

Isolation Products from TI: Benefits, Applications and Systems Considerations

Abhijeeth Aarey | Isolation Group, Texas Instruments

abhijeeth@ti.com | www.ti.com/isolation

Agenda

- Brief Introduction to Isolation standards and terminology.
- TI Isolators Physical Construction and Circuit Architectures.
- Isolation requirements and usage in end equipment and TI solutions:
 - Motor Control
 - Solar Inverter
 - PLC
 - Automotive
 - Power Delivery
- System Considerations:
 - Electromagnetic Compatibility (EMC)
 - Isolator Failure Modes
- TI Designs

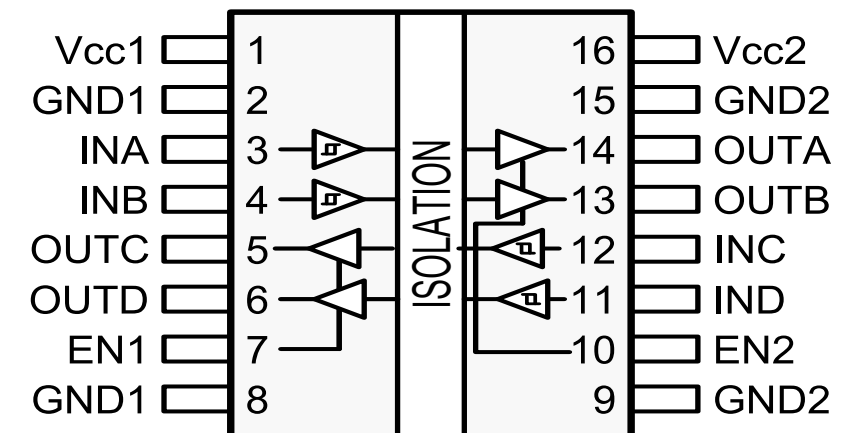
What is Isolation?

Is a means of preventing DC or uncontrolled transient current from flowing between two communicating points.

Why Isolate?

1. Where there is a possibility for high voltage surges that may damage equipment or harm humans.
2. Where interconnections involve large ground potential differences (GPDs) and disruptive ground loops are to be avoided.
3. Communication to high side components in motor drive systems.

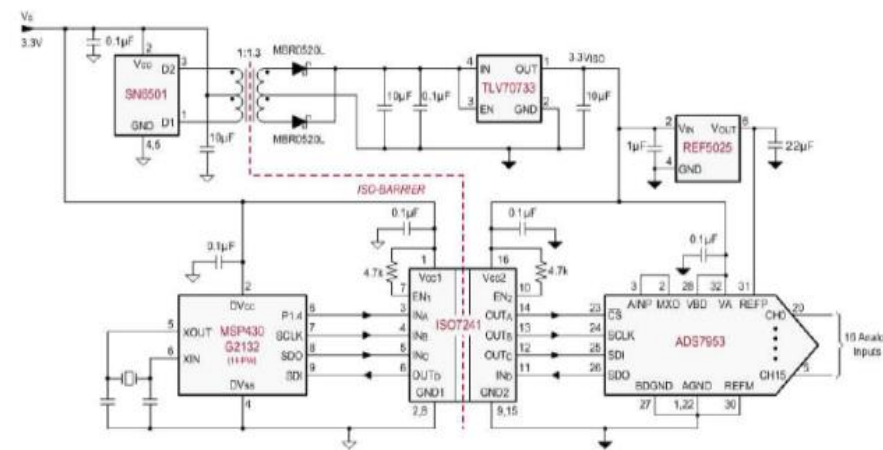
Isolation enables communication between a transmitter and a receiver, referenced to very different ground potentials



Example Isolator in a 16-pin package

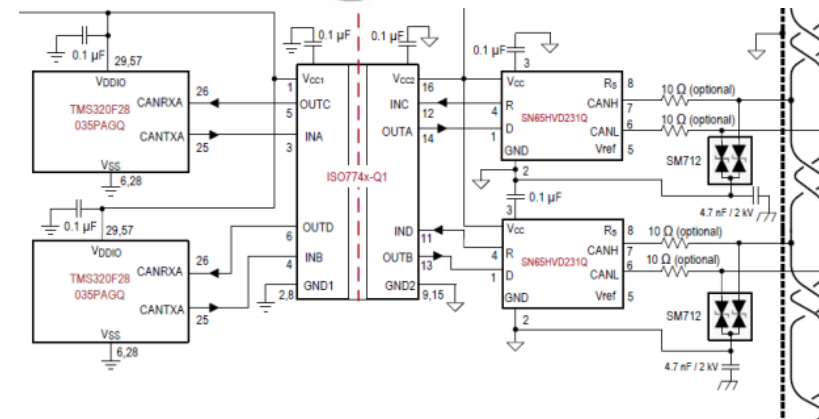
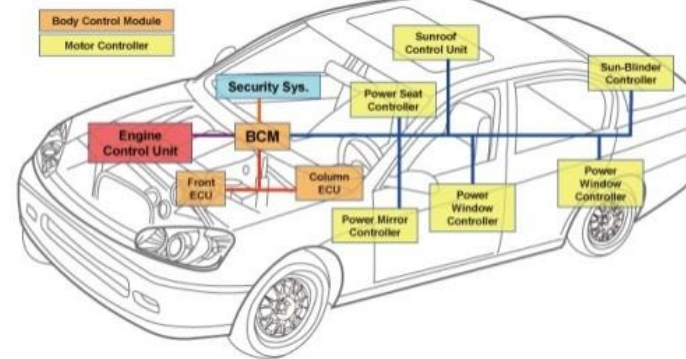
Isolation – example applications

PLC I/O & Communication



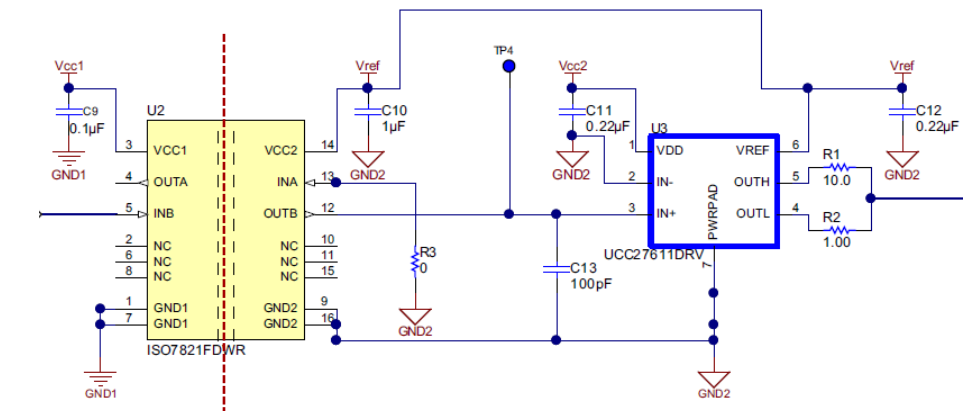
Isolate microcontroller from analog inputs/outputs

Automotive BMS & Communication



Isolate battery management and other automotive systems from high voltage battery packs and high voltage transients from engines / motor drives.

Motor Drives Gate Drive & Sensing



Protect microcontroller from High Voltage. Secondary side ground is connected to IGBT emitter : subject to high voltage transitions by construction.

Other Applications: Patient monitoring systems, Solar Inverters, HVAC

Standards that apply to Isolation

- Component level Standards:
 - IEC 60747-5-5 (VDE 0884-5-5) for Opto Isolators.
 - VDE 0884-10 / VDE 0884-11 for Capacitive/Magnetic isolators, reinforced
 - IEC 60747-17
 - UL 1577
- System Level / End Equipment Standards
 - IEC 61800-5-1, safety requirements for adjustable speed drives
 - IEC 60601-1, Medical equipment standard
 - IEC 61010-1, safety standard for measurement, control and Lab equipment
 - IEC 60950-1, Telecom equipment standard
- EMC and Emissions
 - IEC 61000-4-x , ESD, EFT, Surge, RF immunity
 - CISPR22 or equivalent, EM emissions

TI Isolators must pass

Customer boards and systems
must pass – TI Isolators should
enable

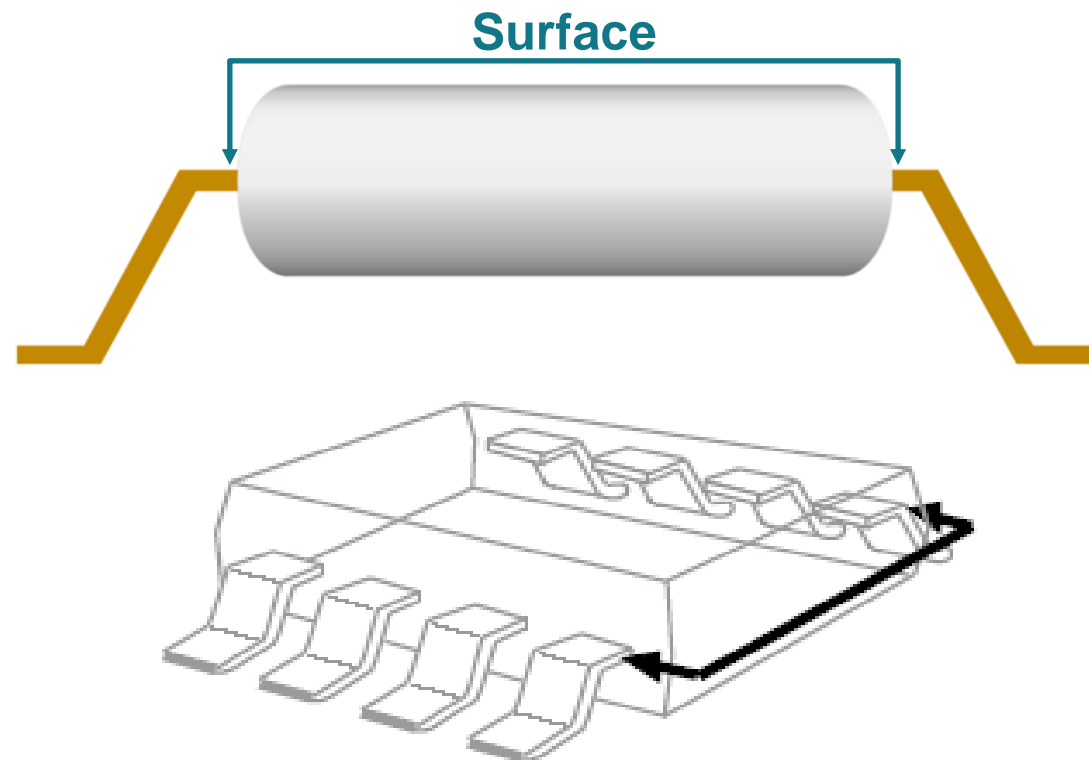
Isolation terminology (in brief)

Parameter	Definition	Relevance
Basic Isolation	Isolation that can provide protection against high voltage as long as the barrier is intact.	Basic isolation needs to be coupled with another insulation barrier, if human access is possible.
Reinforced Isolation	Isolation that is equivalent to two basic isolation barriers in series.	Reinforced isolation by itself is sufficient as a safety barrier against high voltage.
V_{IOTM}	The sinusoidal voltage isolator can tolerate for 60s (defined in peak)	Tolerance to temporary overvoltage on supplies due to load changes, arcing etc.
V_{ISO}	The sinusoidal voltage isolator can tolerate for 60s (defined in rms)	
V_{IORM}	Maximum periodic voltage that the isolator has to handle on a continuous basis throughout its operating life (defined in peak)	The voltage that the isolator has to handle as part of normal operation (for eg. an isolated gate driver sees a pk voltage equal to the DC bus voltage).
V_{IOWM}	Maximum continuous working voltage that the isolator has to on a continuous basis throughout its operating life (defined in rms)	
V_{SURGE}	Maximum peak voltage of the 1.2us/50us standard surge waveform that the isolator can handle.	Represents direct and indirect lightening strikes. Min 10kV required for reinforced isolation.
Creepage	Minimum distance from pins on side 1 to side 2 along the surface of the package	Limits working voltage or continuous voltage due to degradation along package surface (called tracking)
Clearance	Minimum distance from pins on side 1 to side 2 through the air	Limits peak voltages and surge voltages in system environment due to air breakdown
CMTI	The maximum rate of change of ground potential difference (GND1-GND2) that the isolator can withstand without bit errors	Indicates robustness of isolator to ground noise. Very important in gate-drive applications

For details refer: <http://www.ti.com/lit/pdf/slyy063>

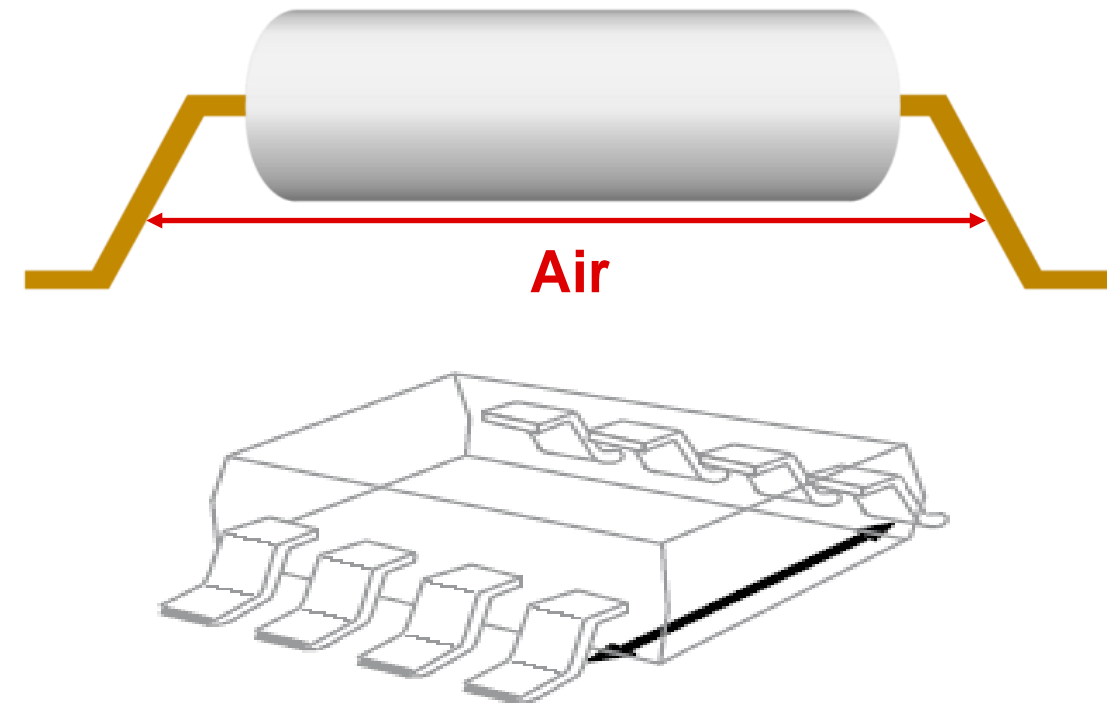
Creepage & clearance

Creepage distance



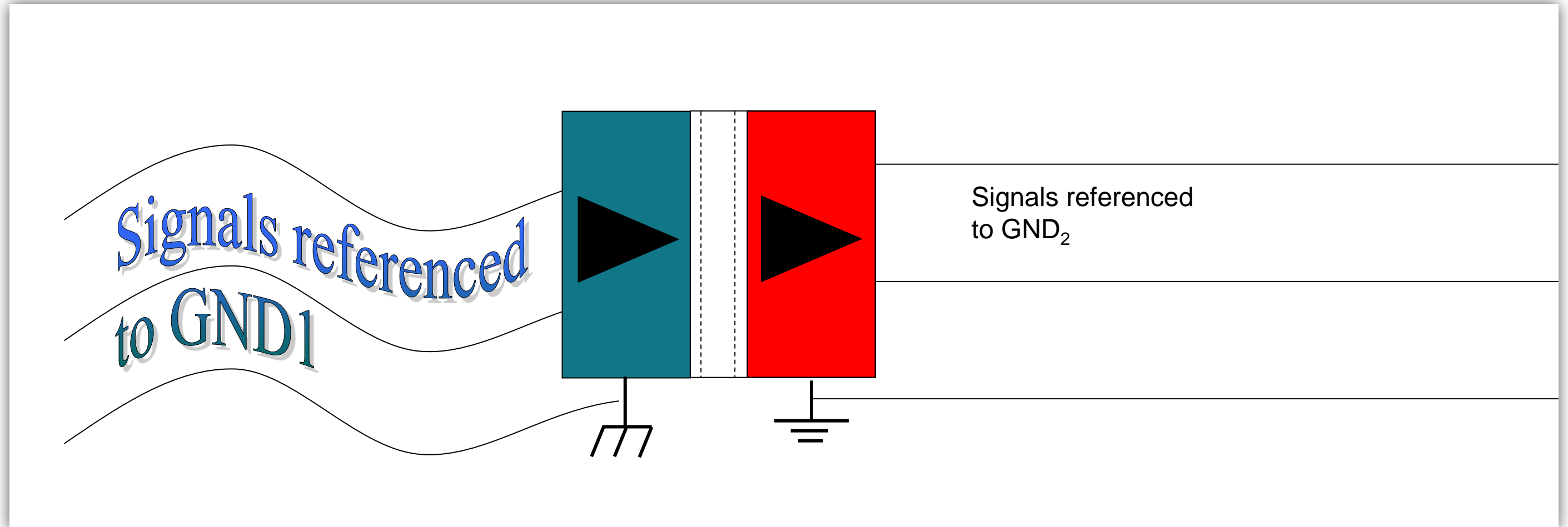
Shortest distance between two conductive leads, across isolation barrier, measured along surface of insulation.

Clearance distance



Shortest distance between two conductive leads , across isolation barrier, measured through air.

Data isolation: Common-Mode Transient Immunity

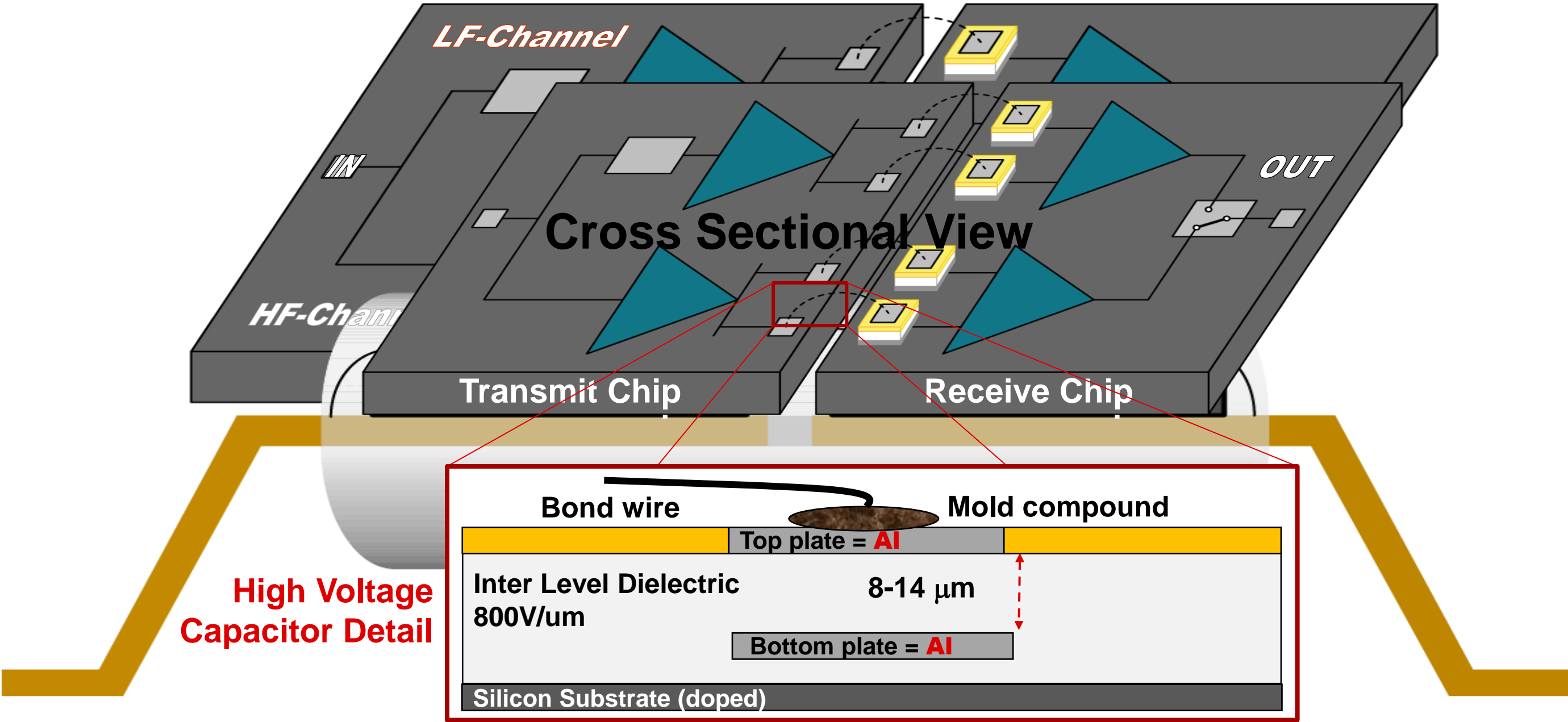


CMTI – The change in ground 1 relative ground 2. Measured in kV / μ Sec.

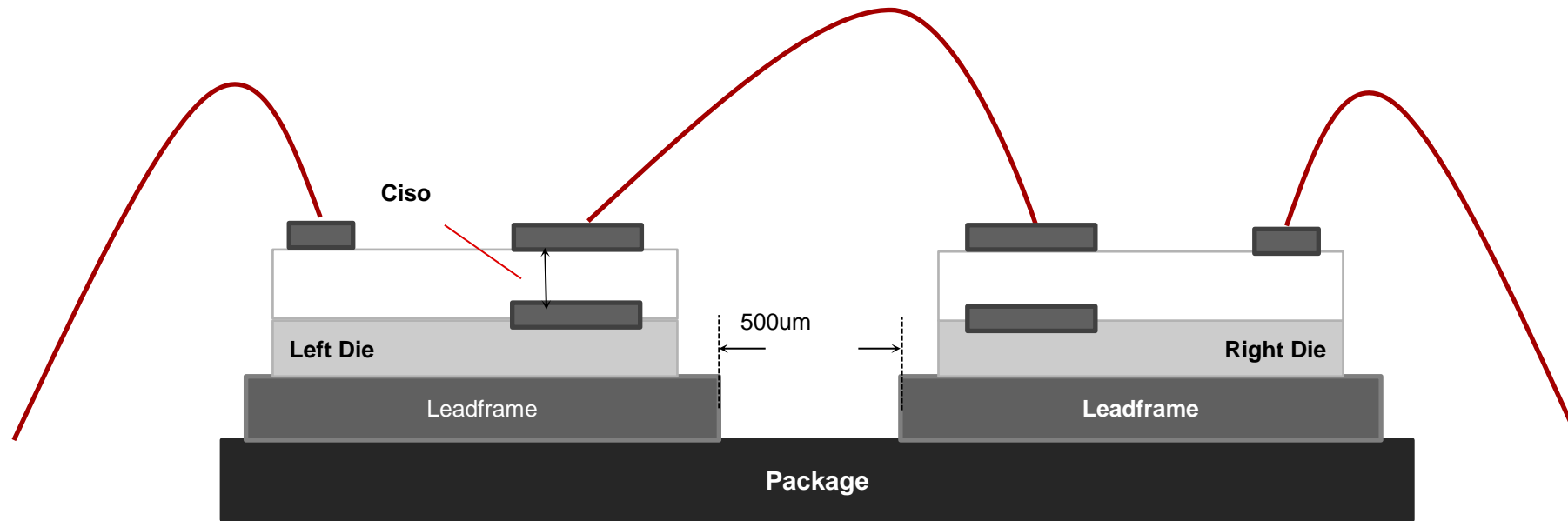
Agenda

- Brief Introduction to Isolation standards and terminology.
- TI Isolators Physical Construction and Circuit Architectures.
- Isolation requirements and usage in end equipment and TI solutions:
 - Motor Control
 - Solar Inverter
 - PLC
 - Automotive
 - Power Delivery
- System Considerations:
 - Electromagnetic Compatibility (EMC)
 - Isolator Failure Modes
- TI Designs

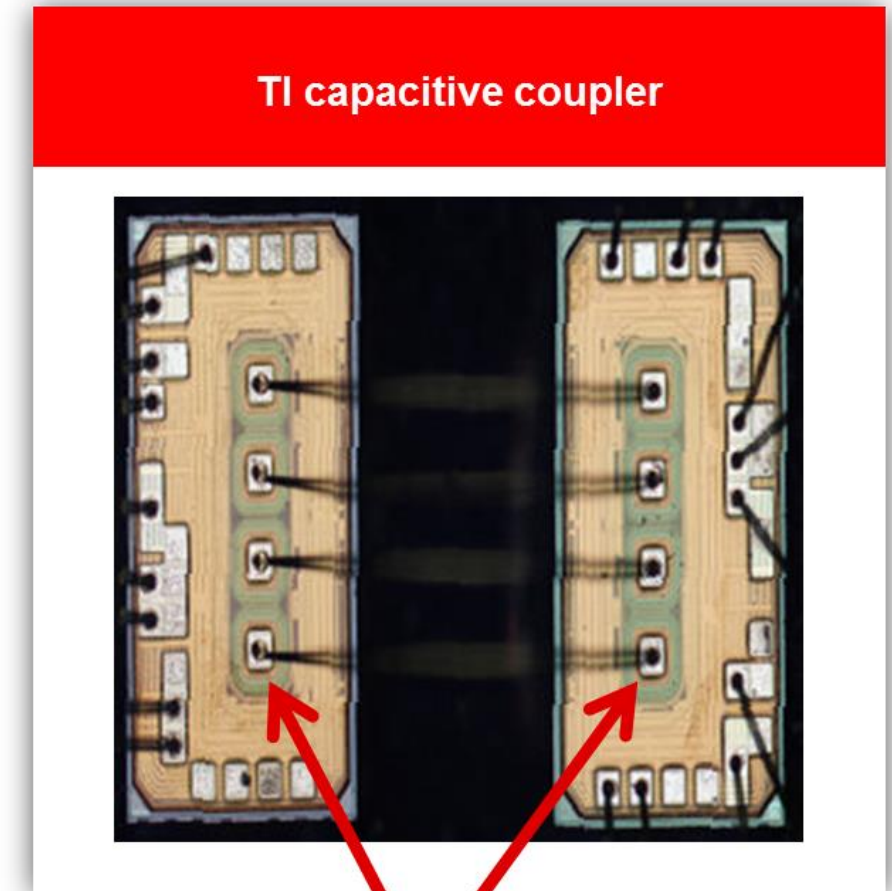
How are capacitive isolators constructed?



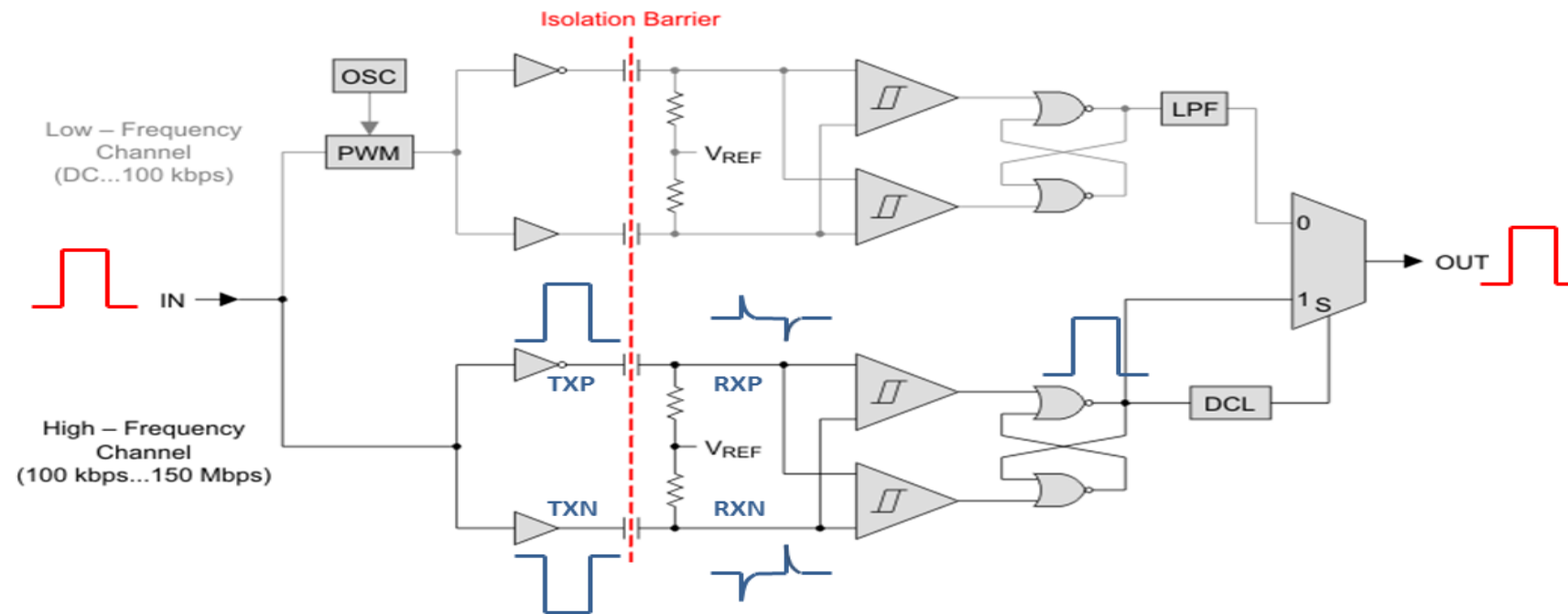
How are capacitive isolators constructed?



**Two Capacitors In Series:
Industry Leading Reinforced Isolation**



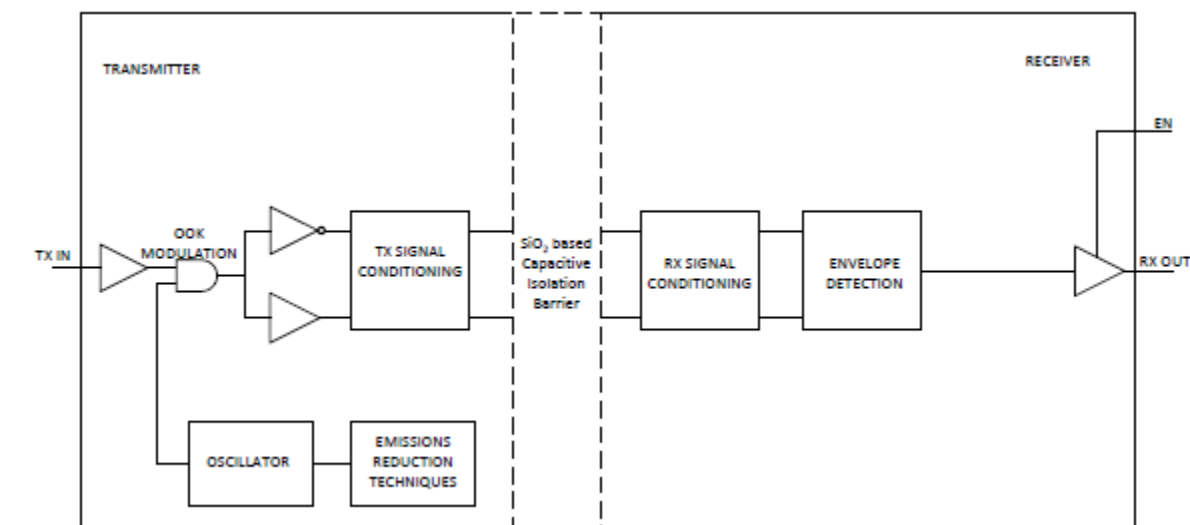
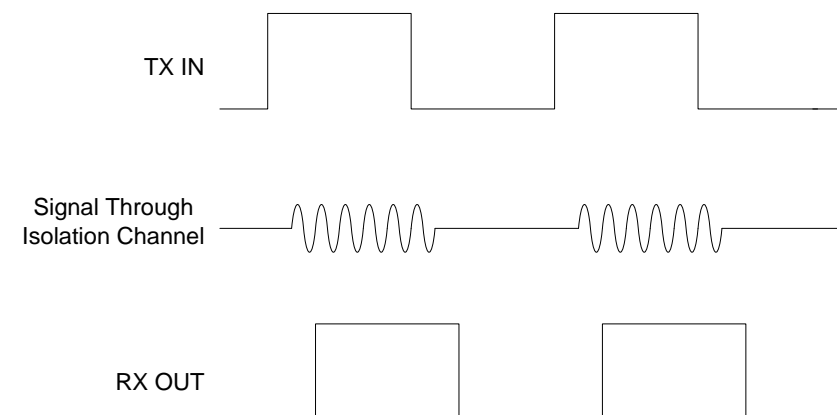
Isolation build with 2 capacitors
(TI couplers with reinforced isolation)



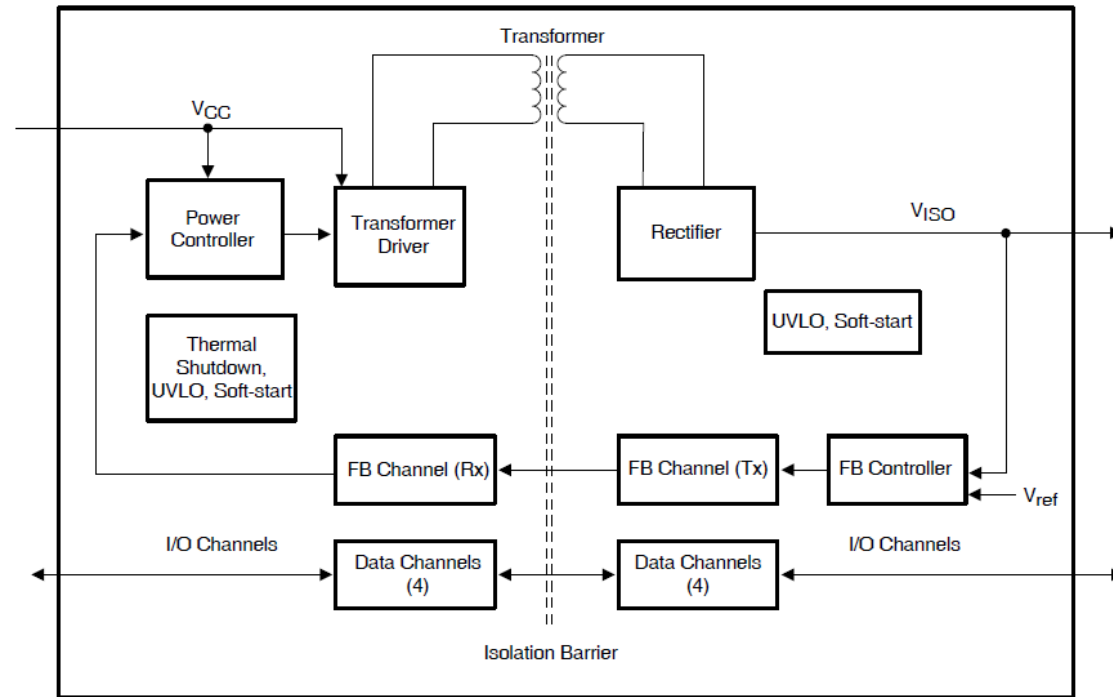
Edge Based Architecture – Best Suited for Low Power

On-Off-Keying Architecture – Best Suited for High Immunity

Spread Spectrum Clock for low emissions



Circuit Technology – ISOW & 24V Digital Input

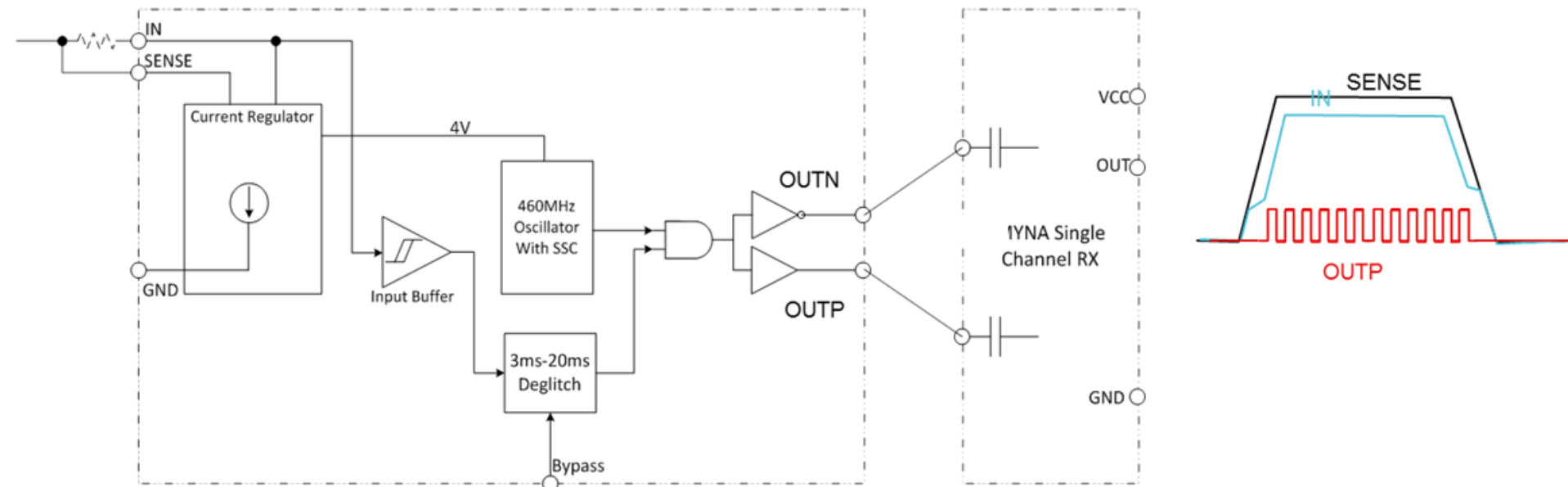


Integrated Signal & Power Architecture – Best Suited high space constraint applications

Spread Spectrum Clocking for both power and signal reduce emissions

24V Digital Input Isolator Architecture – Best Suited for Field Digital Inputs

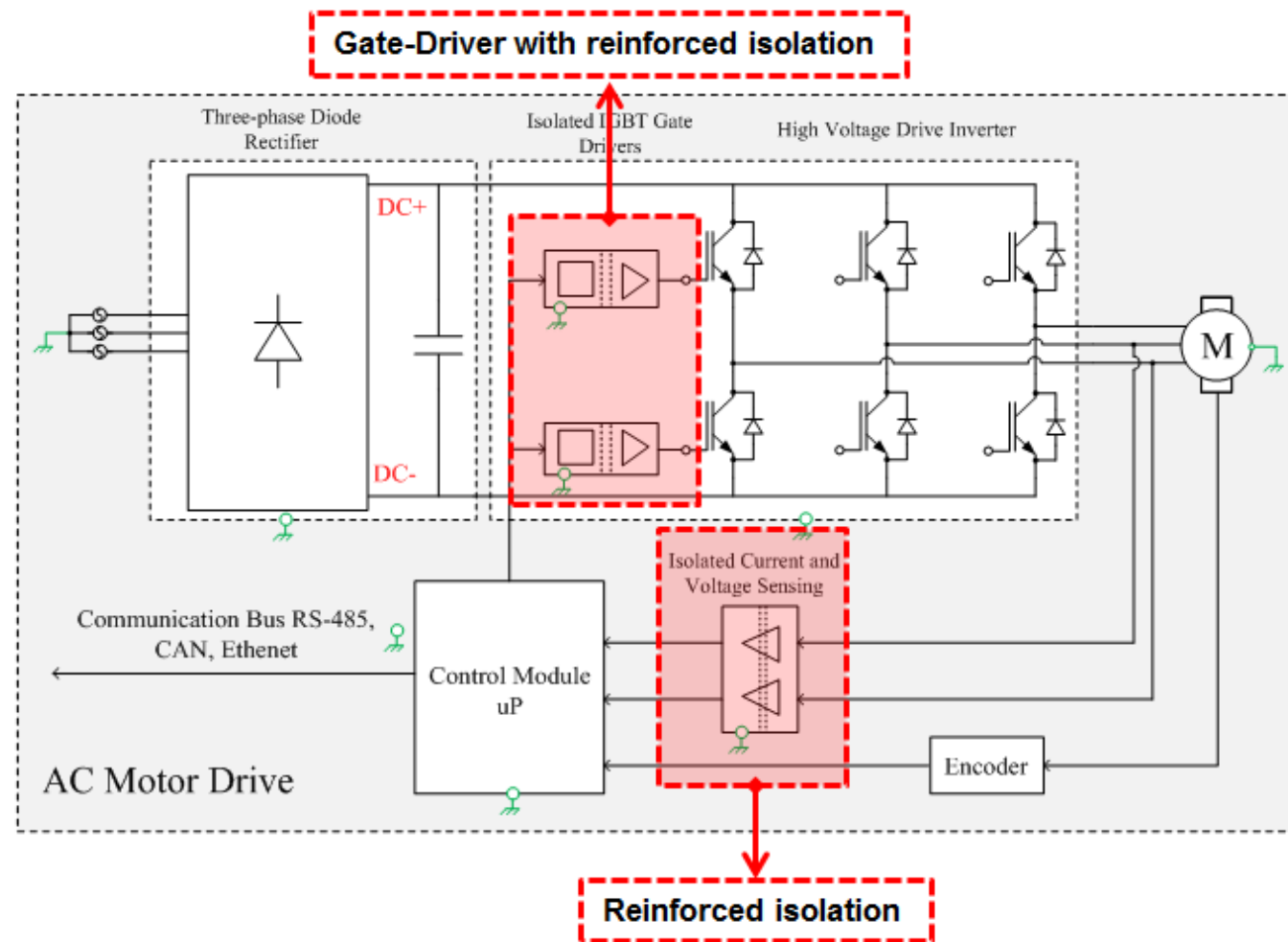
Spread Spectrum Clocking for low emissions



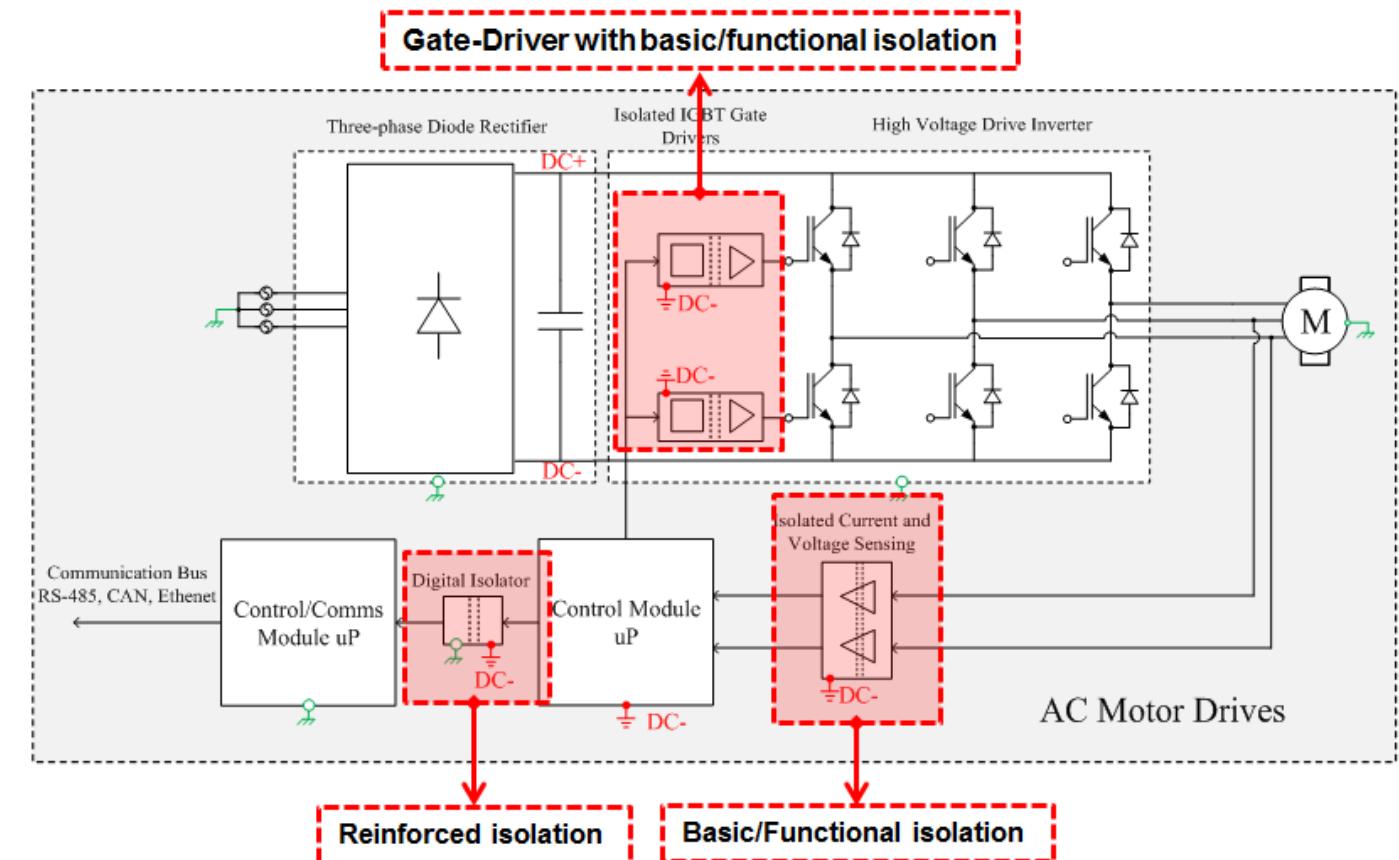
Agenda

- Brief Introduction to Isolation standards and terminology.
- TI Isolators Physical Construction and Circuit Architectures.
- Isolation requirements and usage in end equipment and TI solutions:
 - Motor Control
 - Solar Inverter
 - PLC
 - Automotive
 - Power Delivery
- System Considerations:
 - Electromagnetic Compatibility (EMC)
 - Isolator Failure Modes
- TI Designs

Isolation in motor drives - architectures



Gate-driver and Voltage/Current sense circuits interface with an earth referenced Control Module.



Gate-driver and Voltage/Current sense circuits interface with a DC bus referenced control module.

Isolation in motor drives – insulation coordination

System Voltage (V _{RMS})	Basic/ Reinf	Temporary Overvoltage (V _{RMS} / V _{PK})	Impulse /Surge Voltage (V _{PK})	Clearance (mm)	Working Voltage (V _{RMS})	Creepage		
						CTI I	CTI II	CTI III
300	Basic	1500 / 2120	4000	3	500	2.5	3.6	5
600	Basic	1800 / 2550	6000	5.5	690	3.5	5.6	6.9
1000	Basic	2200 / 3110	8000	8	1000	5	7.1	10
300	Reinf	3000 / 4240	6000	6.7	500	5	7.2	10
600	Reinf	3600 / 5100	8000	8.7	690	7	11.2	13.8
1000	Reinf	4400 / 6200	12000	14	1000	10	14.2	20

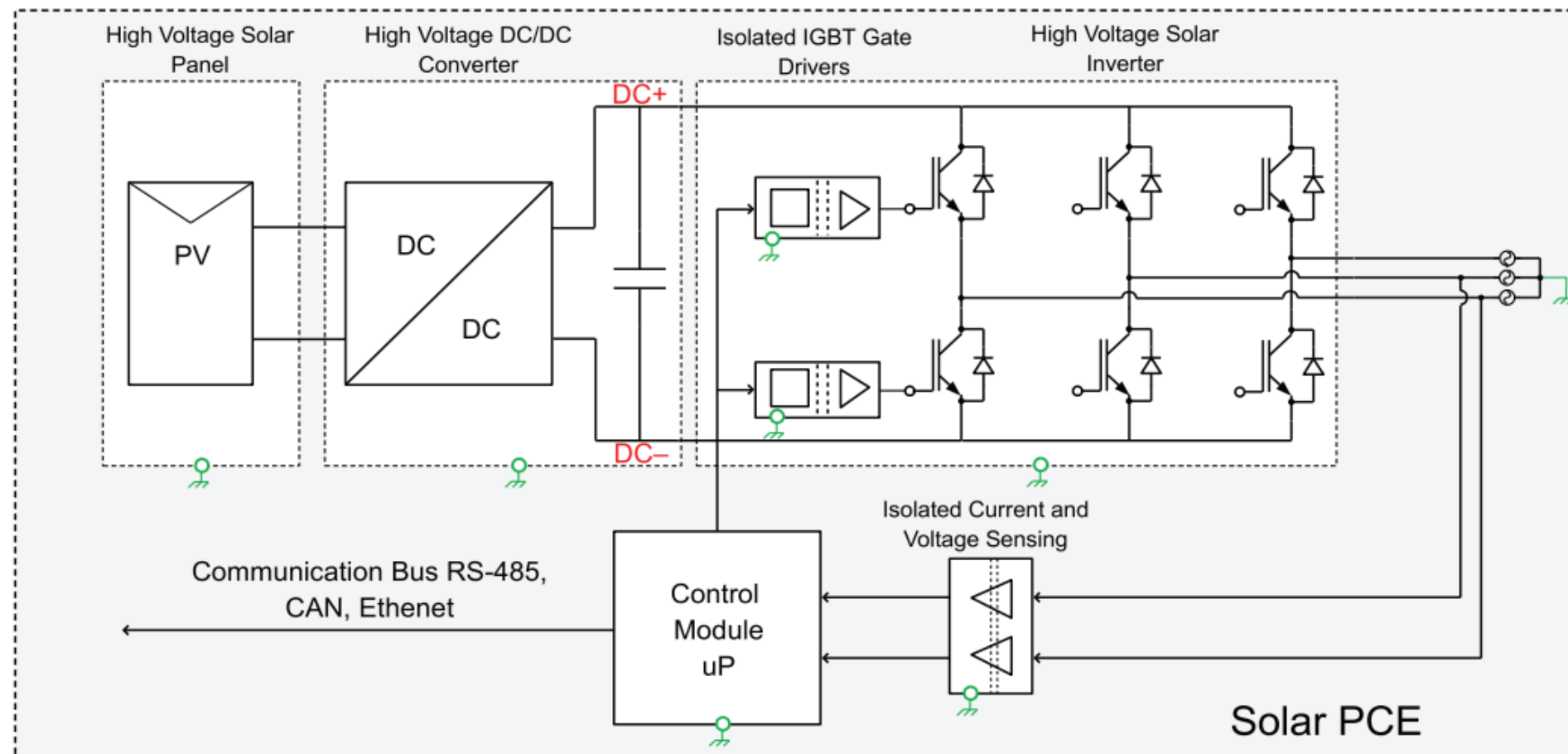


Depending on System Voltage (Related to Input Power Supply), insulation requirements change:

1. Temporary Overvoltage (VISO/VIOTM) – **upto 6220 Vpk**
2. Impulse Voltage (VSURGE) – **upto 12 kVpk**
3. Creepage and Clearance – **upto 14 mm**

For details on isolation in Motor Drives:
<http://www.ti.com/lit/wp/slyy080/slyy080.pdf>

Isolation in Solar Inverter and Wind Energy Inverter



Insulation Coordination and Isolation requirements are very similar to Motor Drives



CMTI is a key care about to improve efficiency and reduce cost per unit power.

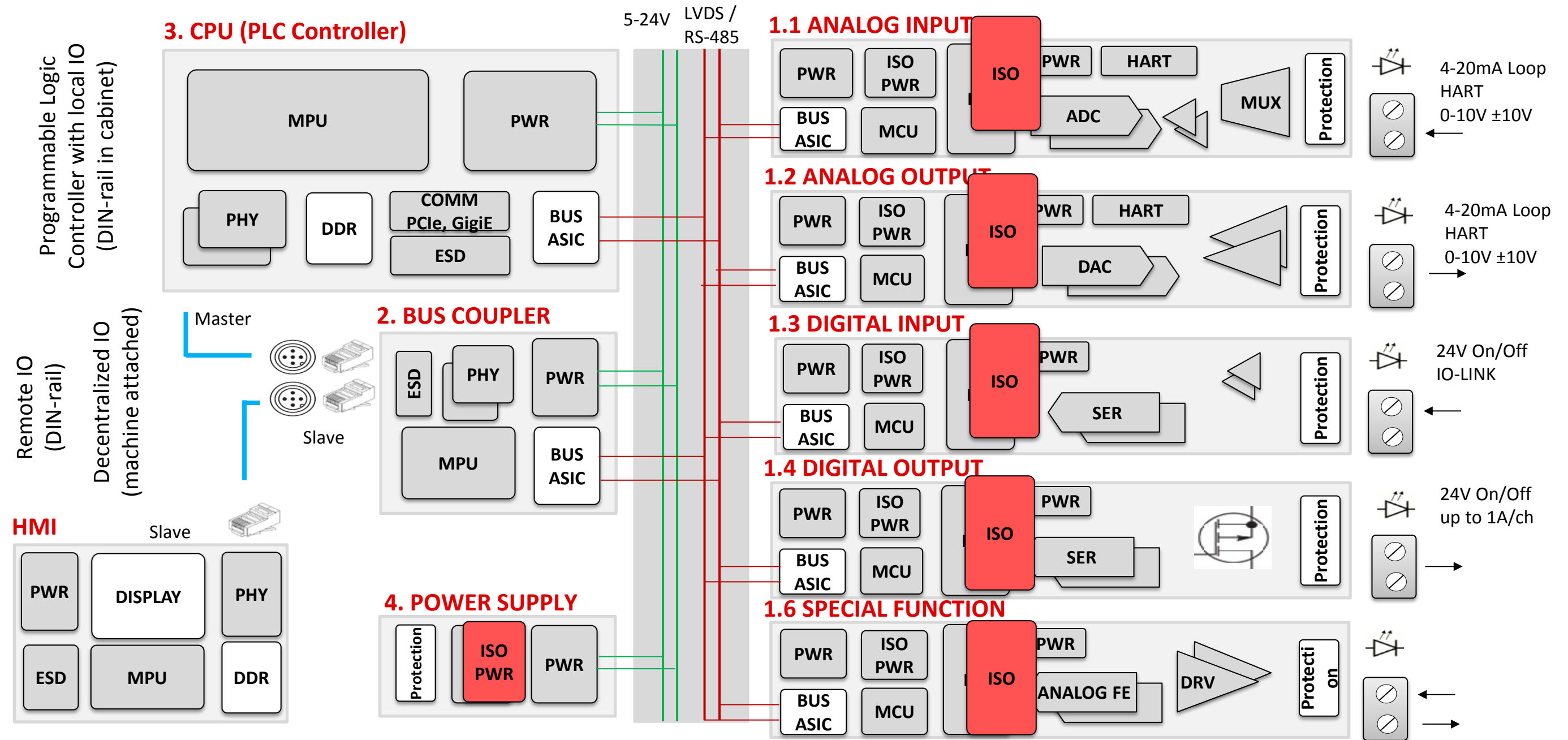
High working voltage is a key requirement due to increasing bus voltages (1500V)

High creepage and clearance preferred due to high altitude operation and pollution (dust and moisture)

TI Isolation Products for Motor Control and Renewable Energy

Products	Description	Key Benefits
ISO78xx DW and DWW	100 Mbps Reinforced Digital Isolators	5.7 kVrms VISO 12.8 kV surge Upto 2 kVrms working voltage 14.5 mm package 100 kV/us min CMTI DESAT and Miller Clamp Safety High data-rates, and low skews CTI > 600 mold compound Fail-Open Behavior
ISO78xxLLx DW and DWW	150 Mbps Reinforced Isolated LVDS buffers	
ISO585x DW and DWW ISO545x DW	Reinforced isolated IGBT/SiC gate-drivers with Safety features	
AMC130x	Reinforced isolated Delta Sigma modulators and amplifiers	
ISO53xx (Samples available)	Compact (8-pin) basic isolated IGBT gate-drivers	Compact size, 100 kV/us CMTI, 0.5A to 10A flexible output current drive

PLC System Block Diagram - Architecture



PLC System – Insulation and Other Requirements

Insulation:

24V powered systems, high voltage is normally not present.

500 Vrms Working Voltage, 2.5 kVrms (1s, VISO), basic isolation is sufficient.

However:

ESD (6kV-8kV) and EFT (4kV) are important !

Especially on the interconnect: ISO-RS485, and ISO-CAN.

Other requirements:

- Low power consumption (to relieve thermal constraints in compact designs).
- EMC – Immunity and Emissions!
- Small packages and multi-channel configurations (6-ch).
- Low propagation delays (for SPI timing closure).
- Lower controller side power supply.



TI Isolation Products for PLC

Products	Description	Key Benefits
ISO73xx and ISO71xx	25 Mbps and 50 Mbps digital isolators	Lowest emissions, Low Power Consumption, Up-to 6 kV surge protection, 4 kV EFT Compact packages (8D and 16DBQ)
SN6501 and SN6505	Push-pull transformer drivers for upto 5W isolated power supplies	Flexible output voltages, high efficiency (80%+), low cost, small footprint, flexible output voltages, ultra low emissions, SSC, Soft Start
ISORS485 and ISOCAN portfolio	ISORS485 and ISOCAN portfolio	Flexible portfolio of interconnect solutions
ISO77xx	100 Mbps Reinforced Digital isolators	2.25V min power supply, > 8kV IEC ESD, EMC hardened, low prop delays, flexible package options (16DW, 8D, 16 DBQ), 6-channel options
ISOW78xx (RTM),	Digital Isolators and Transceivers with Integrated Power Supply	Compact design, fully integrated power+signal isolation. Low emissions, High Efficiency, Soft start
ISO121x (RTM in 2Q'17)	24V isolated digital input receiver with 2mA current limit	Fully integrated solution for digital input modules (1 & 2 channel configurations)

ISOW7841 - Digital Isolators w/ integrated power

5000 V_{RMS}, 100Mbps, 0.65W Output Power, 53% Efficient, Low EMI

Features

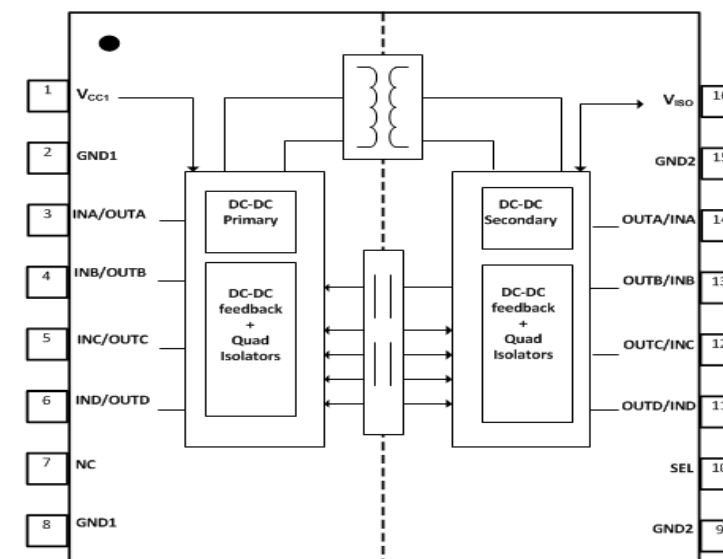
- **Integrated Power with Laminate transformers**
 - > 0.65W power, high efficiency
 - Configurable input/output levels
 - 5V to 5V; 5V to 3.3V; => 130mA output
 - 3.3V to 3.3V => 75mA output
 - Line regulation: 1%
 - Load regulation: 5%
 - UVLO: 2.7V
 - ESD: +/-8kV HBM
 - Robust EMI for IEC61000-4-x ESD, EFT events
 - Soft Start
- **4 Integrated digital isolation channels**
 - 100Mbps, 16ns prop-delay
- **Immunity and Isolation Certifications**
 - 5000 V_{rms} Isolation rating (UL 1577)
 - 10000 V_{pk} Surge VDE Reinforced Isolation
 - 1414 V_{pk} Working (DIN V VDE V 0884-10)
 - 75kV/us min CMTI
- **Power and Package**
 - Wide input Supply Range: 3V to 5V
 - 16-pin Wide SOIC Package (>8.0mm Creepage)
 - Extended Temp: -55 to 125 °C

Applications

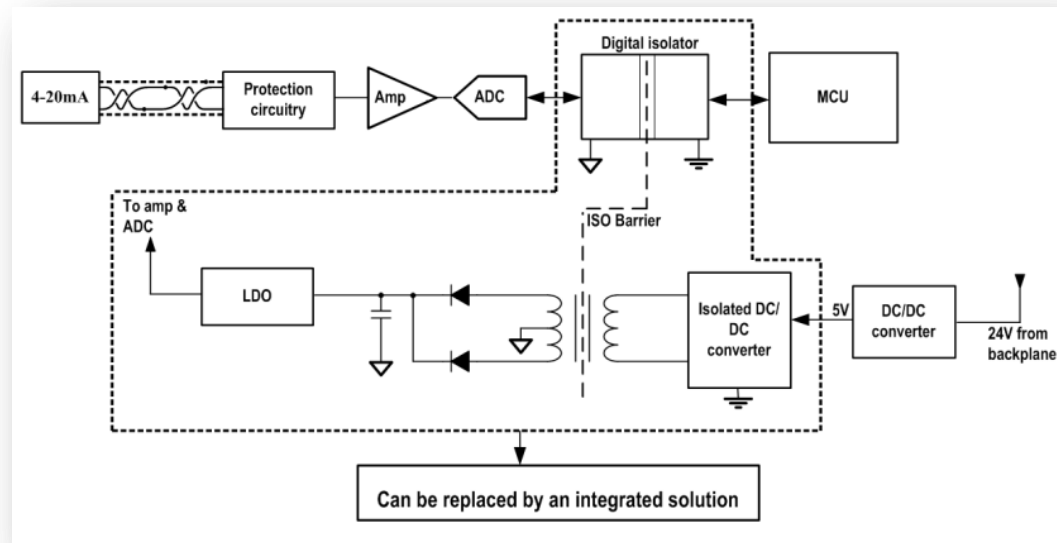
- Industrial Automation
- Motor Control
- Isolated Power Supplies
- Test and Measurement

Benefits

- Isolated communication and power using one chip simplifies system safety compliance testing
- High drive capability to power peripheral interfaces
- Enables cool and low noise operation
- Soft start enables minimal overshoot current, controlled small inrush current.
- Robust isolation performance for reliable operation in harsh environments
- High immunity for noisy environments
- Pin-to-pin with ADuM6401 and ADuM5401



ISOW7841: Value Proposition



Reduces bill of materials and board space

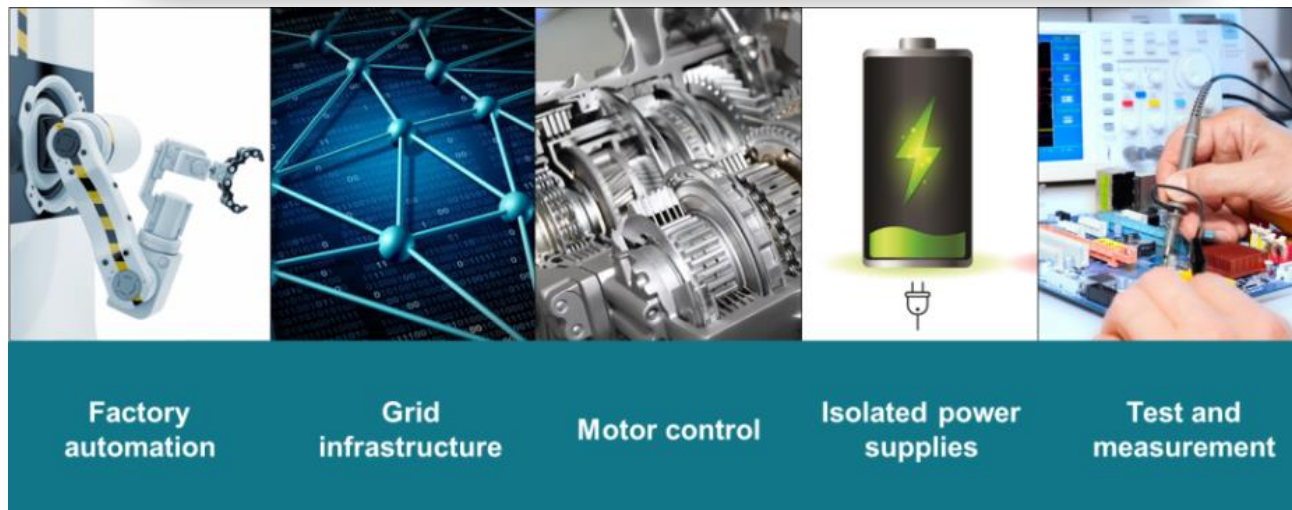
Single chip solution

Ease of system certification

ISOW7841 undergoing all worldwide certifications

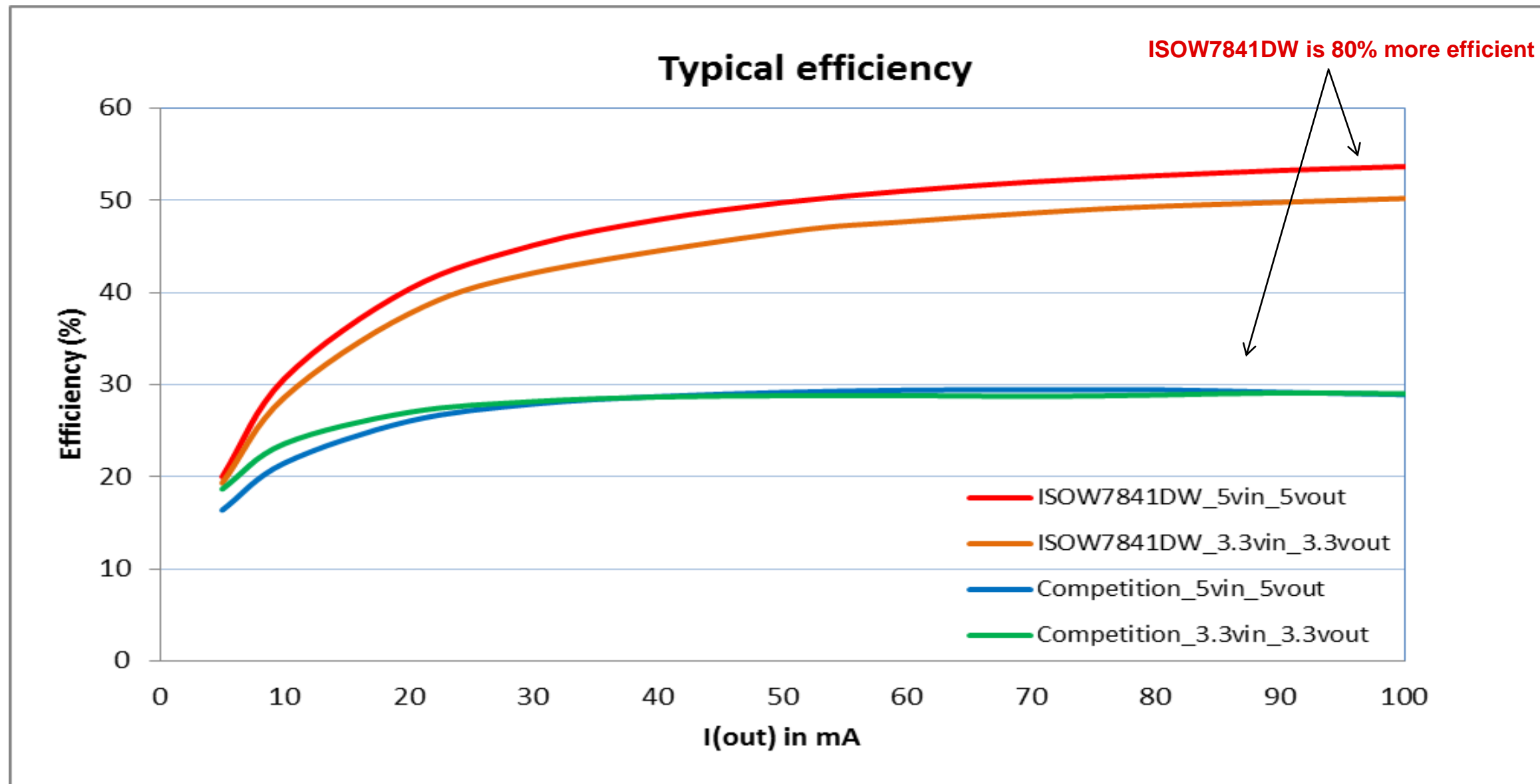
Integrated power promotes simplicity

Emissions: 10dB better; Efficiency: 80% higher



To be truly useful, an integrated data and power isolation solution must offer high efficiency, high power delivery and low emissions while offering high isolation performance.

ISOW7841 v/s Competition Efficiency



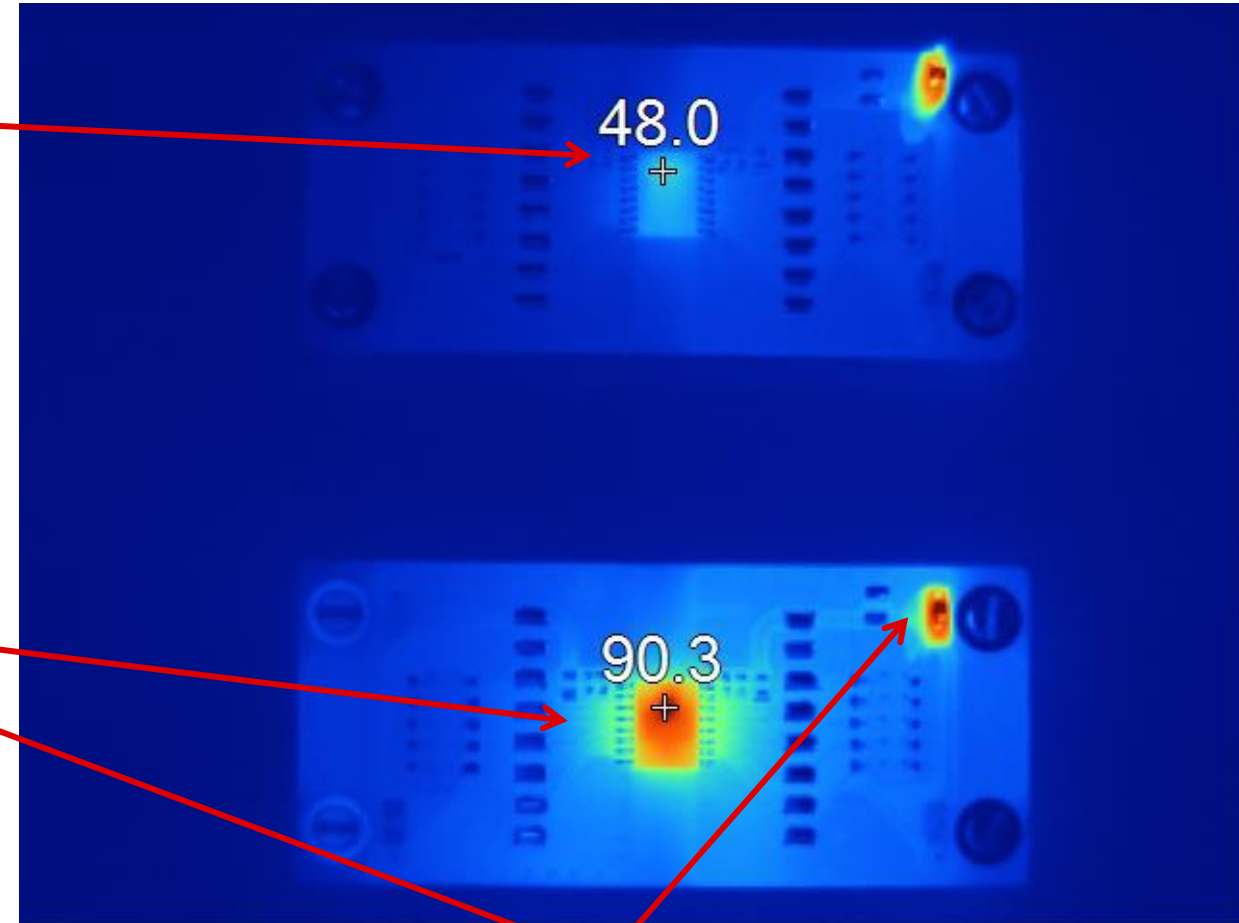
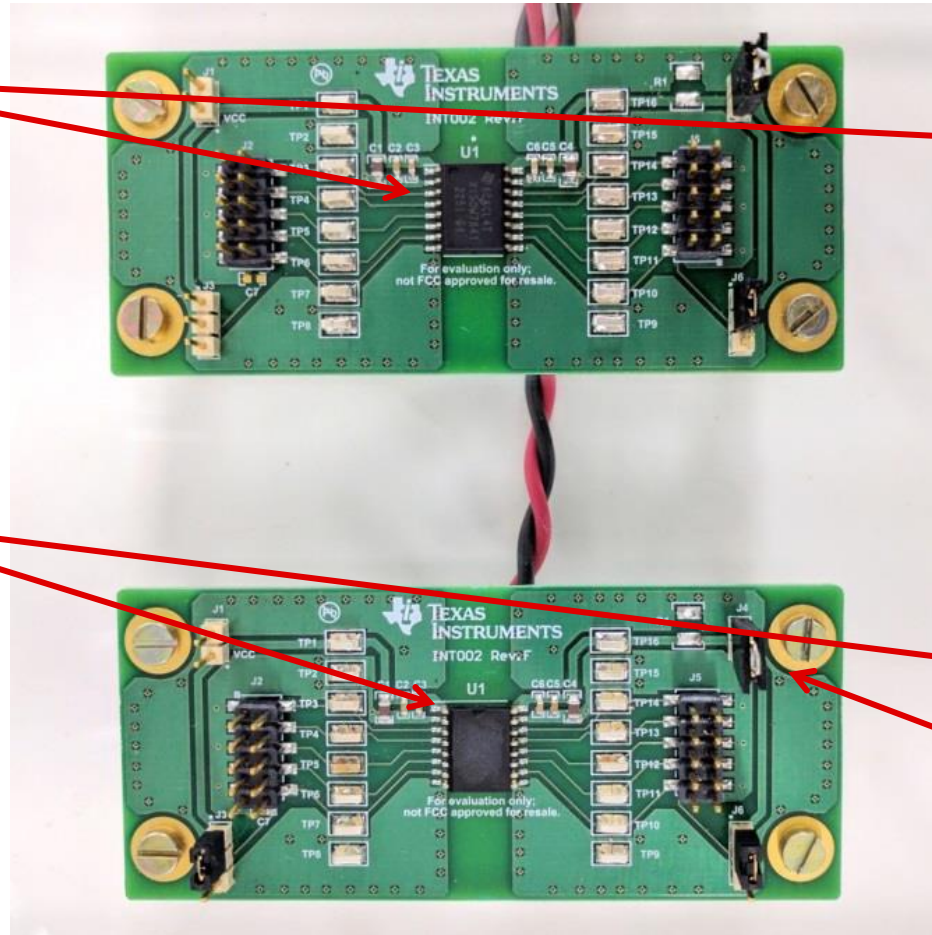
* TI v/s Competition efficiency measurement done at same test setup & conditions

High efficiency = Cooler operation

Image showing setup

Infra-Red image showing hotspots

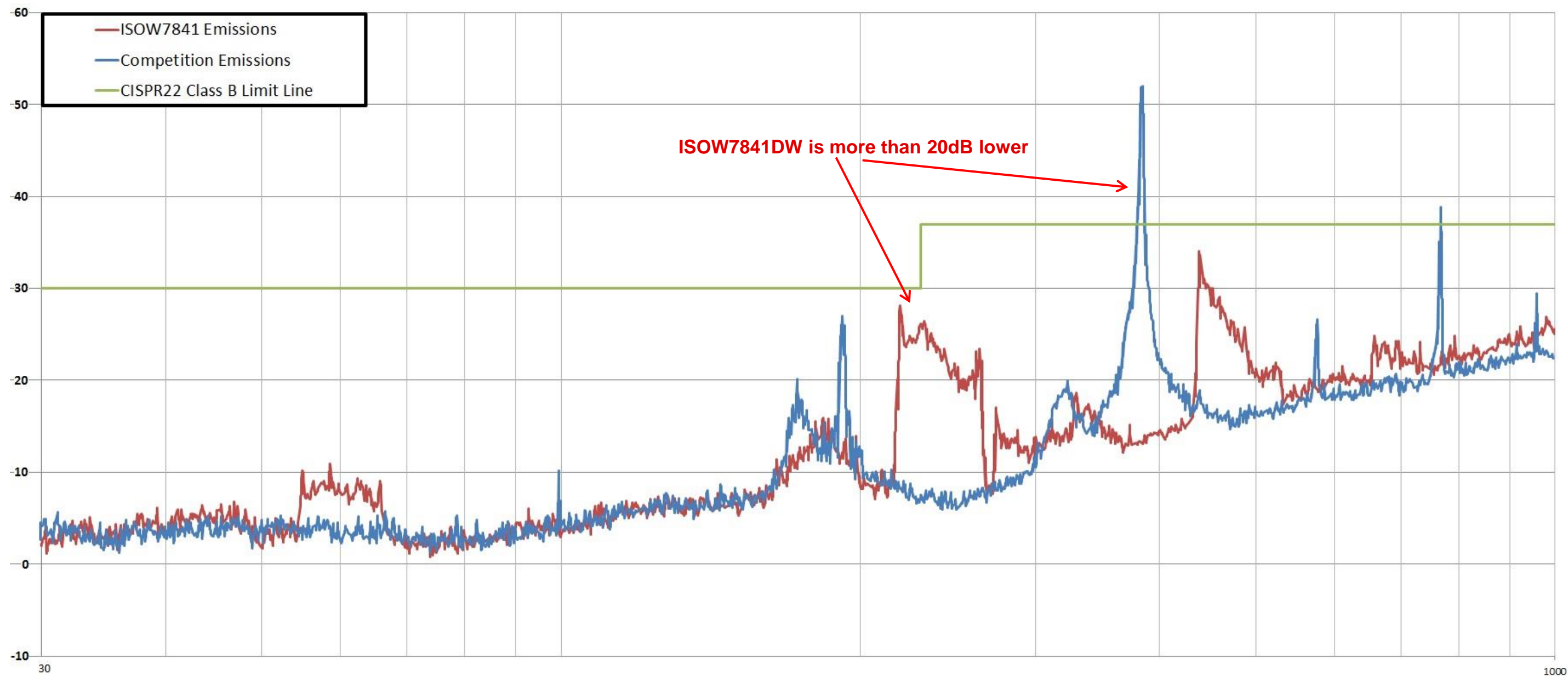
ISOW7841



400mW Load

- TI is **~40°C** cooler than the competition at full load.

ISOW7841 v/s Competition – Radiated Emissions



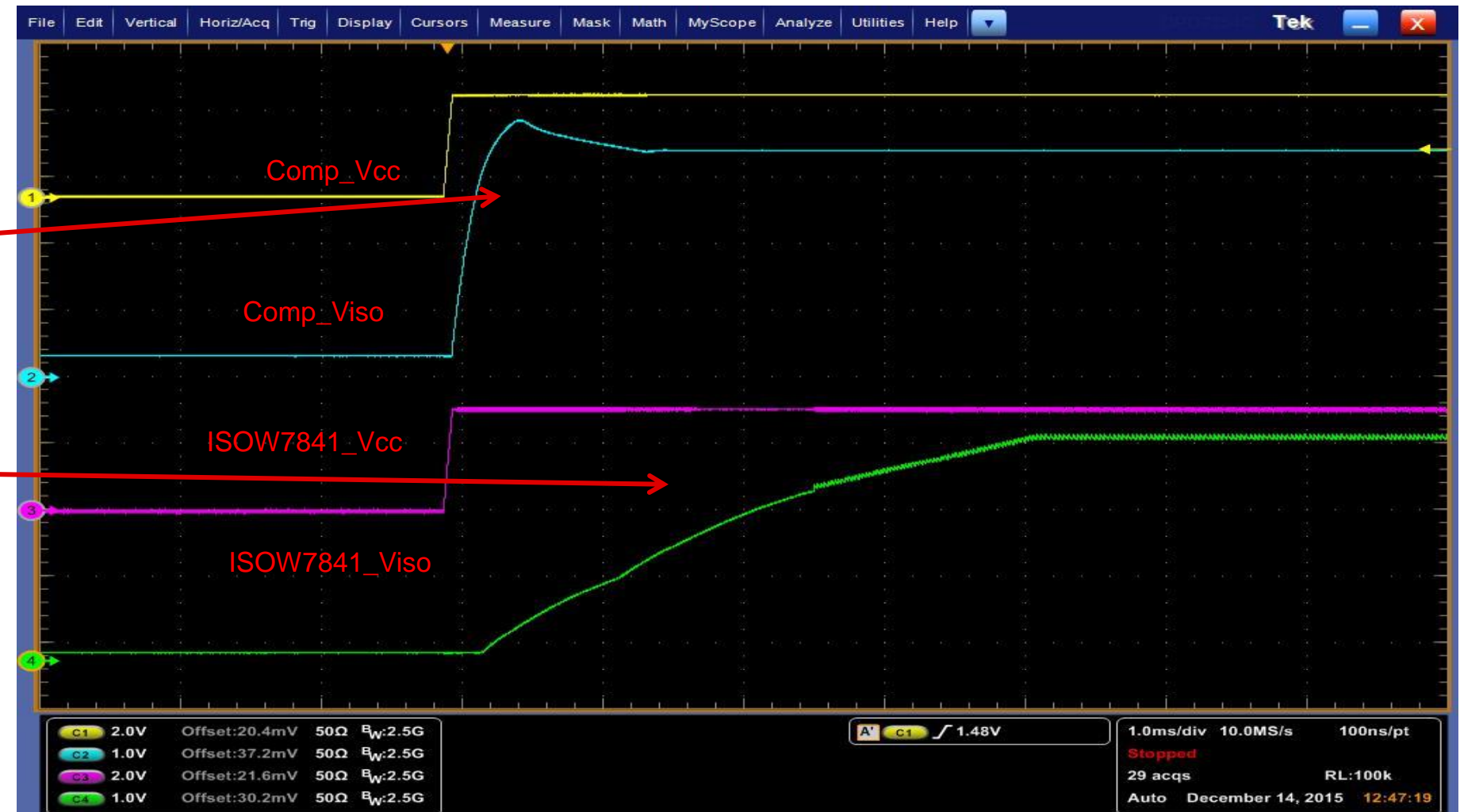
*TI vs Competition emissions measurement done at same test setup & conditions (no stitching cap) at 400mW load at a certified test facility

Soft start = Easier system design

V_{ISO} Power Up Oscilloscope capture

- Competition, overshoots by 0.8V could potentially damage load circuits.
- Very fast power up causes uncontrolled and high inrush current

- ISOW7841 has almost no overshoot.
- Soft start enables controlled small inrush current.



ISO121x – Isolated 24V Digital Input Receiver

3000 V_{RMS}, 5Mbps, with 60V standoff on input pin

Features

• Digital Input Channel

- Does not need field side supply
- IEC 61131-2 Type 1/2/3 characteristics
- +/-60 V stand-off on input pins
- 2.1 mA to 2.5 mA precise current limit, resistor programmable up to 10mA for V_{IN} = 11V to 36V
- 7V to 11V, voltage transition thresholds
- Low propagation delay: 125 ns max
- 5 Mbps data rate

• Integrated SiO₂ Capacitive Isolation

• Immunity and Certifications

- CMTI: 100kV/μs typical (40kV/μs min)
- 3000 V_{RMS} Isolation Rating (UL 1577)
- 6 kV_{PEAK} Surge
- 450 V_{RMS} Working Voltage (DIN V VDE V 0884-10)

• Power and Package

- 2.25V to 5.5V Wide Input Supply Range (V_{CC1})
- Wide temperature range: -55C to 125C
- 1 ch: SOIC - 8D with 4 mm creepage / clearance
- 2 ch: SOIC – 16QSOP with 4 mm creepage/ clearance

Benefits

• Replaces 2mA current limit circuit + Opto-coupler

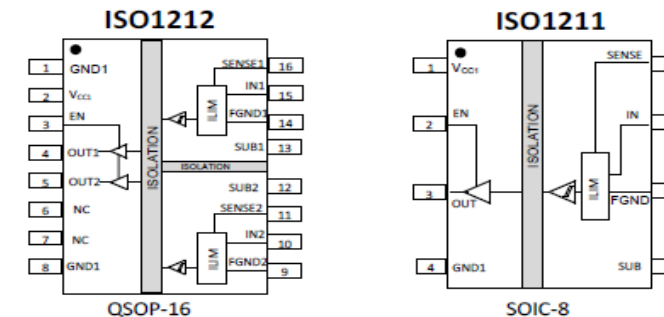
- Does not need field side supply
- Does not need co-design with opto-couplers
- Stable performance over lifetime – no drastic aging

• Basic Safety Isolation rating

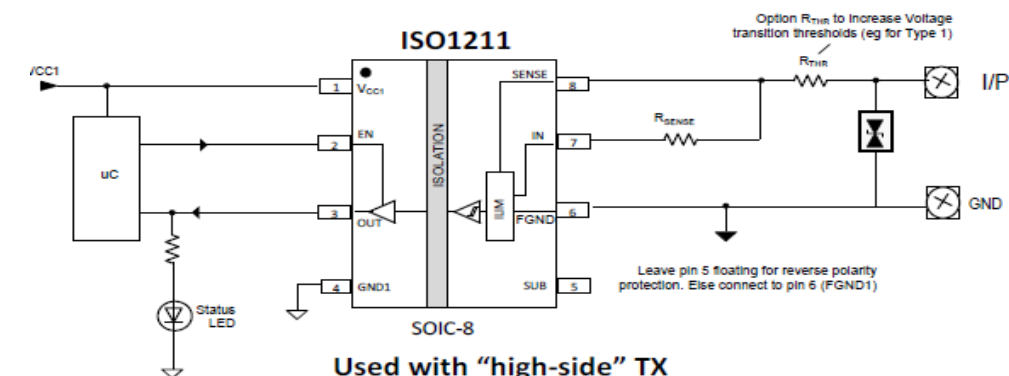
• High Immunity

- Robust EMI for IEC61000-4-x ESD, EFT events
- Class A; High Conducted & Radiated RF immunity
- Integrated glitch filter

• Enables higher data-rates than Opto-couplers.



ISO1211 Application Examples



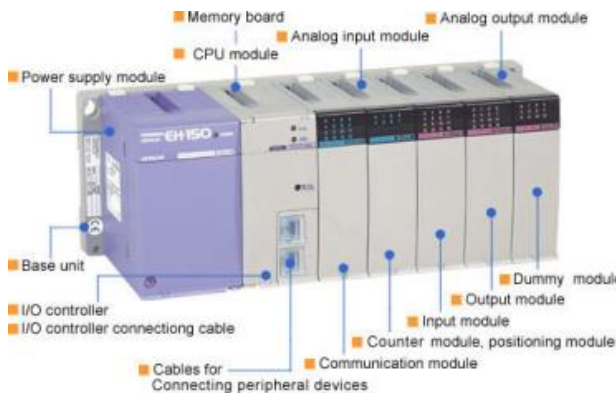
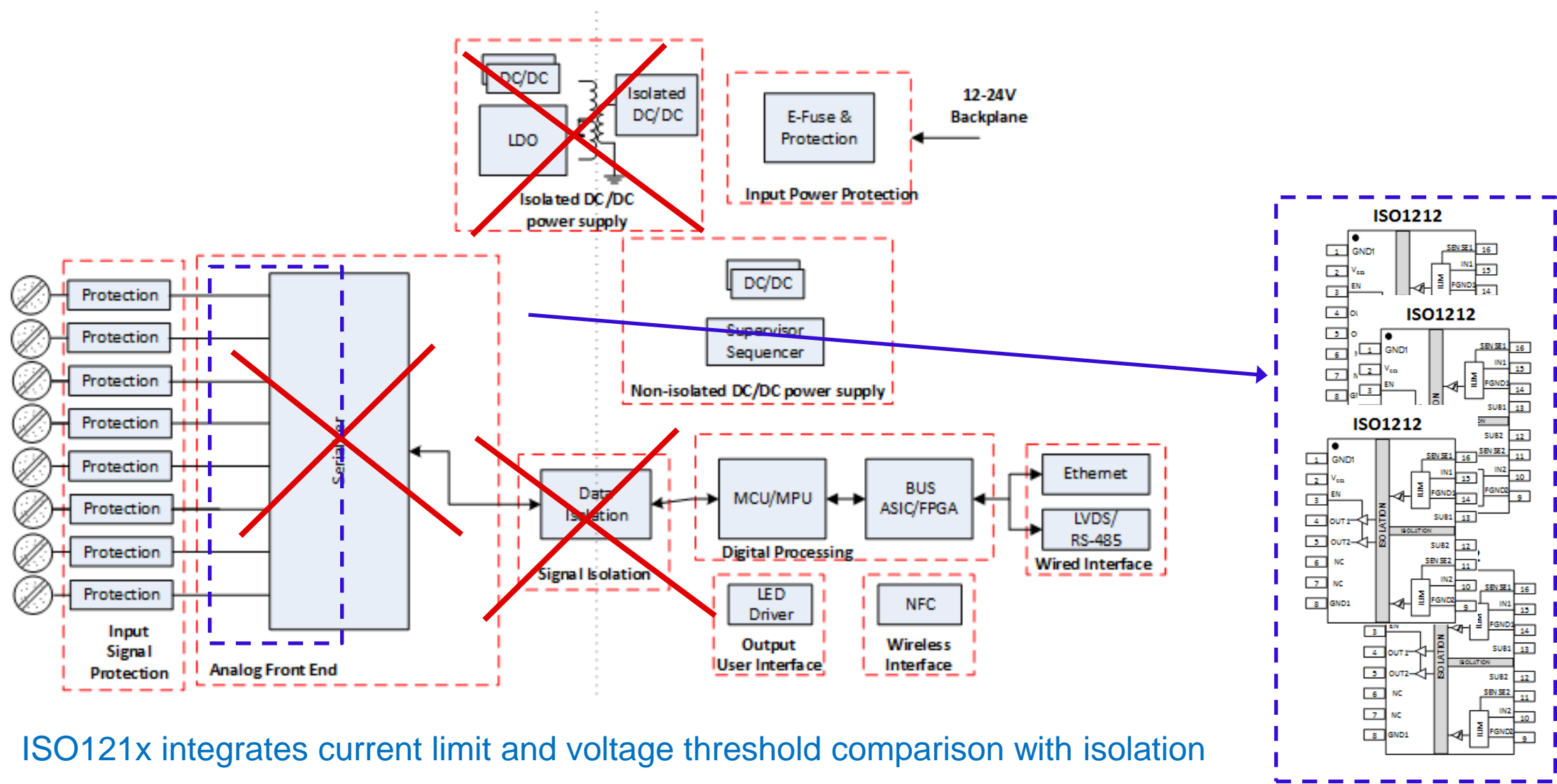
Used with "high-side" TX

Applications

• Industrial Automation

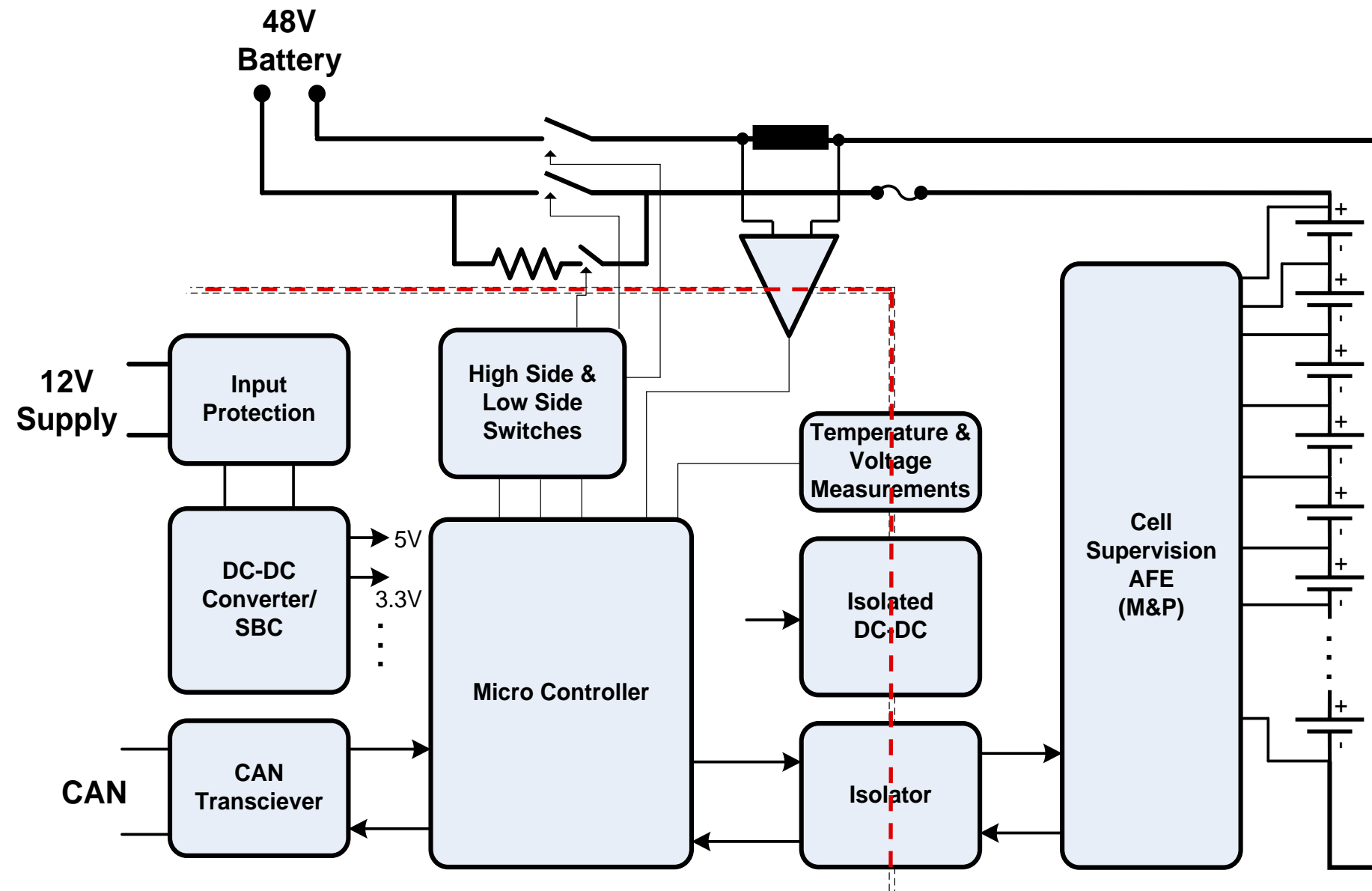
- PLC, Servo, Motor Control, Sensors

ISO121x Simplifies PLC Input Module



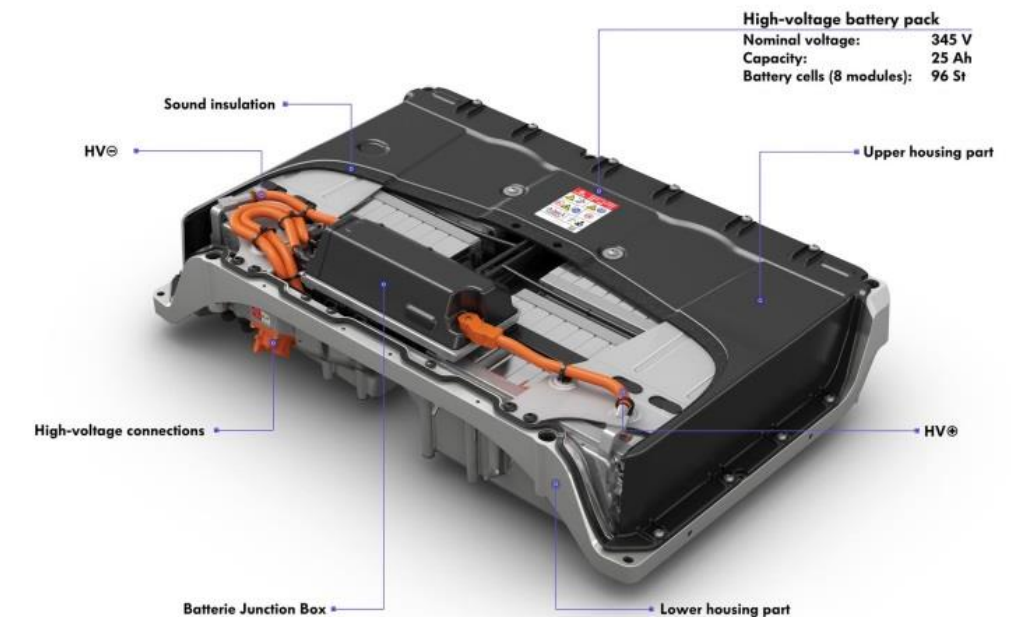
ISO121x integrates current limit and voltage threshold comparison with isolation
Does not need field side power supply!

Isolation in Automotive - Architecture

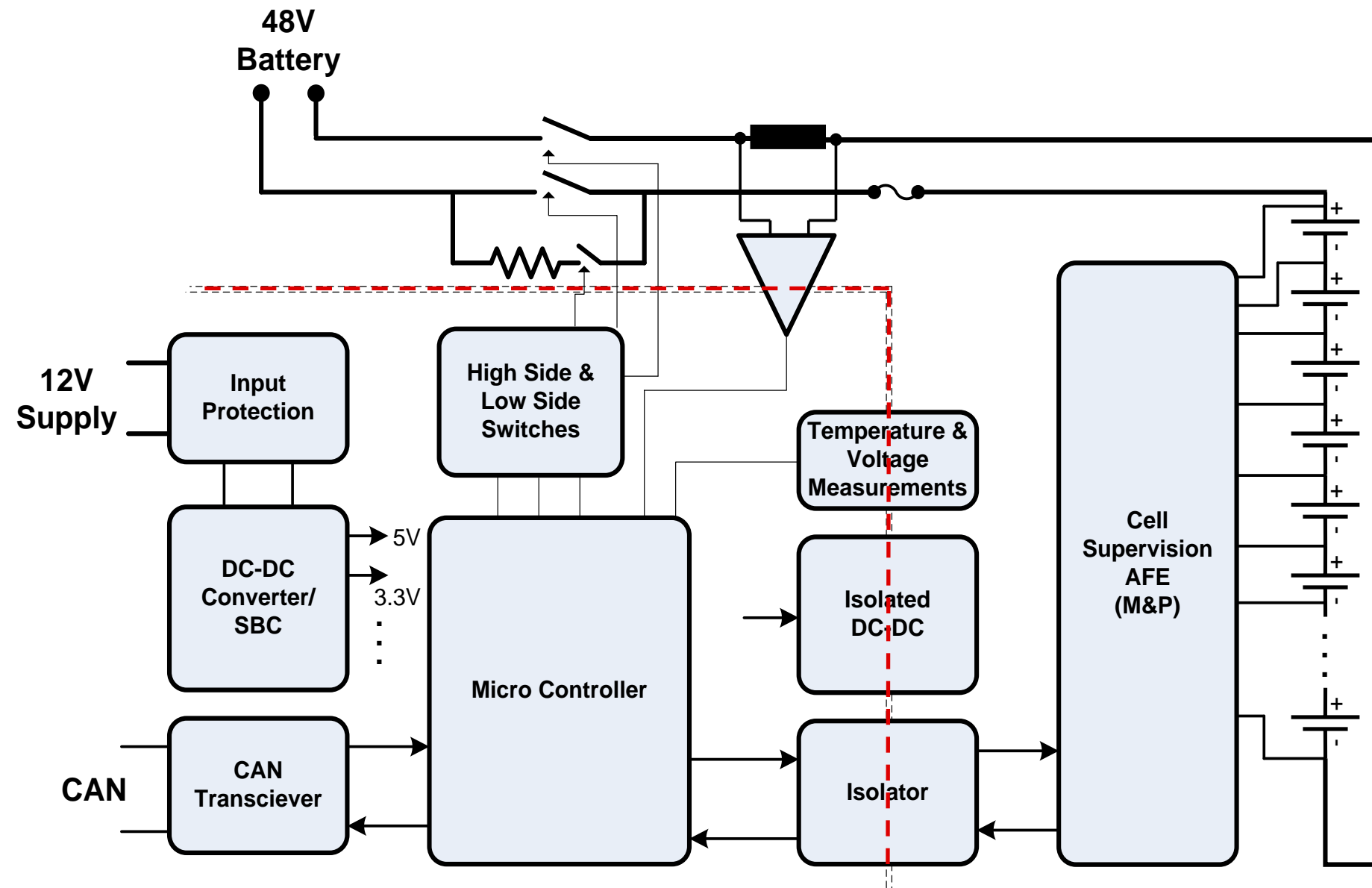


Isolation is used in :

1. Battery Management
2. EV motor drive (200V to 800V batteries)
3. On-board charger gate drives.
4. Sensors (eg. temperature, voltage)
5. 12V to 48V or 12V to HV communication interface



Isolation in Automotive – Insulation coordination



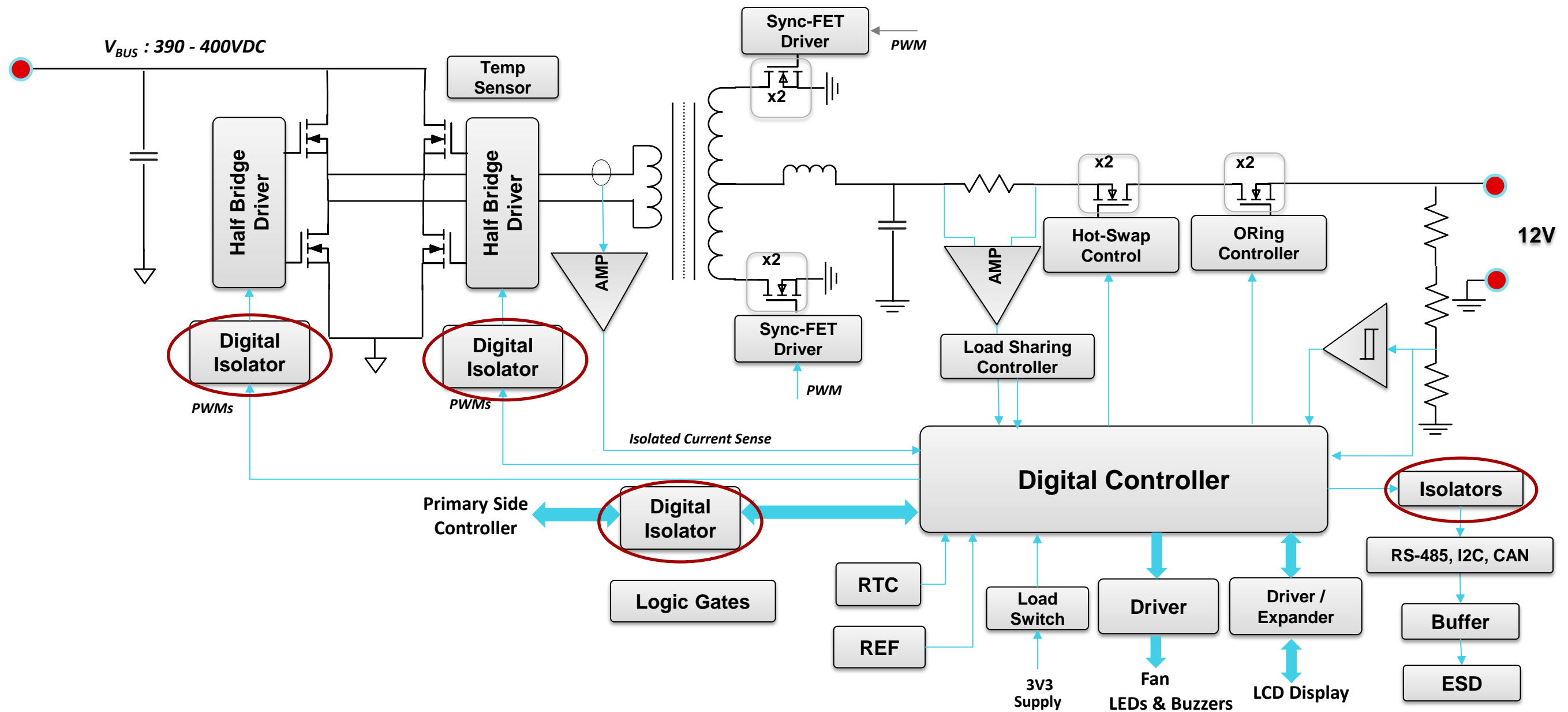
Isolation requirement:

1. Mostly basic isolation is required – Even in EV, battery is floating w.r.t. chassis.
2. Insulation requirement: $(2 \times \text{Working Voltage} + 1000) \text{ Vrms}$ per ISO6469-3.
3. 2.5 kVrms is usually sufficient, though 3 kVrms is sometimes required.
4. Agricultural high power Diesel->Electric drives may need reinforced isolation (though may not need Q100)

TI Isolation Products for Automotive applications

Products	Description	Key Benefits
ISO73xx-Q1 and ISO7142-Q1	25 Mbps and 50 Mbps digital isolators, 3 kVrms	Lowest emissions, Low Power Consumption, 16DW and 8D packages
SN6501-Q1 and SN6505 (Q100 in 2017 planned)	Push-pull transformer drivers for up-to 5W isolated power supplies	Flexible output voltages, high efficiency (80%+), low cost, small footprint, flexible output voltages, ultra low emissions, SSC, Soft Start High output power – suitable for IGBT gate-drive power supplies !
ISO1540/41-Q1	Isolated I2C buffer	Compact two-wire bi-directional communication for isolating sensor ADCs
ISO77xx-Q1	100 Mbps Reinforced Digital isolators	2.25V min power supply, > 8kV IEC ESD, EMC hardened, low prop delays, flexible package options (16DW, 8D, 16 DBQ)
ISOW78xx (RTM),	Digital Isolators with Integrated Power Supply	Compact design, fully integrated power+signal isolation. Low emissions, High Efficiency, Soft start
ISO53xx (samples available)	Compact (8-pin) basic isolated IGBT gate-drivers	Compact size, 100 kV/us CMTI, 0.5A to 10A flexible output current drive.

Isolation in Power Delivery – Architecture



Isolation in Power Delivery – Insulation coordination

Isolation Requirements

1. Basic / Reinforced isolation is required.
2. Governed by IEC 62040.
3. Insulation requirements and Creepage and Clearance requirements dictated by voltages being measured.
4. For upto 300V, 4.5 mm creepage/clearance sufficient.
5. For >600V, 8 mm and higher creepage/clearance required.

Isolation is used in :

1. Uninterruptible Power Supply.
2. Telecom / Network Power.
3. Isolated DC-DC Converter.



TI Isolation Products for Power Delivery

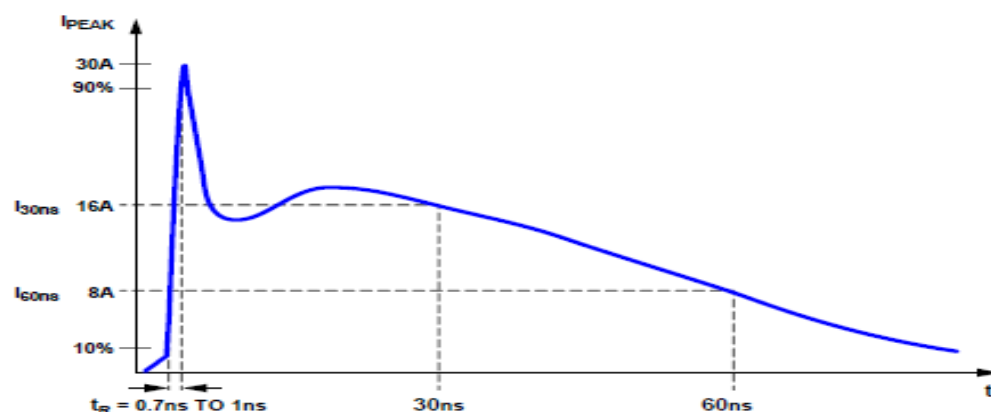
Products	Description	Key Benefits
ISO77xx	100 Mbps Reinforced Digital isolators	5 kVrms VISO, 1 kVrms VIOWM, 85 kV/us min CMTI, 2.25V min power supply, > 8kV IEC ESD, EMC hardened, low prop delays, flexible package options (16DW, 8D, 16 DBQ)
ISO78xx DW	100 Mbps Reinforced Digital Isolators	5.7 kVrms VISO 12.8 kV surge Upto 2 kVrms working voltage 100 kV/us min CMTI DESAT and Miller Clamp Safety High data-rates, and low skews CTI > 600 mold compound Fail-Open Behavior
ISO585x DW and ISO545x DW	Reinforced isolated IGBT/SiC gate-drivers with Safety features	
AMC130x	Reinforced isolated Delta Sigma modulators and amplifiers	
ISORS485 and ISOCAN portfolio	Isolated RS485 and CAN devices	Flexible portfolio of interconnect solutions
ISO53xx (Samples available)	Compact (8-pin) basic isolated IGBT gate-drivers	Compact size, 100 kV/us CMTI, 0.5A to 10A flexible output current drive

Agenda

- Brief Introduction to Isolation standards and terminology.
- TI Isolators Physical Construction and Circuit Architectures.
- Isolation requirements and usage in end equipment and TI solutions:
 - Motor Control
 - Solar Inverter
 - PLC
 - Automotive
 - Power Delivery
- System Considerations:
 - Electromagnetic Compatibility (EMC)
 - Isolator Failure Modes
- TI Designs

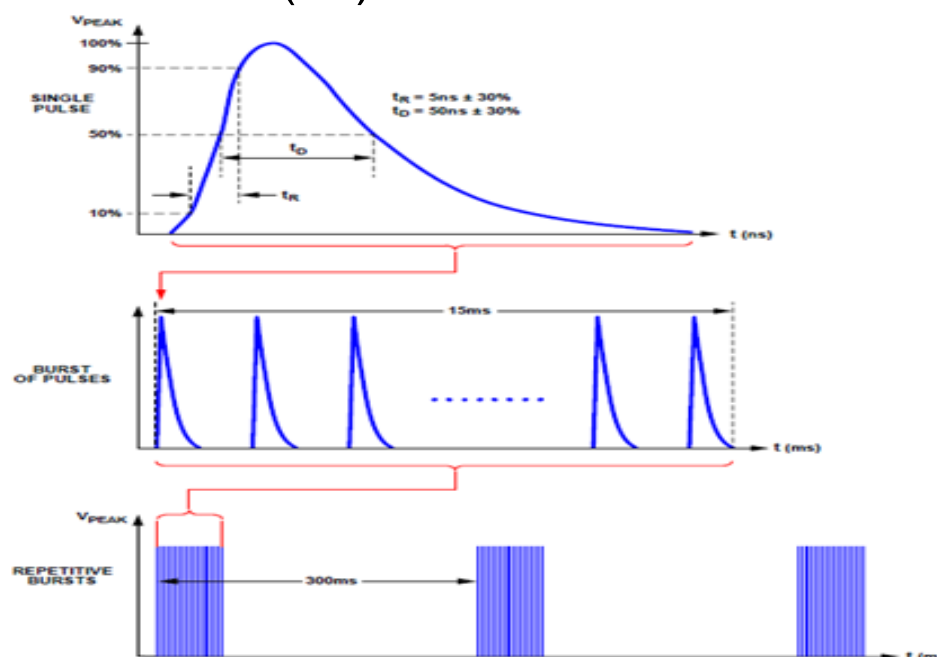
System Considerations: ESD, EFT and Surge Immunity

- IEC 61000-4-2.
- Key specifications (level 4):
 - Voltage peak: 8kV.
 - Current peak: 30A
 - Current rise time: 0.7ns to 1ns.
 - Current at 30ns: 16A.
 - Current at 60ns: 8A.



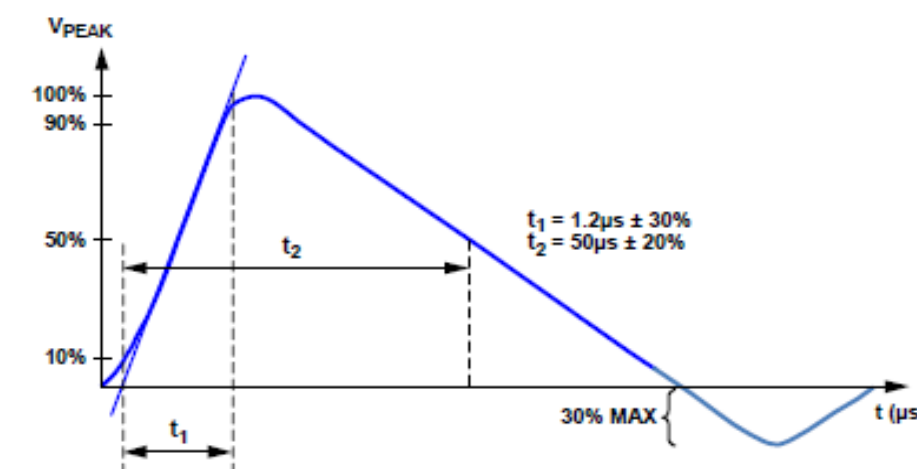
ESD

- IEC 61000-4-4.
- Key specifications (level 4):
 - Voltage peak: 4kV (supply), 2kV(IO).



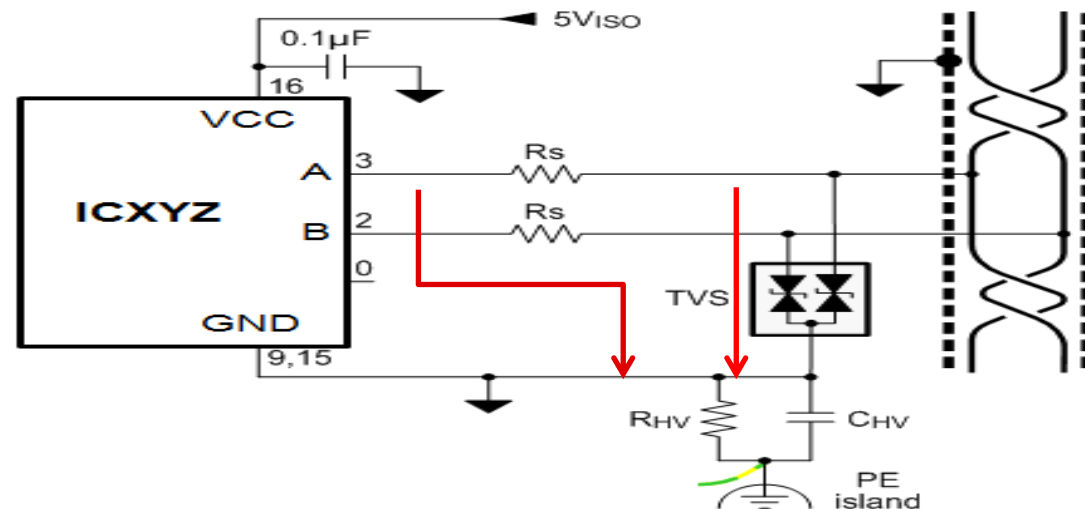
EFT

- IEC 61000-4-5.
- Key specifications (level 4):
 - Voltage peak: 4kV.
 - Output impedance: 2 Ohms.



SURGE

System Design: ESD, EFT and Surge Immunity

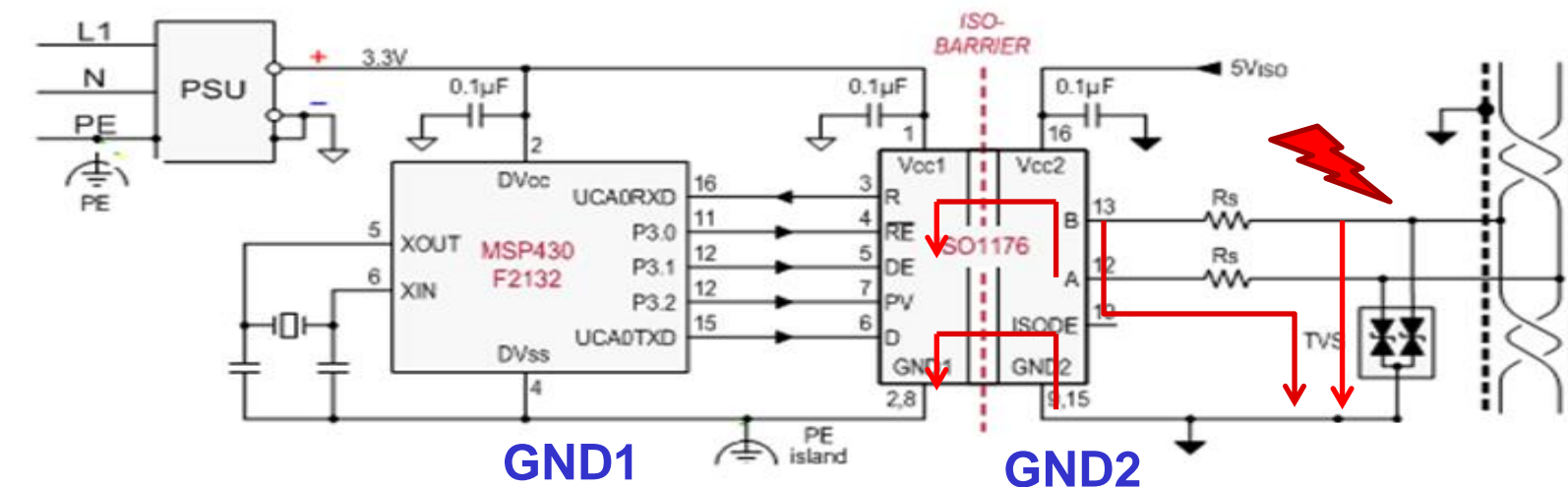


• Non Isolated Case:

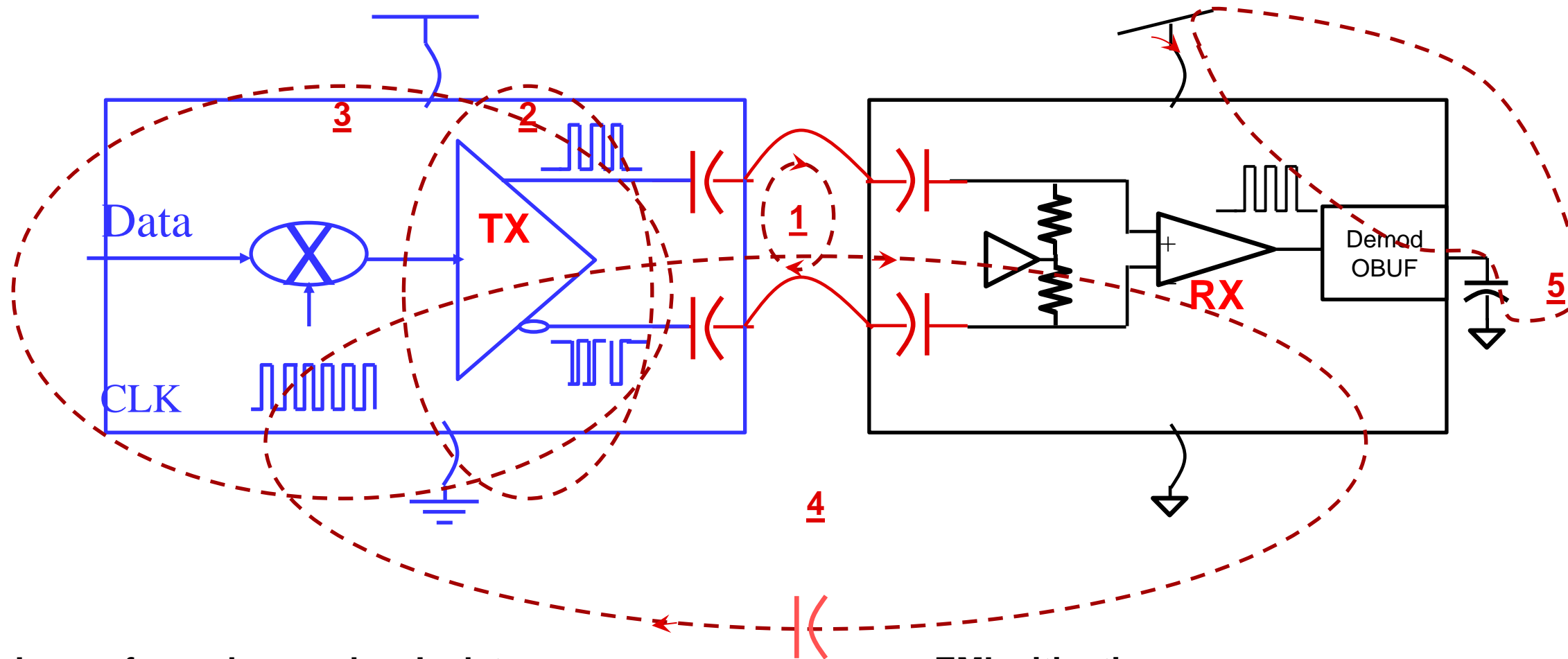
- On board (and on-chip) ESD structures used to handle enormous energy present in ESD/EFT/Surge strikes.
- Ground movement is of relatively lesser consequence.

• Isolated Case:

- Bounce on GND2 is very high, limited only by board parasitic capacitance → high stress and current across the isolation barrier.
- More stress suffered by isolation barrier
- External ESD structures won't help prevent across barrier stress.
- Isolation Capacitor and associated circuitry must handle ESD/EFT/Surge Voltage and associated currents.



System Design: Lowering Emissions

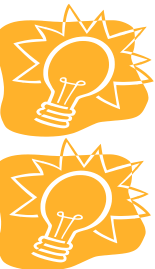


Loops formed around an Isolator:

1. Inter-die loop.
2. IC with on-chip supply de-cap.
3. IC with on-board supply de-cap.
4. Intra die with PCB parasitic cap → A very large loop.
5. Output with On-board supply de-cap.

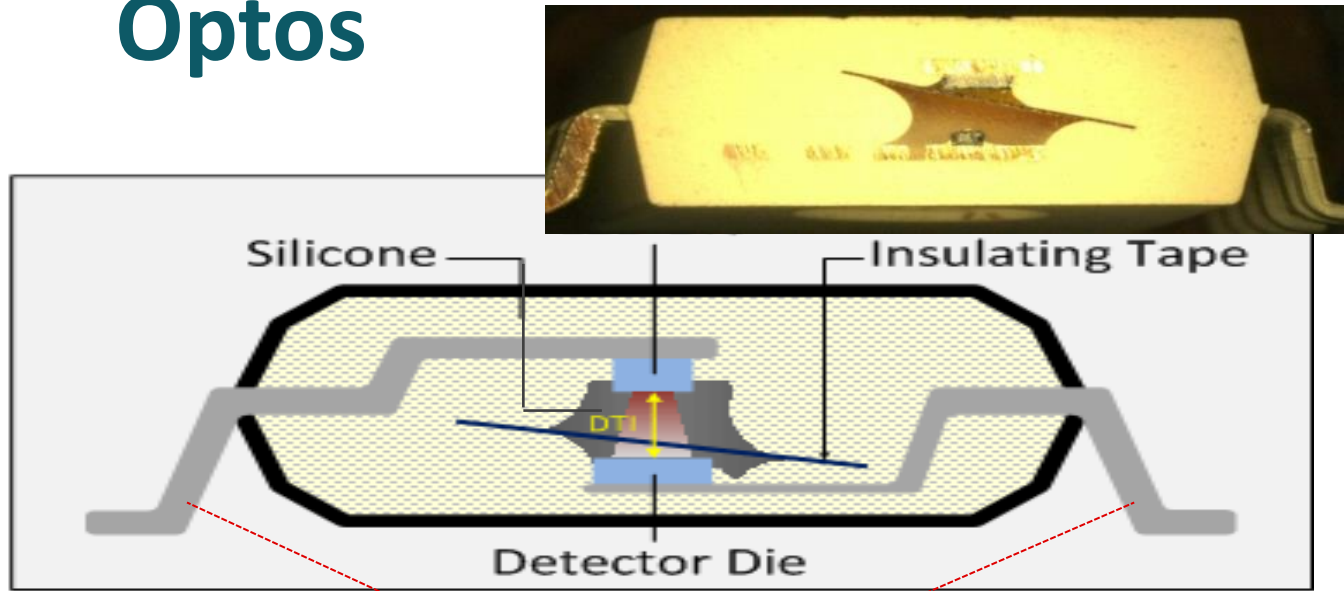
EMI mitigation:

1. Balance TXP and TXN, and add decoupling cap close to TX → Prevent current in loop 3 and loop 4.
2. Slew-rate controlled output buffer, avoiding un-necessarily fast slew rates → prevent current in loop 5.



Optos versus TI Series Cap

Optos

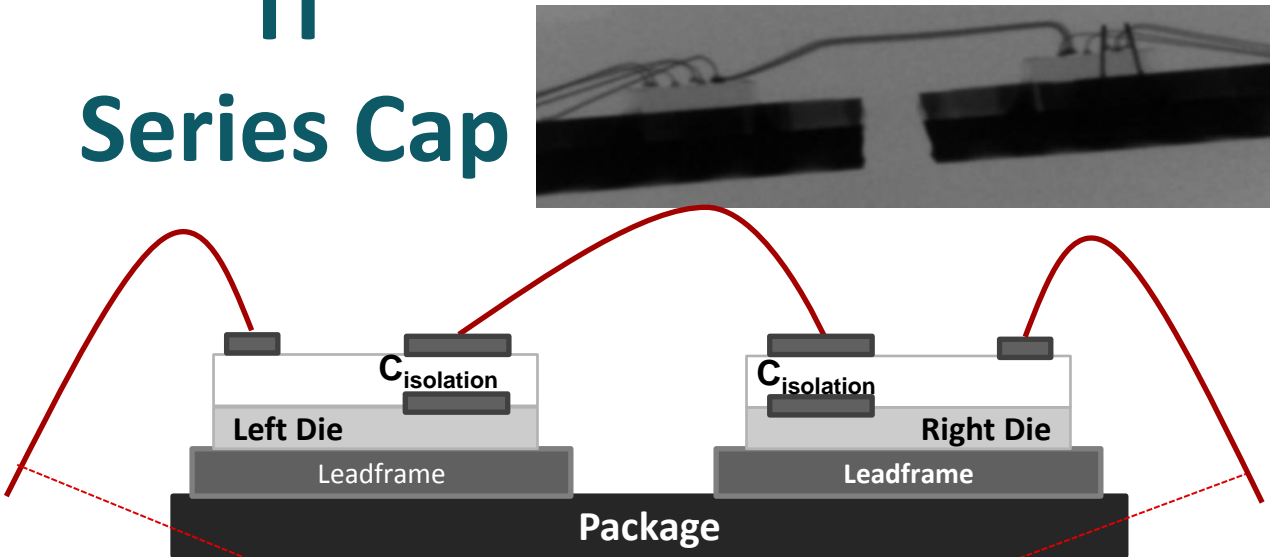


$C_{\text{parasitic}}$

Material: Multi compound packaging process
Silicone + Poly-imide + Mold compound

intrinsic strength: $500\mu\text{m} * 30\text{V}/\mu\text{m} = 15\text{kV}$

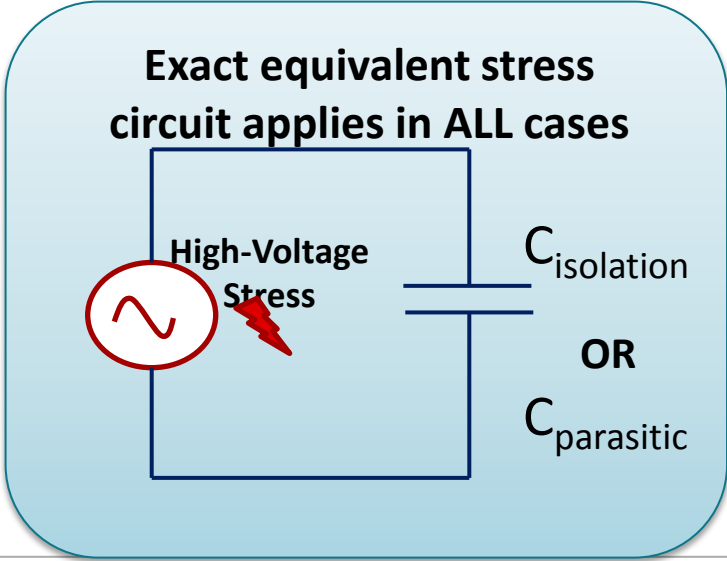
TI Series Cap



$0.5 * C_{\text{isolation}}$

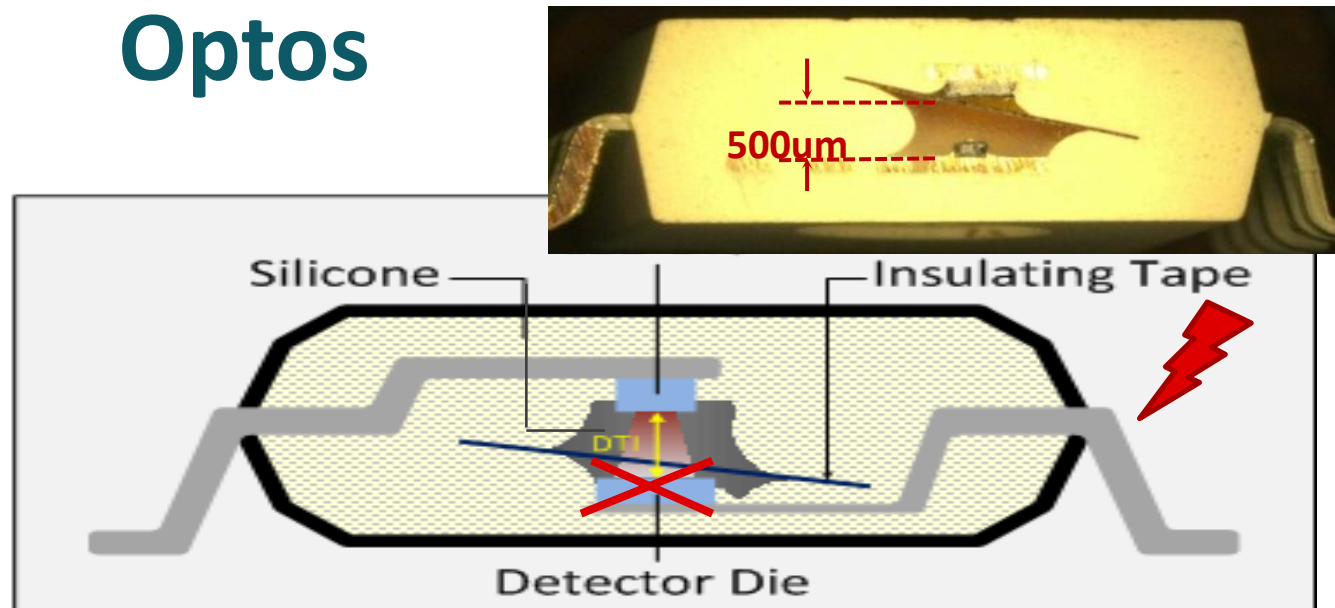
Material: Ultra-low ppm Foundry process
SiO₂

intrinsic strength: $26\mu\text{m} * 800\text{V}/\mu\text{m} = 20\text{kV}$



Optos versus TI Series Cap

Optos



High-Voltage Fault event Chronology:

IEC ESD event or IGBT G-C short occurs

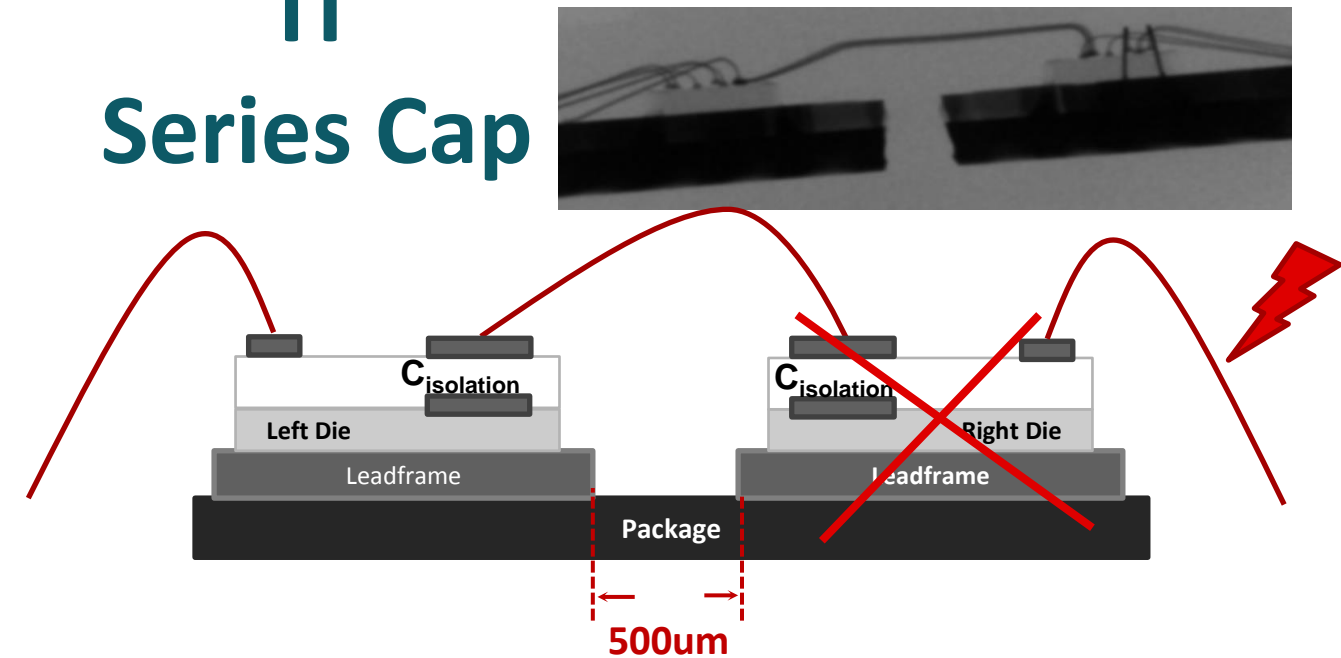
HV side die is physically compromised (crack)

Damage extends outward through **critical isolation**
Isolation layer is compromised – Extent of damage varies depending on fault energy

Aging Effect

LEDs typically have a half-life of 5-10yrs
Barrier lifetime numbers are not available

TI Series Cap



High-Voltage Fault event Chronology:

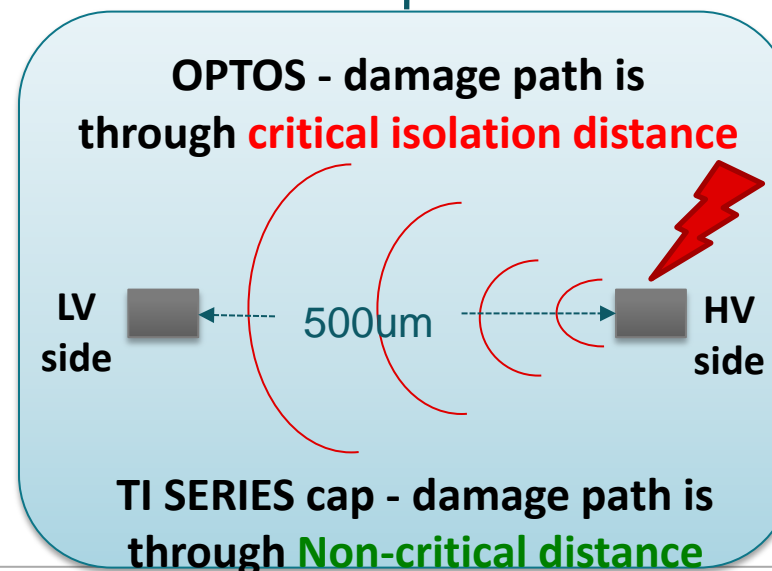
IEC ESD event or IGBT G-C short occurs

HV side die is physically compromised (crack)

Damage extends through **Non-critical die-die spacing**
LV side **BASIC isolation cap protection is present** until energy gets large enough to break both dies

Aging Effect

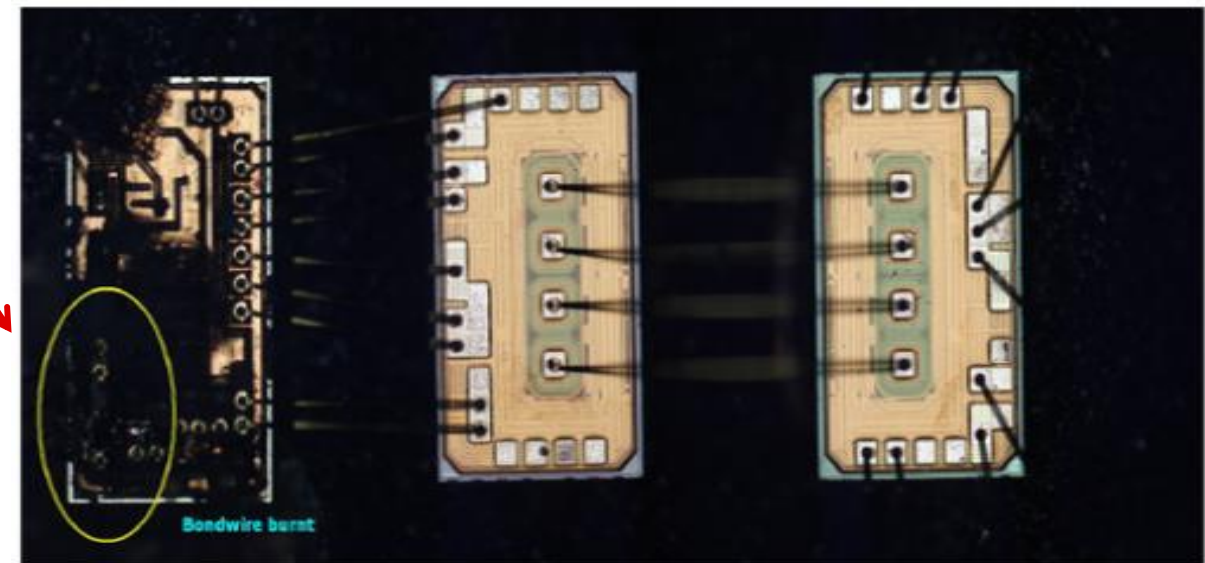
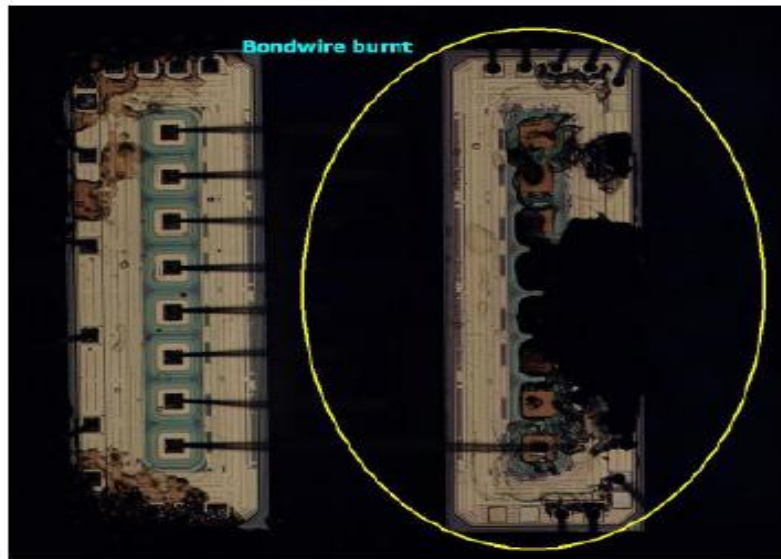
Functional circuit fails will leave insulation intact
TI iso barrier has a **life expectancy of >120yrs** @ 1kVrms



Series Capacitors Isolation: EOS Damage

Isolation barrier
remains intact!

Damage limited to the
over-stressed die only.



For further analysis and test results refer: <http://www.ti.com.cn/cn/lit/wp/slyy081/slyy081.pdf>

Agenda

- Brief Introduction to Isolation standards and terminology.
- TI Isolators Physical Construction and Circuit Architectures.
- Isolation requirements and usage in end equipment and TI solutions:
 - Motor Control
 - Solar Inverter
 - PLC
 - Automotive
 - Power Delivery
- System Considerations:
 - Electromagnetic Compatibility (EMC)
 - Isolator Failure Modes
- TI Designs

Isolated RS-485 Module using Signal & Power Isolated device ISOW7841

TIDA-00892

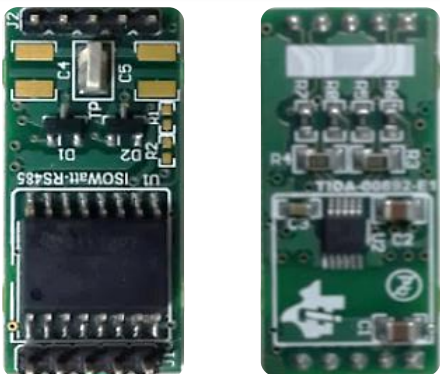
Features

- ± 6 kV across barrier, ± 16 kV same side IEC61000-4-2 ESD
- VISO of ISOW7841 can source up to 100mA load
- Operates at 3.3/5V Vcc
- Supports up to 20Mbps data rate. (Based on transceiver)
- 300V_{RMS} working voltage - 3.8mm clearance
 - 50% of ISOW7841 footprint 7.6mm
- Industry leading Common-Mode Transient Immunity (CMTI): ± 100 -kV/ μ s(Min)
- CISPR22 (Class A) compliant

Target Applications

- Grid communication modules
- Building Automation and HVAC
- Industrial Automation
- Motor Drives and Medical Equipment

Tools & Resources

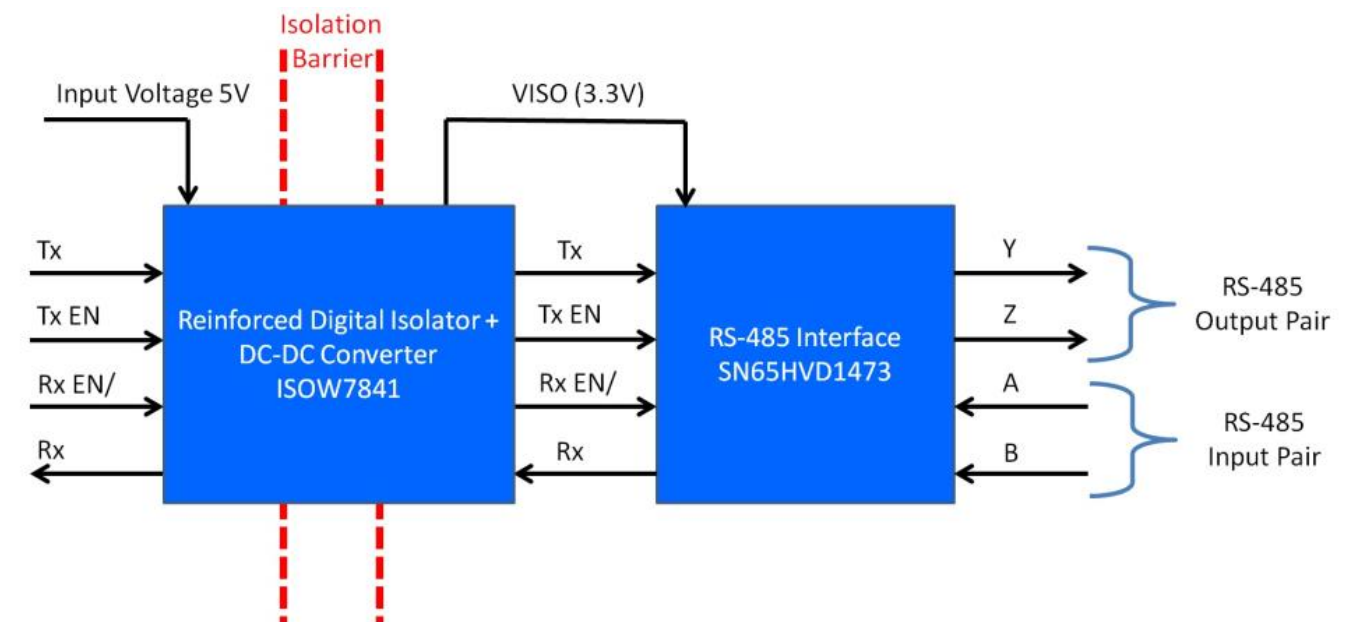


- [TIDA-00892 Tools Folder](#)
- [Design Guide](#)
- [Design Files](#): Schematics, BOM, Gerber
- [Device Datasheets](#):
 - [ISOW7841](#)
 - [SN65HVD1473](#)

Benefits



- Smallest combination solution
 - Equal to ISOW7841 device footprint
- Single power supply solution
 - No separate supply required to power the interface side
- Reduced BOM cost
 - Eliminates requirement for separate transformer
- Simpler design
- Design is extendable to other Full-Duplex RS485 transceivers
 - SN65HVD14xx, SN65HVD7x, SN65HVD3x
 - Can also be extended to Half Duplex with minor layout changes



Isolated RS-232 Module using Signal & Power Isolated device ISOW7842

TIDA-01230

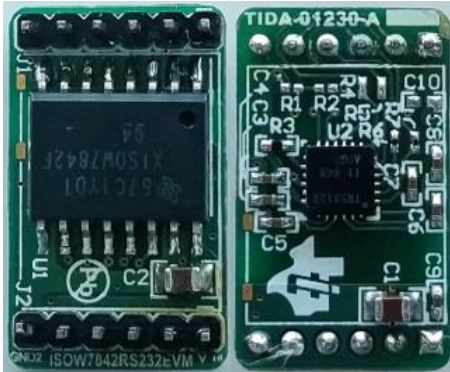
Features

- ± 8 kV across barrier, ± 16 kV same side IEC61000-4-2 ESD
- VISO of ISOW7842 can source up to 100mA load
- Operates at 3.3/5V Vcc
- Supports up to 1Mbps data rate (Based on transceiver)
- 300VRMS working voltage : 3mm clearance
 - 50% of ISOW7842 footprint 7.6mm
- Industry leading Common-Mode Transient Immunity (CMTI): ± 100 -kV/ μ s(Min)
- CISPR 22 (Class A) compliant

Target Applications

- Grid Communication Modules
- Building Automation and HVAC.
- Industrial Automation

Tools & Resources

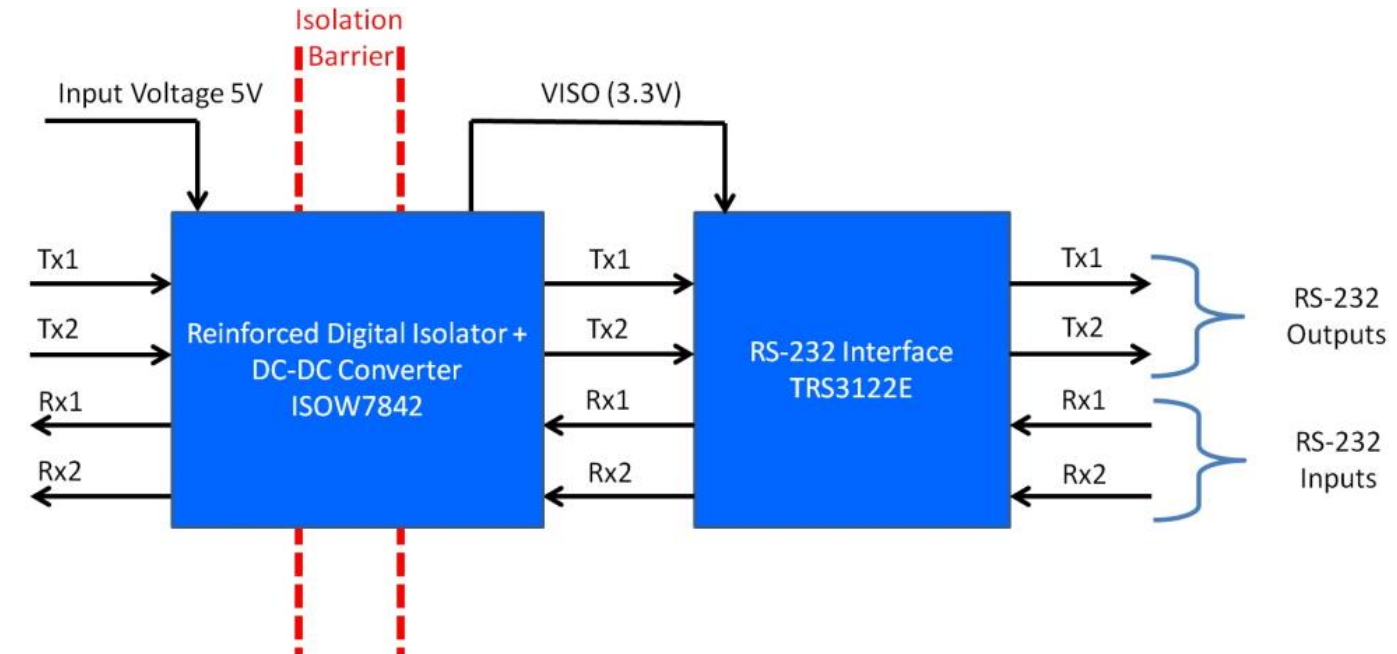


- [TIDA-01230 Tools Folder](#)
- [Design Guide](#)
- [Design Files](#): Schematics, BOM, Gerber.
- [Device Datasheets](#):
 - [ISOW7842](#)
 - [TRS3122E](#)

Benefits

- Smallest combination solution (14.8mm x 11.5mm)
 - Slightly larger than ISOW7842 device footprint
- Single input power supply
 - No separate isolated supply required to power interface-side components
- Reduced BOM cost
 - Solution eliminates need for separate transformer
- Design is extendable to other RS232 transceivers

TIDesigns



Communication Module Reference Design for Functional Isolated RS-485, CAN and I2C Data Transmission / TI Design : TIDA-01281

Features

- Simple isolated communication module for RS-485, CAN and I2C interface
- Functional Isolation and Immunity
 - **4000-V_{PK} & 2500-V_{RMS} Isolation, 560V_{PK} working voltage isolation**
 - Communication devices certified for UL1577, EIN 60747-5-2
- Meets TIA/EIA RS-485 requirements and CAN ISO11898-2 requirements
- Typical Common Mode Transient Immunity (CMTI) of 50 kV/us
- Built-in compact, low emission, high efficiency isolated supply to power isolated-side circuit
- Meets IEC-61000-4-2: ESD ±15kV, IEC-61000-4-4: EFT ± 4kV contact & IEC-61000-4-5: Surge ±2kV

Benefits

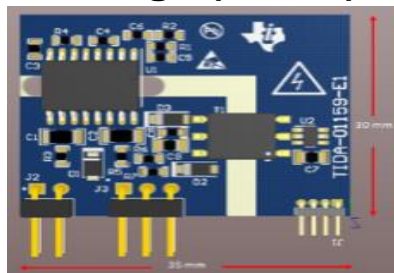
- Compact solution for isolated power and multiple modes of data transmission
- Low component count and cost optimized solution
- Robust isolation performance for reliable operation in harsh environments and High immunity for noisy environments
- **Proven Reliability of SiO₂ Insulation**, Stable over Time, Temperature & Moisture: **Life Span > 25 years @ 105°C**
- Reduced EMI from isolated power supply due to spread spectrum clocking of transformer driver
- Supports operation from 3.0-V to 5-V supply range

Target Applications

- Uninterruptable Power Supplies (UPS)
- Server PSUs & Telecom Rectifiers
- Industrial Power Supplies
- Battery Chargers
- Energy Storage Systems

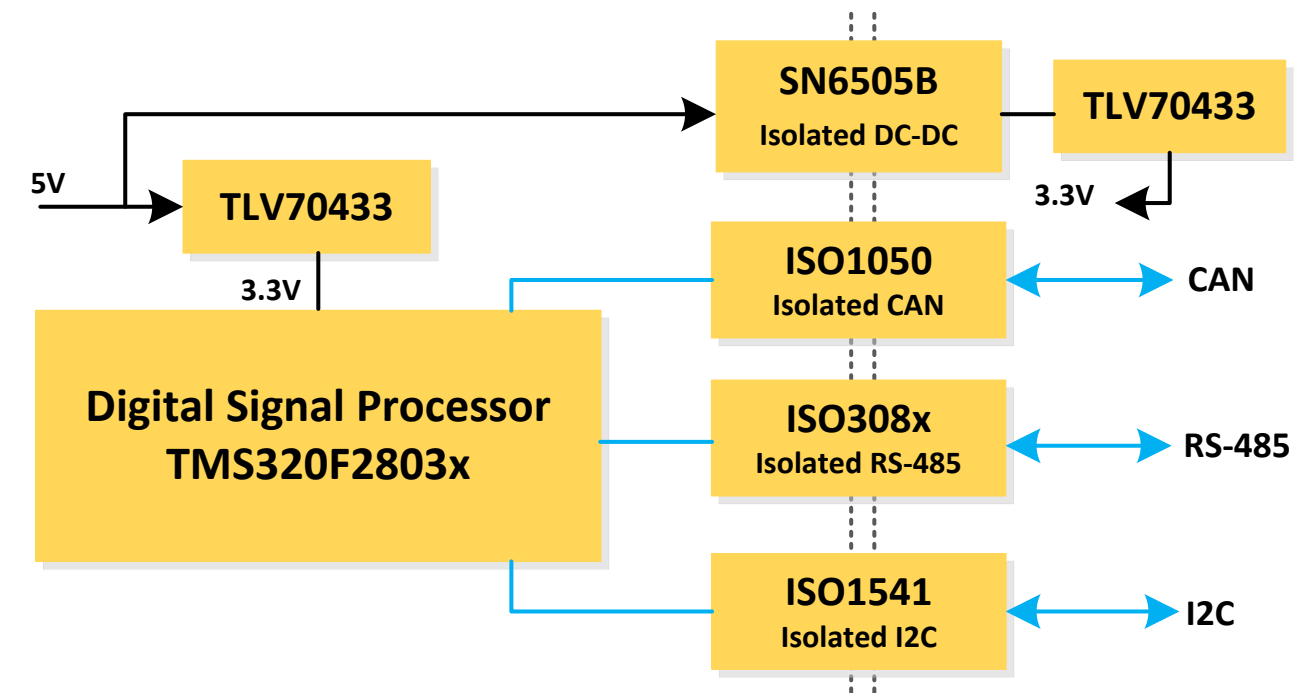
Tools & Resources

Board Image (for ref)



(Communication Module Area)

- [TIDA-01280 and Tools Folder](#)
- [Design Guide](#)
- **Design Files:** Schematics, BOM, Gerbers, and more
- **Device Datasheets:**
 - [TMS320F28033](#), [SN6505B](#), [TLV70433](#), [ISO1050](#), [ISO3082](#), [ISO1541](#)



TIDA-00847: Size and cost optimized Binary module Reference Design using digital isolator with integrated power

Features

- Simplified Binary input module design based on,
 - MCU (MSP430G2332 or MSP430FR2111) – Integrated ADC measures 4 ch. DC or 2 ch. AC/DC voltage
 - Reinforced isolation digital isolator (ISOW7841 or ISOW7841F) with integrated high efficiency power converter with Soft-start and 75 mA current output provides data and power isolation
 - ISOW7841 provides 46% efficiency with output ripple of 100mV for 70mA load (pkpk)
 - Signal conditioning using opamp (LMV614) with gain of $\times 1$ and $\times 3.4$ and stable reference buffer (LM4041 and LMV551) for level shifting inputs
- Accuracy: $\leq \pm 3\%$ of measured value (± 1 V – Programming resolution or step size)
- Binary input impedance $> 300\text{-K}\Omega$ with $\leq 1\text{-mA}$ consumption at 276-V input
- Two LEDs provide status of binary input
- Pre-compliance tests checked for EMI and EMC (IEC61000-4 and CISPR22)

Benefits

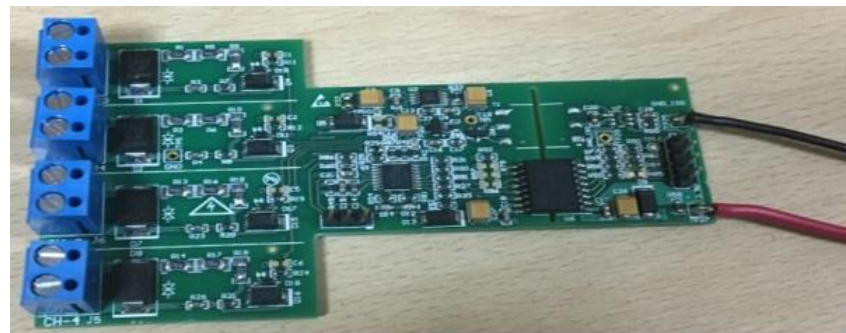


- Uses only two components simplifying system design for 4 channel binary module
- Digital integrator with integrated power converter offers board space savings
- Improved performance using MCU – Accurate and repeatable fault indication and elimination of multiple hardware versions reducing design, test, manufacturing and field support efforts

Target Applications

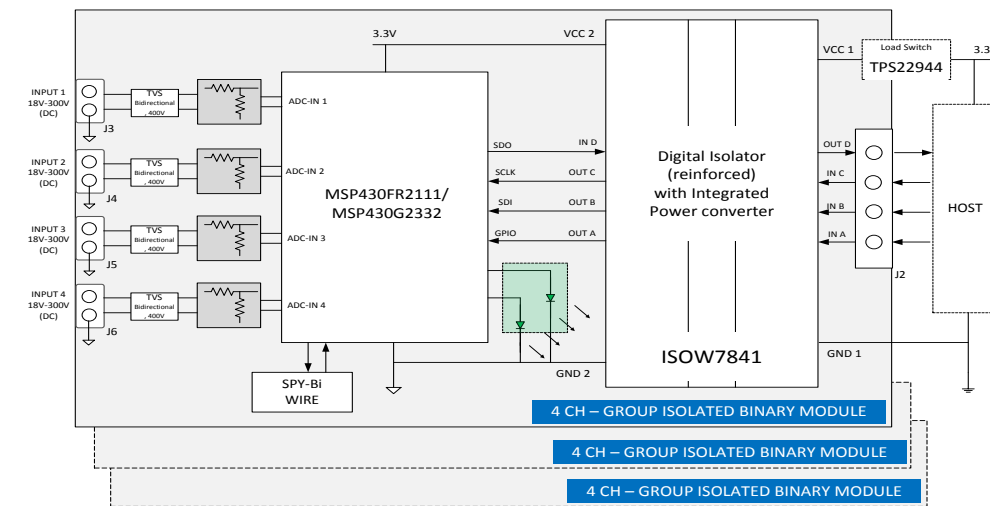
Multi function Protection Relay
Terminal Unit: FTU/ DTU/ RTU/ FRTU
BAY controller
Merging Unit

Tools & Resources



TIDA-00847 Tools Folder

1. [MSP430FR2111](#)
2. [MSP430G2332](#)
3. [ISOW7841](#)
4. [ISO7741](#)
5. [SN6505B](#)
6. [TPS3808](#)
7. [TPS22944](#)
8. [TPS60241](#)
9. [LMV614](#)



Copyright © 2017, Texas Instruments Incorporated

TIDA-01333: 8-ch High Voltage Analog Input Module with ISOW7841 Reference Design

Features

- Isolated 5V supply + isolated SPI in one chip
- Switching between voltage and current measurement for every channel
- 4 channels with CM of up to $\pm 160V$
- 100M Ω input impedance
- BeagleBone compatible

Benefits

- 8 channel inputs with only one single channel ADC
- Voltage measurements without preprocessing needed
- Switching between voltage and current measurement possible for every channel
- Can be powered directly from 5V backplane
- Can be powered and interfaced directly from BeagleBone

Target Applications

- PLC
- Analog Input Modules

Tools & Resources

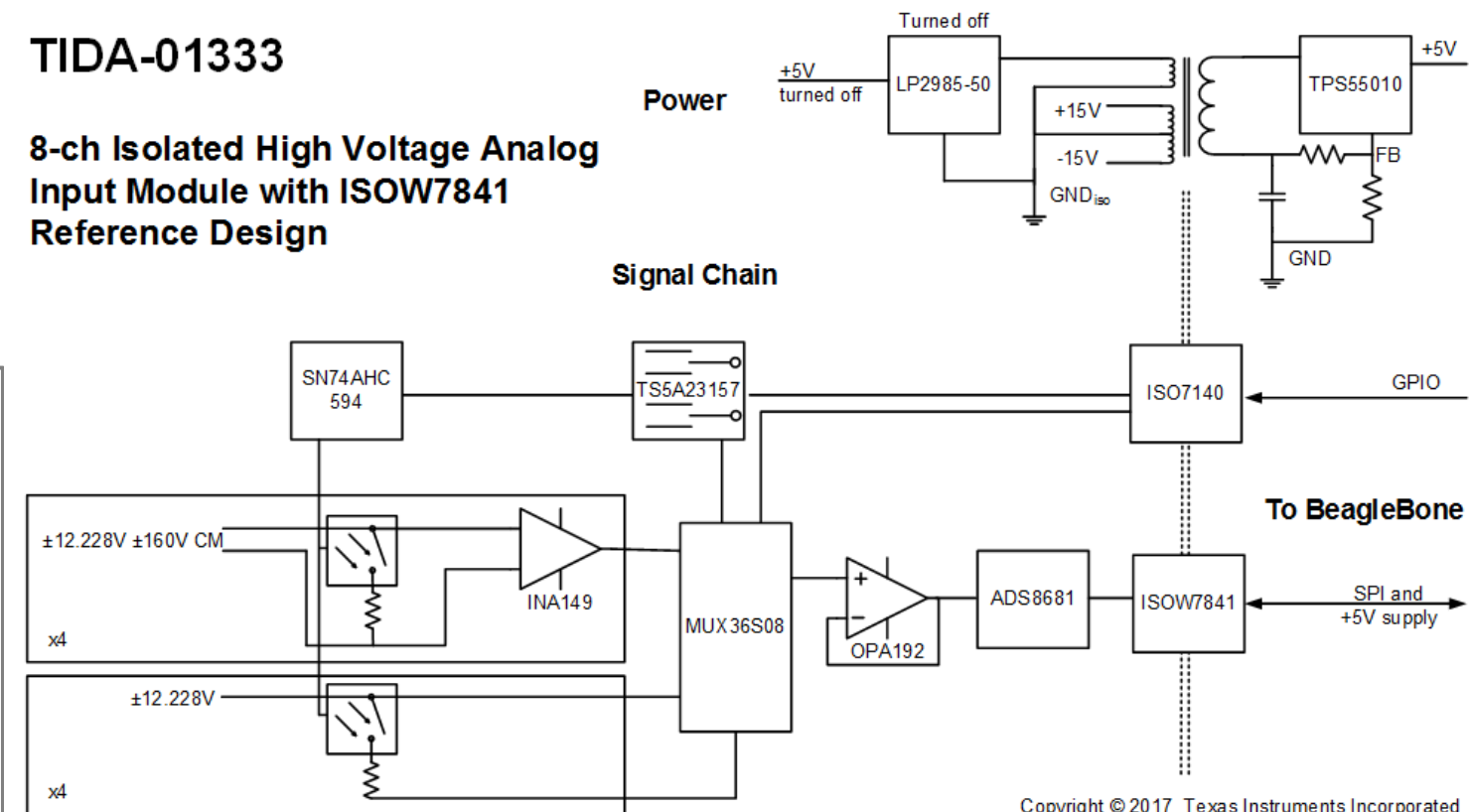
Board Image



- [TIDA-01333 Tools Folder](#)
- **Device Datasheets:**
 - [ISOW7841](#)
 - [ADS8681](#)
 - [OPA192](#)
 - [MUX36S08](#)
 - [TPS55010](#)
 - [ISO7140](#)

TIDA-01333

8-ch Isolated High Voltage Analog Input Module with ISOW7841 Reference Design



Isolated GaN Driver

TI Design Number: TIDA-00785

Features

- Suited for low voltage GaN drives (300 V - 450 V)
- Rail-to-rail peak current drive capability with 4-A source and 6-A current suits driving GaN modules.
- 5000- V_{RMS} Isolation for 1 minute per UL 1577
- Industry leading Common-Mode Transient Immunity (CMTI): $\pm 100\text{-kV}/\mu\text{s}(\text{Min})$
- Spread spectrum operation of transformer driver helps reduce emissions.
- PWM signals of gate drivers can be directly interfaced to controller (3.3V I/O)

Target Applications

- Switch-Mode Power Supplies (SMPS)
- Uninterruptible Power Supplies (UPS)
- DC-to-DC Converters
- Synchronous Rectification
- Solar Inverters
- Motor Control
- Envelope Tracking Power Supplies

Tools & Resources

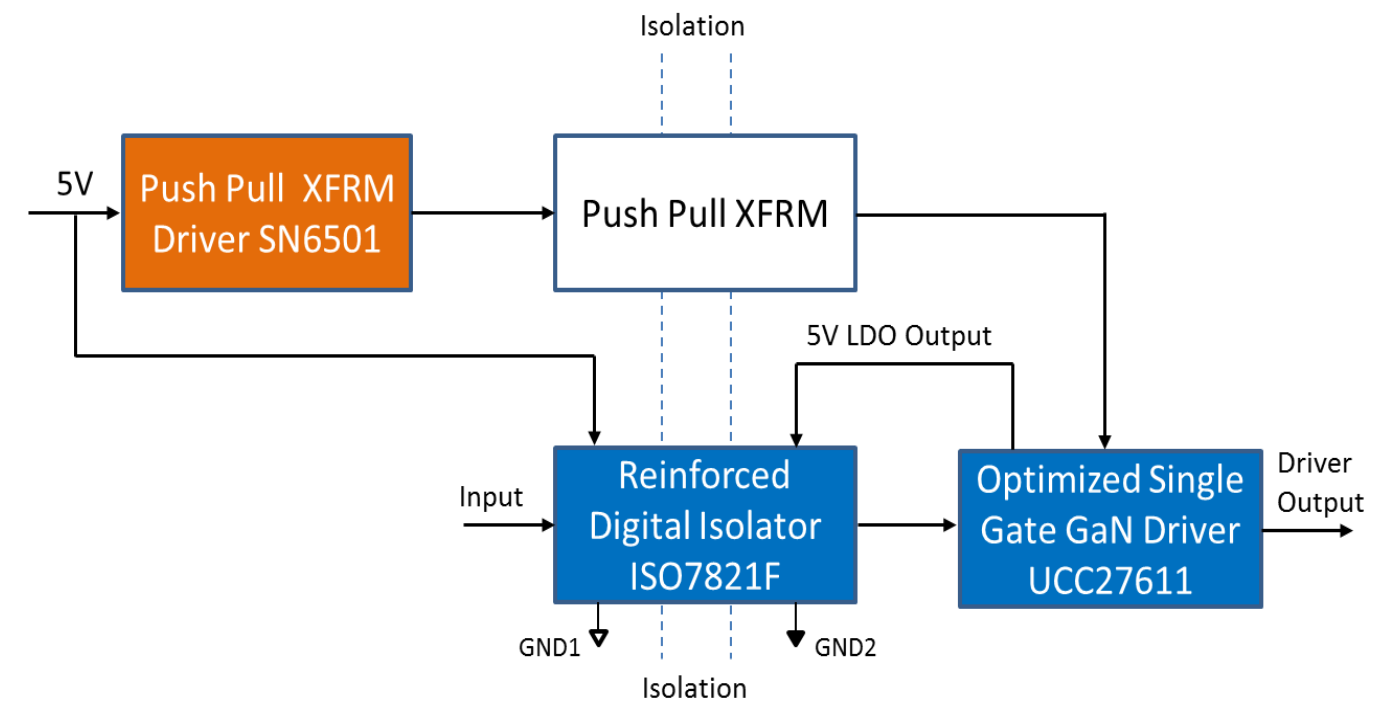
Board Image



- **TIDA-00785 Tools Folder**
- **Design Guide**
- **Design Files:** Schematics, BOM, Gerbers, and more
- **Device Datasheets:**
 - [ISO7821F](#)
 - [SN6501](#)
 - [UCC27611](#)

Benefits

- Smallest solution for reinforced-isolated GaN gate driver power supply
- Precision high-frequency oscillator minimizes magnetics: ultra-small 8mm x 9mm transformer
- Push-pull topology maximizes utilization of transformer currents: close to 90% efficiency
- Spread-spectrum clocking reduces EMI
- Individual power supplies allow inverter gate drive layout flexibility



Customer collateral

The following information is available for you to send for customers

Content title	Content type	Link to content or more details
Isolated RS-485 with integrated power Isolated RS-232 with integrated power	TI Designs	http://www.ti.com/tool/TIDA-00892 http://www.ti.com/tool/TIDA-01230
Solving Isolated Design Challenges with Isolation Products Next Generation Digital Isolation: ISOW7841	Webinar Sessions	https://training.ti.com/solving-isolated-design-challenges-isolation-products-benefits-applications-and-systems?cu=1127787 https://training.ti.com/next-generation-digital-isolation?cu=1127787
HV Reinforced Isolation: Definitions & Test Methodologies Understanding Failure Modes in Isolators How to achieve low Radiated Emissions	White Paper, Technical Content	www.ti.com/lit/pdf/slyy063 www.ti.com/lit/slyy081 http://www.edn.com/design/power-management/4458172/How-to-achieve-low-radiated-emissions-with-fully-integrated-data-and-power-isolation
Digital Isolator Design Guide	Applications Note	www.ti.com/lit/an/slla284a/slla284a.pdf

Thank you !

TI Isolation portfolio: www.ti.com/isolation

Isolation Apps support: isolation_apps@list.ti.com



©Copyright 2017 Texas Instruments Incorporated. All rights reserved.

This material is provided strictly “as-is,” for informational purposes only, and without any warranty.
Use of this material is subject to TI’s **Terms of Use**, viewable at TI.com