

利用AWG产生多路复杂信号

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2016/3/30



Agenda



- **多通道复杂信号的产生应用**
- **AWG信号源的基本原理**
- **是德科技多通道复杂信号产生方案**

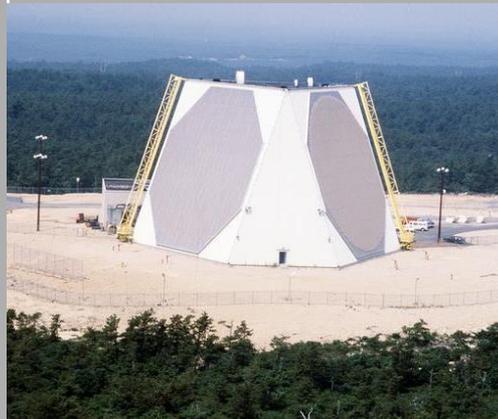
Antenna Architectures

Parabolic Dish Antenna



RADAR Dish Antenna

Passive Electronically Scanned Array

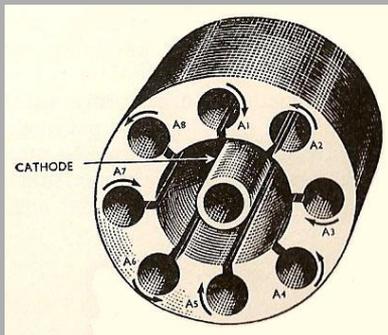


PAVE PAWS - 31 Years Old

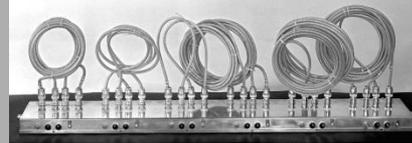
Active Electronically Scanned Array



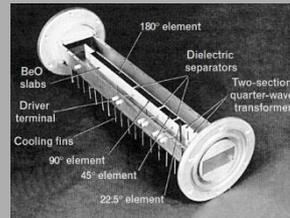
AN/APG-77 (F-22)



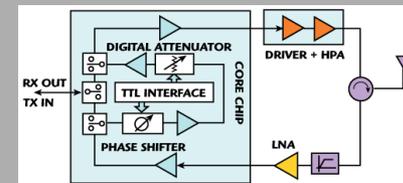
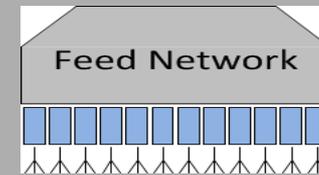
1940 - Cavity Magnetron



6-bit Digital Phase Shifter



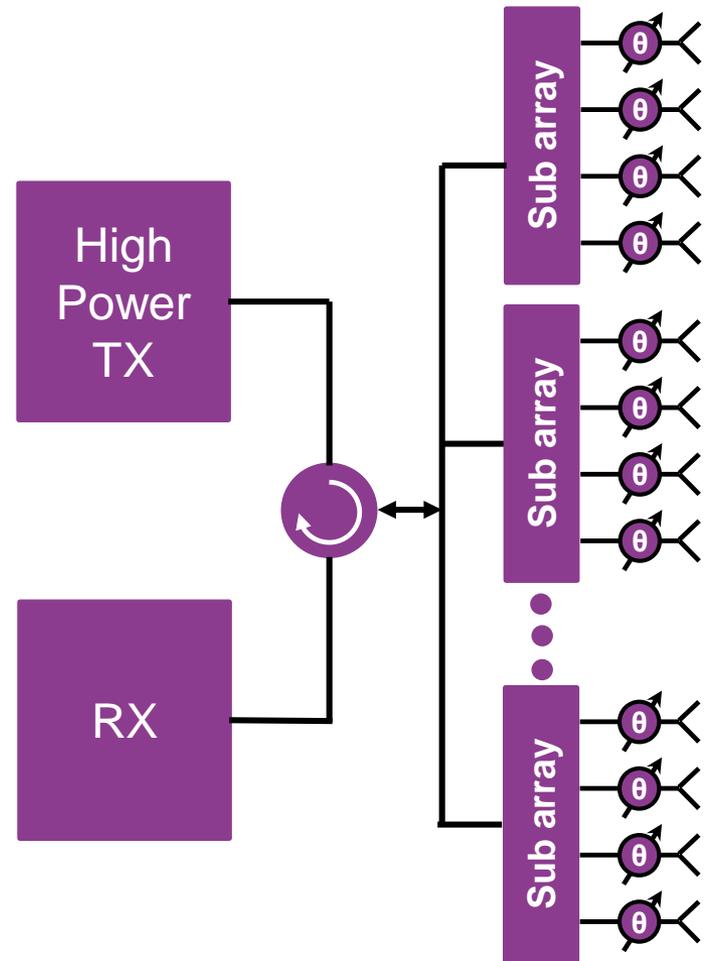
4-bit Digital Phase Shifter



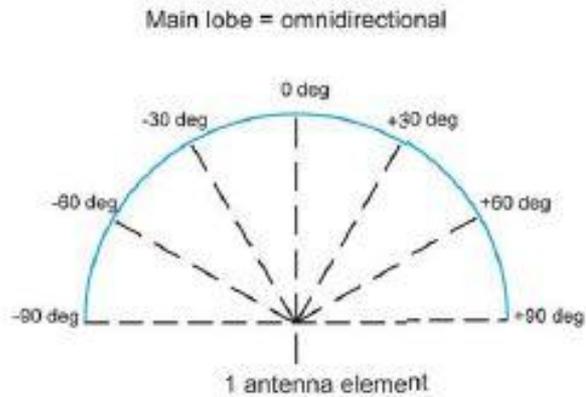
T/R Module

Passive Electronically Steered Arrays (PESA)

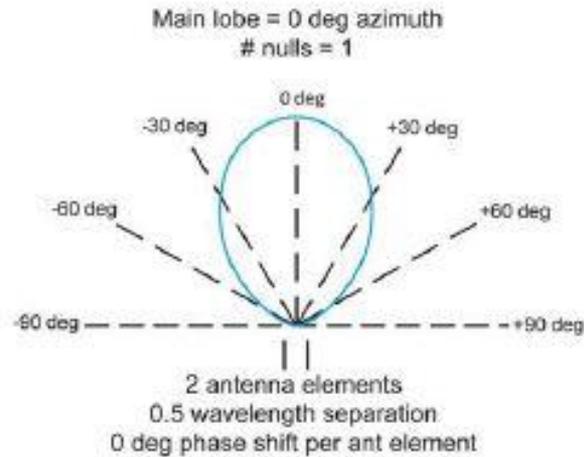
- One Source of RF Energy
 - Klystron
 - Single Point of Failure
 - High Voltage Requirements
- TR Isolation
 - Circulator
 - Duplexer
 - Switch
- Power Distribution
- Phase Shifters
- One Receiver
 - High Dynamic Range Requirements
 - Single Point of Failure



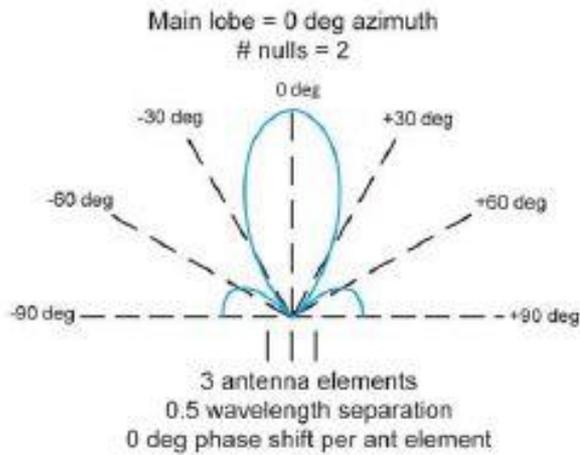
Antenna Arrays Allow Beamforming



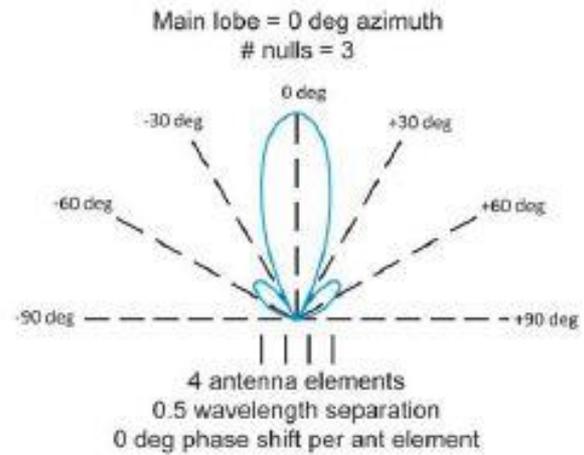
(a)



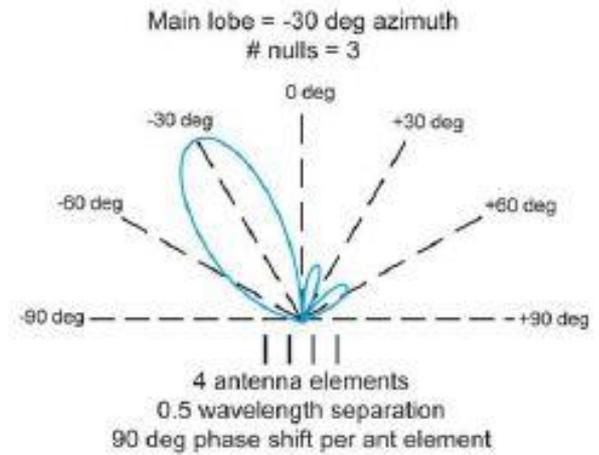
(b)



(c)



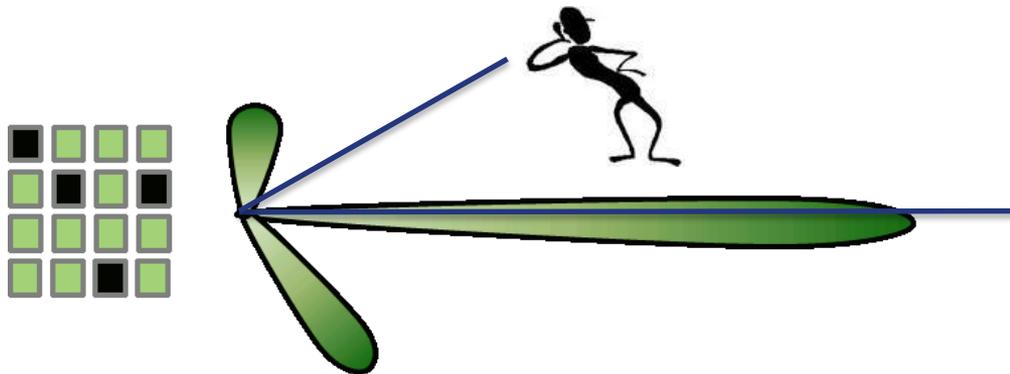
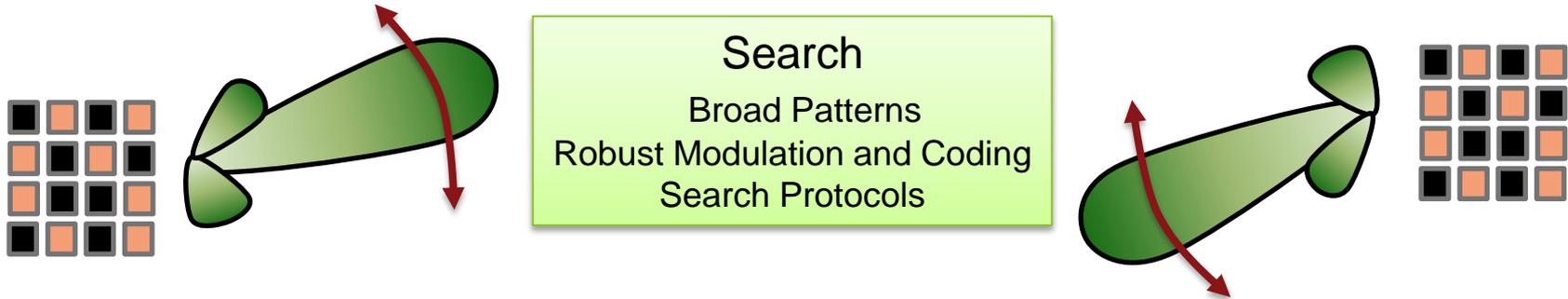
(d)



(e)

Antenna Arrays Allow Flexible Patterns

Especially with large element counts

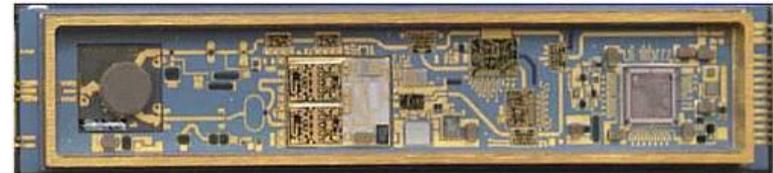
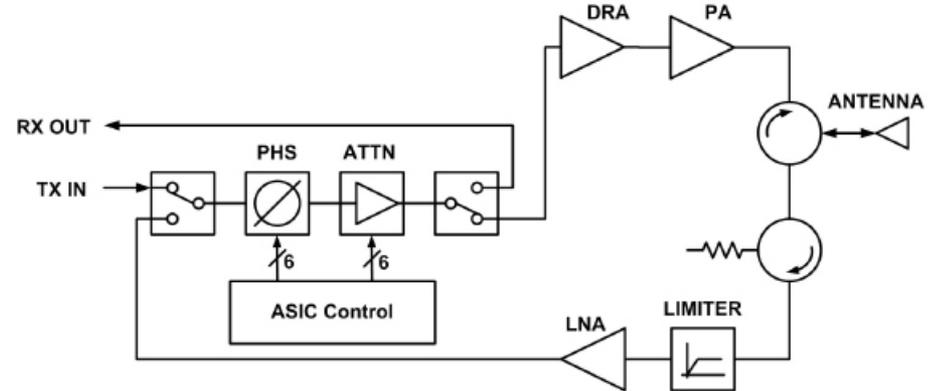
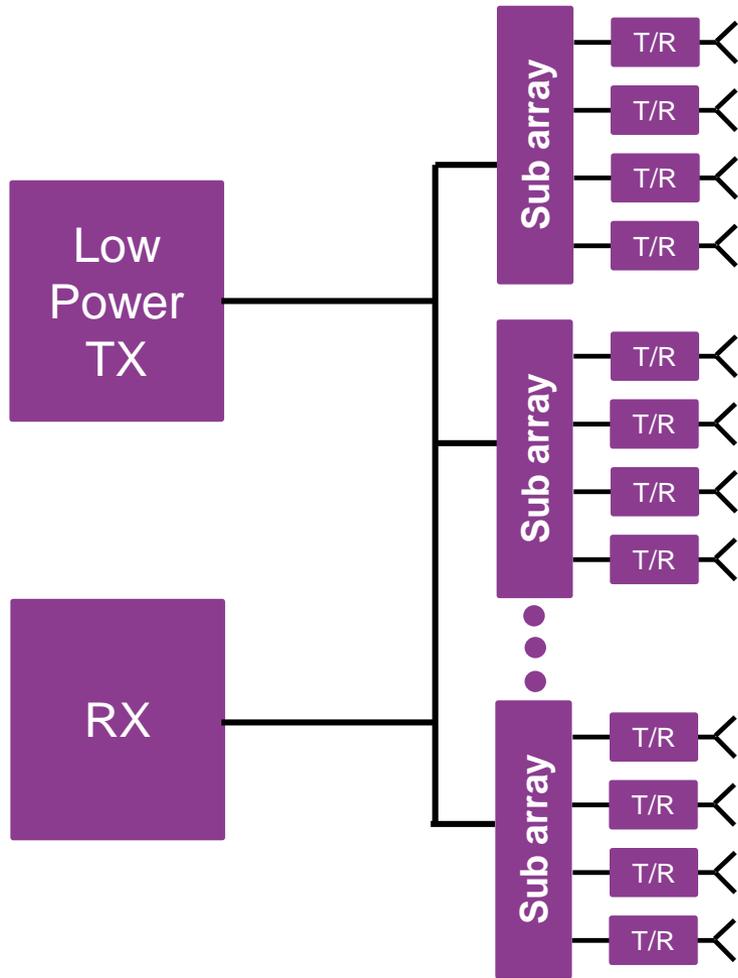


Many possible antenna patterns with main lobe in the desired direction.

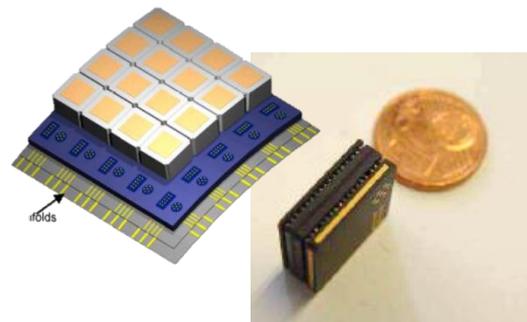
Uses:

- Modify main lobe width
- Place null on interferer when receiving
- Periodically randomize sidelobe direction for security, or for lower interference levels

Active Electronically Steered Arrays (AESA)



Brick



Tile

"T/R-Module Technologies Today and Possible Evolutions",
Patrick Schuh, et. al EADS

Advantages of Active Electronically Scanned Phased Array (AESA) in Satellite Communication

– Key Benefits

- Fixed position antenna
- Ability to form multiple agile beams
- Fast scan rates for wonderful tracking ability
- Independent T/R modules for Multi-band communication
- Reduced power loss from integration of RF source on each T/R
- Graceful degradation – single source failure will not cripple system



5G – Strategic Vectors for Test & Measurement

Massive MIMO

=> New Architectures

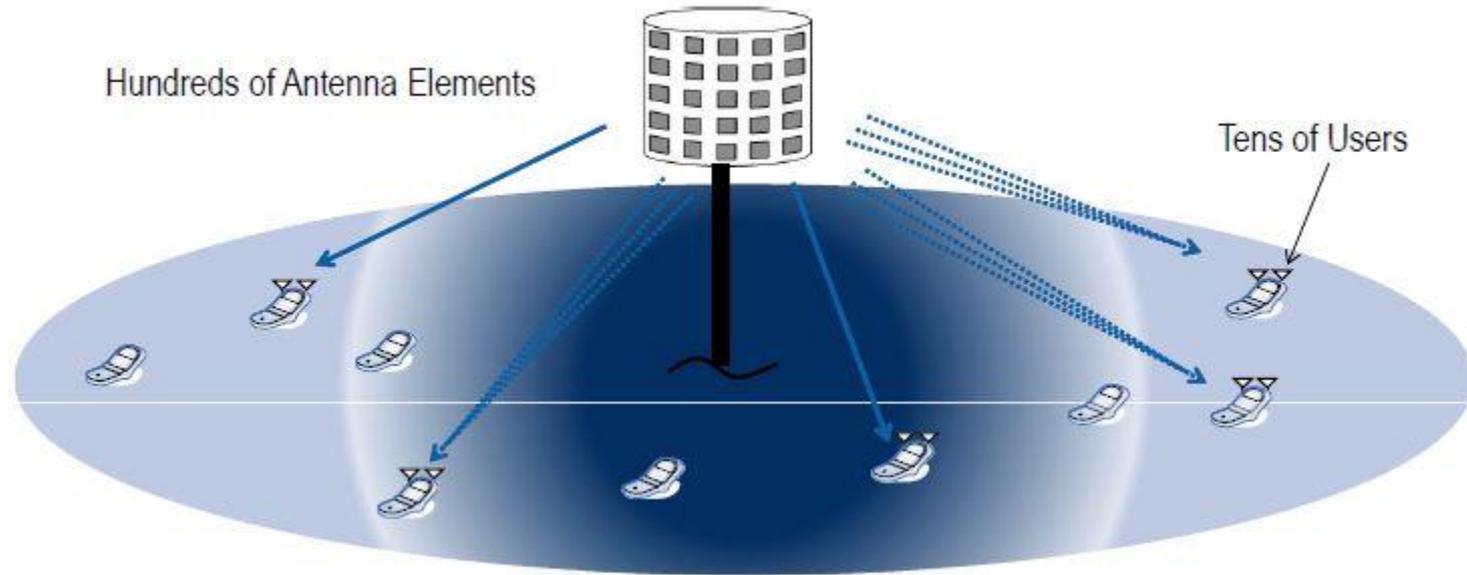
mmWave

=> New Spectrum

Enhanced PHY

=> New Physical Layer

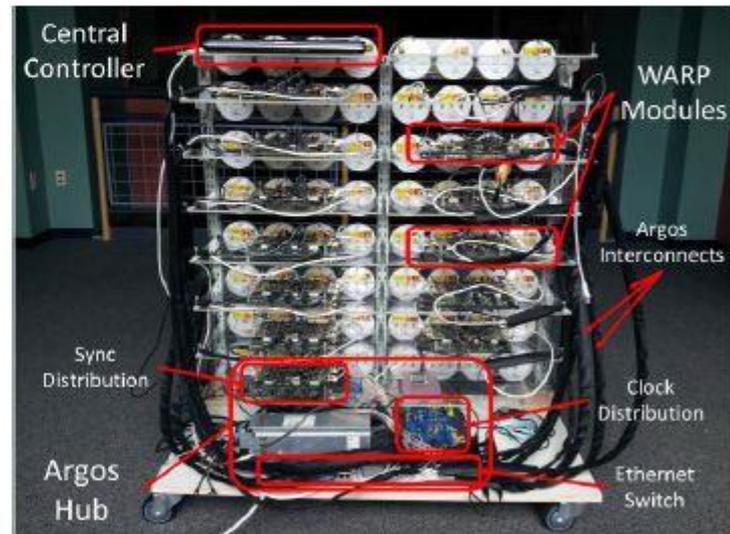
5G -



- Massive MIMO – new research for next generation wireless
- Base station encompasses “hundreds” of antenna elements
- Lower power in the channel

5G

- Argos is a 64-element antenna array built using Rice WARP
- Completely programmable at PHY, Argos can simultaneously communicate with 15 MIMO mobile nodes



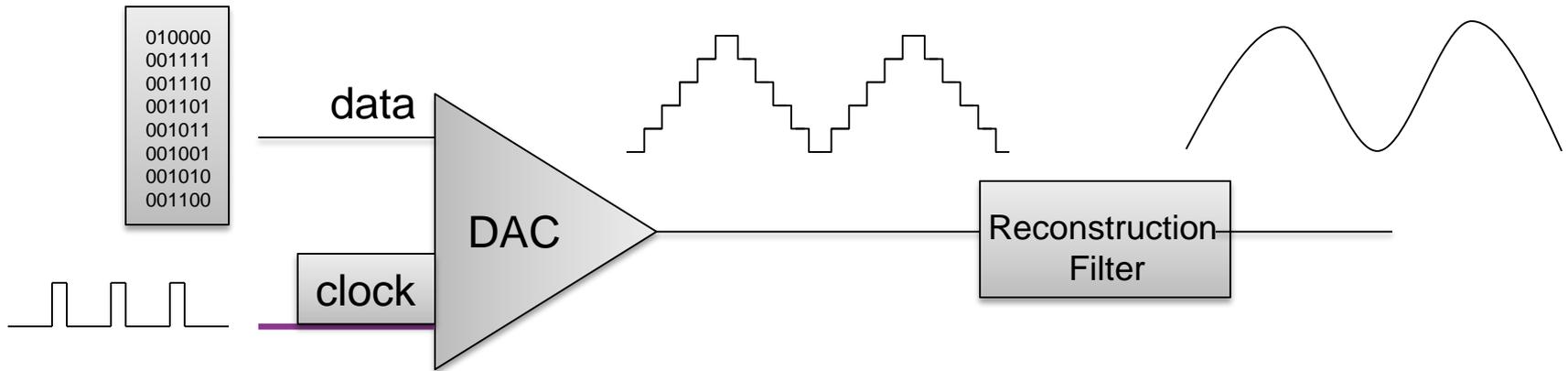
Source: Ashu Sabharwal, Rice University. Used by permission.

5:

Agenda

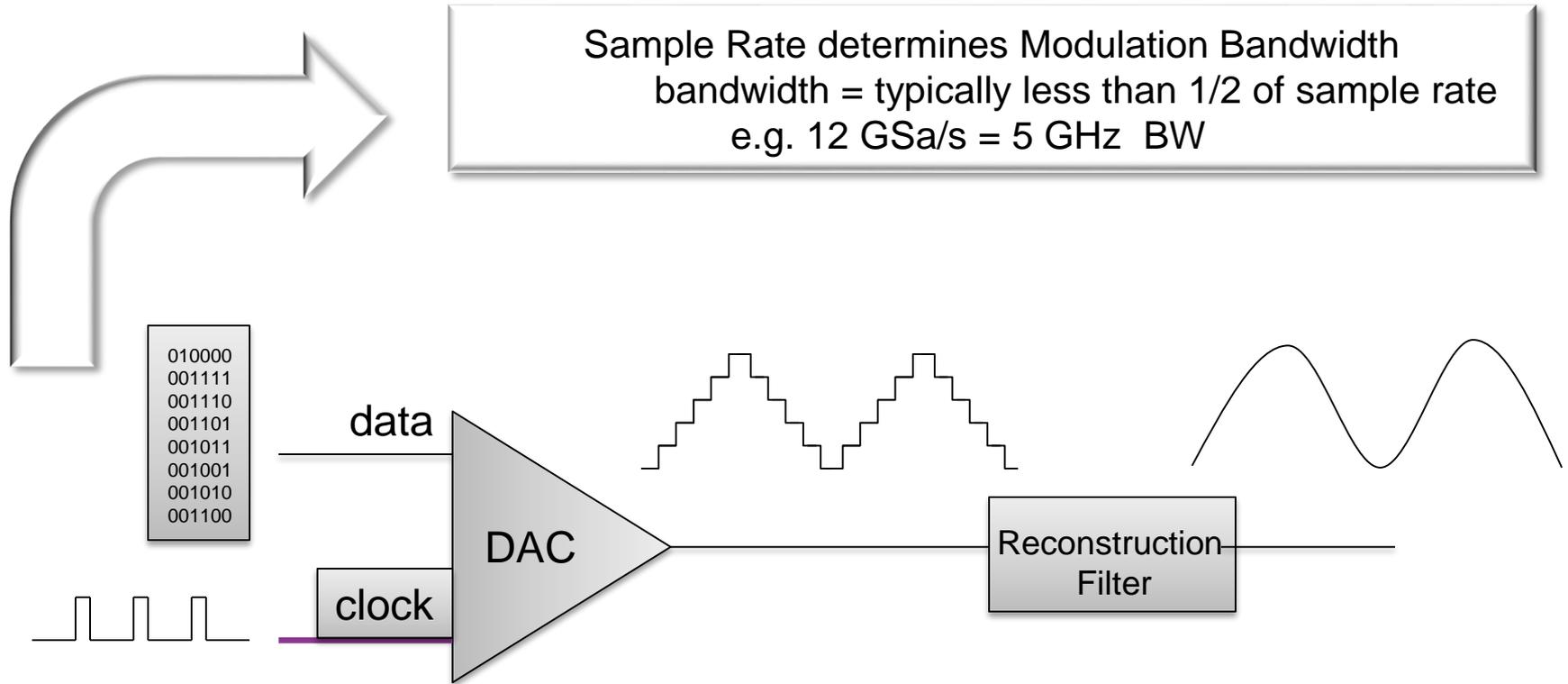
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-  AWG信号源的基本原理
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AWG Basics: Sample waveforms

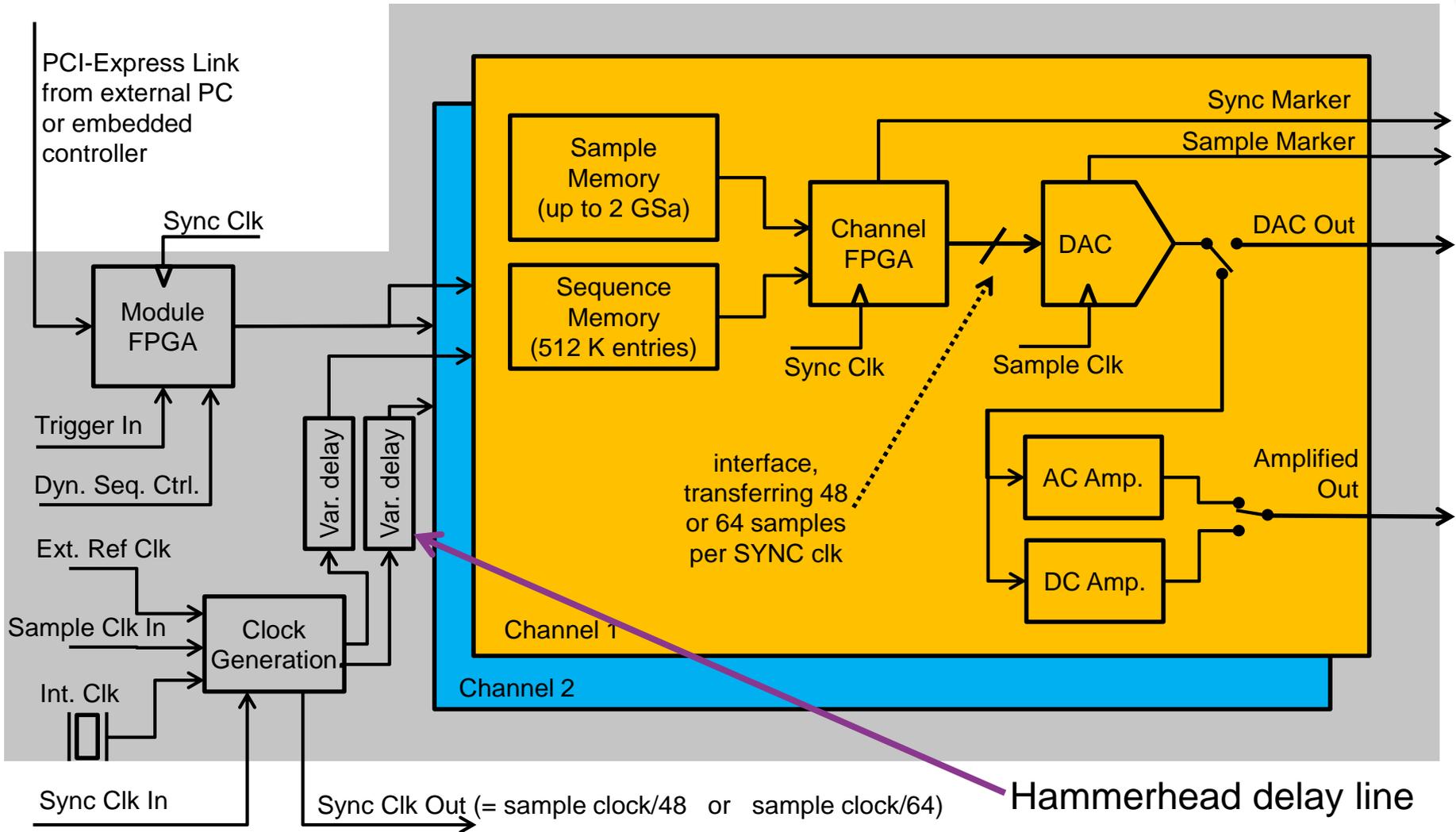


AWG Basics: Sample rate

Sample Rate determines Modulation Bandwidth
bandwidth = typically less than 1/2 of sample rate
e.g. 12 GSa/s = 5 GHz BW



M8190A Block Diagram



(used with multi module sync)

Hammerhead delay line

Enhance your Reality with a Source of Greater Fidelity

Combination
opens up new
applications

Breakthrough performance

Up to 80 dBc SFDR for
Reliable and repeatable measurements

2 GSa memory for
Long play time

5 GHz analog bandwidth
For today's and tomorrow's apps

Operation with leading
software platforms

Best IF signal quality
Digital Up Conversion

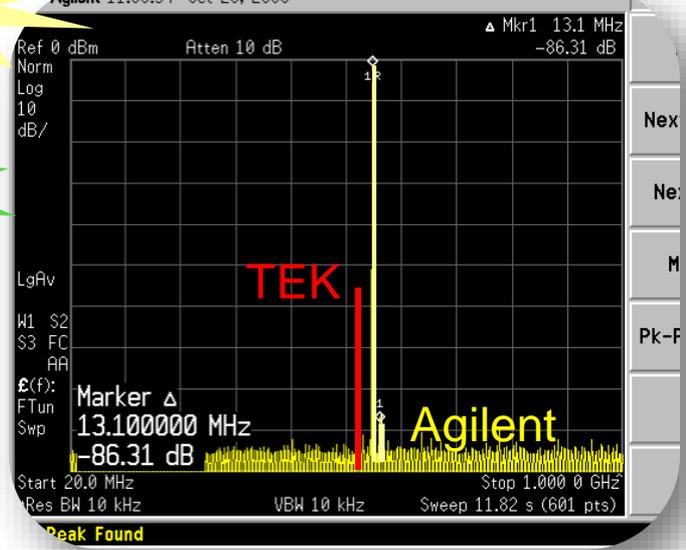
30 – 1,000,000 times more
Digital Up Conversion

Doublet mode:
4-7GHz signals

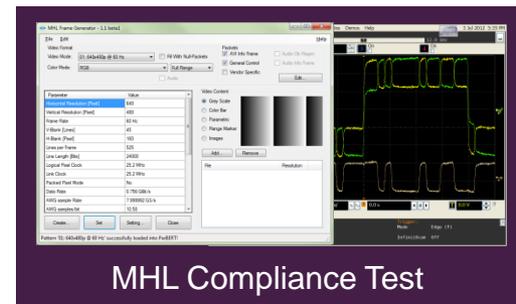
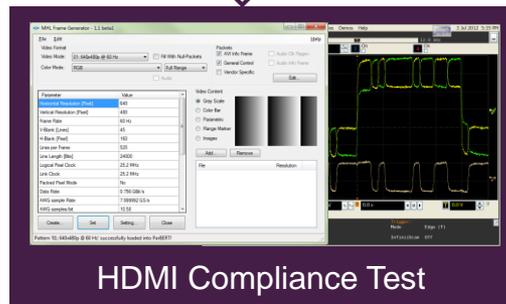
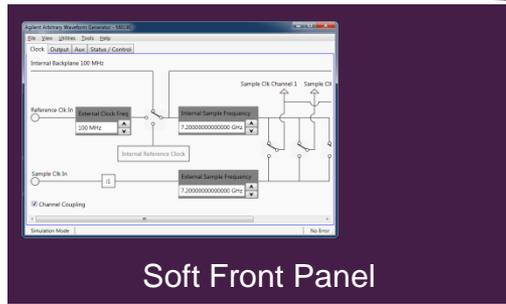
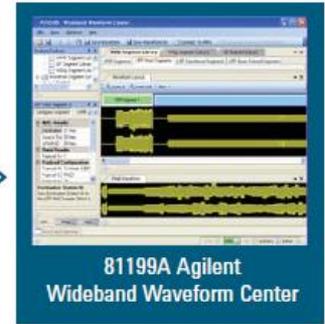
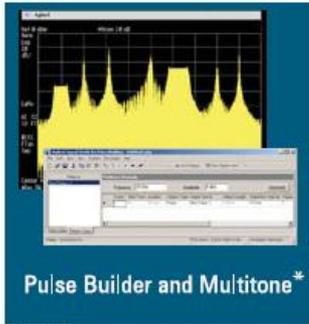
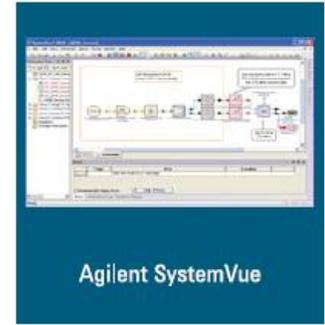
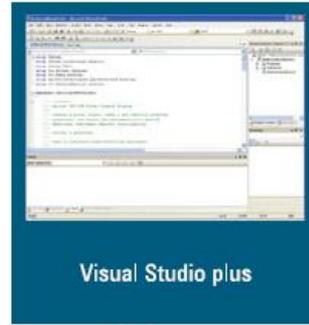
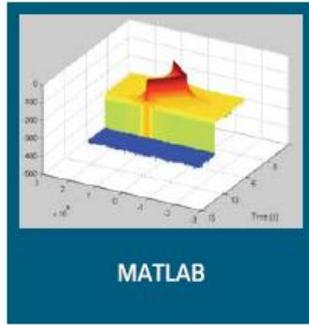
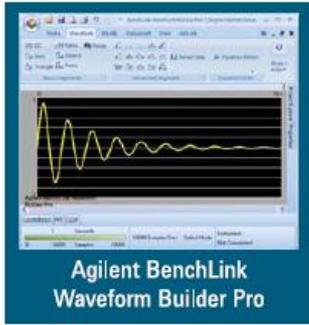
New
Applications:
Pulsebuilder,
HDMI, MHL



M8190A



Supported Software



Frequency Expend to 44GHz with PSG E8267D



Differential I/Q signals



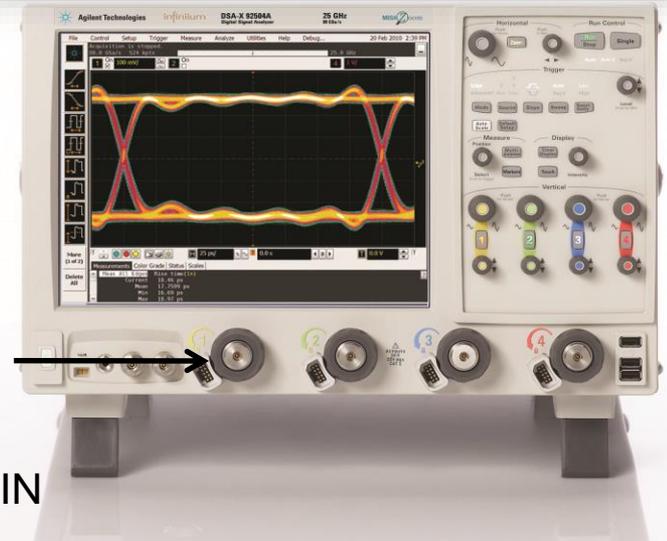
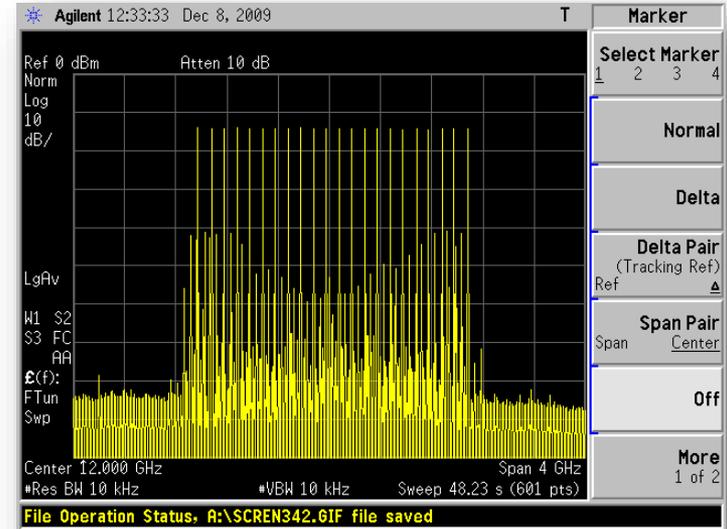
Opt. 016

Modulation BW up to 2 GHz
RF up to 44 GHz



RF/MW out

RF/MW IN



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- AWG信号源的基本原理
- ➔ • 是德科技多通道复杂信号产生方案

Keysight Arbitrary Waveform Generators

Proprietary Technology - Unique Performance

Choose the performance you need

- High Resolution
- Wide Bandwidth

M933xA

M9330A / N8241A

15 bit, 1.2 Gsa/s



Best signal quality in PXI
and LXI form factor

81180B

81180B

12 Bit, 4.6 Gsa/s
1 GHz analog bandwidth



Economic version

M8190A

M8190A

14 bit 8 Gsa/s /
12 bit 12 Gsa/s
5 GHz analog bandwidth



Best signal quality and
longest playtime

SFDR: up to -90 dBc .
10 dB more than the closest
competitor

M8195A

M8195A

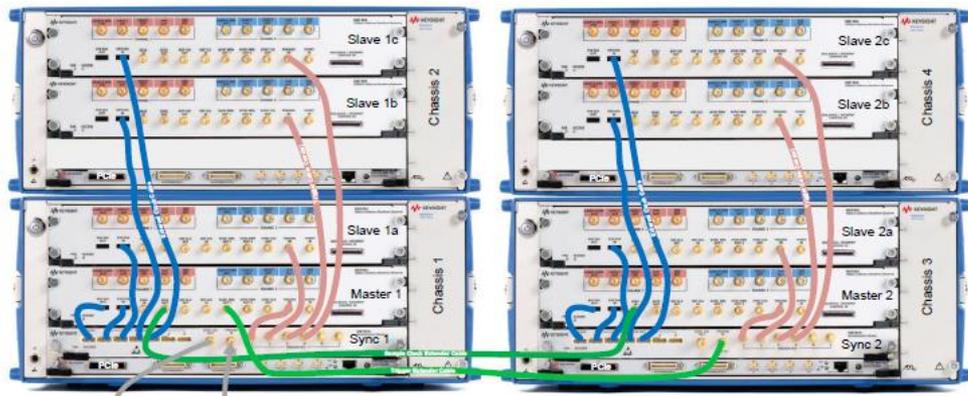
8 bit 65 Gsa/s
20 GHz analog bandwidth



Highest speed, bandwidth
and port density in a 1-slot
AXIe module

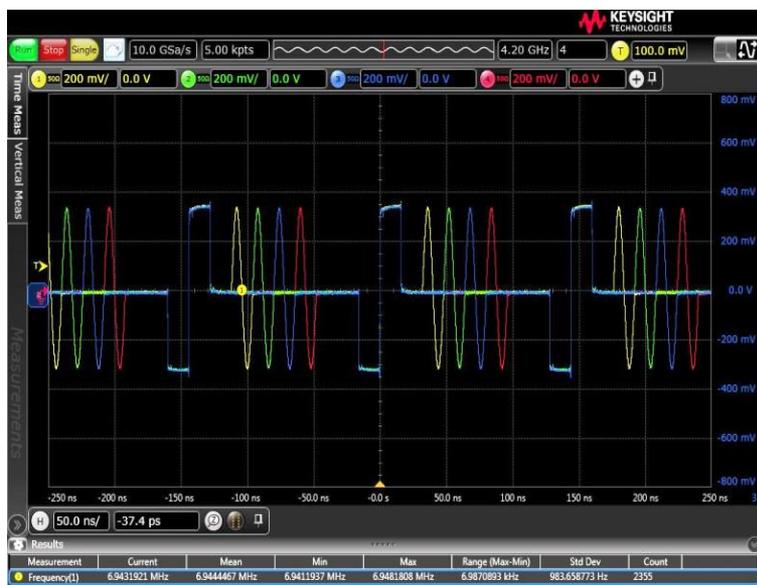
Jitter 5 ps pp @ 32 Gb/s
SFDR: up to -80 dBc
Integrated 16-tap FIR filter

16路多源全相参系统



●快速、精确仿真雷达多目标

- ✓信号路数可依据测试需要灵活配置
- ✓频率覆盖：DC – 6GHz
- ✓信号带宽：6GHz
- ✓16路单端或差分输出
- ✓信号幅度：350 mVp-p to 700 mVp-p
- ✓信号波形：产生或下载用户自制波形文件



●准确、方便的调整多路相参信号的幅度/相位/时延关系

- ✓多路信号的幅度一致性：< 0.1dB
- ✓多路信号之间的相位调整：0.1度
- ✓相参相位的调整精度：< 0.5度
- ✓多路信号之间的时延调整：< 50fs

●友好、清晰的软件界面

- ✓系统自动校准
- ✓相位/幅度/时延修正
- ✓测试精度提升

16 Channels Coherence Signals Generator

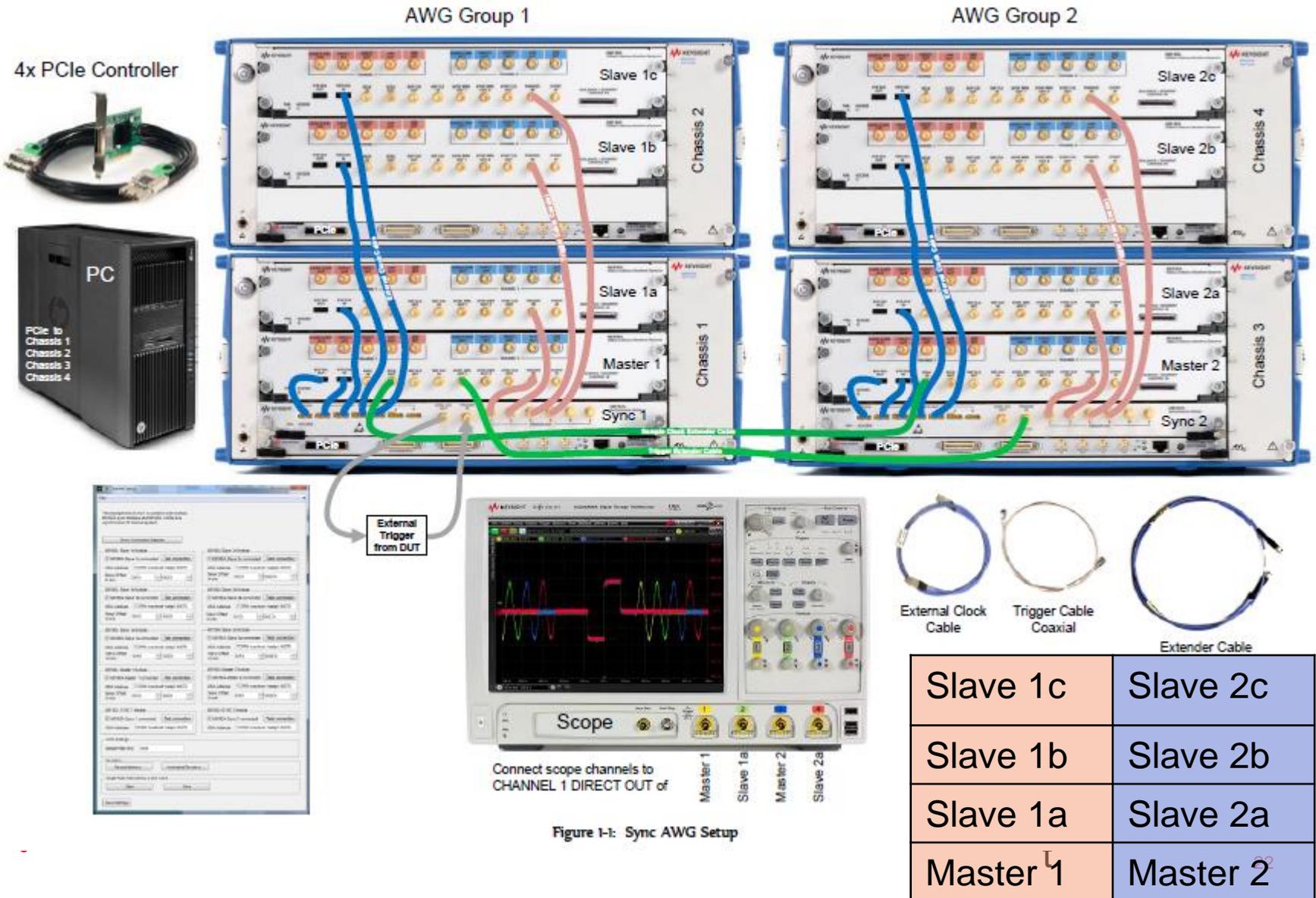


Figure 1-1: Sync AWG Setup

Key Performance of 16 channels signals generator

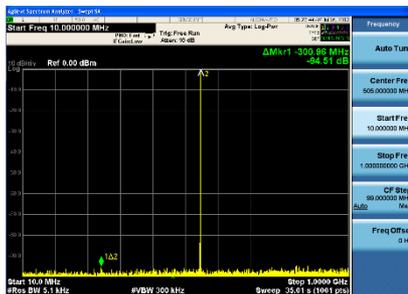
- Frequency range: DC - 6GHz
- Amplitude: 350 mVp-p to 700 mVp-p
- 16 channel differential / single ended output
- Amplitude Consistency: < 0.1dB
- Phase Adjust Accuracy: < 0.5 deg (1GHz)
- Easy 16 Channel auto skew correction / phase calibration

Keysight High-Speed AWG portfolio



M8190A

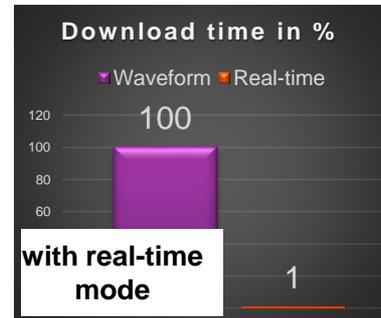
- 8 / 12 GSa/s
- 14 / 12 bit resolution
- 5 GHz BW
- Up to 2 channels



SFDR -94 dBc

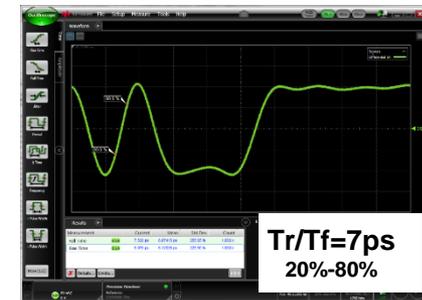
M8195A

- Up to 65 GSa/s
- 8 bit resolution
- 20 GHz BW
- Up to 4 channels



M8196A

- Up to 92 GSa/s
- 8 bit resolution
- 32 GHz BW
- Up to 4 channels



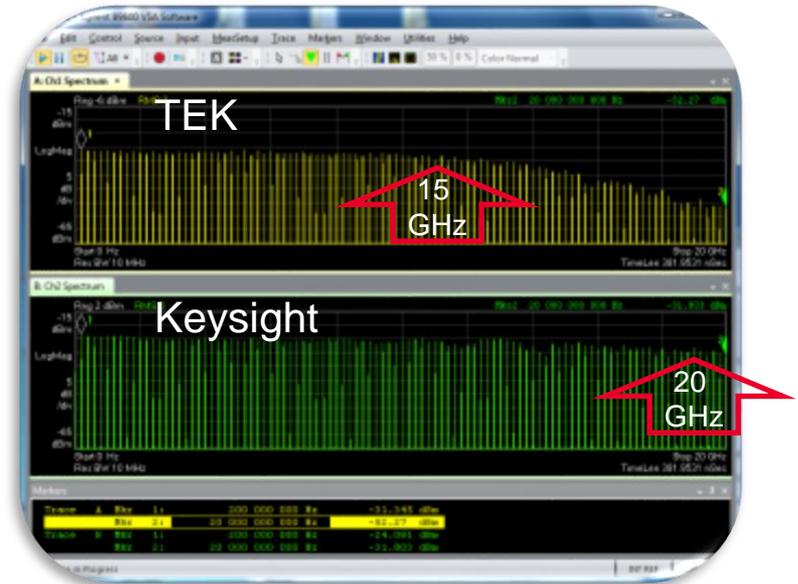
New M8195A AWG

Leading performance

65 GSa/s AWG

20 GHz BW

1, 2 or 4 channels



Multitone from DC to 20 GHz

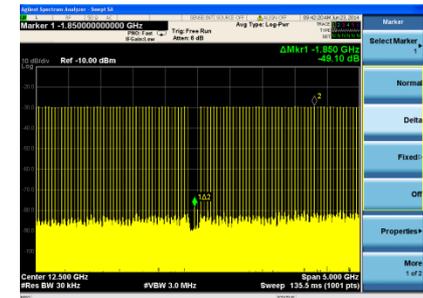
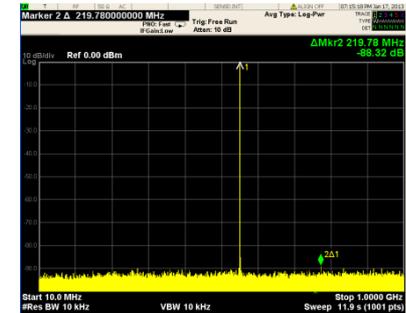
***Go where you have never been able to test before:
in speed, in bandwidth and in channel density.***

Explore your possibilities

M8195A in A/D and Wireless Applications

Explore your possibilities by using wide BW

- Wideband wireless communication signals up to 20 GHz with flexible modulation schemes (nQAM, OFDM, etc.)
- Emitters simulation of in C, L, S, X and Ku band up to 20 GHz directly – without external up-conversion
- Extremely wide modulation of radar pulses with bandwidths (DC to 20 GHz instantaneous BW)
- Fast hopping in picoseconds across a whole frequency band
- Emulation of multiple phase coherent emitters

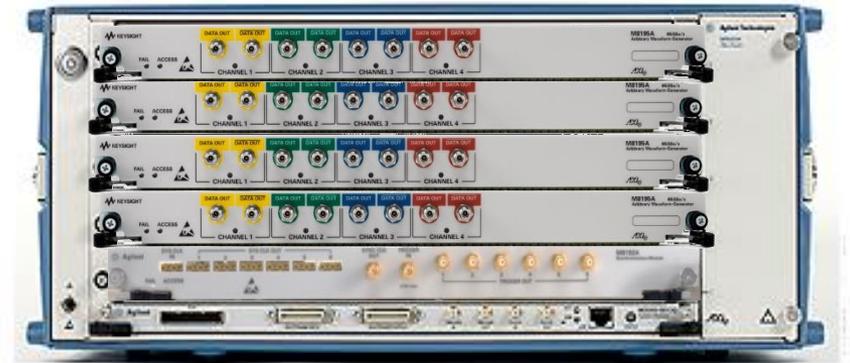


M8195A Multi Channel Support

Requires M8197A sync module (release end of Nov. '15)



4 channels



4 modules (= up to 16 channels) and
1 synchronization Module

- Synchronization of more than 4 modules is possible, too
 - Use asynchronous or synchronous triggering scheme
- M8197A improves trigger accuracy and offers dynamic control input
 - useful even in conjunction with only one M8195A

Keysight M8196A AWG

- Highest speed = **92 GS/s**
- Extremely high bandwidth = **32 GHz**
- High channel density =
Up to **4 synchronized channels**
- Differential outputs:
 - Amplitude up to $1 V_{pp(se)}$ ($2 V_{pp(diff.)}$), voltage window $-1.0 \dots +2.5V$
- **8 bit resolution**
- rise and fall times **below 9 ps**
- 512 kSa memory
- **Software integration**
 - M8070 System software for BER test solutions
 - 81195A optical modulation software
 - Matlab, IQ tools



总结

- 多路复杂信号的产生在无线通信、5G研发、国防军工领域都有非常广泛的应用。
- 是德科技的任意波形发生器AWG系列具有优异的性能指标，极宽的射频带宽，非常适合组建多通道相参发射系统，并且可以产生超宽带复杂信号。
- 由AWG组成的多路相参复杂信号产生系统，灵活性好，集成度高，体积小，精确可调。

Questions



Comments