Application Report
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Modular Communications Transceiver for 4G/5G Distributed Antenna and Base-Stations

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ABSTRACT

This application report describes the methodology to construct modular 4G/5G distributed antenna systems (DAS) and base stations (BTS). It provides an example of an actual design of a 2TX/2RX module that can be adapted to a 4TX/4RX module, with consideration of an additional receiver channel for digital pre-distortion (DPD) processing. The overall design is flexible and modular, and provides wide instantaneous bandwidth, a flexible RF range, and a JESD204B interface that relieves data transfer bottlenecks.

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1 Introduction

This application report describes the methodology to construct modular 4G/5G distributed antenna systems (DAS) and base stations (BTS). It provides an example of an actual design of a 2TX/2RX module that can be adapted to a 4TX/4RX module, with consideration of an additional receiver channel for digital pre-distortion (DPD) processing. The reference design is flexible and modular, and provides wide instantaneous bandwidth, a flexible RF range, and a JESD204B interface that relieves data transfer bottlenecks.

The overall design includes the AFE7686 family of RF-sampling transceivers, which enable modular platform designs with multiple channel counts for transmitters and receivers, as well as various instantaneous bandwidth capabilities.

Features include:

- A modular approach with channel counts, which scales easily by multiples of two to meet the needs of DAS, BTS, andmultiple-input-multiple-output products (MIMO).
- Independent configuration maximizes bandwidth flexibility and provides additional latitude with JESD204B lane assignments for the transmit path, receive path, and transmit observation for DPD (Digital Pre-Distortion).
- Wide RF instantaneous bandwidth support up to 1.2GHz.
- Supports all 3GPP bands from 700 MHz to 5.2 GHz (with modifications to matching network), including time domain duplex (TDD) and frequency domain duplex (FDD) specifications.
- High density PCB design.

Applications include:

- DAS
- Repeaters
- Small Cell
- Macro-BTS
- Massive MIMO (AAS)

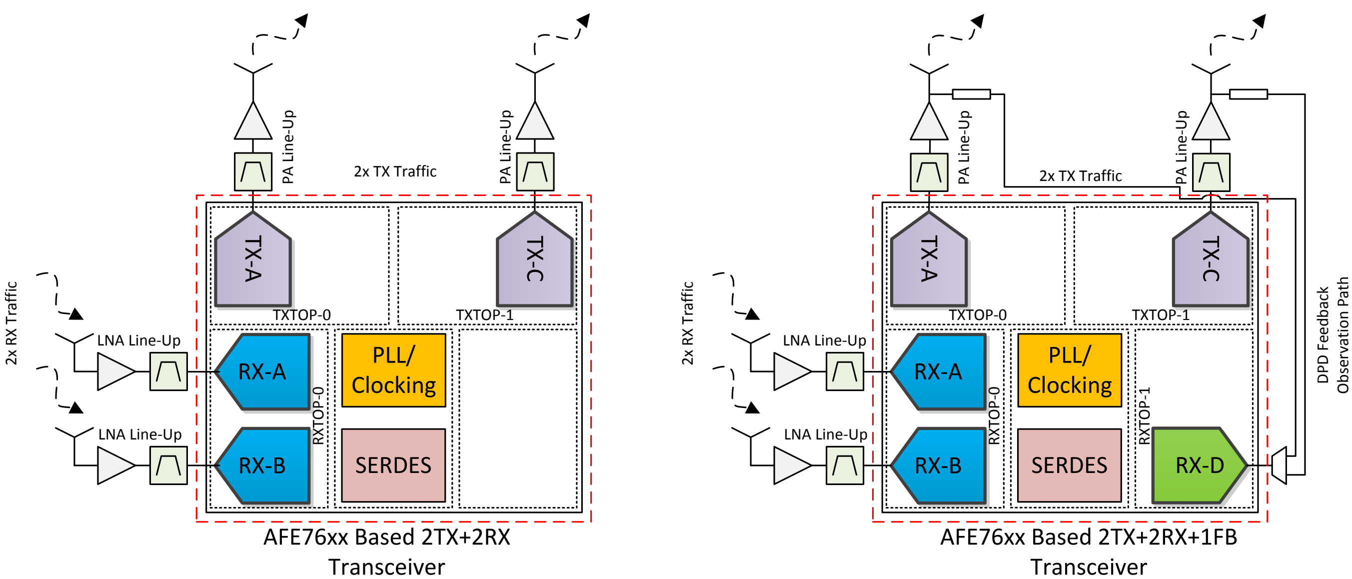


Figure 1. AFE76xx Based Transceiver Designs

2 System Description

Different wireless communication systems serve different purposes depending on the service environment, coverage requirement, and user capacity. To highlight the benefits of the modular based design and its applications to different communications systems, this report focuses on a typical DAS and its service environment. An example of a typical wireless communications system environment using DAS is described in this section. [1]

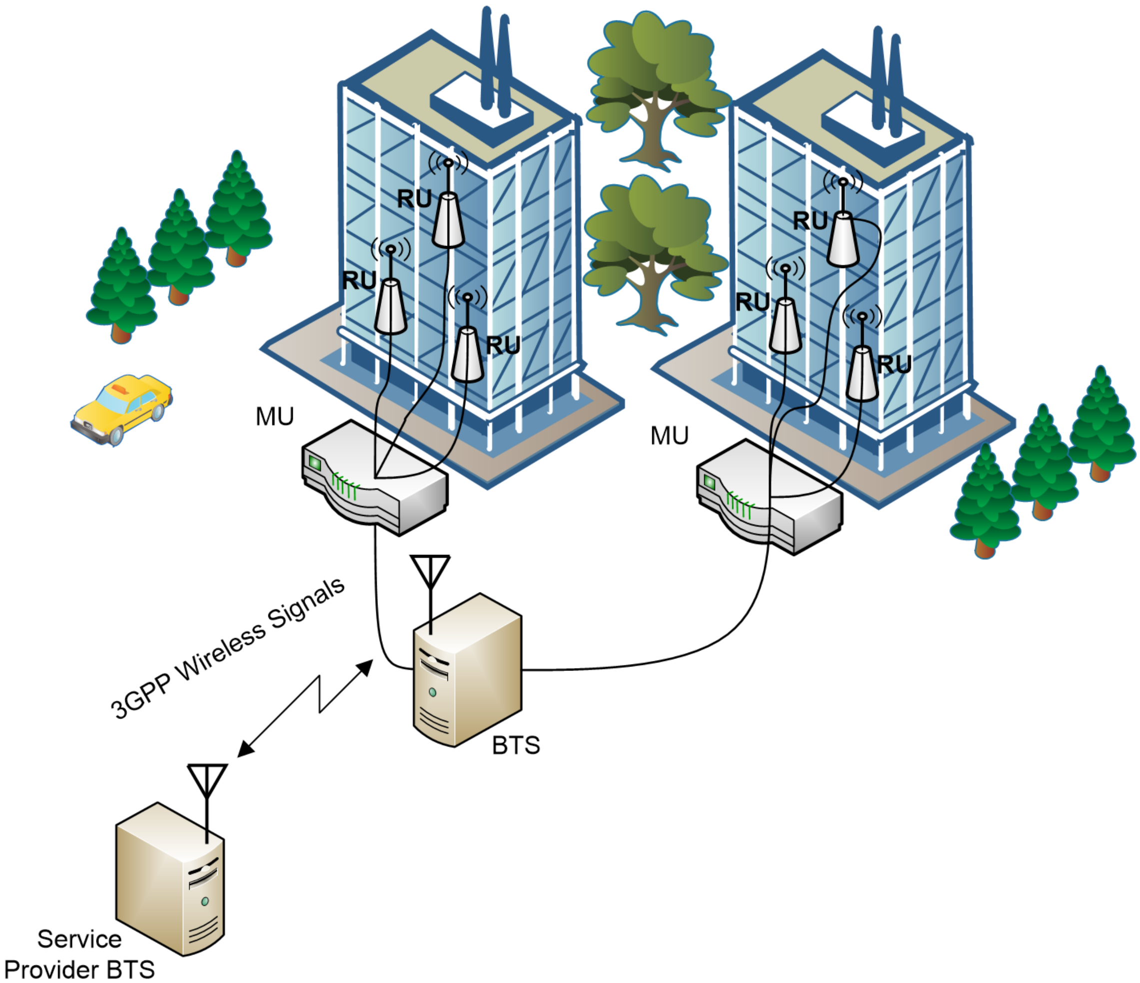


Figure 2. Typical DAS Service Environment

Figure 2 shows a typical service environment for DAS. Many private office buildings and public service buildings have many mobile users in a crowded and enclosed environment. The enclosed nature of the building environment does not allow external wireless signals from a BTS to reach inside the buildings. Therefore, without additional remedies to the wireless signal path, these buildings will have coverage and capacity issues for the mobile users. Figure 3 describes the function and nomenclature of each of the components.

(1) The similarities in the principle of modular design can be extended to repeaters, small cells, and massive MIMO, which are not discussed in this report.

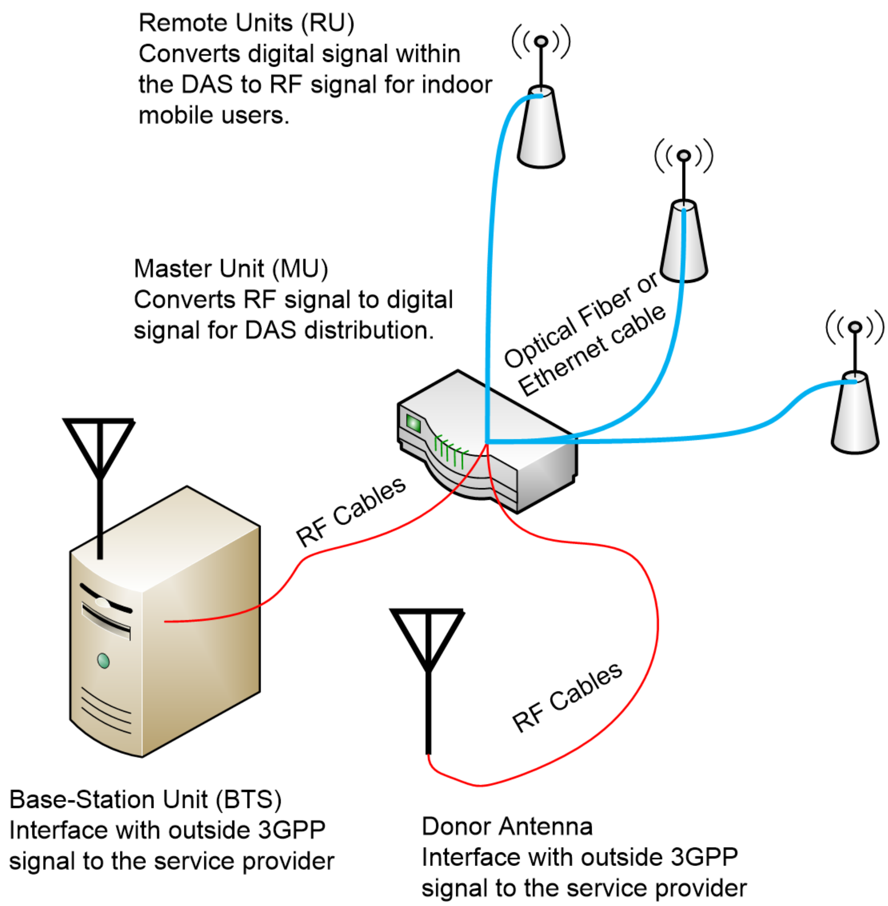


Figure 3. Principle of DAS Operation to Improve Indoor Coverage and Capacity

The building owners or manager can introduce DAS to simply redistribute the wireless signal path from outside the building to inside the building. Per Figure 3, a DAS typically consists of two principle elements: a master unit (MU) and one or more remote units (RU). The simplified operating principle is based on the master unit interface with an outside BTS or donor antenna that redistributes the outside signal indoors through indoor remote units. The indoor remote units can be placed throughout the building to improve coverage and capacity of the service. The key constraint is that the DAS is transparent to the mobile user and the BTS as the DAS is simply redistributing the signal.

The following summarizes the functionalities of each key component of the DAS:

1. MU: this is the master unit of the DAS. The MU interfaces primarily with an outside BTS or donor antenna, and it bridges the outside signal with indoor RUs.
2. RU: the building owner or manager can install various RUs throughout the building to increase coverage and capacity of the interface with the mobile users. The RUs interface with the MU to bridge the mobile users with the MU.
3. BTS: this unit is responsible for the air interface between the mobile service provider and the mobile user. Since the air interface may have difficulty penetrating through the buildings, DAS are installed to bridge the BTS with the mobile user and service provider.
4. Donor Antenna: in case the air interface signal is sufficiently strong without significant fading effect, the MU can interface directly with a donor antenna to reach a more remote BTS as opposed to installing a BTS outside the building. Installing the BTS directly outside the building to interface with the MU directly requires RF cell planning from the service provider to assess potential interference to other cells. The use of a donor antenna can possibly save the building manager the cost of BTS cell planning and installation and also reduces DAS installation time. If a BTS is indeed installed near the building, the MU can connect to the BTS with fiber cable directly without the use of a donor antenna.

2.1 Key System Specifications

As an example of the modular based design utilizing the AFE76xx family of devices, this report focuses on construction of the DAS elements: MU, RU, and BTS.

A summary of the general DAS components and design targets is listed in the following table:

Table 1. Key DAS Specifications

MODULE TYPE	NUMBER OF UPLINK (Receivers)	NUMBER OF DOWNLINK (Transmitters)	NUMBER OF DPD OBERVATION (Feedback Receiver)	UPLINK/DOWNLINK DUPLEXING TYPE	INSTANTANEOUS BANDWIDTH	RF FREQUENCY OPERATING RANGE
Master Unit (MU)	4	4	0	FDD	> 120MHz	700MHz to 3500MHz
Remote Unit (RU)	2	2	1	FDD	> 120MHz	700MHz to 3500MHz
Base Station Unit (BTS)	4	4	1 or 2	FDD	> 120MHz	700MHz to 3500MHz

3 System Overview

3.1 Block Diagrams

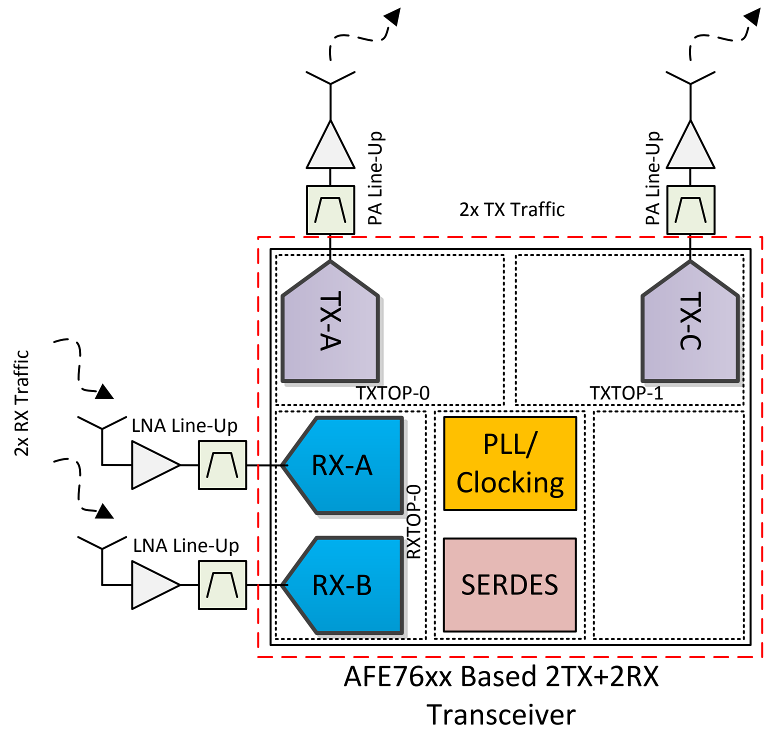


Figure 4. Option 1: AFE76xx Based 2T2R Transceiver Implementation

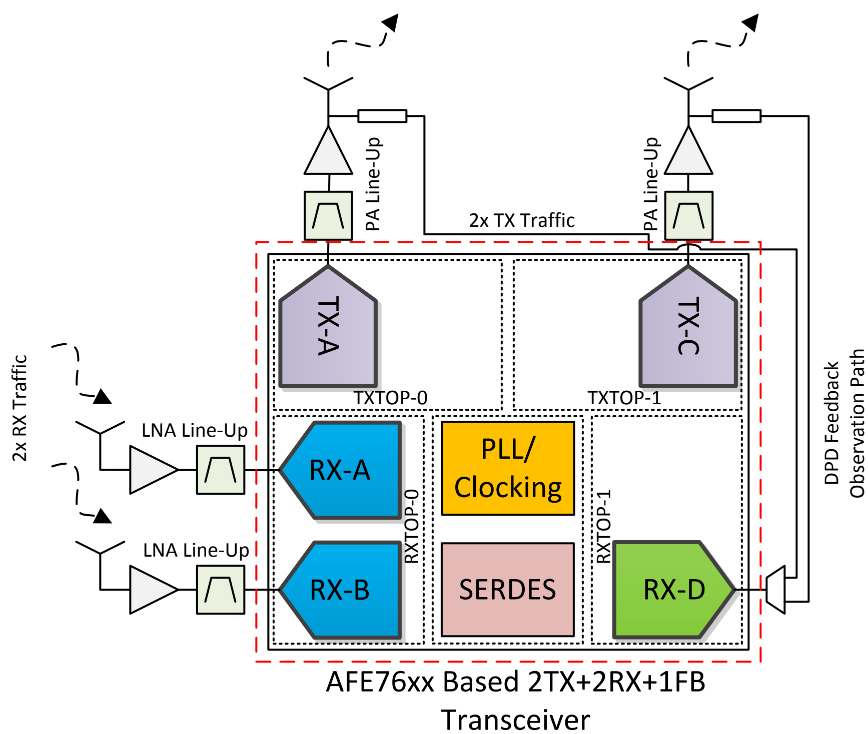


Figure 5. Option 2: AFE76xx 2T2R+1FB Implementation

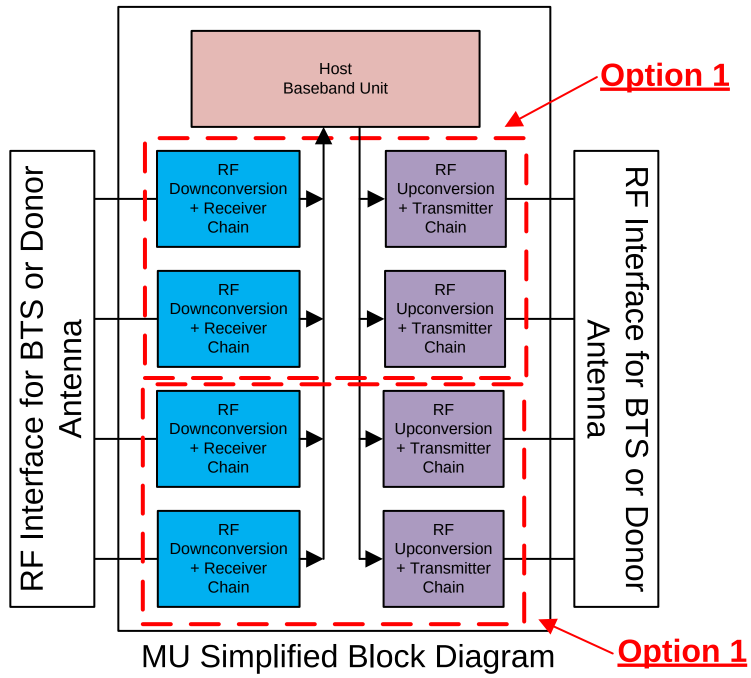


Figure 6. Master Unit Simplified Block Diagram with AFE76xx Implementation Options

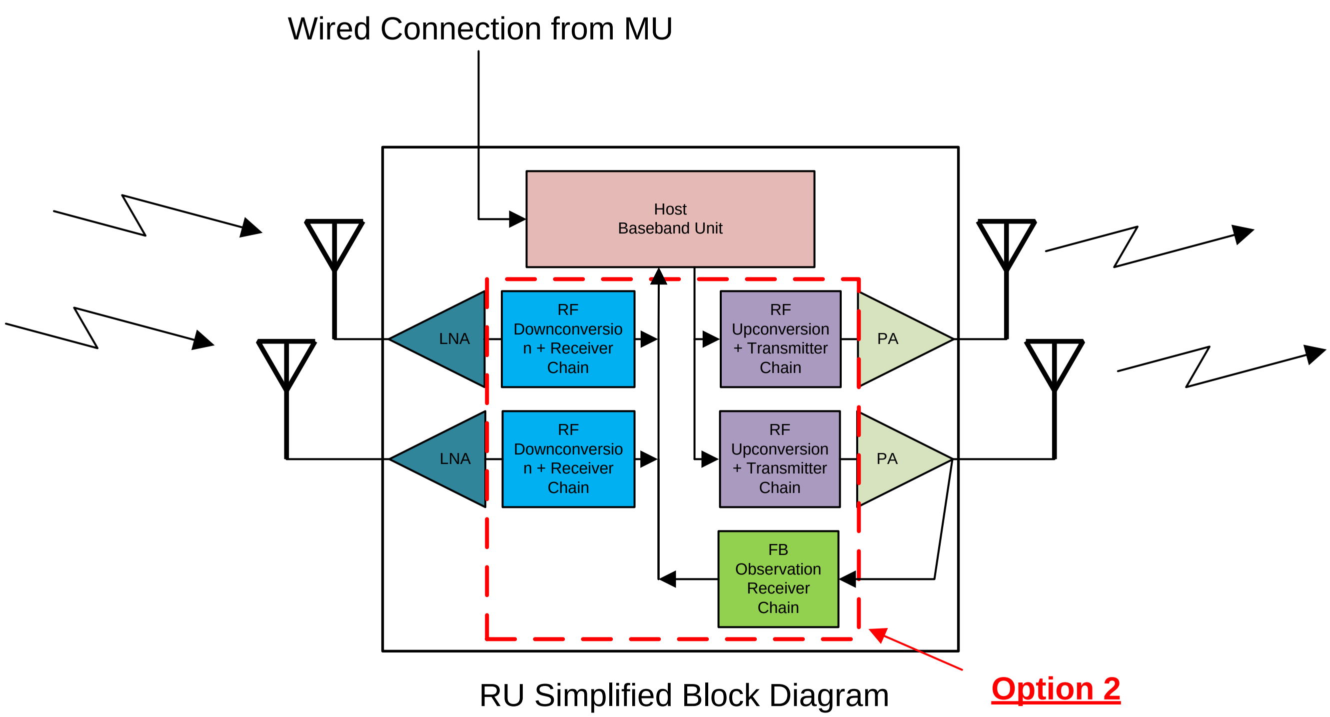


Figure 7. Remote Unit Simplified Block Diagram with AFE76xx Implementation Options

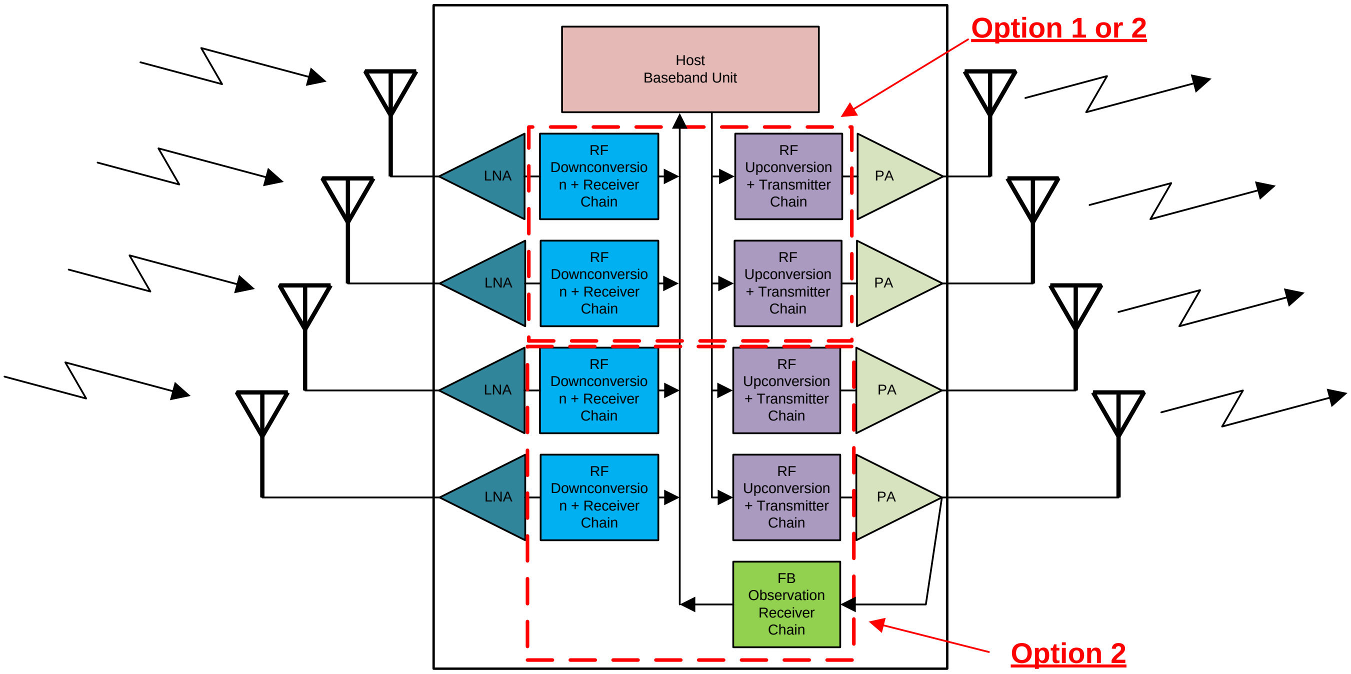


Figure 8. Base Station Unit Simplified Block Diagram with AFE76xx Implementation Options

3.2 Design Considerations

Typical construction of the DAS elements includes the following:

1. The MU has 4T4R. These transmit and receive channels are the gateway to the outside world through either a BTS or donor antenna to the service provider. Since it interfaces with the BTS or RU with wired medium, the MU may not necessary need a power amplifier on the transmitter side. Therefore, the MU may not necessarily need a feedback receiver channel used to observe the transmitter output for power amplifier linearization (for example, Digital Pre-distortion or DPD).
2. The RU has 2T2R with one FB (feedback receiver). The RU provides indoor coverage for the mobile users in the building. Since the RU interfaces with the mobile users through an air interface, the transmitters need power amplifiers before the antenna. Therefore, a feedback receiver channel used for power amplifier linearization is needed. The linearization method is typically the industrial method of digital pre-distortion (DPD).
3. The BTS has 4T4R with one or two FB. Either the BTS or the donor antenna provides the bridge to the service provider. The BTS can connect to the MU directly. FB receivers are needed for power amplifier linearization since an air interface is the transmission medium.
4. The RF input and RF output range and bandwidth have to support all 3GPP bands to allow interface for all service providers and mobile users.

3.3 Highlighted Products

3.3.1 Application of AFE76xx in the DAS Construction

The AFE76xx is a family of high performance, quad/dual channel, 14-bit, integrated RF sampling analog front ends (AFEs) with 9 GSPS DACs and 3 GSPS ADCs, capable of synthesizing and digitizing wideband signals. High dynamic range allows the AFE76xx to generate and digitize 3G/4G signals for wireless base stations. In TDD mode, the receiver channel can be configured for dynamically switching between traffic receiver (TDD RX) status and wideband feedback receiver (TDD FB) status to assist DPD of the PA on the transmitter path.

The AFE76xx family has integrated DSA on the receiver channels and also supports DSA equivalent functionality on the transmitter channels. Each receiver channel has one analog RF peak power detector and various digital power detectors to assist AGC control for receiver channels, and two RF overload detectors for device reliability protection. The AFE76xx family has 8 JESD204B compatible SerDes transceivers running at up to 15 Gbps. The devices have up to two DUCs per TX channel and two DDCs per RX channel, with multiple interpolation/decimation rates and digital quadrature modulators/demodulators with independent, frequency flexible NCOs. A low jitter PLL/VCO simplifies sampling clock generation by allowing the use of a lower frequency reference clock.

Table 2. AFE76xx Family of Parts Highlights

PART NUMBER	# OF CHANNELS	# OF DUCS/DDCS PER CHANNEL	MAX BANDWIDTH	RF FREQUENCY RANGE
AFE7685	4T4R	1	* Single band up to 600MHz with 4T4R	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone
AFE7686	4T4R	2	* Single band up to 800MHz† with 4T4R * Single band up to 1200MHz‡ with 2T2R * Multi-band	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone
AFE7681	4T2R	1	* Single band up to 600MHz with 4T2R	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone
AFE7682	4T2R	2	* Single band up to 800MHz† with 4T2R * Single band up to 1200MHz‡ with 2T2R * Multi-band	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone
AFE7683	2T4R	1	* Single band up to 600MHz with 2T4R	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone
AFE7684	2T4R	2	* Single band up to 800MHz† with 4T2R * Single band up to 1200MHz‡ with 2T2R * Multi-band	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone
AFE7619	2T1R	1	* Single band up to 600MHz with 2T1R	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone
AFE7618	2T1R	2	* Single band up to 1200MHz‡ with 2T1R * Multi-band	up to 5.2GHz with RX performance optimized for 2nd Nyquist zone

3.3.1.1 *Design Block Diagrams*

The primary components discussed in this report are the AFE7683 and AFE7684 (2T4R capable). Based on the block diagrams highlighted in both Figure 4 and Figure 5, the following can be constructed:

1. Option 1 demonstrates 2TX/2RX in a FDD system
2. Option 2 demonstrates 2TX/2RX with FB in a FDD system

By revisiting the design target of the DAS components, the two options can be utilized to construct these components in a modular approach.

1. For MU (Figure 6): the use of two of option 1 to form a 4T4R system
2. For RU (Figure 7): the use of one of option 2 to form a 2T2R with FB system
3. For BTS (Figure 8): the combination of option 1 and option 2 to form a 4T4R with two FB system.

NOTE: The BTS design is for a FDD environment where the traffic transmitters are in one frequency band (band X) while the traffic receivers are in another frequency band (band Y). The frequency duplex nature requires the traffic receivers and the traffic transmitters to be constantly enabled. Therefore, it is not possible to re-use the traffic receivers as a feedback receiver for the transmitter path for PA linearization. Therefore, the system requires dedicated feedback receiver channels for PA linearization.

If the BTS design is for a TDD environment where the traffic transmitters and traffic receivers are all in one frequency band (band Z), but the transmitters are on for time slot α while receivers are on for time slot β, the traffic receivers can possibly be reused during traffic receiver idle time for a transmitter feedback observation path for PA linearization. In such a case, the AFE7685/86 platform can be used to form the 4T/4R with two FB receiver systems. The details of this application can be found in the AFE7685/86 data manual in the RX/FB dynamic switch section.

3.4 System Design Theory

Table 3. Typical DAS RF Uplink/Downlink and Signal Bandwidth Requirements

DESIGN PARAMETER	EXAMPLE VALUE
RF Frequency Range	700MHz to 3600MHz for all 3GPP bands
Signal Bandwidth	120MHz Complex
DPD Bandwidth	360MHz Complex, assuming 3x DPD Expansion

3.4.1 Baseband Input/Output Data Rates

Nyquist theory says that the data rate must be at least two times the highest signal frequency. In this example, the signal bandwidth required is at least 120MHz complex. However, the total DPD bandwidth seen by the transmitter and the observation receiver is at least 360MHz complex, based on the 3x DPD expansion algorithm. Further, the process of interpolation and decimation requires low pass filters that limit the useable input bandwidth to about 82% of the complex input data rate. Therefore, the baseband data rates listed in the following table are chosen:

Table 4. Typical DAS Baseband Interface Requirements

FUNCTIONALITY	BASEBAND DATA RATE	COMPLEX BANDWIDTH
Traffic Transmitters	491.52MSPS	400MHz before interpolation filters (Figure 10)
DPD Observation Receiver	491.52MSPS	400MHz after the decimation filters (Figure 10)
Traffic Receivers	245.76MSPS	200MHz after the decimation filters

3.4.2 NCO Frequencies for DUC/DDC

In the AFE76xx family, the baseband signal is directly converted to/from the desired RF frequencies through the DUC/DDC. The NCOs play the role of local oscillators (LO) of the traditional analog modulator/demodulator. Typically, the NCO frequencies for the DUC/DDC can be set to the center of the desired downlink/uplink frequency bands. Therefore, in this example, the NCO frequencies can be set anywhere between 700MHz to 3500MHz. Since the up-conversion/down-conversion processes are done in the digital domain, the mismatch between in-phase and quadrature path is negligible. Therefore, the typical sideband images and LO feedthrough artifacts occurred in the traditional analog modulator/demodulator will have significantly lower magnitude in the AFE76xx DUC/DDC path.

3.4.3 DAC/ADC Sampling Rate

In the AFE76xx family, the DAC sampling clock is provided either through the integrated PLL/VCO or through an external clock. The ADC sampling clock is internally divided down from the DAC sampling clock by 2, 3, or 4, but cannot be higher than 3GSPS.

When an internal PLL/VCO is preferred, the recommended DAC sampling rates are the center frequencies for the two VCOs: 5898.24MSPS or 8847.36MSPS.

There are a couple of basic considerations when choosing the DAC sampling rate:

1. To keep low order harmonics (HD2, HD3), FDAC/2 clocking mixing products (CMP2), and Fdac/2 out of band.
2. To keep a reasonable distance between the fundamental signal and the 2nd Nyquist zone image.
3. To keep Fout within the 1st Nyquist zone of the DAC, if possible.
4. To keep the highest sampling rate if possible to allow for better NSD. The approximate reduction in phase noise is 20*log10(Fout/FDAC). Therefore, the higher the DAC sampling rate, the better noise reduction is possible.

Since the highest supporting band is 3600MHz, the sampling rate of 8847.36MSPS is necessary in order to keep the RF range within the 1st Nyquist zone (for example, 8847.36MHz/2 = 4423.68MHz, which is greater than 3600MHz. 5898.24MHz/2 = 2949.12MHz, which is less than 3500MHz). Moreover, since the highest supporting DAC rate is chosen, the best possible phase noise can be achieved.

Once the DAC sampling rate is chosen, the ADC sampling rate is divided down from the DAC sampling rate. There are a couple of basic considerations when choosing the ADC sampling rate:

1. To keep low order harmonics (HD2, HD3) out of band.
2. To use the highest sampling rate if possible for better NSD.
3. To keep the input signal within the same Nyquist zone of the ADC.

In this example, the ADC sampling rate of 2949.12MSPS can satisfy the RF band requirements since the RF band requirement of 3GPP bands from 700MHz to 3600MHz is not continuous. Typically, the 3GPP bands are allocated in chunks, such as the examples shown in the following table:

Table 5. Common 3GPP Bands

BAND NUMBER	UPLINK/DOWNLINK FREQUENCY RANGE (MHz)
5	824-849/869-894
65	1920-2010/2210-2200
66	1710-1780/2110-2200
22	3410-3490/3510-3590

Different regions across the globe have different band allocation and utilization based on the local regulation of wireless bands, as well as other regulations such as power supply connections and mechanical structure of DAS. To meet the specific requirements of different regions, the centralized DAS architecture design may need to have some family of variants that are fined tuned to the particular region. For instance, the analog bandpass filters and RF saw filters will need to be changed in the system due to different band utilization, as well as some power supply requirements to fit the local power grid.

Therefore, each variant of the central DAS architecture design will have some adjustment of the Nyquist zone setting within the AFE76xx ADC register settings. The main ADC sampling rate of 2949.12MSPS would not change. Therefore, the overall AFE76xx architectural setup will not change.

3.4.4 Interpolation/Decimation Factors

Once the system engineers have chosen the baseband input and output data rate and the DAC/ADC sampling rate, the interpolation and decimation factors can be derived as:

- Interpolation factor = DAC sampling rate / baseband input data rate
- Decimation factor = ADC sampling rate / baseband output data rate

In this example,

- The interpolation factor for Traffic Transmitter mode = 8847.36MSPS/491.52MSPS = 18x interpolation
- The decimation factor for Traffic Receiver mode = 2949.12MSPS/245.76MSPS = 12x decimation
- The decimation factor for Feedback Observation Receiver mode = 2949.12MSPS/491.52MSPS = 6x decimation.

Note that the supported interpolation and decimation factors are finite in a AFE76xx. System engineers will need to perform iterative adjustments of the baseband input and output data rate and/or adjust the DAC and ADC sampling rate accordingly.

3.4.5 PLL Setup

In the AFE76xx family, the maximum PFD update rate is 500MHz. System engineers should use the highest PFD update rate to maintain the best phase noise performance. Given the reference frequency from an onboard clock chip, like the LMK04028, is 491.52MHz, and the DAC sampling rate is 8847.36MSPS, the high band VCO is selected with the N divider set to be divide-by-1 for a PFD frequency of 491.52MHz. In order to have the feedback side of the PFD to be equal to the reference side, the total pre-scaler factor is equal to 8847.36MHz/491.52MHz = 18. With the programmable pre-scaler set to divide-by-6, the M divider should be set to 18/6 = 3.

3.4.6 SERDES Lanes and JESD204B Frame Formats

For optimal power efficiency and I/O efficiency, it is desired to use the minimum number of SERDES lanes while staying under the maximum line rate possible with the chosen FPGA/ASIC. In the design requirement, the FPGA/ASIC maximum SERDES data rate was given as 10Gbps.

3.4.6.1 TXDAC JESD204B RX Mode

For the chosen input data rate of 491.52MSPS for TX DAC and with 8b/10b encoding on the SERDES lanes, each stream (I-stream or Q-stream) requires a serialized data rate of 9830.4Mbps, as given by the equation below.

Serialized data rate for each TX data stream = 419.52MSPS * 16 * (10/8) = 9830.4Mbps

The total serialized data rate for the four TXDAC channels with complex inputs is 9830.4Mbps * 2 * 4 = 78643.2Mbps. The following table shows the line rate versus the total number of lines. Eight lanes running at 9830.4Mbps is chosen as this is the only workable solution. This sets the JESD204B mode as two sets of 44210 mode for 2TX.

Table 6. JESD204B Line Rate Options for TXDAC

NUMBER OF LANES	LINE RATE	POSSIBLE?
1	78643.2Mbps	No
2	39321.6Mbps	No
4	19660.8Mbps	No
8	9830.4Mbps	Yes

3.4.6.2 RXADC JESD204B TX Mode

Similarly, for the chosen output data rate of 245.76MSPS for RX ADC and with 8b/10b encoding on the SERDES line, each stream (I-stream or Q-stream), requires a serialized data rate of 4915.2Mbps, as given by the equation below.

Serialized data rate for each RX data stream = 245.76MSPS * 16 * (10/8) = 4915.2Mbps

The total serialized data rate for the two RXADC channels with complex output is 4915.2Mbps * 2 *2 = 19660.8Mbps. This total serialized data rate is split among the total number of lanes. Two lanes running at 9830.4Mbps is chosen since the minimum number of lanes is desired. This sets the JESD204B mode as 24410 mode for 2RX.

Table 7. JESD204B Line Rate Options for RXADC

NUMBER OF LANES	LINE RATE	POSSIBLE?
1	19660.8Mbps	No
2	9830.4Mbps	Yes
4	4915.2Mpbs	Yes, limited frame format

Table 7. JESD204B Line Rate Options for RXADC (continued)

NUMBER OF LANES	LINE RATE	POSSIBLE?
8	2457.6Mbps	Yes, limited frame format

3.4.6.3 FB Observation ADC JESD204B TX Mode

For the chosen data rate of 491.52MSPS for FB Observation ADC with 8b/10b encoding on the SERDES lanes, each stream (I-stream or Q-stream) requires a serialized data rate of 9830.4MSPS, as given by the equation below.

Serialized data rate for the FB data stream = 491.52MSPS * 16 * (10/8) = 9830.4Mbps

The total serialized data rate for one channel with complex output is 9830.4Mbps * 2 = 19660.8Mbps. Two lanes running at 9830.4Mbps for the FB channel is chosen since the minimum number of lanes is desired. This sets the JESD204B mode as 22210 mode for 1RX.

Table 8. JESD204B Line Rate Option for FB RXADC

NUMBER OF LANES	LINE RATE	POSSIBLE?
1	19660.8Mbps	No
2	9830.4Mbps	Yes
4	4915.2Mpbs	Yes, limited frame format
8	2457.6Mbps	Yes, limited frame format

3.4.7 Disabling the FB Channel for Option 1 Design

By default, the overall AFE76xx architecture and software code should be set as Option 2 with 2TX, 2RX, and 1FB channel. For option 1 implementation, the FB channel can be placed in standby mode to minimize power consumption. Simply engage the RXTDD pin for the appropriate RXTOP core to logic low to allow the FB channel to enter standby mode. The RXTDD can be set externally through GPIO, or can be programmed through the SPI register within the traffic controller.

4 Hardware, Software, Testing Requirements, and Test Results

4.1 Test Results

Typical performance plots for the common 3GPP bands for both the transmitter DACs and receiver ADCs can be found in the AFE76xx data manual. At the time of the writing of this report, the emerging market for BTS and DAS is the new 3500MHz band. The following performance plots highlight TXDAC and RXADC performance at the 3500MHz band.

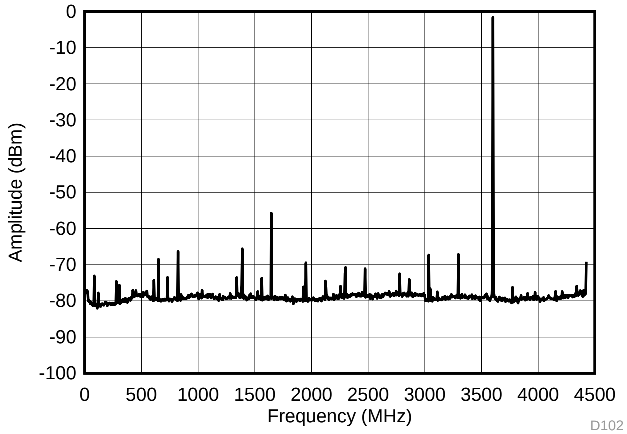


Figure 9. TX Single Tone Output Spectrum (f_{OUT} = 3600 MHz)

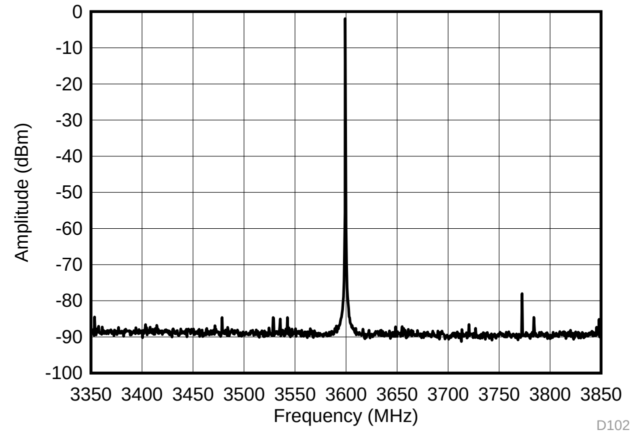


Figure 10. TX Single Tone Output Spectrum Over f_{OUT} ±250 MHz (f_{OUT} = 3600 MHz)

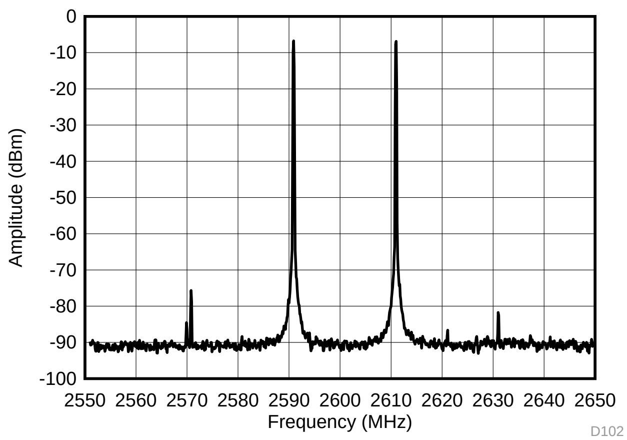


Figure 11. TX Two-Tone Output Spectrum (f_{OUT1} = 2591 MHz, f_{OUT2} = 2611 MHz)

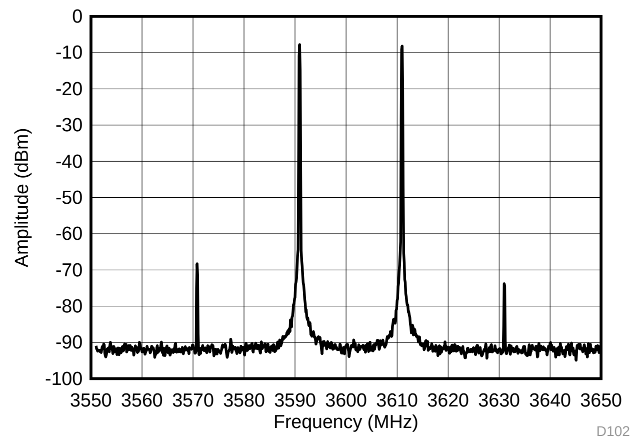
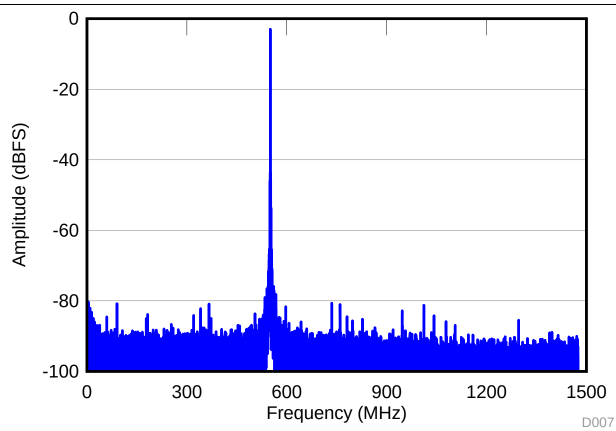
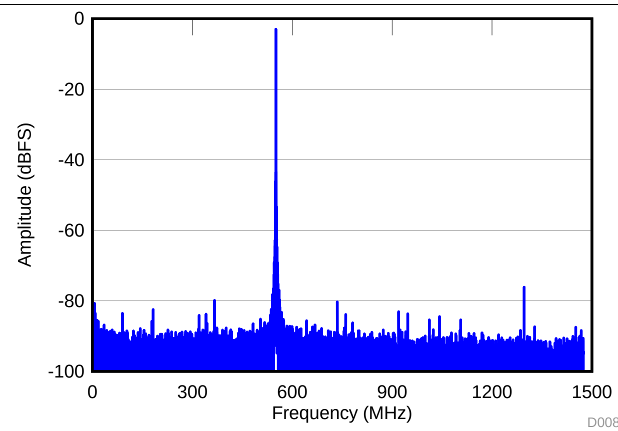


Figure 12. TX Two-Tone Output Spectrum (f_{OUT1} = 3591 MHz, f_{OUT2} = 3611 MHz)



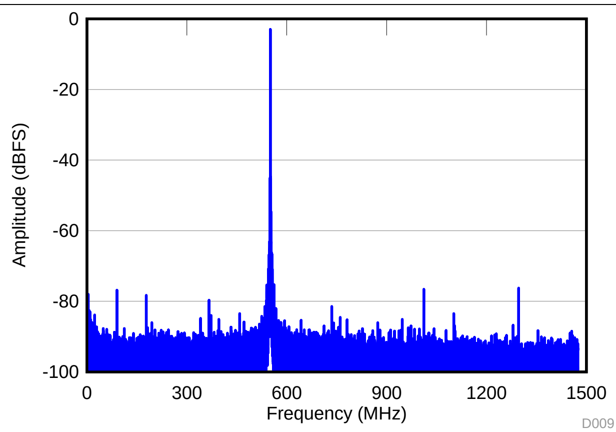
SNR = 54.9 dBFS, HD2 = 93 dBc
HD3 = 82 dBc, Non HD Spur = 83 dBFS, THD = 81 dBc
A_{IN} = –3 dBFS

Figure 13. FFT for 3500-MHz Input Signal (DSA = 4 dB)



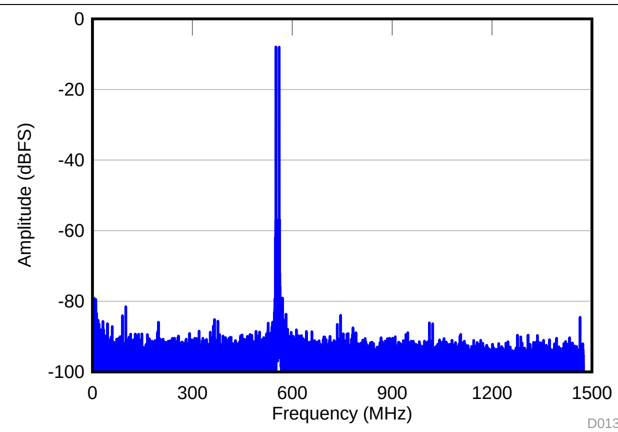
SNR = 55.1 dBFS, HD2 = 90 dBc
HD3 = 74 dBc, Non HD Spur = 83 dBFS, THD = 72.7 dBc
A_{IN} = –3 dBFS

Figure 14. FFT for 3500-MHz Input Signal (DSA = 8 dB)



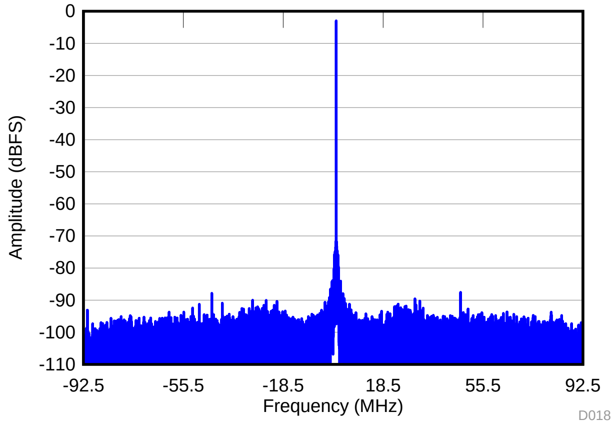
SNR = 54.8 dBFS, HD2 = 81 dBc
HD3 = 73 dBc, Non HD Spur = 80 dBFS, THD = 78 dBc
A_{IN} = –3 dBFS

Figure 15. FFT for 3500-MHz Input Signal (DSA = 12 dB)



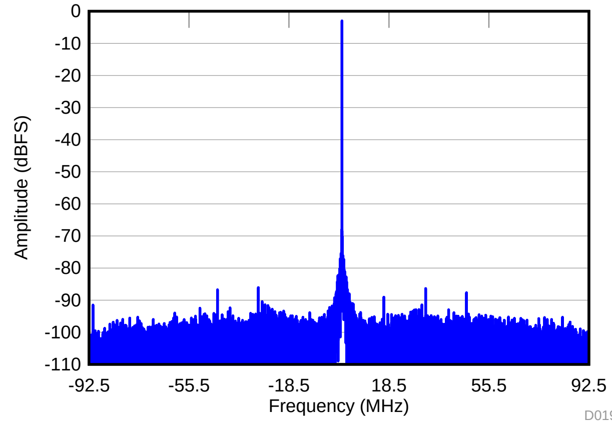
f_{IN1} = 3500 MHz, f_{IN2} = 3510 MHz, A_{IN} = –3 dBFS
IMD3 = 79 dBFS

Figure 16. FFT for Two-Tone Input Signal (-8 dBFS) 3500 MHz and 3510 MHz



SNR = 60.2 dBFS, HD2 = 98 dBc
HD3 = 105 dBc, Non HD Spur = 87 dBFS, THD = 97 dBc
DSA = 0 dB, A_{IN} = –3 dBFS

Figure 17. FFT for 3500-MHz Input Signal (Decimation by 16)



SNR = 61.2 dBFS, HD2 = 98 dBc
HD3 = 105 dBc, Non HD Spur = 87 dBFS, THD = 97 dBc
DSA = 12 dB, A_{IN} = –3 dBFS

Figure 18. FFT for 3500-MHz Input Signal (Decimation by 16)

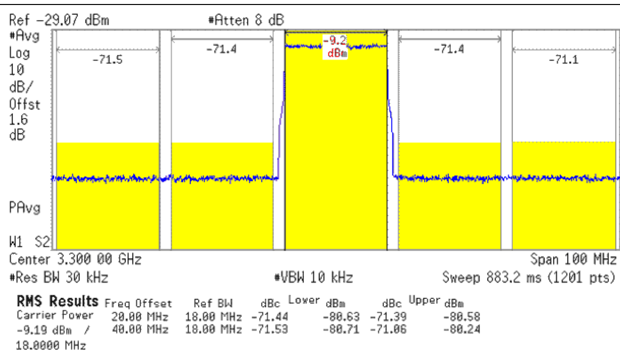


Figure 19. TXDAC LTE 20MHz TM1.1 at 3300-MHz Performance

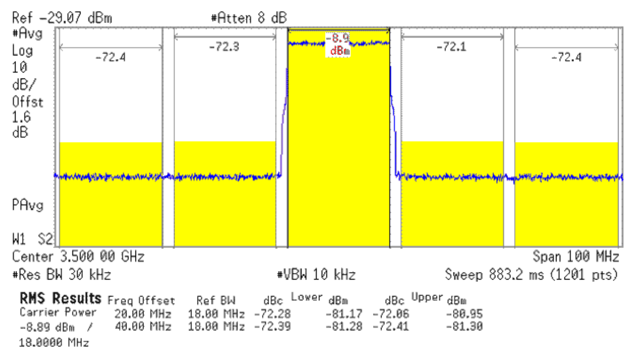


Figure 20. TXDAC LTE 20MHz TM1.1 at 3500-MHz Performance

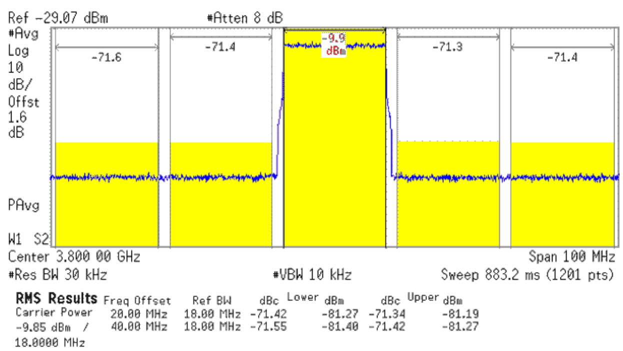


Figure 21. TXDAC LTE 20MHz TM1.1 at 3800-MHz Performance

5 Terminology

Downlink: the traffic transmitter for the communication link, with respective to the main data source at the service provider

TX: Traffic Transmitter for the communication link

TXDAC: digital-to-analog converter used for traffic transmitter

Uplink: the traffic receiver for the communication link, with respective to the main data source at the service provider.

RX: Traffic Receiver for the communication link

RXADC: analog-to-digital converter used for traffic receiver or feedback receiver

DPD: digital pre-distortion for power amplifier linearization

PA: power amplifier for transmitter link

LNA: low noise amplifier for receiver link

DAS: Distributed Antenna System

MU: Master Unit in DAS

RU: Remote Unit in DAS

BTS: Base Station Unit

MIMO: Multiple-Input-Multiple-Output

JESD204B: JEDEC Standard for High Speed Serial Link for Data Converters.

PLL: Phase Locked Loop

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