

DATA SHEET

SKY77589-11 Tx-Rx Quad-Band Front-End Module for GSM / GPRS (824-915 MHz) (1710-1910 MHz) w/ Six Linear TRx Switch Ports

Applications

- Quad-band cellular handsets encompassing
 - Class 4 GSM850 / GSM900
 - DCS1800 / PCS1900
 - Class 12 GPRS multi-slot operation
 - EDGE downlink compatible

Features

- High efficiency
 - 42% (GSM850)
 - 45% (GSM900)
 - 39% (DCS1800 / PCS1900)
- Low transmit supply current
 - 1.35 A (GSM850)
 - 1.26 A (GSM900)
 - 0.92 A (DCS1800 / PCS1900)
- 50 Ω matched Input/Output
- Tx-VCO-to-antenna and antenna-to-Rx-SAW filter RF interface
- RF switch affords high linearity, low insertion loss, and 0 V DC on Rx ports
- Small, low profile package
 - 6 mm x 6 mm x 0.9 mm
 - 28-pad configuration



Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to Skyworks Definition of Green™, document number SQQ4-0074.

Description

SKY77589-11 is a transmit and receive Front-End Module (FEM) with integrated power amplifier control designed in a low profile, compact form factor for quad-band cellular handsets comprising GSM850 / GSM900 and DCS1800 / PCS1900 operation. The SKY77589-11 offers a complete Transmit VCO-to-Antenna and Antenna-to-Receive SAW filter solution. The FEM also supports Class 12 General Packet Radio Service (GPRS) multi-slot operation and EDGE downlink.

The module consists of a GSM850 / GSM900 PA block and a DCS1800 / PCS1900 PA block, impedance-matching circuitry for 50 ohm input and output impedances, Tx harmonics filtering, high linearity / low insertion loss RF switch, and a Power Amplifier Control (PAC) block. One PA block supports the GSM850 / GSM900 bands and the other PA block supports the DCS1800 / PCS1900 bands. Both PA blocks share common power supply pads to distribute current. The output of each PA block and the outputs to the six receive pads are connected to the antenna pad through an RF switch. Six broadband interchangeable receive ports provide flexibility to support multimode and multiband configurations. The GaAs die, the CMOS die, the Switch die, and passive components are mounted on a multi-layer laminate substrate. The assembly is encapsulated with plastic overmold.

Band selection and control of transmit and receive are performed using four external control pads. Refer to the block diagram in Figure 1 below. The band select pad, BS1, BS2, Mode, and TxEN select GSM850, GSM900, DCS, and PCS modes of operation.

Transmit enable TxEN controls receive or transmit mode of the RF switch (Tx = logic 1). Proper timing between transmit enable TxEN and Analog Power Control VRAMP allows for high isolation between the antenna and Tx-VCO while the VCO is being tuned prior to the transmit burst.

The SKY77589-11 is compatible with logic levels from 1.2 V to 2.9 V for BS1, BS2, MODE, and TxEN pads.

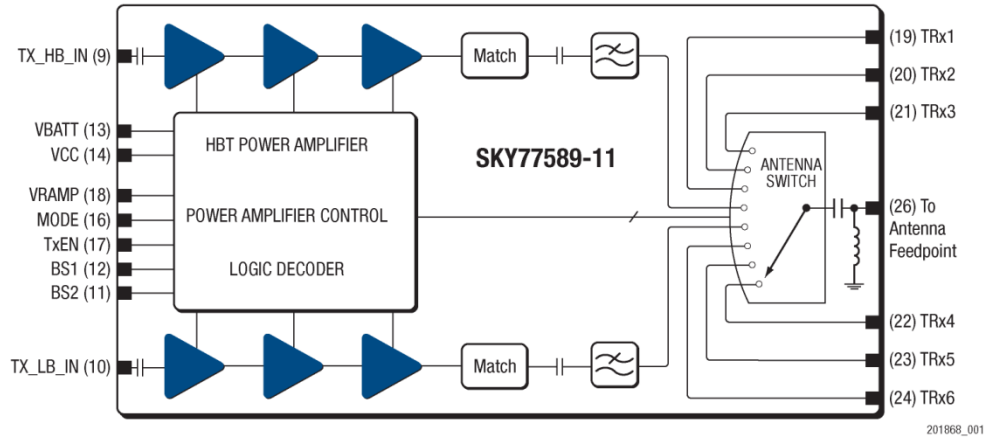


Figure 1. SKY77589-11 Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the SKY77589-11 Front-End Module. The absolute maximum ratings and recommended operating conditions for the SKY77589-11 are listed in Table 1 and Table 2, respectively. Table 3 specifies the mode control logic and Tables 4 through 9 contain the electrical characteristics of the SKY77589-11 for modes GSM850 /

GSM900 and DCS1800 / PCS1900. Figure 2 presents an application schematic for the SKY77589-11.

The SKY77589-11 is a static-sensitive electronic device and should not be stored or operated near strong electrostatic fields. Detailed information on device dimensions, pad descriptions, packaging and handling can be found in later sections of this data sheet.

Table 1. SKY77589-11 Absolute Maximum Ratings

No damage assuming only one parameter is set at limit with all other parameters set at nominal value.

Parameter	Minimum	Nominal	Maximum	Unit
Input Power (P _{IN})	—	—	15	dBm
Supply Voltage (V _{CC}) ¹	Standby	—	6	V
	BS1, BS2, MODE, TxEN	—	V _{BATT}	
Control Voltage (V _{RAMP})	-0.5	—	V _{BATT}	V
Temperature ²	Operating	-40	+25	+85
		Storage	-55	+25
				°C

¹ Standby [Supply voltage < 1 μs (measurement to ground)]

² Ambient temperature.

Table 2. SKY77589-11 Recommended Operating Conditions

Parameter	Minimum	Nominal	Maximum	Unit
Supply Voltage – GMSK ¹	V _{BATT} ²	3.1	3.5	V
	V _{CC}	2.5	3.5	
Operating Case Temperature (T _{CASE}) ³	1-Slot (12.5% duty cycle)	-20	—	+85
	2-Slot (25% duty cycle)	-20	—	+85
	3-Slot (37.5% duty cycle) ⁴	-20	—	+85
	4-Slot (50% duty cycle) ⁴	-20	—	+85
				°C

¹ V_{BATT} and V_{CC} should be common unless DC/DC is used and V_{CC} can be separately supplied.

² For dual-V_{CC} application, the value of V_{BATT} needs to be higher than the value of “IO control voltage minus 0.5 V”.

³ Case Operating Temperature refers to the temperature of the GROUND PAD on the underside of the package.

⁴ Maximum output power must be reduced by 6 dB to support 3-slot and 4-slot operation.

Table 3. SKY77589-11 Mode Control Logic

Mode	Input Control Bits			
	TxEN	MODE	BS1	BS2
Standby	0	0	0	0
LB_GMSK_Tx	1	0	0	1
HB_GMSK_Tx	1	0	1	1
TRx1	0	1	0	0
TRx2	0	1	1	0
TRx3	0	1	0	1
TRx4	0	1	1	1
TRx5	0	0	1	0
TRx6	0	0	0	1

Table 4. SKY77589-11 Electrical Specifications

Unless otherwise specified: T_{CASE} = -20 °C to max. operating temperature (see Table 2); RL = 50 Ω; pulsed operation with pulse width ≤ 1154 μs; duty cycle ≤ 2:8; 3.1 V ≤ V_{CC} ≤ 4.3 V

General								
Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Unit		
Supply Voltage	V _{BATT}	—	3.1	3.5	4.3	V		
	V _{CC}	—	2.5	3.5	4.3			
Power Control Impedance	Z _{VRAMP}	—	5	—	—	MΩ		
BS1 Control Voltage	LOW	V _{BS1_LOW}	-0.1	—	0.3	V		
	HIGH	V _{BS1_HIGH}	1.2	—	Note 1			
BS1 Current	I _{BS1}	—	—	—	36	μA		
BS2 Control Voltage	LOW	V _{BS2_LOW}	-0.1	—	0.3	V		
	HIGH	V _{BS2_HIGH}	1.2	—	Note 1			
BS2 Current	I _{BS2}	—	—	—	36	μA		
MODE Control Voltage	LOW	V _{MODE_LOW}	-0.1	—	0.3	V		
	HIGH	V _{MODE_HIGH}	1.2	—	Note 1			
MODE Select Current	I _{MODE}	—	—	—	36	μA		
TxEN Control Voltage	LOW	V _{TxEN_LOW}	-0.1	—	0.3	V		
	HIGH	V _{TxEN_HIGH}	1.2	—	Note 1			
TxEN Control Current	I _{TxEN}	—	—	—	36	μA		
Leakage Current	Standby Mode	I _{QS}	3.1 V ≤ V _{CC} ≤ 4.3 V, BS1 = V _{BS1_LOW} , V _{RAMP} ≤ 0.1 V, TxEN ≤ TxEN _{LOW} , BS2 ≤ V _{BS2_LOW} , MODE < V _{MODE_LOW} , T _{CASE} = +25 °C, P _{IN} ≤ -60 dBm		—	10	25	μA
	WCDMA Mode	I _{QMODE}	3.1 V ≤ V _{CC} ≤ 4.3 V, V _{RAMP} ≤ 0.1 V, TxEN ≤ TxEN _{LOW} , T _{CASE} = +25 °C, P _{IN} ≤ -60 dBm		—	70	120	

¹ Apply the lesser of 2.9 V or V_{CC}.

Table 5. SKY77589-11 Electrical Specifications

Unless otherwise specified: T_{CASE} = -20 °C to max. operating temperature (see Table 2); RL = 50 Ω; pulsed operation with pulse width ≤ 1154 μs; duty cycle ≤ 2:8; 3.1 V ≤ V_{CC} ≤ 4.3 V

GSM850 (Tx_LB) Mode (f = 824 MHz to 849 MHz; 0 dBm ≤ P _{IN} ≤ 6 dBm)						
Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Unit
Frequency Range	f	—	824	—	849	MHz
Input Power	P _{IN}	—	0	—	6	dBm
Analog Power Control Voltage	V _{RAMP}	Minimum PCL to P _{RATED}	—	—	1.6	V
Power Added Efficiency	PAE	V _{CC} = 3.5 V, P _{OUT} = 33 dBm, P _{IN} = 3 dBm, duty cycle 1:8, T _{CASE} = +25 °C	—	42	—	%
Supply Current at Rated Power	I _{CC_33 dBm}	V _{CC} = 3.5 V, P _{OUT} = 33 dBm, P _{IN} = 3 dBm, duty cycle 1:8, T _{CASE} = +25 °C	—	1.35	—	A
Harmonics	2f ₀ to 13f ₀	BW = 3 MHz, 5 dBm ≤ P _{OUT} ≤ 33 dBm, V _{RAMP} controlled ¹	—	-40	-33	dBm
Output Power	P _{OUT_MAX}	V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{IN} = 0 dBm	—	34.4	—	dBm
	P _{OUT_MAX_EXTREME}	V _{CC} = 3.1 V, -20 °C ≤ T _{CASE} ≤ +85 °C; P _{IN} = 0 dBm	31.0	—	—	
Input VSWR	Γ _{IN}	5 dBm ≤ P _{OUT} ≤ 33 dBm, V _{RAMP} controlled ¹	—	1.5:1	2.5:1	
Forward Isolation ²	P _{OUT_RX}	P _{IN} = 6 dBm, V _{RAMP} ≤ 0.1 V, BS1 = V _{BS1_LOW} , BS2 = V _{BS2_LOW} , TxEN = V _{TxEN_LOW}	—	-58	-42	dBm
	P _{OUT_ENABLED_TX}	P _{IN} = 6 dBm, V _{RAMP} ≤ 0.1 V, BS1 = V _{BS1_LOW} , BS2 = V _{BS2_HIGH} , TxEN = V _{TxEN_HIGH}	—	-40	-15	
Coupling of GSM850/900 Tx Output (f ₀) to Rx Output pad ²	CGHI_Tx-Rx_f ₀	5 dBm ≤ P _{OUT} ≤ 33 dBm	—	—	0	dBm
Coupling of GSM850/900 Tx Output (2f ₀ , 3f ₀) to Rx Output pad ²	CGHI_Tx-DCS_Rx	5 dBm ≤ P _{OUT} ≤ 33 dBm	—	—	-36	dBm
Spurious	Spur	All combinations of the following parameters: V _{RAMP} = controlled ¹ , P _{IN} = min. to max, 3.1 V ≤ V _{CC} ≤ 4.3 V, -20 °C ≤ T _{CASE} ≤ +85 °C, Load VSWR = 12:1, all phase angles	No parasitic oscillation > -36 dBm			
Load Mismatch	Load	All combinations of the following parameters: V _{RAMP} = controlled ¹ , P _{IN} = min. to max, 3.1 V ≤ V _{CC} ≤ 4.3 V, -20 °C ≤ T _{CASE} ≤ +85 °C, Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Noise	RX_NOISE	At f ₀ + 20 MHz (869 MHz to 894 MHz), RBW = 100 kHz, V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{OUT} = 33 dBm	—	-85	-83	dBm
		At 1930 MHz to 1990 MHz, RBW = 100 kHz, V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{OUT} = 33 dBm	—	—	-84	
Power Control Dynamic Range	PCDR	—	30	—	—	dB
Power Control Slope	PCs	V _{CC} = 3.5 V, P _{IN} = 3 dBm, P _{OUT} = 5 dBm, T _{CASE} = +25 °C	—	65	—	dB/V

¹ V_{RAMP} is calibrated to each PCL at T_{CASE} = +25 °C, V_{BATT} = 3.5 V, P_{IN} = 3 dBm, 50 Ω load.

² Terminate all unused RF ports with 50 Ω loads

Table 6. SKY77589-11 Electrical Specifications

Unless otherwise specified: T_{CASE} = -20 °C to max. operating temperature (see Table 2); R_L = 50 Ω; pulsed operation with pulse width ≤ 1154 μs; duty cycle ≤ 2:8; 3.1 V ≤ V_{CC} ≤ 4.3 V

GSM900 (Tx_LB) Mode (f = 880 MHz to 915 MHz, 0 dBm ≤ P _{IN} ≤ 6 dBm)						
Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Units
Frequency Range	f	—	880	—	915	MHz
Input Power	P _{IN}	—	0	—	6	dBm
Analog Power Control Voltage	V _{RAMP}	Minimum PCL to PRATED	—	—	1.6	V
Power Added Efficiency	PAE	V _{CC} = 3.5 V, P _{OUT} = 33 dBm, P _{IN} = 3 dBm, duty cycle 1:8, T _{CASE} = +25 °C	—	45	—	%
Supply Current at Rated Power	I _{CC_33 dBm}	V _{CC} = 3.5 V, P _{OUT} = 33 dBm, P _{IN} = 3 dBm, duty cycle 1:8, T _{CASE} = +25 °C	—	1.26	—	A
Harmonics	2f ₀ to 13f ₀	BW = 3 MHz, 5 dBm ≤ P _{OUT} ≤ 33 dBm, V _{RAMP} controlled ¹	—	-40	-33	dBm
Output Power	P _{OUT_MAX}	V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{IN} = 0 dBm	—	34.3	—	dBm
	P _{OUT_MAX_EXTREME}	V _{CC} = 3.1 V, -20 °C ≤ T _{CASE} ≤ +85 °C, P _{IN} = 0 dBm	31.00	—	—	
Input VSWR	Γ _{IN}	P _{OUT} = 5 dBm to 33 dBm, V _{RAMP} controlled ¹	—	1.5:1	2.5:1	
Forward Isolation ²	P _{OUT_RX}	P _{IN} = 6 dBm, V _{RAMP} ≤ 0.1 V BS1 = V _{BS1_LOW} , BS2 = V _{BS2_LOW} , TxEN = V _{TxEN_LOW}	—	-58	-42	dBm
	P _{OUT_ENABLED_TX}	P _{IN} = 6 dBm, V _{RAMP} ≤ 0.1 V, BS1 = V _{BS1_LOW} , BS2 = V _{BS2_HIGH} , TxEN = V _{TxEN_HIGH}	—	-40	-15	
Coupling of GSM850/900 Tx Output (f ₀) to Rx Output pad ²	CGHI_Tx-Rx_f0	5 dBm ≤ P _{OUT} ≤ 33 dBm	—	—	0	dBm
Coupling of GSM850/900 Tx Output (2f ₀ , 3f ₀) to Rx Output pad ²	CGHI_Tx_Rx	5 dBm ≤ P _{OUT} ≤ 33 dBm	—	—	-36	dBm
Spurious	Spur	All combinations of the following parameters: V _{RAMP} = controlled ¹ , P _{IN} = min. to max, 3.1 V ≤ V _{CC} ≤ 4.3 V, -20 °C ≤ T _{CASE} ≤ +85 °C, Load VSWR = 12:1, all phase angles	No parasitic oscillation > -36 dBm			
Load Mismatch	Load	All combinations of the following parameters: V _{RAMP} = controlled ¹ , P _{IN} = min. to max, 3.1 V ≤ V _{CC} ≤ 4.3 V, -20 °C ≤ T _{CASE} ≤ +85 °C, Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Noise	RX_NOISE	At f ₀ + 20 MHz (935 MHz to 960 MHz), RBW = 100 kHz, V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{OUT} = 33 dBm	—	-85	-83	dBm
		At f ₀ + 10 MHz (925 MHz to 935 MHz), RBW = 100 kHz, V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{OUT} = 33 dBm	—	—	-76	
		At 1805 MHz to 1880 MHz, RBW = 100 kHz, V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{OUT} = 33 dBm	—	-101	-84	
Power Control Dynamic Range	PCDR	—	30	—	—	dB
Power Control Slope	PCs	V _{CC} = 3.5 V, P _{IN} = 3 dBm, P _{OUT} = 5 dBm, T _{CASE} = +25 °C	—	65	—	dB/V

¹ V_{RAMP} is calibrated to each PCL at T_{CASE} = +25 °C, V_{BATT} = 3.5 V, P_{IN} = 3 dBm, 50 Ω load.

² Terminate all unused RF ports with 50 Ω loads

Table 7. SKY77589-11 Electrical Specifications

Unless otherwise specified: T_{CASE} = -20 °C to max. operating temperature (see Table 2); RL = 50 Ω; pulsed operation with pulse width ≤ 1154 μs and duty cycle ≤ 2:8; 3.1 V ≤ V_{CC} ≤ 4.3 V

DCS1800 (Tx_HB) Mode (f = 1710 MHz to 1785 MHz, 0 dBm ≤ P _{IN} ≤ 6 dBm)						
Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Units
Frequency Range	f	—	1710	—	1785	MHz
Input Power	P _{IN}	—	0	—	6	dBm
Analog Power Control Voltage	V _{RAMP}	Minimum PCL to P _{RATED}	—	—	1.6	V
Power Added Efficiency	PAE	V _{CC} = 3.5 V, P _{OUT} = 31 dBm, P _{IN} = 3 dBm, duty cycle 1:8, T _{CASE} = +25 °C	—	39	—	%
Supply Current at Rated Power	I _{CC_31 dBm}	V _{CC} = 3.5 V, P _{OUT} = 31 dBm, P _{IN} = 3 dBm, duty cycle 1:8, T _{CASE} = +25 °C	—	0.92	—	A
Harmonics	2f ₀ to 7f ₀	BW = 3 MHz, 0 dBm ≤ P _{OUT} ≤ 31 dBm, V _{RAMP} controlled ¹	—	-40	-33	dBm
Output Power	P _{OUT_MAX}	V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{IN} = 0 dBm	—	32.0	—	dBm
	P _{OUT_MAX_EXTREME}	V _{CC} = 3.1 V, -20 °C ≤ T _{CASE} ≤ +85 °C, P _{IN} = 0 dBm	29.0	—	—	
Input VSWR	Γ _{IN}	0 dBm ≤ P _{OUT} ≤ 31 dBm, V _{RAMP} controlled ¹	—	1.5:1	2.5:1	—
Forward Isolation ²	P _{OUT_RX}	P _{IN} = 6 dBm, V _{RAMP} ≤ 0.1 V, BS1 = V _{BS1_LOW} , BS2 = V _{BS2_LOW} , TxEN = V _{TxEN_LOW}	—	-60	-51	dBm
	P _{OUT_ENABLED_TX}	P _{IN} = 6 dBm, V _{RAMP} ≤ 0.1 V, BS1 = V _{BS1_HIGH} , BS2 = V _{BS2_HIGH} , TxEN = V _{TxEN_HIGH}	—	-40	-15	
Coupling of DCS Tx output to Receive RF output pad ²	CDCS_Tx-Rx_f0	0 dBm ≤ P _{OUT} ≤ 31 dBm	—	—	5	dBm
Spurious	Spur	All combinations of the following parameters: V _{RAMP} = controlled ¹ , P _{IN} = min. to max, 3.1 V ≤ V _{CC} ≤ 4.3 V, -20 °C ≤ T _{CASE} ≤ +85 °C, Load VSWR = 12:1, all phase angles	No parasitic oscillation > -36 dBm			
Load Mismatch	Load	All combinations of the following parameters: V _{RAMP} = controlled ¹ , P _{IN} = min. to max, 3.1 V ≤ V _{CC} ≤ 4.3 V, -20 °C ≤ T _{CASE} ≤ +85 °C, Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Noise	RX_NOISE	At f ₀ + 20 MHz (1805 MHz to 1880 MHz), RBW = 100 kHz, V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{OUT} = 31 dBm	—	—	-83	dBm
		925 MHz to 960 MHz, RBW = 100 kHz, V _{CC} = 3.5 V, T _{CASE} = +25 °C, P _{OUT} = 31 dBm	—	—	-87	
Power Control Dynamic Range	PCDR	—	35	—	—	dB
Power Control Slope	PCs	V _{CC} = 3.5 V, P _{IN} = 3 dBm, P _{OUT} = 0 dBm, T _{CASE} = +25 °C	—	80	—	dB/V

¹ V_{RAMP} is calibrated to each PCL at T_{CASE} = +25 °C, V_{BATT} = 3.5 V, P_{IN} = 3 dBm, 50 Ω load.

² Terminate all unused RF ports with 50 Ω loads

Table 8. SKY77589-11 Electrical Specifications

Unless otherwise specified: $T_{CASE} = -20\text{ }^{\circ}\text{C}$ to max. operating temperature (see Table 2); $RL = 50\ \Omega$; pulsed operation with pulse width $\leq 1154\ \mu\text{s}$; duty cycle $\leq 2:8$; $3.1\ \text{V} \leq V_{CC} \leq 4.3\ \text{V}$

PCS1900 (Tx_HB) Mode ($f = 1850\ \text{MHz}$ to $1910\ \text{MHz}$, $0\ \text{dBm} \leq P_{IN} \leq 6\ \text{dBm}$)						
Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Units
Frequency Range	f	—	1850	—	1910	MHz
Input Power	P_{IN}	—	0	—	6	dBm
Analog Power Control Voltage	V_{RAMP}	Minimum PCL to P_{RATED}	—	—	1.6	V
Power Added Efficiency	PAE	$V_{CC} = 3.5\ \text{V}$, $P_{OUT} = 31\ \text{dBm}$, $P_{IN} = 3\ \text{dBm}$, duty cycle 1:8, $T_{CASE} = +25\text{ }^{\circ}\text{C}$	—	39	—	%
Supply Current at Rated Power	$I_{CC_31\ \text{dBm}}$	$V_{CC} = 3.5\ \text{V}$, $P_{IN} = 3\ \text{dBm}$, $P_{OUT} = 31\ \text{dBm}$, duty cycle 1:8, $T_{CASE} = +25\text{ }^{\circ}\text{C}$	—	0.92	0.97	A
Harmonics	$2f_0$ to $6f_0$	$BW = 3\ \text{MHz}$, $0\ \text{dBm} \leq P_{OUT} \leq 31\ \text{dBm}$, V_{RAMP} controlled ¹	—	-40	-33	dBm
Output Power	P_{OUT_MAX}	$V_{CC} = 3.5\ \text{V}$, $T_{CASE} = +25\text{ }^{\circ}\text{C}$, $P_{IN} = 0\ \text{dBm}$	—	32.0	—	dBm
	$P_{OUT_MAX_EXTREME}$	$V_{CC} = 3.1\ \text{V}$, $-20\text{ }^{\circ}\text{C} \leq T_{CASE} \leq +85\text{ }^{\circ}\text{C}$, $P_{IN} = 0\ \text{dBm}$	29.0	—	—	
Input VSWR	Γ_{IN}	$0\ \text{dBm}$ $P_{OUT} \leq 31\ \text{dBm}$, V_{RAMP} controlled ¹	—	1.5:1	2.5:1	—
Forward Isolation ²	P_{OUT_RX}	$P_{IN} = 6\ \text{dBm}$, $V_{RAMP} \leq 0.1\ \text{V}$, $BS1 = V_{BS1_LOW}$, $BS2 = V_{BS2_LOW}$, $TxEN = V_{TxEN_LOW}$	—	-60	-51	dBm
	$P_{OUT_ENABLED_TX}$	$P_{IN} = 6\ \text{dBm}$, $V_{RAMP} \leq 0.1\ \text{V}$, $BS1 = V_{BS1_HIGH}$, $BS2 = V_{BS2_HIGH}$, $TxEN = V_{TxEN_HIGH}$	—	-40	-15	
Coupling of PCS Tx Output to Receive RF Output pad ²	CPCS_Tx-Rx_f0	$0\ \text{dBm} \leq P_{OUT} \leq 31\ \text{dBm}$	—	—	5	dBm
Spurious	Spur	All combinations of the following parameters: $V_{RAMP} = \text{controlled}^1$, $P_{IN} = \text{min. to max.}$, $3.1\ \text{V} \leq V_{CC} \leq 4.3\ \text{V}$, $-20\text{ }^{\circ}\text{C} \leq T_{CASE} \leq +85\text{ }^{\circ}\text{C}$, Load VSWR = 12:1, all phase angles	No parasitic oscillation $> -36\ \text{dBm}$			
Load Mismatch	Load	All combinations of the following parameters: $V_{RAMP} = \text{controlled}^1$, $P_{IN} = \text{min. to max.}$, $3.1\ \text{V} \leq V_{CC} \leq 4.3\ \text{V}$, $-20\text{ }^{\circ}\text{C} \leq T_{CASE} \leq +85\text{ }^{\circ}\text{C}$, Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Noise	RX_NOISE	At $f_0 + 20\ \text{MHz}$ (1930 MHz to 1990 MHz), RBW = 100 kHz, $V_{CC} = 3.5\ \text{V}$, $T_{CASE} = +25\text{ }^{\circ}\text{C}$, $P_{OUT} = 31\ \text{dBm}$	—	—	-83	dBm
		869 MHz to 894 MHz, RBW = 100 kHz, $V_{CC} = 3.5\ \text{V}$, $T_{CASE} = +25\text{ }^{\circ}\text{C}$, $P_{OUT} = 31\ \text{dBm}$	—	—	-87	
Power Control Dynamic Range	PCDR	—	35	—	—	dB
Power Control Slope	PCs	$V_{CC} = 3.5\ \text{V}$, $P_{IN} = 3\ \text{dBm}$, $P_{OUT} = 0\ \text{dBm}$, $T_{CASE} = +25\text{ }^{\circ}\text{C}$	—	80	—	dB/V

¹ V_{RAMP} is calibrated to each PCL at $T_{CASE} = +25\text{ }^{\circ}\text{C}$, $V_{BATT} = 3.5\ \text{V}$, $P_{IN} = 3\ \text{dBm}$, $50\ \Omega$ load.

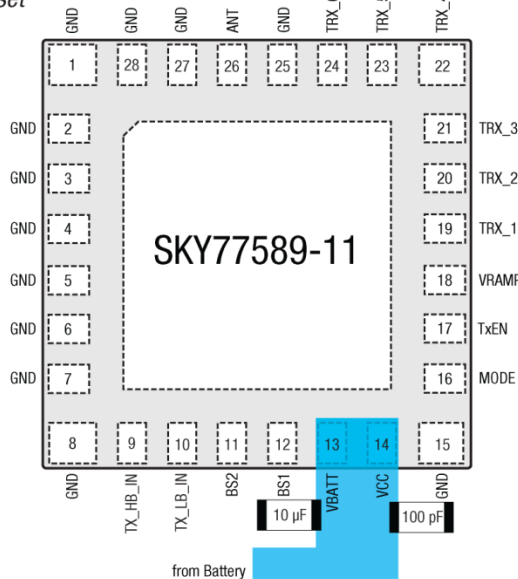
² Terminate all unused RF ports with $50\ \Omega$ loads

Table 9. 77589-11 Electrical Characteristics

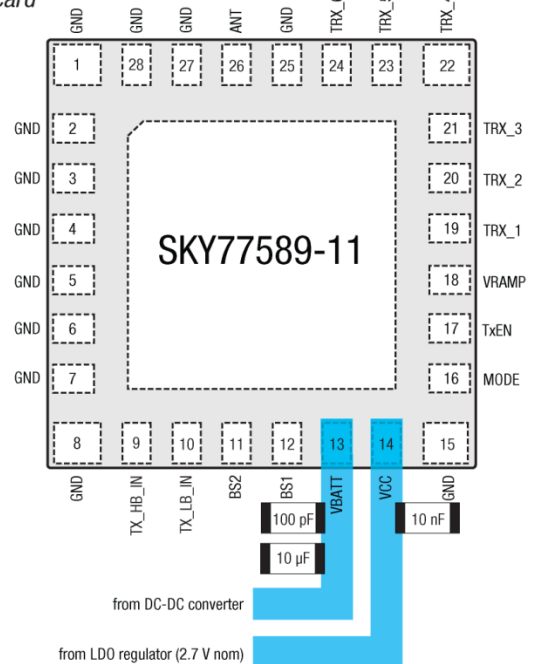
Unless otherwise specified: 50 Ω system; pulsed operation with pulse width 2308 μs; -20 °C ≤ T_{CASE} ≤ +85 °C; 2.5 V ≤ V_{CC} ≤ 4.3 V; Terminate all unused RF ports with 50 Ω during test.

Ports TRx1 to TRx6 – Tx-Rx Mode							
Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Unit	
Frequency Range	3G_Tx/Rx	$f_{3G_Tx/Rx}$	824	—	2170	MHz	
Insertion Loss	ANT – 3G_Tx/Rx	$3G_{Tx/Rx}$	824 MHz to 960 MHz, T _{CASE} = +25°C	—	0.60	0.95	dB
			1710 MHz to 1990 MHz, T _{CASE} = +25°C	—	0.70	0.95	
			2110 MHz to 2170 MHz, T _{CASE} = +25°C	—	1.00	1.20	
Isolation	ADJACENT	Ports TRx1 through TRx6 to any other ADJACENT port (824 MHz to 960 MHz)	25	—	—	dB	
			Ports TRx1 through TRx6 to any other ADJACENT port (1710 MHz to 1990 MHz)	25	—		—
	NON-ADJACENT	Ports TRx1 through TRx6 to any other NON-ADJACENT port (824 MHz to 960 MHz)	30	—	—		
			Ports TRx1 through TRx6 to any other NON-ADJACENT port (1710 MHz to 1990 MHz)	30	—		—
IMD2	$f_{Rx} - f_{Tx}$	Tx Output Power = 20 dBm, Blocker Power = -15 dBm Blocker frequency impedance is swept over all phase angles at the WCDMA port. (Minimum VSWR at blocker is 10:1 to model out-of-band duplexer impedance.	—	—	-95	dBm	
	$f_{Rx} + f_{Tx}$		—	—	-95		
IMD3	$2f_{Tx} - f_{Rx}$		—	—	-97		
	$2f_{Rx} - f_{Tx}$		—	—	-97		
Leakage from Tx to TRx Ports	P_TRx	—	—	—	5	dBm	

Handset



Datacard



NOTE: Place capacitors as near to part as possible.

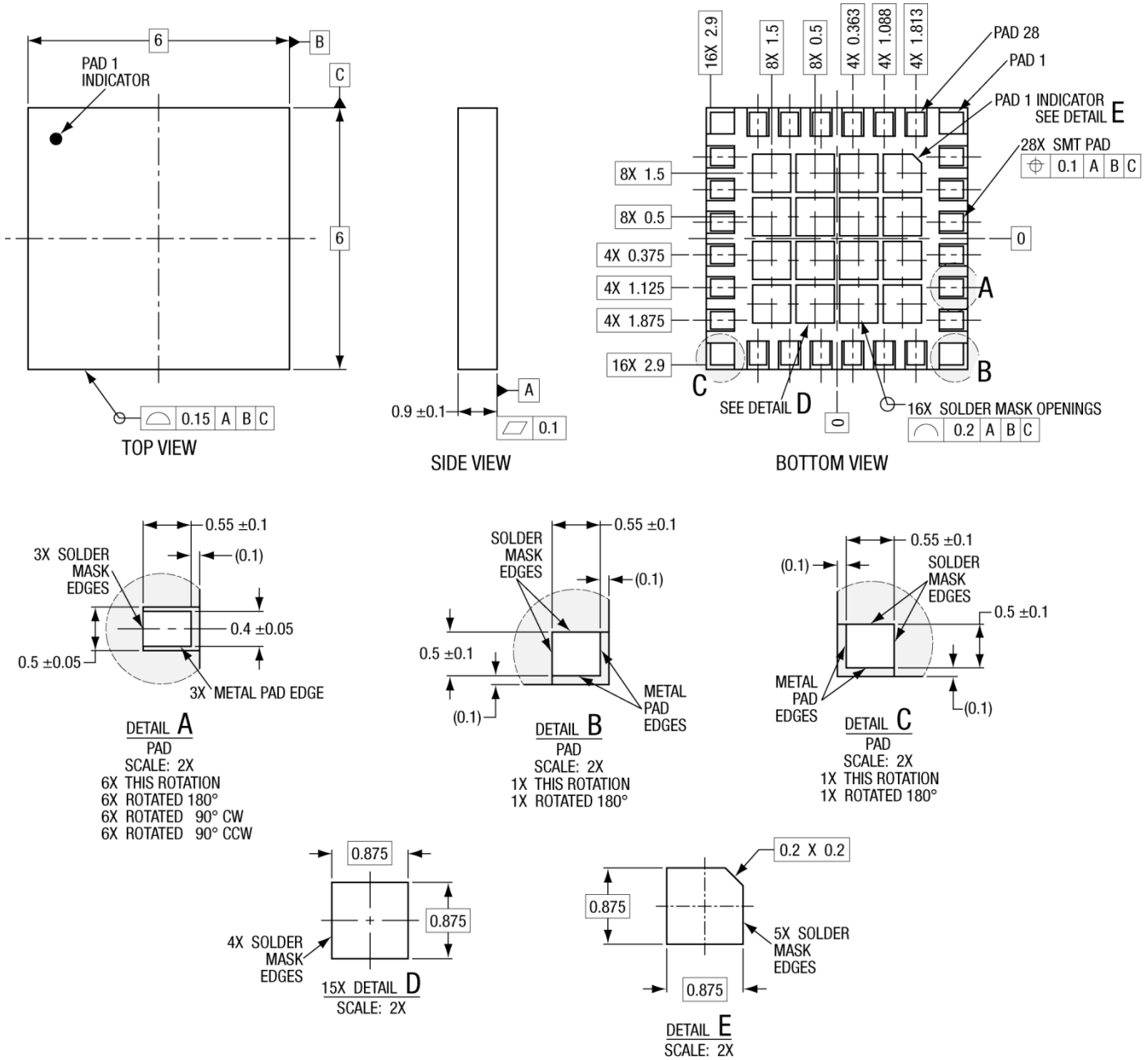
Figure 2. SKY77589-11 Application Schematic Diagram

201868_002

Package Dimensions

Figure 3 is a mechanical diagram of the pad layout for the SKY77589-11, a 28-pad leadless dual-band Front-End Module. Figure 4 provides a recommended phone board layout footprint

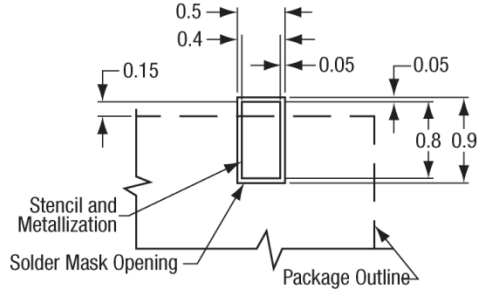
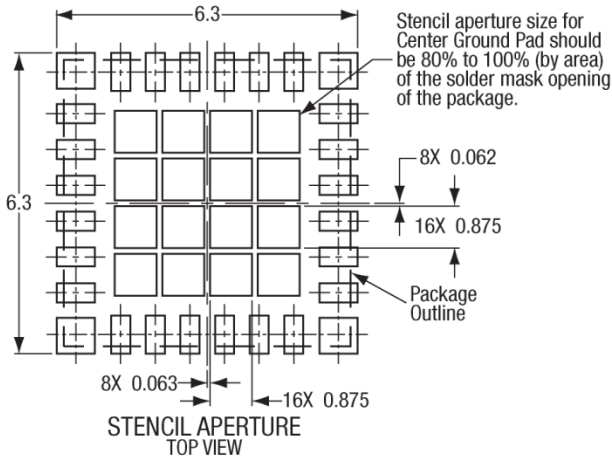
for the Front-End Module to help the designer attain optimum thermal conductivity, good grounding, and minimum RF discontinuity for the 50-ohm terminals.



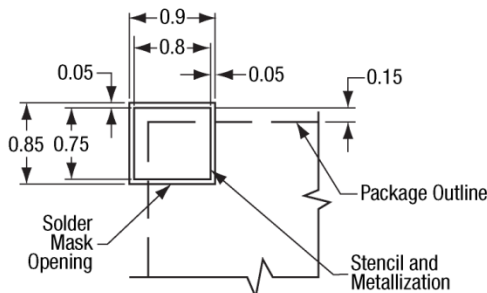
- NOTES: Unless otherwise specified.
 1. Dimensioning and Tolerancing in accordance with ASME Y14.5M-1994.
 2. All dimensions are in millimeters.
 3. Pad definitions per details on drawing.

DS-D544-544 REV 1 01/20/09
201868_003

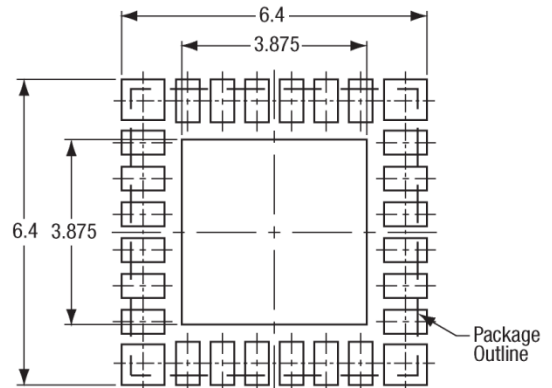
Figure 3. Dimensional Drawing for 6 mm x 6 mm x 0.9 mm, 28-Pad Package – SKY77589-11 Specific (All Views)



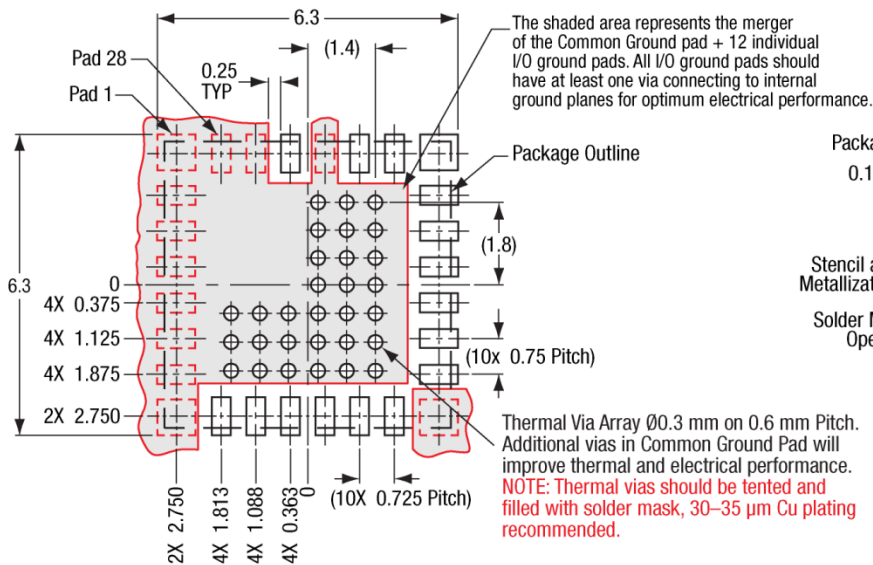
SMT PAD DETAIL
SCALE: 2X
6X THIS ROTATION
6X ROTATED 180°
6X ROTATED 90° CW
6X ROTATED 90° CCW



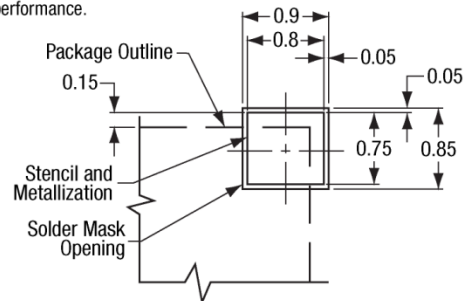
SMT PAD DETAIL
SCALE: 2X
1X THIS ROTATION
1X ROTATED 180°



SOLDER MASK OPENING TOP VIEW



METALLIZATION TOP VIEW

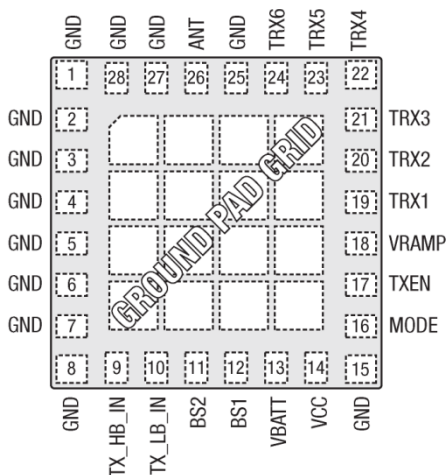


SMT PAD DETAIL
SCALE: 2X
1X THIS ROTATION
1X ROTATED 180°

Figure 4. Phone PCB Layout Footprint for 6 mm x 6 mm, 28-Pad Package with Grid-Bottom Solder Mask – SKY77589-11 Specific.

Package Description

Figure 5 illustrates the device pad configuration and the numbering convention which starts with pad 1 at the lower left,



Pad layout as seen from Top View looking through package.

201868_005

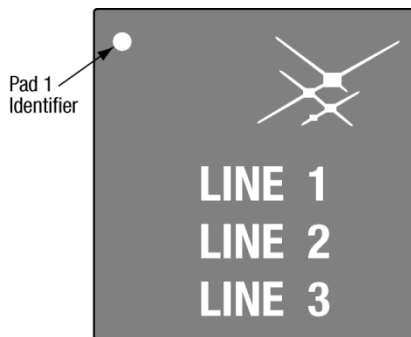
Figure 5. SKY77589-11 Pad Configuration – 28-Pad Leadless (Top View)

Table 10. SKY77589-11 Pad Names and Signal Descriptions

Pad ¹	Name	Description
9	Tx_HB_IN	Input Tx signal 1710 MHz–1910 MHz
10	Tx_LB_IN	Input Tx signal 824 MHz–915 MHz
11	BS2	Band Select
12	BS1	Band Select
13	VBATT	Battery supply voltage
14	VCC	Switch supply voltage
16	MODE	0 = GMSK
17	TxEN	Enable TxEN
18	VRAMP	Controls power in GMSK mode
19	TRx1	Wideband TRx switch port
20	TRx2	Wideband TRx switch port
21	TRx3	Wideband TRx switch port
22	TRx4	Wideband TRx switch port
23	TRx5	Wideband TRx switch port
24	TRx6	Wideband TRx switch port
26	ANT	PA output to Antenna
Ground Pad Grid	Ground Pad Grid (device underside)	

¹ Pads 1–8, 15, 25, 27, 28 are ground pads.

as indicated and increments counter-clockwise around the package. Table 10 lists the pad names and the associated signal descriptions. Figure 6 interprets typical case markings.



NOTE: Lines 1, 2, 3 have a maximum of 12 characters
Line 1 = Part Number and Version
Line 2 = Lot Number
Line 3 = Year–Week–Country Code (MX)

201868_006

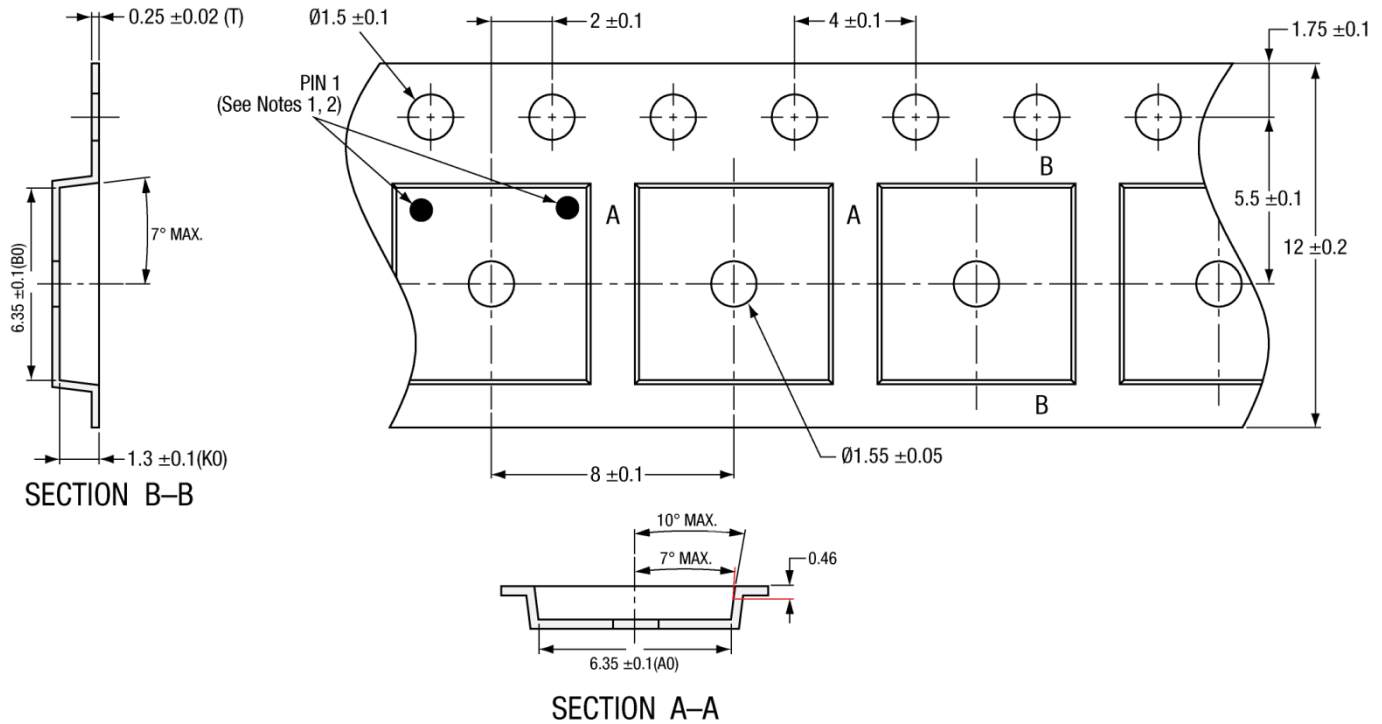
Figure 6. Typical Case Markings

Package Handling Information

Because of its sensitivity to moisture absorption, this device package is baked and vacuum-packed prior to shipment. Instructions on the shipping container label must be followed regarding exposure to moisture after the container seal is broken, otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY77589-11 is capable of withstanding an MSL3/260 °C solder reflow. Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. If the part is attached in a reflow oven, the temperature ramp rate should not exceed 3 °C per second; maximum temperature should not exceed 260 °C. If the part is manually attached, precaution should be taken to insure that the part is not subjected to temperatures exceeding 260 °C for more than 10 seconds. For details on attachment techniques, precautions, and handling procedures recommended by Skyworks, please refer to Skyworks Application Note: *PCB Design and SMT Assembly/Rework*, Document Number 101752. Additional information on standard SMT reflow profiles can also be found in the JEDEC *Joint Industry Standard J-STD-020*.

Production quantities of this product are shipped in the standard tape-and-reel format (Figure 7).



NOTES:

- PIN 1 ORIENTATION IS "TOP LEFT" ONLY FOR RFLGA & MCM PRODUCTS LISTED BELOW:
 SKY73022-21 SKY73022-31
 SKY73023-21 SKY73023-31
- PIN 1 ORIENTATION IS "TOP RIGHT" FOR ALL 6 x 6 mm RFLGA & MCM PRODUCTS EXCEPT THOSE LISTED IN NOTE 1 ABOVE.
- CARRIER TAPE IS BLACK CONDUCTIVE POLYCARBONATE OR POLYSTYRENE.
- COVER TAPE IS TRANSPARENT AND CONDUCTIVE.
- ESD-SURFACE RESISTIVITY IS $\leq 1 \times 10^{10}$ OHMS/SQUARE PER EIA, JEDEC TNR SPECIFICATION.
- ALL DIMENSIONS ARE IN MILLIMETERS.

CARRIER TAPE OVERMOLD MCM/RFLGA 6 x 6 x 0.85 / 1.1 mm BODY SIZE -193H XXXXX_YY

Figure 7. Dimensional Diagram for Carrier Tape Body Size 6 mm x 6 mm x 0.85 / 1.1 mm – MCM

Electrostatic Discharge (ESD) Sensitivity



Attention: Observe Precautions for Handling Electrostatic Sensitive Devices
 Electrostatic Discharge (ESD) can damage this device, which must be protected from ESD at all times. 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.

The SKY77589-11 meets the electrostatic discharge (ESD) sensitivity classifications for Class 1C JESD22-A114 Human Body

- Personnel Grounding
 - Wrist Straps
 - Conductive Smocks, Gloves and Finger Cots
 - Antistatic ID Badges
- Protective Workstation
 - Dissipative Table Top
 - Protective Test Equipment (Properly Grounded)
 - Grounded Tip Soldering Irons
 - Solder Conductive Suckers
 - Static Sensors
- Facility
 - Relative Humidity Control and Air Ionizers
 - Dissipative Floors (less than 1,000 MΩ to GND)
- Protective Packaging and Transportation
 - Bags and Pouches (Faraday Shield)
 - Protective Tote Boxes (Conductive Static Shielding)
 - Protective Trays
 - Grounded Carts
 - Protective Work Order Holders

Model (HBM), Class III JESD22-C101 Charged Device Model (CDM), and Class A JESD22-A115 Machine Model (MM).

To avoid ESD damage, both latent and visible, it is very important that the product assembly and test areas follow the ESD handling precautions listed below.

Ordering Information

Product Name	Order Number	Evaluation Board Part Number
SKY77589-11 Tx-Rx Quad-Band Front-End Module	SKY77589-11	

Revision History

Revision	Date	Description
A	April 20, 2012	Initial Release – Information
B	August 10, 2012	Revise: Tables 2, 3, 5–9, 16
C	January 7, 2013	Revise: Change Data Sheet status from PRELIMINARY to FINAL; add dash number (-11) to part number, all occurrences; Figures 1, 7; Tables 2, 4–8; ESD section WARNING, classification; References
D	May 13, 2016	Revise: Table 1(add Operating temperature info)
E	May 24, 2016	Revise: Table 1

References

Skyworks Application Note: PCB Design and SMT Assembly/Rework, Document Number 101752

Standard SMT Reflow Profiles: JEDEC Standard J-STD-020

Electrostatic Discharge Sensitivity (ESD) Testing: JEDEC Standard, JESD22-A114 Human Body Model (HBM)

Electrostatic Discharge Sensitivity (ESD) Testing: JEDEC Standard, JESD22-A115 Machine Model (MM)

Electrostatic Discharge Sensitivity (ESD) Testing: JEDEC Standard, JESD22-C101 Charged Device Model (CDM).

©2012, 2013, 2016, Skyworks Solutions, Inc. All Rights Reserved

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, "Breakthrough Simplicity," DCR, Helios, HIP3, Innovation to Go, Intera, iPAC, LIPA, Polar Loop, and System Smart are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at www.skyworksinc.com, are incorporated by reference.