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APEC

APEC Conference and Expo 2009

Two new technologies for building faster and more agile switched mode power converters

Difficulties in designing faster SMPCs

As switched mode power converters are pushed to run at higher frequencies, the difficulty in measuring instantaneous DC to wideband current is an increasingly limiting factor

At higher operating frequencies, switching losses contribute an increasingly large percentage of overall losses

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CogniPower is introducing a patent-pending current probe for measuring instantaneous AC and DC current in SMPCs and other pulsed power applications

CogniPower is also demonstrating its patent-pending switch controls which are faster and easier to use than conventional switch drivers

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CogniPower technology

Faster, smaller, more agile, more efficient, and more reliable SMPCs become possible using this new technology

Bill Morong, principle inventor, will provide details

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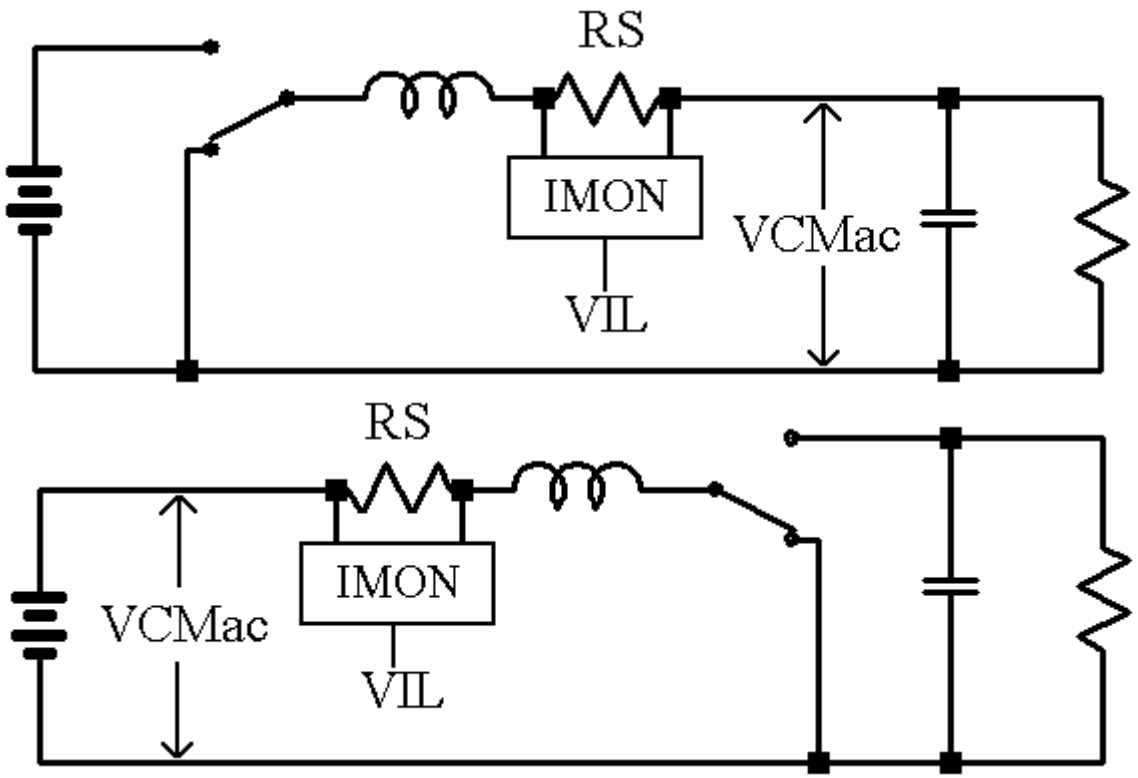

Prior current monitors measure inductive current in the absence of severe CMVac transitions, as is typically possible in traditional SMPC's

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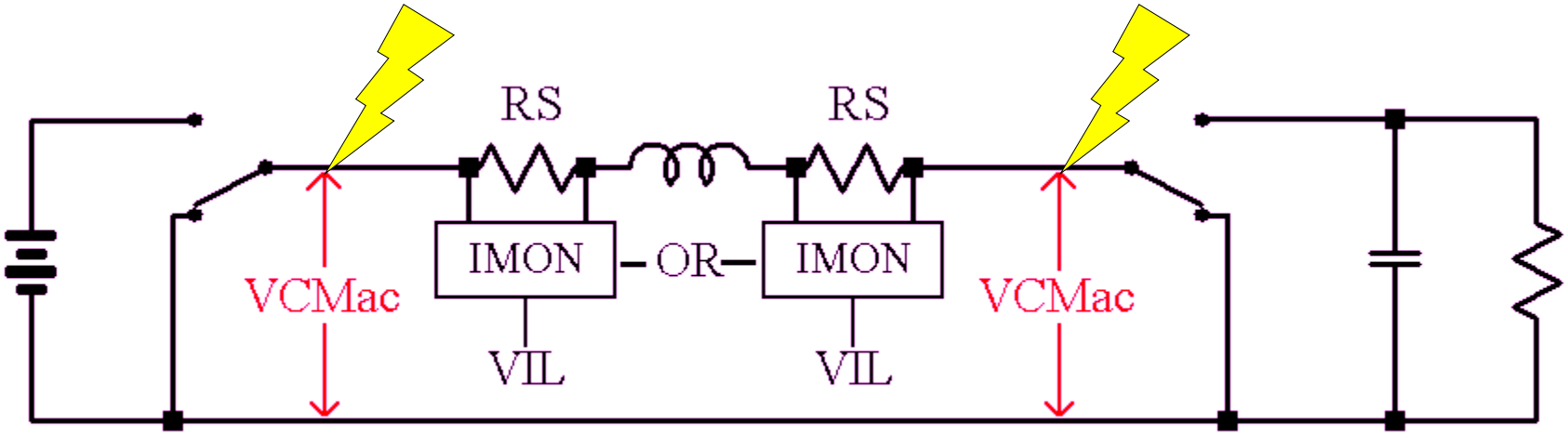

Modern architecture may incur severe CMVac on both ends of an inductor, overloading traditional current monitors. High speed switches are needed to optimize size and efficiency. New and predictive control algorithms, to obtain best efficiency and agile dynamics, require measurement of both AC and DC inductor current with wide bandwidth and minimal data latency.

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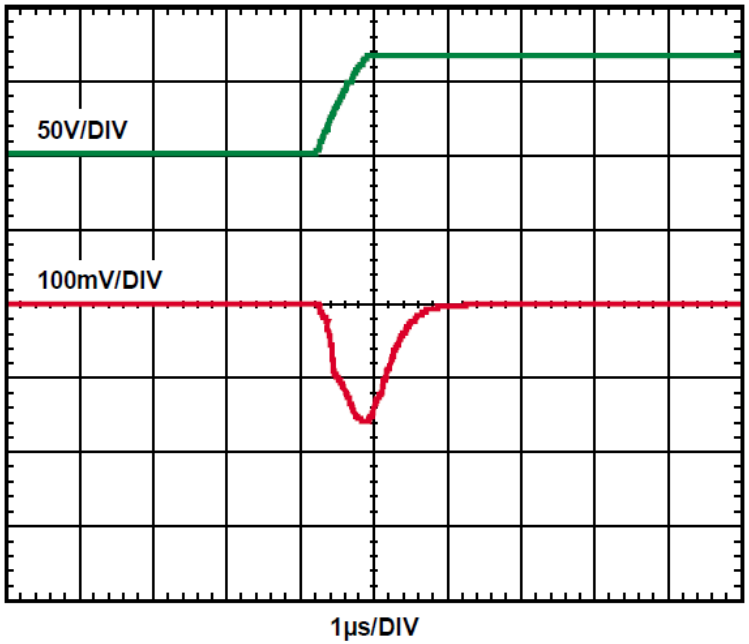
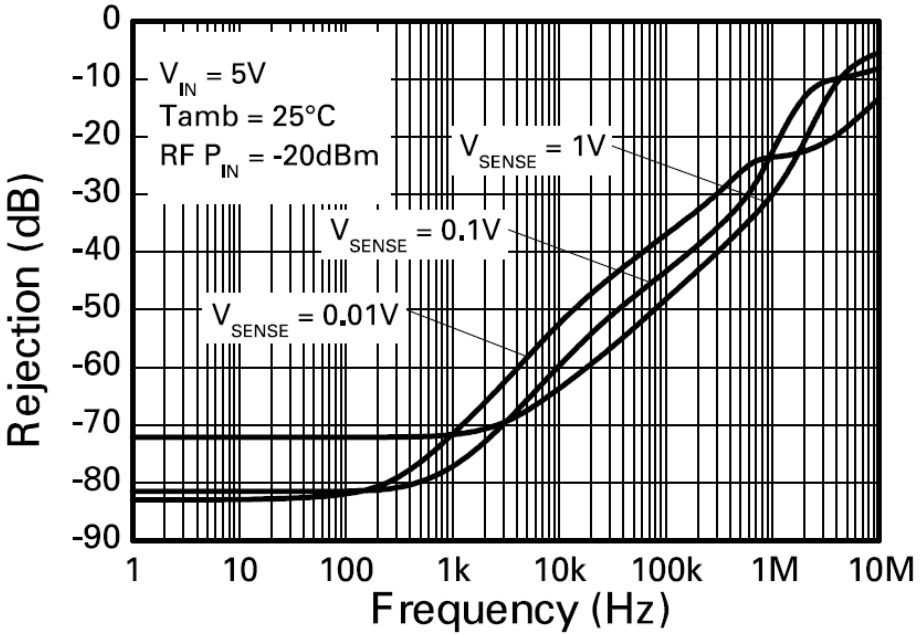


Common-Mode Response (Rising)



Common Mode Rejection

Two high-quality available current monitors that are overwhelmed by the severe CMVac transitions in a modern SMPC

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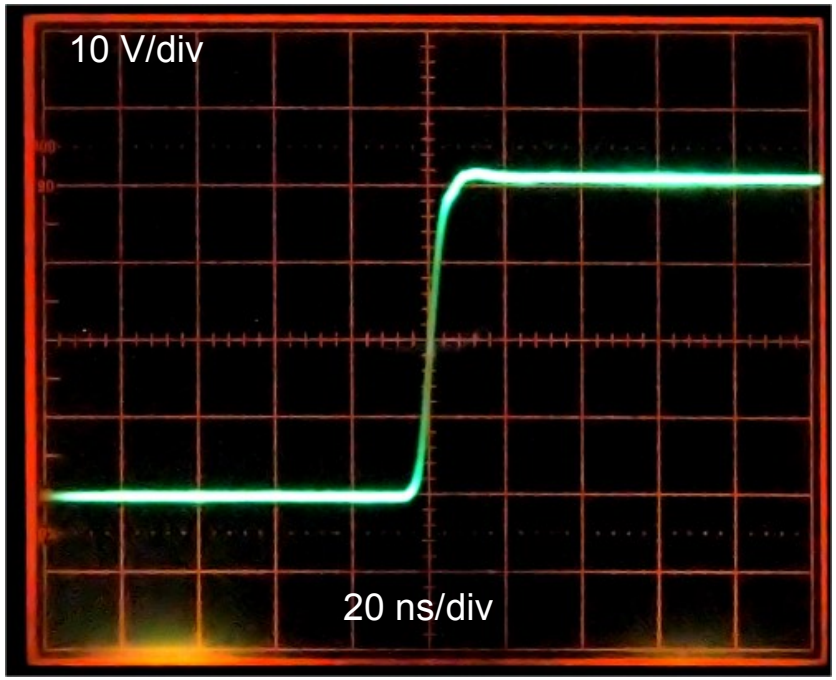
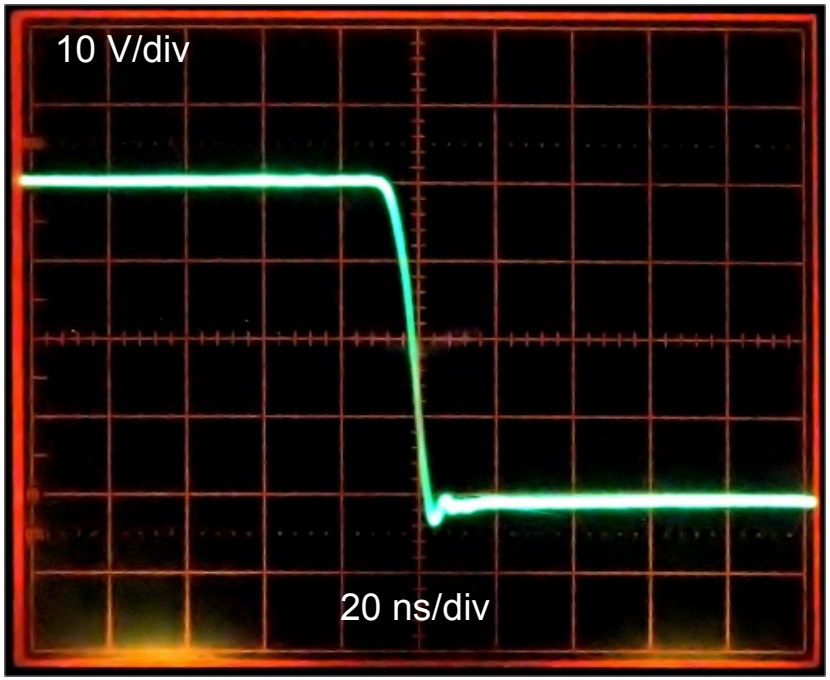
New Cognipower 1 kW totem pole that can run at several MHz is needed for modern SMPC's. Smooth transitions of 10 kV/μS have been generated with this type of totem pole. To measure both AC and DC inductor currents in the presence of such transitions requires a new current monitor.



Transition time is 7 ns and overshoot is less than 2%



Transition time is 9 ns and undershoot is minimal

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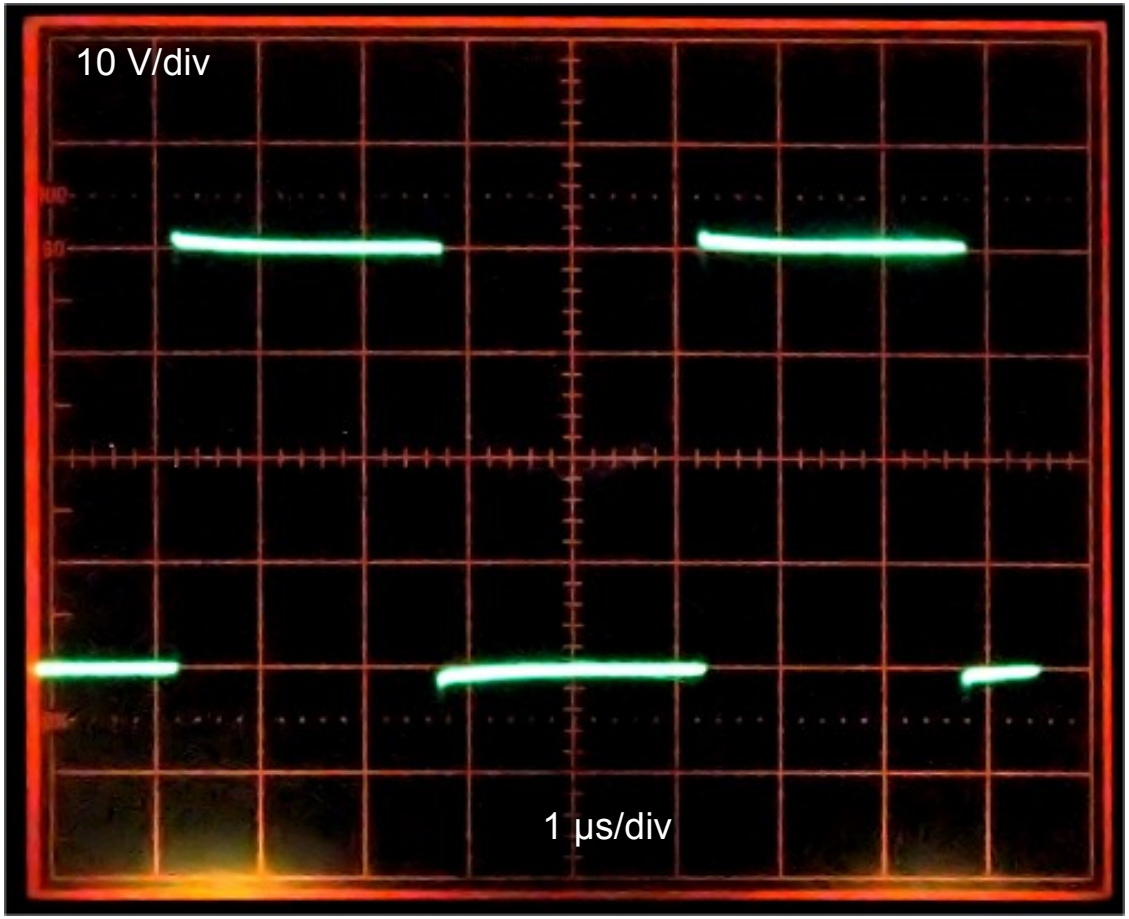

1 kW totem pole output swinging between 0 and 40 volts at 200 kHz without snubbing

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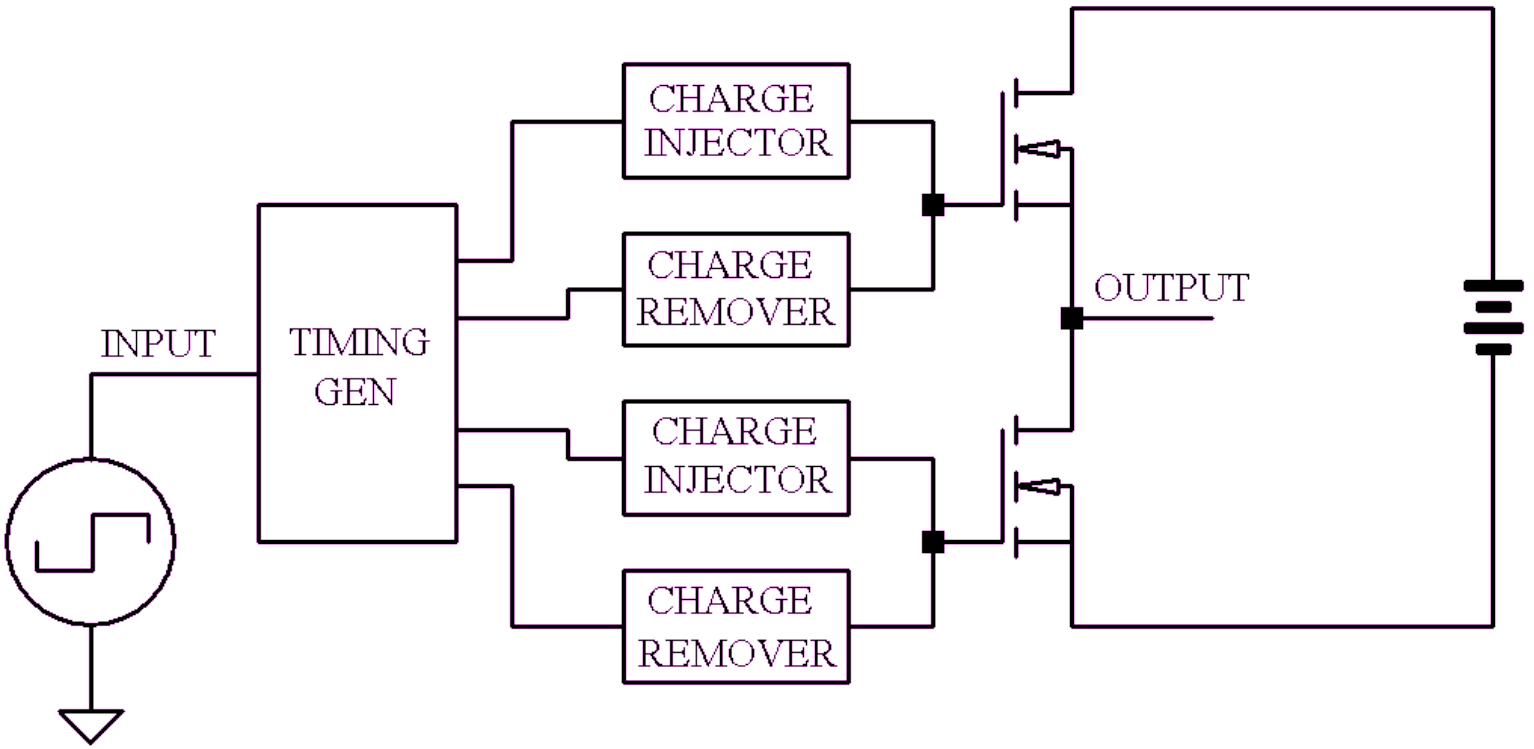
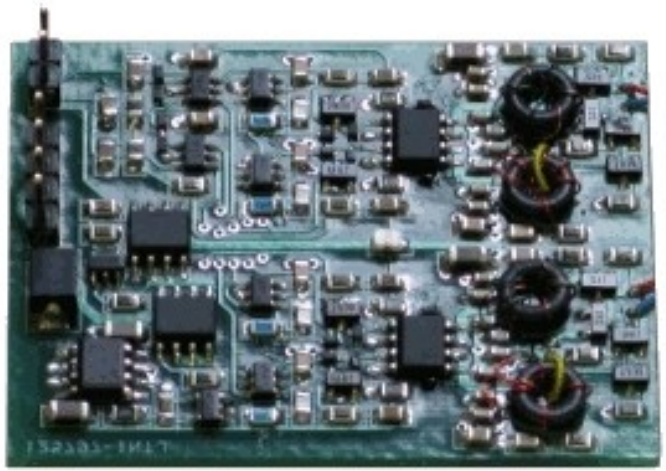


- New Cognipower totem pole driver yields superb transitions needed for high speed operation, and requires no high-side enhancement supply.
- Is set up for very agile break-before-make operation

CogniPower Totem Pole Switch Controller



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New CogniPower driver:

- Drives MOSFET's or IGBT's, large or small
- Isolated, can be used high or low side, or both to form totem-pole
- Needs no enhancement supply
- Provides fast transitions
- Fully controlled and fast break-before-make, set by timing generator, minimizes needed dead-time

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New Cognipower totem-pole:

Control of geometry reduces loop inductance, including bypass capacitors, to less than 500 pH, to minimize inductive energy storage in the totem-pole. Such control yields fast transitions with dynamics so good that snubbing can be minimized or eliminated. Thus more efficient and faster, lower- voltage switches can be used in a given application

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Prior methods for obtaining DC to wide-band current measurements with high-speed transient rejection:

- **Current monitor**
  - May lack bandwidth
  - Inadequate high-speed CMRR
- **Differential amplifier**
  - Requires exquisite control of wide-band division ratio
- **Current Transformer/Rogowski Coil**
  - AC only
  - May incur severe insertion losses
- **Isolation barrier (optical or galvanic)**
  - May lack bandwidth
  - Requires isolated power supply
- **Composite solutions – current transformer with Hall sensor, or with flux-nuller, or with diff-amp**
  - Cost/complexity precludes embedding into supply

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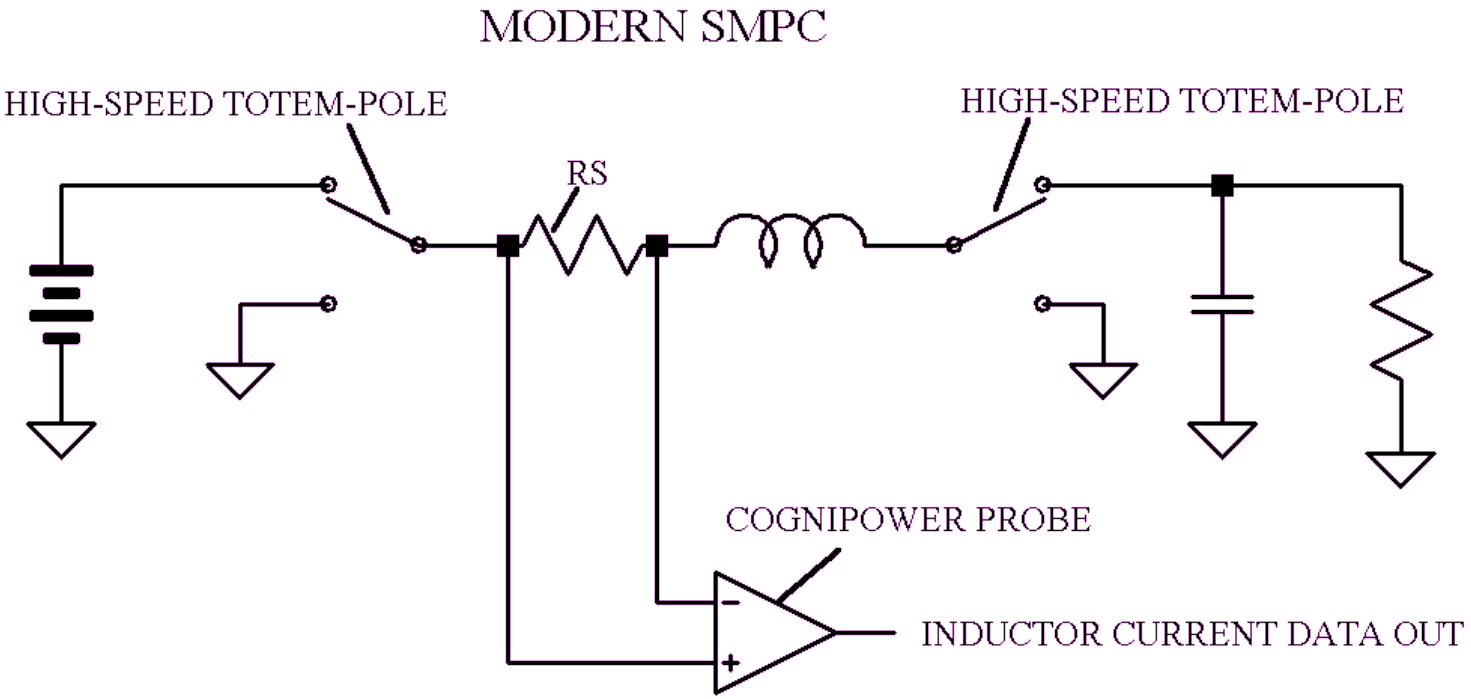
CogniPower Current Probe Application



- Provides DC to wide band amplification and level-shifting
- Provides high-speed CMR
- Insertion loss minimized by sensitivity of tens of mV full-scale
- Practical for use as an instrument, or for inclusion into an SMPC

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CogniPower Current Probe Principle (patent-pending)

- Uses a common-mode choke to provide level-shifting with high-frequency CMR
- Common-mode choke operates to DC using commutation to reset its flux
- Applicable, in various forms, to common-mode voltages to several hundred volts

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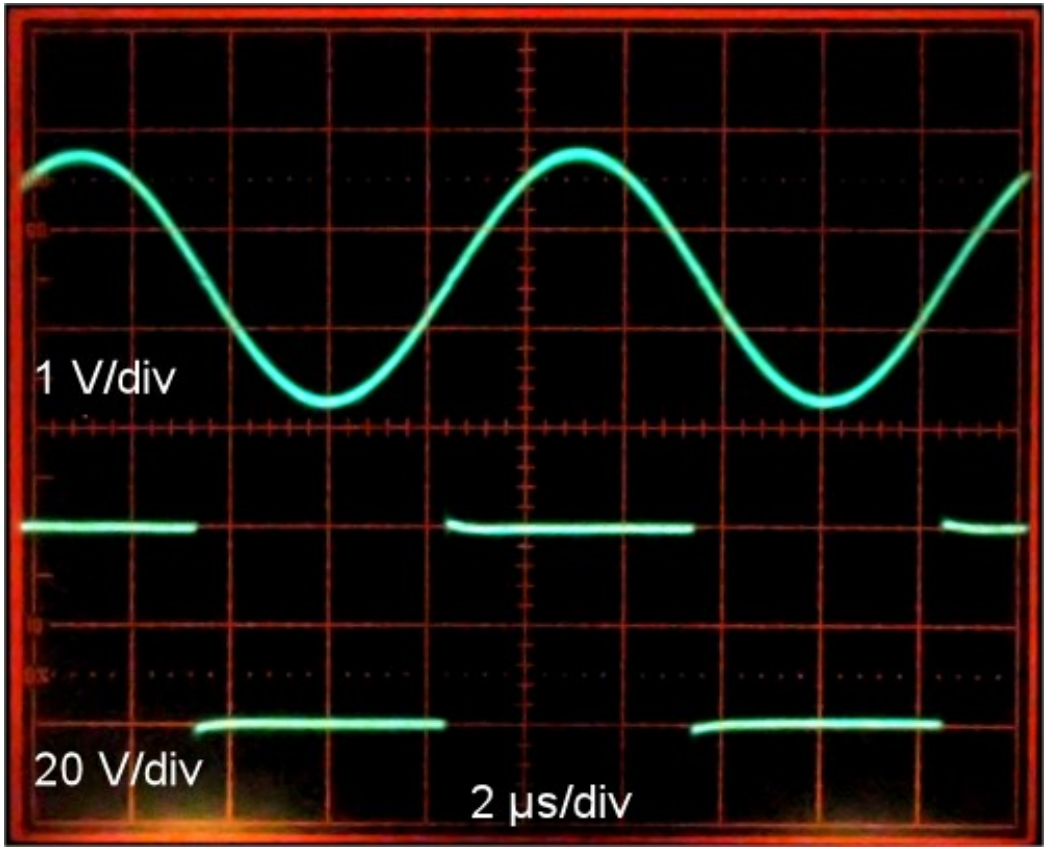
CogniPower CP10 Current Probe



Top trace:
Result of 100 mV p-p input signal

Bottom trace:
40 V common mode voltage

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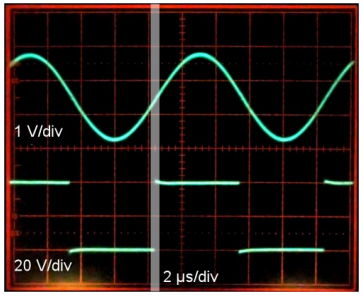
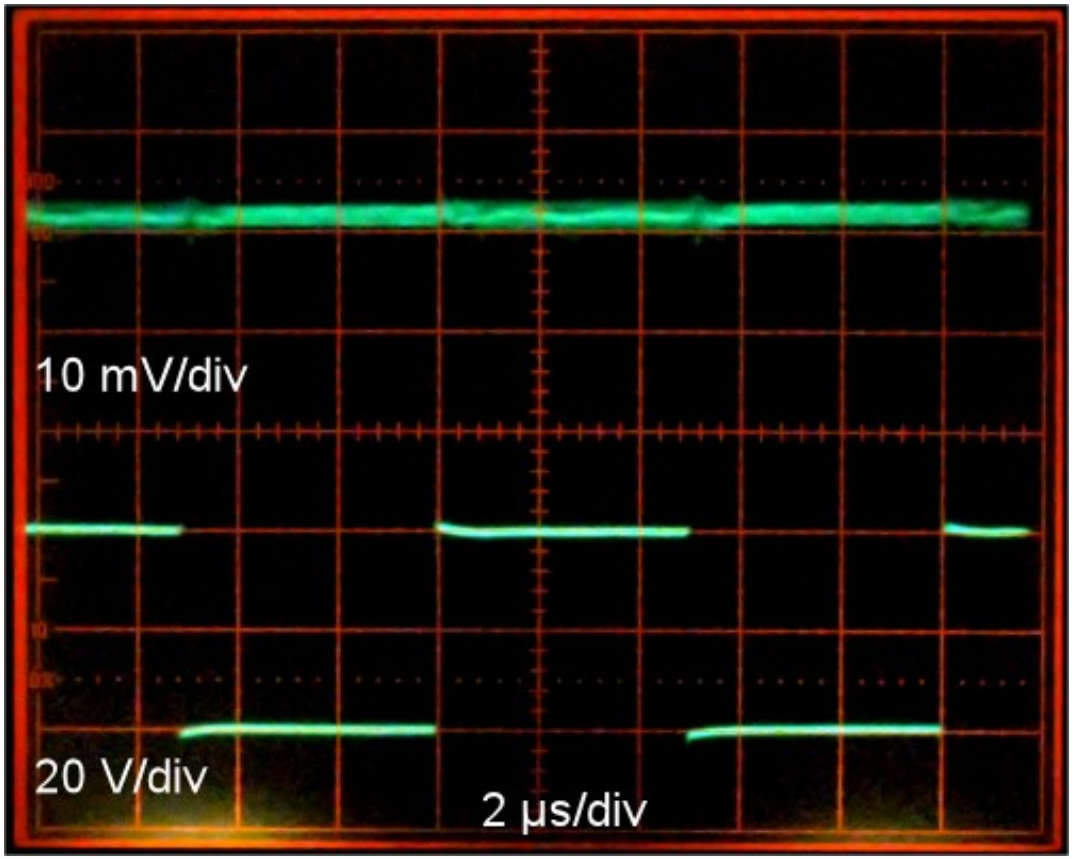
CogniPower CP10 Current Probe



Top trace:
Disruption of signal from common mode edge is barely visible

Bottom trace:
Slew rate is 10,000 V/µs

CogniPower CP10 Current Probe



Top trace:
Baseline disruption from common mode swing (no signal present)

Bottom trace:
40 V common mode voltage

Common mode rejection in the presence of a 10,000 V/µs transition is 78 dB.

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CogniPower CP10 Current Probe

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Conclusions

- CogniPower has developed patent pending technology to allow the instantaneous measurement of current, even in fast switching power converters
- CogniPower has also developed faster, more controlled switching techniques, enabling the development of faster, more efficient, and more agile power converters

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Too good to be true?

Come see a live demonstration in Booth 1112.

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