DRF1278DX1/2/3

500mW Long Range Lora Data Radio Modem V1.00

Features

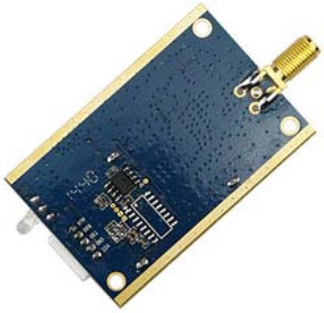
- LoRa™ Frequency Spectrum
- 433Mhz ISM frequency band
- -139dBm receive sensitivity
- 27dBm Max. output power
- TTL/RS232/RS485 interface
- Serial port wake-up
- Wireless wake-up
- Supply voltage: 5~12V

Application

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

TTL Interface DRF1278DX1

RS232 Interface DRF1278DX2



RS485 Interface DRF1278DX3

DESCRIPTION

DRF1278DX is a type of 500mW 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 DRF1278DX modules easy to realize the robust and reliable wireless link.

The DRF1278DX module is similar to DRF1278DL module in function and also have three working modes: Standard Mode, Low Power Mode and Sleep Mode. Comparing to DRF1278DM, it doesn't contain star networking mode and only acts as transparent data radio modem. According to the interface, it can be divided into DRF1278DX1 (TTL interface), DRF1278DX2 (RS232 interface) and DRF1278DX3 (RS485 interface). In order to guarantee the reliable communication, the size of data package should not exceed 60 bytes.

PIN FUNCTIONS

PIN	X1	X2	X3	Function	Description
1	VCC	VCC	VCC	Power	Power supply 5~12V
2	GND	GND	GND	Ground	Ground (0V)
3	TXD	TX	A	Output	Uart TX, RS232 TX or RS485+
4	RXD	RX	B	Input	Uart RX, RS232 RX or RS485-
5	AUX	AUX	AUX	Output	Data indication pin for waking up module

Table 1: DRF1278DX Pin functions

ELECTRICAL SPECIFICATIONS

Symbol	Parameter (condition)	Min.	Typ.	Max.	Units
VCC	Supply Voltage	5		12	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		25		mA
	Transmit mode @ 27dBm		500		mA
	Sleep mode		250		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: DRF1278DX 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 (UART TTL, 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 DRF1278DX will give indication about the data IN/OUT of serial port 2ms in advance in order to wake up the host.

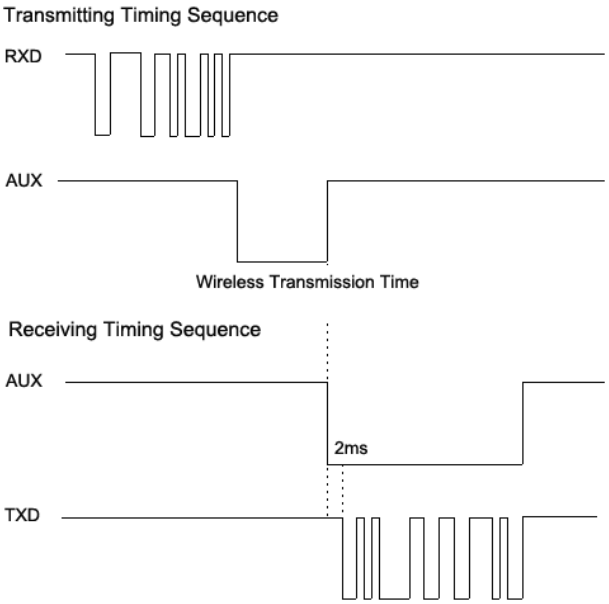


Figure 1: DRF1278DX Timing Sequence

2. LOW POWER MODE

In this mode DRF1278DX 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.

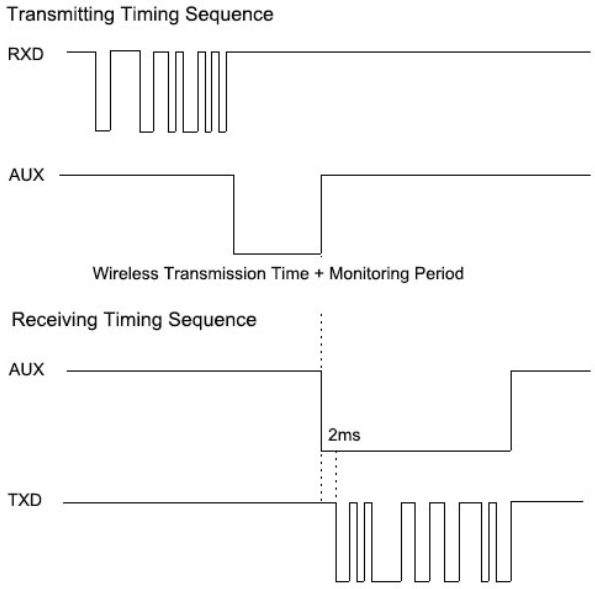


Figure 2: Timing Sequence in Low Power Mode

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

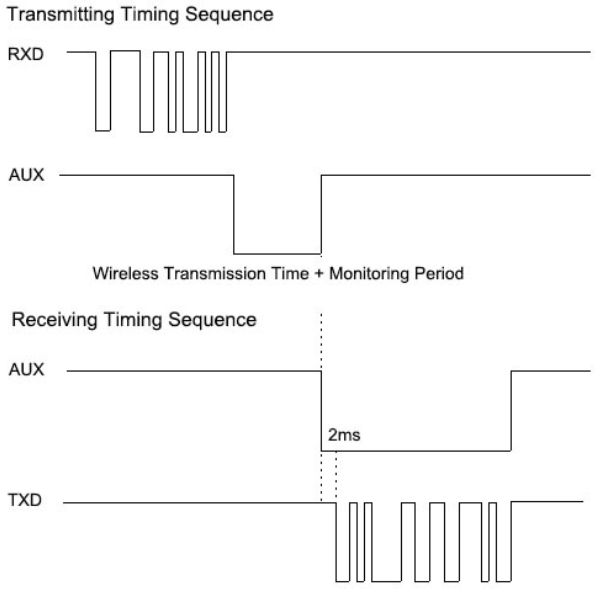


Figure 3: Timing Sequence in Sleep Mode

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

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 DRF1278DX module into UART/RS232/RS485-to-USB converter board and connect them to computer and run the configuration tool.

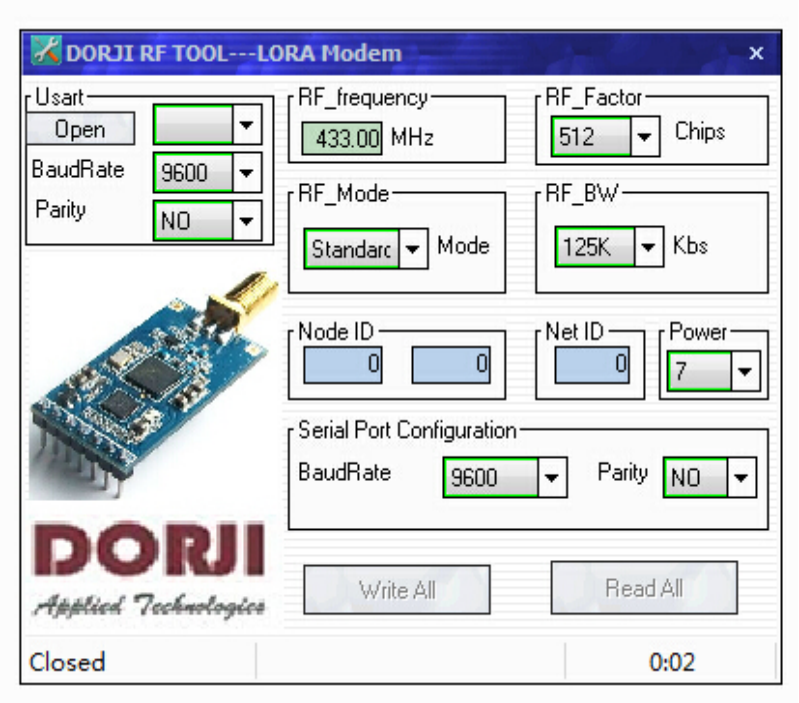


Figure 4: Configuration Tool Interface

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: DRF1278DX 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 SpreadinFactor 6 is not supported by DRF1278DX 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: DRF1278DX 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 number of 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 mode
RF_BW	1 byte	6=62.5k, 7=125k, 8=250k, 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

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, 0x02,0x00,0x00,0x91, 0x0D, 0x0A

Response.: 0xAF, 0xAF, 0x00, 0x00, 0xAF, 0x00, 0x02, 0x02,0x00,0x00,0x91, 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. If needing to keep the changed mode after next power-on, users need to use the write command instead to change the parameters.

MECHANICAL DATA

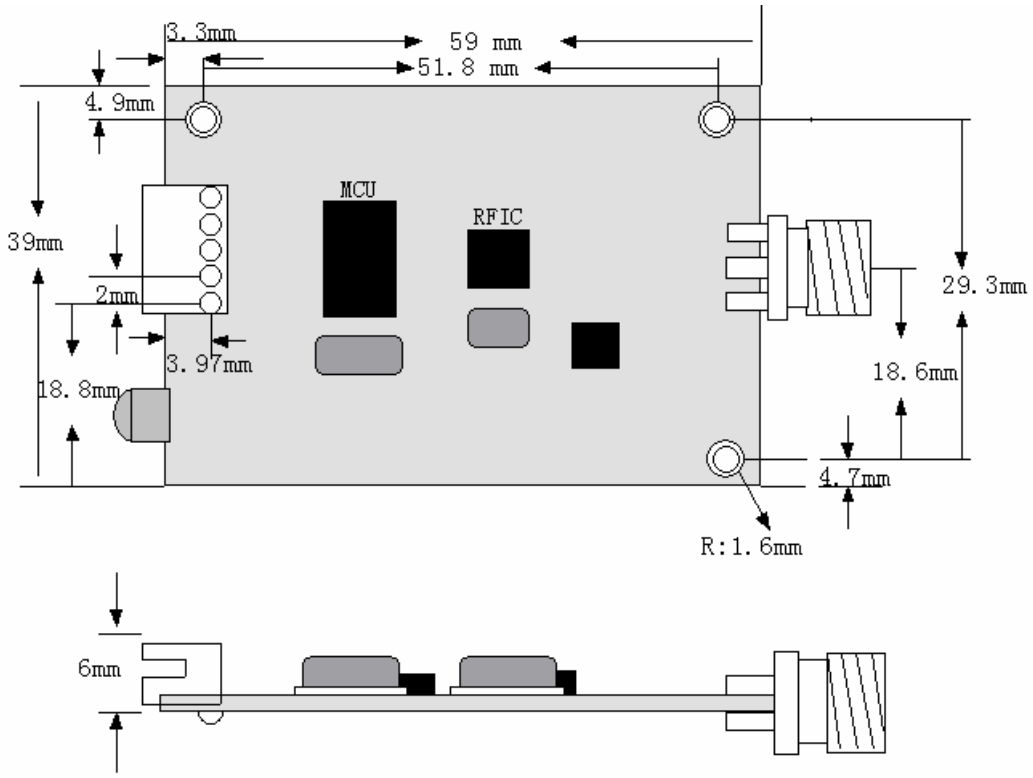


Figure 5: DRF1278DX Dimension

ORDERING INFORMATION

Part Name	Description
DRF1278DX1	433MHz 500mW TTL interface data radio modem
DRF1278DX2	433MHz 500mW RS232 interface data radio modem
DRF1278DX3	433MHz 500mW RS485 interface data radio modem

Table 10: Ordering Information

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