

Webinar: **Capacitive Isolation Technology** for Industrial Applications

Isolation, June 2018

www.ti.com/isolation

<https://e2e.ti.com/support/isolation/>

Agenda

- Overview of Capacitive Isolation Technology
- Capacitive Isolation structure
- Industry standards - Reliability and High-Voltage Testing
- Comparison to other Isolation technologies
- Applications, End Equipment
 - PLCs
 - Motor Drives
 - Power Delivery
- TI Online resources for follow-ups
- Q&A

Introduction

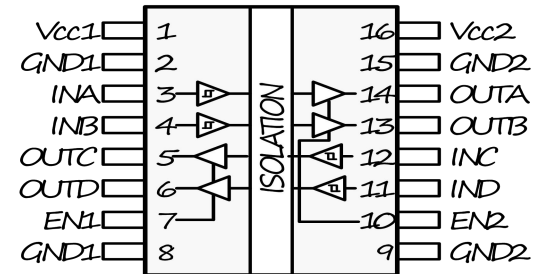
What is Isolation?

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

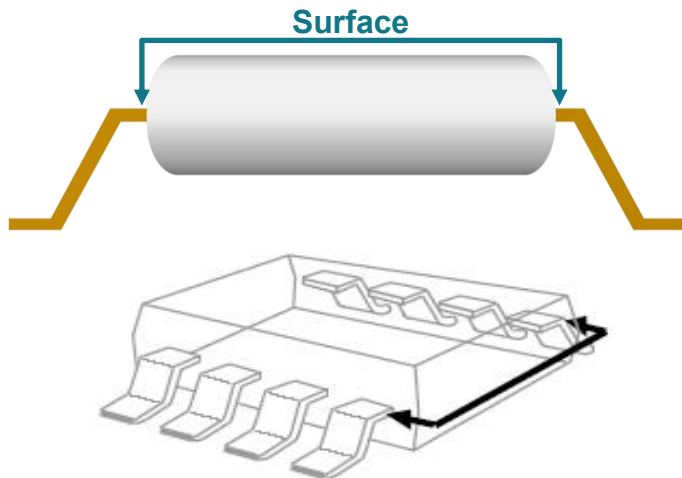
Isolation terminology (in brief)

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 lightning 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 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>

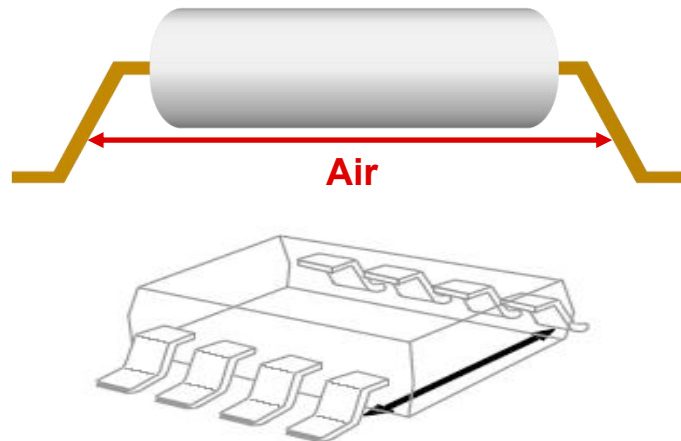
Creepage & clearance

Creepage distance



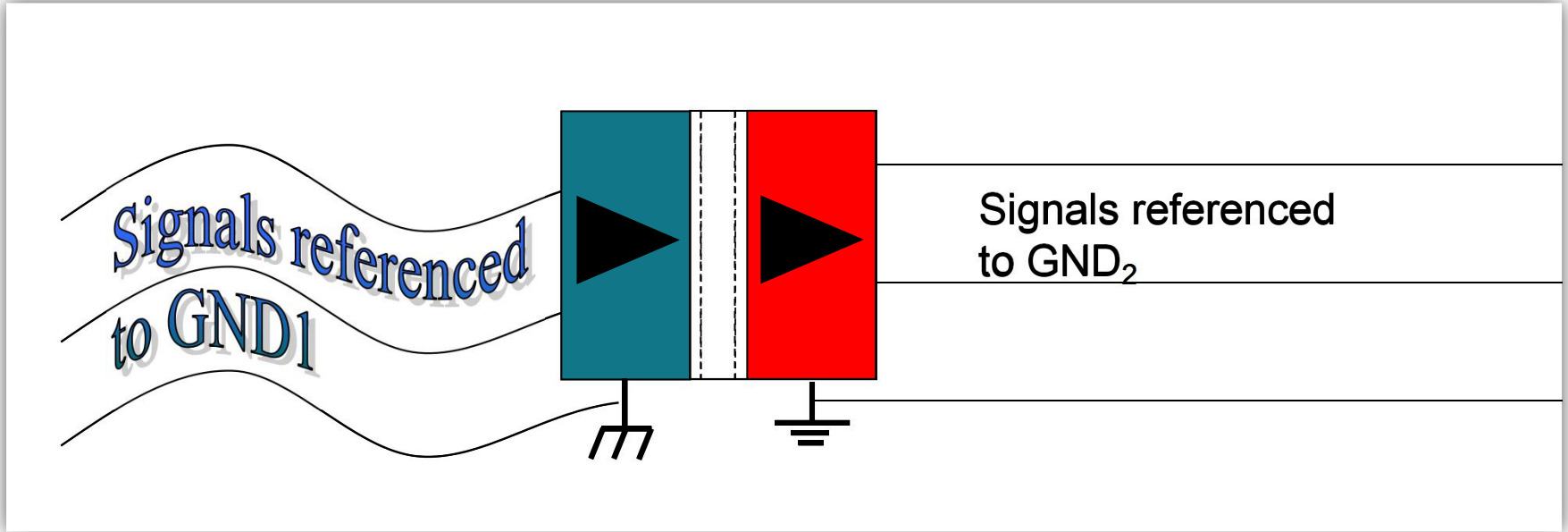
Shortest distance between two conductive leads, across isolation barrier, measured along surface of insulation.

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.

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



TI Isolators must pass

- 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

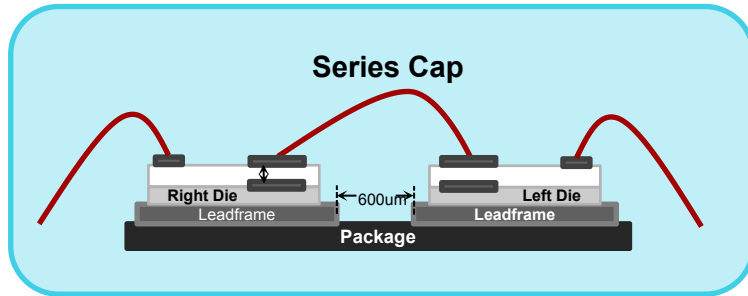


Customer boards and systems must pass – TI Isolators should enable

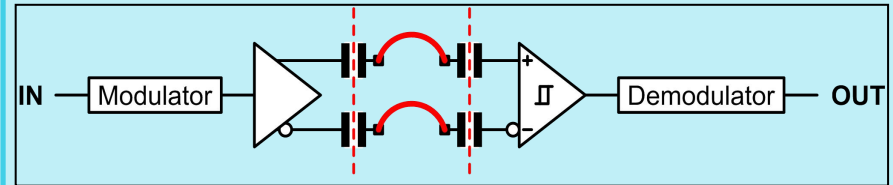
- EMC and Emissions

- IEC 61000-4-x , ESD, EFT, Surge, RF immunity
- CISPR22 or equivalent, EM emissions

Reinforced Isolation Technology

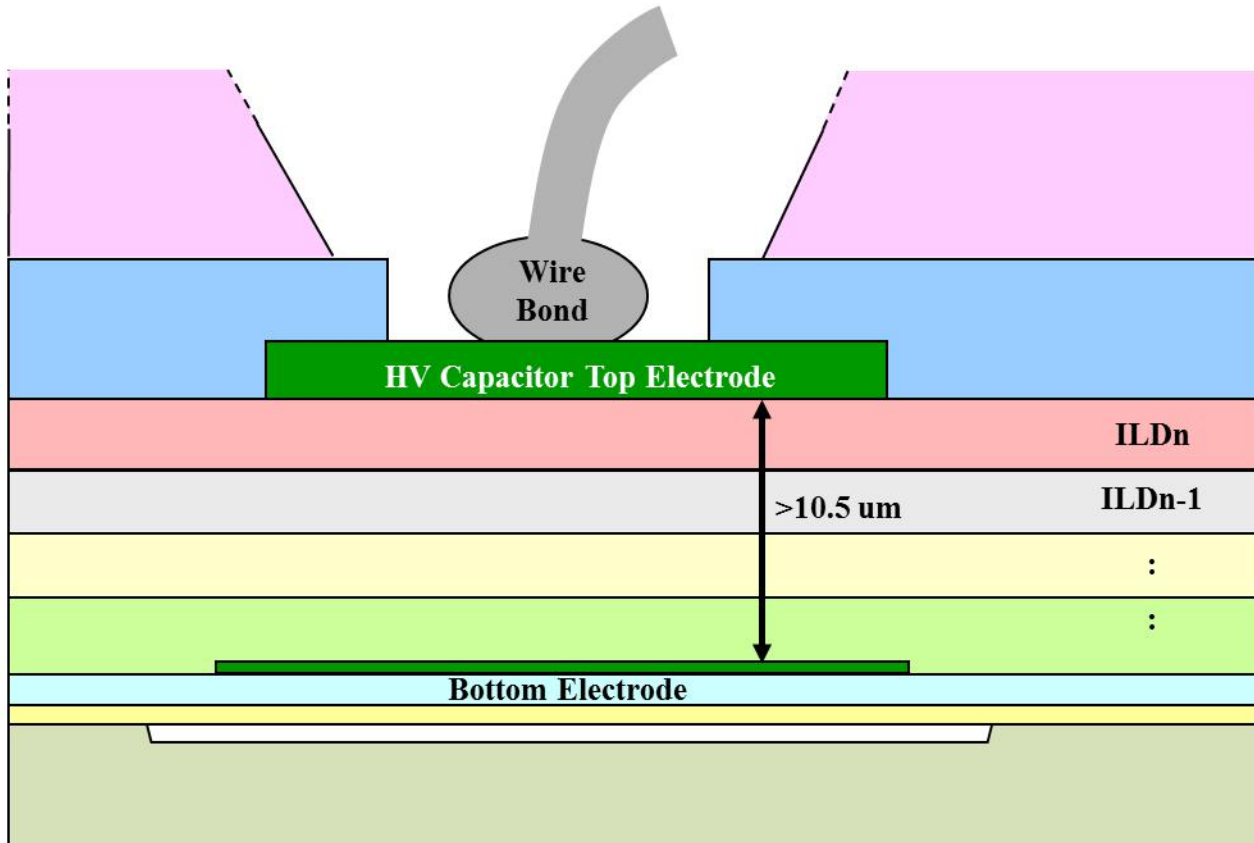


ISO78xx/77xx



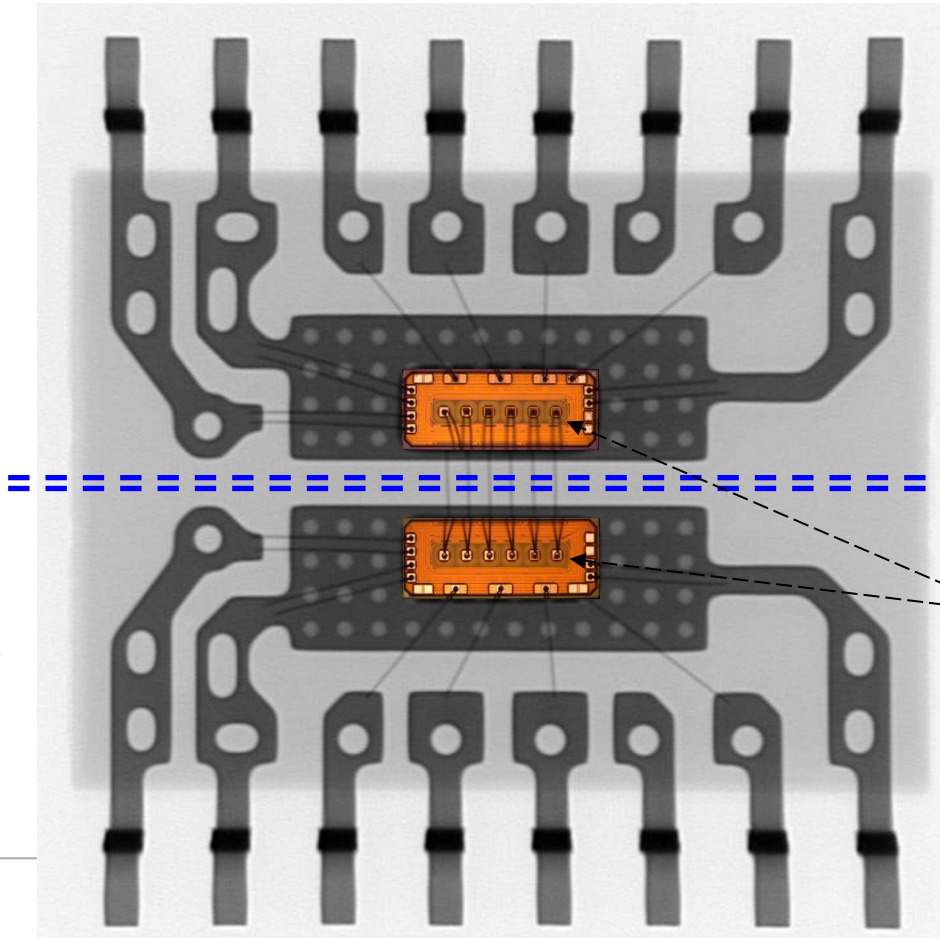
- Reinforced Isolation realized by Series Capacitor configuration
- Combined Isolation capacitor thickness is $\sim 25\mu\text{m}$ (SiO_2)
- 12.8kV surge voltage, 8kVpeak transient over-voltage, 1.5kVrms working voltage

Design for High Voltage



- Reinforced Isolation barrier consists of two high voltage capacitors
 - One on each die
 - Connected in series
- Each capacitor has a thick SiO₂ dielectric
 - Multiple standard dielectric layers
 - CVD films
 - CMP planarization
- Very high isolation voltage capability

Design for High Voltage



X-Ray of
16DW
SOIC
package

Reinforced Isolation Barrier:

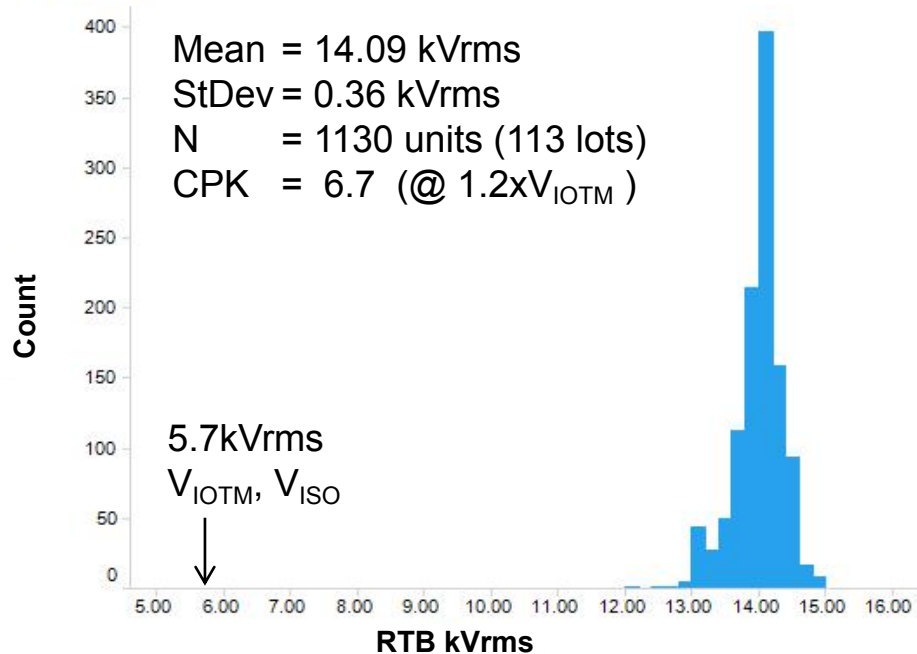
- *Wide Body Package*
 - External clearance and creepage >8mm for 16DW SOIC (shown)
 - Internal spacing between die pads inside the package, > 600um
- *Two die, each with high voltage isolation capacitors*
 - HV capacitors on each die
 - Connected in series

Qualification & Reliability

- Ramp to Breakdown (RTB): **Qualification Test**

- Voltage ramped at a rate of $1 \text{ kV}_{\text{rms}}/\text{second}$ until a breakdown occurs in the isolation barrier

Histogram

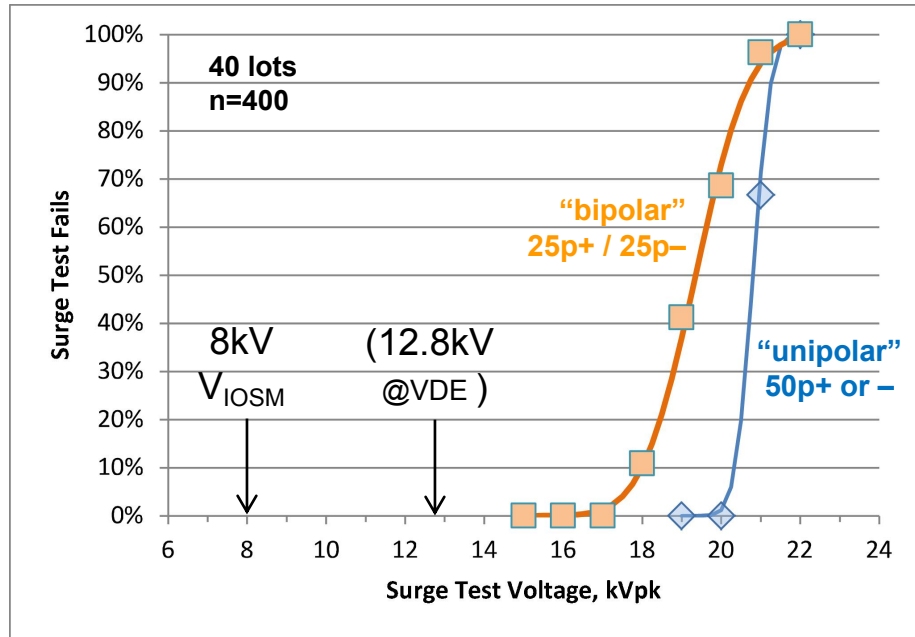


- *Ramp-to-Breakdown sample test.*
 - *Verifies high margin of the actual breakdown voltage above the maximum transient isolation voltage (V_{IOTM})*
 - *For example: ISO77xx, AMC1303*
 $V_{\text{IOTM}} = 5.7 \text{ kVrms}$
- *Very high isolation voltage capability*

Qualification & Reliability

• Surge Test: Qualification Test

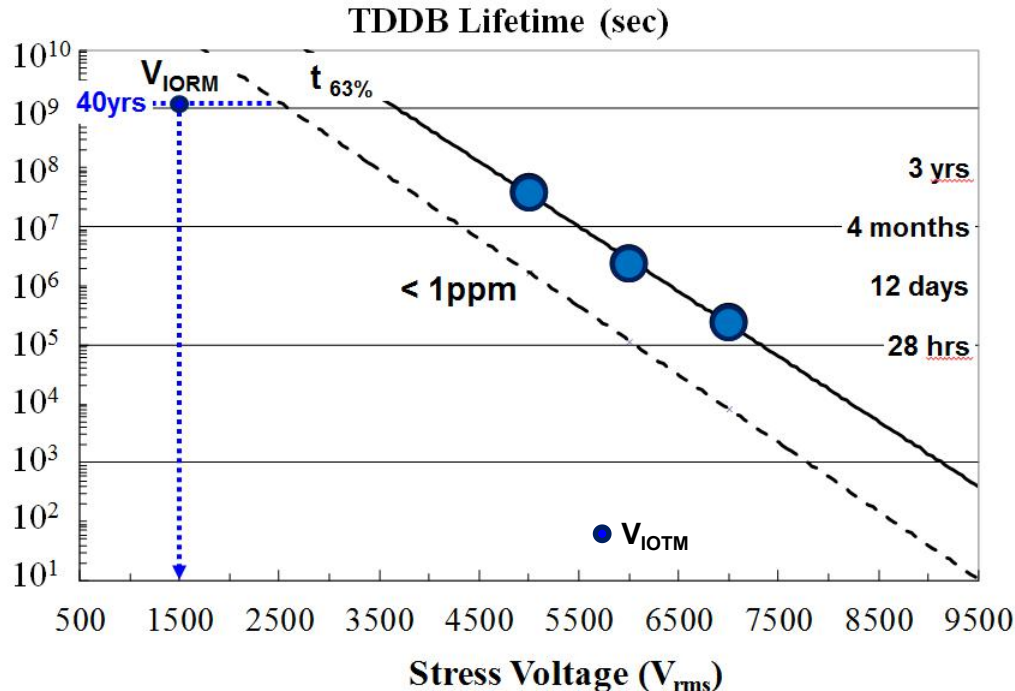
- Surge verifies the DUT's immunity to **very** high voltage levels over a short period of time (such as a lightning strike). Surge peak voltage required by external standards (IEC 61000-4-5 & VDE 0884-1x):



- *Surge characterization sample test.*
 - *Verifies high margin of the actual breakdown voltage above the maximum surge isolation voltage (V_{IOSM})*
 - *For example: ISO77xx, AMC1303*
 $V_{IOSM} = 8.0 \text{ kVpk}$
- *Very high isolation voltage capability*

Qualification & Reliability

- The main Isolation electrical lifetime test is TDDB: **Qualification Test**
 - Standard methodology for determining the lifetime of a dielectric as a function of Voltage



- *TDDB is accelerated lifetime testing of the isolation barrier*
 - Weibull statistics at each voltage
 - Multiple voltages. Fit to model:
 $Time\text{-}to\text{-}Fail = A * \exp(-\gamma * E)$
- *TDDB verifies the lifetime*
 - For example: ISO77xx, AMC1303
 $V_{IORM}, V_{IOWM} = 1.5\text{ kVrms}$
- *First technology in the industry to certify to VDE 0884-11*

Qualification & Reliability

Method B1 & Method A High-Voltage Testing:

- The Method B1 and A tests consist of two parts
 - An *Isolation test*: HV test to screen out units with defective caps
 - An *Partial Discharge test*: We follow the same 5pCoulomb test standard that is required for all isolation technologies
- **Method A: Qualification Test**
 - Isolation stress test at V_{IOTM} for 60s; Partial discharge test at $1.6 \times V_{IORM}$ for 10s
 - Method A is required by external standards **IEC/VDE** to verify V_{IOTM} on a sample basis – Quarterly monitor
- **Method B1: Qualification Test & Production Test**
 - Isolation stress test at $1.2 \times V_{IOTM}$ for 1s; Partial discharge test at $1.875 \times V_{IORM}$ for 1s
 - External standards **IEC/VDE** requires that all reinforced isolation units must be tested in **production**

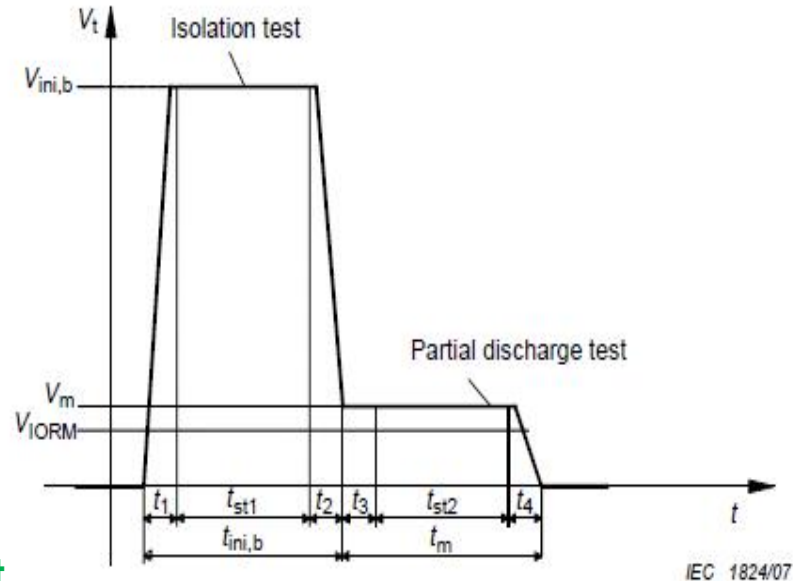


Figure: Method-B1 & Method A testing profiles

SiO₂ Insulation

TI **Capacitive Isolation** uses SiO₂ as the Isolation Dielectric.

- SiO₂ advantages compared to competing HV isolative material are: **reliability** and **dielectric strength**

Insulator Materials	Dielectric Strength, 1 sec	Dielectric Strength, 40yr reliability
Air	~1 Vrms/um	
Epoxies	~20 Vrms/um	
Silica filled Mold compounds	~100 Vrms/um	
Polyimide	~300 Vrms/um	~20 Vrms/um
SiO ₂	~500 Vrms/um	~100 Vrms/um

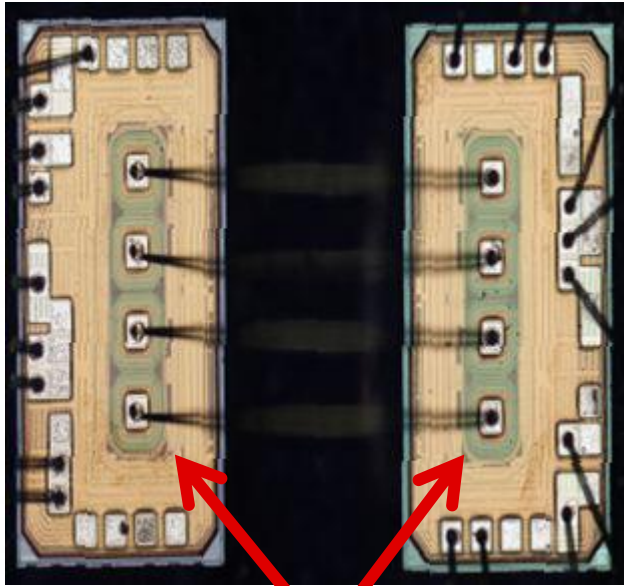
Table 1: Commonly used materials for High-Voltage isolation (SiO₂ has the highest dielectric strength and best reliability)

Dielectric Thickness (SiO₂) Fabrication Process Control & Monitor:

- **Repeatability** and **Reproducibility** – SiO₂ thickness monitored using two methods:
 - Oxide thickness sample measured in the wafer fab for each of the layers of the dielectric stack
 - Tox by capacitance measurement on test structures on every production wafer after fabrication
- **Thickness is tracked on all wafers for each fabrication lot as required by UL standard**

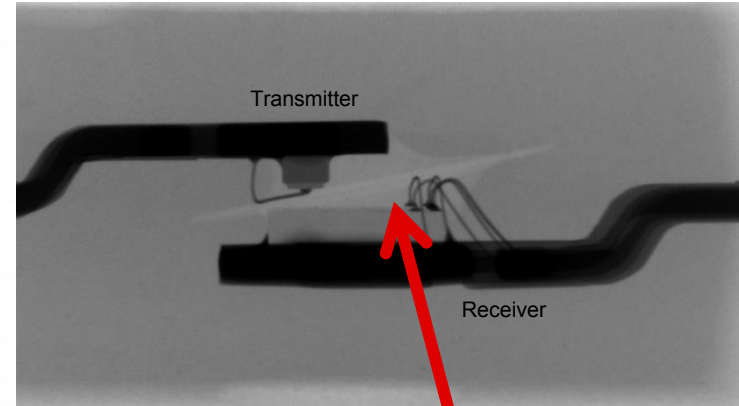
Comparison to other Isolation technologies

TI capacitive coupler



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

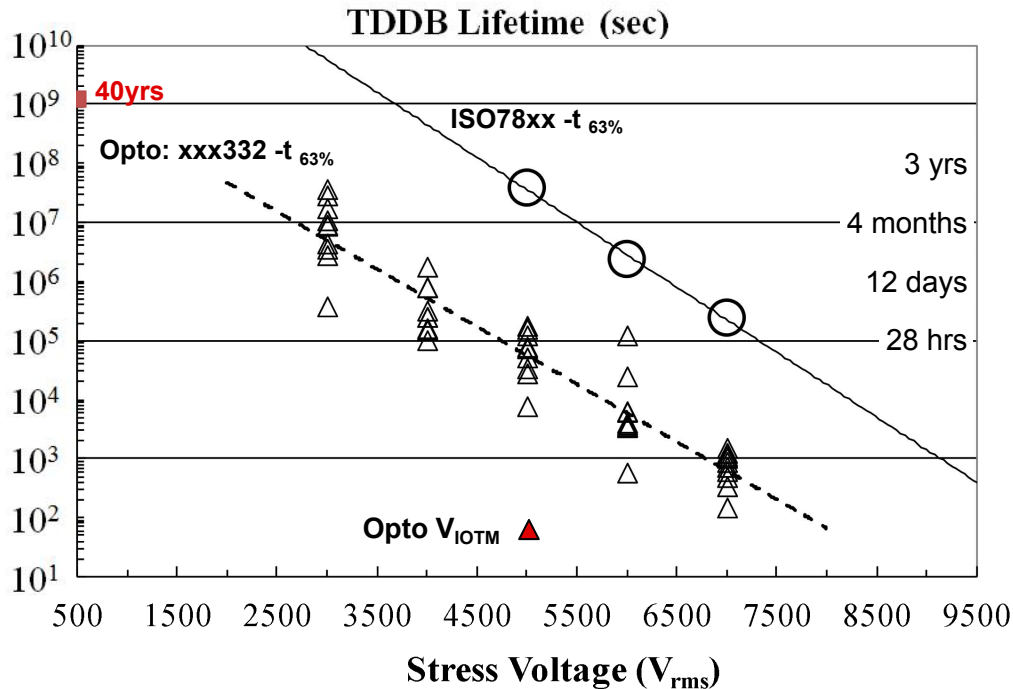
Opto coupler



Isolation built with transparent
silicone and thin tape

Comparing Quality and Reliability

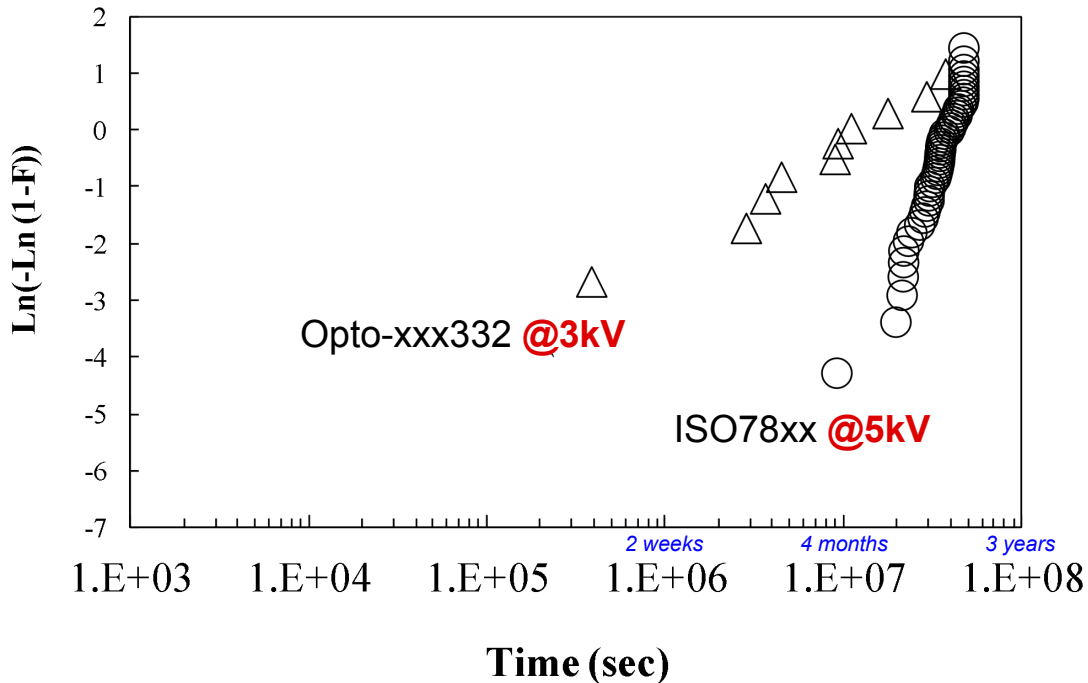
- The main Isolation electrical lifetime test is TDDB: **Qualification Test**
 - Standard methodology for determining the lifetime of a dielectric as a function of Voltage



- Like all dielectric materials, opto-coupler does degrade over time under high voltage stress
- TDDB testing is needed for all HV isolation technologies, in addition to partial discharge testing on each unit
- TDDB data of opto-coupler fits standard TDDB E-Field model, even down to 3kVrms testing

Comparing Quality and Reliability

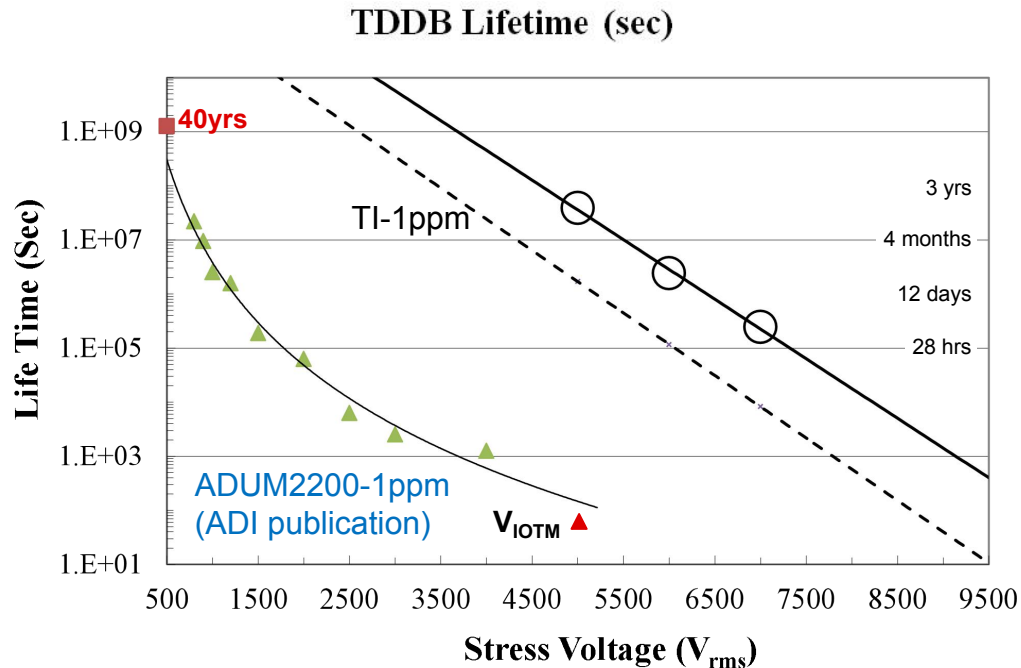
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 - Standard methodology for determining the lifetime of a dielectric as a function of Voltage



- ISO78xx shows much tighter distribution at 5kVrms than opto at 3kVrms TDDB
- At 5kVrms, ISO78xx shows much higher MTTF (mean-time-to-fail), 402 days than 103 days of Opto-xxx332 at 3kV

Comparing Quality and Reliability

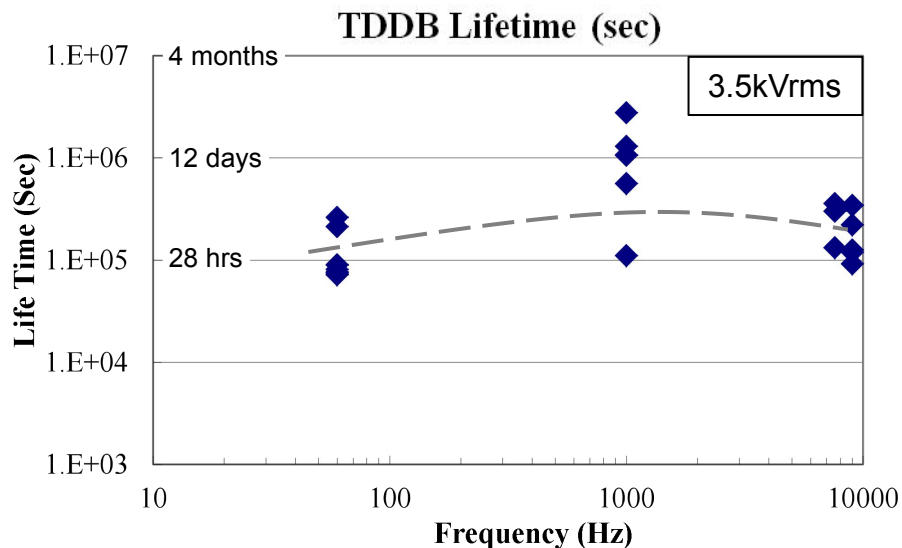
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 - Standard methodology for determining the lifetime of a dielectric as a function of Voltage



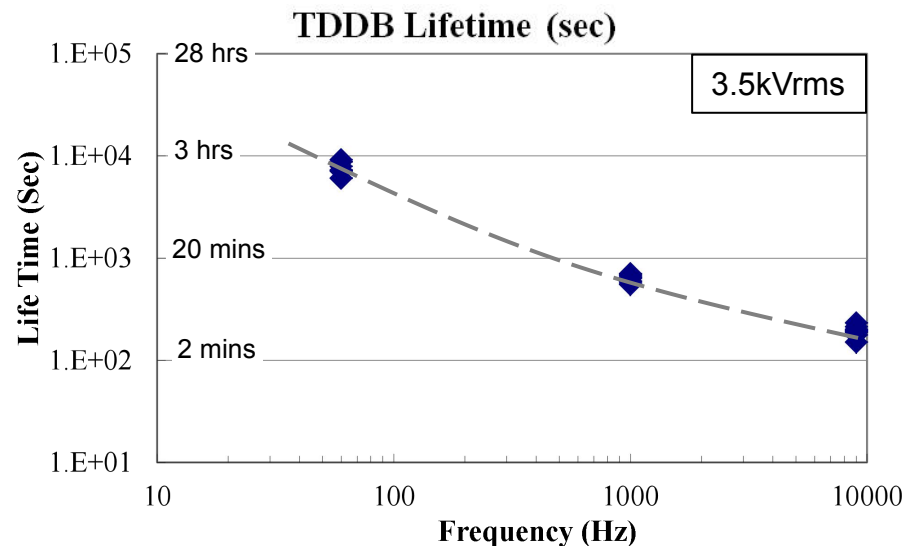
- Polyimide dielectric follows a different exponential relation to the stress voltage (“power-law”).
- Polyimide lifetime degrades after exposure to ambient moisture.
- Polymer TDDB must be tested after units have reached equilibrium with ambient moisture.

Comparing Quality and Reliability

- The main Isolation electrical lifetime test is TDDB: **Qualification Test**
 - Standard methodology for determining the lifetime of a dielectric as a function of Voltage



12.7um SiO₂ single capacitor



*25um Polyimide capacitor
Lifetime degrades at higher frequency*

TI Isolation Technology

Reliability – longer product lifetimes

Industry's highest reliability, reinforced insulation barrier

- Built on TI's 180nm CMOS Process Technology with Series Capacitor Architecture
- Longest lifetime reliability; $>1.5 \text{ kV}_{\text{RMS}}$ working voltage over 100+ years
- Superior transient protection for harsh environments, $>12.8\text{kV}$ surge

Performance & Integration – better for industrial and automotive

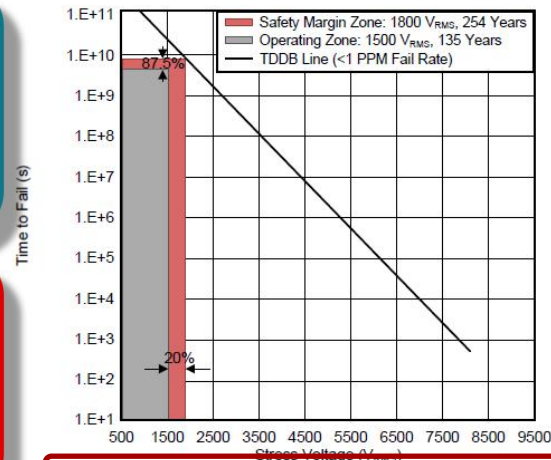
TI portfolio integration of Basic & Reinforced Isolation offers leading solutions

- Lowest Emissions, Highest CMTI, and Power Efficiency
- Meets or exceeds industry certifications standards for insulation, emissions, and immunity
- Isolation plus high performance Analog, Data Conversion, Interface and Power

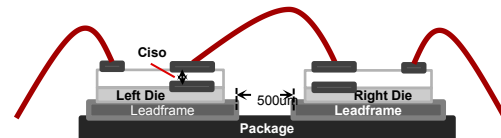
Ease of Design – Partnered support with FAE's & Customers

Complete Portfolio of Discrete and Integrated Isolation Solutions, Tools and Support

- Over 175 TI Reference Designs, White Papers, App Notes and EVMs Available
- Isolation dedicated E2E Online Support Forum & Industry standards and certification experts



T_A upto 150°C Operating lifetime = 135 years



Bullet-Proof Electro Magnetic Compatibility

- EMC is equivalent to Robustness and critical to the Industrial and Automotive Markets
- TI's Reinforced Capacitive Isolation sets new levels for EMC & CMTI
 - Exceeds WW EMC requirements
 - 100kV/us CMTI enables next-gen driver technology - GaN/SiC FETs

EMC metric	Governing Standard	Exceeds Level
Radiated Immunity	✓ IEC-61000-4-3	Class A > 20V/m @ < 1GHz. > 16V/m @ > 1GHz
Conducted Immunity	✓ IEC-61000-4-6	Class A >15Vrms @ < 80MHz
Power frequency, Pulse magnetic	✓ IEC-61000-4-8,9	Class 5 >4kA/m
ESD	✓ IEC-61000-4-2	Level 4 8kV Contact
EFT/Burst	✓ IEC-61000-4-4	Supply/IO 4kV/2kV
Surge	✓ IEC-61000-4-5	Class X - > 10kV
Emissions	✓ EN55022/CISPR22B / SAE J1752-3 / FCC15	Class B At least 4dB better than competition
CMTI	✓ IEC-60747-17	> 100kV/us min



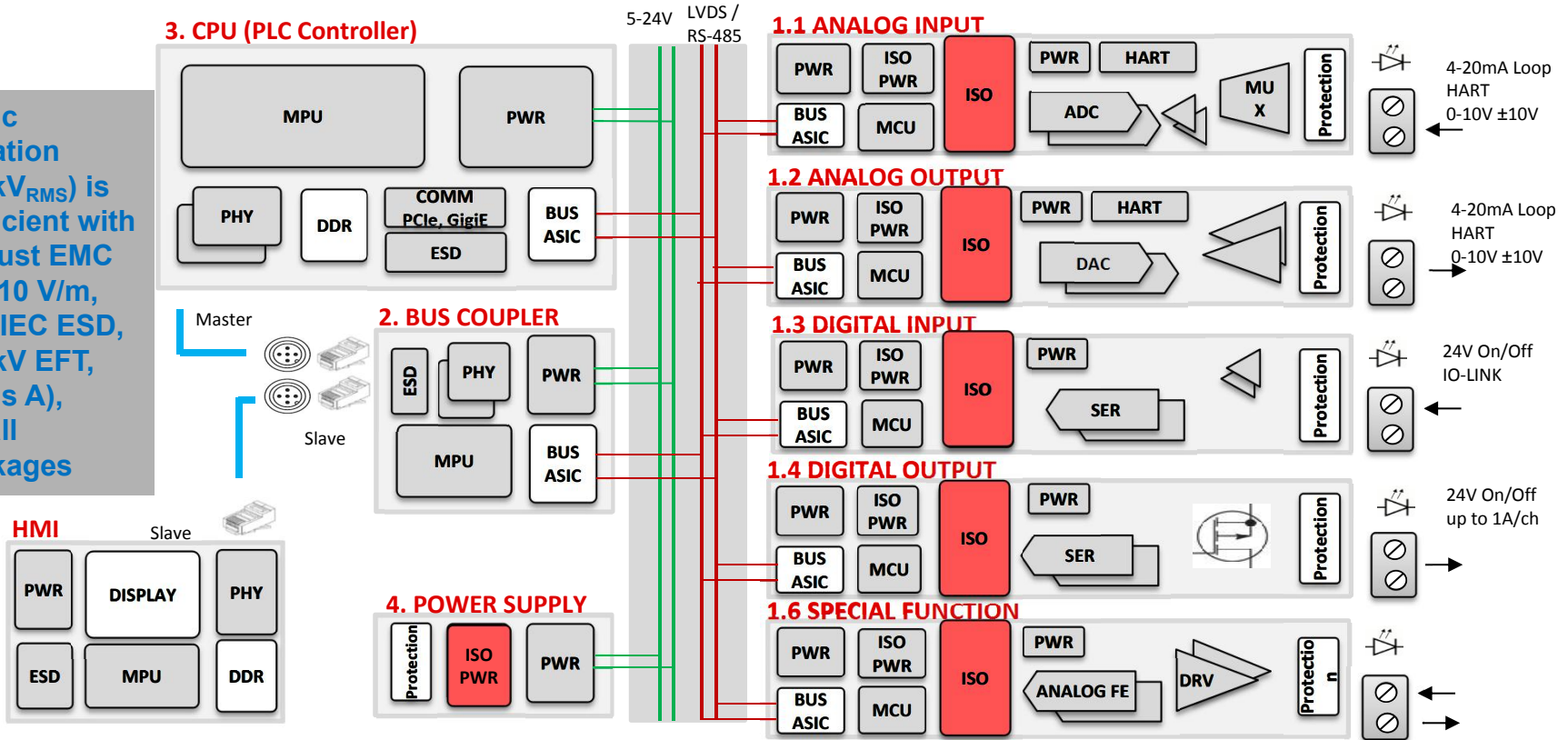
Key Comments

- TI's isolation family of products has high voltage capability that exceeds the requirements for reinforced isolation.
- The quality of HV isolation is demonstrated by substantial margins using statistical test methods.
- The reliability of the HV isolation process technology is proven by TDDb, which is the industry standard method of proving lifetime at use conditions.
- For more details, see the TI white paper "Enabling high voltage signal isolation quality and reliability."

PLCs

PLC System Block Diagram - Architecture

Basic Isolation (2.5kV_{RMS}) is sufficient with Robust EMC (RI: 10 V/m, 8kV IEC ESD, +/-4kV EFT, Class A), Small packages

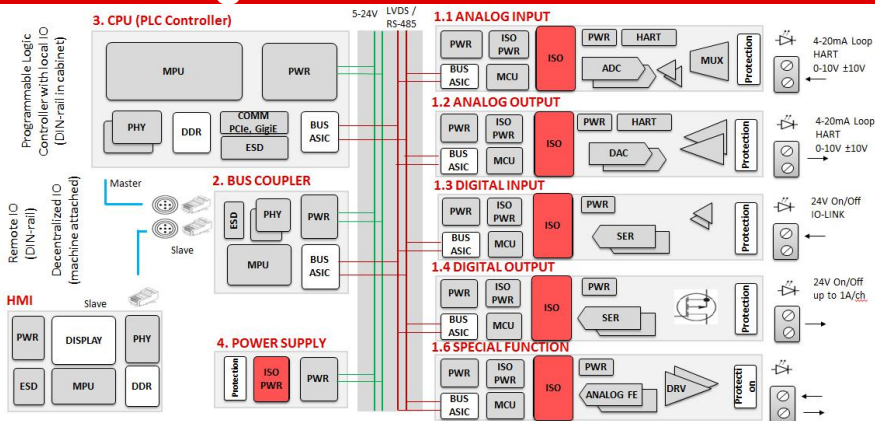


PLC

Key Specifications

- 500Vrms Working Voltage, 2.5kVrms (1s, VISO), basic isolation
- ESD (6kV-8kV) and EFT (4kV)
 - Especially on ISO-RS485 and ISOCAN
- Low power consumption (to relieve thermal constraints in compact designs)
- EMC – Immunity and Emissions
- Small packages and multi-channel configurations
- Low propagation delays (for SPI timing closure)
- Lower controller side power supply

Block Diagram



Key Parts

- ISO121x
 - Does not need field side supply
 - Fully integrated solution for digital input modules
- SN650x
 - Flexible output voltages, high efficiency (80%+), low cost, small footprint, flexible output voltages, ultra low emissions, SSC, Soft Start
- ISOWATT
 - Compact design, fully integrated power+signal isolation. Low emissions, High Efficiency, Soft start
- ISO77xx
 - 2.25V min power supply, > 8kV IEC ESD, EMC hardened, low prop delays, flexible package options (16DW, 8D, 16 DBQ), 6-channel options
- ISOCAN & ISO-RS485
 - Integrated solutions for communication module

Key Collateral

- [How to design 48V, 110V, and 240V DC and AC Digital Inputs](#)
- [How To Simplify Isolated 24-V PLC Digital Input Module Designs](#)
- Isolation for PLC blog series (coming soon)
- 96-channel ISO1212 TI Design (coming soon)

ISO121x Replaces Optocouplers in Isolated Digital Inputs

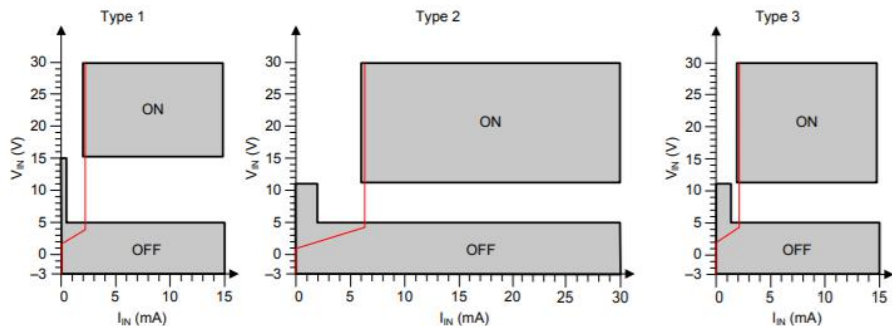
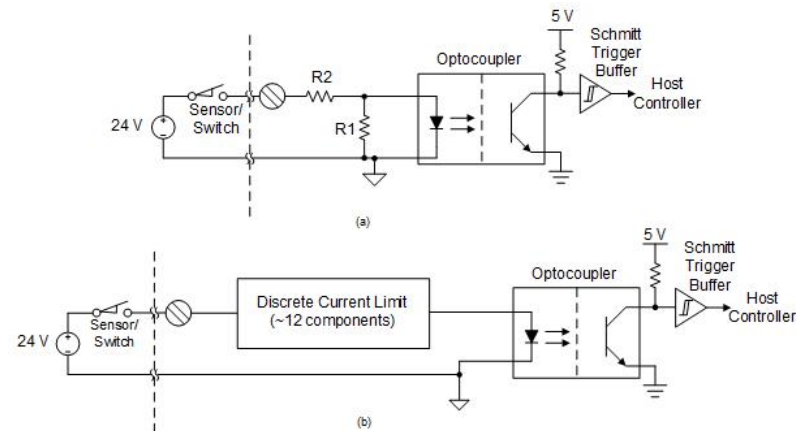
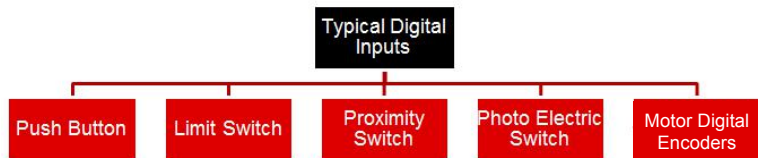
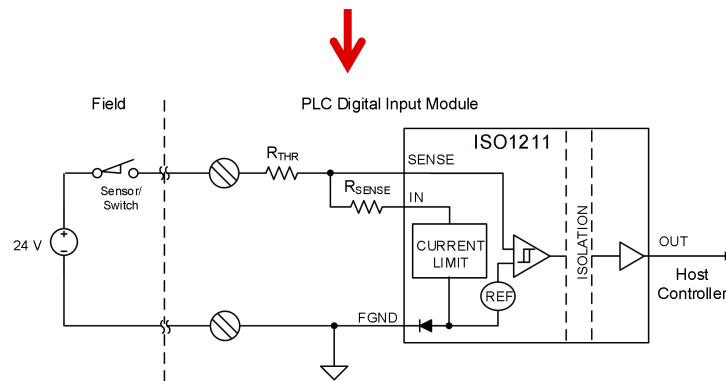


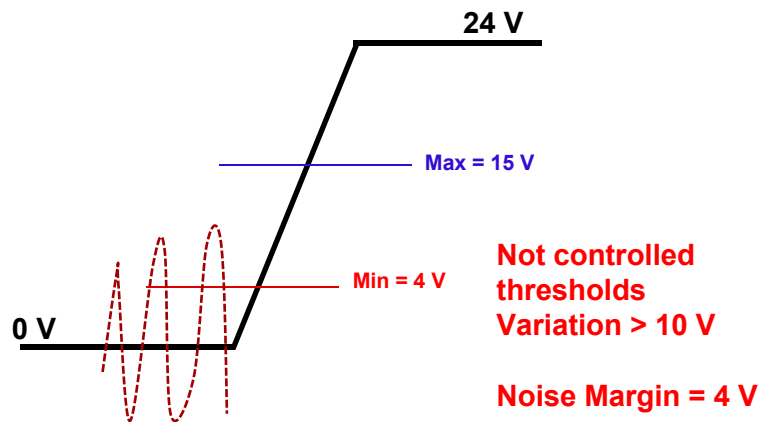
Figure 15. Switching Characteristics for IEC61131-2 Type 1, 2, and 3 Proximity Switches



Better Noise Margins – Low Thresholds and Hysteresis

Opto-Coupler

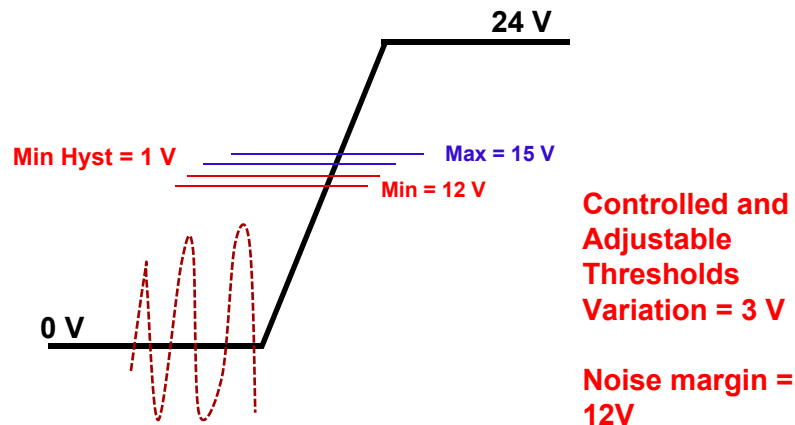
Usually opto-coupler based inputs have very high variation in thresholds, or very high current at 30V input



ISO121x

(Over recommended operating conditions unless otherwise noted).

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
VOLTAGE TRANSITION THRESHOLD ON FIELD SIDE						
V _{IL}	Low level threshold voltage at module input (including R _{THR}) for output high	R _{SENSE} = 562 Ω, R _{THR} = 0 Ω, see Figure 11	6.5	7	V	
		R _{SENSE} = 562 Ω, R _{THR} = 1 kΩ, see Figure 11	6.7	9.2		
		R _{SENSE} = 562 Ω, R _{THR} = 4 kΩ, see Figure 11	15.2	15.8		
V _{IH}	High level threshold voltage at module input (including R _{THR}) for output low	R _{SENSE} = 562 Ω, R _{THR} = 0 Ω, see Figure 11		8.2	8.55	V
		R _{SENSE} = 562 Ω, R _{THR} = 1 kΩ, see Figure 11		10.4	10.95	
		R _{SENSE} = 562 Ω, R _{THR} = 4 kΩ, see Figure 11		17	18.25	
V _{HYS}	Threshold voltage hysteresis at module input	R _{SENSE} = 562 Ω, R _{THR} = 0 Ω, see Figure 11	1	1.2	V	
		R _{SENSE} = 562 Ω, R _{THR} = 1 kΩ, see Figure 11	1	1.2		
		R _{SENSE} = 562 Ω, R _{THR} = 4 kΩ, see Figure 11	1	1.2		



Thermals: ISO1212 vs Traditional Solutions

ISO121x Devices Reduce Board Temperatures vs Traditional Solutions

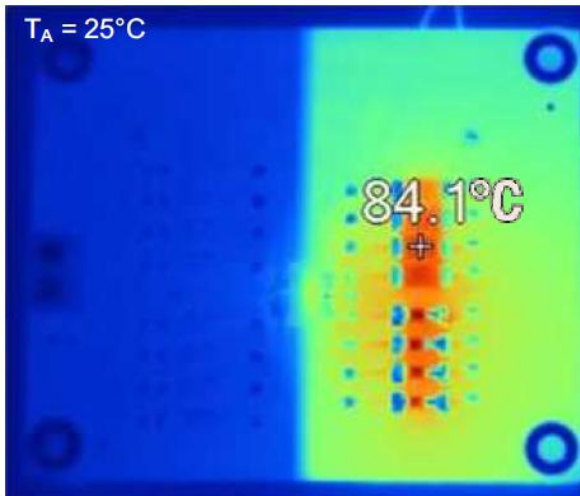
ISO1212:

0.72W power dissipation for 8-ch at 36V input

Needs 0.25W series resistors.



a) 8-Ch With ISO1212

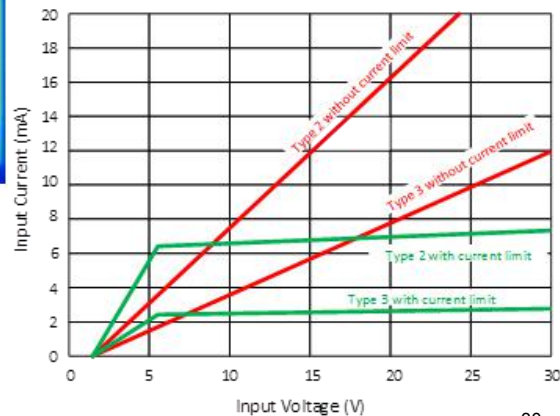


b) 8-Ch Traditional Solution Without Current Limit

ISO121x operates ~40 C cooler vs. traditional solutions

Traditional 3.6W power dissipation for 8-channels at 36V input

Needs 0.5W-1W series resistors

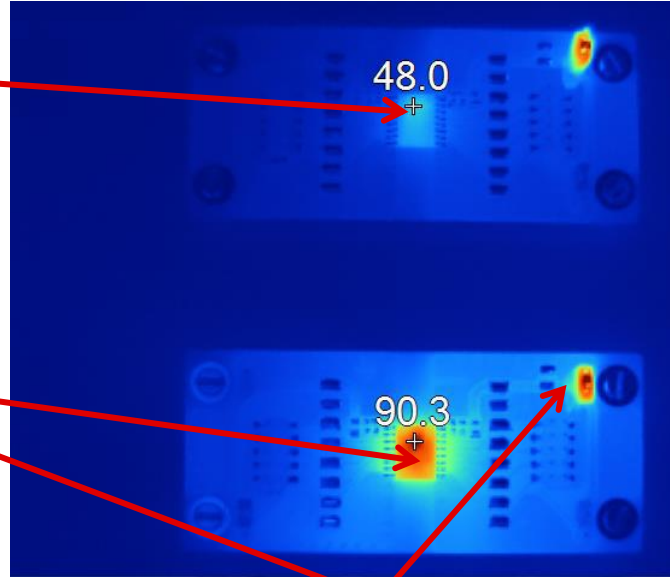
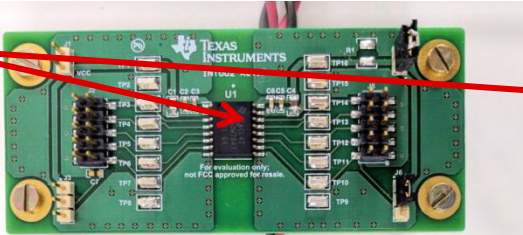


ISOW's efficiency makes microPLC possible

Image showing setup

Infra-Red image showing hotspots

ISOW7841



With PLCs getting smaller and more dense, thermal performance is critical.

400mW Load

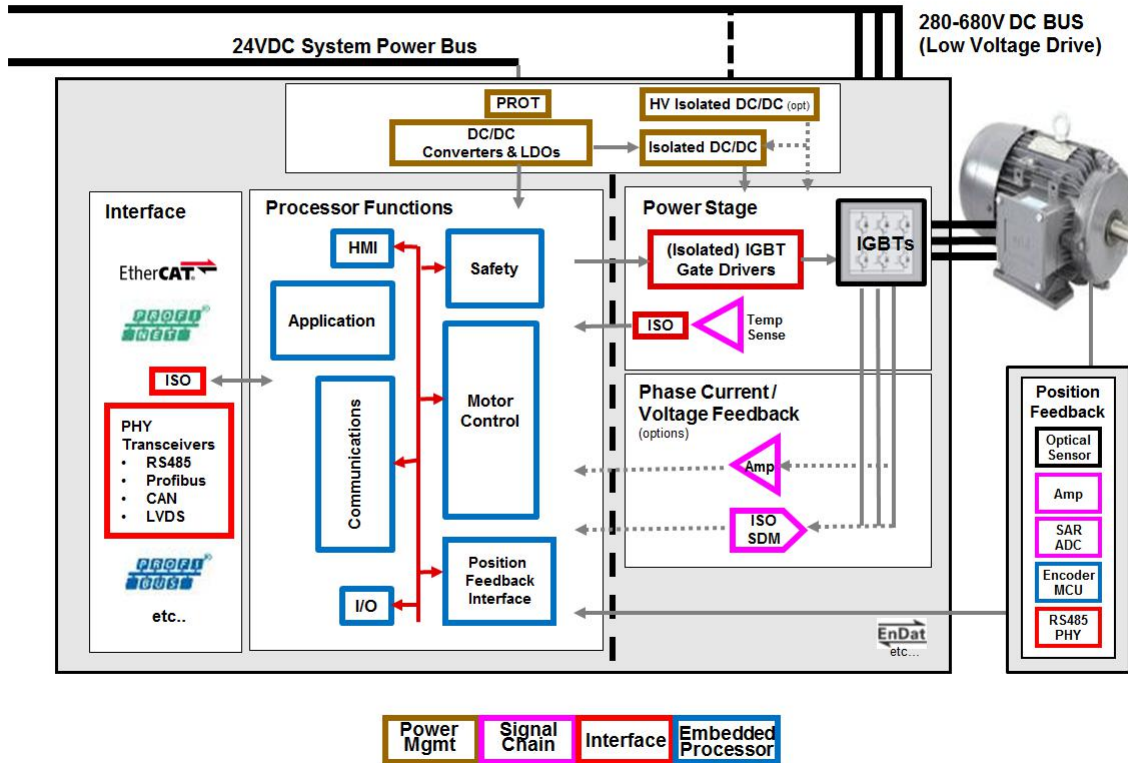
- TI is **~40°C** cooler than the competition at full load.

TI Isolation Products for PLC

Products	Description	Key Benefits
ISO121x	24V isolated digital input receiver with 2mA current limit	Does not need field side supply, fully integrated solution for digital input modules (1 & 2 channel configurations)
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
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
Isolated RS-485 and Isolated CAN portfolios	Isolated RS-485 and Isolated CAN portfolios	Flexible portfolio of interconnect solutions for communication module
ISOW78xx	Digital isolators and transceivers with integrated power supply	Compact design, fully integrated power + signal isolation, low emissions, high efficiency, soft start

Motor Drives

Complete Motor Drive System



Different modules in this EE:

1. Power stage
2. Control module
3. Position feedback
4. Main power supply
5. HMI, I/O, Keyboard
6. Wired, Wireless communication

Signal Isolation is present in:

- a. PWM driving (control stage to Power stage): RS485, CMOS
- b. Voltage, current, Temp sensing
- c. Communication interface (data log, Maintenance, PLC control)
- e. CAN, RS485, Ethernet, Digital I/O

Power isolation present in:

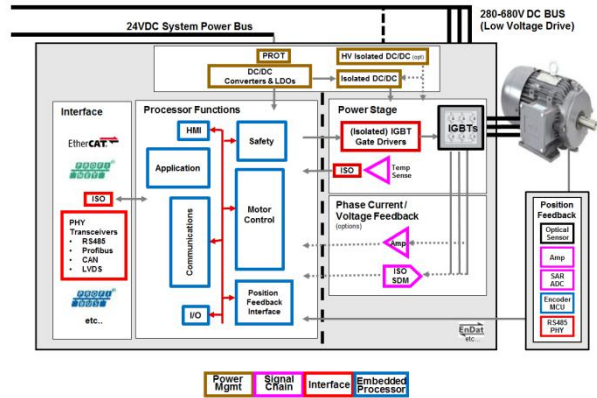
- a. IGBT gate drive power supply
- b. AC/DC main power supply

Motor Drives

Key Specifications

- High Working Voltage – Motor Drives Mains > 690Vrms
- Noise Immunity – for robust isolation barrier against IEC EFT
- Small size – save space & optimize layout. Especially important in Servo drives
- CMTI – Needed for gate driving where a large voltage switching happens.
- Robust isolation barrier (functional safety)

Block Diagram



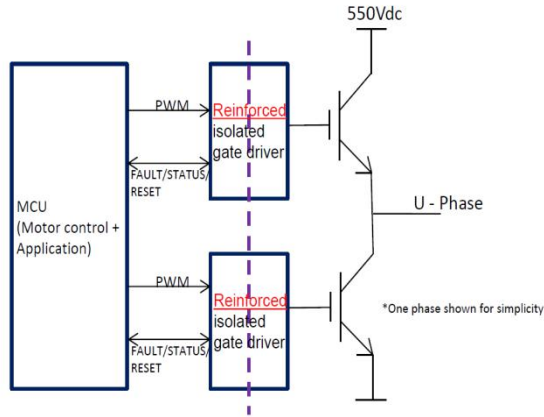
Key Parts

- ISO77xx
 - ISO7760 for gate drive in Servo Control, PWM drive
- ISO121x
 - Safety Inputs, Safety torque off
 - Fast switching ideal for motor positioning
- ISOWATT
 - Compact design, fully integrated power+signal isolation. Low emissions, High Efficiency, Soft start
- ISO35/3082/3086/1176
 - RS485 Communication Port
- ISO1042
 - CAN Communication Port
- SN650x
 - IGBT Power Supply
 - Flexible output voltages, high efficiency (80%+), low cost, small footprint, flexible output voltages, ultra low emissions, SSC, Soft Start

Key Collateral

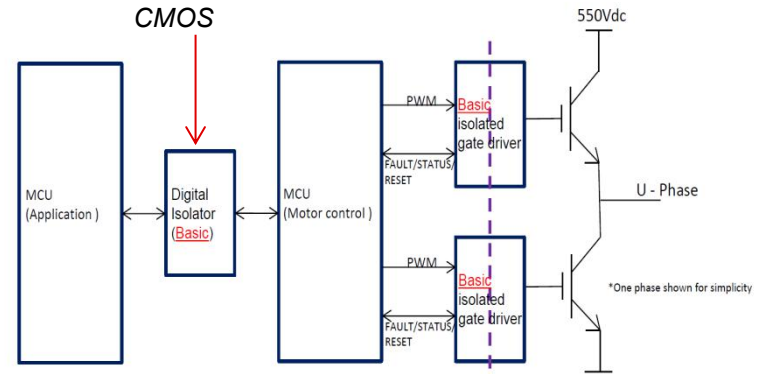
- [Isolation in AC Motor Drives: Understanding the IEC 61800-5-1 Safety Standard](#)
- [3-phase IPM Based Inverter with Single Package Reinforced Isolator Reference Design](#)
- [How to Improve Speed and Reliability of Isolated Digital Inputs in Motor Drives](#)
- ISO7760DW Advantages in IPM based Motor Drives (coming soon)

Reinforced Isolation with single Controller

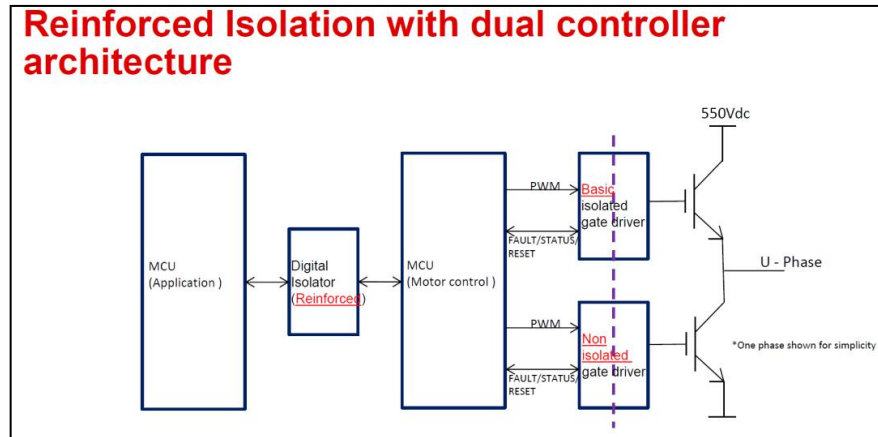


Most common architecture

Basic + Basic Isolation with dual controller architecture



Reinforced Isolation with dual controller architecture



Used for >5-10kW drives

Motor Drives Key Specs

•**High working voltage:** TI' Isolation barrier is at least 25% better than nearest competition. This is required because input mains supply for Drives can go to 690Vrms or even higher.

- ✓ ISO77xx (1kVrms / 1500Vpk working voltage)
- ✓ ISO78xx (1500Vrms DW / 2000Vrms DWW).
- ✓ Only isolator in industry with DWW package (>14mm creepage/clearance).
- ✓ ISO1042 (CAN) has same isolation technology as ISO77xx, high working voltage on isolated transceivers

•**Noise immunity:** Due to fast switching/Ldi/dt, isolation barrier for gate drive/communications needs robust isolation barrier against IEC EFT.

•**Small size:** Multiple isolation channels in same package saves space against optos

- ✓ ISO77xx available till **6 channels** in various package options

•**CMTI:** highest in industry. Needed for gate driving at large voltage switching happens. Future SiC/GaN FETs may require even higher CMTI

- ✓ ISO78xx Minimum CMTI Spec: **+/-100 kV/μs** [Industry Leading]

High Channel Density

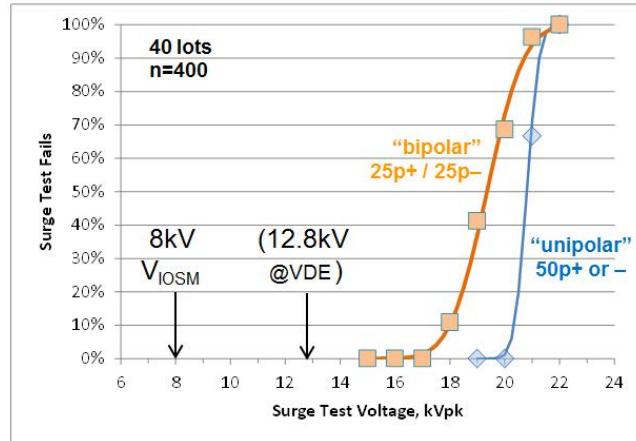
Digital Isolation Packages: ISO77xx Family



Images drawn to scale

Package	Identifier	Length (mm)	Width (mm)	Creepage (mm)	Channels
8-pin SOIC	D	4.90	3.91	4	1, 2
16-pin SSOP	DBQ	4.90	3.90	3.7	3, 4, 6
8-pin SOIC	DWV	5.85	7.50	8	2
16-pin SOIC	DW	10.30	7.50	8	1, 2, 3, 4, 6

Robust isolation barrier



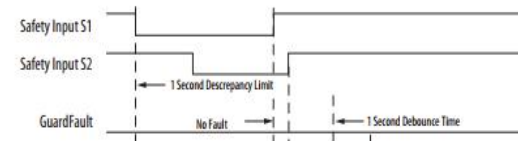
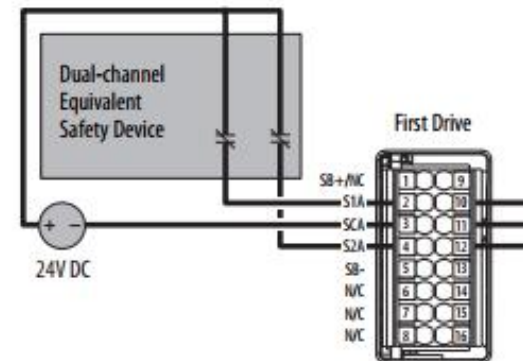
ISO121x in Motor Drives: STO

STO (Safe Torque Off):

- Safe Torque off is a safety function implemented in most drives. This is used as an emergency stop for the motor. This is usually a 24-V input.
- These signals are high by default and implemented with opto-couplers.
 - Default High is used since this automatically provides wire break – wire break will assert STO and stop the motor.
- ISO1212 or ISO1211 provide a better alternative for STO.



- Key benefits of ISO1212 vs. Optocouplers for STO:
 - Precise voltage thresholds and hysteresis for noise immunity.
 - Lower FIT (Failure in Time): ISO121x has 10-20 times lower FIT than optocouplers.
 - **No Aging** : Since **STO signals are always ON**, optocouplers have a greater risk of aging.



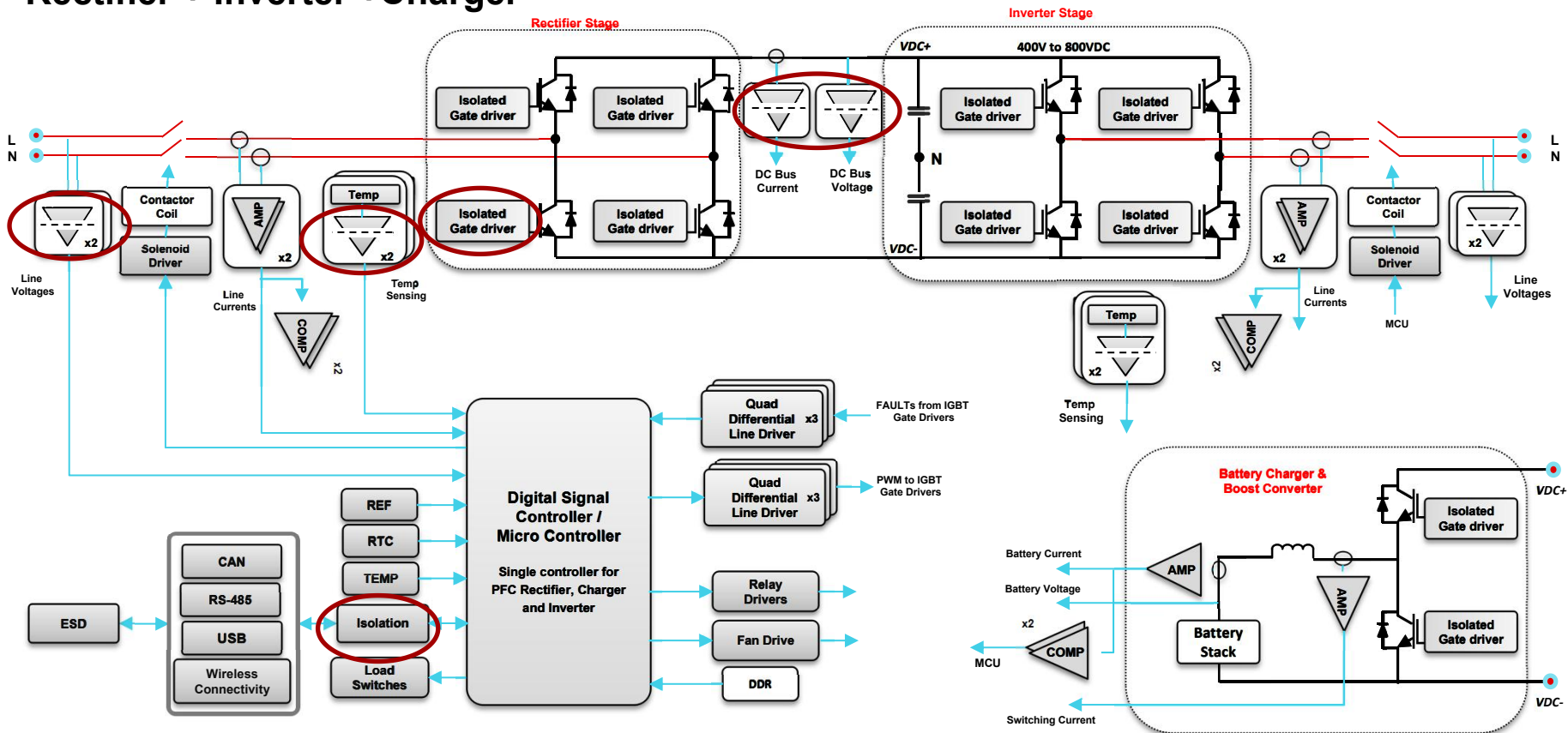
TI Isolation Products for Motor Drives

Products	Description	Key Benefits
ISO121x	24V isolated digital input receiver with 2mA current limit	Does not need field side supply, fully integrated solution for digital input modules, safety inputs, safety torque off, IEC61131-2 Type 1, 2, and 3
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	Digital isolators and transceivers with integrated power supply	Compact design, fully integrated power + signal isolation, low emissions, high efficiency, soft start
ISO1042	Isolated CAN transceiver	Improved HV ISO performance, CMTI, transceiver performance
SN6501 and SN6505	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
ISO5852s and ISO5452	+2.5A/-5A, isolated, high CMTI, single channel driver with integrated protection	Component-level reinforced rating, improved system performance, enabling low power & efficient solutions, high immunity for noisy environments, high reliability in harsh environments
AMC1311	2 Vin, reinforced isolated amplifier for voltage sensing with industry's highest CMTI up to 140 μ V/s	Reinforced isolation rating with input optimized for voltage sensing, 2 grades of performance: AMC1311 and AMC1311B, highest accuracy measurements with low offset and gain error & longer lifetime and reliability with extended temperature range of -55 to 125C.
AMC1300	\pm 250 mVin reinforced isolated amplifier for current sensing with industry's highest CMTI up to 140 μ V/s	Reinforced isolation rating with input optimized for current sensing, 2 grades of performance: AMC1300 and AMC1300B, highest accuracy measurements with low offset and gain error and longer lifetime and reliability with extended temperature range of -55 to 125C.

Power Delivery

Single Phase Online UPS

Rectifier + Inverter + Charger



RS485 is common, other ports shown for completeness



TEXAS INSTRUMENTS

Power Delivery

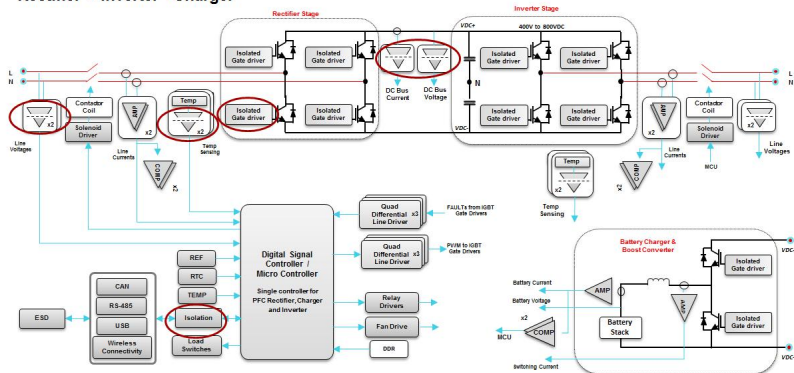
Key Specifications

- Small package size as network power supplies are shrinking
- Multiple channels in one package
- Cost
- Isolation (basic / reinforced depending on where it is used)
- Power consumption (for efficiency specs on PSU)

Block Diagram

Single Phase Online UPS

Rectifier + Inverter + Charger



Key Parts

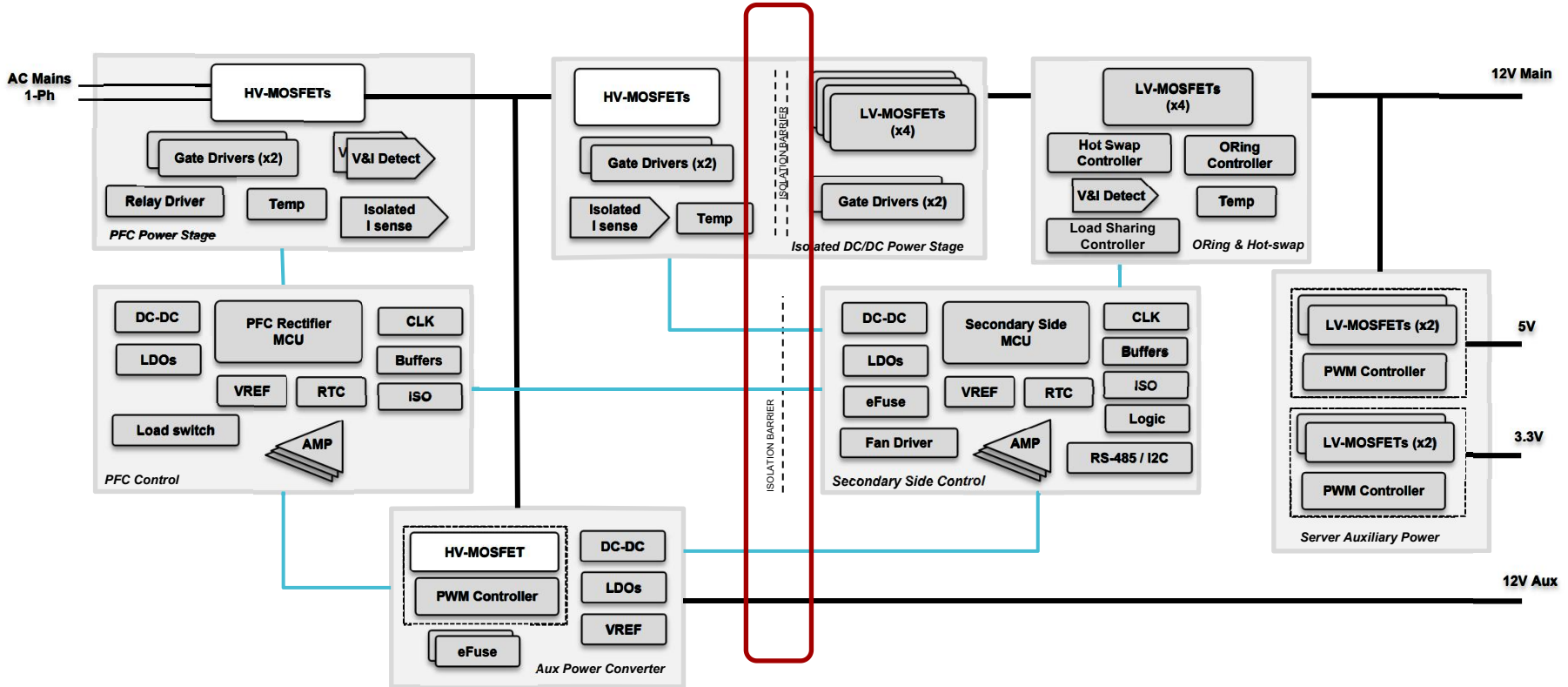
- ISO77xx: Meets basic / reinforced isolation. Package and channel options allow it to fit most sockets.
- SN650x: Size and efficiency make it suitable for IGBT Power Supply
- ISO35/3082/3086: Isolated RS485 for communication in module
- ISO1042: Isolated CAN Transceiver for communication in module
- ISOW784x (For RS485 / CAN Interface + isolated power)
- ISO154x (Telecom rectifier / Network PSU) – communication between MCU1 and MCU2

Key Collateral

- [92% Efficiency, CoC Tier2, 65W USB-PD AC/DC Adapter Reference Design in High Power Density – ISO7710](#)
- [High-Efficiency, 1.6-kW High-Density GaN-Based 1-MHz CrM Totem-Pole PFC Converter Reference Design](#)

Network and Server Power Supply

Distributed Control Architecture



Power Delivery Requirements

- Small package size as network power supplies are shrinking
 - ISO77xx available in DW and DBQ packages
- Multiple channels in one package
 - ISO77xx available in up to 6 channel variants
- Isolation (basic / reinforced depending on where it is used)
- Power consumption (for efficiency specs on PSU)
 - SN650x up to 80% Efficient
- CAN for communication between parallel modules in UPS
 - ISO1042 offers isolation and CAN transceiver all in one device

TI Isolation Products for Power Delivery

Products	Description	Key Benefits
ISO77xx	100 Mbps reinforced digital isolators	Flexible package options (16DW, 8D, 16 DBQ), 6-channel options, 2.25V min power supply, > 8kV IEC ESD, EMC hardened, low prop delays
SN6501 and SN6505	Push-pull transformer drivers for up to 5W isolated power supplies	High efficiency (80%+), flexible output voltages, low cost, small footprint, flexible output voltages, ultra low emissions, SSC, soft start
ISO35/3082/3086	Isolated RS-485 transceivers	Isolated full-duplex and half-duplex transceivers with high ESD protection, 50kV/us CMTI, 20Mbps
ISO1042	Isolated CAN transceiver	Improved HV ISO performance, CMTI, transceiver performance
ISOW78xx	Digital isolators and transceivers with integrated power supply	Compact design, fully integrated power + signal isolation, low emissions, high efficiency, soft start
ISO154x	Isolated I2C	Bidirectional I2C isolator, supports up to 1-MHz
UCC21520 and UCC21222	Isolated dual-channel gate driver with 4-A source and 6-A sink peak current with best-in-class propagation delay and pulse-width distortion	Drop-in replacement with better performance, higher drive could eliminate buffer stages, flexible settings to prevent shoot-through in ½ bridge applications, provides high noise immunity for fast/high current designs such as power supplies
AMC1311	2 Vin, reinforced isolated amplifier for voltage sensing with industry's highest CMTI up to 140 µV/s	Reinforced isolation rating with input optimized for voltage sensing, 2 grades of performance: AMC1311 and AMC1311B, highest accuracy measurements with low offset and gain error & longer lifetime and reliability with extended temperature range of -55 to 125C.
AMC1300	± 250 mVin reinforced isolated amplifier for current sensing with industry's highest CMTI up to 140 µV/s	Reinforced isolation rating with input optimized for current sensing, 2 grades of performance: AMC1300 and AMC1300B, highest accuracy measurements with low offset and gain error and longer lifetime and reliability with extended temperature range of -55 to 125C.

TI Online Resources

TI Home > Isolation

Isolation

Product Tree

- Digital Isolators (162)
- Isolated RS-485 Transceivers (10)
- Isolated CAN Transceivers (2)
- Isolated I2C (4)
- Isolated LVDS (3)
- Transformer Driver (4)
- Isolated ADCs (32)
- Isolated Amplifiers (12)
- Isolated Gate Driver (25)

Overview Tools & software Technical documents Support & training

Isolation Solutions

High voltage isolation for robust and reliable system operation

Digital Isolators & Digital Isolators + Power

Reinforced and basic isolators, including isolators with integrated power, to transmit bit streams up to 100 Mbps over the isolation barrier.

Search products:

[Digital Isolators](#)

Isolated Interface

Used to isolate the digital interface to the uC from the communication bus.

Search products:

[ISO RS-485](#)

[ISO CAN](#)

[ISO I2C](#)

[ISO LVDS](#)

Isolated Gate Drivers

Reinforced and basic isolated gate drivers used to efficiently charge MOSFET, IGBT, and SiC FET gates.

Search products:

[Isolated Gate Drivers](#)

Isolated ADC & Amplifiers

Isolated DS-modules and isolated amplifiers used to isolate and monitor V/I parameters on high voltage nodes for control and metrology applications.


Search products:

[Isolated ADCs](#)

[Isolated Amplifiers](#)

- More learning
- Actual Designs


Technical resources



Isolation technology videos

Filmed in TI's high-voltage lab, this video series will focus on capacitive isolation structure, working voltage reliability, withstand voltage capability, methods for testing reliability, and more.


[Watch videos >](#)



TI Designs Isolation reference designs

Complete board-and system-level reference design circuits to help you quickly evaluate and customize your system.

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Visit our forums for technical support and subscribe to our blog for the latest how-to tips for your isolation designs.

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- Follow-up material
- Online support!

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Overview
Products
Featured products
Tools & software
Technical documents
Certifications

Digital Isolators - Certifications

TI's Digital Isolator certifications ensure that your applications meet worldwide industry standards for personal electronics, automotive and industrial designs. To learn more about the specific product certifications, click on the links below or scroll down the table.

Digital Isolator
Isolated RS-485
Isolated CAN
Isolated I2C
Isolated Gate Driver

Single Channel Digital Isolators

Dual Channel Digital Isolators

Triple Channel Digital Isolators

Quad Channel Digital Isolators

Part number	UL 1577 (Vrms)				VDE 0884		CSA 60950-1		CSA 61010-1		CSA 60601-1	TUV EN 60950-1		TUV EN 61010-1		CQC GB4943.1-2011		
	2500	3000	5000	5700	Basic	Reinforced	Basic	Reinforced	Basic	Reinforced	Reinforced	Basic	Reinforced	Basic	Reinforced	Basic	Reinforced	
ISO7340C		✓			✓		✓	✓	✓	✓								✓
ISO7341C		✓			✓		✓	✓	✓	✓								✓
ISO7342C		✓			✓		✓	✓	✓	✓								✓
ISO7840						✓		✓			✓	✓	✓	✓	✓			✓
ISO7841				✓		✓		✓			✓	✓	✓	✓	✓			✓
ISO7842				✓		✓		✓			✓	✓	✓	✓	✓			✓
ISO7740		✓	✓			✓		✓			✓	✓	✓	✓	✓		✓	✓
ISO7741		✓	✓			✓		✓			✓	✓	✓	✓	✓		✓	✓
ISO7742		✓	✓			✓		✓			✓	✓	✓	✓	✓		✓	✓

Six Channel Digital Isolators

Q&A

Support forum for follow-up:
<https://e2e.ti.com/support/isolation/>



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