User Manual

RF Audio/Data Modem

MD-100D VHF

MD-400D UHF

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1. MD-100D/400D Digital RF Modem Main Functions

The MD-100D / 400D digital RF modem has standardized the external appearance and connector specifications to maintain compatibility with existing analog modems.
It also supports voice call and data communication with DMR transceiver and standard.

When making a voice call, use external microphone and speaker as same as existing digital radio.
It is possible to use transmitter and receiver as a single device when it is used for the village broadcasting.
In case of data communication, it can be used as a general data modem and it is designed to use AT COMMAND.

MD-100D / 400D supports dual (analog / digital) mode. It is compatible with existing analog modem or transceiver. When using digital mode, it is very efficient in data error, clean sound quality and volume, distance and usage time.
32 channel can be selected by using internal DIP switch.

MD-100D/400D Series main functions are below,

- Frequency band - VHF: 150.8~173.4MHz, UHF: 400~470MHz.
- 1 Zones 32 channel selection (1zone = Max 32 channel) .
- Total 32 channels can be set.
- RF Power - VHF : 10 Watt, UHF : 5Watt
- ETSI Standard DMR Protocol Tier1, 2
- Industry Standard AMBE+2 Voice Codec
- Dual mode(Digital & Analog)
- Add AT Command for user convenience.
- 3wires continuous mode / 5wires continuous mode
- Standard 1Vrms Audio Output (adjustable up to 2.5Vrms).
- Carrier Detector
- Encryption mode (AES128, 192, 256) - Option
- RF Communication Data Speed : 9,600bps
- RS-232C communication speed : standard 115,200bps(changed according to program setting)
- PC-based modem Control GUI Software for user convenience
- Aluminum metal Frame Body
- Service Connector : DE-15 Pin Female Connector
- Power Supply Voltage : DC +12V
- Dimensions : 4.77”(H) x 2.44”(W) x 0.96”(D)

2. Specification

2.1 MD-100D/400D

General Information

Frequency Range	MD-100D : 136~174 MHz MD-400 : 400 ~470 MHz
Frequency Stability	±1.5ppm (-30 to +60℃)
Numbers of Channel	1 Zones / 32 Channels
Channel Spacing	12.5KHz
Digital Vocoder	AMBE++
Size	110mm(H) x 25mm(W) x 51mm(D)
Weight	280g
Power	DC +12
Current Consumption	Receive Mode, When using Audio – 350 mA (Audio Max) Transmit Mode – 1,200mA Standby Mode – 110mA

Receiver Specifications

Reception Sensitivity	0.25uV 12 dB SINAD
Squelch Sensitivity	0.22uV 10dB SINAD
Selectivity	65dB (12.5KHz)
Spurious and Harmonic Rejection	70dB
FM Hum and Noise	40dB (12.5KHz)
Audio Output	1Vrms
Audio Distortion	Less than 3%
Audio Characteristics	+1, -3 dB from 6dB per octave de-emphasis Characteristic from 300 ~ 3000Hz

Transmitter Specifications

RF Output	VHF : 10/2 Watt, UHF : 5/2Watt
Spurious and Harmonic	70dB
FM Hum and Noise	40dB (12.5KHz)
Audio Distortion	Less than 3%
Audio Characteristics	+1, -3dB from 6dB per octave pre-emphasis Characteristic from 300 ~ 3000Hz
Output Impedance	50ohms

3. Specification

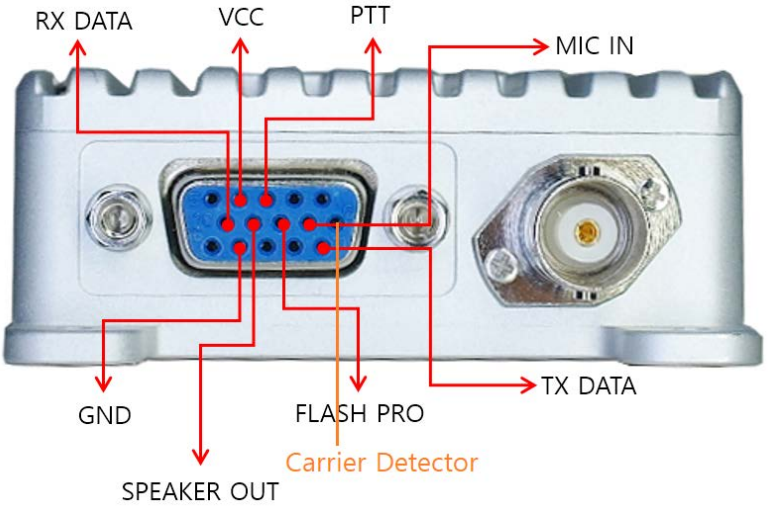
3.1 MD-100D/400D Overview

MD-100D/400D are digital RF modem that supports data and voice communication. It supports serial interface, and it is set and operated with AT command, also it can be applied in various fields.

3.2 MD-100D/400D functions

-. RF Communication Data Speed : 9,600bps
-. Serial Interface support (AT Command) : 115,200 bps
-. Frequency band : 400MHz ~ 470MHz

3.3 MD-100D/400D External Interface



Picture 3-1) Main Pin Specification

Picture 3-2) MD-100D/400D Digital RF Modem

3.4 D-SUB 15Pin Connector Specification

Pin NO	Pin Name	Pin Description	I/O
1	Not use		
2	Not use		
3	PTT	Low Active	I
4	DC12V	DC+12V	I
5	**CTS**		**I**
6	Carrier Detector		O
7	MIC_IN	30mV @ 2KHz Dev	I
8	FLASH_PRO		I
9	SPEAKER_OUT	300mV @ 1KHz dEV	O
10	RX_DATA	3.3V TTL	I
11	TX_DATA	3.3V TTL	O
12	**RTS**		**O**
13	GPS_TX_DATA	3.3V TTL	O
14	Ground	Ground	
15	GPS_RX_DATA	3.3V TTL	I

Figure 3-3) D-SUB 15PIN

3.5 MD-100D/400D Drawing

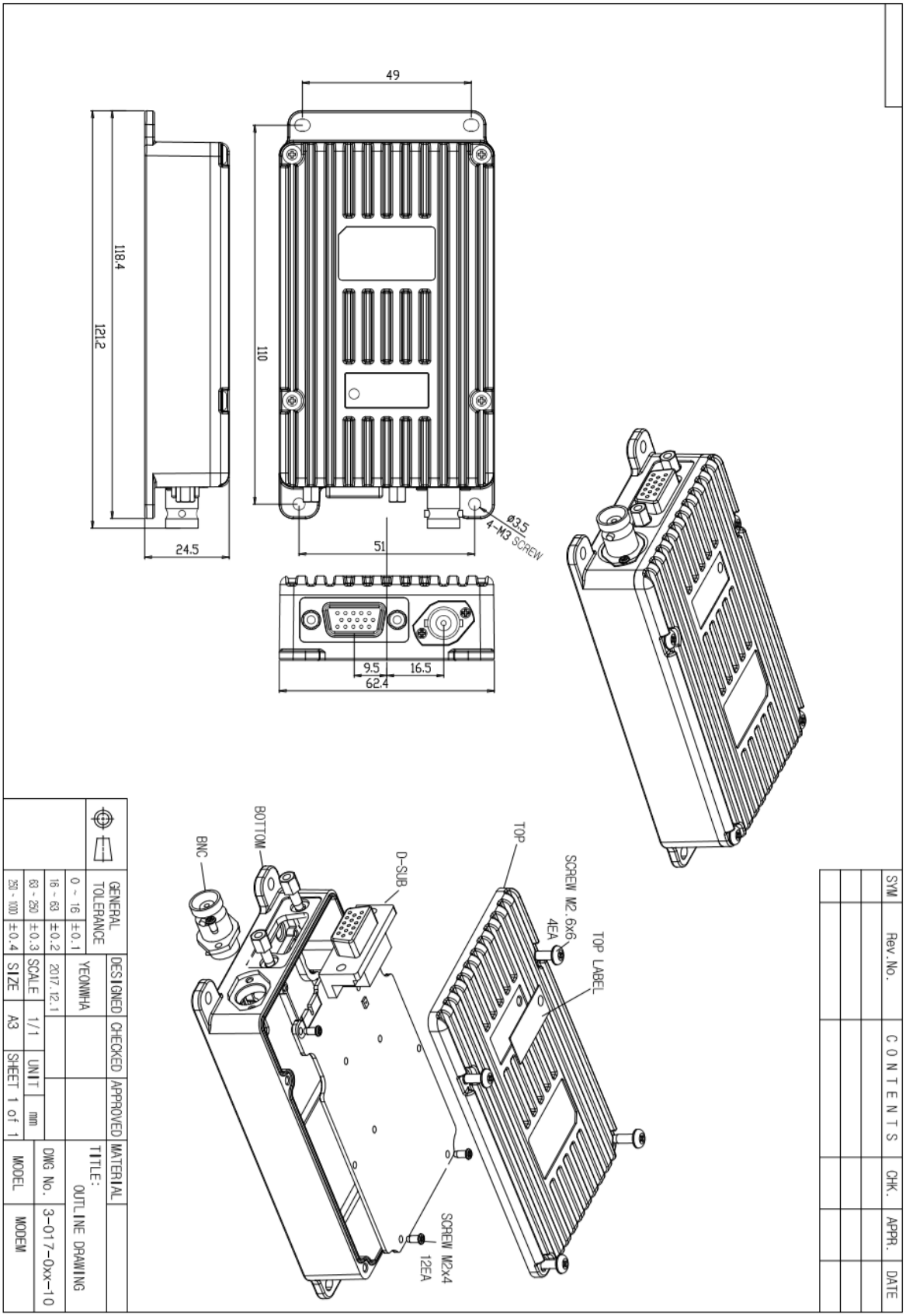
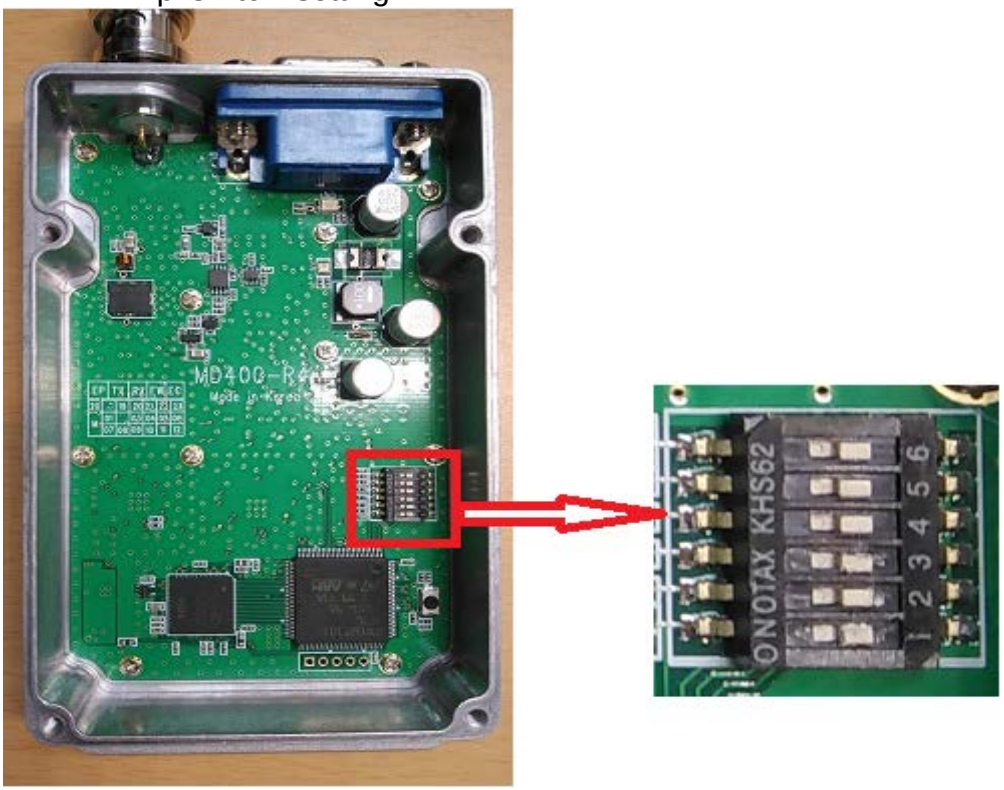


Figure 3-4) MD-100D/400D Drawing

4. How to set DIP Switch

4.1. Dip switch setting



Picture 4-1) Dip Switch TX Power setting and channel setting

4.2 TX Power Setting

TX Power is changed by Switch No.6
Factory default TX Power value is High

Dip Switch	Power Value
	Low Power
	High Power

Picture 4-2) DIP Switch RF Power Setting

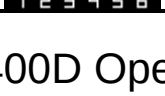
4.3 Channel Setting

There are two ways to set the channel: DIP switch and AT command.
DIP switch channel setting method can be set by using DIP switch 1, 2, 3, 4, 5, total 32 channels.
AT Command channel setting has the following rules for the priority of the two methods.
When the power is turned on, the MD-100D / 400D operates as follows.
1) The channel is set according to the DIP switch when booting.
2) When changing channel with AT Command, DIP Switch will be ignored and return to DIP Switch setting through AT Command (AT * DIP = 1).

DIP Switch Meaning
1 DIP Switch: Binary 5 digit
2 DIP Switch: Binary 4th digit
3 DIP Switch: Binary 3rd digit
4th DIP Switch: 2nd digit in binary
5th DIP Switch: Binary 1st digit

Below is the channel table according to DIP Switch status.

DIP Switch	Binary	Channel Value
	00000	1

			00001	2
			00010	3
			00011	4
			00100	5
			00101	6
			00110	7
			00111	8
			01000	9
			01001	10
			01010	11
			01011	12
			01100	13
			01101	14
			01110	15
			01111	16
			10000	17
			10001	18
			10010	19
			10011	20
			10100	21
			10101	22
			10110	23
			10111	24
			11000	25
			11001	26
			11010	27
			11011	28
			11100	29
			11101	30
			11110	31
			11111	32

5. MD-100D/400D Operation Mode

MD-100D / 400D supports 3 modes: 1) AT Command mode and 2) continuous mode for keyboard input or file transfer using Tera term.

MD-100D/400D operation mode
1) AT Command mode
2) 3 Wires continuous mode
-. Operates in 3 Wire Mode (TXD, RXD, GND).
3) 5 Wires continuous mode (used for many data transmission)
-. Supports H / W flow control using TXD, RXD, CTS, RTS, GND.

When the MD-100D / 400D data modem is booted for the first time, AT Command mode is set.
To change from AT Command mode to Continuous mode, use AT Command as shown below.

Description	MD-100D/400D Operation Mode Setting
Query Answer	AT*CMODE=* “CMODE : * “CMODE OK”
Parameters	3WIRES 5WIRES OFF
Example	AT*CMODE=3WIRES AT*CMODE=5WIRES AT*CMODE= OFF Select the required mode from above

6. AT Command interface

Set the status of MD-100D/400D or user AT Command for function operation. The serial Speed is 115,200 bps.

6.1 VERSION

Description	**Command to check the modem version**
Query Answer	AT*VERSION *VERSION:<value>
Parameters	
Example	AT*VERSION *VERSION:YEONHWA Modem v1.0 OK

6.2 RESET

Description	**Command for reset the modem**
Query Answer	AT*RESET RESET
Parameters	
Example	AT*RESET RESET Going down terminal…

6.3 MSG

Description	**Command for sending a message**
Query Answer	AT*MSG=<value> OK
Parameters	문자열
Example	AT*MSG=AA OK

6.4 VOL

Description	Command for the checking or set the modem volume
Query Answer	AT*VOL? GET VOLUME(<value>)=(<value>)

	AT*VOL=<value> SET VOLUME(<value>)=(<value>)
Parameters	1 ~ 16
Example	AT*VOL? GET VOLUME(15)=(150) AT*VOL=5 SET VOLUME(5)=(47)

6.5 OID

OWN ID setting is available only in CPS program, and can be checked in AT Command only.

Description	**Command for checking OWN ID**
Query Answer	AT*OID? OID:00000001 OK
Parameters	
Example	AT*OID? OID:00000001 OK

6.6 CHKSTAT

Description	**Status check command**
Query Answer	AT*CHKSTAT? *CHKSTAT:STAT OK OK
Parameters	
Example	AT*CHKSTAT? *CHKSTAT:STAT OK OK

6.7 DIP

Description	DIP switch is ignored when setting the channel with AT Command. If you want to change the channel using the DIP switch again, you can use this command to change the channel so that it can be changed by DIP Switch operation
Query Answer	AT*DIP? *DIP=<value> OK AT*DIP=<value> *DIP SET=<value> OK
Parameters	1: Channel setting using DIP Switch 0: Channel setting using AT Command
Example	AT*DIP? *DIP=1 OK AT*DIP=<value> *DIP SET=<value> OK

6.8 CID

Description	Call ID check and setting command Basically, it communicates with Call ID set in CPS tool. You can change the Call ID with this command, and when changing the channel, it will be reset to the Call ID set in the CPS tool.
Query Answer	AT*CID? CUR-CID:<call id>,CF:<call format>

	CID[<index>]:<call id>,CF:<call format> [반복] CALLID OK AT*CID=1 SET CUR-CID:01 CID[01]:00000002,CF:GRP CALLID OK
Parameters	
Example	AT*CID? CID[00]:00000001,CF:GRP CID[01]:00000002,CF:GRP CID[02]:00000003,CF:GRP CID[03]:00000010,CF:GRP CID[04]:********,CF:ALL CALLID OK

6.9 CHSET

Description	Channel setting command (When this command is used, channel value changed by DIP Switch is ignored.)
Query Answer	AT*CHSET=<channel number> CH:<channel number>:<Channel type>,RX:<RX Frequency>,<RX CC>,TX:<TX Frequency>,<TX CC> OK
Parameters	
Example	AT*CHSET=1 CH:01:DMR,RX:41050000,01,TX:41050000,01 OK

6.10 CHLIST

Description	Show channel list command
Query Answer	AT*CHLIST? CUR-CHNUM:<Current channel number> <number>:<Channel type>,RX:<RX Frequency>,<RX CC>,TX:<TX Frequency>,<TX CC> [반복] OK
Parameters	
Example	AT*CHLIST? CUR-CHNUM:04 00:DMR,RX:40550000,01,TX:40550000,01 01:DMR,RX:41050000,01,TX:41050000,01 02:DMR,RX:41550000,01,TX:41550000,01 03:DMR,RX:42050000,01,TX:42050000,01 04:DMR,RX:42550000,01,TX:42550000,01 OK

6.11 MINFO

Description	Current setting parameter display command
Query Answer	AT*MINFO? *MINFO:<channel index>,<Radio type>,RX:<RX Freq>,<CC>,TX:<TX Frequency>,<TX CC> OID:<Own ID>,CID[<Call ID index>:<Call ID>,CF:<Call format> OK
Parameters	
Example	AT*MINFO? *MINFO:04,DMR,RX:425500000,01,TX:425500000,01 OID:00000001,CID[00]:00000001,CF:GRP OK

6.12 PWRLEVEL (Power Level)

Description	Power Level Setting

	It is set according to Dip switch 6 at boot, and it can be changed with this command.
Query Answer	AT*PWRLEVEL? GET PWRLEVEL=<value> OK AT*PWRLEVEL=<value> SET PWRLEVEL=<value> OK
Parameters	0 : Low Power 1 : High Power
Example	AT*PWRLEVEL? GET PWRLEVEL=0 OK AT*PWRLEVEL=1 SET PWRLEVEL=1 OK

6.13 VERSION

Description	Command to check the modem version
Query Answer	AT*VERSION *VERSION:<value>
Parameters	
Example	AT*VERSION *VERSION:YEONHWA Modem v1.0 OK

1. AT Command Data Configuration

AT*MSG=	ASCII Data(80 byte)	0D0A

2. Structure to send text documents using Tera Term wirelessly

1) RS-232C Serial Buffer of MD-100D/400D (Data Modem) has a total of 10 Kbytes.
Each buffer stores 80 bytes of data.

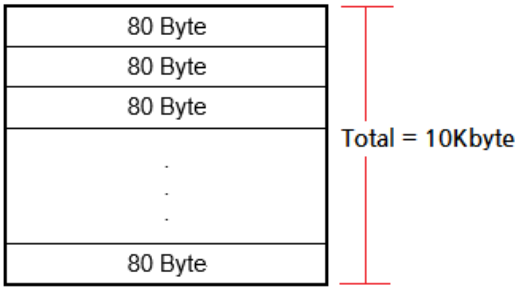
2) Serial transmission Timer transmits maximum 80 bytes after 120msec received buffer check.
-. To improve performance, the Serial Transfer Timer can be reduced by 120msec, and the amount of data transferred can be increased or decreased.

-. Currently, the amount of data transferred is fixed at 80 bytes.

3) Therefore, if you use a program like Tera Term to input characters on the keyboard, it will be sent immediately upon input.

4) You can also transfer files using Tera Term.

SD-674D Serial Buffer Architecture



2) AIR data transfer structure

Header	Data1 (20Byte)	Data2 (20Byte)	Data3 (20Byte)	Data4 (20Byte)
30mSec	30mSec	30mSec	30mSec	30mSec

Since the DMR Data Modem operates in 2: 1 mode, the actual transmission is as follows.
2:1 TDMA : There are two slots (slot1, slot2(30m/s) in a single channel so it operates as the below picture.

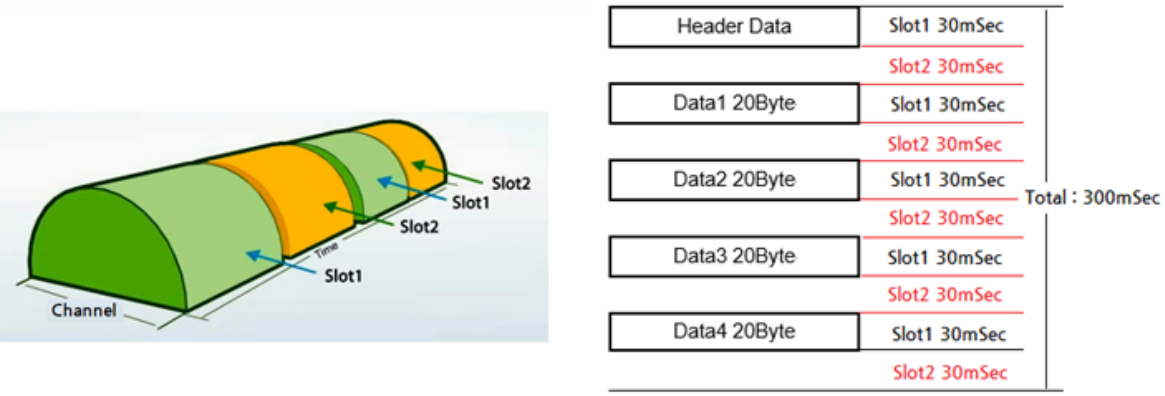
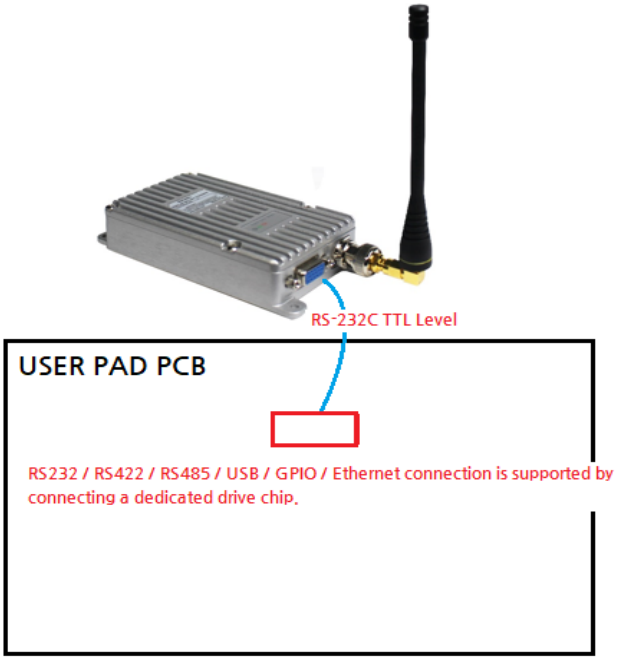


Figure 2: 1 TDMA structure

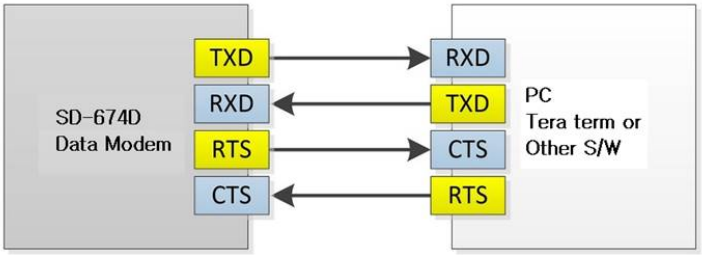
3. How to use RS232 / RS422 / RS485 / USB / GPIO / Ethernet connection



4. Did you use CTS and RTS for the cable?

1) The serial buffer of MD-100D/400D is 10Kbyte. If you want to transfer a lot of data (when the amount of data exceeds 10Kbyte), you should use 5-wire serial communication method as below.
Because the RS232 Speed is 115.200bps and the transmission speed of the wireless section is slower as 9,600bps, memory management must be done in the serial buffer.

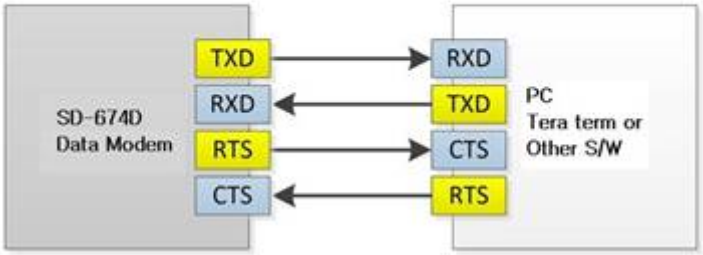
Modem-to-Host Connection
(with flow control)



When RTS is "LOW" (when the MD-100D/400D modem's serial buffer has space): The PC or external device sends normal serial data to the modem.
When RTS is "High" (when the serial buffer of the MD-100D/400D modem is full): it stops sending serial data to the external device.

When CTS is "LOW", data received by modem is transmitted to PC or external device. If it is HIGH, data is not transmitted to PC or external device.

Modem-to-Host Connection
(with flow control)



5. D-SUB 15Pin Change connector specification

1) 5 Pin : **GPIO1 → CTS**

2) **12Pin : SERIAL_BUSY → RTS**

Pin NO	Pin Name	Pin Description	I/O
1	Not use	(Not use CTCSS/DCS)	I
2	Not use	(Not use CTCSS/DCS)	O
3	PTT	Low Active	I
4	Vin(DC12V)	DC+12V	I
5	**GPIO1 → CTS**		**I/O→I**
6	Carrier Detector		O
7	MIC_IN	30mV @ 2KHz Dev	I
8	FLASH_PRO		I
9	SPEAKER_OUT	300mV @ 1KHz dEV	O
10	RX_DATA	3.3V TTL	I
11	TX_DATA	3.3V TTL	O
12	**SERIAL_BUSY → RTS**		**I/O→O**
13	GPS_TX_DATA	3.3V TTL	O
14	Ground	Ground	
15	GPS_RX_DATA	3.3V TTL	I

Figure D-SUB 15 PIN

5. For Safe Operation

5.1 Precautions

⚠	Do not remove the antenna from the radio or do not transform the antenna or do not make any changes on the antenna. The strong electronic wave to be emitted from the radio can have an effect on the performance of the radio and can cause the radio to have a defect.

⚠	Do not use accessories (such as rechargeable battery, adaptor, external speaker microphone and earphone etc.) from the other makers, which can cause defect on battery and malfunction or a defect on the radio.

⚠	Do not disassemble or reorganize the radio. The disassembly or reorganization will cause a defect or malfunction on the radio. It will be impossible to repair afterwards. There will also be a punishment made by the Radio Waves Act.

⚠	Do not use other frequency except for the permitted frequency in order not to be punished by the Radio Waves Act.

⚠	• Do not give an excessive shock to the radio. • Do not place the radio where the direct sunlight and/or the high temperature occurs.. • If the radio is placed for a long time in a car in summer, the hot temperature in the car may cause explosion of battery. • Do not make a damage to the battery by a sharp substance and/or an excessive shock.

5.2 Influences on the Operations of Radio or Other Equipment

The radio emits a strong electronic wave, which may have an effect on the operation of other equipment and also can be influenced by the other devices.

⚠	Please turn off the radio before boarding on the airplane. When using the radio in the airplane, please follow the rules or the instructions of the flight attendants.

⚠	In case of the area that medical equipment are being used, please use the radio after discussion with the equipment producer or the related doctor.

⚠	Please do not use the radio at the place where computer or other electric/electronic devices are being used. The strong electronic wave from the radio can have an effect on the equipment.

6. Safety Notes

Please make sure to read the followings above for safe and effective use of the radio.

⚠	• An indication of the maximum antenna gain permitted to ensure compliance. this would be 1.5 dBi. • At the area where an electromagnetic force can be made, please make sure to turn off the power of the radio. • The user should limit the operation to 50%. • RF Safety Distance on page 13 to match with RF exposure exhibit: 13.21cm for Occupational / Controlled, and 29.46cm for General / Uncontrolled. • Be careful that if the outer surface of the antenna is peeled off, there is a danger of a topic.

7. Handling Caution

• Any changes or modifications not expressly approved by the party responsible for compliance with the FCC regulations could void the user's authority to operate the equipment.

• It is forbidden to install or operate the device other than the responsible person (licensed person).

•The user manual is included in the box.

•How to use and install the product is shown in the figure.

8. Usage

Application

- Water/Waste Treatment
- Plants Oil and Gas Field, SCADA
- Security/Alarm System
- Gate Systems, Remote Controls
- Commercial Sign Control
- Automatic Vehicle Location
- Murphy/Kill Switches
- Weather Monitoring
- Irrigation Systems
- Emergency Call Boxes
- Low Power Repeaters

Warranty Statement

Thank you for purchasing MD-100D/ MD-400D Series.

1. This product has passed strict quality control and testing process by YeonHwa M Tech.

2. Warranty is one year from the day of release.

- When there is malfunction of the product under normal operating conditions during the warranty period, your authorized dealer and the service center will repair it free of charge.

3. Service fees will be charged for the following cases:

- When performance failed, malfunction or damaged after the warranty period.
- When the product is damaged due to user's mishandling or improper operation.
- When the product is damaged due to fire, pollution, earthquakes and any other natural or unnatural conditions, accidents etc.
- Malfunction by not keeping the notices written in the user manual.
- Malfunction by not using the appointed adaptor.
- When the product is damaged due to user's modification, attempts of repairing rather than the appointed service center.

4. Product Check List

Model Name		MD-Series
Serial No.		
Purchase Date		
Purchaser	Name	
	Address	

※ Please fill out this check list when purchasing the product.

YeonHwa M Tech Co., Ltd.

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