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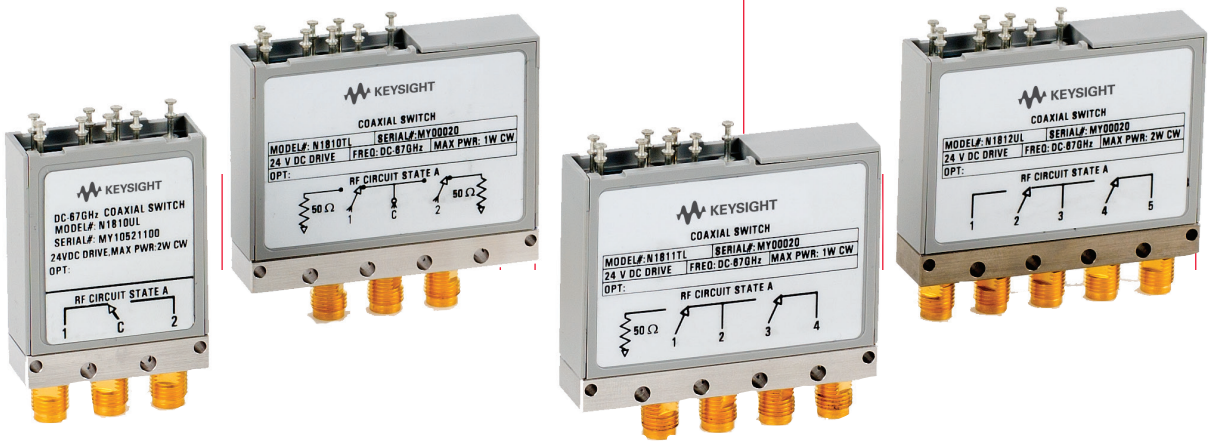
Find the *Keysight / Agilent N1810TL* at our website: ***Click HERE***

Keysight Technologies

N1810/1/2 Coaxial Switches

High Performance Electromechanical Switches for Microwave and RF Manufacturing Test Systems

Technical Overview



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

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Introduction

Key Features

- Insertion loss repeatability: < 0.03 dB up to 40 GHz and <0.08 at 67 GHz up to 5 million cycles
- High isolation: > 120 dB at 4 GHz and > 70 dB at 67 GHz
- Low SWR: < 1.10 at 4 GHz and < 1.90 at 67 GHz
- Low-insertion loss: < 0.27 dB at 4 GHz and < 1.12 at 67 GHz
- Long life: 5 million cycles, 10 million cycles typical

Key Applications

- Radar and satellite testing
- Wireless W-HDMI device testing
- Microwave backhaul applications
  - DC to 4 GHz
  - DC to 20 GHz
  - DC to 26.5 GHz
  - DC to 40 GHz
  - DC to 50 GHz
  - DC to 67 GHz

In today's fast moving technical industries, test engineers need components they can count on. Keysight Technologies, Inc. offers a line of latching coaxial switches that combine legendary reliability with the widest range of performance options available today.

Reduce downtime

Keysight Technologies is the world leader in innovating and developing microwave accessories for communications and aerospace applications. Our innovative design and strict adherence to quality process control ensure that each switch is guaranteed to perform within warranted specifications for its entire lifetime. With fewer breakdowns and less need to recalibrate, your test system moves quicker with less downtime, creating more throughput and revenue.

Raise your standards

All Keysight switches offer excellent repeatability and long life — up to five times the lifecycles of the competition. Add to this aggressive specs for isolation, SWR, and insertion loss, and you have a switch that impresses even the most demanding engineer with its precision and durability.

Increase flexibility

For test systems that require extra functionality or increased performance, the N181x family of switches has a solution that fits your need. The options include:

- Reduced SWR
- Increased isolation
- Standard or TTL drive
- 5, 15, 24 volt drive
- Position indicators

Increase productivity

When you buy your switches from Keysight, you notice a difference. Your test platforms run smoother, longer and faster, while yielding more viable and valuable measurements.

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Description

N1810UL

Unterminated latching

The Keysight N1810UL is a single-pole double-throw switch available in the frequency range from DC to 67 GHz. In precision measurements and monitoring applications where insertion loss repeat-ability is crucial, these switches operate in excess of 5 million cycles with better than 0.03 dB of insertion loss repeatability at 25 °C.

N1810TL

Terminated latching

The Keysight N1810TL is a single-pole double-throw switch available in the frequency range from DC to 67 GHz. The unused port is terminated 50 Ω, making it ideal for applications where port matching is required.

N1811TL

Terminated latching

The N1811TL is a terminated bypass switch available in the frequency range from DC to 67 GHz. The switch's internal load can terminate the device under test when in the bypass mode (up to 1 watt). Because of its compact design, it is ideal for drop-in, drop-out applications.

N1812UL

Unterminated latching

The N1812UL is a versatile, unterminated 5-port switch available in the frequency range from DC to 67 GHz. In transfer switch applications, the fifth port can be terminated externally with a high-power termination. It can also be utilized for signal path reversal or as a calibration port.

Technology

Keysight switches are 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.

Operation

All switches are "break before make," the switched ports are not connected to each other. This prevents damage to sensitive circuits and enhances test simplicity.

Driving

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 page 5, pin-out diagram.

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).

Note: Prior to current interrupts becoming standard on the N181x, Option 403 current interrupt was available for ordering.

Option 401 drives the switch with TTL/5V CMOS compatible logic, which controls the DC power supply to drive the switch.

Option 402 provides electronic indication of switch state. The circuitry consists of two independent commons, which can be connected to outputs corresponding to either position A or B. Because the commons are electrically isolated from each other as well as the drive circuit, this option allows two position signals to be obtained.

Note: For option 402 (position indicator): To achieve maximum system stability, it is recommended to do a pre-cycling of minimum 100 cycles if the switch has been in storage or idling for an extended period of time.

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Specifications

Specifications describe the instrument's warranted performance. Supplemental and typical characteristics are intended to provide information useful in applying the instrument by giving typical, but not warranted performance parameters.

General

Maximum power rating		
Into internal 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	
Coil voltage	5, 15, 24 VDC	
Connector	Option 004/020/026	SMA (f)
	Option 040	2.92 mm (f)
	Option 050	2.40 mm (f)
	Option 067	1.85 mm (f)

Standard performance specifications – N1810/1/2 Series (Frequency Options 004/020/026)

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

	DC	4 GHz	12.4 GHz	20 GHz	26.5 GHz
	90	85	76	67	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

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Specifications (continued)

Standard performance specifications – N1810/1/2 Series (Frequency Options: 040/050/067)

Isolation (dB) = $100 - \left(\frac{30}{26.5}\right)$ F, where F is specified in GHz (Formula Does not apply when F > 26.5 GHz)

	DC	4 GHz	12.4 GHz	20 GHz	26.5 GHz	40 GHz	50 GHz	67 GHz
	100	95	85	77	70	70	70	70

Insertion loss (dB)

Frequency Option 040: $0.35 + \left(\frac{0.45}{26.5}\right)$ F, where F is specified in GHz (DC to 40 GHz)

Frequency Option 050: $0.2 + \left(\frac{0.80}{26.5}\right)$ F, where F is specified in GHz (DC to 50 GHz)

Frequency Option 067: $0.35 + \left(\frac{0.45}{26.5}\right)$ F, where F is specified in GHz (DC to 26.5 GHz)

$0.59 + \left(\frac{0.53}{67}\right)$ F, where F is specified in GHz (26.5 to 67 GHz)

	DC	4 GHz	12.4 GHz	20 GHz	26.5 GHz	40 GHz	50 GHz	67 GHz
Option 040	0.35	0.41	0.56	0.68	0.80	1.02	–	–
Option 050	0.20	0.26	0.40	0.52	0.62	0.84	1.00	–
Option 067	0.35	0.41	0.56	0.68	0.80	0.91	0.99	1.12
SWR	**DC**	**4 GHz**	**12.4 GHz**	**20 GHz**	**26.5 GHz**	**40 GHz**	**50 GHz**	**67 GHz**
Option 040	1.15	1.15	1.25	1.40	1.60	1.80	–	–
Option 050	1.15	1.15	1.25	1.50	1.60	1.80	1.80	–
Option 067	1.15	1.15	1.25	1.30	1.70	1.90	1.90	1.90

Optional high-performance specifications – N1810/1/2 Series (not applicable for Frequency Options 040/050/067)

Isolation (dB) = $125 - \left(\frac{35}{26.5}\right)$ F, where F is specified in GHz

	DC	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Option 301[1]	125	120	109	99	90

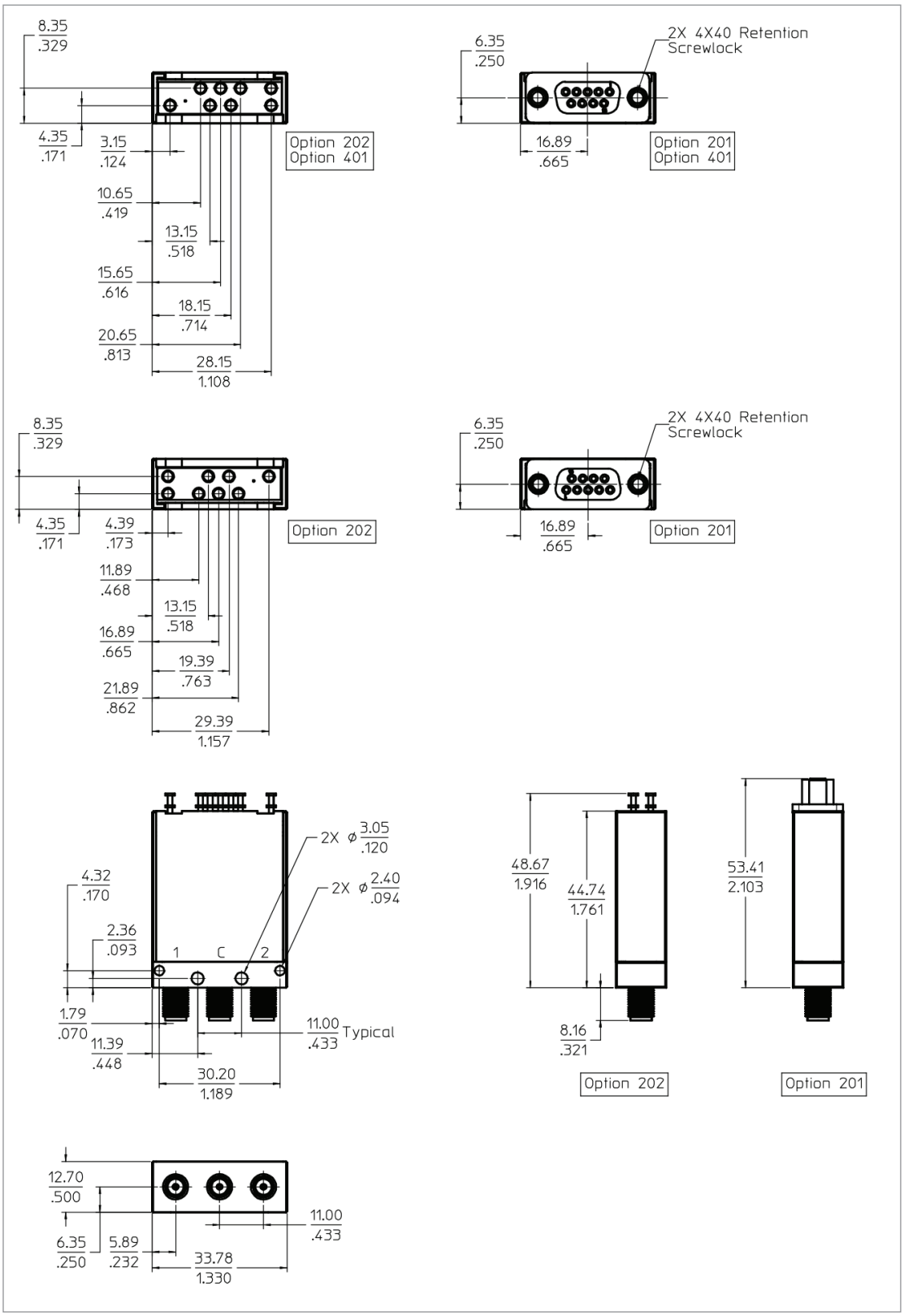
Insertion loss (dB) = $0.20 + \left(\frac{0.45}{26.5}\right)$ F, where F is specified in GHz

	DC	4 GHz	12.4 GHz	20 GHz	26.5 GHz
Option 302	0.2	0.27	0.41	0.53	0.65
SWR		**DC-4 GHz**	**4-12.4 GHz**	**12.4-20 GHz**	**20-26.5 GHz**
Option 302		1.10	1.20	1.23	1.45

1. Option 301:
   Storage and cycling temperature: –55 °C to +65 °C
   Operating temperature: –25 °C to +65 °C

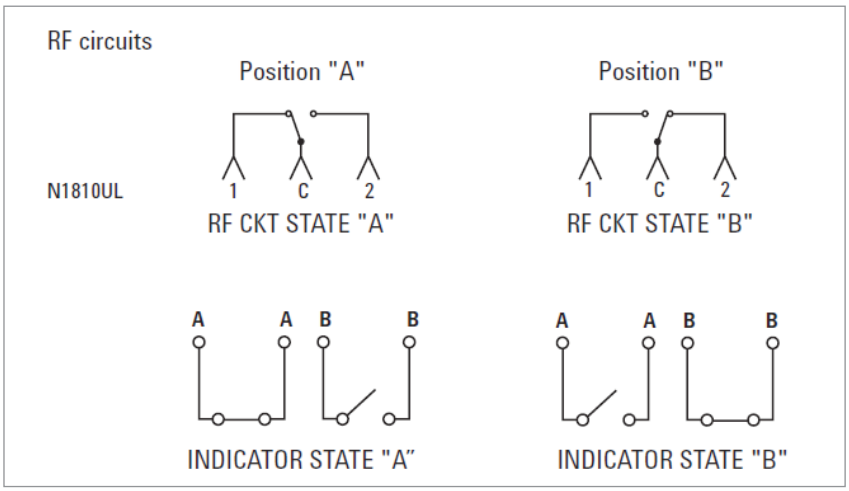
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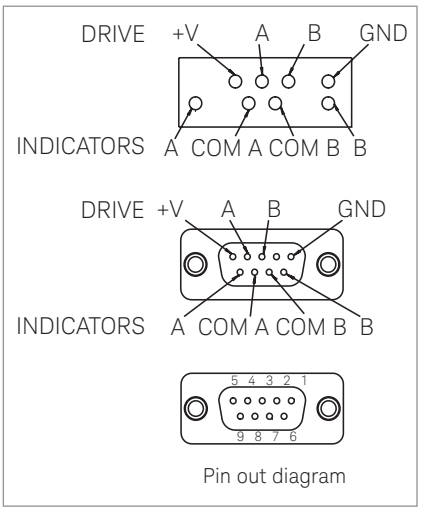
N1810UL



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N1810UL





Switch drive specifications N1810UL

Option	Parameter	Conditions	Min	Nominal	Max	Units
105	Supply voltage		4.5	5	7.0	V
	Supply current	Supply voltage = 5 V		300		mA
115[1]	Supply voltage		12.0	15	20.0	V
	Supply current	Supply voltage = 15 V		125		mA
124[2]	Supply voltage		20.0	24	32.0	V
	Supply current	Supply voltage = 24 V		75		mA.

TTL drive specifications

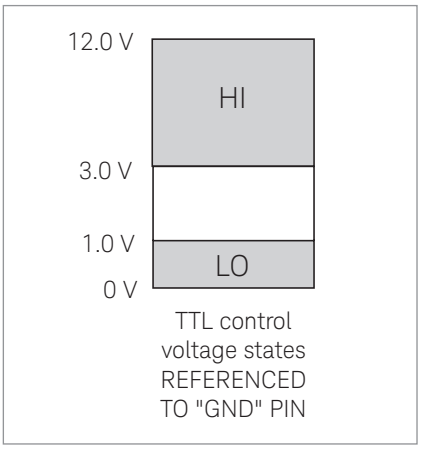
Option	Parameter	Conditions	Min	Nominal	Max	Units
401	High level input		3.0		12.0	V
	Low level input		0.0		1.0	V
	Max input current	Input voltage = 12.0 V			1.0	mA
		Input voltage = 3.85 V		0.25	0.5	mA

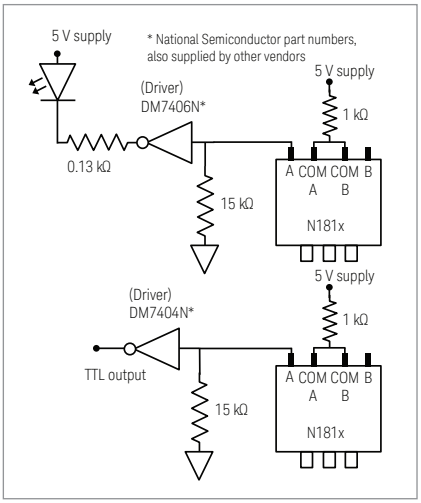
Driving the switch*

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	Indeterminate	NA
OPEN	OPEN	Lo	Lo	Switch remains at previous state	NA

GND: +V - Vsupply (see switch drive specification table, this page)
OPEN* +V to +V - 1.5 volts
Hi 3.0 V to 12.0 V
Lo 0.0 V to 1.0 V Warning drive level below –0.25 V will damage TTL drive circuit!
* WARNING! Use adapter cable 11764-60011 with 87130A switch driver
WARNING! Minimum switch spacing 6.0 mm (0.25 inch)

1. Option 115: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 18-20 VDC.
2. Option 124: Operating life: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 28-32 VDC.



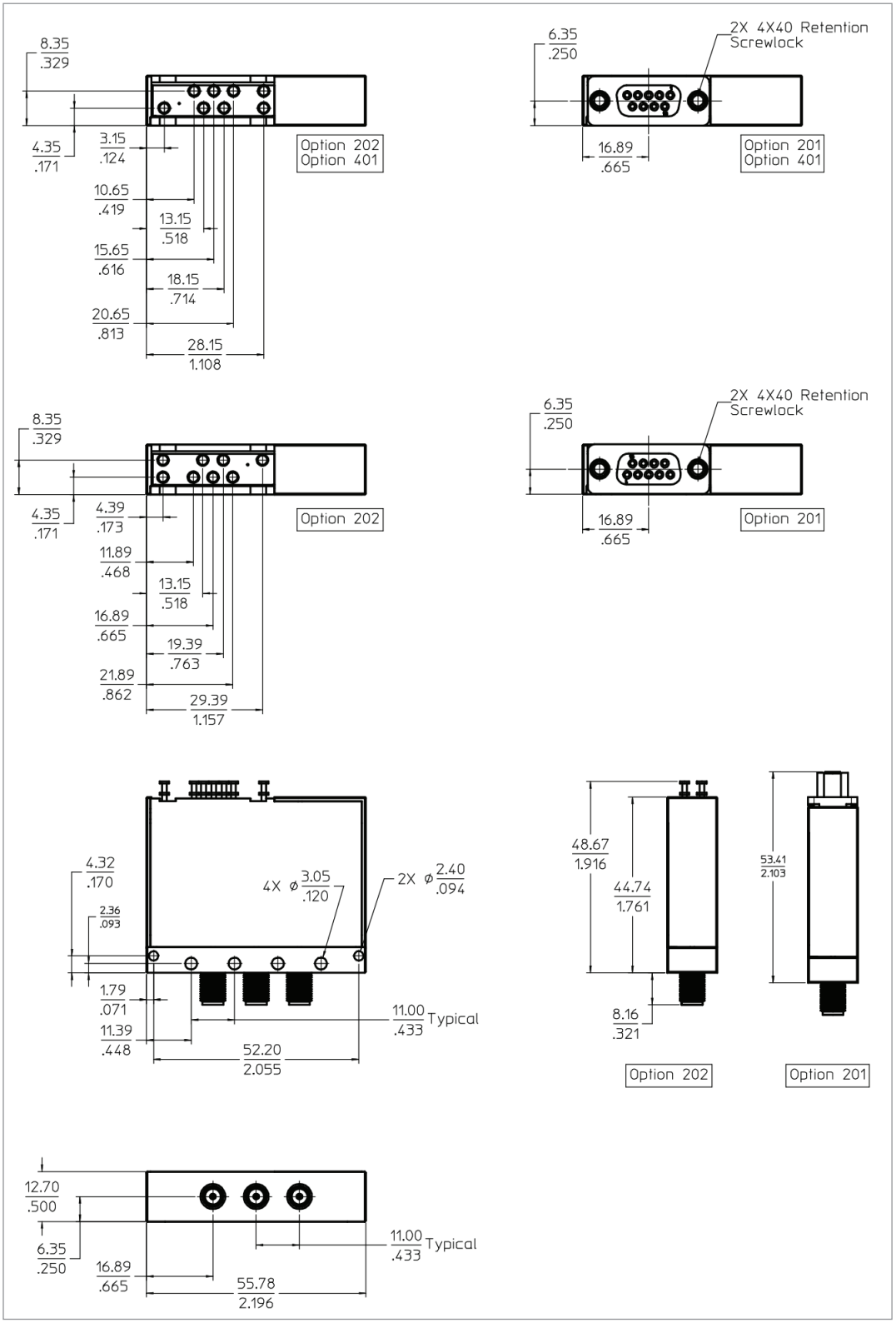


Recommended indicator circuit

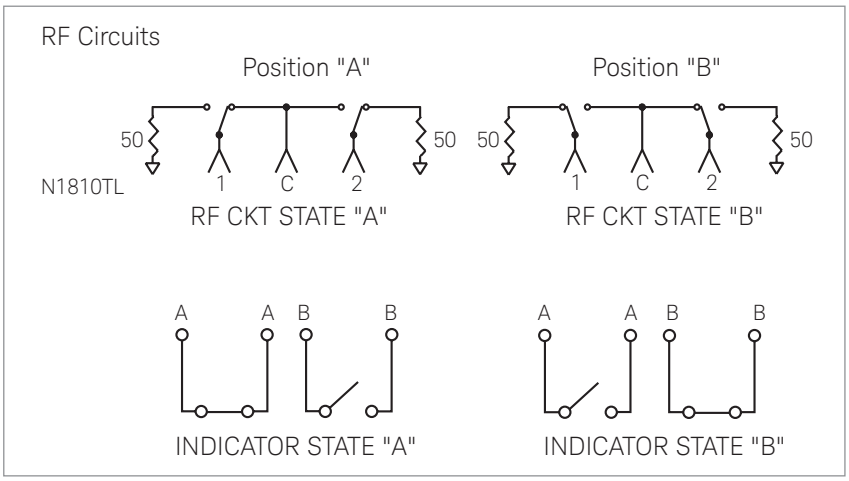
Note: For option 402 (position indicator): To achieve maximum system stability, it is recommended to do a pre-cycling of minimum 100 cycles if the switch has been in storage or idling for an extended period of time.

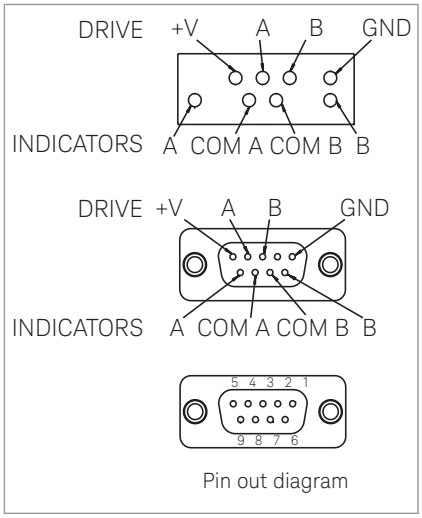
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N1810TL


8.35
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Option 202
Option 401
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.250
2X 4X40 Retention
Screwlock
16.89
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Option 201
Option 401
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2X 4X40 Retention
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Option 201
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Typical
48.67
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Option 202
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Option 201
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16.89
.665
55.78
2.196
11.00
.433
Typical

N1810TL





Pin out diagram

Switch drive specifications N1810TL, N1811TL, N1812UL

Option	Parameter	Conditions	Min	Nominal	Max	Units
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.

TTL drive specifications

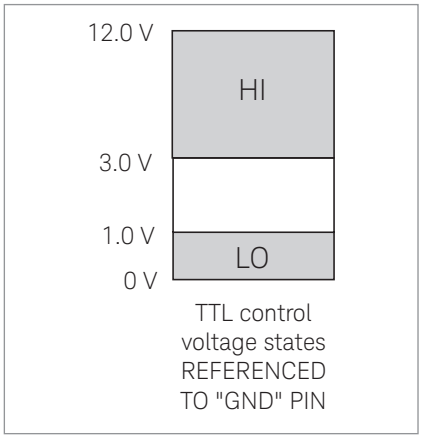
Option	Parameter	Conditions	Min	Nominal	Max	Units
401	High level input		3.0		12.0	V
	Low level input		0.0		1.0	V
	Max input current	Input voltage = 12.0 V			1.0	mA
		Input voltage = 3.85 V		0.25	0.5	mA

Driving the switch*

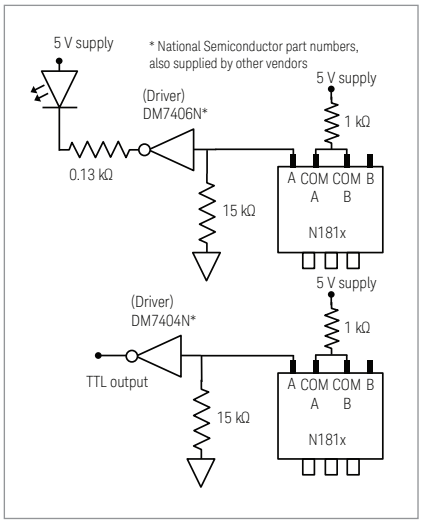
STD drive connect GND to ground		TTL drive connect GND to ground		RF state	INDICATOR state
A	**B**	**A**	**B**		
GND	OPEN	Hi	Lo	"A"	"A"
OPEN	GND	Lo	Hi	"B"	"B"
GND	GND	Hi	Hi	Indeterminate	NA
OPEN	OPEN	Lo	Lo	Switch remains at previous state	NA

GND: +V - Vsupply (see switch drive specification table, this page)
OPEN* +V to +V - 1.5 volts
Hi 3.0 V to 12.0 V
Lo 0.0 V to 1.0 V Warning drive level below –0.25 V will damage TTL drive circuit!
* WARNING! Use adapter cable 11764-60011 with 87130A switch driver
WARNING! Minimum switch spacing 6.0 mm (0.25 inch)

1. Option 115: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 18-20 VDC.
2. Option 124: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 28-32 VDC.



TTL control voltage states REFERENCED TO "GND" PIN

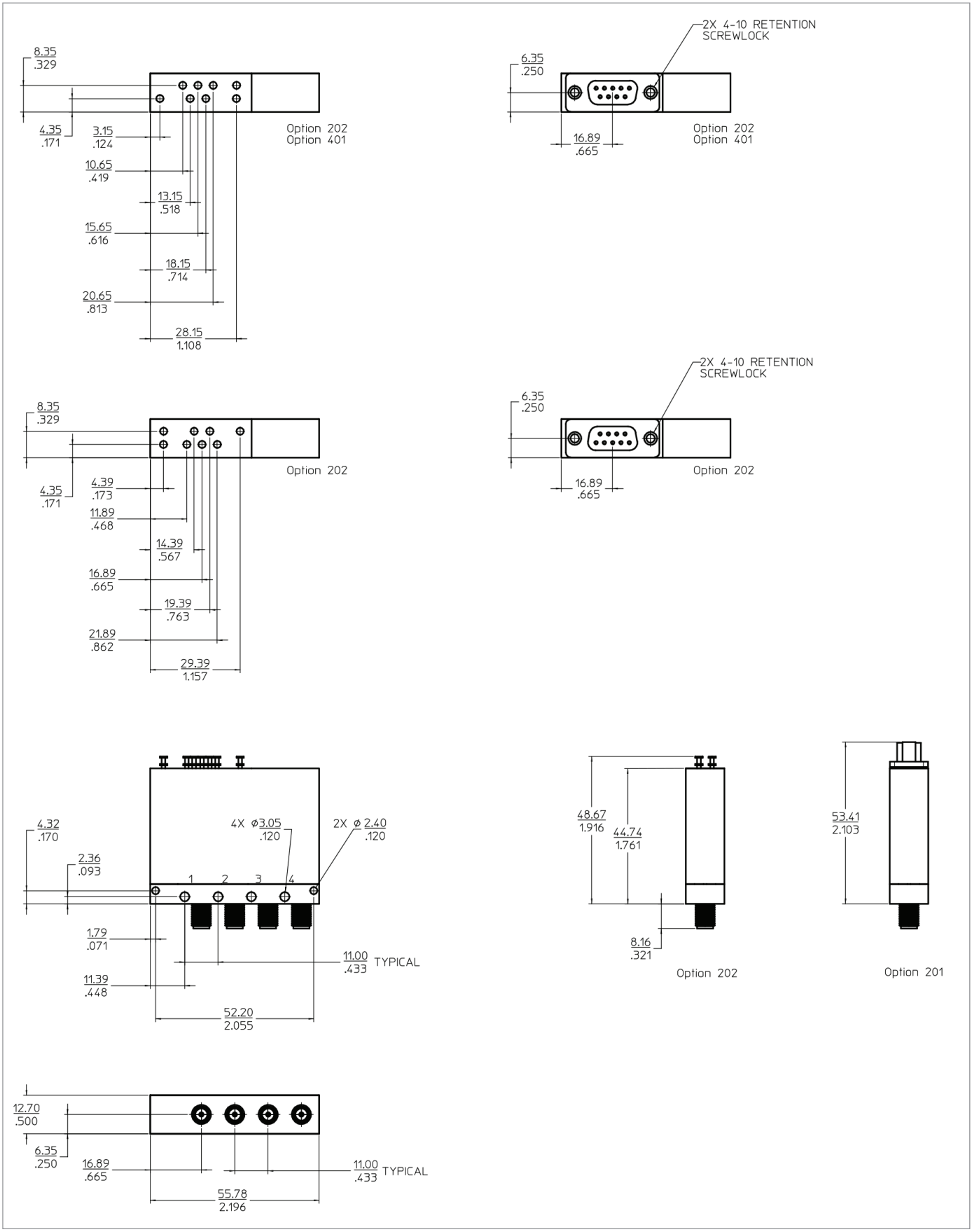


Recommended indicator circuit

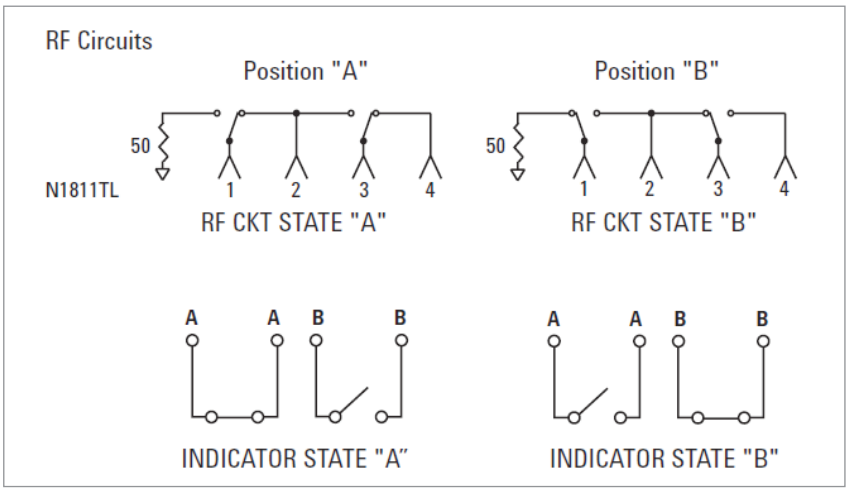
Note: For option 402 (position indicator): To achieve maximum system stability, it is recommended to do a pre-cycling of minimum 100 cycles if the switch has been in storage or idling for an extended period of time.

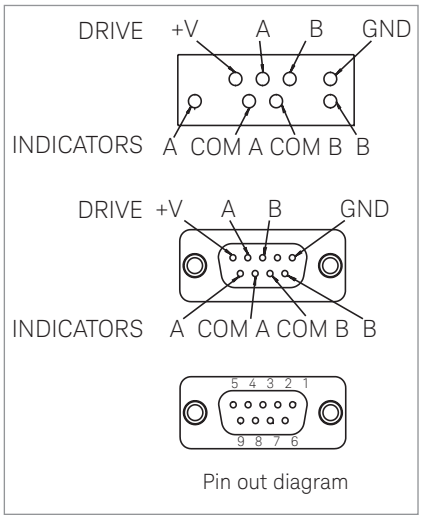
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N1811TL


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N1811TL





Pin out diagram

Switch drive specifications N1810TL, N1811TL, N1812UL

Option	Parameter	Conditions	Min	Nominal	Max	Units
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	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

TTL Drive specifications

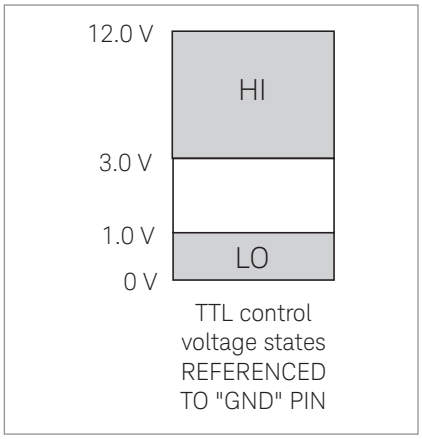
Option	Parameter	Conditions	Min	Nominal	Max	Units
401	High level input		3.0		12.0	V
	Low level input		0.0		1.0	V
	Max input current	Input voltage = 12.0 V			1.0	mA
		Input voltage = 3.85 V		0.25	0.5	mA

Driving the switch*

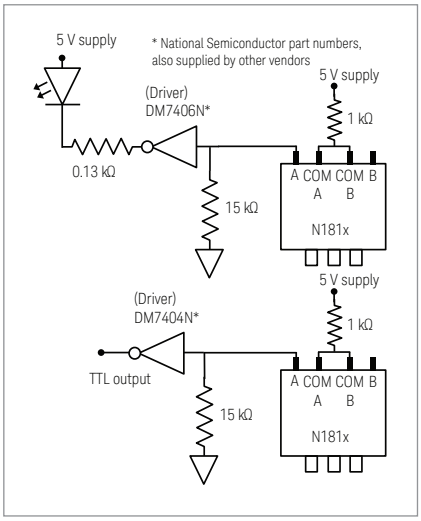
STD drive connect GND to ground		TTL drive connect GND to ground		RF state	INDICATOR state
A	**B**	**A**	**B**		
GND	OPEN	Hi	Lo	"A"	"A"
OPEN	GND	Lo	Hi	"B"	"B"
GND	GND	Hi	Hi	Indeterminate	NA
OPEN	OPEN	Lo	Lo	Switch remains at previous state	NA

GND:	+V - Vsupply (see switch drive specification table, this page)
OPEN*	+V to +V - 1.5 volts
Hi	3.0 V to 12.0 V
Lo	0.0 V to 1.0 V Warning drive level below –0.25 V will damage TTL drive circuit!
	* WARNING! Use adapter cable 11764-60011 with 87130A switch driver
	WARNING! Minimum switch spacing 6.0 mm (0.25 inch)

1. Option 115: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 18-20 VDC.
2. Option 124: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 28-32 VDC.



TTL control voltage states REFERENCED TO "GND" PIN

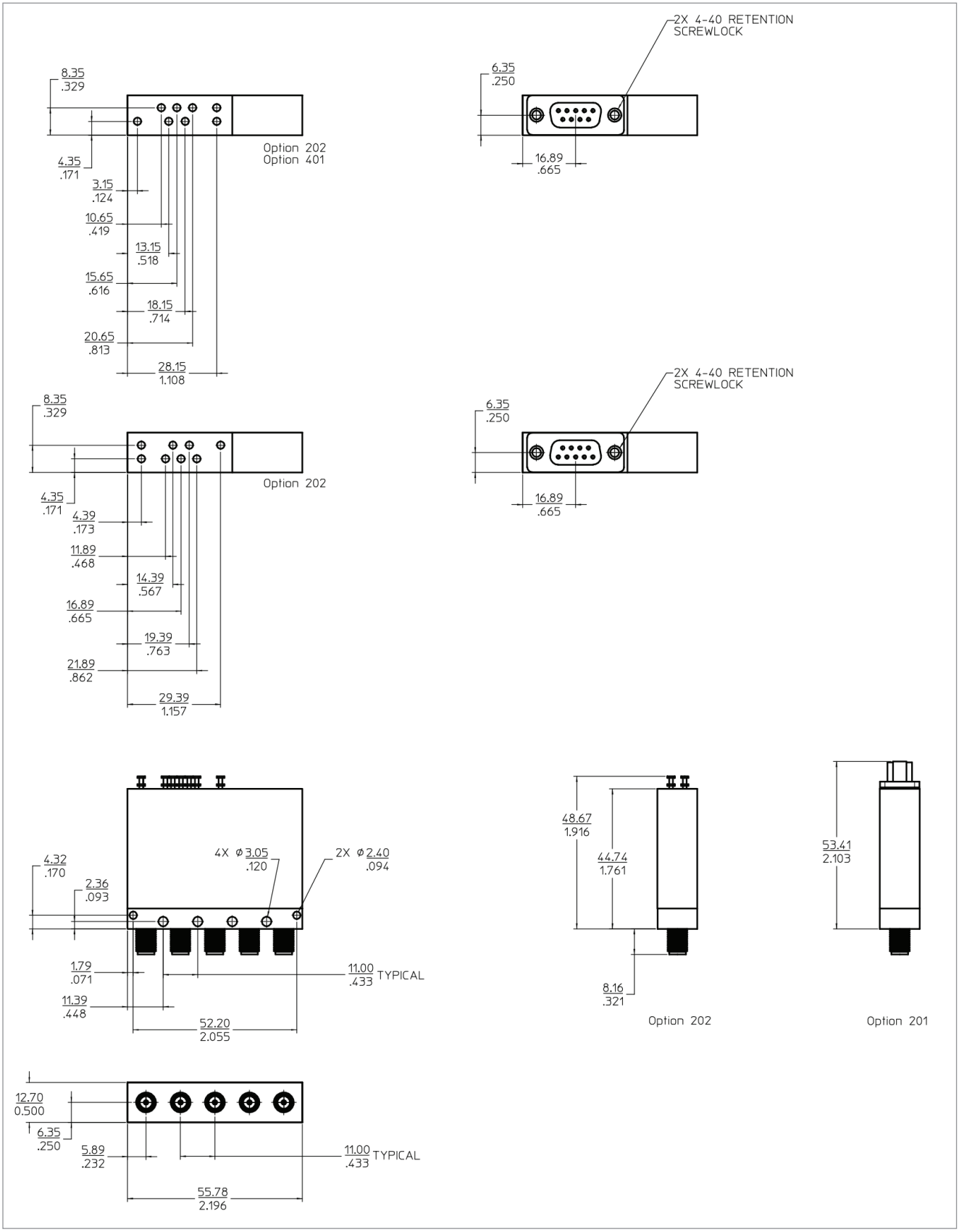


Recommended indicator circuit

Note: For option 402 (position indicator): To achieve maximum system stability, it is recommended to do a pre-cycling of minimum 100 cycles if the switch has been in storage or idling for an extended period of time.

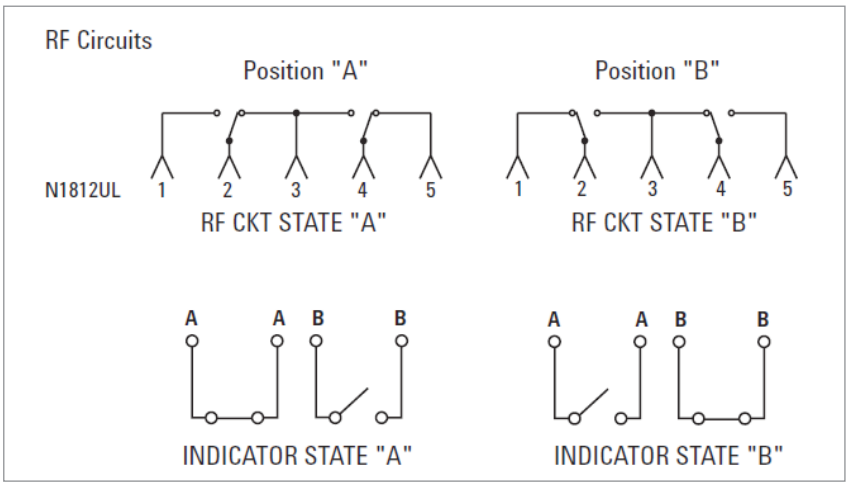
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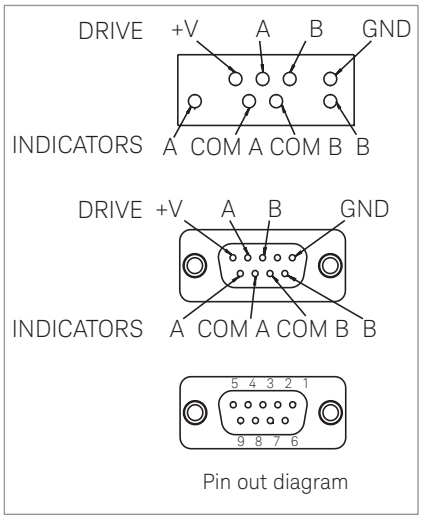
N1812UL



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N1812UL





Switch drive specifications N1810TL, N1811TL, N1812UL

Option	Parameter	Conditions	Min	Nominal	Max	Units
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

TTL drive specifications

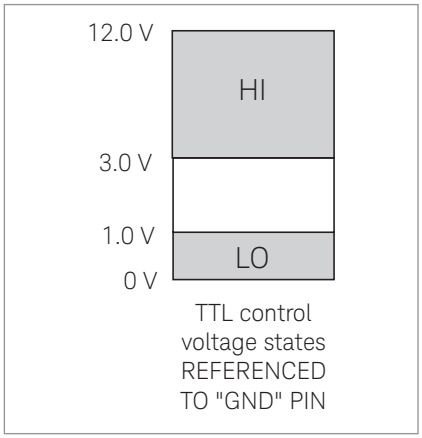
Option	Parameter	Conditions	Min	Nominal	Max	Units
401	High level input		3.0		12.0	V
	Low level input		0.0		1.0	V
	Max input current	Input voltage = 12.0 V			1.0	mA
		Input voltage = 3.85 V		0.25	0.5	mA

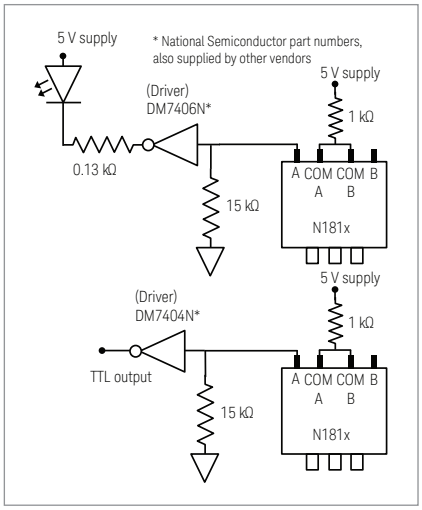
Driving the switch*

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	Indeterminate	NA
OPEN	OPEN	Lo	Lo	Switch remains at previous state	NA

GND: +V - Vsupply (see switch drive specification table, this page)
OPEN* +V to +V - 1.5 volts
Hi 3.0 V to 12.0 V
Lo 0.0 V to 1.0 V Warning drive level below –0.25 V will damage TTL drive circuit!
* WARNING! Use adapter cable 11764-60011 with 87130A switch driver
WARNING! Minimum switch spacing 6.0 mm (0.25 inch)

1. Option 115: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 18-20 VDC.
2. Option 124: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 28-32 VDC.





Recommended indicator circuit

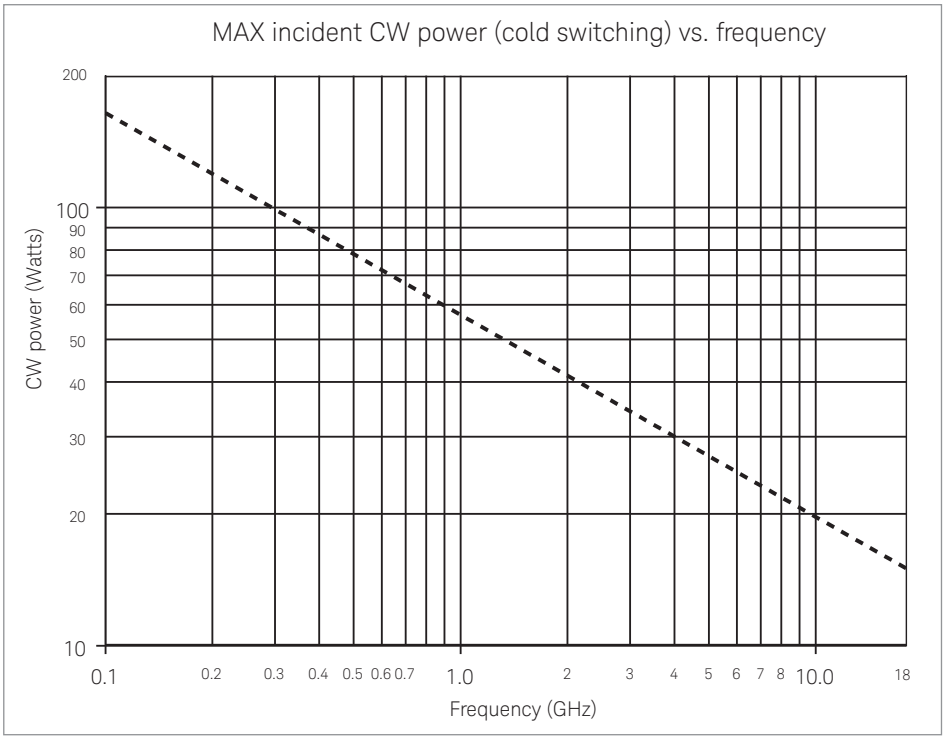
Note: For option 402 (position indicator): To achieve maximum system stability, it is recommended to do a pre-cycling of minimum 100 cycles if the switch has been in storage or idling for an extended period of time.

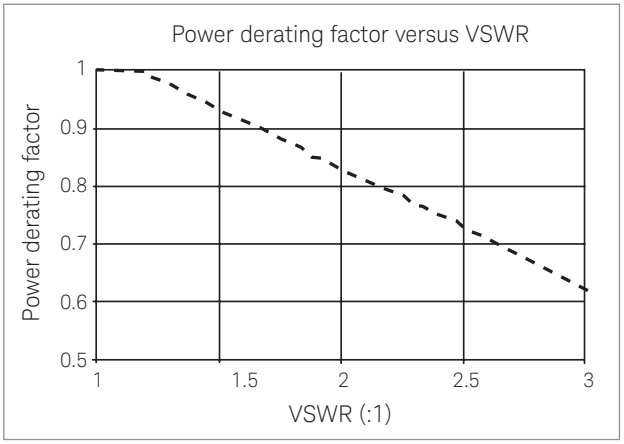
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Supplemental Characteristics

General operating characteristics — N181x series

Switching speed	Repeatability	Life[1,2]	Impedance
< 15 ms	0.03 dB at 40 GHz	> 5 million cycles	50 Ω
	0.05 dB at 50 GHz		
	0.08 dB at 67 GHz		





Reference conditions

- Cold switching only (NO hot switching)
- Ambient temperature of 75 °C or less[3]
- Sea level (0.88 derating at 15,000 ft.)
- Load VSWR < 1.2
  (see graph for derating above 1.2 VSWR)

1. Option 115: Operating life: 5 million cycles minimum, except 1 million cycles minimum when driven at voltages 18-20 VDC.
2. Option 124: Operating life: 1 million cycles minimum.

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Environmental

The switch is designed to fully comply with Keysight Technologies' product operating environment specifications. The following summarizes the environmental specifications for these products (Class B1).

Temperature[1]

Operating: –25 to +75 °C
Storage: –55 to +85 °C
Cycling: –55 to +85 °C, 10 cycles per MIL-STD 202F, 170D, Condition A (modified)

Vibration

Operating: 7 g, 5-2000 Hz at 0.25 in. p-p
Survival: 20 g, 20-2000 Hz at 0.06 in. p-p, 4 min/cycle, 4 cycles/axis
Random: 2.41 g (rms.) 10 min/axis
Shock: Half sine: 500 g at 0.5 ms, 3 drops/direction, 18 total
Operating: 50 g at 6 ms, 6 directions

Humidity

Operating: 15 to 95 % relative humidity
Storage: 65 °C, 95 % RH, 10 days, MIL-STD 202F, Method 106E

Altitude

Operating: 15,000 feet/4.6 km
Storage: 50,000 feet/15.3 km, MIL-STD 202F, Method 105C, Condition B

Troubleshoot guide

		Allowable range		
Probable cause	**Test**	**Low value**	**High value**	**Remedy**
Not connected to supply		See drive specifications		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 drive specifications		
Supply current low	Measure current draw with drive pin selected	See drive specifications		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 drive specifications		Connect ground pin to ground
TTL "LOW" voltage < 0.0 volts	Measure voltage from ground pin to TTL drive pin	See drive specifications		Eliminate ground loops
TTL GND pin not grounded				Connect GND pin to ground
Driving switch with 87130A				Use adapter cable 11764-60011

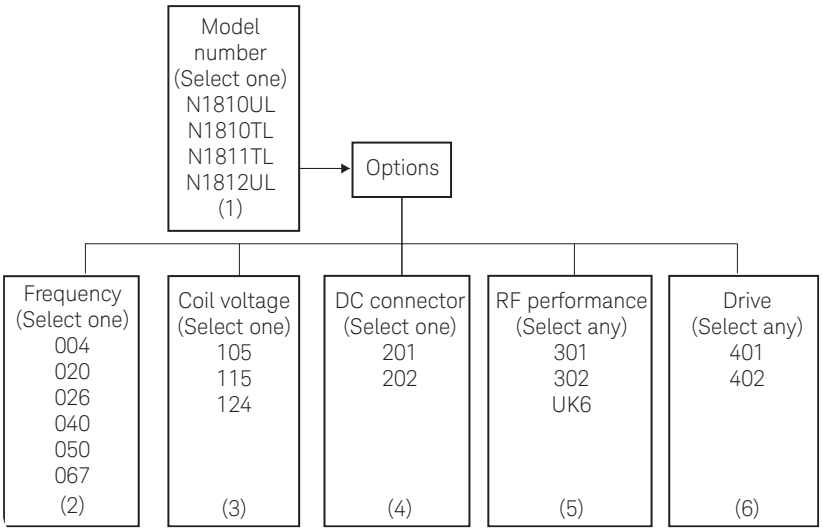
1. Option 301: Storage and cycling temperature: –55 °C to +65 °C Operating temperature: –25 °C to +65 °C
Option 105: Operating temperature: –5 °C to +75 °C
Option 115: Operating temperature: –15 °C to +75 °C

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Ordering Information

Required: Specify one model number, one frequency range, one coil voltage, and one DC connector type (must select one of each)

Optional: Specify RF performance enhancements and drive options (may select any, all, or none)



1. Select a model to fit your application. (Required)
   N1810UL – Unterminated latching 3-port
   N1810TL – Terminated latching 3-port
   N1811TL – Terminated latching 4-port
   N1812UL – Unterminated latching 5-port
2. Select a frequency range. (Required)
   004 – DC to 4 GHz
   020 – DC to 20 GHz
   026 – DC to 26.5 GHz
   040 – DC to 40 GHz
   050 – DC to 50 GHz
   067 – DC to 67 GHz
3. Select a coil voltage level. (Required)
   105* – 5 volts
   115 – 15 volts
   124 – 24 volts
4. Select a DC connector type. (Required)
   201 – "D" subminiature 9 pin female
   202 – Solder lugs
5. Select RF performance enhancements. (Optional)
   301 – Increased isolation
   302 – Reduced standing wave ratio and insertion loss
   UK6 – Calibration certificate with test data
6. Select drive options. (Optional)
   401 – TTL/CMOS compatible 5 V drive
   402 – Position indicators

* Includes options 402

Ordering example

For an unterminated 5 port switch, operating up to 20 GHz, with 15 volt coils, D-sub connector, high isolation, and TTL, the order should look as follows: N1812UL Option 020 115 201 301 401.

Switch units beginning with the serial numbers listed below or higher have current interrupt built-in as a default.

- N1810UL-MY07244672
- N1810TL-MY07247927
- N1811TL-MY07244660
- N1812UL-MY07240668

Related Literature

Keysight Technologies Bench and System Switching Products
Literature Number 5989-9872EN

Keysight RF and Microwave Switch Selection Guide
Literature Number 5989-6031EN

Keysight 11713B/C Attenuator/Switch Drivers Configuration Guide
Literature Number 5989-7277EN

Application Notes

Power Handling Capability of Electromechanical Switches
Literature Number 5989-6032EN

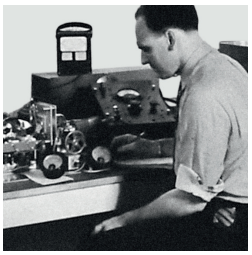
How Operating Life and Repeatability of Keysight's Electromechanical Switches Minimize System Uncertainty
Literature Number 5989-6085EN

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