

Operating and Service Manual

Agilent L7222C Coaxial Transfer Switch



Agilent Technologies

Manufacturing Part Number: L7222-90001

Printed in Malaysia

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Bayan Lepas, Penang 11900 Malaysia

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General Information

L-Series Coaxial Transfer Switch Overview

Agilent L7222C coaxial transfer switch is designed for flexibility in signal routing applications and provides exceptional insertion loss repeatability of 0.03 dB, low insertion loss and high isolation > 80 dB.



Figure 1 L7222C Coaxial Transfer Switch

Table 1 shows general details of L7222C coaxial transfer switch.

Table 1 General Information on L7222C Coaxial Transfer Switch

Model	Frequency Range	Configuration
L7222C	DC to 26.5 GHz	DPDT

Features

- Guaranteed 0.03 dB insertion loss repeatability for 2 million cycles
- Excellent isolation, typically > 80 dB at 26.5 GHz
- Opto-electronic indicators and interrupts
- Magnetic latching
- TTL/5V CMOS compatible (optional)

General Information

The L7222C can be used in a variety of applications such as switching two inputs and two outputs, signal reversal switching or as a drop-out switch. Innovative design and careful process control mean the L7222C meet the requirements for highly repeatable switching elements in test instruments and switching interfaces. L7222C offers exceptional insertion loss repeatability, reducing sources of random errors in the measurement path and improving measurement uncertainty.

Switch life is a critical consideration in production test systems, satellite and antenna monitoring systems and test instrumentation. The longevity of this switch increases system uptime and lowers the cost of ownership by reducing calibration cycles and switch maintenance.

Opto-electronic interrupts and indicators improve reliability and extend the life of the switch by eliminating DC circuit contact failures characteristic of conventional electromechanical switches. The L7222C have circuits that interrupt the current to all the solenoids once switching is complete and offer independent indicators that are controlled by optical interrupts. These indicators provide a closed path between the indicator common pin and the corresponding sense pin of the selected path.

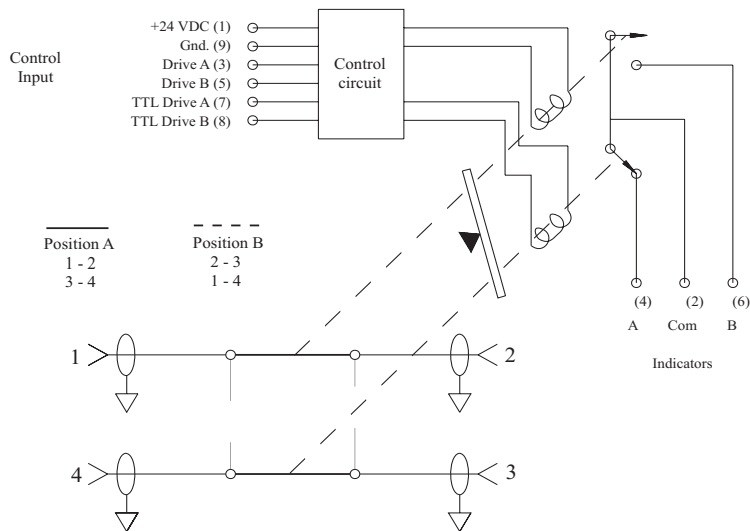


Figure 2 Agilent L7222C Coaxial Transfer Switch Schematic

Driving the Switch

There are two positions for the L7222C coaxial transfer switch. See [Figure 3](#). Position A has RF Port 1 connected to RF Port 2 and RF Port 3 connected to RF Port 4. Position B has RF Port 2 connected to RF Port 3 and RF Port 1 connected to RF Port 4. Either switch can be driven with a standard grounding drive control with or without a separate ground. Single line or Dual line TTL control are also available. The switch operates in a break-before-make mode.

Table 2 Standard Drive Control

RF path	Standard drive voltage	
	Drive A	Drive B
	Pin 3	Pin 5
Position A	Ground	Open
Position B	Open	Ground

Table 3 TTL Drive Control

RF path	Single line TTL/5V CMOS drive voltage		Dual line TTL/5V CMOS drive voltage	
	TTL Drive A	TTL Drive B	TTL Drive A	TTL Drive B
	Pin 7	Pin 8	Pin 7	Pin 8
Position A	High	High	High	Low
Position B	Low	High	Low	High

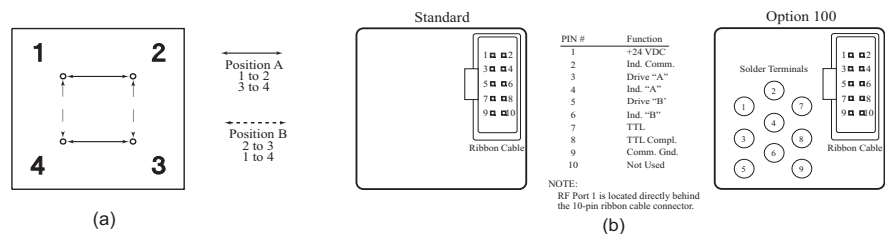


Figure 3 (a) RF Port Connections and (b) Drive Connections

General Information

- Standard Drive**
- Connect pin 1 to supply voltage (+20 Vdc to +32 Vdc) and pin 9 to ground. See [Figure 3](#) for connection diagram and [Table 2](#) for standard drive control.
-

NOTE Pin 9 does not need to be grounded for the switch to operate in standard drive mode. If pin 9 is not grounded, the position indicators will only function while the appropriate drive has ground applied. Therefore, if a pulse drive is used and continuous indicator operation is required, pin 9 must be grounded.

- Select position A by applying ground to pin 3.
 - Select position B by applying ground to pin 5.
-

NOTE After the RF path is switched and latched, the drive current is interrupted by the electronic position-sensing circuitry. Pulsed control is not necessary, but if implemented, the pulse width must be 15 ms minimum to ensure that the switch is fully latched.

- Single Line TTL Drive**
- Connect pin 1 to supply voltage (+20 Vdc to +32 Vdc) and pin 9 to ground. See [Figure 3](#) for connection diagram and [Table 3](#) for TTL drive control.
-

NOTE For TTL drive, pin 9 must be grounded.

In addition to the quiescent current supplying the electronic position-sensing circuitry, the drive current flows out of pin 9 (during switching) when using TTL drive.

- Select position A by applying TTL “High” to pin 7 and TTL “High” to pin 8.
- Select position B by applying TTL “Low” to pin 7 and TTL “High” to pin 8.

NOTE

After the RF path is switched and latched, the drive current is interrupted by the electronic position-sensing circuitry. Pulsed control is not necessary, but if implemented, the pulse width must be 15 ms minimum to ensure that the switch is fully latched.

Dual Line TTL Drive

- Connect pin 1 to supply voltage (+20 Vdc to +32 Vdc) and pin 9 to ground. See [Figure 3](#) for connection diagram and [Table 3](#) for TTL drive control.

NOTE

For TTL drive, pin 9 must be grounded

In addition to the quiescent current supplying the electronic position-sensing circuitry, the drive current flows out of pin 9 (during switching) when using TTL drive.

- Select position A by applying TTL “High” to pin 7 and TTL “Low” to pin 8.
- Select position B by applying TTL “Low” to pin 7 and TTL “High” to pin 8.

NOTE

After the RF path is switched and latched, the drive current is interrupted by the electronic position-sensing circuitry. Pulsed control is not necessary, but

General Information

if implemented, the pulse width must be 15 ms minimum to ensure that the switch is fully latched.

Electronic Position Indicators

The electronic position indicators consist of optically isolated, solid state relays which are driven by photo-electric sensors coupled to the mechanical position of the RF path's moving elements (See [Figure 4](#)). The circuitry consists of a common which can be connected to an output corresponding to either position A or position B. The solid state relays are configured for AC and/or DC operation. See [Table 5](#) for indicator specifications. The electronic position indicators require that the supply (+20 to +32 VDC) be connected to pin 1 but requires that pin 9 be grounded if pulse drive is used and continuous indicators operation is desired. If pin 9 is not grounded, the position indicators will function while the appropriate drive has ground applied.

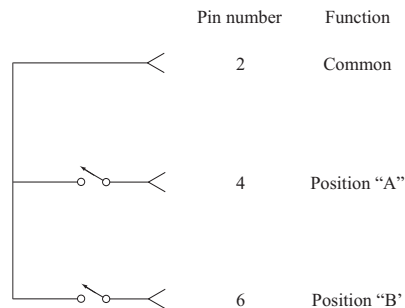


Figure 4 *Pin Function Diagram for Indicator*

Specifications

Specifications refer to the performance standards or limits against which the L7222C coaxial transfer switch 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 italics.

Table 4 General Specifications for L7222C Coaxial Transfer Switch

Agilent Model Number	L7222C
Maximum power rating	
Switching ¹	1W CW
Non-switching	50W Pk (not to exceed 1 W average)
Life	2 million cycles minimum
Switching Speed	15 ms

1. Hot switching. For cold switching, see supplement specifications on page 9.

Table 5 Indicator Specifications for L7222C Coaxial Transfer Switch

Agilent Model Number	L7222C
Maximum withstand voltage	60 V
Maximum current capacity	100 mA
Maximum "ON" resistance	50 Ω
Maximum "OFF" resistance	1 G Ω

Table 6 *RF Specifications for L7222C Coaxial Transfer Switch*

Agilent Model Number	L7222C
Frequency Range	DC to 26.5 GHz
Insertion Loss	0.2 dB + 0.025 x Freq (GHz)
Isolation	110 dB - 2.0 x Freq (GHz)
SWR	< 1.1 (DC to 2 GHz) < 1.15 (2 to 4 GHz) < 1.25 (4 to 12.4 GHz) < 1.40 (12.4 to 20 GHz) < 1.65 (20 to 26.5 GHz)
Repeatability	< 0.03 dB typical
Characteristics	50 Ω
Connectors	SMA (f)

Specifications

Table 7 Switch Drive Specifications for L7222C Coaxial Transfer Switch

	Min	Nominal	Max	Unit
Supply Voltage, Vcc	20	24	32	V
Supply Current, Icc		200 ¹		mA
Supply Current (quiescent)	25		50	mA

1. Switching: Pulse width > 15 ms: Vcc = 24 VDC

Table 8 TTL Drive Specifications for L7222C Coaxial Transfer Switch (Option T24)

	Min	Nominal	Max	Unit
High level input	3		7	V
Low level input			0.8	V
Max high input current ¹		1	1.4	mA

1. Vcc = Max, Vinput = 3.85 Vdc

Supplement Specifications (Cold Switching)

[Figure 5](#) illustrates the maximum incident CW power (cold switching) from 100 MHz to 18 GHz. The reference conditions are as below:

- Cold switching only (NO hot switching)
- Ambient temperature of 75°C or less
- Sea level (0.88 derating @15,000 feet)
- Low VSWR < 1.2 (See [Figure 6](#) for derating above 1.2 VSWR)

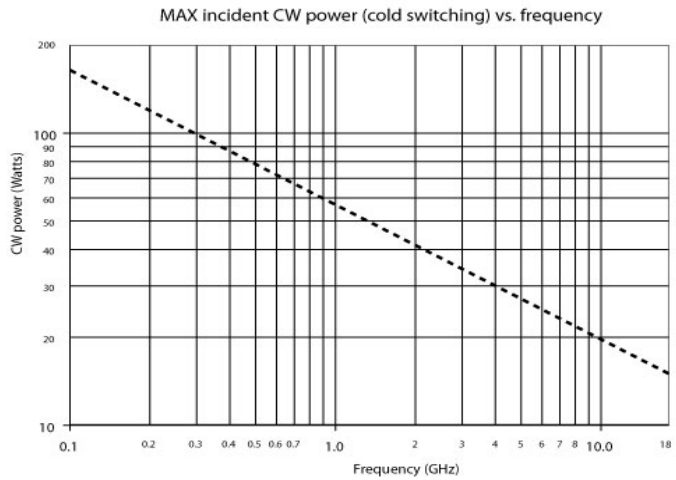


Figure 5 Maximum Incident Power (Cold Switching) vs. Frequency

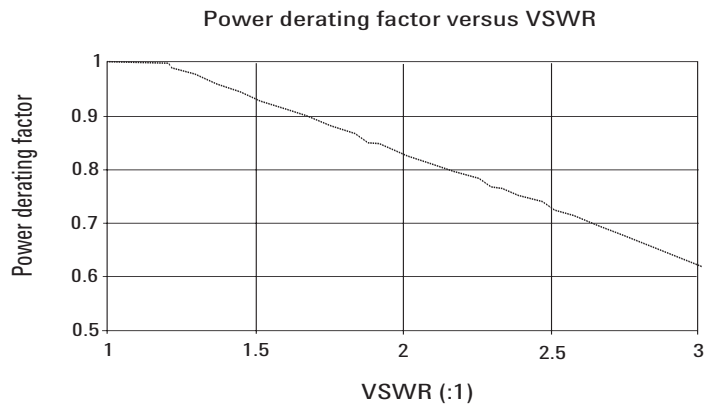


Figure 6 Power Derating Factor vs VSWR

Environmental Specifications

The L-series multiport coaxial switches are designed to fully comply with Agilent Technologies' product operating environmental specifications as shown in [Table 9](#).

Table 9 *L7222C Coaxial Transfer Switch Environmental Specifications*

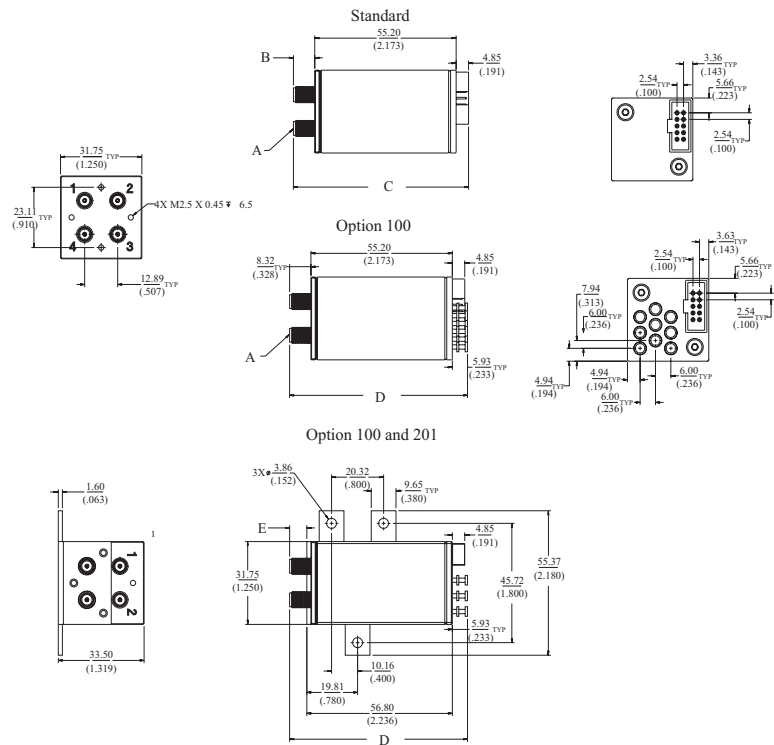
Temperature:	
Operating	-25°C to +75°C
Storage	-55°C to +85°C
Cycling	-55°C to +85°C, 10 cycles per MIL-STD-202F, Method 107D, Condition A (modified)
Humidity:	
Operating	95% RH at 65°C, 10 days per MIL-STD-202F, Method 106E
Shock:	
Half-sine	500 G @ 0.5 ms, 3 drops/direction, 18 total
Operating	50 G @ 6 ms, 18 total
Vibration:	
Operating	7 G rms, 5 to 2000 Hz at 0.25 in p-p
Survival	20 G rms, 20 to 2000 Hz at 0.06 in p-p, 4 min/cycle, 4 cycles/axis
Random	2.41 G rms, 10 minutes/axis
Altitude:	
Storage	<15,240 meters (50,000 feet) per MIL-STD-202F, Method 105C, Condition B
ESD Immunity:	
Direct discharge	4 kV (to outer conductor) per IEC 61000-4-2
Air discharge	8 kV (to center conductor) per IEC 61000-4-2
RFI:	
	Radiated Emission per CISPR 11

Physical Specifications

The physical specifications of L7222C coaxial transfer switch is illustrated in Table 10.

Table 10 L7222C Coaxial Transfer Switch Physical Specifications

Dimensions	Per Figure 7
Net weight, kg (lb)	0.1 (0.23)



Note: Dimensions are in millimeters and (inches) nominal unless specified.

L7222C	A	B	C	D	E
(millimeter)		8.32 (0.328)	68.37 (2.692)	69.46 (2.735)	6.72 (0.265)
(inches)	SMA (f)	TYP	REF	REF	REF

Figure 7 Dimensions of L7222C Coaxial Transfer Switch

Installation

- Initial Inspection**
1. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been 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” or “Performance Tests”.
 2. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, contact the nearest Agilent Technologies Sales and Service office. Refer to the Service and Support information in the front matter of this manual. Agilent 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 materials or their equivalents. Agilent Technologies can provide packaging materials identical to the original materials. Refer to Service and Support information in the front matter of this manual for the Agilent Technologies nearest 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 Instruction

Operator's Check

The operator's check is supplied to allow the operator to make a quick check of the coaxial transfer switch prior to use or if a failure is suspected.

CAUTION

ESD exceeding the level specified in [Table 9](#) or RF power applied is greater than the maximum specified as in [Table 4](#) may cause permanent damage to the device.

Description

The coaxial transfer switch is connected to a network analyzer configured for the s-parameter measurement. The network analyzer may be set to sweep over the whole or selected frequency range of the switch to be verified. The s-parameters measurement is the best way to determine if the switch is working properly.

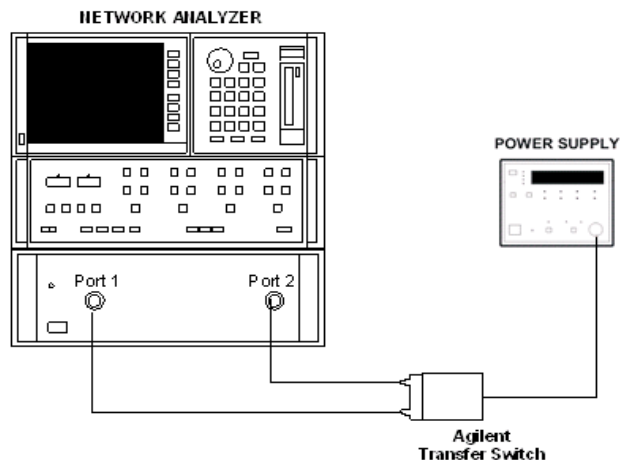


Figure 8 Connection to Perform Quick Check

Operating Instruction

Quick-Check Procedure

1. Connect Port 1 and Port 2 of the network analyzer to switch's Port 1 and Port 2 respectively.
2. Referring to [Table 2](#) (standard drive) or [Table 3](#) (TTL drive), apply appropriate drive voltage to ensure switch is in position A (path 1 connected to path 2, path 3 connected to path 4). Measure S_{11} , S_{21} and S_{22} and verify against specifications in [Table 6](#).
3. Now, still in position A, disconnect switch's Port 1 and Port 2 from network analyzer. Then, connect network analyzer's Port 1 and Port 2 to Port 3 and Port 4 of the switch. Measure S_{11} , S_{21} and S_{22} and verify against specifications in [Table 6](#).
4. Disconnect Port 3 and Port 4 from network analyzer. Connect Port 1 and Port 2 of the network analyzer to switch's Port 1 and Port 4 respectively.
5. Referring to [Table 2](#) (standard drive) or [Table 3](#) (TTL drive), apply appropriate drive voltage to ensure switch is in position B (path 1 connected to path 4, path 2 connected to path 3). Measure S_{11} , S_{21} and S_{22} and verify against specifications in [Table 6](#).
6. Now, still in position B, disconnect switch's Port 1 and Port 2 from network analyzer. Then, connect network analyzer's Port 1 and Port 2 to Port 2 and Port 3 of the switch. Measure S_{11} , S_{21} and S_{22} and verify against specifications in [Table 6](#).

Performance Tests

The coaxial transfer switch 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 instrument using the procedure in the analyzer's operating manual.

Service Instructions

Adjustment

The coaxial transfer switch do not have internal adjustments and should not be opened.

Repair

The L7222C coaxial transfer switch is not recommended for repair as most components are not easily removed.

Maintenance

The connectors, particularly the connector faces, must be kept clean. For instruction on connecting and care of your connectors, refer to the Microwave Connector Care Quick Reference Card (08510-90360).

Service Instructions