DRF1276DM
LORA Long Range SX1276 Data Radio Modem   V1.00

Features

- LoRa^{TM} Frequency Spectrum
- 868/915Mhz ISM frequency band
- -139dBm receive sensitivity
- 20dBm Max. output power
- Serial port wake-up
- Wireless wake-up
- Star networking ability
- Supply voltage 3.4~5.5V

Application

- Home automation
- Security alarm
- Telemetry
- Automatic meter reading
- Contactless access
- Wireless data logger
- Remote motor control
- Wireless sensor network

DESCRIPTION

DRF1276DM is a type of long range low data rate data radio modem based on SX1276 from Semtech. DRF1276DM is a low-cost sub-1 GHz transceiver module designed for operations in the unlicensed ISM (Industrial Scientific Medical) and LPRD bands. Frequency spectrum modulation/demodulation, multi-channel operation, high bandwidth efficiency and anti-blocking performance make DRF1276DM modules easy to realize the robust and reliable wireless link.

The module can work in two different modes: Standard mode and Star network mode. In the standard mode DRF1276DM acts as transparent data radio modem which it communicates with the host at the preset data format without encoding / decoding needed. In start network mode, one module will be the configured to the central module and other modules are set to node modules. The communication between the central module and node module are bidirectional but the node modules can not talk with each other.

PIN FUNCTIONS

PIN	DIP-A	Function	Description
1	GND	Ground	Ground (0V)
2	VCC	Power	Power supply
3	EN	Input	Enable pin, Low effective
4	RXD	Input	RXD: UART input, TTL level
5	TXD	Output	TXD: UART output, TTL level
6	AUX	Output	Data indication pin for waking up module
7	SET	Input	Control pin, effective in central/node mode

Table 1: DRF1276DM Pin functions

Note:

1. If the module is connected to the host (microcontroller or PC through USB board) correctly, it will send a message (seeing the example below) to the host automatically as soon as it is powered on.

9600   N 8 1 DRF1276DM   V1.7

The last alphanumeric characters V1.7 indicate the firmware is 1.7.

2. In order to configure the parameters, the EN pin should be connected to logic low in any mode. In work mode, the EN pin also should be connected to logic low to let modules work normally. If the EN is connected to logic high, the RFIC and MCU of the modules in the two modes will be in deep sleep and only can be waken up by connecting this pin to logic low.

ELECTRICAL SPECIFICATIONS

Symbol	Parameter (condition)	Min.	Typ.	Max.	Units
VCC	Supply Voltage	3.4		5.5	V
Temp	Operating temperature range	-40	25	80	°C
RH	Operating relative humidity	10		90	%
Freq	Frequency range	860		930	MHz
Mod	Modulation type		FS		
I_R	Receive current in standard mode		13.6		mA
	Transmit mode at Max. output		130		mA
	Sleep mode		3.9		uA
Pout	Maximum output power @860Mhz		19	20	
	@900Mhz		19		
	@920Mhz		18.5		dBm
	@920Mhz		18.2		
Sen	Receiving sensitivity		-139		dBm
DR_{IN}	UART data rate	1.2	9.6	57.6	Kbps

T$_R$[1]	Wireless wake-up time		2		s
Z$_{ANT}$	Antenna Impedance		50		Ohm

Table 2: DRF1276DM Electrical Specifications

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min.	Max.	Units
VCC	Supply Voltage	-0.3	5.5	V
VI	Input voltage	-0.3	3.3	V
VO	Output voltage	-0.3	3.3	V
TST	Storage temperature	-55	125	°C

Table 3: DRF1276DM Maximum Ratings

WORKING MODE

1. STANDARD MODE

Standard mode is also called transparent mode in which the module receives from or sends data to the host through serial port (UART) at preset data format and users don't need to care about the process of data inside the module. The AUX pin of DRF1276DM will give indication about the data IN/OUT of serial port 2ms in advance in order to wake up the host. In this mode the EN pin should connect to GND in case the module will enter into deep sleep.
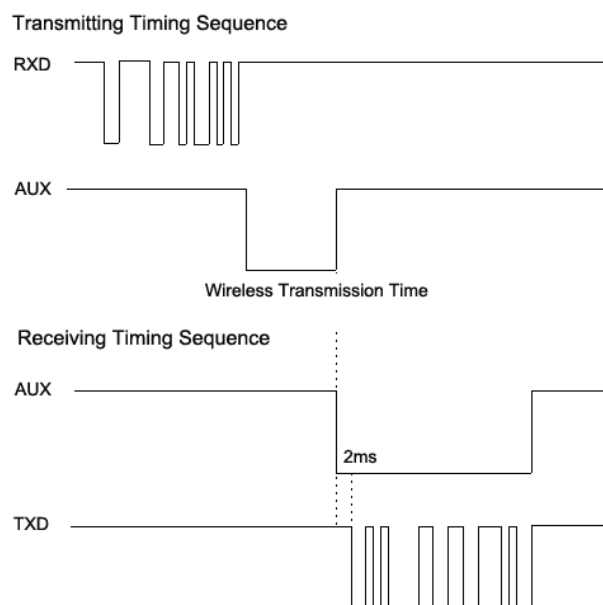
Figure 1: DRF1276DM Timing Sequence

2. STAR NETWORK MODE

In this mode one DRF1276DM module needs to set as the central module and other modules

should be node modules. For central module, it works at the full performance so its power consumption is the same as in the standard mode and the EN should be connected to logic low. The logic level of SET pin for central module should be the same as the node module.

If the EN pin of the node is connected to logic high, the node module will enter into sleep mode. If the EN pin is connected to logic low, the node module will work in one of the two communication ways (normal speed communication and breath period communication) according to the logic level of SET pin. If the SET pin is set to high, the node module will keeps CAD wireless monitor to detect if there is any wireless signal coming at the interval of the breath period. If the SET pin is set to logic low, the node module will keep in receive mode so the central module will not need to send long preamble. That's why the logic level of SET for central module must be the same as the node module.

In the configuration tool, there is an option for Node ID which is used to set the ID of node module. If the ID of the node modules are 0, the node module will not make address detection. In other words all of the nodes will receive the data including address from central module. The data package of the first two bytes should be the node ID.

E.g. The central module sends data '0x00 0x01 0x22 0x33 0x44 0x55', all of the node modules with ID 0x00 0x00 will receive the data '0x00 0x01 0x22 0x33 0x44 0x55'.

If the ID of node module is larger than 0x00 0x00, the node module with ID the same as the one in the first two bytes of data package can receive the real data.

E.g. The Central module sends data '0x00 0x01 0x22 0x33 0x44 0x55', the module with ID 0x00 0x01 can get the data '0x22 0x33 0x44 0x55' and the first two –byte ID will be filtered.

In order to guarantee the reliability of communication, the length of data package should not exceed 64 bytes.

3. **CONFIGURATION**

In some situations the default parameters are not optimized for some applications so users might need to change the parameters. There are two ways to adjust them: by MCU or by PC. In configuration mode, the EN pin must be connected to GND and then the configuration tool or commands can work effectively.

By PC: DORJI offers PC based configuration tool which can be used to change the parameters through graphic interface. Users can insert DRF1276DM module into UART-to-USB converter board DAC02 and connect them to computer and run the configuration tool.
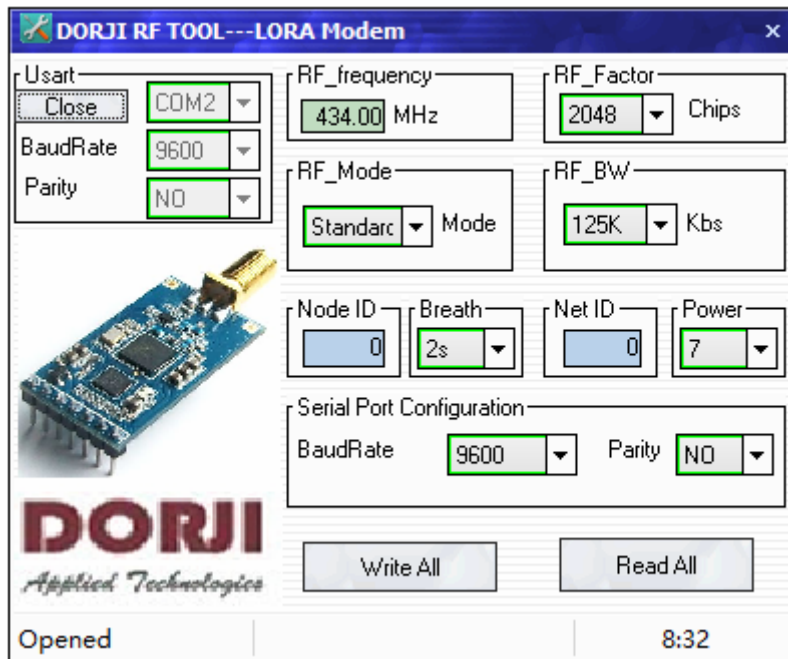
Figure 2: Configuration Tool Interface

Parameter	Description
UART area	The values are fixed at 9.6k bps & no parity check.
RF frequency	It indicates the center frequency of RF carrier
RF mode	Standard mode, central mode and node mode
RF_Factor	Lora spreading factor. Larger value means higher sensitivity but longer air transmission time
RF_BW	Lora bandwidth. Larger value means lower sensitivity. Recommended value: 125K.
Node ID	It is only used for node modules: 0~65535
Breath	The wake-up period for node module.
Net ID	Only the modules with the same network ID (0~255) can communicate with each other. It can avoid interferences from irrelative modules
Power	It is used to set the output power of DRF1276DM. There are 7 power levels. The 7 means the max. output power---20dBm and 0 means the lowest output power.
Serial baudrate	It defines the data rate between DRF1276DM and the host
Serial parity	It defines the parity check between DRF1276DM and the host

Table 4: DRF1276DM Parameter Table

Please note that the preconditions for two or more modules to communicate are that the frequency, RF factor, RF_BW and Net ID must be the same.

Name (Address)	Bits	Variable Name	Mode	Reset	LoRa™ Description
RegModemConfig 2 (0x1E)	7-4	SpreadingFactor	rw	0x07	SF rate (expressed as a base-2 logarithm) 6 → 64 chips / symbol 7 → 128 chips / symbol 8 → 256 chips / symbol 9 → 512 chips / symbol 10 → 1024 chips / symbol 11 → 2048 chips / symbol 12 → 4096 chips / symbol other values reserved.
	3	TxContinuousMode	rw	0	0 → normal mode, a single packet is sent 1 → continuous mode, send multiple packets across the FIFO (used for spectral analysis)
	2	RxPayloadCrcOn	rw	0x00	CRC Information extracted from the received packet header 0 → Header indicates CRC off 1 → Header indicates CRC on
	1-0	SymbTimeout(9:8)	rw	0x00	RX Time-Out MSB

Figure 3: RF_Factor vs: SpreadingFactor

On Page 111 of SX1276/77/88 datasheet, the register RegModemConfig 2 gives the information about the relationship between RF_Factor in configuration tool and SpreadingFactor of LoRa™ modem. The SpreadinFactor 6 is not supported by DRF1276DM module because it uses normal crystal.

SF	BW/kHz	equivalent BR /kbps	Sensitivity
7	500	21.88	-117
8	500	12.5	-120
9	500	7.032	-123
10	500	3.908	-126
11	500	2.148	-129
12	500	1.172	-132

SF	BW/kHz	equivalent BR /kbps	Sensitivity
7	250	10.94	-120
8	250	6.25	-123
9	250	3.516	-126
10	250	1.954	-129
11	250	1.074	-132
12	250	0.586	-135

SF	BW/kHz	equivalent BR /kbps	Sensitivity
7	125	5.47	-123
8	125	3.125	-126
9	125	1.758	-129
10	125	0.977	-132
11	125	0.537	-135
12	125	0.293	-138

Figure 4: Sensitivity: RF_Factor & BW

By MCU: Users also can use microcontroller to change the default parameters. The work mechanism is the same as in PC.

Sync word		ID code		Header	Command		Length	Data	CRC	End code	
0xAF	0xAF	0x00	0x00	0XAF	XX	YY	LEN	XXXX	CS	0X0D	0X0A

Table 5: DRF1276DM Command Structure

Notes: 1. The ID code is 0x00 0x00 in command.

2. In command code, XX in sending command is 0x80 and in response command is 0x00. YY is the command type.

YY	TYPE	YY	TYPE	YY	TYPE	YY	TYPE	YY	TYPE

0x01	write	0x02	read	0x03	standard	0x04	Central	0x05	Node

Table 6: Command Type and Value

3. Length refers to the data bytes between Length byte and CRC byte which the two bytes are not calculated in the length.

4. Data refers to the detailed parameters which need to be changed.

Baudrate	Parity	Frequency	RF_Factor	Mode	RF_BW	ID	NetID	Power	Breath

Table 7: Parameter Sequence in Data Section

Parameters	Length	Values
Baudrate	1 byte	1=1200, 2=2400, 3=4800, 4=9600, 5=19200,6=38400, 7=57600
Parity	1 byte	0=no parity check, 1=odd parity, 2=even parity
Frequency	3 bytes	The value=Frequency/61.035. E.g. For 433MHz, the value= 433000000/61.035
RF_Factor	1 byte	7=128, 8=256, 9=512, 10=1024, 11=2048, 12=4096
Mode	1 byte	0=standard, 1=central, 2=node
RF_BW	1 byte	6=62.5k, 7=125k, 8=256k, 9=500k
ID	2 bytes	0x0000 ~ 0xFFFF, high byte first
NetID	1 byte	0x00~0xFF
RF_Power	1 byte	1=4dBm, 2=7dBm, 3=10dBm, 4=13dBm, 5=14dBm, 6=17dBm, 7=20dBm
Breath	1 byte	0=2s, 1=4s, 2=6s, 3=8s, 4=10s

Table 8: Parameter Length & Value Range

5. CS refers to CRC code which is the remainder of the sum (of the bytes before CS) divided by 256.

6. If the carrier frequency of module is the times of 32MHz, the sensitivity will go down sharply so it will be better to avoid using the times of 32MHz as the carrier frequency.

7. The breath parameter is introduced in the firmware 2.0 or later. In earlier firmware version the breath parameter is fixed at 2s and can not be changed so the data length for old firmware is 12 bytes. For firmware 2.0 or above, the data length is 13 bytes.

In order to understand the commands, the section will demonstrate the use of commands by some examples.

Write Command Code: 0x01

Command: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x80, 0x01, 0x0D, ... CS, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x01, 0x0D, ... CS, 0x0D, 0x0A

Read Command Code: 0x02

For firmware <2.0

Command: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x80, 0x02, 0x0C,0x00,0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,0x9B, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x02, 0x0C ......, 0x0D, 0x0A

For firmware >=2.0

Command: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x80, 0x02, 0x0D,0x00,0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x9C, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x02, 0x0D ......, 0x0D, 0x0A

Standard Mode Command Code: 0x03

Command: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x80, 0x03, 0x02, 0x00, 0x00, 0x92, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x03, 0x02, 0x00, 0x00, 0x12, 0x0D, 0x0A

Central Mode Command Code: 0x04

Command: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x80, 0x04, 0x02, 0x00, 0x00, 0x93, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x04, 0x02, 0x00, 0x00, 0x13, 0x0D, 0x0A

Node Mode Command Code: 0x05

Command: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x80, 0x05, 0x02, 0x00, 0x00, 0x94, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x05, 0x02, 0x00, 0x00, 0x14, 0x0D, 0x0A

Please note that the working modes changed by the 0x03, 0x04 and 0x05 commands will not be written into nonvolatile memory so the working mode will be restored to the former mode before change after power-off. If needing to keep the changed mode after next power-on, users should use the write command instead to change the parameters.

The data below is the response of Read command from the module with firmware < 2.0 so the length byte is 0x0C---12bytes without breath period parameter.

0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x02, 0x0C, 0x04, 0x00, 0x6C, 0x80, 0x12, 0x0B, 0x00, 0x07, 0x00, 0x00, 0x00, 0x07, 0x36, 0x0D, 0x0A
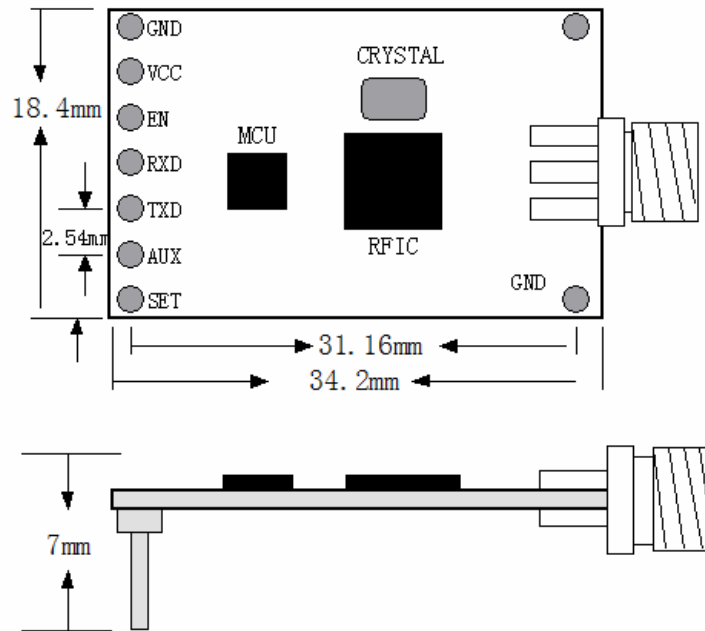
Sync word		ID code		Header	Command		Length	Data	CRC	End code	
0xAF	0xAF	0x00	0x00	0XAF	0x00	0x02	0x0c	XXXX	0x36	0X0D	0X0A

Table 9: Response of Read Command

Baudrate	Parity	Frequency	RF_Factor	Mode	RF_BW	ID	NetID	Power
0x04	0x00	0x6c,0x80,0x12	0x0B	0x00	0x07	0x00,0x00	0x00	0x07
9.6k bps	No	434MHz	2048	Standard	125k	0	0	29dBm

Table 10: The Data Section in Response of Read Command

MECHANICAL DATA

Figure 5: DIP Package Dimension

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