Product Manual

JABIL Technology Services **Design Services**

Low Power ZigBee Module (Ember)

TABLE OF AUTHORISATION

Name	Role	Organisation	Signature
Thomas Chang	PM	PMO	Thomas
Frank Liu	Desing Manager	R&D	Frank

DOCUMENT HISTORY

Date	Version	Status	Author	Change
12/20/10	1.0	Draft	Yao-Ling Cheng	Initial Release

TABLE OF CONTENTS

1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide the product manual and Design Specifications for low power ZigBee (LPZigBee) module.

1.2 SCOPE

The scope of this document is to produce the detail Design of LPZigBee module.

1.3 INTENDED AUDIENCE

This document is intended primarily for the EE Hardware Design.

1.4 DEFINITIONS AND ABBREVIATIONS

Term	Meaning
ADC	Analog to Digital Converter
GPIO	General Purpose Input/Output
I^2C	Inter Integrated Circuit
JTAG	Joint Test Action Group
FEM	Front-end module
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
NF	Noise figure
LPZigBee	Low power ZigBee Module

2 OVERVIEW

LPZigBee module mainly consists of two sections: The System-on-Chip (EM357) and the RF front-end (SE2432L) with power amplifier and low-pass filtering.

The EM357 includes radio transceiver and microcontroller. The radio transceiver handles all actions concerning RF modulation/demodulation, signal processing, frame reception and transmission. MAC hardware acceleration functions are implemented in the radio transceiver, too. Further information about the radio transceiver and the microcontroller are available in the appropriate datasheets, refer to 1.5 references. The RF front-end incorporates signal amplification and filtering of the transmit signal. The degree of filtering depends on operating conditions as well as regional aspects. Switching between reception and transmission is directly controlled by the radio transceiver.

3 CONSTRAINTS, ASSUMPTIONS, AND DEPENDENCIES

Front-end Module Bypass Resistor installed Table

	Resistor installed status	
For SiGe SE2432 installed	Installed	- R213, R215, R218
	DNP	- R214, R216, R219
For Balun installed (i.e. bypass FEM)	Installed	- R214, R216, R219
	DNP	- R213, R215, R218

SE2432L Mode Selection Guide

Mode	CSD (Pin20)	CPS (Pin21)	CTX (Pin24)	Current Draw
1 Shundown	0	X	X	<1uA
2 RX Mode w/o LNA	1	0	0	5uA
3 RX Mode w/ LNA	1	1	0	5mA
4 TX Mode (20dB)	1	1	1	120mA

ANT SEL (Pin16)	ANT SEL (Pin16)
0	ANT1
1	ANT2

4 FEATURES

- Ultra compact size
- High RX sensitivity (-103 dBm)
- Outperforming link budget (123 dB)
- Up to +20 dBm output power
- Very low power consumption:
  — 5 μA in Sleep mode,
  — 30 mA in RX mode,
  — 145 mA in TX mode@Pout is +20 dBm
- Ample memory resources (256 bytes of flash memory, 12K bytes RAM, 4K bytes EEPROM)
- Wide range of interfaces (both analog and digital):
  — Spare GPIO,
  — 2 ADC lines
  — UART
  — I2C
  — SPI
  — JTAG
- Capability to use MAC address written into EEPROM
- IEEE 802.15.4 compliance
- 2.4 GHz ISM band
- Ember embedded software, including UART bootloader and AT command set

5 BLOCK DIAGRAM AND PORT FUNCTION

5.1 UART PORT

LPZigBee Module provides four signals (RX, TX) of standard RS-232 protocol to support user applications. The UART port is set the DCE port and connected with other devices by D-Sub-9 Female connector. But the RX, TX connection between RS-232 Transceiver and D-Sub-9 Female connector can be reversed by Jumpers, allowing use of connecting straight-though or cross-wires cable.

5.2 PROGRAMMING AND DEBUG PORT

The LPZigBee module can be programmed and debugged by JTAG port. It is a 20 pins header and connects with Atmel's debugging tool.

5.3 GPIO PORT

The GPIO connectors provide the SPI, I2C, UART and GPIO interface for external system testing. The recommended operation voltage is +3.3Vdc.

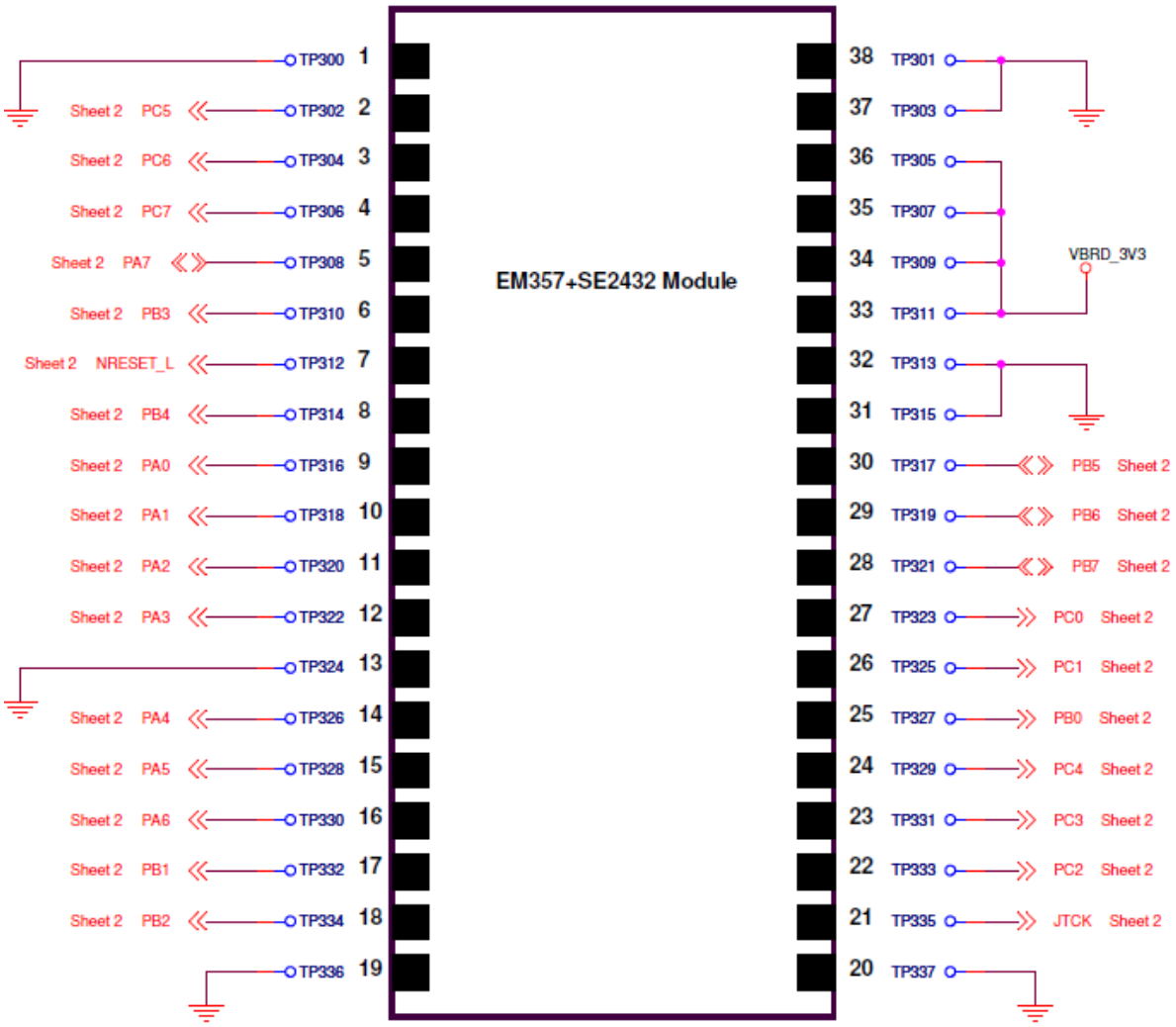
6 DETAIL SPECIFICATIONS

6.1 PIN ASSIGNMENT

6.1.1 LPZigBee Module

Ember	Function
PB3	LCD Display; SPI Chip Select, low-act; Ember output
PA2/SPI_CLK	LCD Display; SPI Clock; Ember output
PA0/SPI_MOSI	LCD Display; SPI Data output from master; Ember output
PB4	LCD Display; SPI Command/Data control, "H"=Data, "L"=Command; Ember output
PB1/UART_TX	UART to USB; Ember output
PB2/UART_RX	UART to USB; Ember output
PC6	Buttons; Ember output, High-act
PC7	Buttons; Ember output, High-act
PA7	Buttons; Ember output, High-act
PA6	Buttons; Ember input, High-act
PC1	Buttons; Ember input, High-act
PA4/ADC4/PTI_EN	Light sensor detect; Ember ADC input
PA5/ADC5/PTI_DATA	Low power detect; Ember ADC input
PB7	Low power detect/Light sensor detect control signal; Ember output, high-act
PB6/IRQB	USB cable plug-in detect; Ember interrupt input, high-act

EM357+SE2432L Module GPIO Interface Illustration



6.2 ELECTRICAL SPECIFICATION

6.2.1 DC power supply range

System module	power supply range
Ember solution w/o FEM	2.1~3.6V
Ember solution with SE2432L@ NF of LNA=2 dB Gain of LNA=12.5 dB	2.1~3.6V

6.2.2 System dBm max & min (maximum and minimum TX output at PCB antenna) and System current & power drawn.

System module	maximum TX output	minimum TX output
Ember solution w/o FEM	8dBm@I=42mA	(-26)dBm@I=21mA
Ember solution with SE2432L@ NF of LNA=2 dB Gain of LNA=12.5 dB	22dBm@Icc=NA	-6dBm@>51mA

6.2.3 System current & power drawn of TX@20dBm and RX

System module	TX@20dBm	RX
Ember solution w/o FEM	NA	I=25 mA
Ember solution with SE2432L@ NF of LNA=2 dB Gain of LNA=12.5 dB	I=145 mA	I=30 mA

6.2.4 System Current and Power consumption during idle and deep sleep mode

System module	Idle mode	Deep sleep mode
Ember solution w/o FEM	6mA @ 12MHz	5µA
Ember solution with SE2432L@ NF of LNA=2 dB Gain of LNA=12.5 dB	6mA @ 12MHz	6µA

6.2.5 System RX Sensitivity (dBm)

System module	*Sensitivity (dBm)*
Ember solution w/o FEM	(-98.6))
Ember solution with SE2432L@ NF of LNA=2 dB Gain of LNA=12.5 dB	(-103.53)

Federal Communication Commission Interference Statement

This module 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 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.

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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

IMPORTANT NOTE:
FCC Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device is intended only for OEM integrators under the following conditions:
1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling
This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: ZAR-TGPBA0010260”.

Manual Information To the End User
The OEM integrator has to be aware not to provide information to the end user

regarding how to install or remove this RF module in the user’s manual of the end

product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.