TEXAS INSTRUMENTS

ISO7220A, ISO7220B, ISO7220C, ISO7220M
ISO7221A, ISO7221B, ISO7221C, ISO7221M

SLLS755N – JULY 2006 – REVISED SEPTEMBER 2015

ISO722x Dual Channel Digital Isolators

1 Features

- 1, 5, 25, and 150-Mbps Signaling Rate Options
  - Low Channel-to-Channel Output Skew; 1-ns Max
  - Low Pulse-Width Distortion (PWD); 1-ns Max
  - Low Jitter Content; 1 ns Typ at 150 Mbps
- 50 kV/μs Typical Transient Immunity
- Operates with 2.8-V (C-Grade), 3.3-V, or 5-V Supplies
- 4-kV ESD Protection
- High Electromagnetic Immunity
- –40°C to 125°C Operating Range
- Typical 28-Year Life at Rated Voltage (see application report *High-Voltage Lifetime of the ISO72x Family of Digital Isolators* (SLLA197) and Figure 22)
- VDE Basic Insulation with 4000-V_{PK} V_{IOTM}, 560 V_{PK} V_{IORM} per DIN V VDE V 0884-10 (VDE V 0884-10):2006-12 and DIN EN 61010-1 (VDE 0411-1)
- 2500 V_{RMS} Isolation per UL 1577
- CSA Approved for Component Acceptance Notice 5A and IEC 60950-1

2 Applications

- Industrial Fieldbus
  - Modbus
  - Profibus™
  - DeviceNet™ Data Buses
- Computer Peripheral Interface
- Servo Control Interface
- Data Acquisition

3 Description

The ISO7220x and ISO7221x devices are dual-channel digital isolators. To facilitate PCB layout, the channels are oriented in the same direction in the ISO7220x and in opposite directions in the ISO7221x. These devices have a logic input and output buffer separated by TI's silicon-dioxide (SiO_2) isolation barrier, providing galvanic isolation of up to 4000 V_{PK} per VDE. Used in conjunction with isolated power supplies, these devices block high voltage and isolate grounds, as well as prevent noise currents on a data bus or other circuits from entering the local ground and interfering with or damaging sensitive circuitry.

A binary input signal is conditioned, translated to a balanced signal, then differentiated by the capacitive isolation barrier. Across the isolation barrier, a differential comparator receives the logic transition information, then sets or resets a flip-flop and the output circuit accordingly. A periodic update pulse is sent across the barrier to ensure the proper dc level of the output. If this dc-refresh pulse is not received every 4 μs, the input is assumed to be unpowered or not being actively driven, and the failsafe circuit drives the output to a logic high state.

The small capacitance and resulting time constant provide fast operation with signaling rates available from 0 Mbps (DC) to 150 Mbps (The signaling rate of a line is the number of voltage transitions that are made per second expressed in the units bps). The A-option, B-option, and C-option devices have TTL input thresholds and a noise filter at the input that prevents transient pulses from being passed to the output of the device. The M-option devices have CMOS V_{CC}/2 input thresholds and do not have the input noise filter and the additional propagation delay.

The ISO7220x and ISO7221x devices require two supply voltages of 2.8 V (C-Grade), 3.3 V, 5 V, or any combination. All inputs are 5-V tolerant when supplied from a 2.8-V or 3.3-V supply and all outputs are 4-mA CMOS.

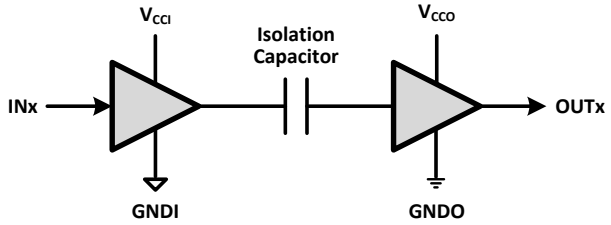
The ISO7220x and ISO7221x devices are characterized for operation over the ambient temperature range of –40°C to 125°C.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
ISO7220x	SOIC (8)	4.90 mm × 3.91 mm
ISO7221x		

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Simplified Schematic



V_{CCI} and GNDI are supply and ground connections respectively for the input channels.

V_{CCO} and GNDO are supply and ground connections respectively for the output channels.

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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4 Revision History

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

Changes from Revision M (October 2014) to Revision N — **Page**

- Changed the VDE Cerification from: DIN EN 60747-5-5 (VDE 0884-5) to: DIN V VDE V 0884-10 (VDE V 0884-10):2006-12 throughout the document ... 1
- Updated the *Simplified Schematic* to a higher quality version. ... 1
- Changed the max value of the IN and OUT voltage from 6 to V_{CC} + 0.5 in the *Absolute Maximum Ratings* table. ... 5
- Added = 150°C to insulation resistance test condition in the *DIN V VDE V 0884-10 (VDE V 0884-10):2006-12 Insulation Characteristics* table. ... 19
- Changed L(I01) MIN value from 4.8 to 4 in the *IEC Package Characteristics* table. ... 19
- Changed L(I01) MIN value from 4.8 to 4 in the *IEC Package Characteristics* table. ... 19
- Added the JEDEC package dimensions note in the *IEC Package Characteristics* table ... 19
- Changed the DTI test condition From: IEC 60112 / VDE 0303 Part 1 To: DIN EN 60112 (VDE 0303-11); IEC 60112 ... 20
- Added the DTI parameter to the *IEC Package Characteristics* table. ... 20
- Added table row with input side V_{CC} = X to the *ISO7220x or ISO7221x Function* table. ... 21

Changes from Revision L (January 2012) to Revision M — **Page**

- Changed the title of this data sheet to *ISO722x Dual Channel Digital Isolators* ... 1
- Added *Pin Configuration and Functions* section, *Handling Rating* table, *Dissipation Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section, changed *Thermal Information* table ... 1
- Updated the Features section ... 1
- Added per VDE to 4000 V_{PK} in second sentence of Description ... 1
- Updated the *Regulatory Information* Table ... 5

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- Added the min and max values to the Storage temperature parameter in the *Absolute Maximum Ratings* table. 5
- Changed in ROC table Max col, V_{IH} row from VCC to 5.5 6
- Changed the Device Options table, Input Threshold column from ≠ symbol to ~ symbol 6 places 19
- Changed the 7.4 title from IEC 60747 ~2 Insulation Characteristics to DIN EN ~ 5 Insulation Characteristics 19
- Changed *Isolation Glossary* 25

Changes from Revision K (January 2010) to Revision L **Page**

- Changed Feature From: Operates with 3.3-V or 5-V Supplies To: Operates with 2.8-V (C-Grade), 3.3-V or 5-V Supplies . 1
- Changed Feature From: 4000-V_{peak} Isolation, 560 V_{peak} V_{IORM} To: 4000-V_{PK} V_{IOTM}, 560 V_{PK} V_{IORM} per IEC 60747-5-2 (VDE 0884, Rev2) 1
- Added device options to V_{CC} in the RECOMMENDED OPERATING CONDITIONS table 6
- Changed Note: (1) in the RECOMMENDED OPERATING CONDITIONS table 6
- Changed I_{CC1} and I_{CC2} test conditions in the 5-V table 7
- Changed I_{CC1} and I_{CC2} test conditions in the V_{CC1} at 5 V, V_{CC2} at 3.3 V table 8
- Changed I_{CC1} and I_{CC2} test conditions in the V_{CC1} at 3.3 V, V_{CC2} at 5 V table 9
- Changed I_{CC1} and I_{CC2} test conditions in the V_{CC1} and V_{CC2} at 3.3 V table 10
- Changed Table Note (1) 10
- Added ELECTRICAL and Switching CHARACTERISTICS table for V_{CC1} and V_{CC2} at 2.8 V (ISO722xC-Only) 10
- Changed Figure 9 15
- Changed Figure 14 17
- Changed the CTI MIN value From: ≥175 V To: ≥400 V 20
- Updated the *Regulatory Information* table 20

Changes from Revision J (May 2009) to Revision K **Page**

- Changed the RECOMMENDED OPERATING CONDITIONS so that Note (2) is associated with all device options in the Input pulse width and Signaling rate 6
- Changed Note (2) From: Typical signaling rate under ideal conditions at 25°C. To: Typical signaling rate and Input pulse width are measured at ideal conditions at 25°C. 6
- Changed column 2 of the AVAILABLE OPTIONS table From: Signaling Rate To: Max Signaling Rate 19

Changes from Revision I (December 2008) to Revision J **Page**

- Changed ISO7221C Marked As column From: TI7221C To: I7221C in the AVAILABLE OPTIONS table 19

Changes from Revision H (May 2008) to Revision I **Page**

- Added "IEC 61010-1, IEC 60950-1 and CSA Approved" to the UL 1577 FEATURES bullet 1

Changes from Revision G (March 2008) to Revision H **Page**

- Added Note: (1) to the RECOMMENDED OPERATING CONDITIONS table 6
- Added Note (1): to the ELECTRICAL CHARACTERISTICS: V_{CC1} and V_{CC2} at 3.3 V 10

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Changes from Revision F (August 2007) to Revision G **Page**

- Added Part Numbers ISO7220B and ISO7221B to the data sheet ... 1
- Added 5-Mbps Signaling rate to the FEATURES list ... 1
- Added Part Numbers ISO7220B and ISO7221B to the ELECTRICAL CHARACTERISTICS: V_{CC1} and V_{CC2} at 5-V table ... 7
- Added Part Numbers ISO7220B and ISO7221B to the ELECTRICAL CHARACTERISTICS: V_{CC1} at 5 V, V_{CC2} at 3.3 V table ... 8
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- Added Part Numbers ISO7220B and ISO7221B to the ELECTRICAL CHARACTERISTICS: V_{CC1} and V_{CC2} at 3.3 V ... 10
- Added PROPAGATION DELAY vs FREE-AIR TEMPERATURE, ISO722xB, Figure 4 ... 15
- Added Part Numbers ISO7220B and ISO7221B to the AVAILABLE OPTIONS table ... 19

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- Added $t_{sk(pp)}$ footnote to the SWITCHING CHARACTERISTICS: V_{CC1} and V_{CC2} at 5-V OPERATION table ... 11
- Added $t_{sk(o)}$ footnote to the SWITCHING CHARACTERISTICS: V_{CC1} and V_{CC2} at 5-V OPERATION table ... 11
- Added $t_{sk(pp)}$ footnote to the SWITCHING CHARACTERISTICS: V_{CC1} at 5 V, V_{CC2} at 3.3 V OPERATION table ... 12
- Added $t_{sk(o)}$ footnote to the SWITCHING CHARACTERISTICS: V_{CC1} at 5 V, V_{CC2} at 3.3 V OPERATION table ... 12
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- Added $t_{sk(pp)}$ footnote to the SWITCHING CHARACTERISTICS table ... 13
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- Changed Figure 1 - Re-scaled the Y-axis ... 15
- Changed Figure 2 - New Curves ... 15

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- Changed Figure 1 - New Curves ... 15
- Changed Figure 2- Re-scaled the Y-axis ... 15

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- Changed Figure 20 - Pin 2 (INA) label From: OUTPUT to INPUT ... 23

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- Added the Signaling rate values to the RECOMMENDED OPERATING CONDITIONS table ... 6
- Added Figure 12 cross reference to the Peak-to-peak eye-pattern jitter of the SWITCHING CHARACTERISTICS table ... 11
- Added Figure 12 cross reference to the Peak-to-peak eye-pattern jitter of the SWITCHING CHARACTERISTICS table ... 12
- Added Figure 12 cross reference to the Peak-to-peak eye-pattern jitter of the SWITCHING CHARACTERISTICS table ... 13
- Added Figure 12 cross reference to the Peak-to-peak eye-pattern jitter of the SWITCHING CHARACTERISTICS table ... 13
- Changed the IEC 60664-1 RATINGS TABLE - Specification I-III test conditions From: Rated mains voltage ≤150 VRMS To: Rated mains voltage ≤300 VRMS. Added a row for the I-II specifications ... 20
- Added Figure 22 - Time Dependent Dielectric Breakdown Test Results ... 23

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- Added the TYPICAL CHARACTERISTIC CURVES to the data sheet. 15
- Added the PARAMETER MEASUREMENT INFORMATION to the data sheet 17
- Added the ELECTRICAL CHARACTERISTICS tables to the data sheet 20
- Added the APPLICATION INFORMATION section to the data sheet..... 22
- Added the ISOLATION GLOSSARY section to the data sheet 25

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- Deleted "and CSA Apporved" from the UL 1577 FEATURES bullet..... 1
- Added option A to the AVAILABLE OPTIONS table 19

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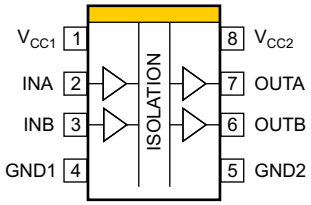
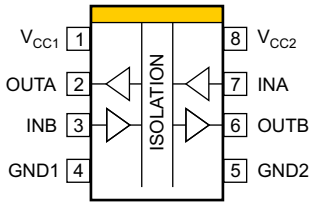
5 Pin Configuration and Functions

ISO7220x D Package
8-Pin SOIC
Top View



ISO7221x D Package
8-Pin SOIC
Top View



Pin Functions

PIN			I/O	DESCRIPTION
NAME	ISO7220x	ISO7221x		
INA	2	7	I	Input, channel A
INB	3	3	I	Input, channel B
GND1	4	4	—	Ground connection for V_{CC1}
GND2	5	5	—	Ground connection for V_{CC2}
OUTA	7	2	O	Output, channel A
OUTB	6	6	O	Output, channel B
V_{CC1}	1	1	—	Power supply, V_{CC1}
V_{CC2}	8	8	—	Power supply, V_{CC2}

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
V_{CC}	Supply voltage(2), V_{CC1}, V_{CC2}	–0.5	6	V
V_I	Voltage at IN, OUT	–0.5	V_{CC} + 0.5(3)	V
I_O	Output current	–15	15	mA
T_J	Maximum junction temperature		170	°C
T_{stg}	Storage temperature	–65	150	°C

(1) Stresses beyond those listed under A*bsolute Maximum Ratings* can cause permanent damage to the device. These ratings are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods can affect device reliability.
(2) All voltage values except differential I/O bus voltages are with respect to network ground pin and are peak voltage values.
(3) Maximum voltage must not exceed 6 V.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	±4000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	±1000	V
		Machine Model, ANSI/ESDS5.2-1996	±200	V

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

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6.3 Recommended Operating Conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage(1), V_{CC1}, V_{CC2}	ISO722xA, ISO722xB, ISO722xM	3		5.5	V
		ISO722xC	2.8		5.5	
I_{OH}	High-level output current		–4			mA
I_{OL}	Low-level output current				4	mA
t_{ui}	Input pulse width(2)	ISO722xA	1	0.67		µs
		ISO722xB	200	100		ns
		ISO722xC	40	33		
		ISO722xM	6.67	5		
$1/t_{ui}$	Signaling rate(2)	ISO722xA	0	1500	1000	kbps
		ISO722xB	0	10	5	Mbps
		ISO722xC	0	30	25	
		ISO722xM	0	200	150	
V_{IH}	High-level input voltage	ISO722xA, ISO722xB, ISO722xC	2		5.5	V
V_{IL}	Low-level input voltage		0		0.8	V
V_{IH}	High-level input voltage	ISO722xM	0.7 V_{CC}		V_{CC}	V
V_{IL}	Low-level input voltage		0		0.3 V_{CC}	V
T_J	Junction temperature		–40		150	°C
H	External magnetic field-strength immunity per IEC 61000-4-8 and IEC 61000-4-9 certification				1000	A/m

(1) For the 5-V operation, V_{CC1} or V_{CC2} is specified from 4.5 V to 5.5 V.
For the 3.3-V operation, V_{CC1} or V_{CC2} is specified from 3 V to 3.6 V.
For the 2.8-V operation, V_{CC1} or V_{CC2} is specified at 2.8 V.
(2) Typical signaling rate and Input pulse width are measured at ideal conditions at 25°C.

6.4 Thermal Information

THERMAL METRIC(1)			ISO7220x ISO7221x	UNIT
			D (SOIC)	
			8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	Low-K Thermal Resistance(2)	212	°C/W
		High-K Thermal Resistance	122	
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance		69.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance		47.7	°C/W
ψ_{JT}	Junction-to-top characterization parameter		15.2	°C/W
ψ_{JB}	Junction-to-board characterization parameter		47.2	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance		—	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report (SPRA953).
(2) Tested in accordance with the Low-K or High-K thermal metric definitions of EIA/JESD51-3 for leaded surface mount packages.

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6.5 Electrical Characteristics, 5 V

V_{CC1} and V_{CC2} at 5 V ± 10% (over recommended operating conditions unless otherwise noted.)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SUPPLY CURRENT							
I_{CC1}	ISO7220x	Quiescent	$V_I = V_{CC}$ or 0 V, no load		1	2	mA
	ISO7221				8.5	17	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		2	3	mA
	ISO7221A, ISO7221B				10	18	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		4	9	mA
	ISO7221C, ISO7221M				12	22	
I_{CC2}	ISO7220x	Quiescent	$V_I = V_{CC}$ or 0 V, no load		16	31	mA
	ISO7221x				8.5	17	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		17	32	mA
	ISO7221A, ISO7221B				10	18	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		20	34	mA
	ISO7221C, ISO7221M				12	22	
V_{OH}	High-level output voltage		I_{OH} = –4 mA, See Figure 13	V_{CC} – 0.8	4.6		V
			I_{OH} = –20 µA, See Figure 13	V_{CC} – 0.1	5		
V_{OL}	Low-level output voltage		I_{OL} = 4 mA, See Figure 13		0.2	0.4	V
			I_{OL} = 20 µA, See Figure 13		0	0.1	
$V_{I(HYS)}$	Input voltage hysteresis				150		mV
I_{IH}	High-level input current		IN from 0 V to V_{CC}			10	µA
I_{IL}	Low-level input current		IN from 0 V to V_{CC}	–10			µA
C_I	Input capacitance to ground		IN at V_{CC}, V_I = 0.4 sin (4E6πt)		1		pF
CMTI	Common-mode transient immunity		$V_I = V_{CC}$ or 0 V, See Figure 15	25	50		kV/µs

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6.6 Electrical Characteristics, 5 V, 3.3 V

V_{CC1} at 5 V ± 10%, V_{CC2} at 3.3 V ± 10% (over recommended operating conditions unless otherwise noted.)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SUPPLY CURRENT							
I_{CC1}	ISO7220x	Quiescent	$V_I = V_{CC}$ or 0 V, no load		1	2	mA
	ISO7221x				8.5	17	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		2	3	mA
	ISO7221A, ISO7221B				10	18	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		4	9	mA
	ISO7221C, ISO7221M				12	22	
I_{CC2}	ISO7220x	Quiescent	$V_I = V_{CC}$ or 0 V, no load		8	18	mA
	ISO7221x				4.3	9.5	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		9	19	mA
	ISO7221A, ISO7221B				5	11	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		10	20	mA
	ISO7221C, ISO7221M				6	12	
V_{OH}	High-level output voltage	ISO7220x, ISO7221x (3.3-V side)	I_{OH} = –4 mA, See Figure 13	V_{CC} – 0.4			V
		ISO7221x (5-V side)		V_{CC} – 0.8			
		All devices	I_{OH} = –20 µA, See Figure 13	V_{CC} – 0.1			
V_{OL}	Low-level output voltage		I_{OL} = 4 mA, See Figure 13			0.4	V
			I_{OL} = 20 µA, See Figure 13			0.1	
$V_{I(HYS)}$	Input voltage hysteresis				150		mV
I_{IH}	High-level input current		IN from 0 V to V_{CC}			10	µA
I_{IL}	Low-level input current		IN from 0 V to V_{CC}	–10			µA
C_I	Input capacitance to ground		IN at V_{CC}, V_I = 0.4 sin (4E6πt)		1		pF
CMTI	Common-mode transient immunity		$V_I = V_{CC}$ or 0 V, See Figure 15	15	40		kV/µs

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6.7 Electrical Characteristics: 3.3 V, 5 V

V_{CC1} at 3.3 V ± 10%, V_{CC2} at 5 V ± 10% (over recommended operating conditions unless otherwise noted.)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SUPPLY CURRENT							
I_{CC1}	ISO7220x	Quiescent	$V_I = V_{CC}$ or 0 V, no load		0.6	1	mA
	ISO7221x				4.3	9.5	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		1	2	mA
	ISO7221A, ISO7221B				5	11	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		2	4	mA
	ISO7221C, ISO7221M				6	12	
I_{CC2}	ISO7220x	Quiescent	$V_I = V_{CC}$ or 0 V, no load		16	31	mA
	ISO7221x				8.5	17	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		18	32	mA
	ISO7221A, ISO7221B				10	18	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		20	34	mA
	ISO7221C, ISO7221M				12	22	
V_{OH}	High-level output voltage	ISO7220x, ISO7221x (5-V side)	I_{OH} = –4 mA, See Figure 13	V_{CC} – 0.8			V
		ISO7221x (3.3-V side)		V_{CC} – 0.4			
		All devices	I_{OH} = –20 µA, See Figure 13	V_{CC} – 0.1			
V_{OL}	Low-level output voltage		I_{OL} = 4 mA, See Figure 13			0.4	
			I_{OL} = 20 µA, See Figure 13		0	0.1	
$V_{I(HYS)}$	Input threshold voltage hysteresis				150		mV
I_{IH}	High-level input current		IN from 0 V or V_{CC}			10	µA
I_{IL}	Low-level input current		IN from 0 V or V_{CC}	–10			µA
C_I	Input capacitance to ground		IN at V_{CC}, V_I = 0.4 sin (4E6πt)		1		pF
CMTI	Common-mode transient immunity		$V_I = V_{CC}$ or 0 V, See Figure 15	15	40		kV/µs

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6.8 Electrical Characteristics, 3.3 V

V_{CC1} and V_{CC2} at 3.3 V ± 10% (over recommended operating conditions unless otherwise noted.)(1)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SUPPLY CURRENT							
I_{CC1}	ISO7220x	Quiescent	V_I = V_{CC} or 0 V, no load		0.6	1	mA
	ISO7221x				4.3	9.5	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		1	2	mA
	ISO7221A, ISO7221B				5	11	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		2	4	mA
	ISO7221C, ISO7221M				6	12	
I_{CC2}	ISO7220x	Quiescent	V_I = V_{CC} or 0 V, no load		8	18	mA
	ISO7221x				4.3	9.5	
	ISO7220A, ISO7220B	1 Mbps	0.5 MHz Input Clock Signal, no load		9	19	mA
	ISO7221A, ISO7221B				5	11	
	ISO7220C, ISO7220M	25 Mbps	12.5 MHz Input Clock Signal, no load		10	20	mA
	ISO7221C, ISO7221M				6	12	
V_{OH}	High-level output voltage		I_{OH} = –4 mA, See Figure 13	V_{CC} – 0.4	3		V
			I_{OH} = –20 µA, See Figure 13	V_{CC} – 0.1	3.3		
V_{OL}	Low-level output voltage		I_{OL} = 4 mA, See Figure 13		0.2	0.4	
			I_{OL} = 20 µA, See Figure 13		0	0.1	
$V_{I(HYS)}$	Input voltage hysteresis				150		mV
I_{IH}	High-level input current		IN from 0 V or V_{CC}			10	µA
I_{IL}	Low-level input current		IN from 0 V or V_{CC}	–10			µA
C_I	Input capacitance to ground		IN at V_{CC}, V_I = 0.4 sin (4E6πt)		1		pF
CMTI	Common-mode transient immunity		V_I = V_{CC} or 0 V, See Figure 15	15	40		kV/µs

(1) For the 3.3-V operation, V_{CC1} or V_{CC2} is specified from 3 V to 3.6 V.

6.9 Electrical Characteristics, 2.8 V

V_{CC1} and V_{CC2} at 2.8 V (over recommended operating conditions unless otherwise noted.) 2.8-V operation is only guaranteed for ISO722xC with production screening starting in January 2012. The first two digits of the Lot Trace Code (YMSLLLLG4) written on top of each device can be used to identify year and month of production respectively.

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SUPPLY CURRENT							
I_{CC1}	ISO7220C	Quiescent	V_I = V_{CC} or 0 V, no load		0.4	0.9	mA
	ISO7221C				3.7	7.5	
	ISO7220C	25 Mbps	12.5 MHz Input Clock Signal, no load		1.5	3.5	mA
	ISO7221C				4.5	10	
I_{CC2}	ISO7220C	Quiescent	V_I = V_{CC} or 0 V, no load		6.8	15	mA
	ISO7221C				3.7	7.5	
	ISO7220C	25 Mbps	12.5 MHz Input Clock Signal, no load		9	17	mA
	ISO7221C				4.5	10	
V_{OH}	High-level output voltage		I_{OH} = –4 mA, See Figure 13	V_{CC} – 0.6	2.55		V
			I_{OH} = –20 µA, See Figure 13	V_{CC} – 0.1	2.8		
V_{OL}	Low-level output voltage		I_{OL} = 4 mA, See Figure 13		0.25	0.6	
			I_{OL} = 20 µA, See Figure 13		0	0.1	
$V_{I(HYS)}$	Input voltage hysteresis				150		mV
I_{IH}	High-level input current		IN from 0 V or V_{CC}			10	µA
I_{IL}	Low-level input current		IN from 0 V or V_{CC}	–10			µA
C_I	Input capacitance to ground		IN at V_{CC}, V_I = 0.4 sin (4E6πt)		1		pF
CMTI	Common-mode transient immunity		V_I = V_{CC} or 0 V, See Figure 15	10	30		kV/µs

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6.10 Dissipation Characteristics

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
P_D	Device Power Dissipation	ISO722xM	V_{CC1} = V_{CC2} = 5.5 V, T_J = 150°C, C_L = 15 pF, Input a 150 Mbps 50% duty cycle square wave			390	mW

6.11 Switching Characteristics, 5 V

V_{CC1} and V_{CC2} at 5 V (over recommended operating conditions unless otherwise noted.)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay	ISO722xA	See Figure 13	280	405	475	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xA	See Figure 13		1	14	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xB	See Figure 13	42	55	70	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xB	See Figure 13		1	3	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xC	See Figure 13	22	32	42	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xC	See Figure 13		1	2	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xM	See Figure 13	6	10	16	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xM	See Figure 13		0.5	1	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xA				180	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xB				17	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xC				10	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xM				3	ns
$t_{sk(o)}$	Channel-to-channel output skew (3)	ISO722xA			3	15	ns
$t_{sk(o)}$	Channel-to-channel output skew (3)	ISO722xB			0.6	3	ns
$t_{sk(o)}$	Channel-to-channel output skew (3)	ISO722xC, ISO722xM			0.2	1	ns
t_r	Output signal rise time		See Figure 13		1		ns
t_f	Output signal fall time		See Figure 13		1		ns
t_{fs}	Failsafe output delay time from input power loss		See Figure 14		3		µs
$t_{jit(pp)}$	Peak-to-peak eye-pattern jitter	ISO722xM	150 Mbps PRBS NRZ data, 5-bit max same polarity input, both channels, See Figure 16, Figure 12		1		ns
$t_{jit(pp)}$	Peak-to-peak eye-pattern jitter	ISO722xM	150 Mbps unrestricted bit run length data input, both channels, See Figure 16		2		ns

(1) Also referred to as pulse skew.
(2) $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified pins of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.
(3) $t_{sk(o)}$ is the skew between specified outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical specified loads.

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6.12 Switching Characteristics, 5 V, 3.3 V

V_{CC1} at 5 V ± 10%, V_{CC2} at 3.3 V ± 10%(over recommended operating conditions unless otherwise noted.)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay	ISO722xA	See Figure 13	285	410	480	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xA	See Figure 13		1	14	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xB	See Figure 13	45	58	75	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xB	See Figure 13		1	3	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xC	See Figure 13	25	36	48	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xC	See Figure 13		1	2	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xM	See Figure 13	7	12	20	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xM	See Figure 13		0.5	1	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xA				180	ns
		ISO722xB				17	
		ISO722xC				10	
		ISO722xM				5	
$t_{sk(o)}$	Channel-to-channel output skew (3)	ISO722xA			3	15	ns
		ISO722xB			0.6	3	
		ISO722xC, ISO722xM			0.2	1	
t_r	Output signal rise time		See Figure 13		2		ns
t_f	Output signal fall time		See Figure 13		2		ns
t_{fs}	Failsafe output delay time from input power loss		See Figure 14		3		µs
$t_{jit(pp)}$	Peak-to-peak eye-pattern jitter	ISO722xM	150 Mbps PRBS NRZ data, 5-bit max same polarity input, both channels, See Figure 16, Figure 12		1		ns
		ISO722xM	150 Mbps unrestricted bit run length data input, both channels, See Figure 16		2		ns

(1) Also referred to as pulse skew.
(2) $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified pins of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.
(3) $t_{sk(o)}$ is the skew between specified outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical specified loads.

6.13 Switching Characteristics, 3.3 V, 5 V

V_{CC1} at 3.3 V ± 10%, V_{CC2} at 5 V ± 10% (over recommended operating conditions unless otherwise noted.)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay	ISO722xA	See Figure 13	285	395	480	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xA	See Figure 13		1	18	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xB	See Figure 13	45	58	75	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xB	See Figure 13		1	4	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xC	See Figure 13	25	36	48	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xC	See Figure 13		1	3	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xM	See Figure 13	7	12	21	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xM	See Figure 13		0.5	1	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xA				190	ns
		ISO722xB				17	
		ISO722xC				10	
		ISO722xM				5	

(1) Also referred to as pulse skew.
(2) $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified pins of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.

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Switching Characteristics, 3.3 V, 5 V (continued)

V_{CC1} at 3.3 V ± 10%, V_{CC2} at 5 V ± 10% (over recommended operating conditions unless otherwise noted.)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{sk(o)}$	Channel-to-channel output skew (3)	ISO722xA			3	15	ns
		ISO722xB			0.6	3	
		ISO722xC, ISO722xM			0.2	1	
t_r	Output signal rise time		See Figure 13		1		ns
t_f	Output signal fall time				1		ns
t_{fs}	Failsafe output delay time from input power loss		See Figure 14		3		µs
$t_{jit(pp)}$	Peak-to-peak eye-pattern jitter	ISO722xM	150 Mbps PRBS NRZ data, 5-bit max same polarity input, both channels, See Figure 16, Figure 12		1		ns
			150 Mbps unrestricted bit run length data input, both channels, See Figure 16		2		

(3) $t_{sk(o)}$ is the skew between specified outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical specified loads.

6.14 Switching Characteristics, 3.3 V

V_{CC1} and V_{CC2} at 3.3 V ± 10% (over recommended operating conditions unless otherwise noted.)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay	ISO722xA	See Figure 13	290	400	485	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)				1	18	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xB		46	62	78	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)				1	4	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xC		26	40	52	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)				1	3	ns
t_{PLH}, t_{PHL}	Propagation delay	ISO722xM		8	16	25	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)				0.5	1	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xA				190	ns
		ISO722xB				17	
		ISO722xC				10	
		ISO722xM				5	
$t_{sk(o)}$	Channel-to-channel output skew (3)	ISO722xA			3	15	ns
		ISO722xB			0.6	3	
		ISO722xC, ISO722xM			0.2	1	
t_r	Output signal rise time		See Figure 13		2		ns
t_f	Output signal fall time				2		ns
t_{fs}	Failsafe output delay time from input power loss		See Figure 14		3		µs
$t_{jit(pp)}$	Peak-to-peak eye-pattern jitter	ISO722xM	150 Mbps PRBS NRZ data, 5-bit max same polarity input, both channels, See Figure 16, Figure 12		1		ns
			150 Mbps unrestricted bit run length data input, both channels, See Figure 16		2		

(1) Also referred to as pulse skew.
(2) $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified pins of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.
(3) $t_{sk(o)}$ is the skew between specified outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical specified loads.

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6.15 Switching Characteristics, 2.8 V

V_{CC1} and V_{CC2} at 2.8 V (over recommended operating conditions unless otherwise noted.)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay	ISO722xC	See Figure 13	26	45	65	ns
PWD	Pulse-width distortion $\lvert t_{PHL} - t_{PLH} \rvert$ (1)	ISO722xC	See Figure 13		1.5	5	ns
$t_{sk(pp)}$	Part-to-part skew (2)	ISO722xC				12	ns
$t_{sk(o)}$	Channel-to-channel output skew (3)	ISO722xC			0.2	5	ns
t_r	Output signal rise time		See Figure 13		2		ns
t_f	Output signal fall time		See Figure 13		2		ns
t_{fs}	Failsafe output delay time from input power loss		See Figure 14		4.6		µs

(1) Also referred to as pulse skew.
(2) $t_{sk(pp)}$ is the magnitude of the difference in propagation delay times between any specified pins of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.
(3) $t_{sk(o)}$ is the skew between specified outputs of a single device with all driving inputs connected together and the outputs switching in the same direction while driving identical specified loads.

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6.16 Typical Characteristics

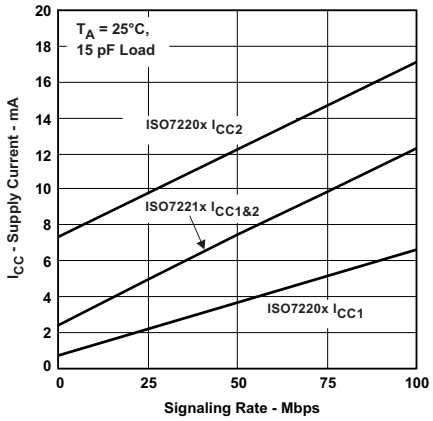

Figure 1. 3.3-V RMS Supply Current vs Signaling Rate (Mbps)

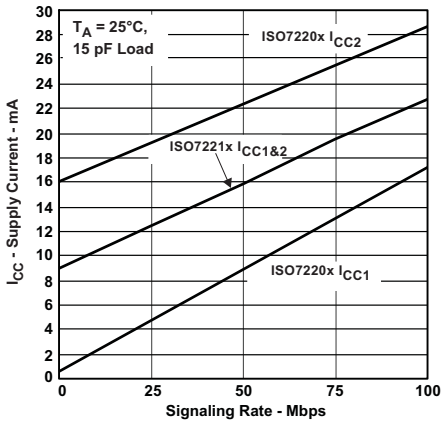

Figure 2. 5-V RMS Supply Current vs Signaling Rate (Mbps)

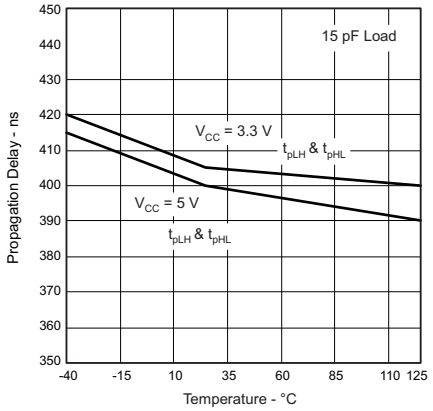

Figure 3. Propagation Delay vs Free-Air Temperature, ISO722xA

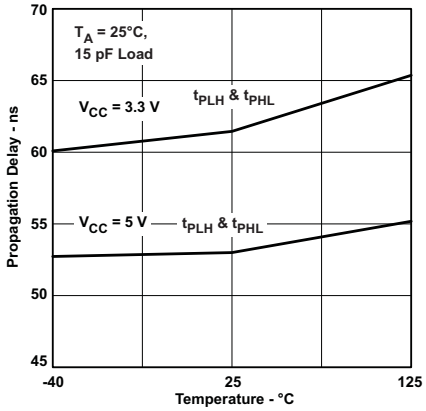

Figure 4. Propagation Delay vs Free-Air Temperature, ISO722xB

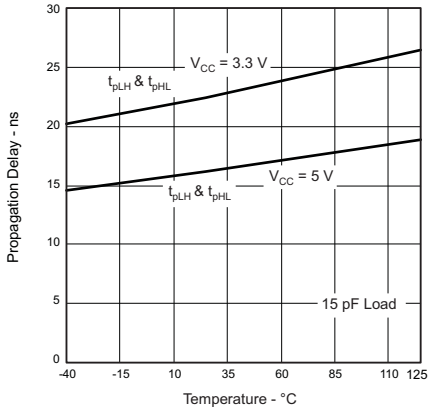

Figure 5. Propagation Delay vs Free-Air Temperature, ISO722xC

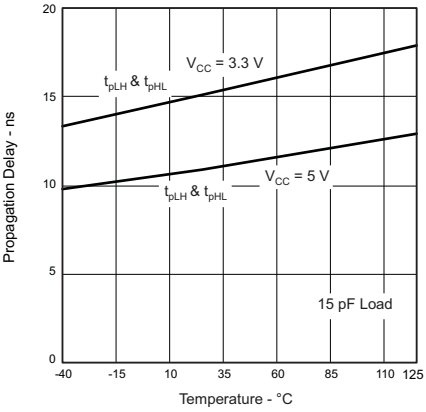

Figure 6. Propagation Delay vs Free-Air Temperature, ISO722xM

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Typical Characteristics (continued)

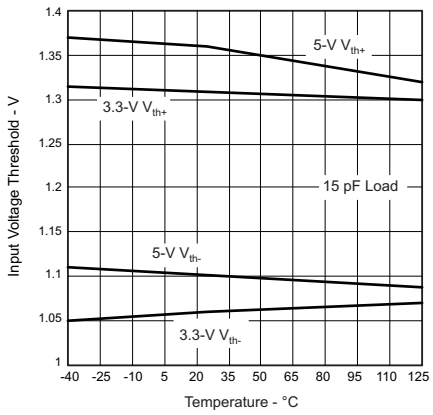

Figure 7. ISO722xA, ISO722xB and ISO722xC Input Voltage Low-to-High Switching Threshold vs Free-Air Temperature

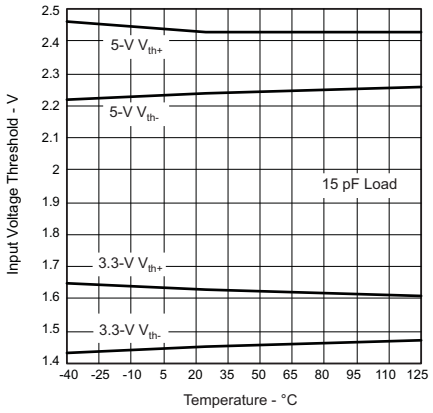

Figure 8. ISO722xM Input Voltage High-to-Low vs Free-Air Temperature

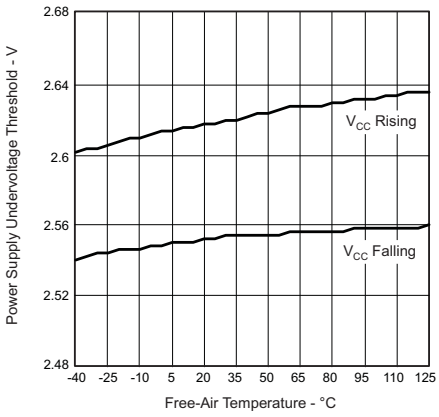

Figure 9. V_{CC} Undervoltage Threshold vs Free-Air Temperature

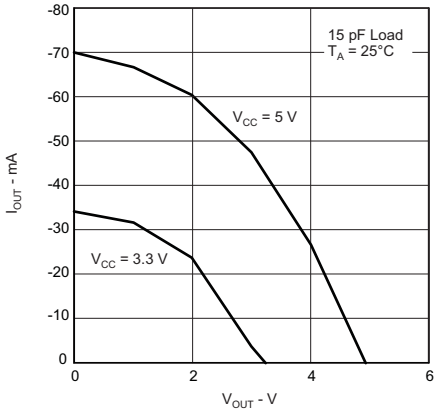

Figure 10. High-Level Output Current vs High-Level Output Voltage

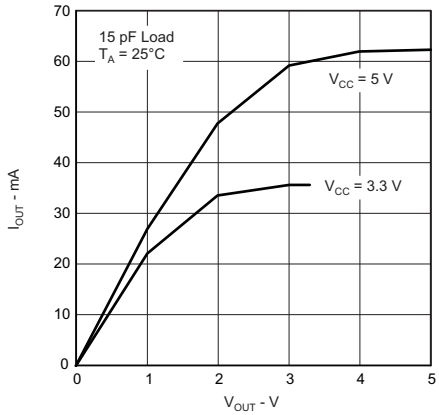

Figure 11. Low-Level Output Current vs Low-Level Output Voltage

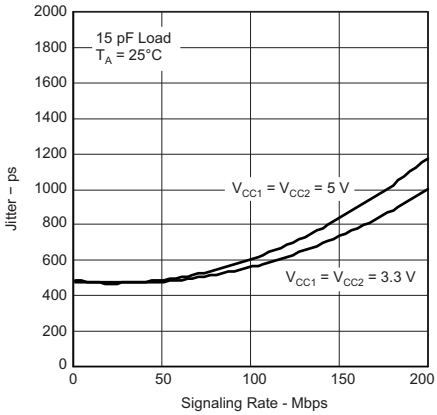

Figure 12. ISO722xM Jitter vs Signaling Rate

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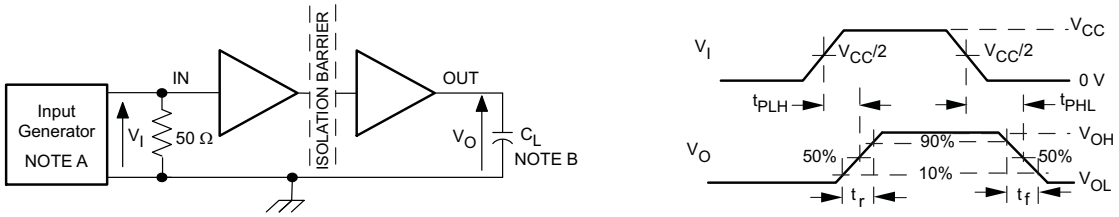
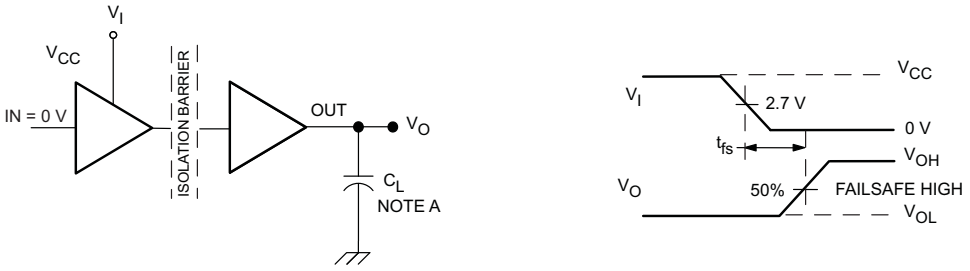
7 Parameter Measurement Information



A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 50 kHz, 50% duty cycle, t_r ≤ 3 ns, t_f ≤ 3 ns, Z_O = 50 Ω.

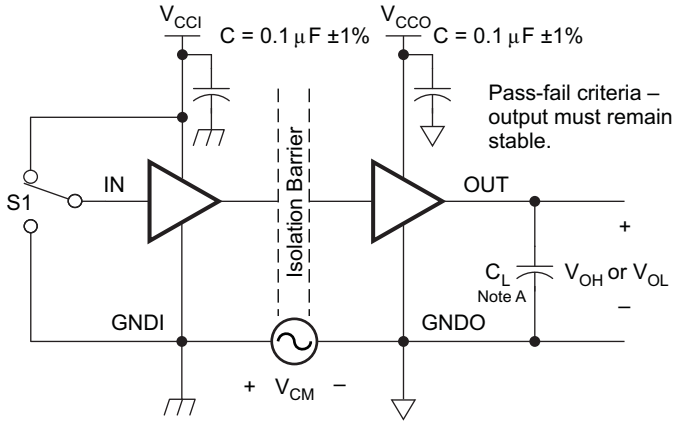
B. C_L = 15 pF and includes instrumentation and fixture capacitance within ± 20%.

Figure 13. Switching Characteristic Test Circuit and Voltage Waveforms



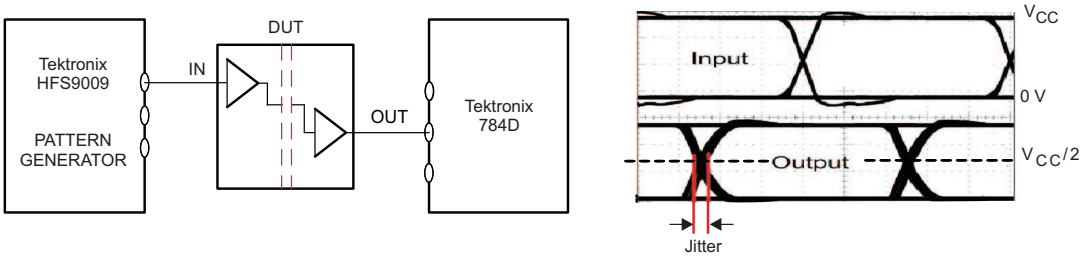
A. C_L = 15 pF and includes instrumentation and fixture capacitance within ± 20%.

Figure 14. Failsafe Delay Time Test Circuit and Voltage Waveforms



A. C_L = 15 pF and includes instrumentation and fixture capacitance within ± 20%.

Figure 15. Common-Mode Transient Immunity Test Circuit



NOTE: PRBS bit pattern run length is 2^{16} – 1. Transition time is 800 ps.

Figure 16. Peak-to-Peak Eye-Pattern Jitter Test Circuit and Voltage Waveform

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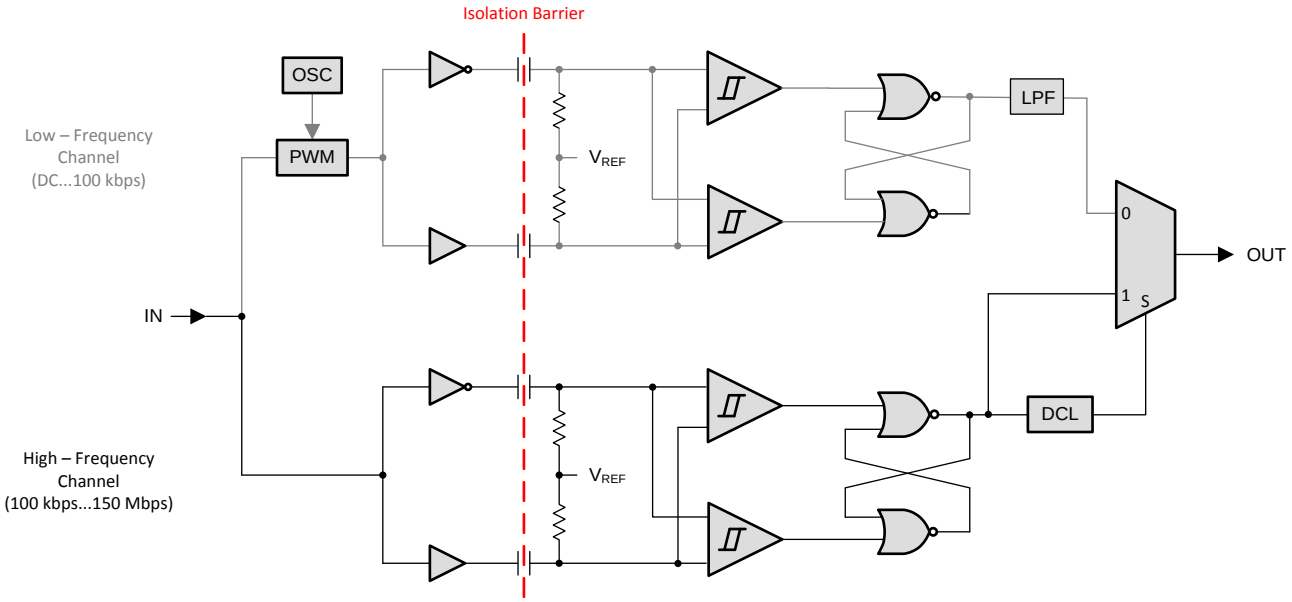
8 Detailed Description

8.1 Overview

The isolator in the *Functional Block Diagram* is based on a capacitive isolation barrier technique. The I/O channel of the ISO7220x and ISO7221x devices consists of two internal data channels, a high-frequency channel (HF) with a bandwidth from 100 kbps up to 150 Mbps, and a low-frequency channel (LF) covering the range from 100 kbps down to DC. In principle, a single-ended input signal entering the HF-channel is split into a differential signal via the inverter gate at the input. The following capacitor-resistor networks differentiate the signal into transients, which then are converted into differential pulses by two comparators. The comparator outputs drive a NOR-gate flip-flop whose output feeds an output multiplexer. A decision logic (DCL) at the driving output of the flip-flop measures the durations between signal transients. If the duration between two consecutive transients exceeds a certain time limit, (as in the case of a low-frequency signal), the DCL forces the output-multiplexer to switch from the high-frequency to the low-frequency channel.

Because low-frequency input signals require the internal capacitors to assume prohibitively large values, these signals are pulse-width modulated (PWM) with the carrier frequency of an internal oscillator, thus creating a sufficiently high frequency signal, capable of passing the capacitive barrier. As the input is modulated, a low-pass filter (LPF) is needed to remove the high-frequency carrier from the actual data before passing it on to the output multiplexer.

8.2 Functional Block Diagram



8.3 Feature Description

PRODUCT	MAX SIGNALING RATE	INPUT THRESHOLD	CHANNEL DIRECTION
ISO7220A	1 Mbps	≈ 1.5 V (TTL) (CMOS compatible)	Same direction
ISO7220B	5 Mbps	≈ 1.5 V (TTL) (CMOS compatible	
ISO7220C	25 Mbps	≈ 1.5 V (TTL) (CMOS compatible)	
ISO7220M	150 Mbps	V_{CC}/ 2 (CMOS)	
ISO7221A	1 Mbps	≈ 1.5 V (TTL) (CMOS compatible)	Opposite directions
ISO7221B	5 Mbps	≈ 1.5 V (TTL) (CMOS compatible)	
ISO7221C	25 Mbps	≈ 1.5 V (TTL) (CMOS compatible)	
ISO7221M	150 Mbps	V_{CC}/ 2 (CMOS)	

8.3.1 DIN V VDE V 0884-10 (VDE V 0884-10):2006-12 Insulation Characteristics(1)

PARAMETER		TEST CONDITIONS	SPECIFICATION	UNIT
V_{IORM}	Maximum working insulation voltage		560	V_{PK}
V_{PR}	Input to output test voltage	After Input/Output safety test subgroup 2/3, V_{PR} = V_{IORM} × 1.2, t = 10 s, Partial discharge < 5 pC	672	
		Method a, After environment tests subgroup 1, V_{PR} = V_{IORM} × 1.6, t = 10 s, Partial discharge < 5 pC	896	
		Method b1, V_{PR} = V_{IORM} × 1.875, 100% Production test with t = 1 s, Partial discharge < 5 pC	1050	
V_{IOTM}	Transient overvoltage	V_{TEST} = V_{IOTM} t = 60 s (qualification) t = 1 s (100% production)	4000	
R_S	Insulation resistance	V_{IO} = 500 V at T_S = 150°C	>10^9	Ω
	Pollution degree		2	

(1) Climatic Classification 40/125/21

NOTE

Creepage and clearance requirements should be applied according to the specific equipment isolation standards of an application. Take care 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 according to the measurement techniques shown in the *Isolation Glossary* in the *Related Documentation* section. Techniques such as inserting grooves, ribs, or both on a printed circuit board are used to help increase these specifications.

8.3.2 IEC Package Characteristics

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
L(I01)	Minimum air gap (Clearance)(1)	Shortest pin-to-pin distance through air	SOIC-8	4			mm
L(I02)	Minimum external tracking (Creepage)(1)	Shortest pin-to-pin distance across the package surface		4			mm

(1) Per JEDEC package dimensions.

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PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
CTI	Tracking resistance (Comparative Tracking Index)	DIN EN 60112 (VDE 0303-11); IEC 60112	400			V
DTI	Distance through the insulation	Minimum Internal Gap (Internal Clearance)	0.008			mm
R_{IO}	Isolation resistance	Input to output, V_{IO} = 500 V, all pins on each side of the barrier tied together creating a two-pin device, T_A = 25°C	10^{12}			Ω
		Input to output, V_{IO} = 500 V, 100°C ≤ T_A ≤ max	10^{11}			Ω
C_{IO}	Barrier capacitance Input to output	V_I = 0.4 sin (4E6πt)		1		pF
C_I	Input capacitance to ground	V_I = 0.4 sin (4E6πt)		1		pF

Table 1. IEC 60664-1 Ratings Table

PARAMETER	TEST CONDITIONS	SPECIFICATION
Basic isolation group	Material group	II
Installation classification	Rated mains voltage ≤150 V_{RMS}	I-IV
	Rated mains voltage ≤300 V_{RMS}	I-III
	Rated mains voltage ≤400 V_{RMS}	I-II

8.3.3 Regulatory Information

VDE	CSA	UL
Certified according to DIN V VDE V 0884-10 (VDE V 0884-10):2006-12 and DIN EN 61010-1 (VDE 0411-1)	Approved according to CSA Component Acceptance Notice 5A and IEC 60950-1	Recognized under UL 1577 Component Recognition Program
Basic Insulation Maximum Transient Overvoltage, 4000 V_{PK} Maximum Surge Voltage, 4000 V_{PK} Maximum Working Voltage, 560 V_{PK}	Evaluated to CSA 60950-1-07 and IEC 60950-1 (2nd Ed.) with 2000 V_{RMS} Isolation rating for products with working voltages ≤ 125 V_{RMS} for reinforced insulation and ≤ 390 V_{RMS} for basic insulation	Single Protection, 2500 V_{RMS} (1)
Certificate Number: 40016131	Master Contract Number: 220991	File Number: E181974

(1) Production tested ≥3000 V_{RMS} for 1 second in accordance with UL 1577.

8.3.4 Safety Limiting Values

Safety limiting intends to prevent potential damage to the isolation barrier upon failure of input or output circuitry. A failure of the IO can allow low resistance to ground or the supply and, without current limiting, dissipate sufficient power to overheat the die and damage the isolation barrier potentially leading to secondary system failures.

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_S	Safety input, output, or supply current	SOIC-8	θ_{JA} = 212°C/W, V_I = 5.5 V, T_J = 170°C, T_A = 25°C			124	mA
			θ_{JA} = 212°C/W, V_I = 3.6 V, T_J = 170°C, T_A = 25°C			190	
T_S	Maximum case temperature	SOIC-8				150	°C

The safety-limiting constraint is the absolute maximum junction temperature specified in *Absolute Maximum Ratings*. The power dissipation and junction-to-air thermal impedance of the ISO7220x and ISO7221x devices installed in the application hardware determines the junction temperature. The assumed junction-to-air thermal resistance in *Thermal Information* is that of a device installed in the JESD51-3, Low Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages and is conservative. The power is the recommended maximum input voltage times the current. The junction temperature is then the ambient temperature plus the power times the junction-to-air thermal resistance.

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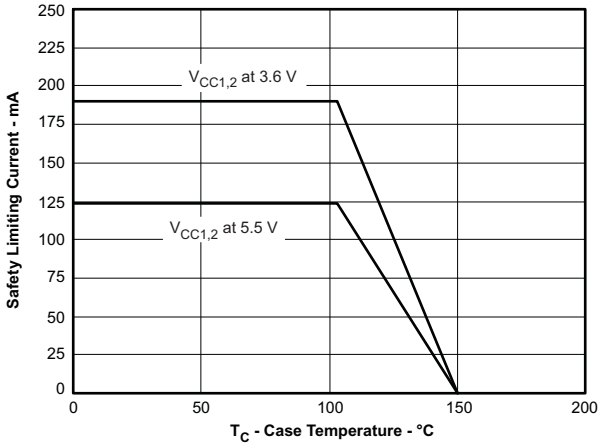

Figure 17. θ_{JC} Thermal Derating Curve per VDE

8.4 Device Functional Modes

The ISO7220x and ISO7221x family of devices functional modes are shown in Table 2.

Table 2. ISO7220x or ISO7221x Function Table(1)

INPUT SIDE V_{CC}	OUTPUT SIDE V_{CC}	INPUT (IN)	OUTPUT (OUT)
PU	PU	H	H
		L	L
		Open	H
PD	PU	X	H
X	PD	X	Undetermined

(1) PU = Powered Up (V_{CC} ≥ 3.0 V), PD = Powered Down (V_{CC} ≤ 2.5 V), X = Irrelevant, H = High Level, L = Low Level

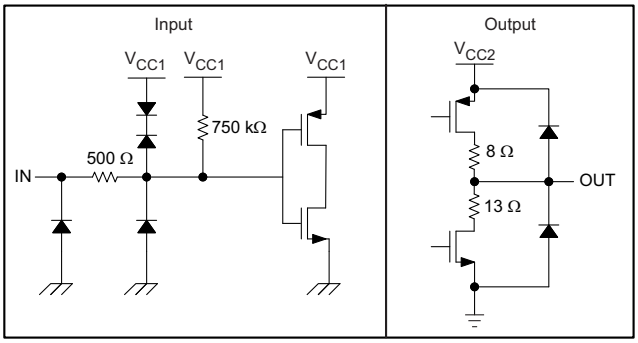

Figure 18. Device I/O Schematics

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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 ISO7220x and ISO7221x devices use single-ended TTL or CMOS-logic switching technology. The supply voltage range is from 3 V (2.8 V for C-grade) to 5.5 V for both supplies, V_{CC1} and V_{CC2}. When designing with digital isolators, 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, µC or UART), and a data converter or a line transceiver, regardless of the interface type or standard.

9.2 Typical Application

The ISO7221x device can be used with Texas Instruments' mixed signal micro-controller, digital-to-analog converter, transformer driver, and voltage regulator to create an isolated 4-20 mA current loop.

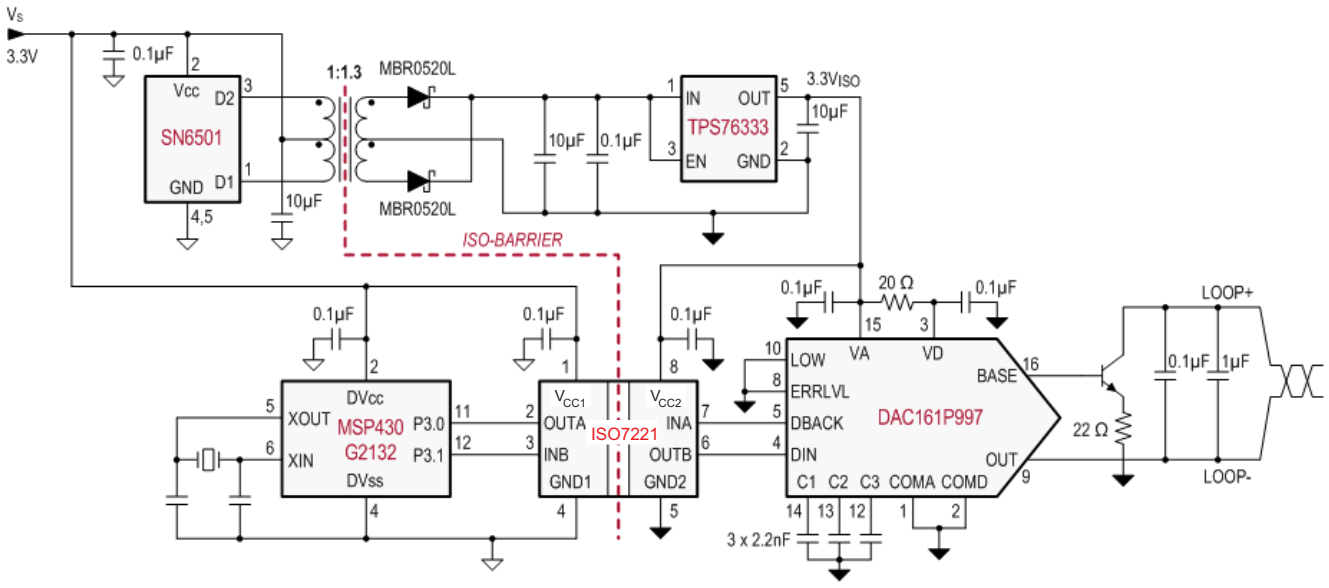

Figure 19. Isolated 4 to 20 mA Current Loop

9.2.1 Design Requirements

Unlike optocouplers, which require external components to improve performance, provide bias (or limit current), the ISO7220x and ISO7221x devices require only two external bypass capacitors to operate.

Typical Application (continued)

9.2.2 Detailed Design Procedure

Figure 20 and Figure 21 show the hookup of a typical ISO7220x and ISO7221x circuit. The only external components are two bypass capacitors.

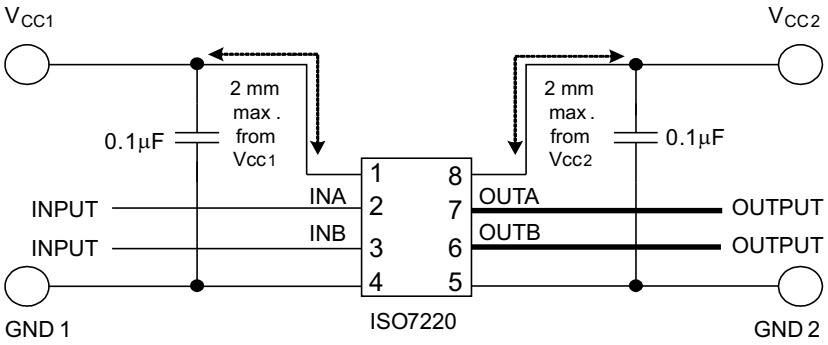

Figure 20. Typical ISO7220x Circuit Hook-Up

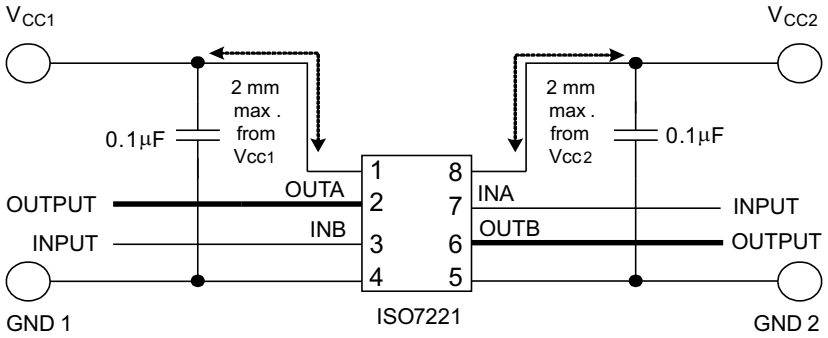

Figure 21. Typical ISO7221x Circuit Hook-Up

9.2.3 Application Curve

At maximum working voltage, the isolation barrier of the ISO7220x and ISO7221x devices has more than 28 years of life.

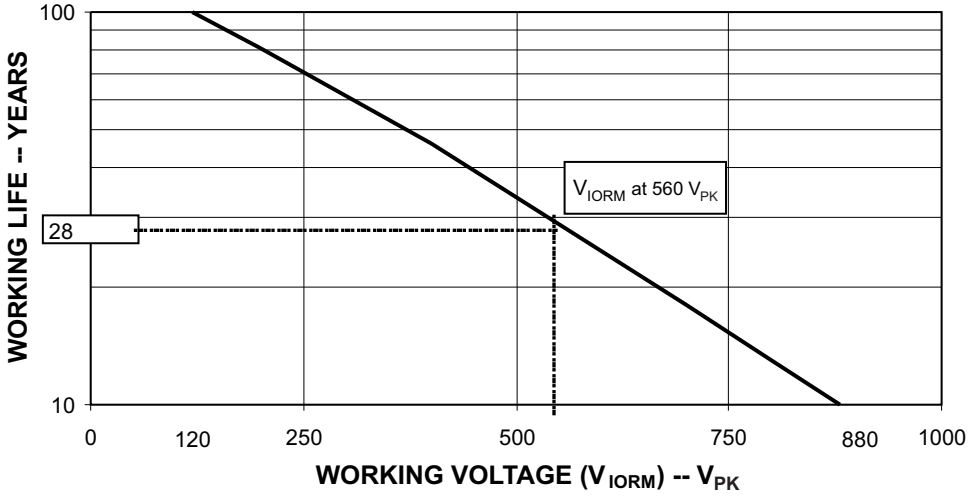

Figure 22. Time-Dependent Dielectric Breakdown Test Results

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10 Power Supply Recommendations

To ensure reliable operation at all data rates and supply voltages, a 0.1-µF bypass capacitor is recommended at input and output supply pins (V_{CC1} and V_{CC2}). The capacitors should 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 such as Texas Instruments SN6501 data sheet. For such applications, detailed power supply design and transformer selection recommendations are available in the data sheet, *SN6501 Transformer Driver for Isolated Power Supplies* (SLLSEA0).

11 Layout

11.1 Layout Guidelines

A minimum of four layers are required to accomplish a low EMI PCB design (see Figure 23). Layer stacking should be in the following order (top-to-bottom): high-speed signal layer, ground plane, power plane and low-frequency signal layer.

- Route the high-speed traces on the top layer to avoid the use of vias (and the introduction of the inductances) and allow for clean interconnects between the isolator and the transmitter and receiver circuits of the data link.
- Place a solid ground plane next to the high-speed signal layer to establish controlled impedance for transmission line interconnects and provide an excellent low-inductance path for the return current flow.
- Place the power plane next to the ground plane to create additional high-frequency bypass capacitance of approximately 100 pF/in^2.
- Route the slower speed control signals on the bottom layer to allow for greater flexibility as these signal links usually 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 it symmetrical. Adding a second plane system to the stack makes the stack mechanically stable and prevents it from warping. 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, see Application Note *Digital Isolator Design Guide* (SLLA284).

11.1.1 PCB Material

For digital circuit boards operating below 150 Mbps, (or rise and fall times higher than 1 ns), and trace lengths of up to 10 inches, use standard FR-4 epoxy-glass as PCB material. FR-4 (Flame Retardant 4) meets the requirements of Underwriters Laboratories UL94-V0, and is preferred over cheaper alternatives because of its lower dielectric losses at high frequencies, less moisture absorption, greater strength and stiffness, and self-extinguishing flammability characteristics.

11.2 Layout Example

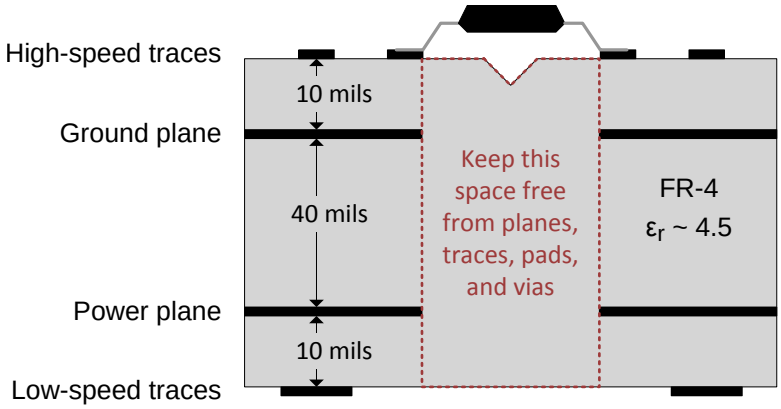

Figure 23. Recommended Layer Stack

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

For related documentation, see the following:

- Transformer Driver for Isolated Power Supplies, SLLSEA0
- Digital Isolator Design Guide, SLLA284
- Isolation Glossary, SLLA353

12.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 3. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
ISO7220A	Click here	Click here	Click here	Click here	Click here
ISO7220B	Click here	Click here	Click here	Click here	Click here
ISO7220C	Click here	Click here	Click here	Click here	Click here
ISO7220M	Click here	Click here	Click here	Click here	Click here
ISO7221A	Click here	Click here	Click here	Click here	Click here
ISO7221B	Click here	Click here	Click here	Click here	Click here
ISO7221C	Click here	Click here	Click here	Click here	Click here
ISO7221M	Click here	Click here	Click here	Click here	Click here

12.3 Community Resources

The following links connect to TI community resources. Linked contents are 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.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.4 Trademarks

E2E is a trademark of Texas Instruments.
DeviceNet is a trademark of Open DeviceNet Vendors Association.
Profibus is a trademark of Profibus.
All other trademarks are the property of their respective owners.

12.5 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

12.6 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

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13 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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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
ISO7220AD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220A	Samples
ISO7220ADG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220A	Samples
ISO7220ADR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220A	Samples
ISO7220ADRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220A	Samples
ISO7220BD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220B	Samples
ISO7220BDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220B	Samples
ISO7220BDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220B	Samples
ISO7220BDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220B	Samples
ISO7220CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220C	Samples
ISO7220CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220C	Samples
ISO7220CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220C	Samples
ISO7220CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220C	Samples
ISO7220MD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220M	Samples
ISO7220MDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220M	Samples
ISO7220MDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220M	Samples
ISO7220MDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7220M	Samples
ISO7221AD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221A	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
ISO7221ADG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221A	Samples
ISO7221ADR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221A	Samples
ISO7221ADRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221A	Samples
ISO7221BD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221B	Samples
ISO7221BDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221B	Samples
ISO7221BDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221B	Samples
ISO7221BDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221B	Samples
ISO7221CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221C	Samples
ISO7221CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221C	Samples
ISO7221CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221C	Samples
ISO7221CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221C	Samples
ISO7221MD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221M	Samples
ISO7221MDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221M	Samples
ISO7221MDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221M	Samples
ISO7221MDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	I7221M	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF ISO7220A, ISO7221A, ISO7221C :

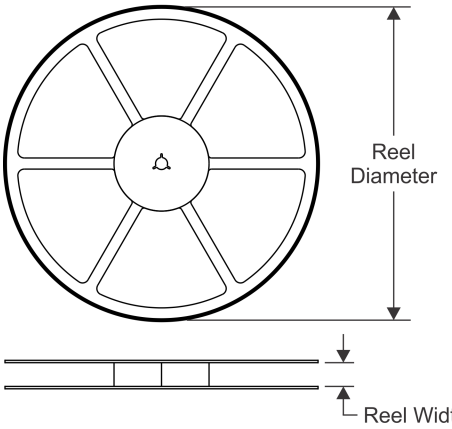
- Automotive: ISO7220A-Q1, ISO7221A-Q1, ISO7221C-Q1

NOTE: Qualified Version Definitions:

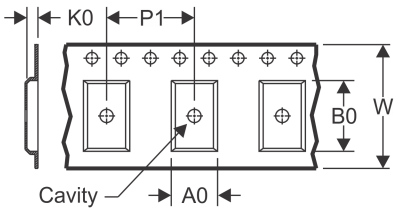
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

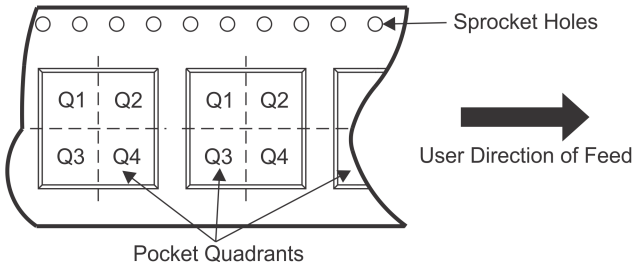


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

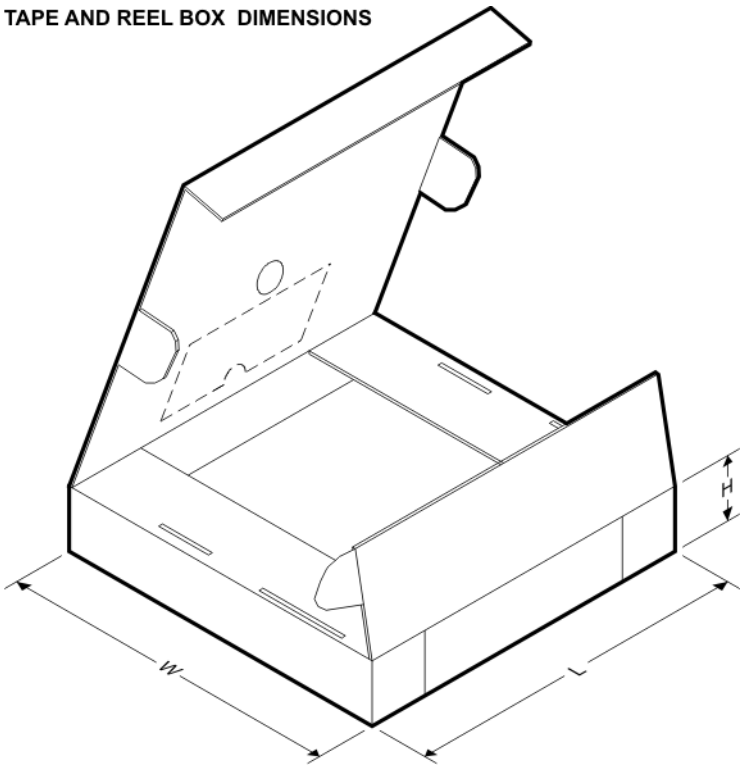
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ISO7220ADR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7220BDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7220CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7220MDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7221ADR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7221BDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7221CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7221MDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

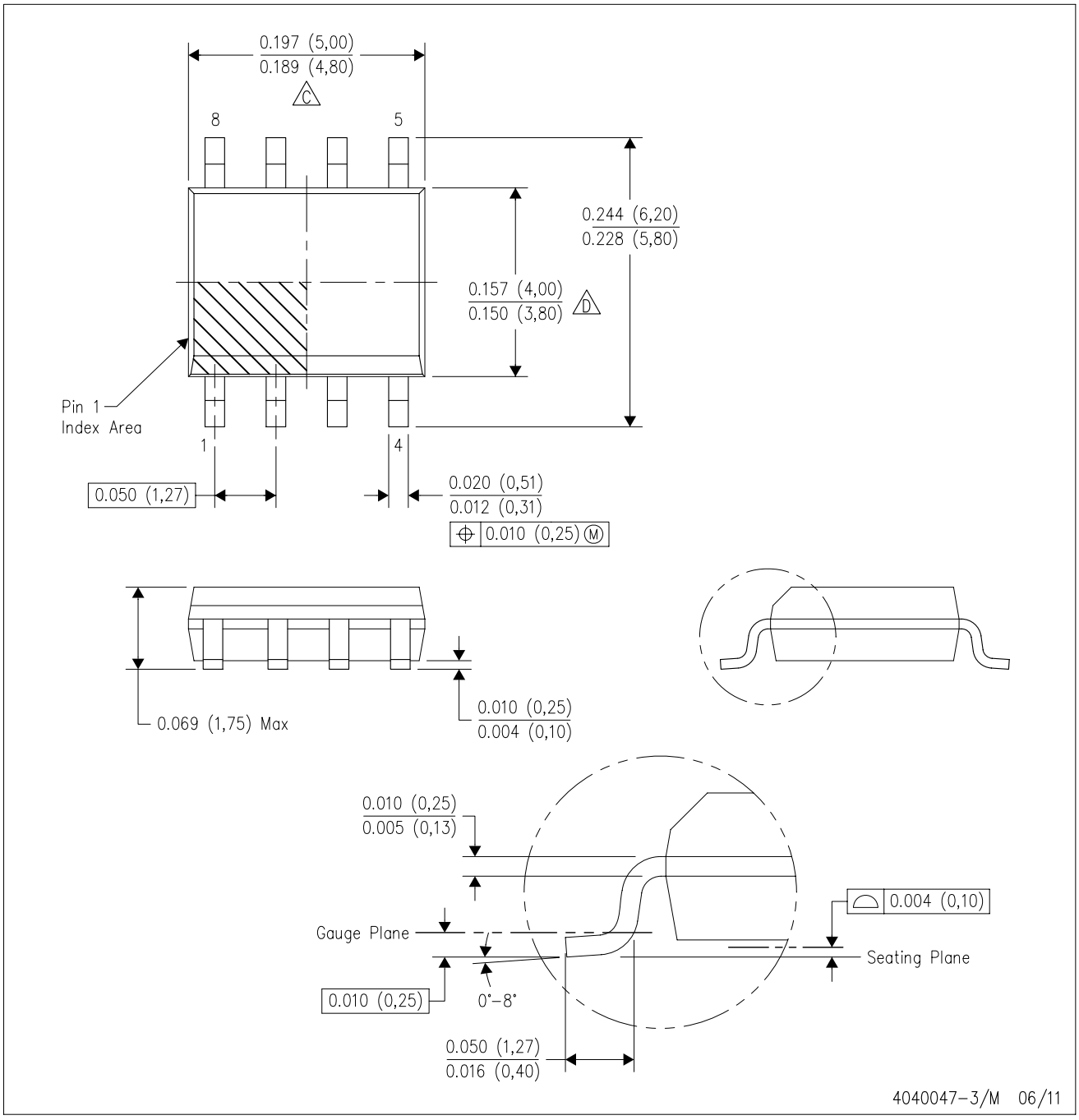
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

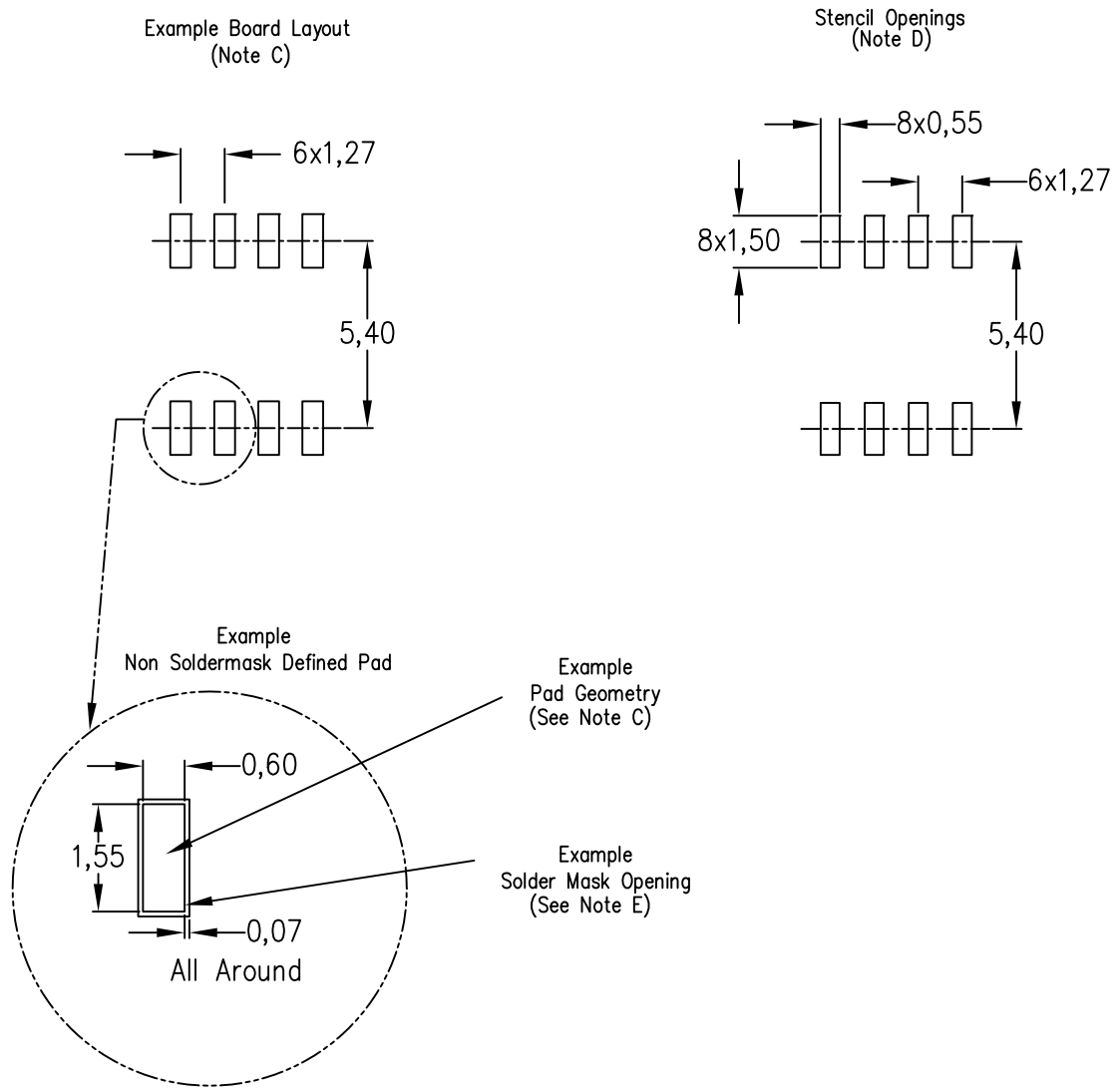
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
ISO7220ADR	SOIC	D	8	2500	367.0	367.0	35.0
ISO7220BDR	SOIC	D	8	2500	367.0	367.0	35.0
ISO7220CDR	SOIC	D	8	2500	367.0	367.0	35.0
ISO7220MDR	SOIC	D	8	2500	367.0	367.0	35.0
ISO7221ADR	SOIC	D	8	2500	367.0	367.0	35.0
ISO7221BDR	SOIC	D	8	2500	367.0	367.0	35.0
ISO7221CDR	SOIC	D	8	2500	367.0	367.0	35.0
ISO7221MDR	SOIC	D	8	2500	367.0	367.0	35.0

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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