Atmel BTLC1000-MR110CA

User Manual

Description

The BTLC1000-MR110CA is an ultra-low power Bluetooth® SMART (BLE 4.1) module with Integrated Transceiver, Modem, MAC, PA, TR Switch, and Power Management Unit (PMU). It can be used as a Bluetooth Low Energy link controller or data pump with external host MCU.
The qualified Bluetooth® Smart protocol stack is stored in dedicated ROM, the firmware includes L2CAP service layer protocols, Security Manager, Attribute protocol (ATT), Generic Attribute Profile (GATT) and the Generic Access Profile (GAP). Additionally, application profiles such as Proximity, Thermometer, Heart Rate, Blood Pressure and many others are supported and included in the protocol stack.

The module contains all circuitry required including a ceramic high gain antenna, 26MHz crystal and PMU circuitry. The customer simply needs to place the module on his board and provide power.

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1 Electrical Specifications

1.1 Absolute Maximum Ratings

Table 1: BTLC1000-MR110CA Absolute Maximum Ratings

Symbol	Characteristic	Min	Max	Unit
VDDIO	I/O Supply Voltage	-0.3	4.6	V
VBATT	Battery Supply Voltage	-0.3	5.0	V
V_{IN}(1)	Digital Input Voltage	-0.3	VDDIO	V
V_{AIN}(2)	Analog Input Voltage	-0.3	1.5	V
V_{ESDHBM}(3)	ESD Human Body Model	-1000, -2000 (see notes below)	+1000, +2000 (see notes below)	V
T_A	Storage Temperature	-65	150	°C
	Junction Temperature		125	°C

Notes:

1. V_{IN} corresponds to all the digital pins
2. V_{AIN} corresponds to the following analog pins: VDDRF_RX, VDDAMS, RFIO, XO_N, XO_P, VDD_SXDIG, VDD_VCO
3. For V_{ESDHBM}, each pin is classified as Class 1, or Class 2, or both:
    - The Class 1 pins include all the pins (both analog and digital)
    - The Class 2 pins include all digital pins only
    - V_{ESDHBM} is +/-1kV for Class1 pins. V_{ESDHBM} is +/-2kV for Class2 pins.

1.2 Recommended Operating Conditions

Table 2: BTLC1000-MR110CA Recommended Operating Conditions

Symbol	Characteristic	Min	Typ	Max	Units
VDDIO	I/O Supply Voltage Low Range	1.62	1.80	4.3	V
VBATT	Battery Supply Voltage	1.8(note 1)	3.6	4.3	V
	Operating Temperature	-40		85	°C

Notes:

1. VBATT supply must be greater than or equal to VDDIO

1.3 Restrictions for Power States

When VDDIO is off (either disconnected or at ground potential), a voltage must not be applied to the device pins. This is because each pin contains an ESD diode from the pin to the VDDIO supply. This diode will turn on when a voltage higher than one diode-drop is supplied to the pin. This in turn will try to power up the part through the VDDIO supply.

If a voltage must be applied to the signal pads while the chip is in a low power state, the VDDIO supply must be on.

Similarly, to prevent the pin-to-ground diode from turning on, do not apply a voltage that is more than 0.3V below ground to any pin.

1.4 Power-Up Sequence

The power-up/down sequence for BTLC1000 is shown in **Figure 1**. The timing parameters are provided in **Table 3**.

Figure 1: Power-Up Sequence

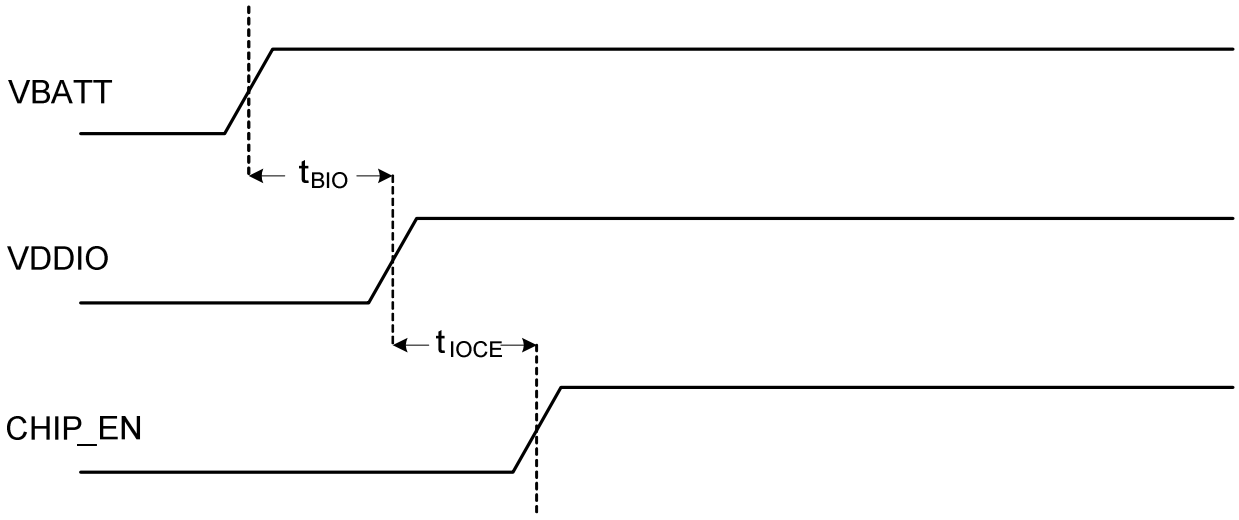

Table 3: Power-Up Sequence Timing

Parameter	Min	Max	Units	Description	Notes
t_{BIO}	0		ms	VBATT rise to VDDIO rise	VBATT and VDDIO can rise simultaneously or can be tied together.
t_{IOCE}	0		ms	VDDIO rise to CHIP_EN rise	CHIP_EN must not rise before VDDIO. CHIP_EN must be driven high or low, not left floating.

2 Application Information

The BTLC1000-MR110 module is fully self-contained. To use the module, just provide VBAT and VDDIO supplies. See Table 2 for the recommended voltages.

3 Placement and Routing Guidelines

It is critical to follow the recommendations listed below to achieve the best RF performance:

- The board should have a solid ground plane. The center ground pad of the device must be solidly connected to the ground plane by using a 3 x 3 grid of vias. Each ground pin of the module should have a ground via placed either in the pad or right next to the pad going down to the ground plane.
- When the module is placed on the motherboard, a provision for the antenna must be made. There should be nothing under the portion of the module which contains the antenna. This means the antenna should not be placed directly on top of the motherboard PCB. This can be accomplished by, for example, placing the module at the edge of the board such that the module edge with the antenna extends beyond the main board edge by 6.5mm. Alternatively, a cut out in the motherboard can be provided under the antenna. The cutout should be at least 22mm x 6.5mm. Ground vias spaced 2.5mm apart should be placed all around the perimeter of the cutout. No large components should be placed near the antenna.
- Keep away from antenna, as far as possible, large metal objects to avoid electromagnetic field blocking.
- Do not enclose the antenna within a metal shield.
- Keep any components which may radiate noise or signals within the 2.4GHz – 2.5GHz frequency band far away from the antenna or better yet, shield those components. Any noise radiated from the main board in this frequency band will degrade the sensitivity of the module.

3.1 Power and Ground

Dedicate one layer as a ground plane. Make sure that this ground plane does not get broken up by routes. Power can route on all layers except the ground layer. Power supply routes should be heavy copper fill planes to insure the lowest possible inductance. The power pins of the module should have a via directly to the power plane as close to the pin as possible. Decoupling capacitors should have a via right next to the capacitor pin and this via should go directly down to the power plane – that is to say, the capacitor should not route to the power plane through a long trace. The ground side of the decoupling capacitor should have a via right next to the pad which goes directly down to the ground plane. Each decoupling capacitor should have its own via directly to the ground plane and directly to the power plane right next to the pad. The decoupling capacitors should be placed as close to the pin that it is filtering as possible.

4 FCC Information

Each module has a label with an FCC ID, however the product User Manual must contain the following statement: “This device complies with Part 15 of the FCC Rules. 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”.

The module must be installed into the end product to provide a separation distance of at least 5 mm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

If the module’s label is not visible when installed, then an additional permanent label referring to the enclosed module: “Contains Transmitter Module FCC ID: 2ADHKBTLC1000” must be installed on the product in a visible location.

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 module/product.
- Increase the separation between the equipment and module/product.
- Consult the dealer or an experienced radio/TV technician for help.

Changes and modifications made to the equipment without the approval of manufacturer could void the user's authority to operate this equipment.

5 Interferers

One of the biggest problems with RF receivers is poor performance due to interferers on the board radiating noise into the antenna or coupling into the RF traces going to input LNA. Care must be taken to make sure that there is no noisy circuitry placed anywhere near the antenna or the RF traces. All noise generating circuits should also be shielded so they do not radiate noise that is picked up by the antenna. Also, make sure that no traces route underneath the RF portion of the BTLC1000. Also, make sure that no traces route underneath any of the RF traces from the antenna to the BTLC1000 input. This applies to all layers. Even if there is a ground plane on a layer between the RF route and another signal, the ground return current will flow on the ground plane and Revision History