

**DATA SHEET**

# SKY13404-466LF: 0.4-2.7 GHz SP10T Switch with GPIO Interface

## Applications

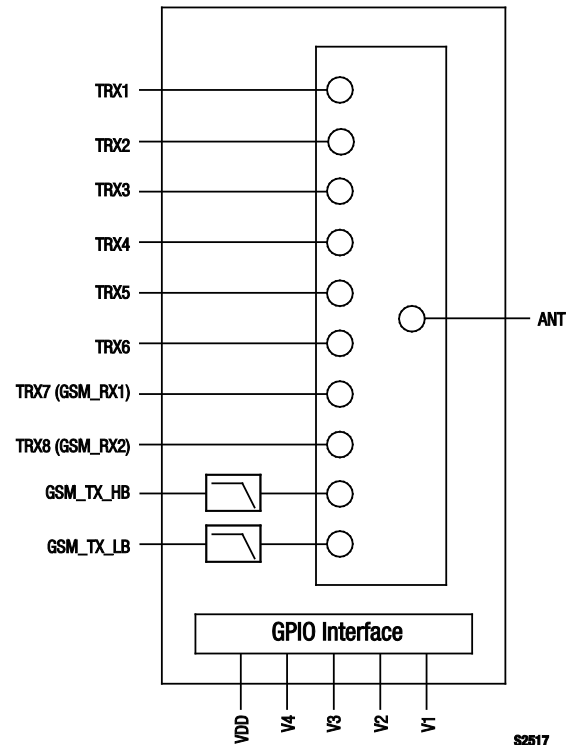
- 2G/3G multimode cellular handsets (UMTS, CDMA2000, EDGE, GSM)
- Embedded data cards

## Features

- Broadband frequency range: 0.4 to 2.7 GHz
- Single, positive DC power supply (2.5 to 3.3 V)
- Excellent Band 13 2<sup>nd</sup> harmonic rejection
- Integrated, low-pass harmonic filter for GSM transmit paths
- Integrated GPIO interface
- Any of eight TRX ports can be used for WCDMA transmit/receive or GSM receive functions
- Small QFN (26-pin, 2.6 x 3.4 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04-0074.



**Figure 1. SKY13404-466LF Block Diagram**

## Description

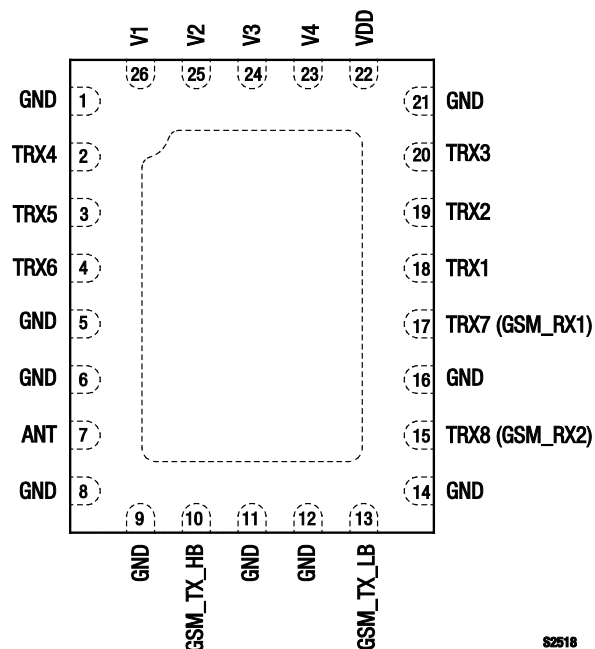
The SKY13404-466LF is a Single Pole, Ten-Throw (SP10T) antenna switch with an integrated General Purpose Input/Output (GPIO) interface and dual low-pass harmonic filters. The switch has eight transmit/receive ports, any of which can be used for WCDMA transmit/receive or GSM receive functions.

Using advance switching technologies, the SKY13404-466LF maintains low insertion loss and high isolation for both transmit and receive switching paths. The switch also exhibits an excellent triple beat ratio and 2<sup>nd</sup>/3<sup>rd</sup> order modulation distortion performance. Band 13 2<sup>nd</sup> harmonic requirements can be met without the use of an external filter.

Switching is controlled by an integrated GPIO interface. Depending on the logic applied to the decoder, the antenna pin is connected to one of ten switched RF ports using a low insertion loss path, while the paths between the antenna pin and the other RF pins are in a high isolation state. No external DC blocking capacitors are required on the RF paths.

The SKY13404-466LF is manufactured in a compact, 2.6 x 3.4 mm, 26-pin Quad Flat No-Lead (QFN) package.

A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.



**Figure 2. SKY13404-466LF Pinout – 26-Pin QFN  
(Top View)**

**Table 1. SKY13404-466LF Signal Descriptions**

Pin #	Name	Description	Pin #	Name	Description
1	GND	Ground	14	GND	Ground
2	TRX4	RF input/output port 4 (dedicated to Band 13)	15	TRX8 (GSM_RX2)	RF input/output port 8
3	TRX5	RF input/output port 5	16	GND	Ground
4	TRX6	RF input/output port 6	17	TRX7 (GSM_RX1)	RF input/output port 7
5	GND	Ground	18	TRX1	RF input/output port 1
6	GND	Ground	19	TRX2	RF input/output port 2
7	ANT	Antenna RF port	20	TRX3	RF input/output port 3
8	GND	Ground	21	GND	Ground
9	GND	Ground	22	VDD	DC power supply
10	GSM_TX_HB	GSM high band transmit RF input port with integrated harmonic filter	23	V4	DC input control voltage 4
11	GND	Ground	24	V3	DC input control voltage 3
12	GND	Ground	25	V2	DC input control voltage 2
13	GSM_TX_LB	GSM low band transmit RF input port with integrated harmonic filter	26	V1	DC input control voltage 1

**Note:** Bottom ground paddles must be connected to ground.

**Table 2. SKY13404-466LF Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
RF input power	$P_{IN}$		+36	dBm
Power supply			5	V
DC control voltage	$V_{CTRL}$		2.7	V
Storage temperature	$T_{STG}$	−40	+125	°C
Operating temperature	$T_{OP}$	−30	+90	°C

**Note:** Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

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**CAUTION:** Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

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## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13404-466LF are provided in Table 2. Electrical specifications are provided in Tables 3 through 6. Table 7 provides the control logic for the SKY13404-466LF.

Typical performance characteristics of the SKY13404-466LF are illustrated in Figures 3 to 10. The isolation matrix shown in Table 8 provides the port-to-port isolation for all available RF states at three different frequencies: 915 MHz, 1910 MHz, and 2700 MHz.

Figure 11 illustrates the test setup used to measure data for Figure 7. This industry standardized test is used to simulate the WCDMA Band 1 linearity of the antenna switch. A +20 dBm Continuous Wave (CW) signal,  $f_{FUND}$ , is sequentially applied to the TRX1 through TRX8 ports, while a −15 dBm CW blocker signal,  $f_{BLK}$ , is applied to the ANT port.

The resulting 3<sup>rd</sup> Order Intermodulation Distortion (IMD3),  $f_{RX}$ , is measured over all phases of  $f_{FUND}$ . The SKY13404-466LF exhibits exceptional performance for all TRX ports.

**Table 3. SKY13404-466LF Electrical Specifications (Note 1) (1 of 2)****(V<sub>DD</sub> = 2.85 V, V<sub>1</sub> = V<sub>2</sub> = V<sub>3</sub> = V<sub>4</sub> = 0/1.8 V, T<sub>OP</sub> = +25 °C, P<sub>IN</sub> = 0 dBm, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
<b>RF Specifications</b>						
Insertion loss: ANT to TRX1 through TRX8 ports	IL	824 to 960 MHz		0.5	0.7	dB
		1710 to 2170 MHz		0.6	0.8	dB
		2300 to 2690 MHz		0.9	1.1	dB
Insertion loss: ANT to TRX4 port (Note 2)	IL	704 to 787 MHz		0.4	0.6	dB
Insertion loss: ANT to GSM_TX_LB port	IL	824 to 915 MHz		1.3	1.5	dB
Insertion loss: ANT to GSM_TX_HB port	IL	1710 to 1910 MHz		1.2	1.4	dB
Isolation (TRX1/2/3/7/8 to TRX4/5/6 ports)	ISO	824 to 1910 MHz	40	43		dB
Isolation (GSM_TX_LB to TRX1 through TRX8 ports)	ISO	824 to 915 MHz	40	43		dB
Isolation (GSM_TX_HB to TRX1 through TRX8 ports)	ISO	1710 to 1910 MHz	37	40		dB
Isolation (TRX4 to TRX6 port)	ISO	824 to 1910 MHz	27	30		dB
Isolation (TRX1 to TRX2, TRX2 to TRX3, TRX4 to TRX5, TRX5 to TRX6, and TRX7 to TRX8 ports)	ISO	824 to 1910 MHz	21	24		dB
Isolation (ANT to TRX8 [TRX7 “on”])	ISO	1805 to 1990 MHz	33	36		dB
Isolation (ANT to TRX7 [TRX8 “on”])	ISO	1805 to 1990 MHz	33	36		dB
Band 13 2 <sup>nd</sup> harmonic	B13 2fo	P <sub>IN</sub> = +25 dBm, f = 787 MHz, TRX1 to TRX8		–85		dBm
Harmonics	UMTS <sub>LOW_BAND</sub>	f = 824 to 915 MHz, P <sub>IN</sub> = +27 dBm		–74	–68	dBm
	UMTS <sub>HIGH_BAND</sub>	f = 1710 to 1950 MHz, P <sub>IN</sub> = +27 dBm		–68	–62	dBm
	GSM <sub>LOW_BAND</sub>	GSM_TX_LB port, P <sub>IN</sub> = +35 dBm		–45	–36	dBm
	GSM <sub>HIGH_BAND</sub>	GSM_TX_HB port, P <sub>IN</sub> = +33 dBm		–44	–36	dBm
Attenuation (GSM_TX_LB port)		GSM850:				
		2f	25	30		dB
		3f	25	28		dB
		>4f		20		dB
		EGSM900:				
		2f	25	28		dB
Attenuation (GSM_TX_HB port)		3f	22	25		dB
		>4f		20		dB
		DCS1800:				
		2f	25	30		dB
		3f	25	28		dB
		>4f		20		dB
Attenuation (GSM_TX_HB port)		PCS1900:				
		2f	25	28		dB
		3f	25	28		dB
		>4f		20		dB

**Table 3. SKY13404-466LF Electrical Specifications (Note 1) (2 of 2)****(V<sub>DD</sub> = 2.85 V, V<sub>1</sub> = V<sub>2</sub> = V<sub>3</sub> = V<sub>4</sub> = 0/1.8 V, T<sub>OP</sub> = +25 °C, P<sub>IN</sub> = 0 dBm, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
<b>RF Specifications (continued)</b>						
Return loss	IS11I	0.4 to 2.2 GHz	14	18		dB
2nd Order Input Intercept Point	IIP2	AWS, PCS, IMT to CDMA2000 modes	+95.5	+105.0		dBm
2nd Order Intermodulation Distortion	IMD2	UMTS mode (Note 3)		−110	−105	dBm
3rd Order Intermodulation Distortion	IMD3	UMTS mode (Note 4)		−110	−105	dBm
Triple Beat Ratio (Note 5)	TBR	650 to 900 MHz	81	90		dBc
		1710 to 2155 MHz	81	90		dBc
1 dB Input Compression Point	IP1dB	GSM_TX_LB port, 824 to 915 MHz	+40			dBm
		GSM_TX_HB port, 1710 to 1910 MHz	+39			dBm
Switching speed		10/90% RF		3	5	μs
<b>DC Specifications</b>						
Supply voltage	V <sub>DD</sub>		2.50	2.85	3.30	V
Supply current	I <sub>DD</sub>			50	100	μA
Control voltage: High Low	V <sub>1</sub> , V <sub>2</sub> , V <sub>3</sub> , V <sub>4</sub>		1.35	1.80	2.50	V
			0		0.45	V
Control current: High Low					10	μA
				5		μA

**Note 1:** Performance is guaranteed only under the conditions listed in this Table.**Note 2:** TRX4 is a dedicated Band 13 port.**Note 3:** See Table 4.**Note 4:** See Table 5.**Note 5:** See Table 6.**Table 4. IP2 Frequencies and Power Levels**

Band	Transmit Frequency (MHz)	Transmit Power (dBm)	Frequency Blocker 1 (MHz)	Frequency Blocker 2 (MHz)	Power Blocker (dBm)	Receive Frequency (MHz)
1	1950.0	+20	190	4090	−15	2140.0
2	1880.0	+20	80	3840	−15	1960.0
4	1732.0	+20	400	3864	−15	2132.0
5	836.5	+20	45	1718	−15	881.5
8	897.0	+20	45	1839	−15	942.0

**Table 5. IP3 Frequencies and Power Levels**

Band	Transmit Frequency (MHz)	Transmit Power (dBm)	Frequency Blocker 1 (MHz)	Frequency Blocker 2 (MHz)	Power Blocker (dBm)	Receive Frequency (MHz)
1	1950.0	+20	1760.0	N/A	-15	2140.0
2	1880.0	+20	1800.0	N/A	-15	1960.0
4	1732.0	+20	1332.0	N/A	-15	2132.0
5	836.5	+20	791.5	N/A	-15	881.5
8	897.0	+20	852.0	N/A	-15	942.0

**Table 6. Triple Beat Ratio Frequencies and Power Levels**

Band	Transmit Frequency 1 (MHz)	Transmit Power 1 (dBm)	Transmit Frequency 2 (MHz)	Transmit Power 2 (dBm)	Frequency Blocker ANT (MHz)	Power Blocker (dBm)	Triple Beat Product Frequency (MHz)
2	1880.0	+21.5	1881.0	+21.5	1960.0	-30	1960.0 ± 1
5	836.5	+21.5	881.5	+21.5	881.5	-30	881.5 ± 1

**Table 7. SKY13404-466LF Mode Control Logic**

Insertion Loss State	V1 (Pin 26)	V2 (Pin 25)	V3 (Pin 24)	V4 (Pin 23)
Standby (all ports in isolation state)	0	0	0	0
ANT to GSM_TX_LB	1	1	0	0
ANT to GSM_TX_HB	1	0	0	0
ANT to TRX7	0	1	1	0
ANT to TRX8	0	1	0	0
ANT to TRX1	0	0	1	0
ANT to TRX2	1	0	1	0
ANT to TRX3	1	1	1	0
ANT to TRX4	1	0	1	1
ANT to TRX5	1	1	1	1
ANT to TRX6	1	0	0	1

## Typical Performance Characteristics

( $V_{DD} = 2.85$  V,  $V_1 = V_2 = V_3 = V_4 = 0/1.8$  V,  $T_{OP} = +25$  °C,  $P_{IN} = 0$  dBm, Characteristic Impedance [ $Z_0$ ] = 50  $\Omega$ , Unless Otherwise Noted)

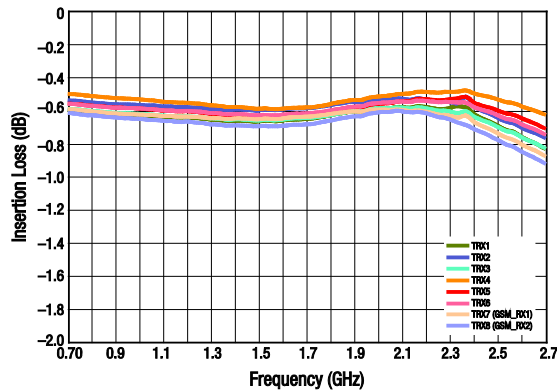


Figure 3. Insertion Loss vs Frequency  
(ANT to All TRX Ports)

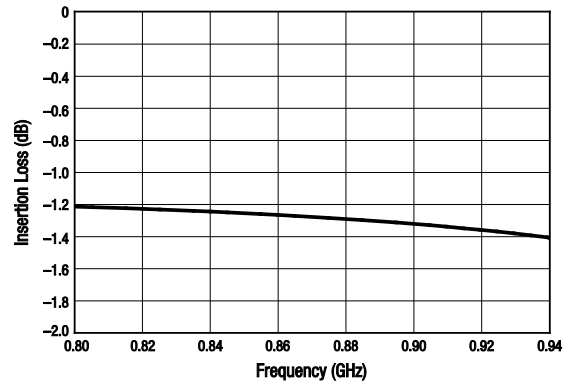


Figure 4. Insertion Loss vs Frequency  
(ANT to GSM\_TX\_LB Port)

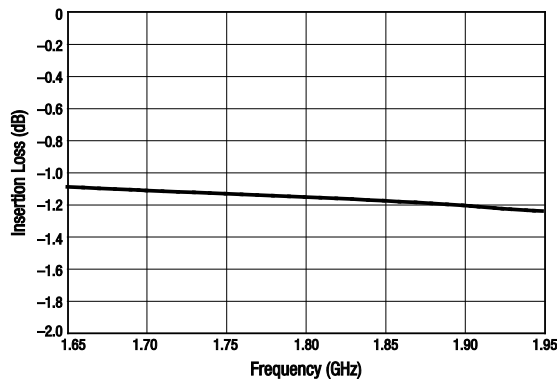


Figure 5. Insertion Loss vs Frequency  
(ANT to GSM\_TX\_HB Port)

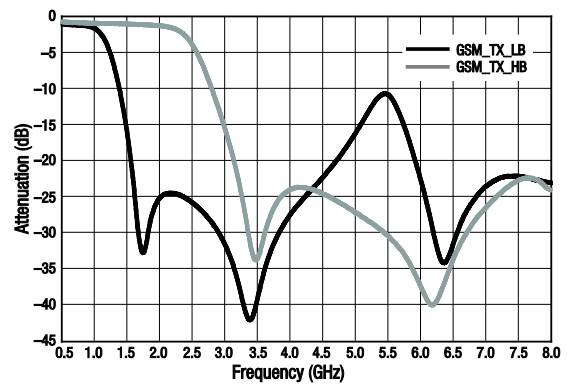


Figure 6. Attenuation vs Frequency  
(ANT to GSM\_TX\_HB/LB Ports)

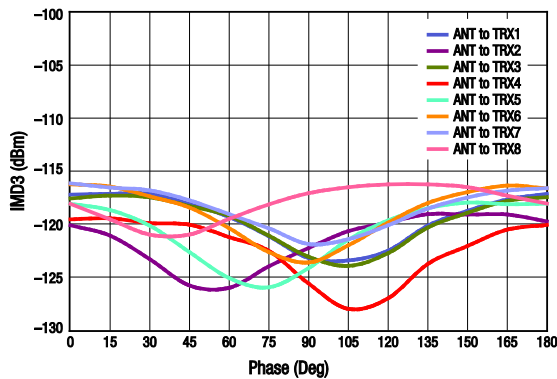


Figure 7. 3<sup>rd</sup> Order Intermodulation Distortion vs Phase, TRX  
Ports ( $f_{FUND} = 1.95$  GHz @ +20 dBm,  $f_{BLK} = 1.786$  GHz @ -15 dBm,  
 $f_{rx} = 2.14$  GHz)

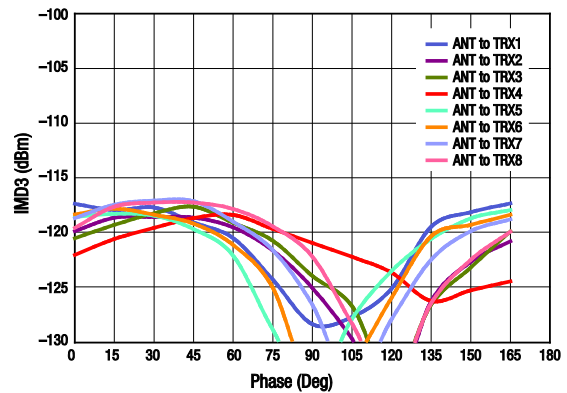
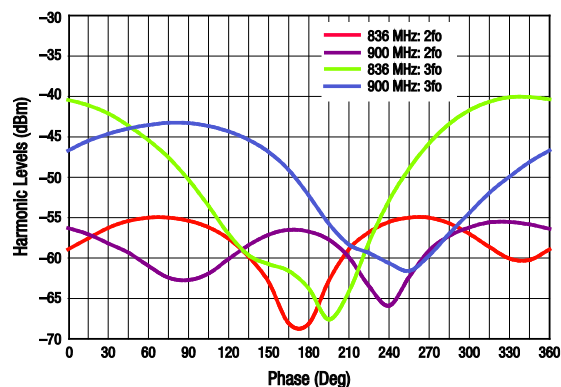
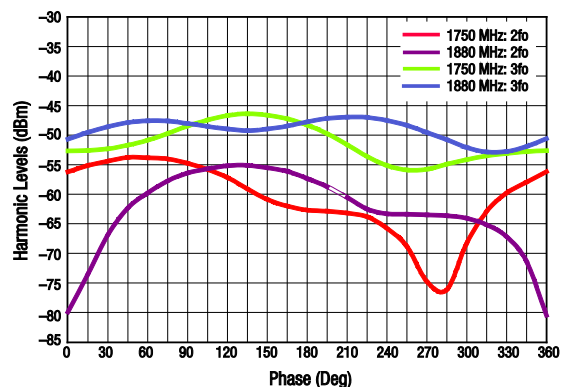


Figure 8. 3<sup>rd</sup> Order Intermodulation Distortion vs Phase, TRX  
Ports ( $f_{FUND} = 836.5$  GHz @ +20 dBm,  $f_{BLK} = 791.5$  GHz  
@ -15 dBm,  $f_{rx} = 881.5$  GHz)



**Figure 9. Harmonics vs Phase**  
(ANT to GSM\_TX\_LB, P<sub>IN</sub> = +35 dBm, 5:1 VSWR Mismatch)



**Figure 10. Harmonics vs Phase**  
(ANT to GSM\_TX\_HB, P<sub>IN</sub> = +33 dBm, 5:1 VSWR Mismatch)

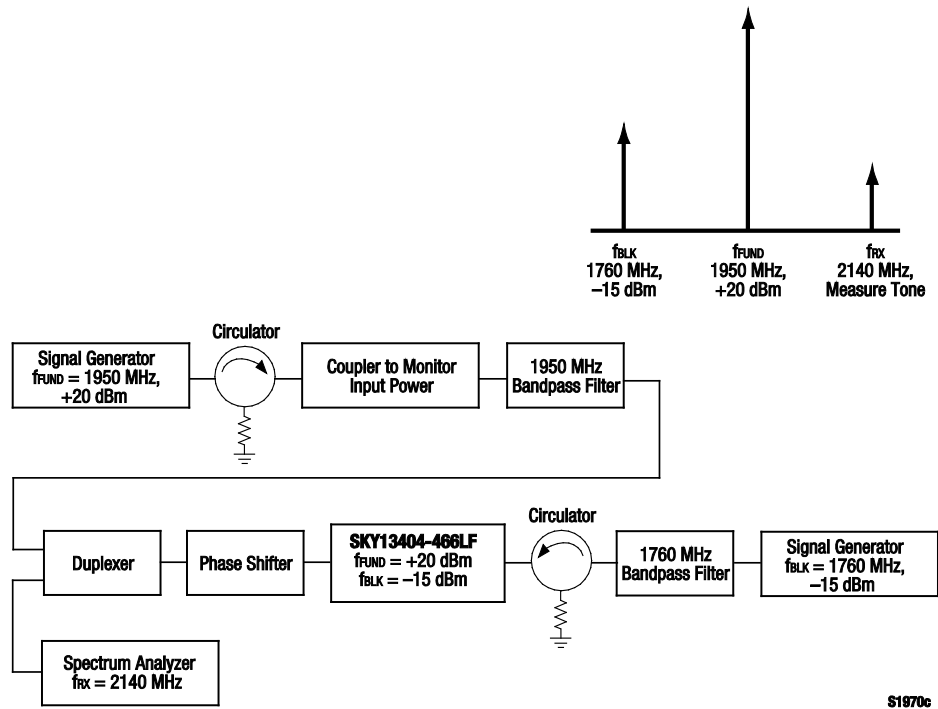
**Table 8. ANT to TX/TRX Isolation Matrix (1 of 2)**

"On" Port	Freq. (GHz)	Isolation									
		GSM_TX_LB (Pin 13)	GSM_TX_HB (Pin 10)	TRX1 (Pin 18)	TRX2 (Pin 19)	TRX3 (Pin 20)	TRX4 (Pin 2)	TRX5 (Pin 3)	TRX6 (Pin 4)	TRX7 (GSM_RX1) (Pin 17)	TRX8 (GSM_RX2) (Pin 15)
TXLB	915	–	-27	-53	-53	-55	-58	-62	-56	-51	-43
TXLB	1910	–	-35	-55	-58	-62	-63	-61	-59	-52	-47
TXLB	2700	–	-38	-55	-58	-62	-62	-60	-58	-52	-48
TXHB	915	-30	–	-55	-55	-57	-56	-60	-53	-55	-52
TXHB	1910	-37	–	-50	-48	-50	-47	-49	-45	-49	-47
TXHB	2700	-37	–	-54	-52	-53	-49	-52	-48	-54	-53
TRX1	915	-56	-36	–	-28	-36	-56	-62	-54	-32	-44
TRX1	1910	-57	-31	–	-23	-31	-46	-49	-45	-26	-37
TRX1	2700	-63	-34	–	-20	-28	-42	-45	-41	-23	-34
TRX2	915	-53	-36	-31	–	-30	-55	-61	-54	-38	-44
TRX2	1910	-60	-31	-26	–	-24	-46	-49	-45	-32	-37
TRX2	2700	-71	-34	-23	–	-21	-42	-45	-41	-29	-34
TRX3	915	-52	-36	-38	-32	–	-54	-61	-54	-41	-45
TRX3	1910	-62	-31	-32	-26	–	-45	-48	-45	-35	-38
TRX3	2700	-74	-34	-29	-24	–	-41	-44	-41	-32	-34
TRX4	915	-51	-36	-58	-56	-57	–	-29	-36	-59	-59
TRX4	1910	-65	-31	-51	-49	-50	–	-24	-31	-51	-51
TRX4	2700	-69	-33	-47	-45	-47	–	-21	-27	-47	-47
TRX5	915	-51	-37	-58	-56	-57	-33	–	-30	-58	-58
TRX5	1910	-63	-31	-51	-48	-50	-27	–	-24	-51	-50
TRX5	2700	-73	-34	-47	-45	-47	-24	–	-21	-47	-46



**Table 8. ANT to TX/TRX Isolation Matrix (2 of 2)**

"On" Port	Freq. (GHz)	Isolation									
		GSM_TX_LB (Pin 13)	GSM_TX_HB (Pin 10)	TRX1 (Pin 18)	TRX2 (Pin 19)	TRX3 (Pin 20)	TRX4 (Pin 2)	TRX5 (Pin 3)	TRX6 (Pin 4)	TRX7 (GSM_RX1) (Pin 17)	TRX8 (GSM_RX2) (Pin 15)
TRX6	915	-50	-37	-57	-55	-57	-38	-33	-	-58	-57
TRX6	1910	-62	-32	-50	-48	-50	-32	-27	-	-50	-50
TRX6	2700	-79	-34	-47	-45	-46	-29	-24	-	-47	-46
TRX7 (GSM_RX1)	915	-72	-36	-29	-35	-40	-56	-63	-55	-	-46
TRX7 (GSM_RX1)	1910	-55	-31	-23	-30	-34	-47	-50	-45	-	-39
TRX7 (GSM_RX1)	2700	-56	-34	-20	-27	-31	-43	-46	-41	-	-37
TRX8 (GSM_RX2)	915	-46	-35	-39	-40	-43	-57	-63	-55	-35	-
TRX8 (GSM_RX2)	1910	-48	-31	-33	-34	-37	-47	-50	-46	-29	-
TRX8 (GSM_RX2)	2700	-47	-34	-30	-31	-34	-43	-46	-41	-26	-

**Figure 11. 3<sup>rd</sup> Order Intermodulation Test Setup**

## Evaluation Board Description

The SKY13404-466LF Evaluation Board is used to test the performance of the SKY13404-466LF SP10T Switch. An Evaluation Board schematic diagram is provided in Figure 12. A recommended ESD protection circuit diagram is provided in Figure 13. An assembly drawing for the Evaluation Board is shown in Figure 14.

## Package Dimensions

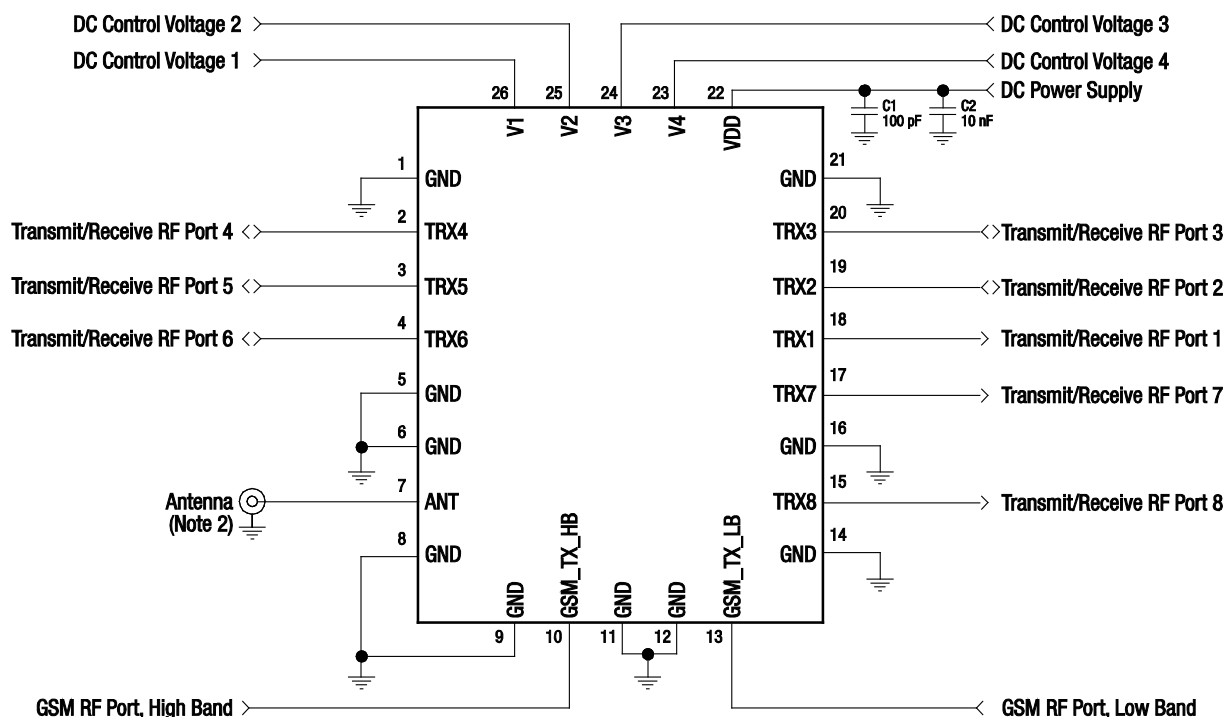
The PCB layout footprint for the SKY13404-466LF is provided in Figure 15. Typical case markings are shown in Figure 16. Package dimensions for the 26-pin QFN are shown in Figure 17, and tape and reel dimensions are provided in Figure 18.

## Package and Handling Information

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

THE SKY13404-466LF is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

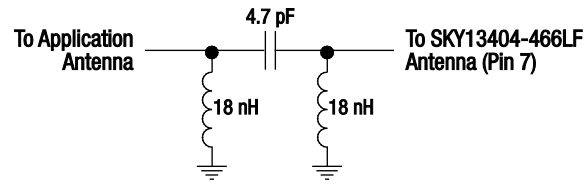


*Note 1: Some component labels may be different than the corresponding component symbol shown here. Component values, however, are accurate as of the date of this Data Sheet.*

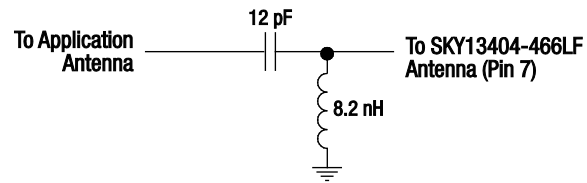
*Note 2: See Figure 22 for ESD protection circuit.*

S2519

**Figure 12. SKY13404-466LF Evaluation Board Schematic**



ESD Circuit 1



ESD Circuit 2

S2520

Figure 13. SKY13404-466LF Recommended ESD Protection Circuits

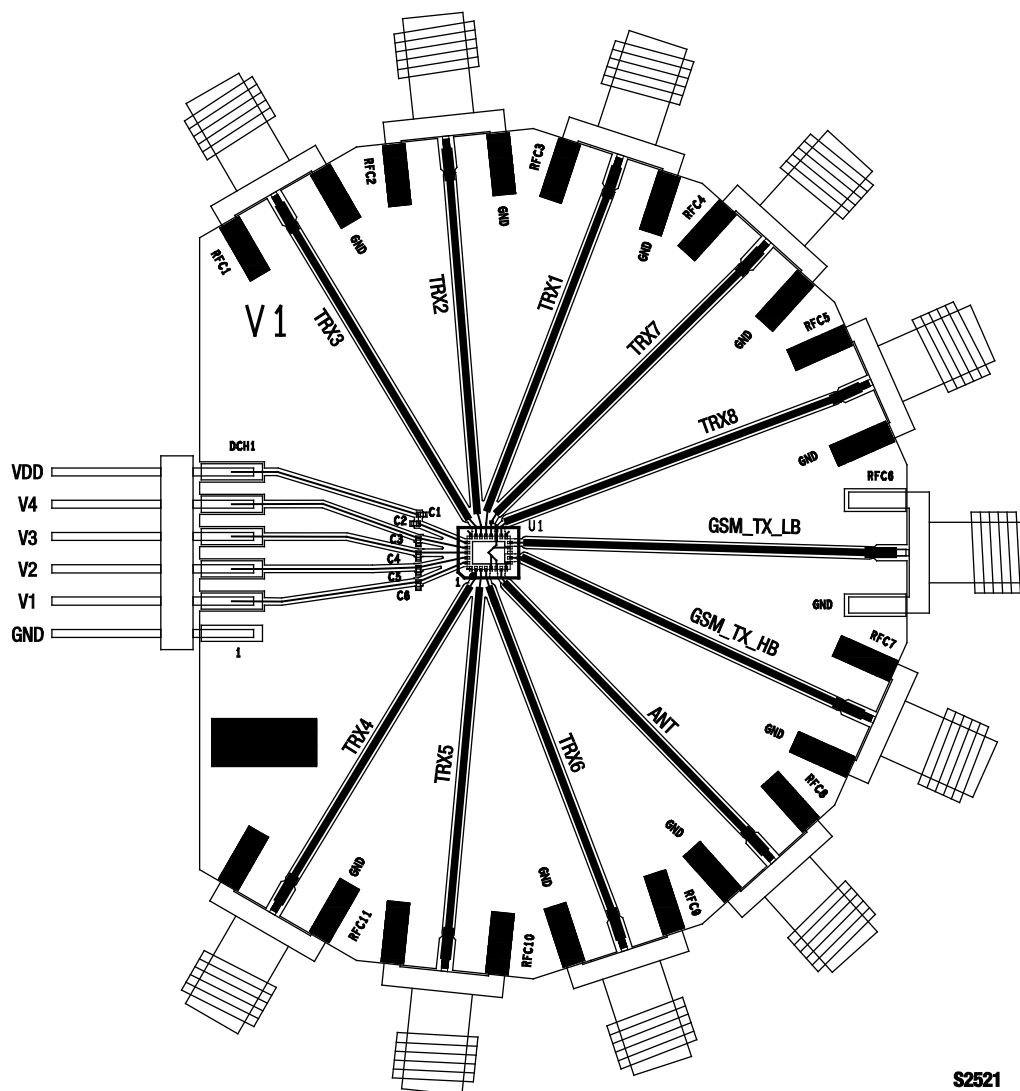
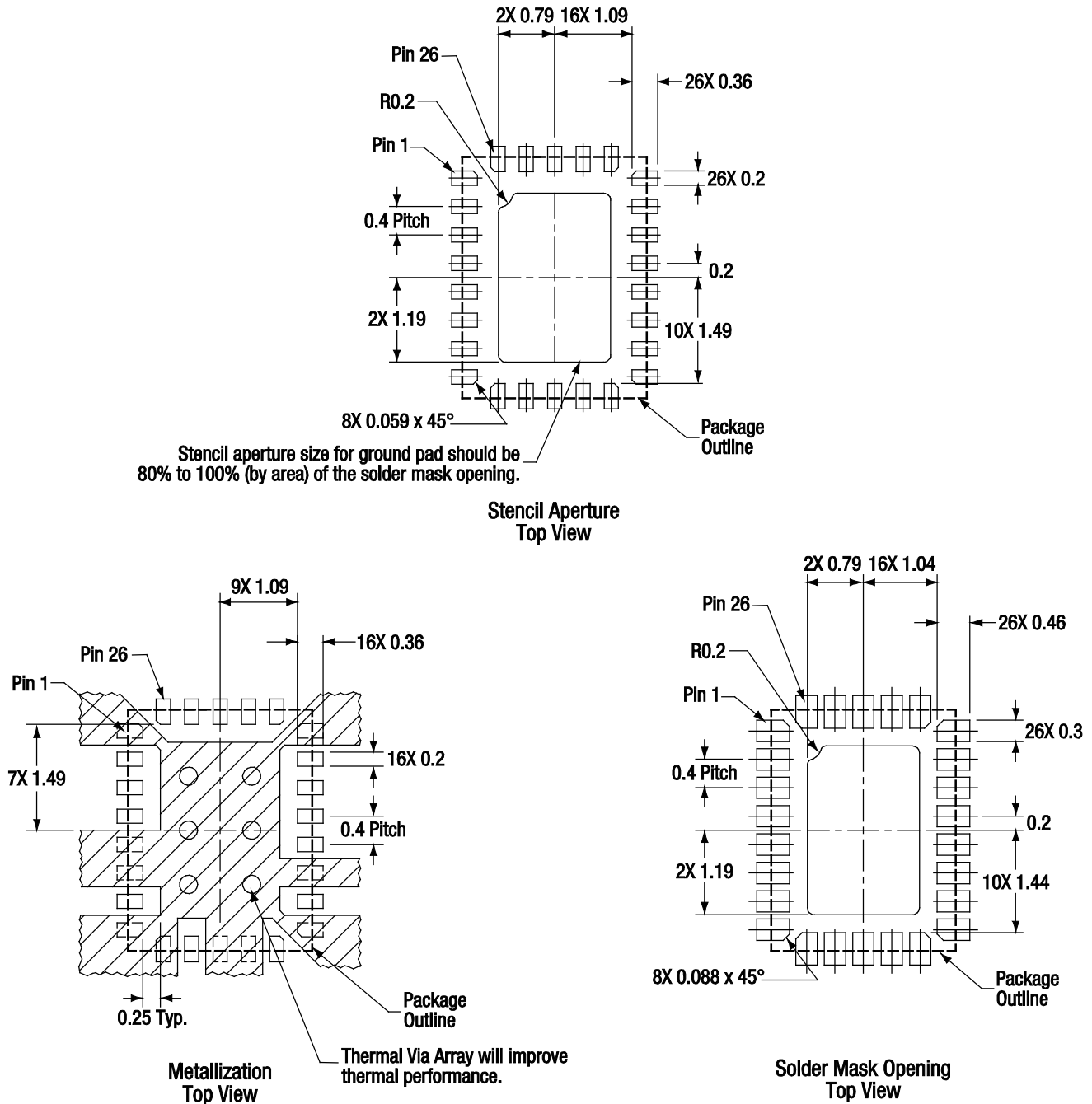


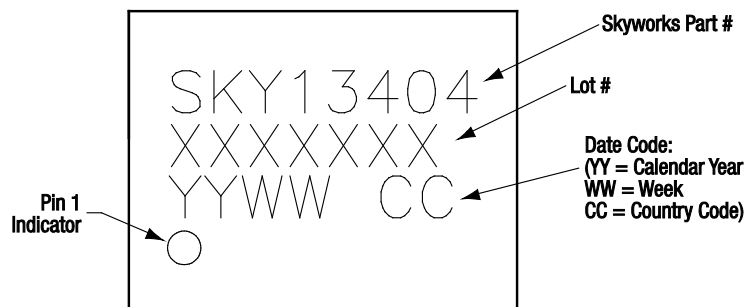
Figure 14. SKY13404-466LF Evaluation Board Assembly Diagram



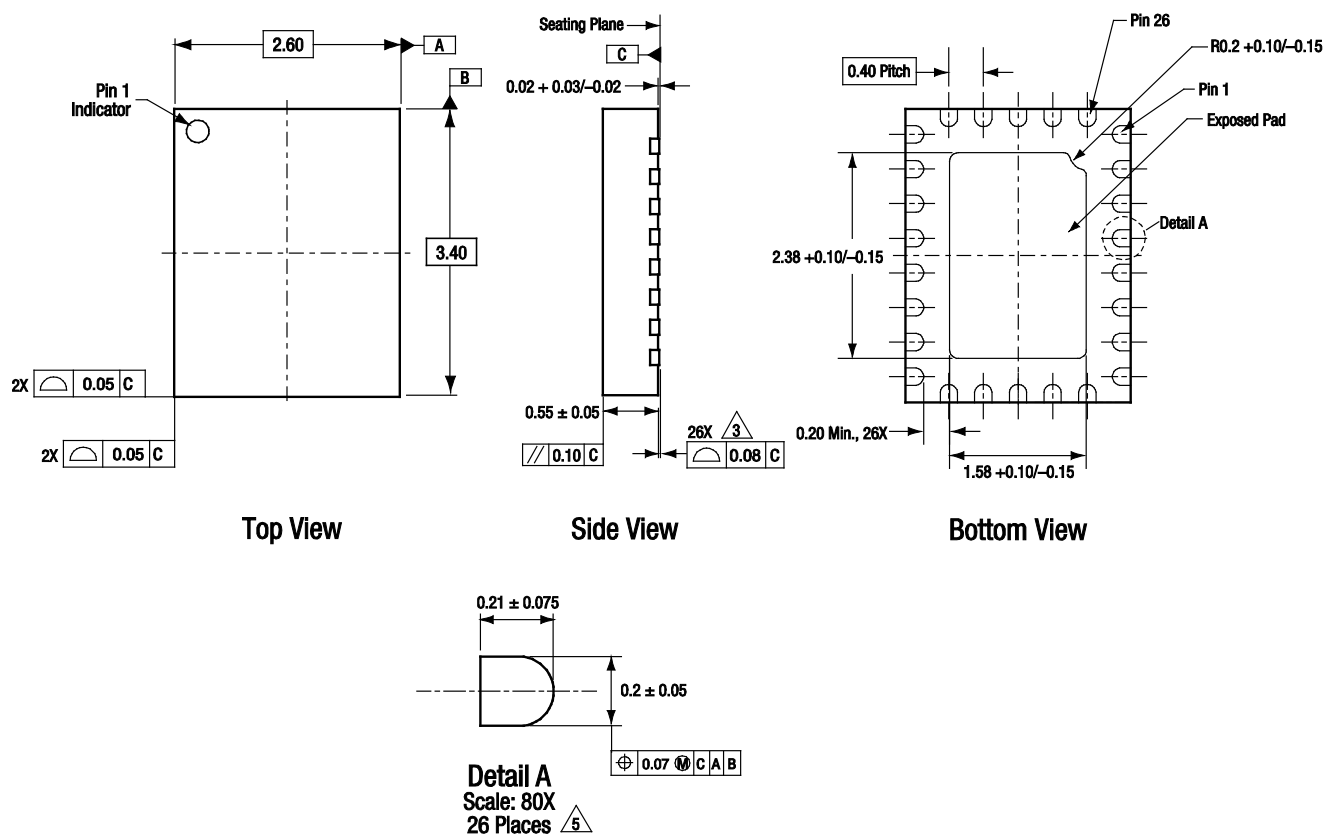
All dimensions are in millimeters

S2701

**Figure 15. SKY13404-466LF PCB Layout Footprint (Top View)**



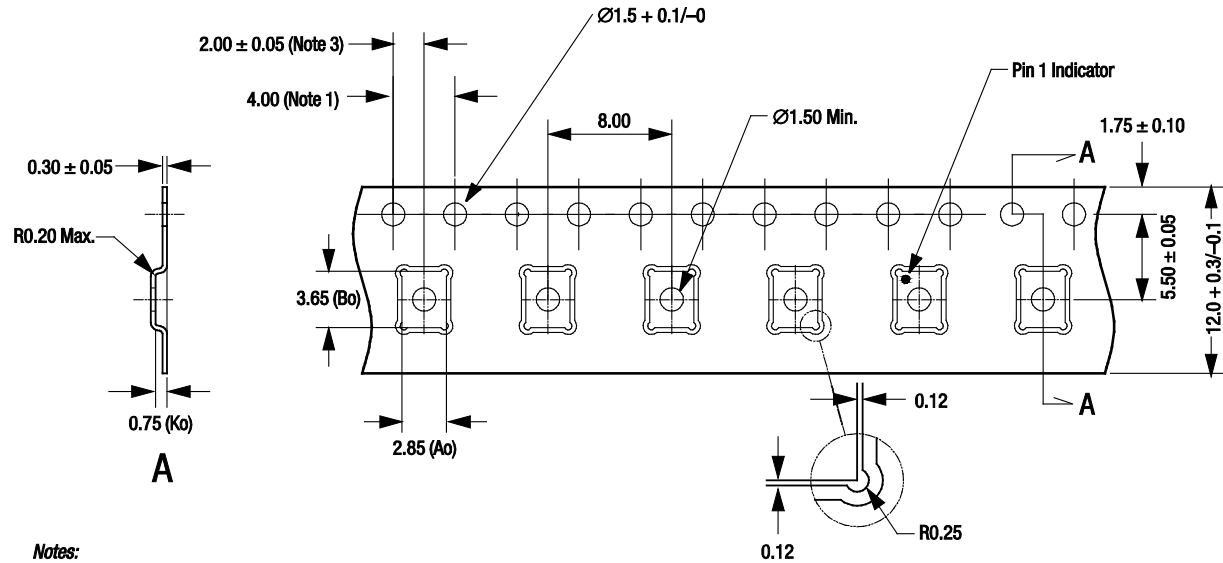
**Figure 16. Typical Part Markings (Top View)**



All measurements are in millimeters.  
Dimensioning and tolerancing according to ASME Y14.5M-1994.  
Coplanarity applies to the exposed bottom surface metalization, as well as the terminals..  
Plating requirement per source control drawing (SCD) 2504.

S2314

**Figure 17. SKY13404-466LF 26-Pin QFN Package Dimensions**



**Notes:**

1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.2$ .
2. Carrier tape material: black conductive polystyrene or polycarbonate.
3. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.
4. Cover tape material: transparent conductive material with 9.30 mm width.
5. All measurements are in millimeters.

S2951

**Figure 18. SKY13404-466LF Tape and Reel Dimensions**

## Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13404-466LF 0.4-2.2 GHz SP10T Switch	SKY13404-466LF	SKY13404-466LF-EVB

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