

# ISO644x-Q1 General-Purpose, Basic and Reinforced, Quad-Channel Digital Isolators

## 1 Features

- AEC-Q100 qualified with the following results:
  - Device temperature Grade 1:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  ambient operating temperature range
- [Functional Safety-Capable](#) (Planned)
  - Documentation available to aid ISO 26262 system design
- Up to 150Mbps data rate
- Robust  $\text{SiO}_2$  isolation barrier:
  - High lifetime at up to  $1061\text{V}_{\text{RMS}}$  and  $1500\text{V}_{\text{DC}}$  working voltage
  - Up to  $5000\text{V}_{\text{RMS}}$  isolation rating
  - Up to 10.4kV surge capability
  - Up to  $\pm 200\text{kV}/\mu\text{s}$  minimum CMTI
- Supply range: 2.25V to 5.5V
- [Overvoltage Tolerant Inputs](#)
- Default output *high* ( ISO644x-Q1 ) and *low* ( ISO644xF-Q1 ) options
- Low propagation delay: 10ns maximum at 5V, 12ns maximum at 3.3V
- Supports SPI up to: 25MHz at 5V, 20.8MHz at 3.3V
- Low pulse width distortion: 1.8ns maximum at 5V, 2.2ns maximum at 3.3V
- Robust electromagnetic compatibility (EMC)
  - System-level RI, ESD, and surge immunity
  - Low emissions
- Small Footprint Packages:
  - Wide-SSOP (DFP-16) Package
  - SSOP (DBQ-16) Package
- Safety-Related Certifications (Planned):
  - DIN EN IEC 60747-17 (VDE 0884-17)
  - UL 1577 and CSA CAS Notice No. 5A
  - IEC 62368-1, IEC 61010-1 and GB 4943.1 certifications

## 2 Applications

- [Hybrid, electric and power train system \(EV/HEV\)](#)
  - [Battery management system \(BMS\)](#)
  - [On-board charger](#)
  - [DC/DC converter](#)
  - [Inverter and motor control](#)

## 3 Description

The ISO644x-Q1 devices are general purpose digital isolators designed for applications requiring up to  $5000\text{V}_{\text{RMS}}$  isolation rating per UL 1577. The devices are also certified by VDE, TUV, and CQC.

The ISO644x-Q1 devices provide high EMC performance while isolating CMOS or LVCMOS digital I/Os. ISO644x-Q1 uses  $\text{SiO}_2$  as the isolation barrier. Each isolation channel has a logic input and output buffer separated by the insulation barrier. These devices come with enable pins that can be used to put the respective outputs in high impedance.

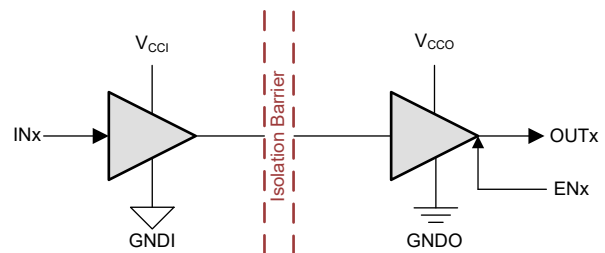
The ISO6440-Q1 and ISO6440F-Q1 devices have all channels in the forward direction. The ISO6441-Q1 and ISO6441F-Q1 devices have one reverse-direction channel. The ISO6442-Q1 and ISO6442F-Q1 devices have two reverse-direction channels.

In the event of input power or signal loss, the default output is *high* for devices without the suffix F and *low* for devices with the suffix F. See the [Device Functional Modes](#) section for further details.

### Package Information

PART NUMBER <sup>(1)</sup>	PACKAGE	PACKAGE SIZE <sup>(2)</sup>
ISO6440-Q1 , ISO6440F-Q1	Wide-SOIC (DW-16) <sup>(3)</sup>	10.3mm × 10.3mm
ISO6441-Q1 , ISO6441F-Q1	Wide-SSOP (DFP-16) <sup>(3)</sup>	10.3mm × 4.65mm
ISO6442-Q1 , ISO6442F-Q1	SSOP (DBQ-16) <sup>(3)</sup>	6mm × 4.9mm

- (1) For more information, see [Mechanical, Packaging, and Orderable Information](#).
- (2) The package size (length × width) is a nominal value and includes pins, where applicable.
- (3) Please refer to Packaging Information table on the Package Option Addendum page in the [Mechanical, Packaging, and Orderable Information](#) section for Production or Preproduction status for specific device and package.



$V_{\text{CCI}}$ =Input supply,  $V_{\text{CCO}}$ =Output supply  
 $\text{GNDI}$ =Input ground,  $\text{GNDO}$ =Output ground

### Simplified Schematic



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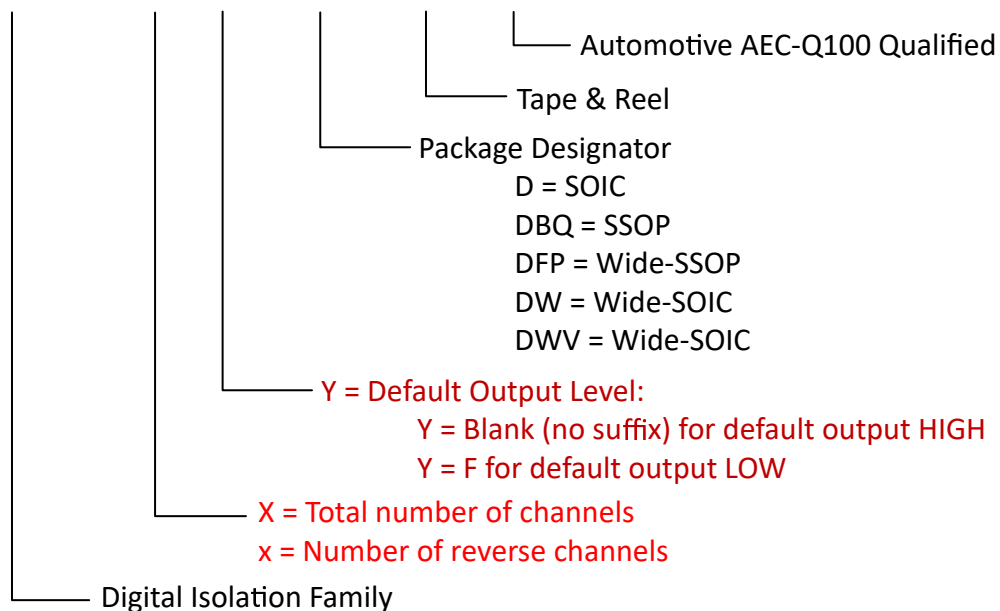
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## 4 Device Comparison

**Table 4-1. Device Comparison Table**

DEVICE NAME	TOTAL CHANNELS	REVERSE CHANNELS	DEFAULT OUTPUT	PACKAGE	CREEPAGE & CLEARANCE	VDE RATING	UL V <sub>ISO</sub>	CMTI
ISO6440DWRQ1	4	0	HIGH	Wide-SOIC (DW-16)	>8.15mm	Reinforced	5000V <sub>RMS</sub>	±250kV/μs typical, ±200kV/μs minimum
ISO6440FDWRQ1			LOW					
ISO6441DWRQ1		1	HIGH					
ISO6441FDWRQ1			LOW					
ISO6442DWRQ1		2	HIGH					
ISO6442FDWRQ1			LOW					
ISO6440DFPRQ1	4	0	HIGH	Wide-SSOP (DFP-16)	>8mm	Reinforced	5000V <sub>RMS</sub>	±250kV/μs typical, ±200kV/μs minimum
ISO6440FDFPRQ1			LOW					
ISO6441DFPRQ1		1	HIGH					
ISO6441FDFPRQ1			LOW					
ISO6442DFPRQ1		2	HIGH					
ISO6442FDFPRQ1			LOW					
ISO6440DBQRQ1	4	0	HIGH	SSOP (DBQ-16)	>3.7mm	Basic	3000V <sub>RMS</sub>	±180kV/μs typical, ±150kV/μs minimum
ISO6440FDBQRQ1			LOW					
ISO6441DBQRQ1		1	HIGH					
ISO6441FDBQRQ1			LOW					
ISO6442DBQRQ1		2	HIGH					
ISO6442FDBQRQ1			LOW					

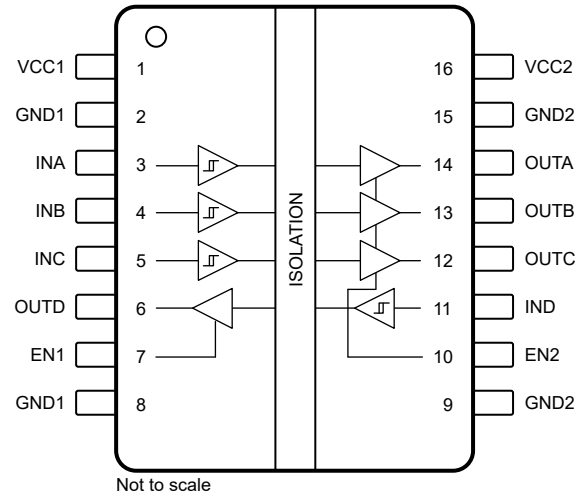
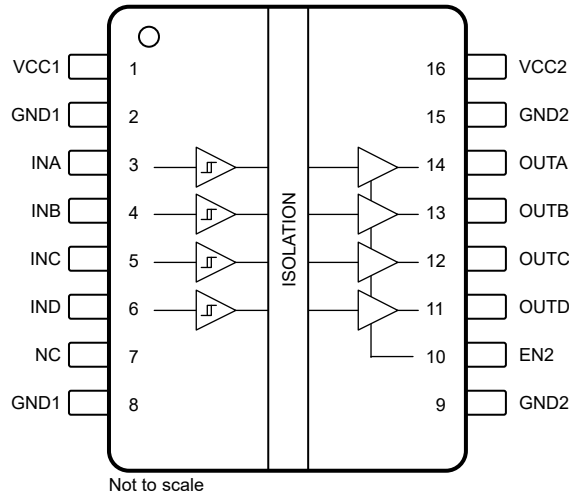
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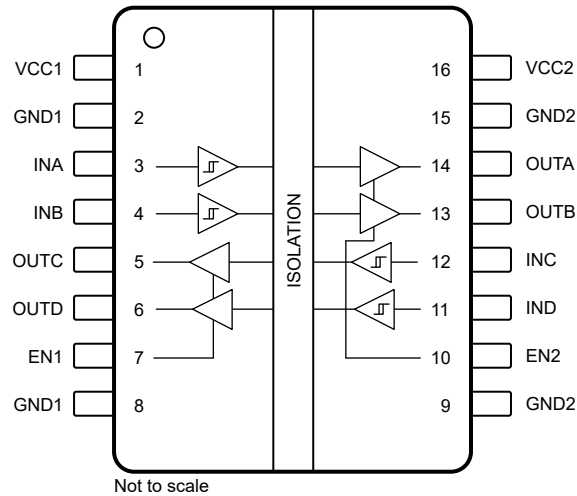
**Figure 4-1. Device Nomenclature**

## 5 Pin Configuration and Functions

### Pin Configuration for Wide-SOIC (DW-16) , Wide-SSOP (DFP-16) and SSOP (DBQ-16)



**Figure 5-1. ISO6440-Q1 and ISO6440F-Q1 Top View** **Figure 5-2. ISO6441-Q1 and ISO6441F-Q1 Top View**



**Figure 5-3. ISO6442-Q1 and ISO6442F-Q1 Top View**

**Table 5-1. Pin Functions**

NAME	PIN			Type <sup>(1)</sup>	DESCRIPTION
	ISO6440-Q1 , ISO6440F-Q1	ISO6441-Q1 , ISO6441F-Q1	ISO6442-Q1 , ISO6442F-Q1		
EN1	-	7	7	I	Output enable 1. Output pins on side 1 are enabled when EN1 is high or open and in high-impedance state when EN1 is low.
EN2	10	10	10	I	Output enable 2. Output pins on side 2 are enabled when EN2 is high or open and in high-impedance state when EN2 is low.
GND1	2, 8	2,8	2,8	—	Ground connection for $V_{CC1}$
GND2	9, 15	9,15	9,15	—	Ground connection for $V_{CC2}$
INA	3	3	3	I	Input, channel A
INB	4	4	4	I	Input, channel B
INC	5	5	12	I	Input, channel C
IND	6	11	11	I	Input, channel D
NC	7	-	-		Not connected
OUTA	14	14	14	O	Output, channel A
OUTB	13	13	13	O	Output, channel B
OUTC	12	12	5	O	Output, channel C
OUTD	11	6	6	O	Output, channel D
$V_{CC1}$	1	1	1	—	Power supply, side 1
$V_{CC2}$	16	16	16	—	Power supply, side 2

(1) I = Input, O = Output

## 6 Specifications

### 6.1 Absolute Maximum Ratings

See<sup>(1)</sup>

		MIN	MAX	UNIT
Supply voltage <sup>(2)</sup>	V <sub>CC1</sub> to GND1	-0.5	6	V
	V <sub>CC2</sub> to GND2	-0.5	6	
Digital Input Voltage	IN <sub>x</sub> to GND <sub>x</sub>	-0.5	6	V
Digital Input Voltage	EN <sub>x</sub> to GND <sub>x</sub>	-0.5	6	V
Digital Output Voltage	OUT <sub>x</sub> to GND <sub>x</sub>	-0.5	V <sub>CCX</sub> + 0.5 <sup>(3)</sup>	V
Digital Output current	I <sub>O</sub>	-15	15	mA
Temperature	Operating junction temperature, T <sub>J</sub>		150	°C
	Storage temperature, T <sub>stg</sub>	-65	150	°C

- (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) All voltage values except differential I/O bus voltages are with respect to the local ground terminal (GND1 or GND2) and are peak voltage values
- (3) Maximum voltage must not exceed 6V.

### 6.2 ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup>	±1500	

- (1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
V <sub>CC_RO</sub> (1)	Supply Voltage Side 1 (Recommended Operating Range)	V <sub>CC1</sub> = 2.5V to 5V (3)	2.25		5.5	V
	Supply Voltage Side 2 (Recommended Operating Range)	V <sub>CC2</sub> = 2.5V to 5V (3)	2.25		5.5	V
V <sub>CC_UVLO+</sub>	V <sub>CC</sub> UVLO threshold when supply voltage is rising				2.24	V
V <sub>CC_UVLO-</sub>	V <sub>CC</sub> UVLO threshold when supply voltage is falling		1.6			V
V <sub>CC_UVLO_HYS</sub>	V <sub>CC</sub> Supply voltage UVLO hysteresis		0.1			V
V <sub>IH(ENx)</sub>	Enable: High level Input voltage	Enable: High level Input voltage	0.7 × V <sub>CCI</sub> (2)		V <sub>CCI</sub>	V
V <sub>IL(ENx)</sub>	Enable: Low level Input voltage	Enable: Low level Input voltage	0	0.3 × V <sub>CCI</sub>		V
V <sub>IH(INx)</sub>	Input: High level Input voltage		0.7 × V <sub>CCI</sub> (2)		V <sub>CCI</sub>	V
V <sub>IL(INx)</sub>	Input: Low level Input voltage		0	0.3 × V <sub>CCI</sub>		V
I <sub>OH</sub>	Output: High level output current	V <sub>CCO</sub> = 5V (2)	-4			mA
		V <sub>CCO</sub> = 3.3V (2)	-2			mA
		V <sub>CCO</sub> = 2.5V (2)	-1			mA
I <sub>OL</sub>	Output: Low level output current	V <sub>CCO</sub> = 5V (2)			4	mA
		V <sub>CCO</sub> = 3.3V (2)			2	mA
		V <sub>CCO</sub> = 2.5V (2)			1	mA
DR	Data Rate	3.0V ≤ V <sub>CCx</sub> ≤ 5.5V and C <sub>L</sub> ≤ 15pF(4)	0		150	Mbps
		2.25V ≤ V <sub>CCx</sub> < 3V and C <sub>L</sub> ≤ 10pF(4)	0		150	Mbps
		2.25V ≤ V <sub>CCx</sub> < 3V and 10pF < C <sub>L</sub> ≤ 15pF(4)	0		100	Mbps
T <sub>A</sub>	Ambient temperature		-40	25	125	°C

- (1) V<sub>CC1</sub> and V<sub>CC2</sub> can be set independent of one another
- (2) V<sub>CCI</sub> = Input-side V<sub>CC</sub>; V<sub>CCO</sub> = Output-side V<sub>CC</sub>
- (3) The channel outputs are in undetermined state when V<sub>CC\_UVLO-</sub> ≤ V<sub>CC1</sub>, V<sub>CC2</sub> < V<sub>CC\_RO(MIN)</sub>.
- (4) See Section 7 .

### 6.4 Thermal Information

PACKAGE	PINS	THERMAL METRIC(1)						UNIT
		R <sub>θJA</sub>	R <sub>θJC(top)</sub>	R <sub>θJB</sub>	Ψ <sub>JT</sub>	Ψ <sub>JB</sub>	R <sub>θJC(bot)</sub>	
DW (Wide-SOIC)	16	83	48.5	49	28	48.4	NA	°C/W
DFP (Wide-SSOP)	16	113.3	63.6	75.6	32.5	74.4	NA	°C/W
DBQ (SSOP)	16	117.8	60	69.8	29.9	69	NA	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application note.

## 6.5 Power Ratings

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>ISO6440-Q1 (default high) and ISO6440F-Q1 (default low, with F suffix)</b>						
$P_D$	Maximum power dissipation (both sides)	$V_{CC1} = V_{CC2} = 5.5V$ , $T_J = 150^\circ C$ , $C_L = 15pF$ , Input a 75MHz 50% duty cycle square wave			268.2	mW
$P_{D1}$	Maximum power dissipation (side-1)				58.1	mW
$P_{D2}$	Maximum power dissipation (side-2)				210.1	mW
<b>ISO6441-Q1 (default high) and ISO6441F-Q1 (default low, with F suffix)</b>						
$P_D$	Maximum power dissipation (both sides)	$V_{CC1} = V_{CC2} = 5.5V$ , $T_J = 150^\circ C$ , $C_L = 15pF$ , Input a 75MHz 50% duty cycle square wave			262.2	mW
$P_{D1}$	Maximum power dissipation (side-1)				94.1	mW
$P_{D2}$	Maximum power dissipation (side-2)				168.1	mW
<b>ISO6442-Q1 (default high) and ISO6442F-Q1 (default low, with F suffix)</b>						
$P_D$	Maximum power dissipation (both sides)	$V_{CC1} = V_{CC2} = 5.5V$ , $T_J = 150^\circ C$ , $C_L = 15pF$ , Input a 75MHz 50% duty cycle square wave			268	mW
$P_{D1}$	Maximum power dissipation (side-1)				134	mW
$P_{D2}$	Maximum power dissipation (side-2)				134	mW

## 6.6 Insulation Specifications

PARAMETER		TEST CONDITIONS	PACKAGE			UNIT
			16-DW	16-DFP	16-DBQ	
<b>IEC 60664-1</b>						
CLR	External clearance <sup>(1)</sup>	Side 1 to side 2 distance through air	>8.15	>8.0	>3.7	mm
CPG	External creepage <sup>(1)</sup>	Side 1 to side 2 distance across package surface	>8.15	>8.0	>3.7	mm
DTI	Distance through the insulation	Minimum internal gap (internal clearance)	>17	>17	>9	µm
CTI	Comparative tracking index	IEC 60112	>600	>600	>600	V
	Material Group	According to IEC 60664-1	I	I	I	
	Overvoltage category	Rated mains voltage ≤ 150V <sub>RMS</sub>	I-IV	I-IV	I-IV	
		Rated mains voltage ≤ 300V <sub>RMS</sub>	I-IV	I-IV	I-III	
		Rated mains voltage ≤ 600V <sub>RMS</sub>	I-IV	I-IV	n/a	
		Rated mains voltage ≤ 1000V <sub>RMS</sub>	I-III	I-III	n/a	
<b>DIN EN IEC 60747-17 (VDE 0884-17)</b>						
	Suitability	DIN EN IEC 60747-17 (VDE 0884-17) suitability <sup>(2)</sup>				
V <sub>IORM</sub>	Maximum repetitive peak isolation voltage	AC voltage (bipolar)	1500	1500	707	V <sub>PK</sub>
V <sub>IOWM</sub>	Maximum isolation working voltage	AC voltage (sine wave); time-dependent dielectric breakdown (TDDB) test.	1061	1061	500	V <sub>RMS</sub>
		DC voltage	1500	1500	707	V <sub>DC</sub>
V <sub>IOTM</sub>	Maximum transient isolation voltage	V <sub>TEST</sub> = V <sub>IOTM</sub> , t = 60s (qualification); V <sub>TEST</sub> = 1.2 × V <sub>IOTM</sub> , t = 1s (100% production)	7071	7071	4243	V <sub>PK</sub>
V <sub>IMP</sub>	Maximum impulse voltage <sup>(3)</sup>	Tested in air, 1.2/50µs waveform per IEC 62368-1	8000	8000	4000	V <sub>PK</sub>
V <sub>IOSM</sub>	Maximum surge isolation voltage <sup>(4)</sup>	V <sub>IOSM</sub> ≥ 1.3 × V <sub>IMP</sub> ; Tested in oil (qualification test), 1.2/50µs waveform per IEC 62368-1	10400	10400	5200	V <sub>PK</sub>
q <sub>pd</sub>	Apparent charge <sup>(5)</sup>	Method a, After Input-output safety test subgroup 2/3, V <sub>ini</sub> = V <sub>IOTM</sub> , t <sub>ini</sub> = 60s; V <sub>pd(m)</sub> = 1.2 × V <sub>IORM</sub> , t <sub>m</sub> = 10s	≤5	≤5	≤5	pC
		Method a, After environmental tests subgroup 1, V <sub>ini</sub> = V <sub>IOTM</sub> , t <sub>ini</sub> = 60s; V <sub>pd(m)</sub> = 1.6 × V <sub>IORM</sub> (for reinforced devices) or 1.2 × V <sub>IORM</sub> (for basic devices) for t <sub>m</sub> = 10s	≤5	≤5	≤5	
		Method b: At routine test (100% production); V <sub>ini</sub> = 1.2 × V <sub>IOTM</sub> , t <sub>ini</sub> = 1s; V <sub>pd(m)</sub> = 1.875 × V <sub>IORM</sub> (for reinforced devices) or 1.5 × V <sub>IORM</sub> (for basic devices), t <sub>m</sub> = 1s (method b1) or V <sub>pd(m)</sub> = V <sub>ini</sub> , t <sub>m</sub> = t <sub>ini</sub> (method b2)	≤5	≤5	≤5	
C <sub>IO</sub>	Barrier capacitance, input to output <sup>(6)</sup>	V <sub>IO</sub> = 0.4 × sin(2 πft), f = 1MHz	≅1.6	≅1.3	≅1.9	pF
R <sub>IO</sub>	Insulation resistance, input to output <sup>(6)</sup>	V <sub>IO</sub> = 500V, T <sub>A</sub> = 25°C	>10 <sup>12</sup>	>10 <sup>12</sup>	>10 <sup>12</sup>	Ω
		V <sub>IO</sub> = 500V, 100°C ≤ T <sub>A</sub> ≤ 125°C	>10 <sup>11</sup>	>10 <sup>11</sup>	>10 <sup>11</sup>	
		V <sub>IO</sub> = 500V at T <sub>S</sub> = 150°C	>10 <sup>9</sup>	>10 <sup>9</sup>	>10 <sup>9</sup>	
	Pollution degree		2	2	2	
	Climatic category		40/125/21	40/125/21	40/125/21	
<b>UL 1577</b>						
V <sub>ISO</sub>	Withstand isolation voltage	V <sub>TEST</sub> = V <sub>ISO</sub> , t = 60s (qualification); V <sub>TEST</sub> = 1.2 × V <sub>ISO</sub> , t = 1s (100% production)	5000	5000	3000	V <sub>RMS</sub>

(1) Creepage and clearance requirements should be applied according to the specific equipment isolation standards of an application. Care should be taken to maintain the creepage and clearance distance of a board design to ensure that the mounting pads of the isolator on the printed-circuit board do not reduce this distance. Creepage and clearance on a printed-circuit board become equal

in certain cases. Techniques such as inserting grooves, ribs, or both on a printed circuit board are used to help increase these specifications.

- (2) This digital isolator is suitable for *safe electrical insulation* (reinforced device) or *basic electrical insulation* (basic device) only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.
- (3) Testing is carried out in air to determine the surge immunity of the package.
- (4) Testing is carried out in oil to determine the intrinsic surge immunity of the isolation barrier.
- (5) Apparent charge is electrical discharge caused by a partial discharge (pd).
- (6) All pins on each side of the barrier tied together creating a two-pin device.

## 6.7 Safety-Related Certifications

VDE	UL	CQC	TUV
Plan to certify according to DIN EN IEC 60747-17 (VDE 0884-17)	Plan to certify according to UL 1577 and CSA CAS Notice No. 5A	Plan to certify according to GB4943.1	Plan to certify according to EN 61010-1 and EN 62368-1
Certificate planned	Certificate planned	Certificate planned	Certificate planned

## 6.8 Safety Limiting Values

Safety limiting<sup>(1)</sup> intends to minimize potential damage to the isolation barrier upon failure of input or output circuitry.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>DW-16 Package</b>						
I <sub>S</sub>	Safety input, output, or supply current	R <sub>θJA</sub> = 83°C/W, V <sub>I</sub> = 5.5V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			273.8	mA
		R <sub>θJA</sub> = 83°C/W, V <sub>I</sub> = 3.6V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			418.3	
		R <sub>θJA</sub> = 83°C/W, V <sub>I</sub> = 2.75V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			547.6	mA
P <sub>S</sub>	Safety input, output, or total power	R <sub>θJA</sub> = 83°C/W, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			1506	
T <sub>S</sub>	Maximum safety temperature				150	°C
<b>DFP-16 Package</b>						
I <sub>S</sub>	Safety input, output, or supply current	R <sub>θJA</sub> = 113.3°C/W, V <sub>I</sub> = 5.5V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			200.6	mA
I <sub>S</sub>	Safety input, output, or supply current	R <sub>θJA</sub> = 113.3°C/W, V <sub>I</sub> = 3.6V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			306.5	mA
I <sub>S</sub>	Safety input, output, or supply current	R <sub>θJA</sub> = 113.3°C/W, V <sub>I</sub> = 2.75V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			401.2	mA
P <sub>S</sub>	Safety input, output, or total power	R <sub>θJA</sub> = 113.3°C/W, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			1103.3	mW
T <sub>S</sub>	Maximum safety temperature				150	°C
<b>DBQ-16 Package</b>						
I <sub>S</sub>	Safety input, output, or supply current	R <sub>θJA</sub> = 117.8°C/W, V <sub>I</sub> = 5.5V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			192.9	mA
I <sub>S</sub>	Safety input, output, or supply current	R <sub>θJA</sub> = 117.8°C/W, V <sub>I</sub> = 3.6V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			294.8	mA
I <sub>S</sub>	Safety input, output, or supply current	R <sub>θJA</sub> = 117.8°C/W, V <sub>I</sub> = 2.75V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			385.9	mA
P <sub>S</sub>	Safety input, output, or total power	R <sub>θJA</sub> = 117.8°C/W, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			1061.1	mW
T <sub>S</sub>	Maximum safety temperature				150	°C

- (1) The maximum safety temperature, T<sub>S</sub>, has the same value as the maximum junction temperature, T<sub>J</sub>, specified for the device. The I<sub>S</sub> and P<sub>S</sub> parameters represent the safety current and safety power respectively. The maximum limits of I<sub>S</sub> and P<sub>S</sub> should not be exceeded. These limits vary with the ambient temperature, T<sub>A</sub>.  
 The junction-to-air thermal resistance, R<sub>θJA</sub>, in the table is that of a device installed on a high-K test board for leaded surface-mount packages. Use these equations to calculate the value for each parameter:  
 $T_J = T_A + R_{\theta JA} \times P$ , where P is the power dissipated in the device.  
 $T_{J(max)} = T_S = T_A + R_{\theta JA} \times P_S$ , where T<sub>J(max)</sub> is the maximum allowed junction temperature.  
 $P_S = I_S \times V_I$ , where V<sub>I</sub> is the maximum input voltage.

## 6.9 Electrical Characteristics—5V Supply

$V_{CC1} = V_{CC2} = 5V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{OH(OUTx)}$	OUTx (output) high-level output voltage	$I_{OH} = -4mA$ ; See <a href="#">Section 7</a>	$V_{CCO} - 0.4^{(1)}$			V
$V_{OL(OUTx)}$	OUTx (output) low-level output voltage	$I_{OL} = 4mA$ ; See <a href="#">Section 7</a>			0.4	
$V_{IT+(INx)}$	INx (input) switching threshold voltage, rising			$0.7 \times V_{CCI}^{(1)}$		
$V_{IT-(INx)}$	INx (input) switching threshold voltage, falling		$0.3 \times V_{CCI}^{(1)}$			
$V_{L\_HYS(INx)}$	INx (input) switching threshold voltage hysteresis		$0.1 \times V_{CCI}^{(1)}$			
$I_{I(INx)}$	INx (input) input current (default high device)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at INx (leakage current)			1	$\mu A$
		LOW Input Current: $V_{IL} = 0V$ at INx (leakage and current through default high pull-up resistance)	-10			
	INx (input) input current (default low device, with F suffix)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at INx (leakage and current through default low pull-down resistance)			10	
		LOW Input Current: $V_{IL} = 0V$ at INx (leakage current)	-1			
$V_{IH(ENx)}$	ENx (enable) threshold voltage, rising			$0.7 \times V_{CCI}^{(1)}$	V	
$V_{IL(ENx)}$	ENx (enable) threshold voltage, falling		$0.3 \times V_{CCI}^{(1)}$			
$V_{L\_HYS(ENx)}$	ENx (enable) threshold voltage hysteresis		$0.1 \times V_{CCI}^{(1)}$			
$I_{I(ENx)}$	ENx (enable) input current (integrated pull-up)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at ENx (leakage current)			1	$\mu A$
		LOW Input Current: $V_{IL} = 0V$ at ENx (leakage and current through default high pull-up resistance)	-10			
CMTI_R	Common mode transient immunity, device rated for reinforced isolation (DW Package , DFP Package)	$V_I = V_{CC}$ or $0V$ , $V_{CM} = 1200V$ , $V_{ENx} = V_{CC}$ ; See <a href="#">Section 7</a>	200	250		kV/ $\mu s$
CMTI_B	Common mode transient immunity, device rated for basic isolation (DBQ Package )	$V_I = V_{CC}$ or $0V$ , $V_{CM} = 500V$ , $V_{ENx} = V_{CC}$ ; See <a href="#">Section 7</a>	150	180		kV/ $\mu s$
$C_i$	Input Capacitance <sup>(2)</sup>	$V_I = V_{CC}/2 + 0.4 \times \sin(2\pi ft)$ , $f = 2MHz$ , $V_{CC} = 5V$		1.5		pF

(1)  $V_{CCI}$  = Input-side  $V_{CC}$ ;  $V_{CCO}$  = Output-side  $V_{CC}$

(2) Measured from input pin to same side ground.

## 6.10 Supply Current Characteristics—5V Supply

$V_{CC1} = V_{CC2} = 5V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER	TEST CONDITIONS		SUPPLY CURRENT	MIN	TYP	MAX	UNIT
<b>ISO6440-Q1 (default high) and ISO6440F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)		$I_{CC1}$		3.4	4.7	mA
			$I_{CC2}$		1.3	1.5	
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)		$I_{CC1}$		11.3	13.1	
			$I_{CC2}$		1.1	1.3	
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}$		7.25	8.9	
			$I_{CC2}$		1.4	1.6	
		10Mbps	$I_{CC1}$		7.35	8.9	
			$I_{CC2}$		3.2	3.9	
		100Mbps	$I_{CC1}$		7.8	10.0	
			$I_{CC2}$		22	26	
<b>ISO6441-Q1 (default high) and ISO6441F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)		$I_{CC1}$		3.2	4.6	mA
			$I_{CC2}$		2.2	3	
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)		$I_{CC1}$		8.5	10.5	
			$I_{CC2}$		3.9	4.8	
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}$		5.9	7.5	
			$I_{CC2}$		3.2	4	
		10Mbps	$I_{CC1}$		6.5	8.1	
			$I_{CC2}$		4.7	5.6	
		100Mbps	$I_{CC1}$		11.5	13.9	
			$I_{CC2}$		18.4	21.7	
<b>ISO6442-Q1 (default high) and ISO6442F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)		$I_{CC1}, I_{CC2}$		2.2	3.15	mA
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)		$I_{CC1}, I_{CC2}$		5.6	7.4	
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}, I_{CC2}$		4.1	5.3	
		10Mbps	$I_{CC1}, I_{CC2}$		5.5	6.5	
		100Mbps	$I_{CC1}, I_{CC2}$		15.2	18.0	

(1)  $V_{CCI} = \text{Input-side } V_{CC}$

(2) Supply current valid for  $ENx = V_{CCx}$

(3) Supply current valid for  $ENx = V_{CCx}$

## 6.11 Electrical Characteristics—3.3V Supply

$V_{CC1} = V_{CC2} = 3.3V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{OH(OUTx)}$	OUTx (output) high-level output voltage	$I_{OH} = -2mA$ ; See <a href="#">Section 7</a>	$V_{CCO} - 0.2^{(1)}$			V
$V_{OL(OUTx)}$	OUTx (output) low-level output voltage	$I_{OL} = 2mA$ ; See <a href="#">Section 7</a>			0.2	
$V_{IT+(INx)}$	INx (input) switching threshold voltage, rising			$0.7 \times V_{CCI}^{(1)}$		
$V_{IT-(INx)}$	INx (input) switching threshold voltage, falling		$0.3 \times V_{CCI}^{(1)}$			
$V_{L\_HYS(INx)}$	INx (input) switching threshold voltage hysteresis		$0.1 \times V_{CCI}^{(1)}$			
$I_{I(INx)}$	INx (input) input current (default high device)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at INx (leakage current)			1	$\mu A$
		LOW Input Current: $V_{IL} = 0V$ at INx (leakage and current through default high pull-up resistance)	-10			
	INx (input) input current (default low device, with F suffix)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at INx (leakage and current through default low pull-down resistance)			10	
		LOW Input Current: $V_{IL} = 0V$ at INx (leakage current)	-1			
$V_{IH(ENx)}$	ENx (enable) threshold voltage, rising			$0.7 \times V_{CCI}^{(1)}$	V	
$V_{IL(ENx)}$	ENx (enable) threshold voltage, falling		$0.3 \times V_{CCI}^{(1)}$			
$V_{L\_HYS(ENx)}$	ENx (enable) threshold voltage hysteresis		$0.1 \times V_{CCI}^{(1)}$			
$I_{I(ENx)}$	ENx (enable) input current (integrated pull-up)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at ENx (leakage current)			1	$\mu A$
		LOW Input Current: $V_{IL} = 0V$ at ENx (leakage and current through default high pull-up resistance)	-10			
CMTI_R	Common mode transient immunity, device rated for reinforced isolation (DW Package , DFP Package)	$V_I = V_{CC}$ or $0V$ , $V_{CM} = 1200V$ , $V_{ENx} = V_{CC}$ ; See <a href="#">Section 7</a>	200	250		kV/ $\mu s$
CMTI_B	Common mode transient immunity, device rated for basic isolation (DBQ Package )	$V_I = V_{CC}$ or $0V$ , $V_{CM} = 500V$ , $V_{ENx} = V_{CC}$ ; See <a href="#">Section 7</a>	150	180		kV/ $\mu s$
$C_i$	Input Capacitance <sup>(2)</sup>	$V_I = V_{CC}/2 + 0.4 \times \sin(2\pi ft)$ , $f = 2MHz$ , $V_{CC} = 3.3V$		1.5		pF

- (1)  $V_{CCI} =$  Input-side  $V_{CC}$ ;  $V_{CCO} =$  Output-side  $V_{CC}$   
(2) Measured from input pin to same side ground.

## 6.12 Supply Current Characteristics—3.3V Supply

$V_{CC1} = V_{CC2} = 3.3V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER	TEST CONDITIONS	SUPPLY CURRENT	MIN	TYP	MAX	UNIT	
<b>ISO6440-Q1 (default high) and ISO6440F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)	$I_{CC1}$		3.3	4.7	mA	
		$I_{CC2}$		1.2	1.5		
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)	$I_{CC1}$		10.3	13.1		
		$I_{CC2}$		1.1	1.3		
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}$		7.5		8.8
			$I_{CC2}$		1.3		1.5
		10Mbps	$I_{CC1}$		7.5		8.9
			$I_{CC2}$		2.5		2.9
		100Mbps	$I_{CC1}$		8.0	9.5	
			$I_{CC2}$		14.9	17.0	
<b>ISO6441-Q1 (default high) and ISO6441F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)	$I_{CC1}$		3.2	4.5	mA	
		$I_{CC2}$		2.2	2.9		
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)	$I_{CC1}$		8.5	10.4		
		$I_{CC2}$		3.8	4.8		
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}$		5.9		7.4
			$I_{CC2}$		3.1		3.9
		10Mbps	$I_{CC1}$		6.2		7.8
			$I_{CC2}$		4.1		5
		100Mbps	$I_{CC1}$		9.5	11.6	
			$I_{CC2}$		13.2	15.5	
<b>ISO6442-Q1 (default high) and ISO6442F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)	$I_{CC1}, I_{CC2}$		2.4	3.1	mA	
	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)	$I_{CC1}, I_{CC2}$		5.6	7.3		
Supply current - AC signal (3)	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)	1Mbps	$I_{CC1}, I_{CC2}$		4.4		5.2
		10Mbps	$I_{CC1}, I_{CC2}$		5.1		6.0
		100Mbps	$I_{CC1}, I_{CC2}$		11.5		13.1

(1)  $V_{CCI} = \text{Input-side } V_{CC}$

(2) Supply current valid for  $ENx = V_{CCx}$

(3) Supply current valid for  $ENx = V_{CCx}$

## 6.13 Electrical Characteristics—2.5V Supply

$V_{CC1} = V_{CC2} = 2.5V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{OH(OUTx)}$	OUTx (output) high-level output voltage	$I_{OH} = -1mA$ ; See <a href="#">Section 7</a>	$V_{CCO} - 0.1^{(1)}$			V
$V_{OL(OUTx)}$	OUTx (output) low-level output voltage	$I_{OL} = 1mA$ ; See <a href="#">Section 7</a>			0.1	
$V_{IT+(INx)}$	INx (input) switching threshold voltage, rising			$0.7 \times V_{CCI}^{(1)}$		
$V_{IT-(INx)}$	INx (input) switching threshold voltage, falling		$0.3 \times V_{CCI}^{(1)}$			
$V_{L\_HYS(INx)}$	INx (input) switching threshold voltage hysteresis		$0.1 \times V_{CCI}^{(1)}$			
$I_{I(INx)}$	INx (input) input current (default high device)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at INx (leakage current)			1	$\mu A$
		LOW Input Current: $V_{IL} = 0V$ at INx (leakage and current through default high pull-up resistance)	-10			
	INx (input) input current (default low device, with F suffix)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at INx (leakage and current through default low pull-down resistance)			10	
		LOW Input Current: $V_{IL} = 0V$ at INx (leakage current)	-1			
$V_{IH(ENx)}$	ENx (enable) threshold voltage, rising			$0.7 \times V_{CCI}^{(1)}$	V	
$V_{IL(ENx)}$	ENx (enable) threshold voltage, falling		$0.3 \times V_{CCI}^{(1)}$			
$V_{L\_HYS(ENx)}$	ENx (enable) threshold voltage hysteresis		$0.1 \times V_{CCI}^{(1)}$			
$I_{I(ENx)}$	ENx (enable) input current (integrated pull-up)	HIGH Input Current: $V_{IH} = V_{CCI}^{(1)}$ at ENx (leakage current)			1	$\mu A$
		LOW Input Current: $V_{IL} = 0V$ at ENx (leakage and current through default high pull-up resistance)	-10			
CMTI_R	Common mode transient immunity, device rated for reinforced isolation (DW Package , DFP Package)	$V_I = V_{CC}$ or $0V$ , $V_{CM} = 1200V$ , $V_{ENx} = V_{CC}$ ; See <a href="#">Section 7</a>	200	250		kV/ $\mu s$
CMTI_B	Common mode transient immunity, device rated for basic isolation (DBQ Package )	$V_I = V_{CC}$ or $0V$ , $V_{CM} = 500V$ , $V_{ENx} = V_{CC}$ ; See <a href="#">Section 7</a>	150	180		kV/ $\mu s$
$C_i$	Input Capacitance <sup>(2)</sup>	$V_I = V_{CC}/2 + 0.4 \times \sin(2\pi ft)$ , $f = 2MHz$ , $V_{CC} = 2.5V$		1.5		pF

- (1)  $V_{CCI}$  = Input-side  $V_{CC}$ ;  $V_{CCO}$  = Output-side  $V_{CC}$   
(2) Measured from input pin to same side ground.

## 6.14 Supply Current Characteristics—2.5V Supply

$V_{CC1} = V_{CC2} = 2.5V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER	TEST CONDITIONS	SUPPLY CURRENT	MIN	TYP	MAX	UNIT	
<b>ISO6440-Q1 (default high) and ISO6440F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)	$I_{CC1}$		3.3	4.6	mA	
		$I_{CC2}$		1.2	1.4		
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)	$I_{CC1}$		11.2	13.0		
		$I_{CC2}$		1.0	1.21		
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}$		7.3		8.8
			$I_{CC2}$		1.2		1.5
		10Mbps	$I_{CC1}$		7.4		8.8
			$I_{CC2}$		2.2		2.5
		100Mbps	$I_{CC1}$		7.6	9.3	
			$I_{CC2}$		11.5	13.3	
<b>ISO6441-Q1 (default high) and ISO6441F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)	$I_{CC1}$		3.1	4.5	mA	
		$I_{CC2}$		2.1	2.9		
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)	$I_{CC1}$		8.5	10.4		
		$I_{CC2}$		3.8	4.7		
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}$		5.8		7.4
			$I_{CC2}$		3.1		3.9
		10Mbps	$I_{CC1}$		6.1		7.7
			$I_{CC2}$		3.8		4.7
		100Mbps	$I_{CC1}$		8.6	10.6	
			$I_{CC2}$		10.7	12.7	
<b>ISO6442-Q1 (default high) and ISO6442F-Q1 (default low, with F suffix)</b>							
Supply current - DC signal (2)	$V_I = V_{CC1}$ (1)(default high); $V_I = 0V$ (default low, with F suffix)	$I_{CC1}, I_{CC2}$		2.1	3.1	mA	
	$V_I = 0V$ (default high); $V_I = V_{CC1}$ (default low, with F suffix)	$I_{CC1}, I_{CC2}$		5.6	7.2		
Supply current - AC signal (3)	All channels switching with square wave clock input; $C_L = 15pF$	1Mbps	$I_{CC1}, I_{CC2}$		3.9		5.2
		10Mbps	$I_{CC1}, I_{CC2}$		4.6		5.8
		100Mbps	$I_{CC1}, I_{CC2}$		9.3		11.5

(1)  $V_{CCI} = \text{Input-side } V_{CC}$

(2) Supply current valid for  $ENx = V_{CCx}$

(3) Supply current valid for  $ENx = V_{CCx}$

## 6.15 Switching Characteristics—5V Supply

$V_{CC1} = V_{CC2} = 5V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}, t_{PHL}$	Propagation delay time	at 100kbps	3.85	6.2	10	ns
PWD	Pulse width distortion <sup>(1)</sup> $ t_{PHL} - t_{PLH} $	See <a href="#">Section 7</a>		0.07	1.8	
$t_{sk(o)}$	Channel-to-channel output skew time <sup>(2)</sup>	Same-direction channels			1.5	ns
$t_{sk(pp)}$	Part-to-part skew time <sup>(3)</sup>				3	
$t_r$	Output signal rise time	See <a href="#">Section 7</a>			3	ns
$t_f$	Output signal fall time				3	
$t_{PHZ}$	Disable propagation delay, high-to-high impedance output	See <a href="#">Section 7</a>			9	ns
$t_{PLZ}$	Disable propagation delay, low-to-high impedance output				8	
$t_{PZH}$	Enable propagation delay, high impedance-to-high output for device with EN	See <a href="#">Section 7</a>			7	ns
$t_{PZL}$	Enable propagation delay, high impedance-to-low output for device with EN				8	
$t_{PU}$	Time from $V_{CC}$ UVLO to valid output data	$V_{CC}$ ramp $< 1\mu s$			90	$\mu s$
$t_{DO}$	Default output delay time from input power loss	Measured from the time $V_{CC}$ goes below $V_{CC\_UVLO-(MIN)}$ . See <a href="#">Section 7</a>		0.045	0.1	$\mu s$
$t_{ie}$	Time interval error	$2^{16} - 1$ PRBS data at 100Mbps		0.23		ns

- (1) Also known as pulse skew.
- (2)  $t_{sk(o)}$  is the skew between outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical loads.
- (3)  $t_{sk(pp)}$  is the magnitude of the difference in propagation delay times between any terminals of different devices switching in the same direction while operating at identical supply voltages, temperature, input signals and loads.

## 6.16 Switching Characteristics—3.3V Supply

$V_{CC1} = V_{CC2} = 3.3V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}, t_{PHL}$	Propagation delay time	at 100kbps	4	7	12	ns
PWD	Pulse width distortion <sup>(1)</sup> $ t_{PHL} - t_{PLH} $	See <a href="#">Section 7</a>		0.35	2.2	
$t_{sk(o)}$	Channel-to-channel output skew time <sup>(2)</sup>	Same-direction channels			1.5	ns
$t_{sk(pp)}$	Part-to-part skew time <sup>(3)</sup>				3	
$t_r$	Output signal rise time	See <a href="#">Section 7</a>			4	ns
$t_f$	Output signal fall time				4	
$t_{PHZ}$	Disable propagation delay, high-to-high impedance output	See <a href="#">Section 7</a>			14	ns
$t_{PLZ}$	Disable propagation delay, low-to-high impedance output				12	
$t_{PZH}$	Enable propagation delay, high impedance-to-high output for device with EN	See <a href="#">Section 7</a>			11	ns
$t_{PZL}$	Enable propagation delay, high impedance-to-low output for device with EN				10	
$t_{PU}$	Time from $V_{CC}$ UVLO to valid output data	$V_{CC}$ ramp < 1 $\mu$ s			70	$\mu$ s
$t_{DO}$	Default output delay time from input power loss	Measured from the time VCC goes below $V_{CC\_UVLO-(MIN)}$ . See <a href="#">Section 7</a>		0.045	0.1	$\mu$ s
$t_{ie}$	Time interval error	$2^{16} - 1$ PRBS data at 100Mbps		0.2		ns

- (1) Also known as pulse skew.
- (2)  $t_{sk(o)}$  is the skew between outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical loads.
- (3)  $t_{sk(pp)}$  is the magnitude of the difference in propagation delay times between any terminals of different devices switching in the same direction while operating at identical supply voltages, temperature, input signals and loads.

## 6.17 Switching Characteristics—2.5V Supply

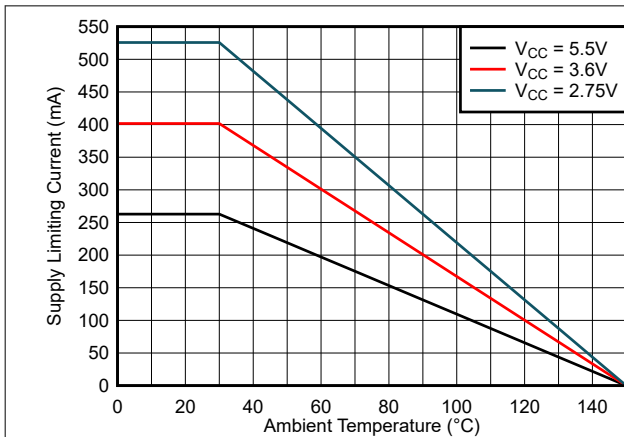
$V_{CC1} = V_{CC2} = 2.5V \pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}, t_{PHL}$	Propagation delay time	at 100kbps	4.75	8.4	14.5	ns
PWD	Pulse width distortion <sup>(1)</sup> $ t_{PHL} - t_{PLH} $	See <a href="#">Section 7</a>		0.55	2.6	
$t_{sk(o)}$	Channel-to-channel output skew time <sup>(2)</sup>	Same-direction channels			1.5	ns
$t_{sk(pp)}$	Part-to-part skew time <sup>(3)</sup>				3	
$t_r$	Output signal rise time	See <a href="#">Section 7</a>			5	ns
$t_f$	Output signal fall time				5	
$t_{PHZ}$	Disable propagation delay, high-to-high impedance output	See <a href="#">Section 7</a>			19	ns
$t_{PLZ}$	Disable propagation delay, low-to-high impedance output				17	
$t_{PZH}$	Enable propagation delay, high impedance-to-high output for device with EN	See <a href="#">Section 7</a>			17	ns
$t_{PZL}$	Enable propagation delay, high impedance-to-low output for device with EN				12	
$t_{PU}$	Time from $V_{CC}$ UVLO to valid output data	$V_{CC}$ ramp < 1 $\mu$ s			80	$\mu$ s
$t_{DO}$	Default output delay time from input power loss	Measured from the time $V_{CC}$ goes below $V_{CC\_UVLO-(MIN)}$ . See <a href="#">Section 7</a>		0.047	0.1	$\mu$ s
$t_{ie}$	Time interval error	$2^{16} - 1$ PRBS data at 100Mbps		0.22		ns

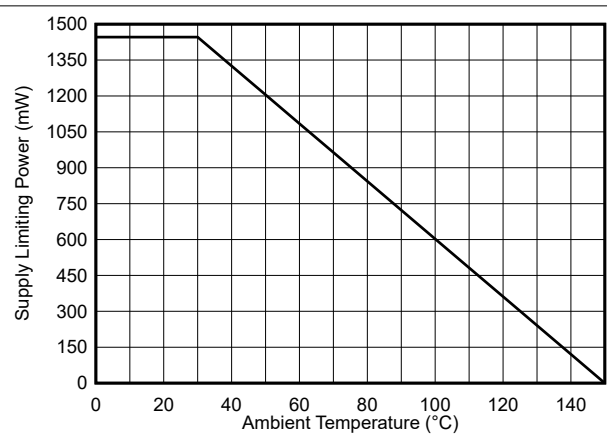
- (1) Also known as pulse skew.
- (2)  $t_{sk(o)}$  is the skew between outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical loads.
- (3)  $t_{sk(pp)}$  is the magnitude of the difference in propagation delay times between any terminals of different devices switching in the same direction while operating at identical supply voltages, temperature, input signals and loads.

## 6.18 Insulation Characteristics Curves

### Insulation Characteristics Curves for Wide-SOIC (DW-16) Package

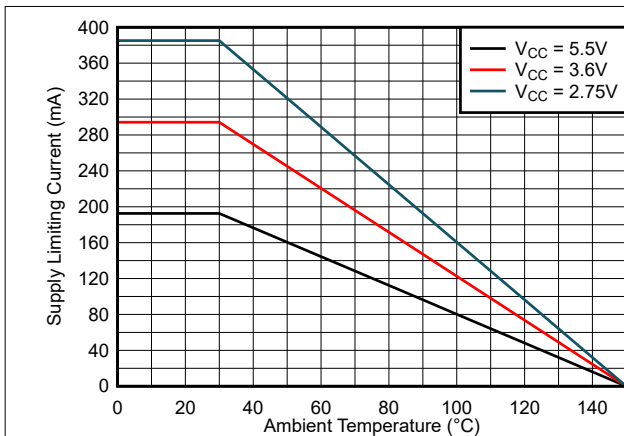


**Figure 6-1. Thermal Derating Curve for Safety Limiting Current for Wide-SOIC (DW-16) Package**

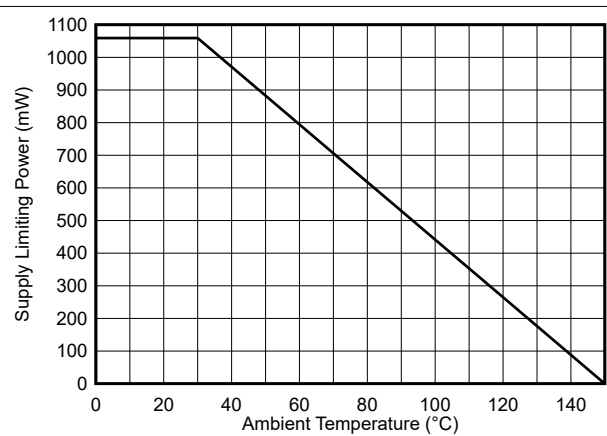


**Figure 6-2. Thermal Derating Curve for Safety Limiting Power for Wide-SOIC (DW-16) Package**

### Insulation Characteristics Curves for Wide-SSOP (DFP-16) Package

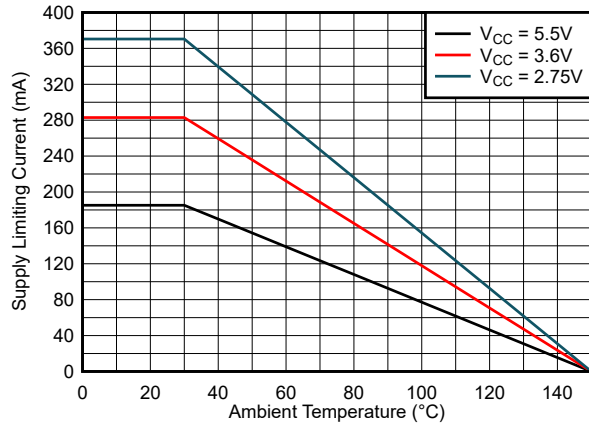


**Figure 6-3. Thermal Derating Curve for Safety Limiting Current for Wide-SSOP (DFP-16) Package**

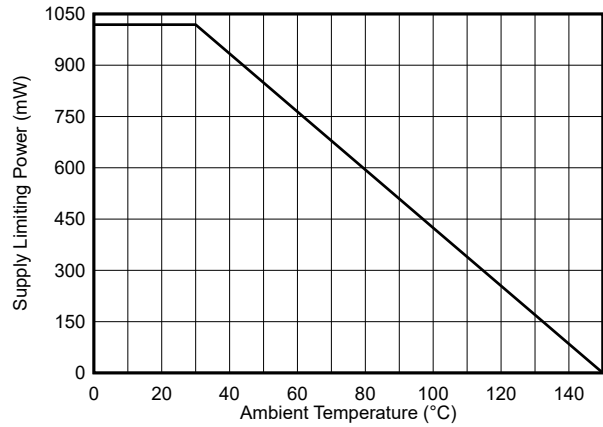


**Figure 6-4. Thermal Derating Curve for Safety Limiting Power for Wide-SSOP (DFP-16) Package**

### Insulation Characteristics Curves for SSOP (DBQ-16) Package

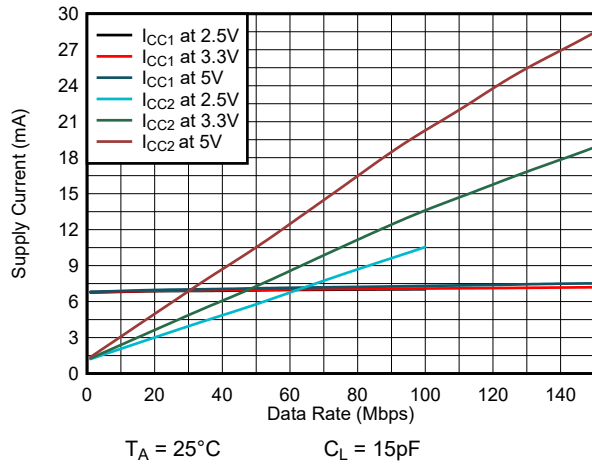


**Figure 6-5. Thermal Derating Curve for Safety Limiting Current for SSOP (DBQ-16) Package**

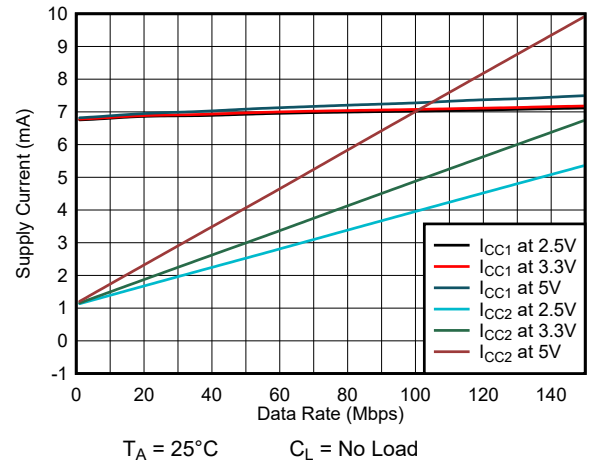


**Figure 6-6. Thermal Derating Curve for Safety Limiting Power for SSOP (DBQ-16) Package**

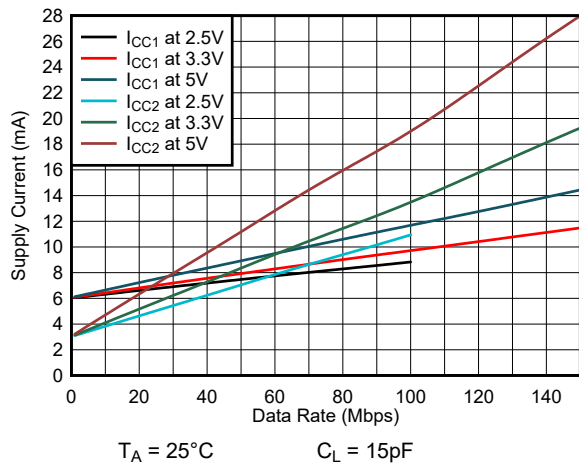
## 6.19 Typical Characteristics



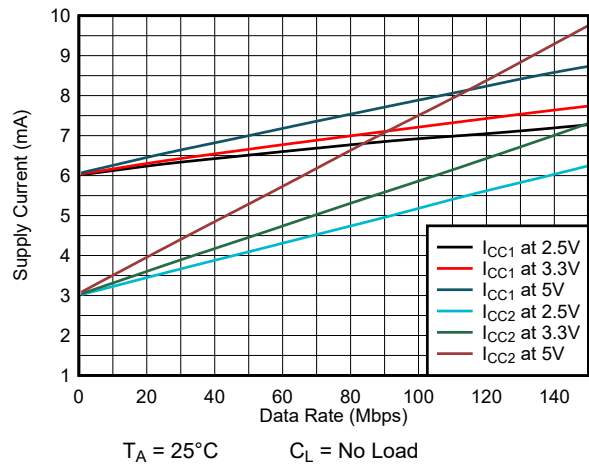
**Figure 6-7. ISO6440-Q1 or ISO6440F-Q1 Supply Current vs Data Rate (With 15pF Load)**



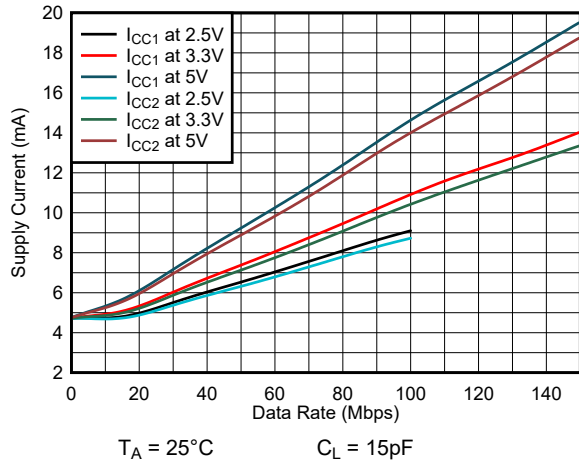
**Figure 6-8. ISO6440-Q1 or ISO6440F-Q1 Supply Current vs Data Rate (With No Load)**



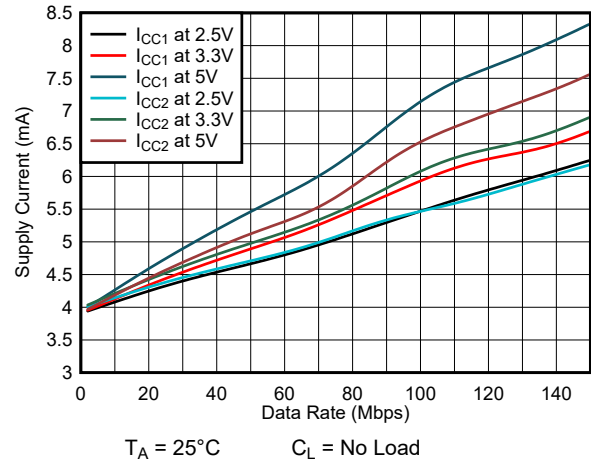
**Figure 6-9. ISO6441-Q1 or ISO6441F-Q1 Supply Current vs Data Rate (With 15pF Load)**



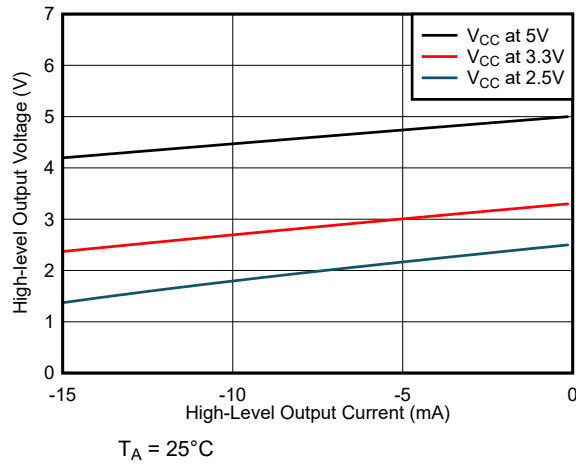
**Figure 6-10. ISO6441-Q1 or ISO6441F-Q1 Supply Current vs Data Rate (With No Load)**



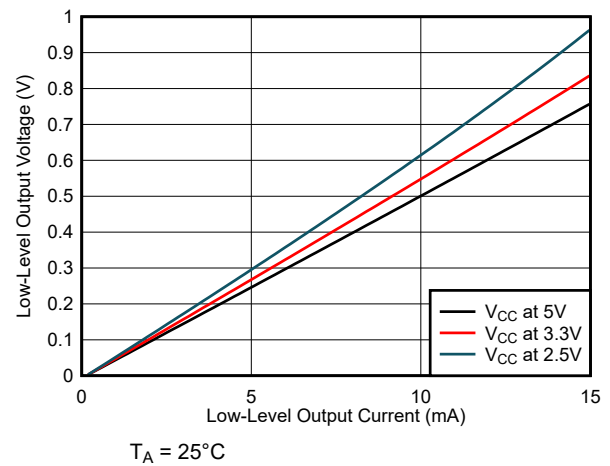
**Figure 6-11. ISO6442-Q1 or ISO6442F-Q1 Supply Current vs Data Rate (With 15pF Load)**



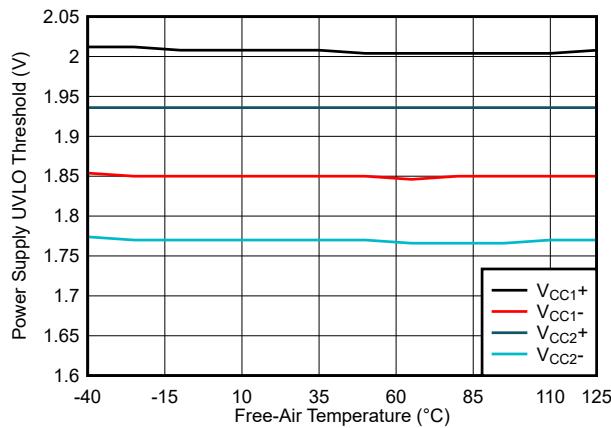
**Figure 6-12. ISO6442-Q1 or ISO6442F-Q1 Supply Current vs Data Rate (With No Load)**



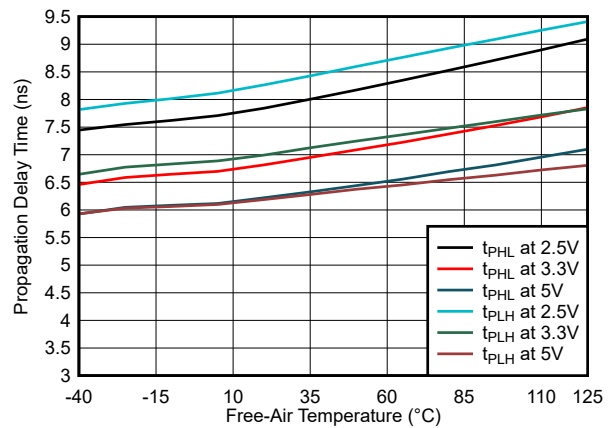
**Figure 6-13. High-Level Output Voltage vs High-level Output Current**



**Figure 6-14. Low-Level Output Voltage vs Low-Level Output Current**

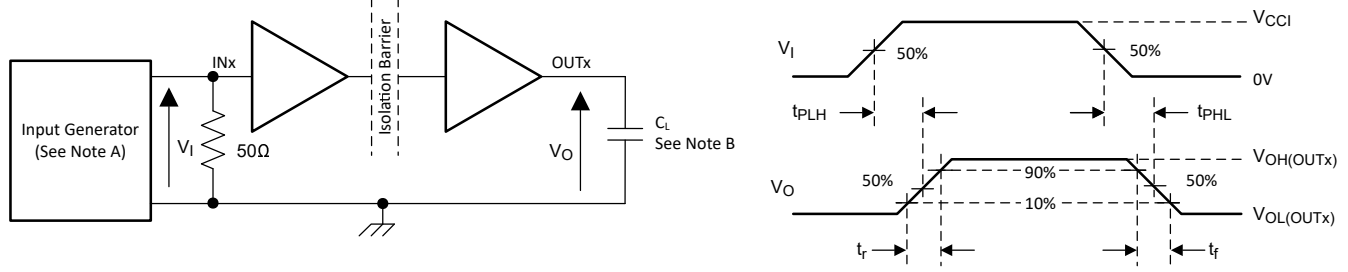


**Figure 6-15. Power Supply Undervoltage Threshold vs Free-Air Temperature**



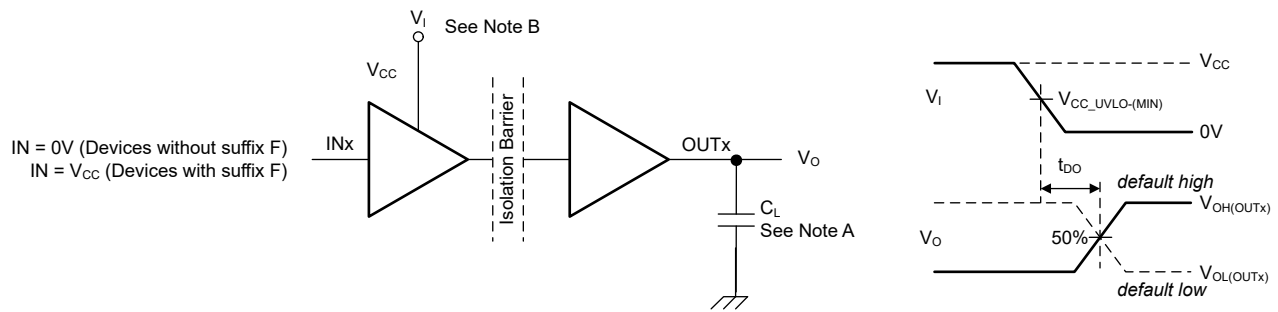
**Figure 6-16. Propagation Delay Time vs Free-Air Temperature**

## 7 Parameter Measurement Information



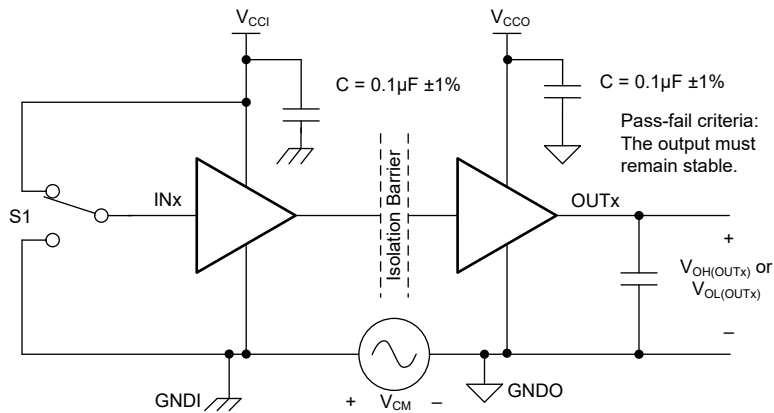
- A. The input pulse is supplied by a generator having the following characteristics: PRR  $\leq$  50kHz, 50% duty cycle,  $t_r \leq 1$ ns,  $t_f \leq 1$ ns,  $Z_0 = 50\Omega$ . At the input,  $50\Omega$  resistor is required to terminate INx (input) generator signal. The  $50\Omega$  resistor is not needed in the actual application.
- B.  $C_L = 15$ pF and includes instrumentation and fixture capacitance within  $\pm 20\%$ .

Figure 7-1. Switching Characteristics Test Circuit and Voltage Waveforms



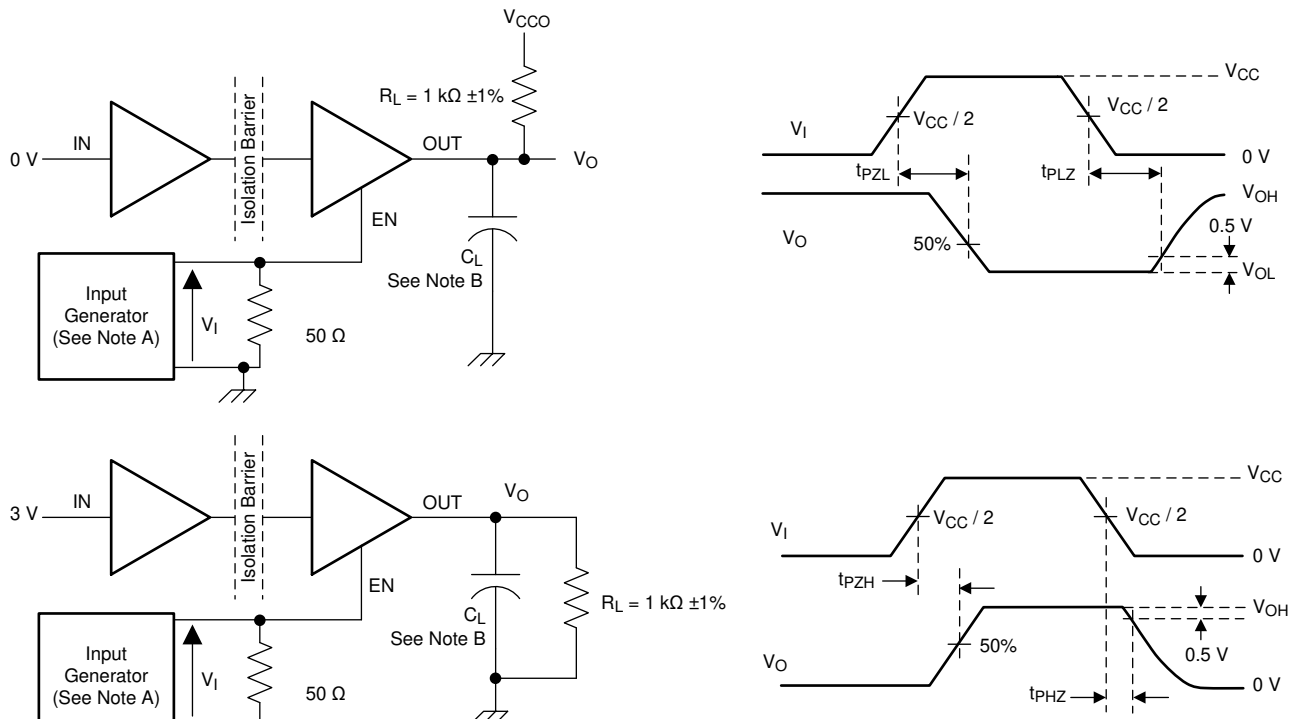
- A.  $C_L = 15$ pF and includes instrumentation and fixture capacitance within  $\pm 20\%$ .
- B. Power Supply Ramp Rate = 10mV/ns

Figure 7-2. Default Output Delay Time Test Circuit and Voltage Waveforms



- A.  $C_L = 15$ pF and includes instrumentation and fixture capacitance within  $\pm 20\%$ .
- B.  $ENx = V_{CC}$ , channels are enabled during CMTI test.

Figure 7-3. Common-Mode Transient Immunity Test Circuit



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- A. The input pulse is supplied by a generator having the following characteristics: PRR  $\leq$  10kHz, 50% duty cycle,  $t_r \leq$  3ns,  $t_f \leq$  3ns,  $Z_O = 50\Omega$ .
- B.  $C_L = 15\text{pF}$  and includes instrumentation and fixture capacitance within  $\pm 20\%$ .

**Figure 7-4. Enable Propagation Delay Time Test Circuit and Waveform**

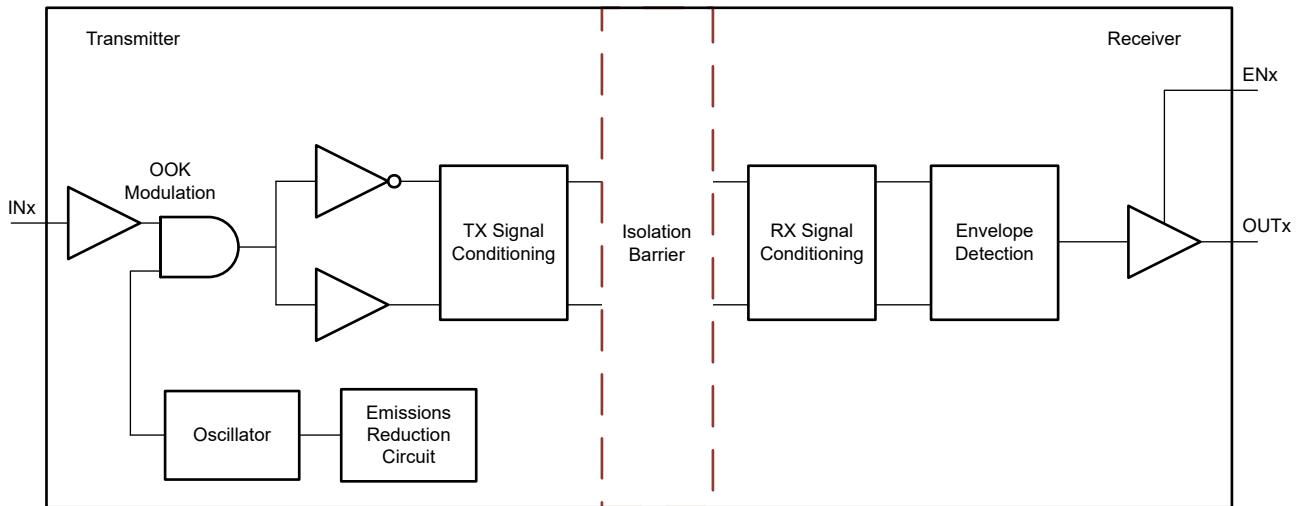
## 8 Detailed Description

### 8.1 Overview

The ISO644x-Q1 family of devices have an ON-OFF keying (OOK) modulation scheme to transmit the digital data across a silicon dioxide based isolation barrier.

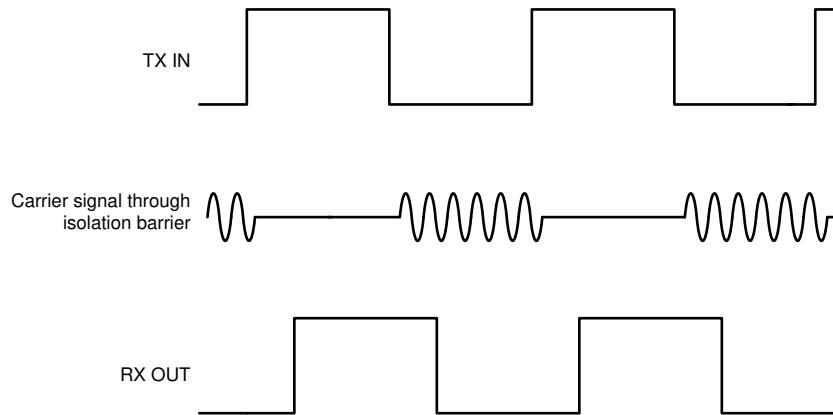
The transmitter sends a high frequency carrier across the barrier to represent one digital state and sends no signal to represent the other digital state. The receiver demodulates the signal after advanced signal conditioning and produces the output through a buffer stage. The ISO644x-Q1 devices also incorporate advanced circuit techniques to maximize the CMTI performance and minimize the radiated emissions due to the high frequency carrier and IO buffer switching.

### 8.2 Functional Block Diagram



**Figure 8-1. Conceptual Block Diagram of an OOK Based Digital Isolator**

Figure 8-2 shows a conceptual detail of how the ON-OFF keying scheme works.



**Figure 8-2. On-Off Keying (OOK) Based Modulation Scheme**

## 8.3 Feature Description

Table 8-1 provides an overview of the device features.

**Table 8-1. Device Features**

PART NUMBER	CHANNEL DIRECTION	MAXIMUM DATA RATE	DEFAULT OUTPUT	PACKAGE
ISO6440-Q1	4 Forward 0 Reverse	150Mbps	High	DW-16 , DFP-16 , DBQ-16
ISO6440F-Q1	4 Forward 0 Reverse	150Mbps	Low	DW-16 , DFP-16 , DBQ-16
ISO6441-Q1	3 Forward 1 Reverse	150Mbps	High	DW-16 , DFP-16 , DBQ-16
ISO6441F-Q1	3 Forward 1 Reverse	150Mbps	Low	DW-16 , DFP-16 , DBQ-16
ISO6442-Q1	2 Forward 2 Reverse	150Mbps	High	DW-16 , DFP-16 , DBQ-16
ISO6442F-Q1	2 Forward 2 Reverse	150Mbps	Low	DW-16 , DFP-16 , DBQ-16

### 8.3.1 Electromagnetic Compatibility (EMC) Considerations

Many applications in harsh industrial environment are sensitive to disturbances such as electrostatic discharge (ESD), electrical fast transient (EFT), surge and electromagnetic emissions. These electromagnetic disturbances are defined and tested by international standards such as IEC 61000-4-x and CISPR 25. Although system-level performance and reliability depends, to a large extent, on the application board design and layout, the ISO644x-Q1 family of devices incorporates many chip-level design techniques to help overall system robustness.

## 8.4 Device Functional Modes

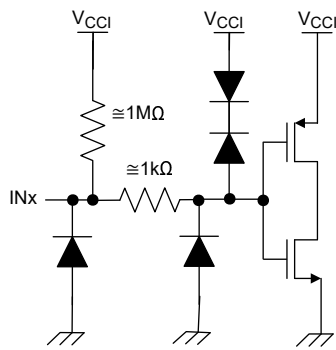
The following table lists the functional modes for the ISO644x-Q1 devices.

**Table 8-2. Function Table**

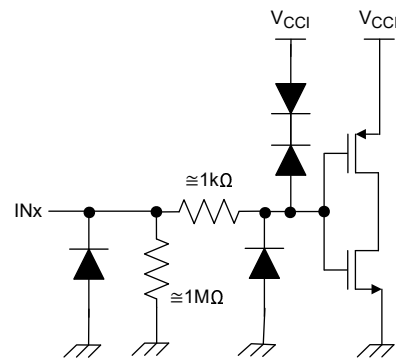
V <sub>CCI</sub> (1)	V <sub>CCO</sub>	INPUT (INx)	OUTPUT ENABLE (ENx)	OUTPUT (OUTx)	COMMENTS
PU	PU	H	H or open	H	Normal Operation: A channel output assumes the logic state of the input.
		L	H or open	L	
		Open	H or open	Default	Default mode: When INx is open, the corresponding channel output goes to the default logic state. Default is <i>High</i> for ISO644x-Q1 and <i>Low</i> for ISO644xF-Q1 (with F suffix).
X	PU	X	L	Z	A low value of output enable causes the outputs to be high-impedance.
PD	PU	X	H or open	Default	Default mode: When V <sub>CCI</sub> is unpowered, a channel output assumes the logic state based on the selected default option. Default is <i>High</i> for ISO644x-Q1 and <i>Low</i> for ISO644xF-Q1 (with F suffix). When V <sub>CCI</sub> transitions from unpowered to powered-up, a channel output assumes the logic state of the input. When V <sub>CCI</sub> transitions from powered-up to unpowered, channel output assumes the selected default state.
X	PD	X	X	Undetermined	When V <sub>CCO</sub> is unpowered, a channel output is undetermined <sup>(2)</sup> . When V <sub>CCO</sub> transitions from unpowered to powered-up, a channel output assumes the logic state of the input.

- (1) V<sub>CCI</sub> = Input-side V<sub>CC</sub>; V<sub>CCO</sub> = Output-side V<sub>CC</sub>; PU = Powered up (V<sub>CC</sub> ≥ V<sub>CC\_RO(MIN)</sub>); PD = Powered down (V<sub>CC</sub> ≤ V<sub>CC\_UVLO-</sub>); X = Irrelevant; H = High level; L = Low level; Z = High Impedance  
 (2) The outputs are in undetermined state when V<sub>CC\_UVLO-</sub> ≤ V<sub>CCI</sub> or V<sub>CCO</sub> < V<sub>CC</sub> ≥ V<sub>CC\_RO(MIN)</sub>.

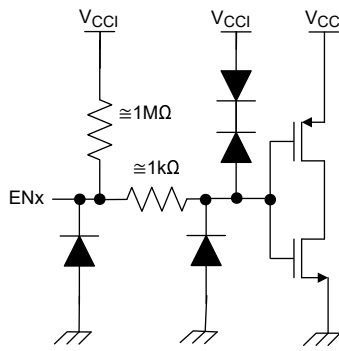
## 8.5 Device I/O Schematics



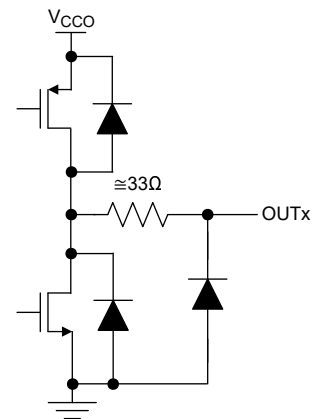
**Figure 8-3. Input (INx) Default High (Device Without F Suffix Device) Schematics**



**Figure 8-4. Input (INx) Default Low (Device With F Suffix Device) Schematics**



**Figure 8-5. Enable (ENx) Schematics**



**Figure 8-6. Output (OUTx) Schematics**

## 8.6 Overvoltage Tolerant Input

The input pins of this device, INx and ENx, support input signal voltage in excess of the supply voltage ( $V_{CCI}$ ) on the input side of the device as long as the voltage on the inputs remains below the voltages listed in the [Recommended Operating Conditions](#) , and [Absolute Maximum Ratings](#) .

This allows the device to support input signal voltages on the inputs when the input supply,  $V_{CCI}$ , is unpowered. In this use case, the outputs transition to the default output state when the input side no longer has a valid supply.

These inputs also provide the capability of the inputs to down translate input signal voltages up to the  $V_{IMAX}$  in the [Recommended Operating Conditions](#) . For example, an input signal 5V high-level can be used while  $V_{CCI}$  is operating a 3.3V.

## 9 Application and Implementation

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

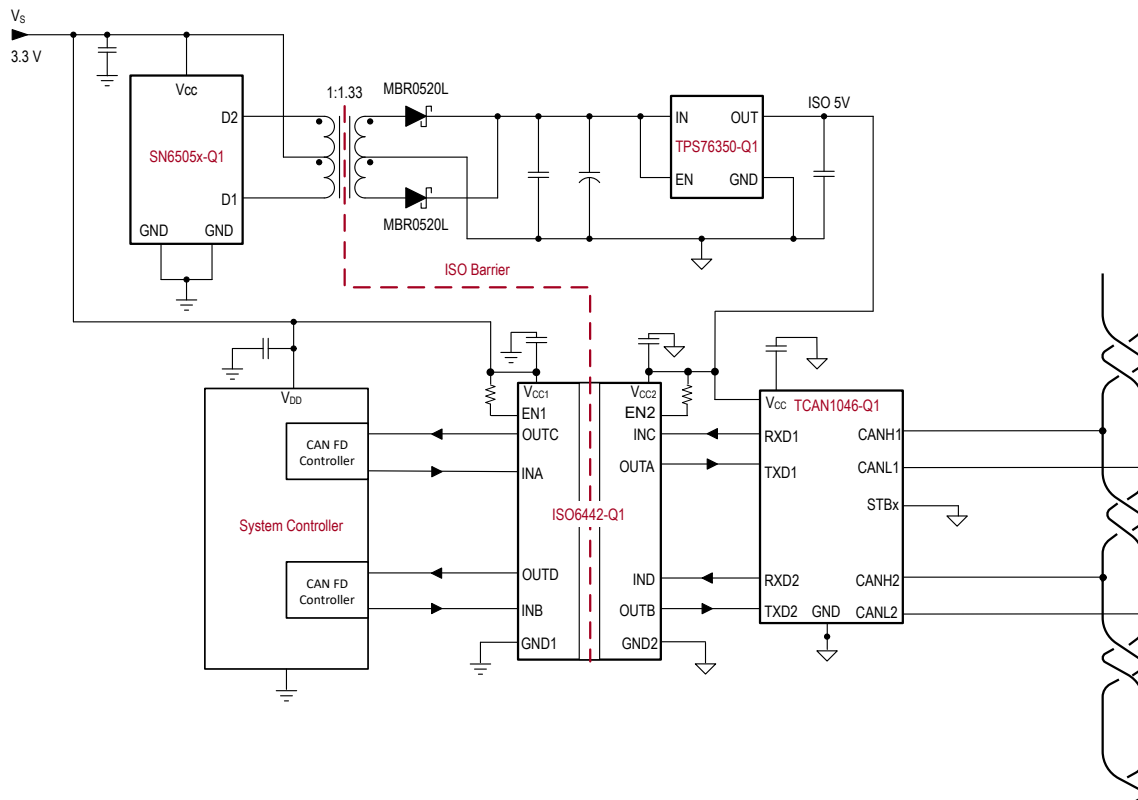
### 9.1 Application Information

The ISO644x-Q1 devices are high-performance, low power, quad-channel digital isolators. These devices come with enable pins on each side which can be used to put the respective outputs in high impedance for parallel (multiple) driver applications. The ISO644x-Q1 devices use single-ended CMOS-logic switching technology.

The supply voltage range is from 2.25V to 5.5V for both supplies,  $V_{CC1}$  and  $V_{CC2}$ . Since an isolation barrier separates the two sides, each side can be sourced independently with any voltage within the [Recommended Operating Conditions](#) section. As an example, supplying ISO644x-Q1  $V_{CC1}$  with 3.3V (which is within 2.25V to 5.5V) and  $V_{CC2}$  with 5V (which is also within 2.25V to 5.5V) is possible. You can use the digital isolator as a logic-level translator in addition to providing isolation. When designing with digital isolators, keep in mind that because of the single-ended design structure, digital isolators do not conform to any specific interface standard and are only intended for isolating single-ended CMOS or TTL digital signal lines. The isolator is typically placed between the data controller (that is, MCU or FPGA), and a data converter or a line transceiver, regardless of the interface type or standard.

### 9.2 Typical Application

Figure 9-1 shows an isolated dual CAN interface implementation.



**Figure 9-1. Typical Isolated Dual CAN Application Circuit**

### 9.2.1 Design Requirements

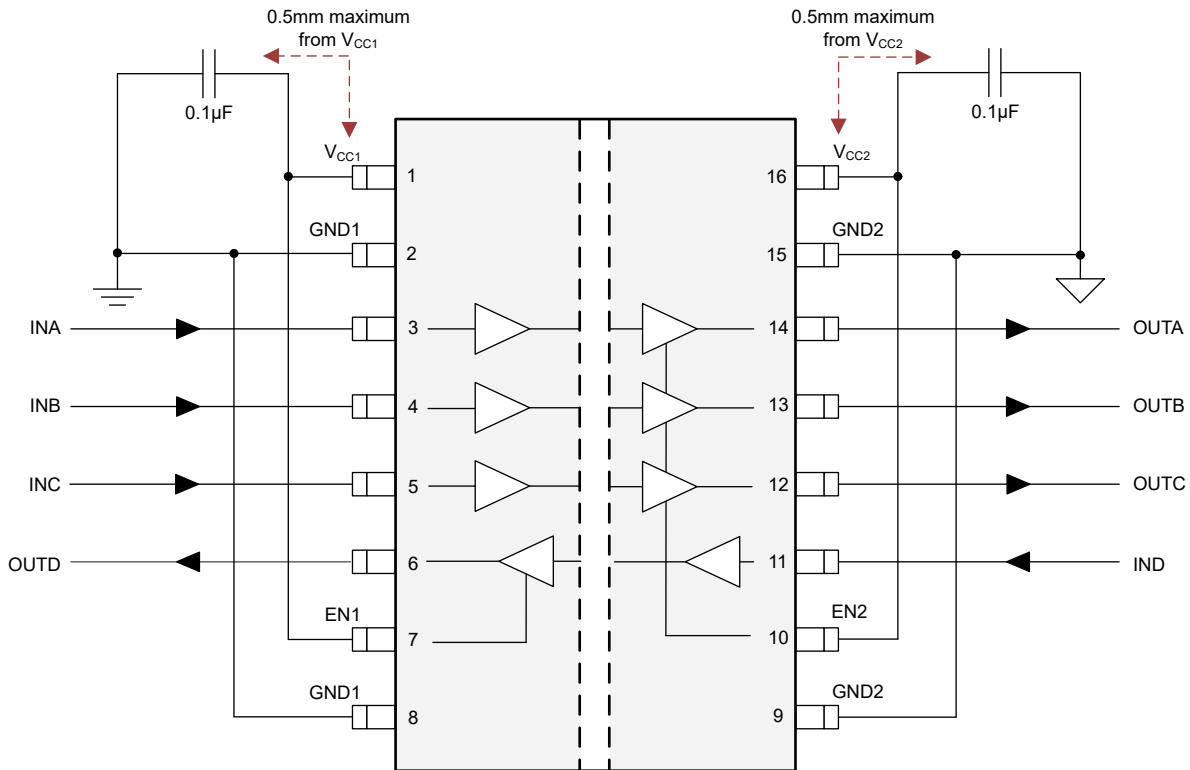
To design with these devices, use the parameters listed in [Table 9-1](#).

**Table 9-1. Design Parameters**

PARAMETER	VALUE
Supply voltage, $V_{CC1}$ and $V_{CC2}$	2.25V to 5.5V
Decoupling capacitor between $V_{CC1}$ and GND1	0.1 $\mu$ F
Decoupling capacitor from $V_{CC2}$ and GND2	0.1 $\mu$ F

### 9.2.2 Detailed Design Procedure

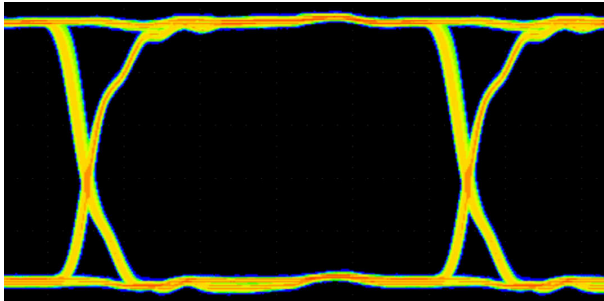
Unlike optocouplers, which require external components to improve performance, provide bias, or limit current, the ISO644x-Q1 family of devices only require two external bypass capacitors to operate.



**Figure 9-2. Typical ISO644x-Q1 Circuit**

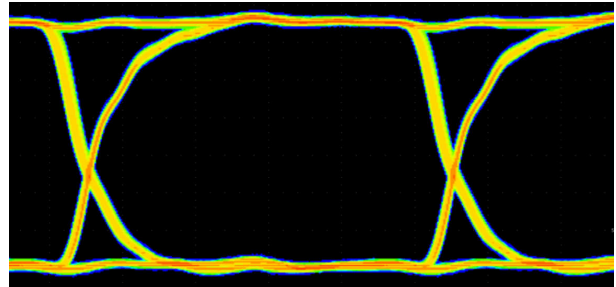
### 9.2.3 Application Curve

The following typical eye diagrams of the ISO644x-Q1 family of devices indicates low jitter and wide open eye at 100Mbps.



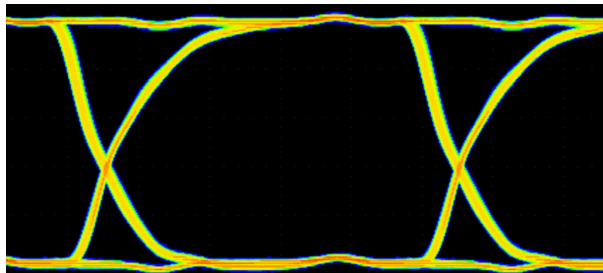
Horizontal 2ns / division, Vertical 1V / division.

**Figure 9-3. ISO644x-Q1 Eye Diagram at 100Mbps  
PRBS 2<sup>16</sup> – 1, 5V and 25°C**



Horizontal 2ns / division, Vertical 500mV / division.

**Figure 9-4. ISO644x-Q1 Eye Diagram at 100Mbps  
PRBS 2<sup>16</sup> – 1, 3.3V and 25°C**



Horizontal 2ns / division, Vertical 500mV / division.

**Figure 9-5. ISO644x-Q1 Eye Diagram at 100Mbps PRBS 2<sup>16</sup> – 1, 2.5V and 25°C**

## 9.3 Power Supply Recommendations

To provide reliable operation at data rates and supply voltages, a 0.1 $\mu$ F bypass capacitor is recommended at the input and output supply pins ( $V_{CC1}$  and  $V_{CC2}$ ). The capacitors must be placed as close to the supply pins as possible. If only a single primary-side power supply is available in an application, isolated power can be generated for the secondary-side with the help of a transformer driver. For automotive applications, please use [SN6501-Q1](#) or [SN6505B-Q1](#). For such applications, detailed power supply design and transformer selection recommendations are available in [SN6501-Q1 Transformer Driver for Isolated Power Supplies](#) or [SN6505B-Q1 Automotive, low-noise, 1A, 420kHz transformer driver with soft start for isolated power supplies](#).

## 9.4 Layout

### 9.4.1 Layout Guidelines

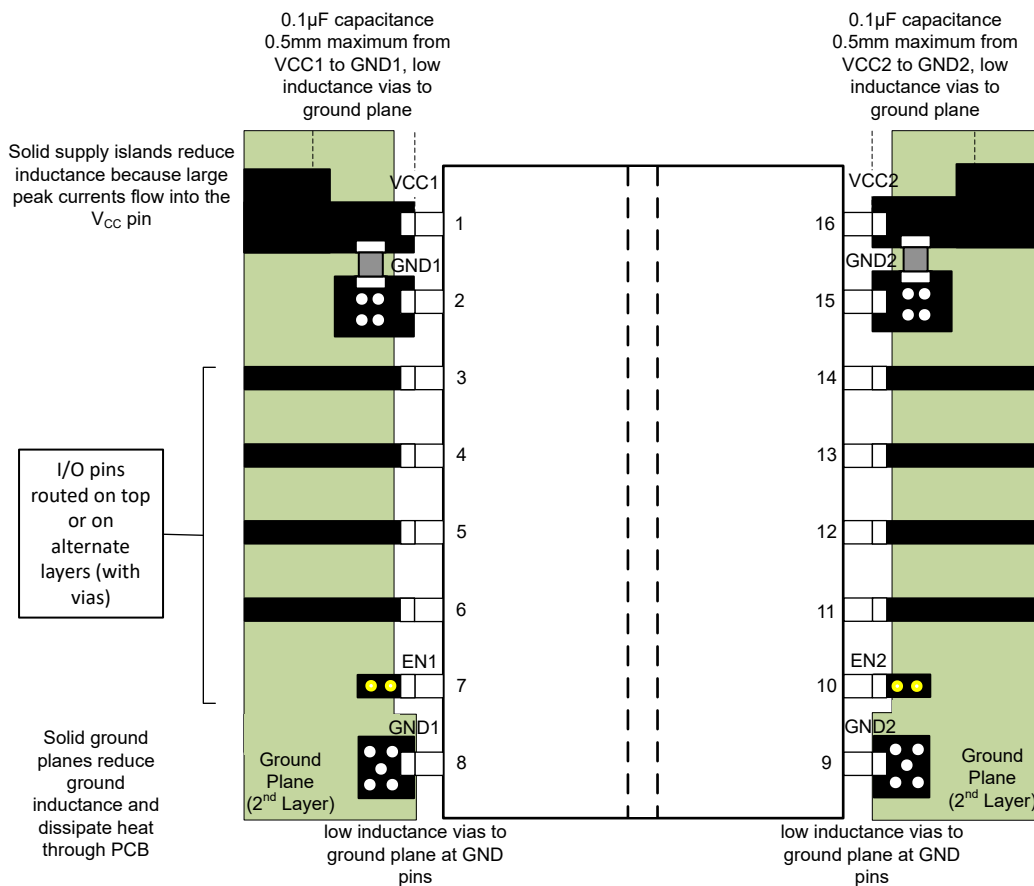
A minimum of two layers is required to accomplish a cost optimized and low EMI PCB design. To further improve EMI, a four layer board can be used (see [Layout Example Schematic](#)). Layer stacking for a four layer board must be in the following order (top-to-bottom): high-speed signal layer, ground plane, power plane and low-frequency signal layer.

- Routing the high-speed traces on the top layer avoids the use of vias (and the introduction of the inductances) and allows for clean interconnects between the isolator and the transmitter and receiver circuits of the data link.
- Placing a solid ground plane next to the high-speed signal layer establishes controlled impedance for transmission line interconnects and provides an excellent low-inductance path for the return current flow.
- Placing the power plane next to the ground plane creates additional high-frequency bypass capacitance of approximately 100pF/inch<sup>2</sup>.
- Routing the slower speed control signals on the bottom layer allows for greater flexibility as these signal links typically have margin to tolerate discontinuities such as vias.

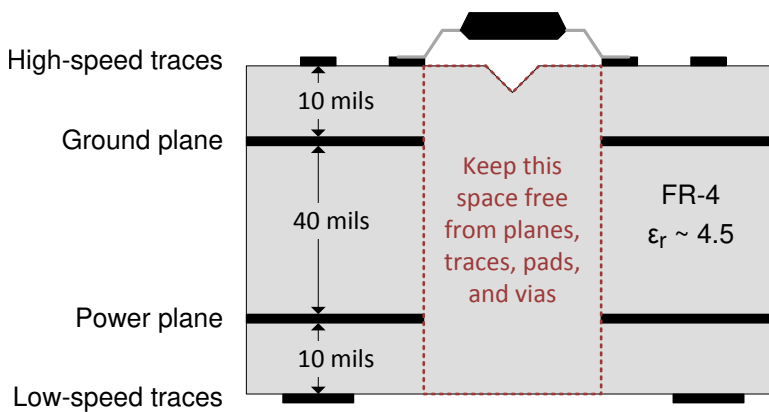
If an additional supply voltage plane or signal layer is needed, add a second power or ground plane system to the stack to keep the planes symmetrical. This design makes the stack mechanically stable and prevents warping. Also the power and ground plane of each power system can be placed closer together, thus increasing the high-frequency bypass capacitance significantly.

For detailed layout recommendations, refer to the [Digital Isolator Design Guide](#) application note.

### 9.4.2 Layout Example



**Figure 9-6. Layout Example**



**Figure 9-7. Layout Example PCB Cross Section**

## 10 Device and Documentation Support

### 10.1 Documentation Support

#### 10.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [ISO6440-Q1 Technical Documents](#)
- Texas Instruments, [ISO6441-Q1 Technical Documents](#)
- Texas Instruments, [ISO6442-Q1 Technical Documents](#)
- Texas Instruments, [SN6505x-Q1 Low-Noise 1A Transformer Drivers for Isolated Power Supplies](#), data sheet

### 10.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 10.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 10.4 Trademarks

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### 10.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 10.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 11 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
April 2026	*	Initial Release

## 12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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