Keysight N1810/1/2 Low PIM Coaxial Switch

Operating and Service Manual

KEYSIGHT TECHNOLOGIES

Notices

Copyright Notice

Manual Part Number

N1810-80002

Edition

Edition 3, March 14, 2019

Printed in:

Printed in Malaysia

Published by:

Keysight Technologies
Bayan Lepas Free Industrial Zone,
11900 Penang, Malaysia

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Declaration of Conformity

Declarations of Conformity for this product and for other Keysight products may be downloaded from the Web. Go to http://www.keysight.com/go/conformity. You can then search by product number to find the latest Declaration of Conformity.

U.S. Government Rights

The Software is “commercial computer software,” as defined by Federal Acquisition Regulation (“FAR”) 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement (“DFARS”) 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at http://www.keysight.com/find/sweula. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED “AS IS,” AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR OF ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT SHALL CONTROL.

Safety Information

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Waste Electrical and Electronic Equipment Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/lowPIM
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

This page is intentionally left blank

Table of Contents

1 Introduction

This chapter provides an overview of the Keysight N181x Coaxial Switch.

General Information

The Keysight N181x 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 N181x 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

2 Switch Configuration

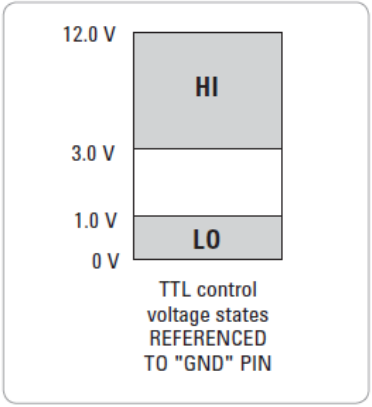
This chapter provides you information on driving the switch and the configuration to utilize the function of the position indicators.

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

Option	Parameter	Condition	Min	Nominal	Max	Unit
105	Supply voltage Supply current	Supply voltage = 5 V	4.5	5 600	7.0	V mA
115[1]	Supply voltage Supply current	Supply voltage = 15 V	12.0	15 250	20.0	V mA
124[2]	Supply voltage Supply current	Supply voltage = 24 V	20.0	24 150	32.0	V 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				12.0	V
	Low level input		3.0		1.0	V
	Max input current	Input voltage = 12.0 V	0.0		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

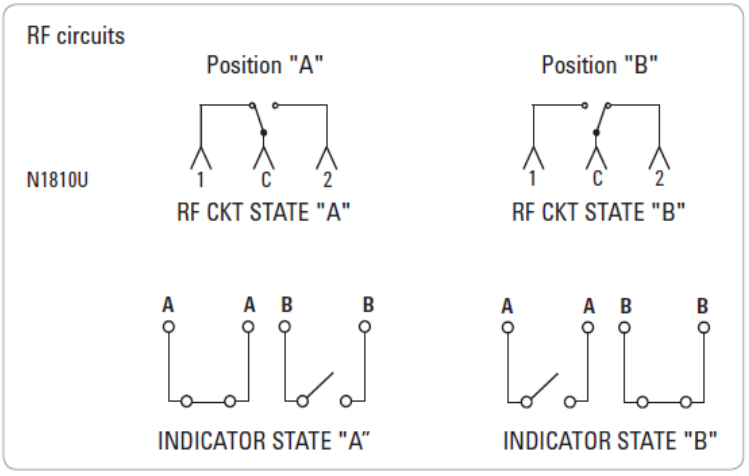
GND: +V –V supply (see "Switch Drive Specifications (N1810T, N1810U, N1811T, N1812U)" on page 12)

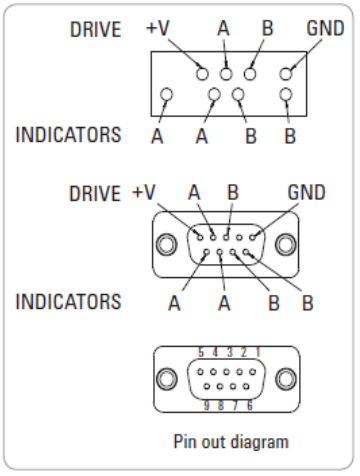
OPEN (see Warning [1] above): +V to +V – 1.5 V

Hi: 3.0 V to 12.0 V

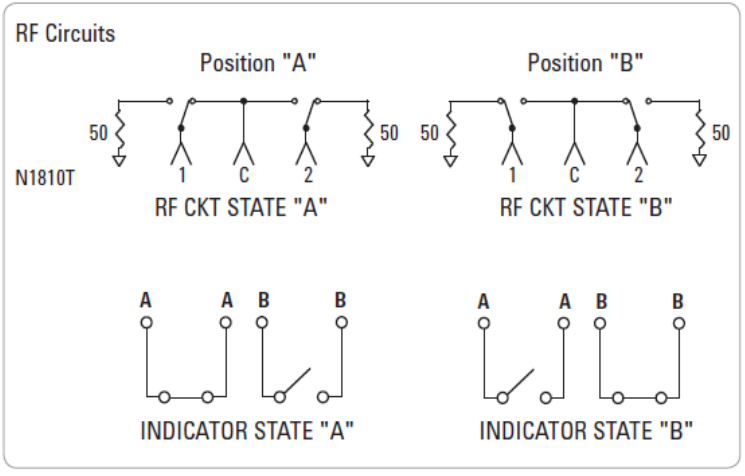
Lo: 0.0 V to 1.0 V (see Warning [2] above)

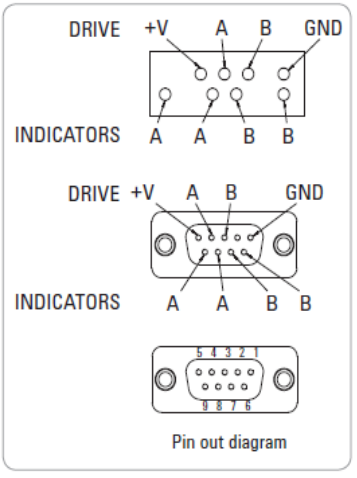
N1810U



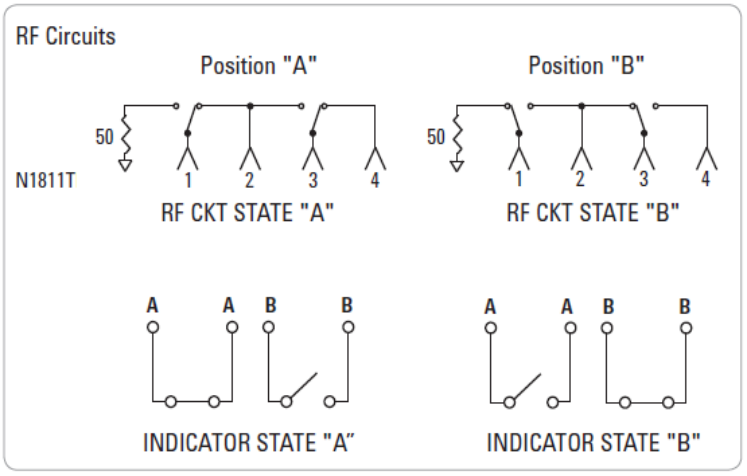


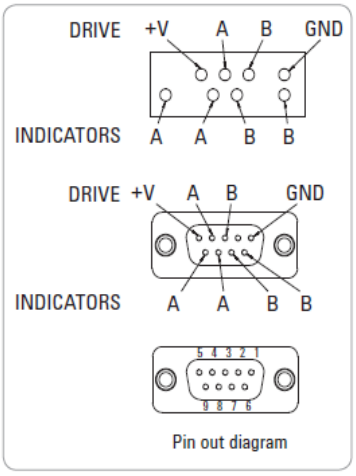
N1810T



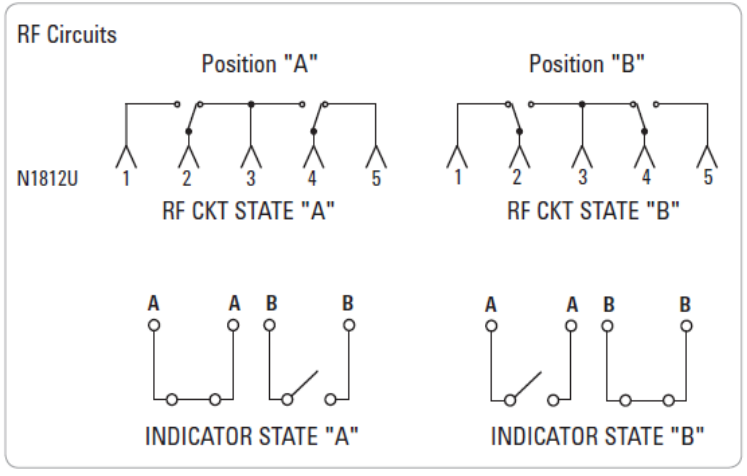


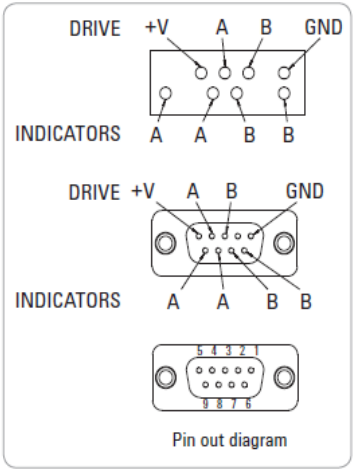
N1811T





N1812U





3 Specifications

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 internal termination – Into thru path – Hot switching – Cold switching	1 W CW, 7 VDC, 50 W pk, 10 μs max pulse duration, not to exceed 1 W average 2 W CW, 10 VDC, 100 W pk, 10 μs max pulse duration, not to exceed 2 W average 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)

Isolation (dB) = 90 dB – $\left(\frac{30}{26.5}\right)$F , where F 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

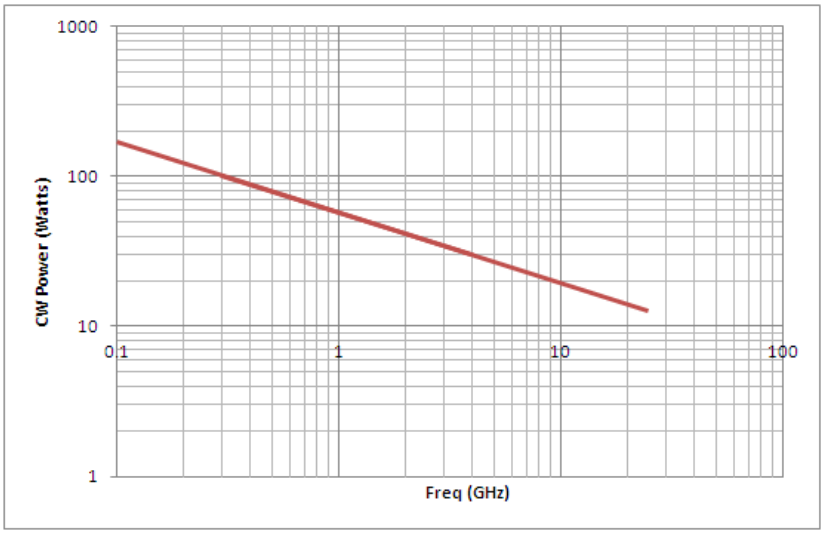
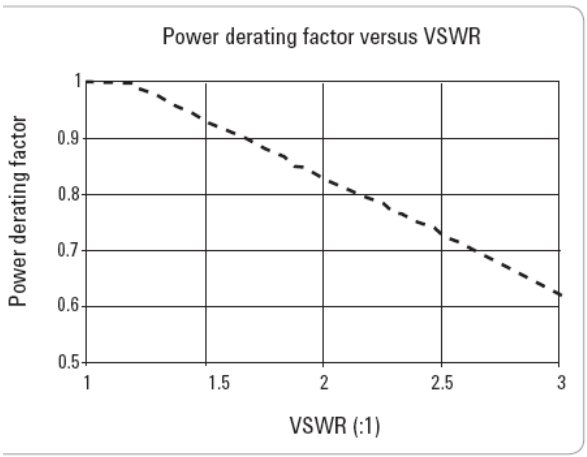


Figure 3-3 MAX Incident CW Power (Cold Switching) vs. Frequency



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

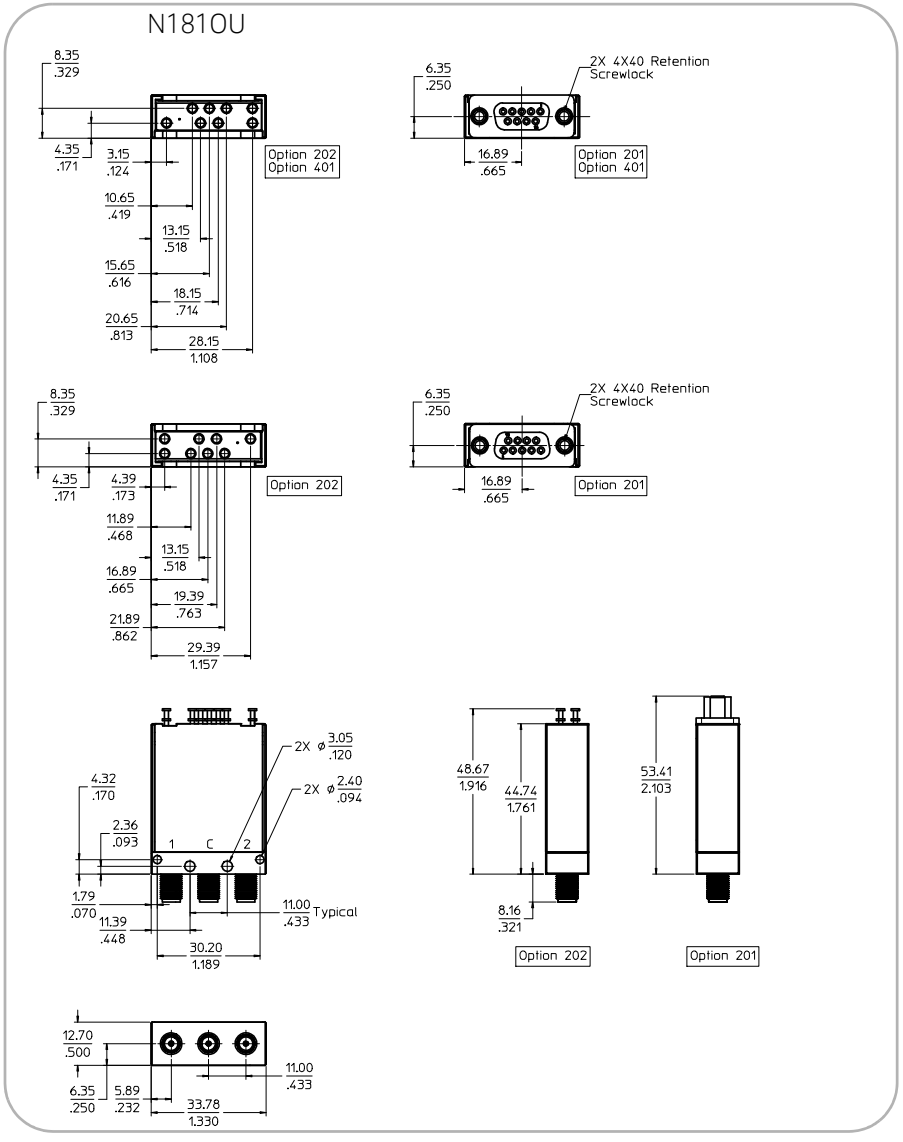
[1] For Option 105, the environmental operating temperature range is –5 °C to +75 °C.

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

Physical Specifications

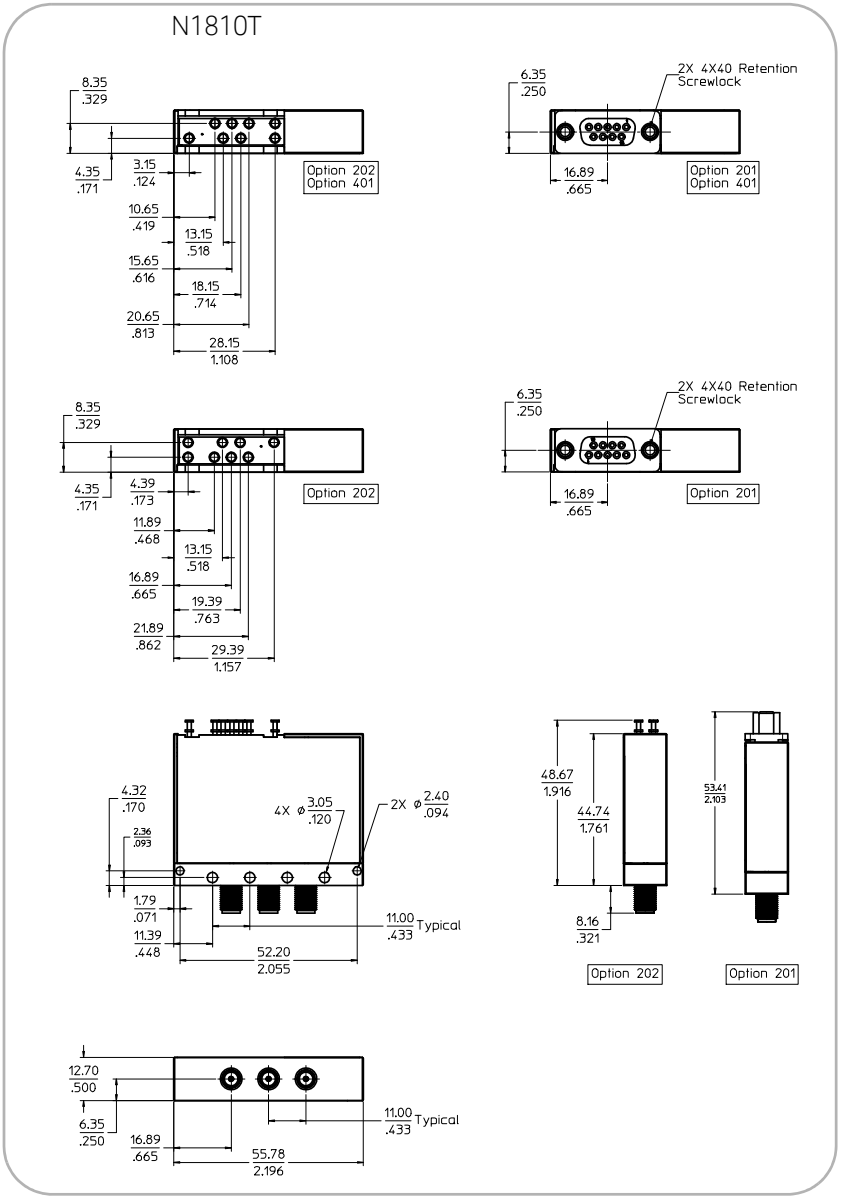
Parameter	Specification
Net weight, kg (lb)	0.0600 (0.13)

Dimensions in millimeters and /inches



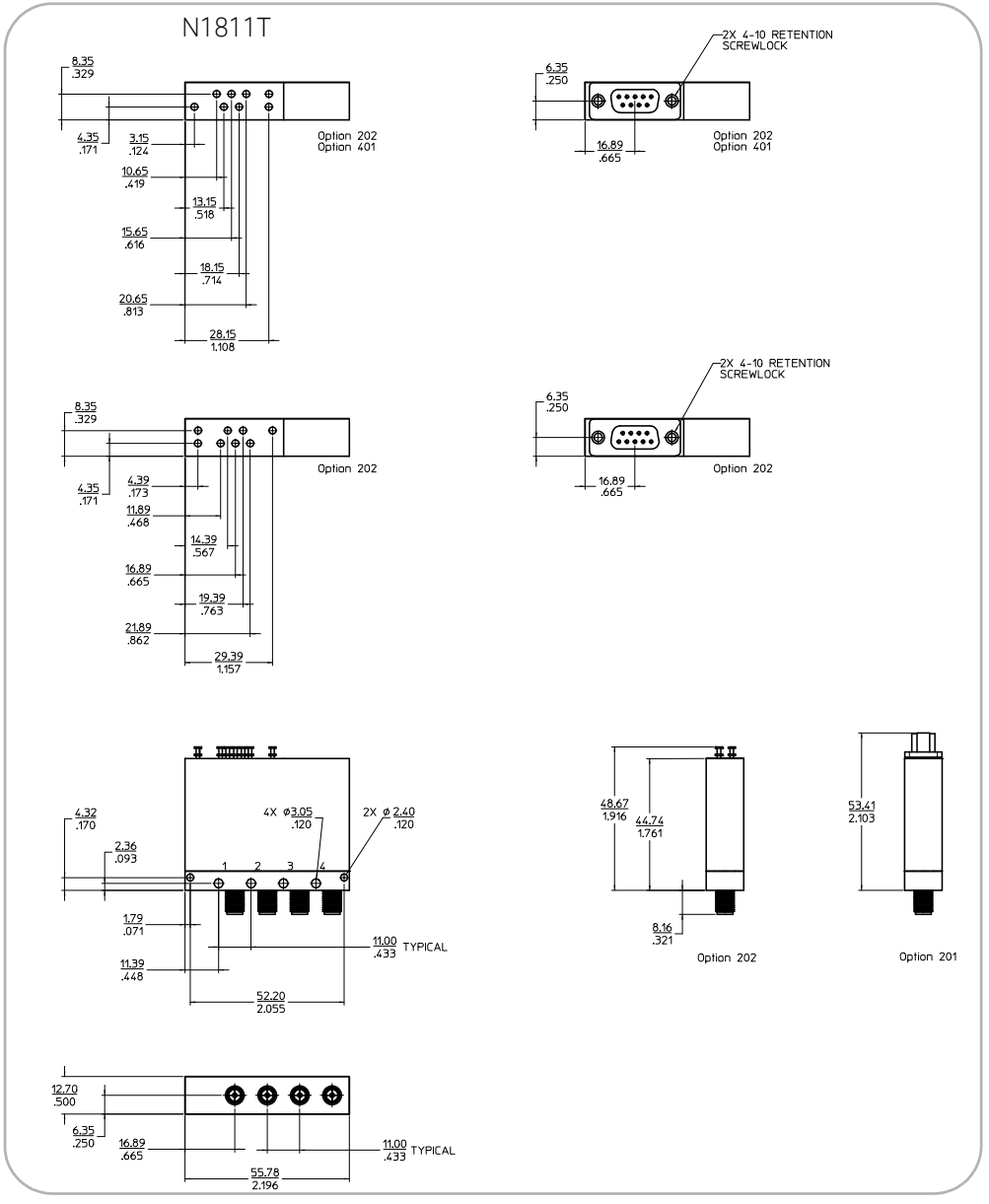
Parameter	Specification
Net weight, kg (lb)	0.100 (0.22)

Dimensions in millimeters and /inches



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

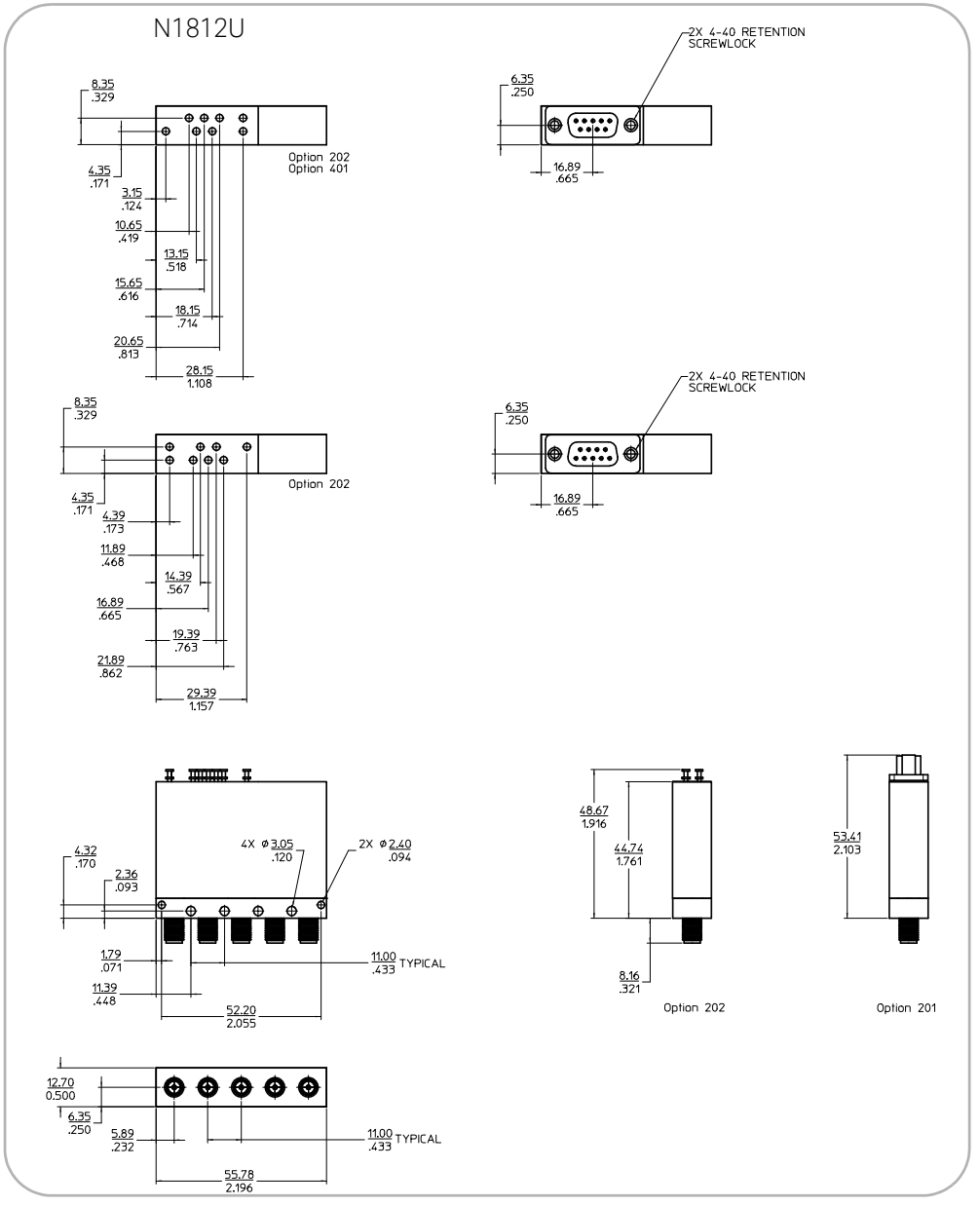
Dimensions in millimeters and /inches



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

Dimensions in millimeters and /inches

N1812U



This page is intentionally left blank

4 Installation and Verification

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 "Sales and Technical Support" on page 3). 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 "Sales and Technical Support" on page 3 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.

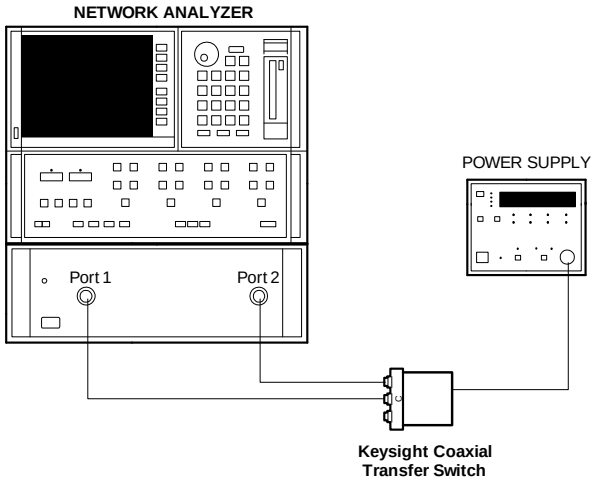


Figure 4-4 Connection to perform Quick Check

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 4-4.
2. For standard drive, apply ground to the corresponding “drive” pin to close the selected path. Refer to “TTL Drive Specifications” on page 13.
3. For TTL drive (option T24), apply “High” to the corresponding “drive” pin to close the selected path. Refer to “TTL Drive Specifications” 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 N181x 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

This page is intentionally left blank

Edition 3, March 14, 2019

Printed in Malaysia

N1810-80002

www.keysight.com