DS01705

Isolated RS485 to LoRaWan wireless modem Product specification

V1.2

Document information

Info	Content
Keywords	*LoRaWAN, RS485, RS232, Isolation, AT Command, UART, LADTP*
Abstract	This document describe the specification of the RHF3M485 designed by RisingHF

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1 Overview

RHF3M485 is a RS485/RS232 to LoRaWan transparent data forward unit, which helps user implement data communication between local end devices to LoRaWan network server, and easily achieve data cloud and data management with adequate supporting application server.
RHF3M485 cover full LoRa frequency band of ISM sub-GHz, 433/470/780/868/915MHz. It will realize data transfer automatically through LoRaWan communication according to the integrated Application Data Transmission Protocol.
Benefit from the excellent wireless RF coverage of LoRa technology, thus saving the complex cabling projects and the cabling cost.
RHF3m485 equipped with an isolated RS485 interface which withstand 1.5kVRMS isolation voltage between the interface side and UART side of the device. RHF3M485 support wide range of input power supply, makes it more suitable for the industrial environment.

1.1 Features

- Comply with EIA RS485, EIA RS232 and Global LoRaWan.
- Comply with Modbus protocol.
- Support RS485 and RS232 communication (alternatively)
- Auto-data transparent forwarder, auto-LoRaWan protocol.
- High isolation RS485 interface, isolation voltage 1.5kVRMS
- Wide range input power supply, Positive and negative Polarity automatic adaptation:
  - DC 6~55V
  - AC 6.8~48V
- Resettable fuse in the input power line for safety.
- Support EU433/CN470/EU868/US915/AU915/AS923/KR920 LoRaWAN protocol
- Support LoRaWan Class A/Class C
- Support LoRa HF/LF: 433/470/780/868/915MHz
- LoRa TX output power 20dBm@434/470MHz, 14dBm@868/915MHz
- LoRa Sensitivity -139dBm@434/470MHz, -137dBm@868/915MHz
- RS485/RS232 baud rate configurable: 600bps~38.4kbps
- Support data bits 7bit/8bit; stop bit 1bit, parity bit: None/odd/even
- Built-in 2KB packet buffer, automatic packet segment and packet assembly.
- Pluggable terminal for convenience of use.
- LED for power and operation indication
- Equipped with LoRa antenna, quick for installation.
- ESD protection: IEC 61000-4-2 contact±4KV; Air discharge ±8K

1.2 Application

- Industrial automatic device
- HVAC air condition control
- AMR
- Wireless monitor and control
- Intelligent home
- Smart city
- Intelligent manufacturing
- Traditional RS485 application update

2 Preface

2.1 Acronyms

Acronyms	Description
LADTP	RisingHF LoRaWAN Application Data Transmission Protocol
DMU	Data Message Unit, RS485/RS232/Modbus devices
DFU	Data Forwarding Unit), LoRaWAN device
LoRa	Semtech Long Range Communication Modulation Technology
LoRaWAN	Long Range Wide Area Network
RS485	EIA RS485: a differential Serial communication bus
RS232	EIA RS232: Asynchronous serial communication interface
LoRaWan Class A/Class C	End device type defined in LoRaWan protocol
ADR	Adaptive data rate
RXWIN1/RXWIN2	Downlink RX windows defined in LoRaWan protocol
SF	Spreading factor, a parameter of LoRa modulation

Table 2-1 Acronyms

2.2 LoRaWan introduction

LoRaWan is the MAC layer protocol managed by LoRa Alliance. It is recommended to download and read the latest LoRaWan specification for detail on LoRa Alliance website, https://www.lora-alliance.org/, you may need register a user name first.

LoRaWAN networks typically are laid out in a star-of-stars topology in which gateways relay messages between end-devices and a central network server at the backend. Gateways are connected to the network server via standard IP connections while end devices use single-hop LoRa™ or FSK communication to one or many gateways. All communication is generally bi-directional, although uplink communication from an end device to the network server is expected to be the predominant traffic. Communication between end-devices and gateways is spread out on different frequency channels and data rates. The selection of the data rate is a trade-off between communication range and message duration, communications with different data rates do not interfere with each other. LoRa data rates range from 0.3 kbps to 50 kbps, with different Band Width and Spreading Factor. To maximize both battery life of the end-devices and overall network capacity, the LoRa network infrastructure can manage the data rate and RF output for each end-device individually by means of an adaptive data rate (ADR) scheme.
End-devices may transmit on any channel available at any time, using any available data rate, as long as the following rules are respected:

1) The end-device changes channel in a pseudo-random fashion for every transmission. The resulting frequency diversity makes the system more robust to interferences.
2) The end-device respects the maximum transmit duty cycle relative to the sub-band used and local regulations.
3) The end-device respects the maximum transmit duration (or dwell time) relative to the sub-band used and local regulations.

2.3 References

1) *LoRaWAN™ Specification V1.0.2: LoRaWAN102-20161012_1398_1.pdf*
2) *LoRaWANRegionalParametersv1.0.2_final_1944_1.pdf*

3 Product specification

Base on the integrated LADTP protocol, the RHF3M485 data forwarding unit process the data from/to the data message unit to achieve the data transmission through LoRaWan transparently. The message will relay to network server by LoRa gateway, and further with the help of adequate supporting application server, we can manage the control the application devices.
The RHF3M485 described in this document is DFU device.
RHF3M485 allows user configure the parameters through a UART interface on the device, including LoRaWan parameters, Frequency channel, Baud rate, serial communication parameters and other parameters, please refer to RHF3M485 user manual for detail.

Unless otherwise specified, the condition of this product specification is under condition: Vin=DC 12V, Baud rate=2400, 1, 8 (2400pbs, 8bit data bits, 1bit start bit, 1bit parity check[odd], 1bit stop bit, room temperature 25℃.

3.1 Function block

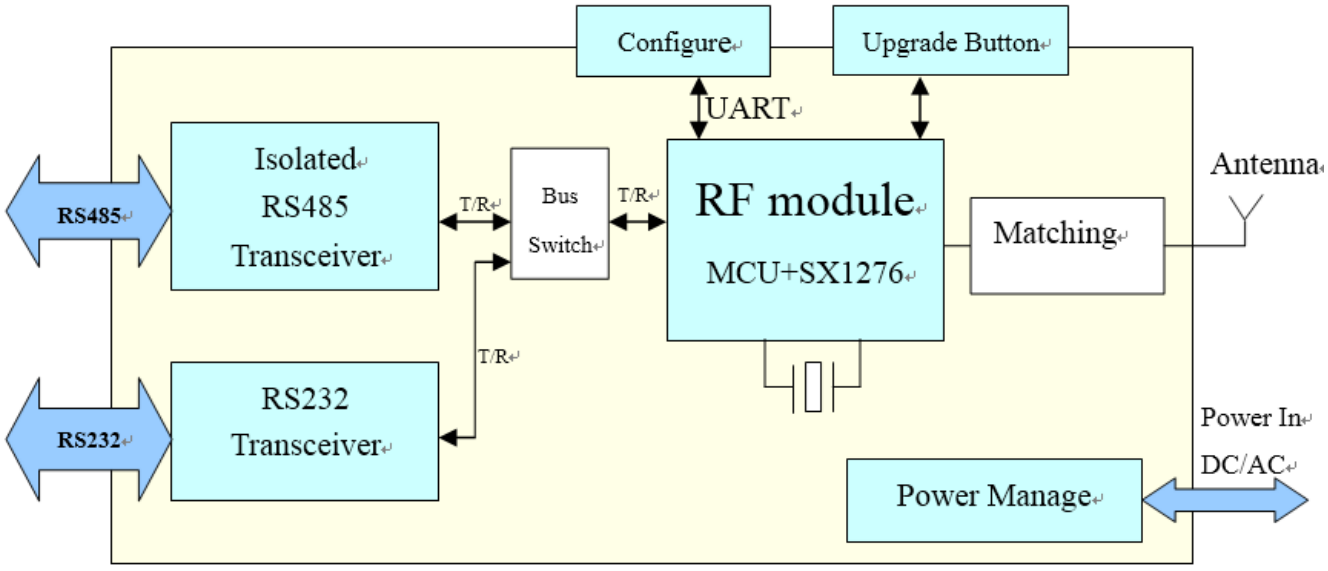

Figure 3-1 Block Diagram of RHF3M485

3.2 General electrical specification

Items	Conditions	Min	Typical	Max	Unit
Input voltage	DC	6	12	55	V
	AC	6.8	24	48	V
Power consumption	Normal operation, when RF in TX will have max Power consumption.	0.5	0.8	1.1	W
Power protection	Short and over current protection	Sustained, self-resettable			
Internal Working voltage		2.97	3.3	3.6	V

Table 3-1 General electrical specification

3.3 Communication support

items	Name	Description
Communication method	RS485	DFU and DMU through RS485
	RS232	DFU and DMU through RS232
	LoRaWan	DFU and LoRaWan gateway, RF communication

Table 3-2 Communication suppport

3.4 RF specification

Items	Conditions	Min	Typical	Max	Unit
Characteristic impedance	--		50		ohm
Operation frequency	LF	410	--	525	MHz
	HF	779	--	1020	MHz
Frequency tolerance	--	-15		+15	PPM
RF TX power	TX @434MHz/470MHz	2	17	19	dBm
	TX @868MHz/915MHz	0	13.5	14	dBm
RF RX sensitivity	SF12, BW125kHz, 434MHz/470MHz		-139		dBm
	SF12, BW125kHz, 868MHz/915MHz		-137		dBm
Harmonics & Spurious	--		-40	-36	dBm
Max RF input	--			+10	dBm
TX Current of LoRa maximum output	LF, 3.3V current (RF)		120		mA
	HF, 3.3V current (RF)		45		mA
RX Current of LoRa	RX current, 3.3V current(RF)		16		mA
LoRa data bit rate	ADR , adaptive ((Multi SF LoRa)	300		50K	bps

Table 3-3 RF specification

3.5 Interface specification

Interface type	Item name	Description
RS485	Interface terminal	A+, B-
	Interface Part	isolation(**isolation spec. Chapter 3.6**) , Pluggable terminal header block
	transmission medium	Twisted wire
	Communication mode	asynchronous, half-duplex, point to point
	Directional control	Data stream auto control the data Direction
	Baud rate	600bps~38.4kbps configurable
	Data bits	7,8 configurable
	Parity	None, Even, Odd
	Stop bit	1
	Wire communication distance	1200m (9600bps)
	Interface Protection level	±4kV ESD Contact
RS232	Interface terminal	TXD, RXD, GND
	Interface Part	DB9 female
	transmission medium	RS232 Cable
	Communication mode	asynchronous, duplex, point to point

Interface type	Item name	Description
	Baud rate	600bps~38.4kbps configurable
	Data bits	7,8 configurable
	Parity	None, Even, Odd
	Stop bit	1
	Wire communication distance	20m (9600bps)
	interface Protection level	±4kV ESD Contact
DC-IN	Interface terminal	V+, GND
	Interface Part	DC Power Jack, inner conductor Φ2.0
AC-IN	Interface terminal	V+, V-
	Interface Part	Pluggable terminal header block
Configure	Interface terminal	TX, RX,GND
	Interface Part	Pluggable terminal header block
	UART configuration	"9600, 8, n, 1" (Baud rate 9600, 8 bits data, no parity, 1 stop bit)
Upgrade Button	Interface terminal	Tactile switch for firmware up gradation, press and hold the button before power on to enter BOOT mode.
LED	Power	Green, power on indication
	FCT	R/G Bi-color LED, green for system status, Green for RS485/232 transceiver. Red LED on indicates the system is in BOOT mode, off indicates the system normal mode. Green LED flickering indicates RS485/232 data communication.
	LoRaWan	R/G Bi-color LED: LoRaWAN TX，Red LED flickering； LoRaWAN RX，Green LED flickering.
RF interface	Interface terminal	SMA connector, 50Ω, for LoRaWan antenan.
LoRaWan antenna	Interface port	SMA male
	Dimension	Φ10.7*115.5mm
	Center frequency	LF: 434MHz or 480MHz HF: 868MHz or 920MHz
	Gain	-0.9dBi
	Efficiency	33.87%
	Material	TPE
	Color	Black

Table 3-4 Interface specification

Figure 3-2 RHF3M485 interface

3.6 Isolation specification

The RS485 interface is isolated from the UART inside of the device, this will make the device more robust against the interference between systems.

The isolation specification:

Item	Condition	Min	Typical	Max	Unit
Isolation Voltage	Dielectric Withstand Voltage Tester, load DC voltage for 1 minute, the leakage current < 1mA		1.5		KV
insulation resistance	Isolation Voltage 500VDC, 1 minute, test with High resistance meter		1000		MΩ

Table 3-5 isolation specification

3.7 Mechanical specification

RHF3M485 will use a Aluminum Case, and installed by screw:

Name	Items	Description
Mechanical specification	Dimension	94.4*84*25mm
	Material	Aluminum

Name	Items	Description
	Color	Black
	Weight	150g
	Installation	Use screw

Table 3-6 mechanical specification

3.8 Operation environment

Name	Items	Description
Operation environment	Operation temperature	-40℃~+ 85℃
	Humidity	5%～95% RH, No condensation.
	Storage temperature	-40℃~+ 85℃

Table 3-7 Operation environment

4 Product typical performance illustration

4.1 Packet segment

4.1.1 Packet segment description

RHF3M485 implement the data forwarder through LoRaWan, it has 2K Bytes internal data buffer, it allows the data from DMU stored in this data buffer first, then DFU (RHF3M485) read the data and complete the forwarding, the DFU (RHF3M485) will decide if the data packet from DMU need be split into several sub segment or not when transfer to LoRaWan format, this will decided by the maximum allowed LoRaWan payload length of different LoRa data rate. If the packet length exceed the maximum payload length of the current LoRa data rate[1], then the DFU will split the packet into several segments, each segments of this packet will marked a same identity (ID) till the packet is complete transferred. All this is done by the built-in LoRaWAN Application Data Transmission Protocol.

Because the data buffer is limited to 2KB, if the DMU transmit data with high data rate and continuously with high frequency, the data read/fetch by LoRaWan will become too late before the data buffer overflowed and the data be overlapped, as the LoRaWan is a low data rate communication.

Besides, the packet segmenting will bring extra expense of LoRaWan protocol transmission, for the purpose of data forwarding efficiency consideration, the built-in LoRaWAN Application Data Transmission Protocol define the maximum packet length from DMU is 500 Bytes, if 500 Bytes is exceed, then only 500Bytes will be proceeded, others will be discarded.

Note 1: for different frequency band, LoRaWan defines the allowed maximum payload length of different data rate, this is because of the limitation of physical layer such as the maximum allowed over air transmission. Please refer to the LoRaWAN Regional Parameters for detail.

4.1.2 Typical packet segmenting illustration

The example below is a device working at CN470 that the Packet from DMU is 80Bytes, while SF12 will only allow the maximum 51 payload length, so packet segmenting will be needed.

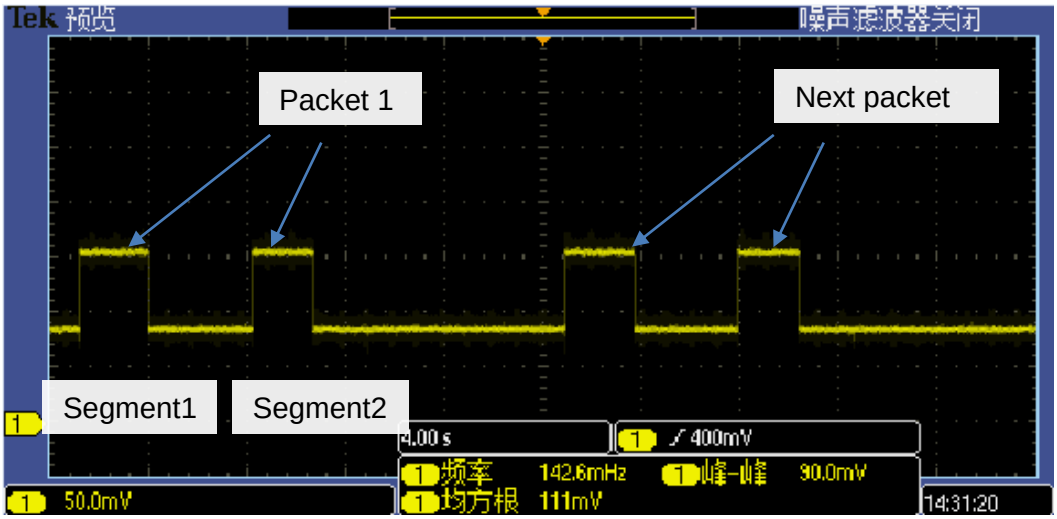

Figure 4-1 RHF3M485 packet segmenting

But if the ADR is enabled, and the SF7 is selected when the Link budget is good enough, then the packet length of 80Bytes can be forwarded directly, no need to segmenting. See below Chapter 4.2.

4.2 LoRaWan ADR enabled

In order to save the power and optimize the network capacity, LoRaWan bring the ADR mechanism to manage the data rate and RF output power of the end devices in the Network.

The signal of Different LoRa data rate will not interfere to each other and thus can be co-existed. Data rare is range from 0.3 kbps to 50 kbps, the Spreading factor is from SF7 to SF12, modulation bandwidth from 125 KHz to 500 KHz.

Furthermore, if the link budget is good enough, the network will go on manage the RF output power of the end devices in the Network.

For the same condition as Chapter 4.1.2, Figure 4-3 shows ADR can have less time over air expense, Lower RF output power. This will increase the efficiency and enlarge the network capacity.

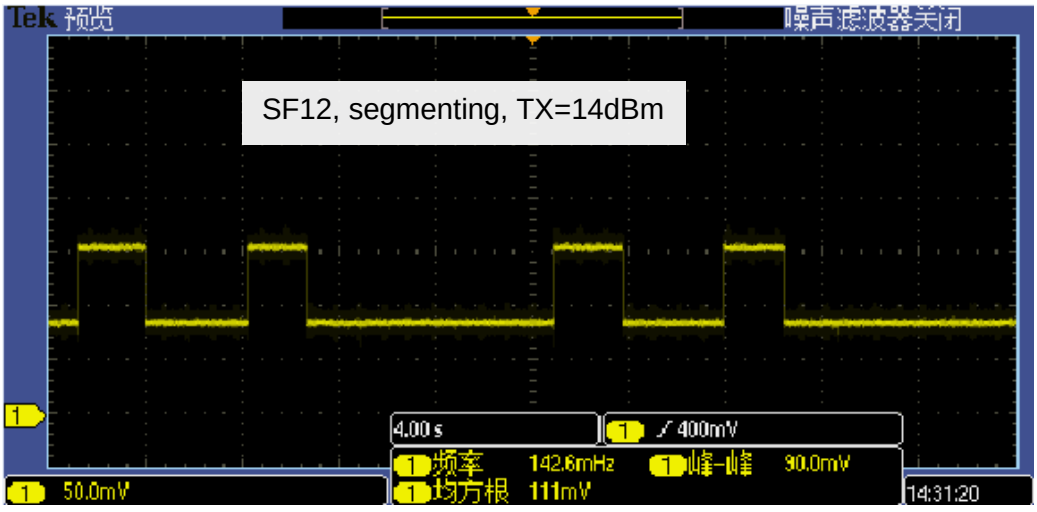

Figure 4-2 LoRaWan ADR (SF12)

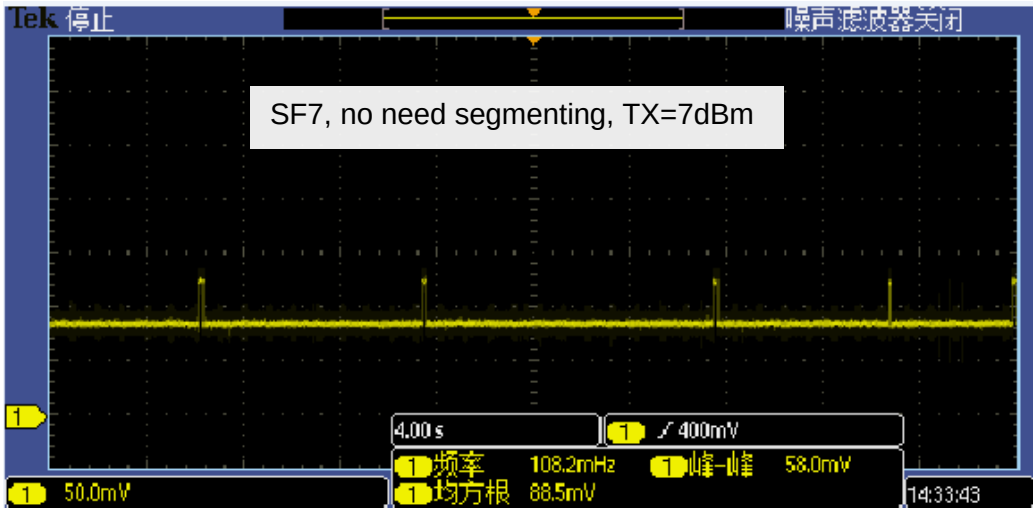

Figure 4-3 LoRaWan ADR (SF7)

4.3 LoRaWan Class A 和 Class C

RHF3M485 support Class A and Class C, they differ in the RX windows of Downlink.

LoRaWan has agreement that for all end devices, a followed downlink RX window is opened after each TX uplink, and three types end devices are defined: Class A/B/C.

Class A has two downlink RX window, RXWIN1 and RXWIN2 after one uplink TX, other downlink RX window should wait until next uplink TX to activate the RX window. If RXWIN1 has received data, RXIN2 will not open accordingly. Class A is fundamental type, all other type end devices should support Class A compatible.

Class C will maintain all the features of Class A, but will keep working at RX mode besides RXWIND1 and RXWIN2, the constant RX window will use the same configuration of RXWIN2.

So Class C will consume more Power thus not suitable for a battery powered device. But this will have less network latency, suit for the quick response application.

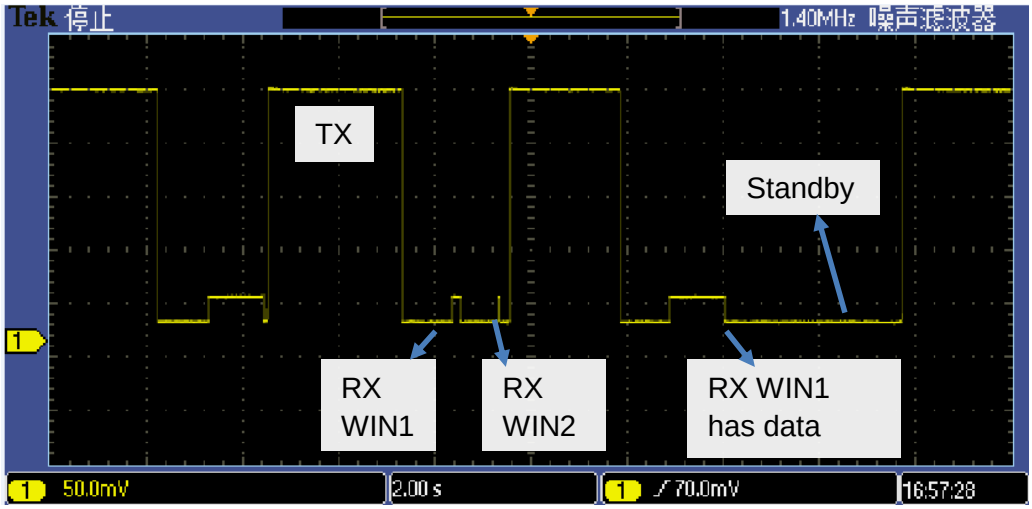

Figure 4-4 Working at Class A mode

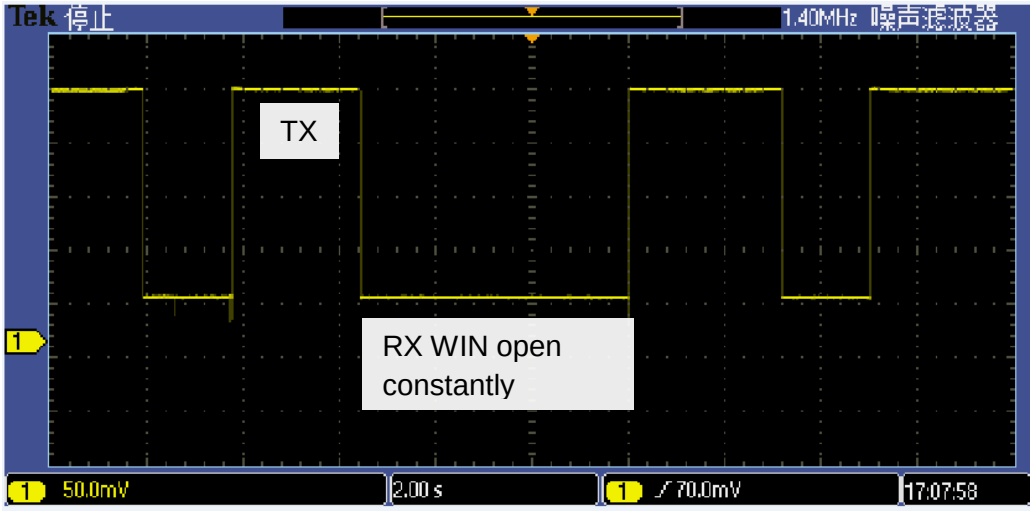

Figure 4-5 working at Class C mode

5 Order information

RHF3M485 cover LoRaWan all frequency range, while the antenna is different with line-up part number. Besides, LF and HF Maximum TX power is different.

5.1 Ordering Information:

Ordering Part Number	Antenna frequency	Maximum TX power	Temp Range
RHF3M485-434	434MHz	20dBm	-40℃~+ 85℃
RHF3M485-470	480 MHz	20dBm	-40℃~+ 85℃
RHF3M485-868	868 MHz	14dBm	-40℃~+ 85℃
RHF3M485-915	920 MHz	14dBm	-40℃~+ 85℃

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+ Complete the specification

V1.1 2017-06-01

+ Delete the support of data bit 9bit

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+ Creation

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