muRata



# Bluetooth Module Data Sheet

Product Description : BlueModule™

Sample Part Number : LBMA465HG1-TEMP
LBMA465HG2-TEMP
LBMA465HG3-TEMP

Product Engineering Section
Bluetooth Modules Department
Component Division III
Murata Manufacturing Co., Ltd.

1. Scope

This specification is applied to the Bluetooth 2.0+EDR module

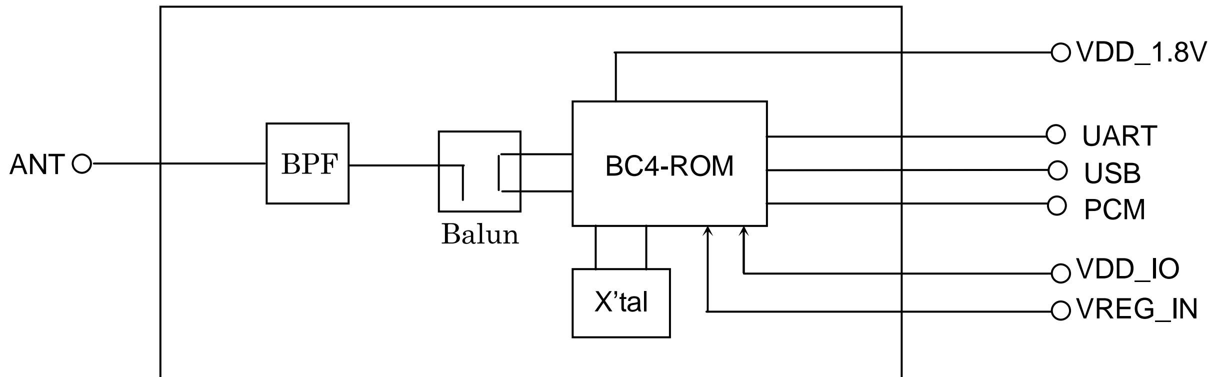
Interface: USB/UART(H4)/BCSP
IC/Firmware: BC4-ROM Ver. 21e (Support 3wire co-existence)
Weight: 0.125g
Reference clock: internal (26MHz)
MSL : 1

2. Part Number

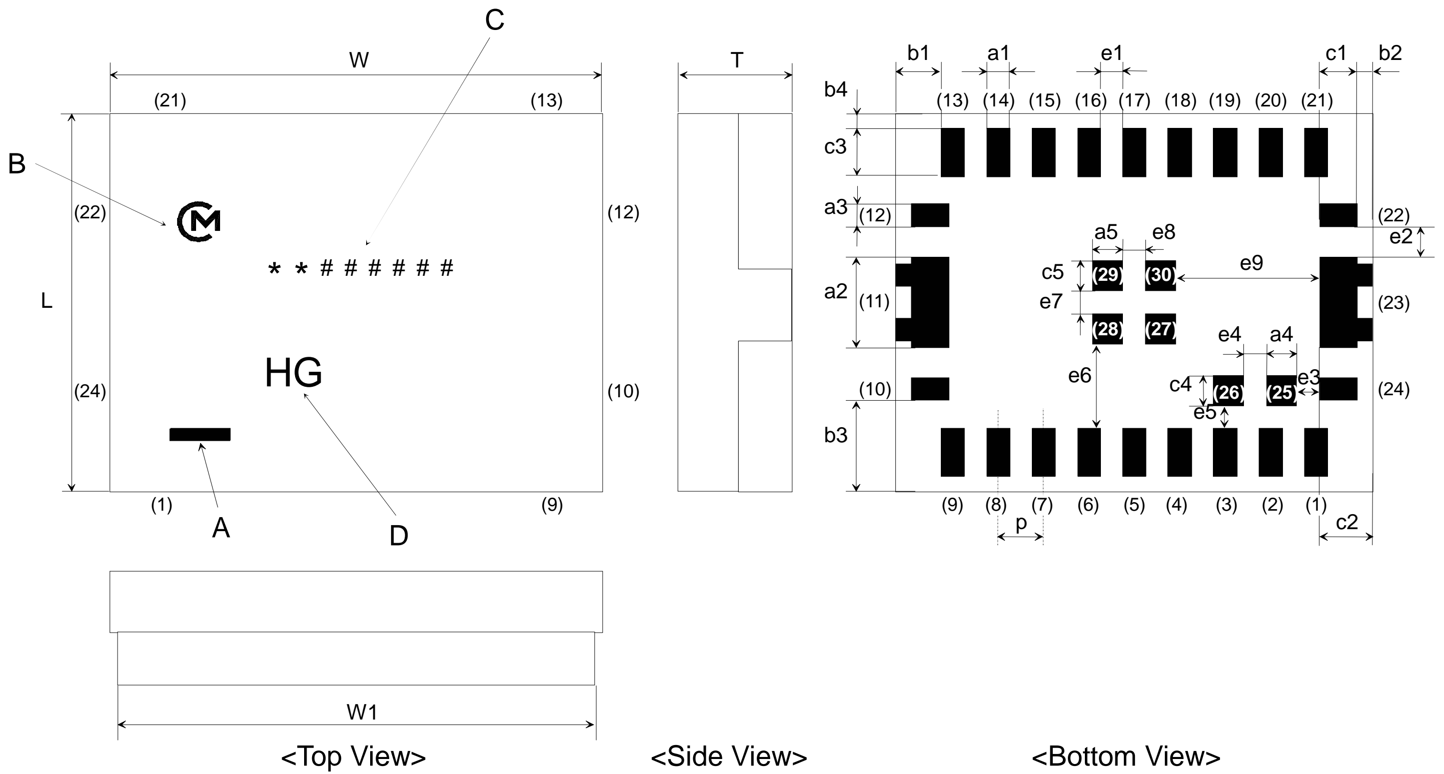
| Part Number | LBMA465HG1-TEMP | LBMA465HG2-TEMP | LBMA465HG3-TEMP |
|---|---|---|---|
| HCI Interface | USB | UART (H4) | BCSP * |

* BCSP (Blue Core Serial Protocol) is a proprietary of CSR's serial protocol.

3. Block Diagram



4. Dimensions, Marking and Terminal Configurations




<Top View> <Side View> <Bottom View>

| Marking | Meaning |
| --- | --- |
| A | Pin 1 Marking |
| B | Murata Logo |
| C | BD Address |
| D | Module Type |

Dimensions

(Unit : mm)

| Mark | Dimension | Mark | Dimension | Mark | Dimension |
| --- | --- | --- | --- | --- | --- |
| L | 5.0 +/- 0.3 | W | 6.4 +/- 0.3 | W1 | 6.3 +/- 0.3 |
| T | 1.5 max. | a1 | 0.3 +/- 0.1 | a2 | 1.2 +/- 0.1 |
| a3 | 0.3 +/- 0.1 | a4 | 0.4 +/- 0.1 | a5 | 0.4 +/- 0.1 |
| b1 | 0.6 +/- 0.2 | b2 | 0.2 +/- 0.2 | b3 | 1.2 +/- 0.2 |
| b4 | 0.2 +/- 0.2 | c1 | 0.5 +/- 0.1 | c2 | 0.7 +/- 0.1 |
| c3 | 0.625 +/- 0.1 | c4 | 0.4 +/- 0.1 | c5 | 0.4 +/- 0.1 |
| e1 | 0.3 +/- 0.1 | e2 | 0.4 +/- 0.1 | e3 | 0.3 +/- 0.1 |
| e4 | 0.3 +/- 0.1 | e5 | 0.3 +/- 0.1 | e6 | 1.125 +/- 0.100 |
| e7 | 0.3 +/- 0.1 | e8 | 0.3 +/- 0.1 | e9 | 1.9 +/- 0.1 |
| p | 0.6 +/- 0.1 | - | - | - | - |

Terminal Configurations

| Terminal No. | Terminal Name | Pad Type | Description |
|---|---|---|---|
| (1) | PIO_3 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (2) | RESETB | CMOS input with weak internal pull-up | Reset if low. Input dedounced so must be low for >5ms to cause a reset |
| (3) | PCM_OUT | CMOS output, tri-state with weak internal pull-down | Synchronous data output |
| (4) | PCM_SYNC | Bi-directional with weak internal pull-down | Synchronous data sync |
| (5) | PCM_IN | CMOS input, with weak internal pull-down | Synchronous data input |
| (6) | PCM_CLK | Bi-directional with weak internal pull-down | Synchronous data clock |
| (7) | UART_RTS | CMOS output, tri-state with weak internal pull-up | UART request to send active low |
| (8) | UART_RX | CMOS input, with weak internal pull-down | UART data input active high |
| (9) | UART_TX | CMOS output, tri-state with weak internal pull-up | UART data output active high |
| (10) | UART_CTS | CMOS input, with weak internal pull-down | UART clear to send active low |
| (11) | GND | GND | GND |
| (12) | ANT | Input / output | RF signal input / output |
| (13) | GND | GND | GND |
| (14) | PIO_0 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (15) | PIO_1 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (16) | VREG_IN | Regulator input (VDD_REG) | Regulator input |
| (17) | VDD_IO | VDD | Positive supply for UART, USB, AIO, PIO, other digital input/output port. |
| (18) | VDD_1.8V | VDD | Positive supply for internal digital circuitry, RF, VCO, synthesizer, analogue circuitry. |
| (19) | PIO_4 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (20) | PIO_5 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line Assigned as BT_STATE |
| (21) | PIO_6 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (22) | PIO_7 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line Assigned as BT_PRIORITY |
| (23) | GND | GND | GND |
| (24) | PIO_2 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (25) | USB_D- | Bi-directional | USB data minus |
| (26) | USB_D+ | Bi-directional | USB data plus |
| (27) | PIO_10 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (28) | PIO_8 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line |
| (29) | GND | GND | GND |
| (30) | PIO_9 | Bi-directional with programmable strength internal pull-up/down | Programmable input/output line Murata confirmed as W-LAN ACTIVE |

5. Rating

| | | min. | max. | unit |
|---|---|---|---|---|
| Storage Temperature | | -40 | +85 | deg.C |
| Supply Voltage : | VDD_1.8V | -0.4 | +2.2 | V |
| | VDD_IO | -0.4 | +3.7 | V |
| | VREG_IN | -0.4 | +5.6 | V |
| | Other terminal | Vss-0.4 | VDD+0.4 | V |

6. Operating Condition

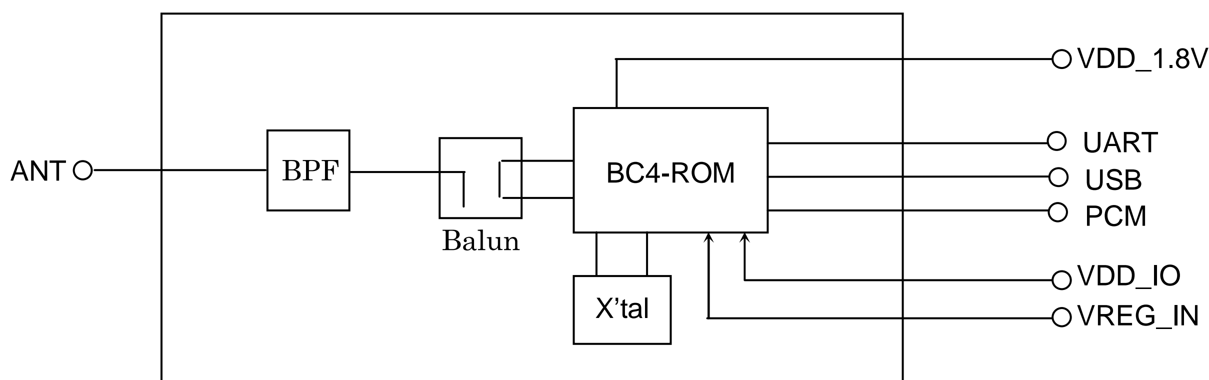
6-1. USB operation

| | | min. | typ. | max. | unit |
|---|---|---|---|---|---|
| Operating Temperature | | -20 | +25 | +75 | deg.C |
| Supply Voltage : | VDD_1.8V | 1.7 | 1.8 | 1.9 | V |
| | VDD_IO | 3.1 | 3.3 | 3.6 | V |
| | VREG_IN | 2.6 | 3.0 | 4.2 | V |

6-2. UART operation

| | | min. | typ. | max. | unit |
|---|---|---|---|---|---|
| Operating Temperature | | -20 | +25 | +75 | deg.C |
| Supply Voltage : | VDD_1.8V | 1.7 | 1.8 | 1.9 | V |
| | VDD_IO | 1.7 | 3.0 | 3.6 | V |
| | VREG_IN | 2.6 | 3.0 | 4.2 | V |

6-3. Power Supply Diagram




| Terminal | 3.0 Power Supply | 1.8V Power Supply |
|---|---|---|
| VDD_1.8V | Bypass capacitor | 1.7 to 1.9V |
| VDD_IO | 1.7 to 3.6V | 1.7 to 1.9V |
| VREG_IN | 2.6 to 4.2V | NC |

7. DC/RF Characteristics

7-2-1. Normal Condition : +25deg.C, VDD_IO=VREG_IN=3.0V

| Items | Contents | | | |
|---|---|---|---|---|
| Bluetooth specification | Ver 2.0 + EDR | | | |
| Channel spacing | 1MHz | | | |
| Number of RF channel | 79 | | | |
| Power class | 2 | | | |
| Operation mode (Rx/Tx) | Time division multiplex either transmit or receive frequency hopping after one Rx/Tx Cycle | | | |
| | min. | typ. (nominal) | max. | unit |
| 1.DC Current | | | | |
| 1) DH1 Packet | - | 40 | | mA |
| 2) DH3 Packet | - | 43 | | mA |
| 3) DH5 Packet | - | 46 | | mA |
| -Tx Characteristics- | min. | typ. (nominal) | max. | unit |
| 2.Fequency Range | 2400 to 2483.5 | | | MHz |
| 3.Output Power | -6 | 1.2 | 4 | dBm |
| 4.-20dB Bandwidth | - | 0.8 | 1 | MHz |
| 5.Adjacent Channel Power *1 | | | | |
| 1) M-N=-2,+2 | - | | -20 | dBm |
| 2) M-N=-3,-4,-5 | - | | -40 | dBm |
| 3) M-N=+3,+4,+5 | - | | -40 | dBm |
| 6.Modulation Characteristics | | | | |
| 1) Modulation δf1avg | 140 | 155 | 175 | kHz |
| 2) Modulation δf2max | 115 | 145 | - | kHz |
| 3) δf2avg/δf1avg | 0.8 | 1.0 | - | |
| 7.Initial Carrier Frequency Tolerance | -75 | 10 | 75 | kHz |
| 8.Carrier Frequency Drift | | | | |
| 1) 1slot | -25 | +/-10 | 25 | kHz |
| 2) 3slot | 40 | - | 40 | kHz |
| 3) 5slot | 40 | - | 40 | kHz |
| 4) Maximum drift rate | -20 | +/-7 | 20 | kHz/50us |
| 9.Out of Band Spurious Emissions | | | | |
| 1) 30MHz - 1000MHz (Operation mode) | - | - | -36 | dBm |
| 2) 1GHz – 12.75GHz (Operation mode) | - | - | -30 | dBm |
| 3) 1.8GHz – 1.9GHz (Operation mode) | - | - | -47 | dBm |
| 4) 5.15GHz – 5.3GHz (Operation mode) | - | - | -47 | dBm |
| 10.EDR Relative Power (DQPSK / 8DPSK) | -4 | - | 1 | dB |
| 11.EDR Carrier Frequency Stability and Modulation Accuracy | | | | |
| 1) ωi (DQPSK and 8DPSK) | -75 | - | 75 | kHz |
| 2) ω0 (DQPSK and 8DPSK) | -10 | - | 10 | kHz |
| 3) ωi+ω0 (DQPSK and 8DPSK) | -75 | - | 75 | kHz |
| 4) RMS DEVM (DQPSK) | - | - | 20 | % |
| 5) 99% DEVM (DQPSK) | - | - | 30 | % |
| 6) Peak DEVM (DQPSK) | - | - | 35 | % |
| 7) RMS DEVM (8DPSK) | - | - | 13 | % |
| 8) 99% DEVM (8DPSK) | - | - | 20 | % |
| 9) Peak DEVM (8DPSK) | - | - | 25 | % |
| 12. EDR Differential Phase Encoding (DQPSK / 8DPSK) | 99 | - | - | % |

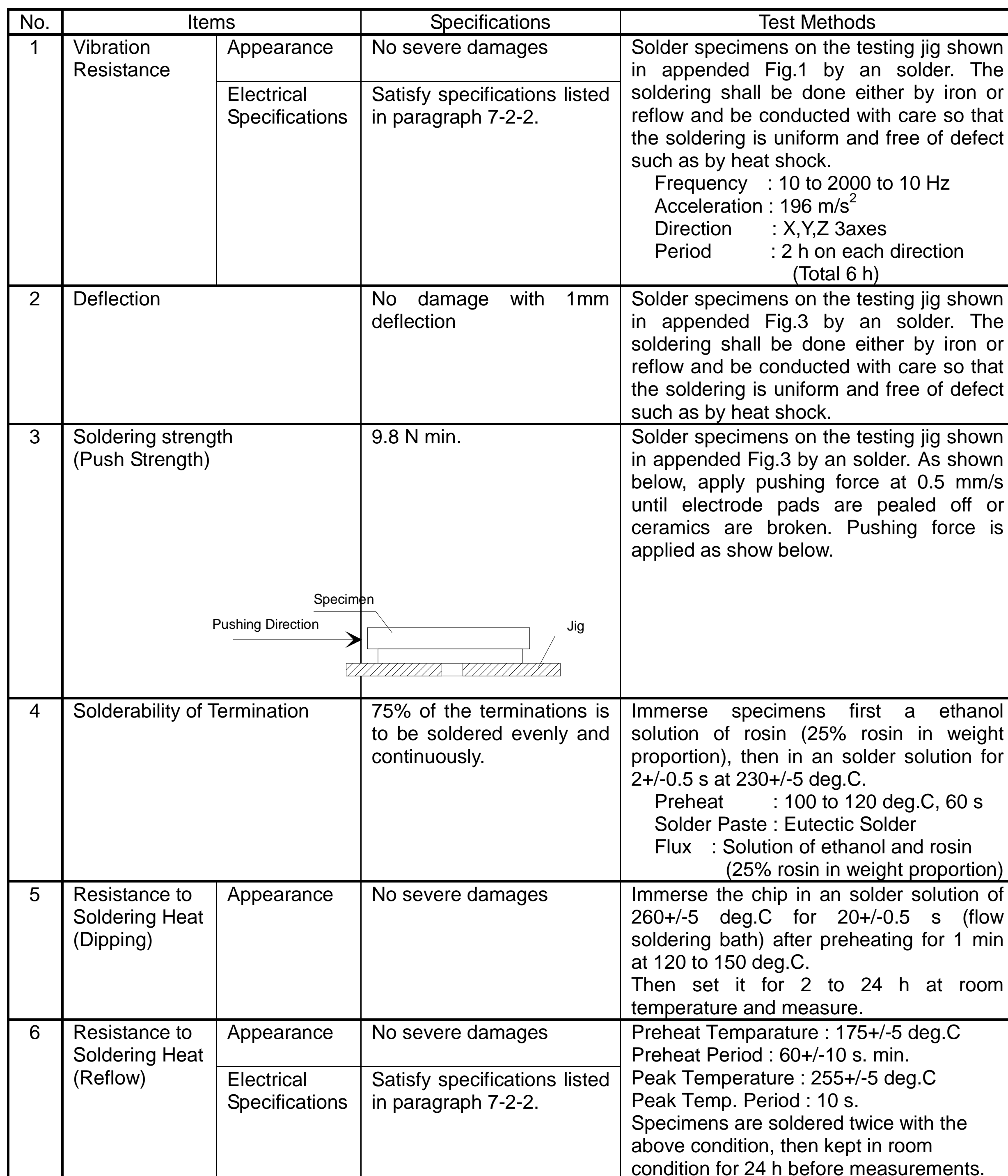
| -Rx Characteristics- | min. | typ. (nominal) | max. | unit |
|---|---|---|---|---|
| 13.Sensitivity (BER ≤ 0.1%) | | | | |
| 1) 2402MHz | - | -84 | -70 | dBm |
| 2) 2441MHz | - | -84 | -70 | dBm |
| 3) 2480MHz | - | -83.5 | -70 | dBm |
| 14.C/I Performance (BER ≤ 0.1%) *2 | | | | |
| 1) co-channel Ratio (-60dBm input) | - | - | 11 | dB |
| 2) 1MHz Ratio (-60dBm input) | - | - | 0 | dB |
| 3) 2MHz Ratio (-60dBm input) | - | - | -30 | dB |
| 4) 3MHz Ratio (-67dBm input) | - | - | -40 | dB |
| 5) Image Ratio (-67dBm input) | - | - | -9 | dB |
| 6) Image +/-1MHz Ratio (-67dBm input) | - | - | -20 | dB |
| 15.Blocking Performance (BER ≤ 0.1%) *3 | | | | |
| 1) 30MHz to 2000MHz | -10 | - | - | dBm |
| 2) 2000MHz to 2400MHz | -27 | - | - | dBm |
| 3) 2500MHz to 3000MHz | -27 | - | - | dBm |
| 4) 3000MHz to 12.75GHz | -20 | - | - | dBm |
| 16.Intermodulation Performance (BER ≤ 0.1% , -64dBm input) | -39 | | - | dBm |
| 17.Maximum Input Level (BER ≤ 0.1%) | -20 | | - | dBm |
| 18.EDR Sensitivity (at 0.007% BER) | | | | |
| 1) DQPSK | - | - | -70 | dBm |
| 2) 8DPSK | - | - | -70 | dBm |

*1 Up to three spurious responses within Bluetooth limits are allowed.
*2 Up to five spurious responses within Bluetooth limits are allowed.
*3 Up to twenty-four spurious responses within Bluetooth limits are allowed.

**Note:**

The above-mentioned values have been obtained according to our own measuring methods (testing jig : Fig.1) and may vary depending on the circuit, in which this component is actually incorporated.
Therefore, you are kindly requested to test the performance of this component incorporating in your set.

8. Other Specification and Methods



| No. | Items | | Specifications | Test Methods |
|---|---|---|---|---|
| 1 | Vibration Resistance | Appearance | No severe damages | Solder specimens on the testing jig shown in appended Fig.1 by an solder. The soldering shall be done either by iron or reflow and be conducted with care so that the soldering is uniform and free of defect such as by heat shock.<br>Frequency : 10 to 2000 to 10 Hz<br>Acceleration : 196 m/s$^2$<br>Direction : X,Y,Z 3axes<br>Period : 2 h on each direction (Total 6 h) |
| | | Electrical Specifications | Satisfy specifications listed in paragraph 7-2-2. | |
| 2 | Deflection | | No damage with 1mm deflection | Solder specimens on the testing jig shown in appended Fig.3 by an solder. The soldering shall be done either by iron or reflow and be conducted with care so that the soldering is uniform and free of defect such as by heat shock. |
| 3 | Soldering strength (Push Strength) | | 9.8 N min. | Solder specimens on the testing jig shown in appended Fig.3 by an solder. As shown below, apply pushing force at 0.5 mm/s until electrode pads are pealed off or ceramics are broken. Pushing force is applied as show below. |
| 4 | Solderability of Termination | | 75% of the terminations is to be soldered evenly and continuously. | Immerse specimens first a ethanol solution of rosin (25% rosin in weight proportion), then in an solder solution for 2+/-0.5 s at 230+/-5 deg.C.<br>Preheat : 100 to 120 deg.C, 60 s<br>Solder Paste : Eutectic Solder<br>Flux : Solution of ethanol and rosin (25% rosin in weight proportion) |
| 5 | Resistance to Soldering Heat (Dipping) | Appearance | No severe damages | Immerse the chip in an solder solution of 260+/-5 deg.C for 20+/-0.5 s (flow soldering bath) after preheating for 1 min at 120 to 150 deg.C.<br>Then set it for 2 to 24 h at room temperature and measure. |
| 6 | Resistance to Soldering Heat (Reflow) | Appearance | No severe damages | Preheat Temparature : 175+/-5 deg.C<br>Preheat Period : 60+/-10 s. min.<br>Peak Temperature : 255+/-5 deg.C<br>Peak Temp. Period : 10 s.<br>Specimens are soldered twice with the above condition, then kept in room condition for 24 h before measurements. |
| | | Electrical Specifications | Satisfy specifications listed in paragraph 7-2-2. | |

| No. | Items | | Specifications | Test Methods |
|---|---|---|---|---|
| 7 | Temperature Cycle | Appearance | No severe damages | Set the specimens to the supporting jig in the same manner and under the same condition as Fig.1 and conduct the 100 cycles according to the temperatures and time shown in the following table. |
| | | Electrical Specifications | Satisfy specifications listed in paragraph 7-2-2. | |
| 8 | Humidity Load Life | Appearance | No severe damages | Temperature : 85 +/-2 deg.C<br>Humidity : 80 to 85 %RH<br>Period : 500 +48/-0 h<br>Room Condition : 2 to 24 h<br>Supply Voltage : 3.6V D.C. |
| | | Electrical Specifications | Satisfy specifications listed in paragraph 7-2-2. | |
| 9 | High Temp. Load Life | Appearance | No severe damages | Temperature : 85 +/-2 deg.C<br>Period : 500 +48/-0 h<br>Room Condition : 2 to 24 h<br>Supply Voltage : 3.6V D.C. |
| | | Electrical Specifications | Satisfy specifications listed in paragraph 7-2-2 | |

| Step | 1 | 2 |
|---|---|---|
| Temp. (deg.C) | Min Strage Temp. +0/-3 | Max Strage Temp. +3/-0 |
| Time (min) | 30+/-3 | 30+/-3 |

Excessive mechanical force or thermal stress may damage the products. Appropriate handling is required.

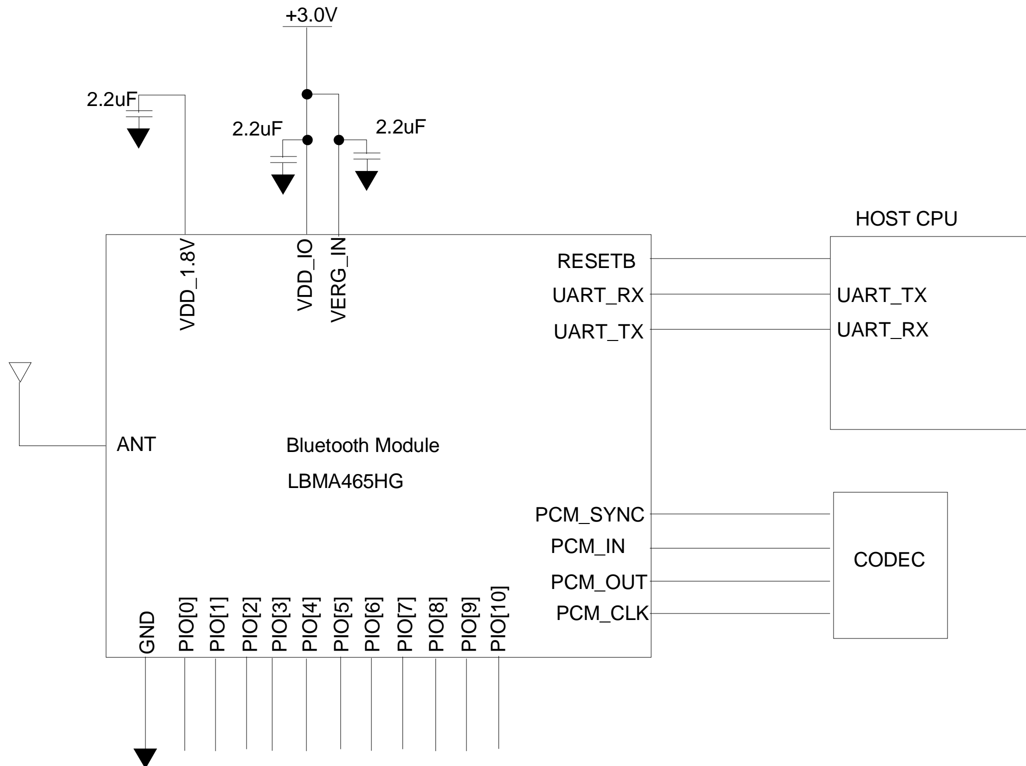
## 9. Production Site

Fukui Murata Manufacturing Co., Ltd.

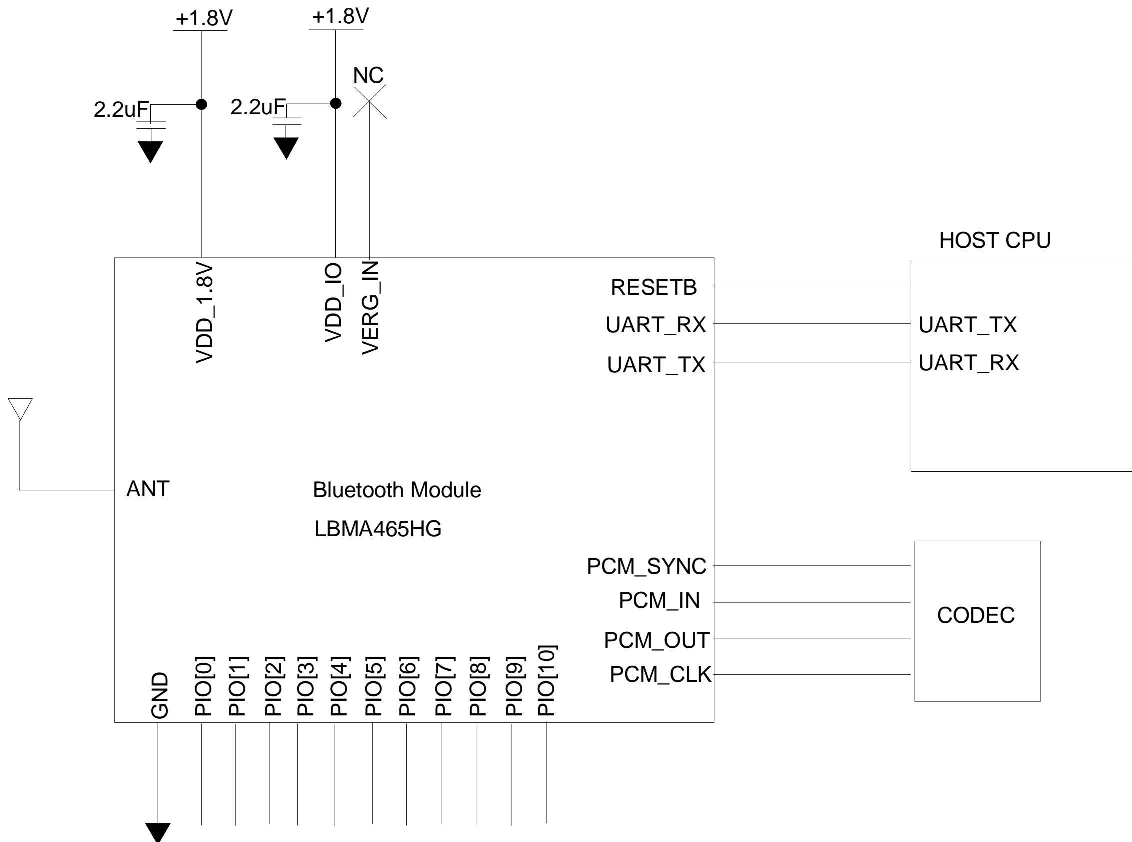
## 10. Reference Circuit

### 10-1. BCSP interface (default)

#### 10-1-1. BCSP I/F, 3.0V Power Supply

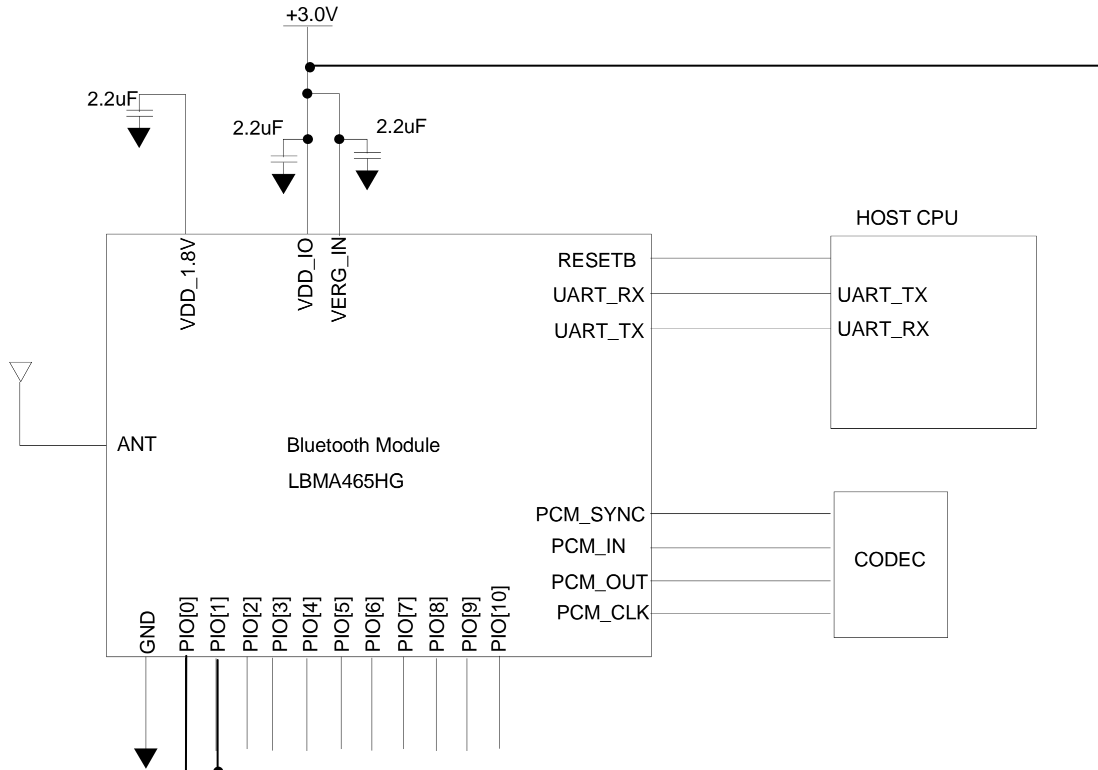



#### 10-1-2. BCSP I/F, 1.8V Power Supply

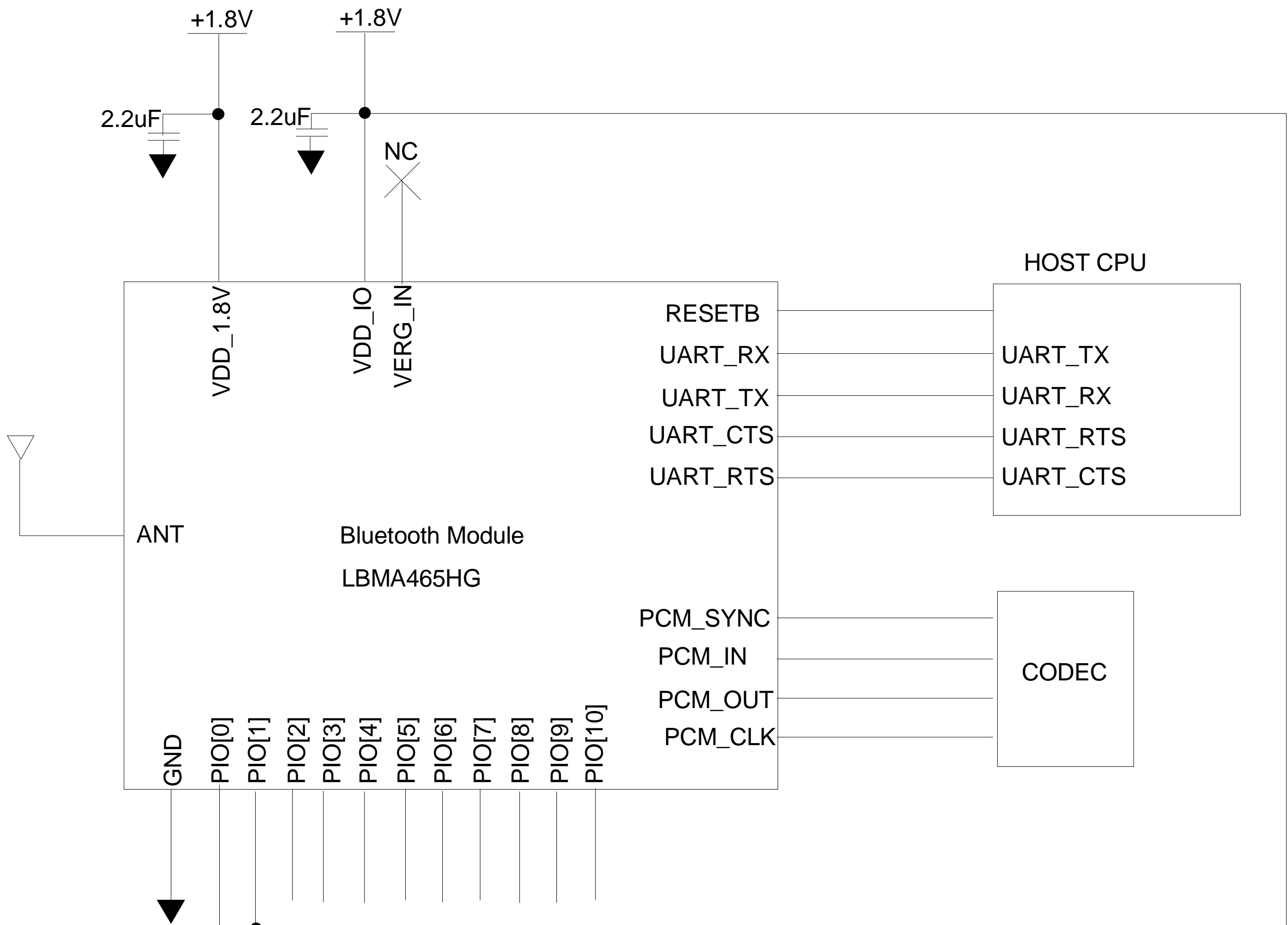


10-2. UART interface

10-2-1. UART I/F, 3.0V Power Supply

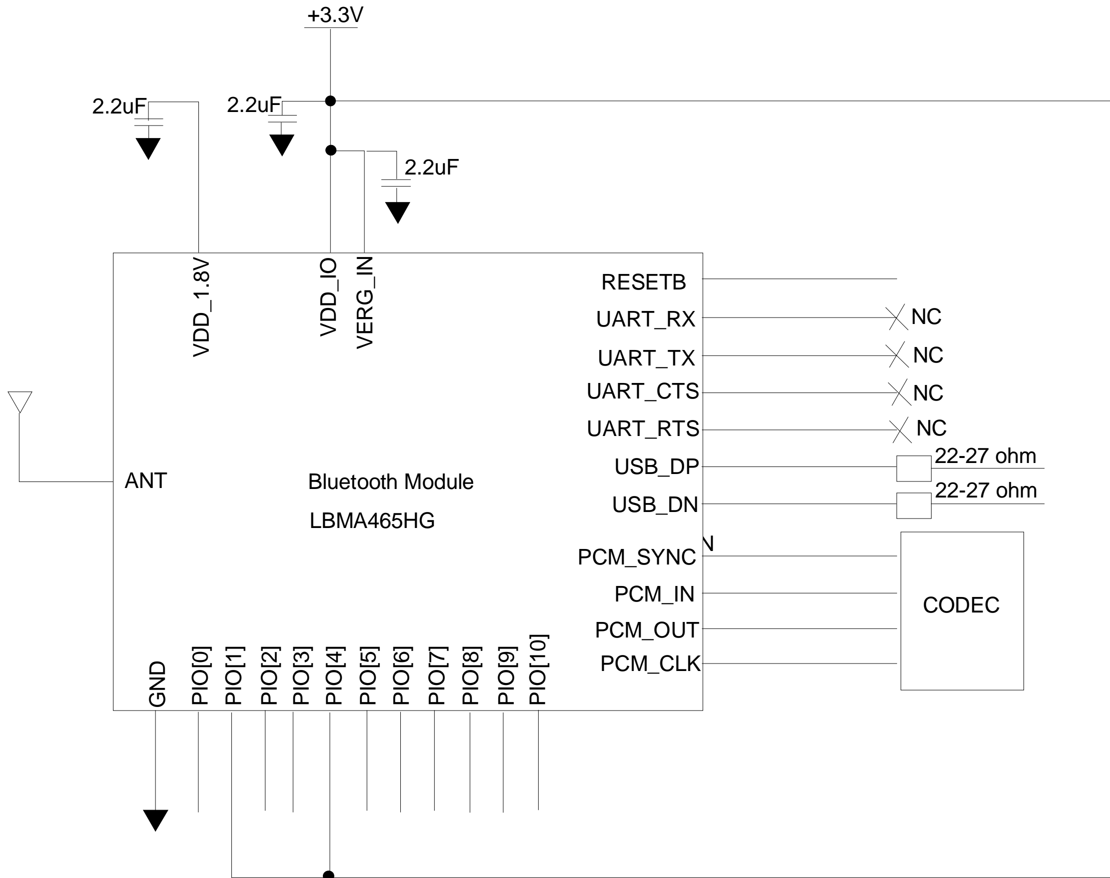



10-2-2. UART I/F, 1.8V Power Supply

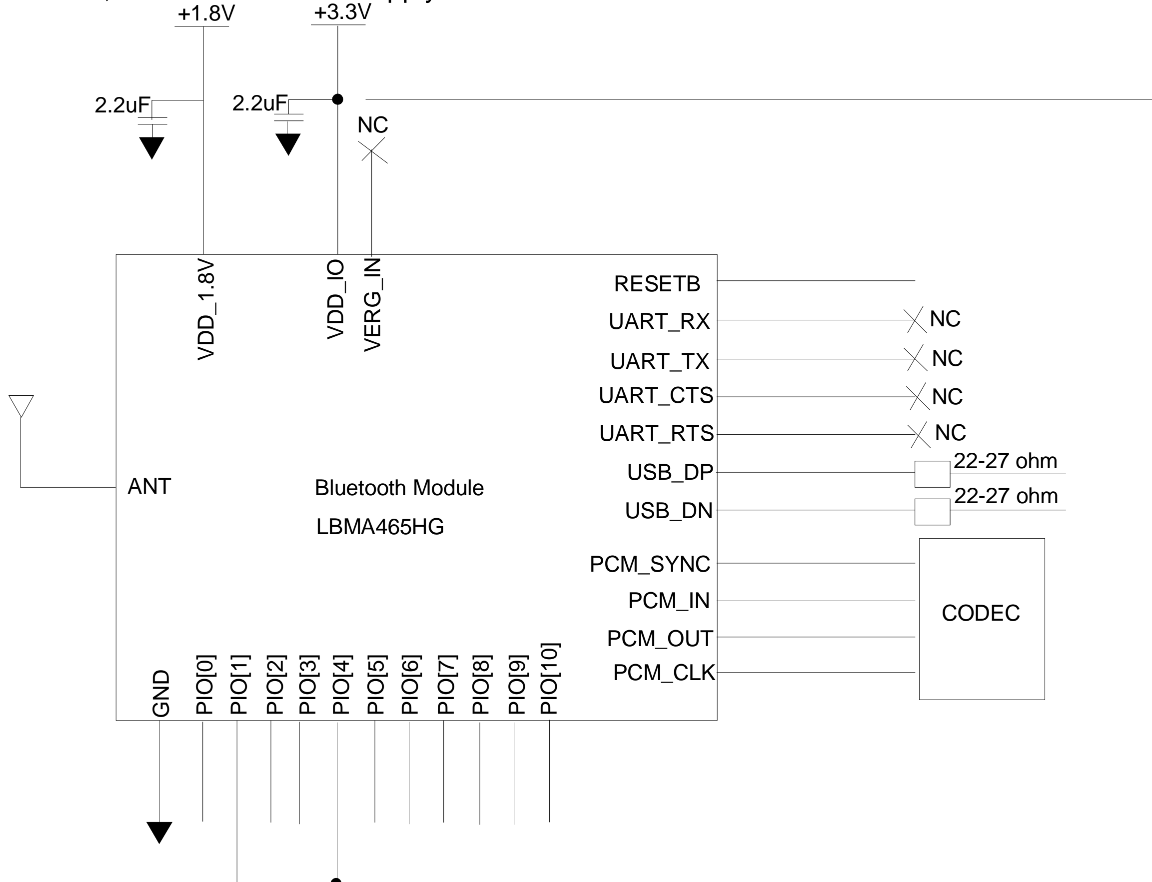


10-3. USB interface

10-3-1. USB I/F, 3.3V Power Supply

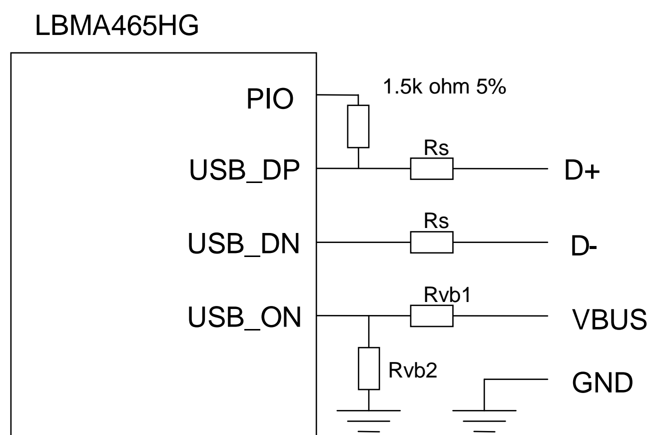



10-3-2. USB I/F, 3.3V / 1.8V Power Supply



### 10-3-3. USB Self Powered Mode

In self-powered mode, the circuit is powered from its own power supply and not from the VBUS (5V) line of the USB cable. It draws only a small leakage current (below 0.5mA) from VBUS on the USB cable. This is the easier mode for which to design, as the design is not limited by the power that can be drawn from the USB hub or root port. However, it requires that VBUS be connected to LBMA465HG via a resistor network (Rvb1 and Rvb2), so LBMA465HG can detect when VBUS is powered up. LBMA465HG will not pull USB_DP high when VBUS is off.
Self-powered USB designs (powered from a battery or PSU) must ensure that a PIO line is allocated for USB pull-up purposes. A 1.5KΩ 5% pull-up resistor between USB_DP and the selected PIO line should be fitted to the design.
Failure to fit this resistor may result in the design failing to be USB compliant in self-powered mode. The internal pull-up in BlueCore is only suitable for bus-powered USB devices, e.g., dongles.




The terminal marked USB_ON can be any free PIO pin. The PIO pin selected must be registered by setting “PSKEY_USB_PIO_VBUS” to the corresponding pin number.
And the PIO line used to control the pull-up resistor on the USB D+ line must be resistered by setting “PSKEY_USB_PIO_PULLUP”.

**“PSKEY_USB_PIO_VBUS(0x02D1)”**
The PIO line used for USB VBus detection. This must be one of the 2 available interrupt input pins (4 or 5). The absence of this key indicates that this feature is not in use. This value is only used if the chip is presenting its USB interface. Default setting is no value.

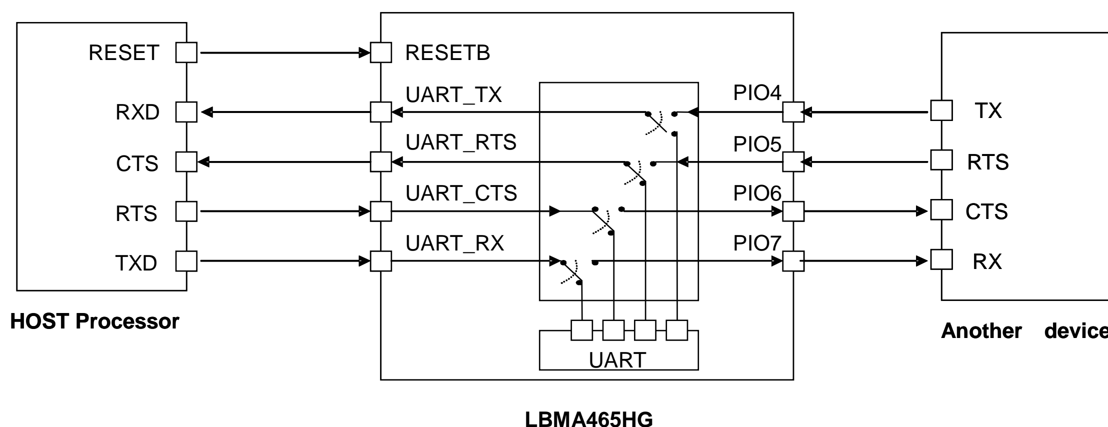
**“PSKEY_USB_PIO_PULLUP(0x02D0)”**
The PIO line used to control the pull-up resistor on the USB D+ line. The absence of this key in the ps indicates that this feature is not in use.
This value is only used if the chip is presenting its USB interface.
See the description of PSKEY_HOST_INTERFACE.
On BlueCore 2, there are 16 PIO lines, 0 to 15, but 12 to 15 are not available for the USB pullup.
However, an internal pullup can be used by setting this key to 16. Default setting is “16” = internal pull up mode.

**Note:**
USB_ON is shared with LBMA465HG PIO terminals.

The resistor values are indicated following table.

| Identifier | Value | Functions |
|---|---|---|
| Rs | 22-27 ohm | Impedance matching to USB cable |
| Rvb1 | 22k ohm 5% | VBUS ON sense divider |
| Rvb2 | 47k ohm 5% | VBUS ON sense divider |

10-4. UART Bypass




10-4-1. UART Configuration While RESET is Active

The UART interface for LBMA465HG while the chip is being held in reset is tri-state. This will allow the user to daisy chain devices onto the physical UART bus. The constraint on this method is that any devices connected to this bus must tri-state when LBMA465HG reset is de-asserted and the firmware begins to run.

10-4-2. UART Bypass Mode

Alternatively, for devices that do not tri-state the UART bus, the UART bypass mode on LBMA465HG can be used. The default state of LBMA465HG after reset is de-asserted; this is for the host UART bus to be connected to the LBMA465HG UART, thereby allowing communication to LBMA465HG via the UART.

In order to apply the UART bypass mode, a BCCMD command will be issued to LBMA465HG.
Upon this issue, it will switch the bypass to PIO[7:4] as above figure indicates. Once the bypass mode has been invoked, LBMA465HG will enter the Deep Sleep state indefinitely.

In order to re-establish communication with LBMA465HG, the chip must be reset so that the default configuration takes effect.

Therefore, it is not possible to have active Bluetooth links while operating the bypass mode.

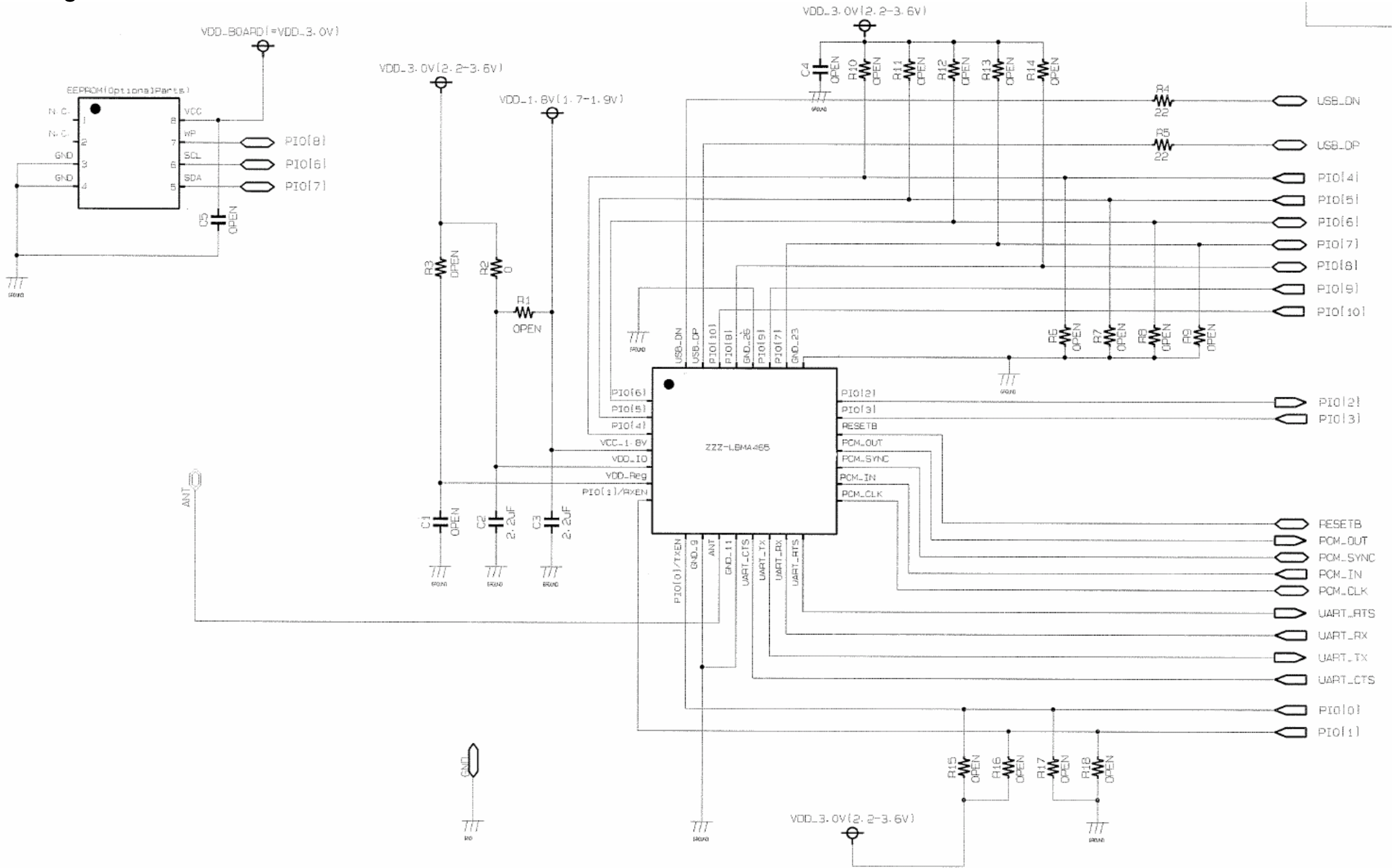
10-4-3. Current Consumption in UART Bypass Mode

The current consumption for a device in UART bypass mode is equal to the values quoted for a device in standby mode

10-5. Interface setting

| I/F | PIN Values | | |
|---|---|---|---|
| | PIO(0) | PIO(1) | PIO(4) |
| BCSP | 0 | 0 | 0 |
| USB | 0 | 1 | 1 |
| UART(H4) | 1 | 1 | 0 |

Fig.1




Measurement Board Circuit

Fig.2

Measurement Board

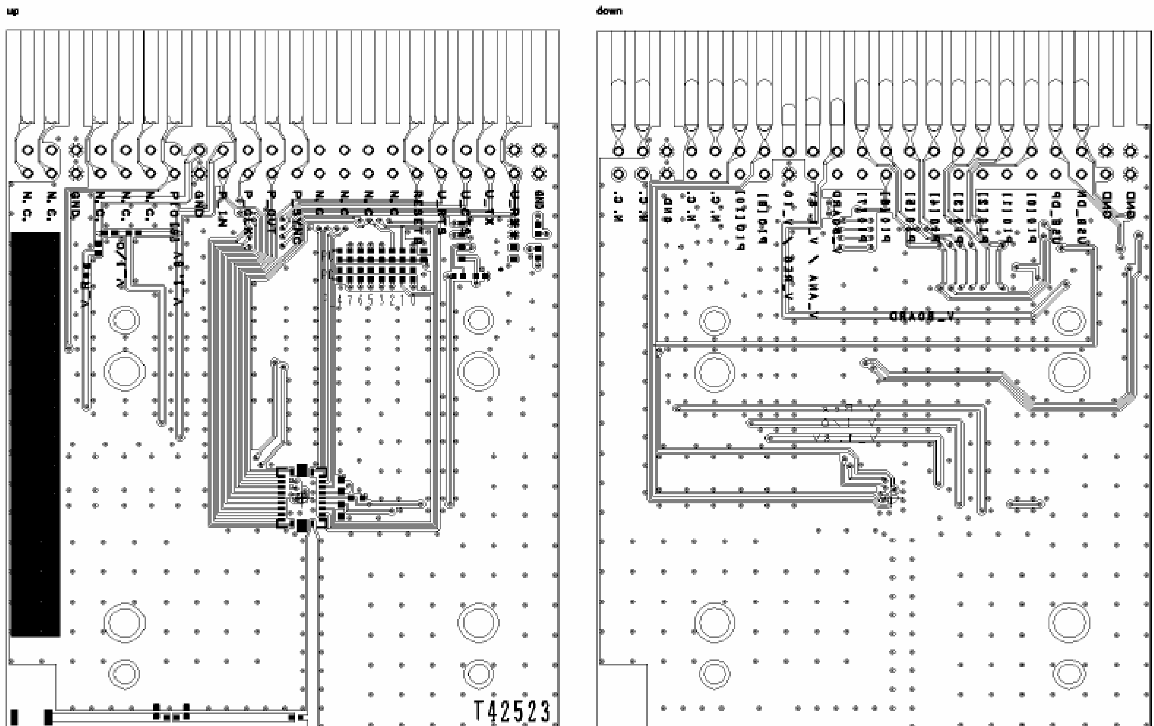
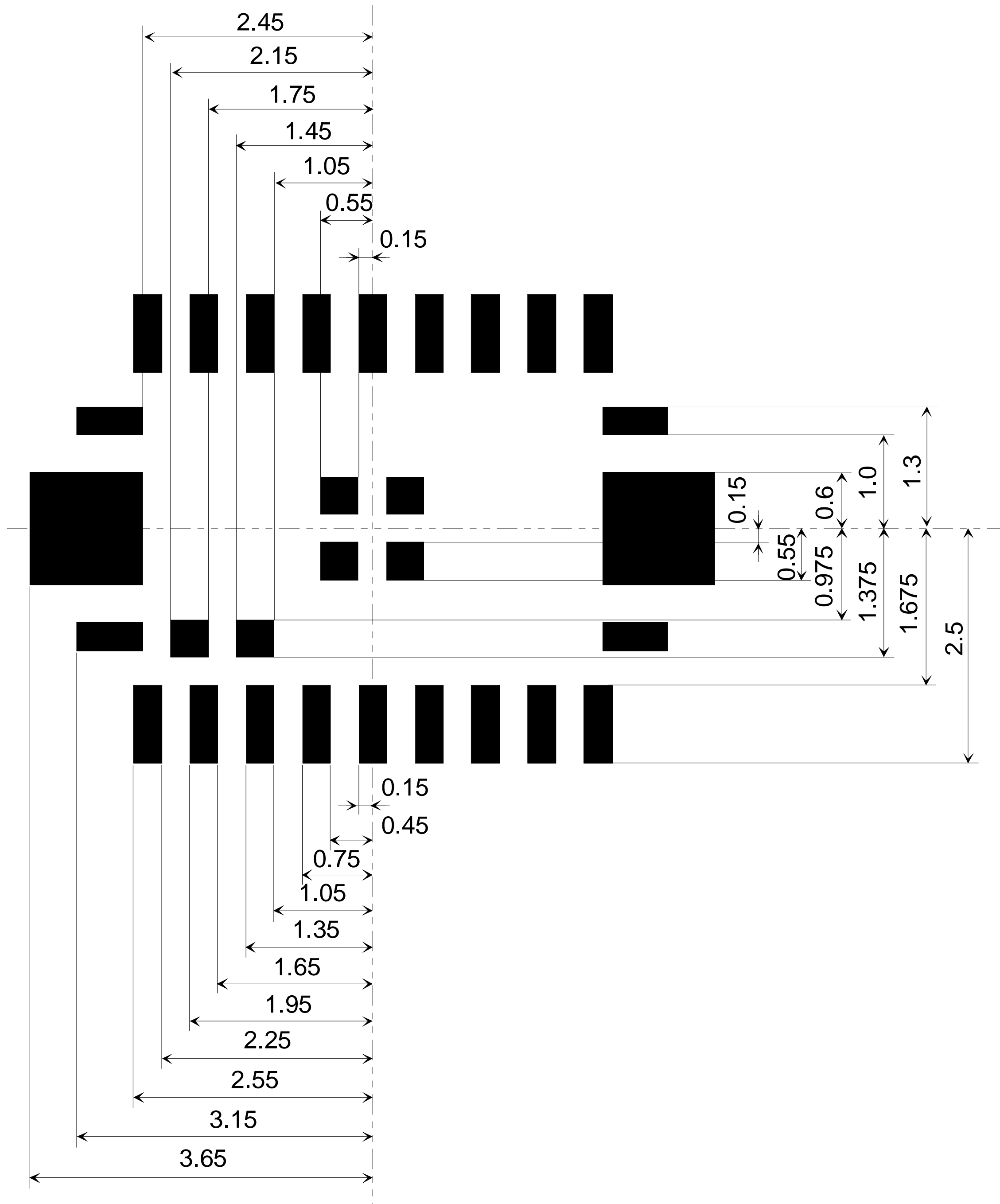


Fig.3

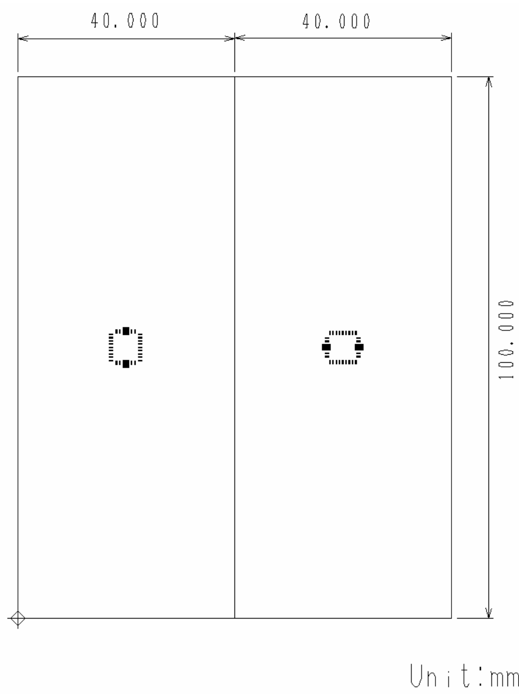
Land Pattern



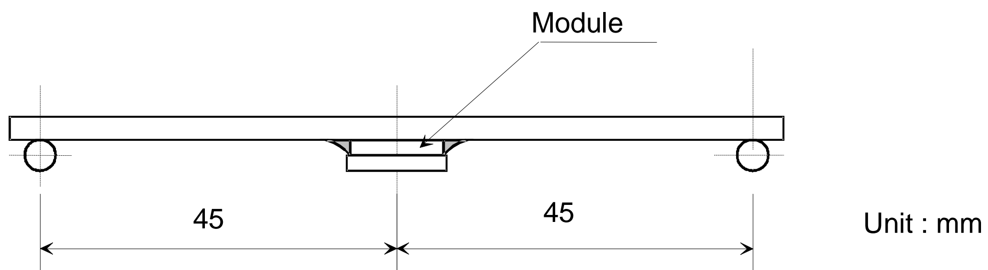

(unit : mm)

Fig.4

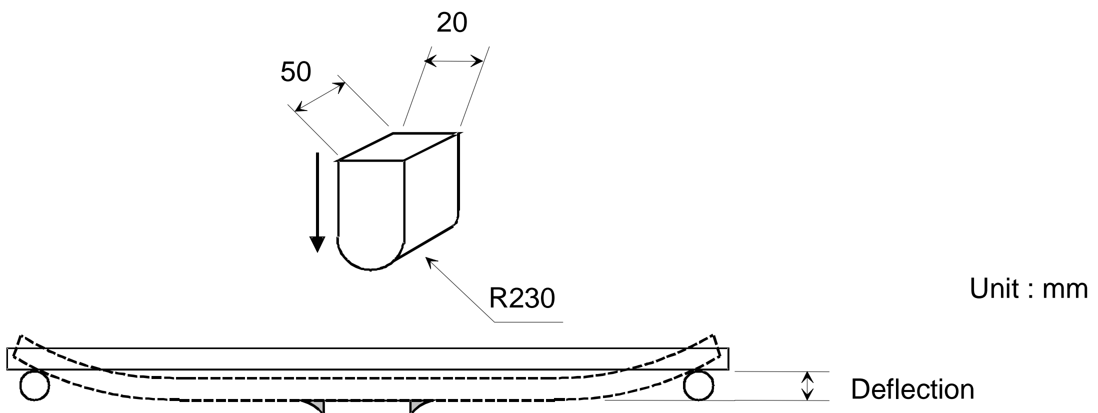
Deflection Test Board




Mounted Situation

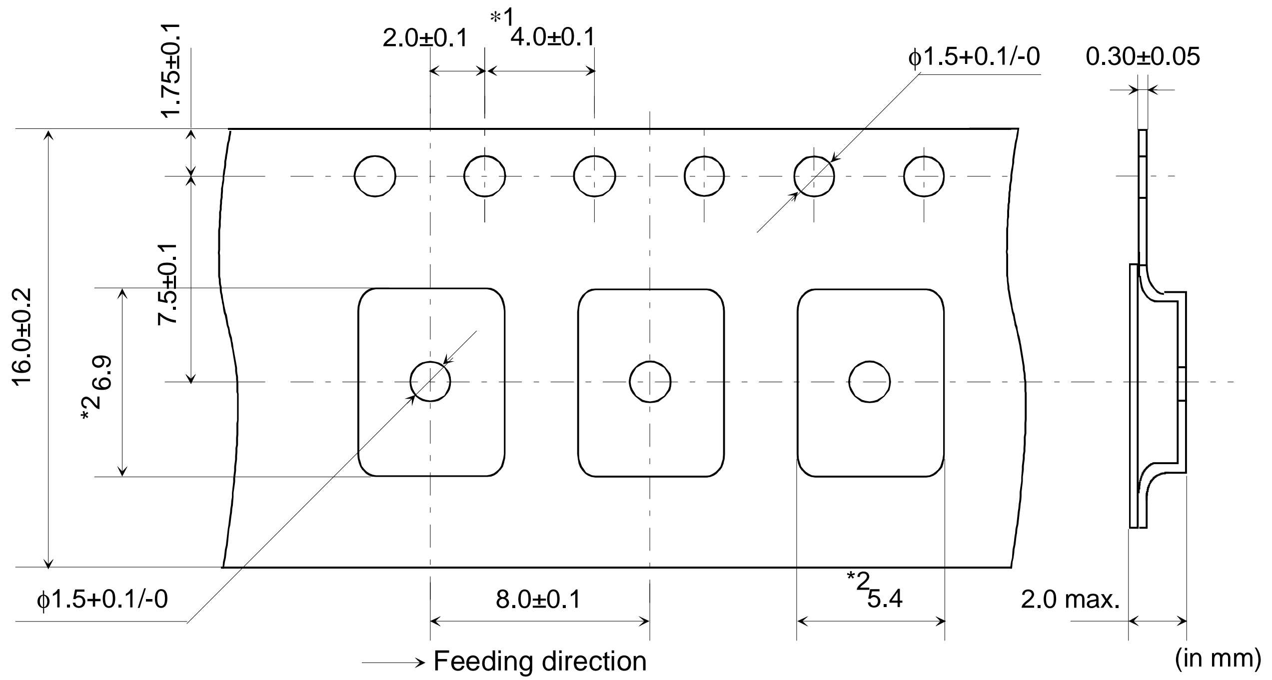



Testing Method

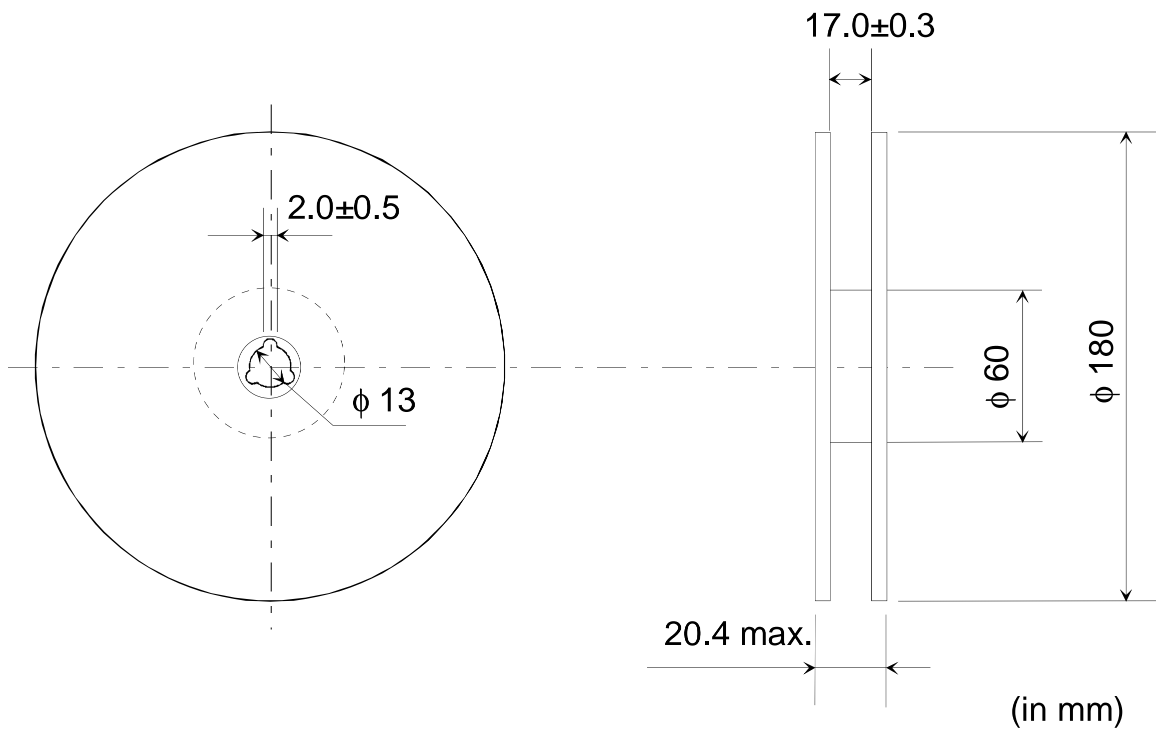


11. Tape and Reel Packing

(1) Dimensions of Tape (Plastic tape)




(2) Dimensions of Reel



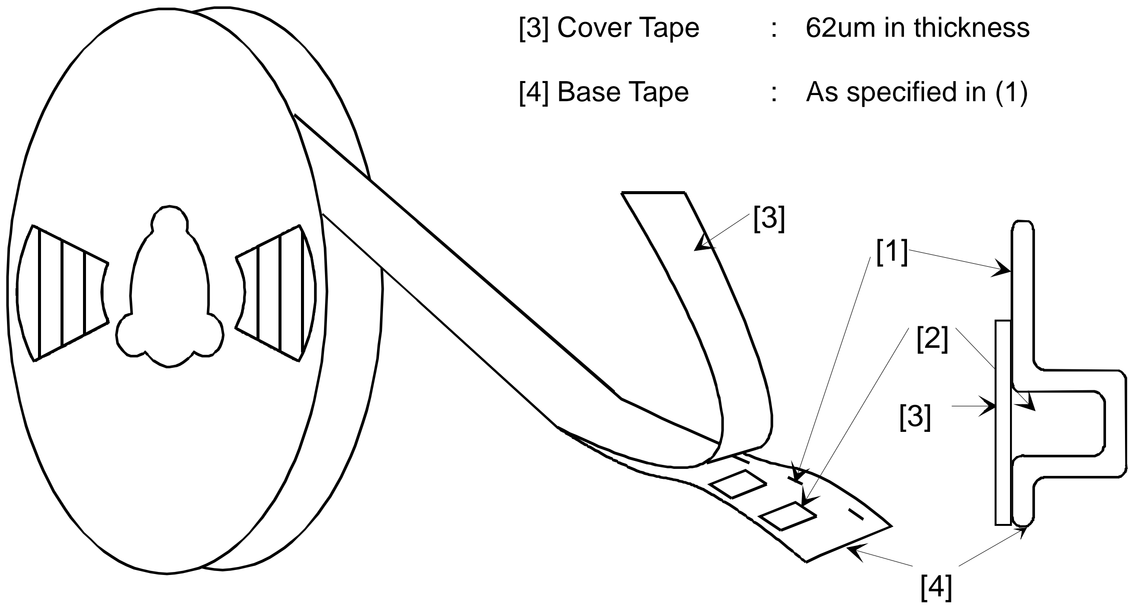
(3) Taping Diagrams

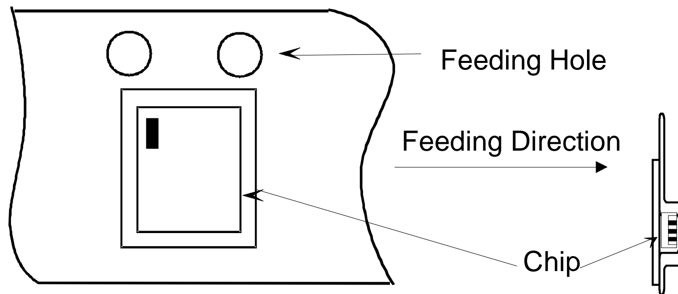
[1] Feeding Hole : As specified in (1)

[2] Hole for Chip : As specified in (1)

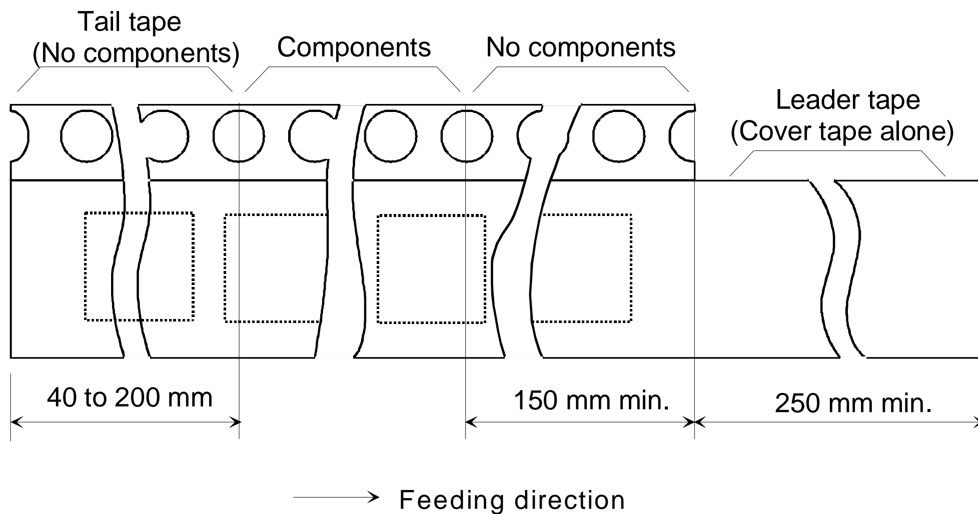
[3] Cover Tape : 62um in thickness

[4] Base Tape : As specified in (1)




(4) Leader and Tail tape



(5) The tape for chips are wound clockwise, the Feeding Holes to the right side as the tape is pulled toward the user.

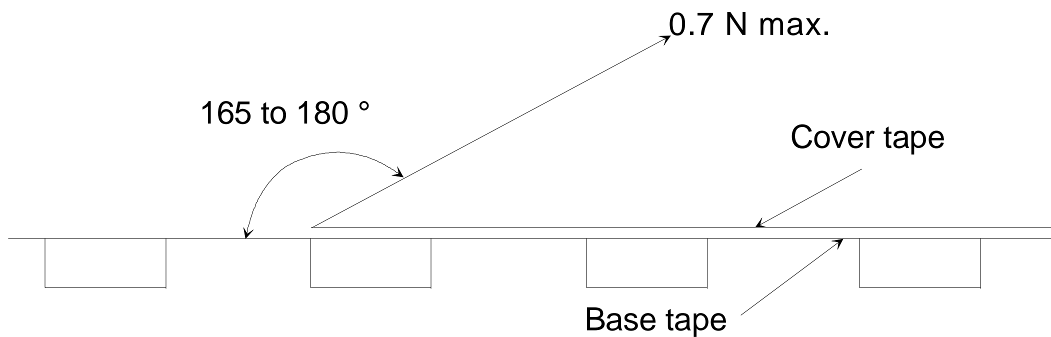
(6) The Cover Tape and Base Tape are not adhered at no components area for 250 mm min.

(7) Tear off strength against pulling of Cover Tape : 5 N min.

(8) Packaging unit : 1000 pcs./ Reel

(9) Material
Base Tape : Plastic
Reel : Plastic
Cover Tape , Base Tape and Reel are made the anti-static processing.

(10) Peeling of force : 0.7 N max. in the direction of peeling as shown below.



**NOTICE**

**1. Storage Conditions:**

The product shall be stored under the following conditions in order not to damage the solderbility of the external electrodes.
- The product shall be stored without opening the packing and at the ambient temperature between 5 and 30 deg.C and humidity between 20 and 70 %RH. And the product shall be used within 6 months after reception. (Packing materials, in particular, may be deformed at the temperature over 45 deg.C.)
- After opening the packing, the product shall be stored at 5 to 30 deg.C / ≦ 60 %RH and the product shall be used within 48 hours. If the product is not used within 48 hours after opening the packing, the product shall be baked under the following conditions.

Baking condition : 125 +/-5 deg.C, 24 hours, 1 time

The products shall be baked on the heat-resistant tray because the material (Base Tape, Reel Tape and Cover Tape) are not heat-resistant.
- The product shall be stored in non corrosive gas ($Cl_2$, $NH_3$, $SO_2$, $No_x$, etc.).
- Solderbility shall be confirmed before use if the product is stored for more than 3 months.
- When the indicator in the packing has changed its color, the product shall be baked before soldering.
- Any excess mechanical shock including, but not limited to, sticking the packing materials by sharp object and dropping the product, shall not be applied in order not to damage the packing materials.

**2. Handling Conditions:**

- Be careful in handling or transporting products because excessive stress or mechanical shock may break products due to the nature of ceramics structure.
- Handle with care because the characteristics of products may change if products may have cracks or damages on their terminals. Do not touch products with bear hands that may result in poor solderability.

**3. Standard PCB Design (Land Patterns and Dimensions) :**

- All the ground terminals should be connected to the ground patterns. Please refer to Fig.2 for the standard land dimensions.
- The recommended land patterns and dimensions are as Murata's standard. The characteristics of products may vary depending on the pattern drawing method, grounding method, land dimensions, land forming method of the NC terminals and the PCB material and thickness. Therefore, be sure to verify the characteristics in the actual set. When using non-standard lands, contact Murata beforehand.

**4. Notice for Chip Placer :**

- When placing products on the PCB, products may be stressed and broken by uneven forces from a worn-out chucking locating claw or a suction nozzle. To prevent products from damages, be sure to follow the specifications for the maintenance of the chip placer being used. For the positioning of products on the PCB, be aware that mechanical chucking may damage products.

**5. Soldering Conditions :**

- Carefully perform preheating so that the temperature difference (delta T) between the solder and products surface should be in the following range. When products are immersed in solvent after mounting, pay special attention to maintain the temperature difference within 100 deg.C. Soldering must be carried out by the above mentioned conditions to prevent products from damage. Contact Murata before use if concerning other soldering conditions.

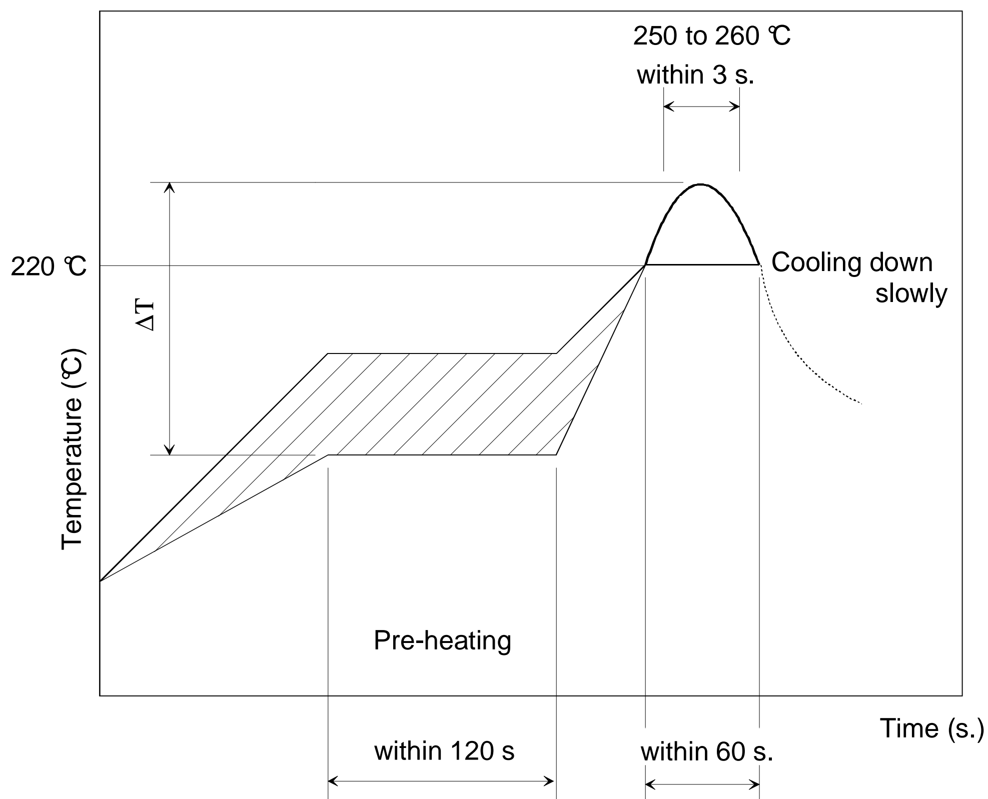
| Soldering methods | Temperature |
|---|---|
| Soldering iron method | delta T ≦ 130 deg.C |
| Reflow method | |

- Soldering iron method conditions are indicated below.

| Items \ Kind of iron | Nichrome heater | Ceramic heater |
|---|---|---|
| Soldering iron wattage | ≦ 30 W | ≦ 18 W |
| Temperature of iron-tip | ≦ 280 deg.C | ≦ 250 deg.C |

- Diameter of iron-tip : $\phi$ 3.0 mm max.
- Do not touch the module itself directly by the iron-tip.

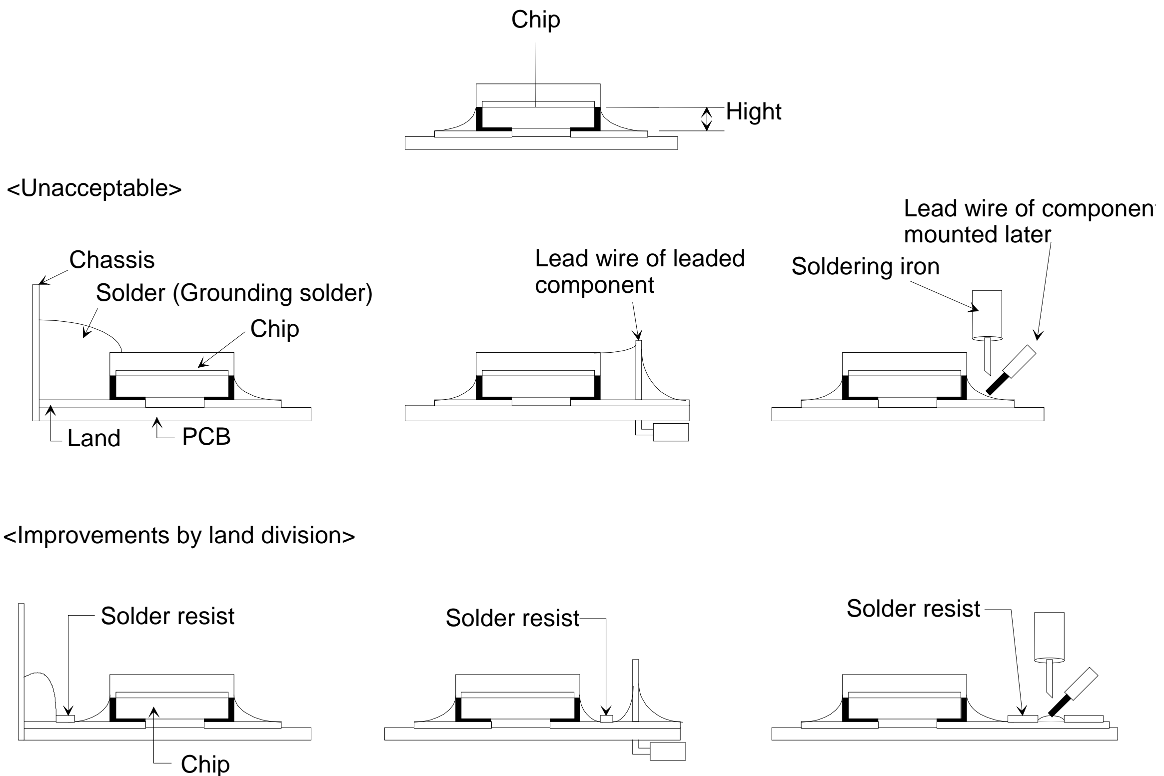
**Reflow soldering standard conditions(Example)**



- Use rosin type flux or weakly active flux with a chlorine content of 0.2 wt% or less. Be careful so as not to remain the flux residue around products. Because there are possibilities to become worse the characteristics.

- Amount of Solder Paste:
Ensure that solder is applied smoothly to a minimum height of 0.2 to 0.5 mm at the end surface of the external electrodes. If too much or little solder is applied, there is high possibility that the mechanical strength will be insufficient, creating the variation of characteristics.

**Amount of solder paste**



## 6. Operational Environment Conditions :

- Products are designed to work for electronic products under normal environmental conditions (ambient temperature, humidity and pressure). Therefore, products have no problems to be used under the similar conditions to the above-mentioned. However, if products are used under the following circumstances, it may damage products and electric shock and abnormal temperature may occur.
    - In an atmosphere containing corrosive gas ($CL_2$, $NH_3$, $SO_x$, $NO_x$, etc.).
    - In an atmosphere containing combustible and volatile gases.
    - Dusty place.
    - Direct sunlight place.
    - Water splashing place.
    - Humid place where water condenses.
    - Freezing place.
- If there are possibilities for products to be used under the preceding clause, consult with Murata before actual use.
- As it might be a cause of degradation or destruction to apply static electricity to products, do not apply static electricity or excessive voltage while assembling and measuring.

## 7. Limitation of Applications :

Please contact Murata before using products for the applications listed below which require especially high reliability for the prevention of defects which might directly cause damage to the third party's life, body or property.

- Aircraft equipment.
- Aerospace equipment.
- Undersea equipment.
- Medical equipment.
- Transportation equipment (vehicles, trains, ships, etc.).
- Traffic signal equipment.
- Disaster prevention / crime prevention equipment.
- Data-processing equipment
- Application of similar complexity and/ or reliability requirements to the applications listed in the above.

**Note :**

- Please make sure that your product has been evaluated and confirmed against your specifications when our product is mounted to your product.

- All the items and parameters in this product specification have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment agreed upon between you and us. You are requested not to use our product deviating from such agreement.

- We consider it not appropriate to include other terms and conditions for transaction warranty in product specifications, drawings or other technical documents. Therefore, even if your original part of this product specification includes such terms and conditions as warranty clause, product liability clause, or intellectual property infringement liability clause, we are not able to accept such terms and conditions in this product specification unless they are based on the governmental regulation or what we have agreed otherwise in a separate contact. We would like to suggest that you propose to discuss them under negotiation of contract.