Introduction of MDO-2000E's Spectrum Analyzer

DSO Business Unit

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Made to Measure

GOOD WILL INSTRUMENT CO., LTD.

Let's think about these -

- Students are accustomed to solving problems from time domain.
 - How about frequency domain measurement?
- Does FFT meet the basic requirement of frequency domain measurement?
 - Is the frequency resolution sufficient? Is it easy to operate?
- The spectrum analyzer is expensive and the repair cost is also not cheap.
 - Is one spectrum analyzer per student possible in the Lab?



The Functionalities for Time and Frequency Domain





FFT

Does FFT Meet The Basic Requirement of Frequency





General FFT on the DSO

Middle to low end oscilloscopes only provide 2k point FFT calculation, which does not have sufficient frequency resolution to observe modulated signals.



Test signal: FSK sine wave 500mVpp fmax: 10.2MHz fmin: 10.0MHz data rate: 10.0kHz



RBW = Sampling Rate / Length of FFT

Key Factors:

- Length of FFT
- **CPU Computing Power**

Most DSO has single core CPU with clock below 500MHz, has limited floating point computing capability => It's difficult to provide more than 10k FFT.

Example:

The different <u>RBW</u> values when measuring 10MHz signal.

1,000 point FFT: RBW = 1GSPS/1000 = 1MHz RBW = 50MSPS/1000 = 50kHz

100k point FFT: RBW = 1GSPS/100k = 10kHz RBW = 50MSPS/100k = 500Hz

MDO-2000E adopts Zynq SoC(dual 1GHz ARM Cortex-A9,FPU and NEON coprocessor) can provide up to 1M point FFT.



The Spectrum Analyzer is expensive and the repair cost is also not cheap

•Students without sufficient experience in precision instruments will cause a high repair cost if not paying attention to the operating procedure.

9kHz ~ 1.5GHz

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9kHz ~ 3GHz 100Hz ~ 8GHz



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Tips for Preventing Spectrum Analyzer Damage

Ensure proper grounding

- Always use the three-prong AC power cord supplied with the analyzer.
- Proper grounding of the instrument will prevent a build-up of electrostatic charge which may be harmful to the instrument and the operator.
- Do not damage the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor.
- Check AC power quality and polarity; typical AC voltage required is 100 V, 120 V, 220 V ± 10% or 240 V +5%/–10%. Typical expected grounding wire resistance is < 1 Ω, the voltage between neutral and ground line is < 1 V. Install uninterruptible power supply [UPS] if necessary.
- For more information, view "Considerations for Instrument Grounding - Application Note".

Read the warning labels and specifications

- Do not exceed the values provided in the specifications guide or as indicated by the yellow warning labels on the analyzer.
- Refer to the specification guide for conditions required to meet with the listed specification. Note information regarding stabilization time, instrument settings and calibration/

Avoid overpowering the analyzer

- Avoid front end damage by having some idea of the signal level to be measured with the spectrum analyzer.
 Overpowering the front end can cause damage to the front end components. Typical maximum RF input signal level is 30 dBm (1 W).
- Before turning on or turning off the connected equipment or the DUT, turn off or reduce the DUT/source power. This should help to prevent unexpected voltage swell or sag affecting the input or the output of analyzer.
- Properly apply a DC block, limiter or external attenuator as needed. For more info visit www.keysight.com/find/mta.
- For example,
 - Keysight Technologies, Inc.'s 11867A RF limiter is available to provide input protection. It will reflect signals up to a level of 10 W

average power and 100 W peak power. 11867A will provide input protection, within the specified frequency range for the attenuator and mixer for many spectrum analyzer applications.

11742A blocking capacitor blocks DC signals below
 45 MHz and passes signals up to 26.5 GHz. Ideal for use with high frequency oscilloscopes or in biased microwave circuits, it will suppress low frequency signals that cap.



The brand new definition of mid-class oscilloscope-MDO-2000E



Features

- MDO-2000E provides time domain waveform from each channel with easy-to-use frequency domain measurement function.
- •Meet the measurement requirement of electronic experiment courses and allow students to learn how to observe signals under frequency domain so as to cultivate problem solving capability for frequency domain.
- •Operation is identical to that of the general spectrum analyzer.

System Block Diagram

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The Core Component – Zynq SoC

Manual Operation(1)

Manual operation(2)

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Manual operation(3)

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Manual operation (4)

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Manual Operation(5)

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Spectrum analyzer comparison

- 1. Compare with Agilent E4402B 3GHz spectrum analyzer
- 2. Compare with Tektronix MDO-3000 series .

Tek MDO-3000

• CF, Span, RBW are the same

- E4402B Marker:
 1.00MHz -14.27dBm.
- MDO-2000E Marker:

1.00MHz -14.4dBm.

Input signal: Sine wave 1MHz AM Freq. 50kHz Depth 50%

Confidential

- E4402B Marker: 10.2MHz -25.51dBm
- MDO-2000E Marker: 10.14MHz -26.4dBM

Input signal:

Sine wave 15MHz

FM Freq. 50kHz

Freq. Deviation 5MHz

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E4402B Marker: 10.188MHz -25.81dBm

• MDO-2000E Marker: 10.187MHz -25.6dBm

Zoom In x40

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- E4402B Marker: 10.2MHz -14.71dBm.
- MDO-2000E Marker: 10.2MHz -15.2dBm.

Input signal: Sine wave 10MHz Hop Freq. 10.2MHz FSK Rate 10kHz

Compared with MDO3000 – AM Signal

Compared with MDO3000 – FM Signal

Input signal: Sine wave 15MHz FM Freq. 50kHz Freq. Deviation 5MHz

- MDO-3000 Marker: 10.20MHz -25.4dBm
- MDO-2000E Marker: 10.14MHz -25.6dBm

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Compared with MDO3000 – FSK Signal

Input signal: Sine wave 10MHz Hop Freq. 10.2MHz FSK Rate 10kHz Confidentia

- MDO-3000 Marker: 10.2MHz -14.6dBm.
- MDO-2000E Marker: 10.2MHz -15.2dBm.

Observe high frequency signals and live demo.

Observing high frequency signals

Use FLUKE 5820A oscilloscope calibrator to input 5Vpp sine wave, frequencies: 20MHz, 50MHz, 100MHz, 200MHz, 300MHz, 400MHz, 499MHz, 500MHz

50 Ohm feed thru termination

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A Live Demo

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MDO-2000E Series

One Oscilloscope, Two Domains

200/100/70MHz DSO

	Spectrum Analyzer	25MHz Dual Channel AWG	5,000 Counts DMM	1A/5V Power supply
MDO-2000EG	V	V		
MDO-2000EX	V	V	V	V

Q&A Discussion

