PRELIMINARY DATA SHEET

SKY77552 Quad-Band Tx / Dual-Band Rx iPAC™ FEM for GSM / GPRS (824–915 MHz and 1710–1910 MHz)

Applications

- U.S. or Euro dual-band cellular handsets encompassing
  - Class 4 GSM850/900
  - DCS1800/PCS1900
  - Class 12 GPRS multi-slot operation

Features

- High efficiency
  - 43.5% GSM
  - 37.5% DCS/PCS
- Low transmit supply current
  - 1.31 A GSM
  - 0.96 A DCS/PCS
- 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
- PHEMT RF switches afford high linearity, low insertion loss, and less than 20 µA supply current in receive modes
- Small, low profile package
  - 7 x mm 6 mm x 0.9 mm
- Compatible with multiple logic families
- Low VRAMP current: 25 µA

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 SKY77552 is a quad-band transmit and dual-band receive front-end module (FEM) with Integrated Power Amplifier Control (iPAC™) for cellular handsets comprising GSM and DCS/PCS operation. The FEM has quad-band capability in applications of U.S. or Euro dual-band platforms. Designed in a low profile, compact form factor, the SKY77552 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 GSM PA block and a DCS/PCS PA block, impedance-matching circuitry for 50 Ω input and output impedances, Tx harmonics filtering, high linearity and low insertion loss PHEMT RF switches, diplexer and a Power Amplifier Control (PAC) block with internal current sense resistor. A custom BiCMOS integrated circuit provides the internal PAC function and decoder circuitry to control the RF switches. The two Heterojunction Bipolar Transistor (HBT) PA blocks are fabricated onto a single Gallium Arsenide (GaAs) die. One PA block supports the GSM band and the other PA block supports the DCS/PCS band. 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 PHEMT RF switches and a diplexer. The GaAs die, PHEMT die, Silicon (Si) 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 modes are performed using two external control pads. Refer to the functional block diagram in Figure 1. The band select pad (BS) selects between GSM and DCS/PCS modes of operation. The transmit enable (TxEN) pad controls receive or transmit mode of the respective 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 SKY77552 is compatible with logic levels from 1.2 V to VCC for BS and TxEN pads, depending on the level applied to the VLOGIC pad. This feature provides additional flexibility for the designer in the selection of FEM interface control logic.

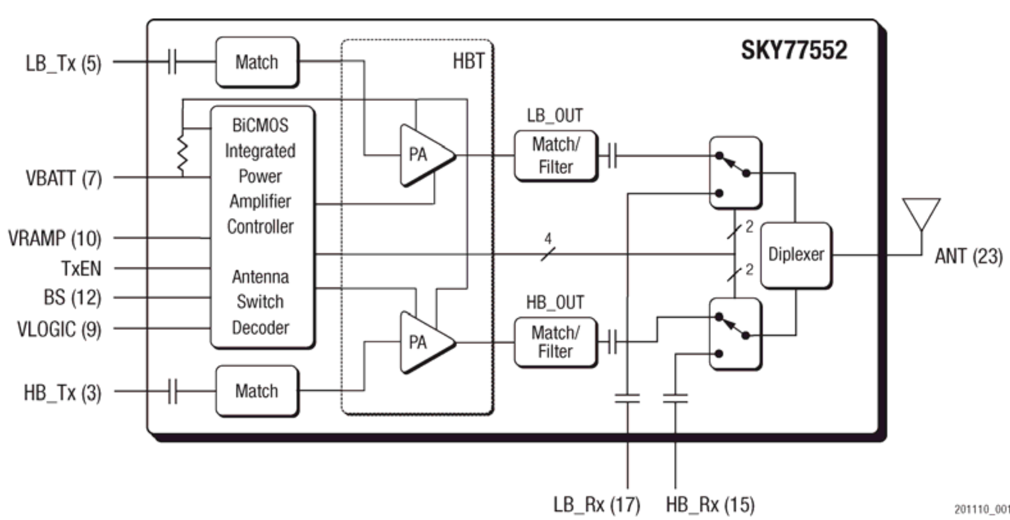


Figure 1. Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the SKY77552 Front-End Module. The absolute maximum ratings and recommended operating conditions for the SKY77552 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 SKY77552 for modes GSM and DCS/PCS. Figure 2 presents an application schematic for the SKY77552.

The SKY77552 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. Absolute Maximum Ratings

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

Table 2. Recommended Operating Conditions

Parameter	Minimum	Typical	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}) – Package Bottom Surface				
1-Slot (12.5% duty cycle)	–20	—	+85	°C
2-Slot (25.0% duty cycle)	–20	—	+85	
3-Slot (37.5% duty cycle)	–20	—	+85	
4-Slot (50.0% duty cycle)	–20	—	+85	

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

Table 3. SKY77552 Mode Control Logic

Mode	V_{LOGIC}	Input Control Bits	
		TxEN	BS
STANDBY	0	X[1]	X[1]
GSM_Rx	1	0	0
DCS/PCS_Rx	1	0	1
GSM_Tx	1	1	0
DCS/PCS_Tx	1	1	1

1 X = don't care

Table 4. SKY77552 Electrical Specifications[1]

General								
Parameter		**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Supply Voltage		V_{CC}	—	3.1	3.5	4.8	V
Power Control Impedance		Z_{VRAMP}	—		300		kΩ
VLOGIC Control Voltage	LOW	V_{LOGIC_LOW}	—	–0.1	—	0.5	V
	HIGH	V_{LOGIC_HIGH}		1.2	—	V_{CC}	
VLOGIC Current		I_{VLOGIC}	VLOGIC ≤ 2.9 V TxEN ≤ 0.4 V BS ≤ 0.4 V	—	1	20	µA
Band Select Control Voltage	LOW	V_{BS_LOW}	—	–0.1	—	30% V_{LOGIC}	V
	HIGH	V_{BS_HIGH}		70% V_{LOGIC}	—	V_{LOGIC}	
Band Select Current		I_{BS}	BS ≤ 2.9 V	—	8	20	µA
TXEN Control Voltage	LOW	V_{TXEN_LOW}	—	–0.1	—	30% V_{LOGIC}	V
	HIGH	V_{TXEN_HIGH}		70% V_{LOGIC}	—	V_{LOGIC}	
TxEN Current		I_{TXEN}	TxEN ≤ 2.9 V	—	8	20	µA
Leakage Current	Standby Mode	I_{QS}	V_{CC} ≤ 4.8 V V_{LOGIC} = V_{LOGIC_LOW} V_{RAMP} ≤ 0.1 V TxEN ≤ 0.4 V BS ≤ 0.4 V BS ≥ V_{LOGIC} – 0.4 V T_{CASE} = +25 °C P_{IN} ≤ –60 dBm	—	2	10	µA
	Receive Mode	I_{QRX}	V_{CC} ≤ 4.8 V 1.2 V ≤ V_{LOGIC} ≤ 2.9 V V_{RAMP} ≤ 0.1 V TxEN ≤ 0.4 V BS ≤ 0.4 V BS ≥ V_{LOGIC} – 0.4 V T_{CASE} = +25 °C P_{IN} ≤ –60 dBm	—	15	50	

Table 5. SKY77543 Electrical Specifications[1]

GSM850 Mode (f = 824 MHz to 849 MHz and P_{IN} = 0 dBm to 6 dBm)						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	824	—	849	MHz
Input Power	P_{IN}	—	0	—	6	dBm
Analog Power Control Voltage	V_{RAMP}	—	0.2	—	1.8	V
Power Added Efficiency	PAE	V_{CC} = 3.5 V P_{OUT} = 33 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 33 dBm pulse width 577 µs duty cycle 1:8 T_{CASE} = +25 °C	38.0	43.5	—	%
Supply Current @ Rated Power	I_{CC}_33 dBm	V_{CC} = 3.5 V P_{OUT} = 33 dBm P_{IN} = 3 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 33 dBm pulse width 577 µs duty cycle 1:8 T_{CASE} = +25 °C	—	1.31	1.5	A
Supply Current @ Minimum Power	I_{CC}_5 dBm	V_{CC} = 3.5 V P_{OUT} = 5 dBm P_{IN} = 3 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 5 dBm pulse width 577 µs duty cycle 1:8 T_{CASE} = +25 °C	—	60	65	mA
Harmonics 2ND to 13TH	$2f_0$ to $13f_0$	BW = 3 MHz 5 dBm ≤ P_{OUT} ≤ 33 dBm V_{RAMP} controlled[4]	—	–40	–33	dBm
Output Power	P_{OUT}	V_{CC} = 3.5 V T_{CASE} = +25 °C P_{IN} = 0 dBm	33.0	33.7	—	dBm
	$P_{OUT\_MAX\ LOW\ VOLTAGE}$	V_{CC} = 3.1 V TxEN = V_{TXEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	30.5	32.2	—	
	$P_{OUT\_MAX\ HIGH\ VOLTAGE}$	V_{CC} = 4.8 V TxEN = V_{TXEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	30.5	34.5	—	
Input VSWR	Γ_{IN}	P_{OUT} = 5 dBm to 33 dBm V_{RAMP} controlled[4]	—	1.8:1	2.5:1	
Forward Isolation[3]	P_{OUT_RX}	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{LOGIC_HIGH} TxEN = V_{TXEN_LOW} Mode = GSM_Rx (see Table 3)	—	–55	–45	dBm
	$P_{OUT\_ENABLED\_TX}$	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{LOGIC_HIGH} TxEN = V_{TXEN_HIGH} Mode = GSM_Tx (see Table 3)	—	–25	–5	
Coupling of GSM850 Tx Output (f_0) to GSM_Rx Output pad[3]	$CGHI_{TX\text{-}RX\_F0}$	5 dBm ≤ P_{OUT} ≤ 33 dBm Mode = GSM_Tx (see Table 3)	—	4	11	dBm
Coupling of GSM850 Tx Output ($2f_0$, $3f_0$) to PCS_Rx Output pad	$CGHI_{TX\text{-}PCS\_RX}$	5 dBm ≤ P_{OUT} ≤ 33 dBm Mode = GSM_Tx (see Table 3)	—	–42	–36	dBm

Table 5. SKY77552 Electrical Specifications[1]

[continued] **GSM850 Mode (f = 824 MHz to 849 MHz and P_{IN} = 0 dBm to 6 dBm)**						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Spurious	Spur	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. V_{CC} = 3.1 V to 4.8 V 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. V_{CC} = 3.1 V to 4.8 V 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 5 dBm ≤ P_{OUT} ≤ 33 dBm T_{CASE} = 25 °C	—	–84	–82	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 5-15 (V_{CC} ≥ 3.3 V)	PC_V	P_{OUT} = 13 dBm to 33 dBm T_{CASE} = 25 °C	–1.0	—	1.0	dB
		P_{OUT} = 13 dBm to 33 dBm	–1.5	—	1.5	
Control level 16-19		P_{OUT} = 5 dBm to 11 dBm T_{CASE} = 25 °C	–2.0	—	2.0	
		P_{OUT} = 5 dBm to 11 dBm	–3.5	—	3.5	
Power Control slope	PC_S	5 dBm to 33 dBm	—	—	150	dB/V
GSM850 RECEIVE (f = 869 MHz to 894 MHz) Mode = GSM_Rx						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	869	—	894	MHz
Insertion Loss, ANT to GSM_Rx[3]	IL_{GSM_Rx}	—	—	1.1	1.3	dB
VSWR ANT, GSM_Rx[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, V_{CC} = 3.1 V to 4.8 V.

2 I_{CC} = 0A to xA, where x = current at P_{OUT} = 33 dBm, 50 Ω load, and V_{CC} = 3.5 V

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, P_{IN} = 3 dBm

Table 6. SKY77542 Electrical Specifications[1]

GSM900 Mode (f = 880MHz to 915 MHz and P_{IN} = 0 dBm to 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}	—	0.2	—	1.8	V
Power Added Efficiency	PAE	V_{CC} = 3.5 V P_{OUT} = 33 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 33 dBm pulse width 577 μs duty cycle 1:8 T_{CASE} = +25 °C	38.0	43.5	—	%
Supply Current @ Rated Power	I_{CC}_33 dBm	V_{CC} = 3.5 V P_{OUT} = 33 dBm P_{IN} = 3 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 33 dBm pulse width 577 μs duty cycle 1:8 T_{CASE} = +25 °C	—	1.31	1.5	A
Supply Current @ Minimum Power	I_{CC}_5 dBm	V_{CC} = 3.5 V P_{OUT} = 5 dBm P_{IN} = 3 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 5 dBm pulse width 577 μs duty cycle 1:8 T_{CASE} = +25 °C	—	60	65	mA
Harmonics 2ND to 13TH	2f_0 to 13f_0	BW = 3 MHz 5 dBm ≤ P_{OUT} ≤ 33 dBm V_{RAMP} controlled[4]	—	–40	–33	dBm
Output Power	P_{OUT}	V_{CC} = 3.5 V T_{CASE} = +25 °C P_{IN} = 0 dBm	33.0	33.7	—	dBm
	$P_{OUT\_MAX\ LOW\ VOLTAGE}$	V_{CC} = 3.1V TxEN = V_{TXEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	30.5	32.2	—	
	$P_{OUT\_MAX\ HIGH\ VOLTAGE}$	V_{CC} = 4.8 V TxEN = V_{TXEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	30.5	34.5	—	
Input VSWR	Γ_{IN}	P_{OUT} = 5 dBm to 33 dBm V_{RAMP} controlled[4]	—	1.8:1	2.5:1	
Forward Isolation[3]	P_{OUT_RX}	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{LOGIC_HIGH} TxEN = V_{TXEN_LOW} Mode = GSM_Rx (see Table 3)	—	–55	–45	dBm
	$P_{OUT\_ENABLED\_TX}$	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{LOGIC_HIGH} TxEN = V_{TXEN_HIGH} Mode = GSM_Tx (see Table 3)	—	–22	–5	
Coupling of GSM900 Tx Output (f_0) to GSM_Rx Output Pad[3]	$CGHI_{TX\text{-}RX\_F0}$	5 dBm ≤ P_{OUT} ≤ 33 dBm Mode = GSM_Tx (see Table 3)	—	4	11	dBm
Coupling of GSM900 Tx Output (2f_0, 3f_0) to DCS/PCS_Rx Output Pad	$CGHI_{TX\text{-}DCS\_RX}$	5 dBm ≤ P_{OUT} ≤ 33 dBm Mode = GSM_Tx (see Table 3)	—	–42	–36	dBm

Table 6. SKY77552 Electrical Specifications[1]

[continued] GSM900 Mode (f = 880MHz to 915 MHz and P_{IN} = 0 dBm to 6 dBm)						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Spurious	Spur	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. V_{CC} = 3.1 V to 4.8 V 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. V_{CC} = 3.1 V to 4.8 V 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 5 dBm ≤ P_{OUT} ≤ 33 dBm T_{CASE} = +25 °C	—	–84	–82	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 5-15 (V_{CC} ≥ 3.3 V)	PC_V	P_{OUT} = 13 dBm to 33 dBm T_{CASE} = +25 °C	–1.0	—	1.0	dB
		P_{OUT} = 13 dBm to 33 dBm	–1.5	—	1.5	
Power Control Variation — Control level 16-19		P_{OUT} = 5 dBm to 11 dBm T_{CASE} = +25 °C	–2.0	—	2.0	
		P_{OUT} = 5 dBm to 11 dBm	–3.5	—	3.5	
Power Control Slope	PC_S	5 dBm to 33 dBm	—	—	150	dB/V
GSM900 RECEIVE (f = 925 MHz to 960 MHz) Mode = GSM_Rx						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	925	—	960	MHz
Insertion Loss, ANT to GSM_Rx[3]	IL_{GSM_RX}	—	—	1.1	1.3	dB
VSWR ANT, GSM_Rx[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, V_{CC} = 3.1 V to 4.8 V.

2 I_{CC} = 0A to xA, where x = current at P_{OUT} = 33 dBm, 50 Ω load, and V_{CC} = 3.5 V

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, P_{IN} = 3 dBm

Table 7. SKY77552 Electrical Specifications[1]

DCS1800 Mode (f = 1710 MHz to 1785 MHz and P_{IN} = 0 dBm to 6 dBm)						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	1710	—	1910	MHz
Input Power	P_{IN}	—	0	—	6	dBm
Analog Power Control Voltage	V_{RAMP}	—	0.2	—	1.8	V
Power Added Efficiency	PAE	V_{CC} = 3.5 V P_{OUT} = 31 dBm TxEN = V_{TxEN_HIGH} V_{RAMP} set for P_{OUT} = 31 dBm pulse width 577 µs duty cycle 1:8 T_{CASE} = +25 °C	34.5	37.5	—	%
Supply Current @ Rated Power	I_{CC}_31 dBm	V_{CC} = 3.5 V P_{OUT} = 31 dBm P_{IN} = 3 dBm TxEN = V_{TxEN_HIGH} V_{RAMP} set for P_{OUT} = 31 dBm pulse width 577 µs duty cycle 1:8 T_{CASE} = +25 °C	—	0.96	1.04	A
Supply Current @ Minimum Power	I_{CC}_0 dBm	V_{CC} = 3.5 V P_{OUT} = 0 dBm P_{IN} = 3 dBm TxEN = V_{TxEN_HIGH} V_{RAMP} set for P_{OUT} = 0 dBm pulse width 577 µs duty cycle 1:8 T_{CASE} = +25 °C	—	45	55	mA
Harmonics 2ND, 3RD, 5TH, 6TH	$2f_0$, $3f_0$, $5f_0$, $6f_0$	BW = 3 MHz, 0 dBm ≤ P_{OUT} ≤ 31 dBm V_{RAMP} controlled[4]	—	–40	–33	dBm
4TH, 7TH	4TH, $7f_0$		—	–35	–31	
Output Power	P_{OUT}	V_{CC} = 3.5 V T_{CASE} = +25 °C P_{IN} = 0 dBm	31.0	32.0	—	dBm
	$P_{OUT\ \_MAX\ LOW\ VOLTAGE}$	V_{CC} = 3.1 V TxEN = V_{TxEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	28.5	30.0	—	
	$P_{OUT\ \_MAX\ HIGH\ VOLTAGE}$	V_{CC} = 4.8 V TxEN = V_{TxEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	28.5	32.5	—	
Input VSWR	Γ_{IN}	P_{OUT} = 0 dBm to 31 dBm V_{RAMP} controlled[4]	—	1.5:1	2.5:1	—
Forward Isolation[3]	$P_{OUT\ Rx}$	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{TxEN_HIGH} TxEN = V_{TxEN_LOW} Mode = DCS_Rx (see Table 3)	—	–57	–53	dBm
	$P_{OUT\_ENABLED\_Tx}$	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{LOGIC_HIGH} TxEN = V_{TxEN_HIGH} Mode = DCS_Tx (see Table 3)	—	–30	–5	
Coupling of DCS Tx Output to Receive RF Output Pad[3]	$CDCS_{Tx\text{-}Rx\_F0}$	0 dBm ≤ P_{OUT} ≤ 31 dBm Mode = DCS_Tx (see Table 3)	—	4	9	dBm

Table 7. SKY77552 Electrical Specifications[1]

[continued] **DCS1800 Mode (f = 1710 MHz to 1785 MHz and P_{IN} = 0 dBm to 6 dBm)**						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Spurious	Spur	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. V_{CC} = 3.1 V to 4.8 V 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. V_{CC} = 3.1 V to 4.8 V Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Rx Band Spurious	R_{X_SPUR}	At f_0 + 20 MHz (1805 MHz to 1824 MHz) RBW = 100 kHz V_{CC} = 3.5 V T_{CASE} = +25 °C 0 dBm ≤ P_{OUT} ≤ 31 dBm	—	—	–77	dBm
		925 MHz to 960 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 0-8, V_{CC} ≥ 3.3 V	PC_V	P_{OUT} = 14 dBm to 31 dBm T_{CASE} = +25 °C	–1.5	—	1.5	dB
		P_{OUT} = 14 dBm to 31 dBm	–2.0	—	2.0	
Control level 9-13		P_{OUT} = 4 dBm to 12 dBm T_{CASE} = +25 °C	–2.5	—	2.5	
		P_{OUT} = 4 dBm to 12 dBm	–3.5	—	3.5	
Control level 14-15		P_{OUT} = 0 dBm to 2 dBm T_{CASE} = +25 °C	–3.0	—	3.0	
		P_{OUT} = 0 dBm to 2 dBm	–4.5	—	4.5	
Power Control Slope	PC_S	0 dBm to 30 dBm	—	—	150	dB/V
DCS 1800 RECEIVE (f =1805 MHz to 1880 MHz) Mode = DCS_Rx						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	1805	—	1880	MHz
Insertion Loss, ANT to DCS_Rx[3]	IL_{DCS_RX}	—	—	1.3	1.5	dB
VSWR ANT, DCS_Rx[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, V_{CC} = 3.1 V to 4.8 V.

2 I_{CC} = 0A to xA, where x = current at P_{OUT} = 31 dBm, 50 Ω load, and V_{CC} = 3.5 V

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, P_{IN} = 3 dBm

Table 8. SKY77552 Electrical Specifications[1]

PCS1900 Mode (f = 1850 MHz to 1910 MHz and P_{IN} = 0 dBm to 6 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}	—	0.2	—	1.8	V
Power Added Efficiency	PAE	V_{CC} = 3.5 V P_{OUT} = 31 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 31 dBm pulse width 577 μs duty cycle 1:8 T_{CASE} = +25 °C	34.5	37.5	—	%
Supply Current @ Rated Power	I_{CC}_31 dBm	V_{CC} = 3.5 V P_{OUT} = 31 dBm P_{IN} = 3 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 31 dBm pulse width 577 μs duty cycle 1:8 T_{CASE} = +25 °C	—	0.96	1.04	A
Supply Current @ Minimum Power	I_{CC}_0 dBm	V_{CC} = 3.5 V P_{OUT} = 0 dBm P_{IN} = 3 dBm TxEN = V_{TXEN_HIGH} V_{RAMP} set for P_{OUT} = 0 dBm pulse width 577 μs duty cycle 1:8 T_{CASE} = +25 °C	—	45	55	mA
Harmonics 2ND to 5TH, 7TH	$2f_0$, $3f_0$, $4f_0$, $5f_0$, $7f_0$	BW = 3 MHz, 0 dBm ≤ P_{OUT} ≤ 31 dBm V_{RAMP} controlled[4]	—	–40	–33	dBm
6TH	$6f_0$		—	–35	–31	
Output Power	P_{OUT}	V_{CC} = 3.5 V T_{CASE} = +25 °C P_{IN} = 0 dBm	31.0	32.0	—	dBm
	$P_{OUT\ \_MAX\ LOW\ VOLTAGE}$	V_{CC} = 3.1 V TxEN = V_{TXEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	28.5	30.0	—	
	$P_{OUT\ \_MAX\ HIGH\ VOLTAGE}$	V_{CC} = 4.8 V TxEN = V_{TXEN_HIGH} T_{CASE} = –20 °C to 85 °C P_{IN} = 0 dBm	28.5	32.5	—	
Input VSWR	Γ_{IN}	P_{OUT} = 0 dBm to 31 dBm V_{RAMP} controlled[4]	—	1.5:1	2.5:1	—
Forward Isolation[3]	$P_{OUT\ Rx}$	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{TXEN_HIGH} TxEN = V_{TXEN_LOW} Mode = PCS_Rx (see Table 3)	—	–57	–53	dBm
	$P_{OUT\_ENABLED\_TX}$	P_{IN} = 6 dBm V_{RAMP} ≤ 0.1 V V_{LOGIC} = V_{LOGIC_HIGH} TxEN = V_{TXEN_HIGH} Mode = PCS_Tx (see Table 3)	—	–30	–5	
Coupling of PCS Tx Output to Receive RF Output Pad[3]	$CPCS_{Tx\text{-}Rx\_F0}$	0 dBm ≤ P_{OUT} ≤ 31 dBm Mode = PCS_Tx (see Table 3)	—	4	9	dBm

Table 8. SKY77552 Electrical Specifications[1]

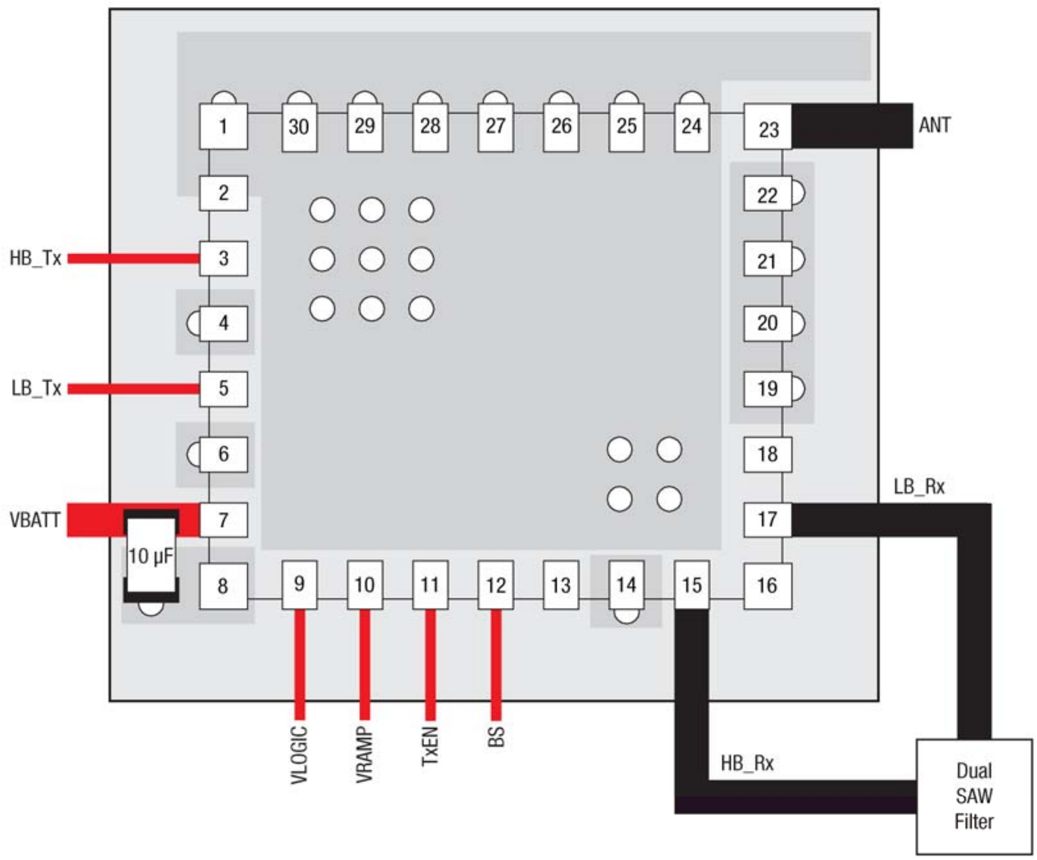
Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Units
[continued] **PCS1900 Mode (f = 1850 MHz to 1910 MHz and P_{IN} = 0 dBm to 6 dBm)**						
Spurious	Spur	All combinations of the following parameters: V_{RAMP} = controlled[2] P_{IN} = min. to max. V_{CC} = 3.1 V to 4.8 V Load VSWR = 12:1, 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. V_{CC} = 3.1 V to 4.8 V 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	—	—	–77	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 0-8, V_{CC} ≥ 3.3 V	PC_V	P_{OUT} = 14 dBm to 31 dBm T_{CASE} = +25 °C	–1.5	—	1.5	dB
		P_{OUT} = 14 dBm to 31 dBm	–2.0	—	2.0	
Control level 9-13		P_{OUT} = 4 dBm to 12 dBm T_{CASE} = +25 °C	–2.5	—	2.5	
		P_{OUT} = 4 dBm to 12 dBm	–3.5	—	3.5	
Control level 14-15		P_{OUT} = 0 dBm to 2 dBm T_{CASE} = +25 °C	–3.0	—	3.0	
		P_{OUT} = 0 dBm to 2 dBm	–4.5	—	4.5	
Power Control Slope	PC_S	0 dBm to 30 dBm	—	—	150	dB/V
PCS1900 RECEIVE (f =1930 MHz to 1990 MHz) Mode = PCS_Rx						
Parameter	**Symbol**	**Test Condition**	**Minimum**	**Typical**	**Maximum**	**Units**
Frequency Range	f	—	1930	—	1990	MHz
Insertion Loss, ANT to PCS_Rx[3]	IL_{PCS_RX}	—	—	1.3	1.5	dB
VSWR ANT, PCS_Rx[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, V_{CC} = 3.1 V to 4.8 V.

2 I_{CC} = 0A to xA, where x = current at P_{OUT} = 31 dBm, 50 Ω load, and V_{CC} = 3.5 V

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, P_{IN} = 3 dBm



NOTES:
1. The value of 10 µF cap is dependent on the noise level on the phone board.
2. Ensure sufficient number of vias to supply battery current to VBATT.
3. VBATT trace width should be ≥ 1 mm.
4. Ground terminal of bypass capacitor connected to ground plane with vias.
5. Layer 2 should be solid ground plane under SKY77552 and any RF trace interconnect.

201110_002

Figure 2. SKY77552 Application Schematic Diagram

Package Dimensions

Figure 3 is a mechanical diagram of the pad layout for the SKY77552, a 30-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.

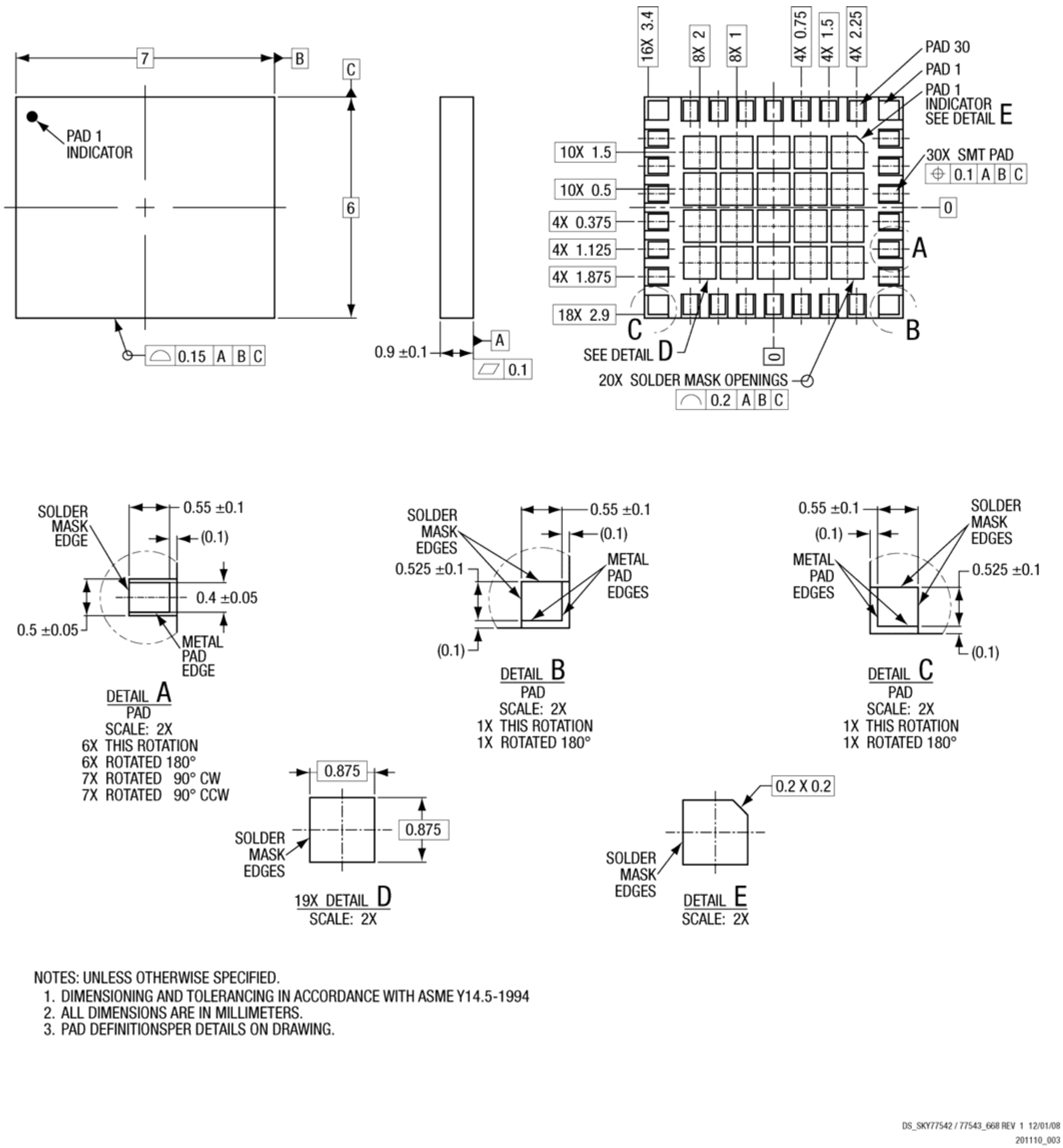


Figure 3. Dimensional Diagram for 7 mm x 6 mm x 0.9 mm, 30-Pad Leadless Package (All Views) – SKY77552

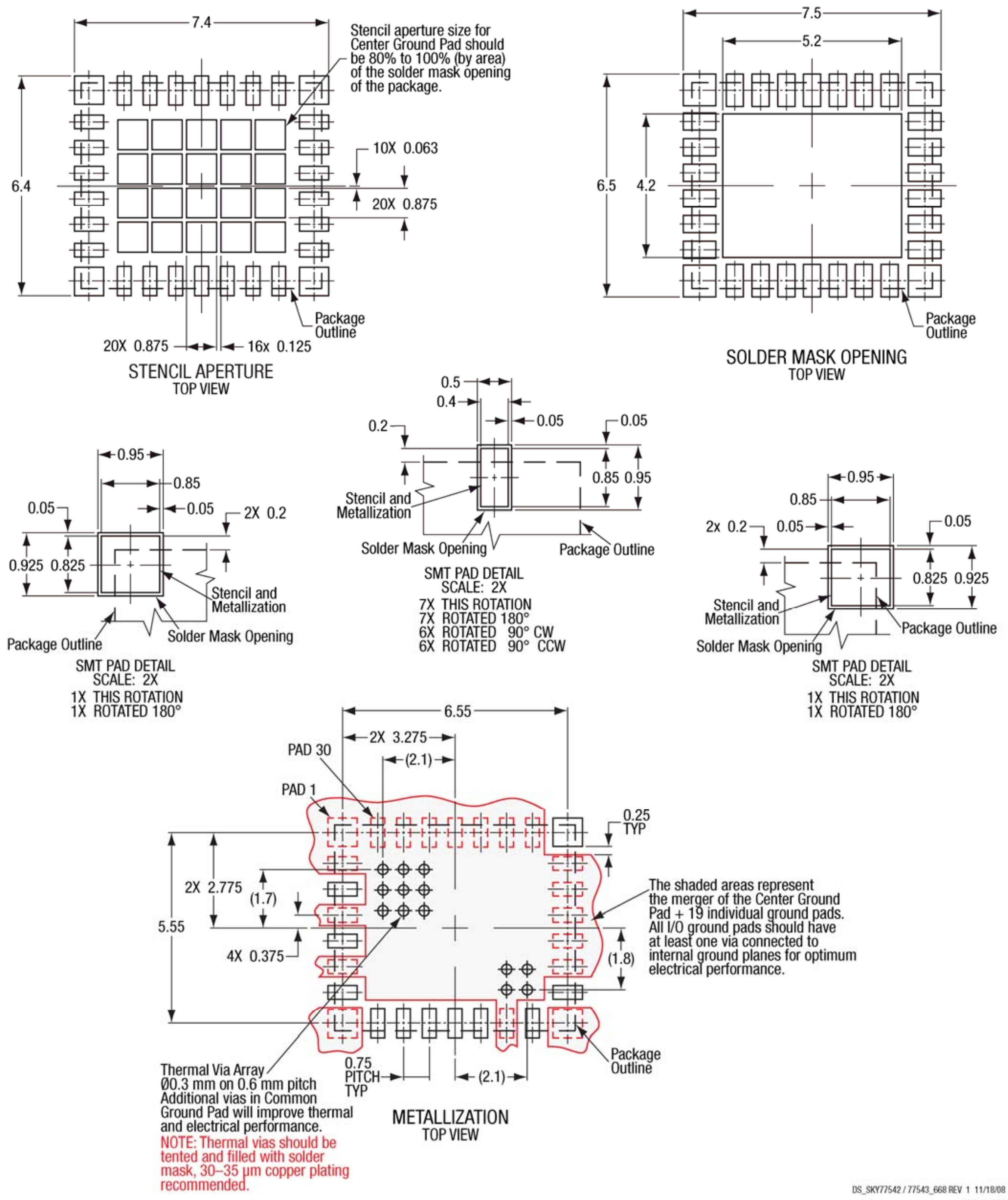


Figure 4. Phone PCB Layout Footprint for 7 mm x 6 mm, 30-Pad Package – SKY77552 Specific

Package Descriptions

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

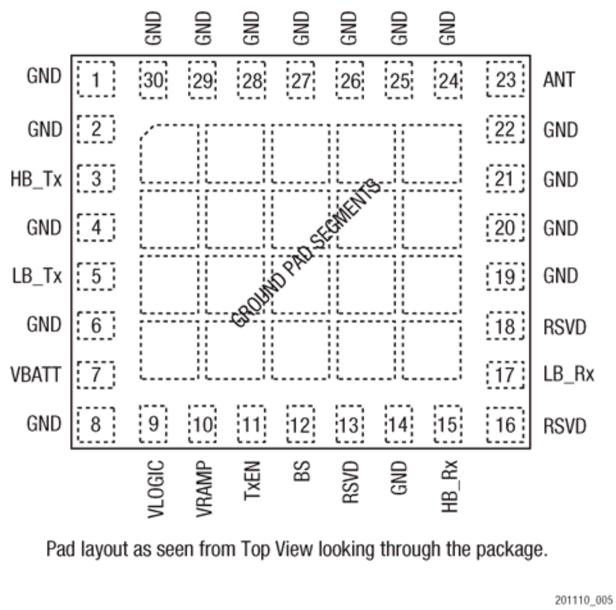


Figure 5. SKY77552 FEM Package Pad Configuration – 30-Pad Leadless (Top View)

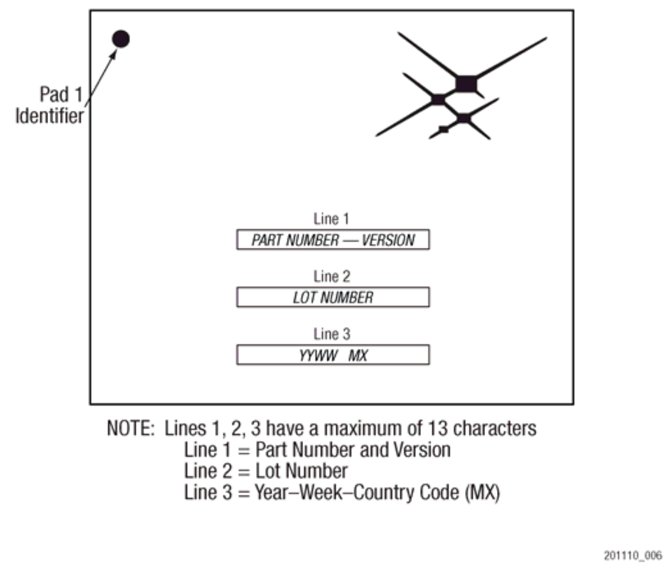


Figure 6. Typical Case Markings

Table 9. SKY77552 Pad Names and Signal Descriptions

Pad[1]	Name	Description
3	HB_Tx	RF input 1710–1910 MHz
5	LB_Tx	RF input 824–915 MHz
7	VBATT	Battery input voltage
9	VLOGIC	Control logic level selection
10	VRAMP	Analog power control voltage input
11	TxEN	Tx/Rx select
12	BS	Band Select (high/low bands)
13	RSVD	Reserved for possible quad-band solution
15	HB_Rx	Receive RF output (1805–1990 MHz)
16	RSVD	Reserved for possible quad-band solution
17	LB_Rx	Receive RF output (869–960 MHz)
18	RSVD	Reserved for possible quad-band solution
23	ANT	Antenna
GROUND GRID		Ground Grid is device underside

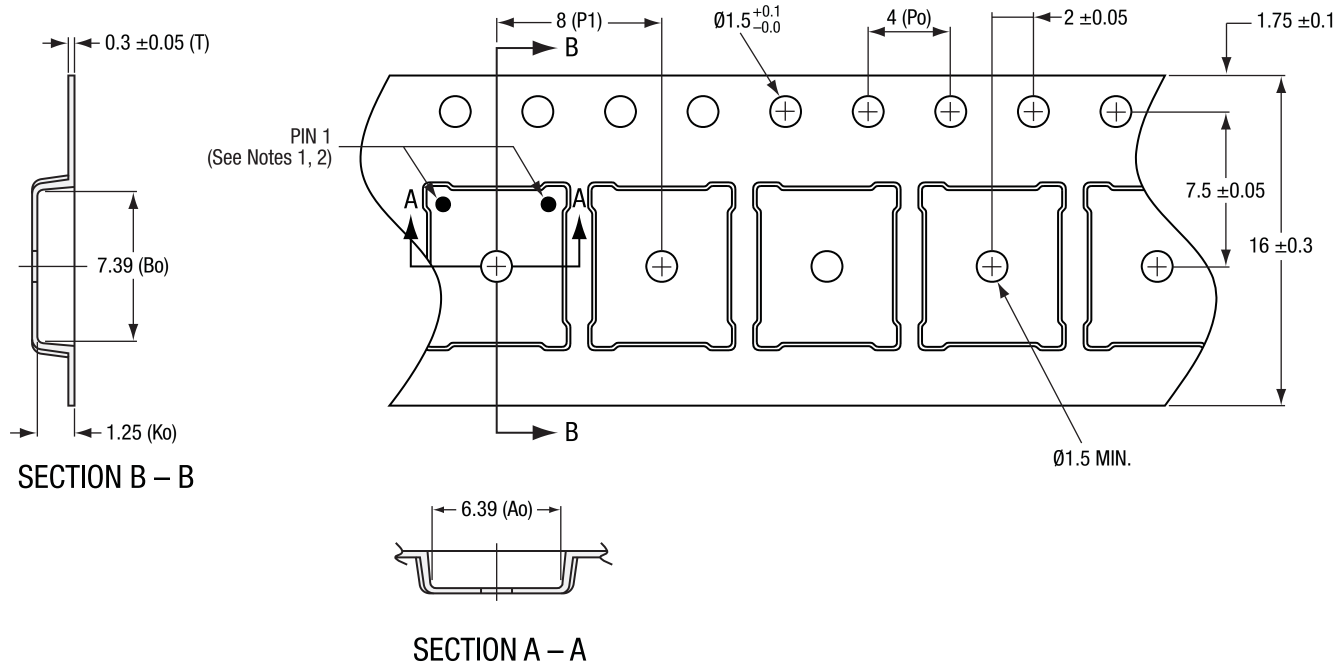
[1] Pads 1, 2, 4, 6, 8, 14, 19–22, 24–30 are GROUND pads.

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 SKY77552 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 SHALL BE "TOP LEFT" FOR ALL 6 x 7 mm RFLGA PRODUCTS & ONLY THE 6 x 7 mm MCM PRODUCTS LISTED BELOW:
   SKY77535-XX SKY77536-XX SKY77537-XX SKY77538-XX
2. PIN 1 ORIENTATION SHALL BE "TOP RIGHT" FOR ALL 6 x 7 mm MCM PRODUCTS EXCEPT THOSE LISTED IN NOTE 1 ABOVE.
3. CARRIER TAPES MUST MEET ALL REQUIREMENTS OF SKYWORKS GP01–D232 PROCUREMENT SPEC FOR TAPE AND REEL SHIPPING.
4. CARRIER TAPE SHALL BE BLACK CONDUCTIVE POLYSTYRENE.
5. COVER TAPE SHALL BE TRANSPARENT CONDUCTIVE PRESSURE-SENSITIVE ADHESIVE (PSA) MATERIAL W/ 13.3 mm WIDTH.
6. ESD-SURFACE RESISTIVITY SHALL BE ≤ 1 X 10^{10} OHMS/SQUARE PER EIA, JEDEC TNR SPECIFICATION.
7. Po / P1, 10 PITCHES CUMULATIVE TOLERANCE ON TAPE: ±0.2 mm.
8. Ao & Bo MEASUREMENT POINT TO BE 0.3 mm FROM BOTTOM POCKET.
9. ALL DIMENSIONS ARE IN MILLIMETERS.
10. PART NO.: eC3-LGA6x7-16-8-F1-L REV. 0 (PLEASE INDICATE ON PURCHASE ORDER).
11. NUMBER OF PARTS per 13 inch (DIAMETER) x 16 mm REEL: 2500.

ePAK CARRIER TAPE

CARRIER TAPE OVERMOLD RFLGA / MCM 6 x 7 x 1.0 mm BODY SIZE GP01-D232-155F
101568_021

Figure 7. Tape and Reel Dimensional Diagram for 6 mm x 7 mm x 1.0 mm Package

Electrostatic Discharge (ESD) Sensitivity

The SKY77552 is a Class 1A device. The ESD testing was performed in compliance with JEDEC JESD22-A114B Human Body Model (HBM) and JEDEC JESD22-A115B Machine Model (MM) requirements.

Various failure criteria can be utilized when performing ESD testing. Many vendors employ relaxed ESD failure standards that fail devices only after “the pad fails the electrical specification limits” or “the pad becomes completely non-functional”. Skyworks employs stringent criteria, rejecting devices as soon as the pad begins to show any degradation on a curve tracer.

To avoid ESD damage, both latent and visible, it is very important that the product assembly and test areas follow the Class 1A 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
SKY77552	SKY77552		MCM 7 mm x 6 mm x 0.9 mm	–20 °C to +85 °C

Revision History

Revision	Date	Description
A	October 14, 2009	Initial Release

References

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

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

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

JEDEC JESD22-A114B Human Body Model (HBM)

JEDEC JESD22-A115B Machine Model (MM)

射 频 和 天 线 设 计 培 训 课 程 推 荐

易迪拓培训(www.edatop.com)由数名来自于研发第一线的资深工程师发起成立，致力并专注于微波、射频、天线设计研发人才的培养；我们于 2006 年整合合并微波 EDA 网(www.mweda.com)，现已发展成为国内最大的微波射频和天线设计人才培养基地，成功推出多套微波射频以及天线设计经典培训课程和 ADS、HFSS 等专业软件使用培训课程，广受客户好评；并先后与人民邮电出版社、电子工业出版社合作出版了多本专业图书，帮助数万名工程师提升了专业技术能力。客户遍布中兴通讯、研通高频、埃威航电、国人通信等多家国内知名公司，以及台湾工业技术研究院、永业科技、全一电子等多家台湾地区企业。

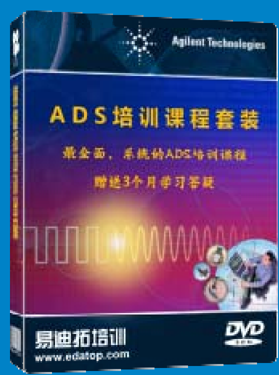
易迪拓培训课程列表：http://www.edatop.com/peixun/rfe/129.html

射频工程师养成培训课程套装

该套装精选了射频专业基础培训课程、射频仿真设计培训课程和射频电路测量培训课程三个类别共 30 门视频培训课程和 3 本图书教材；旨在引领学员全面学习一个射频工程师需要熟悉、理解和掌握的专业知识和研发设计能力。通过套装的学习，能够让学员完全达到和胜任一个合格的射频工程师的要求…

课程网址：http://www.edatop.com/peixun/rfe/110.html

ADS 学习培训课程套装



该套装是迄今国内最全面、最权威的 ADS 培训教程，共包含 10 门 ADS 学习培训课程。课程是由具有多年 ADS 使用经验的微波射频与通信系统设计领域资深专家讲解，并多结合设计实例，由浅入深、详细而又全面地讲解了 ADS 在微波射频电路设计、通信系统设计和电磁仿真设计方面的内容。能让您在最短的时间内学会使用 ADS，迅速提升个人技术能力，把 ADS 真正应用到实际研发工作中去，成为 ADS 设计专家...

课程网址： http://www.edatop.com/peixun/ads/13.html

HFSS 学习培训课程套装

该套课程套装包含了本站全部 HFSS 培训课程，是迄今国内最全面、最专业的 HFSS 培训教程套装，可以帮助您从零开始，全面深入学习 HFSS 的各项功能和在多个方面的工程应用。购买套装，更可超值赠送 3 个月免费学习答疑，随时解答您学习过程中遇到的棘手问题，让您的 HFSS 学习更加轻松顺畅…

课程网址：http://www.edatop.com/peixun/hfss/11.html

CST 学习培训课程套装

该培训套装由易迪拓培训联合微波 EDA 网共同推出，是最全面、系统、专业的 CST 微波工作室培训课程套装，所有课程都由经验丰富的专家授课，视频教学，可以帮助您从零开始，全面系统地学习 CST 微波工作的各项功能及其在微波射频、天线设计等领域的设计应用。且购买该套装，还可超值赠送 3 个月免费学习答疑…

课程网址：http://www.edatop.com/peixun/cst/24.html

HFSS 天线设计培训课程套装

套装包含 6 门视频课程和 1 本图书，课程从基础讲起，内容由浅入深，理论介绍和实际操作讲解相结合，全面系统的讲解了 HFSS 天线设计的全过程。是国内最全面、最专业的 HFSS 天线设计课程，可以帮助您快速学习掌握如何使用 HFSS 设计天线，让天线设计不再难…

课程网址：http://www.edatop.com/peixun/hfss/122.html

13.56MHz NFC/RFID 线圈天线设计培训课程套装

套装包含 4 门视频培训课程，培训将 13.56MHz 线圈天线设计原理和仿真设计实践相结合，全面系统地讲解了 13.56MHz 线圈天线的工作原理、设计方法、设计考量以及使用 HFSS 和 CST 仿真分析线圈天线的具体操作，同时还介绍了 13.56MHz 线圈天线匹配电路的设计和调试。通过该套课程的学习，可以帮助您快速学习掌握 13.56MHz 线圈天线及其匹配电路的原理、设计和调试…

详情浏览：http://www.edatop.com/peixun/antenna/116.html

我们的课程优势：

※ 成立于 2004 年，10 多年丰富的行业经验，

※ 一直致力并专注于微波射频和天线设计工程师的培养，更了解该行业对人才的要求

※ 经验丰富的一线资深工程师讲授，结合实际工程案例，直观、实用、易学

联系我们：

※ 易迪拓培训官网：http://www.edatop.com

※ 微波 EDA 网：http://www.mweda.com

※ 官方淘宝店：http://shop36920890.taobao.com