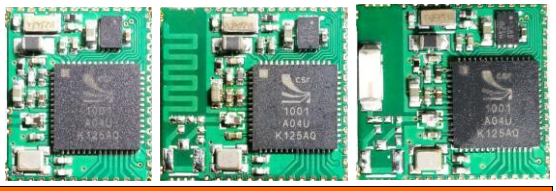
SPK Bluetooth 4.0 LE Single Mode module datasheet

Doc. Version : 20131220



Product ID	**EBM-A21A/B/C**
Product Name	**Bluetooth 4.0 LE single mode(KB) module**
Firmware Version	
Hardware Version	**Rev.1.0.2**

1. DESCRIPTION

EBM-A21 is product from CSR's single-mode keyboard Bluetooth Low Energy solution. CSR μEnergy enables ultra low-power connectivity and basic data transfer for applications previously limited by the power consumption, size constraints and complexity of other wireless standards. The CSR μEnergy platform provides everything required to create a Bluetooth low energy product with RF, baseband, MCU, qualified Bluetooth v4.0 stack and customer application running on a single IC.

2. FEATURES

■ Bluetooth Low Energy available with CSR1011 QFN
■ Bluetooth v4.0 specification
■ Single mode Bluetooth low energy
■ 7.5dBm Bluetooth low energy maximum TX output power
■ -92.5dBm Bluetooth low energy RX sensitivity
■ Support for Bluetooth v4.0 specification host stack including:
ATT, GATT, SMP, L2CAP, GAP
■ RSSI monitoring for proximity applications
■ <600nA ultra low consumption in dormant mode
■ Integrated 32kHz and 16MHz crystal or system clock
■ Switch-mode power supply
■ Programmable general purpose PIO controller
■ 10-bit ADC
■ 32 digital PIOs
■ 3 analogue AIOs
■ UART

■ 512KB EEPROM
■ Debug SPI
■ 3 PWM modules
■ Wake-up interrupt
■ 64KB RAM and 64KB ROM
■ Watchdog timer
■ Dimensions:
13.5 mm x 16.5 mm x 1.8 mm(EBM-A21A)
17.75 mm x 16.5 mm x 1.8 mm
(EBM-A21B with printed antenna/EBM-A21C with integrated chip antenna)
■ Storage temperature range: -40℃ ~ +85℃
■ Operating temperature range: -30℃ ~ +85℃

3. APPLICATIONS

Building an ecosystem using Bluetooth low energy

Bluetooth low energy enables the transfer of simple data sets between compact devices opening up a completely new class of Bluetooth applications such as watches, TV remote controls, medical sensors and fitness trainers.

Bluetooth low energy takes less time to make a connection than conventional Bluetooth wireless technology and can consume approximately 1/20th of the power of Bluetooth Basic Rate. Supports profiles for sensors, watches, HIDs and time synchronization.

Typical Bluetooth low energy applications:

■ Sports and fitness
■ Healthcare
■ Home entertainment
■ Office and mobile accessories
■ Automotive
■ Commercial
■ Watches
■ Human interface devices

3.1 Device Details

3.1.1 Bluetooth Radio

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

3.1.2 Bluetooth Transmitter

■ 7.5dBm RF transmit power with level control from integrated 6-bit DAC over a dynamic

range >30dB

- No external power amplifier or TX/RX switch required

3.1.3 Bluetooth Receiver

- -92.5dBm sensitivity
- Integrated channel filters
- Digital demodulator for improved sensitivity and cochannel rejection
- Fast AGC for enhanced dynamic range

3.1.4 Synthesiser

- Fully integrated synthesiser requires no external VCO varactor diode, resonator or loop filter

3.1.5 Baseband and Software

- Hardware MAC for all packet types enables packet handling without the need to involve the MCU

3.1.6 Physical Interfaces

- SPI master interface
- SPI programming and debug interface
- I²C
- Digital PIOs
- Analogue AIOs

3.1.7 Auxiliary Features

- Battery monitor
- Power management features include software shutdown and hardware wake-up
- Run in low power modes from an external 32.768kHz clock signal
- Integrated switch-mode power supply
- Linear regulator (internal use only)
- Power-on-reset cell detects low supply voltage

3.1.8 Bluetooth Stack

- Support for Bluetooth v4.0 specification features:
- Master and slave operation
- Including encryption
- Software stack in firmware includes:
- GAP
- L2CAP
- Security manager

- Attribute protocol
- Attribute profile
- Bluetooth low energy profile support

4. ELECTRICAL CHARACTERISTICS

4.1 Absolute Maximum Ratings

Rating	Min	Max	Unit
Storage temperature	-40	+85	℃
Battery (VDD_BAT) operation(a)	1.8	3.6	V
I/O supply voltage	-0.4	3.6	V
Other terminal voltages	VSS-0.4	VDD+0.4	V

(a) Short-term operation up to a maximum of 10% of product lifetime is permissible without damage, but output regulation and other specifications are not guaranteed in excess of 4.2V.

4.2 Recommended Operating Conditions

Operating Condition	Min	Typ	Max	Unit
Operating temperature range	-30	-	85	℃
Battery (VDD_BAT) operation	1.8	-	3.6	V
I/O supply voltage (VDD_PADS)	1.2	-	3.6	V

4.3 Input/Output Terminal Characteristics

4.3.1 Switch-mode Regulator

Switch-mode Regulator	Min	Typ	Max	Unit
Input voltage	1.8	-	3.6	V
Output voltage	0.65	1.35	1.35	V3.6
Temperature coefficient	-200	-	200	ppm/℃
Normal Operation				
Output noise, frequency range 100Hz to 100kHz	-	-	0.4	mV rms
Settling time, settling to within 10% of final value	-	-	30	μs
Output current (Imax)	-	-	50	mA
Quiescent current (excluding load, Iload < 1mA)	-	-	20	μA
Ultra Low-power Mode				
Output current (Imax)	-	-	100	μA
Quiescent current	-	-	1	μA

4.3.2 Low-voltage Linear Regulator

Normal Operation	Min	Typ	Max	Unit
Input voltage	0.65	-	1.35	V
Output voltage	0.65	-	1.20	V

4,3,3 Digital Terminals

Input Voltage Levels	Min	Typ	Max	Unit
VIL input logic level low	-0.4	-	0.4	V
VIH input logic level high	0.7 x VDD	-	VDD+0.4	V
T_r/T_f	-	-	25	ns

Output Voltage Levels	Min	Typ	Max	Unit
VOL output logic level low, lOL = 4.0mA	-	-	0.4	V
VOH output logic level high, lOH = -4.0mA	0.75 x VDD	-	-	V
T_r/T_f	1.2	-	5	ns

Input and Tristate Currents	Min	Typ	Max	Unit
With strong pull-up	-150	-40	-10	µA
I₹ with strong pull-up	-250	-	-	µA
With strong pull-down	10	40	150	µA
With weak pull-up	-5.0	-1.0	-0.33	µA
With weak pull-down	0.33	1.0	5.0	µA
CI input capacitance	1.0	-	5.0	pF

4.3.4 AIO

Input Voltage Levels	Min	Typ	Max	Unit
Input voltage	0	-	1.3	V

5. CURRENT CONSUMPTION

Mode	Description	Total Typical Current at 3V
Dormant	All functions are shutdown. To wake up toggle the WAKE pin.	<600nA
Hibernate	VDD_PADS = ON, REFCLK = OFF, SLEEPCLK = ON, VDD_BAT = ON	<1.5µA
Deep sleep	VDD_PADS = ON, REFCLK = OFF, SLEEPCLK = ON, VDD_BAT = ON, RAM = ON, digital circuits = ON, SMPS = ON (low-power mode), 1ms wake-up time	<5µA
Idle	VDD_PADS = ON, REFCLK = ON, SLEEPCLK = ON, VDD_BAT = ON, RAM = ON, digital circuits = ON, MCU = IDLE, <1µs wake-up time	-1mA
RX / TX active	-	~16mA @ 3V peak current

6. SERIAL INTERFACES

6.1 Application Interface

6.1.1 UART Interface

EBM-A21 provides a simple mechanism for communicating with other serial devices using the RS232 protocol. 2 signals implement the UART function, UART_TX and UART_RX. When EBM-A20 is connected to another digital device, UART_RX and UART_TX transfer data between the 2 devices.
UART configuration parameters, e.g. baud rate and data format, are set using EBM-A21 firmware. When selected in firmware PIO[0] is assigned to a UART_TX output and PIO[1] is assigned to a UART_RX input. The UART CTS and RTS signals can be assigned to any PIO pin by the on-chip firmware.

Note: To communicate with the UART at its maximum data rate using a standard PC, the PC requires an accelerated serial port adapter card.

Parameter		Possible Values
Baud rate	Minimum	1200 baud (≤2%Error)
		9600 baud (≤1%Error)
	Maximum	2Mbaud (≤1%Error)
Flow control		CTS / RTS
Parity		None, Odd or Even
Number of stop bits		1 or 2
Bits per byte		8

Table 6.1: Possible UART Settings

6.1.1.1 UART Configuration While in Deep Sleep

The maximum baud rate is 9600 baud during deep sleep.

6.2 SPI Master Interface

The SPI master memory interface in the module is overlaid to uses a further 3 PIOs for the extra pins.

SPI Interface	Pin
Flash_VDD	PIO[2]
SF_DIN	PIO[3]
SF_CS#	PIO[4]
SF_CLK	I2C_SCL
SF_DOUT	I2C_SDA

Table 6.2: SPI Master Serial Flash Memory Interface

7. PIN DESCRIPTION

7.1 Pin Numbering

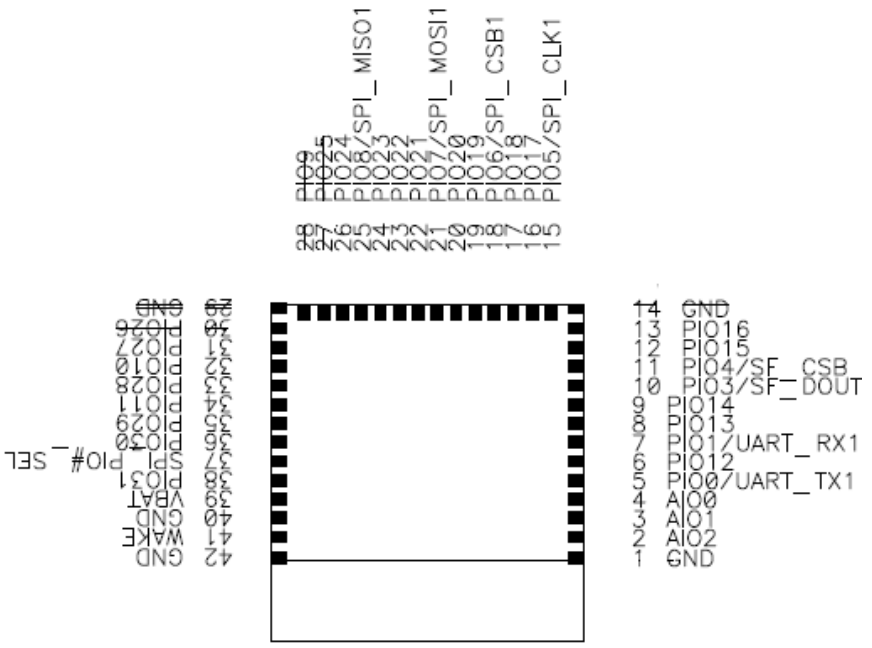


Figure 7.1 EBM-A21C and EBM-A21B Pin Numbering

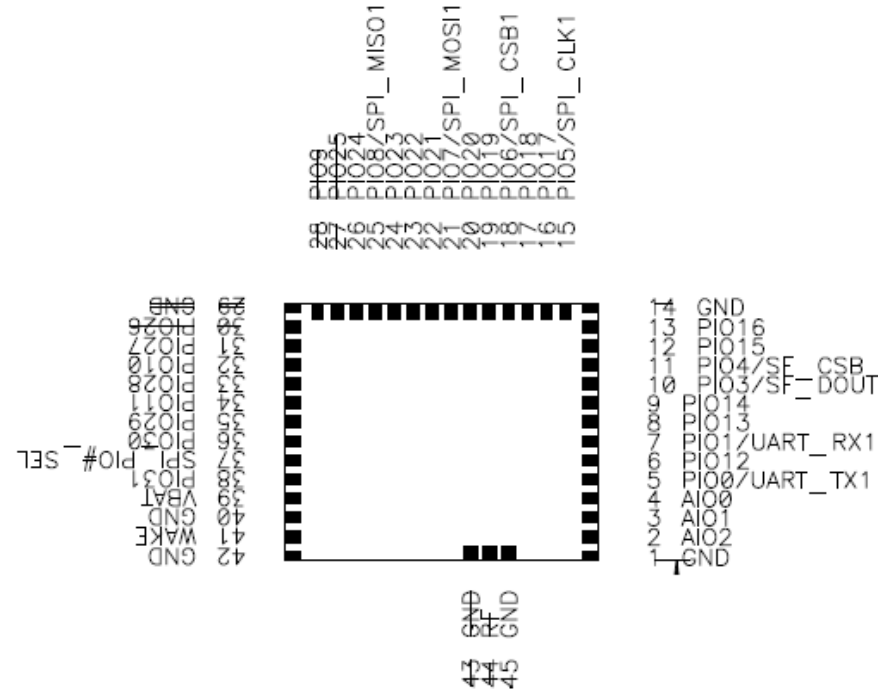


Figure 7.2 EBM-A21A Pin Numbering

7.2 Pin Definition

PIN Name	No		Description
GND	1		Ground
AIO2	2		Analogue programmable I/O line.
AIO1	3		Analogue programmable I/O line.
AIO0	4		Analogue programmable I/O line.
PIO1/UART_TX1	5		Programmable I/O line or UART TX
PIO12	6		Programmable I/O line.
PIO0/UART_RX1	7		Programmable I/O line or UART RX
PIO13	8		Programmable I/O line.
PIO14	9		Programmable I/O line.
PIO3/SF_DOUT	10		Programmable I/O line or SPI serial flash data (SF_DIN) input. If connecting to SPI serial flash, this pin connects to SI on the
PIO4/SF_CSB	11		Programmable I/O line or SPI serial flash chip select (SF_CS#)
PIO15	12		Programmable I/O line.
PIO16	13		Programmable I/O line.
GND	14		Ground
PIO5/SPI_CLK1	15		Programmable I/O line or debug SPI CLK selected by SPI_PIO#.
PIO17	16		Programmable I/O line.
PIO18	17		Programmable I/O line.
PIO6/SPI_CSB1	18		Programmable I/O line or debug SPI chip select(CS#) selected by SPI_PIO#
PIO19	19		Programmable I/O line
PIO20	20		Programmable I/O line
PIO7/SPI_MOSI1	21		Programmable I/O line or debug SPI MOSI selected by SPI_PIO#
PIO21	22		Programmable I/O line
PIO22	23		Programmable I/O line
PIO23	24		Programmable I/O line or SPI serial flash data (SF_DOUT) output
PIO8/SPI_MISO1	25		Programmable I/O line or debug SPI MISO selected by SPI_PIO#
PIO24	26		Programmable I/O line

PIO25	27		Programmable I/O line
PIO9	28		Programmable I/O line.
GND	29		Programmable I/O line
PIO26	30		Programmable I/O line
PIO27	31		Programmable I/O line
PIO10	32		Programmable I/O line
PIO28	33		Programmable I/O line
PIO11	34		Programmable I/O line
PIO29	35		Programmable I/O line
PIO30	36		Programmable I/O line
SPI_PIO#_SEL	37		Selects SPI debug on PIO[8:5]
PIO31	38		Programmable I/O line
VBAT	39		Programmable I/O line or debug SPI MISO selected by SPI_PIO#
GND	40		Ground
WAKE	41		Input to wake CSR1011 QFN from hibernate or dormant
GND	42		Ground
GND	43		Ground(for EBM-A21A only)
RF	44		Bluetooth transmitter/receiver(for EBM-A21A only)
GND	45		Ground(for EBM-A21A only)

8. MECHANICAL CHARACTERICS

8.1 Dimensions

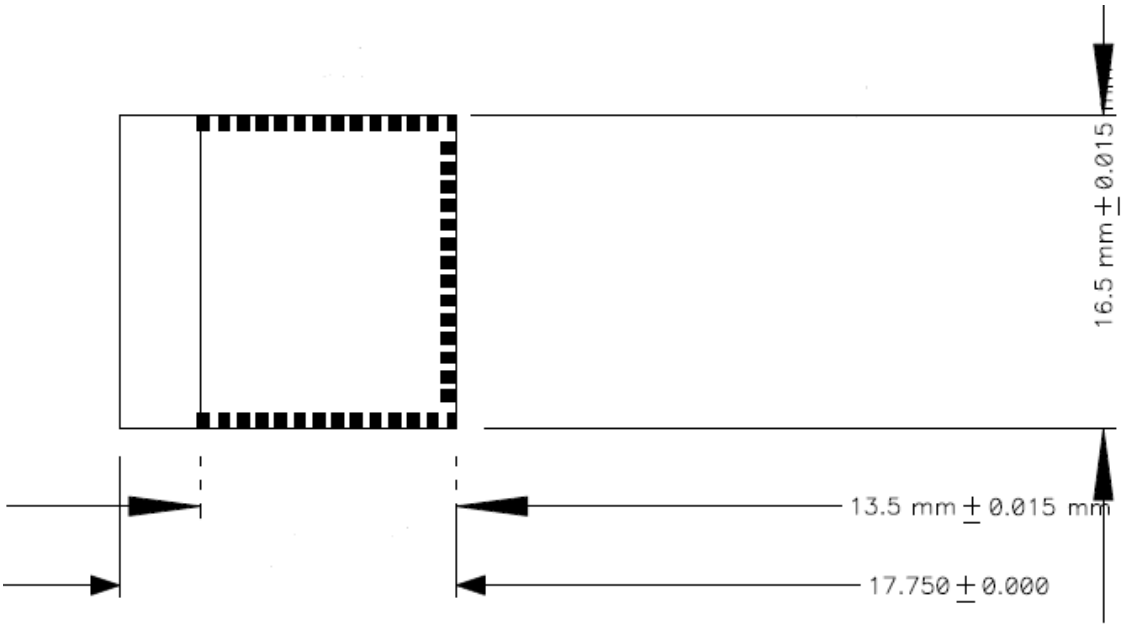


Figure 8.1 EBM-A21C and EBM-A21B dimension

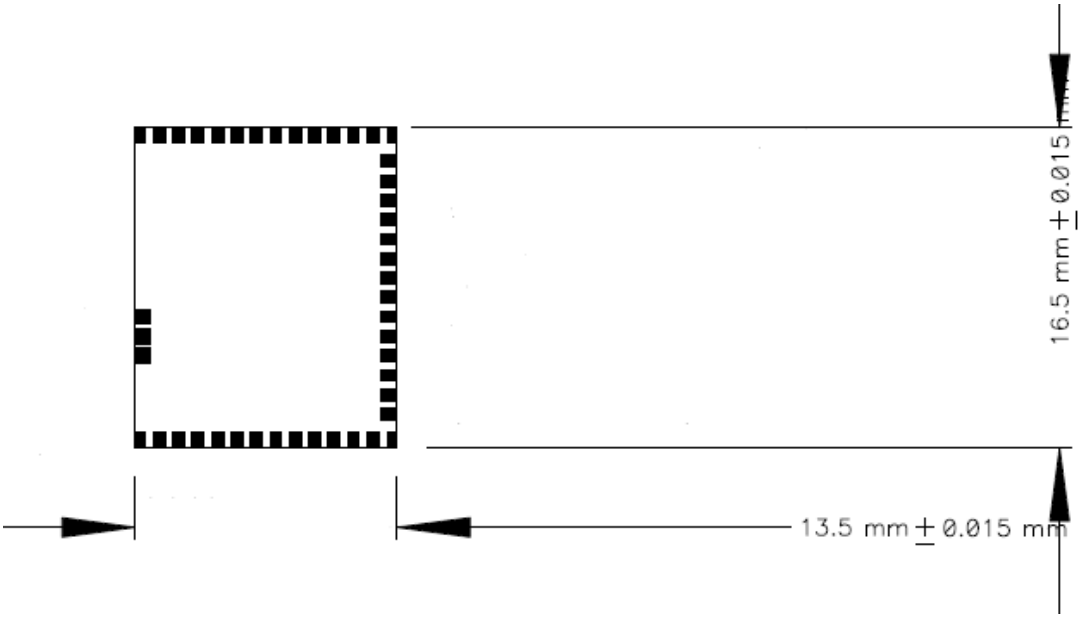


Figure 8.2 EBM-A21A dimension

8.2 Recommended Land Pattern

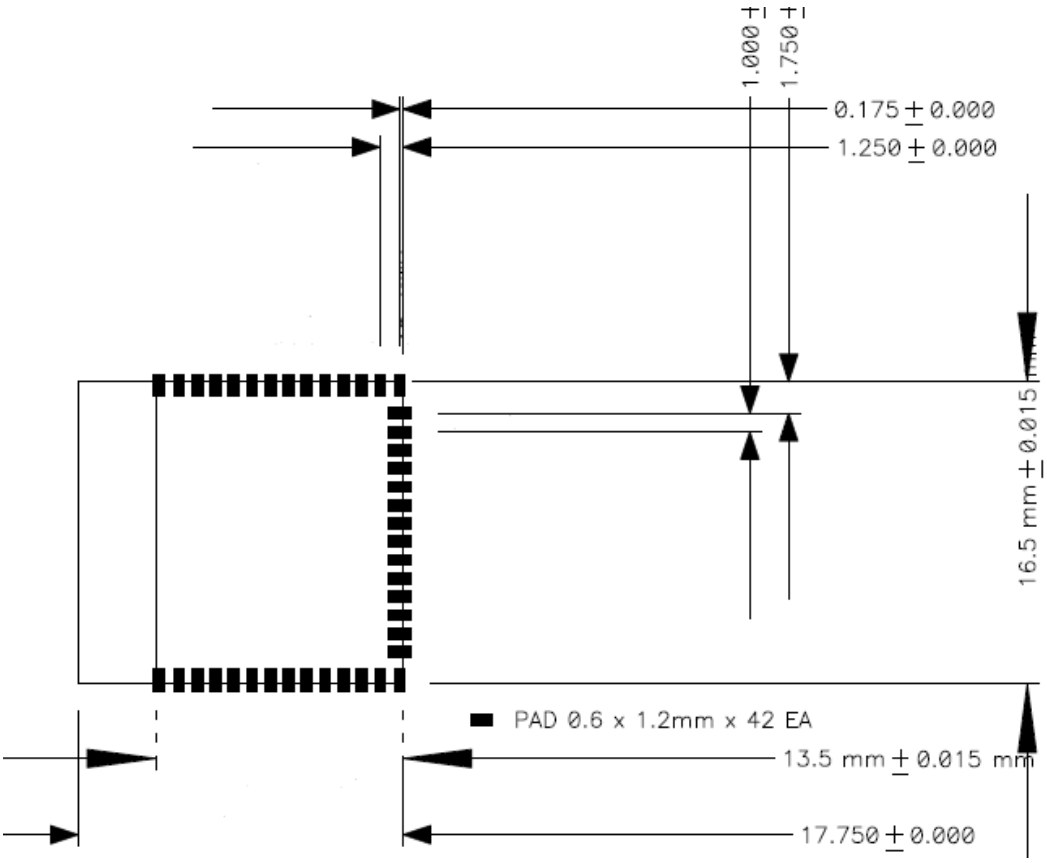


Figure 8.4 EBM-A21B and EBM-A21C land pattern

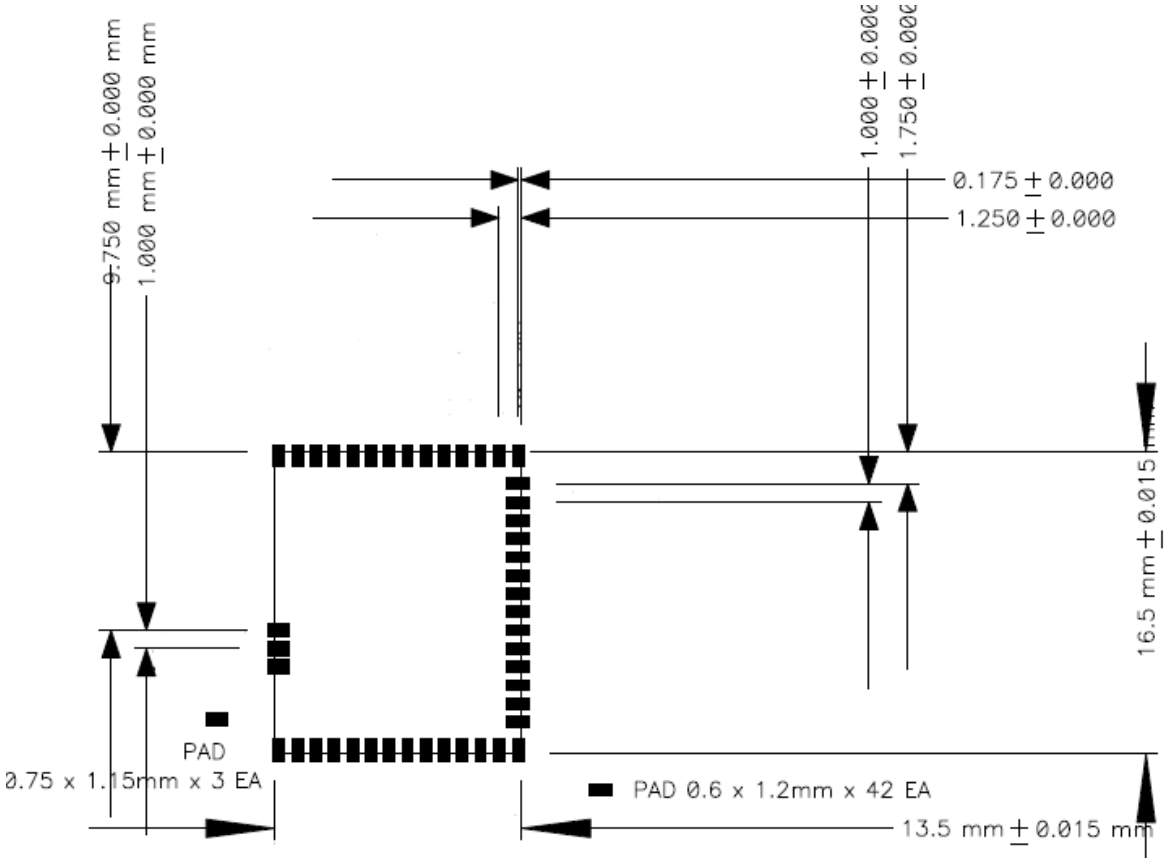
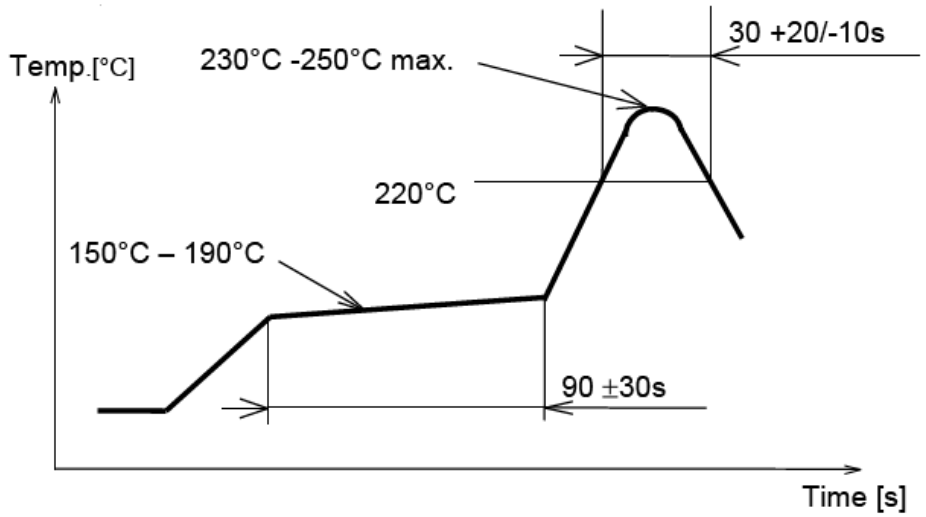


Figure 8.5 EBM-A21A land pattern

8.3 Typical Solder Reflow Profile

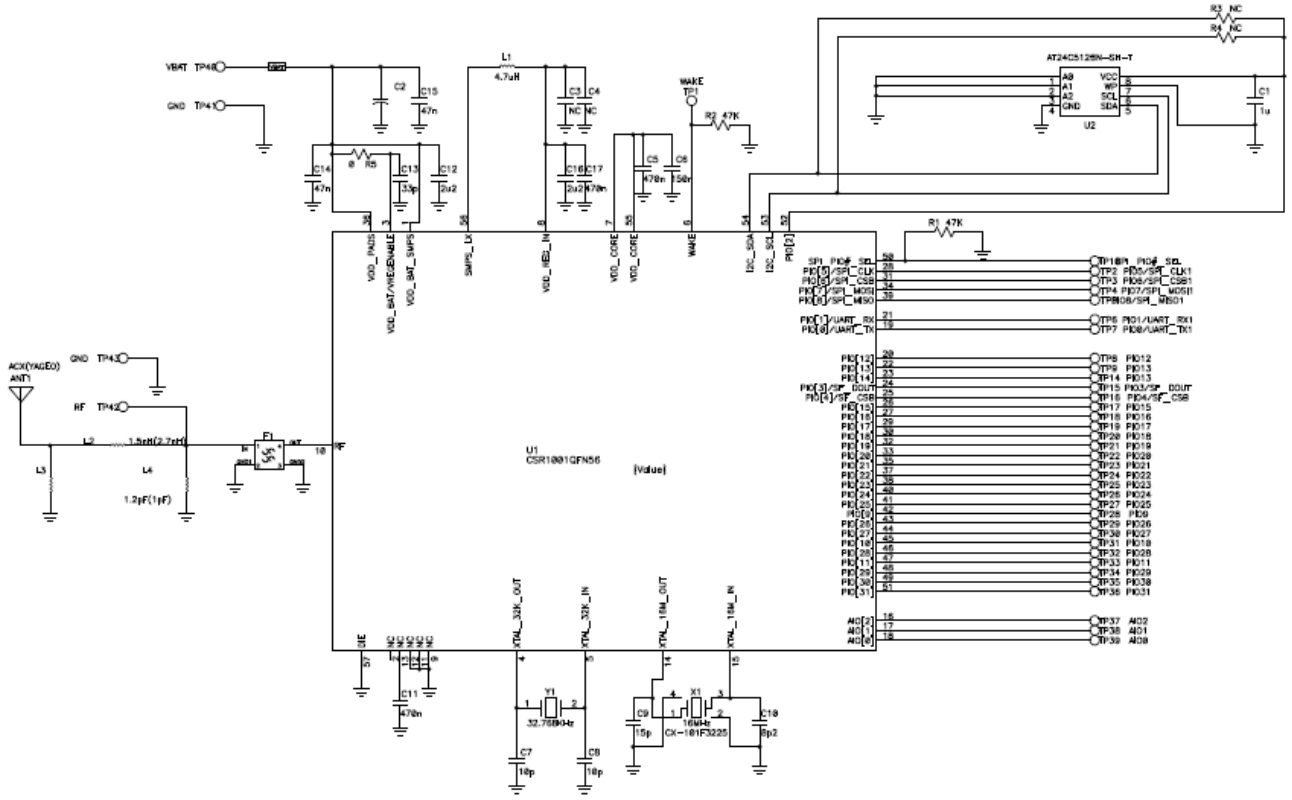


8.4 Housing Guidelines

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

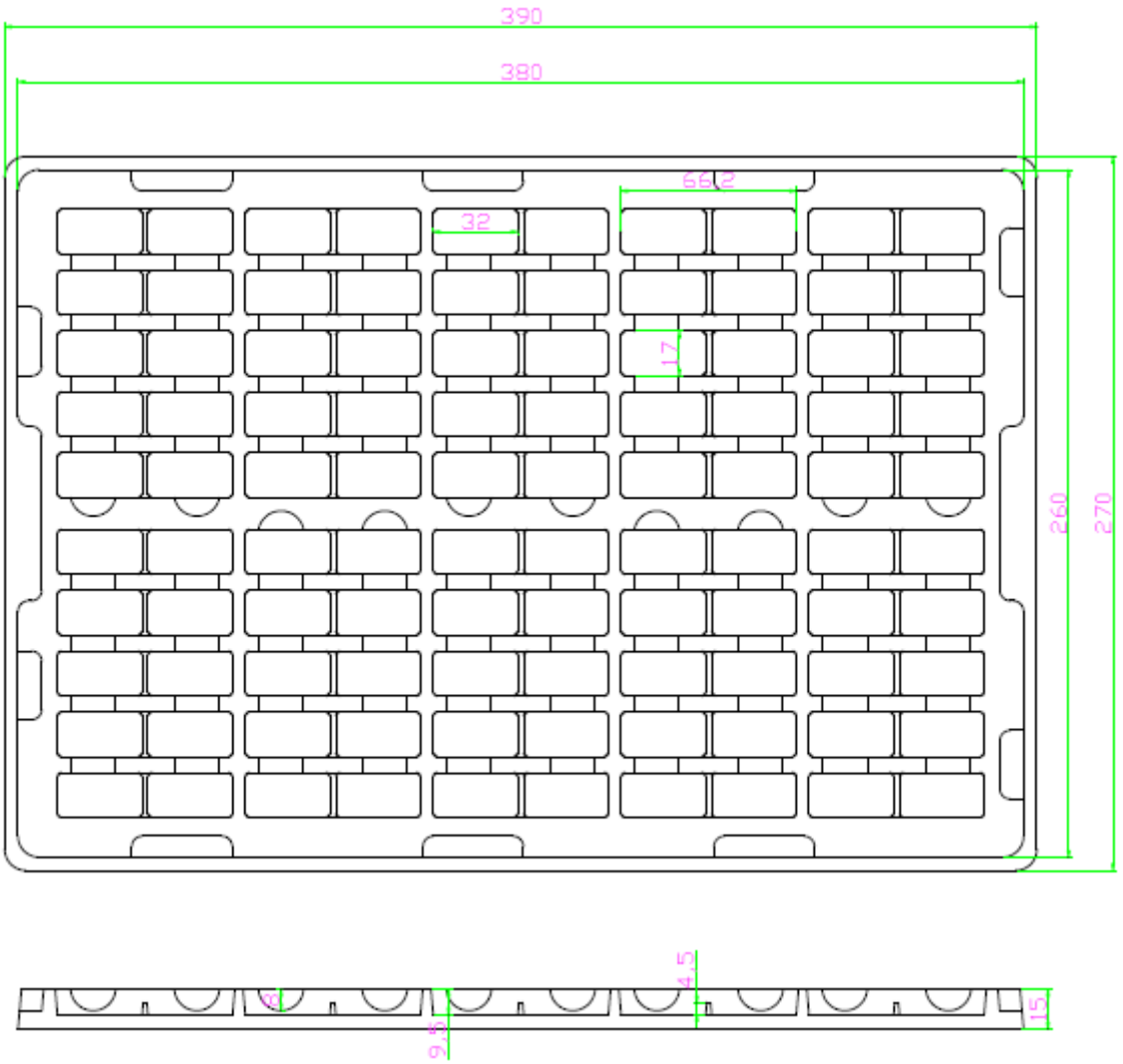
8.5 Application schematic



9. 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