New Communication and Isolation Technology for Gate Driver ICs

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Isolation Protects us from Electric Shock and Reduces Likelihood of Semiconductor Failure

- **Desired features**
  - Allows high signal-speed while preventing signal jitter and delay mismatch
  - Low coupling capacitance
  - Provides immunity to partial-discharge
  - High field immunity
  - Long lifetime with good integrity
  - Low cost

Isolation standards (IEC60664-1, IEC61800-5-1, IEC60077-1)
Gate Driver Isolation Techniques

- **Inductive coupling**
  - Core based pulse transformer
  - IC-integrated coreless transformer
  - Lead frame integrated coreless transformer (FluxLink™)

- **Optical coupling**
  - Optocoupler
  - Fiber optics

- **Capacitive coupling**
  - Capacitive coupler

- **Monolithic coupling**
  - Level shifting only
Magneto-Inductive Coupling

**Planar core**
- Low profile
- Fast and accurate
- Limited isolation capability

**Ring core**
- Rugged
- High isolation capability
- Fast and accurate
- Flexible form factor
- Expensive

**Coreless IC**
- Low cost
- Very fast
- Low coupling capacitance

Leadframe coreless transformer (FluxLink)
Chip-integrated coreless transformers

New Standard: VDE 0884-11 → 17
FluxLink IC Technology: Leadframe Acts as a Coreless Pulse-Transformer

**Benefits**
- Galvanically isolated
- Reinforced isolation for 1200 V (basic for 1700 V)
- Fast and accurate (very low jitter and delay-time)
- Stable, low parameter-shift across lifetime
- Low coupling capacitance
- Supports high switching frequency
- Multible signals, bi-directional
- Maintains isolation integrity after IC destruction
- ≥ 0.4 mm distance filled with homogenous mold compound

**Challenges**
- New technology
- Limited product portfolio
- Single source
FluxLink Provides 6 kV of Surge-Voltage Isolation

FluxLink is certified to VDE 0884-10
FluxLink Isolation is Robust

- Protects from $\frac{di}{dt}$
- Protects from $\frac{dv}{dt}$

Magnetic Field

System Couple Capacity

Common Mode Current

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EMC Tests (External Magnetic Field) - Induce Strong Magnetic Field to Test SCALE-iDriver™ Immunity

- Fast transient magnetic fields were generated
- Up to 2000 A/m created in all three axes

NoiseKen INS-4040 noise generator

SCALE-iDriver on RDHP-1526

Inductive coil connected to noise generator
Produces magnetic field applied to SCALE-iDriver

Field strength measurement coil
EMC Tests (External Magnetic Field) - Induce Strong Magnetic Field to Test SCALE-iDriver Immunity

Magnetic distortion pulse

Output from gate driver
New Industrial Package Easily Meets Requirements of the IEC 60664-1 Standard

- Inner isolation needs to match with outer isolation
  - CTI 600 mold compound
  - Package with 9.65 mm creepage
  - Very thin Package only 2.51mm

<table>
<thead>
<tr>
<th>Package</th>
<th>Agency Reporting</th>
<th>Parameter</th>
<th>Measured plane distance (mm)</th>
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</thead>
<tbody>
<tr>
<td>eSOP-R16B</td>
<td>TUV IEC60950</td>
<td>Creepage</td>
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RDHP-1608: 2-Channel Reference Design Employs a Simple 2-Layer PCB

FluxLink magneto-inductive coupling transmits data across the isolation barrier.

RDHP-1508: 2 Channel IGBT Driver Reference Design
Simplified Schematic – Gate Current Up to 8 A (pk) Drives IGBT Collector Current Up to 600 A

- Isolated power supply
- Short-circuit detection resistors network
- Gate clamping diode
- Minimum-pulse suppression circuit
- Fault output signal pull-up resistor
- Supply voltage capacitors
- Gate resistors
- Power module
Advanced Soft Shut Down (ASSD) Safety Feature

- Key parameters:
  - \( t_{FSSD1} \) – first decrease in \( V_{GE} \)
  - \( t_{FSSD2} \) – decrease in \( V_{GE} \)

Voltage sense measurement (GH)

Gate current-sink measurement (GL)

Gate Voltage and Current control is independent of external components and setups
Active Standards Organizations: Keep Up-to-Date With Rapidly Evolving Requirements

IEC 60747-5-5
Optoelectronic devices photo-couplers

VDE 0884-10 and 0881-11
Magnetic and capacitive couplers for safe isolation
Will be replaced by VDE 0884-17

IEC 60747-17
Magnetic and capacitive coupler for basic and reinforced isolation
Valid from ~ 2018 Target

VDE 0884-17
Magnetic and capacitive coupler for basic and reinforced isolation
Valid from ~ 2018 Target

Component level standards (component insulation capabilities)

System level standards (isolation coordination)

IEC 60664-1
Insulation coordination for equipment within low-voltage systems - principles, requirements and tests

IEC 61800-5-1 new UL 61800-5-1
Adjustable speed electrical power drive systems – safety requirements
Many Isolation Approaches Provide Benefits that Extend Beyond Simple Protection

- Each approach to signal transfer has benefits and disadvantages

- New technologies like FluxLink provide improved performance
  - New opportunities to solve existing problems
  - Very high isolation voltage

- Standards constantly evolving – keep up to date

- For more information visit https://gate-driver.power.com/