RWC5010A NFC Tester

Operating Manual

Version 2.1 (ENG)
(RWC5010A FW Version 2.10)

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RedwoodComm

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I. General Information

This chapter covers specifications, key features, warranty, and safety consideration of the Instrument.

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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, Customer must notify RedwoodComm of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by RedwoodComm. Customer 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 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 operation.

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 do not to exceed ± 10% of the nominal voltage.

Provided Proper Ventilation

To prevent product overheating, provide proper ventilation.

Do Not Operate With Suspected Failures

If you 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

These terms may appear in this manual

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.

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

Close	**Open**	**ATTENTION**	**Indicates earth (ground) terminal**

1.3 Contact Information

The contact information of RedwoodComm Headquarters is as follows:

Telephone: 82-70-7727-7011

E-mail: sales@redwoodcomm.com

Homepage: http://www.redwoodcomm.com

1.4 Key Features

General Descriptions

RWC5010A NFC Tester is a test equipment to test NFC Forum Devices specified in NFC Forum Technical Specifications. It provides very convenient working environment with full control over all system parameters. It supports various kinds of functions such as power vs. time measurement, link analyzer and modulation characteristic and load modulation measurements. The link timings such as FDT and GT are measured in real time with Link analyzer. RWC5010A is a compact low-cost all-in-one tester which includes NFC protocol (as defined in Digital Protocol Specification of NFC Forum and EMVCo), analog hardware (as defined in Analog Specification of NFC Forum), and software for tests and measurements.

Key Features

- Listen Test, Poll Test, and Sniff mode supported
- NFC-A, NFC-B, NFC-F, NFC-V, EMVCo A/B supported
- All types of NFC tags supported: Type-1, Type-2, Type-3, Type-4 and Type-5
- Link message logger and analyzer
- Link timing measurement such as Frame Delay Time (FDT) and Guard Time (GT)
- Graphical Power vs. Time measurement similar to oscilloscopes
- Modulation characteristic measurement
- Load Modulation amplitude measurement
- Resonance Frequency measurement of DUT antenna
- User-controllable ASK modulation index
- Receiver Sensitivity measurement of Polling (or PCD) DUT by adjusting load modulation amplitude
- Receiver Sensitivity measurement of Listening (or PICC) DUT by adjusting VDC level
- User friendly GUI (4.3" TFT LCD and key pad) for easy configuring of all tester parameters
- RJ45 and RS232C Remote Control port
- Automated PC Program for Analog Test Cases specified by NFC Forum

1.5 Specifications

Frequency

- Range: 13.5MHz ~ 13.6MHz for normal In/Out

    10MHz ~ 20MHz for resonance frequency measurement

- Resolution: 1kHz

- Accuracy: $\pm$ 1ppm/year @ operating temperature

Output Level

- Range: MAX. 20Vpp @ 50Ω

- Resolution: 1mV

- Accuracy: ±5%

- Impedance: 50Ω

VSWR

- Better than 1:1.5

Modulation

- ASK (Amplitude Shift Keying) with variable modulation index

- Load Modulation with variable amplitude

Frequency Reference

- Internal Reference & Stability: 10 MHz, $\pm$ 1ppm/year @ operating temperature

- External Reference: 10MHz (0dBm ~ +20dBm MAX)

VDC input port

- Measureable voltage Range: ±10V

- Input Impedance: High (1MΩ)

Remote Programming Ports

- RJ45(TCP/IP)

- RS-232C

Miscellaneous

- Operating temperature: 5 ~ 40°C

- Line Voltage: 100 to 240 VAC, 50/60Hz

- Dimension: 240(w) x 340(d) x 110(h) mm

- Weight: 5.5Kg

1.6 Initial Inspection

After the delivery of the product, damage to its exterior that may occur during the shipping process should be inspected, then it should be carefully checked that all accessories are included as listed in the following table:

NO.	Item Code	Item	Specifications	Q'ty
1	C5010A-00	RWC5010A NFC Tester		1
2	5010A00-8001	PC program & Manual	USB Memory Stick	1
3	6000-0001-001	RG58, BNC(M) to BNC(M)	L:1m	1
4	6002-0003-001	RG174, SMA(M) to BNC(M)	L:1m, Blue Tube	1
5	6002-0001-001	RG174, SMA(M) to SMA(M) Cap	L500mm, Black Tube	1
6	6002-0002-001	RG174, SMA(M) to SMA(M) Cap	L500mm, White Tube	1
7	6211-0002-001	SMA(F) to N(M) Adaptor		2
8	6112-0001-001	RJ45 Cross LAN Cable	2m	1
9	6114-00XX-001	Power Cord	1.5m	1

WARNING: If any damage to interior or exterior of the product is found, please stop using immediately for safety and contact to the technical support.

1.7 Power Requirement

Items	Specifications
Input Voltage	100 VAC - 240 VAC
Input Current	1.2A
Frequency	50/60 Hz
Power Consumption	< 40 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 ±10% of the nominal voltage.

1.8 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 linearity to 50% relative humidity at 40 °C. Over voltage Installation Category II for main 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.

II. Operation

This section describes the basic concepts and details of operating RWC5010A NFC Tester. Understanding the basic concept of your RWC5010A may help you use it effectively.

2.1 Front Panel View

Fig 2.1   RWC5010A Front Panel View

NO	Items	Names and Descriptions
1		LCD Display
2	MENU	Main Menu selection key
3	S1 S2 S3 S4	Sub Menu selection key
4	RUN	RUN / STOP key
5	ZOOM FULL ZOOM OUT ZOOM IN	Zoom Full / Out / In key (POW_TIME only)

6	M1 M2 MOVE 1 A 2 B 3 C abc def 4 D 5 E 6 F ghi jkl mno 7 8 9 pqrs tuv wxyz 0 . – Caps	Number and letter input keys, Float point input key, Minus sign input key, Marker selection key (M1, M2) Graph selection key (MOVE)
7	FREQ Recall	Shortcut key for frequency setting
8	POWER Save	Shortcut key for output power setting
9	ESC Unit	Input cancel, Popup window release, Return to the previous state
10	ENTER	Data input completion, Input mode switching
11	DEL	Key to delete the current character
12	← Tab	Cursor move Cursor mode switching (Tab)
13	→ LOCAL	Cursor mode LOCAL mode switching (LOCAL)
14		Rotary Knob: Cursor move, value changing Push: same as "ENTER"
15	FCN + FREQ Recall FCN + POWER Save FCN + – Caps	Recall Save Caps
16	RF IN 50Ω ⚠ +20dBm MAX 0V DC MAX ○ RF OUT 50Ω	RF IN/OUT Connectors
17		Power Switch

2.2 Rear Panel View
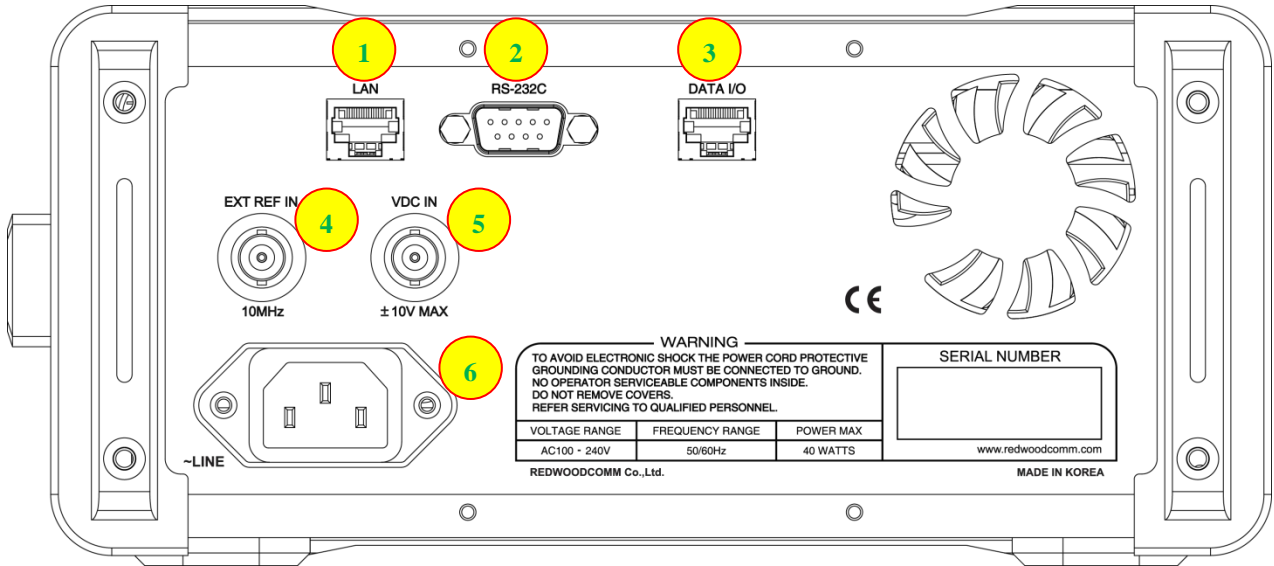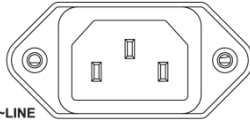
Fig 2.2   RWC5010A Rear Panel View

NO	Items	Names and Descriptions
1	LAN	Ethernet Interface
2	RS-232C	RS-232C Interface
3	DATA I/O	Sync Data I/O between RedwoodComm instruments
4	EXT REF IN 10MHz	10MHz External Reference Signal input
5	VDC IN ± 10V MAX	DC Voltage Input
6	~LINE	100~240VAC Power Input

2.3 Basic Operation

2.3.1 Main Menu Selection

RWC5010A NFC Tester has a tree type menu structure and five main menus. Pressing [MENU] key pops up the main menu selection screen and each main menu can be selected by pressing direct number key (1, 2, 3, 5, or 6) or rotating the rotary knob and pressing the [ENTER] key. The following figure shows the main menu selection screen.

Fig 2.3   Main Menu Selection Screen

Main Menu	Descriptions
LISTEN TEST	This is a menu for testing Listening Device; RWC5010A acts as the reference Polling Device to communicate with Listening Device Under Test, while analyzing protocol messages and measuring the signal quality and performance of DUT.
POLL TEST	This is a menu for testing Polling Device; RWC5010A acts as the reference Listening Device to communicate with Polling Device Under Test, while analyzing protocol messages and measuring the signal quality and performance of DUT.
SNIFF	This is a menu for SPYing communication messages between two NFC devices. RWC5010A only receives protocol messages from NFC devices and does not respond to any messages. This may help to resolve the interoperability among NFC devices.
GENERAL	This is a menu for supplementary functions such as Signal Generator, Power vs. Time Measurement, DC Voltage Meter, and Resonance Frequency Measurement of Antenna.
SETUP	This is a menu for the basic information and configuration of RWC5010A; IP address, Serial Number, Software Version, Calibration information, and etc. During remote control operation, the list of remote commands can be shown in Remote screen.

2.3.2 Sub Menu Selection

Sub menu selection keys((S1) ~ (S4)) allow you to instantly access and alter instrument settings without using the rotary knob. You can use Sub menu selection keys to move quickly between submenus in the same main menu. When Sub menu selection key is pressed, the cursor instantly moves to the related submenu. Four Sub menu selection keys are available for each main screen

2.3.3 Rotary Knob

The rotary knob moves the cursor to every field on the screen that can be changed. By positioning the cursor in front of a field and pressing the knob to select that field, you can alter that field's setting.

2.3.4 Data Input and Modification

1. Move the cursor to the desired input field using rotary knob or arrow keys.

2. Push rotary knob or [ENTER] key for data input mode. The cursor indicates data input position. If there are only two alternatives, push the rotary knob or [ENTER] key to toggle the data. In case of pop-up men rotate the rotary knob to choose.

3. Push Rotary knob to enter data and then the new data is entered.

4. While entering the data, if you press [ESC Unit] or [DEL] key, the input data shall be cancelled or deleted respectively.

2.3.5 Edit String

1. To edit the string of Ensemble Label, Service Label, Service Component Label, DLS, Save name and etc., move cursor to the Label parameter and set it to input mode by pushing the rotary knob or [ENTER] key then input cursor will be placed at the last of string. Press the number keys repeatedly, then the numbers and characters are displayed repeatedly.

2. When desired number or character is displayed, please wait until the cursor is moved to next position.

2.3.6 Zoom and Marker Functions in POW_TIME Screen

1. Every main menu has Power Time Measurement to analyze the measured waveform effectively with convenient Zoom and Marker functions; [ZOOM FULL], [ZOOM OUT], and [ZOOM IN] are keys for Zoom and [1 A] (M1), [2 B] (M2), and [3 C] (MOVE) are keys for Markers.

2. There are two operating modes of cursor in POW_TIME screen. One is 'Normal Mode' where the cursor locates in right-side parameter window and the other is 'Marker Mode' where the cursor

locates in left-side graphical window. Switching between two modes is done by ⬅ key (Tab).

3. [Zoom-In] Pressing ⌨ key makes the measurement screen zoom-in according to Time axis. For user convenience, TIME/DIV values are set to 100us, 50us, 20us, 10us, 5us, 2us, or 1us.

4. [Zoom-Out] Pressing ⌨ key makes the measurement screen zoom-in according to Time axis. For user convenience, TIME/DIV values are set to 100us, 50us, 20us, 10us, 5us, 2us, or 1us.

5. [Zoom-Full] Pressing ⌨ key makes the measurement screen zoom-full according to Time axis, which corresponds to the maximum possible value of TIME/DIV under the current TIMESPAN.

6. [Marker 1] When cursor mode is 'Marker Mode', the red-colored Marker 1 is enabled by pressing 1ᴀ key(M1) and moved by rotating the rotary knob while the measured values at the marker position are updated automatically.

7. [Marker 2] When cursor mode is 'Marker Mode', the blue-colored Marker 2 is enabled by pressing 2ʙ key(M2) and moved by rotating the rotary knob while the measured values at the marker position are updated automatically.

8. [Graph Move] When cursor mode is 'Marker Mode', the waveform can be selected by pressing 3ᴄ key(MOVE) and moved by rotating the rotary knob.

9. [Zoom-In with Marker] To zoom-in the specific part of the waveform at once, move Marker 1 and Marker 2 to the wanted position and push ⌨ key.

10. [Zoom-In with TIME/DIV] Direct input of TIME/DIV value can also be used as Zoom function. This may be useful for analysis by bit duration, e.g. 9.44us for NFC-A.

11. [TIMESPAN] TIMESPAN determines the amount of data to be stored in measurement buffer in Time unit. The maximum value is 308.8ms.
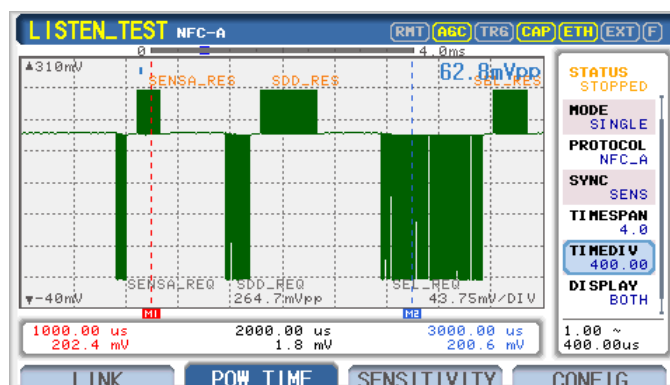
Fig 2.4   Example of Zoom-Full Screen
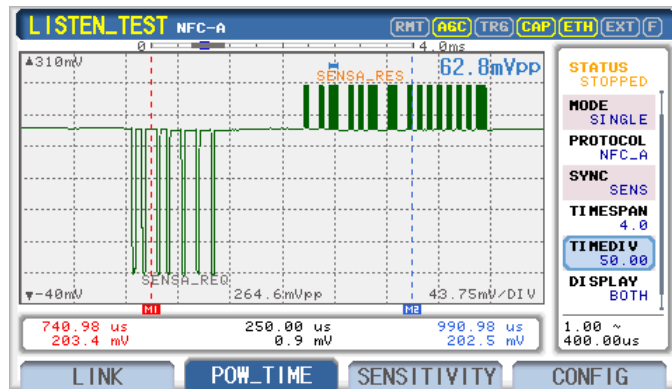
Fig 2.5   Example of Zoom-In Screen
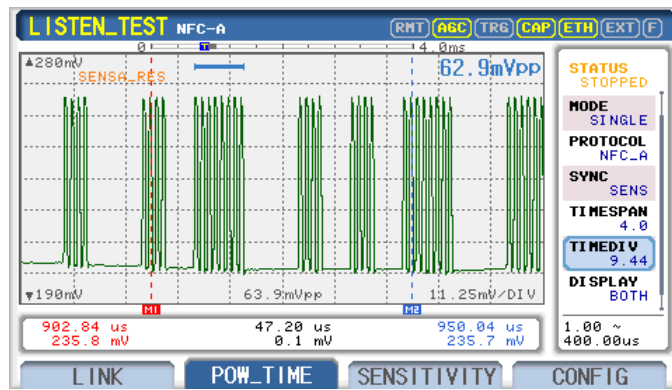
Fig 2.6   Example of TIME/DIV Setting

2.4 Menu Structure

RWC5010A has a tree type menu structure as the following figure. There are five main menus and each main menu has 2 ~ 4 sub menus.
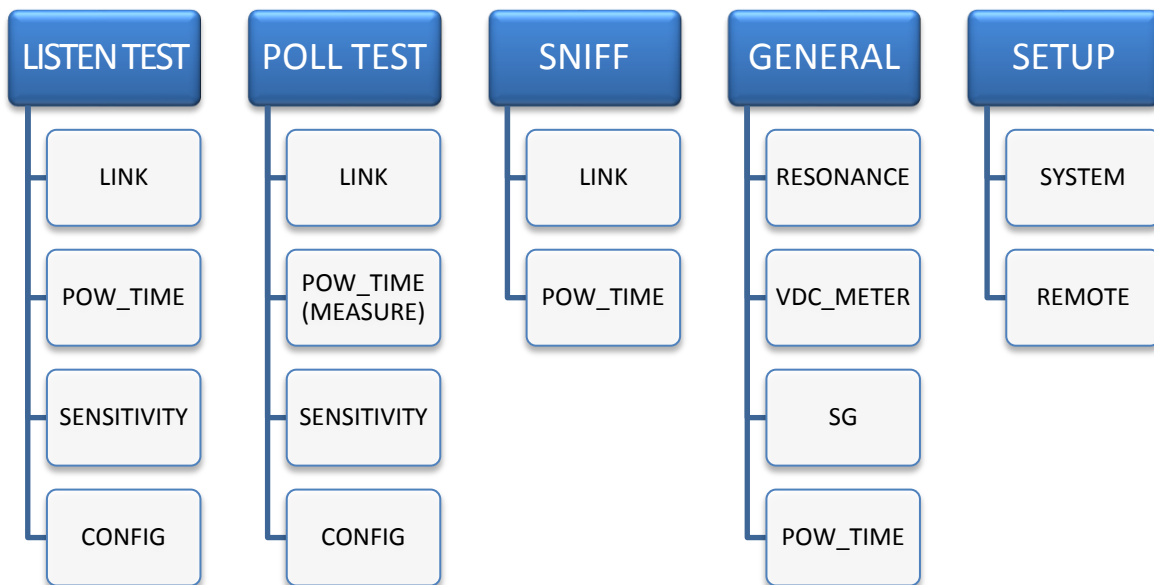
Fig 2.7   RWC5010A Menu Structure

2.5 Display Screen

Status Icon

F: Function Key Status

EXT: External Reference Status

ETH: Ethernet Connection Status

CAP: Capital Key Status

TRG: Measurement Trigger Indicator

AGC: Automatic Gain Control Lock Status

RMT: Remote Control Mode Status

Main Menu

Displays the Selected
Main Menu

Cursor

Cursor to select
parameter.
Moved by Rotary
knob
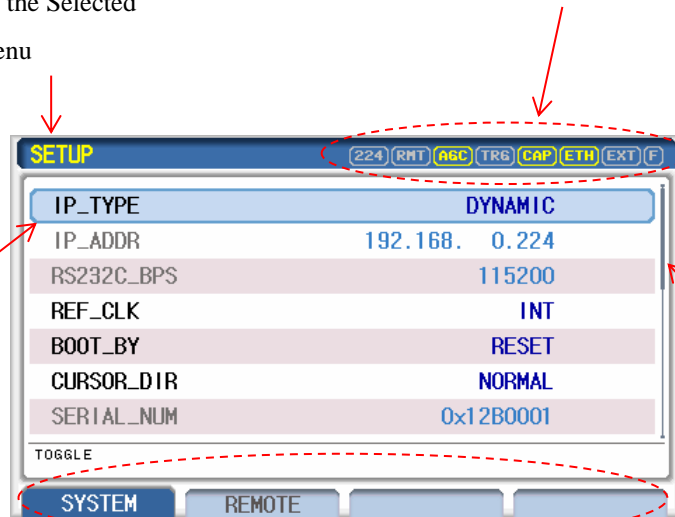
Scroll Bar

When there are a lot
of parameters,
it indicates the
current position

Sub Menu

Selectable Sub Menus

Fig 2.8   RWC5010A Display Screen

2.6 Ethernet IP Setup

IP configuration can be done in 'SETUP/SYSTEM' screen by configuring "IP_TYPE" and "IP_ADDR".

"IP_TYPE" parameter can be set to DYNAMIC or STATIC; DYNAMIC means that IP address may be obtained from the DHCP server automatically, and this configuration is recommended for RJ45 connection to network hub. STATIC means that IP address should be configured manually by users, and this configuration is recommended for direct connection between RWC5010A and a remote PC using a cross cable.
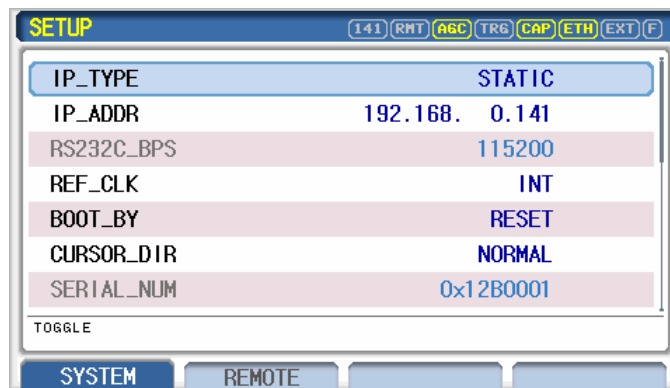
Fig 2.9   Example of STATIC IP
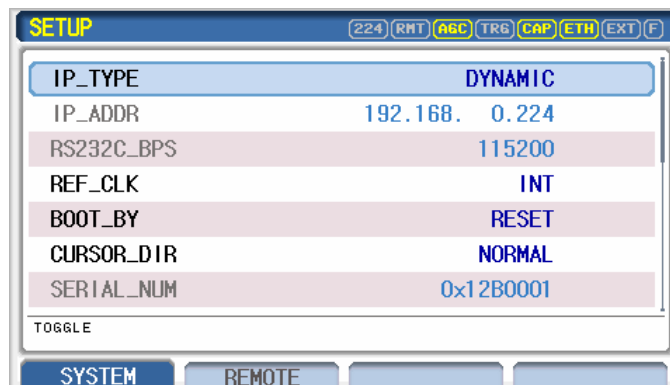
Fig 2.10   Example of DYNAMIC IP

2.7 Firmware Upgrade

As RWC5010A adapted Flash Memory, it is available to upgrade easily by using the PC without changing the Hardware. For upgrading, 'RWC_Upgrader' Program shall be used, which is provided together when the product is purchased or available to download the upgrade package including itself and the upgrade binary files from RedwoodComm Website (http://www.redwoodcomm.com). The information for upgrading shall be kept in providing to the user via email or website.

Normal Firmware Upgrade Procedure

1) Set up Ethernet connection between RWC5010A and a remote PC, using a RJ45 cable for normal connection to network hub or using a cross cable for direct connection between them.

2) In case of direct connection using a cross cable, IP configuration of a remote PC should be done manually as the following figure. For reliable connection, it is recommended that all other networks except of the Ethernet network should be disabled. The IP address of a remote PC shall not be same as that of RWC5010A.
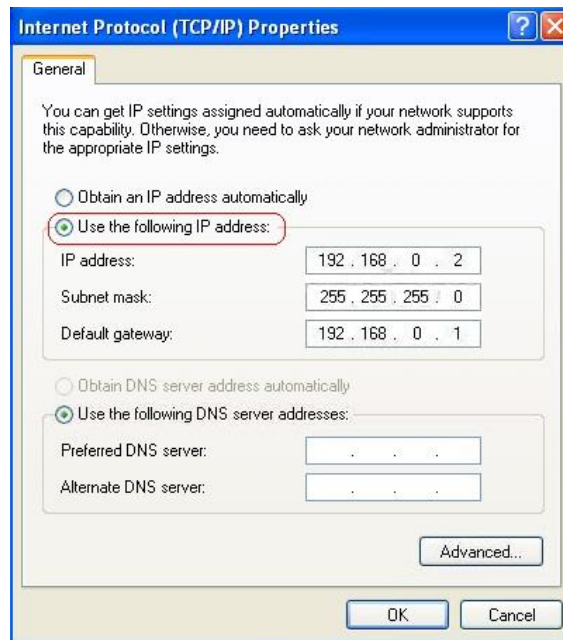
Fig 2.11   IP configuration of a remote PC

3) After downloading upgrade files from RedwoodComm website, execute an application program for upgrading.

4) Set up IP address in the application program, and follow the instructions of the program.

5) During upgrading, RWC5010A may show the progressing information on its screen as the following figure.
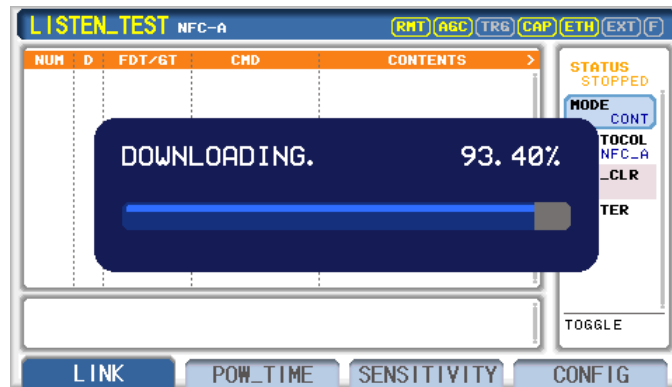
Fig 2.12　RWC5010A Screen for Upgrading

6) After upgrading completed, reboot RWC5010A and check the software version in 'SETUP/SYSTEM' screen.

CAUTION: If upgrading fails, turn on RWC5010A in Emergency Upgrade Mode and upgrade firmware again. Refer to "Emergency Firmware Upgrade Procedure".

Emergency Firmware Upgrade Procedure

1) If Normal Firmware Upgrade Procedure fails during upgrading, the internal memory may be damaged. In this case, RWC5010A may not boot correctly. Then RWC5010A must be upgraded in Emergency Upgrade Mode.

2) Turn off RWC5010A. While keeping (S1) key pressed, turn on RWC5010A. Then RWC5010A will boot in Emergency Upgrade Mode as the following figure.

3) Make direct connection between a remote PC and RWC5010A using a cross cable and wait until IP address of RWC5010A will be displayed on the screen.

4) Follow the steps 3) to 6) of Normal Firmware Upgrade Procedure.
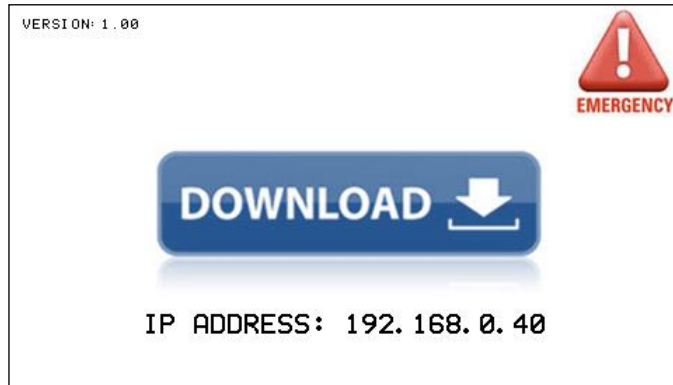
Fig 2.13   RWC5010A Boot Screen of Emergency Upgrade Mode

2.8 Usage of LISTEN_TEST » CONFIG and Basic Setup

2.8.1 Overview

To create a link with a Listening Device Under Test and measure its performances, parameters such as a Reference Poller Antenna to be used, Output Level, protocol type, and other protocol parameters should be configured in advance. This configuration is done in LISTEN_TEST » CONFIG screen as the following figure. Refer to 2.8.2 for descriptions of parameters.

Fig 2.14   LISTEN_TEST » CONFIG Screen

2.8.2 Parameters

FREQUENCY

Normally NFC operates at 13.56MHz frequency with 7kHz tolerance, specified by NFC Forum Analog Specification. The Specification also requires the test equipment operate at 13.55MHz ~ 13.57MHz. RWC5010A supports larger frequency range, 13.5MHz ~ 13.6MHz, to fulfill the requirement sufficiently. The frequency resolution is 1kHz.

REF_POLLER

RWC5010A operates as a reference Polling Device in LISTEN_TEST. Therefore, before starting tests, it is required to determine a Reference Poller Antenna to be used and configure RWC5010A according to this information. NFC Forum defines 3 types of Reference Poller Antennas (Reference Poller 0, Reference Poller 3, and Reference Poller 6) as the following figure.

Fig 2.15　Reference Poller Antenna Set

WARNING: If the REF_POLLER configuration and a reference antenna used in tests should always be matched not to make the test results meaningless.

VDC_TYPE

NFC Forum Analog Test Specification describes the requirements of the Test Tool. One of the requirements is the output level of Polling Device mode to test a Listening Device Under Test, defined as VDC, which can be as VDC_TYPE in RWC5010A. That is the output power of Poll mode of RWC5010A. The Analog Test Specification defines 3 types of VDC levels; MAX, NOMINAL, and MIN, and how to calibrate them. The following figure shows an example of VDC level calibration. The VDC levels of RWC5010A are pre-calibrated according to the Analog Test Specification during production.

Fig 2.16　Example of VDC Level calibration

VDC

The value of VDC level is displayed corresponding to VDC_TYPE parameter.

VDC_OFFSET

This is an offset value to adjust VDC level to an arbitrary value other than MAX, NOMINAL, or MIN. The resultant total value of VDC level will be VDC plus VDC_OFFSET.

REF_LISTENER

This is the informative value which Reference Listener Antenna was used in VDC level calibration for the current REF_POLLER and VDC_TYPE, and cannot be modified.

LOAD_R

This is the informative value which Load Resistor was used in VDC level calibration for the current REF_POLLER, REF_LISTENER, and VDC_TYPE, and cannot be modified.

MOD_SETUP

This is for selection of the modulation condition in Analog Test Cases and its default value is COND_1_820R.

PROTOCOL

This is for selection of protocol type (NFC technology) to test a Listening Device Under Test, among 4 types defined in NFC Forum; NFC-A, NFC-B, NFC-F, and NFC-V. For example, if NFC-A is selected, RWC5010A operates only as NFC-A Polling Device. If EMVCo option is added into the Tester, additional lists will be shown; EMV_A and EMV_B.

ACTIVITY

This is a process within an NFC Forum Device with well-defined pre-conditions and post-conditions, as defined in Activity Technical Specification. An Activity can only start when its pre-conditions are fulfilled. When an Activity ends, its post-conditions are fulfilled.

READ_BNo

This is the value of Block Number (BNo) used to address Tag's memory, which is meaningful only when ACTIVITY is set to TAG_READ.

NDEF_TEXT

This is the value of NDEF Text message to be written into Tag's memory, which is available only when ACTIVITY is set to TAG_WRITE.

ID_SIZE

This is the size of NFC ID of RWC5010A only in case of NFC-A. For NFC-A, there are 3 types of sizes defined in NFC Forum; SINGLE, DOUBLE, and TRIPLE. For NFC-B and NFC-F, the size of

NFC ID is fixed and hidden.

NFDID1, NFCID0, NFCID2, UID

This is the value of NFC ID or UID of RWC5010A.

BPS

This is the value of data rate of RWC5010A in NFC-F.

TSN

This is the value of Time Slot Number (TSN) in NFC-F, which is used for collision resolution and to reduce the probability of collisions.

SLOT_NUM

This is the value of 'Number of Slots' in NFC-V.

2.9 Usage of LISTEN_TEST » LINK

2.9.1 Overview

RWC5010A provides a function of Link Analyzer for each main menu. In LISTEN_TEST, Link Analyzer helps to create a link between RWC5010A and a Listening Device Under Test and to analyze the protocol messages and link timings.

2.9.2 Test Procedure

1. [Main menu selection]
    Set the main menu to LISTEN_TEST referring to 2.3.1.

2. [Antenna connection]
    Connect J1 port and J2 port of the Reference Poller Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Parameter configuration]
    Move to CONFIG screen by pressing (S4) key. Configure REF_POLLER parameter to match with the Reference Poller Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL, VDC_TYPE, and etc. Refer to 2.8 for details.

4. [DUT positioning]
    Place a Listening Device Under Test on the Reference Poller Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Execution]
    Move to LINK screen by pressing (S1) key. Start testing by pressing (RUN) key, and the link messages between DUT and RWC5010A will be displayed in real time. Refer to the following figure for descriptions of the LINK screen.

6. [Analysis and utilization]
    Pressing (←) key (Tab) moves the cursor location to the message window. Link Message. Rotating the rotary knob shows the raw data of the current cursor position at the bottom of the screen in hexa-decimal format. Rotating the rotary knob with (FCN) key pressed scrolls the screen in horizontal direction.

Titles

D: direction (P or L)   FDT/GT: link timing

CMD: Type of Frame   CONTENTS: Message information

Link Messages

Black: RWC5010A Signal

Blue: DUT Signal

Raw Data

Raw data of the current
cursor position

Parameter Window

Displays the
parameter value

Parameter Range

Range of the current
parameter
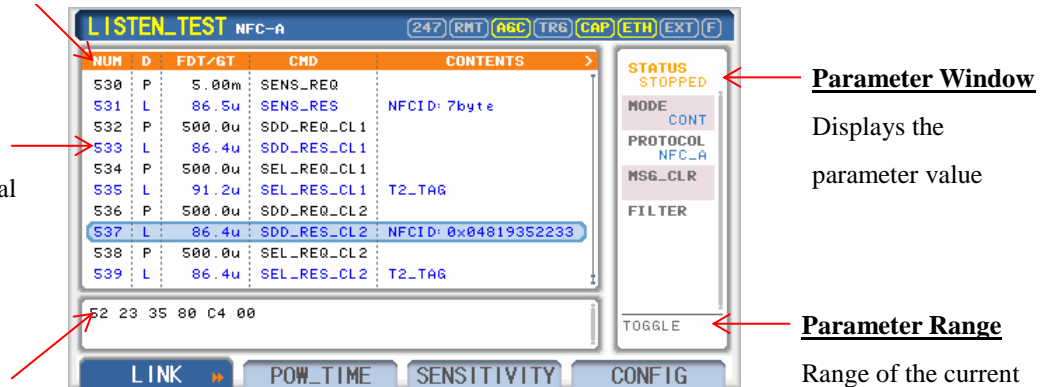
Fig 2.17   LISTEN_TEST » LINK Screen

2.9.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is sending Poll Command repeatedly. Pressing `RUN` key starts or stops the operation of RWC5010A.

MODE

This is the run mode of RWC5010A; in SINGLE mode RWC5010A identifies a Listening Device Under Test once and stops, and in CONTINUOUS mode keep identifying it continuously until `RUN` key is pressed again.

PROTOCOL

Same as PROTOCOL parameter of 2.8.

MSG_CLR

Erases the list of link messages on the screen.

FILTER

This is for selection of the type of link messages to display by checking or un-checking the box in front of each message type using the rotary knob or ENTER key.

Fig 2.18   LINK MESSAGE FILTER Popup Screen

2.10 Usage of LISTEN_TEST » POW_TIME

2.10.1 Overview

RWC5010A provides a function of Power Time Measurement for each main menu. In LISTEN_TEST, Power Time Measurement helps to create a link between RWC5010A and a Listening Device Under Test and to analyze the received waveforms.

2.10.2 Test Procedure

1. [Main menu selection]

    Set the main menu to LISTEN_TEST referring to 2.3.1.

2. [Antenna connection]

    Connect J1 port and J2 port of the Reference Poller Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Parameter configuration]

    Move to CONFIG screen by pressing (S4) key. Configure REF_POLLER parameter to match with the Reference Poller Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL, VDC_TYPE, and etc. Refer to 2.8 for details.

4. [DUT positioning]

    Place a Listening Device Under Test on the Reference Poller Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Execution]

    Move to POW_TIME screen by pressing (S2) key. Start testing by pressing (RUN) key, and the command and response waveforms between DUT and RWC5010A will be displayed on the screen. Refer to the following figure for descriptions of the POW_TIME screen.

6. [Analysis and utilization]

    Refer to 2.3.6 for descriptions of Zoom and Marker functions.

Fig 2.19   LISTEN_TEST » POW_TIME Screen

2.10.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is sending Poll Command repeatedly. Pressing ▢RUN key starts or stops the operation of RWC5010A.

MODE

This is the run mode of RWC5010A; in SINGLE mode RWC5010A executes the measurement once and stops, and in CONTINUOUS mode executes the measurement continuously until ▢RUN key is pressed again.

PROTOCOL

Same as PROTOCOL parameter of 2.8.

SYNC

It provides the command-selective triggering in measurement. If a specific command is selected as

SYNC, the measurement will be triggered right after the corresponding response is received from DUT and be displayed on the screen.

TIMESPAN

TIMESPAN determines the amount of data to be stored in measurement buffer in Time unit. The minimum value is 1ms and the maximum value is 308.8ms.

TIMEDIV

Direct input of TIME/DIV value can also be used as Zoom function. The minimum value is 1us and the maximum value is one tenth of TIMESPAN. This may be useful for analysis by bit duration, e.g. 9.44us for NFC-A.

DISPLAY

This determines whether to display the supplementary information such as the measured Load Modulation amplitude and Message Log. OFF disables all information, RESULT displays the measured Load Modulation amplitude, MSG displays Message Log for each signal, and BOTH displays both ones.
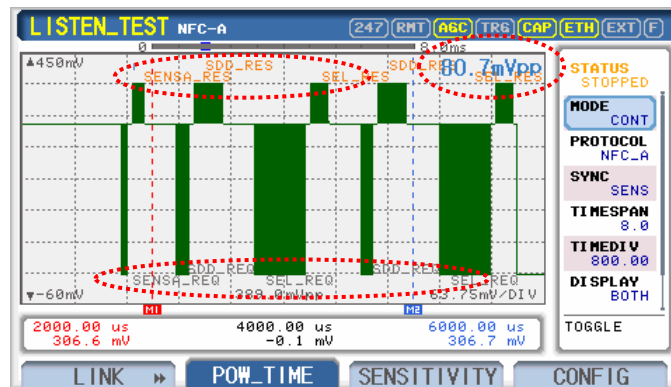
Fig 2.20　Load Modulation and Message Log Display in POW_TIME Screen

SCALE

It determines scaling of Y-axis. AUTO scales automatically for each measurement and MANUAL keeps the current scaling according to MAX_Y and MIN_Y values.

AUTOSET

In case of MANUAL scaling, executing AUTOSET scales automatically for the current measurement once.

MAX_Y

In case of MANUAL scaling, the maximum value of Y-axis can be set.

MIN_Y

In case of MANUAL scaling, the minimum value of Y-axis can be set.

2.11 Usage of LISTEN_TEST » SENSITIVITY

2.11.1 Overview

SENSITIVITY is a function of testing the receiver sensitivity of DUT. SENSITIVITY in LISTEN_TEST has 3 types of operation modes; SEARCH, VDC, and TIME. In SEARCH mode, RWC5010A searches the minimum value of output power level (VDC) at which DUT functions properly according to the internal algorithm. In VDC mode, RWC5010A sweeps its power level (VDC) from the start value to the stop value with the step value and checks whether DUT functions properly. In TIME mode, RWC5010A continuously monitors and accumulates the error rate for a long time with the fixed output level (VDC) condition.

2.11.2 Test Procedure in SEARCH Mode

1. [Main menu selection]

   Set the main menu to LISTEN_TEST referring to 2.3.1.

2. [Antenna connection]

   Connect J1 port and J2 port of the Reference Poller Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Parameter configuration]

   Move to CONFIG screen by pressing $\boxed{S4}$ key. Configure REF_POLLER parameter to match with the Reference Poller Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL and etc. Refer to 2.8 for details.

4. [DUT positioning]

   Place a Listening Device Under Test on the Reference Poller Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Sub-menu and mode selection]

   Move to SENSITIVITY screen by pressing $\boxed{S3}$ key. Set MODE parameter to SEARCH. Set TARGET_PER to user's target value of packet error rate (PER).

6. [Execution]

   Start testing by pressing $\boxed{RUN}$ key, and the test is repeated as many as REPEAT number at each test point. The PER is calculated and Load Modulation amplitude is measured at the same time.

2.11.3 Test Procedure in VDC Mode

1. [Main menu selection]

Set the main menu to LISTEN_TEST referring to 2.3.1.

2. [Antenna connection]

   Connect J1 port and J2 port of the Reference Poller Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Parameter configuration]

   Move to CONFIG screen by pressing (S4) key. Configure REF_POLLER parameter to match with the Reference Poller Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL and etc. Refer to 2.8 for details.

4. [DUT positioning]

   Place a Listening Device Under Test on the Reference Poller Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Sub-menu and mode selection]

   Move to SENSITIVITY screen by pressing (S3) key. Set MODE parameter to VDC. Set START_VDC, STOP_VDC, and STEP_VDC to user's values. Set TARGET_PER to user's target value of packet error rate (PER).

6. [Execution]

   Start testing by pressing (RUN) key, and the test is repeated as many as REPEAT number at each test point. The PER is calculated and Load Modulation amplitude is measured at the same time.

## 2.11.4 Test Procedure in TIME Mode

1. [Main menu selection]
   Set the main menu to LISTEN_TEST referring to 2.3.1.

2. [Antenna connection]
   Connect J1 port and J2 port of the Reference Poller Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Parameter configuration]

   Move to CONFIG screen by pressing (S4) key. Configure REF_POLLER parameter to match with the Reference Poller Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL, VDC_TYPE, and etc. Refer to 2.8 for details.

4. [DUT positioning]

   Place a Listening Device Under Test on the Reference Poller Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Sub-menu and mode selection]

    Move to SENSITIVITY screen by pressing (S3) key. Set MODE parameter to TIME. Set other parameters to user's target values. Refer to 2.11.5 for details in parameter setting.

6. [Execution]

    Start testing by pressing [RUN] key, and the test is repeated as many as REPEAT number at each test point. The PER is calculated and Load Modulation amplitude is measured at the same time.
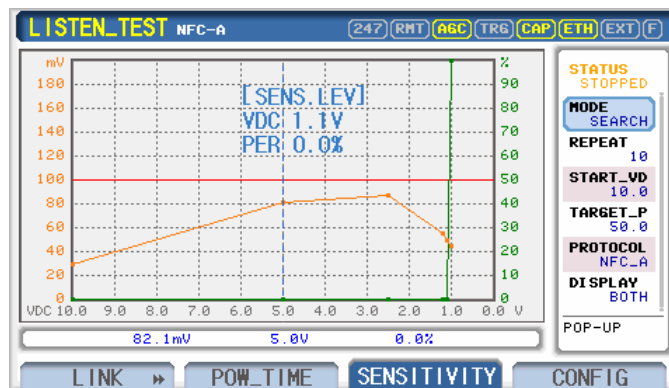
Fig 2.21   SENSITIVITY Test in SEARCH Mode
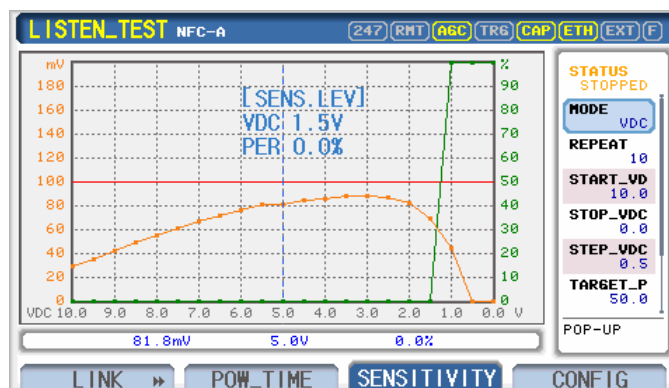
Fig 2.22   SENSITIVITY Test in VDC Mode
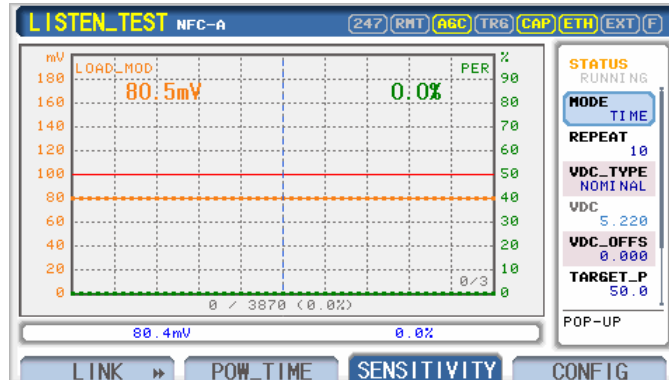
Fig 2.23   SENSITIVITY Test in TIME Mode (VDC fixed)
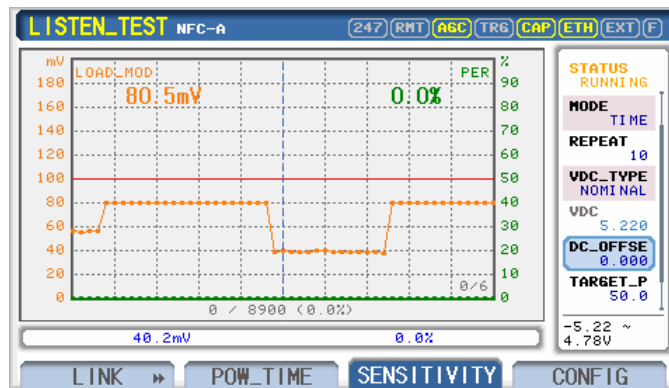
Fig 2.24   SENSITIVITY Test in TIME Mode (VDC adjusted)

2.11.5 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is sending Poll Command repeatedly. Pressing RUN key starts or stops the operation of RWC5010A.

MODE

This is the run mode of SENSITIVITY; SEARCH, VDC, and TIME.

REPEAT

This is the repeat number of tests at each test point. Increasing it the test result may have higher resolution but the testing time may become longer.

START_VDC

This defines the start value of VDC in SEARCH mode and also the start value for VDC sweep in VDC mode.

STOP_VDC

This defines the stop value for VDC sweep in VDC mode.

STEP_VDC

This defines the step value for VDC sweep in VDC mode.

VDC_TYPE

Same as VDC_TYPE parameter of 2.8. This value applies only to TIME mode.

VDC

Same as VDC parameter of 2.8. This value applies only to TIME mode.

VDC_OFFSET

Same as VDC_OFFSET parameter of 2.8. This value applies only to TIME mode.

TARGET_PER

This is a parameter to set user's target PER. In SEARCH mode, SENSITIVITY test stops automatically after finding the minimum VDC level to satisfy TARGET_PER. In VDC mode, SENSITIVITY sweeps fully in the range of VDC and calculates the minimum VDC level to satisfy TARGET_PER.

PROTOCOL

Same as PROTOCOL parameter of 2.8.

<u>DISPLAY</u>

SENSITIVITY measures PER and Load Modulation amplitude simultaneously. This parameter determines which result will be displayed on the screen. BOTH displays both PER and Load Modulation amplitude, SENS displays PER only, and LOAD displays Load Modulation amplitude only.

2.12 Usage of POLL_TEST » CONFIG and Basic Setup

2.12.1 Overview

To create a link with a Polling Device Under Test and measure its performances, parameters such as a Reference Listener Antenna to be used, Load Modulation Level, protocol type, and other protocol parameters should be configured in advance. This configuration is done in POLL_TEST » CONFIG screen as the following figure. Refer to 2.12.2 for descriptions of parameters.

Fig 2.25   POLL_TEST » CONFIG Screen

2.12.2 Parameters

REF_LISTENER

RWC5010A operates as a reference Listening Device in POLL_TEST. Therefore, before starting tests, it is required to determine a Reference Listener Antenna to be used and configure RWC5010A according to this information. NFC Forum defines 3 types of Reference Listener Antennas (Reference Listener 1, Reference Listener 3, and Reference Listener 6) as the following figure.

Fig 2.26   Reference Listener Antenna Set

WARNING: If the REF_LISTENER configuration and a reference antenna used in tests should always be matched not to make the test results meaningless.

LOAD_MOD_TYPE

NFC Forum Analog Test Specification describes the requirements of the Test Tool. One of the requirements is the output level of Listening Device mode to test a Polling Device Under Test, defined as Load Modulation amplitude, which can be as LOAD_MOD_TYPE in RWC5010A. That is the output power of Listen mode of RWC5010A. The Analog Test Specification defines 3 types of Load Modulation amplitudes; MAX, NOMINAL, and MIN, and how to calibrate them. The following figure shows an example of Load Modulation amplitude calibration. The Load Modulation amplitudes of RWC5010A are pre-calibrated according to the Analog Test Specification during production.

Fig 2.27   Example of Load Modulation amplitude calibration

LOAD_MOD

The value of Load Modulation amplitude is displayed corresponding to LOAD_MOD_TYPE parameter.

LOAD_MOD_OFFSET

This is an offset value to adjust Load Modulation amplitude to an arbitrary value other than MAX, NOMINAL, or MIN. The resultant total value of Load Modulation amplitude will be LOAD_MOD plus LOAD_MOD_OFFSET.

REF_POLLER

This is the informative value which Reference Poller Antenna was used in Load Modulation amplitude calibration for the current REF_LISTENER and LOAD_MOD_TYPE, and cannot be modified.

LOAD_R

This is the informative value which Load Resistor was used in Load Modulation amplitude calibration for the current REF_POLLER, REF_LISTENER, and LOAD_MOD_TYPE, and cannot be modified.

PROTOCOL

This is for selection of protocol type (NFC technology) to test a Polling Device Under Test, among 3 types defined in NFC Forum; NFC-A, NFC-B, and NFC-F. For example, if NFC-A is selected, RWC5010A operates only as NFC-A Listening Device.

TAG

This is for selection of the type of TAG to be emulated by RWC5010A, among 4 types in NFC Forum; Type 1, Type 2, Type 3, Type 4, and Type 5. Available types of TAG depend on the PROTOCOL parameter.

MEMORY_SIZE

This is the size of the internal memory of TAG to be emulated by RWC5010A.

NDEF_MSG

This is the type of NDEF messages to be stored in the internal memory of RWC5010A for TAG emulation. User's NDEF messages can be written and saved into RWC5010A.

ID_SIZE

This is the size of NFC ID of RWC5010A only in case of NFC-A. For NFC-A, there are 3 types of sizes defined in NFC Forum; SINGLE, DOUBLE, and TRIPLE. For NFC-B, NFC-F, and NFC-V, the size of NFC ID is fixed and hidden.

NFDID1, NFCID0, NFCID2, UID

This is the value of NFC ID or UID of RWC5010A.

SLOT_NUM

This is the value of Slot Number in NFC-F.

BLEN

This is the value of Block Length of TAG memory in NFC-V.

2.13 Usage of POLL_TEST » LINK

2.13.1 Overview

RWC5010A provides a function of Link Analyzer for each main menu. In POLL_TEST, Link Analyzer helps to create a link between RWC5010A and a Polling Device Under Test and to analyze the protocol messages and link timings.

2.13.2 Test Procedure

1. [Main menu selection]

   Set the main menu to POLL_TEST referring to 2.3.1.

2. [Antenna connection]

   Connect J2 port and J4 port of the Reference Listener Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables. The load resistor shall be set to 820Ω or 330Ω by connecting position 1 or 3 of J3 jumper respectively.

3. [Parameter configuration]

   Move to CONFIG screen by pressing $\boxed{S4}$ key. Configure REF_LISTENER parameter to match with the Reference Listener Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL, LOAD_MOD_TYPE, and etc. Refer to 2.12 for details.

4. [DUT positioning]

   Place a Polling Device Under Test on the Reference Listener Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Execution]

   Move to LINK screen by pressing $\boxed{S1}$ key. Start testing by pressing $\boxed{RUN}$ key, and the link messages between DUT and RWC5010A will be displayed in real time. Refer to the following figure for descriptions of the LINK screen.

6. [Analysis and utilization]

   Pressing $\boxed{\leftarrow}$ key (Tab) moves the cursor location to the message window. Link Message. Rotating the rotary knob shows the raw data of the current cursor position at the bottom of the screen in hexa-decimal format. Rotating the rotary knob with $\boxed{FCN}$ key pressed scrolls the screen in horizontal direction.

7. [NDEF message saving]

   If a new NDEF Message is written to RWC5010A by user's Polling Device, the color of SAVE_NDEF parameter is changed to red. Execute SAVE_NDEF and store the current NDEF message into the

internal memory of RWC5010A.

Titles

D: direction (P or L)   FDT/GT: link timing

CMD: Type of Frame   CONTENTS: Message information

Link Messages

Black: RWC5010A Signal

Blue: DUT Signal

Raw Data

Raw data of the current

cursor position

Fig 2.28   POLL_TEST » LINK Screen

Parameter Window

Displays the

parameter value

Parameter Range

Range of the current

parameter

Fig 2.29   Example of Saving NDEF Message

2.13.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is replying to Poll Command from DUT repeatedly. Pressing RUN key starts or stops the operation of RWC5010A.

PROTOCOL

Same as PROTOCOL parameter of 2.12.

MSG_CLR

Erases the list of link messages on the screen.

FILTER

This is for selection of the type of link messages to display by checking or un-checking the box in front of each message type using the rotary knob or [ENTER] key.

Fig 2.30   LINK MESSAGE FILTER Popup Screen

RESET

If the communication between RWC5010A and DUT fails and does not recover any more when RWC5010A operates in Listen mode, the execution of RESET is recommended to initialize the state of RWC5010A to IDLE state.

SAVE_NDEF

This is a parameter to save a new NDEF message written to RWC5010A by user's Polling Device. The name of NDEF message can be edited and after saving, it is re-configurable by NDEF_MSG parameter in CONFIG screen.

2.14 Usage of POLL_TEST » POW_TIME

2.14.1 Overview

RWC5010A provides a function of Power Time Measurement for each main menu. In POLL_TEST, Power Time Measurement helps to create a link between RWC5010A and a Polling Device Under Test and to analyze the received waveforms.

2.14.2 Test Procedure

1. [Main menu selection]
   Set the main menu to POLL_TEST referring to 2.3.1.

2. [Antenna connection]
   Connect J2 port and J4 port of the Reference Listener Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables. The load resistor shall be set to 820Ω or 330Ω by connecting position 1 or 3 of J3 jumper respectively.

3. [Parameter configuration]
   Move to CONFIG screen by pressing (S4) key. Configure REF_LISTENER parameter to match with the Reference Listener Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL, LOAD_MOD_TYPE, and etc. Refer to 2.12 for details.

4. [DUT positioning]
   Place a Polling Device Under Test on the Reference Listener Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Execution]
   Move to POW_TIME screen by pressing (S2) key. Start testing by pressing (RUN) key, and the command and response waveforms between DUT and RWC5010A will be displayed on the screen. Refer to the following figure for descriptions of the POW_TIME screen.

6. [Analysis and utilization]
   Refer to 2.3.6 for descriptions of Zoom and Marker functions.

Fig 2.31   POLL_TEST » POW_TIME Screen

2.14.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is replying to Poll Command from DUT repeatedly. Pressing [RUN] key starts or stops the operation of RWC5010A.

MODE

This is the run mode of RWC5010A; in SINGLE mode RWC5010A executes the measurement once and stops, and in CONTINUOUS mode executes the measurement continuously until [RUN] key is pressed again.

PROTOCOL

Same as PROTOCOL parameter of 2.12.

SYNC

It provides the command-selective triggering in measurement. If a specific command is selected as SYNC, the measurement will be triggered right after the target command is received from DUT and be displayed on the screen.

TIMESPAN

TIMESPAN determines the amount of data to be stored in measurement buffer in Time unit. The minimum value is 1ms and the maximum value is 308.8ms.

TIMEDIV

Direct input of TIME/DIV value can also be used as Zoom function. The minimum value is 1us and the maximum value is one tenth of TIMESPAN. This may be useful for analysis by bit duration.

DISPLAY

This determines whether to display the supplementary information such as the measured Modulation Characteristic and Message Log. OFF disables all information, RESULT displays the measured Modulation Characteristic, MSG displays Message Log for each signal, and BOTH displays both ones.
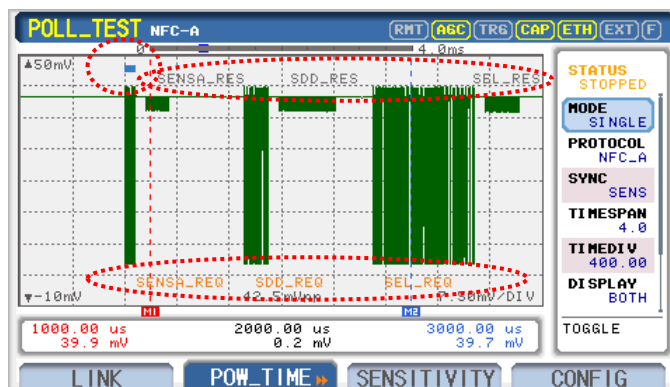
Fig 2.32   Modulation Characteristic and Message Log in POW_TIME Screen

SCALE

It determines scaling of Y-axis. AUTO scales automatically for each measurement and MANUAL keeps the current scaling according to MAX_Y and MIN_Y values.

AUTOSET

In case of MANUAL scaling, executing AUTOSET scales automatically for the current measurement once.

MAX_Y

In case of MANUAL scaling, the maximum value of Y-axis can be set.

MIN_Y

In case of MANUAL scaling, the minimum value of Y-axis can be set.

RESET

If the communication between RWC5010A and DUT fails and does not recover any more when RWC5010A operates in Listen mode, the execution of RESET is recommended to initialize the state of RWC5010A to IDLE state.

2.15 Usage of POLL_TEST » MEASURE

2.15.1 Overview

RWC5010A provides the numerical test results corresponding to Power Time Measurement, such as ASK Modulation Characteristic, Carrier Frequency, power level, and etc. It also automatically calculates the lower and upper limit values according to the NFC Forum Analog Test Specification and makes decision with verdict of PASS/FAIL.

2.15.2 Test Procedure

1. [Main menu selection]
   Set the main menu to POLL_TEST referring to 2.3.1.

2. [Antenna connection]
   Connect J2 port and J4 port of the Reference Listener Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables. The load resistor shall be set to 820Ω or 330Ω by connecting position 1 or 3 of J3 jumper respectively. It shall be set to 820Ω for VDC (V_{OV}) measurement and set to 820Ω or 330Ω for modulation characteristic measurement.

3. [Parameter configuration]
   Move to CONFIG screen by pressing $\boxed{S4}$ key. Configure REF_LISTENER parameter to match with the Reference Listener Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL, LOAD_MOD_TYPE, and etc. Refer to 2.12 for details.

4. [DUT positioning]
   Place a Polling Device Under Test on the Reference Listener Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Execution]
   Move to POW_TIME screen by pressing $\boxed{S2}$ key, then move to MEASURE screen by pressing $\boxed{S2}$ key again. Start testing by pressing $\boxed{RUN}$ key, and the measured numerical values will be displayed on the screen. Refer to the following figure for descriptions of the MEASURE screen.

6. [Analysis and utilization]
   Pressing $\boxed{S2}$ key again will switch the screen to POW_TIME displaying the measured waveforms.

Titles

MIN/AVG/MAX: Min/Avg/Max of the measured values

LL/UL: Lower Limit / Upper Limit

ITEM

CW ON/OFF Power,

Carrier Frequency,

Modulation

Characteristic
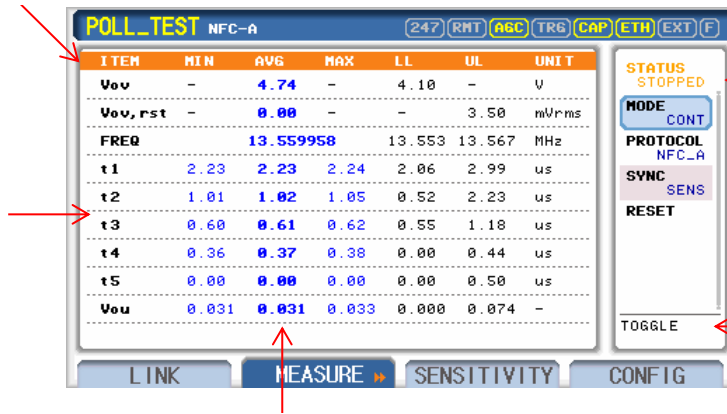
Parameter Window

Displays the

parameter value

Parameter Range

Range of the current

parameter

Blue: PASS

Red: FAIL

Fig 2.33   POLL_TEST » MEASURE Screen

2.15.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is replying to Poll Command from DUT repeatedly. Pressing `RUN` key starts or stops the operation of RWC5010A.

MODE

This is the run mode of RWC5010A; in SINGLE mode RWC5010A executes the measurement once and stops, and in CONTINUOUS mode executes the measurement continuously until `RUN` key is pressed again.

PROTOCOL

Same as PROTOCOL parameter of 2.12.

SYNC

It provides the command-selective triggering in measurement. If a specific command is selected as SYNC, the measurement will be triggered right after the target command is received from DUT and

be displayed on the screen.
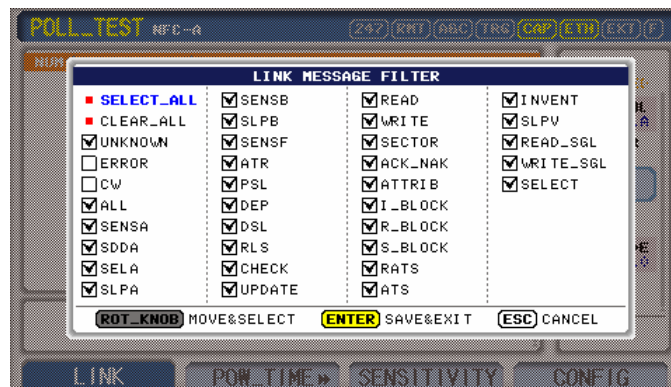
RESET

If the communication between RWC5010A and DUT fails and does not recover any more when RWC5010A operates in Listen mode, the execution of RESET is recommended to initialize the state of RWC5010A to IDLE state.

2.16 Usage of POLL_TEST » SENSITIVITY

2.16.1 Overview

SENSITIVITY is a function of testing the receiver sensitivity of DUT. SENSITIVITY in POLL_TEST has 3 types of operation modes; SEARCH, LM, and TIME. In SEARCH mode, RWC5010A searches the minimum value of output power level (Load Modulation amplitude) at which DUT functions properly according to the internal algorithm. In LM mode, RWC5010A sweeps its power level (Load Modulation amplitude) from the start value to the stop value with the step value and checks whether DUT functions properly. In TIME mode, RWC5010A continuously monitors and accumulates the error rate for a long time with the fixed output level (Load Modulation amplitude) condition.

2.16.2 Test Procedure in SEARCH Mode

1. [Main menu selection]
    Set the main menu to POLL_TEST referring to 2.3.1.

2. [Antenna connection]
    Connect J2 port and J4 port of the Reference Listener Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables. The load resistor shall be set to 330Ω by connecting position 3 of J3 jumper.

3. [Parameter configuration]
    Move to CONFIG screen by pressing (S4) key. Configure REF_LISTENER parameter to match with the Reference Listener Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL and etc. Refer to 2.12 for details.

4. [DUT positioning]
    Place a Polling Device Under Test on the Reference Listener Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Sub-menu and mode selection]
    Move to SENSITIVITY screen by pressing (S3) key. Set MODE parameter to SEARCH. Set TARGET_PER to user's target value of packet error rate (PER).

6. [Execution]
    Start testing by pressing (RUN) key, and the test is repeated as many as REPEAT number at each test point. Then the PER is calculated.

2.16.3 Test Procedure in LM Mode

1. [Main menu selection]

   Set the main menu to POLL_TEST referring to 2.3.1.

2. [Antenna connection]

   Connect J1 port and J2 port of the Reference Poller Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Parameter configuration]

   Move to CONFIG screen by pressing $\boxed{S4}$ key. Configure REF_LISTENER parameter to match with the Reference Listener Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL and etc. Refer to 2.12 for details.

4. [DUT positioning]

   Place a Polling Device Under Test on the Reference Listener Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Sub-menu and mode selection]

   Move to SENSITIVITY screen by pressing $\boxed{S3}$ key. Set MODE parameter to LM. Set START_LM, STOP_LM, and STEP_LM to user's values. Set TARGET_PER to user's target value of packet error rate (PER).

6. [Execution]

   Start testing by pressing $\boxed{RUN}$ key, and the test is repeated as many as REPEAT number at each test point. Then the PER is calculated.

2.16.4 Test Procedure in TIME Mode

1. [Main menu selection]

   Set the main menu to POLL_TEST referring to 2.3.1.

2. [Antenna connection]

   Connect J1 port and J2 port of the Reference Poller Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Parameter configuration]

   Move to CONFIG screen by pressing $\boxed{S4}$ key. Configure REF_LISTENER parameter to match with the Reference Listener Antenna connected to RWC5010A, and configure other parameters such as PROTOCOL, LOAD_MOD_TYPE, and etc. Refer to 2.12 for details.

4. [DUT positioning]

   Place a Polling Device Under Test on the Reference Listener Antenna. It is recommended to use TEST JIG and FIXTURE for reliability of the test environment.

5. [Sub-menu and mode selection]

   Move to SENSITIVITY screen by pressing $\boxed{S3}$ key. Set MODE parameter to TIME. Set other parameters to user's target values. Refer to 2.16.5 for details in parameter setting.

6. [Execution]

   Start testing by pressing $\boxed{RUN}$ key, and the test is repeated as many as REPEAT number at each test point. Then the PER is calculated.
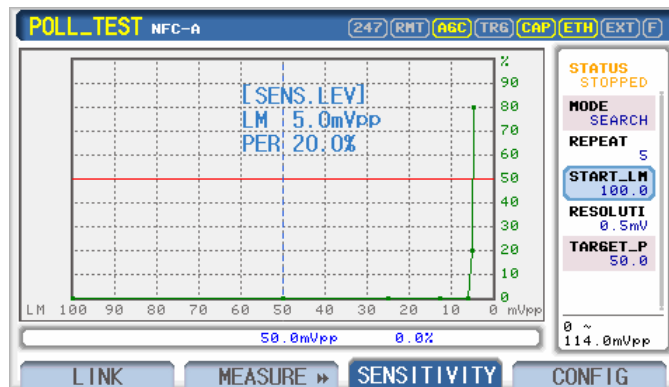
Fig 2.34   SENSITIVITY Test in SEARCH Mode
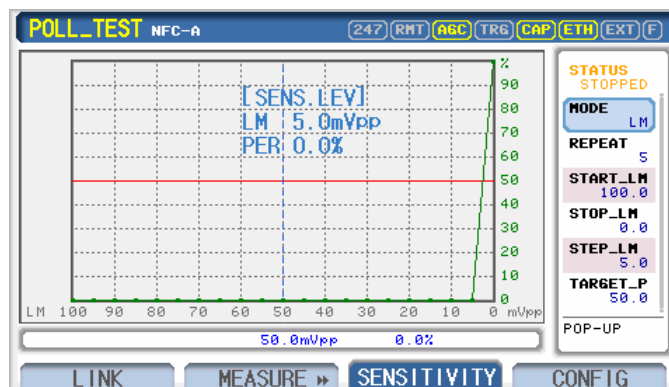
Fig 2.35   SENSITIVITY Test in LM Mode
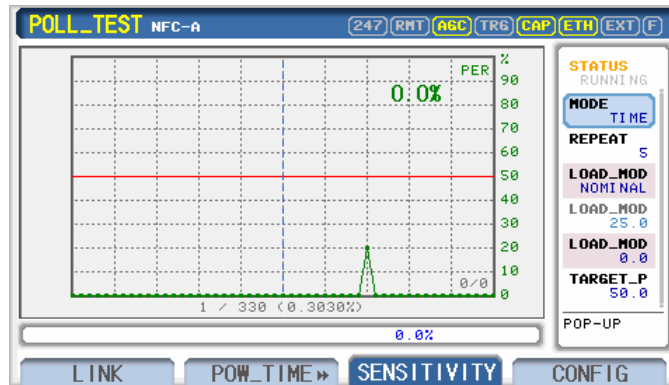
Fig 2.36   SENSITIVITY Test in TIME Mode (LM fixed)
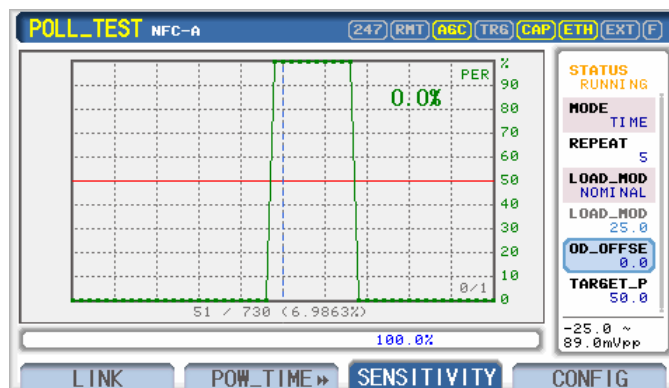
Fig 2.37   SENSITIVITY Test in TIME Mode (LM adjusted)

2.16.5 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is replying to Poll Command from DUT repeatedly. Pressing RUN key starts or stops the operation of RWC5010A.

MODE

This is the run mode of SENSITIVITY; SEARCH, LM, and TIME.

REPEAT

This is the repeat number of tests at each test point. Increasing it the test result may have higher

resolution but the testing time may become longer.

TARGET_PER

This is a parameter to set user's target PER. In SEARCH mode, SENSITIVITY test stops automatically after finding the minimum Load Modulation amplitude to satisfy TARGET_PER. In LM mode, SENSITIVITY sweeps fully in the range of Load Modulation and calculates the minimum Load Modulation amplitude to satisfy TARGET_PER.

START_LM

This defines the start value for Load Modulation sweep in LM mode.

STOP_LM

This defines the stop value for Load Modulation sweep in LM mode.

STEP_LM

This defines the step value for Load Modulation sweep in LM mode.

LOAD_MOD_TYPE

Same as LOAD_MOD_TYPE parameter of 2.12.

LOAD_MOD

Same as LOAD_MOD parameter of 2.12.

LOAD_MOD_OFFSET

Same as LOAD_MOD_OFFSET parameter of 2.12.

2.17 SNIFF Mode Basic Setup

2.17.1 Overview

In SNIFF mode, RWC5010A operates only to receive (SPY) the communication messages between two NFC devices through RF. It provides a function of Link Analyzer that analyzes link messages and link timings, and a function of Power Time Measurement that captures and measures the received waveforms of NFC devices.

The following figure shows an example of test setup in SNIFF mode. Connect SENSE port (J4) of a Reference Listener Antenna to RF IN port of RWC5010A. Place the Reference Listener Antenna between two NFC devices.
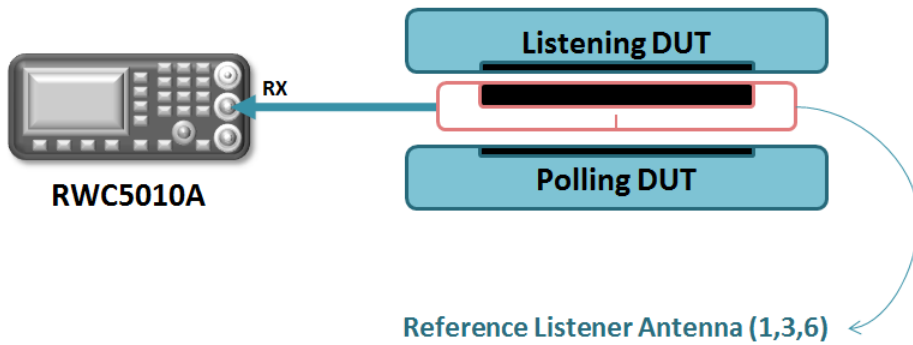
Fig 2.38   Example of Test Setup in SNIFF Mode

2.18 Usage of SNIFF » LINK

2.18.1 Overview

RWC5010A provides a function of Link Analyzer for each main menu. In SNIFF mode, Link Analyzer helps to capture and analyze the protocol messages and link timings between two NFC devices.

2.18.2 Test Procedure

1. [Main menu selection]
    Set the main menu to SNIFF referring to 2.3.1.

2. [Antenna connection]
    Connect J4 (SENSE) port of the Reference Listener Antenna to RF IN port of RWC5010A with an RF cable. RF OUT port of RWC5010A does not need to be connected because only RX part of RWC5010A works in SNIFF mode.

3. [DUT positioning]
    Place the Reference Listener Antenna between two NFC devices.

4. [Execution]
    Move to LINK screen by pressing (S1) key. Start testing by pressing (RUN) key, and the link messages between two DUTs will be displayed in real time. Refer to the following figure for descriptions of the LINK screen.

<u>Titles</u>

D: direction (P or L)　　　　　　FDT/GT: link timing

CMD: Type of Frame　　　　　　CONTENTS: Message information

<u>Link Messages</u>

Blue: Polling DUT Signal

Black: Listening DUT Signal

<u>Raw Data</u>

Raw data of the current cursor position

<u>Parameter Window</u>

Displays the parameter value

<u>Parameter Range</u>

Range of the current parameter
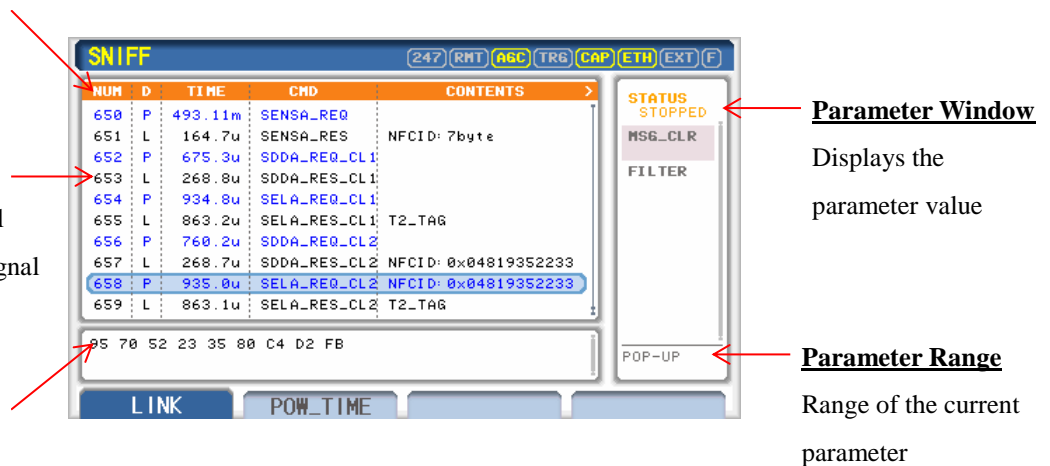
Fig 2.39　SNIFF » LINK Screen

2.18.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is receiving protocol messages from two DUTs continuously. Pressing [RUN] key starts or stops the operation of RWC5010A.

MSG_CLR

Erases the list of link messages on the screen.

FILTER

This is for selection of the type of link messages to display by checking or un-checking the box in front of each message type using the rotary knob or [ENTER] key.
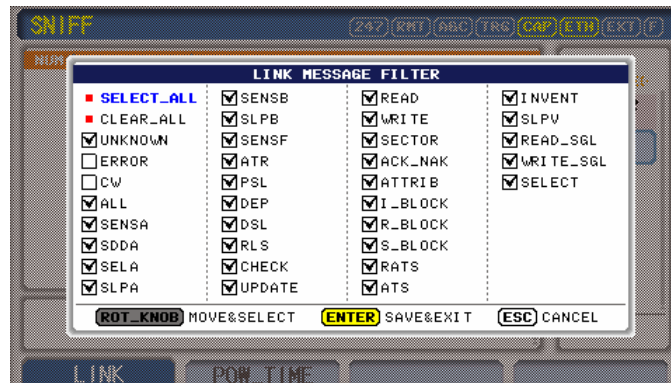
Fig 2.40   LINK MESSAGE FILTER Popup Screen

2.19 Usage of SNIFF » POW_TIME

2.19.1 Overview

RWC5010A provides a function of Power Time Measurement for each main menu. In SNIFF, Power Time Measurement helps to capture and analyze waveforms between two DUTs.

2.19.2 Test Procedure

1. [Main menu selection]

   Set the main menu to SNIFF referring to 2.3.1.

2. [Antenna connection]

   Connect J4 (SENSE) port of the Reference Listener Antenna to RF IN port of RWC5010A with an RF cable. RF OUT port of RWC5010A does not need to be connected because only RX part of RWC5010A works in SNIFF mode.

3. [DUT positioning]

   Place the Reference Listener Antenna between two NFC devices.

4. [Execution]

   Move to POW_TIME screen by pressing $\boxed{S2}$ key. Start testing by pressing $\boxed{RUN}$ key, and the command and response waveforms between two DUTs will be displayed on the screen. Refer to the following figure for descriptions of the POW_TIME screen. Refer to 2.3.6 for descriptions of Zoom and Marker functions.
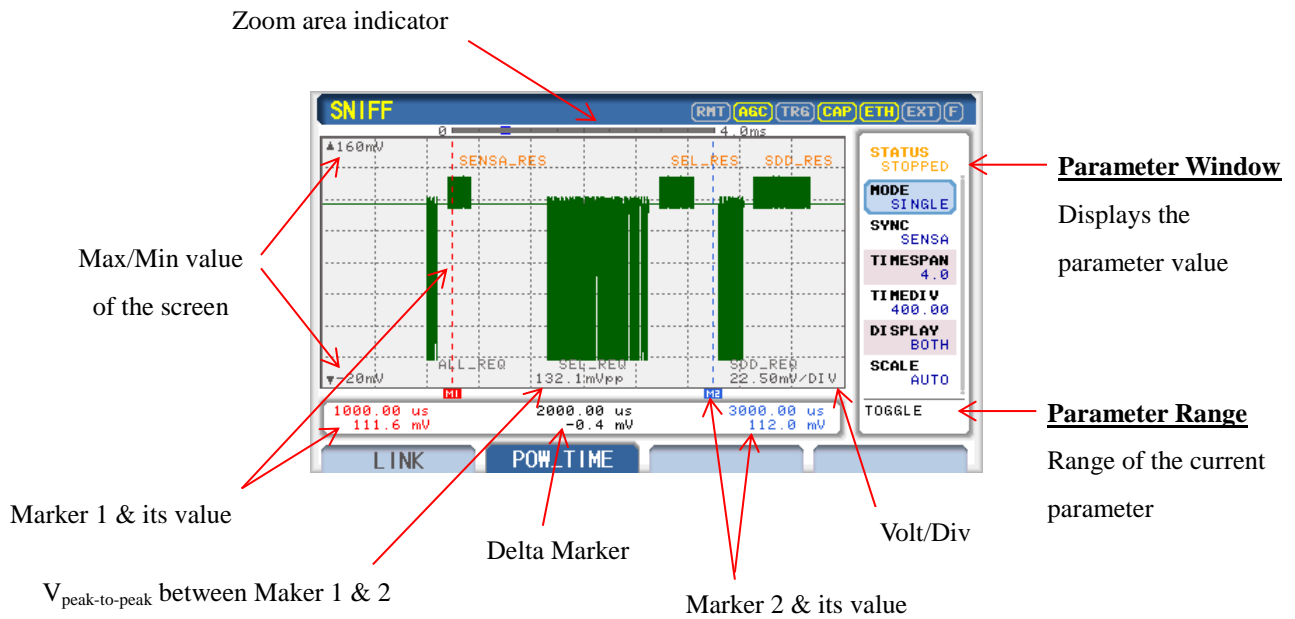
Fig 2.41   SNIFF » POW_TIME Screen

2.19.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is measuring waveforms of two DUTs continuously. Pressing [RUN] key starts or stops the operation of RWC5010A.

MODE

This is the run mode of RWC5010A; in SINGLE mode RWC5010A executes the measurement once and stops, and in CONTINUOUS mode executes the measurement continuously until [RUN] key is pressed again.

SYNC

It provides the command-selective triggering in measurement. If a specific command is selected as SYNC, the measurement will be triggered right after the target command is received from DUT and be displayed on the screen.

TIMESPAN

TIMESPAN determines the amount of data to be stored in measurement buffer in Time unit. The minimum value is 1ms and the maximum value is 308.8ms.

TIMEDIV

Direct input of TIME/DIV value can also be used as Zoom function. The minimum value is 1us and the maximum value is one tenth of TIMESPAN. This may be useful for analysis by bit duration.

DISPLAY

This determines whether to display the supplementary information such as the measured Modulation Characteristic and Message Log. OFF disables all information, RESULT displays the measured Modulation Characteristic (POLL_TEST only), MSG displays Message Log for each signal, and BOTH displays both ones.
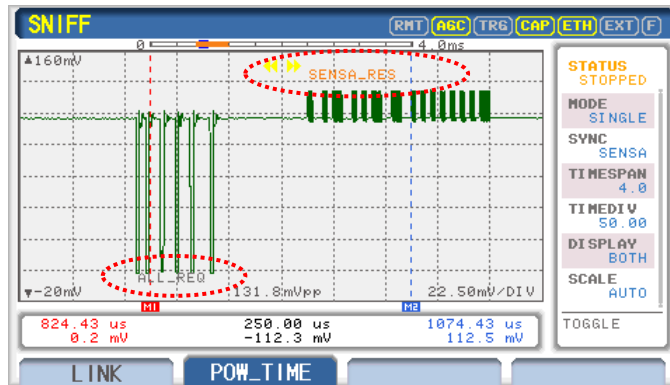
Fig 2.42   Message Log in POW_TIME Screen

SCALE

It determines scaling of Y-axis. AUTO scales automatically for each measurement and MANUAL keeps the current scaling according to MAX_Y and MIN_Y values.

AUTOSET

In case of MANUAL scaling, executing AUTOSET scales automatically for the current measurement once.

MAX_Y

In case of MANUAL scaling, the maximum value of Y-axis can be set.

MIN_Y

In case of MANUAL scaling, the minimum value of Y-axis can be set.

2.20 Usage of GENERAL » RESONANCE

2.20.1 Overview

RESONANCE function in GENERAL main menu is a simple tool to measure the resonance frequency of antenna, similar to S11 parameter measurement of general network analyzer.

2.20.2 Test Procedure

1. [Main menu selection]
   Set the main menu to GENERAL referring to 2.3.1.

2. [Antenna connection]
   Connect Source port and Sense port of the SENSE Antenna to RF OUT port and RF IN port of RWC5010A respectively with RF cables.

3. [Execution and initialization]
   Move to RESONANCE screen by pressing $\boxed{S4}$ key. Start testing by pressing $\boxed{RUN}$ key without DUT and execute CALIBRATE parameter to obtain flat frequency response within the frequency range.

4. [DUT positioning]
   Place DUT on the SENSE Antenna, and the frequency response measurement will be displayed on the screen as the following figure.

Fig 2.43   GENERAL » RESONANCE Screen

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2.20.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is measuring signals continuously. Pressing RUN key starts or stops the operation of RWC5010A.

PEAK

This is an execution parameter to search the position of the peak value of frequency responses. The marker moves to the corresponding position.

dB/DIV

This defines the dB/DIV of Y-axis of the measurement screen.

REF_LEV

This defines the maximum value of Y-axis of the measurement screen.

MEMORY

This determines whether to display the saved graph.

SAVE

This determines whether to save the current graph into the memory.

POWER

This defines the output power level of RWC5010A.

CALIBRATE

This is an execution parameter to get the current frequency responses and compensate it to obtain flat frequency responses (0dB).

![Redwood Comm logo]

2.21 Usage of GENERAL » VDC_METER

2.21.1 Overview

VDC METER function in GENERAL main menu is a simple Volt-meter to measure DC voltage injected to VDC IN port on the rear panel of RWC5010A. The main purpose of this function is measuring VDC from J1 port of a Reference Listener Antenna for some of NFC Forum Analog Tests, without an external Volt-meter.

2.21.2 Test Procedure

1. [Main menu selection]
   Set the main menu to GENERAL referring to 2.3.1.

2. [Signal input]
   Input DC voltage to measure into VDC IN port on the rear panel of RWC5010A.

3. [Execution]
   Move to VDC_METER screen by pressing (S3) key. Start testing by pressing (RUN) key, and the measured DC voltage will be displayed on the screen.
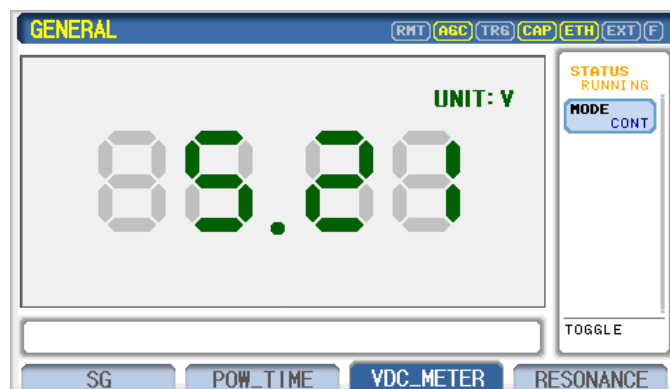
Fig 2.44   GENERAL » VDC_METER Screen

2.21.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing

and RUNNING means that RWC5010A is measuring DC voltage input continuously. Pressing RUN key starts or stops the operation of RWC5010A.

MODE

This is the run mode of RWC5010A; in SINGLE mode RWC5010A executes the measurement once and stops, and in CONTINUOUS mode executes the measurement continuously until RUN key is pressed again.

2.22 Usage of GENERAL » SG

2.22.1 Overview

SG in GENERAL main menu is a function of generating a CW signal or an AM modulated signal regardless of NFC protocols. Refer to 2.22.2 for descriptions of parameters.

Fig 2.45   GENERAL » SG Screen

2.22.2 Parameters

FREQUENCY

Normally NFC operates at 13.56 MHz frequency with 7 kHz tolerance, specified by NFC Forum Analog Specification. The Specification also requires the test equipment operate at 13.55 MHz ~ 13.57 MHz. RWC5010A supports larger frequency range, 13.5 MHz ~ 13.6MHz, to fulfill the requirement sufficiently. The frequency resolution is 1 kHz.

TX_LEVEL_MODE

RWC5010A operates as a reference Polling Device in LISTEN_TEST and a reference Listening Device in POLL_TEST. Therefore, the output level of SG should be able to be configured as that of a Polling Device or that of a Listening Device, as well as normal output power of normal signal generator. This parameter determines the type of output level. TX_LEVEL sets the output level as dBm, Vpp, or Vrms, TX_VDC sets it as VDC, and LOAD_MOD sets it as Load Modulation amplitude.

TX_LEVEL

If TX_LEVEL_MODE is selected as TX_LEVEL, the output level of RWC5010A should be defined as normal output level at its RF OUT port. User can set the output power in one of units and the values in the other units are updated automatically. The output impedance is 50(Ohms).

REF_POLLER

If TX_LEVEL_MODE is selected as TX_VDC, the output level of RWC5010A should be defined as VDC level in Polling Device mode. Therefore, before starting tests, it is required to determine a Reference Poller Antenna to be used and configure RWC5010A according to this information. NFC Forum defines 3 types of Reference Poller Antennas (Reference Poller 0, Reference Poller 3, and Reference Poller 6) as the following figure.

Fig 2.46   Reference Poller Antenna Set

WARNING: If the REF_POLLER configuration and a reference antenna used in tests should always be matched not to make the test results meaningless.

VDC_TYPE

NFC Forum Analog Test Specification describes the requirements of the Test Tool. One of the requirements is the output level of Polling Device mode to test a Listening Device Under Test, defined as VDC, which can be as VDC_TYPE in RWC5010A. That is the output power of Poll mode of RWC5010A. The Analog Test Specification defines 3 types of VDC levels; MAX, NOMINAL, and MIN, and how to calibrate them. The following figure shows an example of VDC level calibration. The VDC levels of RWC5010A are pre-calibrated according to the Analog Test Specification during production.

Fig 2.47   Example of VDC Level calibration

VDC

The value of VDC level is displayed corresponding to VDC_TYPE parameter.

VDC_OFFSET

This is an offset value to adjust VDC level to an arbitrary value other than MAX, NOMINAL, or MIN. The resultant total value of VDC level will be VDC plus VDC_OFFSET.

REF_LISTENER

If TX_LEVEL_MODE is selected as LOAD_MOD, the output level of RWC5010A should be defined as Load Modulation amplitude in Listening Device mode. Therefore, before starting tests, it is required to determine a Reference Listener Antenna to be used and configure RWC5010A according to this information. NFC Forum defines 3 types of Reference Listener Antennas (Reference Listener 1, Reference Listener 3, and Reference Listener 6) as the following figure.

Fig 2.48   Reference Listener Antenna Set

WARNING: If the REF_LISTENER configuration and a reference antenna used in tests should always be matched not to make the test results meaningless.

LOAD_MOD_TYPE

NFC Forum Analog Test Specification describes the requirements of the Test Tool. One of the requirements is the output level of Listening Device mode to test a Polling Device Under Test, defined as Load Modulation amplitude, which can be as LOAD_MOD_TYPE in RWC5010A. That is the output power of Listen mode of RWC5010A. The Analog Test Specification defines 3 types of Load Modulation amplitudes; MAX, NOMINAL, and MIN, and how to calibrate them. The following figure shows an example of Load Modulation amplitude calibration. The Load Modulation amplitudes of RWC5010A are pre-calibrated according to the Analog Test Specification during production.

Fig 2.49   Example of Load Modulation amplitude calibration

LOAD_MOD

The value of Load Modulation amplitude is displayed corresponding to LOAD_MOD_TYPE parameter.

LOAD_MOD_OFFSET

This is an offset value to adjust Load Modulation amplitude to an arbitrary value other than MAX, NOMINAL, or MIN. The resultant total value of Load Modulation amplitude will be LOAD_MOD plus LOAD_MOD_OFFSET.

MODULATION

This is a parameter for AM modulation ON or OFF. Setting ON outputs an AM modulated signal with square-wave.

AM_DEPTH

This is a parameter for the value of AM modulation depth only when MODULATION is ON.

2.23 GENERAL » POW_TIME

2.23.1 Overview

Power Time Measurement function in GENERAL main menu measures and analyzes the signals coming into RF IN port of RWC5010A, regardless of NFC protocols.

2.23.2 Test Procedure

1. [Main menu selection]

   Set the main menu to GENERAL referring to 2.3.1.

2. [Signal input]

   Input signals to measure into RF IN port of RWC5010A.

3. [Execution]

   Move to POW_TIME screen by pressing (S2) key. Start testing by pressing (RUN) key, and the received waveforms will be displayed on the screen. Refer to 2.3.6 for descriptions of Zoom and Marker functions.
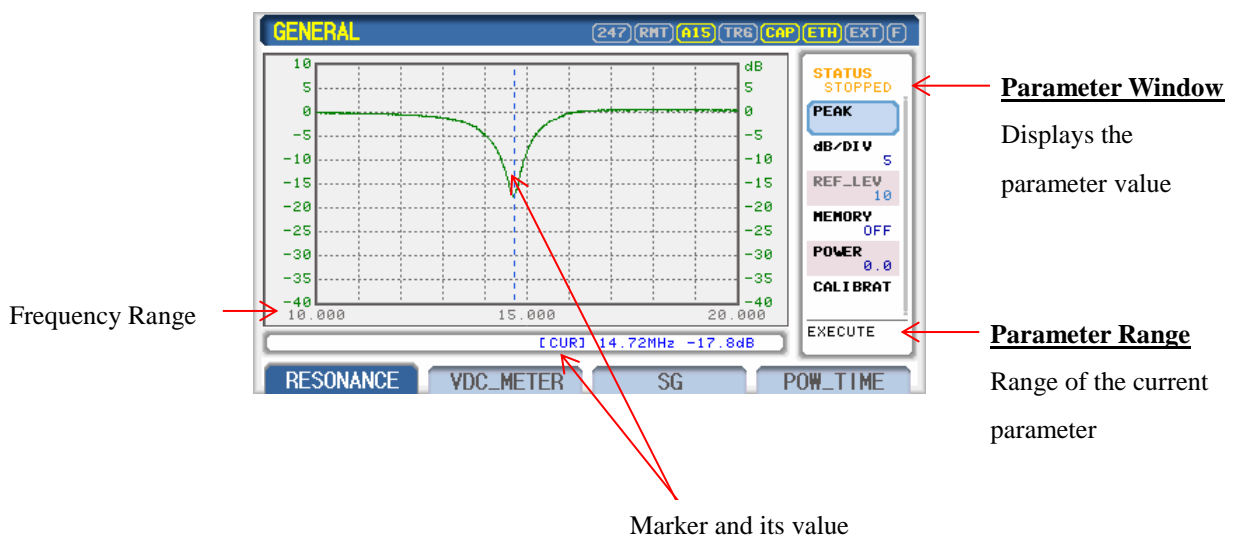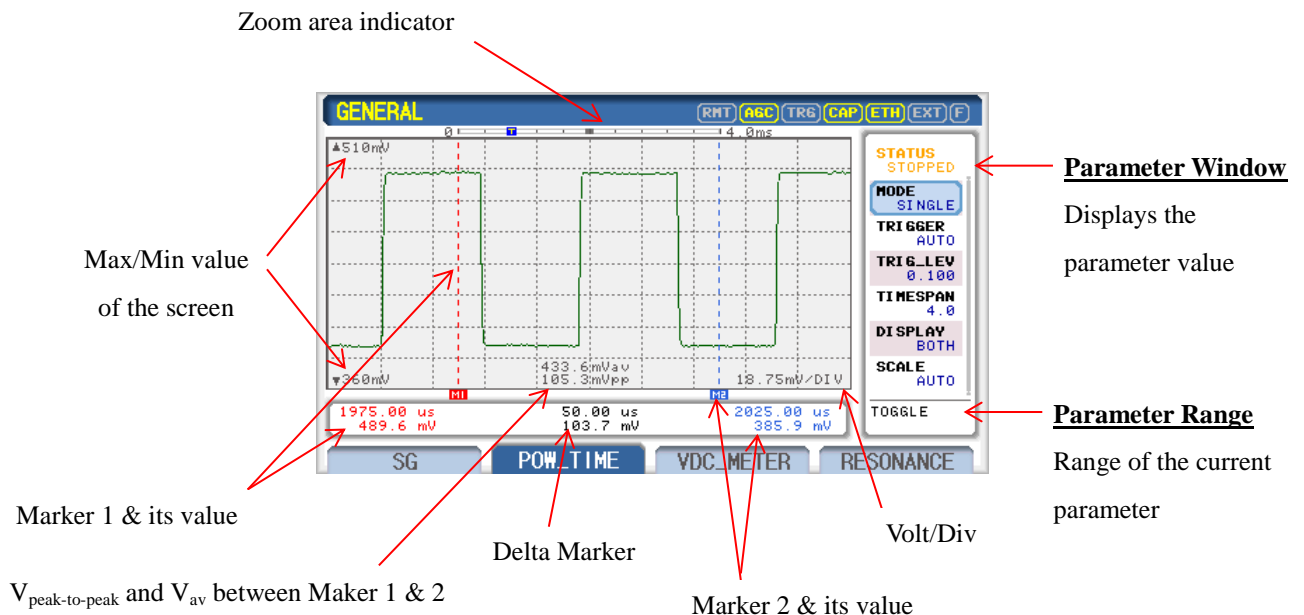

Fig 2.50   GENERAL » POW_TIME Screen

2.21.3 Parameters

STATUS

This indicates the operating status of RWC5010A; STOPPED means that RWC5010A does nothing and RUNNING means that RWC5010A is measuring signal waveforms continuously. Pressing [RUN] key starts or stops the operation of RWC5010A.

MODE

This is the run mode of RWC5010A; in SINGLE mode RWC5010A executes the measurement once and stops, and in CONTINUOUS mode executes the measurement continuously until [RUN] key is pressed again.

TRIGGER

This is a parameter similar to that of a general oscilloscope, which has two modes; AUTO and NORMAL.

TRIG_LEV

When TRIGGER is selected as NORMAL, this parameter determines the threshold level for triggering.

TIMESPAN

TIMESPAN determines the amount of data to be stored in measurement buffer in Time unit. The minimum value is 1ms and the maximum value is 38.6ms.

TIMEDIV

Direct input of TIME/DIV value can also be used as Zoom function. The minimum value is 1us and the maximum value is one tenth of TIMESPAN. This may be useful for analysis by bit duration.

SCALE

It determines scaling of Y-axis. AUTO scales automatically for each measurement and MANUAL keeps the current scaling according to MAX_Y and MIN_Y values.

AUTOSET

In case of MANUAL scaling, executing AUTOSET scales automatically for the current measurement

once.

MAX_Y

In case of MANUAL scaling, the maximum value of Y-axis can be set.

MIN_Y

In case of MANUAL scaling, the minimum value of Y-axis can be set.

2.24 Save/Recall

The SAVE and RECALL functions allow you to store different instrument setups and retrieve them later. By saving test setups, you can save time by eliminating the task of re-configuring the instrument. The instrument supports up to 10 save/recall sets.

2.24.1 Save Method

Make any changes to the instrument that you want to SAVE in a memory. Then press [FCN] + [POWER Save] key to execute SAVE pop-up screen as following figure. Select SAVE buffer number and press [ENTER] key. It will show name editor screen. Refer to 2.3.5 Edit String for details.
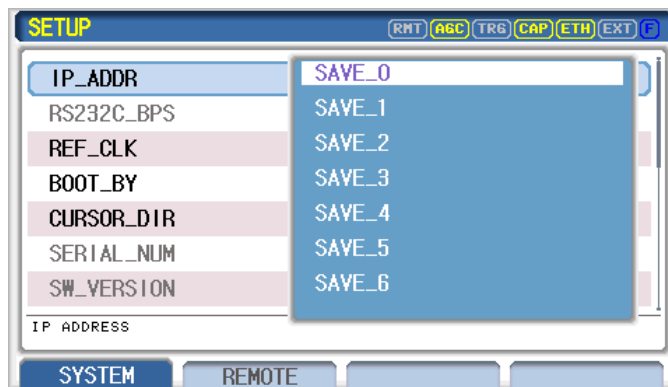
Fig 2.51   Screen of Parameter Configuration SAVE

2.24.2 Recall Method

Then press [FCN] + [FREQ Recall] key to execute RECALL pop-up screen as following figure. Select RECALL buffer number and press [ENTER] key. The first RECALL buffer is RESET. If you select it, the instrument will be reset (factory reset).
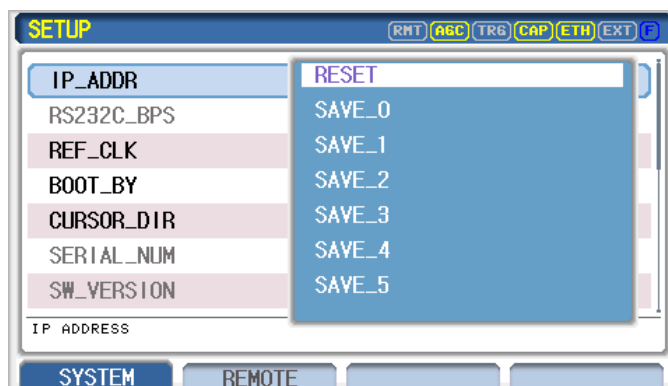
Fig 2.52   Screen of Parameter Configuration RECALL

2.24.3 Selection of Boot Configuration

When restarting the system, one of saved configuration will be retrieved. To define saved configuration for booting, move to the SETUP/SYSTEM screen and modify BOOT_BY parameter to desired RECALL buffer number.
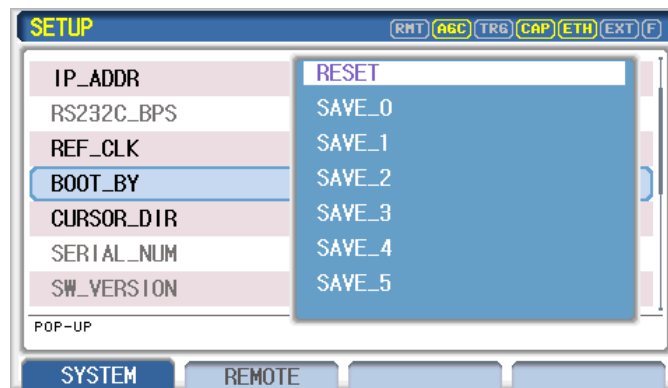
Fig 2.53   Screen of RECALL Configuration Setup for Boot

III. Remote Control Programming

PC may control the RWC5010A remotely through Ethernet or RS232C interface using a comprehensive set of commands. This section provides the necessary information to operate the RWC5010A under Ethernet and RS232C control.

3.1 Introduction

The RWC5010A supports RS232C and Ethernet Interface, located at the rear panel for remote operation under PC control. Ethernet is used for high speed and flexible interfaces. To use Ethernet, socket programming is required. RS232C is a slow serial interface, but it does not need any special devices, and is easy to use.

3.1.1 Command Structure

```
                                    AA
          ┌──────────────────────────┼──────────────────────────┐
    BB (ex: AA:BB )                   CC                          DD
   ┌───────┼────────┐                                      ┌──────┴──────┐
  EE      FF     GG (ex. AA:BB:GG)                         HH            JJ
```
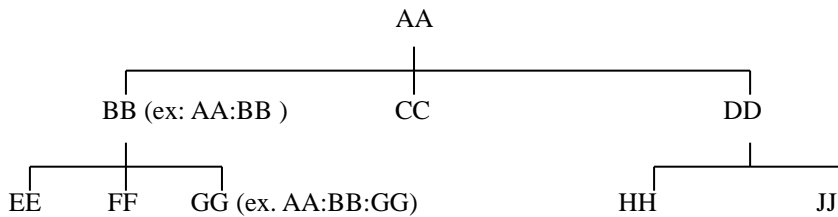
- You must follow a particular path to reach lower level subcommands. For example, if you wish to access the GG command, you must follow the path AA to BB to GG (AA:BB:GG)
- Commands consist of *set commands* and *query commands* (usually simply called commands and queries). Set commands change instrument settings or perform a specific action. Queries cause the RWC5010A to return data and information about its status. Most commands have both a set form and query form. The query form of the command is started with "READ" and the set form of the command is stared with "CONF".
- For example, one of the set commands is **CONF:GENERAL:SG:FREQ 13.56** and one of the query commands is **READ:GENERAL:SG:FREQ?**
- When a *colon* is placed between two command mnemonics, it moves the current path down one level in the command tree
- A *space* is used to separate parameters from commands. AA:BB:FF 20
- Some commands require two parameters. Refer to Command list.

```
         Command        Space        Value
            ╲             ╲            │
             ╲             ╲           │
              ▼             ▼  ▼       ▼
        CONF:GENERAL:SG:FREQ 13.56\n
```
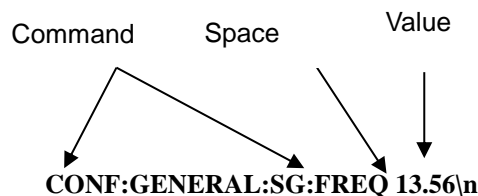
Note: All command s should be finished by LF (Line Feed, Char(10)) or semicolon(;).

3.1.2 Command Parameter Types
- Integer Parameter: CONF:GENERAL:SG:FREQ   <Value> <LF>
- Discrete Parameter: CONF:SETUP:SYSTEM:REF_CLK   {INT | EXT} <LF>

3.1.3 Response to Query
- Integer: Returns an integer value, e.g., 0, 100, 256, -230.
- Discrete: Returns selection

Command & Query	Response
READ:GENERAL:SG:FREQ?	13.56
READ:SETUP:SYSTEM:REF_CLK?	EXT

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

3.2 RS-232C Interface

3.2.1 Configuration

RS-232C Connection

RWC5010A   Remote PC
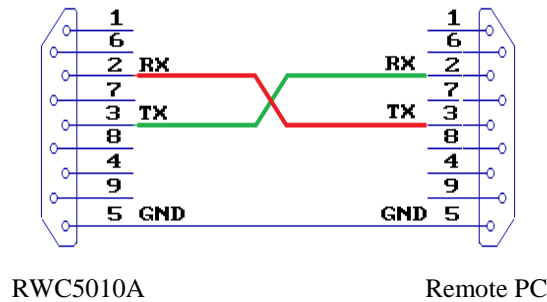
RS232C Parameter Setup

RS232C parameters of Remote PC should be set up as the following:

Parameter	Value	Description
DATA_RATE	115200	BPS
DATA BITS	8-bit	Length of Data Bit
PARITY	Off	Error Check Bit
STOP BIT	1-bit	Stop bit

3.2.2 Remote Programming Guide Using RS232C on a Windows System

Programming Sequence
- 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 result on RWC2010B screen.
- Send 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.

Tips for Programming
- 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)).

3.3 Ethernet Interface

3.3.1 Configuration

1) Connect LAN port of PC and RWC5010A Ethernet port by RJ45 cable. If the PC and RWC5010A are connected directly, cross cable must be used.

2) Set up the IP address as follows to use cross cable.
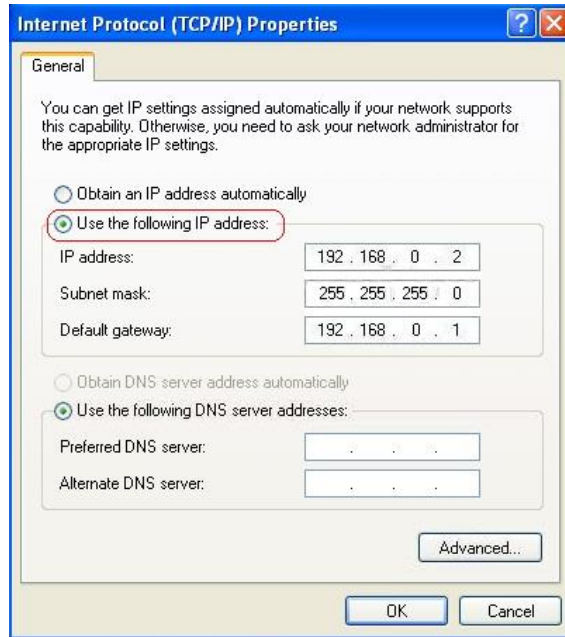
3) Turn RWC5010A power ON, go to the 'SETUP/SYSTEM' screen and configure IP address referring to 2.6.
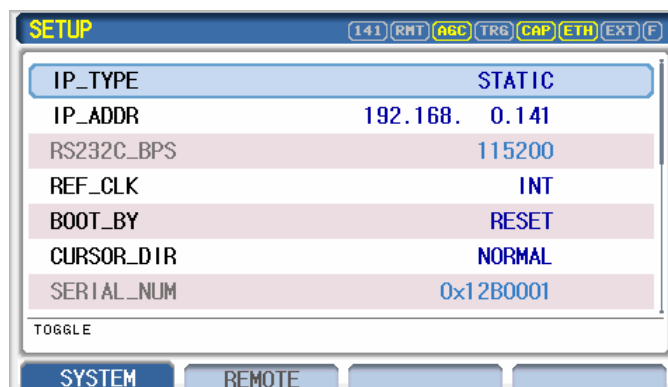
3.4 Command List (for FW V2.1)

3.4.1 Common Commands

Command	Parameter Range	Description
*IDN?	N/A	Query Identification
*RST	N/A	Preset the equipment fully
*SAVE	1 ~ 10	Save the current parameters setting to memory
*RECALL	1 ~ 10	Recall the saved parameters setting from memory

3.4.2 System Commands

Command	Parameter Range	Description
CONF:TESTER_MODE	LISTEN_TEST POLL_TEST SNIFF GENERAL	Configure/Read an operating mode (or Main Menu) of RWC5010A
READ:TESTER_MODE?	Query only	
CONF:PROTOCOL	NFC_A NFC_B NFC_F	Configure/Read a protocol type of RWC5010A
READ:PROTOCOL?	Query only	
CONF:MOVE_SCREEN	LISTEN_LINK LISTEN_POW_TIME LISTEN_SENSITIVITY LISTEN_CONFIG POLL_LINK POLL_POW_TIME POLL_MEASURE POLL_SENSITIVITY POLL_CONFIG SNIFF_LINK SNIFF_POW_TIME GENERAL_SG GENERAL_POW_TIME GENERAL_VDC_METER GENERAL_RESONANCE SETUP_SYSTEM SETUP_REMOTE	Configure a screen (or Sub Menu) of RWC5010A to move directly to

Command	Parameter Range	Description
READ:AGC_LOCK:STATUS?	LOCK UNLOCK	Read the lock status of Automatic Gain Control of the receiver; LOCK means that RWC5010A is ready to receive DUT signal properly
EXEC:REFRESH_SCREEN	N/A	Refresh the current screen
EXEC:LOCAL	N/A	Set the tester to the local mode

3.4.3 Common Commands for LINK

Command	Parameter Range	Description
EXEC:LINK:RUN	N/A	Start link creation
EXEC:LINK:STOP	N/A	Stop the current link
EXEC:LINK:MSG_CLR	N/A	Clear the list of link messages
EXEC:LINK:RESET	N/A	Reset the link status

3.4.4 Common Commands for POW_TIME

Command	Parameter Range	Description
EXEC:POW_TIME:RUN	N/A	Start Power-Time
EXEC:POW_TIME:STOP	N/A	Stop Power-Time
READ:POW_TIME:RUN:STATUS?	IDLE BUSY TIMEOUT	Read the run status of Power-Time
CONF:POW_TIME:MODE	SINGLE CONT	Configure/Read the running mode of measurement
READ:POW_TIME:MODE?	Query only	
CONF:POW_TIME:TIMESPAN	1 ~ 38.6	Configure/Read the time span for display, [ms]
READ:POW_TIME:TIMESPAN?	Query only	
CONF:POW_TIME:SCALE	AUTO MANUAL	Configure/Read the scaling mode of Y-axis

READ:POW_TIME:SCALE?	Query only	
CONF:POW_TIME:MAX_Y	-32000 ~ 32000	Configure/Read the maximum value of Y-axis
READ:POW_TIME:MAX_Y?	Query only	
CONF:POW_TIME:MIN_Y	-32000 ~ 32000	Configure/Read the minimum value of Y-axis
READ:POW_TIME:MIN_Y?	Query only	
EXEC:POW_TIME:AUTOSET	N/A	Run auto-scaling at once
CONF:POW_TIME:DISPLAY	OFF RESULT MSG BOTH	Configure/Read the list of supplementary information to be displayed on the screen
READ:POW_TIME:DISPLAY?	Query only	
CONF:POW_TIME:TRIGGER	AUTO NORMAL	Configure/Read the trigger mode (only applicable to GENERAL mode)
READ:POW_TIME:TRIGGER?	Query only	
CONF:POW_TIME:TRIG_LEV	0 ~ 1000	Configure/Read the trigger level for NORMAL trigger (only applicable to GENERAL mode), [mV]
READ:POW_TIME:TRIG_LEV?	Query only	

3.4.5 Commands for LISTEN_TEST » CONFIG

Command	Parameter Range	Description
CONF:LISTEN_TEST:CONFIG:NFCID0	4-byte hexadecimal	Configure/Read NFCID0 for NFC-B
READ:LISTEN_TEST:CONFIG:NFCID0?	Query only	
CONF:LISTEN_TEST:CONFIG:NFCID1	4,7,10-byte hexadecimal	Configure/Read NFCID1 for NFC-A
READ:LISTEN_TEST:CONFIG:NFCID1?	Query only	
CONF:LISTEN_TEST:CONFIG:NFCID2	8-byte hexadecimal	Configure/Read NFCID2 for NFC-F
READ:LISTEN_TEST:CONFIG:NFCID2?	Query only	

CONF:LISTEN_TEST:CONFIG:ID_SIZE	SINGLE
	DOUBLE
	TRIPLE
		Configure/Read the size of NFCID1 for NFC-A
		  SINGLE: 4-byte
		  DOUBLE: 7-byte
		  TRIPLE: 10-byte

READ:LISTEN_TEST:CONFIG:ID_SIZE?	Query only	
CONF:LISTEN_TEST:CONFIG:BPS	212 424	Configure/Read BPS for NFC-F, [kbps]
READ:LISTEN_TEST:CONFIG:BPS?	Query only	
CONF:LISTEN_TEST:CONFIG:TSN	0 ~ 15	Configure/Read TSN for NFC-F
READ:LISTEN_TEST:CONFIG:TSN?	Query only	
CONF:LISTEN_TEST:CONFIG:VDC_TYPE	NOMINAL MIN MAX TH_RFCA	Configure/Read the type of VDC
READ:LISTEN_TEST:CONFIG:VDC_TYPE?	Query only	
READ:LISTEN_TEST:CONFIG:VDC?	Query only	Read the current value of VDC corresponding to VDC_TYPE, [V]
CONF:LISTEN_TEST:CONFIG:REF_POLLER	POLLER-0 POLLER-3 POLLER-6	Configure/Read the Reference Poller Antenna to be used
READ:LISTEN_TEST:CONFIG:REF_POLLER?	Query only	

READ:LISTEN_TEST:CONFIG:REF_LISTENER?	Query only	Read the Reference Listener Antenna used in calibration of the current type of VDC:
		  LISTENER-1
		  LISTENER-3
		  LISTENER-6

READ:LISTEN_TEST:CONFIG:LOAD_R?	Query only	Read the Load Resistor value of Reference Listener Antenna used in calibration of the current type of VDC:
		  820R
		  82R

CONF:LISTEN_TEST:CONFIG:VDC_OFFSET	Dependent on the type of current VDC	Configure/Read the offset value for VDC;
		VDC + VDC_OFFSET is:
		  0 ~ 4V if MAX
		  0 ~ 10V otherwise

READ:LISTEN_TEST:CONFIG:VDC_OFFSET?	Query only	

Command		Parameter Range	Description
CONF:LISTEN_TEST:CONFIG:MOD_SETUP	COND_1_820R COND_2_820R COND_3_820R COND_4_820R COND_5_820R COND_6_820R COND_7_820R COND_1_330R COND_2_330R COND_3_330R COND_4_330R COND_5_330R COND_6_330R COND_7_330R	Configure/Read the setup for modulation condition; For NFC-A, only COND_1_820R ~ COND_4_820R and COND_1_330R ~ COND_4_330R are configurable
READ:LISTEN_TEST:CONFIG:MOD_SETUP?		Query only	
CONF:LISTEN_TEST:CONFIG:ACTIVITY	RESOLUTION TAG_READ TAG_WRITE TAG_LOCKED DATA_EXCHANGE	Configure/Read the activity profile depending on the type of protocol
READ:LISTEN_TEST:CONFIG:ACTIVITY?		Query only	
CONF:LISTEN_TEST:CONFIG:NDEF_TEXT	8-byte hexadecimal	Configure/Read the NDEF text message to write into Tag's memory when Activity is TAG_WRITE
READ:LISTEN_TEST:CONFIG:NDEF_TEXT?		Query only	
CONF:LISTEN_TEST:CONFIG:READ_BNo	0 ~ 240	Configure/Read the number of bytes to read Tag's memory when Activity is TAG_READ
READ:LISTEN_TEST:CONFIG:READ_BNo?		Query only	
CONF:LISTEN_TEST:CONFIG:UID	8-byte hexadecimal	Configure/Read NFCID0 for NFC-V
READ:LISTEN_TEST:CONFIG:UID?		Query only	
CONF:LISTEN_TEST:CONFIG:SLOT_NUM	1_SLOT 16_SLOT	Configure/Read the number of slots for NFC-V
READ:LISTEN_TEST:CONFIG:SLOT_NUM?		Query only	

3.4.6 Commands for LISTEN_TEST » POW_TIME

Command	Parameter Range	Description

		Read the flag to check whether DUT functions properly: PASS FAIL
READ:LISTEN_TEST:POW_TIME:FCN_VERDICT?	Query only	
READ:LISTEN_TEST:POW_TIME:LOAD_MOD?	Query only	Read the measured Load Modulation amplitude of DUT, [mVpp]
CONF:LISTEN_TEST:POW_TIME:SYNC	For NFC-A, SENS SDD SEL READ For NFC-B, SENSB SLPB For NFC-F, SENSF, ATR For NFC-V, INVENT RD_SGL	Configure/Read the target Poll command of RWC5010A to trigger the measurement
READ:LISTEN_TEST:POW_TIME:SYNC?	Query only	

3.4.7 Commands for LISTEN_TEST » SENSITIVITY

Command	Parameter Range	Description
CONF:LISTEN_TEST:SENSITIVITY:MODE	SEARCH VDC TIME	Configure/Read the operating mode for sensitivity test
READ:LISTEN_TEST:SENSITIVITY:MODE?	Query only	
CONF:LISTEN_TEST:SENSITIVITY:REPEAT	5 ~ 1000	Configure/Read the number of repetition for each test point
READ:LISTEN_TEST:SENSITIVITY:REPEAT?	Query only	
CONF:LISTEN_TEST:SENSITIVITY:START_VDC	0 ~ 10	Configure/Read the start value of VDC in VDC mode only
READ:LISTEN_TEST:SENSITIVITY:START_VDC?	Query only	
CONF:LISTEN_TEST:SENSITIVITY:STOP_VDC	0 ~ 10	Configure/Read the stop value of VDC in VDC mode only
READ:LISTEN_TEST:SENSITIVITY:STOP_VDC?	Query only	

Command	Parameter Range	Description
CONF:LISTEN_TEST:SENSITIVITY:STEP_VDC	0.1 ~ 1	Configure/Read the step value of VDC in VDC mode only
READ:LISTEN_TEST:SENSITIVITY:STEP_VDC?	Query only	
CONF:LISTEN_TEST:SENSITIVITY:DISPLAY	BOTH SENS LOAD	Configure/Read the list for display on the result graph
READ:LISTEN_TEST:SENSITIVITY:DISPLAY?	Query only	
CONF:LISTEN_TEST:SENSITIVITY:TARGET_PER	0 ~ 99.9	Configure/Read the value of users' target PER, [%]
READ:LISTEN_TEST:SENSITIVITY:TARGET_PER?	Query only	
EXEC:LISTEN_TEST:SENSITIVITY:RUN	N/A	Start the sensitivity test
EXEC:LISTEN_TEST:SENSITIVITY:STOP	N/A	Stop the sensitivity test
READ:LISTEN_TEST:SENSITIVITY:RUN:STATUS?	Query only	Read the run status of the current test
READ:LISTEN_TEST:SENSITIVITY:PER?	Query only	Read the PER value corresponding to the resultant sensitivity level, [%]
READ:LISTEN_TEST:SENSITIVITY:RESULT_VDC?	Query only	Read the resultant sensitivity level, [V]

3.4.8 Commands for POLL_TEST » CONFIG

Command	Parameter Range	Description

CONF:POLL_TEST:CONFIG:ID_SIZE	SINGLE
	DOUBLE
	TRIPLE
		Configure/Read the size of NFCID for NFC-A
		    SINGLE: 4-byte
		    DOUBLE: 7-byte
		    TRIPLE: 10-byte

READ:POLL_TEST:CONFIG:ID_SIZE?	Query only	
CONF:POLL_TEST:CONFIG:TAG	TYPE_1 TYPE_2 TYPE_3 TYPE_4	Configure/Read the type of TAG as defined in the Spec.
READ:POLL_TEST:CONFIG:TAG?	Query only	
CONF:POLL_TEST:CONFIG:MEMORY_SIZE	48 ~ 2048 (8-byte step)	Configure/Read the size of memory for Type 2 TAG, [bytes]

READ:POLL_TEST:CONFIG:MEMORY_SIZE?	Query only	
CONF:POLL_TEST:CONFIG:NDEF_MSG	EMPTY TEXT URI SP_BOOKMARK SP_CALL SP_SMS VCARD USER_0 … USER_9	Configure/Read the type of NDEF message for Type 2 TAG
READ:POLL_TEST:CONFIG:NDEF_MSG?	Query only	
CONF:POLL_TEST:CONFIG:NFCID0	4-byte hexadecimal	Configure/Read NFCID0 for NFC-B
READ:POLL_TEST:CONFIG:NFCID0?	Query only	
CONF:POLL_TEST:CONFIG:NFCID1	4,7,10-byte hexadecimal	Configure/Read NFCID1 for NFC-A
READ:POLL_TEST:CONFIG:NFCID1?	Query only	
CONF:POLL_TEST:CONFIG:NFCID2	8-byte hexadecimal	Configure/Read NFCID2 for NFC-F
READ:POLL_TEST:CONFIG:NFCID2?	Query only	
CONF:POLL_TEST:CONFIG:SLOT_NUM	0 ~ 15	Configure/Read the slot number for NFC-F
READ:POLL_TEST:CONFIG:SLOT_NUM?	Query only	
CONF:POLL_TEST:CONFIG:LOAD_MOD_TYPE	NOMINAL MIN MAX	Configure/Read the type of Load Modulation amplitude
READ:POLL_TEST:CONFIG:LOAD_MOD_TYPE?	Query only	
READ:POLL_TEST:CONFIG:LOAD_MOD?	Query only	Read the current value of Load Modulation amplitude corresponding to LOAD_MOD_TYPE, [mVpp]

READ:POLL_TEST:CONFIG:REF_POLLER?	Query only	Read the Reference Poller Antenna used in calibration of the current type of Load Modulation:
		    POLLER-0
		    POLLER-3
		    POLLER-6

CONF:POLL_TEST:CONFIG:REF_LISTENER	LISTENER-1 LISTENER-3 LISTENER-6	Read the Reference Listener Antenna to be used

Command	Parameter Range	Description
READ:POLL_TEST:CONFIG:REF_LISTENER?	Query only	

CONF:POLL_TEST:CONFIG:LOAD_MOD_OFFSET	For LISTENER-1,
	  -25 ~ 89 (NOMIAL)
	  -18 ~ 96 (MIN)
	  -114 ~ 0 (MAX)
	For LISTENER-3,
	  -30 ~ 50 (NOMIAL)
	  -26 ~ 54 (MIN)
	  -54 ~ 0 (MAX)
	For LISTENER-6,
	  -30 ~ 10 (NOMIAL)
	  -26 ~ 14 (MIN)
	  -90 ~ 0 (MAX)
		Configure/Read the offset value for LOAD_MOD, [mVpp]
		
		The resultant LOAD_MOD value is:
		  For LISTENER-1,
		    0 ~ 114 (all)
		  For LISTENER-3,
		    0 ~ 54 (MAX)
		    0 ~ 80 (otherwise)
		  For LISTENER-6,
		    0 ~ 90 (MAX)
		    0 ~ 40 (otherwise)

READ:POLL_TEST:CONFIG:LOAD_MOD_OFFSET?	Query only	
CONF:POLL_TEST:CONFIG:UID	8-byte hexadecimal	Configure/Read UID for NFC-V
READ:POLL_TEST:CONFIG:UID?	Query only	
CONF:POLL_TEST:CONFIG:BLEN	4-BYTE 8-BYTE 16-BYTE 32-BYTE	Configure/Read Block Length for NFC-V
READ:POLL_TEST:CONFIG:BLEN?	Query only	

3.4.9 Commands for POLL_TEST » POW_TIME

Command	Parameter Range	Description

READ:POLL_TEST:POW_TIME:FCN_VERDICT?	Query only	Read the flag to check whether DUT functions properly:
		  PASS
		  FAIL

READ:POLL_TEST:POW_TIME:T_FIELD_OFF?	Query only	Read the measured value of t_{FIELD_OFF}, [us]
READ:POLL_TEST:POW_TIME:V_OV_RESET?	Query only	Read the measured value of $V_{OV,RESET}$, [mV]

3.4.10 Commands for POLL_TEST » MEASURE

Command	Parameter Range	Description
READ:POLL_TEST:MEASURE:CARR_FREQ:AVG?	Query only	Read the measured AVG value of f_C, [MHz]
READ:POLL_TEST:MEASURE:CARR_FREQ:LL?	Query only	Read the calculated Lower Limit value of f_C, [MHz]
READ:POLL_TEST:MEASURE:CARR_FREQ:UL?	Query only	Read the calculated Upper Limit value of f_C, [MHz]
READ:POLL_TEST:MEASURE:V_OV:AVG?	Query only	Read the measured AVG value of V_{OV}, [V]
READ:POLL_TEST:MEASURE:V_OV:LL?	Query only	Read the calculated Lower Limit value of V_{OV}, [V]
READ:POLL_TEST:MEASURE:V_OV_RESET:AVG?	Query only	Read the measured AVG value of $V_{OV,RESET}$, [mVrms]
READ:POLL_TEST:MEASURE:V_OV_RESET:UL?	Query only	Read the calculated Upper Limit value of $V_{OV,RESET}$, [mVrms]
READ:POLL_TEST:MEASURE:NFCA_T1:MIN?	Query only	Read the measured MIN value of t_1, [us]
READ:POLL_TEST:MEASURE:NFCA_T1:AVG?	Query only	Read the measured AVG value of t_1, [us]
READ:POLL_TEST:MEASURE:NFCA_T1:MAX?	Query only	Read the measured MAX value of t_1, [us]
READ:POLL_TEST:MEASURE:NFCA_T1:LL?	Query only	Read the calculated Lower Limit value of t_1, [us]
READ:POLL_TEST:MEASURE:NFCA_T1:UL?	Query only	Read the calculated Upper Limit value of t_1, [us]
READ:POLL_TEST:MEASURE:NFCA_T2:MIN?	Query only	Read the measured MIN value of t_2, [us]
READ:POLL_TEST:MEASURE:NFCA_T2:AVG?	Query only	Read the measured AVG value of t_2, [us]
READ:POLL_TEST:MEASURE:NFCA_T2:MAX?	Query only	Read the measured MAX value of t_2, [us]
READ:POLL_TEST:MEASURE:NFCA_T2:LL?	Query only	Read the calculated Lower Limit value of t_2, [us]
READ:POLL_TEST:MEASURE:NFCA_T2:UL?	Query only	Read the calculated Upper Limit value of t_2, [us]

READ:POLL_TEST:MEASURE:NFCA_T3:MIN?	Query only	Read the measured MIN value of t_3, [us]
READ:POLL_TEST:MEASURE:NFCA_T3:AVG?	Query only	Read the measured AVG value of t_3, [us]
READ:POLL_TEST:MEASURE:NFCA_T3:MAX?	Query only	Read the measured MAX value of t_3, [us]
READ:POLL_TEST:MEASURE:NFCA_T3:LL?	Query only	Read the calculated Lower Limit value of t_3, [us]
READ:POLL_TEST:MEASURE:NFCA_T3:UL?	Query only	Read the calculated Upper Limit value of t_3, [us]
READ:POLL_TEST:MEASURE:NFCA_T4:MIN?	Query only	Read the measured MIN value of t_4, [us]
READ:POLL_TEST:MEASURE:NFCA_T4:AVG?	Query only	Read the measured AVG value of t_4, [us]
READ:POLL_TEST:MEASURE:NFCA_T4:MAX?	Query only	Read the measured MAX value of t_4, [us]
READ:POLL_TEST:MEASURE:NFCA_T4:LL?	Query only	Read the calculated Lower Limit value of t_4, [us]
READ:POLL_TEST:MEASURE:NFCA_T4:UL?	Query only	Read the calculated Upper Limit value of t_4, [us]
READ:POLL_TEST:MEASURE:NFCA_T5:MIN?	Query only	Read the measured MIN value of t_5, [us]
READ:POLL_TEST:MEASURE:NFCA_T5:AVG?	Query only	Read the measured AVG value of t_5, [us]
READ:POLL_TEST:MEASURE:NFCA_T5:MAX?	Query only	Read the measured MAX value of t_5, [us]
READ:POLL_TEST:MEASURE:NFCA_T5:LL?	Query only	Read the calculated Lower Limit value of t_5, [us]
READ:POLL_TEST:MEASURE:NFCA_T5:UL?	Query only	Read the calculated Upper Limit value of t_5, [us]
READ:POLL_TEST:MEASURE:NFCA_V_OU:MIN?	Query only	Read the measured MIN value of $V_{OU,A}$
READ:POLL_TEST:MEASURE:NFCA_V_OU:AVG?	Query only	Read the measured AVG value of $V_{OU,A}$
READ:POLL_TEST:MEASURE:NFCA_V_OU:MAX?	Query only	Read the measured MAX value of $V_{OU,A}$

READ:POLL_TEST:MEASURE:NFCA_V_OU:LL?	Query only	Read the calculated Lower Limit value of $V_{OU,A}$
READ:POLL_TEST:MEASURE:NFCA_V_OU:UL?	Query only	Read the calculated Upper Limit value of $V_{OU,A}$
READ:POLL_TEST:MEASURE:NFCB_MOD_I:MIN?	Query only	Read the measured MIN value of $mod_{i,B}$, [%]
READ:POLL_TEST:MEASURE:NFCB_MOD_I:AVG?	Query only	Read the measured AVG value of $mod_{i,B}$, [%]
READ:POLL_TEST:MEASURE:NFCB_MOD_I:MAX?	Query only	Read the measured MAX value of $mod_{i,B}$, [%]
READ:POLL_TEST:MEASURE:NFCB_MOD_I:LL?	Query only	Read the calculated Lower Limit value of $mod_{i,B}$, [%]
READ:POLL_TEST:MEASURE:NFCB_MOD_I:UL?	Query only	Read the calculated Upper Limit value of $mod_{i,B}$, [%]
READ:POLL_TEST:MEASURE:NFCB_T_F:MIN?	Query only	Read the measured MIN value of $t_{f,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_F:AVG?	Query only	Read the measured AVG value of $t_{f,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_F:MAX?	Query only	Read the measured MAX value of $t_{f,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_F:LL?	Query only	Read the calculated Lower Limit value of $t_{f,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_F:UL?	Query only	Read the calculated Upper Limit value of $t_{f,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_R:MIN?	Query only	Read the measured MIN value of $t_{r,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_R:AVG?	Query only	Read the measured AVG value of $t_{r,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_R:MAX?	Query only	Read the measured MAX value of $t_{r,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_R:LL?	Query only	Read the calculated Lower Limit value of $t_{r,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_T_R:UL?	Query only	Read the calculated Upper Limit value of $t_{r,B}$, [us]
READ:POLL_TEST:MEASURE:NFCB_H_F:MIN?	Query only	Read the measured MIN value of $V_{OU,B \text{ (undershoot)}}$

READ:POLL_TEST:MEASURE:NFCB_H_F:AVG?	Query only	Read the measured AVG value of $V_{OU,B \text{ (undershoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_F:MAX?	Query only	Read the measured MAX value of $V_{OU,B \text{ (undershoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_F:LL?	Query only	Read the calculated Lower Limit value of $V_{OU,B \text{ (undershoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_F:UL?	Query only	Read the calculated Upper Limit value of $V_{OU,B \text{ (undershoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_R:MIN?	Query only	Read the measured MIN value of $V_{OU,B \text{ (overshoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_R:AVG?	Query only	Read the measured AVG value of $V_{OU,B \text{ (overshoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_R:MAX?	Query only	Read the measured MAX value of $V_{OU,B \text{ (overshoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_R:LL?	Query only	Read the calculated Lower Limit value of $V_{OU,B \text{ (overshoot)}}$
READ:POLL_TEST:MEASURE:NFCB_H_R:UL?	Query only	Read the calculated Upper Limit value of $V_{OU,B \text{ (overshoot)}}$
READ:POLL_TEST:MEASURE:NFCF_MOD_I:MIN?	Query only	Read the measured MIN value of $mod_{i,F}$, [%]
READ:POLL_TEST:MEASURE:NFCF_MOD_I:AVG?	Query only	Read the measured AVG value of $mod_{i,F}$, [%]
READ:POLL_TEST:MEASURE:NFCF_MOD_I:MAX?	Query only	Read the measured MAX value of $mod_{i,F}$, [%]
READ:POLL_TEST:MEASURE:NFCF_MOD_I:LL?	Query only	Read the calculated Lower Limit value of $mod_{i,F}$, [%]
READ:POLL_TEST:MEASURE:NFCF_MOD_I:UL?	Query only	Read the calculated Upper Limit value of $mod_{i,F}$, [%]
READ:POLL_TEST:MEASURE:NFCF_T_F:MIN?	Query only	Read the measured MIN value of $t_{f,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_F:AVG?	Query only	Read the measured AVG value of $t_{f,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_F:MAX?	Query only	Read the measured MAX value of $t_{f,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_F:LL?	Query only	Read the calculated Lower Limit value of $t_{f,F}$, [us]

READ:POLL_TEST:MEASURE:NFCF_T_F:UL?	Query only	Read the calculated Upper Limit value of $t_{f,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_R:MIN?	Query only	Read the measured MIN value of $t_{r,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_R:AVG?	Query only	Read the measured AVG value of $t_{r,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_R:MAX?	Query only	Read the measured MAX value of $t_{r,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_R:LL?	Query only	Read the calculated Lower Limit value of $t_{r,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_T_R:UL?	Query only	Read the calculated Upper Limit value of $t_{r,F}$, [us]
READ:POLL_TEST:MEASURE:NFCF_H_F:MIN?	Query only	Read the measured MIN value of $V_{OU,F}$ (undershoot)
READ:POLL_TEST:MEASURE:NFCF_H_F:AVG?	Query only	Read the measured AVG value of $V_{OU,F}$ (undershoot)
READ:POLL_TEST:MEASURE:NFCF_H_F:MAX?	Query only	Read the measured MAX value of $V_{OU,F}$ (undershoot)
READ:POLL_TEST:MEASURE:NFCF_H_F:LL?	Query only	Read the calculated Lower Limit value of $V_{OU,F}$ (undershoot)
READ:POLL_TEST:MEASURE:NFCF_H_F:UL?	Query only	Read the calculated Upper Limit value of $V_{OU,F}$ (undershoot)
READ:POLL_TEST:MEASURE:NFCF_H_R:MIN?	Query only	Read the measured MIN value of $V_{OU,F}$ (overshoot)
READ:POLL_TEST:MEASURE:NFCF_H_R:AVG?	Query only	Read the measured AVG value of $V_{OU,F}$ (overshoot)
READ:POLL_TEST:MEASURE:NFCF_H_R:MAX?	Query only	Read the measured MAX value of $V_{OU,F}$ (overshoot)
READ:POLL_TEST:MEASURE:NFCF_H_R:LL?	Query only	Read the calculated Lower Limit value of $V_{OU,F}$ (overshoot)
READ:POLL_TEST:MEASURE:NFCB_H_R:UL?	Query only	Read the calculated Upper Limit value of $V_{OU,F}$ (overshoot)

READ:POLL_TEST:MEASURE:NFCF_BITRATE?	Query only	Read the measured bit rate for NFC-F:
		    212KBPS
		    424KBPS
		    UNKNOWN

Command	Parameter Range	Description
READ:POLL_TEST:MEASURE:VERDICT?	Query only	Read the verdict of modulation characteristics test results: PASS FAIL

3.4.11 Commands for POLL_TEST » SENSITIVITY

Command	Parameter Range	Description
CONF:POLL_TEST:SENSITIVITY:MODE	SEARCH LM TIME	Configure/Read the operating mode for sensitivity test
READ:POLL_TEST:SENSITIVITY:MODE?	Query only	
CONF:POLL_TEST:SENSITIVITY:REPEAT	5 ~ 1000	Configure/Read the number of repetition for each test point
READ:POLL_TEST:SENSITIVITY:REPEAT?	Query only	

CONF:POLL_TEST:SENSITIVITY:START_LM	For LISTENER-1,
	  0 ~ 114 (all)
	For LISTENER-3,
	  0 ~ 54 (MAX)
	  0 ~ 70 (otherwise)
	For LISTENER-6,
	  0 ~ 90 (MAX)
	  0 ~ 30 (otherwise)
		Configure/Read the start value of Load Modulation (LM) in LM mode only, [mVpp]

READ:POLL_TEST:SENSITIVITY:START_LM?	Query only	
CONF:POLL_TEST:SENSITIVITY:STOP_LM	Same as START_LM	Configure/Read the stop value of LM in LM mode only, [mVpp]
READ:POLL_TEST:SENSITIVITY:STOP_LM?	Query only	
CONF:POLL_TEST:SENSITIVITY:STEP_LM	1 ~ 10	Configure/Read the step value of LM in LM mode only, [mVpp]
READ:POLL_TEST:SENSITIVITY:STEP_LM?	Query only	
CONF:POLL_TEST:SENSITIVITY:TARGET_PER	0 ~ 99.9	Configure/Read the value of users' target PER, [%]
READ:POLL_TEST:SENSITIVITY:TARGET_PER?	Query only	
EXEC:POLL_TEST:SENSITIVITY:RUN	N/A	Start the sensitivity test
EXEC:POLL_TEST:SENSITIVITY:STOP	N/A	Stop the sensitivity test

READ:POLL_TEST:SENSITIVITY:RUN:STATUS?	Query only	Read the run status of the current test
READ:POLL_TEST:SENSITIVITY:PER?	Query only	Read the PER value corresponding to the resultant sensitivity level, [%]
READ:POLL_TEST:SENSITIVITY:RESULT_LM?	Query only	Read the resultant sensitivity level, [mVpp]

3.4.12 Commands for GENERAL » SG

Command	Parameter Range	Description
CONF:GENERAL:SG:FREQ	13.5 ~ 13.6	Configure/Read the carrier frequency, [MHz]
READ:GENERAL:SG:FREQ?	Query only	
CONF:GENERAL:SG:TX_LEVEL_MODE	TX_LEVEL TX_VDC LOAD_MOD TX_OFF	Configure/Read the type of TX level
READ:GENERAL:SG:TX_LEVEL_MODE?	Query only	
CONF:GENERAL:SG:TX_LEVEL	0 ~ 20	Configure/Read the value for TX level in peak-to-peak voltage, [Vpp]
READ:GENERAL:SG:TX_LEVEL?	Query only	
CONF:GENERAL:SG:TX_LEVEL_RMS	0 ~ 3.5	Configure/Read the value for TX level in RMS voltage, [Vrms]
READ:GENERAL:SG:TX_LEVEL_RMS?	Query only	
CONF:GENERAL:SG:TX_LEVEL_DBM	~ 30	Configure/Read the value for TX level(power) in dBm, [dBm]
READ:GENERAL:SG:TX_LEVEL_DBM?	Query only	
CONF:GENERAL:SG:MODULATION	OFF ON	Configure/Read the status of Amplitude Modulation
READ:GENERAL:SG:MODULATION?	Query only	
CONF:GENERAL:SG:AM_DEPTH	5 ~ 30	Configure/Read AM Depth, [%]
READ:GENERAL:SG:AM_DEPTH?	Query only	

3.4.13 Commands for GENERAL » POW_TIME

Command	Parameter Range	Description
READ:GENERAL:POW_TIME:AM_DEPTH?	Query only	Read the measured AM depth, [%]
READ:GENERAL:POW_TIME:V_PP?	Query only	Read the measured peak-to-peak voltage, [Vpp]
READ:GENERAL:POW_TIME:V_AV?	Query only	Read the measured average voltage, [Vav]
READ:GENERAL:POW_TIME:V_OV_FREE_AIR?	Query only	Read the pre-calibrated value of $V_{OV,FREE\_AIR}$ for the current Reference Poller Antenna, measured on J2 of each Reference Poller Antenna, [mV]

3.4.14 Commands for GENERAL » VDC_METER

Command	Parameter Range	Description
READ:GENERAL:VDC_METER:VDC?	Query only	Read the DC voltage measured from VDC input on the rear panel, [V]

3.4.15 Commands for GENERAL » RESONANCE

Command	Parameter Range	Description
EXEC:GENERAL:RESONANCE:RUN	N/A	Start the resonance frequency measurement
EXEC:GENERAL:RESONANCE:STOP	N/A	Stop the resonance frequency measurement
READ:GENERAL:RESONANCE:RUN:STATUS?	Query only	Read the run status of the current measurement
EXEC:GENERAL:RESONANCE:PEAK	N/A	Search the peak value of the current measurement

Command	Parameter Range	Description
CONF:GENERAL:RESONANCE:dB/DIV	1 ~ 10	Configure/Read the dB/DIV of Y-axis
READ:GENERAL:RESONANCE:dB/DIV?	Query only	
READ:GENERAL:RESONANCE:REF_LEV?	Query only	Read the reference level of the current measurement screen
CONF:GENERAL:RESONANCE:MEMORY	OFF ON	Determine whether to display the saved graph
READ:GENERAL:RESONANCE:MEMORY?	Query only	
EXEC:GENERAL:RESONANCE:SAVE	N/A	Save the current graph into memory
CONF:GENERAL:RESONANCE:POWER	-10 ~ 10	Configure/Read the output power of RWC5010A, [dBm]
READ:GENERAL:RESONANCE:POWER?	Query only	
READ:GENERAL:RESONANCE:F_PEAK?	Query only	Read the corresponding frequency value at the peak position, [MHz]
EXEC:GENERAL:RESONANCE:CALIBRATE	N/A	Calibrate the flatness of frequency responses
READ:GENERAL:RESONANCE:F_PEAK_MEM?	Query only	Read the corresponding frequency value at the peak position of the saved graph, [MHz]

3.4.16 Commands for SETUP » SYSTEM

Command	Parameter Range	Description
READ:SETUP:SYSTEM:SW_VERSION?	Query only	Read the software version
CONF:SETUP:SYSTEM:REF_CLK	INT EXT	Configure/Read the selection of source for the reference clock
READ:SETUP:SYSTEM:REF_CLK?	Query only	
CONF:SETUP:SYSTEM:COLOR_SCHEME	DARK BRIGHT	Configure/Read the color scheme for measurement screen (dark or bright)
READ:SETUP:SYSTEM:COLOR_SCHEME?	Query only	

READ:SETUP:SYSTEM:SERIAL_NUM?	Query only	Read the serial number of RWC5010A
READ:SETUP:SYSTEM:OPTION_EMV_PICCT?	Query only	Read the software option information about EMVCo PICC Test
READ:SETUP:SYSTEM:OPTION_EMV_PCDT?	Query only	Read the software option information about EMVCo PCD Test
READ:SETUP:SYSTEM:OPTION_FORUM_LDT?	Query only	Read the software option information about NFC Forum Listening Device Test
READ:SETUP:SYSTEM:OPTION_FORUM_PDT?	Query only	Read the software option information about NFC Forum Polling Device Test
READ:SETUP:SYSTEM:OPTION_SNIFF?	Query only	Read the software option information about Sniff mode

Appendices

A1. Calibration Method of VDC Offset

A1. Calibration Method of VDC Offset

A1.1 Overview

The output level of RWC5010A are pre-calibrated with the provided Reference Antenna Set according to the Analog Test Specification during production, so normally additional calibration is not necessary if the same Antenna Set is used. However, if used combining with other Antenna Set, the output level of RWC5010A should be calibrated again. This section describes how to calibrate the output level manually with Reference Antenna Set.

A1.2 Calibration Procedure

1. Connect J1 port of a Reference Poller Antenna to RF OUT port of RWC5010A. Place the corresponding Reference Listener Antenna on the Reference Poller Antenna with 5mm distance. Refer to the NFC Forum Analog Specification for details.

2. Connect VDC OUT (J1) port of the Reference Listener Antenna to VDC IN port on the rear panel of RWC5010A.
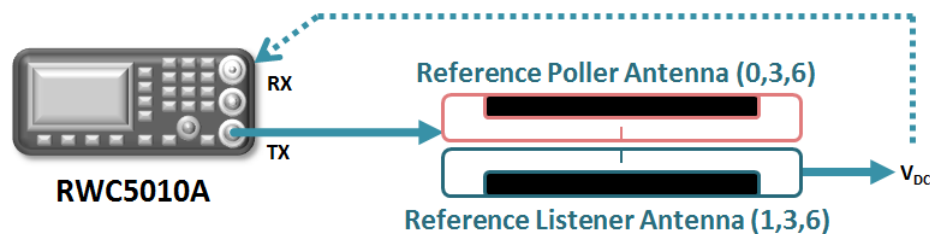

Fig A.1   Example of VDC Offset Calibration

3. Set the main menu to GENERAL and move to SG screen by pressing ⓢ¹ key.

4. Set TX_LEVEL_MODE to TX_VDC. Refer to 2.20 for details.

5. Set REF_POLLER to the same as the Reference Poller Antenna and check whether REF_LISTENER parameter matches with the Reference Listener Antenna. If not, replace it with a Reference Listener Antenna match with REF_LISTENER parameter.

6. Select and set VDC_TYPE to calibrate. Changing VDC_TYPE parameter affects on the load resistor of the Reference Listener Antenna and the value of VDC.

7. Adjust the jumper of the load resistor of the Reference Listener Antenna to match with LOAD_R

parameter.

8. Move to VDC_METER screen by pressing $\boxed{\text{S3}}$ key. Start testing by pressing $\boxed{\text{RUN}}$ key, and the measured value of DC voltage will be displayed on the screen.

9. If the measured value of DC voltage is different from the VDC parameter on SG screen, adjust VDC_OFFSET to match with each other. This VDC_OFFSET is the calibration value for VDC.

10. Repeat 1 to 9 for other VDC_TYPE.

11. Repeat 1 to 10 for other Reference Poller Antenna.

12. After calibration is completed, use SAVE function to store the calibration values into the instrument. The saved configuration can be retrieved by RECALL function later if necessary. Refer to 2.24 for detail descriptions of SAVE/RECALL.