Advance Datasheet

DS-SK62xx-0.80

01 15, 2016

SiBEAM SK62xx-MOD Transceiver Module

Contents

Abstract

This Datasheet describes SiBEAM Snap™ SK62xx-MOD Transceiver Module. It provides guidance and specifications in order to facilitate integration of SK62xx-MOD Transceiver Module in a consumer electronic device.

Overview

SK62xx-MOD Transceiver Module uses SiBEAM Snap™ technology which is a nearfield, high speed, full duplex wireless link operating in 60Ghz band. The purpose of the SK62xx-MOD Transceiver Module is to ease propagation of Snap™ in a variety of end devices while minimizing the integration effort by abstracting some of the design effort and leveraging regulatory investment.

Key features

SK62xx-MOD Transceiver Module is based on near field wireless connector single chip SB62xx transceiver family. In short when 2 end of SB62xx transceiver are spacially placed in each other's range, they act as a USB3.x physical connector substitute with no mechanical contact.

- Simultaneous USB 3.0 and USB 2.0 connections (SS, HS, FS, LS supported)
- Up to 6Gbps full duplex
- 10mm wireless range
- No host driver required
- Power states follow USB states
- Low power Scan when not in range.
- I2C tunneling
- Built in Antenna

- Small form factor 10mm x 26mm x 3mm
- Modular Approval Regulatory
- Single power rail
- Debug and remote debug function Tool suite
- RF performance measurement Tool suite access point

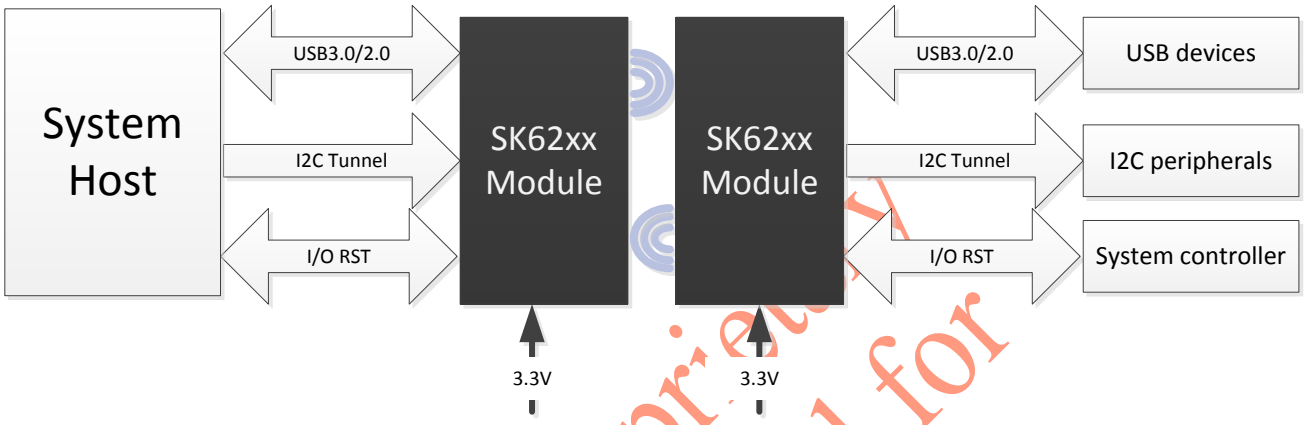


Figure 1. SK62xx-MOD Transceiver Module Wireless connector principle

SB62xx transceiver features

- Simultaneous USB 3.0 and USB 2.0 connections (SS, HS, FS, LS supported)
- I^2C tunneling for remote I^2C connections
- Transparent link maintenance
- 6 Gbps full duplex wireless link
- Close proximity operation (10 mm or less)
- Small form factor 6 mm × 4 mm MFC VFBGA package, including built-in antennas
- Automatic Device Detection and Connection
- No software driver required

SK62xx-MOD Transceiver Module features

The SK62xx-MOD Transceiver Module takes full adavantage of the SB62xx transceiver capabilities but in addition integrates in a single low profile board design:

- power supply,
- clock scheme,
- Debug interface,

- Power rail decoupling,
- EMI shielding

Such that the integration into a final mass produced system is greatly facilitated and the performance expectation is better controlled.

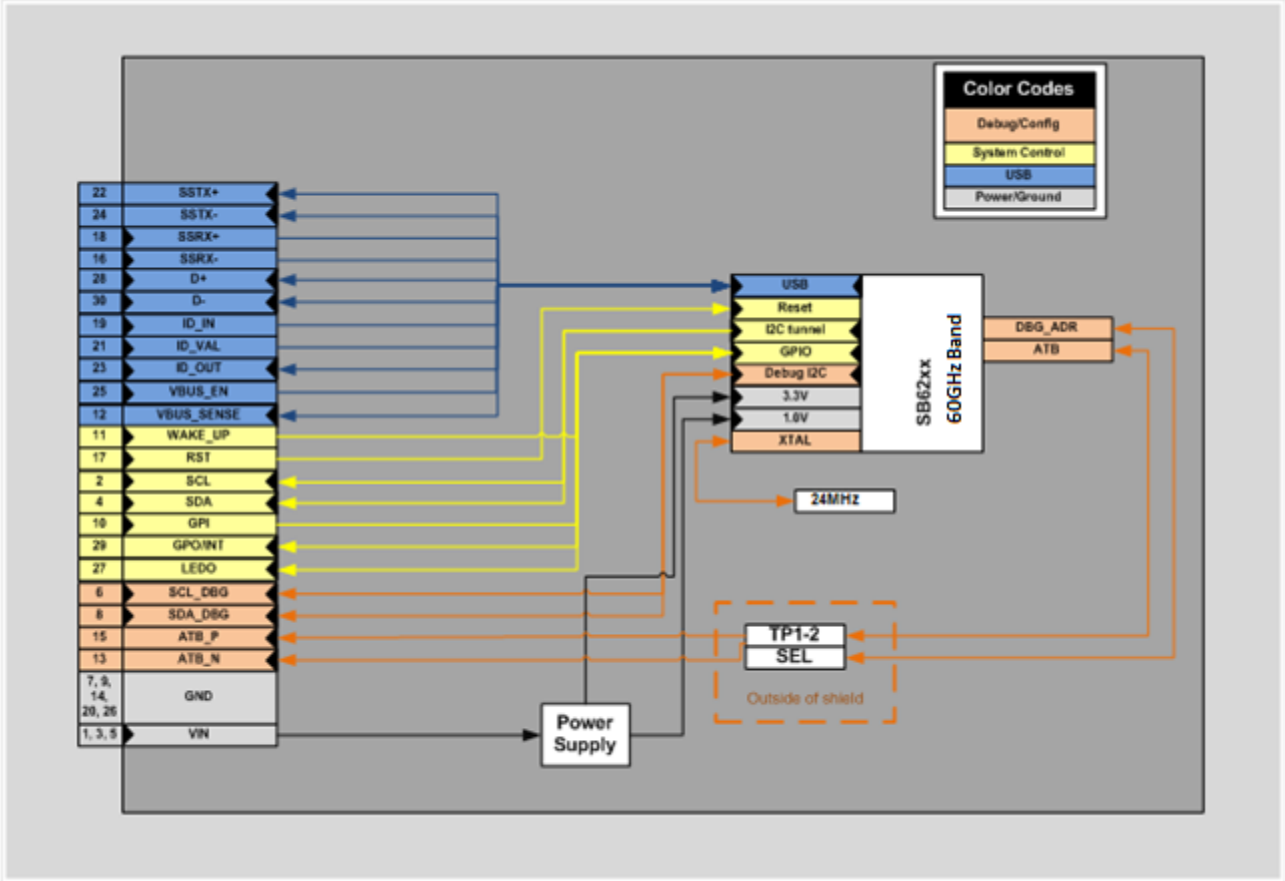


Figure 2. SK62xx-MOD Transceiver Module Block Diagram

SK62xx-MOD Transceiver Module pinout

Table 1. signal pinout

Pin	Name	Type	Dir	Group	Description
1	3V3	Power	Input	Power	3.3V +/-5% power supply
2	SCL	Digital	In/Out O.D.	I²C	I²C Clock, Tunneling port. SB6210/SB6212 Connect to Master; SB6211/SB6213 Connect to Slave
3	3V3	Power	Input	Power	3.3V +/-5% power supply
4	SDA	Digital	In/Out O.D.	I²C	I²C Data, Tunneling port. SB6210/SB6212 Connect to Master; SB6211/SB6213 Connect to Slave
5	3V3	Power	Input	Power	3.3V +/-5% power supply
6	SCL-DBG	Analog	Bi-Dir	USB	USB High Speed/Full Speed/Low Speed Neg I/O
7	GND	Power		Power	Ground
8	SDA-DBG	I²C	In/Out O.D.	Debug	I²C Data, Debug port. Connection to debug controller not required for normal operation.
9	GND	Power		Power	Ground
10	GPI	Digital	Input	GPIO	General purpose input. Status of this input is reflected on the GPO pin on the opposite side of an active wireless link.
11	WAKE_UP	Digital	Input	Control	Force the link to W0 State. This is useful to bypass USB states, when I2C tunnel or GPI signal needs to be used, while the link is in low power states. Active High. Optional.
12	VBUS_SENSE	Digital	Input	USB	USB VBUS status input , 3V3
13	ATB_N	Analog	Ouput	Debug	Differential analog test bus - negative terminal
14	GND	Power		Power	Ground
15	ATB-P	Analog	Output	Debug	Differential analog test bus - positive terminal
16	SSRX-	Analog	Input	USB	USB Super speed Neg Input
17	RST	Digital	Input	Config	Reset Input, active HIGH
18	SSRX+	Analog	Input	USB	USB Super speed Pos Input
19	ID_IN	Digital	Input	USB	USB ID Input
20	GND	Ground		SS isolation	Ground
21	ID-VAL	Digital	Input	USB	USB ID Valid Input
22	SSTX+	Analog	Output	USB	USB Super speed Pos Output
23	ID_OUT	Digital	Output	USB	USB ID Output
24	SSTX-	Analog	Output	USB	USB Super speed Neg Output
25	VBUS_EN	Digital	Output	USB	USB VBUS status output, 3V3
26	GND	Ground		SS isolation	Ground
27	LEDO	Digital	Output	Config	LED output
28	D+	Analog	Bi-Dir	USB	USB High Speed/Full Speed/Low Speed Pos I/O
29	GPO/INT	Digital	Output	GPIO	General purpose output. When a wireless link is active, the status of this output reflects the GPI pin on the opposite side of the wireless link. Also used as I2C tunnel interupt
30	D-	Analog	Bi-Dir	USB	USB High Speed/Full Speed/Low Speed Neg I/O

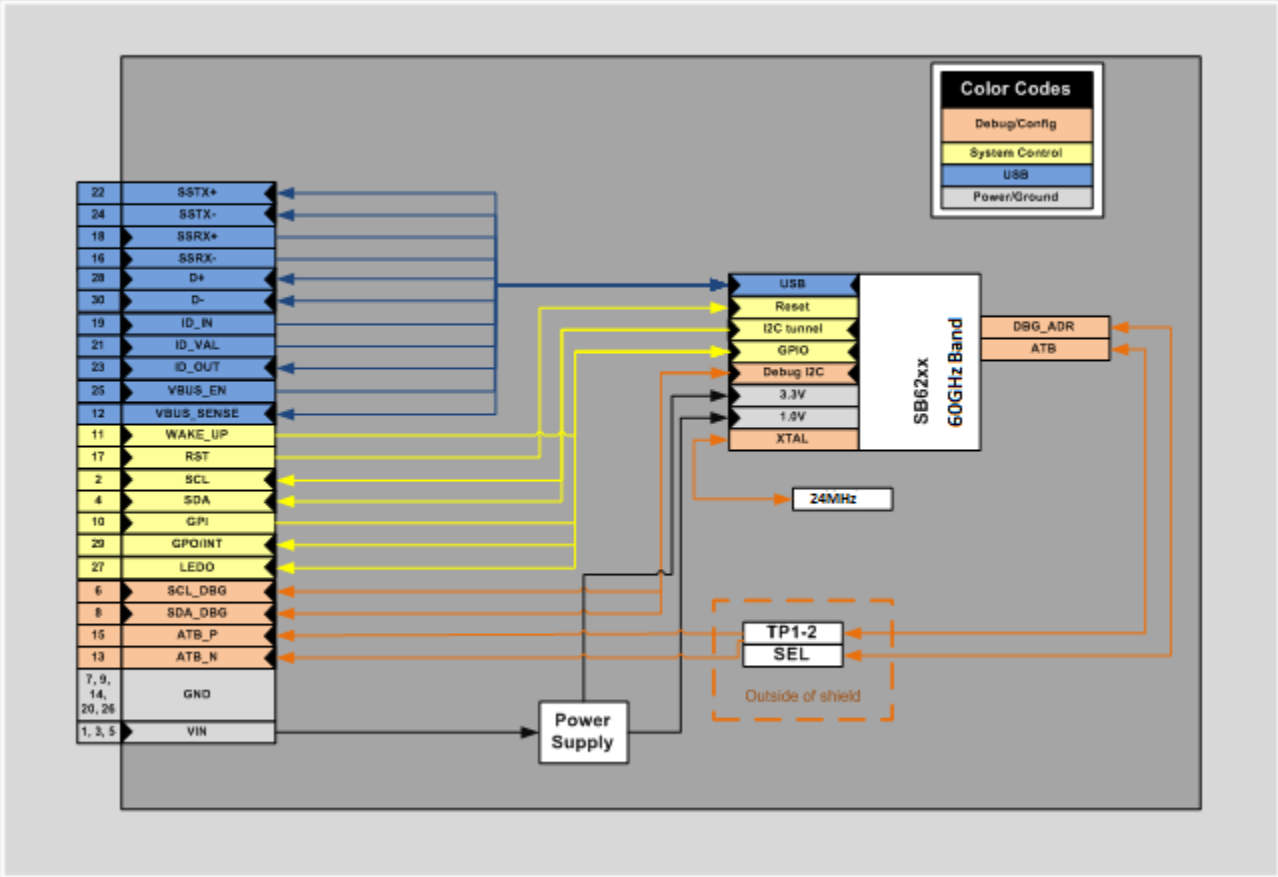


Figure 3. SK62xx-MOD Transceiver Module Pinout

SK62xx-MOD Transceiver Module Dimensions

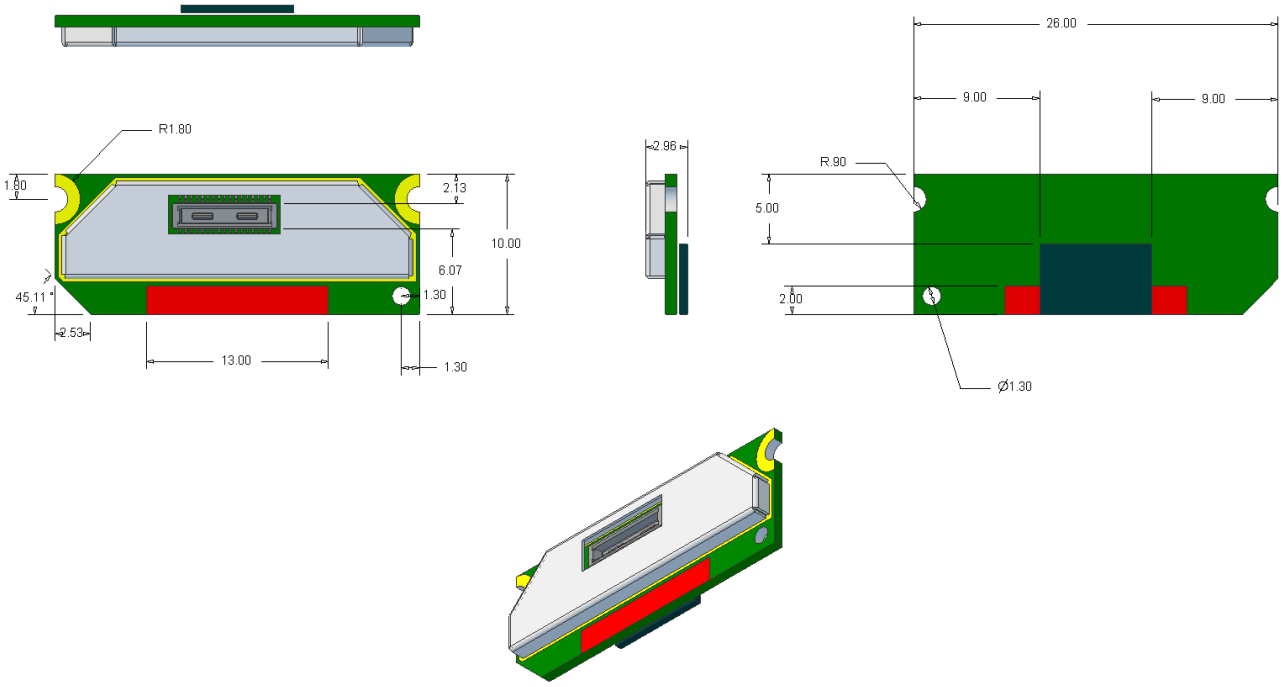


Figure 4. SK62xx-MOD Transceiver Module Dimension (in mm)

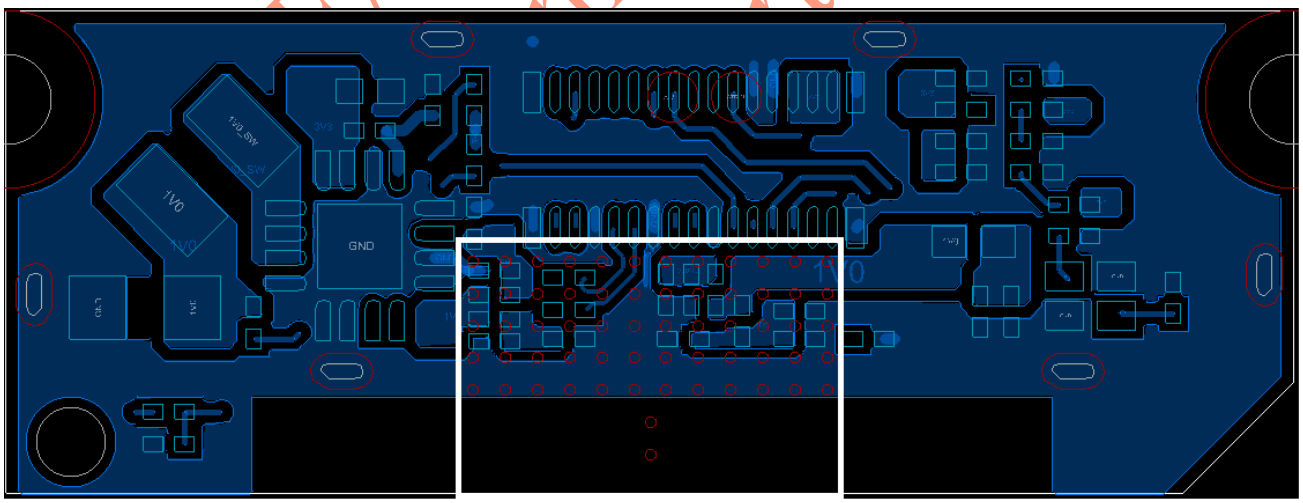


Figure 5. SK62xx-MOD Transceiver Module layout floorplan.

SK62xx-MOD Transceiver Module Connector

The module is designed to be connected to the system board through a single board to board connector:

On the module side:
The connector type is DF40 from Hirose
Part number: DF40C-30DP-0.4V(51)
Description: Dual row Board to Board Receptacle (Plug), 0.4 pitch, 50 pins
A=7.52mm, B=5.6mm, C =1.5mm

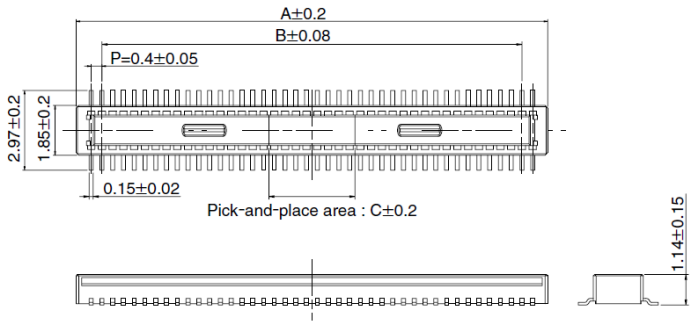


Figure 6. Module side connector.

On the system side the following connector should be used to mate with the module:
On the system side:
The connector type is :
DF40 from Hirose
Part number: DF40C-30DS-0.4V(51)
Description: Dual row Board to Board Socket, 0.4 pitch, 30 pins
A=8.6mm , B=5.6mm, C =1.5mm

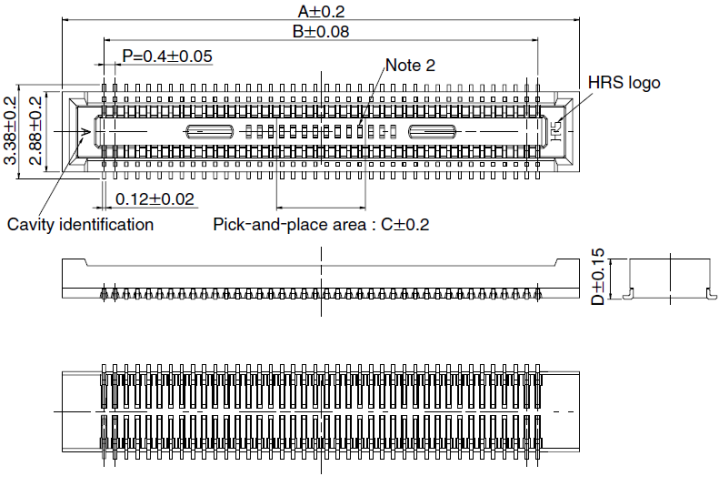


Figure 7. System side connector.

SK62xx-MOD Transceiver Module System application

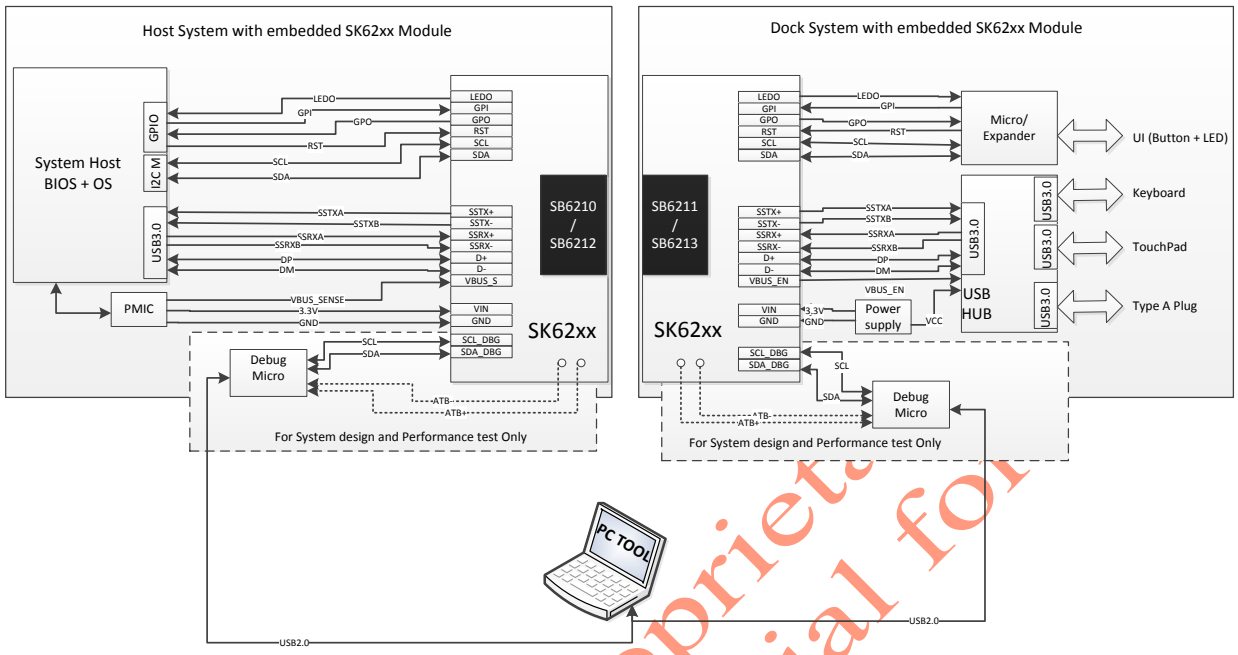


Figure 8. System level integration and test

SK62xx-MOD Transceiver Module Functional description

USB 3.0 Interface

The SK62xx-MOD Transceiver Module interfaces directly with a USB 3.0 port without requiring any additional control or interface logic. “ID_IN” and “ID_VAL” strapping pins on the SK62xx-MOD Transceiver Module are used along with wireless communication to establish the USB port personality as either upstream facing or downstream facing. The ID_OUT signal from each transceiver to the attached USB port indicates upstream or downstream facing transceiver operation.

Table 1. Transceiver Personality Based on Pair Configuration

Pair Configuration				Transceiver Personality						Application Example
SB6210/SB6212		SB6211/SB6213		SB6210/ SB6212	SB6211/ SB6213	SB6210/ SB6212	SB6211/ SB6213	SB6210/S B6212	SB6211/S B6213	
ID_IN	ID_VAL	ID_IN	ID_VAL	ID_OUT	ID_OUT	Facing	Facing	VBUS_En	VBUS_En	
1	1	0	1	0	Z	US	DS	0	1	2 in 1 Laptop
0	1	1	1	Z	0	DS	US	1	0	Sport Camera/ Storage
X	0	1	1	Z	0	DS	US	1	0	Mobile Phone (as Device)
X	0	0	1	0	Z	US	DS	0	1	Mobile Phone (as Host)

The “VBUS” supply from the upstream USB port is used as a VBUS_SENSE input to the transceiver. Note that a resistor divider or equivalent circuit should be used to reduce the +5V VBUS voltage level to a +3.3V voltage level that is compatible with the VBUS_SENSE input. The VBUS status is sent to the downstream facing transceiver, where the “VBUS_EN” signal is used to control the local VBUS status at the downstream USB connection.

When SB6210/SB6212 based Module transceiver is located in close proximity to another SB6211/SB6213 based Module transceiver, the two transceivers automatically establish a wireless connection, enabling high speed communication with the devices on the other side of the link. Establishing a wireless link is analogous to plugging in a USB cable. Once “connected”, this link will act and behave just like a wired USB 3.0 interface. The “ID_OUT” signal emulates the proper grounding of the ID pin that would be seen when attaching a USB 3.0 cable between devices. The “VBUS_EN” signal can be used to either drive a VBUS logic input, or an external FET transistor to actually switch the VBUS power to the downstream facing USB interface.

I2C Tunneling

I2C tunneling is a key feature of the SB62xx transceiver within the SK62xx-MOD Transceiver Module. It simply allows a I2C master on the Mobile side SB6210/SB6212 to communicate with I2C devices connected to the Dock side SB6211/SB6213. The key element of this feature are highlighted below:

- 400kHz interface. Sub-SCL latency, ~100ns
- Application can be, I/O expander, Eprom, low-speed peripherals etc.
- Clock stretching is required to be supported by the I2C bus Master and the I2C peripherals,

The SB62xx transceiver has an internal power management state machine which follows the USB states. It is possible that the first I2C transaction happens when the Wireless link is turned OFF (for power saving reason while USB is inactive). This transaction will wake up the wireless link but it can happen that this first transaction fails to perform while the wireless link is being restored. For this reason designers on the I2C Master side should make sure they have the proper retry mechanism and retry should happen within timeout period.

There is also an auto timeout after which, if no transaction on USB, I/O or I2C tunnel have occurred the system will go back to power saving state and the link will be shut off again.

Note: Timeout with rev3.0 is 200ms

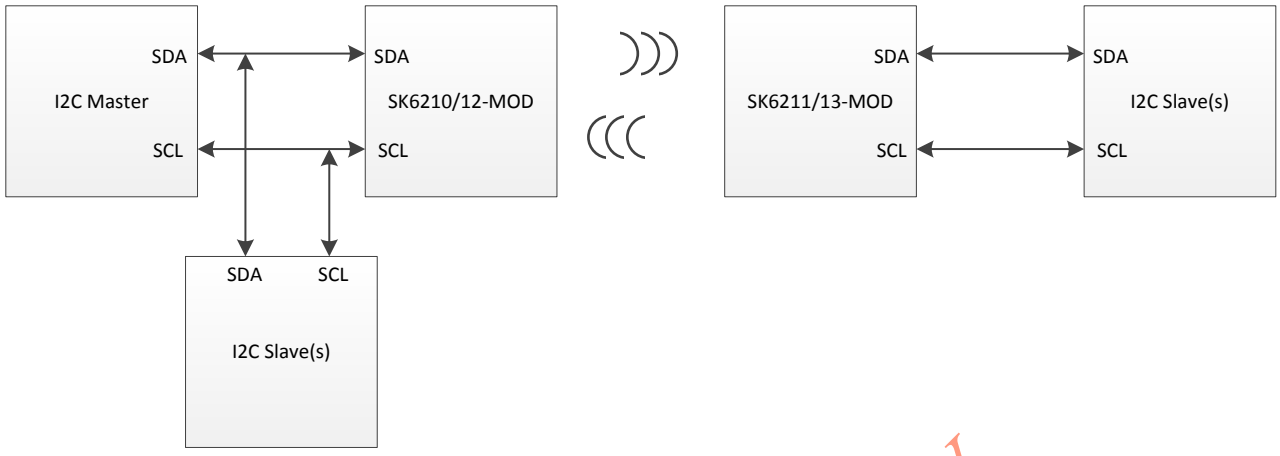


Figure 9. SK62xx-MOD Transceiver Module I2C tunnel principle

Debug Port

An optional I²C debug port may be used to access internal I²C debug registers of the SB62xx transceiver within the SK62xx-MOD Transceiver Module. This debug interface has two addresses, selected by the DBG_ADR pin strapping which is resistor stuff option on the module. The debug port allows access to the internal transceiver registers to configure and monitor diagnostic functions. The use of the Debug Port is exclusively for diagnostics, and no I²C control or setup is required.

SK62xx-MOD Transceiver Module when populated with SB6210/SB6212 has its DBG_ADR set high to the address: 0x2A

SK62xx-MOD Transceiver Module when populated with SB6211/SB6213 has its DBG_ADR set low to the address: 0x7C

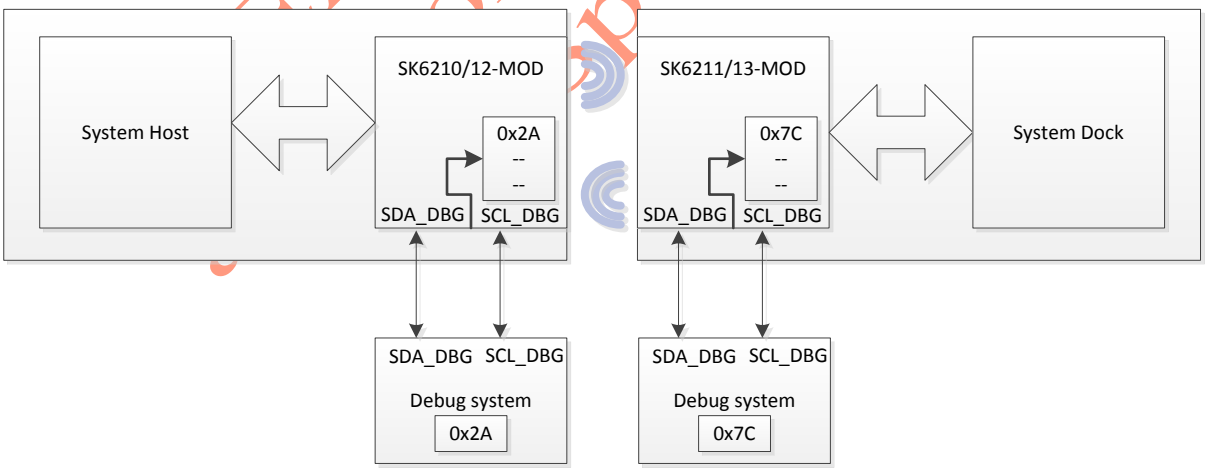


Figure 10. SK62xx-MOD Transceiver Module Local I2C Debug principle

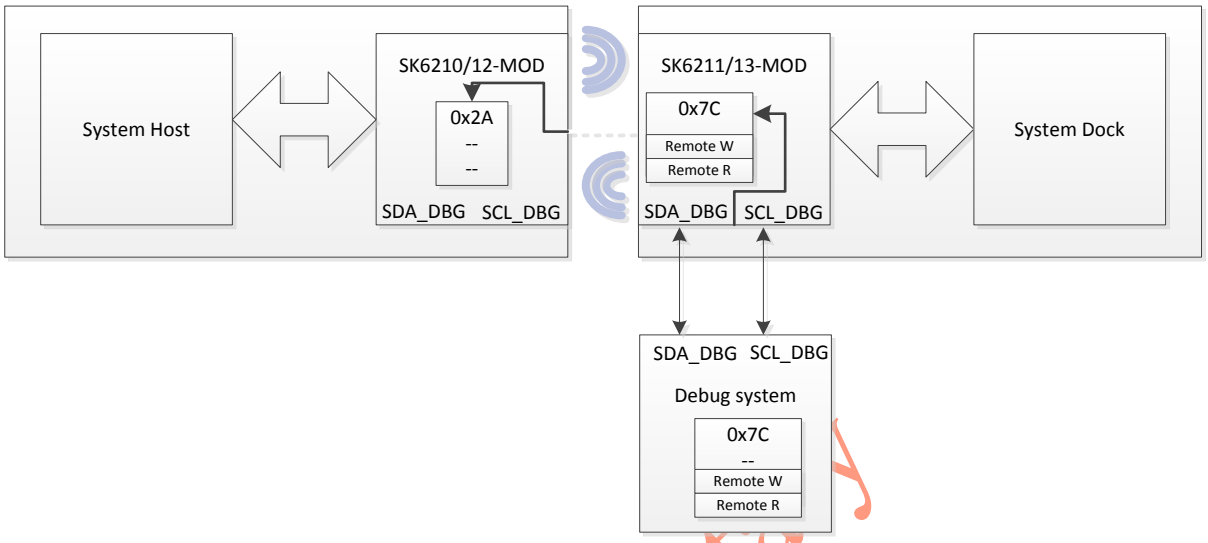


Figure 11. SK62xx-MOD Transceiver Module Remote I2C Debug principle

A unique Feature of the SK62xx-MOD Transceiver Module is the ability to do remote debug. The bottom four registers of each register banks are designed to operate remote I2C access read and write. In a way those remote debug operation are executed in the local I2C register bank by proxy. In this mode only the local register bank is addressed and the address of the remote bank is irrelevant.

The way a remote I2C debug command is executed is by writing the command in 7FC and then specifying the address by writing in 7FD, then read the result or write the value in 7FF and 7FE respectively.

All this is done by addressing the local register bank. Connected to the debug I2C port.

Table 2. remote debug registers description.

Reg	Name	7	6	5	4	3	2	1	0
7FC	Remote command	-	-	-	t.out	err	busy	rd	wr
7FD	Remote address	A[7]	A[6]	A[5]	A[4]	A[3]	A[2]	A[1]	A[0]
7FE	Remote WR	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]
7FF	Remote RD	D[7]	D[6]	D[5]	D[4]	D[3]	A[2]	D[1]	D[0]

GPI , GPO, and LEDO

The SK62xx-MOD Transceiver Module contain a general purpose input (GPI) and a general purpose output (GPO) as well as a dedicated led output (LEDO) pin. At system level those can be routed to a Host MCU or directly to LED devices.

The LEDO will output indicates the state of the wireless link. A persistent low (off state) indicates that the SK6200 Transceiver Module is powered down or being held in reset. A periodic high (blink) indicates that the device is scanning for a connection. A high (on state) indicates that a link is established.

Without a link present, GPO will be low (off state). When a link is established, and the transfer is in the Full speed mode (W0 state), the GPO will reflect the state of the GPI pin on the opposite side of the link. If the GPI pin on the opposite side of the link is left high, the GPO output can be used to indicate a high speed data transfer. If the device goes into a "Detached State", (link established but no data being transferred) the GPO signal will periodically go high (blink).

Each GPI pin can be used to control the state of the GPO pin on the opposite side of the link, but only when the link is in a Full Speed mode (W0 state).

GPI on SK6211/13-MOD to GPO on SK6210/12-MOD can also be used as interrupt function along with the WAKE_UP pin to wake up the wireless link and I2C host for service. Asserting WAKE_UP will force the wireless link to W0 state or stop the link from entering low power modes (W2, W3, IDLE). This combination of WAKE-UP pin and GPO/INT works together with the I2C Tunnel function to prevent the need for polling on the I2C tunnel from the master side.

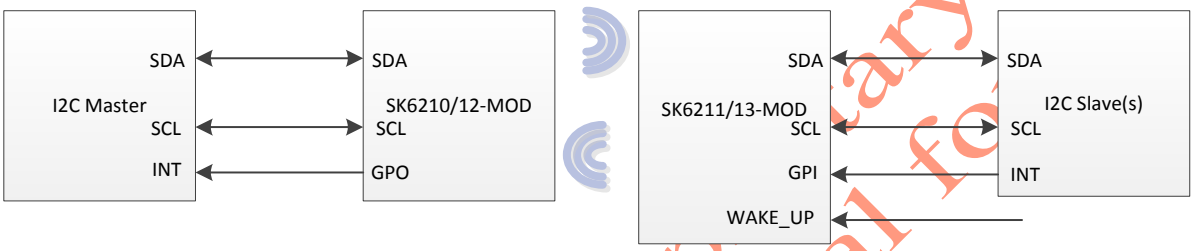


Figure 12. SK62xx-MOD Transceiver Module interrupt based I2C tunnel

Reset

The SK6200 Transceiver Module has an RST input pin that keeps the device in standby. The reset circuit is designed such that if an RST signal is not available. The part will generate an internal RST signal as the device is powered on. In this case, the RST pin should be left connected to GND to avoid any spurious resets during normal operation.

Power States

SK6200 Transceiver Module has an elaborate automatic power state management scheme built in which does not require CPU/Host supervision or control.

When the mobile device is undocked with SK6200 Transceiver Module active the power consumption is only about 5mW.

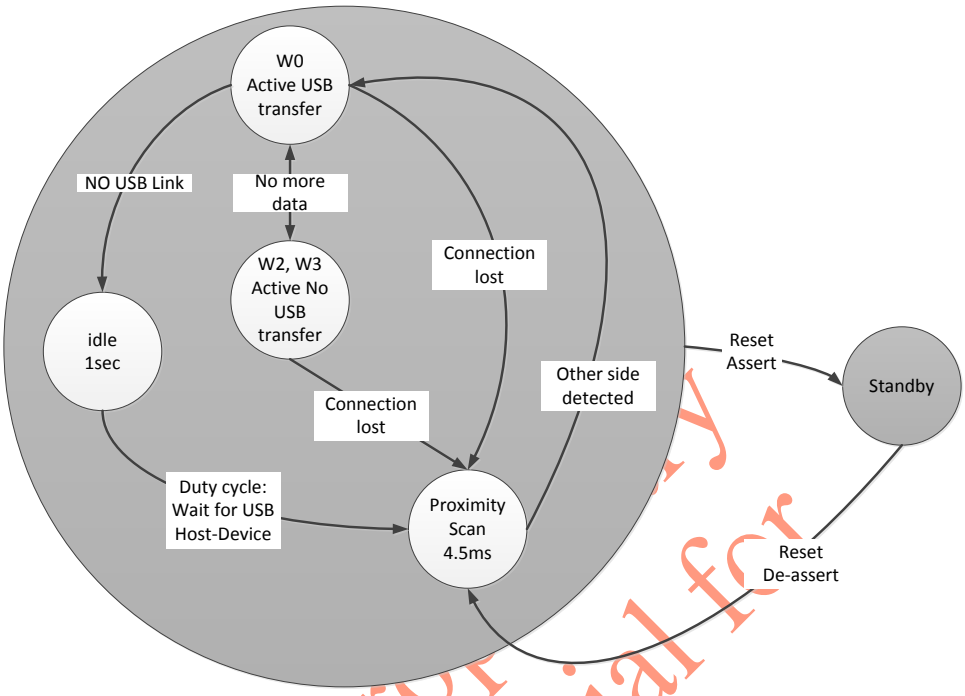
A simple Dock detection mechanism can trigger SK6200 Transceiver Module standby mode and reach a power consumption in the mobile device of about 10uW

It is assumed (in most typical use cases) that the W0 state is only reached when the mobile device is docked to an AC powered accessory.

To comply with some regulations "Flight mode" (all radio OFF) is supported in hardware (RST).

SK6200 Transceiver Module takes full advantage of advanced power profiles defined by USB specs for example, Super speed U2/U3, and USB2.0 SUSPEND/LPM

Design care should be taken when using I2C tunneling or I2C debug features because those will force SNAP to W0 State.



Mechanical Placement for SK62xx-MOD

General consideration

- SK62xx-MOD Transceiver Module operates in the E-Band between 59Ghz and 65Ghz.
- Modulation scheme is OOK which gives 2 isolated wireless links of 6Gbps maximum birate.
- Expected range between 2 aligned chips is 10mm with a link Margin of approximately 5dB.
- This give a target link Budget of 33dB Module to Module
- Package size is 26mm x 10mm x3mm
- Operating on the model of Plug/Receptacle of Physical connectors, odd parts should be mated with a even part. For example SB6210 automatically connects with SB6211 or with SB6213 but will not connect to SB6212.

Antenna position

SB621x has a unique design where the radiating elements (antennas) are built-in the Integrated Circuit substrate and molded into the packaged chip. This makes it simpler for system designers because they may not need

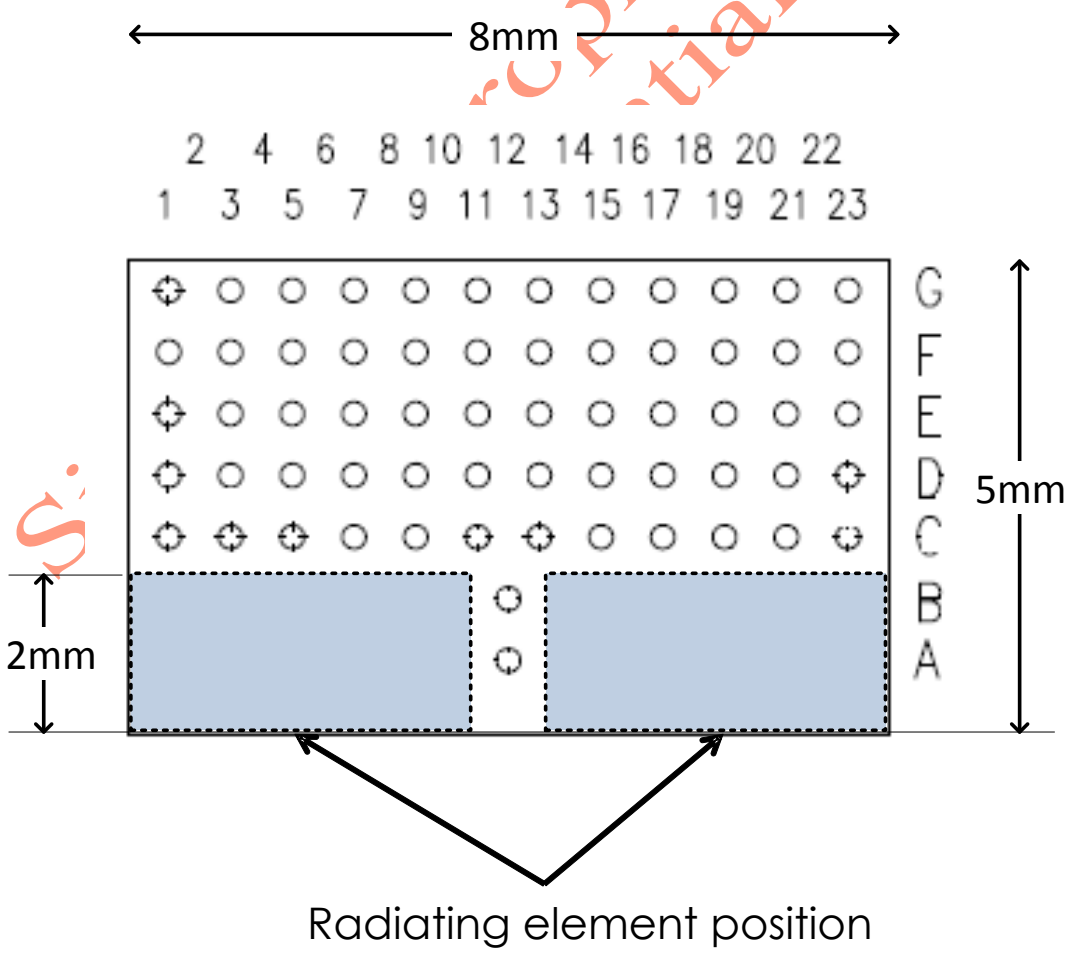


Figure 13. Antenna postion relative to SB621x Package

Antenna configuration

- SB621x have 2 antenna configurations:
  - **SB6210 and SB6211 are called Edge Fire antenna configuration**
  - **SB6212 and SB6213 are called Broad Side antenna configuration**

Edge Fire are built-in antenna design where the center axis or the main radiating lobe is parallel to the chip package surface pointing out of the long edge of the package

Figure 14. Edge Fire antenna configuration

Board Side are built-in antenna design where the center axis of the main radiating lobe is perpendicular to the chip package surface pointing out from the mounting PCB

Figure 15. Broad side antenna configuration

Radiation patterns of SK62xx-MOD

SB6210 Tx

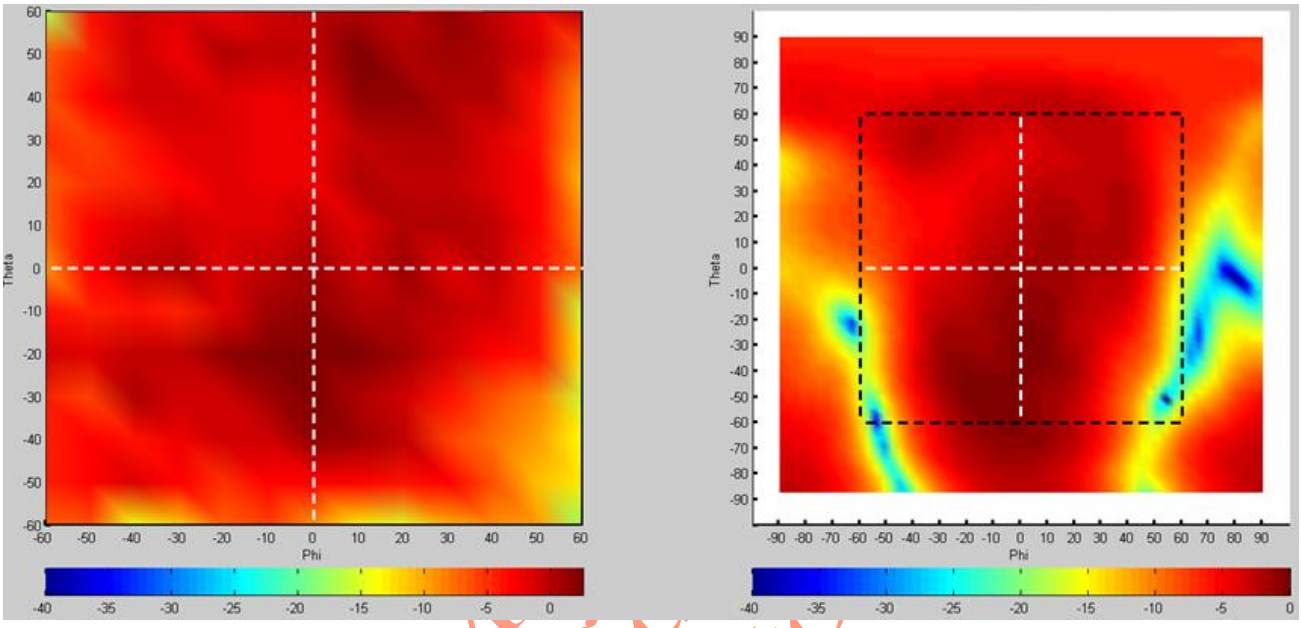


Figure 16. 6210 Tx Measured radiation vs. Simulation

SB6211 Tx

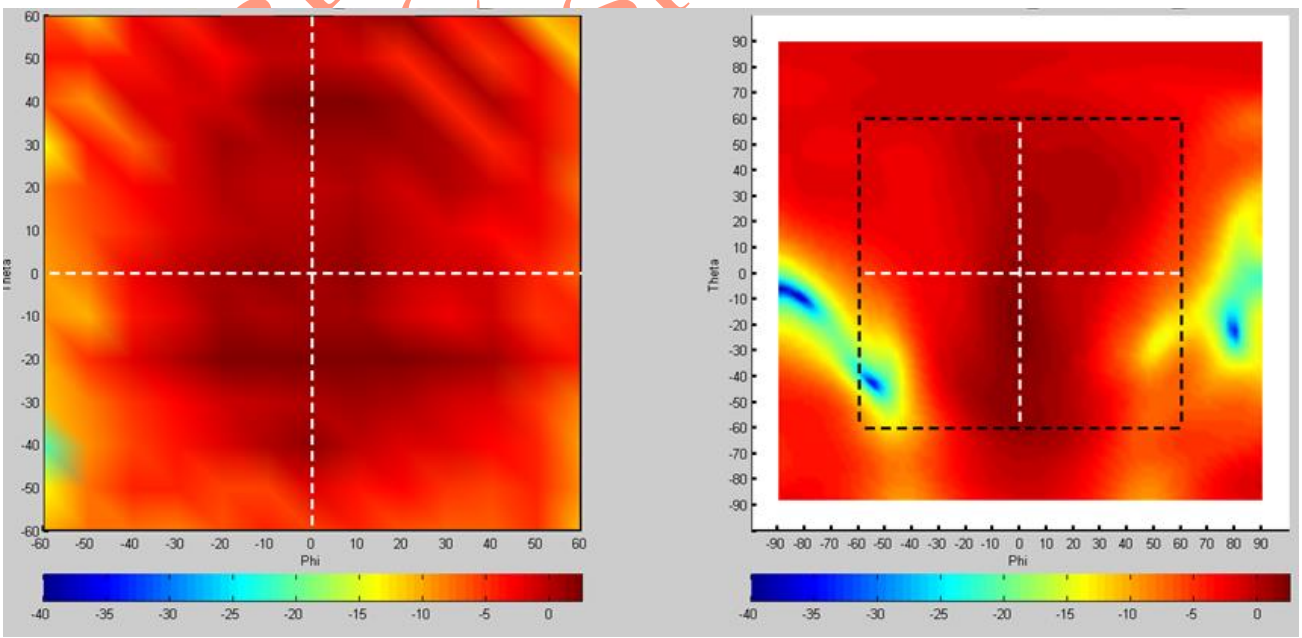


Figure 17. 6211 Tx Measured radiation vs. Simulation

SB6212 Tx

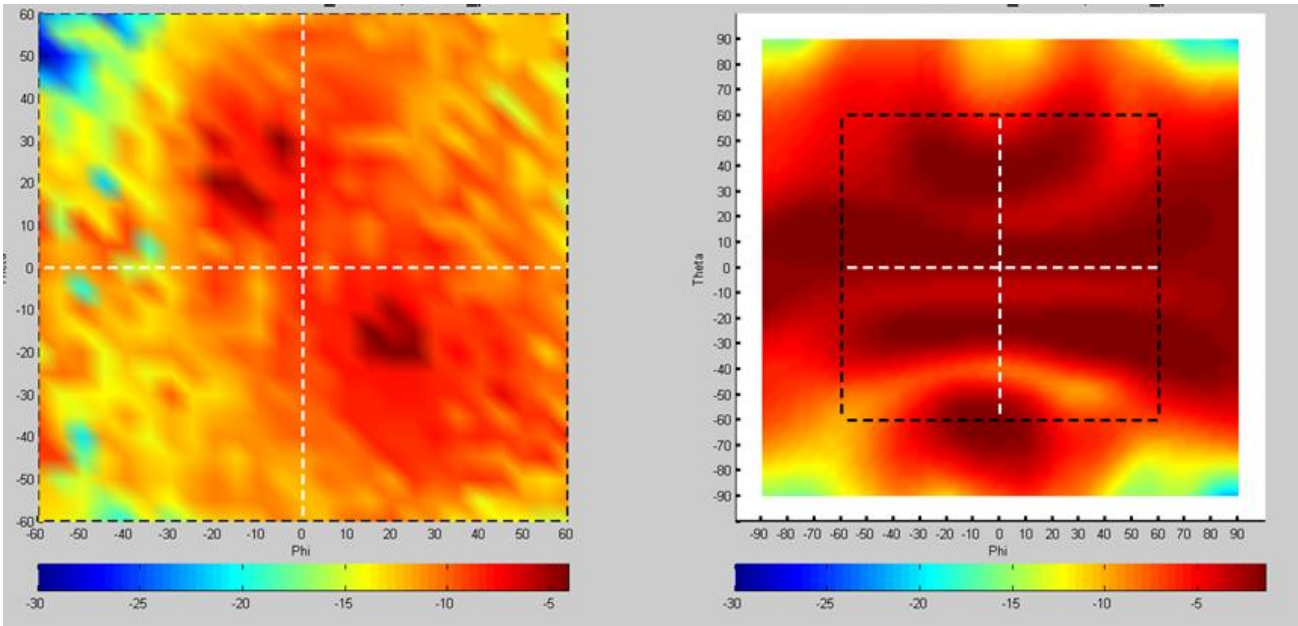


Figure 18. 6212 Tx Measured radiation vs. Simulation

SB6213 Tx

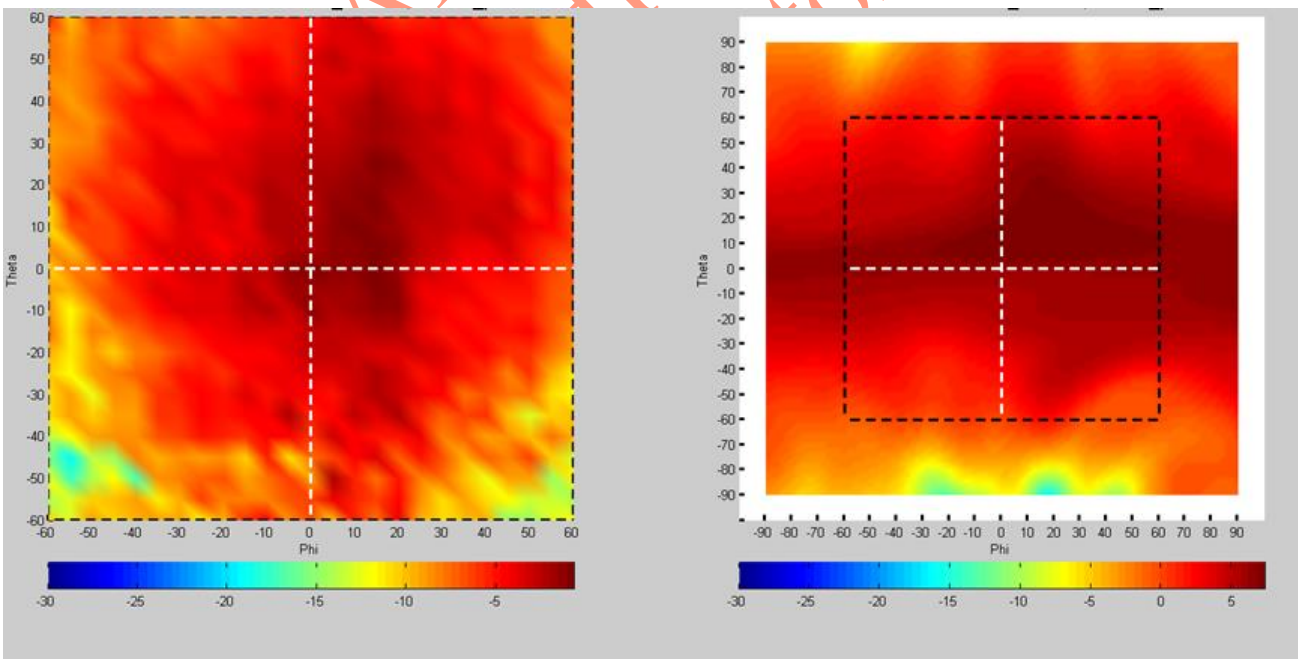


Figure 19. 6213 Tx Measured radiation vs. Simulation

Keep out area

Inside the Keep out volume it is recommended:

- No Layout Traces in PCB
- No ground plane in PCB
- No electronic components
- No Vias in PCB
- No metal parts, fastener or screws.
- No carbon based material,
- No metal paints
- Organic parts may be present in keep out for enclosure purpose:
- ABS, PE, PC is okay, most simple structure are below 2.5dB, which should fit in link margin. Additional loss will result in range reduction.
- Flat surface perpendicular to the beam is preferred,
- No Ribbing, multilayers or complex assembly of several compound.
- Avoid high incidence angle through the material surface.
- <2mm thickness is preferred.
- Representative sample material could be tested, 5cm x 5cm minimum, send to SiBEAM HQ.
- Reflection effects are difficult to predict on simulation model and can cause cross talk or multipath effect, in this case adjustment to mechanical design may be required after prototyping and test.
- Reduction of chip to chip range can help overcome material propagation loss
- Reduction or increase in material thickness may be required

It is not unexepected than the keep-out area can be breached for Industrial Design or other mechanical considerations, in this case, further testing is required, using provided development tools or ask for help with potential simulation models to assess if the impact can be tolerated by the target use case and projected user experience expectation.

Estimated keep out definition for Edge Fire antenna configuration:

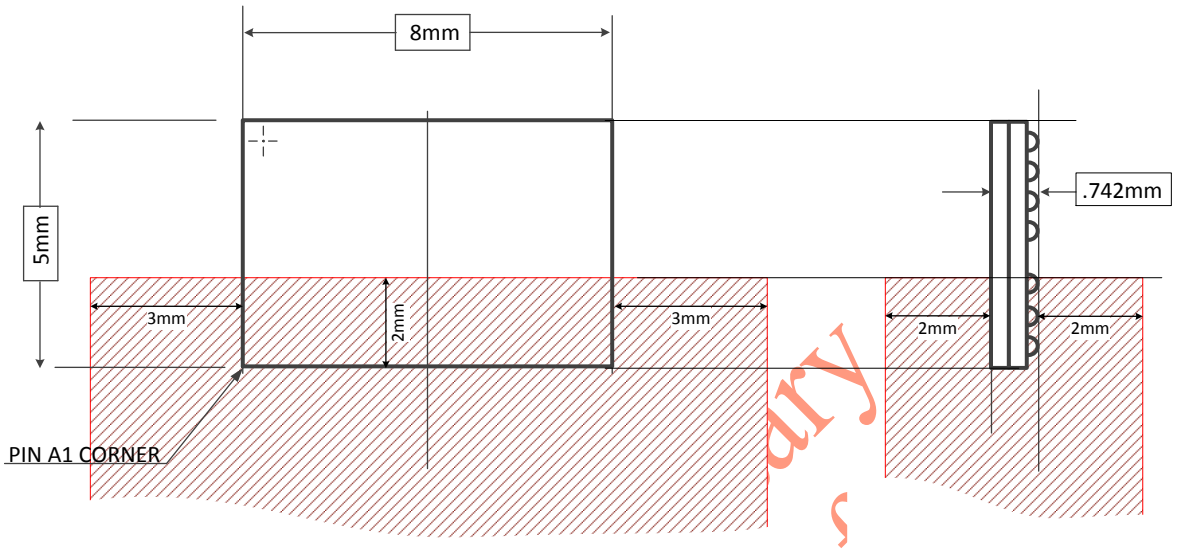


Figure 20. SK6210/11 keep out perimeter

Estimated keep out definition for Broad side antenna configuration:

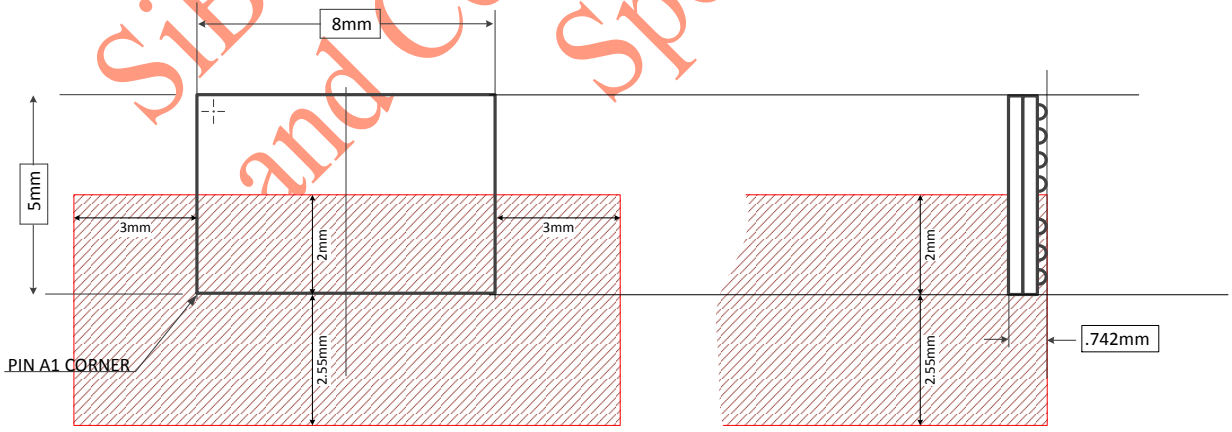


Figure 21. SK6212/13 keep out perimeter

Spectral Mask of SK62xx-MOD

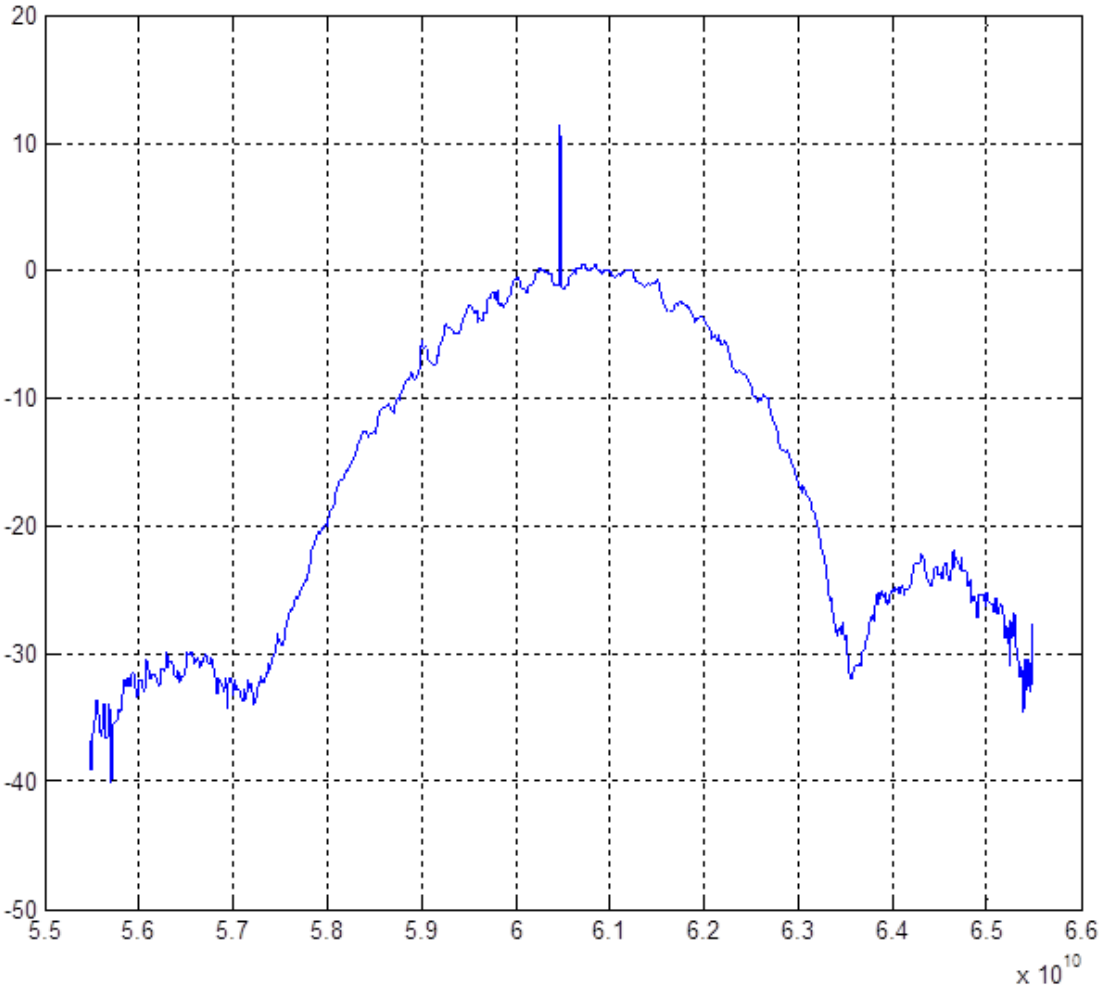


Figure 22. Spectral Mask of SK62xx-MOD Transceiver Module

SK6200 Transceiver Module Specification

Table 3. Module Specifications

Parameter	Value
Mechanical	
Dimensions (mm)	X = 10, Y= 26, Z = 3
Mounting Screw half hole(x 2)	M1.6: ISO 7045:1994 – Pan head screws with type H or type Z
Mounting post diameter (mm)	1
Max Module Case Temperature	90 °C at 60°C ambient
System Connector	B2B, 0.4 mm pitch, 30 pin,
Electrical	
Power Input VIN	3.3 V +/- 5% DC, 200mA
Max Input Voltage Ripple	<10% of VIN peak to peak
Control Serial Port	I^2C 400 kHz, 3.3 V
Max Power	500mW (max)
Connected Power	350mW (typical)
Disconnected Power	5mW
OFF, Disable Power	<10 mA (max)
Radio Frequencies	
Operating Frequency	59–65GHz
Channel Bandwidth	6GHz
Radiated Power (EIRP)	3 dBm (average)
Transmit Antenna Gain	0 dBi
Receiver Sensitivity	-38 dBm (typical)
Noise Figure	10 dB (typical)
10mm Link Margin	5dB (typical)
Compliance and Regulation (not submitted yet)	
FCC	Part 15 subpart C
IC	Part 15 subpart C
EU	Host independent approval (modular): - EN302567 - EN301489-28 - EN62311 - EN55022

Ordering Information

Production Part Numbers:

Module:	Part Number
SK62xx-MOD Transceiver Module mobile side edge	SK6210-MOD
SK62xx-MOD Transceiver Module dock side edge	SK6211-MOD
SK62xx-MOD Transceiver Module mobile side broad	SK6212-MOD
SK62xx-MOD Transceiver Module dock side broad	SK6213-MOD
SK62xx Module development kit edge to egde configuration	SK621011
SK62xx Module development kit broad to board configuration	SK621213
SK62xx Module development kit edge to broad configuration	SK621013

Additional Information

To obtain additional information, contact your local Lattice Semiconductor sales office, or visit the SiBEAM website at www.sibeam.com or Lattice Semiconductor web site at www.latticesemi.com.

Revision History

Rev.	Date	Description
0.70	03/30/2015	First preliminary release.
0.80	**01/21/2016**	**Preliminary Release taking rev3 silicon into account.**