

## UNIVERSAL ISM BAND FSK TRANSCEIVER MODULE

### RFM12B

(the purpose of this spec covers mainly for the physical characteristic of the module, for register configure and its related command info please refer to [RF12B data sheets](#))

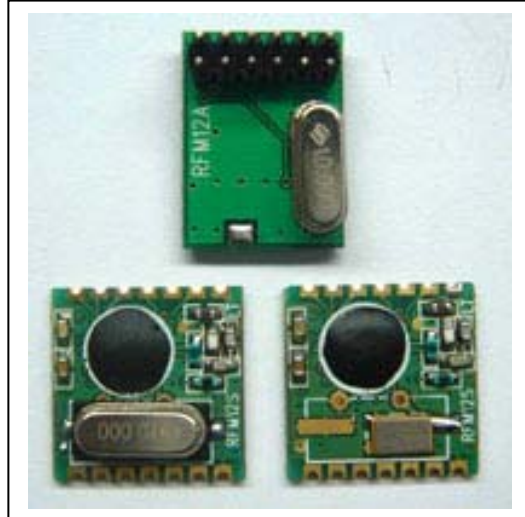
### General Introduction

RFM12B is a low costing ISM band transceiver module implemented with unique PLL. It works signal ranges from 433/868/915MHZ bands, comply with FCC, ETSI regulation. The SPI interface is used to communicate with microcontroller for parameter setting.

### Features:

- Low costing, high performance and price ratio
- Tuning free during production
- PLL and zero IF technology
- Fast PLL lock time
- High resolution PLL with 2.5 KHz step
- High data rate (up to 115.2 kbps with internal demodulator, with external RC filter highest data rate is 256 kbps)
- Differential antenna input/output
- Automatic antenna tuning
- Programmable TX frequency deviation (from 15 to 240 KHz)
- Programmable receiver bandwidth (from 67 to 400 kHz)
- Analog and digital signal strength indicator (ARSSI/DRSSI)
- Automatic frequency control (AFC)
- Data quality detection (DQD)
- Internal data filtering and clock recovery
- RX synchron pattern recognition
- SPI compatible serial control interface
- Clock and reset signal output for external MCU use
- 16 bit RX Data FIFO
- Two 8 bit TX data registers
- Standard 10 MHz crystal reference
- Wakeup timer
- 2.2V – 3.8V power supply
- Low power consumption
- Standby current less than 0.3uA
- Supports very short packets (down to 3 bytes)

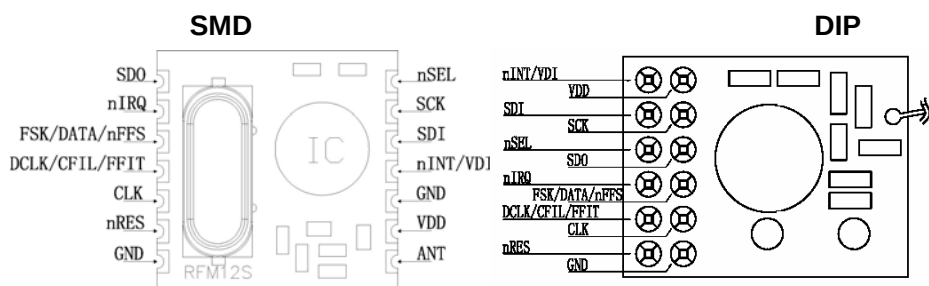
RFM12B



## Typical Application:

- Remote control
- Remote sensor
- Wireless data collection
- Home security system
- Toys
- Tire pressure monitoring system

## Pin Definition:



| definition     | Type      | Function                                                                                                                                                       |
|----------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| nINT/VDI       | DI/ DO    | Interrupt input (active low)/Valid data indicator                                                                                                              |
| VDD            | S         | Positive power supply                                                                                                                                          |
| SDI            | DI        | SPI data input                                                                                                                                                 |
| SCK            | DI        | SPI clock input                                                                                                                                                |
| nSEL           | DI        | Chip select (active low)                                                                                                                                       |
| SDO            | DO        | Serial data output with bus hold                                                                                                                               |
| nIRQ           | DO        | Interrupts request output (active low)                                                                                                                         |
| FSK/DATA/nFFS  | DI/DO/DI  | Transmit FSK data input/ Received data output (FIFO not used)/ FIFO select                                                                                     |
| DCLK/CFIL/FFIT | DO/AIO/DO | Clock output (no FIFO )/ external filter capacitor(analog mode)/ FIFO interrupts(active high)when FIFO level set to 1, FIFO empty interruption can be achieved |
| CLK            | DO        | Clock output for external microcontroller                                                                                                                      |
| nRES           | DIO       | Reset output (active low)                                                                                                                                      |
| GND            | S         | Power ground                                                                                                                                                   |

## Electrical Parameter:

### Maximum (not at working mode)

| symbol          | parameter             | minimum | maximum              | Unit |
|-----------------|-----------------------|---------|----------------------|------|
| V <sub>dd</sub> | Positive power supply | -0.5    | 6.0                  | V    |
| V <sub>in</sub> | All pin input level   | -0.5    | V <sub>dd</sub> +0.5 | V    |

|          |                            |     |      |    |
|----------|----------------------------|-----|------|----|
| $I_{in}$ | Input current except power | -25 | 25   | mA |
| ESD      | Human body model           |     | 1000 | V  |
| $T_{st}$ | Storage temperature        | -55 | 125  | °C |
| $T_{ld}$ | Soldering temperature(10s) |     | 260  | °C |

### Recommended working range

| symbol   | parameter             | minimum | maximum | Unit |
|----------|-----------------------|---------|---------|------|
| $V_{dd}$ | Positive power supply | 2.2     | 3.8     | V    |
| $T_{op}$ | Working temperature   | -40     | 85      | °C   |

### DC characteristic

| symbol             | parameter                                         | Remark                                        | minimum            | typical        | maximum            | Unit |
|--------------------|---------------------------------------------------|-----------------------------------------------|--------------------|----------------|--------------------|------|
| $I_{dd\_TX\_0}$    | Supply current<br>(TX mode, $P_{out} = 0dBm$ )    | 315,433MHz band<br>868MHz band<br>915MHz band |                    | 15<br>16<br>17 | 17<br>18<br>19     | mA   |
| $I_{dd\_TX\_PMAX}$ | Supply current<br>(TX mode, $P_{out} = P_{max}$ ) | 315,433MHz band<br>868MHz band<br>915MHz band |                    | 22<br>23<br>24 | 24<br>25<br>26     | mA   |
| $I_{dd\_RX}$       | Supply current<br>(RX mode)                       | 315,433MHz band<br>868MHz band<br>915MHz band |                    | 11<br>12<br>13 | 13<br>14<br>15     | mA   |
| $I_x$              | Idle current                                      | Crystal oscillator on                         |                    | 0.62           | 1.2                | mA   |
| $I_{pd}$           | Sleep mode current                                | All blocks off                                |                    | 0.3            |                    | uA   |
| $I_{lb}$           | Low battery detection                             |                                               |                    | 0.5            |                    | uA   |
| $V_{lb}$           | Low battery detect<br>threshold                   | 0.1V per step                                 | 2.2                |                | 3.7                | V    |
| $V_{lba}$          | Low battery detection<br>accuracy                 |                                               | 0                  |                | 5                  | %    |
| $V_{il}$           | Low level input                                   |                                               |                    |                | $0.3 \cdot V_{dd}$ | V    |
| $V_{ih}$           | High level input                                  |                                               | $0.7 \cdot V_{dd}$ |                |                    | V    |
| $I_{il}$           | Leakage current                                   | $V_{il}=0V$                                   | -1                 |                | 1                  | uA   |
| $I_{ih}$           | Leakage current                                   | $V_{ih}=V_{dd}, V_{dd}=5.4V$                  | -1                 |                | 1                  | uA   |
| $V_{ol}$           | Low level output                                  | $I_{ol}=2mA$                                  |                    |                | 0.4                | V    |
| $V_{oh}$           | High level output                                 | $I_{oh}=-2mA$                                 | $V_{dd}-0.4$       |                |                    | V    |

### AC characteristic

| symbol    | parameter                            | remark                                                                         | min                        | typical | max                                    | Unit |
|-----------|--------------------------------------|--------------------------------------------------------------------------------|----------------------------|---------|----------------------------------------|------|
| $f_{ref}$ | PLL frequency                        |                                                                                | 9                          | 10      | 11                                     | MHz  |
| $f_{LO}$  | frequency<br>(10MHz crystal<br>used) | 433 MHz band,2.5KHz step<br>868 MHz band,5KHz step<br>915 MHz band,7.5KHz step | 430.24<br>860.48<br>900.72 |         | 439.7<br>5<br>879.5<br>1<br>929.2<br>7 | MHz  |

|                      |                                      |                                                                                |                                       |                                       |                                        |      |
|----------------------|--------------------------------------|--------------------------------------------------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|------|
| $f_{LO}$             | frequency<br>(9MHz crystal<br>used)  | 433 MHz band,2.5KHz step<br>868 MHz band,5KHz step<br>915 MHz band,7.5KHz step | 387.22<br>774.43<br>810.65            |                                       | 395.7<br>6<br>791.5<br>6<br>836.3<br>4 | MHz  |
| $f_{LO}$             | frequency<br>(11MHz crystal<br>used) | 433 MHz band,2.5KHz step<br>868 MHz band,5KHz step<br>915 MHz band,7.5KHz step | 473.26<br>946.53<br>990.79            |                                       | 483.7<br>3<br>967.4<br>6<br>1022.<br>2 | MHz  |
| BW                   | Receiver<br>bandwidth                | mode 0<br>mode 1<br>mode 2<br>mode 3<br>mode 4<br>mode 5                       | 60<br>120<br>180<br>240<br>300<br>360 | 67<br>134<br>200<br>270<br>350<br>400 | 75<br>150<br>225<br>300<br>375<br>450  | KHz  |
| $t_{lock}$           | PLL lock time                        | After 10MHz step hopping, frequency<br>error <10 kHz                           |                                       | 30                                    |                                        | us   |
| tst, P               | PLL startup time                     | With a running crystal<br>oscillator                                           |                                       | 200                                   | 300                                    | us   |
| BR                   | Data rate                            | With internal digital demodulator                                              | 0.6                                   |                                       | 115.2                                  | kbps |
| BR <sub>A</sub>      | Data rate                            | With external RC filter                                                        |                                       |                                       | 256                                    | kbps |
| P <sub>min</sub>     | sensitivity                          | BER 10 <sup>-3</sup> , BW=134KHz,BR=1.2kbps, 433MHz band                       |                                       | -109                                  | -100                                   | dBm  |
|                      |                                      | BER 10 <sup>-3</sup> , BW=134KHz,BR=1.2kbps, 868MHz band                       |                                       | -105                                  | -100                                   |      |
|                      |                                      | BER 10 <sup>-3</sup> , BW=134KHz,BR=1.2kbps, 915MHz band                       |                                       | -105                                  | -100                                   |      |
| AFC <sub>range</sub> | AFC working<br>range                 | df <sub>FSK</sub> : FSK deviation in the received<br>signal                    |                                       | 0.8*<br>df <sub>FSK</sub>             |                                        |      |
| RS <sub>A</sub>      | RSSI accuracy                        |                                                                                |                                       | ±5                                    |                                        | dB   |
| RS <sub>R</sub>      | RSSI range                           |                                                                                |                                       | 46                                    |                                        | dB   |
| C <sub>ARSSI</sub>   | ARSSI filter                         |                                                                                |                                       | 1                                     |                                        | nF   |
| RS <sub>STEP</sub>   | RSSI<br>programmable<br>step         |                                                                                |                                       | 6                                     |                                        | dB   |
| RS <sub>RESP</sub>   | DRSSI response<br>time               | RSSI output high after valid ,<br>CARRSI=5nF                                   |                                       | 500                                   |                                        | us   |

**AC characteristic(Transmitter)**

| symbol            | parameter                                                           | remark                             | min                  | typical | max              | Unit   |
|-------------------|---------------------------------------------------------------------|------------------------------------|----------------------|---------|------------------|--------|
| P <sub>max</sub>  | Max. available output power                                         | 433MHz band                        | 3                    | 5       |                  | dBm    |
|                   |                                                                     | 868MHz band                        | 2                    | 4       |                  |        |
|                   |                                                                     | 915MHz band                        | 2                    | 4       |                  |        |
| P <sub>out</sub>  | Typical output power                                                | Selectable in 3 dB steps           | P <sub>max</sub> -21 |         | P <sub>max</sub> | dbm    |
| C <sub>o</sub>    | Output capacitance<br>(set by the automatic antenna tuning circuit) | In low bands                       | 2                    | 2.6     | 3.2              | pf     |
|                   |                                                                     | In high bands                      | 2.1                  | 2.7     | 3.3              |        |
| Q <sub>o</sub>    | Quality factor of the output capacitance                            | In low bands                       | 13                   | 15      | 17               |        |
|                   |                                                                     | In high bands                      | 8                    | 10      | 12               |        |
| L <sub>out</sub>  | Output phase noise                                                  | 100 kHz from carrier               |                      |         | -80              | dbc/HZ |
|                   |                                                                     | 1 MHz from carrier                 |                      |         | -103             |        |
| BR <sub>TX</sub>  | FSK bit rate                                                        | Via internal TX data register      |                      |         | 172              | kbps   |
| BRA <sub>TX</sub> | FSK bit rate                                                        | TX data connected to the FSK input |                      |         | 256              | kbps   |
| df <sub>fsk</sub> | FSK frequency deviation                                             | Programmable in 15 kHz steps       | 15                   |         | 240              | kHZ    |

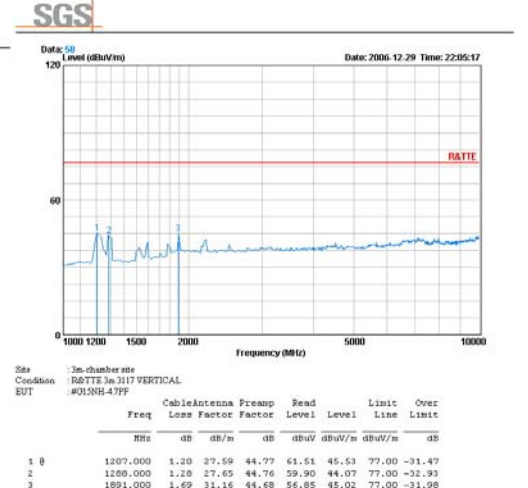
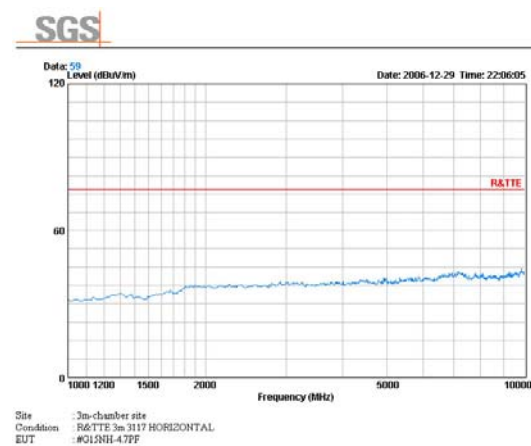
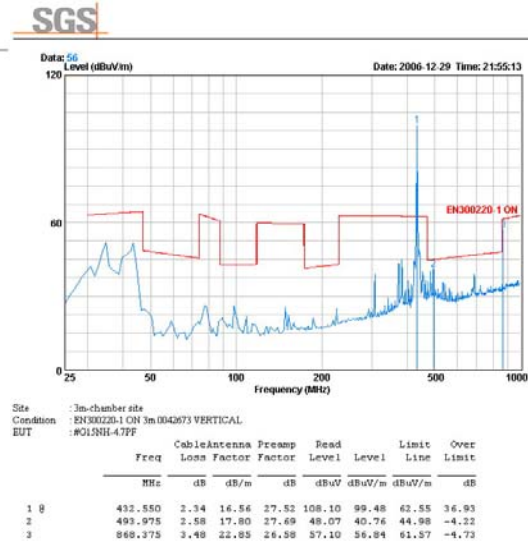
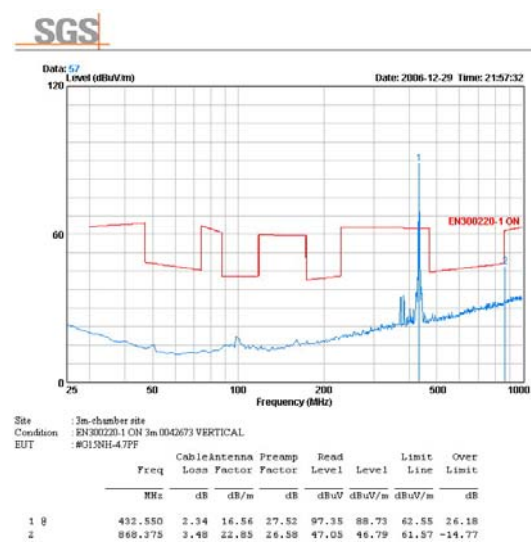
**AC characteristic(Turn-on/Turnaround timings)**

| symbol                     | parameter                            | remark                                                                     | min  | typical | max  | Unit |
|----------------------------|--------------------------------------|----------------------------------------------------------------------------|------|---------|------|------|
| T <sub>st</sub>            | Crystal oscillator startup time      | Crystal ESR < 100                                                          |      | 1       | 5    | ms   |
| T <sub>tx_XTAL_ON</sub>    | Transmitter turn-on time             | Synthesizer off, crystal oscillator on with 10 MHz step                    |      | 250     |      | us   |
| T <sub>rx_XTAL_ON</sub>    | Receiver turn-on time                | Synthesizer off, crystal oscillator on with 10 MHz step                    |      | 250     |      | us   |
| T <sub>tx_rx_SYNT_ON</sub> | Transmitter – Receiver turnover time | Synthesizer and crystal oscillator on during TX/RX change with 10 MHz step |      | 150     |      | us   |
| T <sub>rx_tx_SYNT_ON</sub> | Receiver – Transmitter turnover time | Synthesizer and crystal oscillator on during RX/TX change with 10 MHz step |      | 150     |      | us   |
| C <sub>xl</sub>            | Crystal load capacitance             | Programmable in 0.5 pF steps, tolerance+/- 10%                             | 8.5  |         | 16   | pf   |
| t <sub>POR</sub>           | Internal POR timeout                 | After V <sub>dd</sub> has reached 90% of final value                       |      |         | 100  | ms   |
| t <sub>PBt</sub>           | Wake-up timer clock period           | Calibrated every 30 seconds                                                | 0.96 |         | 1.05 | ms   |
| C <sub>in, D</sub>         | Digital input apacitance             |                                                                            |      |         | 2    | pf   |
| t <sub>r, f</sub>          | Digital output rise/fall time        | 15pF pure capacitive load                                                  |      |         | 10   | ns   |

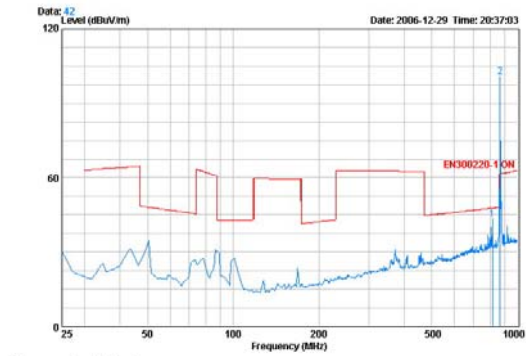
### Field testing range

| Band        | Test condition                                                                                                              | Distance |
|-------------|-----------------------------------------------------------------------------------------------------------------------------|----------|
| 433MHz band | Receiver bandwidth =67KHz, data rate=1.2kbps, transmitter frequency deviation =45KHZ (matches with RFM12) In free open area | >200M    |
| 868MHz band | Receiver bandwidth=67KHz,data rate =1.2kbps,Transmitter frequency deviation =45KHZ (matches with RFM12) in free open area   | >200M    |
| 915MHz band | Receiver bandwidth=67KHz,data rate =1.2kbps,Transmitter frequency deviation =45KHZ (matches with RFM12) in free open area   | >200M    |

### SGS Reports



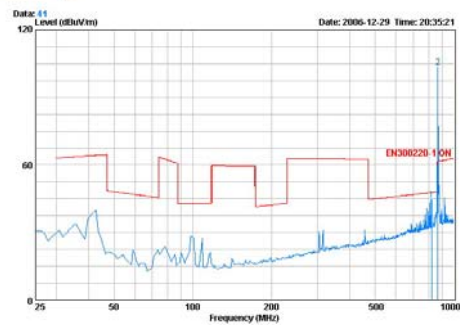
SGS



Site : 3m-chamber site  
Condition : EN300220-1 ON 3m 0040673 HORIZONTAL  
EUT : #D-63NF

|   | Freq    | CableAntenna | Preamp | Read  | Limit  | Over   |
|---|---------|--------------|--------|-------|--------|--------|
|   | MHz     | Loss         | Factor | Level | Line   | Limit  |
|   |         | Factor       | Factor | dBuV  | dBuV/m | dBuV/m |
|   |         | dB           | dB/m   | dB    | dBuV   | dBuV/m |
| 1 | 816.700 | 3.28         | 22.29  | 26.06 | 44.32  | 43.04  |
| 2 | 868.375 | 3.40         | 22.05  | 26.58 | 101.04 | 100.78 |

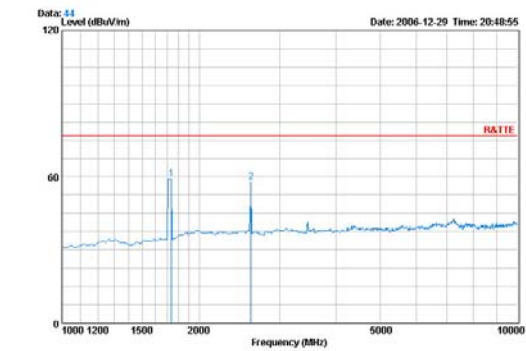
SGS



Site : 3m-chamber site  
Condition : EN300220-1 ON 3m 0040673 VERTICAL  
EUT : #D-63NF

|   | Freq    | CableAntenna | Preamp | Read  | Limit  | Over   |
|---|---------|--------------|--------|-------|--------|--------|
|   | MHz     | Loss         | Factor | Level | Line   | Limit  |
|   |         | Factor       | Factor | dBuV  | dBuV/m | dBuV/m |
|   |         | dB           | dB/m   | dB    | dBuV   | dBuV/m |
| 1 | 820.600 | 3.30         | 22.33  | 26.04 | 45.80  | 44.59  |
| 2 | 868.375 | 3.48         | 22.85  | 26.58 | 103.62 | 103.36 |

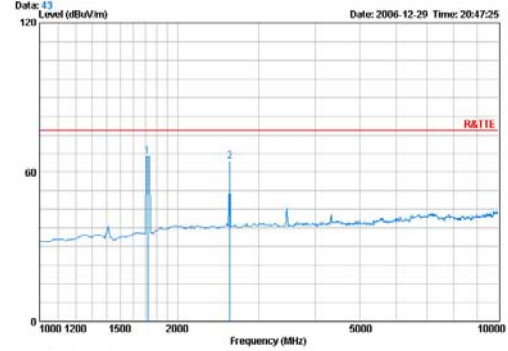
SGS



Site : 3m-chamber site  
Condition : R&TTE 3m 3117 HORIZONTAL  
EUT : #D-63NF

|   | Freq     | CableAntenna | Preamp | Read  | Limit  | Over   |
|---|----------|--------------|--------|-------|--------|--------|
|   | MHz      | Loss         | Factor | Level | Line   | Limit  |
|   |          | Factor       | Factor | dBuV  | dBuV/m | dBuV/m |
|   |          | dB           | dB/m   | dB    | dBuV   | dBuV/m |
| 1 | 1738.000 | 1.60         | 29.94  | 44.70 | 72.33  | 59.18  |
| 2 | 2602.000 | 2.04         | 32.54  | 44.80 | 67.95  | 57.73  |

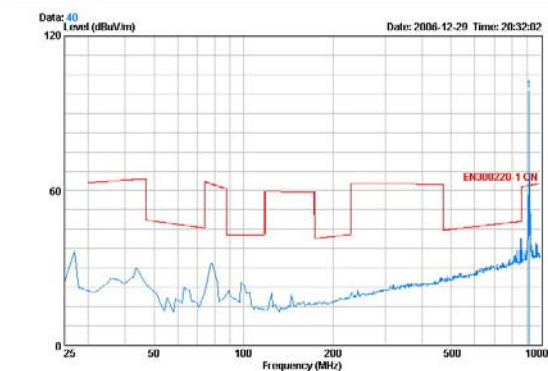
SGS



Site : 3m-chamber site  
Condition : R&TTE 3m 3117 VERTICAL  
EUT : #D-63NF

|   | Freq     | CableAntenna | Preamp | Read  | Limit  | Over   |
|---|----------|--------------|--------|-------|--------|--------|
|   | MHz      | Loss         | Factor | Level | Line   | Limit  |
|   |          | Factor       | Factor | dBuV  | dBuV/m | dBuV/m |
|   |          | dB           | dB/m   | dB    | dBuV   | dBuV/m |
| 1 | 1720.000 | 1.59         | 29.82  | 44.70 | 79.69  | 66.40  |
| 2 | 2602.000 | 2.04         | 32.54  | 44.80 | 74.74  | 64.52  |

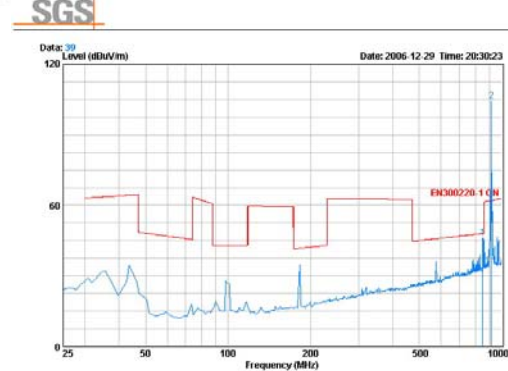
SGS



Site : 3m-chamber site  
Condition : EN300220-1 ON 3m 0040673 HORIZONTAL  
EUT : #F-63NF

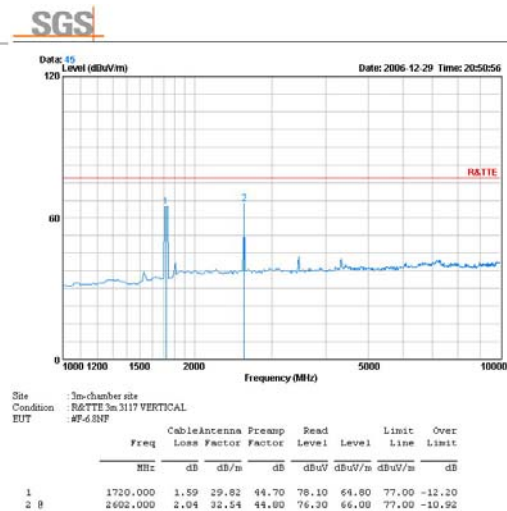
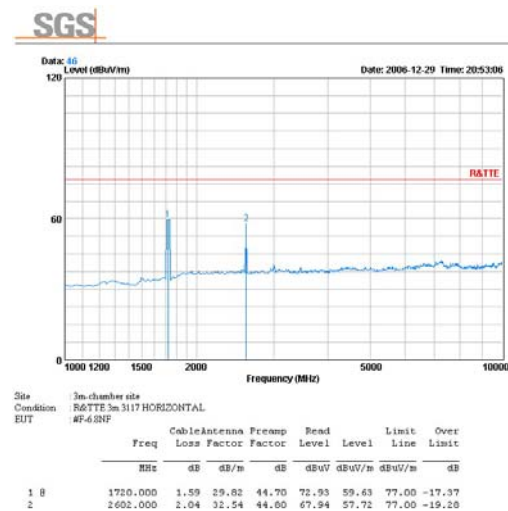
|   | Freq    | CableAntenna | Preamp | Read  | Limit  | Over   |
|---|---------|--------------|--------|-------|--------|--------|
|   | MHz     | Loss         | Factor | Level | Line   | Limit  |
|   |         | Factor       | Factor | dBuV  | dBuV/m | dBuV/m |
|   |         | dB           | dB/m   | dB    | dBuV   | dBuV/m |
| 1 | 914.200 | 3.62         | 23.26  | 26.43 | 90.20  | 90.73  |
| 2 | 914.200 | 3.62         | 23.26  | 26.43 | 103.62 | 104.27 |

SGS



Site : 3m-chamber site  
Condition : EN300220-1 ON 3m 0040673 VERTICAL  
EUT : #F-63NF

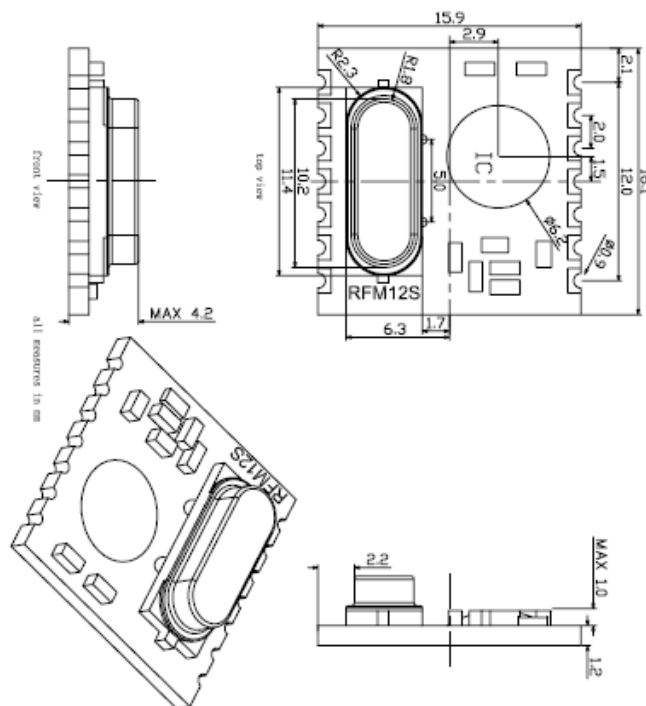
|   | Freq    | CableAntenna | Preamp | Read  | Limit  | Over   |
|---|---------|--------------|--------|-------|--------|--------|
|   | MHz     | Loss         | Factor | Level | Line   | Limit  |
|   |         | Factor       | Factor | dBuV  | dBuV/m | dBuV/m |
|   |         | dB           | dB/m   | dB    | dBuV   | dBuV/m |
| 1 | 951.000 | 3.42         | 22.40  | 26.67 | 46.75  | 45.90  |
| 2 | 914.200 | 3.62         | 23.26  | 26.43 | 103.62 | 104.27 |



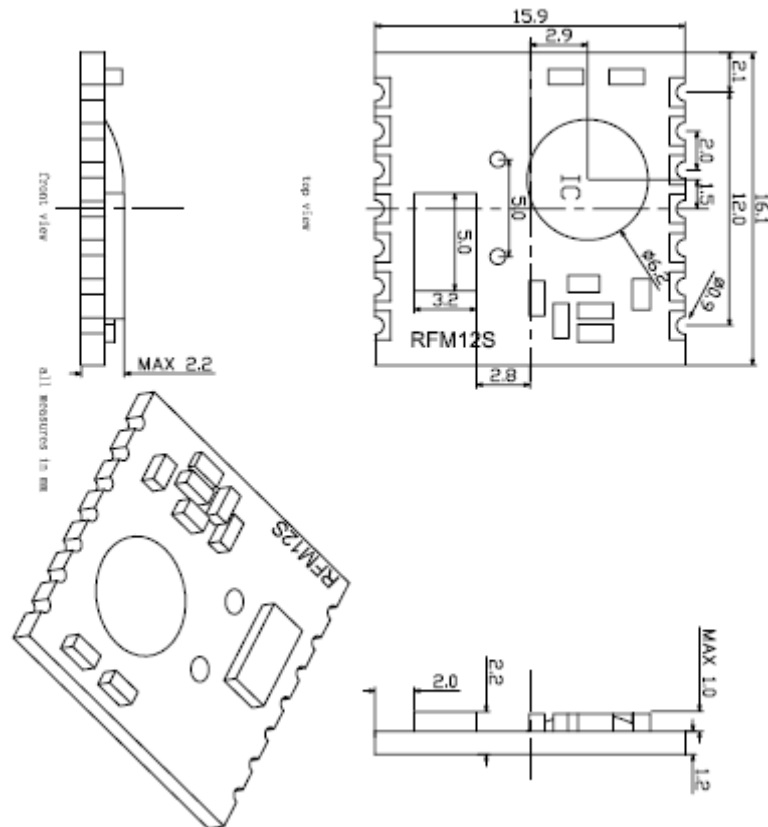
## Mechanical Dimension

(units in mm)

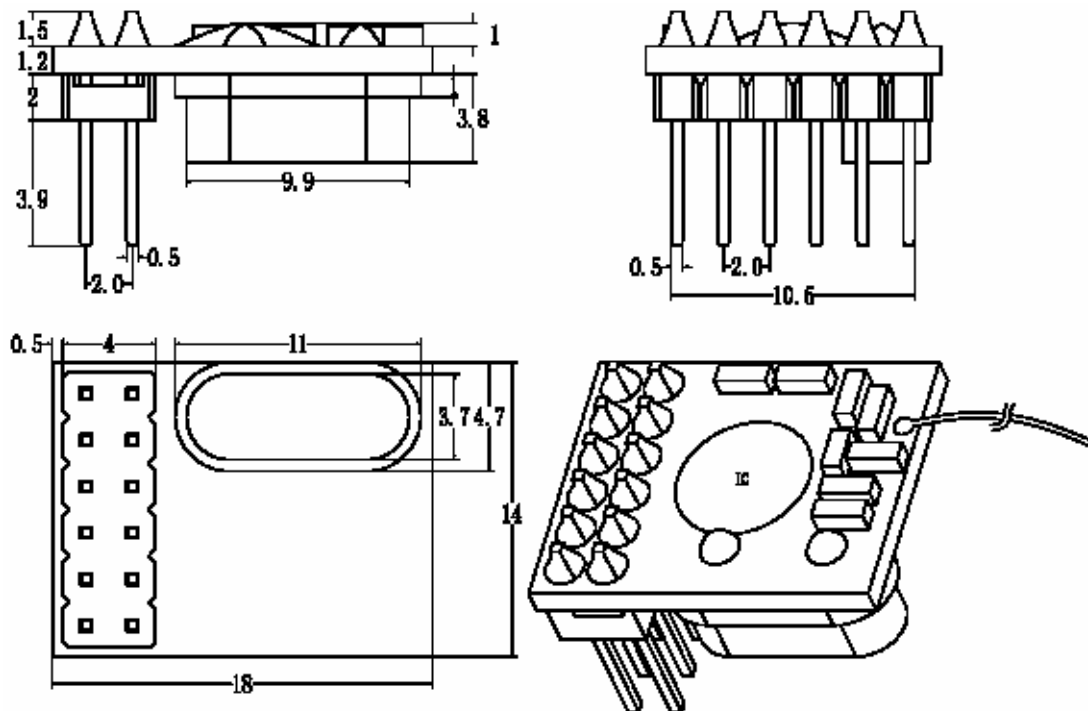
SMD PACKAGE (S1)



SMD PACKAGE (S2)



DIP PACKAGE (D)



## Module Model Definition

model=module-operation\_band-package\_type

**RFM12B – 433-D**

module type

operation band

Package

example: 1, RFM12B module at 433MHz band, DIP : RFM12B-433-D。

2, RFM12B module at 868MHZ band, SMD, thickness at 4.2mm: RFM12B-868-S1。

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