GUZIK PRODUCT BULLETIN

ADP7000 Series

10-bit Modular Digitizer combined with DP7000 Digital Processor

- High-speed waveform digitizer combined with built-in processing hardware and real-time data streaming to external devices via Optical Data Interfaces (ODI)
- 2.5x more processing resources compared to ADC6000
- Up to 10 GHz analog bandwidth of 10-bit A/D Converters with 32 Gsa/s sampling rate in 2 channel mode
- Up to 128 GBytes of acquisition memory per module
- FPGA-based reconfigurable digital signal processing with up to Real-Time 32 Gsa/s processing speed
- Digital frequency and phase response equalization
- Real-Time digital down conversion DDC with frequency and phase response equalization option
- Multiple other Real-Time FPGA firmware options available to accelerate measurements
- High-speed data transfer to host computer and graphics processors (GPU) for fast signal processing
- Up to 6.4 GByte/s data transfer rate to AXIe chassis using PCI Express x8 Gen 3 link
- 2U high AXIe-1 module 280 Watt maximum power consumption

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Overview

Guzik AXIe ADP7000 Series Modular Digitizer and Digital Processor combine high-speed waveform digitizer with built-in digital signal processing, which both enable mixed-domain signal capture and analysis with high-speed data transfer links to computers. The ADP7000 Modules come in a display-less 2U high 19” AXIe modular form factor.

The product addresses demanding ATE and OEM systems applications in advanced research such as 5G, hydrodynamics, plasma fusion, rotational spectroscopy, semiconductor, physics, astronomy, wireline and wireless communications analysis, aerospace, defense, avionics, military, radar electronics and a variety of other disciplines. The wide analog bandwidth and high sampling rate of the digitizers provide multi band coverage on multiple input channels. For example, the direct RF-sampling capabilities of the digitizers cover radar signals in HF, VHF, UHF, L-, S-, C-, and part of X-band. Direct RF-sampling reduces the overall system complexity by eliminating several input analog down-conversion stages.

The waveform digitizer ADP7000 series modules feature 10-bit Keysight Analog to Digital A/D converters with sampling rates up to 2x32 Gsa/s and analog bandwidth DC to 10 GHz with range adjustable front end (-32 dBm to +22 dBm with 1 dB steps). ADP7000 with up to 128 GBytes of acquisition memory, delivers the longest waveform capture time window available in a high bandwidth analog to digital converter instrument.

ADP7000 features an FPGA-based reconfigurable digital signal processor with up to 2 channel 32 Gsa/s combined processing speed to convey massive time-critical computations directly inside the instrument.

The PCI Express Gen 3 link provides fast control access and DMA transfer of the acquired data to the host computer’s GPU and CPU-based processing back-end. The x4 link delivers up to 3.2 GBytes/s data transfer rate in a Gen3 capable AXIe chassis. In addition, four dedicated Optical Data Interfaces can be configured for Real-Time Continuous Streaming to additional DP7000, host PCs or RAIDs at up to 2x32 Gsa/s (80 GBytes/s).

A Software Development Kit is supplied to control the instrument and to integrate the ADP7000 into an existing AXIe measurement system. Guzik also supplies Signal Display Soft Front Panel graphical interface application for signal capturing and visualization.

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

The block diagram below shows the main components of the modular instrument:

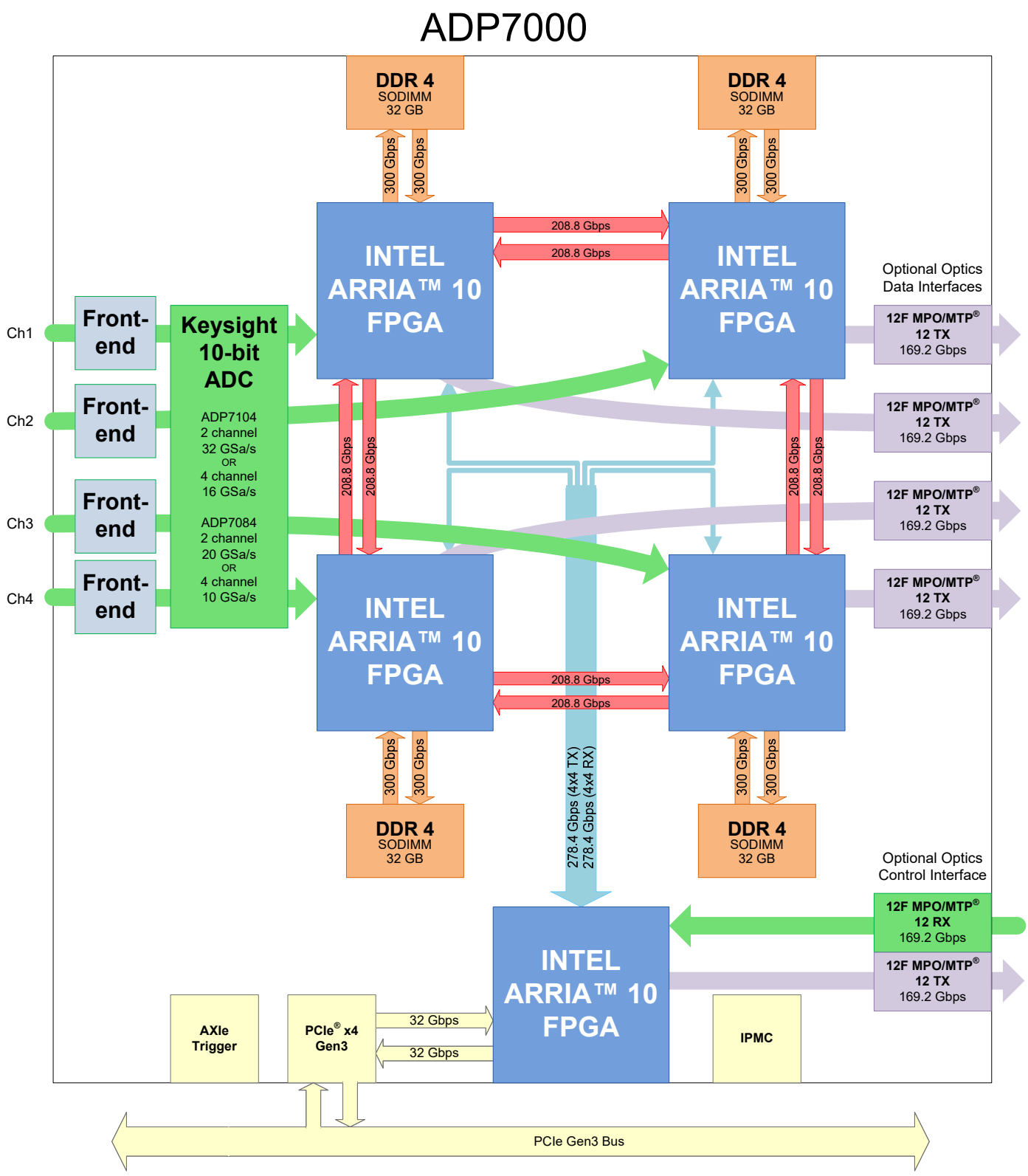


Figure 1. Block Diagram of ADP7000 Module

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

ADP7000 Digitizer Designed for AXIe-1 Standard

The 2U AXIe ADP7000 Modular Digitizer installs into an industry standard AXIe-1 chassis together with other instruments, such as Keysight M8190A 12 Gsa/s, M8195A 65 Gsa/s Arbitrary Waveform Generator, and other AXIe-0 or AXIe-1 modular instruments.

Guzik AXIe Modular ADP7000 Digitizer

ADP7000 Series includes two modules listed in the table below:

	ADP7104	ADP7084
Input Channels	4	4
Analog Bandwidth (-3dB)	10 GHz (2-ch mode) 6.5 GHz (4-ch mode)	8 GHz (2-ch mode) 4 GHz (4-ch mode)
Sampling Rate (per channel)	32 Gsa/s (2-ch mode) 16 Gsa/s (4-ch mode)	20 Gsa/s (2-ch mode) 10 Gsa/s (4-ch mode)
Acquisition Memory[1] (per channel maximum)	48 GSa (2-ch mode) 24 GSa (4-ch mode)	48 GSa (2-ch mode) 24 GSa (4-ch mode)
PCI Express Gen 3 Interface to AXIe chassis	X4 standard	X4 standard

[1] With 15/16 memory utilization

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Acquisition System

At the heart of the ADP7000 Digitizer Modules are state of the art high-speed real-time 10-bit analog to digital converter (ADC) ASICs supplied by Keysight Technologies, which provide high speed waveform capture with 4x more vertical resolution and better SNR than 8-bit ADC-s

A low-noise front-end amplifier/attenuator is connected to each input channel, which enables user selectable wide operational vertical input range.

Combined with the DP7000 digital processor with four Intel Arria 10 processing FPGAs with combined 13,504 multipliers and 6 TeraFlops of IEEE754-compliant floating-point DSP cores.

The patented[2] Guzik digital frequency response equalization further improves the signal fidelity and effective number of bits.

At the maximum sampling rate of 32 Gsa/s (31.25 psec per point), the ADP7000 can capture up to 1.5 seconds of a real-time waveform into its ultra-long acquisition memory per channel in two channel mode.

Internal Clock

Internal clock accuracy is critical for deep-memory applications. The digitizers achieve precise time accuracy with a next-generation premium ultra low phase noise time base architecture. Time scale accuracy of 5 parts per billion after calibration and down to 50 fs of intrinsic jitter.

Channel Trigger

The ADP7000 features a digital processing trigger. This feature makes use of the real-time hardware waveform processing capability and allows you to define trigger parameters based on the actual digital waveform data. This trigger is available on any input channel. In addition, four external trigger/gate source inputs are provided. Trigger conditions are set using the Signal Display software tool or from your application via SDK.

[2] U.S. Patent 7,408,495

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Processing Overview and Capabilities

ADP7000 provides various options for signal processing: FPGA, GPU, and CPU-based processing.

FPGA-based Processing

Inside the ADP7000 are four Intel Altera Arria™ 10 FPGAs for processing. These core processing elements combined with Guzik's implementation of customer-specified measurement algorithms provide end users with a truly tailored measurement solution where speed and throughput count.

The FPGA-based processor combined with Guzik's custom engineering capabilities provides you with the possibility to perform digital signal processing directly in ADP7000 prior to sending waveform data out to computer. Many applications may require only processed results to be sent to the host computer rather than raw waveform data. Guzik can work directly with customers to implement custom processing capabilities drawing from years of experience in waveform analysis. Choice of firmware options includes channel equalization, filtering, multi-segment time-tagged acquisition, Real-Time Digital Down Conversion (DDC), Fast Fourier Transform (FFT), Discrete Fourier Transform (DFT), waveform min/max, Real-Time Waveform Averaging, and parameter calculations among others are all available along with application-specific requests. Guzik can provide custom services after a technical consultation regarding the specific application and required processing.

The combined FPGA processing resources are listed in the table below:

Processing Block	Number	Notes
Logic Cells	2,640,000	Logic Elements
Block RAM	8,532	M20K memory blocks
	168	M20K memory (Mb)
Multipliers	13,504	18-bit x 19-bit multipliers

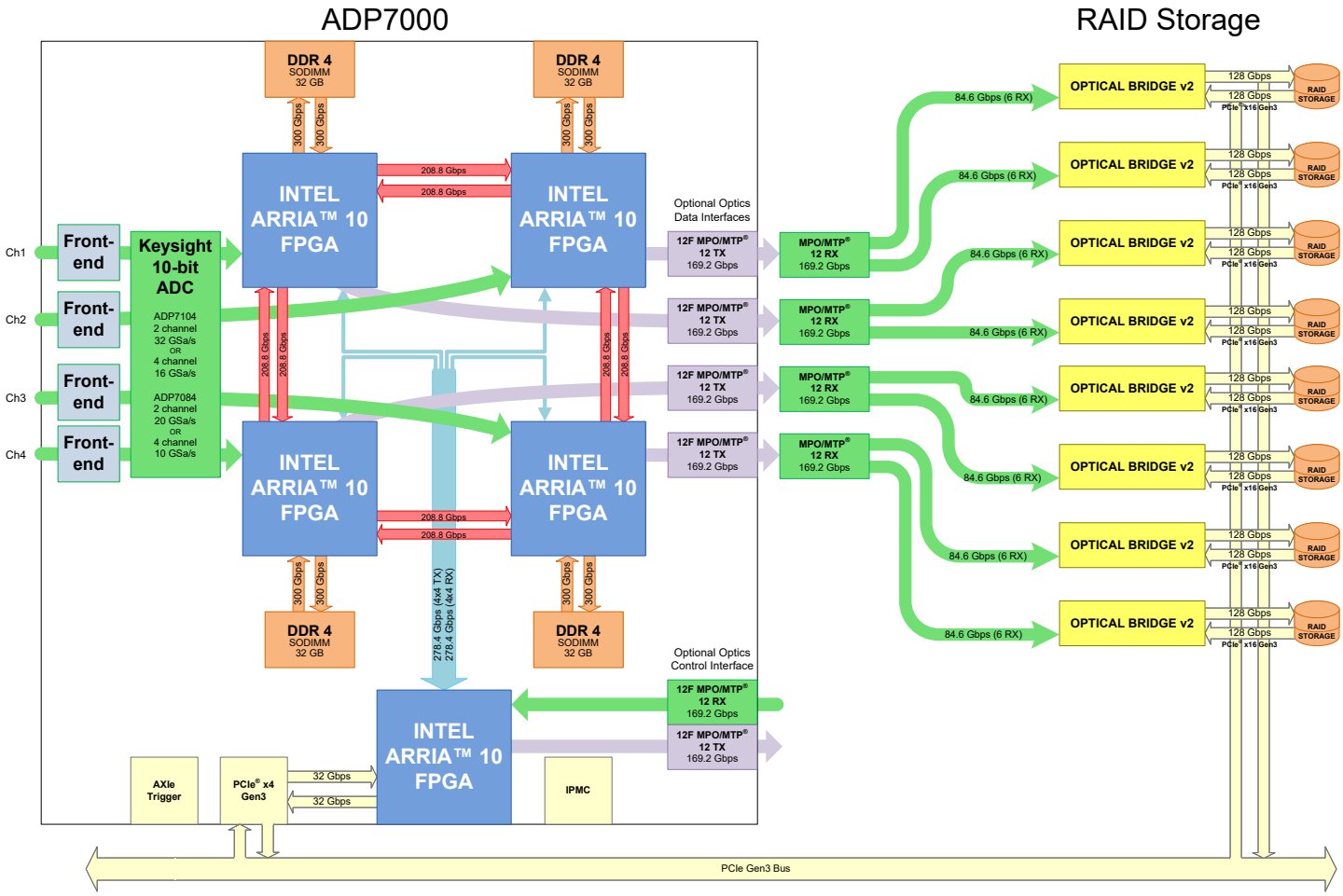
Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Real-Time Stream Processing Architecture via Fiber Optics

The ADP7000 introduces Real-Time Stream Processing Architecture via fiber optics interconnect technology. It allows to cascade additional DP7000 processors together with the ADP7000 digitizer to achieve higher memory capacity and processing capabilities.

Combined with the Optical Bridge Interface Card the DP7000 can be connected to external PC-s and RAID arrays via the fiber optics interconnect technology.

Continuous streaming to additional DP7000-s, host PCs or RAIDs at up to 640 Gbps is shown in the block diagram illustrating the connections and data throughput:



Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

PCI Express Host Computer Control Interface

The ADP7000 provides PCI Express Gen 3 x4 interface to the AXIe backplane. The PCI Express bridge card installs into the host computer, and a standard PCI Express x8 cable connects the AXIe chassis to the host computer. High speed waveform transfer with sustained data rates up to 3.2 GByte/sec is possible from this port back to the host computer with a Gen3 capable AXIe chassis.

GPU-based Processing

General-purpose computation on graphic hardware allows developers to reuse the computational algorithms available for GPU or develop their own algorithms on CUDA C or OpenCL. NVidia® GeForce GTX 1080[3] GPU can be shipped as an option with the ADP7000. It is possible to use any NVidia® GPU with computing capability 2.0 or higher, if its power requirements are satisfied by the host computer.

CPU-based Processing

In addition to FPGA-based and GPU-based computations, customers have an option to perform signal processing using a computer CPU. Multi-core processing libraries, such as OpenMP, allow utilizing full power of modern 12-core CPU computers. Once more powerful computers with additional cores are released, you can upgrade your computer keeping your existing ADP7000 Digitizer Module.

Ultra-fast GPU-based FFT Measurements

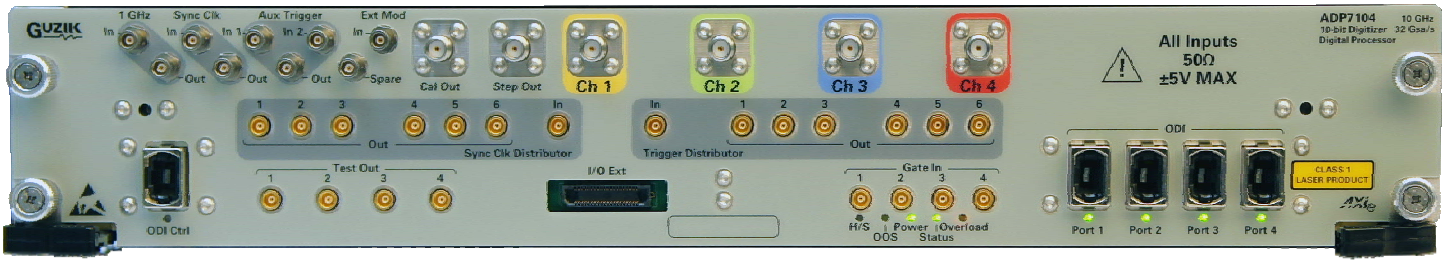
ADP7000 performs frequency domain analysis using the Fast Fourier Transform (FFT) calculated on a GPU. Single NVIDIA® GTX GPU card performs FFT calculations at a 2.5 Gsa/s processing speed. This means, for example, that collecting data at 10 Gsa/s for 100 µs, processing in 400 µs, the full signal spectrum up to 5 GHz with resolution bandwidth 10 kHz – 500,000 spectral lines would take less than 0.5 ms.

Temperature Stabilization

The ADP7000 digitizer modules keep constant temperature for the critical A-to-D components for better measurement accuracy. Tested at ambient temperatures from 15°C to 35°C in standard AXIe chassis.

[3] Current configuration. More powerful GPU cards may be shipped in the future

External Clock and I/O



The ADP7000 Modules feature 50 ohm SMA connectors for inputs and MCX connectors for clock, external gate and control I/O connections.

One Synchronization Clock Input and Output. The Synchronization Clock Input supports 50 MHz, 100 MHz or 200 MHz reference clock frequencies. The front-panel built-in Synchronization Clock Distributor allows precise time synchronization of more than one digitizer to increase the number of phase coherent digitizer channels available in a system.

One ADC 1 GHz Reference Clock Input and Output.

Four Gate Inputs are available to trigger the instrument from external control signals or markers.

Four Test Outputs are available for custom application support and system integration.

External I/O dynamic scenario port provides real-time control access to processing FPGA's. Precise DDC carrier frequency, phase and amplitude settings are possible in real-time through the sequencer control. Complex operations such as frequency sweeps are possible.

ADP7000 provides a programmable built-in calibrator with a variety of test signals. Automatic calibration routine is run during every application start while initializing the sub-systems to ensure accurate operation of the instrument. In addition, the calibrator signals can be user switched to output the test signals to the front panel output connector.

Please contact Guzik Technical Enterprises for more information.

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Information about the available firmware and software options for the ADP7000:

Firmware Option	Description
ADC_BASE (Digitizer Base License)	Base license for simultaneous acquisition and readout of data to the host computer, with patented[4] digital frequency response equalization.
ADC_SM (Segmented Memory Acquisition)	Multi segment acquisitions in the Guzik digitizers use a circular acquisition buffer with minimum inter-segment dead-time of 300ns. This allows, for example, to capture up to 64 million repetitive signals with relatively large repetition intervals and better utilize the already large acquisition memory by discarding dead-time in between signals. Down to femtosecond resolution time-tagging allows to know the precise time between each captured waveform segment.
ADC_BBRT2 (Real-Time 32 Gsa/s Baseband Filtering)	To increase acquisition time for longer signals, which have smaller analog bandwidth than the digitizer, the Real-time 32 Gsa/s baseband digital filtering and decimation option can be used to reduce acquisition data and increase ENOB before storing it to the memory. This option enables triggered streaming and recording.
ADC_ARTDDC (Advanced Real-Time 32 Gsa/s Digital Down Converting)	The Real-Time patented[5] 32 Gsa/s Digital Down Conversion option allows to perform the down conversion in real-time in the ADP7000 digitizer FPGAs. Real-time IF Magnitude triggering can be used to decide if data is to be stored to the digitizer I/Q memory or not. This allows to capture and store only signals of interest within the DDC span and reduces the data amount needed to be transferred to the PC for post processing. Keysight 89600 VSA software can be used to tune each digitizer channel center frequency independently and perform final processing and measurements related to particular transmission standard for measurement channels simultaneously.
ADC_VSM1 (Variable-Length Segments with **ADC_ARTDDC**)	Variable length segmented memory acquisition allows for segmented capture where each segment has a length optimized to capture RF pulses using the Real-Time IF Magnitude Trigger and have minimal dead time capture. This greatly extends the utility of the memory.
ADC_AVG (High Speed Deep Averaging)	Averaging for noise reduction is used in measurements when high dynamic range is required. Averaging is done in real-time in FPGAs thousands of times faster compared to other methods. With the 40-bit 1024K internal accumulator the accuracy of measurements is greatly increased by allowing up to 4 billion averaged waveforms. This allows viewing side bands spectral regrowth and other repetitive signals previously hidden in the noise.
ADC_AVGS (Bundles ADC_SM and ADC_AVG) (High Speed Deep Segmented Averaging)	Segmented averaging mode further advances the measurement flexibility by utilizing groups of data of interest into segments. Each segment may either have its own trigger event programmed or just suspend the data accumulation process for specified period of time.

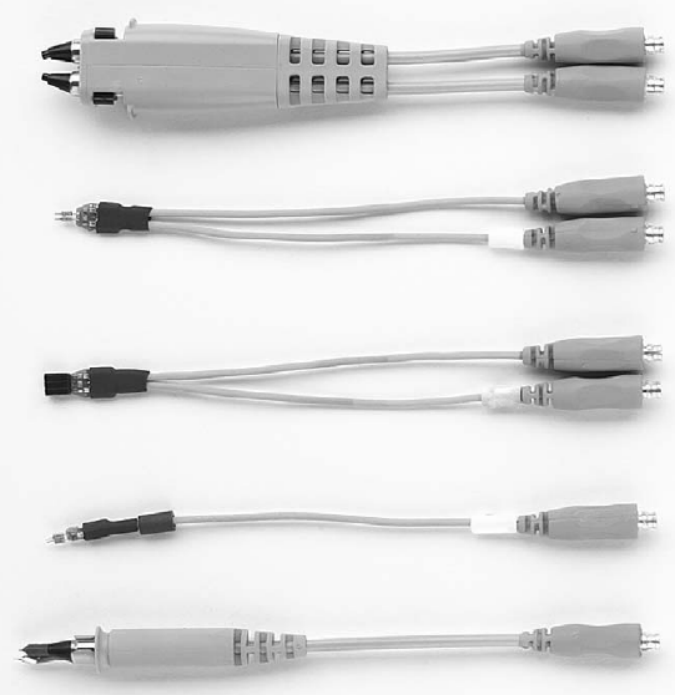
[4] U.S. Patent 7,408,495

[5] U.S. Patent 9,641,191

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

ADC_SYNC1 (Multi-Module Synchronization Capability)	Multi-module synchronization capability, allows to increase the total number of digitizer channels by combining multiple modules into one instrument. The option enables multichannel phase coherent time-tagged input channels to be triggered from common source or independently. Synchronization is performed during digitizer initialization and channel-to-channel skew is restored and maintained between instrument channels. The digitizers can be setup to follow an external 50 MHz, 100 MHz or 200 MHz time base without uncertainty, which is critical for ATE and OEM systems application.

Signal Connection and Probing



For applications that require single ended or differential probing, Guzik recommends the **Keysight InfiniiMax** series of probing tools for use with the ADP7000 digitizer Modules. Detailed selection information can be found at the following link: http://www.keysight.com/find/probes document 5968-7141EN. A wide variety of probe solutions up to 13 GHz in bandwidth can be purchased directly from Keysight.

The Keysight InfiniiMax Series[6] features a variety of probe amplifier and body styles.

The interface to the ADP7000's input connector is the Keysight N1022B Probe Adapter, the 1143A Probe Offset Control and Power Module with an additional ruggedized 3.5 mm to SMA cable pictured below.

[6] Keysight and InfiniiMax are registered trademarks of Keysight Technologies.

GSA Toolkit Software

Guzik provides a GSA Toolkit to control the ADP7000 Digitizer Modules, which includes three software components:

1. Interchangeable Virtual Instrument (IVI) Digitizer Compliant Instrument Driver

2. GSA SDK – software development kit to create your custom standalone applications for ADP7000 or to integrate ADP7000 into your existing software environment; please refer to *"Guzik Signal Analyzer Software Development Kit User's Guide"* document P/N 02-107544 for more details.

3. Signal Display application designed for easy instrument setup, waveform acquisition and visualization. Signal Display provides oscilloscope-like graphical user interface to display multiple signal waveforms, control acquisition parameters (sampling rate, duration, trigger settings, etc), and perform multiple trigger (multi-sector) acquisitions. The application allows for saving acquired signals to the computer storage. You can also load and display signals from files in various formats, including the previously saved waveforms. One of the useful features of Signal Display is tracking (monitoring) acquired signals during GSA SDK-based application execution. Please refer to *"Signal Display User's Guide"* document P/N 02-107548 for more details.

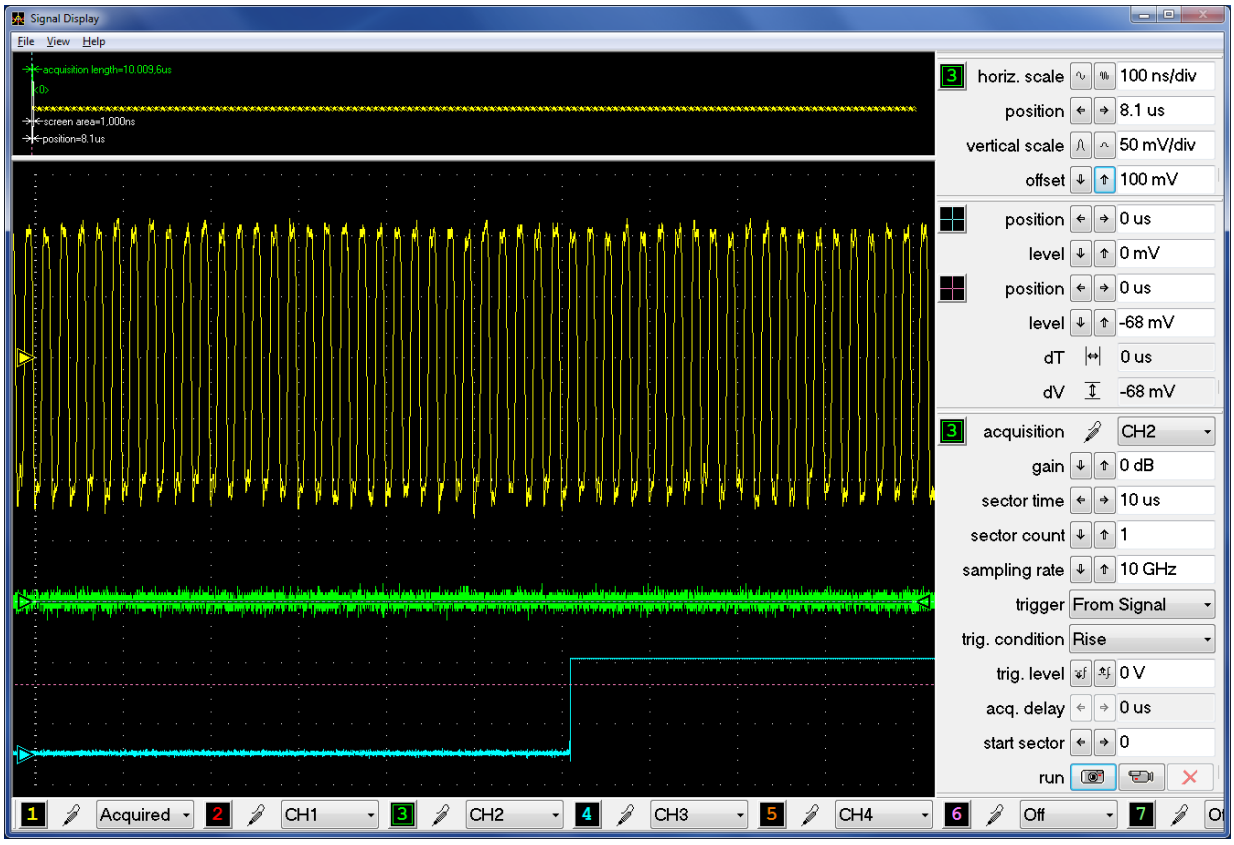
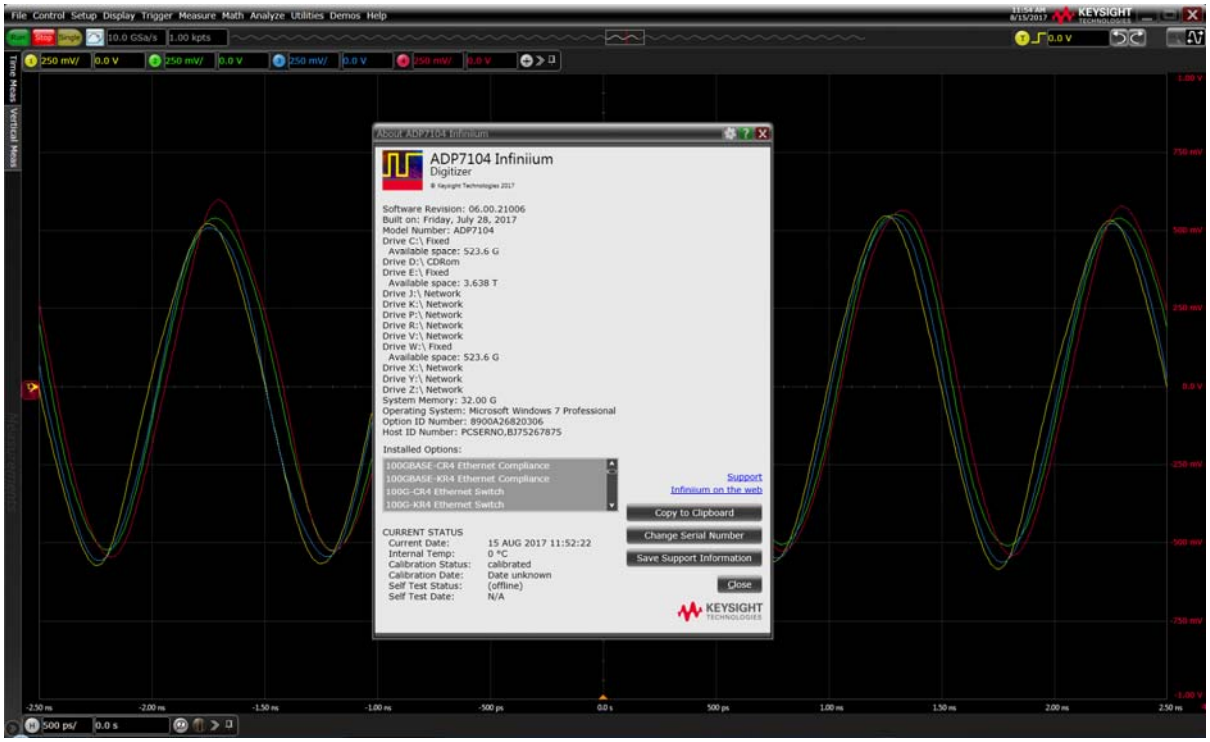


Figure 2. Signal Display Application

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Guzik ADP7000 Digitizer Modules integrate seamlessly with the following Keysight Software to provide hardware accelerated RF and Time-Domain Measurement capabilities.

Keysight Infiniium Hosted Oscilloscope Interface Software for Digitizers (N8901A)



Key Features & Specifications

Productivity

- Use your PC to view and analyze to get additional insight, without having to be with your scope and target system.
- Share scope measurements more easily across your team, and if needed with customers and vendors.
- Create more useful documentation, faster.
- Supports a variety of popular file formats from Keysight Infiniium and InfiniiVision oscilloscopes as well as generic .csv, .txt, and .tsv files.

Standard Features

- Open and view up to 8 waveforms (supports up to 16-bit vertical bits)
- Use familiar scope horizontal and vertical controls to quickly navigate and zoom in to any event of interest

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

- Access over 60 built-in automated measurements with a mouse click.
- 20 math operators including FFT and filters, up to four independent/cascaded math functions

Optional Features

- Protocol decode (I2C, SPI, RS-232, CAN, LIN, FlexRay, JTAG, USB, PCIe, MIPI D-Phy, 8B/10B, SAS, SATA…)
- Jitter analysis with EZJIT and EZJIT+
- Eye analysis and clock recovery for high-speed serial

Licensing

- Requires a License

More information at www.keysight.com/find/InfiniiumUserInterface

Keysight Vector Signal Analyzer Software (89600 VSA and WLA)

Overview

Software tools to explore every facet of a signal and optimize your designs.

Measure a broad range of signals including 5G, IoT, radar and more.

Gain greater insight in frequency, time and modulation domains.

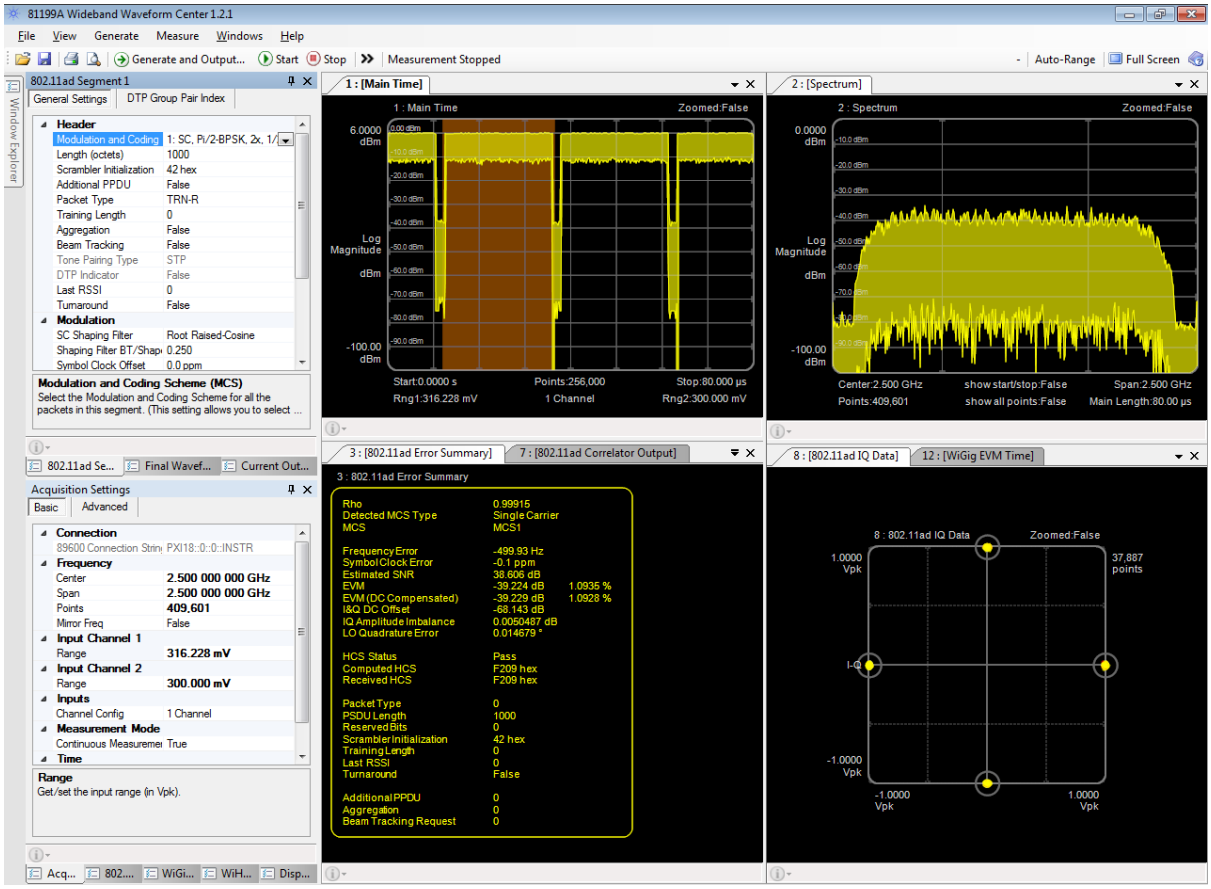
Licensing

- Requires a License

More information at http://www.keysight.com/find/89600

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Keysight Wideband Waveform Analyzer (81199A)



Key Features & Specifications

- Standard-compliant waveform generation. Libraries are available for Wireless HD, WiGig and IEEE802.11ad
- Complete high precision testing
  - Signal simulation on the transmitter side
  - Signal analysis on the receiver side
- Waveform creation using simple drag and drop actions
- Measurement results at a glance. All important results can be configured on one screen. A color-coded composite constellation display allows fast detection of problems.
- Simple drill down to possible parameters.
- Calibration routines for optimizing performance of devices.
- For usage with Arbitrary Waveform Generators M8190A and 81180B.

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Description

The trend continues: Increasingly convenient wireless access is driving demand for more data in less time. As transmission rates climb, it puts additional strain on components, infrastructure, frequency spectrum and developers. The demand for wideband data is also inspiring the creation of new standards that utilize increasingly complex modulation schemes to transmit more data through the available spectrum.

To help you keep pace with higher frequencies, wider bandwidths and new standards, Keysight has created the 81199A Wireless Waveform Center software. Key elements include the Wideband Waveform Creator signal-generation application and the Wideband Waveform analyzer application. Both support emerging wideband modulation formats such as

- Wireless HD,
- WiGig and
- IEEE 802.11ad.

81199A simplifies the test challenges for 60 GHz wireless tests

- Compliant testing for Wireless HD, WiGig & IEEE802.11ad
- Complete transmitter and receiver testing
- Simple signal generation simple with drag & drop creation
- Modulation analysis at a glance of fully coded signals
- Addresses the challenge of 2 GHz modulation bandwidth
  - 100 times wider bandwidth than 802.11n
  - 1.5 times wider bandwidth than 802.11ac

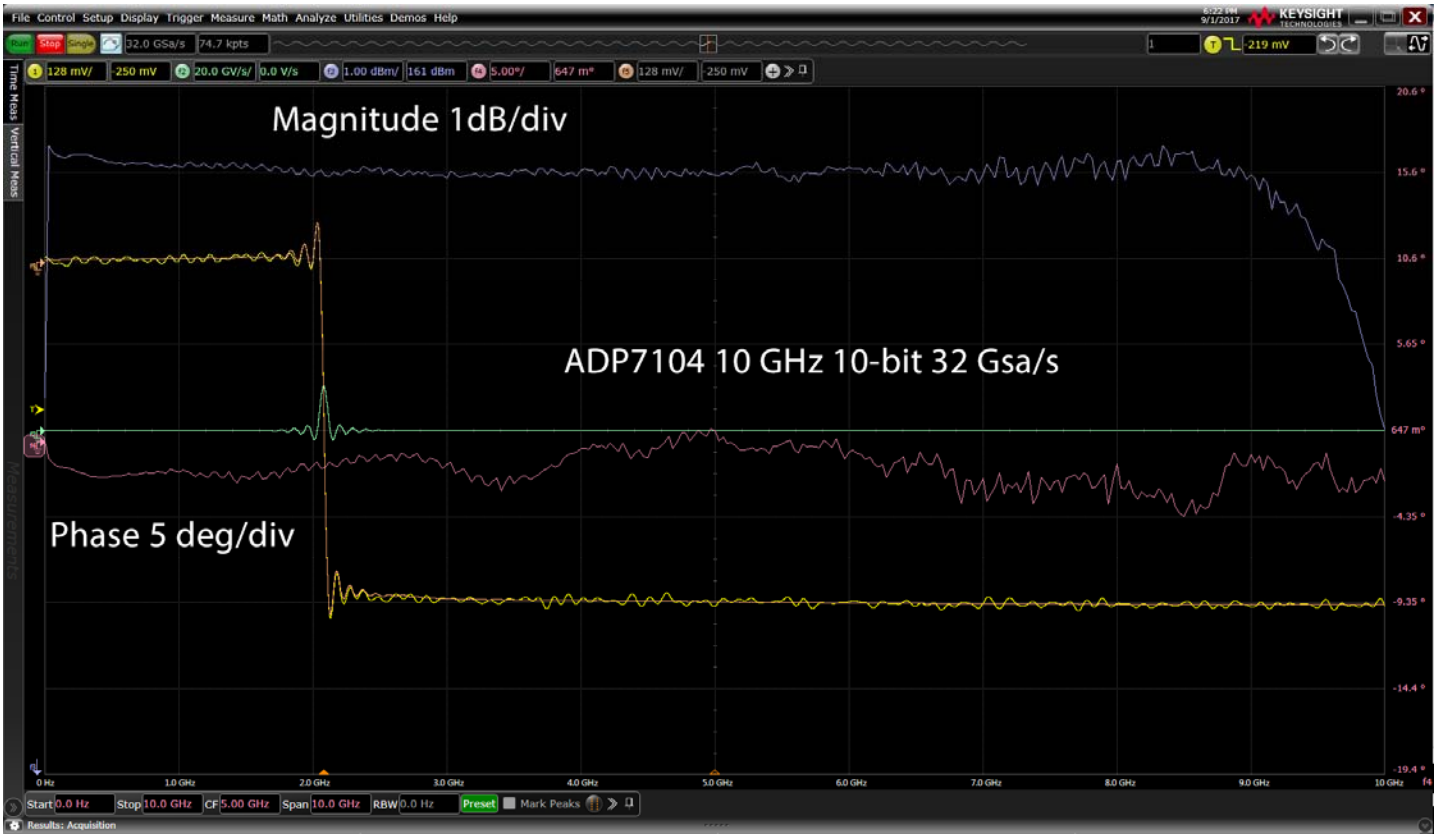
Licensing

- Requires a License

More information at www.keysight.com/find/81199A

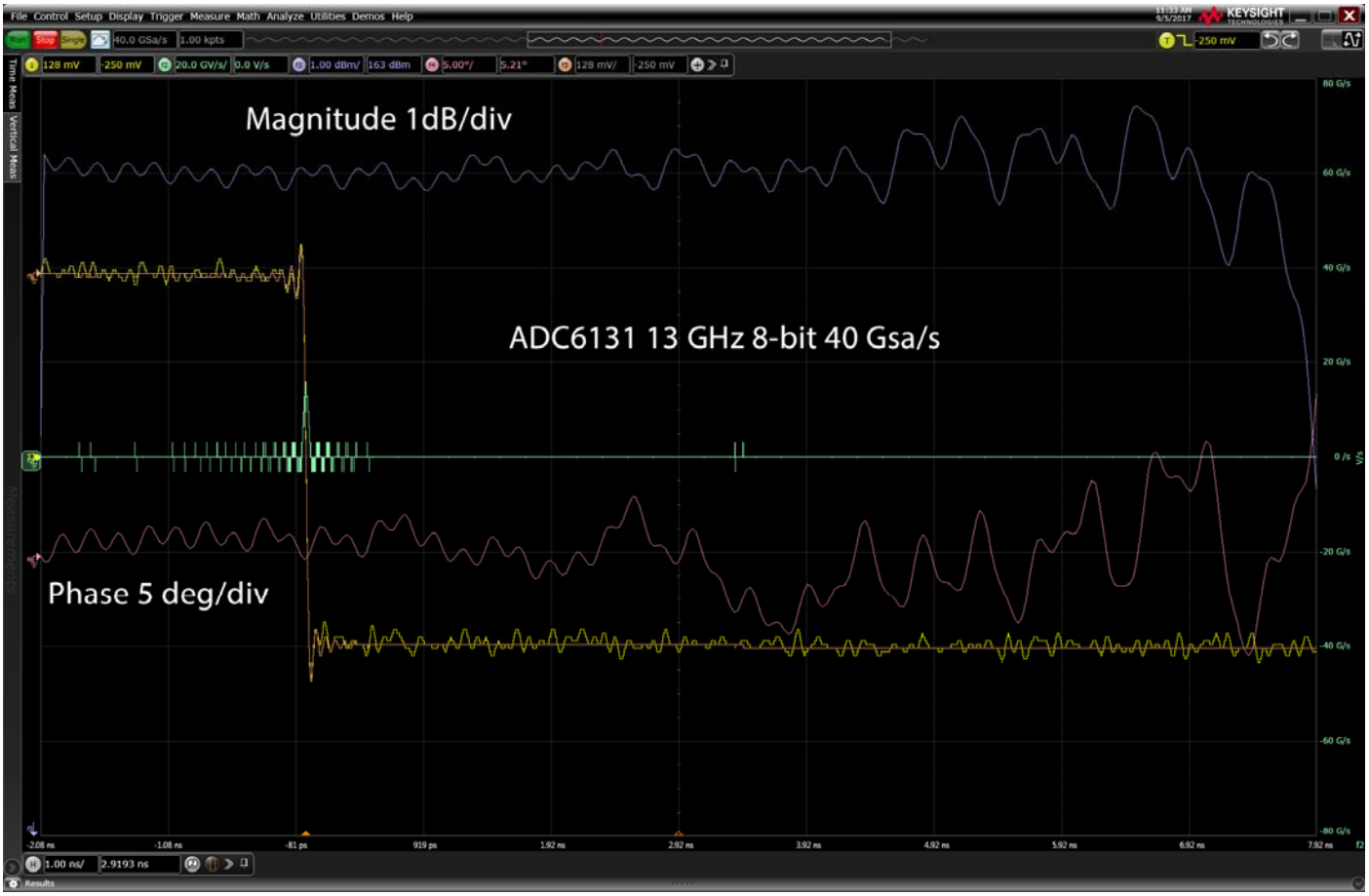
Preliminary RF Characteristics

The ADP7000 digitizers have excellent frequency response and phase response critical for wideband signal capture.



Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

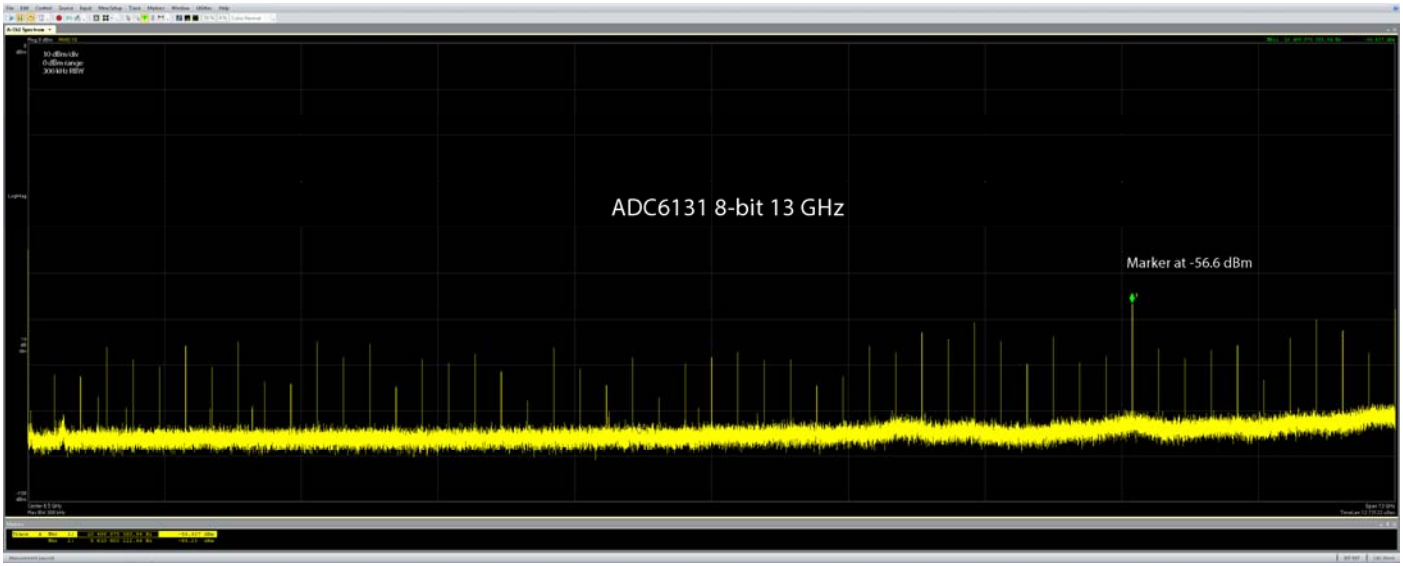
Compared to ADC6131:

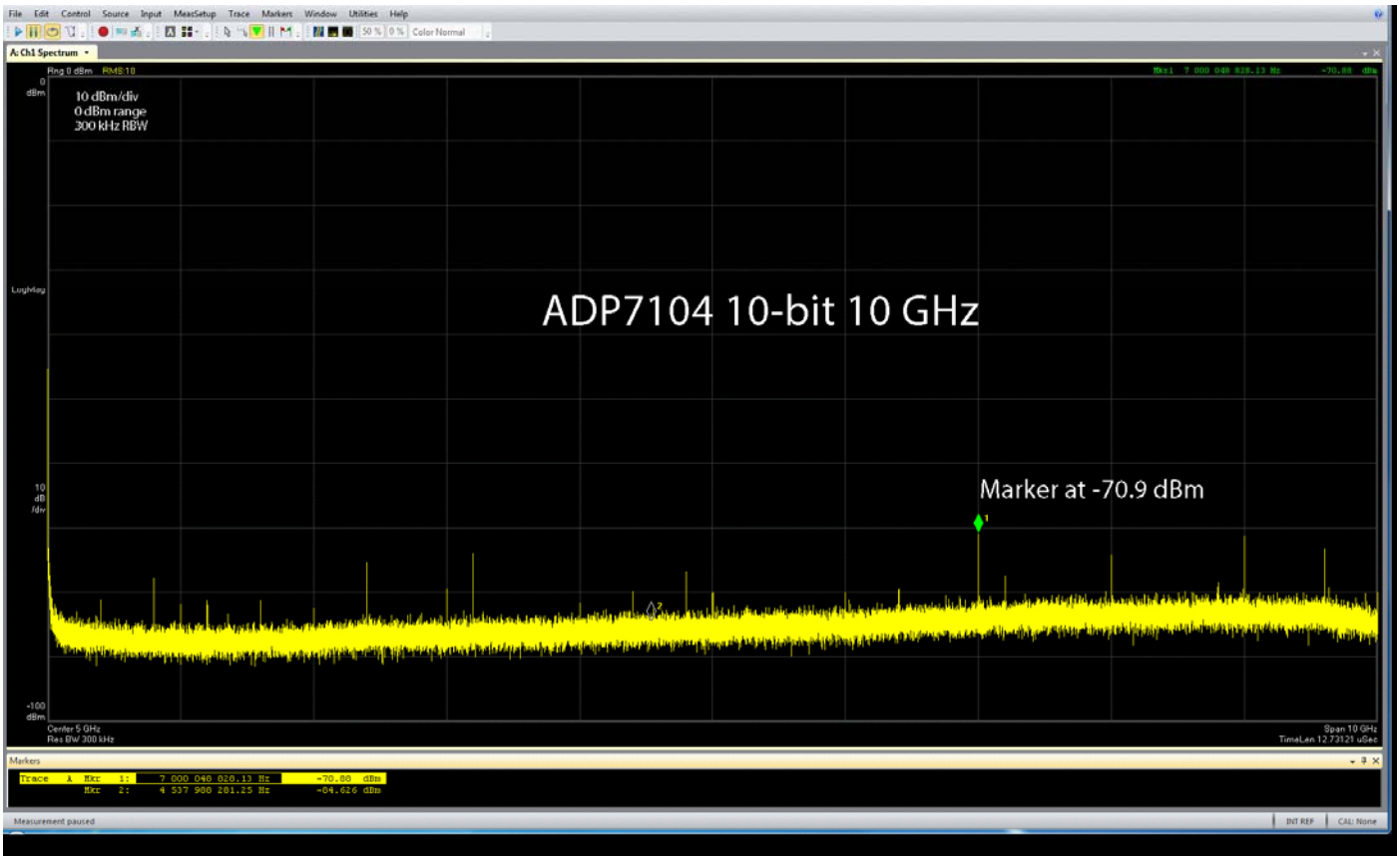


Keysight N2806A Calibration Pulse Generator was used as a stimulus.

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

The ADP7000 digitizers have much improved noise floor and fewer spurious components compared to 8-bit technology.



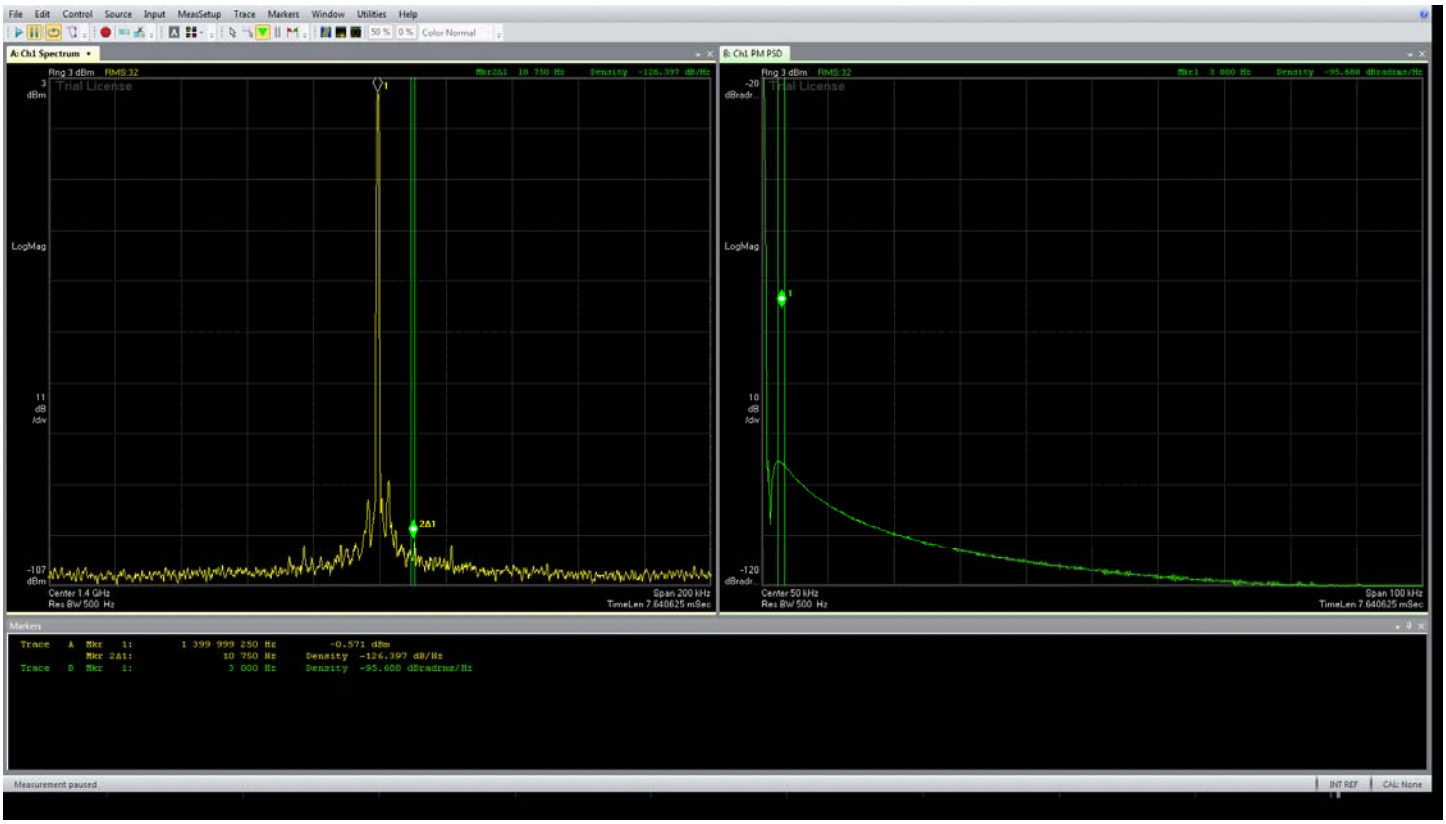


Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

For wideband RF applications, the preliminary RF characteristics for the ADP7104 Series Digitizer are listed below with graphs showing characterization results. Preliminary RF characteristics values from measured results with ADP7104 in 2-channel 32 Gsa/s mode.

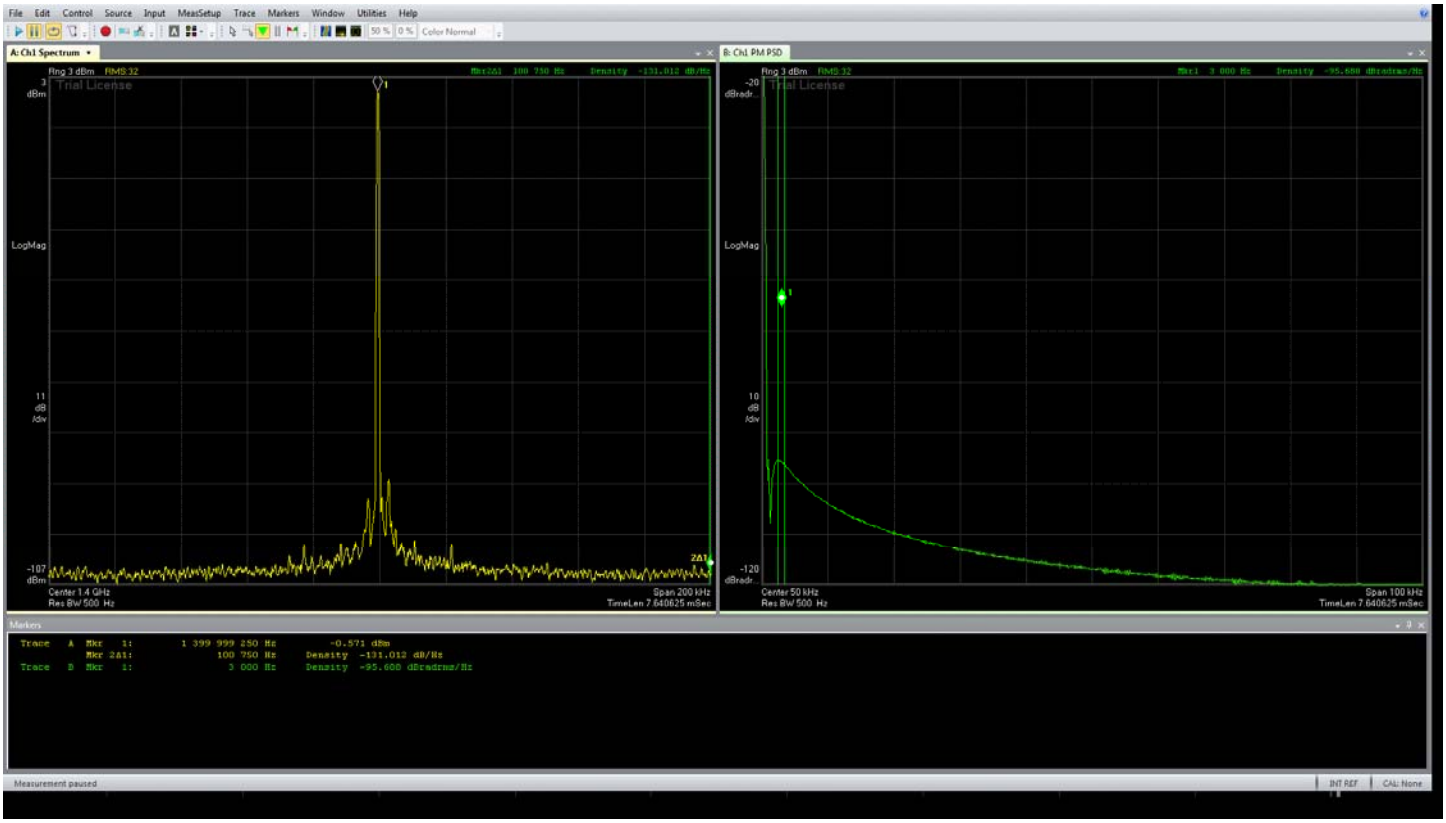
		ADP7104
Sensitivity / Noise Density		-160 dBm/Hz
Signal-to-noise Ratio / Dynamic Range		14 dB
Phase Noise (at 1.4 GHz)	10 kHz offset	-126.397 dBc/Hz
	100 kHz offset	-131.012 dBc/Hz
EVM	802.11 2.4 GHz carrier 20 MHz wide 64 QAM -3dB Full Scale	-46 dB (0.5%)
	802.11 5.8 GHz carrier 20 MHz wide 64 QAM -4dB Full Scale	-47 dB (0.47%)
Two-tone Third-Order Intercept (TOI) Point – IMD3	0 dBm input tones 2.436 GHz and 2.438 GHz, 2 MHz separation 2.437 GHz center frequency 10 MHz span 30 kHz RBW 8 dBm input range	+26.6 dBm

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P



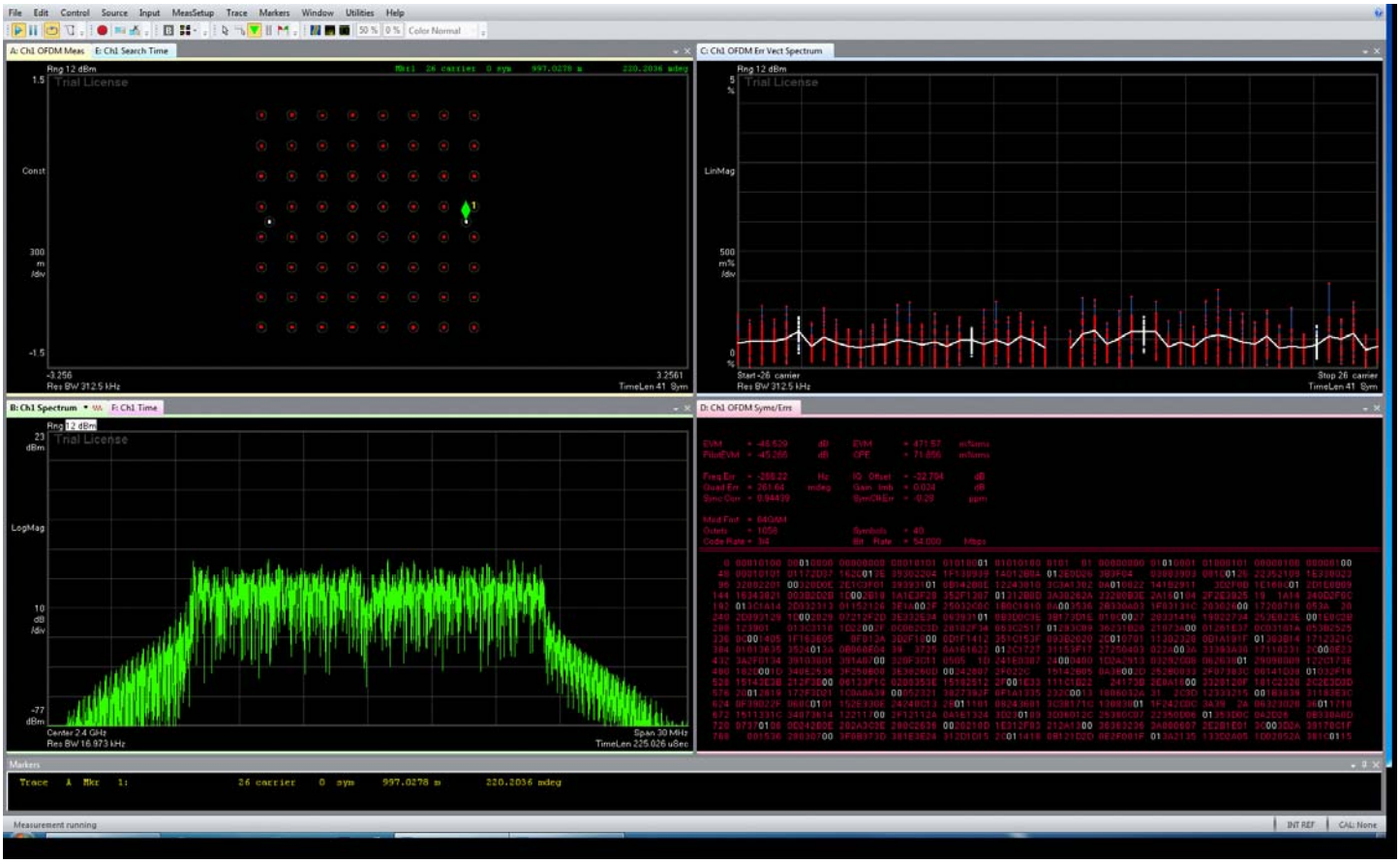
Phase noise (at 1.4 GHz with 10 kHz offset)

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

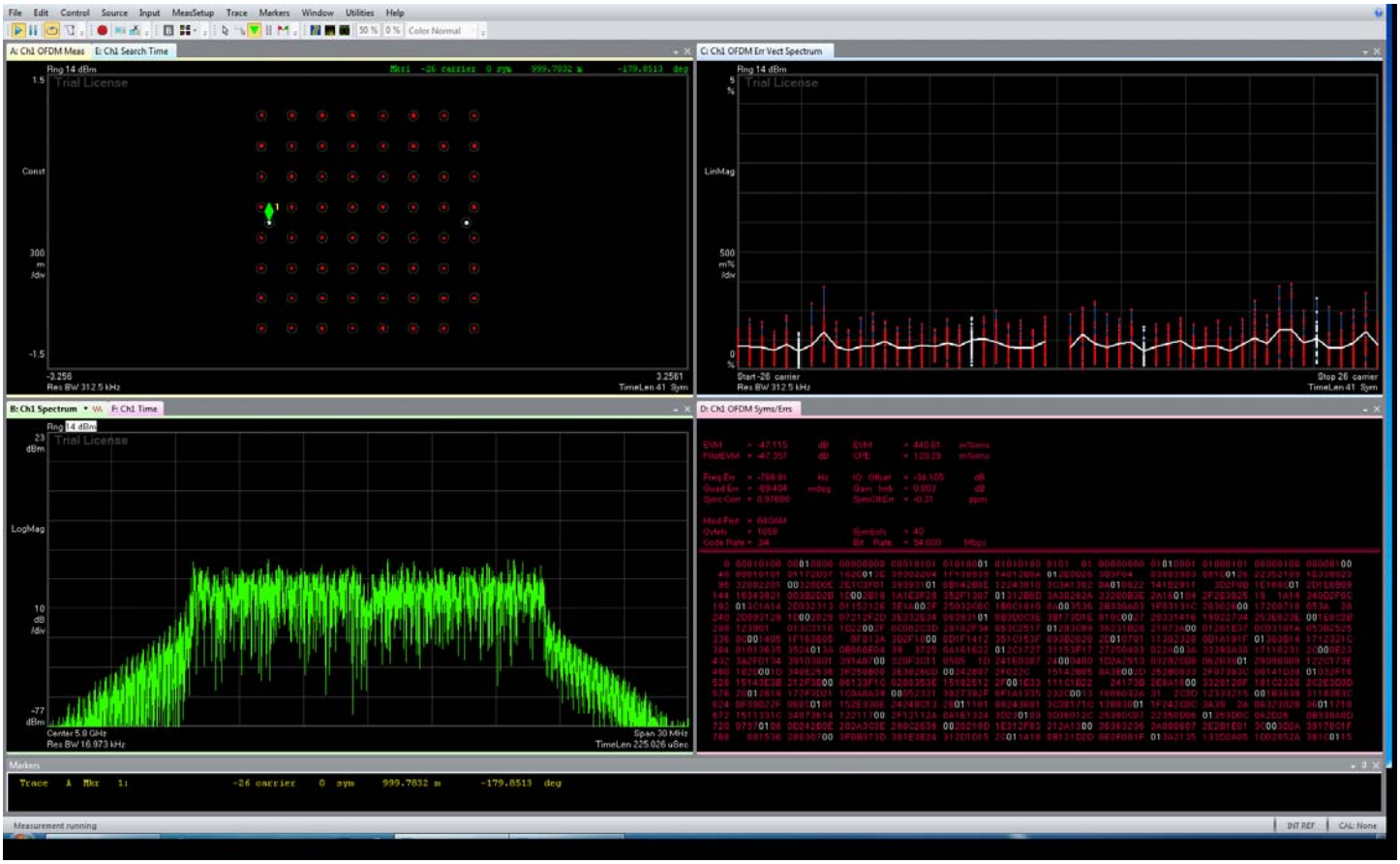


Phase noise (at 1.4 GHz with 100 kHz offset)

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

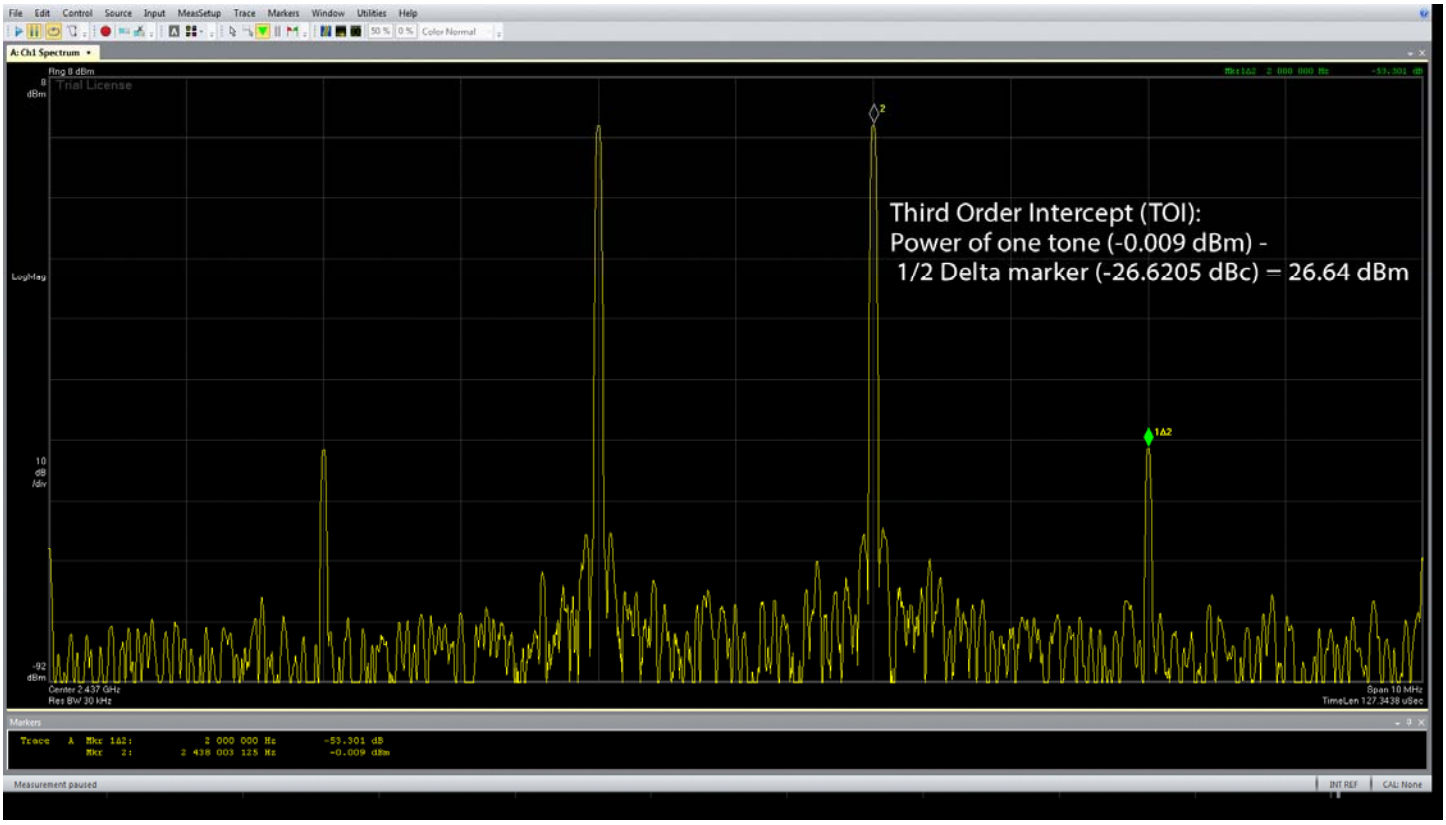


VSA shows an EVM for IEEE 802.11 QAM 64 centered at 2.4 GHz of 0.5%. Modulated signal generated by N5182B MXG X-Series RF Vector Signal Generator with Internal Correction Factors turned On.



VSA shows an EVM for IEEE 802.11 QAM 64 centered at 5.8 GHz of 0.47%. Modulated signal generated by N5182B MXG X-Series RF Vector Signal Generator with Internal Correction Factors turned On.

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P



VSA shows an excellent TOI value of 26.6 dBm. Signals generated by two phase locked Keysight 83712B Synthesized CW Generators, combined through coax low-pass filters, attenuators and Keysight 11667B Power Splitter.

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Preliminary Specifications[7]

Vertical System ADP7000	ADP7084			ADP7104		
	2 Channel Mode	**2 Channel Mode**	**4 Channel Mode**	**2 Channel Mode**	**2 Channel Mode**	**4 Channel Mode**
Input Channels	2, SMA Female	2, SMA Female	4, SMA Female	2, SMA Female	2, SMA Female	4, SMA Female
Analog Bandwidth (-3dB) [1,2]	8 GHz	4 GHz	4 GHz	10 GHz	6.5 GHz	6.5 GHz
Bandwidth Flatness [1] **(-6 dBFs)**	± 0.5 dB to 7.5 GHz	± 0.5 dB to 3.5 GHz	± 0.5 dB to 3.5 GHz	± 0.5 dB to 8.5 GHz	± 0.5 dB to 5 GHz	± 0.5 dB to 5 GHz
	-3 dB @ 8 GHz	-3 dB @ 4 GHz	-3 dB @ 4 GHz	-3 dB @ 10 GHz	-3 dB @ 6.5 GHz	-3 dB @ 6.5 GHz
Vertical Resolution	10 bits					
Input Impedance	50 Ohm ± 3.5% (typical ± 1% at 25 °C)					
Input Coupling	DC					
Maximum Input Voltage	± 5 V					
Input Sensitivity	16 mV ... 8 V *(Full Scale)*					
Phase Response Deviation [1] **(-3 dBFs, 400 mV Full Scale)** Full Bandwidth	± 2 deg	± 1 deg	± 1 deg	± 2 deg	± 1 deg	± 1 deg
Effective Bits [1] **(-3 dBFs, 400 mV Full Scale)** Frequency 1 GHz	6.5	7.0	6.7	6.2	6.6	6.5
Rise / Fall Time [3] **(10-90%)**	53.8 ps	107.5 ps	107.5 ps	43 ps	66.2 ps	66.2 ps

[7] Specification values provided are preliminary based on two samples. Specifications are subject to change.

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Vertical System ADP7000		ADP7084			ADP7104		
	Sensitivity (Full Scale)	2 Channel Mode	2 Channel Mode	4 Channel Mode	2 Channel Mode	2 Channel Mode	4 Channel Mode
RMS Noise Floor [1]	16 mV	291 uV	170 uV	172 uV	375 uV	233 uV	236 uV
	40 mV	307 uV	182 uV	192 uV	384 uV	245 uV	254 uV
	80 mV	366 uV	228 uV	255 uV	448 uV	295 uV	315 uV
	160 mV	527 uV	348 uV	413 uV	553 uV	366 uV	396 uV
	400 mV	1.234 mV	810 uV	988 uV	1.492 mV	1.114 mV	1.198 mV
	800 mV	2.632 mV	1.678 mV	2.016 mV	3.07 mV	2.347 mV	2.437 mV
	1.6 V	5.348 mV	3.418 mV	4.078 mV	5.9 mV	4.689 mV	4.94 mV
	4 V	12.425 mV	8.332 mV	10.127 mV	13.802 mV	10.658 mV	11.266 mV
	8 V	21.807 mV	14.809 mV	18.696 mV	23.279 mV	17.347 mV	20.149 mV
Spurious Free Dynamic Range (SFDR) [1] **(-3 dBFS, 400 mV Full Scale)** Frequency 1 GHz Excluding in-band 2nd and 3rd harmonics		66.6 dBc	71.4 dBc	67.3 dBc	70.1 dBc	66.6 dBc	68.1 dBc
Nonlinear Distortions 2nd and 3rd harmonics	2 GHz	59.7 dBc	58.8 dBc	58.7 dBc	61 dBc	61.1 dBc	60.3 dBc
	3 GHz	53.9 dBc	53.8 dBc	53.9 dBc	52.6 dBc	52.5 dBc	51.8 dBc
DC Gain Accuracy		± 3% of full scale at full resolution (± 1% for 40 mV to 8 V Full Scale)					
Offset Range All Sensitivities		± 4.5 V					
Offset Accuracy		TBD					
Channel to Channel Isolation (any two channels with equal Vertical settings)	100 MHz ... 1 GHz	72 dB					
	> 1 GHz	49 dB					

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Vertical System ADP7000		ADP7084			ADP7104		
	Sensitivity (Full Scale)	2 Channel Mode	2 Channel Mode	4 Channel Mode	2 Channel Mode	2 Channel Mode	4 Channel Mode
Return Loss	< 320 mV 0 … 9 GHz	16 dB	16 dB	16 dB	16 dB	16 dB	16 dB
	> 320 mV 0 … 9 GHz	19 dB	19 dB	19 dB	19 dB	19 dB	19 dB
	< 320 mV @ 10 GHz	12 dB	12 dB	12 dB	12 dB	12 dB	12 dB
	> 320 mV @ 10 GHz	13 dB	13 dB	13 dB	13 dB	13 dB	13 dB

Acquisition System ADP7000	ADP7084			ADP7104		
	2 Channel Mode	2 Channel Mode	4 Channel Mode	2 Channel Mode	2 Channel Mode	4 Channel Mode
Maximum Real Time Sample Rate	20 Gsa/s	20 Gsa/s	10 Gsa/s	32 Gsa/s	32 Gsa/s	16 Gsa/s
Maximum Memory Depth per Channel	64 GBytes	64 GBytes	32 GBytes	64 GBytes	64 GBytes	32 GBytes
Maximum Acquired Time per Channel at Highest Real Time Sample Rate	2.4 seconds	2.4 seconds	2.4 seconds	1.5 seconds	1.5 seconds	1.5 seconds

Trigger

Trigger Types		Internal digital edge trigger on an input channel
		External edge gate input
Gate Input		4, MCX Female
	Impedance	50 Ohm
	Voltage Range	± 5V
	Trig. Level Range	± 5V
	Threshold Resolution	4 mV
	Max. Frequency	100 MHz
	Hold-off time	300 ns in post-trigger mode, 1 micro-second in pre-trigger mode

Note:
Inputs are resampled

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Control Signal Connections

Calibrator Output (Cal Out)		1, SMA Female	
	Impedance	50 Ohm	
Step Output (Step Out)		1, SMA Female	
	Impedance	50 Ohm	
Sync Clock Input (Sync Clk In)		1, MCX Female	
	Frequency	50 MHz, 100 MHz, 200 MHz	
	Level	0 to +10 dBm	
	Impedance	50 Ohm	
	Coupling	AC	
	Stability	+/- 10 ppm MAX	
Sync Clock Output (Sync Clk Out)		1, MCX Female	
	Frequency	**ADP7084** 125 MHz	**ADP7104** 200 MHz
	Level	800 mV p/p nominal	
	Impedance	50 Ohm	
	Coupling	AC	
External 1 GHz Clock Input (1 GHz In)		1, MCX Female	
	Level	0 to +10 dBm	
	Impedance	50 Ohm	
	Coupling	AC	
	Stability	+/- 10 ppm MAX	
Test Outputs (Test Out 1 - 4)		4, MCX Female	
	Level	3.3V LV TTL	
Spare		1, MCX Female	

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Host Computer

Transfer Interface	One PCI-Express x4 Generation 3 connection
Transfer Speed from PC to chassis	Up to 1.6 GByte/s via PCI-Express x8 Generation 2 link from PC to AXIe-1 Gen2 capable chassis.
Transfer Speed from chassis to module	Up to 3.2 GByte/s via PCI-Express x4 Generation 3 link to AXIe-1 module.
Operating System	64-bit Windows 7 64-bit Windows 10 Linux/Windows Hybrid Configuration supported

Module Physical

Weight	8.8 lbs / 4 kg
Power	270 Watt Max
Operating Temperature Range	+5 C to +40 C
Non-Operating Temperature	-40 C to +70 C
Operating Altitude	Up to 4,000 meters (12,000 feet)
Non-Operating Altitude	Up to 15,300 meters (50,000 feet)

[1] With digital equalization

[2] 6-pole Butterworth approximation

[3] Calculated based on Tr = 0.43/BW

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

Ordering and Availability

Hardware Base Modules:	P/N	Price	Typical Lead Time
MOD:ADP7084, 40GSa/sec ADC, 128 GByte AXIe Digitizer w/ "basic" software	S90-620200-XX	Call	Call
MOD:ADP7084, 40GSa/sec ADC, 128 GByte AXIe Digitizer w/ optics and "basic" software	S90-620200-XX.02	Call	Call
MOD:ADP7104, 64GSa/sec ADC, 128 GByte AXIe Digitizer w/ "basic" software	S90-620201-XX	Call	Call
MOD:ADP7104, 64GSa/sec ADC, 128 GByte AXIe Digitizer w/ optics and "basic" software	S90-620201-XX.02	Call	Call
DP7000, 128 GByte AXIe Digital Processor Module with “basic” software	S90-620202-XX	TBA	Call
Hardware Options:			
UPGR:ADP7000 Optics Upgrade	S95-990467-XX	TBA	Call
UPGR:ADP7084 to ADP7104 Hardware Upgrade	S95-990468-XX	TBA	Call
WARR:DIGITIZER EXTENDED WARRANTY AND BASIC SOFTWARE MAINTENANCE, 3YR	S95-990661-XX.03	TBA	Call
Firmware Options:			
MSFT:ADC_BASE Equalization of Multiple Interleaved ADCs (1 YR SOFTWARE MAINTENANCE)	S87-777627	Included with base module	
MSFT:ADC_SM Segmented Memory Acquisitions (1 YR SOFTWARE MAINTENANCE)	S87-777623	Available	Call
MSFT:ADC_BB Baseband Acceleration (1 YR SOFTWARE MAINTENANCE)	S87-777624	Available	Call
MSFT:ADC_AVG High Speed Deep Averaging (1 YR SOFTWARE MAINTENANCE)	S87-777618	Call	Call
MSFT:ADC_AVGS High Speed Deep Segmented Averaging (1 YR SOFTWARE MAINTENANCE) (Includes ADC_SM and ADC_AVG)	S87-777625	Call	Call
MSFT:ADC_DDC Accelerated Digital Down Converting (1 YR SOFTWARE MAINTENANCE)	S87-777626	Call	Call
MSFT:ADC_ADDCRT1 Real-time Advanced 32 Gsa/s Digital Down Converting (1 YR SOFTWARE MAINTENANCE)	S87-777644	Call	Call

Rev. 11/15/2017 Guzik Part Number: 02-107703-01P

MSFT:ADC_VSM1 Real-time variable segment option (1 YR SOFTWARE MAINTENANCE)	**S87-777642**	**Call**	**Call**
MSFT:ADC_BBRT2 Real-time 32 GSa/s Baseband Lowpass Filtering (1 YR SOFTWARE MAINTENANCE)	**S87-777646**	**Call**	**Call**
MSFT:ADC_CEQRE1 Fast Complex Equalizer/Resampler using one GPU (1 YR SOFTWARE MAINTENANCE)	**S87-777645**	**Call**	**Call**
MSFT:ADC_FFT1 Fast FFT with one GPU (1 YR SOFTWARE MAINTENANCE)	**S87-777630**	**Call**	**Call**
MSFT:ADC_SYNC1 Multi-module synchronization capability (1 YR SOFTWARE MAINTENANCE)	**S87-777639**	**Call**	**Call**
Accessories:			
Guzik Optical Bridge to PC PCIe host card 24F 14.1G	**S60-707115-XX**	**Call**	**Call**
Software Packages			

“Basic” software package includes:

- **GSA SDK APIs: Acquisition Sample code (C++, Matlab)**
- **Signal Display Soft Front Panel**

One Guzik ADP7104 AXIe Digitizer and Processor, Keysight M8190A 12 GSa/s Arbitrary Waveform Generator controlled by one Keysight M9537A AXIe High Performance Embedded Controller in a 4U Keysight M9505A AXIe 5-Slot Chassis pictured below:

More information available at www.guzik.com

2443 Wyandotte Street
Mountain View, CA 94043
Phone: (650) 625-8000
Fax: (650) 625-9325
E-mail: modularsales@guzik.com
http://www.guzik.com/
http://www.twitter.com/GuzikTest
http://www.facebook.com/GuzikTest