Agilent
W-CDMA Bit Error Ratio (BER) Test on picoChip Femtocell Reference Design Using the Agilent N5182A MXG Vector Signal Generator

Application Note

Introduction

Femtocells (3GPP Home Node B for W-CDMA/HSPA and enhanced Home Node B for LTE) are low-power wireless access points that connect standard mobile devices to a mobile operator's network via residential DSL or cable broadband.

While a compelling entrant into the broadband Consumer Premises Equipment (CPE) market dominated by Wireless LANs, femtocells are forcing manufacturers to confront a number of test considerations; cost, quality and volume. Early femtocells are costly (roughly $100-$300), multiformat (e.g., may require GPS, support for W-CDMA, LTE or WiMAX™, etc...), operate in the licensed spectrum, and face stringent conformance requirements.

This application note is intended to facilitate single direction BER testing of femtocell devices based on picoChip femtocell reference designs with the use of an Agilent vector signal generator and specific waveforms for femtocell devices based on 3GPP TS 25.141.

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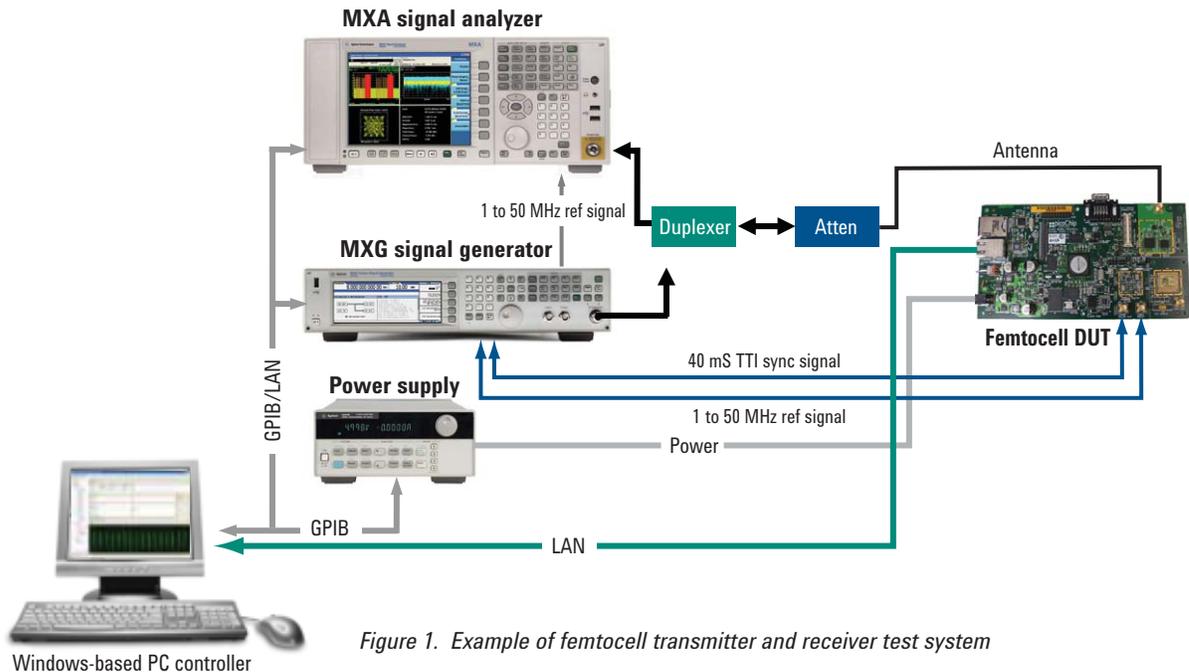# Femtocell Test System Architecture

Figure 1. Example of femtocell transmitter and receiver test system

A typical femtocell transmitter and receiver test system is shown in Figure 1. This system can make femtocell measurements to ensure compliance to the 3GPP TS 25.104 ver 8.5.0 2008-12 standard. Example measurements include maximum output power, dynamic range, code-domain power, EVM, peak code-domain error, frequency error, spectrum emission mask, receiver sensitivity, and more.

A specific list of equipment and test procedures for W-CDMA BER testing using the 12.2 Kbps reference measurement channel (RMC12.2k) on a femtocell device is listed below.

Equipment

1. N5182A MXG vector signal generator
   a. MXG Firmware version - A.01.50 or later
   b. N5182A Option 651   - 31 MSa/s internal baseband generator
   c. N5182A Option 019   - Increase baseband generator memory to 64MS
   d. N5182A Option 221[1]   - 5-pack waveform license[1]
   e. N5182A Option 503   - 250 kHz to 3 GHz frequency range

2. N7600B Signal Studio for W-CDMA[1]
   a. N7600B software version - 5.3.0.0 or later
   b. N7600B Option 3FP   - Connect to N5162A/82A MXG, fixed, perpetual
   c. N7600 Option EFP   - Basic W-CDMA FDD-R7 7/07, fixed, perpetual
   d. N7600 Option FFP   - Basic W-CDMA FDD-R8 9/07, fixed, perpetual
   e. N7600 Option QFP   - Advanced W-CDMA FDD-R8 12/08, fixed, perpetual

3. E66311B mobile communications DC power supply

4. Duplexer and attenuator

5. picoChip femtocell BER/BLER DtscApp application software[2]

6. PC controller (windows based)

1. The N7600B Signal Studio for W-CDMA can be substituted with N5182A option 221 5-pack waveform license. This may be appropriate for manufacturing applications where only several known waveforms will be used. For more information on 5-pack waveform licensing see the Signal Studio brochure at **http://cp.literature.agilent. com/litweb/pdf/5989-6448EN.pdf**

2. For further information on performing BER/BLER measurements using the picoChip femtocell reference design please contact picoChip at **support@picochip.com**.

Test procedure

1. Setup physical connection as illustrated in the diagram shown in Figure 1: (*Note:* signal analyzer not required for BER test)

    1.1 Connect sync signal from femtocell DUT to MXG pattern trigger for synchronization. In the case of W-CDMA RMC 12.2k a TTI of 40 ms or greater is required to enable proper decoding of the DTCH transport channel. (PAT TRIG in Figure 2)

    1.2 Share a common frequency reference between the MXG and the femtocell DUT. The MXG has a flexible reference input and can accept frequencies between 1 MHz and 50 MHz. (REF IN in Figure 2)

Figure 2. MXG signal generator rear panel connections

    1.3 Connect the MXG RF output port to the femtocell DUT direct or via duplexer/attenuator setup.

2. Initialize the MXG and femtocell DUT for BER measurement

    2.1 Run factory preset on the MXG (green **Preset** button on front panel). Confirm it is defaulted to "Preset" and not "Last" or "User" preset.

    2.2 Set MXG for expected external reference input frequency.
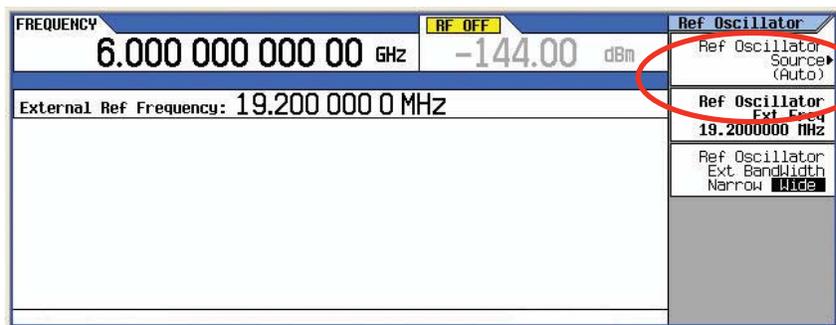
Figure 3. Reference oscillator set to auto

Example front panel keystrokes:

Preset
FREQ > More > Reference Oscillator > Ref Oscillator Ext Freq> 19.2 MHz

Example SCPI command:

:SYST:PRES
:ROSC:FREQ:EXT:19.2 MHz

2.3 Setup MXG RF frequency and power level (make sure RF output is off)
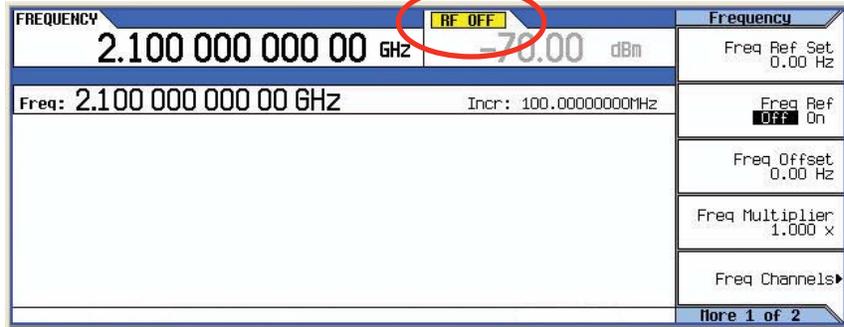

Figure 4. Set frequency and amplitude

Example front panel keystrokes:

RF OFF (indicated on display) **and RF On/Off** (LED indicator light off)
FREQ > 2 > . > 1 > GHz
AMPLD > - > 7 > 0 > dBm

Example SCPI command:

:OUTP:STAT OFF
:FREQ:FIX 2100 MHz
:POW:LEV:IMM:AMPL −70 dBm

2.4 Load or select RMC12.2K waveform, (confirm ARB is still off)

Figure 5. Select waveform "RMC12.2K" and turn arb off

Example front panel keystrokes:

Select Waveform > Waveform Segments > Load (highlighted) **>**
(turn knob until "RMC12.2K" is highlighted under Segment column in
the Int Storage window) **> Load Segment From Int Media > Return >**
(turn knob until "RMC12.2K" is highlighted under Segment column in the
BBG Memory window) **> Select Waveform Mode > Dual ARB >**
(verify that ARB OFF is indicated on display)

Example SCPI command:

:RAD:ARB:WAV "WFM1:RMC12.2K"
:RAD:ARB:STAT OFF

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The "RMC12.2K" waveform should be pre-calculated and stored in the MXG BBG memory from the Agilent N7600B Signal Studio software. If this has been completed skip to step 2.5. If this has not been completed, follow steps A through K to generate and download the waveform file using the PC controller and N7600B Signal Studio for 3GPP W-CDMA.

Prepare the PC controller, install Signal Studio software, and make instrument connections

To view the PC requirements, installation instructions and basic connections for the N7600B Signal Studio for 3GPP W-CDMA FDD and the N5182A MXG vector signal generator go to **http://wireless.agilent.com/wireless/helpfiles/n7600b/n7600b.htm** or **www.agilent.com/find/signalstudio** and navigate to the online documentation under the N7600B Signal Studio for 3GPP W-CDMA FDD.

RMC12.2K waveform generation and download

A. Start the N7600B Signal Studio for 3GPP W-CDMA FDD software from the PC controller.

B. Change the default label from "Untitled" to a suitable name for recall later like "**RMC12.2K**"
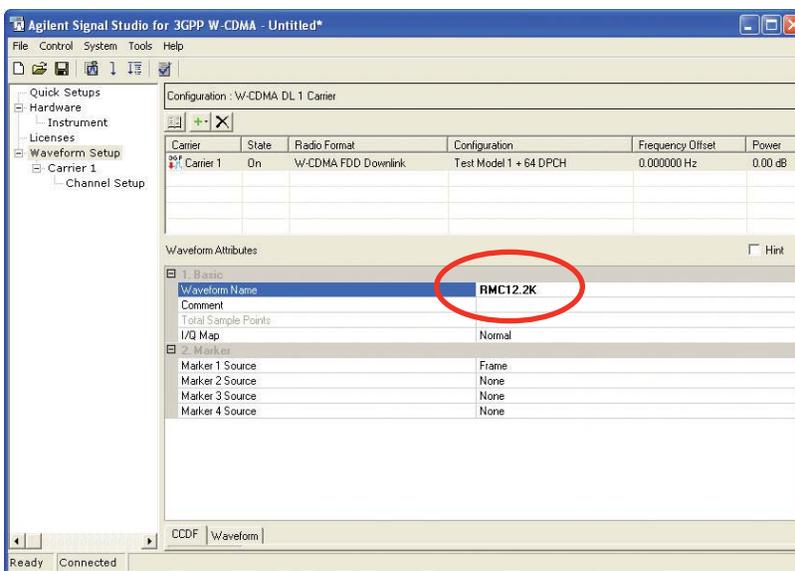
Figure 6. Select waveform "RMC12.2K" and turn arb off

C. Add uplink advanced carrier (Adv W-CDMA FDD UL(Rel 8 Dec 08))

D. Delete downlink carrier (W-CDMA FDD Downlink)
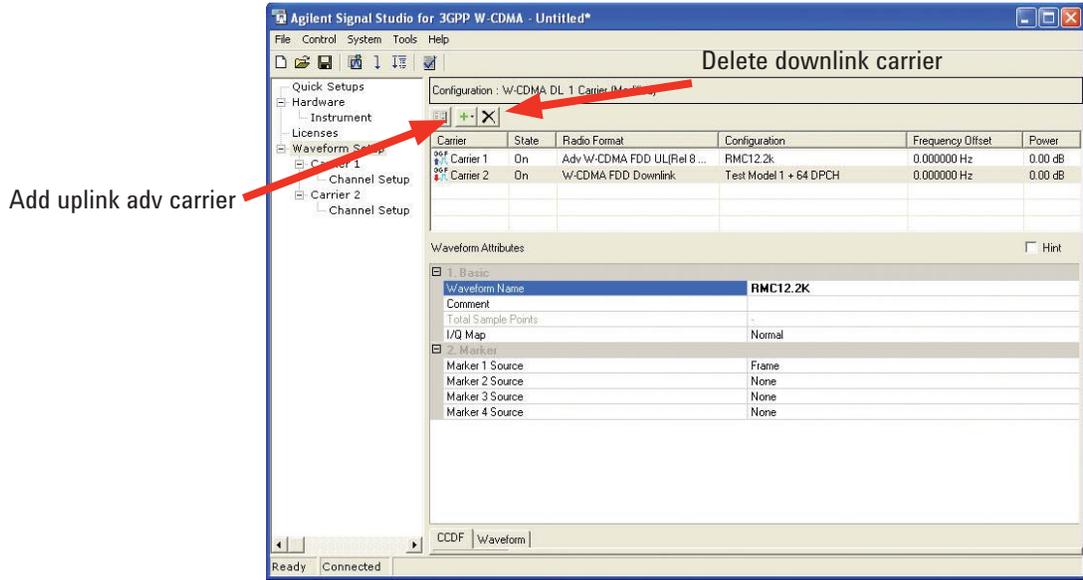
Figure 7. Uplink advanced carrier

E. Select **Carrier 1** in the navigation tree view, and then select **RMC 12.2k** from the predefined setup under **Channel Configuration** in the drop down menu. (Default is RMC 12.2k)

F. Confirm that **Real-Time Modulation Filter** is turned **On**.*
(requires FW version A.01.50 or greater.)
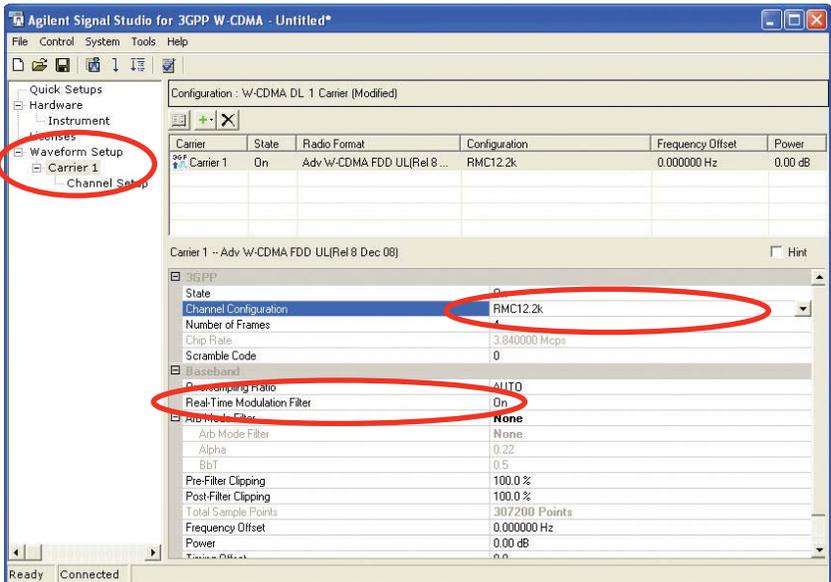
Figure 8. Channel configuration

G. Set the **Number of Frames** to **1022**. This enables a continuous PN9 in the DTCH logic channel in the transport layer of the DPDCH.
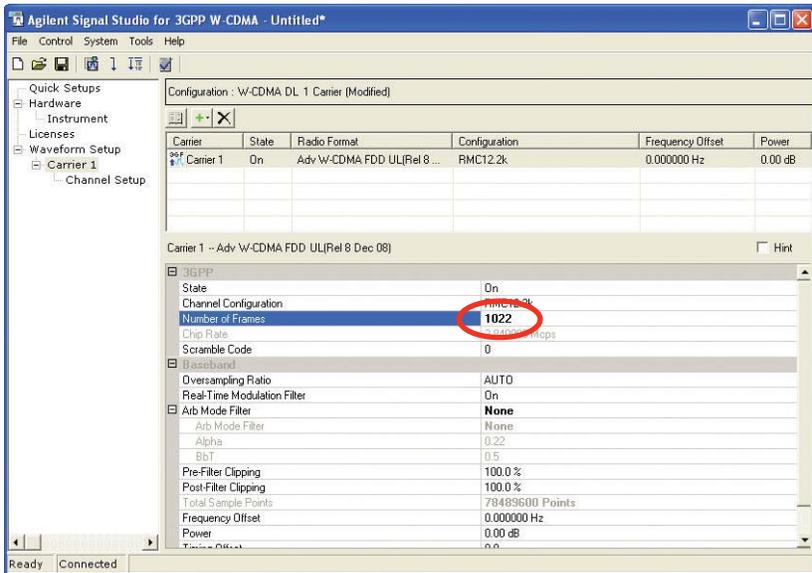
Figure 9. Frames

H. Set the **Scramble Code** to match the basestation/femtocell.
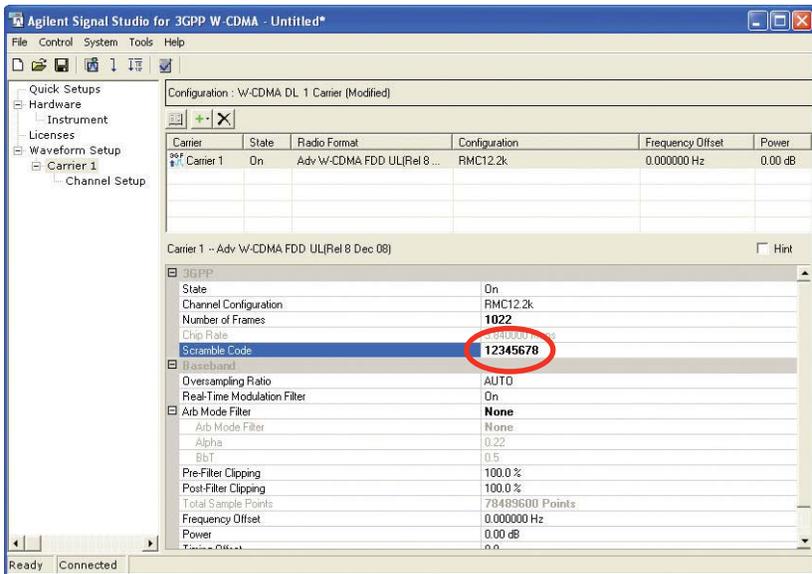
Figure 10. Scramble code

I. Generate and download waveform. This will take approximately 10 minutes to calculate and download the waveform into the MXG's BBG memory.

J. Store the waveform to MXG internal memory storage or PC desktop/directory for future recall. This will save time by not having to re-calculate the waveform.

   i. Store the waveform into the MXG's internal non-volatile memory storage (Int Storage). Front panel keystrokes: **Mode > Dual ARB > Select Waveform > Waveform Segments >** (turn knob until "RMC12.2K" is highlighted under Segment column under BBG Memory window) **> Store Segment To Int Media**. *Note: to recall waveform follow instructions in step 2.4.*

   ii. Store the waveform to your PC desktop or other file location (including USB memory stick connected to PC). From the file menu of the N7600B Signal Studio for 3GPP W-CDMA FDD software, select **Export Waveform Data**, navigate to the PC desktop or other desired file location, type in filename "RMC12.2K" for example and save (this will take approximately five minutes). *Note: to recall waveform into BBG Memory on the MXG either use FTP over LAN or load from USB memory stick. For FTP, enter the IP address of the LAN connected MXG into your internet web browser to load the instruments home web page.*

Figure 11. MXG home web page

Click on **Signal Generator FTP Access**, drag and drop the waveform
file from the PC desktop or other file location into the FTP file location
USER/BBG1/SECURWAVE/ window that opens.
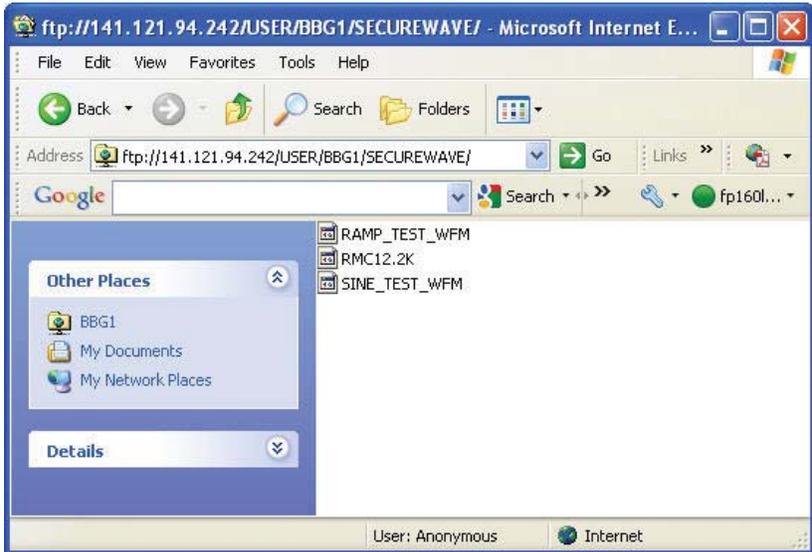
Figure 12. FTP window

For USB memory stick, connect it to the MXG, use the knob to highlight
the waveform file, press **Copy File to Instrument > Waveform > BBG
Memory.**

K. If continuing directly to step 2.5 using front panel keystrokes first press:
Mode > Dual ARB

2.5 Setup trigger to following values:
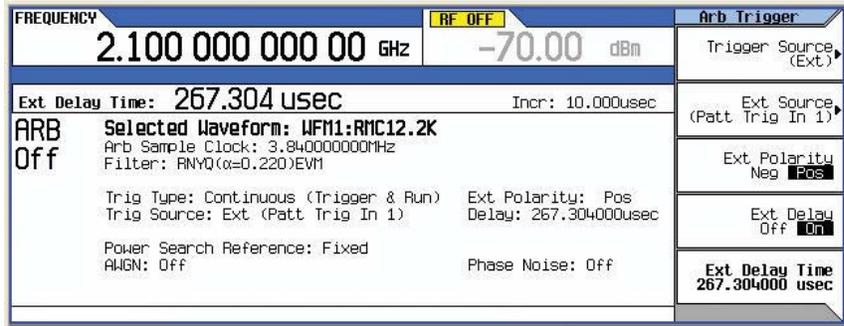
Figure 13. Trigger

Trigger Type: **CONTINUOUS , TRIGGER & RUN**
Trigger Source: **EXT**
Ext Polarity: **POS**
Ext Delay: **ON**
Ext Delay Time trigger delay range:
Between **267.3 usec ~ 270 usec** (depends on BTS/femtocell design)

Example front panel keystrokes:

Trigger Type > Continuous > Trigger & Run >
Trigger Source > Ext Polarity Pos >
Ext Delay On > Ext Delay Time > 2 > 6 > 7 > . > 3 > 0 > 4 > usec

Example SCPI command:

:RAD:ARB:TRIG EXT
:RAD:ARB:TRIG:EXT EPT1
:RAD:ARB:TRIG:TYPE CONT
:RAD:ARB:TRIG:TYPE:CONT TRIG
:RAD:ARB:TRIG:EXT:SLOP POS
:RAD:ARB:TRIG:EXT:DEL:STAT ON
:RAD:ARB:TRIG:EXT:DEL 267.304 us

2.6 Initiate (initialize and setup) BER and BLER measurement of DUT using the DtcsApp application software from picoChip[1]. Keep on standby mode and do not run.
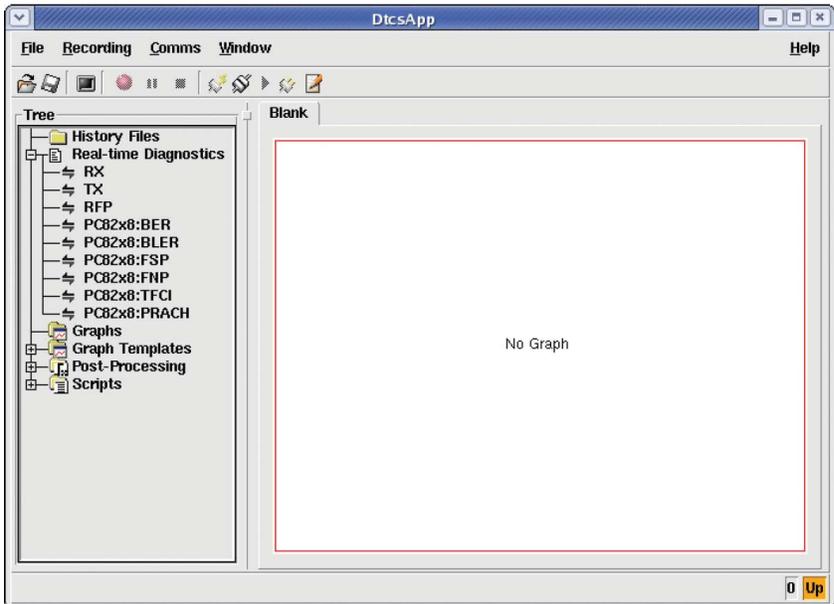
Figure 14. DtcsApp real-time diagnostics menu

2.7 Turn on ARB waveform generator and then RF.
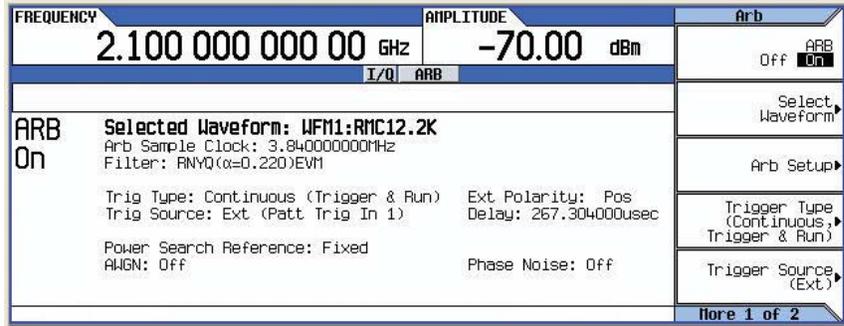
Figure 15. ARB ON and RF ON

Example Front Panel Keystrokes:

Mode > Dual ARB > ARB On
RF On/Off (LED indicator light on)

Example SCPI Command:

:RAD:ARB:STAT ON
:OUTP:STAT ON

3. Execute (start) DUT BER/BLER measurement and get BER/BLER result using the DtcsApp application software from picoChip[1].

Complete listing of remote control SCPI commands for the MXG signal generator

:SYST:PRES
:ROSC:FREQ:EXT:19.2 MHz
:OUTP:STAT OFF (Default is off)
:FREQ:FIX 2100 MHz
:POW:LEV:IMM:AMPL −70 dBm
:RAD:ARB:STAT OFF (Default is off)
:RAD:ARB:WAV "WFM1:RMC12.2K"
:RAD:ARB:TRIG EXT
:RAD:ARB:TRIG:EXT EPT1
:RAD:ARB:TRIG:TYPE CONT
:RAD:ARB:TRIG:TYPE:CONT TRIG
:RAD:ARB:TRIG:EXT:SLOP POS
:RAD:ARB:TRIG:EXT:DEL:STAT ON
:RAD:ARB:TRIG:EXT:DEL 267.304 us
:RAD:ARB:STAT ON
:OUTP:STAT ON

For more information on Agilent's femtocell solutions, please visit
www.agilent.com/find/femtocell.

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1. *For further information on performing BER/BLER measurements using the picoChip femtocell reference design please contact picoChip at* **support@picochip.com**.

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