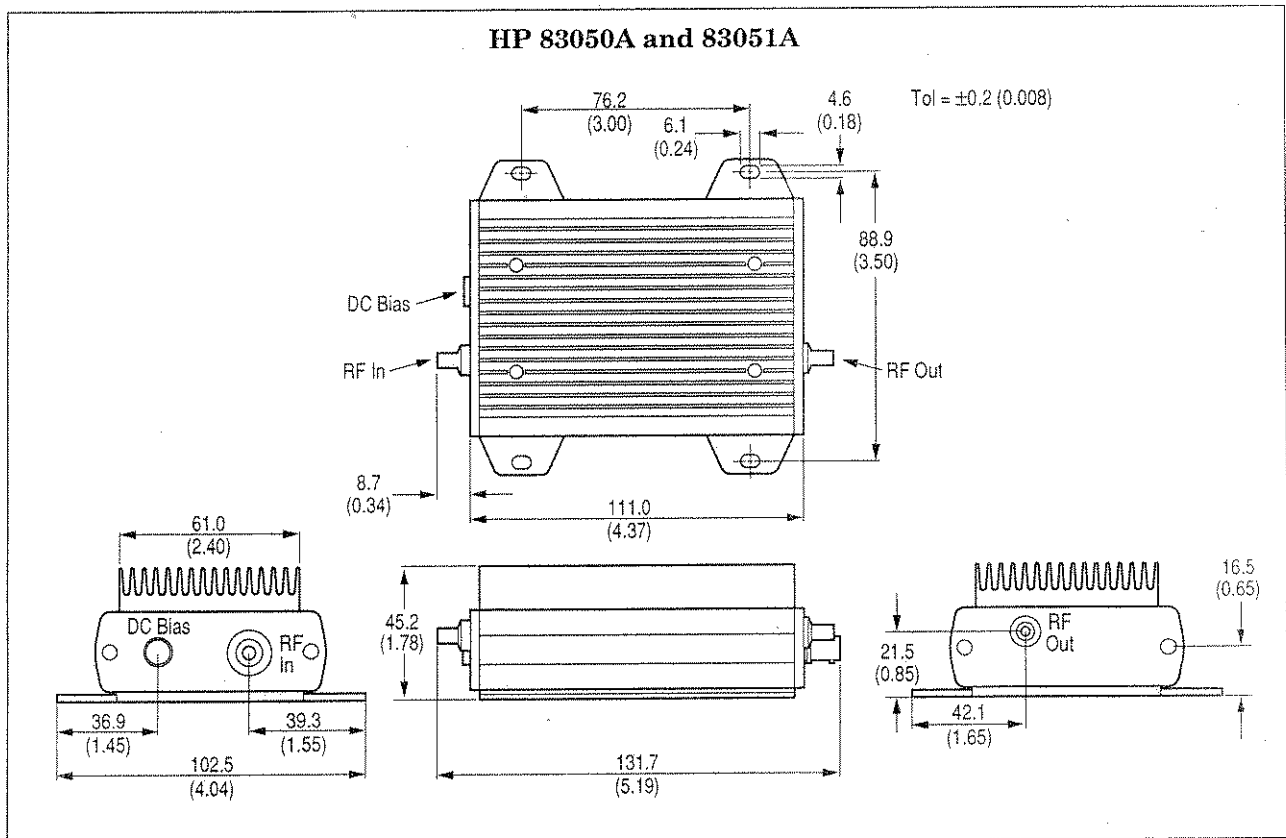
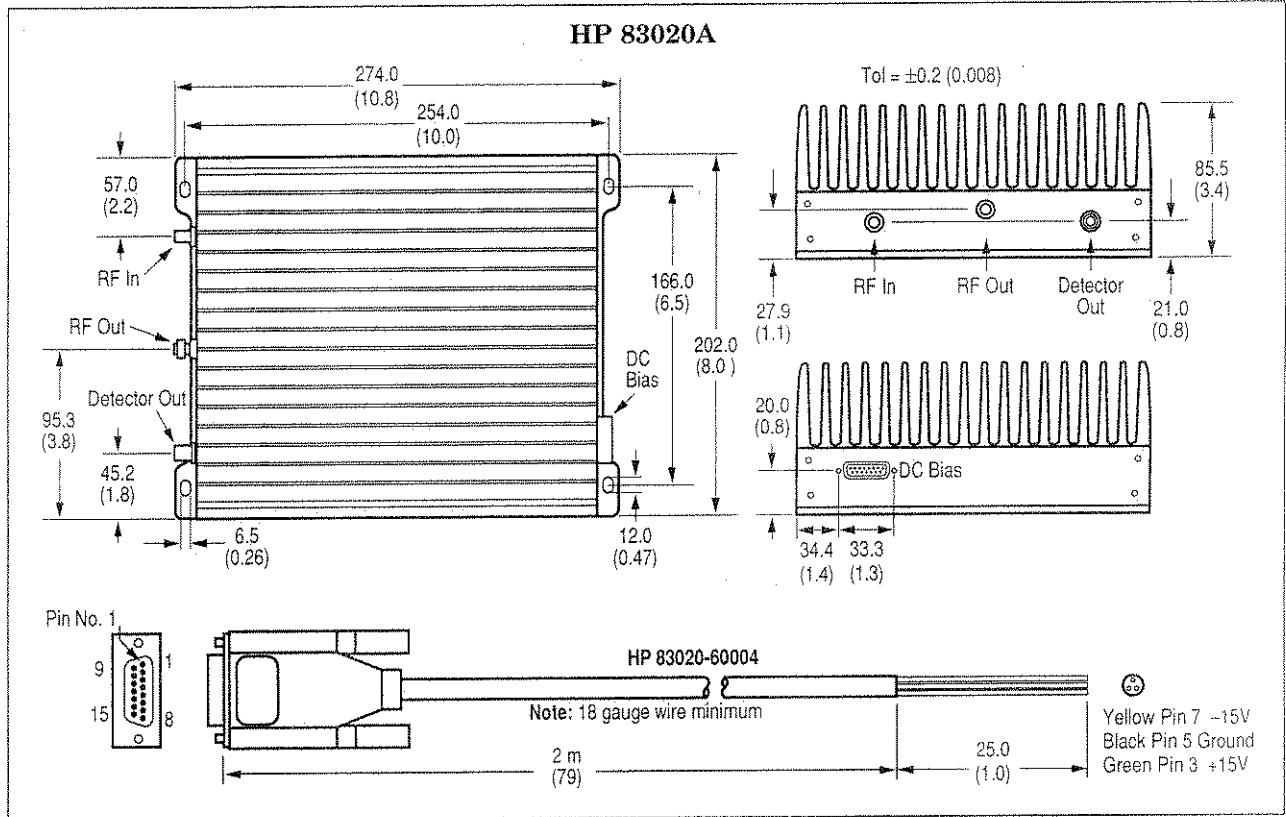
**HP 83017A**



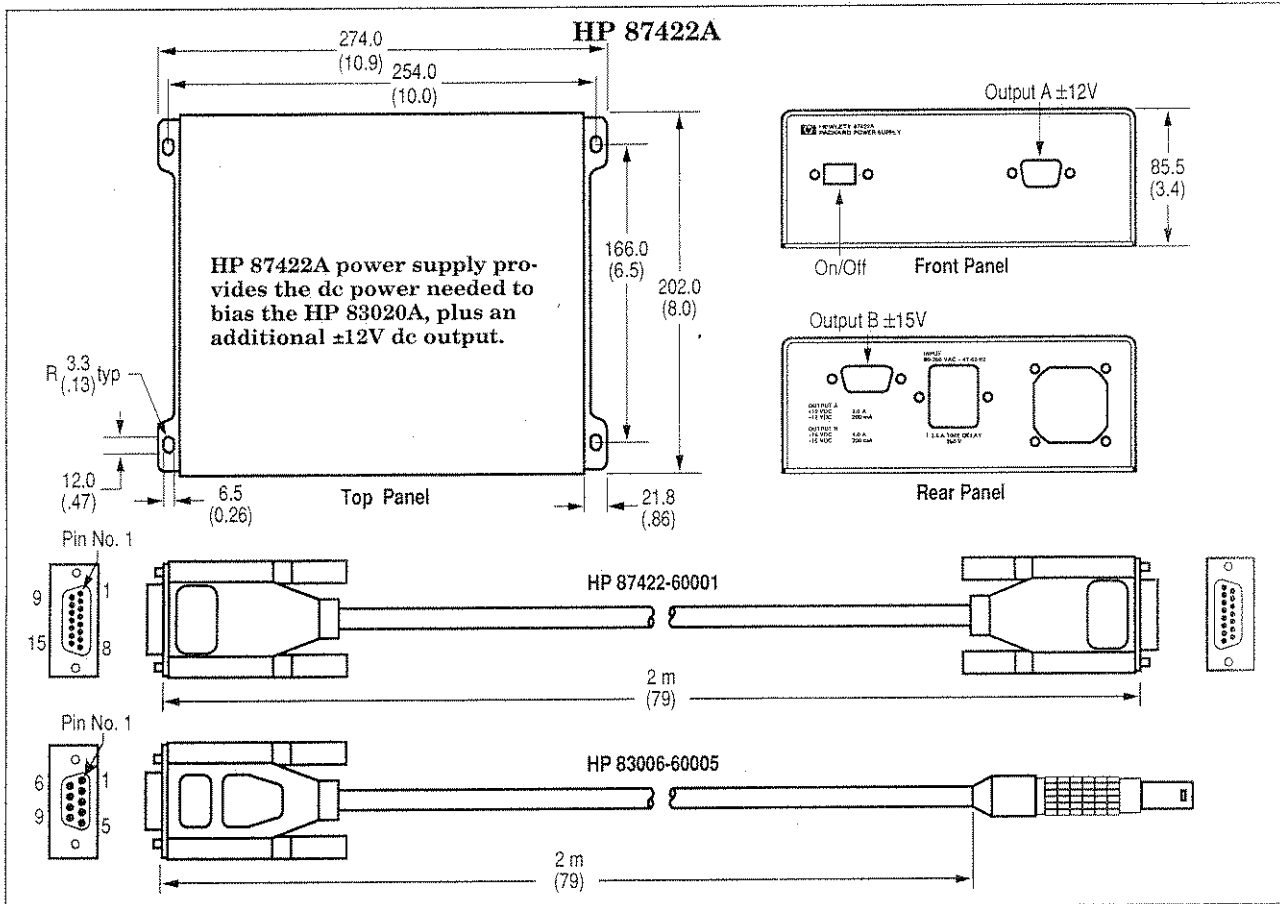
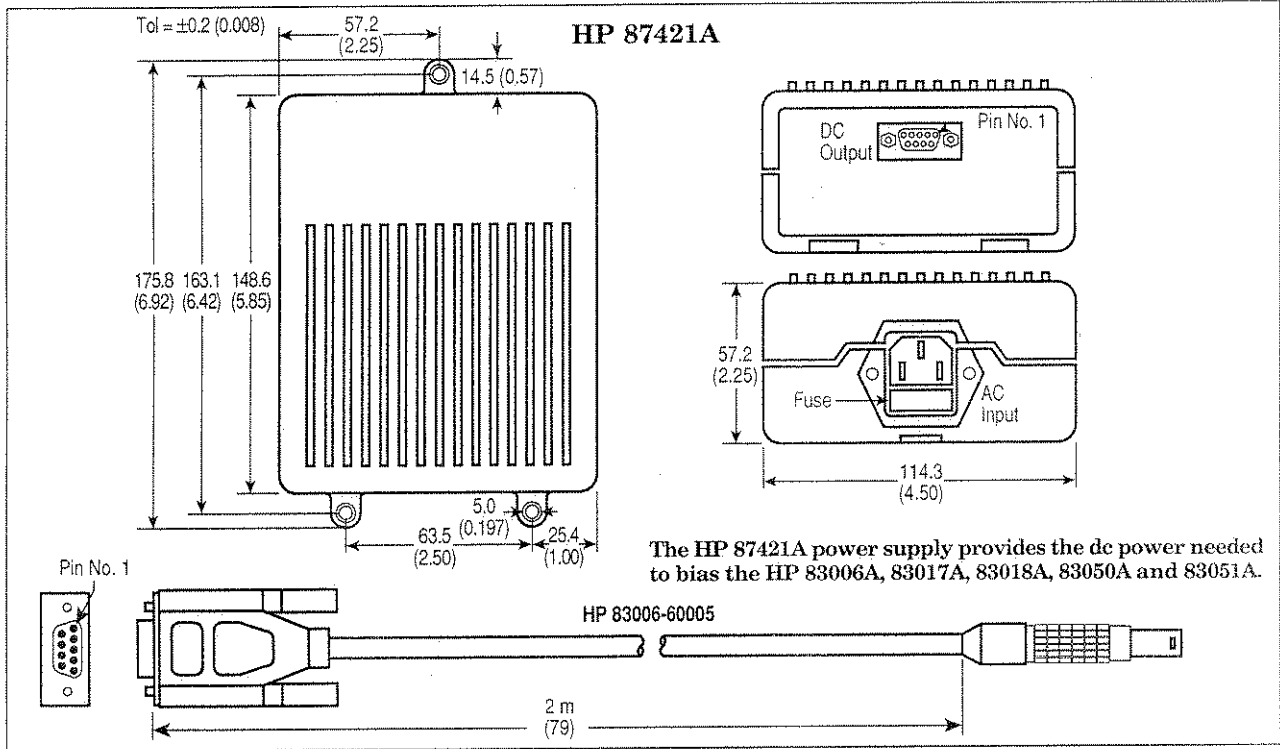
**HP 83018A**



# Amplifier Outline Drawings (cont'd)



# Power Supply Outline Drawings



## Ordering Information

### **HP 83006A, 83017A, 83050A and 83051A microwave system amplifiers**

Includes amplifier and HP part number 83006-60004, which is a two-meter cable with a three-pin connector on one end and three-wire leads on the other end.

### **HP 83018A microwave system amplifier**

Includes amplifier and HP part number 83006-60004, which is a two-meter cable with a three-pin connector on one end and three-wire leads on the other end.

- **Option 001:** Delete coupler/detector providing higher output power.
- **Special Applications:** Higher performance models available upon request.

### **HP 83020A microwave system power amplifier**

Includes amplifier and HP part number 83020-60004, which is a two-meter cable with a fifteen-pin connector on one end and three-wire leads on the other end.

- **Option 001:** Delete coupler/detector providing higher output power.
- **Special Applications:** Higher performance models available upon request.

## Other Instruments and Accessories

### **HP 83036C coaxial GaAs directional detector**

0.01–26.5 GHz, for use with the HP 83006A.

### **HP 87421A power supply**

Includes power supply and HP part number 83006-60005, which is a two-meter cable with a three-pin connector on one end and a D-sub-miniature connector on the other end for direct connection to the HP 83006A, 83017A, 83018A, 83050A and 83051A.

### **HP 87422A power supply**

Includes power supply and HP part number 83020-60001, which is a two-meter cable with fifteen-pin connectors for direct connection to the HP 83020A amplifier. One additional cable, HP part number 83006-60005, is provided for direct connection of the 12V dc output to a preamplifier such as the HP 83006A, 83017A, 83018A, 83050A or 83051A.

## Support Literature

### **HP 83036C technical data**

HP literature number 5952-1874

### **HP 87421A/87422A technical data**

HP literature number 5091-4292E

**For more information, call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.**

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# Technical Data Sheet Supplement



HP Part No. 5951-5993  
Printed in USA January 1995

Edition 2



## **CERTIFICATION**

*Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST, formerly NBS), to the extent allowed by the institute's calibration facility, and to the calibration facilities of other International Standards Organization members.*

## **WARRANTY**

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of delivery. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

## **LIMITATION OF WARRANTY**

The foregoing warranty shall not apply to defects resulting from improper maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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Hewlett-Packard Inter-Americas  
3495 Deer Creek Rd.  
Palo Alto, California 94304

# DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

**Manufacturer's Name:** Hewlett-Packard Co.

**Manufacturer's Address:** Microwave Instruments Division  
1400 Fountaingrove Parkway  
Santa Rosa, CA 95403-1799  
USA

declares that the product

**Product Name:** Amplifier

**Model Number:** HP 83006A, HP 83017A, HP 83018A,  
HP 83020A, HP 83050A, HP 83051A

**Product Options:** This declaration covers all options of the  
above products.

conforms to the following Product specifications:

Safety: IEC 348:1978/HD 401 S1:1981  
CAN/CSA-C22.2 No. 231 (Series M-89)

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A  
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD  
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz  
IEC 801-4:1988/EN 50082-1:1992 0.5 kV Sig. Lines, 1 kV Power Lines

## Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Safety qualification test for these products were performed prior to 1 December 1993.

These products were tested with HP 87421A and HP 87422A power supplies.

Santa Rosa, California, USA 17 April 1996

  
Dixon Browder/Quality Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department  
HQ-TRE, Herrenberger Strasse 130, D-71034 Böblingen, Germany (FAX +49-7031-14-3143)