HEWLETT PACKARD
Expanding Possibilities

HP 33311A/B/C, 33312B, 33313A/B/C Coaxial Switches

Product Overview

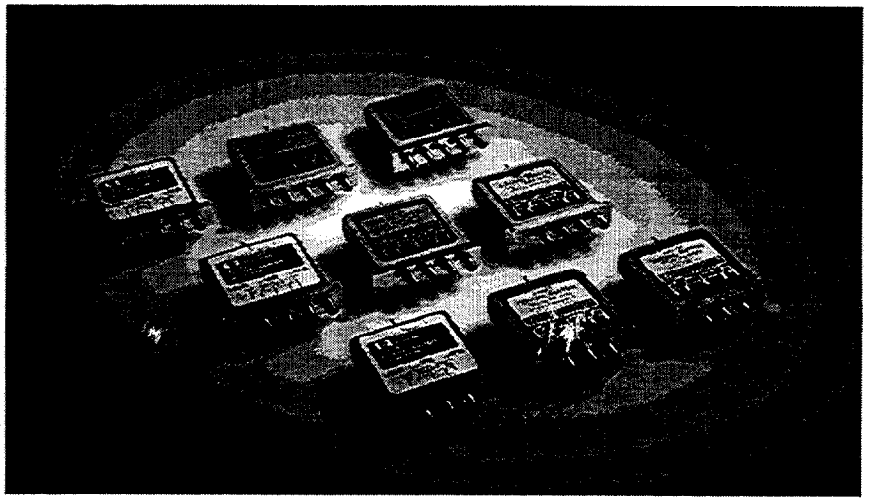
dc to 4 GHZ
dc to 18 GHz
dc to 26.5 GHz

High performance switches for microwave and RF instrumentation and systems

Hewlett-Packard offers a versatile line of multiport coaxial switches. These 50Ω mechanical-latching switches come with the performance and reliability that you have come to expect in HP microwave accessories.

Offering excellent electrical and mechanical performance with broadband operation, high isolation, low SWR, long life and exceptional repeatability, these switches are designed with your applications in mind. Frequency ranges are available to 4 GHz and 18 GHz for the A and B models with SMA connectors and to 26.5 GHz for the C models with –3.5 mm connectors.

The HP 33311A, HP 33311B, and HP 33311C (Figure 1) are single-pole double-throw switches with high isolation, >100 dB at 4 GHz for the A model, >90 dB at 18 GHz for the B model and >50 dB at 26.5 GHz for the C model. All models terminate the unused port with 50Ω, a key feature for your applications where low SWR is required on all ports.



The HP 33312B (Figure 2) has 4 RF ports with one internal 50Ω termination designed for applications requiring a transfer switch or a cross switching element.

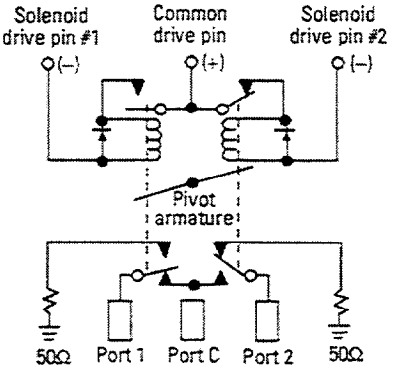


Figure 1. HP 33311

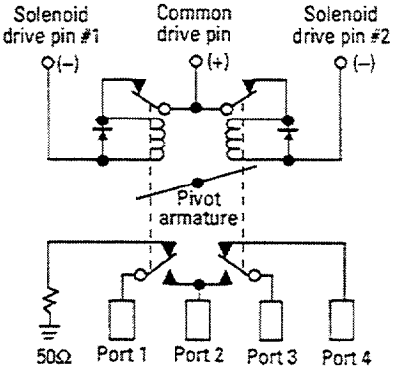


Figure 2. HP 33312B

The HP 33313A, 33313B, and 33313C (Figure 3) round out the family with 5 RF ports, giving you flexibility to configure the switch for your specific needs.

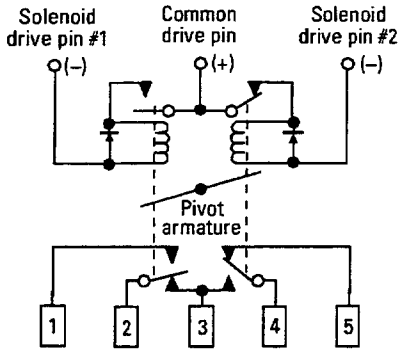


Figure 3. HP 33313A/B/C

Applications

Multi-source switching

The HP 33311A, 33311B or 33311C is an excellent choice for applications where you require selection of multiple signal sources, frequency counters, or signal control devices such as modulators or filters, or routing signals from multiple sources as shown in Figure 4.

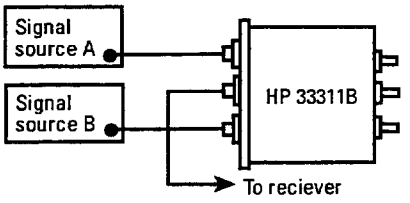


Figure 4. Multi-source switching

Transfer switching

For applications requiring a "transfer switch," as shown in Figure 5, an HP 33312B is the ideal choice to insert a component, such as a filter or mixer, into a signal path. Another popular use is to switch between a device under test and a through path for system calibration. The HP 33312B's internal load can terminate the device under test when in the through mode (up to 1watt).

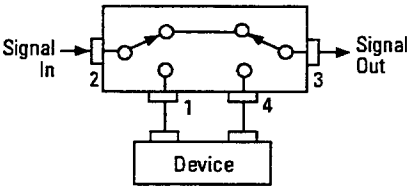


Figure 5. HP 33312B used as a transfer switch (equivalent circuit action)

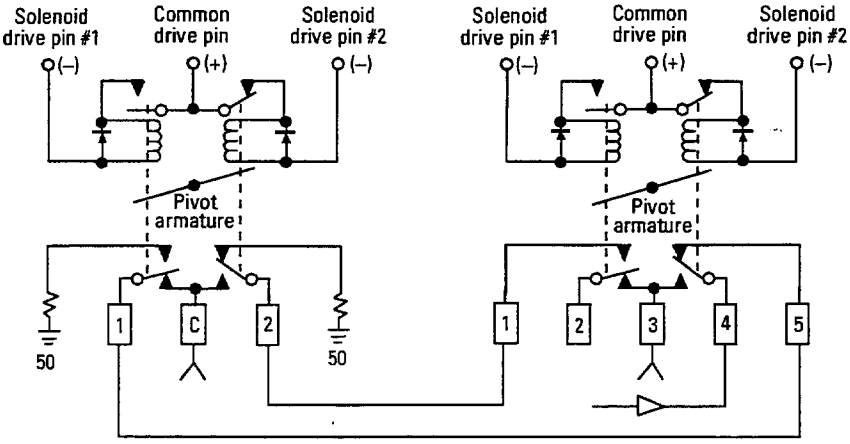


Figure 6. Signal reversal

Reverse signal path

Figure 6 shows how an HP 33311 and HP 33313 may be used to provide a "transceiver" configuration. This example illustrates how one amplifier can be used to transmit or receive. Any application where the signal path direction needs to be reversed could use this configuration.

Portable and remote applications
Due to their small package size, light weight, low power consumption, and high reliability, these switches are ideal for your portable or remote applications. The light weight and repeatability make them well suited for portable spectrum analyzers and other portable microwave test equipment. Their 1,000,000 cycle life make them the ideal candidate for system design, such as communications repeaters or remote monitoring stations that demand minimal maintenance. The switch's automatic coil disconnect feature and low current drain during switching minimize the amount of power needed for operating the switches.

Dedicated Switching
For larger switching systems, where many switches will be used to provide complex signal routing, a switch driver such as the HP 87130A or 70611A is recommended. The HP 87130A rack-and-stack switch driver and the MMS-based HP 70611A Option 001 are convenient, flexible HP-Interface Bus (HP-IB) or Modular Systems Interface Bus (MS-IB) switch controllers, providing driver circuitry, indicator readback circuitry and firmware that makes it easy to integrate switch components into a switching system. Controlling the HP 87130A is simple using either a PC or workstation based HP-IB controller and HP Interactive Test Generator (HP-ITG) or HP-Visual Engineering Environment (HP-VEE). The HP 70611A gives manual control via the MMS user interface or can also be controlled via an HP-IB equipped PC or workstation.

In addition, the built-in firmware makes it possible to define often used switch paths. With the path command, macros can be designed which open and close the right solenoids to select the desired switch port, and the path may be given a meaningful name. Remember that only one select pin should be activated at one time to prevent rapid cycling of the switch.

Both the HP 87130A and 70611A provide position monitoring and reporting, which make it possible for a program to determine if all the switches are in their proper state (position) before the program continues with testing. A programmable wake up condition makes it possible to ensure that the matrix or switching system starts up in a predetermined state, to prevent damage to delicate equipment from excessive power. This would also be the state that the system returns to after a power interruption. Reference literature number 5091-3268E, *HP 87130A Attenuator/Switch Driver* and literature number 5952-3715E, *HP 70611A Attenuator/Switch Driver.*

Accessory cables and adapters make it easy to quickly get the *HP 33311/12/13 working with the HP 87130A or HP 70611A.* Reference literature number 5963-2038E, *Switch Attenuator Driver Configuration Guide.*

For smaller switching needs, the HP 11713A attenuator/switch controller provides simple HP-IB control for up to ten HP 33311/12/13 switches. Connecting cables can be ordered which make it easy to connect the switches to the HP 11713A.

Help for your special needs
For more information on the applications of Hewlett-Packard Switches, request Application Note 332, *Microwave Switching from SPDT to Full-Access Matrix,* literature number 5953-6466, or contact HP for your special switching needs.

Application Note 332-1, *Novel Combinations of Microwave Switches and Step Attenuators for Programming Applications,* literature number 5954-8892, expands on some interesting product capabilities.

Operation and use

How the switch works

All the switches are "break before make"; the switched ports are not connected to each other preventing possible damage to sensitive circuits. The standard configuration switch uses 24 Vdc for the switching voltage, Option 011 specifies a voltage of 5 Vdc, and Option 015 specifies 15 Vdc.

Driving the switch

For standard, Option 011, and 015 switches, switching is accomplished by applying the supply voltage to pin "C" and grounding the appropriate pin to actuate the switching mechanism. **Avoid grounding both RF path select pins as rapid cycling may occur.** After the switch is fully latched (30 ms), the drive current is automatically disconnected. If the drive circuit is pulsed, the pulse duration must be at least 30 ms to ensure that the switch will fully latch.

Remote Indication

The position of the switch may be determined by utilizing the open and closed states of the internal coil contacts. Figure 7 displays two indicator circuits, one to provide a TTL output and one that directly activates an LED. The circuits will output a TTL "HI" and LED "ON" if the switch is in the state shown in Figure 7. When drive pin 1 contact is closed (as shown), RF port 2 is connected to common port. For the HP 33311/12/13, see Figures 2, 3, and Table 1 for corresponding RF port connections. The circuits shown are designed to operate with coil voltage of 24V. If other voltage switches are used, the circuit components must be modified to accommodate that voltage.

Since current is drawn through the solenoid for these indicator circuits, inadvertent switching is prevented by limiting the current to 5 mA. Additional design information may be required from the component manufacturer for the circuits described in Figure 7, depending upon specific applications. *Hewlett-Packard assumes no responsibility for use of any circuits described herein, and makes no representations or warranties, expressed or implied, that such circuits are free from patent infringements.*

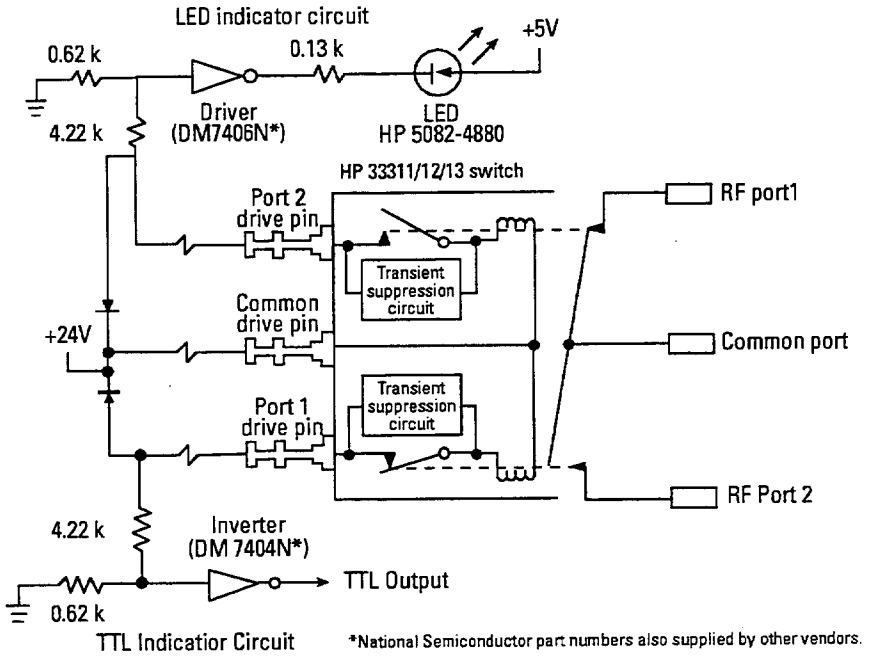


Figure 7. TTL and LED remote indicator circuits

Model Number	*Standard Drive*		
	Pin 1	Pin 2	RF Path
HP 33311A/B/C	Ground	Open	1 to C closed 2 terminated
	Open	Ground	2 to C closed 1 terminated
HP 33312B	Ground	Open	1 to 2 closed 3 to 4 closed
	Open	Ground	1 terminated 2 to 3 closed 4 open
HP 33313A/B/C	Ground	Open	1 open 2 to 3 closed 4 to 5 closed
	Open	Ground	1 to 2 closed 3 to 4 closed 5 open

Table 1. Switching logic table

Specifications

HP model numbers	HP 33311A HP 33313A	HP 33311B HP 33312B HP 33313B	HP 33311C HP 33313C
Frequency range	dc to 4 GHz	dc to 18 GHz	dc to 26.5 GHz
Insertion loss	<0.20 dB, dc to 2 GHz <0.25 dB, 2 to 4 GHz	<0.20 dB, dc to 2 GHz <0.50 dB, 2 to 18 GHz	<0.25 dB, dc to 2 GHz <0.50 dB, 2 to 18 GHz <1.25 dB, 18 to 26.5 GHz
Isolation between ports >50 dB, 18 to 26.5 GHz	>100 dB, dc to 4 GHz	>90 dB, dc to 18 GHz	>90 dB, dc to 18 GHz
SWR through line	<1.10, dc to 2 GHz <1.20, 2 to 4 GHz	<1.10, dc to 2 GHz <1.20, 2 to 12.4 GHz <1.30, 12.4 to 18 GHz	<1.15, dc to 2 GHz <1.25, 2 to 12.4 GHz <1.40, 12.4 to 18 GHz <1.80, 18 to 26.5 GHz
Into internal 50Ω load (HP 8762s and HP 8763s)	<1.10, dc to 2 GHz <1.20, 2 to 4	<1.10, dc to 2 GHz <1.20, 2 to 12.4 GHz <1.30, 12.4 to 18 GHz	<1.15, dc to 2 GHz <1.25, 2 to 12.4 GHz <1.30, 12.4 to 18 GHz <1.80, 18 to 26.5 GHz
Connectors	SMA (f)	SMA (f)	3.5 mm (f)
Insertion loss repeatability dc to 18 GHz 18 to 26.5 GHz (Up to 1,000,000 cycles measured at 25° C)	0.03 dB maximum	0.03 dB maximum	0.03 dB maximum 0.5 dB maximum

General operating data

Maximum power rating	1 watt average; 100 watts peak (not to exceed average power rating); +7 Vdc
Life	1,000,000 cycles minimum
Switching solenoid	Switching speed 30 ms maximum

Switch drive data

Parameter	Test conditions	Minimum	Nominal	Maximum	Units
Supply voltage					
Standard		20	24	32	V
Option 015		12	15	20	V
Option 011		4.5	5	7	V
Supply current	Switching; pulse width ≥ 30 ms maximum				
Standard	@ Vcc = 24 Vdc		120		mA
Option 015	@ Vcc = 15 Vdc		182		mA
Option 011	@ Vcc = 5 Vdc		400		mA
Impedance					
Standard			200		ohm
			127		mH
Option 015			82		ohm
			57		mH
Option 011			13		ohm
			8		mH

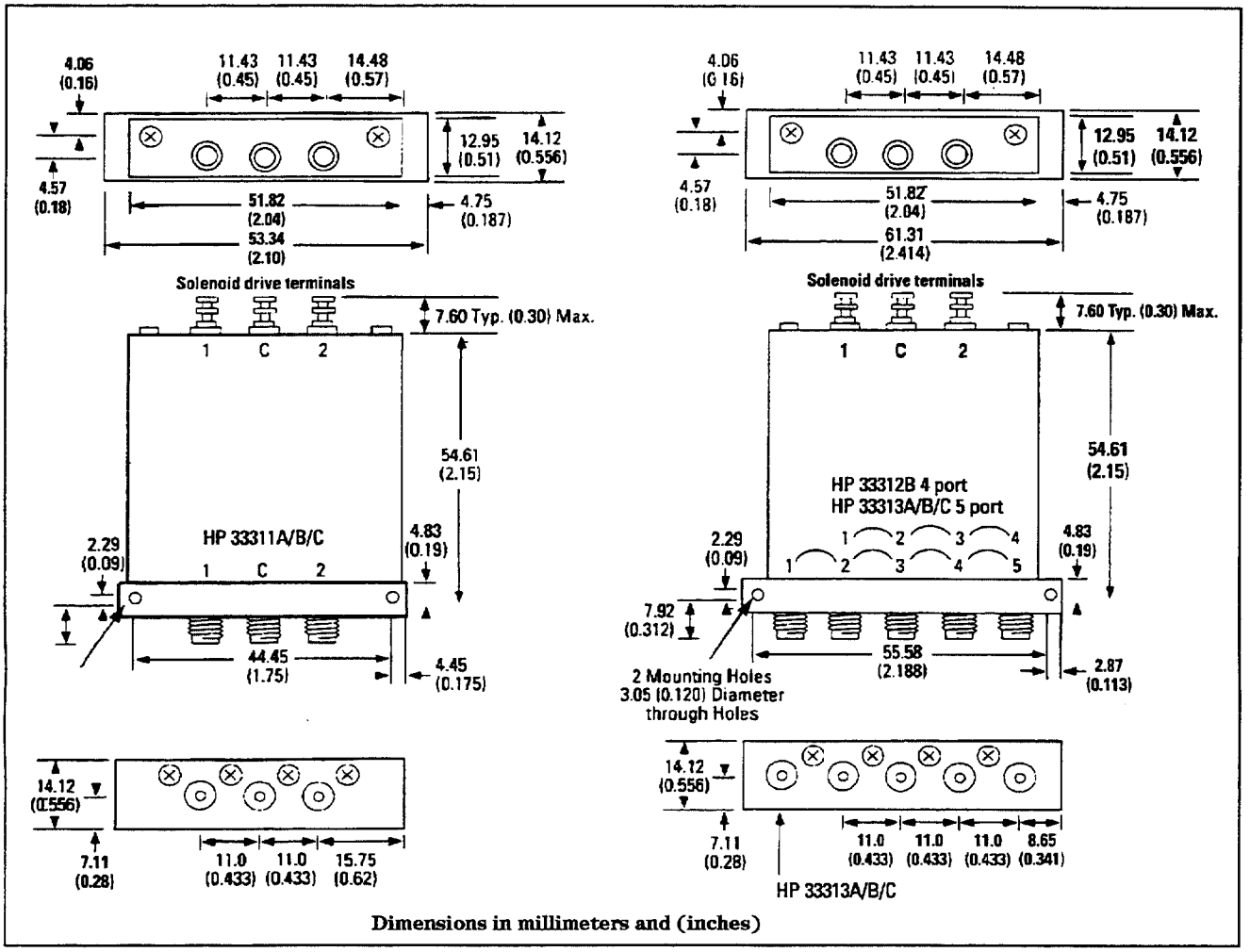
Environmental

Operating temperature	Humidity	Vibration	Shock
–25° to +75°C	95% RH, 40°C, 5 days	0.05", 10 to 55 Hz	50 g's, 3 ms

Physical specifications

Dimensions:	Per Figure 9
Weight:	245 g (9 oz.)

Specifications (continued)



Dimensions in millimeters and (inches)

Figure 9. Product outlines