Spectrum Analyzer Solutions

Application Introduction

Spectrum analyzers are used to measure the magnitude of the input signal versus frequency within the full frequency range of the instrument. Distortion, harmonics, bandwidth, and other spectral components of a signal can be observed by analyzing the spectrum of electrical signals that are not easily detectable in time domain waveforms. These parameters are useful to characterize electronic devices, such as wireless transmitters. Spectrum analyzers are also used in electromagnetic interference (EMI) compliance testing.

System Design Considerations and Major Challenges

With innovations in technology, spectrum analyzers now have frequency requirements up to tens of GHz range. The first challenge for spectrum analyzer designers is to find a good enough component to cover such a wide bandwidth. Moreover, designers may need to add different signal paths for different bands or extra stages.

The second challenge for spectrum analyzer designers is to control the noise floor of the system to meet the market requirements of improving the system's dynamic range. However, using more digital signal processing and RF signal processing increases the radiated noise. So it is more difficult to get clean signals.

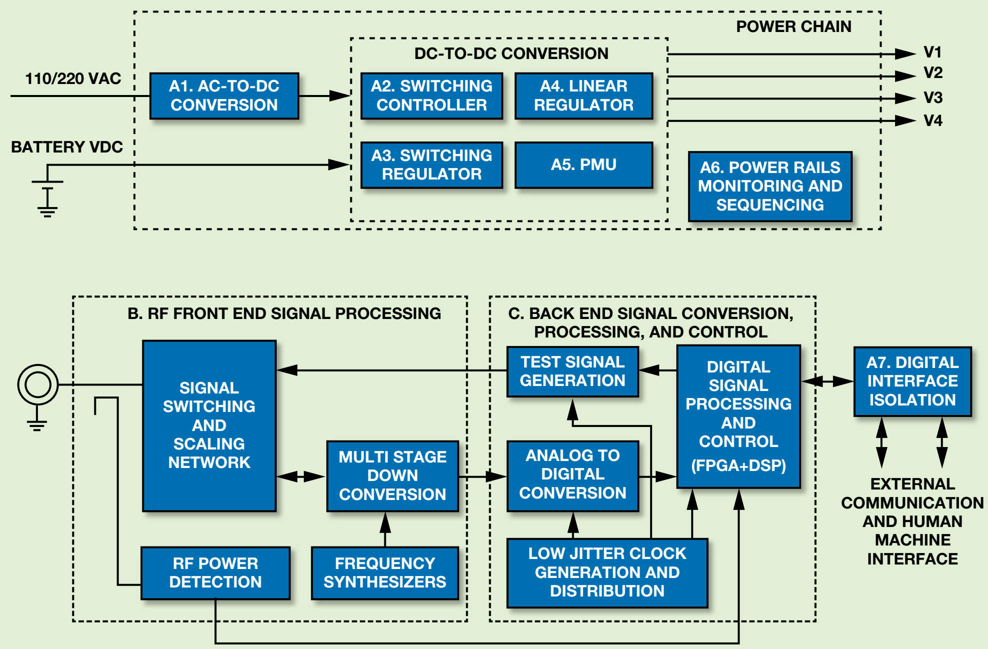
Solutions from ADI

ADI Solution Value Proposition

- One stop shopping to provide the broadest product portfolio, from digital to RF components, such as phase-locked loops (PLL), mixers, power detectors, ADCs, DACs, amplifiers, and digital signal processors.
- Extensive RF design resources, like easy-to-use simulation tools (ADIsimPLL,™ ADIsimRF,™ ADIsimSRD,™ ADIsimCLK™), the RF forum in ADI's EngineerZone™ site, and fully populated evaluation boards.
- ADI's product compatibility supports design migration across multiple platforms, such as pin compatible high speed ADCs for different sample rates and resolutions.

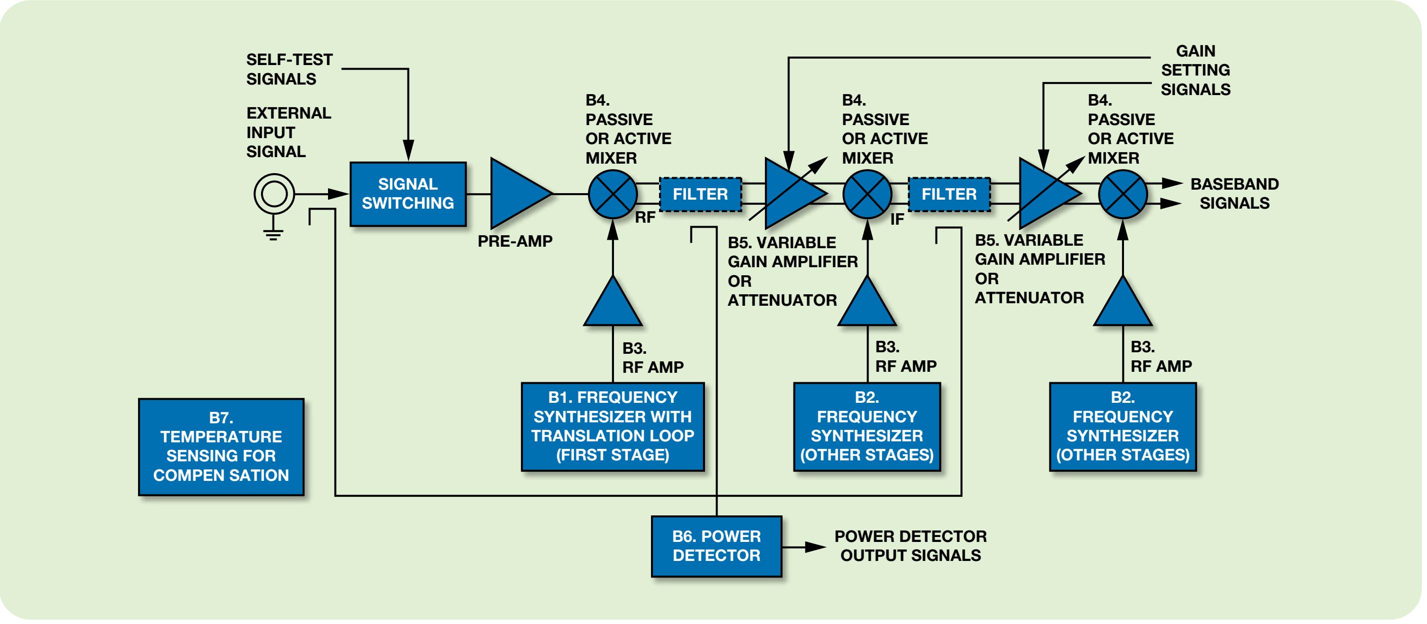
System Block Diagram

A. This is the system overview of a spectrum analyzer. Generally, it can be divided by 3 major subsystems, as shown in the diagram below. The first subsystem is the power chain subsystem. The second subsystem is the RF front-end signal processing subsystem. The third subsystem is the back-end signal conversion, processing, and control subsystem.



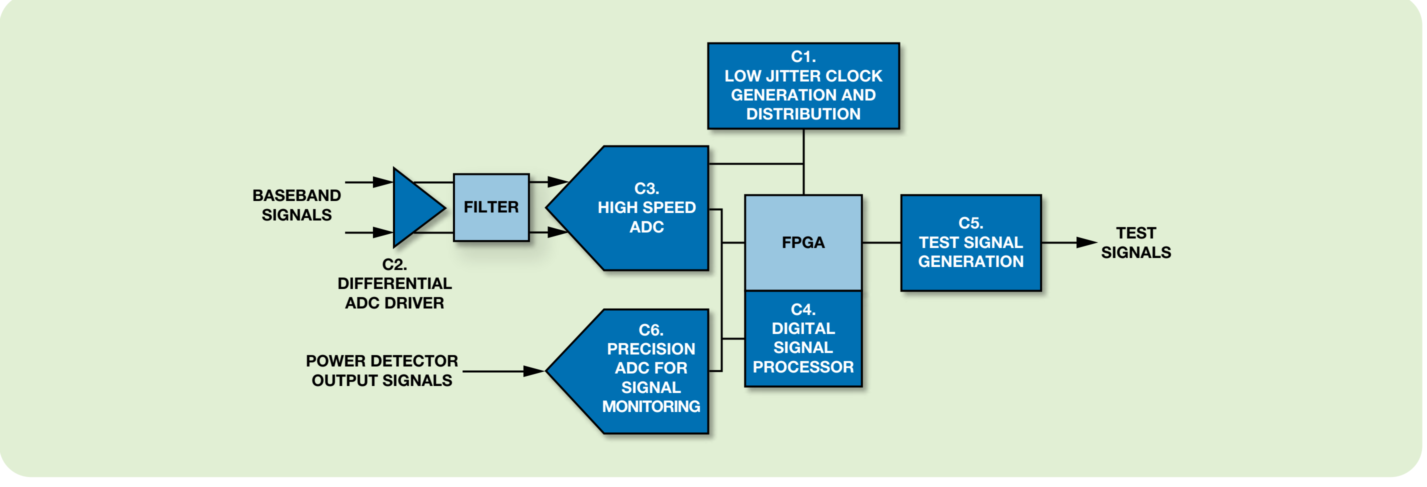
A1. Digital Power Management for AC-to-DC Conversion	A2. Switching Controller	A3. Switching Regulator	A4. Linear Regulator	A5. Power Management Unit(PMU)	A6. Power Rails Monitoring	A7. Digital Interface Isolation
ADP1043A/ADP1047/ ADP1048	ADP1850	ADP2323/ ADP2301	ADP150/ADP151/ ADP7102/ADP7104	ADP5040/ ADP5041	ADM13305/ ADM13307	ADuM3160/ ADuM7441

B. The diagram below shows the second subsystem: RF front-end signal processing. ADI RF components offer the differential architecture to minimize noise. In addition, low power consumption coupled with high linearity provides an optimum solution for portable spectrum analyzers. To compensate for drift over temperature, such as in oscillators (TCXO/OCXO), ADI's temperature sensors can be very accurate, less than 1°C over the entire temperature range.



B1. Frequency Synthesizer with Translation Loop (First Stage)	B2. Frequency Synthesizer (Other Stages)	B3. RF Amplifier	B4. Passive or Active Mixer	B5. Variable Gain Amplifier or Attenuator	B6. Power Detector	B7. Temperature Sensor for Compensation
ADF4108/ADF41020/ AD9912/3/ADL5801	ADF4350 ADF4351	ADL5541/ ADL5542	ADL5801	ADL5240/ ADL5201	ADL5513/ ADL5902	ADT7310/ADT7410/ ADT7320/ADT7420

C. The diagram below shows the third subsystem: back-end signal conversion, processing, and control. ADI's data converter portfolio includes a broad range of high speed and precision ADCs and DACs for signal conversion, generation, and system control. ADI also has an expanding portfolio of fixed-point DSPs and floating-point DSPs for a wide variety of general-purpose and application-specific needs. In addition, ADI offers ultra-low jitter clock distribution and clock generation products for sub-picosecond performance. These are ideal for clocking high performance ADCs and DACs (see AN-756 shown at the end of this document).



C1. Low Jitter Clock Generation and Distribution	C2. Differential ADC Driver	C3. High Speed ADC	C4. Digital Signal Processor	C5. Test Signal Generation	C6. Precision ADC for Signal Monitoring
AD9510/AD9511/AD9512/AD9513/AD9514/ AD9515/AD9516/AD9517/AD9518/ AD9520/AD9523/AD9524/ ADCLK846	ADL5561/ ADL5562/ ADL5565	AD9255/AD9265/ AD9446/AD9460/ AD9461/AD9649	ADSP2126x/ ADSP21469/ ADSP-BF526	ADF4350/ ADF4351	AD7291/ ADuC7023

Note: The signal chains above are representative of spectrum analyzer design. The technical requirements of the blocks vary, but the products listed in the table below are representative of ADI's solutions that meet some of those requirements.

Major Product Introductions

Part Number	Description	Key Specs and Features	Benefits
ADP2323	20 V, dual, 3 A, synchronous step-down regulator	180 degrees out of phase operation; current limit adjustable; precision enable	Sync input/output and phase shift function for low noise design, achieve high efficiency with low side MOSFET and low cost with Schottky diode
ADP7102/ ADP7104	20 V, ultralow noise, 300 mA and 500 mA LDO	Low noise performance, 15 μV rms for fixed voltage output, high PSRR 60 dB at 10 kHz, reverse current protection, wide voltage input range 3.3 V to 20 V	Improves performance of noise sensitive loads
ADP5041	Power management unit (PMU)	One 1.2 A buck, two 300 mA LDOs, supervisory, watchdog, manual reset	Integration makes design easier and BOM cost lower
ADF4108	Frequency synthesizer	Integer-N PLL, 0.5 GHz to 8 GHz RF bandwidth, –219 dBC/Hz normalized phase noise	Programmable charge pump current and prescaler values
ADL5541/ ADL5542	Wideband amplifier (gain block)	Fixed gain of 15 dB/20 dB, 50 MHz to 6 GHz	Wideband, input/output internally matched to 50 Ω
ADL5801	High IP3 active mixer	+27 dBm input IP3, +12.5 dBm input P1dB, +1.5 dB power gain	Wideband RF, LO, and IF ports, single-channel up/down converter
ADL5513	Logarithmic detector/controller	Wide bandwidth: 1 MHz to 4 GHz, 80 dB dynamic range (±3 dB), sensitivity: –70 dBm	Wide bandwidth, constant dynamic range over frequency power-down feature: 1 mW @ 5 V
ADL5240	Digitally controlled variable gain amplifier	31.5 dB gain control range with 0.25 dB step accuracy, 6-bit 0.5 dB digital step attenuator	Both serial and parallel interface, wideband from 100 MHz to 4 GHz, gain block or digital attenuator can be first
ADCLK846	Clock fanout buffer	6 LVDS/12 CMOS outputs, 100 fs additive broadband jitter	Selectable LVDS/CMOS outputs, low power operation
AD9255	14-bit 125 MSPS/105 MSPS/ 80 MSPS LVDS 1.8 V ADC	SNR 78 dBFS at 70 MHz and 125 MSPS, 371 mW at 125 MSPS, IF sampling up to 300 MHz	Integer 1 to 8 clock divider, low power consumption, power-down mode, CMOS or LVDS output
ADSP-2126x	Digital processor (floating-point SHARC DSP)	150 MHz/200 MHz floating-point DSP, 1 Mbit/2 Mbit on-chip RAM	Low cost floating-point DSP
ADSP-21469	Digital processor (floating-point SHARC DSP)	400 MHz floating-point DSP, 5 Mbit on-chip RAM	High performance floating-point DSP

Design Resources

Circuits from the Lab™

- *Very Low Jitter Sampling Clocks for High Speed Analog-to-Digital Converters Using the ADF4002 PLL* (CN0003)—*www.analog.com/CN0003*
- *Powering a Fractional-N Voltage Controlled Oscillator (VCO) with Low Noise LDO Regulators for Reduced Phase Noise* (CN0147)—*www.analog.com/CN0147*
- *Powering the AD9268, Dual Channel, 16-Bit, 125 MSPS Analog-to-Digital Converter with the ADP2114 Synchronous Step-Down DC-to-DC Regulator for Increased Efficiency* (CN0137)—*www.analog.com/CN0137*

Application Notes/Articles

- *Super-Nyquist Operation of the AD9912 Yields a High RF Output Signal* (AN-939)—*www.analog.com/AN-939*
- *Sampled Systems and the Effects of Clock Phase Noise and Jitter* (AN-756)—*www.analog.com/AN-756*
- "Direct Digital Synthesis (DDS) Control Waveforms in Test, Measurement, and Communications." *Analog Dialogue,* Volume 39, August 2005, *www.analog.com/library/AnalogDialogue*

Design Tools/Forums

- ADIsimPLL™: PLL design and simulation—*www.analog.com/ADIsimPLL*
- ADIsimRF™: Easy-to-use RF signal chain calculator; cascaded gain, noise figure, IP3, P1dB, and total power consumption calculations—*www.analog.com/ADIsimRF*
- DiffAmpCalc™: ADI's differential amplifier calculator—*www.analog.com/diffampcalc*
- EngineerZone™: Online Technical Support Community—*ez.analog.com*

To View Additional Signal Generator Resources, Tools, and Product Information, Please Visit *instrumentation.analog.com*

Customer Interaction Center

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Free Sample	***www.analog.com/sample***

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