



BSM8001-05-NRY/ WSG303M(LiteON Tech. Co.) Datasheet

Elite Semiconductor Memory Technology Inc.

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Revision Control

Rev	Date	Description of Change	Approved
1.0	12/12/2018	Document First version	Charles Lee
1.01	1/4/2019	Module pad location and dimension added	Charles Lee
1.02	30/8/2019	RF test pad diagram updated for clearer illustration	Charles Lee
1.3	1/10/2019	Update pin description	Charles Lee

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1 Product Overview

The BSM8001-05 is a Sigfox Verified modem module for the low power wide area network (LPWAN) market. It is designed with ESMT's Uplynx XS8001/XS8001-T SOCs. The module was designed for high performance, high quality, small form factor and a low cost. The design is fully compliant with ARIB T108 regulations. The Sigfox application is ported over the Uplynx XS8001/XS8001-T and executed at high efficiency using its internal 32bit core processor. Every module is preloaded with Sigfox application software and module specific ID/KEY/PAC as specified by the Sigfox network system. The preloaded software also includes a bootloader which allows software updates or future user application development.

2 Product Features

- Sigfox Verified™ RF modem (SIGFOX Library Version: V2.3.1)
- Support RCZ1,2,3c,4 and 5
- Supports user application development with the XS8001 software development kit
- Sigfox Region support:
 - RCZ1: Europe (868MHz)
 - RCZ2: US (902MHz)
 - RCZ3c: Japan (923MHz)
 - RCZ4: Argentina, Colombia, Australia, New Zealand, Hong-Kong, Singapore, Taiwan (920MHz)
 - RCZ5: Korea (923MHz)
- Operating Voltage: 3.5V to 5.5V
- Operating Temperature: -40°C to 85°C
- Module enabling pin (POW_EN)
- 0.05µA OFF current
- 6x GPIO (UARTx2, SPI, I2C), 2x ADC (10bit , 0~2.5V)
- Preloaded bootloader, Sigfox ID/PAC, AT command interface
- LGA 29 24mm x 13.5mm (RF IPEX connector) Land Grid Array

3 Functional Block

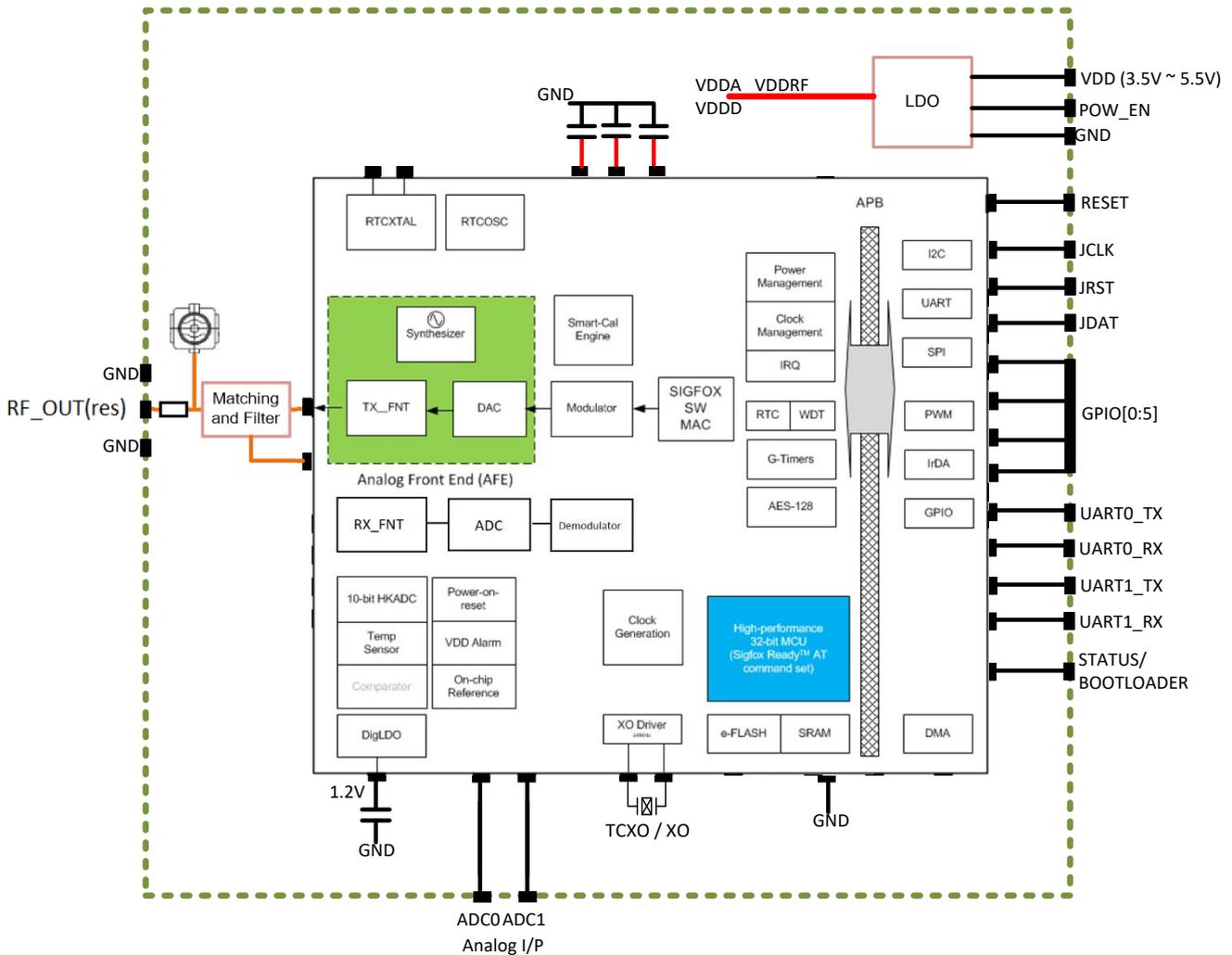


Figure 3-1 Module Block Diagram

The core of the BSM8001-05 module is the Uplynx XS8001/XS8001-T SOCs. The module design is based on the XS8001 Sigfox Verified™ reference design. The BSM8001-05 has 2 analogue ADC inputs, 6 digital multi-function GPIO pins and 2 sets of UART. Each multi-function pin can be configured by the user via SDK.

The BSM8001-05 communicates with the host MCU over a UART interface. The preloaded UART interface firmware is configured at 9600bps baud rate, 8-bit data, no parity bit, 1 stop bit and no flow control.

The STATUS pin indicates the activity of the Sigfox AT command interface and. The module is switched ON and OFF with the POW_EN pin. In OFF mode, the module current consumption can be cut to its minimum (0.05µA) for longer battery operating time, an essential requirement for Sigfox where modem activity is very low.

The RF output is a 50Ω IPEX connector and the whole module is shielded for best spurious containment.

4 Pin Assignment and Package Mechanicals

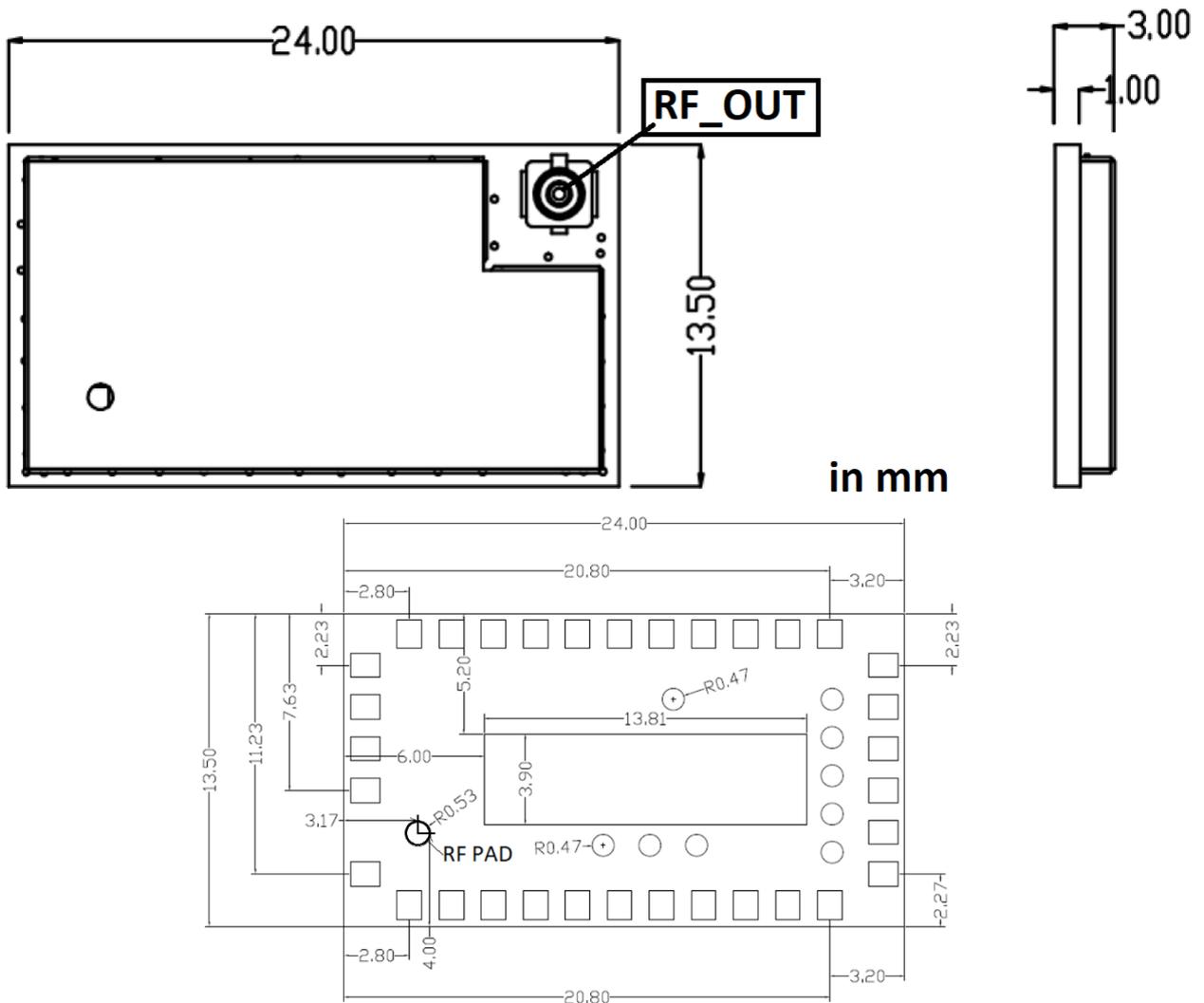


Figure 4-1 Module Dimension and pad location

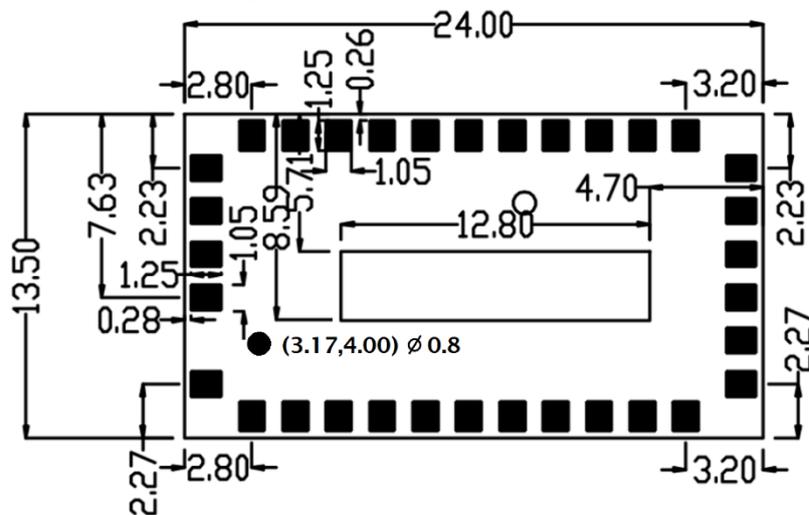


Figure 4-2 Recommended Footprint

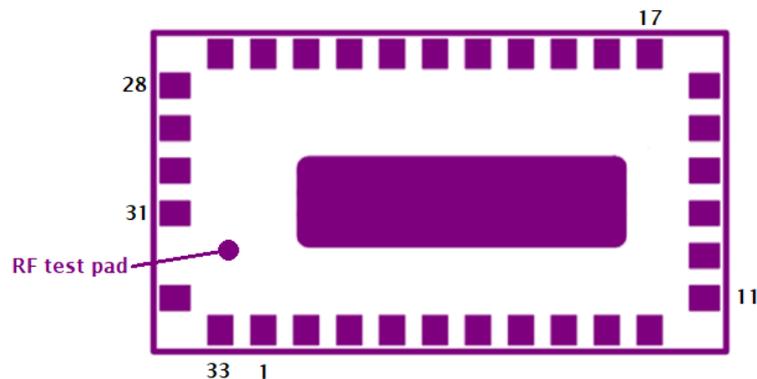


Figure 4-3 Module Pinout

Pin num	Pad Name	IO	Pin function with AT command	Pin definition with SDK (XS8001-T pin)
1	ADC1	I	Analogue input 1(0-2.5V) to internal 10 bit ADC ADGPIO1 (pin 7)	
2	ADC0	I	Analogue input 0 (0-2.5V) to internal 10 bit ADC ADGPIO2 (pin 8)	
3	UART1_RX	I	-	UART1_RX or GPIO23(pin23)
4	UART1_TX	O	-	UART1_TX or GPIO24(pin24)
5	Ground	GND	GND	
6	STATUS/ Bootloader	IO	Logic High: Module ready	GPIO2 (pin16)
			Logic Low: Module busy	
			(BOOTLOADER is enabled when STATUS pin is pulled low by application circuit during power ON)	
7	UART_TX	O	UART Tx data (9600bps) to host UART receiver	UART0_TX or GPIO19(pin17)
8	UART_RX	I	UART Rx data (9600bps) to host UART transmitter	UART0_RX or GPIO20(pin18)
9	GPIO[0]	IO	Digital GPIO[0]	I2C_CLK or GPIO21(pin19)
10	GPIO[1]	IO	Digital GPIO[1]	I2C_SDA or GPIO22(pin20)
11	JDAT	I	JTAG Interface DAT	
12	JCLK	I	JTAG Interface CLK	
13	RESET_N	I	Reset: When asserted LOW sets module to INITIAL state	
14	Ground	GND	GND	
15	POW_EN	I	Enable: Logic low for Disable; Logic high for Enable	
16	VDD_SYS	VDD	Power	
17	GPIO[2]	IO	Digital GPIO[2]	SPI_MOSI or GPIO9(pin33) ¹
18	GPIO[3]	IO	Digital GPIO[3]	SPI_MISO or GPIO5(pin29)
19	GPIO[4]	IO	Digital GPIO[4]	SPI_CLK or GPIO11(pin39)
20	GPIO[5]	IO	Digital GPIO[5]	SPI_CS or GPIO10(pin34)
21	VLDO	O	Operating voltage monitor point	
22-30	Ground	GND	GND	
31	RF_OUT(res)	RF	RF port (reserved), Default via IPEX connector	
32-33	Ground	GND	GND	
	RF_OUT	RF	IPEX connector	
			RF test pad	

¹ Input interrupt is not supported on this pin

5 Electrical Specifications

Parameter	Min	Max	Unit
Power (VDD)	-0.3	5.5	V
Voltage on GPIO	-0.3	3.5	V
Storage Temperature	-40	140	°C
Maximum soldering temperature		250	°C

Table 5-1 Absolute Maximum Ratings

Parameter	Min	Max	Unit
VDD	3.5	5.5	V
Operating Temperature	-40	85	°C

Table 5-2 Recommended Operating Conditions

Parameter	Min	Typ.	Max	Unit
Off mode		0.05	1	μA
Average current RCZ35 send bit at 923MHz (13dBm)		56		mA
Average current RCZ4 send bit at 902/920MHz (20dBm)		130		mA

Table 5-3 DC Current Characteristics

Parameter	Min	Typ.	Max	Unit
Output power	8		20	dBm
Output Power deviation vs Input voltage (3.5V ~5.5V)			1	dB
Listen Before Talk Threshold 923MHz		-80		dBm

Table 5-4 Transmitter RF Performance

Zone of operation	Centre Frequency
RCZ1	868.130
RCZ2	902.2
RCZ3c	923.2
RCZ4	920.8
RCZ5	923.25

Table 5-5 Sigfox Operating Zone support

Parameter	Note	Min	Typ.	Max	Unit
Calibrated frequency	±5% course calibration		32.768		kHz
Frequency accuracy after calibration	With software offset adjustment routine			±1	%
Supply voltage coefficient	Frequency drift when supply voltage changes after calibration		+10		%/V
Initial calibration time			2.5		ms

Table 5-6 32kHz RC Oscillator Specification

Parameter	Condition/Note	Min	Typ.	Max	Unit
TCXO Frequency			24		MHz
Frequency accuracy			±5		ppm

Table 5-7 Oscillator Specification

Parameter	Min	Typ.	Max	Unit
Input Low Voltage	-0.3		0.8	V
Input High Voltage	2		3.6	V
Threshold point	1.36	1.45	1.55	V
Output High Voltage	2.4			V
Output Low Voltage			0.4	V
Schmitt Trigger Low to High Threshold Point	1.56	1.66	1.76	V
Schmitt Trigger High to Low Threshold Point	1.1	1.19	1.27	V
Input Leakage Current			±10	µA
Pull up resistor	42k	59k	88k	Ω
Pull down resistor	34k	54k	92k	Ω
Output current drive			20	mA

Table 5-8 Pin IO Voltage

6 Preloaded Software

The BSM8001-05 is loaded with the following software prior shipping:

1. Sigfox Verified™ Application
2. Bootloader
3. Device ID, KEY and Portable Access Code (PAC)

For Sigfox Verified AT command interface, operation details can be found in:
ESUG-UPLYNX-001 Uplynx AT Command GUI and EasyAT Users Manual

For Software development on the module, the features of the bootloader can be found in:
ESAN-UPLYNX-003 Uplynx Products (Addendum - Boot Procedure)

6.1 Bootloader

The preloaded bootloader allows the user to reprogram the flash in the SOC. To enter the firmware update mode;

- I. Pull pin 16 low at startup (i.e. STATUS/BOOTLOADER pin of module)
On start up, the bootloader polls the module “STATUS” pin which is the pin 16 of the SOC. If the pin is logically low, the UART on the SOC is configured as 115200bps and the bootloader is waiting for firmware via XMODEM. User can then upload the application binary file to the SOC via XMODEM. Details can be found in ESUG-UPLYNX-001: Uplynx AT Command GUI and EasyAT Users Manual. The application will be stored at the application startup address and be loaded up after the system is rebooted. Details can be found in ESUG-UPLYNX-005: Uplynx Software Development Kit Users Manual. Since the “STATUS” pin is an output pin at normal operation, it is important to ensure the pin is NOT pulled down by the application circuit during normal startup.
- II. Enter AT\$FW=1 when the Sigfox verified AT command interface is uploaded, the module enters XMODEM mode after the AT\$FW command is asserted. The speed of UART is configurable to 115200bps. The new firmware is to be transmitted via XMODEM protocol over UART and will be installed automatically. Upon successful update, the new firmware will be loaded on the next reboot. Details can be found in ESUG-UPLYNX-001: Uplynx AT Command GUI and EasyAT Users Manual

6.2 Device ID, KEY and Portable Access Code

As part of the Sigfox operation requirements, each Sigfox device must be assigned a unique identification number (ID), encryption key (KEY) and portable access code (PAC). This information is preloaded in the module and only the ID and PAC can be read via AT command.

7 Application Information

7.1 Recommended Connection to Essential Pins

PIN	Recommendation
RF_OUT	The 50Ω RF output should be connected to a pi/T antenna matching circuit for potential antenna tuning. An ESD diode could be placed at the antenna port to protect the product against an ESD event induced due to human activity.
VSS	The RF performance relies strongly on a good quality ground. It is recommended to use a ground plane if possible or thick and close ground traces are required to minimize radiation and ensure the best RF performance
STATUS/ BOOTLOADER	Can be connected to the host processor to detect module status or the pin can lead to a status LED for displaying purposes (This pin must not be pulled down during power up or the unit will enter firmware update mode)
VDD	The voltage supply can come directly from a cell, ac adapter or USB. A decoupling capacitor of size 10μF placed close to the 5V input is recommended. The allowable voltage at this power input is below 5.5V and above 3.4V.
POW_EN	It is connected to a host processor to switch on and off the modem module.
RST_N	This can be tied to a universal reset pin or the host processor. It is internally pulled high to VLDO. In other words, RST_N only works when POW_EN is set high. A 10μF capacitor would be recommended in place close to the module pin in case the supply voltage to the module. The pull high resistance onto pin RESET_N from the system must be smaller than 50kΩ to ensure proper module startup.
VLDO	This is the output of the internal LDO of the module. This voltage supply is used by the module RF system and it is highly recommended to leave this pin unconnected. In case this supply is used by another part of the system, a 1μF capacitor is recommended to be put close to the module.
UART_TX / UART_RX	When module is OFF, pin must not be asserted HIGH . Isolation circuit is recommended to avoid current leakage.
GPIO[0:5], UART1_TX /UART1_RX	When module is OFF, pin must not be asserted HIGH . Isolation circuit is recommended to avoid current leakage. UART1_TX and UART1_RX are reserved for SDK applications.
ADC0 , ADC1	Analogue voltage input to internal ADC. To avoid leakage, ADC0 and ADC1 should be grounded when the module is power OFF. Noise suppression and isolation technique

Table 7-1 Recommended Pin Connections

7.2 Switch ON and OFF Procedure

To ensure proper operation, POW_EN must be asserted high after VDD settles and wait for 5ms before AT commands can be passed down the UART interface. The settling time is required for the LDO and oscillator to settle to their operating conditions. A software routine can be used to poll the status of STATUS pin or wait for a prompt "UPLYNX" at the UART interface before any actual payload is passed to the module.

After switching the module OFF, by pulling POW_EN low, it is highly recommended that the system should wait for at least 10ms before another attempt to power ON.

7.3 RF Grounding for EMC

The BSM8001-05 is designed to deliver 8dBm to 20dBm and its RCZ3 setting is compliant to ARIB T108 emission regulations at 13dBm. To achieve the tight emission limitation of the restricted bands, the grounding of the module must be maintained by connecting all the ground pads to a large ground plan in the PCB stack. It is highly recommended that the mother board be designed with a dedicated ground plane which connects to all the VSS pins on the module. The VSS pads must be connected to the ground plane with a minimum of 3 vias. Decoupling capacitors must be located close to the module supply voltage. To maximize heat dissipation, the large ground pad must be connected to the host PCB. Special care must be paid to the solder mask on the mother board to ensure highest yield.

8 Certification

- ETSI EN 300 220 compliant
- Japan ARIB STD-T108
- FCC Part 15.247
- KCC rules 30

9 Order Information

Part Number	Description
BSM8001-05-NRY	Sigfox Verified RCZ12345 modem module 3.5V

10 Special Note

BSM8001-05-NRY is identical to LiteON Technology Co. WSG303M