

# SPK Bluetooth 4.0 Dual Mode USB HCI module datasheet

Doc. Version : 20151020

<b>Product ID</b>	<b>EBM-A18/ eBD-A18 PCBA</b>
<b>Product Name</b>	<b>Bluetooth 4.0 dual mode USB HCI module/Dongle</b>
<b>Firmware Version</b>	
<b>Hardware Version</b>	<b>Rev.1.0.1</b>

## 1. DESCRIPTION

EBM-A18 is a single-chip radio and baseband solution for Bluetooth 2.4GHz systems including EDR to 3Mbps. Dedicated signal and baseband processing is included for full Bluetooth operation. SPK designed CSR8510 based EBM-A18 module/dongle PCBA to reduce PCB area and the number of external components, including no requirement for an external balun.

## 2. FEATURES

- Support for Bluetooth low energy available with CSR8510WLCSP
- Fully qualified Bluetooth® v4.0 specification system
- Dual-mode Bluetooth/Bluetooth low energy operation
- HCI mode operation with full Bluetooth stack
- HID proxy mode for boot mode support and stackless operation
- High-sensitivity Bluetooth and Bluetooth low energy receiver
- Class 1/2/3 support without external power amplifier or TX/RX switch
- Baseband processor running Bluetooth HCI firmware stack
- Full-speed USB 2.0 interface
- RFKill functionality for PCs (hardware and software radio enable controls)
- WLAN coexistence interface
- External EEPROM I2C interface
- On-chip synthesizer
- Internal power regulation for self-contained operation from USB vbus for dongles
- Selectable I/O voltage
- Real-time signal strength indicator (RSSI)

- Dimensions:  
15.0 mm x 11.3 mm x 1.8 mm(with printed antenna)
- Storage temperature range: -40°C ~ +85°C
- Operating temperature range: -30°C ~ +85°C

### 3. APPLICATIONS

A. Computing devices including:

- PCs
- All-in-Ones
- Laptops
- Netbooks
- Tablets

B. Embedded home entertainment devices including:

- Digital TVs
- Set-top Boxes

C. After-market low-power Bluetooth accessories:

- USB dongles

#### 3.1 Device Details

##### 3.1.1 Bluetooth low energy

- Dual-mode Bluetooth low energy operation
- Support for Bluetooth basic rate/EDR and low energy connections
- 5 Bluetooth low energy connections at the same time as basic rate A2DP

##### 3.1.2 Bluetooth Radio

- Integrated balun (50Ω impedance in TX and RX modes)
- No external trimming is required in production
- Bluetooth v4.0 specification compliant

##### 3.1.3 Bluetooth Transmitter

- Typical 9.7dBm RF transmit power with level control from on-chip 6-bit DAC over a dynamic range >30dB
- Class 1, Class 2 and Class 3 support without need for external PA or TX/RX switch

##### 3.1.4 Bluetooth Receiver

- Typical receive sensitivity of -91dBm for basic rate
- Integrated channel filters
- Digital demodulator for improved sensitivity and cochannel rejection
- Real-time digitized RSSI available on HCI interface

- Fast AGC for enhanced dynamic range
- Channel classification for AFH

### **3.1.5 Synthesiser**

- Fully integrated synthesiser requires no external VCO varactor diode, resonator or loop filter
- Compatible with external clock 16MHz to 40MHz and crystal oscillator 16MHz to 32MHz

### **3.1.6 Baseband and Software**

- Internal RAM enables full-speed data transfer, mixed voice and data, and full piconet operation, including all medium rate packet types
- Logic for forward error correction, header error control, access code correlation, CRC, demodulation, encryption bit stream generation, whitening and transmit pulse shaping. Includes support for eSCO and AFH.

### **3.1.7 Bluetooth Stack**

A. Support for Bluetooth v4.0 specification features:

- Master and slave operation
- Including encryption

B. Software stack in firmware includes:

- GAP
- L2CAP
- Security Manager
- Attribute protocol
- Attribute profile
- Bluetooth low energy profile support

### **3.1.8 Physical Interfaces**

- Full-speed (12Mbps) USB 2.0 interface
- Synchronous serial interface up to 4Mbps for system debugging

### **3.1.9 Auxiliary Features**

A. Power management includes digital shutdown and wake up commands with an integrated low power oscillator

B. Integrated linear regulators:

- USB: USB bus supply to 3.3V
- High-voltage: 2.3V to 4.8V input to 1.85V
- Low-voltage: VDD\_DIG, VDD\_RADIO and VDD\_AUX regulators

C. Power-on-reset cell detects low supply voltage

D. Arbitrary sequencing of power supplies is permitted

## 4. MEMORY INTERFACE AND MANAGEMENT

### 4.1 Memory Management Unit

The MMU provides a number of dynamically allocated ring buffers that hold the data that is in transit between the host and the air. The dynamic allocation of memory ensures efficient use of the available RAM and is performed by a hardware MMU to minimise the overheads on the processor during data/voice transfers.

### 4.2 System RAM

56KB of integrated RAM supports the RISC MCU and is shared between the ring buffers for holding voice/data for each active connection and the general-purpose memory required by the Bluetooth stack.

### 4.3 Internal ROM Memory (5Mb)

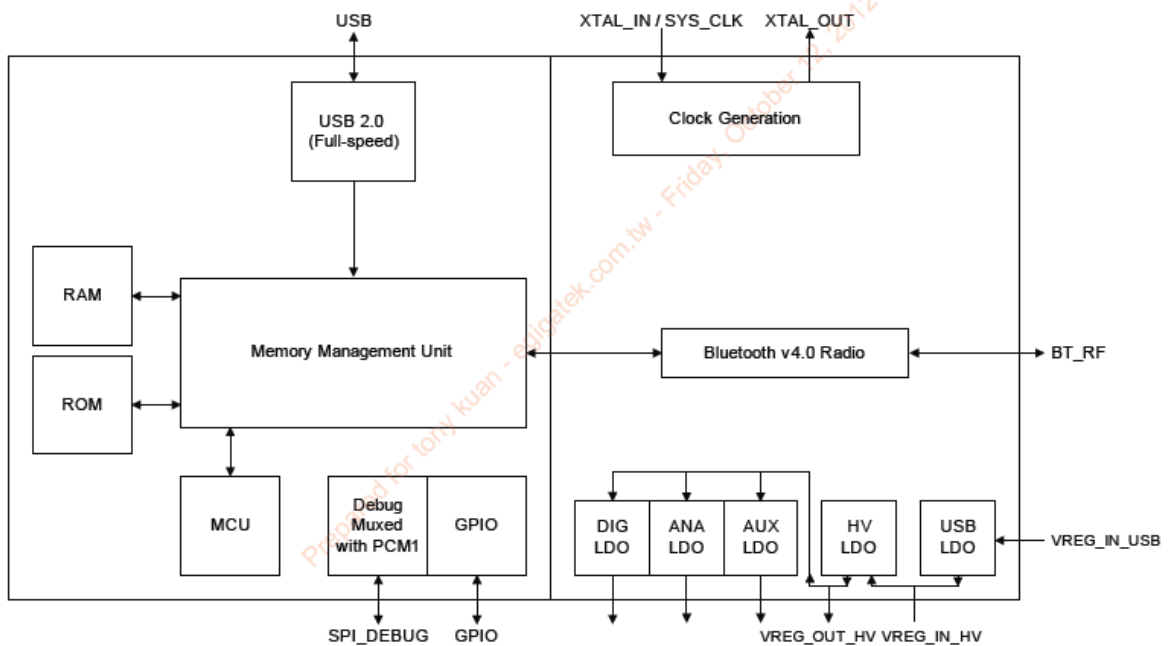
5Mb of internal ROM memory is available on CSR8510 WLCSP. This memory is provided for system firmware, storing CSR8510 WLCSP settings and program code.

### 4.4 EEPROM

Uses an 16Kb I<sup>2</sup>C EEPROM to store device specific configuration information (PS Keys) such as Bluetooth address and USB descriptors.

EEPROM	EBM-A18	Description
SCL	PIO 【3】	I <sup>2</sup> C clock
SA	PIO 【4】	I <sup>2</sup> C data
WP	NC	Write protect, tie the EEPROM WP line active on PCB.

## 5. BLOCK DIAGRAM



## 6. ELECTRICAL CHARACTERISTICS

### 6.1 Absolute Maximum Ratings

Rating	Min	Max	Unit
Storage temperature	-40	+85	°C
VREG_IN_USB	-0.4	5.75	V
VREG_IN_HV	-0.4	4.8	V
VDD_HOST	-0.4	3.6	V
VDD_PADS	-0.4	3.6	V
Other terminal voltages	VSS-0.4	VDD+0.4	V

### 6.2 Recommended Operating Conditions

Operating Condition	Min	Max	Unit
Operating temperature range	-30	85	°C
VREG_IN_USB	4.25	5.75	V
VREG_IN_HV	3.0	4.8	V
VDD_HOST	3.1	3.6	V
VDD_PADS	1.2	3.6	V

### 6.3 Input/Output Terminal Characteristics

#### 6.3.1 USB Linear Regulator

Normal Operation	Min	Typ	Max	Unit
Input voltage	4.25	5.0	5.75	V
Output voltage	3.2	3.3	3.4	V
Output current	-	-	150	mA
Output current available for external use	-	-	50	mA

### 6.3.2 High-voltage Linear Regulator

Normal Operation	Min	Typ	Max	Unit
Input voltage	2.3	3.3	4.8	V
Output voltage	1.75	1.85	1.95	V
Temperature coefficient	-200	-	200	ppm/°C
Output noise(frequency range 100Hz to 100kHz)	-	-	0.4	mV rms
Settling time(settling to within 10% of final value)	-	-	5	μs
Output current	-	-	100	mA

### 6.3.3 Low-voltage VDD\_DIG Linear Regulator

Normal Operation	Min	Typ	Max	Unit
Output voltage	0.90	-	1.25	V
Output current	-	-	30	mA

### 6.3.4 Low-voltage VDD\_AUX Linear Regulator

Normal Operation	Min	Typ	Max	Unit
Output voltage	1.30	1.35	1.40	V
Output current	-	-	5	mA

### 6.3.5 Low-voltage VDD\_DIG Linear Regulator

Normal Operation	Min	Typ	Max	Unit
Output voltage	1.30	1.35	1.45	V
Output current	-	-	60	mA

### 6.3.6 Digital

Digital Terminals	Min	Typ	Max	Unit
Input Voltage				
V <sub>IL</sub> input logic level low	-0.4	-	0.4	V
V <sub>IH</sub> input logic level high	0.7 x VDD	-	VDD+0.4	V
Output Voltage				
V <sub>OL</sub> output logic level low, I <sub>OL</sub> = 4.0mA	-	-	0.4	V
V <sub>OH</sub> output logic level high, I <sub>OH</sub> = -4.0mA	0.75 x VDD	-	-	V
Input and Tristate Currents				
Strong pull-up	-150	-40	-10	μA

Strong pull-down	10	40	150	μA
Weak pull-up	-5	-1.0	-0.33	μA
Weak pull-down	0.33	1.0	5.0	μA
C <sub>i</sub> input capacitance	1.0	-	5.0	pF
<b>PIO</b>				
Source current(driving high)	-	-	8	mA
Sink current(driving low)	-	-	8	mA

### 6.3.7 Clock

Clock Source	Min	Typ	Max	Unit
<b>External Clock</b>				
XTAL_IN input resistance	30	-	-	kΩ
XTAL_IN input capacitance	-	-	4	pF

### 6.3.8 Sleep Clock

Leep Clock		Min	Typ	Max	Unit	
Frequency <sup>(a)</sup>		30	32.768	35	kHz	
Frequency tolerance <sup>(b)</sup>		-	-	250	±ppm	
Duty Cycle		30:70	50:50	70:30	%	
Jitter		f <sub>ref</sub> = 32.768kHz				
Integrated rms jitter 10Hz to 20kHz		-	-	20	ns rms	
Phase noise	f <sub>ref</sub> = 32.768kHz	1kHz offset	-	-	-100	dBc/Hz
		10kHz offset	-	-	-120	
Digital input, values as 6.3.6						

## 7. SERIAL INTERFACES

### 7.1 USB Interface

EBM-A18 has a full-speed (12Mbps) USB interface for communicating with other compatible digital devices. The USB interface acts as a USB peripheral, responding to requests from a master host controller. EBM-A18 supports the USB v2.0 Specification) and the application note describes:

- Power distribution for high and low bus-powered configurations
- Power distribution for self-powered configuration, which includes USB VBUS monitoring
- USB enumeration
- Electrical design guidelines for the power supply and data lines, as well as PCB tracks and the effects of ferrite beads
- USB suspend modes and Bluetooth low-power modes:
  - Global suspend
  - Selective suspend, includes remote wake
  - Wake on Bluetooth, includes permitted devices and set-up prior to selective suspend
  - Suspend mode current draw
  - PIO status in suspend mode
  - Resume, detach and wake PIOs
- Battery charging from USB, which describes dead battery provision, charge currents, charging in suspend modes and USB VBUS voltage consideration
- USB termination when interface is not in use

## 8. AUDIO INTERFACES

EBM-A18 has two digital audio interfaces that are configurable as either PCM or I<sup>2</sup>S ports.

### 8.1 PCM Interface

The audio PCM interface on the EBM-A18 supports:

- Continuous transmission and reception of PCM encoded audio data over Bluetooth.
- Processor overhead reduction through hardware support for continual transmission and reception of PCM data.
- A bidirectional digital audio interface that routes directly into the baseband layer of the firmware. It does not pass through the HCI protocol layer.
- Hardware on CSR8510 WLCSP for sending data to and from a SCO connection.
- Up to 3 SCO connections on the PCM interface at any one time.



- PCM interface master, generating PCM\_SYNC and PCM\_CLK.
- PCM interface slave, accepting externally generated PCM\_SYNC and PCM\_CLK.
- Various clock formats including:
  - Long Frame Sync
  - Short Frame Sync
  - GCI timing environments
- 13-bit or 16-bit linear, 8-bit  $\mu$ -law or A-law companded sample formats.
- Receives and transmits on any selection of 3 of the first 4 slots following PCM\_SYNC.

The PCM configuration options are enabled by setting PSKEY\_PCM\_CONFIG32.

### 8.1.1 PCM Interface Master/Slave

When configured as the master of the PCM interface, CSR8510 generates PCM\_CLK and PCM\_SYNC.

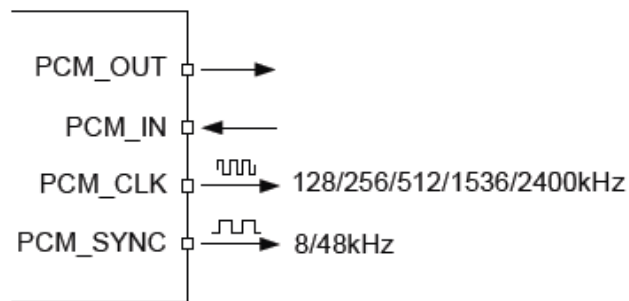


Figure 8.1: PCM Interface Master

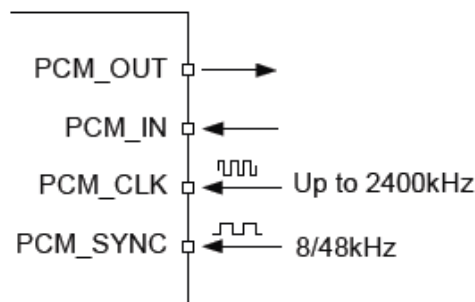
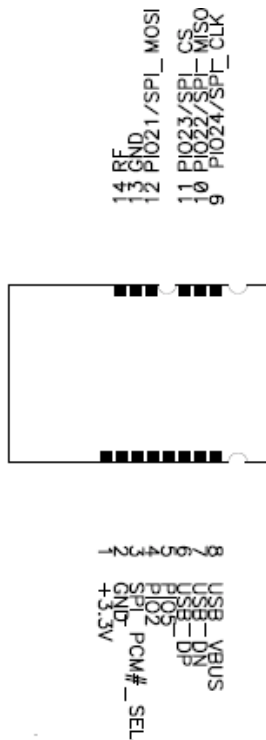


Figure 8.2: PCM Interface Slave

## 9. PIN DESCRIPTION

### 9.1 Pin Numbering



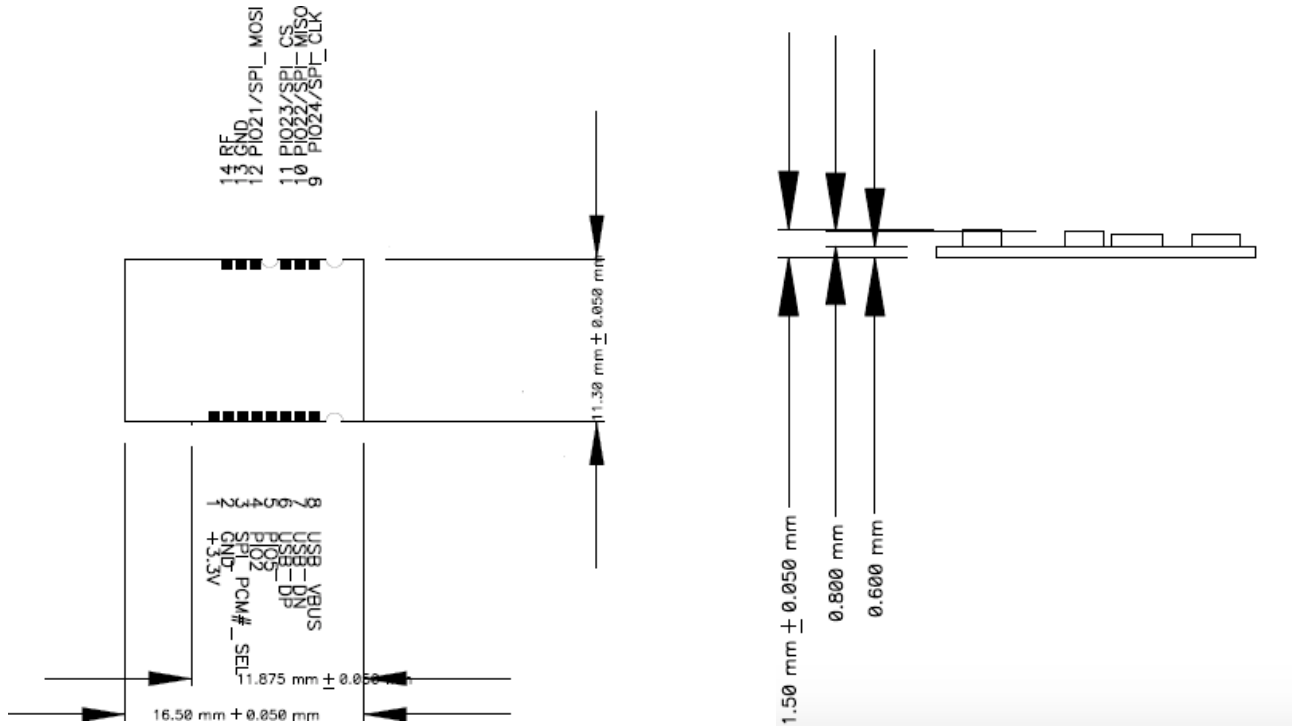
### 9.2 Pin Definition

PIN Name	No	Description
VREG_IN_HV	1	+3.3V
GND	2	Ground
SPI_PCM#_SEL	3	High switches SPI/PCM lines to SPI, low switches SPI/PCM lines to PCM/PIO use.
PIO2	4	Programmable Input/Output line.
PIO5	5	Programmable Input/Output line.
USB_DP	6	USB data plus with selectable
USB_DN	7	USB data minus
USB_VBUS	8	+5V in
PIO24/SPI_CLK	9	PCM synchronous data clock SPI clock Programmable Input/Output line.
PIO22/SPI_MISO	10	PCM synchronous data output SPI data output Programmable Input/Output line.

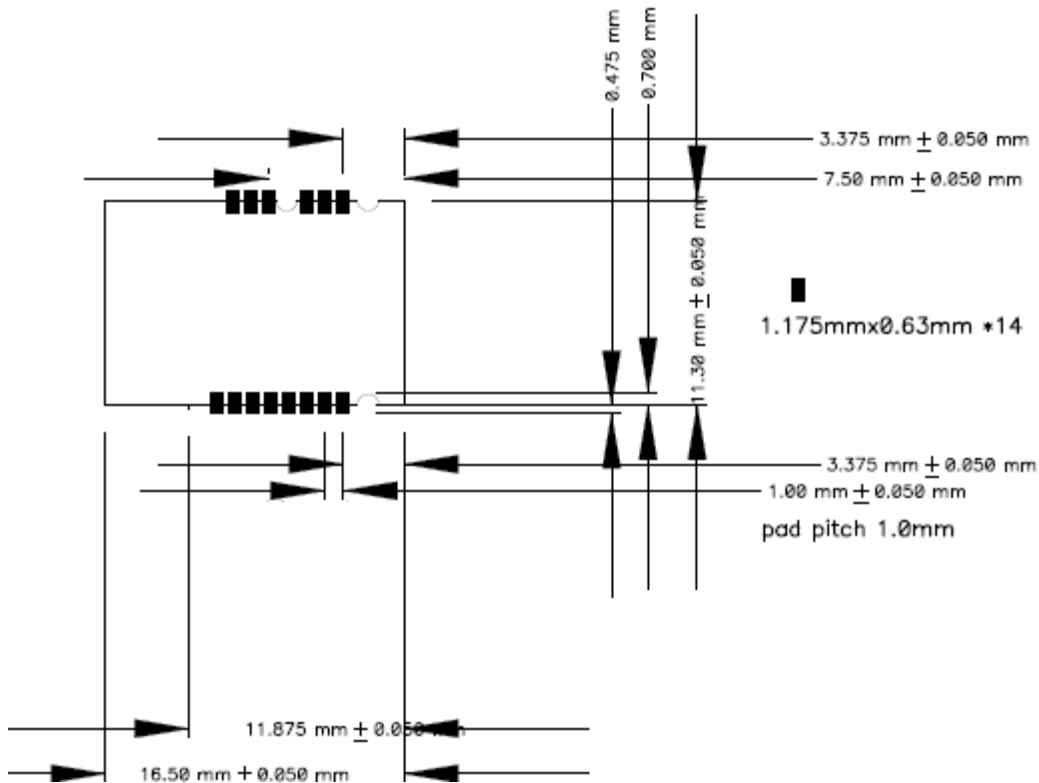
PIO23/SPI_CS	11	PCM synchronous data sync SPI chip select, active low Programmable Input/Output line.
PIO21/SPI_MOSI	12	PCM synchronous data input SPI data input Programmable Input/Output line.
GND	13	Ground
RF	14	Bluetooth transmitter/receiver port

# 10. MECHANICAL CHARACTERISTICS

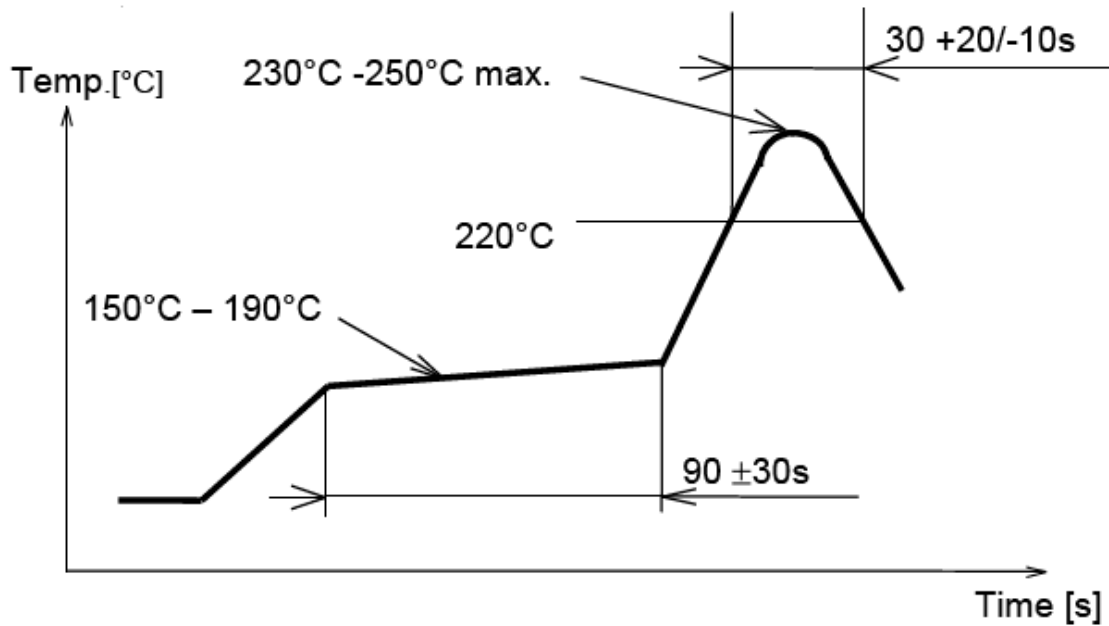
## 10.1 Dimensions



## 10.2 Recommended Land Pattern



### 10.3 Typical Solder Reflow Profile

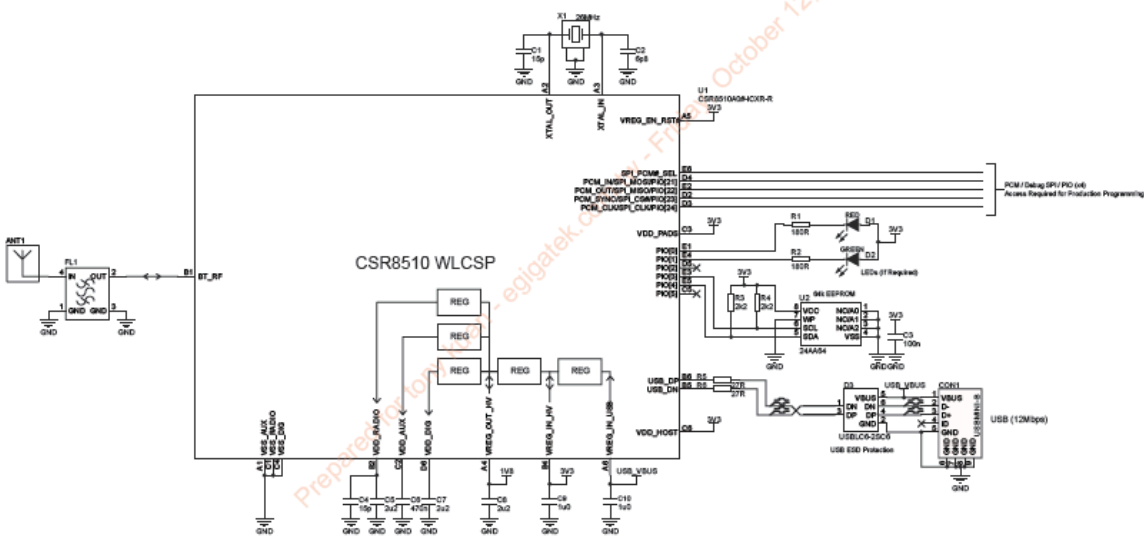


### 10.4 Housing Guidelines

The individual case must be checked to decide whether a specific housing is suitable for the use of the internal antenna. A plastic housing must at least fulfill the following requirements:

- ✧ Non-conductive material, non-RF-blocking plastics
- ✧ No metallic coating
- ✧ ABS is suggested

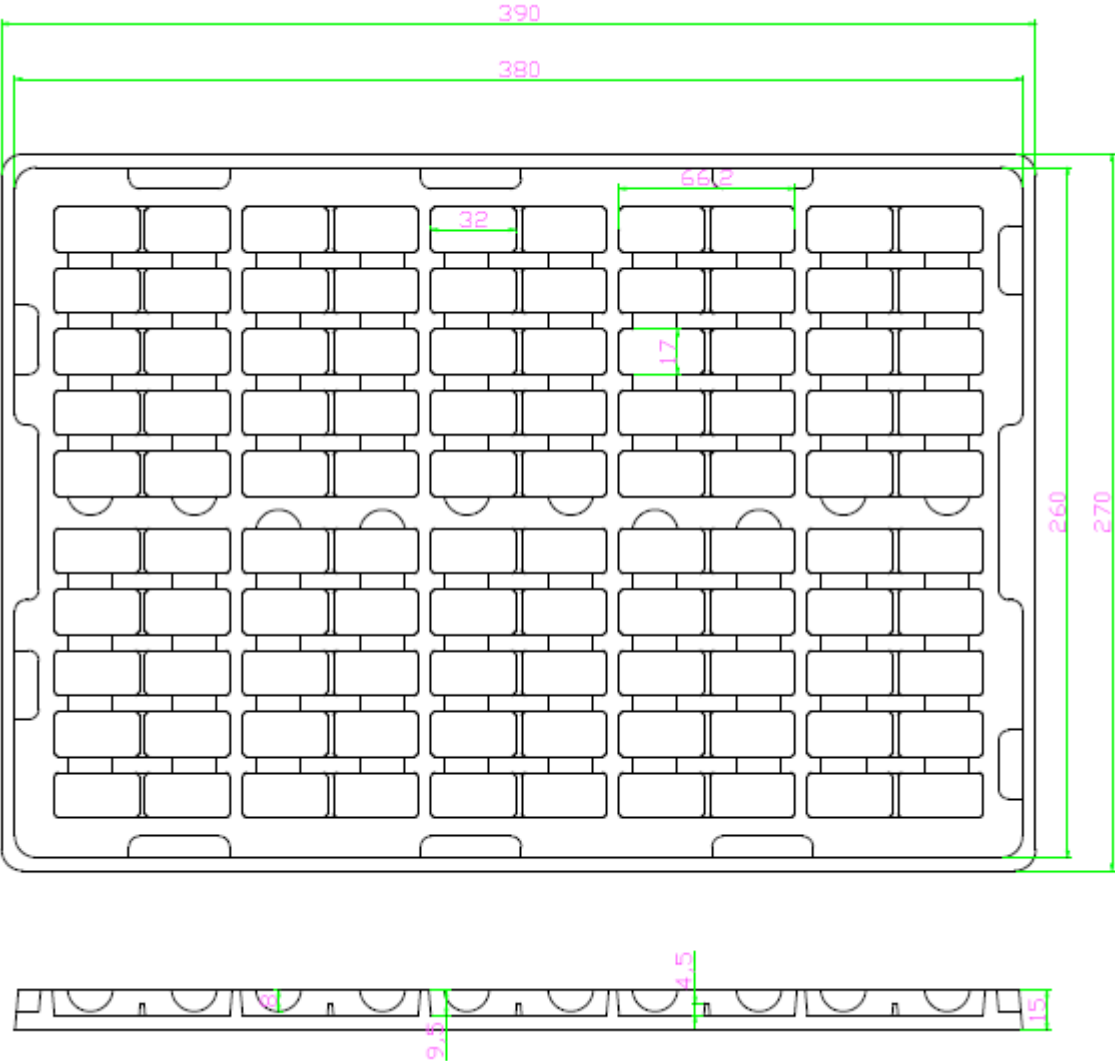
# 10.5 Application schematic



# 11. PACKAGE

## Tray Type

- a. Carrier not be exceed 1mm in 100mm.
- b. Packing dimensions meet : 390mm \* 270mm \* 15mm
- c. Material : white anti-static polystyrene
- d. Component load per tray : 100pcs



## SPK Bluetooth module design data