# Application Document for DRF1262DS/DRF1268DS

This document introduces the basic functions and configuration method of DRF1262DS/DRF1268DS modules. Both of the two modules are UART interface with the same function except they have different working frequencies. Users can use a USB-to-TTL converter board (DAC02) to connect the module to computer and run the configuration tool to change the default parameters in order to get the best performance for different applications.

USB Board DAC02	DRF126xDS	Pin Description
GND	GND	Ground
VDD	VDD	2.8V~6V
	EN	Ground or 3.3V
TX	RX	3.3V TTL
RX	TX	3.3V TTL
	AU	Auxiliary pin, can be floating
	MO	Ground or 3.3V

Table 1: Connection between DRF126xDS and USB Board

The EN pin and MO pin are used to choose the power mode of the modules but the parameters of the modules only can be changed in power mode 0 or mode 1. The two pins must be connected to a fixed level (0V or 3.3V) in case the external interference make the module misjudge the level on the two pins. If VDD>3.5V, the TTL logic high level can be 3.3V. If VDD<3.5V, the TTL logic high level can not exceed VDD.

Mode	EN	MO	Description
0	0	0	Short preamble
1	0	1	Long preamble
2	1	0	Half sleep
3	1	1	Full sleep

Table 2: EN/MO Pin Level vs Power Mode

Users can solder wires on the module to connect the USB converter board DAC02 or solder the module on the testing board **DAC07** directly and insert it into the USB board. When the module with USB board is connected to the computer, users can run the configuration tool, choose the right COM port and click the OPEN button on the right-top corner of the tool to activate the tool. The default UART data format is: 9600 bps, 1 stop bit, 8 data bits and no parity check.

COM	COM18 🔻	Baud Rate	9600	•	Stop Bit	1	•	Data Bit 8 🔻	Parity Bit	None	•	Operate 🛛	OPEN	
					Fig	ure	1: <b>Г</b>	Default UART Data	Format					

The configuration tool has four function block: Config, Update, Cmd and Tools. Users can click related button on the left side to activate corresponding interface.

## **FUNCTION BLOCKS**

#### 1. Config

It's the main interface of the configuration tool, which can be used to read or change the parameters of the DRF1262DS/DRF1268DS modules.

Config	CMD Button				
	Start	Read	Save	Default	Reset

Figure 2: Configuration Button



After clicking Start button, the other four buttons will also be activated and the module will enter into configuration mode. The display area on the top-right side will give response (ff ff 02 1c 1e) for this operation.

COM22	▼ Baud Rat	e 9600 🔻	Stop Bit	t 1 🔻	Data Bit 8 🔻	Pari	ity Bit None 🔻	Operate CLOSE
onfig	CMD Button						CC CC 00 1 1	
	Finish	Read	S	ave Defa	ult Rese	t	ff ff 23 02 00 ff 01 03 19 de 50 80 19 de 50 80 11 01 00 01 00 ff 01 ee	00 00 00 0b 02 01 16 01 00 00 00 00 00 00 00
	Baud Rate	9600	•	TX Frequency	434.00			
odate	Parity Bit	None	•	RX Frequency	434.00			
	Stop Bit	1	•	Bandwidth	125kHz 🔻			
	LBT Enable	NO	•	Spread Factor	11 🔻			
	ID Enable	YES	-	TX Power	22 🖨 d	lBm		
Cmd	RSSI Enable	NO	•	Work Mode	STANDARD 🔻			
	RX Gain	NO	•	Star Mode	NORMAL -			
	Sleep Time	1	SEC	Time Slot	1 🗘 S	EC	S:0 R:43	Clear RX 🗹 HEX
-	Device ID	255	<b>*</b>	Start ID	1			
0012	Net ID	1	•	End ID	255			
	Pre-wakeup	0	SEC	Sensor Type	Type 1 🔻			
	CAD Peak	17	<b>•</b>	Code Rate	4/5 💌		Send LF Send	Clear TX 🗌 HEX

Figure 3: Configuration Mode

Pressing Read button, the tool will show the parameters in the module. Users can change the default parameters and click Save button to save the new parameters. A dialog box will pop up to show the successful saving operation.

8	Tip	×
	Save	e OK

Figure 4: Successful Saving Operation

Clicking the Default button will show the factory parameters inside the module and users need to click the Reset button to save the factory settings.

The meanings of the parameters in the interface of function block Config are explained in the datasheet of DRF1262DS/DRF1268DS module. In this document these parameters will be discussed in more details according to different applications.

1.1 Frequency: there are two frequencies: Transmit frequency and Receive frequency. The two parameters can be set to the same or not same. If they are different, the TX frequency of transmitting module must be the same as the RX frequency of receiving module or vice versa. This function is useful for the low power consumption applications.



For example, there are five modules among which one is used as the central module (C1) and the other four as node modules (N1, N2, N3, N4). In order to reduce power consumption, the node modules are set in mode 2 (half sleep mode) which means the node module will wake up periodically to check if there is any data from the C1 (central module).

Assuming C1 module.: TX frequency=434MHz RX frequency=435MHz N1/N2/N3/N4 module: TX frequency=435MHz RX frequency=434MHz.

When C1 transmits data at 434MHz, the node modules will receive the data at 434MHz. If the N1 wants to send data to C1 at 435MHz (needing to switch it to mode 0 or 1), other node modules will not be woken up since the RX frequency of them is 434MHz. In short the node module in transmitting will not interfere other node modules in mode 2.

1.2 Communication: if two or more modules want to communicate, some of the parameters must be configured to the same. Different work modes have different requirements on the parameters (seeing table 3). For other parameters, they can be different or same except Device ID.

Parameter	Standard data transmission	Normal mode in star	Passive mode in star
Bandwidth	same	same	same
Spread Factor	same	same	same
Code Rate	same	same	same
Work Mode	Standard	Node or Central	Node or Central
Sleep time	same	same	same
Net ID	same	same	same
Star Mode		Normal	Passive
Start ID			same
End ID			same
Time slot			same

 Table 3: Parameters for the Same in different Work Mode

1.3 The Spread Factor and Bandwidth determines the RF data rate and sensitivity when the Code Rate is fixed. The table below gives the reference values in different combinations. Narrower bandwidth and larger Spread Factor means higher sensitivity and longer distance but longer air transmission time. Please note that the sensitivity in power mode 2 is lower than in power mode 0/1 so the values in blue color are not recommended for modules power mode 2.

Bandwidth	Spread Factor	RF rate	Sens.	Bandwidth	Spread Factor	RF rate	Sens.
500kHz	12	1.172kbps	-131dBm	250kHz	12	0.586kbps	-134dBm
500kHz	11	2.148kbps	-128.5dBm	250kHz	11	1.074kbps	-131.5dBm
500kHz	10	3.906kbps	-126dBm	250kHz	10	1.953kbps	-129dBm
500kHz	9	7.031kbps	-123dBm	250kHz	9	3.516kbps	-126dBm
500kHz	8	12.5kbps	-120dBm	250kHz	8	6.25kbps	-123dBm
500kHz	7	21.875kbps	-117dBm	250kHz	7	10.938kbps	-120dBm
500kHz	6	37.5kbps	-112dBm	250kHz	6	18.75kbps	-115dBm
500kHz	5	62.5kbps	-111dBm	250kHz	5	31.25kbps	-114dBm
125kHz	12	0.293kbps	-137dBm	62.5kHz	12	0.146kbps	-140dBm
125kHz	11	0.537kbps	-134.5dBm	62.5kHz	11	0.269kbps	-137.5dBm
125kHz	10	0.977kbps	-132dBm	62.5kHz	10	0.488kbps	-135dBm
125kHz	9	1.758kbps	-129dBm	62.5kHz	9	0.879kbps	-133dBm
125kHz	8	3.125kbps	-126dBm	62.5kHz	8	1.563kpbs	-129dBm
125kHz	7	5.469kbps	-123dBm	62.5kHz	7	2.734kbps	-126dBm
125kHz	6	9.375kbps	-118dBm	62.5kHz	6	4.688kbps	-121dBm
125kHz	5	15.625kbps	-116dBm	62.5kHz	5	7.813kbps	-121dBm
41.67kHz	12	0.098kbps	-141.8dBm	31.25kHz	12	0.073kbps	-143.1dBm
41.67kHz	11	0.179kbps	-139.3dBm	31.25kHz	11	0.134kbps	-140.6dBm
41.67kHz	10	0.326kbps	-137dBm	31.25kHz	10	0.244kbps	-138.4dBm
41.67kHz	9	0.586kbps	-134.1dBm	31.25kHz	9	0.439kbps	-135.6dBm



#### ADW1021

41.67kHz	8	1.042kbps	-131.2dBm	31.25kHz	8	0.781kbps	-132.8dBm
41.67kHz	7	1.823kbps	-127.8dBm	31.25kHz	7	1.367kbps	-129.2dBm
41.67kHz	6	3.125kbps	-123.6dBm	31.25kHz	6	2.344kbps	-125.4dBm
41.67kHz	5	5.209kbps	-122dBm	31.25kHz	5	3.906kbps	-123dBm

Table 4: Bandwidth/Spread Factor vs Sensitivity/RF Data Rate

1.4 Code Rate: To further improve the robustness of the link the LoRa® modem employs cyclic error coding to perform forward error detection and correction. A higher coding rate provides better noise immunity at the expense of longer transmission time. In normal conditions a factor of 4/5 provides the best trade-off; in the presence of strong interferers a higher coding rate may be used. Therefore the default value 4/5 is enough for normal operations.

1.5 Time slot: It refers to the data collection time in the passive mode of star network. Usually it is closely related to the RF data rate, size of data package from node module and the UART data rate. The configuration tool provides a calculator which can be used to estimate the time slot. This function will be introduced in the function block Tools.

#### 2. Update

This function is preserved in the preliminary version of the firmware so it might be canceled when the function of the firmware is fixed.

	10 III	12 18
	Open	Start
	Vpdate steps	
	1.SW pin should be connected to GND	) before module is powered
	on.	
lindata	2. Run configuration tool after the	module is connected to PC
opuare		
	through USB-IIL converter board. Se	et baud rate:57600, 1 stop
	bit, 8 data bits and no parity chec	k and then open the COM por
	3. Click OPEN button, find the bin f	file from the local computer
	and then click Start button. Reset	the module by RST pin and
1	then the firmware will be undeting	Disconnect the SW min when
Cmd	then the fillmware will be updating.	bisconnect the 5% pin when
	downloading is finished and then re	estart the module. Please
	don't power off the module or close	the configuration tool
	during updating!	
Tools		

# Figure 5: Function Block---Update

## 3. CMD

This function block shows the available command list. Each command can be selected through the drop-down menu and corresponding command format and response will be showed in the display area on the right. Some uncommon commands which are not listed in the datasheet also can be found in this block. For example, when users choose the command Get Version, the details of this command will be showed on the right side.

#### Command format: FF FF 02 29 2B

Description: Get the firmware version of the module, which which is a 4-byte string. The value in the response is 56 31 2e 31 as example.



Response: FF FF 06 2A 56 31 2e 31 16

The four bytes (56 31 2e 31) are ASCII in Hex format so the corresponding ASCII is V1.1 for firmware version.

	Command format: FF FF 02 29 2B
	Description: Get the firmware version of the module, which which is a 4-byte string. The value in the response is 56 31 2e 31 as example.
	Response: FF FF 06 2A 56 31 2e 31 16
Get Version 🔻	

Figure 6: Function Block--- CMD

## 4. Tools

This function block provides some auxiliary tool which can be used to calculate the values of some parameters as reference. It includes three parts: Settings, Reference Values and Time Reference.

Settings area --- users need to make selection of the parameters in the area before the calculation starts. No matter what the present values of these parameters are showed, users need to **make selection for the Spread Factor** (no matter change it or not) to activate the tool. The Spread Factor and Bandwidth determines the air transmission rate (RF rate) and then the payload (effective data) will determine how much time will be used to transmit the data at this air transmission rate. Please note that the calculation is made when the code rate is set to 4/5. If the code rate is different, the air time will be longer than the calculated values.

Spread Factor	11	•	CAD Symbols	2 🔻
Bandwidth	125KHz	•	Payload Size	50 🜲

Figure 7: Settings in Function Block---Tools

Reference Values --- this area shows the calculated results when the parameters in the Settings are selected. These values are only used for reference so users need to leave the margin when using the products in real-time applications.



lues				
16.38	MS	CAD Time	32. 77	MS
1233.00	MS	Air Rate	0.537	Kbps
	1ues 16. 38 1233. 00	14es 16.38 MS 1233.00 MS	14es 16.38 MS CAD Time 1233.00 MS Air Rate	14es 16.38 MS CAD Time 32.77 1233.00 MS Air Rate 0.537

Figure 8: Reference Values in Function Block---Tools

Time Reference --- It gives the reference value for time slot when the parameters in the Settings are selected. When the Spread Factor, Bandwidth and Payload Size are selected, the air time will be calculated, which determines the time slot for node modules in passive mode of Star network. When users change any of the three parameters, the value of Time Slot will be updated and the max. number of nodes in this period will be showed.

For example: if Spread Factor=11 (this parameter must be selected in order to activate the calculator) Bandwidth=125kHz and the payload=50 bytes. The estimated Air Time is about 1233ms and the recommended Time Slot=2 SEC. If the Sampling Period is set to 1 minute and the Star Mode is selected to Passive Mode (must be clicked in order to activate the calculation), the max. number of node is showed as 20.

Sampling Period	1	Min 🔻	Time Slot	2	SEC
Number of Node	20		Star Mode	Passive Mode 🔻	1

Figure 9: Time Reference in Function Block---Tools

As discussed in the datasheet, one round collection of data in passive mode concerns the interactions between the central module and its host, between the central module and node module, and between the node module and its host. The time slot assigned to the node module is counted as soon as the central sends the data collection command to it. It means the node module should fulfill the data transmission in 1 time slot which can be sliced as below:

- 1. The central module sends the data collection command to the node module.
- 2. The node module receives the command and then send the data to the central module.
- 3. The central module receives the data.

If the central module receives the data in the time shorter than 1 time slot, it will finish the counting and start to send the data collection cmd to the next node and restart the counting for 1 time slot. If it doesn't receive the full data in 1 time slot, it will give up the data collection for present node and send the data collection cmd to the next node directly. The calculated Time Slot in the tool is a reference value. If users choose the extra low RF data rate or large payload, the value can be increased manually in order to avoid data loss or dumping.



# **COMMUNICATIONS:**

#### 1. Standard Data Transmission:

If the parameters of the modules in table 3 are the same and the TX/RX frequencies are the same (or crossed), the modules can connect to any UART host with the same data format (Baud rate, parity check, data bit, stop bit, etc). In order to demonstrate the function of DRF126xDS easily, the modules are soldered on the testing kit DAC07 and are connected to the PC through USB-to-TTL converter board DAC02. Users can check the datasheet of DAC07 for more details about the power mode setting.



Figure 10: DRF126xDS module on DAC07 Board

In order to facilitate the testing, the module is set to power mode 0 (EN pin=0V, MO pin=0V) through the jumpers on the DAC07 board. After inserting the two kits into USB-to-TTL converter board DAC02 and connecting them to the computer, users can run the configuration tool by clicking the OPEN button to activate the tool, click Start to enter into the configuration mode and can click Read to read out the default parameters of the two modules. If the new values of the parameters are set, users need to click **Finish** to quit the configuration mode.

The tool can test the simple communication among modules. There are two areas on the right side of the tool. In configuration mode, the display area (called as RX area hereafter) at the top shows the response of the modules to the commands. In the normal communication mode, this area shows the data which the module receives. Users can send data or command in the textbox at the bottom area (called as TX area hereafter). The checkbox HEX can be used to receive or display the data in Hex format or not. For command input or communication in star network, the checkbox should be checked in order to interrupt the command or recognize the ID information correctly.



COM26	▼ Baud Rat	e 9600 💌	Stop Bit	1 💌	Data Bit	8 <b>•</b> Pa	arity Bit	None		•	Oper	ate	CLOSE
onfig	CMD Button Finish	Read	Se	we Defa	ult	Reset	ff f ff f	E 02 1 ( E 23 02	2 1e 2 00 0	1 01 03	3 00 00	00 01	5 02 01 10
	Baud Rate	9600	•	TX Frequency	434.00	<b>•</b>	11 0:	00 01	00 f	£ 01 £	כ		
date	Parity Bit	None	•	RX Frequency	434.00	<b>÷</b>							
	Stop Bit	1	•	Bandwi dth	125kHz	•							
	LBT Enable	NO	*	Spread Factor	11	•							
	ID Enable	YES	•	TX Power	22	🔹 dBm							
Cmd	RSSI Enable	NO	•	Work Mode	STANDARD	•							
	RX Gain	NO	•	Star Mode	NORMAL	•		×2	120				1
	Sleep Time	1	\$ SEC	Time Slot	1	SEC	S:U	К	:43	5	Llear	KX	E HEX
	Device ID	1	÷	Start ID	1	÷							
0015	Net ID	1	Ť	End ID	255	÷							
	Pre-wakeup	0	SEC	Sensor Type	Type 1	-							
	CAD Peak	17	•	Code Rate	4/5	•	Set	nd LF	S	end	Cle	ar TX	HEX

Figure 11: Module 1 Occupying COM 26 in Configuration Mode

COM27	▼ Baud R	ate 9600 ▼ S	top Bit	± 1 ▼	Data Bit 8 🔻	Pari	ty Bit	None		•	Oper	ate [	CLOSE	!
nfig	CMD Button						ff ff	02 1a	1.0					
	Finish	Read	Sav	e Defa	ult Rese	t	ff ff 19 de	23 02 50 80	00 01 19 de	01 03 50 80	00 00 01 00	00 01	02 01	16 00
	Baud Rate	9600 🔻		TX Frequency	434.00		11 01	00 01	00 ff	01 £0				
data	Parity Bit	None 💌		RX Frequency	434.00									
	Stop Bit	1 •		Bandwi dth	125kHz 🔻									
	LBT Enable	NO 🔻		Spread Factor	11 🔻									
	ID Enable	YES 👻		TX Power	22 🗘	1Bm								
Cmd	RSSI Enable	NO 🔻		Work Mode	STANDARD -									
	RX Gain	NO 💌		Star Mode	NORMAL 💌				2	1			I	
	Sleep Time	1	SEC	Time Slot	1 🔹 5	SEC	S:0	R:4	13		Clear	RX	⊡ HEX	
	Device ID	1		Start ID	1									
2100	Net ID	1		End ID	255									
	Pre-wakeup	0	SEC	Sensor Type	Type 1 🔻									
	CAD Peak	17		Code Rate	4/5 💌		Sen.	l LF	Sei	nd	Cle	ar TX	п	EX

Figure 12: Module 2 Occupying COM 27 in Configuration Mode



If the default parameters don't need to be changed, users need to click the Finish button to quit the configuration mode. The response information in RX area can be cleared by clicking the Clear RX button before testing communication. Input data (Test the communication between module 1 and module 2) in the TX area in the module 1 and click Send, the module 2 will show this message in the RX area.

COM26	▼ Baud Rat	e 9600 🔻	Stop Bit	1 🔻	Data Bit 8 🔹	r Pau	rity Bit None 🔻 Operate C	LOSE
onfig	CMD Button							
	Start	Read	S	ave Defe	alt Re	set		
	Baud Rate	9600	•	TX Frequency	434.00	]		
pdate	Parity Bit	None	•	RX Frequency	434.00	]		
	Stop Bit	1	•	Bandwidth	125kHz 🔻	]		
	LBT Enable	NO	•	Spread Factor	11 👻	]		
	ID Enable	YES	•	TX Power	22 🗘	] dBm		
Cmd	RSSI Enable	NO	•	Work Mode	STANDARD -	]		
	RN Gain	NO	•	Star Mode	NORMAL 🔻	]		10216
	Sleep Time	1	SEC	Time Slot	1	SEC	Test the communication between module 1	and
Cools	Device ID	1	•	Start ID	1	]	module 2	IIId
	Net ID	1	•	End ID	255	]		
	Pre-wakeup	0	SEC	Sensor Type	Type 1 🔻			
	CAD Peak	17	÷	Code Rate	4/5 🔻	]	Send LF Send Clear TX	] HEX

Figure 13: Module 1 Sending Data to Module 2

COM27	▼ Baud F	Rate 9600 ▼	Stop B	it 1 🔻	Data Bit 8 💌 P	arity Bit None 💌	Operate CLOSE
onfig	CMD Button Start	Read	S	ave Defs	ult Reset	Test the communication module 2	on between module 1 and
	Baud Rate	9600	•	TX Frequency	434.00		
pdate	Parity Bit	None	•	RX Frequency	434.00		
	Stop Bit	1	•	Bandwidth	125kHz 🔻		
	LBT Enable	NO	·	Spread Factor	11 💌		
	ID Enable	YES	•	TX Power	22 🔹 dBm		
Cmd	RSSI Enable	NO 🗖	•]	Work Mode	STANDARD -		
	RX Gain	NO •	•	Star Mode	NORMAL -		
	Sleep Time	1	SEC	Time Slot	1 🗘 SEC	S:0 R:52	Clear RX HEX
	Device ID	1	8	Start ID	1		
ools	Net ID	1		End ID	255		
	Pre-wakeup	0	SEC	Sensor Type	Type 1 💌		
	CAD Peak	17		Code Rate	4/5 🔻	Send LF Send	Clear TX HEX

Figure 14: Module 2 Receiving Data from Module 1



Except configuration tool, users also can choose other serial port tool to test the communication as long as the UART data format are set to the same. Below is the testing with Advanced Serial Port Monitor.

Advanced Serial Port Monitor 3.7.1 build 1021		
File View Edit Options Data source Mode Plugins Help   COM port COM22   Baud rate 9600   Parity type None   Stop bits 1   Auto delay   500   Test the communication between module 1 and module 2   Send   Close   est the communication between module 1 and module 2   Write to file  Clear Clear Manual Source> String Keys sent:52 Advanced Serial Port Monitor 3.7.1 build 1021 File View Edit Options Data source Mode Plugins Help COM port COM23 Baud rate 9600 Data bits 8 Send Close Send Close Send Close Send Close Close Comparity type None Stop bits 1 Auto delay Source> Stop Close Send Close Comparity type None Stop bits 1 Auto delay Source> Stop Send Close Close Comparity type None Stop bits 1 Auto delay Source> Stop Send Close Comparity type None Stop bits 1 Auto delay Source> Stop Send Close Send Close Close Close Send Close Send Close	Advanced Serial Port Monitor 3.7.1 build 1021 -	X
COM port COM22 Baud rate 9600   Parity type None Stop bits 1   Auto delay 500   Test the communication between module 1 and module 2 Send © Close est the communication between module 1 and module 2 Write to file < Clear Clear Clear Mis opened Mode> Manual Source> String Send Source> String K< Bytes sent:52 Advanced Serial Port Monitor 3.7.1 build 1021 File View Edit Options Data source Mode Plugins Help COM port COM23 Baud rate 9600 Data bits 8 Send © Close	File View Edit Options Data source Mode Plugins Help	
Parity type None Stop bits 1 Auto delay 500 Send Close Test the communication between module 1 and module 2 Send Close est the communication between module 1 and module 2 Write to file Clear Cle	COM port COM22 🗸 Baud rate 9600 🗸 Data bits 8 🗸 🛤 📑 🥔 🛅	
Test the communication between module 1 and module 2       Send © Close         est the communication between module 1 and module 2         Write to file •       Clear         Image: String       Send © Close         DM is opened       Mode> Manual         Source> String       Sent:52         Image: String	Parity type None Stop bits 1 Auto delay 500	
Write to file  Clear Cle	Test the communication between module 1 and module 2	
Write to file  Clear Cle	Fest the communication between module 1 and module 2	
Write to file  Clear Cle		
Write to file  Clear Cle		
Write to file  Clear Cle		
Write to file  Clear Clear Clear Clear Clear Composed Mode> Manual Cource> String Composed Serial Port Monitor 3.7.1 build 1021 Composed Composed Close Close Composed Close Composed Close Composed Close Composed Close Composed Close Composed Close Close Composed Close Close Composed Close C		
Write to file  Clear Cle		
OM is opened       Mode> Manual       Source> String       << Bytes sent:52         Image: Advanced Serial Port Monitor 3.7.1 build 1021       —       —       —         File View Edit Options       Data source       Mode Plugins       Help         COM port COM23       Baud rate 9600       ✓       Data bits 8       ✓       Image: Stop bits 1       ✓         Parity type       None       ✓       Stop bits 1       ✓       Auto delay       500       Image: Stop bits 2	Write to file - Clear	
Advanced Serial Port Monitor 3.7.1 build 1021 - C File View Edit Options Data source Mode Plugins Help COM port COM23 Baud rate 9600 Data bits 8 E Parity type None Stop bits 1 Auto delay 500 Send OC Lose Send OC Lose	COM is opened Mode> Manual Source> String << Bytes sent:52	
Advanced Serial Port Monitor 3.7.1 build 1021 - File View Edit Options Data source Mode Plugins Help COM port COM23 Baud rate 9600 Data bits 8  Parity type None Stop bits 1 Auto delay 500  Send Science Stop Stop bits 1 Send Science Scie		
File View Edit Options Data source Mode Plugins Help COM port COM23  Baud rate 9600  Data bits 8  Baud rate 9600  Data bits 8  Baud rate 9600  Baud rate 9600  Data bits 8  Baud rate 9600  Data bits 8  Baud rate 9600  Data bits 8  Data bits 8  Baud rate 9600  Data bits 8  Baud rate 9600  Data bits 8  Baud rate 9600  Data bits 8  Data bits 8  Baud rate 9600  Data bits 8  Baud rate 9600  Data bits 8  Data bits 8  Baud rate 9600  Data bits 8  Baud rate 9600  Data bits 8	Advanced Serial Port Monitor 3.7.1 build 1021 —	×
COM port COM23 Send rate 9600 Data bits 8 E Baud rate 9600 Data bits 8 E Baud rate 9600 Stop bits 1 Auto delay 500 Send O Close	File View Edit Options Data source Mode Plugins Help	
Parity type None Stop bits 1 Auto delay 500 Send Sciose	COM port COM23 V Baud rate 9600 V Data bits 8 V 🛤 📑 🍻 🗎	
v Send ⊗ Close	Parity type None Stop bits 1 Stop delaw 500	
set the second set in between a data 1 and a data 2		
est the communication between module 1 and module 7	Fest the communication between module 1 and module 2	
	Write to file •   🥒 Clear 🛛 💻 💷 💷	
Write to file - Zlear	COM is opened Modes Manual Sources String >> Bytes received :1	

Figure 15: Testing with Advanced Serial Port Monitor

In summary if users don't need to change the default parameters, users only need to make the UART data format (serial port parameters) of the host the same as the data format of the modules. When the module receives the data from its host, it will transmit it automatically. If the module receives the wireless data from another module, it will transfer it to its host directly. If users want to use a different RF data rate (air transmission rate), the Spread Factor and Bandwidth can be changed.



#### 2. Normal Mode in Star Network

The work mechanism in this mode is nearly the same as in standard data transmission except that the ID verification function is added. The parameter ID Enable determines if the central module filters the first two bytes (Device ID of the node module) of the data package which it receives from the node modules or not. Therefore this parameter only affects the central module in star network mode. ID Enable is set to YES by default.

Users can let the modules enter into the configuration mode and change the work mode of module 1 (in COM26) to CENTRAL and module 2 (in COM27) to NODE. The Star Modes of the two modules are set to NORMAL. For central module, it needs to specify the device ID of the node module in the data package and the ID must be shown in HEX format in case the node module can not recognize it. When the node module sends data to the central module, it doesn't need to specify the device ID of the central module which will receive the data from the node modules with the same net ID automatically. Assuming the net ID of module 1 and module 2 are set to 1, the device ID of module 1(the central module)=1 and the device ID of module 2 (the node module)=2. The checkbox HEX must be selected.

The central module sends out three data packages(00 00 01 02 03 04 05), (00 01 02 03 04 05 06) and (00 02 03 04 05 06 07) one by one (totally 21 bytes). The ID=00 00 in the first data package means it's a broadcasting data so any node module can receive the data (01 02 03 04 05). The ID=00 01 in the second data means the data is for the node module with device ID=1 so it can not be received by the node module. The ID=00 02 in the last data package is for the node module with device ID=2 so it is well received. Therefore the node module receives the first one and the last one (totally 10 bytes).

COM26	▼ Baud R	ate 9600 🔻	Stop B	it 1 🔻	Data Bit	8 🔻	Parity	Bit None	•	Operate	CLOSE
nfig	CMD Button Start	Read	S	ave Defa	ult	Reset					
	Baud Rate	9600 👻	]	TX Frequency	434.00	¢					
date	Parity Bit	None 🔻		RX Frequency	434.00	÷					
	Stop Bit	1 -	]	Bandwidth	125kHz	•					
	LBT Enable	NO -	]	Spread Factor	11	•					
	ID Enable	YES -	]	TX Power	22	🔹 dBm					
Cmd	RSSI Enable	NO -	]	Work Mode	CENTRAL	•					
	RX Gain	NO -	]	Star Mode	NORMAL	•		21 R-	0	Clear BY	Г. нву
	Sleep Time	1	SEC	Time Slot	1	➡ SEC	0	0 02 03 04	05 06 07	CTERL IV	Van Van
ols	Device ID	1	]	Start ID	1	•					
	Net ID	1	3	End ID	255	•					
	Pre-wakeup	0	SEC	Sensor Type	Type 1	•					
	CAD Peak	19		Code Rate	4/5	•		Send LF	Send	Clear TX	⊡ HEX

Figure 16: Module 1(Central Module in COM26) Sends Data to Module 2



COM27	<ul> <li>Baud Rat</li> </ul>	e 9600 🔻	Stop Bit	1 -	Data Bit 8 🔻	Parity Bit None 🔻 Operate CLO	SE
nfig	CMD Button Start	Read	St	ave Defe	ault Reset	01 02 03 04 05 03 04 05 06 07	
	Baud Rate	9600	•	TX Frequency	434.00		
data	Parity Bit	None	•	RX Frequency	434.00		
dure	Stop Bit	1	•	Bandwidth	125kHz 🔻		
	LBT Enable	NO	•	Spread Factor	11 🔻		
	ID Enable	YES	•	TX Power	22 🗘 dBm		
Cmd	RSSI Enable	NO	•	Work Mode	NODE -		
	RX Gain	NO		Star Mode	NORMAL. 🔻		
	Sleep Time	1	➡ SEC	Time Slot	1 🗘 SEC	S:0 R:10 Clear RX M	ŝX
ools	Device ID	2	•	Start ID	1	r.	
	Net ID	1	-	End ID	255		
	Pre-wakeup	0	SEC	Sensor Type	Type 1 🔻		
	CAD Peak	19	•	Code Rate	4/5 💌	Send LF Send Clear TX 🗹	HEX

Figure 17: Module 2(Node Module in COM27) Receives Data from Module 1

COM27	▼ Baud Rat	te 9600 🔻	Stop Bit	1 -	Data Bit 8 🔻	Parity Bit None 🔻 Operate CLOS
nfig	CMD Button Start	Read	Si	ave Defs	ult Reset	01 02 03 04 05 03 04 05 06 07
	Baud Rate	9600	¥	TX Frequency	434.00	
date	Parity Bit	None	•	RX Frequency	434.00	
	Stop Bit	1	•	Bandwi dth	125kHz 🔻	
	LBT Enable	NO	-	Spread Factor	11 -	
	ID Enable	YES	•	TX Power	22 🗘 dBm	
md	RSSI Enable	NO	-	Work Mode	NODE -	
	RX Gain	NO	•	Star Mode	NORMAL -	
	Sleep Time	1	SEC \$	Time Slot	1 🖨 SEC	S:7 R:10 Clear RX ME
	Device ID	2	ŧ	Start ID	1	00 00 01 02 03 04 05
ols	Net ID	1	÷	End ID	255	
	Pre-wakeup	0	\$ SEC	Sensor Type	Type 1 🔻	
	CAD Peak	19	•	Code Rate	4/5 💌	Sand IF Sand Claus IF []

Figure 18: Module 2(Node Module) Sends Data to Module 1



COM26	▼ Baud R	ate 9600 🔻 S	itop Bit 1 🔻	Data Bit 8	• Pe	arity Bit None    Operate CLOSE
onfig	CMD Button Start	Read	Save Def:	ult Re:	et	00 02 00 00 01 02 03 04 05
	Baud Rate	9600 👻	TX Frequency	434.00		
odate	Parity Bit	None 🔻	RX Frequency	434.00 🗘		
	Stop Bit	1 •	Bandwidth Spread Rector	125kHz •		
	ID Enable	YES •	TX Power	22	dBm	
Cmd	RSSI Enable	NO 🔻	Work Mode	CENTRAL 🔻		
	RX Gain	NO 🔻	Star Mode	NORMAL -		S:21 R:9 Clear RX V HEX
	Sleep Time	1	SEC Time Slot	1	SEC	00 02 03 04 05 06 07
ools	Device ID	1	Start ID	1		
	Net ID		End ID	255		
	CAD Peak	19	Code Rate	4/5 •		
				911		Send LF Send Clear TX 🗹 HEX

Figure 19: Module 1(Central Module) Receives Data from Module 2

The node module sends data (00 00 01 02 03 04 05) and the central module receives the data (00 02 00 00 01 02 03 04 05). Since the ID Enable is YES, the device ID (00 02) of the node module is shown in the data package. If ID Enable is NO, the central module will receive the data (00 00 01 02 03 04 05).

3. Passive Mode in Star Network

Users need to change the star mode of the two modules to PASSIVE through configuration tool and keep other parameters unchanged. In low power applications, the node module usually works in power mode 2 (EN=1, MO=0). It means the central module needs to send longer preamble in order to wake up the node module effectively. Therefore the power mode of the central module should be set to mode 1 (EN=0, MO=1).

Parameter	Module 1	Module 2
Net ID	1	1
Device ID	1	2
Work mode	Central	Node
Star mode	Passive	Passive
Sleep time	1s	1s
Time Slot	2s	2s

Table 5: Parameters in Passive Mode

If the data which will be sent by node is 0123456789 (totally 10 bytes), the time slot can be calculated in the Tool block of the configuration tool.



M. COM27 ▼	Baud Rate 9600 - Stop Bit 1 - Data Bit 8 - Pa	arity Bit None    Operate CLOSE
Config Update	Settings Spread Factor 11 CAD Symbols 4 Bandwidth 125KHz Payload Size 10 Reference Values Symbol Time 16.38 MS CAD Time 196.61 MS Air Time 496.00 MS Air Rate 0.537 Kbps	01 02 03 04 05 03 04 05 06 07 ff ff 02 10 1e ff ff 02 04 06
Cmd Tools	Time Reference Sampling Period 1 + Min - Time Slot 2 SEC Mumber of Node 20 Star Mode Passive Mode -	S:7 R:20 Clear RX MEX
		Send LF Send Clear TX MEX

Figure 20: Calculating the Time Slot

One successful data collection in passive mode concerns the commands and responses between the central module and its host, broadcasting command from the central module to the node modules and the data / command exchange between the node module and its host. Therefore the configuration tool can not satisfy the testing for the modules in the passive mode of star network. DORJI provides another simple testing tool which can be used to demonstrate the whole process for one round of data collection. The tool also shows the basic use of commands concerning the passive mode of star network. Making sure the two modules are configured with the correct parameters and the corresponding COM ports occupying by the configuration tools are closed before running the testing tool.



COM26	▼ Baud R	ate 9600 👻 :	Stop B:	it 1 🔻	Data Bit 8 💌	Parit	ry Bit None 🔻	Operate OPEN
onfig	CMD Button Start	Read	Sa	ave Defa	ult Reset		00 02 00 00 01 02 03 04 ff ff 02 1c 1e ff ff 02 04 06	05
	Baud Rate	9600 👻		TX Frequency	434.00			
date	Parity Bit	None 🔻		RX Frequency	434.00			
dure	Stop Bit	1 👻		Bandwi dth	125kHz 🔻			
	LBT Enable	NO 👻		Spread Factor	11 👻			
	ID Enable	YES 🔻		TX Power	22 🗘 dBm			
Cmd	RSSI Enable	NO 🔻		Work Mode	CENTRAL -			
	RX Gain	NO 👻		Star Mode	PASSIVE -			
	Sleep Time	1	SEC	Time Slot	2 SEC		00 02 03 04 05 06 07	Llear KX MEX
alr	Device ID	1		Start ID	1			
JOIN	Net ID	1		End ID	255			
	Pre-wakeup	0	SEC	Sensor Type	Type 1 🔻			
	CAD Peak	19		Code Rate	4/5 👻		Send LF Send	Clear TX 🗹 HEX

Figure 21: Module 1 in COM26 is Set to Central Module in Passive Mode

COM27	▼ Baud Rat	te 9600 🔻 S	top Bit 1	•	Data Bit	8 🕶	Parit	y Bit None	•	Operate	OPEN
nfig	CMD Button Start Baud Rate	Read 9600 -	Save TX I	Defa	ult	Reset		01 02 03 04 03 04 05 06 ff ff 02 1c ff ff 02 04	05 07 1e 06		
date	Parity Bit Stop Bit	None 🔻	RX I Band	<sup>7</sup> requency lwidth	434.00 125kHz	÷					
Cmd	LBT Enable ID Enable RSSI Enable	NO - YES - NO -	Spr: TX I Worl	ead Factor 'ower : Mode	11 22 NODE	▼ ↓ dBm					
	RX Gain Sleep Time	NO -	Star	- Mode e Slot	PASSIVE	▼ \$EC		S:7 R:	20 03 04 05	Clear RX	🛛 🖂 HEX
pols	Device ID Net ID	2	] Stau	rt ID ID	255	* *					
	Pre−wakeup CAD Peak	0	SEC Sens	sor Type e Rate	Туре 1 4/5	•		Send LF	Send	Clear T)	( инех

Figure 22: Module 2 in COM27 is Set to Node Module in Passive Mode



The testing tool for passive mode of star network contains three parts. The first part refers to the parameters concerning UART data format which has the same meaning in the configuration tool. Users need to set the same parameters as what the DRF126xDS modules have.

COM	COM26 👻		
Baud Rate	9600 👻		
Stop Bit	1		
Data Bit	8 👻		
Parity Bit	None 🔻		
Operate	CLOSE		
_		Clear RX 🖂 HEX	
End ID: 0	🔹 Timer: 1 🔹 Min		
SET	START		
SET Node	START		
SET Node User data:	START Device ID: 1		
SET Node User data:	Device ID: 1 + Net ID: 1 +		

Figure 23: Testing Tool for Passive Mode in Star Network

The parameters in the second part (Center area) are used for the central module. The Start ID and End ID specify the range of device ID of the node modules. The time slot determines the max time for the central module to collect the data from one node module. The timer refers to the period which the central fulfills one round of data collection for targeted node modules.

The third part (Node area) sets the data which the node module will send to the central module. There is a text area (User data) in which the testing data (e.g. 0123456789) can be input. When the node module receives the wake-up command, it will pick up the data in this area as if the data is from its host. After the node module receives the data collection command from the central module, it will send the data to the central module at once.Users also can change the Device ID and Net ID of the node module and click SET button to make the new parameters come into effect.

By following some of the parameters from previous section, the central module is set with Net ID=1 and Device ID=1 and the node module is set with Net ID=1 and Device ID=2. The time slot for 10 bytes of data (0123456789) is 2S when Spread Factor=11 and Bandwidth=125kHz (refer to Figure 20). Since the device ID of node module is 2, the Start ID can be set to 1 and the End ID can be set to 3 for verification. The timer can be set to 1 minute for simple.

Now the central module can be connected to the testing tool by opening the corresponding COM port. When the new parameters are input in the center area, users can click SET button to make new values come into effect.

The (ff ff 07 0d 00 01 00 03 02 1a) is the Network Parameter Setting Command (table 6 in the datasheet) sent to the central module by the host (here is the testing tool) and (ff ff 02 0e 10) is the response of the central module to this command from the host.





СОМ	COM26 👻	ff ff 07 0d 00 01 00 03 02 1a ff ff 02 0e 10
Baud Rate	9600 💌	
Stop Bit	1	
Data Bit	8 💌	
Parity Bit	None 💌	
Operate	CLOSE	
Start ID: 1 End ID: 3 SET	Time slot     2       Timer:     1       Timer:     1	Set Success
Node		Yes
User data:	Device ID: 1	
	Net ID: 1	
	SET	

Figure 24: Setting Parameters for Central module

Users can connect the node module to another testing tool and input 0123456789 in the User data and keep device ID and Net ID unchanged since the node module is set with Net ID=1 and Device ID=2 already through configuration tool. If the Net ID of the node module is not the same as central module's and its Device ID is out of the range Start ID ~ End ID, users also can make quick changes here and click the SET button to make the new parameters come into effect. For example, we change the Device ID=2 and Net ID=1, the RX area on the right-top of the tool shows the SET ID command (ff ff 05 09 00 02 01 11) but there is no response. Since the node module is set to power mode 2 in which mode the module can not be configured with parameters, users need to switch the module to power mode 0 or mode 1 (EN=0, MO=0/1) and then click the SET button. The module will give the correct response (ff ff 02 0a 0c) for this change.

COM	C0M27 -	ff ff 05 09 00 02 01 11 ff ff 05 09 00 02 01 11 ff ff 05 09 00 02 01 11 ff ff 02 0a 0c
Baud Rate	9600 🔻	
Stop Bit	1	
Data Bit	8 🔻	
Parity Bit	None 🔻	
Operate	CLOSE	
Start ID: 0	<ul> <li>Time slot 1 ÷</li> <li>Timer: 1 ÷ Min</li> </ul>	C Tip X
SET	START	U Set Success
Node User data:	Device ID: 2	Yes
0123456789	Net ID: 1 호	

Figure 25: Changing ID of the Node Module



Assuming the testing tool connecting the central module is central tool and the testing tool connecting the node module is node tool. Users can click the START button in the central tool to start the data collection. The tool will send wake-up command (ff ff 02 21 23) to the central module. When the latter receives it, it will give the response (ff ff 02 22 24) to the host (which is showed in the tool) and meanwhile the central module broadcasts the wake-up command to the node modules to wake them up from power mode 2. After waiting for 1 time slot, the central module will send data collection command one by one (from Start ID to End ID)

com Baud Rate	C0M26 ▼ 9600 ▼	ff ff 07 0d 00 01 00 03 02 1a ff ff 02 0e 10 ff ff 02 22 24
Stop Bit	1	
Data Bit	8 🔻	
Parity Bit	None 🔻	
Operate	CLOSE	
Center		Clear RX 🗹 HEX
Start ID: 1	➡ Time slot 2 ➡	
End ID: 3	🔹 Timer: 1 🔹 Min	
SET	STOP	
Node		
Viron data:	Device ID: 1	
oser data.	N.4 TD. 1	
	Net ID: I	

Figure 26: The Central Module Gives Response and Broadcasts the Wake-up Command

When the node module receives the wake-up command and finds its device ID is included, it will switch to the power mode 0 (no matter its former mode is mode 0 or mode 2) and send Data Request Command (ff ff 02 1f 21) to its host (here refers to the testing tool connecting to it). The node tool then responds to the node module with the data at the fixed data format (ff ff 0c 20 30 31 32 33 34 35 36 37 38 39 39) among which the ff ff is the header, 0c is the length of the command, 20 is the command type, 30 31 32 33 34 35 36 37 38 39 is the data (from the User data area in HEX format) and the last 39 is the CRC byte. The node module keeps the data inside and wait for the data collection command containing its ID from the central module. As soon as the node module gets the command, it will send the data to the central module and switch from power mode 0 to its former power mode (determined by the logic levels on EN and MO pins). The Figure 27 shows the process on the node module side.





				1
COM	COM27	•	ff ff 02 1f 21 ff ff 0c 20 30 31 32 33 34 35 36 37 38 39 39	
Baud Rate	9600	•	ff ff 02 1f 21 ff ff 0° 20 30 31 32 33 34 35 36 37 38 39 39 ff ff 0° 20 1f 21	
Stop Bit	1	•	ff ff 0° 20 30 31 32 33 34 35 36 37 38 39 39	
Data Bit	8	-		
Parity Bit	None	•		
Operate	CLOSE			
Center			Clear RX 🗹 HEX	
Start TD: 0	Time slot 1			1
Start ID: 0	<ul> <li>Time slot 1</li> <li>Timer: 1</li> </ul>	÷ t Min		
Start ID: 0 End ID: 0 SET	Time slot 1         Timer: 1         START	Min		
Start ID: 0 End ID: 0 SET Node	Time slot 1 Timer: 1 START	÷ Min		
Start ID: 0 End ID: 0 SET Node User data:	<ul> <li>Time slot 1</li> <li>Timer: 1</li> <li>START</li> <li>Device ID:</li> </ul>	÷ Min		
Start ID: 0 End ID: 0 SET Node User data: 0123456789	<ul> <li>Time slot 1</li> <li>Timer: 1</li> <li>START</li> <li>Device ID:</li> <li>Net ID:</li> </ul>	<ul> <li>➡</li> <li>Min</li> <li>2</li> <li>■</li> <li>1</li> </ul>		

Figure 27: The Node Module Gets the Data

When the central module receives the data from the node module, it transfers it  $(00\ 02\ 30\ 31\ 32\ 33\ 34\ 35\ 36\ 37\ 38\ 39)$  to its host (here refers to the testing tool). The first two bytes  $(00\ 02)$  in the data package is the device ID of the node module and 30 31 32 33 34 35 36 37 38 39 is the data in Hex format from the node.

LUM	C0M26	•	ff ff 07 0d 00 01 00 03 02 1a ff ff 02 0e 10	]
Baud Rate	9600	•	11 11 02 22 24 00 02 30 31 32 33 34 35 36 37 38 39 1ff ff 02 22 24	
Stop Bit	1	-	00 02 30 31 32 33 34 35 36 37 38 39 ff ff 02 22 24	
Data Bit	8	-	00 02 30 31 32 33 34 35 36 37 38 39	
Parity Bit	None	*		
Dperate	CLOSE			
antar			Clear RX 🗹 HEX	
End ID: 3	Timer: I	🗢 Min		
SET	STUE			
SET Node				
SET Node User data:	Device ID:	1		
SET Node User data:	Device ID:	1 ÷		

Figure 28: Broadcasting the Wake-up Command



In the testing the central module sends totally three data collection commands with device ID from 1 to 3. Since there is only one node module with device ID=2, the central module only gets one data package in one round of collection (Timer=1 minute). When the counting of 1 minute is finished, the central tool will send wake-up command again to start the next round of data collection and repeat this process till users click the STOP button to finish the testing. The central tool sends a STOP command (FF FF 02 23 25) to the central module which will inform the node modules go back to former power mode. The central module gives response (ff ff 02 24 26) to this command.

COM	C0M26 👻	ff ff 07 0d 00 01 00 03 02 1a ff ff 02 0e 10	
Baud Rate	9600 🔻	ff ff 02 22 24 00 02 30 31 32 33 34 35 36 37 38 39	
Stop Bit	1 -	00 02 30 31 32 33 34 35 36 37 38 39 ff ff 02 22 24	
Data Bit	8 🔻	00 02 30 31 32 33 34 35 36 37 38 39 ff ff 02 22 24	
Parity Bit	None 🔻	00 02 30 31 32 33 34 35 36 37 38 39 ff ff 02 22 24 00 29 20 31 32 33 34 35 26 37 38 39	
Operate	CLOSE	ff ff 02 24 26	
Start ID: 1 End ID: 3	<ul> <li>Time slot 2 </li> <li>Timer: 1 </li> <li>₩</li> </ul>	Gn	
Start ID: 1 End ID: 3 SET	Time slot     2       Timer:     1       START	fin	
Start ID: 1 End ID: 3 SET Node	Time slot   2     Timer:   1     START	fin	
Start ID: 1 End ID: 3 SET Node User data:	Time slot     2       Timer:     1       START         Device ID:	tin ÷	
Start ID: 1 End ID: 3 SET Node User data:	Time slot       2       2         Timer:       1       4       N         START       START       1       1         Device ID:       1       1       1         Net ID:       1       1       1	tin •	

Figure 29: Finish Testing with STOP Command

Notes:

1. To start the first round of data collection, the host needs to send two commands to the central module. One is Parameter Setting Command which sets the Start ID, End ID and Time slot and another is Wake-up command which will let the central module wake up related node modules and start the counting for one round of data collection. If users want to start the second round (or more) of data collection, users only need to send the wake-up command if the network parameters are not changed.

2. The function of wake-up command is to let the central module wake up all of related node modules if the latter are in power mode 2 (half sleep mode) and force them to work in power mode 0 so the central module doesn't need to send long preamble to wake up the node module one by one. It will let the central module collect the data more quickly. The disadvantage of it is that the targeted node modules are all woken up and keep in the receive status till the data are collected. Therefore the power consumption will be increased if there are a lot of node modules needing to be collected in one round. For example, if the Start ID=1 and End ID=100, there are 100 node modules will be woken up when the central module receives the wake-up command from its host. When the node module with Device ID=1 receives the first data collection command, it will be back to former power mode (mode 0 or mode 2 depending on the EN/MO pins) after it sends out the data to the central module. For the node module with Device ID=100, it will keep in the receive status (power mode 0) till it receives the 100<sup>th</sup> data collection command from the central module. Therefore the 100<sup>th</sup> node module consumes the highest energy. If users use higher RF data rate, the air transmission time can be reduced and the waiting time of the last node modules also be reduced correspondingly but the communication distance will be affected.



Therefore users need to make the trade-off between the number of node modules and the RF data rate according to the application.

3. If users don't need to consider power consumption, the node modules can work in power mode 0 (EN=0, MO=0) and the central module can work in power mode 0 or power mode 1. If the node module is used in lower power applications, it must be set to power mode 2 (EN=1, MO=0) and the central module must be set to power mode 1 (EN=0, MO=1) in order to send longer preamble to wake up the node modules effectively.

4. The testing tool connecting the node module can show the formatted data in the RX area so users can input the data into the User data area and get the formatted data when the node module sends the data to the central module. It is useful when the users want to send data to the node module through microcontroller and don't know how to format the data at the start.



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