DRF1278DL
LoRa RS232/RS485 Interface Data Radio Modem V1.10

Features

- LoRa™ Frequency Spectrum
- 433Mhz ISM frequency band
- -139dBm receive sensitivity
- 20dBm Max. output power
- Serial port wake-up
- Wireless wake-up
- RS232/RS485 interface
- 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

DRF1278DL is a type of long range low data rate data radio modem based on SX1278 from Semtech. It 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 DRF1278DL modules easy to realize the robust and reliable wireless link.

DRF1278DL is a transparent data radio modem which means the module transfers or receives data from the host with preset data format without encoding/decoding needed so the communication between them is transparent. DRF1278DL offers two types of interfaces for selection which one board only contains one interface. Users can choose RS232 interface DRF1278DL1 or DRF1278DL2 according to the application. Comparing to DRF1278DM module, DRF1278DL doesn't have star networking function. Users can set both DRF1278DM and DRF1278DL module to standard mode to make them compatible.

PIN FUNCTIONS

PIN	L1	L2	Function	Description
1	VCC	VCC	Power	Power supply
2	GND	GND	Ground	Ground (0V)
3	TXD	A	Output	RS485+ or RS232 TX
4	RXD	B	Input	RS485- or RS232 RX
5	AUX	AUX	Output	Data indication pin for waking up module

Table 1: DRF1278DL Pin functions

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	420		450	MHz
Mod	Modulation type		FS		
I_R	Receive current in standard mode Transmit mode @ 20dBm Sleep mode		15.2 75 3.9		mA mA uA
Pout	Maximum output power			20	dBm
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: DRF1278DL Electrical Specifications

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 (RS232 or RS485) at preset data format and users don't need to care about the process of data inside the module. The AUX pin of DRF1278DL will give indication about the data IN/OUT of serial port 2ms in advance in order to wake up the host.

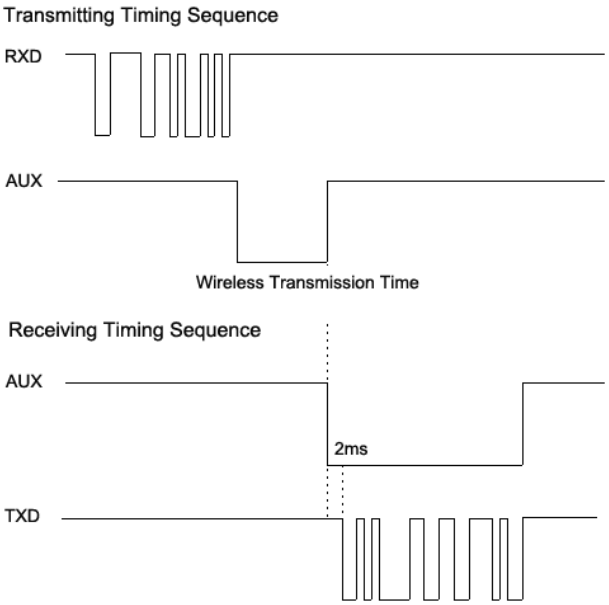

Figure 1: Timing Sequence in Standard Mode

2. LOW POWER MODE

In this mode DRF1278DL enables serial port and CAD monitor which means the module monitors the wireless link periodically. When it detects the wireless signal in the wake-up period, it will open the receive circuit, pick out the effective data and transfer it to the host through the serial port. The AUX pin will produce a low level signal 2ms in advance to inform the host that the data comes.

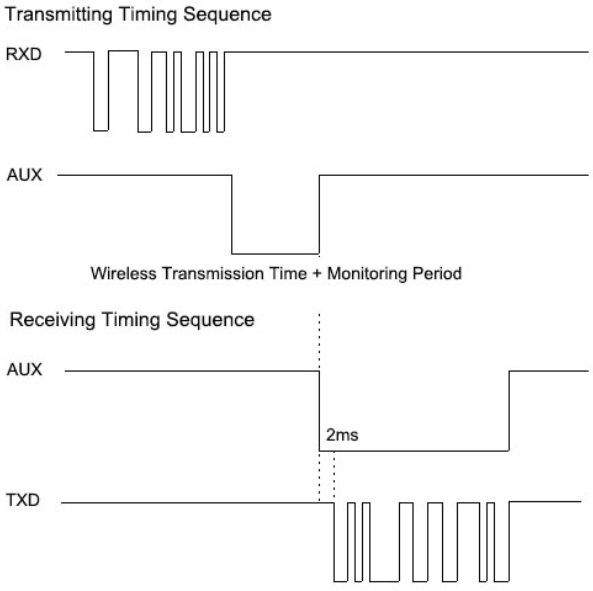

Figure 2: Timing Sequence in Low Power Mode

3. SLEEP MODE

In this mode most functions of the modules are disabled so if two modules are set to the Sleep Mode, they can not communicate with each other so one module must be in Low Power Mode. Comparing to Low Power Mode, the modules in SLEEP MODE will not enable serial port and only keeps CAD monitor. When it detects effective wireless signal, it will then enable the serial port. If there is no data In/Out in 1 second, it will close the serial port and continue the CAD monitor

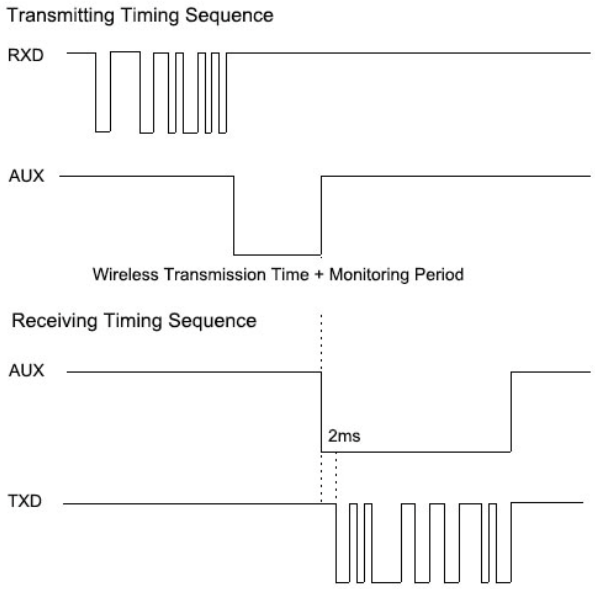

Figure 3: Timing Sequence in Sleep Mode

Please note that the module in Low Power Mode can communicate with Sleep Mode but the modules in any of the two modes can not communicate with the module in Standard Mode.

4. CONFIGURATION MODE

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.

By PC: DORJI offers PC based configuration tool which can be used to change the parameters through graphic interface. Users can insert DRF1278DL module into USB -to-RS232/RS485 converter board and connect them to computer and run the configuration tool.

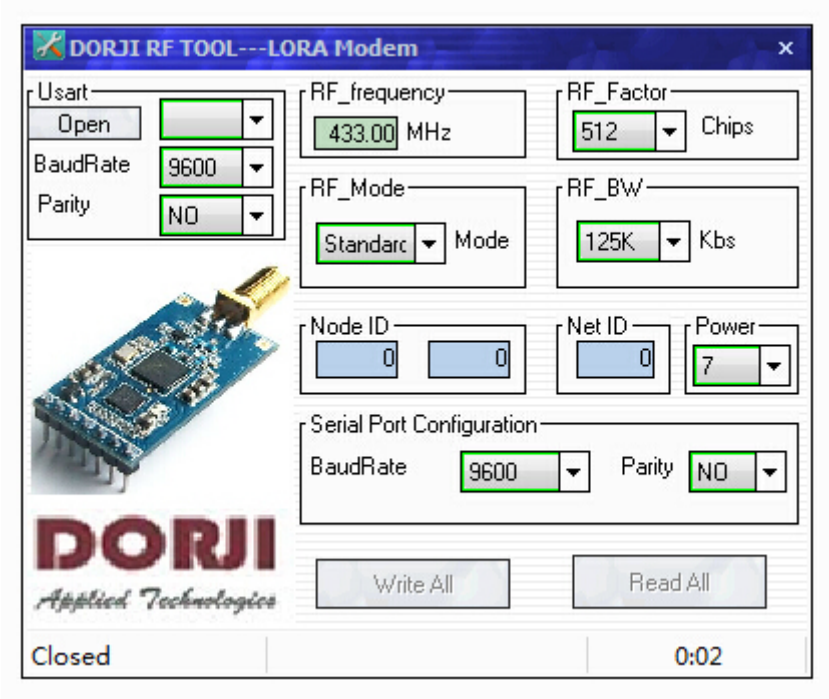

Figure 4: Configuration Tool Interface

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	Reserved
Net ID	Only the modules with the same network ID can communicate with each other. It can avoid interferences from irrelative modules
Power	It is used to set the output power of DRF1278D. 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 DRF1278D and the host
Serial parity	It defines the parity check between DRF1278D and the host

Table 3: DRF1278DL Parameter Table

Please note that the preconditions for two or 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

Table 4: 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 SpreadingFactor 6 is not supported by DRF1278DL 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

Table 5: 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 6: DRF1278DL 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	low power	0x05	sleep

Table 7: 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

Table 8: 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, 1=2048, 12=4096
Mode	1 byte	0=standard, 1=low power, 2=sleep
RF_BW	1 byte	6=62.5k, 7=125k, 8=256k, 9=512k
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

Table 9: Parameter Length & Value Range

5. CS refers to CRC code which is the remainder of the sum (of all 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.

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, 0x0C, ... CS, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x01, 0x0C, ... CS, 0x0D, 0x0A

Read Command Code: 0x02

Command: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x80, 0x02, 0x0C,0x00,0x00, 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

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

Low Power 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

Sleep 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. Users can use the WRITE command to change the working mode of module to standard mode or low power mode but the sleep mode will be restored to standard mode after next power-on even if the WRITE command is used.

MECHANICAL DATA

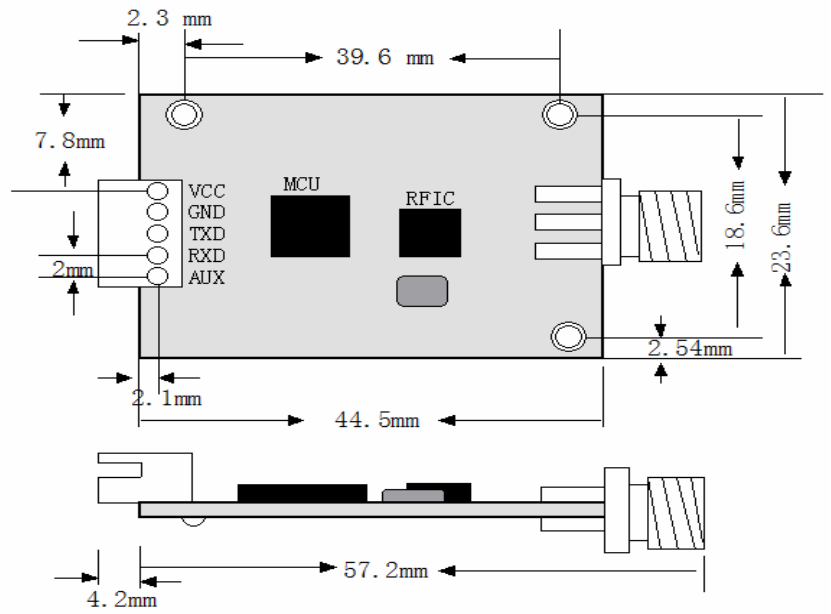

Figure 5: DRF1278DL Dimensions

ORDERING INFORMATION

Part Name	Description
DRF1278DL1	433MHz RS232 interface data radio modem
DRF1278DL2	433MHz RS485 interface data radio modem

Table 10: Ordering Information

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