PRELIMINARY DATA SHEET

SKY77824-11 Power Amplifier Module for FDD LTE Bands 7 and 30, TDD LTE Bands 38/41 and 40, and AXGP Band

Applications

- Long-Term Evolution (LTE)
- Evolved Universal Terrestrial Radio Access Networks (EUTRAN)
- Handsets and Data Cards

Features

- Optimized for Average Power Tracking (APT)
- High efficiency Broadband 2.3 GHz to 2.69 GHz
- MIPI® RFFE interface
- Integrated output switch including TDD Tx/Rx function for single SAW architecture
- RF I/O internally matched to 50 ohms
- Small, low profile package
  - 4.0 x 3.65 x 0.8 mm Max.
  - 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 SQ04-0074.

Description

The SKY77824-11 Power Amplifier Module (PAM) is a fully matched, 28-pad surface mount (SMT) module developed for LTE applications. The module includes broadband coverage of FDD LTE Bands 7 and 30, TDD LTE Bands 38/40, and Band 41 in a compact 4.0 x 3.65 mm package. Attaining high efficiencies throughout the entire power range while meeting the stringent linearity requirements of LTE, the SKY77824-11 delivers unsurpassed savings in current consumption for data-intensive applications.

The Gallium Arsenide (GaAs) Microwave Monolithic Integrated Circuit (MMIC) contains all amplifier active circuitry, including input, interstage, and output matching circuits. Output match into a 50-ohm load is realized off-chip within the module package to optimize efficiency and power performance. Silicon-on-insulator (SOI) switch follows the wideband power amplifier to direct the RF output signal to either a band 7 duplexer or one of three TDD filters supporting bands 38, 40, and 41. Additional throws in the SOI switch allow the reuse of TDD filters in Rx mode by providing paths to either the band 40 Rx port (T/R1) or a shared band 38/41/7 Rx port (T/R2). Bias for the PA MMIC and switch is generated on a CMOS IC controlled through a MIPI RFFE interface.

The SKY77824-11 is manufactured with Skyworks' InGaP GaAs Heterojunction Bipolar Transistor (HBT) process which provides for all positive voltage DC supply operation and maintains high efficiency and good linearity. Optimal performance is obtained with VCC1 and VCC2 sourced from a DC-DC power supply based on target output power. No external supply side switch is required as typical "off" leakage is a few microamperes.

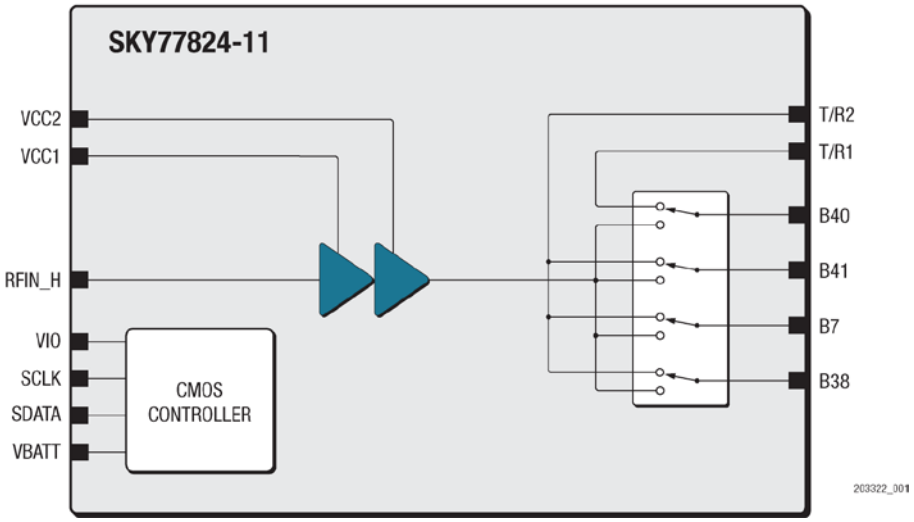


FIGURE 1. SKY77824-11 FUNCTIONAL BLOCK DIAGRAM

Electrical Specifications

The following tables list the electrical Parameter of the SKY77824-11 Power Amplifier. Absolute maximum operating conditions are listed in Table 1 and Table 2 shows the recommended operating conditions. Electrical specifications for nominal operating conditions are listed in Tables 4 through 10.

Table 1. SKY77824-11 Absolute Maximum Operating Conditions[1]

Parameter		Symbol	Minimum	Nominal	Maximum	Unit
RF Input Power		P_{IN}		0	10	dBm
Supply Voltage	No RF	V_{CC1}			6.0	Volts
	With RF	V_{CC2} V_{BATT}			5.2	
Digital Control Lines		VIO, SCLK, SDATA			2	Volts
Case Temperature[2]	Operating	T_{CASE}	–30	25	+100	°C
	Storage	T_{STG}	–40		+150	
ESD – Human Body Mode (HBM)		ESD_{HBM}	–1		1	kV

[1] *Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value.*

[2] *Case Operating Temperature (TCASE) refers to the temperature of the GROUND PAD at the underside of the package.*

Table 2. SKY77824-11 Recommended Operating Conditions

Parameter		Symbol	Minimum	Nominal	Maximum	Unit
Supply Voltage		V_{CC1}	0.55	3.4	3.8	Volts
		V_{CC2}	0.55	3.4	3.8	
		V_{BATT}	3.0	3.4	4.6	
MIPI RFFE Supply		VIO	1.65	1.8	1.95	Volts
MIPI RFFE Signal Levels for SCLK, SDATA	Low	V_{MIPI_LOW}	0.0	0.0	0.2 x VIO	Volts
	High	V_{MIPI_HIGH}	0.8 x VIO	1.8	VIO	
Leakage Current	VBATT = 3.4 V	$I_{\_BATT\_LK}$			10	µA
	VCC1, VCC2 =3.4 V	$I_{\_CC\_LK}$			10	
Case Operating Temperature Range		T_{RANGE}	–20	+25	+85	°C

TABLE 3. SKY77824-11 ELECTRICAL SPECIFICATIONS FOR NOMINAL OPERATING CONDITIONS – FDD LTE BAND 7

UNLESS OTHERWISE SPECIFIED: VBATT = 3.4 V; TCASE= +25 °C; LTE SIGNAL = QPSK/10 MHz/12RB FOR MPR = 0 AND QPSK/20 MHz/100RB FOR MPR = 1.

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Operating Frequency		f_O		2500	2535	2570	MHz
Maximum Output Power		P_{OUT_MAX}	MPR = 0[1]	28.0			dBm
		$P_{OUT\_MAX\_ETC}$	$V_{BATT} = V_{CC1} = V_{CC2}$ = 3.0V, $T_{CASE} = T_{RANGE}$	27.0			
Gain		G_{HIGH}	$P_{OUT} = P_{OUT\_MAX}$ T_{CASE} = +25 °C	28.0	30.0	31.5	dB
		G_{HIGH_EXT}	$P_{OUT} = P_{OUT\_MAX}$ $T_{CASE} = T_{RANGE}$	26.0		33.3	
		G_{LOW}	P_{OUT} = 3 dBm	13.0	15.5	17.5	
Power Added Efficiency[2]		PAE_{APT}	$P_{OUT} = P_{OUT\_MAX}$		31.5		%
Total Supply Current[3]		$I_{\_TOT\_MAX}$	$P_{OUT} = P_{OUT\_MAX}$, V_{BATT} = 3.8 V		560		mA
Adjacent Channel Leakage power Ratio[4]	E-UTRA offset	E-UTRA$_{ACLR}$	$P_{OUT} \le (P_{OUT\_MAX}$ – MPR[1])		–38	–35	dBc
	UTRA offset	UTRA$_{ACLR1}$			–40	–38	
		UTRA$_{ACLR2}$			–42	–41	
Harmonic Suppression	Second	$2f_0$	$P_{OUT} \le P_{OUT\_MAX}$, RB ≥ 1			–15	dBm
	Third	$3f_0$				–10	
	Fourth	$4f_0$				–20	
	Fifth	$5f_0$				–30	
Tx Noise in Rx Bands	Rx Band	$PNRX_{\_LTE}$	2620 MHz–2690 MHz[5]			–126	dBm/Hz
	GPS Rx	$PNRX_{\_GPS}$	1574 MHz–1577 MHz[5]			–140	
	BT, WLAN	$PNRX_{\_BT}$	2400 MHz–2452 MHz[5]			–108	
	WLAN	$PNRX_{\_5GHz}$	4900 MHz–5800 MHz[5]			–140	
EVM		EVM	$P_{OUT} \le P_{OUT\_MAX}$, Load = 50 ohms		3		%
Turn On Time		T_{ON}	Gain settled to within P_{OUT_MAX} – 0.5 dB			5	µs
Turn Off Time		T_{OFF}	Gain settled to below P_{OUT_MAX} – 30 dB			5	µs
Input Voltage Standing Wave Ratio		VSWR			1.8:1		
Stability (Spurious output)		S	6:1 VSWR All phases			–36	dBm
Ruggedness – no damage		Ru	$P_{OUT} \le P_{OUT\_MAX}$, mismatch load with all phases applied	10:1			VSWR

[1] MPR is the maximum power reduction as defined in 3GPP TS36.101

[2] V_{CC} optimized for ACLR1$_{EUTRA}$ = –39 dBc, QPSK 10 MHz / 12RB.

[3] $I_{\_TOT} = I_{BATT} + (I_{CC1} + I_{CC2})(V_{CC}/V_{BATT})(1/DC\_DC\_EFF)$. V_{CC} – 3.4 V, DC_DC_EFF ~ 96%.

[4] ACLR1$_{EUTRA}$ Max = –33, ACLR1$_{UTRA}$ Max = –35, ACLR2$_{UTRA}$ Max = –39 for ETC.

[5] Measured with 20 MHz/100RB LTE Waveform.

TABLE 4. SKY77824-11 ELECTRICAL SPECIFICATIONS FOR NOMINAL OPERATING CONDITIONS – FDD LTE BAND 30 (WCS) (RF OUTPUT ON PAD 23)

UNLESS OTHERWISE SPECIFIED: V_{BATT} = 3.4 V; T_{CASE}= +25 °C; LTE SIGNAL = QPSK/10 MHz/12RB FOR MPR = 0 AND QPSK/10 MHz/50RB FOR MPR = 1.

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Operating Frequency		f_0		2305	2310	2315	MHz
Maximum Output Power		P_{OUT_MAX}	MPR = 0[1]	28.0			dBm
		$P_{OUT\_MAX\_ETC}$	V_{BATT} = V_{CC1} = V_{CC2} = 3.0 V, T_{CASE} = T_{RANGE}	27.0			
Gain		G_{HIGH}	P_{OUT} = P_{OUT_MAX} T_{CASE} = +25 °C	27.5	29.0	31.0	dB
		G_{HIGH_EXT}	P_{OUT} = P_{OUT_MAX} T_{CASE} = T_{RANGE}	26.0		32.5	
		G_{LOW}	P_{OUT} = 3 dBm	13.0	15.3	17.5	
Power Added Efficiency[2]		PAE_{APT}	P_{OUT} = P_{OUT_MAX}		31		%
Total Supply Current[3]		$I_{\_TOT\_MAX}$	P_{OUT} = P_{OUT_MAX}, V_{BATT} = 3.8 V		565		mA
Adjacent Channel Leakage power Ratio[4]	E-UTRA offset	E-UTRA$_{ACLR}$	P_{OUT} ≤ (P_{OUT_MAX} – MPR[1])		–38	–35	dBc
	UTRA offset	UTRA$_{ACLR1}$			–40	–38	
		UTRA$_{ACLR2}$			–42	–41	
Harmonic Suppression	Second	$2f_0$	P_{OUT} ≤ P_{OUT_MAX}, RB ≥ 1			–9	dBm
	Third	$3f_0$				–9	
	Fourth	$4f_0$				–15	
	Fifth	$5f_0$				–30	
Tx Noise in Rx Bands	GPS Rx	$PNRX_{GPS}$	1574 MHz–1577 MHz[5]			–140	dBm/Hz
	BT, WLAN	$PNRX_{BT}$	2400 MHz–2483.5 MHz[5]			–113	
	WLAN	$PNRX_{5GHz}$	4900 MHz–5800 MHz[5]			–140	
EVM		EVM	P_{OUT} ≤ P_{OUT_MAX}, Load = 50 ohms		3		%
Turn On Time		T_{ON}	Gain settled to within P_{OUT_MAX} – 0.5 dB			5	µs
Turn Off Time		T_{OFF}	Gain settled to below P_{OUT_MAX} – 30 dB			5	µs
Input Voltage Standing Wave Ratio		VSWR			2.3:1		
Stability (Spurious output)		S	6:1 VSWR All phases			–36	dBm
Ruggedness – no damage		Ru	P_{OUT} ≤ P_{OUT_MAX}, mismatch load with all phases applied	10:1			VSWR

[1] MPR is the maximum power reduction as defined in 3GPP TS36.101

[2] V_{CC} optimized for $ACLR1_{EUTRA}$ = –39 dBc, QPSK 10 MHz / 12RB.

[3] $I_{\_TOT}$ = I_{BATT} + (I_{CC1} + I_{CC2})(V_{CC}/V_{BATT})(1/DC_DC_EFF). V_{CC} – 3.4 V, DC_DC_EFF ~ 96%.

[4] $ACLR1_{EUTRA}$ Max = –33, $ACLR1_{UTRA}$ Max = –35, $ACLR2_{UTRA}$ Max = –39 for ETC.

[5] Measured with 10 MHz/50RB LTE Waveform.

TABLE 5. SKY77824-11 ELECTRICAL SPECIFICATIONS FOR NOMINAL OPERATING CONDITIONS – TDD BAND 38

UNLESS OTHERWISE SPECIFIED: VBATT = 3.4 V; TCASE = +25 °C; LTE SIGNAL = QPSK/10 MHz/12RB FOR MPR = 0 AND QPSK/20 MHZ/100 RB FOR MPR = 1.

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Operating Frequency		f_0		2570	2595	2620	MHz
Maximum Output Power		P_{OUT_MAX}	MPR = 0[1]	28.0			dBm
		$P_{OUT\_MAX\_ETC}$	$V_{BATT} = V_{CC1} = V_{CC2}$ = 3.0 V, $T_{CASE} = T_{RANGE}$	27.0			
Gain		G_{HIGH}	$P_{OUT} = P_{OUT\_MAX}$ T_{CASE} = +25 °C	29.0	30.5	32.5	dB
		G_{HIGH_EXT}	$P_{OUT} = P_{OUT\_MAX}$ $T_{CASE} = T_{RANGE}$	26.0		33.0	
		G_{LOW}	P_{OUT} = 3 dBm	13.0	15.0	17.5	
Power Added Efficiency[2]		PAE_{APT}	$P_{OUT} = P_{OUT\_MAX}$		31		%
Total Supply Current[3]		$I_{\_TOT\_MAX}$	$P_{OUT} = P_{OUT\_MAX}$, V_{BATT} = 3.8 V		565		mA
Adjacent Channel Leakage power Ratio[4]	E-UTRA offset	E-UTRA$_{ACLR}$	$P_{OUT} \le (P_{OUT\_MAX}$ – MPR[1])		–38	–35	dBc
	UTRA offset	UTRA$_{ACLR1}$			–40	–38	
		UTRA$_{ACLR2}$			–42	–41	
Harmonic Suppression	Second	$2f_0$	$P_{OUT} \le P_{OUT\_MAX}$, RB ≥ 1			–15	dBm
	Third	$3f_0$				–10	
	Fourth	$4f_0$				–20	
	Fifth	$5f_0$				–30	
Tx Noise in Rx Bands	GPS Rx	PNRX$_{GPS}$	1574 MHz–1577 MHz[5]			–140	dBm/Hz
	BT, WLAN	PNRX$_{BT}$	2400 MHz–2483.5 MHz[5]			–113	
	WLAN	PNRX$_{5GHz}$	4900 MHz–5800 MHz[5]			–140	
EVM		EVM	$P_{OUT} \le P_{OUT\_MAX}$ Load = 50 ohms		3		%
Turn On Time		T_{ON}	Gain settled to within P_{OUT_MAX} – 0.5 dB			5	µs
Turn Off Time		T_{OFF}	Gain settled to below P_{OUT_MAX} – 30 dB			5	µs
Input Voltage Standing Wave Ratio		VSWR			1.8:1		
Stability (Spurious output)		S	6:1 VSWR All phases			–36	dBm
Ruggedness – no damage		Ru	$P_{OUT} \le P_{OUT\_MAX}$, mismatch load with all phases applied	10:1			VSWR

[1] MPR is the maximum power reduction as defined in 3GPP TS36.101

[2] V_{CC} optimized for ACLR1$_{EUTRA}$ = –39 dBc, QPSK 10 MHz / 12RB.

[3] $I_{TOT} = I_{BATT} + (I_{CC1} + I_{CC2})(V_{CC}/V_{BATT})(1/DC\_DC\_EFF)$. V_{CC} – 3.4 V, DC_DC_EFF ~ 96%.

[4] ACLR1$_{EUTRA}$ Max = –33, ACLR1$_{UTRA}$ Max = –35, ACLR2$_{UTRA}$ Max = –39 for ETC.

[5] Measured with 20 MHz/100RB LTE Waveform.

TABLE 6. SKY77824-11 ELECTRICAL SPECIFICATIONS FOR NOMINAL OPERATING CONDITIONS – TDD BAND 40

UNLESS OTHERWISE SPECIFIED: VBATT = 3.4 V; TCASE = +25 °C; LTE SIGNAL = QPSK/10 MHZ/12RB FOR MPR = 0 AND QPSK/20 MHZ/100 RB FOR MPR = 1.

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Operating Frequency		f_0		2300	2350	2400	MHz
Maximum Output Power		P_{OUT_MAX}	MPR = 0[1]	28.0			dBm
		$P_{OUT\_MAX\_ETC}$	$V_{BATT} = V_{CC1} = V_{CC2}$ = 3.0 V, $T_{CASE} = T_{RANGE}$	27.0	29.5	31.5	
Gain		G_{HIGH}	$P_{OUT} = P_{OUT\_MAX}$ T_{CASE} = +25 °C	27.5	29.0	31.0	dB
		G_{HIGH_EXT}	$P_{OUT} = P_{OUT\_MAX}$ $T_{CASE} = T_{RANGE}$	26.0		33.0	
		G_{LOW}	P_{OUT} = 3 dBm	13.0	15.0	17.5	
Power Added Efficiency[2]		PAE_{APT}	$P_{OUT} = P_{OUT\_MAX}$		31		%
Total Supply Current[3]		$I_{\_TOT\_MAX}$	$P_{OUT} = P_{OUT\_MAX}$, V_{BATT} = 3.8 V		565		mA
Adjacent Channel Leakage power Ratio[4]	E-UTRA offset	E-UTRA$_{ACLR}$	$P_{OUT} \leq (P_{OUT\_MAX}$ – MPR[1])		–38	–35	dBc
	UTRA offset	UTRA$_{ACLR1}$			–40	–38	
		UTRA$_{ACLR2}$			–42	–41	
Harmonic Suppression	Second	$2f_0$	$P_{OUT} \leq P_{OUT\_MAX}$, RB ≥ 1			–9	dBm
	Third	$3f_0$				–9	
	Fourth	$4f_0$				–15	
	Fifth	$5f_0$				–30	
Tx Noise in Rx Bands	GPS Rx	PNRX$_{GPS}$	1574 MHz–1577 MHz[5]			–140	dBm/Hz
	BT, WLAN	PNRX$_{BT}$	2447 MHz–2483.5 MHz[5]			–104	
	WLAN	PNRX$_{5GHz}$	4900 MHz–5800 MHz[5]			–140	
EVM		EVM	$P_{OUT} \leq P_{OUT\_MAX}$ Load = 50 ohms		3		%
Turn On Time		T_{ON}	Gain settled to within P_{OUT_MAX} – 0.5 dB			5	µs
Turn Off Time		T_{OFF}	Gain settled to below P_{OUT_MAX} – 30 dB			5	µs
Input Voltage Standing Wave Ratio		VSWR			2.3:1		
Stability (Spurious output)		S	6:1 VSWR All phases			–36	dBm
Ruggedness – no damage		Ru	$P_{OUT} \leq P_{OUT\_MAX}$, mismatch load with all phases applied	10:1			VSWR

[1] MPR is the maximum power reduction as defined in 3GPP TS36.101

[2] V_{CC} optimized for ACLR1$_{EUTRA}$ = –39 dBc, QPSK 10 MHz / 12RB.

[3] $I_{TOT} = I_{BATT} + (I_{CC1} + I_{CC2})(V_{CC}/V_{BATT})(1/DC\_DC\_EFF)$. V_{CC} – 3.4 V, DC_DC_EFF ~ 96%.

[4] ACLR1$_{EUTRA}$ Max = –33, ACLR1$_{UTRA}$ Max = –35, ACLR2$_{UTRA}$ Max = –39 for ETC.

[5] Measured with 20 MHz/100RB LTE Wave form.

TABLE 7. SKY77824-11 ELECTRICAL SPECIFICATIONS FOR NOMINAL OPERATING CONDITIONS – TDD BAND 41, TDD AXGP BAND

UNLESS OTHERWISE SPECIFIED: V_{BATT} = 3.4 V; T_{CASE} = +25 °C; LTE SIGNAL = QPSK/10 MHz/12RB FOR MPR = 0 AND QPSK/20 MHZ/100 RB FOR MPR = 1.

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Operating Frequency		f_0		2496	2595	2690	MHz
Maximum Output Power		P_{OUT_MAX}	MPR = 0[1]	27.7			dBm
		$P_{OUT\_MAX\_ETC}$	$V_{BATT} = V_{CC1} = V_{CC2}$ = 3.0 V, $T_{CASE} = T_{RANGE}$	26.7			
Gain		G_{HIGH}	$P_{OUT} = P_{OUT\_MAX}$, T_{CASE} = +25 °C	28.0	30.5	32.2	dB
		G_{HIGH_EXT}	$P_{OUT} = P_{OUT\_MAX}$, $T_{CASE} = T_{RANGE}$	26.0		33.2	
		G_{LOW}	P_{OUT} = 3 dBm	13.0	15.0	17.5	
Power Added Efficiency[2]		PAE_{APT}	$P_{OUT} = P_{OUT\_MAX}$		31		%
Total Supply Current[3]		I_{TOT_MAX}	$P_{OUT} = P_{OUT\_MAX}$, V_{BATT} = 3.8 V		565		mA
Adjacent Channel Leakage power Ratio[4]	E-UTRA offset	E-UTRA$_{ACLR}$	$P_{OUT} \le (P_{OUT\_MAX}$ – MPR[1])		–38	–35	dBc
	UTRA offset	UTRA$_{ACLR1}$			–40	–38	
		UTRA$_{ACLR2}$			–42	–41	
Harmonic Suppression	Second	$2f_0$	$P_{OUT} \le P_{OUT\_MAX}$, RB ≥ 1			–15	dBm
	Third	$3f_0$				–10	
	Fourth	$4f_0$				–20	
	Fifth	$5f_0$				–30	
Tx Noise in Rx Bands	GPS Rx	PNRX$_{GPS}$	1574 MHz–1577 MHz[5]			–140	dBm/Hz
	BT, WLAN	PNRX$_{BT}$	2400 MHz–2452 MHz[5]			–104	
	WLAN	PNRX$_{5GHz}$	4900 MHz–5800 MHz[5]			–140	
EVM		EVM	$P_{OUT} \le P_{OUT\_MAX}$, Load = 50 ohms		3		%
Turn On Time		T_{ON}	Gain settled to within P_{OUT_MAX} – 0.5 dB			5	µs
Turn Off Time		T_{OFF}	Gain settled to below P_{OUT_MAX} – 30 dB			5	µs
Input Voltage Standing Wave Ratio		VSWR			1.8:1		
Stability (Spurious output)		S	6:1 VSWR All phases			–36	dBm
Ruggedness – no damage		Ru	$P_{OUT} \le P_{OUT\_MAX}$, mismatch load with all phases applied	10:1			VSWR

[1] MPR is the maximum power reduction as defined in 3GPP TS36.101

[2] V_{CC} optimized for ACLR1$_{EUTRA}$ = –39 dBc, QPSK 10 MHz / 12RB.

[3] $I_{TOT} = I_{BATT} + (I_{CC1} + I_{CC2})(V_{CC}/V_{BATT})(1/DC\_DC\_EFF)$. V_{CC} – 3.4 V, DC_DC_EFF ~ 96%.

[4] ACLR1$_{EUTRA}$ Max = –33, ACLR1$_{UTRA}$ Max = –35, ACLR2$_{UTRA}$ Max = –39 for ETC.

[5] Measured with 20 MHz/100RB LTE Wave form.

TABLE 8. SKY77824-11 ELECTRICAL SPECIFICATION – BAND SELECT SWITCH

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Unit
Frequency Range	*f*		2300		2690	MHz
Insertion Loss	IL	B40 to T/R1		0.70		dB
		B38 to T/R2		0.75		
		B41 to T/R2		0.80		
		B7 to T/R2		0.75		
Voltage Standing Wave Ratio	VSWR	Any RF port tested in Rx mode			1.5:1	
Isolation	ISO	B7 Tx to B38 Tx, Tx Mode	30			dB
		B7 Tx to B40 Tx, Tx Mode	30			
		B7 Tx to B41 Tx, Tx Mode	35			
		B40 Tx to T/R2, Tx Mode	30			
		B38 Tx to T/R2, Tx Mode	25			
		B41 Tx to T/R2, Tx Mode	30			
		B7 Tx to T/R2, Tx Mode	25			
		B40 Tx to T/R1, Tx Mode	30			
		B38 Tx to T/R1, Tx Mode	30			
		B41 Tx to T/R1, Tx Mode	30			
		B7 Tx to T/R1, Tx Mode	35			
Switching Time	Tsw	Isolation to Rx, Isolation to Tx, Tx to Rx, Rx to Tx, Rx to Isolation, and Tx to Isolation			2.5	µS

[1] *Tx Mode for each Condition defines as follows, using Condition **B7_Tx to B38_Tx** as an example: The carrier frequency is set to Band 7 at the **B7_Tx** port with POUT set to 28 dBm. The **B7_Tx** port is then terminated and carrier power is measured at the **B38_Tx** port. This procedure is repeated for each of the paired ports listed in the Conditions column.*

MIPI RFFE Information

TABLE 9. SKY77824-11 MIPI RFFE REGISTER MAP (1 OF 2)

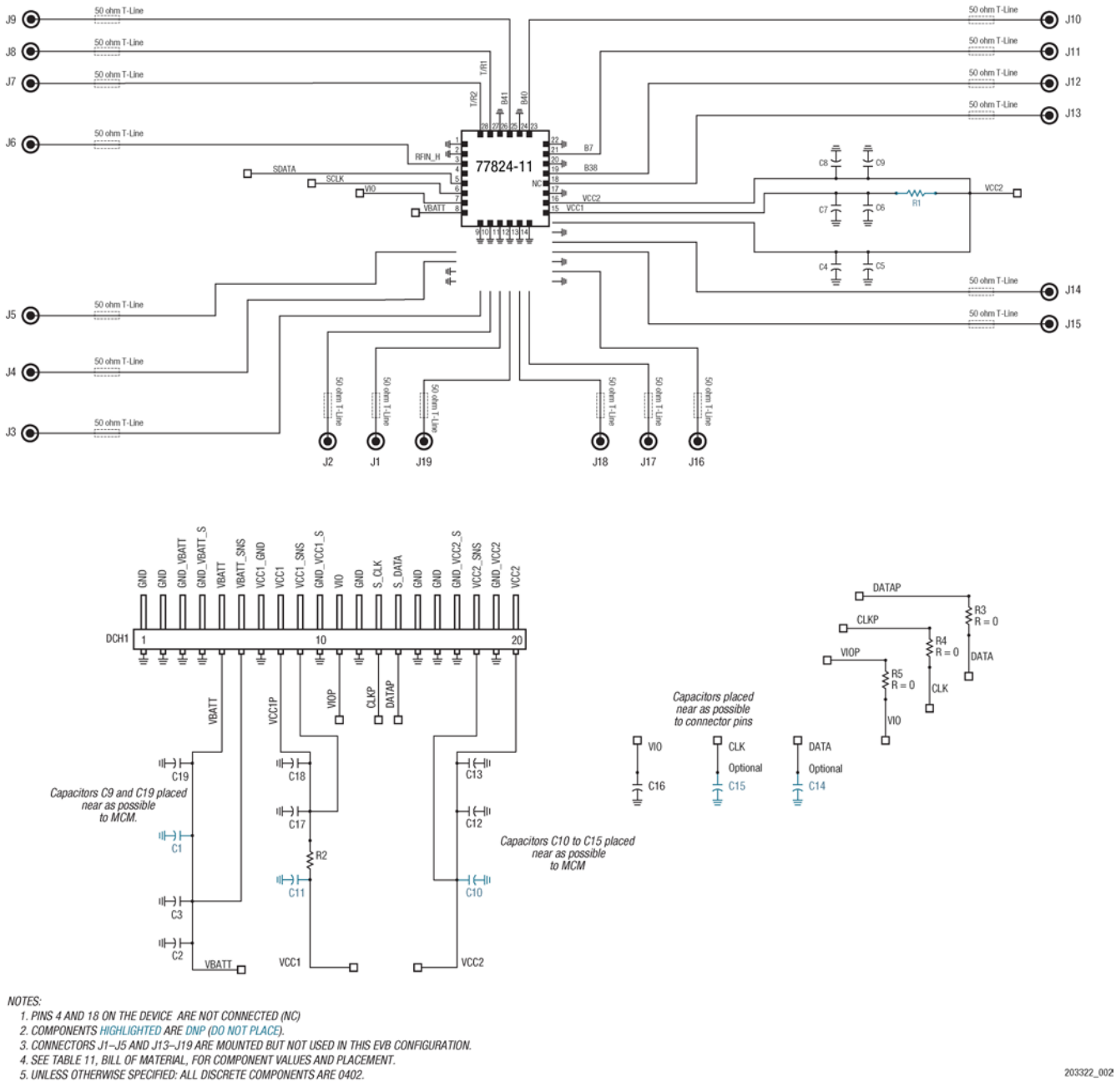
Register 0, Address: 0x00 (PA_CTRL0)			
Register 0	**Description**	**Default**	**Notes**
[7]	Trigger Select	0	0 = Trigger 0, 1, 2 or'd together 1 = Trigger 0, 1, 2 fire independently
[6:3]	PA Band Select Control Mode	0000	Control Mode 0000 = PAs Disabled 0001 = B41_TX (HB) 0010 = B40_TX (HB) 0011 = B38_TX (HB) 1000 = B7_TX (HB) 0100 = Reserved 1110 = Reserved 1001 = Reserved 0101 = Reserved 0110 = Reserved 0111 = Reserved 1010 = Reserved 1111 = PA's Disabled 1011 = Reserved 1100 = Reserved 1101 = Reserved
[2]	PA Enable	0	PA Enable 0 = Off 1 = On
[1:0]	PA Mode	00	PA Mode 00 = HPM 01 = Reserved 10 = Reserved 11 = Reserved
Register 1, Address: 0x01 (BIAS_CTRL)			
Register 1	**Description**	**Default**	**Notes**
[7:4]	Stage 2 (Final) Bias Current Reference	0000	0000 = Disable if Reg1 [3:0] = 0000; otherwise = 0.25 mA. 0001 = 0.375 mA 0010 = 0.500 mA 0011 = 0.625 mA 0100 = 0.750 mA 0101 = 0.875 mA 0110 = 1.000 mA 0111 = 1.125 mA 1000 = 1.250 mA 1001 = 1.375 mA 1010 = 1.500 mA 1011 = 1.625 mA 1100 = 1.750 mA 1101 = 1.875 mA 1110 = 2.000 mA 1111 = 2.125 mA
[3:0]	Stage 1 (Driver) Bias Current Reference	0000	0000 = Disable 0001 = 0.15 mA 0010 = 0.30 mA 0011 = 0.45 mA 0100 = 0.60 mA 0101 = 0.75 mA 0110 = 0.90 mA 0111 = 1.05 mA 1000 = 1.20 mA 1001 = 1.35 mA 1010 = 1.50 mA 1011 = 1.65 mA 1100 = 1.80 mA 1101 = 1.95 mA 1110 = 2.10 mA 1111 = 2.25 mA
Register 2, Address: 0x02 (SWITCH_CTRL)			
Register 2	**Description**	**Default**	**Notes**
[7:4]	Reserved	0000	
[3:0]	Band Switch Control Mode	0000	Control Mode 0000 = Switch Off (Standby) 0111 = B7_Rx 1000 = B7_Tx 1001 = B40_Tx 1010 = B38_Tx 1011 = B41_Tx 1100 = B40_Rx 1101 = B38_Rx 1110 = B41_Rx 1111 = High Isolation Rest = High Isolation

TABLE 9. SKY77824-11 MIPI RFFE REGISTER MAP (2 OF 2)

Register 3, Address: 0x03 (BIAS_CTRL)			
Register 3	**Description**	**Default**	**Notes**
[7]	Enable Boost Bias Current	0	Boost Bias Enable 1 = Boost bias enabled
[6:4]	Bias Temperature Compensation	000	xx0: Driver = High, Final = Low 001: Driver = Low, Final = Low 011: Driver = High, Final = Low 101: Driver = Low, Final = High 111: Driver = High, Final = High
[3:0]	Boost Bias Current Reference (Register 3[7] = 1)	0000	0000 = Disable 0001 = 0.200 mA 0110 = 0.575 mA 1011 = 0.950 mA 0010 = 0.275 mA 0111 = 0.650 mA 1100 = 1.025 mA 0011 = 0.350 mA 1000 = 0.725 mA 1101 = 1.100 mA 0100 = 0.425 mA 1001 = 0.800 mA 1110 = 1.175 mA 0101 = 0.500 mA 1010 = 0.875 mA 1111 = 1.250 mA
Register 27, Address 0x1B (GROUP_SID)			
Register 27	**Description**	**Default**	**Notes**
[7:4]	Reserved	0000	Read Only
[3:0]	Group Slave ID	0000	Read/Write
Register 28, Address: 0x1C (PM_TRIG)			
Register 28	**Description**	**Default**	**Notes**
[7:6]	PWR_MODE	00	00 = Normal Operation (ACTIVE) 01 = Default Settings (STARTUP) 10 = Low Power (LOW POWER) 11 = Reserved
[5]	Trigger Mask 2	0	Trigger Enable: 0 Trigger Disable: 1
[4]	Trigger Mask 1	0	Trigger Enable: 0 Trigger Disable: 1
[3]	Trigger Mask 0	0	Trigger Enable: 0 Trigger Disable: 1
[2]	Trigger Register 2	0	Not supported
[1]	Trigger Register 1	0	1 = Latch Register 2 contents
[0]	Trigger Register 0	0	1 = Latch Register 0, 1, 3 contents
Register 29, Address: 0x01D (PROD_ID)			
Register 29	**Description**	**Default**	**Notes**
[7:0]	Product ID	0x90	Product ID = 0x90
Register 30, Address: 0x01E (MAN_ID)			
Register 30	**Description**	**Default**	**Notes**
[7:0]	Manufacturer ID	0xA5	Manufacturer ID[7:0] = 0xA5
Register 31 Address: 0x01F (USID)			
Register 31	**Description**	**Default**	**Notes**
[7:6]	Spare	00	
[5:4]	Manufacturer ID	01	Manufacturer ID[9:8] = 0x01
[3:0]	User ID	1111	User ID = 1111

Evaluation Board Description

The evaluation board (EVB) is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the SKY77824-11, the evaluation board schematic and assembly diagrams are included for analysis and design. Figure 2 shows the basic schematic of the EVB board and Figure 3 shows the EVB assembly. In both views, placement of components is shown for normal operation. Table 11 provides the bill of material for the EVB.



NOTES:
1. PINS 4 AND 18 ON THE DEVICE ARE NOT CONNECTED (NC)
2. COMPONENTS HIGHLIGHTED ARE DNP (DO NOT PLACE).
3. CONNECTORS J1–J5 AND J13–J19 ARE MOUNTED BUT NOT USED IN THIS EVB CONFIGURATION.
4. SEE TABLE 11, BILL OF MATERIAL, FOR COMPONENT VALUES AND PLACEMENT.
5. UNLESS OTHERWISE SPECIFIED: ALL DISCRETE COMPONENTS ARE 0402.

203322_002

FIGURE 2. SKY77824-11 EVALUATION BOARD SCHEMATIC DIAGRAM

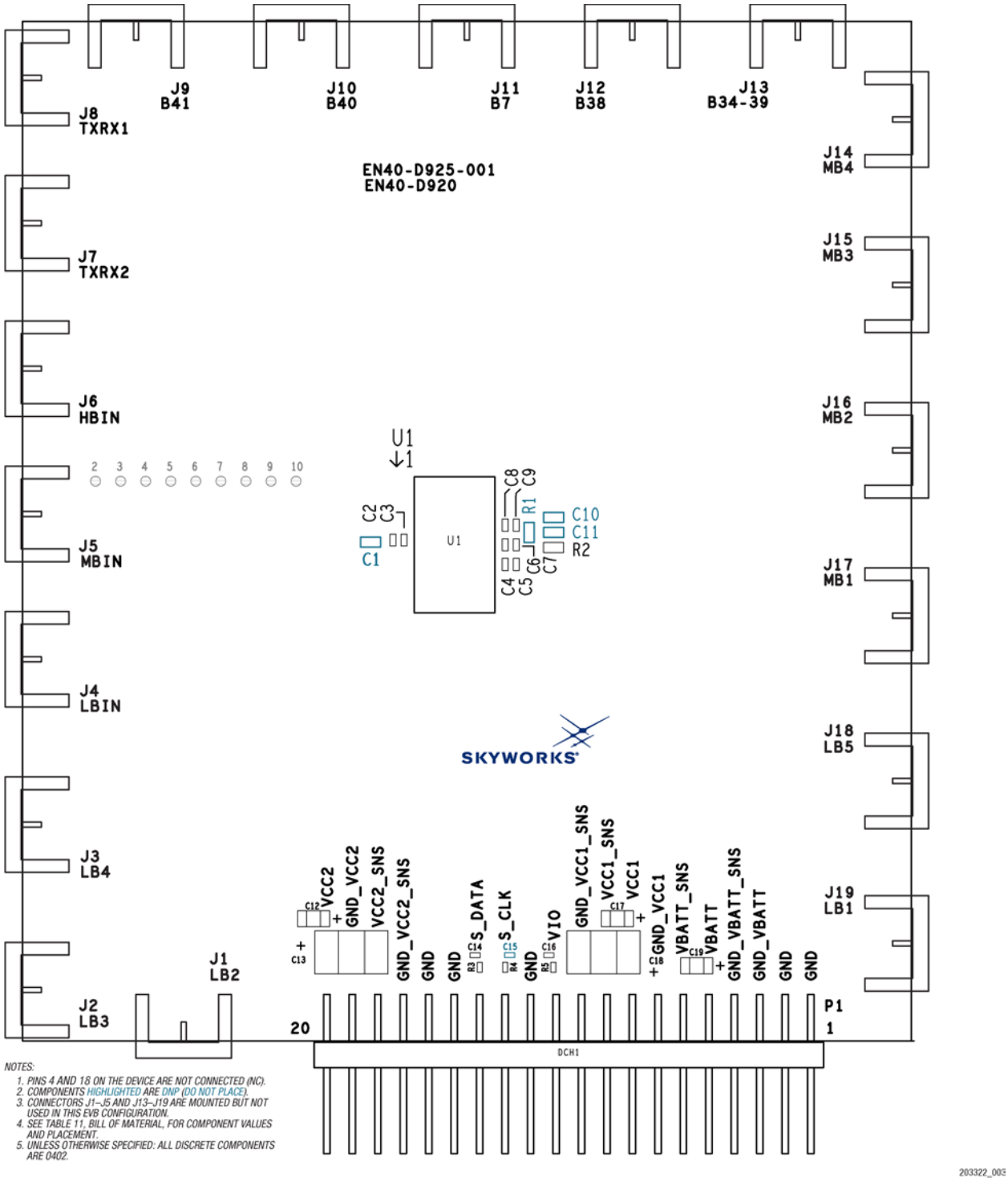


FIGURE 3. SKY77824-11 EVALUATION BOARD ASSEMBLY DIAGRAM

TABLE 10. SKY77824-11 EVALUATION BOARD LIST OF MATERIAL

ITEM	QTY	REFERENCE DESIGNATORS	PART DESCRIPTION
1	1	P1	CONNECTOR, 20 PINPOST LENGTH = 0.53"
2	19	J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16, J17, J18, J19	CONNECTOR, SMA END LAUNCH JACK TAB CONTACT GOLD, .062
3	4	C2, C4, C7, C8	CAPACITOR, CERAMIC, 100 PF, 10%, X7R, 16 V, 0201 (RSI)
4	4	C3, C5, C6, C9	CAPACITOR, CERAMIC, 0.1 µF, 10%, X5R, 10 V, 0201 (RSI)
5	3	C12, C17, C19	CAPACITOR, TANTALUM MOLDED 10 µF, 16 V, ±10%, 1206
6	2	C13, C18	CAPACITOR, 220 µF, TANT, LOW ESR, CASE D, AVX
7	1	C16	CAPACITOR, CERAMIC, 270 pF, 10%, X7R, 50 V, 0402
8	4	R2, R3, R4, R5	RESISTOR, 0 OHM, JUMPER, 0.063 W, 0402
9	6	C1, C10, C11, C14, C15, R1	DNP (DO NOT PLACE)

NOTE: Highlighted items C1, C10, C11, C14, C15, R1 are DNP (Do Not Place).

Package Dimensions

The SKY77824-11 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board. Figure 4 is a mechanical drawing of the pad layout for this package. Figure 5 provides a recommended phone board layout footprint for the PAM to help the designer attain optimum thermal conductivity, good grounding, and minimum RF discontinuity for the 50-ohm terminals.

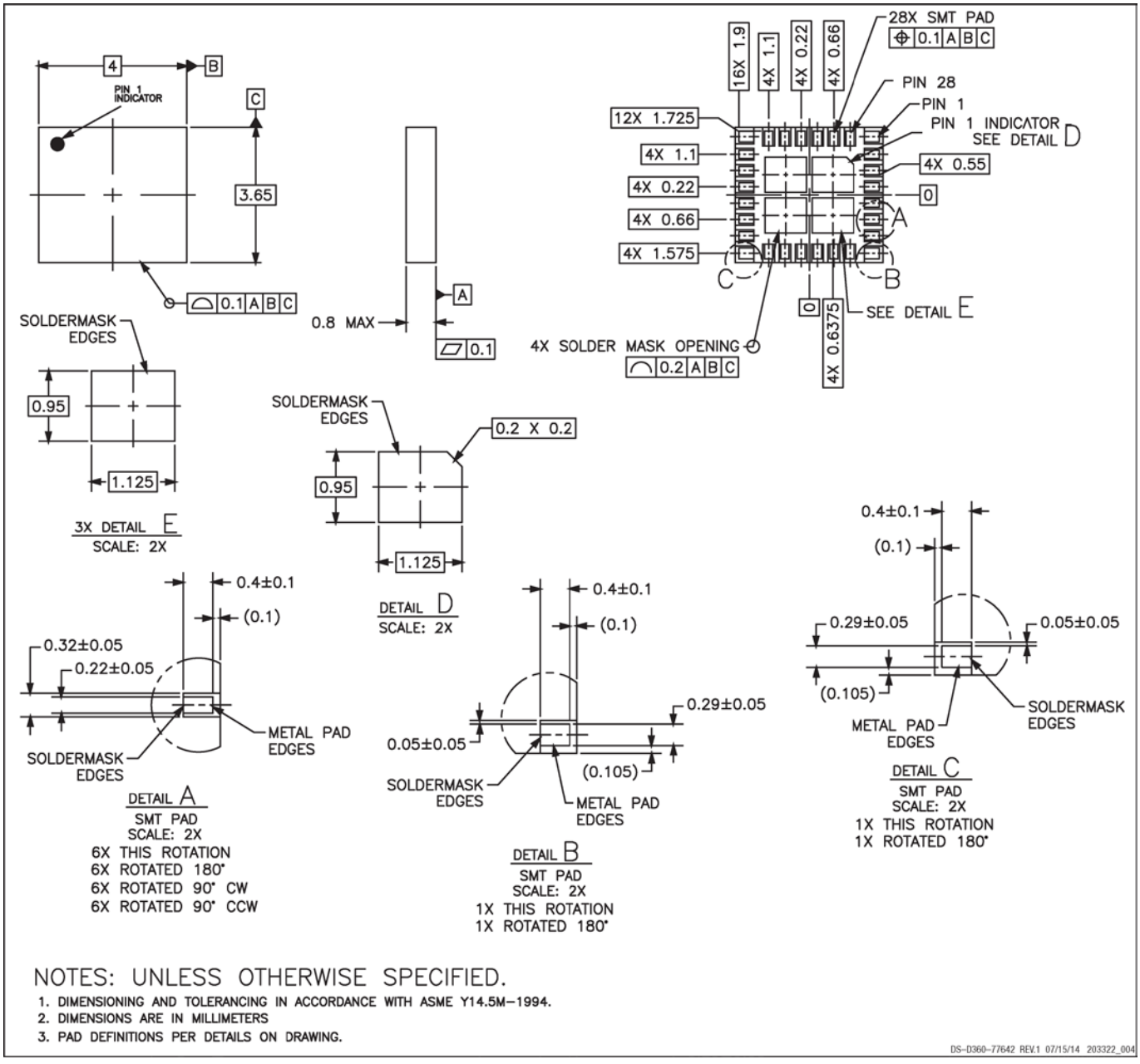


FIGURE 4. DIMENSIONAL DIAGRAM FOR 4.0 mm x 3.65 mm x 0.8 mm Max, 28-pad PACKAGE – SKY77824-11 SPECIFIC

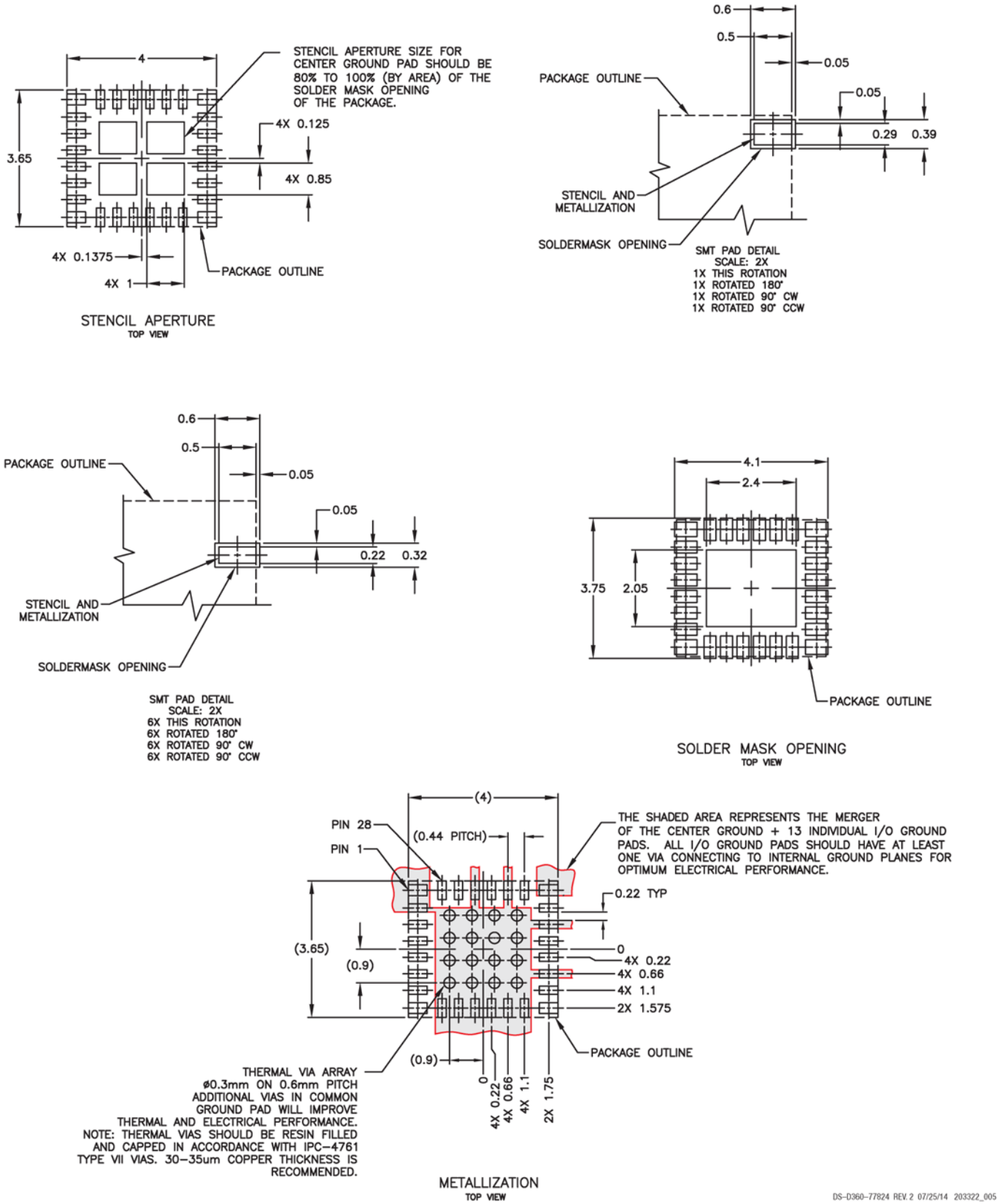


FIGURE 5. PCB LAYOUT DIAGRAM – 4.0 mm x 3.65 mm, 28-PAD PACKAGE – SKY77824-11

Package Description

Figure 6 shows the pad labels and the pad numbering convention, which starts with pad 1 in the upper left and increments counter-clockwise around the package. Table 12 lists pad labels and descriptions. Typical case markings are illustrated in Figure 7.

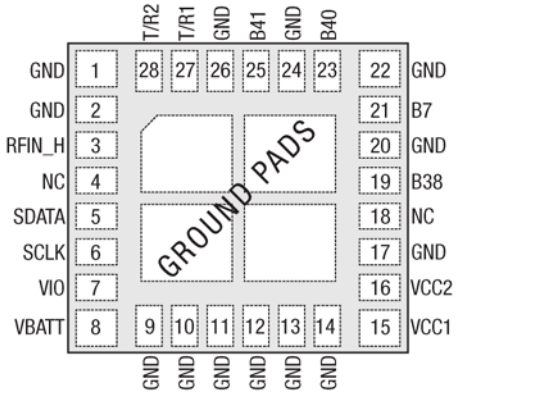


FIGURE 6. SKY77824-11 PAD NAMES AND CONFIGURATION (TOP VIEW)

TABLE 11. SKY77824-11 PAD NAMES AND DESCRIPTIONS

Pad #	Pad Label	Function
3	RFIN_H	High Band (HB) input
4	NC	Not used (may float or connect to Ground)
5	SDATA	MIPI data bus
6	SCLK	MIPI clock bus
7	VIO	MIPI supply
8	VBATT	Battery supply
15	VCC1	1st stage PA collector supply
16	VCC2	2nd stage PA collector supply
18	NC	Not used (may float or connect to Ground)
19	B38	RF output Band 38
21	B7	Band 7 RF output
23	B40	Band 40 RF output (Band 30 supported)
25	B41	Band 41 RF output (AXGP band supported)
27	T/R1	Band 40 Rx
28	T/R2	Band 7, Band 38, Band 41 Rx

[1] *Pads 1, 2, 9–14, 17, 20, 22, 24 are Ground pads*

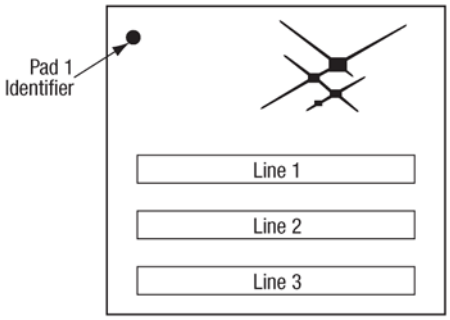


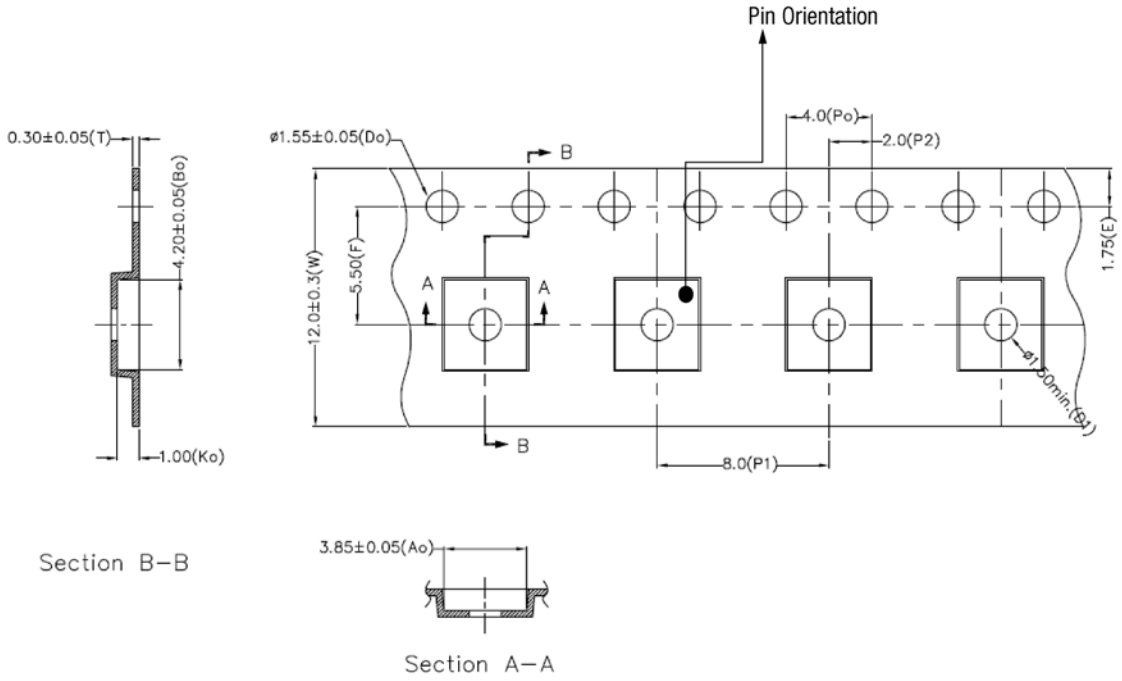
FIGURE 7. TYPICAL CASE MARKINGS

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 SKY77824-11 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 Standard J-STD-020.

Production quantities of this product are shipped in the standard tape-and-reel format (Figure 8).



NOTES:

1. MATERIAL: CONDUCTIVE POLYSTYRENE
2. Po/P1 10 PITCHES CUMULATIVE TOLERANCE ON TAPE: ±0.20
3. Ao & Bo MEASUREMENT POINT TO BE 0.3 FROM BOTTOM POCKET .
4. ALLOWABLE CAMBER TO BE 1/100mm, NON–CUMULATIVE OVER 250mm
5. SURFACE RESISTIVITY 10^4 TO 10^11 OHMS/SQ
6. MOLD TYPE: ROTARY MOLD

CARRIER TAPE BODY SIZE 3.65 x 4.00 mm MCM -072A

FIGURE 8. DIMENSIONAL DIAGRAM FOR CARRIER TAPE BODY SIZE 4.0 mm x 3.65 mm x 0.75–0.90 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 SKY77824-11 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

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 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

Ordering Information

Product Name	Order Number	Evaluation Board Part Number
SKY77824-11 Power Amplifier Module	SKY77824-11	EN40–D925–001

Revision History

Revision	Date	Description
A	September 15, 2014	Initial Release – Preliminary Information
B	January 20, 2015	Revise: Tables 1– 10 Add: Figures 2, 3; Table 11
C	February 27, 2015	Revise: Tables 3–7, 9 Delete: Table 10

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)*