

# ISO764xFM Low-Power Quad-Channel Digital Isolators

## 1 Features

- Signaling Rate: 150 Mbps
- Low Power Consumption, Typical  $I_{CC}$  per Channel (3.3-V Supplies):
  - ISO7640FM: 2 mA at 25 Mbps
  - ISO7641FM: 2.4 mA at 25 Mbps
- Low Propagation Delay: 7-ns Typical
- Output Defaults to Low-State in Fail-Safe Mode
- Wide Temperature Range:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- 50-KV/ $\mu\text{s}$  Transient Immunity, Typical
- Long Life With  $\text{SiO}_2$  Isolation Barrier
- Operates From 2.7-V, 3.3-V, and 5-V Supply and Logic Levels
- Wide Body SOIC-16 Package
- Safety and Regulatory Approvals
  - 6000  $V_{PK}$  / 4243  $V_{RMS}$  for 1 Minute per UL 1577
  - VDE 6000  $V_{PK}$  Transient Overvoltage, 1414  $V_{PK}$  Working Voltage per DIN V VDE V 0884-10 (VDE V 0884-10):2006-12
  - CSA Component Acceptance Notice 5A, IEC 60950-1, IEC 61010-1, and IEC 60601-1 End Equipment Standards
  - TUV 5  $KV_{RMS}$  Reinforced Insulation per EN/UL/CSA 60950-1 and EN/UL/CSA 61010-1
  - CQC Reinforced Insulation per GB4943.1-2011

## 2 Applications

- Optocoupler Replacement in:
  - Industrial Fieldbus
    - Profibus
    - Modbus
    - DeviceNet™ Data Buses
  - Servo Control Interface
  - Motor Control
  - Power Supplies
  - Battery Packs

## 3 Description

ISO7640FM and ISO7641FM provide galvanic isolation up to 6  $KV_{PK}$  for 1 minute per UL and VDE. These devices are also certified up to 5- $KV_{RMS}$  Reinforced isolation at a working voltage of 400  $V_{RMS}$  per end equipment standards EN/UL/CSA 60950-1 and 61010-1. ISO7640F and ISO7641F are quad-channel isolators; ISO7640F has four forward and ISO7641F has three forward and one reverse-direction channels. Suffix F indicates that output defaults to Low-state in fail-safe conditions (see Table 4). M-Grade devices are high-speed isolators capable of 150-Mbps data rate with fast propagation delays.

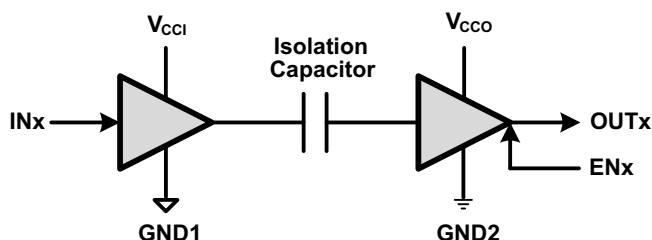
Each isolation channel has a logic input and output buffer separated by a silicon dioxide ( $\text{SiO}_2$ ) insulation barrier. Used in conjunction with isolated power supplies, these devices prevent noise currents on a data bus or other circuits from entering the local ground and interfering with or damaging sensitive circuitry. The devices have TTL input thresholds and can operate from 2.7-V, 3.3-V, and 5-V supplies. All inputs are 5-V tolerant when supplied from 3.3-V or 2.7-V supplies.

### Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
ISO7640FM	SOIC (16)	10.30 mm × 7.50 mm
ISO7641FM		

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

### Simplified Schematic



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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 F (September 2013) to Revision G Page

- Added *Pin Configuration and Functions* section, *ESD 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 ..... **1**
- VDE standard changed to DIN V VDE V 0884-10 (VDE V 0884-10):2006-12. .... **1**

### Changes from Revision E (January 2013) to Revision F Page

- Changed the REGULATORY INFORMATION table, TUV column From: Certificate Number: U8V 13 07 77311 009 To: Certificate Number: U8V 13 09 77311 010 ..... **23**

### Changes from Revision D (July 2012) to Revision E Page

- Changed Z to Undetermined in the OUTPUT (OUTx) column of the FUNCTION TABLE ..... **25**

**Changes from Revision C (January 2012) to Revision D**
**Page**

Deleted devices: ISO7631FM, ISO7631FC, ISO7640FC, ISO7641FC from the data sheet .....	1
Changed the Title From: Low Power Triple and Quad Channels Digital Isolators To: Low Power Quad Channels Digital Isolators .....	1
Deleted devices from the Features List.....	1
Changed the DESCRIPTION .....	1
Changed EN1 and EN2 Pin Descriptions.....	5
Changed the ELECTRICAL, SWITCHING, and SUPPLY CURRENT CHARACTERISTICS tables .....	7
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Changed the TYPICAL CHARACTERISTICS section.....	17
Deleted device from the Available Options Table .....	21
Deleted devices from the TYPICAL SUPPLY CURRENT EQUATIONS section .....	28

**Changes from Revision B (December 2011) to Revision C**
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Changed Safety and Regulatory Approvals bullet From: 6000 V <sub>PK</sub> / 4243 V <sub>RMS</sub> for 1 Minute per UL1577 (pending) To: 6000 V <sub>PK</sub> / 4243 V <sub>RMS</sub> for 1 Minute per UL 1577 (approved).....	1
Changed Description text From: The devices have TTL input thresholds and can operate from 2.7 V, 3.3 V and 5 V supplies. To: The devices have TTL input thresholds and can operate from 2.7 V (M-Grade), 3.3 V and 5 V supplies.....	1
Changed the ESD standards.....	6
Changed the typical characteristics section .....	17
Deleted the Product Preview Note From the Available Options Table.....	21

**Changes from Revision A (October 2011) to Revision B**
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Changed feature bullet From: ISO7641FC: 1.2 mA at 10 Mbps To: ISO7641FC: 1.3 mA at 10 Mbps .....	1
Changed Safety and Regulatory Approvals bullet From: 6 KV <sub>PK</sub> for 1 Minute per UL1577 and VDE (Pending) To: 6000 V <sub>PK</sub> / 4243 V <sub>RMS</sub> for 1 Minute per UL 1577 (pending) .....	1
Changed Safety and Regulatory Approvals bullet From: To: 6000 V <sub>PK</sub> / 4243 V <sub>RMS</sub> for 1 Minute per UL 1577 (approved) .	1
Changed Safety and Regulatory Approvals bullet From: CSA Component Acceptance Notice 5A, IEC 60601-1 Medical Standard (pending) To: CSA Component Acceptance Notice 5A, IEC 60601-1 Medical Standard (approved) .....	1
Changed all the ELECTRICAL CHARACTERISTICS tables .....	7
Changed the SWITCHING CHARACTERISTICS table ISO7640F and ISO7641F C-Grade values .....	9
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**Changes from Original (September 2011) to Revision A**
**Page**

Changed <a href="#">Figure 11</a> - From: 0 V or V <sub>CC</sub> To: IN = V <sub>CC</sub> .....	20
Added Note (1) "Per JEDEC package dimensions" to the IEC INSULATION AND SAFETY-RELATED SPECIFICATIONS FOR DW-16 PACKAGE table.....	20

**ISO7640FM, ISO7641FM**

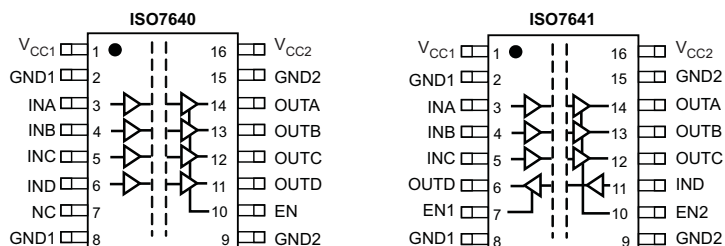
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• Changed L(I01) Min Value From: 8 mm To: 8.3 mm.....	20
• Changed L(I02) Min Value From: 7.8 mm To: 8.1 mm.....	20
• Added pinout for ISO7641 and ISO7631.....	28

## 5 Pin Configuration and Functions

**DW Package  
16-Pin SOIC  
Top View**



**Pin Functions**

NAME	PIN		I/O	DESCRIPTION
	ISO7640	ISO7641		
EN	10	-	I	Enables (when High or Open) or Disables (when Low) OUTA, OUTB, OUTC and OUTD of ISO7640
EN1	-	7	I	Enables (when High or Open) or Disables (when Low) OUTD of ISO7641
EN2	-	10	I	Enables (when High or Open) or Disables (when Low) OUTA, OUTB, and OUTC of ISO7641
GND1	2	2	–	Ground connection for V <sub>CC1</sub>
	8	8		
GND2	9	9	–	Ground connection for V <sub>CC2</sub>
	15	15		
INA	3	3	I	Input, channel A
INB	4	4	I	Input, channel B
INC	5	5	I	Input, channel C
IND	6	11	I	Input, channel D
NC	7	-	-	No Connect pins are floating with no internal connection
OUTA	14	14	O	Output, channel A
OUTB	13	13	O	Output, channel B
OUTC	12	12	O	Output, channel C
OUTD	11	6	O	Output, channel D
V <sub>CC1</sub>	1	1	–	Power supply, V <sub>CC1</sub>
V <sub>CC2</sub>	16	16	–	Power supply, V <sub>CC2</sub>

## 6 Specifications

### 6.1 Absolute Maximum Ratings<sup>(1)</sup>

		MIN	MAX	UNIT
Supply voltage <sup>(2)</sup>	V <sub>CC1</sub> , V <sub>CC2</sub>	–0.5	6	V
Voltage	IN <sub>x</sub> , OUT <sub>x</sub> , EN <sub>x</sub>	–0.5	V <sub>CC</sub> + 0.5 <sup>(3)</sup>	V
Output Current, I <sub>O</sub>		–15	15	mA
Maximum junction temperature, T <sub>J</sub>			150	°C
Storage temperature, T <sub>stg</sub>		–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 <sub>(ESD)</sub> Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>	±4000	V
	Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup>	±1500	
	Machine model, per JEDEC JESD22-A115-A	±200	

- (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.

### 6.3 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
V <sub>CC1</sub> , V <sub>CC2</sub>	Supply voltage	2.7		5.5	V
I <sub>OH</sub>	High-level output current	–4			mA
I <sub>OL</sub>	Low-level output current			4	mA
V <sub>IH</sub>	High-level input voltage	2		5.5	V
V <sub>IL</sub>	Low-level input voltage	0		0.8	V
t <sub>ui</sub>	Input pulse duration	≥3-V Operation		6.67	ns
		<3-V Operation		10	
1 / t <sub>ui</sub>	Signaling rate	≥3-V Operation		0	Mbps
		<3-V Operation		0	
T <sub>J</sub>	Junction temperature	–40		136	°C
T <sub>A</sub>	Ambient temperature	–40	25	125	°C

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		ISO76xx	UNIT	
		DW (SOIC)		
		16 PINS		
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	72	°C/W	
R <sub>θJC(top)</sub>	Junction-to-case(top) thermal resistance	38		
R <sub>θJB</sub>	Junction-to-board thermal resistance	39		
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	9.4		
P <sub>D</sub>	Maximum Device Power Dissipation	V <sub>CC1</sub> = V <sub>CC2</sub> = 5.5V, T <sub>J</sub> = 150°C, C <sub>L</sub> = 15 pF Input a 75-MHz 50% duty cycle square wave	399	mW

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

## 6.5 Electrical Characteristics: $V_{CC1}$ and $V_{CC2}$ at 5 V $\pm 10\%$

$V_{CC1}$  and  $V_{CC2}$  at 5 V  $\pm 10\%$  (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 <a href="#">Figure 9</a>	$V_{CCO}^{(1)} - 0.8$	4.8		V
	$I_{OH} = -20$ $\mu$ A; see <a href="#">Figure 9</a>	$V_{CCO}^{(1)} - 0.1$	5		
$V_{OL}$ Low-level output voltage	$I_{OL} = 4$ mA; see <a href="#">Figure 9</a>		0.2	0.4	V
	$I_{OL} = 20$ $\mu$ A; see <a href="#">Figure 9</a>		0	0.1	
$V_{I(HYS)}$ Input threshold voltage hysteresis			450		mV
$I_{IH}$ High-level input current	$V_{IH} = V_{CC}$ at INx or ENx			10	$\mu$ A
$I_{IL}$ Low-level input current	$V_{IL} = 0$ V at INx or ENx	-10			
CMTI Common-mode transient immunity	$V_I = V_{CC}$ or 0 V; see <a href="#">Figure 12</a>	25	75		kV/ $\mu$ s

(1)  $V_{CCO}$  is the supply voltage,  $V_{CC1}$  or  $V_{CC2}$ , for the output channel that is being measured.

## 6.6 Electrical Characteristics: $V_{CC1}$ at 5 V $\pm 10\%$ and $V_{CC2}$ at 3.3 V $\pm 10\%$

$V_{CC1}$  at 5 V  $\pm 10\%$  and  $V_{CC2}$  at 3.3 V  $\pm 10\%$  (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 <a href="#">Figure 9</a>	OUTx on $V_{CC1}$ (5V) side	$V_{CC1} - 0.8$	4.8	V
		OUTx on $V_{CC2}$ (3.3V) side	$V_{CC2} - 0.4$	3	
	$I_{OH} = -20$ $\mu$ A; see <a href="#">Figure 9</a>	OUTx on $V_{CC1}$ (5V) side	$V_{CC1} - 0.1$	5	
		OUTx on $V_{CC2}$ (3.3V) side	$V_{CC2} - 0.1$	3.3	
$V_{OL}$ Low-level output voltage	$I_{OL} = 4$ mA; see <a href="#">Figure 9</a>		0.2	0.4	V
	$I_{OL} = 20$ $\mu$ A; see <a href="#">Figure 9</a>		0	0.1	
$V_{I(HYS)}$ Input threshold voltage hysteresis			430		mV
$I_{IH}$ High-level input current	$V_{IH} = V_{CC}$ at INx or ENx			10	$\mu$ A
$I_{IL}$ Low-level input current	$V_{IL} = 0$ V at INx or ENx	-10			
CMTI Common-mode transient immunity	$V_I = V_{CC}$ or 0 V; see <a href="#">Figure 12</a>	25	50		kV/ $\mu$ s

## 6.7 Electrical Characteristics: $V_{CC1}$ at 3.3 V $\pm 10\%$ and $V_{CC2}$ at 5 V $\pm 10\%$

$V_{CC1}$  at 3.3 V  $\pm 10\%$  and  $V_{CC2}$  at 5 V  $\pm 10\%$  (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 <a href="#">Figure 9</a>	OUTx on $V_{CC1}$ (3.3 V) side	$V_{CC1} - 0.4$	3	V
		OUTx on $V_{CC2}$ (5 V) side	$V_{CC2} - 0.8$	4.8	
	$I_{OH} = -20$ $\mu$ A; see <a href="#">Figure 9</a>	OUTx on $V_{CC1}$ (3.3 V) side	$V_{CC1} - 0.1$	3.3	
		OUTx on $V_{CC2}$ (5 V) side	$V_{CC2} - 0.1$	5	
$V_{OL}$ Low-level output voltage	$I_{OL} = 4$ mA; see <a href="#">Figure 9</a>		0.2	0.4	V
	$I_{OL} = 20$ $\mu$ A; see <a href="#">Figure 9</a>		0	0.1	
$V_{I(HYS)}$ Input threshold voltage hysteresis			430		mV
$I_{IH}$ High-level input current	$V_{IH} = V_{CC}$ at INx or ENx			10	$\mu$ A
$I_{IL}$ Low-level input current	$V_{IL} = 0$ V at INx or ENx	-10			
CMTI Common-mode transient immunity	$V_I = V_{CC}$ or 0 V; see <a href="#">Figure 12</a>	25	50		kV/ $\mu$ s

## 6.8 Electrical Characteristics: $V_{CC1}$ and $V_{CC2}$ at 3.3 V $\pm 10\%$

$V_{CC1}$  and  $V_{CC2}$  at 3.3 V  $\pm 10\%$  (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 <a href="#">Figure 9</a>	$V_{CCO}^{(1)} - 0.4$	3		V
	$I_{OH} = -20$ $\mu$ A; see <a href="#">Figure 9</a>	$V_{CCO}^{(1)} - 0.1$	3.3		
$V_{OL}$ Low-level output voltage	$I_{OL} = 4$ mA; see <a href="#">Figure 9</a>		0.2	0.4	V
	$I_{OL} = 20$ $\mu$ A; see <a href="#">Figure 9</a>		0	0.1	
$V_{I(HYS)}$ Input threshold voltage hysteresis			425		mV
$I_{IH}$ High-level input current	$V_{IH} = V_{CC}$ at INx or ENx			10	$\mu$ A
$I_{IL}$ Low-level input current	$V_{IL} = 0$ V at INx or ENx	-10			
CMTI Common-mode transient immunity	$V_I = V_{CC}$ or 0 V; see <a href="#">Figure 12</a>	25	50		kV/ $\mu$ s

(1)  $V_{CCO}$  is the supply voltage,  $V_{CC1}$  or  $V_{CC2}$ , for the output channel that is being measured.

## 6.9 Electrical Characteristics: $V_{CC1}$ and $V_{CC2}$ at 2.7 V

$V_{CC1}$  and  $V_{CC2}$  at 2.7 V<sup>(1)</sup> (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 <a href="#">Figure 9</a>	$V_{CCO}^{(2)} - 0.5$	2.4		V
	$I_{OH} = -20$ $\mu$ A; see <a href="#">Figure 9</a>	$V_{CCO}^{(2)} - 0.1$	2.7		
$V_{OL}$ Low-level output voltage	$I_{OL} = 4$ mA; see <a href="#">Figure 9</a>		0.2	0.4	V
	$I_{OL} = 20$ $\mu$ A; see <a href="#">Figure 9</a>		0	0.1	
$V_{I(HYS)}$ Input threshold voltage hysteresis			350		mV
$I_{IH}$ High-level input current	$V_{IH} = V_{CC}$ at INx or ENx			10	$\mu$ A
$I_{IL}$ Low-level input current	$V_{IL} = 0$ V at INx or ENx	-10			
CMTI Common-mode transient immunity	$V_I = V_{CC}$ or 0 V; see <a href="#">Figure 12</a>	25	50		kV/ $\mu$ s

(1) For 2.7-V operation, max data rate is 100 Mbps.

(2)  $V_{CCO}$  is the supply voltage,  $V_{CC1}$  or  $V_{CC2}$ , for the output channel that is being measured.



## 6.10 Supply Current: $V_{CC1}$ and $V_{CC2}$ at 5 V $\pm 10\%$

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

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT	
ISO7640FM							
I <sub>CC1</sub>	Disable	EN = 0 V		0.6	1.2	mA	
I <sub>CC2</sub>				4.5	6.6		
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF		0.7	1.3		
I <sub>CC2</sub>				4.6	6.7		
I <sub>CC1</sub>	10 Mbps			1.1	2		
I <sub>CC2</sub>				6.6	10.5		
I <sub>CC1</sub>	25 Mbps			1.9	3		
I <sub>CC2</sub>				9.7	14.7		
I <sub>CC1</sub>	150 Mbps			8.2	14.5		
I <sub>CC2</sub>				35	58		
ISO7641FM							
I <sub>CC1</sub>	Disable		EN1 = EN2 = 0 V		2.6	4.2	mA
I <sub>CC2</sub>				4.2	6.8		
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF		2.7	4.3		
I <sub>CC2</sub>				4.3	6.9		
I <sub>CC1</sub>	10 Mbps			3.6	4.9		
I <sub>CC2</sub>				6	8.2		
I <sub>CC1</sub>	25 Mbps			5.1	6.6		
I <sub>CC2</sub>				8.8	11.4		
I <sub>CC1</sub>	150 Mbps			17	22		
I <sub>CC2</sub>				31	42		

**ISO7640FM, ISO7641FM**

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**6.11 Supply Current:  $V_{CC1}$  at 5 V  $\pm 10\%$  and  $V_{CC2}$  at 3.3 V  $\pm 10\%$** 
 $V_{CC1}$  at 5 V  $\pm 10\%$  and  $V_{CC2}$  at 3.3 V  $\pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT	
ISO7640FM							
I <sub>CC1</sub>	Disable	EN = 0 V	0.6		1.2	mA	
I <sub>CC2</sub>			3.6		5.1		
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF	0.7		1.3		
I <sub>CC2</sub>			3.7		5.2		
I <sub>CC1</sub>	10 Mbps		1.1		2		
I <sub>CC2</sub>			5		7.1		
I <sub>CC1</sub>	25 Mbps		1.9		3		
I <sub>CC2</sub>			6.9		11		
I <sub>CC1</sub>	150 Mbps		8.2		14.5		
I <sub>CC2</sub>			24		40		
ISO7641FM							
I <sub>CC1</sub>	Disable		EN1 = EN2 = 0 V	2.6		4.2	mA
I <sub>CC2</sub>		3.2		4.9			
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF	2.7		4.3		
I <sub>CC2</sub>			3.3		5		
I <sub>CC1</sub>	10 Mbps		3.6		4.9		
I <sub>CC2</sub>			4.4		5.8		
I <sub>CC1</sub>	25 Mbps		5.1		6.6		
I <sub>CC2</sub>			6.1		7.6		
I <sub>CC1</sub>	150 Mbps		17		22		
I <sub>CC2</sub>			20.6		26.5		

## 6.12 Supply Current: $V_{CC1}$ at 3.3 V $\pm 10\%$ and $V_{CC2}$ at 5 V $\pm 10\%$

$V_{CC1}$  at 3.3 V  $\pm 10\%$  and  $V_{CC2}$  at 5 V  $\pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
ISO7640FM						
I <sub>CC1</sub>	Disable	EN = 0 V	0.35		0.7	mA
I <sub>CC2</sub>			4.5		6.6	
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF	0.4		0.8	
I <sub>CC2</sub>			4.6		6.7	
I <sub>CC1</sub>	10 Mbps		0.7		1.2	
I <sub>CC2</sub>			6.6		10.5	
I <sub>CC1</sub>	25 Mbps		1.1		2	
I <sub>CC2</sub>			9.7		14.7	
I <sub>CC1</sub>	150 Mbps		5		8.5	
I <sub>CC2</sub>			35		58	
ISO7641FM						
I <sub>CC1</sub>	Disable	EN1 = EN2 = 0 V	1.9		2.9	mA
I <sub>CC2</sub>			4.2		6.8	
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF	2		3	
I <sub>CC2</sub>			4.3		6.9	
I <sub>CC1</sub>	10 Mbps		2.5		3.5	
I <sub>CC2</sub>			6		8.2	
I <sub>CC1</sub>	25 Mbps		3.4		4.5	
I <sub>CC2</sub>			8.8		11.4	
I <sub>CC1</sub>	150 Mbps		10.5		14.5	
I <sub>CC2</sub>			31		42	

**ISO7640FM, ISO7641FM**

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[www.ti.com](http://www.ti.com)
**6.13 Supply Current:  $V_{CC1}$  and  $V_{CC2}$  at 3.3 V  $\pm 10\%$** 
 $V_{CC1}$  and  $V_{CC2}$  at 3.3 V  $\pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER			TEST CONDITIONS			MIN	TYP	MAX	UNIT
ISO7640FM									
I <sub>CC1</sub>	Disable	EN = 0 V	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF				0.35	0.7	mA
I <sub>CC2</sub>							3.6	5.1	
I <sub>CC1</sub>	DC to 1 Mbps					0.4	0.8		
I <sub>CC2</sub>						3.7	5.2		
I <sub>CC1</sub>	10 Mbps					0.7	1.2		
I <sub>CC2</sub>						5	7.1		
I <sub>CC1</sub>	25 Mbps					1.1	2		
I <sub>CC2</sub>						6.9	11		
I <sub>CC1</sub>	150 Mbps					5	8.5		
I <sub>CC2</sub>						24	40		
ISO7641FM									
I <sub>CC1</sub>	Disable	EN1 = EN2 = 0 V	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF				1.9	2.9	mA
I <sub>CC2</sub>							3.2	4.9	
I <sub>CC1</sub>	DC to 1 Mbps					2	3		
I <sub>CC2</sub>						3.3	5		
I <sub>CC1</sub>	10 Mbps					2.5	3.5		
I <sub>CC2</sub>						4.4	5.8		
I <sub>CC1</sub>	25 Mbps					3.4	4.5		
I <sub>CC2</sub>						6.1	7.6		
I <sub>CC1</sub>	150 Mbps					10.5	14.5		
I <sub>CC2</sub>						20.6	26.5		

## 6.14 Supply Current: $V_{CC1}$ and $V_{CC2}$ at 2.7 V

$V_{CC1}$  and  $V_{CC2}$  at 2.7 V (over recommended operating conditions unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
ISO7640FM						
I <sub>CC1</sub>	Disable	EN = 0 V		0.2	0.6	mA
I <sub>CC2</sub>				3.3	5	
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF		0.2	0.7	
I <sub>CC2</sub>				3.4	5.1	
I <sub>CC1</sub>	10 Mbps			0.4	1.1	
I <sub>CC2</sub>				4.4	6.8	
I <sub>CC1</sub>	25 Mbps			0.8	1.8	
I <sub>CC2</sub>				6	9.5	
I <sub>CC1</sub>	100 Mbps			2.7	5	
I <sub>CC2</sub>				14.2	21	
ISO7641FM						
I <sub>CC1</sub>	Disable	EN1 = EN2 = 0 V		1.6	2.4	mA
I <sub>CC2</sub>				2.8	4.1	
I <sub>CC1</sub>	DC to 1 Mbps	DC Signal: V <sub>I</sub> = V <sub>CC</sub> or 0 V, AC Signal: All channels switching with square wave clock input; C <sub>L</sub> = 15 pF		1.7	2.5	
I <sub>CC2</sub>				2.9	4.2	
I <sub>CC1</sub>	10 Mbps			2.1	3	
I <sub>CC2</sub>				3.8	5	
I <sub>CC1</sub>	25 Mbps			2.8	3.8	
I <sub>CC2</sub>				5.2	6.7	
I <sub>CC1</sub>	100 Mbps			6.4	7.5	
I <sub>CC2</sub>				11.8	15.5	

## 6.15 Switching Characteristics: $V_{CC1}$ and $V_{CC2}$ at 5 V $\pm 10\%$

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$ , $t_{PHL}$ Propagation delay time	See Figure 9	3.5	7	10.5	ns
PWD <sup>(1)</sup> Pulse width distortion $ t_{PHL} - t_{PLH} $					
$t_{sk(o)}$ <sup>(2)</sup> Channel-to-channel output skew time	Same-direction Channels			2	
	Opposite-direction Channels			3	
$t_{sk(pp)}$ <sup>(3)</sup> Part-to-part skew time				4.5	
$t_r$ Output signal rise time	See Figure 9		1.6		ns
$t_f$ Output signal fall time					
$t_{PHZ}$ Disable Propagation Delay, high-to-high impedance output	See Figure 10		5	16	ns
$t_{PLZ}$ Disable Propagation Delay, low-to-high impedance output					
$t_{PZH}$ Enable Propagation Delay, high impedance-to-high output					
$t_{PZL}$ Enable Propagation Delay, high impedance-to-low output					
$t_{fs}$ Fail-safe output delay time from input data or power loss	See Figure 11		9.5		$\mu s$

(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: $V_{CC1}$ at 5 V $\pm 10\%$ and $V_{CC2}$ at 3.3 V $\pm 10\%$

 $V_{CC1}$  at 5 V  $\pm 10\%$  and  $V_{CC2}$  at 3.3 V  $\pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$ , $t_{PHL}$ Propagation delay time	See Figure 9	4	8	13	ns
PWD <sup>(1)</sup> Pulse width distortion $ t_{PHL} - t_{PLH} $					
$t_{sk(o)}$ <sup>(2)</sup> Channel-to-channel output skew time	Same-direction Channels			2.5	
	Opposite-direction Channels			3.5	
$t_{sk(pp)}$ <sup>(3)</sup> Part-to-part skew time				6	
$t_r$ Output signal rise time	See Figure 9		2		ns
$t_f$ Output signal fall time					
$t_{PHZ}$ Disable Propagation Delay, high-to-high impedance output	See Figure 10		6.5	17	ns
$t_{PLZ}$ Disable Propagation Delay, low-to-high impedance output					
$t_{PZH}$ Enable Propagation Delay, high impedance-to-high output					
$t_{PZL}$ Enable Propagation Delay, high impedance-to-low output					
$t_{fs}$ Fail-safe output delay time from input data or power loss	See Figure 11		9.5		$\mu s$

(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: $V_{CC1}$ at 3.3 V $\pm 10\%$ and $V_{CC2}$ at 5 V $\pm 10\%$

$V_{CC1}$  at 3.3 V  $\pm 10\%$  and  $V_{CC2}$  at 5 V  $\pm 10\%$  (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$ , $t_{PHL}$	Propagation delay time	See Figure 9	4	7.5	12.5	ns
PWD <sup>(1)</sup>	Pulse width distortion $ t_{PHL} - t_{PLH} $				2	
$t_{sk(o)}$ <sup>(2)</sup>	Channel-to-channel output skew time	Same-direction Channels			2.5	
		Opposite-direction Channels			3.5	
$t_{sk(pp)}$ <sup>(3)</sup>	Part-to-part skew time				6	
$t_r$	Output signal rise time	See Figure 9		1.7		ns
$t_f$	Output signal fall time			1.1		
$t_{PHZ}$	Disable Propagation Delay, high-to-high impedance output	See Figure 10		5.5	17	ns
$t_{PLZ}$	Disable Propagation Delay, low-to-high impedance output			5.5	17	
$t_{PZH}$	Enable Propagation Delay, high impedance-to-high output			4.5	17	
$t_{PZL}$	Enable Propagation Delay, high impedance-to-low output			4.5	17	
$t_{fs}$	Fail-safe output delay time from input data or power loss	See Figure 11		9.5		$\mu s$

(1) Also known as Pulse Skew.

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

(3)  $t_{sk(pp)}$  is the magnitude of the difference in propagation delay times between any terminals of different devices switching in the same direction while operating at identical supply voltages, temperature, input signals and loads.

## 6.18 Switching Characteristics: $V_{CC1}$ and $V_{CC2}$ at 3.3 V $\pm 10\%$

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$ , $t_{PHL}$	Propagation delay time	See Figure 9	4	8.5	14	ns
PWD <sup>(1)</sup>	Pulse width distortion $ t_{PHL} - t_{PLH} $				2	
$t_{sk(o)}$ <sup>(2)</sup>	Channel-to-channel output skew time	Same-direction Channels			3	
		Opposite-direction Channels			4	
$t_{sk(pp)}$ <sup>(3)</sup>	Part-to-part skew time				6.5	
$t_r$	Output signal rise time	See Figure 9		2		ns
$t_f$	Output signal fall time			1.3		
$t_{PHZ}$	Disable Propagation Delay, high-to-high impedance output	See Figure 10		6.5	17	ns
$t_{PLZ}$	Disable Propagation Delay, low-to-high impedance output			6.5	17	
$t_{PZH}$	Enable Propagation Delay, high impedance-to-high output			5.5	17	
$t_{PZL}$	Enable Propagation Delay, high impedance-to-low output			5.5	17	
$t_{fs}$	Fail-safe output delay time from input data or power loss	See Figure 11		9.2		$\mu s$

(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.

## 6.19 Switching Characteristics: $V_{CC1}$ and $V_{CC2}$ at 2.7 V

 $V_{CC1}$  and  $V_{CC2}$  at 2.7 V (over recommended operating conditions unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$ , $t_{PHL}$	Propagation delay time	See Figure 9	5	8	16	ns
PWD <sup>(1)</sup>	Pulse width distortion $ t_{PHL} - t_{PLH} $				2.5	
$t_{sk(o)}$ <sup>(2)</sup>	Channel-to-channel output skew time	Same-direction Channels			4	
		Opposite-direction Channels			5	
$t_{sk(pp)}$ <sup>(3)</sup>	Part-to-part skew time				8	
$t_r$	Output signal rise time	See Figure 9		2.3		ns
$t_f$	Output signal fall time			1.8		
$t_{PHZ}$	Disable Propagation Delay, high-to-high impedance output	See Figure 10		8	18	ns
$t_{PLZ}$	Disable Propagation Delay, low-to-high impedance output			8	18	
$t_{PZH}$	Enable Propagation Delay, high impedance-to-high output			7	18	
$t_{PZL}$	Enable Propagation Delay, high impedance-to-low output			7	18	
$t_{fs}$	Fail-safe output delay time from input data or power loss	See Figure 11		8.5		$\mu$ s

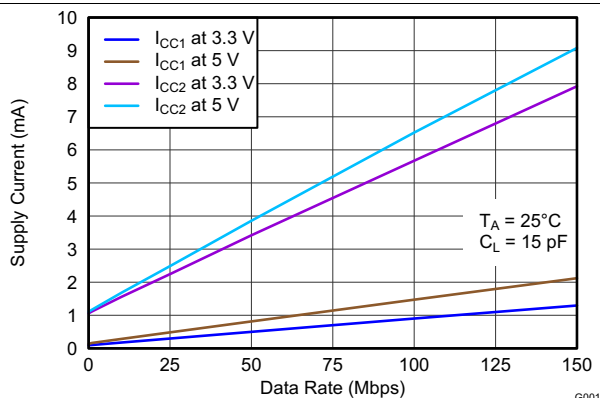
(1) Also known as Pulse Skew.

(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.

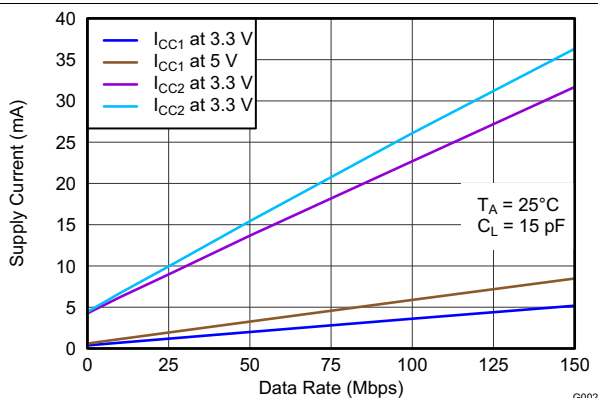
(3)  $t_{sk(pp)}$  is the magnitude of the difference in propagation delay times between any terminals of different devices switching in the same direction while operating at identical supply voltages, temperature, input signals and loads.



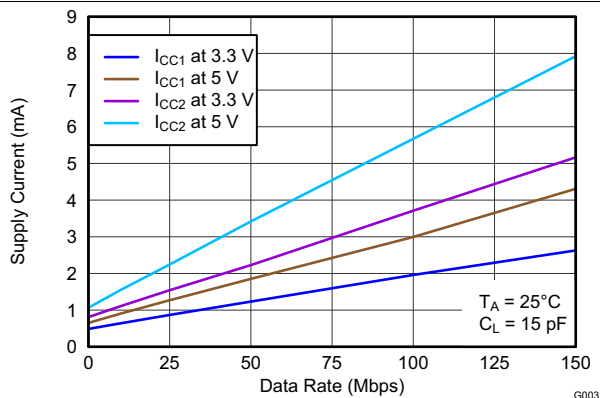
## 6.20 Typical Characteristics



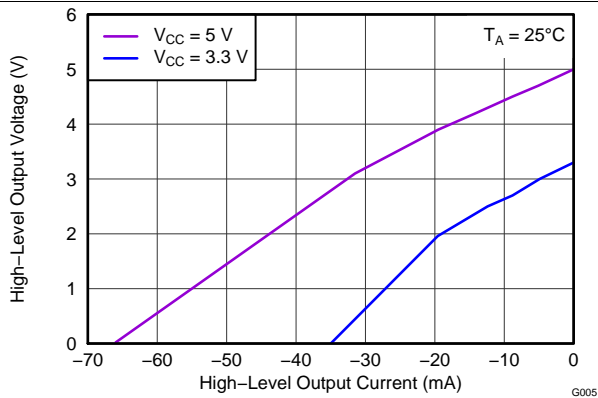
**Figure 1. ISO7640FM Supply Current per Channel vs Data Rate**



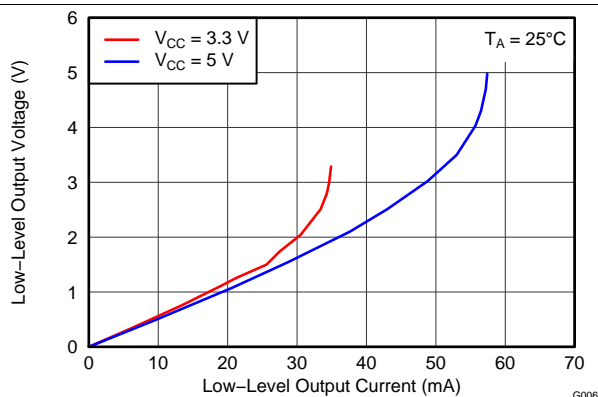
**Figure 2. ISO7640FM Supply Current for All Channels vs Data Rate**



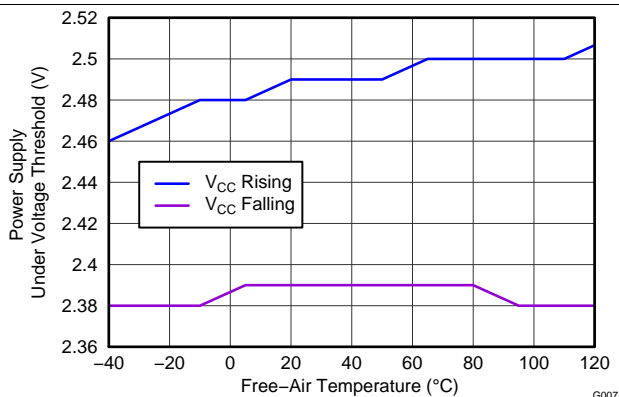
**Figure 3. ISO7641FM Supply Current per Channel vs Data Rate**



**Figure 4. High-Level Output Voltage vs High-Level Output Current**

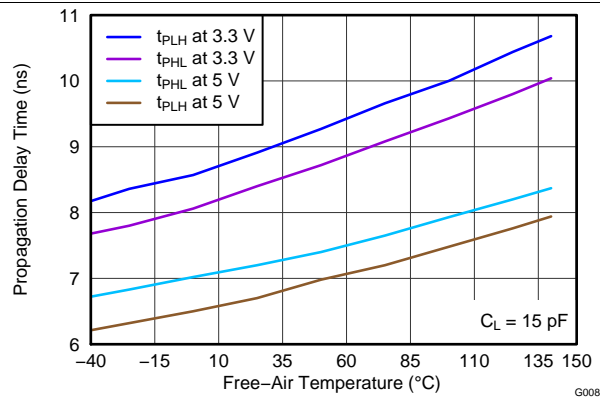


**Figure 5. Low-Level Output Voltage vs Low-Level Output Current**

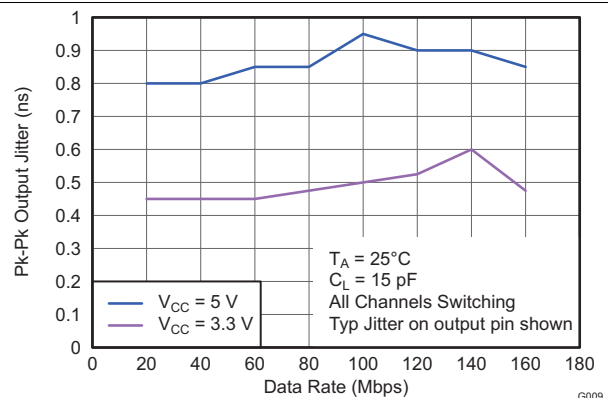


**Figure 6. V<sub>CC</sub> Undervoltage Threshold vs Free Air Temperature**

## Typical Characteristics (continued)

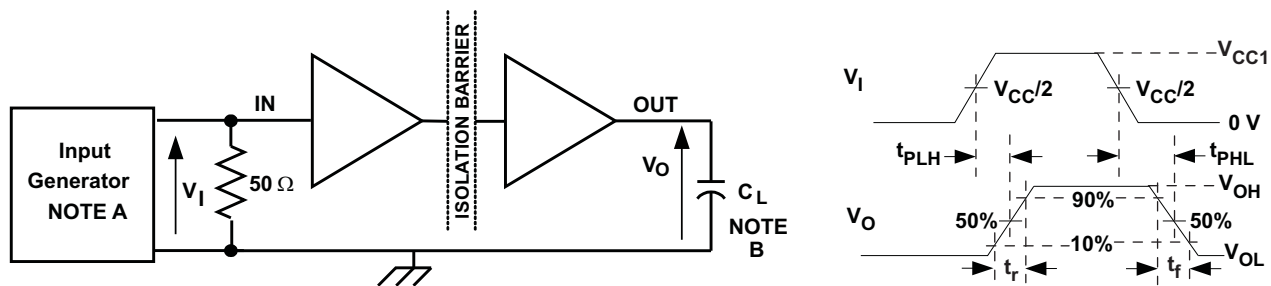


**Figure 7. Propagation Delay Time vs Free Air Temperature**



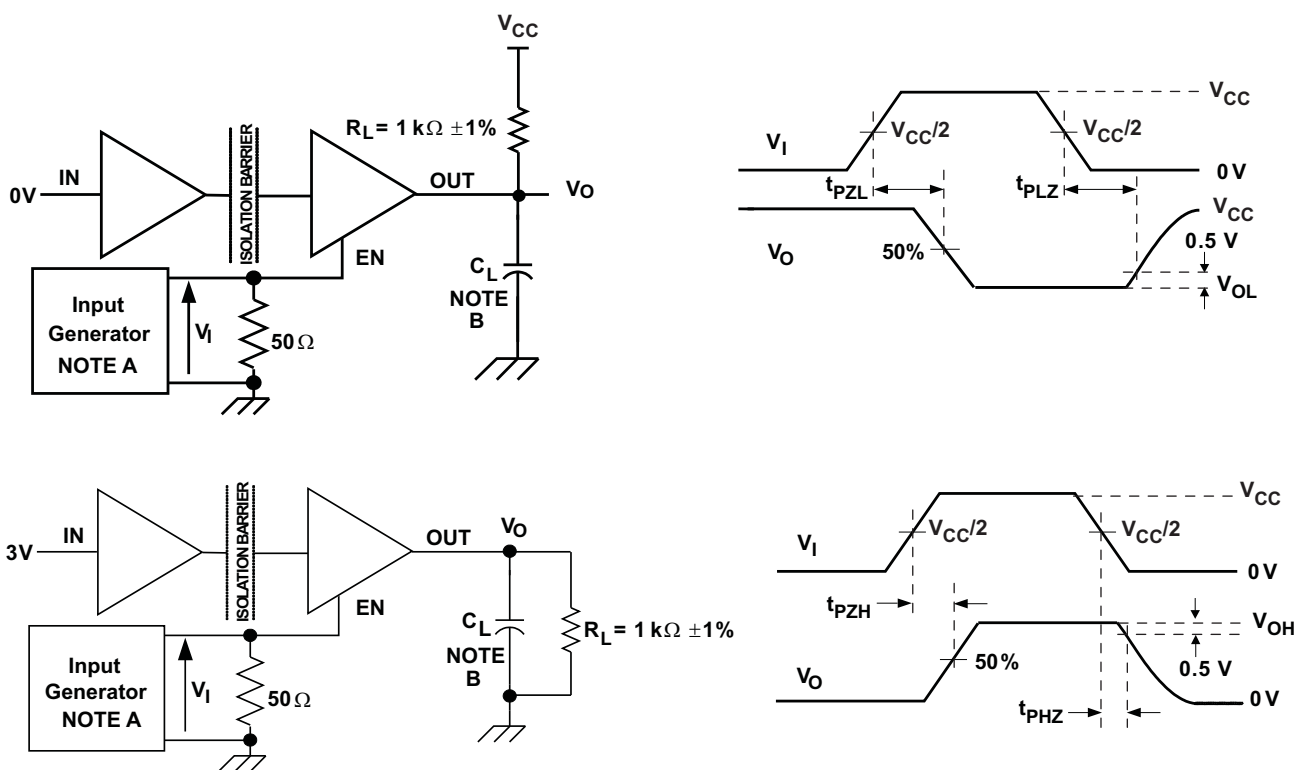
**Figure 8. Output Jitter vs Data Rate**

## 7 Parameter Measurement Information



- A. The input pulse is supplied by a generator having the following characteristics: PRR  $\leq$  50 kHz, 50% duty cycle,  $t_r \leq 3$  ns,  $t_f \leq 3$  ns,  $Z_O = 50 \Omega$ . At the input, 50- $\Omega$  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  $\pm 20\%$ .

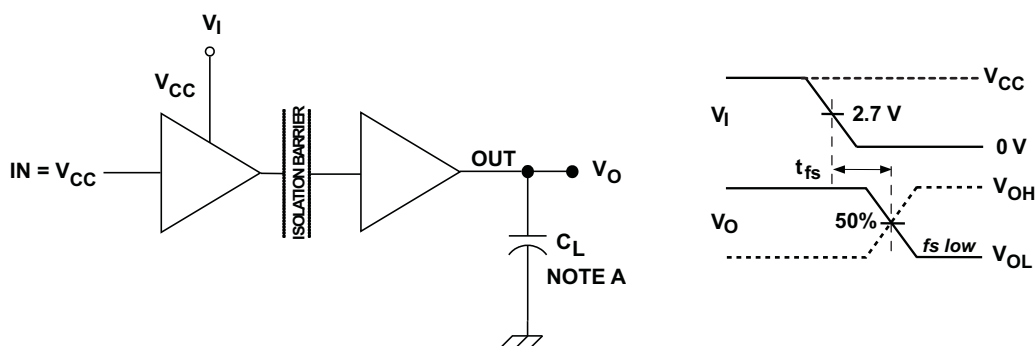
**Figure 9. Switching Characteristics Test Circuit and Voltage Waveforms**



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

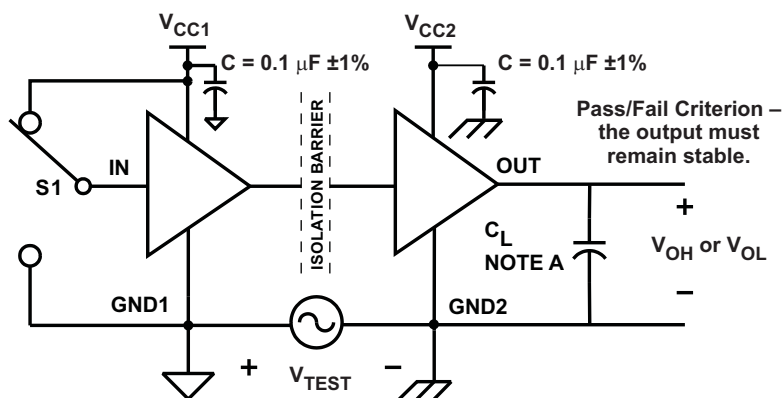
**Figure 10. Enable/Disable Propagation Delay Time Test Circuit and Waveform**

### Parameter Measurement Information (continued)



A.  $C_L = 15$  pF and includes instrumentation and fixture capacitance within  $\pm 20\%$ .

### Figure 11. Fail-Safe Delay Time Test Circuit and Voltage Waveforms



A.  $C_L = 15$  pF and includes instrumentation and fixture capacitance within  $\pm 20\%$ .

### Figure 12. Common-Mode Transient Immunity Test Circuit

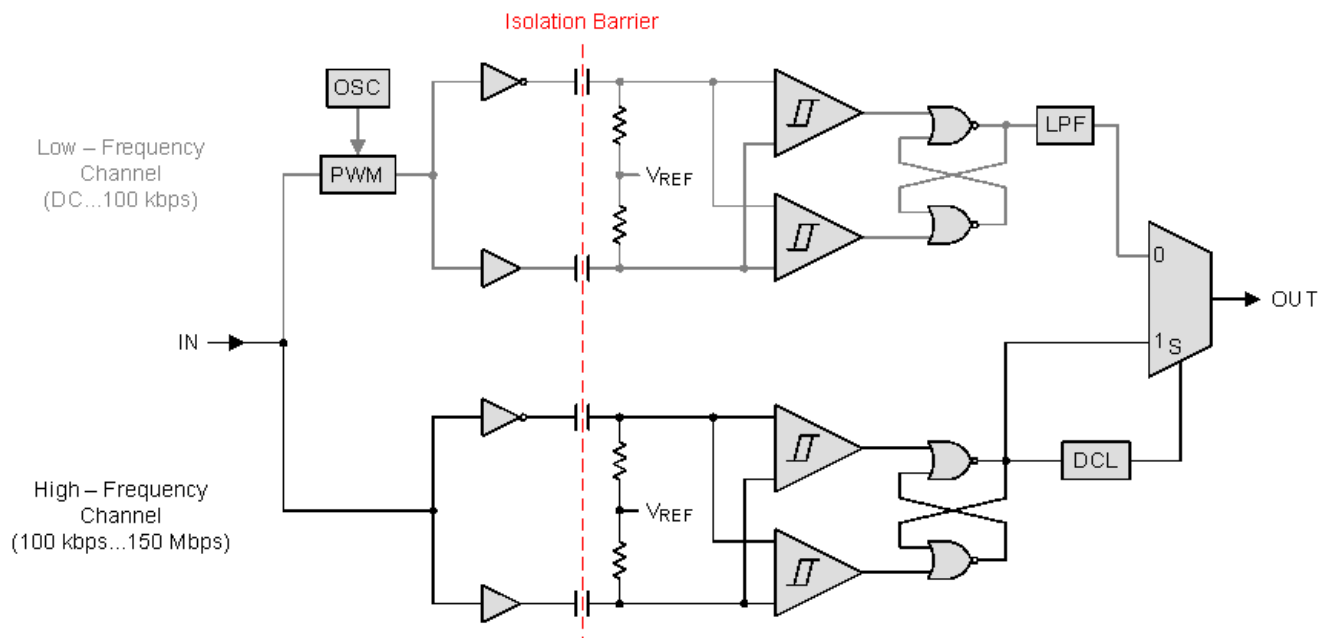
## 8 Detailed Description

### 8.1 Overview

The isolator in [Figure 13](#) is based on a capacitive isolation barrier technique. The I/O channel of the device 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- 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



**Figure 13. Conceptual Block Diagram of a Digital Capacitive Isolator**

### 8.3 Feature Description

PRODUCT	RATED ISOLATION	PACKAGE	INPUT THRESHOLD	DATA RATE, INPUT FILTER	CHANNEL DIRECTION
ISO7640FM	6 KV <sub>PK</sub> / 5 KV <sub>RMS</sub> <sup>(1)</sup>	DW-16	1.5 V TTL	150 Mbps, No Noise Filter	4 Forward, 0 Reverse
ISO7641FM					3 Forward, 1 Reverse

(1) See the [Table 2](#) table for detailed isolation ratings.

### 8.3.1 IEC Insulation and Safety-Related Specifications for DW-16 Package

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
L(I01)	Minimum air gap (Clearance)	Shortest terminal to terminal distance through air	8.3			mm
L(I02) <sup>(1)</sup>	Minimum external tracking (Creepage)	Shortest terminal to terminal distance across the package surface	8.1			mm
CTI	Tracking resistance (Comparative Tracking Index)	DIN IEC 60112 / VDE 0303 Part 1	≥400			V
	Minimum Internal Gap (Internal Clearance)	Distance through the insulation	0.014			mm
R <sub>IO</sub> <sup>(2)</sup>	Isolation resistance, Input to Output	V <sub>IO</sub> = 500 V, T <sub>A</sub> = 25°C		>10 <sup>12</sup>		Ω
		V <sub>IO</sub> = 500 V, 100°C ≤ T <sub>A</sub> ≤ T <sub>A</sub> max		>10 <sup>11</sup>		
C <sub>IO</sub> <sup>(2)</sup>	Barrier capacitance, Input to Output	V <sub>I</sub> = 0.4 sin (2πft), f = 1MHz		2		pF
C <sub>I</sub> <sup>(3)</sup>	Input capacitance	V <sub>I</sub> = V <sub>CC</sub> /2 + 0.4 sin (2πft), f = 1MHz, V <sub>CC</sub> = 5 V		2		pF

(1) Per JEDEC package dimensions.

(2) All pins on each side of the barrier tied together creating a two-terminal device.

(3) Measured from input pin to ground.

#### NOTE

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 (PCB) do not reduce this distance.

Creepage and clearance on a PCB become equal according to the measurement techniques shown in the Isolation Glossary. Techniques such as inserting grooves and/or ribs on a PCB are used to help increase these specifications.

### 8.3.2 DIN V VDE V 0884-10 (VDE V 0884-10) Insulation Characteristics

over recommended operating conditions (unless otherwise noted)<sup>(4)</sup>

PARAMETER		TEST CONDITIONS	SPECIFICATION	UNIT
V <sub>IORM</sub>	Maximum working insulation voltage		1414	V <sub>PEAK</sub>
V <sub>PR</sub>	Input-to-output test voltage	After Input/Output safety test subgroup 2/3, V <sub>PR</sub> = V <sub>IORM</sub> × 1.2, t = 10 s, Partial discharge < 5 pC	1697	V <sub>PEAK</sub>
		Method a, After environmental tests subgroup 1, V <sub>PR</sub> = V <sub>IORM</sub> × 1.6, t = 10 s, Partial Discharge < 5 pC	2262	
		Method b1, 100% Production test V <sub>PR</sub> = V <sub>IORM</sub> × 1.875, t = 1 s Partial discharge < 5 pC	2652	
V <sub>IOTM</sub>	Maximum transient overvoltage	V <sub>TEST</sub> = V <sub>IOTM</sub> t = 60 sec (Qualification) t = 1 sec (100% Production)	6000	V <sub>PEAK</sub>
R <sub>S</sub>	Insulation resistance	V <sub>IO</sub> = 500 V at T <sub>S</sub>	>10 <sup>9</sup>	Ω
	Pollution degree		2	

(4) Climatic Classification 40/125/21

**Table 1. IEC 60664-1 Ratings Table**

PARAMETER	TEST CONDITIONS	SPECIFICATION
Basic Isolation Group	Material Group	II
Installation classification	Rated mains voltage $\leq 300 V_{RMS}$	I–IV
	Rated mains voltage $\leq 600 V_{RMS}$	I–III
	Rated mains voltage $\leq 1000 V_{RMS}$	I–II

**Table 2. Regulatory Information**

VDE	TUV	CSA	UL	CQC
Certified according to DIN VDE V 0884-10 (VDE V 0084-10):2006-12	Certified according to EN/UL/CSA 60950-1 and EN/UL/CSA 61010-1	Approved under CSA Component Acceptance Notice 5A, IEC 61010-1, IEC 60950-1, IEC 60601-1	Recognized under UL 1577 Component Recognition Program	Certified according to GB4943.1-2011
Basic Insulation, Maximum Transient Overvoltage, 6000 $V_{PK}$ , Maximum Working Voltage, 1414 $V_{PK}$	5000 $V_{RMS}$ Isolation Rating, Reinforced Insulation, 400 $V_{RMS}$ maximum working voltage, Basic Insulation, 600 $V_{RMS}$ maximum working voltage	5000 $V_{RMS}$ Isolation Rating, 380 $V_{RMS}$ Reinforced and 760 $V_{RMS}$ Basic working voltage per CSA 60950-1-07 and IEC 60950-1 (2nd Ed.), 300 $V_{RMS}$ Reinforced and 600 $V_{RMS}$ Basic working voltage per CSA 61010-1-04 and IEC 61010-1 (2nd Ed.), 2 Means of Patient Protection at 125 $V_{RMS}$ per CSA 60601-1:08 and IEC 60601-1 (3rd Ed.)	Single Protection, 4243 $V_{RMS}^{(1)}$	Reinforced Insulation, Altitude $\leq 5000$ m, Tropical Climate, 250 $V_{RMS}$ maximum working voltage
Certificate number: 40016131	Certificate number: U8V 13 09 77311 010	Master contract number: 220991	File Number: E181974	Certificate number: CQC14001109542

(1) Production tested  $\geq 5092 V_{RMS}$  for 1 second in accordance with UL 1577.

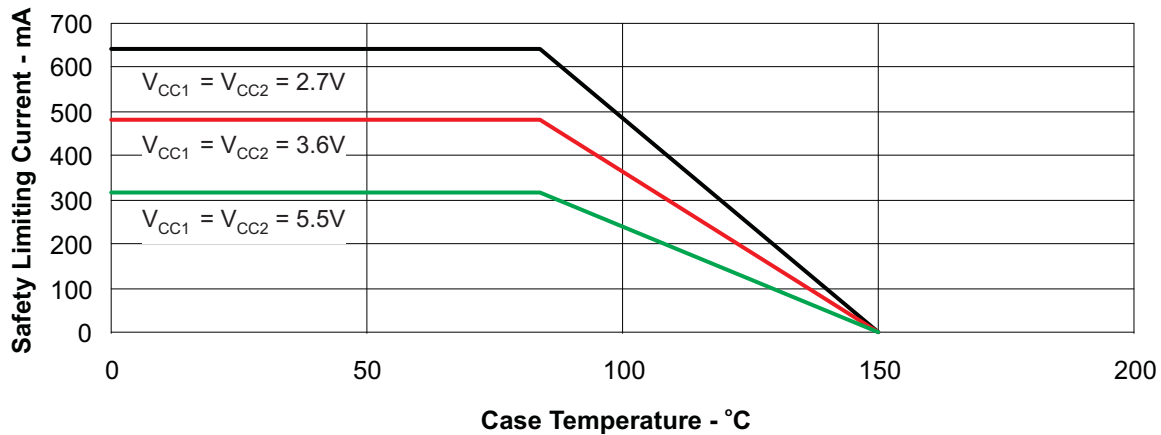
### 8.3.3 Safety Limiting Values

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.

**Table 3. Safety Limiting Values**

PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
$I_S$ Safety input, output, or supply current	DW-16	$\theta_{JA} = 72^\circ\text{C/W}$ , $V_I = 5.5\text{ V}$ , $T_J = 150^\circ\text{C}$ , $T_A = 25^\circ\text{C}$				316	mA
		$\theta_{JA} = 72^\circ\text{C/W}$ , $V_I = 3.6\text{ V}$ , $T_J = 150^\circ\text{C}$ , $T_A = 25^\circ\text{C}$				482	
		$\theta_{JA} = 72^\circ\text{C/W}$ , $V_I = 2.7\text{ V}$ , $T_J = 150^\circ\text{C}$ , $T_A = 25^\circ\text{C}$				643	
$T_S$ Maximum case temperature						150	$^\circ\text{C}$

The safety-limiting constraint is the absolute maximum junction temperature specified in the absolute maximum ratings table. The power dissipation and junction-to-air thermal impedance of the device installed in the application hardware determines the junction temperature. The assumed junction-to-air thermal resistance in the [Thermal Information](#) table is that of a device installed on a High-K Test Board for Leaded Surface Mount Packages. 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.


**Figure 14. DW-16  $\theta_{JC}$  Thermal Derating Curve per DIN V VDE V 0884-10**

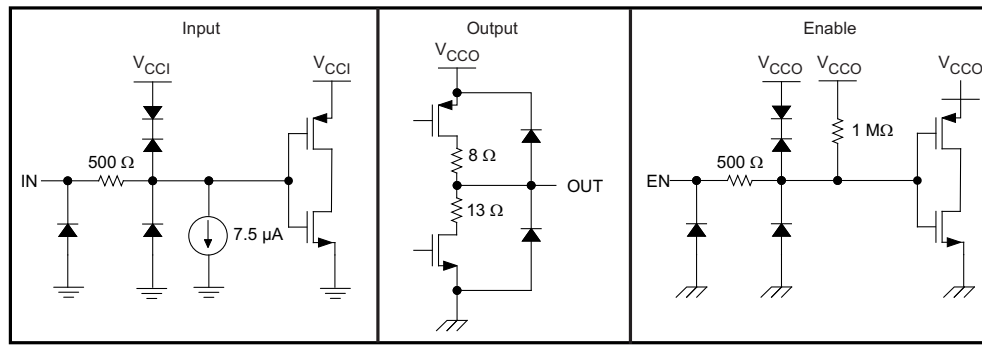


## 8.4 Device Functional Modes

**Table 4. Function Table<sup>(1)</sup>**

$V_{CCI}$	$V_{CCO}$	INPUT (INx)	OUTPUT ENABLE (ENx)	OUTPUT (OUTx)
PU	PU	H	H or Open	H
		L	H or Open	L
		X	L	Z
		Open	H or Open	L
PD	PU	X	H or Open	L
PD	PU	X	L	Z
X	PD	X	X	Undetermined

(1)  $V_{CCI}$  = Input-side VCC;  $V_{CCO}$  = Output-side VCC; PU = Powered Up ( $V_{CC} \geq 2.7$  V); PD = Powered Down ( $V_{CC} \leq 2.1$  V); X = Irrelevant; H = High Level; L = Low Level; Z = High Impedance



**Figure 15. Device I/O Schematics**

## 9 Application and Implementation

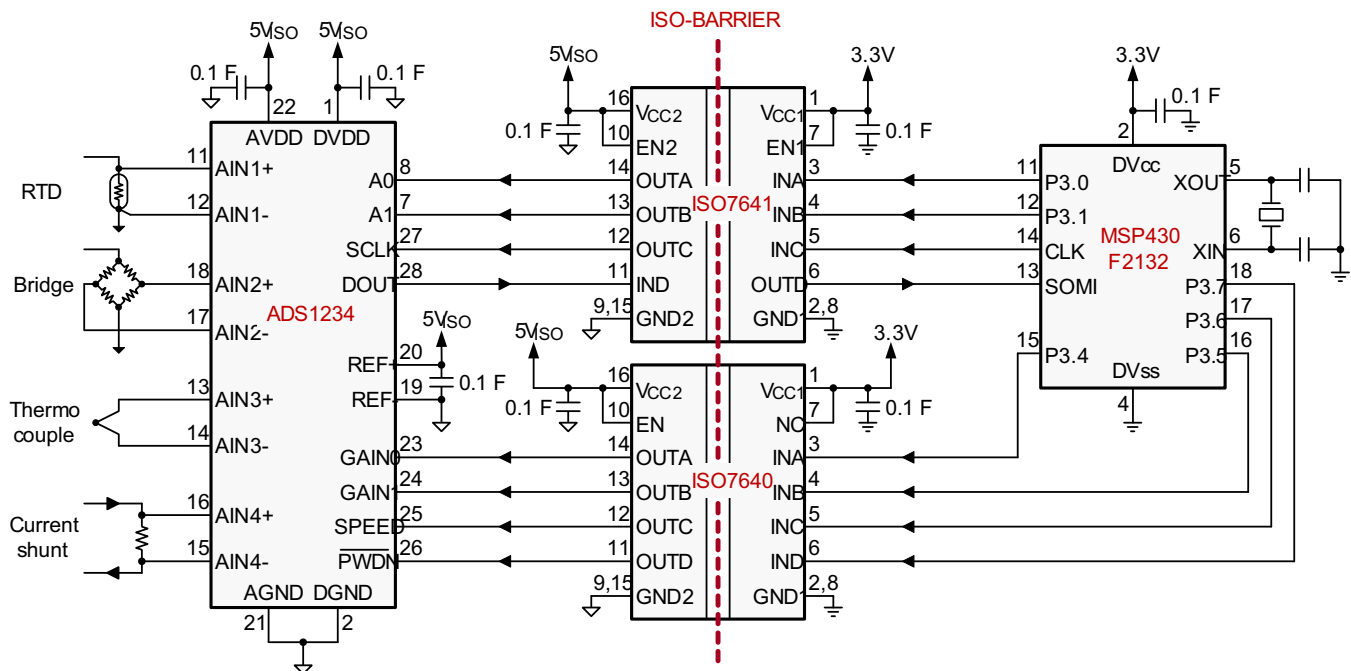
### NOTE

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

ISO764x use single-ended TTL-logic switching technology. Its supply voltage range is from 3 V to 5.5 V for both supplies,  $V_{CC1}$  and  $V_{CC2}$ . When designing with digital isolators, it is important to note that due to 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,  $\mu$ C or UART), and a data converter or a line transceiver, regardless of the interface type or standard.

### 9.2 Typical Application



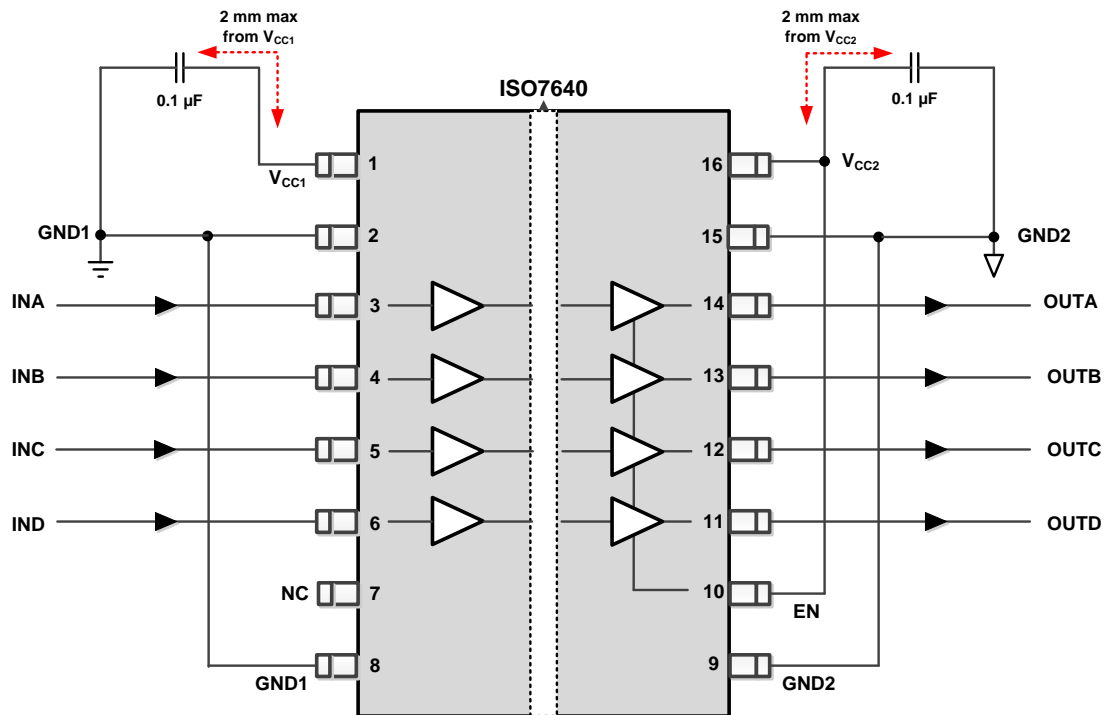
**Figure 16. Isolated Data Acquisition System for Process Control**

#### 9.2.1 Design Requirements

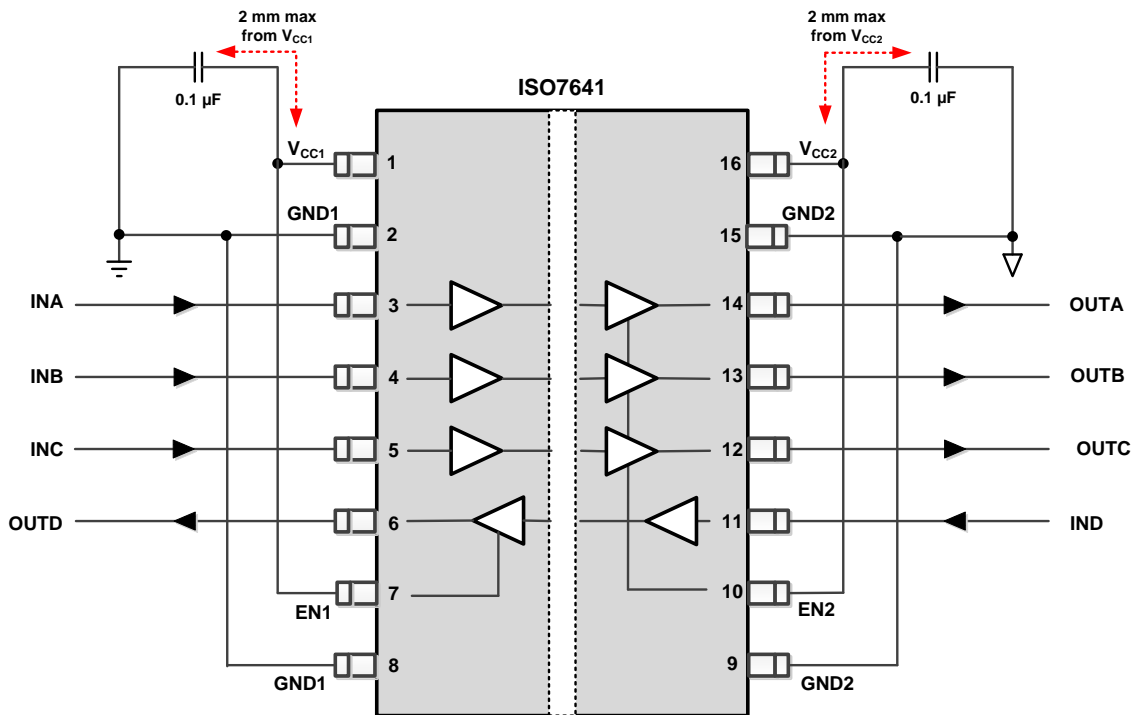
Unlike optocouplers, which require external components to improve performance, provide bias, or limit current, the ISO764x device only requires two external bypass capacitors to operate.

## Typical Application (continued)

### 9.2.2 Detailed Design Procedure



**Figure 17. Typical ISO7640FM Circuit Hookup**



**Figure 18. Typical ISO7641FM Circuit Hookup**

## Typical Application (continued)

### 9.2.2.1 Typical Supply Current Equations

(Calculated based on room temperature and typical Silicon process)

#### ISO7640FM:

At  $V_{CC1} = V_{CC2} = 3.3\text{ V}$

$$I_{CC1} = 0.388 + 0.0312 \times f \quad (1)$$

$$I_{CC2} = 3.39 + 0.03561 \times f + 0.006588 \times f \times C_L \quad (2)$$

At  $V_{CC1} = V_{CC2} = 5\text{ V}$

$$I_{CC1} = 0.584 + 0.05349 \times f \quad (3)$$

$$I_{CC2} = 4.184 + 0.05597 \times f + 0.009771 \times f \times C_L \quad (4)$$

#### ISO7641FM:

At  $V_{CC1} = V_{CC2} = 3.3\text{ V}$

$$I_{CC1} = 1.848 + 0.03233 \times f + 0.001645 \times f \times C_L \quad (5)$$

$$I_{CC2} = 3.005 + 0.03459 \times f + 0.0049395 \times f \times C_L \quad (6)$$

At  $V_{CC1} = V_{CC2} = 5\text{ V}$

$$I_{CC1} = 2.369 + 0.05385 \times f + 0.002448 \times f \times C_L \quad (7)$$

$$I_{CC2} = 3.857 + 0.05506 \times f + 0.007348 \times f \times C_L \quad (8)$$

$I_{CC1}$  and  $I_{CC2}$  are typical supply currents measured in mA;  $f$  is data rate measured in Mbps;  $C_L$  is the capacitive load on each channel measured in pF.

### 9.2.3 Application Curves

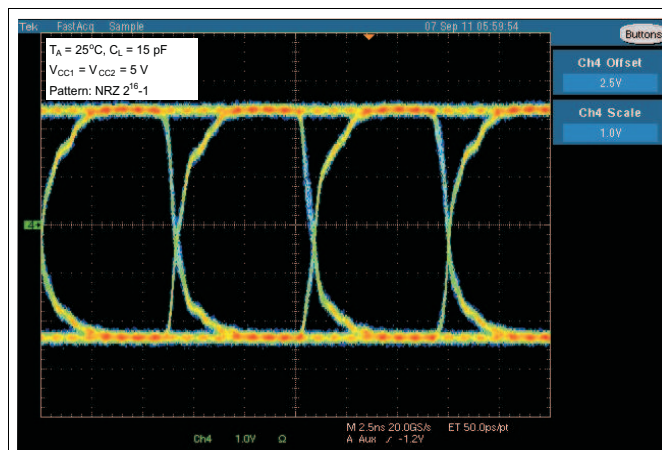


Figure 19. Typical Eye Diagram at 150 Mbps,  
5-V Operation

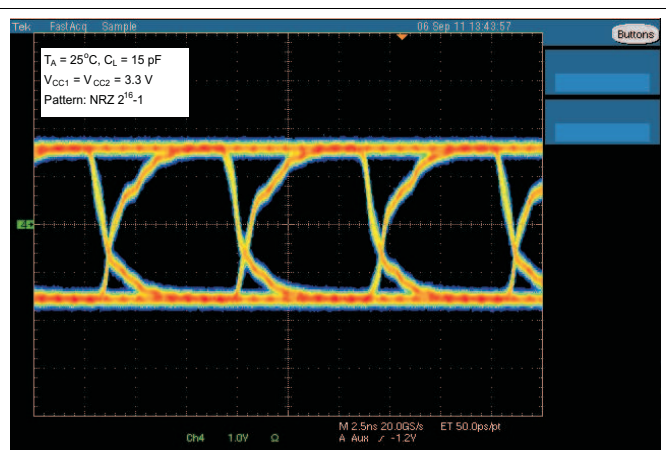


Figure 20. Typical Eye Diagram at 150 Mbps,  
3.3-V Operation

## 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](#). For such applications, detailed power supply design and transformer selection recommendations are available in SN6501 data sheet ([SLLSEA0](#)).

## 11 Layout

### 11.1 Layout Guidelines

A minimum of four layers is required to accomplish a low EMI PCB design (see [Figure 21](#)). Layer stacking should be in the following order (top-to-bottom): high-speed signal layer, ground plane, power plane and low-frequency signal layer.

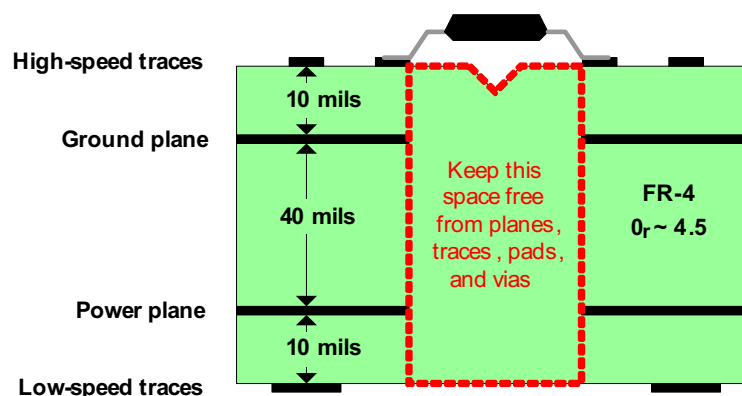
- Routing the high-speed traces on the top layer avoids the use of vias (and the introduction of their inductances) and allows for clean interconnects between the isolator and the transmitter and receiver circuits of the data link.
- Placing a solid ground plane next to the high-speed signal layer establishes 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<sup>2</sup>.
- 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 and 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.

#### NOTE

For detailed layout recommendations, see *Digital Isolator Design Guide*, [SLLA284](#).

### 11.2 Layout Example



**Figure 21. Recommended Layer Stack**

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation, see the following:

- *Digital Isolator Design Guide*, [SLLA284](#)
- *Transformer Driver for Isolated Power Supplies*, [SLLSEA0](#)

### 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 5. Related Links**

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
ISO7640FM	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>
ISO7641FM	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>

### 12.3 Trademarks

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### 12.4 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.

### 12.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

[SLLA353](#) -- *Isolation Glossary*.

## 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.

## PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">ISO7640FMDW</a>	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7640FM
ISO7640FMDW.A	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7640FM
ISO7640FMDWG4	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7640FM
ISO7640FMDWG4.A	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7640FM
<a href="#">ISO7640FMDWR</a>	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7640FM
ISO7640FMDWR.A	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7640FM
<a href="#">ISO7641FMDW</a>	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7641FM
ISO7641FMDW.A	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7641FM
<a href="#">ISO7641FMDWR</a>	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7641FM
ISO7641FMDWR.A	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7641FM
ISO7641FMDWRG4	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7641FM
ISO7641FMDWRG4.A	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISO7641FM

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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## TAPE AND REEL INFORMATION



\*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
ISO7640FMDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7641FMDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISO7641FMDWRG4	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	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)
ISO7640FMDWR	SOIC	DW	16	2000	350.0	350.0	43.0
ISO7641FMDWR	SOIC	DW	16	2000	350.0	350.0	43.0
ISO7641FMDWRG4	SOIC	DW	16	2000	350.0	350.0	43.0

## TUBE



\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
ISO7640FMDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
ISO7640FMDW.A	DW	SOIC	16	40	506.98	12.7	4826	6.6
ISO7640FMDWG4	DW	SOIC	16	40	506.98	12.7	4826	6.6
ISO7640FMDWG4.A	DW	SOIC	16	40	506.98	12.7	4826	6.6
ISO7641FMDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
ISO7641FMDW.A	DW	SOIC	16	40	506.98	12.7	4826	6.6

## 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

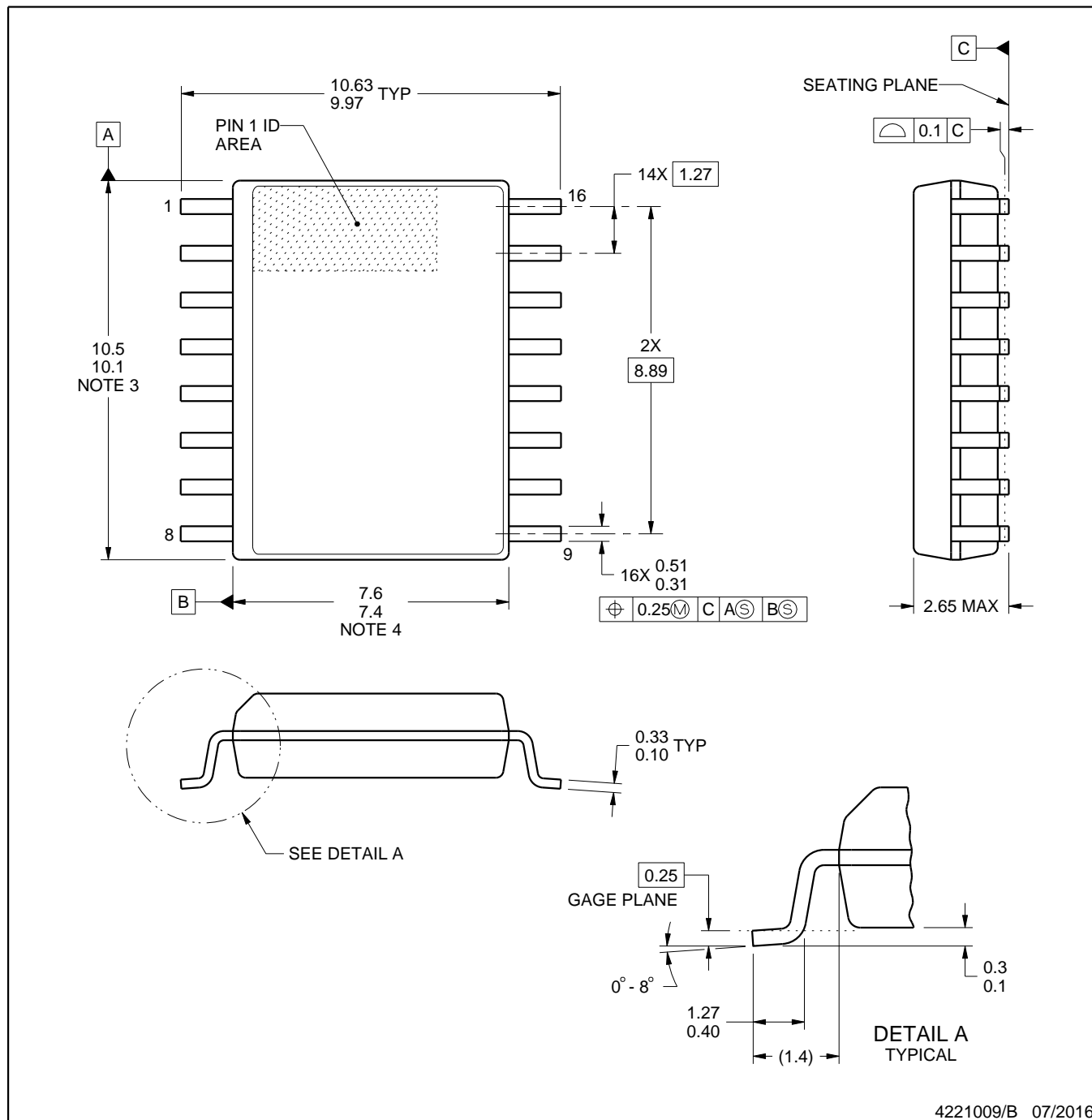


DW0016B

# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4221009/B 07/2016

### NOTES:

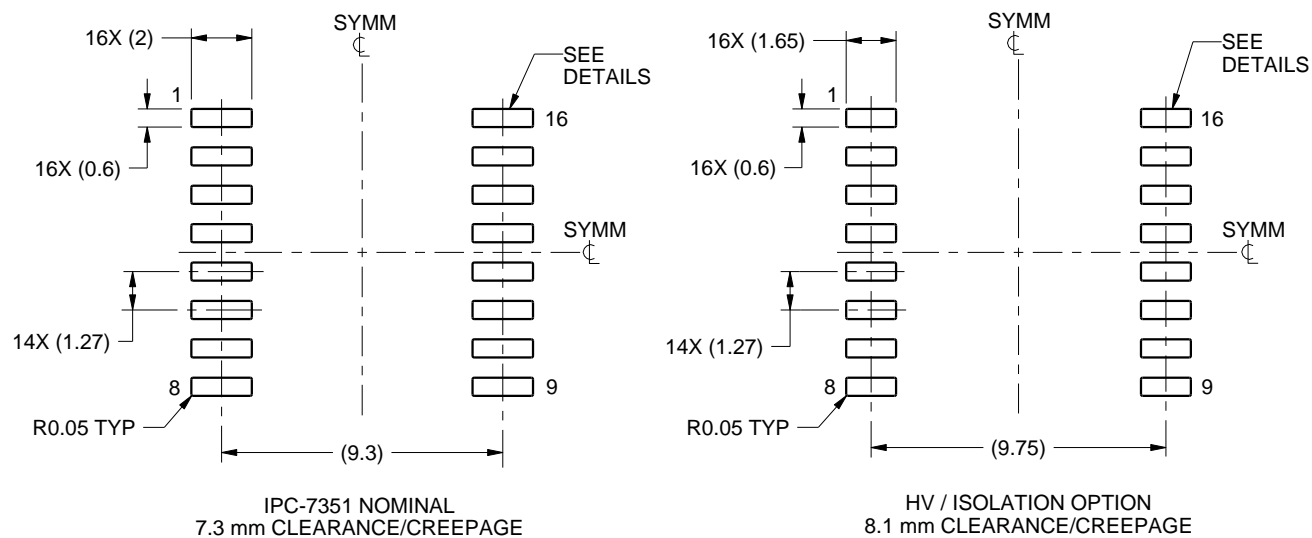
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate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

# EXAMPLE BOARD LAYOUT

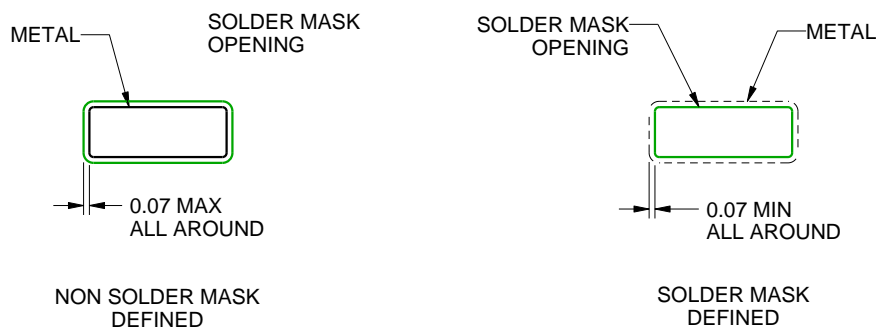
DW0016B

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:4X



SOLDER MASK DETAILS

4221009/B 07/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

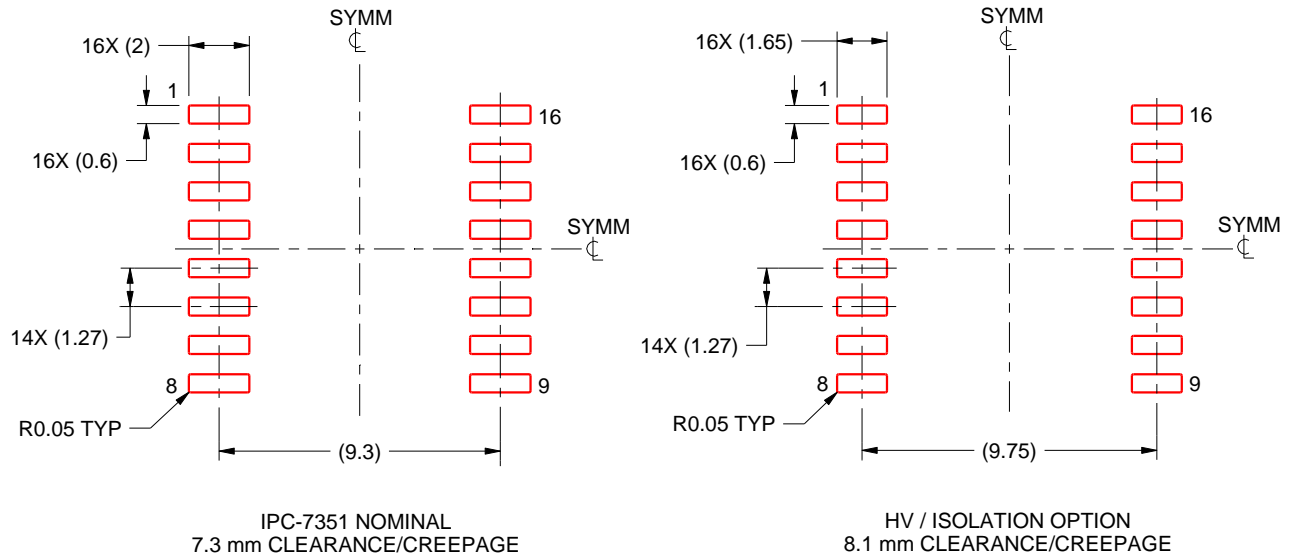
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0016B

SOIC - 2.65 mm max height

SOIC



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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Last updated 10/2025