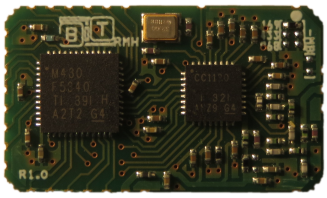
RF Transceiver Module (Radio Modem)

Application

- Ultra low power wireless Transceiver
- 169/433/868/915 MHz ISM/SRD band systems
- Consumer Electronics
- Wireless audio
- Alarm and security systems
- Home and building automation
- Wireless sensor networks
- Industrial monitoring and control
- Low power Telemetry



Product Description

BITxxxRMH-LP is a very low cost transceiver module designed for very low power wireless applications.
This module is intended for ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band at 169, 433, 868/915 MHz., but can easily be programmed for operation at other frequencies:
BIT169RMH-LP 164 – 192 MHz
BIT433RMH-LP 410 – 480 MHz
BIT868RMH-LP 820 – 960 MHz
It is designed to realize RF solutions easy to use providing a reliable data transfer among remote equipment. The module can operate with a UART (up to 115.2 kbps) connected host or as a stand- alone complete RF module.
BITxxxRM-LP has up to 17 I/O pins completely programmable from a remote controller; so it can act as an RF I/O expander (battery operated sensor solution).
It's fully programmable in a very small package: only 15 x 28 mm ready for SMT assembly.

Key Features

- Small size (15 x 28 mm package, 17 pins).
- Frequency bands:
- BIT169RMH-LP 169,4 – 169,475 MHz
- BIT433RMH-LP 430 – 434 MHz
- BIT868RMH-LP 866 – 870 MHz, 905 – 925 MHz
- High sensitivity : -123 dBm at 1.2 kpbs, 1% PER
- Programmable output power up to + 16 dBm
- Power Down < 2 µA With WakeOnRadio Timer Running
- Low current consumption (22 mA in RX, 45 mA in TX at +14dBm

- Operating Voltage : 1.8 to 3.6 V
- UART Data rate up to 115.2 kBaud
- Modulation: GFSK
- Fully customizable upon request.
- Programmable data rate
- Ideal for multi-channel operation.
- Forward Error Correction with interleaving.
- Excellent receiver selectivity and blocking performance.
- Suited for system compliant with EN 300 220, ETSI EN 54-25 (Europe) and FCC CFR Part 15, FCC CFR47 Part 90, 24 and 101 (US).

1. Pin-Out

The radio modem is equipped with a certain number of pin available for the host application. Some are already used (see next sections); for the others it is possible to agree a product customization.

PINOUT

PIN N.	Description	Direction
1	GND	
6	GND	
10	EXT PA CBYP	OUT
11	EXT PA SHDN	OUT
12	UART TX	I/O
13	UART RX	I/O
14	MSP P5.2 XT2IN	I/O
15	MSP P5.3 XT2OUT	I/O
16	MSP TEST (ICSP)	
17	MSP RESET (ICSP)	
18	EXT PA TXEN	OUT
19	EXT PA RXEN	OUT
20	P6.5/CB5/A5	I/O
21	MSP P5.4 XIN	I/O
22	MSP P5.5 XOUT	I/O
23	MODULE UART READY	OUT
24	P1.3/TA0.2	I/O

25	HOST UART READY	IN
26	MSP P3.0/UCB0SIMO/UCB0SDA	I/O
27	MSP P3.1/UCB0SOMI/UCB0SCL	I/O
28	MSP P3.2/UCB0CLK/UCA0STE	I/O
29	VDD	CONNECT TO 3V3
30	GND	
38	GND	
42	GND	
43	RF IN/OUT	ANTENNA
44	GND	

Table 1.1: Pin Description

2. Absolute Maximum Ratings

Parameter	Min.	Max.	Units	Remarks
Supply Voltage, VDD	-3	3.9	V	
Voltage on any pin	-0.3	VDD+0.3	V	
Input RF level		10	dBm	
Diode current at any device pin	-2	2	mA	
Storage temperature range	-40	125	°C	

3. Operating Conditions and Specifications

Parameter	Min.	Typ.	Max.	Units	Remarks
RF Frequency Range	169,4125 433.32 864.00	169,4375 433.92 868.30	169,4625 434.52 869.90	MHz MHz MHz	169 version 433 version 868 version
Operation ambient temperature	-30		85	°C	
Supply voltage	1.8	-	3.6	V	
Current Consumption		1 45 22		uA mA	Sleep mode Transmit mode @ max output power Receive mode @ 1.2 kbps
Sensitivity		-123 -119 -117		dBm dBm dBm	@ 1,2 kbps @ 4,8 kbps @ 9,6 kbps

4. Available Versions

The product is available in three different versions that can be identified and ordered as follows:

BIT169RMH-LP
Operating in the frequency band range between 169,400-169,475 MHz .

BIT433RMH-LP
Operating in the frequency band range between 433.320-434.520 MHz .

BIT868RMH-LP
Operating in the frequency band range between 864.000-869.900 MHz and 905.000-925.000 MHz.

4.1. Product customization

The product is fully customizable upon request; it is possible to customize operating frequencies, data-rate, pin use, functions, etc. Please contact the Distributors closest to you for further information.

5. UART Interface

In order to communicate via the UART interface pin P25 from host has to be HI and pin P23 from module have to be HI.
If host want to send an UART command, it must set the pin P25 to logic HI and wait for the module to set pin P23 to logic HI.
If module has to send an UART command, it must set pin P23 to logic HI and wait for the host to set pin P25 to logic HI.
If Host set pin P25 to logic LO the microcontroller on the module go in Power Down and module set pin P23 to logic LO and host microcontroller can go in Power Down

Any UART message has to be terminated by CRC a carriage return and a new line character (\crc\r\n – CRC 0x0D 0x0A).
CRC is 8bit sum of all previous bytes with start value 0x80
At power on Module send a message "**BITxxxRMH-LP Ready\crc\r\n**" where xxx is frequency 169, 433 or 868.

Comm	Syntax	Description	val	Def Value
BR	BR=val\crc\r\n	Set the UART baud rate	0 to 7	7
PA	PA=val\crc\r\n	Set the output power	3 to 64	See 5.2
CH	CH=val\crc\r\n	Sets the RF channel	0 to 12	See 5.3
RF	RF=val\crc\r\n	Set the RF configuration	0 to 2	See 5.4
NWA	NWA=val\crc\r\n	Set the module Network Address	0 to 255	211
MYA	MYA=val\crc\r\n	Set the module Address	0 to 255	255
WOR	WOR=val\crc\r\n	Set module Wake On Radio mode	0 or 26 to 58000	1000
TX	TXval	Set the module TX mode	See 5.6	See 5.6
PD	PD=val\crc\r\n	Set the module power down mode	0 or 26 to 58000	0
CCA	CCA=val\crc\r\n	Enable CCA mode	0 or 1	1
STA	STA=?\crc\r\n	Return Module Status	Only '?'	
FWVER	FWVER=?\crc\r\n	Return FW version	Only '?'	
SAVE	SAVE=1\crc\r\n	Save all current settings in NVM	Only '1'	

If val is the character '?', BITxxxRMH-LP return the current value of the command followed by CRC a carriage return and a new line (\r\n – 0x0D 0x0A) .
val values are ASCII coded values.
If val is one of the allowable values, BITxxxRMH-LP returns the string “OK\crc\r\n” if the command is correctly executed, “ERR\crc\r\n” otherwise.

Exception is the TX command. For this command '?' parameter is not allowed.
BITxxxRMH-LP returns the string “OK\crc\r\n” if the command syntax is correct, “ERR\crc\r\n” otherwise. If transmission can not be completed (CCA mode enabled), module return the string CCA\crc\r\n. When transmission is completed, module return the string ETX\crc\r\n.

5.1. BR: UART Baud Rate

The UART baud rate can be set to 5 different values. The possible settings are shown in next table.

BR	UART Baud Rate (bps)
0	2400
1	4800
2	9600
3	19200
4	38400
5	57600
6	76800
7 (default)	**115200**

5.2. PA: Output Power

Set the RF output power level with 0.5 dB resolution

$$Output\ Power = (VAL + 1)/2 - 18\,[dBm]$$

Where 3 ≤ VAL ≤ 63 **(Default Value 63)**

5.3. CH: RF Channel

13 channels placed at a distance of 100 kHz one from another are available for the versions 433 and 868. A particular attention goes to the use of the various available channels, as they are strictly linked to the adopted RF configuration (channel length, baud rate, etc.) in order to respect the approval specifications.

Channel	Central Frequency(MHz)		
	169 version	**433 version**	**868 version**
0	169.4125	433.32	863.50
1	169.4250	433.42	863.75
2	**169.4375 (default)**	433.52	864.00
3	169.4500	433.62	864.25
4	169.4625	433.72	864.50
5	N/D	433.82	864.75
6	N/D	433.92	868.20
7	N/D	434.02	**868.30 (default)**
8	N/D	434.12	868.40
9	N/D	**434.22 (default)**	868.85
10	N/D	434.32	868.95
11	N/D	434.42	869.05
12	N/D	434.52	869.50
13	N/D	434.57	869.85

5.4. RF: RF Configuration

Config	bps	RX filter bandwidth	Modulation	Typical Sensitivity (dbm)
0	1200	10 KHz	GFSK	-123 (default)
1	4800	25 KHz	GFSK	-119
2	9600	25 KHz	GFSK	-117

5.5. Addressing

The module allows addressed packet transmissions and broadcast transmissions. Each module has a *Network Address* (one byte) and its own *My Address* (one byte). The Network Address and My Address can be programmed for each module using the configuration interface.
All Node in one system should have the same Network Address, and each node should be set to a different My Address.

5.5.1. NWA: Network Address

The network address helps to filter the RF packets with its own network address; briefly, all radio modems with the same network address are able to communicate among themselves.

5.5.2. MYA: My Address

My address filter all the RF packets that don't have in the destination address field the same value of MA.
MYA = "255" receive all message

5.6. WOR: Wake On Radio Mode

Set the RX mode of the module.
If argument val is '0', module enter RX mode without any power down state.
When argument val is not '0', module goes in power down mode and wake up every val ms.
ATTENTION: If RF config is = 0 the minimun WOR time is 600ms
If a RSSI above a fixed treshold is sampled, module stay in RX; otherwise return in power down. Time for sampling RSSI is 310 us.
After a valid RSSI is sampled, if a PQT valid is sampled in an RX timeout time (min 500 us, max 0,0305% of val), module stay in RX to check the message address; otherwise return in power down .
When a packet is received the module send to UART the following message:

RX[RSSI_VAL][SRC_ADDR][PLEN][DATA0][DATA1]...[DATAN]

RX are the character 'R' and 'X'
RSSI_VAL is the RSSI of the received message ranging from -127 to 0 dBm
SRC_ADDR is the address of the sender
PLEN is the packet len (max 58)
DATA0, DATA1, …, DATAN are the data bytes

5.7. TX: TX Mode

Set the TX mode of the module. TX command has several parameter.
TX[TIME_PRE_LO][TIME_PRE_HI][DEST_ADDR][PLEN][DATA0][DATA1]...[DATAN]
TX are the character 'T' and 'X'
TIME_PRE_LO and TIME_PRE_HI are a 16 bit value (Little Endian); this is the preamble time.
DEST_ADDR is the Destination address (0xFF is broadcast)
PLEN is the packet len (max 58)
DATA0, DATA1, …, DATAN are the data bytes
If transmission can not be completed (CCA mode enabled), module return the string CCA\r\n. When transmission is completed, module return the string ETX\r\n.

5.8. PD: Power Down Mode

Set the Power Down mode of the module.
If argument val is '0', module enter power down mode and exit from power down only if pin P06 from host is set to logic HI.
If argument val is not '0', module goes in power down mode and wakes up after val ms.
In any case, when module exit from power down mode, it switch to last WOR mode saved.
When module enter in power down set pin P01,P29 and P30 to logic LO and when module exit from power down set pin P01 in Input, P30 to logic HI and P29 to logic LO (RX mode)

5.9. CCA: Clear Channel Assessment

If argument val is '0', CCA mode is disabled; if argument val is different to '0', CCA mode is enabled and the possible settings with RSSI Threshold are calculated according to the following formula

$$RSSI\ Threshold = (85 + VAL)[dBm]$$ Where 0 ≤ VAL ≤ 16

When enabled, module does not enter TX mode is current selected channel is busy and module return the string CCA\crc\r\n.

5.10. STA: Read Module Sta

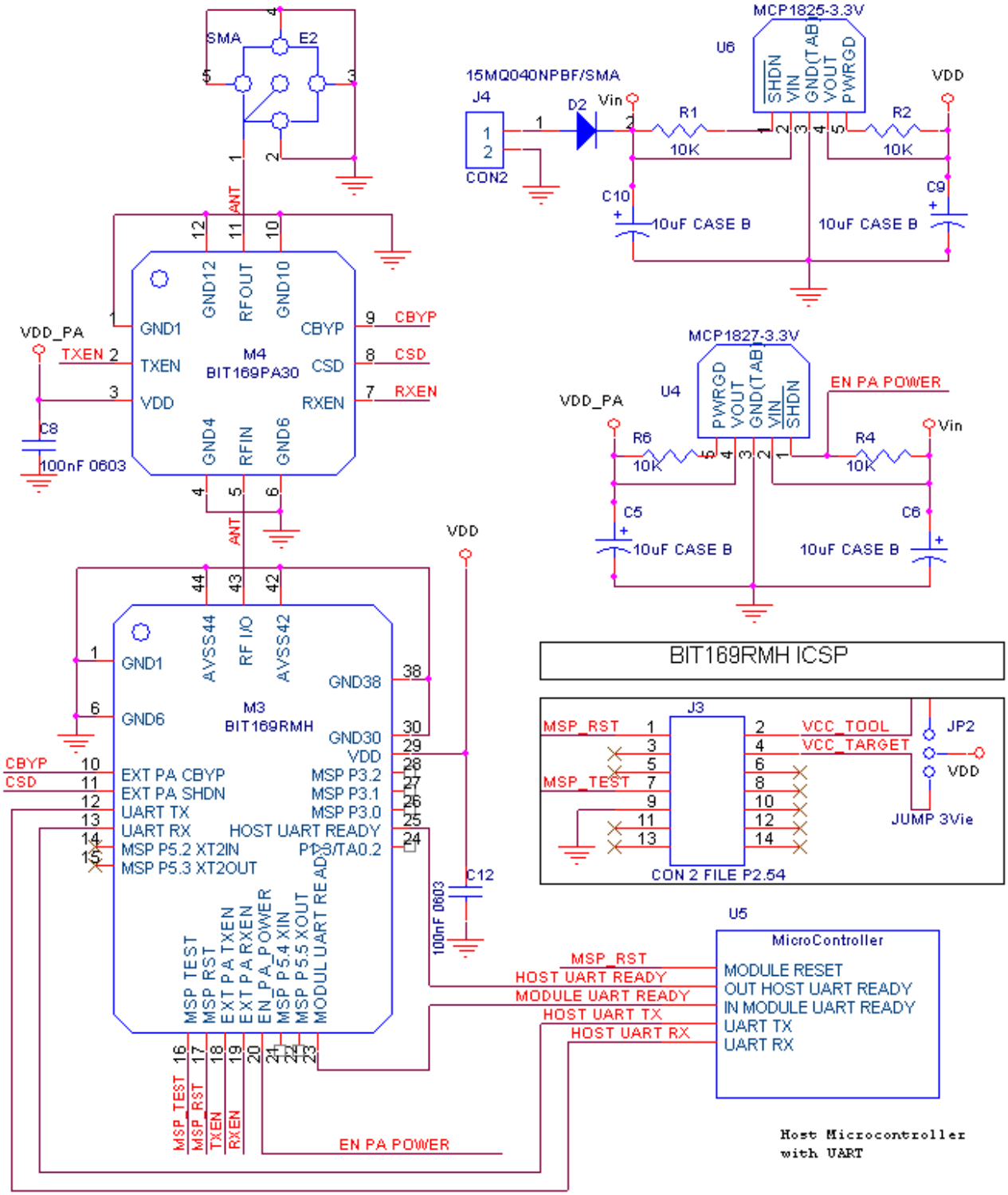
Return an ASCII coded byte (0 to 255). It has to be interpreted in bit mode as below:

bit	7	6	5	4	3	2	1	0
Value	NA	NA	NA	NA	NA	NA	RF TX Active	RF RX Active

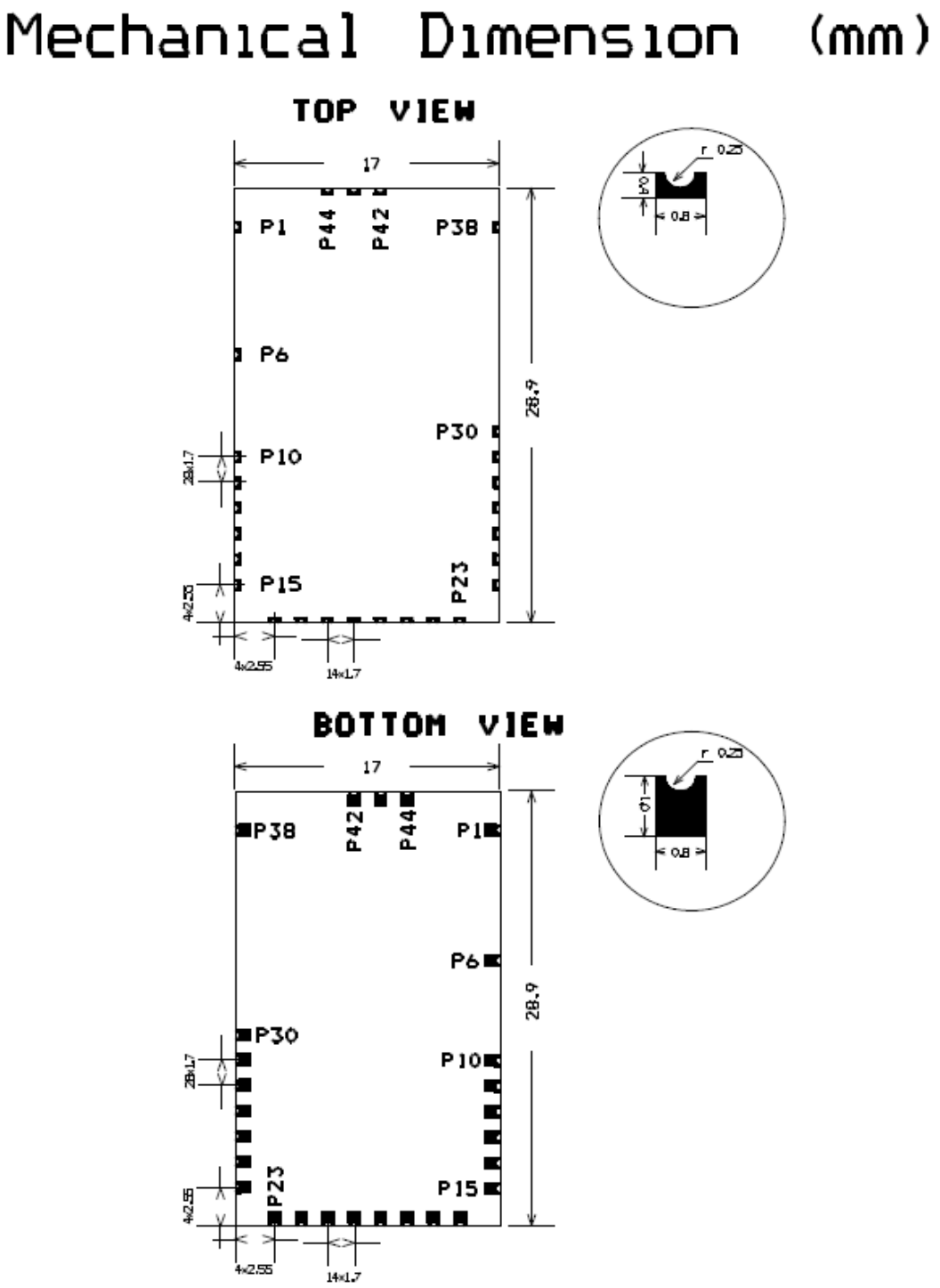
5.11. FWVER: Return Firmware Version

Return firmware version as 5 ASCII coded bytes: MM.mm
MM: major version, mm: minor version

TYPICAL APPLICATION WITH RANGE EXTENDER



6. Package Description



The area underneath the module should be covered with solder resist in order to prevent short circuiting the test pads on the back side of the module. A solid ground plane is preferred.

7. Appendix A: CEPT ERC RECOMMENDATION 70-03

A summary of the recommendation for the 433MHz and 868MHz band SRDs follows based on the 19 August 1999 edition. The complete document can be downloaded from www.ero.dk.

Class	Frequency band	Power e.r.p.	Duty cycle	Channel spacing	Comments
1e	433.050-434.790	10mW	10%	No channel spacing specified	
10c	863.000 –865.000	10mW	100%	200kHz	Consumer radio microphones
13a	863.000 –865.000	10mW	100%	No channel spacing specified (300kHz for analogue systems)	Wireless audio (cordless loudspeakers and headphones) Integrated antenna only
1f	868.000 - 868.600	25mW	1%	25kHz, wide-band,100kHz spread spectrum	
7a	868.600 - 868.700	10mW	0.1%	25kHz	Alarms in general
1g	868.700 - 869.200	25mW	0.1%	25kHz wide-band,100kHz spread spectrum	
7d	869.200 - 869.250	10mW	0.1%	25kHz	Social Alarms
7b	869.250 - 869.300	10mW	0.1%	25kHz	Alarms in general
1h	869.300 – 869.400	t.b.d.	t.b.d.	25kHz	
1i	869.400 - 869.650	500mW	10%	25kHz. Or one broadband channel	
7c	869.650 - 869.700	25mW	10%	25kHz	Alarms in general
1k	869.700 - 870.000	5mW	100%	25kHz or 50kHz, or wide-band	

8. Revision History

Revision	Date	Description
01.00	02/02/2017	First Revision
01.01	09/02/2017	Not run without xtal 32.768 KHz
		•
		•
		•
		•
		•
		•
		•
		•
		•

General Information

- **Disclaimer**

B.I.T. srl believes the information contained herein is correct and accurate at the time of this printing. However, B.I.T. srl reserves the right to make changes to this product without notice. B.I.T. srl does not assume any responsibility for the use of the described product; neither does it convey any license under its patent rights, or the rights of others. The latest updates are available at the BIT website or by contacting BIT directly.

As far as possible, major changes of product specifications and functionality, will be stated in product specific Errata Notes published at the BIT website. Customers are encouraged to sign up to the Developers Newsletter for the most recent updates on products and support tools.

Compliance with regulations is dependent on complete system performance. It is the customer's responsibility to ensure that the system complies with regulations.

- **Life Support Policy**

This BIT product is not designed for use in life support appliances, devices, or other systems where malfunction can reasonably be expected to result in significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. B.I.T. srl customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify B.I.T. srl for any damages resulting from any improper use or sale.

Bit is **I**talian **T**echnology S.r.l.
Viale delle Industrie, 20 20020 ARESE (MI)
Tel.: (+39) 02 30465311, fax: (+39) 02 30465396
http://www.bit.it/ info@bit.it

A KEVIN SCHURTER company
http://www.kevin.it/
info@kevin.it