SKY66430-11 / SQN66430-11 SiP

Evaluation Board User Manual
V1.0

This SiP includes the Sequans Monarch 3330 chipset

1.0 Overview

This document provides an overview of the Monarch SiP SKY66430-11 evaluation board, its basic installation procedures and a quick startup reference.

Note: *This user guide is applicable when using LTE-M software release LR5.2.1-XXXXX or greater.*

2.0 Evalution Board Presentation

2.1 Evaluation Board Contents

Out of the box, the evaluation board is delivered with the following:

- The evaluation board: standalone Cellular Modem board with SKY66430-11
- One USB-MiniUSB cable

Note: *Cellular (LTE-M or NB-IoT) SIM card is NOT delivered as part of the evaluation board.*

2.2 Evaluation Board Software Dependencies

The evaluation board requires external software to help you perform some operations.

Mandatory

Serial Terminal Emulator under Windows, necessary to interact with the evaluation board through AT Commands. The examples illustrated in this document are based on Tera Term Software.

Optional (Not Needed for Standard Evaluation Usage)

These tools are released on request and when necessary by the Sequans support team.

For inquiries please reach out to Sequans support through your established contacts or through sequans-sales@sequans.com.

- **Sequans Point-to-Point Protocol Software**

  Bridge allowing to send data over PPP to the network (com2ppp)

- **Sequans Software Upgrade (SFU)**

  Tool necessary to perform modem software upgrade

- **Sequans Debug and Monitoring Tool (DM Tool)**

  Maintenance tool allowing the access to advanced LTE information for debugging purposes

2.3 Evaluation Board Connectors

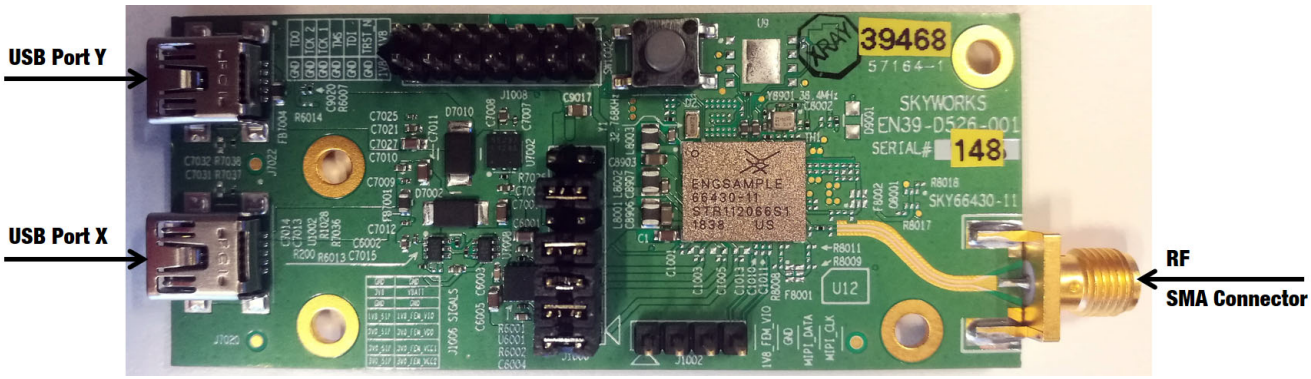


Figure 1. SKY66430-11 Evaluation Board Connector Diagram

Note: *For jumbers default settings, please refer to the appendix.*

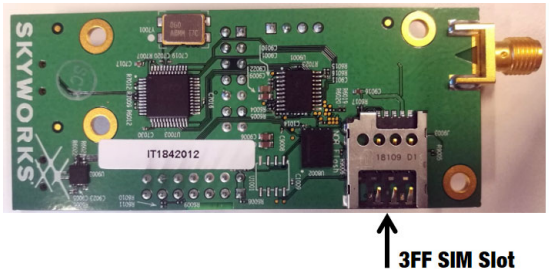


Figure 2. SKY66430-11 Evaluation Board Connector Diagram

3.0 Getting Started

3.1 Board Preparation

- Connect an antenna or the SMA RF cable of your testing equipment to the board LTE RF SMA Connector
- Insert your 3FF SIM card in the SIM slot
- Plug the mini-USB cable from your PC to the board USB port X

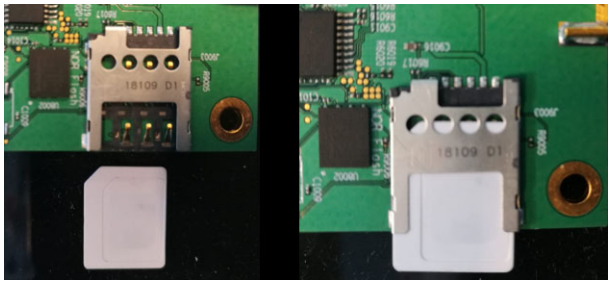


Figure 3. SKY66430-11Board Preparation

3.2 Drivers Installation

- When you plug the USB connector for the first time in your PC, you need to wait for approximately one minute to allow the drivers to be automatically installed on Windows
- The USB connects the on-board UART-USB bridge IC to provide ACM interfaces (virtual COM) in order to access the board through UART
- You should see a popup window with the following information

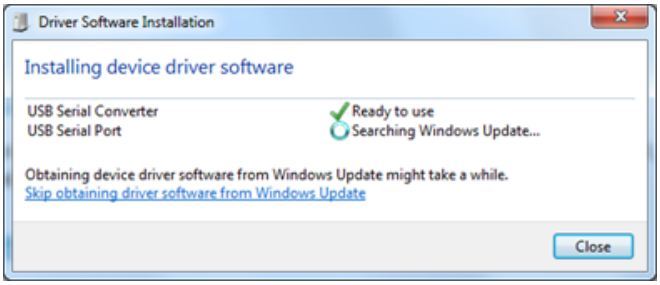


Figure 4. Driver Software Installaion Popup Window

- If the driver fails to automatically install on Windows, you can always install manually from http://www.ftdichip.com/Drivers/VCP.htm FTDI driver labelled UART/USB
- After driver installation, it is safer to unplug the evaluation board and reboot your PC

3.3 Verifying Your Installation

- After completing the drivers' installation, whenever you plug the USB cable you should be able to see the following, under Windows Control Panel > Device Manager

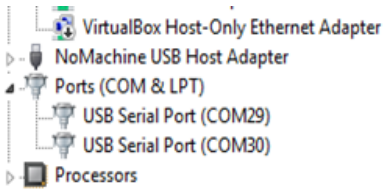


Figure 5. Windows Control Panel > Device Manager

- Indeed, port enumeration can be different on your PC from the given the example, depending on your local settings (e.g., COM23, COM24, etc.)

3.4 Overview of the COM Ports

The following table summarizes the COM ports under Windows and their mapping and configuration to the evaluation board.

3.4.1 COM Ports Overview Tables

Table 1. USB Port X

Board Mapping	Port Enumeration	Usage	Baudrate	Data Bits	Flow Control	Parity	Stop
UART 0	COMa (e.g.,COM29)	AT Command Dat Over PPP SFU	921600	8	Hardware	None	1
UART 1	COMb (e.g., COM30)	DM Tool	921600	8	Hardware	None	1

Table 2. USB Port Y

Board Mapping	Port Enumeration	Usage	Baudrate	Data Bits	Flow Control	Parity	Stop
UART 2	COMc (e.g.,COM31)	Console	115200	8	None	None	1

IMPORTANT: *COM ports cannot be shared between two different applications at the same time. One of the applications will be in error.*

3.5 Configuring and Verifying Installed COM Ports

After COM drivers are installed, open the Windows device manager, expand Ports (COM&LPT) label and click on each one of the USB Serial Port (COMx), tab Port Settings and enter the appropriate values as described in the COM ports overview table.

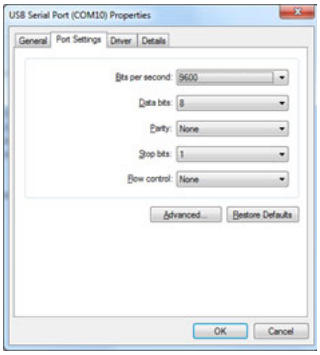


Figure 6. USB Serial Port Properties

4.0 Using the Evaluation Board

4.1 AT Commands

- The evaluation board configuration and usage is all being done through AT commands
- In order to send AT commands to the board, you need to use a Serial Terminal program under Windows (e.g., Tera Term freeware)
- To send an AT command to the board, you need to connect your Serial Terminal to the "UART 0" port, corresponding to COMa on Windows enumeration. Please refer to the table in Overview of the COM Ports on page 5 to determine the exact COM port on your PC
- Configure the correct Baudrate 921600 and the other settings in the terminal

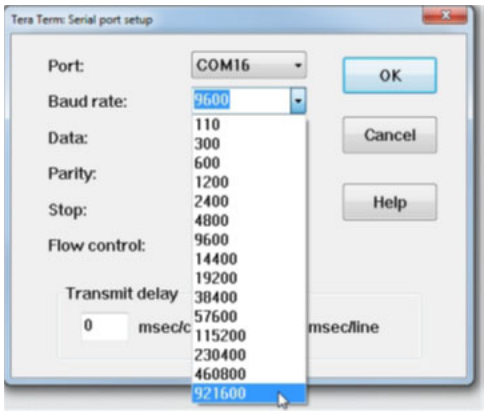


Figure 7. Tera Term Serial Port Setup

- Once the correct setting is done, you should be able to start sending AT commands and receiving their corresponding output
- You can start with ATE1 to enable the echo for the current session

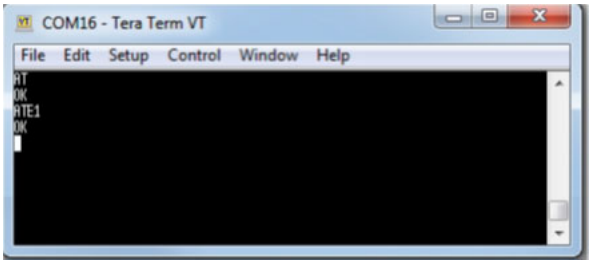


Figure 8. AT Command Window

Note: *You can access the latest version of the AT Command Reference Manual through the same channel where you obtained this document. This reference manual describes the complete list of AT commands supported by SKY66430 SiP firmware.*

4.2 Console Terminal

Connecting a serial terminal to the COM port mapped on UART 2 of the evaluation board will allow you to access to the evaluation board console. The console is a maintenance window and not necessary for regular operations. However, it is useful to have during maintenance phases, such as firmware upgrade or to observe the boot messages after hitting the reset button.

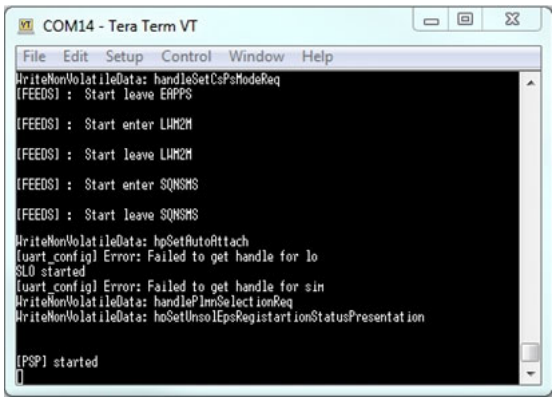


Figure 9. Console Window

5.0 Supported Operators

5.1 List of Supported Operators

The list of the operators is predefined in the software and automatically configured when inserting their SIM card is presented in List of Operators on page 8.

Note: *The SIM card will be read when the UE is in +CFUN=1 or +CFUN=4 states. When the SIM card is read for the first time, the modem will be reconfigured automatically and will reboot.*

Table 3. List of Operators

Operator's Name	LTE Bands	Comments
Truphone (MVNO)	B1, B2, B4, B8, B12, B20	See https://iot.truphone.com/support/lpwa/ for updated list
Verizon	B13	Tested
AT&T	B2, B4, B12	Tested
Softbank	B1, B8	Tested
Docomo	B1, B19	Tested
SKT	B3, B5, B26	Tested
Telstra	B3, B28	Tested
KDDI	B18, B26	Tested
Chunghwa (Taiwan)	B3, B8	Tested
AIS (Thailand)	B1, B3, B8	Untested
APTG (Taiwan)	B1, B8	Untested
Bell Canada	B4	Untested
Dialog Axiata (Sri Lanka)	B3, B8	Untested
Etisalat (UAE)	B3, B20	Untested
KPN (The Netherlands)	B3, B20	Untested
Orange (France and Belgium)	B3, B20	Untested
Singtel (Singapore)	B3, B8	Untested
Spark (NZ)	B1, B3, B28	Untested
Swisscom (Switzerland)	B3, B20	Untested
Telenor (Norway)	B3, B8, B20	Untested
Turkcell	B20, B1, B3, B8	Untested
Vodafone (NZ and The Netherlands)	B3, B8, B28, B20	Untested

5.2 Unsupported Operators or Test Equipment

- When inserting test SIM card or a SIM card from an operator that is not part of the above list, the modem will automatically reconfigure itself in standard mode and reboot.
- In standard mode after reboot, the UE will scan the following bands in that order:

  1. B20, B12, B13, B8, B18, B19, B28

  If no CATM cell is found on these bands, the UE will then continue scanning the other set of bands.

  2. B1, B2, B3, B4, B26, B5, B17, B25, B66, B14

Note: *The mode can be checked with the command AT+SQNCTM?*

6.0 Connecting the Board to a Network

If you have access to an LTE-M 4G network or simular:

- Connect the RF cable or the antenna to the RF port of the board
- Insert your SIM card in the SIM slot (cf Board Preparation)
- To check the SIM card state,
  - From the terminal, enter

    AT+CFUN=1

    AT+CPIN?
  - Response will be

    +CPIN: <***code***>

    <***code***> = Ready : SIM card is present and unlocked

    <***code***>=SIM PIN : Modem is waiting SIM PIN to be entered

    <***code***>= SIM PUK : Modem is waiting SIM PUK to be given

    or ERROR, when SIM is not inserted or not detected
- From the terminal, enter AT+CEREG=1
  - This command will allow getting notification every time there is a change of the network registration status
- From the terminal, enter AT+CFUN=1
- Response will be
  - OK
  - Followed by

    CEREG=<***stat***>

    <***stat***>=0 : Modem is not registered and is not currently searching an operator to register to

    Possible cause: SIM card error or registration ongoing

    <***stat***>=1 : Modem is registered on network -board connected-

    <***stat***>=2 : Modem is not registered, but is currently trying to attach or is searching for an operator to register to
    Possible causes:
    No network available
    Available networks have bad coverage
    PLMN available but the registration is rejected

    <***stat***>=3 : Registration denied
    Possible causes:
    Illegal mobile equipment
    IMSI unknown at HLR
    PLMN not allowed
    Location area not allowed
    Roaming not allowed in this location area
    Network failure
    Network congestion

6.1 Checking the Signal Strength

When your board is connected to a network, you can check the signal strength and characteristics through the following AT command:

- AT+CSQ
- Response will be

  +CSQ:<***rssi***>,<***ber***>

  where <***rssi***> represents the signal strength at the antenna and <***ber***> is the bit error rate in %.

Table 4. <rssi> Conversion Table

<rssi> Parameter	Signal Description with RSSI Value Range
0-9	Marginal: -113 dBm to -95 dBm
10-14	OK: -93 dBm to -85 dBm
15-19	Good: -83 dBm to -75 dBm
20-30	Excellent: -73 dBm to -53 dBm
31	Excellent: -51 dBm or greater
99	Unknown or not detectable

Table 5. <ber> Conversion Table

<ber> Parameter	Bit Error Rate (in %)
0	Less than 0.2%
1	0.2% to 0.4%
2	0.4% to 0.8%
3	0.8% to 1.6%
4	1.6% to 3.2%
5	3.2% to 6.4%
6	6.4% to 12.8%
7	More than 12.8%
99	Unknown or not detectable

6.2 Sending Data Through the Evaluation Board

- When your Kit is connected to a network, you can attempt to do a ping to a remote server using AT+PING

  Example:

  AT+PING=”8.8.8.5”

  Response:

  +PING: 1,8.8.8.8,2190,119

  +PING: 2,8.8.8.8,310,119

  +PING: 3,8.8.8.8,430,119

  +PING: 4,8.8.8.8,110,119

- Documentation for PING as well as other AT commands allowing to open TCP, UDP sockets, send data requests over HTTP or connect to an MQTT broker can be found in the AT commands Reference Manual, see [1].

7.0 Device Maintenance

7.1 Introduction

This section is not part of the default usage of the evaluation board. It is to be used as a reference in case you have been in contact with the support team, and they invited you to run some of the following actions.

7.2 Firmware Upgrade

7.2.1 Firmware Upgrade Introduction

This section is only informative in case you are invited to upgrade the SW of the evaluation board.

The evaluation board you received is normally loaded with up-to-date software and it is ready to work. However, your support at Sequans may ask you to upgrade the default software for some reasons at any time.

To upgrade your board you need to obtain the following from Sequans:

- The Sequans Firmware Upgrade (SFU) Tool

  - sfu_1.1-xxx

- The SFU User Manual
  - Monarch_SFU_UserGuide-RevX.pdf
  - The new firmware to upload on the evaluation board: it is a file with the .dup extension (e.g., GM01M-REV3_B2B3B4B8B12B20_B-BA1-RFA3-SKY6800131_LR5.1.1.0-34234.dup)

The first time you use SFU, you need to install it on your PC.

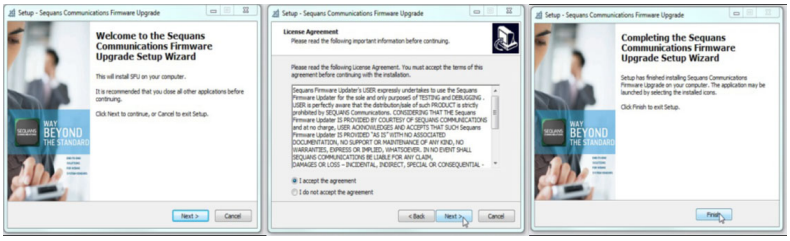


Figure 10. Sequans Firmware Upgrade (SFU) Program

Note: *The SFU program program operates on "UART 1". Refer to COM Ports Overview Tables on page 5 to map it for your setup.*

7.2.2 Upgrading the Evaluation Board

For detailed SFU usage, please refer to the SFU User Manual document.

Typical upgrade operation:

- SFU works UART 0, thus plug the mini-USB cable from your PC to the **USB Port X** of the board.
- You also need to open a console to monitor the upgrade activity. The console is accessible through UART 2 (also plug the mini-USB cable from your PC to the USB Port Y of the board).
- Open a CMD in Administrator mode
- Change the working directory to SFU installation directory
- Run the following command:

  sfu upgrade -b 921600 -z 2 COM## <xxxxxxxxxxxxxxx.dup>

  COM## is your COM port associated to **UART 1**; ***xxxxxxxxxxxxxxx.dup*** file is the new Firmware to upgrade

7.3 DM Tool

This section is only informative in case you are invited to use DM Tool.

DM Tool is a Sequans proprietary tool, only needed for troubleshooting 3GPP protocols issues.

In general, all the operations on the evaluation board are to be run through AT Commands via serial terminal. DM Tool can allow performing specific deep Monitoring and Debugging sessions.

When you are invited to use DM Tool, you need to have access to the following deliverables from your Sequans support.

- ***DM Tool Installation Program (sqn4gdm_setup_1.x-xxx.exe)***

  Basic DM documentations are embedded in the tool itself, through the help Menu.

- **DM Tool Application Note** Document

7.3.1 Connecting DM Tool to the Board

DM Tool has to be connected to UART 1, thus plug the mini-USB cable from your PC to the USB **Port X** of the board.

7.3.2 Using DM Tool

Read the **DM Tool Application Note** to configure and use the DM tool.

8.0 Troubleshooting Issues

8.1 Most Common Issues

The following is a list of common issues and possible ways to fix the issue.

Symptom	Solution
The board doesn't boot up	Check your USB cable connection
No RF signal	Check that the RF cable is properly connected on the UE side and on the eNB simulator side Check network coverage
Weak LTE signal	Check that the RF cable is properly connected on the eNB side and UE side Check that the power level on the eNB is set to a proper level Check that there is no additional attenuator inserted in the RF cable chain Check network coverage
No eNB detected	Check that the eNB simulator power is ON and that the cell signal generation is turned ON
The UE doesn't find the cell signal due to incorrect frequency value	Check that the band/earcfn value set on the eNB simulator side matches with the band capabilities of the evaluation board
The UE finds the cell but doesn't attach due to USIM	Check that the PLMN value of the USIM card used matches with the PLMN value set on the eNB simulator side Check the USIM card status with AT+CPIN? ; if ERROR is returned it could be a HW issue (voltage or USIM wrongly/not inserted) ; if PIN is returned, the USIM needs to enter a PIN CODE to be unlocked.
The UE finds the cell but doesn't attach due to eNB not configured for LTE CatM	Check that the eNB is configured for LTE Cat M
The UE finds the cell but doesn't attach due to eNB sending a NAS Attach Reject message	Check the APN settings: name, IP type and authentication
eDRX or PSM is not enabled	Check that eDRX or PSM is enabled on eNB and UE side
The UE cannot enter IDLE	Check there is no undesirable UL or DL traffic Verify Windows chatty services

9.0 Appendix

- Below is the default jumper setting for the SKY66430 evaluation board.
- It is setup from the factory. However, if a jumper was knocked off during shipment or when invited by the support to change some setting during maintenance session, here is a diagram for the proper jumper settings:

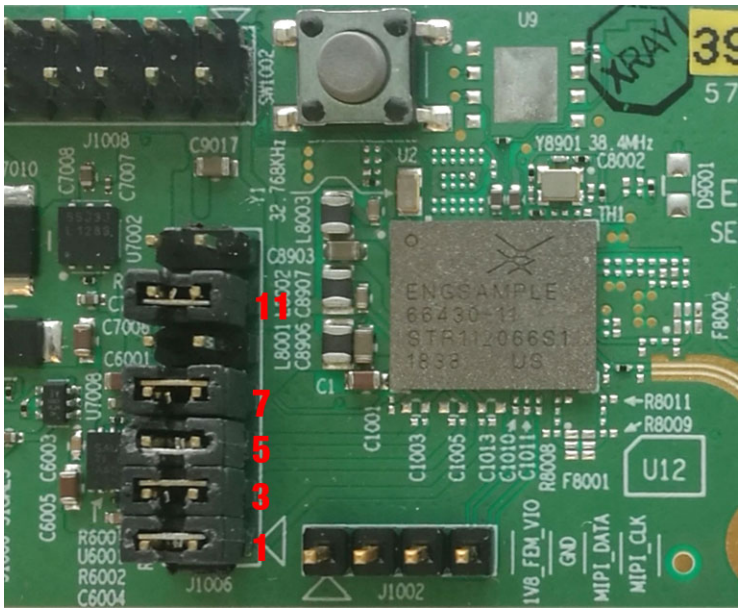


Figure 11. Default Jumper Settings

10.0 References

	Revision	Date	Document Name	Document Title
[1]	1.0	April 2019	4G-EZ Software SuiteMonarch PlatformLR5.2.1.0AT Commands Reference Manual	Monarch-LR5210-ATCmdRefMan_Rev1.pdf

PRELIMINARY DATA SHEET

SKY66430-11: LTE for IoT System-in-Package

Applications

- Wearables
- Personal trackers
- Asset trackers
- Alarm systems
- Security cameras
- Industrial monitoring devices
- Low-power IoT devices

Features

- Complete BB to RF solution in a single package:
  - Integrated baseband, transceiver, RF front end, RAM memory, and power management
  - 8.8 x 10.8 x 0.95 mm BGA package, 0.5 mm pitch
  - Device weight: 229 mg
- Compliant to 3GPP Rel-13 LTE Advanced Pro specifications, including VoLTE support
- Upgradable to 3GPP Rel-14
- Optimized for LTE half-duplex operation (HD-FDD) for LTE-M/NB-IoT
- Global frequency band support:
  - Low-band: B5, B8, B12, B13, B14, B17, B18, B19, B20, B26, B28, B85
  - Mid-band: B1, B2, B3, B4, B25, B66
- Two AUX ports to support additional bands
- Extended DRX and PSM features for long sleep duration cases
- Extremely low leakage internal PMU that enables operability for 10 years
- Smart PA biasing scheme to maximize efficiencies during low-output power operation
- Throughput:
  - LTE-M (1.4 MHz bandwidth) up to 300 kbps DL, 375 kbps UL
  - NB-IoT (200 kHz bandwidth):
    - NB1: 27.2 kbps DL, 62.5 kbps UL
    - NB2: 120 kbps DL, 170 kbps UL
- Single 3.1 V to 5.5 V supply operation
- Operating temperature range: -40 °C to +85 °C
- Skyworks conformal shielding
- Lead (Pb)-free and RoHS-compliant
- MSL3 @ 260 °C per JEDEC J-STD-020

Description

The SKY66430-11 is a multi-band multi-chip System-in-Package (SiP) supporting cellular LTE-M/NB-IoT (half-duplex FDD) platforms. The SiP integrates the entire RF front end, transceiver, power management, memory, and baseband modem for an LTE multi-band radio operating in the 698 to 2200 MHz frequency range. NOR flash, crystals, and a few passives external to the package complete the SiP implementation.

Front-End Section

The front-end section includes Rx low-pass filters, broadband PA with bias controller, Tx low-pass harmonic filter, and antenna switch.

Rx Section

Receive low-pass filters are integrated into the SIP along with the necessary matching to yield a 50 Ω single-ended impedance for the antenna. The filters provide a high level of rejection to out-of-band interferers, protecting the transceiver from high blocking signal levels and guaranteeing 3GPP LTE blocking test conformance. The Rx low-pass filters are cascaded with the low throw count switch to establish a lower insertion loss and noise figure than conventional LTE receivers.

Tx Section

The PA load-line is optimized for high efficiency while simultaneously meeting 3GPP ACLR and emissions mask specifications with LTE up to 6 RB. An integrated LPF is implemented to reject the PA and transceiver harmonics while at the same time minimizing any post PA loss for an optimized transmit current consumption. Out-of-band emissions performance is emphasized by the design to be 3GPP-compliant for low-band B5, B8, B12, B13, B14, B17, B18, B19, B20, B26, B28, B85 and mid-band B1/B2/B3/B4/B25/B66.

This SiP includes the Sequans Monarch 3330 chipset

Transceiver Section

A direct-conversion RF solution using low power technology has the following functional characteristics:

- Direct conversion in the Tx and Rx paths
- On-chip Fractional-N frequency synthesizers
- On-chip anti-alias filters
- On-chip AGC circuit
- On-chip reconstruction filters
- On-chip calibration including VCO and DC offset correction in the Rx paths
- Rx and Tx gain and phase correction loops between the RF and baseband
- Software control for synthesizer, Tx/Rx, adjustment, and gain control
- External clock reference of 38.4 MHz

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.

Baseband Modem Section

- DL processing block, handling LTE downlink physical layer (Rx)
- UL processing block, handling LTE uplink physical layer (Tx)
- Synchronization processing block, handling frequency search and synchronization to LTE network
- Optimized for new Cat-M1 channels and operation of 3GPP Release 13
- An MCU with instruction and data cache, running LTE protocol stack at frequency up to 312 MHz
- A quad-IO SPI interface (QSPI) to 1.8 V serial NOR flash of 64 Mbit or 128 Mbit size, running at 104 MHz, with support of eXecute-in-Place (XIP) and critical word first wrapping reads
- A pSRAM controller interfacing with an embedded 64-Mbit pSRAM at 104 MHz
- Three high-speed UARTs with hardware flow control
- One I^2C master up to 3.4 Mbps
- One SPI master and slave up to 13 MHz
- Muxed GPIOs interruptible, with support of pulse counter and PWM functionality
- Two UICC interfaces compliant with ETSI TS 102 221 specification, including SIM card removal detection and support for 1.8 V and 3 V voltage levels
- Secured JTAG, with possibility of enabling or disabling the interface by hardware or secured software

NOTE: *This SiP includes the Sequans Monarch 3330 chipset. For more specific information related to that chipset, which is not included in this data sheet, refer to the data sheet for that product.*

A functional block diagram is shown in Figure 1. A typical application block diagram is shown in Figure 2. The pinout is shown in Figure 3. Signal pin assignments and functional pin descriptions are described in Table 1.

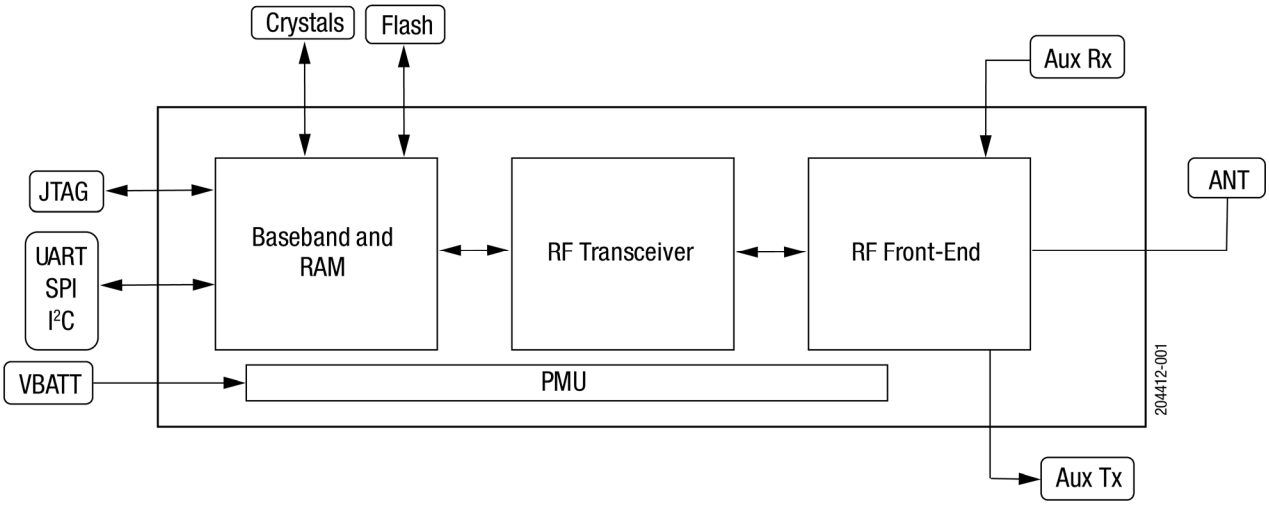


Figure 1. SKY66430-11 Functional Block Diagram

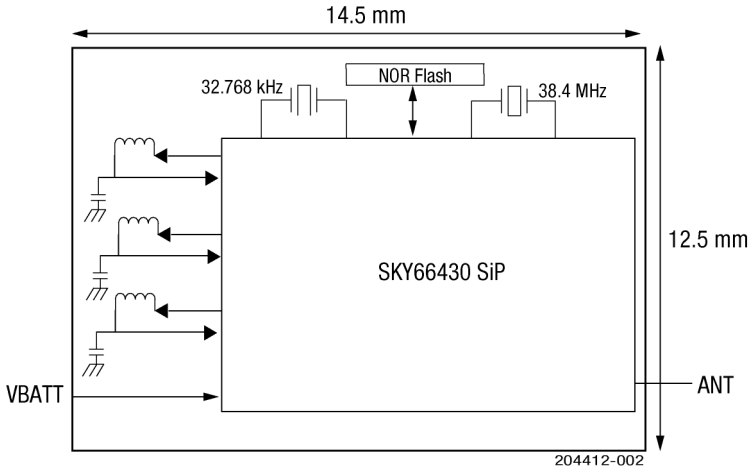
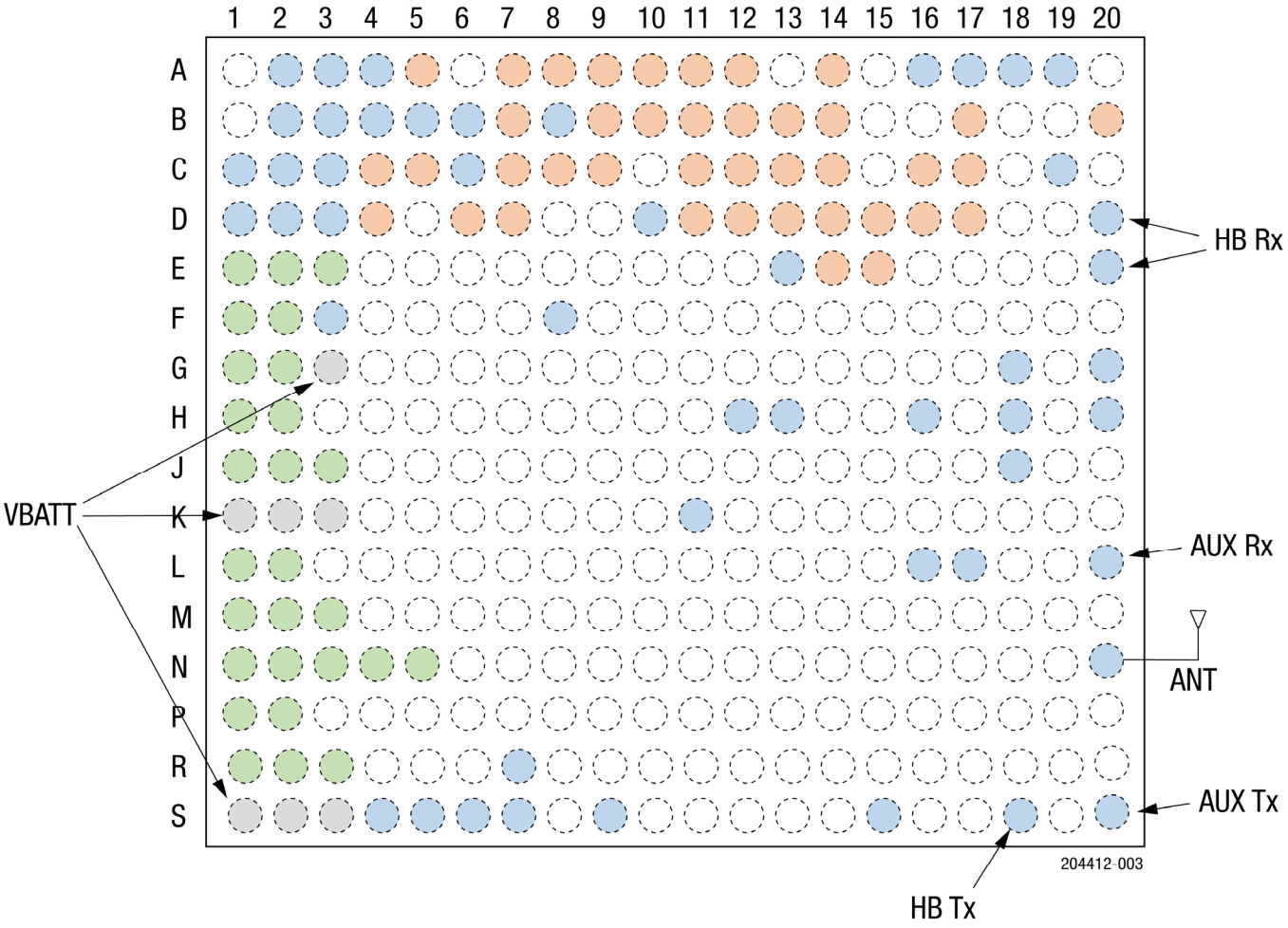


Figure 2. SKY66430-11 Typical Application Block Diagram



Color Coding Legend for Pinout

Group 1 – Interfaces							Group 2	Group 3	Group 4
UART0	UART1	UART2	QSPI	MSSPI	I2C	SCI	PMU	RF	VBATT

Figure 3. SKY66430-11 Signal Pin Assignments (Top View)

Color Coding Legend for Table 1

Group 1 – Interfaces							Group 2	Group 3	Group 4
UART0	UART1	UART2	QSPI	MSSPI	I2C	SCI	PMU	RF	VBATT

Table 1. SKY66430-11 Signal Pin Assignments and Functional Pin Descriptions (1 of 4)

Ball ID	Ball Name	Description	GPIO	Direction	IO Power Group	Pad Type	Drive (mA)	State @ Reset
A2	SAR_DETECT	Can be enabled to perform SAR detect function (input for external proximity detection interrupt). GPIO with wake capability (wake capability not enabled by default)	GPIO[36]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
A3	TDI	JTAG						
A4	TDO	JTAG						
A5	WAKE_UART0_CTS_N	UART0_CTS_N input Active low (wake-up function)	GPIO[37]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
A7	UART2_SOUT	UART2 data out	GPIO[10]	In/Out	PMU_1V8	BIDIR	2	In, PU
A8	UART2_RTS_N	UART2_RTS_N output	GPIO[12]	In/Out	PMU_1V8	BIDIR	2	In, PU
A9	VCC_SCI0	External SIM supply connection						
A10	SCI_EXT_DATA	External SIM data. A 4.7 kΩ pull-up resistor to VCC_SCI0 is mandatory.	GPIO[20]	In/Out	VCC_SCI0	BIDIR	2	In, PU
A11	VCC_SCI1	SIM supply						
A12	SCI_INT_CLK	Internal SIM clock	GPIO[24]	Out	VCC_SCI1	BIDIR	2	Out, PD
A14	UART1_SOUT	UART1 data out	GPIO[6]	In/Out	PMU_1V8	BIDIR	2	In, PU
A16	DCXOP	Reference crystal connection						
A17	RFDATA_8	RF control signal	N/A	In/Out	PMU_1V8	BIDIR	2	In, HiZ
A18	RFDATA_6	RF control signal	N/A	In/Out	PMU_1V8	BIDIR	2	In, HiZ
A19	WAKE_GPIO_0	Wake source (wake capability not enabled by default)	GPIO[28]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
B2	RING0	Output signal that indicates URC or data event on UART AT channel. It is recommended to pull-up this pin with the application host processor supply as it will become high impedance when module is in deep sleep mode. RING0 is active low (from high to low). Can be configured with AT+SQNRICFG	GPIO[35]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
B3	TCK	JTAG						
B4	TRST_N	JTAG						
B5	RFDATA_15	RF control signal						
B6	RFDATA_13	RF control signal						
B7	UART2_CTS_N	UART2_CTS_N input	GPIO[11]	In/Out	PMU_1V8	BIDIR	2	In, PU
B8	1V8_BBREG	1.8 V supply output for TCXO						
B9	SCI_EXT_RST_N	External SIM reset	GPIO[22]	In/Out	VCC_SCI0	BIDIR	2	In, HiZ
B10	WAKE_SCI_EXT_DETECT	External SIM detect. Wake source	GPIO[39]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
B11	WAKE_SCI_INT_DETECT	Internal SIM detect. Wake source	GPIO[40]	In/Out	PMU	BIDIR_WAKE	0	In, HiZ
B12	SCI_INT_RST_N	Internal SIM reset	GPIO[25]	In/Out	VCC_SCI1	BIDIR	2	In, HiZ
B13	WAKE_UART1_CTS_N	UART1_CTS_N input Active low (wake-up function).	GPIO[38]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ

Table 1. SKY66430-11 Signal Pin Assignments and Functional Pin Descriptions (2 of 4)

Ball ID	Ball Name	Description	GPIO	Direction	IO Power Group	Pad Type	Drive (mA)	State @ Reset
B14	UART1_CLK	UART CLK not enabled by default, available as GPIO	GPIO[4]	In/Out	PMU_1V8	BIDIR	2	In, PU
B17	MSSPI_SDO	Master-slave SPI output data	GPIO[17]	In/Out	PMU_1V8	BIDIR	2	In, PU
B20	STATUS_LED	Status LED output (see AT+SQNLED)	GPIO[32]	In	PMU	BIDIR_WAKE	N/A	In, HiZ
C1	Reserved	Reserved pad: it must be pulled up to +1V8, supply (PMU_1V8) and connected to a test point	GPIO[29]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
C2	WAKE_GPIO_3	Wake source (wake capability not enabled by default)	GPIO[31]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
C3	TMS	JTAG						
C4	UART0_CLK	UART CLK not enabled by default, available as GPIO	GPIO[0]	In/Out	PMU_1V8	BIDIR	2	In, PU
C5	UART0_SIN	UART0 data in	GPIO[1]	In/Out	PMU_1V8	BIDIR	2	In, PU
C6	RFDATA_14	RF control signal						
C7	UART2_CLK	UART CLK not enabled by default, available as GPIO	GPIO[8]	In/Out	PMU_1V8	BIDIR	2	In, PU
C8	UART2_SIN	UART2 data in	GPIO[9]	In/Out	PMU_1V8	BIDIR	2	In, PU
C9	SCI_EXT_CLK	External SIM clock	GPIO[21]	Out	VCC_SCI0	BIDIR	2	Out, PD
C11	SCI_INT_DATA	Internal SIM data. A 4.7 kΩ pull-up resistor to VCC_SCI1 is mandatory.	GPIO[23]	In/Out	VCC_SCI1	BIDIR	2	In, PU
C12	QSPI_IO_1	Quad-SPI Flash I/0 1						
C13	QSPI_IO_2	Quad-SPI Flash I/0 2						
C14	UART1_SIN	UART1 data in	GPIO[5]	In/Out	PMU_1V8	BIDIR	2	In, PU
C16	PS_STATUS	PS_STATUS: High = modem active / low = modem in low power modes.	GPIO[33]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
C17	MSSPI_CLK	Master-Slave SPI clock	GPIO[15]	In/Out	PMU_1V8	BIDIR	2	In, PU
C19	WAKE_PWR_OFF_GPIO	Wake source (wake capability not enabled by default)	GPIO[27]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
D1	WAKE_TIMESTAMP_SNAP_0	Wake source (wake capability not enabled by default)	GPIO[34]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
D2	WAKE_GPIO_2	Wake source (wake capability not enabled by default)	GPIO[30]	In/Out	PMU	BIDIR_WAKE	N/A	In, HiZ
D3	KHZ32_CLK_OUT	Output 32 kHz	GPIO[26]	Out	PMU_1V8	BIDIR	2	In, HiZ
D4	UART0_SOUT	UART0 data out	GPIO[2]	In/Out	PMU_1V8	BIDIR	2	In, PU
D6	UART0_RTS_N	UART0_RTS_N output	GPIO[3]	In/Out	PMU_1V8	BIDIR	2	In, PU
D7	I2C_SCL	I^2C interface clock. Output only for I2C_SCL function. In/Out for GPIO function	GPIO[14]	In/Out	PMU_1V8	BIDIR	2	In, PU
D10	RFIC_LDO_EN	Internal LDO enable: connect external 100K pull-down resistor to GND						
D11	QSPI_CS_N	Quad-SPI chip select						
D12	QSPI_IO_3	Quad-SPI I/O 3						
D13	QSPI_CLK	Quad-SPI clock						
D14	QSPI_IO_0	Quad-SPI I/O 0						

Table 1. SKY66430-11 Signal Pin Assignments and Functional Pin Descriptions (3 of 4)

Ball ID	Ball Name	Description	GPIO	Direction	IO Power Group	Pad Type	Drive (mA)	State @ Reset
D15	UART1_RTS_N	UART1_RTS_N output	GPIO[7]	In/Out	PMU_1V8	BIDIR	2	In, PU
D16	MSSPI_CS_1_N	Master-Slave SPI chip select 1	GPIO[19]	In/Out	PMU_1V8	BIDIR	2	In, PU
D17	MSSPI_SDI	Master-Slave SPI input data	GPIO[16]	In/Out	PMU_1V8	BIDIR	2	In, PU
D20	RXHBP	Optional HB differential RX, positive						
E1	PMU_OSCO	32.768 kHz crystal connection						
E2	PMU_LPM_N	Reserved, 1.8 V always-on supply						
E3	PMU_POWERON_PULSE	Active high power-on pulse; connect to GND						
E14	QSPI_RST_N	Quad-SPI flash reset						
E15	MSSPI_CS0_N	Master-Slave SPI chip select 0	GPIO[18]	In/Out	PMU_1V8	BIDIR	2	In, PU
E20	RXHBN	Optional HB differential Rx, negative						
F1	PMU_OSCI	32.768 kHz crystal connection						
F2	PMU_POWERON_PULSE_N	Active low power-on pulse; connect to GND						
F3	EXT_RST_N	Chip reset: active low: no external pull-up required						
F8	I2C_SDA	I^2C interface data	GPIO[13]	In/Out	PMU_1V8	BIDIR	2	In, PU
G1	PMU_1V1	1.1 V DCDC feedback/supply input						
G2	PMU_1V1	1.1 V DCDC feedback/supply input						
G3	VBATT (PMU_VISNS)	VBATT Sense node						
G18	1V2_RXVCO	Internal 1.2 V LDO output for external stability capacitor						
G20	RFDATA_7	RF control signal	N/A	In/Out	PMU_1V8	BIDIR	2	In, HiZ
H1	PMU_LX1V1	1V1 DCDC Switching node to external LC						
H2	PMU_LX1V1	1V1 DCDC Switching node to external LC						
H12	RFIC_BBREG2A5_EN	Internal 2V5 regulator enable (recommended to add 100K pull-down resistor)						
H13	RFIC_DCXO_REG1V8_EN	Internal LDO enable: connect external 100K pull-down resistor to GND						
H14	RFIC_RESET_N	Chip Reset, requiring 100K pull down						
H16	AUXADC1	External connection to AUX ADC						
H18	AUXADC2	External connection to AUX ADC						
H20	RFDATA_3	RF control signal	N/A	In/Out	PMU_1V8	BIDIR	2	In, HiZ
J1	PMU_PGND2	1.1 V DCDC power ground						
J2	PMU_PGND2	1.1 V DCDC power ground						
J3	PMU_PGND2	1.1 V DCDC power ground						
J18	AUXADC3	External connection to AUX ADC						
K1	VBATT (PMU_VI2)	VBATT power input to 1.8 V/ 1.1 V DCDC						
K2	VBATT (PMU_VI2)	VBATT power input to 1.8 V/ 1.1 V DCDC						
K3	VBATT (PMU_VI2)	VBATT power input to 1.8 V/ 1.1 V DCDC						

Table 1. SKY66430-11 Signal Pin Assignments and Functional Pin Descriptions (4 of 4)

Ball ID	Ball Name	Description	GPIO	Direction	IO Power Group	Pad Type	Drive (mA)	State @ Reset
K11	1V2_TXVCO	Internal 1.2V LDO output for external stability capacitor						
L1	PMU_LX1V8	1V8 DCDC Switching node to external LC						
L2	PMU_LX1V8	1V8 DCDC Switching node to external LC						
L16	RFDATA_1_CAP	Internal MIPI RFFE SDATA line						
L17	RFDATA_2_CAP	Internal MIPI RFFE SCLK line						
L20	FEM_AUX1_RX	Optional HB RX SP6T connection						
M1	PMU_1V8	1.8 V DCDC feedback/supply input						
M2	PMU_1V8	1.8 V DCDC feedback/supply input						
M3	PMU_1V8	SoC 1.8 V supply (input)						
N1	PMU_PGND1	1.8/3.0 V DCDC power ground						
N2	PMU_PGND1	1.8/3.0 V DCDC power ground						
N3	PMU_PGND1	1.8/3.0 V DCDC power ground						
N4	VP_1V8	PSRAM Power (connect to N5)						
N5	1V8_I_PSRAM	PSRAM Power (connect to N4)						
N20	FEM_ANT	Antenna						
P1	PMU_LX3V0							
P2	PMU_LX3V0	DCDC switch node to external LC						
R1	PMU_3V0	3.0 V DCDC feedback/supply input						
R2	PMU_3V0	3.0 V DCDC feedback/supply input						
R3	PMU_3V0	3.0 V DCDC feedback/supply input						
R7	3V0_FEM_VCC2	3.0 V FEM VCC2						
S1	PMU_VI1 (VBATT)	VBATT power input to 3.0 V DCDC						
S2	PMU_VI1 (VBATT)	VBATT power input to 3.0 V DCDC						
S3	PMU_VI1 (VBATT)	VBATT power input to 3.0 V DCDC						
S4	1V8_FEM_VIO	1.8 V FEM VIO						
S5	3V0_FEM_VDD	3.0 V FEM VDD						
S6	3V0_FEM_VCC1	3.0 V FEM VCC1						
S7	3V0_FEM_VCC2	3.0 V FEM VCC2						
S9	RFDATA_5	RF control signal	N/A	In/Out	PMU_1V8	BIDIR	2	In, HiZ
S15	FEM_VIO_CAP	Internal 1.8 V supply node to FEM MIPI block: optional decoupling						
S18	TXHB2	Optional HB TX						
S20	FEM_AUX2_TX	Optional HB TX SP6T connection						
A15, B1, B15, C15, D8, E4, E5, E6, E7, E9, E10, E11, E12, E13, E16, E17, F5, F6, F7, F9, F10, F11, F12, F14, F15, F16, G4, G5, G6, G7, G10, G11, G12, G13, G14, G16, G17, H4, H5, H6, H9, H10, H11, H15, H17, J5, J6, J7, J8, J9, J12, J15, K5, K6, K7, K9, K14, K16, L4, L5, L6, L7, L9, M4, M5, M6, M7, N6, N7, S13, and S14.						**These pins are designated as Do Not Connect.**		
All other pins not specifically listed here are ground pins.								

UART Expected Usage

- **UART0:** Main AT interface to be connected with host application. Wake from low power via HW flow control is active in this UART.
- **UART1:** Debug interface. Wake from low power via HW flow control is active in this UART.
- **UART2:** Modem console or debug interface.

Figure 3a represents the typical implementation for the hardware flow control for UART0, UART1, and UART2. TXD and RXD signals are mandatory.

CTS/RTS are mandatory in order to control SiP low power modes. The SKY66430 is designed for use as data communications equipment (DCE). Based on the conventions for DCE-DTE connections, the DCE device will communicate with the customer application (DTE) using the following signals:

- Port TXD on the Application send data to the SKY66430 SIN signal line.
- Port RX on the Application receives data from the SKY66430 SOUT signal line.

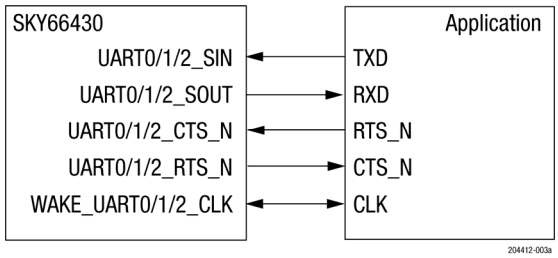


Figure 3a. UART0, UART1, and UART2 Signals Convention and Flow Control

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66430-11 are shown in Table 2. Recommended operating conditions of the SKY66430-11 are provided in Table 3. SIP electrical specifications are shown in Table 4. The electrical specifications for low-band Tx are provided in Table 5. Table 6 shows the electrical specifications for mid-band Tx.

Table 7 shows the Rx electrical specifications for low-band and mid-band RX. Table 8 shows the AUX port electrical specifications.

Table 2. SKY66430-11 Absolute Maximum Ratings[1]

Parameter	Symbol	Min	Typ	Max	Units
RF input power (AUX Tx/Rx)	CW P_{IN}			37.5	dBm
Supply voltages (with RF)	VBATT	-0.5		TBD	V
Operating case temperature	T_{CASE}[2]	-40	25	+85	°C
Storage temperature	T_{STG}	-40		+150	°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 and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

2 T_{CASE} refers to the temperature of the ground pad on the underside of the package.

***ESD HANDLING**: Although this device is designed to be as robust as possible, electrostatic discharge (ESD) can damage this device. This device must be protected at all times from ESD when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

Table 3. SKY66430-11 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Supply voltage	VBATT	3.1	3.8	5.5	V
Case operating temperature range	T_{RANGE}	-40	+25	+85	°C

Table 4. SKY66430-11 Power Consumption Electrical Specifications
(V_{BATT} = 3.8 V, T_{CASE} = +25°C, QPSK/5 MHz BW / 6RB (MPR = 0), Unless Otherwise Specified)

Power Consumption	Test Condition	Min	Typ	Max	Units
TX Peak Current[1]					
Itotal_13dBm	B13 uplink, CW, P_{OUT} = +13 dBm		270		mA
Itotal _18dBm	B13 uplink, CW, P_{OUT} = +18 dBm		360		mA
Itotal_20dBm	B13 uplink, CW, P_{OUT} = +20 dBm		410		mA
Itotal_23dBm	B13 uplink, CW, P_{OUT} = +23 dBm		520		mA
eDRX Mode Current					
I_average			TBD		mA
I_idle			TBD		uA
PSM Sleep Current					
I_leak			1		uA

1 Listed as measured peak current consumption in LTE Tx/Rx configurations CW mode. It represents the maximum RMS current. Actual power consumption depends on LTE band of operation and duty cycle. Table 4 listed for LTE band 13 only.

Table 5. SKY66430-11 Low-Band TX Electrical Specifications (1 of 2)
(V_{BATT} = 3.8 V, T_{CASE} = +25°C, LTE Low-Band, f = 782 MHz, QPSK/5 MHz BW/6RB, Unless Otherwise Specified)

Parameter			Symbol	Conditions	Min	Typ	Max	Units
Frequency			f		698		915	MHz
Maximum output power			P_{OUT_MAX}		24			dBm
			$P_{OUT\_MAX\_ETC}$[1]		23			
Power variation			$DELTA_{\_POUT}$	P_{OUT} = P_{OUT_MAX}		2		dB
Adjacent channel leakage ratio (based on 5 MHz LTE channels) 6 RB transmitted signal on RB 19 through 24		EUTRA	$EUTRA_{\_ACLR1}$ (power measured in adjacent 5 MHz LTE channel)	P_{OUT} = P_{OUT_MAX}		-35	-34	dBc
				T_{CASE} = T_{RANGE}			-33	
		UTRA1	$UTRA_{\_ACLR1}$ (power measured in adjacent 3.84 MHz UTRA channel)	P_{OUT} = P_{OUT_MAX}		-38	-37	
				T_{CASE} = T_{RANGE}			-36	
Modulation accuracy			$EVM_{\_QPSK}$	Load = 50 Ω, P_{OUT} = +23 dBm		3	5	%
Harmonics	Second		2fo	P_{OUT} = P_{OUT_MAX}		-40	-35	dBm/MHz
	Second (B13)		2fo			-54	-52	dBm/MHz
	Second (B28)		2fo			-40	-38	dBm/MHz
	Third		3fo			-40	-35	dBm/MHz
	Third (B28)		3fo			-55	-50	dBm/MHz
	Fourth and higher		4fo			-65	-60	dBm/MHz
Noise during B12 TX	LB (B12) noise in B12 Rx band		$P_{NOISE\_Emissions\_Bands}$	f_{MEAS} = 729 MHz[2]		-60		dBm/MHz
	LB (B12) noise in B17 Rx band			f_{MEAS} = 734 MHz[2]		-65		dBm/MHz
	LB (B12) noise in GPS Band			f_{MEAS} = 1574.42 to 1576.42 MHz[2]		-75		dBm/MHz
	LB (B12) noise in GNSS band			f_{MEAS} = 1559.00 MHz to 1574.42 MHz[2] f_{MEAS} = 1576.42 MHz to 1610.00 MHz[2]		-75 -75		dBm/MHz dBm/MHz

Table 5. SKY66430-11 Low-Band TX Electrical Specifications (2 of 2)
(V_{BATT} = 3.8 V, T_{CASE} = +25°C, LTE Low-Band, f = 782 MHz, QPSK/5 MHz BW/6RB, Unless Otherwise Specified)

Parameter		Symbol	Conditions	Min	Typ	Max	Units
Noise during B13 TX	LB (B13) noise in B13 Rx band	$P_{NOISE\_Emissions\_Bands}$	f_{MEAS} = 756 MHz[2]		-65		dBm/MHz
	LB (B13) noise in B14 Rx band		f_{MEAS} = 768 MHz[2]		-60		dBm/MHz
	LB (B13) noise in public safety (NS_07)		f_{MEAS} = 775 MHz[2]		-60		dBm/6.25kHz
	LB (B13) noise in GPS Band		f_{MEAS} = 1574.42 to 1576.42 MHz[3]		-75		dBm/MHz
	LB (B13) noise in GNSS band		f_{MEAS} = 1559.00 MHz to 1574.42 MHz[3] f_{MEAS} = 1576.42 MHz to 1610.00 MHz[3]		-50 -75		dBm/MHz dBm/MHz
ANT port return loss		RL_{ANT}	P_{IN} = -30 dBm		10		dB
Stability		S	No oscillations, all spurious: < -36 dBm/100 kHz @ 30 MHz~1 GHz < -30 dBm/MHz @ 1 GHz ~12.5 GHz T_{CASE} = T_{RANGE}	6:1			VSWR
Ruggedness		Ru	No permanent damage to module P_{OUT} = P_{OUT_MAX} @ Load = 50 Ω T_{CASE} = T_{RANGE}	10:1			VSWR

[1] ETC = Extreme Temperature Condition, T_{CASE} = -40 °C and T_{CASE} = +85 °C.

[2] Measured with +24 dBm TX on 5 MHz LTE channel centered at 779.5 MHz, lowest 6RB.

[3] Measured with +24 dBm TX on 5 MHz LTE channel centered at 784.5 MHz, highest 6RB.

Table 6. SKY66430-11 Mid-Band TX Electrical Specifications
(V_{BATT} = 3.8 V, T_{CASE} = +25°C, LTE Mid-band, f = 1732 MHz, QPSK/5 MHz BW/6RB, Unless Otherwise Specified)

Parameter		Symbol	Conditions	Min	Typ	Max	Units
Frequency		f		1710		1980	MHz
Maximum output power		P_{OUT_MAX}		+24			dBm
		$P_{OUT\_MAX\_ETC}$[1]		+23			dBm
Power variation		DELTA_POUT	$P_{OUT} = P_{OUT\_MAX}$		2		dB
Adjacent channel leakage ratio (based on 5 MHz LTE channels) 6 RB transmitted signal on RB 19 through 24	EUTRA	$EUTRA_{ACLR1}$ (power measured in adjacent 5 MHz LTE channel)	$P_{OUT} = P_{OUT\_MAX}$		-35	-34	dBc
			$T_{CASE} = T_{RANGE}$			-33	dBc
	UTRA1	$UTRA_{ACLR1}$ (power measured in adjacent 3.84 MHz UTRA channel)	$P_{OUT} = P_{OUT\_MAX}$		-38	-37	dBc
			$T_{CASE} = T_{RANGE}$			-36	dBc
Modulation accuracy		EVM_{QPSK}	Load = 50 Ω, P_{OUT} = +23 dBm		3	5	%
Harmonics	Second	2fo	$P_{OUT} = P_{OUT\_MAX}$		-40	-35	dBm/MHz
	Third	3fo			-40	-35	dBm/MHz
	Fourth and higher	4fo			-40	-35	dBm/MHz
Noise	Noise in B4 Rx band	PNOISE_Emissions_Bands	f_{MEAS} = 2110 MHz[2]		-50		dBm/MHz
	Noise in GPS Band		f_{MEAS} = 1574.42 to 1576.42 MHz[3]		-70		dBm/MHz
	Noise in GNSS band		f_{MEAS} = 1559.00 MHz to 1574.42 MHz[3] f_{MEAS} = 1576.42 MHz to 1610.00 MHz[3]		-70		dBm/MHz
ANT port return loss		RL_{ANT}	P_{IN} = -30 dBm		10		dB
Stability		S	No oscillations, all spurious: < -36 dBm/100 kHz @ 30 MHz~1 GHz < -30 dBm/MHz @ 1 GHz ~12.5 GHz $T_{CASE} = T_{RANGE}$	6:1			VSWR
Ruggedness		Ru	No permanent damage to module $P_{OUT} = P_{OUT\_MAX}$ @ Load = 50 Ω $T_{CASE} = T_{RANGE}$	10:1			VSWR

[1] ETC = Extreme Temperature Condition, T_{CASE} = -40 °C and T_{CASE} = +85 °C.

[2] Measured with +24 dBm TX on 5 MHz LTE channel centered at 1752.5 MHz, highest 6 RB.

[3] Measured with +24 dBm TX on 5 MHz LTE channel centered at 1712.5 MHz, lowest 6 RB.

Table 7. SKY66430-11 Low-Band and Mid-Band Rx Electrical Specifications
(V_{BATT} = 3.8 V, T_{CASE} = +25°C, Unless Otherwise Specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Low-Band						
Operating frequency	f		729		960	MHz
ANT port return loss	RL_{ANT}	In/Out, 50 Ω, 729 to 960 MHz	7	10		dB
RSSI	$RSSI_{LB}$	QPSK/5 MHz BW/4RB, CINR = 13 dB		-109.7		dBm
Mid-Band						
Operating frequency	f		1805		2200	MHz
ANT port return loss	RL_{ANT}	In/Out, 50 Ω, 1805 to 2200 MHz	7	10		dB
RSSI	$RSSI_{MB}$	QPSK/5 MHz BW/4RB, CINR = 13 dB		-109.7		dBm

Table 8. SKY66430-11 AUX Port Electrical Specifications
(V_{BATT} = 3.8 V, T_{CASE} = +25°C, Unless Otherwise Specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
AUX1_RX port insertion loss	IL_{AUX}	0.7 to 1.0 GHz 1.4 to 2.0 GHz 2.0 to 2.7 GHz		0.4 0.5 0.6		dB
AUX1_RX port return loss	RL_{AUX}	In/Out, 50 Ω, 0.7 to 2.7 GHz	7	10		dB
AUX1_RX port compression point, P0.1dB	$P0.1dB_{AUX}$	0.7 to 2.7 GHz		38		dBm
AUX1_RX port third order input intercept point	$IP3_{AUX}$	0.7 to 2.7 GHz		70		dBm
AUX2_TX port insertion loss	IL_{AUX}	0.7 to 1.0 GHz 1.4 to 2.0 GHz 2.0 to 2.7 GHz		0.4 0.5 0.6		dB dB dB
AUX2_TX port return loss	RL_{AUX}	In/Out, 50 Ω, 0.7 to 2.7 GHz	7	10		dB
AUX2_TX port compression point, P0.1dB	$P0.1dB_{AUX}$	AUX1 port, 0.7 to 2.7 GHz		38		dBm
AUX2_TX port third order input intercept point	$IP3_{AUX}$	AUX1 port, 0.7 to 2.7 GHz		70		dBm

Evaluation Board Description

The SKY66430-11 Evaluation Board is used to test the performance of the SKY66430-11 SiP. The schematic diagrams for the SKY66430-11 are shown in Figures 4a through 4d.

An assembly diagram of the Evaluation Board is shown in Figure 5.

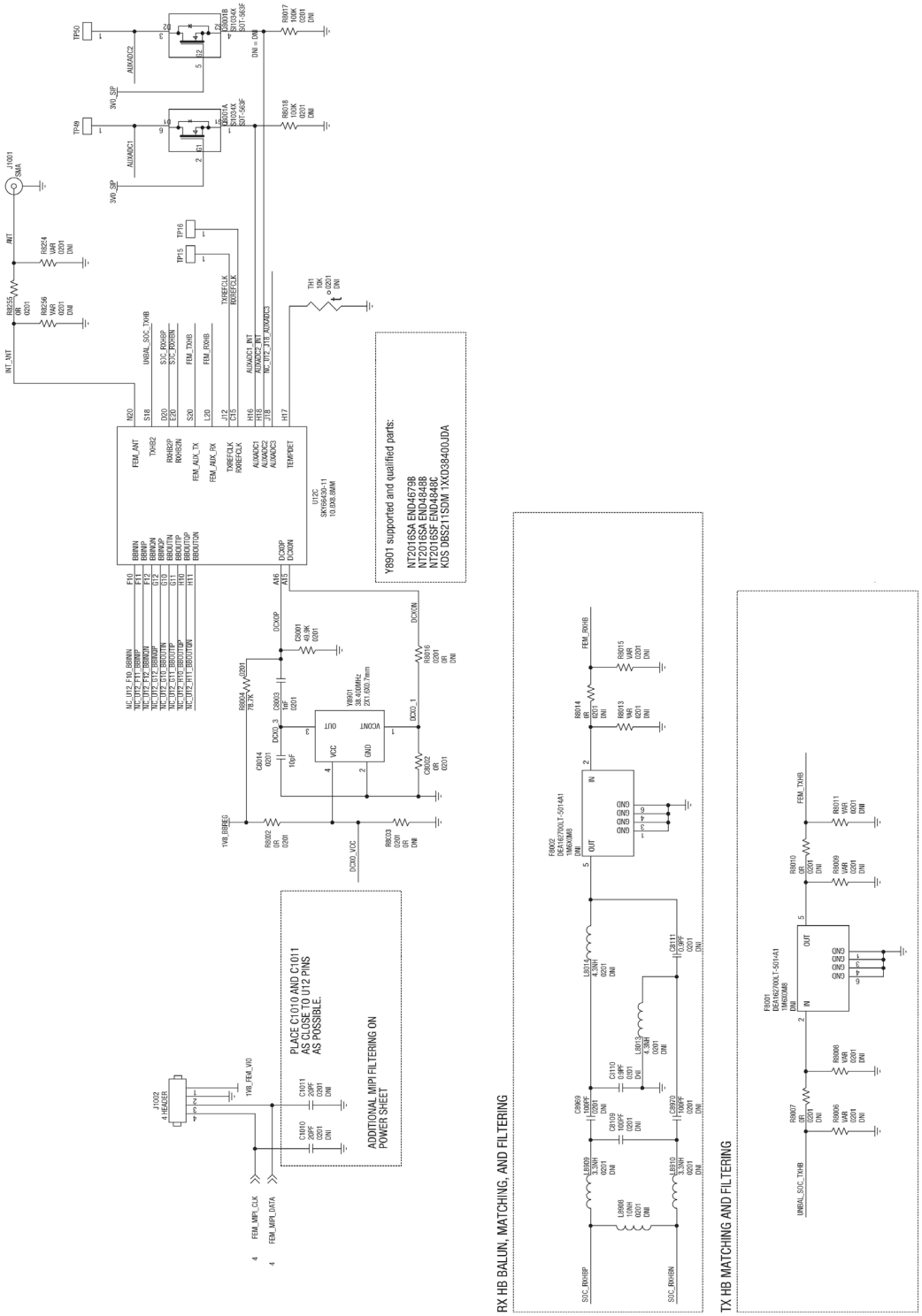


Figure 4a. SKY66430-11 Evaluation Board Schematic - Analog/RF

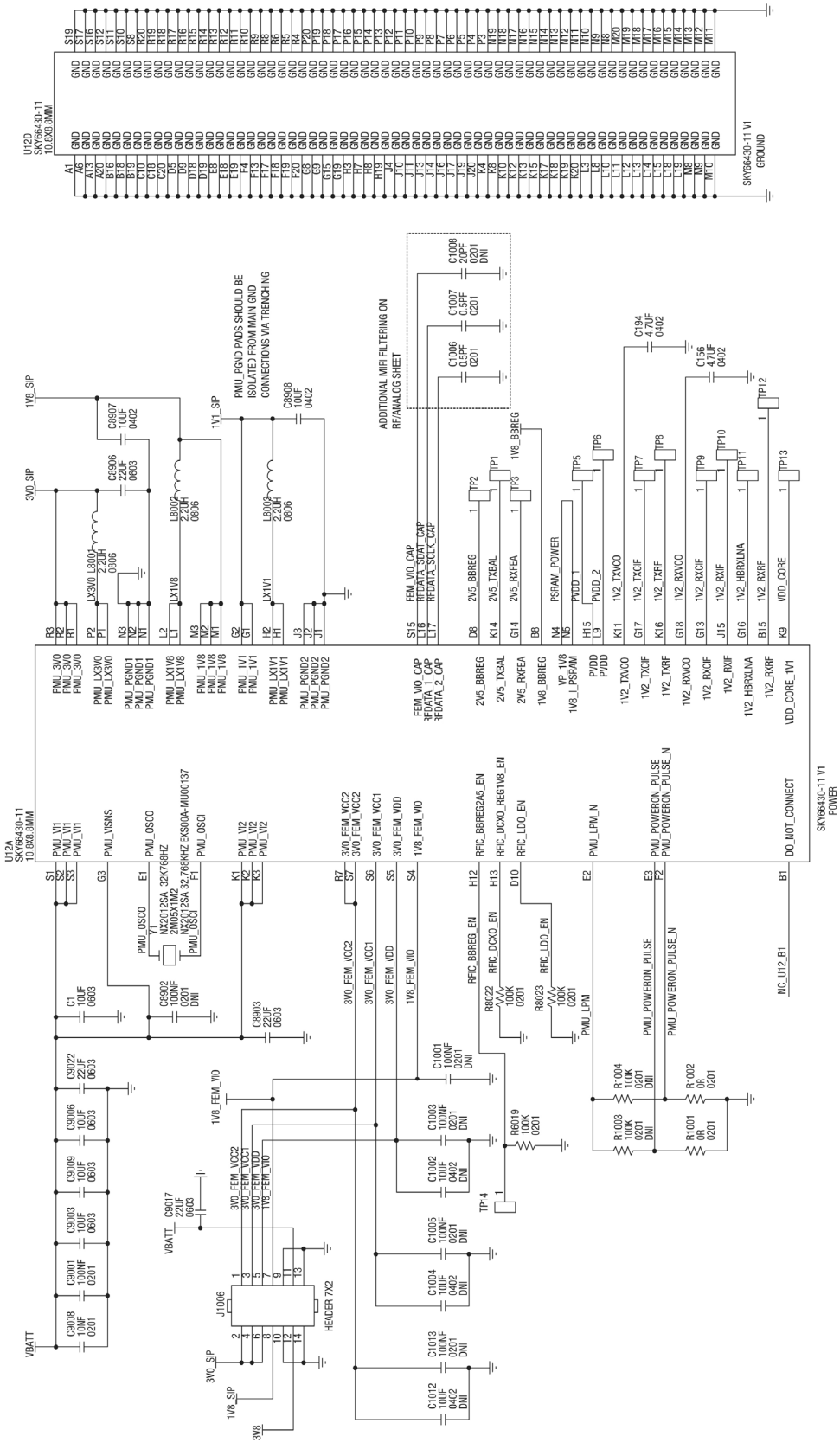


Figure 4b. SKY66430-11 Evaluation Board Schematic - Power

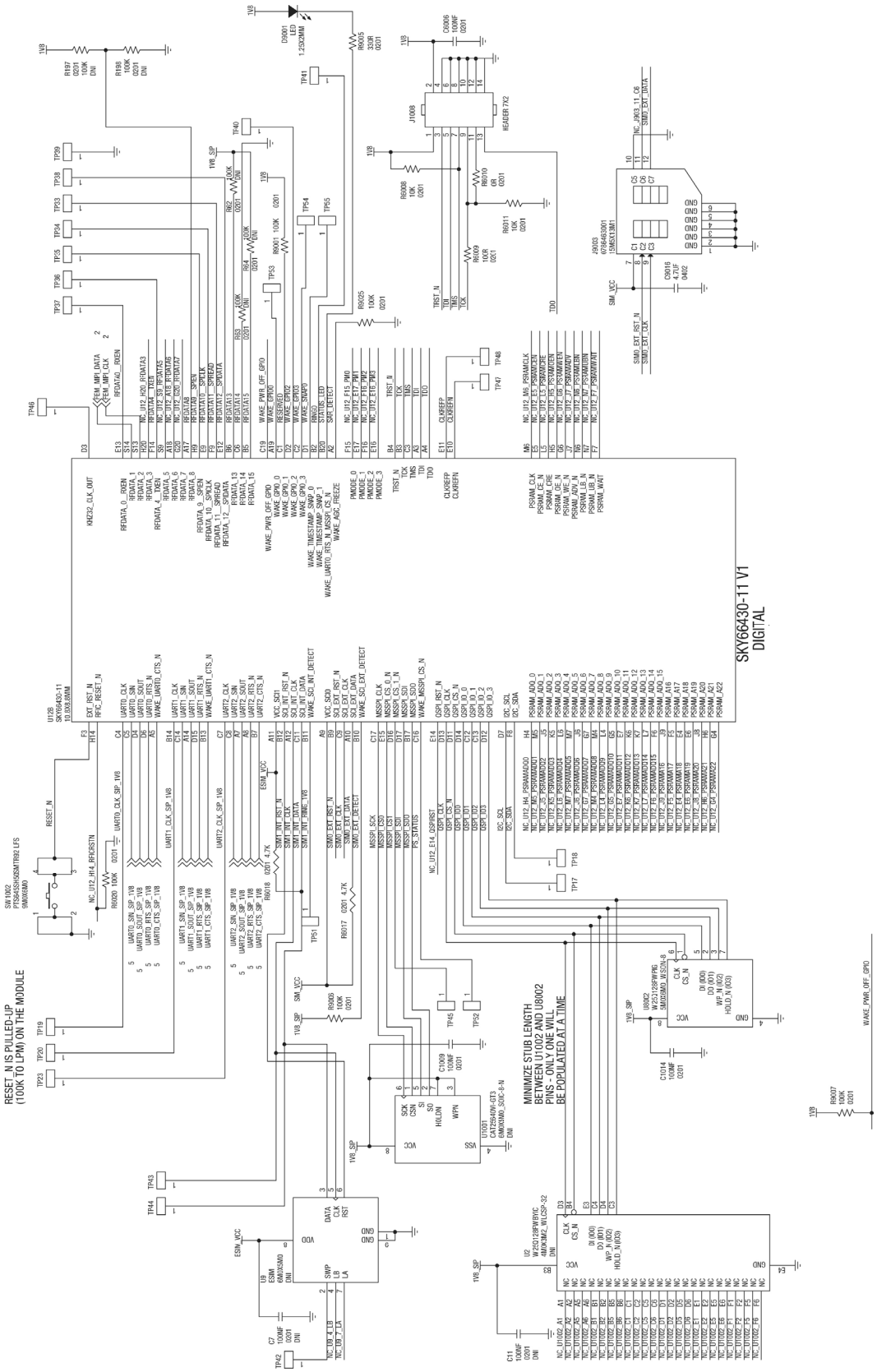


Figure 4c. SKY66430-11 Evaluation Board Schematic - Digital

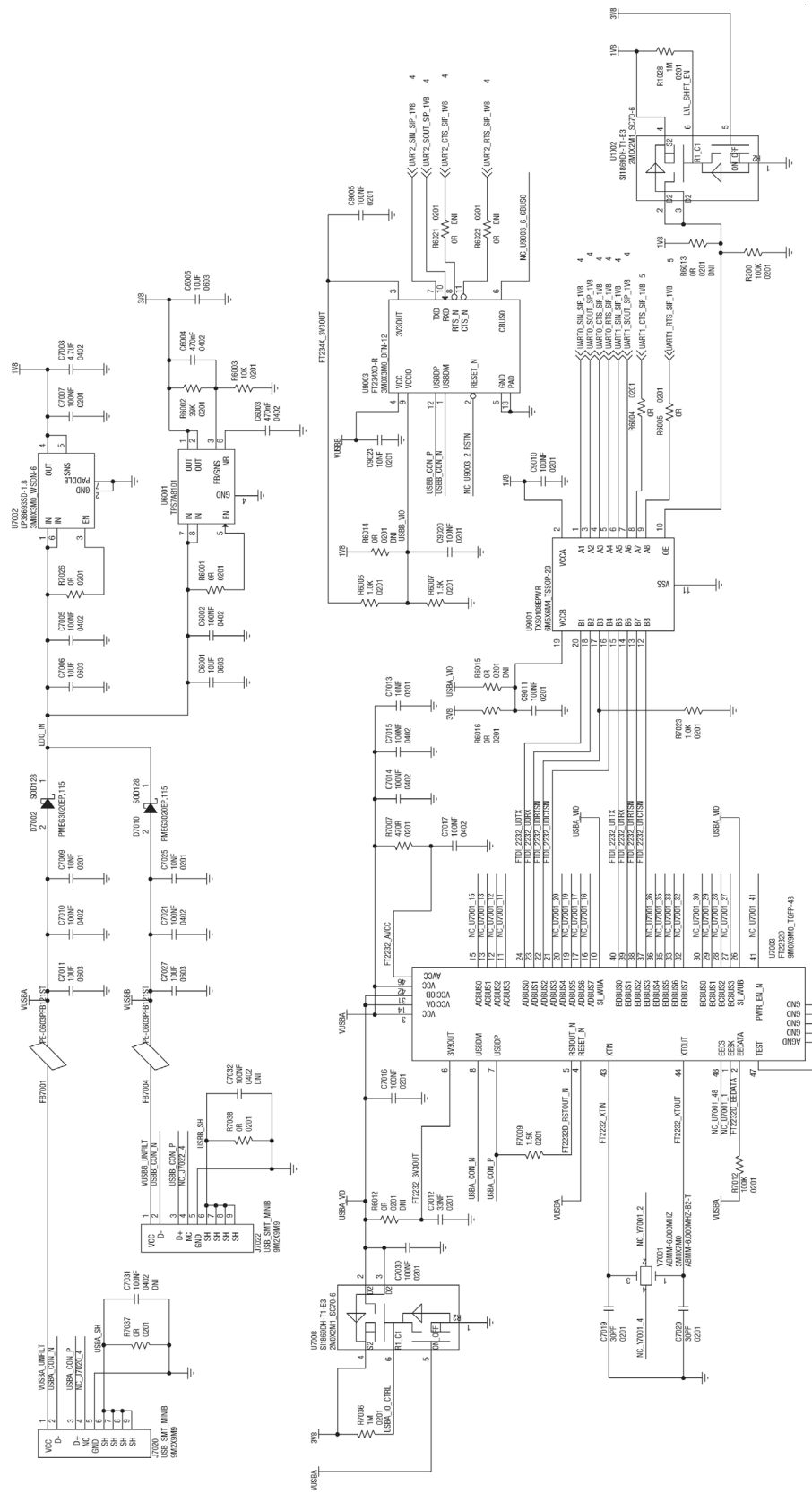
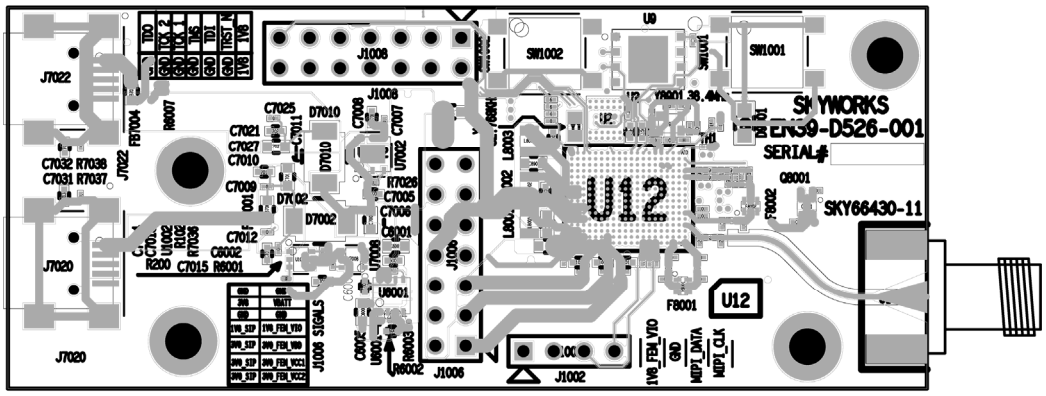
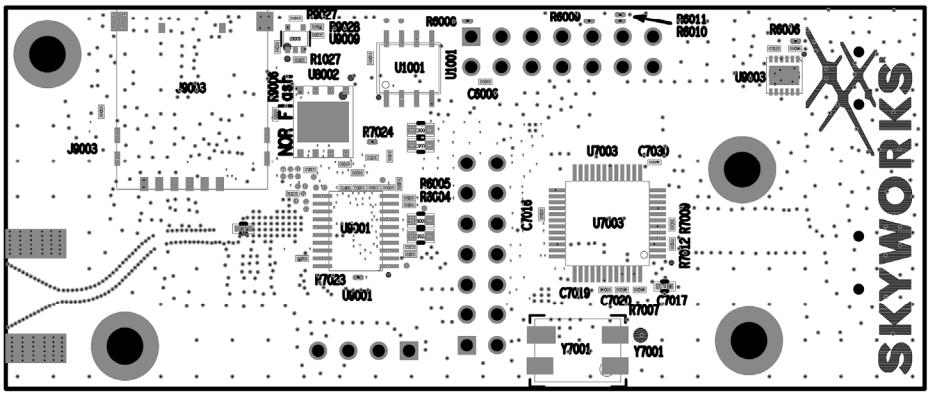


Figure 4d. Evaluation Board Schematics - Miscellaneous



Top View



Bottom View

Figure 5. SKY66430-11 Application Board Assembly Diagram

Package Dimensions

The typical part marking for the SKY66430-11 is shown in Figure 6. The PCB layout footprint for the SKY66430-11 is shown in Figure 7. Package dimensions are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY66430-11 is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

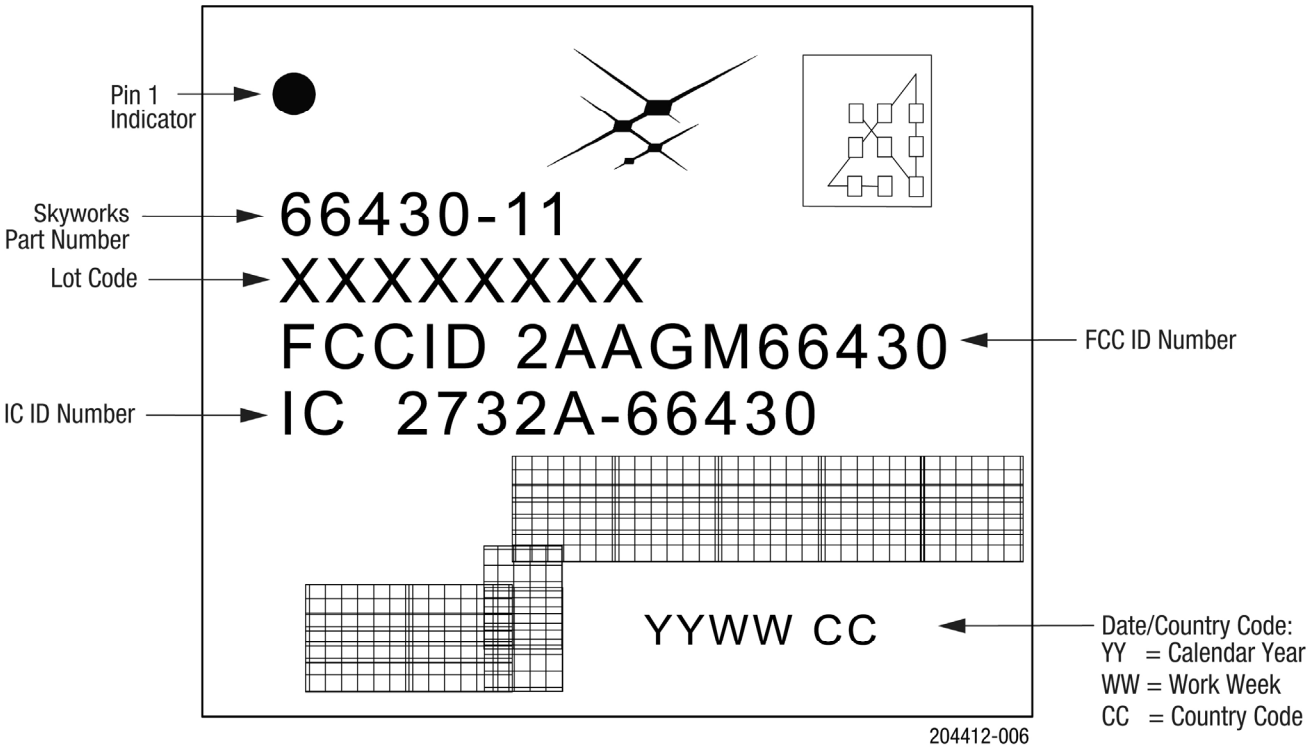
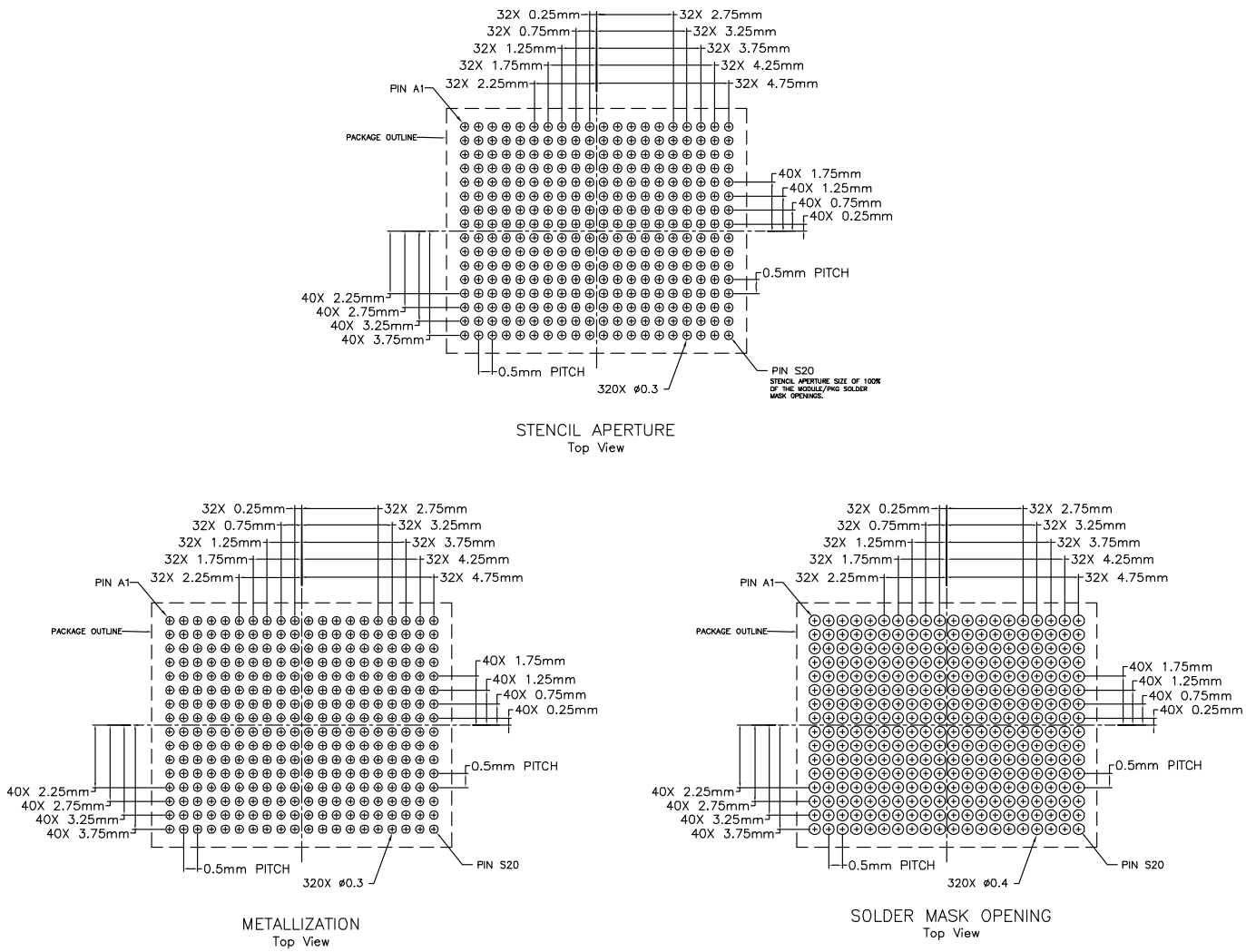
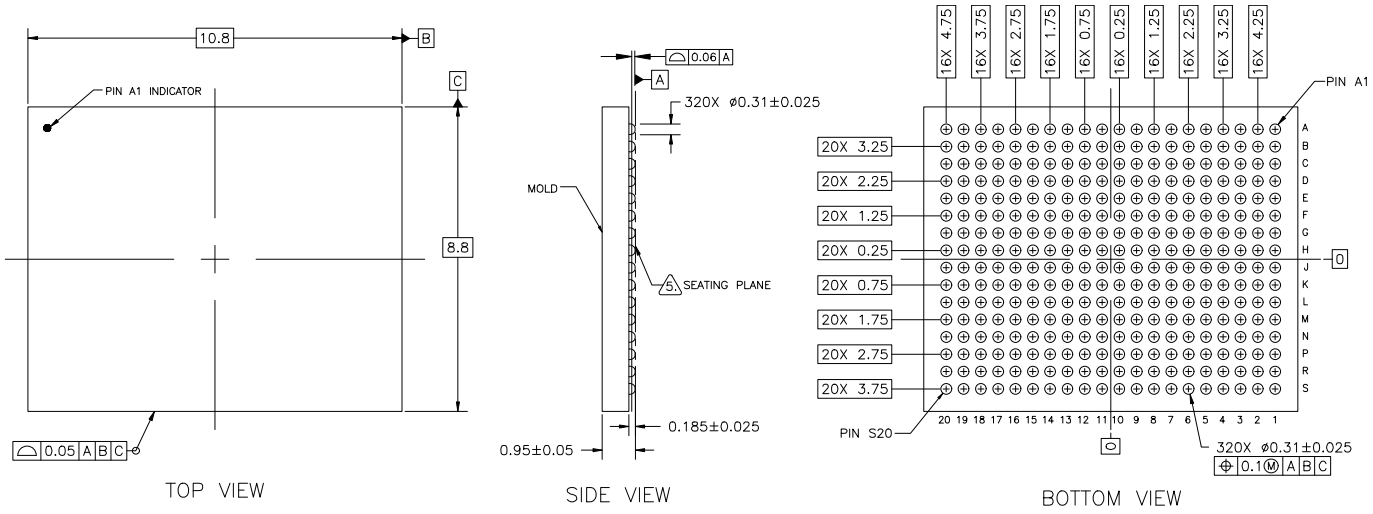


Figure 6. SKY66430-11 Typical Part Marking



NOTE: THERMAL VIAS SHOULD BE RESIN FILLED AND CAPPED IN ACCORDANCE WITH IPC–4761 TYPE VII VIAS. 30–35UM Cu THICKNESS IS RECOMMENDED.

Figure 7. SKY66430-11 PCB Layout Footprint



NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M–1994.
2. SEE APPLICABLE BONDING DIAGRAM AND DEVICE ASSEMBLY DRAWING FOR DIE AND COMPONENT PLACEMENT.
3. PAD DEFINITIONS PER DETAILS ON DRAWING.
4. PCB TYPE 6L NS SSV 40 G5 250.
5. PRIMARY DATUM A AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
6. THIS PACKAGE IS COMPATIBLE WITH TRANSFER AND COMPRESSION MOLD.
7. THIS PACKAGE CONFORMAL SHIELDING.

204412-008

Figure 8. SKY66430-11 Package Dimensions

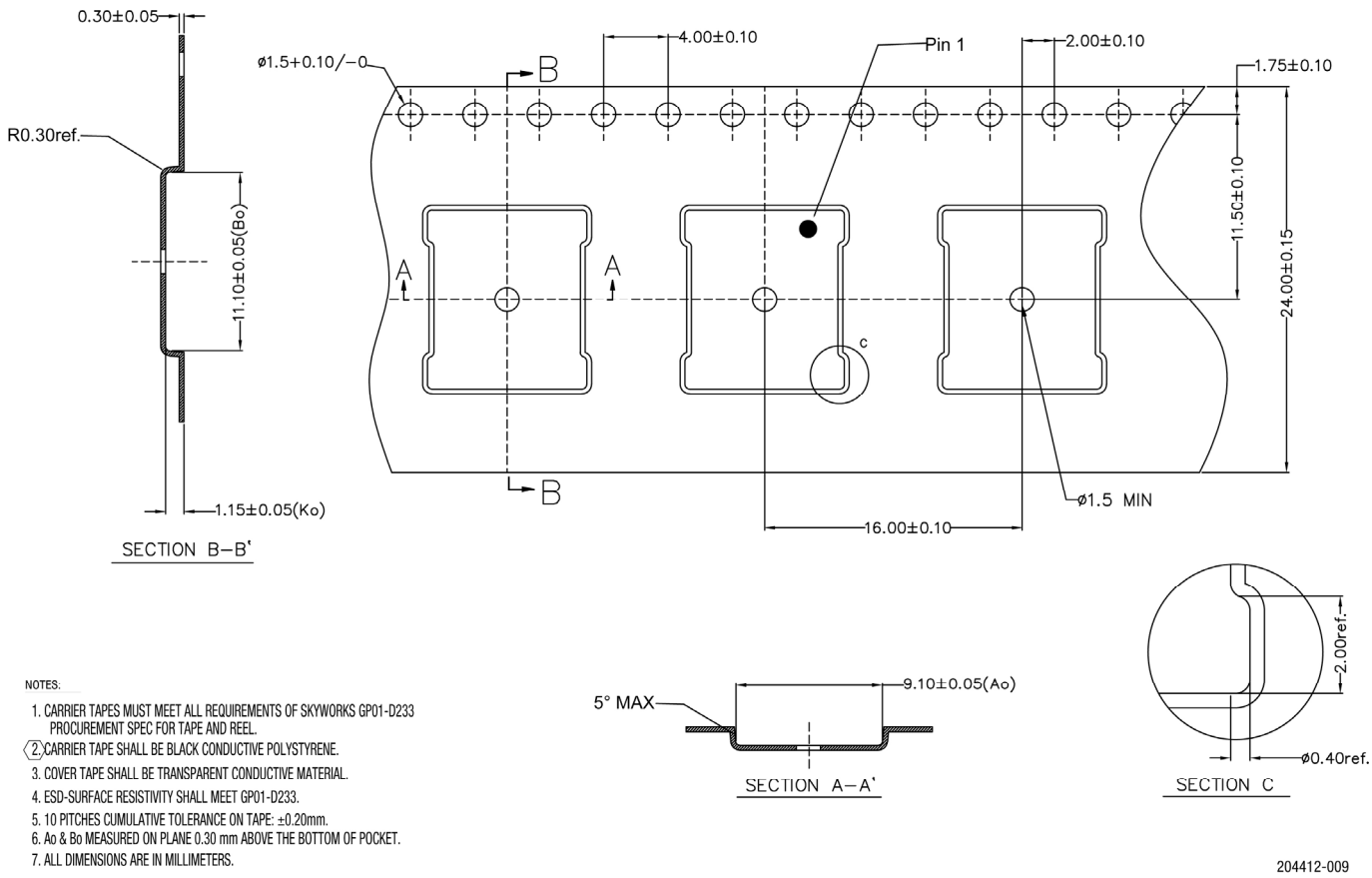


Figure 9. SKY66430-11 Tape and Reel Dimensions

FCC Regulatory Approval for the SKY66430-11

Note: *This section applies to the SKY66430-11 part number only. The LTE Bands that are compliant with FCC are Band 2, Band 4, Band 12, Band 13, and Band 25.*

Attention

SKY66430-11 FCC-ID: 2AAGM66430 (single modular approval)

This above identified LTE radio module is not intended to be provided to end users, but is for installation by OEM integrators only.

Installation/Integration

OEM integrators must follow SKY66430-11 installation instructions to provide for and benefit from FCC compliant module integrations and must abide especially by the following:

The maximum antenna gain value (accounting for cable attenuation) to comply with the FCC maximum ERP/EIRP limits and with RF Exposure rules is 2 dBi.

The SKY66430-11module integration guidelines must be closely followed.

Compliance of host integrations of the module is limited to hosts adaptation designs which are identical to SKY66430-11-reference design.

Host integrations with adaption designs deviating from SKY66430-11 reference design require either class 2 permissive change to this modular approval or a separate host approval with different FCC-ID.

Host integrations with co-located (simultaneously operating) radio transmitters must be evaluated in accordance with FCC multi-transmitter rules and may require either class 2 permissive change to this modular approval or a separate host approval with different FCC-ID, dependent on the result of the evaluation; Inquiry at FCC or a TCB is urgently recommended.

Integrations of the module into host products which are intended for portable use, i.e. less than 20 cm distance between its radiating structures (antenna) and the body of nearby persons, or which otherwise put additional technical requirements like Hearing Aid compatibility require either class 2 permissive change to this modular approval or a separate host approval with different FCC-ID.

Compliance with Unwanted Emission Limits for Digital Device

If the OEM host integration fully complies with the above described reference design and can completely inherit and rest on compliance of the existing modular approval the OEM remains still responsible to show compliance of the overall end-product with the FCC limits for unwanted conducted and radiated emissions from the digital device (unintentional radio) portion of such end-product (commonly addressed as part 15B compliance or similar).

End-Product Labelling

- FCC-ID

The module's FCC-ID must either be visible from the exterior of the host product (e.g. per window) or per electronic display, or shall be displayed on an additional exterior label per the following or similar string: `contains FCC-ID: 2AAGM66430`

- Digital Device - Unwanted Emissions Notice

  If the end-product falls under part 15 of the FCC rules (it shall display the following user notice on its exterior acc. to part 15.19 (the notice may be printed in the manual in case the host is too small):

```
This device complies with Part 15 of the FCC Rules. Operation is subject to the following
two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may
cause undesired operation.
```

- Further Labelling Requirements may apply dependent on the FCCrule parts relevant to the host product.
- End-Product User Instructions / Notices in the Manual
  At a minimum, end-product users must be provided with the following notices at a prominent location of the product literature furnished with the product:

```
* Product Modifications
  Modifications not expressly approved by the party responsible for compliance could void the
  user's authority to operate this equipment.

* RF Exposure Compliance
  This equipment complies with FCC radio frequency radiation exposure rules and limits set
  forth for an uncontrolled environment, when installed and operated with minimum distance
  of 20cm between its radiating structures (antenna) and the body of nearby persons and
  when not operated simultaneously with other nearby
  radio-transmitters.
```

- Maximum Antenna Gain
  The user instructions of end-products equipped with standard external antenna connectors for the modular radio transmitter providing the option to connect other antennae than those which may or may not be bundled with the end-product must list the maximum allowed antenna gain values as derived from those given above, accounting for the cable attenuations of the actual installation.
- Digital Device - Unwanted Emissions Notice
  If the end-product is or contains a digital device (unintentional radio portions) and is not exempted by its use case (like vehicular use) the following part 15.105 (b) user notice shall be provided at prominent location of the product literature:

```
This equipment has been tested and found to comply with the limits for a Class B digital
device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable
protection against harmful interference in a residential installation.
This equipment generates uses and can radiate radio frequency energy and, if not installed
and used in accordance with the instructions, may cause harmful interference to radio
communications. However, there is no guarantee that interference will not occur in a
particular installation. If this equipment does cause harmful interference to radio or
television reception, which can be determined by turning the equipment off and on, the user
is encouraged to try to correct the interference by one or more of the following measures:
o   Reorient or relocate the receiving antenna.
o   Increase the separation between the equipment and receiver.
o   Connect the equipment into an outlet on a circuit different from that to which the
receiver is connected.
o  Consult the dealer or an experienced radio/TV technician for help
```

- Further User Notices
  May be required dependent on the FCC rule parts relevant to the host product.
- Non-Allowed User Instructions
  The end-product user guidance may NOT include instructions about how to install or de-install the module.

Industry Canada Statement

Note: *This section applies to SKY66430-11 part number only.*

This device complies with ISED's licence exempt RSSes. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d' ISED applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et

(2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

This device is intended only for OEM integrators under the following conditions: (For module device use)

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be colocated with any other transmitter or antenna

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

1. L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2. Le module émetteur peut ne pas être coïmp lanté av ec un autre émetteur ou antenne.

Tant que les 2 conditions ci dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

Important Note

In the event that these conditions cannot be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

Note Importante

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "`Contains IC:66430`".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "`Contient des IC: 12732A-66430`".

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SKY66430-11 / SQN66430-11	LTE for IoT System-in-Package	SKY66430-11EK1