Project Code: APM_RF_ETM_2016

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

ADI RF AND MICROWAVE SOLUTIONS FOR ELECTRONIC TEST AND MEASUREMENT

Application Introduction

RF and microwave ICs are widely used in electronic test and measurement instruments, such as spectrum analyzers, network analyzers, signal generators, and communication testers. As wireless communications, such as 4G/5G and IoT become more and more popular, the demand for test bench technology also increases. In this article, we will talk about how ADI's products fit in the following signal chains.

Main Challenges and System Design Considerations

Wide Dynamic Range

Minimizing factors such as phase noise in an RF test bench's noise floor is important for maintaining test signal purity in a wide dynamic range. However, more digital signal processing tasks make it difficult to receive clean signals due to an increase in radiated noise.

Wide Bandwidth

Maximizing an RF test bench's bandwidth is another key objective. The software-defined radio can be implemented in RF test bench for ease of configuration, operation, maintenance, and upgrade. However, finding the right component to cover wide bandwidth operation can be challenging.

Stability

Drift with time and temperature are two critical factors to receiving accurate and repeated readings from electronic test and measurement instrument in the operating range. However, calibrating out drift with time and temperature is not easy.

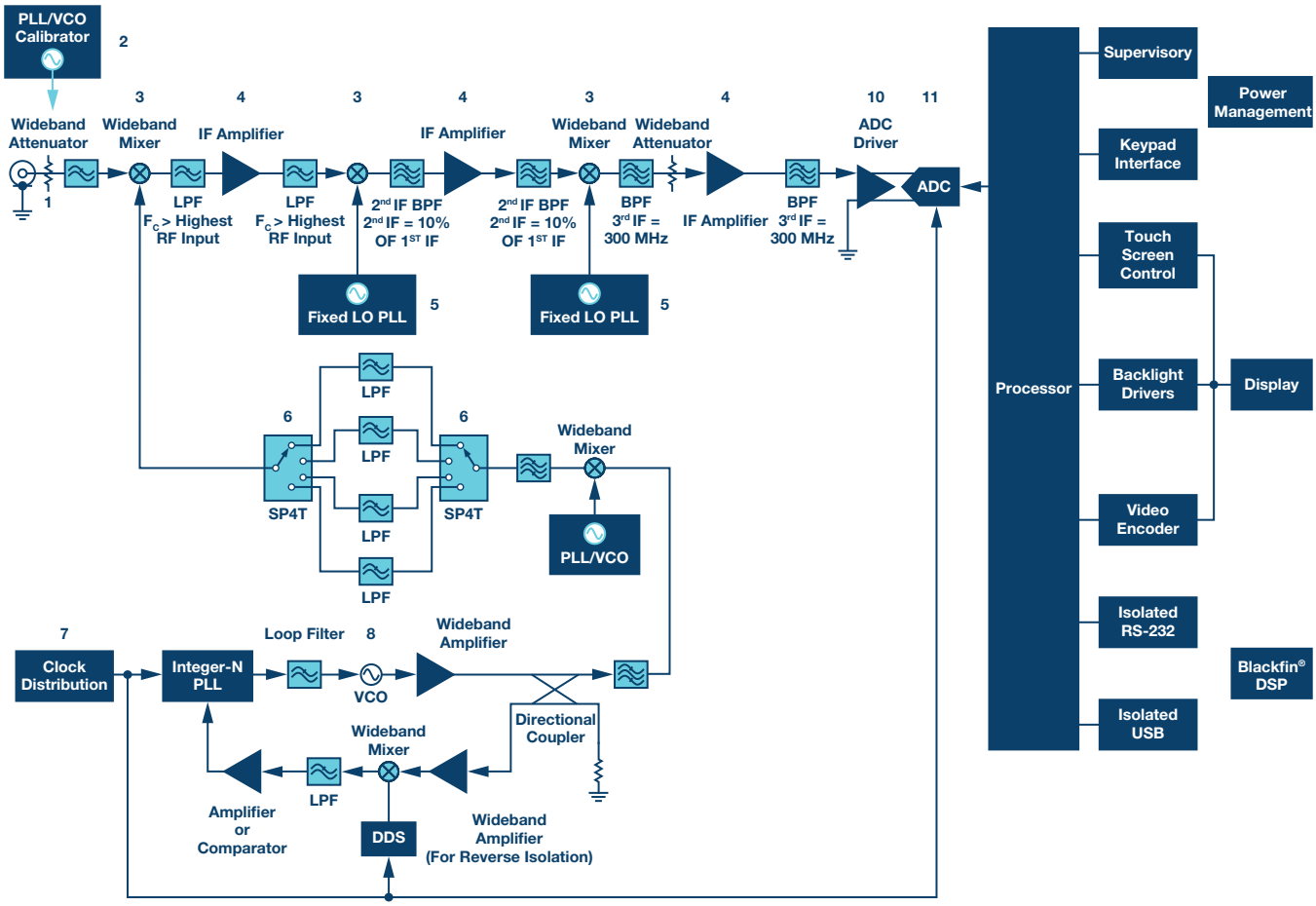
Why Choose ADI

- With over 1000 high performance RF ICs, ADI offers a wide variety of RF function blocks, as well as highly integrated solutions for electronic test and measurement systems.
- A full range of design resources to ease the development of RF systems, including free design tools, FMC rapid prototyping platforms, Circuits from the Lab® reference designs, and EngineerZone® technical forums.
- For over 50 years, ADI's commitment to performance, reliability, and sustainability has made ADI a preferred supplier.

Related Signal Chains

Spectrum/Signal Analyzer

Below is a classic spectrum/signal analyzer signal chain. Analog Devices offers a variety of solutions for signal analysis and synthesis, including DDS-based solutions and phase-locked loops for generating LOs and test signals, as well as low noise amplifiers and gain blocks, mixers, variable gain video and RF amplifiers, and high accuracy, resolution, and speed ADCs. This portfolio completes transmit and receive signal chains, and also posses high accuracy, resolution, and speed ADCs. For low cost solutions and internal level calibration, ADI offers wideband RF detectors, as well as dual RF power detectors capable of gain and phase measurement.

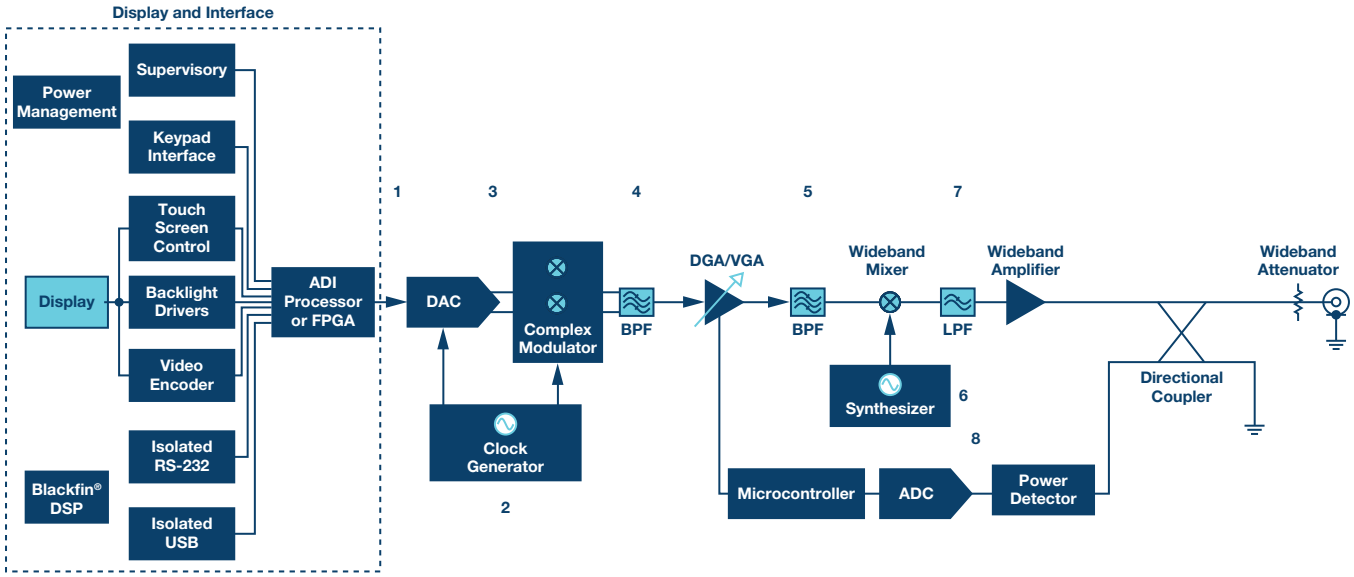


1. Wideband Attenuators	2. PLL/VCO Calibrators	3. Wideband Mixers	4. IF Amplifiers	5. Fixed LO PLLs
HMC624A/HMC802A	ADF5355/HMC832/ HMC833/HMC835	HMC558A/HMC773A/ HMC1048A	HMC311/HMC788A	ADF4350/ADF4351/ADF4355/ HMC829/HMC830/HMC832/ HMC833/HMC835

6. RF Switches	7. Clock Distribution	8. VCOs	9. DDS	10. ADC Drivers	11. ADCs
HMC232A/HMC1118/ HMC641A	AD9510/AD9511/AD9512/ AD9516/HMC7044	HMC586/HMC587/ HMC588/HMC732/ HMC733	AD9956/AD9912/AD9914	ADL5562/ADL5565	AD6676/AD9652

Signal Synthesis

Analog devices offers a variety of solutions for frequency synthesis, including fully digital DDS-based solutions, phase-locked loops for RF applications, and high speed DACs capable of direct multicarrier signal synthesis at baseband, IF, and RF frequencies as well as the mixers, modulators, variable gain amplifiers and video and RF amplifiers to complete the signal chain.



Frequency Synthesizer With Complex Modulation

1. DACs	2. Clock Generators	3. Complex Modulators	4. DGAs/VGAs	5. Wideband Mixers	6. Synthesizers	7. Wideband Amplifiers	8. Power Detectors	9. Wideband Attenuators
AD9122/AD9129	AD9520/ AD9522/ AD9525/ HMC1034/ HMC1035/ HMC7044	ADL5386/ HMC1097	ADL5240/ ADL5243/ HMC346A/ HMC742A	HMC553A/ HMC557A/ HMC1048A	HMC703/ HMC704/ ADF4159/ ADF41020	HMC311/ HMC313/ ADL5541/ ADL5542	HMC602/ HMC611/ ADL5519/ ADL5902	HMC653/ HMC655/ HMC656

Featured Products

Part Number	Description	Key Features and Benefits
DACs		
AD9119/ AD9129	11-/14-bit, 5.7 GSPS, RF digital-to-analog converter	DAC update rate: up to 5.7 GSPS, direct RF synthesis at 2.85 GSPS data rate, high dynamic range and signal reconstruction bandwidth support RF signal synthesis of up to 4.2 GHz
ADC Driver		
ADL5565	6 GHz ultrahigh dynamic range differential amplifier	–3 dB bandwidth of 6 GHz (AV = 6 dB), pin strappable gain adjust: 6 dB, 12 dB, and 15.5 dB, differential or single-ended input to differential output
Wideband Mixer		
HMC773A	GaAs MMIC fundamental mixer; 6 GHz to 26 GHz	Passive: no dc bias required, input third-order intercept (IP3): 20 dBm, local oscillator (LO) to radio frequency (RF) isolation: 37 dB, wide IF bandwidth: dc to 8 GHz
Clock Generators		
AD9525	Low jitter clock generator with eight LVPECL outputs	Integrated ultralow noise synthesizer, 8 differential 3.6 GHz LVPECL outputs and 1 LVPECL SYNC output or 2 CMOS SYNC outputs, 2 differential reference inputs and 1 single-ended reference input
HMC1034	Clock generator with fractional-N PLL and integrated VCO; 125 MHz to 3000 MHz	Frequency range: 125 MHz to 3000 MHz, 78 fs rms jitter generation (typical), –165 dBc/Hz phase noise floor, maximum phase detector rate 100 MHz, figure of merit (FOM) –227 dBc/Hz, 24-bit step size, resolution: 3 Hz typical
DDS		
AD9914	3.5 GSPS direct digital synthesizer with 12-bit DAC	3.5 GSPS internal clock speed, integrated 12-bit DAC, frequency tuning resolution to 190 pHz, 16-bit phase tuning resolution, 12-bit amplitude scaling, programmable modulus, automatic linear and nonlinear frequency sweeping capability, 32-bit parallel datapath interface, 8 frequency/phase offset profiles, phase noise: –128 dBc/Hz (1 kHz offset at 1396 MHz), wideband SFDR < –50 dBc, serial or parallel I/O control

Part Number	Description	Key Features and Benefits
PLL with VCO		
ADF5355	Microwave wideband synthesizer with integrated VCO	RF output frequency range: 54 MHz to 13,600 MHz, fractional-N synthesizer and integer-N synthesizer, high resolution 38-bit modulus, phase frequency detector (PFD) operation to 125 MHz, reference frequency operation to 600 MHz
HMC830	Fractional-N PLL with integrated VCO 25 MHz to 3000 MHz	RF bandwidth: 25 MHz to 3000 MHz, maximum phase detector rate 100 MHz, ultra low phase noise –110 dBc/Hz in band typ, figure of merit (FOM) –227 dBc/Hz
Power Detectors		
HMC602	Logarithmic detector/controller SMT, 1 MHz to 8000 MHz	Wide dynamic range: up to 70 dB, high accuracy: ±1 dB with 60 dB range up to 6 GHz, fast: 10 ns output response time
HMC611	Logarithmic detector controller chip and SMT, 0.001 GHz to 10 GHz	Excellent stability over temperature, log linearity: ±2 dB, fast rise/fall times: 5 ns/15 ns, single positive supply: 3.3 V
ADC		
AD9652	16-bit, 310 MSPS, 3.3 V/1.8 V dual analog-to-digital converter (ADC)	High dynamic range, buffered temperature sensor output
AD6676	Wideband IF receiver subsystem	Tunable band-pass Σ-Δ analog-to-digital converter (ADC), 20 MHz to 160 MHz signal bandwidth, 70 MHz to 450 MHz IF center frequency, noise spectral density (NSD) as low as –159 dBFS/Hz
Switch		
HMC232A	GAAS MMIC spdt non-reflective switch, dc to 12 GHz	Isolation: 57 dB @ 3 GHz, 50 dB @ 6 GHz, input P1dB: +30 dBm, insertion loss: 1.5 dB typical @ 6 GHz, nonreflective design

Design Resources

Solution Bulletins and Brochures

- **Selection Guide:** RF and Microwave IC Selection Guide 2015—*www.analog.com/RF-and-Microwave-ICs-Selection-Guide.pdf*
- **Selection Guide:** Powering ADI Components—*www.analog.com/Powering-ADI-Components.pdf*

Technical Articles/Application Notes

- **Technical Article:** Replacing YIG-Tuned Oscillators with Silicon by Using an Ultra-wideband PLL/VCO with Precise Phase Control—*www.analog.com/Replacing-YIG-Tuned-Oscillators-with-Silicon-by-Using-anUltra-Wideband-PLL-VCO-with-Precise-Phase-Control.pdf*
- **Application Note:** AN-1039, Correcting Imperfections in IQ Modulators to Improve RF Signal Fidelity—*www.analog.com/en/AN-1039.pdf*

Design Tools/Forums

- **ADIsimPE Powered by SIMetrix/SIMPLIS:** ADIsimPE, which is powered by SIMetrix/SIMPLIS, is a circuit simulation suite optimized for the design and development of analog and mixed signal circuits—*www.analog.com/en/design-center/interactive-design-tools/adisimpe*
- **Visual Analog™:** A software package that combines a powerful set of simulation and data analysis tools with a user-friendly graphical interface for designers who are selecting or evaluating high speed ADCs—*www.analog.com/en/visualanalog*
- **ADIsimRF:** An easy to use RF signal chain calculator. ADIsimRF calculates cascaded gain, noise figures, IP3, P1dB, and power consumption. The number of stages can be varied up to a maximum of 20.—*https://form.analog.com/Form_Pages/RFComms/ADISimRF.aspx*
- **ADIsimCLK:** ADIsimCLK is a highly successful tool for predicting phase noise and jitter for ADI clock products—*www.analog.com/en/adisimclk*
- **ADIsimPLL:** A comprehensive and easy to use PLL synthesizer design and simulation tool—*https://form.analog.com/Form_Pages/RFComms/ADISimPll.aspx*
- **Forum:** EngineerZone—*ez.analog.com/welcome*

Reference Circuits of RF and Microwave Solutions for Electronic Test and Measurement

- **AD-FMCOMMS6-EBZ:** A 400 MHz to 4.4 GHz receiver based on the AD9652 dual, 16-bit analog-to-digital converter, the ADL5566 high dynamic range, RF/IF dual differential amplifier, and the ADL5380 quadrature demodulator. This is an I&Q demodulation approach to direct convert (also known as a homodyne or zero IF) receiver architecture—*wiki.analog.com/resources/eval/user-guides/ad-fmcomms6-ebz*
- **AD-FMCOMMS5-EBZ:** An FMC board for the AD9361, a highly integrated RF Agile Transceiver,™ that demonstrates how to design a platform that shows how to connect and synchronize (at the RF side) multiple AD9361s for SIMO/MISO/SU-MIMO/MU-MIMO applications. For many broadband wireless access (BWA) systems, multi-input and multi-output (SIMO/MISO/SU-MIMO/MU-MIMO) operation and RF beamforming are proven techniques for maximizing throughput and efficient spectrum utilization.—*wiki.analog.com/resources/eval/user-guides/ad-fmcomms5-ebz*

If you need more ADI RF and microwave solutions for electronic test and measurement applications, please visit: *www.analog.com/en/instrumentation-and-measurement*

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