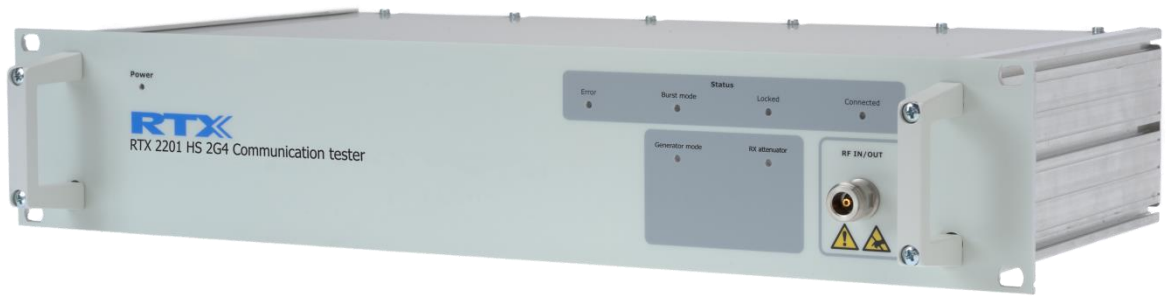
RTX2201

41-10-1333

2.4 GHz Communication Tester

User’s manual



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This instrument product is warranted against defects in material and Workman ship for a period of one year from date of shipment. During the warranty period, RTX will at its option, either repair or replace products, which prove to be defective. For warranty service or repair, this product must be returned to a service facility designated by RTX. Buyer shall prepay shipping charges to RTX and RTX shall pay shipping charges, duties, and taxes for products returned to RTX from another country. RTX warrants that its software and firmware designated by RTX for use with an instrument will execute its programming instructions when properly installed on that instrument.
RTX does not warrant that the operation of the instrument, or firmware will be uninterrupted or error free.

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The general safety precautions, according to the RTX2201 User's Manual, must be observed during all phases of operation. RTX A/S assumes no liability for the customer's failure to comply with these requirements.

The purpose of the document is to provide guidance to users of the RTX2201 2.4 GHz Communication Tester. The User's manual describes general functions of the tester and also describes the use of the Windows® based interface, as well as interfacing with a production application programme.

For further information about programming the RF Communication tester, refer to the section Programming reference.

Safety information

The following general safety precautions must be observed during all phases of operation and service of this instrument.
Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. RTX assumes no liability for the customer's failure to comply with these requirements.

WARNING! This is a Safety Class I instrument (provided with a protective Earth ground, incorporated in the power cord).
The mains plug shall only be inserted in a socket outlet provided with a protective earth contact.
Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

DO NOT defeat the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground connector. If you are using an autotransformer, make sure its common terminal is connected to the protective earth contact of the power source outlet socket.
DO NOT operate the product in an explosive atmosphere or in the presence of flammable gasses or fumes.
DO NOT use repaired fuses or short-circuited fuse holders: For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.
DO NOT perform procedures involving cover or shield removal unless you are qualified to do so: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel at RTX only.

Electrostatic Discharge

Electrostatic discharge (ESD) can damage electronic test equipment.
Working with electronic components or test equipment should always be performed at a static-safe place.

High Voltage

Some power supply can generate high voltage, which can damage the RF in/out port of the Tester.
If using a double insulated switch mode power supply, the test device should be earthed to the same ground potential, as the tester.

To prevent damage to the RTX2201 2.4 GHz Communication Tester, the following should be observed:

- Connect the RF cable path, before applying DC power to the test device.
- Be careful when connecting RF connectors, that the centre core does not touch any unearthed metal.
- Make sure that the test device is properly earthed.

Documentation information

This user's manual contains the information that is needed for general-purpose use of the test equipment, and also detailed description for high throughput production purpose.

The User's manual provide programming guidance to users of the 2.4 GHz Communication Tester. The programming reference on page 85 describes general tester initialisation and typical RF test sequences for base and handset RF production tests. The test sequence description contains both RF tester commands and target (base/handset) commands.
This information is supplied only as guidance to ease customers test program development, and RTX takes no responsibility for debugging and verification of the actual test program developed by the customer.

The User's manual also Show you how to unpack, install and operate your 2.4 GHz Communication Tester from the supplied User Interface for a PC or using remote command applications.

Conventions Used in this manual

The following text conventions are used in this guide.

RUN used to represent the text in the Windows® based user interface
Parameter used to represent a parameter, value or data in an entry field
The following abbreviations are used in this guide.

RFPI Radio Fixed Part Identity
DUT Device under Test
NTP Normally Transmitted Power or Average Burst Power
BS Bit Sequence
BER Bit Error Rate
FER Frame Error Rate

CONTENT

Getting Started

Introduction

The RTX2201 2.4 GHz Communication Tester supports a range of different RF tests and can be used for high throughput manufacturing applications, and also as a development or service tool.
For some test situations specified, additional test equipment, such as a spectrum analyzer or signal generator, can be used to compliment the 2.4 GHz RF Communication Tester.
The tester can basically be setup as either a wireless game pad or a base control station, with added test capabilities.

You can operate the tester using the supplied Windows® based user interface or by sending SCPI format commands, either in the Windows environment or from within a test executive.
The operation of the DUT is controlled via the Air Interface. Using a RF tool program or with a batch file execution, you can set the DUT into test mode and carry out Transmitter and Loop back Tests.
2.4 GHz RF components that are unable to establish a link can be tested using the implemented RF Analyzer and RF Generator modes.

In addition to the RF IN/OUT port for connection with the DUT, several additional rear panel connections are provided. These are shown in the External Connections on page 18.

Unpacking the 2.4 GHz Communication Tester

Initial Inspection

Please inspect the shipping container for damage. If the shipping container or packaging material is damaged, it should be kept until the contents have been checked mechanically and electrically. If there is any mechanical damage, notify RTX.
Keep the damaged shipping materials (if any) for inspection by the carrier and an RTX representative.

Box content

Unpack the RTX2201 2.4 GHz Communication Tester and verify whether the items listed are all included.

- RTX2201 2.4 GHz Communication Tester
- Main Power cable
- Parallel communication cable
- Certificate of conformity
- Calibration report
- Mounting kit

RTX2201 2.4 GHz Communication Tester Installation

The RTX2201 2.4 GHz Communication Tester can be used on the bench top or installed in a 19 inch rack cabinet. This section shows you how to:

- check the operating voltage and fuse rating
- switch on for the first time
- confirm successful power on
- install your 2.4 GHz RF Tester in a 19 inch rack (if required)
- make connections to the rear panel interfaces
- make connections to the front panel interface
- install the user interfaces and DLL files on your PC
- perform a confidence check

Voltage setting label

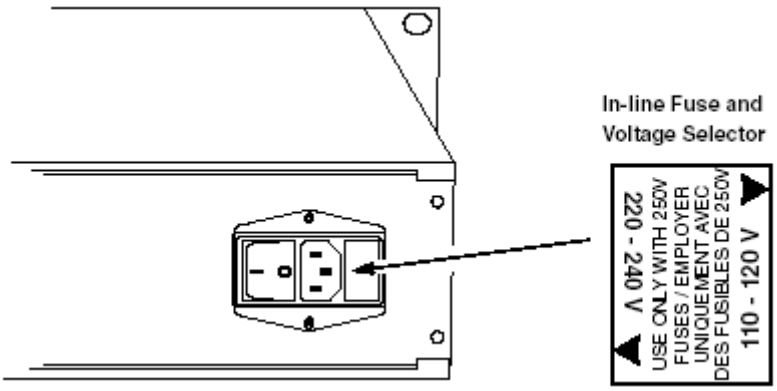
The Appliance coupler is secured with a yellow warning label, which indicates the fuse rating settings.

Check whether the fuse settings are compliant to the local region before connecting the Main Power Cord.

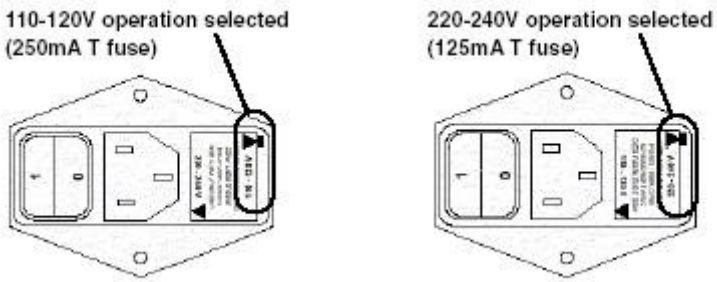
Powering On

Appliance coupler (mains input power cord) is the power disconnect device.
Do not position the instrument such that access to the coupler is impaired.

Check the operating voltage setting and fuse rating.



Select the required operating voltage by removing and replacing the fuse holder as shown below. Ensure the correct fuse is fitted.

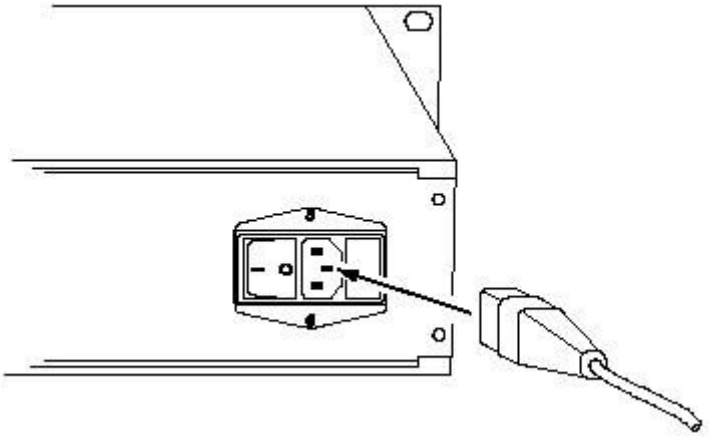


NOTE!
Please ensure you have read and understood the safety information at the start of this guide before proceeding.

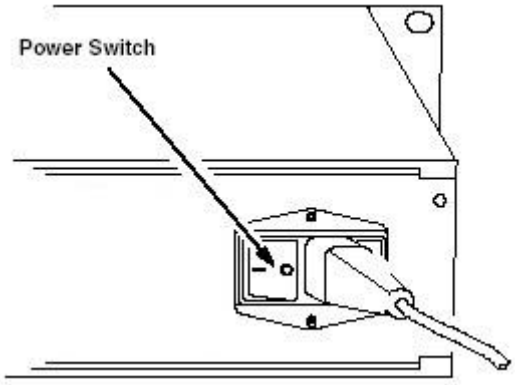
Before switching on this instrument, make sure that the line voltage selector is set to the voltage of the power supply and the correct fuse is installed. Ensure the power supply voltage is in the specified range.

Main Power Cord

Connect the Main Power Cord.

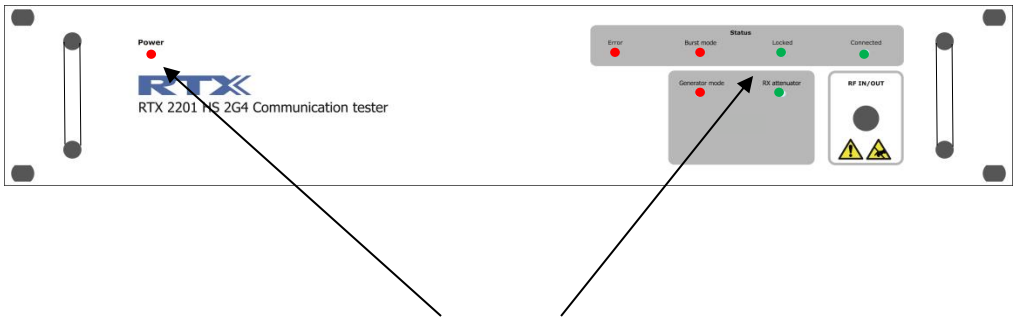


Switch the Tester on by pressing the On (I) switch.



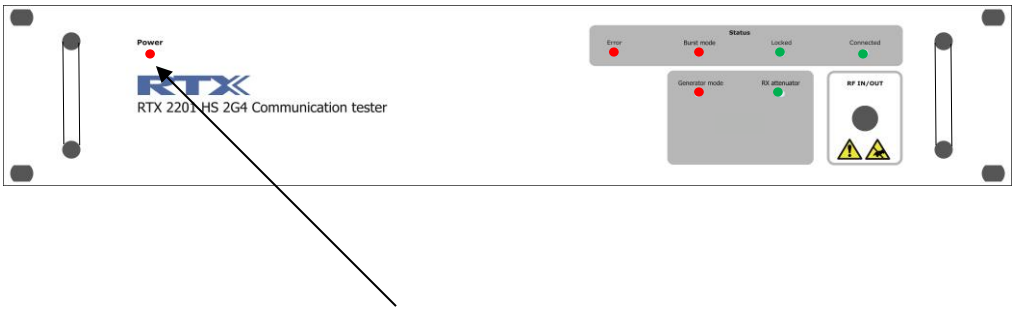
Power On test

During powering on, observe that all front panel LED’s light up for a short time.



All LED’s

After a few seconds, only the Power LED remains lit.



Power LED

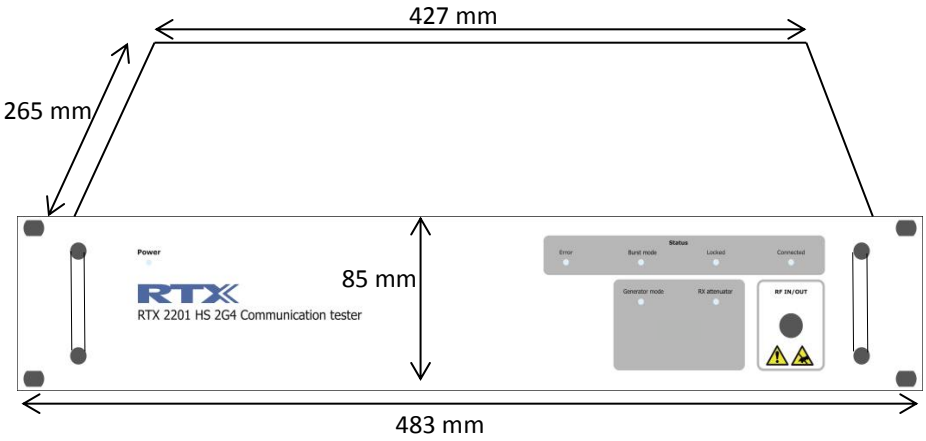
The Power On sequence indicates a functional running firmware.

To ensure your 2.4 GHz RF Tester meets its specifications, ensure the environmental conditions are met and allow a 60-minute warm-up period before making any measurements.

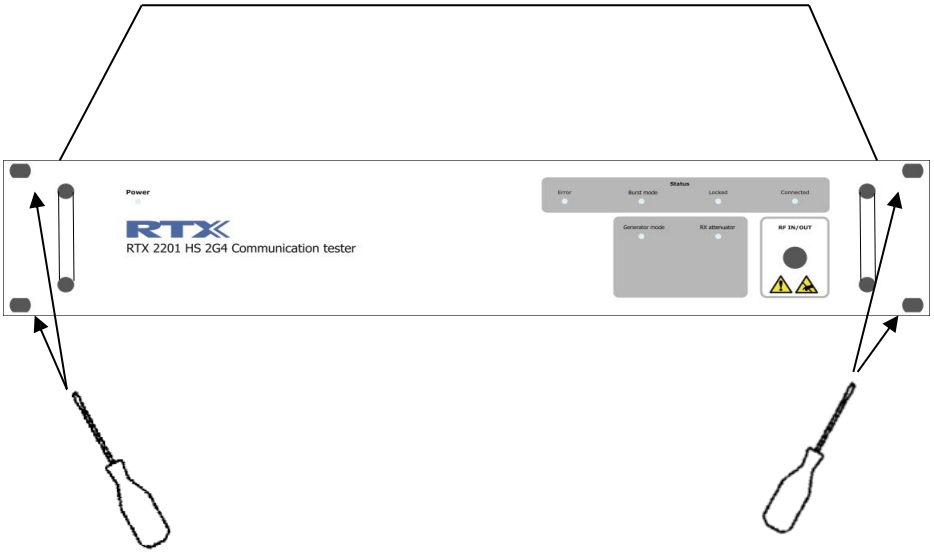
Rack Mounting

The RTX2201 is not fitted with a power switch on the front panel. To allow rapid disconnection from mains power when rack mounted, the RTX2201 shall only be fitted to a rack cabinet with an easily accessible power isolation switch.

Dimensions of the Tester are shown below. Ensure the space and airflow requirements within the rack cabinet is met.



Place the Tester in the rack and secure it to the frame using four screws as shown below.



Rear Panel connections

The RTX2201 Tester provides rear panel input/outputs for the following functions:

Timeslot, BNC-connector with the "TIME_SLOT" output, an output signal, going high and low together with the TX signal from the test device.

Receive Data, BNC-connector with the inverted analogue signal representing "RECDAT", which is the demodulated signal.

CLK 100, BNC-connector with the "FRAME_CLK" signal (equal to the CLK_100 in DECT).

Power Envelope, BNC-connector containing an analogue signal "POWER" with a voltage indication of the instantaneous received power from the DUT.

USB Interface, should be used together with a Windows® based PC in order to control the test set and to query data from the test set. The USB interface on the tester is a Type B receptacle, and hence, a standard USB cable with Type A-B plugs can be used to connect the tester to a PC.

AC input / AC switch. Power supply 110 / 220V.

RS-232 RS-232 operation for download firmware purpose (for RTX bench work only)

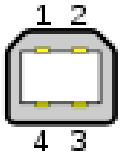
Available connections

USB Interface

To operate the tester, you must connect a PC or system controller to the USB port using a standard USB cable with Type A-B plugs (supplied together with the tester).

Standard USB cable with Type A-B plugs

USB Interface on the tester (Type B receptacle) and pin overview

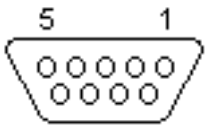


Pin	Name	Direction	Description
1	VBUS		Power (+5V)
2	D-	PC<->2201	DATA-
3	D+	PC<->2201	DATA+
4	GND		SIGNAL GND

RS 232 interface

The serial interface is used for downloading firmware purposes.

Serial interface connections - 9 PIN D-SUB FEMALE



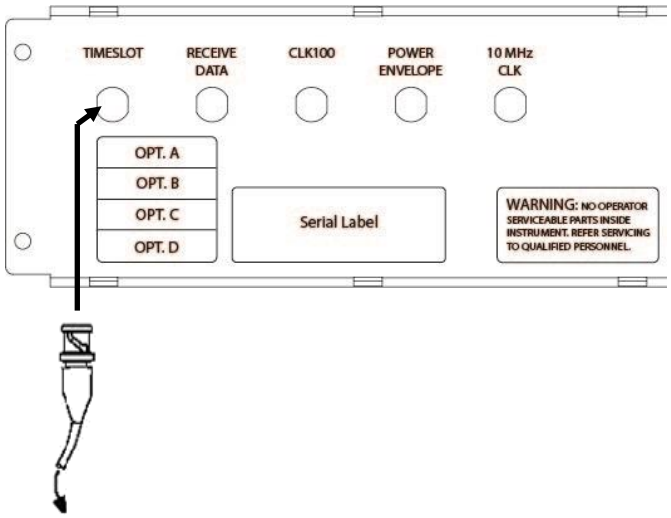
Pin	Name	Direction	Description
2	TXD	2201->PC	TRANSMIT DATA
3	RXD	PC->2201	RECEIVE DATA
4	DTR	PC->2201	DATA TERMINAL READY
5	GND		SIGNAL GND
7	RTS	PC->2201	REQUEST TO SEND

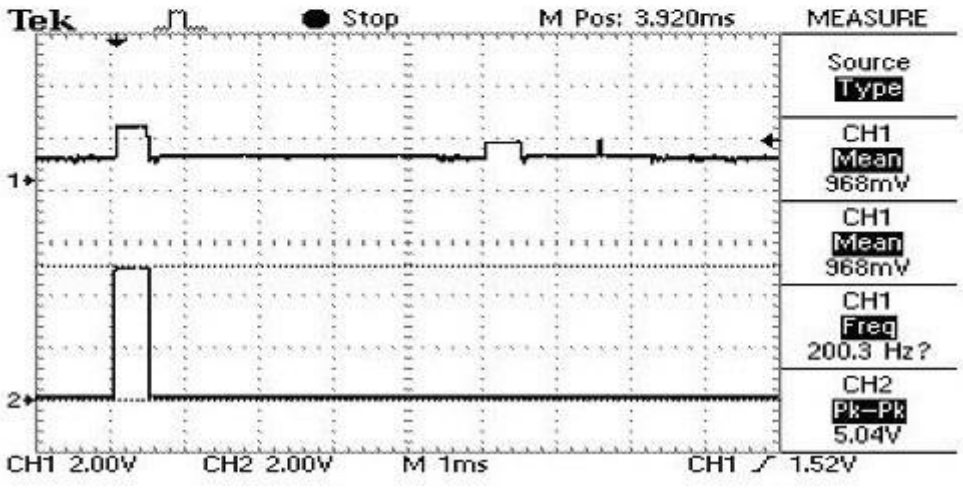
NOTE!
The download routine must be handled only by authorized personal, and under supervision of RTX representative.

Timeslot

The BNC-connector supplies an output signal, going high and low together with the TX signal from the test device.

Making a connection to the BNC TIME_SLOT



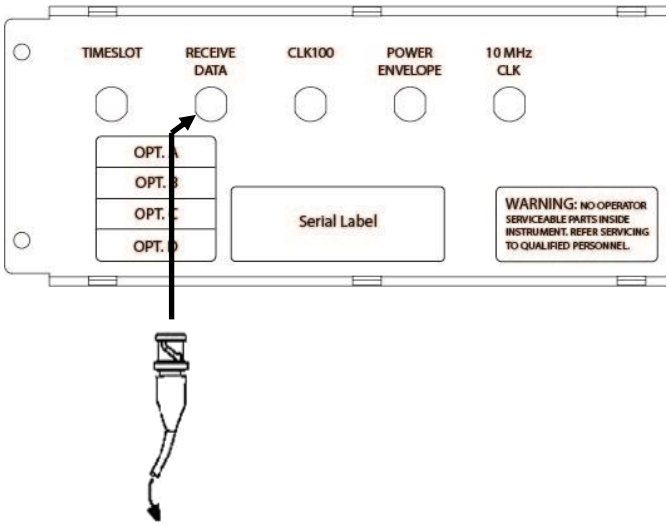


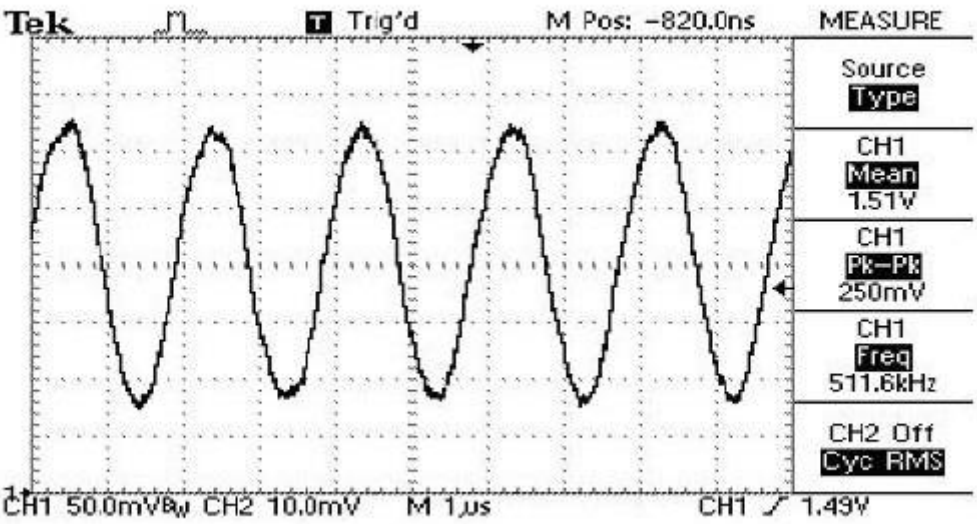
BNC_TIME_SLOT signal

Receive Data

The BNC connector supplies an inverted output of the demodulated signal.

Making a connection to the RECDAT output

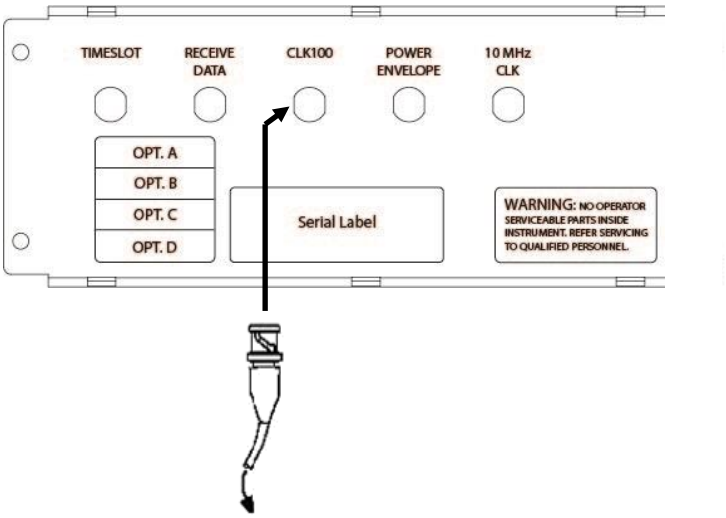




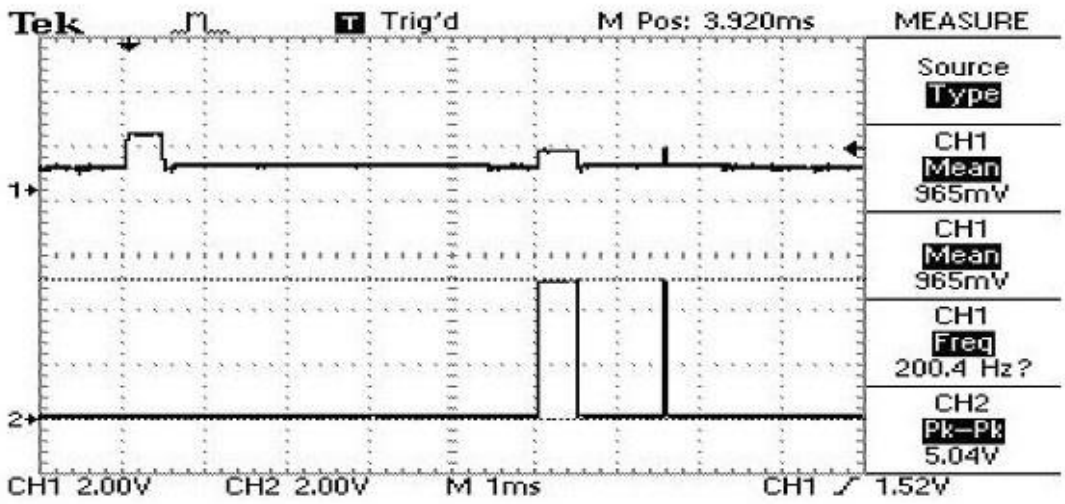
CLK 100

BNC-connector with the "FRAME_CLK" signal
The BNC-connector supplies an output signal, going high and low together with the TX signal from the RTX2201 Tester.

Making a connection to the CLK 100 output signal.



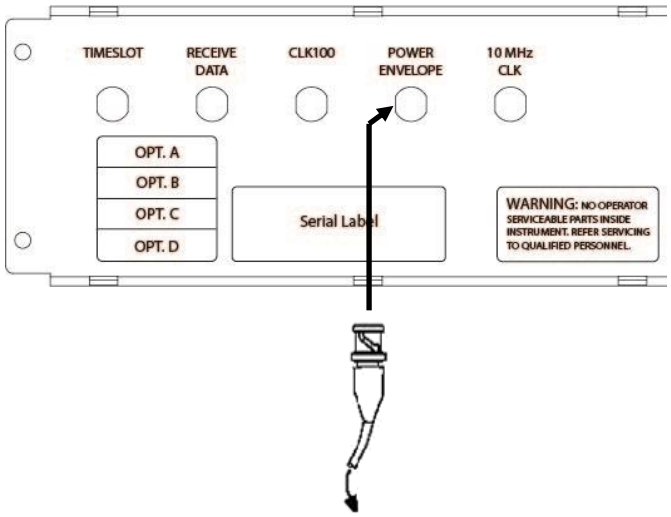
FRAME_CLK signal

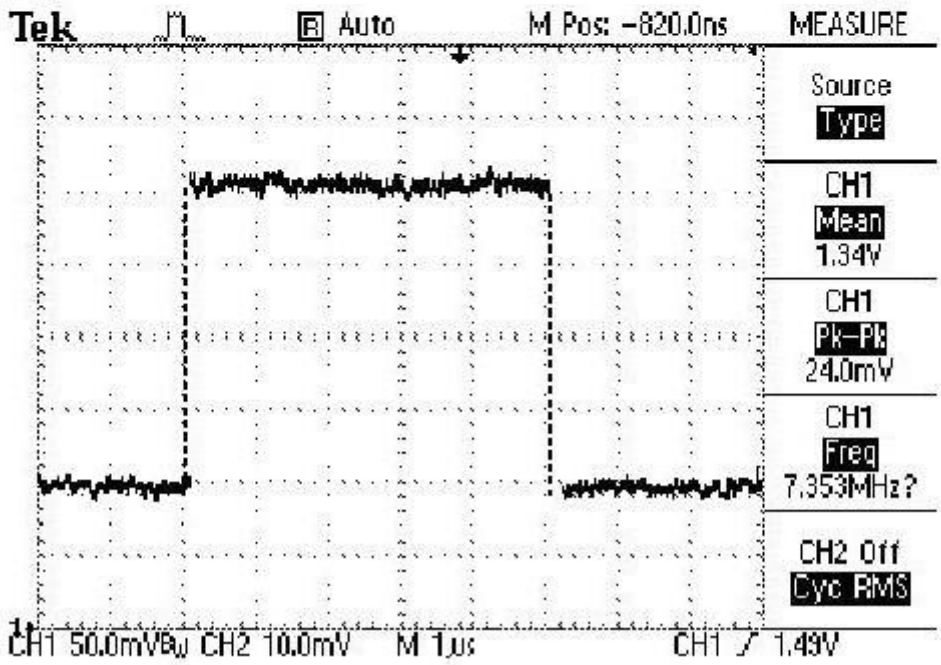


Power Envelope

BNC connector with an analog signal "POWER" voltage indication of the instantaneous received power from the DUT.

Making a connection to the Power Envelope signal





Power envelope signal

Front Panel Connections

RF Input / RF Output

The RTX2201 Tester provides front panel input/output for the 50 Ω N-type RF connector

Make an RF cable connection between DUT and the RF IN/RF OUT connector.

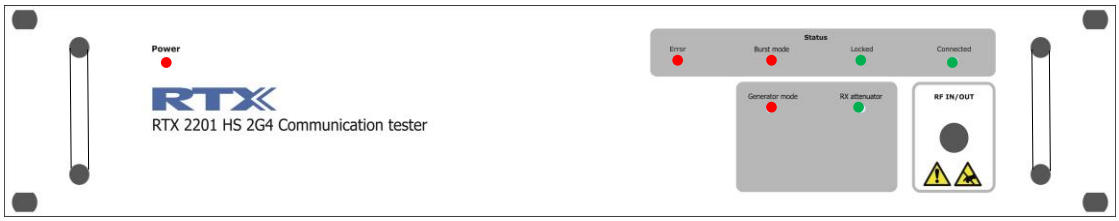
NOTE!
Antenna coupled measurement results are uncalibrated.
If the power level input is higher than 30 dBm, an external attenuator must be inserted in the RF path to prevent power saturation.

To avoid noise and interference, always use an antenna in a screened environment.

NOTE! The RF Input/Output connector must be secured for ESD and high voltage. Please refer to page 5 for further information.

Front Led Indications

This section show views from the front panel of the Test Set in order to give an overview of the front led indicators.



POWER

Red Light Emitting Diode indicating that the power switch is on and the Tester is connected to the AC mains.

ERROR

Red Light Emitting Diode indicating that a communication error appears.

Burst mode

Red Light Emitting Diode indicating that the tester is in analyzer mode.

Generator mode

Red Light Emitting Diode indicating that the tester is in Generator mode.

LOCKED

Green Light Emitting Diode indicates that the RTX2201 is locked in FP test

RF Attenuator

N/A

CONNECTED

Green Light Emitting Diode indicates that the RTX2201 is connected to either a controller Part or a handheld Part.

Installing the PC Software

The RTX2201 2.4GHz Communication Tester is equipped with a parallel interface. This section shows you how to:

- Install the Windows based User Interface on your PC
- Install the Dynamic Link Library (DLL) for remote control purposes
- Connect your PC or system controller to the RTX2201 tester

Minimum System Requirements

For successful operation of the User Interface, your PC must meet at least the following requirements:

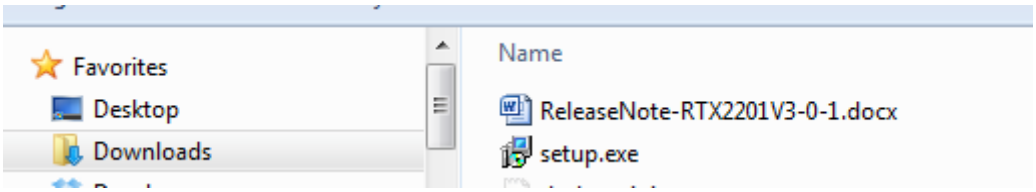
CPU	Pentium 300 MHz
RAM	128 Mbytes
Disc Space	50 Mbytes
Monitor Resolution	1024 x 768 pixels (recommended) or higher
Ports	One USB port
Operating System	Windows XP / Win 7 (32) / Win 7 (64)

Install the Windows user interface

Turn on the computer and download the RTX2201 PC-software from the RTX Download center at http://www.rtx.dk/Download_Center_Testers-4096.aspx.

NOTE! The following figures are shown, using Win 7. Other Windows OS setup can appear different.

Select **Setup.exe** file from the **Download folder**.



Follow the instructions which guide you through the installation procedure. The RTX2201 user interface is default installed into the directory path:
C:\Program Files (x86)\RTX\RTX2201

When complete, The RTX2201 User interface icons are placed on the PC desktop, and in the Start menu under Programs – RTX2201.

Restart the PC after installation.

NOTE!
As shown, an additional 'Debug' mode of operation of the Windows interface is available. This can be useful when developing your own test programs.
This chapter, on page 37 in this User's Manual shows you how to access the debug mode.

Confidence test

You can quickly check the operation of your RTX2201 Tester.

Ensure that:

- The Windows based user interface is installed on your PC
- The tester is switched on
- Your PC and test set are connected using the parallel cable
- No connection to the RF Input/Output connector

Double click on the RTX2201 Tester icon

During connection, the following message is displayed.

Starting the Windows User Interface in Debug mode

Double click on the RTX2201 Debug icon

During connection, the following message is displayed.

If the following message is displayed, the PC has been unable to establish communication with the Tester. Confirm all connections and the Power LED on the Tester front panel.

The message indicates that the communication fails, but the User interface starts up.

NOTE! Only the System and Setup Page Tabs is available if connection fails in debug mode.

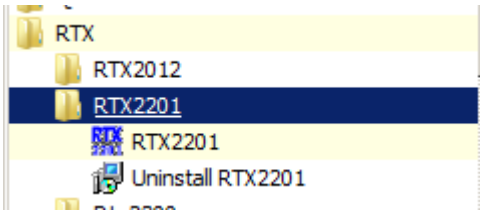
Windows Interface

Introduction

The RTX2201 2.4 GHz Communication Tester can be controlled by the supplied Windows based user interface or by use of the SCPI compliant remote command set. The Windows user interface is intended for easy use in development and service situations.
The user interface requires only a small amount of desktop space by using tab dividers to separate each major system mode.
The program supports installation in Windows 95/98/2000/2003 server/NT, Windows XP, and Win 7

You can start the user interface by double-clicking the desktop icon:

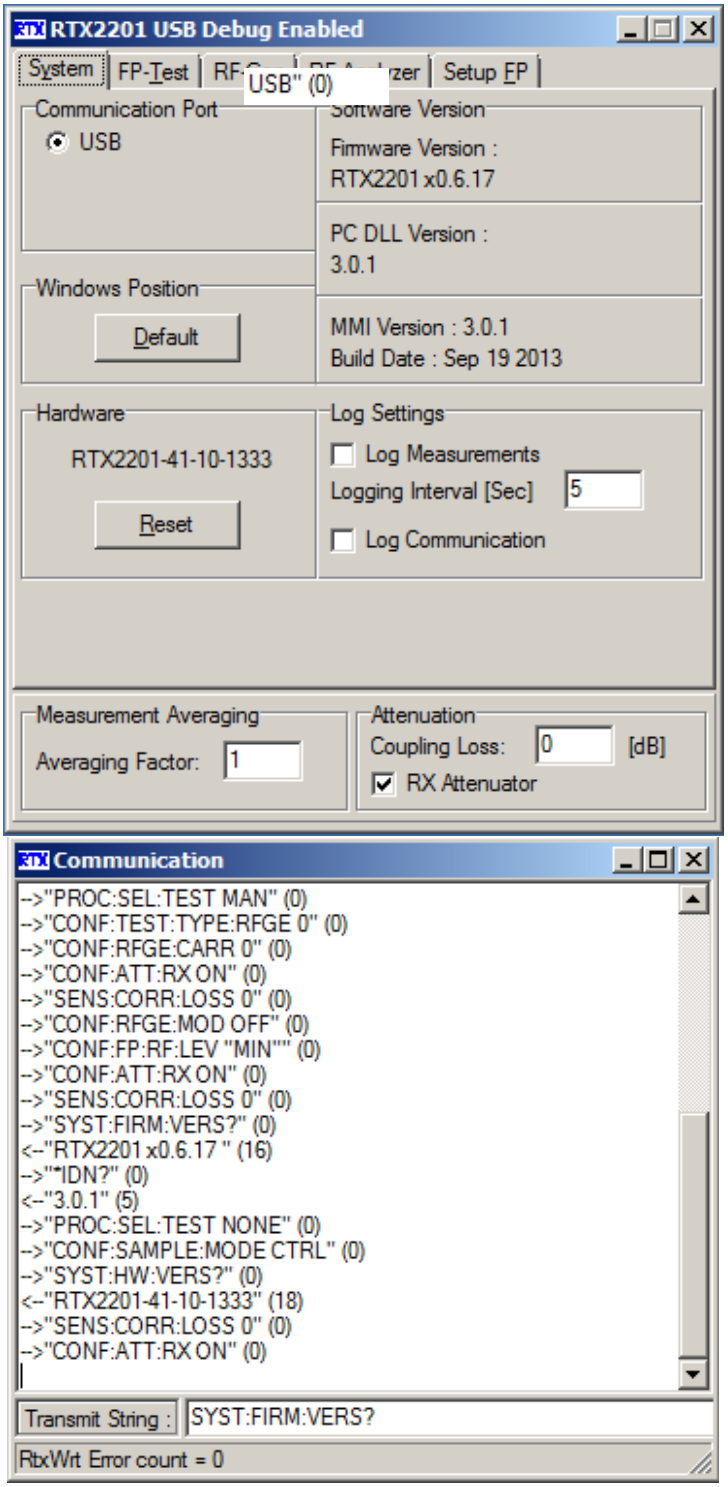
Or by selecting RTX2201 Tester from the **Start**, **Programs** menu



NOTE!
Selecting **RTX2201 Debug** starts a windows interface which includes an additional window showing the remote command dialogue between your computer and the RF Tester. The dialogue or the measurements can be captured in a log file and may be of use if you intend to develop your our control programs.

System Page

The System Page contains all the settings required for communication between a PC and the Tester and between the Tester and the DUT.



NOTE!

The Windows User Interface depicted is opened in "Debug" mode.

System Page structure

The user interface always opens with the **System** page displayed.
It contains the following panels:

Communication Port

The **Communication Port** panel are used to select
USB port to be used for control of the test set.

Windows Position

Pressing **Default** places the user interface window in the upper left corner of your PC display, and all windows are restored back to default size and position.

Hardware

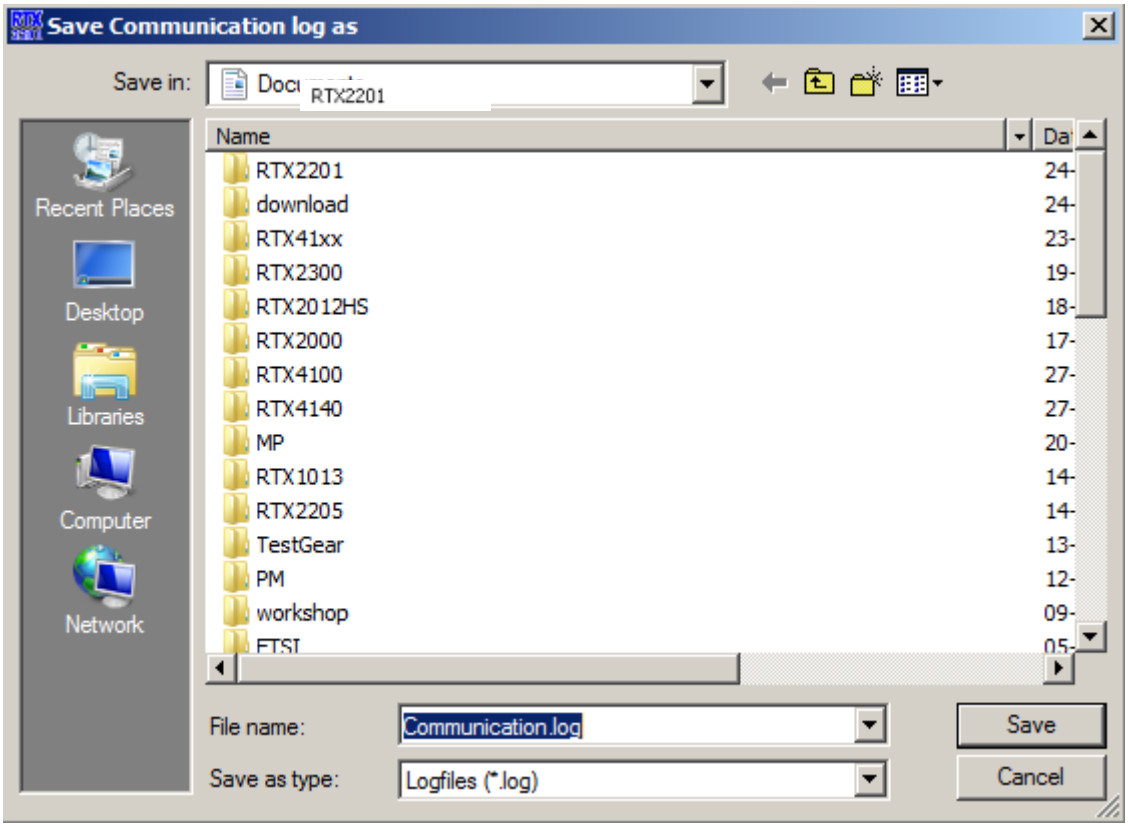
The Hardware Tester type is displayed. For support issues, please refer to this information.
Press **Reset** to initialize the test set. All prior test set configurations are retained.

Software Version

When the test set is started and the user interface program is launched, the test set returns information about the firmware version and the PC Dynamic Link Library (DLL) file.
This panel also shows the MMI Version.

Log Settings

The user interface can be configured to store measurement and communication information from the tester at set intervals. The default interval is 5 seconds and can be changed by entering the interval in the **Logging Interval (Sec.)** Field.
Clicking the **Log Measurements** check box opens a dialog box where you can choose the filename and path.



The saved file contains measured values regarding the 2.4 GHz RF measurements.
For example, in loop back measurements, with a 5 second interval; the BER values are logged into the file as shown below. This type of text-only file can easily be imported into a spreadsheet for analysis.

```
16:49:27;
16:49:27;   NTP; FrqDev; FrqOff; FrqDft;      BER;      FER;
16:49:32;   ---;    ---;    ---;    ---;      ---;      ---;
16:49:37;   ---;    ---;    ---;    ---;      ---;      ---;
16:49:42;  21.3;  233.7;    4.9;    4.9;  0.00000;  0.00000;
16:49:47;  21.1;  233.6;    4.2;    6.6;  0.00000;  0.00000;
16:49:52;  20.8;  232.9;    4.5;    4.1;  0.00000;  0.00000;
16:49:57;  21.3;  233.8;    0.8;    5.4;  0.00000;  0.00000;
16:50:02;  21.1;  233.2;    6.0;    7.0;  0.00000;  0.00000;
16:50:07;  21.8;  239.4;   11.7;    9.6;  0.00000;  0.00000;
16:50:12;  21.4;  238.8;   12.7;    7.2;  0.00000;  0.00000;
16:50:17;  21.3;  232.8;   11.0;    7.9;  0.00000;  0.00000;
16:50:22;  22.1;  239.6;   16.8;    8.9;  0.00000;  0.00000;
16:50:27;  21.4;  236.6;   23.9;    7.6;  0.00000;  0.00000;
```

NOTE! Communication logs are only available if the application is started in "Debug mode"

Measurement Averaging

You can choose to make measurements on single bursts or average the results over a number of bursts up to a maximum of 200. A lower number updates the measurement more frequently. The default setting of 1 is often the optimum value.

If a higher number of bursts than 1 are selected, the power and frequency measurements are indicated with a yellow background until the selected number of bursts is obtained.

Attenuation

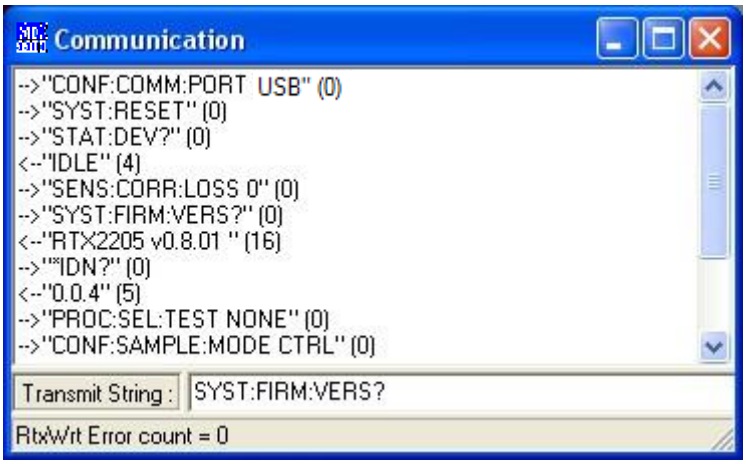
If the coupling loss at the RF IN/OUT connector is known, the value can be entered in the **Coupling Loss:** field. The test set factors the loss into the measured results and compensate for power transmitted from the Tester.

The **RX Attenuator** check box, enables an internal attenuator in the receive direction of the tester. The internal attenuation is automatically calculated into the results.

NOTE!
To avoid power saturation, this field must be checked, if the input power signal is above 0 dBm.

Communication Window

The Communication window is only displayed when you start the user interface in debug mode (**Start**, **Programs**, **RTX2201**, **RTX2201 Debug**).



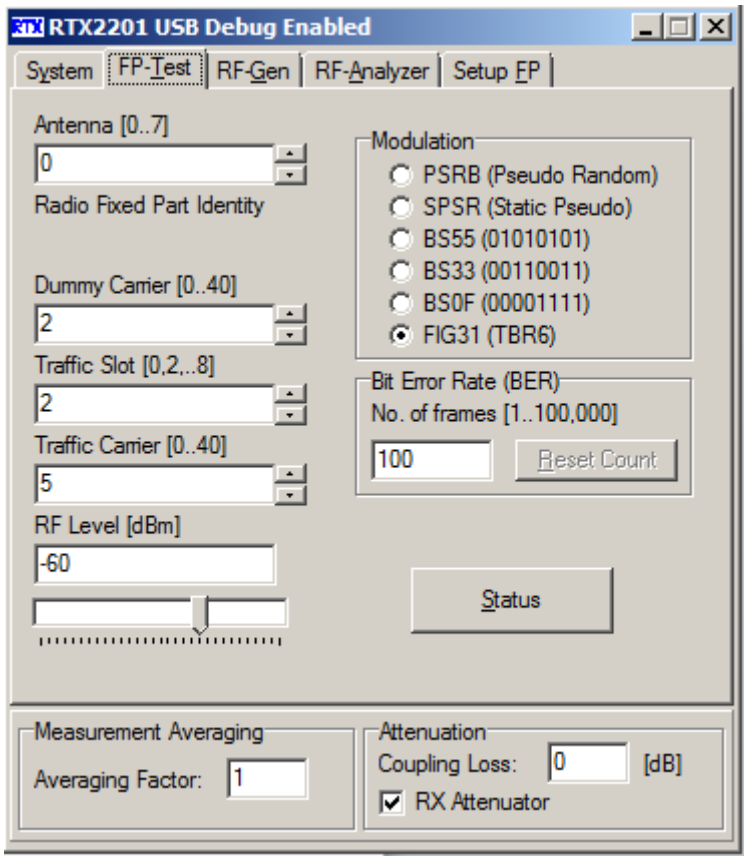
You can use this window to view and record the communication between your PC and test set, and send one command at a time in the **Transmit String** line.
For more information about this feature refer to "Detailed Command Descriptions".

System Page panel overview

Panel	Parameters	Description
Communication Port	USB	USB Port configuration
Windows Position		Places the User Interface MMI in the left top corner of the PC display, and all windows are restored back to default size and position.
Hardware	RTX2201-41-10-1333	2.4 GHz Communication Tester Tester type
Software Version		Returns the Software versions from the Tester and the MMI
Log Settings	Logging interval 5 to 999 [Sec]	Logs data in a file
Measurements Averaging	Average Factor 1 to 200	Number of frames for average measurement.
Attenuation	Coupling Loss 0 to 100 [dB]	Enter the known cable Coupling loss

Fixed Part Test Page

The FP-test Page contains the settings required for making measurements with the Tester set to act as Handset.



NOTE!
There are variations in how the settings must be, in respect to the type of hardware testing on.

Fixed Part Test Page Structure

This page contains the following panels and entry fields.

Antenna

If the DUT supports this feature, it is possible to select which antenna used for transmitting the signals. The 2.4 GHz RF Tester can handle Antenna selection 0 to 7.

Traffic Carrier

Input of the channel number of the Traffic Carrier with call setup.
The Traffic Carrier is the signal which contains the RF parameters.

RF Level

The RF power level in the tester transmit direction can be adjusted for sensitivity measurements. The power level is continuously variable from –100 to -45 dBm in 1dB increments. The power level can be entered directly in the **RF Level [dBm]** field or adjusted by moving the **RF Level** slider.

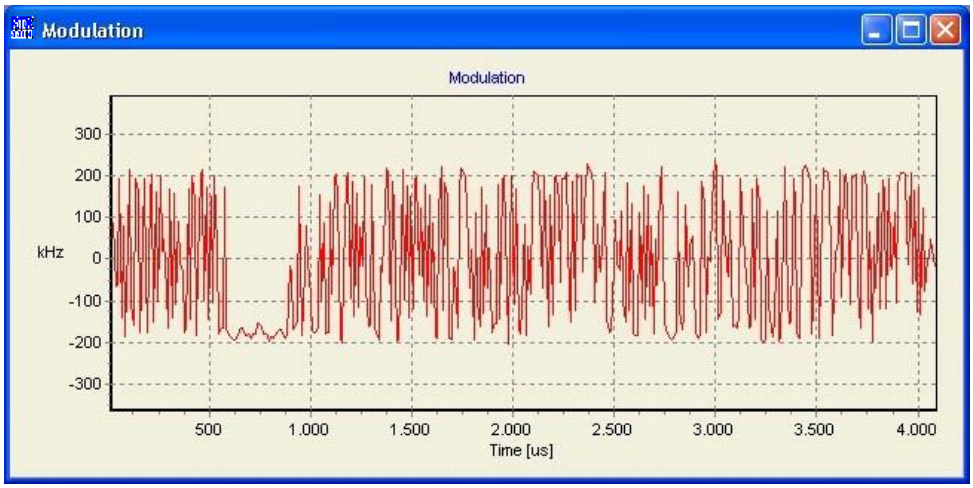
Modulation

In this panel, six different modulation patterns can be chosen.

PSRB Pseudo Random Bit sequence
SPSR Static Pseudo Random bit sequence
BS55 Alternating zeros and ones
BS33 Alternating double zeros and ones
BS0F Four times zero and one, alternating
FIG31 Test signal used for deviation and sensitivity measurements.

PSRB

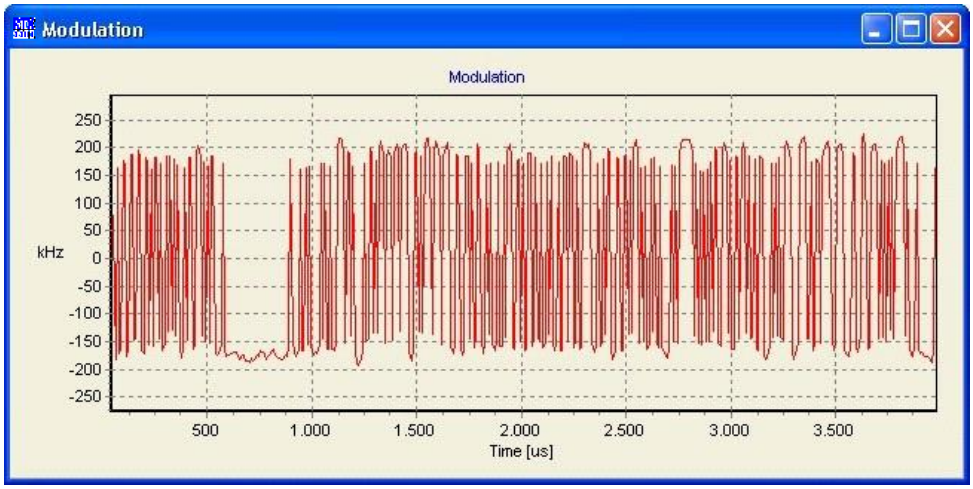
The Pseudo Random bit sequence is a haphazard modulation sequence, simulating a real transmit operation.



This modulation pattern is recommendable in sensitivity measurements.

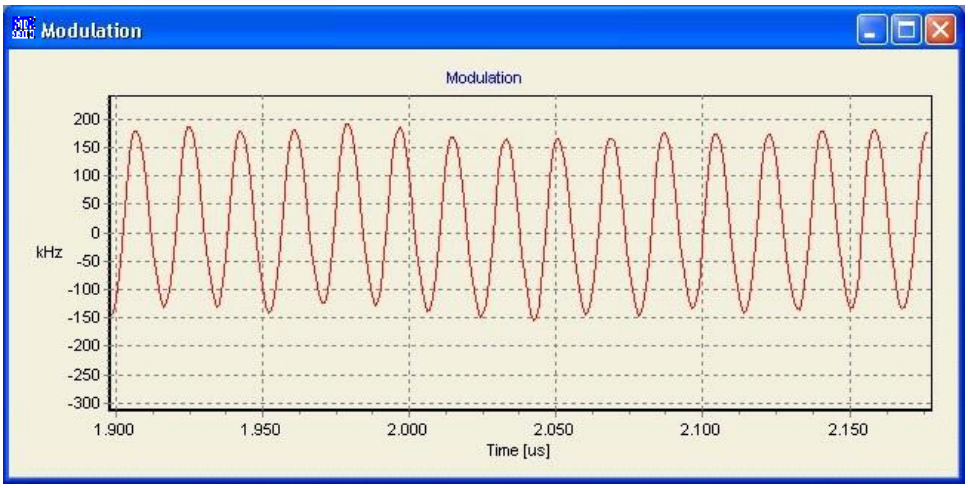
SPSR

The Static Pseudo Random bit sequence repeats the same bit pattern in every frame transmitted.



BS55

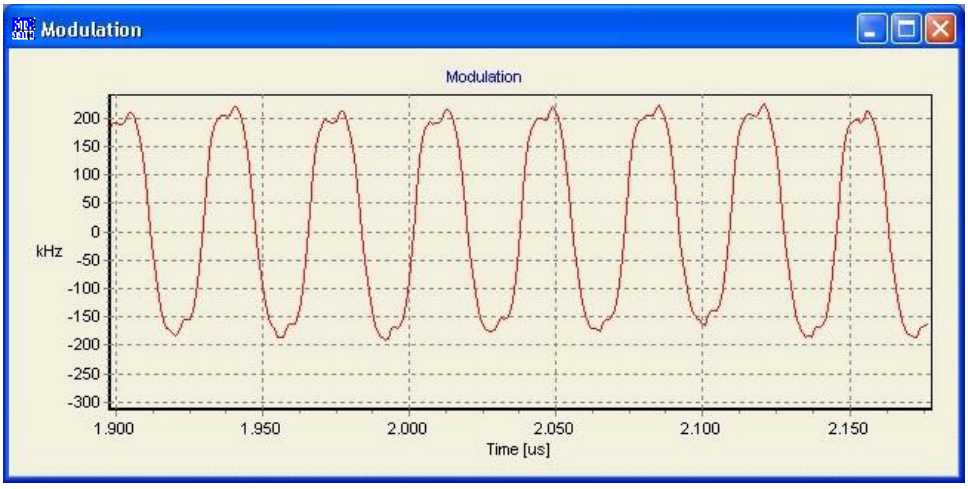
Data sequence with alternating zeros and ones.



The modulation has the smallest deviation, and preferable in frequency drift measurements.

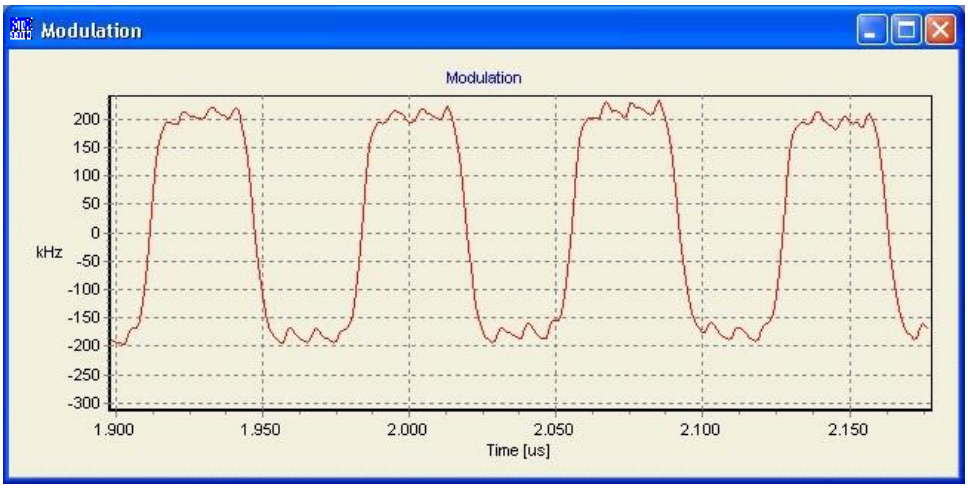
BS33

Data sequence with two times zeros and two times ones.



BS0F

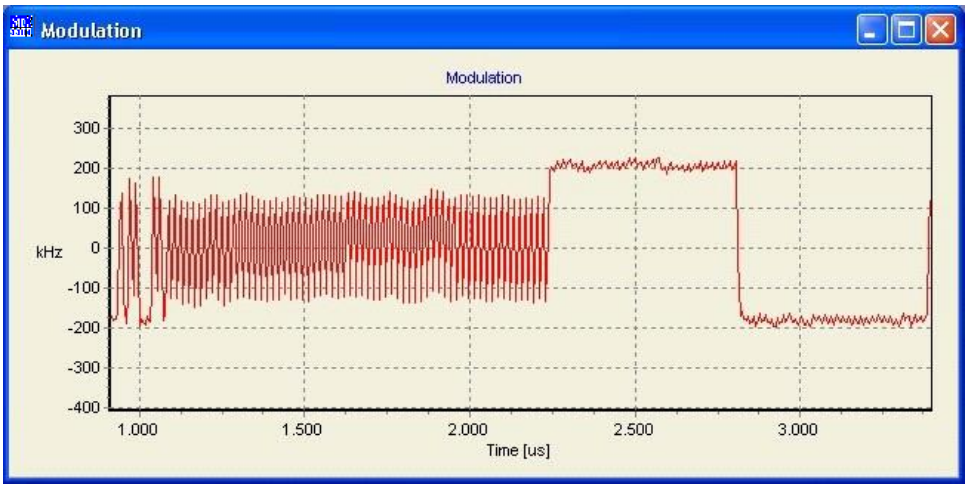
Data sequence with four times zeros and four times ones.



A modulation pattern with high deviation.

FIG31

This modulation pattern is preferable for deviation measurements, since the long sequence of zeros and ones.



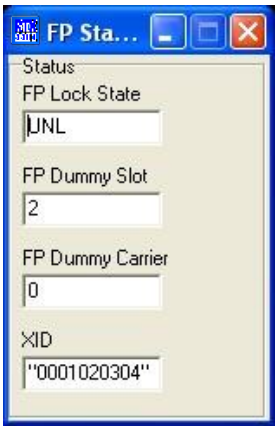
Bit Error Rate

You can enter the number of frames to be used in measuring the **Bit Error Rate** in the entry field. The valid range is 1 to 100,000 frames.
The Bit Error Rate can be seen to change rapidly with small changes in RF level.
A change from 0.01% to over 1% is possible due to a 5dB level change.

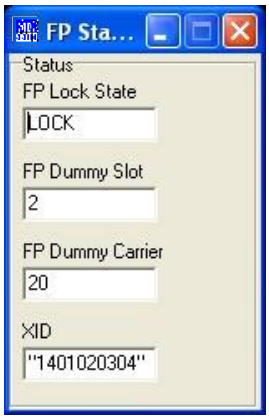
Most 2G4 Hz radios have a sensitivity level at – 80 dBm to – 95 dBm.

Status, and Connection

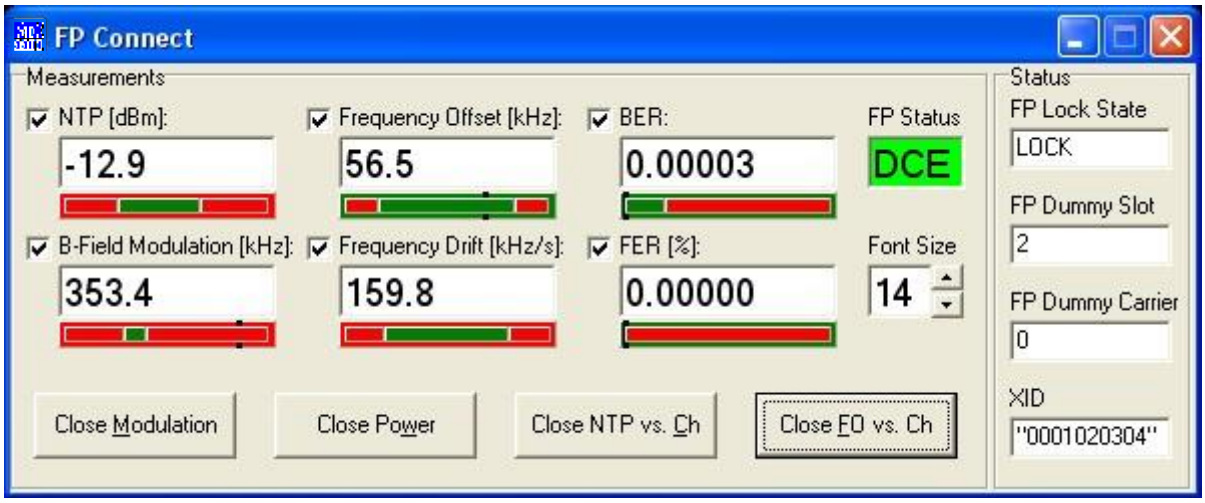
Clicking **Status** opens the FP Status window. If the DUT is set in test mode, the 2.4 GHz RF Tester can lock onto the device.



When the Tester is locked onto the DUT, the Status changes from UNL to LOCK.



Clicking **Connection** establishes a link between the Tester and the DUT, and the **FP Connect** measurement window appears.



On call connection, the **Connection** button changes to **Release**.
Clicking **Release** closes the connection.

FP Connect Window

When a connection is established, the **FP Connect** window is displayed.
The measurement results are continuously updated and shown in the display fields of this window. Associated with each result is a red/green bar with a small indicator in black, which are described in details in the section Set-up Page.

Each display field can be switch on/off by clicking the corresponding checkbox.

Font size

To view the measurements results from a greater distance you can change the displayed size of text on the **FP Connect** window.
The font size is selectable from 8 to 14. (Default is 14.).

Status

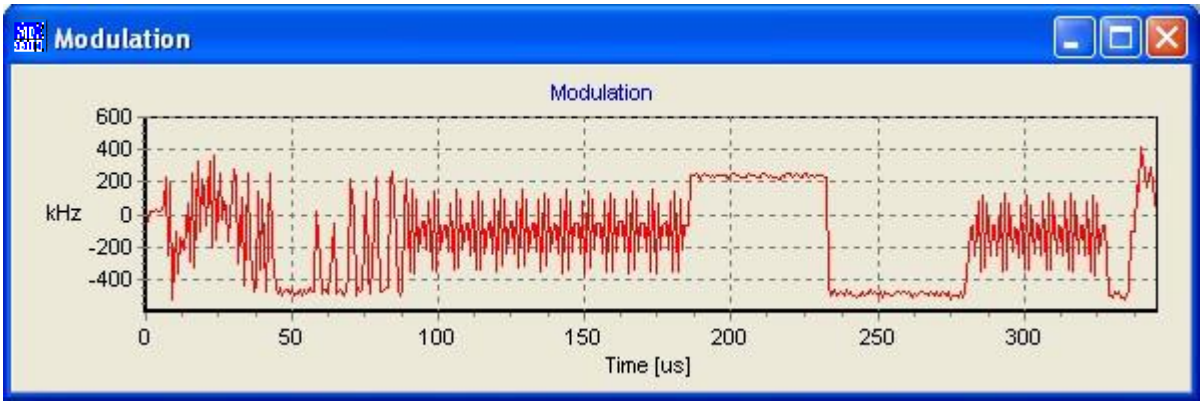
The status display line shows the state of the tester or if the connection is off. Colour coding is also used to indicate the state.

(Refer to Chapter "Programming Reference" about the SCPI states).

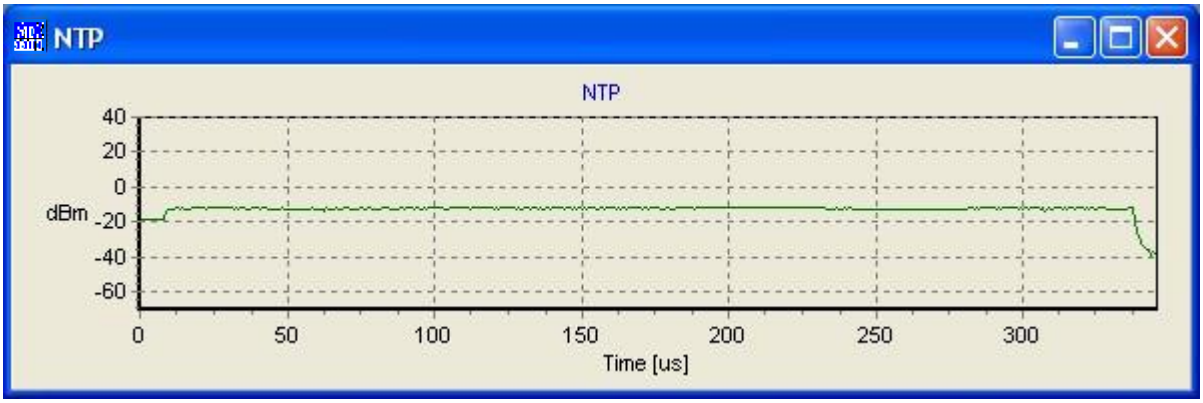
Show/Close Measurement Graphs

When a connection is established, graphs windows can be opened and/or closed. Pressing **Show Modulation**, **Show NTP**, **Show NTP vs. Ch and show FO vs. Ch** displays the graphs as shown below. When a graph is displayed, the associated button changes to **Close**.

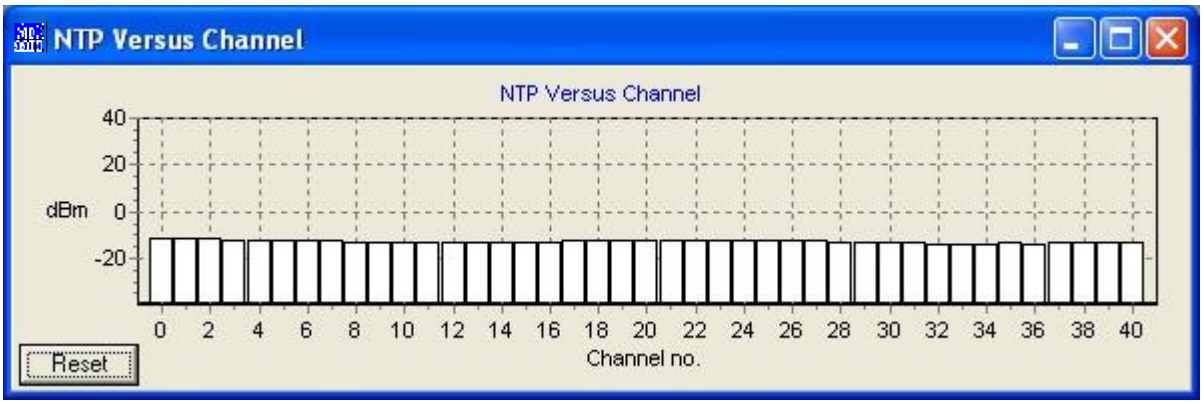
Modulation Graphs



NTP Graphs

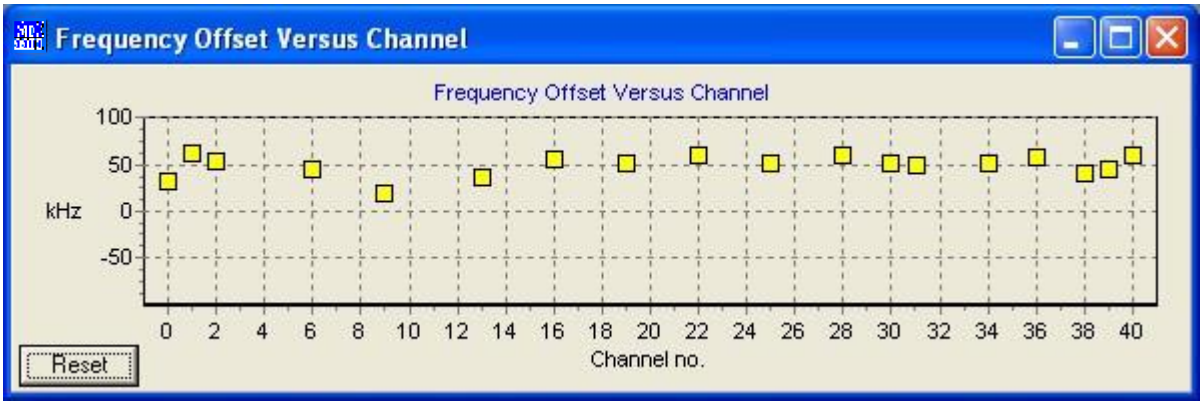


NTP versus Channel Graphs



NTP is measured for each channel. The NTP vs. Channel display can be captured even when the DUT is changing frequency. Simply chose another channel to be visited.
The Reset button erases the current measurements, and starts a new continuously data sampling.

Frequency Offset versus Channel Graphs

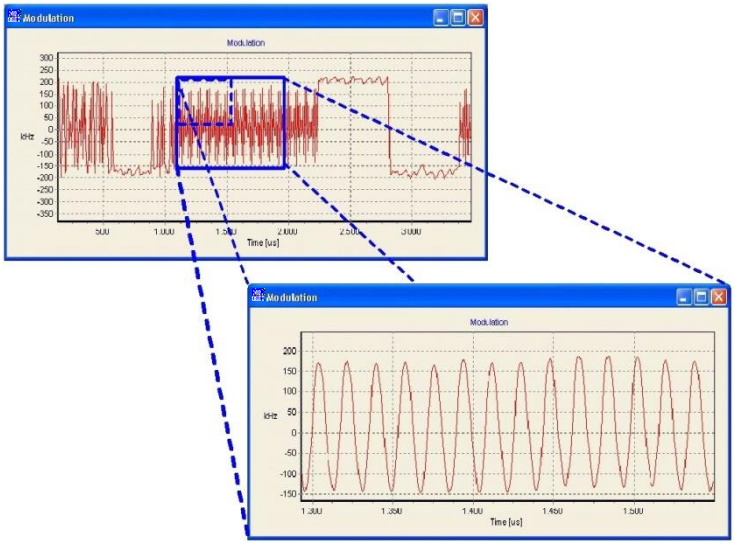


Like vice NTP measurements, Frequency Offset is measured and depicted for every channel measured.

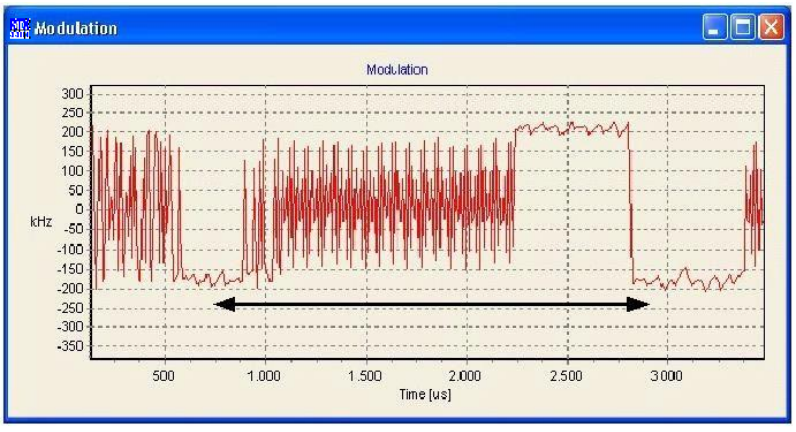
Zoom functions in the graphs windows

You can zoom in and out on the four graph windows by left clicking and dragging the mouse.

Begin in the upper left corner of the graph. Left click and drag a rectangle to the lower right and release the mouse button.



Now right click in the display and slide the graph to view the area of interest.



NOTE!
Only a small amount of the available data is used to generate the graphical displays.
The displays should be regarded only as a close approximation.
When maximum zoom is reached, all sampled data is shown.

RF Measurements Parameters

The following parameters are displayed in the **FP Connect** window during Test:

- **NTP**
- **B-Field Modulation**
- **Frequency Offset**
- **Frequency Drift**
- **BER**
- **FER**

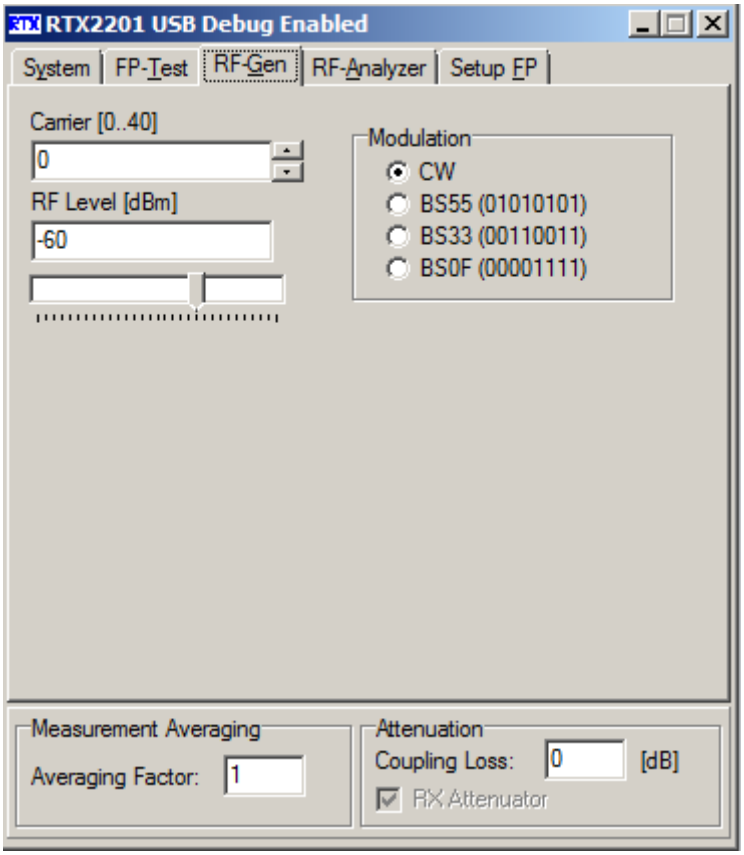
Refer to the section “Making measurements”, for further information.

Fixed Part Page Panel Overview

Panel	Parameters	Description
Antenna	0 to 7	Selection of Antenna used for signaling
Traffic Carrier	0 to 40	Channel number. The highest channel number differs in respect to the type of hardware used.
RF Level	-100 to -45 [dBm]	Entry field or slider controlled. The RF lever is to be changed on the fly, during measurements.
Modulation	PSRB, SPSR, BS55, BS33, BS0F, FIG31	Select the modulation pattern for measurements.
Bit Error Rate	1 to 100.000	Selects the number of frames for BER measurements
Status/Connect		Lock onto DUT Call up or closes connection.

RF Generator Page

The **RF-Gen** (RF-Generator) page is used to generate RF signals from the tester on a selected channel within the 2.4 GHz radio band. It can be useful to check a DUT that cannot establish a link or to calibrate a parameter such as Receive Signal Strength Indication (RSSI).



RF Generator Page Structure

This page contains the following panels and entry fields.

Carrier

The carrier frequency can be chosen, by selecting one of the 41, channels on the ISM band.

RF- Level

The RF power level in the tester transmit direction can be adjusted for sensitivity measurements.
The power levels can be adjusted from –100 to -45 dBm.
The power level can be entered directly in the **RF Level [dBm]** field or adjusted by moving the **RF Level** slider.

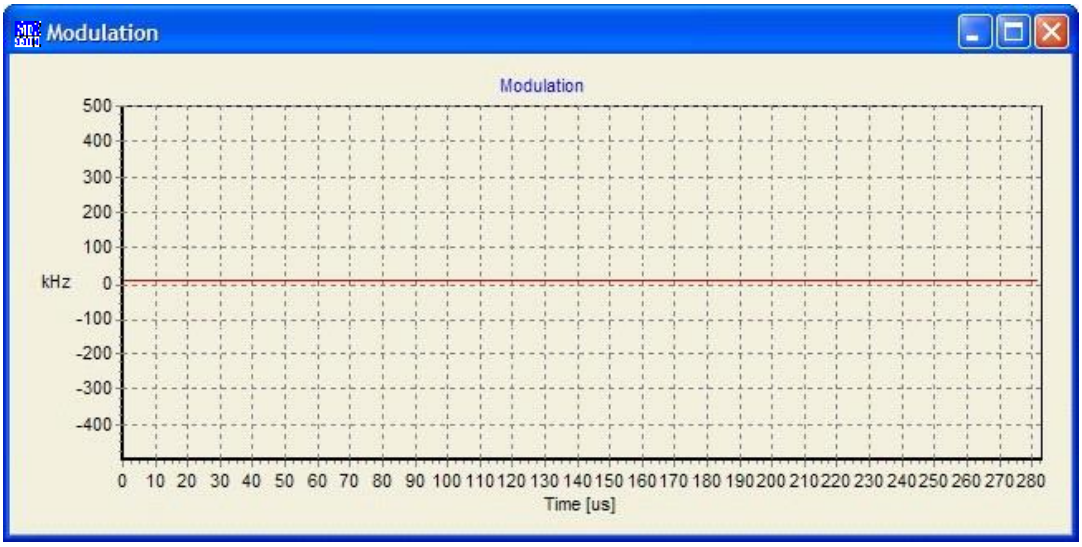
Modulation

Four modulation patterns are available (**CW**, **BS55**, **BS33**, and **BS0F**).
The modulation patterns for BS55, BS33 and BS0F are shown in the section describing Fixed Part Testing.

CW

Continuous Waves modulation is an unvarying carrier signal, transmitted at the selected channel frequency.

The CW signal can be useful adjusting frequency settings.

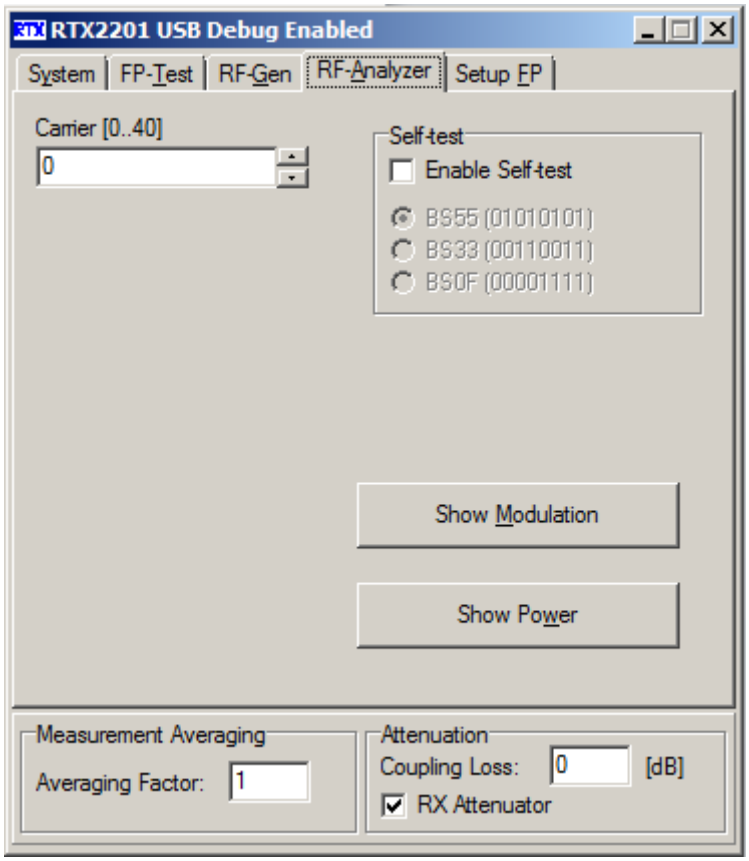


RF Generator Page Panel Overview

Panel	Parameters	Description
Carrier	0 to 40	Channel number.
RF Level	-100 to -45 [dBm]	Entry field or slider controlled. The RF lever is to be changed on the fly, during measurements.
Modulation	CW, BS55, BS33, BS0F	Select the modulation pattern for measurements.

RF Analyzer Page

The **RF-Analyzer** page can make RF measurements on the DUT without first establishing an RF connection.



RF-Analyzer Page structure

The **RF-Analyzer** page contains the following panels and entry fields:

Carrier

The carrier frequency can be chosen, by selecting one of 41 (Channel 0 – 40) on the ISM band.

NOTE!
It is important that the selected channel is identical with DUT transmitted frequency.

Self-test

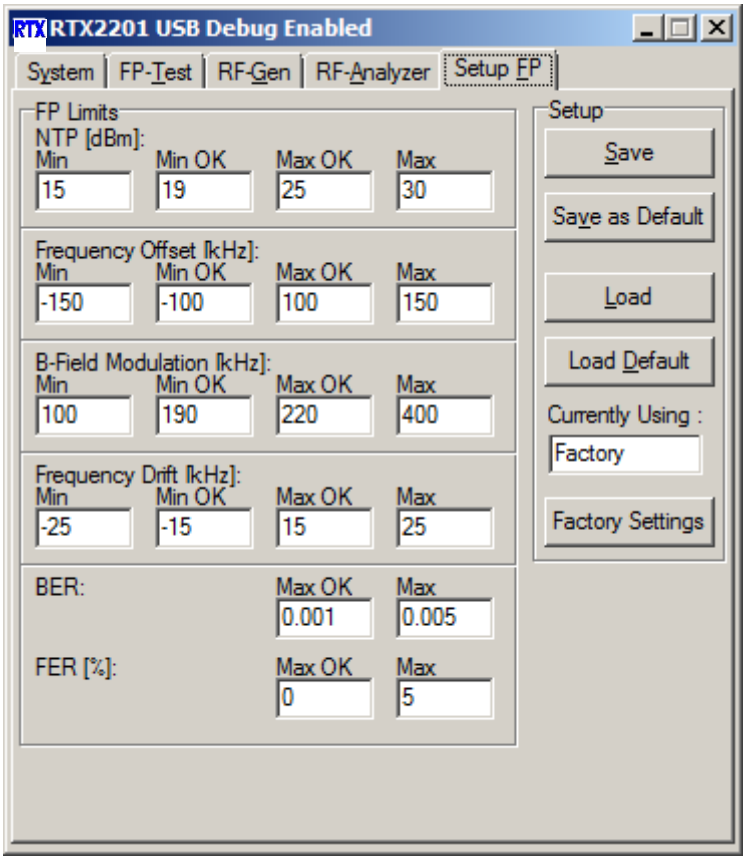
With the self-test mode enabled, the chosen modulation pattern is shown.
This is use full in diagnostics and confidence tests.

RF Analyzer Page Panel Overview

Panel	Parameters	Description
Carrier	0 to 40	Channel number. The channel must match the DUT transmitted frequency.
Self-test	Checkbox BS55, BS33, BS0F	Modulation pattern in self-test mode.
Show Modulation		Opens the Modulation graph.
Show NTP		Opens the NTP graph.

Setup Fixed Part Page

The **Setup FP** page provides a limits matrix where you can enter pass and fail values for the measurement parameters. You can quickly configure parameters using the Save/Load function to setup previously saved settings.
The data entered in this page is used to specify the scale of the red/green bar indicators on the **FP Connect** windows.



FP Setup Page structure

The **FP Setup** page contains the following panels and entry fields:

Limits

You can use the entry fields to enter and display the required limits.
The parameters and default values are as follows:

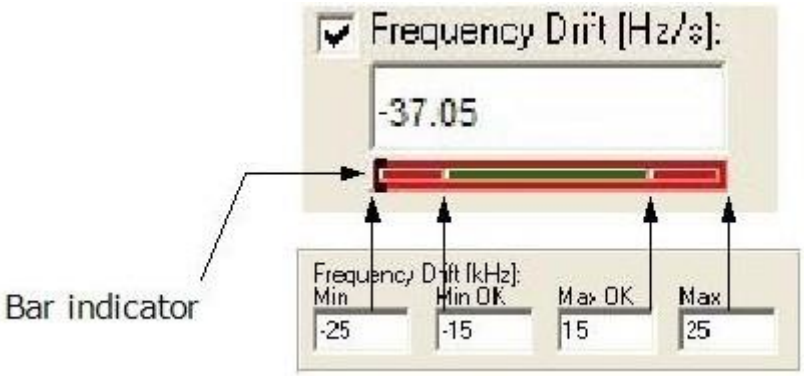
Entry fields	Default settings			
	Min	Min Ok	Max Ok	Max
• NTP	15	19	25	30
• Frequency Offset	-150	-100	100	150
• B-Field Modulation	100	190	220	400
• Frequency Drift	-25	-15	15	25
• BER			0.001	0.005
• FER (%)			0	5

How the Limits are used

Four limits are required for each parameter. **Min**, **Min OK**, **Max OK**, and **Max** are used to scale the red/green bars for each of the associated parameters on the **FP Connect** windows.

– **Min** and **Max** limits set the end points of the bar.
– **Min OK** and **Max OK** limits set the position and size of the green 'OK' or 'Pass' section.
– Sections of the bar between the **Min OK** and **Max OK** regions are colored red to indicate a 'Fail'.

– The measurement result is shown numerically in the display field.
It is also indicated along the length of the bar by a marker.
– The background area is red when the result is outside the 'OK' limits and changes to green when within the 'OK' limits.



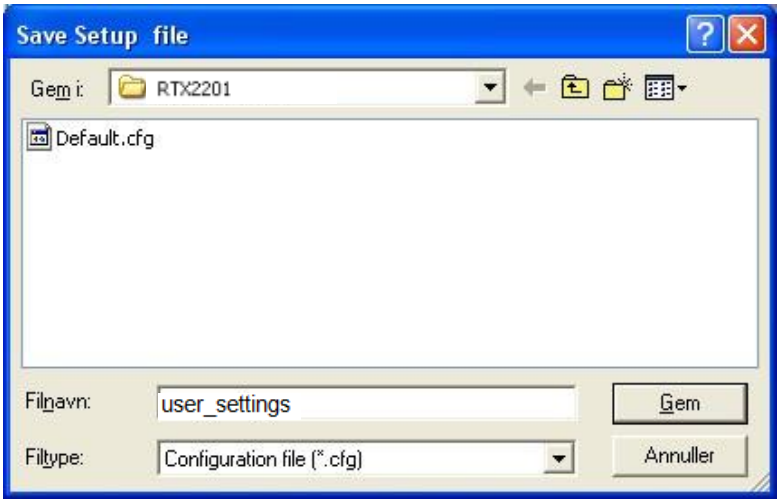
Setup

Setup files provide a convenient and quick method of changing the values in the **Limits** fields.
All the values you have entered in the **Limits** fields can be saved in a setup file (.cfg file extension).

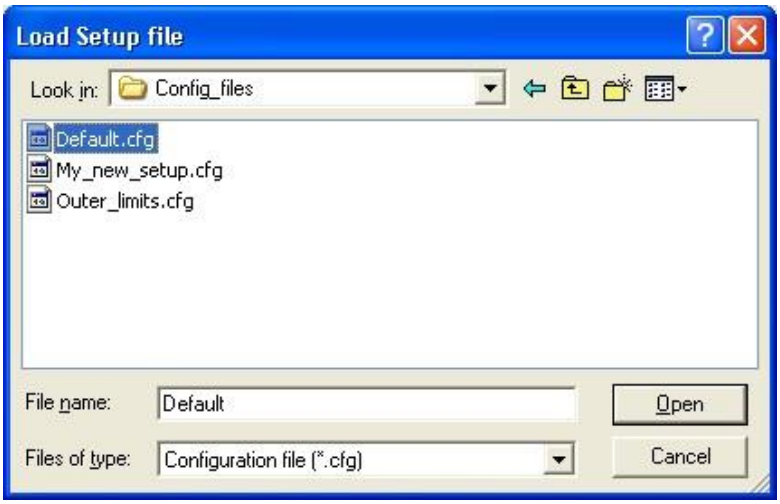
A setup file can be loaded again to reconfigure the limits to the required values.
The name of the set-up file in use is displayed in the **Currently Using:** display line.

Saving and loading Setup files

Clicking **Save** opens a dialog window where you can choose the file and path name to create a setup file of the current values.
Save these in a folder other than the tester application folder to prevent them being lost if the application folder is uninstalled or removed.



Clicking **Load** opens a dialog window for you to choose the required file.



You can save the current set of **Limits** as the default configuration by clicking **Save as Default**.
The current configuration is saved in a file as default.cfg. To restore the Limits to your chosen default configuration click **Load Default**. In addition, you can return all the settings to the factory default values by pressing **Factory Settings**.

Making Measurements

Getting Started

Confirm all the required connections have been made between your PC and the tester. Connect the tester to the DUT using an RF cable.

NOTE!
To maintain regulatory compliance, antenna connection to the DUT must be carried out within a screened environment. Also, an antenna connection can introduce significant errors.
If the DUT transmits high power (above 0 dBm), the RF attenuator must be enabled.

On the Windows Interface

Double click the RTX2201 Tester icon on your PC desktop.

Click the **System** tab:

- Confirm the Software Versions are matching.
- Select **Log Measurements** or/and **Log Communication**, if required.
- Type in the known cable Coupling Loss.

FP Test

To configure a 2.4 GHz Test Mode connection with a Portable DUT
click the **FP-Test** tab:

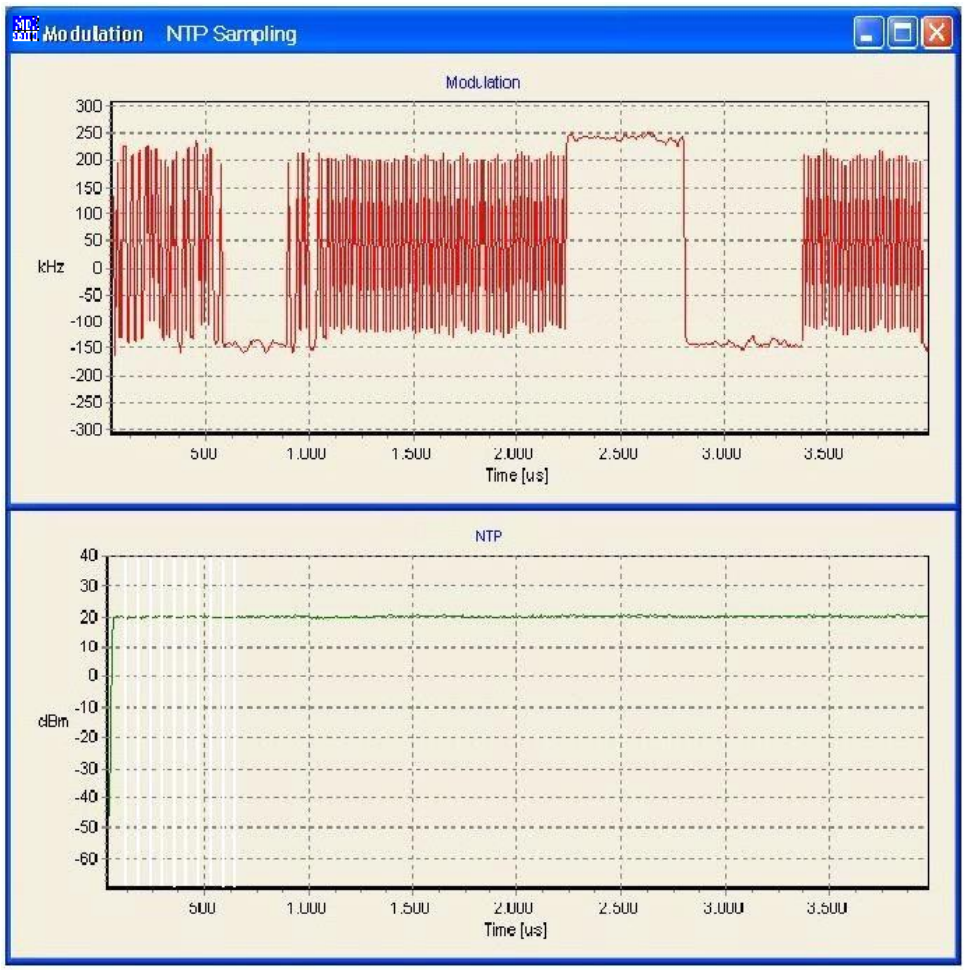
- Select the required antenna used.
- Select Traffic Carrier
- Select the tester RF Level output**.**
- Select the required Modulation pattern.
- Use the controls supplied for the DUT to ensure that it is setup to make a test mode connection.
- Click **Status/Connect** to make an RF connection in Test Mode.

Power Measurements

NTP Power of the DUT can be measured in FP- Test connections.

Normal Transmit Power (NTP)

With a Test Mode connection, average power is measured by sampling the power value at twenty bits over the synch word part of the burst.
The Power measurements are valid with using any modulation pattern (e.g. BS55 – SPSR).



NTP measurements window

NOTE!
The depicted readings is above the max limits, see Setup Page structure on page 60.

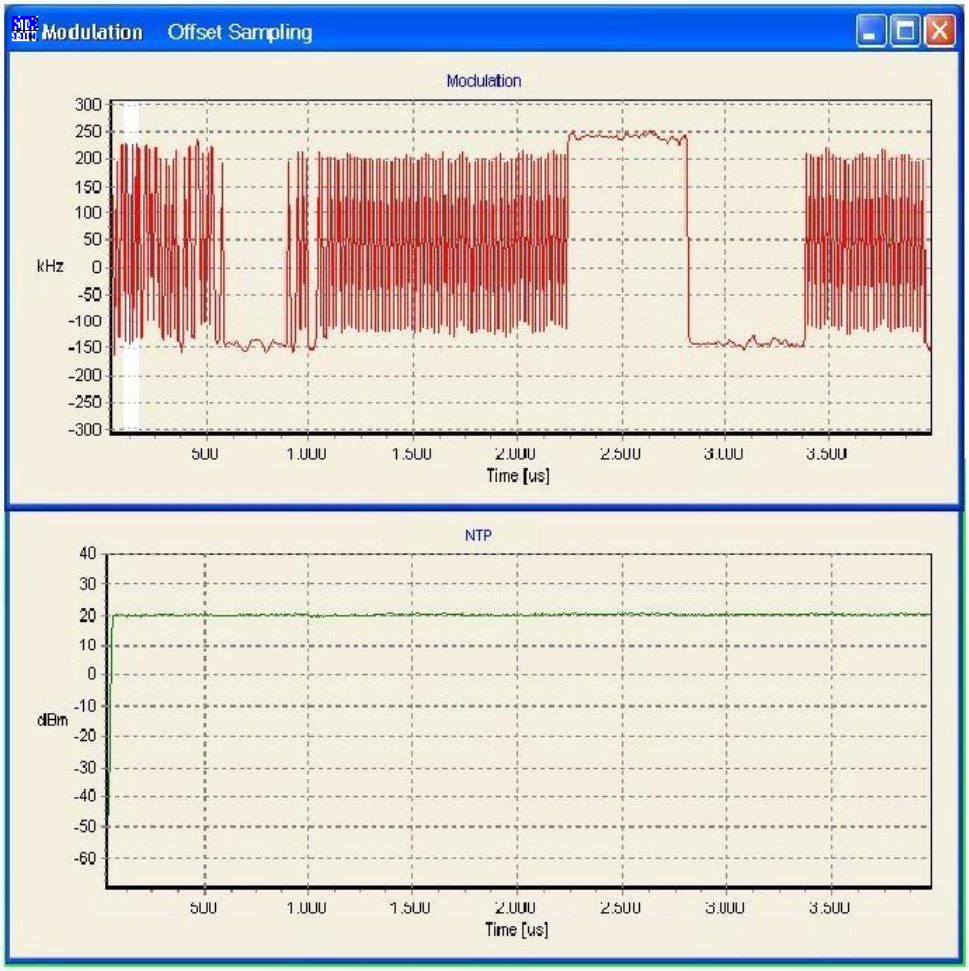
Remote Commands: The Power values can be read out by sending the remote command: **READ:NTP?** Measures NTP.

For more details, refer to the section describing Remote Commands.

Frequency and Modulation Measurements

Frequency Offset Measurements

Frequency Offset measurements is carried out by identifying the preamble part of the burst. Four bits in the preamble is sampled an average value gives the Frequency Offset value.
The Frequency Offset measurement is valid using any of the six different modulation pattern.



Frequency Offset measurements window

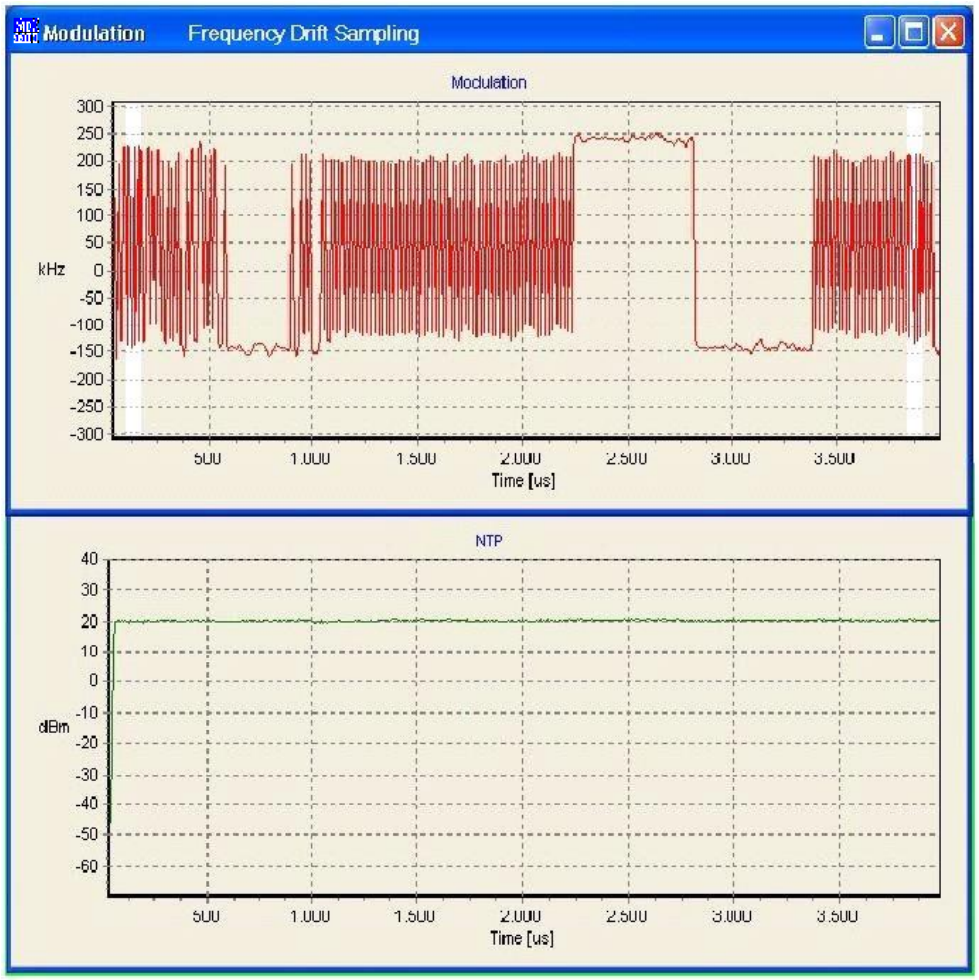
The Frequency Offset value can be read out by using the SCPI command:
READ:FREQ:OFFS?

For more details, refer to the section describing Remote Commands.

Frequency Drift Measurements

The Frequency drift measurement is carried out, by sampling four alternating bits in the preamble (as in the Frequency Offset measurement), and four alternating bits in the end of the B-field modulation part. The individual samples are then averaged and the "worst case" difference of the two sample parts gives the Frequency Drift measurement.

Only BS55 and FIG31 modulation pattern is valid during Frequency Drift measurements.



Frequency Drift measurements window

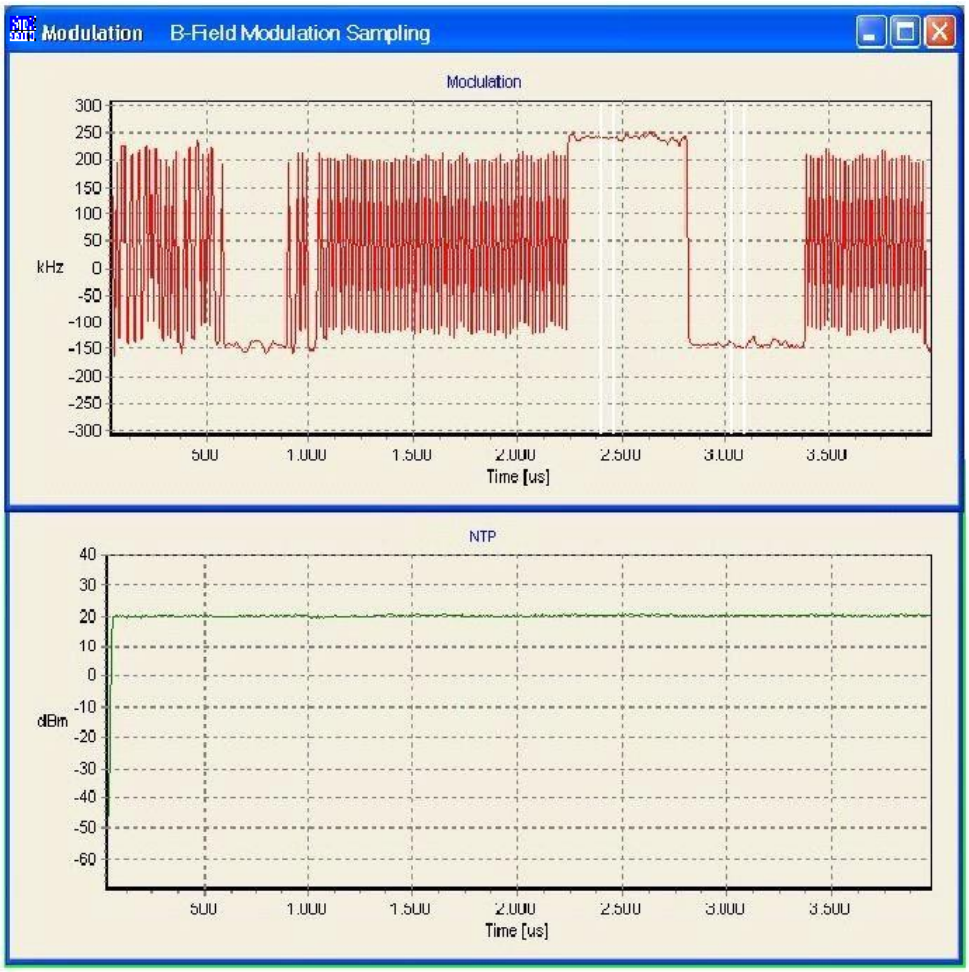
The Frequency Drift measurement can be read out by sending the remote SCPI command: **READ:FREQ:DRIF?**

For more details, refer to the section describing Remote Commands.

B-Field Modulation Measurements

Finding the highest deviation in the ones/zeros part of the modulation pattern FIG31 carries out the B-Field Modulation measurement.

Only the modulation pattern FIG31 can be used, since this is the modulation with the highest deviation.



B-Field Modulation Measurements window

Note!
The measured values is out limits, see Setup Page structure on page 60.

The B-Field Modulation measurement can be read out by sending the remote SCPI command: **READ:BF?**

For more details, refer to the section describing Remote Commands.

Sensitivity Measurements

The sensitivity of the Device Under Test is determined using a BER (Bit Error Rate) or FER (Frame Error Rate) measurements.
The received bits are compared with the bits transmitted in a loop back setup, and the detected bits faulty compared to the number of all bits transmitted gives the BER.
If at least 25% of all bits in a frame are detected to by faulty, they are not considered in the BER, but in the Frame Error Rate, which is the ratio of faulty frames compared to all transmitted frames.

Bit Error Rate and Frame Error Rate

BER sensitivity measurements, is carried out by examining every bit in the pre- selected number of frames.
One frame consists of 328 bits.
The default value of BER readings is 100 frames, corresponding to 32800 bits.

The modulation pattern used is PSRB or SPSR, which is nearby a real communication link.

Bit Error Rate and Frame Error Rate measurements window

The Bit Error Rate can be read out by using the SCPI command:

CONF:EVAL:WIND [Parameter]

READ:BER?

Using the SCPI command in a command string returns both the BER and FER, as shown below:

<-- 0.000100000,0.005000000

The first 10 digits is the BER result measured in number of faulty bits encountered.
The next 10 digits, separated by a comma, is the FER result in percent.

The BER/FER counts can be reset by sending the SCPI command:

PROC:STRT:BER

For more details, refer to the section describing Remote Commands.

DLL Interfacing

Introduction

The purpose of this chapter is to help you develop your own production test applications in the test executive you intend to use. In order to successfully control the RTX2201 2.4 GHz Communication Tester using the SCPI command set, you must first understand how to link to the supplied RTX2201 Dynamic Link Library (DLL).
Once this is understood, consult the Programming Reference on page 85 for information on the functionality provided by the DLL.

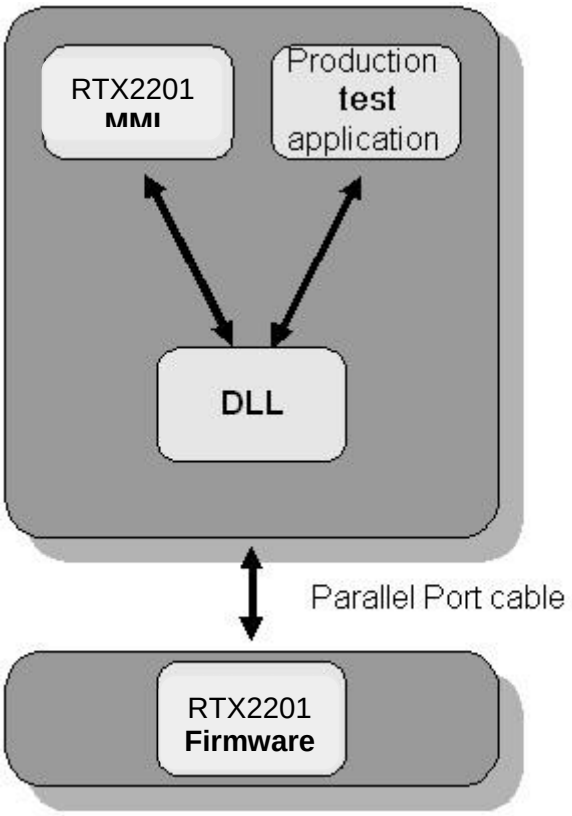
Microsoft Windows provides ways to use dynamic link libraries and various programming/compiler tools adopt slightly different approaches to DLL linking.
In this section the most common ways to perform DLL linking using Windows WIN32 C++ API are described.
Minor adaptations may be necessary when other programming tools are used.

Terms Used

DLL: Windows Dynamic Link Library
API: Application Program Interface

DLL Interface

The USB port is used to communicate with the RTX2201 2.4 GHz Communication Tester. The commands required for parallel port operation are primitive, involving the use of 'peek' and 'poke' commands to transfer data and functions. The Dynamic Link Library (DLL) acts as a translator between the SCPI commands and the parallel interface commands.
An overview of the DLL Interface function is shown below.
The DLL is available for use by your own test application as shown in the section Calling Convention.



Calling Convention

Different programming languages and compilers use different approaches when performing subroutine calls. The methods used to store parameters, return addresses, and so on, on the stack vary. This is called *the calling convention.*
Since the Application may not have been created in the same programming language as the DLL, it becomes necessary to know the calling convention to use when DLL functions are called.
The calling convention used by the RTX2201 Tester DLL is the **__stdcall**.
When C++ is used as the Application Programming language, the calling convention is explicitly specified by the **__stdcall** keyword in the interface header file cmd_2201.h.

DLL Filename and Location

cmd_2201.dll

Windows NT/98/2000/2003 server/ C:\Winnt\system32

Windows XP: C:\WINDOWS\system32

Win 7: C:\Program Files (x86)\RTX\RTX2201

General Format

The general command format is:

RtxWrt(command-string)

A query can be performed using the format:

RtxWrt(query-string?) followed by a RtxRd(result-string)

NOTE!
RtxWrt is a function call to the DLL.

The command consists of a sequence of abbreviations for some words.
It is only necessary to enter the upper-case part of the words.
All commands are structured in a way analogous to the SCPI description.
The upper-case letters indicate the short form of the command.
The RTX2201 Tester only accepts this short form as an abbreviation (according to SCPI), otherwise the long form is used.

Explicit DLL Linking

With *Explicit Linking,* the Application only requires the interface header file R2201dll.h and the DLL itself. All DLL linking is done explicitly by the application program. Using this approach you must first load the DLL module using the WIN API function:

• LoadLibrary(DLL filename)

Thereafter you must retrieve the addresses for each DLL function explicitly.
• functionPtr = GetProcAddress(DllHandle, function name)

An example is shown below:

```
//------------------------------------------------------------
// Microsoft Visual C++ 6.0 Win32 Console Demo Application
// demonstrating how to use the dll-interface of the RTX2201.
//
// RTX Products, 2002
//------------------------------------------------------------
/
*****************************************************************
* Include files
*****************************************************************
/
#define RTX2201_VARS // Tells the R2201dll.h that we want to
// declare the Dll interface functions as
// function-pointers, which are then loaded
// explicitly.
#include "cmd_2201dll.h"
#include "Win32Err.h"
#include "stdio.h"
/*****************************************************************
* Macro definitions
*****************************************************************
/
#define RTX2201_DLL_NAME " cmd_2201.dll"
#define LOADFUNC(fname) \
fname = GetProcAddress(DllHandle, #fname); \
if (fname == NULL) \
{ \
ShowWin32Error(#fname " not found in " RTX2201_DLL_NAME); \
return FALSE; \
}
/
*****************************************************************
* Enumerations/Type definitions/Structs
```

```
/
*****************************************************************
* Global variables/const
*****************************************************************
/
/
*****************************************************************
* Local variables/const
*****************************************************************
/
static HINSTANCE DllHandle;
char ScpiStr[200];
char ResponseStr[200]
/
*****************************************************************
* Local Function prototypes
*****************************************************************
/
/
*****************************************************************
* Implementation
*****************************************************************
/
/
*****************************************************************
* DESCRIPTION:
*****************************************************************
/
boolean LoadDll(void)
{
// First load the DLL library
if (DllHandle == NULL)
{
DllHandle = LoadLibrary(RTX2201_DLL_NAME);
if (DllHandle == NULL)
DllHandle = LoadLibrary("." RTX2201_DLL_NAME);
if (DllHandle == NULL)
{
ShowWin32Error(RTX2201_DLL_NAME);
return FALSE;
}
// Then setup function pointers.
#ifdef __BORLANDC__
#pragma warn -8075
// Avoid Borland warning
#endif
#pragma warning( disable : 4057) // Avoid Microsoft VC warning
#pragma warning( disable : 4133) // Avoid Microsoft VC warning
#pragma warning( disable : 4113) // Avoid Microsoft VC warning
LOADFUNC(RtxWrt);
LOADFUNC(RtxRd);}
return TRUE;
}
/
```

```
*****************************************************************
* DESCRIPTION:
*****************************************************************
/
void UnloadDll(void)
{
if (DllHandle != NULL)
{
FreeLibrary(DllHandle);
DllHandle = NULL;
}
}
// End of file.
/
*****************************************************************
* DESCRIPTION:
*****************************************************************
/
void SendScpiCommand(char* ScpiStr)
{
uint16 Errors;
// Send SCPI command
printf("SCPI command : %s",ScpiStr);
Errors = RtxWrt((far int8 *)ScpiStr);
printf("\nSCPI Errors detected: %d",Errors);
// Read the response
RtxRd((int8 *)ResponseStr);
printf("\nSCPI response : %s\n\n",ResponseStr);
}
/
*****************************************************************
* DESCRIPTION:
*****************************************************************
/
int main(int argc, char *argv[])
{
printf("\nRTX Products, 2002\n");
printf("\nMicrosoft Visual C++ 6.0 Win32 Console Demo
Application.");
printf("\nDemonstrating how to use the dll-interface of the
RTX2201.\n\n");
if(LoadDll())
{
// Demonstrate different SCPI commands
SendScpiCommand("SYST:PC:VERS?");
SendScpiCommand("SYST:FIRM:VERS?");
SendScpiCommand("STAT:DEV?");
}
return 0;
}
```

Implicit DLL Linking

With *Implicit Linking* the Application requires the interface header file cmd_2201.h **plus** the cmd_2201.lib file (and the DLL itself).
The DLL linking is now done implicitly by the compiler used for creating the Application program.
The compiler will recognize this because of the keyword **__declspec(dllimport)** specified in the interface header file. The information needed for the compiler to perform this linking is included in the .lib file. The lib file shall therefore be included in the source file list of the Application project.
Unfortunately there seems to be compiler differences between .lib formats.
Therefore it is recommended to use the implicit DLL linking method only with Borland compilers.

In other cases (e.g. Microsoft), the explicit DLL linking method is recommended.

Agilent Vee Pro DLL Linking

When using the DLL with an Agilent Vee Pro Application it is necessary to use a special interface header file.

The Agilent Vee Pro cannot interpret the conditional compiler directives within cmd_2201.h.
The special interface header file, is therefore basically a stripped down version of the cmd_2201.h file.

Programming Reference

Introduction

The RTX2201 Communication Tester is equipped with a USB interface as the communication path, between a PC and the Tester.

The Tester supports the standard commands (SCPI Commands) according to the IEEE 488.2 standard.

This Chapter lists and describes the SCPI command set.

It contains these sections:

- Introduction to the SCPI language
- Detailed Command Descriptions

– CONFigure Subsystem
– PROCedure Subsystem
– READ Subsystem
– STATus Subsystem
– SYSTem Subsystem

- Example Program

Introduction to the SCPI language

The SCPI (standard commands for programmable instruments) command language is recommended when you want to use the test set in high throughput manufacturing environments where the PC user interface is not suitable.

The SCPI commands used with the test set is similar in structure to the SCPI commands used with other test instruments.
The SCPI language for the test set comprises three levels set up in a hierarchy.

Example:
CONF First level
:TEST Second level
:TYPE < > Third level

The commands should be placed in the corresponding way in accordance with the three command levels.
The condition of many of the commands can be queried by adding a '?' to the end of the string.

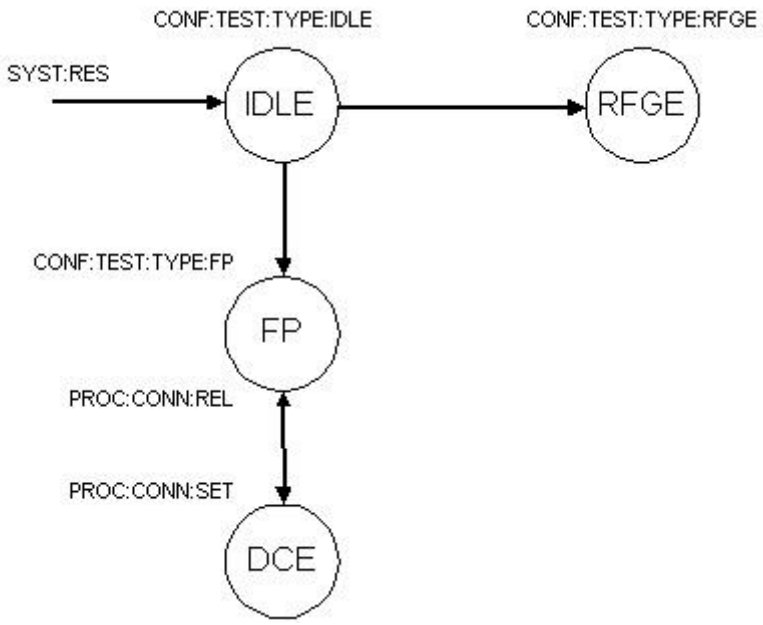
Example:

CONF:TEST:TYPE ?

returns IDLE, DCE, DFP or RFGE.

System States

The tester has 4 states. The remote command set and the PC interface are used to change the state according to the required task.
IDLE for example, is the state immediately after power-on or system reset.
The FP (Fixed Part) is the state required for establish a connection to a Fixed Part (Base Station).
When a connection is established, the Tester changes to DCE state.
The RFGE state is used for other measurements such as power level.



*IDN?
CONF:ATT:RX <value>
CONF:AVER:BURS <numeric value>
CONF:BER:DATA <value>
CONF:BER:EVAL:WIND <numeric value>
CONF:COMM:PORT
CONF:FP:ANT <numeric value>
CONF:FP:RF:LEV <numeric value>
CONF:FP:TRAF:CARR <numeric value>
CONF:RFGE:CARR <value>
CONF:RFGE:MOD <value>
CONF:SAMP:CONT
CONF:SAMP:MODE <setting>
CONF:TEST:RFGE <channel>
CONF:TEST:TYPE <value>
PROC:CONN:REL
PROC:CONN:SET
PROC:FO:CHAN:INIT
PROC:NTP:CHAN:INIT
PROC:SAMP:FORC
PROC:SEL:TEST <value>
PROC:STRT:BER
READ:BER:LTER?
READ:BER?
READ:BF?
READ:FO:CHAN? <chan no.>
READ:FREQ:DRIF?
READ:FREQ:OFFS?
READ:NTP:CHAN? <chan no.>
READ:NTP?
SENS:CORR:LOSS <numeric value>
SENS:SIGN:STAT?
STAT:DEV?
SYST:ERR?
SYST:FIRM:VERS?
SYST:HW:VERS?
SYST:RESET

Detailed Command Descriptions

The following section lists the available commands and parameters in the individual states.
Default Values are the values configured when the test set is reset.

Common commands

System Reset

Syntax:	SYST:RESET	
Value Range:		Default: N/A
State:	Set: All Query: N/A	
Description:		
Example:	"SYST:RESET"	

Set System Communication Port

Syntax:	CONF:COMM:PORT <value>	
Values:	USB [port address (4 hex digits)]	Default: USB
State:	Set: All Query: All	
Description:	This command is used for configuring the communication port on the PC. If used as query it will return the current port address. ***Please note that the RTX2201 only supports USB as PC interface***.	

Query status

Syntax:	STAT:DEV?	
Value Range:	OFF IDLE DFP DCE RFGE	Default: N/A
State:	Set: N/A Query: All	
Description:	After a reset or at power-on the state is OFF until the system has initialized properly.	
Example:	"STAT:DEV?"	

Query firmware version

Syntax:	SYST:FIRM:VERS?	
Value Range:	String containing firmware information	Default: N/A
State:	Set: N/A Query: All	
Description:		
Example:	SYST:FIRM:VERS?	

Query PC-DLL Software version

Syntax:	*IDN?	
Value Range:	String containing PC-DLL Software Version	Default: N/A
State:	Set: N/A Query: All	
Description:		
Example:	"*IDN?"	

Query Hardware type

Syntax:	SYST:HW:VERS?	
Value Range:	String containing tester hardware type information	Default: N/A
State:	Set: N/A Query: All	
Description:		
Example:	SYST:HW:VERS?	

Query Last error

Syntax:	SYST:ERR?	
Value Range:	Returns last error string.	Default: N/A
State:	Set: N/A Query: All	
Description:		
Example:	"SYST:ERR?"	

RF Attenuator switch

Syntax:	CONF:ATT:RX <value>		
Value Range:	ON OFF		Default Value: ON
State:	Set: All Query: All		
Description:	This command set the RF attenuator in the RX direction, allowing a higher level input.		
Example:	"CONF:ATT:RX ON"		

External attenuation at RF In/Out

Syntax:	SENS:CORR:LOSS <numeric value>	
Value Range:	0..100 (unit: dB) Possible to input values with a resolution of 0.1dB	Default: 0
State:	Set: All Query: All	
Description:	Sets the value of the RF cable loss, to compensate for power in TX/RX direction.	
Example:	"SENS:CORR:LOSS 6.5"	

Configure Sample Mode

Syntax:	CONF:SAMP:MODE <setting>		
Value Range:	AUTO CTRL	Sampling is handling automatically Sampling is controlled by application	Default Value: AUTO
State:	Set: All Query: All		
Description:	This command configures the sampling mode of the RTX2201. If AUTO is selected, then a sampling is done automatically when a new measurement is requested. If CTRL is selected, then a new sampling is only done when triggered by the PROC:SAMP:FORC command.		
Example:	"CONF:SAMP:MODE CTRL"		

Force ADC sample

Syntax:	PROC:SAMP:FORC		
Value Range:	N/A		Default: N/A
State:	DCE		
Description:	This command forces an ADC sampling.		
Example:	"PROC:SAMP:FORC"		

Continuous sampling

Syntax:	CONF:SAMP:CONT		
Value Range:	ON OFF		Default: N/A
State:	Set : All Query: N/A		
Description:	This command forces continuous sampling, and do NOT uses the trigger like Force ADC sample does. This will make the system behave like in the older systems, with no control that the measurement is not calculated over 2 bursts!.		
Example:	"CONF:SAMP:CONT ON"		

Averaging factor

Syntax:	CONF:AVER:BURS <numeric value>	
Value Range:	1 .. 200	Default: 1
State:	Set: All Query : All	
Description:	Number of burst for measurement averaging. At the first measurement after connection establishment or after applying this command, the number of specified bursts for averaging is acquired till fill up the averaging filter. NB! FER and BER are not averaged	
Example:	"CONF:AVER:BURS 100"	

NOTE! If modulation is changed "on the fly" the command "CONF:AVER:BURS" must be send after worth.

RF-generator

RF-generator mode

Syntax:	CONF:TEST:RFGE <channel>	
Value Range:	0..40	Default: 0
State:	Set: All Query: N/A	
Description:	Note the channel parameter is optional, but can be used to set to generator mode and set the channel number in one step. When in generator mode and wanting to change the channel number use the CONF:RFGE:CARR command	
Example:	"CONF:TEST:RFGE", "CONF:TEST:RFGE 0"	

Carrier for RF-generator

Syntax:	CONF:RFGE:CARR <value>	
Value Range:	0..40	Default: 0
State:	Set: All Query: All	
Description:		
Example:	"CONF:RFGE:CARR 0"	

Modulation scheme for RF-generator

Syntax:	CONF:RFGE:MOD <value>	
Value Range:	BS55 BS33 BS0F OFF (no modulation, CW signal)	Default: BS55
State:	Set: All Query: All	
Description:		
Example:	"CONF:RFGE:MOD BS55"	

Traffic Carrier for FP test

Syntax:	CONF:FP:TRAF:CARR <numeric value>	
Value Range:	0..40	Default:0
State:	Set: IDLE, DFP Query: All	
Description:		
Example:	"CONF:FP:TRAF:CARR 0"	

RF level for FP-test

Syntax:	CONF:FP:RF:LEV <numeric value>	
Value Range:	-45 .. –100 (unit: dBm)	Default: -60
State:	Set: All Query: All	
Description:	Can be set in 0.1dB intervals	
Example:	"CONF:FP:RF:LEV –100"	

Antenna of the FP

Syntax:	CONF:FP:ANT <numeric value>	
Value Range:	0 .. 7	Default: 0
State:	Set: IDLE, DFP Query: All	
Description:		
Example:	"CONF:FP:ANT 0"	

Query of Lock state

Syntax:	SENS:SIGN:STAT?	
Value Range:	LOCK UNL	Default: N/A
State:	Query: DFP	
Description:		
Example:	"SENS:SIGN:STAT?"	

General commands

Device type

Syntax:	CONF:TEST:TYPE <value>	
Value Range:	DFP, FP (Testing fixed part)	Default: N/A
State:	Set: All Query: All	
Description:	Asking for type.	
Example:	"CONF:TEST:TYPE?"	

Test mode

Syntax:	PROC:SEL:TEST <value>	
Value Range:	NONE MAN	Default: N/A
State:	Set: All Query: N/A	
Description:		
Example:	"PROC:SEL:TEST NONE"	

Modulation scheme for and FP-test

Syntax:	CONF:BER:DATA <value>	
Value Range:	PSRB: Pseudo random bit sequence SPSR: Static Pseudo random bit sequence BS55: Bit sequence 01010101 (= 55 hex) BS33: Bit sequence 00110011 (= 33 hex) BS0F: Bit sequence 00001111 (= 0F hex) FIG31: CTR06 Fig. 31	Default: FIG31
State:	Set: All Query: All	
Description:		
Example:	"CONF:BER:DATA FIG31"	

Setup connection

Syntax:	PROC:CONN:SET	
Value Range:	N/A	Default: N/A
State:	DFP Check with STAT:DEV? if connection was established.	
Description:		
Example:	PROC:CONN:SET	

Connection release

Syntax:	PROC:CONN:REL	
Value Range:	N/A	Default: N/A
State:	DFP	
Description:		
Example:	PROC:CONN:REL	

Query Normal Transmit Power (NTP)

Syntax:	READ:NTP?	
Value Range:	<value> (unit: dBm)	Default: N/A
State:	Query: DCE, RFGE	
Description:		
Example:	"READ:NTP?"	

Initialize Normal Transmit Power versus Channel

Syntax:	PROC:NTP:CHAN:INIT	
Value Range:	N/A	Default Value: N/A
State:	DCE	
Description:	The init of the NTP vs. Channel is used to reset the NTP measured over the number of channels specified by the system. This is useful when changing the coupling loss or switching attenuators during a connection, because you don't have to release the connection.	
Example:	"PROC:NTP:CHAN:INIT"	

Query Normal Transmit Power Channel (NTP)

Syntax:	READ:NTP:CHAN? <chan no.>		
Value Range:	<chan no.> <value>	Channel no. [0..40] For 41 channel tester. NTP for chan no.[dBm]	Default Value: N/A
State:	Query: DCE		
Description:	This query is used to request the average output power of the DUT for a certain channel. The RTX2201 will respond the most recent measured NTP value for the specified channel. If the NTP has not previously been measured for this channel, a INV is returned.		
Example:	"READ:NTP:CHAN? 40"		

Query Frequency Offset

Syntax:	READ:FREQ:OFFS?	
Value Range:	<value> (unit: kHz)	Default: N/A
State:	Query: DCE, RFGE	
Description:		
Example:	"READ:FREQ:OFFS?"	

Initialize Frequency Offset versus Channel

Syntax:	PROC:FO:CHAN:INIT	
Value Range:	N/A	Default Value: N/A
State:	DCE	
Description:	The init of the Frequency offset vs. Channel is used to reset the frequency offset measured over the number of channels specified by the system.	
Example:	"PROC:FO:CHAN:INIT"	

Query Frequency Offset versus Channel

Syntax:	READ:FO:CHAN? <chan no.>		
Value Range:	<chan no.> <value>	Channel no. [0..40] For 41channel tester. NTP for chan no.[dBm]	Default Value: N/A
State:	Query: DCE		
Description:	This query is used to request the average output power of the DUT for a certain channel. The RTX2201 will respond the most recent measured frequency offset value for the specified channel. If the frequency offset not previously been measured for this channel, a INV is returned.		
Example:	"READ:FO:CHAN? 40"		

Query B-Field Modulation

Syntax:	READ:BF?	
Value Range:	<value>,<value> (unit: kHz)	Default: N/A
State:	Query: DCE, RFGE	
Description:		
Example:	"READ:BF?"	

Query Frequency Drift

Syntax:	READ:FREQ:DRIF?	
Value Range:	<value> (unit: kHz/s)	Default: N/A
State:	Query: DCE, RFGE	
Description:		
Example:	"READ:FREQ:DRIF?"	

Evaluation window for BER and FER measurements

Syntax:	CONF:BER:EVAL:WIND <numeric value>	
Value Range:	1 ..100,000	Default: 100
State:	Set: All Query: All	
Description:		
Example:	"CONF:BER:EVAL:WIND 1000"	

Start a new BER and FER measurement

Syntax:	PROC:STRT:BER	
Value Range:	N/A	Default: N/A
State:	DCE	
Description:		
Example:	"PROC:STRT:BER"	

Query BER and FER

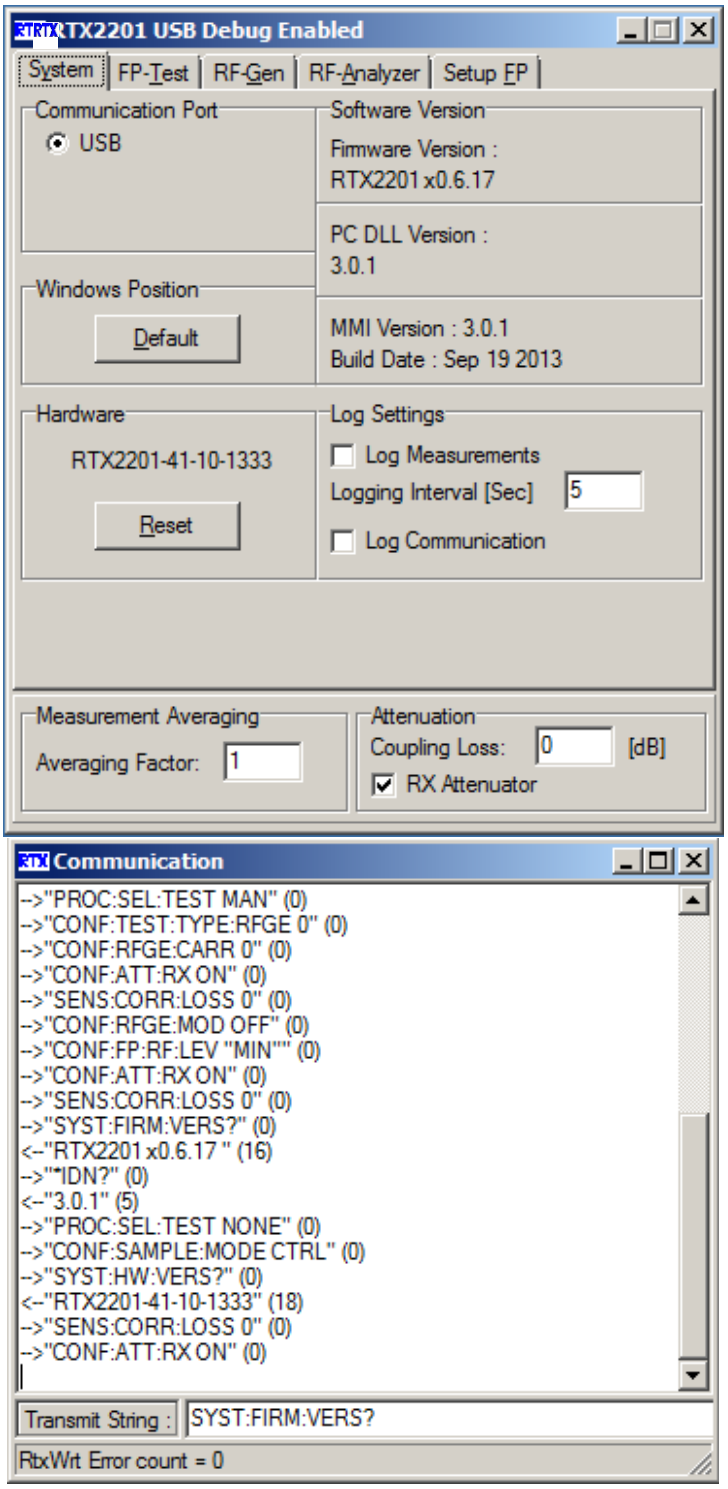
Syntax:	READ:BER:LTER?	
Value Range:	<value>,<value> (unit: none, %)	Default: N/A
State:	Query: DFP, DCE	
Description:		
Example:	READ:BER:LTER?	

Query BER and FER (modified)

Syntax:	READ:BER?	
Value Range:	<value>,<value> (unit: none, %)	Default: N/A
State:	Query: DFP, DCE	
Description:	This new command for BER/FER doesn't hang the system like the old one did.	
Example:	READ:BER?	

Sending Commands from the User Interface

The PC interface can be used as communication media for a SCPI command string. Starting in debug mode gives you access to a single line command field for testing and diagnostics.
When starting in debug mode (**Start**, **Programs**, **RTX2201 Tester**, **RTX2201 Debug**), a communication window appears below the main program.
The communication window contains an area showing the commands between the PC and the test set, and a single-line command field.



At the start of the commands showed in the communication area is an arrow showing the direction of the command e.g. an arrow pointing to the right --> is communication from the PC and an arrow pointing to the left <-- is reply from the test set.
Returning a (0) means no errors, and (1) indicates a setting or communication error.

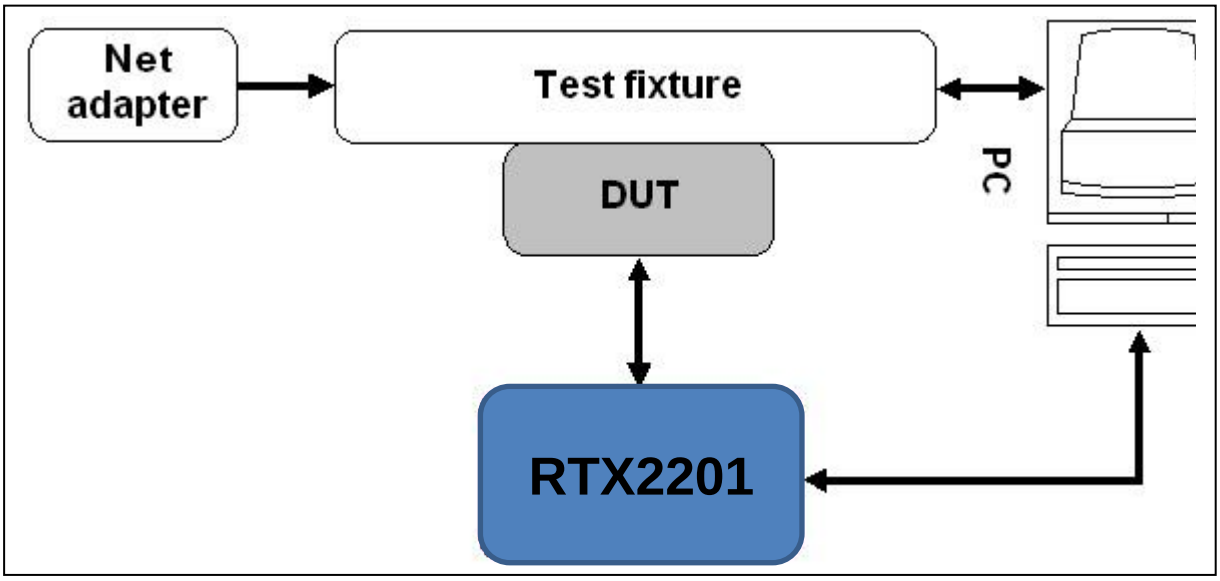
System error codes

Switching between the page tabs shows the commands for configuring the system.
You can enter commands in the single line entry field.
You can also capture the dialogue between your PC and test set when operating from the user interface. Saving this log file allows you to examine the commands and can help in the development of your own operating programs.

Error	Code Error
+0	No Error
-102	Syntax Error
-221	Settings Conflict
-222	Data out of Range
-224	Parameter Not Allowed
-365	Time Out Error
-366	Target Error

Example Program

An example of remote command setup for RF measurements on a device under test is shown in the following example.



Initial setup for RTX2201 Fixed Part Setup

- RtxWrt("PROC:SEL:TEST MAN");
- RtxWrt("CONF:FP:SIGN:MODE LOOP");
- RtxWrt("CONF:FP:RF:LEV -45");
- RtxWrt("CONF:BER:DATA FIG31");
- RtxWrt("CONF:AVER:BURS 20");

Fixed Part Link Setup

- RtxWrt("CONF:FP:TRAF:CARR " + Channel); // Channel is in Dec
- SLEEP(200);
- // Wait for RTX2201 to lock to DUT

- RtxWrt("PROC:CONN:SET"); // Try to Setup Connection
- SLEEP(300);

- RtxWrt("STAT:DEV?"); // Check if RF Connection has been established
- RtxRd(Result);
- If (Result == "DCE") Connection is established, else wait approx 400 ms. And go to step 7

Example for RF measurements on a Fixed Part DUT.

NOTE!
Ensure that a connection Link is established.

- Read Transmitter Power
  RtxWrt("READ:NTP?");
  RtxRd(Char_work);

- Adjust Transmitter Modulation
  RtxWrt("READ:BF?");
  RtxRd(Char_work);

  Adjust Modulation until it is within the value specified by the test specification.

- Read Frequency Drift
  RtxWrt("READ:FREQ:DRIF?");
  RtxRd(Char_work);

- Read Frequency Offset
  RtxWrt("READ:FREQ:OFFS?");
  RtxRd(Char_work);

- Read Bit Error Rate

  This will lock your application while the measurement is running.

  RtxWrt("READ:BER?");
  RtxRd(Char_work);

- Change Channel
  RtxWrt("PROC:CONN:REL");

  Channel is changed to new channel
  Perform Fixed Part Link Setup - To establish Radio Link

- Read Transmitter Power
  RtxWrt("READ:NTP?");
  RtxRd(Char_work);

- Adjust Transmitter Modulation
  RtxWrt("READ:BF?");
  RtxRd(Char_work);

  Adjust Modulation until it is within the value specified by the test specification.

- Read Frequency Drift
  RtxWrt("READ:FREQ:DRIF?");
  RtxRd(Char_work);

- Read Frequency Offset
  RtxWrt("READ:FREQ:OFFS?");
  RtxRd(Char_work);

- Read Bit Error Rate
  RtxWrt("READ:BER?");
  RtxRd(Char_work);

Specifications and characteristics

Introduction

This chapter details the functionality, specifications, performance and characteristics of the RTX2201 2.4 GHz Communication Tester.

Functionality – an overview of the features implemented.

Performance and characteristics – describe the warranted performance and apply after a 60-minute warm-up.
These specifications are valid over the operating and environmental range of the test set unless otherwise stated.

General Specifications - information on environmental and physical specifications.

Functionality

Fixed Part test – Ability to act as a Handset/portable part, locking onto a fixed part under test.
With the fixed part test mode enabled, the RF characteristics can be measured.

Using the Windows based MMI, all transmitter and receiver measurements are shown in a separately window, with bars and graphs for identifying pass/fail limits.

Operating frequency

Under test, all frequencies can be used as a single channel manually shifting between all the channels, simulating a normal transmission environment.

RF level

The RF output level can be adjusted "on the fly" for determining sensitivity of the device under test. The RF Level output range is between -100 to -45 dBm.

Signaling mode

The RTX2201 2.4GHz Communication Tester is using loop back signaling, transmitting data to the DUT and receive the looped data for RF analyses.
This method makes it possible to measure several RF parameters transmitted by the Device under test, as well as determine the DUT receiver sensitivity.

Modulation

Several different RF test signal modulation can be selected to obtain accurate measurements.

PSRB	Pseudo random bit sequence, similar to the signals sent in a real-life operation.
SPSR	Static pseudo random bit sequence.
BS55	Alternating zeroes and ones. Has the smallest deviation.
BS33	Alternating double zeroes and ones.
BS0F	Four times zeroes and four times ones repeatable.
Fig 31	A structured combination of zeroes and ones, preferable used for frequency deviation and frequency drift measurements.

RF measurements

The listed measurements are available with the tester.

- NTP
- Frequency Offset
- Frequency Drift
- Frequency Deviation
- Bit Error Ratio
- Frame Error Ratio

Graphical results showed using the MMI:

NTP
Modulation
NTP versus channel
Frequency offset versus channel

Performance and characteristics

The tester complies with the specifications after 2 hours of storage within the environmental temperature, and 60 minutes after turn on.
All values refer to the RF input N- connector.

Signal generator

Frequency

RTX2201-41-10-1333 Ranging from 2402.0000 to 2484.0000 MHz

Accuracy ± 1.5 ppm
Aging rate ± 1.0 ppm/year

Output Power

Level range: -100 to -45 dBm
Resolution: 0.1 dB
Error < ± 1.6 dB (-95 to -45 dBm)
Error < ± 2.2 dB (-100 to -95 dBm)

Analyzer

Frequency

RTX2201-41-10-1333 Ranging from 2402.0000 to 2484.0000 MHz

Power measurement

Input level (NTP): +30 to -45 dBm

Resolution 0.1 dB

NTP Error < ± 1.5 dB

FM Demodulator

Range -450 to 450 kHz deviation

Resolution 1 kHz

Modulation error (Fig31) approx. 20 kHz at max deviation

NOTE!
Analogue output not calibrated

All above specified is measured in single frequency selection.

General Specifications

Input/output connectors

RF In/Out N(f), 50 Ω

Parallel Port 25-pin D-sub (m)

Serial Port (RS 232) 9-pin D-sub (m)

Analog Outputs, BNC(f)

Receive Data (inverted)

Power Envelope

Digital outputs, BNC(f)

Timeslot

CLK 100

The following loads are allowed for TTL and CMOS levels:

TTL:
V_{OH} = 2.4V_{min} @ I_{OHmax} = 260 uA , RL_{min} = 12kohm
V_{OL} = 0.8V_{max} @ I_{OLmax} = -10 mA

CMOS:
V_{OH} = 3.5V_{min} @ I_{OHmax} = 150 uA , RL_{min} = 25kohm
V_{OL} = 1.5V_{max} @ I_{OLmax} = -10 mA

Environmental Conditions

Rated operating temperature range **15°C to 35°C**

Storage temperature range **-20°C to 60°C**

Operating Humidity Up to **95% relative humidity to 40°C** (non-condensing)

Power Supply

Supply Voltage **100-120VAC, 200- 250VAC 50-60 Hz**

Power consumption **30 VA maximum**

Physical Dimensions **92 mm (H) x 484 mm (W) x 280 mm (D)**

Weight **3.0 kg**

Regulatory Information

Safety

Electrical Safety EN 6110-1 / VDE 0411, class 1.

Responsibilities of the Customer

The customer shall provide:

- Access to the products during the specified periods of coverage to perform maintenance
- Adequate working space around the products for servicing by RTX personnel.
- Access to and use of all information and facilities determined necessary by RTX to service and/or maintain the products.
- Routine operator maintenance and cleaning as specified in this User's Manual.
- Consumables such as replacement fuses, etc.

Maintenance

Introduction

This chapter describes the built in tests, error messages, and general maintenance. It contains these sections:

- LED Indicators
- Operator Maintenance
- Contacting RTX A/S
- Calibration and Service

LED Indicators

There are 7 LED indicators on the front panel of the RTX2201 Tester.
The table below shows the behaviour of the LED indicators according to the mode of the tester. The Error LED is turned on if the last SCPI command issued was wrong.
The Error LED is turned off again as soon as a correct SCPI command is received.

Mode	Power	Error	Burst	Gen	Locked	RX ATT	Connected
Off							
Initializing	ON	ON	ON	ON	ON	ON	ON
Idle Mode	ON	ON[1]					
RF-generator	ON	ON[1]	ON	ON			
RF-Analyzer	ON	ON[1]	ON	ON			
Burst	ON	ON[1]	ON		ON[2]		
Connected FP	ON	ON[1]	ON		ON[2]		ON

1 If wrong SCPI commands is being used.
2 When locked on a DUT

Operator Maintenance

This section describes how to replace the power line fuse and clean the tester.

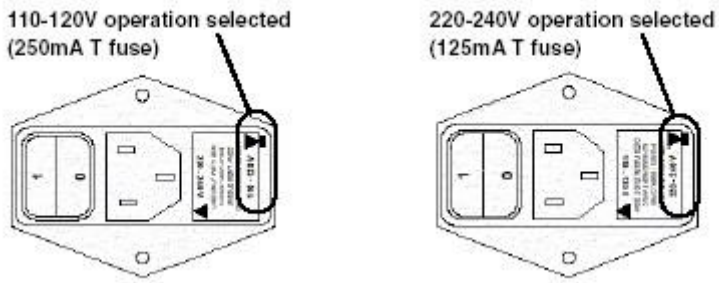
Replacing the Power Line Fuse

The power line fuse is located within the fuse holder and line switch assembly on the rear panel. For 110V to 120V operation the fuse is a T0.25 250V, for 220-240V operations the fuse is a T0.125 250V.

1 Remove the power cord from the test set.

2 Install the correct fuse in the "selected" position as shown in the figure below.

3 Replace the fuse holder assembly in the rear panel.



Cleaning

To clean the test set, disconnect the supply power and wipe with a damp cloth only.

Contacting RTX

This section details what to do if you have a problem with your tester.
If you have a problem with your tester, first refer to the section.
This chapter contains a checklist that will help identify some of the most common problems.
If you wish to contact RTX about any aspect of the tester, from service problems to ordering information refer to see Sales and Service Offices on page 115.
If you wish to return the tester to RTX refer to see Returning Your RTX2201 Tester for Service on page 117.

Before calling RTX

Before calling RTX or returning the test set for service, please make the checks listed in see Check the Basics on page 114. If you still have a problem, please read the warranty printed at the front of this guide. If your test set is covered by a separate maintenance agreement, please be familiar with the terms.

RTX offers several different maintenance plans to service your tester after warranty expiration. Call RTX Sales and Service Office for full details.

If the tester becomes faulty and you wish to return the faulty instrument, follow the description on how to return the faulty instrument in the section see Sales and Service Offices on page 115.

Check the Basics

Problems can be solved by repeating what was being performed when the problem occurred. A few minutes spent in performing these simple checks may eliminate time spent waiting for instrument repair.
Before calling RTX or returning the test set for service, please make the following checks:

- Check that the line socket has power.
- Check that the test set is plugged into the proper ac power source.
- Check that the test set is switched on.
- Check that the line fuse is in working condition.
- Check that the other equipment, cables, and connectors are connected properly and operating correctly.
- Check the equipment settings in the procedure that was being used when the problem occurred.
- Check that the test being performed and the expected results are within the specifications and capabilities of the tester.
- Check operation by performing the Power on Test, as described on page 16.

After performing the checklist above and the Tester still is faulty, contact the RTX Service office for information and support.

Instrument serial numbers

RTX service personnel have access to complete records of design changes for each instrument. The information is based on the serial number of each tester.
Whenever you contact RTX about your tester, have a complete serial number available. This ensures you obtain the most complete and accurate service information. The serial number can be obtained from the serial number label.
The serial number label is attached to the rear of each instrument.

Sales and Service Office

For more information about RTX test and measurement products, applications, services, and for a current sales office listing, visit our web site: http://www.RTX.dk
You can also contact one of the following Sales Offices and ask for a test and measurement sales representative.

Europe and Asia:

RTX A/S

Stroemmen 6
DK-9400 Noerresundby
Denmark

Tel. +45 96 32 23 00
Fax +45 96 32 23 10
E-mail Sales: Sales@rtx.dk
E-mail Service: Service@rtx.dk
Web: WWW.rtx.dk

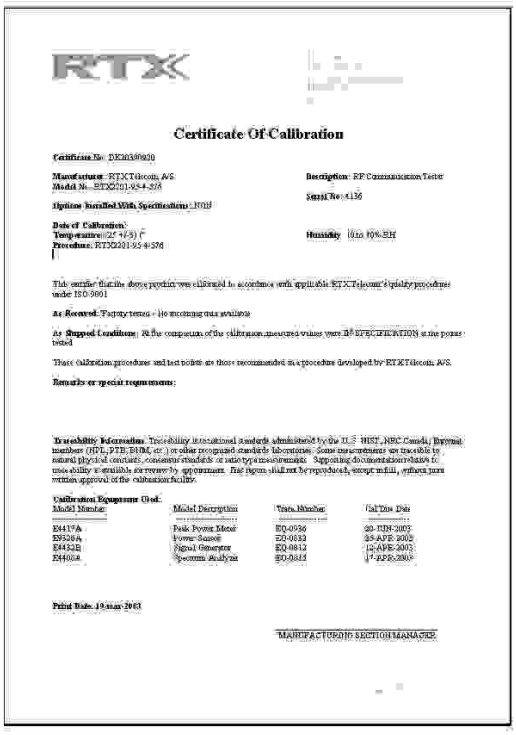
In any correspondence or telephone conversations, refer to the RTX2201 tester by its model number and full serial number. With this information, the RTX representative can quickly determine whether your unit is still within its warranty period.

Calibration and Service

Routine calibration and performance testing of your RTX2201 Tester should be carried out on a yearly basis.

The annual recalibration is done at RTX by qualified personal, and in accordance to strictly specifications.

Example of a Certificate and calibration report are shown below:



Certificate Of Calibration

Certificate No: DK0309020

Manufacturer: RTX Telecom A/S
Model No.: RTX2201-93-4-378
Options Installed With Specification: 1003

Serial No: 4136

Date of Calibration:
Temperature: (25° +/-5) C
Procedure: RTX2201-95-6-376

Humidity: (10 to 90)% RH

We certify that the above product was calibrated in accordance with applicable RTX Telecom's quality procedure under ISO 9001

As Received: Factory terms - No incoming data available

As Shipped Condition: At the completion of the calibration measured values were IN SPECIFICATION at the points tested

These calibration procedures and test points are those recommended in a procedure developed by RTX Telecom A/S.

Remarks or special requirements:

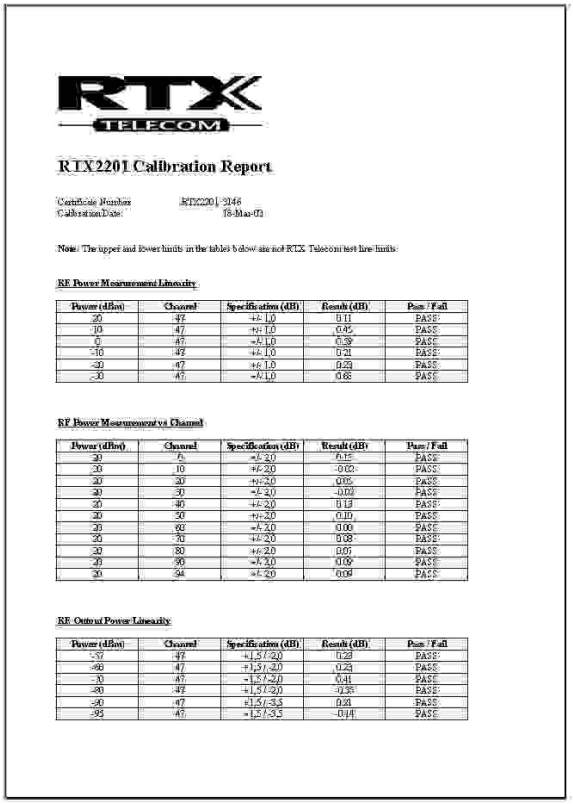
Traceability Information: Traceability to national standards administered by the U.S. NIST, NRC Canada, Imperial members (BIPM, ETE, PTB, etc.) or other recognized standards laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment. This report shall not be reproduced, except in full, without prior written approval of the calibration facility.

Calibration Equipment Used:

Model Number	Model Description	Trace. Number	Cal Due Date
E4417A	Peak Power Meter	E0-0936	20-JUN-2003
E9326A	Power Sensor	E0-0833	25-APR-2002
E4432B	Signal Generator	E0-0812	12-APR-2003
E4405B	Spectrum Analyzer	E0-0815	17-APR-2003

Print Date: 19-mar-2003

MANUFACTURING SECTION MANAGER



RTX TELECOM

RTX2201 Calibration Report

Certificate Number: RTX2201 - 2146
Calibration Date: 18-Mar-03

Note: The upper and lower limits in the tables below are not RTX Telecom test line limits

RF Power Measurement Linearity

Power (dBm)	Channel	Specification (dB)	Result (dB)	Pass / Fail
20	47	+/- 1.0	0.11	PASS
10	47	+/- 1.0	0.45	PASS
0	47	+/- 1.0	0.39	PASS
-10	47	+/- 1.0	0.21	PASS
-20	47	+/- 1.0	0.29	PASS
-30	47	+/- 1.0	0.68	PASS

RF Power Measurement vs Channel

Power (dBm)	Channel	Specification (dB)	Result (dB)	Pass / Fail
20	0	+/- 2.0	0.15	PASS
20	10	+/- 2.0	0.02	PASS
20	20	+/- 2.0	0.05	PASS
20	30	+/- 2.0	0.02	PASS
20	40	+/- 2.0	0.13	PASS
20	50	+/- 2.0	0.10	PASS
20	60	+/- 2.0	0.00	PASS
20	70	+/- 2.0	0.02	PASS
20	80	+/- 2.0	0.05	PASS
20	90	+/- 2.0	0.08	PASS
20	94	+/- 2.0	0.09	PASS

RF Output Power Linearity

Power (dBm)	Channel	Specification (dB)	Result (dB)	Pass / Fail
-57	47	+1.5 / -2.0	0.28	PASS
-68	47	+1.5 / -2.0	0.23	PASS
-70	47	+1.5 / -2.0	0.41	PASS
-80	47	+1.5 / -2.0	0.35	PASS
-90	47	+1.5 / -3.5	0.21	PASS
-95	47	+1.5 / -3.5	-0.14	PASS

Contact RTX sales and service office for details.

Returning Your RTX2201 Tester for Service

Use the information in this section if you need to return your test set to RTX.

NOTE!
All returns to RTX MUST be initialized by obtaining an Return Material Authorization (RMA).
Any returns without authorization cannot be handled in the normal service process and in a timely manner.

Obtaining an RMA for service return

Contact the RTX Service office by E-mail or Phone with the following information's:

- Any error messages generated by the tester.
- Any information on the performance of the tester.
- Fault description
- Company Name
- Company address
- Contact information
- Serial number of the Tester
- Model Type
- Type of Service agreement, warranty or re-calibration.

The Service office will then provide an RMA number, which must be placed visible at the shipping box and at which all communication, regarding the return, must be referred to.

RTX Service e-mail address: service@rtx.dk

Packing the Tester for Shipment

Use the following steps for packing the tester for shipment to RTX for service:

1 Fill in a note and attach it to the tester or place it visible in the shipping box. Please be as specific as possible about the nature of the problem.

NOTE!
Damage can result from using packaging materials other than those specified.
Never use styrene pellets in any shape as packaging materials.
They do not adequately cushion the tester or prevent it from shifting in the carton.
Styrene pellets cause damage by generating static electricity.

2 Use the original packaging materials or a strong shipping container that is made of double-walled, corrugated cardboard with 159 kg (350 lb) bursting strength. The carton must be both large enough and strong enough to accommodate the tester and allow at least 3 to 4 inches on all sides of the tester for packing material.

3 Surround the tester with at least 3 to 4 inches of packing material, or enough to prevent the tester from moving in the carton. If packing foam is not available, the best alternative is SD-240 Air Cap ™ from Sealed Air Corporation (Commerce, CA 90001). Air Cap looks like a plastic sheet covered with 1-1/4 inch air filled bubbles.
Use the pink Air Cap to reduce static electricity. Wrap the tester several times in the material to both protect the test set and prevent it from moving in the carton.

4 Seal the shipping container securely with strong nylon adhesive tape.

5 Mark the shipping container "FRAGILE, HANDLE WITH CARE" to ensure careful handling.

6 Retain copies of all shipping papers.