

RWC2010M Digital Radio Tester

Operating Manual



Version 1.00
(F/W Version 1.00)

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1 General Information

This chapter covers instrument Specifications, Key Features and Safety Consideration.

- 1.1 Warranty
- 1.2 Safety Considerations
- 1.3 General Information
- 1.4 Exterior
- 1.5 Operating Environment
- 1.6 Ordering Information

1.1 Warranty

RedwoodComm Warrants that this product will be free from defects in materials and workmanship for a period of two(2) years from the date of shipment. During the warranty period, RedwoodComm Company will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, customers must notify RedwoodComm of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customers shall be responsible for packaging and shipping the defective product to the service center designated by RedwoodComm. Customers shall prepay shipping charge to RedwoodComm designated service center and RedwoodComm shall pay shipping charge to return the product to customer. Customer is responsible for all shipping charges including freight, taxes, and any other charge if the product is returned for service to RedwoodComm, if the customer is located outside of Korea.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate malignance by buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, accident or abnormal conditions of operations.

RedwoodComm responsibility to repair or replace deductive products is the sole and exclusive remedy provided to the customer for breach of this warranty. RedwoodComm will not be liable for any indirect, special, incidental, or consequential damages irrespective of whether RedwoodComm has advance notice of the possibility of such damages.

1.2 Safety Considerations

Review the following safety precautions to avoid injury and prevent damage to this product or any product connected to it.

1.2.1 Injury Precautions

Use Proper Power Cord

To avoid fire hazard, use only the power cord specified for this product.

Avoid Electric Overload

To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is specified beyond the range.

Ground the Product

This product is grounded through the grounding conductor of the power cord. In case no ground is available at the power outlet, it is recommended to provide a separate grounding path to the instrument by connecting wire between the instrument ground terminal and an

earth ground to avoid electric shock or instrument damage. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Do Not Operate Without Covers

To avoid electric shock or product damage, do not operate this product with protective covers removed.

Do Not Operate in Wet/Damp Conditions

To avoid injury or fire hazard, do not operate this product in wet or damp conditions.

Do not use in a manner not specified by the manufacturer

1.2.2 Product Damage Precautions

Use Proper Power Source

Do not operate this product from a power source that applies more than the voltage specified. Main supply voltage fluctuations not to exceed $\pm 10\%$ of the nominal voltage.

Provided Proper Ventilation

To prevent product overheating, provide proper ventilation.

Do Not Operate With Suspected Failures

If there is damage to this product, have it inspected by qualified service personnel.

Environmental Conditions

Refrain from using this equipment in a place subject to much vibration, direct sunlight, outdoor and where the flat is not level. Also, do not use it where the ambient temperature is outside 5°C to 40°C , and altitude is more than 2000m. The maximum relative humidity is 80% for temperatures up to 31°C decreasing linearity to 50% relative humidity at 40°C . Over voltage Installation Category II for mains supply. Pollution Degree 2

1.2.3 Safety Symbols and Terms

Symbols on the Product : The following symbols may appear on the product



Close



Open



ATTENTION



**Indicates earth
(ground) terminal**

WARNING

Warning statements identify conditions or practices that could result in injury or loss of life.

CAUTION

Caution statements identify conditions or practices that could result in damage to this product or other property.

1.3 General Information

ETI (or MDI) files describe the characteristics of a signal suitable for transporting a full DAB Ensemble (or DRM Multiplex), where the ETI comprises a number of subchannels and a formatted Fast Information Channel (FIC) between a DAB Ensemble provider and a transmission network provider, and the MDI comprises a number of streams and a formatted Service Description Channel (SDC) between a DRM Multiplex provider and a transmission network provider. It means that if a specific broadcasting station's T-DMB/DAB (or DRM) signal is recorded as an ETI (or MDI) file, the recorded file contains all the information about the station.

Using the RWC2010M's ETI/MDI player function with these files, specific broadcasting stations' T-DMB/DAB signals or DRM signals can be easily regenerated in labs. The RWC2010M also provides analog functions as AM/FM transmission and audio analyzer. It also provides RDS functionality as a way to play pre-encoded RDS files.

It can be operated stand-alone, and also can be controlled and played with the RWC2010x PC application. The RWC2010x PC application provides various control and measurement functions such as file handling, AM/FM setting, remote controlling and gathering audio measurement data from RWC2010M. Audio measurement data includes SINAD, SNR, THD, waveform and spectrum.

1.3.1 Key Feature

ETI/MDI

- Support ETI/MDI player
- Provide tone ETI/MDI files

FM RDS/AM Transmitter

- Support a single FM/AM transmission
- Support various Audio Modes (MONO / STEREO / WAV File / SWEEP)

Audio Analyzer (TBD)

- Make it possible to test receiver sensitivity
- Audio measurement: SINAD / SNR / THDN
- Audio waveform and spectrum

File Play

- Stand alone playable
- PC application controllable

1.3.2 Specification

Frequency

- LF/MF/HF Band: 0.15 to 30MHz
- BAND I/II/III: 47 to 68MHz, 87 to 108MHz, 174 to 250MHz
- Resolution: 1kHz
- Accuracy: $\pm 1.5\text{ppm/yr}$ @ operating temperature

Output Level

- 0 to -110dBm (OFDM: -10 to -120dBm) for BAND I/II/III
- -10 to -110dBm (OFDM: -20 to -120dBm) for LF/MF/HF BAND
- Resolution: 0.1dB
- Accuracy: $\pm 1\text{dB}$

Output Level with RWC9500B (optional)

- +15 to -55dBm (CW/OFDM)
- Resolution: 0.1dB
- Accuracy: $\pm 1\text{dB}$

Audio Analyzer Characteristics

- Input Frequency: 0.1 to 20 kHz
- Input Range: Single Ended 2.25 Vrms
- Bandwidth: 20 kHz
- Common-Mode Rejection Ratio(CMRR): 56 dB
- Connection Type: 3.5 pi Stereo

VSWR

- Better than 1:1.5

Frequency Reference

- Internal Reference & Stability: 10MHz, $\pm 1.5\text{ppm/yr}$ @ operating temperature
- External Reference Input: 10MHz, 0 to +20dBm MAX.

Data IO Port

- Ethernet for Remote: RJ45
- RS232 for Remote: D-sub 9

Miscellaneous

- Operating temperature: 5 to 40°C
- DC Power: 12V/3A VDC
- Dimension: 200(W) x 70(H) x 220(D) mm
- Weight: 2.2kg
- Display: 2.8" gray OLED

- Internal storage: 256GB

** The specifications are subject to change without notice.*

1.4 Power Requirement

This Tester is a portable instrument and requires no physical installation other than connection to a power source. The manufacturer does not take any responsibility for problems that occur when the adapter provided with the product is not used.

Items	Specifications
Input voltage	12V/3A VDC
Input current	1.50A
Power Consumption	Less than 20 watt

CAUTION: If AC power is beyond the range of operation, the equipment may malfunction or could be permanently damaged. Main supply voltage fluctuations should be not to exceed $\pm 10\%$ of the nominal voltage.

1.5 Operating Environment

Refrain from using this equipment in a place subject to much vibration, direct sunlight, outdoor and where the flat is not level. Also, do not use it where the ambient temperature is outside 5 °C to 40 °C, and altitude is more than 2000m.

The maximum relative humidity is 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C. Over voltage Installation Category II for mains supply. Pollution Degree 2.

The storage temperature range for this equipment is -20 °C to 70 °C. When this equipment is not used for a long period of time, store it in a dry place away from direct sunlight, covered with vinyl or placed in a cardboard box.

1.6 Ordering Information

C2010M-00: Digital Radio Tester - Full Option
ETI/MDI Player, RDS/FM/AM Transmitter

C2010M-01: Digital Radio Tester - ETI+MDI
ETI/MDI Player

C2010M-02: Digital Radio Tester - ETI+Analog
ETI Player, RDS/FM/AM Transmitter

C2010M-03: Digital Radio Tester - MDI+Analog
MDI Player, RDS/FM/AM Transmitter

C2010M-04: Digital Radio Tester - ETI Only
ETI Player

C2010M-05: Digital Radio Tester - MDI Only
MDI Player

C2010M-06: Digital Radio Tester - Analog Only
RDS/FM/AM Transmitter

2. Basic Operation

This section describes the basic concepts and details of operating RWC2010M ETI/MDI Player. Understanding the basic concepts of your RWC2010M helps you use it effectively.

2.1 Exterior

2.1.1 Front Panel View

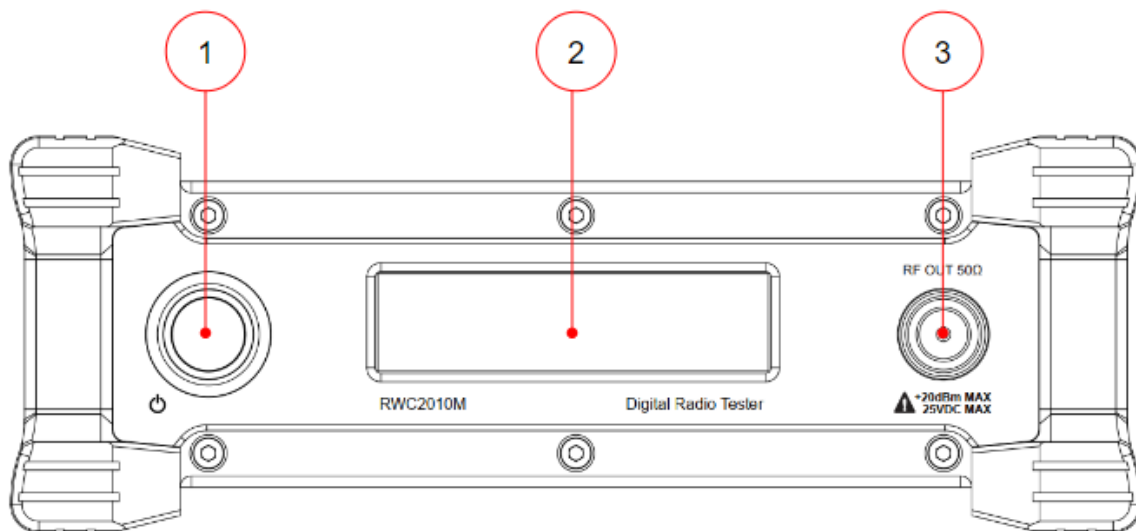


Fig. RWC2010M Front Panel View

1. POWER ON/OFF SWITCH
2. 2.8" Grayscale OLED
3. N-type RF OUT Port

2.1.2 Rear Panel View

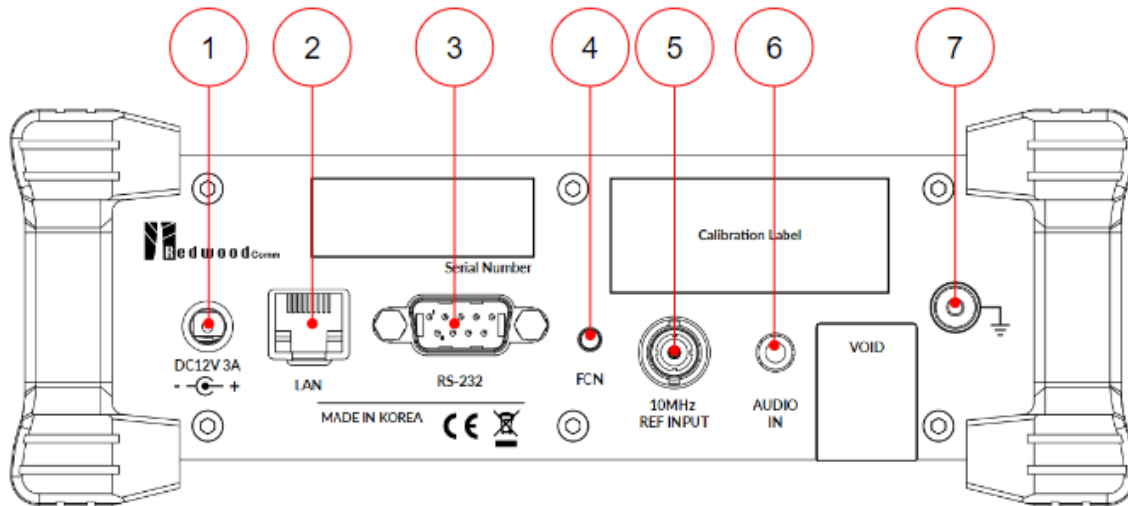


Fig. RWC2010M Rear Panel View

1. 12V DC power input
2. RJ45 connector
3. RS232 male connector
4. Function button
5. 10MHz input BNC
6. Audio In 3.5pi
7. GND Terminal

2.2 Screen Layout

2.2.1 Booting Screen

When the power is turned on, the FW version and serial number are displayed as shown in the screen below.



Fig. Screen to select test mode

2.2.1 Information

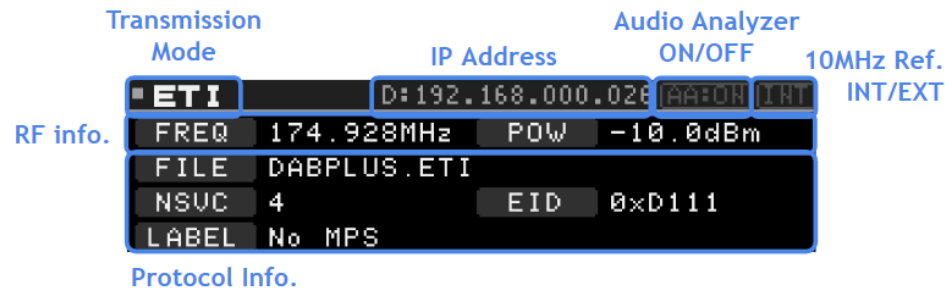


Fig. Screen Layout

Common Information

Transmission MODE	ETI/MDI/FM/AM
Frequency	Transmission Frequency MHz
Power	Transmission Power dBm or dBuV
IP Address	IP4 D:123.123.123.123 D:Dynamic S:Static
AA ON/OFF	Audio Analyzer ON/OFF status
INT/EXT	INTernal or EXTernal 10MHz reference use

ETI Mode

ETI	D:192.168.000.026	AA:ON	INT
FREQ	174.928MHz	POW	-10.0dBm
FILE	DABPLUS.ETI		
NSUC	4	EID	0xD111
LABEL	No MPS		

ETI	Transmission mode
FILE	Playback content file
NSVC	Number of service
EID	Ensemble ID
LABEL	SERVICE LABEL, rotationally display

MDI Mode

MDI	D:192.168.000.026	AA:ON	INT
FREQ	174.928MHz	POW	-10.0dBm
FILE	AUDIO_BWS_18K.MDI		
ROB	A	BW	18kHz
MSC	64-QAM	SDC	16-QAM

FILE	Playback content file
ROB	Robustness A,B,C,D,E
BW	Signal Bandwidth 4.5/5/9/10/18/20 kHz
MSC	Modulation method for Main Service Channel
SDC	Modulation method for Service Description Channel

FM Mode

```

# FM D:192.168.000.026 [AA:00] [LRT]
FREQ 87.700MHz POW -10.0dBm
MODE WAVE DEV 50.00KHz
FILE LEMON_TREE.wav
RDS RedwoodComm_BC.rds

```

MODE	MONO / STEREO / SWEEP / WAVE
DEV	FM Deviation
AUDIO FREQUENCY	Left / Right audio frequency kHz
SWEEP CONDITION	START - STOP / STEP kHz
WAVE FILE NAME	playback .wav filename stored in RWC2010M
RDS	playback .rds filename stored in RWC2010M

AM information

```

AM D:192.168.000.026 [AA:00] [LRT]
FREQ 100000.0KHz POW -10.0dBm
MODE MONO INDEX 100%
AUDIO 1.00KHz

```

MODE	MONO / SWEEP / FILE
AUDIO FREQUENCY	audio signal frequency kHz
SWEEP CONDITION	START - STOP / STEP kHz
INDEX	Modulation Index 1-100%
WAVE FILE NAME	playback .wav filename stored in RWC2010M

Audio Analyzer

ON/OFF	ON / OFF status
SNR	Signal to Noise Ratio, Left/Right, Unit dB
SINAD	Signal to Noise and Distortion Ratio, Left/Right, Unit dB
THDN	Total Harmonic Distortion and Noise, Left/Right, Unit %

2.2.3 Setup parameters

RWC2010M, a dongle type device, does not have any console key, so direct parameter setting through the device is impossible. Even RF basic parameters such as frequency and power must be set through the PC application. However, in case of standalone operation, the last setup values are saved and recalled when booting, so it can be used repeatedly without setting parameters.

2.3 Operation

When booting, RWC2010M automatically operates in the last setting mode and setting conditions and outputs RF transmission signals. We define a mode that works without a PC application as standalone.

RWC2010M can be used while controlling it with a PC application software. Users can control it with users' own designed software, remote commands, or can use RWC2010x_application.exe which controls through Ethernet or RS232.

2.3.1 Standalone

For standalone operation, a file that can be played during booting must be downloaded in advance. If there is no file, automatic play does not work, and no RF signal is output.

The file setting should be set by PC software, and the mode last used is automatically saved, and when the mode is changed or terminated in the PC application, it is automatically saved.

2.3.2 Controlling with PC Software

RedwoodComm provides RWC2010x PC application program for RWC201B/C/M control. Users can use RWC2010x to download content files, delete downloaded files, set play mode, and perform tasks such as ETI/EMI play and FM-RDS/AM transmission. Also, if the Audio Analyzer option is included, you can control the Audio Analyzer and save audio data using the application. In addition, standalone mode of RWC2010M and related parameters can be set.

When RWC2010x PC software is connected to RWC2010M, functions such as Multi Control, DRM MRR, RT editor provided for RWC2010B/C cannot be used.



Fig. Menu of the RWC2010x PC application



Fig. Menu of the RWC2010x PC application after RWC2010M connection

2.3.3 Operation Mode

RWC2010M supports ETI/MDI player and FM-RDS/AM transmission mode. All transmission modes operate one mode at a time.

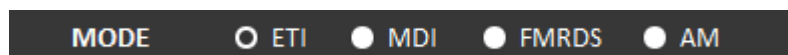


Fig. Transmitter Mode Selection

- ETI Player: Plays ETI files. The ETI file must be saved in RWC2010M internal storage.
- MDI Player: Plays DMI files. The MDI file must be saved in RWC2010M internal storage.

- FM transmitter: Select Mode to generate tone or select WAV file to transmit as FM modulated signal. In order to transmit the WAVE file, the wave file must be saved in the internal storage of RWC2010M. At this time, the RDS signal can be simultaneously transmitted by selecting the RDS file.
- AM Transmitter: Select Mode to generate tone or select WAV file to transmit AM modulated signal. In order to transmit the WAVE file, the wave file must be saved in the internal storage of RWC2010M.
- Audio Analyzer : RWC2010M provides audio analyzer function. This measures the audio signal input to the 3.5pi stereo jack on the rear panel of RWC2010M. Since it is independent of the transmitter, it can be operated concurrently with the transmission. To use Audio Analyzer, you need to activate the function using PC software.

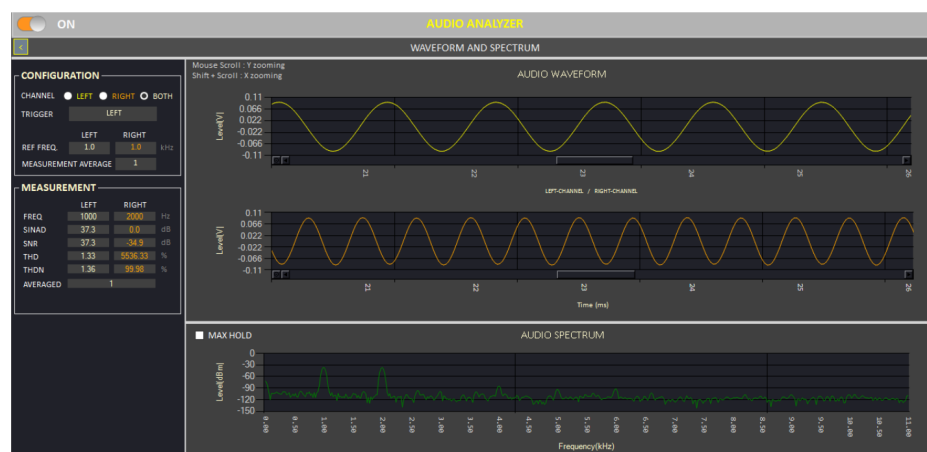


Fig. The screen of the audio analyzer of the RWC2010x PC application

If the IP setting and connection is done successfully, there will be a “Connected” icon displayed in the left bottom of screen. If there is no “Connected” icon, please try again step 1~5.

2.4 Content file

When RWC2010M operates as an ETI/MDI player or FM/AM transmitter, the necessary files (ETI, MDI, RDS, WAV) depending on the mode are called content files.

The content files stored in the internal storage space of RWC2010M can be downloaded from the RWC file server to the user's PC at any time using the RWC2010x application, and can also be downloaded to the RWC2010M internal storage.

2.4.1 ETI, MDI, WAV files

ETI, MDI, and WAV files created or owned by the user can be downloaded to RWC2010M using the RWC2010x PC application.

Please refer to chapter 2.4 to know how to download content files for detail.

2.4.2 RDS files

In the case of RDS files, due to compatibility issues, the user's own files cannot be used. The RDS files provided by RedwoodComm can be used, or dumped ones using the RWC2100F sold by RedwoodComm can be used.

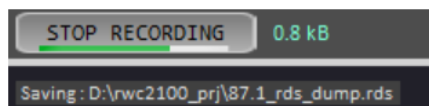
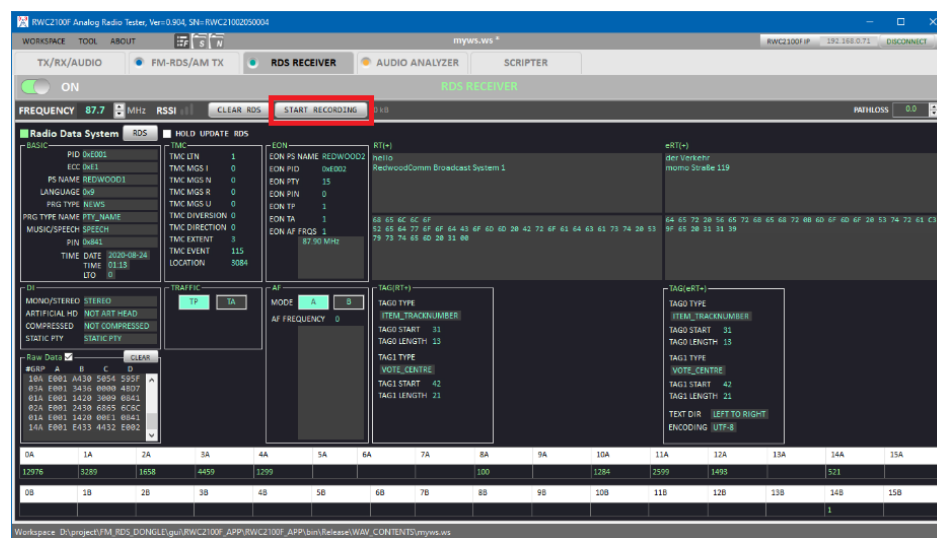


Fig. Recording RDS data using RWC2100F PC Application software

2.4.3 Downloading files from RedwoodComm's Server

Click the UPDATE LIST button of SERVER, then the FILE MANAGER will update the file list.

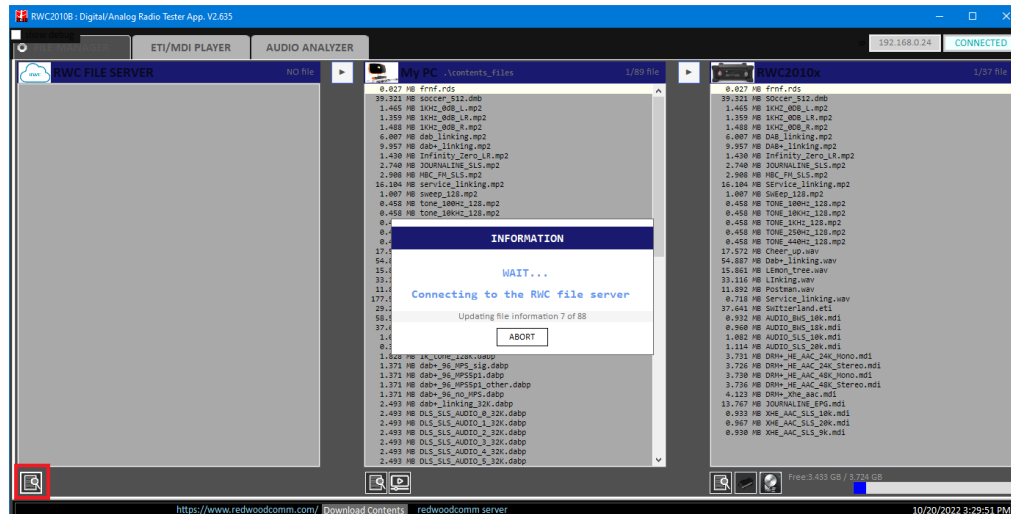


Fig. Updating file list of RWC file server

Users can download content files from the server to the users' PC by clicking the DOWNLOAD button(►). All Files are selective. The FILE MANAGER shows duplicate files between server and PC with highlighted background color after selecting files.

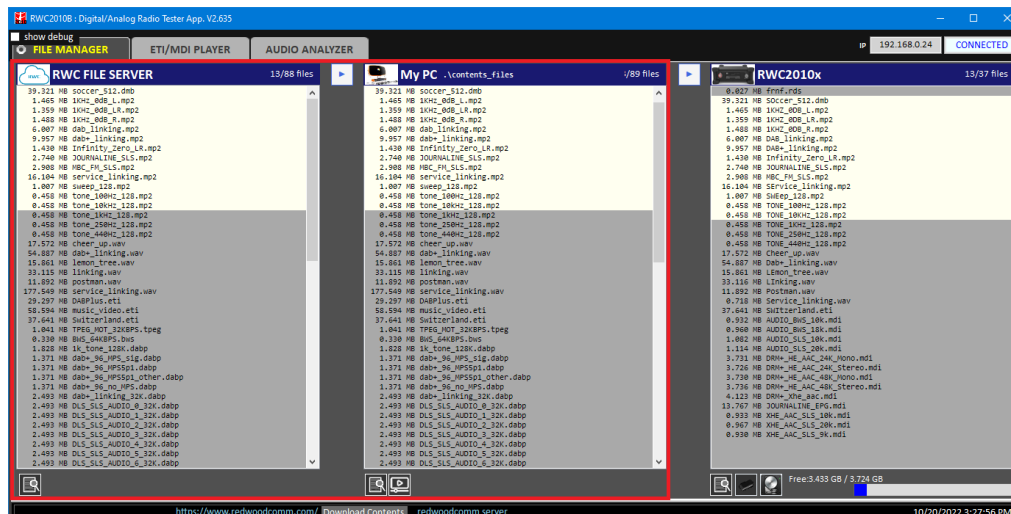


Fig. Getting content files from RWC file server

2.4.4 Downloading files from PC to RWC2010M

Click the "UPDATE LIST" button of the PC before starting to download, then the FILE MANAGER will update the file list of the user PC. Users can download files from the PC to the RWC2010M by clicking the DOWNLOAD button(►). All Files are selective. The FILE MANAGER shows replicated files between the PC and the RWC2010M with highlighted background color after selecting files.

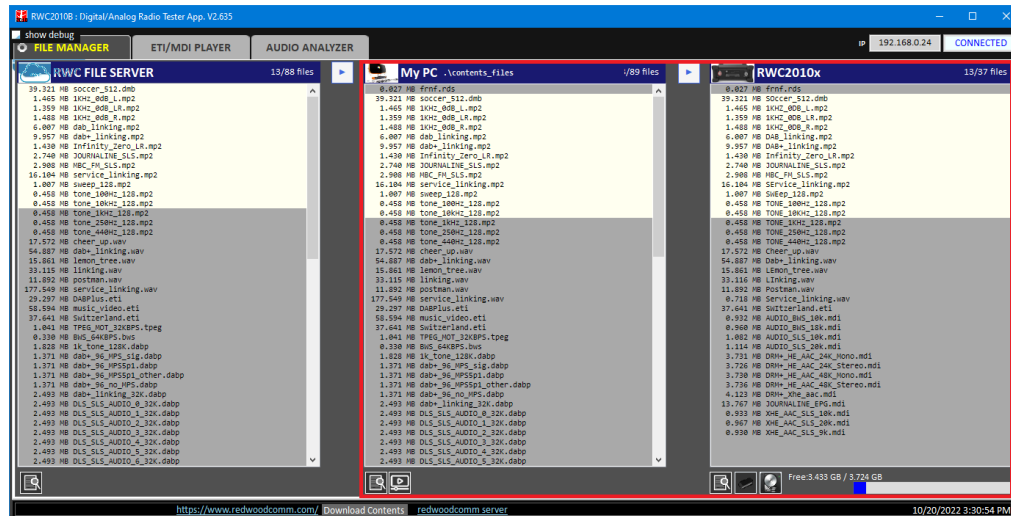


Fig. Downloading content files from User pc to RWC2010M equipment

2.4.5 Internal Storage

RWC2010M has 256 GBytes internal storage. All types of content files are saved in it. Users can format it. Free space of the storage displayed in the FILE MANAGER tab.

2.5 Firmware Upgrade

As RWC2010M adapted Flash Memory, it is available to upgrade easily by using the PC without changing the Hardware. For upgrading, RWC2010M Application Program shall be used. The program is provided together with the product and it is available to download the upgrade data from RedwoodComm Website or provide it via post-mail. The information for upgrading shall be kept in providing to the user via email or website.

2.5.1 Normal Firmware Upgrade

Setup Ethernet connection between RW2010M and RWC_upgrader.exe

The download sequence is as follows. For the next processing, click the NEXT button.

- Execute RWC_upgrader.exe
- Click the CONNECT button for the recognition the RWC2010M
- Upgrader will find the valid equipment, and check the version of equipment and bin file
- Click the NEXT button for confirming upgrade
- A confirming window will pop up again to make sure of the download.
- Upgrading firmware will be starting
- After downloading the binary file, reboot the RWC2010M

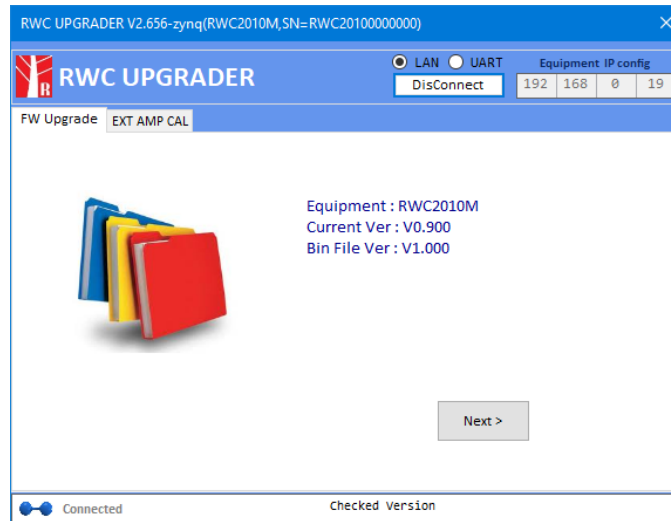


Fig. RWC UPGRADER Screen

2.5.2 Emergency Firmware Upgrade Sequence

Failing of Normal Upgrading can affect or disable RWC2010M. In this case, the RWC2010M should be booted in Emergency Upgrade mode.

If the normal program behaves abnormally and cannot be upgraded with the Upgrader program, the normal program must be deleted for emergency booting. To delete the normal program, please keep pressing the **FCN** key on the rear panel, and turn the RWC2010M power ON. RWC2010M will ask if you want to delete normal programs. Please reboot the RWC2010M after deleting the normal program for emergency upgrade mode.

Repeat the upgrading sequence from the beginning.

3. Transmission Mode

RWC2010M provides ETI/MDI/FM/AM transmission mode.

Users can select one of them using RWC2010x application software. And control all parameters according to the selected transmission mode.

3.1 ETI Play Mode

ETI stands for Ensemble Transport Interface. In the ETI/MDI player tab of RWC2010x application software, users can set the RWC2010M as an ETI player. Using this function, the user can generate almost the same as a real Ensemble signal in the Lab. RWC2010M supports not only ETI(NI, G703) but also ETI(NI, V11).

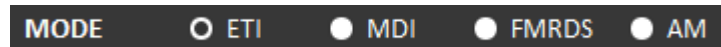


Fig. ETI Player Selection

3.1.1 ETI File Transmission

RWC2010M operates as an ETI file player. Users can not modify ETI file parameters but just play with ETI compatible files. Users control the starting position of the playback file by scrolling the progress bar or by modifying the “MOVE TO” value. Users can directly change the RF frequency or use the DAB channel name for the EU region.

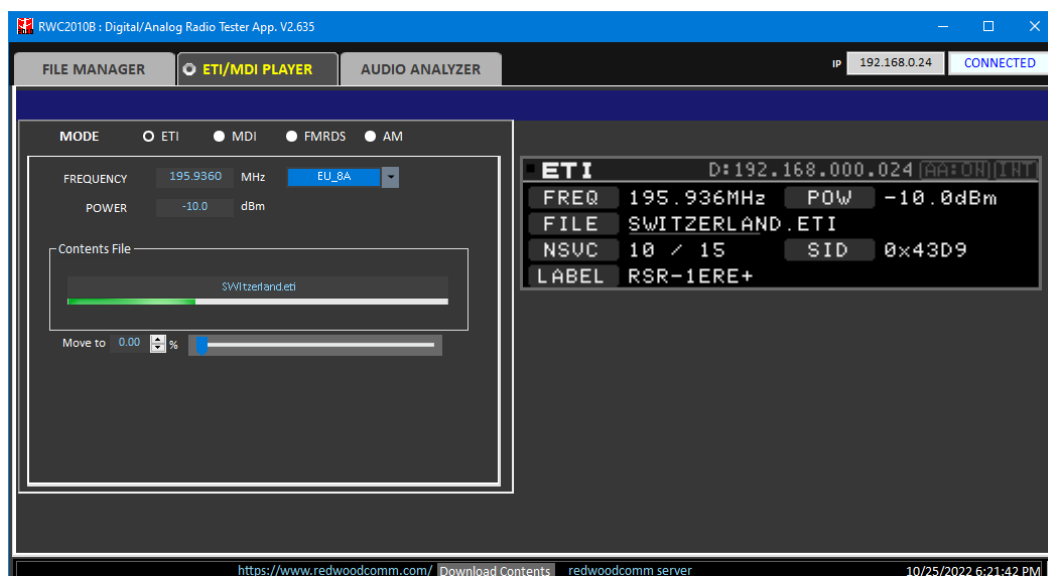


Fig. ETI Setup Screen

3.1.2 ETI Contents File

To play ETI files, set the test mode as ETI by clicking the ETI radio button. Then ETI file playing is started automatically. Select desired ETI contents file using the “CONTENTS file” combobox.

RWC2010M shows the selected content file(.eti) on the screen.

While the ETI is transmitting, you can check the file information and status such as TX Mode, Ensemble ID, Label, etc... To see the ETI file information.

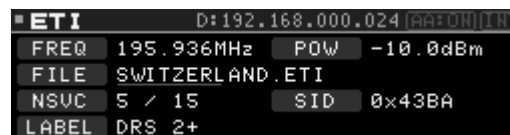


Fig. ETI Player Information Screen

3.2 MDI Play Mode

Using this function, the user can generate almost the same as a real DRM signal in the Lab.

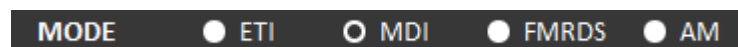


Fig. MDI Player selection

3.2.1 MDI File Transmission

RWC2010M operates as an MDI file player. To play MDI files, set the test mode as MDI by clicking the MDI radio button.

Users can not modify MDI file parameters but just play with MDI compatible files. Users control the starting position of the playback file by scrolling the progress bar or by modifying the “MOVE TO” value.

3.2.2 MDI Content Files

To play MDI files, set the test mode as MDI by clicking the MDI radio button. Then MDI file playing is started automatically. Select desired MDI contents file using the “CONTENTS file” combobox.

RWC2010M shows the selected content file(.mdi) on the screen.

While the MDI is playing, you can check the file information and status such as Robustness Mode, Spectrum BW, Label, etc.

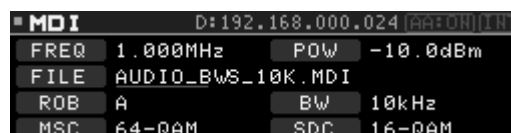


Fig. MDI Player Information Screen

3.3 FM Transmission

RWC2010M provides Analog mode for FM/AM test purposes. FM mode supports MONO, Stereo, Sweep and wave file player mode. RWC2010M supports just one channel FM test function. Users can enable an RDS(Radio Data System) data channel by clicking the RDS FILE radio button.

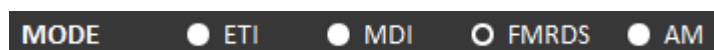


Fig. FM Transmitter selection

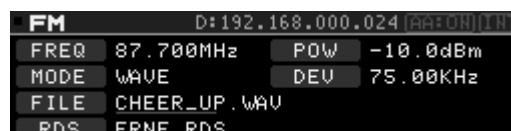


Fig. FM transmitters Information Screen

3.3.1 Parameters

FREQUENCY : FM carrier frequency in kHz
 POWER : FM output power in dBm or dBuV
 FM DEVIATION : FM deviation 0-75.00 kHz
 PRE-EMPHASIS : Pre-emphasis value OFF/50/75 us
 PILOT LEVEL : 0-15.00 %
 AUDIO VOLUME : 0-100%
 AUDIO SOURCE : parameter for selecting one of MONO/STEREO/WAVE/SWEEP

FREQUENCY	87.7	MHz	POWER	-10.0	dBm
AUDIO VOLUME	100	%	PATHLOSS	0.0	dB
FM DEVIATION	75.00	kHz	PRE-EMPHASIS	75	us
PILOT LEVEL	9.00	%	AUDIO SOURCE	WAVE	

Fig. Configurable Parameters of FM Transmitter of RWC2010x PC application

3.3.2 AUDIO SOURCE

MONO

Set the MODE parameter as 'MONO' for FM Mono transmission.

FREQUENCY : Audio Frequency in kHz

FREQUENCY	87.7	MHz	POWER	-10.0	dBm
AUDIO VOLUME	100	%	PATHLOSS	0.0	dB
FM DEVIATION	75.00	kHz	PRE-EMPHASIS	75	us
PILOT LEVEL	9.00	%	AUDIO SOURCE	MONO	

Mono Audio Parameters

FREQUENCY kHz

Fig. FM Transmission - Mono mode

STEREO

Set the MODE parameter as 'STEREO' for FM Stereo transmission. In this mode, two audio signals(LEFT/RIGHT) are FM modulated. For the stereo FM test, users set left audio parameters and right audio parameters separately.

LEFT/RIGHT : LEFT_ONLY/RIGHT_ONLY/LEFT_AND_RIGHT selection

LEFT FREQUENCY : Left side audio frequency in kHz

RIGHT FREQUENCY : Right side audio frequency in kHz

FREQUENCY	87.7	MHz	POWER	-10.0	dBm
AUDIO VOLUME	100	%	PATHLOSS	0.0	dB
FM DEVIATION	75.00	kHz	PRE-EMPHASIS	75	us
PILOT LEVEL	9.00	%	AUDIO SOURCE	STEREO	

Stereo Audio Parameters

LEFT / RIGHT ▼

LEFT FREQUENCY kHz

RIGHT FREQUENCY kHz

Fig. FM Transmission - Stereo mode

WAVE

Set the MODE parameter as 'WAVE' for FM Wave file transmission. Downloaded wave file can be played with FM modulation. Users can select one of the wave files and move the current playing position with the slide control bar as the following figure.

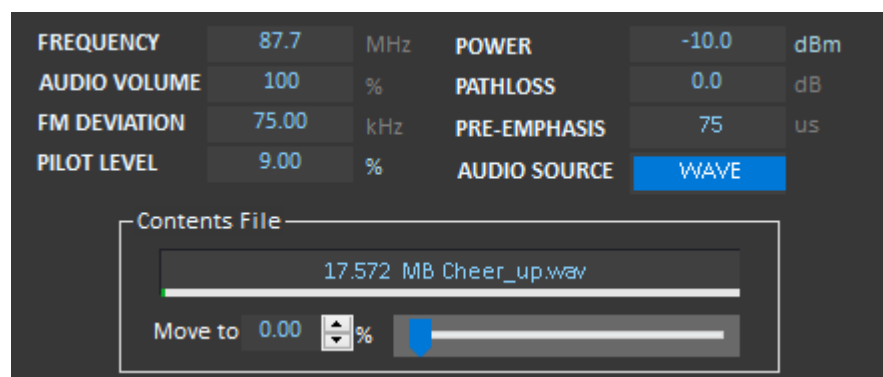


Fig. FM Transmission - Wave mode

SWEEP

Set the MODE parameter as 'SWEEP' for FM SWEEP Mode test. In FM_SWEEP mode, RWC2010M sweeps FM audio tone frequency from the SWEEP_START to the SWEEP_STOP during SWEEP_TIME.

START FREQUENCY : Start frequency of test tone sweep in kHz

STOP FREQUENCY : Stop frequency of test tone sweep in kHz

TIME : Sweep time between start and stop frequency of test tone in ms

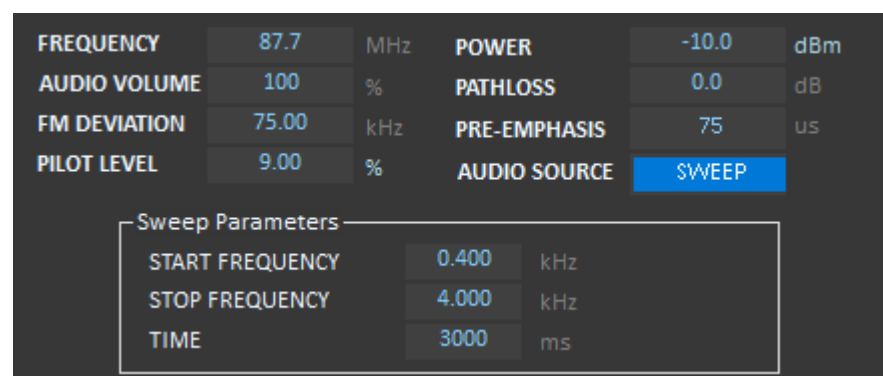


Fig. FM Transmission - Sweep mode

3.3.3 RDS FILE

RWC2010M provides RDS file playback function. Users can select RDS on(FILE) or off. When RDS FILE mode is selected, a stored .rds file will be playing automatically.

Users can select one of the RDS files and move the current playing position with the slide control bar as the following figure.

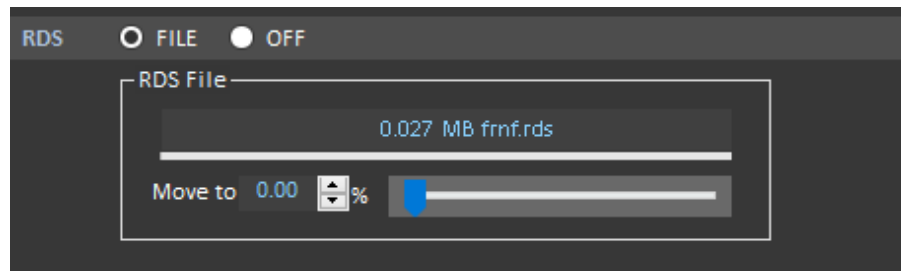


Fig. RDS file and play position selection

3.4 AM Transmission



RWC2010M provides Analog mode for FM/AM test purposes. Analog AM mode supports MONO AM test function and wave file player function.

3.4.1 PARAMETERS

FREQUENCY : AM carrier frequency in kHz

POWER : AM output power in dBm

AM INDEX : parameter for AUDIO VOLUME, 0-100%

AUDIO SOURCE : parameter for selecting one of MONO/WAVE/SWEEP

3.4.2 AUDIO SOURCE

MONO

In AM_MONO mode, one audio signal is AM modulated.

FREQUENCY : Audio Frequency in kHz

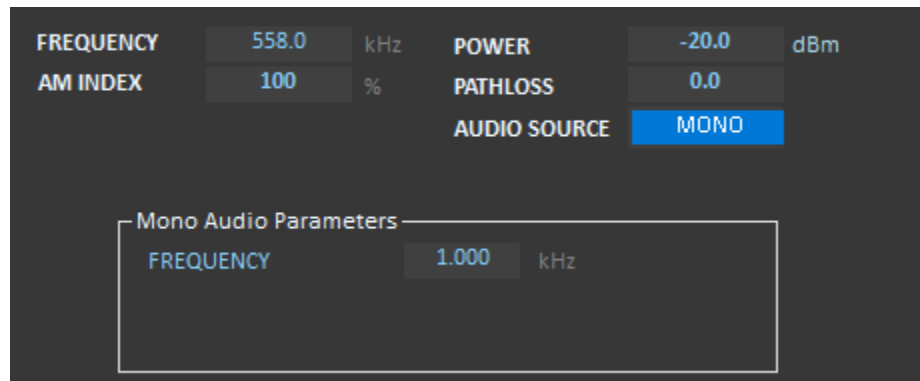


Fig. Mono AM test screen

WAVE

A stored wave file can be played with AM transmission. Users can select one of the wave files and move the current playing position with the slide control bar as the following figure.

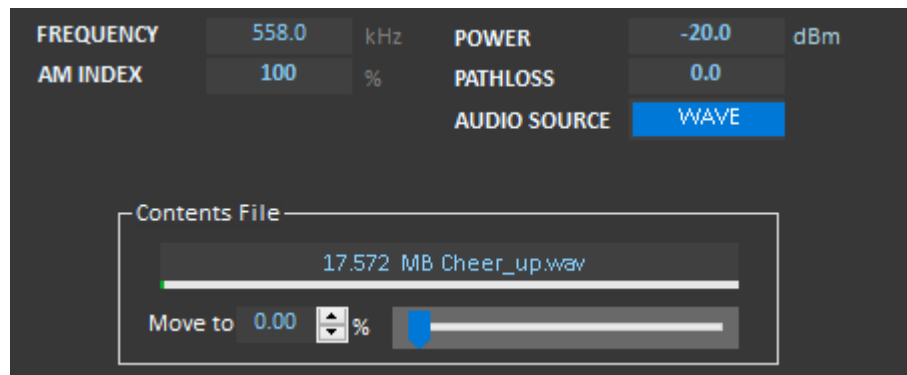


Fig. AM File mode test screen

SWEEP

AM Set the MODE parameter as 'SWEEP' for the AM SWEEP Mode test. In AM_SWEEP mode, RWC2010M sweeps AM audio tone frequency from the SWEEP_START to the SWEEP_STOP during SWEEP_TIME.

START FREQUENCY : Start frequency of test tone sweep in kHz

STOP FREQUENCY : Stop frequency of test tone sweep in kHz

TIME : Sweep time between start and stop frequency of test tone in ms

FREQUENCY	558.0	kHz	POWER	-20.0	dBm
AM INDEX	100	%	PATHLOSS	0.0	
			AUDIO SOURCE	SWEEP	

Sweep Parameters

START FREQUENCY	0.400	kHz
STOP FREQUENCY	4.000	kHz
TIME	3000	ms

Fig. AM Sweep mode test screen

4. Audio Analyzer

RWC2010M provides an audio analyzer function. With this function, you can measure frequency, SINAD, SNR, THD and THDN. You have to input the audio signal into the 3.5mm audio input jack on the rear panel.

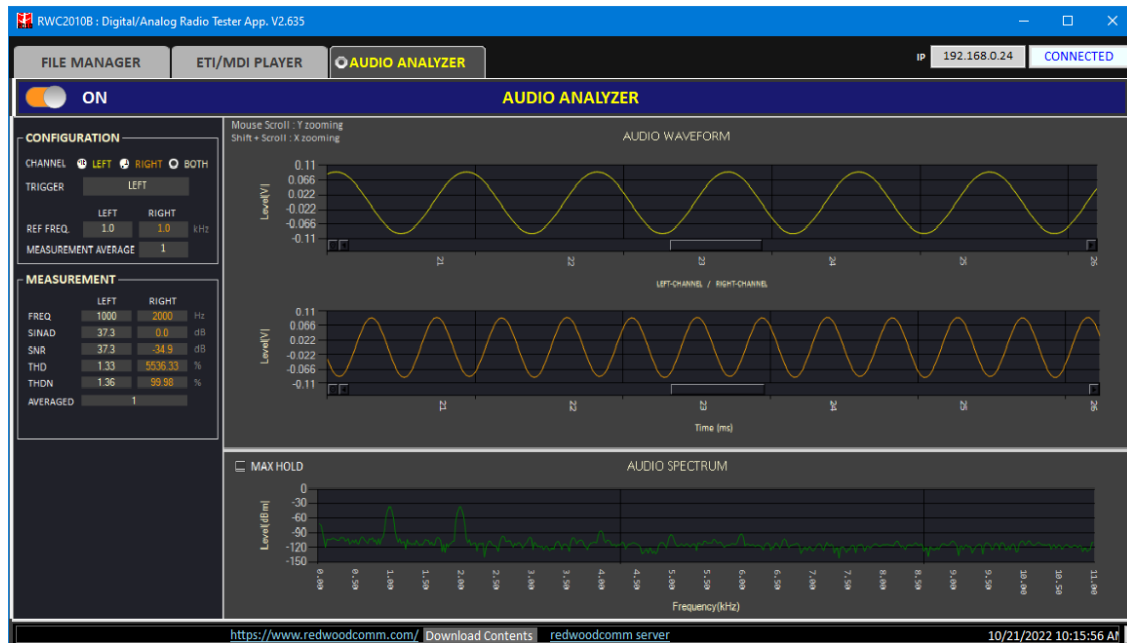


Figure 3.27 Audio analyzer function

4.1 Operation

4.1.1 Specification

The number of point for WAVEFORM and SPECTRUM: 2048

Displaying time duration: 460 msec

Displaying bandwidth: 11.025 kHz

4.1.2 Zooming audio waveform

Using mouse scrolling up or down, you can zoom up or down the audio waveform in voltage axis direction.

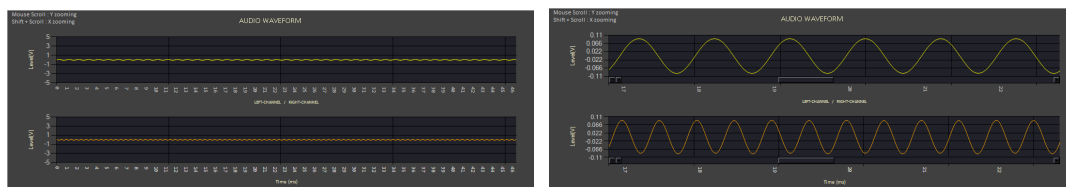
If you scroll up or down with the [SHIFT] key, you can zoom up or down the audio waveform in the time axis direction.

4.1.3 Fitting audio waveform

The audio analyzer provides a zoom function using the mouse wheel.

Both x-axis and y-axis are available. With only mouse scrolling, the y-axis zoom works, and with [shift] keying and the mouse scrolling, the x-axis zoom works.

Also, by double-clicking with the left mouse button, it adjusts the signal to the y-axis in full scale automatically.



a. Before zooming

b. After zooming

Figure 3.28 Zooming of the audio analyzer

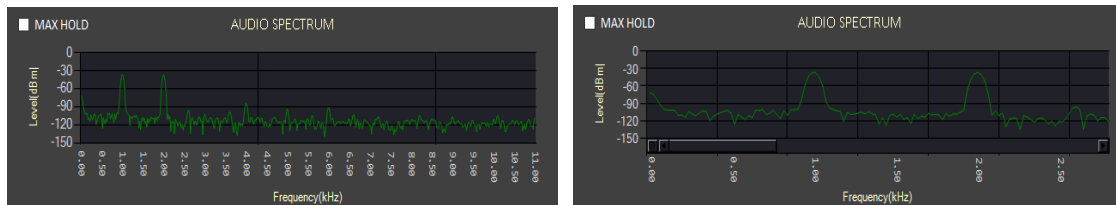
4.1.4 Zooming audio spectrum

The spectrum analyzer provides a zoom function using the mouse wheel.

Only x-axis is available. With [shift] keying and the mouse scrolling, the x-axis zoom works.

Also, by double-clicking with the left mouse button, it adjusts the signal to x-axis in full scale automatically.

The double click fitting is only available for the x axis.



a. Before zooming

b. After zooming

Figure 3.29 Zooming of spectrum analyzer

4.1.5 Max hold of spectrum analyzer

If you check the MAX HOLD option, it shows the maximum values of the spectrum.

If you want to reset the max value, uncheck and check the MAX HOLD check box.

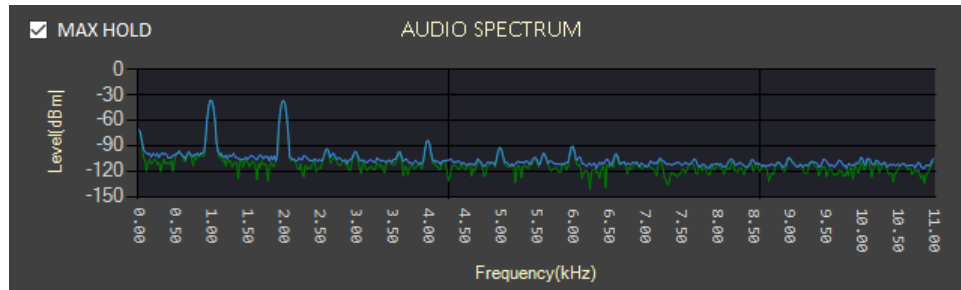


Figure 3.30 Max hold of spectrum analyzer

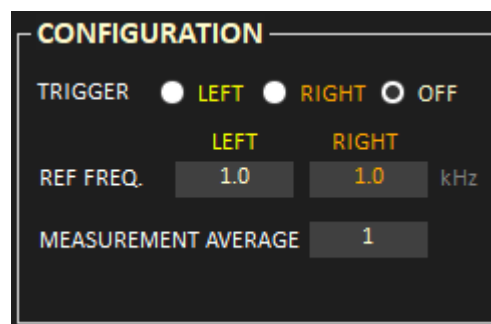
4.2 Parameters

4.2.1 CONFIGURATION PARAMETER

TRIGGER : LEFT/RIGHT/OFF

REF FREQUENCY : Reference Frequency in kHz to compare audio input signal for measurement

MEASUREMENT AVERAGE : The average number while measuring audio signal



4.2.2 TRIGGER

It provides three types of trigger methods such as LEFT, RIGHT, and OFF.

With an OFF trigger, the audio waveform can be swung in x-axis because RWC2010M dumps audio data without any trigger.



Fig. Trigger option of audio analyzer

4.2.3 REFERENCE FREQUENCY

For accurate measurement, users need to set up correct left and right reference frequencies expected.

If the reference frequency and measuring frequency are mismatched, all measured quality values are not reliable.

CONFIGURATION		
CHANNEL	<input checked="" type="radio"/> LEFT <input type="radio"/> RIGHT <input type="radio"/> BOTH	
TRIGGER	LEFT	
	LEFT	RIGHT
REF FREQ.	1.0	1.0 kHz
MEASUREMENT AVERAGE	1	

MEASUREMENT		
	LEFT	RIGHT
FREQ	1000	2000 Hz
SINAD	47.3	0.0 dB
SNR	47.3	-42.2 dB
THD	0.32	12925.94 %
THDN	0.43	100.00 %
AVERAGED	1	

Fig. Mismatched reference example.

Transmitted frequency: 2kHz, Measured frequency: 2kHz, reference frequency: 1kHz

4.2.4 Measurement average

It indicates how many times the RWC2010M measures the quality of the input audio signal and averages them.

4.3 Measurement

RWC2010M measures and displays values such as FREQUENCY, SINAD, SNR, THD, and THDN. All measured values will be displayed as left and right channels separately.

MEASUREMENT		
	LEFT	RIGHT
FREQ	1000	1000 Hz
SINAD	48.3	48.4 dB
SNR	48.4	48.4 dB
THD	0.09	0.08 %
THDN	0.38	0.37 %
AVERAGED	10	

Fig. Measured quality value for audio signal

4.3.1 Frequency

A measured frequency of single tone from audio input port. The unit is Hz.

4.3.2 SINAD (Signal-to-noise and distortion ratio)

It is the measured value of SINAD of tone signal from the audio input port.

The quality of a signal from a communications device, often defined as

$$SINAD = \frac{P_{sig} + P_{noise} + P_{dist}}{P_{noise} + P_{dist}}, \text{ where}$$

P_{sig} : the average power of the signal

P_{noise} : the average power of noise

P_{dist} : the average power of distortion components

Unit: dB

4.3.3 SNR (Signal to noise ratio)

It is the measured SNR value of tone signal from audio input port

$$SNR = \frac{P_{sig}}{P_{noise}}, \text{ where}$$

P_{sig} : the average power of the signal

P_{noise} : the average power of noise

Unit: dB

4.3.4 THD (Total Harmonic Distortion)

THD is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency.

$$THD_F = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \dots}}{V_1}, \text{ where}$$

V_n : the RMS (Root Mean Squared) voltage of the n-th harmonic

n = 1: the fundamental frequency

Unit: %

4.3.5 THDN

It is THD plus noise value of sine wave at audio input port.

It is notch filtered output, and compared the ratio between the output signal with the sine wave

$$THDN = \frac{\sum_{n=2}^{\infty} \text{harmonics+noise}}{\text{fundamental}}, \text{ where}$$

V_n : the RMS (Root Mean Squared) voltage of the n-th harmonic

n = 1: the fundamental frequency

Unit: %

4.3.6 AVERAGED

It is the value showing how many times have been averaged so far while measuring the SINAD, THD, THDN and SNR.

5. Remote Control Programming

PC may control the RWC2010M remotely through Ethernet or RS232C interface using a comprehensive set of commands. This section provides the necessary information to operate the RWC2010M under Ethernet and RS232C control

- 5.1 Introduction
- 5.2 RS-232C Interface
- 5.3 ETHERNET Interface
- 5.4 Command Tables

5.1.1 Command Structure

5.1.2 Command Parameter Types

- Integer Parameter : CONF:SETUP:BASIC:POWER <Value> <LF>
- Double Integer parameter : CONF:SETUP:BASIC:POWER <Value> <Value> <LF>
- Discrete Parameter : CONF:SETUP:BASIC:RF {ON | OFF} <LF>

5.1.3 Response to Query

- Integer: Return an integer value, e.g. 0, 100, 256, -230.
- Discrete: Return a selection.

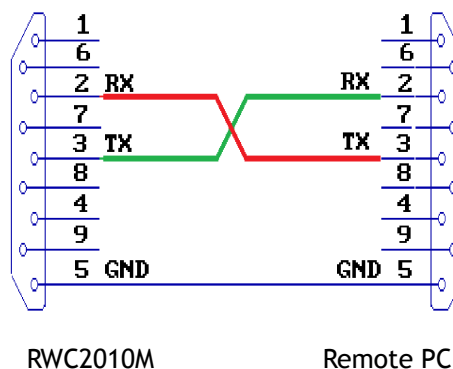
Command & Query	Response
<u>READ:SETUP:BASIC:POWER?</u>	-10
<u>READ:SETUP:BASIC:RF?</u>	ON

▣ **Note:** All responses are finished by LF (Line Feed, Char(10)).

5.2 Interface for Remote Control

5.2.1 RS-232C interface

Cable Connection



Control Parameters

To use RS-232C, the parameters of the Any PC software terminal program should be set up as follows.

Parameter	Range	Description
BAUD RATE	115200bps	data speed
DATA BITS	8-bit	Length of Data bit
PARITY	Off	Error check bit
STOP BIT	1-bit	Stop bit
CONTROL BIT	NONE	

5.2.2 Ethernet Interface

Connect LAN port of PC and RWC2010M Ethernet port by RJ45 cable. You can see the IP address of RWC2010M at the upper right side of the screen. The ethernet protocol is UDP and the port number is 5001.

If the PC and RWC2010M are connected directly, Cross cable must be used. And set up the IP address as follows.

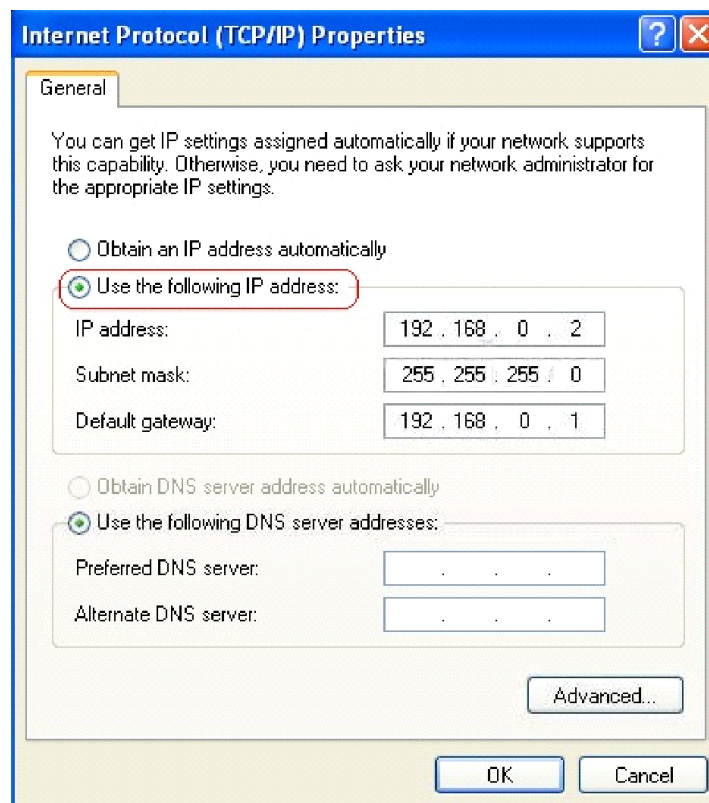


Fig. How to set up the static IP address of PC with Window OS

5.2.3 Remote Programming guide

- Set Serial Port
- Set up Baud Rate, Parity Bit (None), Data Bit (8 bit), Stop Bit (1 bit).
- Open port.
- Send RS232C command through serial port.
- Check command execution results on the RWC2010M screen.
- Send the next command after successful execution of the previous command.
- If it is difficult to check the execution of the previous command, the next command should be sent after a few milliseconds.
- A colon is used between commands.
- A space is only used between parameter values and commands.
- All commands should be finished by LF (Line Feed, char(10)).

5.3 Command Tables

5.3.1 Common Commands

Command	<value> Range	Description
*IDN?		Query Identification
*RST		Full preset command
READ:SETUP:RF?		
CONF:SETUP:RF <value>	OFF, ON	RF On/Off
READ:SETUP:FREQUENCY?		
CONF:SETUP:FREQUENCY <value>	0.15 ~ 30 MHz 47 ~ 68 MHz 87 ~ 108 MHz 174 ~ 250 MHz	LF/MF/HF Band Band I Band II Band III
READ:SETUP:POWER?		Read Power(dBm)
CONF:SETUP:POWER <value>	-120.0 ~ 0.0	Set Power(dBm)
READ:SETUP:POWER:DBUV?		Read Power(dBuV)
CONF:SETUP:POWER:DBUV <value>	-13.0 ~ 97.0	Set Power(dBuV)
READ:SETUP:PATH_LOSS?		Compensated power for pathloss(dB)

CONF:SETUP:PATH_LOSS <value>	-60.0 ~ 60.0	Compensation power for pathloss(dB)
READ:SETUP:TESTER_MODE?		
CONF:SETUP:TESTER_MODE <value>	FM, AM, ETI, MDI	

5.3.2 ETI SETUP

Command	<value> Range	Description
READ:ETI:CONFIG:MODE?		
CONF:ETI:CONFIG:MODE <value>	ETI, MDI	
READ:ETI:CONFIG:CONTENTS?		
CONF:ETI:CONFIG:CONTENTS <value>	The name of playback content file	
EXEC:ETI:CONFIG:CONTENTS_RST		Reset the file reading pointer

5.3.3 ANALOG FM

Command	<value> Range	Description
READ:ANALOG:FM:CHANNEL? <value>		
CONF:ANALOG:FM:CHANNEL <value>	OFF, ON	
READ:ANALOG:FM:FM_MODE? <value>		
CONF:ANALOG:FM:FM_MODE <value>	MONO, STEREO, WAVE, SWEEP	
READ:ANALOG:FM:FREQUENCY? <value>		
CONF:ANALOG:FM:FREQUENCY <value>	87.0000 ~ 108.0000	Unit : Mhz
READ:ANALOG:FM:AUDIO_FREQ? <value>		
CONF:ANALOG:FM:AUDIO_FREQ <value>	0 ~ 10.00	Unit : kHz
READ:ANALOG:FM:FM_DEVIATION? <value>		
CONF:ANALOG:FM:FM_DEVIATION <value>	0 ~ 75.00	Unit : kHz

READ:ANALOG:FM:STEREO_MODE? <value>		
CONF:ANALOG:FM:STEREO_MODE <value>	LEFT_AND_RIGHT, LEFT_ONLY, RIGHT_ONLY	
READ:ANALOG:FM:AUDIO_FREQ_R? <value>		
CONF:ANALOG:FM:AUDIO_FREQ_R <value>	0 ~ 10.00	Unit : kHz
READ:ANALOG:FM:AUDIO_FREQ_L? <value>		
CONF:ANALOG:FM:AUDIO_FREQ_L <value>	0 ~ 10.00	Unit : kHz
EXEC:ANALOG:FM:CONTENTS_RST <value>		Reset the file reading pointer
READ:ANALOG:FM:CONTENTS? <value>		
CONF:ANALOG:FM:CONTENTS <value>	The name of wave content file	
READ:ANALOG:FM:SWEEP_START? <value>		
CONF:ANALOG:FM:SWEEP_START <value>	0 ~ 10.00	
READ:ANALOG:FM:SWEEP_STOP? <value>		
CONF:ANALOG:FM:SWEEP_STOP <value>		
READ:ANALOG:FM:SWEEP_TIME? <value>		
CONF:ANALOG:FM:SWEEP_TIME <value>	20 ~ 10000	Unit : ms
READ:ANALOG:FM:PILOT_LEVEL? <value>		
CONF:ANALOG:FM:PILOT_LEVEL <value>	0 ~ 15.0	
READ:ANALOG:FM:PRE_EMPHASIS? <value>		
CONF:ANALOG:FM:PRE_EMPHASIS <value>	OFF, ON	
READ:ANALOG:FM:TIME_CONSTANT? <value>		
CONF:ANALOG:FM:TIME_CONSTANT <value>	25, 50, 75	
READ:ANALOG:FM:AUDIO_VOLUME? <value>		
CONF:ANALOG:FM:AUDIO_VOLUME <value>	0 ~ 100	

5.3.4 ANALOG RDS

Command	<value> Range	Description
READ:ANALOG:RDS:RDS_MODE? <value>		

CONF:ANALOG:RDS:RDS_MODE <value>	OFF, FILE
READ:ANALOG:RDS:CONTENTS? <value>	
CONF:ANALOG:RDS:CONTENTS <value>	The name of playback content file

5.3.5 ANALOG AM

Command	<value> Range	Description
READ:ANALOG:AM:MODE?		
CONF:ANALOG:AM:MODE <value>	MONO, WAVE, SWEEP	
READ:ANALOG:AM:AUDIO_FREQ?		
CONF:ANALOG:AM:AUDIO_FREQ <value>	0 ~ 10.000	Unit : kHz
READ:ANALOG:AM:AM_INDEX?		
CONF:ANALOG:AM:AM_INDEX <value>	0 ~ 100	Unit : %
READ:ANALOG:AM:CONTENTS_TYPE?		
EXEC:ANALOG:AM:CONTENTS_RST		
READ:ANALOG:AM:CONTENTS?		
CONF:ANALOG:AM:CONTENTS <value>	The name of wave content file	
READ:ANALOG:AM:SWEEP_START?		
CONF:ANALOG:AM:SWEEP_START <value>	0 ~ 10	
READ:ANALOG:AM:SWEEP_STOP?		
CONF:ANALOG:AM:SWEEP_STOP <value>	0 ~ 10	
READ:ANALOG:AM:SWEEP_TIME?		
CONF:ANALOG:AM:SWEEP_TIME <value>	20 ~ 10000	

5.3.6 SETUP SYSTEM

Command	<value> Range	Description
---------	------------------	-------------

READ:SETUP:SYSTEM:IP_TYPE?		
CONF:SETUP:SYSTEM:IP_TYPE	STATIC DYNAMIC	Static or Dynamic
READ:SETUP:SYSTEM:IP_ADDR?		
CONF:SETUP:SYSTEM:IP_ADDR	000.000.000.000 255.255.255.255	IP4 type