

Keysight N1810/1/2 Low PIM Coaxial Switch

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Contents

1	Introduction	7
	General Information	8
	Key Features	9
2	Switch Configuration	11
	Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)	12
	TTL Drive Specifications	12
	Driving the Switch	13
	N1810U	14
	N1810T	14
	N1811T	15
	N1812U	15
3	Specifications	17
	Specifications	18
	General operating data	18
	RF specifications — N1810/1/2 Series (Frequency Options 004/020/026)	18
	Supplemental Characteristics	20
	General operating characteristics — N181x series	20
	Environmental Specifications	21
	Physical Specifications	22

Contents

4	Installation and Verification	27
	Installation	28
	Initial inspection	28
	Operating and Service Instruction	29
	Operator's check	29
	Performance test	30
	Service instructions	30
	Troubleshooting Guide	31

Keysight N1810/1/2 Low PIM Coaxial Switch Operating and Service Manual

1 Introduction

General Information 8

Key Features 9

This chapter provides an overview of the Keysight N1810/1/2 Low PIM Coaxial Switch.

General Information

The Keysight N1810/1/2 low PIM coaxial switch is designed with a rectangular coaxial structure similar to edge-line. This transmission line structure provides for movement of the edge-line center conductor between two fixed, continuous ground planes. The main advantage of this innovation is that the moving contacts can be easily activated, yet maintain high-isolation and low-insertion loss.

The RF contact configuration is designed for controlled wiping action. Since the outer conductor is not part of the switching function, repeatability and life are improved. The switching action occurs typically within 15 milliseconds, after which permanent magnets latch the contacts to retain the new switch position.



Figure 1-1 Keysight N1810/1/2 Low PIM Coaxial Switch

The N181x switch is “break before make”, the switched ports are not connected to each other. This prevents damage to sensitive circuits and enhances test simplicity.

There are two positions for the N181x family of switches. Standard switching is accomplished by applying the supply voltage to pin 5 (+V) and grounding either pin 4 (A) or pin 3 (B) to actuate the mechanism to the desired state. See [“Physical Specifications” on page 22](#).

WARNING

Minimum switch spacing is 6.0 mm (0.25 inch).

The N181x comes with current interrupt, the drive current is automatically disconnected after the switch is fully latched (15 ms).

Key Features

- High repeatability: <0.03 dB guaranteed up to 26.5 GHz up to 2 million cycles
- High isolation: >95 dB at 2 GHz
- Low SWR: <1.15 at 4 GHz
- Low-insertion loss: <0.42 dB at 4 GHz
- PIM level (typical): -165 dBc

1 Introduction

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2 Switch Configuration

Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U) 12

TTL Drive Specifications 12

Driving the Switch 13

N1810U 14

N1810T 14

N1811T 15

N1812U 15

This chapter provides you information on driving the switch and the configuration to utilize the function of the position indicators.

2 Switch Configuration

Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)

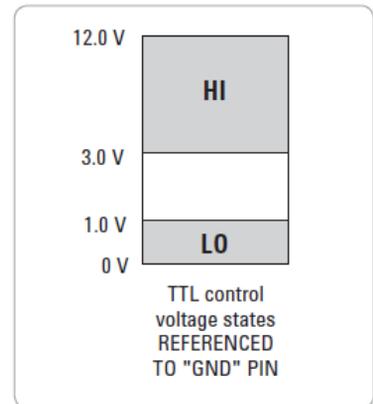
Option	Parameter	Condition	Min	Nominal	Max	Unit
105	Supply voltage		4.5	5	7.0	V
	Supply current	Supply voltage = 5 V		600		mA
115 ^[1]	Supply voltage		12.0	15	20.0	V
	Supply current	Supply voltage = 15 V		250		mA
124 ^[2]	Supply voltage		20.0	24	32.0	V
	Supply current	Supply voltage = 24 V		150		mA

[1] Option 115: Characteristic life: 2 million cycles minimum, less than 2 million cycles when driven at voltages 18 - 20 VDC.

[2] Option 124: Characteristic life: 2 million cycles minimum, less than 2 million cycles when driven at voltages 28 - 32 VDC.

TTL Drive Specifications

Option	Parameter	Condition	Min	Nominal	Max	Unit	
401	High level input		3.0		12.0	V	
	Low level input		0.0		1.0	V	
	Max input current	Input voltage = 12.0 V				1.0	mA
		Input voltage = 3.85 V		0.25	0.5		mA



Driving the Switch

WARNING

- [1] Use adapter cable 11764-60011 with 87130A switch driver.
- [2] Drive level below -0.25 V will damage the TTL drive circuit.
- [3] Driving both select lines will disable the switch (see **“Troubleshooting Guide” on page 31**).
- [4] Minimum switch spacing is 6.0 mm (0.25 inch).

STD drive connect GND to ground		TTL drive connect GND to ground		RF state	INDICATOR state
A	B	A	B		
GND	OPEN	Hi	Lo	“A”	“A”
OPEN	GND	Lo	Hi	“B”	“B”
GND	GND	Hi	Hi	Switching disabled (see Warning [3] above)	NA
OPEN	OPEN	Lo	Lo	Switch remains at previous state	NA

GND: +V –V supply (see **“Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)” on page 12**)

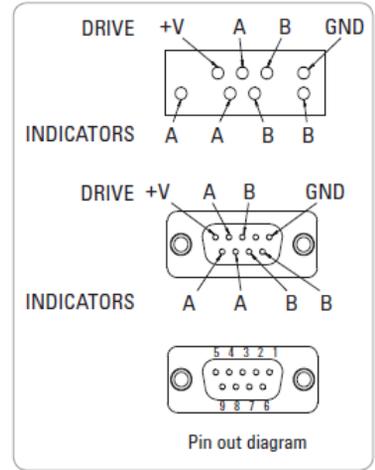
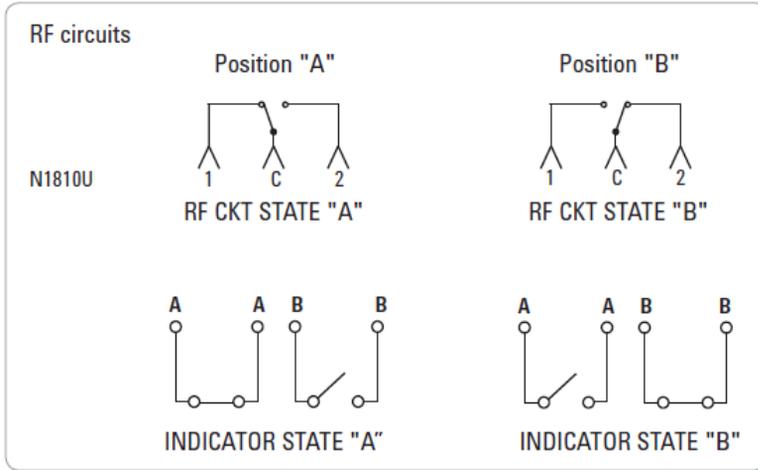
OPEN (see Warning [1] above): +V to +V – 1.5 V

Hi: 3.0 V to 12.0 V

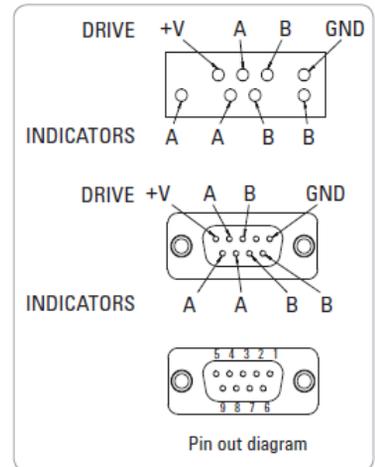
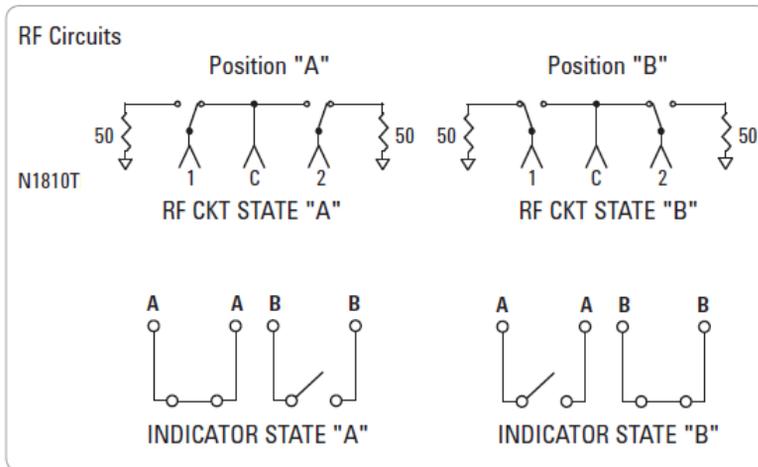
Lo: 0.0 V to 1.0 V (see Warning [2] above)

2 Switch Configuration

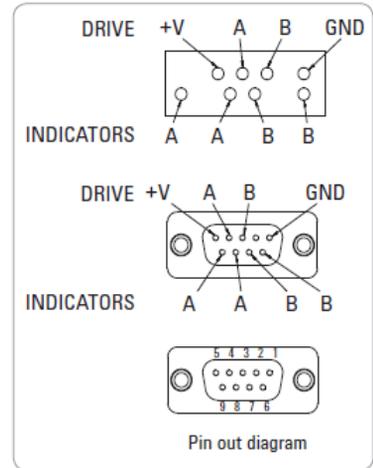
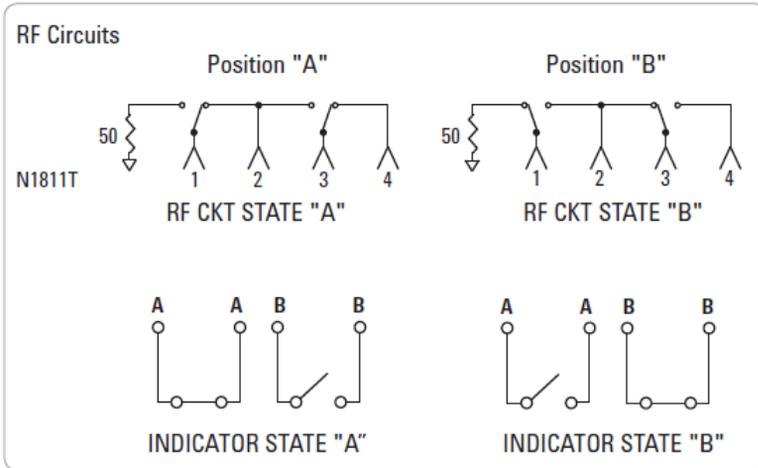
N1810U



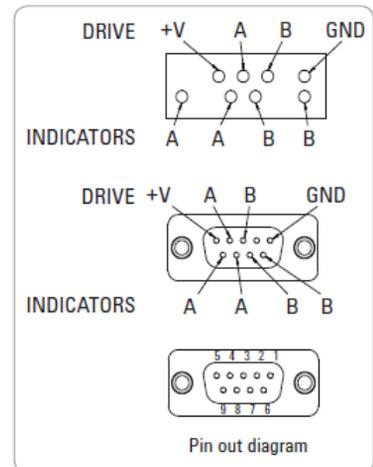
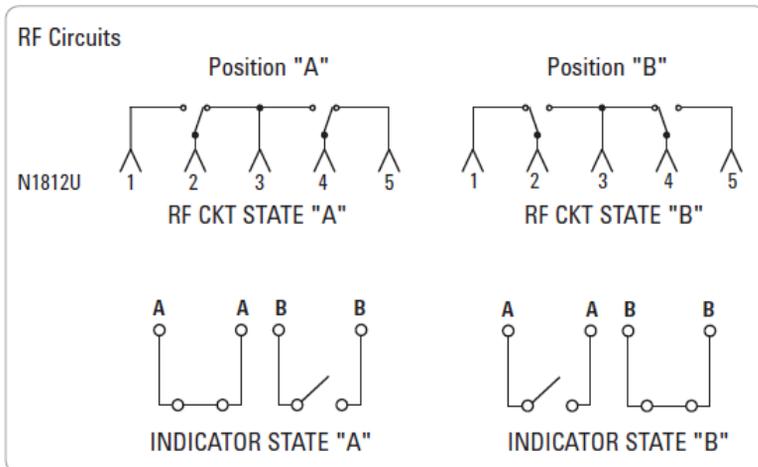
N1810T



N1811T



N1812U



2 Switch Configuration

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3 Specifications

Specifications 18

General operating data 18

RF specifications — N1810/1/2 Series (Frequency Options
004/020/026) 18

Supplemental Characteristics 20

General operating characteristics — N181x series 20

Environmental Specifications 21

Physical Specifications 22

This chapter provides the specifications of the switch.

Specifications describe the warranted performance of the switch.

Supplemental and typical characteristics are intended to provide information useful in applying the switch by giving typical, but not warranted performance parameters.

Specifications

Specifications refer to the performance standards or limits against which the 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.

General operating data

Parameter	Specification
Maximum power rating	
Into interal termination	1 W CW, 7 VDC, 50 W pk, 10 μs max pulse duration, not to exceed 1 W average
Into thru path	
Hot switching	2 W CW, 10 VDC, 100 W pk, 10 μs max pulse duration, not to exceed 2 W average
Cold switching	150 W CW at 3 GHz, 25 °C 120 W CW at 4.2 GHz, 25 °C
Coil voltage	5, 15, 24 VDC
Connector	SMA (f)

RF specifications — N1810/1/2 Series (Frequency Options 004/020/026)

$$\text{Isolation (dB)} = 90 \text{ dB} - \left(\frac{30}{26.5}\right) F, \text{ where } F \text{ is specified in GHz}$$

DC	4 GHz	12.4 GHz	20 GHz	26.5 GHz
90	85.47	75.96	67.36	60

Insertion loss (dB) = $0.35 + \left(\frac{0.45}{26.5}\right) F$, where F is specified in GHz

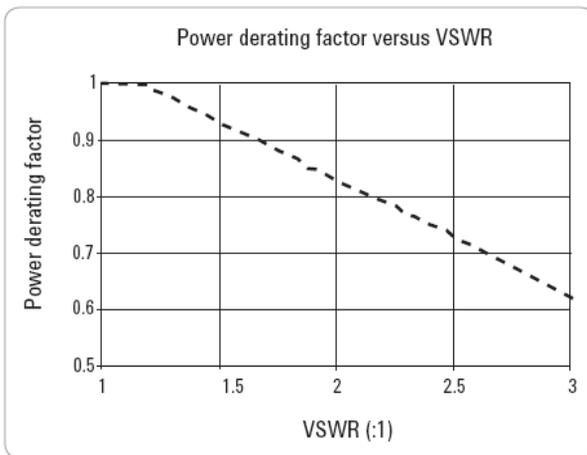
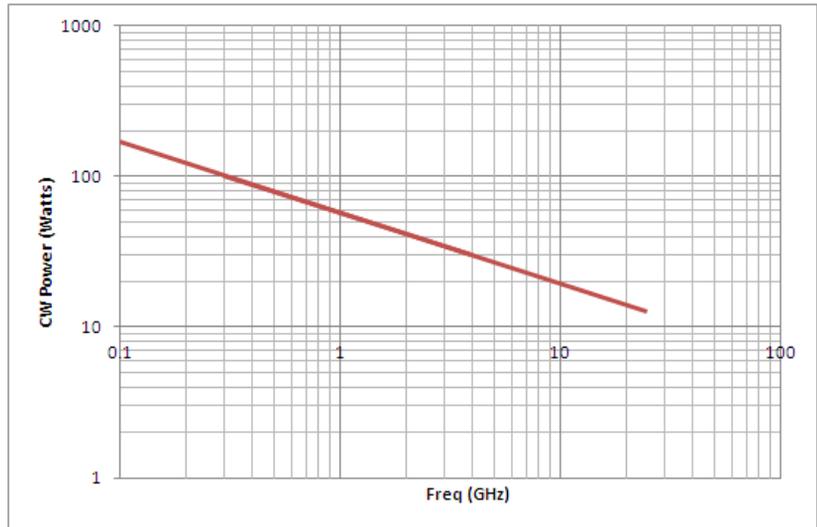
	DC	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	0.35	0.42	0.56	0.69	0.80

SWR	DC-4 GHz	4-12.4 GHz	12.4-20 GHz	20-26.5 GHz
	1.15	1.25	1.30	1.60

Supplemental Characteristics

General operating characteristics — N181x series

MAX incident CW power (cold switching) vs. frequency



Reference conditions:

- Cold switching only (NO hot switching)
- Ambient temperature of 75 °C or less
- Sea level (0.88 derating at 15000 ft.)
- Load VSWR < 1.2 (see graph for derating above 1.2 VSWR)

Environmental Specifications

The switch is designed to fully comply with Keysight's product operating environmental specifications.

Parameter	Specification
Temperature ^[1]	
• Operating	–25 °C to 75 °C
• Storage	–55 °C to 85 °C
• Cycling	–50 °C to 150 °C, 10 cycles
Humidity	
• Operating	40 °C/95% RH, 5 days
• Storage	65 °C/90% RH, 24 hours
• Condensation	40 °C/95% RH
Shock	
• Non-operating:	
• Half-sine	500 G at 0.5 ms, 3 drops/direction
• Transportation	50 G Vibration: 8 m/s ±10%
• Operating	50 G at 6 ms, 6 directions
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	7 G rms, 50 to 2000 Hz, 15 min/axis
ESD immunity	
• Direct discharge	6 kV (to outer conductor)
• Air discharge	15 kV (to outer conductor)
RFI	Radiated emission per CISPR 11
Magnetic field	
• Operating emission	AC magnetic emission (1.88 G rms) DC magnetic emission (5 G)
• Operating immunity	30 A/M rms at 47 Hz, 50 Hz, 60 Hz, and 189 Hz 150 A/M rms at 47 Hz and 189 Hz

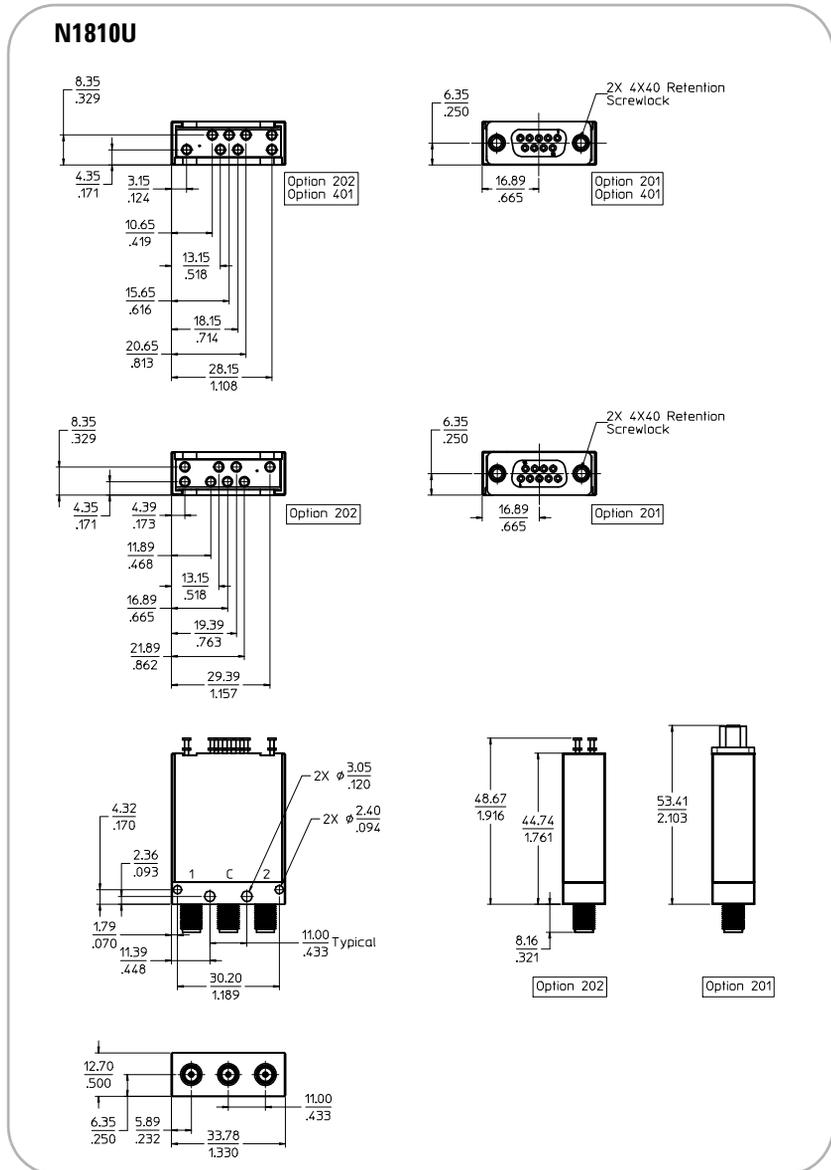
[1] For Option 105, the environmental operating temperature range is –5 °C to +75 °C.

For Option 115, the environmental operating temperature range is –15 °C to +75 °C.

Physical Specifications

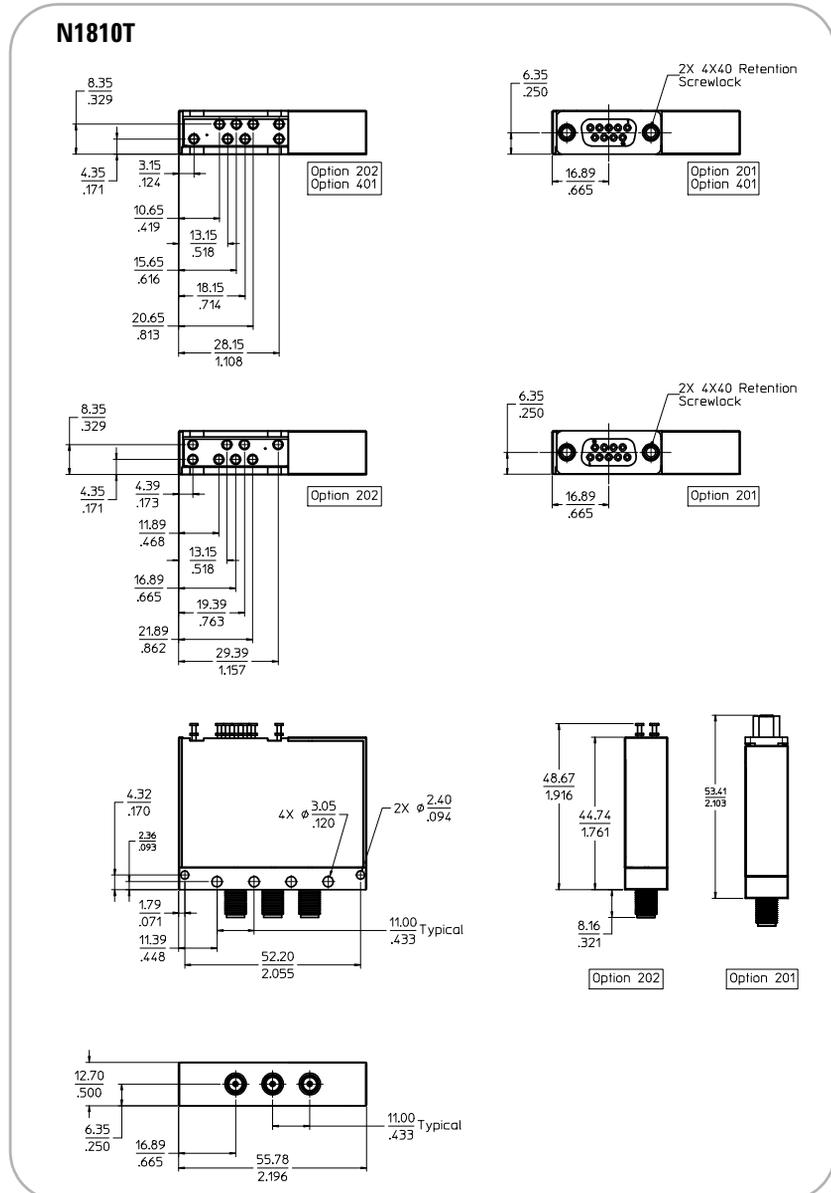
Parameter	Specification
Net weight, kg (lb)	0.0600 (0.13)

Dimensions in millimeters and /inches



Parameter	Specification
Net weight, kg (lb)	0.100 (0.22)

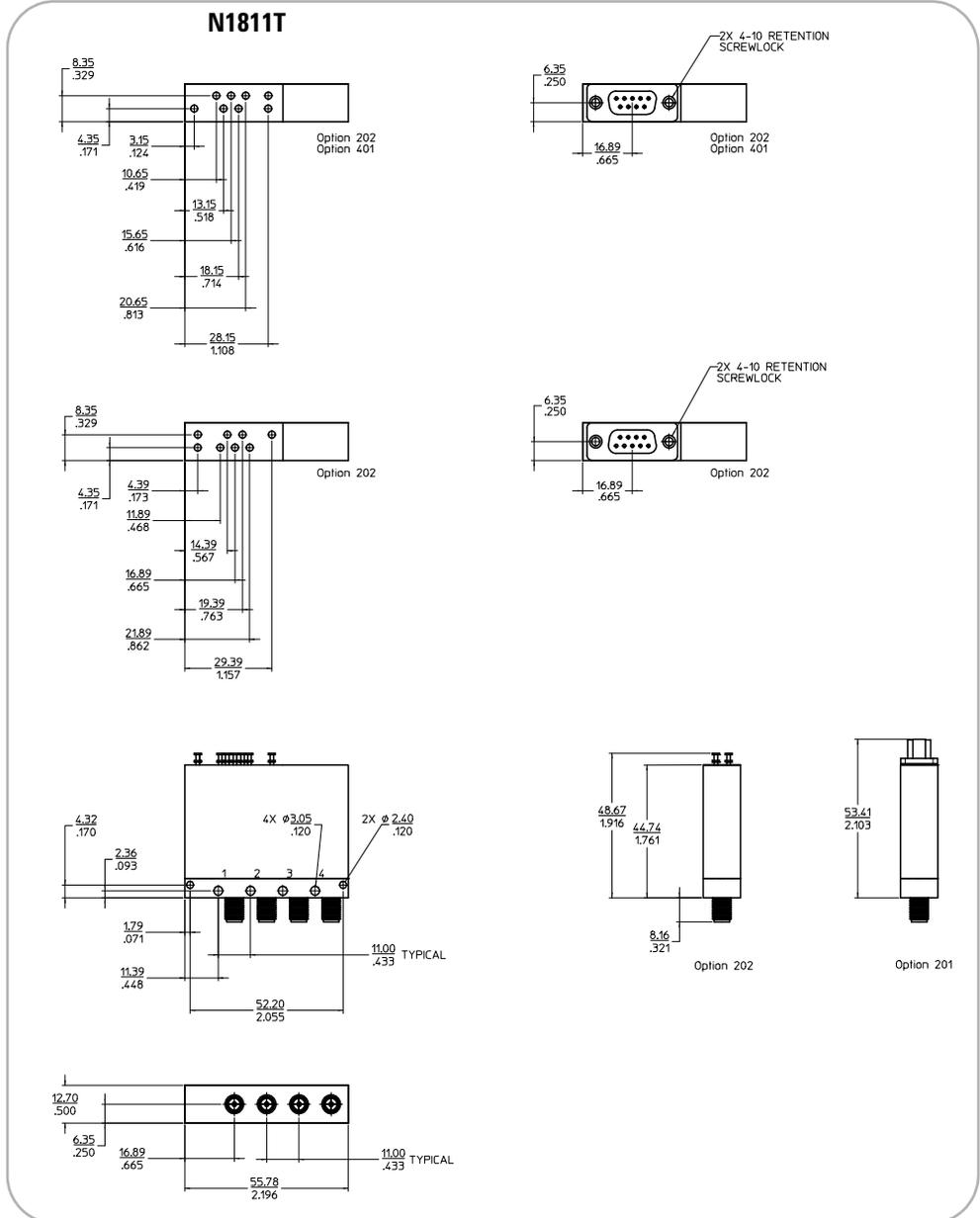
Dimensions in millimeters and /inches



3 Specifications

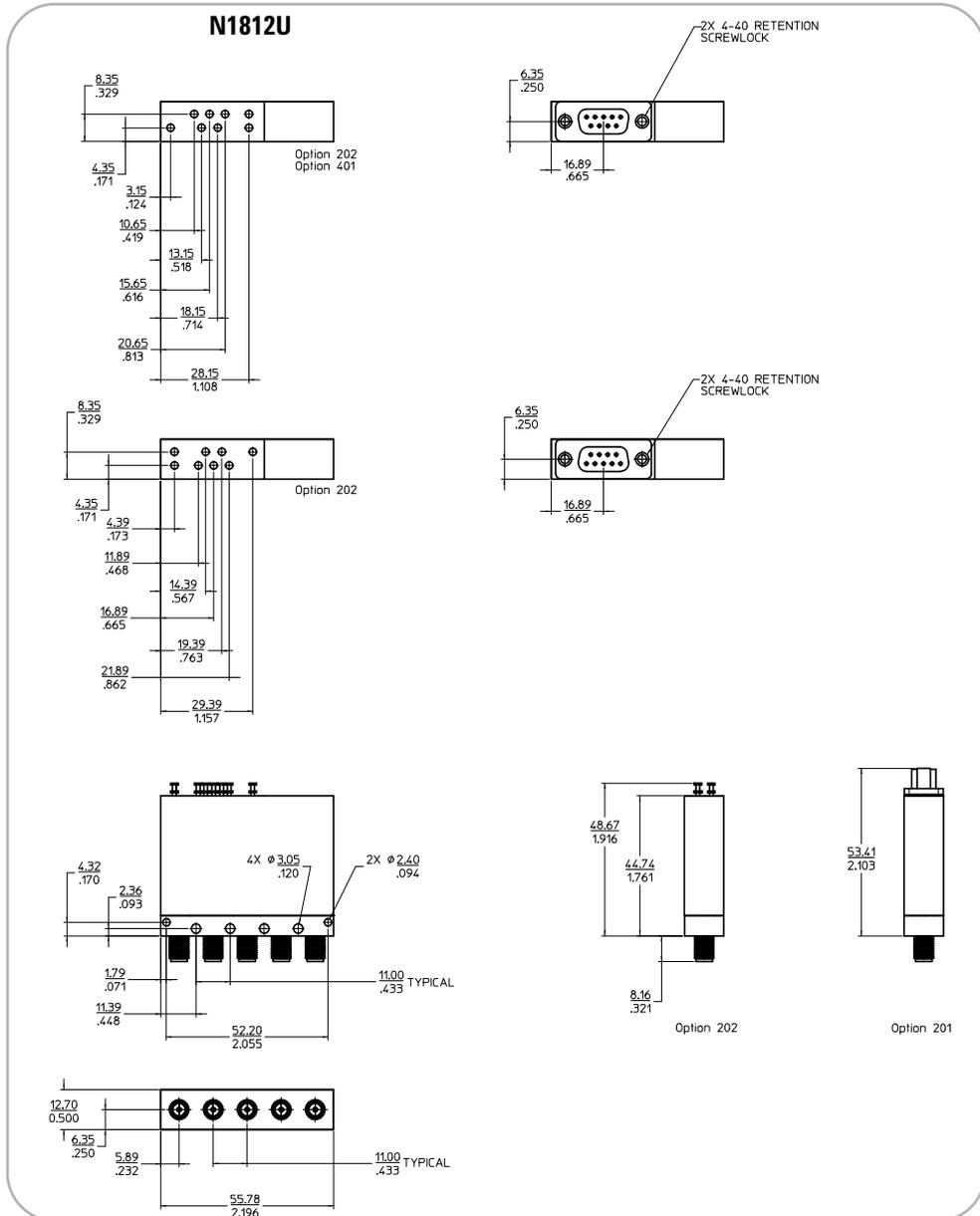
Parameter	Specification
Net weight, kg (lb)	0.100 (0.22)

Dimensions in millimeters and /inches



Parameter	Specification
Net weight, kg (lb)	0.100 (0.22)

Dimensions in millimeters and /inches



3 Specifications

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4 Installation and Verification

Installation	28
Initial inspection	28
Operating and Service Instruction	29
Operator's check	29
Performance test	30
Service instructions	30
Troubleshooting Guide	31

This chapter provides you installation information and simple verification steps of the 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” on page 29 or “Performance test” on page 30.
- 2 If the contents are incomplete, there is mechanical damage or defect, or the instrument does not pass the electrical performance test, contact the nearest Keysight Sales and Service office (refer to “Contacting Keysight” on page 4). Keysight 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. Keysight can provide packaging materials identical to the original materials. Refer to “Contacting Keysight” on page 4 for the Keysight office nearest to 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 its model number and serial number.

Operating and Service Instruction

Operator's check

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

CAUTION

ESD exceeding the level specified in “**Environmental Specifications**” or RF power applied is greater than the maximum specified as in “**Specifications**” may cause permanent damage to the device.

Description

The N181x series coaxial 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-parameter measurement is the best way to determine if the switch is working properly.

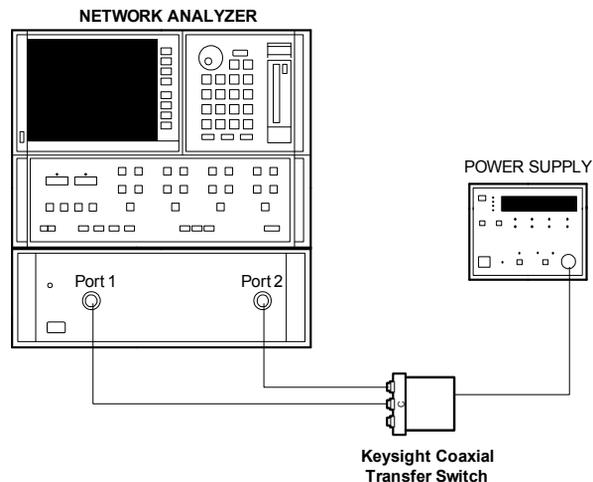


Figure 4-1 Connection to perform quick check

Quick check procedure

- 1 Connect the common port of the switch to Port 1 of the network analyzer and one of the outer RF ports to Port 2 of the network analyzer as illustrated in [Figure 4-1](#).
- 2 For standard drive, apply ground to the corresponding “drive” pin to close the selected path. Refer to [“Driving the Switch” on page 13](#).
- 3 For TTL drive (option T24), apply “High” to the corresponding “drive” pin to close the selected path. Refer to [“Driving the Switch” on page 13](#).
- 4 Perform the S-parameter measurement and verify against [“Supplemental Characteristics” on page 20](#).
- 5 Repeat steps 1 to 4 until all paths are measured and verified.

Performance test

The coaxial 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 and repair

Keysight N1810/1/2 low PIM coaxial switch does not require internal adjustments and is not recommended for repair.

NOTE

If any of the low PIM coaxial switches fails within the warranty period, a new unit will be replaced.

Maintenance

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

Troubleshooting Guide

Probable cause	Test	Allowable range		Remedy
		Low value	High value	
Not connected to supply		See "Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)" on page 12		Connect +V to power supply
Supply not turned on				Turn on power supply
Supply voltage less than minimum	Measure voltage from control pin to +V	See "Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)" on page 12		
Supply current low	Measure current draw with drive pin selected	See "Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)" on page 12		Increase drive voltage or reduce drive line resistance
OPEN state voltage too low	Measure voltage from control pin to +V	(+V–1.5) volts		+V volts
Select lines not at ground (STD DRIVE)	Measure voltage from drive select pin to ground			Eliminate ground loops and lead high resistance
TTL "LOW" voltage too high	Measure voltage from ground pin to TTL drive pin	See "Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)" on page 12		Connect ground pin to ground
TTL "LOW" voltage < 0.0 V	Measure voltage from ground pin to TTL drive pin	See "Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)" on page 12		Eliminate ground loops
TTL GND pin not grounded				Connect GND pin to ground
Driving switch with 87130A				Use adapter cable 11764-60011

4 Installation and Verification

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