DATA SHEET

# SKY77912-61 Tx-Rx Front-End Module for Quad-Band GSM / GPRS / EDGE w/ 10 Linear TRx Switch Ports, Dual-Band TD-SCDMA, and TDD LTE Band 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 39

## Features

- 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 load
- High Efficiency (inclusive of coupler)
  - 40% GSM850   31% DCS1800
  - 40% GSM900   33% PCS1900
- Tx harmonics below –40 dBm
- Supports APT, buck DC-DC supply
- 10 low insertion loss/high linearity TRx switch ports
- RF input switching to 3G/4G path
- Integrated broadband directional coupler
- Built-in IEC-compliant antenna ESD protection
- High impedance control inputs: 20 μA, maximum
- Current limiting and over-voltage protection for ruggedness and extended battery life
- Power control circuitry built-in for improved TRP variation
- Small, low profile package
  - 5.5 mm x 5.3 mm x 0.8 mm Max
  - 38-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

SKY77912-61 is a Tx-Rx Front-End Module (FEM) which offers the complete transmit VCO-to-Antenna and Antenna-to-receive SAW filter solution for advanced cellular handsets comprising quad-band GSM, GPRS, EDGE multi-slot operation, and TD-SCDMA and TDD LTE transmission. The FEM fully enables broadband 3G/4G RF switch-through, outward switching of the Power Amplifier (PA) RF inputs, 10 transmit / receive (TRx) antenna switch ports, and an integrated directional coupler.

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 user-optional control of linear RF or analog VRAMP of the GMSK envelope. A distinct MIPI register mapping included in this Data Sheet provides for each of these control paradigms, including associated approaches to PA and switch control.

The Heterojunction Bipolar Transistor (HBT) PA blocks are fabricated in Gallium Arsenide (GaAs). The low band (LB) PA transmits in the GSM850/900 bands. The high band (HB) PA supports DCS, PCS, TD-SCDMA bands 34/39, and TDD LTE band 39. The HBT, switch, and controller die, and passive components mount onto a multi-layer laminate substrate and the entire assembly encapsulated with plastic over-mold.

Built into the SKY77912-61 is a complete features set for state-of-the-art performance and minimal phone board complexity, including PA over-voltage and over-current protection, 50 ohms matching and zero DC offset on all RF pins, TRx high linearity/low loss switching and high off-state isolation, integrated directional coupler, IEC ruggedness at antenna output, LB and HB input switching for alternate RF routing 3G/4G Tx paths, power supply pads shared between LB and HB, and ultra-low leakage currents for long standby times.

Selecting the linear-GMSK operation standard disables VRAMP input so all PA biasing depends only on MIPI mode selection. The transmitted envelope is 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.

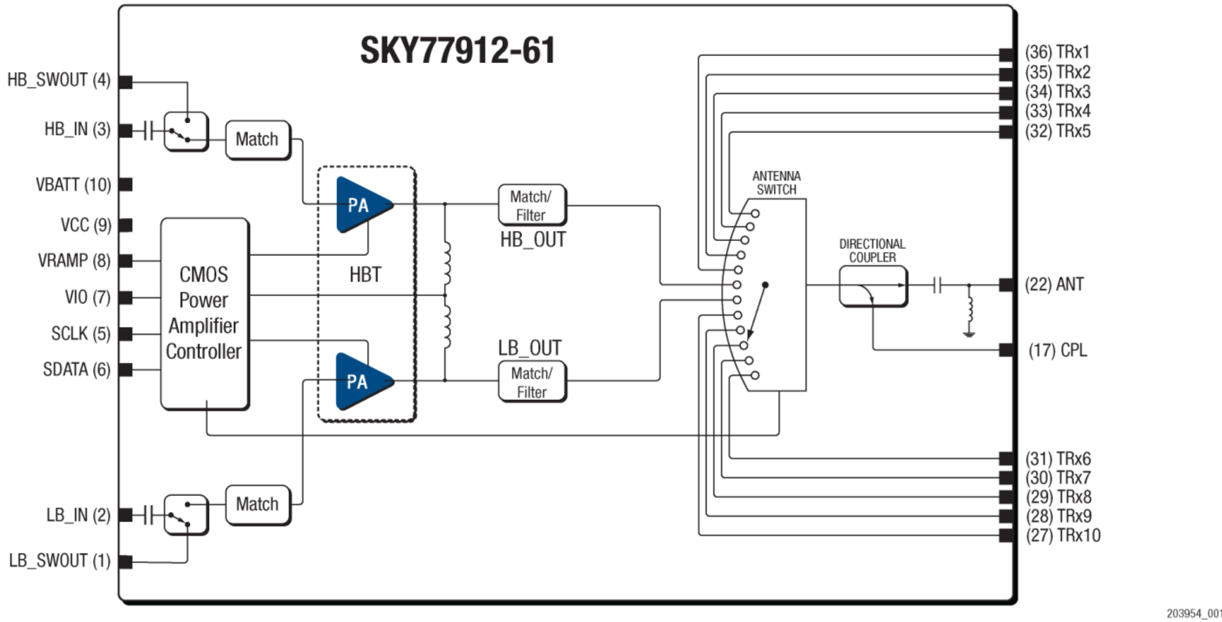



**Figure 1. SKY77912-61 Functional Block Diagram**

## Electrical Specifications

The following tables list the electrical specifications of the SKY77912-61 Front-End Module. Table 1 lists the absolute maximum ratings and Table 2 lists the recommended operating conditions. Table 5 through Table 11 provide the electrical specifications of the SKY77912-61 for GMSK, EDGE, TD-SCDMA, and TDD LTE transmission, and TRx port modes including control logic descriptions for the various modes.

The SKY77912-61 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[1]**

| Parameter | | Symbol | Min | Nominal | Max | Unit |
|---|---|---|---|---|---|---|
| Input Power | | $P_{IN}$ | — | — | 15 | dBm |
| Supply Voltage ≤ 1 μs (measured to GND) | | $V_{BATT}$ | 1.2[2] | — | 6.0 | V |
| | | $V_{CC}$ | 0.5 | | 6.0[3] | |
| DC Continuous During Burst[4] | | $I_{BATT}$ | — | — | 2.5 | 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 Vcc and Vbatt are tied together*

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

**Table 2. SKY77912-61 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 | $V_{BATT}$ | 3.0 | 3.5 | 4.6 | V |
| | EDGE/TD-SCDMA/TDD LTE | | 3.0 | 3.6 | 4.6 | |
| | | $V_{CC}$ | 3.0 | — | 4.6 | |
| APT Supply Voltage | | $V_{BATT}$ | 0.5 | 3.6 | 4.3 | V |
| 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 $V_{CC}$ can be separately supplied. In 3G/4G TRx switch-through modes, $V_{BATT}$ may be set to 0 V.*

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

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

**Table 3. SKY77912-61 Interface Specifications**

***Unless otherwise specified: ETC per Table 2.***

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| PA Supply Current (on $V_{BATT}$) | $I_{BATT}$ | | 0 | — | 2.5 | 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 | $V_{RAMP}$ < 1.45 V | 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 | $V_{RAMP}$ | | 0.2 | — | 1.6 | V |
| Standby Current | $I_{\_STANDBY}$ | Standby mode<br>NTC<br>VIO = 0 V | — | 5 | 20 | μA |
| TRx Mode Current | $I_{\_TRx}$ | Any TRx Mode | — | 150 | 300 | μA |

**Table 4. SKY77912-61 Linear GMSK/EDGE Power Modes -- Recommended Maximum Operating Power**

***Unless otherwise specified: Values are used as each Power Mode's Prated Test Condition***

| Band | Waveform | Power Mode | $P_{RATED}$ | Unit |
|---|---|---|---|---|
| LB | GMSK | High Power Mode (HPM) | 33.5 | dBm |
| | | Medium Power Mode (MPM) | 29.0 | |
| | | Low Power Mode (LPM) | 23.0 | |
| | | Ultra-Low Power Mode (ULPM) | 15 | |
| | EDGE | Medium Power Mode (MPM) | 27.5 | |
| | | Low Power Mode (LPM) | 21.5 | |
| | | Ultra-Low Power Mode (ULPM) | 15.5 | |
| HB | GMSK | High Power Mode (HPM) | 30.8 | |
| | | Medium Power Mode (MPM) | 28.5 | |
| | | Low Power Mode (LPM) | 22.5 | |
| | | Ultra-Low Power Mode (ULPM) | 14.5 | |
| | EDGE | Medium Power Mode (MPM) | 26.5 | |
| | | Low Power Mode (LPM) | 20.5 | |
| | | Ultra-Low Power Mode (ULPM) | 14.5 | |

**TABLE 5-1. SKY77912-61 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 |
| $P_{SAT}$ | $P_{SAT\_GMSK}$ | GMSK HPM | $P_{IN}$ = 9 dBm, NTC | 33.5 | 34.3 | — | dBm |
| $P_{SAT}$ Degraded | $P_{SAT\_GMSK\_ETC}$ | GMSK HPM | $P_{IN}$ = 9 dBm, ETC | 31.5 | | — | dBm |
| Power Added Efficiency, saturated | $PAE_{\_GMSK\_SAT}$ | GMSK HPM | NTC<br>$P_{OUT}$ = $P_{SAT}$, $P_{IN}$ = 9 dBm | — | 44 | — | % |
| Power Added Efficiency | $PAE_{\_GMSK}$ | GMSK HPM | | — | 41 | — | |
| | | GMSK MPM | | — | 24.0 | — | |
| | | GMSK LPM | | — | 12.0 | — | |
| | | GMSK ULPM | | — | 4.5 | — | |
| Gain | $GAIN_{\_GMSK}$ | GMSK HPM | | 27.7 | 29.7 | 31.7 | dB |
| | | GMSK MPM | | 27.5 | 29.5 | 31.5 | |
| | | GMSK LPM | | 26.0 | 28.0 | 30.0 | |
| | | GMSK ULPM | | 16.2 | 18.7 | 21.2 | |
| Gain | $GAIN_{\_EDGE}$ | EDGE MPM | | 28.0 | 30.7 | 32.7 | dB |
| | | EDGE LPM | | 26.0 | 28.0 | 30.0 | |
| | | EDGE ULPM | | 17.7 | 20.2 | 21.7 | |
| Gain Compression Over $P_{OUT}$ | $\Delta Gain_{\_POUT}$ | EDGE MPM | Gain($P_{RATED}$) – Gain($P_{RATED}$ – 10 dB) | –1 | — | 1 | dB |
| | | EDGE LPM | | –1 | — | 1 | |
| | | EDGE ULPM | | –1 | — | 1 | |
| Gain Change Over Temperature | | GMSK HPM | ETC, except $V_{BATT}$ = Vcc = 3.5 V | –1.5 | — | 1 | dB |
| | | GMSK MPM | | –1.5 | — | 1.2 | |
| | | GMSK LPM | | –1.5 | — | 1.9 | |
| | | GMSK ULPM | | –2.5 | — | 2.5 | |
| Gain Change Over Voltage | | GMSK ALL | ETC, except T = +25 °C | –0.5 | — | 1 | dB |
| Power Added Efficiency | $PAE_{\_EDGE}$ | EDGE MPM | | — | 19 | — | % |

**TABLE 5-2. SKY77912-61 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 | 2ƒo-13ƒo | GMSK ALL | ETC, $P_{OUT} \leq P_{RATED}$ | — | — | –33 | dBm |
| Input VSWR | $VSWR_{\_IN}$ | ALL | NTC | — | — | 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<br>ETC<br>$P_{IN}$ adjusted for Temperature | — | — | –28 | dBm/30kHz |
| | | GMSK MPM | | — | — | –28 | |
| | | GMSK LPM | | — | — | –28 | |
| | | GMSK ULPM | | — | — | –28 | |
| ACPR<br>(M-ORFS, No Predistortion) | $ACPR_{\_200}$ | EDGE MPM | 200 kHz offset<br>ETC[1]<br>$P_{IN}$ adjusted for Temperature | — | — | –36.5 | dBc/30 kHz |
| | | EDGE LPM | | — | — | –36.5 | |
| | | EDGE ULPM | | — | — | –36.5 | |
| | $ACPR_{\_400}$ | EDGE MPM | 400 kHz offset<br>ETC[1]<br>$P_{IN}$ adjusted for Temperature | — | — | –58 | |
| | | EDGE LPM | | — | — | –58 | |
| | | EDGE ULPM | | — | — | –58 | |
| | $ACPR_{\_600}$ | EDGE MPM | 600 kHz offset<br>ETC[1]<br>PIN adjusted for Temperature | — | — | –65 | |
| | | EDGE LPM | | — | — | –65 | |
| | | EDGE ULPM | | — | — | –65 | |
| EVM (No Predistortion) | $EVM_{\_rms}$ | EDGE MPM | ETC[1]<br>$P_{IN}$ adjusted for Temperature | — | 2.0 | 3.5 | % |
| | | EDGE LPM | | — | 2.0 | 3.5 | |
| | | EDGE ULPM | | — | 2.0 | 3.5 | |

[1] *ETC condition for EDGE linearity: $V_{BATT} \geq 3.2$ V. $P_{OUT}$ = 26.5 dBm at low $V_{BATT}$.*

**Table 6-1. SKY77912-61 Electrical Specifications – GMSK Low Band (VRAMP-Based Operation)**

***Unless otherwise specified: PRATED = 33 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 | |
| Output Power | | $P_{OUT\_GMSK}$ | $P_{IN}$ = 0 dBm<br>$V_{RAMP}$ = 1.65 V<br>NTC | 33 | 34 | — | dBm |
| | | $P_{OUT\_GMSK\_EX}$ | $P_{IN}$ = 0 dBm<br>$V_{BATT}$ = 3.0 V<br>$V_{RAMP}$ = 1.65 V | 31 | — | — | |
| Supply Current | | $I_{BATT}$ | — | — | — | 2.5 | A |
| Power Added Efficiency | GSM850 | PAE | $P_{OUT}$ = $P_{RATED}$<br>NTC<br>Duty cycle = 1:8 | — | 40 | — | % |
| | GSM900 | | | — | 40 | — | |
| Harmonics | | $2f_0$ to $13f_0$ | BW = 3 MHz<br>5 dBm ≤ Cal-$P_{OUT}$ ≤ $P_{RATED}$<br>$V_{RAMP}$ = Cal-$V_{RAMP}$[1] | — | –40 | –33 | dBm |
| Input VSWR | | VSWR_IN | $P_{OUT}$ ≤ $P_{RATED}$, NTC | — | — | 2.5:1 | |
| Isolation | | ISO_PDSD | $P_{IN}$ ≤ 6 dBm<br>Isolation Mode<br>$V_{RAMP}$ ≤ 0.1 V | — | –70 | –51 | dBm |
| | | ISO_PESE | NTC<br>$P_{IN}$ ≤ 6 dBm<br>LB_GMSK_Tx Mode<br>$V_{RAMP}$ ≤ 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 |

**Table 6-2. SKY77912-61 Electrical Specifications – GMSK Low Band (VRAMP-Based Operation)**

***Unless otherwise specified: $P_{RATED}$ = 33 dBm; ETC per Table 2.***

| *GSM850/900*<br>*GMSK Mode* | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Conditions** | **Min** | **Typ** | **Max** | **Unit** |
| Stability | S | All combinations of the following parameters:<br>5 dBm ≤ $P_{OUT}$ ≤ $P_{RATED}$<br>Load VSWR = 12:1, all phase angles | No parasitic oscillation > –36 dBm | | | |
| Load Mismatch | Load | All combinations of the following parameters:<br>5 dBm ≤ $P_{OUT}$ ≤ $P_{RATED}$<br>Load VSWR = 20:1, all phase angles. | No module damage or permanent degradation | | | |
| Noise Power | $P_{NOISE\_850}$ | $f$_Rx = 869 MHz to 894 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –83 | dBm |
| | $P_{NOISE\_900}$ | $f$_Rx = 935 MHz to 960 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –83 | |
| | | $f$_Rx = 925 MHz to 935 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –79 | |
| | | $f$_Rx =1805 MHz to 1880 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –86 | |
| | $P_{NOISE\_750}$ | $f$_Rx = 734 MHz to 757 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | | | –83 | |
| | $P_{NOISE\_ISM}$ | $f$_Rx = 2400 MHz to 2500 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | | –106 | — | |

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

**Table 7-1. SKY77912-61 Electrical Specifications – EDGE Low Band (VRAMP-Based Operation)**

***Unless otherwise specified: $V_{RAMP}$ = 1.45 V; $P_{RATED}$ = 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 | | $P_{OUT\_EDGE}$ | NTC<br>Gain / ACPR / EVM in specification | 27.5 | — | — | dBm |
| | | $P_{OUT\_EDGE\_EX}$ | Gain / ACPR / EVM in specification | 26.0 | — | — | |
| Gain | | $G_{NOM\_850}$ | $P_{OUT}$ = $P_{RATED}$<br>NTC | 29.0 | 30.5 | 32.5 | dB |
| | | $G_{NOM\_900}$ | | 28.7 | 30.2 | 31.7 | |
| | | $G_{EX\_850}$ | $P_{OUT}$ = $P_{OUT\_EDGE}$,<br>$P_{OUT\_EDGE\_EX}$ | 27.0 | — | 33.0 | |
| | | $G_{EX\_900}$ | | 26.7 | — | 33.0 | |
| Power Added Efficiency | GSM850 | $PAE_{GSM850}$ | $P_{OUT}$ = $P_{RATED}$<br>NTC<br>Duty cycle = 1:8 | — | 19 | — | % |
| | GSM900 | $PAE_{GSM900}$ | | — | 19 | — | |
| Harmonics | | $2f_0$ to $15f_0$ | BW = 3 MHz<br>5 dBm ≤ $P_{OUT}$ ≤ $P_{OUT\_EDGE}$, $P_{OUT\_EDGE\_EX}$ | — | –45 | –36 | dBm |
| Input VSWR | | $VSWR_{IN}$ | $P_{OUT}$ ≤ $P_{RATED}$, NTC | — | — | 2.5:1 | |
| ACPR | | $ACPR_{200}$ | $P_{OUT}$ = $P_{OUT\_EDGE}$,<br>$P_{OUT\_EDGE\_EX}$<br>Bandwidth = 30 kHz | — | –38.0 | –36.5 | dBc |
| | | $ACPR_{400}$ | | — | –65.0 | –60.0 | |
| | | $ACPR_{600}$ | | — | –75.0 | –70.0 | |
| EVM | | $EVM_{RMS}$ | $P_{OUT}$ = $P_{OUT\_EDGE}$,<br>$P_{OUT\_EDGE\_EX}$ | — | 2.0 | 3.5 | % |
| Bias 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 |

**Table 7-2. SKY77912-61 Electrical Specifications – EDGE Low Band (VRAMP-Based Operation)**

***Unless otherwise specified: $V_{RAMP}$ = 1.45 V; $P_{RATED}$ = 27.5 dBm; ETC per Table 2.***

| *GSM850/900 EDGE Mode* | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Conditions** | **Min** | **Typ** | **Max** | **Unit** |
| Stability | S | All combinations of the following parameters:<br>5 dBm ≤ $P_{OUT}$ ≤ $P_{RATED}$<br>Load VSWR = 12:1, all phase angles | No parasitic oscillation > –36 dBm | | | |
| Load Mismatch | Load | All combinations of the following parameters:<br>5 dBm ≤ $P_{OUT}$ ≤ $P_{RATED}$<br>Load VSWR = 20:1, all phase angles. | No module damage or permanent degradation | | | |
| Noise Power | $P_{NOISE\_850}$ | ƒ_Rx = 869 MHz to 894 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –83 | dBm |
| | $P_{NOISE\_900}$ | ƒ_Rx = 935 MHz to 960 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –83 | |
| | | ƒ_Rx = 925 MHz to 935 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –82 | |
| | | ƒ_Rx = 1805 MHz to 1880 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –86 | |
| | $P_{NOISE\_750}$ | ƒ_Rx = 734 MHz to 757 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –83 | |
| | $P_{NOISE\_ISM}$ | ƒ_Rx = 2400 MHz to 2500 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | –106 | — | |

**TABLE 8-1. SKY77912-61 ELECTRICAL SPECIFICATIONS – GMSK/EDGE HIGH 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 |
| $P_{SAT}$ | $P_{SAT\_GMSK}$ | GMSK HPM | $P_{IN}$ = 6 dBm, NTC | 31.0 | 32.0 | — | dBm |
| $P_{SAT}$ Degraded | $P_{SAT\_GMSK\_ETC}$ | GMSK HPM | $P_{IN}$ = 6 dBm, ETC | 29.0 | | — | dBm |
| Power Added Efficiency, saturated | $PAE_{\_GMSK\_SAT}$ | GMSK HPM | NTC<br>$P_{OUT} = P_{SAT}$, $P_{IN}$ = 6 dBm | — | 36 | — | % |
| Power Added Efficiency | $PAE_{\_GMSK}$ | GMSK HPM | | — | 32.0 | — | |
| | | GMSK MPM | | — | 25.0 | — | |
| | | GMSK LPM | | — | 10.0 | — | |
| | | GMSK ULPM | | — | 3.5 | — | |
| Gain | $GAIN_{\_GMSK}$ | GMSK HPM | | 27.7 | 29.7 | 31.7 | dB |
| | | GMSK MPM | | 27.5 | 29.5 | 31.5 | |
| | | GMSK LPM | | 26.0 | 28.0 | 30.0 | |
| | | GMSK ULPM | | 19.0 | 21.5 | 31.5 | |
| Gain | $GAIN_{\_EDGE}$ | EDGE MPM | | 29.5 | 31.5 | 33.5 | dB |
| | | EDGE LPM | | 27.5 | 30.0 | 31.5 | |
| | | EDGE ULPM | | 19.7 | 22.2 | 23.7 | |
| Gain Compression Over $P_{OUT}$ | $\Delta Gain_{\_POUT}$ | EDGE MPM | $Gain(P_{RATED}) – Gain(P_{RATED}$ – 10 dB) | –1 | — | 1 | dB |
| | | EDGE LPM | | –1 | — | 1 | |
| | | EDGE ULPM | | –1 | — | 1 | |
| Gain Change Over Temperature | | GMSK HPM | ETC, except $V_{BATT} = V_{CC}$ = 3.5 V | –1.5 | — | 1 | dB |
| | | GMSK MPM | | –1.5 | — | 1.2 | |
| | | GMSK LPM | | –1.5 | — | 1.3 | |
| | | GMSK ULPM | | –2.5 | — | 1.8 | |
| Gain Change Over Voltage | | GMSK ALL | ETC, except T = 25 °C | -0.5 | — | 1 | dB |
| PAE | $PAE_{\_EDGE}$ | EDGE MPM | | — | 17 | — | % |

**TABLE 8-2. SKY77912-61 ELECTRICAL SPECIFICATIONS – GMSK/EDGE HIGH 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 | 2ƒo-13ƒo | GMSK ALL | ETC, $P_{OUT} \leq P_{RATED}$ | — | — | –33 | dBm |
| Input VSWR | VSWR_IN | ALL | NTC | — | — | 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<br>ETC<br>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<br>ETC[1]<br>PIN adjusted for Temperature | — | — | –36.5 | dBc/30kHz |
| | | EDGE LPM | | — | — | –36.5 | |
| | | EDGE ULPM | | — | — | –36.5 | |
| | ACPR_400 | EDGE MPM | 400 kHz offset<br>ETC[1]<br>PIN adjusted for Temperature | — | — | –58 | |
| | | EDGE LPM | | — | — | –58 | |
| | | EDGE ULPM | | — | — | –58 | |
| | ACPR_600 | EDGE MPM | 600 kHz offset<br>ETC[1]<br>PIN adjusted for Temperature | — | — | –65 | |
| | | EDGE LPM | | — | — | –65 | |
| | | EDGE ULPM | | — | — | –65 | |
| EVM (no pre–distortion) | EVM_RMS | EDGE MPM | ETC[1]<br>PIN adjusted for Temperature | — | 2.0 | 3.5 | % |
| | | EDGE LPM | | — | 2.0 | 3.5 | |
| | | EDGE ULPM | | — | 2.0 | 3.5 | |

[1] *ETC condition for EDGE linearity: $V_{BATT} \geq 3.2$ V. $P_{OUT} = 25.5$ dBm.*

**Table 9-1. SKY77912-61 Electrical Specifications – GMSK High Band (VRAMP-based Operation)**
***Unless otherwise specified: PRATED = 30.5 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 | — | 1916 | |
| Output Power | | $P_{OUT\_GMSK}$ | $P_{IN}$ = 0 dBm<br>$V_{RAMP}$ = 1.65 V<br>NTC | 31.0 | 31.5 | — | dBm |
| | | $P_{OUT\_GMSK\_EX}$ | $P_{IN}$ = 0 dBm<br>$V_{BATT}$ = 3.0 V<br>$V_{RAMP}$ = 1.65 V | 28.5 | — | — | |
| Power Added Efficiency | | $PAE_{DCS1800}$ | $P_{OUT}$ = $P_{RATED}$<br>NTC<br>Duty cycle = 1:8 | — | 31 | — | % |
| | | $PAE_{PCS1900}$ | | — | 33 | — | |
| Harmonics | | $2f_0$ to $7f_0$ | BW = 3 MHz<br>0 dBm ≤ Cal-$P_{OUT}$ ≤ $P_{RATED}$<br>$V_{RAMP}$ = Cal- $V_{RAMP}$[1] | — | –40 | –33 | dBm |
| Input VSWR | | $\Gamma_{IN}$ | $P_{OUT}$ ≤ $P_{RATED}$, NTC | — | — | 2.5:1 | |
| Isolation | | $ISO_{PDSD}$ | $P_{IN}$ ≤ 6 dBm<br>Isolation Mode<br>$V_{RAMP}$ ≤ 0.1 V | — | –65 | –53 | dBm |
| | | $ISO_{PESE}$ | NTC<br>$P_{IN}$ ≤ 6 dBm<br>HB_GMSK_Tx Mode<br>$V_{RAMP}$ ≤ 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 |

**TABLE 9-2. SKY77912-61 ELECTRICAL SPECIFICATIONS – GMSK HIGH BAND (VRAMP-BASED OPERATION)**

***UNLESS OTHERWISE SPECIFIED: PRATED = 30.5 dBm; ETC PER TABLE 2.***

| GSM1800/1900 GMSK Mode | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Conditions** | **Min** | **Typ** | **Max** | **Unit** |
| Stability | S | All combinations of the following parameters:<br>0 dBm ≤ POUT ≤ PRATED<br>Load VSWR = 12:1, all phase angles | No parasitic oscillation >–36 dBm | | | |
| Load Mismatch | Load | All combinations of the following parameters:<br>0 dBm ≤ POUT ≤ PRATED<br>Load VSWR = 20:1, all phase angles. | No module damage or permanent degradation | | | |
| Noise Power | PNOISE_1800 | ƒ_Rx = 1805 MHz to 1880 MHz<br>POUT = PRATED<br>NTC<br>RBW = 100 kHz | — | — | –83 | dBm |
| | | ƒ_Rx = 925 MHz to 960 MHz<br>POUT = PRATED<br>NTC<br>RBW = 100 kHz | — | — | –84 | |
| | PNOISE_1900 | ƒ_Rx = 1930 MHz to 1990 MHz<br>POUT = PRATED<br>NTC<br>RBW = 100 kHz | — | — | –83 | |
| | | ƒ_Rx = 869 MHz to 894 MHz<br>POUT = PRATED<br>NTC<br>RBW = 100 kHz | — | — | –84 | |
| | PNOISE_750 | ƒ_Rx = 734 MHz to 757 MHz<br>POUT = PRATED<br>NTC<br>RBW = 100 kHz | — | — | –83 | |
| | PNOISE_ISM | ƒ_Rx = 2400 MHz to 2500 MHz<br>POUT = PRATED<br>NTC<br>RBW = 100 kHz | — | –106 | — | |

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

**Table 10-1. SKY77912-61 Electrical Specifications –EDGE High Band (VRAMP-based Operation)**

***Unless otherwise specified: VRAMP = 1.45 V; PRATED = 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<br>Gain / ACPR / EVM / in specification | 26.5 | — | — | dBm |
| | | $P_{OUT\_EDGE\_EX}$ | Gain / ACPR / EVM / in specification | 25.0 | — | — | |
| Gain | | $G_{\_NOM\_1800}$ | $P_{OUT}$ = $P_{RATED}$<br>NTC | 30.2 | 31.6 | 33.7 | dB |
| | | $G_{\_NOM\_1900}$ | | 29.5 | 31.1 | 33.0 | |
| | | $G_{\_EX\_1800}$ | $P_{OUT}$ = $P_{OUT\_EDGE}$,<br>$P_{OUT\_EDGE\_EX}$ | 27.6 | — | 34.6 | |
| | | $G_{\_EX\_1900}$ | | 26.6 | — | 34.1 | |
| Power Added Efficiency | | $PAE_{\_DCS1800}$ | $V_{BATT}$ = 3.6 V<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>Duty cycle = 1:8 | — | 17 | — | % |
| | | $PAE_{\_PCS1900}$ | | — | 18 | — | |
| Harmonics | | $2f_0$ to $7f_0$ | BW = 3 MHz<br>0 dBm ≤ $P_{OUT}$ ≤ $P_{OUT\_EDGE}$, $P_{OUT\_EDGE\_EX}$ | — | –45 | –36 | dBm |
| Input VSWR | | $\Gamma_{IN}$ | $P_{OUT}$ ≤ $P_{RATED}$, NTC | — | — | 2.5:1 | |
| ACPR | | $ACPR_{\_200}$ | $P_{OUT}$ = $P_{OUT\_EDGE}$,<br>$P_{OUT\_EDGE\_EX}$<br>Bandwidth = 30 kHz | — | –38.0 | –36.5 | dBc |
| | | $ACPR_{\_400}$ | | — | –65.0 | –59.0 | |
| | | $ACPR_{\_600}$ | | — | –75.0 | –70.0 | |
| EVM | | $EVM_{\_RMS}$ | $P_{OUT}$ = $P_{OUT\_EDGE}$,<br>$P_{OUT\_EDGE\_EX}$ | — | 2.0 | 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 |

**TABLE 10-2. SKY77912-61 ELECTRICAL SPECIFICATIONS –EDGE HIGH BAND ($V_{RAMP}$-BASED OPERATION)**

***UNLESS OTHERWISE SPECIFIED: $V_{RAMP}$ = 1.45 V; $P_{RATED}$ = 26.5 dBm; ETC PER TABLE 2.***

| ***GSM1800/1900<br>EDGE Mode*** | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Conditions** | **Min** | **Typ** | **Max** | **Unit** |
| Stability | S | All combinations of the following parameters:<br>0 dBm ≤ $P_{OUT}$ ≤ $P_{RATED}$<br>Load VSWR = 12:1, all phase angles | No parasitic oscillation >–36 dBm | | | |
| Load Mismatch | Load | All combinations of the following parameters:<br>0 dBm ≤ $P_{OUT}$ ≤ $P_{RATED}$<br>Load VSWR = 20:1, all phase angles | No module damage or permanent degradation | | | |
| Noise Power | $P_{NOISE\_1800}$ | $f$_Rx = 1805 MHz to 1880 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –80 | dBm |
| | | $f$_Rx = 925 MHz to 960 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –84 | |
| | $P_{NOISE\_1900}$ | $f$_Rx = 1930 MHz to 1990 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –80 | |
| | | $f$_Rx = 869 MHz to 894 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –84 | |
| | $P_{NOISE\_750}$ | $f$_Rx = 734 MHz to 757 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | — | –83 | |
| | $P_{NOISE\_ISM}$ | $f$_Rx = 2400 MHz to 2500 MHz<br>$P_{OUT}$ = $P_{RATED}$<br>NTC<br>RBW = 100 kHz | — | –106 | — | |

**TABLE 11. SKY77912-61 ELECTRICAL SPECIFICATIONS – TD-SCDMA BAND 39**

***UNLESS OTHERWISE SPECIFIED: HPM (LINEAR GMSK/EDGE OPERATION); VRAMP = 1.45 V (VRAMP-BASED 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 |
| | | $P_{OUT\_TD\_EX}$ | | 23.5 | — | — | |
| Gain | High Power | $G_{HPM\_TDLTE\_NOM}$ | $P_{OUT} = P_{OUT\_TD\_NOM}$ | 27.7 | 29.9 | 31.2 | dB |
| | | $G_{HPM\_EX}$ | $P_{OUT} = P_{OUT\_TD\_EX}$ | 25.2 | | 32.2 | |
| | Low Power | $G_{LPM}$ | $P_{IN}$ = –35 dBm, $V_{RAMP}$ = 0.3 V | — | 17 | 22 | |
| Power Added Efficiency | | $PAE_{HPM}$ | $P_{OUT} = P_{OUT\_TD\_NOM}$ | — | 13.5 | — | % |
| Adjacent Channel Leakage power Ratio[1] | 1.6 MHz offset | ACLR1.6 | $P_{OUT\_TD\_NOM}$ | — | –47 | –42 | dBc |
| | | | $P_{OUT\_TD\_EX}$ | — | — | –38 | |
| | 3.2 MHz offset | ACLR3.2 | $P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$ | — | –64 | –60 | |
| Spectral Emissions Margin | | SEM1–SEM3 | $P_{OUT} = P_{OUT\_TD\_NOM}$, Margin to ETSI SEM mask | 5 | — | — | dB |
| Error Vector Magnitude[1] | | $EVM_{RMS}$ | $P_{OUT\_TD\_NOM}$ | — | 1 | 2 | % |
| | | | $P_{OUT\_TD\_EX}$ | — | — | 2 | |
| Harmonic Suppression[1] | | $f_0 2$–$f_0 6$ | $P_{OUT} \le P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$, RBW = 1 MHz | — | — | –36 | dBm |
| Tx Noise in Rx Bands[1] | DCS Rx | | $f$_Rx = 1805 MHz to 1850 MHz,<br>$P_{OUT} = P_{OUT\_TD\_NOM}$<br>NTC<br>RBW = 100 kHz | — | — | –81 | dBm |
| Input Voltage Standing Wave Ratio | | $VSWR_{IN}$ | NTC | — | — | 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. SKY77912-61 Electrical Specifications – TD-SCDMA Band 34**

***Unless otherwise specified: HPM (Linear GMSK/EDGE Operation); VRAMP = 1.45 V (VRAMP-based 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 |
| | | $P_{OUT\_TD\_EX}$ | | 23.5 | — | — | |
| Gain | High Power | $G_{HPM\_TDLTE\_NOM}$ | $P_{OUT} = P_{OUT\_TD\_NOM}$ | 26.5 | 28.3 | 30.0 | dB |
| | | $G_{HPM\_EX}$ | $P_{OUT} = P_{OUT\_TD\_EX}$ | 23.0 | — | 31.0 | |
| | Low Power | $G_{LPM}$ | $P_{IN}$ = –35 dBm, $V_{RAMP}$ = 0.3 V | — | 15.0 | 20.0 | |
| Power Added Efficiency | | $PAE_{HPM}$ | $P_{OUT} = P_{OUT\_TD\_NOM}$ | — | 13.5 | — | % |
| Adjacent Channel Leakage power Ratio[1] | 1.6 MHz offset | ACLR1.6 | $P_{OUT\_TD\_NOM}$ | — | –44 | –40 | dBc |
| | | | $P_{OUT\_TD\_EX}$ | — | — | –38 | |
| | 3.2 MHz offset | ACLR3.2 | $P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$ | — | –62 | –58 | |
| Spectral Emissions Margin | | SEM1–SEM3 | $P_{OUT} = P_{OUT\_TD\_NOM}$, Margin to ETSI SEM mask | 5 | — | — | dB |
| Error Vector Magnitude[1] | | $EVM_{\_RMS}$ | $P_{OUT\_TD\_NOM}$ | — | 1 | 2 | % |
| | | | $P_{OUT\_TD\_EX}$ | — | — | 2 | |
| Harmonic Suppression[1] | | $f_0 2$–$f_0 6$ | $P_{OUT} \le P_{OUT\_TD\_NOM}$, $P_{OUT\_TD\_EX}$, RBW = 1 MHz | — | — | –36 | dBm |
| Tx Noise in Rx Bands[1] | DCS Rx | | $f$_Rx = 1805 MHz to 1880 MHz,<br>$P_{OUT} = P_{OUT\_TD\_NOM}$<br>NTC,<br>RBW = 100 kHz | — | — | –81 | dBm |
| Input Voltage Standing Wave Ratio | | $VSWR_{\_IN}$ | NTC | — | — | 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. SKY77912-61 ELECTRICAL SPECIFICATIONS –TDD LTE BAND 39**

***UNLESS OTHERWISE SPECIFIED: HPM (LINEAR GMSK/EDGE OPERATION); VRAMP = 1.2 V (VRAMP-BASED OPERATION); ETC PER TABLE 2.***

| *TDD LTE Band 39 (1880–1920 MHz)* | | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **Symbol** | **Condition** | **Min** | **Typ** | **Max** | **Unit** |
| Output Power[1] | POUT_TDLTE_NOM | NTC | 23.5 | — | — | dBm |
| | POUT_TDLTE_EX | | 22.5 | — | — | |
| Gain[1] High Power | GHPM_TDLTE_NOM | POUT = POUT_TDLTE_NOM | 26.5 | 28.3 | 30.0 | dB |
| | GHPM_TDLTE_EX | POUT = POUT_TDLTE_EX | 24.0 | — | 30.5 | |
| Low Power | GLPM | PIN = –35 dBm, VRAMP = 0.3 V | — | 15.0 | 20.0 | |
| Power Added Efficiency | PAEHPM | POUT = POUT_TDLTE_NOM | — | 13.5 | — | % |
| Low Power Mode Current | IBATT_LPM | VRAMP = 0.3 V<br>POUT = 0 dBm<br>NTC | — | 50 | — | mA |
| Adjacent Channel Leakage power Ratio[1] | EUTRA_ACLR1 | POUT = POUT_TDLTE_NOM | — | –42 | — | dBc |
| | | POUT = POUT_TDLTE_EX | — | — | –36 | |
| | UTRA_ACLR1 | POUT = POUT_TDLTE_NOM | — | –45 | — | |
| | | POUT = POUT_TDLTE_EX | — | — | –39 | |
| | UTRA_ACLR2 | POUT = POUT_TDLTE_NOM | — | –48 | — | |
| | | POUT = POUT_TDLTE_EX | — | — | –42 | |
| Spectral Emissions Margin | SEM1–SEM9 | POUT = POUT_TDLTE_NOM, Margin to ETSI SEM mask | 5 | — | — | dB |
| Error Vector Magnitude[1] | EVM_RMS | POUT = POUT_TDLTE_NOM | — | 1.7 | 2.5 | % |
| | | POUT = POUT_TDLTE_EX | — | — | 2.5 | |
| Harmonic Suppression[2] Second | ƒ02 | POUT ≤ POUT_TDLTE_NOM, POUT_TDLTE_EX,<br>RBW = 1 MHz | — | — | –36 | dBm |
| Third | ƒ03 | | — | — | –46 | |
| Tx Noise in Rx Bands[3] Band 34 Rx | PNOISE_TDLTE_B34 | ƒ_Rx = 2010 to 2025 MHz,<br>POUT = POUT_TDLTE_NOM – MPR,<br>NTC<br>RBW = 100 kHz | — | — | –75 | |
| Input Voltage Standing Wave Ratio | VSWR_IN | NTC | — | — | 2.5:1 | — |
| Rise / Fall Time | TONDC | TRx Mode to TDD LTE Tx, from MIPI command and >90% VRAMP to 0.5 dB RF settling | — | — | 10 | µs |
| | TOFFDC | 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)*

**Table 14-1. SKY77912-61 Electrical Specifications – TRx Ports**

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

| Ports TRx1 to TRx14 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Conditions** | | **Min** | **Typ** | **Max** | **Unit** |
| Frequency Range | | $f_{TRx}$ | — | | 699 | — | 2690 | MHz |
| Insertion Loss | | Rx_IL_LB | 699 MHz to 960 MHz, NTC | TRx7 | — | 0.55 | 0.70 | dB |
| | | | | TRx2/3/4/9/10 | — | 0.65 | 0.80 | |
| | | | | TRx1/5/6/8 | — | 0.75 | 0.90 | |
| | | Rx_IL_MB | 1710 MHz to 2400 MHz, NTC | TRx7 | — | 0.65 | 0.85 | |
| | | | | TRx2/3/4/9/10 | — | 0.90 | 1.20 | |
| | | | | TRx1/5/6/8 | — | 0.95 | 1.25 | |
| | | Rx_IL_HB | 2500 MHz to 2700 MHz, NTC | TRx7 | — | 0.80 | 1.05 | |
| | | | | TRx2/3/4/9/10 | — | 1.10 | 1.35 | |
| | | | | TRx1/5/6/8 | — | 1.25 | 1.60 | |
| TRx Mode VSWR[1] | | $VSWR_{TRx}$ | NTC | | — | 1.5:1 | — | VSWR |
| Isolation | Active TRx port to any adjacent TRx port | $ISO_{ADJ\_TRx\_LB}$ | 699 MHz to 960 MHz | | 26.0 | 35.0 | — | dB |
| | | $ISO_{ADJ\_TRx\_MB}$ | 1710 MHz to 1990 MHz | | 23.0 | 30.0 | — | |
| | | $ISO_{ADJ\_TRx\_HB}$ | 2010 MHz to 2690 MHz | | 20.0 | 25.0 | — | |
| | Active TRx port to any non-adjacent TRx port | $ISO_{NONADJ\_TRx\_LB}$ | 699 MHz to 960 MHz | | 33.5 | 40.0 | — | |
| | | $ISO_{NONADJ\_TRx\_MB}$ | 1710 MHz to 1990 MHz | | 27.0 | 35.0 | — | |
| | | $ISO_{NONADJ\_TRx\_HB}$ | 2010 MHz to 2690 MHz | | 24.0 | 30.0 | — | |
| TRx Harmonics | | $TRx_{2fo}$, $TRx_{3fo}$ | NTC, 50 ohm, $P_{IN\_TRx}$ = +27 dBm | | — | — | –55 | dBm |
| | | | NTC VSWR 5:1 at ANT port, $P_{IN\_TRx}$ = +27 dBm | | — | — | –50 | |
| Band 13 – 2nd Harmonic | | $TRx_{2fo\_B13}$ | $P_{TRX}$ = 25 dBm at 787 MHz, NTC | | | –70 | | dBm |

**TABLE 14-2. SKY77912-61 ELECTRICAL SPECIFICATIONS – TRX PORTS**

***UNLESS OTHERWISE SPECIFIED: ANY TRX MODE; ETC PER TABLE 2.***

| *Ports TRx1 to TRx14* | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Conditions** | **Min** | **Typ** | **Max** | **Unit** |
| 2nd Order Intermodulation Distortion $f$_IMD2 = \| $f$_tx ± $f$_blocker \| | IMD2 | Tx Output Power = 20 dBm CW<br>Blocker Power = –15 dBm CW<br>NTC<br>TRx port duplexer termination VSWR ≥ 10:1 at $f$_blocker, all phases | — | –102 | –98 | dBm |
| 3rd Order Intermodulation Distortion $f$_IMD3 = 2$f$_tx – $f$_blocker | IMD3 | | — | –105 | –102 | |
| | IMD3_TRx234 | | | –109 | –105 | |
| Leakage from Tx to TRx Ports | $P_{TxTRx}$ | Any TX Mode | — | — | 0 | dBm |
| Coupling Factor in TRx Mode[2] | $CPL_{TRx\_LB}$ | 699 to 960 MHz, NTC | — | –27 | — | dB |
| | $CPL_{TRx\_MB}$ | 1710 to 1990 MHz, NTC | — | –23 | — | |
| | $CPL_{TRx\_HB}$ | 2010 to 2690 MHz, NTC | — | –22 | — | |
| Coupling Factor Variation over Output VSWR[3] | $CPL_{SWR\_TRx\_LB}$ | 699 to 960 MHz, VSWR 2.5:1 at ANT port | –0.8 | — | 0.8 | dB |
| | $CPL_{SWR\_TRx\_MB}$ | 1710 to 1990 MHz, VSWR 2.5:1 at ANT port | –1.0 | — | 1.0 | |
| | $CPL_{SWR\_TRx\_HB}$ | 2010 to 2690 MHz, VSWR 2.5:1 at ANT port | –1.0 | — | 1.0 | |
| Coupling Factor Variation over Temperature[3,4] | $CPL_{TV\_TRx\_LB}$ | 699 to 960 MHz | –0.5 | — | 0.5 | dB |
| | $CPL_{TV\_TRx\_MB}$ | 1710 to 1990 MHz | –1.0 | — | 1.0 | |
| | $CPL_{TV\_TRx\_HB}$ | 2010 to 2690 MHz | –1.0 | — | 1.0 | |
| Turn-on Time | $T_{ON\_VBATT}$ | From 50% VBATT and VIO to 0.5 dB RF settling | — | — | 20 | μs |
| TRx-to-TRx Switch Speed | $T_{\_TRxTRx}$ | From MIPI command to 0.5 dB RF settling | — | 2 | 5 | μs |

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

*2 Defined as the ratio of CPL port to ANT port output power, driven from TRx.*

*3 Variation with respect to 50 ohm reference.*

*4 Variation with respect to NTC.*

## MIPI RFFE Information

**Table 15. SKY77912-61 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<br>0001 = High Band EDGE<br>0010 = Low Band GMSK<br>0011 = High Band GMSK<br>0100 = B34/39 TD-SCDMA<br>0101 = B39 TDD LTE<br>0110 = Low Band Switch OUT<br>0111 = High Band Switch OUT |
| [2] | PA Enable | | | 0 | 0 = PA Tx Disabled<br>1 = PA Tx Enabled |
| [1:0] | Power Range Mode | | | 00 | 00 = High Power Mode (HPM)<br>01 = Mid Power Mode (MPM)<br>10 = Low Power Mode (LPM)<br>11 = Ultra-Low Power Mode (ULPM) |
| **Register 1, Address 0x01 (RESERVED)** | | | | | |
| [7:0] | RESERVED | Trigger0 | R/W | 00000000 | RESERVED |
| **Register 2, Address 0x02 (Switch Control)** | | | | | |
| [7:5] | RESERVED | Trigger0 | R/W | 000 | RESERVED |
| [4:0] | Switch Control | | | 00000 | 0x00 = Standby<br>0x01 = TRx9<br>0x02 = TRx8<br>0x03 = Forward Isolation<br>0x04 = TRx4<br>0x05 = TRx6<br>0x06 = TRx5<br>0x07 = TRx7<br>0x08 = TRx3<br>0x09 = Low Band PA Tx<br>0x0B = High Band PA Tx<br>0x0C = TRx2<br>0x11 = TRx1<br>0x12 = TRx10<br>0x10 = TRx8 + TRx9 (UL CA)<br>0x13 = TRx9 + TRx10 (UL CA)<br>Other = Reserved (Do Not Use) |
| **Register 3, Address 0x03 (RESERVED)** | | | | | |
| [7:0] | RESERVED | Trigger0 | R/W | 00000000 | RESERVED |
| **Register 4, Address 0x04 (RESERVED)** | | | | | |
| [7:0] | RESERVED | Trigger0 | R/W | 00000000 | RESERVED |
| **Register 5, Address 0x05 (RESERVED)** | | | | | |
| [7:0] | RESERVED | | R/W | 00000000 | RESERVED |
| **Register 6, Address 0x06 (RESERVED)** | | | | | |
| [7:0] | RESERVED | | R/W | 00000000 | RESERVED |

**Table 16. SKY77912-61 MIPI RFFE Register Map (Vramp-based Operation only)**

| Bit Position | Description | Trigger Support | R/W | Default | Notes | | |
|---|---|---|---|---|---|---|---|
| **Register 0, Address 0x00 (Mode 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] | Gain Control (GMSK) | | | 0 | 0 = nominal gain | 1 = reduced gain | |
| [5] | Gain Control (linear) | | | 0 | 0 = nominal gain | 1 = reduced gain | |
| [4:0] | TxFEM Mode Control | | | 00000 | 0x00 = Standby | 0x06 = Forward Isolation | 0x0E = HB GMSK/ VRAMP Tx |
| | | | | | 0x01 = TRx4 | 0x08 = TRx9 | 0x0F = HB EDGE/Linear Tx |
| | | | | | 0x02 = TRx3 | 0x09 = TRx6 | 0x14 = TRx10 |
| | | | | | 0x03 = TRx2 | 0x0A = LB GMSK/VRAMP Tx | 0x18 = TRx1 |
| | | | | | 0x04 = TRx8 | 0x0B = LB EDGE/Linear Tx | 0x10 = TRx8 + TRx9 (UL CA) |
| | | | | | 0x05 = TRx5 | 0x0D = TRx7 | 0x1C = TRx9 + TRx10 (UL CA) |
| | | | | | | | Other = Reserved (Do Not Use) |
| **Register 1, Address 0x01 (Bias Control)** | | | | | | | |
| [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 | |
| **Register 2, Address 0x02 (RESERVED)** | | | | | | | |
| [7:0] | RESERVED | Trigger0 | R/W | 00000000 | RESERVED | | |
| **Register 3, Address 0x03 (RESERVED)** | | | | | | | |
| [7:0] | RESERVED | Trigger0 | R/W | 00000000 | RESERVED | | |
| **Register 4, Address 0x04 (RESERVED)** | | | | | | | |
| [7:0] | RESERVED | Trigger0 | R/W | 00000000 | RESERVED | | |
| **Register 5, Address 0x05 (RESERVED)** | | | | | | | |
| [7:0] | RESERVED | | R/W | 00000000 | RESERVED | | |
| **Register 6, Address 0x06 (RESERVED)** | | | | | | | |
| [7:0] | RESERVED | | R/W | 00000000 | RESERVED | | |

**Table 17-1. SKY77912-61 MIPI RFFE Register Map (Common Registers)**

| Bit Position | Description | Trigger Support | R/W | Default Value | Notes |
|---|---|---|---|---|---|
| **Register 26, Address 0x1A (RFFE Status)** | | | | | |
| 7 | SOFTWARE RESET | No | R/W | 0 | Reset all configurable registers to default values except for USID, GROUP_SID, and PM_TRIG. The RFFE_STATUS register shall reset after it is read. SOFTWARE RESET always reads back as zero.<br>0 = normal operation 1 = software reset. |
| 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. |
| **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<br>(See Note) | No | R/W | 00 | 00 = Normal Operation (ACTIVE)<br>01 = Default Settings<br>10 = Low Power (LOW POWER)<br>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 | Not supported |
| 0 | Trigger Register 0 | | | 0 | 1 = Latch Register contents |

**Table 17-2. SKY77912-61 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 | 0x9D | 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 | | | 1111 | USID |
| **Register 32, Address 0x20 (EXT_PRODUCT_ID)** | | | | | |
| 7:0 | EXT_PROD_ID | No | R | 0x00 | |
| **Register 35, Address 0x23 (UDR_RST)** | | | | | |
| 7 | SOFTWARE RESET | No | R/W | 0 | 1 = Reset (see Register 26) |
| 6:0 | (Reserved) | No | R/W | 0000000 | Reserved. Set to zero. |

***NOTE**: When an RFFE Slave is initially powered up and comes out of reset, it enters Low Power Mode. During Low Power Mode, all Slave registers shall be set to their default settings.*

## Technical Information

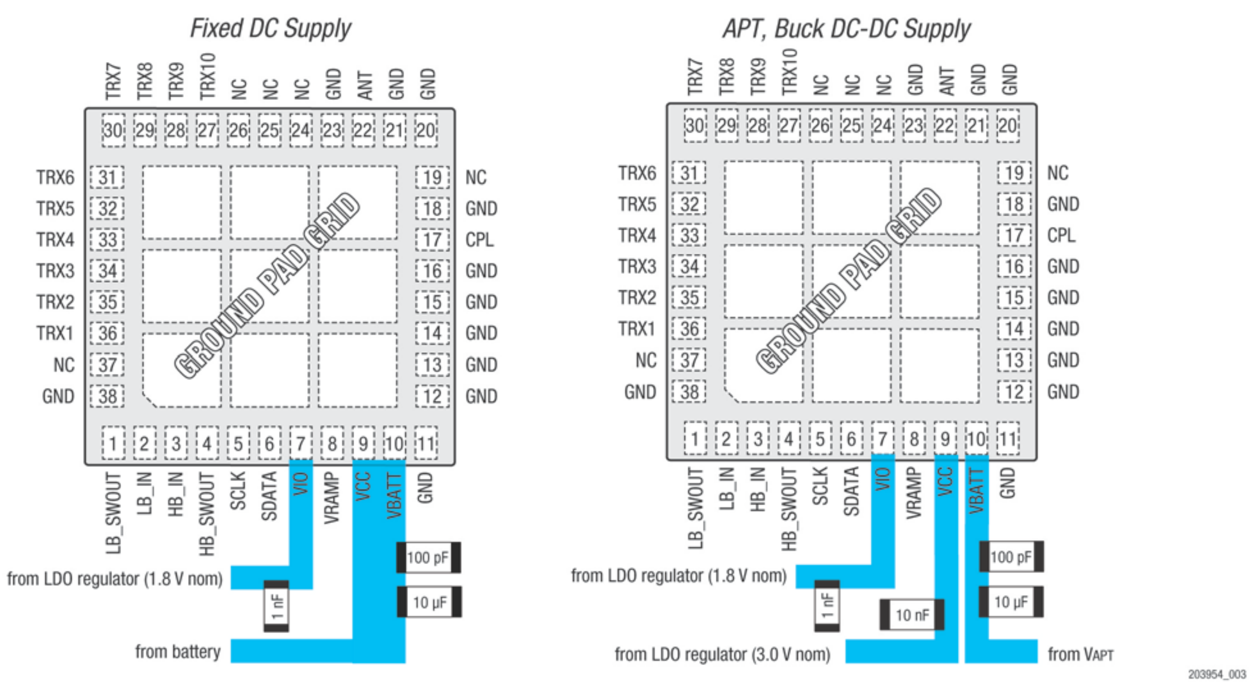



**Figure 2. SKY77912-61 Application Schematics**

## Package Dimensions

The SKY77912-61 quad-band front-end module is a 5.5 mm x 5.3 mm x 0.8 mm, 38-pad, leadless package. Figure 3 is a three-view mechanical drawing of the pad configuration with layout dimensions. 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.

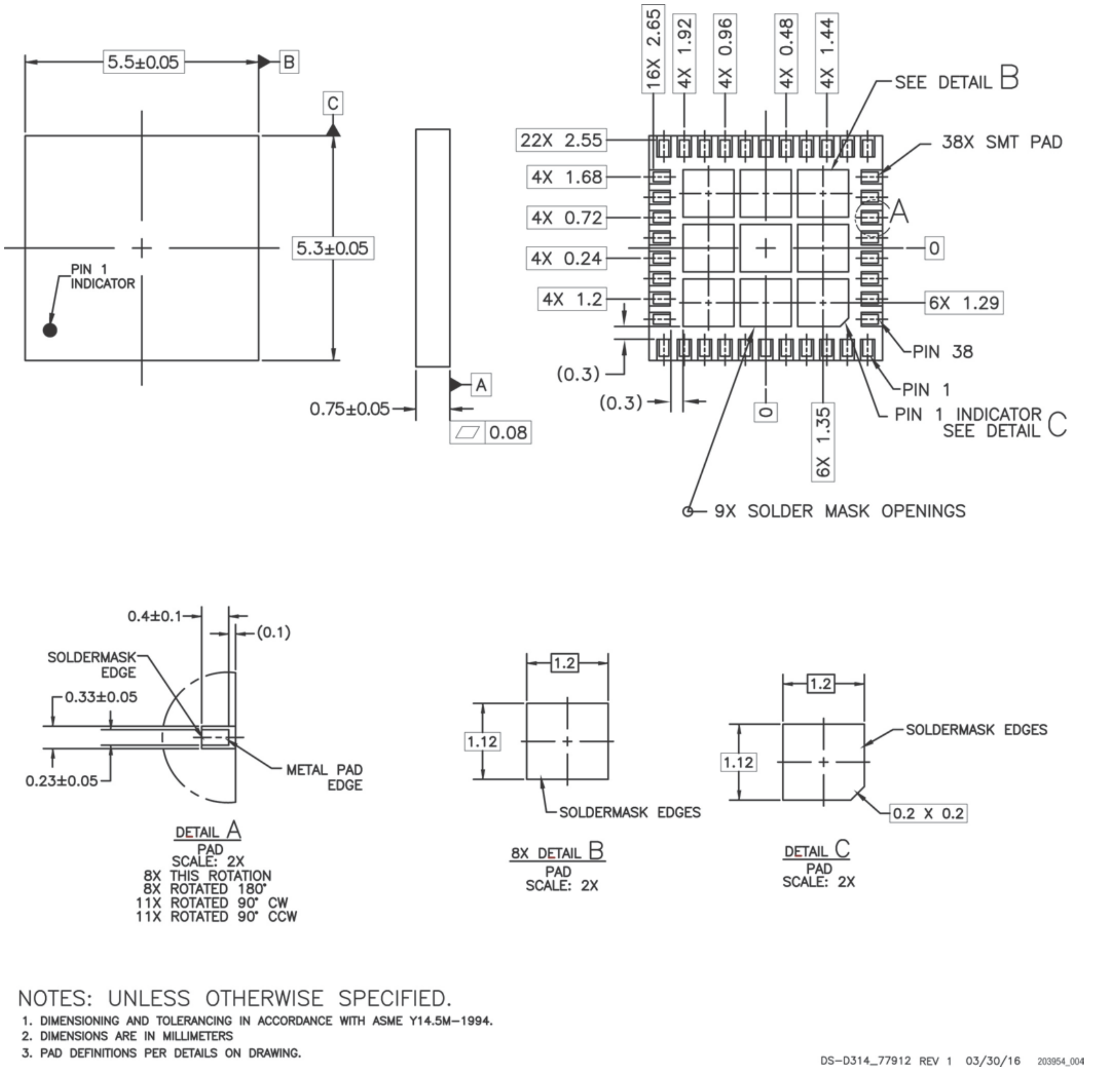



**Figure 3. Dimensional Diagram for 5.5 mm x 5.3 mm x 0.8 mm, 38-Pad Leadless Package – SKY77912-61 (All Views)**

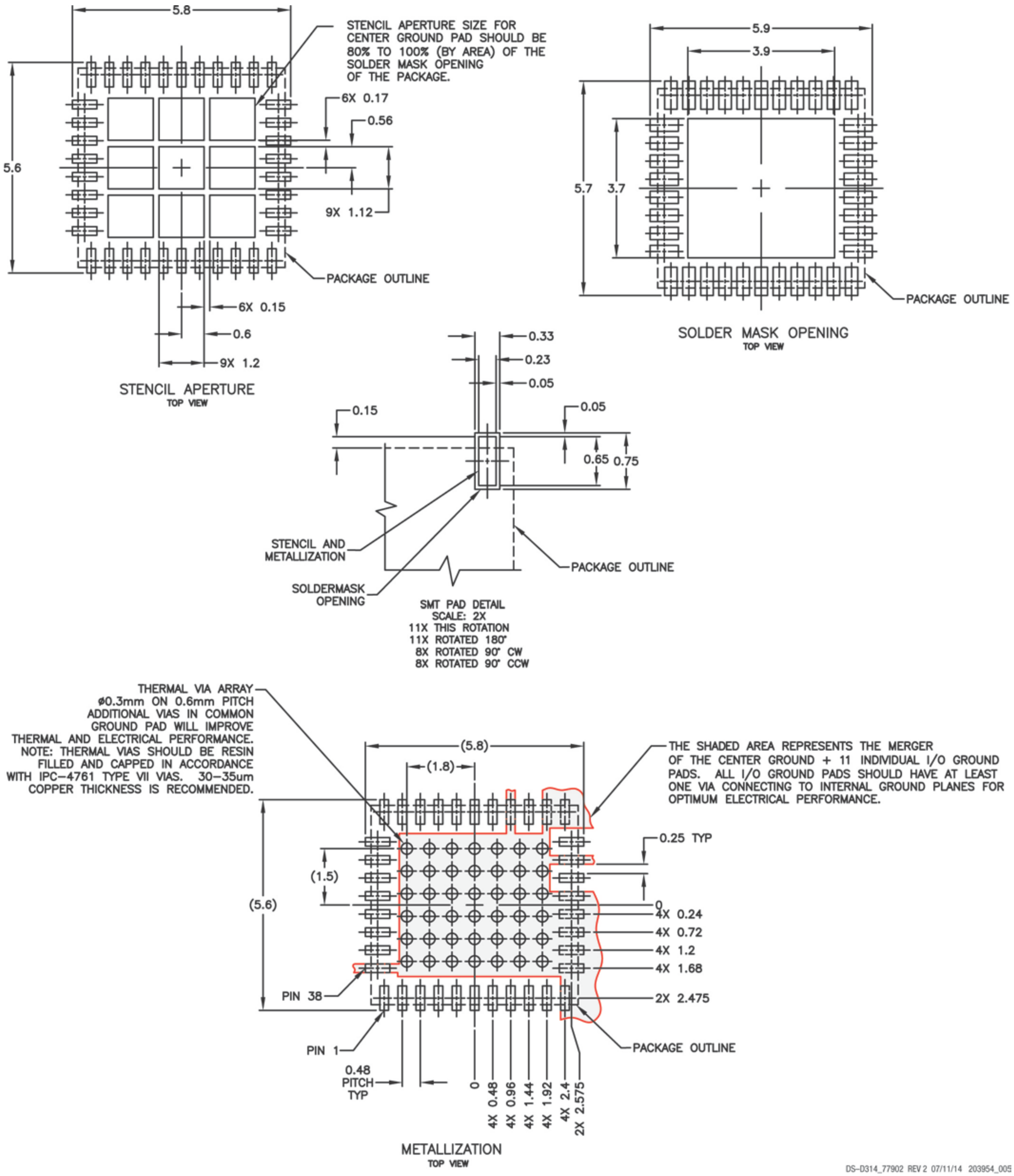



**Figure 4. PCB Layout for 5.5 mm x 5.3 mm, 38-Pad Leadless Package – SKY77912-61 Specific**

## 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 18 lists the pad names and signal descriptions. Figure 6 illustrates the typical case markings.

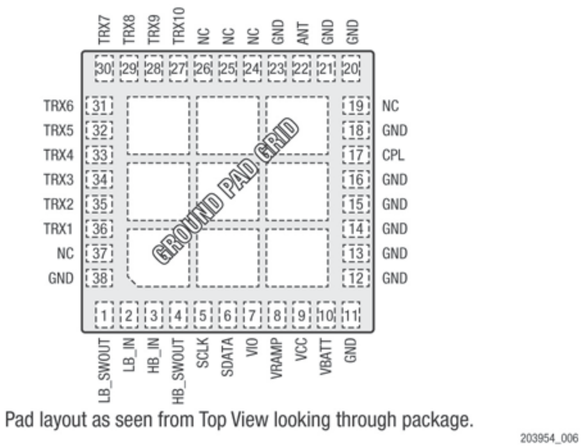



**Figure 5. SKY77912-61 Pad Names and Configuration (Top View)**

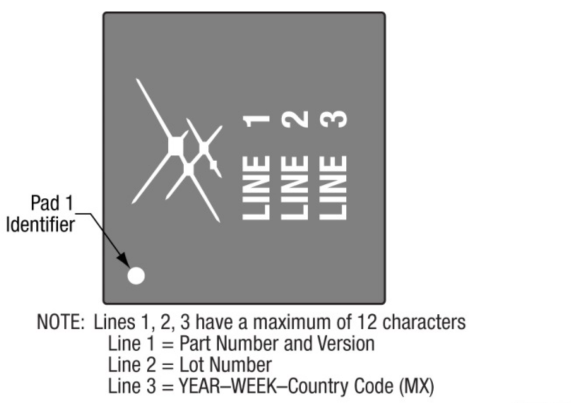



**Figure 6. Typical Case Markings**

## Package Handling Information

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

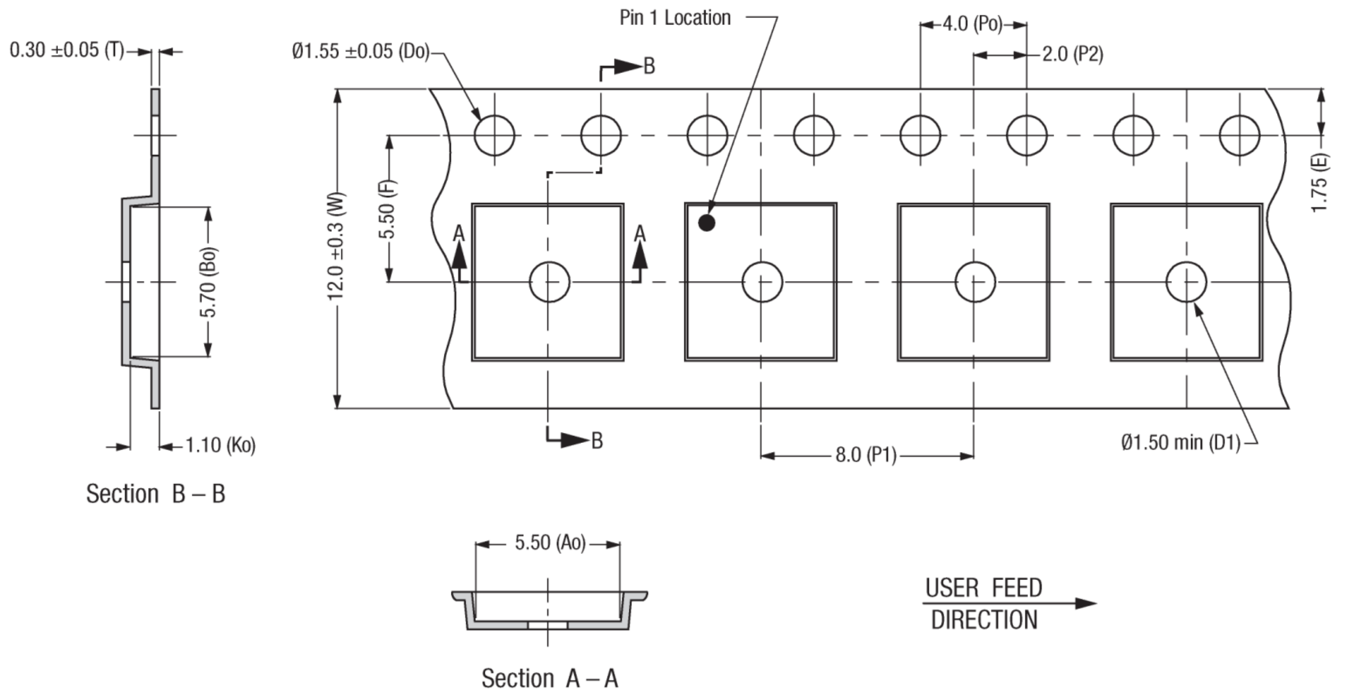
The SKY77912-61 is capable of withstanding an MSL3/260 °C solder reflow. Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. If the part is attached in a reflow oven, the temperature ramp rate should not exceed 3 °C per second; maximum 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).

**Table 18. SKY77912-61 Pad Descriptions and Functions**

| 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 | HB_IN | RF input to HB PA or HB_SWOUT |
| 4 | HB_SWOUT | Alternate RF output path for HB_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 | Output switch supply voltage |
| 10 | VBATT | PA supply voltage |
| 17 | CPL | Directional coupler RF output |
| 19 | NC | No connection |
| 22 | ANT | RF output to antenna |
| 24–26 | NC | No connection |
| 27–36 | TRx10–TRx1 | Wideband TRx switch ports |
| Ground Pad Grid | | Ground Pad Grid (device underside) |

[1] *Pads 11–16, 18, 20, 21, 23, and 38 are ground pads.*




NOTES:
1. CARRIER TAPE IS BLACK CONDUCTIVE POLYSTYRENE OR POLYCARBONATE.
2. COVER TAPE IS TRANSPARENT AND CONDUCTIVE.
3. ESD SURFACE RESISTIVITY $10^4$ TO $10^{11}$ OHMS/SQ, PER EIA, JEDEC TAPE AND REEL SPEC.
4. Po/P1 10 PITCHES CUMULATIVE TOLERANCE ON TAPE: ±0.20 mm.
5. Ao & Bo MEASUREMENT POINT TO BE 0.3 mm FROM BOTTOM 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 5.3 x 5.5 x 0.80–1.10 mm D232-076D

**Figure 7. Dimensional Diagram for Carrier Tape Body Size 5.3 mm x 5.5 mm x 0.85–1.10 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.

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 |
|---|---|---|
| SKY77912-61 Tx-Rx Front-End Module | SKY77912-61 | |

## Revision History

| Revision | Date | Description |
|---|---|---|
| A | April 1, 2016 | Initial Release – Preliminary Information |

## 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*