Technical Datasheet

for

RDM-UART-A8FZ-LR

Long-range RF Module in 850-870 MHz

With

UART and AT Command Interface

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Document Revision History

Version No.	Release Date	Description of Changes
1.0	March 14, 2011	Initial Release
1.1	June 18, 2013	Changes to the default values for the following AT commands: 1. Set Carrier Sense Threshold 2. Default serial baud rate 3. Default RF baud rate 4. RF output power

Table of Contents

1. Overview

This document describes the hardware and firmware features of RDM-UART-A8FZ-LR, long range RF Module. The module works as a high power RF transceiver, to transmit the data given through the UART. The module has UART data interface and operable between 850MHz to 870 MHz (License-free frequency band targeted for India and Europe).The integrated RF front end gives an output power of +27dBm. Most of the RF parameters and other network parameters can be configured on the module through the AT command interface which makes it flexible for use. This module can be integrated with the energy meters with little customization and minimum effort. The UART data transfer between the host processor and the high power UART module is done with first byte as length byte.

2. Block Diagram

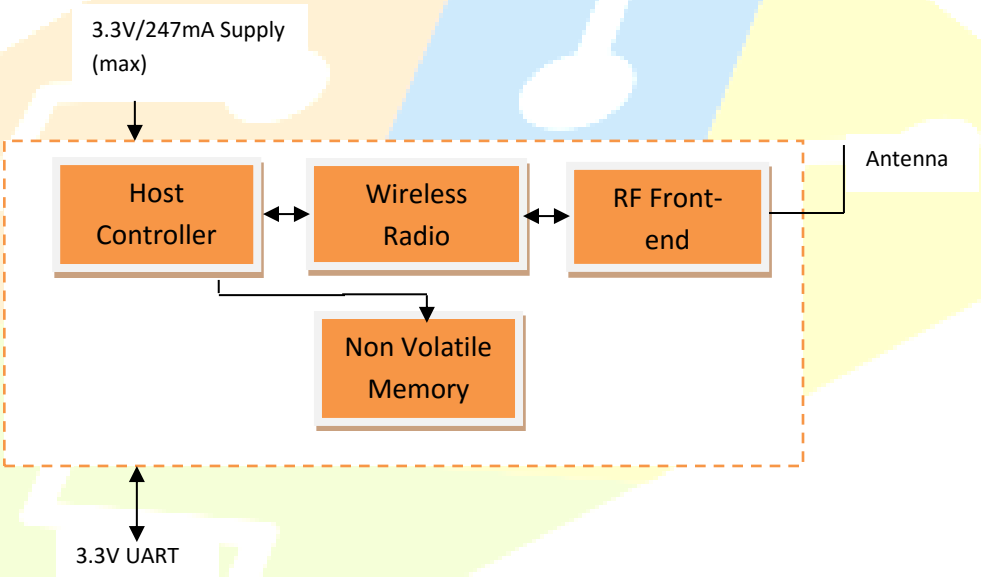


Figure 1. Block Diagram

3. Key Features

- Long range, high performance transceiver Module
- Frequency bands: 850 MHz to 870 MHz
- Data rates supported: 1 kbps to 300 kbps
- 3.3 to 3.6 V power supply
- Configurable RF Output Power
- Receiver sensitivity (BER)
    - −116 dBm at 1.0 kbps, 2FSK, GFSK
    - −107.5 dBm at 38.4 kbps, 2FSK, GFSK
    - −102.5 dBm at 150 kbps, GFSK, GMSK
    - −100 dBm at 300 kbps, GFSK, GMSK

  - −104 dBm at 19.2 kbps, OOK

- Very low power consumption
  - 18mA in PHY_RX mode (Max front-end gain)
  - 247mA in PHY_TX mode (27dBm output)
  - 30 µA in PHY_SLEEP Mode
  - 17 µA in PHY_SLEEP Mode (Deep Sleep Mode 1)

- Configurable RF output power from 9 dBm to +24.1dBm
- Digital received signal strength indication (RSSI) Request
- 240 byte Packet Buffer for TX/RX data
- Efficient UART data interface
- AT Command Interface for Configuration of parameters

4. Application Areas

- Smart Metering
- IEEE 802.15.4g
- Lighting Control
- Home Automation
- Process and Building Control
- Wireless Sensor Networks (WSN)
- Wireless Healthcare

5. Device Specifications

5.1. General Specifications

Parameter	Min	Typ	Max	Unit
Dimensions		36.6 x 23 x 5		mm
Weight		25		grams
Operating Temperature	-40		+85	°C
Humidity	20		85	%RH
Supply Voltage	3.3		3.6	V

5.2. RF Specifications

Parameter	Min	Typ	Max	Unit
Frequency Range	850		870	MHz
Data Rate	1		300	Kbps

RF Output Power	+9	+24	dBm
RF Sensitivity		-116	dBm
Transmit Current Consumption			
9 dBm	73.8		mA
11 dBm	75.8		mA
17 dBm	101.8		mA
20 dBm	167.0		mA
22dBm	203.4		mA
Receive Current Consumption	20		mA
Sleep Current Consumption	17		µA
Harmonics			
Second Harmonic	-34.8		dBm
Third Harmonic	-33		dBm
Fourth Harmonic	-62		dBm
Fifth Harmonic	-56		dBm

5.3. Antenna Specifications

Parameter	Min	Typ	Max	Unit
Centre Frequency	850		870	MHz
Bandwidth		25		MHz
Wavelength		¼ wave		
VSWR		≤ 2.0		
Impedance		50		Ohm

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

6. Pin Configuration and Description

The High power UART module has 2 x 10 headers (JP3 and JP4) for interfacing with host microcontroller. Figure 1 shows the pin diagram of high power UART Module. And the description of each pin's functionality is given in Table 4.1. All the pins operate at the voltage levels of 0V to 3.3V.The supply for the High Power UART Module should be 3.3V regulated power supply capable of delivering maximum current of 300mA. TDO, TDI, TMS and TCK

pins can be used to upgrade the firmware of the processor. The RF module has six general purpose I/Os which can be customized for a particular application Scenario.

7. Pin Diagram

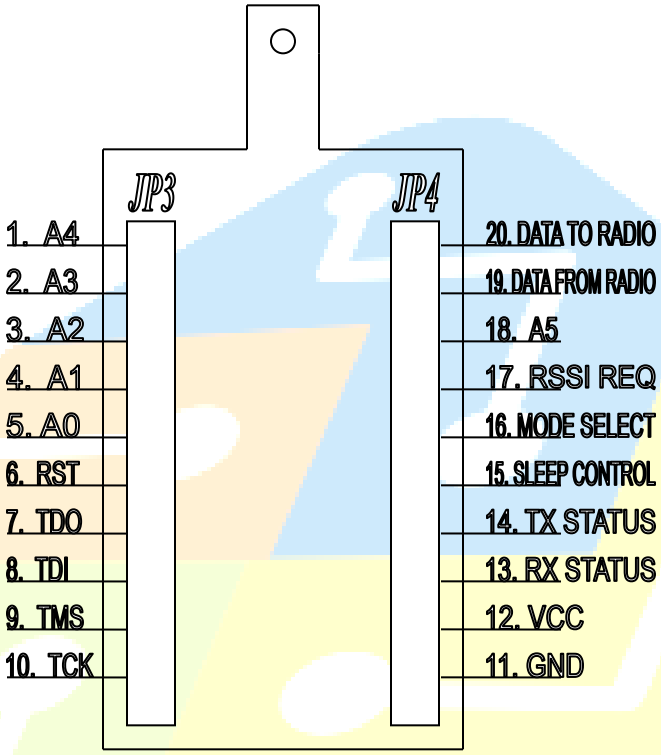


Figure 1. High Power UART Module –Pin Diagram

8. Pin Descriptions

No.	Pin Signal	Direction	Description
1	A4	I/O	General Purpose Input/Output
2	A3	I/O	General Purpose Input/Output
3	A2	I/O	General Purpose Input/Output
4	A1	I/O	General Purpose Input/Output
5	A0	I/O	General Purpose Input/Output

6	RST	I	Reset: It is the reset signal of the processor in the RF Module
7	TDO	O	Test data output port
8	TDI	I	Test data input
9	TMS	I	Test mode select. TMS is used as an input port for device programming and test
10	TCK	I	Test clock. TCK is the clock input port for device programming and test
11	GND	I	Ground or Negative of 3.3V Supply
12	VCC	I	Positive of 3.3V supply
13	RX STATUS	O	The logic level of this signal toggles after every reception. This can be used to check the reception status
14	TX STATUS	O	The logic level of this signal toggles after every RF transmission. This can be used to check the transmission status
15	SLEEP CONTROL	I	When the rising edge is detected at this pin, the RF module goes into sleep state. The RF module wakes up if UART reception happens or the rising edge at any one of the following pins - RSSI REQ/MODE SELECT/ SLEEP CONTROL /RST
16	MODE SELECT	I	The rising edge at this pin causes the RF module to enter into the Command Mode. Entering into command mode enables the host processor to give the AT Commands to change the settings
17	RSSI REQ	I	RSSI REQUEST: This signal is used to get the RSSI value. Once the rising edge at this pin is detected, the RF module gives 1 byte RSSI value in dBm (without sign) to UART
18	A5	I/O	General Purpose Input/Output
19	DATA FROM RADIO	O	UART Data Output from the RF Module to the Host Processor
20	DATA TO RADIO	I	UART data input to the RF module from the host processor

9. Interfacing with Microcontroller

9.1. General

To interface the High Power RF Module with the host processor the typical hardware connections has to be done as shown in Figure 2.

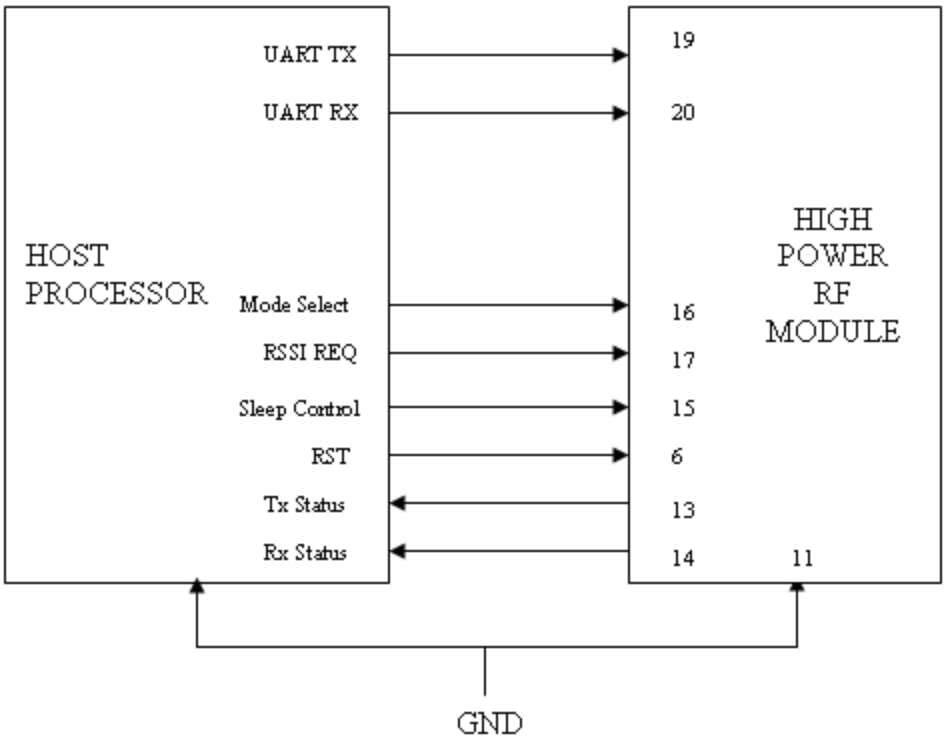
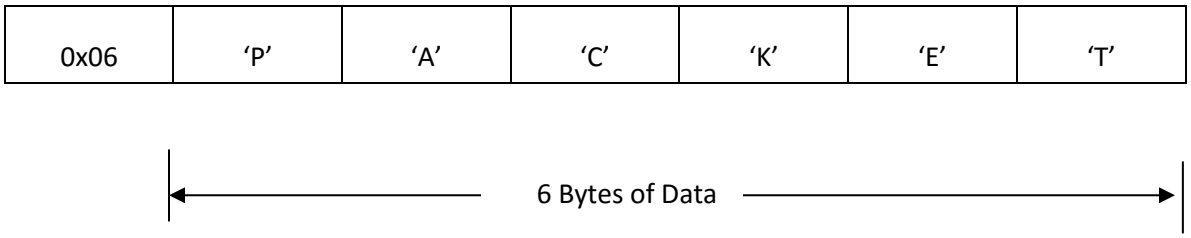


Figure 2: Typical Hardware Connection Diagram

To transmit the data wirelessly, the host processor has to send the data through UART to the RF module. Depending upon the first byte received by the UART, mode selection will take place. There are two modes of operation. They are Data mode and Command mode. If the first byte received by the UART is zero, then the remaining bytes will be taken as command. These commands can be used for the configuration of RF module. If the first byte is a non-zero value, then it will be taken as length byte and the succeeding bytes are taken as data.

0x00	'A'	'T'	'N'	'C'	'H'	0X0D

3.a.Example of AT Command format



3.b. Example of Data packet format (from Host Processor)

Figure 3: Packet Format for Host Interface

If the data from the Host processor is less than the length byte, then the module will show "ERROR" as response and the data received through UART will be discarded. If the length of the data is more than the length byte (first byte) value, then the module gives "OK..." as response and transmits only the part of the data packet, whose length is equal to the length byte (first byte) value. Remaining bytes are discarded. The default serial baud rate used is **38400 bps**. And the baud rate for the UART communication can be changed by the AT Commands. The default packet timeout used is **200ms**. So the data from the host processor should be given continuously through UART and the time delay between two successive UART transmissions (from host processor) should not exceed 200ms. If it is more than 200ms, then packet timeout happens and it will give "ERROR" as Response through UART.

Since we have used first byte as length byte, the maximum number of bytes we can transmit is **236 bytes** along with length byte. So the host processor can give 236 bytes of UART data at one go. The default wireless packet size is 236 bytes. The packet size can be changed by using the AT commands. The RF module uses the Cyclic Redundancy Check (CRC) to ensure the message integrity of the received wireless packets.

9.2. OTHER SIGNALS

9.2.1. Sleep Control

The 15th pin of the high power RF module is the sleep control pin. When the RF module detects the rising edge at this pin, it goes to the sleep state. The current consumption of the radio module at the sleep state is measured as 1.3mA. The RF module wakes up from the sleep state when either UART reception happens or RSSI REQ/MODE SELECT/RST signal is given.

Figure 4: Timing Diagram for Sleep Control Signal

9.2.2 RSSI Request

The 17th pin of the RF module is RSSI Request pin. When the RF module detects the rising edge at this pin, it measures the Received Signal Strength Indicator (RSSI) value and gives it a one byte RSSI value without sign to UART. For example if the RSSI measured is -55dBm, then the one byte RSSI given to the host processor is 55_d (0x37).

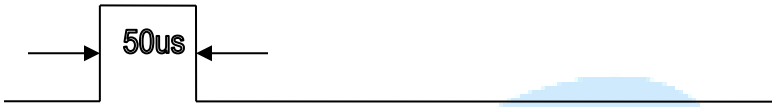


Figure 5: Timing Diagram for RSSI Request Signal

9.2.3. Mode Select

The 16th pin of the RF module is Mode Select pin. When the RF module detects the rising edge at this pin, the RF module enters into Command Mode. There are two modes of operation for the RF module.

They are

1. Data Mode – In this mode, the user data from the host processor has been received through UART and subsequently that will be transmitted wirelessly.
2. Command Mode – In this mode, the AT commands from the host processor has been received through UART and the replies are sent back from the RF module.

The Command mode can be entered either through giving zero as first byte from the host processor to RF module through UART or by issuing a pulse as shown in Figure 6. To exit from the command mode, an AT command ATGEX<CR> is used.

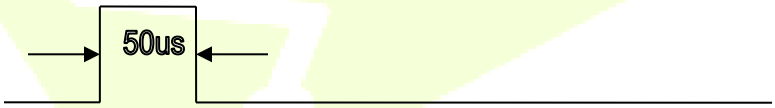


Figure 6.Timing Diagram for Mode Select Input

9.2.4. RST

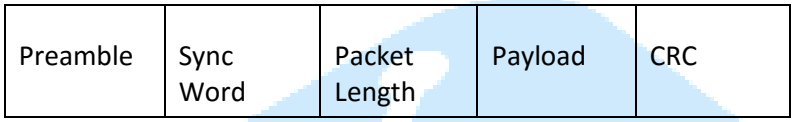
The 6th pin of RF module is the hardware reset pin. When the logical low signal (0V) is given to this pin, it resets the RF module and the firmware execution restarts.

9.2.5. TX Status and RX Status

The 13th and 14th pin are the TX Status and RX Status pins. These pins can be used to indicate the wireless transmit and receive status. After every wireless transmission and reception, the signal level at this pin toggles to indicate the transmission and reception.

9.3. Data Frame Format

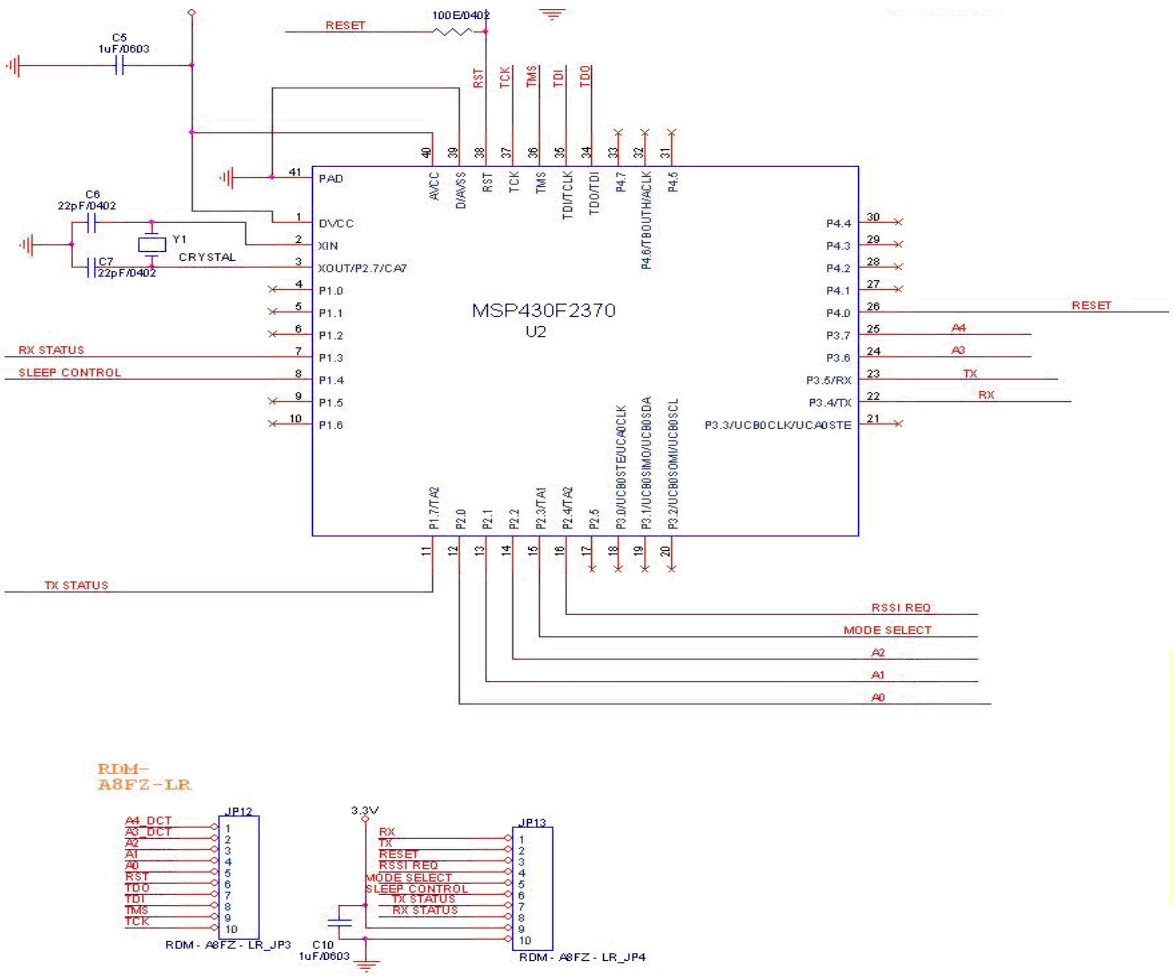
Figure 7 shows the wireless packet frame format. The 10 byte preamble and 3 byte Sync word are included with the packet by the transceiver. The first byte of the 9 byte header is packet length and the rest of the 8 bytes are the source address and destination address. The maximum payload length should be less than or equal to 211 bytes. This length can be configured by the AT command ATSPK, referred in the page number 28. The two byte CRC ensures the message integrity. The wireless reception happens only if the CRC matches in the receiver.



Preamble: 10 bytes Sync word: 3 bytes Packet length: 1 byte Payload: up to 236 bytes

Figure 7: Data Packet format

10. Example Circuit



11. Mechanical Drawings

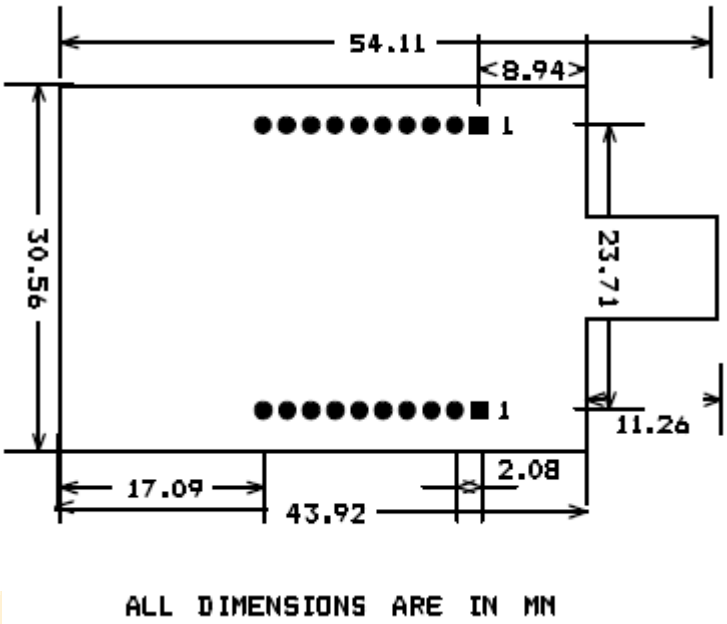


Figure 8: Mechanical dimensions of High Power RF Module

12. List of AT Commands

All the AT COMMANDS should be preceded by NULL Character (0x00) to differentiate command and data.

12.1. Write Parameters to Permanent Memory

Command

ASCII Value - ATGWR<CR>
Hex Command - 41 54 47 57 52 0D

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Description

This AT Command is used to store the set parameters to permanentmemory. This AT command has to be used after the AT command for setting aconfiguration parameter. When this AT command is issued after the ATcommand for setting a configuration parameter, it returns “OK..” as theresponse. If this AT Command is

issued after an AT command which is not usedto set the configuration parameter, then the response for this AT command willbe “ERROR”.

12.2. Store Parameters in Temporary Memory

Command

ASCII Value - ATTEMP<CR>
Hex Command - 41 54 54 45 4D 50 0D

Response

ASCII Value - OK..
Hex Command –4F 4B 0D 0D

Description

This AT Command is used to Store the set parameters to Temporarymemory without affecting the settings stored in permanent memory. After resetthese parameters will be lost. This AT command can be used after setting aconfiguration parameter using another AT command. This AT command isredundant and practically there is no need to use this AT command as ATcommand for setting the configuration parameter itself, stores the set value inthe temporary memory.

12.3. Read Frequency Channel

Command

ASCII Value - ATNCH<CR>
Hex Command - 41 54 4E 43 48 0D

Response

ASCII Value – (Channel No.)
Hex Command –(X) 0D 0D, Where X is the Channel No.

Default Value/Factory Settings

0x00

Description

Channel Number	RF Frequency
0	865.1
1	865.3
2	865.5

3	865.7
4	865.9
5	866.1
6	866.3
7	866.5
8	866.7
9	866.9

This AT Command is used to read the RF Frequency channel (X) used for wireless transmission and reception between modules. Range of X = (0 - 9). The central frequencies corresponding to each Channel Number is given below. The License-free frequency band of 865-867MHz (in India) has been mentioned in the table but it can be customized to include a wider frequency range.

12.4. Setting the RF Frequency Channel

Command

ASCII Value - ATNCH<X><CR>
Hex Command - 41 54 4E 43 48(X) 0D, where X is the Channel No.

Response

If the parameters are within 0 to 9 and the RF channel has been successfullychanged, then it returns the following:

ASCII Value - OK..

Hex Command - 4F 4B 0D 0D

If the parameter value is greater than 9 it returns the string “ERROR”

Default Value/Factory Settings

0x00

Description

This AT Command is used to set the RF Frequency channel (X) used forwireless transmission and reception between modules. Range of X = (0 - 9).Thecentral frequencies associated with the channel number are given in the table under section 12.3.

12.5. Read Sleep Mode

Command

ASCII Value - ATPSM<CR>
Hex Command - 41 54 50 53 4D 0D

Response

ASCII Value – (SLEEP MODE)
Hex Command –(X) 0D 0D, Where X is the Sleep mode.

Default Value/Factory Settings

0x00

Description

This AT Command is used to read the Sleep mode(X).

Range of X =(0 – None, 1 – Pin Assert, 2 – Cyclic)

12.6. Set Sleep Mode

Command

ASCII Value - ATPSM<X><CR>
Hex Command - 41 54 50 53 4D(X) 0D, Where X is the Sleep mode.

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Default Value/Factory Settings

0x00

Description

This AT Command is used to set Sleep mode(X).Range of X =(0 – None, 1 – Pin Assert, 2 – Cyclic)

12.7. Get Sleep Time

Command

ASCII Value - ATPST<CR>
Hex Command - 41 54 50 53 54 0D

Response

ASCII Value – (SLEEP TIME)
Hex Command –(X) 0D 0D, Where X is the Sleep time.

Default Value/Factory Settings

0x000A

Description

Sleep time reference for different sleep modes. The sleep time is in milliseconds. The maximum sleep time which can be given is 65,535 ms or 65.535 seconds. Range of X = (0 – 0xFFFF).

12.8. Set Sleep Time

Command

ASCII Value - ATPST<X><CR>
Hex Command - 41 54 50 53 54(X) 0D, Where X is the Sleep time.

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Default Value/Factory Settings

0x000A

Description

Sleep time reference for different sleep modes. Range of X = (0 – 0xFFFF).The sleep time is in milliseconds. The maximum sleep time which can be given is65,535 ms or 65.535 seconds. This time is used as the sleep time during the cyclicsleep mode. Range of X = (0 – 0xFFFF).

12.9. Read Wakeup Time

Command

ASCII Value - ATPBS<CR>
Hex Command - 41 54 50 42 53 0D

Response

ASCII Value – (TIME).

Hex Command –(X) 0D 0D, Where X is the time before sleep.

Default Value/Factory Settings

0x000A

Description

This AT Command is used to read the time before sleep. In other words, wake-up time (time for which the RF module is in wake up state) can be read by thiscommand. This time is used as the wake on time for the RF module during cyclic sleepmode (X).Range of X =(0 – 0xFFFF).

12.10. Set Wakeup Time

Command

ASCII Value - ATPBS<X><CR>
Hex Command - 41 54 50 42 53(X) 0D, Where X is the time before sleep.

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Default Value/Factory Settings

0x000A

Description

This AT Command is used to set the time before sleep. That is the timefor which the RF module is in wake up state. This time is used as the wake on time forthe RF module during cyclic sleep mode (X).Range of X = (0 – 0xFFFF).

12.11. Read Packet Timeout

Command

ASCII Value - ATSTO<CR>
Hex Command - 41 54 53 54 4F 0D.

Response

ASCII Value – (TIMEOUT).
Hex Command –(X) 0D 0D, Where X is the packet time out.

Default Value/Factory Settings

0xC8

Description

This AT Command is used to read the packet time out. In data mode, if specified number of bytes (given by first byte) has not been received through UART, then the RF module waits for this timeout period and if this time elapses then the RF module will give “ERROR” as response through UART and the data received will be discarded. This timeout is given in milliseconds (X).Range of X (0 -255 ms).

12.12. Set Packet Timeout

Command

ASCII Value - ATSTO<X><CR>
Hex Command - 41 54 53 54 4F(X) 0D, Where X is the packet time out.

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Default Value/Factory Settings

0xC8

Description

This AT Command is used to set the packet time out. In data mode, if specified number of bytes (given by first byte) has not been received through UART, then the DCT waits for this timeout period and if this time elapses then the DCT will give “ERROR” as response through UART and the data received will be discarded. This timeout is given in milliseconds (X).Range of X (0 – 255 milliseconds).

12.13. Read RF Packet Size

Command

ASCII Value - ATSPK<CR>
Hex Command - 41 54 53 50 4B 0D.

Response

ASCII Value – (SIZE)
Hex Command –(X) 0D 0D, Where X is the RF packet size.

Default Value/Factory Settings

0xEC (236 decimal)

Description

This AT Command is used to read RF packet size. If the data given to RF modulethrough UART is above this packet size then the UART data will be made asmultiple wireless packets of size set by this command. (X).Range of X = (1 – 236).

12.14. Set RF Packet Size

Command

ASCII Value - ATSPK<X><CR>
Hex Command - 41 54 53 50 4B(X) 0D, Where X is the RF packet size.

Default Value/Factory Settings

0xEC (236 decimal)

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Description

This AT Command is used to set RF packet size(X).Range of X =(1 – 236 decimal).

12.15. Set RF Baud Rate

Command

ASCII Value - ATSBR<X><CR>

Hex Command – 41 54 53 42 52(X) 0D, Where X is the RF packet size.

Default Value/Factory Settings

0x08

Response

ASCII Value - OK..

Hex Command - 4F 4B 0D 0D

Description

This command is used to set the RF baud rate for communication. Here is the list of RF baud rates and the corresponding values to be set in the RF module.

Set Value	RF Baud Rate (in kbps)
0	12
1	14.4
2	19.2
3	24
4	28.8
5	33.6
6	38.4
7	43.2
8	48
9	50

12.16. Set RF Output Power

Command

ASCII Value – ATPOP <X><CR>
Hex Command - 41 54 50 4F 50<X> 0D

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Default Values/Factory Settings

0x0C

Description

This AT Command is used to set the output power. The output power levelchanges from 9dBm – 24.1dBm. Range of X =(0x00 – 0x0C).

Set Value	RF Output Power (in dBm)

0x00	9
0x01	11
0x02	13
0x03	15
0x04	17
0x05	18
0x06	19
0x07	20.8
0x08	22.2
0x09	23.3
0x0A	23.8
0x0B	24
0x0C	24.1

12.17. Set Serial Baud Rate

Command

ASCII Value – ATSBD <X><CR>
Hex Command - 41 54 53 42 44 <X> 0D

Response

ASCII Value - OK..
Hex Command - 4F 4B 0D 0D

Default Values/Factory Settings

0x05

Description

This AT Command is used to set the Serial baud rate.

Range of X =(0x00 – 0x07).The serial baud rate level changes from 1200 to 115200 bps

Set Value	Serial Baud Rate (in kbps)
0x00	1200
0x01	2400
0x02	4800
0x03	9600
0x04	19200
0x05	38400
0x06	56000

0x07	115200

12.18. Set Destination Sync Word

Command

ASCII Value – ATDSY <X Y Z><CR>

Hex Command - 41 54 44 53 59 <X Y Z>0D

Response

ASCII Value - OK..

Hex Command - 4F 4B 0D 0D

Default Values/Factory Settings

0x10 0x20 0x30

<X Y Z> - X, Y, Z are three byte sync word which should be DC free and different from preamble bytes which are 0xAA.

Description

This AT Command is used to set the destination Sync word. Usually the default sync value for the source and the destination will be the same. When the multiple modules are transmitting in a same location, then it is recommended to have different sync words for source and destination. The transceiver will receive the packet when the sync word in the packet matches with its sync word. The destination sync word is the sync word which gets transmitted with the packet.

Note: This same command given without parameters can be used to read the 3 byte destination sync word.

12.19. Set Source Sync Word

Command

ASCII Value – ATSSY <X Y Z><CR>

Hex Command - 41 54 54 53 59 0D

Response

ASCII Value - OK..

Hex Command - 4F 4B 0D 0D

Default Values/Factory Settings

0x10 0x20 0x30

<X Y Z> - X, Y, Z are three byte sync word which should be DC free and different from preamble bytes which are 0xAA.

Description

This AT Command is used to set the source sync word. Usually the default sync value for the source and the destination will be the same. When the multiple modules are transmitting in a same location, then it is recommended to have different sync words for source and destination. The transceiver will receive the packet when the sync word in the packet matches with **source sync word**. The destination sync word is the sync word which gets transmitted with the packet.

Note: This same command given without parameters can be used to read the 3 byte source sync word. The reply for this AT command contains the 3 byte source sync word.

12.20. Set Carrier Sense Threshold

Command

ASCII Value – ATCST <X><CR>

Hex Command - 41 54 43 53 54 <X> 0D

Response

ASCII Value - OK..

Hex Command - 4F 4B 0D 0D

Default Values/Factory Settings

40

Description

This AT Command is used to set the carrier sense threshold which can be used in the collision avoidance algorithm. The RF module has a persistent Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA) algorithm for a collision free data transmission. The parameter for this command is carrier sense threshold in dBm (without sign). That is the default carrier sense threshold '40' indicates the carrier sense threshold of -40dBm.

12.21. Store Default Values (Factory Settings)

Command

ASCII Value - ATGRD<CR>

Hex Command - 41 54 47 52 44 0D

Response

ASCII Value - OK..

Hex Command - 4F 4B 0D 0D

Description

This AT Command is used to store the default values (Factory Settings). This AT command has to be used for setting default configuration parameters. When this AT command is issued, it returns "OK.." as the response.

13. Custom Applications

For cost-sensitive and custom applications, such as wireless sensor networks and AMR, Reindeer Technologies can embed the application software directly into a microcontroller built into the module. For more information on this service, please contact Reindeer Technologies.

14. Ordering Information

Ordering Part Number	Description
RDM-UART-A8FZ-LR	Long Range RF Transceiver Module (850 to 870 MHz)

15. Contact Us

15.1. Technical Support

Reindeer Technologies Pvt. Ltd. has built a solid technical support infrastructure so that you can get answers to your questions when you need them. Our technical support engineers are available Mon-Fri between 9:30 am and6:00 pm Indian standard time.

The best way to reach a technical support engineer is to send an email to *support@reindeersystems.com*. E-mail support requests are given priority because we can handle them more efficiently than phone support requests.

15.2. Sales Support

Our sales department can be reached via e-mail at *sales@reindeersystems.com*or by phone at +91-44-45022335. Our sales department is available Mon-Fri between 9:00 am and 6:30 pm.

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