PRELIMINARY DATA SHEET

SKY77925-21 SkyLiTE™ 2.0 Tx-Rx Front-End Module for Quad-Band GSM / GPRS / EDGE w/ 15 Linear TRx Switch Ports Dual-Band TD-SCDMA, TDD LTE Band 34/39

Applications

- Cellular handsets encompassing Quad-Band GSM/EDGE, Dual-Band TD-SCDMA, and TDD LTE
  - Class 4 GSM850/900
  - Class 1 DCS1800/PCS1900
  - Class 12 GPRS multi-slot operation
  - Linear EDGE operation
  - TD-SCDMA Bands 34/39
  - TDD LTE Band 34/39
- Carrier Aggregation (CA)

Features

- Small, low profile package; 44-pad configuration
  - 5.5 mm x 5.5 mm x 0.75 mm
- MIPI® RFFE control with dual-standard support
  - User-selectable register mappings
  - Linear or VRAMP-based GMSK power control
- RF ports internally matched to 50 Ω w/ zero DC offset
- High GMSK POUT (inclusive of coupler and diplexer)
  34 dBm GSM850/900 31 dBm DCS1800/PCS1900
- Tx harmonics below –40 dBm
- Supports APT, buck DC-DC supply
- 15 low loss/high linearity/high isolation TRx switch ports
- RF input switching to external 3G/4G path
- Integrated forward direction coupler
- Downlink inter-band CA with built-in antenna diplexer
- Integrated 2.4 GHz WiFi coexistence notch filter
- Integrated diplexer rejects noise and harmonics for excellent 5 GHz WiFi coexistence
- Built-in IEC-compliant antenna ESD protection
- High impedance control inputs and low standby current
- Current limiting and overvoltage protection for ruggedness and extended battery life
- Power control circuitry built-in for improved TRP variation
- Supports Uplink Carrier Aggregation in Band 39 (35 MHz)
- Support High Power User Equipment (HPUE) input power via TRx port

Description

The SKY77925-21 SkyLiTE™ Tx/Rx Front-End Module (FEM) offers a complete Power Amplifier (PA) and switching solution for advanced 2G/3G/4G cellular handsets.

Two PAs support quad-band GSM, GPRS, EDGE multi-slot operation and TD-SCDMA and TDD LTE transmission. The low band (LB) PA transmits in the GSM850/900 bands. The mid-band (MB) PA covers DCS1800, PCS1900, TD-SCDMA bands 34/39, and TDD LTE band 34/39. The FEM facilitates flexible broadband RF switch-through by means of outward switching of the LB/MB PA RF inputs and 15 transmit/receive (TRx) antenna switch ports covering all 3G/4G bands from 700 MHz through 2300-2700 MHz. In support of downlink inter-band Carrier Aggregation (CA), the TRx ports are partitioned into two independent switch blocks, comprising 6 LB ports and 9 M/HB ports. Each switch block includes a forward direction coupler that may be monitored on the CPL port. A built-in diplexer provides simultaneous LB and M/HB reception required for downlink CA at the single antenna port.

The SKY77925-21 includes a full set of features for state-of-the-art performance and minimal phone board complexity. The Heterojunction Bipolar Transistor (HBT) PA blocks are fabricated in Gallium Arsenide (GaAs). The HBT, switches, controller die, and passive components are mounted on a multi-layer laminate substrate. A plastic over-mold encapsulates the entire assembly.

A new multi-standard CMOS controller provides PA band/mode selection and bias control, including the Mobile Industry Processor Interface (MIPI) RFFE logic and switch decoder circuitry. The controller supports selection of the GMSK envelope control technology by either linear RF amplification or analog VRAMP. A distinct MIPI register mapping included in this Data Sheet provides for each of these control paradigms, including associated approaches to PA mode, power output and switch control.

Selecting the linear-GMSK operation standard disables VRAMP input, so all PA biasing depends only on MIPI mode selection. The transmitted envelope is then a linear function of RF input. Selecting VRAMP-enabled operation, the PA controller provides VRAMP control of the GMSK envelope and reduces sensitivity to input drive, temperature, power supply, and process variations. Skyworks' Finger-Based Integrated Power Amplifier Control (FB-iPAC) minimizes output power variation into mismatch. In EDGE and TD-SCDMA / TDD LTE linear modes, VRAMP voltage and MIPI-based bias settings jointly optimize PA linearity and efficiency.

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.

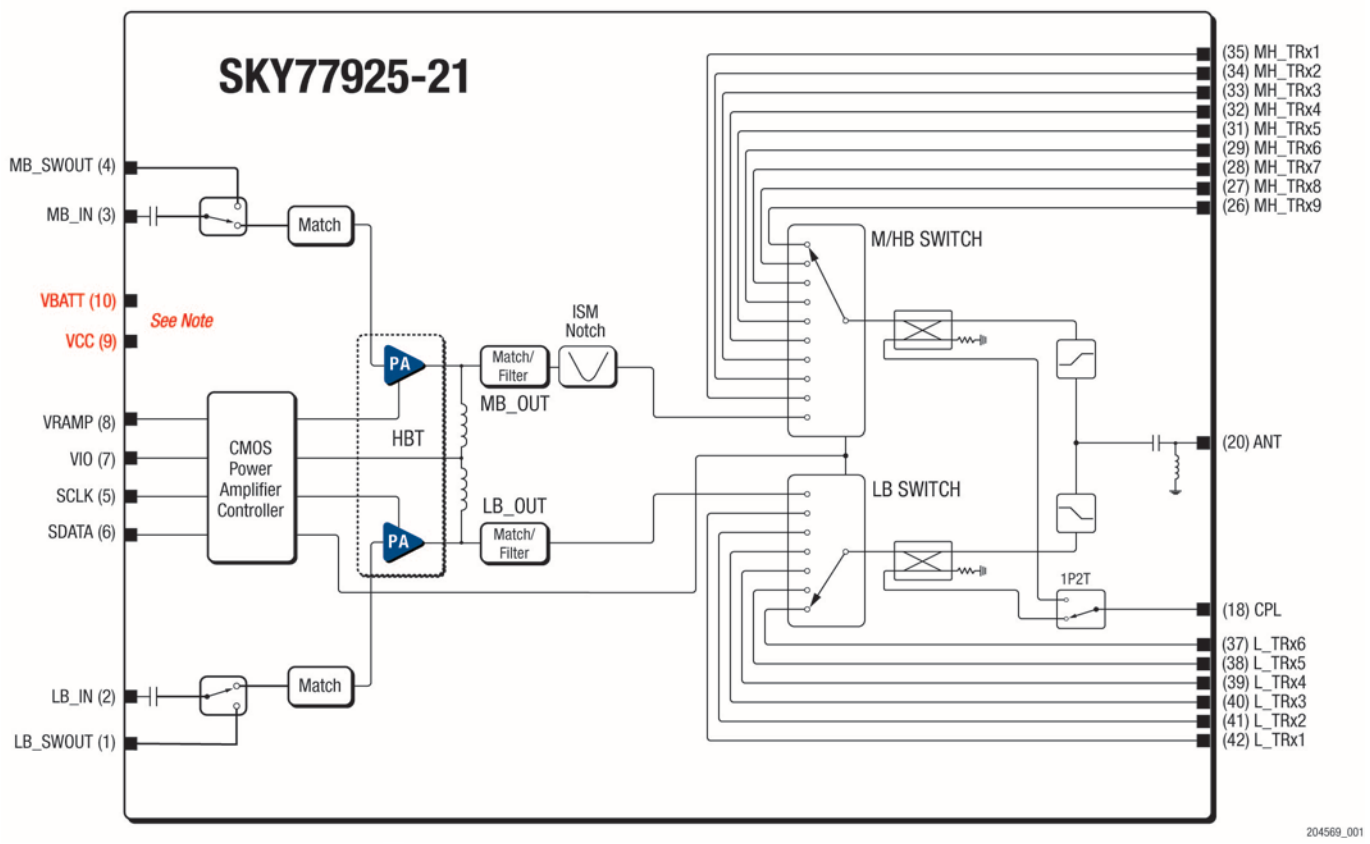


Figure 1. SKY77925-21 Functional Block Diagram

Important Note About Pads 9 and 10

*The definitions of **VCC** and **VBATT** differ from similar legacy Tx-Rx FEM products. Although the pad labels are unchanged, the **VCC** pad (9) now supplies the PA/HBT block, whereas the **VBATT** pad (10) powers the PA bias controller and switch blocks.*

Electrical Specifications

The following tables list the electrical specifications of the SKY77925-21 Front-End Module. Table 1 lists the absolute maximum ratings and Table 2 lists the recommended operating conditions. Tables 5 through 16 provide the electrical specifications of the SKY77925-21 for GMSK, EDGE, TD-SCDMA, and TDD LTE transmission and TRx port modes including control logic descriptions for the various modes.

The SKY77925-21 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. SKY77925-21 Absolute Maximum Ratings[1]

Parameter		Symbol	Min	Nominal	Max	Unit
Input Power		P_{IN}	—	—	15	dBm
Supply Voltage ≤ 1 µs (measured to GND)		V_{CC}	–1.2[2]	—	6.0	V
		V_{BATT}	–0.5	—	6.0[3]	
DC Continuous During Burst[4]		I_{CC}	—	—	3.2	A
GMSK Burst Duty Cycle		D_B	—	—	50	%
Voltage Standing Wave Ratio		VSWR	—	—	20:1	V
Power Control Voltage		V_{RAMP}	–0.3	—	3.0	V
MIPI Supply Voltage		VIO	—	—	2.0	V
MIPI Data and Clock Voltage		V_{MIPI}	—	—	2.0	V
Temperatures	Operating	T_{CASE}	–30	—	+100	°C
	Storage	T_{STG}	–40	—	+150	
Moisture Sensitivity Level		MSL	—	—	3	
Reflow Solder Temperature (J-STD-020B)		T_{SOLDER}	260	—	—	°C

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 at a time and all other parameters set at or below their nominal value.*

2 *Pulsed at –1.2 V for 100 µs.*

3 *Applies when V_{CC} and V_{BATT} are tied together.*

4 *Applied voltage must be current-limited to specified range.*

Table 2. SKY77925-21 Recommended Operating Conditions[1]

Unless otherwise specified: 50 Ω system; terminate all RF ports with 50 Ω during test.

Parameter		Symbol	Min	Typ[2]	Max	Unit
Supply Voltage[3]	GMSK	V_{CC}	3.0	3.5	4.8	V
	EDGE/TD-SCDMA/TDD LTE		3.0	3.6	4.8	
		V_{BATT}	3.0	—	4.8	
GMSK Input Power – V_{RAMP}-Based Operation		P_{IN}	0	3	6	dBm
Operating Case Temperature[4]	GMSK/EDGE 1–4 Slots (12.5%–50% duty cycle)[5]	T_{CASE}	–20	+25	+85	°C
	TD-SCDMA/TDD LTE		–20	+25	+85	

1 *Extreme Test Conditions (ETC) are defined by the applicable min/max values of the parameters.*

2 *Nominal Test Condition (NTC) is defined by the applicable typical values.*

3 *V_{BATT} and V_{CC} should be connected unless DC/DC is used and V_{BATT} can be separately supplied.*

4 *Case Operating Temperature refers to the temperature at the GROUND PAD on the underside of the package.*

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

Table 3. SKY77925-21 Interface Specifications

Unless otherwise specified: ETC per Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
APT Supply Voltage	V_{CC}		0.5	—	3.4	V
PA Supply Current (on V_{BATT})	I_{CC}	P_{IN} = 10 dBm, VSWR = 15:1	0	—	3.2	A
GMSK/EDGE Burst Duty Cycle	D_B		12.5	—	50	%
Resistance of V_{RAMP}	$R_{\_VRAMP}$	DC resistance to ground	5	—	—	MΩ
Capacitance of V_{RAMP}	$C_{\_VRAMP}$	Capacitance to ground	—	—	2	pF
MIPI Supply Voltage	VIO		1.65	1.8	1.95	V
MIPI Signal Levels	V_{MIPI_LOW}		0		0.2 x VIO	
	V_{MIPI_HIGH}		0.8 x VIO		VIO	
Power Control Voltage	V_{RAMP}	Required for operation up to P_{RATED}	0.2	—	1.6	V
Standby Current	$I_{\_STANDBY}$	Standby mode NTC VIO = 0 V	—	7	20	µA
TRx Mode Current	$I_{\_TRx}$	Any TRx Mode	—	250	400	µA

Table 4. SKY77925-21 Linear GMSK/EDGE Power Modes – Recommended Maximum Operating Power

Unless otherwise specified, values are used as each Power Mode's Test Condition

Band	Waveform	Power Mode	PRATED	Unit
LB	GMSK	High Power Mode (HPM)	34.0	dBm
		Medium Power Mode (MPM)	29.0	
		Low Power Mode (LPM)	23.0	
		Ultra-Low Power Mode (ULPM)	15.0	
	EDGE	Medium Power Mode (MPM)	27.5	
		Low Power Mode (LPM)	17.0	
		Ultra-Low Power Mode (ULPM)	10.0	
HB	GMSK	High Power Mode (HPM)	31.0	
		Medium Power Mode (MPM)	28.0	
		Low Power Mode (LPM)	24.0	
		Ultra-Low Power Mode (ULPM)	16.0	
	EDGE	Medium Power Mode (MPM)	26.5	
		Low Power Mode (LPM)	22.0	
		Ultra-Low Power Mode (ULPM)	16.0	

Table 5-1. SKY77925-21 Electrical Specifications – GMSK/EDGE Low Band (Linear GMSK Operation)

Unless otherwise specified: Conditions NTC per Table 2; Duty Cycle 25%;
POUT = PRATED per "Power Modes" Table 4 at NTC, then varies with gain

Parameter	Symbol	Waveform/ Bias Mode	Condition	Min	Typ	Max	Units
Operating Frequency Range				824		915	MHz
PSAT	PSAT_GMSK	GMSK HPM	PIN = 9 dBm, NTC	34.2	34.5		dBm
PSAT Degraded	PSAT_GMSK_ETC	GMSK HPM	PIN = 9 dBm, ETC	31.8			dBm
Power Added Efficiency, saturated	PAE_GMSK_SAT	GMSK HPM	POUT = PSAT, PIN = 9 dBm		33		%
Power Added Efficiency	PAE_GMSK	GMSK HPM			32		
		GMSK MPM			19		
		GMSK LPM			10		
		GMSK ULPM			4		
Gain	GAIN_GMSK	GMSK HPM		26.0	29.7	32.0	dB
		GMSK MPM		28.0	29.7	33.0	
		GMSK LPM		24.0	26.1	29.0	
		GMSK ULPM		14.0	17.0	19.0	
	GAIN_EDGE	EDGE MPM		29.0	31.4	33.0	dB
		EDGE LPM		27.75	28.9	31.25	
		EDGE ULPM		17.25	19.9	20.75	
Gain Compression		EDGE HPM	Gain(PRATED – 10 dB) – Gain(PRATED)			1	dB
Gain Change Over Temperature		GMSK HPM	ETC, except VBATT = Vcc = 3.5 V	–2.3		1.3	dB
		GMSK MPM		–2.0		1.2	
		GMSK LPM		–2.4		1.5	
		GMSK ULPM		–2.5		2.5	
Gain Change Over Voltage		GMSK HPM	ETC, except T = 25 °C	–1.2		1.0	dB
		GMSK MPM		–0.5		1.0	
		GMSK LPM		–0.5		1.0	
		GMSK ULPM		–0.5		1.0	
PAE	PAE_EDGE	EDGE MPM			14		%

Table 5-2. SKY77925-21 Electrical Specifications – GMSK/EDGE Low Band (Linear GMSK Operation)

Unless otherwise specified: Conditions NTC per Table 2; Duty Cycle 25%;
POUT = PRATED per "Power Modes" Table 4 at NTC, then varies with gain

Parameter	Symbol	Waveform/ Bias Mode	Condition	Min	Typ	Max	Units
Output Noise Power		ALL	NTC, Rx = 747 MHz to 757 MHz			–84	dBm/100 kHz
			NTC, Rx = 757 MHz to 762 MHz			–84	
			NTC, Rx = 869 MHz to 894 MHz			–84	
			NTC, Rx = 925 MHz to 935 MHz			–80	
			NTC, Rx = 935 MHz to 960 MHz			–83	
			NTC, Rx = 1805 MHz to 1880 MHz			–90	
			NTC, Rx = 1930 MHz to 1990 MHz			–90	
Harmonics	$2fo$-$13fo$	GMSK ALL	ETC, $P_{OUT} \leq P_{RATED}$			–36	dBm
Input Voltage Standing Wave Ratio	$VSWR_{IN}$	ALL				2.5:1	
Stability	S	ALL	VSWR <= 12:1			–36	dBm
Ruggedness	Ru	HPM	All Load Phases	15:1			
Switching Transients	SWT_{400}	GMSK HPM	400 kHz offset ETC P_{IN} adjusted for Temperature			–28	dBm/30kHz
		GMSK MPM				–28	
		GMSK LPM				–28	
		GMSK ULPM				–28	
ACPR (M-ORFS, No Predistortion)	$ACPR_{200}$	EDGE MPM	200 kHz offset ETC except $V_{CC} \geq 3.2$ V P_{IN} adjusted for Temperature			–35.5	dBc/30 kHz
		EDGE LPM				–35.5	
		EDGE ULPM				–35.5	
	$ACPR_{400}$	EDGE MPM	400 kHz offset ETC except $V_{CC} \geq 3.2$ V P_{IN} adjusted for Temperature			–58.0	
		EDGE LPM				–58.0	
		EDGE ULPM				–58.0	
	$ACPR_{600}$	EDGE MPM	600 kHz offset ETC except $V_{CC} \geq 3.2$ V PIN adjusted for Temperature			–65.0	
		EDGE LPM				–65.0	
		EDGE ULPM				–65.0	
EVM (No Predistortion)	EVM_{rms}	EDGE MPM	ETC except $V_{CC} \geq 3.2$ V P_{IN} adjusted for Temperature		2	4	%
		EDGE LPM			2	4	
		EDGE ULPM			2	4	

Table 6. SKY77925-21 Electrical Specifications – GMSK Low Band (VRAMP-Based Operation)

Unless otherwise specified: PRATED = 34.0 dBm; ETC per Table 2.

GSM850/900 GMSK Mode							
Parameter		**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Frequency Range	GSM850	f_0	—	824	—	849	MHz
	GSM900			880	—	915	
Supply Current		ICC	—	—	—	2.9	A
Power Added Efficiency	GSM850	PAE	POUT = PRATED, NTC, Duty cycle = 1:8	—	32	—	%
	GSM900			—	32	—	
Harmonics		$2f_0$ to $13f_0$	BW = 3 MHz, 5 dBm ≤ Cal-POUT ≤ PRATED VRAMP = Cal-VRAMP[1]	—	–44	–33	dBm
Output Power		POUT_MAX_NTC	NTC, PIN = 0 dBm, VRAMP = 1.65 V	34.5	35.0	—	dBm
		POUT_MAX_ETC	VCC = 3.0 V, PIN = 0 dBm, VRAMP = 1.65 V	31.8	—	—	
Input Voltage Standing Wave Ratio		VSWR_IN	POUT ≤ PRATED	—	—	2.5:1	
Isolation		ISO_PDSD	PIN ≤ 6 dBm, Isolation Mode, VRAMP ≤ 0.1 V	—	–60	–51	dBm
		ISO_PESE	NTC, LB GMSK/VRAMP Tx Mode, PIN ≤ 6 dBm, VRAMP ≤ 0.1 V	—	—	–15	
Mode Switching Time		T_MODE_GMSK	Time from EDGE to GMSK mode transition to application of GMSK RF input drive to meet forward isolation PESE			2	µs
Stability		S	All combinations of the following parameters: 5 dBm ≤ POUT ≤ PRATED Load VSWR = 12:1, all phase angles	No parasitic oscillation > –36 dBm			
Load Mismatch		Load	All combinations of the following parameters: 5 dBm ≤ POUT ≤ PRATED Load VSWR = 20:1, all phase angles.	No module damage or permanent degradation			
Noise Power[2]		PNOISE_850	f_Rx = 869 MHz to 894 MHz, POUT = PRATED, NTC, RBW = 100 kHz	—	—	–83	dBm
		PNOISE_900	f_Rx = 935 MHz to 960 MHz, POUT = PRATED, NTC, RBW = 100 kHz	—	—	–83	
			f_Rx = 925 MHz to 935 MHz, POUT = PRATED, NTC, RBW = 100 kHz	—	—	–79	
			f_Rx =1805 MHz to 1880 MHz, POUT = PRATED, NTC, RBW = 100 kHz	—	—	–86	
		PNOISE_750	f_Rx = 734 MHz to 757 MHz, POUT = PRATED, NTC, RBW = 100 kHz			–83	
		PNOISE_ISM	f_Rx = 2400 MHz to 2500 MHz, POUT = PRATED, NTC, RBW = 100 kHz			–156	dBm/Hz
		PNOISE_5GHZ_WIFI	f_Rx = 5150 MHz to 5850 MHz, POUT = PRATED, NTC, RBW = 100 kHz			–156	

[1] *Cal-VRAMP = VRAMP at POUT = Cal-POUT, NTC*

[2] *Harmonics excluded.*

Table 7. SKY77925-21 Electrical Specifications – EDGE Low Band (VRAMP-Based Operation)

Unless otherwise specified: VRAMP = 1.45 V; PRATED = 27.5 dBm; ETC per Table 2.

GSM850/900 EDGE Mode							
Parameter		**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Frequency Range	GSM850	f_0	—	824	—	849	MHz
	GSM900			880	—	915	
Output Power		POUT_EDGE	NTC, Gain / ACPR / EVM in specification	27.5	—	—	dBm
		POUT_EDGE_EX	Gain / ACPR / EVM in specification	26.0	—	—	
Gain		G_NOM_850	POUT = PRATED NTC	29.5	31.5	32.5	dB
		G_NOM_900		29.5	31.5	32.5	
		G_EX_850	POUT = POUT_EDGE, POUT_EDGE_EX	27.0	—	34.5	
		G_EX_900		27.0	—	34.5	
Power Added Efficiency	GSM850	PAE_GSM850	POUT = PRATED NTC Duty cycle = 1:8	—	14.5	—	%
	GSM900	PAE_GSM900		—	14.5	—	
Harmonics		$2f_0$ to $15f_0$	BW = 3 MHz, 5 dBm ≤ POUT ≤ POUT_EDGE, POUT_EDGE_EX	—	–45	–36	dBm
Input Voltage Standing Wave Ratio		VSWR_IN	POUT ≤ PRATED	—	—	2.5:1	
ACPR		ACPR_200	POUT = POUT_EDGE, POUT_EDGE_EX Bandwidth = 30 kHz	—	–37.5	–35.5	dBc
		ACPR_400		—	–64.0	–60.0	
		ACPR_600		—	–75.0	–70.0	
EVM		EVM_RMS	POUT = POUT_EDGE, POUT_EDGE_EX	—	—	3.5	%
Bias Switching Time		T_ON_EDGE	Rx to Tx transition time from final MIPI command and 90% VRAMP to 0.5 db RF settling.	—	—	1	µs
Stability		S	All combinations of the following parameters: 5 dBm ≤ POUT ≤ PRATED, Load VSWR = 12:1, all phase angles	No parasitic oscillation > –36 dBm			
Load Mismatch		Load	All combinations of the following parameters: 5 dBm ≤ POUT ≤ PRATED, Load VSWR = 20:1, all phase angles.	No module damage or permanent degradation			
Noise Power[1]		PNOISE_850	f_Rx = 869 MHz to 894 MHz, POUT ≤ PRATED, NTC, RBW = 100 kHz	—	—	–83	dBm
		PNOISE_900	f_Rx = 935 MHz to 960 MHz, POUT ≤ PRATED, NTC, RBW = 100 kHz	—	—	–83	
			f_Rx = 925 MHz to 935 MHz, POUT ≤ PRATED, NTC RBW = 100 kHz	—	—	–82	
			f_Rx = 1805 MHz to 1880 MHz, POUT ≤ PRATED, NTC, RBW = 100 kHz	—	—	–86	
		PNOISE_750	f_Rx = 734 MHz to 757 MHz, POUT ≤ PRATED, NTC, RBW = 100 kHz	—	—	–83	
		PNOISE_ISM	f_Rx = 2400 MHz to 2500 MHz, POUT ≤ PRATED, NTC, RBW = 100 kHz	—	—	–156	dBm/Hz
		PNOISE_5GHZ_WIFI	f_Rx = 5150 MHz to 5850 MHz, POUT = PRATED, NTC, RBW = 100 kHz			–156	

[1] *Harmonics excluded.*

Table 8-1. SKY77925-21 Electrical Specifications – GMSK/EDGE Mid-Band (Linear GMSK Operation)

Unless otherwise specified: Conditions NTC per Table 2; Duty Cycle 25%; POUT = PRATED per "Power Modes" Table at NTC, then varies with Gain

Parameter	Symbol	Waveform/ Bias Mode	Condition	Min	Typ	Max	Units
Operating Frequency Range				1710		1910	MHz
PSAT	PSAT_GMSK	GMSK HPM	PIN = 6 dBm, NTC	31.2	32.0		dBm
PSAT Degraded	PSAT_GMSK_ETC	GMSK HPM	PIN = 6 dBm, ETC	29.0			dBm
Power Added Efficiency, saturated	PAE_GMSK_SAT	GMSK HPM	POUT = PSAT, PIN = 6 dBm		35		%
Power Added Efficiency	PAE_GMSK	GMSK HPM			32		%
		GMSK MPM			22		
		GMSK LPM			16		
		GMSK ULPM			6		
Gain	GAIN_GMSK	GMSK HPM		27.0	29.7	32.5	dB
		GMSK MPM		26.0	28.7	31.0	
		GMSK LPM		23.5	25.9	28.5	
		GMSK ULPM		20.0	22.6	25.0	
	GAIN_EDGE	EDGE MPM		29.4	31.1	33.6	dB
		EDGE LPM		25.1	26.8	28.6	
		EDGE ULPM		22.5	24.3	25.2	
Gain Compression		EDGE HPM	Gain(PRATED – 10 dB) – Gain(PRATED)			1.0	dB
Gain Change Over Temperature		GMSK HPM	ETC, except VBATT = VCC = 3.5 V	–2.0		1.0	dB
		GMSK MPM		–2.0		1.0	
		GMSK LPM		–2.0		1.0	
		GMSK ULPM		–2.0		1.0	
Gain Change Over Voltage		GMSK HPM	ETC, except T = 25 °C	–1.4		1.8	dB
		GMSK MPM		–0.8		0.8	
		GMSK LPM		–0.8		0.8	
		GMSK ULPM		–0.8		0.8	
PAE	PAE_EDGE	EDGE MPM			17		%

Table 8-2. SKY77925-21 Electrical Specifications – GMSK/EDGE Mid-Band (Linear GMSK Operation)

Unless otherwise specified: Conditions NTC per Table 2; Duty Cycle 25%; POUT = PRATED per "Power Modes" Table at NTC, then varies with Gain

Parameter	Symbol	Waveform/ Bias Mode	Condition	Min	Typ	Max	Units
Output Noise Power		ALL	NTC, Rx = 747 MHz to 757 MHz			–93	dBm/100kHz
			NTC, Rx = 757 MHz to 762 MHz			–93	
			NTC, Rx = 869 MHz to 894 MHz			–93	
			NTC, Rx = 925 MHz to 935 MHz			–90	
			NTC, Rx = 935 MHz to 960 MHz			–90	
			NTC, Rx = 1805 MHz to 1880 MHz			–81	
			NTC, Rx = 1930 MHz to 1990 MHz			–82	
Harmonics	2*fo*-13*fo*	GMSK ALL	ETC, POUT <= PRATED			–36	dBm
Input Voltage Standing Wave Ratio	VSWR_IN	ALL				2.5:1	
Stability	S	ALL	VSWR <= 12:1			–36	dBm
Ruggedness	Ru	HPM	All Load Phases	15:1			
Switching Transients	SWT_400	GMSK HPM	400 kHz offset ETC PIN adjusted for Temperature			–28	dBm/30kHz
		GMSK MPM				–28	
		GMSK LPM				–28	
		GMSK ULPM				–28	
ACPR (M-ORFS, no pre-distortion)	ACPR_200	EDGE MPM	200 kHz offset ETC except VCC = 3.2 V, POUT = 25.5 dBm PIN adjusted for Temperature			–35.5	dBc/30kHz
		EDGE LPM				–35.5	
		EDGE ULPM				–35.5	
	ACPR_400	EDGE MPM	400 kHz offset ETC except VCC = 3.2 V, POUT = 25.5 dBm PIN adjusted for Temperature			–58.0	
		EDGE LPM				–58.0	
		EDGE ULPM				–58.0	
	ACPR_600	EDGE MPM	600 kHz offset ETC except VCC = 3.2 V, POUT = 25.5 dBm PIN adjusted for Temperature			–65.0	
		EDGE LPM				–65.0	
		EDGE ULPM				–65.0	
EVM (no pre–distortion)	EVM_RMS	EDGE MPM	ETC except VCC = 3.2 V, POUT = 25.5 dBm PIN adjusted for Temperature		2	4	%
		EDGE LPM			2	4	
		EDGE ULPM			2	4	

Table 9. SKY77925-21 Electrical Specifications – GMSK Mid-Band (V_{RAMP}-Based Operation)

Unless otherwise specified: P_{RATED} = 31.0 dBm; ETC per Table 2.

GSM1800/1900 GMSK Mode							
Parameter		**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Frequency Range	DCS1800	f_0	—	1710	—	1785	MHz
	PCS1900		—	1850	—	1910	
Power Added Efficiency		$PAE_{DCS1800}$	$P_{OUT} = P_{RATED}$, NTC, Duty cycle = 1:8	—	31	—	%
		$PAE_{PCS1900}$		—	34	—	
Harmonics		$2f_0$ to $7f_0$	BW = 3 MHz, 0 dBm ≤ Cal-P_{OUT} ≤ P_{RATED}, V_{RAMP} = Cal- V_{RAMP}[1]	—	–40	–33	dBm
Output Power		$P_{OUT\_MAX\_NTC}$	NTC, P_{IN} = 0 dBm, V_{RAMP} = 1.65 V	31.5	32.0	—	dBm
		$P_{OUT\_MAX\_ETC}$	V_{CC} = 3.0 V, P_{IN} = 0 dBm, V_{RAMP} = 1.65 V	29.0	—	—	
Input Voltage Standing Wave Ratio		Γ_{IN}	$P_{OUT} \le P_{RATED}$	—	—	2.5:1	
Isolation		ISO_{PDSD}	P_{IN} ≤ 6 dBm, Isolation Mode, V_{RAMP} ≤ 0.1 V	—	–60	–51	dBm
		ISO_{PESE}	NTC, HB GMSK/V_{RAMP} Tx Mode, P_{IN} ≤ 6 dBm, V_{RAMP} ≤ 0.1 V	—	—	–15	
Mode Switching Time		T_{MODE_GMSK}	Time from EDGE to GMSK mode transition to application of GMSK RF input drive to meet forward isolation PESE	—	—	2	µs
Stability		S	All combinations of the following parameters: 0 dBm ≤ P_{OUT} ≤ P_{RATED} Load VSWR = 12:1, all phase angles	No parasitic oscillation >–36 dBm			
Load Mismatch		Load	All combinations of the following parameters: 0 dBm ≤ P_{OUT} ≤ P_{RATED} Load VSWR = 20:1, all phase angles.	No module damage or permanent degradation			
Noise Power[2]		P_{NOISE_1800}	f_Rx = 1805 MHz to 1880 MHz, $P_{OUT} \le P_{RATED}$, NTC, RBW = 100 kHz	—	—	–81	dBm
			f_Rx = 925 MHz to 960 MHz, $P_{OUT} \le P_{RATED}$, NTC, RBW = 100 kHz	—	—	–84	
		P_{NOISE_1900}	f_Rx = 1930 MHz to 1990 MHz, $P_{OUT} \le P_{RATED}$, NTC, RBW = 100 kHz	—	—	–81	
			f_Rx = 869 MHz to 894 MHz, $P_{OUT} \le P_{RATED}$, NTC, RBW = 100 kHz	—	—	–84	
		P_{NOISE_750}	f_Rx = 734 MHz to 757 MHz, $P_{OUT} \le P_{RATED}$, NTC, RBW = 100 kHz	—	—	–83	
		P_{NOISE_ISM}	f_Rx = 2450 MHz to 2500 MHz, $P_{OUT} \le P_{RATED}$, NTC, RBW = 100 kHz	—	—	–156	dBm/Hz
		$P_{NOISE\_5GHz\_WiFi}$	f_Rx = 5150 MHz to 5850 MHz, $P_{OUT} = P_{RATED}$, NTC, RBW = 100 kHz			–156	

[1] *Cal-V_{RAMP} = V_{RAMP} at P_{OUT} = Cal-P_{OUT}, NTC*

[2] *Harmonics excluded.*

Table 10. SKY77925-21 Electrical Specifications – EDGE Mid-Band (V_{RAMP}-Based Operation)

Unless otherwise specified: V_{RAMP} = 1.55 V; P_{RATED} = 26.5 dBm; ETC per Table 2.

GSM1800/1900 EDGE Mode							
Parameter		**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Frequency Range	DCS1800	f_0	—	1710	—	1785	MHz
	PCS1900			1850	—	1916	
Output Power		P_{OUT_EDGE}	NTC, Gain / ACPR / EVM / in specification	26.5	—	—	dBm
		$P_{OUT\_EDGE\_EX}$	Gain / ACPR / EVM / in specification	25.0	—	—	
Gain		G_{NOM_1800}	P_{OUT} = P_{RATED}, NTC	28.8	30.8	32.8	dB
		G_{NOM_1900}		29.9	31.9	33.9	
		G_{EX_1800}	P_{OUT} = P_{OUT_EDGE}, $P_{OUT\_EDGE\_EX}$	26.0	—	33.0	
		G_{EX_1900}		27.6	—	34.6	
Power Added Efficiency		$PAE_{DCS1800}$	NTC, Duty cycle = 1:8	—	17	—	%
		$PAE_{PCS1900}$		—	17	—	
Harmonics		$2f_0$ to $7f_0$	BW = 3 MHz, 0 dBm ≤ P_{OUT} ≤ P_{OUT_EDGE}, $P_{OUT\_EDGE\_EX}$	—	–45	–36	dBm
Input Voltage Standing Wave Ratio		Γ_{IN}	P_{OUT} ≤ P_{RATED}	—	—	2.5:1	
ACPR		$ACPR_{200}$	P_{OUT} = P_{OUT_EDGE}, $P_{OUT\_EDGE\_EX}$, Bandwidth = 30 kHz	—	–37.5	–35.5	dBc
		$ACPR_{400}$		—	–64.0	–59.0	
		$ACPR_{600}$		—	–75.0	–70.0	
EVM		EVM_{RMS}	P_{OUT} = P_{OUT_EDGE}, $P_{OUT\_EDGE\_EX}$	—	—	3.5	%
Mode Switching Time		T_{ON_EDGE}	Rx to Tx transition time from final MIPI command and 90% V_{RAMP} to 0.5 dB RF settling	—	—	1	µs
Stability		S	All combinations of the following parameters: 0 dBm ≤ P_{OUT} ≤ P_{RATED} Load VSWR = 12:1, all phase angles	No parasitic oscillation >–36 dBm			
Load Mismatch		Load	All combinations of the following parameters: 0 dBm ≤ P_{OUT} ≤ P_{RATED}, Load VSWR = 20:1, all phase angles	No module damage or permanent degradation			
Noise Power[1]		P_{NOISE_1800}	f_Rx = 1805 MHz to 1880 MHz, P_{OUT} ≤ P_{RATED}, NTC, RBW = 100 kHz	—	—	–80	dBm
			f_Rx = 925 MHz to 960 MHz, P_{OUT} ≤ P_{RATED}, NTC, RBW = 100 kHz	—	—	–84	
		P_{NOISE_1900}	f_Rx = 1930 MHz to 1990 MHz, P_{OUT} ≤ P_{RATED}, NTC, RBW = 100 kHz	—	—	–80	
			f_Rx = 869 MHz to 894 MHz, P_{OUT} ≤ P_{RATED}, NTC, RBW = 100 kHz	—	—	–84	
		P_{NOISE_750}	f_Rx = 734 MHz to 757 MHz, P_{OUT} ≤ P_{RATED}, NTC, RBW = 100 kHz	—	—	–83	
		P_{NOISE_ISM}	f_Rx = 2450 MHz to 2500 MHz, P_{OUT} ≤ P_{RATED}, NTC, RBW = 100 kHz	—	—	–156	dBm/Hz
		$P_{NOISE\_5GHz\_WiFi}$	f_Rx = 5150 MHz to 5850 MHz, POUT = PRATED, NTC, RBW = 100 kHz			–156	

[1] *Harmonics excluded.*

Table 11. SKY77925-21 Electrical Specifications – TD-SCDMA Band 39

Unless otherwise specified: MPM (Linear GMSK/EDGE Operation); ETC per Table 2.

TD-SCDMA Band 39 (1880–1920 MHz)							
Parameters		**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Output Power		$P_{OUT\_TD\_NOM}$	NTC	24.5	—	—	dBm
		$P_{OUT\_TD\_EX}$	ETC	23.5			
Gain	High Power	$G_{MPM\_TDLTE\_NOM}$	$P_{OUT} = P_{OUT\_TD\_NOM}$	29.1	30.9	32.6	dB
		G_{MPM_EX}	$P_{OUT} = P_{OUT\_TD\_EX}$	25.9	—	33.9	
	Ultra-Low Power	G_{ULPM}	P_{OUT} = –5 dBm, ULPM or V_{RAMP} = 0.17 V	—	17.0	20.0	
Power Added Efficiency		PAE_{MPM}	$P_{OUT} = P_{OUT\_TD\_NOM}$	—	14	—	%
Ultra-Low Power Mode Current		I_{CC_ULPM}	V_{RAMP} = 0.17 V, P_{OUT} = 0 dBm ,NTC	—	65	—	mA
Adjacent Channel Leakage power Ratio[1]	1.6 MHz offset	ACLR1.6	$P_{OUT\_TD\_NOM}$	—	–44	–42	dBc
			$P_{OUT\_TD\_EX}$	—	—	–38	
	3.2 MHz offset	ACLR3.2	$P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$	—	–64	–60	
Error Vector Magnitude[1]		EVM_{RMS}	$P_{OUT\_TD\_NOM}$	—	2	3	%
			$P_{OUT\_TD\_EX}$	—	—	4	
Spectral Emissions Margin		SEM1–SEM3	$P_{OUT} = P_{OUT\_TD\_NOM}$, Margin to ETSI SEM mask	5			dB
Harmonic Suppression[1]		$2f_0$–$6f_0$	$P_{OUT} \le P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$, RBW = 1 MHz	—	—	–36	dBm
Tx Noise in Rx Bands[1]	DCS Rx		f_Rx = 1805 MHz to 1850 MHz, $P_{OUT} = P_{OUT\_TD\_NOM}$, NTC, RBW = 100 kHz	—	—	–81	dBm
Input Voltage Standing Wave Ratio		$VSWR_{IN}$	—	—	—	2.5:1	—
Rise / Fall Time		$T_{ON}DC$	TRx Mode to TDD LTE Tx, from MIPI command and >90% VRAMP to 0.5 dB RF settling	—	—	10	µs
		$T_{OFF}DC$	TDD LTE Tx to TRx Mode, from MIPI command or <10% VRAMP to 30 dB gain drop	—	—	10	
Stability		S	VSWR = 12:1 All phases, RBW = 1 MHz	—	—	–36	dBm
Ruggedness - no damage		Ru	All phases, time = 10 seconds	20:1	—	—	VSWR

[1] *Measured using ETSI TS 125.102 UL reference measurement channel (12.2 kbps), 16% duty cycle.*

Table 12. SKY77925-21 Electrical Specifications – TD-SCDMA Band 34

Unless otherwise specified: MPM (Linear GMSK/EDGE Operation); ETC per Table 2.

TD-SCDMA Band 34 (2010–2025 MHz)							
Parameters		**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Output Power		$P_{OUT\_TD\_NOM}$	NTC	24.5	—	—	dBm
		$P_{OUT\_TD\_EX}$	ETC	23.5	—	—	
Gain	High Power	$G_{MPM\_TDLTE\_NOM}$	$P_{OUT} = P_{OUT\_TD\_NOM}$	27.8	30.3	32.0	dB
		G_{MPM_EX}	$P_{OUT} = P_{OUT\_TD\_EX}$	23.8	—	32.9	
	Ultra-Low Power	G_{ULPM}	P_{OUT} = –5 dBm, ULPM or V_{RAMP} = 0.17 V	—	15.9	20.0	
Power Added Efficiency		PAE_{MPM}	$P_{OUT} = P_{OUT\_TD\_NOM}$	—	14	—	%
Ultra-Low Power Mode Current		I_{CC_ULPM}	V_{RAMP} = 0.17 V, P_{OUT} = 0 dBm, NTC		65		mA
Adjacent Channel Leakage power Ratio[1]	1.6 MHz offset	ACLR1.6	$P_{OUT\_TD\_NOM}$	—	–43	–41	dBc
			$P_{OUT\_TD\_EX}$	—	—	–38	
	3.2 MHz offset	ACLR3.2	$P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$	—	–64	–60	
Error Vector Magnitude[1]		EVM_{RMS}	$P_{OUT\_TD\_NOM}$	—	2	3	%
			$P_{OUT\_TD\_EX}$	—	—	4	
Spectral Emissions Margin		SEM1–SEM3	$P_{OUT} = P_{OUT\_TD\_NOM}$, Margin to ETSI SEM mask	5			dB
Harmonic Suppression[1]		$f0$2–$f0$6	$P_{OUT} \leq P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$, RBW = 1 MHz	—	—	–36	dBm
Tx Noise in Rx Bands[1]	DCS Rx		f_Rx = 1805 MHz to 1880 MHz, $P_{OUT} = P_{OUT\_TD\_NOM}$, NTC, RBW = 100 kHz	—	—	–81	dBm
Input Voltage Standing Wave Ratio		$VSWR_{IN}$	—	—	—	2.5:1	—
Rise / Fall Time		T_{ON}DC	TRx Mode to TDD LTE Tx, from MIPI command and >90% VRAMP to 0.5 dB RF settling	—	—	10	µs
		T_{OFF}DC	TDD LTE Tx to TRx Mode, from MIPI command or <10% VRAMP to 30 dB gain drop	—	—	10	
Stability		S	VSWR = 12:1 All phases, RBW = 1 MHz	—	—	–36	dBm
Ruggedness - no damage		Ru	All phases, time = 10 seconds	20:1	—	—	VSWR

[1] *Measured using ETSI TS 125.102 UL reference measurement channel (12.2 kbps), 16% duty cycle.*

Table 13. SKY77925-21 Electrical Specifications – TDD LTE Band 39

Unless otherwise specified: MPM (Linear GMSK/EDGE Operation); ETC per Table 2.

TDD LTE Band 39 (1880–1920 MHz)							
Parameters		**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Output Power[1]		$P_{OUT\_TDLTE\_NOM}$	NTC	23.5	—	—	dBm
		$P_{OUT\_TDLTE\_EX}$		22.5	—	—	
Gain[1]	High Power	$G_{MPM\_TDLTE\_NOM}$	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	29.4	31.1	32.5	dB
		$G_{MPM\_TDLTE\_EX}$	$P_{OUT} = P_{OUT\_TDLTE\_EX}$	27.1	—	33.5	
	Ultra-Low Power	G_{ULPM}	P_{OUT} = –5 dBm, ULPM or V_{RAMP} = 0.19 V	—	16.0	20.0	
Power Added Efficiency		PAE_{MPM}	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	13	—	%
Ultra-Low Power Mode Current		I_{CC_ULPM}	ULPM or V_{RAMP} = 0.19 V, P_{OUT} = 0 dBm, NTC	—	85	—	mA
Adjacent Channel Leakage power Ratio[1]		$EUTRA_{\_ACLR1}$	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	–42	—	dBc
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	–36	
		$UTRA_{\_ACLR1}$	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	–42	—	
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	–38	
		$UTRA_{\_ACLR2}$	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	–48	—	
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	–42	
Error Vector Magnitude[1]		$EVM_{\_RMS}$	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	2	3	%
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	4	
Spectral Emissions Margin		SEM1–SEM9	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$, Margin to ETSI SEM mask	5			dB
Harmonic Suppression[2]	Second	$f_0 2$	$P_{OUT} \le P_{OUT\_TDLTE\_NOM}$, $P_{OUT\_TDLTE\_EX}$, RBW = 1 MHz	—	—	–36	dBm
	Third	$f_0 3$		—	—	–46	
Tx Noise in Rx Bands[3,4]	ISM Band	$P_{NOISE\_TDLTE\_ISM}$	f_Rx = 2450 to 2500 MHz, $P_{OUT} = P_{OUT\_TDLTE\_NOM}$ – MPR, NTC	—	—	–156	dBm/Hz
	WiFi 5 GHz Band	$P_{NOISE\_TDLTE\_5G}$	f_Rx = 5150 to 5850 MHz, $P_{OUT} = P_{OUT\_TDLTE\_NOM}$ – MPR, NTC	—	—	–156	
	Band 1 Rx	$P_{NOISE\_TDLTE\_B1}$	f_Rx = 2110 to 2170 MHz, $P_{OUT} = P_{OUT\_TDLTE\_NOM}$ – MPR, NTC	—	—	–125	
Input Voltage Standing Wave Ratio		$VSWR_{\_IN}$	—	—	—	2.5:1	—
Rise / Fall Time		$T_{ON}DC$	TRx Mode to TDD LTE Tx, from MIPI command and >90% VRAMP to 0.5 dB RF settling	—	—	10	µs
		$T_{OFF}DC$	TDD LTE Tx to TRx Mode, from MIPI command or <10% VRAMP to 30 dB gain drop	—	—	10	
Stability		S	VSWR = 12:1 All phases, RBW = 1 MHz	—	—	–36	dBm
Ruggedness - no damage		Ru	All phases, time = 10 seconds	20:1	—	—	VSWR

[1] Performance is measured using UL reference measurement channel, 10 MHz. QPSK, 12RB, per ETSI TS 136.101 (Release 12, section A.2.3.2.1-4a).

[2] Harmonic suppression is measured using UL reference measurement channel, 1.4 MHz, QPSK, 1RB, per ETSI TS 136.01 (Release 12, section A.2.3.2.1-1).

[3] Noise is measured using UL reference measurement channel, 20 MHz, QPSK, 100 RB, per ETSI TS 136.101 (Release 12, section A.2.3.1.1)

[4] Harmonics excluded

Table 14. SKY77925-21 Electrical Specifications – TDD LTE Band 34

Unless otherwise specified: MPM (Linear GMSK/EDGE Operation); ETC per Table 2.

TDD LTE Band 34 (2010–2025 MHz)							
Parameters		**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
Output Power[1]		$P_{OUT\_TDLTE\_NOM}$	NTC	23.5	—	—	dBm
		$P_{OUT\_TDLTE\_EX}$		22.5	—	—	
Gain[1]	High Power	$G_{MPM\_TDLTE\_NOM}$	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	28.7	30.4	31.8	dB
		$G_{MPM\_TDLTE\_EX}$	$P_{OUT} = P_{OUT\_TDLTE\_EX}$	25.0	—	33.2	
	Ultra-Low Power	G_{ULPM}	P_{OUT} = –5 dBm, ULPM or V_{RAMP} = 0.19 V	—	14.0	20.0	
Power Added Efficiency		PAE_{MPM}	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	12	—	%
Ultra-Low Power Mode Current		I_{CC_ULPM}	ULPM or V_{RAMP} = 0.19 V, P_{OUT} = 0 dBm, NTC		85		mA
Adjacent Channel Leakage power Ratio[1]		EUTRA_ACLR1	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	–42	—	dBc
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	–36	
		UTRA_ACLR1	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	–42	—	
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	–38	
		UTRA_ACLR2	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	–48	—	
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	–42	
Error Vector Magnitude[1]		EVM_{RMS}	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$	—	2	3	%
			$P_{OUT} = P_{OUT\_TDLTE\_EX}$	—	—	4	
Spectral Emissions Margin		SEM1–SEM9	$P_{OUT} = P_{OUT\_TDLTE\_NOM}$, Margin to ETSI SEM mask	5			dB
Harmonic Suppression[2]	Second	$f_0 2$	$P_{OUT} \le P_{OUT\_TDLTE\_NOM}$, $P_{OUT\_TDLTE\_EX}$, RBW = 1 MHz	—	—	–36	dBm
	Third	$f_0 3$		—	—	–46	
Tx Noise in Rx Bands[3,4]	ISM Band	$P_{NOISE\_TDLTE\_ISM}$	f_Rx = 2450 to 2500 MHz, $P_{OUT} = P_{OUT\_TDLTE\_NOM}$ – MPR, NTC	—	—	–156	dBm/Hz
	WiFi 5 GHz Band	$P_{NOISE\_TDLTE\_5G}$	f_Rx = 5150 to 5850 MHz, $P_{OUT} = P_{OUT\_TDLTE\_NOM}$ – MPR, NTC			–156	
	Band 1 Rx	$P_{NOISE\_TDLTE\_B1}$	f_Rx = 2110 to 2170 MHz, $P_{OUT} = P_{OUT\_TDLTE\_NOM}$ – MPR, NTC	—	—	–125	
Input Voltage Standing Wave Ratio		$VSWR_{IN}$	—	—	—	2.5:1	—
Rise / Fall Time		$T_{ON}DC$	TRx Mode to TDD LTE Tx, from MIPI command and >90% VRAMP to 0.5 dB RF settling	—	—	10	µs
		$T_{OFF}DC$	TDD LTE Tx to TRx Mode, from MIPI command or <10% VRAMP to 30 dB gain drop	—	—	10	
Stability		S	VSWR = 12:1 All phases, RBW = 1 MHz	—	—	–36	dBm
Ruggedness - no damage		Ru	All phases, time = 10 seconds	20:1	—	—	VSWR

[1] Performance is measured using UL reference measurement channel, 10 MHz. QPSK, 12RB, per ETSI TS 136.101 (Release 12, section A.2.3.2.1-4a).

[2] Harmonic suppression is measured using UL reference measurement channel, 1.4 MHz, QPSK, 1RB, per ETSI TS 136.01 (Release 12, section A.2.3.2.1-1).

[3] Noise is measured using UL reference measurement channel, 15 MHz, QPSK, 75RB, per ETSI TS 136.101 (Release 12, section A.2.3.1.1)

[4] Harmonics excluded

Table 15-1. SKY77925-21 Electrical Specifications – TRx Ports

Unless otherwise specified: any TRx Mode; Tested CW; ETC per Table 2.

Ports L_TRx1 to L_TRx6, MH_TRx1 to MH_TRx9							
Parameter		**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Frequency Range		f_{TRX}		699		2690	MHz
Insertion Loss		RX_{IL_LLB}	699 MHz to 800 MHz, NTC, L_TRx1–L_TRx6		0.85	1.25	dB
		RX_{IL_ULB}	800 MHz to 960 MHz, NTC, L_TRx1–L_TRx6		1.00	1.50	
		RX_{IL_LMB}	1427 MHz to 1700 MHz, NTC, MH_TRx1–MH_TRx7		1.50	1.70	
		RX_{IL_UMB}	1710 MHz to 2170 MHz, NTC, MH_TRx1–MH_TRx7		1.10	1.40	
		RX_{IL_HB}	2300 MHz to 2690 MHz, NTC, MH_TRx1–MH_TRx7		1.20	1.60	
		$RX_{ULIL\_HB\_B7}$	2500 MHz to 2690 MHz, NTC, MH_TRx8/9 only		1.00	1.30	
TRx Mode VSWR[1]		$VSWR_{TRx}$	NTC, Applies where insertion loss is specified		1.5:1		VSWR
Active-to-Inactive TRx Isolation	Active TRx port to any adjacent inactive TRx port	$ISO_{ADJ\_TRx\_LB}$	699 MHz to 960 MHz (two L_TRX)	30			dB
		$ISO_{ADJ\_TRx\_MB}$	1710 MHz to 2170 MHz (two MH_TRX)	25			
		$ISO_{ADJ\_TRx\_HB}$	2300 MHz to 2690 MHz (two MH_TRX)	20			
	Active TRx port to any non-adjacent inactive TRx port	$ISO_{NADJ\_TRx\_LB}$	699 MHz to 960 MHz (two L_TRX)	35			
		$ISO_{NADJ\_TRx\_MB}$	1710 MHz to 2170 MHz (two MH_TRX)	30			
		$ISO_{NADJ\_TRx\_HB}$	2300 MHz to 2690 MHz (two MH_TRX)	25			
LB-MB/HB Cross-switch Isolation[2]		$ISO_{CA\_TRx\_LB}$	699 MHz to 960 MHz		25		dB
		$ISO_{CA\_TRx\_MB}$	1463 MHz to 1700 MHz		16		
			1710 MHz to 2170 MHz		30		
		$ISO_{CA\_TRx\_HB}$	2300 MHz to 2690 MHz		32		
TRx Harmonics	LB	TRx_{2fo} TRx_{3fo}	NTC, 50 ohm, P_{IN_TRX} = +27 dBm			–80	dBm
	M/HB					–70	
	LB	TRx_{2fo} TRx_{3fo}	NTC, VSWR 5:1 at ANT port, P_{IN_TRX} = +27 dBm			–75	
	M/HB					–65	
Band 13 2nd Harmonic in GPS Band		TRx_{2fo_B13}	P_{IN_TRX} = 25 dBm at 787 MHz, NTC			–85	dBm

Table 15-2. SKY77925-21 Electrical Specifications – TRx Ports

Unless otherwise specified: any TRx Mode; Tested CW; ETC per Table 2.

Ports L_TRx1 to L_TRx6 and MH_TRx1 to MH_TRx9						
Parameter	**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
2nd Order Intermodulation Distortion f_IMD2 = | f_TX ± f_blocker |	IMD2	Tx Output Power = +20 dBm, Blocker Power = –15 dBm NTC, TRx port duplexer termination VSWR 10:1 at $f_{BLOCKER}$, all phases			–105	dBm
3rd Order Intermodulation Distortion f_IMD3 = 2f_TX – f_blocker	IMD3	Tx Output Power = +20 dBm, Blocker Power = –15 dBm NTC, TRx port duplexer termination VSWR 10:1 at $f_{BLOCKER}$, all phases			–105	dBm
Band 7 IMD w/ WiFi	IMD3_B7	P_TRX = +24 dBm at 2550 MHz, P_blocker = +2 dBm at 2430 MHz, NTC, MH_TRx8/9 only		–92	–88	dBm
Leakage from Tx to TRx Ports	P_{TxTRx}	Any TX Mode			0	dBm
Coupling Factor in TRx Mode[3]	CPL_{TRx_LB}	699 to 960 MHz, L_TRx ports only, NTC		–23		dB
	CPL_{TRx_MB}	1710 to 2025 MHz, MH_TRx ports only, NTC		–23		
	CPL_{TRx_HB}	2300 to 2690 MHz, MH_TRx ports only, NTC		–20		
Coupling Factor in GMSK Mode[3]	CPL_{GMSK_LB}	824 to 915 MHz, NTC		–24		dB
	CPL_{GMSK_MB}	1710 to 1910 MHz, NTC		–24		
Coupling Factor Variation over Output VSWR[4]	$CPL_{SWR\_TRx\_LB}$	699 to 960 MHz, L_TRx ports only, VSWR 2.5:1 at ANT port	–0.5		0.5	dB
	$CPL_{SWR\_TRx\_MB}$	1710 to 2025 MHz, MH_TRx ports only, VSWR 2.5:1 at ANT port	–1.0		1.0	
	$CPL_{SWR\_TRx\_HB}$	2300 to 2690 MHz, MH_TRx ports only, VSWR 2.5:1 at ANT port	–1.0		1.0	
Coupling Factor Variation over Temperature[5]	$CPL_{TV\_TRx\_LB}$	699 to 960 MHz, L_TRx ports only	–0.5		0.5	dB
	$CPL_{TV\_TRx\_MB}$	1710 to 2025 MHz, MH_TRx ports only	–1.0		1.0	
	$CPL_{TV\_TRx\_HB}$	2300 to 2690 MHz, MH_TRx ports only	–1.0		1.0	
Turn-on Time	T_{ON_VBATT}	From 50% V_{BATT} and VIO to 0.5 dB RF settling			20	us
TRx-to-TRx Switch Speed	T_{TRxTRx}	From MIPI command to 0.5 dB RF settling		2	5	us

[1] Based on the worst of TRx and ANT port reflection coefficients.

[2] Any active L_TRx1-6 port to any active MH_TRx1-9 port.

[3] Defined as the ratio of CPL port to ANT port output power, driven from TRx.

[4] Variation with respect to 50 ohm reference, forward direction only.

[5] Variation with respect to NTC, forward direction only.

Table 16. SKY77925-21 Electrical Specifications– Input Switch

Unless otherwise specified: any TRx Mode; Tested CW; ETC per Table 2.

Ports LB_SWOUT and MB_SWOUT						
Parameter	**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Frequency Range	$f_{\_INSW}$		600		2025	MHz
Insertion Loss	LBSWOUT_IL	600 MHz to 915 MHz, NTC, LB_SWOUT		0.6	1.0	dB
	MBSWOUT_IL	1710 MHz to 2025 MHz, NTC, MB_SWOUT		1.15	1.7	

Table 17. SKY77925-21 MIPI RFFE Register Map (Linear GMSK Power Control only)

Bit Position	Description	Trigger Support	R/W	Default	Notes
Register 0, Address 0x00 (Mode Control)					
[7]	Register Map & Power Control Selector	Trigger0	R/W	0	(set to 0 to select this Linear GMSK Power Control register map)
[6:3]	PA Bias Mode Control			0000	0000 = Low Band EDGE 0010 = Low Band GMSK 0100 = B34/39 TD-SCDMA 0001 = Mid Band EDGE 0011 = Mid Band GMSK 0101 = B34/39 TDD LTE
[2]	PA Enable			0	0 = PA Tx Disabled 1 = PA Tx Enabled
[1:0]	Power Range Mode			00	00 = High Power Mode (HPM – GMSK only) 01 = Mid Power Mode (MPM) 10 = Low Power Mode (LPM) 11 = Ultra-Low Power Mode (ULPM)
Register 1, Address 0x01 (RESERVED)					
[7:0]	RESERVED	Trigger0	R/W	00000000	RESERVED
Register 4, Address 0x04					
[7:6]	Input Switch Control	Trigger0	R/W	00	01 = LB Switch Out 11 = MB Switch Out 00 = Switch Off

Table 18. SKY77925-21 MIPI RFFE Register Map (VRAMP-Based Operation only)

Bit Position	Description	Trigger Support	R/W	Default	Notes
Register 0, Address 0x00 (PA Control)					
[7]	Register Map and Power Control Selector	Trigger0	R/W	0	(set to 1 to select this VRAMP GMSK Power Control register map)
[6]	Reserved			0	Reserved; (set to zero)
[5]	Gain Control (linear)			0	0 = nominal gain 1 = reduced gain
[4:0]	TxFEM Mode Control			00000	0x00 = PA off 0x0B = LB EDGE/Linear Tx 0x0F = MB EDGE/TDD Modes 0x0A = LB GMSK/Vramp Tx 0x0E = MB GMSK/Vramp Tx Other = Reserved (Do Not Use)
Register 1, Address 0x01 (BIAS_CTRL)					
[7:4]	PA Stage 3 Bias (DAC3)	Trigger0	R/W	0000	0000 = 250 µA 0110 = 1750 µA 1100 = 3250 µA 0001 = 500 µA 0111 = 2000 µA 1101 = 3500 µA 0010 = 750 µA 1000 = 2250 µA 1110 = 3750 µA 0011 = 1000 µA 1001 = 2500 µA 1111 = 4000 µA 0100 = 1250 µA 1010 = 2750 µA 0101 = 1500 µA 1011 = 3000 µA
[3:0]	PA Stage 1-2 Bias (DAC12)			0000	0000 = 250 µA 0110 = 1750 µA 1100 = 3250 µA 0001 = 500 µA 0111 = 2000 µA 1101 = 3500 µA 0010 = 750 µA 1000 = 2250 µA 1110 = 3750 µA 0011 = 1000 µA 1001 = 2500 µA 1111 = 4000 µA 0100 = 1250 µA 1010 = 2750 µA 0101 = 1500 µA 1011 = 3000 µA

Table 19-1. SKY77925-21 MIPI RFFE Register Map (Common Registers)

Bit Position	Description	Trigger Support	R/W	Default Value	Notes
Register 2, Address 0x02 (ASM_CTRL)					
[7:4]	(RESERVED)	Trigger 0	R/W	0000	Reserved (set to all zeroes)
[3:0]	LB Switch Control			0000	0000 = Standby 0010 = L_TRx1 0011 = L_TRx2 0100 = L_TRx3 0101 = L_TRx4 0110 = L_TRx5 0111 = L_TRx6 1111 = LB PA Out Other = isolation
Register 3, Address 0x03 (RESERVED)					
[7:0]	(RESERVED)			0X00	(Reserved; set to zero)
Register 4, Address 0x04 (CPL_CRTL)					
[7:5]	(RESERVED)	Trigger0		000	(Reserved; set to zeroes)
[4:3]	Coupler Mode		R/W	00	00 = Standby 01 = LB Coupler ON 10 = M/HB Coupler On
[2]	(RESERVED)		R/W	0	(Reserved; set to zero)
[1:0]	Coupler Termination		R/W	00	00 = Termination A 01 = Termination B 10 = Termination C 11 = Termination D
Register 5, Address 0x05 (ASM_CTRL2)					
[7:4]	(RESERVED)	Trigger 0	R/W	0000	Reserved (set to zeroes)
[3:0]	M/HB Switch Control			0000	0000 = Standby 0001 = MH_TRx1 0010 = MH_TRx2 0011 = MH_TRx3 0100 = MH_TRx4 0101 = MH_TRx5 0110 = MH_TRx6 0111 = MH_TRx7 1000 = MH_TRx8 1001 = MH_TRx9 1111 = MB PA Out Other = isolation
Register 27, Address 0x1B (GROUP_ID)					
7:4	(RESERVED)	No	R/W	0000	(Reserved)
3:0	Group SID			0000	Group slave ID
Register 28, Address 0x1C (PM_TRIG)					
7:6	PWR_MODE (See Note)	No	R/W	10	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	(Reserved)
0	Trigger Register 0			0	1 = Latch Triggered Register Contents

Table 19-2. SKY77925-21 MIPI RFFE Register Map (Common Registers)

Bit Position	Description	Trigger Support	R/W	Default Value	Notes
Register 29, Address 0x1D (PROD_ID)					
7:0	Product ID	No	R	0x2D	Product ID
Register 30, Address 0x1E (MAN_ID)					
7:0	Manufacturer ID	No	R	0xA5	Manufacturer ID [7:0]
Register 31, Address 0x1F (USID)					
7:6	(RESERVED)	No	R/W	00	(Reserved)
5:4	Manufacturer ID (MSB)		R	01	Manufacturer ID [9:8]
3:0	User ID		R/W	1110	USID
Register 32, Address 0x20 (EXT_PRODUCT_ID)					
7:0	EXT_PRODUCT_ID	No	R	0x04	
Register 35, Address 0x23 (UDR_RST)					
7	SOFTWARE_RESET	No	R/W	0	
6:0	(RESERVED)		R/W	0000000	(Reserved; set to zero)
Register 36, Address 0x24 (ERR_SUM)					
7	RESERVED	No	R/W	0	Reserved
6	COMMAND_FRAME_ PARITY_ERR			0	Command Sequence received with parity error – discard command. The RFFE_STATUS register shall reset after it is read.
5	COMMAND_LENGTH_ ERR			0	Command length error. The RFFE_STATUS register shall reset after it is read.
4	ADDRESS_FRAME_ PARITY_ERR			0	Address frame with parity error. The RFFE_STATUS register shall reset after it is read.
3	DATA_FRAME_PARITY _ERR			0	Data frame with parity error. The RFFE_STATUS register shall reset after it is read.
2	READ_UNUSED_REG			0	Read command to an invalid address. The RFFE_STATUS register shall reset after it is read.
1	WRITE_UNUSED_REG			0	Write command to an invalid address. The RFFE_STATUS register shall reset after it is read.
0	BID_GID_ERR			0	Read command with a BROADCAST_ID or GROUP_ID. The RFFE_STATUS register shall reset after it is read.

***NOTE**: When an RFFE Slave is initially powered up and comes out of reset, it enters LOW POWER. During LOW POWER, the device will be in Standby mode.*

Technical Information

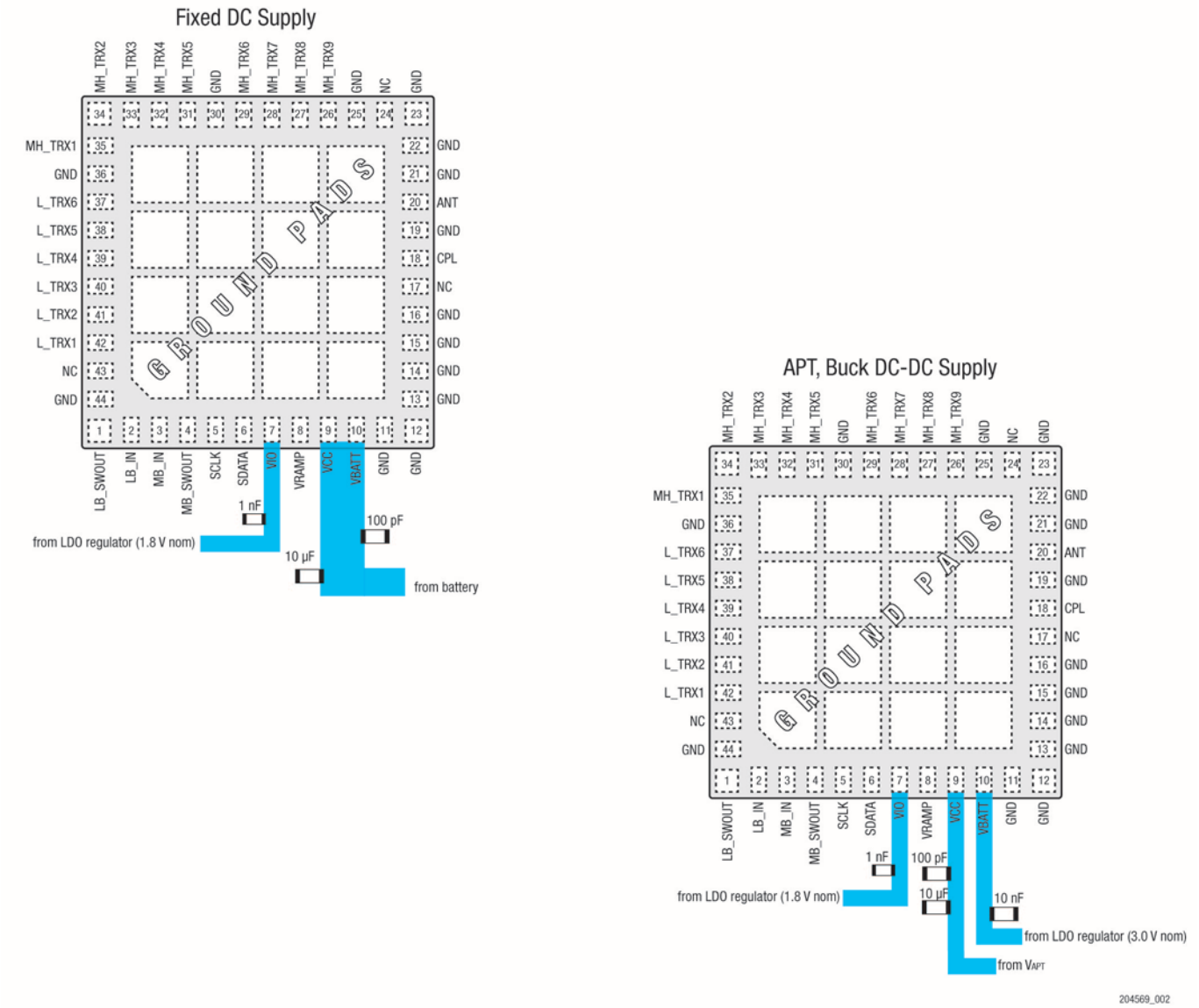


Figure 2. SKY77925-21 Application Schematic

Package Dimensions

The SKY77925-21 quad-band front-end module is a 5.5 mm x 5.5 mm x 0.75 mm, 44-pad, leadless package. Figure 3 is a three-view mechanical drawing of the pad configuration with layout dimensions. Figure 4 provides a recommended PCB layout footprint for the FEM to help the designer attain optimum thermal conductivity, good grounding, and minimum RF discontinuity for the 50-ohm terminals.

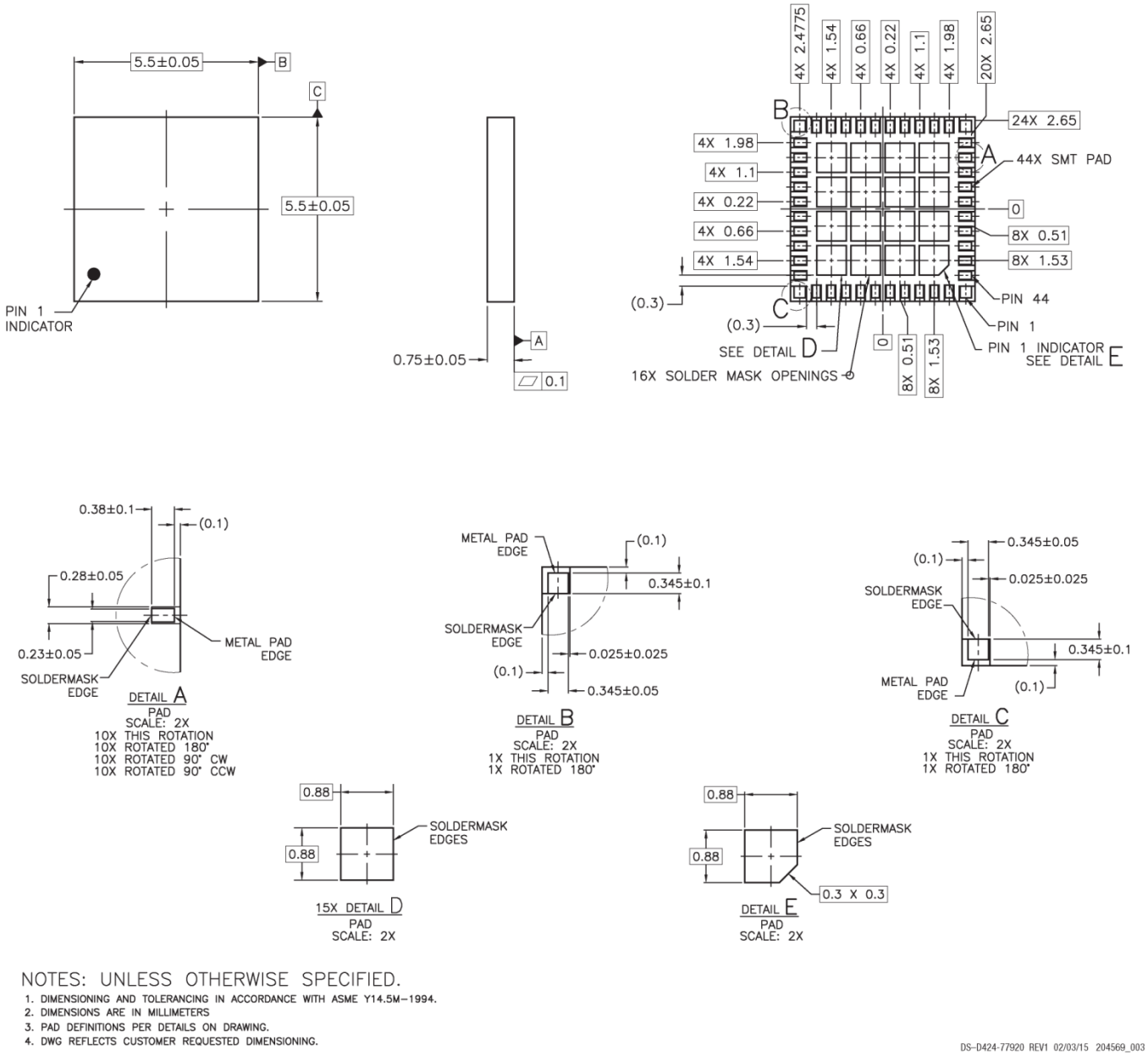


Figure 3. Dimensional Diagram for 5.5 mm x 5.5 mm x 0.75 mm, 44-pad Leadless Package – SKY77925-21 (All Views)

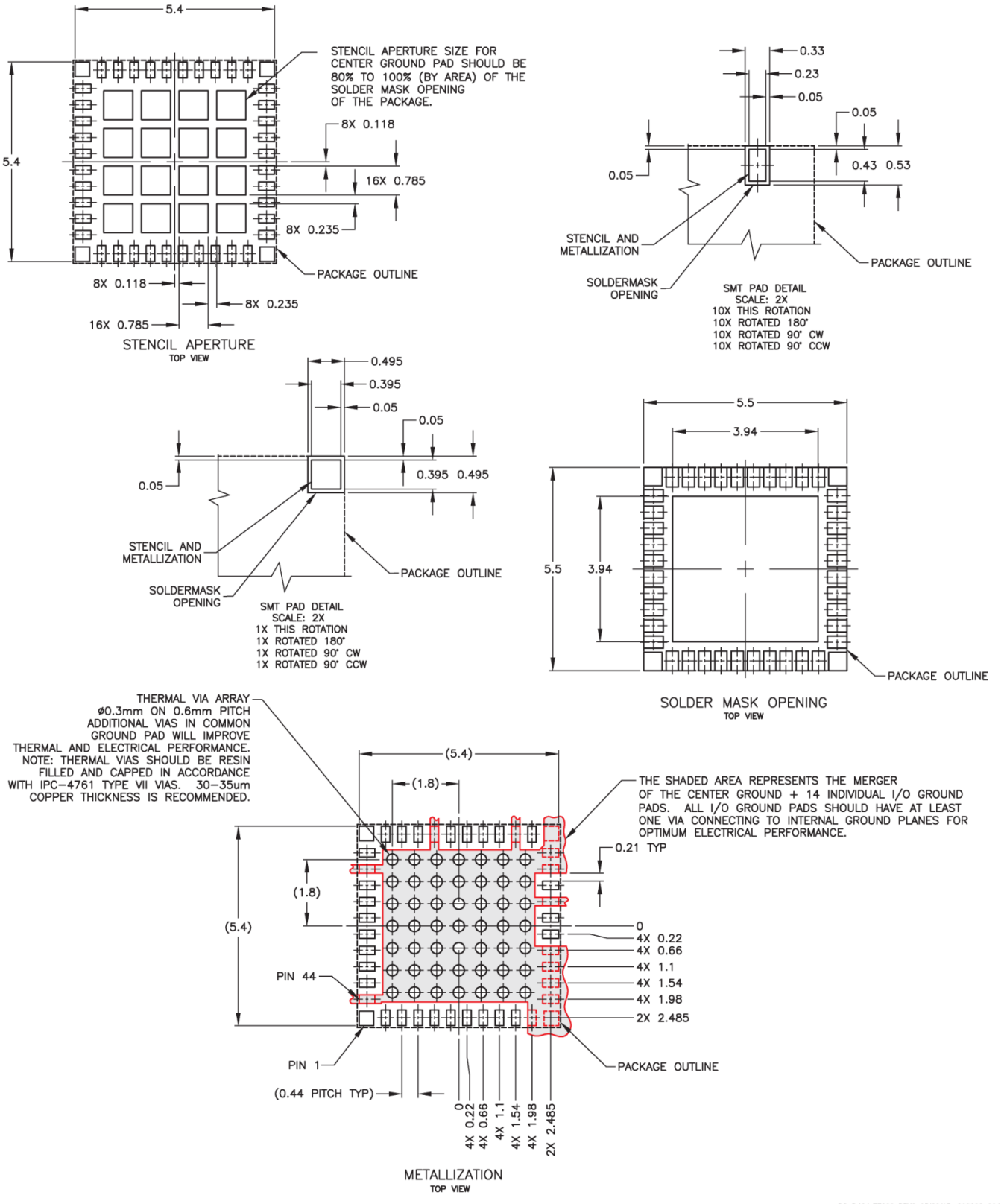
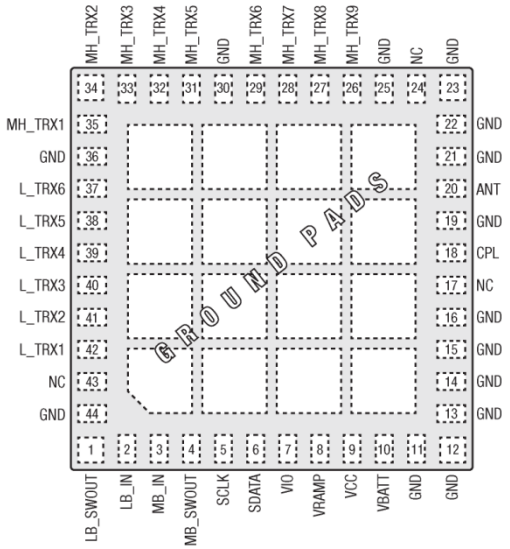


Figure 4. PCB Layout for 5.5 mm x 5.5 mm, 44-pad Leadless Package – SKY77925-21 Specific

Package Description

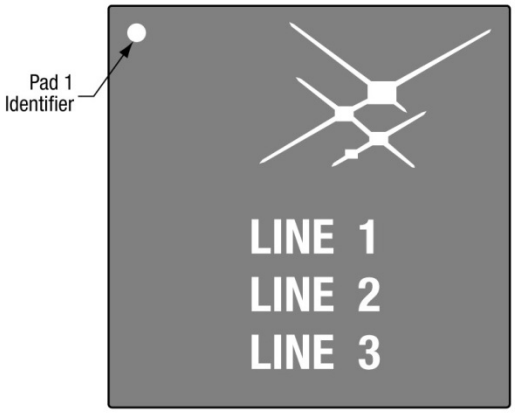
Figure 5 shows the device pad configuration and the pad numbering convention, which starts with pad 1 in the lower left and increments counter-clockwise around the package. Table 19 lists the pad names and signal descriptions. Figure 6 illustrates the typical case markings.



Pad layout as seen from Top View looking through package.

204569_005

Figure 5. SKY77925-21 Pad Configuration (Top View)



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

204569_006

Figure 6. Typical Case Markings

Table 20. SKY77925-21 Signal Descriptions

Pad[1]	Name	Description
1	LB_SWOUT	Alternate RF output path for LB_IN
2	LB_IN	RF input to LB PA or LB_SWOUT
3	MB_IN	RF input to MB PA or MB_SWOUT
4	MB_SWOUT	Alternate RF output path for MB_IN
5	SCLK	MIPI clock
6	SDATA	MIPI serial data
7	VIO	MIPI supply voltage
8	VRAMP	Controls GMSK power; EDGE, TD-SCDMA, TDD LTE bias
9	VCC	PA supply
10	VBATT	Antenna switch supply, PA bias supply
17	NC	No connection
18	CPL	Directional coupler RF output
20	ANT	RF output to antenna
24	NC	No connect
26–29	MH_TRX9 ~ MH_TRX6	MHB TRx Switch ports
31–35	MH_TRx5 ~ MH_TRX1	M/HB TRx Switch ports
37–42	L_TRX6 ~ L_TRX1	LB TRx Switch ports
43	NC	No connection
Ground Pad Grid		Ground Pad Grid (device underside)

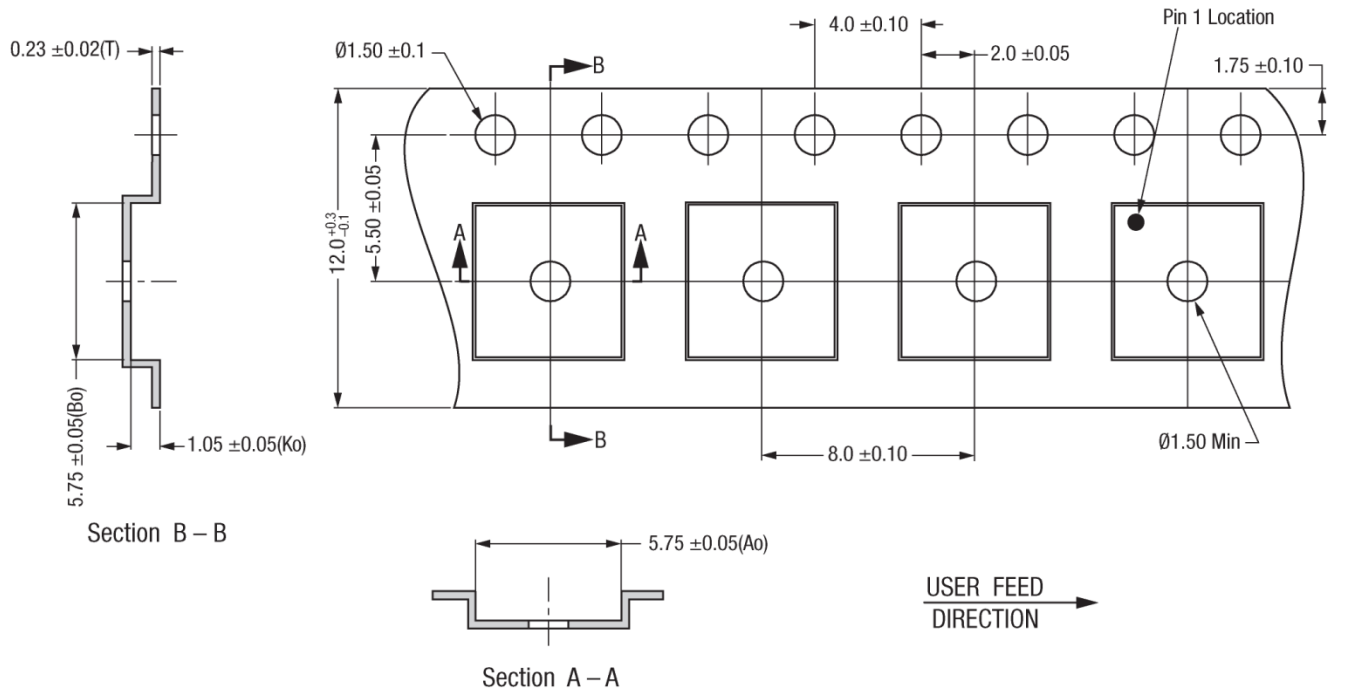
[1] *Pads 11–16, 19, 21–23, 25, 30, 36, 44 are ground pads.*

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 relate to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY77925-21 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 7).



NOTES:
1. CARRIER TAPE IS BLACK CONDUCTIVE POLYSTYRENE OR POLYCARBONATE.
2. COVER TAPE IS TRANSPARENT AND CONDUCTIVE.
3. ESD SURFACE RESISTIVITY ≤ $1x10^{10}$ OHMS/SQ, PER EIA, JEDEC TAPE AND REEL SPEC.
4. 10 SPROCKET HLE PITCH CUMULATIVE TOLERANCE ON TAPE: ±0.20 mm.
5. Ao & Bo MEASURESD ON PLANE 0.30 mm ABOVE BOTTOM OF POCKET.
6. ALLOWABLE CAMBER TO BE 1/100 mm, NON-CUMULATIVE OVER 250 mm.
7. ALL DIMENSIONS ARE IN MILLIMETERS.

Carrier Tape for Body Size 5.5 x 5.5 x 0.80–1.10 mm D232-XXX(076D)

Figure 7. Dimensional Diagram for Carrier Tape Body Size 5.5 мм x 5.5 мм x 0.85–1.10 мм – 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.

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 Description	Product Part Number	Evaluation Board Part Number
SKY77925-21 SkyLiTE™ Tx-Rx Front-End Module	SKY77925-21	SKY77925-21EK1

Revision History

Revision	Date	Description	
A	April 5, 2017	Initial Release – Preliminary Information	CN 13838
B	April 27, 2017	Revise: Correct Figure 1	CN 14750
C	October 2, 2017	Revise: Features list (p1); Figures 1, 2; Tables 1–16, 20; Ordering Information table (last page)	CN 17133

References

Skyworks Application Note: *PCB Design and SMT Assembly/Rework Guidelines for MCM–L Packages;* Document Number 101752

Standard SMT Reflow Profiles: *JEDEC Standard J–STD–020*