ISO734x Robust EMC, Low Power, Quad-Channel Digital Isolators

1 Features

- Signaling Rate: 25 Mbps
- Integrated Noise Filter on the Inputs
- Default Output 'High' and 'Low' Options
- Low Power Consumption, Typical I_{CC} per Channel at 1 Mbps:
  - ISO7340: 0.9 mA (5 V Supplies), 0.7 mA (3.3 V Supplies)
  - ISO7341: 1.2 mA (5 V Supplies), 0.9 mA (3.3 V Supplies)
  - ISO7342: 1.3 mA (5 V Supplies), 0.9 mA (3.3 V Supplies)
- Low Propagation Delay: 31 ns Typical (5 V Supplies)
- 3.3 V and 5 V Level Translation
- Wide Temperature Range: –40°C to 125°C
- 70 KV/µs Transient Immunity, Typical (5 V Supplies)
- Robust Electromagnetic Compatibility (EMC)
  - System-level ESD, EFT, and Surge Immunity
  - Low Emissions
- Operates from 3.3 V and 5 V Supplies
- Wide Body SOIC-16 Package
- Safety and Regulatory Approvals:
  - 4242 V_{PK} Basic Isolation per DIN V VDE 0884-10
  - 3 KV_{RMS} Isolation for 1 minute per UL 1577
  - CSA Component Acceptance Notice #5A, IEC 60950-1 and IEC 61010-1 End Equipment Standards
  - GB4943.1-2011 CQC Certification
  - All Agencies Approvals Pending

2 Applications

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

3 Description

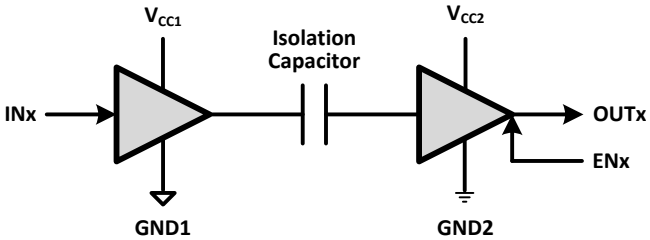
ISO734x provide galvanic isolation up to 3000 V_{RMS} for 1 minute per UL and 4242 V_{PK} per VDE. These devices have four isolated channels comprised of logic input and output buffers separated by a silicon dioxide (SiO_2) insulation barrier. ISO7340 has four channels in forward direction, ISO7341 has three forward and one reverse-direction channels; and ISO7342 has two forward and two reverse-direction channels. In case of input power or signal loss, default output is 'low' for devices with suffix 'F' and 'high' for devices without suffix 'F'. See *Device Functional Modes* for further details. 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. ISO734x has integrated noise filter for harsh industrial environment where short noise pulses may be present at the device input pins. ISO734x has TTL input thresholds and operates from 3 V to 5.5 V supply levels. Through innovative chip design and layout techniques, electromagnetic compatibility of ISO734x has been significantly enhanced to enable system-level ESD, EFT, Surge and Emissions compliance.

Device Information(1)

ORDER NUMBER	PACKAGE	BODY SIZE
ISO7340C	SOIC (16)	10.3mm x 7.50mm
ISO7340FC		
ISO7341C		
ISO7341FC		
ISO7342C		
ISO7342FC		

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

Simplified Schematic



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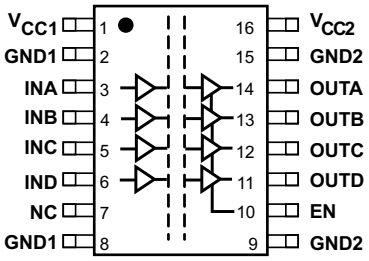
4 Revision History

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

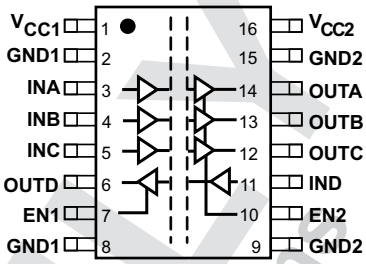
Changes from Original (September 2014) to Revision A	Page
• Changed From a 1 page Product Preview to the full datasheet	1
• Changed the Simplified Schematic, added ground symbols	1

5 Pin Configuration and Functions

ISO7340
DW Package
Top View



ISO7341
DW Package
Top View



ISO7342
DW Package
Top View

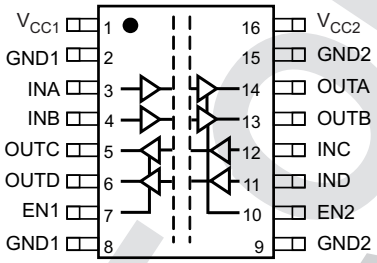


Table 1. Pin Functions

PIN				I/O	DESCRIPTION
NAME	ISO7340	ISO7341	ISO7342		
INA	3	3	3	I	Input, channel A
INB	4	4	4	I	Input, channel B
INC	5	5	12	I	Input, channel C
IND	6	11	11	I	Input, channel D
OUTA	14	14	14	O	Output, channel A
OUTB	13	13	13	O	Output, channel B
OUTC	12	12	5	O	Output, channel C
OUTD	11	6	6	O	Output, channel D
EN1	–	7	7	I	Output enable 1. Output pins on side-1 are enabled when EN1 is high or disconnected and disabled when EN1 is low.
EN2	–	10	10	I	Output enable 2. Output pins on side-2 are enabled when EN2 is high or disconnected and disabled when EN2 is low.
EN	10	–	–	I	Output enable. All output pins are enabled when EN is high or disconnected and disabled when EN is low.
V_{CC1}	1	1	1	–	Power supply, V_{CC1}
V_{CC2}	16	16	16	–	Power supply, V_{CC2}
GND1	2,8	2,8	2, 8	–	Ground connection for V_{CC1}
GND2	9,15	9,15	9, 15	–	Ground connection for V_{CC2}
NC	7	–	–	–	No Connect pins are floating with no internal connection

6 Specifications

6.1 Absolute Maximum Ratings(1)

		VALUE		UNIT
		MIN	MAX	
Supply voltage(2)	V_{CC1}, V_{CC2}	–0.5	6	V
Voltage	INx, OUTx, ENx	–0.5	V_{CC} + 0.5	V
Output Current	I_O		±15	mA
Maximum junction temperature	T_J		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.

6.2 Handling Ratings

			MIN	MAX	UNIT
T_{stg}	Storage temperature		–65	150	°C
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	–4	4	kV
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2)	–1.5	1.5	kV

(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

PARAMETER		MIN	TYP	MAX	UNIT
V_{CC1}, V_{CC2}	Supply voltage	3		5.5	V
I_{OH}	High-level output current	-4			mA
I_{OL}	Low-level output current			4	mA
V_{IH}	High-level input voltage	2		5.5	V
V_{IL}	Low-level input voltage	0		0.8	V
t_{ui}	Input pulse duration	40			ns
1 / t_{ui}	Signaling rate	0		25	Mbps
T_J	Junction temperature(1)			136	°C
T_A	Ambient temperature	-40	25	125	°C

(1) To maintain the recommended operating conditions for T_J, see the *Thermal Information* table.

6.4 Thermal Information

THERMAL METRIC			DW (16 Pins)	UNITS
$R_{\theta JA}$	Junction-to-ambient thermal resistance		78.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case(top) thermal resistance		41.0	
$R_{\theta JB}$	Junction-to-board thermal resistance		43.0	
ψ_{JT}	Junction-to-top characterization parameter		15.6	
ψ_{JB}	Junction-to-board characterization parameter		42.5	
$R_{\theta JC(bottom)}$	Junction-to-case(bottom) thermal resistance		n/a	
P_D	Maximum Power Dissipation by ISO7340	$V_{CC1} = V_{CC2} = 5.5V$, $T_J = 150°C$, $C_L = 15pF$, Input a 12.5 MHz 50% duty cycle square wave	92	mW
P_{D1}	Maximum Power Dissipation by Side-1 of ISO7340		24	
P_{D2}	Maximum Power Dissipation by Side-2 of ISO7340		68	
P_D	Maximum Power Dissipation by ISO7341	$V_{CC1} = V_{CC2} = 5.5V$, $T_J = 150°C$, $C_L = 15pF$, Input a 12.5 MHz 50% duty cycle square wave	102	mW
P_{D1}	Maximum Power Dissipation by Side-1 of ISO7341		42	
P_{D2}	Maximum Power Dissipation by Side-2 of ISO7341		60	
P_D	Maximum Power Dissipation by ISO7342	$V_{CC1} = V_{CC2} = 5.5V$, $T_J = 150°C$, $C_L = 15pF$, Input a 12.5 MHz 50% duty cycle square wave	111	mW
P_{D1}	Maximum Power Dissipation by Side-1 of ISO7342		55.5	
P_{D2}	Maximum Power Dissipation by Side-2 of ISO7342		55.5	

6.5 Electrical Characteristics

V_{CC1} and V_{CC2} at 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 9		V_{CCx} (1) – 0.5	4.7		V
		I_{OH} = –20 µA; see Figure 9		V_{CCx} (1) – 0.1	5		
V_{OL}	Low-level output voltage	I_{OL} = 4 mA; see Figure 9			0.2	0.4	V
		I_{OL} = 20 µA; see Figure 9			0	0.1	
$V_{I(HYS)}$	Input threshold voltage hysteresis				480		mV
I_{IH}	High-level input current	V_{IH} = V_{CC} at INx or ENx				10	µA
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 Figure 12		25	70		kV/µs
Supply Current (All inputs switching with square wave clock signal for dynamic I_{CC} measurement)							
ISO7340							
I_{CC1}	Supply current	Disable	EN = 0 V		0.6	1.4	mA
I_{CC2}					0.4	0.8	
I_{CC1}		DC to 1 Mbps	DC Signal: V_I = V_{CC} or 0 V, AC Signal: All channels switching with square wave clock input; C_L = 15 pF		0.6	1.4	
I_{CC2}					3	4.8	
I_{CC1}		10 Mbps			1.4	2.3	
I_{CC2}					5.1	7.1	
I_{CC1}		25 Mbps			2.7	4	
I_{CC2}					8.6	12	
ISO7341							
I_{CC1}	Supply current	Disable	EN1 = EN2 = 0 V		0.9	1.8	mA
I_{CC2}					0.7	1.3	
I_{CC1}		DC to 1 Mbps	DC Signal: V_I = V_{CC} or 0 V, AC Signal: All channels switching with square wave clock input; C_L = 15 pF		1.9	3.2	
I_{CC2}					2.7	4.4	
I_{CC1}		10 Mbps			3	4.5	
I_{CC2}					4.5	6.5	
I_{CC1}		25 Mbps			4.8	7	
I_{CC2}					7.4	11	
ISO7342							
I_{CC1}, I_{CC2}	Supply current	Disable	EN1 = EN2 = 0 V		0.7	1.6	mA
I_{CC1}, I_{CC2}		DC to 1 Mbps	DC Signal: V_I = V_{CC} or 0 V, AC Signal: All channels switching with square wave clock input; C_L = 15 pF		2.5	4	
I_{CC1}, I_{CC2}		10 Mbps			4.1	5.6	
I_{CC1}, I_{CC2}		25 Mbps			6.4	9	

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

6.6 Switching Characteristics

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

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay time		See Figure 9	20	31	58	ns
PWD(1)	Pulse width distortion $\lvert t_{PHL} - t_{PLH} \rvert$		See Figure 9			4	ns
$t_{sk(o)}$ (2)	Channel-to-channel output skew time		Same-direction Channels			2.5	ns
			Opposite-direction Channels			17	ns
$t_{sk(pp)}$ (3)	Part-to-part skew time					23	ns
t_r	Output signal rise time		See Figure 9		2.1		ns
t_f	Output signal fall time		See Figure 9		1.7		ns
t_{PHZ}	Disable Propagation Delay, high-to-high impedance output		See Figure 10		7	13	ns
t_{PLZ}	Disable Propagation Delay, low-to-high impedance output		See Figure 10		7	13	ns
t_{PZH}	Enable Propagation Delay, high impedance-to-high output	ISO734xC	See Figure 10		6	13	ns
		ISO734xFC	See Figure 10		15000	23000(4)	ns
t_{PZL}	Enable Propagation Delay, high impedance-to-low output	ISO734xC	See Figure 10		15000	23000(4)	ns
		ISO734xFC	See Figure 10		7	13	ns
t_{fs}	Fail-safe output delay time from input power loss		See Figure 11		9.4		µs

(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.
(4) The enable signal rate should be ≤ 43 Kbps.

6.7 Electrical Characteristics

V_{CC1} and V_{CC2} at 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} = –4 mA; see Figure 9		V_{CCx} (1) – 0.5	3		V
		I_{OH} = –20 µA; see Figure 9		V_{CCx} (1) – 0.1	3.3		
V_{OL}	Low-level output voltage	I_{OL} = 4 mA; see Figure 9			0.2	0.4	V
		I_{OL} = 20 µA; see Figure 9			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	µA
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 Figure 12		25	50		kV/µs
Supply Current (All inputs switching with square wave clock signal for dynamic I_{CC} measurement)							
ISO7340							
I_{CC1}	Supply current	Disable	EN = 0 V		0.4	0.7	mA
I_{CC2}					0.3	0.6	
I_{CC1}		DC to 1 Mbps	DC Signal: V_I = V_{CC} or 0 V, AC Signal: All channels switching with square wave clock input; C_L = 15 pF		0.4	0.7	
I_{CC2}					2.3	3.6	
I_{CC1}		10 Mbps			0.8	1.3	
I_{CC2}					3.6	5.1	
I_{CC1}		25 Mbps			1.6	2.4	
I_{CC2}					5.9	8	
ISO7341							
I_{CC1}	Supply current	Disable	EN1 = EN2 = 0 V		0.6	1	mA
I_{CC2}					0.5	0.8	
I_{CC1}		DC to 1 Mbps	DC Signal: V_I = V_{CC} or 0 V, AC Signal: All channels switching with square wave clock input; C_L = 15 pF		1.4	2.3	
I_{CC2}					2	3.2	
I_{CC1}		10 Mbps			2	3	
I_{CC2}					3.1	4.5	
I_{CC1}		25 Mbps			3.2	4.7	
I_{CC2}					5	7.2	
ISO7342							
I_{CC1}, I_{CC2}	Supply current	Disable	EN1 = EN2 = 0 V		0.5	0.9	mA
I_{CC1}, I_{CC2}		DC to 1 Mbps	DC Signal: V_I = V_{CC} or 0 V, AC Signal: All channels switching with square wave clock input; C_L = 15 pF		1.8	2.8	
I_{CC1}, I_{CC2}		10 Mbps			2.8	4	
I_{CC1}, I_{CC2}		25 Mbps			4.3	5.8	

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

6.8 Switching Characteristics

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

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}, t_{PHL}	Propagation delay time		See Figure 9	22	35	66	ns
PWD(1)	Pulse width distortion $\lvert t_{PHL} - t_{PLH} \rvert$					2.5	
$t_{sk(o)}$ (2)	Channel-to-channel output skew time		Same-direction Channels			3	
			Opposite-direction Channels			16	
$t_{sk(pp)}$ (3)	Part-to-part skew time					28	
t_r	Output signal rise time		See Figure 9		2.8		ns
t_f	Output signal fall time				2.1		
t_{PHZ}	Disable Propagation Delay, high-to-high impedance output		See Figure 10		9	18	ns
t_{PLZ}	Disable Propagation Delay, low-to-high impedance output				9	18	
t_{PZH}	Enable Propagation Delay, high impedance-to-high output	ISO734xC			9	18	
		ISO734xFC			16	24000(4)	
t_{PZL}	Enable Propagation Delay, high impedance-to-low output	ISO734xC			16	24000(4)	
		ISO734xFC			9	18	
t_{fs}	Fail-safe output delay time from input power loss		See Figure 11		9.4		µs

(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.
(4) The enable signal rate should be ≤ 45 Kbps.

6.9 Typical Characteristics

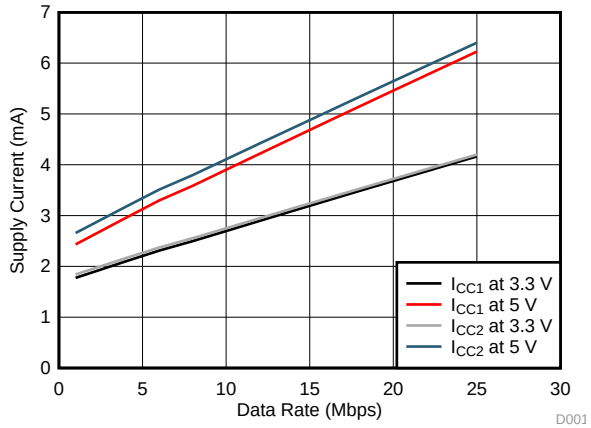


Figure 1. ISO7342 Supply Current vs Data Rate (with 15 pF Load)

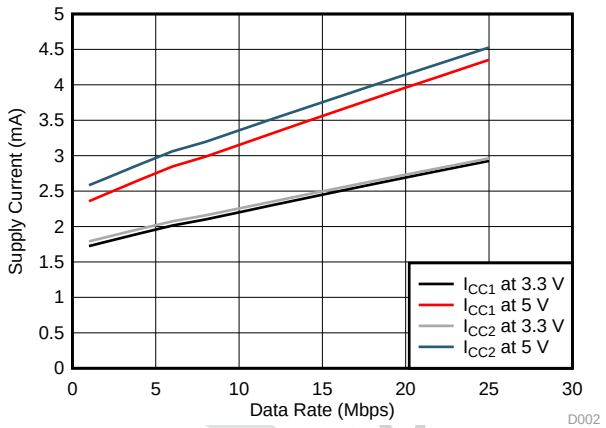


Figure 2. ISO7342 Supply Current vs Data Rate (with No Load)

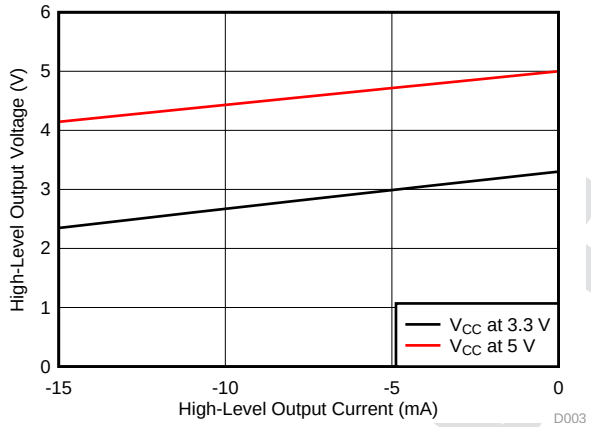


Figure 3. High-Level Output Voltage vs High-level Output Current

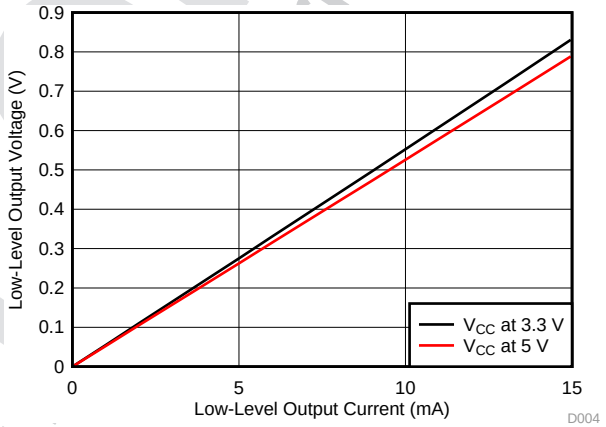


Figure 4. Low-Level Output Voltage vs Low-Level Output Current

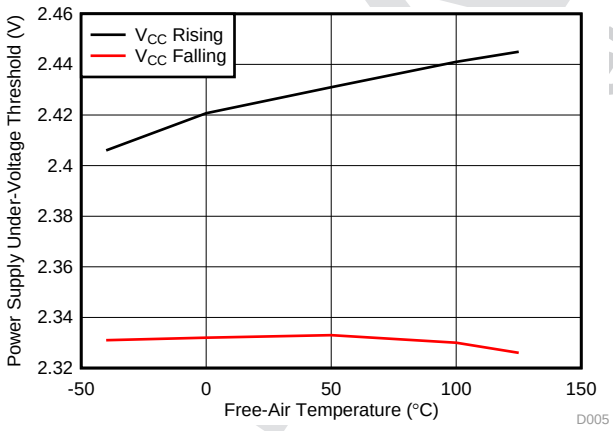


Figure 5. Power Supply Undervoltage Threshold vs Free-Air Temperature

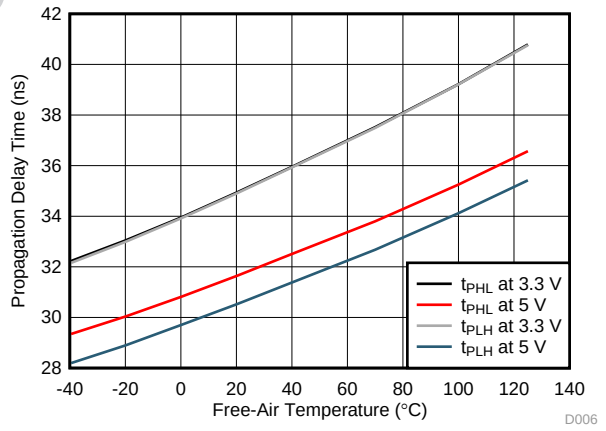


Figure 6. Propagation Delay Time vs Free-Air Temperature

PRODUCT PREVIEW

Typical Characteristics (continued)

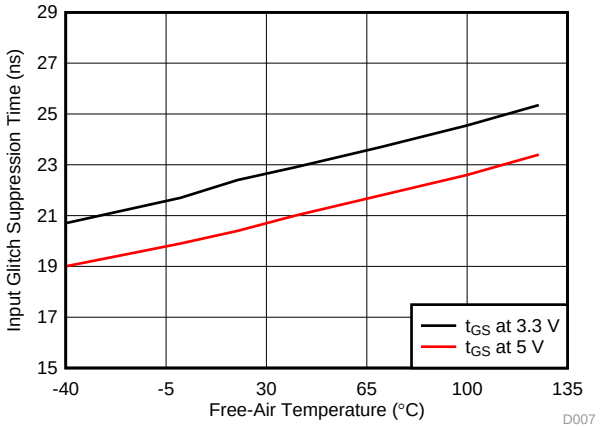
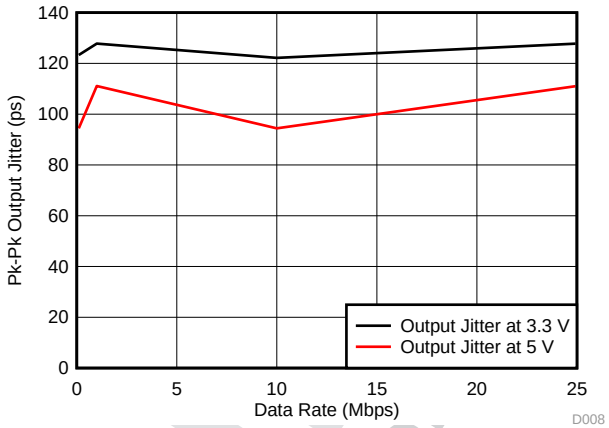


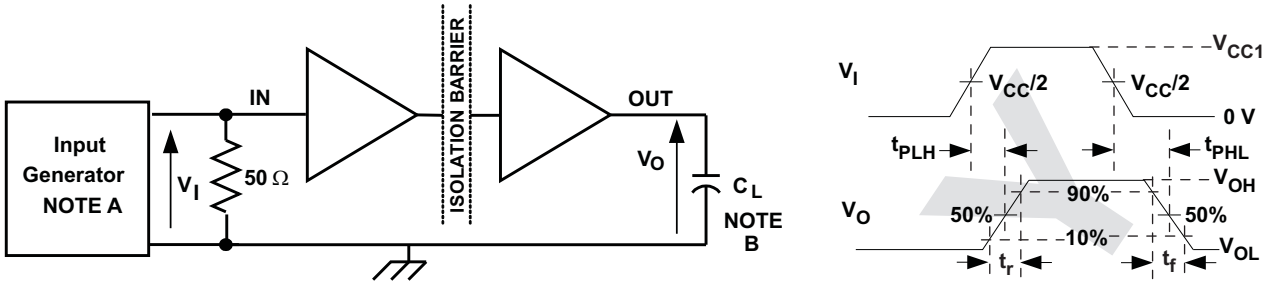
Figure 7. Input Glitch Suppression Time vs Free-Air Temperature



T_A = 25°C

Figure 8. Output Jitter vs Data Rate

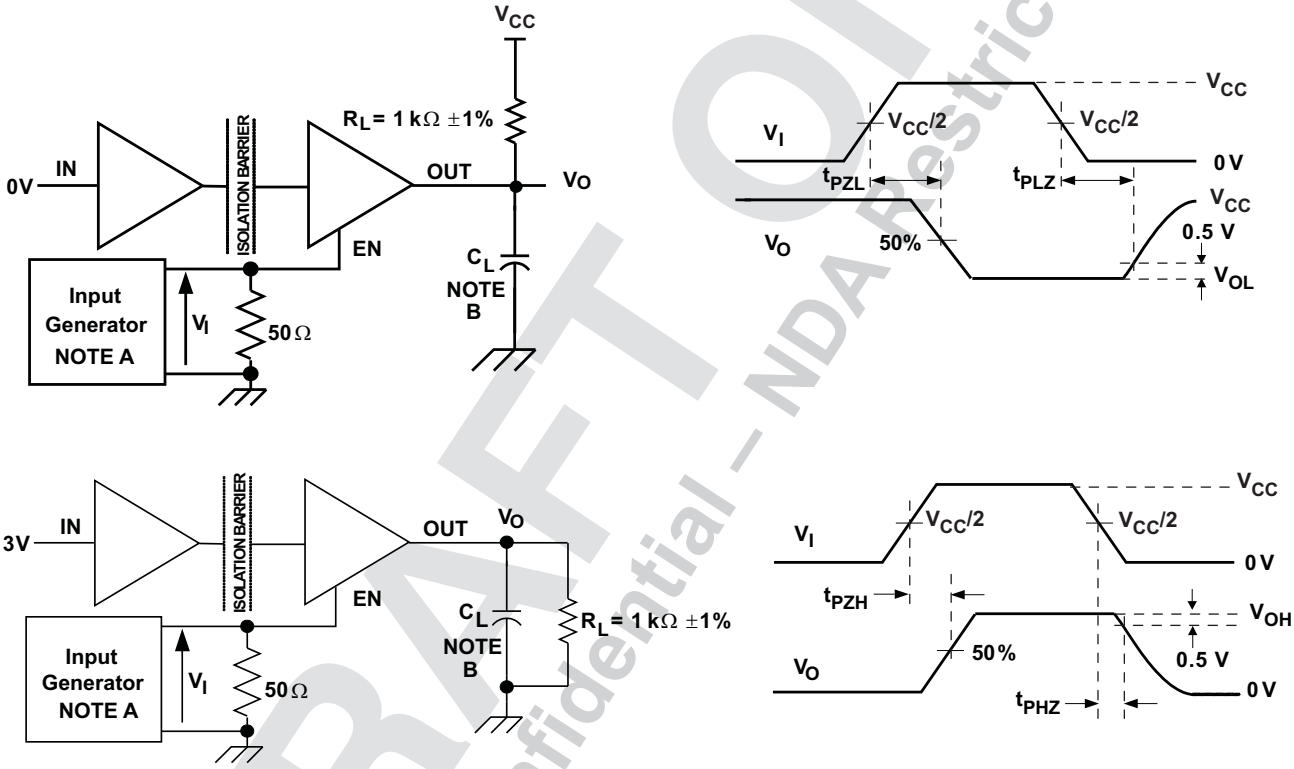
7 Parameter Measurement Information



A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 50 kHz, 50% duty cycle, t_r ≤ 3 ns, t_f ≤ 3ns, 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 9. Switching Characteristics Test Circuit and Voltage Waveforms

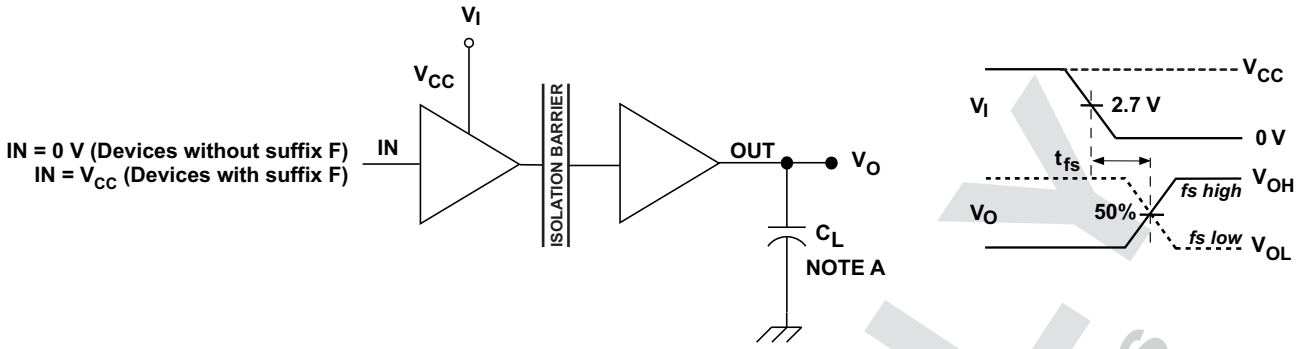


A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 10 kHz, 50% duty cycle, t_r ≤ 3 ns, t_f ≤ 3 ns, Z_O = 50 Ω.

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

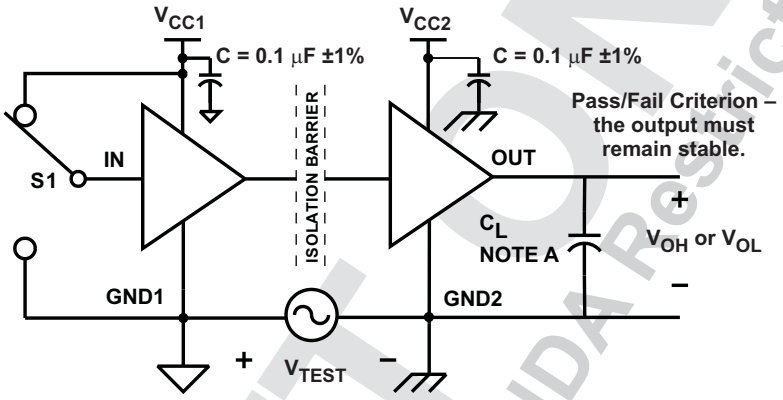
Figure 10. Enable/Disable Propagation Delay Time Test Circuit and Waveform

Parameter Measurement Information (continued)



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

Figure 11. Failsafe Delay Time Test Circuit and Voltage Waveforms



A. C_L = 15 pF and includes instrumentation and fixture capacitance within ±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 (HF) channel with a bandwidth from 100 kbps up to 25 Mbps, and a low-frequency (LF) channel 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 transient pulses, which then are converted into CMOS levels by a comparator. The transient pulses at the input of the comparator can be either above or below the common mode voltage VREF depending on whether the input bit transitioned from 0 to 1 or 1 to 0. The comparator threshold is adjusted based on the expected bit transition. A decision logic (DCL) at the output of the HF channel comparator measures the durations between signal transients. If the duration between two consecutive transients exceeds a certain time limit, (as in the case of a low-frequency signal), the DCL forces the output-multiplexer to switch from the high-frequency to the low-frequency channel.

Because low-frequency input signals require the internal capacitors to assume prohibitively large values, these signals are pulse-width modulated (PWM) with the carrier frequency of an internal oscillator, thus creating a sufficiently high frequency, 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

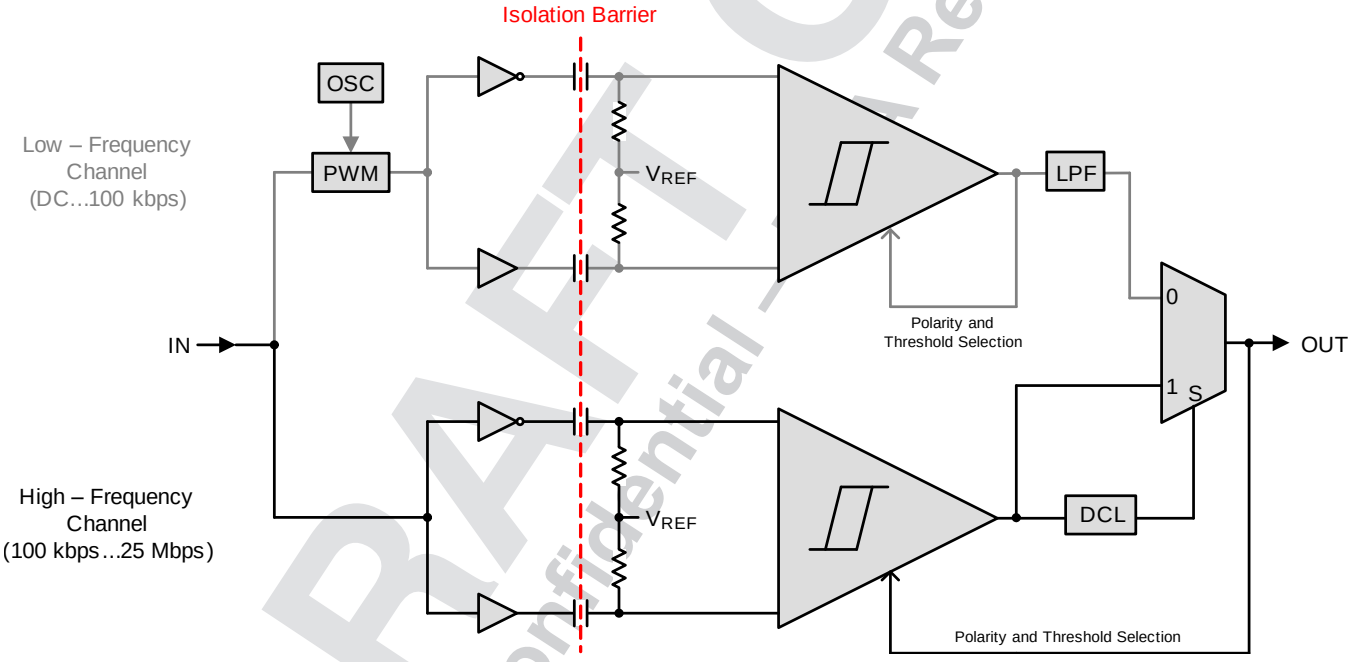


Figure 13. Conceptual Block Diagram of a Digital Capacitive Isolator

8.3 Feature Description

ISO734x are available in multiple channel configurations and default output state options to enable wide variety of application uses.

PRODUCT	CHANNEL DIRECTION	RATED ISOLATION	MAX DATA RATE	DEFAULT OUTPUT
ISO7340C	4 Forward, 0 Reverse	3000 V_{RMS} / 4242 V_{PK} (1)	25 Mbps	High
ISO7340FC				Low
ISO7341C	3 Forward, 1 Reverse			High
ISO7341FC				Low
ISO7342C	2 Forward, 2 Reverse			High
ISO7342FC				Low

(1) See the *Regulatory Information* section for detailed isolation ratings.

8.3.1 High Voltage Feature Description

8.3.1.1 IEC Insulation and Safety-Related Specifications for DW-16 Package

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
L(I01)	Minimum air gap (clearance)	Shortest terminal-to-terminal distance through air	8			mm
L(I02)	Minimum external tracking (creepage)	Shortest terminal-to-terminal distance across the package surface	8			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_{IO}	Isolation resistance, input to output(1)	V_{IO} = 500 V, T_A < 100°C		$>10^{12}$		Ω
		V_{IO} = 500 V, 100°C ≤ T_A ≤ max		$>10^{11}$		Ω
C_{IO}	Isolation capacitance, input to output(1)	V_{IO} = 0.4 sin (2πft), f = 1 MHz		2.4		pF
C_I	Input capacitance(2)	$V_I = V_{CC}/2 + 0.4 \sin(2\pi ft)$, f = 1 MHz, V_{CC} = 5 V		3.4		pF

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

8.3.1.2 Insulation Characteristics

over recommended operating conditions (unless otherwise noted)

PARAMETER(1)		TEST CONDITIONS	SPECIFICATION	UNIT
V_{IOWM}	Maximum isolation working voltage		1000	V_{RMS}
V_{IORM}	Maximum repetitive peak voltage per DIN V VDE 0884-10		1414	V_{PEAK}
V_{PR}	Input-to-output test voltage per DIN V VDE 0884-10	After Input/Output safety test subgroup 2/3, V_{PR} = V_{IORM} x 1.2, t = 10 s, Partial discharge < 5 pC	1697	V_{PEAK}
		Method a, After environmental tests subgroup 1, V_{PR} = V_{IORM} x 1.6, t = 10 s, Partial Discharge < 5 pC	2262	
		Method b1, V_{PR} = V_{IORM} x 1.875, t = 1 s (100% Production test) Partial discharge < 5 pC	2651	
V_{IOTM}	Maximum transient overvoltage per DIN V VDE 0884-10	V_{TEST} = V_{IOTM} t = 60 sec (qualification) t= 1 sec (100% production)	4242	V_{PEAK}
V_{ISO}	Withstand isolation voltage per UL 1577	V_{TEST} = V_{ISO}, t = 60 sec (qualification)	3000	V_{RMS}
		V_{TEST} = 1.2 x V_{ISO}, t = 1 sec (100% production)	3600	
R_S	Insulation resistance	V_{IO} = 500 V at T_S	>10^9	Ω
	Pollution degree		2	

(1) Climatic Classification 40/125/21

Table 2. IEC 60664-1 Ratings Table

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

8.3.1.3 Regulatory Information

VDE	CSA	UL	CQC
Certified according to DIN V VDE 0884-10	Approved under CSA Component Acceptance Notice #5A	Recognized under UL 1577 Component Recognition Program	Certified according to GB4943.1-2011
Basic Insulation Maximum Transient Overvoltage, 4242 V_{PK} Maximum Repetitive Peak Voltage', 1414 V_{PK}	Basic and Reinforced Insulation per CSA 60950-1 and IEC 60950-1 Reinforced Insulation per CSA 61010-1 and IEC 61010-1	Single protection, 3000 V_{RMS} (1)	Basic Insulation, Altitude ≤ 5000 m, Tropical Climate, 250 V_{RMS} maximum working voltage
Certificate number: Approval pending	Master contract number: 220991 (Approval pending)	File number: E181974 (Approval pending)	Certificate number: CQC14001109540 (Approval pending)

(1) Production tested ≥ 3600 V_{RMS} for 1 second in accordance with UL 1577.

8.3.1.4 IEC 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 I/O can allow low resistance to ground or the supply and, without current limiting, dissipate sufficient power to overheat the die and damage the isolation barrier, potentially leading to secondary system failures.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_S	Safety input, output, or supply current	$R_{\theta JA}$ = 78.4 °C/W, V_I = 5.5 V, T_J = 150°C, T_A = 25°C			290	mA
		$R_{\theta JA}$ = 78.4 °C/W, V_I = 3.6 V, T_J = 150°C, T_A = 25°C			443	
T_S	Maximum case temperature				150	°C

The safety-limiting constraint is the absolute-maximum junction temperature specified in the *Absolut Maximun 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.

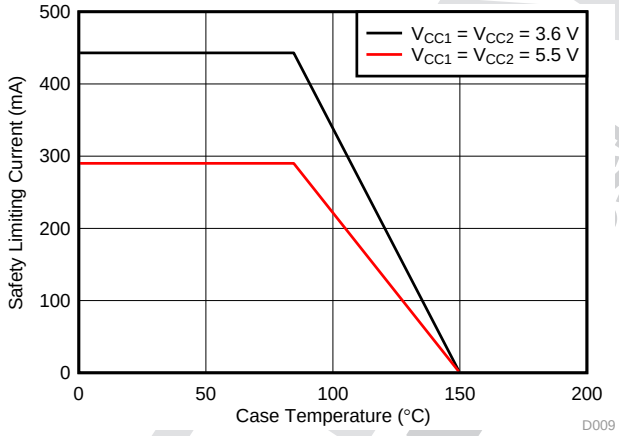


Figure 14. θ_{JC} Thermal Derating Curve per DIN V VDE 0884-10

8.4 Device Functional Modes

ISO734x functional modes are shown in Table 3.

Table 3. Function Table(1)

INPUT-SIDE V_{CC}	OUTPUT-SIDE V_{CC}	INPUT (INx)	OUTPUT ENABLE (ENx)	OUTPUT (OUTx)	
				ISO734xC	ISO734xFC
PU	PU	H	H or Open	H	H
		L	H or Open	L	L
		X	L	Z	Z
		Open	H or Open	H(2)	L(3)
PD	PU	X	H or Open	H(2)	L(3)
X	PU	X	L	Z	Z
X	PD	X	X	Undetermined	Undetermined

(1) PU = Powered up (V_{CC} ≥ 3 V); PD = Powered down (V_{CC} ≤ 2.1 V); X = Irrelevant; H = High level; L = Low level
(2) In fail-safe condition, output defaults to high level
(3) In fail-safe condition, output defaults to low level

8.4.1 Device I/O Schematics

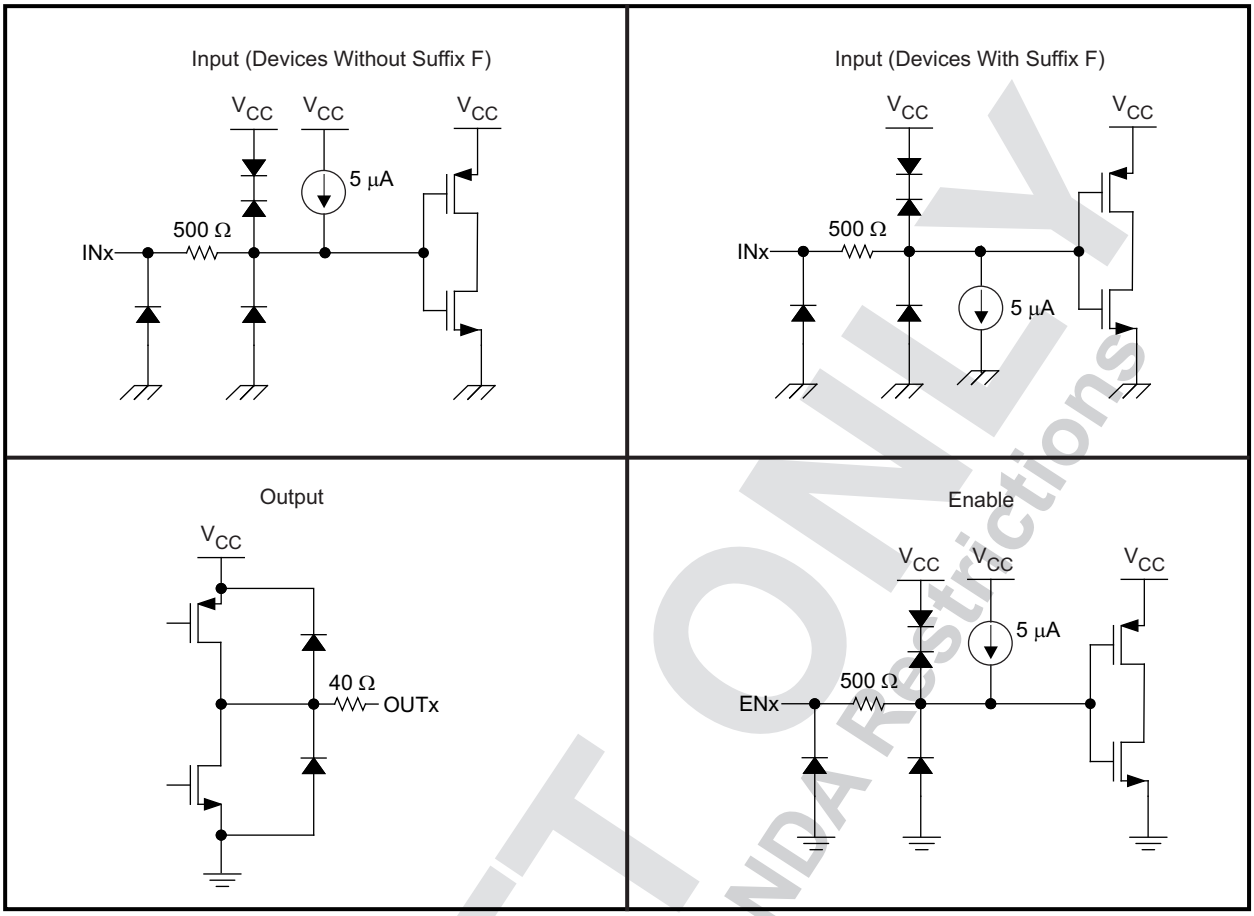


Figure 15. Device I/O Schematics

9 Applications 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

ISO734x 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, µC or UART), and a data converter or a line transceiver, regardless of the interface type or standard.

9.2 Typical Application

ISO734x combined with Texas Instruments' precision analog-to-digital converter and mixed signal micro-controller can create an advanced isolated data acquisition system as shown in Figure 16.

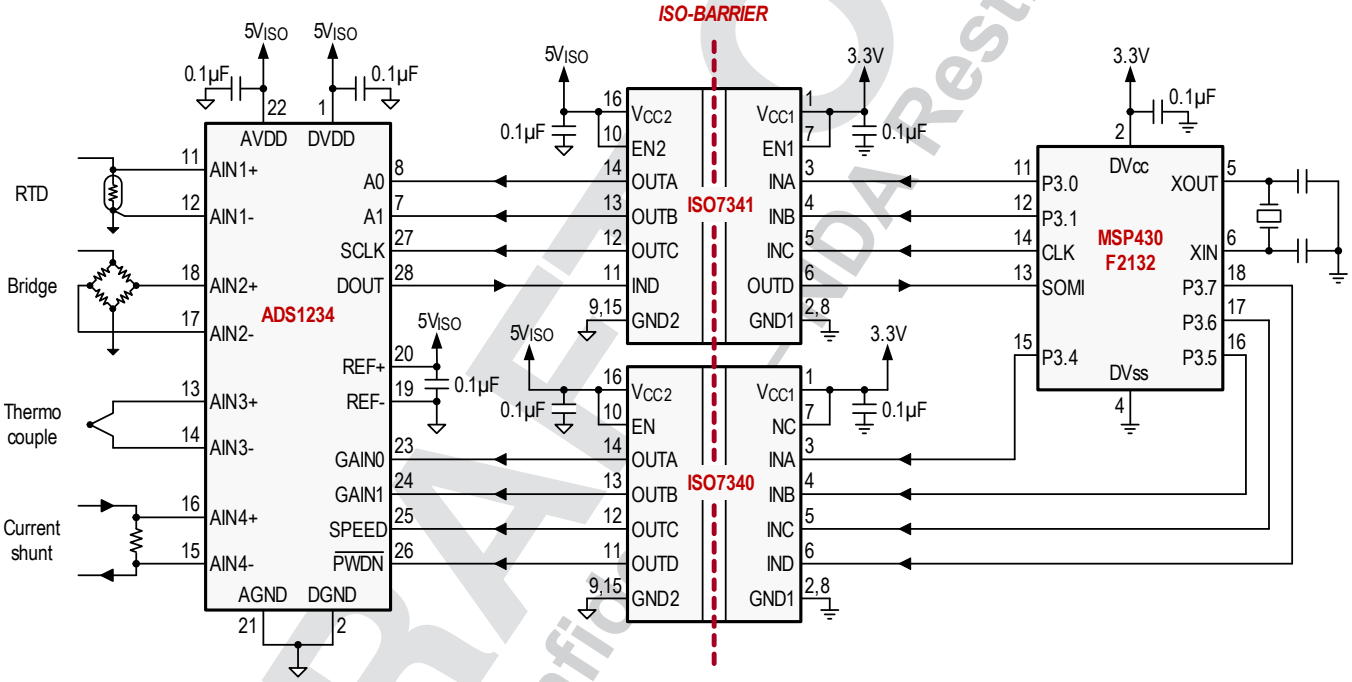


Figure 16. Isolated Data Acquisition System for Process Control

Typical Application (continued)

9.2.1 Design Requirements

Unlike optocouplers, which need external components to improve performance, provide bias, or limit current, ISO734x only needs two external bypass capacitors to operate.

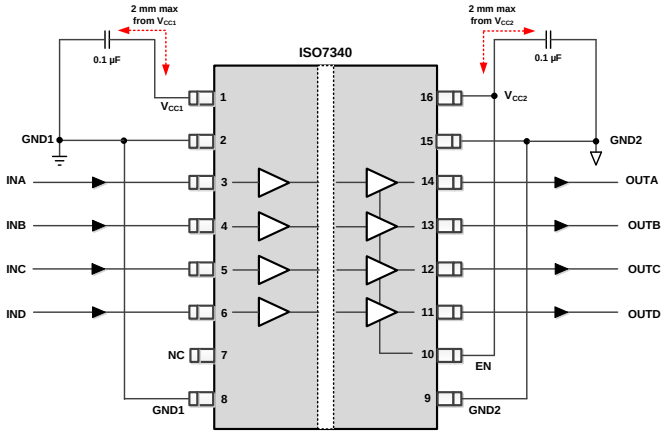


Figure 17. Typical ISO7340 Circuit Hook-up

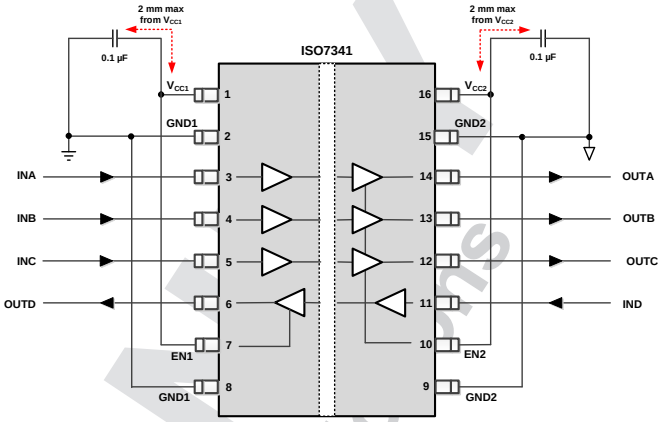


Figure 18. Typical ISO7341 Circuit Hook-up

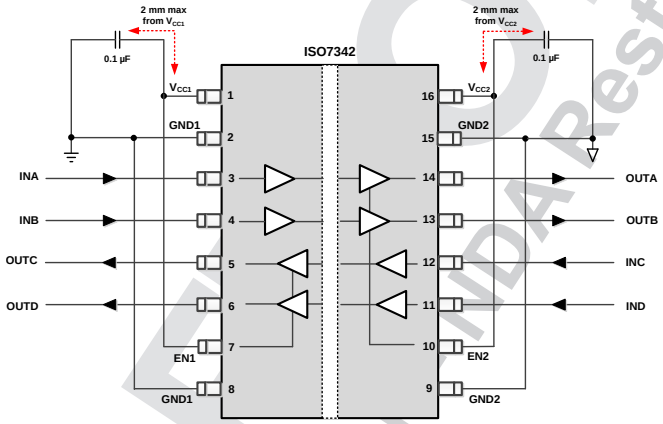


Figure 19. Typical ISO7342 Circuit Hook-up

9.2.1.1 Typical Supply Current Equations

9.2.1.1.1 ISO7340

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

$$I_{CC1} = 0.54366 + (0.0873 \times f) \quad (1)$$

$$I_{CC2} = 2.74567 + (0.08433 \times f) + (0.01 \times f \times C_L) \quad (2)$$

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

$$I_{CC1} = 0.3437 + (0.04922 \times f) \quad (3)$$

$$I_{CC2} = 2.1068 + (0.04374 \times f) + (0.007045 \times f \times C_L) \quad (4)$$

9.2.1.1.2 ISO7341

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

$$I_{CC1} = 1.7403 + (0.1006 \times f) + (0.001711 \times f \times C_L) \quad (5)$$

$$I_{CC2} = 2.502 + (0.09629 \times f) + (0.00687 \times f \times C_L) \quad (6)$$

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

$$I_{CC1} = 1.2915 + (0.046 \times f) + (0.00185 \times f \times C_L) \quad (7)$$

$$I_{CC2} = 1.8833 + (0.0566 \times f) + (0.004514 \times f \times C_L) \quad (8)$$

Typical Application (continued)

9.2.1.1.3 ISO7342

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

$$I_{CC1}, I_{CC2} = 2.1254 + (0.08694 \times f) + (0.004868 \times f \times C_L) \quad (9)$$

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

$$I_{CC1}, I_{CC2} = 1.5912 + (0.0410 \times f) + (0.003785 \times f \times C_L) \quad (10)$$

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 measured in pF.

9.2.2 Detailed Design Procedure

9.2.2.1 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 ISO734x incorporate 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.

9.2.3 Application Performance Curves

Typical eye diagrams of ISO734x below indicate low jitter and wide open eye at the maximum data rate of 25 Mbps.

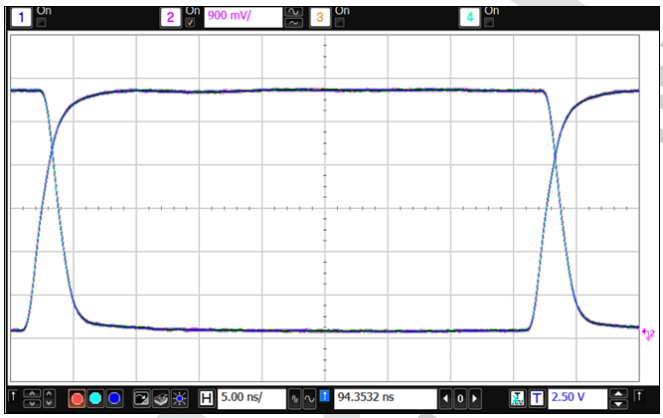


Figure 20. Eye Diagram at 25 Mbps, 5 V and 25°C

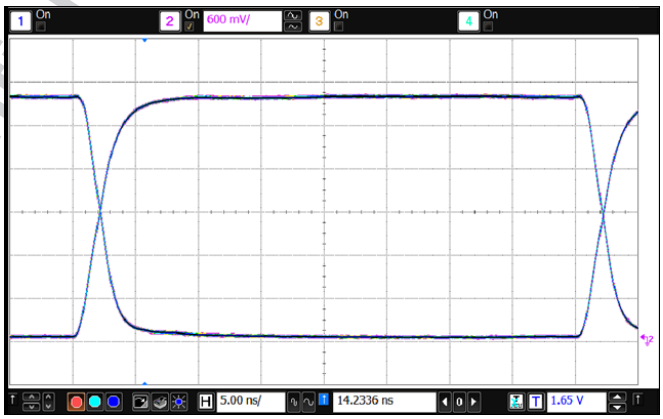


Figure 21. Eye Diagram at 25 Mbps, 3.3 V and 25°C

Typical Application (continued)

9.2.4 Typical Application for Module with 16 Inputs

ISO7341 and several other components from Texas Instruments can be used to create an isolated SPI interface for input module with 16 inputs.

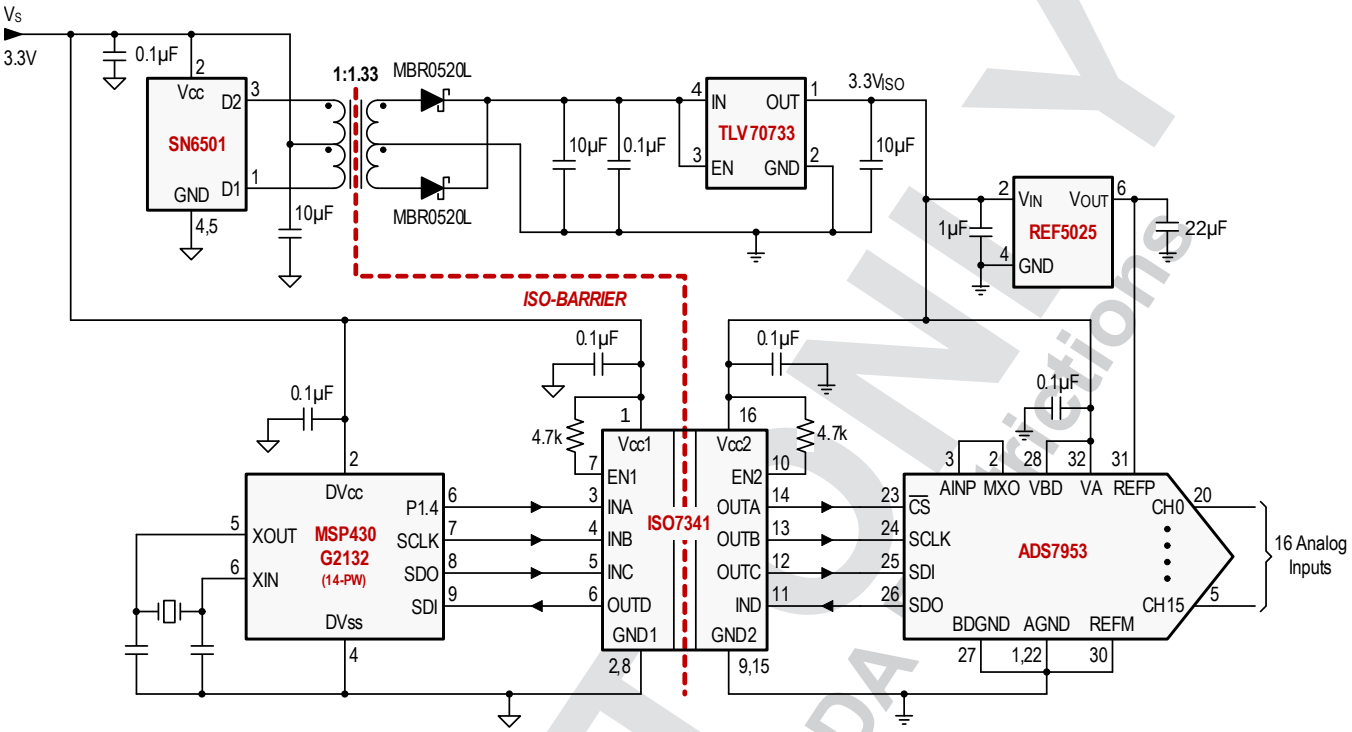


Figure 22. Isolated SPI Interface for an Analog Input Module with 16 Inputs

See the Typical Application *Design Requirements*.

See the Typical Application *Detailed Design Procedure*.

See the Typical Application *Application Performance Curves*.

Typical Application (continued)

9.2.5 Typical Application for RS-232 Interface

Typical isolated RS-232 interface implementation is shown in Figure 23.

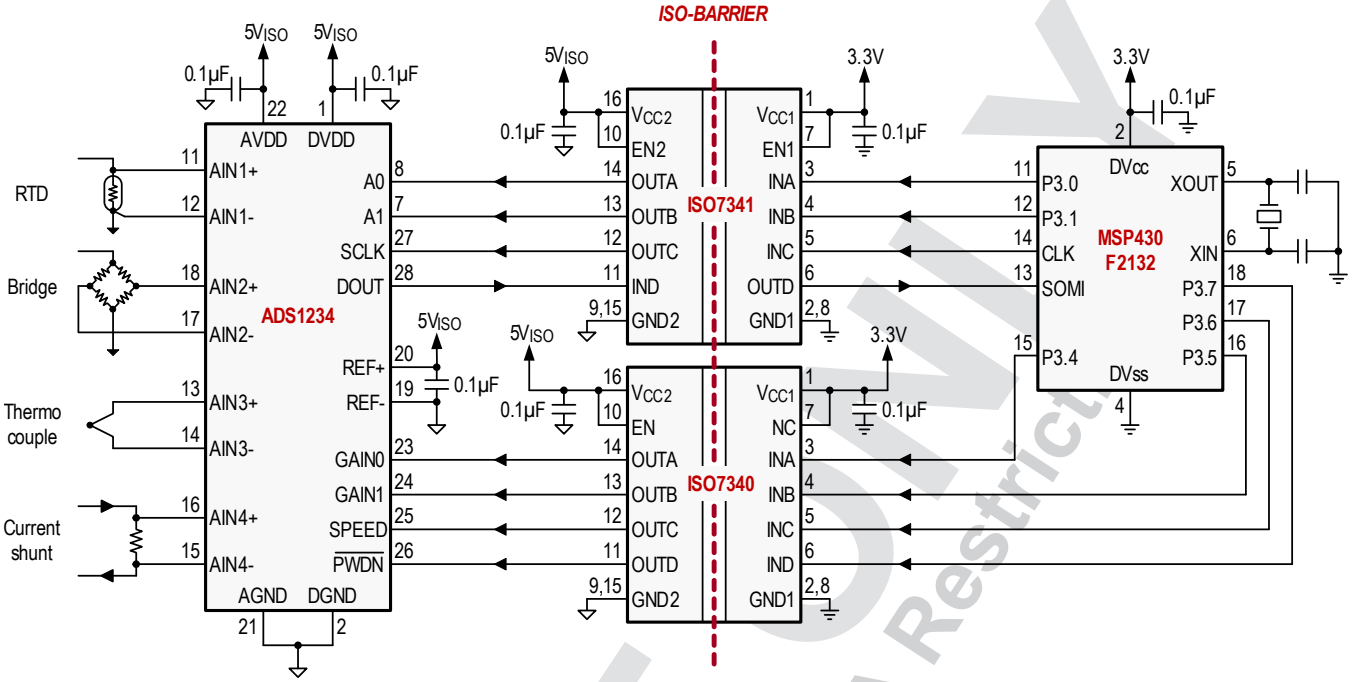


Figure 23. Isolated RS-232 Interface

See the Typical Application *Design Requirements*.

See the Typical Application *Detailed Design Procedure*.

See the Typical Application *Application Performance Curves*.

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 datasheet (SLLSEA0) .

11 Layout

11.1 PCB Material

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

11.2 Layout Guidelines

A minimum of four layers is required to accomplish a low EMI PCB design (see Figure 24). 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 100pF/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 / 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, see Application Note SLLA284, *Digital Isolator Design Guide*.

11.3 Layout Example

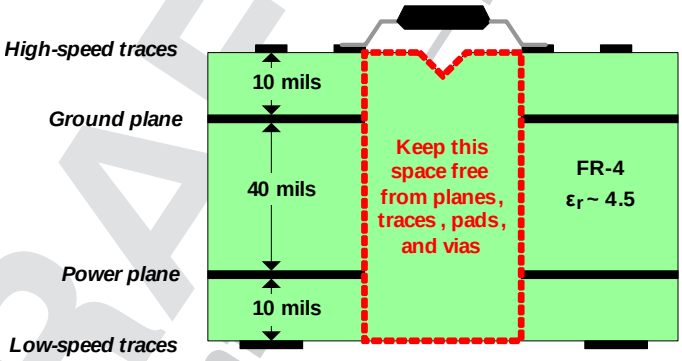


Figure 24. Recommended Layer Stack

12 Device and Documentation Support

12.1 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	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
ISO7340C	Click here	Click here	Click here	Click here	Click here
ISO7340FC	Click here	Click here	Click here	Click here	Click here
ISO7341C	Click here	Click here	Click here	Click here	Click here
ISO7341FC	Click here	Click here	Click here	Click here	Click here
ISO7342C	Click here	Click here	Click here	Click here	Click here
ISO7342FC	Click here	Click here	Click here	Click here	Click here

12.2 Trademarks

All trademarks are the property of their respective owners.

12.3 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.

12.4 Glossary

SLYZ022 — *TI Glossary*.

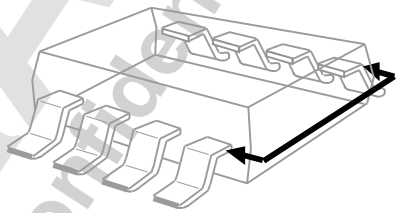
This glossary lists and explains terms, acronyms, and definitions.

12.5 Isolation Glossary

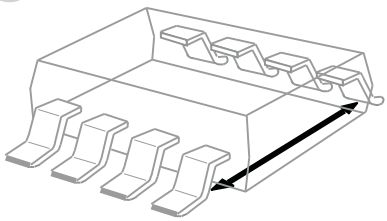
Primary Circuit — A circuit that is directly connected to an external mains supply for its power needs.

Secondary Circuit — A circuit that has no direct connection to a primary circuit and derives its power from a transformer, converter or equivalent isolation device, or from a battery.

Creepage — The shortest distance between two conductive parts measured along the surface of a solid insulation. The shortest path is typically found around the end of the package body.



Clearance — The shortest distance between two conductive parts measured through air.



Isolation Glossary (continued)

Isolation Capacitance (C_{IO}) — The total capacitance between the terminals on a first side of the isolation barrier connected together and the terminals on a second side of the isolation barrier connected together forming a two-terminal device.

Isolation Resistance (R_{IO}) — The resistance between the terminals on a first side of the isolation barrier connected together and all the terminals on a second side of the isolation barrier connected together forming a two-terminal device.

Rated Isolation Voltages — The maximum voltage between all input terminals (connected together) and all output terminals (connected together) respectively.

Maximum Rated Isolation Working Voltage (V_{IOWM}) — An r.m.s or equivalent d.c. voltage assigned by the manufacturer, characterizing the specified long term withstand capability of its isolation.

Maximum Rated Repetitive Peak Isolation Voltage (V_{IORM}) — A peak voltage assigned by the manufacturer, characterizing the specified withstand capability of its isolation against repetitive peak voltages. It includes all repetitive transient voltages, but excludes all non-repetitive transient voltages.

Maximum Rated Transient Isolation Voltage (V_{IOTM}) — A peak impulse voltage assigned by the manufacturer, characterizing the specified withstand capability of its isolation against transient overvoltages.

Withstand Isolation Voltage (V_{ISO}) — Maximum AC r.m.s. isolation voltage for one minute.

Surge Isolation Voltage (V_{IOSM}) — The highest instantaneous value of an isolation voltage pulse with short time duration and of specified wave shape.

Partial Discharge — Localized electrical discharge which occurs in the insulation between all terminals of the first side and all terminals of the second side of the coupler.

Comparative Tracking Index (CTI) — CTI is an index used for electrical insulating materials that is defined as the numerical value of the voltage which causes failure by tracking during standard testing. Tracking is the process that produces a partially conducting path of localized deterioration on or through the surface of an insulating material as a result of the action of electric discharges on or close to an insulation surface -- the higher the CTI value of the insulating material, the smaller the minimum creepage distance required.

Generally, insulation breakdown occurs either through the material, over its surface, or both. Surface failure may arise from flashover or from the progressive degradation of the insulation surface by small localized sparks. Such sparks are the result of the breaking of a surface film of conducting contaminant on the insulation. The resulting break in the leakage current produces an overvoltage at the site of the discontinuity, and an electric spark is generated. These sparks often cause carbonization on insulation material and lead to a carbon track between points of different potential. This process is known as *tracking*.

Material Groups — Materials are classified into four groups according to their CTI values. These values are determined in accordance with IEC 60112. The groups are as follows:

- Material group I: 600V ≤ CTI
- Material group II: 400V ≤ CTI < 600
- Material group II: 175V ≤ CTI < 400
- Material group II: 100V ≤ CTI < 175

12.5.1 Insulation:

Functional insulation — Insulation needed for the correct operation of the equipment.

Basic insulation — Insulation that provides basic protection against electric shock.

Supplementary insulation — Independent insulation applied in addition to basic insulation in order to ensure protection against electric shock in the event of a failure of the basic insulation.

Double insulation — Insulation comprising both basic and supplementary insulation.

Reinforced insulation — A single insulation system which provides a degree of protection against electric shock equivalent to double insulation.

Isolation Glossary (continued)

12.5.2 Pollution Degree:

Pollution is any addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation. There are four categories of pollution:

Pollution Degree 1 — No pollution or only dry, nonconductive pollution occurs. The pollution has no influence.

Pollution Degree 2 — Only nonconductive pollution occurs. However, a temporary conductivity caused by condensation is to be expected.

Pollution Degree 3 — Conductive pollution occurs or dry non-conductive pollution occurs which becomes conductive due to condensation which is to be expected.

Pollution Degree 4 – Continuous conductivity occurs due to conductive dust, rain, or other wet conditions.

12.5.3 Overvoltage Categories and Installation Classification:

Overvoltage Categories define transient overvoltage conditions. There are four different levels as indicated in IEC 60664.

I: Signal level — Special protected equipment or parts of equipment, e.g., circuit board inside a DVD player.

II: Local level — Portable equipment that is supplied from the wall outlet, e.g., a DVD player

III: Distribution level — Equipment in fixed installation such as HVAC system, Washers / Dryers, etc.

IV: Primary supply level — Equipment for use at the origin of the installations such as overhead lines, cable systems, etc.

Lower level category is subject to smaller transients than the category above.

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.

IMPORTANT NOTICE

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