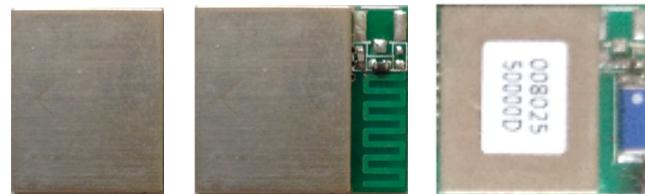


# EGIGATEK Bluetooth 4.0 LE

## Single Mode module datasheet

Doc. Version : 20140218



|                  |                                     |
|------------------|-------------------------------------|
| Product ID       | eGM-A20A/B/C                        |
| Product Name     | Bluetooth 4.0 LE single mode module |
| Firmware Version |                                     |
| Hardware Version | Rev.1.0.2                           |

## 1. DESCRIPTION

Bluetooth v4.0 Low Energy specifies two types(single mode and dual mode) of implementation.

Single mode chips implement the low energy specification and consume a fraction of the power of classic Bluetooth to allow the short-range wireless standard to extend to coin cell battery applications. Single mode BLE is not backwards compatible with previous Bluetooth standards.

Dual mode chips combine low energy with the power of classic Bluetooth and to become a defacto feature in new Bluetooth enabled **cellular** phones and **computers**. Dual mode BLE is backwards compatible but targeted to **gateway** products.

eGM-A20 is product from CSR's single mode BLE solution. CSR  $\mu$ Energy 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  $\mu$ Energy 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 CSR1010 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
- 11 digital PIOs
- 3 analogue AIOs
- UART
- 512KB EEPROM
- 3 PWM modules
- Wake-up interrupt
- 64KB RAM and 64KB ROM
- Watchdog timer
- Dimensions:
  - eGM-A20A : 11.75 mm x 14.0 mm x 2.5 mm
  - eGM-A20B with printed antenna : 16.0 mm x 14.0 mm x 2.5 mm
  - eGM-A20C with chip antenna : 16.0 mm x 14.0 mm x 2.5 mm
- Storage temperature range: -40°C ~ +85°C
- Operating temperature range: -30°C ~ +85°C
- Manufactured in conformance with RoHS

### 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
- I<sup>2</sup>C
- 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 | °C   |

### 4.2 Recommended Operating Conditions

| Operating Condition         | Min | Typ | Max | Unit |
|-----------------------------|-----|-----|-----|------|
| Operating temperature range | -30 | -   | 85  | °C   |

### 4.3 Input/Output Terminal Characteristics

#### 4.3.1 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    |
| Tr/T <sub>f</sub>          | -         | -   | 25      | ns   |

| Output Voltage Levels                     | Min        | Typ | Max | Unit |
|---|------------|-----|-----|------|
| VOL output logic level low, IOL = 4.0mA   | -          | -   | 0.4 | V    |
| VOH output logic level high, IOH = -4.0mA | 0.75 x VDD | -   | -   | V    |
| Tr/T <sub>f</sub>                         | 1.2        | -   | 5   | ns   |

| Input and Tristate Currents          | Min  | Typ  | Max   | Unit |
|--------------------------------------|------|------|-------|------|
| With strong pull-up                  | -150 | -40  | -10   | µA   |
| I <sup>2</sup> C 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   |
| Cl input capacitance                 | 1.0  | -    | 5.0   | pF   |

#### 4.3.2 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

eGM-A20 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 eGM-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 eGM-A20 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           | 1200 baud ( $\leq 2\%$ Error) |
|                     | 9600 baud ( $\leq 1\%$ Error) |
| Maximum             | 2Mbaud ( $\leq 1\%$ 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.

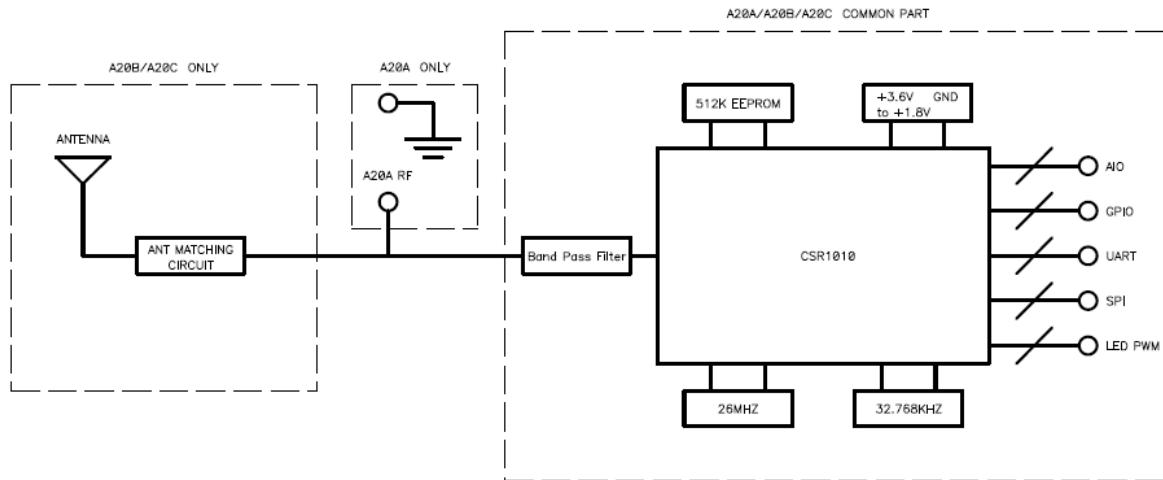
### 6.2 SPI Master Interface

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. BLOCK DIAGRAM



## 8. PIN DESCRIPTION

### 8.1 Pin Numbering

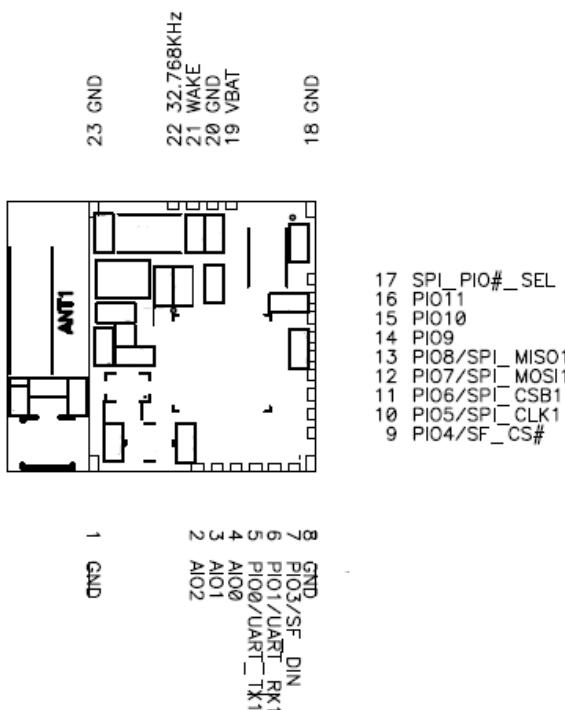


Figure 8.1 eGM-A20C Pin Numbering

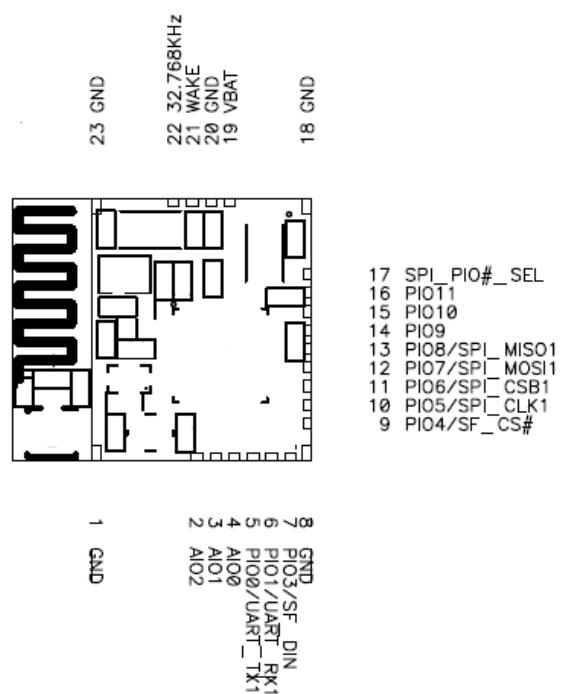


Figure 8.2 eGM-A20B Pin Numbering

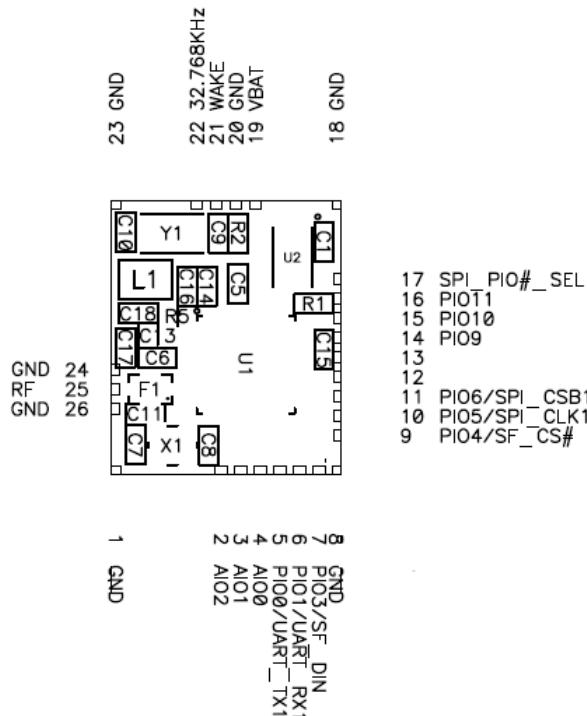


Figure 8.3 eGM-A20A Pin Numbering

## 8.2 Pin Definition

| PIN Name       | No | Description  |
|----------------|----|--|
| GND            | 1  | Ground   |
| AI02           | 2  | Analogue programmable I/O line.  |
| AI01           | 3  | Analogue programmable I/O line.  |
| AI00           | 4  | Analogue programmable I/O line.  |
| PIO0 UART_TX1  | 5  | Programmable I/O line or UART TX.  |
| PIO1 UART_RX1  | 6  | Programmable I/O line or UART RX.  |
| PIO3 SF_DIN    | 7  | Programmable I/O line or SPI serial flash data (SF_DIN) input.             |
| GND            | 8  | Ground   |
| PIO4 SF_CS#    | 9  | Programmable I/O line or SPI serial flash chip select (SF_CS#).            |
| PIO5 SPI_CLK1  | 10 | Programmable I/O line or debug SPI CLK selected by SPI_PIO#.               |
| PIO6 SPI_CSB1  | 11 | Programmable I/O line or debug SPI chip select (CS#) selected by SPI_PIO#. |
| PIO7 SPI_MOSI1 | 12 | Programmable I/O line or debug SPI MOSI selected by SPI_PIO#.              |
| PIO8 SPI_MISO1 | 13 | Programmable I/O line or debug SPI MISO                                    |
| PIO9           | 14 | Programmable I/O line.   |
| PIO10          | 15 | Programmable I/O line.   |

|              |    |  |   |
|--------------|----|--|---|
| PIO11        | 16 |  | Programmable I/O line.  |
| SPI_PIO#_SEL | 17 |  | Selects SPI debug on PIO(3.3V SPI mode, 0V<br>PIO mode 10~13) . |
| GND          | 18 |  | Ground  |
| VBAT         | 19 |  | Battery input and regulator enable (active                      |
| GND          | 20 |  | Ground  |
| WAKE         | 21 |  | Input to wake from hibernate.                                   |
| 32.768KHz_IN | 22 |  | Crystal   |
| GND          | 23 |  | Ground  |
| GND          | 24 |  | Ground(for eGM-A20A only)                                       |
| RF           | 25 |  | Bluetooth transmitter/receiver(for eGM-A20A<br>only)            |
| GND          | 26 |  | Ground(for eGM-A20A only)                                       |

## 9. MECHANICAL CHARACTERISTICS

### 9.1 Dimensions

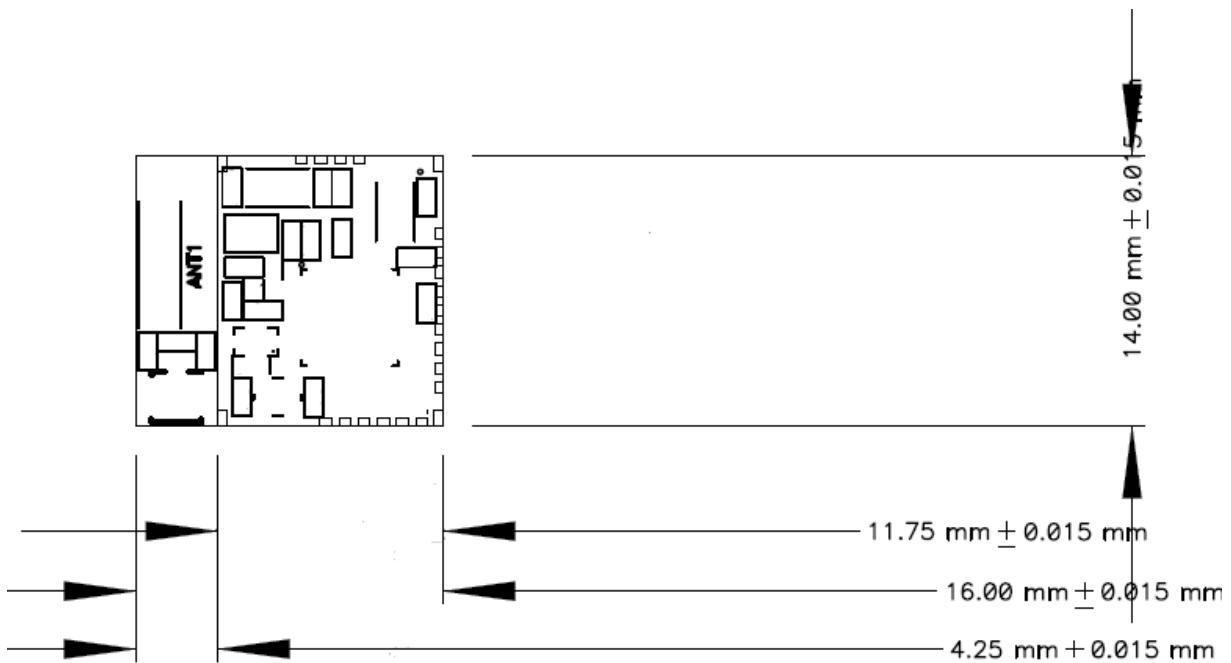


Figure 9.1 eGM-A20C dimension

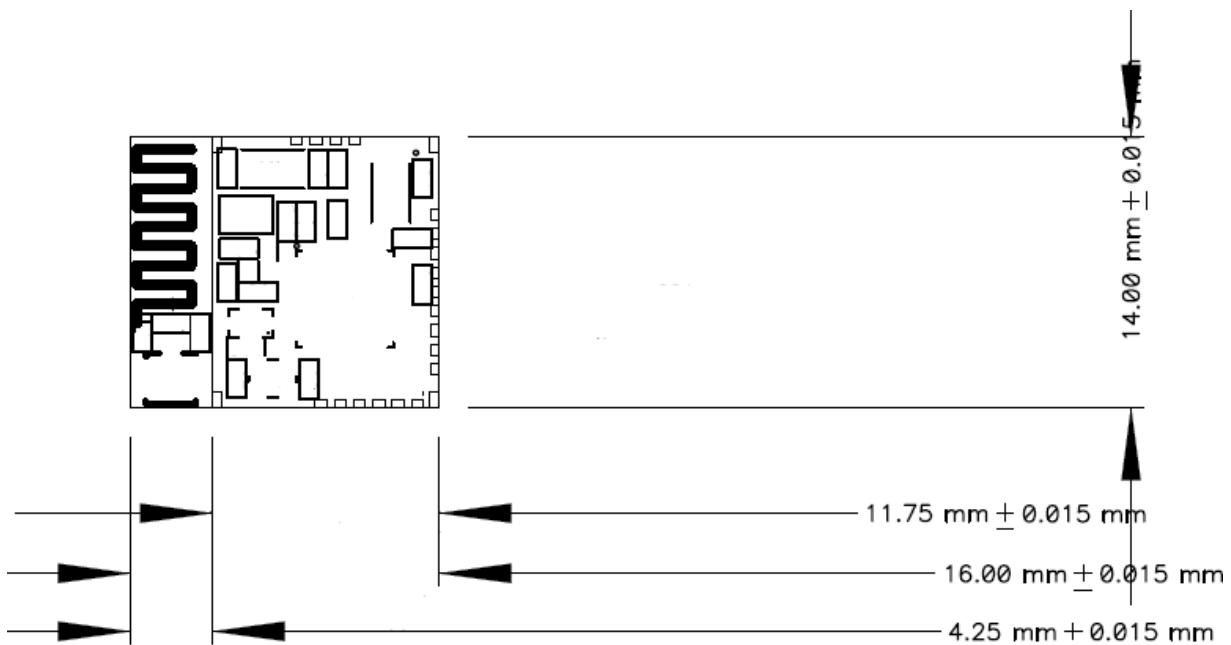
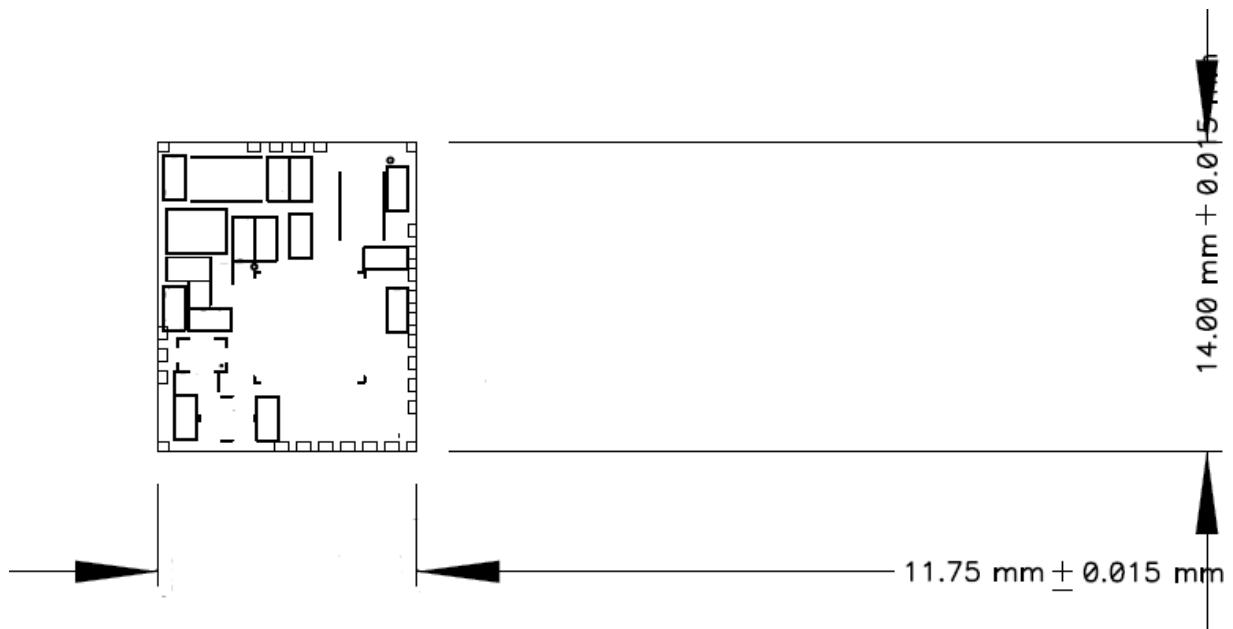
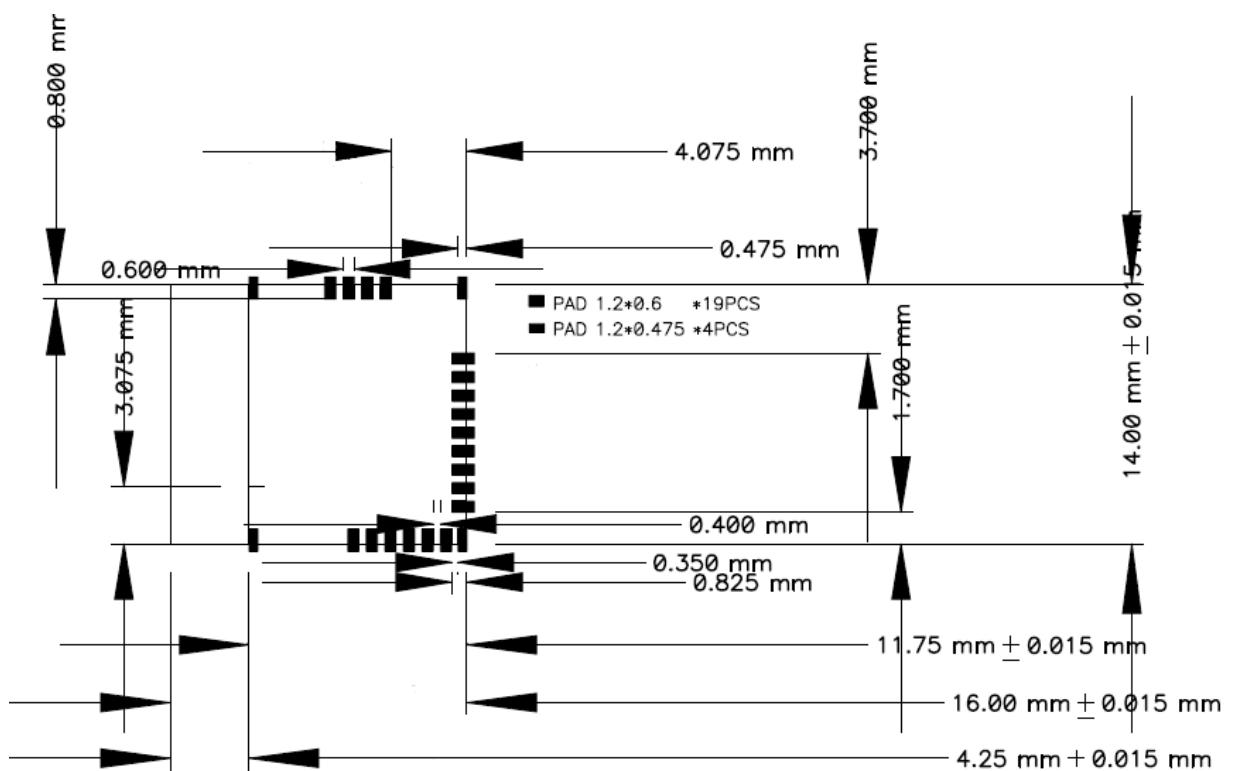


Figure 9.2 eGM-A20B dimension



**Figure 9.3 eGM-A20A dimension**

## 9.2 Recommended Land Pattern



**Figure 9.4 eGM-A20B and eGM-A20C land pattern**

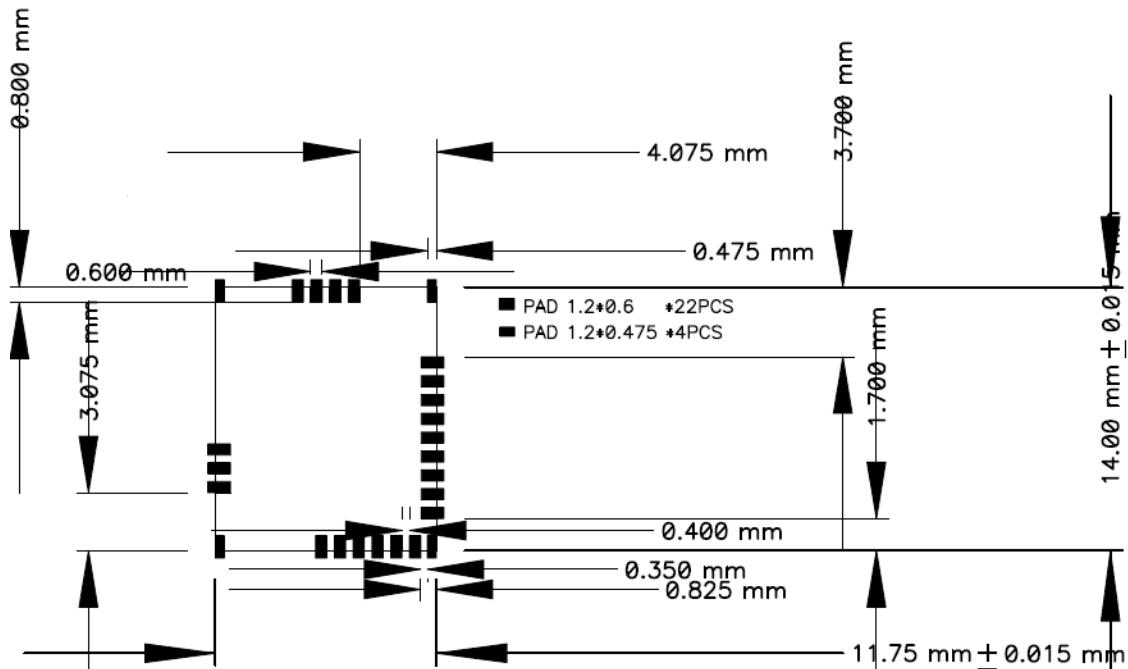
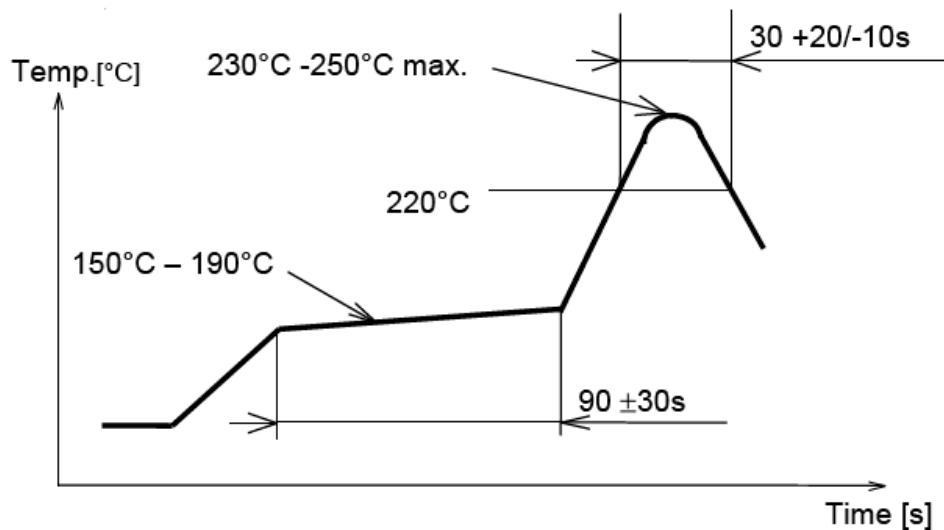


Figure 9.5 eGM-A20A land pattern

### 9.3 Typical Solder Reflow Profile

Temperature profile for reflow soldering



### 9.4 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

## 9.5 Antenna Issues

eGM-A20 is shipped with 3 different antenna designs: eGM-A20C comprises a ceramic antenna which as a component is soldered to the circuit board. This is functional for a eGM-A20B or C integrated into a plastic housing. No additional antenna is required.

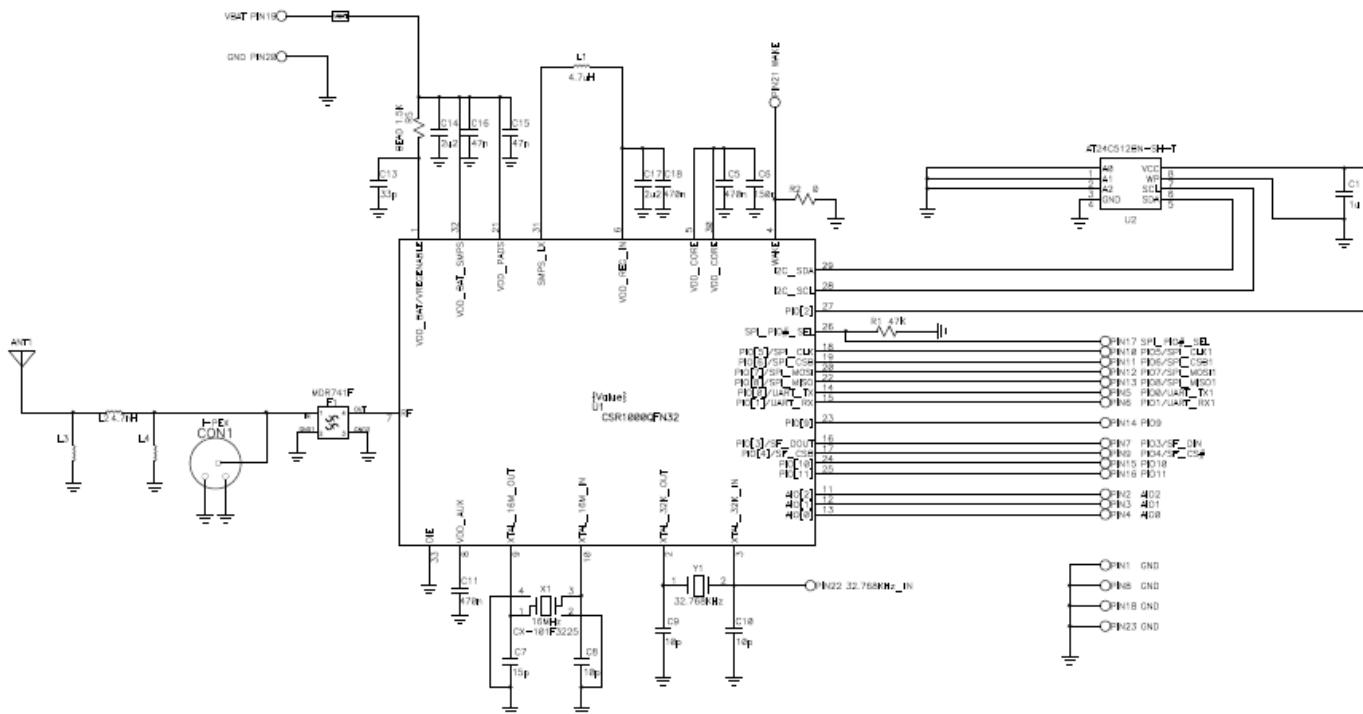
For an external antenna to be set in, e.g. because the eGM-A20 is integrated into a metal housing, the ceramic antenna is replaced.

eGM-A20A routes the antenna signal to pin 25. The gain of the external antenna shall not exceed +2dBi.

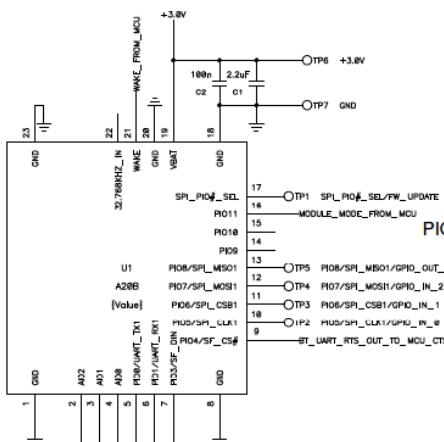
When using an external Antenna the antenna is fixed and cannot be removed or replaced by the end user. The performance of the internal antenna respectively the external antenna has in any case to be checked within the final integration environment. Adjacent PCBs, components, cables, housings etc. could otherwise influence the radiation pattern or be influenced by the radio wave energy.

It must be ensured that the antenna is not co-located or operating in conjunction with any other antennas, transmitters, cables or connectors. When the internal ceramic antenna is used, certain restrictions are to be considered.

## 9.6 Application schematic



WAKE: WAKE ON HIGH

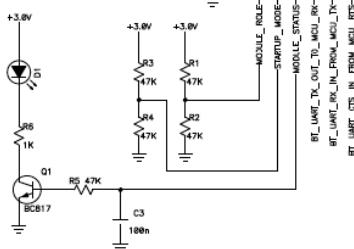


AI02: R1&R2 for Acceptor  
R2 for Initiator

AI01: R3&R4 for Command mode  
R4 for Basic mode

AI00: constant high: connected  
constant low: not connected  
Pulse f=2Hz 50/50: bondable

PIO11: Low=>High: start timer for second behavior  
High=>Low switch to second behavior



Please Note Pin Assignment by your application and you must refer  
"Terminal\_IO\_BLE\_User\_Guide\_r07" Page49-51

## **10. APPROVALS/CERTIFICATIONS**

The eGM-A20A or B or C has been tested to comply to the appropriate EU, FCC and IC directives. CE testing is intended for end products only. Therefore CE testing is not mandatory for a Bluetooth Module sold to OEM's. However EGIGA TECHNOLOGIES CO LTD provides CE tested modules for customers in order to ease CE compliance assessment of end products and to minimize test effort.

### **10.1 Declaration of Conformity CE**

The eGM-A20A or B or C fully complies with the essential requirements of the following EU directives:

R&TTE 1999/5/EC (Variant /C for external antenna with less than +2dBi gain)

RoHS 2011/65/EC

### **10.2 FCC Compliance**

The eGM-A20B or C has been tested to fulfill the FCC requirements. Test reports are available on request. Grants of the Full Modular Approval will be shown below.

eGM-A20A only:

For selling products implementing the eGM-A20A in the USA you'll have to apply for a Class II Permissive Change from the FCC authorities. Depending on antenna gain and other factors the FCC TCB will issue a reduced test plan for re-testing. EGIGATEK can assist customers with conducting this procedure on request. Especially the test plan reduction and cost optimization may be items worth to look at.

#### **10.2.1 FCC Grant**

#### **10.2.2 FCC Statement**

This device complies with 47 CFR Part 2 and Part 15 of the FCC Rules and with.

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.

#### **10.2.3 FCC Caution**

Warning: Changes or modifications made to this equipment not expressly approved by EGIGA TECHNOLOGIES CO LTD may void the FCC authorization to operate this equipment.

#### **10.2.4 FCC Warning**

You are cautioned that changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

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:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### **10.2.5 FCC RF Radiation Exposure Statement**

The eGM-A20B or C complies with the FCC/ radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The output power is < 10mW *EIRP* and therefore according to "FCC KDB 447498 D01 General RF Exposure Guidance v05" Appendix A, table "SAR Exclusion Threshold", excluded from SAR testing for test separation distances  $\geq 5\text{mm}$  and if it is not used in co-locations with other antennas. If the product implementing the eGM-A20B or C has other antennas in co-location or separation distances  $< 5\text{mm}$  an FCC TCB should be asked for a Class II Permissive Change.

RF exposure evaluation of devices implementing the eGM-A20A should be done with the collaboration of the FCC TCB working on the Class II Permissive Change Request.

#### **10.2.6 FCC Labeling Requirements for the End Product**

Any end product integrating the Model: eGM-A20A or B or C must be labeled with at least the following information:

This device contains transmitter with

FCC ID: **2ABQH-eGMA20**

### **10.3 IC Compliance**

The eGM-A20A has been tested to fulfill the IC requirements. Test reports RSS-210 of Industry Canada are available on request. Grants of the Full Modular Approval will be shown below.

For selling products implementing the eGM-A20B or C in Canada you'll have to apply for a Class II Permissive Change from the IC authorities. Depending on antenna gain and other factors the IC TCB will issue a reduced test plan for re-testing. EGIGATEK can assist customers with conducting this procedure on request. Especially the test plan reduction and cost optimization may be items worth to look at.

#### **10.3.1 IC Grant**

#### **10.3.2 IC Statement**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil numerique de est conforme aux normes canadiennes licence-exempt RSS standard(s).

Son fonctionnement est soumis aux deux conditions suivantes :

- (1) cet appareil ne doit pas causer d'interference et
- (2) cet appareil doit accepter toute interference, notamment les interferences qui peuvent affecter son fonctionnement.

#### **10.3.3 IC Caution**

Warning: Changes or modifications made to this equipment not expressly approved by EGIGA TECHNOLOGIES CO LTD may void the IC authorization to operate this equipment.

#### **10.3.4 IC RF-exposure Statement**

This equipment is portable device. The output power of this device is less than 20mW. The SAR test is not required.

RF exposure evaluation of devices implementing the eGM-A20A should be done with the collaboration of the IC TCB working on the Class II Permissive Change

Request.

### **10.3.5 IC Labeling Requirements for the End Product**

Any end product integrating the Model: eGM-A20A or B or C must be labeled with at least the following information:

This device contains transmitter with

IC-ID: **11696A-eGMA20**

### **10.3.6 IC Label Information**

The eGM-A20 shows IC-ID on the product label. IC allows to state the IC-ID in the product manual. This product has been granted to do so.

Model: eGM-A20A or B or C

**The IC-ID is: 11696A-eGMA20**

## **10.4 TELEC Compliance**

## **10.5 Bluetooth Qualification**

The eGM-A20 is a qualified design according to the Bluetooth Qualification Program Reference Document (PRD) V2.1 The Qualified Design ID (QDID) is:

**B022156**

According to the Bluetooth SIG rules (Qualification Program Reference Document – PRD V2.1) you are required to perform the mandatory End Product Listing (EPL) for your product.



## The Bluetooth SIG Hereby Recognizes

**EGIGA TECHNOLOGIES CO LTD**

Member Company

**Bluetooth 4.0 LE single mode module**

Qualified Design Name

Qualified Design ID(s): **B022156**

Specification Name: **4.0**

Product Type: **Controller Subsystem**

Model Number: **eGM-A20(A/B/C)**

BQE Name: **Ricky Chen**

Listing Date: **23 January 2014**

Assessment Date: **23 January 2014**

Hardware Version Number: **Rev.1.0.2**

Software Version Number: **0.92**

This certificate acknowledges the *Bluetooth*® Specifications declared by the member were achieved in accordance with the *Bluetooth* Qualification Process as specified within the *Bluetooth* Specifications and as required within the current PRD



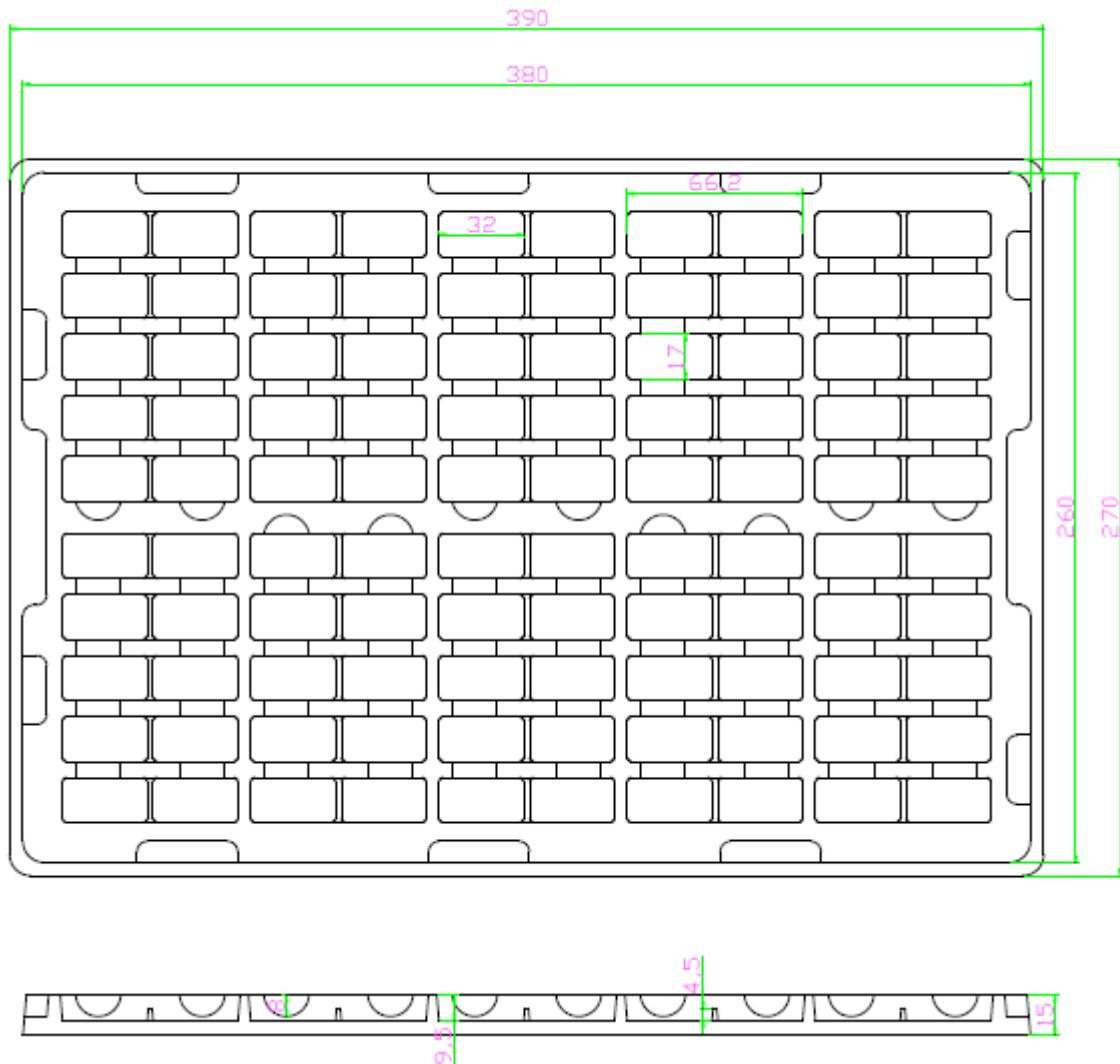
## 10.6 RoHS/SVHC Declaration

The actual version of RoHS Supplier Declaration according to the EU Directive 2011/65/EC.

## 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



**EGIGATEK Bluetooth module design data**