



## WIRELESS SOLUTIONS – WCDMA & LTE RRU TEST SYSTEM

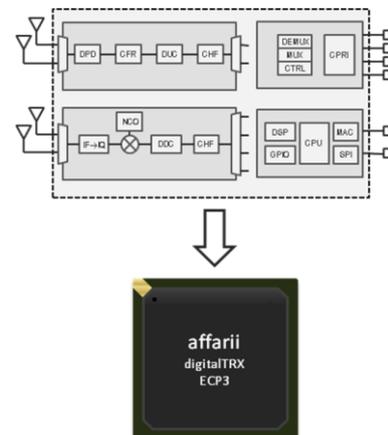


Next generation networks have increasingly adopted Remote Radio Head (RRH) technology to provide a flexible and scalable network architecture that is easy upgraded. These RRH designs include advanced signal processing technologies such as Crest Factor Reduction and Digital Pre-Distortion that optimise overall transmission efficiency and reduce net unit BOM cost.

Affarii Technologies provides complete Remote Radio Unit reference designs for 1-4 carriers of mixed WCDMA and LTE in up to 20MHz of modulation bandwidth that include Crest Factor Reduction and Digital Pre-distortion suitable for LDMOS Class AB and Doherty HPAs.

The 3GPP reference designs include the following features:

- Supports all RRH functions; DUC, DDC, CFR and DPD.
- Integrated with CPRI and Fast C&M RMII Bridge.
- On chip DPD adaption with acceleration.
- Predistortion transmitter operation up to 184.32Msps<sup>†</sup>.
- Low power consumption: 1500mW @ 125Msps<sup>†</sup>.
- High integration, low power, low cost.



<sup>†</sup> WCDMA RRH supporting 1x1 antenna configuration with single CPRI interface.

To assist in system testing and evaluation of the RRU Reference Design Affarii provide an RRU test system comprising:

- A fully functional RRU Demonstration Unit supporting 3.072G CPRI SFP interface.
- A CPRI REC Emulator with internal ARB waveform generation and Fast C&M Ethernet.
- Matlab based 3GPP test signal generation and measurement software.

These test systems allow end developers to setup and test fully RRU operation including switched multi-carrier and multi-mode operation.



## RRU DEMONSTRATION UNIT



### Key Features:

- Fully Featured 20MHz 1x1 RRU Demonstration Unit Supporting WCDMA & LTE.
- Banded for operation in the IMT band (2110-2200 DL) or UDD/EDD bands (730-830 DL).
- Supports all RRH functions: CPRI, DUC, DDC, CFR and DPD.
- Integrated host  $\mu$ P with control software for RRH configuration, monitoring and control.
- USB debug port for direct IP block access.

The RRU demonstration unit is a fully functional 20MHz 1x1 RRU that allows evaluation of Affarii's 3GPP DUC, DDC, CFR and DPD IP blocks for WCDMA and LTE on the Lattice ECP3-150 FPGA.

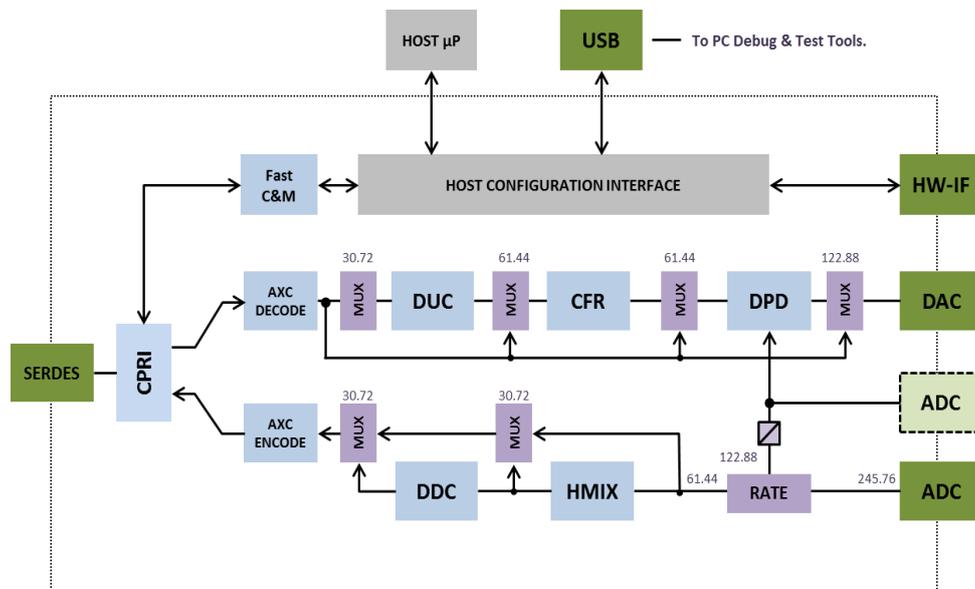


Figure 1: Demonstration RRU FPGA Functional Diagram

The demonstration unit supports a 3.072G CPRI interface using pluggable SFP modules that allows test data to be supplied and captured remotely using the Affarii REC Emulator.

Within the RRU demonstration unit access to transmit and receive signal path processing blocks is available via switchable datapath multiplexers. This allows direct data input and output of IP block as shown in Figure 1.

Setup and control of the unit is via a USB port with PC based drivers giving direct register access and of each IP block, or via the CPRI Fast C&M link to an embedded PIC32 processor that supports development of end user control software.



## DEMONSTRATION UNIT – RF BANDS AND SAMPLE RATES

The RRU Demonstration Unit is available in two band variants:

- 3G-4G-IMT – Providing a 2110-2220MHz DL band using the internal TRF3761 VCO with Complex IF RF conversion.
- 4G-US-EDD – Providing a 730-830MHz DL band using and external LO and Zero IF RF conversion.

Extended range variants can be configured for bands between 1500-2700MHz by arrangement.

### ECP3 RRU UNIT CONFIGURATIONS

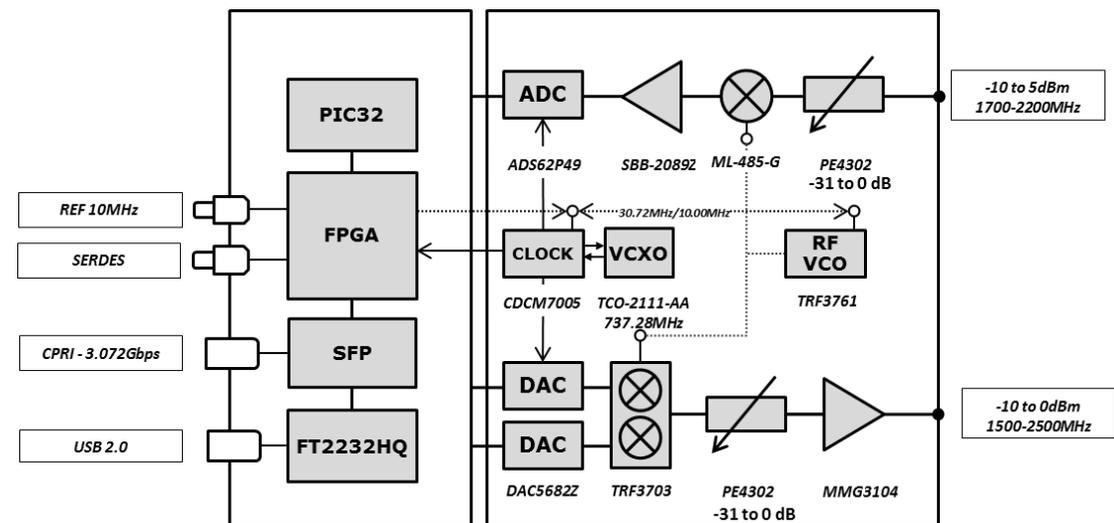
PLATFORM BANDS	
Variant	Band
3G-4G-IMT	2110-2220 MHz
4G-US-EDD	730-830 MHz

Table 1: RRH Demonstration System Banding

SUPPORTED SAMPLE RATES (TYP/MAX)						
PORT	DEVICE	BITS	Typical		Maximum	
TX	DAC5682Z <sup>1</sup>	16	122.88Msps	100 MHz	245.76Msps	200 MHz
RX	ADS61B49 <sup>1</sup>	14	122.88Msps	50 MHz	245.76Msps	100 MHz
DPD	ADS61B49 <sup>1</sup>	14	122.88Msps	50 MHz	245.76Msps	100 MHz

Table 2: RRH Demonstration System Sample Rates

Note 1: In regions where ADC/DAC sample rate and bit resolution restrictions apply, devices DAC5687 and ADS62C17 are substituted with a maximum rate of 184Msps.



The RRU Demonstration Unit supports up to 100MHz of transmit bandwidth using a Texas Instruments DAC5682z DAC and TRF3703 mixer operating in either ZIF or CIF configurations. Receiver or DPD observation is provided by a TI ADS61B49 ADC with TriQuint ML-485 for 3G-4G-IMT or ML-483 for 4G-US-EDD variants.



## CPRI REC EMULATOR WITH ARB



### Key Features:

- CPRI REC emulator with Arbitrary Waveform Generator (ARB).
- 32M sample IQ waveform memory depth.
- Supports CPRI rates 1228.8Mbps, 2457.6Mbps, and 3072Mbps.
- Supports up to 32 AxC IQ samples per CPRI basic frame.
- CPRI Fast C&M channel to 100-BaseT Ethernet bridge.
- Supports CPRI UL IQ data recording for receiver testing.
- 3GPP TS25.141/TS36.141 Test Generator and Waveforms available.

The Affarii CPRI REC Emulator provides a simple test interface for CPRI based Remote Radio Units employing the CPRI Fast C&M (Ethernet) channel for unit control.

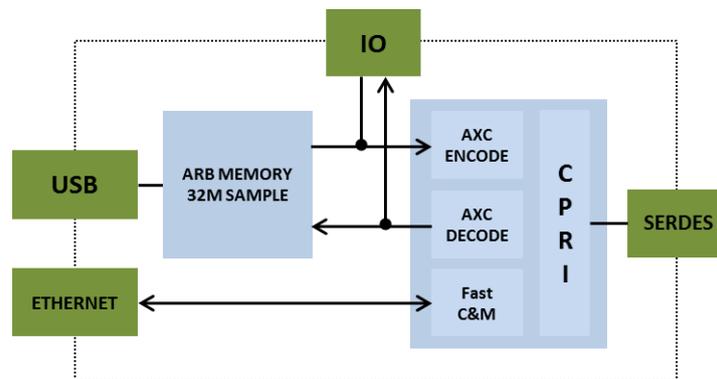


Figure 2: CPRI REC Emulator Functional Diagram

The REC Emulator includes an internal 32M sample memory that supports download of CPRI AxC I+Q data samples for RE testing and includes a user programmable CPRI AxC encoder that allows up to 32 32bit AxC samples in each CPRI frame.

To support RRU receiver or data loopback tests the REC Emulator includes a programmable AxC decoder that allows 32 AxC I+Q samples per frame to be decoded and captured to the internal ARB memory.

For RRU supporting control over the CPRI Fast C&M channel via TCP/IP protocols the emulator includes a CPRI Fast C&M to 100-BaseT Ethernet bridge that allows the REC control software to be developed and tested using hardware on a standard Ethernet network.



## RRU TEST AND MEASUREMENT

The RRU Demonstration Unit and REC Emulator allow a complete BTS test solution to be assembled as show in Figure 3.

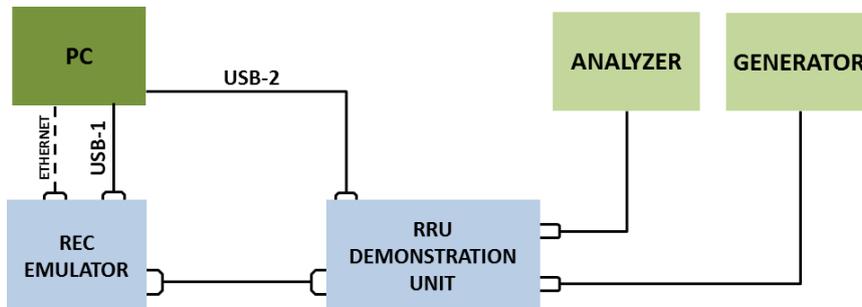


Figure 3: RRU and REC Emulator Setup for 3GPP Performance

For full BTS testing developers can load test waveforms to the REC Emulator and send setup commands to the RRU using a USB connection from a PC (USB-1). Affarii provide a simple RRU configuration GUI in Matlab to configure the test system, shown in Figure 4.

For IP block tests or debug a direct USB connection to the RRU unit allows read and write access to all IP registers and settings (USB-2). With this interface developers can create their own Matlab tests scripts to control the RRU and download their own REC Emulator test waveforms.

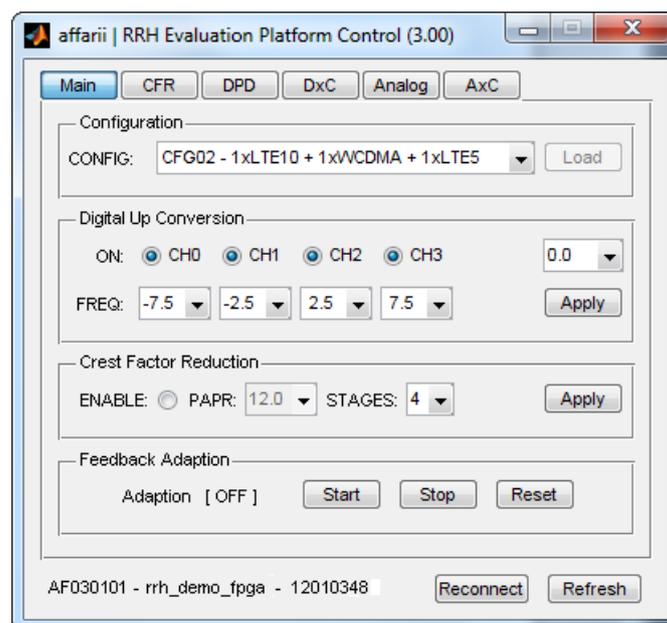


Figure 4: RRU Control Interface for MATLAB Signal Analysis.



### WCDMA AND LTE TEST WAVEFORMS

The RRU test setup supports generation of the standard 3GPP test waveforms in Table 3 and Table 4 for direct RF measurement.

3GPP WCDMA - TS25.141 – TM1/3/6 UTRA Test Waveforms				
Model	DPCH-16	DPCH-32	DPCH-64	DPCH-30+HSPDSCH-8
TM1	X	X	X	
TM3	X	X		
TM6				X

Table 3: 3GPP WCDMA BTS Test Waveforms

3GPP LTE - TS36.141 – TM1 EUTRA Test Waveforms						
Model-TM1	LTE-1.4	LTE-3	LTE-5	LTE-10	LTE-15	LTE-20
QPSK	X	X	X	X	X	X
64QAM				X		X

Table 4: 3GPP LTE BTS Test Waveforms

Standard 3GPP test waveforms are with commercial test equipment may be combined to form multi-carrier system setups for BTS ACP1 and EVM performance measurements.

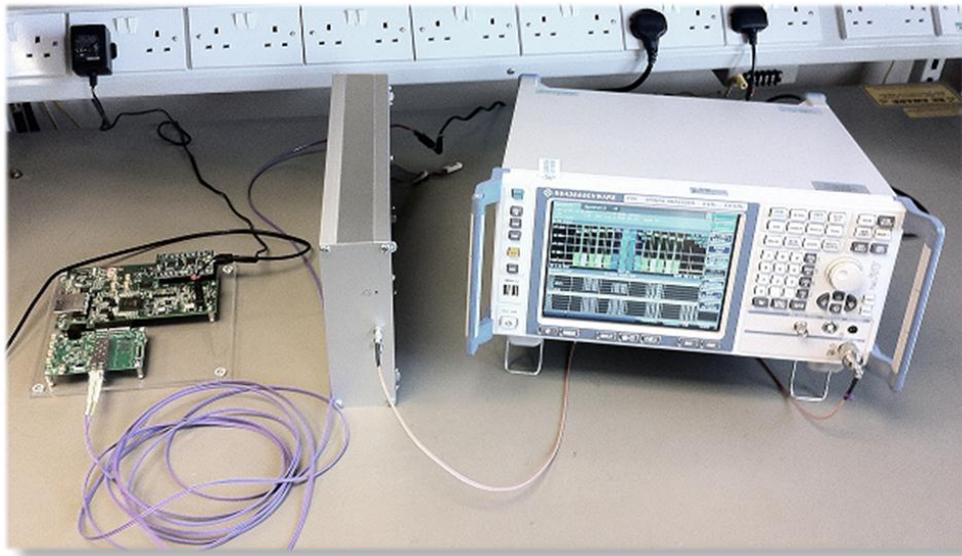


Figure 5: RRU and REC Emulator Setup for 3GPP Performance Testing

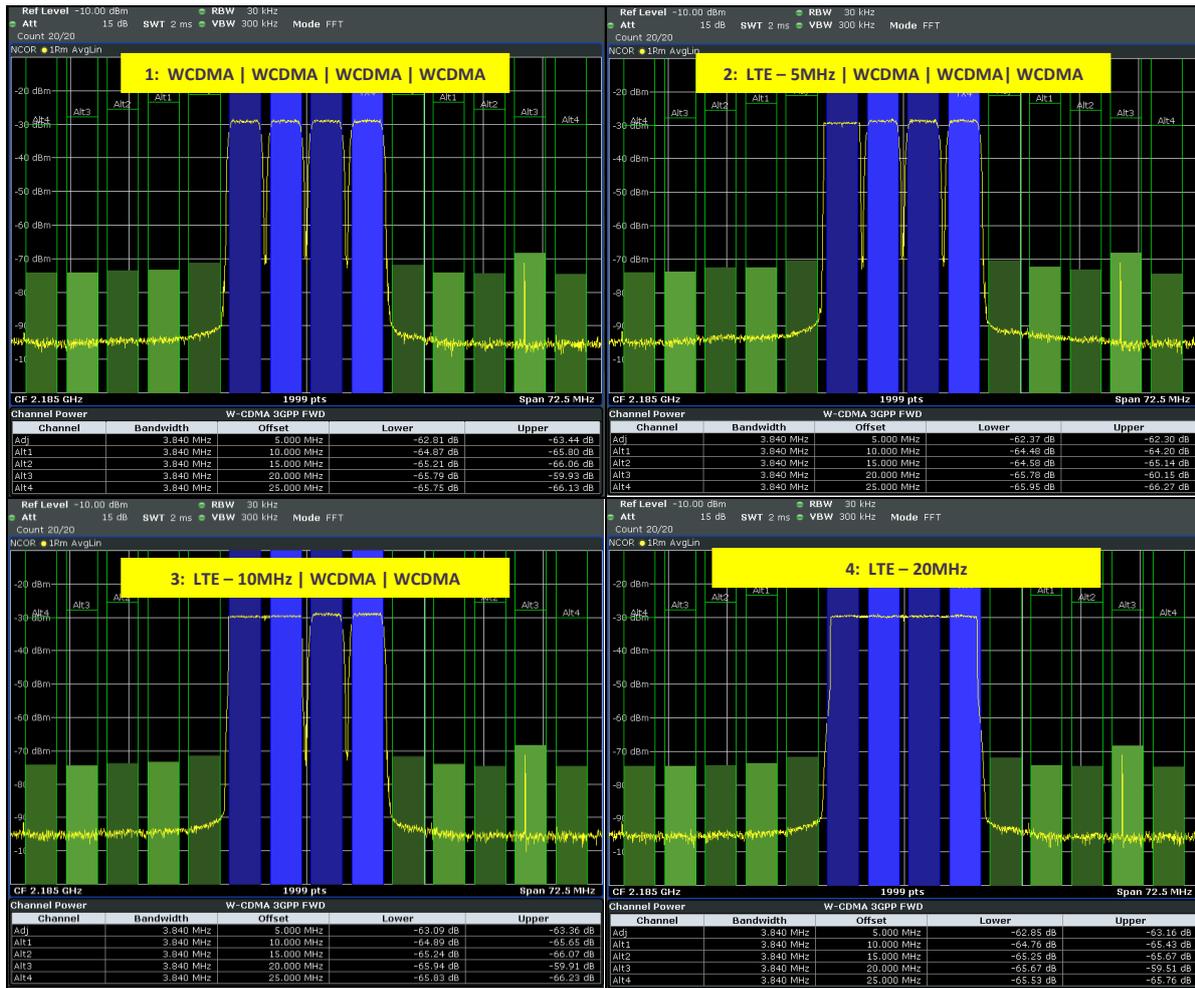


Figure 6: WCDMA + LTE Multi-Mode 3GPP Test Examples



## Additional Information

### Revision History:

Revision History   Product Brief – RRU-DEMO-UNIT – RRU Demonstration Unit with CPRI.		
Date	Revision	Description
27-FEB-2012	1.01	FIRST ISSUE

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