USB 2.0 COMPLIANT, HIGH-SPEED, ISOLATED USB REPEATERS

New Product Update

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Product Marketing Engineer

Agenda

- Isolated USB repeater applications

- Our SiO2 capacitive isolation technology

- Product highlight: ISOUSB211 (HS) and ISOUSB111 (FS/LS)

- TI.com resources

Isolation portfolio

Digital isolators

Products
- Low cost digital isolators
- Reinforced isolators
- Basic isolators
- Ultra-low low power isolators

Applications
- Factory automation
- Motor control and grid infrastructure
- Power delivery
- Automotive – HEV/EV

Isolated interfaces

Products
- ISO RS-485
- ISO CAN
- ISO I2C
- ISO IO
- ISO LVDS

- ISO USB

Applications
- Factory automation
- Motor drives and grid infrastructure
- Servers/Enterprise
- Automotive – HEV/EV

Isolated DC/DC (ISOW)

Products
- ISOW – Channel ISO
- ISOW – RS485
- ISOW – CAN
- Transformer drivers

Applications
- Industrial networks
- Grid infrastructure
- Industrial transport
- Automotive – HEV/EV

Isolated USB repeater applications

Factory automation & control / Motor drive	Medical	Grid infrastructure / Test measurement
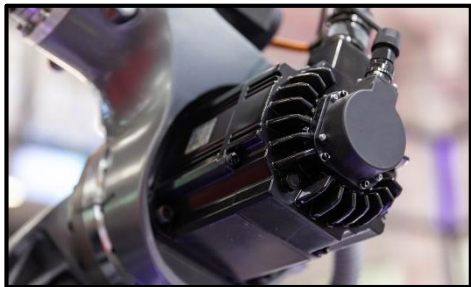
- PLC - Comms module
- Industrial / Rugged PC
- Servo motor drive / AC inverter
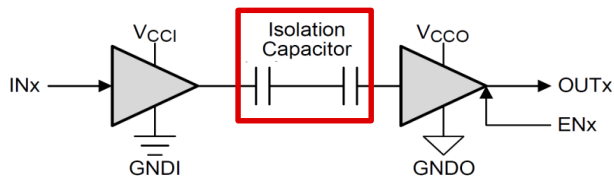
- CPAP machine
- Patient monitor
- Hospital bed

- Data concentrator
- UPS
- Semiconductor tester

TEXAS INSTRUMENTS

TI's capacitive isolation technology

Our reinforced isolators use a logic input and output buffer separated by a **double capacitive SiO₂ insulation barrier**
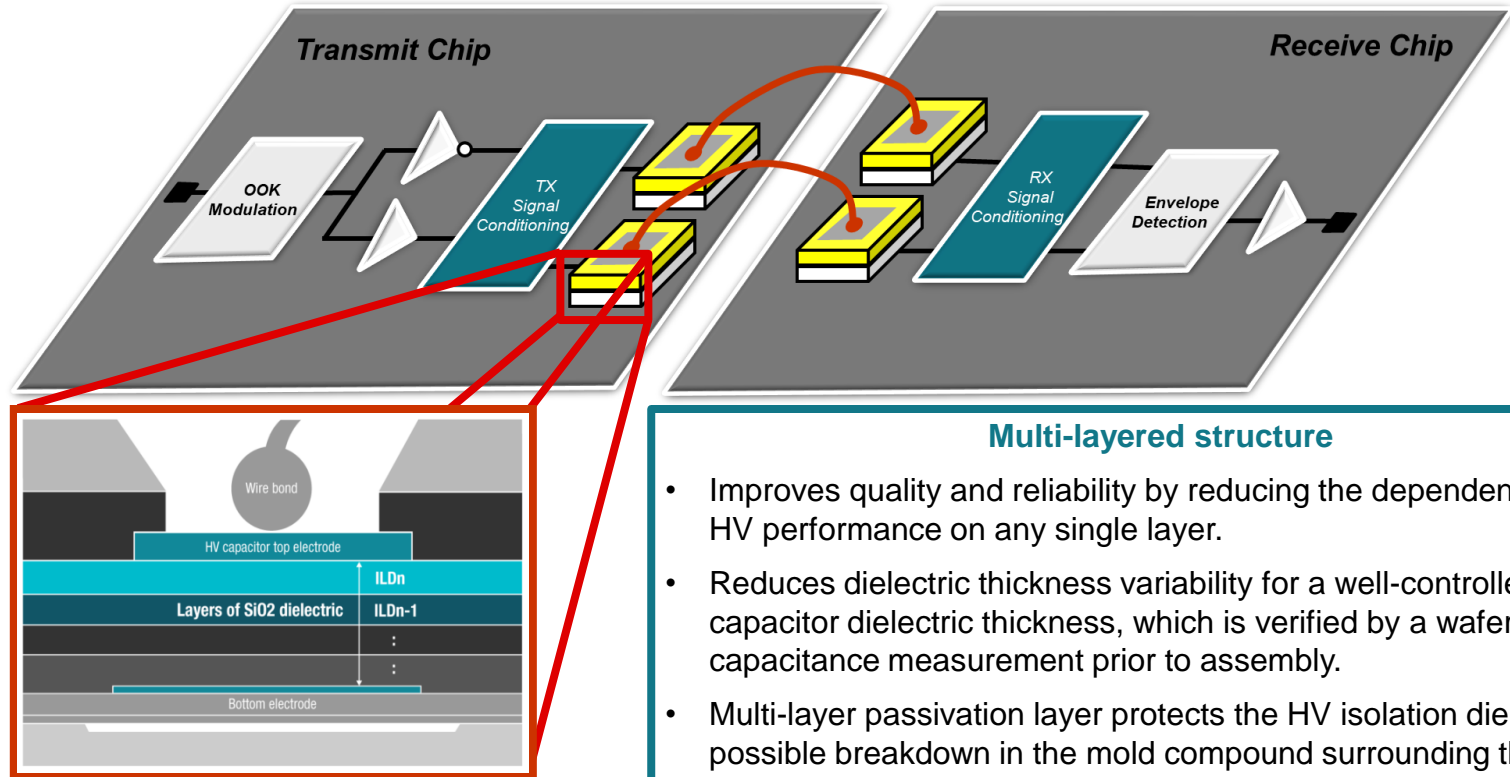

Manufactured and thoroughly tested in a controlled environment to ensure the highest quality isolation products.

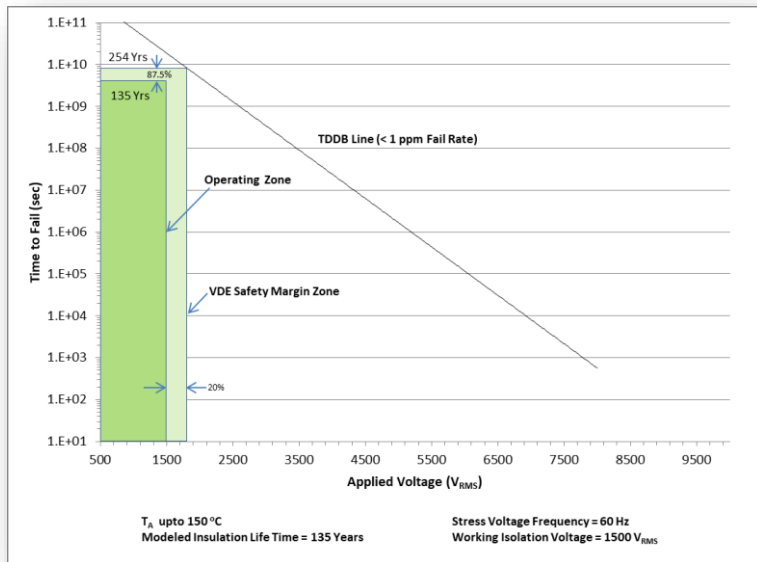Silicon dioxide (SiO_2) offers the **highest** dielectric strength in the industry

Insulator Materials	Dielectric Strength
Air	~1 Vrms/μm
Epoxies	~20 Vrms/μm
Silica filled Mold Compounds	~100 Vrms/μm
Polyimide	~300 Vrms/μm
SiO₂	~500 Vrms/μm

Unlike polyimide and other polymer based insulators, the reliability of an SiO_2-insulated capacitor does not degrade with exposure to ambient moisture.
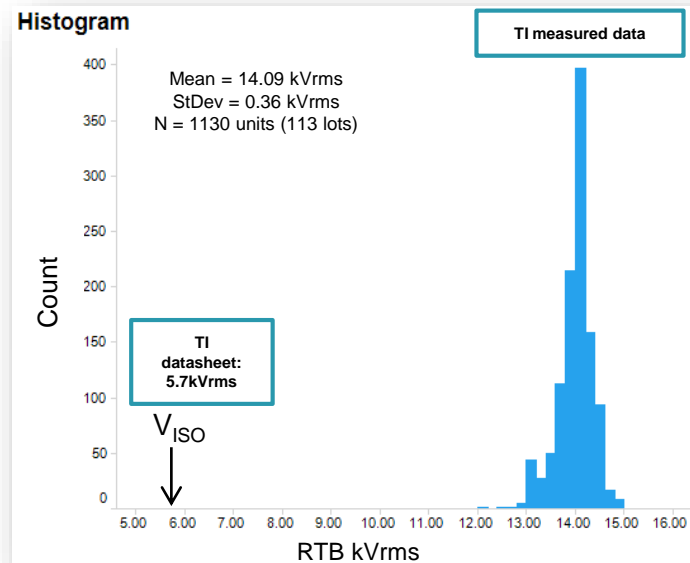
TEXAS INSTRUMENTS

TI's capacitive isolation technology

Multi-layered structure

- Improves quality and reliability by reducing the dependence of the HV performance on any single layer.

- Reduces dielectric thickness variability for a well-controlled total capacitor dielectric thickness, which is verified by a wafer-level capacitance measurement prior to assembly.

- Multi-layer passivation layer protects the HV isolation die from possible breakdown in the mold compound surrounding the die.

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TEXAS INSTRUMENTS

TI's capacitive isolation technology

Insulation lifetime projection

Ramp to breakdown qualification test

Our capacitive isolation portfolio combines **highest working voltage** and **highest reliability** to enable extended system lifetime and protection.

ISOUSB211:
Robust 5.7kVrms USB 2.0 LS/FS/HS isolator

Features

- **Isolation, immunity and certifications**
  - Integrated SiO_2 dielectric capacitors
  - Reinforced and basic isolation (DIN V VDE V 0884-11)
  - V_{ISO} rating: up to 5,700 V_{RMS}
  - V_{IOSM} surge: >10,000 V_{PK}
  - V_{IOWM} working voltage: up to 1,000 V_{RMS}
  - CMTI: 100 kV/µs (typ) 85 kV/µs (min)

- **Electrical characteristics**
  - Data rate: 480 Mbps (max)
  - In-built connect and speed detection
  - Host, hub, cable or device Isolation
  - Supports L0/L1/L2 power states
  - US VBUS OK signal on DS side
  - Adjustable Equalization/Pre-emphasis to compensate channel Inter-symbol Interference (ISI)
  - Takes up the timing budget of two hubs
  - BC1.2 CDP support
  - Operating temperature range: -40˚C to 120˚C

- **Package**
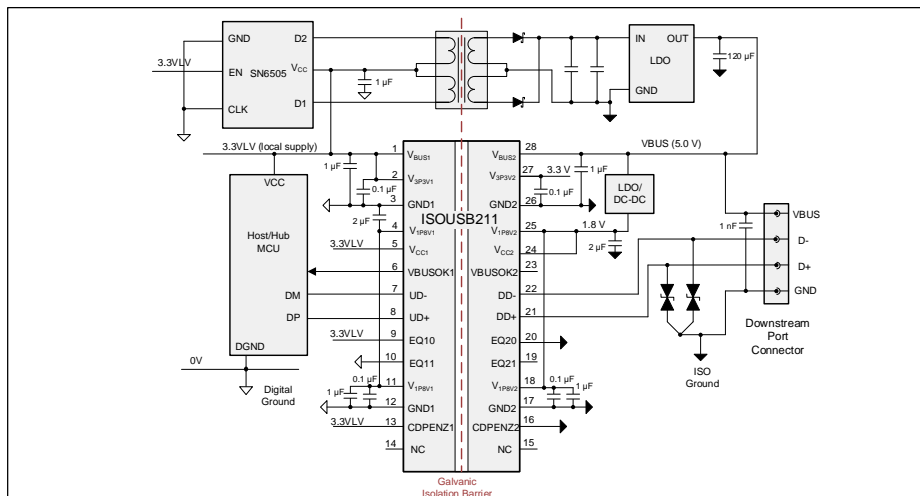 - SOIC-28DP: 8 mm creepage / clearance

Applications

- Motor control
- Factory automation
- Grid infrastructure
- Medical
- Power delivery
- Wired networking

Benefits

- Plug-and-play USB isolation: LS/FS/HS

  - Fits seamlessly with existing hubs/hosts/devices

- High immunity and robustness

  - System level EMC for IEC61000-4-x ESD, EFT events, radiated and conducted RF immunity.

  - Low EM emissions

TEXAS INSTRUMENTS

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Robust 5.7kVrms USB 2.0 LS/FS isolator

Features

- **Isolation, immunity and certifications**
  - Integrated SiO_2 dielectric capacitors
  - Reinforced and basic isolation (DIN V VDE V 0884-11)
  - V_{ISO} rating: up to 5,700 V_{RMS}
  - V_{IOSM} surge: >10,000 V_{PK}
  - V_{IOWM} working voltage: up to 1,000 V_{RMS}
  - CMTI: 100 kV/µs (typ) 85 kV/µs (min)

- **Electrical characteristics**
  - Data rate: 12 Mbps (max)
  - In-built connect and speed detection
  - Host, hub, cable or device Isolation
  - Supports L0/L1/L2 power states
  - VBUS and 3.3V power supplies.
  - In-built VBUS to 3.3V LDO.
  - Operating temperature range: -40˚C to 125˚C

- **Package**
  - SOIC-16DW: 8 mm creepage / clearance

Applications

- Motor control
- Factory automation
- Grid infrastructure
- Medical
- Power delivery
- Wired networking

Benefits

- Plug-and-play USB isolation: LS/FS
  - Fits seamlessly with existing hubs/hosts/devices

- High immunity and robustness
  - System level EMC for IEC61000-4-x ESD, EFT events, radiated and conducted RF immunity.
  - Low EM emissions
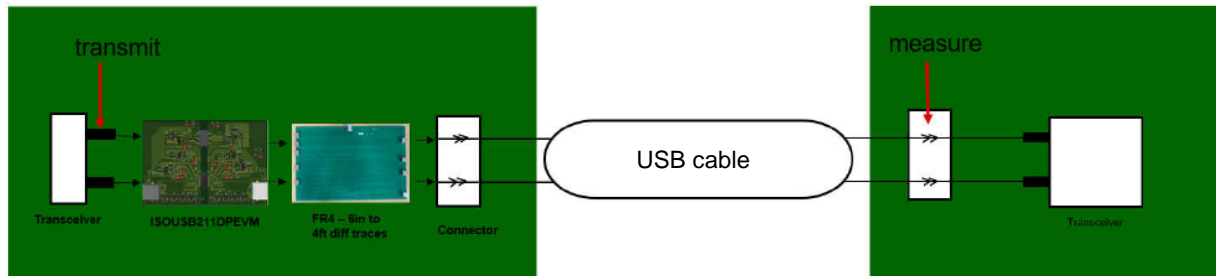
- Pin compatible with ADUM3160 & ADUM4160

TEXAS INSTRUMENTS
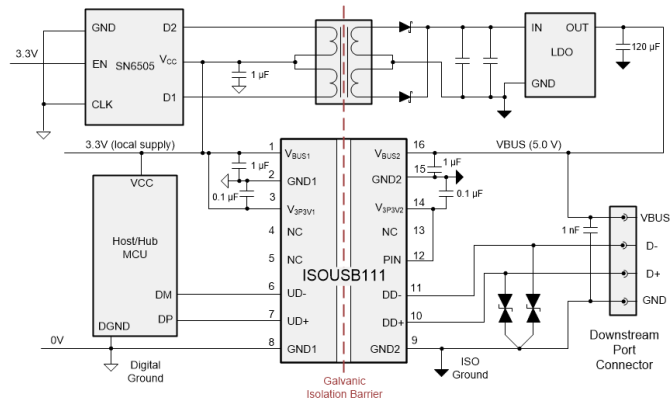
CISPR32 Class B emissions
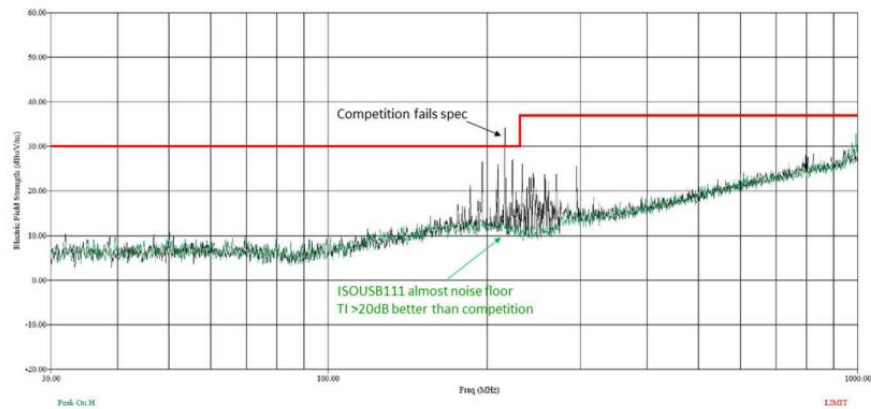
ISOUSB111 CISPR32 Class B emissions compared to competition
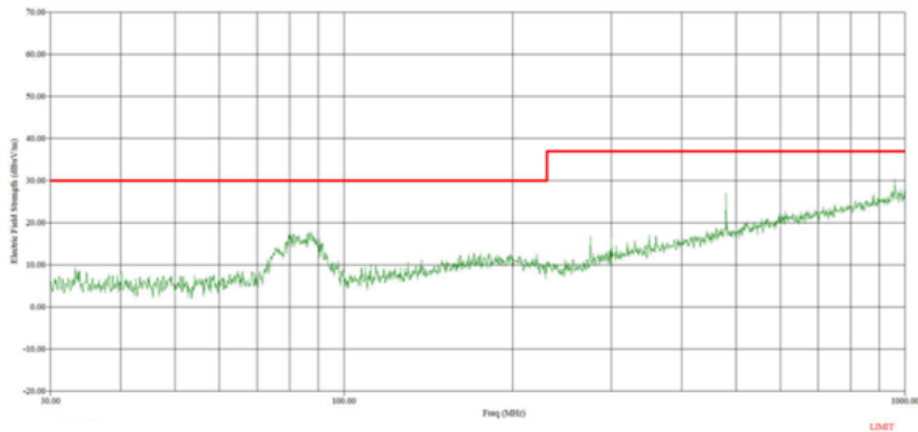
ISOUSB211 CISPR32 Class B emissions

TEXAS INSTRUMENTS

Signal integrity improvement with ISOUSB211 equalizer and pre-emphasis

Far-end eye measurement set-up

	00	0f	01	f0	ff	f1	10	1f	11
6inch	0.7361	0.7917	0.83006	0.8686	0.91386	0.91386	1.0478	1.0478	1.1166
1ft	0.70288	0.74485	0.7827	0.82115	0.8689	0.914	0.9859	1.0707	1.0832
2ft	0.6097	0.6498	0.6913	0.7306	0.7719	0.8074	0.8843	0.9821	0.9885
3ft	0.577	0.618	0.6334	0.6802	0.7102	0.738	0.8188	0.929	0.9411
4ft	0.4787	0.5246	0.5595	0.59259	0.6325	0.63256	0.73192	0.8352	0.8372

fail ▮ marginal ▮ pass ▮ optimal ▮

fail = EH and/or EW violate eye-mask
marginal= EH < 5mV or EW < 0.05UI from eye-mask
pass = meet eye-mask
optimal = best performance setting

EQUALIZATION AND PRE-EMPHASIS

EQ_{HS}	High-speed RX Equalization	EQ1=low, EQ0=low, 240MHz	-0.24	0.46	0.75	dB
EQ_{HS}	High-speed RX Equalization	EQ1=low, EQ0=float, 240MHz	0.27	0.98	1.5	dB
EQ_{HS}	High-speed RX Equalization	EQ1=low, EQ0=high, 240MHz	0.70	1.50	2.2	dB
EQ_{HS}	High-speed RX Equalization	EQ1=float, EQ0=low, 240MHz	1.04	2.00	2.81	dB
EQ_{HS}	High-speed RX Equalization	EQ1=float, EQ0=float, 240MHz	1.45	2.68	3.8	dB
EQ_{HS}	High-speed RX Equalization	EQ1=float, EQ0=high, 240MHz	1.73	3.09	4.4	dB
EQ_{HS}	High-speed RX Equalization	EQ1=high, EQ0=low, 240MHz	2.00	3.46	4.7	dB
EQ_{HS}	High-speed RX Equalization	EQ1=high, EQ0=float, 240MHz	2.25	3.80	5.1	dB
EQ_{HS}	High-speed RX Equalization	EQ1=high, EQ0=high, 240MHz	2.25	3.80	5.1	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=low, EQ0=low, 240MHz	0.25	0.48	0.75	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=low, EQ0=float, 240MHz	0.62	0.9	1.2	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=low, EQ0=high, 240MHz	0.89	1.36	1.5	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=float, EQ0=low, 240MHz	1.4	1.7	2.0	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=float, EQ0=float, 240MHz	1.7	2.1	2.5	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=float, EQ0=high, 240MHz	2.1	2.5	2.9	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=high, EQ0=low, 240MHz	2.7	3.2	3.7	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=high, EQ0=float, 240MHz	3.4	4.0	4.6	dB
PE_{HS}	High-speed TX Pre-emphasis	EQ1=high, EQ0=high, 240MHz	3.4	4.0	4.6	dB

Application note: *Compensate for Channel Loss with Equalizer Settings on High-Speed USB Isolators*

TI.com resources

Technical documents:

- Protect your Designs with Low-Emissions USB 2.0 Compliant 480 Mbps Isolators
- Compensate for Channel Loss with Equalizer Settings on High-Speed USB Isolators

Evaluation modules:

- ISOUSB211 high/full/low speed isolated USB repeater evaluation module
- ISOUSB111 evaluation module for full/low speed isolated USB repeater

E2E™ design support forums

- Isolation forum

www.ti.com/isolation

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