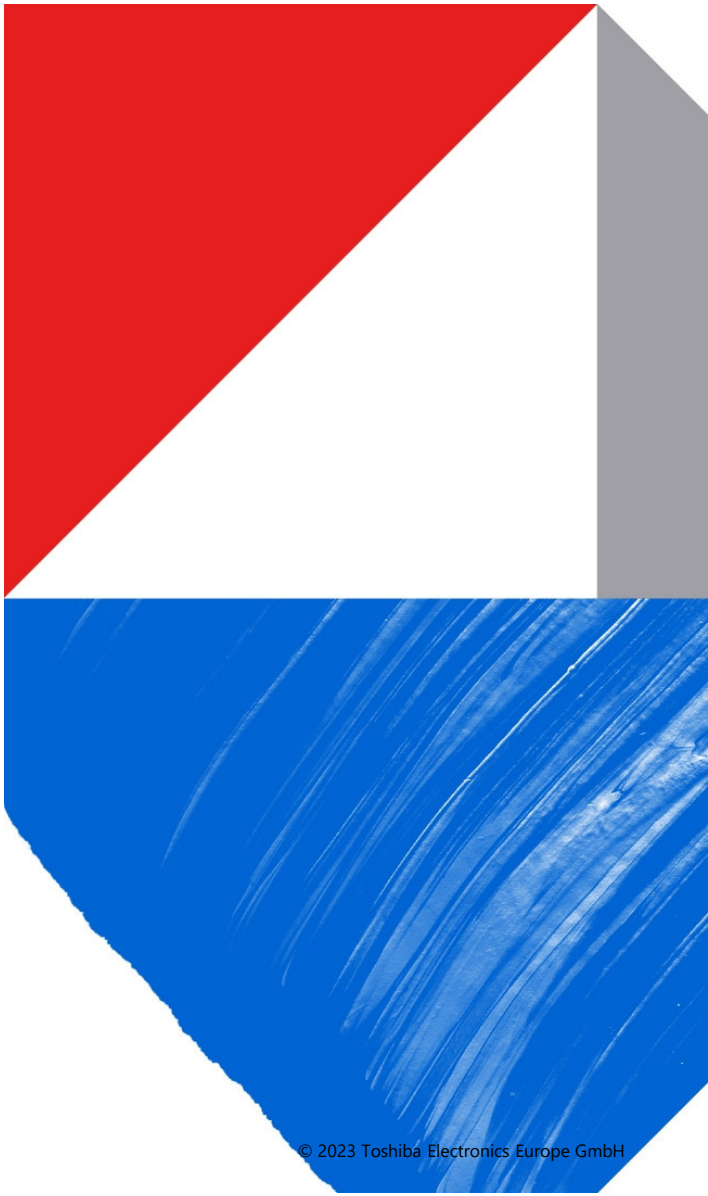
TOSHIBA

Farnell update

Introduction of Digital Isolators



Toshiba Electronics Europe GmbH

March 2023

Scope of Disclosure	TEE
Head of Information Owner Section	TEE Discrete Marketing

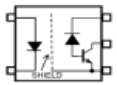
Contents

01

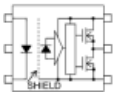
Isolation Business Overview

Toshiba Photocoupler Portfolio

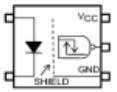
IC output



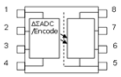
High speed I/O
- 20kbps~50Mbps



IGBT / MOSFET drive
- 0.6~6.0A output
- Smart Driver

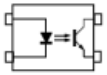


IPM Interface
- 1~10Mbps

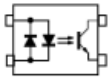


Isolation Amplifier
- Analog Output
- Digital Output

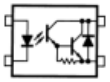
Tr. output



DC input
TLP383 (Low If)
TLP291(SE
TLP293 (Low If)



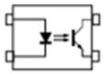
AC input
TLP290(SE
TLP292 (Low If)



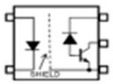
Darlington Tr.
TLP187

Multi Channel
TLP291-4
TLP293-4

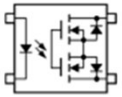
Automotive



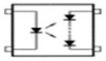
Transistor
- DC input



High speed I/O
- 1~20Mbps

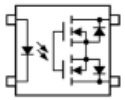


Photorelay
- TLX9175J

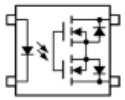


Photovoltaic
- TLX990x

Photorelays

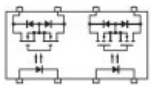


1a
TLP240J/ 172AM
TLP3420 / 3475

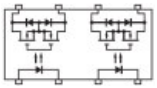


1b
TLP4176G
TLP4590A

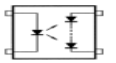
1a1b



2b

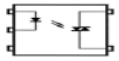


Photovoltaic

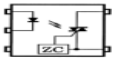


TLP3905
TLP3906

Triac output

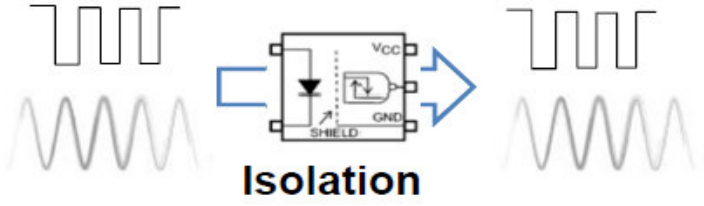


Non ZC
TLP267J

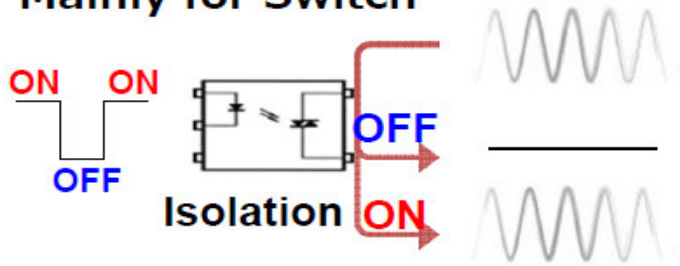


ZC
TLP268J

Mainly for signal transmission



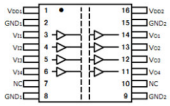
Mainly for Switch



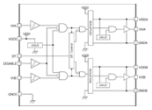
Toshiba Isolator Portfolio

NEW: Digital Isolators

IC output



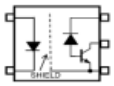
High speed I/O
- ~150Mbps
- 4-ch / 2-ch



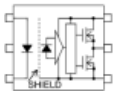
IGBT drive
- 4.0A output
- 2-channel

Optical Isolators: Photocouplers

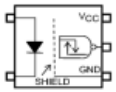
IC output



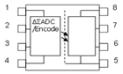
High speed I/O
- 20kbps~50Mbps



IGBT / MOSFET drive
- 0.6~6.0A output
- Smart Driver

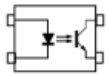


IPM Interface
- 1~10Mbps

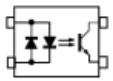


Isolation Amplifier
- Analog Output
- Digital Output

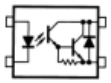
Tr. output



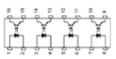
DC input
TLP383 (Low If)
TLP291(SE
TLP293 (Low If)



AC input
TLP290(SE
TLP292 (Low If)

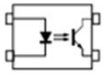


Darlington Tr.
TLP187

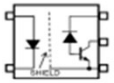


Multi Channel
TLP291-4
TLP293-4

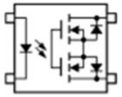
Automotive



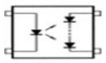
Transistor
- DC input



High speed I/O
- 1~20Mbps

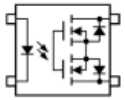


Photorelay
- TLX9175J

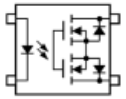


Photovoltaic
- TLX990x

Photorelays

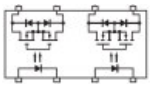


1a
TLP240J/ 172AM
TLP3420 / 3475



1b
TLP4176G
TLP4590A

1a1b



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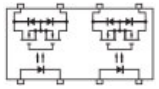
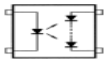
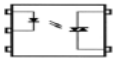


Photovoltaic

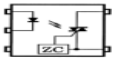


TLP3905
TLP3906

Triac output



Non ZC
TLP267J



ZC
TLP268J

Toshiba Strength

Toshiba can supply both solutions.

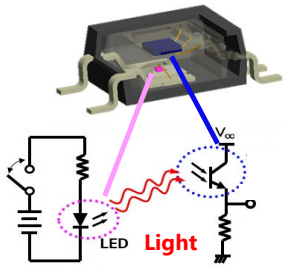
Photocouplers/Photorelays

- 50 years business results in the market
- The market leader for the last 12 years

➢ **Higher reliability insulation**

➢ **Better EMC** (Electromagnetic noise Compatibility)

➢ **Original dedicated packaging technology**



Digital Isolators

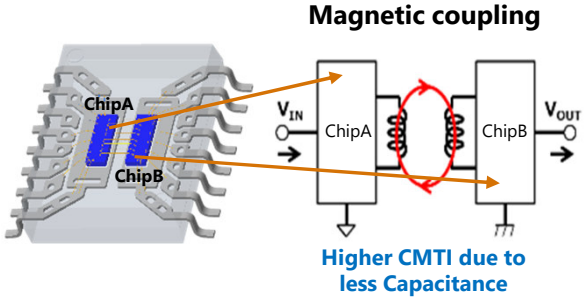
New

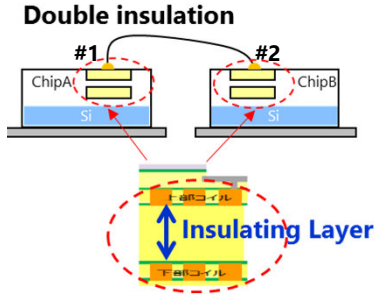
- Expands isolator business
- MP starts from Apr. 2023

➢ **High-speed and Multi channel**
(up to 150Mbps)

➢ **Higher CMTI with Magnetic coupling**
(>200kV/μs)

➢ **Robust safety with Double insulation**

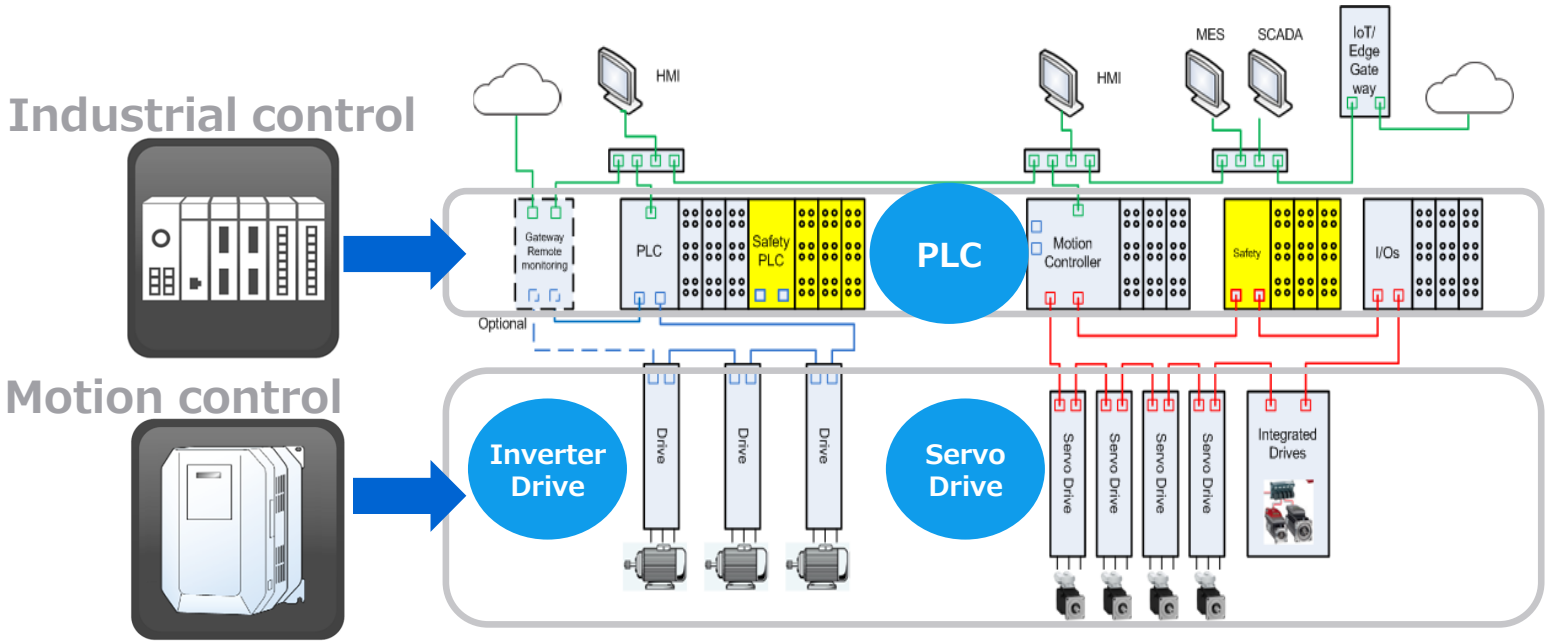




CMTI: Common Mode Transient Immunity, dV/dt noise between primary side and secondary side

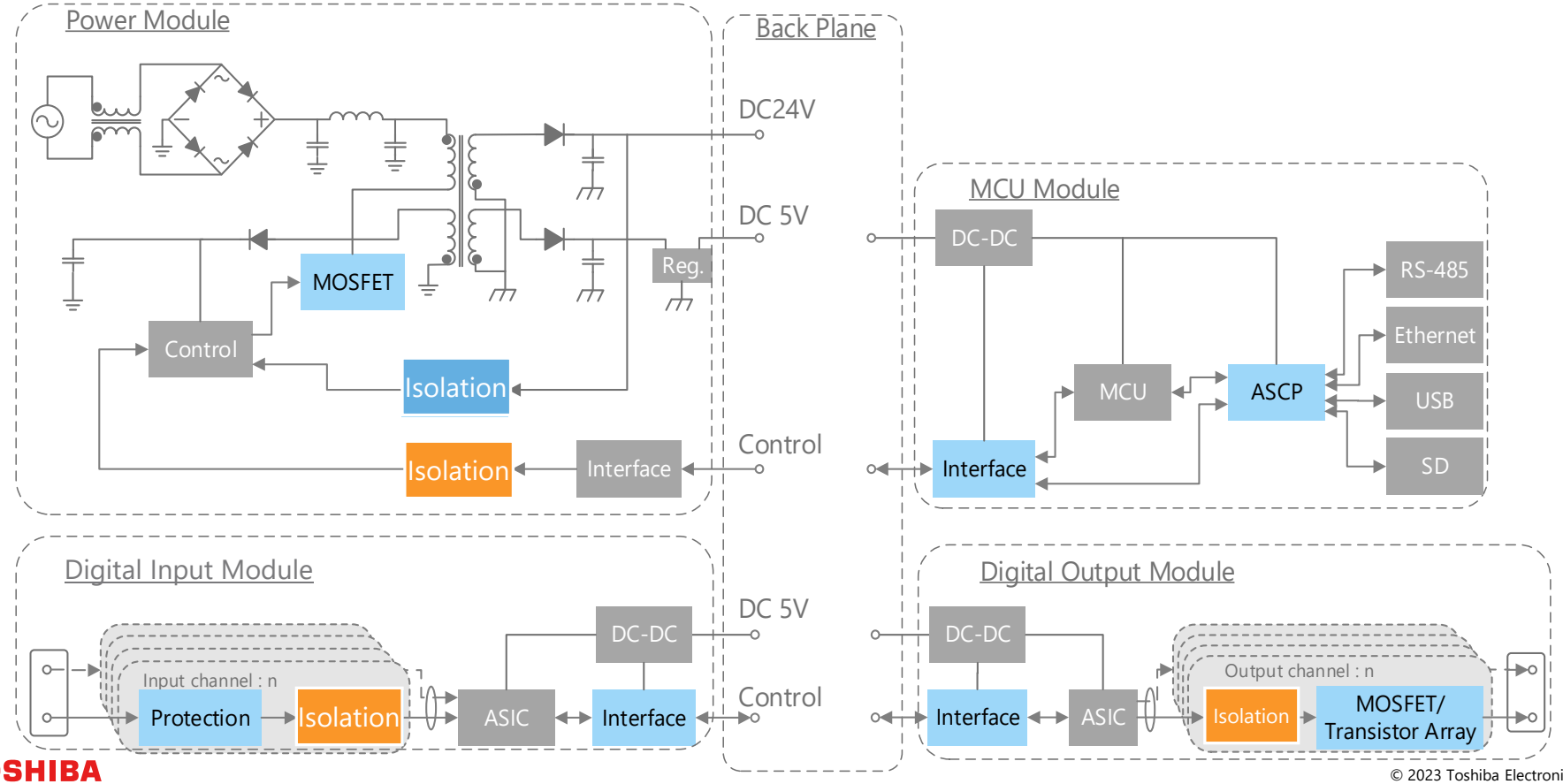
Toshiba = HIGH QUALITY ISOLATION

Focusing on PLC and Inverters for Digital Isolators



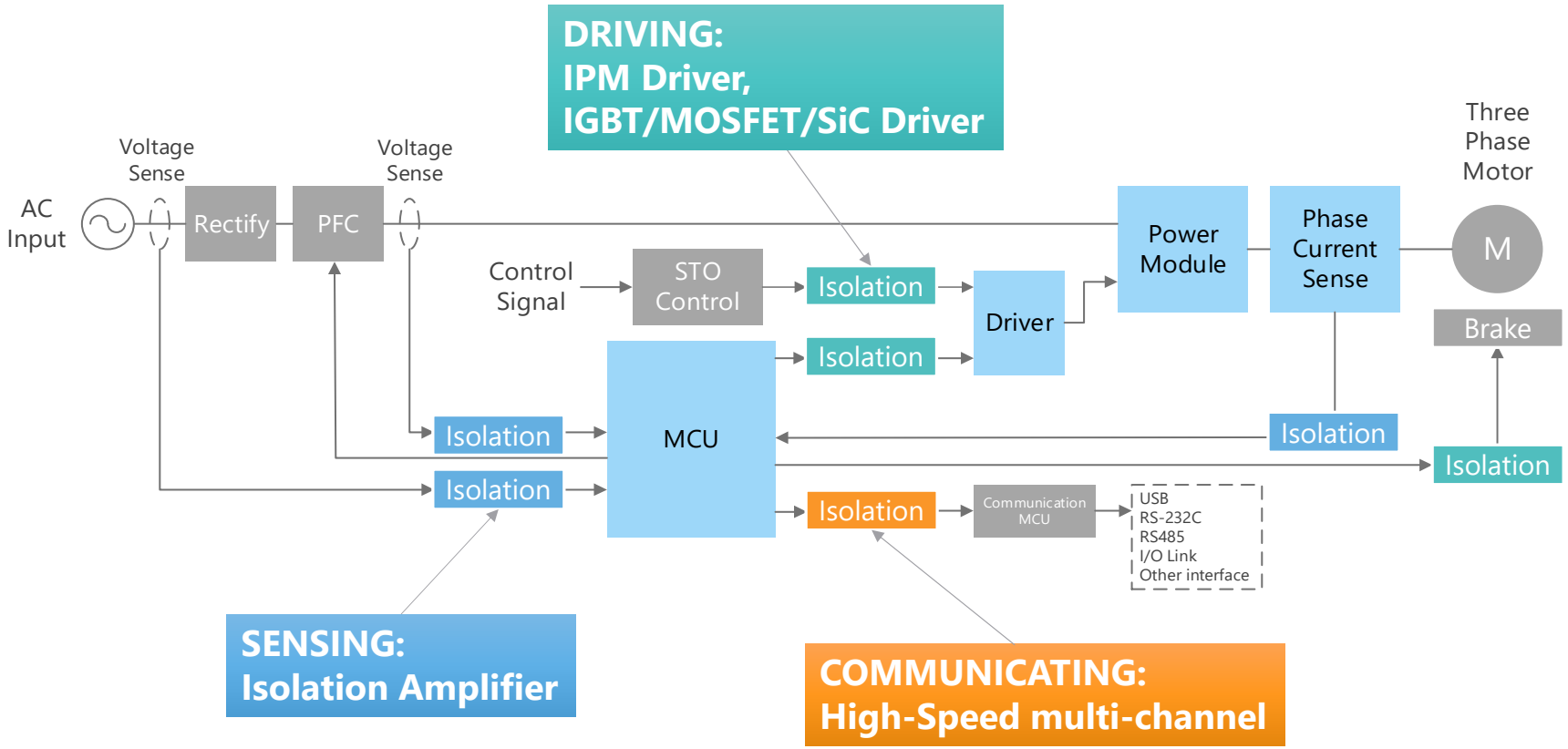
Focus Application: PLC

Isolators for Sensing and Communication



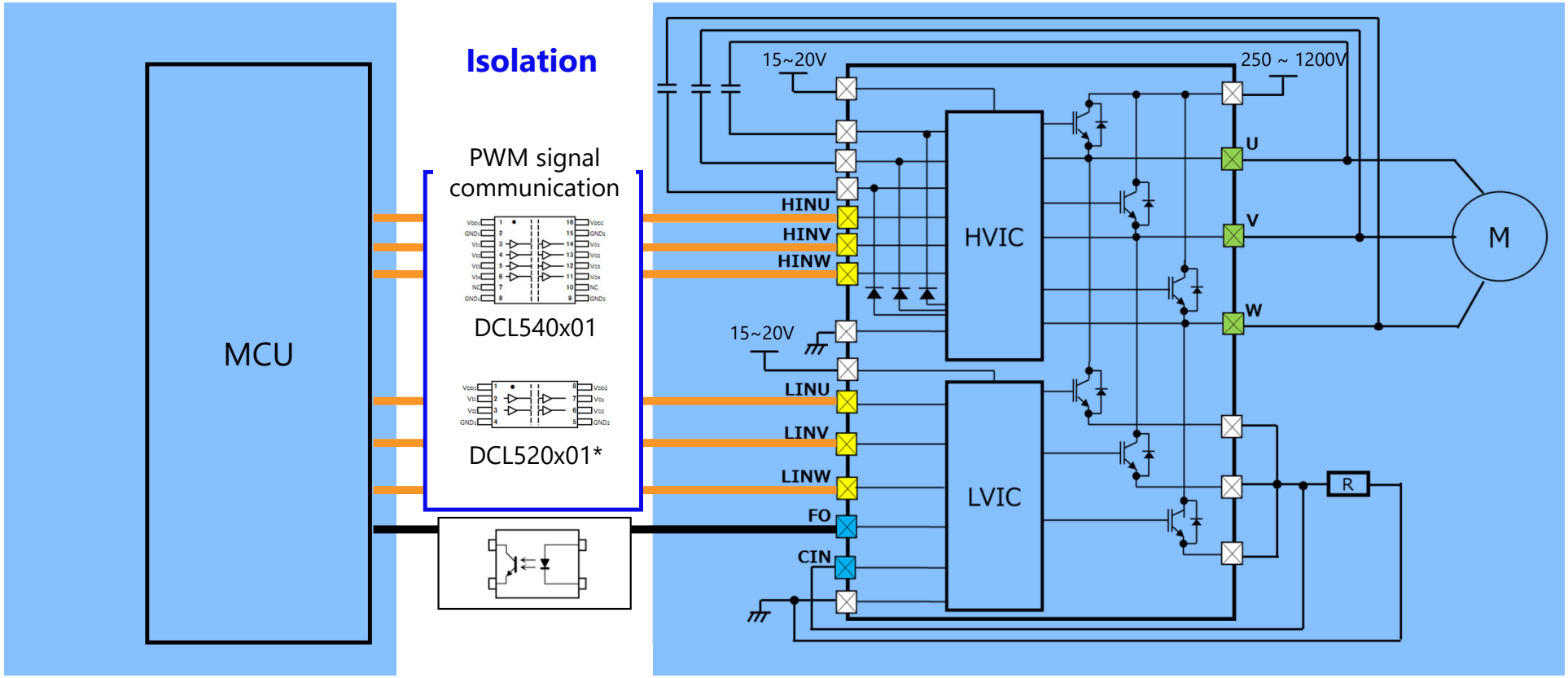
Focus Application: Inverter Control

Isolators for Sensing, Driving and Communication



“IPM (Intelligent Power Module)”

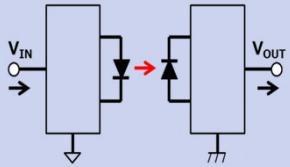
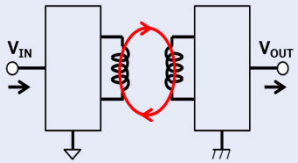
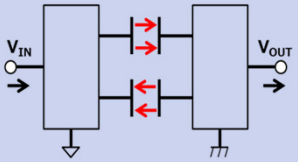
High speed signal communication is required.



02

Isolation Technology and Features of Toshiba Digital Isolators

Pros and Cons of Photocouplers and Digital Isolators

	Coupling	Isolation (Physical Gap)	Transmission Rate	Multi-channel	CMTI	EMC
Photo coupler	**Optical coupling** 	☀	☁☀	☁	☁	☀
Digital Isolator	**Magnetic coupling** 	☁	☀	☀	☀	☁*
	Capacitive coupling 	☁	☀	☀	☁☀	☁☀

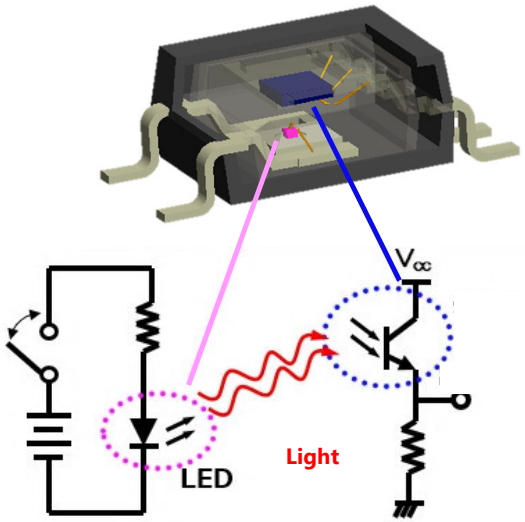
*: Adopting our proprietary method to prevent noise from external magnetic field.

CMTI : Common Mode Transient Immunity
EMC : Electromagnetic Compatibility

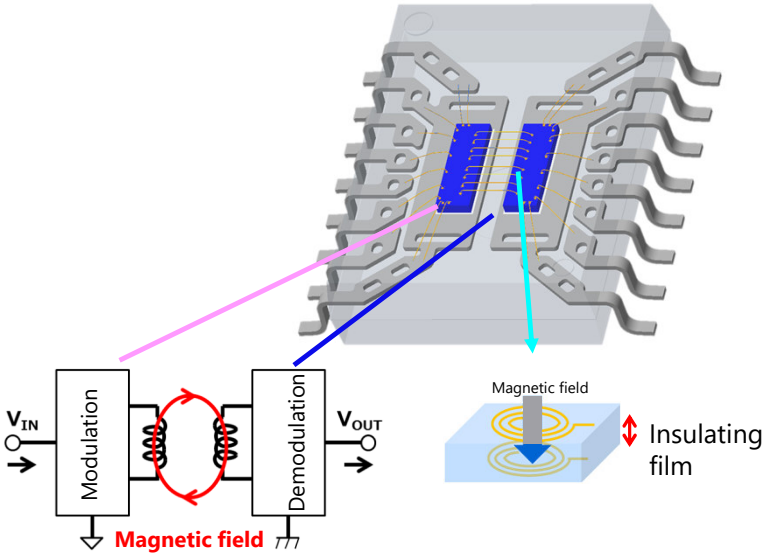
Toshiba 1st generation of Digital Isolators consist of Magnetic coupling structure for High-CMTI

Internal construction comparison

Photocouplers
Using Light Signal



Digital Isolators
Using magnetic or electrical field Signal



TOSHIBA = supplier of both technologies

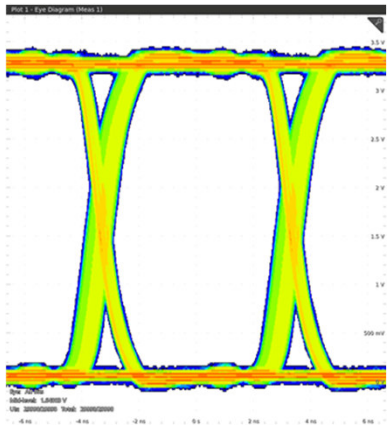
Features of Toshiba Digital Isolators

Satisfying key industrial requirement

1 High-speed

- **Max. data rate 150 Mbps**
- 4ch/2ch high-speed logic

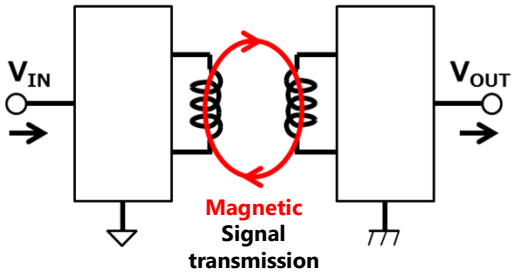
Eye Pattern: 150Mbps



2 High CMTI

- **CMTI = 200 (kV/μs) typ.**
- Good noise isolation due to Magnetic coupling

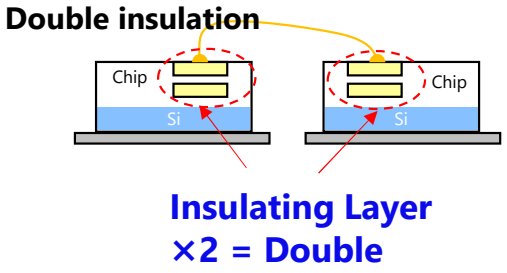
Compared with the capacitive type, the magnetic type can cut off noise at the insulation part.



3 High Reliability / Robust safety

- **Long life (>70 years) Insulation**
- Double insulation structure
- Reinforced insulation 5kVrms

Adopting double insulation structure for the robust safety.



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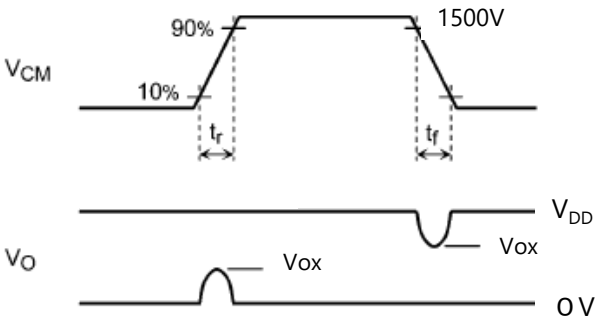
CMTI (Common Mode Transient Immunity) & Benchmarking

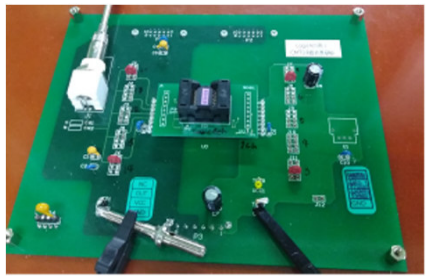
CMTI measurement

A common-mode voltage dV/dt is applied between the input side GND and output side GND to evaluate CMTI noise immunity.



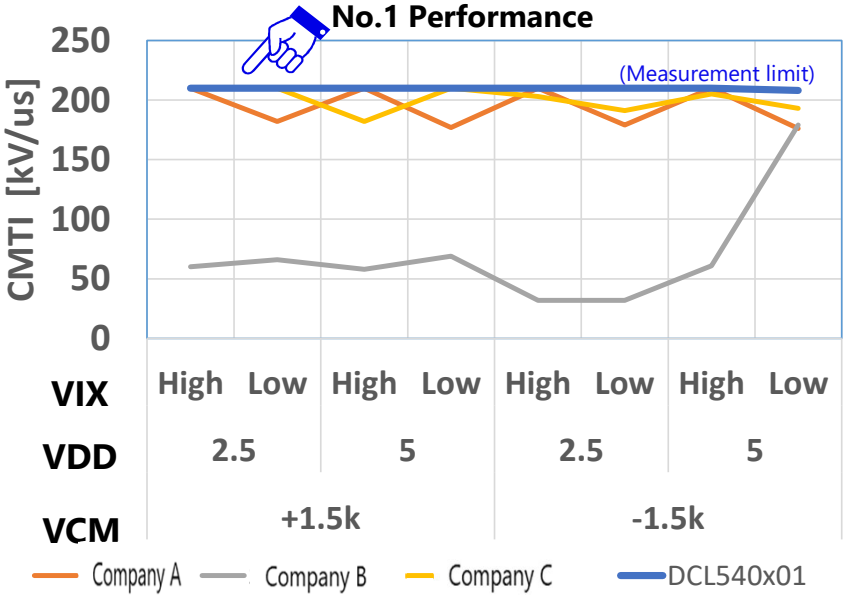
1. Apply common mode voltage

2. Check output voltage levels



Benchmark results

Toshiba Digital Isolators are most resistant to malfunction for high transient voltages.



High Reliability and Safety

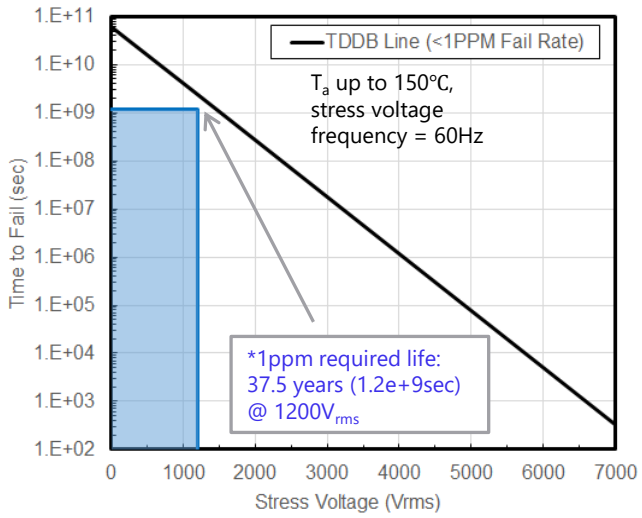
Toshiba's CMOS process and double-insulation construction ensure high dielectric strength and reliability

Long Life Insulation

Over 70 years life expectancy @1200V_{rms} determined by TDDB test

Apply 1.2 x V_{iowm} (VDE V 0884-11 specified as safety factor)

Estimated insulation life expectancy



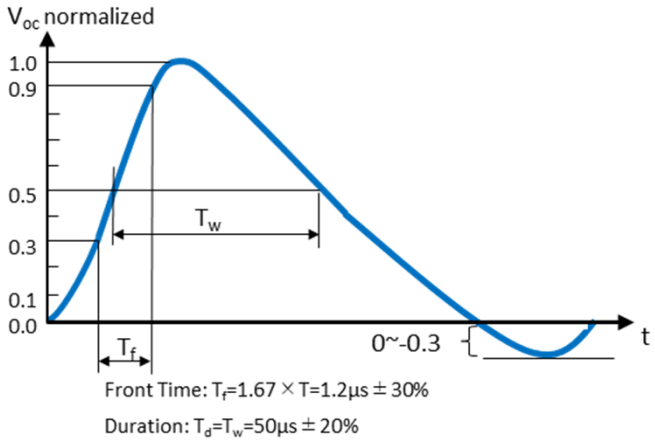
High Dielectric Strength

Surge strength minimum 12.8kV

Surge Immunity Test Specified in IEC 61000-4-5

Surge-voltage (1.2/50 µs waveform) applied using a combination waveform generator

Voltage surge waveform

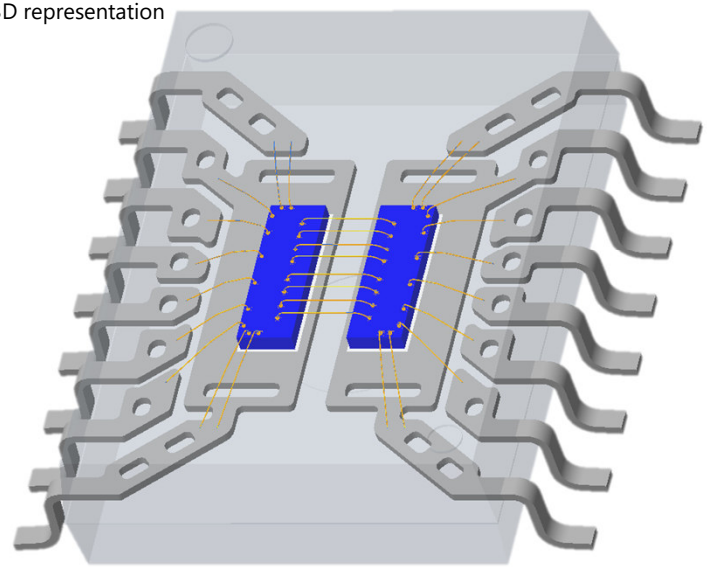


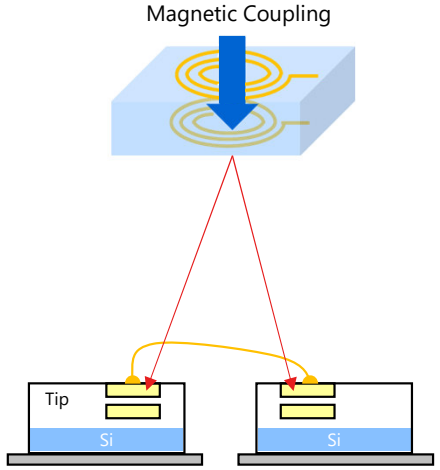
- TDDB : Time Dependent Dielectric Breakdown
- VDE V0884-11 : Magnetic and capacitive coupler for basic and reinforced isolation
- IEC 61000-4-5 : Surge Immunity Test

Double insulation structure magnetic coupling

No short-circuit, even if one side isolation fails!

Toshiba Digital Isolator 3D representation



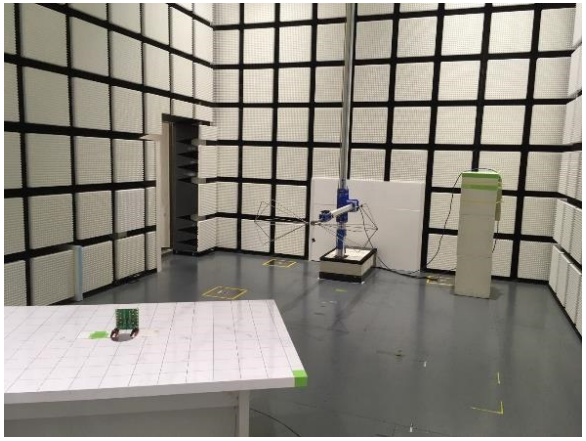


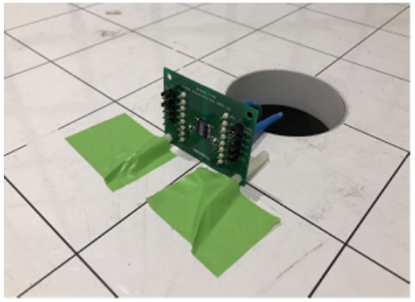
Double implementation per DI

CISPR32 EMC testing for radiated emissions

DCL541x01 EVB passed the CISPR32 Class B limit with more than 10dB margin!

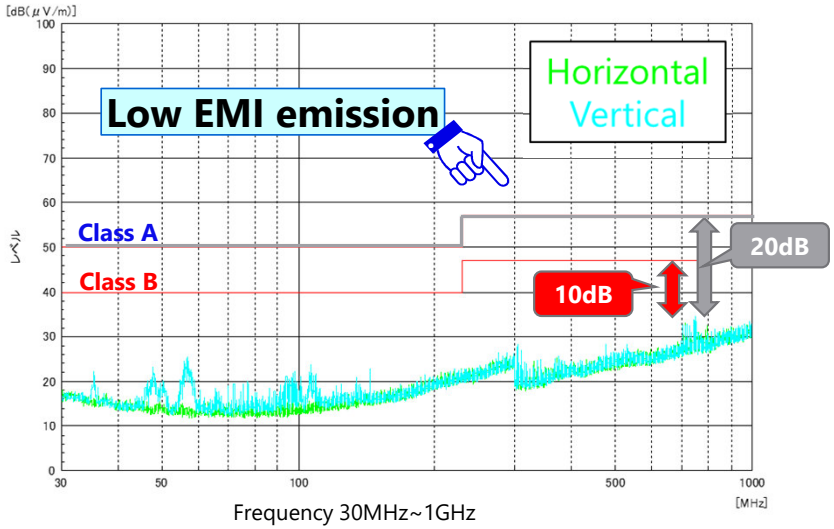
Test setup: Measurement in an anechoic chamber





Linear distance of 3m between sample and antenna

Test Results: Pass CISPR32 Class B



Frequency 30MHz~1GHz

*EMC : Electro Magnetic Compatibility
*EMI : Electro Magnetic Interference
*EVB : Evaluation board
*EUT : Equipment Under Test
*CISPR32 : Electro Magnetic Compatibility of Multimedia equipment

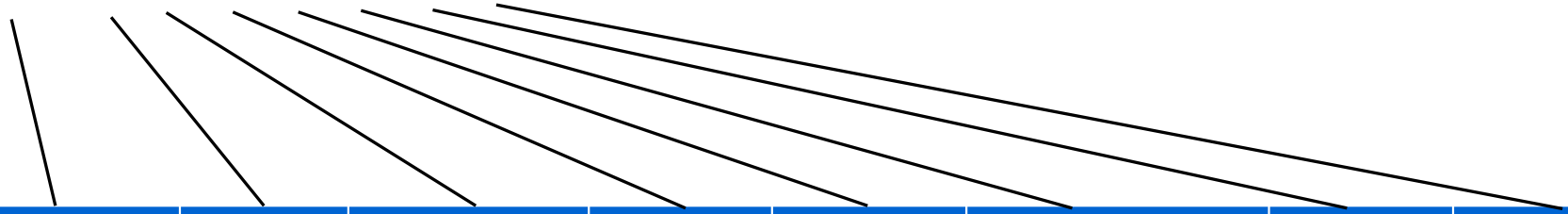
03

Part Naming Conventions

Part Naming Conventions: Standard Digital Isolators

DC L 5 4 0 C 0 1

1 2 3 4 5 6 7 8



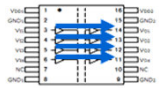
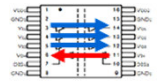
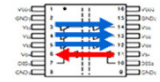
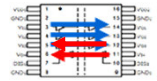
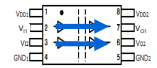
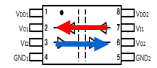
1	2	3	4	5	6	7	8
Category	Output	Data rate	Total Channel	Reverse channel	Control-pin (Default output)	Option	Package
DC: Digital-isolator	L: Logic	1:～1Mbps 2:～10Mbps 3:～50Mbps 4:～100Mbps 5:～200Mbps	Primary input +Secondly input	Number of reverse channels	L: Enable(Low) H: Enable(High) A: Disable(Low) B: Disable(High) C: None(Low) D: None(High)	0: w/o	0: SOIC8-N 1: SOIC16-W 2: SOIC8-DW B: SSOP16

04

First Products and Benchmark

Toshiba 1st line-up Digital Isolators

Standard Digital Isolators

Category		P/N	Number of Inputs (Forward:Reverse)	Max Data Rate (Mbps)	Default Output State	Control signal	Package	Pin layout	MP
Standard Digital Isolators	4ch	DCL540C01	4 : 0	150	Low	-	SOIC16-W		Apr. '23
		DCL540D01			High				
		DCL540L01			Low	Output Enable			
		DCL540H01			High				
		DCL541A01	3 : 1	150	Low	Input Disable	SOIC16-W		
		DCL541B01			High				
		DCL541L01	3 : 1	150	Low	Output Enable	SOIC16-W		Jun. '23
		DCL541H01			High				
		DCL542L01	2 : 2	150	Low	Output Enable	SOIC16-W		Aug.'23
		DCL542H01			High				
	2ch	DCL520C00	2 : 0	150	Low	-	SOIC8-N		CY'24
		DCL520D00			High				
		DCL521C00	1 : 1	150	Low	-	SOIC8-N		Sep. '23
		DCL521D00			High				

4-channel High Speed Standard Digital Isolators

Under development
MP: Apr. '23

DCL541x01 (3:1) and DCL540x01 (4:0)

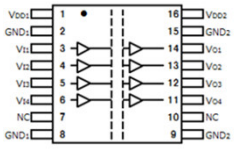
Features

- 4 channel high-speed digital isolator
- Maximum data rate 150Mbps (Max)
- High CMTI >100kV/us
- Double-insulation construction

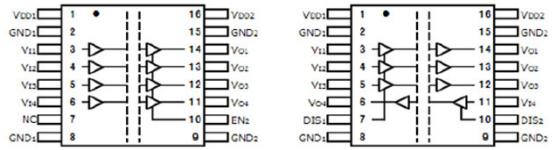
Main Characteristics

Terms	Spec
Package	SOIC16-W
Storage temp.	-65～150 ℃
Operating temp.	-40～110 ℃
Supply voltage	2.25~5.5V
Propagation delay (Max)	21.0ns
Isolation voltage (Min)	5 kVrms
Safety standard (planned)	UL1577, VDE V 0884-11

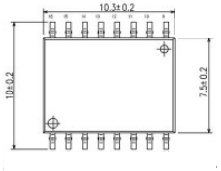
Pin-Layout/Outline



(4 : 0)



(3 : 1)



D7.5×W10.3×H2.65(Max)

(unit : mm)

P/N	Default output state	Control pin
DCL540C01	Low	None
DCL540D01	High	
DCL540L01	Low	Enable(No.10)
DCL540H01	High	
DCL541A01	Low	Disable(No.7,10)
DCL541B01	High	

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4-channel High Speed Standard Digital Isolators

Under development
MP: Jun. '23(DCL541)
Aug. '23(DCL542)

DCL541x01 (3:1) and DCL542x01 (2:2)

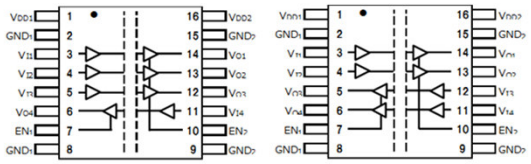
Features

- 4 channel high-speed digital isolator
- Maximum data rate 150Mbps (Max)
- High CMTI >100kV/us
- Double-insulation construction

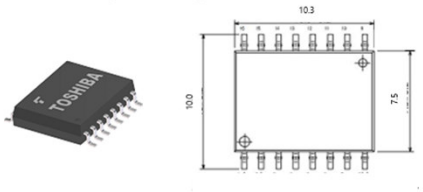
Main Characteristics

Terms	Spec
Package	SOIC16-W
Storage temp.	-65～150 ℃
Operating temp.	-40～110 ℃
Supply voltage	2.25~5.5V
Propagation delay (Max)	21.0ns
Isolation voltage (Min)	5 kVrms
Safety standard (planned)	UL1577, VDE V 0884-11

Pin-Layout/Outline



(3:1) (2:2)



D7.5xW10.3xH2.65 (Max)
(unit : mm)

P/N	Default output state	Control pin
DCL542L01	Low	Output Enable (No.7,10)
DCL542H01	High	
DCL541L01	Low	Output Enable (No.7,10)
DCL541H01	High	

TOSHIBA

2-channel High Speed Standard Digital Isolators

Under development
MP: Sep. '23

DCL521x00 (1:1)

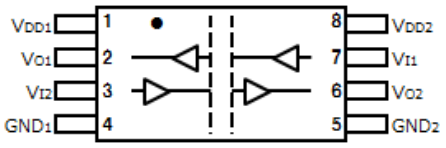
Features

- 2 channel high-speed digital isolator
- Maximum data rate 150Mbps (Max)
- High CMTI >100kV/us
- Double-insulation construction

Main Characteristics

Terms	Spec
Package	SOIC8
Storage temp.	-65～150 ℃
Operating temp.	-40～125 ℃
Supply voltage	2.25~5.5V
Propagation delay (Max)	21.0ns
Isolation voltage (Min)	3 kVrms
Safety standard (planned)	UL1577, VDE V 0884-11

Pin-Layout/Outline



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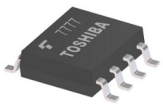
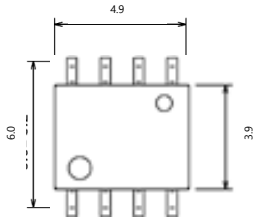




D3.9xW4.9xH1.75(Max)
(unit : mm)

P/N	Default output state
DCL521C00	Low
DCL521D00	High

TOSHIBA

2-channel High Speed Standard Digital Isolators

Under development
MP: CY24

DCL520x00 (2:0)

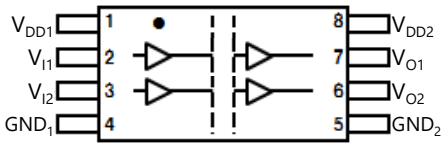
Features

- 2 channel high-speed digital isolator
- Maximum data rate 150Mbps (Max)
- High CMTI >100kV/us
- Double-insulation construction

Main Characteristics

Terms	Spec
Package	SOIC8
Storage temp.	-65～150 ℃
Operating temp.	-40～125 ℃
Supply voltage	2.25~5.5V
Propagation delay (Max)	21.0ns
Isolation voltage (Min)	3 kVrms
Safety standard (planned)	UL1577, VDE V 0884-11

Pin-Layout/Outline



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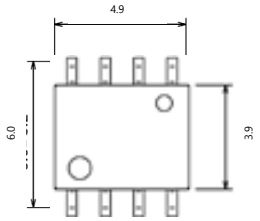

D3.9xW4.9xH1.75(Max)
(unit：mm)

P/N	Default output state
DCL520C00	Low
DCL520D00	High

TOSHIBA

Cross Reference

Digital Isolator Major Equivalents

Product category	TOSHIBA	ADI	TI	Skyworks (SiLabs)
4ch High-speed Standard Digital Isolators	DCL540/1x01 **Under development**	ADuM240/1	ISO7740/1	Si8640/1
2ch High-speed Standard Digital Isolators	DCL521x00 **Under development**	ADuM121	ISO7721	Si8621

Benchmark 4-ch High Speed

4 channel High Speed Standard Digital Isolators

Term	DCL540x01 /DCL541x01	ADuM240 /ADuM241	ISO7740 /ISO7741	Si8640xxT /Si8641xxT	Unit	Note
Coupling method	Magnetic	Magnetic	Capacitive	Capacitive		
Data rate	150	150	100	150	Mbps	
Total channel number	4	4	4	4	ch	
Forward ch.	4/3	4/3	4/3	4/3	ch	
Reverse ch.	0/1	0/1	0/1	0/1	ch	
Operating current：Idd1@100Mbps	18.4/24.5	17.4/20	5.7/11.3	5/9.8	mA	VDD=5.5V, CL=15pF
Operating current：Idd2@100Mbps	37.1/35.2	29.5/26.4	28/22	22.8/18.5	mA	VDD=5.5V, CL=15pF
Propagation delay@VDD=2.5V (Max)	21	14	18.5	14	ns	
Pulse distortion	☆ 3	3	5.1	5.0	ns	Low distortion
CMTI(Min/Typ)	☆ 100/200	75/100	85/100	35/50	kV/us	High CMTI
Isolation voltage (Min)	5000	5000	5000	5000	Vrms	
Creepage (Min)	8	7.8	8	8	mm	
Operating temp.	-40 to 110	-40 to 125	-55 to 125	-40 to 125	℃	
Junction temp. (Max)	150	150	150	150	℃	
Package	SOIC16	SOIC16	SOIC16	SOIC16		
Isolation topology	☆ Dual insulation	Single insulation	Dual insulation	Dual insulation		Safety
Isolation life (TDDB result)	☆ 70 years	50 years	100 years	60 years		Reliability

☆ : advantage

Benchmark 2-ch High Speed

2 channel High Speed Standard Digital Isolators

Term	DCL520x00 / DCL521x00	ADuM120 /ADuM121	ISO7720 /ISO7721	Si8620 /Si8622	Unit	Note
Coupling method	Magnetic	Magnetic	Capacitive	Capacitive		
Data rate	150	150	100	150	Mbps	
Total channel number	2	2	2	2	ch	
Forward ch.	1	1	1	1	ch	
Reverse ch.	1	1	1	1	ch	
Operating current : Idd1@100Mbps	12	12.3	9	8.1	mA	(Max) VDD=5.5V, CL=15pF
Operating current : Idd2@100Mbps	12	12.7	9	8.1	mA	(Max) VDD=5.5V, CL=15pF
Propagation delay@VDD=2.5V (Max)	21	14	18.5	14	ns	
Pulse distortion	☆ 3	3	5.1	5.0	ns	Low distortion
CMTI(Min/Typ)	☆ 100/200	75/100	85/100	35/50	kV/us	High CMTI
Isolation voltage (Min)	3000	3000	3000	3750	Vrms	
Creepage (Min)	4	4	4	4	mm	
Operating temp.	-40 to 125	-40 to 125	-55 to 125	-40 to 125	℃	
Junction temp. (Max)	150	150	150	150	℃	
Package	SOIC8	SOIC8	SOIC8	SOIC8		
Isolation topology	☆ Dual insulation	Single insulation	Dual insulation	Dual insulation		Safety
Isolation life (TDDB result)	☆ 70 years	50 years	100 years	60 years		Reliability

☆ : advantage

05

Promotion Tools

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