

General Purpose Microwave SPST Switches and Attenuators DC-18 GHz

Technical Data

**33102A
33104A**

Features

- **Low Insertion Loss**
- **High Isolation**
- **Low SWR**
- **Package and Connector Variety**

Description

HP SPST switches utilize PIN diodes in shunt across a 50 ohm transmission line. At microwave frequencies the PIN diode presents a high impedance at zero bias. With the diode in shunt, the switch is "on" at zero bias (well matched and passing all the incident RF power). Approximately 50 mA of DC current per diode reduces the diode impedance to much less than 50 ohms. Thus the switch is "off" when the diode is

heavily forward biased (high mismatch reflecting most of the power back to the source). When switching from the "on" to "off" state, the switch can be set at any attenuation level between these two extremes. The PIN diode allows a smooth and repeatable variation of attenuation with change in bias level. Typical switching speed is 50 ns.

The HP 33100 is a complete switch, with RF connector, bias circuit, and built in DC return. Ordering information is given on the following page.

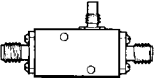
For further technical details, see HP Application Note 922, "Application of PIN Diodes."



Ordering Information

The HP 33100 series switch is a broadband general purpose switch. The standard unit is supplied with SMA jack (female) RF connectors and SMC jack bias connector. An SMA jack bias connector is available as Option 001.

Selection Guide

Description/Configuration	Standard (2-diode)	High Isolation (4-diode)	Connector Options	DC Bias Circuit
Broadband 33100 Series 	33102A	33104A	SMA Only	Built-In

Electrical Specifications

Maximum Ratings

Parameter	33100 Series
Operating Temperature	-55°C to +95°C
Storage Temperature	-55°C to +125°C
CW RF Power at $T_{CASE} = 25^{\circ}C$	2 W (Derate to 0.85 Watt at 95°C)
Pulse RF Power at $T_{CASE} = 25^{\circ}C$ (1 μs 0.001 duty cycle)	75 W (Derate to 33 Watt at 95°C)
Control Current/Voltage	See following table

Maximum Control Current/Voltage

Model	Current (mA)	Voltage (V)
33102	-200	+100 to -1.0
33104	-400	+100 to -1.0

Noise Figure

Equal to attenuation.

Distortion

Internally generated harmonics in the General Purpose Series are typically 40 dB below the fundamental at input power levels up to 2 watts.

RF to DC Isolation

Isolation of the RF from the control circuit is typically 30 dB.

Driver Considerations

Driver requirements are dictated by the specific application. When the switch is used as a modulator or attenuator, a current amplifier is required. Suitable integrated circuits can be obtained for either laboratory or OEM applications. For example, an HP 33190B is suitable as a driver.

Switch Schematics



Figure 1. Module Schematic.

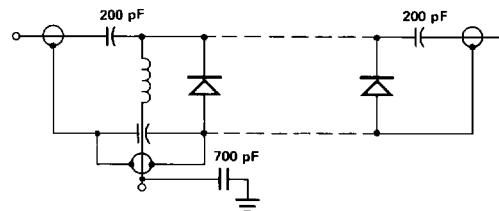


Figure 2. Switch Assembly Schematic.

Typical Switching Speed (10%-90%)	General Purpose
	33102A, 33104A
Off-On	50 ns
On-Off	50 ns

Model	Diode Polarity	Number of Diodes
33102	As Shown	2
33104	As Shown	4

Electrical Specifications at $T_{CASE} = 25^{\circ}C$
33100 Series Broadband

Model	Parameter	Conditions	Frequency Range (GHz)					
			0.1-1.0	1.0-2.0	2.0-4.0	4.0-8.0	8.0-12.0	12.0-18.0
33102A	Min. Isolation (dB)	$I_C = -100$ mA	33	35	40	43	43	43
	Max. Insertion Loss (dB)	$I_C = 0$	1.0	1.0	1.3	2.0	2.0	2.5
	Max. SWR		1.7	1.7	1.8	2.0	2.0	2.5
33104A	Min. Isolation (dB)	$I_C = -200$ mA	42	65	80	80	80	-
	Max. Insertion Loss (dB)	$I_C = 0$	1.0	1.0	1.5	2.1	2.2	-
	Max. SWR		1.7	1.8	2.0	2.0	2.0	-

Typical Attenuation Characteristics

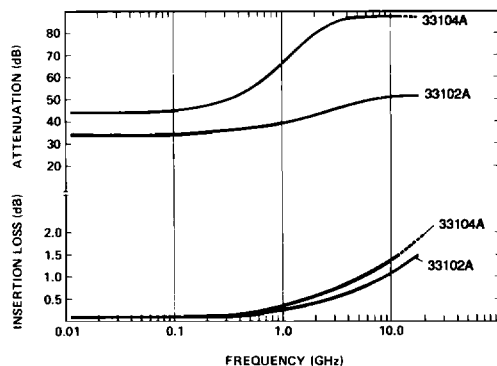


Figure 3. Attenuation and Insertion Loss vs. Frequency, 33100 Series.

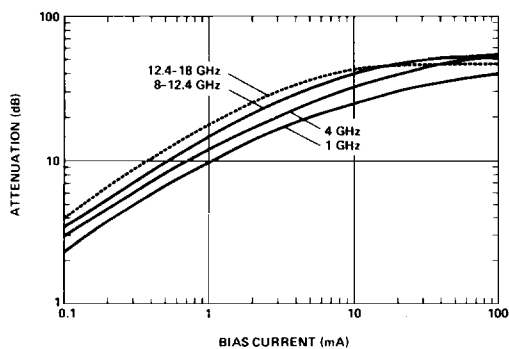


Figure 4. Attenuation vs. Bias with Frequency as a Parameter, 33102A.

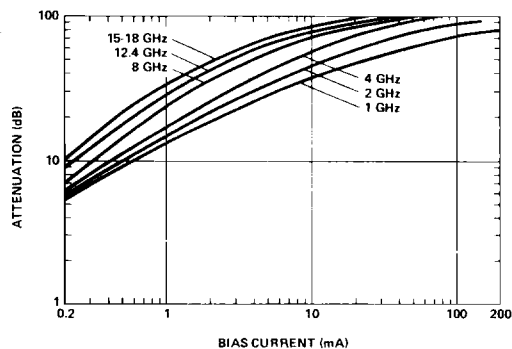


Figure 5. Attenuation vs. Bias with Frequency as a Parameter, 33104A.

RF Power Handling

The breakdown voltage of the diode, the maximum diode power dissipation, the bias state, and the frequency of the RF signal all determine the maximum RF power a switch can handle. Under full isolation conditions, the limiting factor which defines power handling capability is energy storage capacity of the diodes. Under insertion loss conditions the limiting factor which defines power handling capability is diode breakdown voltage.

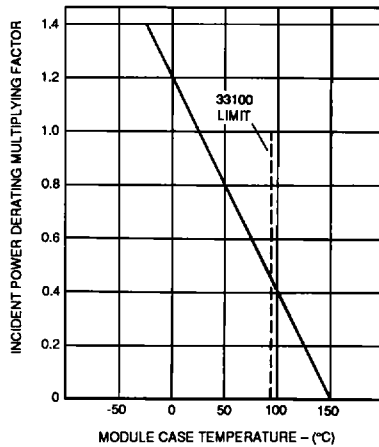


Figure 6. Temperature Derating of Incident Power.

RF Power Handling at $T_{CASE} = 25^{\circ}C$

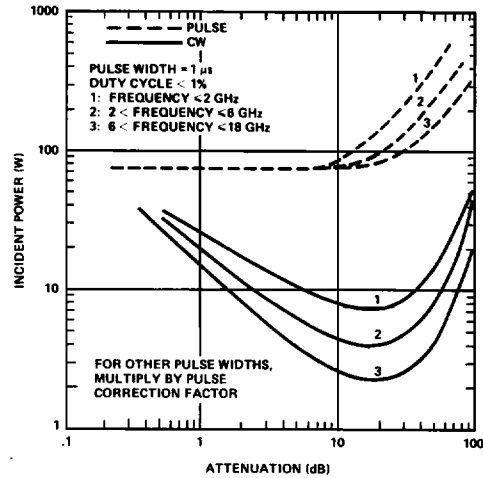


Figure 7. Incident Pulse and CW Power Ratings vs. Attenuation, General Purpose 4-Diode Switches. See Table for Pulse Correction Factor.

Pulse Width Correction Factor

Apply to Incident Power Ratings of Figure 7.

Pulse Width	Correction Factor
0.5 μ s	1.55
2.0 μ s	0.62

Typical Phase Shift Characteristics

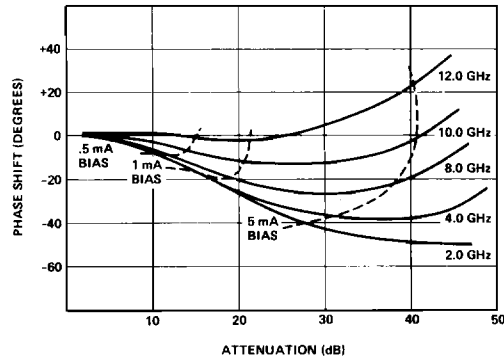


Figure 8. Phase Shift vs. Attenuation, 33102A.

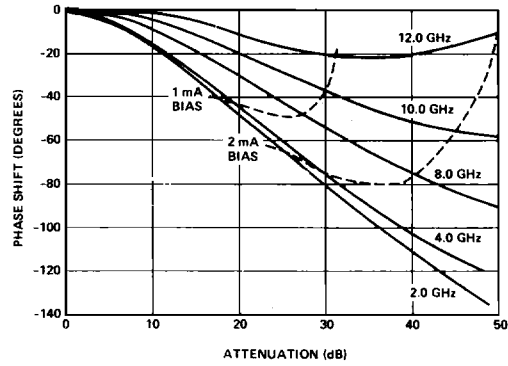


Figure 9. Phase Shift vs. Attenuation, 33104A.

Typical Temperature Effects

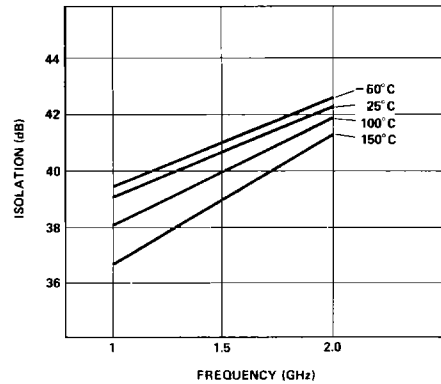


Figure 10. Typical Isolation vs. Frequency with Temperature as a Parameter of Recommended Bias, General Purpose 2-Diode Switches.

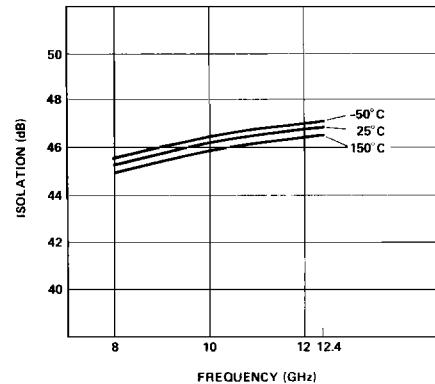


Figure 11. Typical Isolation vs. Frequency with Temperature as a Parameter at Recommended Bias, General Purpose 2-Diode Switches.

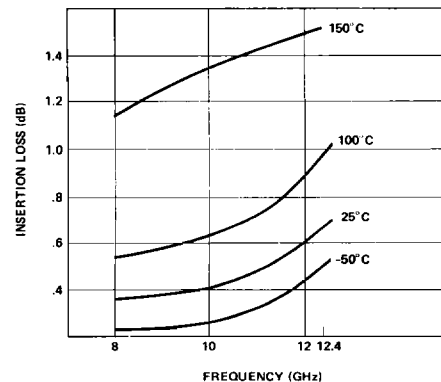


Figure 12. Typical Insertion Loss vs. Frequency with Temperature as a Parameter at $I_C = 0$, General Purpose 2-Diode Switches.

Environmental Capabilities

33100 Series:

Non-Operating Temperature Cycling: MIL-STD-883, Method 1010, Test Condition B (-55°C to +125°C).

Shock: MIL-STD-883, Method 2002, Test Condition B.

Moisture Resistance: MIL-STD-883, Method 1004.

Salt Atmosphere: (corrosion) MIL-STD-883, Method 1009, Test Condition A.

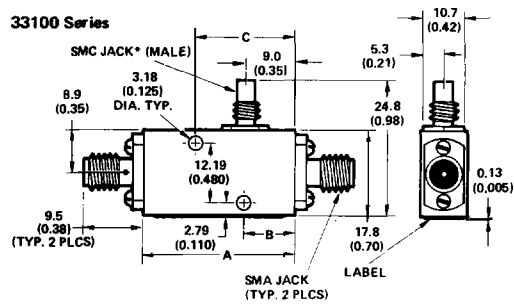
Mechanical Specifications

Size: See Outline Drawing

Finish: 33100 Series - Body: painted

Maximum Weight	33100 Series	
	33102A	33104A
Ounces	0.8	1.0
Grams	23	29

Outline Drawing



Model	A	B	C
33102	31.8 (1.25)	9.7 ± 0.25 (0.383 ± 0.010)	21.9 ± 0.25 (0.863 ± 0.010)
33104	37.3 (1.47)	12.5 ± 0.25 (0.493 ± 0.010)	24.7 ± 0.25 (0.973 ± 0.010)

*SMA Jack available as Option 001.