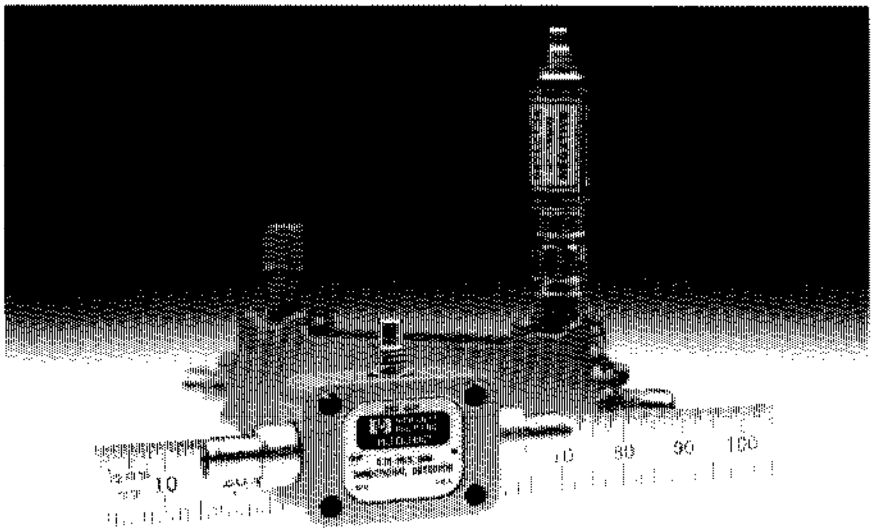
HEWLETT PACKARD

HP 83036C Coaxial GaAs Directional Detector

0.01 to 26.5 GHz

Technical Data



Features and Description

- Exceptional flatness: ±1 dB
- Extremely broadband: 0.01 – 26.5 GHz
- Compact size
- Environmentally rugged

The HP 83036C is a broadband microwave power sampler which operates in the same fashion as a traditional coupler-detector combination, but with improved frequency response and much smaller size. The directional detector is designed to perform over the 10 MHz to 26.5 GHz frequency band with +/-1.0 dB of output voltage variation at room temperature. The directional detector is capable of operating with greater than one watt of input power when terminated with well matched source and load impedances. An input power derating curve is provided for calculating the maximum input power for other source and load impedances.

The HP 83036C is comprised of a resistive bridge and a broadband planar-doped barrier (PDB) diode. The circuit is shown in

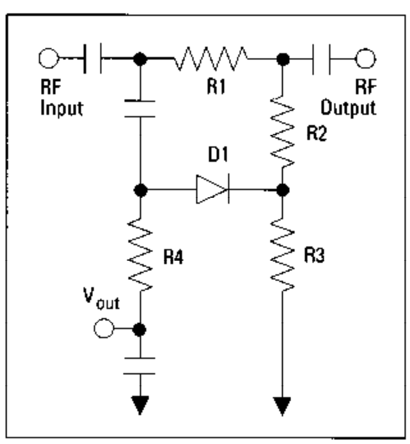


Figure 1.
Bridge circuit.

Figure 1. The bridge is manufactured by depositing thin film resistors directly onto GaAs substrate material. The use of a resistive bridge as the signal sampling device makes possible the extremely broadband device response.

The addition of a PDB diode and charging capacitor completes the GaAs bridge chip design. The PDB diode is fabricated using HP's proprietary Modified Barrier Integrated Diode (MBID) process which produces a detector diode with superior temperature, flatness and square law response characteristics.

An external RF bypass capacitor, DC blocking capacitors and two off-chip resistors complete the directional detector design. The input blocking capacitors are rated at 15 V_{dc} maximum. The complete circuit exhibits a room temperature video impedance of approximately 8000Ω. This video impedance results in a typical detector risetime of less than 2 microseconds.

The HP 83036C is much smaller than the directional coupler-detector combinations which it is designed to replace. The entire unit occupies a volume of less than 0.47 cubic inches (<8 cm^3) vs. a typical connectorized detector which alone can occupy more than 1 cubic inch (16.4 cm^3). The directional detector features 3.5 mm microwave connectors and an SMC connector at its dc output.

Applications for the HP 83036C include broad band amplifier leveling circuits (Figure 2), power monitoring circuits (Figure 3), and SWR alarm circuits (Figure 4) in instrument, communication and EW applications.

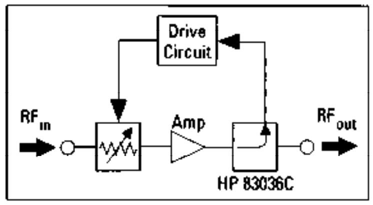


Figure 2. Amplifier leveling loop.

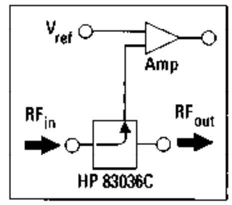


Figure 3. Forward power monitor.

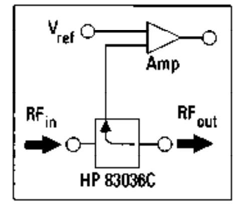


Figure 4. Reverse power monitor.

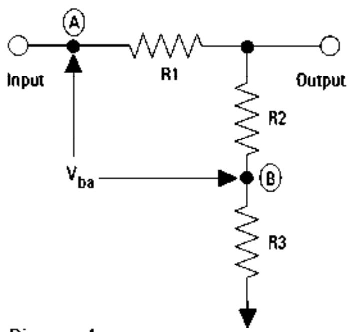


Diagram 1.
Circuit approximation.

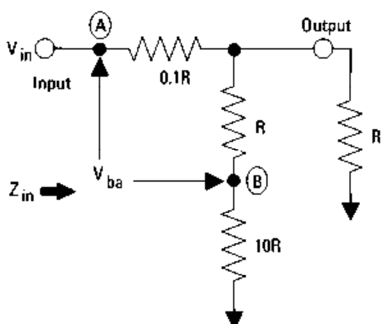


Diagram 2.
Input impedance.

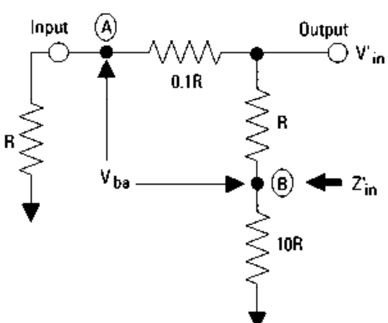


Diagram 3.
Output impedance.

Why a Directional Bridge?

A directional bridge is inherently a much broader band device than a directional coupler. Fabricated from thin film resistors, the directional bridge exhibits superior, repeatable performance from dc to 26.5 GHz when compared to microstrip or stripline couplers operating over the same band.

To properly separate forward signals from reverse signals, resistor values must be carefully chosen and manufactured to precision tolerances. A typical bridge configuration is shown in Figure 1. Assuming that the diode detector, D1, exhibits high input impedance over the entire frequency band, this circuit can be approximated by the circuit shown in Diagram 1. The diode voltage is determined by the voltage V_{ba}.

For a transmission line of characteristic impedance R, the bridge resistor values are chosen in the ratios shown in Diagram 2. The input impedance of the circuit and the voltage V_{ba} are then calculated as shown in Equations 1 and 2.

$$Z_{in} = R^*(R + 10R) / (R + (R + 10R)) + 0.1R \qquad (1)$$
$$= 1.02R =\sim R$$

$$V_{ba} = (V_{in}/1.02R) * [0.1R + (R * R) / 12R] \qquad (2)$$
$$= 0.18\, V_{in}$$

Using the same resistor values, the output impedance of the circuit can be calculated (see Diagram 3) as can the voltage impressed between the points A and B by a signal traveling in the reverse direction. These calculations are shown in Equations 3 and 4.

$$Z'_{in} = (0.1R + R) * (R + 10R) / [(0.1R + R) + (R + 10R)] \qquad (3)$$
$$= R$$

$$V_{ba} = (V'_{in}/R) * [(11R * 0.1R) / (12.1R) - (1.1R * R) / (12.1R)] \qquad (4)$$
$$= 0$$

These calculations indicate that the bridge will be well matched at its input and output and, in the ideal case, will exhibit infinite directivity, i.e., a positive V_{ba} value for a forward traveling signal, $V_{ba} = 0$ for a reflected or backward traveling signal.

While the analysis given above assumes 50Ω source and load impedances, a complete analysis reveals that the directivity and coupling values of the bridge are maintained over a wide range of source and load impedances. The net result is that the HP 83036C is capable of maintaining an excellent source match when terminated in a wide range of output load impedances.

Typical Performance Data

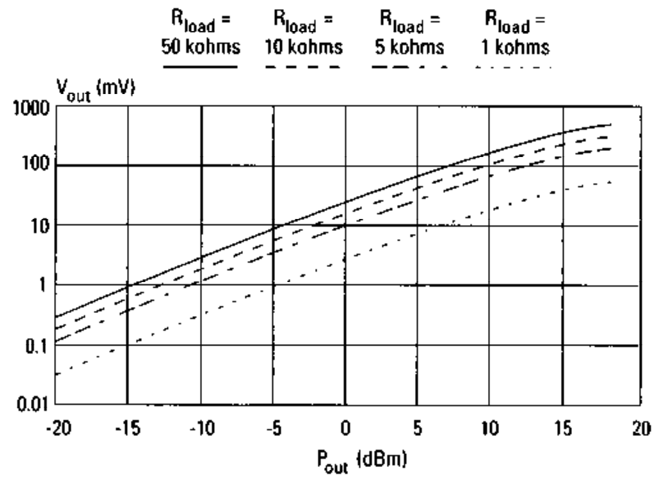


Figure 5.
Typical transfer characteristic.
Frequency = 18 GHz
Temperature = +25° C

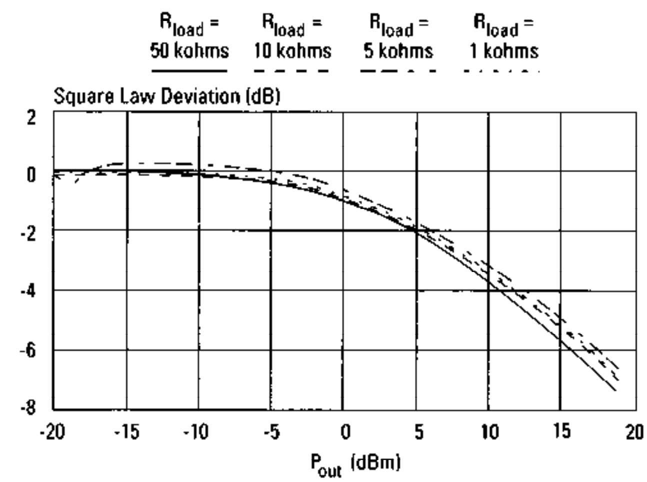


Figure 6.
Typical square law deviation.
Frequency = 18 GHz
Temperature = +25° C

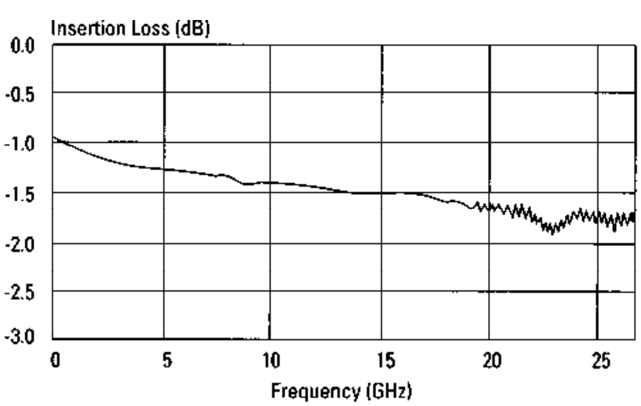


Figure 7.
Typical insertion loss.

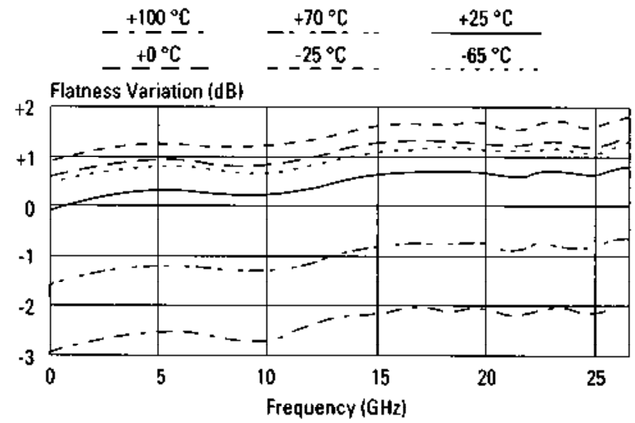


Figure 8.
Typical flatness at various temperatures.
R_{load} = 100 kΩ

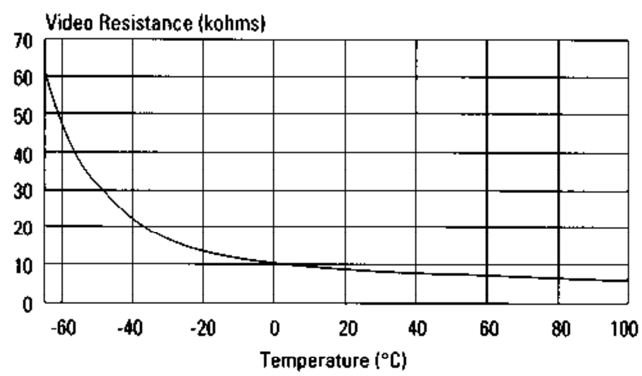


Figure 9.
Typical video resistance variation with temperature.
Frequency = 18 GHz
P_{out} = -10 dBm

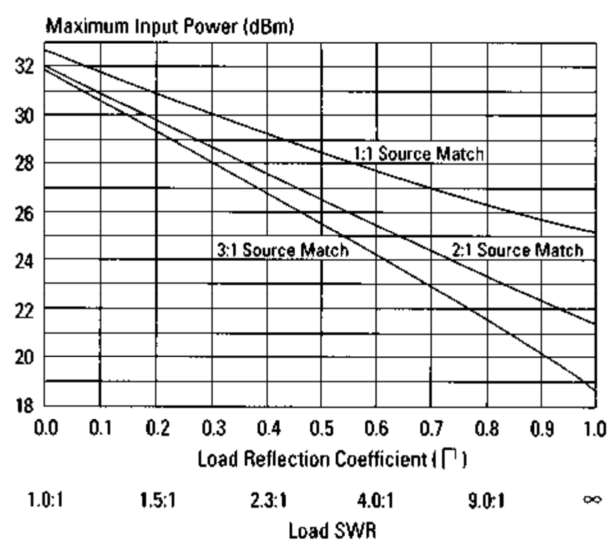


Figure 10.
Maximum input power @ 25° C.
Derate by 3 dB @ 70° C.

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Specifications at 25° C

Frequency : 0.01 to 26.5 GHz
Loss: 2.2 dB maximum
Directivity: 14 dB minimum
Input SWR: 1.7:1 (2:1 below 50 MHz)
Output SWR: 1.7:1 (2:1 below 50 MHz)
Flatness: ±1 dB maximum
Sensitivity: 18 µV/µW minimum
Output Polarity: negative

Environmental

Non-Operating Temperature:
-65 to +150° C

Random Vibration: in accordance with MIL-STD-883, method 2026, condition IIA: 5.9 Grms, 50 to 2000 Hz.

Shock: in accordance with MIL-STD-883, method 2002.3, condition B: 1500 g for 0.5 mS.

Moisture Resistance: in accordance with MIL-STD-883, method 1004.5: 10 cycles, -10 to +65° C at 90 to 100% RH.

Altitude: in accordance with MIL-STD-883, method 1001, condition C: 50000 ft. operating altitude.

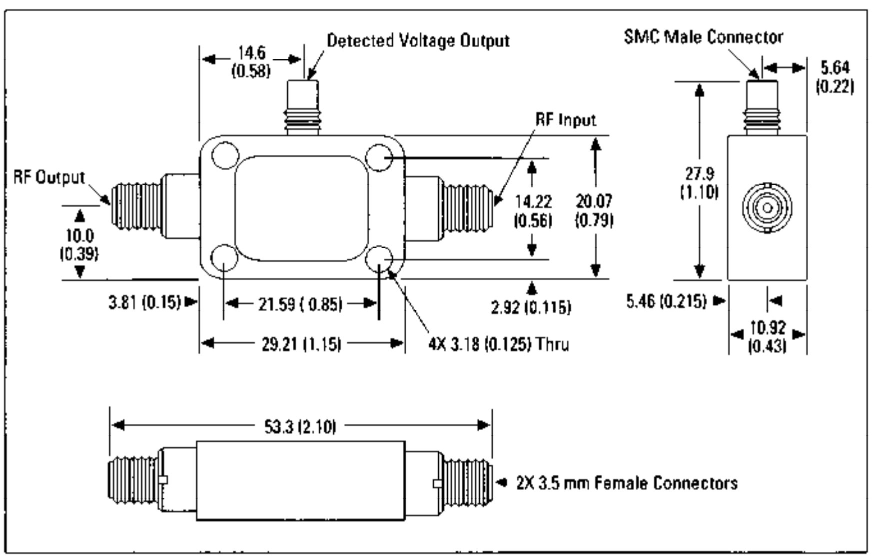

Figure 11. Dimensions in millimeters and (inches).

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