

Bluetooth Low Energy Module Data Sheet

Dialog Semiconductor Chipset
for Bluetooth 4.1

Tentative P/N : LBCA2HNZYZ-TEMP

Revision History

Revision Code	Date	Description
	Oct.24.2013	First issue
A	Feb.13.2014	4. Dimensions and Terminal Configurations Added Dimensions of m6 and m7 5. Revised Absolute Maximum Ratings 6. Revised Operating Condition 10. Revised RF Characteristics 12. Recommended Land Pattern Corrected to Top view
B	Mar.20.2014	11. packing Information Added the figure of Tape and Reel
C	Apr.23.2014	1. Revised Scope Added the weight 5.Revised Absolute Maximum Ratings 8.Revised Sleep Clock for 32kHz Crystal 10.Revised RF Characteristics 13.Revised Application Circuit
D	Apr.29.2014	11.Revised Packing Information
E	Jun.04.2014	5.Revised Absolute Maximum Ratings 6. Operating Conditions 10.Revised RF Characteristics
F	Jul.02.2014	4.Revised Dimensions and Terminal Configurations 10.Revised RF Characteristics 13.Revised Application Circuit
G	Nov.6.2014	1.Scope 2.Part Number 3.RoHS Compliance 5.Dimensions and Terminal Configurations 6. Absolute Maximum Ratings 7.Operating Conditions 9.Sleep Clock: Recommended Operating Conditions 14.Application Circuit 15,Other Attentions 16.Wireless / BT Certification Numbers
H	Feb.12.2014	14. Application Circuit
I	Feb.23.2015	16. Wireless / BT Certification Numbers
J	Feb.27.2015	14. Application Circuit

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Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Murata products and disclaimers thereto appears at the end of this specification sheet.

1. Scope

This specification is applied to the Bluetooth low energy module.

- Interface : GPIO(supporting UART / SPI / I2C)
- IC : DA14580-01 (Dialog Semiconductor)
- Reference Clock : Internal Crystal.
- Weight : 0.107g
- MSL : 3

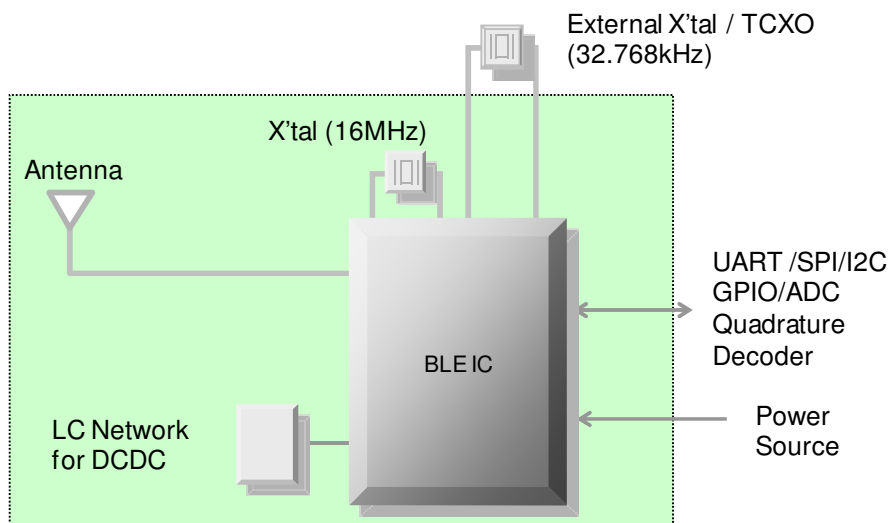
2. Part Number

Sample	LBCA2HNZYJ-TEMP
Design Kit	LBCA2HNZYJ-TEMP-DK
Daughter Board	LBCA2HNZYJ-TEMP-D-MU

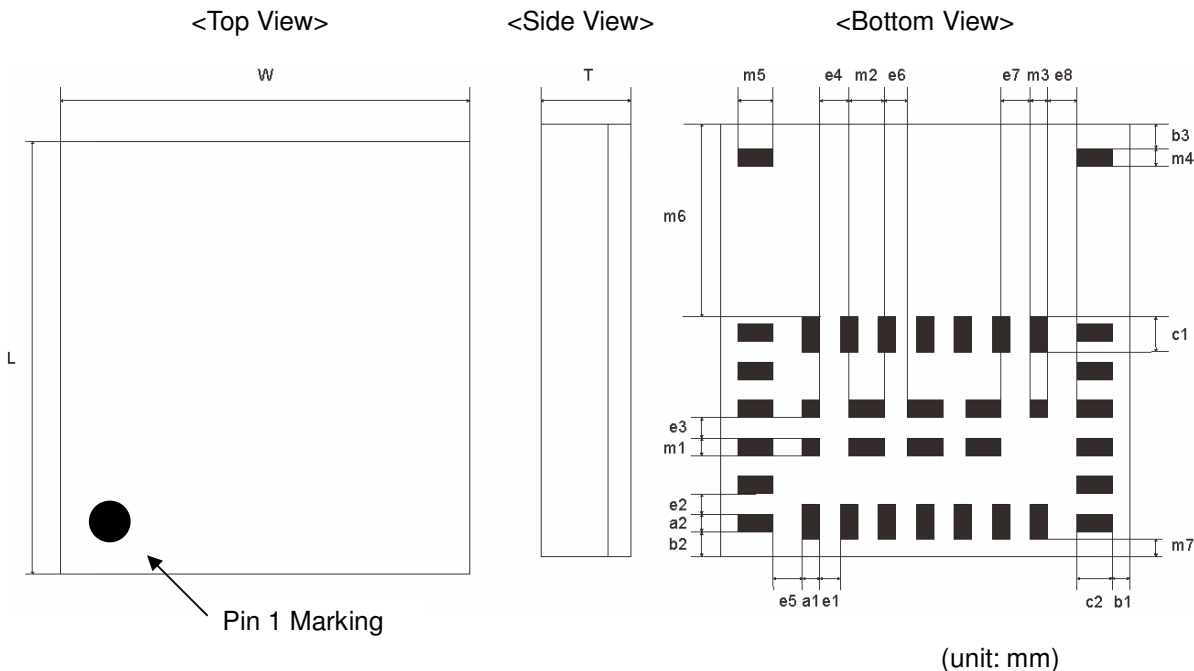
3. RoHS Compliance

This component can meet with RoHS compliance.

4. Block Diagram



5. Dimensions and Terminal Configurations

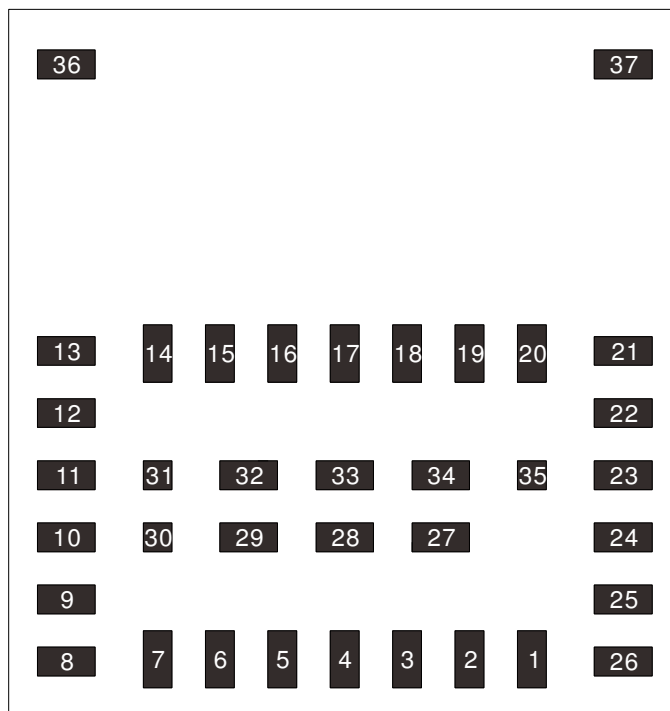


Dimension

Mark	Dimensions	Mark	Dimensions	Mark	Dimensions	Mark	Dimensions
L	7.4±0.25	W	7.0±0.25	T	1.0 Max		
a1	0.3±0.1	a2	0.3±0.1				
b1	0.3±0.2	b2	0.425±0.2	b3	0.425±0.2		
c1	0.6±0.1	c2	0.6±0.1				
e1	0.35±0.1	e2	0.35±0.1	e3	0.35±0.1	e4	0.5±0.1
e5	0.5±0.1	e6	0.4±0.1	e7	0.5±0.1	e8	0.5±0.1
m1	0.3±0.1	m2	0.6±0.1	m3	0.3±0.1	m4	0.3±0.1
m5	0.6±0.1	m6	3.3±0.2	m7	0.3±0.2		

Terminal Configurations

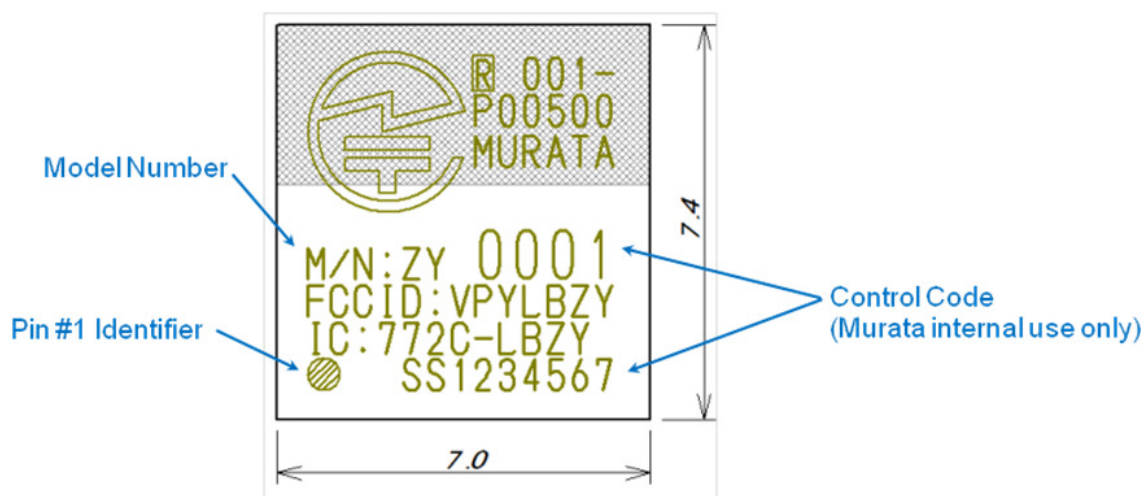
<Bottom View>



No.	Terminal Name	Connection to IC Terminal	Description
1	P0_5	P0_5	INPUT/OUTPUT with selectable pull up/down resistor. Pull-down enabled during and after reset. General purpose I/O port bit or alternate function nodes. Contain state retention mechanism during power down.
2	P0_7	P0_7	
3	P0_6	P0_6	
4	SWCLK	SWCLK	INPUT JTAG clock signal
5	SWDIO	SWDIO	INPUT/OUTPUT. JTAG Data input/output. Bidirectional data and control communication
6	GND	GND	Ground
7	VBAT	VBAT	INPUT Battery connection.
8	GND	GND	Ground
9	XTAL32KP	XTAL32KP	INPUT. Crystal input for the 32.768 kHz XTAL
10	XTAL32KM	XTAL32KM	OUTPUT. Crystal output for the 32.768 kHz XTAL
11	P0_3	P0_3	INPUT/OUTPUT with selectable pull up/down resistor. Pull-down enabled during and after reset. General purpose I/O port bit or alternate function nodes. Contain state retention mechanism during power down.
12	P0_2	P0_2	
13	ANTout	-	RF input/output. Refer to reference schematic
14	ANTin	-	
15	GND	GND	Ground
16	GND	GND	
17	GND	GND	
18	GND	GND	

No.	Terminal Name	Connection to IC Terminal	Description
19	NC	-	No connection
20	GND	GND	Ground
21	GND	GND	
22	P0_1	P0_1	INPUT/OUTPUT with selectable pull up/down resistor. Pull-down enabled during and after reset. General purpose I/O port bit or alternate function nodes. Contain state retention mechanism during power down.
23	P0_0	P0_0	
24	P0_4	P0_4	
25	RST	RST	INPUT. Reset signal (Active High, Internally Pulled Down). It can be open or connected to GND if not used.
26	GND	GND	Ground
27	GND	GND	
28	GND	GND	
29	GND	GND	
30	P1_1	P1_1	INPUT/OUTPUT with selectable pull up/down resistor. Pull-down enabled during and after reset. General purpose I/O port bit or alternate function nodes. Contain state retention mechanism during power down.
31	VPP	VPP	INPUT. This pin is used while OTP programming. Should be left open when not programming.
32	GND	GND	Ground
33	GND	GND	
34	GND	GND	
35	P1_0	P1_0	INPUT/OUTPUT with selectable pull up/down resistor. Pull-down enabled during and after reset. General purpose I/O port bit or alternate function nodes. Contain state retention mechanism during power down.
36	NC		No Connection
37	NC		No Connection

Marking Information



6. Absolute Maximum Ratings

Item	Min	Max	Unit	Remarks
Storage Temperature	-40	85	degC	
VBAT supply voltage	-0.1	3.6	V	
VPP supply voltage	-0.1	6.8	V	Supply only during OTP programming
Input voltage for XTAL32KM	-0.2	Min(1.2,VBAT+0.2)	V	
Input voltage for XTAL32KP	-0.2	Min(1.5,VBAT+0.2)	V	
Input voltage for all other pins	-0.1	Min(3.6,VBAT+0.2)	V	

Stresses in excess of the absolute ratings may cause permanent damage. Functional operation is not implied under these conditions. Exposure to absolute ratings for extended periods of time may adversely affect reliability. No damage assuming only one parameter is set at limit at a time with all other parameters are set within operating condition.

7. Recommend Operating Condition

Item	Min	Typ	Max	Unit	Remarks
Operating Temperature ^{*1}	-40		85	degC	
VBAT supply voltage	2.35		3.3	V	
VBAT supply voltage for cold boot	2.5		3.3	V	
VPP supply voltage	6.6	6.7	6.8	V	Supply only during OTP programming.
Input voltage for all other pins	0		Min(3.3,VBAT+0.2)	V	
RF Load Impedance		50		Ω	
Output current for Each I/O pin			4.8	mA	

*1: Please keep derating / margin as much as possible at extreme temperature.

8. DC Characteristics

Parameters	Description	Conditions	Min	Typ	Max	Unit
V_{IH}	HIGH level input voltage	Active mode	0.84			V
V_{IL}	LOW level input voltage	Active mode			0.36	V
V_{OH}	HIGH level output voltage	Active mode	1.88			V
V_{OL}	LOW level output voltage	Active mode			0.47	V
$I_{IH}(PD)$	HIGH level input current with internal pull down enabled	$V_{in} = V_{BAT} = 2.5V$	50		150	μA
$I_{IL}(PU)$	LOW level input current with internal pull up enabled	$V_{in} = GND = 0V$	-150		-50	μA

9. Sleep Clock: Recommended Operating Conditions

For 32kHz Crystal

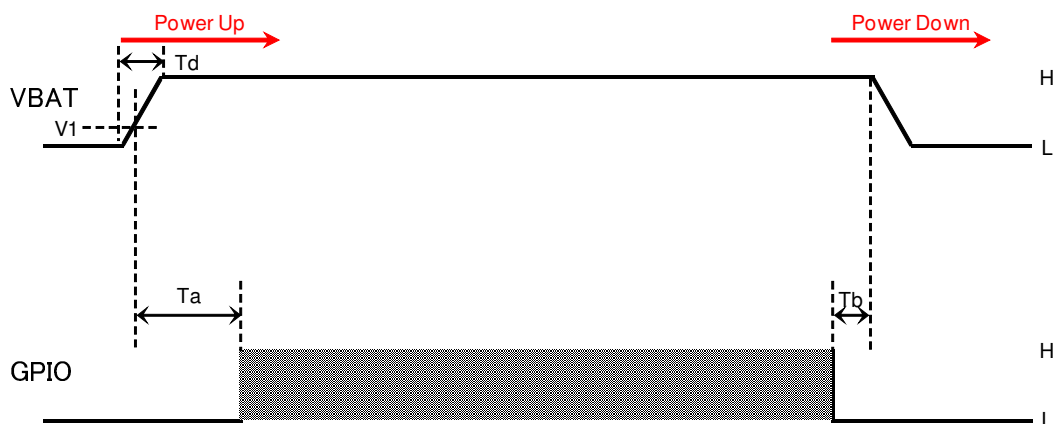
Parameters	Description	Conditions	Min	Typ	Max	Unit
f_{XTAL}	Crystal frequency			32.768		kHz
ESR	Equivalent Series Resistance				100	kohm
C_L	Load Capacitance		6	7	9	pF
C_0	Shunt Capacitance			1	2	pF
df_{XTAL}	Crystal frequency tolerance		-250		250	ppm
D_{Lmax}	Maximum drive level		0.1			μW

For 32kHz Crystal Oscillator

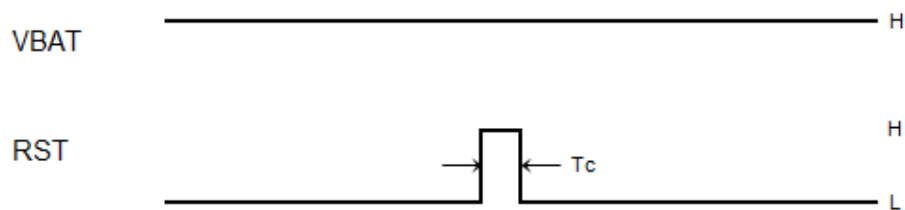
Parameters	Description	Conditions	Min	Typ	Max	Unit
f_{XO}	Oscillator frequency			32.768		kHz
A_{XO}	Amplitude		100		1500	mVpp
df_{XO}	Frequency tolerance		-250		250	ppm

10. Power Sequence

Power Up / Down Sequence



Reset and Power Cycle Sequence



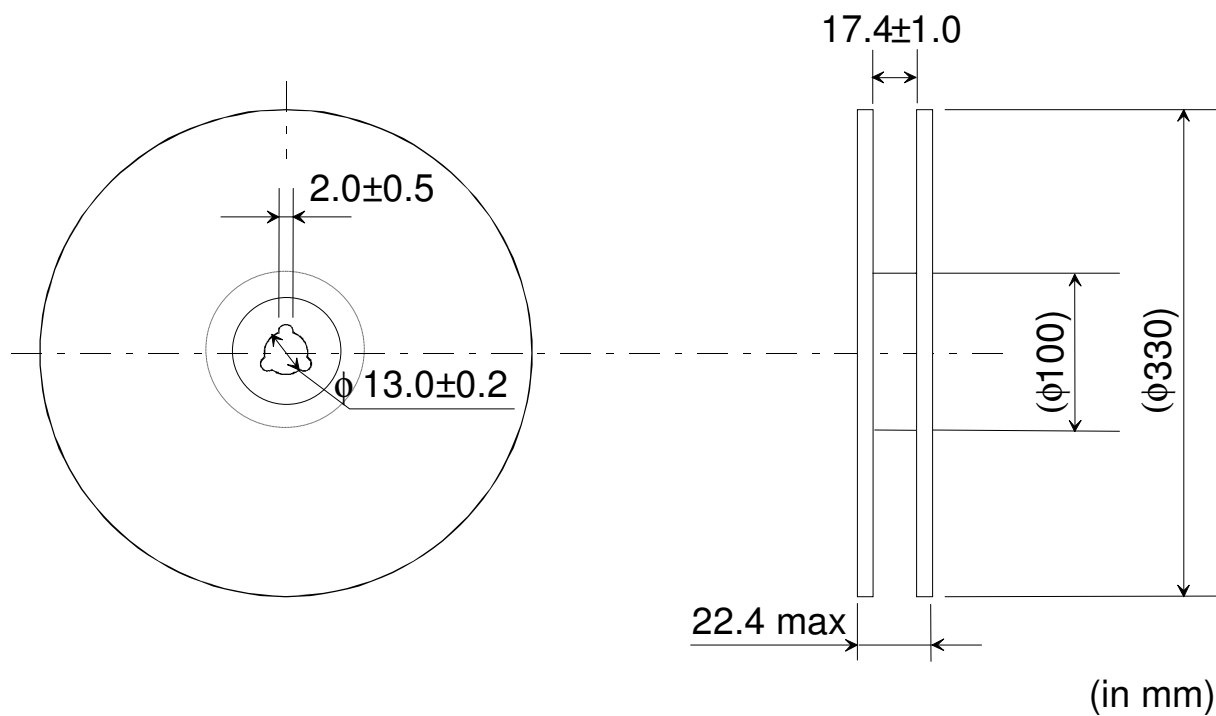
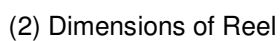
Symbol	Description	Typ	Unit
Ta	Time between VCC valid and GPIO enabled	Ta > 500	us
Tb	Time between GPIO invalid and VCC invalid	Tb > 0	us
Tc	Length of RST pulse	Tc > 10	us
Td	Required VBAT ramp-up time	Td < 50	ms
V1	Threshold voltage of VBAT rise up	V1 > 2.35	V

11. RF Characteristics

Normal Condition: VBAT=3.0V, +25deg.C, (otherwise notified)

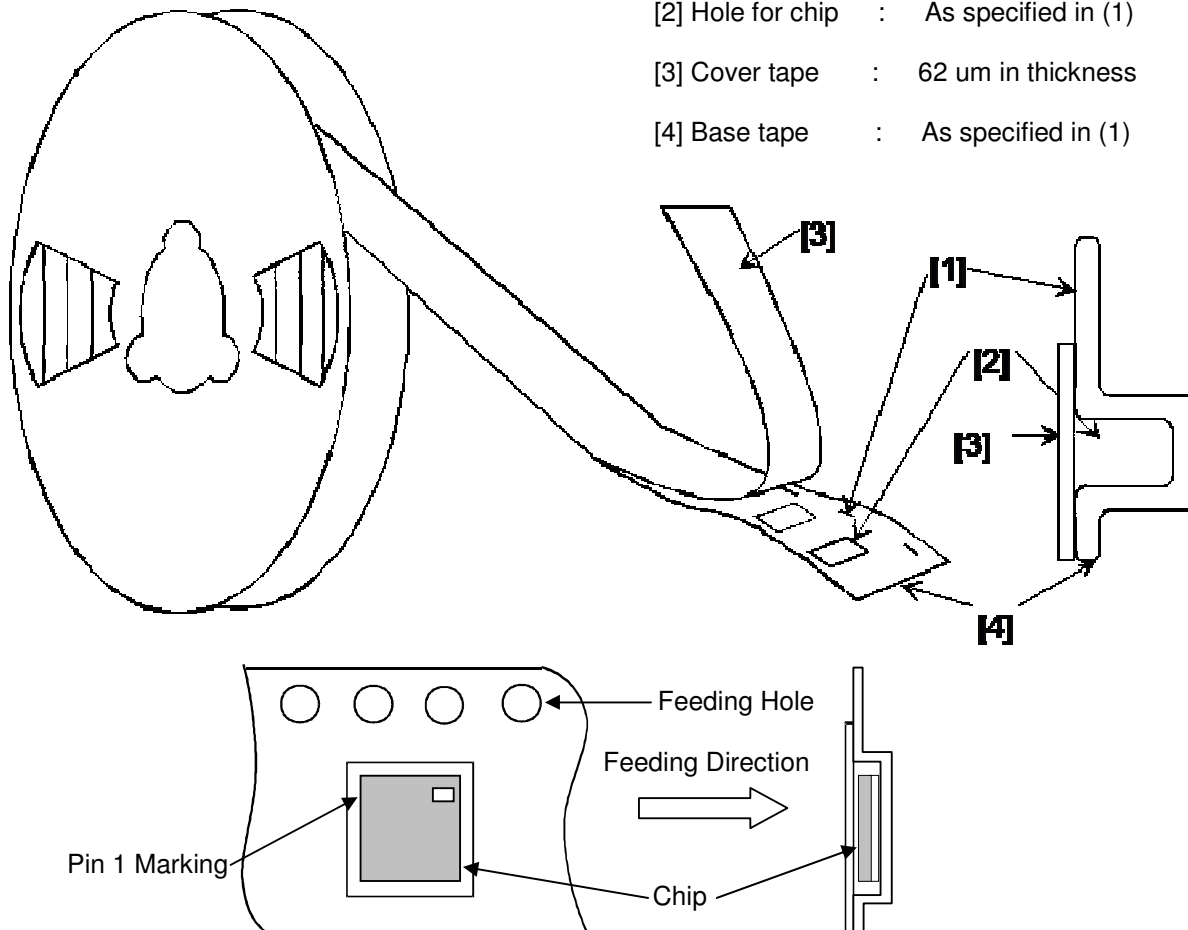
Item / Conditions	Spec.			Unit
	MIN	TYP	MAX	
Center frequency	2402	-	2480	MHz
Channel Spacing	-	2	-	MHz
Number of RF Channels	-	40	-	-
Output power (Measured at ANT pin)	-	-1	-	dBm
Modulation characteristics				
1) $\Delta f_{1\text{avg}}$	225	-	275	kHz
2) $\Delta f_{2\text{max}}$ (at 99.9%)	185	-	-	kHz
3) $\Delta f_{2\text{avg}} / \Delta f_{1\text{avg}}$	0.8	-	-	-
Carrier frequency offset and drift				
1) Frequency offset: $ f_n - f_{TX} $	-	-	150	kHz
2) Frequency drift: $ f_0 - f_n $	-	-	50	kHz
3) Drift rate #0: $ f_1 - f_0 $	-	-	20	kHz
4) Drift rate #n: $ f_n - f_{n-5} $	-	-	20	kHz
Receiver sensitivity (Ideal transmitter PER <= 30.8%)	-	-93	-70	dBm
Maximum input signal level (PER <= 30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm input)	50	-	65.4	%
TX Current consumption	-	4.8	-	mA
RX Current consumption	-	5.1	-	mA

(1) Dimensions of Tape (Plastic tape)

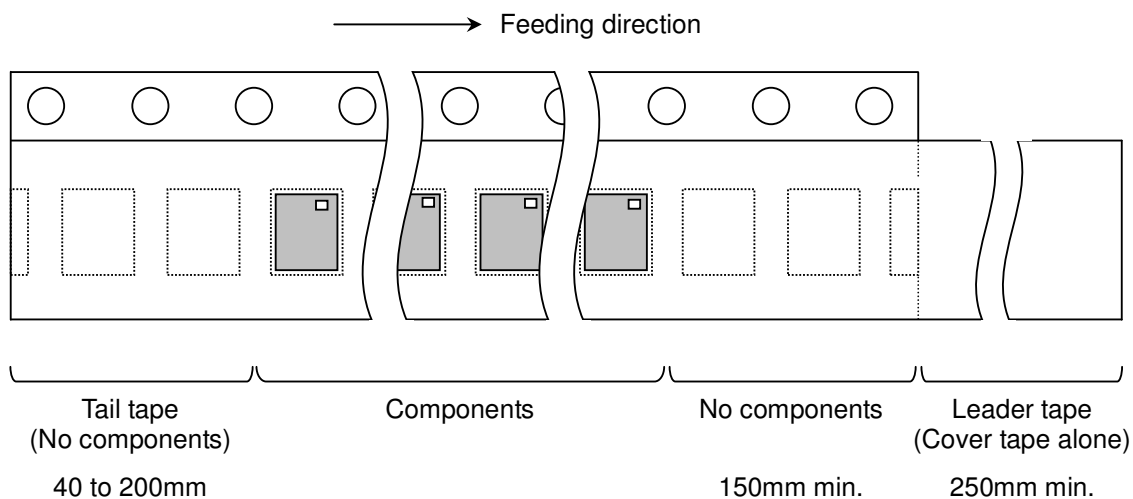


Preliminary
< Specification may be changed by Murata without notice >
Murata Manufacturing Co., Ltd.

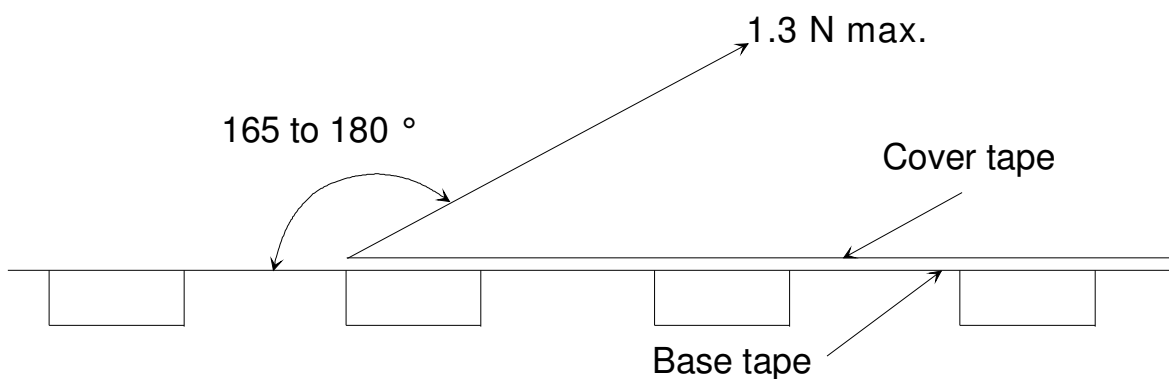
(3) Taping Diagrams



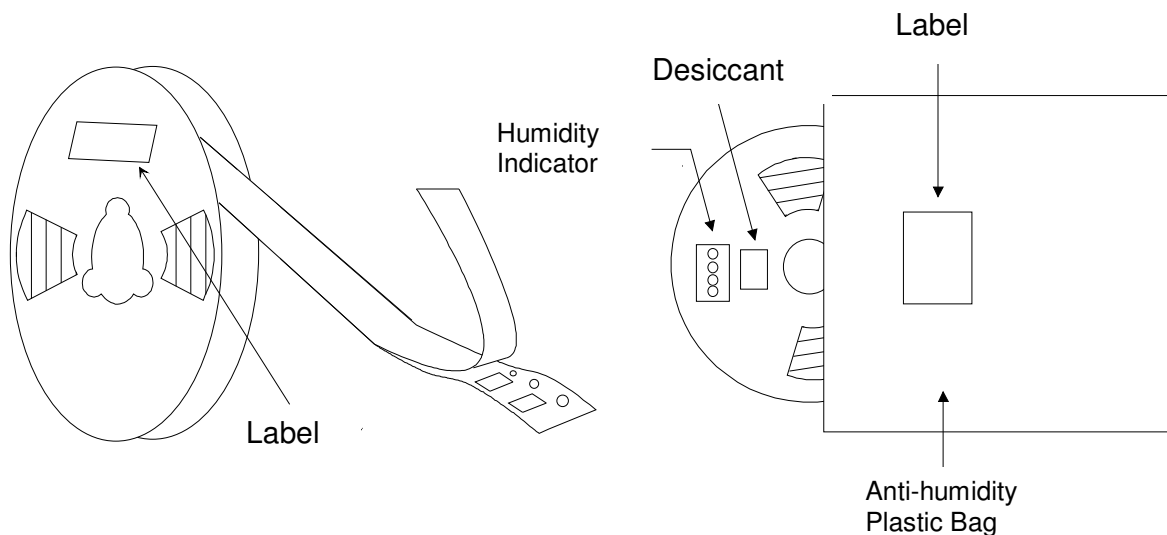
(4) Leader and Tail tape



- (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 , cavity tape and reel are made the anti-static processing.
- (10) Peeling of force : 1.3 N max. in the direction of peeling as shown below.



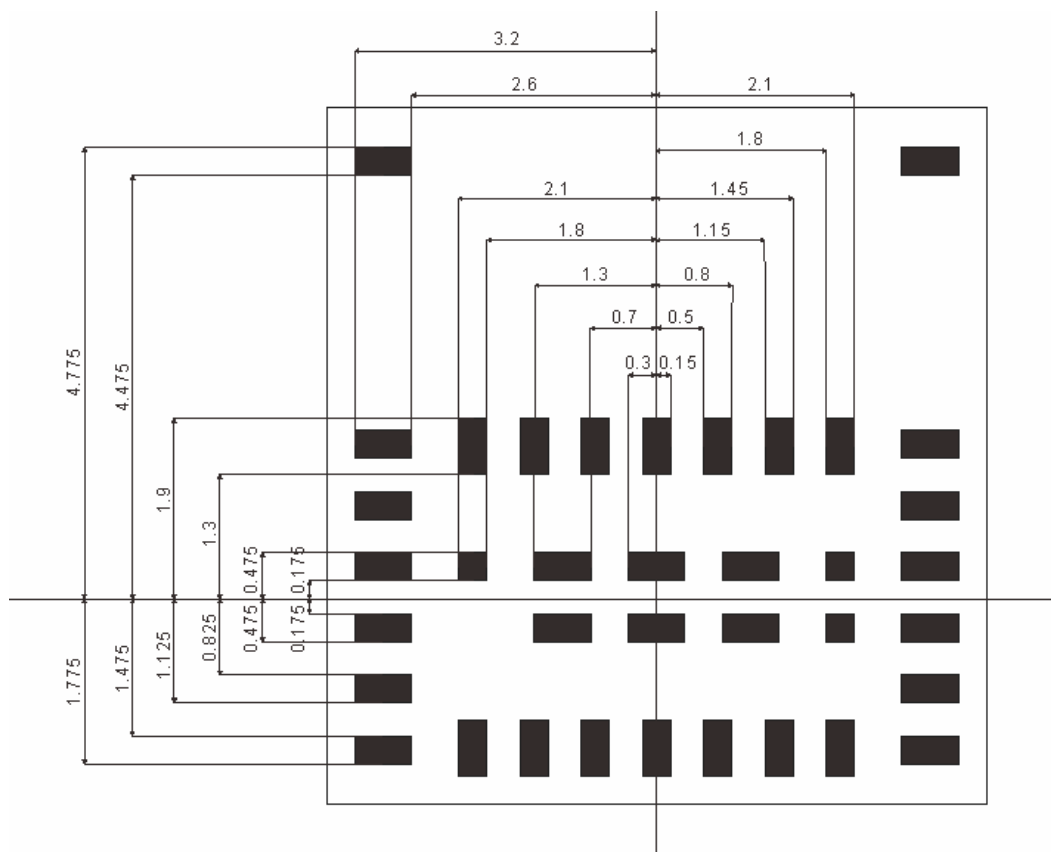
- (11) PACKAGE (Humidity proof Packing)



Tape and reel must be sealed with the anti-humidity plastic bag. The bag contains the desiccant and the humidity indicator.

13. Recommended Land Pattern

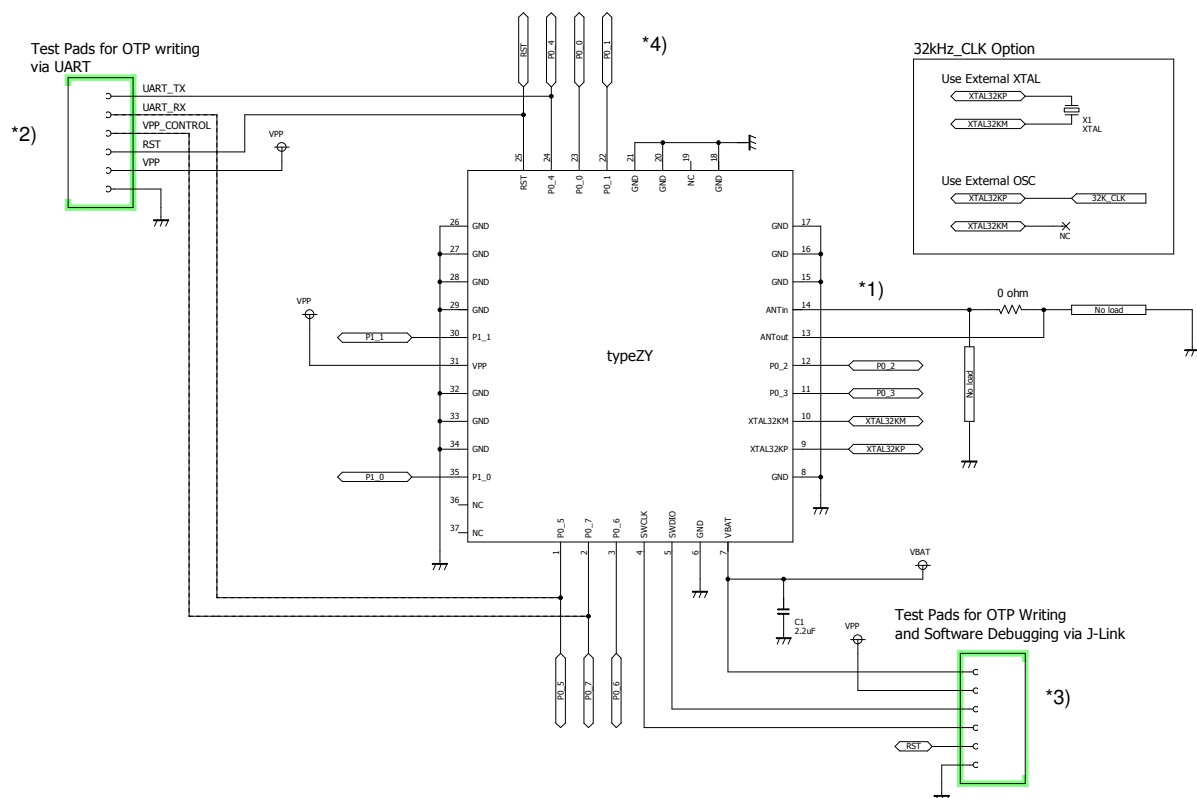
<Top View>



(Unit : mm)

14. Application Circuit

(1) Configuration using internal OTP



*1) ANTout and ANTin are to be connected with pi-matching network. Connected line is recommended to be as short as possible.

*2) Connection is necessary for writing program to the OTP via UART.

Other GPIO pin can be used for VPP CONTROL instead of P0_7.

Please see the document "Hardware setup Guide for OTP Programming".

Other pairs of GPIO can be used for UART instead of P0_4 and P0_5.

Please see the document "Overview of DA1458X Initial Boot Sequence and Available Interface Pins".

*3) Connection is necessary for software debugging in your product via J-Link.

OTP writing can also be done using J-Link.

Please see the document "Hardware Setup for Software Debugging".

RST input logic should be inverted externally if J-Link reset is enabled.

*4) 10 GPIOs (P0_0 to P0_7, P1_0 and P1_1) are available for multipurpose use.

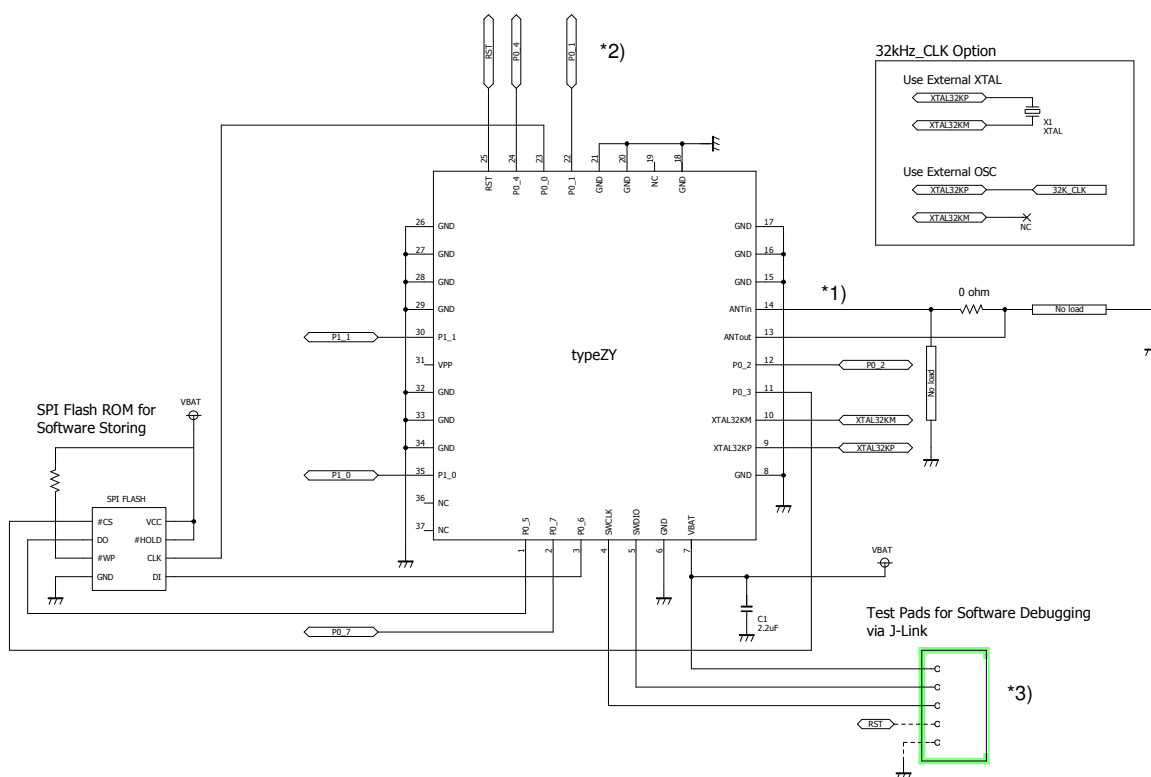
P0_0 to P0_3 can be used for analog input.

Note: XTAL32K_DISABLE_AMPREG register should be '1' for using external OSC. See DA14580 datasheet for more details.

Note: Internal RCX oscillator might be functional for sleep clock instead of external 32kHz XTAL / OSC under some limitations noted below:

- Environment temperature change is flat, connection interval < 2sec.
- Confirmation in actual condition should be done enough by the customer's responsibility.

(2) Configuration using external Flash ROM



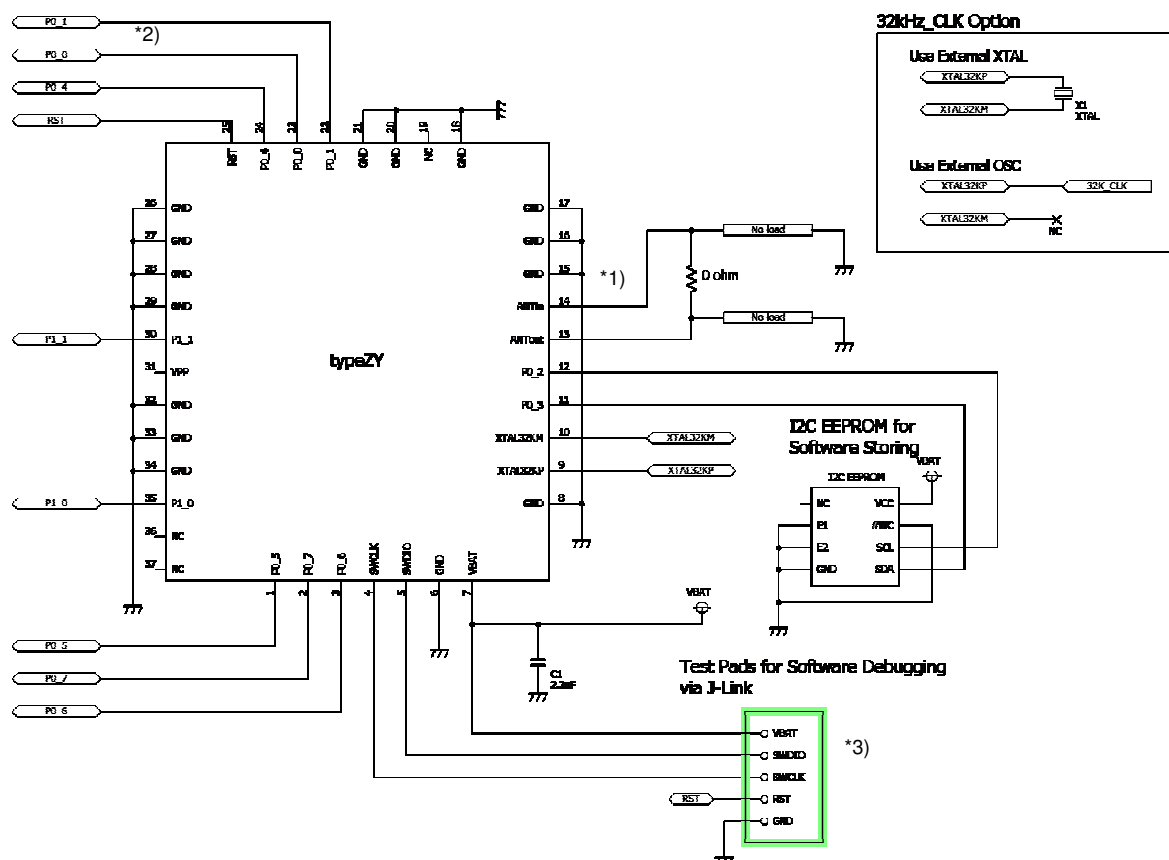
- *1) ANTout and ANTin are to be connected with pi-matching network. Connected line is recommended to be as short as possible.
- *2) 6 GPIOs (P0_1, P0_2, P0_4, P0_7, P1_0 and P1_1) are available for multipurpose use.
P0_1 and P0_2 can be used for analog input.
Please do NOT toggle those pins by external devices during starting up.
Please see the document "Overview of DA1458X Initial Boot Sequence and Available Interface Pins".
- *3) Connection is necessary for software debugging in your product via J-Link.
Please see the document "Hardware Setup for Software Debugging".
RST input logic should be inverted externally if J-Link reset is enabled.

Note: XTAL32K_DISABLE_AMPREG register should be '1' for using external OSC. See DA14580 datasheet for more details.

Note: Internal RCX oscillator might be functional for sleep clock instead of external 32kHz XTAL / OSC under some limitations noted below:

- Environment temperature change is flat, connection interval < 2sec.
- Confirmation in actual condition should be done enough by the customer's responsibility.

(3) Configuration using external I2C EEPROM



*1) ANTout and ANTin are to be connected with pi-matching network. Connected line is recommended to be as short as possible.

*2) 8 GPIOs (P0_0, P0_1, P0_4 to P0_7, P1_0 and P1_1) are available for multipurpose use.

P0_0 and P0_1 can be used for analog input.

Please do NOT toggle those pins by external devices during starting up.

Please see the document "Overview of DA1458X Initial Boot Sequence and Available Interface Pins".

*3) Connection is necessary for software debugging in your product via J-Link.

Please see the document "Hardware Setup for Software Debugging".

Note: XTAL32K_DISABLE_AMPREG register should be '1' for using external OSC. See DA14580 datasheet for more details.

Note: Internal RCX oscillator might be functional for sleep clock instead of external 32kHz XTAL / OSC under some limitations noted below:

- Environment temperature change is flat, connection interval < 2sec.
- Confirmation in actual condition should be done enough by the customer's responsibility.

15. Other Attentions

This product is not confirmed connectivity to all Bluetooth(R) Smart Ready devices, so the connectivity to all devices in actual use is not guaranteed. Also the Bluetooth(R) Low Energy wireless technology sometimes fails connections depending on surrounding environment (radio interference, noise, disturbance etc.), so it is highly recommended to implement connection-retry scheme in the customer's application software.

When starting design the device, please refer to following application notes provided by Murata.

- Hardware Setup Guide for OTP Programming
- Hardware Setup Guide for Software Debugging
- Overview of OTP Header Structure
- Overview of DA1458X Initial Boot Sequence and Available Interface Pins.
- TypeZY/ZS What should you do for Wireless Certification?
- TypeZY/ZS Antenna Performance Layout Guide

16. Wireless / BT Certification Numbers

This product is certified by following regulation bodies.

- Japanese Radio Law (日本電波法)
Type certification (工事設計認証)



R001-P00500

- FCC (United States) FCC Part 15 subpart C
Limited Modular Approval
FCC ID: VPYLBZY

- IC (Canada) RSS-210
Limited Modular Approval
IC: 772C-LBZY

- CE (Europe) EN 300328 V1.8.1
Conducted Test Report available
Note: CE marking and declaration should be done by customer as a final product.

- Bluetooth(R) SIG Qualifications
QDID: 56016 (Controller Subsystem by Murata)
Design Name: Bluemodule Type93

QDID: 52696 (Host Subsystem by Dialog)
Design Name: DA14580 - HOST - Updated

QDID: 56907 (Profile Subsystem by Dialog)
Design Name: DA14580 - Profiles

Note: Profile subsystem QDID is needed only if SIG standard profile is used.

NOTICE

1.Storage Conditions:

Please use this product within 6month after receipt.

- The product shall be stored without opening the packing under the ambient temperature from 5 to 35deg.C and humidity from 20 to 70%RH.

(Packing materials, in particular, may be deformed at the temperature over 40deg.C.)

- The product left more than 6months after reception, it needs to be confirmed the solderbility before used.

- The product shall be stored in non corrosive gas (Cl2, NH3, SO2, Nox, etc.).

- 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.

This product is applicable to MSL3 (Based on JEDEC Standard J-STD-020)

- After the packing opened, the product shall be stored at <30deg.C / <60%RH and the product shall be used within 168hours.

- When the color of the indicator in the packing changed, the product shall be baked before soldering.

Baking condition: 125+5/-0deg.C, 24hours, 1time

The products shall be baked on the heat-resistant tray because the material (Base Tape, Reel Tape and Cover Tape) are not heat-resistant.

2.Handling Conditions:

Be careful in handling or transporting products because excessive stress or mechanical shock may break products.

Handle with care if products may have cracks or damages on their terminals, the characteristics of products may change. Do not touch products with bear hands that may result in poor solder ability and destroy by static electrical charge.

3.Standard PCB Design (Land Pattern and Dimensions):

All the ground terminals should be connected to the ground patterns. Furthermore, the ground pattern should be provided between IN and OUT terminals. Please refer to the specifications for the standard land dimensions.

The recommended land pattern and dimensions is 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.

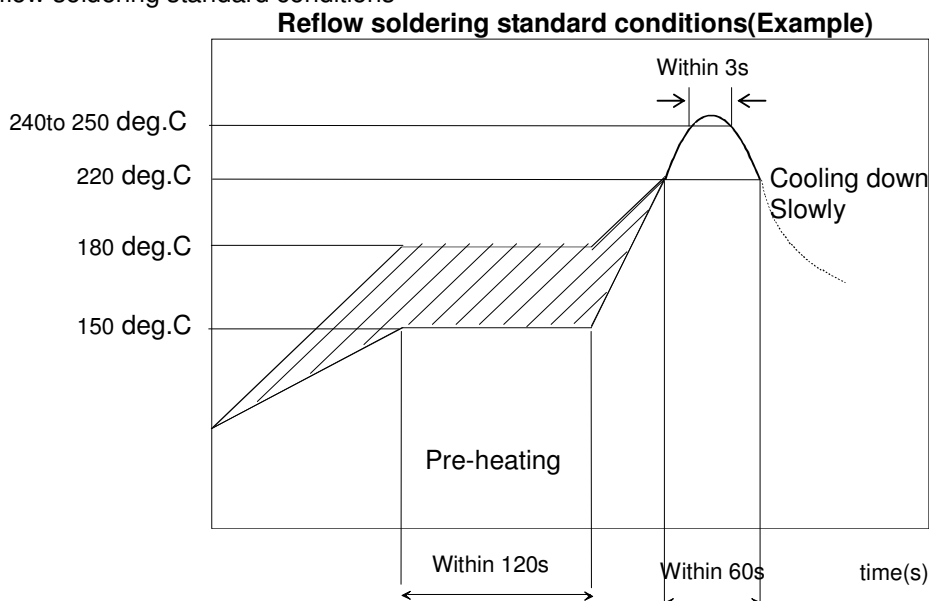
4.Notice for Chip Placer:

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:

The recommendation conditions of soldering are as in the following figure.
When products are immersed in solvent after mounting, pay special attention to maintain the temperature difference within 100 °C. Soldering must be carried out by the above mentioned conditions to prevent products from damage. Set up the highest temperature of reflow within 260 °C. Contact Murata before use if concerning other soldering conditions.

Reflow soldering standard conditions



Please use the reflow within 2 times.

Use rosin type flux or weakly active flux with a chlorine content of 0.2 wt % or less.

6.Cleaning:

Since this Product is Moisture Sensitive, any cleaning is not permitted.

7.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 leakage of electricity and abnormal temperature may occur.

- In an atmosphere containing corrosive gas (Cl₂, NH₃, 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.

8.Input Power Capacity:

Products shall be used in the input power capacity as specified in this specifications.

Inform Murata beforehand, in case that the components are used beyond such input power capacity range.

PRECONDITION TO USE OUR PRODUCTS

PLEASE READ THIS NOTICE BEFORE USING OUR PRODUCTS.

Please make sure that your product has been evaluated and confirmed from the aspect of the fitness for the specifications of our product when our product is mounted to your product.

All the items and parameters in this product specification/datasheet/catalog have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment specified in this specification. You are requested not to use our product deviating from the condition and the environment specified in this specification.

Please note that the only warranty that we provide regarding the products is its conformance to the specifications provided herein. Accordingly, we shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this specification.

WE HEREBY DISCLAIMS ALL OTHER WARRANTIES REGARDING THE PRODUCTS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THAT THEY ARE DEFECT-FREE, OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS.

The product shall not be used in any application listed below which requires especially high reliability for the prevention of such defect as may directly cause damage to the third party's life, body or property. You acknowledge and agree that, if you use our products in such applications, we will not be responsible for any failure to meet such requirements. Furthermore, YOU AGREE TO INDEMNIFY AND DEFEND US AND OUR AFFILIATES AGAINST ALL CLAIMS, DAMAGES, COSTS, AND EXPENSES THAT MAY BE INCURRED, INCLUDING WITHOUT LIMITATION, ATTORNEY FEES AND COSTS, DUE TO THE USE OF OUR PRODUCTS IN SUCH APPLICATIONS.

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

We expressly prohibit you from analyzing, breaking, reverse-engineering, remodeling altering, and reproducing our product. Our product cannot be used for the product which is prohibited from being manufactured, used, and sold by the regulations and laws in the world.

We do not warrant or represent that any license, either express or implied, is granted under any our patent right, copyright, mask work right, or our other intellectual property right relating to any combination, machine, or process in which our products or services are used. Information provided by us regarding third-party products or services does not constitute a license from us to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from us under our patents or other intellectual property.

Please do not use our products, our technical information and other data provided by us for the purpose of developing of mass-destruction weapons and the purpose of military use.

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Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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