PRELIMINARY DATA SHEET

SKY13378-389LF: 0.4-2.2 GHz GaAs SP10T Switch with MIPI Decoder

Applications

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

Features

- Broadband frequency range: 0.4 to 2.2 GHz
- Single, positive DC power supply (2.5 to 3.0 V)
- Excellent triple beat ratio performance
- Integrated, low-pass harmonic filter for GSM transmit paths
- Integrated MIPI decoder
- Small QFN (26-pin, 3.0 x 3.8 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

NEW

Skyworks Green™ products are RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, are halogen free according to IEC-61249-2-21, and contain <1,000 ppm antimony trioxide in polymeric materials.

Description

The SKY13378-389LF is a GaAs pHEMT Single Pole, Ten-Throw (SP10T) antenna switch with an integrated Mobile Industry Processor Interface (MIPI) decoder and dual low-pass harmonic filters. The switch has five transmit/receive ports that make it ideal for any combination of 2G/3G multimode cellular applications.

Using advance switching technologies, the SKY13378-389LF maintains low insertion loss and high isolation for both transmit and receive switching paths. The switch also exhibits an excellent triple beat ratio and 2nd/3rd order modulation distortion performance.

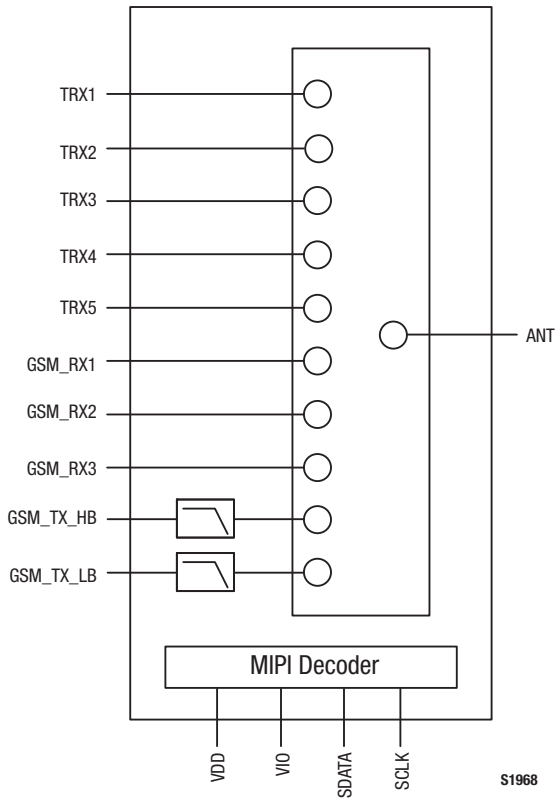

Figure 1. SKY13378-389LF Block Diagram

Switching is controlled by an integrated MIPI decoder. The VIO signal (pin 23) enables and disables the decoder. The SDATA and SCLK signals (pins 24 and 25, respectively) clock in the data to the decoder. 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 SKY13378-389LF is manufactured in a compact, 3.0 x 3.8 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.

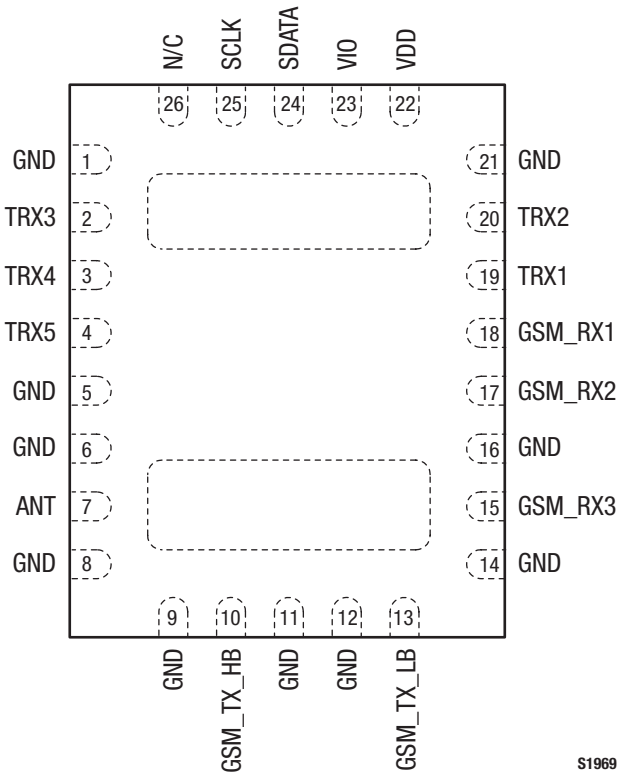

Figure 2. SKY13378-389LF Pinout – 26-Pin QFN
(Top View)

Table 1. SKY13378-389LF Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	GND	Ground	14	GND	Ground
2	TRX3	RF input/output port 3	15	GSM_RX3	GSM RF output port 3
3	TRX4	RF input/output port 4	16	GND	Ground
4	TRX5	RF input/output port 5	17	GSM_RX2	GSM RF output port 2
5	GND	Ground	18	GSM_RX1	GSM RF output port 1
6	GND	Ground	19	TRX1	RF input/output port 1
7	ANT	Antenna RF port	20	TRX2	RF input/output port 2
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	VIO	MIPI decoder enable
11	GND	Ground	24	SDATA	Serial data input
12	GND	Ground	25	SCLK	Clock input
13	GSM_TX_LB	GSM low band transmit RF input port with integrated harmonic filter	26	N/C	No connection. Pin may be connected to ground with no change in performance.

Note: Bottom ground paddles must be connected to ground.

Table 2. SKY13378-389LF Absolute Maximum Ratings

Parameter	Symbol	Minimum	Typical	Maximum	Units
RF input power	P_{IN}			+36	dBm
Power supply				5	V
Interface supply	VIO			1.9	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.

***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.*

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13378-389LF are provided in Table 2. Electrical specifications are provided in Table 3.

Typical performance characteristics of the SKY13378-389LF are illustrated in Figures 3 to 14.

The MIPI interface is programmed serially according to the logic shown in Tables 4, 5, and 6.

Figure 15 illustrates the test setup used to measure data for Figure 12. 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 TRX5 ports, while a –15 dBm CW blocker signal, f_{BLK}, is applied to the ANT port.

The resulting 3rd Order Intermodulation Distortion (IMD3), f_{RX}, is measured over all phases of f_{FUND} The SKY13378-389LF exhibits exceptional performance for all TRX ports.

Table 3. SKY13378-389LF Electrical Specifications (Note 1) (1 of 2)
(V_{DD} = 2.65 V, T_{OP} = +25 °C, P_{IN} = 0 dBm, Characteristic Impedance [Z_0] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
RF Specifications						
Insertion loss	IL	0.4 to 2.2 GHz				
		ANT to TRx ports		0.5	0.8	dB
		ANT to GSM_TX_LB port		1.0	1.2	dB
		ANT to GSM_TX_HB port		1.1	1.3	dB
		ANT to Rx ports		1.1	1.3	dB
Isolation	ISO	0.4 to 2.2 GHz, TRx1/2 to TRx3/4/5 ports	32			dB
		824 to 915 MHz, GSM_TX_LB to TRx/GSM Rx ports	30			dB
		1710 to 1910 MHz, GSM_TX_HB to TRx/GSM Rx ports	32			dB
		0.4 to 2.2 GHz, TRX3 to TRX5 port	25			dB
		0.4 to 2.2 GHz, TRX1 to TRX2, TRX3 to TRX4, and TRX4 to TRX5 ports	17			dB
		1805 to 1990 MHz, ANT to GSM_RX2 and GSM_RX3 ports	27			dB
Harmonics		UMTS	62			dBc
		GSM_TX_LB port, P_{IN} = +35 dBm	70	78		dBc
		GSM_TX_HB port, P_{IN} = +32 dBm	67	78		dBc
GSM transmit attenuation		2f, 3f	25			dB
		3f to 12.75 GHz	20			dB
Return loss	|S11|	0.4 to 2.2 GHz	14			dB
2nd Order Input Intercept Point	IIP2	AWS, PCS, IMT to CDMA2000 modes	+95.5			dBm
		Cellular to CDMA2000 mode	+113.5			dBm
		UMTS mode	+102.0			dBm
3rd Order Input Intercept Point	IIP3	UMTS mode	+61			dBm
Triple Beat Ratio	TBR	650 to 900 MHz		81		dBc
		1710 to 2155 MHz		81		dBc
GSM transmit low band 1 dB Input Compression Point	IP1dB	824 to 915 MHz	+40			dBm
GSM transmit high band 1 dB Input Compression Point	IP1dB	1710 to 1910 MHz	+39			dBm
8-PSK spectrum due to modulation		+30 dBm at ANT; 400, 600, 1800 kHz offset	70			dBc
Switching speed		10/90% RF		5		µs

Table 3. SKY13378-389LF Electrical Specifications (Note 1) (2 of 2)
(V_{DD} = 2.65 V, T_{OP} = +25 °C, P_{IN} = 0 dBm, Characteristic Impedance [Z_0] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
DC Specifications						
Supply voltage	V_{DD}		2.50	2.65	3.00	V
Supply current	I_{DD}				0.5	mA
Interface supply	VIO		1.15	1.80	1.90	V
Interface signal: High Low	SDATA		 0.8 × VIO 0		 VIO 0.2 × VIO	 V V
Control current: High Low				 5	50	 µA µA

Note 1: Performance is guaranteed only under the conditions listed in this Table.

Typical Performance Characteristics

(V_{DD} = 2.65 V, T_{OP} = +25 °C, P_{IN} = 0 dBm, Characteristic Impedance [Z_0] = 50 Ω, Unless Otherwise Noted)

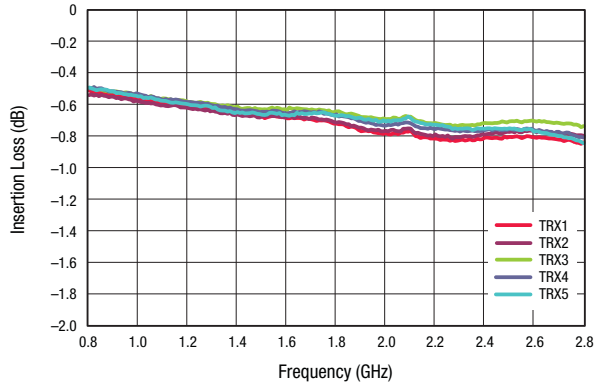

Figure 3. Insertion Loss vs Frequency (ANT to TRX Ports)

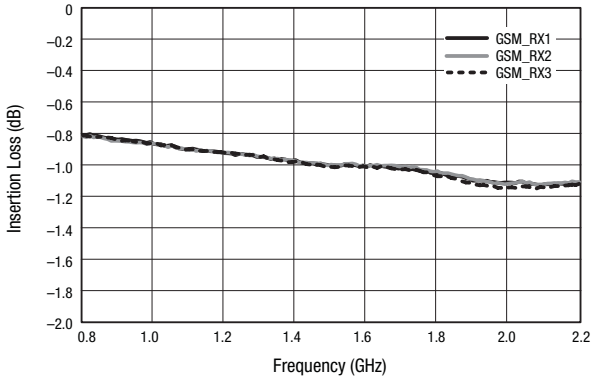

Figure 4. Insertion Loss vs Frequency (ANT to GSM_RX Ports

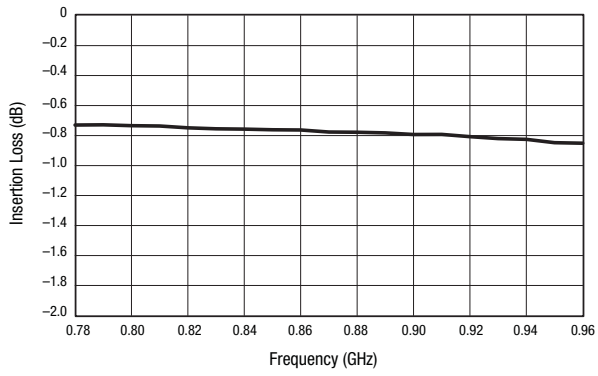

Figure 5. Insertion Loss vs Frequency (ANT to GSM_TX_LB Port)

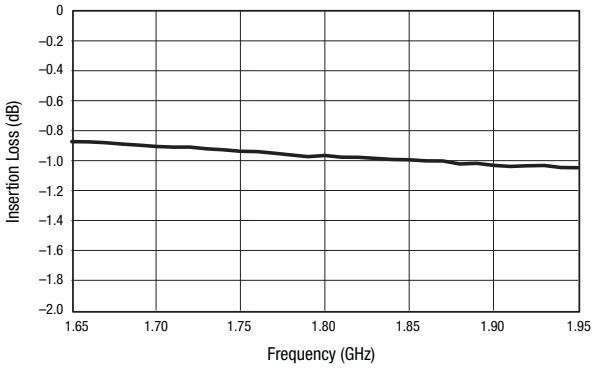

Figure 6. Insertion Loss vs Frequency (ANT to GSM_TX_HB Port)

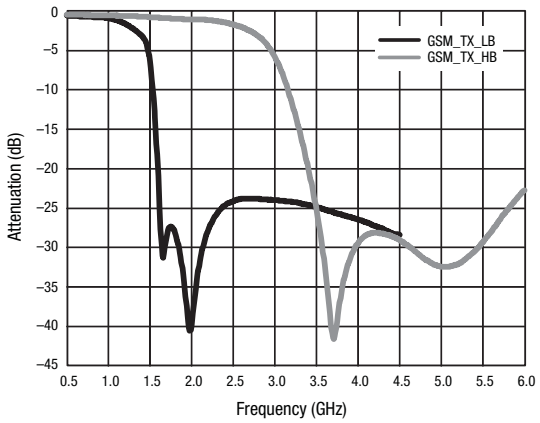

Figure 7. Attenuation vs Frequency (ANT to GSM_TX_HB/LB Ports)

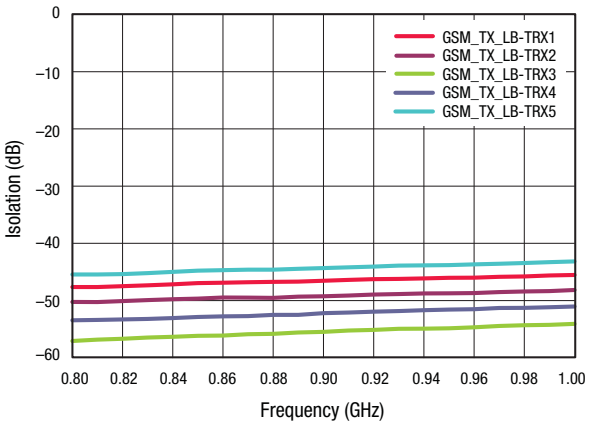

Figure 8. Isolation vs Frequency (GSM_TX_LB to TRX Ports)

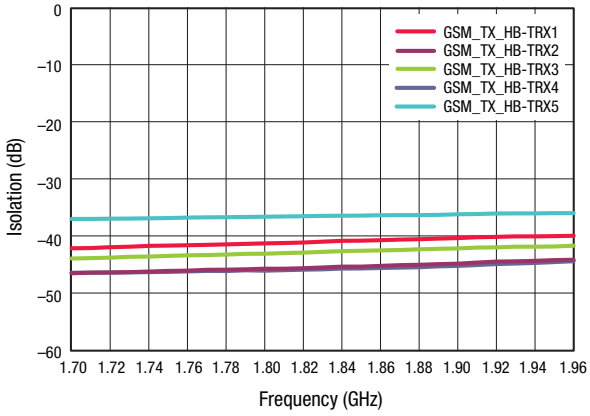

Figure 9. Isolation vs Frequency (GSM_TX_HB to TRX Ports)

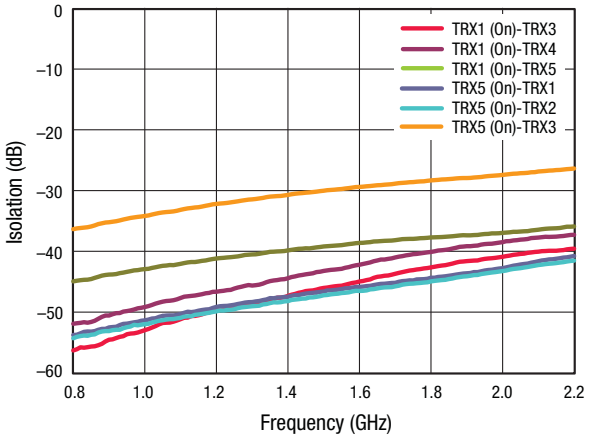

Figure 10. Isolation vs Frequency (TRX to TRX Ports)

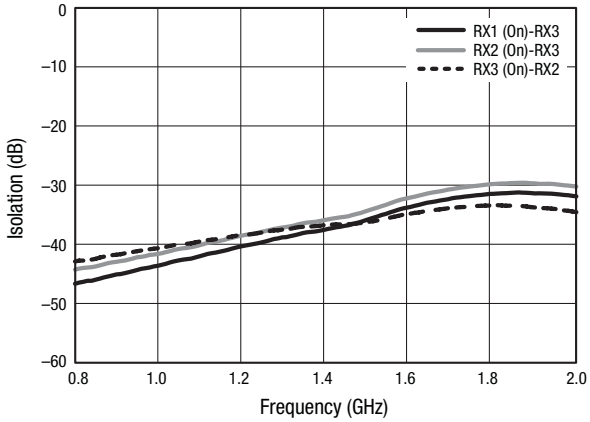

Figure 11. Isolation vs Frequency (GSM_RX to GSM_RX Ports)

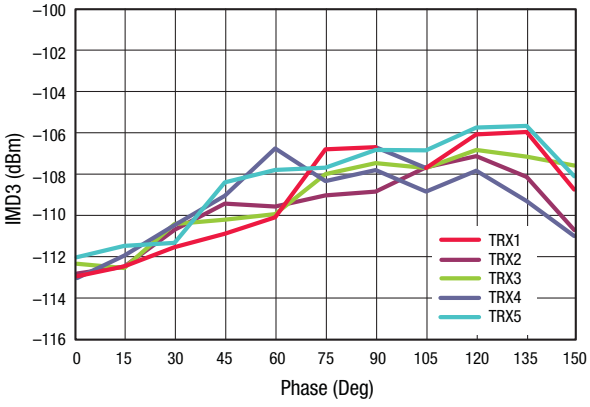

Figure 12. 3rd Order Intermodulation Distortion vs Phase, TRX Ports (f_{FUND} = 1.95 GHz, f_{BLK} = 1.76 GHz, f_{RX} = 2.14 GHz)

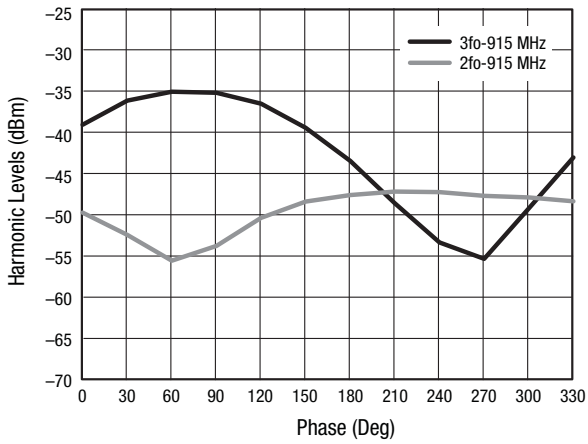

Figure 13. Harmonics vs Phase (ANT to GSM_TX_LB, P_{IN} = +35 dBm, 5:1 VSWR Mismatch)

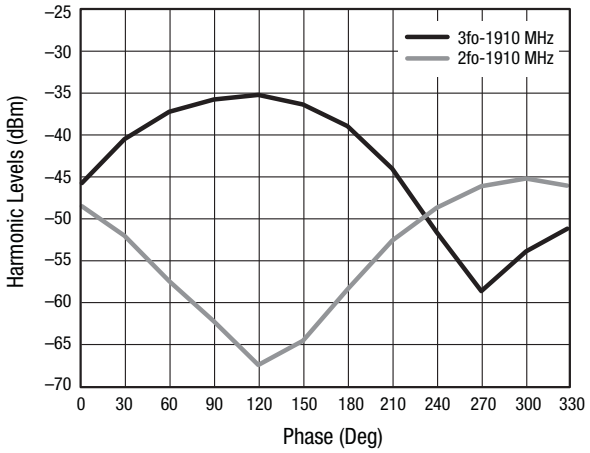

Figure 14. Harmonics vs Phase (ANT to GSM_TX_HB, P_{IN} = +33 dBm, 5:1 VSWR Mismatch)

Table 4. MIPI Interface Insertion Loss Logic (Note 1)

Insertion Loss State	SDATA Signal (Pin 24)			
	Bit 3	Bit 2	Bit 1	Bit 0
ANT to GSM_TX_LB	0	0	1	1
ANT to GSM_TX_HB	0	0	0	1
ANT to GSM_RX1	0	1	0	0
ANT to GSM_RX2	0	1	1	0
ANT to GSM_RX3	0	0	1	0
ANT to TRX1	0	1	0	1
ANT to TRX2	0	1	1	1
ANT to TRX3	1	1	0	1
ANT to TRX4	1	1	1	1
ANT to TRX5	1	0	0	1
Power off (low current) (Note 2)	0	0	0	0

Note 1: "1" = (0.8 × VIO – VIO); "0" = (0 – 0.2 × VIO). Any state other than that described in this Table places the switch into an undefined state. An undefined state will not damage the device.

Note 2: The power off (low current) state is also enabled when pin 23 (VIO) is pushed low.

Table 5. MIPI Interface Unique Slave Identifier (USID) Logic

USID	SDATA Signal (Pin 24)			
	Bit 3	Bit 2	Bit 1	Bit 0
	1	0	1	1

Table 6. MIPI Interface Skyworks Product ID (P_ID) Logic

P_ID	SDATA Signal (Pin 24)							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Skyworks	0	0	0	1	0	0	0	0

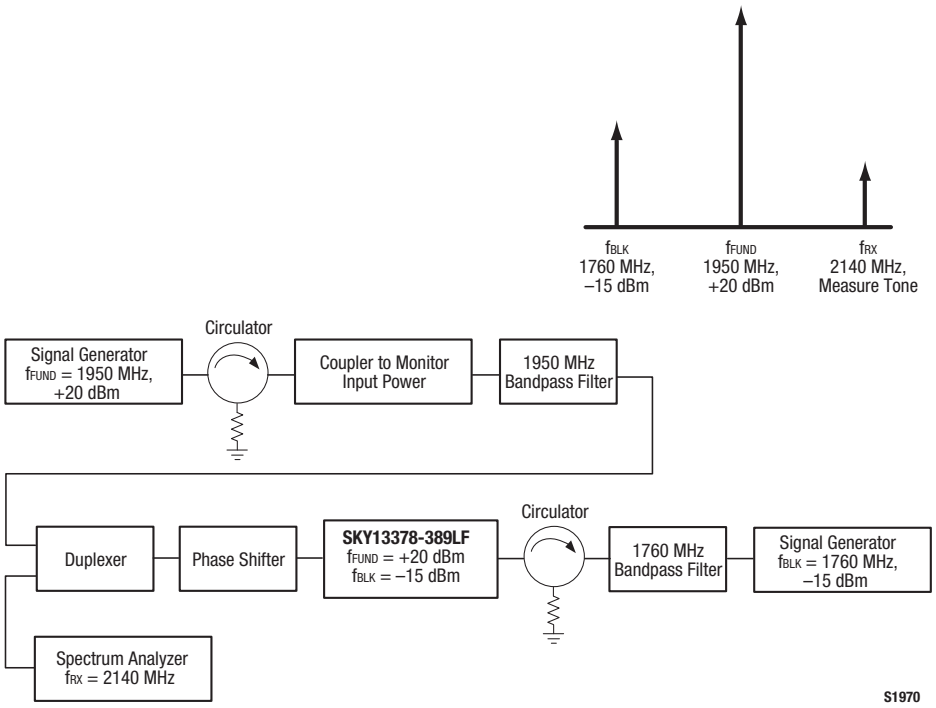

Figure 15. 3rd Order Intermodulation Test Setup

Evaluation Board Description

The SKY13378-389LF Evaluation Board is used to test the performance of the SKY13378-389LF SP10T Switch. An Evaluation Board schematic diagram is provided in Figure 16. An assembly drawing for the Evaluation Board is shown in Figure 17.

Package Dimensions

The PCB layout footprint for the SKY13378-389LF is provided in Figure 18. Typical case markings are shown in Figure 19. Package dimensions for the 26-pin QFN are shown in Figure 20, and tape and reel dimensions are provided in Figure 21.

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 SKY13378-389LF 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.

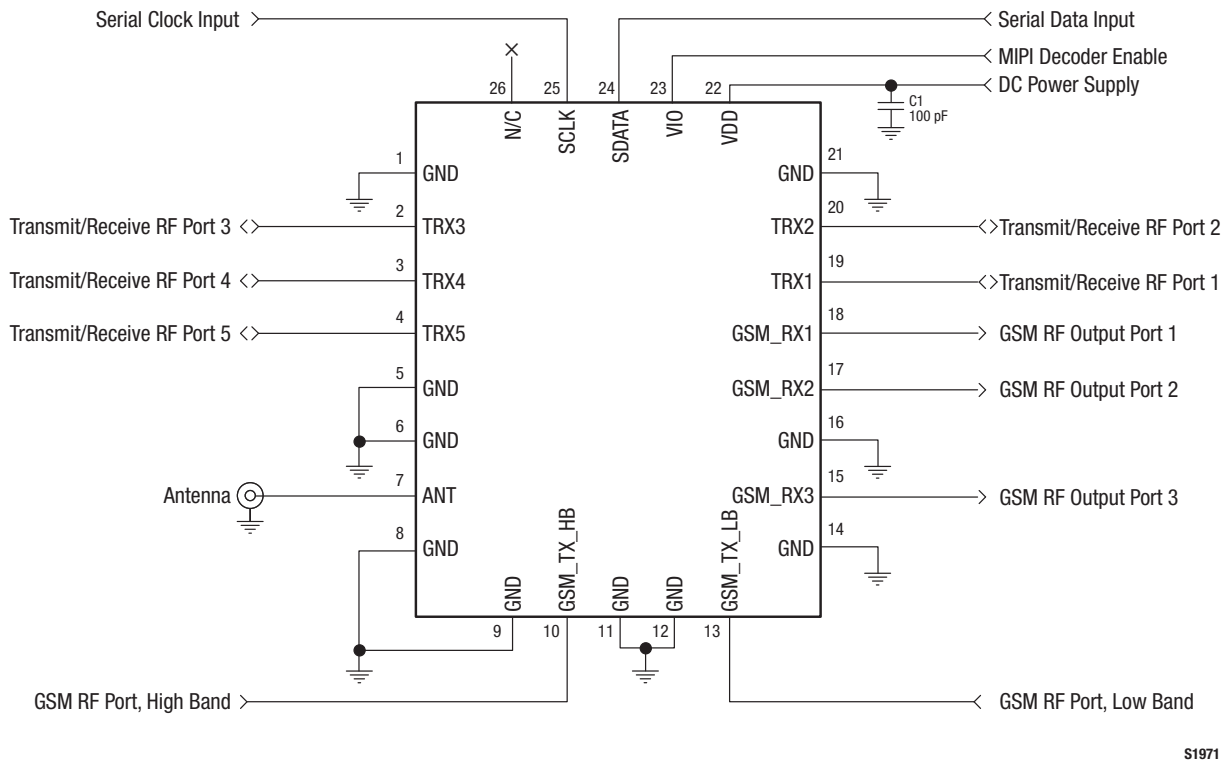

Figure 16. SKY13378-389LF Evaluation Board Schematic

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Figure 17. SKY13378-389LF Evaluation Board Assembly Diagram

*** TBD ***

Figure 18. SKY13378-389LF PCB Layout Footprint
(Top View)

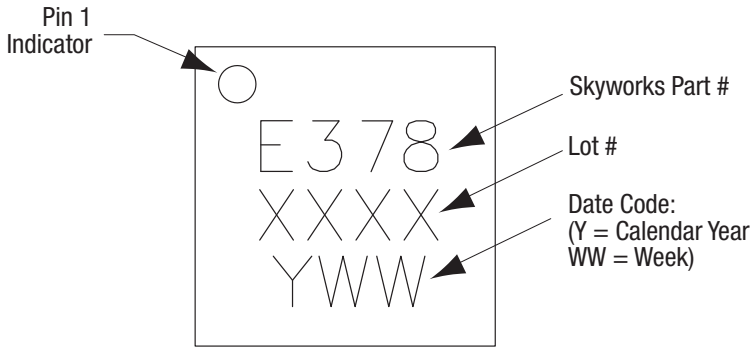
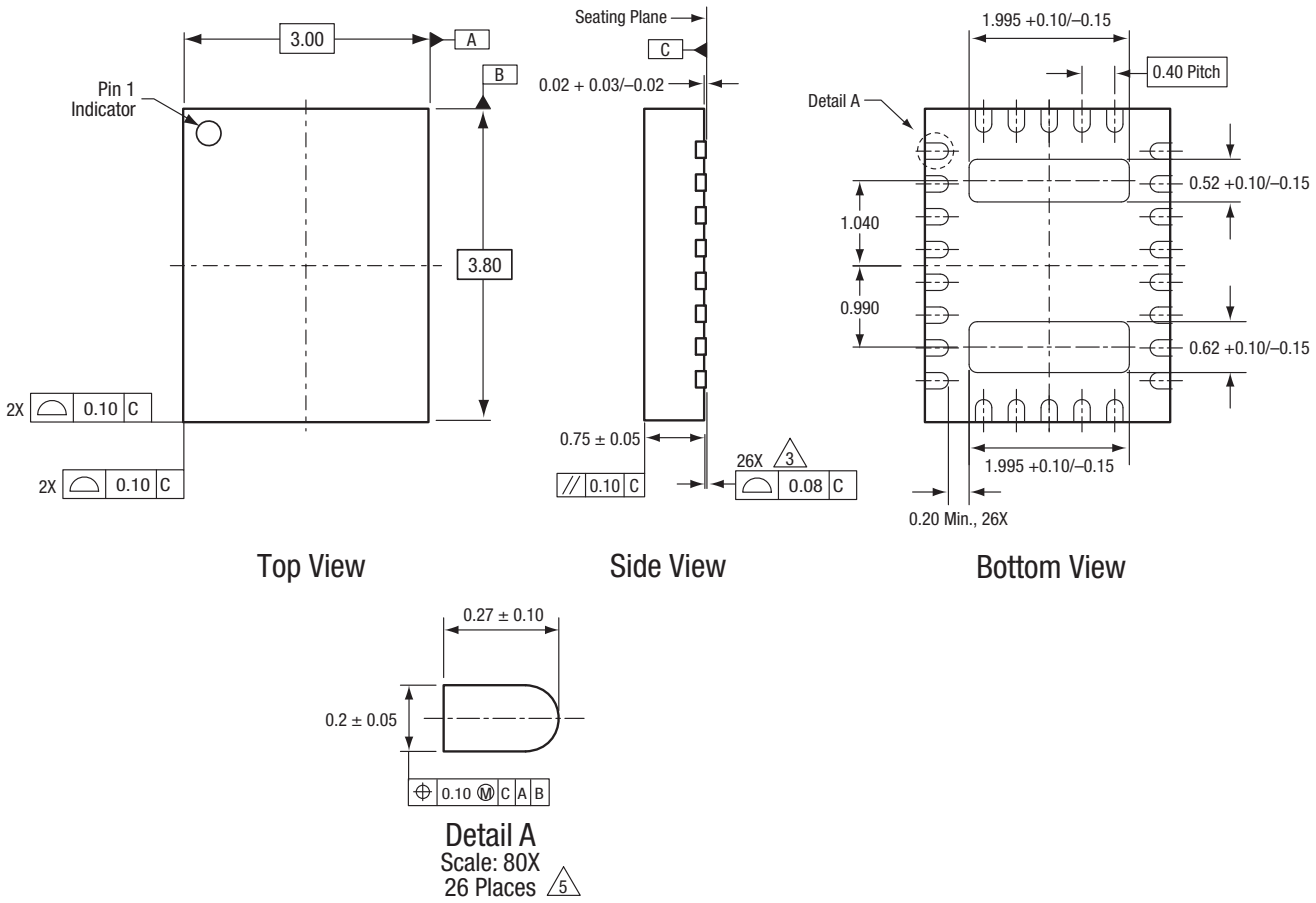


Figure 19. Typical Part Markings
(Top View)



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.

S1904

Figure 20. SKY13378-389LF 26-Pin QFN Package Dimensions

*** TBD ***

Figure 21. SKY13378-389LF Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13378-389LF 0.4-2.2 GHz SP10T Switch	SKY13378-389LF	***** TBD *****