

ISOW7821 高性能、5000V_{RMS}強化デュアル・チャンネル・デジタル・アイソレータ、高効率低放射のDC/DCコンバータ内蔵

1 特長

- 高効率の DC/DC コンバータとオンチップ変圧器を内蔵
- 100Mbps のデータ・レート
- 堅牢な絶縁バリア
 - 1kV_{RMS} の動作電圧で推定寿命 100 年以上
 - 最高 5000V_{RMS} の絶縁定格
 - 最高 10kV_{PK} のサージ能力
 - 最小 CMTI: ±100kV/μs
- 3V~5.5Vの広い入力電源範囲
- レギュレートされた5Vまたは3.3V出力
- 最大0.65Wの出力電力
- 5Vから5V、5Vから3.3V: 利用可能な負荷電流 ≥ 130mA
- 3.3Vから3.3V: 利用可能な負荷電流 ≥ 75mA
- ソフトスタートにより突入電流を制限
- 過負荷および短絡保護
- サーマル・シャットダウン
- デフォルト出力: HIGHとLOWのオプション
- 短い伝搬遅延: 標準値 13ns (5V 電源)
- 堅牢な電磁環境適合性(EMC)
 - システム・レベルでのESD、EFT、サージ耐性
 - 絶縁バリアを挟んだ接触放電に対する保護: ±8kV IEC 61000-4-2
 - 低い放射
- 16ピンのワイドSOICパッケージ
- 拡張温度範囲: -40°C~+125°C
- 安全関連の認定
 - DIN VDE V 0884-11:2017-01 に従い 7071V_{PK} の強化絶縁
 - UL1577に準拠した絶縁耐圧: 5000V_{RMS} (1分間)
 - IEC 60950-1、IEC 62368-1、IEC 60601-1最終機器標準に準拠したCSA認定
 - GB4943.1-2011 準拠の CQC 認定
 - EN 60950-1、EN62368-1、EN 61010-1 に従った TUV 認定

2 アプリケーション

- 産業用オートメーション
- モータ制御
- グリッド・インフラストラクチャ
- 医療用機器
- 試験/測定機器

3 概要

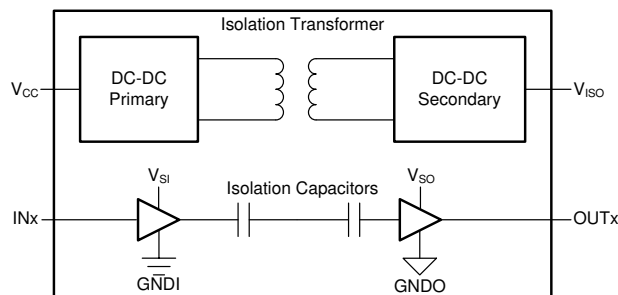
ISOW7821デバイスは、高効率電力コンバータを内蔵した、高性能デュアル・チャンネル強化デジタル・アイソレータです。内蔵のDC/DCコンバータは最大650mWの絶縁電力を高効率で供給し、各種の入力および出力電圧に構成可能です。このため、このデバイスを使用すると、スペースに制約のある絶縁設計において別個の絶縁電源が不要になります。

製品情報⁽¹⁾

型番	パッケージ	本体サイズ(公称)
ISOW7821	SOIC (16)	10.30mm×7.50mm

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

概略回路図



V_{CC}はGND1を基準とする一次電源電圧です。V_{ISO}はGND2を基準とする絶縁電源電圧です。

V_{SI}とV_{SO}は、チャンネルの方向によりV_{CC}またはV_{ISO}のいずれかです。

V_{SI}はGNDIを基準とする入力側電源電圧、V_{SO}はGND0を基準とする出力側電源電圧です。

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4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision A (March 2018) から Revision B に変更

	Page
• ドキュメント全体を通して編集および装飾的な変更	1
• 「 特長 」に「堅牢な絶縁バリア」の箇条書き項目を追加	1
• 「 $1kV_{RMS}$ の動作電圧で推定寿命 100 年以上」の箇条書き項目を「 特長 」に追加	1
• 「最高 $5000V_{RMS}$ の絶縁定格」の箇条書き項目を「 特長 」に追加	1
• 「最高 $10kV_{PK}$ のサージ能力」の箇条書き項目を「 特長 」に追加	1
• 「絶縁バリアを挟んだ接触放電に対する保護: $\pm 8kV$ IEC 61000-4-2」箇条書き項目を「 特長 」に追加	1
• 「 特長 」および「 Insulation Specifications 」表で、VDE 標準名を「DIN V VDE V 0884-11:2017-01」から「DIN VDE V 0884-11:2017-01」に変更	1
• 「 特長 」の TUV 認定についての箇条書き項目に、「EN 62368-1」標準を追加	1
• 「 特長 」の「すべての代理認定は計画中」箇条書き項目を削除	1
• 「 概略回路図 」を更新し、1 つの絶縁チャネルにつき 1 つのコンデンサではなく、2 つの絶縁コンデンサを直列に記載	1
• Added "Contact discharge per IEC 61000-4-2; Isolation barrier withstand test" specification of ± 8000 in ESD Ratings table	6
• Added table note "IEC ESD strike is applied across the barrier with all pins on each side tied together creating a two-terminal device" to ESD Ratings table	6
• Deleted "TJ or Junction temperature" parameter from Recommended Operating Conditions table as it is already specified in Absolute Maximum Ratings table	6
• Added "See 図 34 " to TEST CONDITIONS of V_{IOWM} specification	8

改訂履歴 (continued)

• Updated Safety-Related Certifications table	9
• Added the following note to Figure 25 : "Optional 100 μ F capacitor can be added between V_{CC} and GND1; refer to Power Supply Recommendations "	22
• Added the following note to Figure 30 : "Optional 100 μ F capacitor can be added between V_{CC} and GND1; refer to Power Supply Recommendations "	28
• Added the following text to Design Requirements : "Optional 100 μ F decoupling capacitor can be added between V_{CC} and GND1 pins; refer to Power Supply Recommendations for more details"	29
• Added text to Power Supply Recommendations section to emphasise that input decoupling capacitor should be larger than output capacitor by at least 100 μ F	31
• Added the following note to Figure 35 : "Optional 100 μ F capacitor can be added between V_{CC} and GND1; refer to Power Supply Recommendations "	33

2017年11月発行のものから更新
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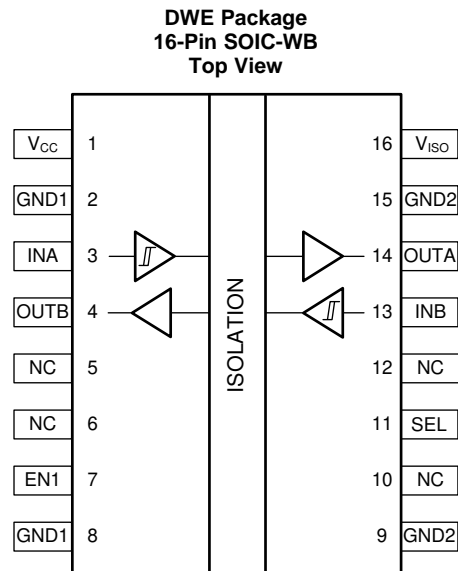
• Changed OUTB to pin 4 and INB to pin 13 in the <i>Pin Functions</i> table	5
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5 概要 (続き)

ISOW7821 デバイスは高い電磁気耐性と低い放射を実現しながら、CMOS または LVCMOS デジタル I/O を絶縁します。信号絶縁チャンネルでは、ロジック入力および出力バッファが二酸化ケイ素 (SiO_2) 絶縁バリアによって分離されています。また電力絶縁では、薄膜ポリマーを絶縁素材としたオンチップの変圧器を使用しています。順方向および逆方向チャンネルの各種構成を利用可能です。入力信号が消失した場合のデフォルト出力は、ISOW7821 デバイスでは HIGH、末尾に F が付くデバイスでは LOW です(「[デバイスの特長](#)」を参照)。

これらのデバイスにより、データバスや他の回路上のノイズ電流がローカル・グランドへ入り込み、ノイズに敏感な回路に干渉したり損傷を与えたりすることを防止できます。革新的なチップ設計およびレイアウト技法により、ISOW7821 デバイスは電磁環境適合性が大幅に強化されているため、システムレベルで ESD、EFT、サージ、放射のコンプライアンスを容易に達成できます。電力コンバータの効率が高いため、より高い周囲温度での動作が可能です。ISOW7821 デバイスは、16ピン SOICワイドボディ(SOIC-WB) DWEパッケージで供給されます。

6 Pin Configuration and Functions



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
EN1	7	—	Output enable for side 1. Output pins on side 1 are enabled when EN1 is high or open. Output pins on side 1 are high impedance when EN1 is low.
GND1	2, 8	—	Ground connection for V_{CC}
GND2	9, 15	—	Ground connection for V_{ISO}
INA	3	I	Input channel A
OUTB	4	I	Output channel B
NC	5	—	Not connected
NC	6	—	Not connected
NC	10	—	Not connected
NC	12	—	Not connected
OUTA	14	O	Output channel A
INB	13	O	Input channel B
SEL	11	I	V_{ISO} selection pin. $V_{ISO} = 5\text{ V}$ when SEL is connected to V_{ISO} . $V_{ISO} = 3.3\text{ V}$, when SEL is connected to GND2 or left floating. For more information see the Device Functional Modes .
V_{CC}	1	—	Supply voltage
V_{ISO}	16	—	Isolated supply voltage determined by SEL pin

7 Specifications

7.1 Absolute Maximum Ratings

See ⁽¹⁾⁽²⁾

		MIN	MAX	UNIT
V _{CC}	Supply voltage	-0.5	6	V
V _{ISO}	Isolated supply voltage	-0.5	6	V
V _{IO}	Voltage at INx, OUTx, SEL pins	-0.5	V _{CC} + 0.5, V _{ISO} + 0.5 ⁽³⁾	V
I _O	Maximum output current through data channels	-15	15	mA
T _J	Junction temperature		150	°C
T _{stg}	Storage temperature	-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. 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 pin (GND1 or GND2) and are peak voltage values.
- (3) This value depends on whether the pin is located on the V_{CC} or V_{ISO} side. The maximum voltage at the I/O pins should not exceed 6 V.

7.2 ESD Ratings

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±1000
		Contact discharge per IEC 61000-4-2; Isolation barrier withstand test ⁽³⁾	±8000

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.
- (3) IEC ESD strike is applied across the barrier with all pins on each side tied together creating a two-terminal device.

7.3 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
V _{CC}	Supply voltage		3	5.5	V
I _{OH}	High level output current ⁽²⁾	V _{SO} ⁽¹⁾ = 5 V	-4		mA
		V _{SO} = 3.3 V	-2		
I _{OL}	Low level output current ⁽²⁾	V _{SO} = 5 V		4	mA
		V _{SO} = 3.3 V		2	
V _{IH}	High-level input voltage	0.7 × V _{SI}		V _{SI}	V
V _{IL}	Low-level input voltage	0		0.3 × V _{SI}	V
DR	Data rate			100	Mbps
T _A	Ambient temperature	-40		125	°C

- (1) V_{SI} is the input side supply, V_{SO} is the output side supply
- (2) This current is for data output channel.

7.4 Thermal Information

THERMAL METRIC ⁽¹⁾		ISOW7821	UNIT
		DWE (SOIC)	
		16 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	56.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	15.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	28.5	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	2.4	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	28.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	°C/W

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

7.5 Power Ratings

$V_{CC} = 5.5\text{ V}$, $I_{ISO} = 110\text{ mA}$, $T_J = 150^\circ\text{C}$, $T_A \leq 80^\circ\text{C}$, $C_L = 15\text{ pF}$, input a 50-MHz 50% duty-cycle square wave

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
P_D	Maximum power dissipation (both sides)				1.16	W
P_{D1}	Maximum power dissipation (side-1)				0.58	W
P_{D2}	Maximum power dissipation (side-2)				0.58	W

7.6 Insulation Specifications

PARAMETER		TEST CONDITIONS	VALUE	UNIT
GENERAL				
CLR	External clearance ⁽¹⁾	Shortest terminal-to-terminal distance through air	>8	mm
CPG	External creepage ⁽¹⁾	Shortest terminal-to-terminal distance across the package surface	>8	mm
DTI	Distance through the insulation	Minimum internal gap (internal clearance – capacitive signal isolation)	> 21	µm
		Minimum internal gap (internal clearance – transformer power isolation)	>120	
CTI	Comparative tracking index	DIN EN 60112 (VDE 0303-11); IEC 60112	> 600	V
	Material group	According to IEC 60664-1	I	
	Overvoltage category per IEC 60664-1	Rated mains voltage ≤ 300 V _{RMS}	I-IV	
		Rated mains voltage ≤ 600 V _{RMS}	I-IV	
		Rated mains voltage ≤ 1000 V _{RMS}	I-III	
DIN VDE V 0884-11:2017-01⁽²⁾				
V _{IORM}	Maximum repetitive peak isolation voltage	AC voltage (bipolar)	1414	V _{PK}
V _{IOWM}	Maximum working isolation voltage	AC voltage; Time dependent dielectric breakdown (TDDB) Test; See 34	1000	V _{RMS}
		DC voltage	1414	V _{DC}
V _{IOTM}	Maximum transient isolation voltage	V _{TEST} = V _{IOTM} ; t = 60 s (qualification); V _{TEST} = 1.2 × V _{IOTM} ; t = 1 s (100% production)	7071	V _{PK}
V _{IOSM}	Maximum surge isolation voltage ⁽³⁾	Test method per IEC 62368-1, 1.2/50 µs waveform, V _{TEST} = 1.6 × V _{IOSM} = 10000 V _{PK} (qualification)	6250	V _{PK}
q _{pd}	Apparent charge ⁽⁴⁾	Method a, after input/output safety test subgroup 2/3, V _{ini} = V _{IOTM} , t _{ini} = 60 s; V _{pd(m)} = 1.2 × V _{IORM} = 1697 V _{PK} , t _m = 10 s	≤ 5	pC
		Method a, after environmental tests subgroup 1, V _{ini} = V _{IOTM} , t _{ini} = 60 s; V _{pd(m)} = 1.6 × V _{IORM} = 2263 V _{PK} , t _m = 10 s	≤ 5	
		Method b1, at routine test (100% production) and preconditioning (type test), V _{ini} = 1.2 × V _{IOTM} , t _{ini} = 1 s; V _{pd(m)} = 1.875 × V _{IORM} = 2652 V _{PK} , t _m = 1 s	≤ 5	
C _{IO}	Barrier capacitance, input to output ⁽⁵⁾	V _{IO} = 0.4 × sin(2πft), f = 1 MHz	~3.5	pF
R _{IO}	Insulation resistance ⁽⁵⁾	V _{IO} = 500 V, T _A = 25°C	> 10 ¹²	Ω
		V _{IO} = 500 V, 100°C ≤ T _A ≤ 125°C	> 10 ¹¹	
		V _{IO} = 500 V, T _S = 150°C	> 10 ⁹	
	Pollution degree		2	
	Climatic category		40/125/21	
UL 1577				
V _{ISO(UL)}	Withstand isolation voltage	V _{TEST} = V _{ISO(UL)} , t = 60 s (qualification), V _{TEST} = 1.2 × V _{ISO(UL)} = 6000 V _{RMS} , t = 1 s (100% production)	5000	V _{RMS}

- Creepage and clearance requirements should be applied according to the specific equipment isolation standards of an application. Care should be taken to maintain the creepage and clearance distance of a board design to ensure that the mounting pads of the isolator on the printed-circuit board do not reduce this distance. Creepage and clearance on a printed-circuit board become equal in certain cases. Techniques such as inserting grooves, ribs, or both on a printed circuit board are used to help increase these specifications.
- This coupler is suitable for safe electrical insulation only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.
- Testing is carried out in air or oil to determine the intrinsic surge immunity of the isolation barrier.
- Apparent charge is electrical discharge caused by a partial discharge (pd).
- All pins on each side of the barrier tied together creating a two-terminal device.

7.7 Safety-Related Certifications

VDE	CSA	UL	CQC	TUV
Certified according to DIN VDE V 0884-11:2017-01	Certified according to IEC 60950-1, IEC 62368-1, and IEC 60601-1	Recognized under UL 1577 Component Recognition Program	Certified according to GB 4943.1-2011	Certified according to EN 61010-1:2010/A1:2019, EN 60950-1:2006/A2:2013 and EN 62368-1:2014
Reinforced insulation; Maximum transient isolation voltage, 7071 V _{PK} ; Maximum repetitive peak isolation voltage, 1414 V _{PK} ; Maximum surge isolation voltage, 6250 V _{PK}	Reinforced insulation per CSA 60950-1-07+A1+A2, IEC 60950-1 2nd Ed.+A1+A2, CSA 62368-1-14 and IEC 62368-1 2nd Ed., 800 V _{RMS} maximum working voltage (pollution degree 2, material group I); 2 MOPP (Means of Patient Protection) per CSA 60601-1:14 and IEC 60601-1 Ed. 3+A1, 250 V _{RMS} maximum working voltage; Temperature rating is 90°C for reinforced insulation and 125°C for basic insulation; see certificate for details.	Single protection, 5000 V _{RMS}	Reinforced Insulation, Altitude ≤ 5000 m, Tropical Climate, 700 V _{RMS} maximum working voltage;	5000 V _{RMS} Reinforced insulation per EN 61010-1:2010/A1:2019 up to working voltage of 600 V _{RMS} ; 5000 V _{RMS} Reinforced insulation per EN 60950-1:2006/A2:2013 and EN 62368-1:2014 up to working voltage of 800 V _{RMS}
Certificate number: 40040142	Master contract number: 220991	File number: E181974	Certificate number: CQC15001121716	Client ID number: 77311

7.8 Safety Limiting Values

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I _S Safety input, output, or supply current ⁽¹⁾	R _{θJA} = 56.8°C/W, V _I = 5.5 V, T _J = 150°C, T _A = 25°C, see 1			400	mA
	R _{θJA} = 56.8°C/W, V _I = 3.6 V, T _J = 150°C, T _A = 25°C, see 1			611	
P _S Safety input, output, or total power ⁽¹⁾	R _{θJA} = 56.8°C/W, T _J = 150°C, T _A = 25°C, see 2			2200	mW
T _S Maximum safety temperature ⁽¹⁾				150	°C

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

The junction-to-air thermal resistance, R_{θJA}, in the [Thermal Information](#) table is that of a device installed on a high-K test board for leaded surface-mount packages. Use these equations to calculate the value for each parameter:

$$T_J = T_A + R_{\theta JA} \times P, \text{ where } P \text{ is the power dissipated in the device.}$$

$$T_{J(max)} = T_S = T_A + R_{\theta JA} \times P_S, \text{ where } T_{J(max)} \text{ is the maximum allowed junction temperature.}$$

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

7.9 Electrical Characteristics—5-V Input, 5-V Output

 $V_{CC} = 5\text{ V} \pm 10\%$, SEL shorted to V_{ISO} (over recommended operating conditions, unless otherwise specified)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{ISO}	Isolated supply voltage	External $I_{ISO} = 0$ to 50 mA	4.75	5.07	5.43	V
		External $I_{ISO} = 0$ to 130 mA	4.5	5.07	5.43	
$V_{ISO(LINE)}$	DC line regulation	$I_{ISO} = 50$ mA, $V_{CC} = 4.5$ V to 5.5 V	2			mV/V
$V_{ISO(LOAD)}$	DC load regulation	$I_{ISO} = 0$ to 130 mA	1%			
EFF	Efficiency at maximum load current	$I_{ISO} = 130$ mA, $C_{LOAD} = 0.1\ \mu\text{F} \parallel 10\ \mu\text{F}$; $V_I = V_{SI}$ (ISOW7821); $V_I = 0$ V (ISOW7821 with F suffix)	53%			
$V_{CC+(UVLO)}$	Positive-going UVLO threshold on V_{CC} , V_{ISO}		2.7			V
$V_{CC-(UVLO)}$	Negative-going UVLO threshold on V_{CC} , V_{ISO}		2.1			V
$V_{HYS (UVLO)}$	UVLO threshold hysteresis on V_{CC} , V_{ISO}		0.2			V
V_{ITH}	Input pin rising threshold		0.7			V_{SI}
V_{ITL}	Input pin falling threshold		0.3			V_{SI}
$V_{I(HYS)}$	Input pin threshold hysteresis (INx)		0.1			V_{SI}
I_{IL}	Low level input current	$V_{IL} = 0$ at INx or SEL	-10			μA
I_{IH}	High level input current	$V_{IH} = V_{SI}^{(1)}$ at INx or SEL	10			μA
V_{OH}	High level output voltage	$I_O = -4$ mA, see 24	$V_{SO}^{(1)} - 0.4$	$V_{SO} - 0.2$		V
V_{OL}	Low level output voltage	$I_O = 4$ mA, see 24		0.2	0.4	V
$ CM_H $	High-level common-mode transient immunity	$V_I = V_{SI}$, $V_{CM} = 1000$ V; see 25	100			kV/ μs
$ CM_L $	Low-level common-mode transient immunity	$V_I = 0$ V, $V_{CM} = 1000$ V; see 25	100			kV/ μs
I_{CC_SC}	DC current from supply under short circuit on V_{ISO}	V_{ISO} shorted to GND2	137			mA
$V_{ISO(RIP)}$	Output ripple on isolated supply (pk-pk)	20-MHz bandwidth, $C_{LOAD} = 0.1\ \mu\text{F} \parallel 20\ \mu\text{F}$, $I_{ISO} = 130$ mA	100			mV

 (1) V_{SI} = input side supply; V_{SO} = output side supply

7.10 Supply Current Characteristics—5-V Input, 5-V Output

 $V_{CC} = 5\text{ V} \pm 10\%$, SEL shorted to V_{ISO} (over recommended operating conditions, unless otherwise specified)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC}	Current drawn from supply	No external I_{LOAD} ; $V_I = 0\text{ V}$ (ISOW7821); $V_I = V_{SI}^{(1)}$ (ISOW7821 with F suffix)		21		mA
		No external I_{LOAD} ; $V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)		17		
		All channels switching with square wave clock input of 1 Mbps; $C_L = 15\text{ pF}$; No external I_{LOAD}		19		
		All channels switching with square wave clock input of 10 Mbps; $C_L = 15\text{ pF}$; No external I_{LOAD}		20		
		All channels switching with square wave clock input of 100 Mbps; $C_L = 15\text{ pF}$; No external I_{LOAD}		33		
$I_{ISO(OUT)}^{(2)}$	Current available on isolated supply	$V_I = 0\text{ V}$ (ISOW7821); $V_I = V_{SI}$ (ISOW7821 with F suffix)	127			mA
		$V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)	130			
		All channels switching with square wave clock input of 1 Mbps; $C_L = 15\text{ pF}$	128			
		All channels switching with square wave clock input of 10 Mbps; $C_L = 15\text{ pF}$	128			
		All channels switching with square wave clock input of 100 Mbps; $C_L = 15\text{ pF}$	125			

(1) V_{SI} = input side supply; V_{SO} = output side supply

(2) Current available to load should be derated by 2 mA/°C for $T_A > 80^\circ\text{C}$.

7.11 Electrical Characteristics—5-V Input, 3.3-V Output

$V_{CC} = 5\text{ V} \pm 10\%$, SEL shorted to GND2 (over recommended operating conditions, unless otherwise specified)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{ISO}	Isolated supply voltage	External $I_{ISO} = 0$ to 50 mA	3.13	3.34	3.56	V
		External $I_{ISO} = 0$ to 130 mA	3	3.34	3.56	
$V_{ISO(LINE)}$	DC line regulation	$I_{ISO} = 50\text{ mA}$, $V_{CC} = 4.5\text{ V}$ to 5.5 V	2			mV/V
$V_{ISO(LOAD)}$	DC load regulation	$I_{ISO} = 10$ to 130 mA	1%			
EFF	Efficiency at maximum load current	$I_{ISO} = 130\text{ mA}$, $C_{LOAD} = 0.1\text{ }\mu\text{F} \parallel 10\text{ }\mu\text{F}$; $V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)	48%			
$V_{CC+(UVLO)}$	Positive-going UVLO threshold on V_{CC} , V_{ISO}		2.7			V
$V_{CC-(UVLO)}$	Negative-going UVLO threshold on V_{CC} , V_{ISO}		2.1			V
$V_{HYS(UVLO)}$	UVLO threshold hysteresis on V_{CC} , V_{ISO}		0.2			V
V_{ITH}	Input pin rising threshold		0.7			V_{SI}
V_{ITL}	Input pin falling threshold		0.3			V_{SI}
$V_{I(HYS)}$	Input pin threshold hysteresis (INx)		0.1			V_{SI}
I_{IL}	Low level input current	$V_{IL} = 0$ at INx or SEL	-10			μA
I_{IH}	High level input current	$V_{IH} = V_{SI}^{(1)}$ at INx or SEL	10			μA
V_{OH}	High level output voltage	$I_O = -2\text{ mA}$, see 24	$V_{SO}^{(1)} - 0.3$	$V_{SO} - 0.1$		V
V_{OL}	Low level output voltage	$I_O = 2\text{ mA}$, see 24		0.1	0.3	V
$ CM_H $	High-level common-mode transient immunity	$V_I = V_{SI}$, $V_{CM} = 1000\text{ V}$; see 25	100			kV/ μs
$ CM_L $	Low-level common-mode transient immunity	$V_I = 0\text{ V}$, $V_{CM} = 1000\text{ V}$; see 25	100			kV/ μs
I_{CC_SC}	DC current from supply under short circuit on V_{ISO}	V_{ISO} shorted to GND2	137			mA
$V_{ISO(RIP)}$	Output ripple on isolated supply (pk-pk)	20-MHz bandwidth, $C_{LOAD} = 0.1\text{ }\mu\text{F} \parallel 20\text{ }\mu\text{F}$, $I_{ISO} = 130\text{ mA}$	100			mV

(1) V_{SI} = input side supply; V_{SO} = output side supply

7.12 Supply Current Characteristics—5-V Input, 3.3-V Output

 $V_{CC} = 5\text{ V} \pm 10\%$, SEL shorted to GND2 (over recommended operating conditions, unless otherwise specified)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC}	Current drawn from supply	No external I_{LOAD} ; $V_I = 0\text{ V}$ (ISOW7821); $V_I = V_S^{(1)}$ (ISOW7821 with F suffix)		17		mA
		No external I_{LOAD} ; $V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)		14		
		All channels switching with square wave clock input of 1 Mbps; $C_L = 15\text{ pF}$, No external I_{LOAD}		16		
		All channels switching with square wave clock input of 10 Mbps; $C_L = 15\text{ pF}$, No external I_{LOAD}		17		
		All channels switching with square wave clock input of 100 Mbps; $C_L = 15\text{ pF}$, No external I_{LOAD}		27		
$I_{ISO(OUT)}^{(2)}$	Current available on isolated supply	$V_I = 0\text{ V}$ (ISOW7821); $V_I = V_{SI}$ (ISOW7821 with F suffix)	127			mA
		$V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)	130			
		All channels switching with square wave clock input of 1 Mbps; $C_L = 15\text{ pF}$	128			
		All channels switching with square wave clock input of 10 Mbps; $C_L = 15\text{ pF}$	128			
		All channels switching with square wave clock input of 100 Mbps; $C_L = 15\text{ pF}$	126			

(1) V_{SI} = input side supply; V_{SO} = output side supply

(2) Current available to load should be derated by 2 mA/°C for $T_A > 105^\circ\text{C}$.

7.13 Electrical Characteristics—3.3-V Input, 3.3-V Output

 $V_{CC} = 3.3\text{ V} \pm 10\%$, SEL shorted to GND2 (over recommended operating conditions, unless otherwise specified)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{ISO}	Isolated supply voltage	External $I_{ISO} = 0$ to 30 mA	3.13	3.34	3.58	V
		External $I_{ISO} = 0$ to 75 mA	3	3.34	3.58	
$V_{ISO(LINE)}$	DC line regulation	$I_{ISO} = 30\text{ mA}$, $V_{CC} = 3\text{ V}$ to 3.6 V	2			mV/V
$V_{ISO(LOAD)}$	DC load regulation	$I_{ISO} = 0$ to 75 mA	1%			
EFF	Efficiency at maximum load current	$I_{ISO} = 75\text{ mA}$, $C_{LOAD} = 0.1\ \mu\text{F} \parallel 10\ \mu\text{F}$; $V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)	47%			
$V_{CC+(UVLO)}$	Positive-going UVLO threshold on V_{CC} , V_{ISO}		2.7			V
$V_{CC-(UVLO)}$	Negative-going UVLO threshold on V_{CC} , V_{ISO}		2.1			V
$V_{HYS (UVLO)}$	UVLO threshold hysteresis on V_{CC} , V_{ISO}		0.2			V
V_{ITH}	Input pin rising threshold		0.7			V_{SI}
V_{ITL}	Input pin falling threshold		0.3			V_{SI}
$V_{I(HYS)}$	Input pin threshold hysteresis (INx)		0.1			V_{SI}
I_{IL}	Low level input current	$V_{IL} = 0$ at INx or SEL	-10			μA
I_{IH}	High level input current	$V_{IH} = V_{SI}^{(1)}$ at INx or SEL	10			μA
V_{OH}	High level output voltage	$I_O = -2\text{ mA}$, see 24	$V_{SO}^{(1)} - 0.3$	$V_{SO} - 0.1$		V
V_{OL}	Low level output voltage	$I_O = 2\text{ mA}$, see 24		0.1	0.3	V
$ CM_H $	High-level common-mode transient immunity	$V_I = V_{SI}$, $V_{CM} = 1000\text{ V}$; see 25	100			kV/ μs
$ CM_L $	Low-level common-mode transient immunity	$V_I = 0\text{ V}$, $V_{CM} = 1000\text{ V}$; see 25	100			kV/ μs
I_{CC_SC}	DC current from supply under short circuit on V_{ISO}	V_{ISO} shorted to GND2	143			mA
$V_{ISO(RIP)}$	Output ripple on isolated supply (pk-pk)	20-MHz bandwidth, $C_{LOAD} = 0.1\ \mu\text{F} \parallel 20\ \mu\text{F}$, $I_{ISO} = 75\text{ mA}$	90			mV

 (1) V_{SI} = input side supply; V_{SO} = output side supply

7.14 Supply Current Characteristics—3.3-V Input, 3.3-V Output

 $V_{CC} = 3.3\text{ V} \pm 10\%$, SEL shorted to GND2 (over recommended operating conditions, unless otherwise specified)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC}	Current drawn from supply	No external I_{LOAD} ; $V_I = 0\text{ V}$ (ISOW7821); $V_I = V_S^{(1)}$ (ISOW7821 with F suffix)		24		mA
		No external I_{LOAD} ; $V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)		19		
		All channels switching with square wave clock input of 1 Mbps; $C_L = 15\text{ pF}$, No external I_{LOAD}		22		
		All channels switching with square wave clock input of 10 Mbps; $C_L = 15\text{ pF}$, No external I_{LOAD}		22		
		All channels switching with square wave clock input of 100 Mbps; $C_L = 15\text{ pF}$, No external I_{LOAD}		32		
$I_{ISO(OUT)}^{(2)}$	Current available on isolated supply	$V_I = 0\text{ V}$ (ISOW7821); $V_I = V_{SI}$ (ISOW7821 with F suffix)	72			mA
		$V_I = V_{SI}$ (ISOW7821); $V_I = 0\text{ V}$ (ISOW7821 with F suffix)	75			
		All channels switching with square wave clock input of 1 Mbps; $C_L = 15\text{ pF}$	75			
		All channels switching with square wave clock input of 10 Mbps; $C_L = 15\text{ pF}$	73			
		All channels switching with square wave clock input of 100 Mbps; $C_L = 15\text{ pF}$	71			

(1) V_{SI} = input side supply; V_{SO} = output side supply

(2) Current available to load should be derated by 2 mA/°C for $T_A > 115^\circ\text{C}$.

7.15 Switching Characteristics—5-V Input, 5-V Output

V_{CC} = 5 V ±10%, SEL shorted to V_{ISO} (over recommended operating conditions, unless otherwise specified)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH} , t _{PHL} Propagation delay time	See 24		13	17.6	ns
PWD Pulse width distortion ⁽¹⁾ t _{PHL} – t _{PLH}			0.6	4.7	ns
t _{SK(o)} Channel-channel output skew time ⁽²⁾	Same-direction channels			4	ns
t _{SK(p-p)} Part-part skew time ⁽³⁾				4.5	ns
t _r , t _f Output signal rise and fall times			2	4	ns

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

7.16 Switching Characteristics—5-V Input, 3.3-V Output

V_{CC} = 5 V ±10%, SEL shorted to GND2 (over recommended operating conditions, unless otherwise specified)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH} , t _{PHL} Propagation delay time	See 24		14	19.7	ns
PWD Pulse width distortion ⁽¹⁾ t _{PHL} – t _{PLH}			0.6	4.4	ns
t _{SK(o)} Channel-channel output skew time ⁽²⁾	Same-direction channels			4	ns
t _{SK(p-p)} Part-part skew time ⁽³⁾				4.5	ns
t _r , t _f Output signal rise and fall times			1	4	ns

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

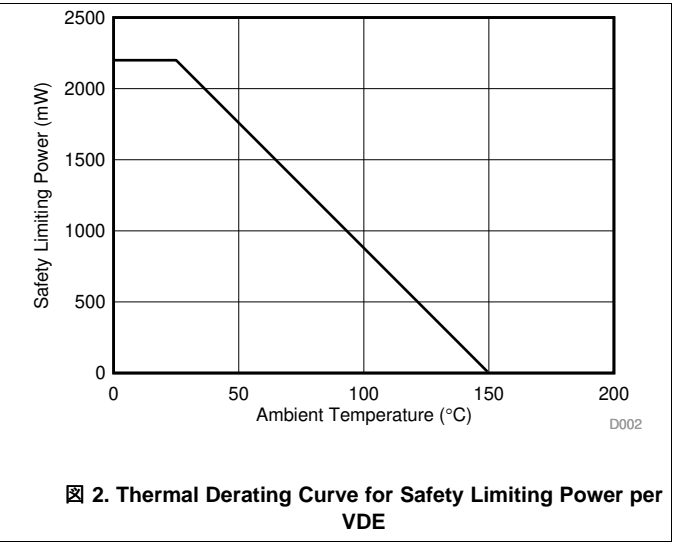
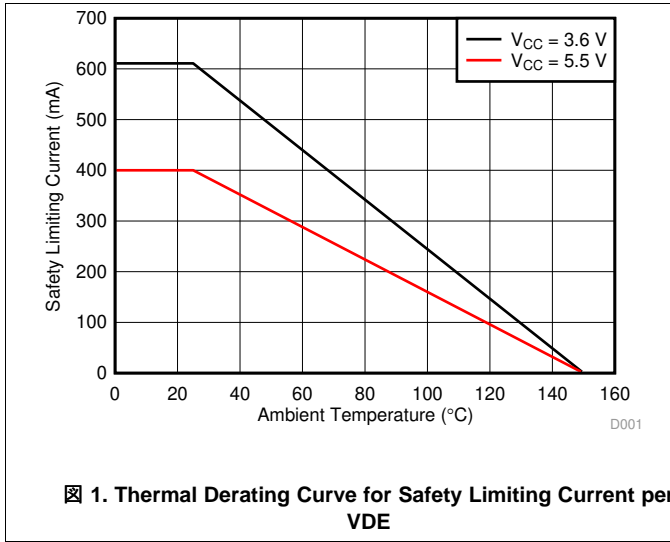
7.17 Switching Characteristics—3.3-V Input, 3.3-V Output

V_{CC} = 3.3 V ±10%, SEL shorted to GND2 (over recommended operating conditions, unless otherwise specified)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH} , t _{PHL} Propagation delay time	See 24		14.5	20.2	ns
PWD Pulse width distortion ⁽¹⁾ t _{PHL} – t _{PLH}			0.6	4.4	ns
t _{SK(o)} Channel-channel output skew time ⁽²⁾	Same-direction channels			4	ns
t _{SK(p-p)} Part-part skew time ⁽³⁾				4.5	ns
t _r , t _f Output signal rise and fall times			1	3	ns

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

7.18 Insulation Characteristics Curves



7.19 Typical Characteristics

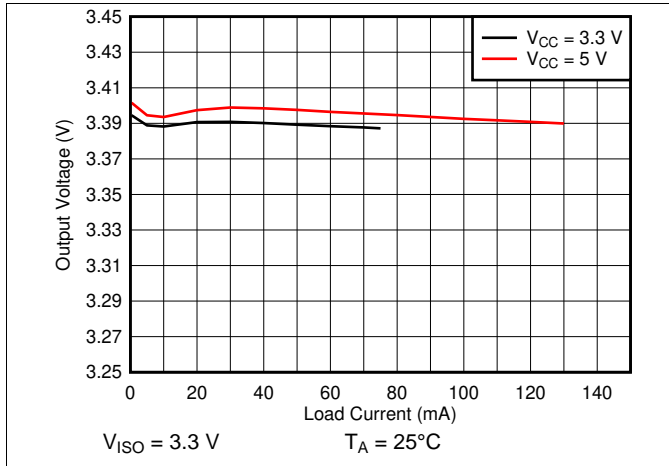


图 3. Isolated Supply Voltage (V_{ISO}) vs Load Current (I_{ISO})

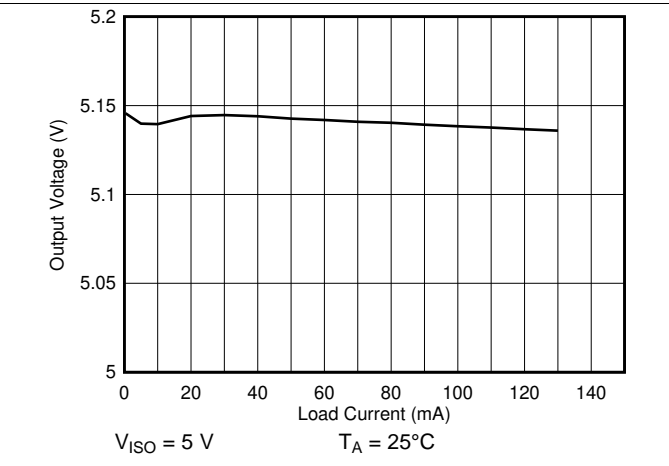


图 4. Isolated Supply Voltage (V_{ISO}) vs Load Current (I_{ISO})

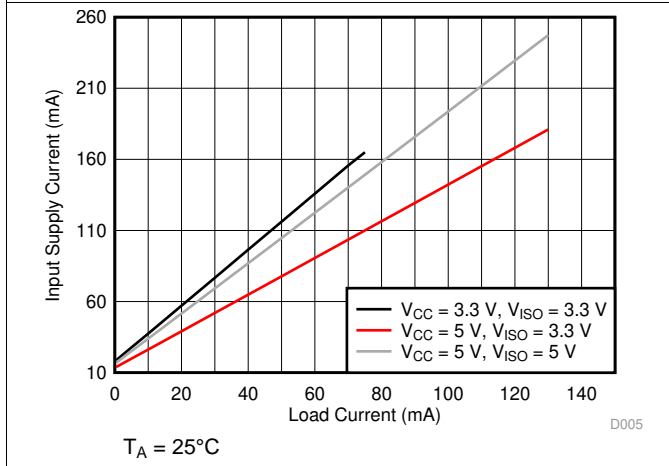


图 5. ISOW7821 Supply Current (I_{CC}) vs Load Current (I_{ISO})

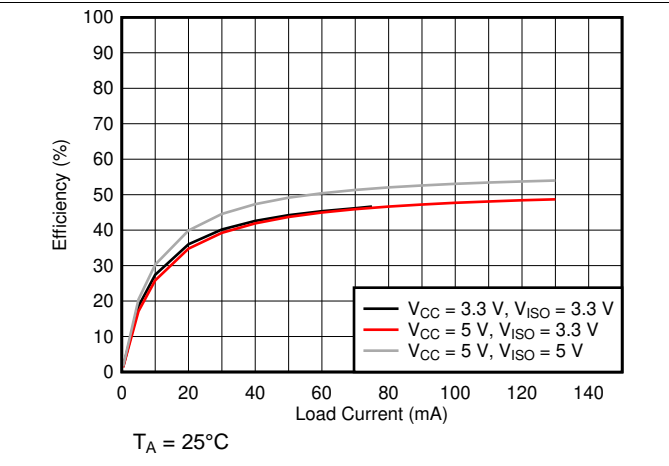


图 6. Efficiency vs Load Current (I_{ISO})

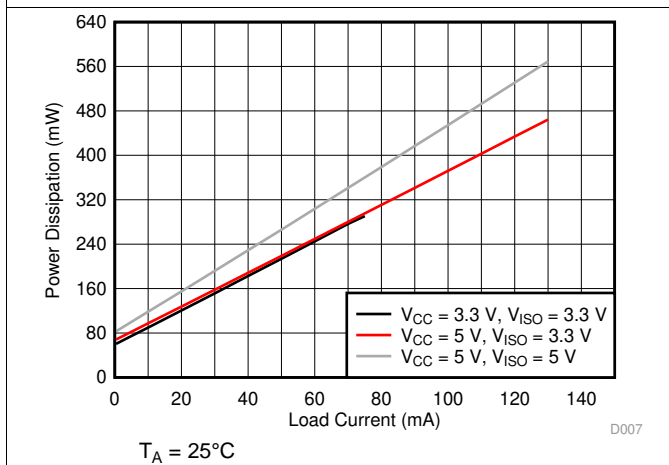


图 7. Power Dissipation vs Load Current (I_{ISO})

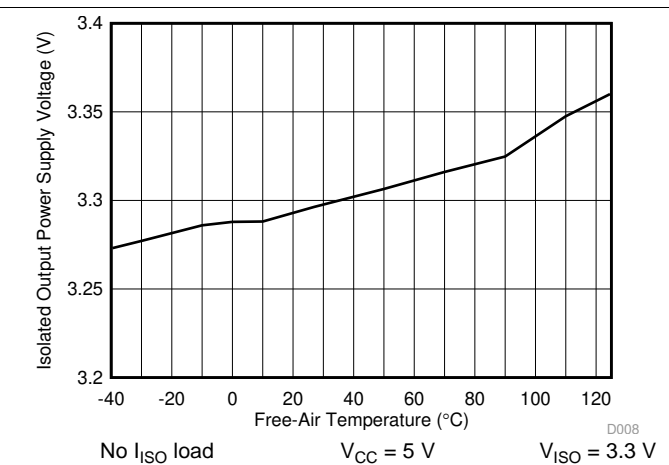
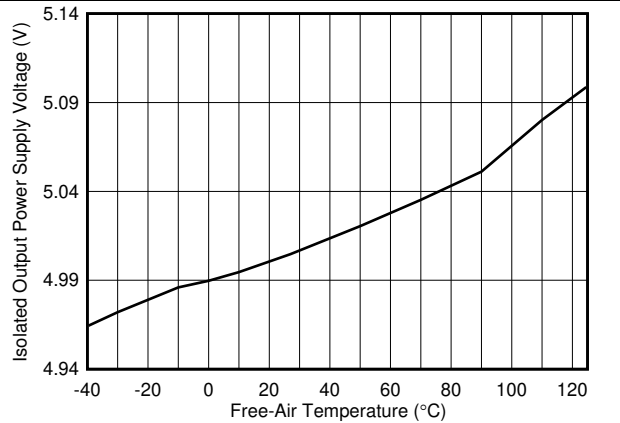
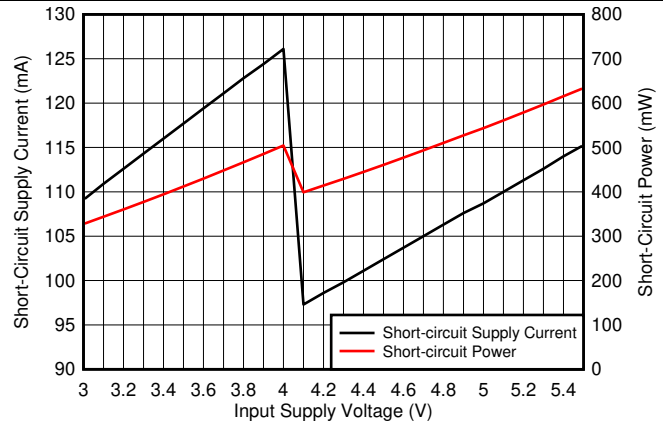


图 8. 3.3-V Isolated Supply Voltage (V_{ISO}) vs Free-Air Temperature

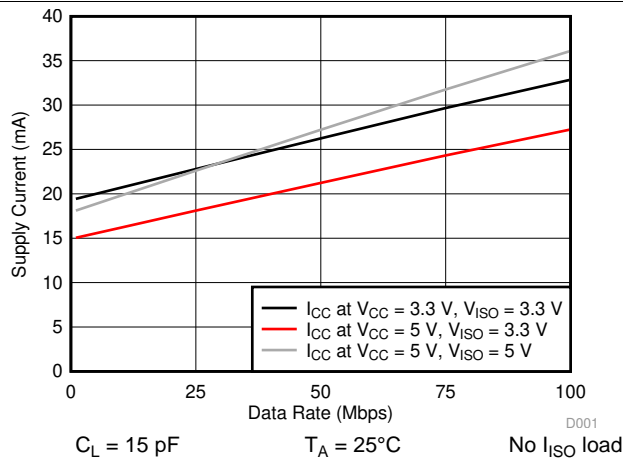
Typical Characteristics (continued)



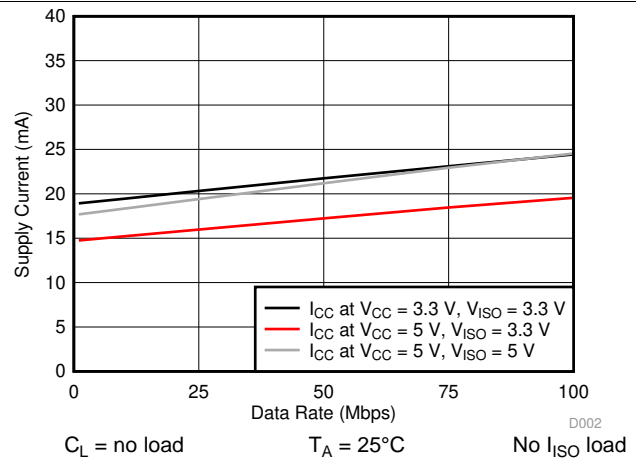
9. 5-V Isolated Supply Voltage (V_{ISO}) vs Free-Air Temperature



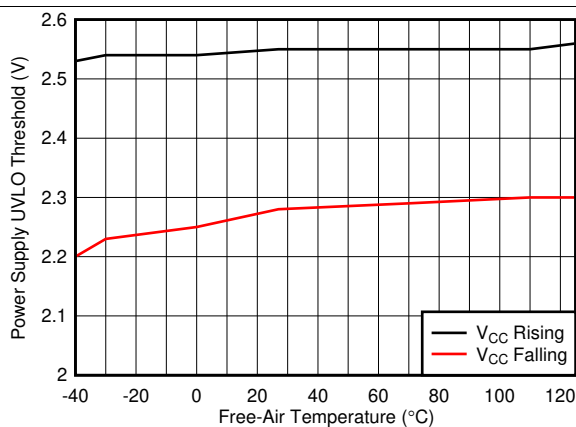
10. Short-Circuit Supply Current (I_{CC}) and Power (P) vs Supply Voltage (V_{CC})



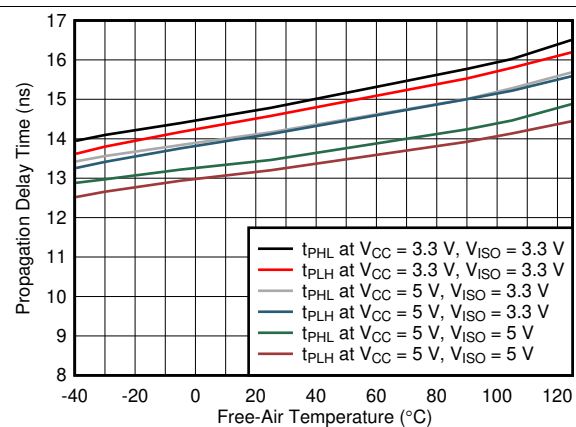
11. Supply Current vs Data Rate



12. Supply Current vs Data Rate

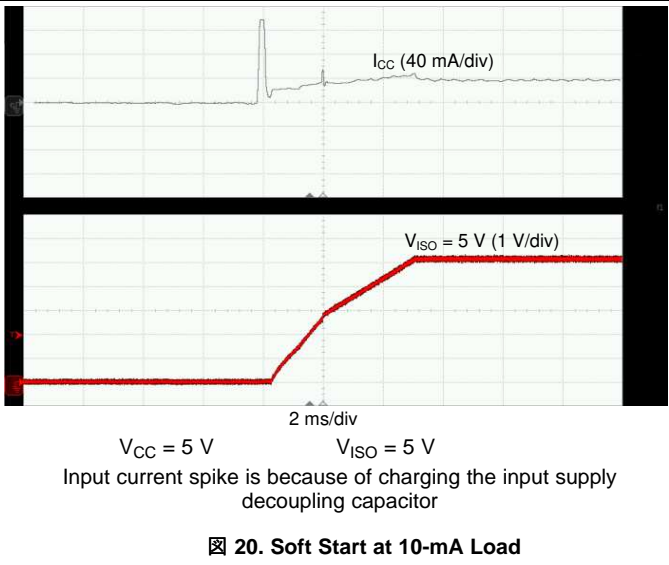
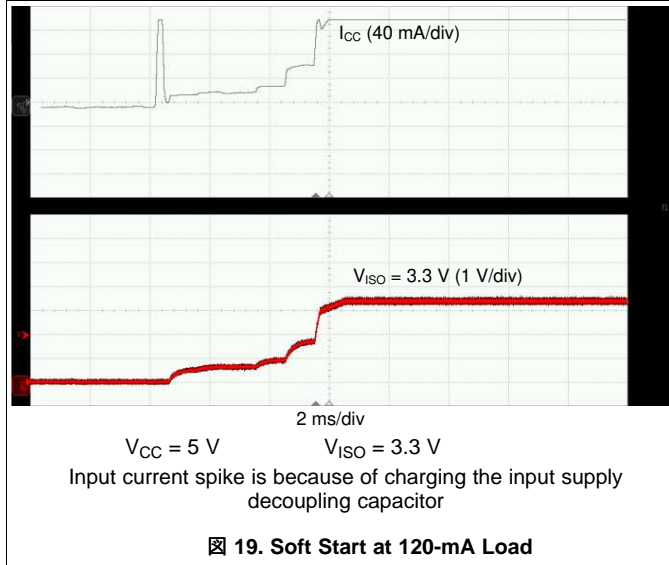
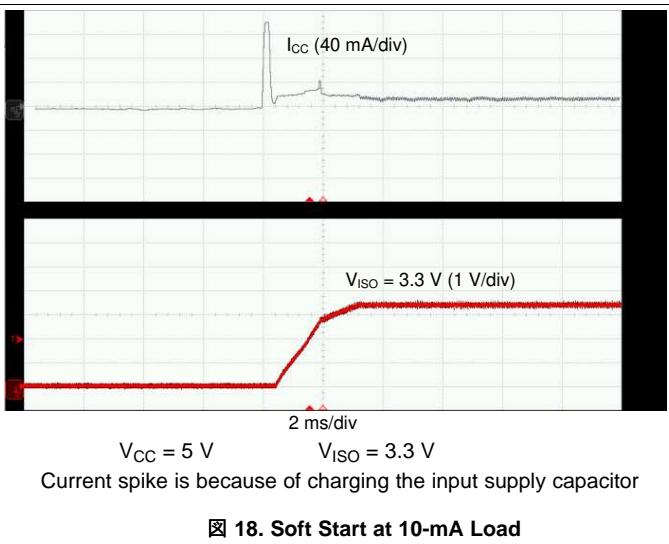
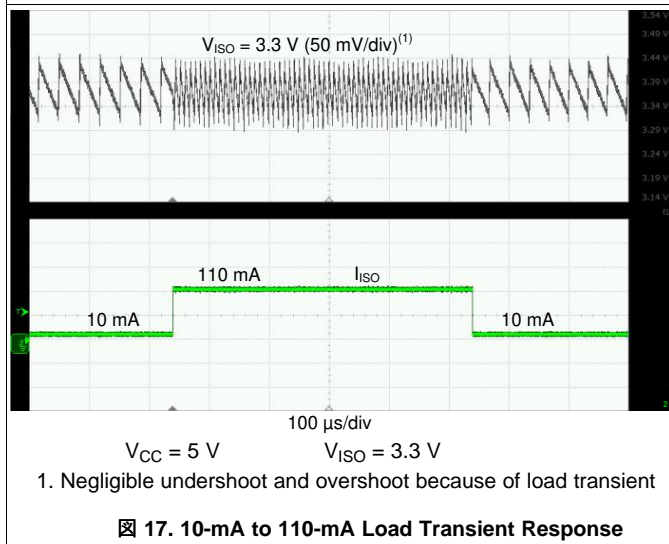
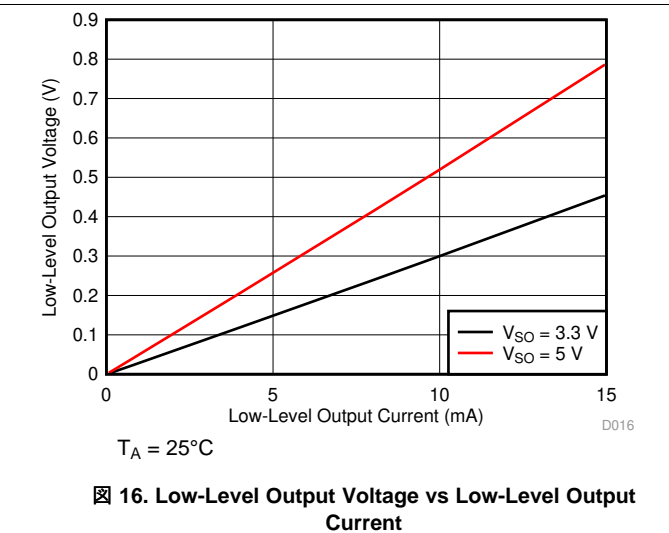
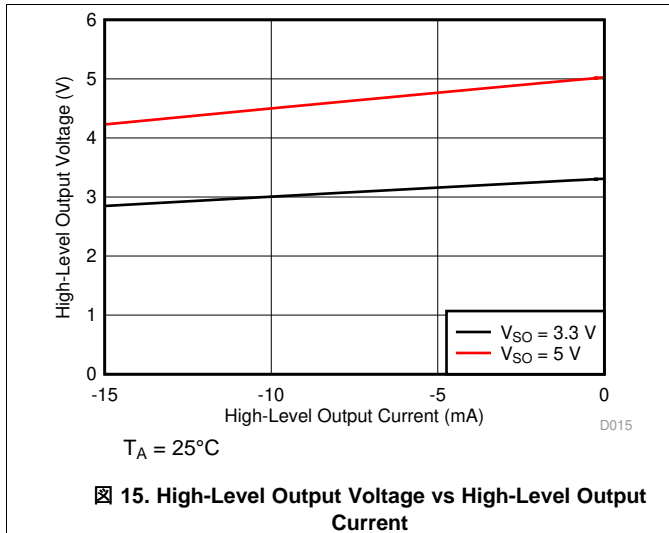


13. Power-Supply Undervoltage Threshold vs Free Air Temperature

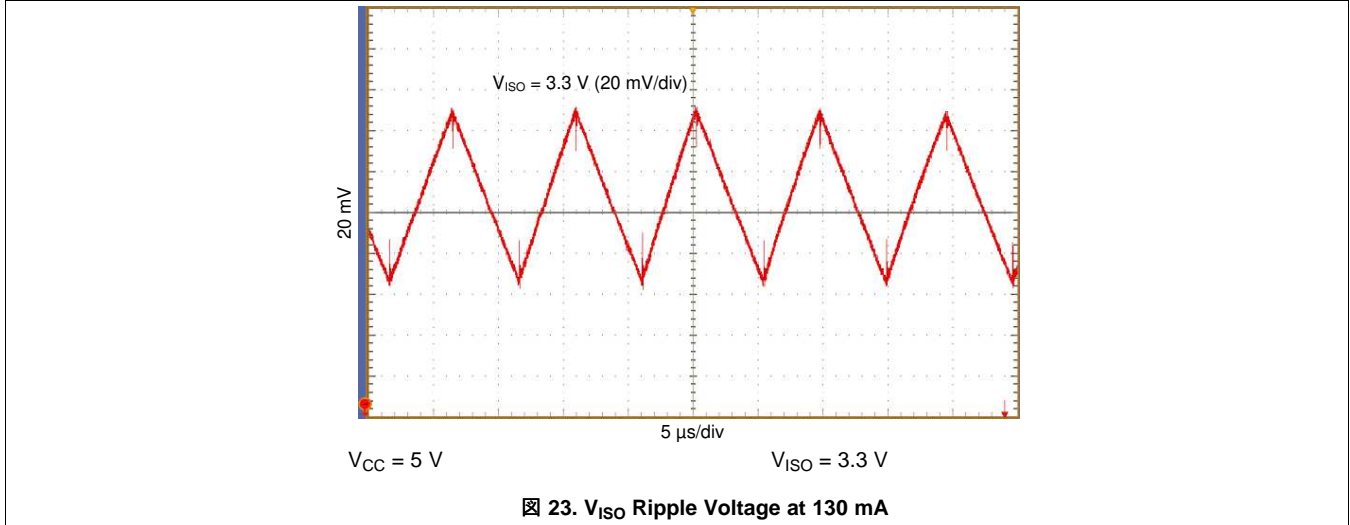
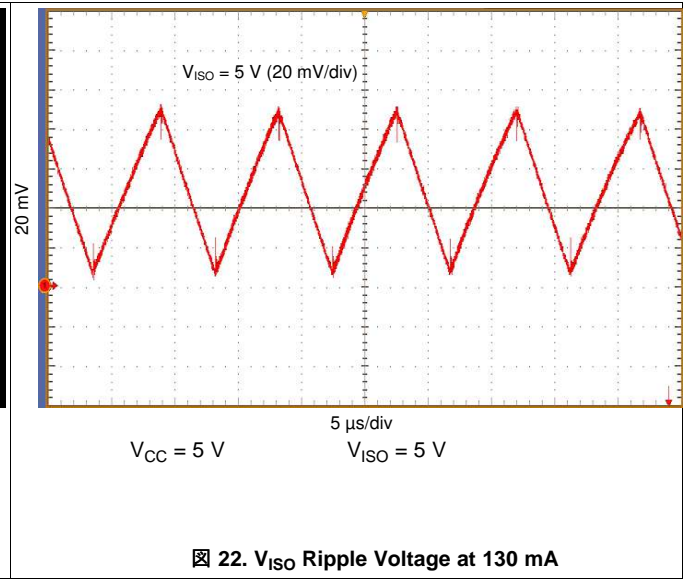
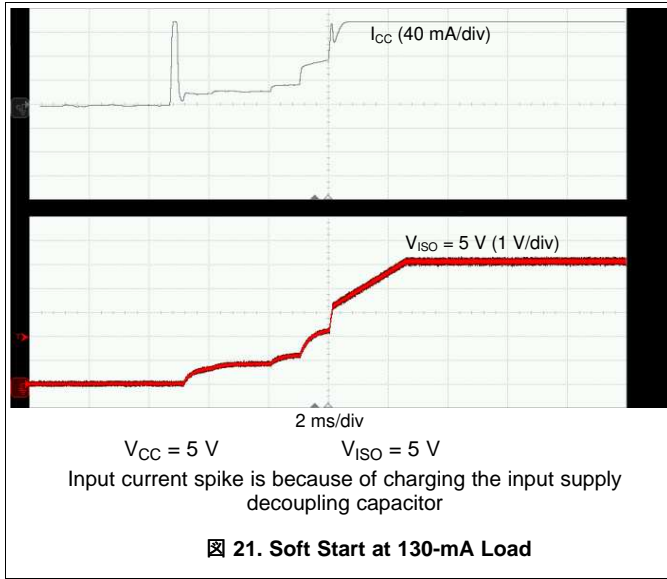


14. Propagation Delay Time vs Free-Air Temperature

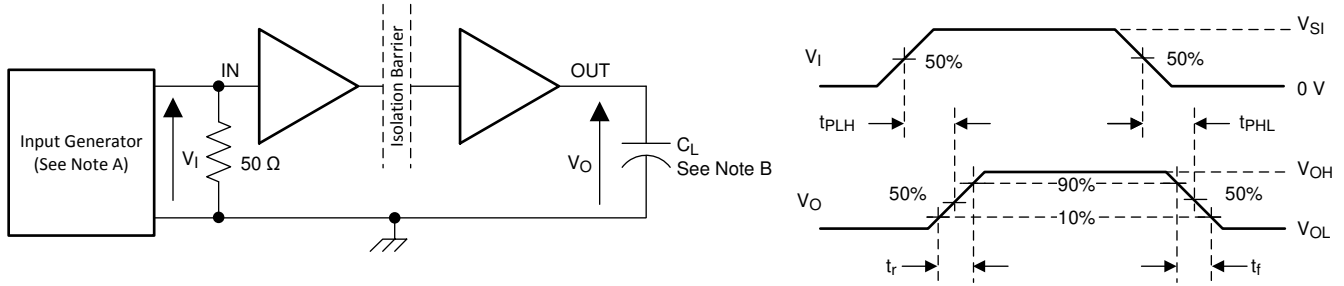
Typical Characteristics (continued)



Typical Characteristics (continued)



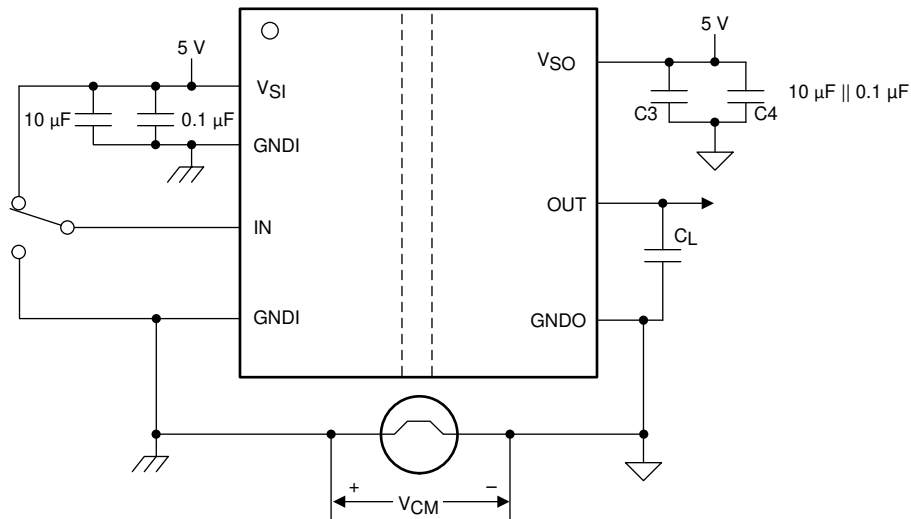
8 Parameter Measurement Information



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- Ω resistor is required to terminate the input generator signal. The resistor is not required in the actual application.

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

Figure 24. Switching Characteristics Test Circuit and Voltage Waveforms



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

Optional 100 μ F capacitor can be added between V_{CC} and GND1; refer to [Power Supply Recommendations](#).

Pass-fail criteria: Outputs must remain stable.

Figure 25. Common-Mode Transient Immunity Test Circuit

9 Detailed Description

9.1 Overview

The ISOW7821 device comprises a high-efficiency, low-emissions isolated DC-DC converter and two high-speed isolated data channels. [Figure 26](#) shows the functional block diagram of the ISOW7821 device.

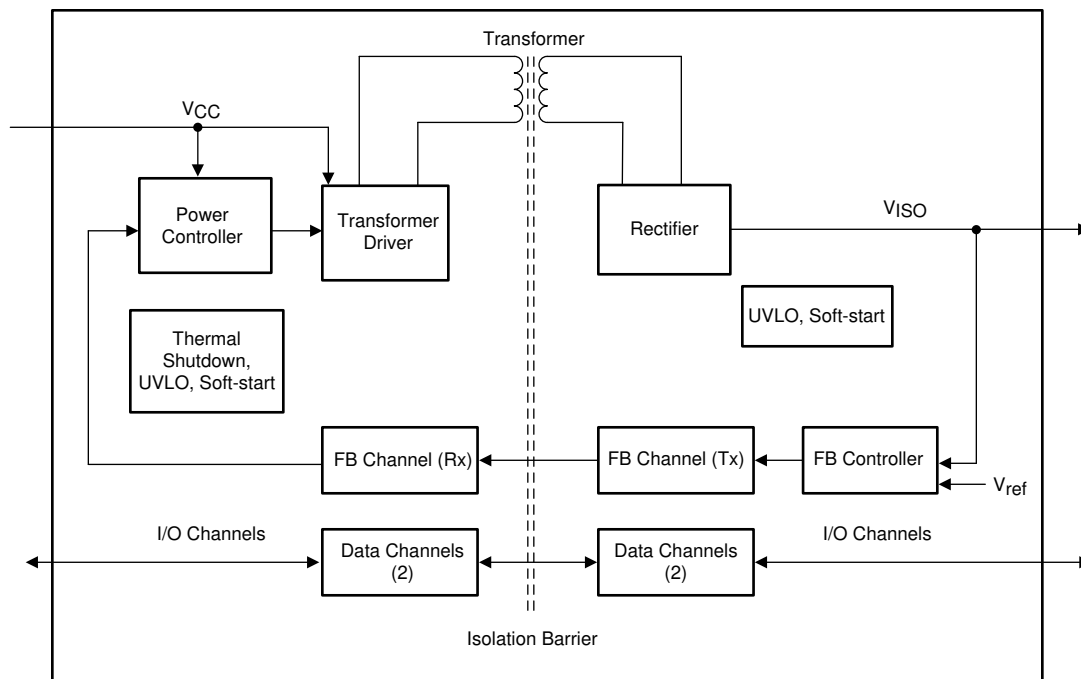
The integrated DC-DC converter uses switched mode operation and proprietary circuit techniques to reduce power losses and boost efficiency. Specialized control mechanisms, clocking schemes, and the use of a high-Q on-chip transformer provide high efficiency and low radiated emissions. The integrated transformer uses thin film polymer as the insulation barrier.

The V_{CC} supply is provided to the primary power controller that switches the power stage connected to the integrated transformer. Power is transferred to the secondary side, rectified and regulated to either 3.3 V or 5 V, depending on the SEL pin. The output voltage, V_{ISO} , is monitored and feedback information is conveyed to the primary side through a dedicated isolation channel. The duty cycle of the primary switching stage is adjusted accordingly. The fast feedback control loop of the power converter ensures low overshoots and undershoots during load transients. Undervoltage lockout (UVLO) with hysteresis is integrated on the V_{CC} and V_{ISO} supplies which ensures robust system performance under noisy conditions. An integrated soft-start mechanism ensures controlled inrush current and avoids any overshoot on the output during power up.

The integrated signal-isolation channels employ an ON-OFF keying (OOK) modulation scheme to transmit the digital data across a silicon-dioxide based isolation barrier. The transmitter sends a high-frequency carrier across the barrier to represent one state and sends no signal to represent the other state. The receiver demodulates the signal after signal conditioning and produces the output through a buffer stage. The signal-isolation channels incorporate advanced circuit techniques to maximize the CMTI performance and minimize the radiated emissions from the high frequency carrier and IO buffer switching. [Figure 27](#) shows a functional block diagram of a typical signal isolation channel.

The ISOW7821 device is suitable for applications that have limited board space and require more integration. These devices are also suitable for very-high voltage applications, where power transformers meeting the required isolation specifications are bulky and expensive.

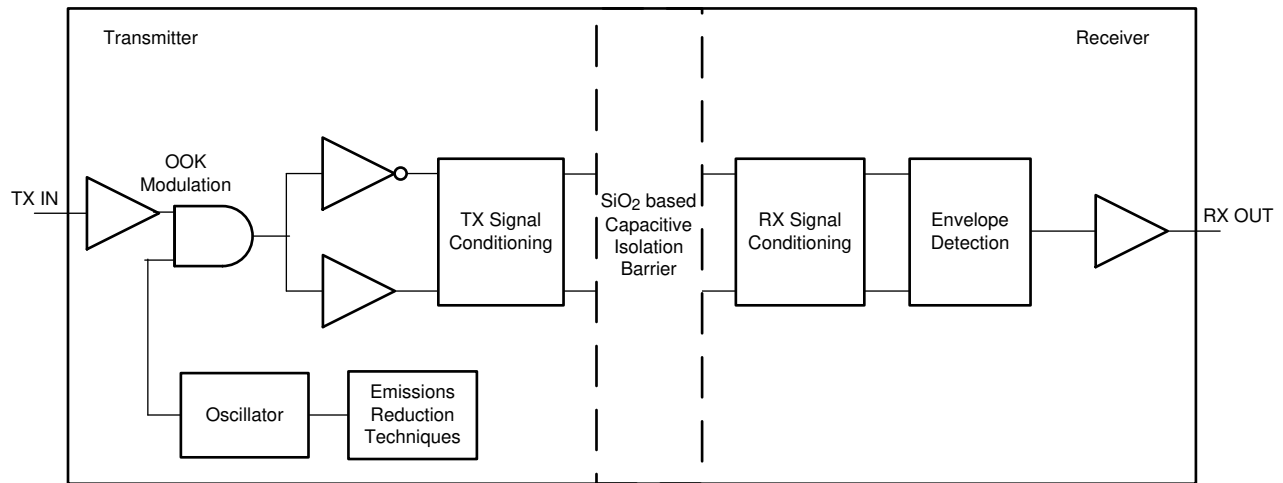
9.2 Functional Block Diagram



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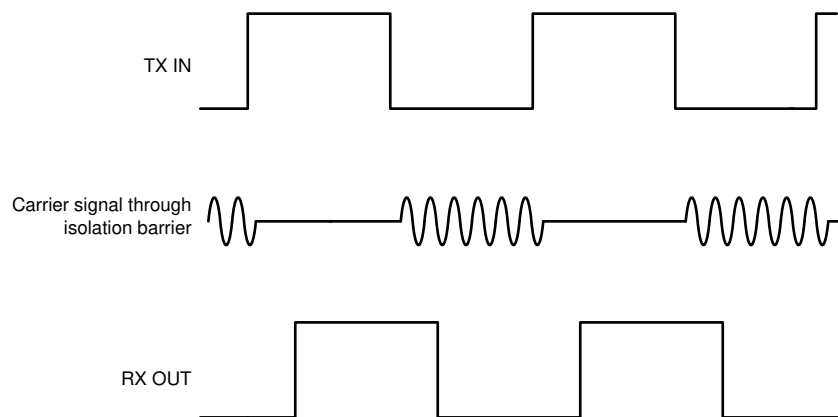
Figure 26. ISOW7821 Block Diagram

Functional Block Diagram (continued)



27. Conceptual Block Diagram of a Capacitive Data Channel

28 shows a conceptual detail of how the OOK scheme works.



28. On-Off Keying (OOK) Based Modulation Scheme

9.3 Feature Description

表 1 provides an overview of the device features.

表 1. Device Features

PART NUMBER ⁽¹⁾	CHANNEL DIRECTION	MAXIMUM DATA RATE	DEFAULT OUTPUT STATE	RATED ISOLATION ⁽²⁾
ISOW7821	1 forward, 1 reverse	100 Mbps	High	5000 V _{RMS} / 7071 V _{PK}
ISOW7821F			Low	

(1) The F suffix is part of the orderable part number. See the [メカニカル、パッケージ、および注文情報](#) section for the full orderable part number.

(2) For detailed isolation ratings, see the [Safety-Related Certifications](#) table.

9.3.1 Electromagnetic Compatibility (EMC) Considerations

The ISOW7821 device uses emissions reduction schemes for the internal oscillator and advanced internal layout scheme to minimize radiated emissions at the system level.

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 ISOW7821 device incorporates many chip-level design improvements for overall system robustness. Some of these improvements include:

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

9.3.2 Power-Up and Power-Down Behavior

The ISOW7821 device has built-in UVLO on the V_{CC} and V_{ISO} supplies with positive-going and negative-going thresholds and hysteresis. When the V_{CC} voltage crosses the positive-going UVLO threshold during power-up, the DC-DC converter initializes and the power converter duty cycle is increased in a controlled manner. This soft-start scheme limits primary peak currents drawn from the V_{CC} supply and charges the V_{ISO} output in a controlled manner, avoiding overshoots. Outputs of the isolated data channels are in an indeterminate state until the V_{CC} or V_{ISO} voltage crosses the positive-going UVLO threshold. When the UVLO positive-going threshold is crossed on the secondary side V_{ISO} pin, the feedback data channel starts providing feedback to the primary controller. The regulation loop takes over and the isolated data channels go to the normal state defined by the respective input channels or their default states. Design should consider a sufficient time margin (typically 10 ms with 10-μF load capacitance) to allow this power up sequence before valid data channels are accounted for system functionality.

When V_{CC} power is lost, the primary side DC-DC controller turns off when the UVLO lower threshold is reached. The V_{ISO} capacitor then discharges depending on the external load. The isolated data outputs on the V_{ISO} side are returned to the default state for the brief time that the V_{ISO} voltage takes to discharge to zero.

9.3.3 Current Limit, Thermal Overload Protection

The ISOW7821 device is protected against output overload and short circuit. Output voltage starts dropping when the power converter is not able to deliver the current demanded during overload conditions. For a V_{ISO} short-circuit to ground, the duty cycle of the converter is limited to help protect against any damage.

Thermal protection is also integrated to help prevent the device from getting damaged during overload and short-circuit conditions on the isolated output. Under these conditions, the device temperature starts to increase. When the temperature goes above 180°C, thermal shutdown activates and the primary controller turns off which removes the energy supplied to the V_{ISO} load, which causes the device to cool off. When the junction temperature goes below 150°C, the device starts to function normally. If an overload or output short-circuit condition prevails, this protection cycle is repeated. Care should be taken in the design to prevent the device junction temperatures from reaching such high values.

9.4 Device Functional Modes

表 2 lists the supply configurations for these devices.

表 2. Supply Configurations

SEL INPUT	V_{CC}	V_{ISO}
Shorted to V_{ISO}	5 V	5 V
Shorted to GND2 or floating	5 V	3.3 V
Shorted to GND2 or floating	3.3 V ⁽¹⁾	3.3 V ⁽²⁾

- (1) $V_{CC} = 3.3$ V, SEL shorted to V_{ISO} (essentially $V_{ISO} = 5$ V) is not recommended mode of configuration.
 (2) The SEL pin has a weak pulldown internally. Therefore for $V_{ISO} = 3.3$ V, the SEL pin should be strongly connected to the GND2 pin in noisy system scenarios.

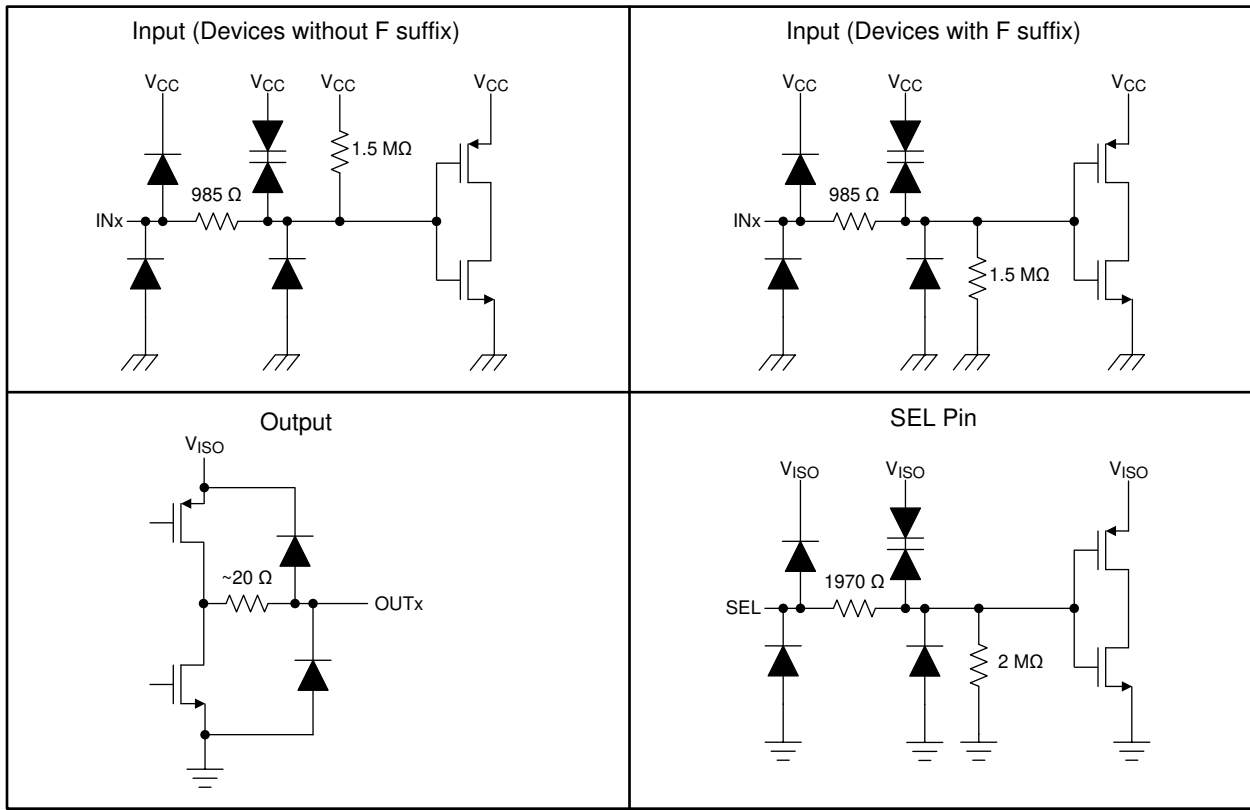
表 3 lists the functional modes for ISOW7821 device.

表 3. Function Table⁽¹⁾

INPUT SUPPLY (V_{CC})	INPUT (INx)	OUTPUT (OUTx)	COMMENTS
PU	H	H	Output channel assumes the logic state of its input
	L	L	
	Open	Default	Default mode ⁽²⁾ : When INx is open, the corresponding output channel assumes logic based on default output mode of selected version
PD	x	Undetermined ⁽³⁾	

- (1) PU = Powered up ($V_{CC} \geq 2.7$ V); PD = Powered down ($V_{CC} < 2.1$ V); X = Irrelevant; H = High level; L = Low level, V_{CC} = Input-side supply
 (2) In the default condition, the output is high for ISOW7821 and low for ISOW7821 with the F suffix.
 (3) The outputs are in an undetermined state when $V_{CC} < 2.1$ V.

9.4.1 Device I/O Schematics



29. Device I/O Schematics

10 Application and Implementation

注

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.

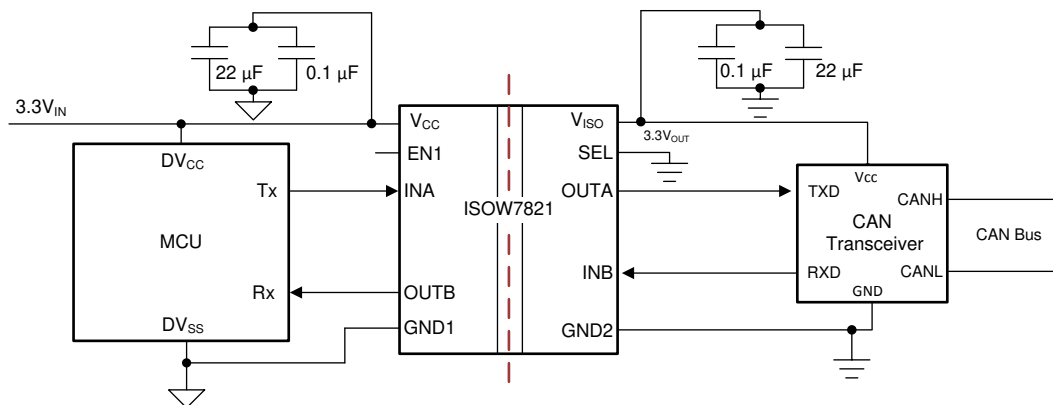
10.1 Application Information

The ISOW7821 high-performance, dual channel digital isolator with integrated DC-DC converter. Typically digital isolators require two power supplies isolated from each other to power up both sides of device. Due to the integrated DC-DC converter in the ISOW7821 device, the isolated supply is generated inside the device that can be used to power isolated side of the device and peripherals on isolated side, thus saving board space. The ISOW7821 device uses single-ended CMOS-logic switching technology. When designing with digital isolators, keep in mind that because of the single-ended design structure, digital isolators do not conform to any specific interface standard and are only intended for isolating single-ended CMOS or TTL digital signal lines. The isolator is typically placed between the data controller (that is a microcontroller or UART), and a data converter or a line transceiver, regardless of the interface type or standard.

The ISOW7821 device is suitable for applications that have limited board space and desire more integration. These devices are also suitable for very high voltage applications, where power transformers meeting the required isolation specifications are bulky and expensive.

10.2 Typical Application

Figure 30 shows the typical schematic for CAN isolation.



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Optional 100 µF capacitor can be added between V_{CC} and GND1; refer to [Power Supply Recommendations](#).

Figure 30. Isolating CAN Bus and Generating Isolated Power for CAN Transceiver

10.2.1 Design Requirements

To design with this device, use the parameters listed in [Table 4](#).

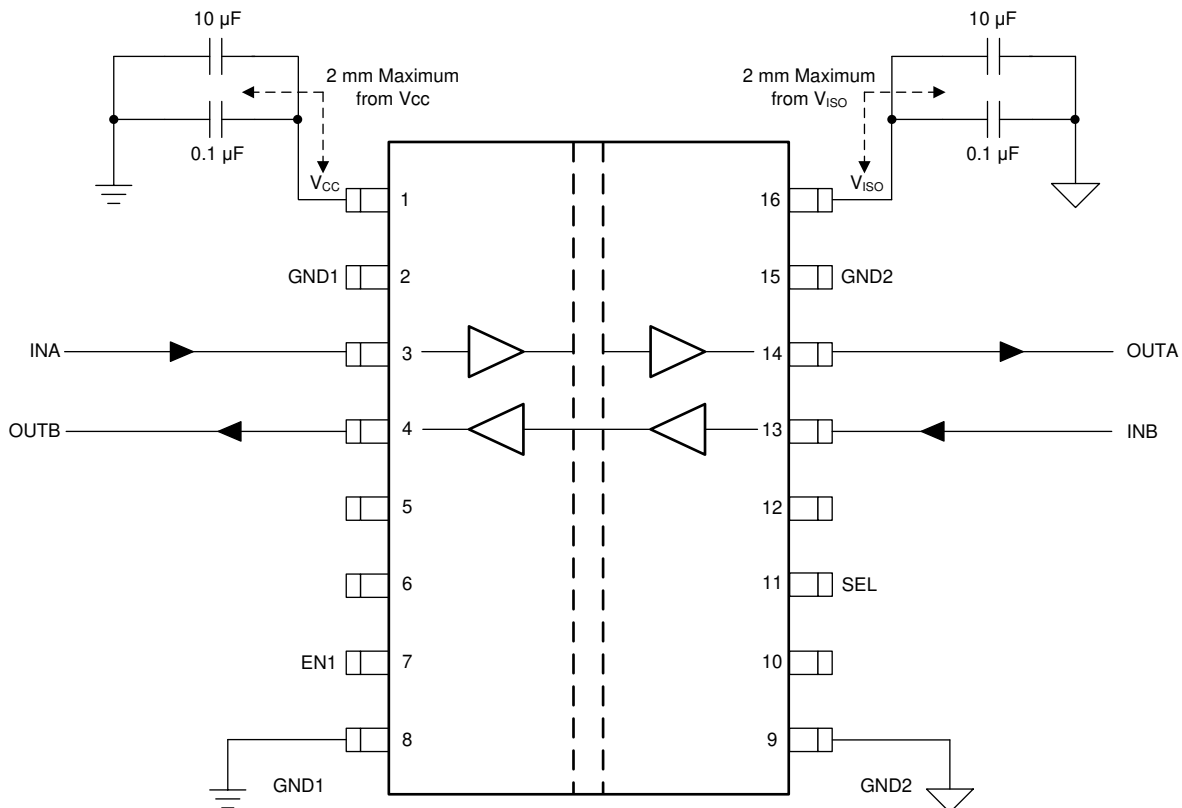
Table 4. Design Parameters

PARAMETER	VALUE
Input voltage	3 V to 5.5 V
Decoupling capacitor between V_{CC} and GND1	0.1 µF to 10 µF
Decoupling capacitor between V_{ISO} and GND2	0.1 µF to 10 µF

Because of very-high current flowing through the ISOW7821 V_{CC} and V_{ISO} supplies, higher decoupling capacitors typically provide better noise and ripple performance. Although a 10- μF capacitor is adequate, higher decoupling capacitors (such as 47 μF) on both the V_{CC} and V_{ISO} pins to the respective grounds are strongly recommended to achieve the best performance. Optional 100 μF decoupling capacitor can be added between V_{CC} and GND1 pins; refer to [Power Supply Recommendations](#) for more details.

10.2.2 Detailed Design Procedure

The ISOW7821 device only requires external bypass capacitors to operate. These low-ESR ceramic bypass capacitors must be placed as close to the chip pads as possible.



Optional 100 μF capacitor can be added between V_{CC} and GND1; refer to [Power Supply Recommendations](#).

Figure 31. Typical Circuit Hook-Up

The V_{CC} power-supply input provides power to isolated data channels and to the isolated DC-DC converter. Use [Equation 1](#) to calculate the total power budget on the primary side.

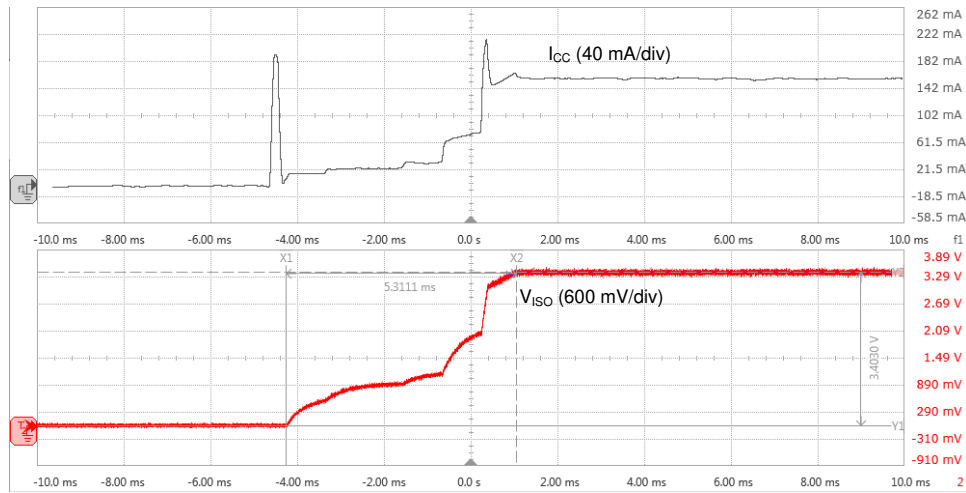
$$I_{CC} = (V_{ISO} \times I_{ISO}) / (\eta \times V_{CC}) + I_{inpx}$$

where

- I_{CC} is the total current required by the primary supply.
- V_{ISO} is the isolated supply voltage.
- I_{ISO} is the external load on the isolated supply voltage.
- η is the efficiency.
- V_{CC} is the supply voltage.
- I_{inpx} is the total current drawn for the isolated data channels and power converter when data channels are toggling at a specific data rate. This data is shown in the [Electrical Characteristics—5-V Input, 5-V Output](#) table.

(1)

10.2.3 Application Curve



$V_{CC} = 3.3\text{ V}$

$I_{ISO} = 70\text{ mA}$

Input current spike is because of charging the input supply decoupling capacitor

Figure 32. Soft-Start Waveform

10.2.3.1 Insulation Lifetime

Insulation lifetime projection data is collected by using industry-standard Time Dependent Dielectric Breakdown (TDDB) test method. In this test, all pins on each side of the barrier are tied together creating a two-terminal device and high voltage applied between the two sides; See Figure 33 for TDDB test setup. The insulation breakdown data is collected at various high voltages switching at 60 Hz over temperature. For reinforced insulation, VDE standard requires the use of TDDB projection line with failure rate of less than 1 part per million (ppm). Even though the expected minimum insulation lifetime is 20 years at the specified working isolation voltage, VDE reinforced certification requires additional safety margin of 20% for working voltage and 87.5% for lifetime which translates into minimum required insulation lifetime of 37.5 years at a working voltage that's 20% higher than the specified value.

Figure 34 shows the intrinsic capability of the isolation barrier to withstand high voltage stress over its lifetime. Based on the TDDB data, the intrinsic capability of the insulation is 1000 V_{RMS} with a lifetime of 1184 years.

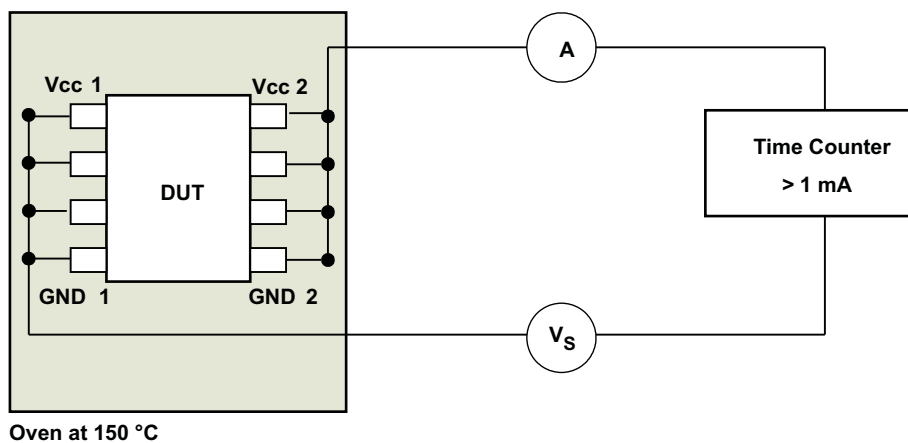
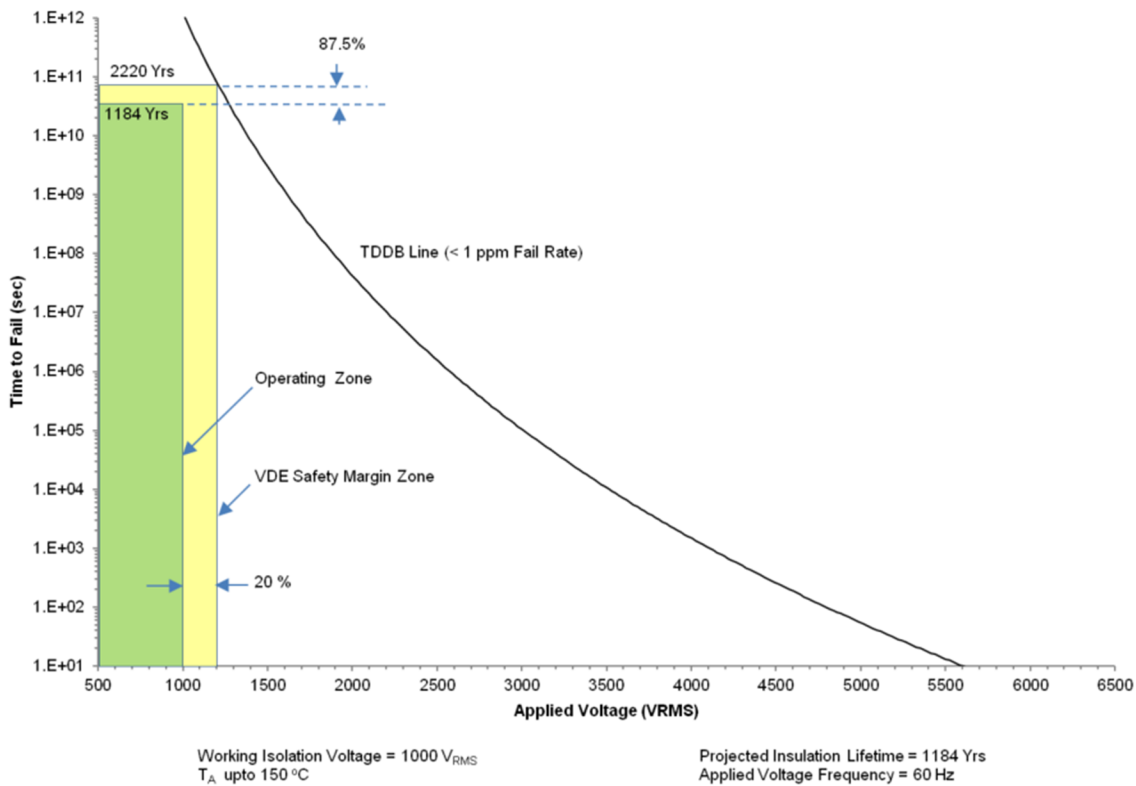


Figure 33. Test Setup for Insulation Lifetime Measurement



34. Insulation Lifetime Projection Data

11 Power Supply Recommendations

To help ensure reliable operation at data rates and supply voltages, adequate decoupling capacitors must be located as close to supply pins as possible. The input supply must have an appropriate current rating to support output load and switching at the maximum data rate required by the end application. For more information, refer to the [Detailed Design Procedure](#) section.

ISOW7821 integrates a synchronous, isolated DC/DC converter along with isolated data channels. Due to finite efficiency of the integrated micro-transformer, for any given output load current, the input current will be proportionally higher. Thus, the input supply (V_{CC}) decoupling capacitor also needs to be sufficiently larger than the output supply (V_{ISO}) decoupling capacitor. It is recommended to have an input capacitor that is larger than the output capacitor by at least 100 μF . It is also recommended to have an input power supply to ISOW7821 with sufficient current limit to support output load current requirements. For an output load current of 130 mA, it is recommended to have >600 mA of input current limit and for lower output load currents, the input current limit can be proportionally lower. When the input supply is lower than 2.7 V, the device can go into a protected under-voltage lock out (UVLO) state per the UVLO thresholds specified in datasheet. Under UVLO state, it is recommended that the output voltage also be discharged to less than 2.1 V. This can be accomplished by having an input capacitor that is 100 μF larger compared to the output capacitor. It also helps to have a small load (~10 mA) at the output capacitor to bleed off any unwanted, residual charge. To make sure ISOW7821 quickly transitions from UVLO state to powered state, it is recommended to have an input supply rise time of less than 10 ms.

If it is not possible to follow the aforementioned recommendations and frequent brownouts are expected on the input supply, then simple secondary side monitoring, protection and reset components can help improve the robustness of overall system and power-up or reset mechanisms. More details on output monitoring, protection and an example of reset mechanism can be found in [Overvoltage protection for isolated DC/DC converter](#).

12 Layout

12.1 Layout Guidelines

A minimum of four layers is required to accomplish a low-EMI PCB design (see [Figure 35](#)). 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/in².
- 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.
- Keep decoupling capacitors as close as possible to the V_{CC} and V_{ISO} pins.

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

Because the device has no thermal pad to dissipate heat, the device dissipates heat through the respective GND pins. Ensure that enough copper is present on both GND pins to prevent the internal junction temperature of the device from rising to unacceptable levels.

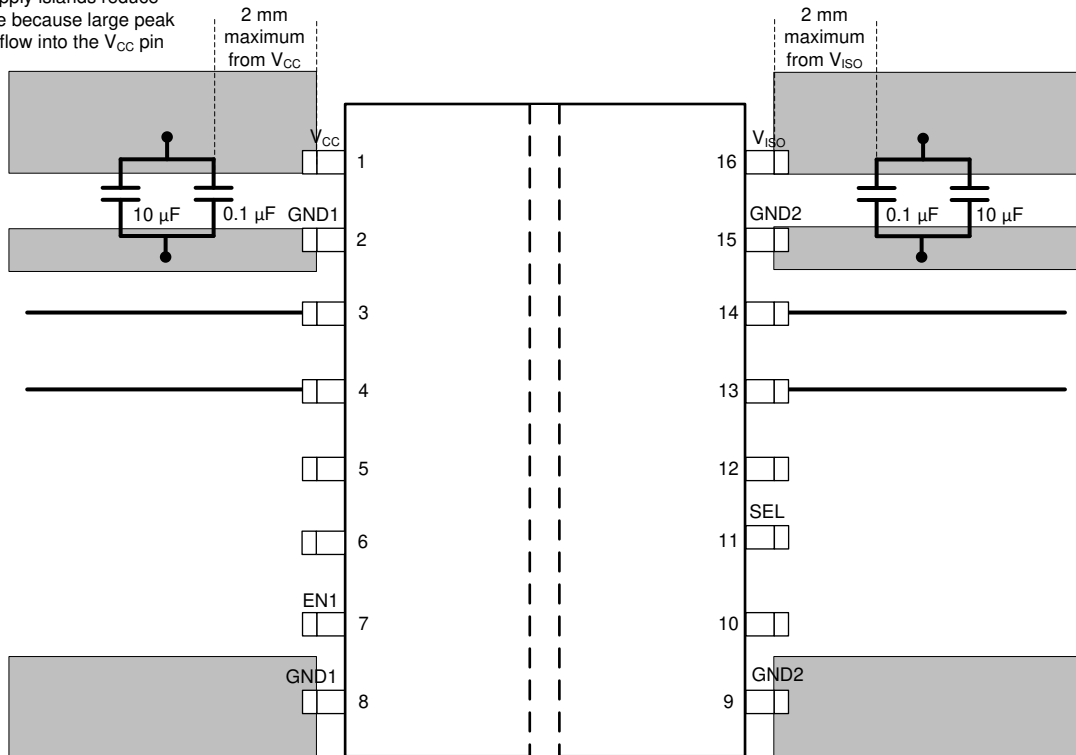
The ISOW7821 integrated signal and power isolation device simplifies system design and reduces board area. The use of low-inductance micro-transformers in the ISOW7821 device necessitates the use of high frequency switching, resulting in higher radiated emissions compared to discrete solutions. The ISOW7821 device uses on-chip circuit techniques to reduce emissions compared to competing solutions. For further reduction in radiated emissions at system level, refer to the [Low-Emission Designs With ISOW7841 Integrated Signal and Power Isolator application report](#).

12.1.1 PCB Material

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

12.2 Layout Example

Solid supply islands reduce inductance because large peak currents flow into the V_{CC} pin



Solid ground islands help dissipate heat through PCB

Optional 100 μF capacitor can be added between V_{CC} and GND1; refer to [Power Supply Recommendations](#).

图 35. Layout Example

13 デバイスおよびドキュメントのサポート

13.1 デバイス・サポート

13.1.1 開発サポート

開発サポートについては、『[電源が内蔵されたデジタル・アイソレータを使用する、サイズとコストの最適化されたバイナリ・モジュールのリファレンス・デザイン](#)』TI Designを参照してください。

13.2 ドキュメントのサポート

13.2.1 関連資料

関連資料については、以下を参照してください。

- テキサス・インスツルメンツ、『[デジタル・アイソレータ設計ガイド](#)』
- テキサス・インスツルメンツ、『[絶縁の用語集](#)』
- テキサス・インスツルメンツ、『[ISOW784x DC/DCコンバータ内蔵のクワッド・チャネル・デジタル・アイソレータ評価基板](#)』ユーザー・ガイド

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13.7 Glossary

[SLYZ022](#) — TI Glossary.

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

14 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。これらの情報は、指定のデバイスに対して提供されている最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
ISOW7821DWE	ACTIVE	SOIC	DWE	16	40	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISOW7821	Samples
ISOW7821DWER	ACTIVE	SOIC	DWE	16	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISOW7821	Samples
ISOW7821FDWE	ACTIVE	SOIC	DWE	16	40	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISOW7821F	Samples
ISOW7821FDWER	ACTIVE	SOIC	DWE	16	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	ISOW7821F	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

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

(6) Lead finish/Ball material - Orderable Devices 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.

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ISOW7821DWER	SOIC	DWE	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
ISOW7821FDWER	SOIC	DWE	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)
ISOW7821DWER	SOIC	DWE	16	2000	350.0	350.0	43.0
ISOW7821FDWER	SOIC	DWE	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)
ISOW7821DWE	DWE	SO-MOD	16	40	506.98	12.7	4826	6.6
ISOW7821FDWE	DWE	SO-MOD	16	40	506.98	12.7	4826	6.6

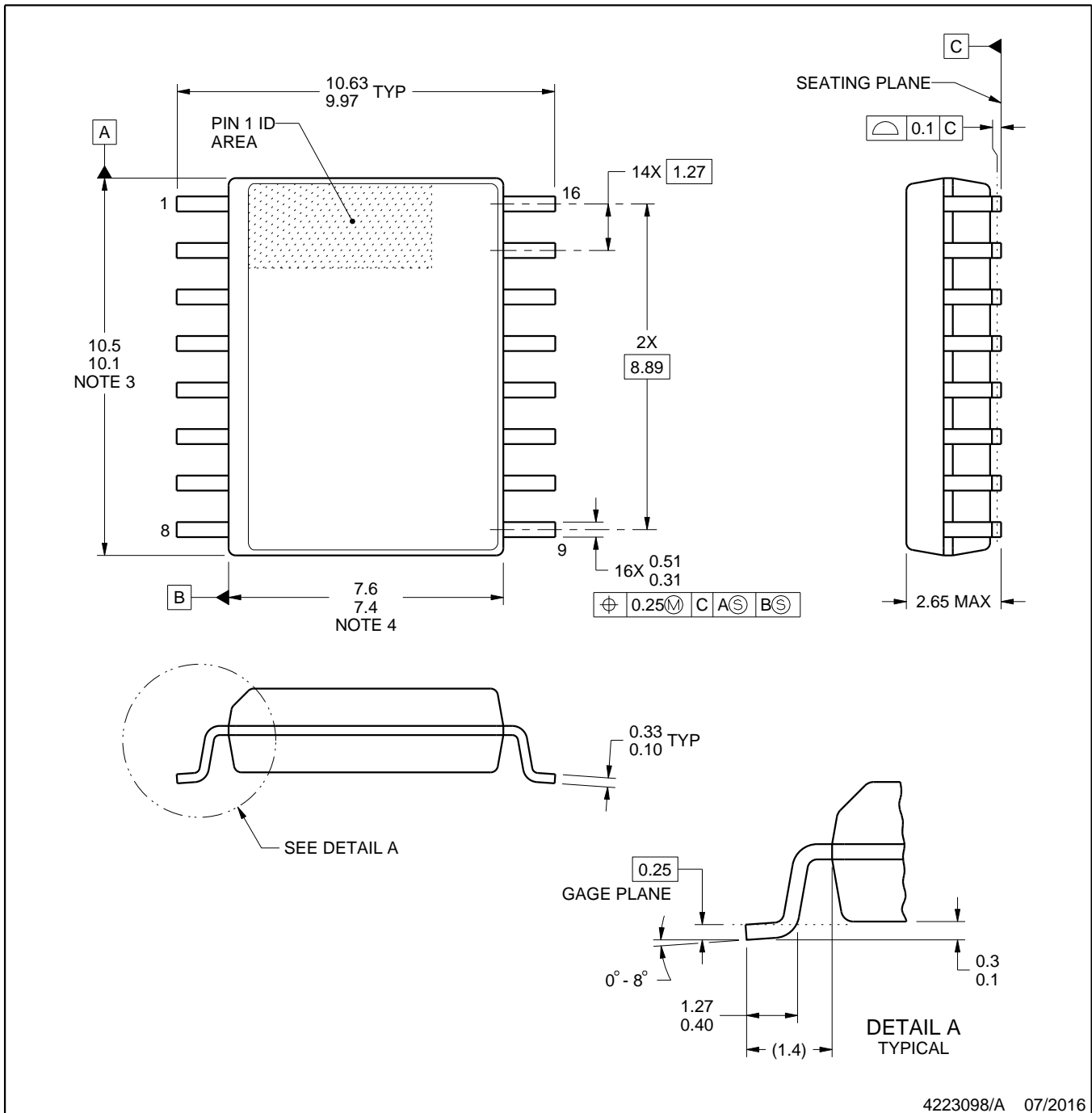


DWE0016A

PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



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NOTES:

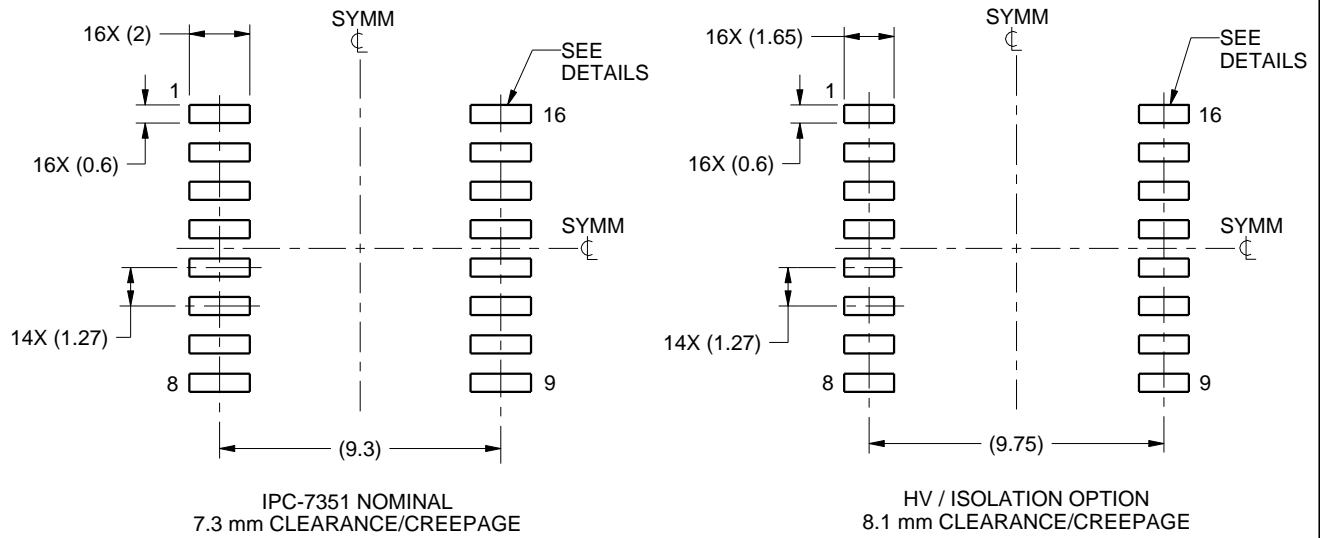
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

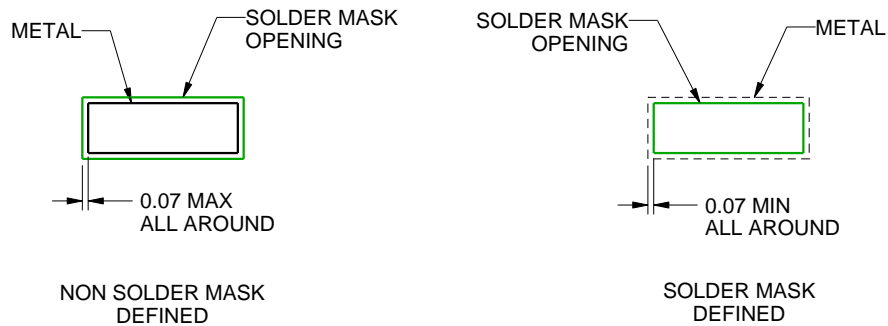
DWE0016A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:4X



SOLDER MASK DETAILS

4223098/A 07/2016

NOTES: (continued)

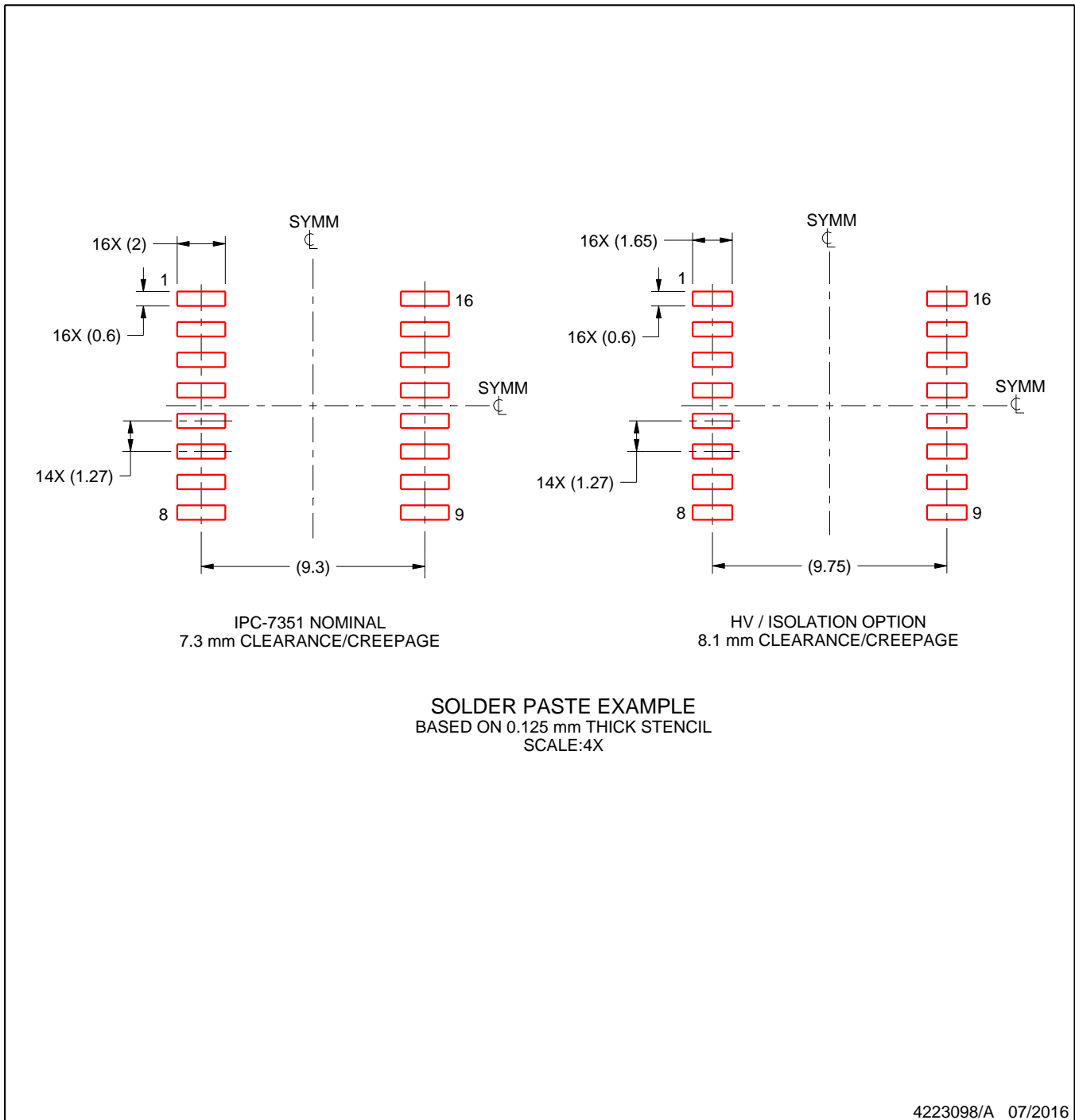
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DWE0016A

SOIC - 2.65 mm max height

SOIC



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.

重要なお知らせと免責事項

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