ISO772x High-Speed, Robust EMC, Reinforced and Basic Dual-Channel Digital Isolators

1 Features

- 100 Mbps data rate
- Robust isolation barrier:
  - >100-Year projected lifetime at 1.5 kV_{RMS} working voltage
  - Up to 5000 V_{RMS} Isolation Rating
  - Up to 12.8 kV surge capability
  - ±100 kV/µs Typical CMTI
- Wide supply range: 2.25 V to 5.5 V
- 2.25-V to 5.5-V level translation
- Default output *High* (ISO772x) and *Low* (ISO772xF) Options
- Wide temperature range: –55°C to +125°C
- Low power consumption, typical 1.7 mA per channel at 1 Mbps
- Low propagation delay: 11 ns typical
- Robust electromagnetic compatibility (EMC)
  - System-Level ESD, EFT, and surge immunity
  - ±8 kV IEC 61000-4-2 contact discharge protection across isolation barrier
  - Low emissions
- Wide-SOIC (DW-16, DWV-8) and Narrow-SOIC (D-8) package options
- Automotive Version Available: *ISO772x-Q1*
- Safety-related certifications:
  - DIN VDE V 0884-11:2017-01
  - UL 1577 component recognition program
  - CSA, CQC and TUV certifications

2 Applications

- Industrial automation
- Motor control
- Power supplies
- Solar inverters
- Medical equipment

3 Description

The ISO772x devices are high-performance, dual-channel digital isolators with 5000 V_{RMS} (DW and DWV packages) and 3000 V_{RMS} (D package) isolation ratings per UL 1577. This family includes devices with reinforced insulation ratings according to VDE, CSA, TUV and CQC. The ISO7721B device is designed for applications that require basic insulation ratings only.

The ISO772x devices provide high electromagnetic immunity and low emissions at low power consumption, while isolating CMOS or LVCMOS digital I/Os. Each isolation channel has a logic input and output buffer separated by a double capacitive silicon dioxide (SiO_2) insulation barrier. The ISO7720 device has both channels in the same direction while the ISO7721 device has both channels in the opposite direction. In the event of input power or signal loss, the default output is *high* for devices without suffix F and *low* for devices with suffix F. See the *Device Functional Modes* section for further details.

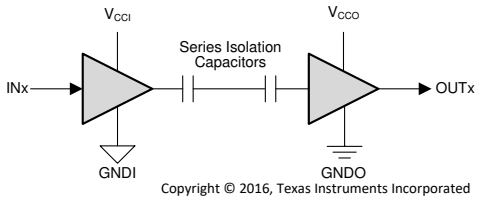
Used in conjunction with isolated power supplies, these devices help prevent noise currents on data buses, such as RS-485, RS-232, and CAN, from damaging sensitive circuitry. Through innovative chip design and layout techniques, the electromagnetic compatibility of the ISO772x devices has been significantly enhanced to ease system-level ESD, EFT, surge, and emissions compliance. The ISO772x family of devices is available in 16-pin SOIC wide-body (DW), 8-pin SOIC wide-body (DWV), and 8-pin SOIC narrow-body (D) packages.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
ISO7720, ISO7721 ISO7721F, ISO7721F	D (8)	4.90 mm × 3.91 mm
	DWV (8)	5.85 mm × 7.50 mm
	DW (16)	10.30 mm × 7.50 mm
ISO7721B, ISO7721FB	DW (16)	10.30 mm × 7.50 mm

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

Simplified Schematic



V_{CCI}=Input supply, V_{CCO}=Output supply

GNDI=Input ground, GNDO=Output ground

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.

Table of Contents

1 Features ... 1
2 Applications ... 1
3 Description ... 1
4 Revision History ... 2
5 Pin Configuration and Functions ... 4
6 Specifications ... 5
6.1 Absolute Maximum Ratings ... 5
6.2 ESD Ratings ... 5
6.3 Recommended Operating Conditions ... 5
6.4 Thermal Information ... 6
6.5 Power Ratings ... 6
6.6 Insulation Specifications ... 7
6.7 Safety-Related Certifications ... 8
6.8 Safety Limiting Values ... 9
6.9 Electrical Characteristics—5-V Supply ... 10
6.10 Supply Current Characteristics—5-V Supply ... 10
6.11 Electrical Characteristics—3.3-V Supply ... 11
6.12 Supply Current Characteristics—3.3-V Supply ... 11
6.13 Electrical Characteristics—2.5-V Supply ... 12
6.14 Supply Current Characteristics—2.5-V Supply ... 12
6.15 Switching Characteristics—5-V Supply ... 13
6.16 Switching Characteristics—3.3-V Supply ... 13
6.17 Switching Characteristics—2.5-V Supply ... 13
6.18 Insulation Characteristics Curves ... 14
6.19 Typical Characteristics ... 15
7 Parameter Measurement Information ... 17
8 Detailed Description ... 18
8.1 Overview ... 18
8.2 Functional Block Diagram ... 18
8.3 Feature Description ... 19
8.4 Device Functional Modes ... 20
9 Application and Implementation ... 21
9.1 Application Information ... 21
9.2 Typical Application ... 22
10 Power Supply Recommendations ... 26
11 Layout ... 26
11.1 Layout Guidelines ... 26
11.2 Layout Example ... 26
12 Device and Documentation Support ... 27
12.1 Device Support ... 27
12.2 Documentation Support ... 27
12.3 Related Links ... 27
12.4 Receiving Notification of Documentation Updates ... 27
12.5 Community Resources ... 27
12.6 Trademarks ... 27
12.7 Electrostatic Discharge Caution ... 28
12.8 Glossary ... 28
13 Mechanical, Packaging, and Orderable Information ... 28

4 Revision History

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

Changes from Revision D (January 2019) to Revision E — **Page**

- Added ISO7721B device to this data sheet for applications that require basic insulation only. Previous data sheet literature number for ISO7721B was SLLSEY9A ... 1
- Changed VDE standard name From: DIN V VDE V 0884-11:2017-01 To: DIN VDE V 0884-11:2017-01 throughout the document ... 1
- Changed UL certification bullet in Features From: '5000 V_{RMS} (DW-16, DWV-8) and 3000 V_{RMS} (D-8) Isolation Rating per UL 1577' To: 'UL 1577 component recognition program' ... 1
- Combined CSA, CQC, and TUV Features bullets into a single bullet ... 1
- Updated certification information in Safety-Related Certifications table ... 8

Changes from Revision C (July 2018) to Revision D — **Page**

- Made editorial and cosmetic changes throughout the document ... 1
- Changed From: "Isolation Barrier Life: >40 Years" To:">100-Year Projected Lifetime at 1.5 kV_{RMS} Working Voltage" in Features ... 1
- Added "Up to 5000 V_{RMS} Isolation Rating" in Features ... 1
- Added "Up to 12.8 kV Surge Capability" in Features ... 1
- Added "±8 kV IEC 61000-4-2 Contact Discharge Protection across Isolation Barrier" in Features ... 1
- Added "Automotive Version Available: ISO772x-Q1" in Features ... 1
- Deleted "Certification Planned" statement throughout the document ... 1
- Updated Applications list ... 1

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- Updated Simplified Schematic to show two isolation capacitors in series per channel instead of a single isolation capacitor 1
- Added "Contact discharge per IEC 61000-4-2" specification of ±8000 V in ESD Ratings table 5
- Changed 'Signaling' rate to 'Data' rate and added table note to *Data rate* specification in Recommended Operating Conditions table 5
- Changed V_{IORM} Value for DW-16 and DWV-8 packages From: "1414 V_{PK}" To: "2121 V_{PK}" in Insulation Specifications table 7
- Changed V_{IOWM} Values for DW-16 and DWV-8 packages From: "1000 V_{RMS}" and "1414 V_{DC}" To: "1500 V_{RMS}" and "2121 V_{DC}" in Insulation Specifications table 7
- Added 'see Figure 26" to TEST CONDITIONS of V_{IOWM} specification 7
- Changed V_{IOTM} TEST CONDITIONS for 100% production test From: "$V_{TEST} = V_{IOTM}$" To: "$V_{TEST} = 1.2 \times V_{IOTM}$" in Insulation Specifications table 7
- Changed V_{IOSM} TEST CONDITIONS From: "Test method per IEC 60065" To: "Test method per IEC 62368-1" in Insulation Specifications table 7
- Changed q_{pd} TEST CONDITIONS for method b1 test From: "$V_{ini} = V_{IOTM}$" To: "$V_{ini} = 1.2 \times V_{IOTM}$" in Insulation Specifications table 7
- Updated certification information in Safety-Related Certifications table 8
- Added *Insulation Lifetime* sub-section under Application Curve section 24
- Added '*How to use isolation to improve ESD, EFT and Surge immunity in industrial systems*' application report to Documentation Support section 27

Changes from Revision B (March 2017) to Revision C **Page**

- Added the 8-pin SOIC package (DWV) to the data sheet 1
- Updated the VDE and CSA certification description throughout the document 1
- Changed the climatic category for the D package from 5/125/21 to 55/125/21 7
- Changed the maximum working voltages for DW-16 and D-8 from 400 to 700 V_{RMS} and 250 to 400 V_{RMS} (respectively) in the *Safety-Related Certifications* table 8
- Switched the line colors for V_{CC} at 2.5 V and V_{CC} at 3.3 V in the *Low-Level Output Voltage vs Low-Level Output Current* graph 15
- Deleted EN from the *Common-Mode Transient Immunity Test Circuit* figure 17
- Added the *Device Support* section 27

Changes from Revision A (December 2016) to Revision B **Page**

- Added D-8 values for TUV in the *Safety-Related Certifications* table 8
- Changed the minimum CMTI value from 40 kV/μs to 85 kV/μs in all *Electrical Characteristics* tables 10
- Added the *Receiving Notification of Documentation Updates* section 27
- Changed the *Electrostatic Discharge Caution* statement 27

Changes from Original (November 2016) to Revision A **Page**

- Changed *Feature* From: IEC 60950-1, IEC 60601-1 and IEC 61010-1 End Equipment Standards To: IEC 60950-1 and IEC 60601-1 End Equipment Standards 1
- Added Climatic category to the *Insulation Specifications* 7
- Changed the CSA column of *Regulatory Information* 8
- Changed DW package) To: (DW-16) in the TUV column of *Regulatory Information* 8
- Changed t_{ie} TYP value From: 1.5 To 1 in *Switching Characteristics—5-V Supply* 13
- Changed t_{ie} TYP value From: 1.5 To 1 in *Switching Characteristics—3.3-V Supply* 13
- Changed t_{ie} TYP value From: 1.5 To 1 in *Switching Characteristics—2.5-V Supply* 13

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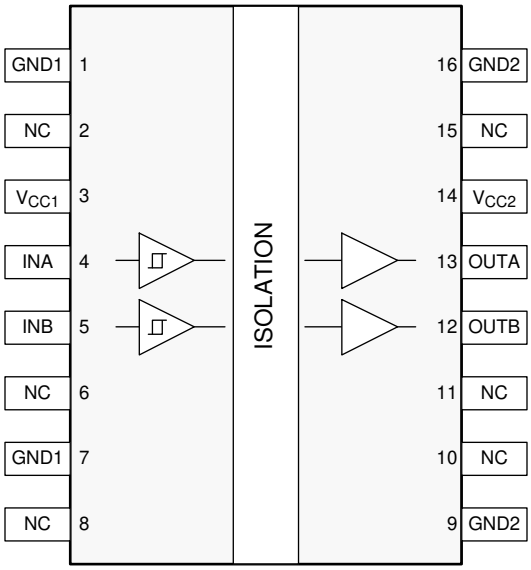
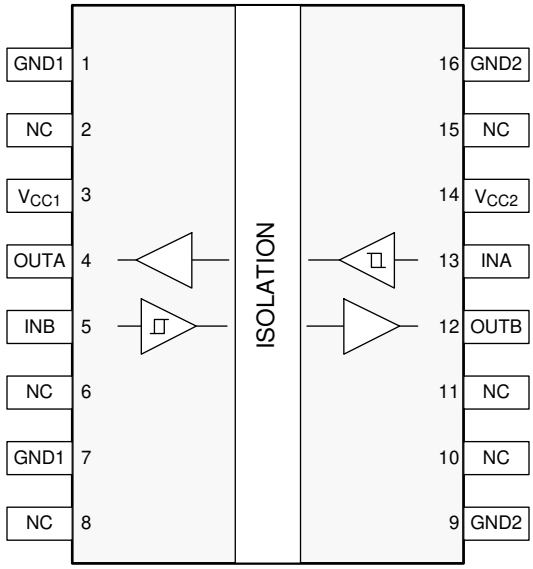
5 Pin Configuration and Functions

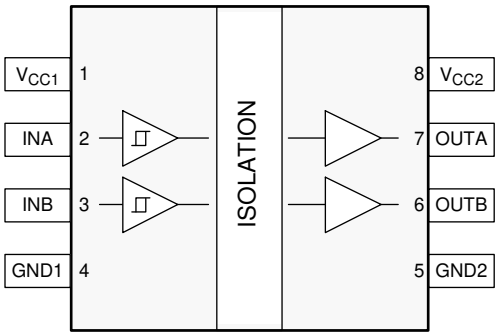
ISO7720 DW Package
16-Pin SOIC
Top View



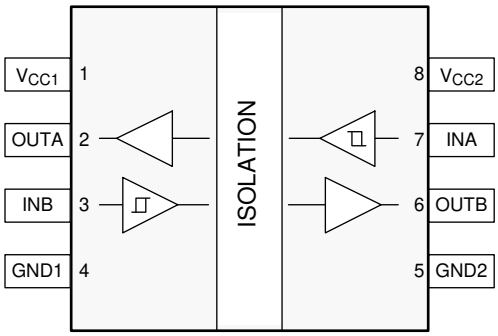
ISO7721 DW Package
16-Pin SOIC
Top View



ISO7720 D and DWV Package
8-Pin SOIC
Top View



ISO7721 D and DWV Package
8-Pin SOIC
Top View



Pin Functions

PIN					I/O	DESCRIPTION
NAME	DW PACKAGE		D, DWV PACKAGE			
	ISO7720	ISO7721	ISO7720	ISO7721		
GND1	1, 7	1, 7	4	4	—	Ground connection for V_{CC1}
GND2	9	9	5	5	—	Ground connection for V_{CC2}
	16	16				
INA	4	13	2	7	I	Input, channel A
INB	5	5	3	3	I	Input, channel B
NC	2, 6, 8, 10, 11, 15	2, 6, 8, 10, 11, 15	—	—	—	Not connected
OUTA	13	4	7	2	O	Output, channel A
OUTB	12	12	6	6	O	Output, channel B
V_{CC1}	3	3	1	1	—	Power supply, V_{CC1}
V_{CC2}	14	14	8	8	—	Power supply, V_{CC2}

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6 Specifications

6.1 Absolute Maximum Ratings

See (1).

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

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These 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 may affect device reliability.
(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 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)	±6000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	±1500	
		Contact discharge per IEC 61000-4-2; Isolation barrier withstand test(3)(4)	±8000	

(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.
(3) IEC ESD strike is applied across the barrier with all pins on each side tied together creating a two-terminal device.
(4) Testing is carried out in air or oil to determine the intrinsic contact discharge capability of the device.

6.3 Recommended Operating Conditions

			MIN	NOM	MAX	UNIT
V_{CC1}, V_{CC2}	Supply voltage		2.25		5.5	V
$V_{CC(UVLO+)}$	UVLO threshold when supply voltage is rising			2	2.25	V
$V_{CC(UVLO-)}$	UVLO threshold when supply voltage is falling		1.7	1.8		V
$V_{HYS(UVLO)}$	Supply voltage UVLO hysteresis		100	200		mV
I_{OH}	High-level output current	V_{CCO}(1) = 5 V	–4			mA
		V_{CCO} = 3.3 V	–2			
		V_{CCO} = 2.5 V	–1			
I_{OL}	Low-level output current	V_{CCO} = 5 V			4	mA
		V_{CCO} = 3.3 V			2	
		V_{CCO} = 2.5 V			1	
V_{IH}	High-level input voltage		0.7 × V_{CCI}(1)		V_{CCI}	V
V_{IL}	Low-level input voltage		0		0.3 × V_{CCI}	V
DR(2)	Data rate		0		100	Mbps
T_A	Ambient temperature		–55	25	125	°C

(1) V_{CCI} = Input-side V_{CC}; V_{CCO} = Output-side V_{CC}.
(2) 100 Mbps is the maximum specified data rate, although higher data rates are possible.

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6.4 Thermal Information

THERMAL METRIC(1)		ISO772x			UNIT
		DW (SOIC)	DWV (SOIC)	D (SOIC)	
		16 PINS	16 PINS	8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	86.5	84.3	137.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance	49.6	36.3	54.9	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	49.7	47.0	71.7	°C/W
ψ_{JT}	Junction-to-top characterization parameter	32.3	7.4	7.1	°C/W
ψ_{JB}	Junction-to-board characterization parameter	49.2	45.1	70.7	°C/W
$R_{\theta JC(bottom)}$	Junction-to-case(bottom) thermal resistance	N/A	N/A	N/A	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.

6.5 Power Ratings

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
ISO7720						
P_D	Maximum power dissipation	$V_{CC1} = V_{CC2} = 5.5$ V, $T_J = 150$°C, $C_L = 15$ pF, input a 50 MHz 50% duty cycle square wave			100	mW
P_{D1}	Maximum power dissipation by side-1	$V_{CC1} = V_{CC2} = 5.5$ V, $T_J = 150$°C, $C_L = 15$ pF, input a 50 MHz 50% duty cycle square wave			20	mW
P_{D2}	Maximum power dissipation by side-2	$V_{CC1} = V_{CC2} = 5.5$ V, $T_J = 150$°C, $C_L = 15$ pF, input a 50 MHz 50% duty cycle square wave			80	mW
ISO7721						
P_D	Maximum power dissipation	$V_{CC1} = V_{CC2} = 5.5$ V, $T_J = 150$°C, $C_L = 15$ pF, input a 50 MHz 50% duty cycle square wave			100	mW
P_{D1}	Maximum power dissipation by side-1	$V_{CC1} = V_{CC2} = 5.5$ V, $T_J = 150$°C, $C_L = 15$ pF, input a 50 MHz 50% duty cycle square wave			50	mW
P_{D2}	Maximum power dissipation by side-2	$V_{CC1} = V_{CC2} = 5.5$ V, $T_J = 150$°C, $C_L = 15$ pF, input a 50 MHz 50% duty cycle square wave			50	mW

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6.6 Insulation Specifications

PARAMETER		TEST CONDITIONS		VALUE			UNIT
				DW	DWV	D	
CLR	External clearance (1)	Shortest terminal-to-terminal distance through air		8	8.5	4	mm
CPG	External creepage (1)	Shortest terminal-to-terminal distance across the package surface		8	8.5	4	mm
DTI	Distance through the insulation	Minimum internal gap (internal clearance)		21	21	21	µm
CTI	Comparative tracking index	DIN EN 60112 (VDE 0303-11); IEC 60112; UL 746A		>600	>600	>600	V
	Material group	According to IEC 60664-1		I	I	I	
	Overvoltage category per IEC 60664-1	Rated mains voltage ≤ 150 V_{RMS}		I–IV	I–IV	I–IV	
		Rated mains voltage ≤ 300 V_{RMS}		I–IV	I–IV	I–III	
		Rated mains voltage ≤ 600 V_{RMS}		I–IV	I–IV	n/a	
		Rated mains voltage ≤ 1000 V_{RMS}		I–III	I–III	n/a	
DIN V VDE V 0884-11:2017-01 (2)							
V_{IORM}	Maximum repetitive peak isolation voltage	AC voltage (bipolar)	ISO772x	2121	2121	637	V_{PK}
			ISO7721B	1414	n/a	n/a	
V_{IOWM}	Maximum working isolation voltage	AC voltage; Time dependent dielectric breakdown (TDDB) test; see Figure 26	ISO772x	1500	1500	450	V_{RMS}
			ISO7721B	1000	n/a	n/a	
		DC voltage	ISO772x	2121	2121	637	V_{DC}
			ISO7721B	1414	n/a	n/a	
V_{IOTM}	Maximum transient isolation voltage	$V_{TEST} = V_{IOTM}$, t = 60 s (qualification); $V_{TEST} = 1.2 \times V_{IOTM}$, t = 1 s (100% production)		8000	7071	4242	V_{PK}
V_{IOSM}	Maximum surge isolation voltage (3)	Test method per IEC 62368-1, 1.2/50 µs waveform,	$V_{TEST} = 1.6 \times V_{IOSM}$ (ISO772x)	8000	8000	5000	V_{PK}
			$V_{TEST} = 1.3 \times V_{IOSM}$ (ISO7721B)	6000	n/a	n/a	
q_{pd}	Apparent charge (4)	Method a, After Input/Output safety test subgroup 2/3, $V_{ini} = V_{IOTM}$, t_{ini} = 60 s; $V_{pd(m)} = 1.2 \times V_{IORM}$, t_m = 10 s		≤5	≤5	≤5	pC
		Method a, After environmental tests subgroup 1, $V_{ini} = V_{IOTM}$, t_{ini} = 60 s;	$V_{pd(m)} = 1.6 \times V_{IORM}$, t_m = 10 s (ISO772x)	≤5	≤5	≤5	
			$V_{pd(m)} = 1.2 \times V_{IORM}$, t_m = 10 s (ISO7721B)	≤5	n/a	n/a	
		Method b1; At routine test (100% production) and preconditioning (type test), $V_{ini} = 1.2 \times V_{IOTM}$, t_{ini} = 1 s;	$V_{pd(m)} = 1.875 \times V_{IORM}$, t_m = 1 s (ISO772x)	≤5	≤5	≤5	
			$V_{pd(m)} = 1.5 \times V_{IORM}$, t_m = 1 s (ISO7721B)	≤5	n/a	n/a	
C_{IO}	Barrier capacitance, input to output (5)	V_{IO} = 0.4 × sin (2πft), f = 1 MHz		~0.5	~0.5	~0.5	pF
R_{IO}	Isolation resistance (5)	V_{IO} = 500 V, T_A = 25°C		$>10^{12}$	$>10^{12}$	$>10^{12}$	Ω
		V_{IO} = 500 V, 100°C ≤ T_A ≤ 125°C		$>10^{11}$	$>10^{11}$	$>10^{11}$	
		V_{IO} = 500 V at T_S = 150°C		$>10^{9}$	$>10^{9}$	$>10^{9}$	
	Pollution degree			2	2	2	
	Climatic category			55/125/21	55/125/21	55/125/21	

(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 and/or ribs on a printed circuit board are used to help increase these specifications.
(2) This coupler is suitable for *safe electrical insulation* 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 or oil to determine the intrinsic surge immunity of the isolation barrier.
(4) Apparent charge is electrical discharge caused by a partial discharge (pd).
(5) All pins on each side of the barrier tied together creating a two-terminal device.

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Insulation Specifications (continued)

PARAMETER		TEST CONDITIONS	VALUE			UNIT
			DW	DWV	D	
UL 1577						
V_{ISO}	Withstanding isolation voltage	$V_{TEST} = V_{ISO}$, t = 60 s(qualification); $V_{TEST} = 1.2 \times V_{ISO}$, t = 1 s (100% production)	5000	5000	3000	V_{RMS}

6.7 Safety-Related Certifications

VDE	CSA	UL	CQC	TUV
Certified according to DIN VDE V 0884-11:2017-01	Certified according to IEC 60950-1, IEC 62368-1 and IEC 60601-1	Recognized under UL 1577 Component Recognition Program	Certified according to GB4943.1-2011	Certified according to EN 61010-1:2010/A1:2019, EN 60950-1:2006/A2:2013 and EN 62368-1:2014
Maximum transient isolation voltage, 8000 V_{PK} (DW-16), 7071 V_{PK} (DWV-8) and 4242 V_{PK} (D-8); Maximum repetitive peak isolation voltage, 2121 V_{PK} (DW-16, DWV-8, Reinforced), 1414 V_{PK} (DW-16, Basic) and 637 V_{PK} (D-8); Maximum surge isolation voltage, 8000 V_{PK} (DW-16, DWV-8, Reinforced), 6000 V_{PK} (DW-16, Basic) and 5000 V_{PK} (D-8)	800 V_{RMS} (DW-16) and 850 V_{RMS} (DWV-8) reinforced insulation and 400 V_{RMS} (D-8) basic insulation working voltage per CSA 60950-1-07+A1+A2, IEC 60950-1 2nd Ed.+A1+A2, CSA 62368-1-14 and IEC 62368-1:2014, (pollution degree 2, material group I); 2 MOPP (Means of Patient Protection) per CSA 60601-1:14 and IEC 60601-1 Ed. 3.1, 250 V_{RMS} (DW-16, DWV-8) max working voltage	**DW-16, DWV-8:** Single protection, 5000 V_{RMS}; **D-8:** Single protection, 3000 V_{RMS}	**DW-16, DWV-8:** Reinforced Insulation, Altitude ≤ 5000 m, Tropical Climate,700 V_{RMS} maximum working voltage; **D-8:** Basic Insulation, Altitude ≤ 5000 m, Tropical Climate, 400 V_{RMS} maximum working voltage	5000 V_{RMS} (DW-16, DWV-8) and 3000 V_{RMS} (D-8) Reinforced insulation per EN 61010-1:2010/A1:2019 up to working voltage of 600 V_{RMS} (DW-16, DWV-8) and 300 V_{RMS} (D-8) 5000 V_{RMS} (DW-16, DWV-8) and 3000 V_{RMS} (D-8) Reinforced insulation per EN 60950-1:2006/A2:2013 and EN 62368-1:2014 up to working voltage of 800 V_{RMS} (DW-16, DWV-8) and 400 V_{RMS} (D-8)
Certificate numbers: 40040142 (Reinforced) 40047657 (Basic)	Master contract number: 220991	File number: E181974	Certificate numbers: CQC15001121716 (DW-16) CQC18001199096 (DWV-8) CQC15001121656 (D-8)	Client ID number: 77311

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6.8 Safety Limiting Values

Safety limiting intends to minimize potential damage to the isolation barrier upon failure of input or output circuitry.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
DW-16 PACKAGE						
I_S	Safety input, output, or supply current(1)	$R_{\theta JA}$ = 86.5 °C/W, V_I = 5.5 V, T_J = 150°C, T_A = 25°C, see Figure 1			263	mA
		$R_{\theta JA}$ = 86.5 °C/W, V_I = 3.6 V, T_J = 150°C, T_A = 25°C, see Figure 1			401	
		$R_{\theta JA}$ = 86.5 °C/W, V_I = 2.75 V, T_J = 150°C, T_A = 25°C, see Figure 1			525	
P_S	Safety input, output, or total power(1)	$R_{\theta JA}$ = 86.5 °C/W, T_J = 150°C, T_A = 25°C, see Figure 2			1445	mW
T_S	Maximum safety temperature(1)				150	°C
DWV-8 PACKAGE						
I_S	Safety input, output, or supply current(1)	$R_{\theta JA}$ = 84.3 °C/W, V_I = 5.5 V, T_J = 150°C, T_A = 25°C, see Figure 3			270	mA
		$R_{\theta JA}$ = 84.3 °C/W, V_I = 3.6 V, T_J = 150°C, T_A = 25°C, see Figure 3			412	
		$R_{\theta JA}$ = 84.3 °C/W, V_I = 2.75 V, T_J = 150°C, T_A = 25°C, see Figure 3			539	
P_S	Safety input, output, or total power(1)	$R_{\theta JA}$ = 84.3 °C/W, T_J = 150°C, T_A = 25°C, see Figure 4			1483	mW
T_S	Maximum safety temperature(1)				150	°C
D-8 PACKAGE						
I_S	Safety input, output, or supply current(1)	$R_{\theta JA}$ = 137.7 °C/W, V_I = 5.5 V, T_J = 150°C, T_A = 25°C, see Figure 5			165	mA
		$R_{\theta JA}$ = 137.7 °C/W, V_I = 3.6 V, T_J = 150°C, T_A = 25°C, see Figure 5			252	
		$R_{\theta JA}$ = 137.7 °C/W, V_I = 2.75 V, T_J = 150°C, T_A = 25°C, see Figure 5			330	
P_S	Safety input, output, or total power(1)	$R_{\theta JA}$ = 137.7 °C/W, T_J = 150°C, T_A = 25°C, see Figure 6			908	mW
T_S	Maximum safety temperature(1)				150	°C

(1) The maximum safety temperature, T_S, has the same value as the maximum junction temperature, T_J, specified for the device. The I_S and P_S parameters represent the safety current and safety power respectively. The maximum limits of I_S and P_S should not be exceeded. These limits vary with the ambient temperature, T_A.

The junction-to-air thermal resistance, $R_{\theta JA}$, in the *Thermal Information* 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 $T_{J(max)}$ is the maximum allowed junction temperature.

$P_S = I_S \times V_I$, where V_I is the maximum input voltage.

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6.9 Electrical Characteristics—5-V Supply

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = –4 mA; see Figure 15	V_{CCO} (1) – 0.4	4.8		V
V_{OL}	Low-level output voltage	I_{OL} = 4 mA; see Figure 15		0.2	0.4	V
$V_{IT+(IN)}$	Rising input threshold voltage			0.6 x V_{CCI}	0.7 x V_{CCI}	V
$V_{IT-(IN)}$	Falling input threshold voltage		0.3 x V_{CCI}	0.4 x V_{CCI}		V
$V_{I(HYS)}$	Input threshold voltage hysteresis		0.1 × V_{CCI}	0.2 × V_{CCI}		V
I_{IH}	High-level input current	V_{IH} = V_{CCI} (1) at INx			10	µA
I_{IL}	Low-level input current	V_{IL} = 0 V at INx	–10			µA
CMTI	Common-mode transient immunity	V_I = V_{CCI} or 0 V, V_{CM} = 1200 V; see Figure 17	85	100		kV/µs
C_I	Input Capacitance (2)	V_I = V_{CC}/ 2 + 0.4×sin(2πft), f = 1 MHz, V_{CC} = 5 V		2		pF

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

6.10 Supply Current Characteristics—5-V Supply

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

PARAMETER	TEST CONDITIONS		SUPPLY CURRENT	MIN	TYP	MAX	UNIT
ISO7720							
Supply current - DC signal	V_I = V_{CCI} (ISO7720), V_I = 0 V (ISO7720 with F suffix)		I_{CC1}		0.8	1.1	mA
			I_{CC2}		1.1	1.7	
	V_I = 0 V (ISO7720), V_I = V_{CCI} (ISO7720 with F suffix)		I_{CC1}		2.9	4.2	
			I_{CC2}		1.2	1.9	
Supply current - AC signal	All channels switching with square wave clock input; C_L = 15 pF	1 Mbps	I_{CC1}		1.8	2.7	
			I_{CC2}		1.3	1.9	
		10 Mbps	I_{CC1}		1.9	2.7	
			I_{CC2}		2.2	3	
		100 Mbps	I_{CC1}		2.5	3.2	
			I_{CC2}		11.6	14	
ISO7721							
Supply current - DC signal	V_I = V_{CCI} (ISO7721), V_I = 0 V (ISO7721 with F suffix)		I_{CC1}, I_{CC2}		1	1.6	mA
	V_I = 0 V (ISO7721), V_I = V_{CCI} (ISO7721 with F suffix)		I_{CC1}, I_{CC2}		2.2	3.2	
Supply current - AC signal	All channels switching with square wave clock input; C_L = 15 pF	1 Mbps	I_{CC1}, I_{CC2}		1.7	2.4	
		10 Mbps	I_{CC1}, I_{CC2}		2.2	3	
		100 Mbps	I_{CC1}, I_{CC2}		7.3	9	

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6.11 Electrical Characteristics—3.3-V Supply

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = –2 mA; see Figure 15	V_{CCO}(1) – 0.3	3.2		V
V_{OL}	Low-level output voltage	I_{OL} = 2 mA; see Figure 15		0.1	0.3	V
$V_{IT+(IN)}$	Rising input voltage threshold			0.6 x V_{CCI}	0.7 x V_{CCI}	V
$V_{IT-(IN)}$	Falling input voltage threshold		0.3 x V_{CCI}	0.4 x V_{CCI}		V
$V_{I(HYS)}$	Input threshold voltage hysteresis		0.1 × V_{CCI}	0.2 × V_{CCI}		V
I_{IH}	High-level input current	V_{IH} = V_{CCI}(1) at INx			10	µA
I_{IL}	Low-level input current	V_{IL} = 0 V at INx	–10			µA
CMTI	Common-mode transient immunity	V_I = V_{CCI} or 0 V, V_{CM} = 1200 V; see Figure 17	85	100		kV/µs

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

6.12 Supply Current Characteristics—3.3-V Supply

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

PARAMETER	TEST CONDITIONS		SUPPLY CURRENT	MIN	TYP	MAX	UNIT
ISO7720							
Supply current - DC signal	V_I = V_{CCI} (ISO7720), V_I = 0 V (ISO7720 with F suffix)		I_{CC1}		0.8	1.1	mA
			I_{CC2}		1.1	1.7	
	V_I = 0 V (ISO7720), V_I = V_{CCI} (ISO7720 with F suffix)		I_{CC1}		2.9	4.2	
			I_{CC2}		1.2	1.9	
Supply current - AC signal	All channels switching with square wave clock input; C_L = 15 pF	1 Mbps	I_{CC1}		1.8	2.7	
			I_{CC2}		1.2	1.9	
		10 Mbps	I_{CC1}		1.9	2.7	
			I_{CC2}		1.9	2.6	
		100 Mbps	I_{CC1}		2.2	3.1	
			I_{CC2}		8.6	11	
ISO7721							
Supply current - DC signal	V_I = V_{CCI} (ISO7721), V_I = 0 V (ISO7721 with F suffix)		I_{CC1}, I_{CC2}		1	1.6	mA
	V_I = 0 V (ISO7721), V_I = V_{CCI} (ISO7721 with F suffix)		I_{CC1}, I_{CC2}		2.2	3.2	
Supply current - AC signal	All channels switching with square wave clock input; C_L = 15 pF	1 Mbps	I_{CC1}, I_{CC2}		1.6	2.4	
		10 Mbps	I_{CC1}, I_{CC2}		2	2.8	
		100 Mbps	I_{CC1}, I_{CC2}		5.6	7	

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6.13 Electrical Characteristics—2.5-V Supply

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = –1 mA; see Figure 15	V_{CCO}(1) – 0.2	2.45		V
V_{OL}	Low-level output voltage	I_{OL} = 1 mA; see Figure 15		0.05	0.2	V
$V_{IT+(IN)}$	Rising input voltage threshold			0.6 x V_{CCI}	0.7 x V_{CCI}	V
$V_{IT-(IN)}$	Falling input voltage threshold		0.3 x V_{CCI}	0.4 x V_{CCI}		V
$V_{I(HYS)}$	Input threshold voltage hysteresis		0.1 × V_{CCI}	0.2 × V_{CCI}		V
I_{IH}	High-level input current	V_{IH} = V_{CCI}(1) at INx			10	µA
I_{IL}	Low-level input current	V_{IL} = 0 V at INx	–10			µA
CMTI	Common-mode transient immunity	V_I = V_{CCI} or 0 V, V_{CM} = 1200 V; see Figure 17	85	100		kV/µs

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

6.14 Supply Current Characteristics—2.5-V Supply

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

PARAMETER	TEST CONDITIONS		SUPPLY CURRENT	MIN	TYP	MAX	UNIT
ISO7720							
Supply current - DC signal	V_I = V_{CCI} (ISO7720), V_I = 0 V (ISO7720 with F suffix)		I_{CC1}		0.8	1.1	mA
			I_{CC2}		1.1	1.7	
	V_I = 0 V (ISO7720), V_I = V_{CCI} (ISO7720 with F suffix)		I_{CC1}		2.9	4.2	
			I_{CC2}		1.2	1.9	
Supply current - AC signal	All channels switching with square wave clock input; C_L = 15 pF	1 Mbps	I_{CC1}		1.8	2.7	
			I_{CC2}		1.3	1.9	
		10 Mbps	I_{CC1}		1.9	2.7	
			I_{CC2}		1.7	2.4	
		100 Mbps	I_{CC1}		2.2	3	
			I_{CC2}		6.8	9	
ISO7721							
Supply current - DC signal	V_I = V_{CCI} (ISO7721), V_I = 0 V (ISO7721 with F suffix)		I_{CC1}, I_{CC2}		1	1.6	mA
	V_I = 0 V (ISO7721), V_I = V_{CCI} (ISO7721 with F suffix)		I_{CC1}, I_{CC2}		2.2	3.2	
Supply current - AC signal	All channels switching with square wave clock input; C_L = 15 pF	1 Mbps	I_{CC1}, I_{CC2}		1.6	2.4	
		10 Mbps	I_{CC1}, I_{CC2}		1.9	2.7	
		100 Mbps	I_{CC1}, I_{CC2}		4.6	6	

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6.15 Switching Characteristics—5-V Supply

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay time	See Figure 15	6	11	16	ns
PWD	Pulse width distortion(1) $\lvert t_{PHL} - t_{PLH} \rvert$			0.5	4.9	ns
$t_{sk(o)}$	Channel-to-channel output skew time(2)	Same direction channels			4	ns
$t_{sk(pp)}$	Part-to-part skew time(3)				4.5	ns
t_r	Output signal rise time	See Figure 15		1.8	3.9	ns
t_f	Output signal fall time			1.9	3.9	ns
t_{DO}	Default output delay time from input power loss	Measured from the time V_{CC} goes below 1.7 V. See Figure 16		0.1	0.3	µs
t_{ie}	Time interval error	2^{16} – 1 PRBS data at 100 Mbps		1		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—3.3-V Supply

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay time	See Figure 15	6	11	16	ns
PWD	Pulse width distortion(1) $\lvert t_{PHL} - t_{PLH} \rvert$			0.5	5	ns
$t_{sk(o)}$	Channel-to-channel output skew time(2)	Same direction channels			4.1	ns
$t_{sk(pp)}$	Part-to-part skew time(3)				4.5	ns
t_r	Output signal rise time	See Figure 15		0.7	3	ns
t_f	Output signal fall time			0.7	3	ns
t_{DO}	Default output delay time from input power loss	Measured from the time V_{CC} goes below 1.7 V. See Figure 16		0.1	0.3	µs
t_{ie}	Time interval error	2^{16} – 1 PRBS data at 100 Mbps		1		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—2.5-V Supply

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay time	See Figure 15	7.5	12	18.5	ns
PWD	Pulse width distortion(1) $\lvert t_{PHL} - t_{PLH} \rvert$			0.5	5.1	ns
$t_{sk(o)}$	Channel-to-channel output skew time(2)	Same direction channels			4.1	ns
$t_{sk(pp)}$	Part-to-part skew time(3)				4.6	ns
t_r	Output signal rise time	See Figure 15		1	3.5	ns
t_f	Output signal fall time			1	3.5	ns
t_{DO}	Default output delay time from input power loss	Measured from the time V_{CC} goes below 1.7 V. See Figure 16		0.1	0.3	µs
t_{ie}	Time interval error	2^{16} – 1 PRBS data at 100 Mbps		1		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.

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6.18 Insulation Characteristics Curves

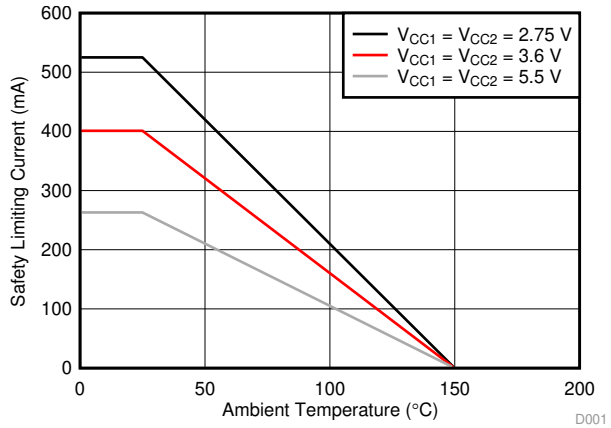

Figure 1. Thermal Derating Curve for Limiting Current per VDE for DW-16 Package

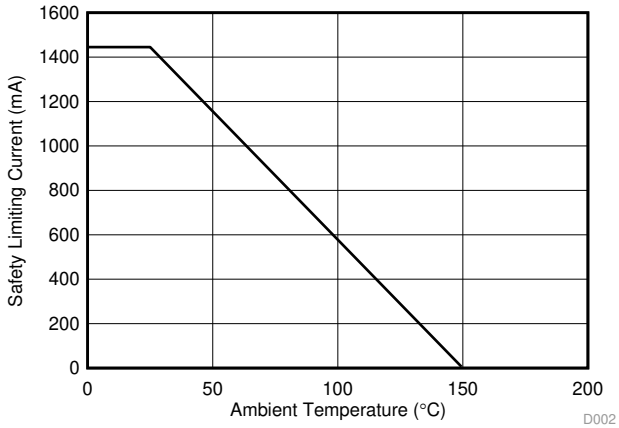

Figure 2. Thermal Derating Curve for Limiting Power per VDE for DW-16 Package

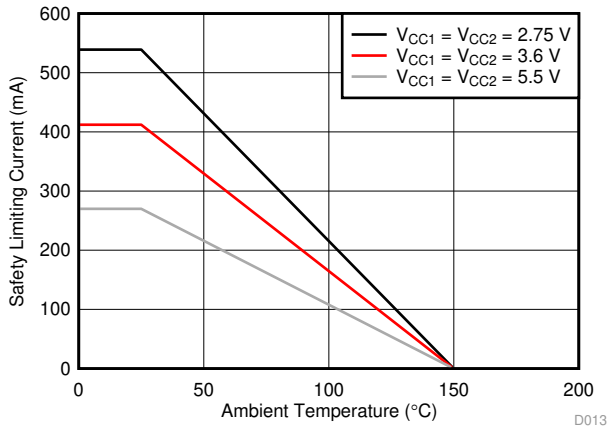

Figure 3. Thermal Derating Curve for Limiting Current per VDE for DWV-8 Package

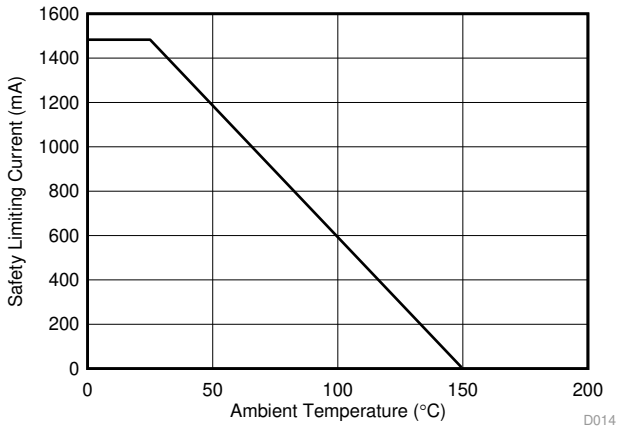

Figure 4. Thermal Derating Curve for Limiting Power per VDE for DWV-8 Package

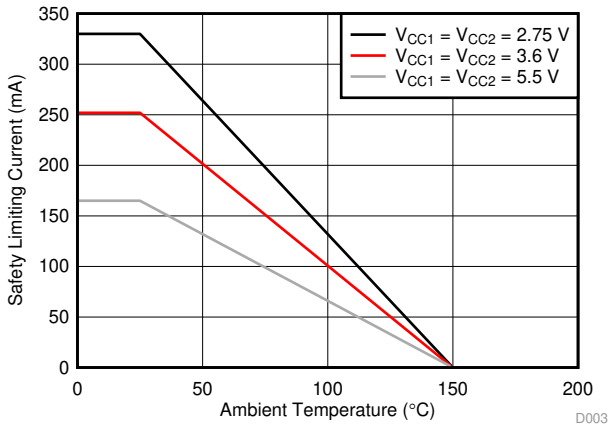

Figure 5. Thermal Derating Curve for Limiting Current per VDE for D-8 Package

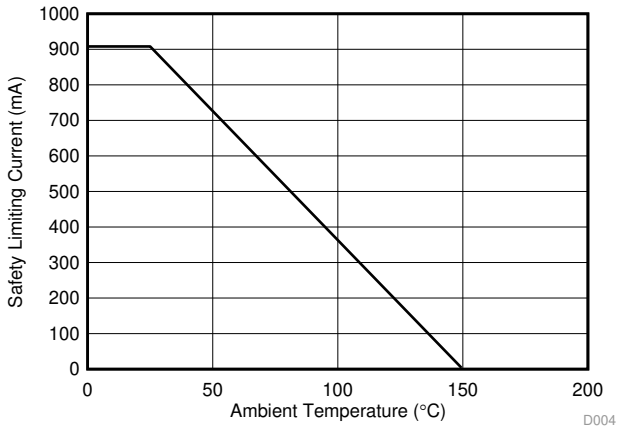

Figure 6. Thermal Derating Curve for Limiting Power per VDE for D-8 Package

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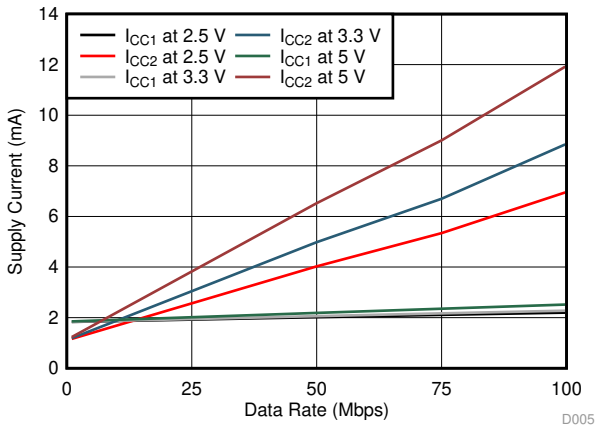
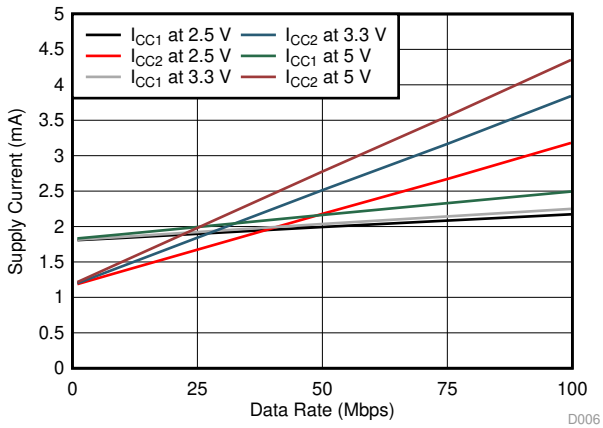
6.19 Typical Characteristics



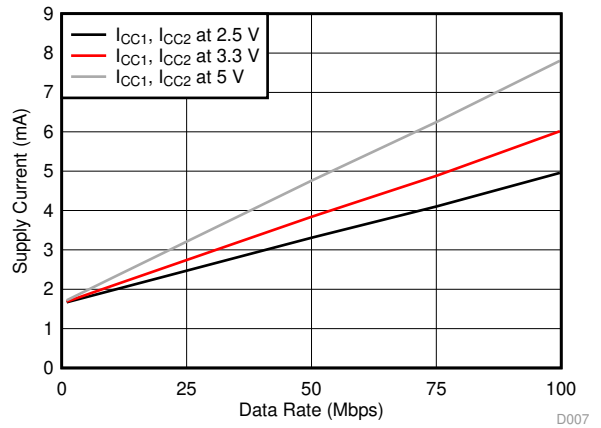
T_A = 25°C C_L = 15 pF

Figure 7. ISO7720 Supply Current vs Data Rate (With 15-pF Load)



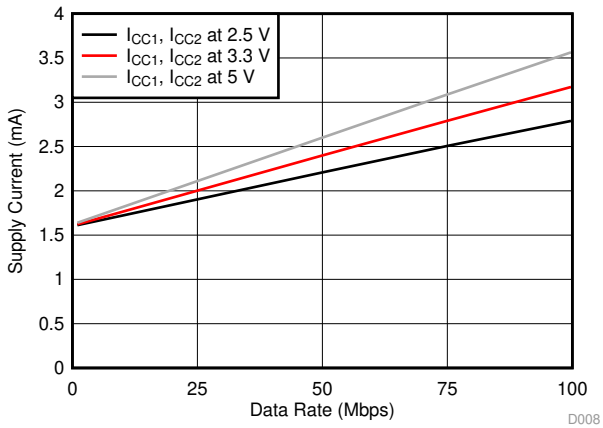
T_A = 25°C C_L = No Load

Figure 8. ISO7720 Supply Current vs Data Rate (With No Load)



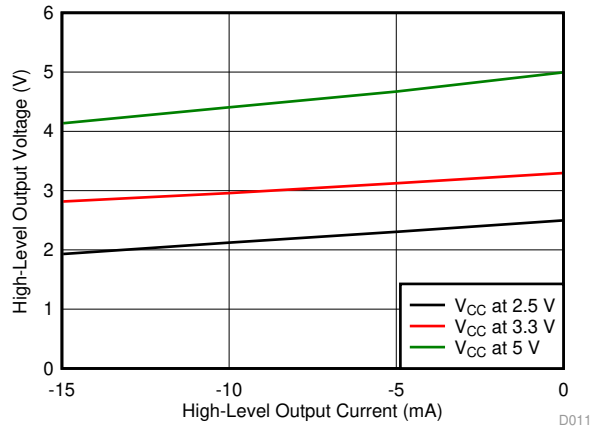
T_A = 25°C C_L = 15 pF

Figure 9. ISO7721 Supply Current vs Data Rate (With 15-pF Load)



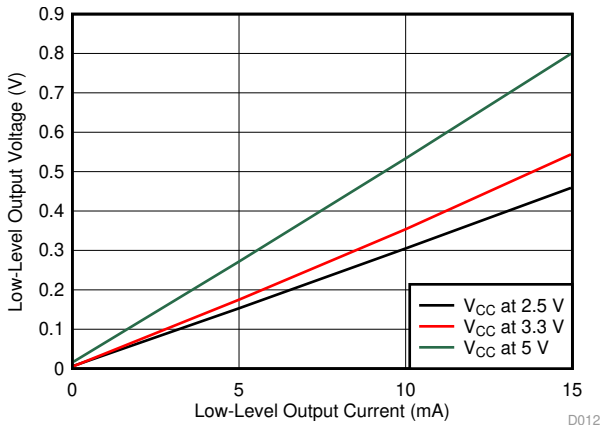
T_A = 25°C C_L = No Load

Figure 10. ISO7721 Supply Current vs Data Rate (With No Load)



T_A = 25°C

Figure 11. High-Level Output Voltage vs High-level Output Current



T_A = 25°C

Figure 12. Low-Level Output Voltage vs Low-Level Output Current

Typical Characteristics (continued)

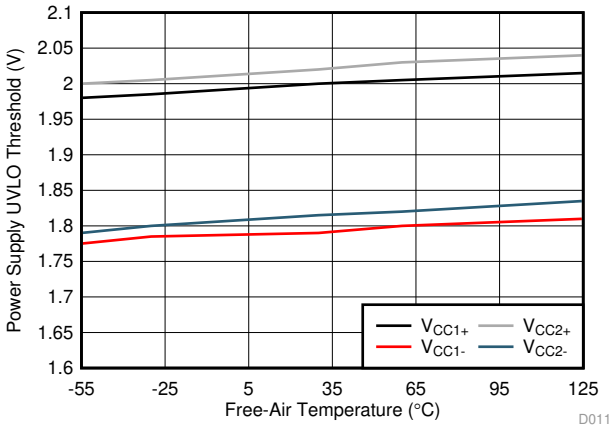


Figure 13. Power Supply Undervoltage Threshold vs Free-Air Temperature

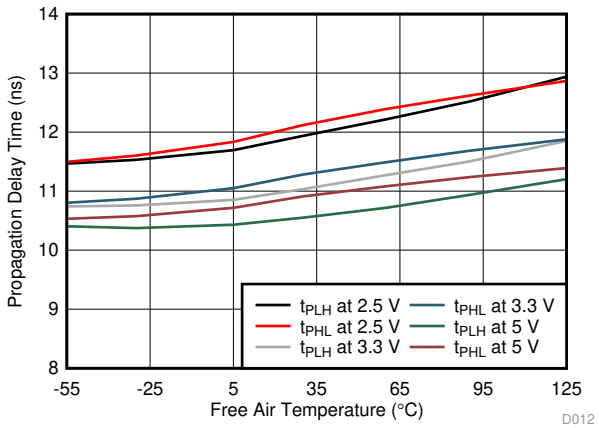


Figure 14. Propagation Delay Time vs Free-Air Temperature

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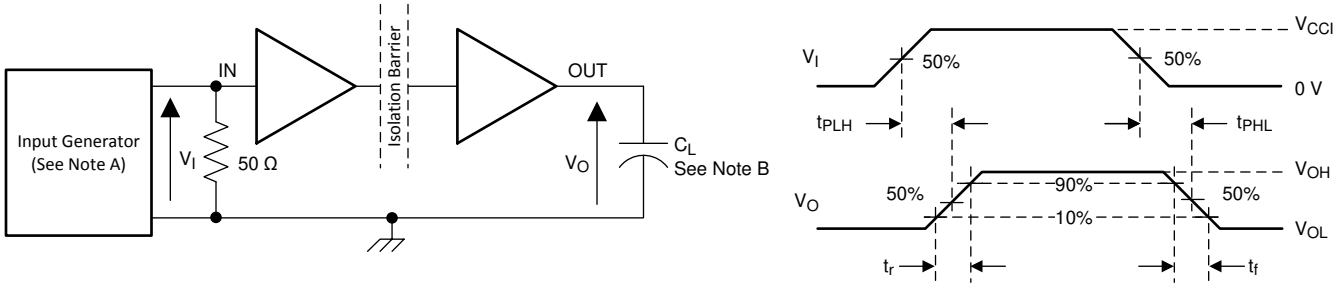
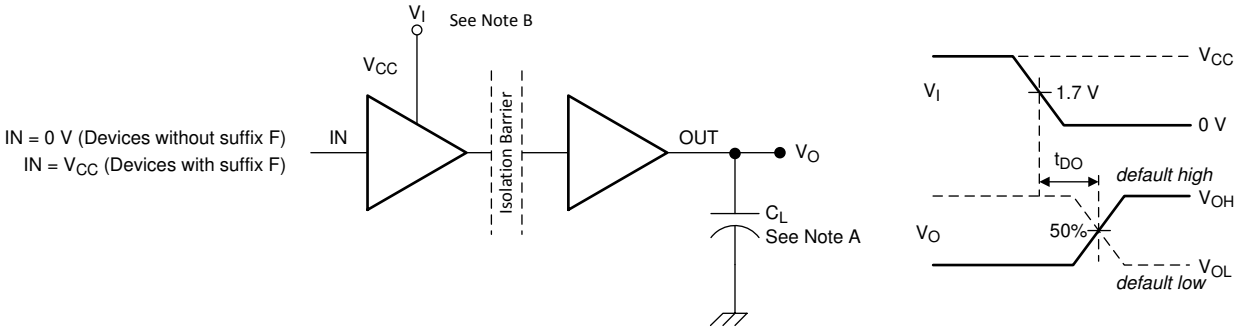
7 Parameter Measurement Information



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. At the input, 50 Ω resistor is required to terminate Input Generator signal. It is not needed in actual application.

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

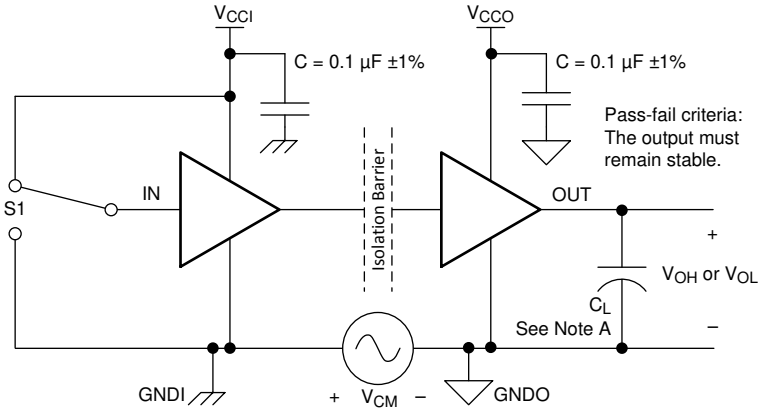
Figure 15. Switching Characteristics Test Circuit and Voltage Waveforms



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

B. Power Supply Ramp Rate = 10 mV/ns

Figure 16. Default Output Delay Time Test Circuit and Voltage Waveforms



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

Figure 17. Common-Mode Transient Immunity Test Circuit

8 Detailed Description

8.1 Overview

The ISO772x family of devices has 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. These devices also incorporate advanced circuit techniques to maximize the CMTI performance and minimize the radiated emissions due the high frequency carrier and IO buffer switching. The conceptual block diagram of a digital capacitive isolator, Figure 18, shows a functional block diagram of a typical channel.

8.2 Functional Block Diagram

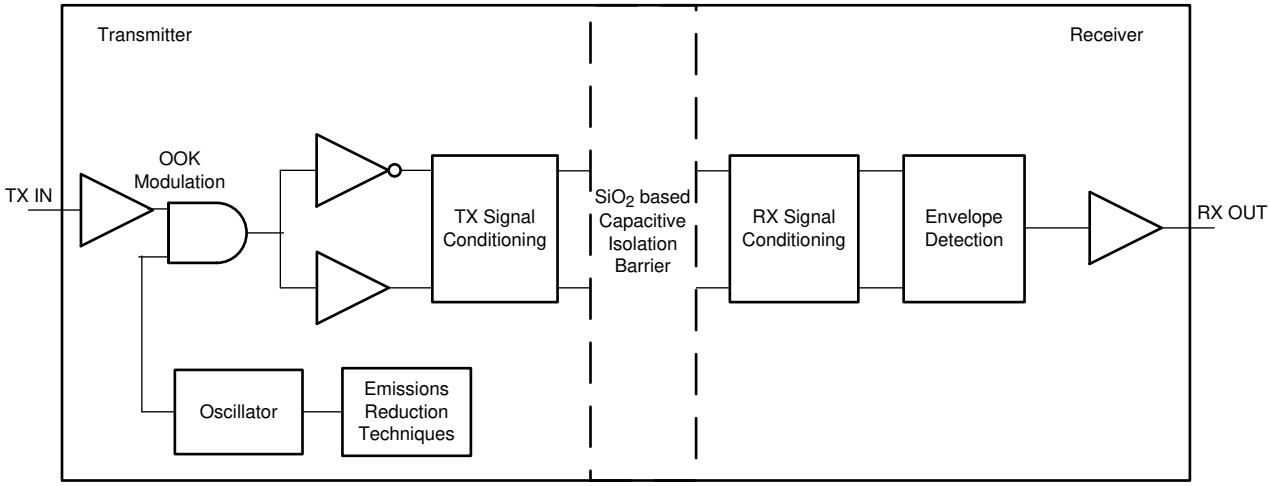


Figure 18. Conceptual Block Diagram of a Digital Capacitive Isolator

Figure 19 shows a conceptual detail of how the OOK scheme works.

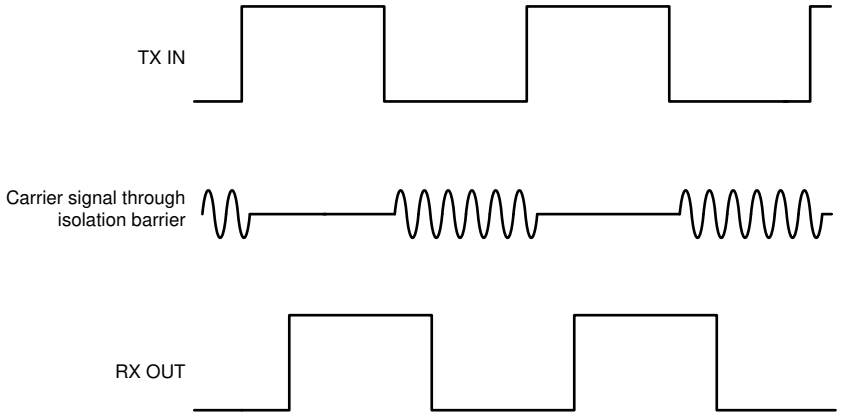


Figure 19. On-Off Keying (OOK) Based Modulation Scheme

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8.3 Feature Description

The ISO772x family of devices is available in two channel configurations and default output state options to enable a variety of application uses. Table 1 lists the device features of the ISO772x devices.

Table 1. Device Features

PART NUMBER	MAXIMUM DATA RATE	CHANNEL DIRECTION	DEFAULT OUTPUT STATE	PACKAGE	RATED ISOLATION(1)
ISO7720	100 Mbps	2 Forward, 0 Reverse	High	DW-16	5000 V_{RMS} / 8000 V_{PK}
				DWV-8	5000 V_{RMS} / 7071 V_{PK}
				D-8	3000 V_{RMS} / 4242 V_{PK}
ISO7720F	100 Mbps	2 Forward, 0 Reverse	Low	DW-16	5000 V_{RMS} / 8000 V_{PK}
				DWV-8	5000 V_{RMS} / 7071 V_{PK}
				D-8	3000 V_{RMS} / 4242 V_{PK}
ISO7721	100 Mbps	1 Forward, 1 Reverse	High	DW-16	5000 V_{RMS} / 8000 V_{PK}
				DWV-8	5000 V_{RMS} / 7071 V_{PK}
				D-8	3000 V_{RMS} / 4242 V_{PK}
ISO7721F	100 Mbps	1 Forward, 1 Reverse	Low	DW-16	5000 V_{RMS} / 8000 V_{PK}
				DWV-8	5000 V_{RMS} / 7071 V_{PK}
				D-8	3000 V_{RMS} / 4242 V_{PK}
ISO7721B	100 Mbps	1 Forward, 1 Reverse	High	DW-16	5000 V_{RMS} / 8000 V_{PK}
ISO7721FB	100 Mbps	1 Forward, 1 Reverse	Low	DW-16	5000 V_{RMS} / 8000 V_{PK}

(1) See the *Safety-Related Certifications* section for detailed isolation ratings.

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 regulated by international standards such as IEC 61000-4-x and CISPR 22. Although system-level performance and reliability depends, to a large extent, on the application board design and layout, the ISO772x family of devices incorporates many chip-level design improvements for overall system robustness. Some of these improvements include:

- Robust ESD protection cells for input and output signal pins and inter-chip bond pads.
- Low-resistance connectivity of ESD cells to supply and ground pins.
- Enhanced performance of high voltage isolation capacitor for better tolerance of ESD, EFT and surge events.
- Bigger on-chip decoupling capacitors to bypass undesirable high energy signals through a low impedance path.
- PMOS and NMOS devices isolated from each other by using guard rings to avoid triggering of parasitic SCRs.
- Reduced common mode currents across the isolation barrier by ensuring purely differential internal operation.

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8.4 Device Functional Modes

Table 2 lists the functional modes for the ISO772x devices.

Table 2. Function Table(1)

V_{CCI}	V_{CCO}	INPUT (INx)(2)	OUTPUT (OUTx)	COMMENTS
PU	PU	H	H	Normal Operation: A channel output assumes the logic state of the input.
		L	L	
		Open	Default	Default mode: When INx is open, the corresponding channel output goes to the default logic state. The default is *High* for ISO772x and *Low* for ISO772x with F suffix.
PD	PU	X	Default	Default mode: When V_{CCI} is unpowered, a channel output assumes the logic state based on the selected default option. The default is *High* for ISO772x and *Low* for ISO772x with F suffix. When V_{CCI} transitions from unpowered to powered-up, a channel output assumes the logic state of the input. When V_{CCI} transitions from powered-up to unpowered, channel output assumes the selected default state.
X	PD	X	Undetermined	When V_{CCO} is unpowered, a channel output is undetermined(3). When V_{CCO} transitions from unpowered to powered-up, a channel output assumes the logic state of the input

(1) V_{CCI} = Input-side V_{CC}; V_{CCO} = Output-side V_{CC}; PU = Powered up (V_{CC} ≥ 2.25 V); PD = Powered down (V_{CC} ≤ 1.7 V); X = Irrelevant; H = High level; L = Low level
(2) A strongly driven input signal can weakly power the floating V_{CC} via an internal protection diode and cause undetermined output.
(3) The outputs are in undetermined state when 1.7 V < V_{CCI}, V_{CCO} < 2.25 V.

8.4.1 Device I/O Schematics

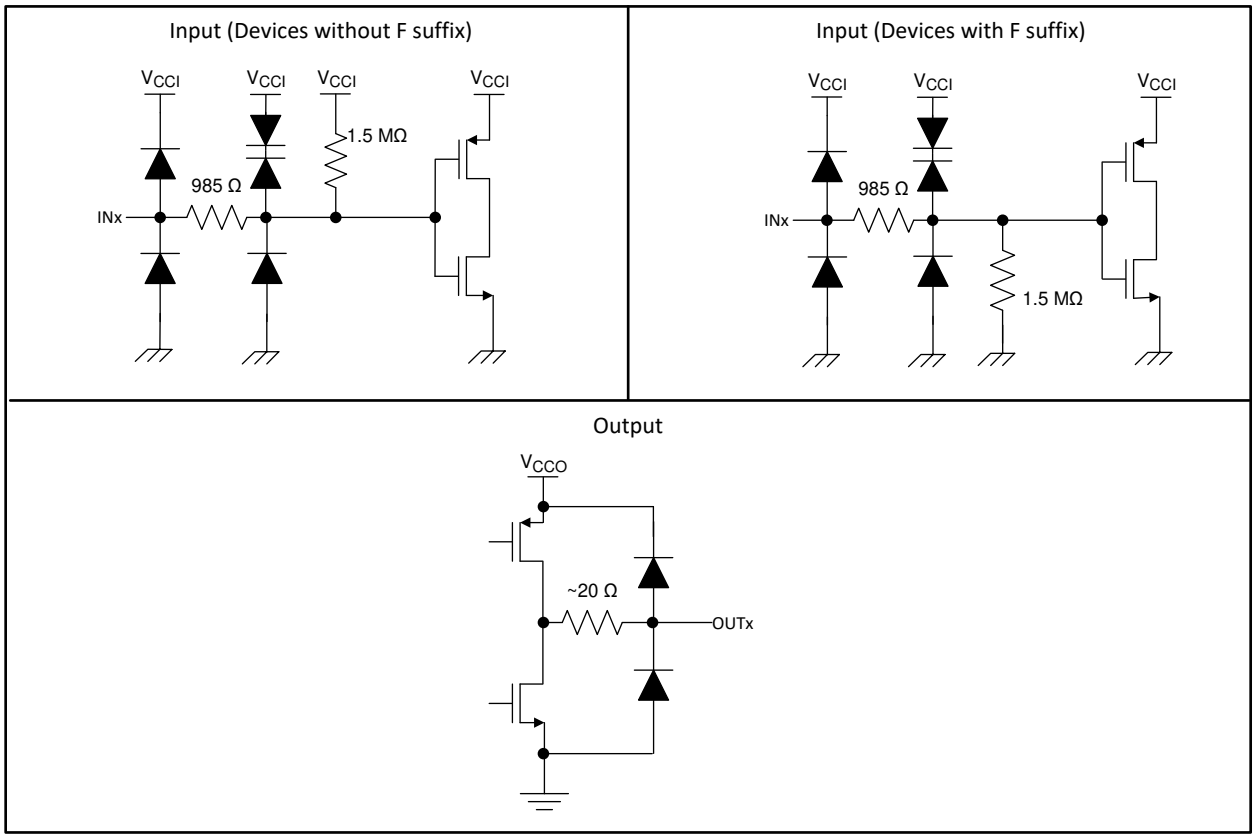

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Figure 20. Device I/O Schematics

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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 the 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 ISO772x devices are high-performance, dual-channel digital isolators. The devices use single-ended CMOS-logic switching technology. The supply voltage range is from 2.25 V to 5.5 V for both supplies, V_{CC1} and V_{CC2}. 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, μC or UART), and a data converter or a line transceiver, regardless of the interface type or standard.

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9.2 Typical Application

The ISO7721 device can be used with Texas Instruments' mixed signal microcontroller, digital-to-analog converter, transformer driver, and voltage regulator to create an isolated 4-mA to 20-mA current loop.

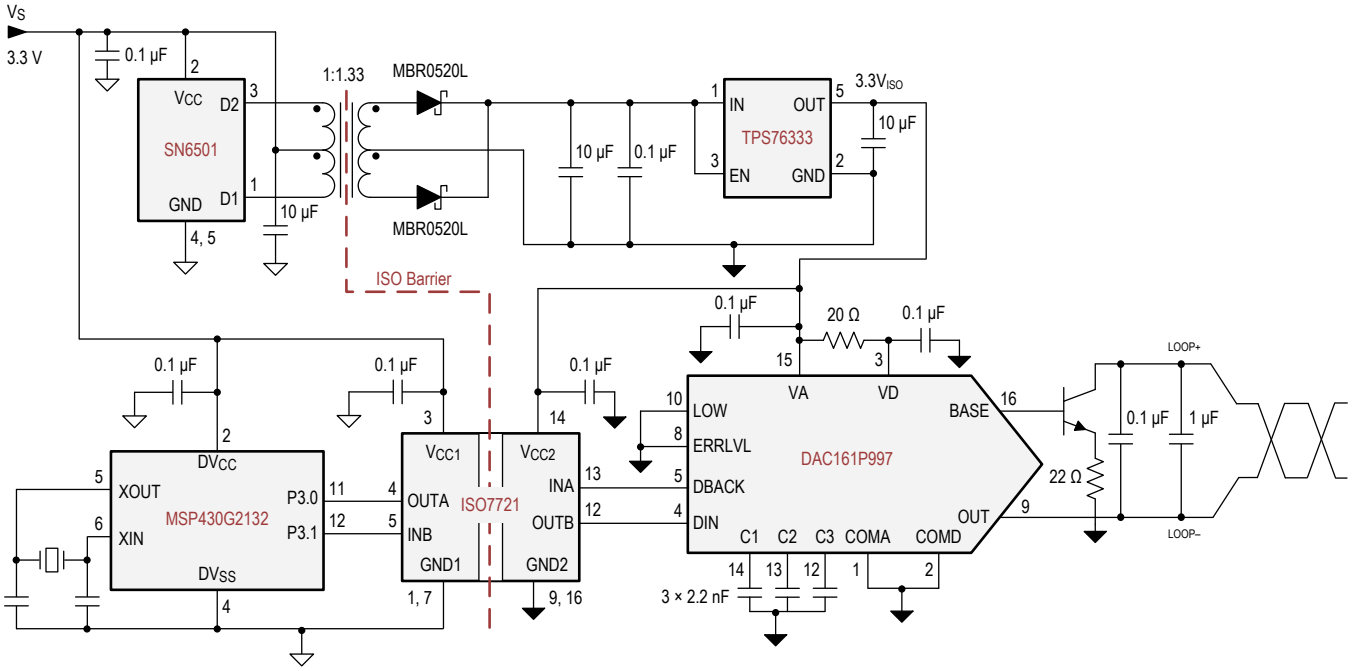

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Figure 21. Isolated 4-mA to 20-mA Current Loop

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Typical Application (continued)

9.2.1 Design Requirements

To design with these devices, use the parameters listed in Table 3.

Table 3. Design Parameters

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

9.2.2 Detailed Design Procedure

Unlike optocouplers, which require external components to improve performance, provide bias, or limit current, the ISO772x devices only require two external bypass capacitors to operate.

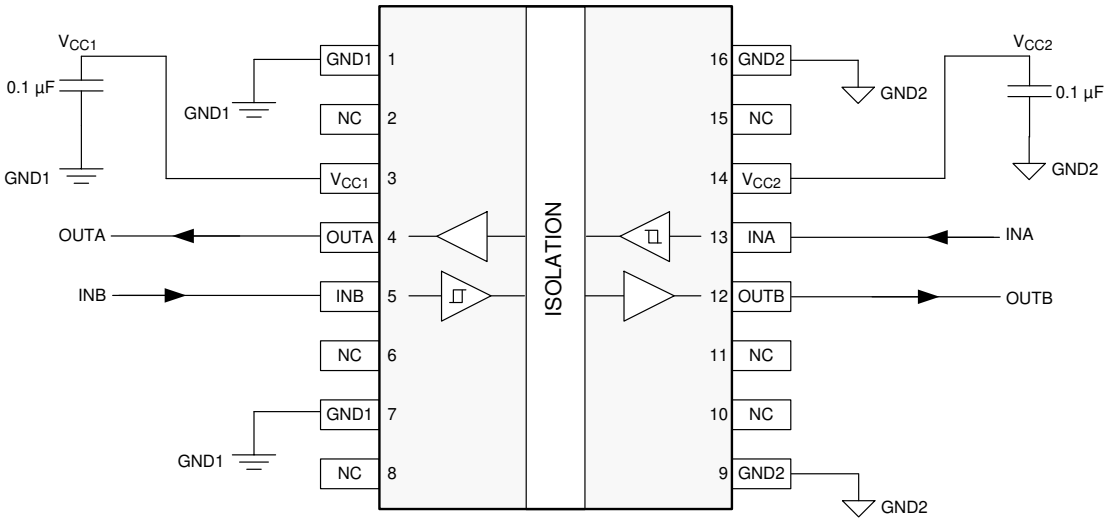

Figure 22. Typical ISO7721 Circuit Hook-up

9.2.3 Application Curve

The following typical eye diagrams of the ISO772x family of devices indicate low jitter and wide open eye at the maximum data rate of 100 Mbps.

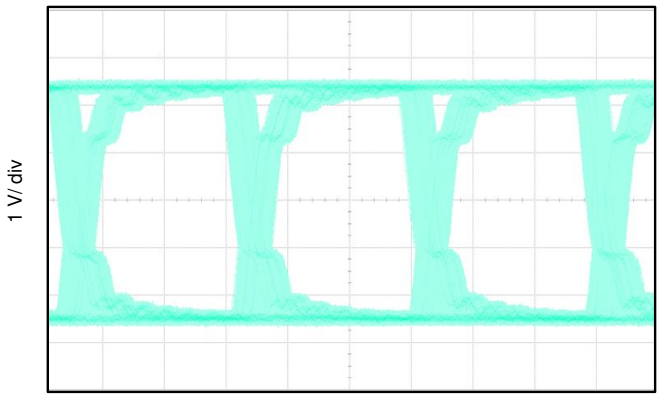

Figure 23. ISO7720 Eye Diagram at 100 Mbps PRBS, 5-V Supplies and 25°C

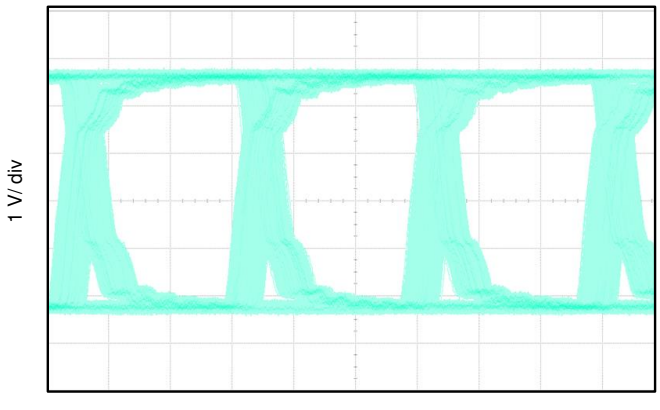

Figure 24. ISO7721 Eye Diagram at 100 Mbps PRBS, 5-V Supplies and 25°C

9.2.3.1 Insulation Lifetime

Insulation lifetime projection data is collected by using industry-standard Time Dependent Dielectric Breakdown (TDDB) test method. In this test, all pins on each side of the barrier are tied together creating a two-terminal device and high voltage applied between the two sides; See Figure 25 for TDDB test setup. The insulation breakdown data is collected at various high voltages switching at 60 Hz over temperature. For reinforced insulation, VDE standard requires the use of TDDB projection line with failure rate of less than 1 part per million (ppm). Even though the expected minimum insulation lifetime is 20 years at the specified working isolation voltage, VDE reinforced certification requires additional safety margin of 20% for working voltage and 87.5% for lifetime which translates into minimum required insulation lifetime of 37.5 years at a working voltage that's 20% higher than the specified value.

Figure 26 shows the intrinsic capability of the isolation barrier to withstand high voltage stress over its lifetime. Based on the TDDB data, the intrinsic capability of the insulation is 1500 V_{RMS} with a lifetime of 135 years. Other factors, such as package size, pollution degree, material group, etc. can further limit the working voltage of the component. The working voltage of DW-16 and DWV-8 packages is specified up to 1500 V_{RMS} and D-8 package up to 450 V_{RMS}. At the lower working voltages, the corresponding insulation lifetime is much longer than 135 years.

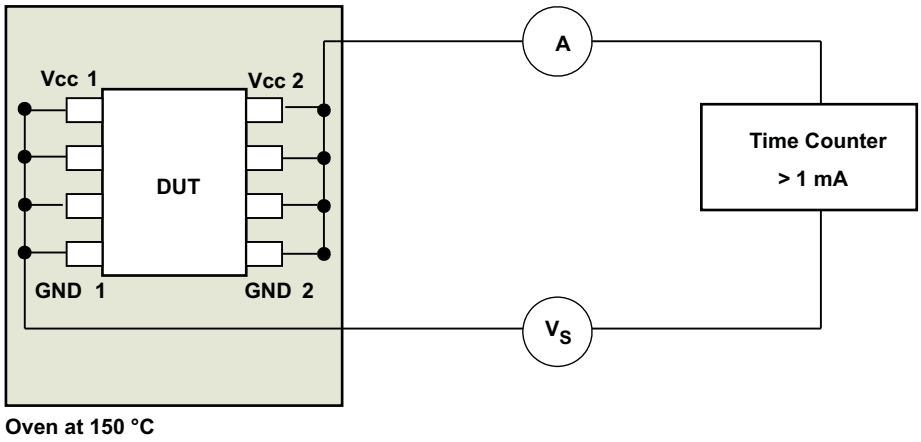

Figure 25. Test Setup for Insulation Lifetime Measurement

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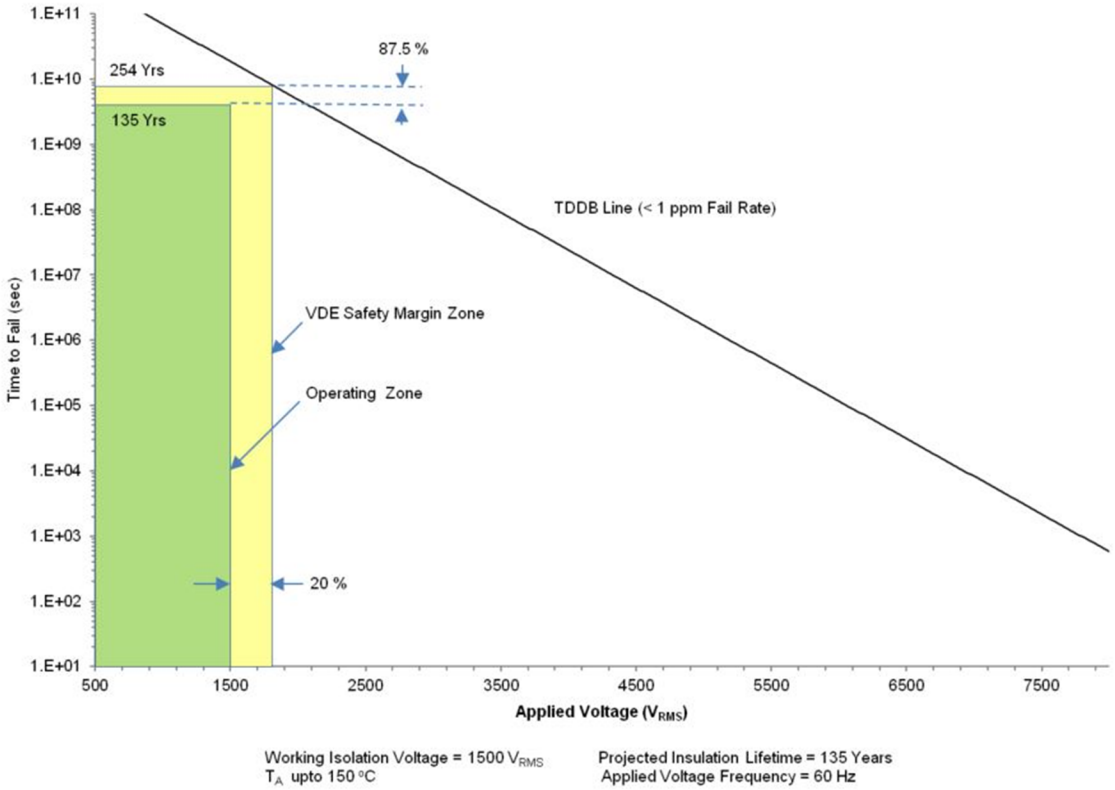

Figure 26. Insulation Lifetime Projection Data

10 Power Supply Recommendations

To help ensure reliable operation at data rates and supply voltages, a 0.1-μF bypass capacitor is recommended at the 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 or SN6505A. For such applications, detailed power supply design and transformer selection recommendations are available in *SN6501 Transformer Driver for Isolated Power Supplies* or *SN6505 Low-Noise 1-A Transformer Drivers for Isolated Power Supplies*.

11 Layout

11.1 Layout Guidelines

A minimum of four layers is required to accomplish a low EMI PCB design (see Figure 27). Layer stacking should 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 their 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 100 pF/in^2.
- Routing the slower speed control signals on the bottom layer allows 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. This makes the stack mechanically stable and prevents it from 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*.

11.1.1 PCB Material

For digital circuit boards operating at less than 150 Mbps, (or rise and fall times greater than 1 ns), and trace lengths of up to 10 inches, use standard FR-4 UL94V-0 printed circuit board. This PCB is preferred over cheaper alternatives because of lower dielectric losses at high frequencies, less moisture absorption, greater strength and stiffness, and the self-extinguishing flammability-characteristics.

11.2 Layout Example

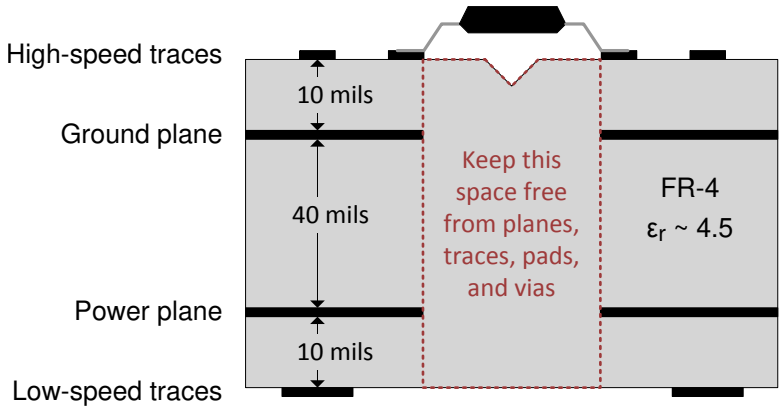

Figure 27. Layout Example

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12 Device and Documentation Support

12.1 Device Support

12.1.1 Development Support

For development support, refer to:

- Isolated CAN Flexible Data (FD) Rate Repeater Reference Design
- Isolated 16-Channel AC Analog Input Module Reference Design Using Dual Simultaneously Sampled ADCs
- Polyphase Shunt Metrology with Isolated AFE Reference Design
- Reference Design for Power-Isolated Ultra-Compact Analog Output Module

12.2 Documentation Support

12.2.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, *Digital Isolator Design Guide*
- Texas Instruments, *How to use isolation to improve ESD, EFT and Surge immunity in industrial systems* application report
- Texas Instruments, *Isolation Glossary*
- Texas Instruments, *DAC161P997 Single-Wire 16-bit DAC for 4- to 20-mA Loops* data sheet
- Texas Instruments, MSP430G2132 *Mixed Signal Microcontroller* data sheet
- Texas Instruments, *SN6501 Transformer Driver for Isolated Power Supplies* data sheet
- Texas Instruments, TPS76333 *Low-Power 150-mA Low-Dropout Linear Regulators* data sheet

12.3 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 4. Related Links

PARTS	PRODUCT FOLDER	ORDER NOW	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
ISO7720	Click here	Click here	Click here	Click here	Click here
ISO7721	Click here	Click here	Click here	Click here	Click here

12.4 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

12.5 Community 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.

12.6 Trademarks

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All other trademarks are the property of their respective owners.

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12.7 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.

12.8 Glossary

SLYZ022 — *TI Glossary*.

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

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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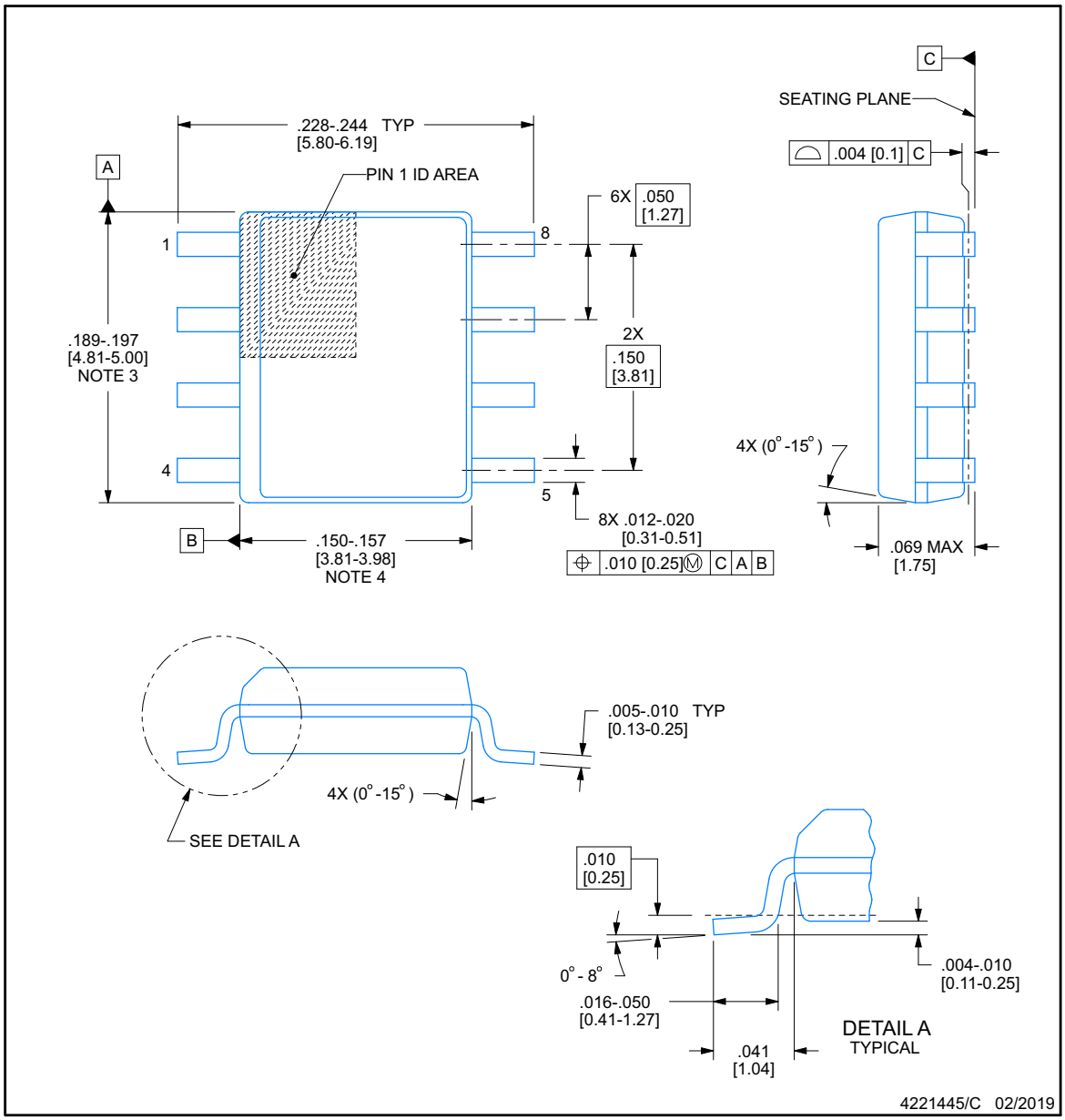
PACKAGE OUTLINE

D0008B

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15], per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

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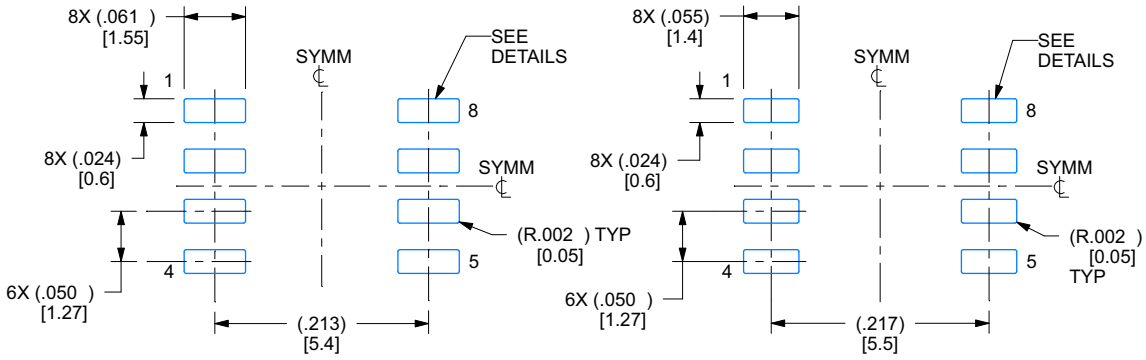
EXAMPLE BOARD LAYOUT

D0008B

SOIC - 1.75 mm max height

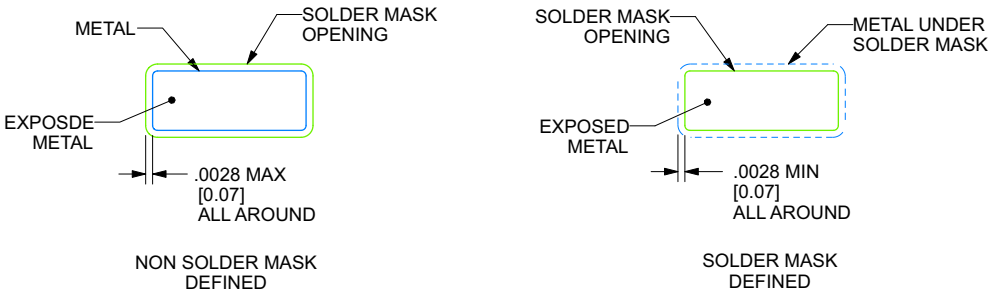
SMALL OUTLINE INTEGRATED CIRCUIT



IPC-7351 NOMINAL
.150 [3.85] CLEARANCE / CREEPAGE

HV / ISOLATION OPTION
.162 [4.1] CLEARANCE / CREEPAGE

LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X



NON SOLDER MASK
DEFINED

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

4221445/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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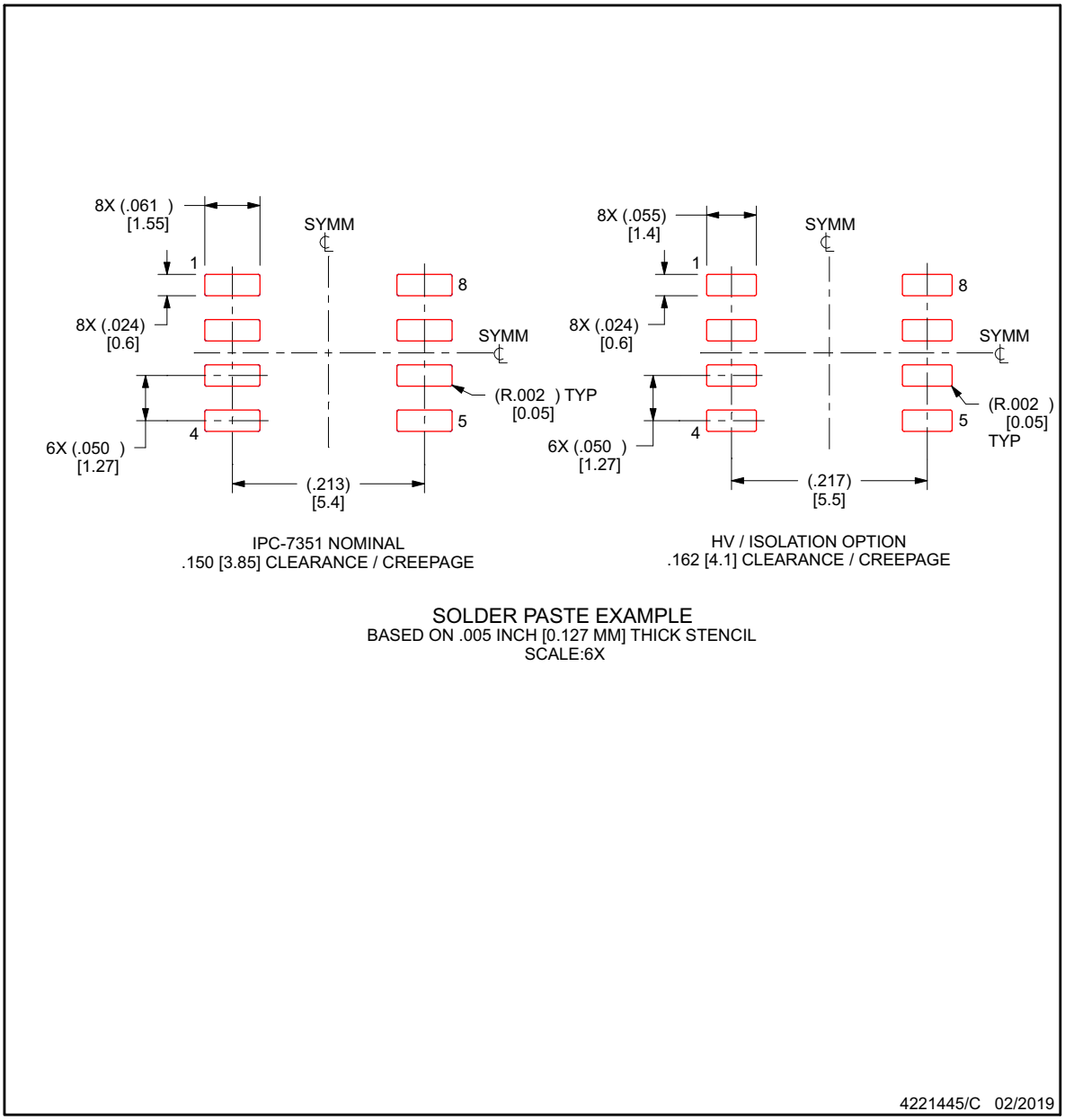
EXAMPLE STENCIL DESIGN

D0008B

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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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
ISO7720D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720	Samples
ISO7720DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720	Samples
ISO7720DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7720	Samples
ISO7720DWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7720	Samples
ISO7720DWV	ACTIVE	SOIC	DWV	8	64	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720	Samples
ISO7720DWVR	ACTIVE	SOIC	DWV	8	1000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720	Samples
ISO7720FD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720F	Samples
ISO7720FDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720F	Samples
ISO7720FDW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7720F	Samples
ISO7720FDWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7720F	Samples
ISO7720FDWV	ACTIVE	SOIC	DWV	8	64	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720F	Samples
ISO7720FDWVR	ACTIVE	SOIC	DWV	8	1000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7720F	Samples
ISO7721BDW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721B	Samples
ISO7721BDWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721B	Samples
ISO7721D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721	Samples
ISO7721DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721	Samples
ISO7721DW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721	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
ISO7721DWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721	Samples
ISO7721DWV	ACTIVE	SOIC	DWV	8	64	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721	Samples
ISO7721DWVR	ACTIVE	SOIC	DWV	8	1000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721	Samples
ISO7721FBDW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721FB	Samples
ISO7721FBDWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721FB	Samples
ISO7721FD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721F	Samples
ISO7721FDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721F	Samples
ISO7721FDW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721F	Samples
ISO7721FDWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	ISO7721F	Samples
ISO7721FDWV	ACTIVE	SOIC	DWV	8	64	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721F	Samples
ISO7721FDWVR	ACTIVE	SOIC	DWV	8	1000	Green (RoHS & no Sb/Br)	NIPDAU	Level-2-260C-1 YEAR	-55 to 125	7721F	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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 ISO7720, ISO7721 :

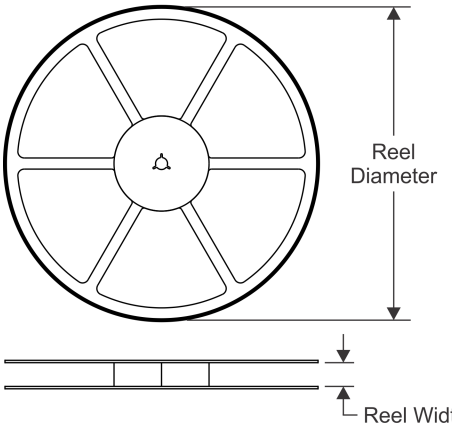
- Automotive: ISO7720-Q1, ISO7721-Q1

NOTE: Qualified Version Definitions:

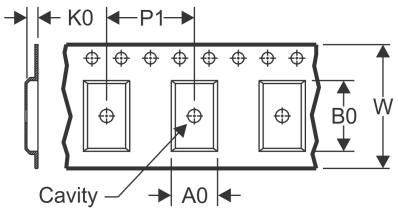
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

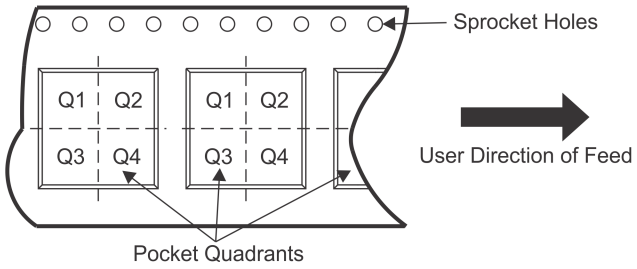


TAPE DIMENSIONS



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

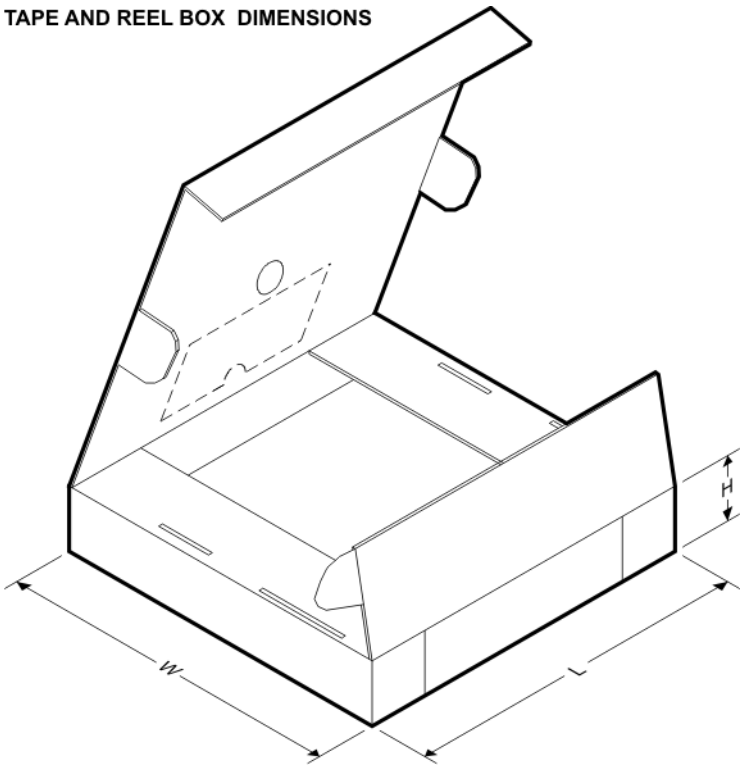
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

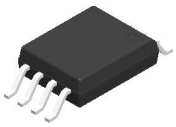
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ISO7720DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7720DWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7720DWVR	SOIC	DWV	8	1000	330.0	16.4	12.05	6.15	3.3	16.0	16.0	Q1
ISO7720FDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7720FDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7720FDWVR	SOIC	DWV	8	1000	330.0	16.4	12.05	6.15	3.3	16.0	16.0	Q1
ISO7721BDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7721DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7721DWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7721DWVR	SOIC	DWV	8	1000	330.0	16.4	12.05	6.15	3.3	16.0	16.0	Q1
ISO7721FBDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7721FDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
ISO7721FDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7721FDWVR	SOIC	DWV	8	1000	330.0	16.4	12.05	6.15	3.3	16.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

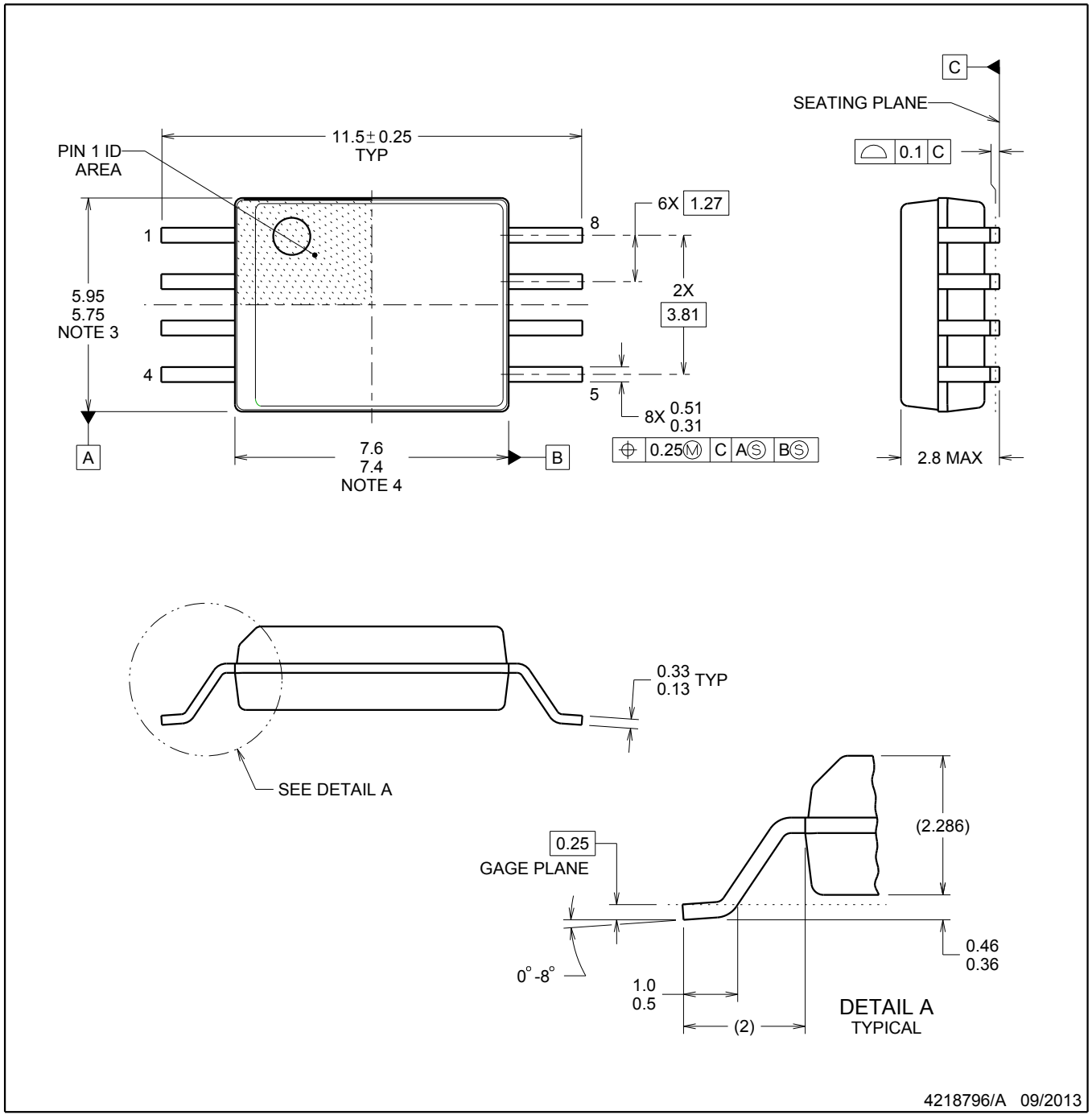
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
ISO7720DR	SOIC	D	8	2500	350.0	350.0	43.0
ISO7720DWR	SOIC	DW	16	2000	350.0	350.0	43.0
ISO7720DWVR	SOIC	DWV	8	1000	350.0	350.0	43.0
ISO7720FDR	SOIC	D	8	2500	350.0	350.0	43.0
ISO7720FDWR	SOIC	DW	16	2000	350.0	350.0	43.0
ISO7720FDWVR	SOIC	DWV	8	1000	350.0	350.0	43.0
ISO7721BDWR	SOIC	DW	16	2000	535.4	167.6	48.3
ISO7721DR	SOIC	D	8	2500	350.0	350.0	43.0
ISO7721DWR	SOIC	DW	16	2000	350.0	350.0	43.0
ISO7721DWVR	SOIC	DWV	8	1000	350.0	350.0	43.0
ISO7721FBDWR	SOIC	DW	16	2000	350.0	350.0	43.0
ISO7721FDR	SOIC	D	8	2500	350.0	350.0	43.0
ISO7721FDWR	SOIC	DW	16	2000	350.0	350.0	43.0
ISO7721FDWVR	SOIC	DWV	8	1000	350.0	350.0	43.0



DWV0008A

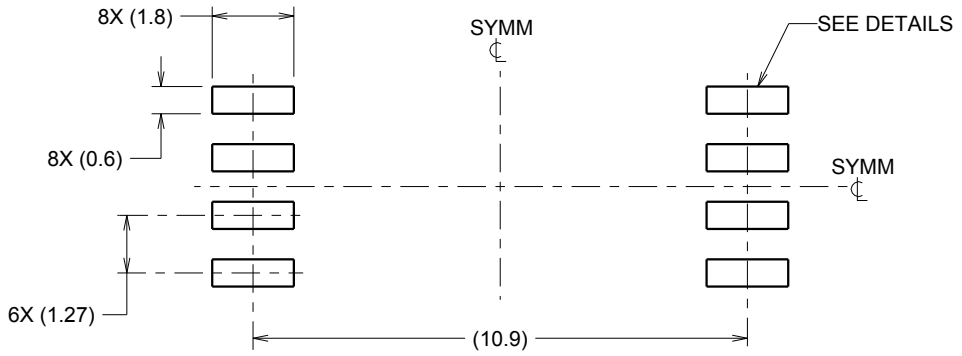
SOIC - 2.8 mm max height

SOIC

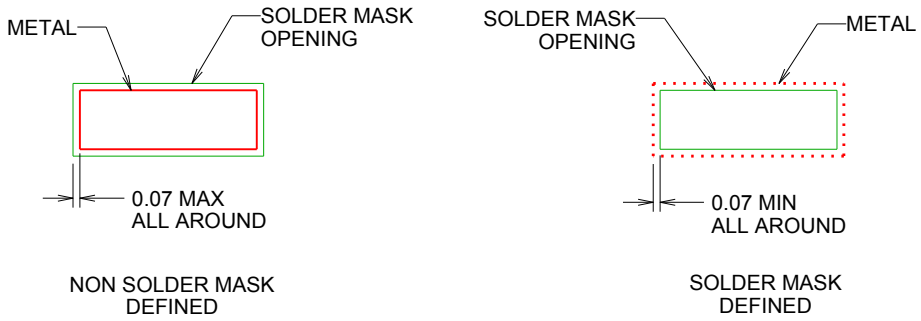


NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.



LAND PATTERN EXAMPLE
9.1 mm NOMINAL CLEARANCE/CREEPAGE
SCALE:6X



SOLDER MASK DETAILS

4218796/A 09/2013

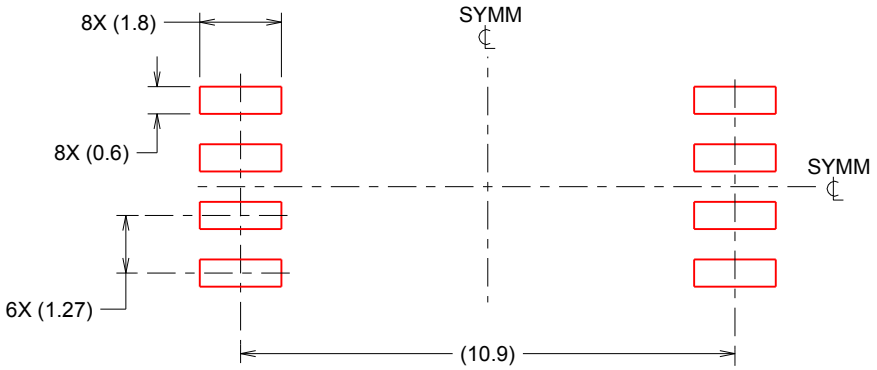
NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

DWV0008A

SOIC - 2.8 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4218796/A 09/2013

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

GENERIC PACKAGE VIEW

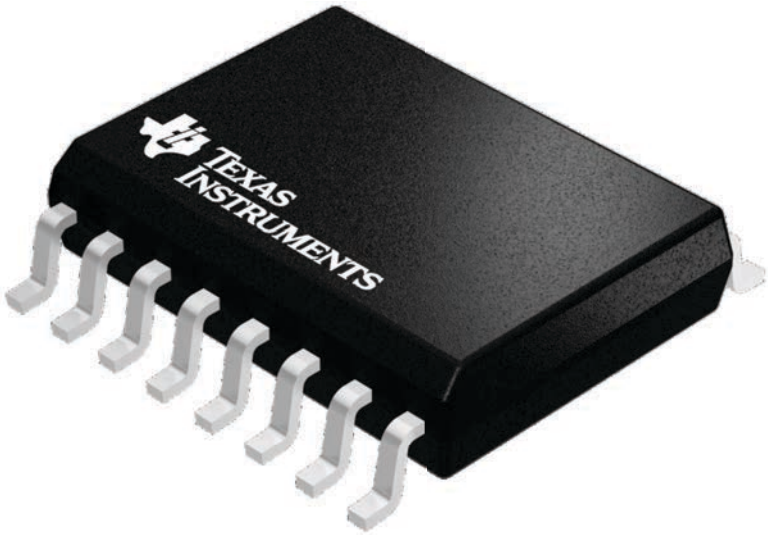
DW 16

SOIC - 2.65 mm max height

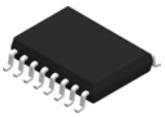
7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4224780/A

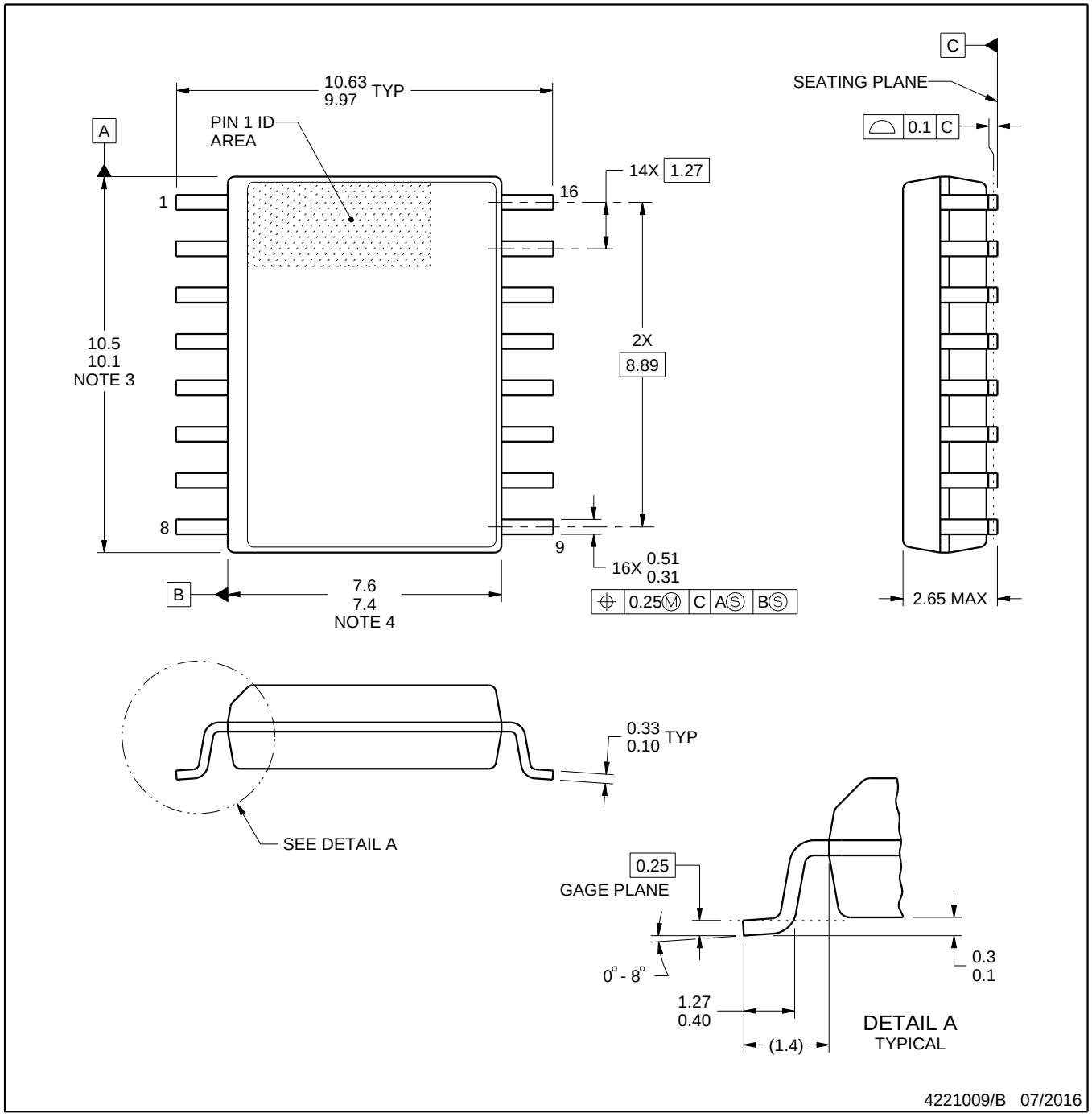


PACKAGE OUTLINE

DW0016B

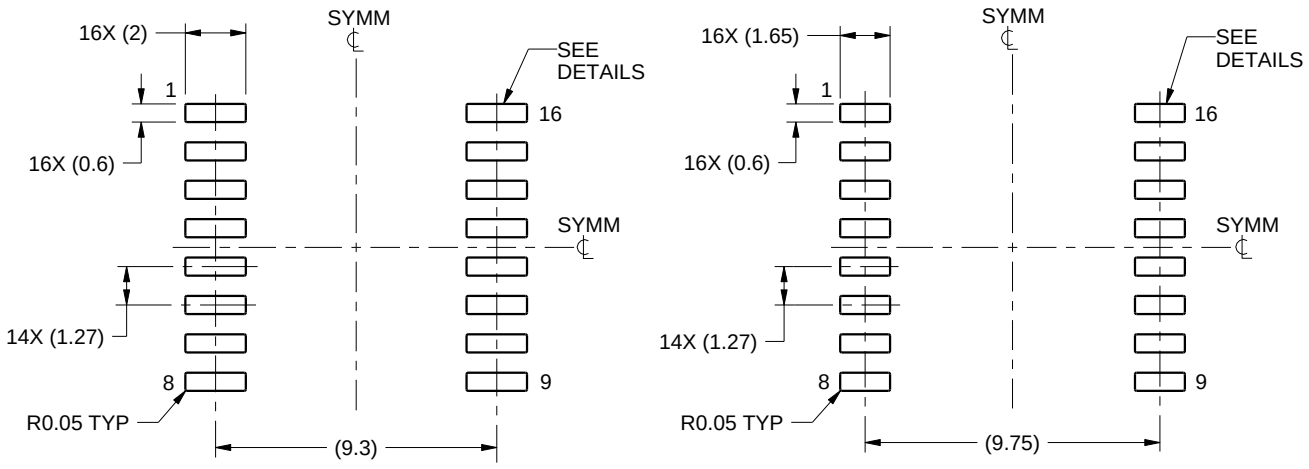
SOIC - 2.65 mm max height

SOIC



NOTES:

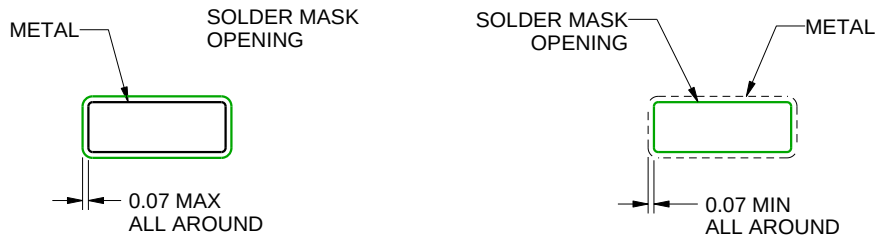
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.
5. Reference JEDEC registration MS-013.



IPC-7351 NOMINAL
7.3 mm CLEARANCE/CREEPAGE

HV / ISOLATION OPTION
8.1 mm CLEARANCE/CREEPAGE

LAND PATTERN EXAMPLE
SCALE:4X



NON SOLDER MASK DEFINED

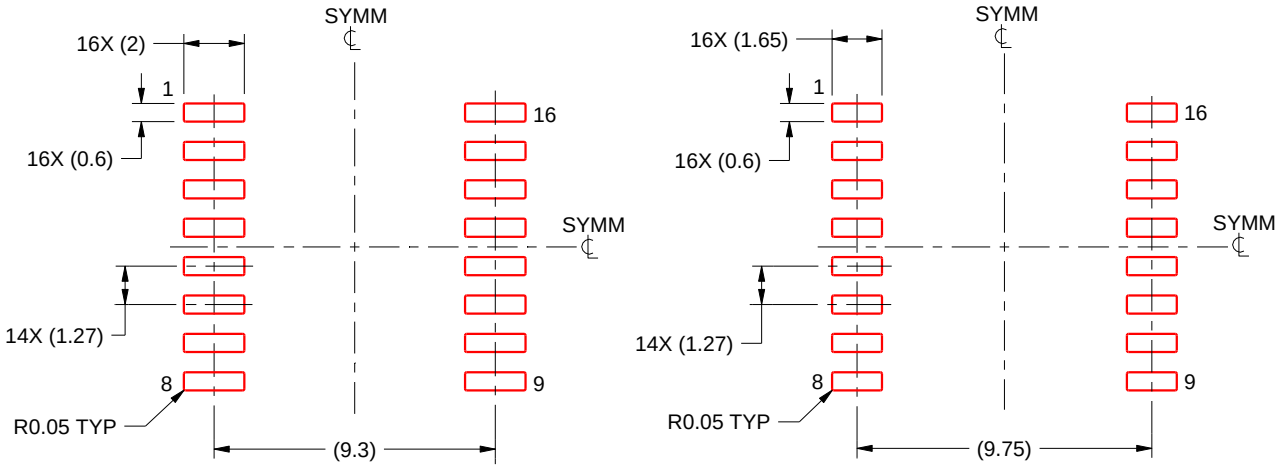
SOLDER MASK DEFINED

SOLDER MASK DETAILS

4221009/B 07/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



IPC-7351 NOMINAL
7.3 mm CLEARANCE/CREEPAGE

HV / ISOLATION OPTION
8.1 mm CLEARANCE/CREEPAGE

SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:4X

4221009/B 07/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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