RTX2012 HS

RF Test Platform for DECT/DECT 6.0/CAT-iq

User's Manual

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This instrument 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 RTX2012 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 RTX2012 RF Test Platform for DECT/DECT 6.0/CAT-iq 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 program.

For further information about programming of the RTX2012 RF Test tester, please refer to the "Programming Reference" section of this document.

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. Furthermore, any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is therefore 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 – it is therefore strongly emphasized here that 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 supplies 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 RTX2012 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 – i.e. avoid touching any unearthed metal with the centre core
- Make sure that the test device is properly earthed

Documentation information

This User's Manual contains essential items of information needed for general-purpose use of the test equipment along with a detailed description for high throughput production purposes.

In this document you will find valuable information on how to unpack, install and operate your RTX2012 Tester using the supplied PC application or a test program using the remote command set.

The User's Manual provides programming guidance to users of the RTX2012 tester who would like to write their own test programs. In chapter 4 and 5 you find a programming reference along with a detailed description of the SCPI commands supported by the tester. Furthermore, you also find information on how to use the provided RTX2012 DLL file and a few examples on how to use the DLL function calls in your source code are outlined. However, please note that the examples and code fragments are included for informational reasons only and should only be used as a guidance to ease test program development. *It is therefore strongly emphasized here that RTX takes no responsibility for debugging and verification of the actual test program developed by the customer.*

Conventions Used in this Manual

The following text conventions are used in this guide:

Parameter	used to represent a parameter, value or data in an entry field
RUN	used to represent the text in the Windows® based user interface

Abbreviations Used in this Manual

The following abbreviations are used in this guide:

BER	Bit Error Rate
BS	Bit Sequence
DUT	Device Under Test
FER	Frame Error Rate
FP	Fixed Part
NTP	Normally Transmitted Power or Average Burst Power
PP	Portable Part
RFPI	Radio Fixed Part Identity
SCPI	Standard Commands for Programmable Instruments

CONTENT

1. Getting Started

A. **Introduction**

The RTX2012 RF Test Platform for DECT/DECT6.0/CAT-iq is a multi-purpose RF tester for DECT/DECT 6.0/CAT-iq devices. It supports a range of different RF tests and can be used for high throughput manufacturing applications as well as a development or service tool.

For some test situations specified, additional test equipment (such as a spectrum analyser or signal generator) can be used to compliment the RTX2012 tester.

Basically the tester can act as either a handset or a base station with added test capabilities. The tester can be operated using the supplied Windows® based user interface or by sending SCPI format commands (either in the Windows environment or from within a test executive) to the tester.

Operation of the DUT is controlled via the Air Interface. In case a DUT is unable to establish a link it can be physically connected to the tester through the RF IN/OUT connector on the front panel, and debugged using the implemented RF Analyser and RF Generator modes.

In addition to the RF IN/OUT connector several additional rear panel connections are also provided. A detailed description of the rear panel connectors is provided later in this chapter.

It is important to emphasize here that it is crucial to ensure the environmental conditions specified in this document are met. Hence, in order to ensure that your RTX2012 tester meets its specifications please allow a 60-minute warm-up period after power ON before making any measurements.

B. **Unpacking the RTX2012 Tester**

i. 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 any mechanical or electrical damage is observed please notify RTX. Please refer to the description on how to contact RTX provided in this document. Please also keep the damaged shipping materials (if any) for inspection by the carrier and an RTX representative.

ii. Box content

When unpacking the RTX2012 tester please verify that the items listed below are included in the box.

- RTX2012 RF Test Platform for DECT/DECT6.0/CAT-iq tester unit
- RTX2012 CD-ROM containing documentation, drivers and software
- Main Power cable
- USB cable (for communication between the tester and a PC)
- Certificate of conformity
- Calibration report
- Mounting kit

C. Installation of the RTX2012 Tester Unit

The RTX2012 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
- Switching the tester on for the first time
- Power on sequence check
- Install your RTX2012 tester in a 19 inch rack (if required)
- Connect units to the rear panel connectors
- Connect a unit to the front panel connector
- Install the user interface executables and DLL files on your PC
- Launch the RTX2012 Windows Application in both normal and debug mode

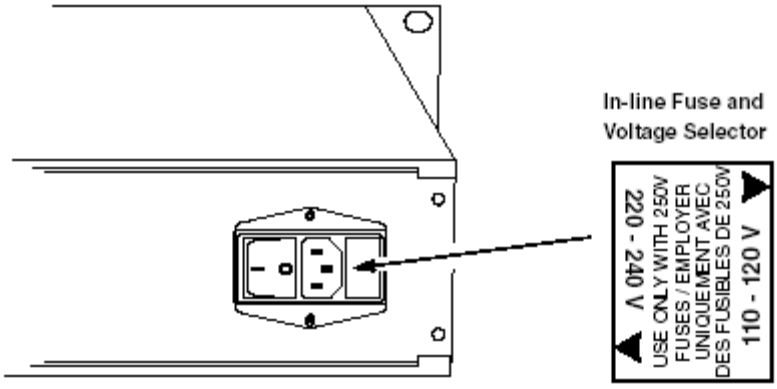
i. Check voltage setting and fuse rating

Please ensure that the appliance coupler (mains input power cord) is disconnected and that the Power Switch is in the Off (0) position. When installing the RTX2012 tester please do not position the instrument such that access to the coupler is impaired.

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

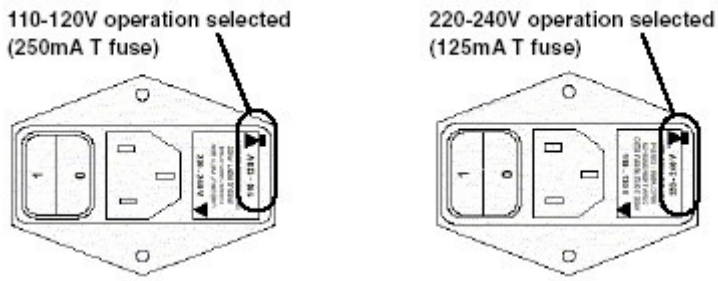
IMPORTANT!
Check whether the fuse settings are compliant to the local region before connecting the Main Power Cord (see instructions below).

Check the operating voltage setting and fuse rating



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

Voltage setting and fuse rating overview



IMPORTANT!
Please ensure that you have read and understood the safety information outlined in the beginning of this User's Manual before proceeding.

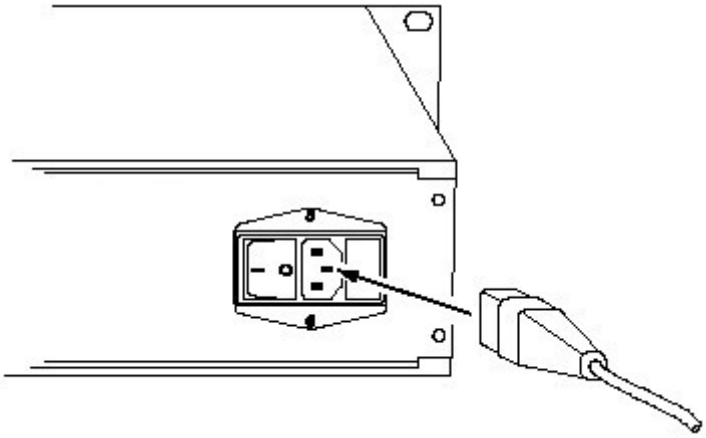
ii. Switching On the Tester for the First Time

Before switching this instrument ON please make sure that the:

1) Line voltage selector is set to the voltage of the power supply
2) Correct fuse is installed
3) Power supply voltage is in the specified range

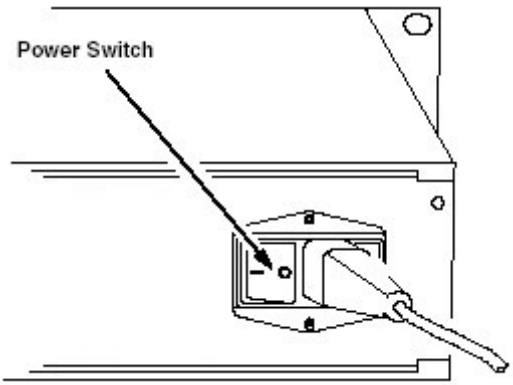
Connect the Main Power Cord as outlined in the figure below.

Connect the Main Power Cord



The tester is switched ON by pressing the Power Switch so that it is ON position (I).

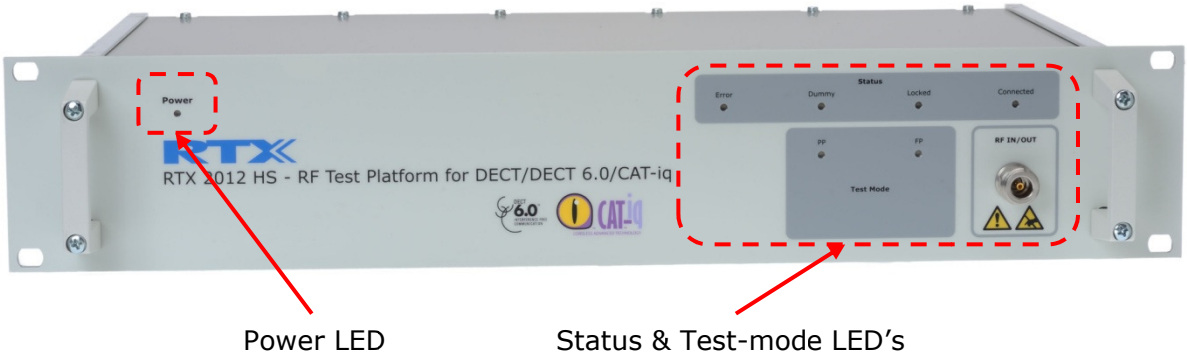
Power Switch location



iii. Power On Sequence Check

During the power on sequence please observe that all front panel LED's light up for a short time. After a few seconds only the Power LED should remain lit. This indicates that the power on sequence was completed successfully and the tester is ready for use.

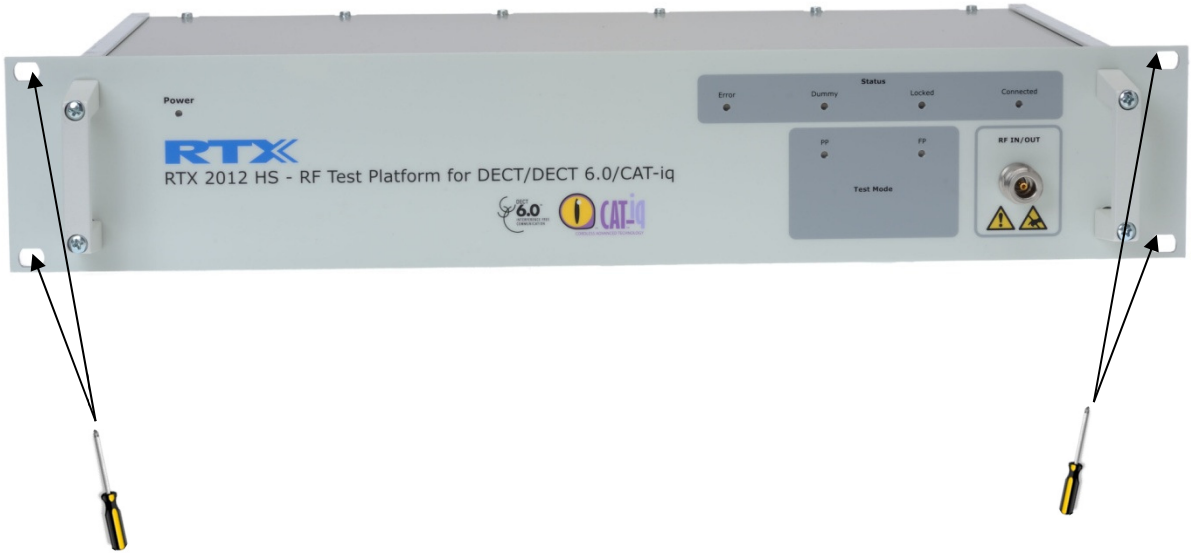
Front Panel LED's



iv. Rack Mounting of the RTX2012

The RTX2012 tester is not fitted with a power switch on the front panel. Hence, to allow easy and fast disconnection from mains power when the tester has been mounted in a rack, it shall only be fitted to a rack cabinet with an easily accessible power isolation switch. Please place the tester in the rack and secure it to the frame using four screws as shown below.

Rack mounting of the RTX2012 tester



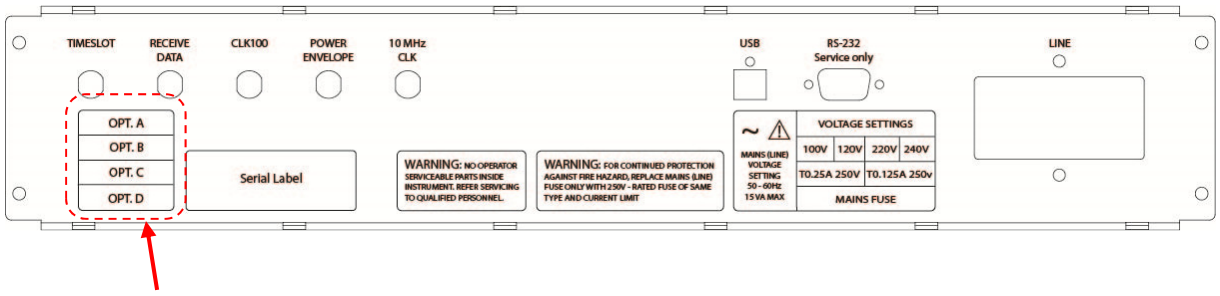
Furthermore, please ensure that the space and airflow requirements within the rack cabinet are met. Dimensions of the RTX2012 tester and are shown in the figure below.

RTX2012 tester dimensions

v. Supported Options Information

The supported options are outlined on the rear panel of the tester (see location below). Each supported option will be represented by one label.

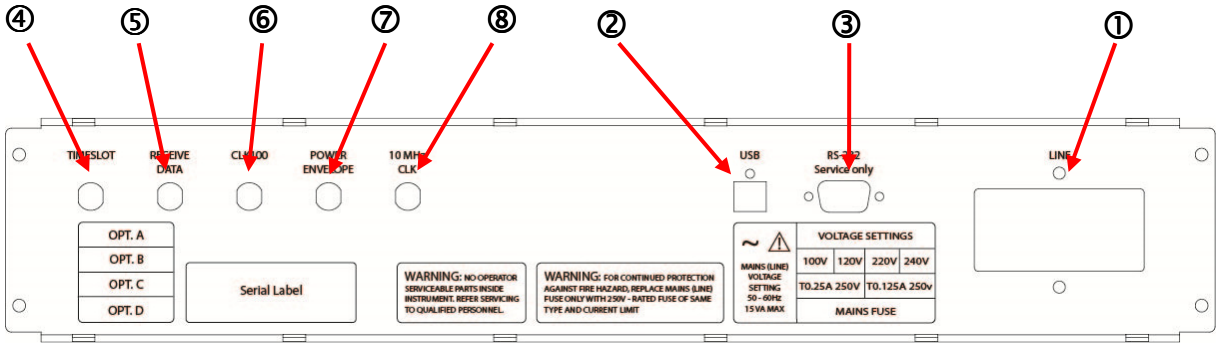
Location of supported options information



vi. Rear Panel Connectors

The RTX2012 tester provides rear panel inputs/outputs for a number of functions. Below a brief overview of the available connectors is provided along with a description of each of the connectors (except the AC input/AC switch).

Available rear panel connectors



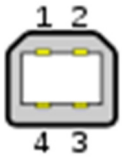
- **AC input/AC switch (①):** Power supply (110 / 220V).
- **USB Interface (②)**: This interface should be used together with a Windows® based PC in order to control the test set and to query data from the test set. The USB interface on the tester is a Type B receptacle, and hence, a standard USB cable with Type A-B plugs can be used to connect the tester to a PC.
- **RS-232 (③):** RS-232 operation – used for firmware download (for RTX bench work only).
- **Timeslot (④):** BNC-connector with the "TIME_SLOT" signal (output). This signal goes high and low together with the TX signal from the test device.
- **Receive Data (⑤):** BNC-connector with the inverted analogue signal representing "RECDAT" (the demodulated signal).
- **CLK 100 (⑥):** BNC-connector with the "FRAME_CLK" signal.
- **Power Envelope (⑦):** BNC-connector containing an analogue signal "POWER" with a voltage indication of the instantaneous received power from the DUT.
- **10 MHz Clock (⑧) (only available with Option B):** BNC-connector for an external 10 MHz reference clock. ***Please note that this connector is ONLY available on testers with Option B support (see also section xii on page 44 for information on this option).*** The 10 MHz Clock input connector is used for providing an external clock reference to the tester. Using a more advanced and higher quality clock generator than the internal RTX2012 clock generator the precision of measurements can be improved.

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

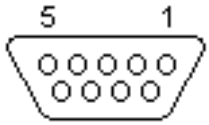


Pin	Name	Direction	Description
1	VBUS		Power (+5V)
2	D-	PC<->2012	DATA-
3	D+	PC<->2012	DATA+
4	GND		SIGNAL GND

RS 232 interface

The serial interface is used solely for firmware download.

Serial Interface Connector (9-pin D-SUB female) and pin overview



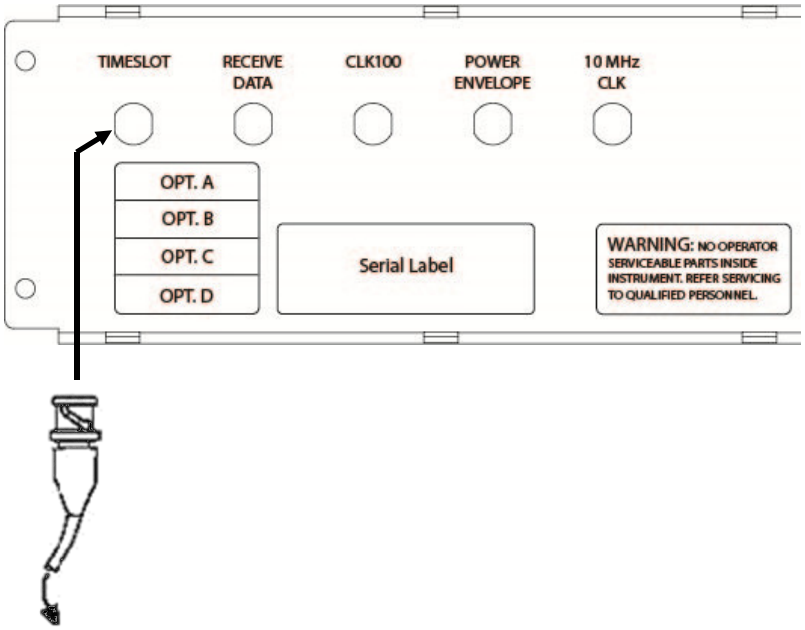
Pin	Name	Direction	Description
2	TXD	2012->PC	TRANSMIT DATA
3	RXD	PC->2012	RECEIVE DATA
4	DTR	PC->2012	DATA TERMINAL READY
5	GND		SIGNAL GND
7	RTS	PC->2012	REQUEST TO SEND

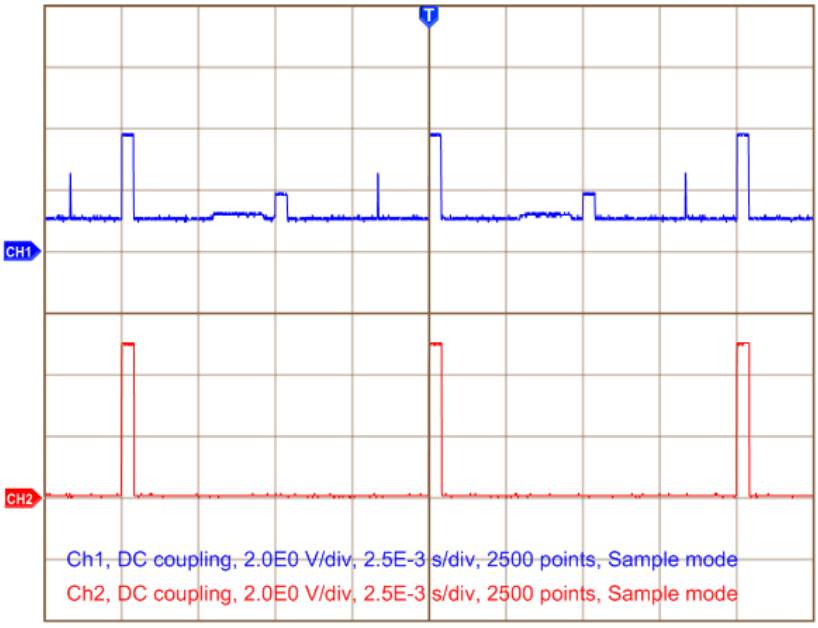
IMPORTANT!
Firmware download must be handled only by authorized personal and under supervision of an RTX representative.

Timeslot

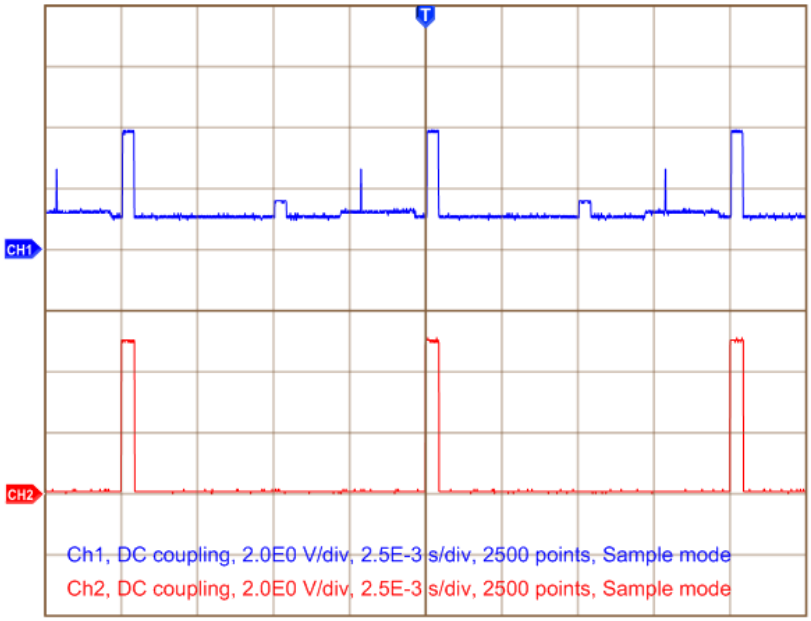
The BNC-connector supplies an output signal, going high and low together with the TX signal from the test device. Below you find some figures outlining output from this connector.

Connecting a cable to the BNC TIMESLOT Connector





CH1: PP connection on traffic slot 4.
CH2: Traffic slot 0,2,4,6,8,10

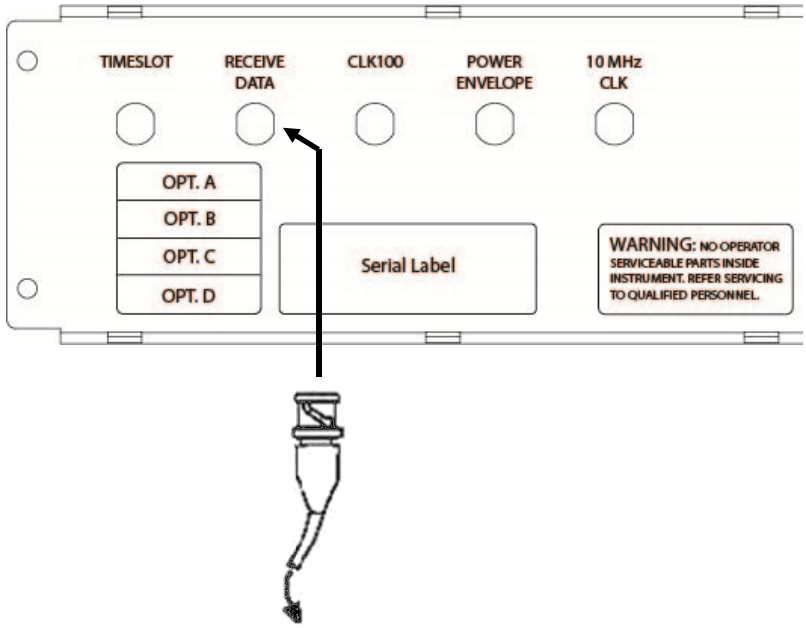


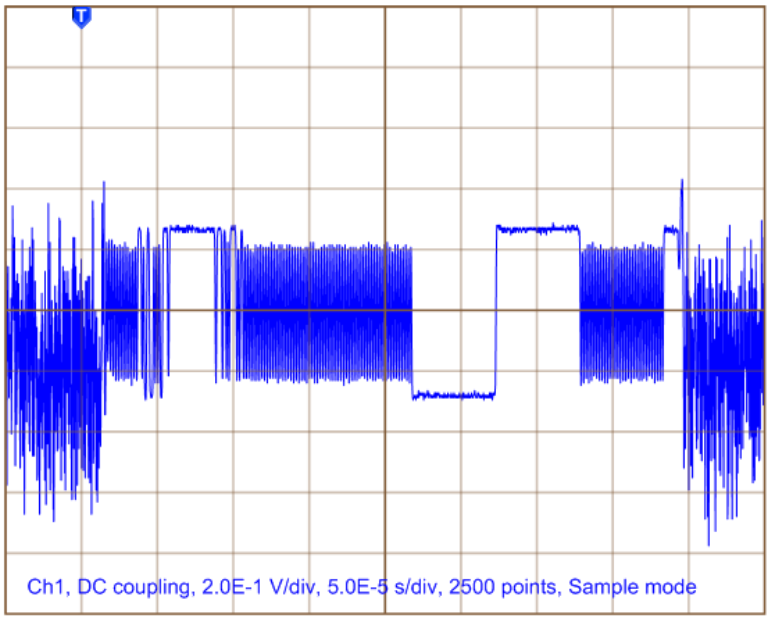
CH1: Online calibration, RTX2012 TX, FP TX.
CH2: Timeslot for FP TX

Receive Data

This BNC connector supplies an inverted output of the demodulated signal. Below you find a figure outlining output from this connector.

Connecting a cable to the BNC RECEIVE DATA Connector

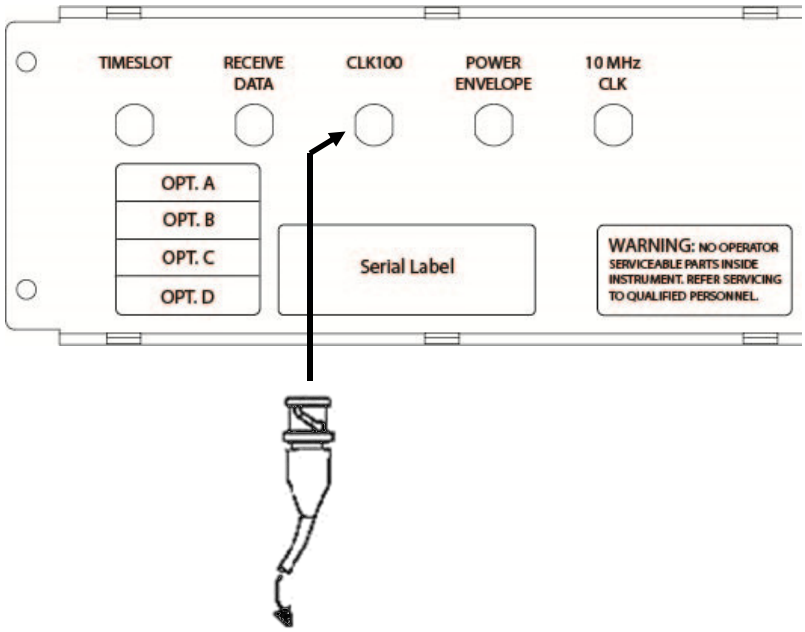


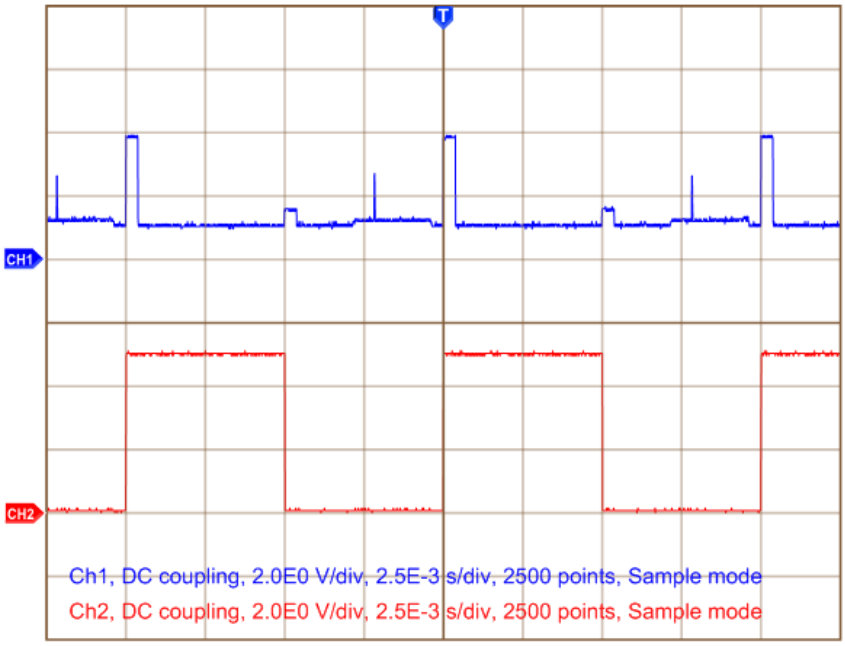


CLK 100

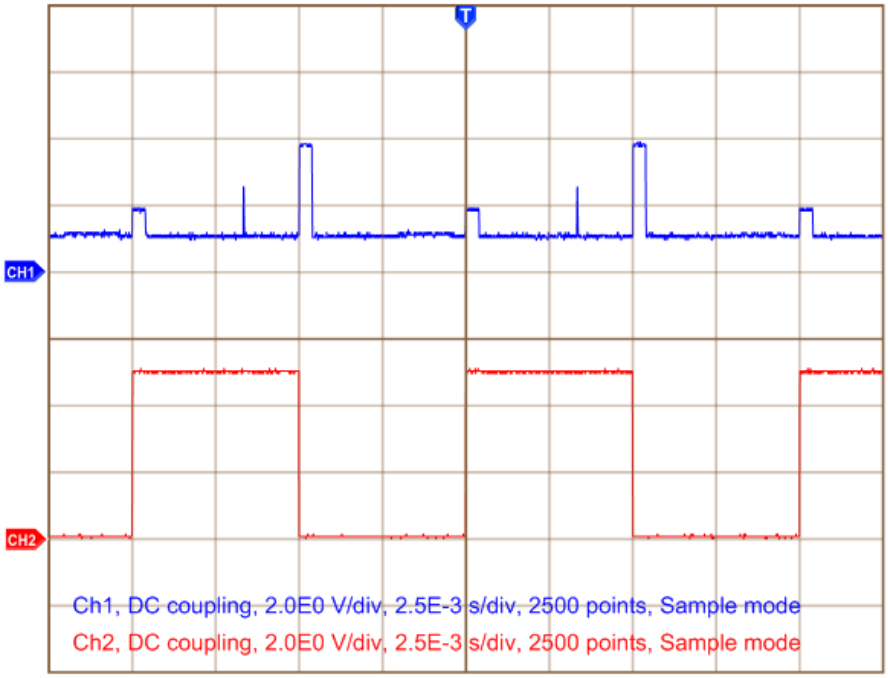
This BNC-connector supplies an output signal. Below you find a figure outlining output from this connector.

Connecting a cable to the BNC CLK100 Connector





CH1: TX from device (FP), TX from RTX2012, online calibration
CH2: Clock 100 synchronizing for RTX2012 TX

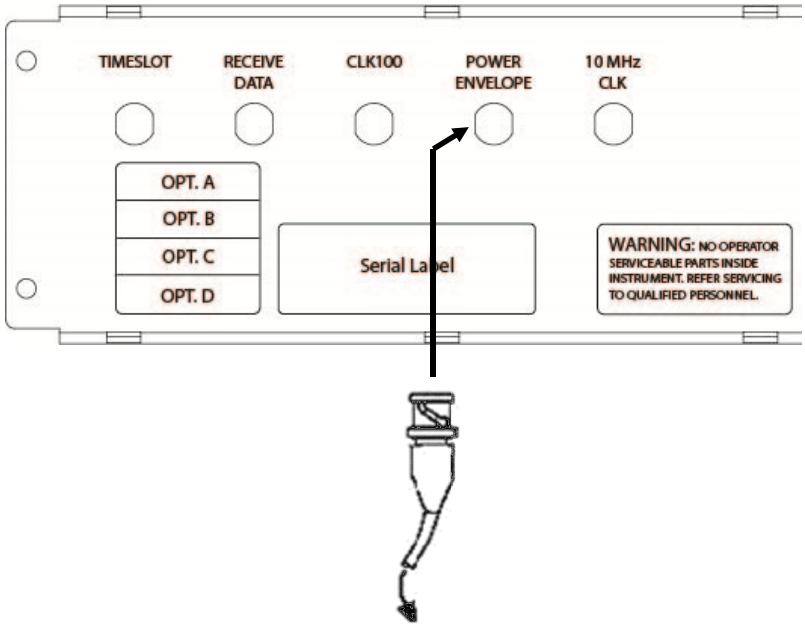


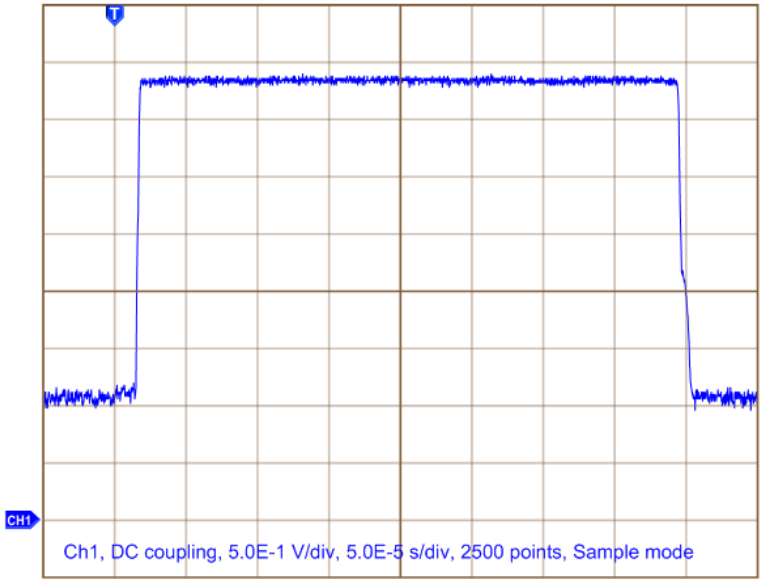
CH1: TX from device (PP), TX from RTX2012, online calibration
CH2: Clock 100 synchronizing for RTX2012 TX

Power Envelope

This BNC connector supplies the analogue signal "POWER" and it is equal to voltage indication of the instantaneous received power from the DUT. Below you find a figure outlining output from this connector.

Connecting a cable to the BNC POWER ENVELOPE Connector

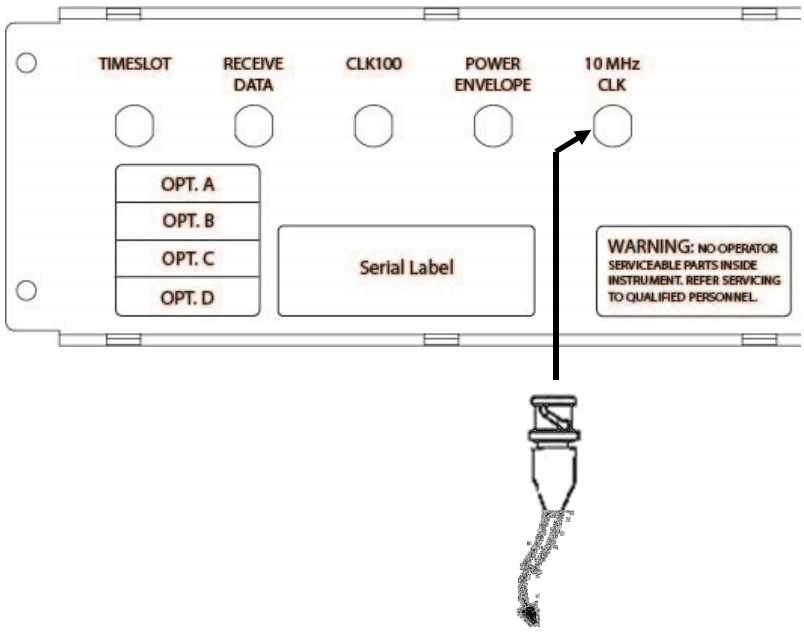




10 MHz Clock (Requires Option B)

This BNC connector is used for connecting an external 10 MHz reference clock generator. ***Please note that this connector only is present if the tester supports Option B.***

Connecting a cable to the BNC 10 MHz CLK Connector



vii. Front Panel Connectors

The RTX2012 tester provides only one front panel input/output. This is the 50 Ω N-type RF connector. Below a brief overview of this connector is provided.

Available front panel connector

RF Input / RF Output

The 50 Ω N-type RF connector is used to connect a DUT to the tester with the objective of debugging the RF interface of the DUT.

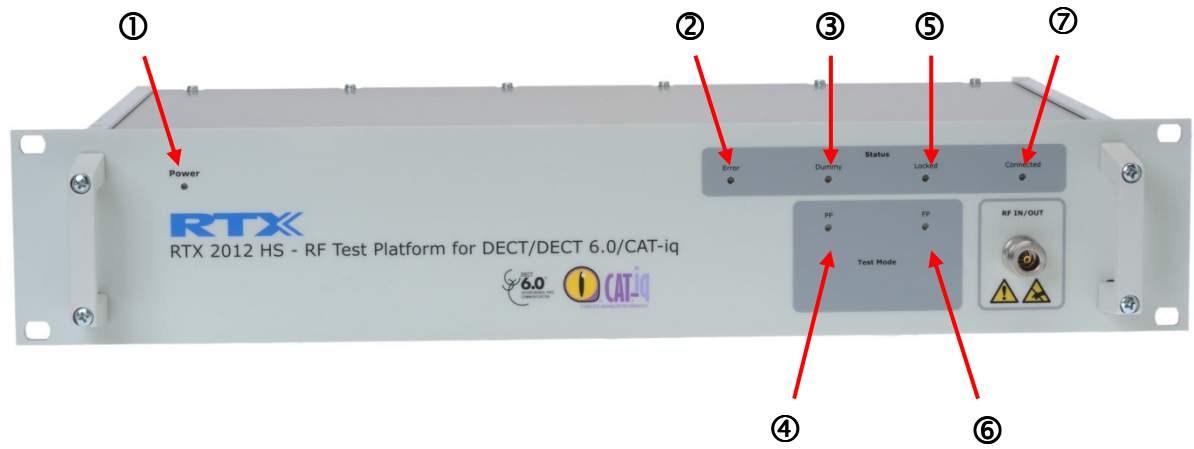
IMPORTANT!
Please note that antenna coupled measurement results are un-calibrated. If the power level input is higher than 30 dBm an external attenuator must be inserted in the RF path to prevent power saturation. Furthermore, to avoid noise and interference please always use an antenna in a screened environment.

IMPORTANT!
The RF Input / Output connector must be secured for ESD and high voltage. Please refer to the items of information provided on the first pages of this document in relation to ESD.

viii. Front LED Indicators

On the front panel of the RTX2012 there are in total there seven LED indicators. Each of these LED indicators is described in more detail below. Furthermore, an overview of the behaviour of the LED indicators depending on the mode of the tester is also provided in this paragraph.

Front LED Indicators



- **POWER (① - Red LED)** – If this LED is lit it indicates that the tester is connected to the AC mains and that the power switch is ON.
- **ERROR (② - Red LED)** - This LED indicates whether or not a communication error has occurred. If lit this means that a communication error has occurred. Please refer to the Programming Reference chapter in how to check which error occurred.
- **Dummy (③ - Red LED)** - If lit then this LED indicates that the tester is in PP test mode and not connected to a DUT.
- **PP (④ - Red LED)** – If lit then this indicates that the tester is in PP test mode.
- **LOCKED (⑤ - Green LED)** – If lit then this LED indicates that the tester is locked in FP test mode.
- **FP (⑥ - Green LED)** - If lit this indicates that the tester is in FP test mode.
- **CONNECTED (⑦ - Green LED)** - If lit this indicates that the tester is connected to either a base-station or a handset.

The table below outlines the behaviour of the LED indicators according to the mode of the tester. Please note that the Error LED is turned on in case the last SCPI command issued was erroneous - the LED will be turned off again as soon as the tester has received a correct SCPI command.

Mode	Power	Error	Dummy	Locked	PP	FP	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**	
FP Locked	**ON**	**ON**[1]		**ON**[2]		**ON**	
Connected FP	**ON**	**ON**[1]		**ON**[2]		**ON**	**ON**
PP Locked	**ON**	**ON**[1]		**ON**[2]	**ON**		
Connected PP	**ON**	**ON**[1]		**ON**[2]	**ON**		**ON**

1) *The Error LED is ON if a wrong SCPI commands has been sent to the tester and it will remain ON until the error is cleared again by sending a correct SCPI command to the tester.*
2) *The Locked LED is ON when the tester is locked on a DUT.*

D. Installing the PC Software

In this paragraph the installation process of the supplied SW outlined. The following items of information are included:

- Overview of the minimum system requirements to the PC on which the SW must be installed
- Installing the RTX2012 USB driver
- Installing the Windows based User Interface on your PC
- Installing the RTX2012 Dynamic Link Library (DLL) for remote control purposes

i. Minimum System Requirements

For successful operation of the Windows User Interface your PC must meet at least the minimum requirements outlined in the table below.

System Part	Minimum requirement
CPU	1 GHz processor (Intel© or AMD) or faster
RAM	1 GB (2 GB for 64-bit operation)
Available disc space	75 MB
Monitor resolution	1280 x 1024 pixels or higher
CD-ROM drive	YES
Ports	Available USB port
Operating System	Windows XP/Windows 7 (32- or 64-bit)

ii. Installing the RTX2012 USB driver

In order to use the RTX2012 tester on a PC the USB driver for the tester must be installed. Before installing any RTX2012 SW please make sure that your PC adheres to the minimum requirements listed above. *Please note that the RTX2012 USB driver has not yet been digitally signed by Microsoft. Furthermore,* ***it is strongly emphasized here that only 32-bit operation is recommendable.*** *Although the driver should work on a 64-bit Windows platform, problems could occur. Hence, if you want to use the RTX2012*

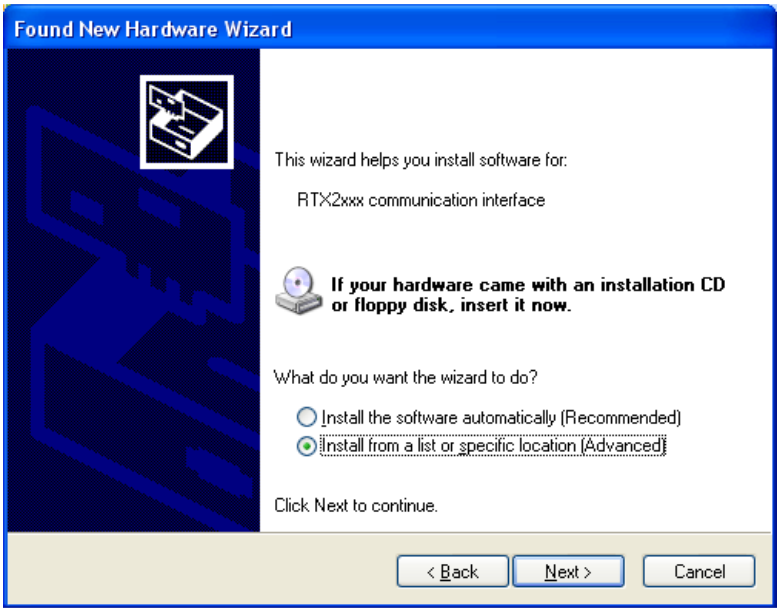
USB driver on a 64-bit platform please contact RTX (see chapter 8 section D for contact information) if you experience problems in 64-bit mode.

To install the USB driver please turn on your computer and do the following:

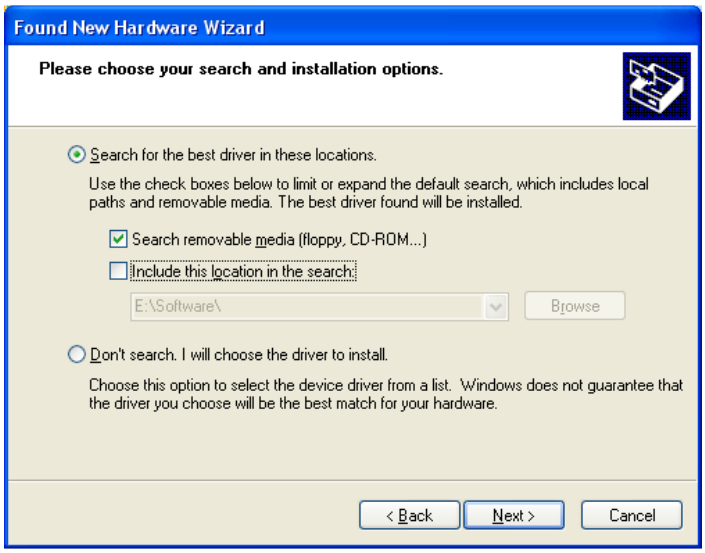
1) Connect one end of the supplied USB cable into the USB port of the RTX2012 tester (on rear panel) and connect the other end to a USB port on your Windows PC.

2) Connect the RTX2012 tester to a power source and turn on the tester. The **Found New Hardware Wizard** window will now appear (see below).

3) Select **No, not this time** and click **Next**.

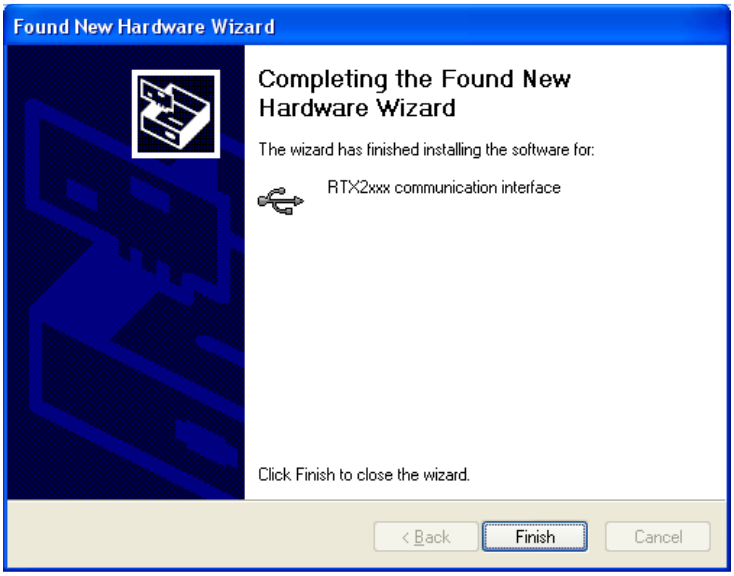


4) Insert the supplied RTX2012 CD ROM into the CD ROM drive and select **Install from a list or specific location (Advanced)**.



5) Select **Search for the best driver in these locations** and **Search removable media** and click **Next**. Alternatively select **Include this location in the search** and enter a direct path to the driver. The installation should start, hence showing the **Please wait while the wizard installs the software** message.

6) Upon completion of the USB driver installation the **Completing the Found Hardware Wizard** is displayed (see below).



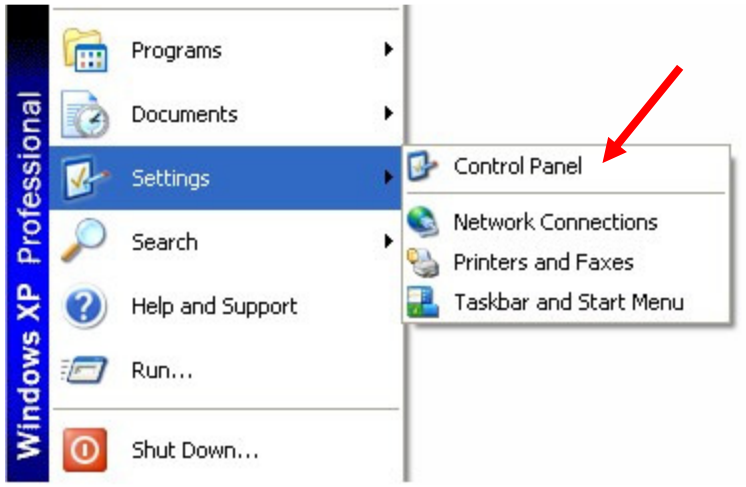
3) Click **Finish** to close the wizard. The RTX2012 USB driver should now be successfully installed and you can proceed with installation of the RTX2012 User Interface along with the RTX2012 DLL (see subsections iii and iv in this chapter).

iii. Installing the Windows based User Interface

As a first step please make sure that your PC adheres to the minimum requirements listed above. Thereafter please turn on the PC and insert the supplied RTX2012 CD ROM into the CD ROM drive.

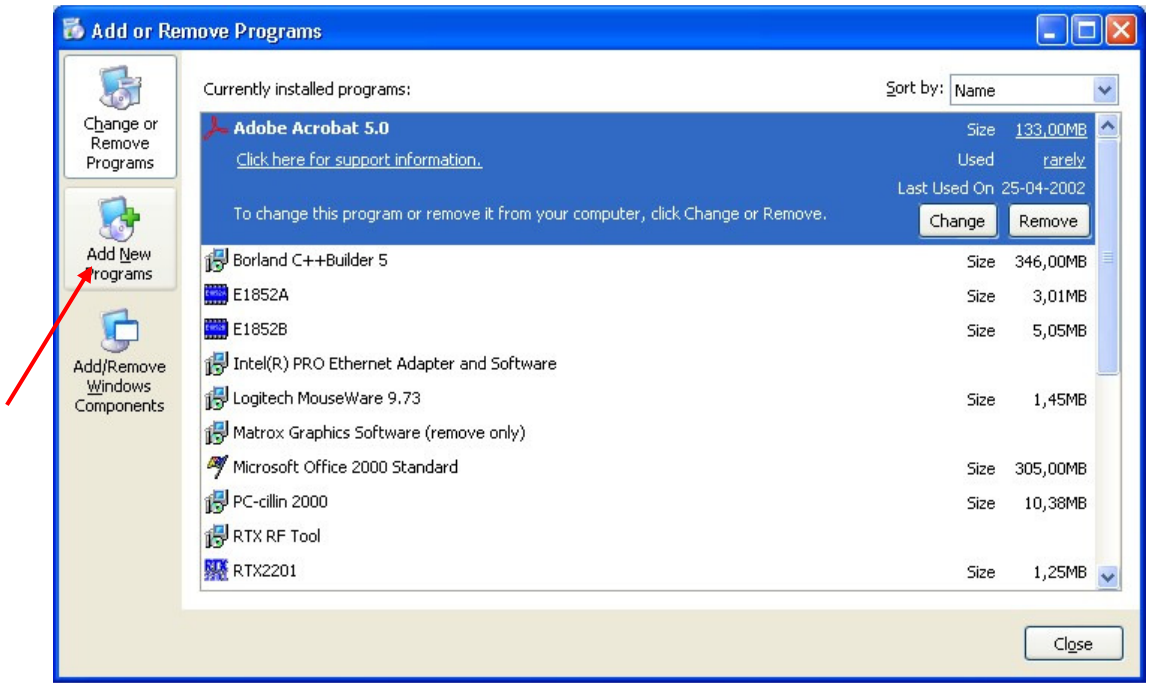
Please note that the outlined screenshots and the procedure described in this paragraph are based on a PC using Windows XP. Hence, if you use another Windows OS on your PC the setup procedure can deviate a bit from the one shown here.

❶ Select **Settings** from **Start** button. Select **Control Panel**.

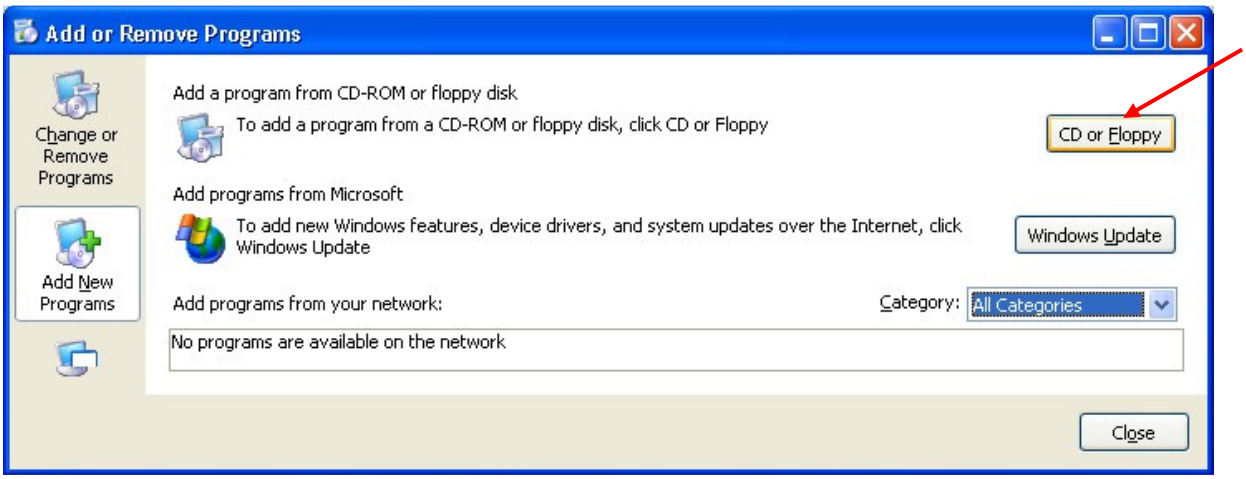


❷ Click **Add or Remove Programs**.

❸ Click **Add New Programs**.

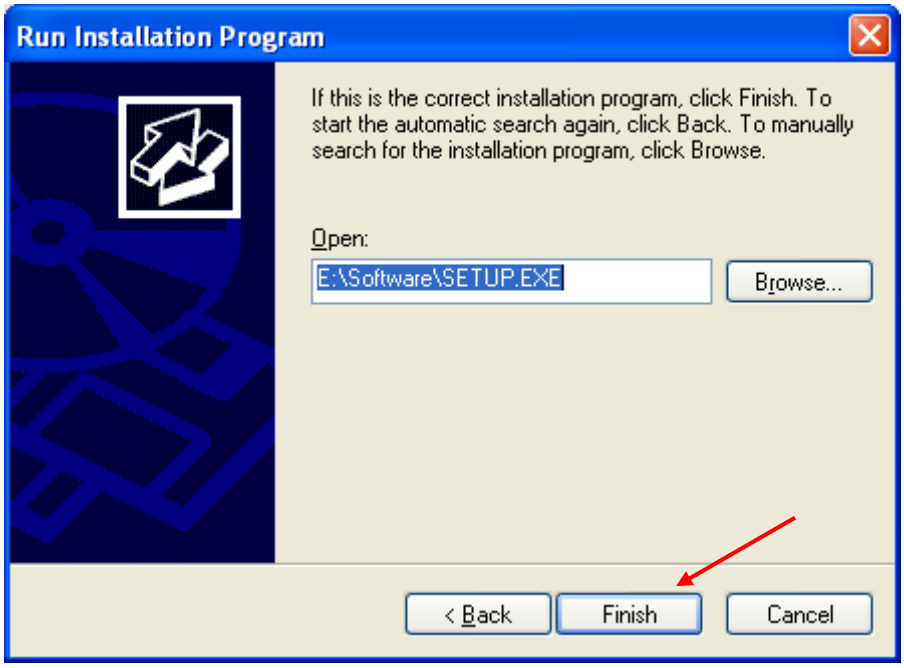


❹ Click **CD or Floppy**.



- Please insert the RTX2012 CD ROM and click **Next.**

❺ Click **Browse** to find `Setup.exe` for the Windows application or enter the path name



Click **Finish** and you will be guided through the rest of the installation procedure. Please note that the RTX2012 Windows Application is installed into the following directory path as default:

`C:\Program files\RTX\RTX2012\`

Upon completion of the installation procedure the RTX2012 Windows Application icons (see below) should be visible on the PC desktop as well as in the **Start** menu under **All Programs – RTX2012**. Please also restart the PC after installation.

Please note that there are two different applications – `RTX2012` and `RTX2012 Debug`. The only difference between these two is that the latter is a special ”Debug” mode of the ”normal” RTX2012 Windows application.

Running the RTX2012 Windows application in ”Debug” mode can be very useful when developing your own test programs. Please refer to section C in the Programming Reference chapter (i.e. chapter 5) for more information on how to use the ”Debug” mode.

iv. Installing the RTX2012 DLL

It is not necessary to explicitly install the RTX2012 DLL. It will be installed as part of the RTX2012 User Interface installation process. After successful installation of the RTX2012 SW the DLL will be in the location indicated in paragraph i on page 90.

E. Launching the RTX2012 Windows Application

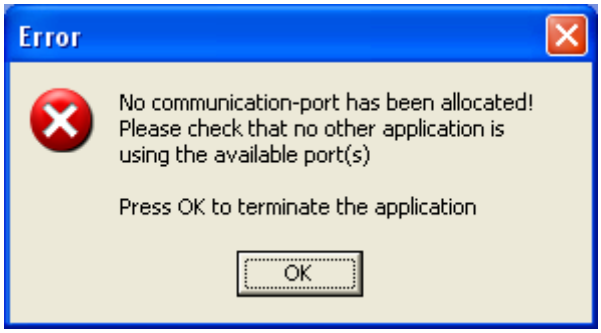
This paragraph outlines how to launch the RTX2012 Windows application in both normal and debug mode. Hereby you can also check that the installation was successful. Prior to launching the RTX2012 Windows application please ensure that:

- The RTX2012 Windows application has been installed on your PC
- The RTX2012 tester is connected to your PC using the USB interface
- The RTX2012 tester is switched on
- Nothing is connected to the RF Input/Output connector on the front panel

i. Launching the RTX2012 Windows Application in Normal mode

If you want to start the RTX2012 Windows application in normal mode, double click on the `RTX2012 Tester` icon on the desktop (or select the application from the start menu).

If you see the error message below the PC has been unable to establish communication with the RTX2012 tester.



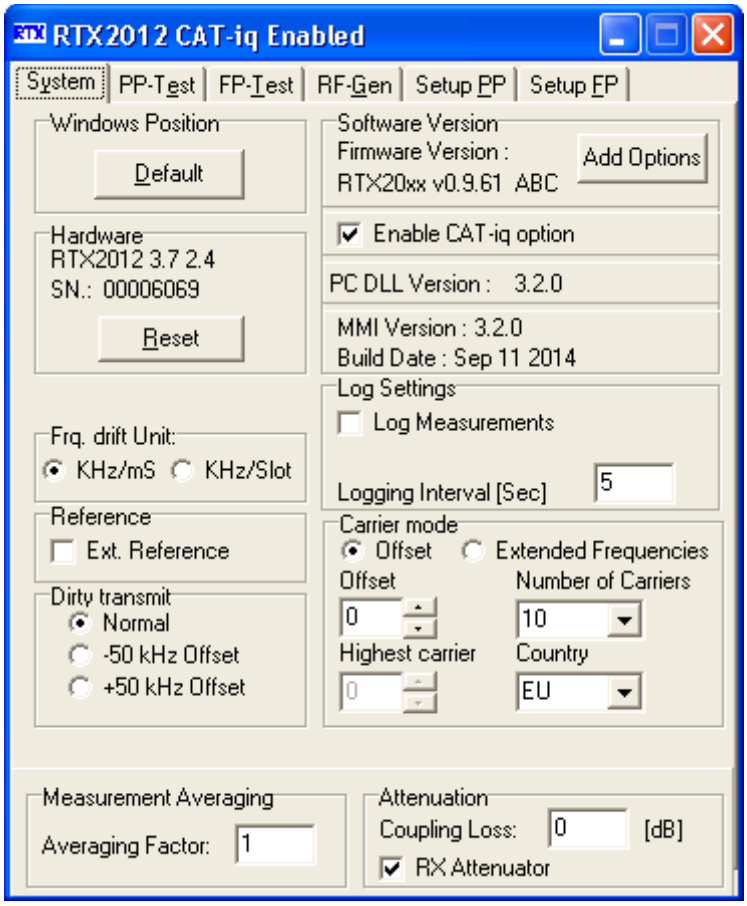
Please click **OK** and check all connections between the PC and tester along with the Power LED on the front panel. If the power LED is lit the tester should be operational, and hence, please check and/or replace the USB cable between the PC and the tester and try launching the application again.

If you still experience problems after trying the steps outlined above you could either try to reinstall the RTX2012 SW package or refer to the Maintenance chapter (chapter 8) on how to proceed if this does not help either.

Please note that the RTX2012 Windows application is unable to launch in both normal and debug mode if the communication to the tester fails.

If the USB connection to the tester is valid the message below is displayed, hence indicating that the RTX2012 Windows application is starting up.

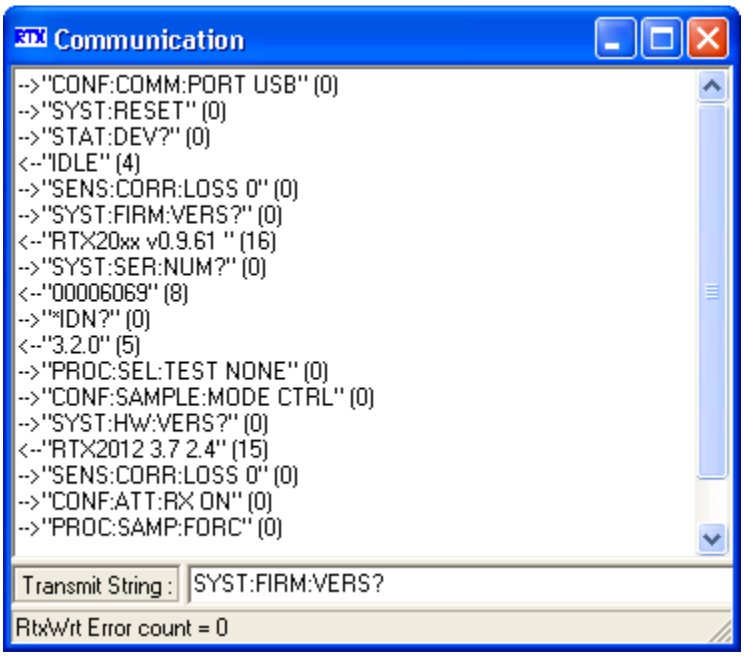
After successful initialization of the tester the RTX2012 User Interface will appear (see below) and the installation is ok.



ii. Launching the RTX2012 Windows Application in Debug mode

If you want to start the RTX2012 Windows application in debug mode, double click on the `RTX2012 Debug` icon on the desktop (or select the application from the start menu). Here the same procedure in relation to connection failure applies to the debug mode start-up.

If the connection to the tester could be established an extra window will be opened together with the normal RTX2012 User Interface window. This communication window (see below) shows all communication between the PC and the RTX2012 tester. Furthermore, SCPI commands can be sent directly to the tester using the command field on the communication window. For more information about the command interface please refer to section C in chapter 5.



2. Windows Interface

A. **Introduction**

As mentioned in the previous chapter the RTX2012 tester can be controlled through the supplied Windows based user interface or by using the SCPI compliant remote command set (through your own test programs or the command field in the communication window of the RTX2012 user interface in debug mode).

The Windows user interface is intended for use in development and service situations and supports installation in Windows XP / Windows 7 environments. It offers easy access to a wide range of functions for use in test of both DECT/DECT 6.0/CAT-iq FP's and PP's. The user interface requires only a small amount of desktop space by using tab dividers to separate each major system mode. Each of the tabs will be described in more detail in the following sections.

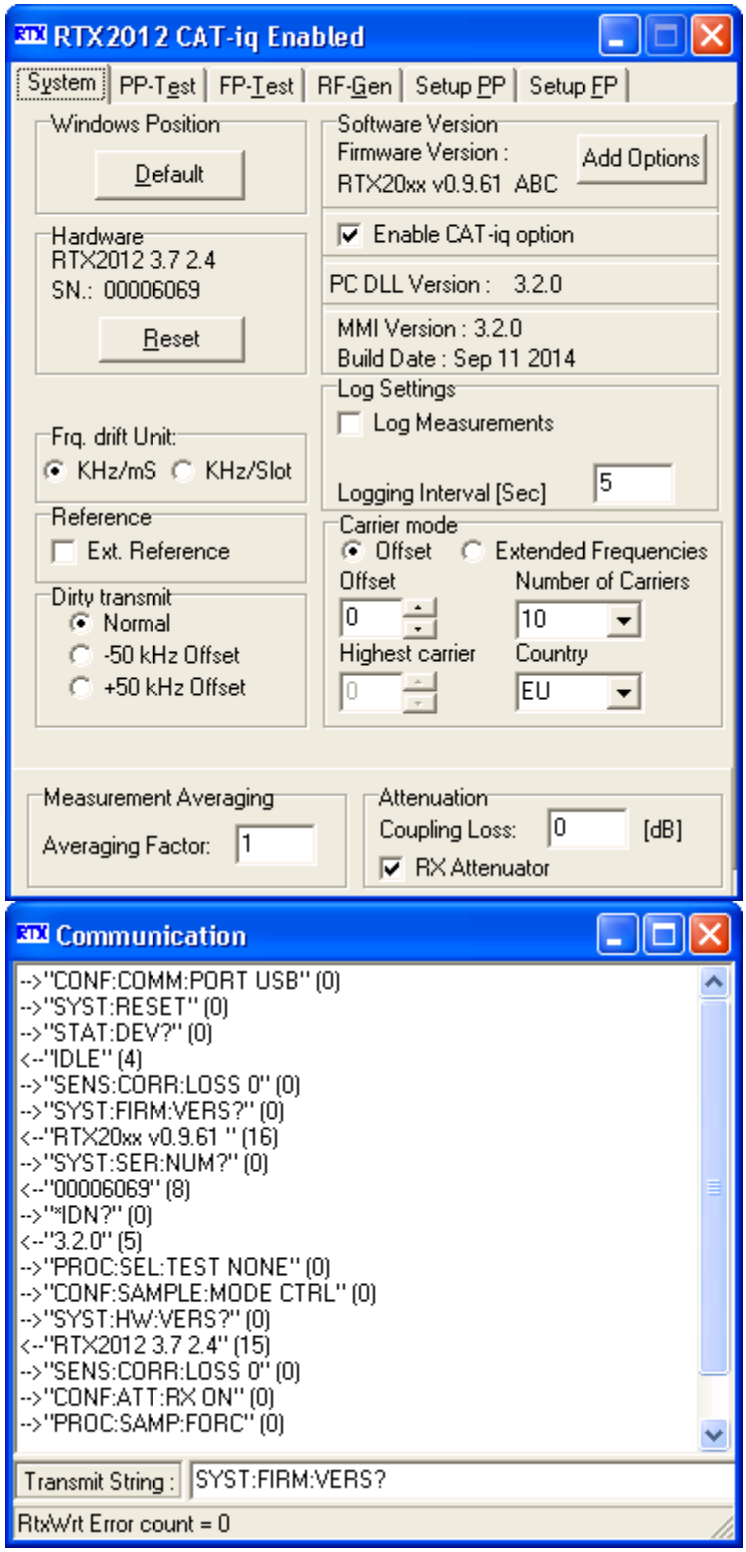
Double-click on the `RTX2012 Tester` desktop icon to launch the Windows user interface.

Alternatively, find and select `RTX2012 Tester` from the `Start`→`Programs` menu (as outlined below).

Please note that selecting `RTX2012 Debug` instead launches the Windows user interface in debug mode. In this mode an additional window will open and it the complete remote command dialogue between your computer and the RTX2012 tester is shown. All entries in the window can be captured in a log file. This feature is especially useful if you intend to develop your our control programs.

B. **System Page**

The **System** page (see below) contains all the settings required for communication between a PC and the tester and between the tester and a DUT.



Please note that the RTX2012 user interface shown above is opened in "Debug" mode. The extra communication window below the main RTX2012 user interface can be used for

recording the communication between your PC and tester, and furthermore, the **Transmit String** command line field in the bottom of the window can be used for manually sending a command to the tester. For details on the command set including additional information on how to use this field please refer to the "Programming Reference" in chapter 5.

i. System Page Overview

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

Panel	Parameters	Short description
Windows Position	N/A	Reset RTX2012 user interface windows size and placement on the desk top
Hardware	N/A	Tester type, hardware version and serial number
Frequency Drift Unit	kHz/ms, kHz/slot	Selects the unit used in the Frequency Drift Unit
Reference	ON, OFF	Selects the reference 10 MHz clock source (i.e. ON = external ref., OFF = internal ref.) – option B required
Dirty transmit	Normal, -50 kHz offset, +50 kHz offset	Selects the transmit offset – this can be +/- 50 kHz or normal (i.e. no offset) – option B required
Software Version	N/A	Software version of the tester Firmware, DLL and MMI along with the enabled options
Log Settings	Log level and logging interval (0-999 [sec])	Indicating what to include in the log and how often the log should be updated.
Offset and Extended Frequencies selection	Offset or Extended Frequencies	Select the desired carrier numbering. Option C required.
Number of Carriers	1 to 10	Number of avaible test carriers. 10 for EU DECT and 5 for US DECT
Carrier Offset	-22 to 3	Offset for carriers – 0=EU DECT and -18=US DECT
Highest carrier	0 and 10 to 31	Carrier number of the highest frequency it is possible to connect on. 0=EU DECT and 27=US DECT. Option C required.
Measurement Averaging	Average factor (1-200)	Number of frames used for average measurements
Attenuation	Coupling loss (0-100 [dB])	Known cable coupling loss

All of the above panels and fields will be described in more detail in the following paragraphs.

ii. Windows Position

Pressing the **Default** button in the **Windows Position** panel will restore all RTX2012 user interface window(s) back to the default size and position (i.e. upper left corner of your PC display).

iii. Hardware

In the **Hardware** panel the tester type, hardware version and serial number are displayed. Hence, in the user interface above the tester type is RTX2012, hardware version is 2.4.3.7, and the serial number is 00006138). Please refer to these items of information from your tester in support issues.

Clicking **Reset** will reset the tester and all prior tester configurations are retained. Please note that the **Reset** button will change to **Wait**, hence indicating that a reset is in progress. When complete the button will change to **Reset** again.

iv. Frequency Drift Unit

Using the radio buttons in the **Frq. Drift Unit** panel will set the unit for Frequency Drift measurements accordingly. The unit can be either kHz/ms or kHz/Slot.

v. Reference

The check-box in the **Reference** panel is used for indicating which reference 10 MHz clock generator must be used when performing measurements. If selected an external source for the 10 MHz clock is used. The external reference clock is connected to the "10MHz CLK" BNC input on the rear panel of the tester (see page 26). If not selected the internal reference is used. ***Please note that the external reference support comes with Option B***, and hence, this functionality is not available without Option B support in the tester firmware. ***Please ensure that the external reference clock generator is connected and operating correctly when using the external reference mode. The tester will NOT automatically switch over to the internal reference if the external reference is either not connected or operating properly.***

vi. Dirty Transmit

Using the radio buttons in the **Dirty Transmit** panel the transmit offset can be set to + / - 50 kHz or normal (i.e. no offset). ***Please note*** that the dirty transmit feature requires Option B support, and hence, this functionality is not available without Option B.

vii. Software Version

In essence the **Software Version** panel contains the version of the SW parts in the RTX2012 setup along with an overview of the available options. Hence, the following items of information are included:

- RTX2012 Tester Firmware version
- Available options (enabled / disabled)
- Software version of the RTX2012 DLL
- Software version of the RTX2012 Windows user interface

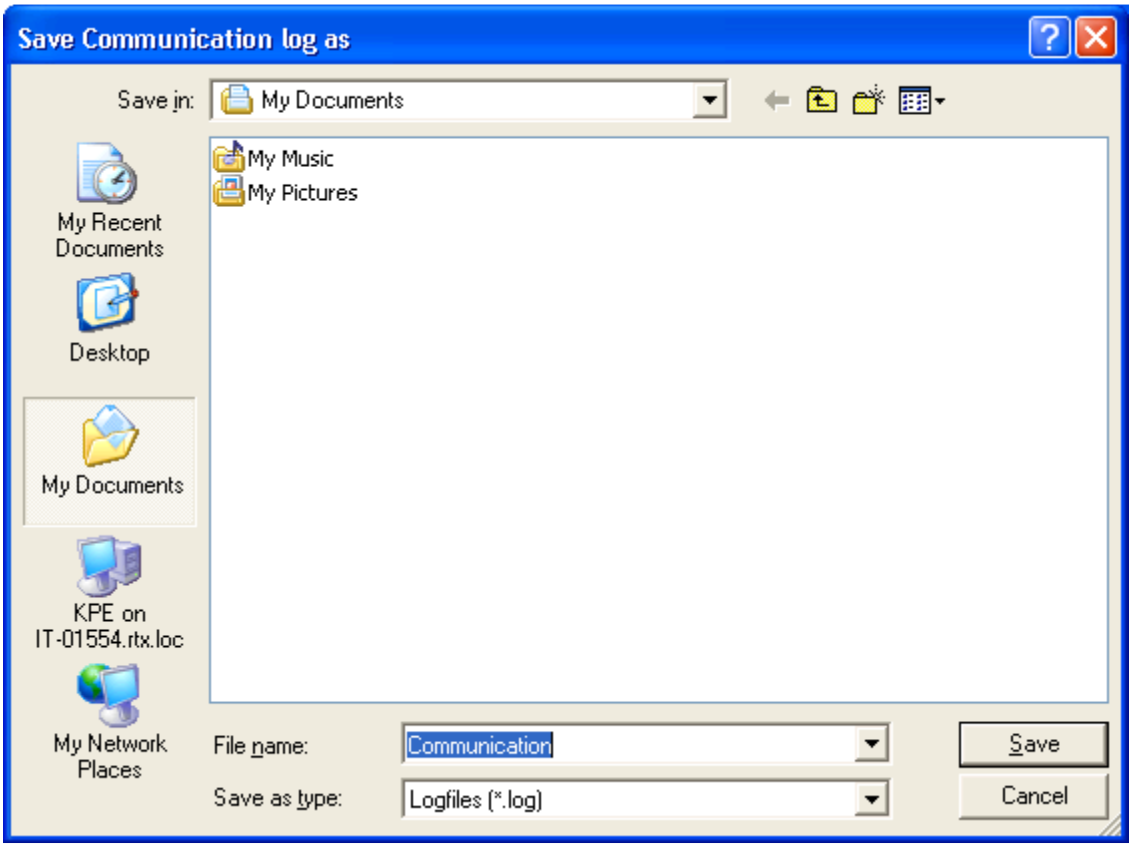
Consequently, the items of information shown in the **Software Version** panel on page 39 will translate to:

- RTX2012 Tester Firmware SW version: 0.9.49 AB
- Available (and enabled) options: CAT-iq (A), External Reference Support (B)
- Software version of the RTX2012 DLL: 3.0.0
- Software version of the RTX2012 Windows user interface: 3.0.0

Please note that the character(s) after the Firmware SW version indicates the options which are enabled in Firmware. Please refer to paragraph xii on page 44 for more details on the available options and how to enable/disable them.

viii. Log Settings

The user interface can be configured to store measurement and communication information from the tester at user defined intervals (default: 5 seconds). The logging interval can be changed to anything between 0 and 999 seconds by entering the interval in the **Logging Interval [Sec.]** field. Clicking the **Log Measurements** or **Log Communication** check-box will open a dialog box and here you can choose the filename and path of the log-file. Please note that the **Log Communication** check-box is only available in Debug mode.



Please note that the measurements and communication logs are stored in different files. Furthermore it is emphasized here that the communication logging is only available in "Debug" mode. The communication log-file contains the same information that will be shown in the communication window.

The measurement log-file contains measured values related to the DECT RF measurements performed. For example, in loop back measurements, with a 5 second interval the BER values are logged into the file as shown below.

```
11:22:04; FP Mode
11:22:04;   NTP;+FrqDev;-FrqDev; FrqOff;  FrqDft;   BER;   FER;  +Jitter;  -Jitter;
11:22:09;  23.6;  353.9; -354.9;   -2.5;    1.1;  0.00000;  0.00000; 0.1;-0.1;
11:22:14;  23.6;  355.1; -356.7;   -1.9;   -2.6;  0.00000;  0.00000; 0.1;-0.1;
11:22:19;  23.6;  355.1; -353.1;   -3.1;    3.5;  0.00000;  0.00000; 0.1;-0.1;
11:22:24;  23.6;  354.5; -353.3;   -1.7;   11.6;  0.00000;  0.00000; 0.1;-0.1;
```

This type of text-only file can easily be imported into a spreadsheet for analysis.

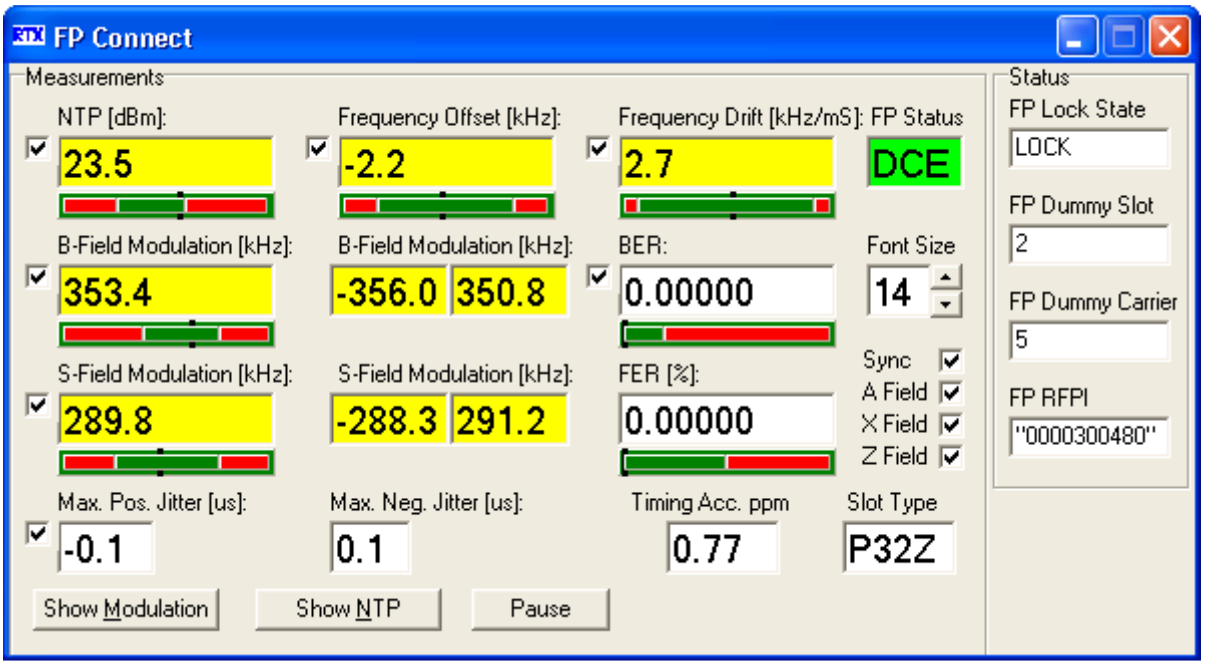
ix. Carrier Offset

The carrier offset can be set either using the pull-down list (right side) in the **Carrier Offset** pane or by using the up/down arrows (left side). Please note that only two values are available through the pull-down list – EU (=0) and US (=-18).

x. Measurement Averaging

You can choose to perform measurements on single bursts or average the results over a number of bursts (up to a maximum of 200) but the default setting of 1 is often the optimum value.

If a higher number of bursts than 1 is selected, the power and frequency measurements are indicated with a yellow background until the selected number of bursts has been obtained (see example below).



xi. Attenuation

If the coupling loss at the RF IN/OUT connector is known, the value can be entered in the **Coupling Loss** field. The tester factors the loss into the measured results and compensates 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.

IMPORTANT!
In order to avoid power saturation the RX Attenuator must be enabled if the input power signal is above 6 dBm.

xii. RTX2012 Firmware Options

Available Options

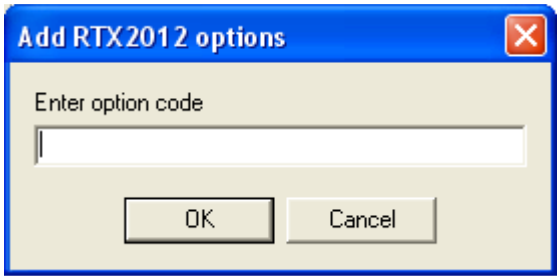
The following options are available for the RTX2012 tester:

- **CAT-iq (Option A)** – This option enables measurements using CAT-iq slot types.
- **External 10MHz Reference (Option B)** – This option enables the use of an external 10 MHz reference clock generator and the transmission offset (Dirty Transmit) feature.
- **Extenden frequencies (Option C)** – This option used extended frequencies according to EN 300 175-2 V2.5.1 Annex F.2. It is possible to use carrier number 0-31 when this option is active.

The options supported by your tester are indicated in the firmware version (and on the option label on the rear panel of the tester – see also page 16) - if the option letter is part of the firmware version then the option is supported (see the screen shot below). If it is not supported then you can purchase the option and add it as outlined in the paragraph "Adding new options" (see below).

Adding new options

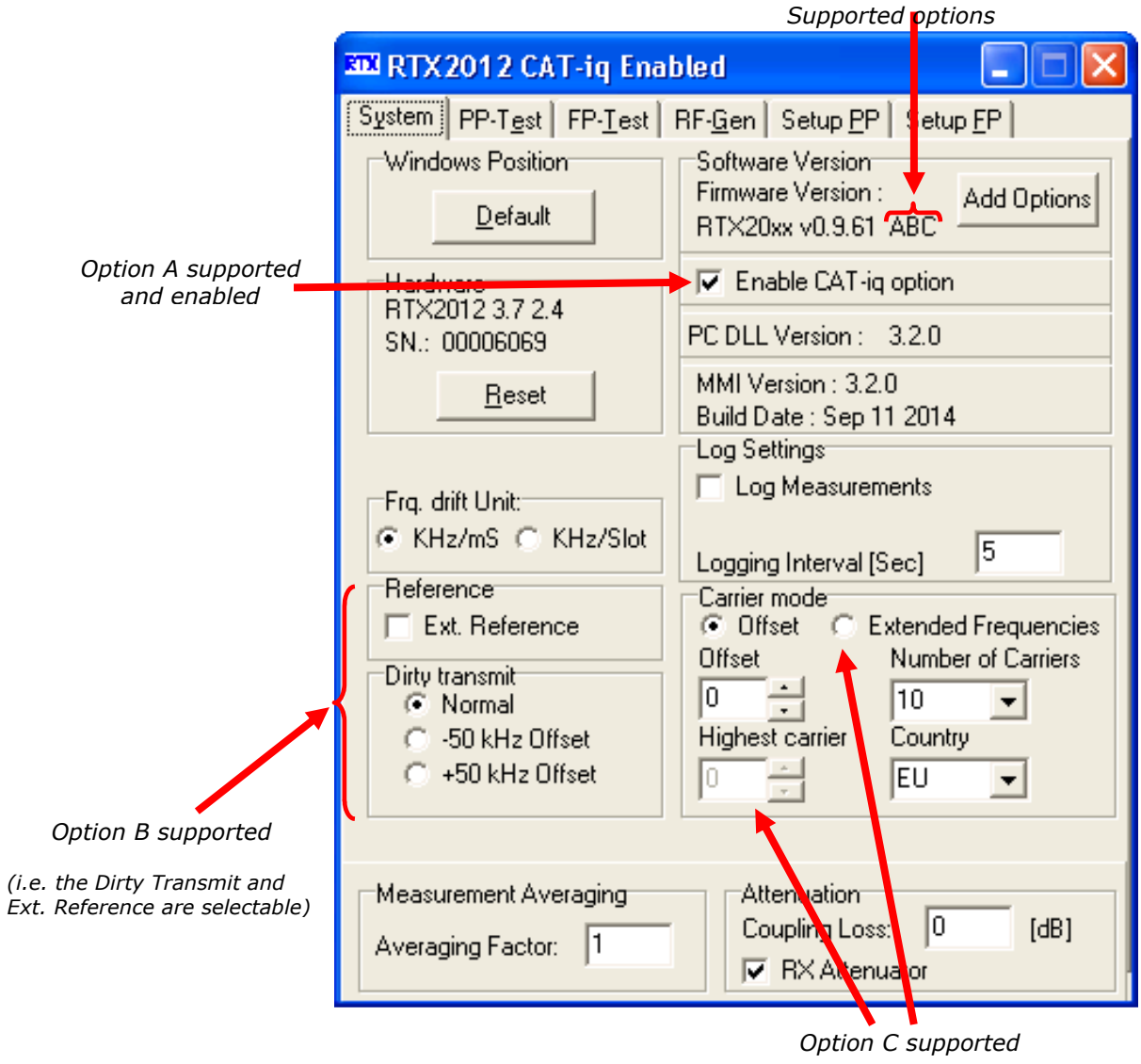
Click on the **Add Options** button on the System page and a small window will open (see below).



Enter the option code for the specific tester and click **OK**. The added option should now appear as a character at the end of the firmware version (e.g. A = CAT-iq, B = External Clock Reference etc.).

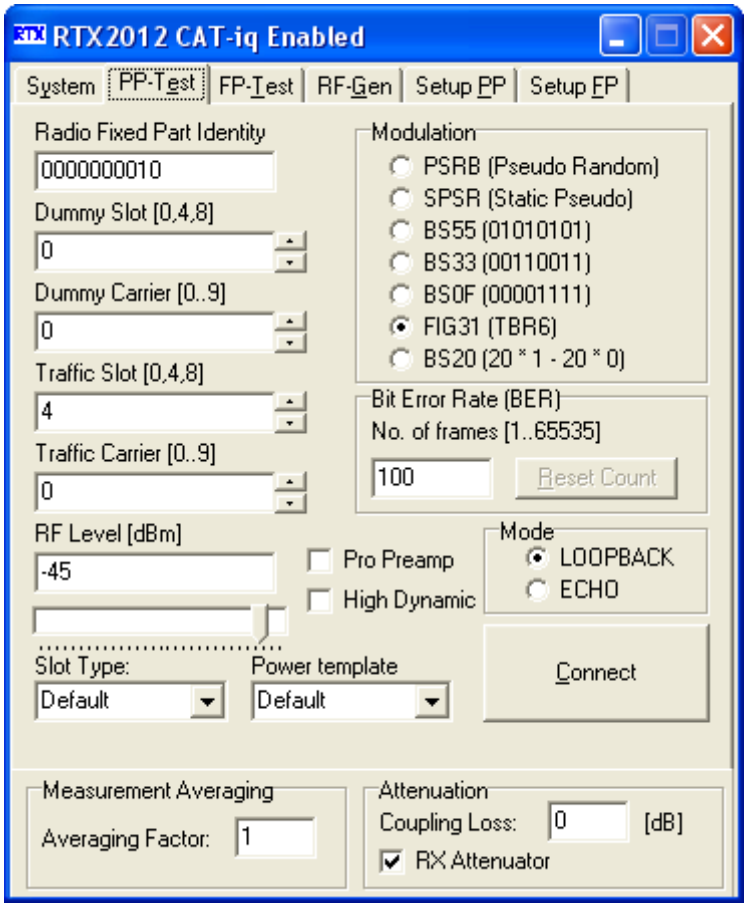
Enabling/disabling options

If the tester firmware supports an option it can be enabled and disabled through the **System** page. If an option is not supported in firmware the panes related to the specific option cannot be selected (indicated by light grey colour). In the example below both option A and B are supported (i.e. the functionality for the options are selectable on the User Interface). Please note that supported options always will be enabled after a system reset.



C. **Portable Part Test Page**

The "PP-Test" page (see below) contains the settings required for performing measurements with the tester on a Portable Part (i.e. the tester acts as fixed part).



i. PP-Test Page Overview

The **PP-Test** page contains the following panels:

Panel	Parameters	Short description
Radio Fixed Part Identity	0x00000000001–0xFFFFFFFFFF	Radio Fixed Part Identity of the tester
Dummy Slot	0, 2, 4, 6, 8, 10 or 0, 4, 8 (CAT-iq enabled)	Selects the slot to use for the dummy bearer
Dummy Carrier	0 to 9	Selects the carrier to use for the dummy bearer
Traffic Slot	0, 2, 4, 6, 8, 10 or 0, 4, 8 (CAT-iq enabled)	Selects the slot to use for the traffic bearer
Traffic Carrier	0 to 9	Selects the carrier to use for the traffic bearer
RF Level	-100 to -40 dBm	Selects power level in the tester in transmit direction
Slot Type	P32Z and P64Z (CAT-iq enabled)	Selects the slot type used for connection setup
Power Template	P32Z, PP32Z and P64Z, PP64Z (CAT-iq enabled)	Selects the slot type used in power ramp measurements
Modulation	PSRB, SPSR, BS55, BS33, BS0F, FIG31, BS20	Selects the modulation pattern for measure-ments
Bit Error Rate (BER)	1 to 65.535	Selects the number of frames used in BER measurements
Mode	LOOPBACK, ECHO	Selects Loop-Back or Echo mode
Connect	N/A	Connect to a PP
Pro Preamp	N/A	Selects normal or prolonged preamble support
High Dynamic	N/A	Selects the dynamic range for power ramp measurements

All of the above panels and fields will be described in more detail in the following para-graphs. Please be aware of the fact that the settings must respect the type of device under test.

ii. Radio Fixed Part Identity

The **Radio Fixed Part Identity** indicates the Radio Fixed Part Identity (RFPI) of the tester (5 bytes in the range 0x0000000001 to 0xFFFFFFFFFF). The RFPI in the input field must be input as 10 hex digits. Please note that 0x0000000000 is not a valid RPFI value.

iii. Dummy Slot

The number in the **Dummy Slot** input indicates the time slot to use for the dummy bearer. Valid slots are 0, 2, 4, 6, 8 and 10 if the CAT-iq option is disabled. If the CAT-iq option is enabled only slots 0, 4 and 8 are available.

iv. Dummy Carrier

The number in the **Dummy Carrier** input field indicates the carrier to use for the dummy bearer. Valid carriers are 0 to Number of Carriers in Offset mode, but with option C and Extended frequencies activated the limits are set by Highest Carrier and Number of carriers.

v. Traffic Slot

The number in the **Traffic Slot** input indicates the time slot to use in call setup. Valid slots are 0, 2, 4, 6, 8 and 10 if the CAT-iq option is disabled. If the CAT-iq option is enabled only slots 0, 4 and 8 are available.

vi. Traffic Carrier

The number in the **Traffic Carrier** input field indicates the carrier to use in call setup (i.e. this carrier contains the RF parameters). Valid carriers are 0 to Number of Carriers in Offset mode, but with option C and Extended frequencies activated the limits are set by Highest Carrier and Number of carriers.

vii. RF Level

The **RF Level [dBm]** indicates the power level in the tester in the transmit direction and it can be adjusted for sensitivity measurements (variable from –100 dBm to -40 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 (i.e. the slider under the input field). Please note that the in the input fields changes when moving the slider.

viii. Slot Type

The number in the **Slot Type** input indicates the slot type (P32Z or P64Z) to use in connection establishment. Please note that the slot type P64Z is only available with the CAT-iq option enabled.

ix. Power Template

The number in the **Power Template** input indicates the slot type (P32Z, PP32Z, P64Z or PP64Z) to use in power ramp measurements. Please note that the slot types P64Z and PP64Z are only available with the CAT-iq option enabled.

x. Modulation

In this panel six different modulation patterns can be chosen (described in the following):

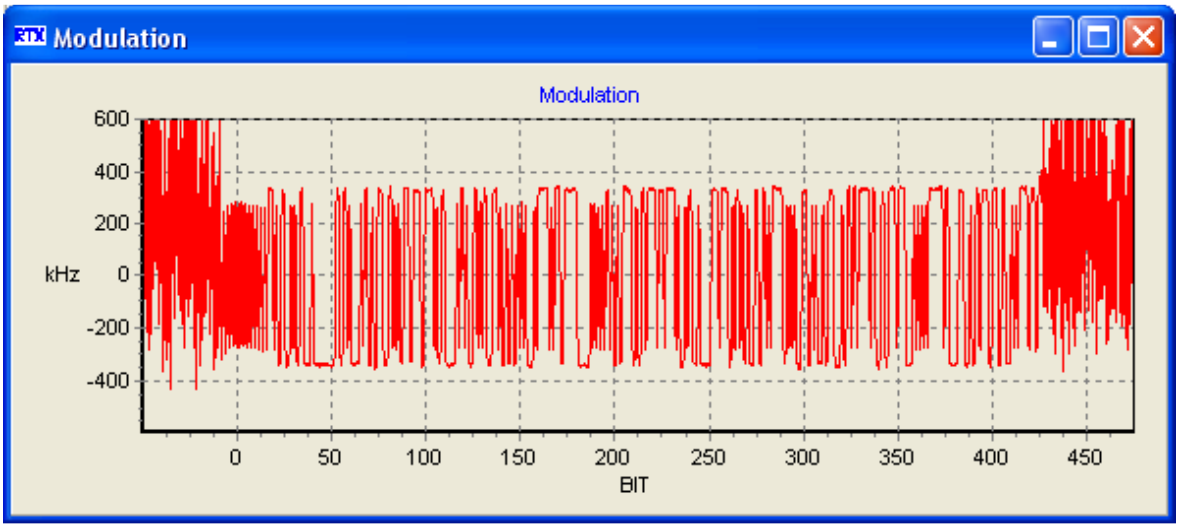
- PSRB = Pseudo Random Bit sequence
- SPSR = Static Pseudo Random bit sequence
- BS55 = Alternating zeros and ones
- BS33 = Alternating double zeros and ones

- BS0F = Four times zero and one, alternating
- FIG31 = Test signal used for deviation and sensitivity measurements.
- BS20 = 20 times one and zero, alternating

PSRB

The Pseudo Random bit sequence is a haphazard modulation sequence, simulating a real transmit operation. This modulation pattern is recommendable in sensitivity measurements.

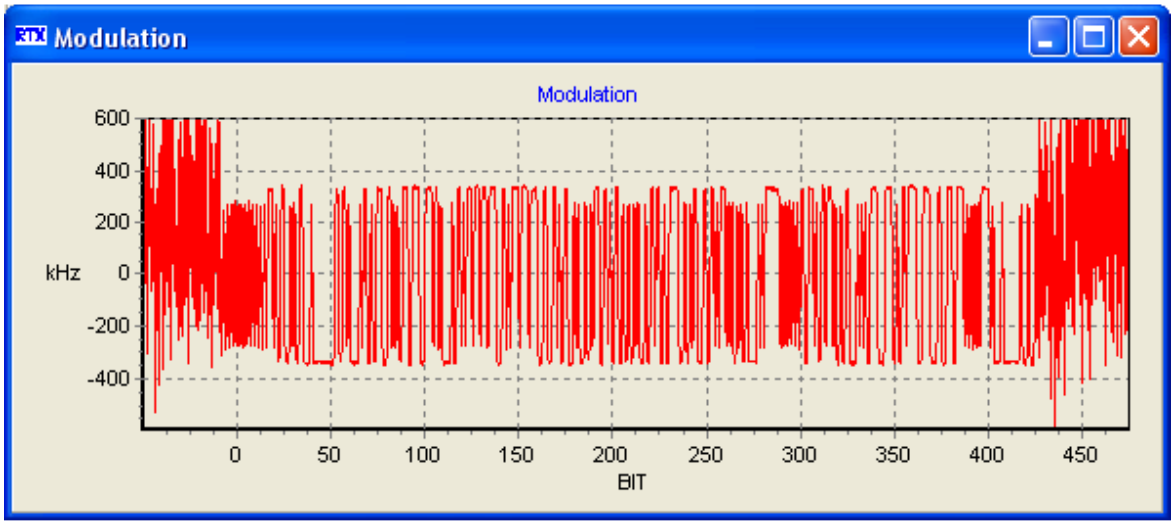
PSRB modulation pattern



SPSR

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

SPSR modulation pattern



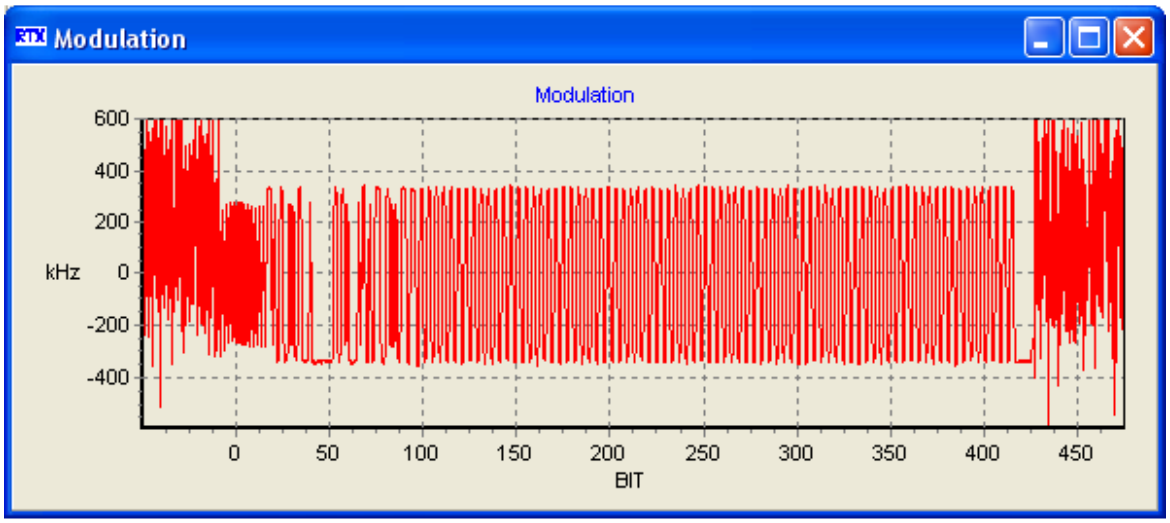
BS55

The BS55 data sequence is alternating zeros and ones. This modulation has the smallest deviation and is preferable in frequency drift measurements.

BS33

The BS33 data sequence is alternating between two times zeros and two times ones.

BS33 modulation pattern



BS0F

The BS0F data sequence alternates between four times zeros and four times ones. This pattern has a high deviation.

BS0F modulation pattern

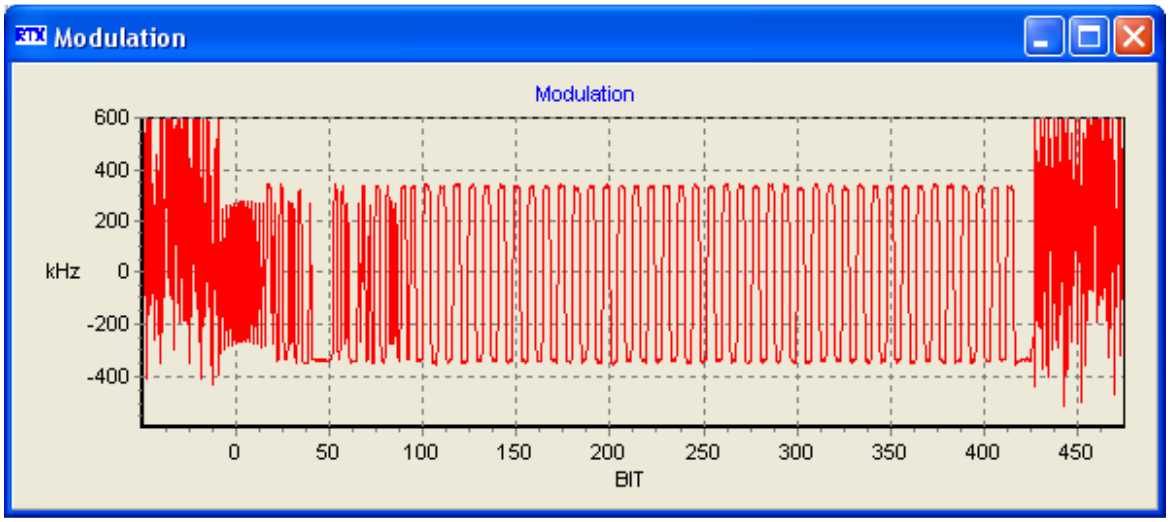
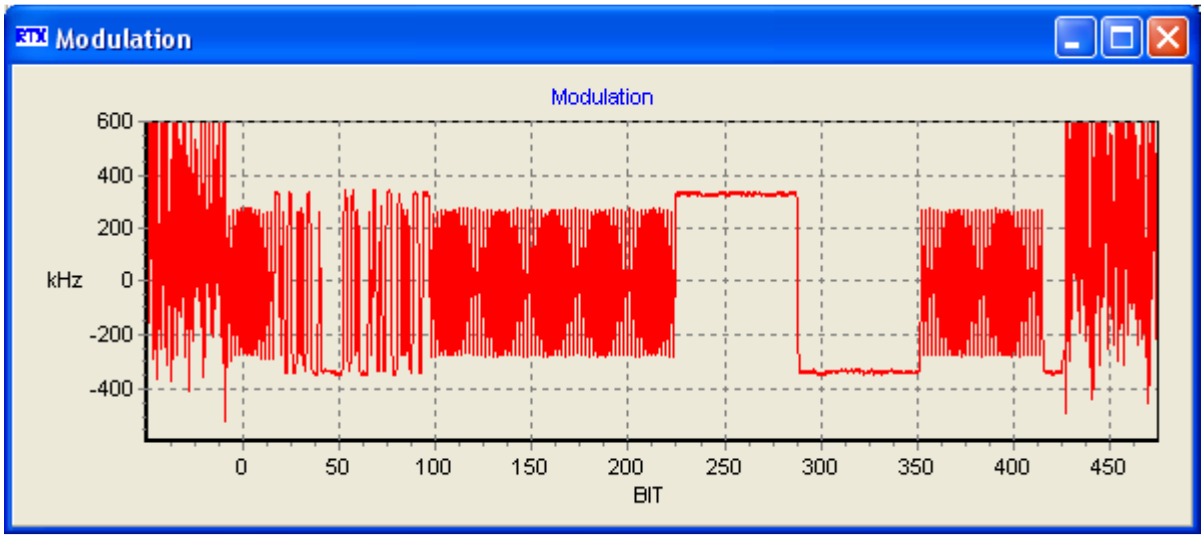


FIG31

This modulation pattern is preferable when performing deviation measurements due to the long sequence of zeros and ones.

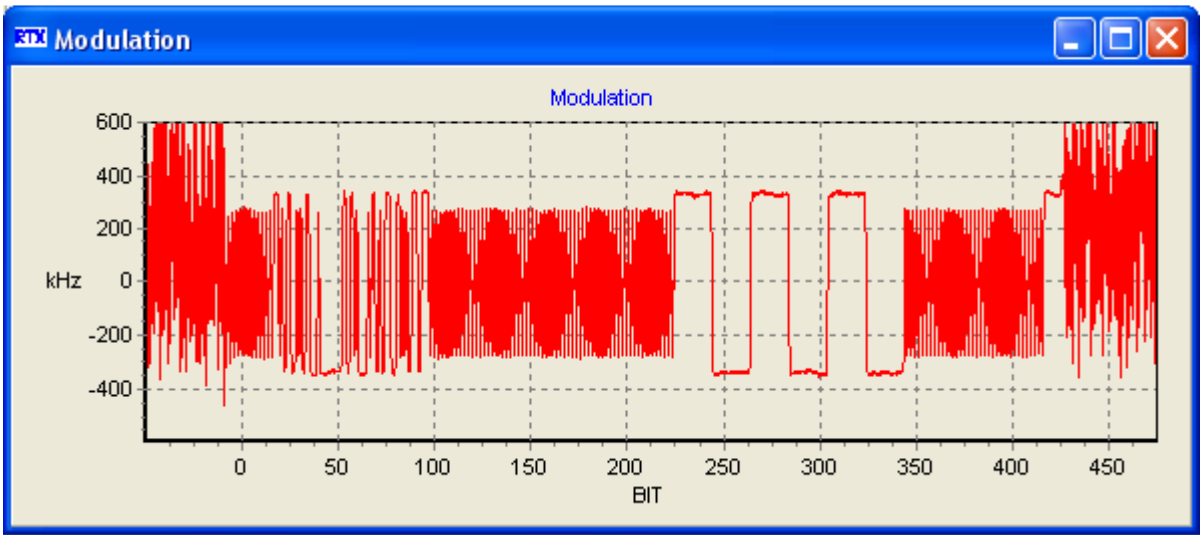
FIG31 modulation pattern



BS20

The BS20 data sequence alternates between 20 times ones and 20 times zeros.

BS20 modulation pattern



xi. Bit Error Rate (BER)

The number of frames to be used in calculating the measured **Bit Error Rate (BER)** can be input in the entry field. The valid range is 1 to 65535 frames (default 100). The **Reset Count** button will become active when a connection has been established and when clicking it the BER calculation will be restarted.

Please note that the BER can vary quite a lot with small changes in the RF level. A change from 0.01% to over 1% is possible due to a 5dB level change. Most DECT radios have a sensitivity level at – 80 dBm to – 95 dBm.

xii. Mode

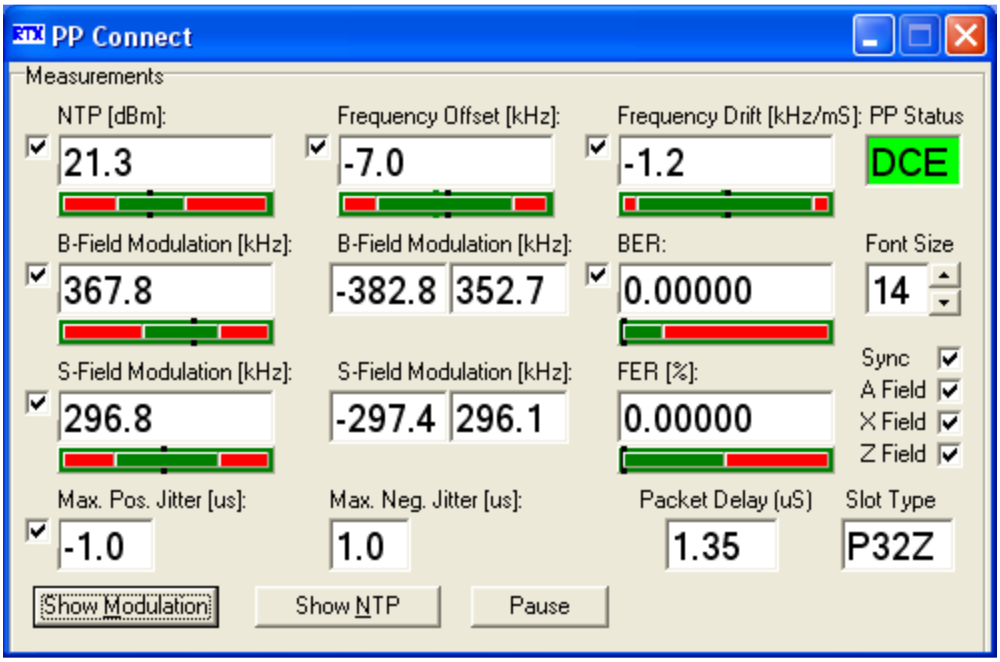
Using the radio buttons in the **Mode** panel will set the mode of operation. This can be either LOOPBACK or ECHO.

If the mode is set to LOOPBACK the DUT will be set to loopback mode, hence returning the transmitted data without modification. Please note that this mode is a prerequisite for modulation, frequency offset, frequency drift, and BER/FER measurements.

If the mode is set to ECHO the tester will send the signals received from the DUT back to the DUT with a delay of one second. This mode is mainly used for qualitative testing of the DUT. Please also see section D on page 81 on how to perform tests in ECHO mode.

xiii. Connect (→ Release)

When clicking the **Connect** button a **PP Connect** window will open (see below) and the **Connect** button will change to a **Release** button. Consequently the connection can be closed again by clicking the **Release** button. Please note that closing the connection will also close the **PP Connect** window and the button on the **PP-Test** page will be reverted back to **Connect**.



The **PP Connect** window contains a wide range of connection related information. In essence the following four categories of information are provided in the **PP Connect** window:

- **RF Measurement Parameters**
- **Modulation graph**
- **NTP graph**
- **PP Status**

Each of these categories will be described in more detail in the following along with a paragraph outlining the zoom functionality for graph windows. Please also note that the measurements can be set on hold at any time by clicking the **Pause** button. This button will then change text to **Continue** and clicking this button the measurements are restarted again. Furthermore, the font size of the text in all fields on the **PP Connect** window can be changed by either typing a new value in the input field or by using the arrows. The font size is selectable from 8 to 14 (default).

RF Measurements Parameters

The following RF measurement parameters are displayed in the **PP Connect** window during active testing:

- **NTP**
- **Frequency Offset**
- **Frequency Drift**
- **B-Field Modulation**
- **S-Field Modulation**
- **BER**
- **FER**
- **Jitter and Packet Delay**
- **Packet Information**
- **Slot Type**

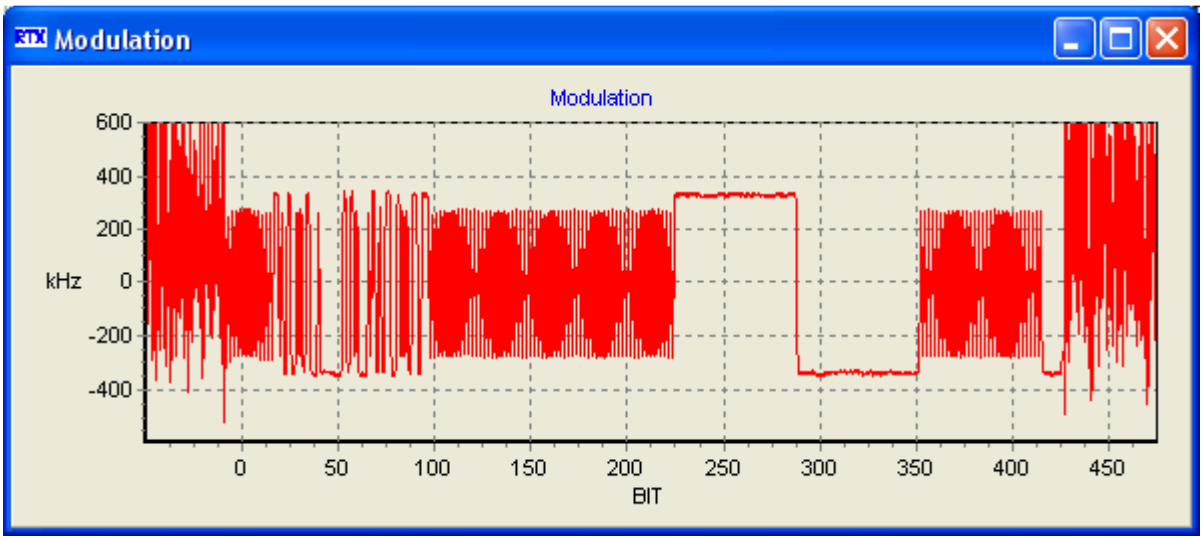
The measurement results are continuously updated and shown in the display fields of the **PP Connect** window. Associated with each result is a red/green bar with a small indicator in black. These bars are described in detail in paragraph ii of section F ("Setup PP") on page 64. Furthermore, each display field can be switch on/off by clicking the corresponding checkbox.

Please refer to "Performing Measurements" (chapter 3) for a more detailed explanation of each of the parameters above.

Modulation Graphs

Clicking on the **Show Modulation** button in the bottom left corner of the **PP Connect** window will launch a graph window outlining the real-time modulation (see below) and the button will change to **Close Modulation**. Hence, clicking this will close the modulation graph window.

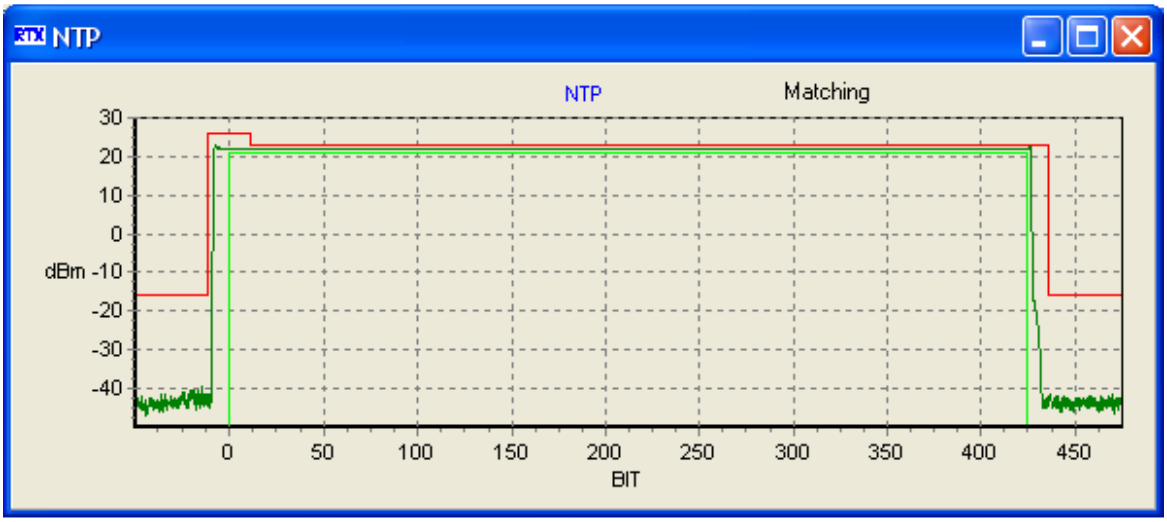
Modulation graph window



NTP Graphs

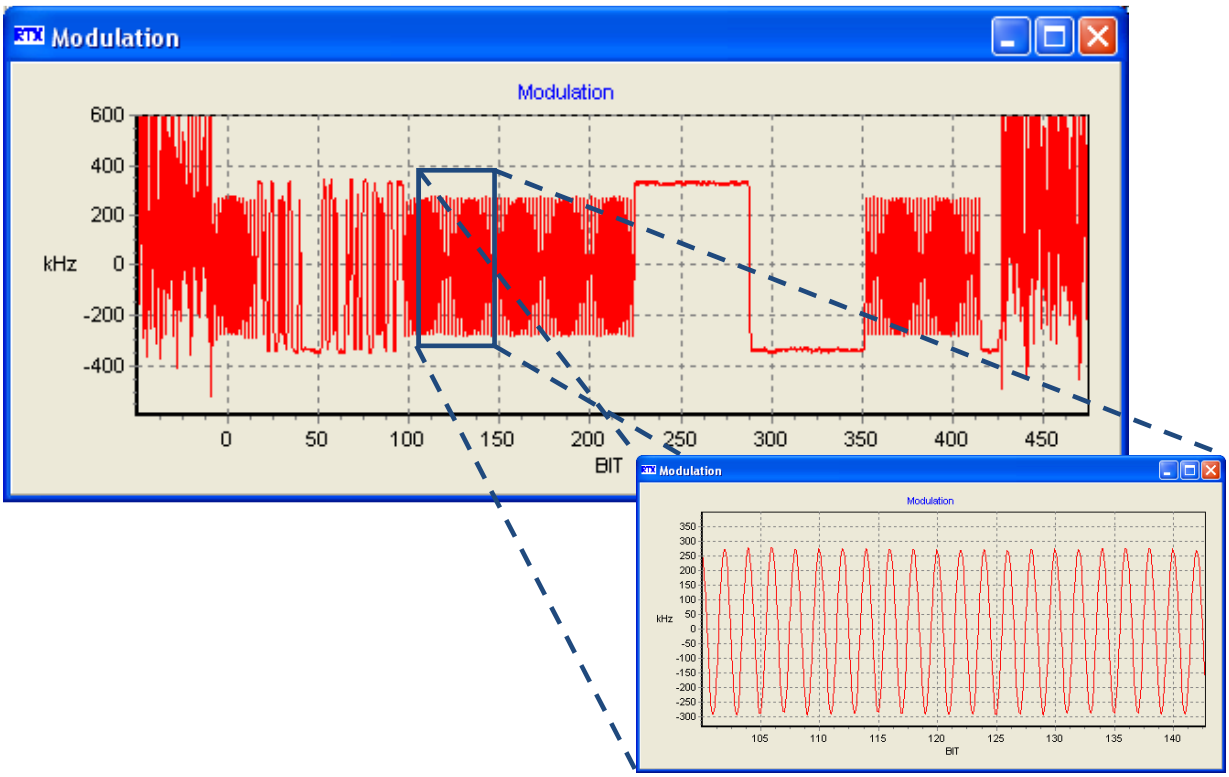
Clicking on the **Show NTP** button in the bottom of the **PP Connect** window will launch a graph window outlining the real-time NTP along with the power ramp template (see below) and the button will change to **Close NTP**. Hence, clicking this will close the NTP graph window.

NTP graph window (low dynamic)



Zoom functions in the graph windows

In all graph windows you can use the zoom functionality. Left click on the upper left corner of the area you want to examine in detail and drag the (white) rectangle to the lower right corner. When you release the button the selected area will be displayed in the graph window (see below).



Furthermore, you can slide the graph in all directions by right clicking on the graph and slide it in the in the proper direction to view the area of interest.

IMPORTANT!
Please note that only a small amount of the available data is used to generate the graphical displays. Consequently, the displays should be regarded only as a close approximation. However, when maximum zoom is reached all sampled data is shown.

PP Status

The **PP Status** field indicates the state of the tester. Please note that a colour coding is used together with the state. Red translates to "connection not established" (i.e. in this case state DPP) and green to "connection established" (i.e. state DCE). Please refer to the "Programming Reference" (chapter 5) in relation to the description of states.

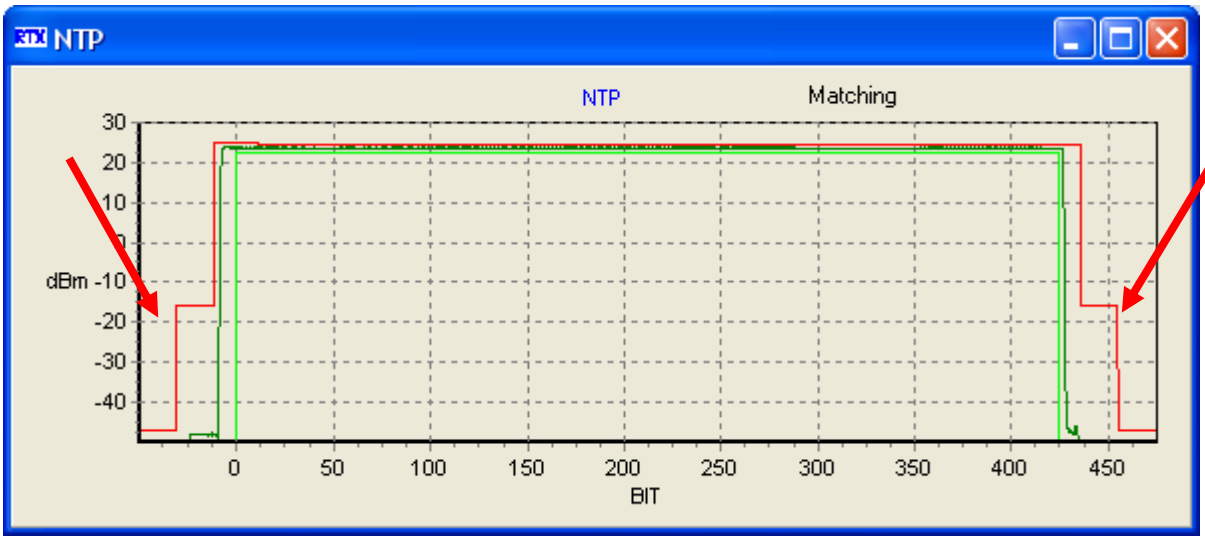
xiv. Pro Preamp

The **Pro Preamp** check-box indicates whether or not the tester should support the prolonged preamble – if checked the tester (which acts as FP in PP test mode) will use the prolonged preamble otherwise the normal preamble is used.

xv. High Dynamic

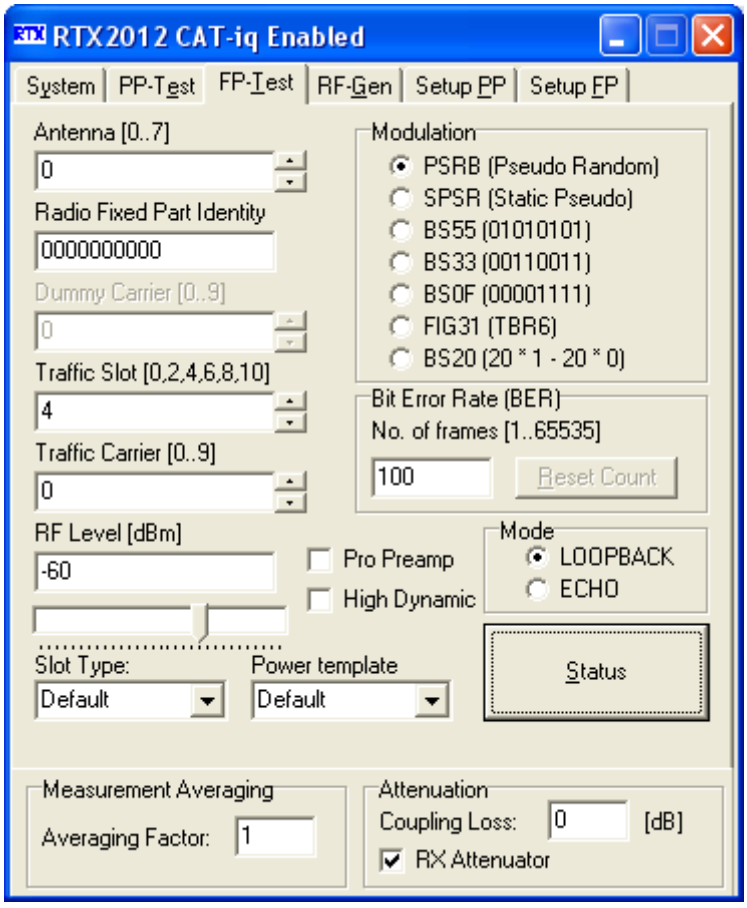
The **High Dynamic** check-box is used for setting the dynamic range for Power Ramp Measurements – if checked the tester will use HIGH dynamic range (i.e. ability to check the tolerance A in the power graph) otherwise it will use LOW dynamic range (i.e. tolerance A in the power graph cannot be checked). Below an NTP graph window with HIGH dynamic range enabled is shown (notice the extra parts of the power template).

NTP graph window (with High Dynamic enabled)



D. Fixed Part Test Page

The **FP-Test** page (see below) contains the settings required for performing measurements with the tester on a Fixed Part (i.e. the tester acts as a portable part).



i. FP-Test Page Overview

The **FP-Test** page contains the panels outlined in the table below.

Panel	Parameters	Short description
Antenna	0 to 7	Selection of antenna to use in signalling
Radio Fixed Part Identity	0x0000000000 – 0xFFFFFFFFFF	Radio Fixed Part Identity of the FP to test
Traffic Slot	0, 2, 4, 6, 8, 10	Selects the slot to use for the traffic bearer
Traffic Carrier	0 to 9	Selects the carrier to use for the traffic bearer
RF Level	-100 to -40 dBm	Selects power level in the tester in transmit direction
Slot Type	P32Z and P64Z (CAT-iq enabled)	Selects the slot type used for connection setup
Power Template	P32Z, PP32Z and P64Z, PP64Z (CAT-iq enabled)	Selects the slot type used in power ramp measurements
Modulation	PSRB, SPSR, BS55, BS33, BS0F, FIG31, BS20	Selects the modulation pattern for measure-ments
Bit Error Rate (BER)	1 to 65535	Selects the number of frames used in BER measurements
Mode	LOOPBACK, ECHO	Selects Loop-Back or Echo mode
Status	N/A	This button will change to Connect and Release upon locking on to a DUT and establishing a connection
Pro Preamp	N/A	Selects normal or prolonged preamble support
High Dynamic	N/A	Selects the dynamic range for power ramp measurements

ii. Antenna

If the DUT supports this feature, it is possible to select which antenna should be used for transmitting signals. The RTX2012 tester supports antenna selection in the range 0 to 7.

iii. Radio Fixed Part Identity

The **Radio Fixed Part Identity** indicates the Radio Fixed Part Identity (RFPI) of the Fixed Part to test (and lock to). The RFPI is a 5 byte value in the range 0x0000000000 to 0xFFFFFFFFFF. Please note that the RFPI in the input field must be input as 10 hex digits. If the RFPI is 0x0000000000 then the tester will lock to any FP – otherwise it will only lock to the FP with the RFPI indicated in this field.

iv. Traffic Slot

Please refer to the description of Traffic Slot in the PP-Test page overview subsection on page 48. However, please note that the tester supports slots 0, 2, 4, 6, 8, and 10 in both normal and CAT-iq mode (as also indicated on the user interface).

v. Traffic Carrier

Please refer to the description of Traffic Carrier in the PP-Test page overview subsection on page 48.

vi. RF Level

Please refer to the description of RF Level in the PP-Test page overview subsection on page 48.

vii. Slot Type

Please refer to the description of Slot Type in the PP-Test page overview subsection on page 48.

viii. Power Template

Please refer to the description of Power Template in the PP-Test page overview sub-section on page 48.

ix. Modulation

Please refer to the description of Modulation in the PP-Test page overview subsection on page 48.

x. Bit Error Rate

Please refer to the description of Bit Error Rate (BER) in the PP-Test page overview sub-section on page 52.

xi. Mode

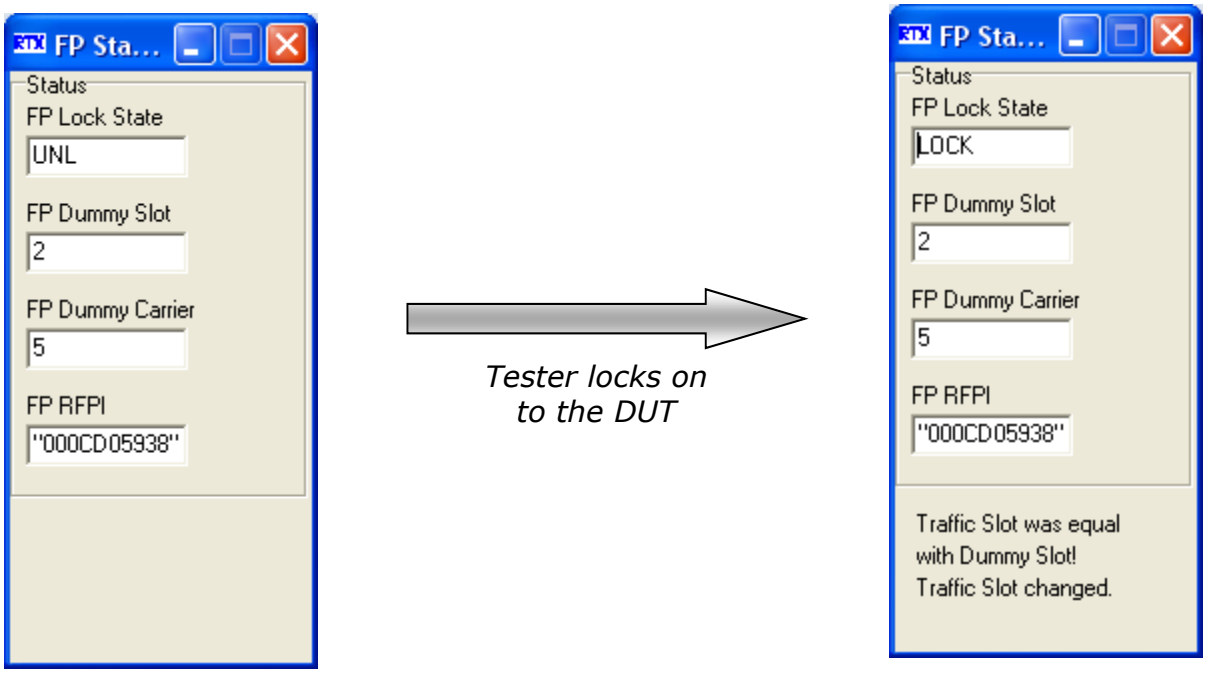
Please refer to the description of Mode in the PP-Test page overview subsection on page 52.

xii. Status (→ Connect → Release)

When clicking the **Status** button a **FP Status** window will open and the **Status** button will change to a **Connect** button (which will not be selectable until the tester has locked on to the DUT). The **FP Status** window provides status information in relation to the link to the DUT. The following status information is provided:

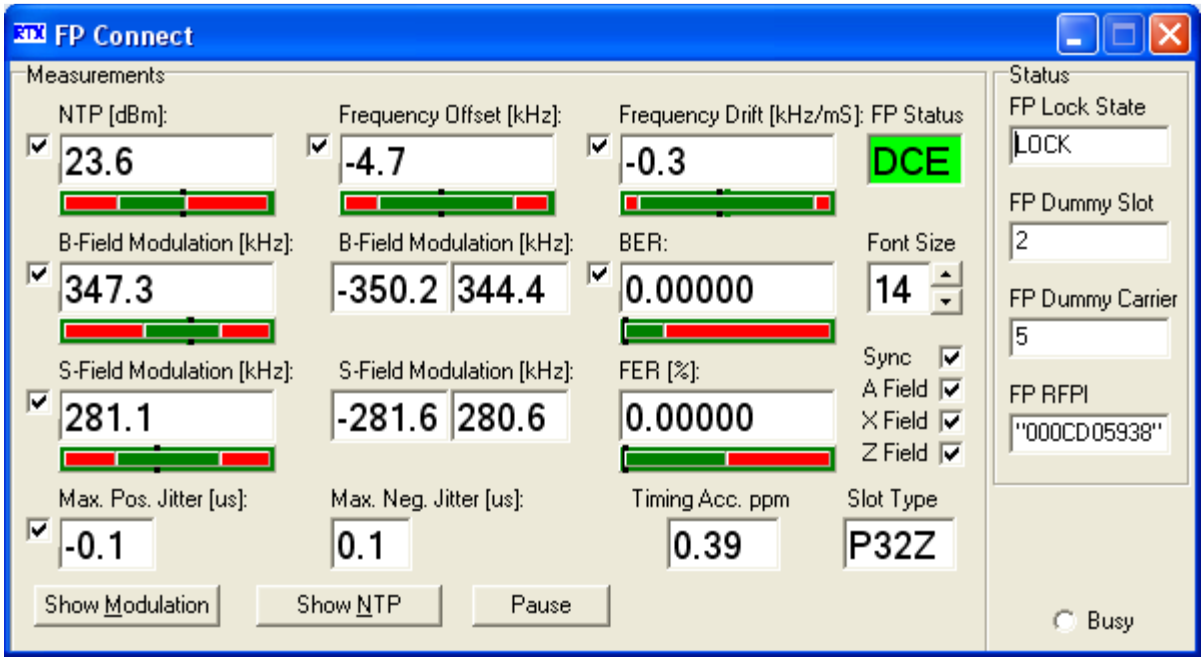
- **FP Lock State** – the status can either be UNL or LOCK depending on whether or not the tester has locked onto the DUT
- **FP Dummy Slot** – this is the slot number of the dummy bearer from the DUT
- **FP Dummy Carrier** – this is the carrier number of the dummy bearer from the DUT
- **FP RFPI** – this is the Radio Fixed Part Identity of the DUT

Initially the FP Lock State is UNLocked and the RFPI is the same as the one in the Radio Fixed Part Identity field on the **FP-Test** Page (see below). The FP Dummy Slot and FP Dummy Carrier information will become valid when the tester has locked on to the DUT.



If the DUT has been set in test mode the RTX2012 tester can lock onto the device and the **FP Lock State** will change to LOCK when locked on to the DUT (see above). Please note that the Traffic Slot will be changed automatically if the Dummy Slot is the same as the defined Traffic Slot (as indicated in bottom of the FP Status window above).

After the tester has locked to the FP DUT the **Connect** button on the **FP-Test** Page will now be selectable and when clicking this button the tester will establish a connection to the DUT. Upon successful connection establishment the **FP Status** window will be replaced by a new window – **FP Connect** (see below) - and the **Connect** button on the **FP-Test** Page will now change to a **Release** button. Consequently the connection can be closed again by clicking the **Release** button. Please note that closing the connection will also close the **FP Connect** window and the button on the **FP-Test** page will be reverted back to **Status**.



The **FP Connect** window contains a wide range of connection related information along with the information from the **FP Status** window. In essence the following four categories of information are provided in the **FP Connect** window:

- **RF Measurement Parameters**
- **Modulation graph**
- **NTP graph**
- **FP Status**

In essence the functionality is the same as for the PP Connect window, and hence, each of the categories above will only be described briefly here. For more details please refer to paragraph xiii in section C (on page 52). The same applies to the pause functionality, the font size, and the zoom functionality.

RF Measurements Parameters

The following RF measurement parameters are displayed in the **FP Connect** window during active testing:

- **NTP**
- **Frequency Offset**
- **Frequency Drift**
- **B-Field Modulation**
- **S-Field Modulation**
- **BER**
- **FER**
- **Jitter and timing accuracy**
- **Packet Information**
- **Slot Type**

The measurement results are continuously updated and shown in the display fields of the **FP Connect** window. Associated with each result is a red/green bar with a small indicator in black. These bars are described in detail in paragraph ii of section F ("Setup PP") on page 64. Furthermore, each display field can be switch on/off by clicking the corresponding checkbox.

Please refer to "Performing Measurements" (chapter 3) for a more detailed explanation of each of the parameters above.

Modulation Graphs

Clicking on the **Show Modulation** button in the bottom left corner of the **FP Connect** window will launch a graph window outlining the real-time modulation and the button will change to **Close Modulation**. Hence, clicking this will close the modulation graph window. Please refer to paragraph xiii in section C (on page 52) for an example modulation graph (page 53).

NTP Graphs

Clicking on the **Show NTP** button in the bottom of the **FP Connect** window will launch a graph window outlining the real-time NTP along with the power ramp template and the button will change to **Close NTP**. Hence, clicking this will close the NTP graph window. Please refer to paragraph xiii in section C (on page 52) for an example NTP graph (page 54).

FP Status

The **FP Status** field indicates the state of the tester. Please note that a colour coding is used together with the state. Red translates to "connection not established" (i.e. in this case state DFP) and green to "connection established" (i.e. state DCE). Please refer to the "Programming Reference" (chapter 5) in relation to the description of states.

xiii. Pro Preamp

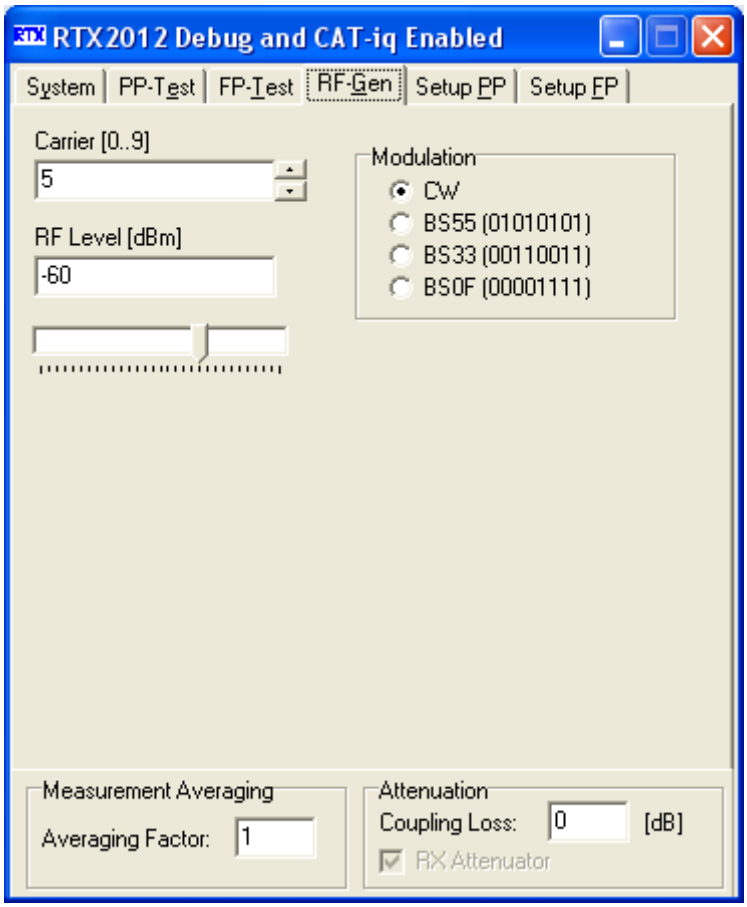
Please refer to the description of Pro Preamp in the PP-Test page overview subsection on page 55.

xiv. High Dynamic

Please refer to the description of High Dynamic in the PP-Test page overview subsection on page 55.

E. **RF Generator Page**

The **RF-Gen** (RF-Generator) page is used for generating RF signals from the tester on a selected channel within the DECT radio band. This can be useful when checking a DUT that cannot establish a link or to calibrate a parameter such as the Receive Signal Strength Indication (RSSI).



i. RF Generator Page Overview

The **RF-Gen** page contains the panels outlined in the table below.

Panel	Parameters	Short description
Carrier	0 to 9	Selects the carrier to use in the RF generator
RF Level	-100 to -40 dBm	Selects power level in the tester in transmit direction
Modulation	CW, BS55, BS33, BS0F	Selects the modulation pattern for the measurements

ii. Carrier

The number in the **Carrier** input field indicates the carrier to use when activating the RF generator. Valid carriers are 0 to Number of Carriers in Offset mode, but with option C and Extended frequencies activated the limits are set by Higest Carrier and Number of carriers..

iii. RF-Level

Please refer to the description of RF Level in the PP-Test page overview subsection on page 48.

iv. Modulation

In this panel four different modulation patterns for the RF generator can be chosen:

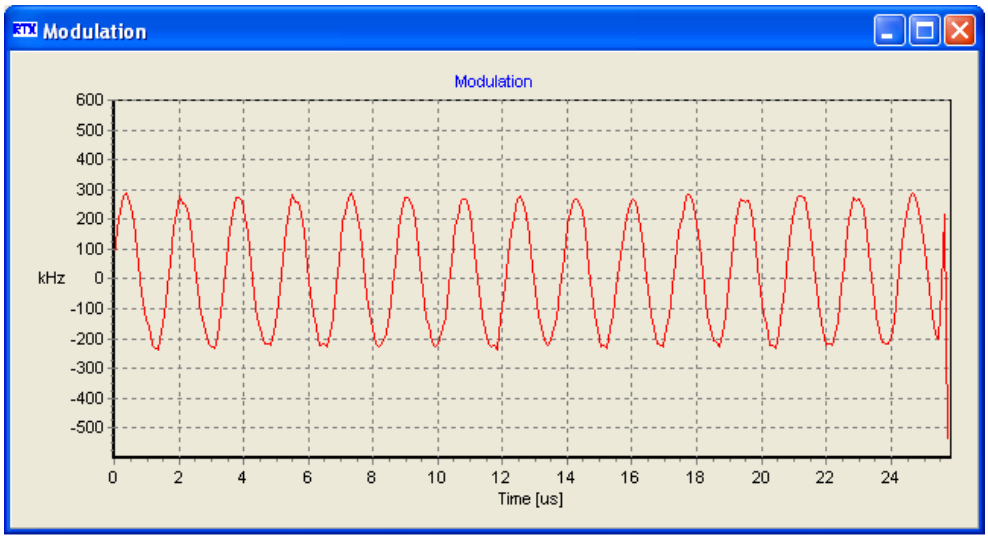
- CW = Continuous Wave
- BS55 = Alternating zeros and ones
- BS33 = Alternating double zeros and ones
- BS0F = Four times zero and one, alternating

The modulation patterns for BS55, BS33 and BS0F are shown in paragraph x of section C in this chapter. The CW modulation form is described below.

CW

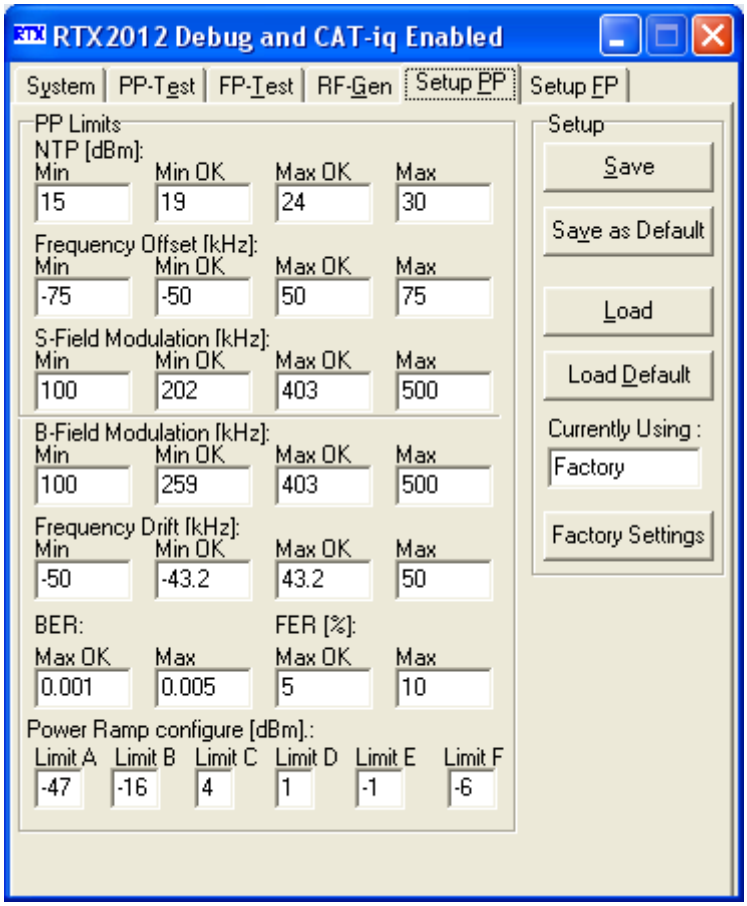
Continuous Waves modulation is an unvarying carrier signal, transmitted at the selected channel frequency (see below). This modulation form can be very useful when adjusting frequency settings.

CW modulation pattern



F. Setup Portable Part Page

The **Setup-PP** page provides a limits matrix where you can enter PASS and FAIL values for the measurement parameters.



i. Setup Portable Part Page Overview

Basically the Setup-PP page contains two main functions:

- **Parameter configuration (limits) for measurement limits**
- **Load/save configurations**

These will be outlined in more detail in the following.

ii. Limits

The parameters entered in the **PP Limits** input fields are used to specify the scale of the red/green bar indicators in the **PP Connect** and **FP Connect** windows (i.e. when performing measurements). The values can be changed directly in the input fields or you can load a configuration from a file (see next paragraph). The parameters and default values are outlined below and in the end of this paragraph you find a more detailed description on how the limits are used.

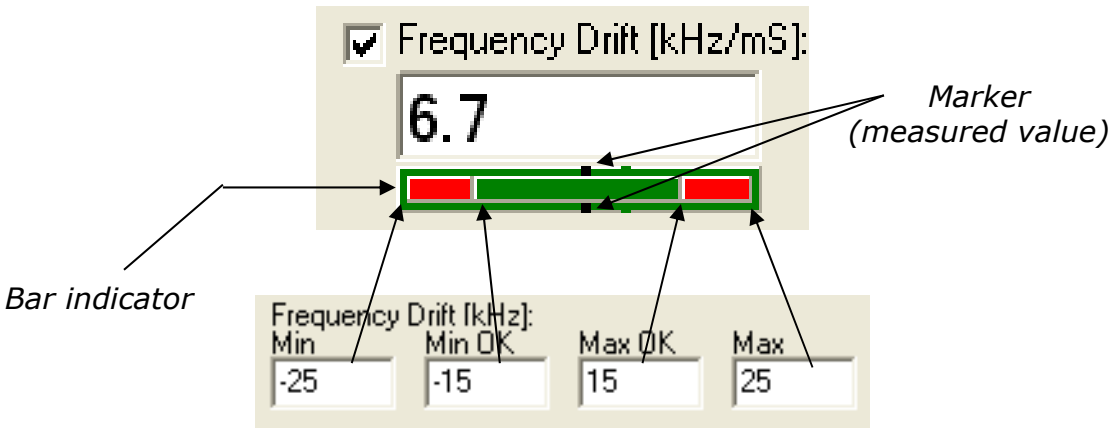
Entry fields	Parameters			
	Min	Min OK	Max OK	Max
NTP (dBm)	15	19	24	30
Frequency Offset (kHz)	-75	-50	50	75
S-Field Modulation (kHz)	100	202	403	500
B-Field Modulation (kHz)	100	259	403	500
Frequency Drift (kHz)	-50	-43.2[1)]	43.2[1)]	50
BER			0.001	0.005
FER			5	10

1) *Please note that the frequency drift per slot is allowed to be +/- 43.2 kHz per slot – however it is allowed to take a measurement tolerance of +/- 2 kHz into account, hence yielding a frequency drift limit of +/- 49 kHz per slot.*

Furthermore the limits for the Power ramp are as follows:

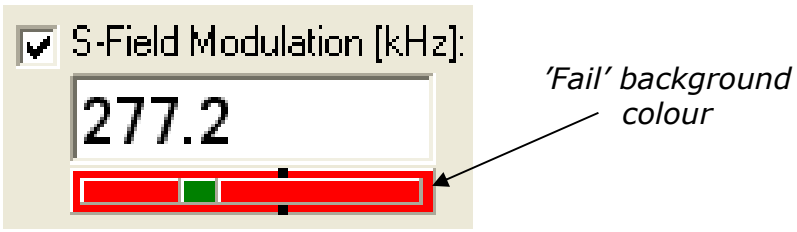
Power Ramp configuration (dBm)					
Limit A	**Limit B**	**Limit C**	**Limit D**	**Limit E**	**Limit F**
-47	-16	4	1	-1	-6

In total four limits are required for each parameter (**Min**, **Min OK**, **Max OK**, and **Max**) and as noted above these limits are used to scale the red/green bars for each of the associated parameters on the **FP Connect** windows (see below).



The **Min** and **Max** limits set the end points of the bar and **Min OK** and **Max OK** limits set the position and size of the green 'OK' (or 'Pass') section. The **Min ↔ Min OK** and **Max OK ↔ Max** sections of the bar are coloured red in order to indicate 'Fail' (i.e. the measured value is not within the defined min or max 'OK' values.

A marker (two black dots on each side of the bar indicator) indicates the location of the measured value (i.e. the value shown numerically in the display field) in relation to the defined limits. Please note that the background area of the bar indicator will become red if the measured value is outside the 'OK' limits (see below). In case the measured value is within the 'OK' limits the background will be green.



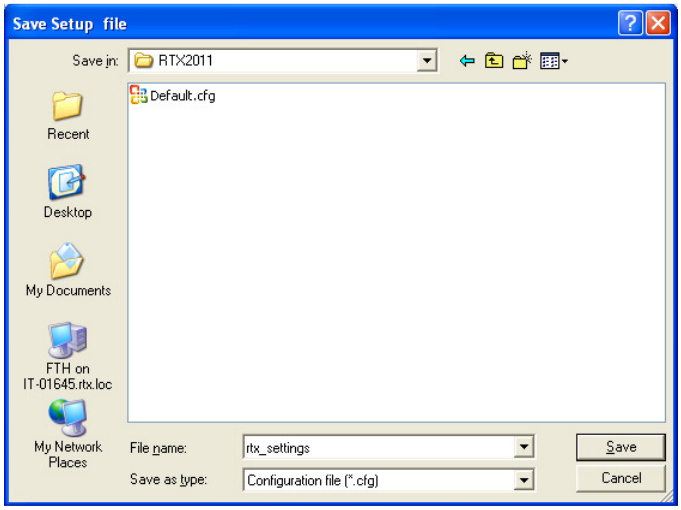
iii. Load/save of configuration files

All values entered in the **PP Limits** input fields can be saved in a configuration file (with `.cfg` file extension). You can also save the current set of **PP Limits** as the default configuration by clicking **Save as Default** – this will save the current configuration in the `default.cfg` file.

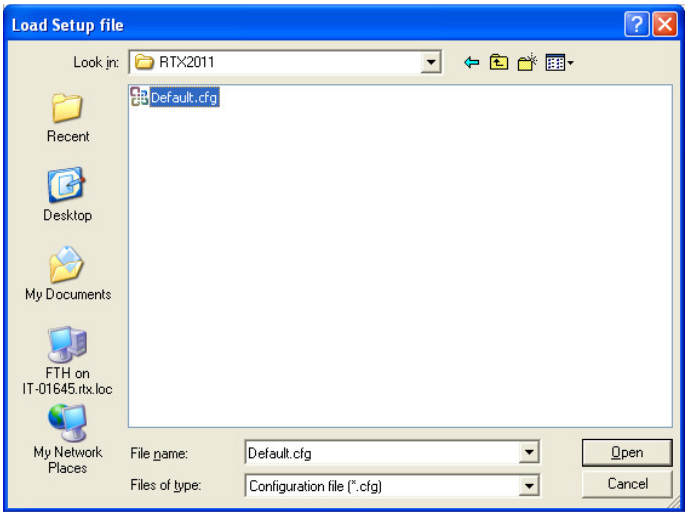
The load functionality provides a convenient and quick method of changing the values in the **PP Limits** input fields. You can configure parameters by either loading previously saved settings (**Load**) or by loading the default settings by clicking the **Load Default** button. Doing this will load the settings from the `Default.cfg` file. Furthermore, you also have the possibility to revert back to factory settings by clicking the **Factory Settings** button.
The name of the configuration file currently used is displayed in the **Currently Using** field. Please note that if the factory settings are used (i.e. after pressing **Factory Settings**) "Factory" will be displayed instead of the file name.

Clicking **Save** will open a dialog window (see below). Here you can choose the file and path name to create a setup file of the current values. Click **Save** on the file window to save the configuration values in the file.

IMPORTANT!
In order to prevent the configuration files you create to be lost if the RTX2012 application folder is uninstalled or removed please place the files in a folder other than the tester application folder.

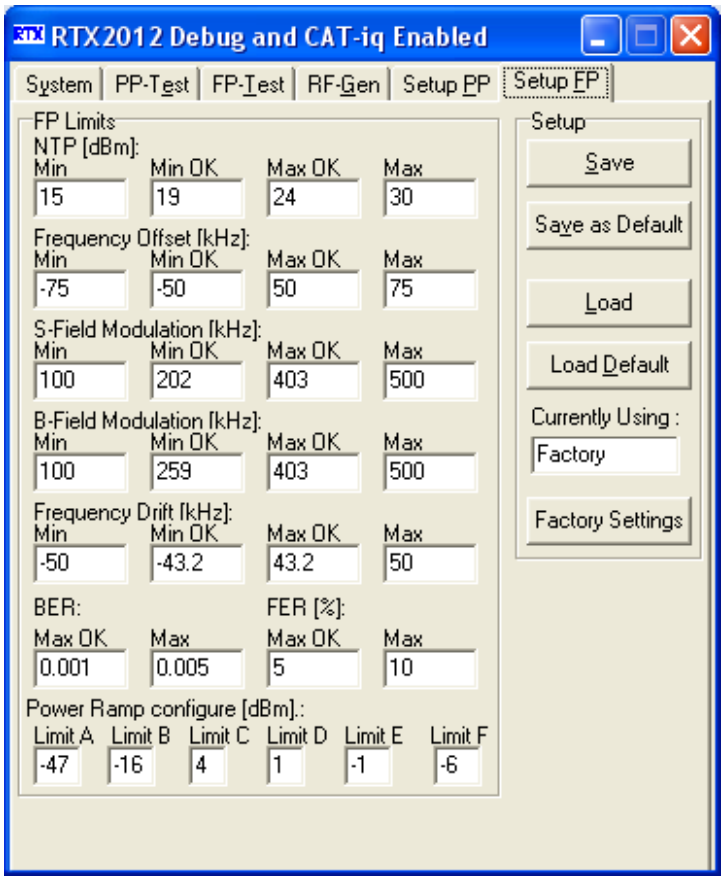


Clicking **Load** will open a dialog window (see below) for you to choose the required file. Locate the configuration file you want to use and click **Open** on the file window.



G. Setup Fixed Part Page

The **Setup-FP** page provides a limits matrix where you can enter PASS and FAIL values for the measurement parameters.



i. Setup Fixed Part Page overview

Basically the **Setup-FP** page contains two main functions:

- **Parameter configurations (limits) for measurement limits**
- **Load/save configurations**

In essence these are the same as for the **Setup-PP** page.

ii. Limits

The limits for all parameters including the Power Ramp configuration are the same as in the **Setup-PP** Page. Consequently, please refer to paragraph ii in section F (on page 64) for the default values and how to use the **Min**, **Min OK**, **Max OK**, and **Max** limits.

iii. Load/save of configuration files

The load/save functionality is the same as in the **Setup-PP**. Consequently, for a detailed description of this functionality please refer to paragraph iii in section F (on page 66).

3. Performing Measurements

A. **Initial preparation**

Before launching the RTX2012 user interface please confirm that all equipment is connected correctly (i.e. the tester is connected to the PC and the DUT is connected to the tester using an RF cable).

IMPORTANT!
In order to maintain regulatory compliance the antenna connection to the DUT must be carried out within a screened environment. Furthermore, please be aware of the fact that the antenna connection can be a serious source of errors, hence introducing significant errors when using the tester. Consequently, it is strongly emphasized here to be careful and ensure that the RF connection to the DUT correctly connected. Please note that if the DUT transmits with high power (i.e. above 0 dBm) the RF attenuator must be enabled (please see page 44 for details on enabling the RF attenuator).

When all connections have been validated, please launch the RTX2012 user interface ("RTX2012 Tester") by either double clicking on the "RTX2012 Tester" icon on your PC desk-top or selecting the "RTX2012 Tester" application from the System tab in Windows. The RTX2012 user interface should now open. Please do the following before proceeding to the measurements:

- Confirm that the Software Versions are matching
- Select **Log Measurements** or/and **Log Communication** (if required in your measurements)
- Type in the known cable **Coupling Loss** in the input field under the **Attenuation** pane on the **System** tab

In the following measurements for both FP and PP will be outlined. Furthermore, an explanation of the echo mode along with a PP test situation with CAT-iq enabled is also provided.

B. **Performing measurements on a Fixed Part DUT**

In order to configure a test mode connection to a Fixed Part DUT please click the **FP-Test** tab and do the following:

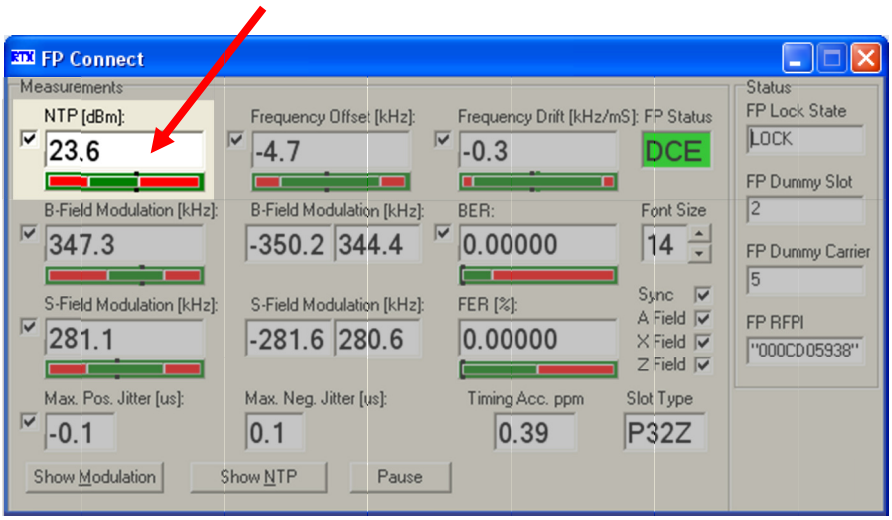
- Validate the current **FP-test** settings (i.e. required antenna to be used, traffic bearer, RF level output, required modulation pattern etc.)
- Validate the current limits in the **Setup FP** pane
- Ensure that that the DUT is setup to make a test mode connection
- Click **Status/Connect** to make an RF connection in test mode

If successful the connection to the FP DUT will be established and the **FP Connect** window should appear (see below). The following measurements will be outlined in the next subsections:

- **NTP Power**
- **Frequency and modulation (frequency drift, B-Field, and S-Field)**
- **Sensitivity (BER and FER)**
- **Jitter**
- **Timing Accuracy**
- **Packet Information**
- **Slot Type**

i. Power Measurements (NTP)

The measured NTP power of the DUT is displayed in the NTP field in the upper left corner of the **FP Connect** window (see below).



As indicated in the screen shot above the measured NTP power of the DUT is in this case 23.6 dBm. Please note that the measured NTP power value is within the limits specified in the **Setup FP** pane for NTP power (indicated by a green frame and a value indicator within the green area).

The measured NTP power could also be read out by sending the SCPI command **READ:NTP?** (for more details please refer to the "Programming Reference").

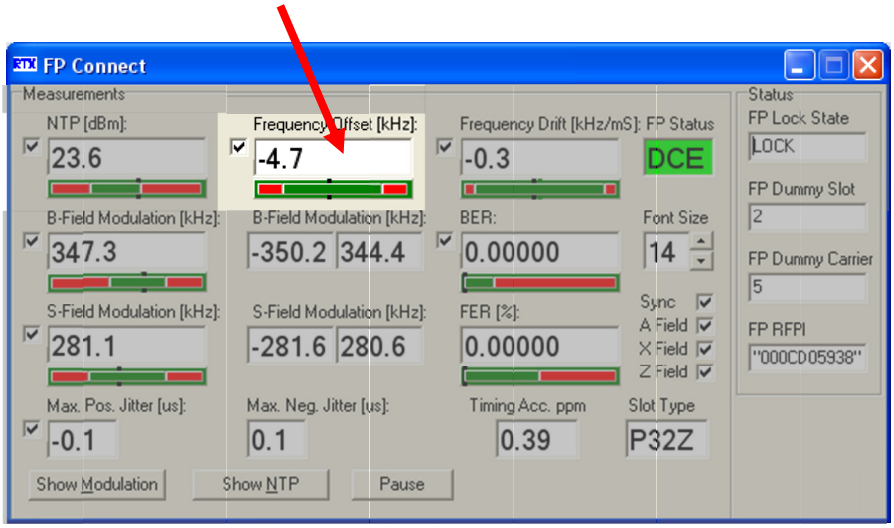
ii. Frequency and Modulation Measurements

In this section frequency and modulation measurements for FP tests will be outlined.

Frequency Offset

The measured Frequency Offset of the DUT is displayed in the middle of the top row of the **FP Connect** window (see below).

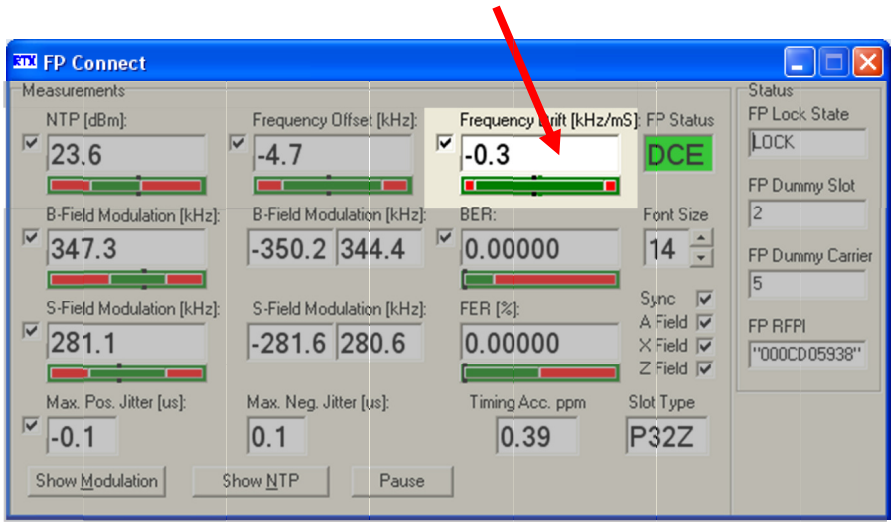
As indicated in the screen shot below the measured Frequency Offset is -4.7 kHz (which is within the limits defined for this parameter).



The measured Frequency Offset could also be read out by sending the SCPI command **READ:FREQ:OFFS?** (for more details please refer to the "Programming Reference").

Frequency Drift

The measured Frequency Drift of the DUT is displayed in the right side of the top row of the **FP Connect** window (see below).



As indicated in the screen shot above the measured Frequency Drift is -0.3 kHz/mS (which is within the limits defined for this parameter). Please note here that the unit is set to kHz/mS – alternatively this could be kHz/slot.

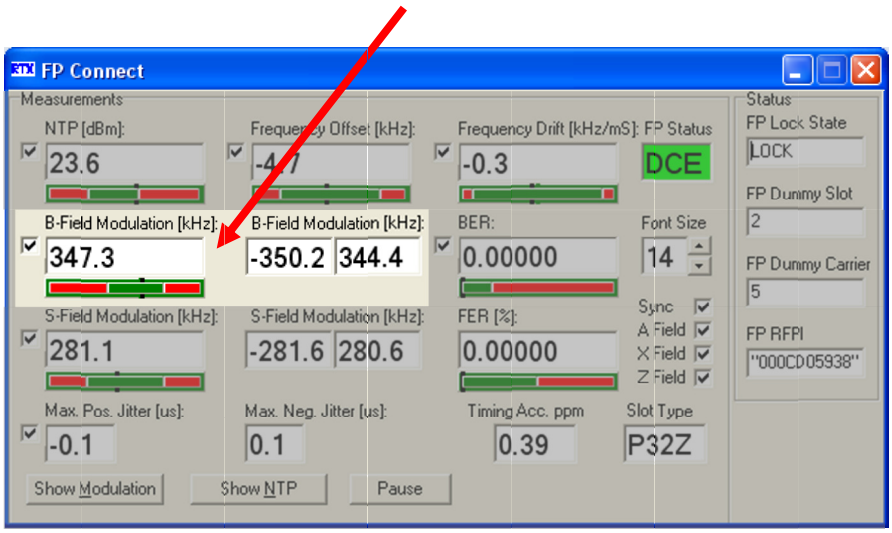
The Frequency Drift measurement is carried out by sampling four alternating bits in the preamble (as in the Frequency Offset measurement above), and four alternating bits in the end of the B-field modulation part. The individual samples are then averaged and the "worst case" difference of the two sample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

Please note that only the BS55, BS20 and FIG31 modulation patterns are valid during Frequency Drift measurements.

The measured Frequency Drift could also be read out by sending the SCPI command **READ:FREQ:DRIF?** (for more details please refer to the "Programming Reference").

B-Field Modulation

The measured B-Field Modulation of the DUT is displayed in the left side (upper part of the middle row) of the **FP Connect** window (see below).



As indicated in the screen shot above the measured B-Field Modulation is 347.3 kHz.

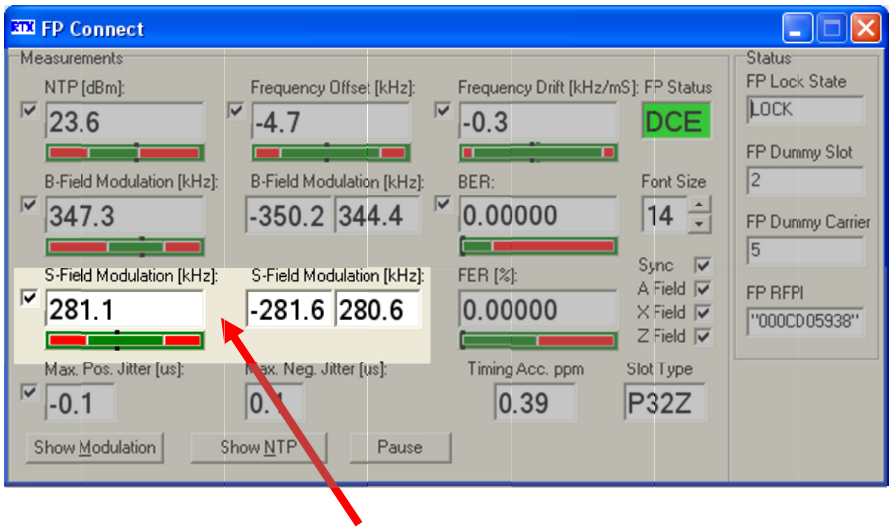
The measured B-Field Modulation could also be read out by sending the SCPI command **READ:BF?** (for more details please refer to the "Programming Reference").

S-Field Modulation

The measured S-Field Modulation of the DUT is displayed in the left side (lower part of the middle row) of the **FP Connect** window (see below).

As indicated in the screen shot below the measured B-Field Modulation is 281.1 kHz.

The measured S-Field Modulation could also be read out by sending the SCPI command **READ:SF?** (for more details please refer to the "Programming Reference").

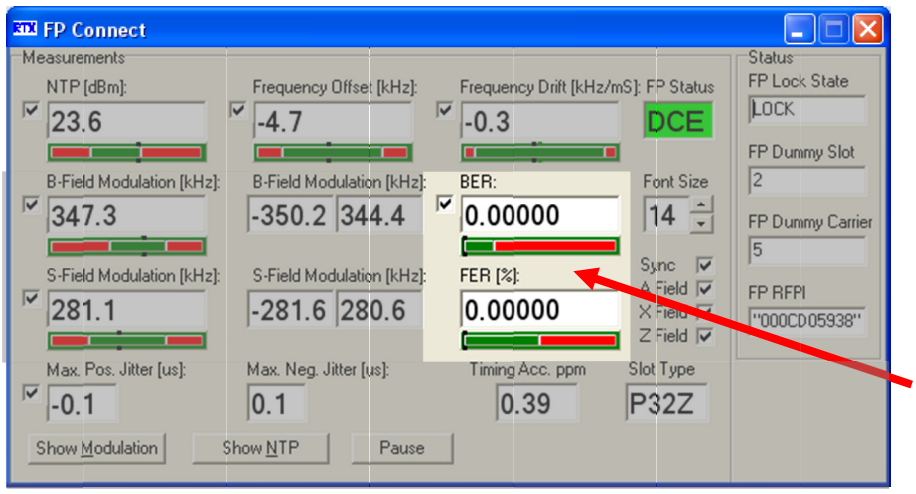


iii. Sensitivity Measurements

In essence the sensitivity of the DUT is determined using the BER (Bit Error Rate) or FER (Frame Error Rate) measurements. These parameters are measured by comparing received bits to the ones transmitted in a loop-back setup. The number of erroneous bits relative to the total number of bits transmitted gives the Bit Error Rate. 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 (i.e. the number of frames indicated in the **Bit Error Rate (BER)** input field on the **System** pane). One frame consists of 328 bits, and hence, using the default number of frames (i.e. 100) corresponds to a BER measurement over 32800 bits. Please note that the FER is indicated in percent.



Please note that the modulation patterns PSRB and SPSR should be used in sensitivity measurements, since these are close to the behaviour of a real communication link.

The measured BER and FER of the DUT is displayed in the right side (middle row) of the **FP Connect** window (see above).

As indicated in the screen shot above the measured BER and FER are 0.00000 (which are within the defined limits).

Both the BER and FER can also be read out by sending the SCPI commands:

CONF:BER:EVAL:WIND 100

READ:BER?

The response from the tester (see below) will include both the measured BER and FER values.

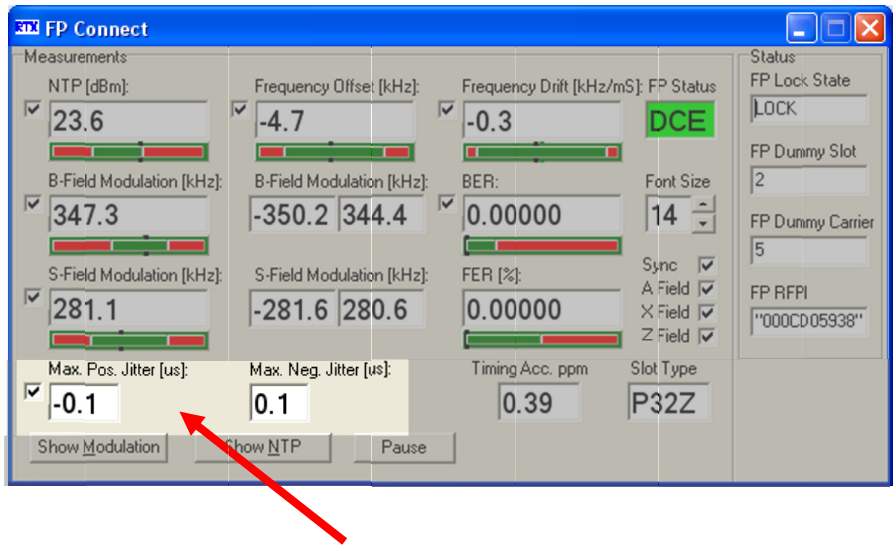
<-- 0.000100000,0.005000000

The first number is the BER (i.e. number of faulty bits relative to the total number of bits) and the second is the FER in percent.

Please note that the BER and FER counts can be reset by sending the SCPI command **PROC:STRT:BER**. For more details on the SCPI commands mentioned above please refer to the "Programming Reference".

iv. Jitter measurements

The measured Jitter of the DUT is displayed in the bottom left of the **FP Connect** window (see below).

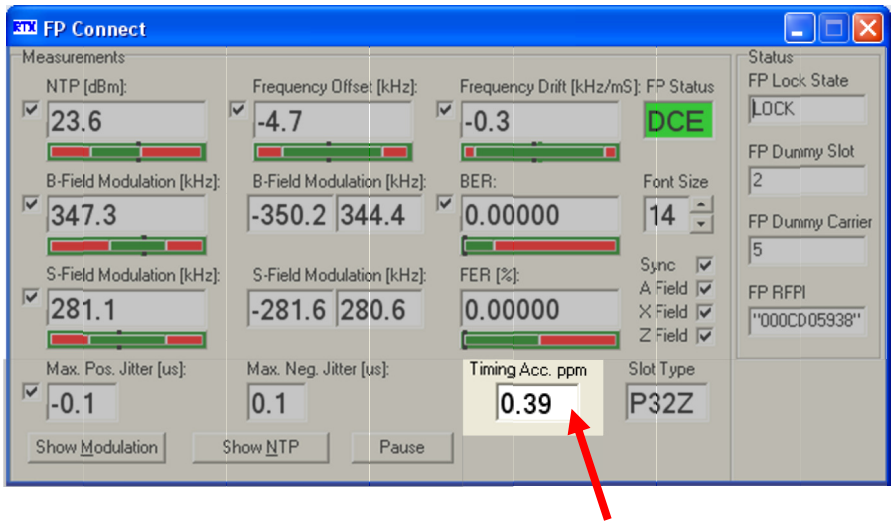


As indicated in the screen shot above the measured maximum positive jitter is -0.1 µs and maximum negative jitter is 0.1 µs.

The measured Jitter could also be read out by sending the SCPI command **READ[:SCAL]:JITT?** (for more details please refer to the "Programming Reference"). The response will include both the maximum positive and negative jitter measurement.

v. Timer Accuracy Measurements

The measured Timing Accuracy of the DUT is displayed in the bottom right part of the **FP Connect** window (see below).



As indicated in the screen shot above the measured Timing Accuracy in ppm (parts per million) is 0.39.

The measured Timing Accuracy could also be read out by sending the SCPI command **READ:TIME:ACC?** (for more details please refer to the "Programming Reference").

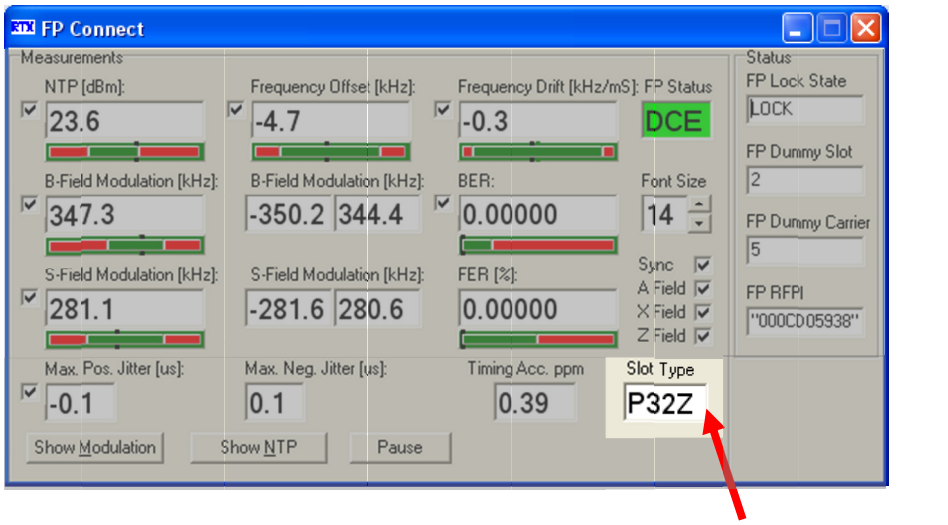
vi. Packet Information

The packet information in relation to the Sync-, A-, X-, and Z-Field in the packets from the DUT is displayed in the right part of the **FP Connect** window (see below). As indicated all fields are present in the packets (indicated by the check-mark in the check-box).

The packet information could also be read out by sending the SCPI command **READ:CRC?** (for more details please refer to the "Programming Reference").

vii. Slot Type Indicator

The last measurement parameter on the **FP Connect** window is the Slot Type (see below).



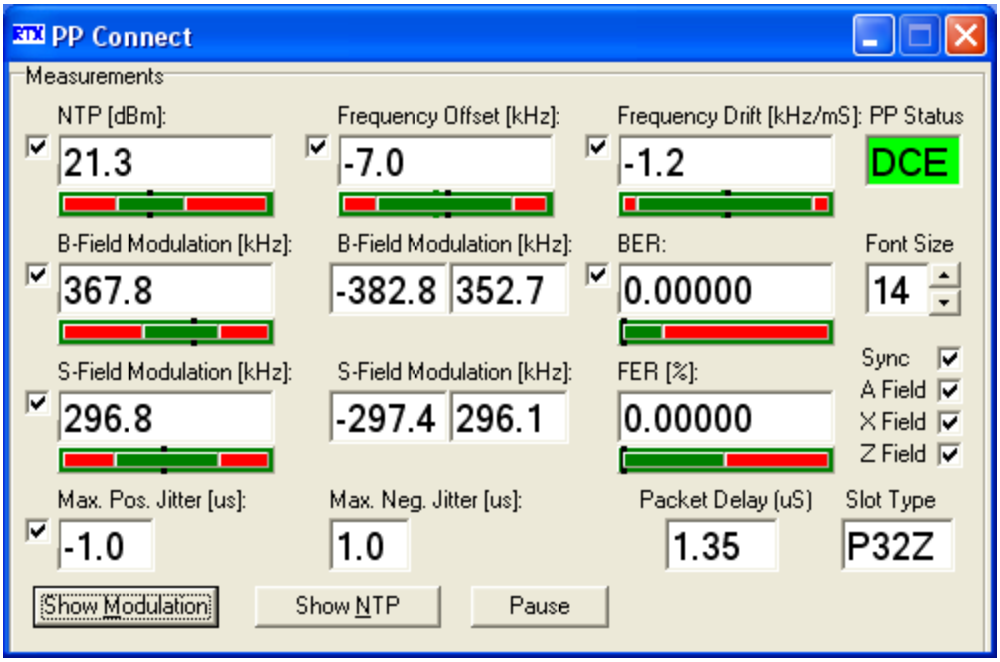
This indicates the slot type used for the established connection. Please note that the Slot Type also can be read out by using the SCPI command **READ:SLOT:SIZE?** – this command will return the number of bytes per slot (i.e. P32Z = 40 bytes). For more details please refer to the "Programming Reference".

C. **Performing measurements on a Portable Part DUT**

Prior to establishing a test mode connection to a Portable Part DUT please click the **PP-Test** tab and do the following:

- Validate the current **PP-test** settings (i.e. RFPI of the FP, dummy and traffic bearer, RF level output, required modulation pattern etc.)
- Validate the current limits in the **Setup PP** pane
- Ensure that that the DUT is setup to make a test mode connection
- Click **Connect** to make an RF connection in test mode

If successful the connection to the PP DUT will be established and the **PP Connect** window should appear (see below).



The following measurements will be outlined in the next subsections:

- **NTP Power**
- **Frequency and modulation (frequency drift, B-Field, and S-Field)**
- **Sensitivity (BER and FER)**
- **Jitter**
- **Packet delay**
- **Packet Information**
- **Slot Type**

Please note that the first four categories are the same as for the FP measurements, and hence, the measurement procedure and screen shots are quite similar. Therefore this section will mainly refer to the appropriate paragraphs in the FP measurement section. However, please note that the limits used for the limit bars on the **PP Connect** page are defined in the **Setup PP** page.

i. Power Measurements (NTP)

The measured NTP power of the DUT is displayed in the NTP field in the upper left corner of the **PP Connect** window. From the screen shot on page **Error! Bookmark not defined.** the measured NTP power can be seen to be 21.3 dBm and it is within the limits defined in the **Setup PP** page (please also see paragraph i on page 71).

ii. Frequency and Modulation Measurements

As in the approach for the FP the frequency offset, frequency drift, B-Field modulation, and S-Field Modulation are part of the frequency and modulation measurements for the PP as well. Please refer to paragraph ii on page 71 for more detailed information on how to determine the measured value for each of the four parameters. From the screen shot of the **PP Connect** page on page **Error! Bookmark not defined.** the measured values for the four parameters can be seen to be (please note that all values are within the limits defined in the **Setup PP** page):

- Frequency Offset = -7.0 kHz
- Frequency Drift = -1.2 kHz/mS
- B-Field Modulation = 367.8 kHz
- S-Field Modulation = 296.8 kHz

iii. Sensitivity Measurements

As in the approach for the FP the BER and FER are part of the sensitivity measurements for the PP as well. Please refer to paragraph iii on page 74 for more detailed information on how to determine the measured BER and FER. From the screen shot of the **PP Connect** page on page **Error! Bookmark not defined.** the measured values for BER and FER can be seen to be BER = 0.00000 and FER = 0.00000. Both are within the limits defined in the **Setup PP** page.

iv. Jitter Measurements

The measured Jitter of the DUT is displayed in the bottom left of the **PP Connect** window and from the screen shot of the **PP Connect** page on page **Error! Bookmark not defined.** the measured maximum positive and negative jitter can be seen to be -1.0 µs and 1.0 µs, respectively. Please refer to paragraph iv on page 75 for more detailed information on how to determine the measured jitter.

v. Packet Delay Measurements

The measured Packet Delay of the DUT is displayed in the bottom right part of the **PP Connect** window (see below). As indicated in the screen shot above the measured Packet Delay is 1.35 µs.

The measured Packet Delay could also be read out by sending the SCPI command **READ[:SCAL]:PACK:DEL?** (for more details please refer to the "Programming Reference"). Please note that this command will return three values – i.e. the actual packet delay and the minimum and maximum packet delay (all in µs).

vi. Packet Information

The Packet Information is located to the right in the **PP Connect** window and it indicates which fields are included in the packets from the DUT (Sync-, A-, X-, and Z-Field). As indicated all fields are present (indicated by the check-mark in the check-box). Please also refer to paragraph vi on page 76.

vii. Slot Type Indicator

The Slot Type Indicator is located in the bottom right of the **PP Connect** window and it indicates the slot type used for the established connection. In this case it can be seen that the slot type is P32Z (see the screen shot of the **PP Connect** page on page **Error! Bookmark not defined.**). Please also refer to paragraph vii on page 77.

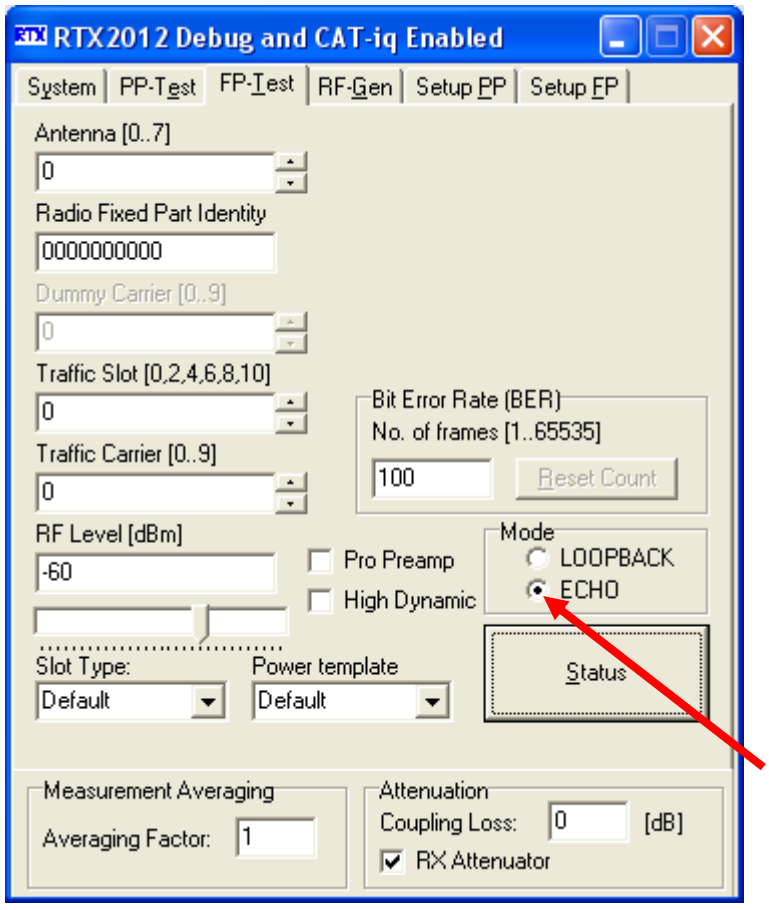
D. Testing in ECHO Mode

i. Introduction

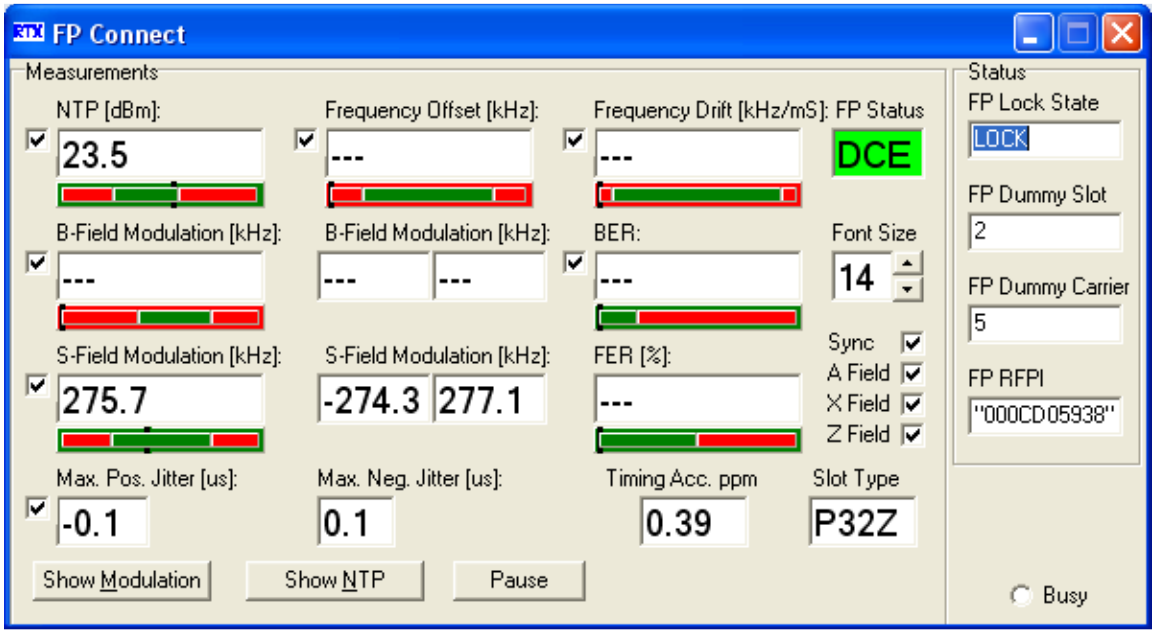
In this section the ECHO Mode is briefly described for both PP and FP tests. Please see paragraph xii on page 52 for more information about the ECHO mode.

ii. Setup for FP ECHO Mode

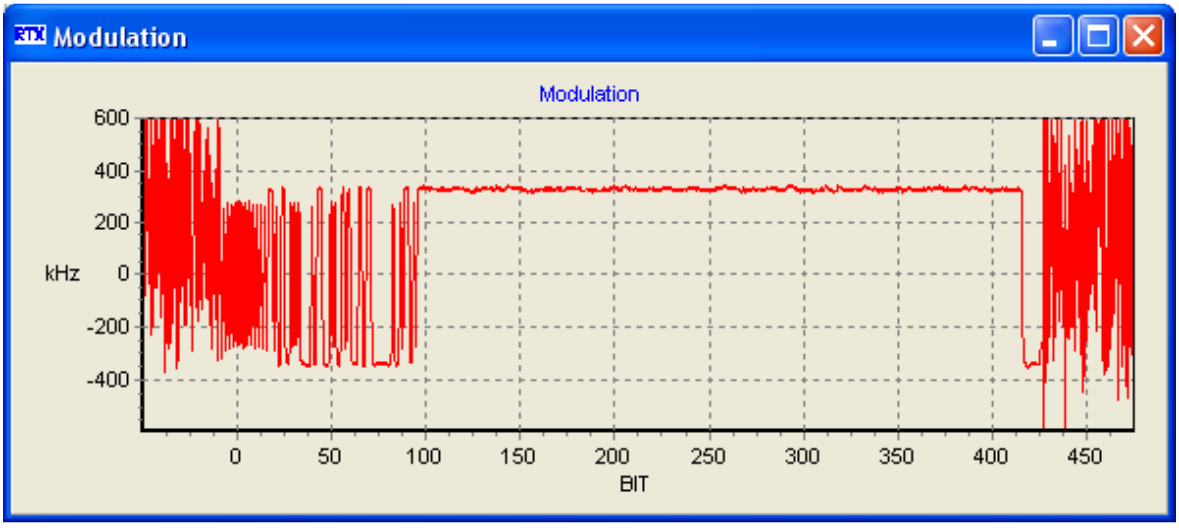
The ECHO mode is setup in the **FP-Test** page under the **Mode** settings. Click on the ECHO radio button to select the ECHO mode (see arrow below).



Continue with connection establishment (i.e. clicking on the **Status/Connect** button and connecting to a DUT) and the **FP Connect** window will open.

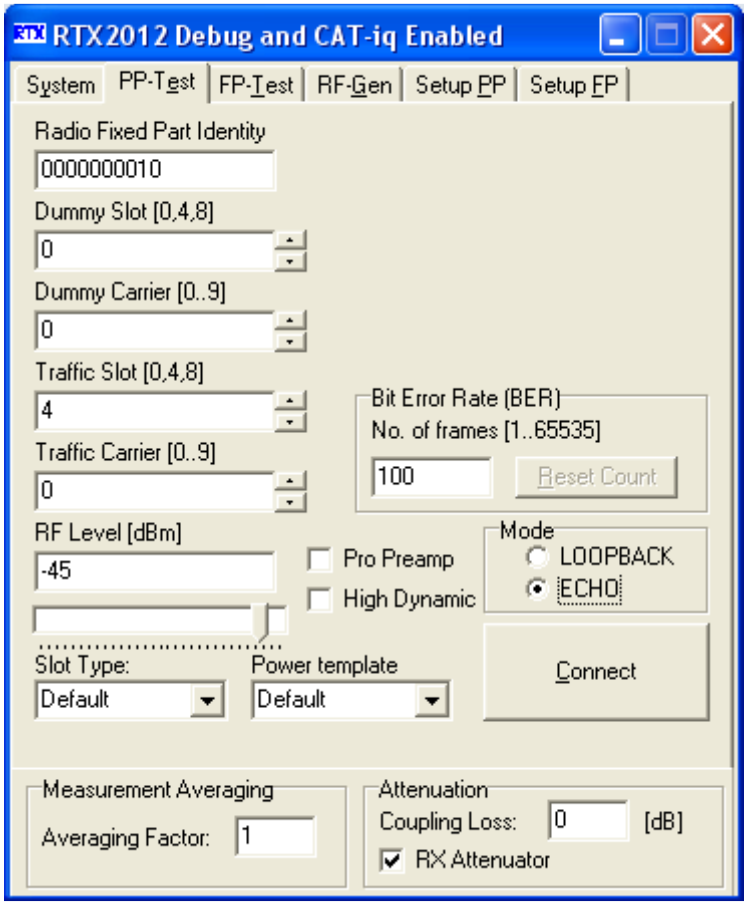


Please note that the **FP Connect** window now only shows the NTP, S-Field Modulation, Jitter, Timing Accuracy, and Slot Type. Hence, Frequency Offset, Frequency Drift, B-Field Modulation and BER/FER are not available in ECHO mode. Clicking the Show Modulation button will open a new window outlining the modulation (see below).

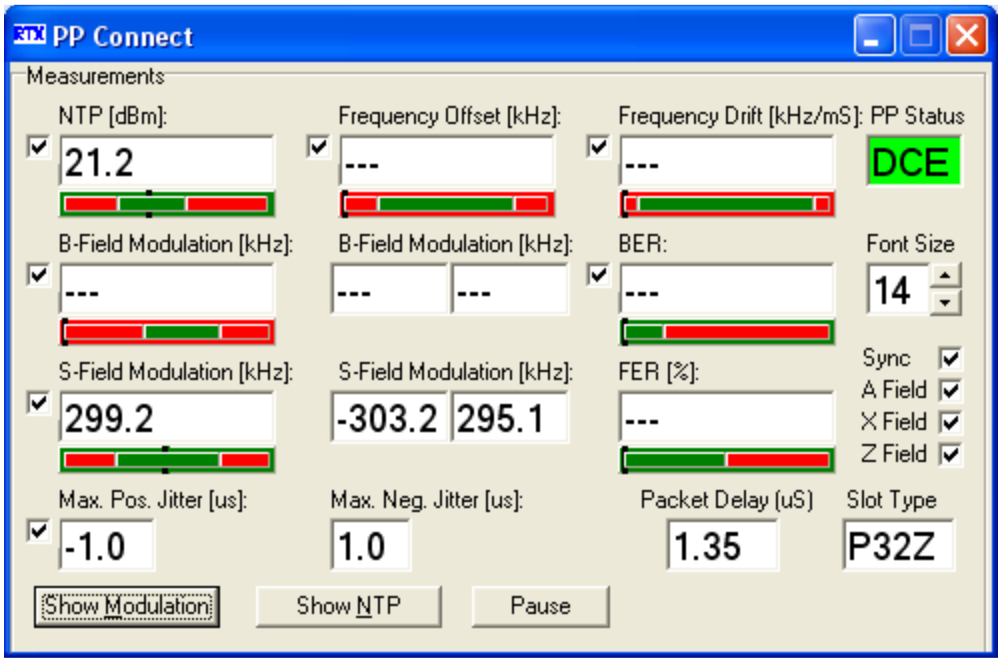


iii. Setup for PP ECHO Mode

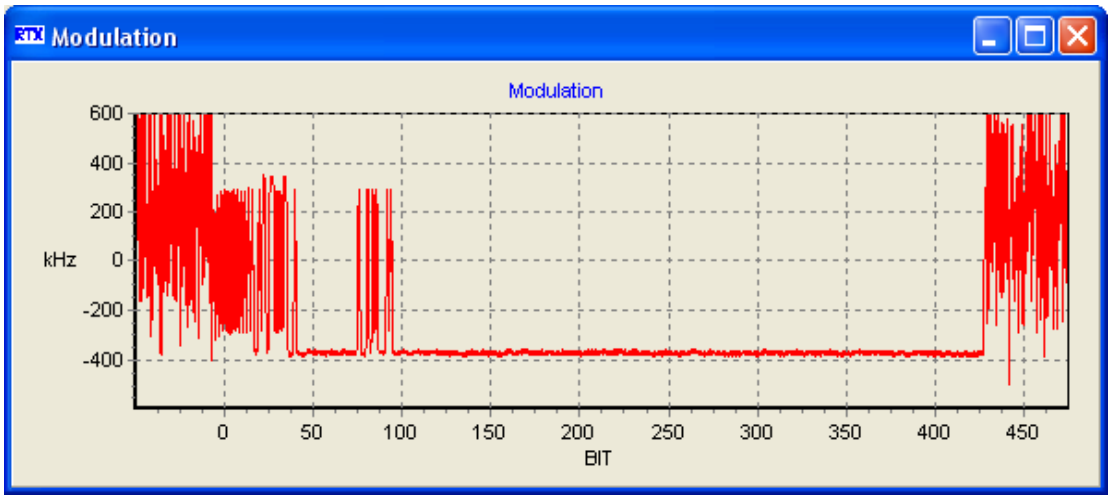
The ECHO mode setup is similar to the FP approach outlined above – i.e. click the ECHO radio button in the **Mode** settings and click on the **Connect** button to setup a connection to the PP.



After connection establishment the PP Connect window will open (see below).



Please note that the **PP Connect** window only shows the NTP, S-Field Modulation, Jitter, Packet Delay, and Slot Type. Hence, Frequency Offset, Frequency Drift, B-Field Modulation and BER/FER are not available in ECHO mode. Clicking the Show Modulation button will open a new window outlining the modulation (see below).



E. CAT-iq Mode Measurements (Requires Option A)

i. Introduction

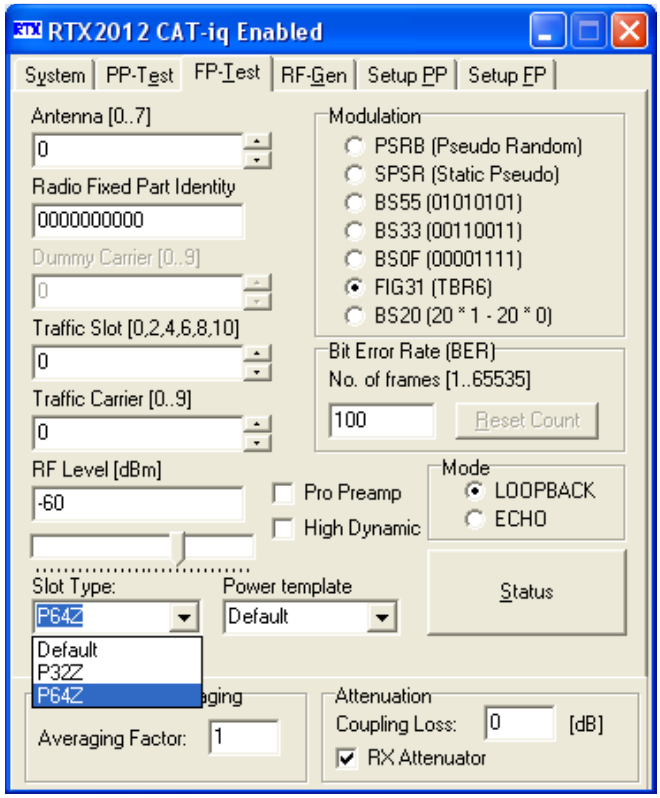
This chapter briefly describes the differences between CAT-iq and "normal" mode in relation to measurements. Both FP and PP measurements will be outlined briefly but if a more elaborate explanation of the different measurements is needed please refer to section B or **Error! Reference source not found.** in chapter 3.

Before continuing please make sure that you have a tester with a firmware version that supports CAT-iq (indicated by an "A" at the end of the firmware version and the **Enable CAT-iq Option** check-box on the **System** pane should be selectable). If CAT-iq is supported please make sure to enable the CAT-iq option (i.e. a check mark in the **Enable CAT-iq Option** check-box). See also page 45.

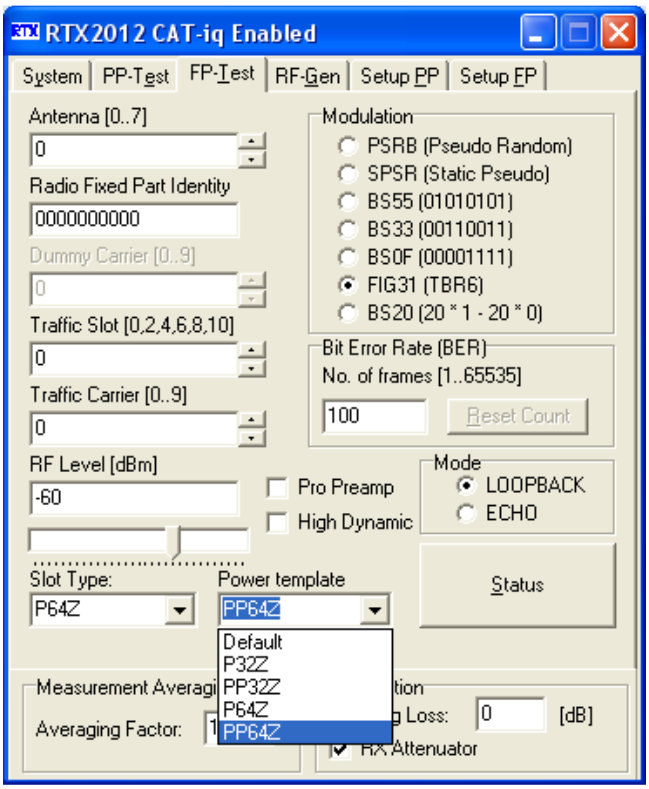
IMPORTANT!
When CAT-iq is enabled the tester is broadcasting for advanced A-field setup. Hence, the DUT must in this case support advanced A-field setup in order to connect to the tester. If the DUT does not support advanced A-field setup then the CAT-iq option needs to be disabled before establishing a connection.

ii. Performing Fixed Part CAT-iq measurements

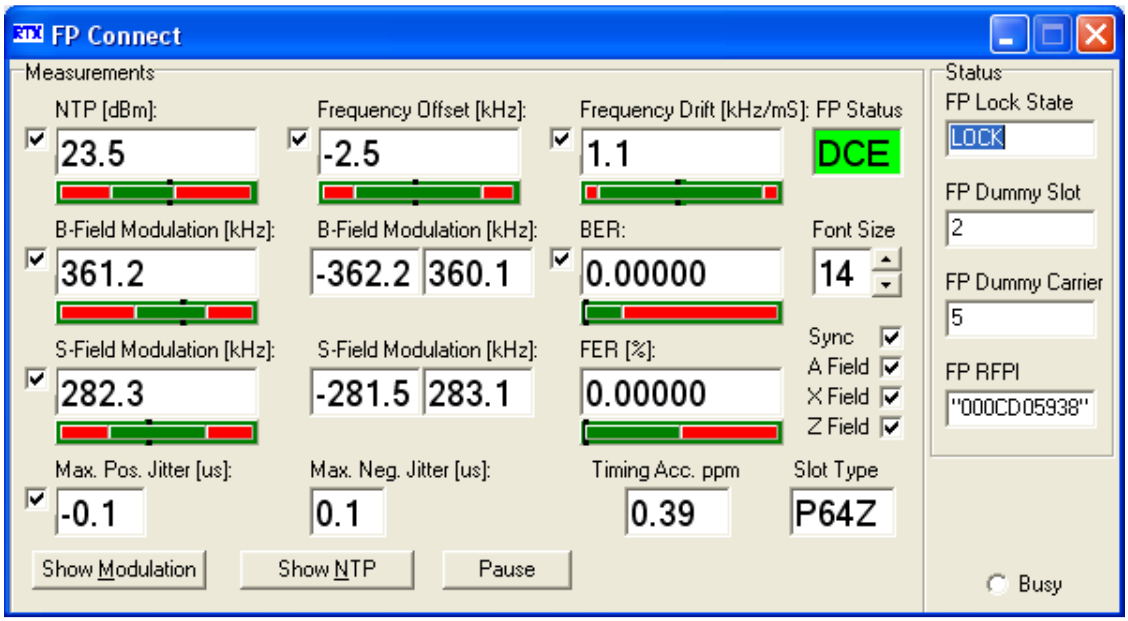
In essence the difference between CAT-iq and "normal" mode when setting up the connection is limited to the slot type to use when establishing a link to the DUT. In CAT-iq mode the P64Z can be selected from the drop-down list in the **Slot Type** pane on the **FP-Test** page (see below). If the **Slot Type** is set to Default the FP connection will be established using the P32Z slot type, hence please make sure to change the slot type to P64Z to select CAT-iq connection establishment.



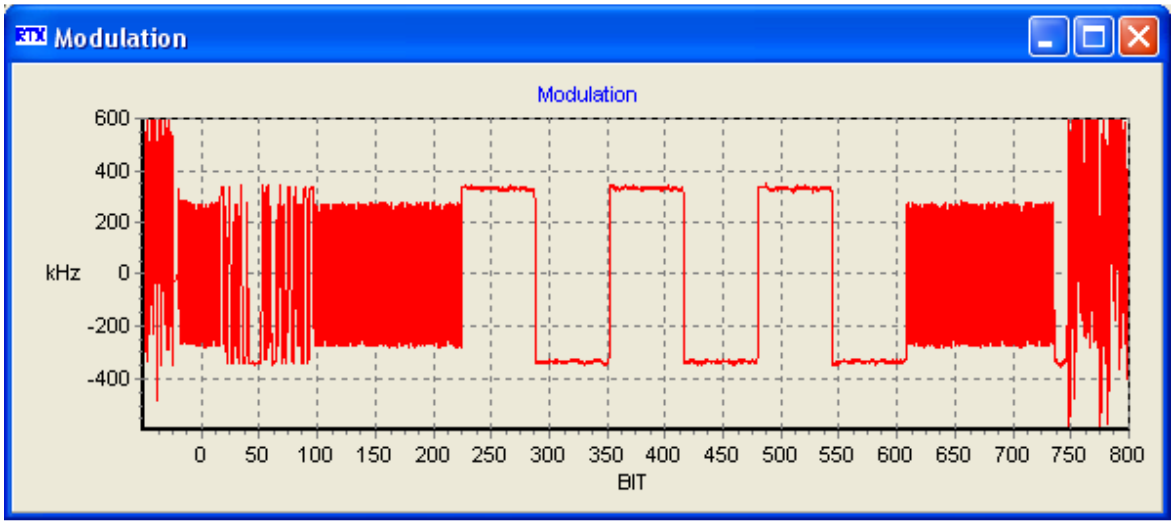
Please check that the power template is appropriate in relation to the chosen slot type – i.e. selecting an appropriate type from the **Power template** drop down list (see below). Please ensure to select the correct power template (i.e. PP64Z for CAT-iq).



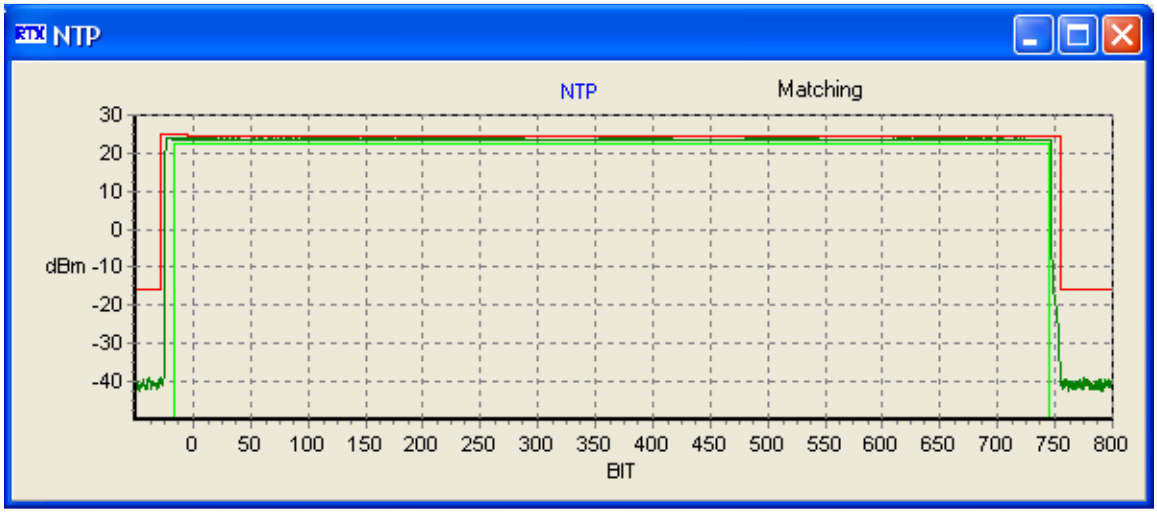
After selecting the slot type, the connection can now be established by clicking **Status/ Connect**. Upon successful connection establishment an **FP Connect** window will open (see below). As indicated here the Slot Type is P64Z, and hence, the CAT-iq connection establishment was successful.



Clicking **Show Modulation** will open a modulation graph (see below).

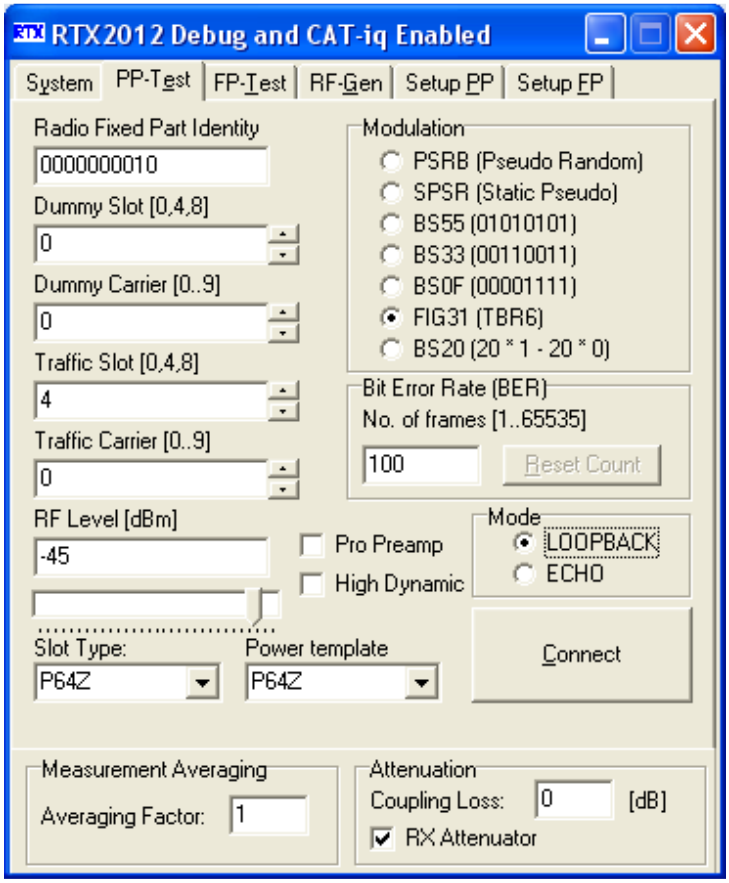


Please note that a higher number of bits are included than in the "normal" P32Z case. This is also the case with the NTP graph (see below). If the NTP graph does not match please check that you are using the correct power template.

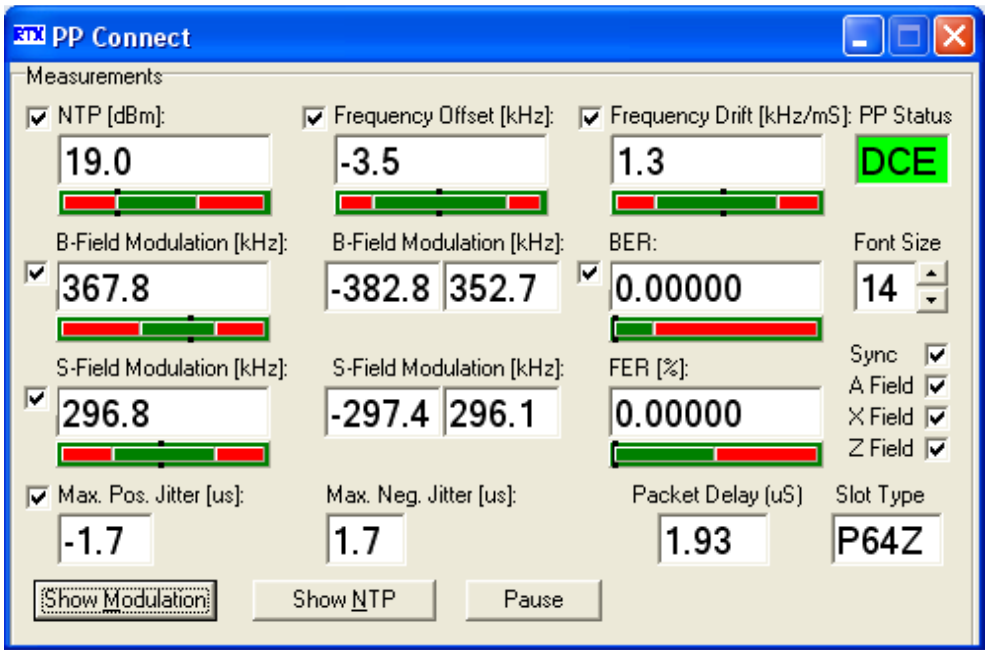


iii. Setting up for PP CAT-iq test

The measurement preparation for PP CAT-iq is similar to the FP CAT-iq approach outlined above – i.e. ensure that the **Slot Type** is P64Z or Default on the **PP-Test** page. If the **Slot Type** is set to Default the connection will be established using the longest possible slot type – i.e. if the PP DUT supports CAT-iq the connection will be established using P64Z. Please ensure to use the correct power template (i.e. PP64Z for CAT-iq).



Now establish a connection to the PP by clicking **Connect** on the **PP-Test** page and the **PP Connect** window will open (see below).



As a last step we can verify that a CAT-iq connection has been established by checking the **Slot Type** on the **PP Connect** window. As indicated above the slot type is P64Z (i.e. CAT-iq).

4. Dynamic Link Library Interfacing

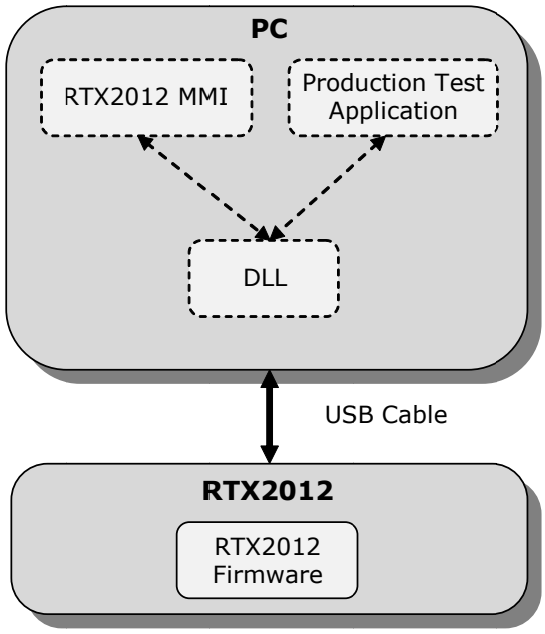
A. **Introduction**

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 RTX2012 tester using the SCPI command set you must first understand how to link to the supplied RTX2012 Dynamic Link Library (DLL). Once this is understood please consult the Programming Reference (see chapter 5) for information on the functionality provided by the DLL.

Microsoft Windows provides ways to use dynamic link libraries but it is important to be aware of the fact that 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.

B. **Dynamic Link Library Interface Description**

The USB interface is used to communicate with the RTX2012 tester. In order to make the tester user friendly the USB communication has been encapsulated in a number of API functions, which are provided as a Windows DLL. In essence the DLL acts as translator between the SCPI commands and the USB interface commands. The RTX2012 MMI makes use of this DLL for communication with the tester and you can also make use of the DLL in your own test application (as outlined below).



In the following paragraphs central items of information regarding use of the DLL in your own programs are provided. Issues like calling convention, command format and explicit/ implicit linking of the DLL are outlined.

i. DLL Filename and Location

File Name: R2012dll.dll

Windows XP / Windows 7 location: C:\WINDOWS\system32

ii. Calling Convention

As mentioned above different programming languages and compilers use different approaches when performing subroutine calls. For example the methods used to store parameters and return addresses on the stack vary. The term *calling convention* is defined to cover the different access methods. Hence, since the user application may not have been created in the same programming language as the DLL, it is crucial to know the calling convention to use when DLL functions are called from your source code.

The calling convention used by the RTX2012 Tester DLL is the **__stdcall**. If C++ is used as the application programming language the calling convention is explicitly specified by the **__stdcall** keyword in the interface header file cmd_2012.h.

iii. General Format

The general command format for SCPI calls using the RTX2012 DLL is:

```
RtxWrt(<string>);
```

Here the parameter `<string>` includes a sting with a SCPI command (e.g. "SYST:RESET"). Please note that the parameter <string> can be both a command and a query string (e.g. "STAT:DEV?" is a query string). For a complete list of supported SCPI commands please refer to the Programming Reference (chapter 5). If a result string is expected the `RtxWrt()` function call should be followed by a `RtxRd()` function call. The implementation of both `RtxWrt()` and `RtxRd()` are located in the DLL.

iv. Explicit DLL Linking

With *Explicit DLL Linking* the application only requires the interface header file R2011dll.h and the DLL itself. All DLL linking is done explicitly by the application program. Hence, using this approach you must first load the DLL module using the WIN API function `LoadLibrary()`. Thereafter retrieve the addresses for each DLL function explicitly through the function `GetProcAddress()`- i.e. for example:

```
DllHandle = LoadLibrary(<DllName>);
functionPtr = GetProcAddress(<DllHandle>, <function name>);
```

Please refer to Appendix A on page 134 for example source code for using the RTX2012 DLL with explicit linking.

v. Implicit DLL Linking

With *Implicit Linking* the application requires the *R2012DLL.lib* file in addition to the interface header file `R2012DLL.h` and the DLL. The DLL linking is in this case 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 by the compiler to perform implicit linking is included in the .lib file, and hence, `R2012DLL.lib` must 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 implicit DLL linking only with Borland compilers**. In other cases (e.g. Microsoft) explicit DLL linking is recommended.

5. Programming Reference

A. **Introduction**

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

The Tester supports standard SCPI (Standard Commands for Programmable Instruments) commands according to the IEEE 488.2 standard.

This chapter outlines and describes the SCPI command sub-set supported by the Tester, and hence, contains the following sections:

- *Introduction to the SCPI language*
- *Detailed Command Descriptions*
  - CALCulate Subsystem
  - CONFigure Subsystem
  - PROCedure Subsystem
  - READ Subsystem
  - STATus Subsystem
  - SYSTem Subsystem
- *Sending Commands from the User Interface*
- *Example Program*

B. **Introduction to the SCPI language**

The SCPI command language is recommended when the test set is to be used 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. For example using "CONF:TEST:TYPE?" will return DCE or DFP.

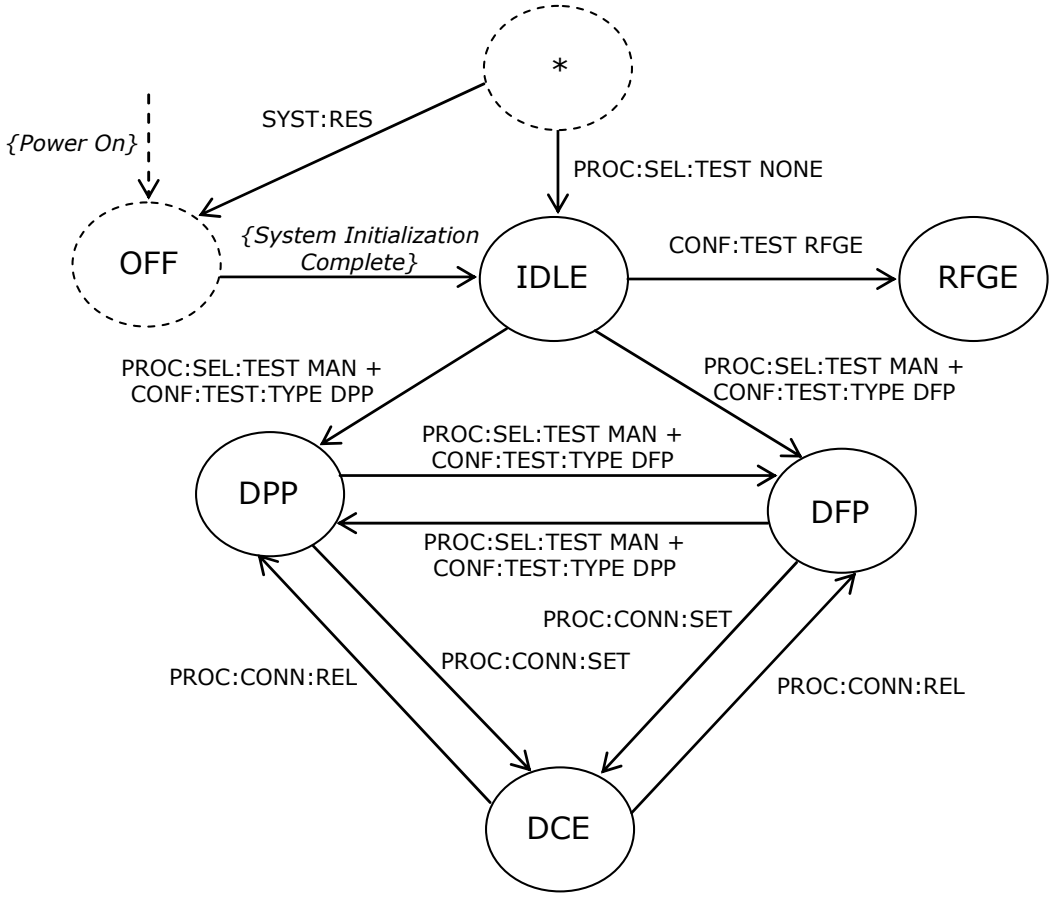
i. SCPI Command overview

System States

The Tester has in total six permissible states (see detailed description and state diagram below).

- **OFF** – This state is kind of an intermediate state. Right after power-on or system reset (using the SYST:RESET command) the tester will enter this state and will stay there until the initialization of the tester has completed. Upon completion the tester will change to the IDLE state.
- **IDLE** – In this state the tester is ready to process SCPI commands.
- **DFP -** In this state the tester can establish a connection to a Fixed Part (Base Station). When a connection is established, the tester enters the DCE state.
- **DPP** – In this state the tester can establish a connection to a Portable Part (Handset). When a connection is established, the tester enters the DCE state.
- **DCE** – In this state the tester is connected to a DUT.
- **RFGE** – In this state the RF Generator is active and it is used for performing measurements such as power level.

The remote command set can be accessed through the PC interface and the state of the Tester is changed according to the executed commands.



ii. SCPI Command Summary

Commands	Page	Set	Query
*IDN?	97		X
CALC:LIM:POW:TRAN:MAT ?	112		X
CALC:LIM:POW:RMPA <value>	107	X	
CALC:LIM:POW:RMPB <value>	108	X	
CALC:LIM:POW:RMPC <value>	108	X	
CALC:LIM:POW:RMPD <value>	108	X	
CALC:LIM:POW:RMPE <value>	108	X	
CALC:LIM:POW:RMPF <value>	108	X	
CONF:ATT:RX <value>	98	X	X
CONF:AVER:BURS <numeric value>	99	X	X
CONF:BER:DATA <value>	109	X	X
CONF:BER:EVAL:WIND <numeric value>	114	X	X
CONF:BER:RF:LEV <numeric value>	114		
CONF:COMM:PORT <value>	96	X	X
CONF:CARR:OFFS <numeric value>	100	X	
CONF:CARR:REF <numeric value>	99	X	X
CONF:FP:ANT <numeric value>	102	X	X
CONF:FP:CARR:OFFS <numeric value>	110	X	
CONF:FP:FREQ:OFFS <value>	103	X	
CONF:FP:RF:LEV <numeric value>	102	X	X
CONF:FP:RFPI <numeric value>	102	X	X
CONF:FP:SIGN:MODE <value>	103	X	
CONF:FP:SIGN:PRO <value>	103	X	X
CONF:FP:TRAF:CARR <numeric value>	101	X	X
CONF:FP:TRAF:SIZE <numeric value>	101	X	
CONF:FP:TRAF:SLOT <numeric value>	101	X	X
CONF:MOD:DRIF:UNIT <value>	107	X	
CONF:NUMB:CARR <numeric value>	100	X	X
CONF:PACK:EVAL:WIND <value>	109	X	
CONF:POW:DYN:RANG <value>	111	X	X
CONF:POW:PACK <value>	107	X	
CONF:PP:CARR:OFFS <numeric value>	110	X	
CONF:PP:FREQ:OFFS <value>	106	X	
CONF:PP:DUMM:CARR <numeric value>	104	X	X
CONF:PP:DUMM:SLOT <numeric value>	104	X	X
CONF:PP:RF:LEV <numeric value>	105	X	
CONF:PP:RFPI <numeric value>	106	X	X
CONF:PP:SIGN:MODE <value>	105	X	
CONF:PP:SIGN:PRO <value>	106	X	X
CONF:PP:TRAF:CARR <numeric value>	104	X	X
CONF:PP:TRAF:SIZE <numeric value>	105	X	
CONF:PP:TRAF:SLOT <numeric value>	104	X	X
CONF:RFGE:CARR <numeric value>	100	X	X
CONF:RFGE:MOD <value>	101	X	X
CONF:SAMP:MODE <value>	99	X	X
CONF:SYNC:FREQ:REF <value>	110	X	
CONF:TEST <value>	96	X	

Commands (cont.)	Page	Set	Query
CONF:TEST:EXTF <numeric value>	99	X	X
CONF:TEST:RFGE [<numeric value>]	100	X	
CONF:TEST:TYPE <value>	107	X	X
FETC:BER:LTER?	115		X
FETC[:SCAL]:JITT?	116		X
FETC[:SCAL]:PACK:DEL?	106		X
PROC:CONN:REL	110	X	
PROC:CONN:SET	109	X	
PROC:SAMP:FORC	98	X	
PROC:SEL:TEST <value>	109	X	
PROC:STRT:BER	114	X	
READ:BER?	115		X
READ:BER:LTER?	115		X
READ:BER:NOW?	115		X
READ:BF?	112		X
READ:CRC?	115		X
READ:SF?	113		X
READ:FREQ:DRIF?	113		X
READ:FREQ:MS?	113		X
READ:FREQ:SLOT?	113		X
READ:FREQ:OFFS?	112		X
READ[:SCAL]:PACK:DEL?	105		X
READ[:SCAL]:JITT?	116		X
READ:SLOT:SIZE?	112		X
READ:TIME:ACC?	103		X
READ:NTP?	112		X
READ:MEAS:ALTX?	114		X
READ:XZF:MATC?	116		X
SENS:CORR:LOSS <numeric value>	98	X	X
SENS:DET:RFPI?	102		X
SENS:SIGN:STAT?	102		X
STAT:DEV?	97		X
SYST:ERR?	98		X
SYST:FIRM:VERS?	97		X
SYST:HW:VERS?	97		X
SYST:OPT?	98		X
SYST:RESET	96	X	
SYST:SER:NUM?	97		X

iii. Detailed Command Descriptions

In the following sections the available commands and parameters in the individual states are described in more detail. Unless otherwise specified, the values given in the column "Default" are set upon reset of the Tester.

Please note that the Tester only accepts the listed commands and if a command is not supported an error will be returned. Furthermore, an error is returned if a mandatory parameter is missing in the command sent to the Tester.

In the following <numeric value> denotes a numeric value and the value range is indicated in the command description. Likewise <value> denotes a specific entry from the list of permissible values.

Please note that square brackets (i.e. [ ]) are used to indicate that a parameter or subcommand is optional – i.e. [<numeric value>] means that the <numeric value> parameter is optional in the command.

Please note that a number of commands will return INV if used as query in invalid states. Furthermore, this return value is also valid where stated explicitly in the detailed descriptions.

iv. Common commands

System Reset

Syntax:	SYST:RESET	
Value:	N/A	Default: N/A
State:	Set: All Query: N/A	
Description:	This command resets the tester. Please note that the tester will change to the intermediate state OFF and remain in this state until the initialization procedure has completed. Thereafter the tester will enter the IDLE state.	
Example:	"SYST:RESET"	

Disable options

Syntax:	CONF:TEST <value>	
Value:	NOP0 (Option A = CAT-iq)	Default: N/A
State:	Set: IDLE Query: N/A	
Description:	This command will disable the indicated option until next reset.	
Example:	"CONF:TEST NOP0"	

Set System Communication Port

Syntax:	CONF:COMM:PORT <value>	
Values:	USB | NONE [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. NONE releases USB port. ***Please note that the RTX2012 only supports USB as PC interface***.	
Example:	"CONF:COMM:PORT USB", "CONF:COMM:PORT?"	

Query status

Syntax:	STAT:DEV?	
Return:	OFF | IDLE | DFP | DPP | DCE | RFGE	Default: N/A
State:	Set: N/A Query: All	
Description:	This query returns the current state of the tester. Please note that after a reset (using "SYS:RES") or at power-on the state is OFF until the system has initialized properly.	
Example:	"STAT:DEV?"	

Query firmware version

Syntax:	SYST:FIRM:VERS?	
Return:	<string>	Default: N/A
State:	Set: N/A Query: All	
Description	This query returns the firmware version of the tester – example return string: "RTX20xx v0.9.61"	
Example:	"SYST:FIRM:VERS?"	

Query software version

Syntax:	*IDN?	
Return:	<string>	Default: N/A
State:	Set: N/A Query: All	
Description	This query returns the PC-DLL Software Version – example return string: "3.2.0".	
Example:	"*IDN?"	

Query serial number

Syntax:	SYST:SER:NUM?	
Return:	<string>	Default: N/A
State:	Set: N/A Query: All	
Description	This query returns the serial number of the tester – example return string: "00006006".	
Example:	"SYST:SER:NUM?"	

Query Hardware type

Syntax:	SYST:HW:VERS?	
Return:	<string>	Default: N/A
State:	Set: N/A Query: All	
Description	This query returns the tester hardware type information – example return string: "RTX2012 4.1 2.7"	
Example:	"SYST:HW:VERS?"	

Query Options available

Syntax:	SYST:OPT?	
Return:	<string>	Default: N/A
State:	Set: N/A Query: All	
Description	This query returns the option letter for the available options – example return string for option A and B: "AB"	
Example:	"SYST:OPT?"	

Query Last error

Syntax:	SYST:ERR?	
Return:	<string>	Default: N/A
State:	Set: N/A Query: All	
Description	This query returns the last error string stored in the tester. Please refer to section C in this chapter for a list of error strings.	
Example:	"SYST:ERR?"	

Force ADC sample

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

RF Attenuator switch

Syntax:	CONF:ATT:RX <value>	
Values:	ON | OFF	Default: ON
State:	Set: All Query: All	
Description:	This command set the RF attenuator in the RX direction, allowing a higher level input. If used as query it will return the state of the attenuator switch.	
Example:	"CONF:ATT:RX ON", "CONF:ATT:RX?"	

External attenuation at RF In/Out

Syntax:	SENS:CORR:LOSS <numeric value>	
Value Range:	0 .. 100 (Unit: dB , Resolution: 0.1dB)	Default: 0.0
State:	Set: All Query: All	
Description:	Sets the value of the RF cable loss in order to compensate for power in TX/RX direction. Please note that the resolution is 0.1dB. If used as query it will return the configured cable loss in dB.	
Example:	"SENS:CORR:LOSS 6.5", "SENS:CORR:LOSS?"	

Configure Sampling Mode

Syntax:	CONF:SAMP:MODE <value>	
Values:	AUTO | CTRL	Default: AUTO
State:	Set: All Query: All	
Description:	This command configures the sampling mode of the tester. 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. If used as query it will return the current sample mode. Please note that it is not recommended to use CTRL mode with CONF:AVER:BURS > 1.	
Example:	"CONF:SAMP:MODE CTRL", "CONF:SAMP:MODE?"	

Averaging factor

Syntax:	CONF:AVER:BURS <numeric value>	
Value Range:	1 .. 200	Default: 1
State:	Set: All Query : All	
Description:	This command configures the number of bursts used for measurement averaging. Collection of measurements will be initiated right after connection setup or after applying this command until the specified number of measurements for averaging have been collected. *Please note that FER and BER are not averaged.* If used as query it will return the current number of bursts used for averaging. Furthermore, if the modulation is changed "on-the-fly" this command MUST be send right after the change in order to restart the measurements for averaging.	
Example:	"CONF:AVER:BURS 100", "CONF:AVER:BURS?"	

Disable/enable Extended frequencies function

Syntax:	CONF:TEST:EXTF <numeric value>	
Value Range:	0,1 (Disable/enable)	Default:0
State:	Set: IDLE Query : All	
Description:	This command is used to enable and disable extended frequencies. *Please note that option C is required to enable extended frequencies.*	
Example:	"CONF:TEST:EXTF 1", "CONF:TEST:EXTF?"	

Highest used carrier number

Syntax:	CONF:CARR:REF <numeric value>	
Value Range:	0,10-31	Default:0
State:	Set: IDLE Query : All	
Description:	This command is used to set the channel number for the highest frequency used for extended frequencies. *Please3 note that option C is required and extended frequencies should be enabled.*	
Example:	CONF:CARR:REF 0, "CONF:CARR:REF?"	

Number of used carriers

Syntax:	CONF:NUMB:CARR <numeric value>	
Value Range:	1 – 10	Default:10
State:	Set: IDLE Query : All	
Description:	This command is used to set the desired number of test carriers.	
Example:	CONF:NUMB:CARR 10, "CONF:NUMB:CARR?"	

Set Carrier Offset

Syntax:	CONF:CARR:OFFS <numeric value>	
Value Range:	3 - -22	Default: 0 (=EU DECT)
State:	Set: IDLE Query: IDLE	
Description:	This command is used for setting the FP carrier offset. The default value is 0, which is equal to EU DECT. A value of -18 equals US DECT. If used as query it will return the offset configured in the tester. ***Please note that this command will set the PP and FP carrier offset to the same value as well.***	
Example:	"CONF:FP:CARR:OFFS -3"	

v. RF-generator

RF-generator mode

Syntax:	CONF:TEST:RFGE [<numeric value>]	
Value Range:	0 .. 9	Default: 0
State:	Set: All Query: N/A	
Description:	This command sets the carrier for the RF-generator. Please note that the channel parameter is optional. However, it can be used to set both generator mode and the channel number in one step. *When in generator mode and wanting to change the channel number please use the CONF:RFGE:CARR command instead.* If the channel parameter is not included channel 0 will be used as default carrier for the RF-generator.	
Example:	"CONF:TEST:RFGE", "CONF:TEST:RFGE 0"	

Carrier for RF-generator

Syntax:	CONF:RFGE:CARR <numeric value>	
Value Range:	0 .. 9	Default: 0
State:	Set: All Query: All	
Description	This command sets the carrier for the RF-generator. This command should first and foremost be used when the tester is in the RF-generator state. If used as query it will return the current carrier used for the RF-generator.	
Example:	"CONF:RFGE:CARR 0", "CONF:RFGE:CARR?"	

Modulation scheme for RF-generator

Syntax:	CONF:RFGE:MOD <value>	
Values:	BS55 | BS33 | BS0F | OFF (no modulation, CW signal)	Default: BS55
State:	Set: All Query: All	
Description	This command sets the modulation scheme of the RF-generator. If used as query it will return the current modulation scheme of the RF-generator.	
Example:	"CONF:RFGE:MOD BS55", "CONF:RFGE:MOD?"	

vi. FP-Test

Traffic Carrier for FP test

Syntax:	CONF:FP:TRAF:CARR <numeric value>	
Value Range:	0 .. 9	Default: N/A
State:	Set: IDLE, DFP Query: All	
Description	This command is used for selecting the traffic carrier in FP test mode. If used as query it will return the current traffic carrier for the FP test mode.	
Example:	"CONF:FP:TRAF:CARR 0", "CONF:FP:TRAF:CARR?"	

Traffic Slot for FP test

Syntax:	CONF:FP:TRAF:SLOT <numeric value>	
Value Range:	0, 2, 4, 6, 8, 10	Default: 0
State:	Set: IDLE, DFP Query: All	
Description	This command is used for setting the slot number used for traffic in FP test mode. Please note that all slots are supported in both normal and CAT-iq mode. If used as query it will return the current traffic slot for the FP test mode.	
Example:	"CONF:FP:TRAF:SLOT 0", "CONF:FP:TRAF:SLOT?"	

Set FP Traffic Slot size

Syntax:	CONF:FP:TRAF:SIZE <numeric value>	
Value Range:	40 | (P32 slot size) 80 (P64 slot size) (see description)	Default: 40
State:	Set: IDLE Query: N/A	
Description:	This configuration command specifies the slot size for use in FP tests. Please note that the P64 slot (i.e. size 80) is only available if the CAT-iq option has been enabled.	
Example:	"CONF:FP:TRAF:SIZE 40"	

RF level for FP-test

Syntax:	CONF:FP:RF:LEV <numeric value>	
Value Range:	-40 .. –100 (Unit: dBm , Resolution: 0.1dBm) Range is dependent on SENS:CORR:LOSS setting.	Default: -60.0
State:	Set: All Query: All	
Description:	This command is used for setting the RF level for the FP-test. Please note that the resolution is 0.1dBm. If used as query it will return the current RF level for FP-test.	
Example:	"CONF:FP:RF:LEV –100", "CONF:FP:RF:LEV?"	

Antenna of the FP

Syntax:	CONF:FP:ANT <numeric value>	
Value Range:	0 .. 7	Default: 0
State:	Set: IDLE, DFP Query: All	
Description	This command is used for configuring the antenna in the FP. If used as query it will return the id of the antenna currently configured in the FP.	
Example:	"CONF:FP:ANT 0", "CONF:FP:ANT?"	

Query of Lock state

Syntax:	SENS:SIGN:STAT?	
Return:	LOCK | UNL	Default: N/A
State:	Set: N/A Query: DFP	
Description:	This command is used for query of the state. If "LOCK" is returned the tester is locked to an FP.	
Example:	"SENS:SIGN:STAT?"	

RFPI of the DUT

Syntax:	SENS:DET:RFPI?	
Return:	<string> (10 digits in hex format)	Default: N/A
State:	Set: N/A Query: DFP, DCE	
Description:	This command is used for detecting the RFPI of the FP.	
Example:	"SENS:DET:RFPI?"	

Setting RFPI for FP

Syntax:	CONF:FP:RFPI <string>	
Value:	<string> (10 digits in hex format)	Default: 0x0000000000
State:	Set: IDLE, DFP Query: All	
Description:	This command is used for setting the RFPI of the FP to lock on to. Please note that a value of all zeros indicates that the tester will lock on to any FP. If used as query it will return the RFPI of the FP the tester will lock on to.	
Example:	"CONF:FP:RFPI "0000000000"", "CONF:FP:RFPI?"	

Signalling-Mode for FP test

Syntax:	CONF:FP:SIGN:MODE <value>	
Value:	LOOP | ECHO	Default: LOOP
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the signalling mode of the FP. This can be either loop-back or echo.	
Example:	"CONF:FP:SIGN:MODE LOOP"	

Query of FP timing accuracy

Syntax:	READ:TIME:ACC?	
Return:	<Value> (Unit: ppm)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for reading the FP timing accuracy. The value returned is in ppm (parts per million). Please note that this command is only supported for FP since it is not required for PP (ref. 300 175-2).	
Example:	"READ:TIME:ACC?"	

Prolonged preamble for FP-test

Syntax:	CONF:FP:SIGN:PRO <value>	
Value:	ON | OFF	Default: ON
State:	Set: DFP Query: All	
Description:	This command is used for enabling (ON) / disabling (OFF) support for prolonged preamble. If used as query it will return the current state of the prolonged preamble (i.e. ON or OFF).	
Example:	"CONF:FP:SIGN:PRO OFF", "CONF:FP:SIGN:PRO?"	

Frequency off-set for FP-test

Syntax:	CONF:FP:FREQ:OFFS <value>	
Value:	NORM | P50K | (+50 kHz) M50K (-50 kHz)	Default: NORM
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the transmit frequency offset – this can be set to either +/- 50 kHz or normal (no offset). Please note that both the PP and FP version maps to the same DLL function (i.e. a call to the FP version will also set the offset for PP and vice versa). ***Please note that this command requires Option B.***	
Example:	"CONF:FP:FREQ:OFFS NORM"	

vii. PP-test

Dummy Carrier for PP test

Syntax:	CONF:PP:DUMM:CARR <numeric value>	
Value Range:	0 .. 9	Default: N/A
State:	Set: IDLE, DFP Query: All	
Description:	This command is used for selecting the dummy carrier in PP test mode.	
Example:	"CONF:PP:DUMM:CARR 0", "CONF:PP:DUMM:CARR?"	

Dummy Slot for PP test

Syntax:	CONF:PP:DUMM:SLOT <numeric value>	
Value Range:	0, 2(*), 4, 6(*), 8, 10(*) ((*) = available only if CAT-iq option disabled)	Default: 4
State:	Set: IDLE, DFP Query: All	
Description:	This command is used for setting the slot number used for the dummy bearer in PP test mode. Please note that with the CAT-iq option enabled the number of dummy slots is reduced from six to three. Please note that the dummy slot must be different from the traffic slot by at least 2. If used as query it will return the configured dummy slot.	
Example:	"CONF:PP:DUMM:SLOT 0", "CONF:PP:DUMM:SLOT?"	

Traffic Carrier for PP test

Syntax:	CONF:PP:TRAF:CARR <numeric value>	
Value Range:	0 .. 9	Default: N/A
State:	Set: IDLE, DFP Query: All	
Description:	This command is used for selecting the traffic carrier in PP test mode.	
Example:	"CONF:PP:TRAF:CARR 0", "CONF:PP:TRAF:CARR?"	

Traffic Slot for PP test

Syntax:	CONF:PP:TRAF:SLOT <numeric value>	
Value Range:	0, 2(*), 4, 6(*), 8, 10(*) ((*) = available only if CAT-iq option disabled)	Default: 0
State:	Set: IDLE, DFP Query: All	
Description:	This command is used for setting the slot number used for traffic in PP test mode. Please note that with the CAT-iq option enabled the number of traffic slots is reduced from six to three. Please note that the dummy slot must be different from the traffic slot by at least 2. If used as query it will return the configured traffic slot.	
Example:	"CONF:PP:TRAF:SLOT 0", "CONF:PP:TRAF:SLOT?"	

Set PP Traffic Slot size

Syntax:	CONF:PP:TRAF:SIZE <numeric value>	
Value Range:	0 | (use longest possible slot size) 40 | (P32 slot size) 80 (P64 slot size) (if CAT-iq option is enabled)	Default: 0
State:	Set: IDLE Query: N/A	
Description:	This configuration command specifies the slot size for PP tests. When the default value of 0 is used then the connection will be made with the longest possible slot size (i.e. if the PP supports P64 then this will be used – if not the connection will be setup using P32). Please note that the P64 slot size is available only if the CAT-iq option is enabled.	
Example:	"CONF:PP:TRAF:SIZE 40"	

RF level for PP-test

Syntax:	CONF:PP:RF:LEV <numeric value>	
Value Range:	-40 .. –100 (Unit: dBm , Resolution: 0.1dBm) Range is dependent on SENS:CORR:LOSS setting.	Default: -60.0
State:	Set: All Query: All	
Description:	This command is used for setting the RF level for the PP-test. Please note that the resolution is 0.1dBm. If used as query it will return the current RF level for PP-test.	
Example:	"CONF:PP:RF:LEV –100", "CONF:PP:RF:LEV?"	

Query of PP packet delay

Syntax:	READ[:SCAL]:PACK:DEL?	
Return:	<actual value>,<max. value>,<min. value> (Unit: µs)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command returns the PP packet delay in µs (actual, min., max.). Please note that this command is only supported for PP since this parameter is not required for FP.	
Example:	"READ:PACK:DEL?", "READ:SCAL:PACK:DEL?"	

Signalling-Mode for PP test

Syntax:	CONF:PP:SIGN:MODE <value>	
Value:	LOOP | ECHO	Default: LOOP
State:	Set: IDLE Query: N/A	
Description:	This command is used to set the signalling mode of the PP.	
Example:	"CONF:PP:SIGN:MODE LOOP"	

Frequency off-set for PP-test

Syntax:	CONF:PP:FREQ:OFFS <value>	
Value:	NORM | +50K | (+50 kHz) -50K (-50 kHz)	Default: NORM
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the transmit frequency offset – this can be set to either +/- 50 kHz or normal (no offset). Please note that both the PP and FP version maps to the same DLL function (i.e. a call to the PP version will also set the offset for FP and vice versa). ***Please note that this command requires Option B.***	
Example:	"CONF:PP:FREQ:OFFS NORM"	

Prolonged preamble for PP-test

Syntax:	CONF:PP:SIGN:PRO <value>	
Value:	ON | OFF	Default: ON
State:	Set: DPP Query: All	
Description:	This command is used for enabling (ON) / disabling (OFF) support for prolonged preamble. If used as query it will return the current state of the prolonged preamble (i.e. ON or OFF).	
Example:	"CONF:PP:SIGN:PRO OFF", "CONF:PP:SIGN:PRO?"	

RFPI of the tester in PP test

Syntax:	CONF:PP:RFPI <string>	
Value:	<string> (10 digits in hex format)	Default: 0x0000000010
State:	Set: IDLE, DPP Query: All	
Description:	This command is used for setting the RFPI of the tester – i.e. the RFPI the DUT will lock on to. Please note that all zero's is not a valid RFPI. If used as query it will return the current RFPI of the tester.	
Example:	"CONF:PP:RFPI "0000000010"", "CONF:PP:RFPI?"	

Fetch Packet Delay

Syntax:	FETC[:SCAL]:PACK:DEL?	
Return:	<act. val.>,<max. val.>,<min. val.> | (Unit: µs) INV	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command returns the PP packet delay in µs (actual value, max. value, min. value) from the most recent measurement. The max./min. values are reset upon connection establishment, upon a READ[:SCAL]:JITT? command, and upon a CONF:PACK:EVAL:WIND command. Please note that this command is only supported for PP since this parameter is not required for FP.	
Example:	"FETC:PACK:DEL?", "FETC:SCAL:PACK:DEL?"	

viii. General commands

Device type

Syntax:	CONF:TEST:TYPE <value>	
Value:	DFP | (Testing fixed part) DPP (Testing portable part)	Default: N/A
State:	Set: All Query: All	
Description:	This command is used for setting the test type (i.e. testing FP or PP). If used as a query it will return the test type (DFP or DPP) or IDLE.	
Example:	"CONF:TEST:TYPE DFP", "CONF:TEST:TYPE?"	

Selectable Units for Frequency Drift

Syntax:	CONF:MOD:DRIF:UNIT <value>	
Value:	SLOT | MS	Default: MS
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the unit for Frequency drift – this can be either kHz/mS or kHz/Slot.	
Example:	"CONF:MOD:DRIF:UNIT SLOT"	

Packet Type (Power Ramp Measurements)

Syntax:	CONF:POW:PACK <value>	
Value:	P32Z | PP32Z | P64Z | (if CAT-iq option is enabled) PP64Z (if CAT-iq option is enabled)	Default: P32Z
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the packet type to use in the Power Ramp measurements. Please note that P64Z and PP64Z are available only if the CAT-iq option is supported and has been enabled.	
Example:	"CONF:POW:PACK P32Z"	

Tolerance Range for Power-Time-Template (Part A)

Syntax:	CALC:LIM:POW:RMPA <numeric value>	
Value Range:	-50 - 0 (Unit: dBm)	Default: -47 dBm
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the tolerance for the Part A of the Power-time-Template.	
Example:	"CALC:LIM:POW:RMPA -47"	

Tolerance Range for Power-Time-Template (Part B)

Syntax:	CALC:LIM:POW:RMPB <numeric value>	
Value Range:	-20 - 0 (Unit: dBm)	Default: -16 dBm
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the tolerance for the Part B of the Power-time-Template.	
Example:	"CALC:LIM:POW:RMPB -16"	

Tolerance Range for Power-Time-Template (Part C)

Syntax:	CALC:LIM:POW:RMPC <numeric value>	
Value Range:	0 – 10 (Unit: dBm)	Default: 4 dBm
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the tolerance for the Part C of the Power-time-Template.	
Example:	"CALC:LIM:POW:RMPC 4"	

Tolerance Range for Power-Time-Template (Part D)

Syntax:	CALC:LIM:POW:RMPD <numeric value>	
Value Range:	0 – 10 (Unit: dBm)	Default: 1 dBm
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the tolerance for the Part D of the Power-time-Template.	
Example:	"CALC:LIM:POW:RMPD 1"	

Tolerance Range for Power-Time-Template (Part E)

Syntax:	CALC:LIM:POW:RMPE <numeric value>	
Value Range:	-10 – 0 (Unit: dBm)	Default: -1 dBm
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the tolerance for the Part E of the Power-time-Template.	
Example:	"CALC:LIM:POW:RMPE -1"	

Tolerance Range for Power-Time-Template (Part F)

Syntax:	CALC:LIM:POW:RMPF <numeric value>	
Value Range:	-20 – 0 (Unit: dBm)	Default: -6 dBm
State:	Set: IDLE Query: N/A	
Description:	This command is used for setting the tolerance for the Part F of the Power-time-Template.	
Example:	"CALC:LIM:POW:RMPF -6"	

Set Frames for Packet delay and Jitter measurements

Syntax:	CONF:PACK:EVAL:WIND <numeric value>	
Value Range:	1 – 65535	Default: 200
State:	Set: IDLE Query: IDLE	
Description:	This command sets the number of frames used for packet delay and jitter measurements.	
Example:	"CONF:PACK:EVAL:WIND 100"	

Test mode

Syntax:	PROC:SEL:TEST <value>	
Value:	NONE | MAN	Default: N/A
State:	Set: (NONE) All, MAN (IDLE) Query: N/A	
Description:	This command sets the test mode – if the parameter value NONE is used the Tester will return to state IDLE. The value MAN is only valid in state IDLE and indicates that the Tester is set into DECT test mode (i.e. FP or PP test). Using this command with value MAN is optional, but if used please make sure to send it before sending "CONF:TEST:TYPE <value>".	
Example:	"PROC:SEL:TEST NONE"	

Modulation scheme for PP and FP-test

Syntax:	CONF:BER:DATA <value>	
Value:	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) BS20 (Bit sequence 20 * 1 – 20 * 0)	Default: FIG31
State:	Set: All Query: All	
Description:	This command is used for setting the modulation scheme for the PP- and FP-tests. If used as a query it will return the configured modulation scheme. **NOTE!** If the modulation is changed "on-the-fly" the command "CONF:AVER:BURS" MUST be send right after the modulation change in order to restart the measurements for averaging.	
Example:	"CONF:BER:DATA FIG31", "CONF:BER:DATA?"	

Setup connection

Syntax:	PROC:CONN:SET	
Value:	N/A	Default: N/A
State:	Set: DFP, DPP Query: N/A (check with STAT:DEV? if connection was established).	
Description:	This command is used for setting up a connection. Please note that STAT:DEV? must be used when checking whether or not the connection was established successfully. The tester will go to DCE state if the connection was established.	
Example:	"PROC:CONN:SET"	

Connection release

Syntax:	PROC:CONN:REL	
Value:	N/A	Default: N/A
State:	Set: DCE Query: N/A	
Description:	This command is used for releasing a connection. The tester will go back to either DFP or DPP state, depending on the mode.	
Example:	"PROC:CONN:REL"	

Set Carrier Offset for FP

Syntax:	CONF:FP:CARR:OFFS <numeric value>	
Value Range:	3 - -22	Default: 0 (=EU DECT)
State:	Set: IDLE Query: IDLE	
Description:	This command is used for setting the FP carrier offset. The default value is 0, which is equal to EU DECT. A value of -18 equals US DECT. If used as query it will return the offset configured in the tester. ***Please note that this command will set the PP carrier offset to the same value as well.***	
Example:	"CONF:FP:CARR:OFFS -3"	

Set Carrier Offset for PP

Syntax:	CONF:PP:CARR:OFFS <numeric value>	
Value Range:	3 - -22	Default: 0 (=EU DECT)
State:	Set: IDLE Query: IDLE	
Description:	This command is used for setting the PP carrier offset. The default value is 0, which is equal to EU DECT. A value of -18 equals US DECT. If used as query it will return the offset configured in the tester. ***Please note that this command will set the FP carrier offset to the same value as well.***	
Example:	"CONF:PP:CARR:OFFS -3"	

Reference synchronization frequency

Syntax:	CONF:SYNC:FREQ:REF <value>	
Value Range:	I10M | (Internal 10 MHz clock) E10M (External 10 MHz clock)	Default: I10M
State:	Set: IDLE Query: N/A	
Description:	This command is used for selecting the current 10 MHz reference clock generator. ***Please note that this command requires Option B.*** Either an external 10 MHz reference clock generator or the internal 10 MHz clock can be selected. ***Please ensure that the external reference clock generator is connected and operating correctly when using the external reference mode. The tester will NOT automatically switch over to the internal reference if the external reference is either not connected or operating properly.***	
Example:	"CONF:SYNC:FREQ:REF E10M"	

Dynamic range for Power Ramp Measurements

Syntax:	CONF:POW:DYN:RANG <value>	
Value:	HIGH | LOW	Default: LOW
State:	Set: IDLE Query: N/A	
Description:	This command is used for selecting the dynamic range for Power Ramp Measurements. If set to LOW only one burst is used as basis for the power ramp measurement and the tolerance A in the power graph cannot be checked. If set to HIGH two bursts with different input sensitivity will be measured, hence enabling checking of the tolerance A in the power graph.	
Example:	"CONF:POW:DYN:RANG LOW"	

ix. Measurements

Query Normal Transmit Power (NTP)

Syntax:	READ:NTP?	
Return:	<value> (Unit: dBm)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command reads the normal transmit power (NTP) – the value returned is in dBm. Please note that INV will be returned if no NTP measurements are available.	
Example:	"READ:NTP?"	

Power ramp match

Syntax:	CALC:LIM:POW:TRAN:MAT?	
Return:	NMAT | MATC | INV	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for matching the actual power ramp to the configured power ramp template. If it returns NMAT the signal does not match the template. If it returns MATCH the signal matches the template. If it returns INV there are no available measurement results.	
Example:	"CALC:LIM:POW:TRAN:MAT?"	

Query of actual slot size

Syntax:	READ:SLOT:SIZE?	
Return:	40 | (P32Z) 80 | (P64Z) (if CAT-iq option has been enabled)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command will return either 40 (P32Z) or 80 (P64Z). Please note that slot size 80 (i.e. P64Z) is available only if CAT-iq has been enabled.	
Example:	"READ:SLOT:SIZE?"	

Query Frequency Offset

Syntax:	READ:FREQ:OFFS?	
Return:	<value> (Unit: Hz)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the frequency offset in Hz.	
Example:	"READ:FREQ:OFFS?"	

Query B-Field Modulation

Syntax:	READ:BF?	
Return:	<value>,<value> (Unit: Hz)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting B-Field modulation information – the return values are in Hz.	
Example:	"READ:BF?"	

Query S-Field Modulation

Syntax:	READ:SF?	
Return:	<value>,<value> (Unit: Hz)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting S-Field modulation information – the return values are in Hz.	
Example:	"READ:SF?"	

Query Frequency Drift

Syntax:	READ:FREQ:DRIF?	
Return:	<value> (Unit: see description)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the frequency drift. Please note that the unit of the returned value depends on the settings of "CONF:MOD:DRIF:UNIT <value>". If the value has been set to SLOT the unit here is kHz/Slot. If the value has been set to MS the unit here is kHz/ms.	
Example:	"READ:FREQ:DRIF?"	

Query Frequency Drift - MS

Syntax:	READ:FREQ:DRIF:MS?	
Return:	<value> (Unit: kHz/ms)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the frequency drift measured in kHz/ms.	
Example:	"READ:FREQ:DRIF:MS?"	

Query Frequency Drift - SLOT

Syntax:	READ:FREQ:DRIF:SLOT?	
Return:	<value> (unit: kHz/slot)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the frequency drift measured in kHz/Slot.	
Example:	"READ:FREQ:DRIF:SLOT?"	

Query Measure All TX (ALTX)

Syntax:	READ:MEAS:ALTX?	
Return:	<value>, <value>, <value>, <value>, <value>, <value>, <value>, <value>, <value> | (Unit: dBm, kHz, kHz, kHz, kHz, kHz, kHz/unit, kHz/slot, kHz/ms,)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command reads all the TX measurements on the same sets of samples, giving the fastest possible measurements time if more than one of the results is needed. The first value is the same result as "READ:NTP?", The second value is the same result as "READ:FREQ:OFFS?", The third and fourth values are the same results as "READ:BF?", The fifth and sixed values are the same results as "READ:SF?", The seventh value is the same result as "READ:FREQ:DRIF?", The eight value is the same result as "READ:FREQ:DRIF:SLOT?", The ninth value is the same result as "READ:FREQ:DRIF:MS?". Please note that INV will be returned if no measurements are available.	
Example:	"READ:MEAS:ALTX?"	

Evaluation window for BER and FER measurements

Syntax:	CONF:BER:EVAL:WIND <numeric value>	
Value Range:	1 .. 65535	Default: 100
State:	Set: All Query: All	
Description:	This command is used for setting the evaluation window of the BER and FER measurements. If used as query it will return the current window.	
Example:	"CONF:BER:EVAL:WIND 1000", "CONF:BER:EVAL:WIND?"	

RF level for BER-test

Syntax:	CONF:BER:RF:LEV <numeric value>	
Value Range:	-40 .. –100 (Unit: dBm , Resolution: 0.1dBm) Range is dependent on SENS:CORR:LOSS setting.	Default: -60.0
State:	Set: All Query: All	
Description:	This command is used for setting the RF level for the BER-test. Please note that the resolution is 0.1dBm. If used as query it will return the current RF level for BER-test.	
Example:	"CONF:BER:RF:LEV –100", "CONF:BER:RF:LEV?"	

Start a new BER and FER measurement

Syntax:	PROC:STRT:BER	
Value:	N/A	Default: N/A
State:	Set: DCE Query: N/A	
Description:	This command is used for initiating a new BER and FER measurement.	
Example:	"PROC:STRT:BER"	

Query BER and FER

Syntax:	READ:BER:LTER?	
Return:	<value>,<value> (Unit: <none>, <%>)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the BER and FER values (and starting a new measurement). The first value is the BER (no unit) and the second value is the FER (in %).	
Example:	"READ:BER:LTER?"	

Fetch BER and FER

Syntax:	FETC:BER:LTER? or READ:BER?	
Return:	<value>,<value> | (Unit: <none>, <%>) INV	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the measured BER and FER values. The first value is the BER (no unit) and the second value is the FER (in %). *Please also note that the difference between the READ:BER:LTER? command and this command is that the fetch command does not start a new measurement, but only request the most recent measurement. Hence, if the first measurement is still ongoing the command will return INV.*	
Example:	"READ:BER?", "FETC:BER:LTER?"	

Read BER and FER NOW

Syntax:	READ:BER:NOW?	
Return:	<value>,<value>,<value> | (Unit: <none>, <%>, <none>) INV	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the measured BER, FER and frame count values. The first value is the BER (no unit), the second value is the FER (in %) and the third value is the frame count (no unit). *Please note that this command is intended to monitor the progress of the FETC:BER:LTER? command, for long BER and FER measurements.*	
Example:	"READ:BER:NOW?"	

Read packet information

Syntax:	READ:CRC?	
Return:	<value>,<value>,<value>,<value> (Unit: None)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for requesting the packet information – i.e. information regarding presence of Sync-, A-, X-, and/or Z-Field (in this order). The return value will be four values indicating either 0 = "Field not present" or 1 = "Field present". Consequently, a return value of 1,1,0,0 indicates presence of Sync- and A-Field while the X- and Z-Field are not present.	
Example:	"READ:CRC?"	

Check match of X- and Z-Field

Syntax:	READ:XZF:MATC?	
Return:	MATC | NMAT | INV	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command is used for matching the X- and Z-Field – if they match MATC is returned. If not then NMAT is returned. Please note that the modulation form must be PSRB – otherwise INV is returned.	
Example:	"READ:XZF:MATC?"	

Query of Jitter

Syntax:	READ[:SCAL]:JITT?	
Return:	<min. value>,<max. value> (Units: µs)	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command returns the jitter in µs (min., max.).	
Example:	"READ:JITT?", "READ:SCAL:JITT?"	

Fetch Jitter

Syntax:	FETC[:SCAL]:JITT?	
Return:	<min. value>,<max. value> | (Units: µs) INV	Default: N/A
State:	Set: N/A Query: DCE	
Description:	This command returns the jitter in µs (min., max.) since last reset of value. The min/max values are reset upon connection establishment, upon a READ[:SCAL]:JITT? command, and upon a CONF:PACK:EVAL:WIND command.	
Example:	"FETC:JITT?", "FETC:SCAL:JITT?"	

C. **Sending Commands from the User Interface**

Upon start-up of the RTX2012 PC Application in debug mode, a communication window appears below the main application window. The communication window contains two fields - ① an area showing the communication between the PC and the test set, and ② a single-line command field.

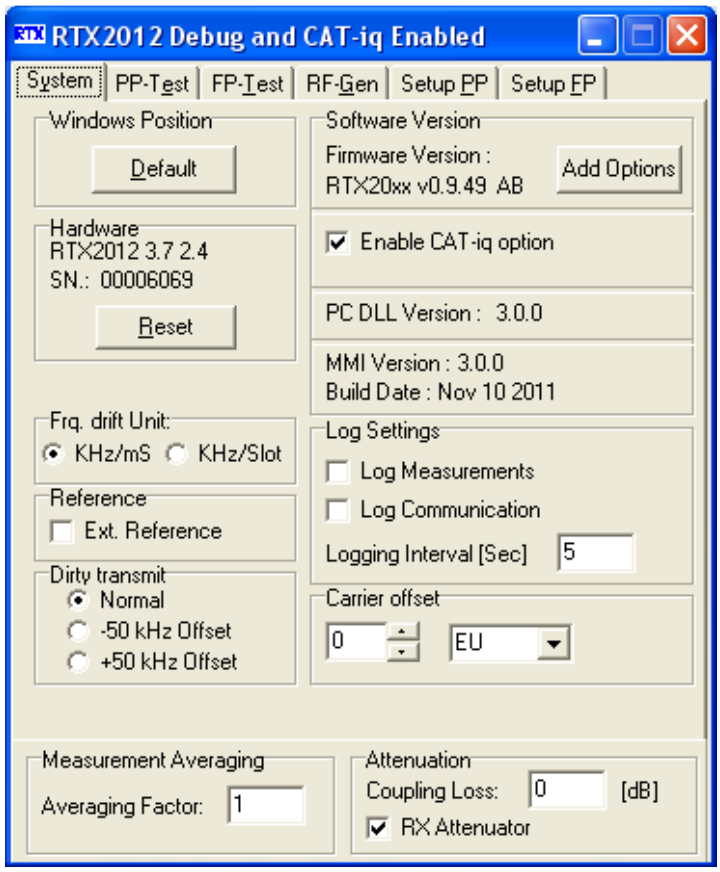
The main application works like in normal mode but in debug mode all communication between the PC and test set is made visible to the user. Hence performing different functions from the UI, the corresponding commands and values can directly be seen along with the responses from the test set. Consequently, the information from the communication window can for example be used for problem diagnostics in your own operating programs. Furthermore, in debug mode SCPI commands can also be executed manually by using the command-line field in the bottom of the communication window.

At the beginning of each line in the communication window ① an arrow indicates the direction of the communication. An arrow pointing to the right --> indicates that the string following the arrow has been sent from the PC to the test set. An arrow pointing to the left <-- indicates that the string following the arrow has been received from the test set.

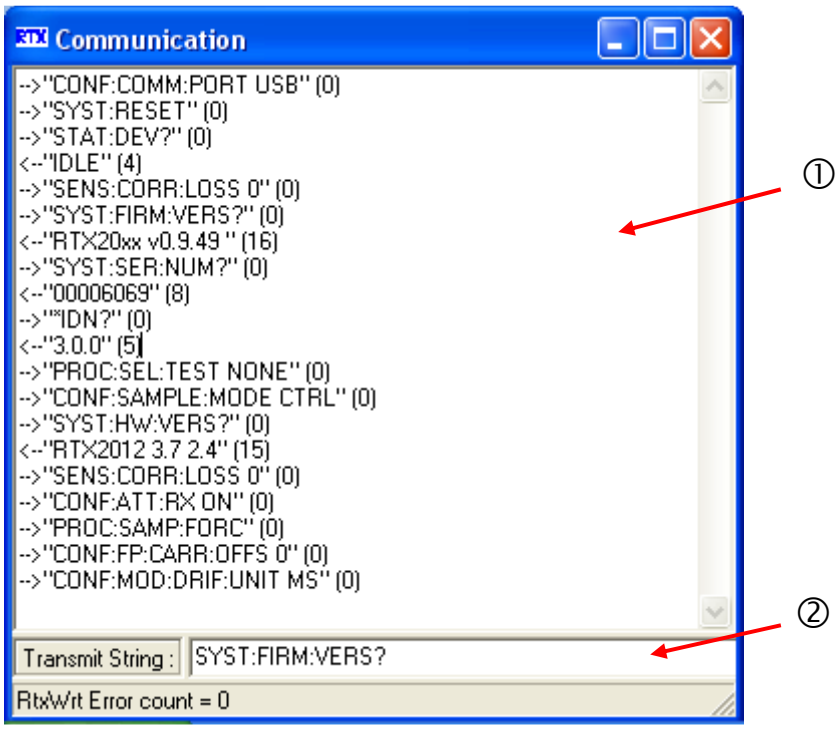
Depending on the direction the value in parenthesis in each line has a different meaning. In responses from the test set the number in the parenthesis indicates the number of received characters from the test set. In communication from the PC to the test set the number in parenthesis indicates the communication status and it can be either 0 or 1. If communication is ok then the value will be 0. If the value is 1 then this indicates an error has occurred. In order to get the actual error details from the tester the SCPI command "SYST:ERR?" must be sent to the tester. The response will indicate both the error id and a short error description (example: "<--"-102,"Syntax Error"" (20)"). See the table below for an overview of defined errors id's.

Error id	Error Description
+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

RTX2012 User Interface in Debug mode (main window)



RTX2012 User Interface in Debug mode (debug window)



D. Example Program – RTX2012 setup for FP Tests

The figure below shows a block-diagram of a typical remote command setup for RF measurements on a DUT (Device Under Test).

As indicated earlier the PC (USB) interface is used as communication media for the SCPI command strings. Hence, please make sure to connect the Tester to an available USB interface on the PC before executing the program. The connection between the PC and DUT (potentially through a test fixture) is used for debugging the DUT. In the following C-code for a test program for testing an FP is outlined.

i. Initial setup for RTX2012 Fixed Part Setup

```
1. RtxWrt("PROC:SEL:TEST MAN");       // Set the tester in MANual test mode
2. RtxWrt("CONF:TEST:TYPE DFP");      // Set the tester in FP test mode
3. RtxWrt("CONF:FP:SIGN:MODE LOOP"); // Set signalling mode to loop-back
4. RtxWrt("CONF:FP:RF:LEV -45");      // Set RF level to -45dBm for the test
5. RtxWrt("CONF:BER:DATA FIG31");     // Set the modulation scheme to FIG31
6. RtxWrt("CONF:AVER:BURS 20");       // Set # of bursts for averaging to 20
```

ii. Fixed Part Link Setup

```
1. RtxWrt("CONF:FP:TRAF:CARR " + Channel); // Set chan for traffic carrier
2. SLEEP(200);

3. // Wait for RTX2012 to lock to DUT

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

6. RtxWrt("STAT:DEV?");      // Check if RF Connection has been established
7. RtxRd(Result);
8. If (Result == "DCE")      // Connection established - otherwise wait
                                approx 400 ms. and repeat step 6 - 8
```

iii. RF measurements on a Fixed Part DUT

This section outlines source code for performing a number of RF measurements on a FP DUT. Please note that the prerequisite for doing the tests is that the tester is in state DCE – i.e. that a connection to the FP has been established (for example by executing the procedures from paragraph i and ii in this subsection).

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

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

  Note! Adjust the 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);
```

  Note! This will lock your application while the measurement is running.

- *Change Channel*
```
RtxWrt("PROC:CONN:REL");     // Release connection
```

  Change channel and perform fixed part link setup as outlined in paragraph ii in this subsection in order to re-establish the radio link.

- *Perform the same measurements as above on the new channel*
  - Read Transmitter Power
  - Adjust Transmitter Modulation
  - Read Frequency Drift
  - Read Frequency Offset
  - Read Bit Error Rate

6. Specifications and characteristics

A. Introduction

This chapter includes specific details related to the functionality and performance characteristics of the RTX2012. The following items of information are included:

- **Functionality** – this subsection provides a brief description of the main features in the RTX2012.
- **Performance and characteristics** – this subsection describes details related to the warranted performance. Please read this section very thoroughly.
- **Signal generator** - this section includes detailed specifications related to the signal generator.
- **Analyzer** - this section includes detailed specifications related to the analyzer mode.
- **General Specifications** - information on environmental and physical specifications.

B. Functionality

i. Fixed Part test

RTX2012 can act as a handset/portable part locking onto a fixed part under test. In the fixed part test mode RF characteristics can be measured. Using the Windows based MMI all transmitter and receiver measurements are shown in a separate window with bars and graphs for identifying pass/fail limits.

ii. Portable Part test

RTX2012 can act as fixed part and support connections from a handset/portable part under test. In the portable part test mode RF characteristics can also be measured. Using the Windows based MMI all transmitter and receiver measurements are shown in a separate window with bars and graphs for identifying pass/fail limits.

iii. Operating frequency

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

iv. 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.

v. Signalling mode

RTX2012 makes use of loop-back signalling as a basis for performing RF analysis, hence transmitting data to the DUT and receiving the looped data from the DUT. This method does not only make it possible to measure several RF parameters transmitted by the DUT but also makes it possible to determine the receiver sensitivity of the DUT.

vi. Modulation

Several different RF test signal modulation schemes can be selected to obtain accurate measurements. The RTX2012 supports the following modulation schemes:

PSRB	Pseudo random bit sequence - similar to the signals sent in a "live" system
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
BS20	20 times ones and 20 zeroes times ones repeatable
Fig31	A structured combination of zeroes and ones - preferred modulation scheme in frequency deviation and frequency drift measurements

vii. RF measurements

RTX2012 supports the following measurements:

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

Graphical results can be shown using the MMI for:

- NTP
- Modulation

C. Performance and characteristics

The tester complies with the specifications after 2 hours of storage within the environmental temperature, and 60 minutes after turn-on. In essence the specifications mentioned below for the signal generator and analyzer are valid over the operating and environmental range of the test set unless otherwise stated. Please note that all values refer to the RF input N-connector.

D. Signal generator

Important! - Analogue outputs are not calibrated and all below specified are measured in single frequency selection.

i. Frequency

Ranging from 1876.608 to 1935.360 MHz

Accuracy ± 1.0 ppm
Aging rate ± 0.5 ppm/year

ii. Output Power

Level range: -100 to -40 dBm
Resolution: 0.1 dB

Error < ± 1.6 dB (-95 to -40 dBm)
Error < ± 2.2 dB (-100 to -95 dBm)

E. Analyzer

Important! - Analogue outputs are not calibrated and all below specified are measured in single frequency selection.

i. Frequency

Ranging from 1876.608 to 1937.088 MHz

ii. Power measurement

Input level (NTP): +30 to -40 dBm
Resolution 0.1 dB

NTP Error < ± 1.5 dB (-15 to 25 dBm)
NTP Error < ± 2.5 dB (-45 to -15 dBm and 25 to 30 dBm)

iii. FM Demodulator

Range -450 to 450 kHz deviation
Resolution 1 kHz

Modulation error (Fig31) max 20 kHz at 300 kHz deviation.

F. General Specifications

i. Input/output connectors

RF In/Out N(f), 50 Ω

USB Port (Type B receptacle)

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

Analogue Outputs, BNC(f)
- Receive Data (inverted)
- Power Envelope

Digital Outputs, BNC(f)
- Timeslot
- CLK 100

Digital Inputs, BNC(f)
- 10 MHz Clock

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

ii. Environmental Conditions

Rated operating temperature range **15°C to 35°C (59°F to 95°F)**

Storage temperature range **-20°C to 60°C (38°F to 140°F)**

Operating Humidity up to **95% relative humidity to 40°C (104°F)** (non-condensing)

iii. Power Supply

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

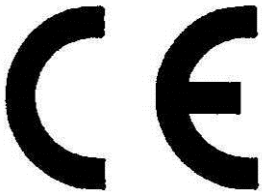
Power consumption **15 VA maximum**

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

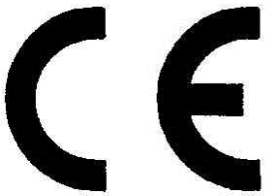
Weight **3.0 kg**

7. Regulatory Information

A. **Compliance and Markings**



Electromagnetic Compatibility Complies with the requirements of the European EMC directive (2004/108/EC).



Mechanical resistance Shock: IEC 68-2-29 bump test 1000 times 40 G in 6 axes.

B. **Safety**

Electrical Safety complies with the requirements of the European Low Voltage Directive (LVD/95/EC, EN 61010-1:2001 and EN 61010-2-81:2002+A1:203).

8. Maintenance

A. **Introduction**

This chapter describes general maintenance of the RTX2012 including central items of information in relation to calibration and return procedures. It contains the following sections:

- General customer responsibilities
- Operator Maintenance
- Contacting RTX
- Calibration and Service
- Returning your RTX2012 tester for service

B. **General customer responsibilities**

In general the customer shall:

- Do replacement of consumables such as fuses etc.
- Perform routine operator maintenance and cleaning as specified in the paragraph "Cleaning" below.
- Provide access to and use of all items of information and facilities determined necessary by RTX in order to service and/or maintain the products.
- Provide access to the product(s) during the specified maintenance period(s) in order to enable RTX personnel to perform maintenance on the product(s).
- Provide adequate working space around the products for servicing by RTX personnel.

C. **Operator Maintenance**

This section describes general responsibilities of the customer. Furthermore, instructions on how to replace the power line fuse and clean the tester are also provided in this section.

i. Replacing the Power Line Fuse

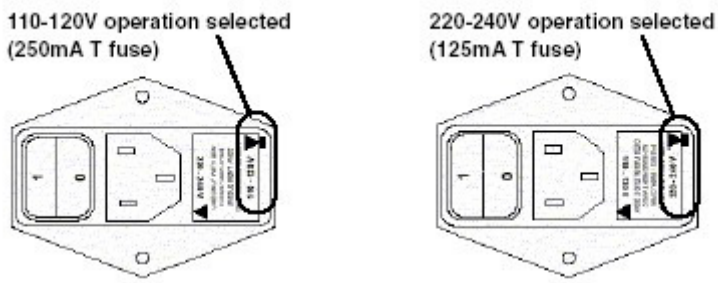
The power line fuse is located within the fuse holder and line switch assembly on the rear panel. For 110V to 120V operation the fuse is a T0.25 250V. For 220-240V operations the fuse is a T0.125 250V. To replace the fuse do the following:

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

Fuse Location



ii. Cleaning

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

D. Contacting RTX

If you experience problems with your RTX2012 Tester please read this section carefully before contacting RTX, since important aspects and items of information in relation to support is outlined here.

If you wish to contact RTX in relation to any aspect of the tester - from service problems to ordering information - please refer to the paragraph *"Sales and Service Offices"* later in this section.

If you wish to return the tester to RTX please refer to the paragraph *"Returning Your RTX2012 Tester for Service"* later in this section.

i. Before calling RTX

Before calling RTX or returning the test set for service please take a couple of minutes to go through the checklist outlined in the paragraph "Check the Basics" later in this section. The checklist will guide you through some basic checks to rule out some of the most common problems. Furthermore, it could help you identify the root cause of your problem(s).

If this does not solve your problem(s) then please read the warranty printed in the first pages of this User's Manual. If the problem(s) you experience seem to be covered by the warranty please state this when contacting RTX.

If your test set is covered by a separate maintenance agreement then please look into the terms of the agreement and validate that your problem(s) is covered by the agreement.
RTX offers several different maintenance plans to service your tester after the warranty period has expired. Please contact RTX for full details – see contact details in the paragraph *"Sales and Service Office"* later in this section.

If your RTX2012 tester becomes faulty and you wish to return it please follow the description on how to return the faulty instrument in the paragraph *"Sales and Service Offices"* later in this section.

ii. Check the Basics

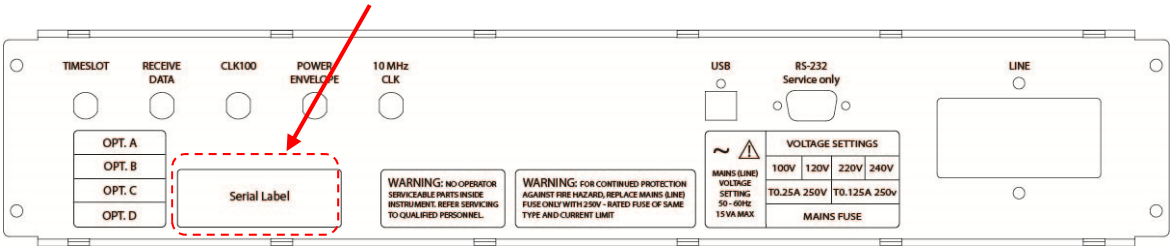
In order to rule out some of the basic problems that could occur please take a minute to go through the checklist below. If the Tester is still faulty after performing the above checks please contact the RTX service office for information and support.

- 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 tests as described in chapter 1 (specifically paragraph iii in section C).

iii. Instrument serial numbers

RTX service personnel have access to complete records of design changes for each instrument. This detailed information is based on the serial number of each tester. Consequently, please have the complete serial number at hand whenever contacting RTX in relation to your tester. This way we can ensure that you obtain the most complete and accurate service information. The serial number can be obtained from the serial number label (located at the rear of the instrument as indicated in the picture below).

Location of Instrument serial number



iv. Sales and Service Office

You can contact one of the following Sales Offices and ask for a test and measurement sales representative. In any correspondence or telephone conversations, please refer to the RTX2012 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.

Worldwide:

RTX A/S
Stroemmen 6
DK-9400 Noerresundby
Denmark

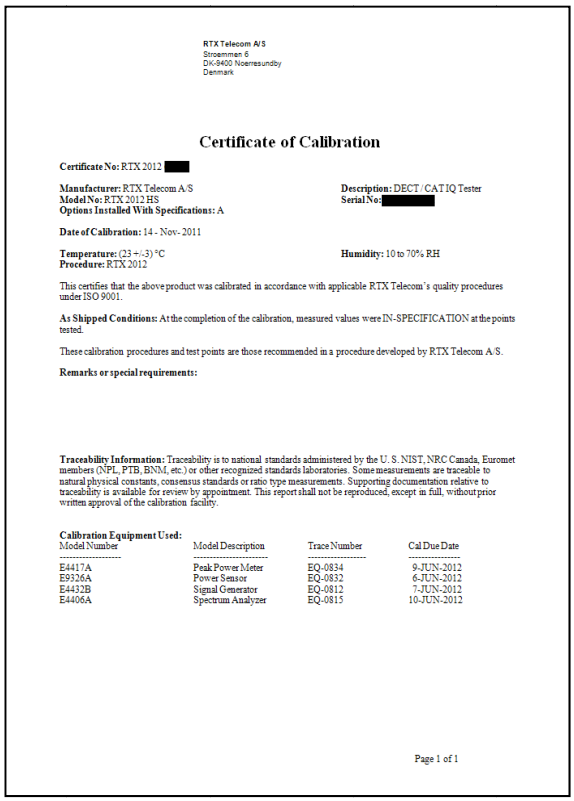
Tel. +45 96 32 23 00
Fax +45 96 32 23 10
E-mail Sales: sales@rtx.dk
E-mail Service: rtesupport@rtx.dk

For more information about RTX test and measurement products, applications, services, and for a current sales office listing, please visit our web site http://www.rtx.dk or http://www.rtx.dk/Contact_Us-2807.aspx

E. **Calibration and Service**

Routine calibration and performance testing of your RTX2012 tester should be carried out on a yearly basis.

The annual recalibration is done at RTX by qualified personal, and in accordance to strict specifications. After each calibration you receive a new "Certificate of Calibration" report to verify that the tester has been calibrated by authorized RTX personnel.
Please contact a RTX Sales and Service office for details on the calibration. Below you find an example of a "Certificate of Calibration" report from RTX.



RTX Telecom A/S
Stroemmen 6
DK-9400 Noerresundby
Denmark

Certificate of Calibration

Certificate No: RTX 2012 [redacted]

Manufacturer: RTX Telecom A/S
Model No: RTX 2012 HS
Options Installed With Specifications: A
Description: DECT / CAT IQ Tester
Serial No: [redacted]

Date of Calibration: 14 - Nov - 2011

Temperature: (23 +/-3) °C
Procedure: RTX 2012
Humidity: 10 to 70% RH

This certifies that the above product was calibrated in accordance with applicable RTX Telecom's quality procedures under ISO 9001.

As Shipped Conditions: 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 is to national standards administered by the U. S. NIST, NRC Canada, Euromet members (NPL, PTB, BNM, 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	EQ-0834	9-JUN-2012
E9326A	Power Sensor	EQ-0832	6-JUN-2012
E4432B	Signal Generator	EQ-0812	7-JUN-2012
E4406A	Spectrum Analyzer	EQ-0815	10-JUN-2012

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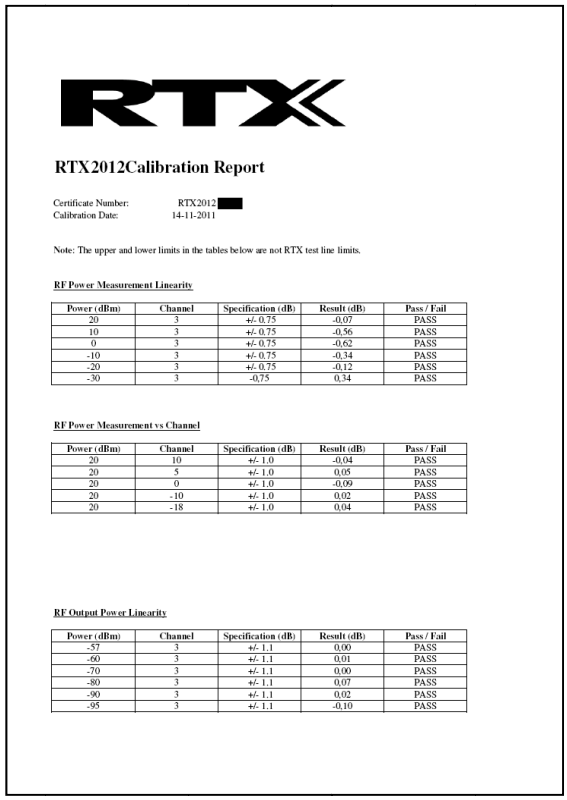


RTX2012Calibration Report

Certificate Number: RTX2012 [redacted]
Calibration Date: 14-11-2011

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

RF Power Measurement Linearity

Power (dBm)	Channel	Specification (dB)	Result (dB)	Pass / Fail
20	3	+/- 0.75	-0,07	PASS
10	3	+/- 0.75	-0,56	PASS
0	3	+/- 0.75	-0,62	PASS
-10	3	+/- 0.75	-0,34	PASS
-20	3	+/- 0.75	-0,12	PASS
-30	3	-0,75	0,34	PASS

RF Power Measurement vs Channel

Power (dBm)	Channel	Specification (dB)	Result (dB)	Pass / Fail
20	10	+/- 1.0	-0,04	PASS
20	5	+/- 1.0	0,05	PASS
20	0	+/- 1.0	-0,09	PASS
20	-10	+/- 1.0	0,02	PASS
20	-18	+/- 1.0	0,04	PASS

RF Output Power Linearity

Power (dBm)	Channel	Specification (dB)	Result (dB)	Pass / Fail
-57	3	+/- 1.1	0,00	PASS
-60	3	+/- 1.1	0,01	PASS
-70	3	+/- 1.1	0,00	PASS
-80	3	+/- 1.1	0,07	PASS
-90	3	+/- 1.1	0,02	PASS
-95	3	+/- 1.1	-0,10	PASS

F. **Returning Your RTX2012 Tester for Service**

This section contains important items of information in case you need to return your test set to RTX.

It is strongly emphasized here that all returns to RTX <u>MUST</u> be initialized by obtaining a Return Material Authorization (RMA). Any returns without authorization cannot be handled in the normal service process and in a timely manner.

Please read the paragraphs very carefully and follow the instructions closely. The first step if you want to return your RTX2012 tester to RTX is to obtain an RMA. In order to avoid damages to the tester when shipping it please pack your tester according to the recommendations provided in this section.

i. Obtaining an RMA for service return

In order to obtain an RMA (Return Material Authorization) please contact one of the RTX Service office by E-mail (service@rtx.dk) or phone with the following items of information:

- 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

Upon receiving the above information the Service Office will provide an RMA number. This number must be placed at a visible location on the shipping box, and furthermore, the RMA number must be used as a reference in all communication in relation to the return procedure.

ii. Packing the Tester for Shipment

Please perform the steps below when packing the tester for shipment to RTX for service.

Please note that damage can result from using packaging materials other than those specified. Never use styrene pellets in any shape as packaging materials since they do not adequately cushion the tester or prevent it from moving in the box. Furthermore, styrene pellets cause damage by generating static electricity. Consequently, the original packing materials should always be used when shipping the tester.

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 in order to give us the best basis for debugging the problem.

2. Use the original packaging materials or a strong shipping container 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. Please use the pink Air Cap to reduce static electricity. Wrap the tester several times in the material to both protect the tester 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.

Appendix A – Sample remote control code

```
//-------------------------------------------------------------------
// Microsoft Visual C++ 6.0 Win32 Console Demo Application
// demonstrating how to use the dll-interface of the RTX2012.
//-------------------------------------------------------------------
/
*********************************************************************
* Include files
*********************************************************************
/
#define RTX2012_VARS // Tells the RTX2012dll.h that we want to
                     // declare the DLL interface functions as
                     // function-pointers, which are then loaded
                     // explicitly.
#include "RTX2012dll.h"
#include "Win32Err.h"
#include "stdio.h"

/*********************************************************************
* Macro definitions
*********************************************************************
/
#define RTX2012_DLL_NAME " R2012dll.dll"
#define LOADFUNC(fname) \
          fname = GetProcAddress(DllHandle, #fname); \
          if (fname == NULL) \
          { \
            ShowWin32Error(#fname " not found in " RTX2012_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(RTX2012_DLL_NAME);
    if (DllHandle == NULL)
    DllHandle = LoadLibrary("." RTX2012_DLL_NAME);
    if (DllHandle == NULL)
    {
      ShowWin32Error(RTX2012_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;
  }
}
```

```
/
*****************************************************************
* 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, 2012\n");
  printf("\nMicrosoft Visual C++ 6.0 Win32 Console Demo Application.");
  printf("\nDemo on how to use the DLL-interface to the RTX2012.\n\n");
  if(LoadDll())
  {
    // Demonstrate different SCPI commands
    SendScpiCommand("*IDN?");
    SendScpiCommand("SYST:FIRM:VERS?");
    SendScpiCommand("STAT:DEV?");
  }
  return 0;
}
```

Appendix B - RTX 2010 HS KDECT

A. **Introduction**

This appendix describes the areas where the RTX 2010 HS KDECT differentiates from the RTX 2012 HS in specification and setting of the product:

B. **Signal generator**

i. Frequency

Ranging from 1785.888 to 1801.440 MHz

C. **Analyzer**

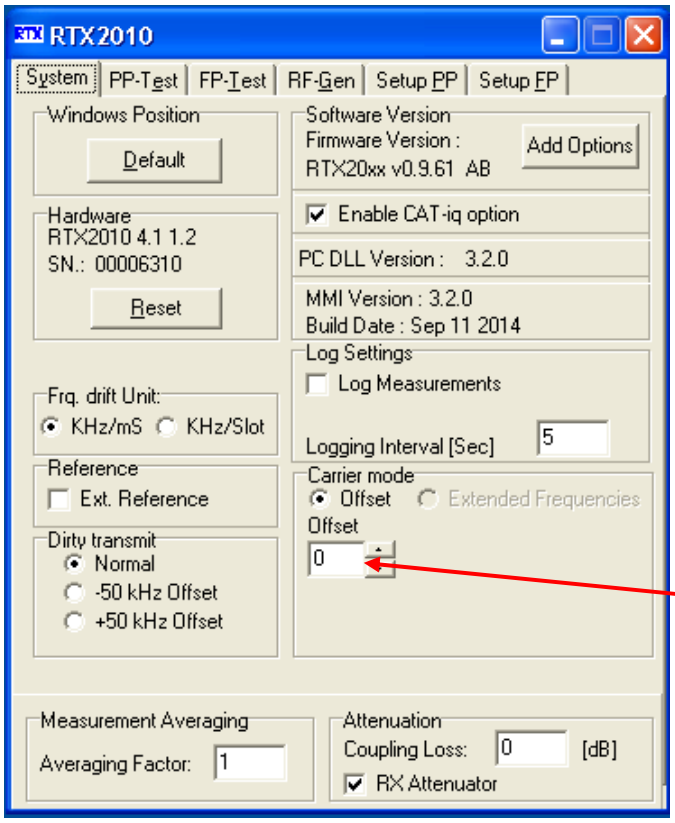
ii. Frequency

Ranging from 1785.888 to 1801.440 MHz

D. Channel setting

The RTX 2010 does support two variants of channel-numbering schemes; Ch. 1-3 and Ch. 6-8.
The variant is selected by using either 0 or -5 as offset on the system page in the GUI.

iii. System page



Channel offset

iv. Channel-numbering schemes

Freq [Mhz]	Ch number Offset 0	Ch number Offset -5
1801.440	-5	0
1799.712	-4	1
1797.984	-3	2
1796.256	-2	3
1794.528	-1	4
1792.800	0	5
1791.072	1	6
1789.344	2	7
1787.616	3	8
1785.888	4	9

K-DECT in band frequencies