RTU-RL8xxM

Modbus Slave RS-485 Relay Modules.

This manual is used for the firmware version 2.xx

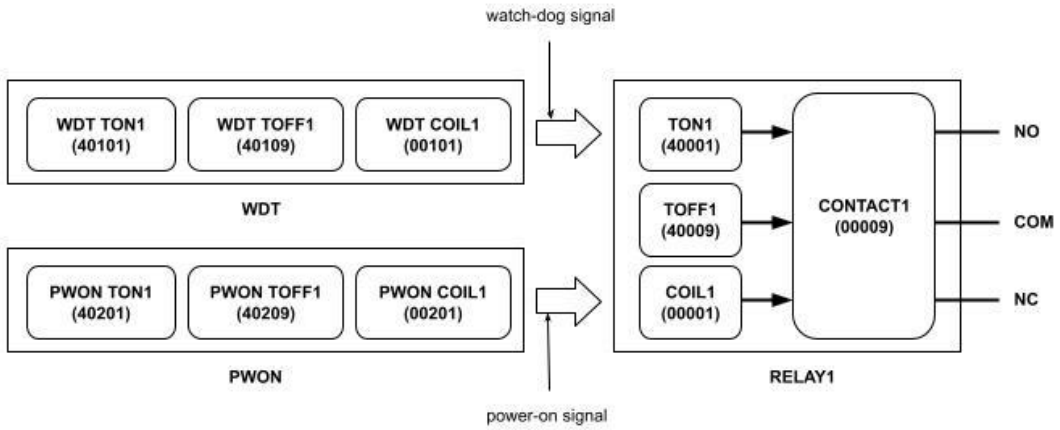
Introduction

RTU-RL8xxM is a slave board for Modbus 2-wire RS-485 serial communication. It connects to RS-485 network using Modbus RTU and ASCII protocols. It has eight relays which can be configured for working in three different modes, an on/off mode, a timer mode, and a pulse-with-modulation mode. All registers are performed through serial communication. Also, the relays can be previously defined states for powering-on, resetting and communication failure of the board.

Registers

The RTU-RL8xxM has three main groups of registers dealing with each relay. They are RELAY, WDT and PWON registers. And it has some registers for communication and auxiliary. The communication registers are used to configure Modbus network communication. For the auxiliary registers are used for troubleshooting.

Each relay has four registers, COIL, CONTACT, TON, and TOFF registers. These registers can be specified values for working in three different modes, ON/OFF mode, Timer mode, and Pulse-With-Modulation (PWM) mode. Users can read and write to the COIL, TON and TOFF registers but cannot write to the CONTACT register. This register just only be read. The CONTACT register is an action between COM, NC, and NO contacts. The CONTACT registers will be "1" when the relays turn on, but they will be "0" when the relays turn off. The following is a diagram of RELAY1. RELAY2 to RELAY8 have the same model as RELAY1. When the board is powered-on or reset, PWON registers load into RELAY registers. But the WDT registers load into RELAY registers when the communication-watchdog timer expires.



ON/OFF Mode

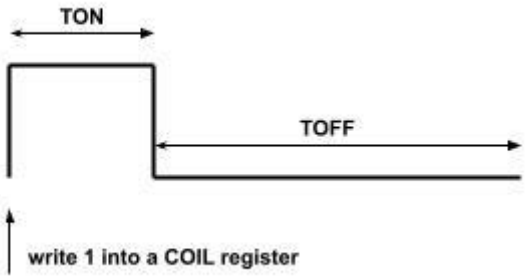
This mode allows the users to turn on/off relays. If the users want to turn on a relay. The value of TOFF register must be "0" and the value of the TON register must be greater than zero. And then the users must write "1" into the COIL register. But if the users want to turn off the relay. The value of the COIL register or the TON register must be "0". The value of the CONTACT register will be "1" when the relay turns on, but "0" when the relay turns off.

Write values			Read values
COIL	**TON**	**TOFF**	**CONTACT**
1	1 - 65535	0	1
1	0	don't care (0 - 65535)	0
0	don't care (0 - 65535)	don't care (0 - 65535)	0

Timer Mode

This mode allows the users to turn on a relay for a desired time. By writing 65535 into the TOFF register and setting a desired time into the TON register. The value in the TON register must be greater than zero. After "1" is written into the COIL register the relay contacts will turn on. The relay contacts turn off when the TON timer expires. While the relay is turning on, the value of the CONTACT register will be "1".

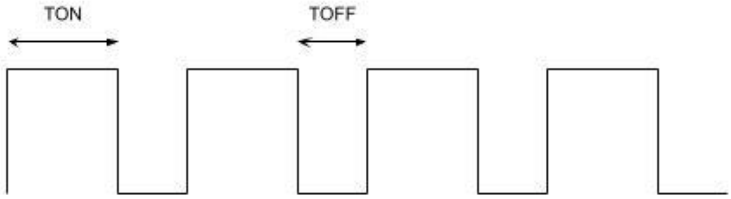
Write values			Read values
COIL	**TON**	**TOFF**	**CONTACT**
1	1 - 65535	65535	"1" for a specified time of TON and then go to "0"



Pulse With Modulation (PWM) Mode.

This mode allows the users to set up each relay to generate pulse-with-modulation signal. If the users want a relay to generate a pulse-with-modulation signal. The users must write a desired time-on period into the TON register and write a desired time-off period into the TOFF register. The relay will generate a pulse-with-modulation signal when the value in the COIL register is "1". The users can read the CONTACT register to know the state of the relay. While the relay contacts close, the value in the CONTACT register is "1", otherwise the value is "0".

Input values			Output values
COIL	TON	TOFF	CONTACT
1	1 - 65535	1 - 65534	0, 1 (PWM)



Register Summary

Register Names	Modbus PDU Addresses	Device Data Addresses	Descriptions	Values		Units	Functions		
				MIN.	MAX.		Write	Read	R/W
COIL1	00001	00002	A coil of relay1	0	1		FC05, FC15	FC01	R/W
COIL2	00002	00003	A coil of relay2	0	1		FC05, FC15	FC01	R/W
COIL3	00003	00004	A coil of relay3	0	1		FC05, FC15	FC01	R/W
COIL4	00004	00005	A coil of relay4	0	1		FC05, FC15	FC01	R/W
COIL5	00005	00006	A coil of relay5	0	1		FC05, FC15	FC01	R/W
COIL6	00006	00007	A coil of relay6	0	1		FC05, FC15	FC01	R/W
COIL7	00007	00008	A coil of relay7	0	1		FC05, FC15	FC01	R/W
COIL8	00008	00009	A coil of relay8	0	1		FC05, FC15	FC01	R/W
CONTACT1	00009	00010	Visual contacts of relay1	0	1		FC05, FC15	FC01	R
CONTACT2	00010	00011	Visual contacts of relay2	0	1		FC05, FC15	FC01	R
CONTACT3	00011	00012	Visual contacts of relay3	0	1		FC05, FC15	FC01	R
CONTACT4	00012	00013	Visual contacts of relay4	0	1		FC05, FC15	FC01	R
CONTACT5	00013	00014	Visual contacts of relay5	0	1		FC05, FC15	FC01	R
CONTACT6	00014	00015	Visual contacts of relay6	0	1		FC05, FC15	FC01	R

Register Names	Modbus PDU Addresses	Device Data Addresses	Descriptions	Values		Units	Functions		
				MIN.	MAX.		Write	Read	R/W
CONTACT7	00015	00016	Visual contacts of relay7	0	1		FC05, FC15	FC01	R
CONTACT8	00016	00017	Visual contacts of relay8	0	1		FC05, FC15	FC01	R
TON1	40001	40002	Time-on period of relay1	0	65535	100 ms	FC06, FC16	FC03	R/W
TON2	40002	40003	Time-on period of relay2	0	65535	100 ms	FC06, FC16	FC03	R/W
TON3	40003	40004	Time-on period of relay3	0	65535	100 ms	FC06, FC16	FC03	R/W
TON4	40004	40005	Time-on period of relay4	0	65535	100 ms	FC06, FC16	FC03	R/W
TON5	40005	40006	Time-on period of relay5	0	65535	100 ms	FC06, FC16	FC03	R/W
TON6	40006	40007	Time-on period of relay6	0	65535	100 ms	FC06, FC16	FC03	R/W
TON7	40007	40008	Time-on period of relay7	0	65535	100 ms	FC06, FC16	FC03	R/W
TON8	40008	40009	Time-on period of relay8	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF1	40009	40010	Time-off period of relay1	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF2	40010	40011	Time-off period of relay2	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF3	40011	40012	Time-off period of relay3	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF4	40012	40013	Time-off period of relay4	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF5	40013	40014	Time-off period of relay5	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF6	40014	40015	Time-off period of relay6	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF7	40015	40016	Time-off period of relay7	0	65535	100 ms	FC06, FC16	FC03	R/W
TOFF8	40016	40017	Time-off period of relay8	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT COIL1	00101	00102	Communication watchdog coil of relay1	0	1		FC05, FC15	FC01	R/W
WDT COIL2	00102	00103	Communication watchdog coil of relay2	0	1		FC05, FC15	FC01	R/W
WDT COIL3	00103	00104	Communication watchdog coil of relay3	0	1		FC05, FC15	FC01	R/W
WDT COIL4	00104	00105	Communication watchdog coil of relay4	0	1		FC05, FC15	FC01	R/W
WDT COIL5	00105	00106	Communication watchdog coil of relay5	0	1		FC05, FC15	FC01	R/W
WDT COIL6	00106	00107	Communication watchdog coil of relay6	0	1		FC05, FC15	FC01	R/W
WDT COIL7	00107	00108	Communication watchdog coil of relay7	0	1		FC05, FC15	FC01	R/W
WDT COIL8	00108	00109	Communication watchdog coil of relay8	0	1		FC05, FC15	FC01	R/W
WDT TON1	40101	40102	Time-On of relay1 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TON2	40102	40103	Time-On of relay2 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TON3	40103	40104	Time-On of relay3 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TON4	40104	40105	Time-On of relay4 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TON5	40105	40106	Time-On of relay5 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TON6	40106	40107	Time-On of relay6 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W

Register Names	Modbus PDU Addresses	Device Data Addresses	Descriptions	Values		Units	Functions		
				MIN.	MAX.		Write	Read	R/W
WDT TON7	40107	40108	Time-On of relay7 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TON8	40108	40109	Time-On of relay8 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF1	40109	40110	Time-Off of relay1 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF2	40110	40111	Time-Off of relay2 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF3	40111	40112	Time-Off of relay3 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF4	40112	40113	Time-Off of relay4 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF5	40113	40114	Time-Off of relay5 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF6	40114	40115	Time-Off of relay6 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF7	40115	40116	Time-Off of relay7 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
WDT TOFF8	40116	40117	Time-Off of relay8 when communication is failure.	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON COIL1	00201	00202	A coil of relay1 when power-on	0	1		FC05, FC15	FC01	R/W
PWON COIL2	00202	00203	A coil of relay2 when power-on	0	1		FC05, FC15	FC01	R/W
PWON COIL3	00203	00204	A coil of relay3 when power-on	0	1		FC05, FC15	FC01	R/W
PWON COIL4	00204	00205	A coil of relay4 when power-on	0	1		FC05, FC15	FC01	R/W
PWON COIL5	00205	00206	A coil of relay5 when power-on	0	1		FC05, FC15	FC01	R/W
PWON COIL6	00206	00207	A coil of relay6 when power-on	0	1		FC05, FC15	FC01	R/W
PWON COIL7	00207	00208	A coil of relay7 when power-on	0	1		FC05, FC15	FC01	R/W
PWON COIL8	00208	00209	A coil of relay8 when power-on	0	1		FC05, FC15	FC01	R/W
PWON TON1	40201	40202	Time-On of relay1 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TON2	40202	40203	Time-On of relay2 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TON3	40203	40204	Time-On of relay3 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TON4	40204	40205	Time-On of relay4 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TON5	40205	40206	Time-On of relay5 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TON6	40206	40207	Time-On of relay6 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TON7	40207	40208	Time-On of relay7 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W

Register Names	Modbus PDU Addresses	Device Data Addresses	Descriptions	Values		Units	Functions		
				MIN.	MAX.		Write	Read	R/W
PWON TON8	40208	40209	Time-On of relay8 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF1	40209	40210	Time-Off of relay1 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF2	40210	40211	Time-Off of relay2 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF3	40211	40212	Time-Off of relay3 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF4	40212	40213	Time-Off of relay4 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF5	40213	40214	Time-Off of relay5 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF6	40214	40215	Time-Off of relay6 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF7	40215	40216	Time-Off of relay7 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
PWON TOFF8	40216	40217	Time-Off of relay8 when power-on	0	65535	100 ms	FC06, FC16	FC03	R/W
NODE	40901	40902	node address	0	247		FC06, FC16	FC03	R/W
BAUD	40902	40903	baud rate	see details			FC06, FC16	FC03	R/W
BITS	40903	40904	data bits	7, 8			FC06, FC16	FC03	R/W
PARITY	40904	40905	parity bits	0, 2, 3			FC06, FC16	FC03	R/W
STOP	40905	40906	stop bits	1, 2			FC06, FC16	FC03	R/W
MB MODE	40906	40907	Modbus mode, RTU/ASCII	1, 2			FC06, FC16	FC03	R/W
COMM WDT	40907	40908	A timer for communication watchdog	0	65535	1 sec	FC06, FC16	FC03	R/W
RPY DLY	40908	40909	A timer for reply delay	0	65535	1 ms	FC06, FC16	FC03	R/W
UPTIME	41001	41000	Up-Time of a device	0	65535	1 sec	FC06, FC16	FC03	R/W
SYS STATUS	41002	41001	System statuses	0	15		FC06, FC16	FC03	R/W
REBOOT	42001	42000	Slave reboot, writing 4972 (0x136C) this register will reset the slave module.	0	65535		FC06, FC16	FC03	R/W
VERSION	30901	30902	Software versions	0	65535			FC04	R

PUD - Protocol Data Unit, for more details, refer to *Modbus Application Protocol Specification*.
Visual contact – the values are not the real physical contracts of relays, but they are the values of internal memories.

Register Details

COIL
These registers can be read and written. The values of these registers are not stated of relay contacts.

Relay action	Value in the registers	Relay modes
deactivate	0	ON/OFF
activate	1	
	1	TIMER
	1	PWM

CONTACT
These registers are read only. They keep the current states of relay contacts, COM, NC, and NO. They are visual contacts of relays. The values of CONTACT registers are not the real physical or mechanical values from contacts of relays, but

they are the values of internal memories. In case the contracts of relays fail to operate such as they are burned, the values of CONTRACT registers are not correct.

Actions of contacts (NO, COM)	Value in the registers
opened	0
closed	1

TON

These registers can be read and written. They are used to specify the time-on period of each relay.

Time-On period (10 ms)	Value in the register	Relay Modes
	0 - 65535	ON/OFF
100 – 6,553,500 ms	1 - 65535	TIMER
100 – 6,553,500 ms	1 - 65535	PWM

TOFF

These registers can be read and written. They are used to specify the time-off period of each relay.

Time-Off period (10 ms)	Value in the register	Relay Modes
	0 - 65535	ON/OFF
	65535	TIMER
100 – 6,553,400 ms	1 - 65534	PWM

WDT COIL

These registers can be read and written. The values of the registers are stored in EEPROM when the registers are written. When the communication-watchdog timer expires the values of these registers load into COIL registers of relays.

Relay actions	Value in the register	Relay modes
deactivate	0	ON/OFF
activate	1	
	1	TIMER
	1	PWM

WDT TON

These registers can be read and written. The values of the registers are stored in EEPROM when the registers are written. When the communication-watchdog timer expires the values of these registers load into TON registers of relays.

Time-On Period (10 ms)	Value In Register	Relay Mode
	0 - 65535	ON/OFF
100 – 6,553,500 ms	1 - 65535	TIMER
100 – 6,553,500 ms	1 - 65535	PWM

WDT TOFF

These registers can be read and written. The values of the registers are stored in EEPROM when the registers are written. When the communication-watchdog timer expires the values of these registers load into TOFF registers of relays.

Time-Off period (10 ms)	Value in the registers	Relay modes
	0 - 65535	ON/OFF
	65535	TIMER
100 – 6,553,400 ms	1 - 65534	PWM

PWON COIL

These registers can be read and written. The values of the registers are stored in EEPROM when the registers are written. When the board is powered-on or reset the values of these registers load into COIL registers of relays.

Relay actions	Value in the registers	Relay modes
Deactivate	0	ON/OFF
Activate	1	
	1	TIMER
	1	PWM

PWON TON

These registers can be read and written. The values of the registers are stored in EEPROM when the registers are written. When the board is powered-on or reset the values these registers load into TON registers of relays.

Time-On period (10 ms)	Value in the registers	Relay modes
	0 - 65535	ON/OFF
100 – 6,553,500 ms	1 - 65535	TIMER
100 – 6,553,500 ms	1 - 65535	PWM

PWON TOFF

These registers can be read and written. The values of the registers are stored in EEPROM when the registers are written. When the board is powered-on or reset the values of these registers load into TOFF registers of relays.

Time-On Period (10 ms)	Value in registers	Relay modes
	0 - 65535	ON/OFF
100 – 6,553,500 ms	65535	TIMER
100 – 6,553,400 ms	1 - 65534	PWM

NODE

This register is used to specify a node address. It can be read and written. The values of this register are between 0 and 247. Address 0 is used for a broadcast address. When a Modbus function writes a node address to the register. The node address is written into EEPROM. It is not directly written into the NODE register. The NODE register will be updated when the board is powered-on or reset.

BAUD

This register is used to specify a baud rate of a serial communication. It can be read and written. When a Modbus function writes a baud rate to the register. The baud rate is written into EEPROM. It is not directly written into the BAUD register. The BAUD register will be updated when the board is powered-on or reset.

Baud rate	Value in the registers
1200	12
2400	24
4800	48
9600	96
14400	144
19200	192
28800	288
38400	384
57600	576
76800	768
115200	1152

BITS

This register is used to specify a data bit of a serial communication. It can be read and written. When a Modbus function writes the data bit to the register. The data bit is written into EEPROM. It is not directly written into the BITS register. The BITS register will be updated when the board is powered-on or reset.

Data bits	Value in the registers
7 bits	7
8 bits	8

PARITY

This register is used to specify a parity bit of a serial communication. It can be read and written. When a Modbus function writes the parity bit to the register. The parity bit is written into EEPROM. It is not directly written into the PARITY register. The PARITY register will be updated when the board is powered-on or reset.

Parity bits	Value in the registers
NONE	0
EVEN	2
ODD	3

STOP

This register is used to specify a stop bit of a serial communication. It can be read and written. When a Modbus function writes the stop bit to the register. The stop bit is written into EEPROM. It is not directly written into the STOP register. The STOP register will be updated when the board is powered-on or reset.

Stop bits	Value in the registers
1 bit	1
2 bits	2

MB MODE

MB MODE stands for Modbus mode. This register is used to specify the mode of a Modbus module. It can be read and written. When a Modbus function writes the mode to the register. The mode is written into EEPROM. It is not directly written into the MB MODE register. The MB MODE register will be updated when the board is powered-on or reset.

Modbus modes	Value in the registers
RTU	1
ASCII	2

COMM WDT

COMM WDT stands for communication-watchdog. This register is used to specify the value of timer for communication-watchdog. The communication-watchdog is reset every time a slave module receives a command from a master. Whenever a communication between the master and the slave fails, and then the communication-watchdog timer expires. The whole values of the WDT registers load into RELAY registers. The communication-watchdog can be disabled by writing "0" into COMM WDT register. The communication-watchdog is not a CPU hardware watchdog. When a Modbus function writes a timer value to the COMM WDT register. The COMM WDT register updates the new timer value and then EEPROM stores this new timer value.

Watchdog timer (seconds)	Value in the registers
1 - 65535 seconds	1 - 65535
disable	0

RPY DLY

RPY DLY stands for slave reply delay. It is used to specify a reply delay time of the slave module. Normally when a master sends commands to a salve module. The slave immediately sends back an answer to the master when the value in this register is 0. If the value in this register is greater than zero, the slave module delays for a specified time and then sends an answer back to the master. Usually, this feature is used for wireless network communication.

Delay time (ms)	Value in the registers
0 – 65,535 ms	0 - 65535

UPTIME

UPTIME stands for up time. It is a clock that counts every second. It starts counting from zero when the RTU-RL8xxM is powered-up or reset. The uptime counts until 65535, and then rolls over. The values of the UPTIME register are stored in unsigned 16-bit registers. UPTIME is not a hard real time clock, but it is a software clock simulator. So, the value of this register is not exactly accurate as the hardware real time clock.

Time (second)	Value in the registers
0 - 65535 seconds	0 - 65535

SYS STATUS

SYS STATUS stands for system statuses. SYS STATUS is a register for indicating internal hardware statuses of devices. SYS STATUS is a 16-bit unsigned register. A master program can read and write the values from/to this register. The values indicate sources of resets. The data in this register are arranged as below.

X	X	X	X	X	X	X	X	X	X	X	X	D3	D2	D1	D0

X = don't care.

The sources of reset of bit3 to bit0 of SYS STATUS register as shown below.

D3	D2	D1	D0
1 = Hardware Watchdog Reset 0 = no reset	1 = Brown-Out Reset 0 = no reset	1 = External Reset 0 = no reset	1 = Power-On Reset 0 = no reset
Clear this bit by power-on reset or by writing logic 0 to this bit.	Clear this bit by power-on reset or by writing logic 0 to this bit.	Clear this bit by power-on reset or by writing logic 0 to this bit.	Clear this bit by writing logic 0 to this bit.

Bit15 to bit4 are not used now.

Example, if A master program reads the value of 0x0005. It means the device is reset by power-on and brown-out resets. The users can read the values of this register to check what kinds of resets to re-start the device.

Reset types	Reset meaning
Power-On Reset	A power supply was applied to the board.
External Reset	The reset button on the board was pressed.
Brown-Out Reset	The power supply voltage was dropped below the reset threshold voltage.
Hardware Watchdog Reset	The firmware was failure, it was not run in normal, or some parts of hardware were failure.

REBOOT

This is a reboot(reset) register. It is an alternative method for remote rebooting slaves for the master program doesn't support the Reset Slave command of diagnostics function (08). The users must write a reset number (see the RESET NUMBER in the register table) to this register. After the slave reboots, the value of this register will be 0, it means no reset. The value of this register is not kept in EEPROM. The effect of this command is the same as power-on reset. Usually, the users must reboot the slave devices when the users change slave address and communication parameters such as baud rate and data bit because changing these parameters will affects after devices reboot.

VERSION

This register shows a firmware version of the board. If the firmware version is 2.00, the value 200 will be returned from the slave module when a master requests. This register is read only.

Configurations

RTU-RL8xxM boards must be configured before connecting them on RS-485 network. The configuration is a setting of Modbus communication parameters. Since the firmware version 2.00 has been released, the users have the methods for setting the Modbus communication parameters. The first method is writing to the Modbus holding registers. The second method is to use the jumper for setting the default parameter values. (In older firmware version, the configuration uses a terminal command line).

For the new version of firmware, the users can set the jumper to INIT and then press the reset button, the boards will set up the Modbus communication parameters to default values (as the table below). After that the users can use a Modbus master program to communicate with the RTU-RL8xxM boards with the default parameters.

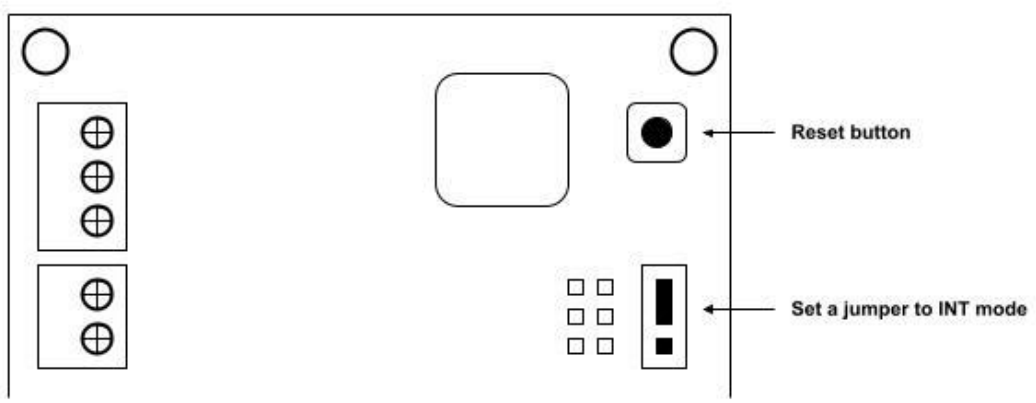
After that when the users prefer to change the Modbus communication parameters. The users can write parameter values to the holding registers of communication parameters. The written parameter values will not write to the registers immediately, but They will be written to EEPROM. However, the Modbus communication parameters in the registers will be changed when the next reset occurs. So, after the users change the communication parameters through a Modbus master program. The users must remove the jumper and reset the board. So, the RTU-RL8xxM will load the communication parameters from EEPROM to communication registers. The reset process of the boards can be three methods, a reset button, diagnostics function, and writing to the REBOOT register.

Remove the jumper and reset the boards, the TRU-RL8XXM will be in RUN mode and use communication parameters from the Modbus holding registers.

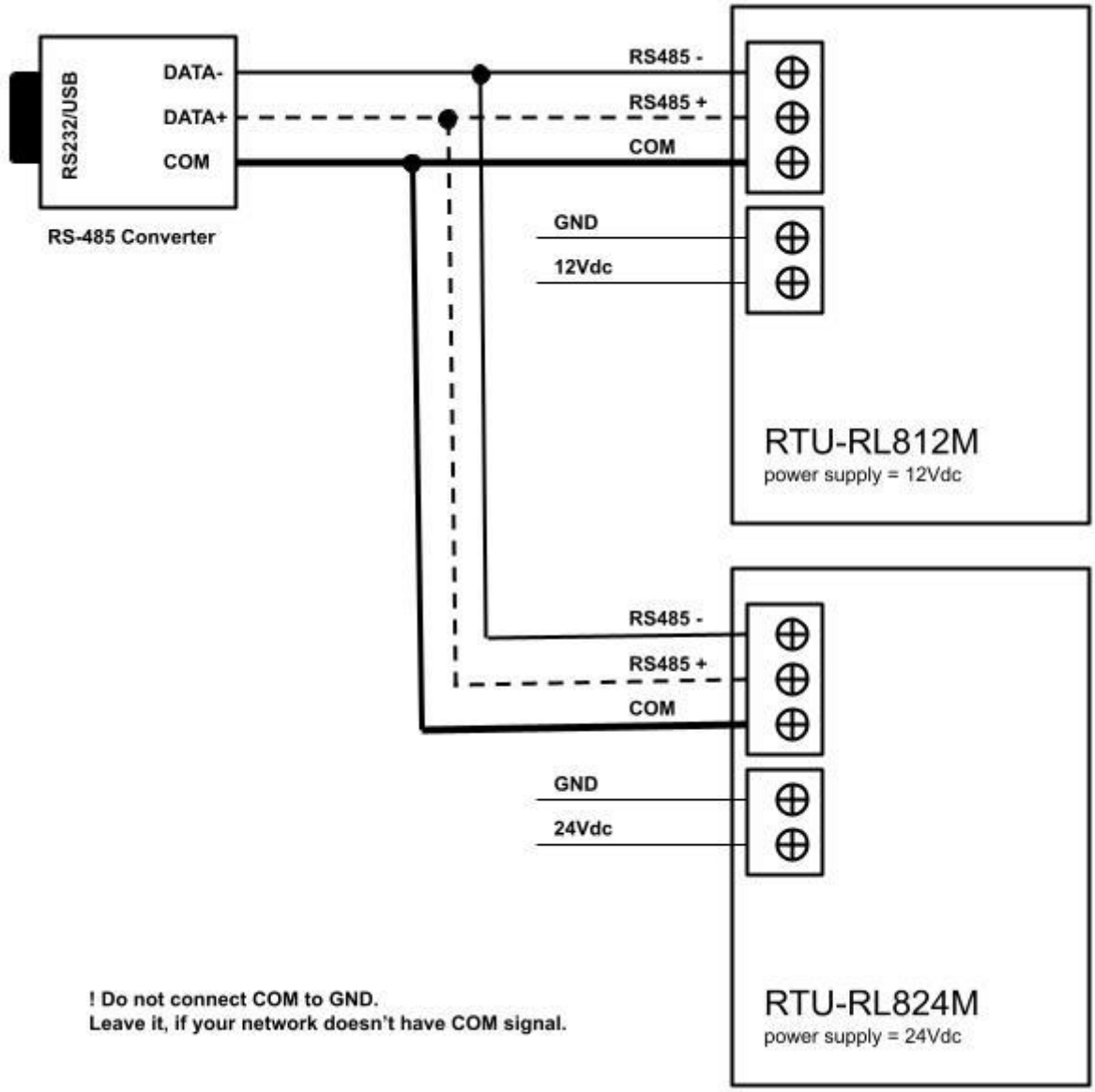
Modbus communication parameters	Default values
Slave address	1
Baud rate	9600
Parity	None.
Data bits	8
Stop bits	1
Modbus Slave Node ID	1
Modbus Slave Mode	Modbus RTU
Modbus Communication Watchdog	0
Modbus Reply Delay	0

Set Default Communication Parameters.

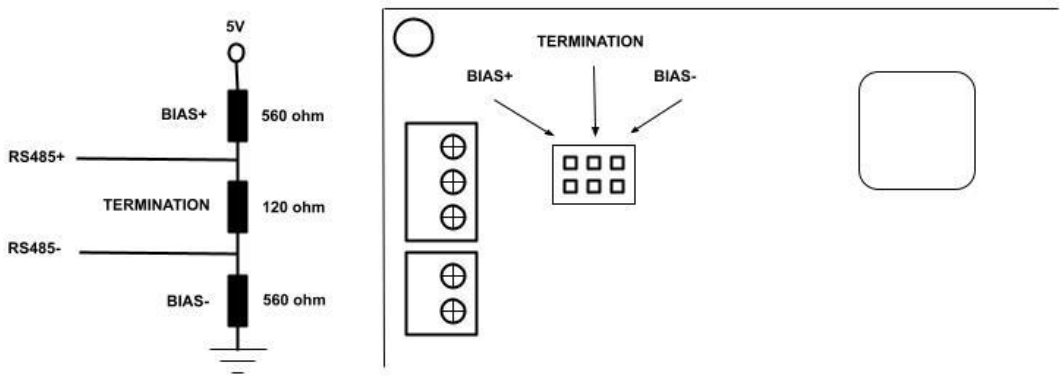
1. Connect power supply.
2. Set the jumper to INIT.
3. Press the button.
4. The RTU-RL8XXM can communicate to a master program with default values.



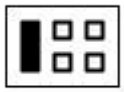
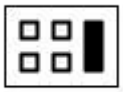
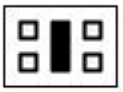
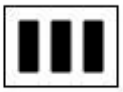
RS-485 Connection



Bias Resistors



Bias Setting

Enable BIAS+	Enable BIAS-	Enable Termination	Enable BIAS+, BIAS-	Enable All
				

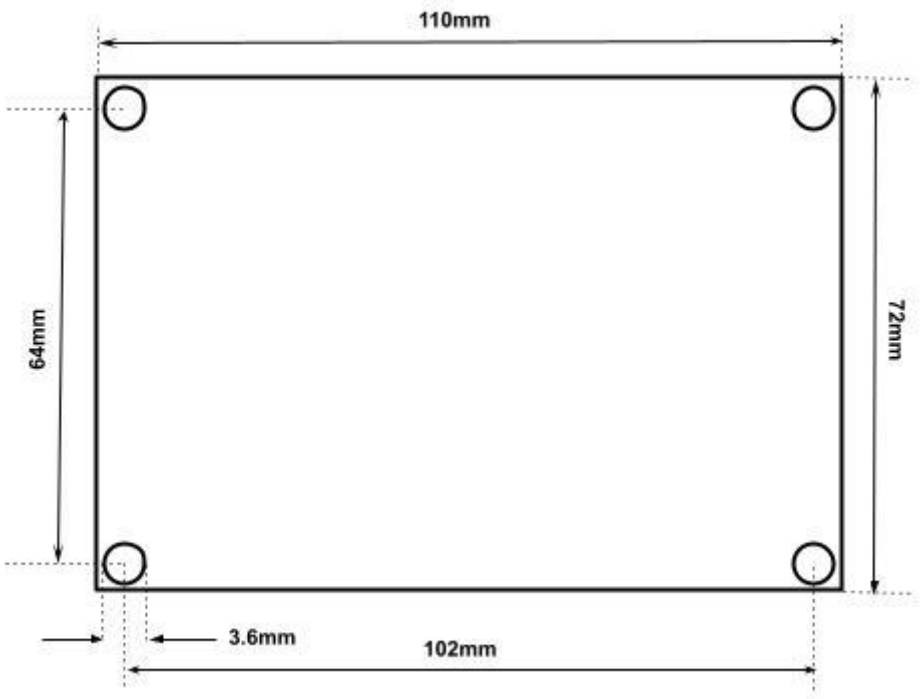
Specifications

	RTU-RL812M	RTU-RL824M
Power supply	12Vdc	24Vdc
Relay contact rating	10A @120Vac/24Vdc 6A @250Vac	10A @120Vac/24Vdc 6A @250Vac
Maximum nodes	32	32

System Requirements

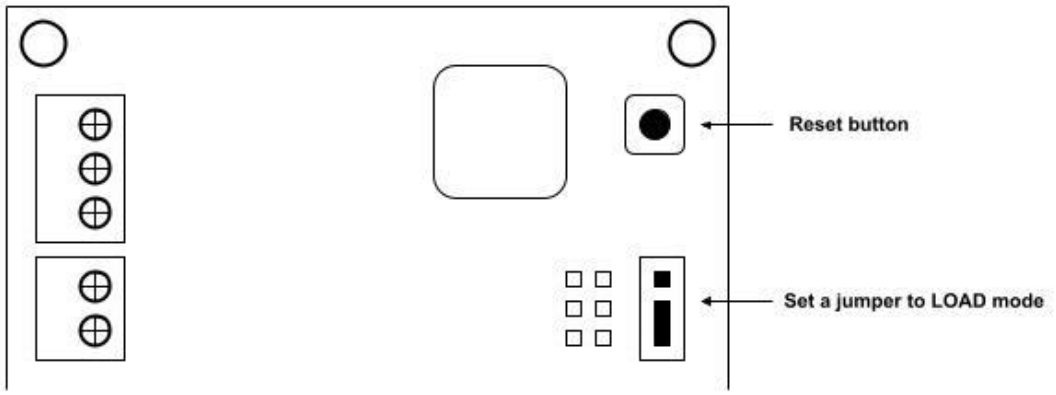
A Computer
An RS-485 Converter
A Power Supply (12Vdc, 24Vdc)

Dimensions

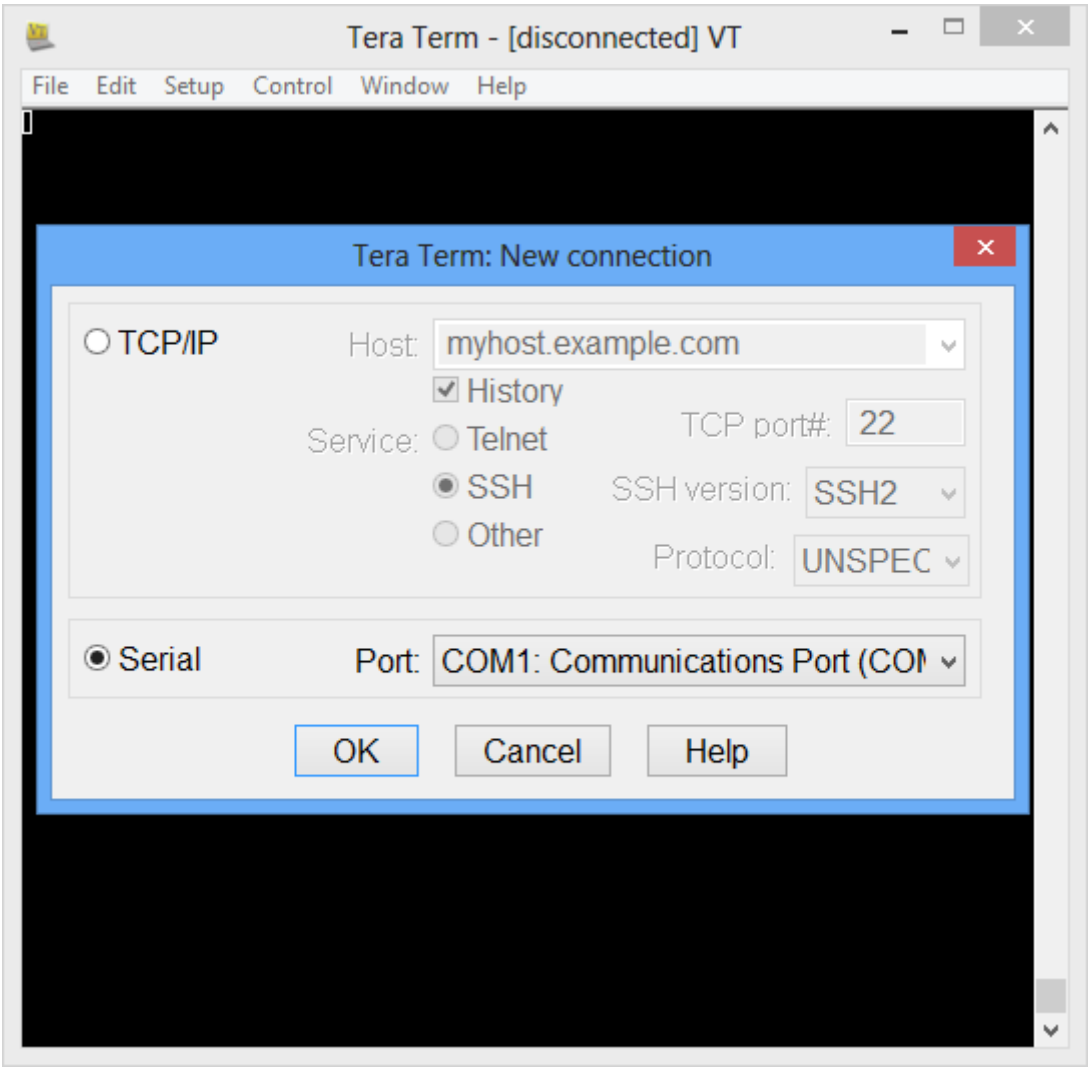


Upgrading Firmware

1. Connect the board to RS-485 converter (with auto direction control).
2. Connect power supply.
3. Set a jumper to **LOAD**.

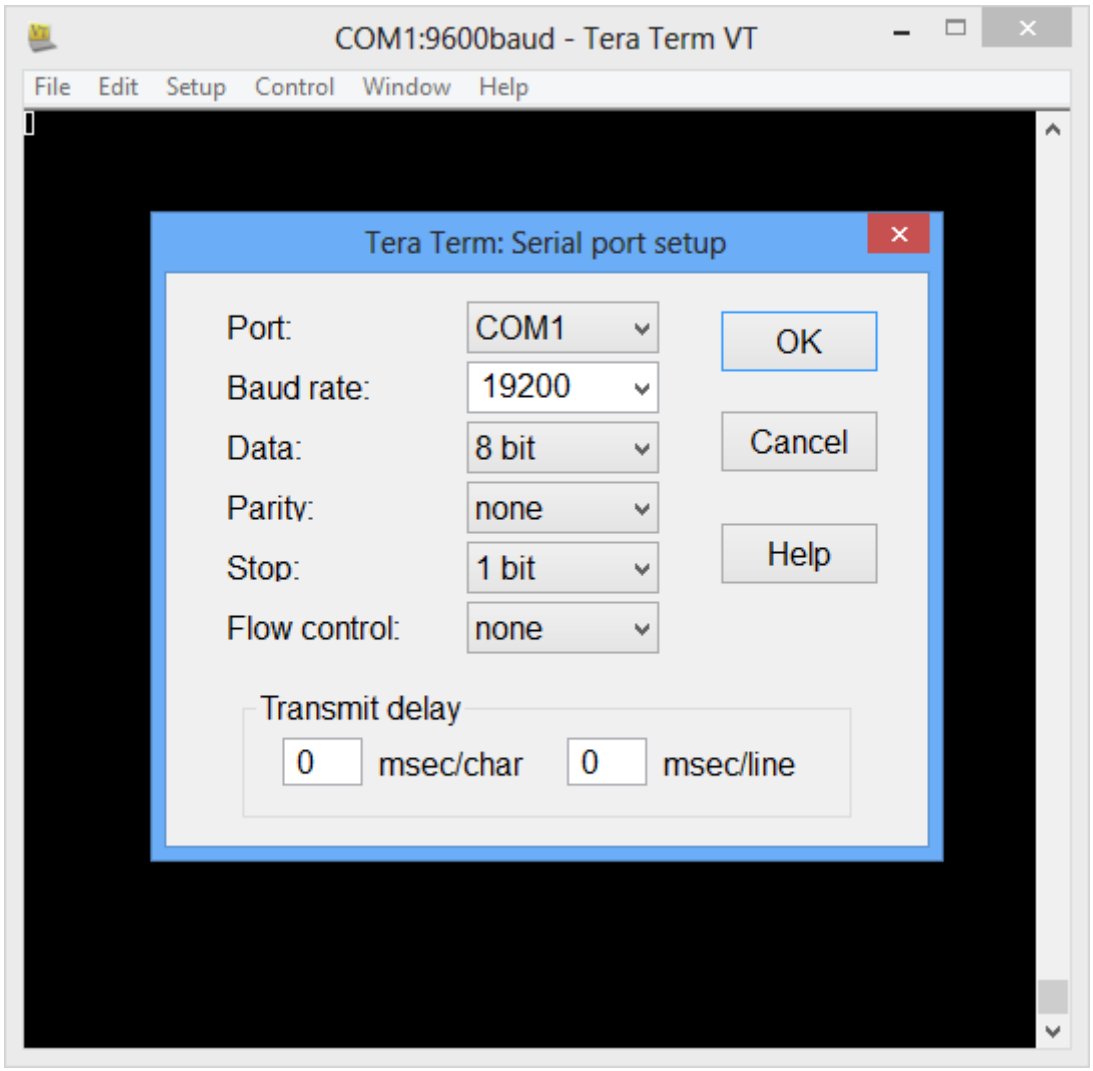


4. Run **Tera Term** program (or a serial terminal program which can send file with XMODEM).

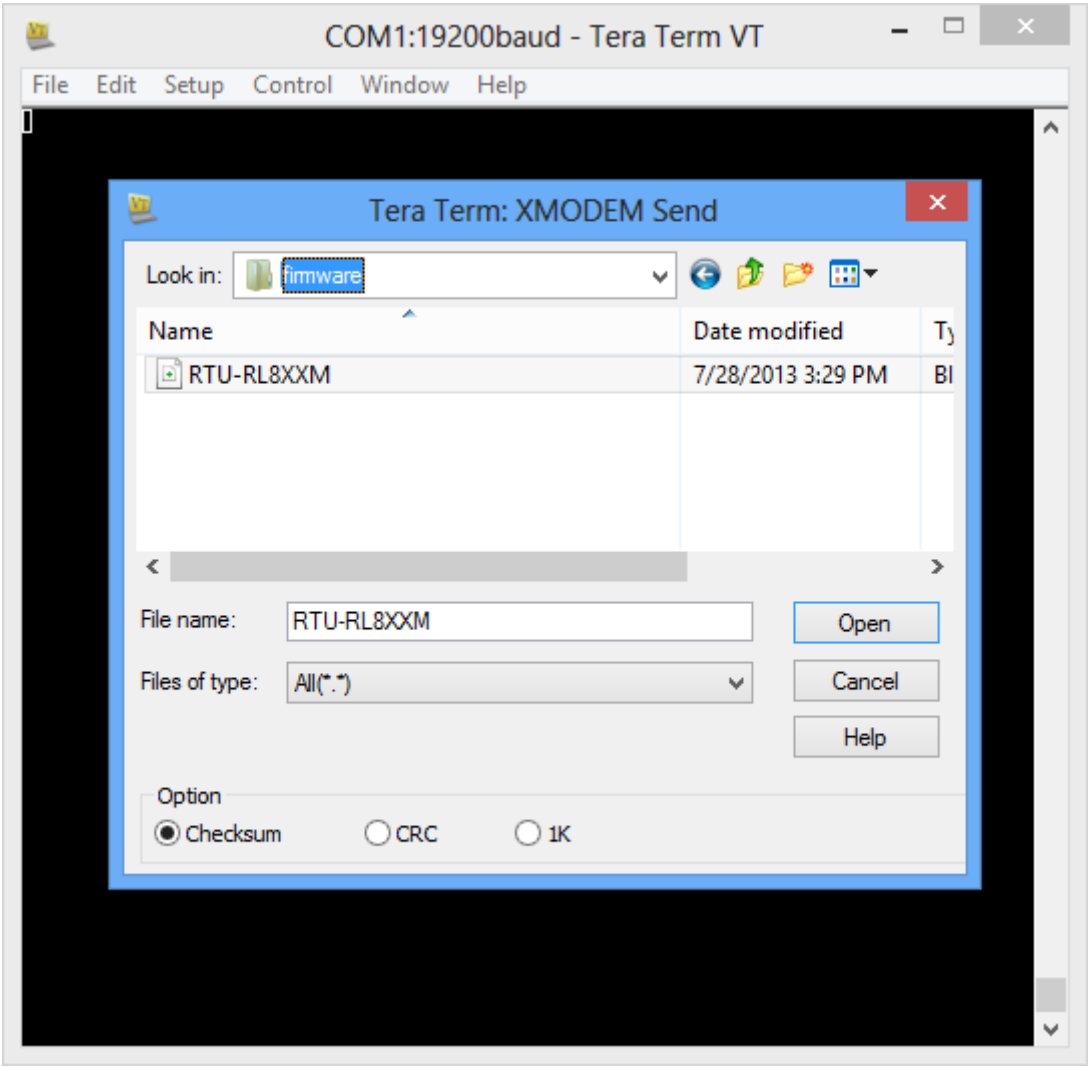


5. Select **Serial** and then click the **OK** button.
6. Setup serial port from **Setup** menu.

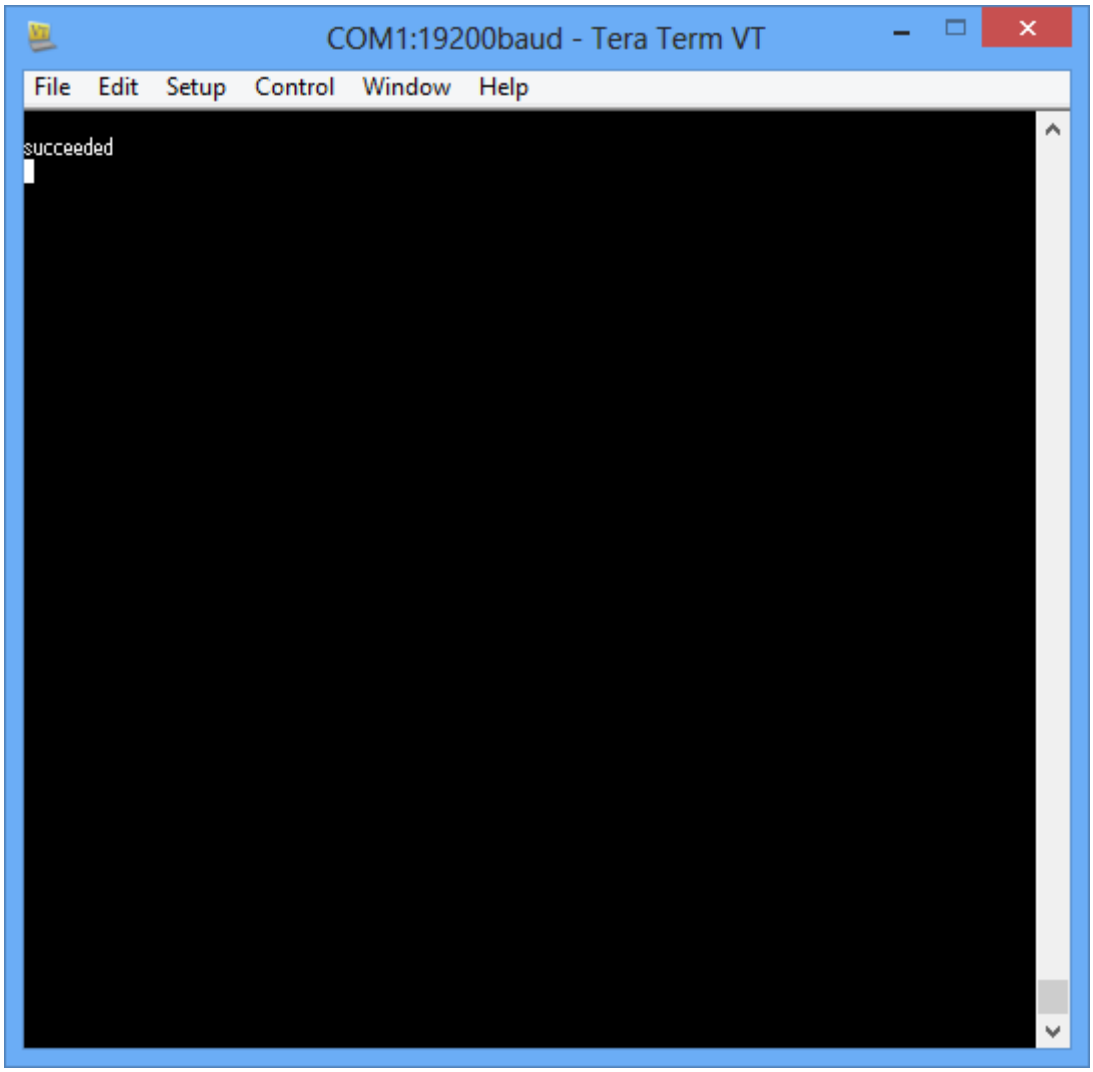
7. Set Comport, Baud rate = 19200, Data bits = 8, Parity bits = None, Stop bits = 1, Flow control = NONE and then click **OK** button.



8. Go to menu bar and select **File->Transfer->XMODEM->Send...**



9. Open a new firmware file **xxx.bin** and then click the **Open** button.
10. Press the **RESET** button on the board the LED will blink and wait until the screen shows succeeded.



11. Remove the jumper and press the **RESET** button to run the program in normal mode.
12. In case the upgrading firmware is failure, the computer screen doesn't show a progress of upgrading, or the upgrading is stuck. Back to step4 then try to do it again.

Modbus Functions

The RTU-RL8xxM supports many Modbus functions as the table below.

Function Codes	Function Names
01 (0x01)	Read Coils
03 (0x03)	Read Holding Registers
05 (0x05)	Write Single Coil
06 (0x06)	Write Single Register
07(0x07)	Read Exception Status
08 (0x08)	Diagnostics Function
15 (0x0F)	Write Multiple Coils
16 (0x10)	Write Multiple Registers
17 (0x11)	Report Slave ID
22 (0x16)	Mask Write Register
23 (0x17)	Read/Write Multiple Registers

Read Exception Status 07(0x07)

This function code is used to read eight Exception Status outputs. The eight Exception Status outputs indicate in a byte (8 bits). For the RTU-RL8xxM will response 0 (0x00)

Request		Response	
Function	0x07	Function	07(0x07)

		Data	00(0x00)

Diagnostics Function 08(0x08)

The RTU-RL8xxM supports the sub-function codes as below.

Sub-function code	Name
0x0000	Return query data
0x0001	Restart communication option

(0x0000) Return Query Data

The data passed in the request field will be returned in the response.

Request		Response	
Function	08(0x08)	Function	08(0x08)
Sub-function HI	00(0x00)	Sub-function HI	00(0x00)
Sub-function LO	00(0x00)	Sub-function LO	00(0x00)
Data HI	79(0x4F)	Data HI	79(0x4F)
Data LO	33(0x21)	Data LO	33(0x21)

(0x0001) Restart Communication Option

This command is used to reboot a device. The effect of this command is the same as power-on reset. Usually, the users must reboot the slave devices when the users change slave address and communication parameters such as baud rate, data bits, and parity bits because changing these parameters will affect after devices reboot.

The sub-function 01 (Restart Communications) of the Diagnostics Function (08) is used to reset the devices. This command doesn't operate on any registers. The broadcast (slave address 0) is not supported for this command. The device will be re-initialized after a few seconds of this command has been taken.

Sub-function codes	Data Field	Actions
0x0001	0x0000	Reset and leave comm event log.
0x0001	0xFF00	Reset but clear comm event log.

*The RTU-RL8xxM has no Event Log.

Request		Response	
Function	08(0x08)	Function	08(0x08)
Sub-function HI	00(0x00)	Sub-function HI	00(0x00)
Sub-function LO	01(0x01)	Sub-function LO	01(0x01)
Data HI	00(0x00)	Data HI	00(0x00)
Data LO	00(0x00)	Data LO	00(0x00)

Report Salve ID 17 (0x11)

This function is used to read description and information specific to the device. For the RTU-RL8XXM the Slave ID is always 0x00 that means the device model is RTU-RL8XXM. The Run Indicator Status is always 0xFF.

Request		Response	
Function	17(0x11)	Function	17(0x11)
		Salve ID	00(0x00) = RTU-RL8xxM
		Run indicator status	255(0xFF) = ON

Modbus Exception Responses

From Modbus exception responses in the Modbus Application Protocol specification. One of four cases for responding to a master can occur.

- If the master device receives the request without a communication error, and can handle the query normally, it returns a normal response.
- If the master does not receive the request due to a communication error, no response is returned. The master program will eventually process a timeout condition for the request.
- If the slave device receives the request, but detects a communication error (parity, LRC, CRC, …), no response is returned. The master program will eventually process a timeout condition for the request.

The RTU-RL8xxM(s) reserve a size of communication buffer for the longest consecutive sequence of coils and registers on them. They don't reserve the communication buffer for the maximum possible consecutive sequence of coils, discreate inputs, and registers as specified in the Modbus specification.

In case the master sends a long continuous data to the RTU-RL8xxM causes of the communication buffer overflow, no response is returned. The master program will eventually process a timeout condition for this request.

- If the salve device receives the request without a communication error, but cannot handle it (for examples, if the request is to read a non-existent output or register), the slave device will return an exception response informing the master of the nature of the error. See the exception responses in Modbus Exception Codes.

Modbus Exception Codes

Since firmware version 2.00, the RTU-RL8xxM has fixed bug for supporting four exception response as the table below. The users who are using older versions can download a new version of firmware, and then do the instructions of firmware upgrading.

Exception Codes	Exception Names
01	ILLEGAL FUNCTION
02	ILLEGAL DATA ADDRESS
03	ILLEGAL DATA VALUE
04	SLAVE DEVICE FAILURE

Firmware Releases

Firmware Version 2.00
- Change initialization or configuration method.
- Fixed bugs of exception responses.
- Fixed bugs of function code 04 for reading version register.
- Added the UPTIME register.
- Added the SYS STATUS register.
- Added the REBOOT register.
- Added the Modbus function code 07(0x07) read exception status.
- Added the Modbus diagnostics function code 08 (0X08) and the slave reset command.
- Added the Modbus function code 17(0x11) report slave ID.
- Added the Modbus function code 22(0x16) mask write register.
- Added the Modbus function code 23(0x17) read/write multiple registers.

Firmware Version 1.00
- First released.

Declaration

ERE Company Limited continue to improve our products. Therefore, we reserve the right to change the specifications at any time without notice.