ZigBee Module

Data sheet

DFZM-E82xx

An IEEE 802.15.4 System–On-Chip ZigBee module

Contents

Revision History

Version	Date	Reason of change	Maker
0.1	2013/12/31	Initial release	Monch
0.2	2014/06/27	1. Add RF exposure warning statement including FCC statement. 2. Modify 5.6 Radio Parameter for DFZM-E821x .	Monch

DFZM-E82xx
IEEE802.15.4 System-On-Chip ZigBee Module

THIS DOCUMENT describes the DFZM-E82xx ZigBee module hardware specification. The EM3587 based modules provide cost effective, low power, and flexible platform to add ZigBee connectivity for embedded devices for a variety of applications, such as wireless sensors、energy and security monitoring、building(or home) automation and control . It combines 32-bit ARM Cortex-M3 processor, in-system programable flash memory, 64-KB RAM, 512KB flash memory and off module certified antenna options, and various RF front end options for end customer range needs in order to provide a ZigBee and regulatory certified. The module has various operating modes, making it highly suit for system where ultralow power consumption is required. Short transition times between operating modes further ensure low energy consumption.

1. Features

► Family of modules with different antenna and output power options:

- DFZM-E82xx 27 mm by 16 mm by 3.3 mm (Length * Width * Height) 28-pin Dual Flat pack PCB Surface Mount Package.

- DFZM-E8220, DFZM-E8221, DFZM-E8210, and DFZM-E8211 are all pin to pin compatible (see section 7 Ordering Information), and the user has to account only for power consumption for various end applications.

- Simple API for embedded markets covering large areas of applications.

► Compliant with IEEE 802.15.4-2003 and regulatory domains:

- RoHS compliant.

► Microcontroller:

- Industry-leading ARM Cortex-M3 processor.

- 512KB Flash with optional read protection.

- 64KB RAM memory.

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- Flexible nested vectored interrupt controller.

► Interfaces:

- Internal antenna or external antenna options.

- Flexible ADC, UART/SPI/TWI serial communications, and general purpose timers.

- Up to 24 configurable general purpose I/Os.

- Single voltage operation: 2.1~3.6V

► Embedded RTC (Real Time Clock) can run directly from battery.

2. ZigBee Model No. Definition

D F Z M - E 8 2 2 0 - DT 0 R

Free-lead		E=Pb free R=RoHS N=NG L=Process with Lead
Serial no.		0~9 then A~Z
Customer code		DT= Delta Define
Antenna Version		0= External Antenna 1=PCB printed Antenna
Power Version		1= High Power 2= Low Power
Frequency		2= 2.4GHz
Chip Type		8=EM3587
Chip Vendor		E=Ember(Silicon Labs)
Product-type		M= Module
Property		Z= ZigBee
Substrate		F= FR4
Company		D= DELTA
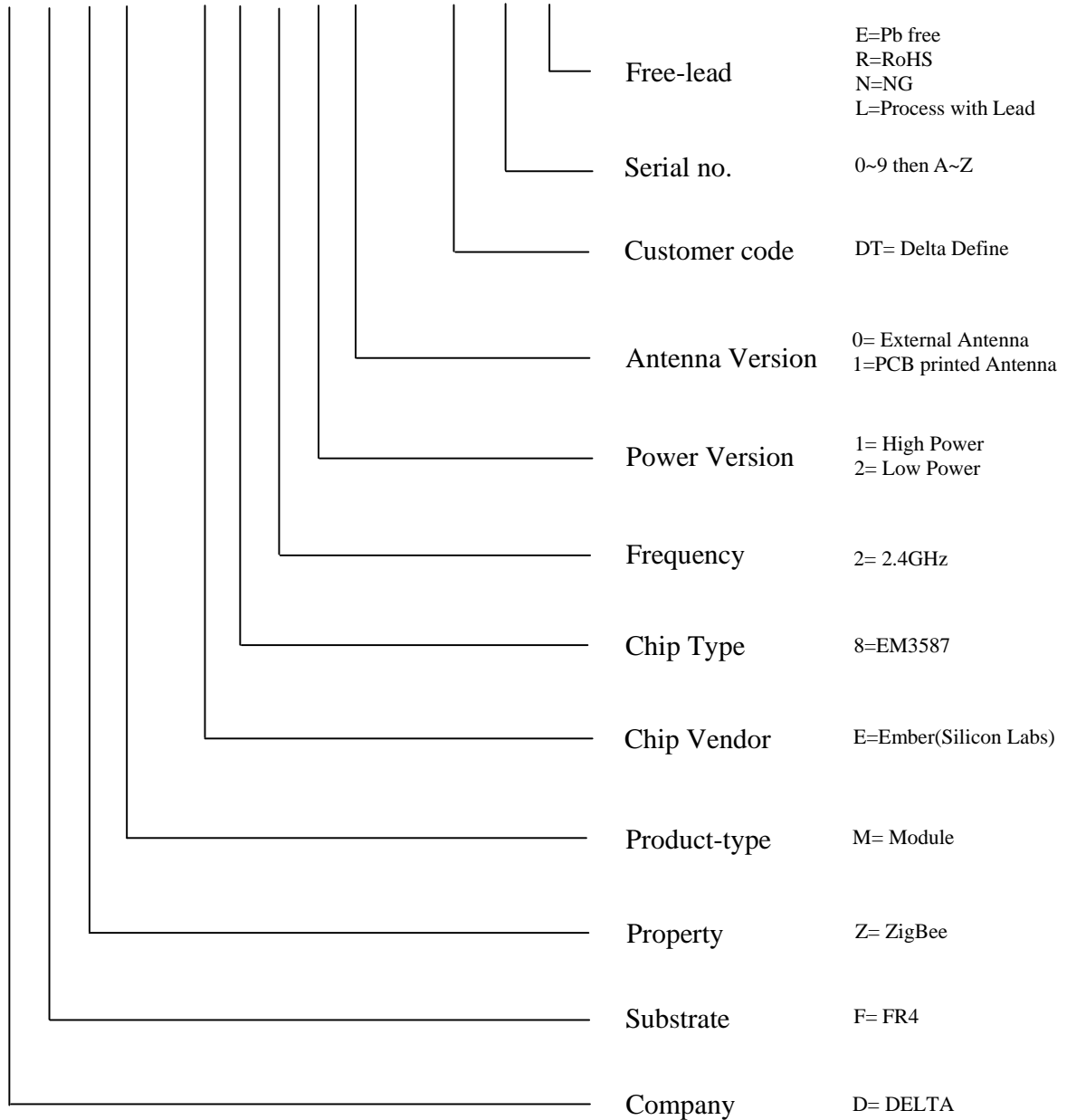
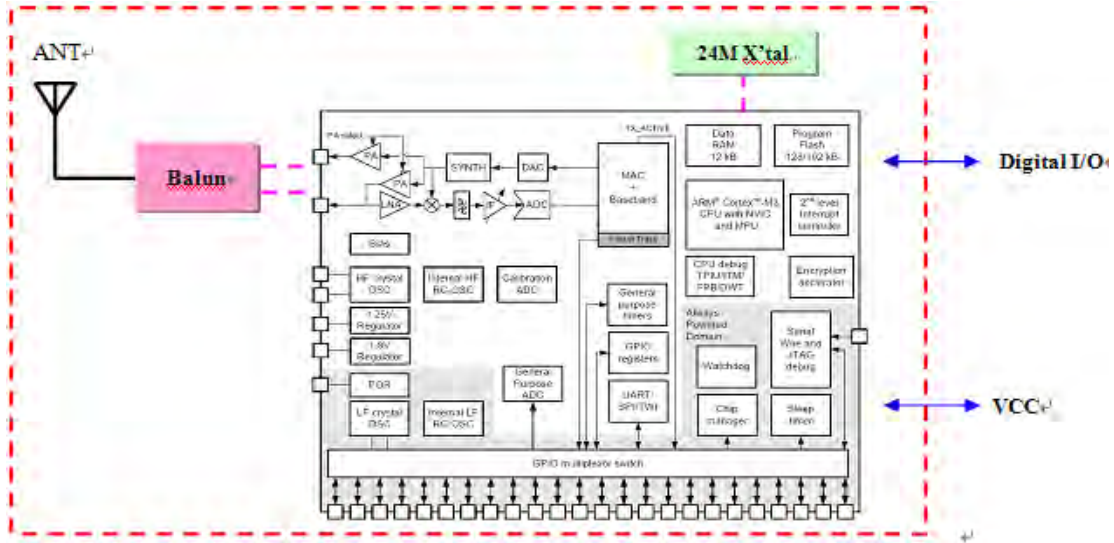# 3. Architecture

3-1.Block Diagram

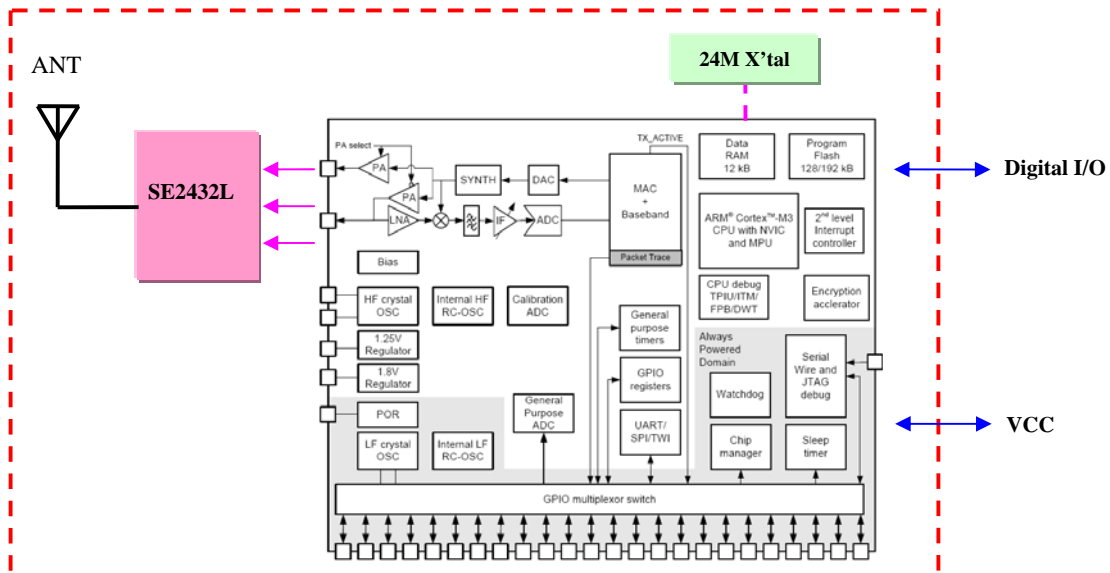**Figure 3-1: DFZM-E822x Block Diagram**

Figure 3-2: DFZM-E821x Block Diagram

3-2.Block Diagram Description

3-2-1.Overview

DFZM-E82xx module is a highly integrated ZigBee system-on-chip (SOC) that contains the following:

- The module includes Silicon Labs EM3587 SoC, which contains CPU- and memory-related, peripherals-related, clocks and power management-related in a single package.

- The module features an IEEE802.15.4-compliant radio transceiver with onboard 24 MHz crystal circuitries, RF, and certified antenna or external antenna options.

  o The low power module option has a capability of +8dBm output power at the antenna (see Figure 3-1).

  o The high power module option has a capability of +18.5dBm output power at the antenna (see Figure 3-2).

- Variety of interfaces are available such as UART, SPI, TIMER, ADC, Operational amperifier and GPIO.

- DFZM-E82xx contains single power supply (VCC).

3-2-2.CPU and Memory

The EM3587 integrates the ARM® Cortex-M3 microprocessor. The ARM® Cortex-M3 is an advanced 32-bit modified Harvard architecture processor that has separate internal program and data buses, but presents a unified program and data address space to software. The word width is 32 bits for both the program and data sides. The ARM® Cortex-M3 allows unaligned word and half-word data accesses to support efficiently-packed data structures.

The ARM® Cortex-M3 clock speed is configurable to 6 , 12 , or 24 MHz. For normal operation 24 MHz is preferred over 12 MHz due to improved performance for all applications and improved duty cycling for applications using sleep modes. The 6 MHz operation can only be used when radio operations are not required since the radio requires an accurate 12 MHz clock.

The ARM® Cortex-M3 in the EM3587 has also been enhanced to support two separate memory protection levels. Basic protection is available without using the MPU, but normal operation uses the MPU. The MPU allows for protecting unimplemented areas of the memory map to prevent common software bugs from interfering with software operation. The architecture could also allow for separation of the networking stack from the application code using a fine granularity RAM protection module. Errant writes are captured and details are reported to the

developer to assist in tracking down and fixing issues. Figure 3.3 shows the EM357 ARM® Cortex-M3 memory map.

Figure 3-3: DFZM-E82xx memory map

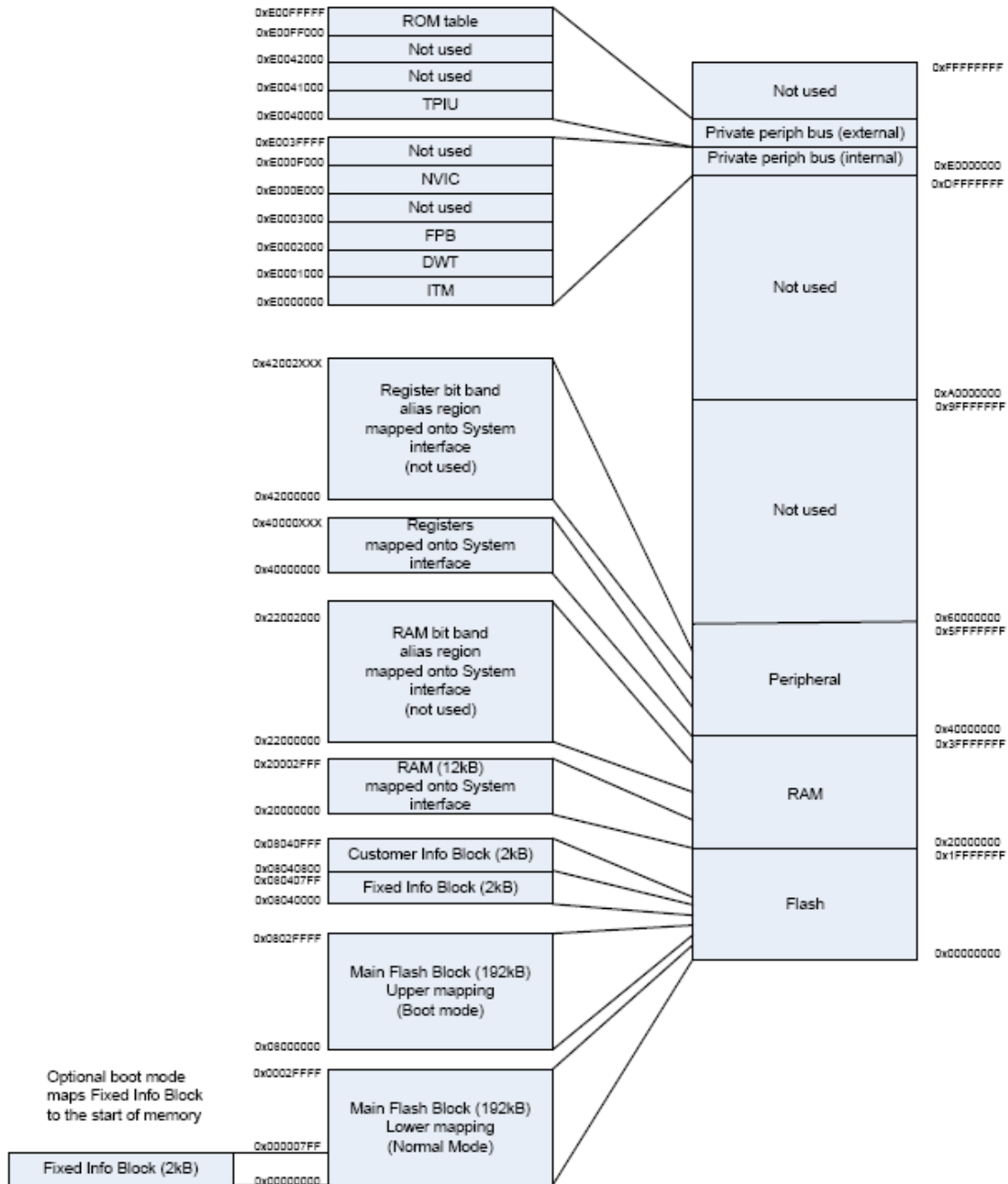### 3-2-3.Clocks and Power Management

The DFZM-E82xx integrates three oscillators:

■ 12 MHz RC oscillator

■ 24 MHz crystal oscillator

■ 10 kHz RC oscillator

Figure 3-4 shows a block diagram of the clocks in the DFZM-E82xx. This simplified view shows all the clock sources and the general areas of the chip to which they are routed
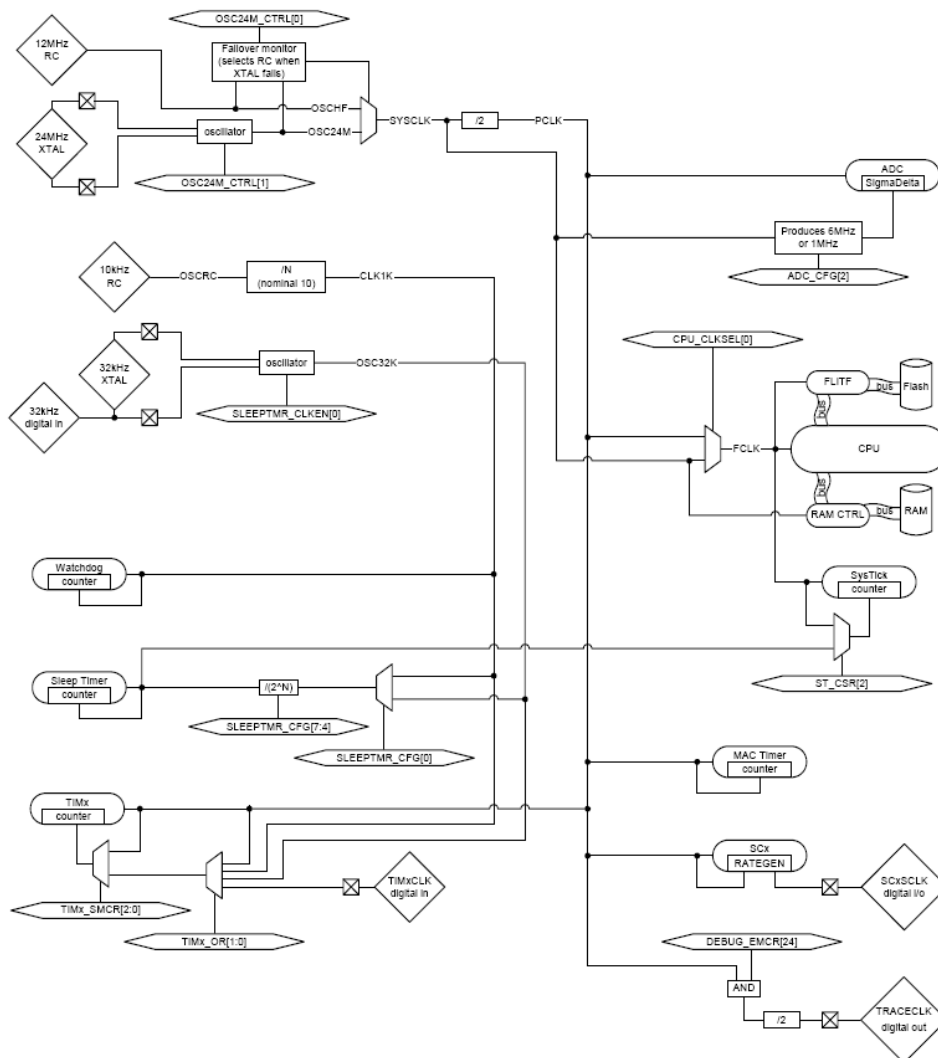

Figure 3-4: DFZM-E82xx block diagram of the clocks

The DFZM-E82xx's power management system is designed to achieve the lowest deep sleep current consumption possible while still providing flexible wakeup sources, timer activity, and debugger operation. The DFZM-E82xx has four main sleep modes:

■ Idle Sleep: Puts the CPU into an idle state where execution is suspended until any interrupt occurs. All power domains remain fully powered and nothing is reset.

■ Deep Sleep 1: The primary deep sleep state. In this state, the core power domain is fully powered down and the sleep timer is active.

■ Deep Sleep 2: The same as Deep Sleep 1 except that the sleep timer is inactive to save power. In this mode the sleep timer cannot wake up the DFZM-E82xx.

■ Deep Sleep 0 (also known as Emulated Deep Sleep): The chip emulates a true deep sleep without powering down the core domain. Instead, the core domain remains powered and all peripherals except the system debug components (ITM, DWT, FPB, NVIC) are held in reset. The purpose of this sleep state is to allow DFZM-E82xx software to perform a deep sleep cycle while maintaining debug configuration such as breakpoints.

The power management state diagram in Figure 3-5 shows the basic operation of the power management controller.
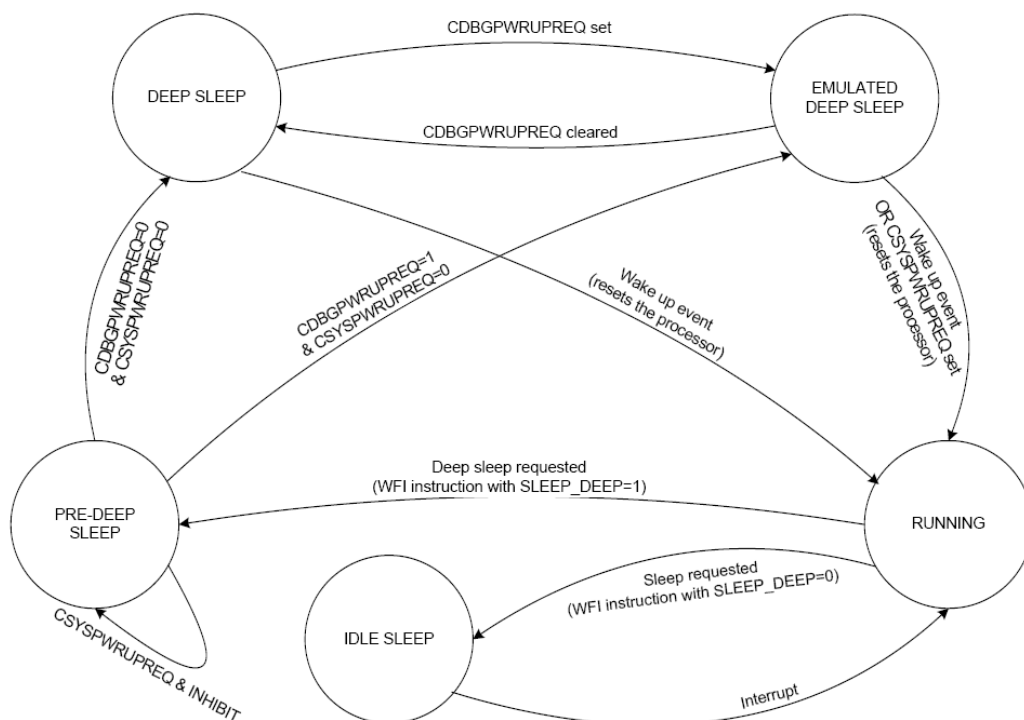

Figure 3-5: DFZM-E82xx power management state diagram

3-2-4.Peripherals

The DFZM-E82xx has 24 multipurpose GPIO pins, which may be individually configured as:

- General purpose output
- General purpose open-drain output
- Alternate output controlled by a peripheral device
- Alternate open-drain output controlled by a peripheral device
- Analog
- General purpose input
- General purpose input with pull-up or pull-down resistor

The GPIO signal assignments are shown in Table 3-1.

GPIO	Analog	Alternate Output	Input	Output Current Drive
PA0		TIM2C3[1], SC2MOSI	TIM2C3[1], SC2MOSI	Standard
PA1		TIM2C3[1], SC2MISO, SC2SDA	TIM2C3[1], SC2MISO, SC2SDA	Standard
PA2		TIM2C4[1], SC2SCLK, SC2SCL	TIM2C4[1], SC2SCLK, SC2SCL	Standard
PA3		TIM2C2[1]	TIM2C2[1], SC2nSSEL	Standard
PA4	ADC4	PTI_EN, TRACEDATA2		Standard
PA5	ADC5	PTI_DATA, TRACEDATA3	nBOOTMODE[2]	Standard
PA6		TIM1C3	TIM1C3	High
PA7		TIM1C4, REG_EN[3]	TIM1C4	High
PB0	VREF	TRACEDATA2	TRACEDATA2, TIM2MSK, IRQA,TIM1CLK	Standard
PB1		TIM2C1[4], SC1TXD, SC1MOSI, SC1MISO, SC1SDA	TIM2C1[4], SC1SDA	Standard
PB2		TIM2C2[4], SC1SCL	TIM2C2[4], SC1MISO, SC1MOSI, SC1SCL, SC1RXD	Standard
PB3		TIM2C3[4], SC1SCLK	TIM2C3[4], SC1SCLK, SC1nCTS	Standard
PB4		TIM2C4[4], SC1nRTS	TIM2C4[4], SC1nSSEL	Standard
PB5	ADC0		TIM2CLK, TIM1MSK	Standard
PB6	ADC1	TIM1C1	TIM1C1, IRQB	High
PB7	ADC2	TIM1C2	TIM1C2, IRQC	High

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PC0		TRACEDATA1	JRST, IRQD	High
PC1	ADC3	TRACEDATA3		Standard
PC2		JTDO[6], SWO , TRACEDATA0		Standard
PC3		TRACECLK	JTDI[5 ,] TRACECLK	Standard
PC4		SWDIO[7]	SWDIO[7], JTMS[7]	Standard
PC5		TX_ACTIVE		Standard

Notes:

1. Default signal assignment (not remapped).

2. Overrides during reset as an input with pull up.

3. Overrides after reset as an open-drain output.

4. Alternate signal assignment (remapped).

5. Overrides in JTAG mode as a input with pull up.

6. Overrides in JTAG mode as a push-pull output.

7. Overrides in Serial Wire mode as either a push-pull output, or a floating input, controlled by the debugger.

Table 3-1: DFZM-E82xx GPIO signal assignments

The DFZM-E82xx has two serial controllers, SC1 and SC2, which provide several options for full-duplex synchronous and asynchronous serial communications.

- SPI (Serial Peripheral Interface), master or slave
- TWI (Two Wire serial Interface), master only
- UART (Universal Asynchronous Receiver/Transmitter), SC1 only
- Receive and transmit FIFOs and DMA channels, SPI and UART modes

Before using a serial controller, configure and initialize it as follows:

1. Set up the parameters specific to the operating mode (master/slave for SPI, baud rate for UART, etc.).

2. Configure the GPIO pins used by the serial controller as shown in Tables 3-2 and 3-3.

3. If using DMA, set up the DMA and buffers.

4. If using interrupts, select edge- or level-triggered interrupts with the SCx_INTMODE register, enable the desired second-level interrupt sources in the INT_SCxCFG register, and finally enable the top-level SCx interrupt in the NVIC.

5. Write the serial interface operating mode (SPI, TWI, or UART) to the SCx_MODE register

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	PB1	**PB2**	**PB3**	**PB4**
SPI-Master	SC1MOSI Alternate Output	SC1MISO Input	SC1SCLK Alternate Output	(not used)
SPI-Slave	SC1MISO Alternate Output	SC1MOSI Input	SC1SCLK Input	SC1nSSEL Input
TWI-Master	SC1SDA Alternate Output (open-drain)	SC1SCL Alternate Output (open-drain)	(not used)	(not used)
UART	TXD Alternate Output	RXD Input	SC1nCTS Input	SC1nRTS Alternate Output

Table 3-2: DFZM-E82xx SC1 GPIO Usage and Configuration

	PA0	**PA1**	**PA2**	**PA3**
SPI-Master	SC2MOSI Alternate Output	SC2MISO Input	SC2SCLK Alternate Output	(not used)
SPI-Slave	SC2MOSI Input	SC2MISO Alternate Output	SC2SCLK Input	SC2nSSEL Input
TWI-Master	(not used)	SC2SDA Alternate Output (open-drain)	SC2SCL Alternate Output (open-drain)	(not used)

Table 3-3: DFZM-E82xx SC2 GPIO Usage and Configuration

4. Pin-out and Signal Description
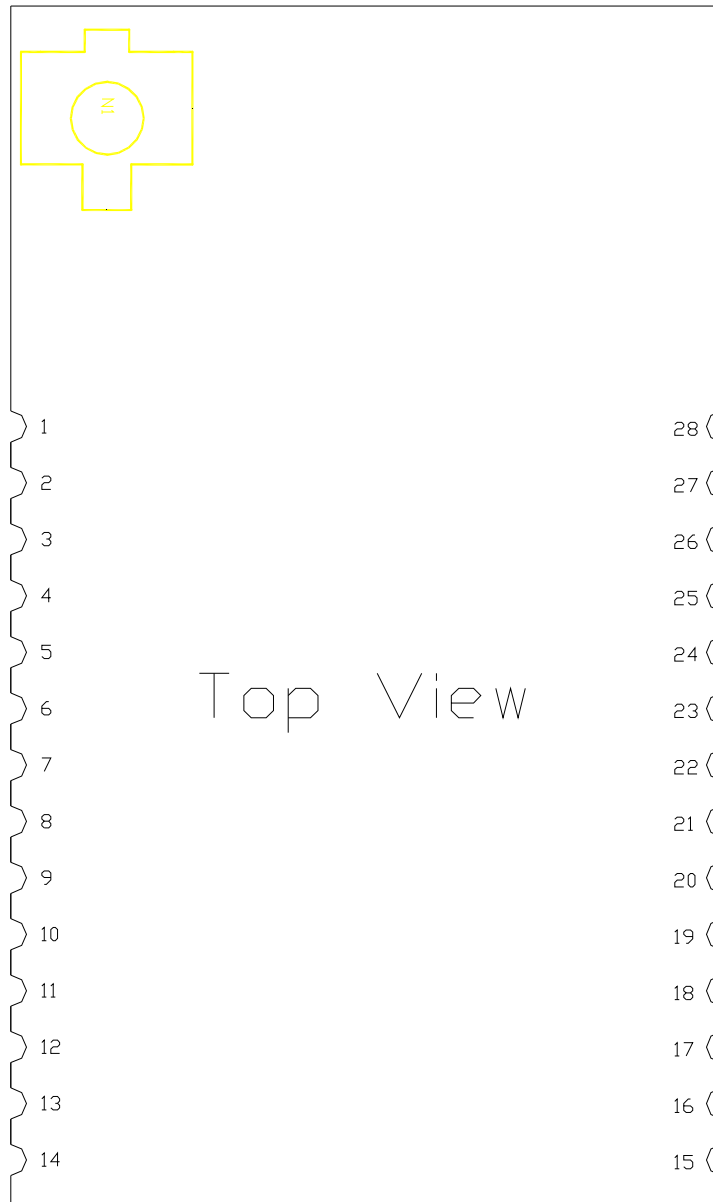
4-1. Device Pin-out Diagram (Module top view)

Figure 4-1: DFZM-E82xx Device Pin-out Diagram (Module top view)

Proprietary Information and Specifications are Subject to Change

4-2.Module Pins Description

Pins	Name	Pin Type	Description
1	GND	Ground	Ground
2	PC5	I/O	Digital I/O(Not available for DFZM-E821X-DT0R)
	TX_ACTIVE	O	Logic-level control for external Tx/Rx switch .The EM358 baseband controls Tx active and drives it high(VDD_PADS) when in Tx mode. Select alternate output function with GPIO_PCCFGH[7:4].
3	nRESET	I	Active low chip reset(internal pull-up)
4	PA7	I/O	Digital I/O, High current, Disable REG_EN with GPIO_DBGCFG[4]
	TIM1C4	O	Timer 1 Channel 4 output, Enable timer output with TIM1_CCER Select alternate output function with GPIO_PACFGH[15:12] Disable REG_EN with GPIO_DBGCFG[4]
	TIM1C4	I	Timer 1 Channel 4 input, Cannot be remapped
	REG_EN	O	External regulator open drain output, Enabled after reset
5	PB3	I/O	Digital I/O
	TIM2C3	O	Timer 2 channel 3 output, Enable remap with TIM2_OR[6] Enable timer output in TIM2_CCER Select alternate output function with GPIO_PBCFGL[15:12]
	TIM2C3	I	Timer 2 channel 3 input, Enable remap with TIM2_OR[6]
	SC1nCTS	I	UART CTS handshake of Serial Controller 1 Enable with SC1_UARTCFG[5], Select UART with SC1_MODE
	SC1SCLK	O	SPI master clock of Serial Controller 1 Either disable timer output in TIM2_CCER, or disable remap with TIM2_OR[6] Enable master with SC1_SPICFG[4], Select SPI with SC1_MODE Select alternate output function with GPIO_PBCFGL[15:12]
	SC1SCLK	I	SPI slave clock of Serial Controller 1 Enable slave with SC1_SPICFG[4], Select SPI with SC1_MODE
6	PB4	I/O	Digital I/O
	TIM2C4	O	Timer 2 channel 4 output, Enable remap with TIM2_OR[7] Enable timer output in TIM2_CCER

			Select alternate output function with GPIO_PBCFGH[3:0]
	TIM2C4	I	Timer 2 channel 4 input, Enable remap with TIM2_OR[7]
	SC1nRTS	O	UART RTS handshake of Serial Controller 1 Either disable timer output in TIM2_CCER,or disable remap with TIM2_OR[7] Enable with SC1_UARTCFG[5], Select UART with SC1_MODE Select alternate output function with GPIO_PBCFGH[3:0]
	SC1nSSEL	I	SPI slave select of Serial Controller 1 Enable slave with SC1_SPICFG[4], Select SPI with SC1_MODE
7	PA0	I/O	Digital I/O
	TIM2C1	O	Timer 2 channel 1 output, Disable remap with TIM2_OR[4] Enable timer output in TIM2_CCER Select alternate output function with GPIO_PACFGL[3:0]
	TIM2C1	I	Timer 2 channel 1 input, Disable remap with TIM2_OR[4]
	SC2MOSI	O	SPI master data out of Serial Controller 2 Either disable timer output in TIM2_CCER, or enable remap with TIM2_OR[4] Enable master with SC2_SPICFG[4], Select SPI with SC2_MODE Select alternate output function with GPIO_PACFGL[3:0]
	SC2MOSI	I	SPI slave data in of Serial Controller 2 Enable slave with SC2_SPICFG[4], Select SPI with SC2_MODE
8	PA1	I/O	Digital I/O
	TIM2C3	O	Timer 2 channel 3 output, Disable remap with TIM2_OR[6] Enable timer output in TIM2_CCER Select alternate output function with GPIO_PACFGL[7:4]
	TIM2C3	I	Timer 2 channel 3 input, Disable remap with TIM2_OR[6]
	SC2SDA	I/O	TWI data of Serial Controller 2, Either disable timer output in TIM2_CCER, or enable remap with TIM2_OR[6], Select TWI with SC2_MODE Select alternate open-drain output function with GPIO_PACFGL[7:4]
	SC2MISO	O	SPI slave data out of Serial Controller 2, Either disable timer output in TIM2_CCER, or enable remap with TIM2_OR[6], Enable slave with SC2_SPICFG[4], Select SPI with SC2_MODE, Select alternate output function with GPIO_PACFGL[7:4]
	SC2MISO	I	SPI master data in of Serial Controller 2

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			Enable slave with SC2_SPICFG[4], Select SPI with SC2_MODE
9	PA2	I/O	Digital I/O
	TIM2C4	O	Timer 2 channel 4 output Disable remap with TIM2_OR[7], Enable timer output in TIM2_CCER Select alternate output function with GPIO_PACFGL[11:8]
	TIM2C4	I	Timer 2 channel 4 input, Disable remap with TIM2_OR[7]
	SC2SCL	I/O	TWI clock of Serial Controller 2, Either disable timer output in TIM2_CCER, or enable remap with TIM2_OR[7], Select TWI with SC2_MODE Select alternate open-drain output function with GPIO_PACFGL[11:8]
	SC2SCLK	O	SPI master clock of Serial Controller 2 Either disable timer output in TIM2_CCER, or enable remap with TIM2_OR[7] Enable master with SC2_SPICFG[4], Select SPI with SC2_MODE Select alternate output function with GPIO_PACFGL[11:8]
	SC2SCLK	I	SPI slave clock of Serial Controller 2 Enable slave with SC2_SPICFG[4], Select SPI with SC2_MODE
10	PA3	I/O	Digital I/O
	SC2nSSEL	I	SPI slave select of Serial Controller 2 Enable slave with SC2_SPICFG[4], Select SPI with SC2_MODE
	TIM2C2	O	Timer 2 channel 2 output Disable remap with TIM2_OR[5], Enable timer output in TIM2_CCER Select alternate output function with GPIO_PACFGL[15:12]
	TIM2C2	I	Timer 2 channel 2 input, Disable remap with TIM2_OR[5]
11	PA4	I/O	Digital I/O
	ADC4	Analog	ADC Input 4, Select analog function with GPIO_PACFGH[3:0]
	PTI_EN	O	Frame signal of Packet Trace Interface (PTI) Disable trace interface in ARM core, Enable PTI in Ember software Select alternate output function with GPIO_PACFGH[3:0]
	TRACEDATA2	O	Synchronous CPU trace data bit 2 Select 4-wire synchronous trace interface in ARM core Enable trace interface in ARM core Select alternate output function with GPIO_PACFGH[3:0]

12	PA5	I/O	Digital I/O
	ADC5	Analog	ADC Input 5, Select analog function with GPIO_PACFGH[7:4]
	PTI_DATA	O	Data signal of Packet Trace Interface (PTI) Disable trace interface in ARM core, Enable PTI in Ember software Select alternate output function with GPIO_PACFGH[7:4]
	nBOOTMODE	I	Activate FIB monitor instead of main program or bootloader when coming out of reset. Signal is active during and immediately after a reset on nRESET.
	TRACEDATA3	O	Synchronous CPU trace data bit 3 Select 4-wire synchronous trace interface in ARM core Enable trace interface in ARM core Select alternate output function with GPIO_PACFGH[7:4]
13	PA6	I/O	Digital I/O, High current
	TIM1C3	O	Timer 1 channel 3 output, Enable timer output in TIM1_CCER Select alternate output function with GPIO_PACFGH[11:8]
	TIM1C3	I	Timer 1 channel 3 input, Cannot be remapped
14	GND	Ground	Ground
15	VCC	Power	Power Supply Input
16	PB1	I/O	Digital I/O
	SC1MISO	O	SPI slave data out of Serial Controller 1 Either disable timer output in TIM2_CCER, or disable remap with TIM2_OR[4] Select SPI with SC1_MODE, Select slave with SC1_SPICR Select alternate output function with GPIO_PBCFGL[7:4]
	SC1MOSI	O	SPI master data out of Serial Controller 1 Either disable timer output in TIM2_CCER, or disable remap with TIM2_OR[4] Select SPI with SC1_MODE, Select master with SC1_SPICR Select alternate output function with GPIO_PBCFGL[7:4]
	SC1SDA	I/O	TWI data of Serial Controller 1, Either disable timer output in TIM2_CCER, or disable remap with TIM2_OR[4], Select TWI with SC1_MODE Select alternate open-drain output function with GPIO_PBCFGL[7:4]
	SC1TXD	O	UART transmit data of Serial Controller 1 Either disable timer output in TIM2_CCER, or disable remap with TIM2_OR[4]

			Select UART with SC1_MODE Select alternate output function with GPIO_PBCFGL[7:4]
	TIM2C1	O	Timer 2 channel 1 output Enable remap with TIM2_OR[4], Enable timer output in TIM2_CCER Select alternate output function with GPIO_PACFGL[7:4]
	TIM2C1	I	Timer 2 channel 1 input, Disable remap with TIM2_OR[4]
17	PB2	I/O	Digital I/O
	SC1MISO	I	SPI master data in of Serial Controller 1 Select SPI with SC1_MODE, Select master with SC1_SPICR
	SC1MOSI	I	SPI slave data in of Serial Controller 1 Select SPI with SC1_MODE, Select slave with SC1_SPICR
	SC1SCL	I/O	TWI clock of Serial Controller 1, Either disable timer output in TIM2_CCER, or disable remap with TIM2_OR[5], Select TWI with SC1_MODE Select alternate open-drain output function with GPIO_PBCFGL[11:8]
	SC1RXD	I	UART receive data of Serial Controller 1, Select UART with SC1_MODE
	TIM2C2	O	Timer 2 channel 2 output Enable remap with TIM2_OR[5], Enable timer output in TIM2_CCER Select alternate output function with GPIO_PBCFGL[11:8]
	TIM2C2	I	Timer 2 channel 2 input, Enable remap with TIM2_OR[5]
18	SWCLK	I/O	Serial Wire clock input/output with debugger Selected when in Serial Wire mode (see JTMS description, Pin 35)
	JTCK	I	JTAG clock input from debugger Selected when in JTAG mode (default mode, see JTMS description, Pin 35) Internal pull-down is enabled
19	PC2	I/O	Digital I/O, Enable with GPIO_DBGCFG[5] and GPIO_PCCFGH[1] clear
	JTDO	O	JTAG data out to debugger Selected when in JTAG mode (default mode, see JTMS description, Pin 35)
	SWO	O	Serial Wire Output asynchronous trace output to debugger Select asynchronous trace interface in ARM core, Enable trace interface in ARM core Select alternate output function with GPIO_PCCFGL[11:8] Enable Serial Wire mode (see JTMS description, Pin 35), Internal pull-up is enabled

	TRACEDATA0	O	Synchronous CPU trace data bit 3 , Select 4-wire synchronous trace interface in ARM core , Enable trace interface in ARM core , Select alternate output function with GPIO_PCCFGL[11:8].
20	PC3	I/O	Digital I/O, Either Enable with GPIO_DBGCFG[5] or enable Serial Wire mode (see JTMS description)
	JTDI	I	JTAG data in from debugger Selected when in JTAG mode (default mode, see JTMS description, Pin 35) Internal pull-up is enabled
	TRACECLK	O	Synchronous CPU trace clock , Enable trace interface in ARM core , Select alternate output function with GPIO_PCCFGL[15:12].
21	PC4	I/O	Digital I/O, Enable with GPIO_DBGCFG[5]
	JTMS	I	JTAG mode select from debugger, Selected when in JTAG mode (default mode) JTAG mode is enabled after power-up or by forcing nRESET low Select Serial Wire mode using the ARM-defined protocol through a debugger Internal pull-up is enabled
	SWDIO	I/O	Serial Wire bidirectional data to/from debugger Enable Serial Wire mode (see JTMS description) Select Serial Wire mode using the ARM-defined protocol through a debugger Internal pull-up is enabled
22	PB0	I/O	Digital I/O(Not available for DFZM-E821X-DT0R)
	VREF	Analog O	ADC reference output, Enable analog function with GPIO_PBCFGL[3:0]
	VREF	Analog I	ADC reference input, Enable analog function with GPIO_PBCFGL[3:0] Enable reference output with an Ember system function
	IRQA	I	External interrupt source A
	TRACEDATA2	O	Synchronous CPU trace data bit 2 Select 4-wire synchronous trace interface in ARM core Enable trace interface in ARM core, Select alternate output function with GPIO_PCCFGL[3:0]
	TIM1CLK	I	Timer 1 external clock input
	TIM2MSK	I	Timer 2 external clock mask input
23	PC1	I/O	Digital I/O

	ADC3	Analog	ADC Input 3, Enable analog function with GPIO_PCCFGL[7:4]
	TRACEDATA3	O	Synchronous CPU trace data bit 3 Select 1-, 2- or 4-wire synchronous trace interface in ARM core Enable trace interface in ARM core Select alternate output function with GPIO_PCCFGL[7:4]
24	PC0	I/O	Digital I/O, High current, Either enable with GPIO_DBGCFG[5] or enable Serial Wire mode (see JTMS description, Pin 35) and disable TRACEDATA1
	JRST	I	JTAG reset input from debugger Selected when in JTAG mode (default mode, see JTMS description) and TRACEDATA1 is disabled, Internal pull-up is enabled
	IRQD	I	Default external interrupt source D
	TRACEDATA1	O	Synchronous CPU trace data bit 1 Select 2- or 4-wire synchronous trace interface in ARM core Enable trace interface in ARM core, Select alternate output function with GPIO_PCCFGL[3:0]
25	PB7	I/O	Digital I/O, High current
	ADC2	Analog	ADC Input 2, Enable analog function with GPIO_PBCFGH[15:12]
	IRQC	I	Default external interrupt source C
	TIM1C2	O	Timer 1 channel 2 output, Enable timer output in TIM1_CCER Select alternate output function with GPIO_PBCFGH[15:12]
	TIM1C2	I	Timer 1 channel 2 input, Cannot be remapped
26	PB6	I/O	Digital I/O, High current
	ADC1	Analog	ADC Input 1, Enable analog function with GPIO_PBCFGH[11:8]
	IRQB	I	External interrupt source B
	TIM1C1	O	Timer 1 channel 1 output, Enable timer output in TIM1_CCER Select alternate output function with GPIO_PBCFGH[11:8]
	TIM1C1	I	Timer 1 channel 1 input, Cannot be remapped
27	PB5	I/O	Digital I/O(Not available for DFZM-E821X-DT0R)
	ADC0	Analog	ADC Input 0, Enable analog function with GPIO_PBCFGH[7:4]
	TIM2CLK	I	Timer 2 external clock input
	TIM1MSK	I	Timer 1 external clock mask input

28	GND	Ground	Ground

5. Electrical Characteristics

5-1.Absolute Maximum Rating

Conditions beyond those cited in Table 5-1 may cause permanent damage to the DFZM-E72xx, and must be avoided.

Parameter	Minimum	Maximum	Unit
Supply voltage(VCC)	-0.3	3.6	V
Storage temperature range	-40	125	ºC
Voltage on any digitai I/O	-0.3	VCC+0.3	V

Table 5-1: Absolute Maximum Ratings

5-2.Recommended Operating Conditions

Parameter	Minimum	Maximum	Unit
Operating supply voltage(VCC)	2.1	3.6	V
Operating ambient temperature range(T_A)	-40	+85	ºC

Table 5-2: Recommended Operating Conditions

5-3.Power Consumption

Test Conditions: T_A=25 ℃, VCC=3.0V

Parameter	Test conditions	Mim	Typ	Max	Unit
Deep Sleep Current					
Quiescent current, internal RC oscillator disabled			1		uA
Quiescent current, including internal RC oscillator			1.25		uA
Simulated deep sleep (debug mode) current	With no debugger activity		500		uA
Reset Current					
Quiescent current, nRESET asserted			2	3	mA
Processor and Peripheral Currents					
ARM® Cortex-M3, RAM, and flash memory	ARM® Cortex-M3 running at 24 MHz from crystal oscillator Radio and all peripherals off		8.5		mA
ARM® Cortex-M3, RAM, and flash memory sleep current	ARM® Cortex-M3 sleeping, CPU clock set to 12 MHz from the crystal oscillator Radio and all peripherals off		7.5		mA
Serial controller current	For each controller at maximum data rate		0.2		mA
General purpose timer current	For each timer at maximum clock rate		0.25		mA
General purpose ADC current	At maximum sample rate, DMA enabled		1.1		mA
RX Current					
Radio receiver, MAC, and baseband	ARM® Cortex-M3 sleeping, CPU clock set to 12 MHz		22		mA
Total RX current (= IRadio receiver, MAC and baseband, CPU + IRAM, and Flash memory)	ARM® Cortex-M3 running at 24 MHz		26.5	31	mA
Boost mode total RX current (= IRadio receiver, MAC and baseband, CPU+ IRAM, and flash memory)	ARM® Cortex-M3 running at 24 MHz		28.5		mA

TX current						
Radio transmitter, MAC, and baseband	max. power out (+3 dBm typical) ARM® Cortex-M3 sleeping, CPU clock set to 12 MHz		26.0		mA
Total TX current (= IRadio transmitter, MAC and baseband, CPU + IRAM, and flash memory)	maximum power setting (+8 dBm); ARM® Cortex-M3 running at 24 MHz		43.5		mA
	maximum power setting (+18.5 dBm); ARM® Cortex-M3 running at 24 MHz		110		mA

Table 5-3: Poewr Consumption

5-4.Digital I/O and nRESET Pin Specifications

Test Conditions: T_A=25 ℃, VCC=3.0V

Parameter	Test conditions	Min	Typ	Max	Unit
Low Schmitt switching threshold	VSWIL, Schmitt input threshold going from high to low	0.42 x VCC		0.5 x VCC	V
High Schmitt switching threshold	VSWIH, Schmitt input threshold going from low to high	0.62 x VCC		0.80 x VCC	V
Input current for logic 0	IIL			-0.5	uA
Input current for logic 1	IIH			+0.5	uA
Input pull-up resistor value	RIPU	24	29	34	kΩ
Input pull-down resistor value	RIPD	24	29	34	kΩ
Output voltage for logic 0	VOL(IOL = 4 mA for standard pads, 8 mA for high current pads)	0		0.18 x VCC	V
	>85 °C VOL(IOL = 2 mA for standard pads, 4 mA for high current pads)	0		0.18 x VCC	V
Output voltage for logic 1	VOH(IOH = 4 mA for standard pads, 8 mA for high current pads)	0.82 x VCC		VCC	V
	>85 °C VOH(IOH = 2 mA for standard pads, 4 mA for high current pads)	0.82 x VCC		VCC	V
Output source current	IOHS			4	mA

Parameter	Test conditions	Min	Typ	Max	Unit
(standard current pad)					
Output sink current (standard current pad)	IOLS			4	mA
Output source current high current pad: PA6, PA7, PB6, PB7, PC0	IOHH			8	mA
Output sink current high current pad: PA6, PA7, PB6, PB7, PC0	IOLH			8	mA
Total output current (for I/O Pads)	IOH + IOL			40	mA

Table 5-4: Digital I/O Specifications

Parameter	Test conditions	Min	Typ	Max	Unit
Low Schmitt switching threshold	VSWIL, Schmitt input threshold going from high to low	0.42 x VCC		0.5 x VCC	V
High Schmitt switching threshold	VSWIH, Schmitt input threshold going from low to high	0.62 x VCC		0.68 x VCC	V
Input current for logic 0	IIL			-0.5	uA
Input current for logic 1	IIH			+0.5	uA
Input pull-up resistor value	RIPU, Pull-up value while the chip is not reset	24	29	34	kΩ
Input pull-down resistor value	RIPURESET, Pull-up value while the chip is reset	12	14.5	17	kΩ

Table 5-5: nRESET pin Specifications

5-5.Wake-up and Timing

Test Conditions: T_A=25 ºC, VCC=3.0V

Parameter	Test conditions	Min	Typ	Max	Unit
System wake time from deep sleep	From wakeup event to first ARM® Cortex-M3 instruction running from 6 MHz internal RC clock Includes supply ramp		110		us

Proprietary Information and Specifications are Subject to Change

Parameter	Test conditions	Min	Typ	Max	Unit
	time and oscillator startup time				
Shutdown time going into deep sleep	From last ARM® Cortex-M3 instruction to deep sleep mode		5		us

Table 5-6: Wake-up and Timing

5-6.Radio Parameters

Test Conditions: T_A=25 ℃, VCC=3.0V

Parameter	Min	Typ	Max	Unit	Notes
RF Frequency range	2400		2500	MHz	
TX/RX specification for DFZM-E822x					
Output power(boost mode)	1	8		dBm	
Output power	-3	5		dBm	
Error vector magnitude (EVM)		5	15	%	
Frequency error tolerance	-30	0	30	ppm	
Receiver sensitivity(boost mode)		-102	-96	dBm	PER = 1%
Receiver sensitivity		-100	-94	dBm	PER = 1%
Saturation(Maximum input level)	0			dBm	PER = 1%,
TX/RX specification for DFZM-E821x					
Output power	16	17.5	23	dBm	
Error vector magnitude (EVM)		5	15	%	
Frequency error tolerance	-30	0	30	ppm	
Receiver sensitivity(boost mode)		-102	-96	dBm	PER = 1%,
Saturation(Maximum input level)	0			dBm	PER = 1%,

Table 5-7: Radio Parameters

5-7.ADC Parameters

Test Conditions: T_A=25 ℃, VCC=3.0V

Parameter	Min	Typ	Max	Unit
VREF	1.17	1.2	1.23	V
VREF output current			1	mA
VREF load capacitance			10	nF
External VREF voltage range	1.1	1.2	1.3	V
External VREF input impedance	1			MΩ
Minimum input voltage	0			V
Maximum input vlotage			VREF	V
Single-ended signal range	0		VREF	V
Differential signal range	-VREF		+VREF	V
Common mode range	0		VREF	V
Input referred ADC offset	-10		10	mV
Input Impedence 1MHz sample clock 6MHz sample clock Not sample	 1 0.5 10			 MΩ
*Note: The signal-ended ADC measurements are limited in their range and only guaranteed for accuracy within the limits shown in this table. The ADC's internal design allows for measurements outside of this range (±200 mV), but the accuracy of such measurements is not guaranteed. The maximum input voltage is of more interest to the differential sampling where a differential measurement might be small, but a common mode can push the actual input voltage on one of the signals towards the upper voltage limit.				

Table 5-8: ADC Parameters

6. Package and Layout Guidelines

6-1.Recommended PCB Footprint and Dimensions
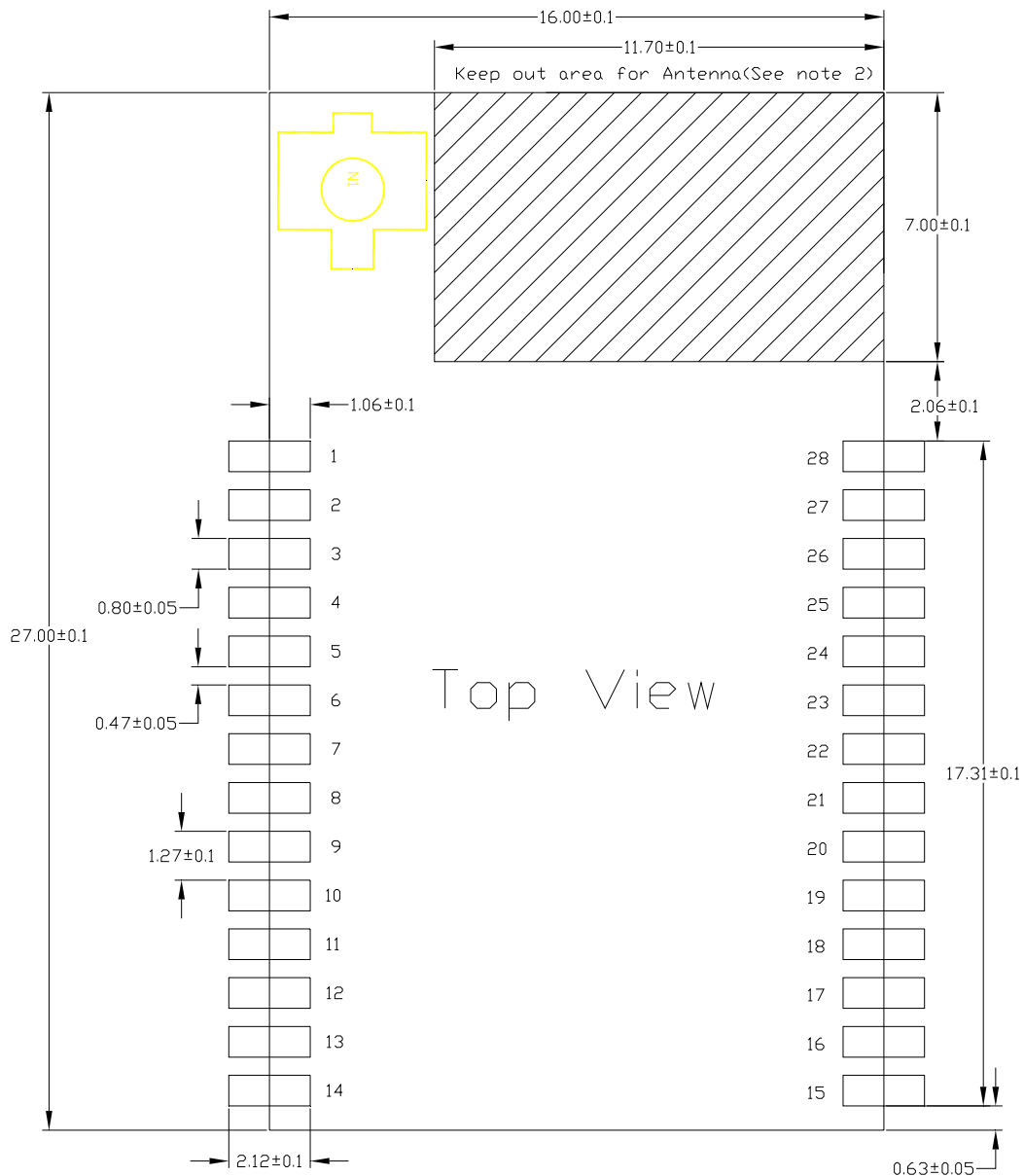
Figure 6-1: DFZM-E82xx Module Recommended PCB Footprint (in mm)
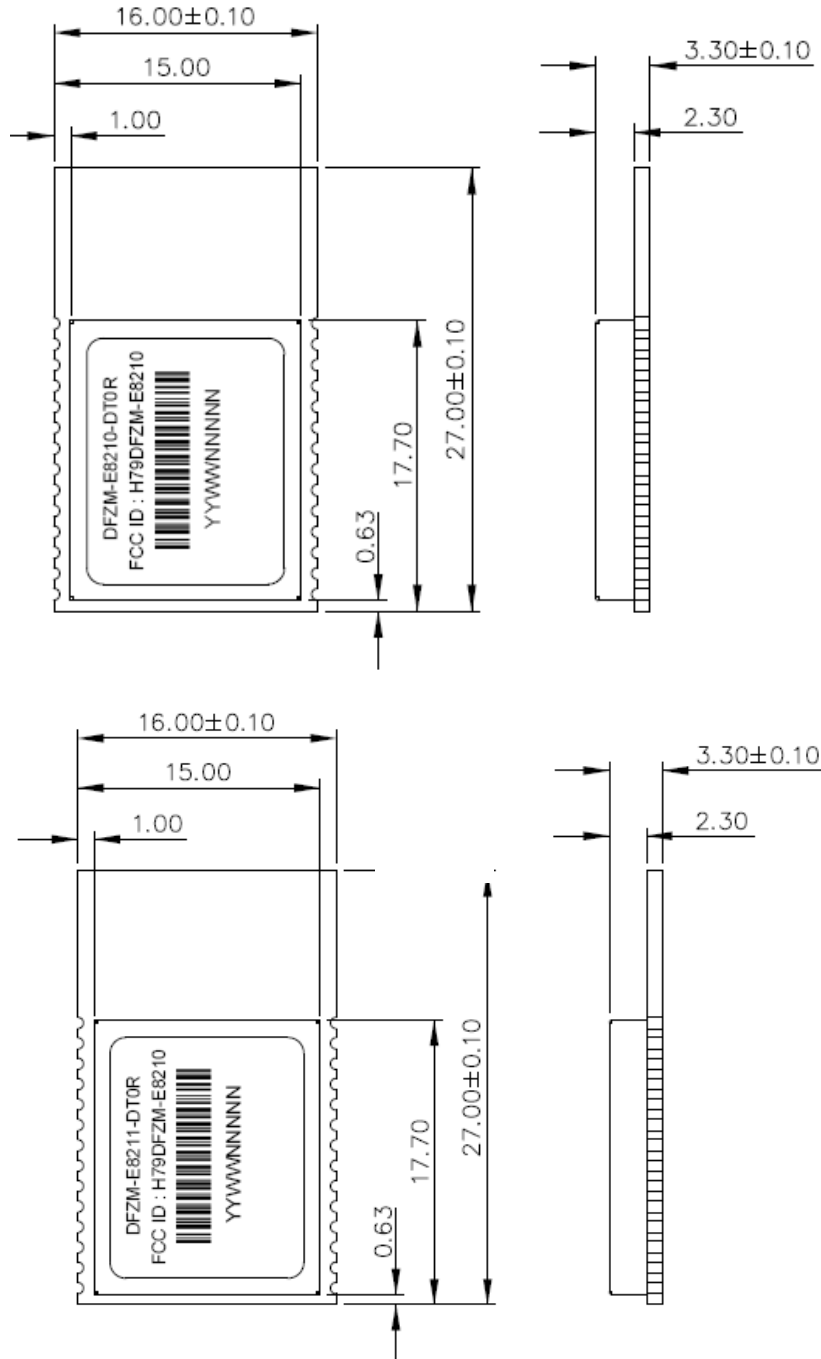
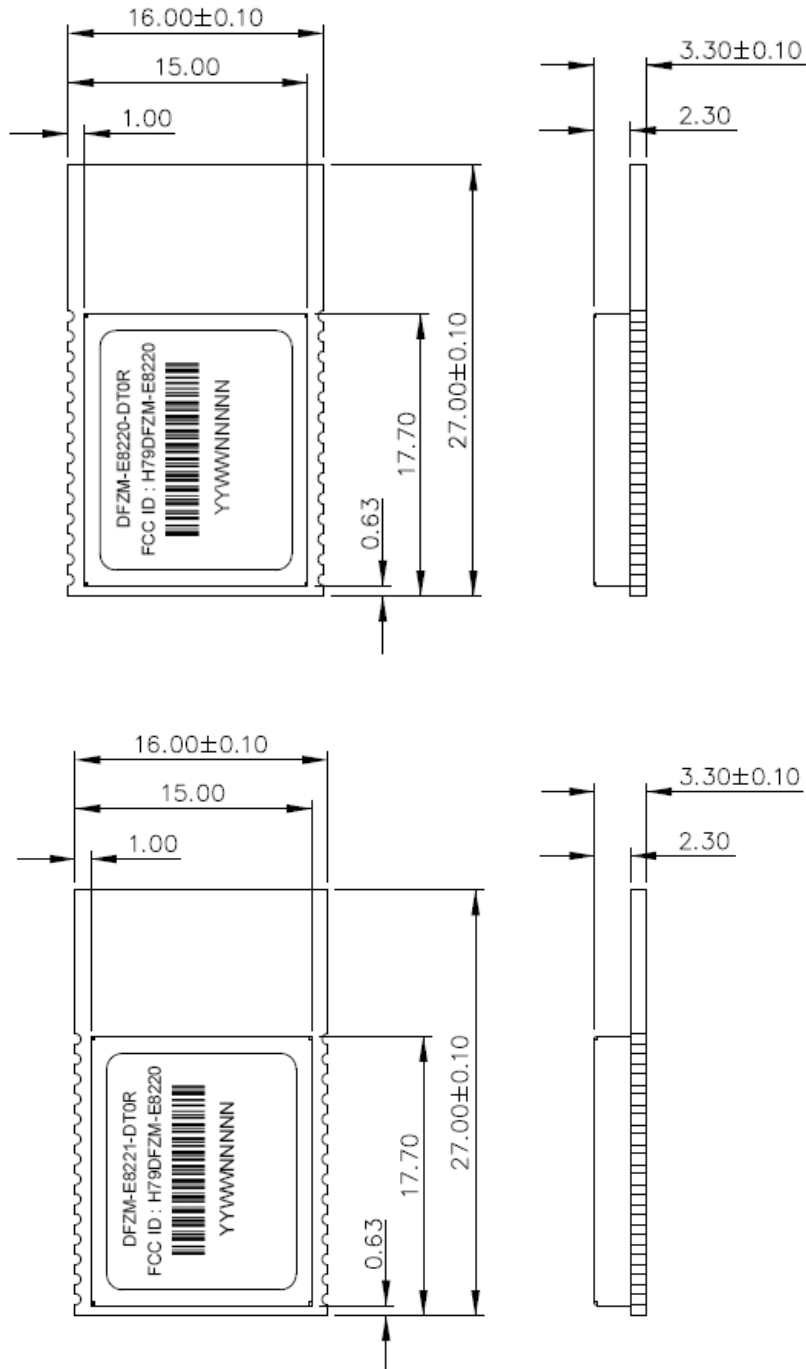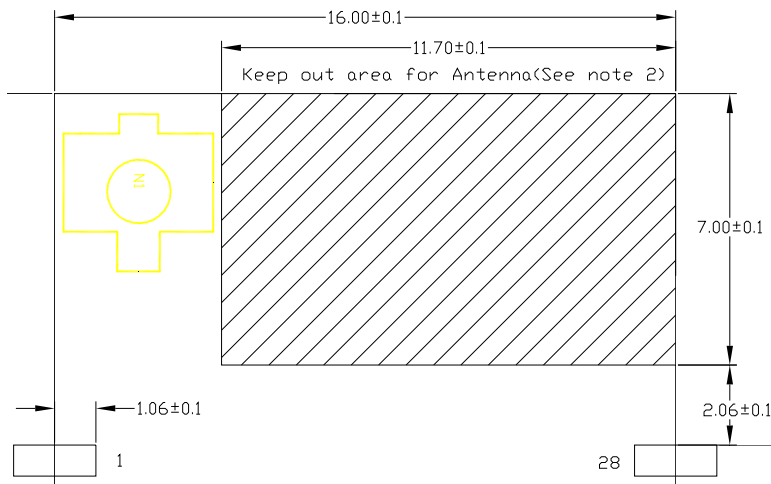**Figure 6-2: DFZM-E821x Module Dimensions (in mm)**

Figure 6-3: DFZM-E822x Module Dimensions (in mm)

6-2.Layout Guidelines

Keep out area for onboard antenna. All layers on the

PCB must be clear.

(i.e. No GND, Power trace/plane, traces.)

Note: If guidelines are not followed, DFZM-E72xx

range with onboard antenna will be compromised.

Figure 6-4: DFZM-E82xx module onboard antenna keep-out layout guidelines (in mm)

Notes:

1. All Dimensions are in mm. Tolerances shall be ±0.10 mm.

2. Absolutely no metal trace or ground layer underneath this area.

3. It is recommended not to run circuit traces underneath the module.

4. In performing SMT or manual soldering of the module to the base board, please align the two row of pins.

In addition to the guidelines in Figure 6-4, note the following suggestions:

DFZM-E82xx

• External Bypass capacitors for all module supplies should be as close as possible to the module pins.

• Never place the antenna very close to metallic objects.

• The external dipole antennas need a reasonable ground plane area for antenna efficiency.

DFZM-E8221; DFZM-E8211 onboard antenna specific

- The onboard antenna keep out area, as shown in Figure 6-4, must be adhered to. In addition it is recommended to have clearance above and below the PCB trace antenna (Figure 6-4) for optimal range performance.

- Do not use a metallic or metalized plastic for the end product enclosure.

- Recommendation is to keep plastic enclosure clearance of 1cm from top and bottom of the DFZM-E82xx onboard antenna keep-out area, if possible. 5-mm (0.2 in) clearance shall be the minimum as shown in Figure 6-5.
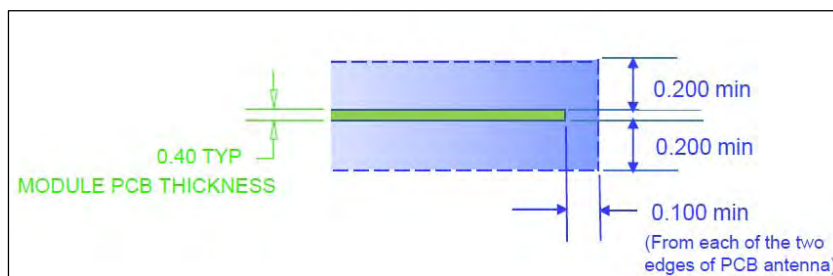

Figure 6-5 Recommended clearance above and below the PCB trace antenna

6-2-1.Surface Mount Assembly

The reflow profile is shown in Figure 6-6.
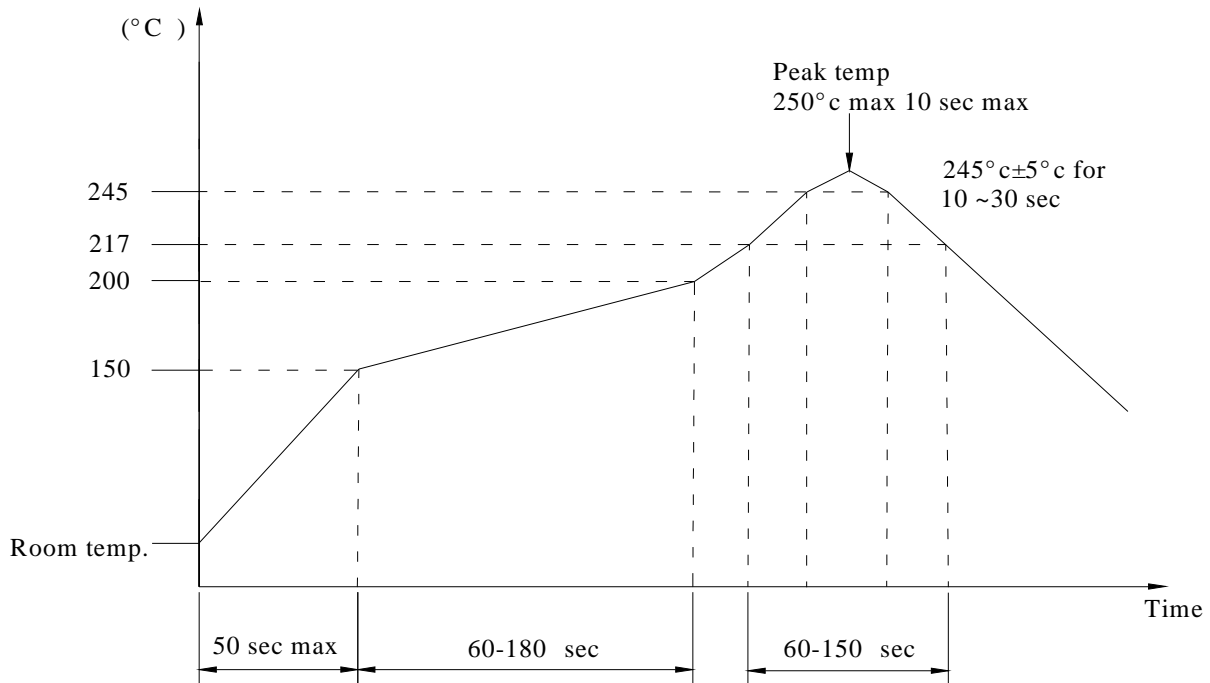
Figure 6-6: Reflow temperature profile

Note:

1. Perform adequate test in advance as the reflow temperature profile will vary accordingly to the conditions of the parts and boards, and the specifications of the reflow furnace.

2. Be careful about rapid temperature rise in preheat zone as it may cause excessive slumping of the solder paste.

3. If the preheat is insufficient, rather large solder balls tend to be generated. Conversely, if performed excessively, fine balls and large balls will generate in clusters at a time.

4. If the temperature is too low, non-melting tends to be caused in the area with large heat capacity after reflow.

5. Be careful about sudden rise in temperature as it may worsen the slump of solder paste.

6. Be careful about slow cooling as it may cause the positional shift of parts and decline in joining strength at times.

6-3.Recommended Stencil Aperture

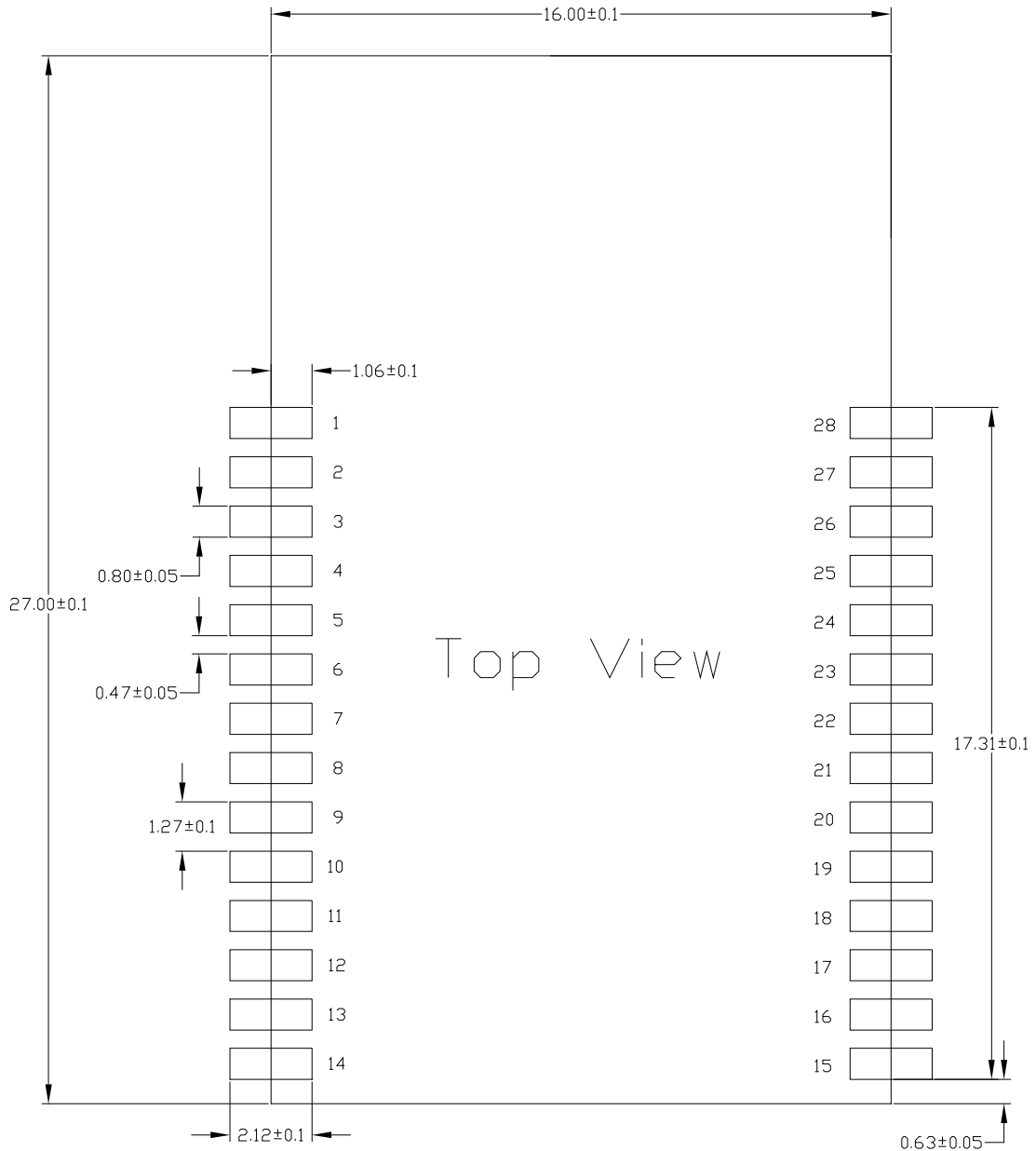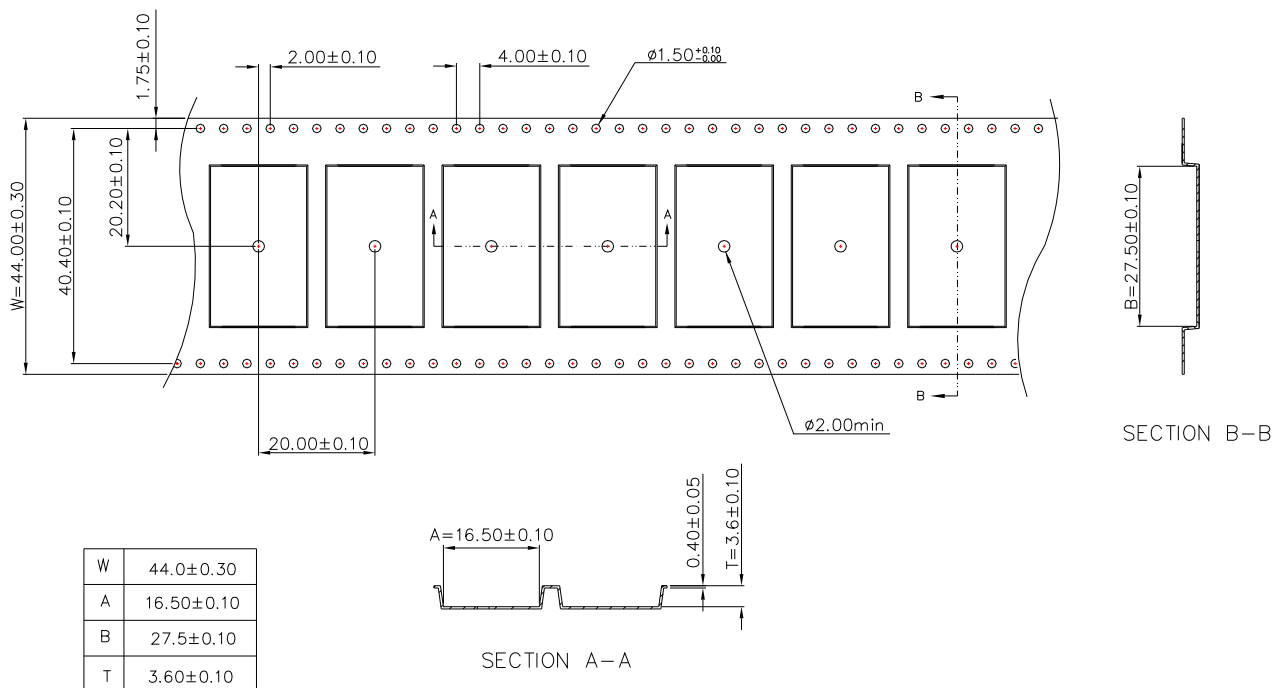Note: The thickness of the stencil should be 0.15mm over this area.

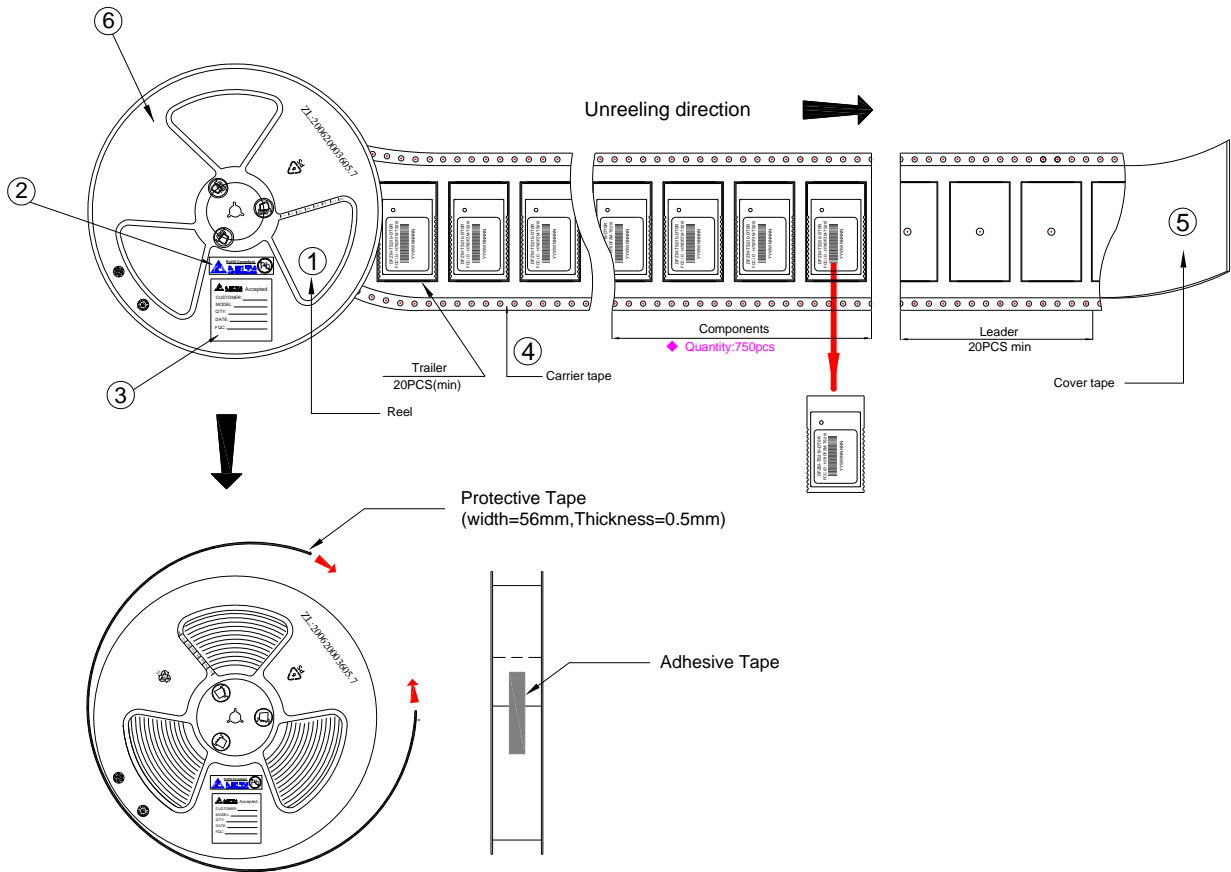**Figure 6-7: DFZM-E82xx recommended PCB footprint (in mm)**

7. Ordering Information

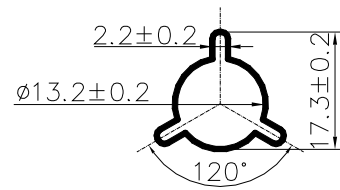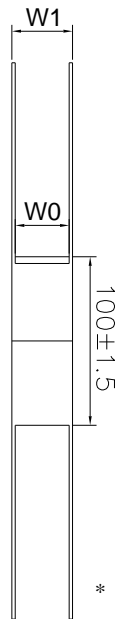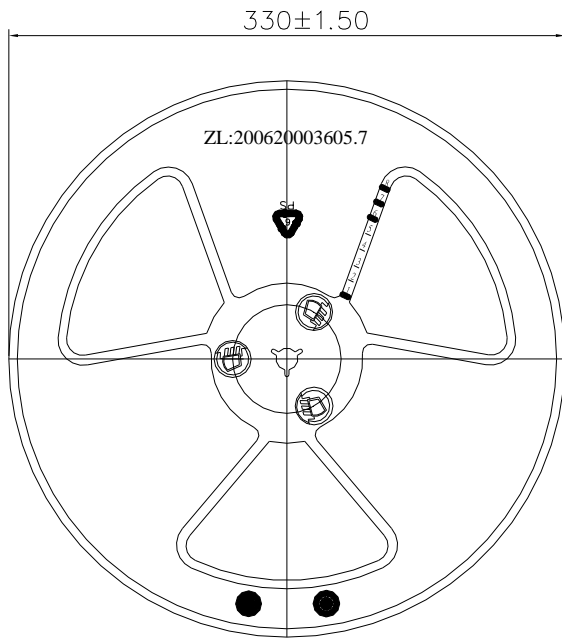| DEVICE DESCRIPTION	ORDERING NUMBER
Extended range module using external antenna	DFZM-E8210-DT0R
Extended range module using onboard antenna	DFZM-E8211-DT0R
Low power module using external antenna	DFZM-E8220-DT0R
Low power module using onboard antenna	DFZM-E8221-DT0R

8. Package

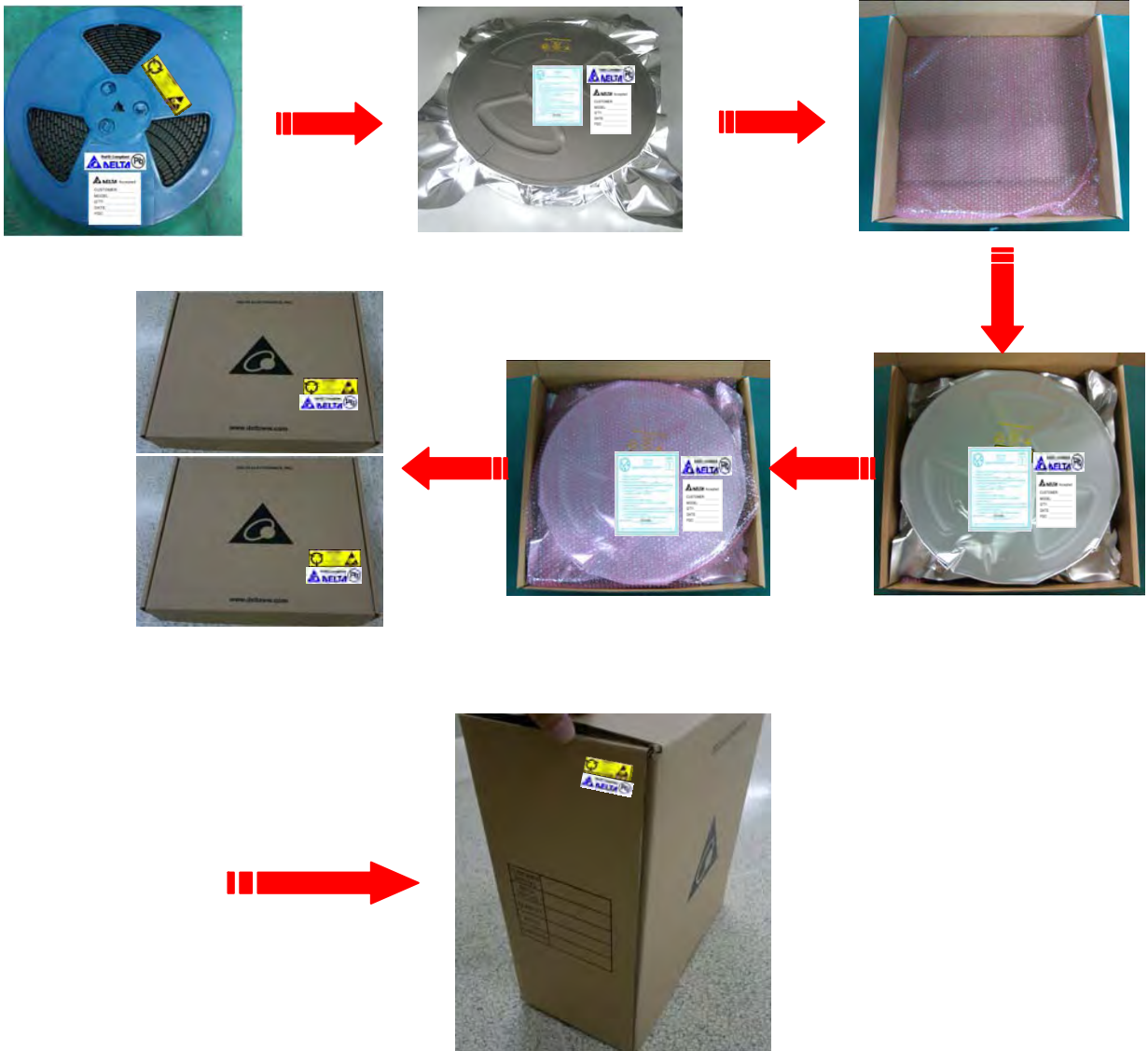## 8-1.Information of carrier tape direction&packaging dimension

W	44.0±0.30
A	16.50±0.10
B	27.5±0.10
T	3.60±0.10

Unreeling direction

Components
◆ Quantity:750pcs

Leader
20PCS min

Cover tape

Trailer
20PCS(min)

Carrier tape

Reel

Protective Tape
(width=56mm,Thickness=0.5mm)

Adhesive Tape

8-2.Reel dimension

330±1.50

ZL:200620003605.7

W1

W0

100±1.5

2.2±0.2

Ø13.2±0.2

17.3±0.2

120°

規 格 品 名	瑋鋒編號	W0	W1
13" 100*44mm旋轉式圓盤	RUR-26-3-XL	45.0±0.5	50.0±1.0

* 代表顏色編碼　B 黑色 , C 寶藍色 ,　L 藍色 , W 白色

Proprietary Information and Specifications are Subject to Change

8-3.Total Package

Proprietary Information and Specifications are Subject to Change

8-4. RF exposure warning statement

FCC Label 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.

Federal Communications Commission (FCC) Statement

15.21

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.

15.105(b)

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.

FCC RF Radiation Exposure Statement:

This equipment complies with 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.