Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

RF1276-868

Long distance Transceiver Module V2.0

Product Overview

The RF1276-868 is a low cost, ultra-low power, high performance transparent two way half-duplex LoRa modulation transceiver operating at 869.5MHz. It integrates with a high speed MCU from ST and the high performance RF IC SX1276. By adopting high efficiency forword error correction with interleaving encoding (FEC) technology, anti-interference ability and reception sensitivity is greatly improved. That guarantees good performance in harsh industrial environments. The FEC technique is advanced and unique in the radio data communication field. RF1276 has a TTL UART interface making it easy to implement wireless data transmission. It is flexible for users to set the baud rate, output power, air data rate etc. The modules size makes it an ideal option for radio date communication application.

Product Features

Output Power: Max 25mW

Air Data Rate: 300 - 11000bps

On Air Transmission: 3.75 ~ 136.75Bps (<10% Air Data Rate)

UART Data Rate: 1200 - 115200bps

UART Parity: 8E1 / 8N1 / 801

Frequency: 869.5MHz

Bandwidth: 125kHz ; 250kHz

Supply Voltage: 4.5 ~ 5.5V (ripple < +/- 100mW)

Dimensions: 44.5mm x 23.6mm x 7mm

Model List

Part Number	Interface
RF1276868	TTL
RF1276868232	RS232
RF1276868485	RS485

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

Application

- Automated Meter Reading (AMR)
- Remote control, remote measurement system
- Access control
- Data collection
- Identification system
- IT household appliance
- Baby monitoring system

Maximum Specification

Symbol	Parameter	Min	Max	Units
VCC	Supply Voltage	4.5	5.5	V
TOT	Operation Temperature	-30	85	℃
HOH	Operation Humidity	10%	90%	
TST	Storage Temperature	-55	125	℃

Pin Out

The RF1276-868 module has 5 pins, refer to table 1

Table 1: Pin definition

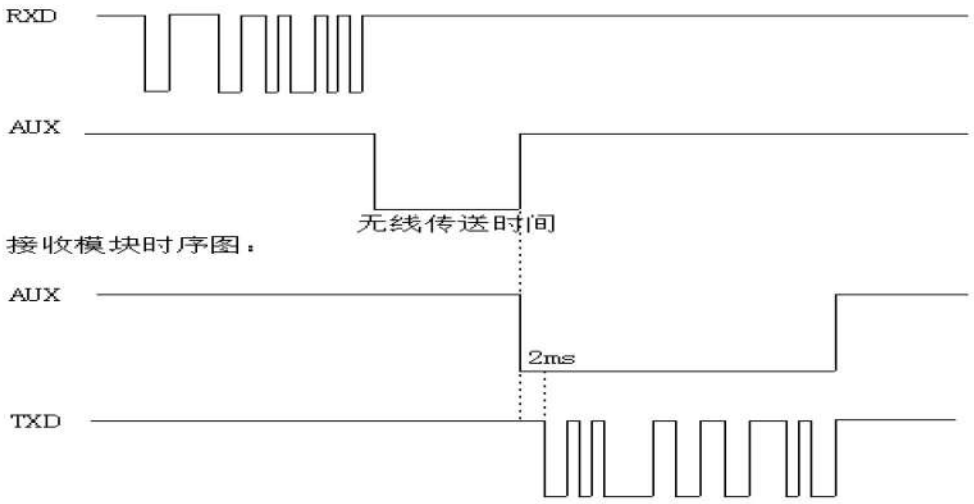
RF1276		
Pin NO.	Pin Name	Description
1	VCC	Power supply DC 4.5V-6.5V
2	GND	Grounding of Power Supply
3	RXD	Serial input
4	TXD	Serial output
5	AUX	Data in/out indication

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

Working Mode

a. Standard Mode

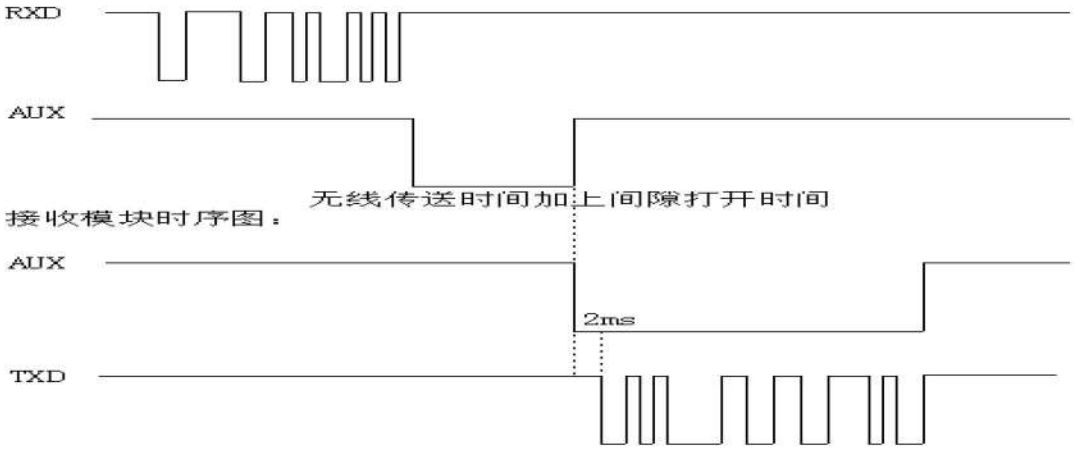
Standard mode is also called transparent mode in which the module receives from or sends data to the host through serial port (TTL) at present data format and users dont need to care about the process of data inside the module. The AUX pin of RF1276-868 will give an indication about the data IN/OUT of serial port 2ms in advance in order to wake up the host.



Timing Sequence in Standard Mode

b. Lower Power Mode

In this mode RF1276-868 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 when the data comes.

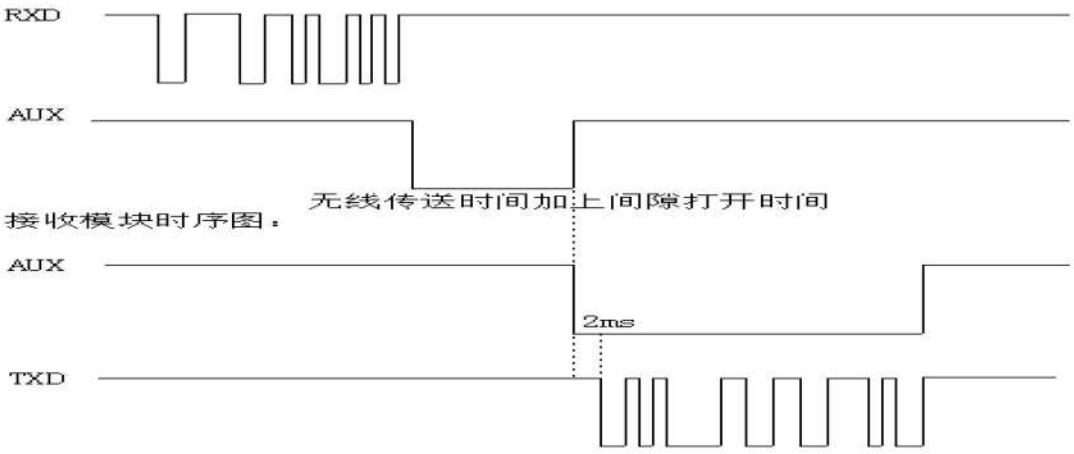


Timing Sequence in Low Power Mode

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

c. Sleep Mode

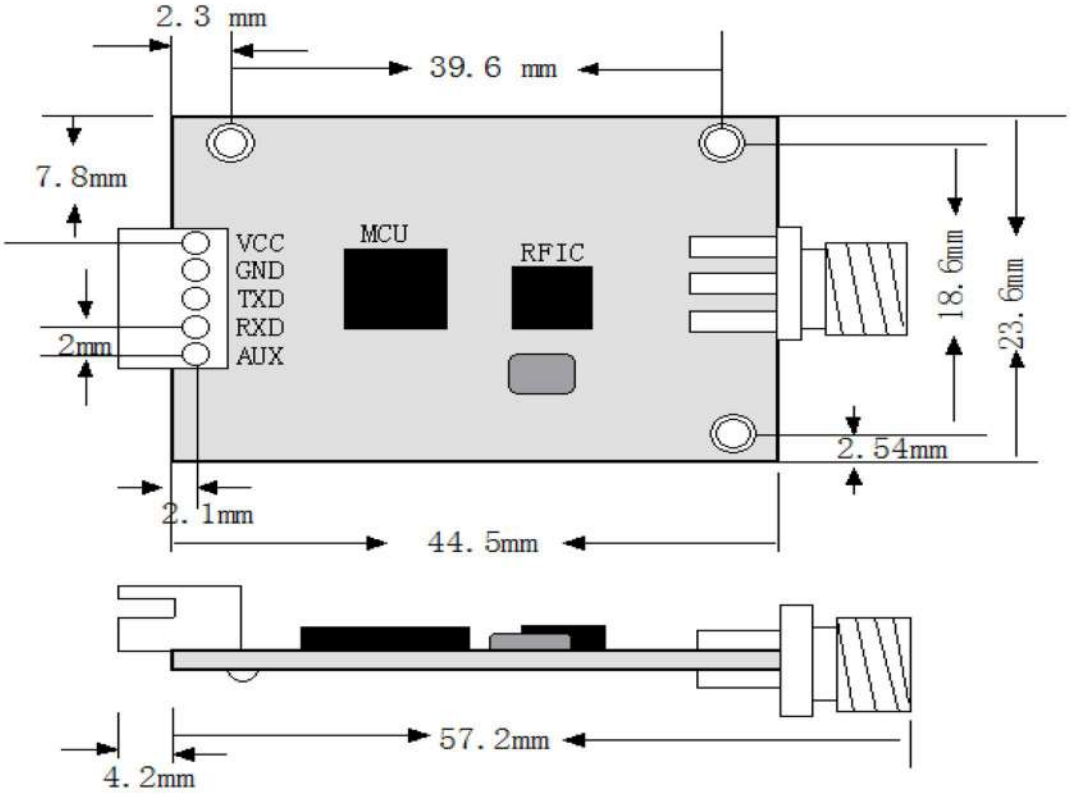
In this mode most functions of the modules are disabled so if two modules are set up to sleep mode, they cannot communicate with each other, so one module must be in Low Power Mode. Comparing to Low Power Mode, the modules in SLEEP MODE will not enable the serial port and only keeps CAD monitor. When it detects an 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.



Time Sequence in Sleep Mode

Dimension

Figure 1. Size of the Module



Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

Parameter Configuration

Through the serial port or using the setting tool 'RF-Tool', users can configure relative parameters such as frequency, UART rate, air rate, checkout mode and so on. It is very simple for configuration. Based on different requirements, all options can be selected visually. It is shown in Table 2 and Figure 3.

Parameter	Description
UART area	The values are fixed at 9.6k bps & no parity check.
RF mode	Standard mode, Low Power 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 RF1276. 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 RF1276 and the host
Serial parity	It defines the parity check between RF1276 and the host

Table 2. Parameter Specification

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

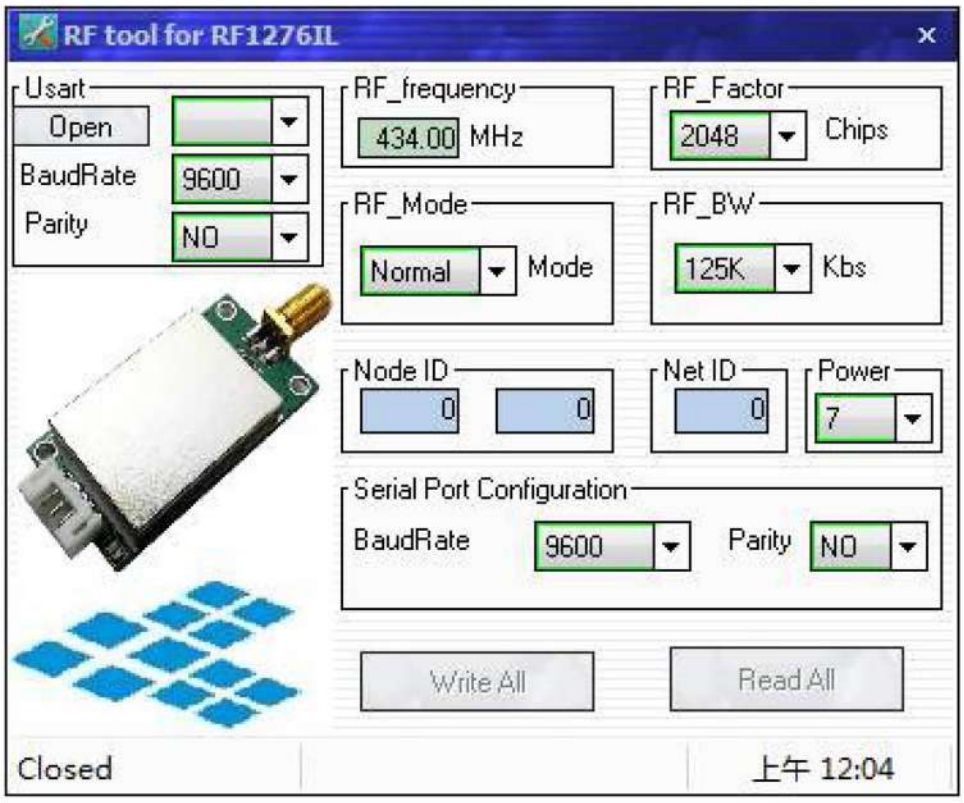


Figure 3. Interface of RF Tool

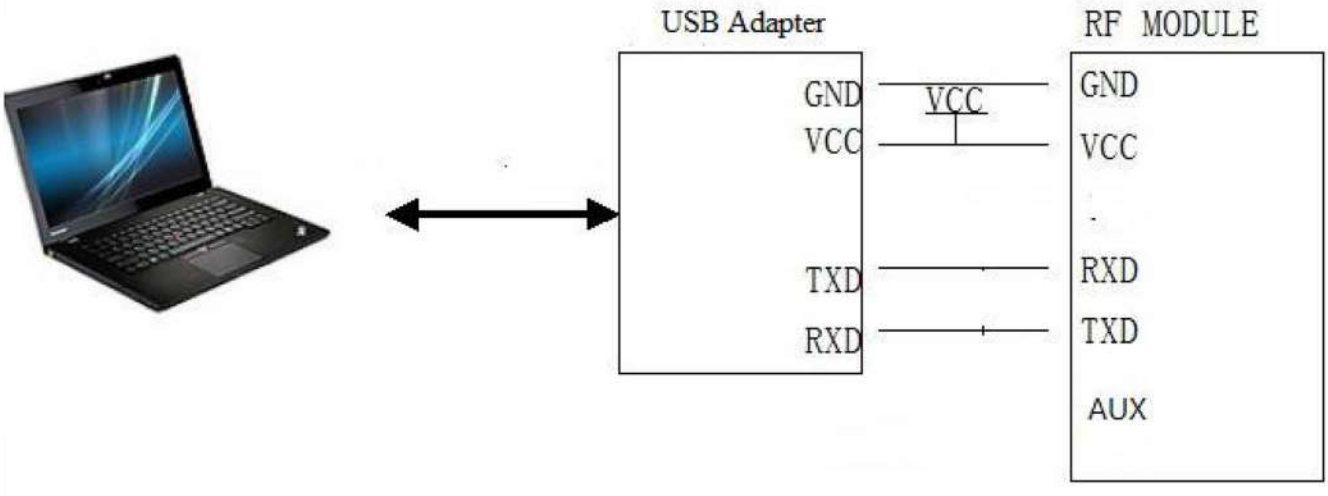
Users can configure the parameters (output power, RF Factor, RF Bandwidth etc) through the PC or in the circuit.

- **Security through PC.**
  RF 1276-868 port is TTL. When RF1276-868 connects with the PC, users need to use TTL adaptors. Appcon Wireless provides USB adaptors as accessories. The schematic is shown in Figure 4.

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

Firstly, users connect the converter board to the PC through the DB9 cable and open 'RF Tool', then insert the module into the converter board. After that, the status column of 'RF Tool' will give the indication, 'Found Device'. Users then can read/write to the module.

If the user connects the USB converter, the USB drive 'PL-2303_Driver_Installer' needs to be installed first. The drive has different versions for different OS. USB converters have four wires with five terminals: Black, Red, Blue, Yellow and White The black wire is the GND pin. The red wire is the VCC pin, the blue wire is the TXD pin and the yellow wire is the RXD pin.



The Connection Diagram

• Setting in the Circuit

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

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

RF 1276-868 Command Structure

Notes:

1. The ID code is 0x00 in the command
2. In the command code, XX in sending the 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**

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

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

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=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

Parameter Length and Value Range

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

5. CS refers to the CRC code which is the remainder of the sum of the data section divided by 256. In order to understand the command, 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, 0x92, 0x0D, 0x0A

Low Power Mode: 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, 0x93, 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, 0x94, 0x0D, 0x0A

Please note that the working modes changed by the 0x03, 0x04 and 0x05 commands will not be written into non-volatile 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 the module to standard mode or low power mode but the sleep mode will be restored to standard mode after the next power-on even if thh WRITE command is used.

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

9. Application Schematic

The connection schematic between RF1276-868 and MCU or terminal is shown as below. The parameter of RF1276-868 serial port must match with MCU or terminals (RF1276-868 has the same serial port band rate and parity style with MCU or terminal. Two or more RF1276-868's in a system should have the same parameters such as TX/RX frequency, air date rate and RF channel

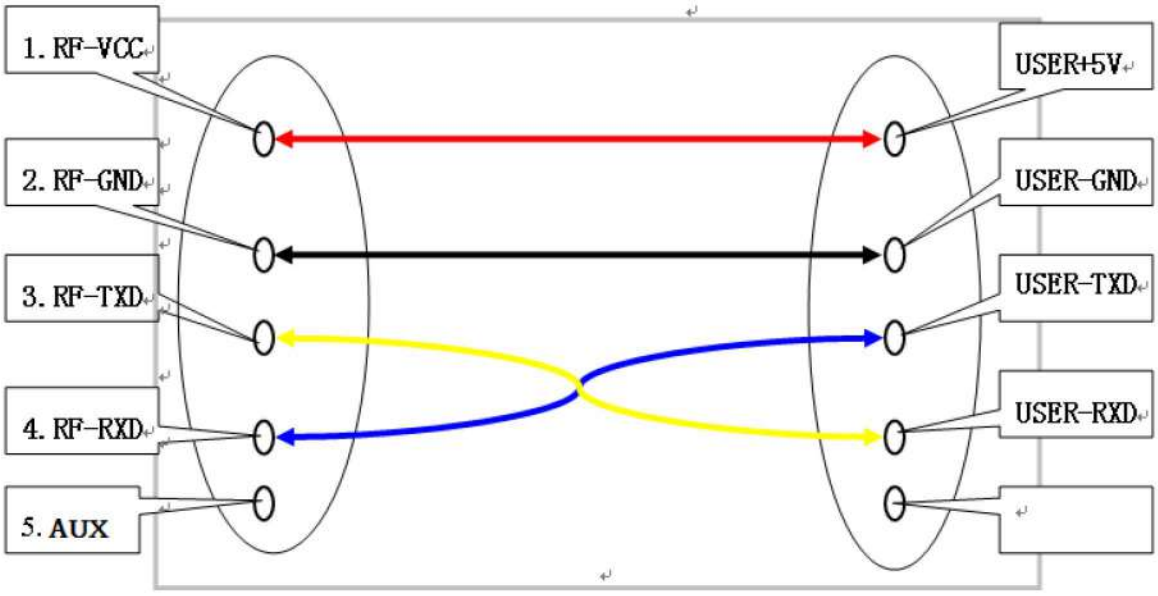


Figure 7. Conection between Module and Device (TTL/RS232 port)

Caution:

1. When the RF1276-868 is installed, make sure the antenna is far away from the device to enhance the performance.

2. RF1276-868 should have the same common ground with MCU or terminal. Otherwise it may cause the moduule irregular working.

3. When RF1276-868 works as normal, DO NOT touch the module and antenna.

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

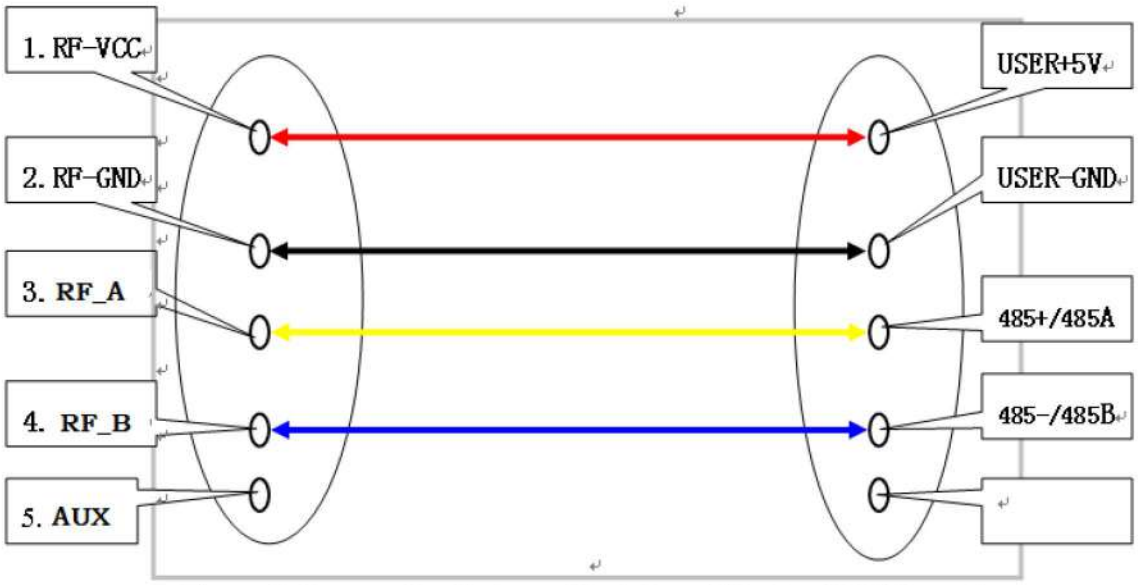


Figure 8. Connection Between Module and Device (RS485 port)

10. Constructing Network (one point to multi-point):

RF1276-868 is a semi-duplex module which can be used to create point-to-multipoint networks. Every module with the same RF configuration and NetID will receive a transmitted data pocket. The host MCU should determine if the received data pocket was intended for them or another node in the network.

The user should pay attention to the following questions based on the complete transfers in the air and some inherency characteristics of wireless communication:

1. Latency of wireless communication

The wirelss terminal keeps receiving data packets after waiting for a while to ensure no data anymore. There should be tens to hundreds of milliseconds latency from transfer to receiver (the exact latency depends on the UART rate, air rate and the size of the data package). In addition, it also needs to consume some time to transmit from the module to terminal, but the delay time is permanent in the same condition

2. Range of wireless connection

Depending on the size and interval of the data pockets transmitted, various RF configurations can be used to attain a better transmission range for your LoRa nodes.

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

3. Data Flux Control

Although there is a buffer zone with 256bytes in the wireless module, when the UART rate is higher than the air rate, there may be a problem about the data flux. Some data may be lost because it overflows from the buffer. Under this condition, it must be ensured that the average UART rate should NOT be higher than 60% of the air rate. For instance, the UART rate is 9600bps, the air rate is 4800bps. If the UART rate is the same as the air rate, the only way is to manage the interval between data packets. For example, if the terminal transmits 100bytes to the UART every time, it will take 104ms every time.
(104ms/0.6) x (9600/4800)= 347ms. So, the interval time that the terminal transmitts 100bytes to UART should NOT be less than 347ms every time, then those mentioned problems can be avoided.

4. Error Control

The wireless network module has strong capability of anti-interference because of the high efficiecy checking error correction with interleaving encoding technology. However, when it is in a bad circumstance that has strong electric interference, the data may be lost or receive some error data. Users can increase the development of the system link layer protocol. For instance, if the user can increase the TCP/IP slip window and repeat the transmitting functions, it will improve the reliability and ability of the wireless network communication.

5. Selection of the Antenna

The antenna is a very important factor of the communication system. The quality of the antenna impacts the capability of the communication system, so the user should take the care when selecting their antenna. Generally speaking, there are two main factors to consider: the type of antenna (size) and its electric capability. The antenna must be matched with the frequency of the communicaion system.

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

11. Q&A

Questions and Answers	
Can not communicate between two devices	1. The communication protocol is different between two modules, for instance: data rate and checkout.
	2. The frequency or RF data rate is different between two communicated modules.
	3. They are not the same kind products.
	4. The connection between module and terminal is wrong.
	5、The module is wrong.
	6. The setting of EN is wrong.
	7. The communication distance exceeds the range, or the connection of antenna is bad.
Short communication distance	1. The supply voltage exceeds range
	2. The ripple of power is too big.
	3. The connection of antenna is bad or it is a wrong kind of antenna
	4. Antenna is too close to the surface of metal or the ground
	5. Receiving circumstance is very bad, for instance buildings and strong interference.
	6. There is interference of the same frequency
Receive wrong data	1. Wrong setting of COM, for example, Baud rate is wrong
	2. The connection of UART is wrong.
	3. The cable to the UART is too long.

Otto Wireless Solutions
58 Wakis Avenue, Strijdompark
Randburg, 2155
PO BOX 55536 Northlands 2116
Republic of South Africa
Tel: +27 11 791 1033 | Fax: +27 11 791 1187
wireless@otto.co.za | www.otto.co.za

Disclaimer:

This Datasheet reflects the performance of modules which have been specifically tailored to meet ICASA requirements for the local South African market. Performance and functionality of modules for the South African market do not correspond to the manufacturer's original datasheet, which includes performance options which will exceed local performance allowable parameters.