Probing challenges when testing WBG devices

[link to power-conference.com/]

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Tektronix: supporting humankind's greatest advances and future vision since 72 years

2001: A Space Odyssey
Measurements are required for simulation as inputs

- From Fraunhofer presentation
T&M Solutions in Power Electronics

Test Solution system

Processing → Acquisition → Probing

Math
I x V = P

Mostly 8 bits
350MHz

Unchanged since a while

Simulation → Design → Implementation

DUT
Wide Band Gap Technology enables high Power Density

High Switching Frequency = Small parts (Capacitor and Inductors)
SiC Module Packaging
All aspects of a New Era Power T&M Solution

Test Solution system

- Processing
- Acquisition
- Probing
- DUT

High accuracy losses calculation
Deskew/delay comp.
Automated tools

Tek49 12 bit architecture

BW shift
Resolution Increase > 4 channels

Disruptive change

Fast switching
Low parasitic
Small size
New package
Testing Requirements?

CRITICAL PARAMETERS FOR GaN & SiC DESIGN

- Miller Charge Qg much lower, which allows fast switching speeds
- Requires significantly less parasitic capacitance, resistance and inductance.

- GaN - Max Vgs and max Vth is much lower
- SiC - Requires high Vgs and negative bias on turn-off
- Requires tight regulation of Vgs and Vth voltage

- Body Diode voltage drop is higher
- Requires tight control of dead time to minimize losses.

- Ability to measure extremely fast dv/dt, di/dt and high frequency and reduce loading, Inductance and capacitance.

- Ability to accurately measure Vgs on all gate nodes in the circuit on high-side and low-side.

- Ability to accurately measure turn-on, turn-offs, dead-time and eliminate measurement effects of phantom ringing on high side and low side switches.
Challenges

Drive circuit optimization

Very low \( V_{\text{gate}} \) threshold

high side may oscillate

“Miller effect”

Do not add further parasitic load

Need to measure fast \( dv/dt \)

Need to reject common mode

Need to probe tiny things
Are Traditional HV differential probes the answer?
How do design a probe for WBG testing?

- Increase Bandwidth
- Drastically increase high frequency common mode response
- Reduce ground loop inductance
- Reduce input capacitance
- Completely shield the signal at the board

NEW IsoVu Optically Isolated Differential Probe System
What is IsoVu™ Technology?

ISOLATED - DIFFERENTIAL MEASUREMENT SYSTEM

IsoVu™ technology is the ONLY differential probing system for WBG Testing!

Enables differential measurements on floating, fast signals

• New Differential Probes characteristics:
  ◦ High Common Mode Rejection
  ◦ High Bandwidth
  ◦ Wide Input range
  ◦ Max Flexibility
  ◦ Up to ±2,5kV input range
  ◦ Up to 60kV CM
  ◦ Up to 1GHz (<350ps rise time)
  ◦ Up to 80dB CMRR @1GHz
IsoVu Offers 1 Million to 1 CMRR

ISOVU IS 100,000 TIMES BETTER THAN THE ANY SOLUTION IN THE MARKET

- 1 Million to 1 at 100 MHz
- More than 10,000 to 1 at 1 GHz
See real signals not artifacts

- IsoVu gives you an accurate, repeatable measurement providing meaningful correlation with expected performance.

Expected Simulation Results

Probe with 10:1 common mode error

IsoVu rejects common mode interference, so you can see the true differential signal.
Connectivity Options

FOR BEST PERFORMANCE USE THE RIGHT CONNECTIONS

Connectivity Options:
- High BW MMCX Connectors (Best Performance)

Connectivity Options:
- Square pin
- Square pin - MMCX Adapter
Simply **different**, starting from the **connector**
Fits 0402 resistors
CMRR performance with exposed square pins

Sqr pins shorted on PCB – CM signal
CMRR performance with MMCX

MMCX shorted on PCB – CM signal

CM Voltage Pulse

TIVH Output Waveform
MMCX for High-BW Low-C passive probes (1GHz)

- Tip mates directly with MMCX connector:
  - Shielded, low inductance connection to test points
  - Secure hands-free connectivity
  - Uses low-cost, industry-standard MMCX connectors
  - MMCX connectors may be "tacked on" and used as unplanned test points

- Adapters connect to standard pitch pins:
  - Two adapters available for connecting to square pins
    - Spaced on 0.1 in. (2.54 mm) centers
    - Spaced on 0.062 in. (1.57 mm) centers
  - Solder tool available for placing 0.062 in. pins

- "Y" leads connect to non-standard-pitch pins:
  - Y-lead adapter works with the 0.1 in. adapter

- Tripod mount for added stability:
  - Tripod mount adds stability to square-pin mounted probes
  - Tripod may be glued down to the PCB
Thanks for your attention

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Come Visit us and try it yourself at our booth or schedule an onsite with our technical experts