PRELIMINARY DATA SHEET

SKY77550 Tx Quad-Band / Rx Dual-Band BiFET iPAC™ FEM for GSM / GPRS (824-915 MHz and 1710-1910 MHz)

Applications

- Dual-band cellular handsets encompassing
  - Class 4 GSM850/900
  - DCS1800/PCS1900
  - Class 12 GPRS multi-slot operation

Features

- High efficiency
  - 42% (GSM850)
  - 42% (GSM900)
  - 42% (DCS1800
  - 41% (PCS1900)
- Low transmit supply current
  - 1.36 A (GSM850)
  - 1.36 A (GSM900)
  - 0.86 A (DCS1800)
  - 0.88 A (PCS1900)
- Internal ICC sense resistor for iPAC
- Closed loop iPAC
- 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

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

SKY77550 is a transmit and receive Front-End Module (FEM) with Integrated Power Amplifier Control (iPAC™) designed in a low profile, compact form factor for dual-band cellular handsets comprising GSM850/900 and DCS1800/PCS1900 operation. The SKY77550 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.

The module consists of a GSM850/900 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 with internal current sense resistor. The two Heterojunction Bipolar Transistor (HBT) PA blocks, a BiFET PAC and switch control circuit are fabricated onto a single Gallium Arsenide (GaAs) die. One PA block supports the GSM850/900 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 two receive pads are connected to the antenna pad through an RF switch. The GaAs die, 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, BS, selects 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 SKY77550 is compatible with logic levels from 1.2 V to 2.9 V for BS, TxEN, and VSW_EN pads.

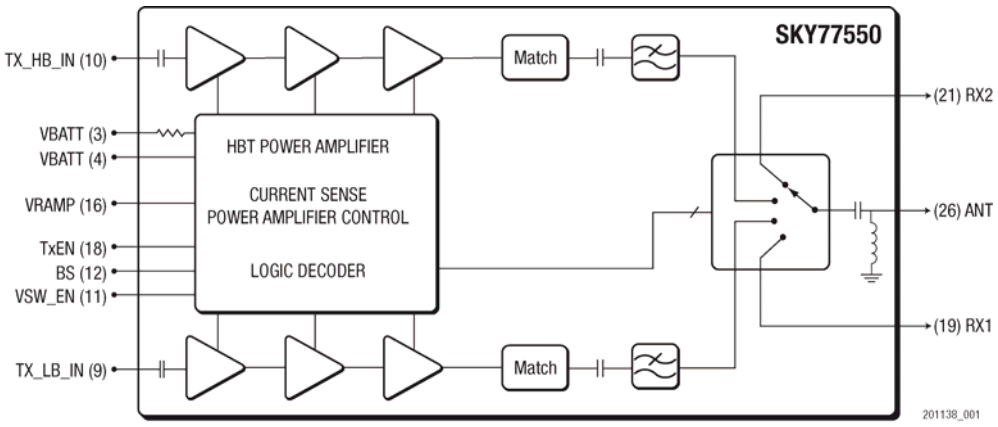


Figure 1. SKY77550 Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the SKY77550 Front-End Module. The absolute maximum ratings and recommended operating conditions for the SKY77550 are listed in Table 1 and Table 2, respectively. Table 3 specifies the mode control logic and Table 4 contains the electrical characteristics of the SKY77550 for modes GSM850/900 and DCS1800/PCS1900. Figure 2 presents an application schematic for the SKY77550.

The SKY77550 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. SKY77550 Absolute Maximum Ratings

Parameter	Minimum	Nominal	Maximum	Unit
Input Power (P_{IN})	—	3	15	dBm
Supply Voltage (V_{CC}), Standby $V_{RAMP} \leq 0.3$ V $V_{SW\_EN} \leq 0.5$ V	—	3.5	7	V
Control Voltage (V_{RAMP})	–0.5	1.6	V_{CC_MAX} – 0.2 V (See Table 4)	V
Storage Temperature	–55	+25	+150	°C

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

Table 2. SKY77550 Recommended Operating Conditions

Parameter		Minimum	Nominal	Maximum	Unit
Supply Voltage (V_{CC})		3.1	3.5	4.8	V
Supply Current (I_{CC})		0	—	1.8	A
Operating Case Temperature (T_{CASE})[1]	1-Slot (12.5% duty cycle)	–20	—	+85	°C
	2-Slot (25% duty cycle)	–20	—	+85	
	3-Slot (37.5% duty cycle)[2]	–20	—	+85	
	4-Slot (50% duty cycle)[2]	–20	—	+85	

[1] Case Operating Temperature refers to the temperature of the GROUND PAD on the underside of the package.

[2] Max. output power must be reduced by 6 dB to support 3-slot and 4-slot operation.

Table 3. SKY77550 Mode Control Logic

Mode	Input Control Bits		
	VSW_EN	TxEN	BS
STANDBY	0	0	0
Rx1[1]	1	0	0
Rx2[1]	1	0	1
Tx_LB	1	1	0
Tx_HB	1	1	1

[1] Rx1 and Rx2 are broadband receive ports and each supports the GSM850, GSM900, DCS, and PCS bands.

Table 4. SKY77550 Electrical Specifications[1]

General							
Parameter		**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Unit**
Supply Voltage		V_{CC}	—	3.1	3.5	4.8	V
Power Control Impedance		Z_{VRAMP}	—	—	120	—	kΩ
VSW_EN Control Voltage	LOW	$V_{SW\_EN\_LOW}$	—	–0.1	—	0.3	V
	HIGH	$V_{SW\_EN\_HIGH}$		1.2	—	2.9	
VSW_EN Current		I_{VSW_EN}	—	—	—	25	µA
Band Select Control Voltage	LOW	V_{BS_LOW}	—	–0.1	—	0.3	V
	HIGH	V_{BS_HIGH}		1.2	—	2.9	
Band Select Current		I_{BS}	—	—	—	25	µA
TxEN Control Voltage	LOW	V_{TxEN_LOW}	—	–0.1	—	0.3	V
	HIGH	V_{TxEN_HIGH}		1.2	—	2.9	
TxEN Control Current		I_{TxEN}	—	—	—	60	µA
Leakage Current	Standby Mode	I_{QS}	$3.1\ V \le V_{CC} \le 4.2\ V$ $V_{SW\_EN} = V_{SW\_EN\_LOW}$ $V_{RAMP} \le 0.1\ V$ $TxEN \le TxEN_{LOW}$ $BS \le V_{BS\_LOW}$ $MODE < V_{MODE\_LOW}$ $T_{CASE} = +25\ °C$ $P_{IN} \le –60\ dBm$	—	30	50	µA
	Receive Mode	I_{QRx}	$V_{CC} \le 4.2\ V$ $1.8\ V \le V_{SW\_EN} \le 2.5\ V$ $V_{RAMP} \le 0.1\ V$ $TxEN \le TxEN_{LOW}$ $MODE < V_{MODE\_LOW}$ $T_{CASE} = +25\ °C$ $P_{IN} \le –60\ dBm$	—	200	250	

[1] Unless specified otherwise:
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} ≤ 4.8 V .

Table 5. SKY77550 Electrical Specifications[1] (1 of 2)

GSM850 (Tx_LB) Mode (f = 824 MHz to 849 MHz, –1 dBm ≤ P_{IN} ≤ 5 dBm)						
Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Unit
Frequency Range	f	—	824	—	849	MHz
Input Power	P_{IN}	—	–1	—	5	dBm
Analog Power Control Voltage	V_{RAMP}	—	0.2	—	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	39	42	—	%
Supply Current @ 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	—	1.36	1.46	A
	I_{CC}_29 dBm	V_{CC} = 3.5 V P_{OUT} = 29 dBm P_{IN} = 3 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	770	—	mA
Supply Current @ Minimum Power	I_{CC}_5 dBm	V_{CC} = 3.5 V P_{OUT} = 5 dBm P_{IN} = 3 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	70	85	mA
Harmonics	$2f_0$ to $13f_0$	BW = 3 MHz 5 dBm ≤ P_{OUT} ≤ 33 dBm V_{RAMP} controlled[2]	—	–40	–33	dBm
Mismatch Harmonics	$2f_0$ to $7f_0$	BW = 3 MHz V_{RAMP} = Max V_{RAMP}[4] V_{BATT} = 3.5 V VSWR = 3:1 all phases T_{CASE} = +25 °C	—	—	–33	
Output Power	P_{OUT}	V_{CC} = 3.5 V T_{CASE} = +25 °C P_{IN} = –1 dBm	33.0	33.7	—	dBm
	P_{OUT} _MAX LOW VOLTAGE	V_{CC} = 3.1 V V_{RAMP} = Max V_{RAMP}[4] –20 °C ≤ T_{CASE} ≤ +85 °C P_{IN} = –1 dBm	30.5	32.0	—	
	P_{OUT}_MAX HIGH VOLTAGE	V_{CC} = 4.8 V V_{RAMP} = Max V_{RAMP}[4] –20 °C ≤ T_{CASE} ≤ +85 °C P_{IN} = –1 dBm	30.5	34.5	—	
Input VSWR	Γ_{IN}	5 dBm ≤ P_{OUT} ≤ 33 dBm V_{RAMP} controlled[2]	—	1.5:1	2.5:1	
Forward Isolation[3]	P_{OUT_Rx}	P_{IN} = 5 dBm V_{RAMP} ≤ 0.1 V V_{SW_EN} = $V_{SW\_EN\_HIGH}$ TxEN = V_{TxEN_LOW} Rx1 Mode	—	–55	–45	dBm
	$P_{OUT\_ENABLED\_Tx}$	P_{IN} = 5 dBm V_{RAMP} ≤ 0.1 V V_{SW_EN} = $V_{SW\_EN\_HIGH}$ TxEN = V_{TxEN_HIGH}	—	–25	–5	

Table 5. SKY77550 Electrical Specifications[1] (2 of 2)

[continued] *GSM850 (Tx_LB) Mode (f = 824 MHz to 849 MHz, –1 dBm ≤ P_{IN} ≤ 5 dBm)*						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Unit**
Coupling of GSM850/900 Tx Output (f_0) to Rx[5] Output pad[4]	CGHI_Tx-Rx_f_0	5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–5	0	dBm
Coupling of GSM850/900 Tx Output ($2f_0$, $3f_0$) to Rx[5] Output pad[4]	CGHI_Tx-DCS_Rx	5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–45	–36	dBm
Spurious	Spur	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. 3.1 V ≤ V_{CC} ≤ 4.8 V –20 °C ≤ T_{CASE} ≤ +85 °C Load VSWR = 12:1, all phase angles	No parasitic oscillation > –35 dBm			
Load Mismatch	Load	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. 3.1 V ≤ V_{CC} ≤ 4.8 V –20 °C ≤ T_{CASE} ≤ +85 °C Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Spurious	Rx_{SPUR}	At f_0 + 20 MHz (869 MHz to 894 MHz) RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–84	–83	dBm
		At 1930 MHz to 1990 MHz RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–101	–84	
Power Control Dynamic Range	PC_{DR}	—	30	50	—	dB
Power Control Variation — Control Level 5	PC_V	V_{BATT} = 3.5 V P_{OUT} = 33 dBm T_{CASE} = +25 °C	–1.5	—	1.5	dB
		P_{OUT} = 33 dBm	–2.0	—	2.0	
Control Level 6-15		V_{BATT} = 3.5 V 13 dBm ≤ P_{OUT} ≤ 31 dBm T_{CASE} = +25 °C	–2.5	—	2.5	
		13 dBm ≤ P_{OUT} ≤ 31 dBm	–3.5	—	3.5	
Control Level 16-19		V_{BATT} = 3.5 V 5 dBm ≤ P_{OUT} ≤ 11 dBm T_{CASE} = +25 °C	–4.5	—	4.5	
		5 dBm ≤ P_{OUT} ≤ 11 dBm	–5.5	—	5.5	
Power Control Slope	PC_S	5 dBm to 33 dBm	—	—	250	dB/V
GSM850 RECEIVE (f = 869 MHz to 894 MHz) Rx Mode						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	869	—	894	MHz
Insertion Loss, ANT to Rx[5,3]	IL_Rx[5]	T_{CASE} = +25 °C	—	1.0	1.3	dB
VSWR ANT, Rx[5,3]	Γ_{IN}, Γ_{OUT}	—	—	1.2:1	1.5:1	

1 Unless specified otherwise:
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} ≤ 4.8 V.

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

3 Terminate all unused RF ports with 50 Ω loads

4 Max V_{RAMP} = V_{RAMP} @ P_{OUT} =33 dBm, 50 Ω load, T_{CASE} = +25 °C, V_{BATT} = 3.5 V, P_{IN} = 3 dBm

5 Rx1 and Rx2 are broadband receive ports and each supports the GSM850, GSM900, DCS, and PCS bands.

Table 6. SKY77550 Electrical Specifications[1] (1 of 3)

GSM900 (Tx_LB) Mode (f = 880 MHz to 915 MHz, –1 dBm ≤ P_{IN} ≤ 5 dBm)						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	880	—	915	MHz
Input Power	P_{IN}	—	–1	—	5	dBm
Analog Power Control Voltage	V_{RAMP}	—	0.2	—	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	39	42	—	%
Supply Current @ 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	—	1.36	1.46	A
	I_{CC}_29 dBm	V_{CC} = 3.5 V P_{OUT} = 29 dBm P_{IN} = 3 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	750	—	mA
Supply Current @ Minimum Power	I_{CC}_5 dBm	V_{CC} = 3.5 V P_{OUT} = 5 dBm P_{IN} = 3 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	70	85	mA
Harmonics	$2f_0$ to $13f_0$	BW = 3 MHz 5 dBm ≤ P_{OUT} ≤ 33 dBm V_{RAMP} controlled[2]	—	–40	–33	dBm
Mismatch Harmonics	$2f_0$ to $7f_0$	BW = 3 MHz V_{RAMP} = Max V_{RAMP}[4] V_{BATT} = 3.5 V VSWR = 3:1 all phases T_{CASE} = +25 °C	—	—	–33	dBm
Output Power	P_{OUT}	V_{CC} = 3.5 V T_{CASE} = +25 °C P_{IN} = –1 dBm	33.0	33.7	—	dBm
	P_{OUT} _MAX LOW VOLTAGE	V_{CC} = 3.1 V V_{RAMP} = Max V_{RAMP}[4] –20 °C ≤ T_{CASE} ≤ +85 °C P_{IN} = –1 dBm	30.5	32.0	—	
	P_{OUT}_MAX HIGH VOLTAGE	V_{CC} = 4.8 V V_{RAMP} = Max V_{RAMP}[4] –20 °C ≤ T_{CASE} ≤ +85 °C P_{IN} = –1 dBm	30.5	34.5	—	
Input VSWR	Γ_{IN}	P_{OUT} = 5 dBm to 33 dBm V_{RAMP} controlled[2]	—	1.5:1	2.5:1	

Table 6. SKY77550 Electrical Specifications[1] (2 of 3)

[continued] *GSM900 (Tx_LB) Mode (f = 880 MHz to 915 MHz, –1 dBm ≤ P_{IN} ≤ 5 dBm)*						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Forward Isolation[3]	P_{OUT_RX}	P_{IN} = 5 dBm V_{RAMP} ≤ 0.1 V V_{SW_EN} = $V_{SW\_EN\_HIGH}$ TxEN = V_{TxEN_LOW} Rx1 Mode	—	–55	–45	dBm
	$P_{OUT\_ENABLED\_TX}$	P_{IN} = 5 dBm V_{RAMP} ≤ 0.1 V V_{SW_EN} = $V_{SW\_EN\_HIGH}$ TxEN = V_{TxEN_HIGH}	—	–25	–5	
Coupling of GSM850/900 Tx Output (f_0) to Rx[5] Output pad[3]	CGHI_Tx-Rx_f0	5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–5	0	dBm
Coupling of GSM850/900 Tx Output ($2f_0$, $3f_0$) to Rx[5] Output pad[3]	CGHI_Tx_Rx[5]	5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–45	–36	dBm
Spurious	Spur	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. 3.1 V ≤ V_{CC} ≤ 4.8 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[2] P_{IN} = min. to max. 3.1 V ≤ V_{CC} ≤ 4.8 V –20 °C ≤ T_{CASE} ≤ +85 °C Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Spurious	R_{X_SPUR}	At f_0 + 20 MHz (935 MHz to 960 MHz) RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–84	–83	dBm
		At f_0 + 10 MHz (925 MHz to 935 MHz) RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–80	–76	
		At 1805 MHz to 1880 MHz RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 5 dBm ≤ P_{OUT} ≤ 33 dBm	—	–101	–84	
Power Control Dynamic Range	PC_{DR}	—	30	50	—	dB
Power Control Variation — Control Level 5	PC_V	V_{BATT} = 3.5 V P_{OUT} = 33 dBm T_{CASE} = +25 °C	–1.5	—	1.5	dB
		P_{OUT} = 33 dBm	–2.0	—	2.0	
Control Level 6-15		V_{BATT} = 3.5 V 13 dBm ≤ P_{OUT} ≤ 31 dBm T_{CASE} = +25 °C	–2.5	—	2.5	
		13 dBm ≤ P_{OUT} ≤ 31 dBm	–3.5	—	3.5	
Control Level 16-19		V_{BATT} = 3.5 V 5 dBm ≤ P_{OUT} ≤ 11 dBm T_{CASE} = +25 °C	–4.5	—	4.5	
		5 dBm ≤ P_{OUT} ≤ 11 dBm	–5.5	—	5.5	
Power Control Slope	PC_S	5 dBm to 33 dBm	—	—	250	dB/V

Table 6. SKY77550 Electrical Specifications[1] (3 of 3)

GSM900 RECEIVE (f = 925 MHz to 960 MHz) Rx Mode						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	925	—	960	MHz
Insertion Loss, ANT to Rx[5,3]	IL_Rx[5]	T_{CASE} = +25 °C	—	1.0	1.3	dB
VSWR ANT, Rx[5,3]	Γ_{IN}, Γ_{OUT}	—	—	1.2:1	1.5:1	

1 Unless specified otherwise:
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} ≤ 4.8 V.

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

3 Terminate all unused RF ports with 50 Ω loads

4 Max V_{RAMP} = V_{RAMP} @ P_{OUT} =33 dBm, 50 Ω load, T_{CASE} +25 °C, V_{BATT} = 3.5 V, P_{IN} = 3 dBm

5 Rx1 and Rx2 are broadband receive ports and each supports the GSM850, GSM900, DCS, and PCS bands.

Table 7. SKY77550 Electrical Specifications [1] (1 of 3)

DCS1800 (Tx_HB) Mode (f = 1710 MHz to 1785 MHz, –1 dBm ≤ P_{IN} ≤ 5 dBm)						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	1710	—	1785	MHz
Input Power	P_{IN}	—	–1	—	5	dBm
Analog Power Control Voltage	V_{RAMP}	—	0.2	—	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	37	42	—	%
Supply Current @ 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	—	0.86	0.97	A
	I_{CC}_28 dBm	V_{CC} = 3.5 V P_{OUT} = 28 dBm P_{IN} = 3 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	630	—	mA
Supply Current @ Minimum Power	I_{CC}_0 dBm	V_{CC} = 3.5 V P_{OUT} = 0 dBm P_{IN} = 3 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	40	55	mA
Harmonics	$2f_0$ to $7f_0$	BW = 3 MHz, 0 dBm ≤ P_{OUT} ≤ 31 dBm V_{RAMP} controlled[2]	—	–40	–33	dBm
Mismatch Harmonics	$2f_0$, $3f_0$	BW = 3 MHz V_{RAMP} = Max V_{RAMP}[4] V_{BATT} = 3.5 V VSWR = 3:1 all phases T_{CASE} = +25 °C	—	—	–33	dBm

Table 7. SKY77550 Electrical Specifications [1] (2 of 3)

[continued] ***DCS1800 (Tx_HB) Mode (f = 1710 MHz to 1785 MHz, –1 dBm ≤ PIN ≤ 5 dBm)***						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Output Power	POUT	VCC = 3.5 V TCASE = +25 °C PIN = –1 dBm	31.0	32.0	—	dBm
	POUT _MAX LOW VOLTAGE	VCC = 3.1 V VRAMP = MAX VRAMP[4] –20 °C ≤ TCASE ≤ +85 °C PIN = –1 dBm	28.5	30.0	—	
	POUT _MAX HIGH VOLTAGE	VCC = 4.8 V VRAMP = Max VRAMP[4] –20 °C ≤ TCASE ≤ +85 °C PIN = –1 dBm	28.5	32.5	—	
Input VSWR	ΓIN	0 dBm≤ POUT ≤ 31 dBm VRAMP controlled[2]	—	1.5:1	2.5:1	—
Forward Isolation[3]	POUT RX	PIN = 5 dBm VRAMP ≤ 0.1 V VSW_EN = VSW_EN_HIGH TxEN = VTxEN_LOW Rx2 Mode	—	–65	–53	dBm
	POUT_ENABLED_TX	PIN = 5 dBm VRAMP ≤ 0.1 V VSW_EN = VSW_EN_HIGH TxEN = VTxEN_HIGH	—	–35	–5	
Coupling of DCS Tx output to Receive RF output pad[3]	CDCS_Tx-Rx_f0	0 dBm ≤ POUT ≤ 31 dBm	—	0	5	dBm
Spurious	Spur	All combinations of the following parameters: VRAMP = controlled[2] PIN = min. to max. 3.1 V ≤ VCC ≤ 4.8 V –20 °C ≤ TCASE ≤ +85 °C Load VSWR = 12:1, all phase angles	No parasitic oscillation > –36 dBm			
Load Mismatch	Load	All combinations of the following parameters: VRAMP = controlled[2] PIN = min. to max. 3.1 V ≤ VCC ≤ 4.8 V –20 °C ≤ TCASE ≤ +85 °C Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Spurious	RX_SPUR	At f0 + 20 MHz (1805 MHz to 1880 MHz) RBW = 100 kHz VCC = 3.5 V TCASE = +25 °C 0 dBm ≤ POUT ≤ 31 dBm	—	–83	–78	dBm
		925 MHz to 960 MHz RBW = 100 kHz VCC = 3.5 V TCASE = +25 °C 0 dBm ≤ POUT ≤ 31 dBm	—	—	–87	
Power Control Dynamic Range	PCDR	—	35	50	—	dB

Table 7. SKY77550 Electrical Specifications [1] (3 of 3)

[continued] *DCS1800 (Tx_HB) Mode (f = 1710 MHz to 1785 MHz, –1 dBm ≤ PIN ≤ 5 dBm)*							
Parameter		**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Power Control Variation	Control Level 0	PCV	VBATT = 3.5 V 30 dBm ≤ POUT ≤ 31 dBm TCASE = +25 °C	–1.5	—	1.5	dB
			30 dBm ≤ POUT ≤ 31 dBm	–2.0	—	2.0	
	Control Level 1-8		VBATT = 3.5 V 14 dBm ≤ POUT ≤ 28 dBm TCASE = +25 °C	–2.5	—	2.5	
			14 dBm ≤ POUT ≤ 28 dBm	–3.5	—	3.5	
	Control Level 9-13		VBATT = 3.5 V 4 dBm ≤ POUT ≤ 12 dBm TCASE = +25 °C	–3.5	—	3.5	
			4 dBm ≤ POUT ≤ 12 dBm	–4.5	—	4.5	
	Control Level 14-15		VBATT = 3.5 V 0 dBm ≤ POUT ≤ 2 dBm TCASE = +25 °C	–4.5	—	4.5	
			0 dBm ≤ POUT ≤ 2 dBm	–5.5	—	5.5	
Power Control Slope		PCS	0 dBm to 31 dBm	—	—	250	dB/V
DCS1800 RECEIVE (f =1805 MHz to 1880 MHz) Rx Mode							
Parameter		**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range		f	—	1805	—	1880	MHz
Insertion Loss, ANT to Rx[5,3]		IL_Rx[5]	TCASE = +25 °C	—	1.2	1.5	dB
VSWR ANT, Rx[5,3]		ΓIN, ΓOUT	—	—	1.2:1	1.5:1	

[1] Unless specified otherwise:
TCASE = –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 ≤ VCC ≤ 4.8 V.

[2] VRAMP is calibrated to each PCL at TCASE = +25 °C, VBATT = 3.5 V, PIN = 3 dBm, 50 Ω load.

[3] Terminate all unused RF ports with 50 Ω loads

[4] Max VRAMP = VRAMP @ POUT =31 dBm, 50 Ω load, TCASE +25 °C, VBATT = 3.5 V, PIN = 3 dBm

[5] Rx1 and Rx2 are broadband receive ports and each supports the GSM850, GSM900, DCS, and PCS bands.

Table 8. SKY77550 Electrical Specifications[1] (1 of 3)

PCS1900 (Tx_HB) Mode (f = 1850 MHz to 1910 MHz, –1 dBm ≤ PIN ≤ 5 dBm)						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	1850	—	1910	MHz
Input Power	PIN	—	–1	—	5	dBm
Analog Power Control Voltage	VRAMP	—	0.2	—	1.6	V
Power Added Efficiency	PAE	VCC = 3.5 V POUT = 31 dBm PIN = 3 dBm duty cycle 1:8 TCASE = +25 °C	37	41	—	%

Table 8. SKY77550 Electrical Specifications [1] (2 of 3)

[continued] *PCS1900 (Tx_HB) Mode (f = 1850 MHz to 1910 MHz, –1 dBm ≤ P_{IN} ≤ 5 dBm)*						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Supply Current @ Rated Power	I_{CC}_31 dBm	V_{CC} = 3.5 V P_{IN} = 3 dBm P_{OUT} = 31 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	0.88	0.97	A
	I_{CC}_28 dBm	V_{CC} = 3.5 V P_{IN} = 3 dBm P_{OUT} = 28 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	630	—	mA
Supply Current @ Minimum Power	I_{CC}_0 dBm	V_{CC} = 3.5 V P_{IN} = 3 dBm P_{OUT} = 0 dBm duty cycle 1:8 T_{CASE} = +25 °C	—	45	55	mA
Harmonics	$2f_0$ to $7f_0$	BW = 3 MHz, 0 dBm ≤ P_{OUT} ≤ 31 dBm V_{RAMP} controlled[2]	—	–40	–33	dBm
Mismatch Harmonics	$2f_0$, $3f_0$	BW = 3 MHz V_{RAMP} = MAX V_{RAMP}[4] V_{BATT} = 3.5 V VSWR = 3:1 all phases T_{CASE} = +25 °C			–33	dBm
Output Power	P_{OUT}	V_{CC} = 3.5 V T_{CASE} = +25 °C P_{IN} = –1 dBm	31.0	32.0	—	dBm
	P_{OUT} _MAX LOW VOLTAGE	V_{CC} = 3.1 V V_{RAMP} = MAX V_{RAMP}[4] –20 °C ≤ T_{CASE} ≤ +85 °C P_{IN} = –1 dBm	28.5	30.0	—	
	P_{OUT} _MAX HIGH VOLTAGE	V_{CC} = 4.8 V V_{RAMP} = MAX V_{RAMP}[4] –20 °C ≤ T_{CASE} ≤ +85 °C P_{IN} = –1 dBm	28.5	32.5	—	
Input VSWR	Γ_{IN}	0 dBm P_{OUT} ≤ 31 dBm V_{RAMP} controlled[2]	—	1.5:1	2.5:1	—
Forward Isolation[3]	$P_{OUT\ Rx}$	P_{IN} = 5 dBm V_{RAMP} ≤ 0.1 V V_{SW_EN} = $V_{SW\_EN\_HIGH}$ TxEN = V_{TxEN_LOW} Rx2 Mode	—	–60	–53	dBm
	$P_{OUT\_ENABLED\_Tx}$	P_{IN} = 5 dBm V_{RAMP} ≤ 0.1 V V_{SW_EN} = $V_{SW\_EN\_HIGH}$ TxEN = V_{TxEN_HIGH}	—	–35	–5	
Coupling of PCS Tx Output to Receive RF Output pad[3]	CPCS_Tx-Rx_f0	0 dBm ≤ P_{OUT} ≤ 31 dBm	—	0	5	dBm
Spurious	Spur	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max 3.1 V ≤ V_{CC} ≤ 4.8 V –20 °C ≤ T_{CASE} ≤ +85 °C Load VSWR = 12:1, all phase angles	No parasitic oscillation > –36 dBm			

Table 8. SKY77550 Electrical Specifications [1] (3 of 3)

[continued] *PCS1900 (Tx_HB) Mode (f = 1850 MHz to 1910 MHz, –1 dBm ≤ P_{IN} ≤ 5 dBm)*						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Load Mismatch	Load	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. 3.1 V ≤ V_{CC} ≤ 4.8 V –20 °C ≤ T_{CASE} ≤ +85 °C Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Spurious	Rx_{SPUR}	At f_0 + 20 MHz (1930 MHz to 1990 MHz) RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 0 dBm ≤ P_{OUT} ≤ 31 dBm	—	–83	–78	dBm
		869 MHz to 894 MHz RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 0 dBm ≤ P_{OUT} ≤ 31 dBm	—	—	–87	
Power Control Dynamic Range	PC_{DR}		35	50	—	dB
Power Control Variation — Control Level 0	PC_V	V_{BATT} = 3.5 V 30 dBm ≤ P_{OUT} ≤ 31 dBm T_{CASE} = +25 °C	–1.5	—	1.5	dB
		30 dBm ≤ P_{OUT} ≤ 33 dBm	–2.0	—	2.0	
Control Level 1-8		V_{BATT} = 3.5 V 14 dBm ≤ P_{OUT} ≤ 28 dBm T_{CASE} = +25 °C	–2.5	—	2.5	
		14 dBm ≤ P_{OUT} ≤ 28 dBm	–3.5	—	3.5	
Control Level 9-13		V_{BATT} = 3.5 V 4 dBm ≤ P_{OUT} ≤ 12 dBm T_{CASE} = +25 °C	–3.5	—	3.5	
		4 dBm ≤ P_{OUT} ≤ 12 dBm	–4.5	—	4.5	
Control Level 14-15		V_{BATT} = 3.5 V 0 dBm ≤ P_{OUT} ≤ 2 dBm T_{CASE} = +25 °C	–4.5	—	4.5	
		0 dBm ≤ P_{OUT} ≤ 2 dBm	–5.5	—	5.5	
Power Control Slope	PC_S	0 dBm to 31 dBm	—	—	250	dB/V
PCS1900 RECEIVE (f = 1930 MHz to 1990 MHz) = Rx Mode						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	1930	—	1990	MHz
Insertion Loss, ANT to Rx[5,3]	IL_Rx[5]	T_{CASE} = +25 °C	—	1.2	1.5	dB
VSWR ANT, Rx[5,3]	Γ_{IN}, Γ_{OUT}	—	—	1.2:1	1.5:1	

[1] Unless specified otherwise:
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} ≤ 4.8 V.

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

[3] Terminate all unused RF ports with 50 Ω loads

[4] Max V_{RAMP} = V_{RAMP} @ P_{OUT} =31 dBm, 50 Ω load, T_{CASE} +25 °C, V_{BATT} = 3.5 V, P_{IN} = 3 dBm

[5] Rx1 and Rx2 are broadband receive ports and each supports the GSM850, GSM900, DCS, and PCS bands.

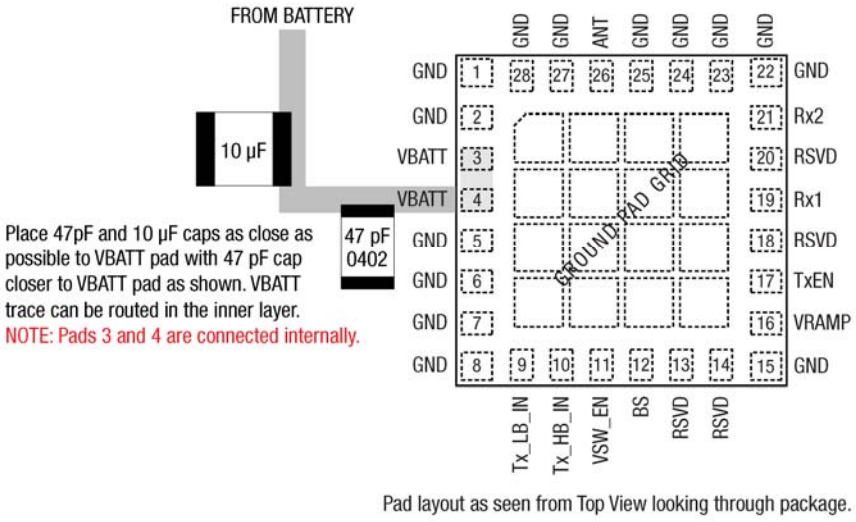
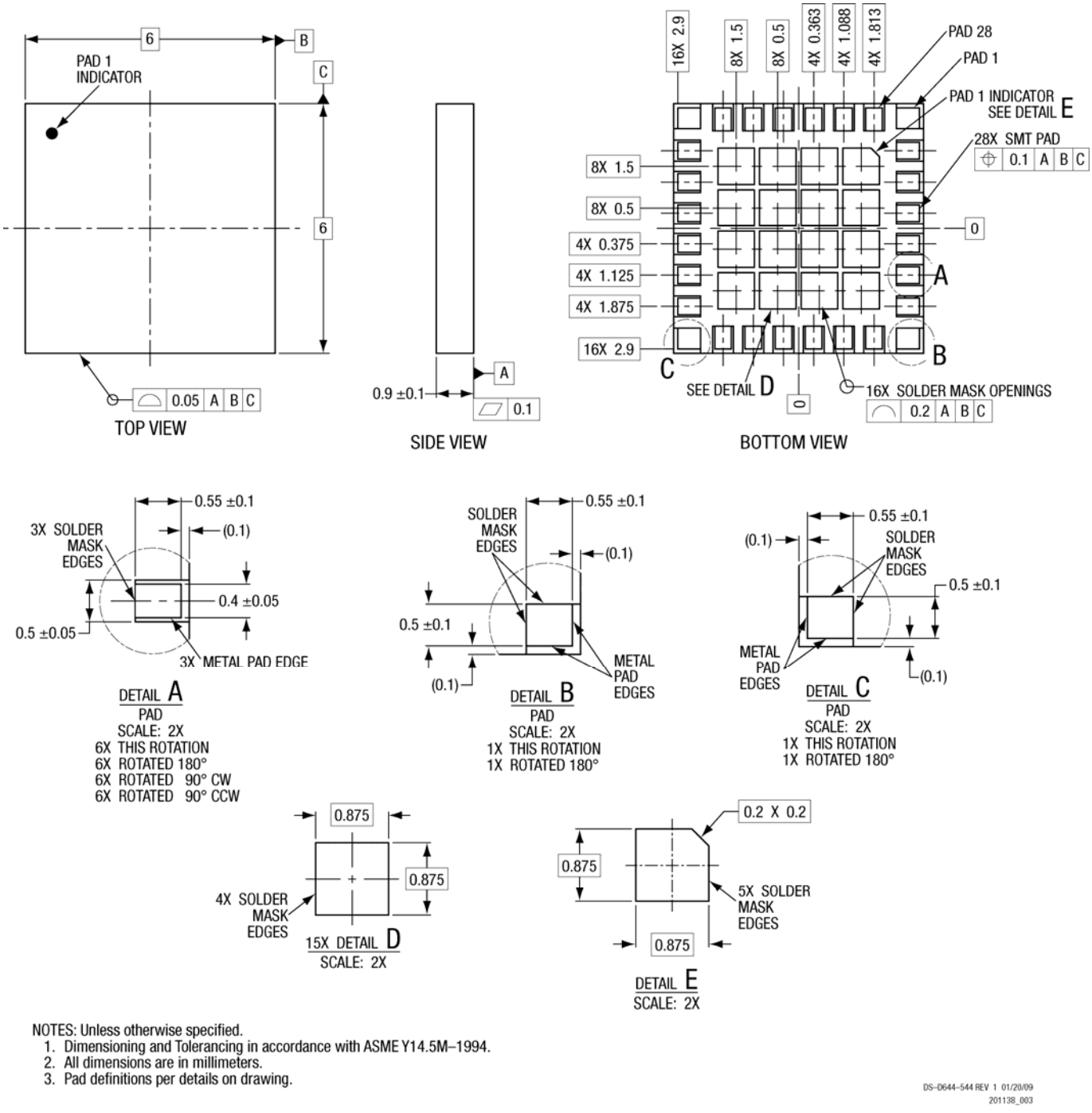


Figure 2. SKY77550 Application Schematic Diagram

Package Dimensions

Figure 3 is a mechanical diagram of the pad layout for the SKY77550, a 28-pad leadless dual-band FEM. Figure 4 provides a recommended phone board layout footprint for the FEM 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.

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201138_003

Figure 3. Dimensional Drawing for 6 mm x 6 mm x 0.9 mm, 28-Pad Package – SKY77550 Specific (All Views)

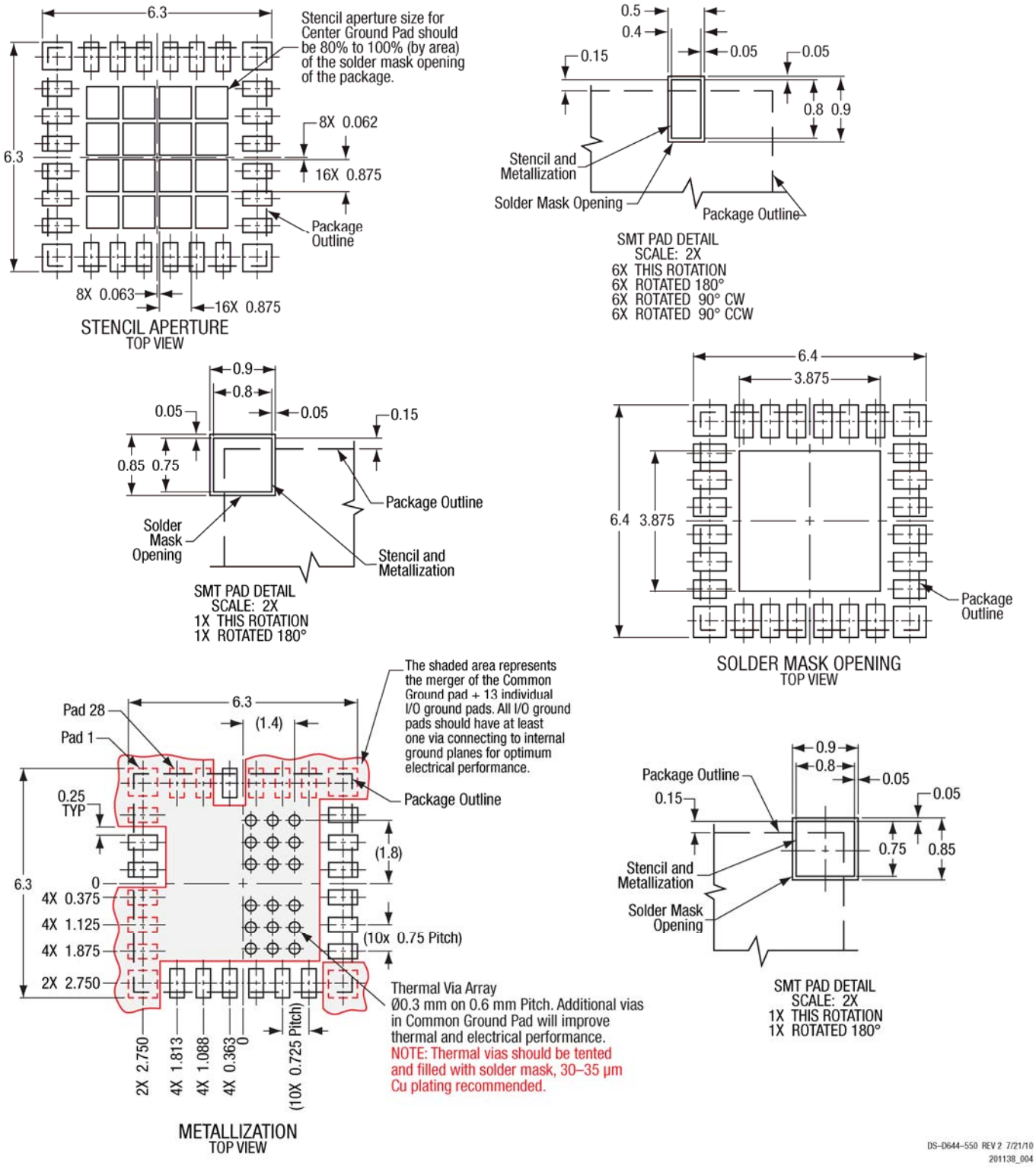


Figure 4. Phone PCB Layout Footprint for 6 mm x 6 mm, 28-Pad Package with Grid-Bottom Solder Mask – SKY77550 Specific.

Package Description

Figure 5 illustrates the device pad configuration and the numbering convention which starts with pad 1 at the lower left, as indicated and increments counter-clockwise around the package. Table 9 lists the pad names and the associated signal descriptions. Figure 6 interprets typical case markings.

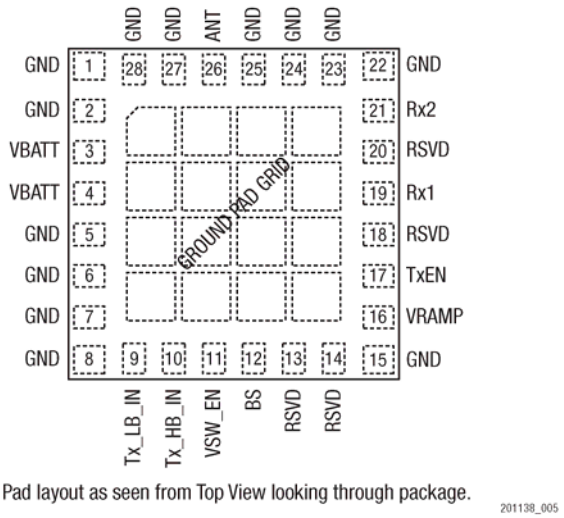


Figure 5. SKY77550 FEM Pad Configuration – 28-Pad Leadless (Top View)

Table 9. SKY77550 Pad Names and Signal Descriptions

Pad [1]	Name	Description
3, 4	VBATT	Battery input voltage (pads internally common)
9	Tx_LB_IN	RF input 824–915 MHz
10	Tx_HB_IN	RF input 1710–1910 MHz
11	VSW_EN	Control logic level selection/Standby control
12	BS	Band Select (mode control)
16	VRAMP	Analog power control voltage input
17	TxEN	Tx-Rx select (mode control)
19	Rx1	Broadband Receive Port
21	Rx2	Broadband Receive Port
26	ANT	RF_IN / RF_OUT to Antenna

[1] Pads 1, 2, 5–8, 15, 22–25, 27, 28 are ground pads. Pads 13, 14, 18, 20 are Reserved

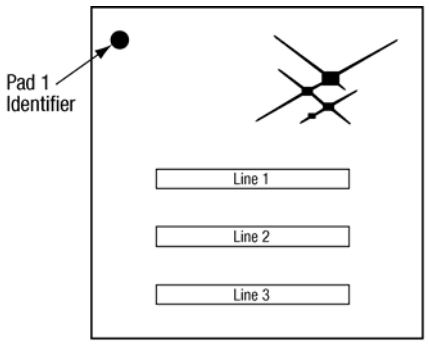


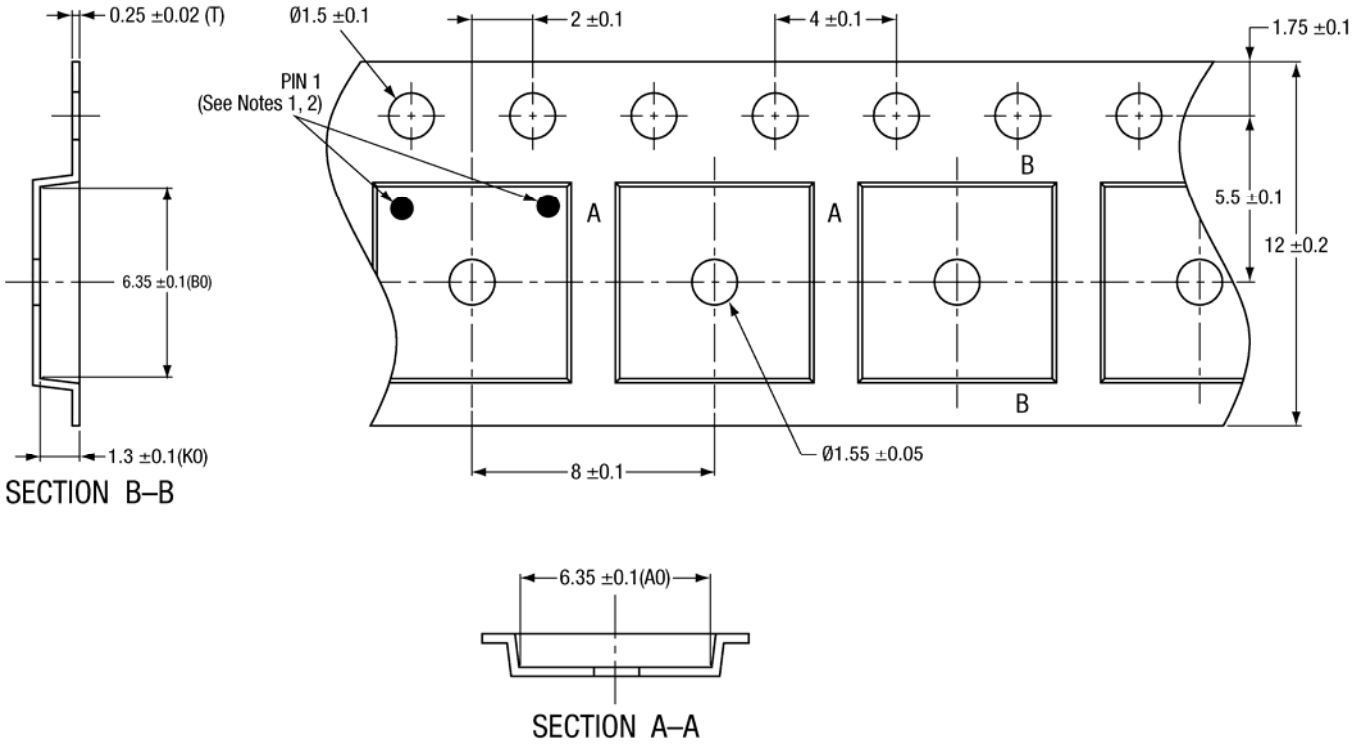
Figure 6. Typical Case Markings

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 SKY77550 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:

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

CARRIER TAPE OVERMOLD MCM/RFLGA 6 x 6 x 0.85 / 1.1 mm BODY SIZE -193G
201138_008

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

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.

- 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 109 Ω 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

Ordering Information

Model Number	Manufacturing Part Number	Product Revision	Package	Operating Temperature
SKY77550	SKY77550		MCM 6 mm x 6 mm x 0.9	–20 °C to +85 °C

Revision History

Revision	Date	Description
A	October 27, 2009	Initial Release – Advance Information
B	November 9, 2009	Revise: Figure 4
C	April 11, 2010	Revise: Description (p1); Tables 2–8
D	May June 14, 2010	Revise: Change Data Sheet status to “Preliminary” from “Advance”; Description, Features list (p1); Figure 2; Tables 4–9; References
E	September 8, 2010	Revise: Features list (p1); Tables 4–8; Figures 4, 7

References

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

Skyworks Application Note: iPAC™ Peak Output Power Calibration, Document Number 103180

Skyworks Application Note: SKY77550 BiFET iPAC™ Front-End Module – Implementation, Document Number 201287

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