

# ISOM811x-Q1 3.75kV<sub>RMS</sub>, Automotive Single-Channel Opto-Emulator With Analog Transistor Output

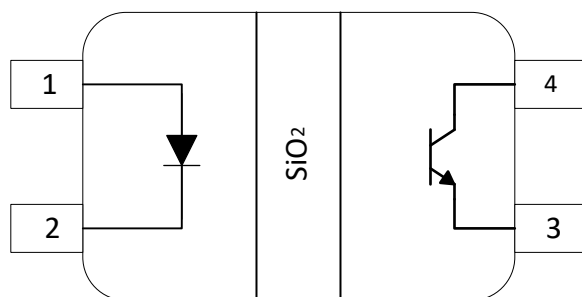
## 1 Features

- Drop-in replacement and pin-to-pin upgrade to industry-standard phototransistor optocouplers
- AEC-Q100 qualified with the following results:
  - Device temperature Grade 1: -40°C to 125°C ambient operating temperature range
- 1-channel LED-emulator input
- Current transfer ratio (CTR) at  $I_F = 5\text{mA}$ ,  $V_{CE} = 5\text{V}$ :
  - ISOM8110, ISOM8115: 100% to 155%
  - ISOM8111, ISOM8116: 150% to 230%
  - ISOM8112, ISOM8117: 255% to 380%
  - ISOM8113, ISOM8118: 375% to 560%
- High collector-emitter voltage:  $V_{CE}(\text{max}) = 80\text{V}$
- Robust isolation barrier
  - Isolation rating: 3750V<sub>RMS</sub>
  - Working voltage: 500V<sub>RMS</sub>, 707V<sub>PK</sub>
  - Surge capability: up to 10kV
- Response time: 3μs (typical) at  $V_{CE} = 10\text{V}$ ,  $I_C = 2\text{mA}$ ,  $R_L = 100\Omega$
- [Functional Safety-Capable](#)
  - Documentation available to aid functional safety system design: [ISOM811x-Q1](#)
- Safety-related certifications planned:
  - UL 1577 recognition, 3750V<sub>RMS</sub> isolation
  - DIN EN IEC 60747-17 (VDE 0884-17) conformity per VDE
  - IEC 62368-1, IEC 61010-1 certifications
  - CQC GB 4943.1 certification

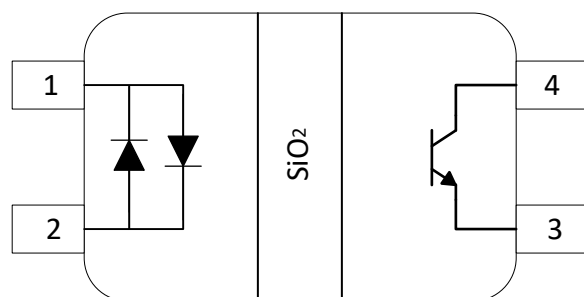
## 2 Applications

- [Switching power supply](#)
- [Advanced driver assistance systems \(ADAS\)](#)
- [Motor drive I/O and position feedback](#)
- [Body electronics & lighting](#)
- [Infotainment & cluster](#)
- [HEV/EV battery-management system \(BMS\)](#)

ISOM811(0-3)



ISOM811(5-8)



Simplified Schematic

## 3 Description

The ISOM811x-Q1 devices are single-channel optocoupler-emulators with LED-emulator input and transistor output. The devices are pin-compatible and drop-in replacements for many traditional optocouplers, allowing enhancement to existing systems with no PCB redesign.

ISOM811x-Q1 opto-emulators offer significant reliability and performance advantages compared to optocouplers, including high bandwidth, low turn-off delay, low power consumption, wider temperature ranges, and tight CTR and process controls resulting in small part-to-part skew. Since there is no aging effect or temperature variation to compensate for, the emulated LED input stage consumes less power than optocouplers.

ISOM811x-Q1 devices are offered in small SOIC-4 packages with 2.54mm and 1.27mm pin pitches, supporting a 3.75kV<sub>RMS</sub> isolation rating and DC (ISOM811[0-3]) and bidirectional DC (ISOM811[5-8]) input options. The high performance and reliability of ISOM811x-Q1 enables these devices to be used in power supply feedback design, motor drives, I/O modules in industrial controllers, factory automation applications, and more.

### Package Information

PART NUMBER	PACKAGE <sup>(1)</sup>	PACKAGE SIZE <sup>(3)</sup>	BODY SIZE (NOM)
ISOM811x-Q1	SO-4 (DFG)	7.0mm × 3.5mm	4.8mm × 3.5mm
	SO-4 (DFH) <sup>(2)</sup>	7.0mm × 2.7mm	4.8mm × 2.7mm

(1) For more information, see [Section 12](#).

(2) Preview only.

(3) The package size (length × width) is a nominal value and includes pins, where applicable.



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## 4 Device Comparison

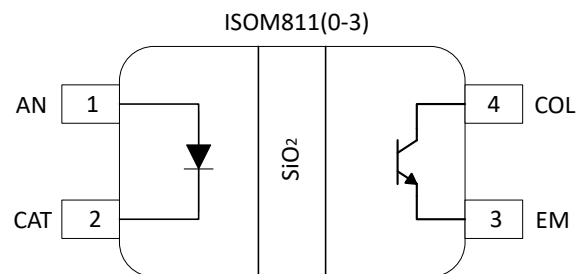
**Table 4-1. Device Selection**

PART NUMBER <sup>(2)</sup>	CTR	PACKAGE <sup>(1)</sup>	PIN PITCH
ISOM8110-Q1, ISOM8115-Q1	100% to 155%	4-pin SOIC (DFG), 4-pin SOIC (DFH)	2.54mm, 1.27mm
ISOM8111-Q1, ISOM8116-Q1	150% to 230%		
ISOM8112-Q1, ISOM8117-Q1	255% to 380%		
ISOM8113-Q1, ISOM8118-Q1	375% to 560%		

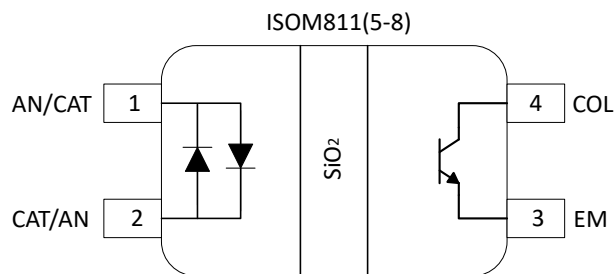
(1) DFH package is preview only.

(2) ISOM8111-3 and ISOM8115-8 are preview only.

## 5 Pin Configuration and Functions



**Figure 5-1. ISOM811(0-3) 4-Pin SOIC (Top View)**



**Figure 5-2. ISOM811(5-8) 4-Pin SOIC (Top View)**

**Table 5-1. Pin Functions**

PIN		TYPE <sup>(1)</sup>	DESCRIPTION
NO.	NAME		
1	AN	I	Anode connection of input LED emulator
2	CAT	I	Cathode connection of input LED emulator
3	EM	O	Emitter for transistor
4	COL	O	Collector for transistor

(1) I = Input, O = Output

## 6 Specifications

### 6.1 Absolute Maximum Ratings

See <sup>(1)</sup> <sup>(2)</sup>

			MIN	MAX	UNIT
I <sub>F(max)</sub>	Maximum Input forward current	ISOM8110, ISOM8111, ISOM8112, ISOM8113		50	mA
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		±50	mA
V <sub>CEO</sub>	Collector-emitter voltage	ISOM8110, ISOM8111, ISOM8112, ISOM8113		80	V
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		80	V
V <sub>ECO</sub>	Emitter-collector voltage	ISOM8110, ISOM8111, ISOM8112, ISOM8113		7	V
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		7	V
I <sub>FP</sub>	Input pulse forward current (1µs width)	ISOM8110, ISOM8111, ISOM8112, ISOM8113		1	A
I <sub>FP</sub>	Input pulse forward current (1µs width)	ISOM8115, ISOM8116, ISOM8117, ISOM8118		±1	A
V <sub>R</sub>	Input reverse voltage at I <sub>R</sub> = 10µA	ISOM8110, ISOM8111, ISOM8112, ISOM8113		7	V
P <sub>I</sub>	Input power dissipation	ISOM8110, ISOM8111, ISOM8112, ISOM8113		140	mW
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		140	mW
I <sub>C</sub>	Collector current	ISOM8110, ISOM8111, ISOM8112, ISOM8113		50	mA
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		50	mA
P <sub>C</sub>	Collector power dissipation	ISOM8110, ISOM8111, ISOM8112, ISOM8113		150	mW
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		150	mW
P <sub>T</sub>	Total power dissipation	ISOM8110, ISOM8111, ISOM8112, ISOM8113		290	mW
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		290	mW
T <sub>A</sub>	Ambient temperature	ISOM8110, ISOM8111, ISOM8112, ISOM8113	-55	125	°C
		ISOM8115, ISOM8116, ISOM8117, ISOM8118	-55	125	°C
T <sub>J</sub>	Operating junction temperature	ISOM8110, ISOM8111, ISOM8112, ISOM8113		150	°C
		ISOM8115, ISOM8116, ISOM8117, ISOM8118		150	°C

- (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under the operational sections of this document. If used outside the listed operational conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) All specifications are at T<sub>A</sub> = 25°C unless otherwise noted

## 6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per AEC Q100-002 <sup>(1)</sup> HBM ESD Classification Level 3A	±2000	V
		Charged-device model (CDM), per AEC Q100-011 CDM ESD Classification Level C6	±1000	

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

## 6.3 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
$I_{F(ON)}$	Input ON-state forward current	0.7		20	mA
$V_{CEO}$	Collector-emitter voltage	-5		48	V
$T_A$	Ambient temperature	-40		125	°C

## 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		ISOM811x		UNIT
		DFG (SOIC)	DFH (SOIC)	
		4 PINS	4 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	283.9	288.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	173.1	173.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	201.4	192.9	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	125.1	121.5	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	198.0	190.0	°C/W

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

## 6.5 Insulation Specifications

PARAMETER		TEST CONDITIONS	VALUE	UNIT
			4-DFG, 4-DFH	
<b>IEC 60664-1</b>				
CLR	External clearance <sup>(1)</sup>	Side 1 to side 2 distance through air	> 5	mm
CPG	External creepage <sup>(1)</sup>	Side 1 to side 2 distance across package surface	> 5	mm
DTI	Distance through the insulation	Minimum internal gap (internal clearance)	>17	μm
CTI	Comparative tracking index	IEC 60112; UL 746A	>400	V
	Material Group	According to IEC 60664-1	II	
	Overvoltage category per IEC 60664-1	Rated mains voltage ≤ 150 V <sub>RMS</sub>	I-IV	
		Rated mains voltage ≤ 300 V <sub>RMS</sub>	I-IV	
		Rated mains voltage ≤ 600 V <sub>RMS</sub>	I-III	
<b>DIN VDE V 0884-11:2017 <sup>(6)</sup></b>				
V <sub>IORM</sub>	Maximum repetitive peak isolation voltage	AC voltage (bipolar)	707	V <sub>PK</sub>
V <sub>IOWM</sub>	Maximum isolation working voltage	AC voltage (sine wave); time-dependent dielectric breakdown (Tddb) test	500	V <sub>RMS</sub>
		DC voltage	707	V <sub>DC</sub>
V <sub>IOTM</sub>	Maximum transient isolation voltage	V <sub>TEST</sub> = V <sub>IOTM</sub> , t = 60s (qualification); V <sub>TEST</sub> = 1.2 × V <sub>IOTM</sub> , t = 1s (100% production)	5303	V <sub>PK</sub>
V <sub>IMP</sub>	Maximum impulse voltage <sup>(2)</sup>	Tested in air, 1.2/50μs waveform per IEC 62368-1	7200	V <sub>PK</sub>
V <sub>IOSM</sub>	Maximum surge isolation voltage <sup>(3)</sup>	V <sub>IOSM</sub> ≥ 1.3 × V <sub>IMP</sub> ; tested in oil (qualification test), 1.2/50μs waveform per IEC 62368-1	10000	V <sub>PK</sub>
q <sub>pd</sub>	Apparent charge <sup>(4)</sup>	Method a: After I/O safety test subgroup 2/3, V <sub>ini</sub> = V <sub>IOTM</sub> , t <sub>ini</sub> = 60s; V <sub>pd(m)</sub> = 1.2 × V <sub>IORM</sub> , t <sub>m</sub> = 10s	≤ 5	pC
		Method a: After environmental tests subgroup 1, V <sub>ini</sub> = V <sub>IOTM</sub> , t <sub>ini</sub> = 60s; V <sub>pd(m)</sub> = 1.6 × V <sub>IORM</sub> , t <sub>m</sub> = 10s	≤ 5	
		Method b: At routine test (100% production) and preconditioning (type test), V <sub>ini</sub> = 1.2 × V <sub>IOTM</sub> , t <sub>ini</sub> = 1s; V <sub>pd(m)</sub> = 1.875 × V <sub>IORM</sub> , t <sub>m</sub> = 1s	≤ 5	
C <sub>IO</sub>	Barrier capacitance, input to output <sup>(5)</sup>	V <sub>IO</sub> = 0.4 × sin (2 πft), f = 1MHz	1	pF
R <sub>IO</sub>	Insulation resistance, input to output <sup>(5)</sup>	V <sub>IO</sub> = 500V, T <sub>A</sub> = 25°C	> 10 <sup>12</sup>	Ω
		V <sub>IO</sub> = 500V, 100°C ≤ T <sub>A</sub> ≤ 125°C	> 10 <sup>11</sup>	
		V <sub>IO</sub> = 500V at T <sub>S</sub> = 150°C	> 10 <sup>9</sup>	
	Pollution degree		2	
	Climatic category		40/125/21	
<b>UL 1577</b>				
V <sub>ISO</sub>	Withstand isolation voltage	V <sub>TEST</sub> = V <sub>ISO</sub> , t = 60s (qualification); V <sub>TEST</sub> = 1.2 × V <sub>ISO</sub> , t = 1s (100% production)	3750	V <sub>RMS</sub>

- (1) Creepage and clearance requirements should be applied according to the specific equipment isolation standards of an application. Care should be taken to maintain the creepage and clearance distance of a board design to ensure that the mounting pads of the isolator on the printed-circuit board do not reduce this distance. Creepage and clearance on a printed-circuit board become equal in certain cases. Techniques such as inserting grooves, ribs, or both on a printed circuit board are used to help increase these specifications.
- (2) Testing is carried out in air to determine the surge immunity of the package.
- (3) Testing is carried out in oil to determine the intrinsic surge immunity of the isolation barrier.
- (4) Apparent charge is electrical discharge caused by a partial discharge (pd).
- (5) All pins on each side of the barrier tied together creating a two-pin device.

- (6) 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.

## 6.6 Safety-Related Certifications

VDE	CSA	UL	CQC	TUV
Plan to certify according to DIN EN IEC 60747-17 (VDE 0884-17)	Plan to certify according to IEC 61010-1, IEC 62368-1 and IEC 60601-1	Plan to certify according to UL 1577 Component Recognition Program	Plan to certify according to GB4943.1-2011	Plan to certify according to EN 61010-1:2010/A1:2019 and EN 62368-1:2014
Certificate planned	Certificate planned	Certificate planned	Certificate planned	Certificate planned

## 6.7 Safety Limiting Values

Safety limiting<sup>(1)</sup> intends to minimize potential damage to the isolation barrier upon failure of input or output circuitry.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>SO-4 PACKAGE (DFG)</b>						
I <sub>S</sub>	Safety limiting input current	R <sub>θJA</sub> = 283.9°C/W, V <sub>F</sub> = 1.4V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			300	mA
		R <sub>θJA</sub> = 283.9°C/W, V <sub>CEO</sub> = 40V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			10.5	mA
		R <sub>θJA</sub> = 283.9°C/W, V <sub>CEO</sub> = 24V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			17.5	mA
		R <sub>θJA</sub> = 283.9°C/W, V <sub>CEO</sub> = 15V, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			28	mA
P <sub>S</sub>	Safety limiting total power	R <sub>θJA</sub> = 283.9°C/W, T <sub>J</sub> = 150°C, T <sub>A</sub> = 25°C			420	mW
T <sub>S</sub>	Maximum safety temperature				150	°C

- (1) The I<sub>S</sub> and P<sub>S</sub> parameters represent the safety current and safety power respectively. The maximum limits of I<sub>S</sub> and P<sub>S</sub> must not be exceeded. These limits vary with the ambient temperature, T<sub>A</sub>. The junction-to-air thermal resistance, R<sub>θJA</sub>, in the table is that of a device installed on a high-K test board for leaded surface-mount packages. Use these equations to calculate the value for each parameter:  
 $T_J = T_A + R_{\theta JA} \times P$ , where P is the power dissipated in the device.  
 $T_{J(max)} = T_S = T_A + R_{\theta JA} \times P_S$ , where T<sub>J(max)</sub> is the maximum allowed junction temperature.  
 $P_S = I_S \times V_I$ , where V<sub>I</sub> is the maximum input voltage.

## 6.8 Electrical Characteristics

All specifications are at  $T_A = 25^\circ\text{C}$  unless otherwise noted

PARAMETER		TEST CONDITIONS	GPN	MIN	TYP	MAX	UNIT
<b>INPUT</b>							
$V_F$	Input forward voltage	$I_F = 5\text{mA}$	ISOM8110, ISOM8111, ISOM8112, ISOM8113		1.2	1.4	V
$V_F$	Input forward voltage	$I_F = 5\text{mA}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8110, ISOM8111, ISOM8112, ISOM8113		1.2	1.6	V
$V_F$	Input forward voltage	$I_F = \pm 5\text{mA}$	ISOM8115, ISOM8116, ISOM8117, ISOM8118		1.2	1.5	V
$V_F$	Input forward voltage	$I_F = \pm 5\text{mA}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8115, ISOM8116, ISOM8117, ISOM8118		1.2	1.5	V
$I_R$	Input reverse current	$V_R = 5\text{V}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8110, ISOM8111, ISOM8112, ISOM8113			10	$\mu\text{A}$
$C_{IN}$	Input capacitance	At 1MHz, $V_F = 0\text{V}$	ISOM8110, ISOM8111, ISOM8112, ISOM8113		19		pF
$C_{IN}$	Input capacitance	At 1MHz, $V_F = 0\text{V}$	ISOM8115, ISOM8116, ISOM8117, ISOM8118		6		pF
<b>OUTPUT</b>							
$C_{CE}$	Collector-emitter capacitance	1MHz, $V_F = 0\text{V}$	ISOM811x		10		pF
$V_{CE(SAT)}$	Collector-emitter saturation voltage	$I_F = 20\text{mA}$ , $I_C = 1\text{mA}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8110, ISOM8111, ISOM8112, ISOM8113			0.3	V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	$I_F = \pm 20\text{mA}$ , $I_C = 1\text{mA}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8115, ISOM8116, ISOM8117, ISOM8118			0.3	V
$I_{C\_DARK}$	Collector dark current	$V_{CE} = 20\text{V}$ , $I_F = 0\text{mA}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM811x			100	nA
$I_{EC}$	Reverse current	$V_{EC} = 7\text{V}$ , $I_F = 0\text{mA}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM811x			100	$\mu\text{A}$
$I_{C\_OFF}$	OFF_state collector current	$V_F = 0.7\text{V}$ , $V_{CE} = 48\text{V}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8110, ISOM8111, ISOM8112, ISOM8113			10	$\mu\text{A}$
$I_{C\_OFF}$	OFF_state collector current	$V_F = \pm 0.7\text{V}$ , $V_{CE} = 48\text{V}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8115, ISOM8116, ISOM8117, ISOM8118			10	$\mu\text{A}$
<b>CTR<sup>(1)</sup></b>							



All specifications are at  $T_A = 25^\circ\text{C}$  unless otherwise noted

PARAMETER		TEST CONDITIONS	GPN	MIN	TYP	MAX	UNIT
CTR	Current Transfer Ratio	$I_F = 2\text{mA}$ , $V_{CE} = 5\text{V}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8110	80	130	180	%
			ISOM8115	80	130	180	%
			ISOM8111	120	180	270	%
			ISOM8116	120	180	270	%
			ISOM8112	200	300	450	%
			ISOM8117	200	300	450	%
			ISOM8113	295	440	655	%
			ISOM8118	295	440	655	%
CTR	Current Transfer Ratio	$I_F = 5\text{mA}$ , $V_{CE} = 5\text{V}$ , $T_A = -40$ to $125^\circ\text{C}$	ISOM8110	100	120	155	%
			ISOM8115	100	120	155	%
			ISOM8111	150	180	230	%
			ISOM8116	150	180	230	%
			ISOM8112	255	300	380	%
			ISOM8117	255	300	380	%
			ISOM8113	375	440	560	%
			ISOM8118	375	440	560	%

(1)  $\text{CTR} (\%) = (I_C / I_F) \times 100\%$

## 6.9 Switching Characteristics

All specifications are at  $T_A = 25^\circ\text{C}$  unless otherwise noted

PARAMETER		TEST CONDITIONS	GPN	MIN	TYP	MAX	UNIT
<b>AC</b>							
$t_r$	Rise time, see <a href="#">Figure 7-2</a> and <a href="#">Figure 7-3</a>	$V_{CC} = 10\text{V}$ , $I_C = 2\text{mA}$ , $R_L = 100\Omega$ , $C_L = 50\text{pF}$	ISOM8110		3.2		$\mu\text{s}$
			ISOM8113		1.1		$\mu\text{s}$
$t_f$	Fall time, see <a href="#">Figure 7-2</a> and <a href="#">Figure 7-3</a>	$V_{CC} = 10\text{V}$ , $I_C = 2\text{mA}$ , $R_L = 100\Omega$ , $C_L = 50\text{pF}$	ISOM8110		4.0		$\mu\text{s}$
			ISOM8113		7.5		$\mu\text{s}$
$T_{ON}$	Turn on time, see <a href="#">Figure 7-2</a> and <a href="#">Figure 7-3</a>	$V_{CC} = 10\text{V}$ , $I_C = 2\text{mA}$ , $R_L = 100\Omega$ , $C_L = 50\text{pF}$	ISOM8110, ISOM8115		5.7		$\mu\text{s}$
			ISOM8111, ISOM8116		9.5		$\mu\text{s}$
			ISOM8112, ISOM8117		8.1		$\mu\text{s}$
			ISOM8113, ISOM8118		20		$\mu\text{s}$
$T_{OFF}$	Turn off time, see <a href="#">Figure 7-2</a> and <a href="#">Figure 7-3</a>	$V_{CC} = 10\text{V}$ , $I_C = 2\text{mA}$ , $R_L = 100\Omega$ , $C_L = 50\text{pF}$	ISOM8110, ISOM8115		3.6		$\mu\text{s}$
			ISOM8111, ISOM8116		2.3		$\mu\text{s}$
			ISOM8112, ISOM8117		1.7		$\mu\text{s}$
			ISOM8113, ISOM8118		0.68		$\mu\text{s}$
$t_s$	Storage time; time required for the output waveform to change from 0% (100%) to 10% (90%) when input is turned on and back off, see <a href="#">Figure 7-3</a>	$V_{CC} = 5\text{V}$ , $I_F = 1.6\text{mA}$ , $R_L = 4.7\text{k}\Omega$	ISOM811x			21	$\mu\text{s}$
BW	Bandwidth, see <a href="#">Figure 7-4</a> and <a href="#">Figure 7-5</a>	$V_{IN\_DC} = 5\text{V}$ , $V_{IN\_AC} = 1\text{Vpk}$ , $R_{IN} = 2\text{k}\Omega$ , $V_{CC} = 5\text{V}$ , $R_{LOAD} = 100\Omega$ , $C_L = 50\text{pF}$ , measured at $V_{CE} -3\text{dB}$ sinewave	ISOM8110, ISOM8115		680		kHz
			ISOM8111, ISOM8116		680		kHz
			ISOM8112, ISOM8117		680		kHz
			ISOM8113, ISOM8118		680		kHz

## 6.10 Typical Characteristics

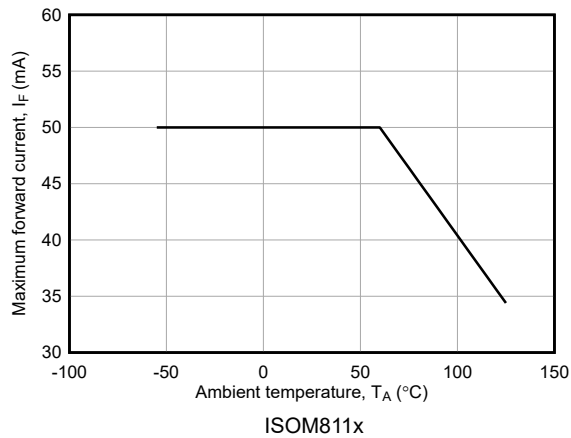


Figure 6-1. Maximum Forward Current vs Ambient Temperature

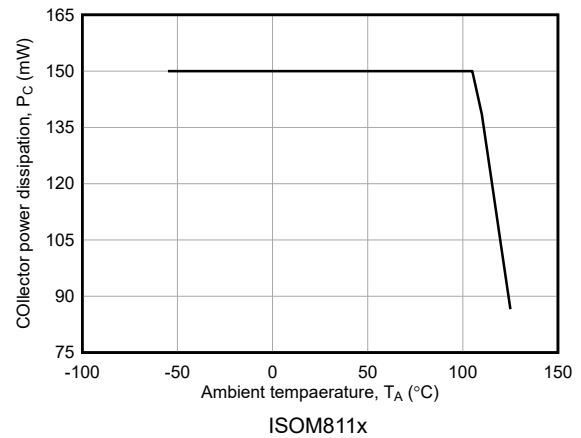


Figure 6-2. Maximum Collector Power Dissipation vs Ambient Temperature

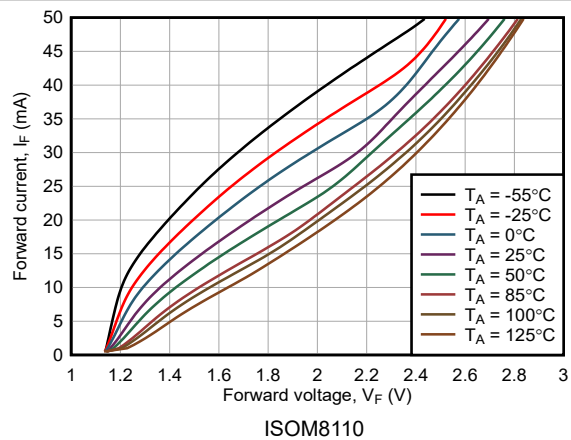


Figure 6-3. Forward Voltage vs Forward Current

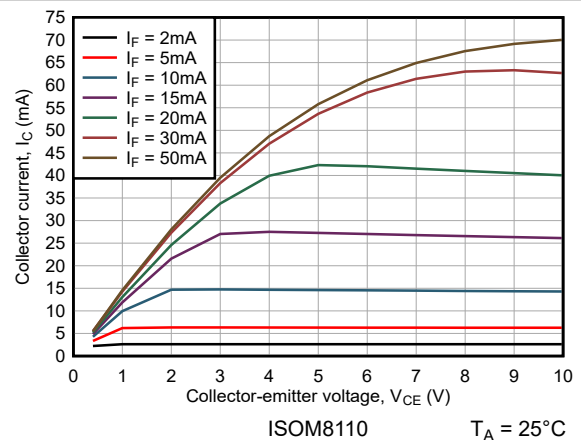


Figure 6-4. Collector Current vs Collector-Emitter Voltage

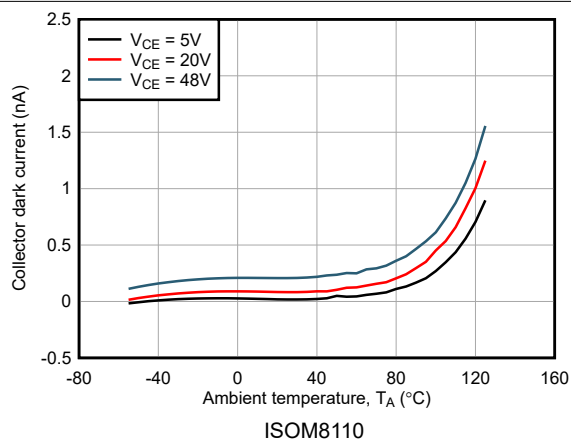


Figure 6-5. Collector Dark Current vs Ambient Temperature

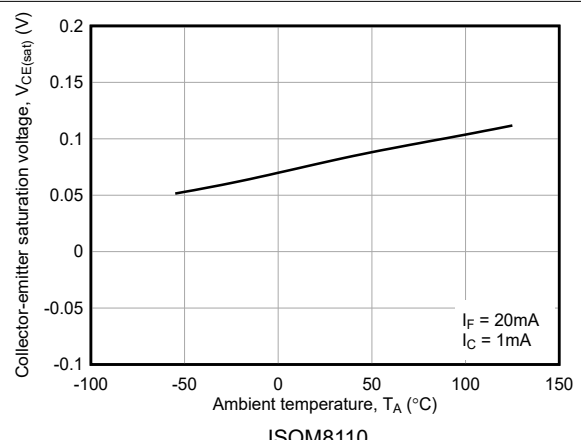
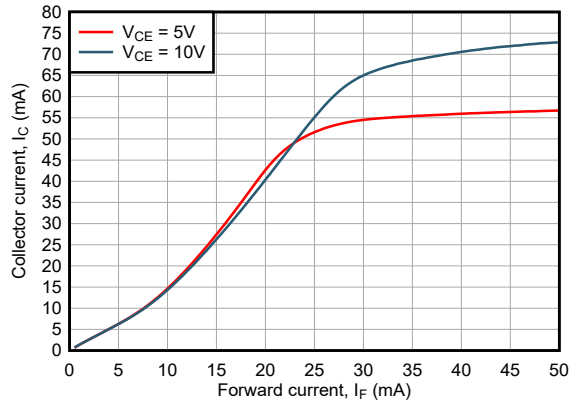
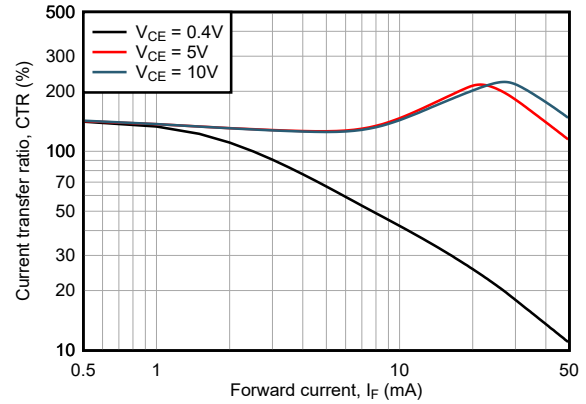


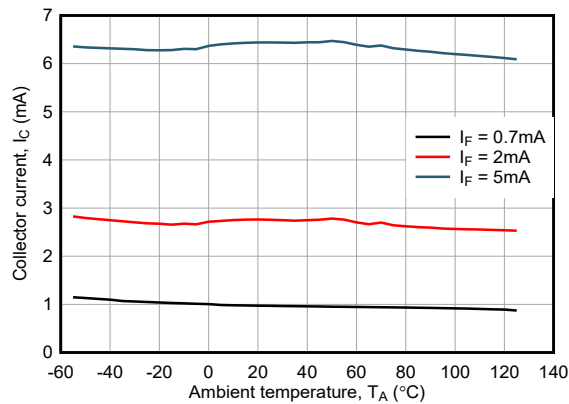
Figure 6-6. Collector-Emitter Saturation Voltage vs Ambient Temperature



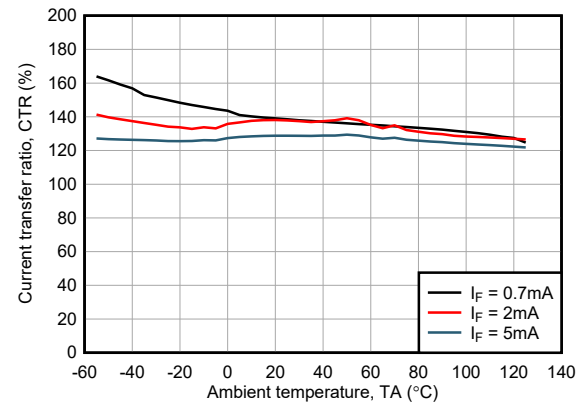
ISOM8110  $T_A = 25^\circ\text{C}$   
**Figure 6-7. Collector Current vs Forward Current**



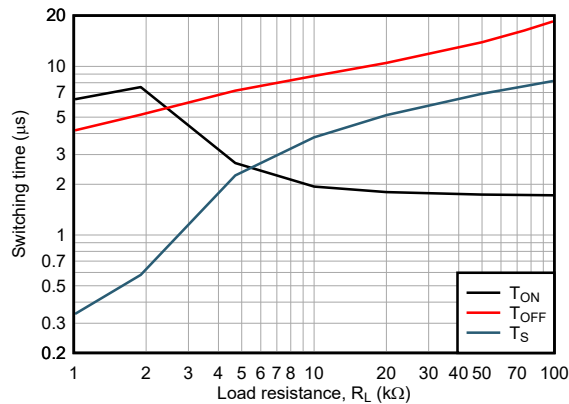
ISOM8110  $T_A = 25^\circ\text{C}$   
**Figure 6-8. Current Transfer Ratio vs Forward Current**



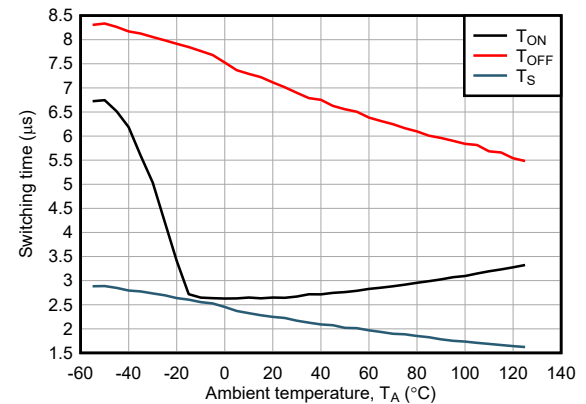
ISOM8110  $V_{CE} = 5\text{V}$   
**Figure 6-9. Collector Current vs Ambient Temperature**



ISOM8110  $V_{CE} = 5\text{V}$   
**Figure 6-10. Current Transfer Ratio vs Ambient Temperature**



$I_F = 1.6\text{mA}$  ISOM8110  $V_{CC} = 5\text{V}$   
**Figure 6-11. Switching Time vs Load Resistance**



$I_F = 1.6\text{mA}$  ISOM8110  $V_{CC} = 5\text{V}$   
 $R_L = 4.7\text{k}\Omega$   
**Figure 6-12. Switching Time vs Ambient Temperature**

## 7 Parameter Measurement Information

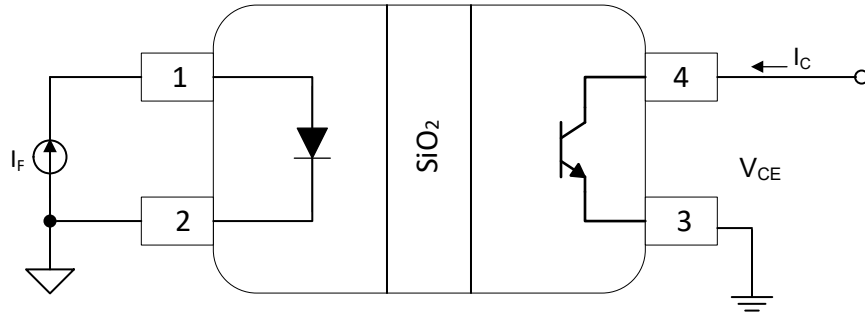


Figure 7-1. ISOM811x Test Circuit for CTR

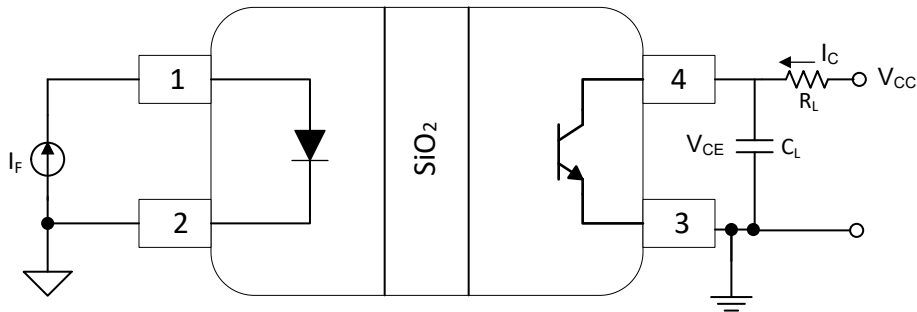


Figure 7-2. ISOM811x Test Circuit for Switching Timing

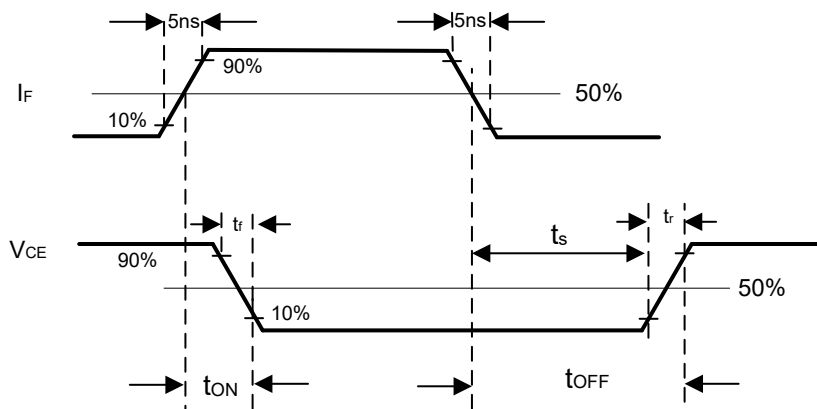


Figure 7-3. ISOM811x Switching Timing Waveforms

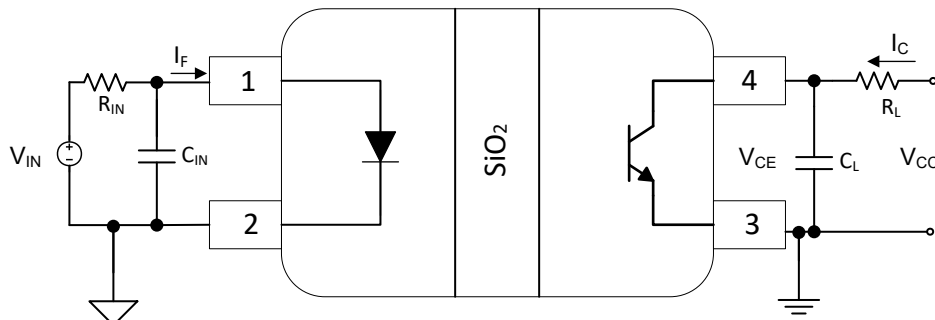


Figure 7-4. ISOM811(0-3) Test Circuit for Bandwidth

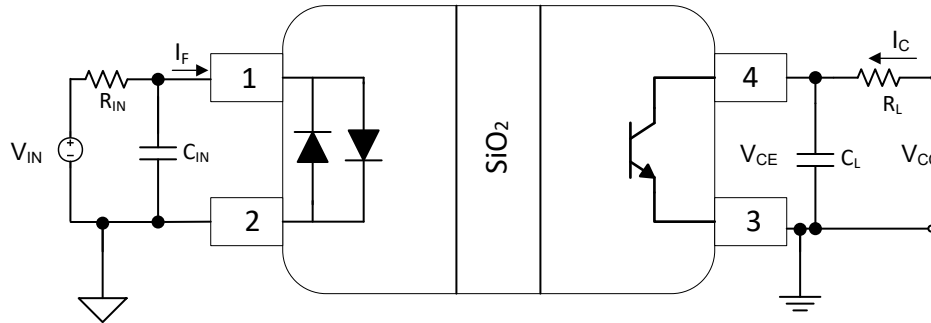


Figure 7-5. ISOM811(5-8) Test Circuit for Bandwidth

## 8 Detailed Description

### 8.1 Overview

The ISOM811x-Q1 opto-emulators are pin-compatible, single-channel, drop-in replacements for many traditional optocouplers. While standard optocouplers use an LED as the input stage, ISOM811x-Q1 uses an emulated LED as the input stage. The input and output stages are isolated by TI's proprietary silicon dioxide-based ( $\text{SiO}_2$ ) isolation barrier. This isolation technology makes ISOM811x-Q1 resistant to the wear-out effects found in optocouplers that degrade performance with increasing temperature, forward current, and device age. Ordering options include four different ranges of current transfer ratio (CTR) and input options supporting uni-polar and bi-polar DC flow.

The ISOM811x-Q1 family of devices isolate DC and bidirectional DC signals and offer performance, reliability, and flexibility advantages not available with traditional optocouplers.

The functional block diagram of ISOM811x-Q1 devices are shown in [Section 8.2](#). The input signal is transmitted across the isolation barrier using an on-off keying (OOK) modulation scheme. The transmitter sends a high-frequency carrier across the barrier that contains information on how much current is flowing through the input pins. The receiver demodulates the signal after advanced signal conditioning and produces the signal through the output stage. These devices also incorporate advanced circuit techniques to maximize bandwidth and minimize radiated emissions. [Figure 8-3](#) shows conceptual details of how the OOK scheme works.

### 8.2 Functional Block Diagram

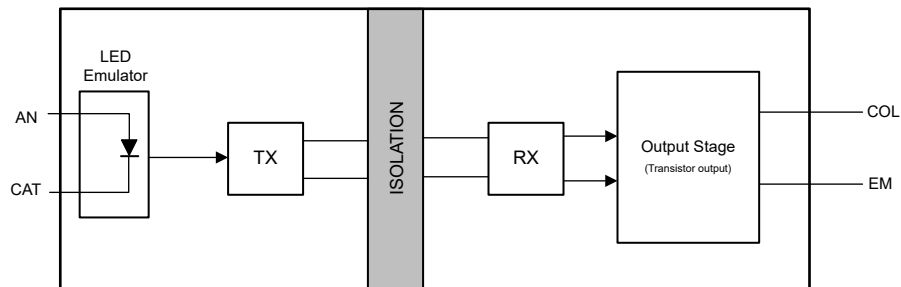
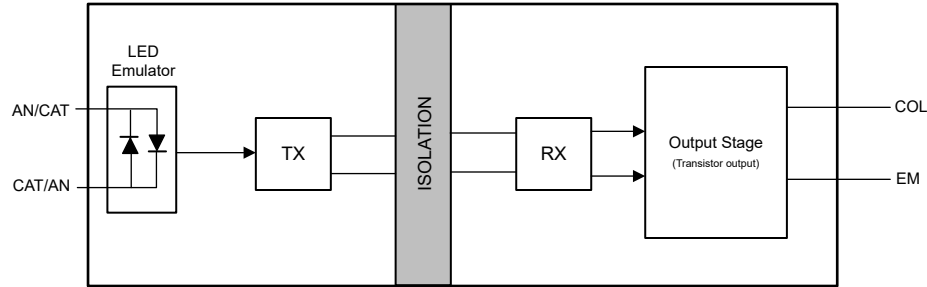
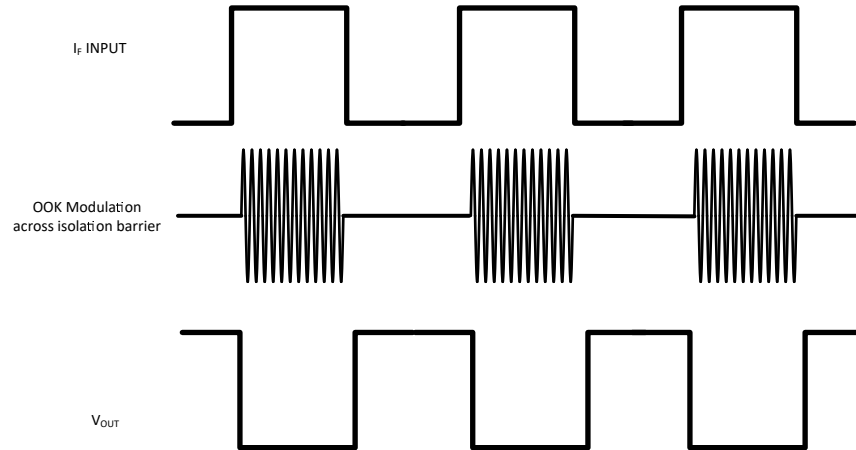


Figure 8-1. Conceptual Block Diagram of an Opto-emulator ISOM811(0-3)



**Figure 8-2. Conceptual Block Diagram of an Opto-emulator ISOM811(5-8)**



**Figure 8-3. On-off Keying (OOK) Based Modulation Scheme**

### 8.3 Feature Description

The ISOM811x-Q1 devices isolate DC and bidirectional DC signals. ISOM811x-Q1 has an open-collector output with multiple CTR options. All devices support an isolation withstand voltage of 3750V<sub>RMS</sub> between side 1 and side 2.

### 8.4 Device Functional Modes

Table 8-1 lists the functional modes for the ISOM811x-Q1 devices.

**Table 8-1. Function Table**

CTR <sup>1</sup>	PART NUMBER	Input type
100% to 155%	ISOM8110	DC
	ISOM8115	Bidirectional DC
150% to 230%	ISOM8111	DC
	ISOM8116	Bidirectional DC
255% to 380%	ISOM8112	DC
	ISOM8117	Bidirectional DC
375% to 560%	ISOM8113	DC
	ISOM8118	Bidirectional DC

1.  $I_F = 5\text{mA}$ ,  $T_A = 25^\circ\text{C}$ ,  $V_{CE} = 5\text{V}$ .

## 9 Application and Implementation

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### 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, as well as validating and testing their design implementation to confirm system functionality.

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### 9.1 Application Information

The ISOM811x-Q1 devices are single-channel opto-emulators with LED-emulator input and transistor output. The devices use on-off keying modulation to transmit data across the isolation barrier. The input stage is isolated from the driver stage by TI's proprietary silicon dioxide-based ( $\text{SiO}_2$ ) isolation barrier which provides robust isolation. With wider temperature ratings than traditional optocouplers, ISOM811x-Q1 opto-emulators can provide reliable signal isolation in harsh environments.

The ISOM811x-Q1 devices are capable of sinking current when subjected to an external load being connected to the device. Like typical transistor output optocouplers, the output current depends on the input current level ( $I_F$ ) and the current transfer ratio (CTR). With multiple CTR options (100% - 560%), low input current, high bandwidth, low turn-off delay, low power consumption, and wider temperature range, ISOM811x-Q1 devices are designed for use in a variety of industries such as factory automation, building automation, e-mobility, automotive, avionics, medical, and power delivery.

#### 9.1.1 Typical Application

ISOM811x-Q1 opto-emulators are commonly used in the feedback control loops of isolated power supplies. These devices are used to solve the problem of feeding back current while isolating the primary and secondary domains to regulate the output voltage.

In power supplies, the output voltage is isolated from main input voltage using a transformer (for example: flyback converter). For analog power supply units, the controller IC is usually on the primary side of the transformer. For closed loop control, measuring the output voltage on the secondary side and feeding the voltage back to the controller on the primary is necessary. The most common method of achieving this design is using an opto-emulator such as ISOM811x-Q1, error amplifier (commonly TL431), and a voltage comparator to form a feedback loop across the isolation barrier

[Figure 9-1](#) illustrates a typical isolated power supply. In this implementation, the output voltage is sensed by an error amplifier using the resistor divider (R1 and R2). Depending on the voltage level that the error amplifier senses, the TL431 can drive the current of the ISOM811x-Q1 higher or lower which is then compared to a voltage reference. The information is passed across the isolation barrier through ISOM811x-Q1 to the primary side, where the PWM control circuit modulates the power stage to regulate the output voltage. The TL431 and ISOM811x-Q1 play an important role for stable feedback and control loop.

The ISOM811x-Q1 devices enable improvements in transient response, reliability, and stability as compared to commonly used optocoupler as the CTR is stable over wide temperature range providing a small, low-cost, highly reliable, and easy-to-design implementation.



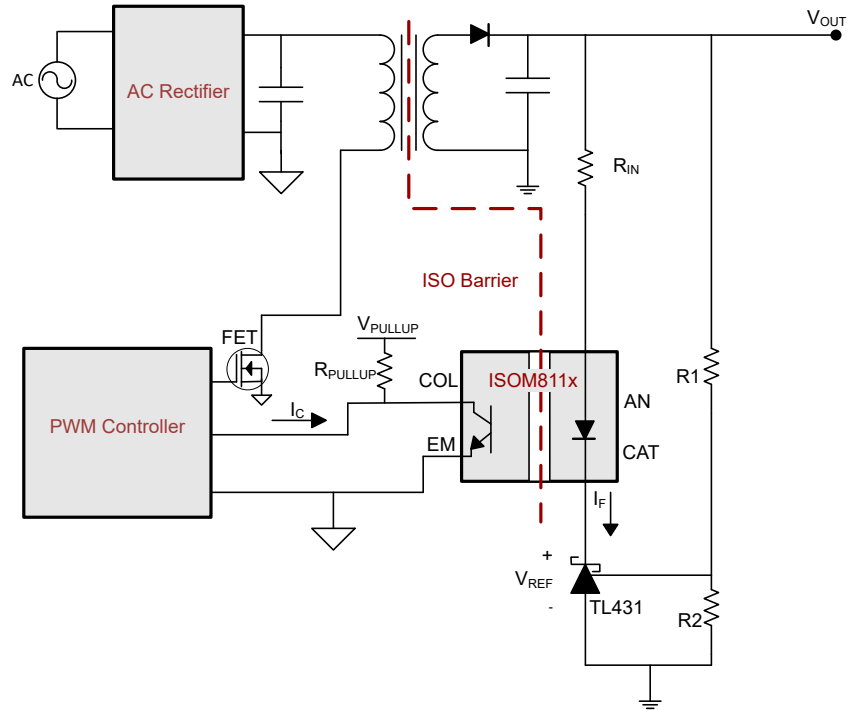


Figure 9-1. Typical Isolated Power Supply Application Using ISOM811x-Q1

### 9.1.1.1 Design Requirements

To design with ISOM811x-Q1 devices, use the parameters listed in [Table 9-1](#).

Table 9-1. Design Parameters

PARAMETER	VALUE
Input forward current range, $I_F$	0.7mA (min), 20mA (max)
Current transfer ratio at $I_F = 5\text{mA}$ , CTR	100% to 155%
Collector current tolerance, $I_C$	50mA (max)
Collector-emitter voltage (saturation), $V_{CE(SAT)}$	0.3V (max)
Input forward voltage, $V_F$	1.2V (typ)

### 9.1.1.2 Detailed Design Procedure

This section presents the design procedure for using the ISOM811x-Q1 opto-emulators. External components must be selected to operate ISOM811x-Q1 within the *Recommended Operating Conditions*. The following recommendations on component selection focus on the design of a typical feedback control loop for an isolated flyback converter.

When using an optocoupler in a feedback control loop for an isolated power supply, many variables can affect how to properly use the optocoupler, including the output voltage of the power supply and the type of controller the feedback signal is being sent to. For this example, assume that the output voltage of this power supply,  $V_{OUT}$ , is 5V, and the PWM controller being used has an integrated error amplifier with a COMP pin that acts as the output of this amplifier.

#### 9.1.1.2.1 Sizing $R_{PULLUP}$

The transistor output of ISOM811x-Q1 operates in active, saturation, reverse, and cut-off regions, just like a regular transistor. To verify that the output does not get damaged when the output is saturated, the minimum value of  $R_{PULLUP}$  can be calculated for a given pull-up voltage,  $V_{PULLUP}$ , in [Equation 1](#):

$$R_{PULLUP} > \frac{V_{PULLUP} - V_{CE(SAT)}}{I_{C(MAX)}} \quad (1)$$

For the example of a feedback loop application, we can calculate the minimum required value for  $R_{PULLUP}$  for a given  $V_{PULLUP}$  of 10V, the maximum output voltage of the error amplifier ( $V_{COMP(MAX)}$ ) of 2.5V, and the maximum output current of the error amplifier is internally clamped at 1.6mA. The equation to calculate  $R_{PULLUP}$  is shown in Equation 2:

$$R_{PULLUP} > \frac{V_{PULLUP} - V_{COMP(MAX)}}{I_{COMP(CLAMP)}} = \frac{10V - 2.5V}{1.6mA} = 4.66k\Omega \quad (2)$$

#### 9.1.1.2.2 Sizing $R_{IN}$

The input side of ISOM811x-Q1 is current-driven. To limit the amount of current flowing into the AN pin, placing a series resistor,  $R_{IN}$ , in series with the input as shown in Figure 9-1 is recommended.

Depending on how the ISOM811x-Q1 device is being used, the value of  $R_{IN}$  can vary quite a bit. However, at a high level, to make sure the input does not get damaged, the minimum value of  $R_{IN}$  can be calculated for a given input voltage,  $V_{IN}$ , in Equation 3:

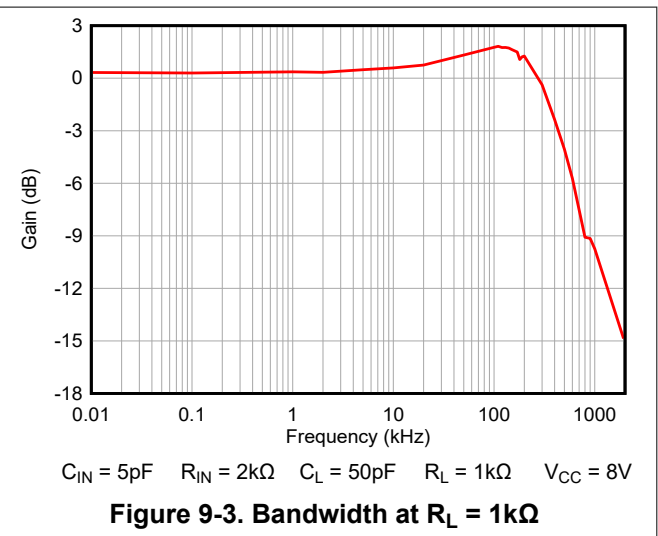
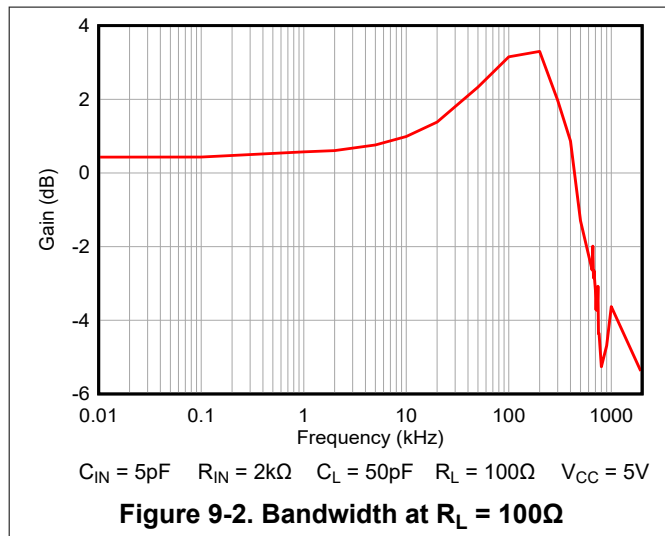
$$R_{IN} > \frac{V_{IN} - V_F}{I_{C(MAX)}} \quad (3)$$

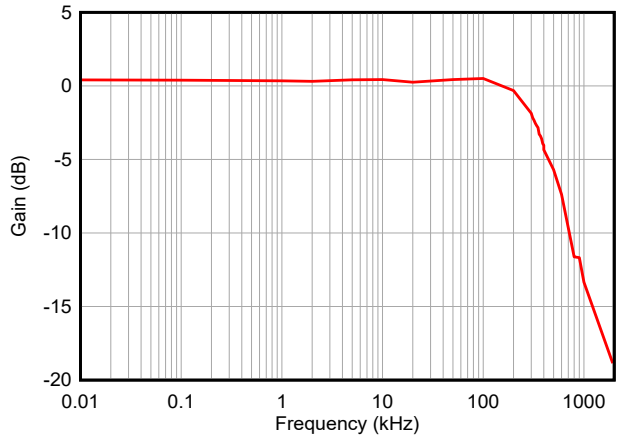
However, in the use case of a feedback loop,  $R_{IN}$  directly affects the mid-band gain of the loop. Assuming that the TL431 has been configured to give a reference voltage,  $V_{REF}$ , of 2.5V and  $R_{PULLUP}$  is 5k $\Omega$ , Equation 4 is used to calculate the maximum value of  $R_{IN}$  verifying that the  $V_{COMP}$  voltage on the primary side can be pulled to the saturation voltage of the ISOM811x-Q1,  $V_{CE(SAT)}$ .

$$R_{IN} < \frac{(V_{OUT} - V_{REF} - V_F) \times R_{PULLUP} \times CTR_{MIN}}{V_{PULLUP} - V_{CE(SAT)}} = \frac{(5V - 2.5V - 1.2V) \times 5k\Omega \times 100\%}{10V - 0.3V} = 670\Omega \quad (4)$$

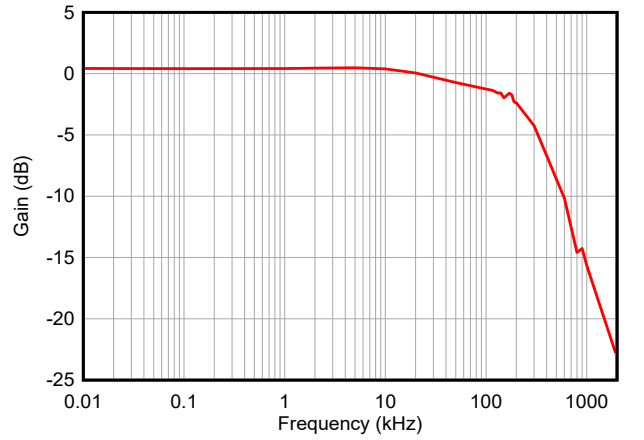
#### 9.1.1.3 Application Curves

The following curves show ISOM8110 bandwidth performance over different loading conditions where  $V_{IN} = 5V_{DC} + 2V_{PK}$ . See Figure 7-4 for setup details.

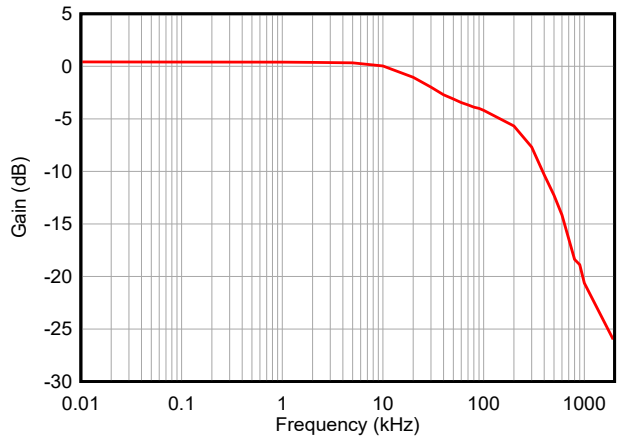




**Figure 9-4. Bandwidth at  $R_L = 2\text{k}\Omega$**



**Figure 9-5. Bandwidth at  $R_L = 4.7\text{k}\Omega$**



**Figure 9-6. Bandwidth at  $R_L = 10\text{k}\Omega$**

## 9.2 Power Supply Recommendations

ISOM811x-Q1 does not require a dedicated power supply to operate since there is no supply pin. Take care to not violate recommended I/O specifications for proper device functionality.

## 9.3 Layout

### 9.3.1 Layout Guidelines

- The device connections to ground must be tied to the PCB ground plane using a direct connection or two vias to help minimize inductance.
- The connections of capacitors and other components to the PCB ground plane must use a direct connection or two vias for minimum inductance.

### 9.3.2 Layout Example

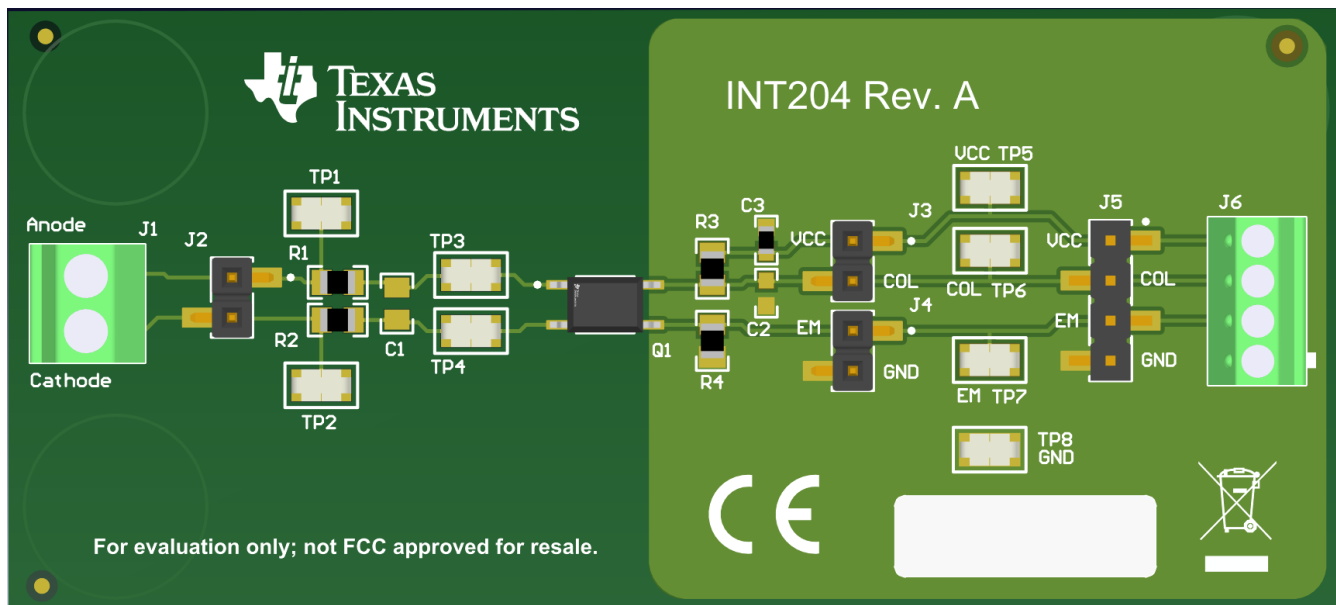


Figure 9-7. Layout Example of ISOM811x With a Single Layer Board

## 10 Device and Documentation Support

### 10.1 Documentation Support

#### 10.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, [Isolation Glossary](#), application note
- Texas Instruments, [Introduction to Opto-Emulators](#), application note
- Texas Instruments, [ISOM8110 Single-Channel Opto-Emulator with Analog Transistor Output Evaluation Module](#), EVM user's guide

### 10.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on [Notifications](#) to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 10.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 10.4 Trademarks

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### 10.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 10.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 11 Revision History

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

DATE	REVISION	NOTES
April 2024	*	Initial Release

## 12 Mechanical, Packaging, and Orderable Information

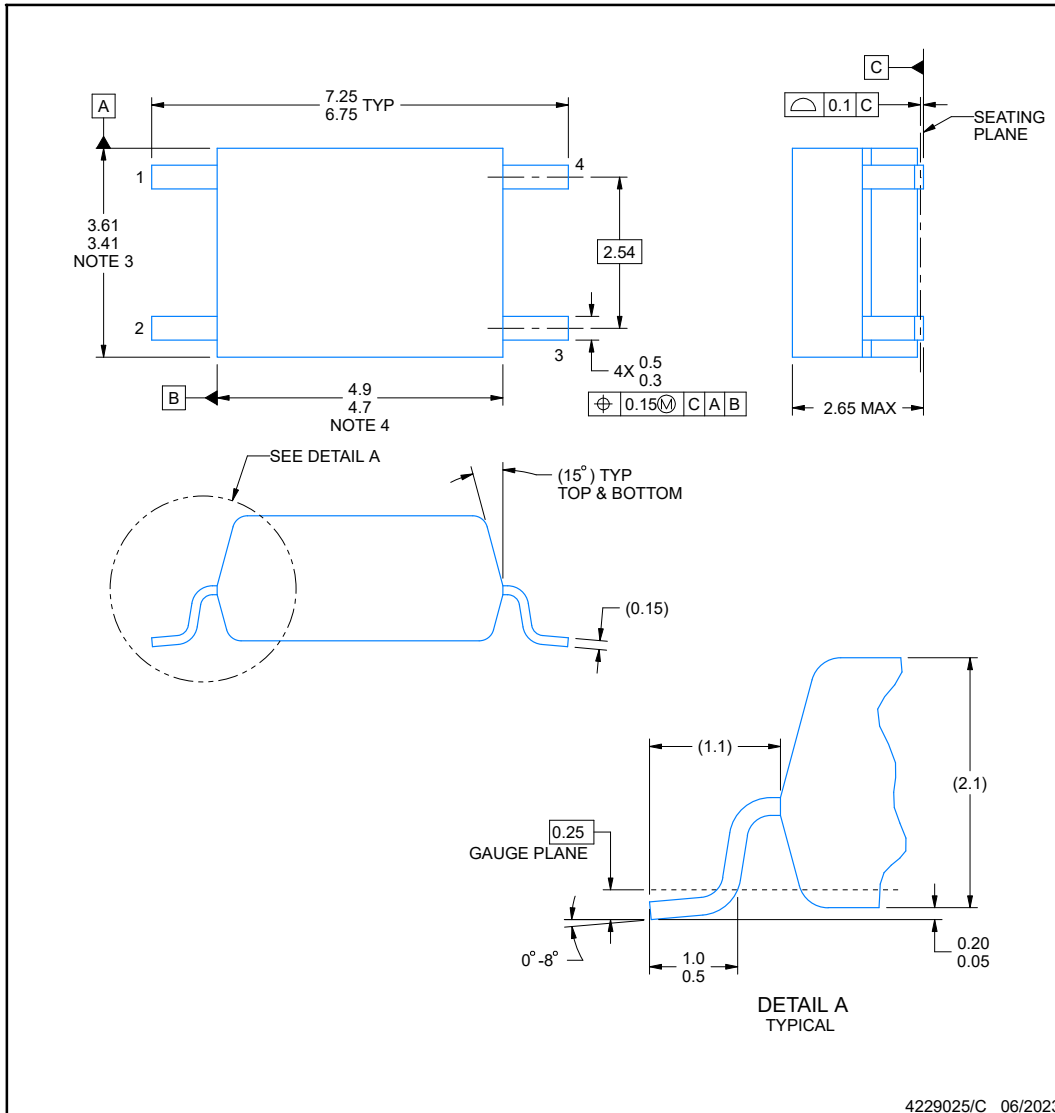
The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGE OUTLINE**

**DFG0004A-C01**

**SOIC - 2.65 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



**NOTES:**

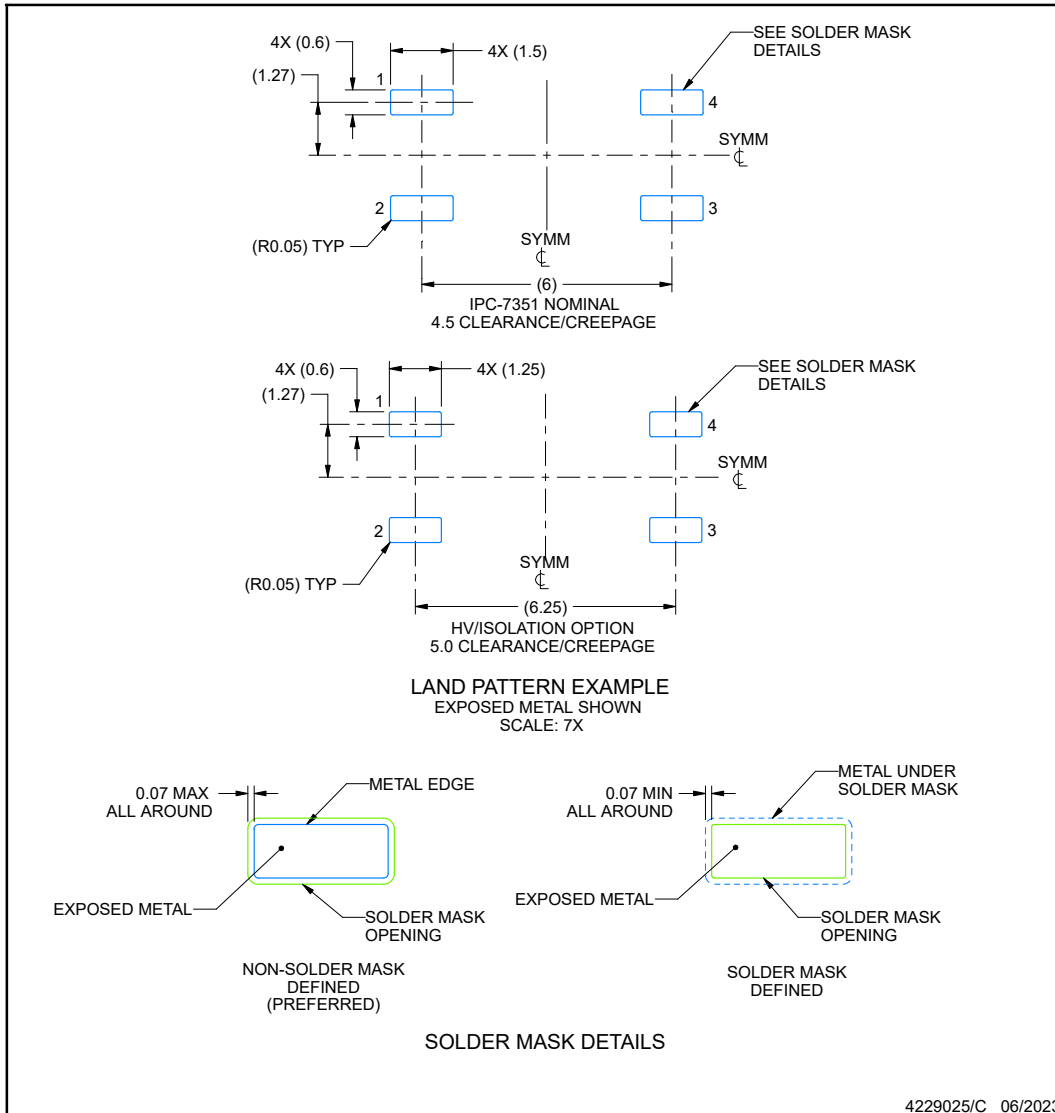
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

## EXAMPLE BOARD LAYOUT

**DFG0004A-C01**

**SOIC - 2.65 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

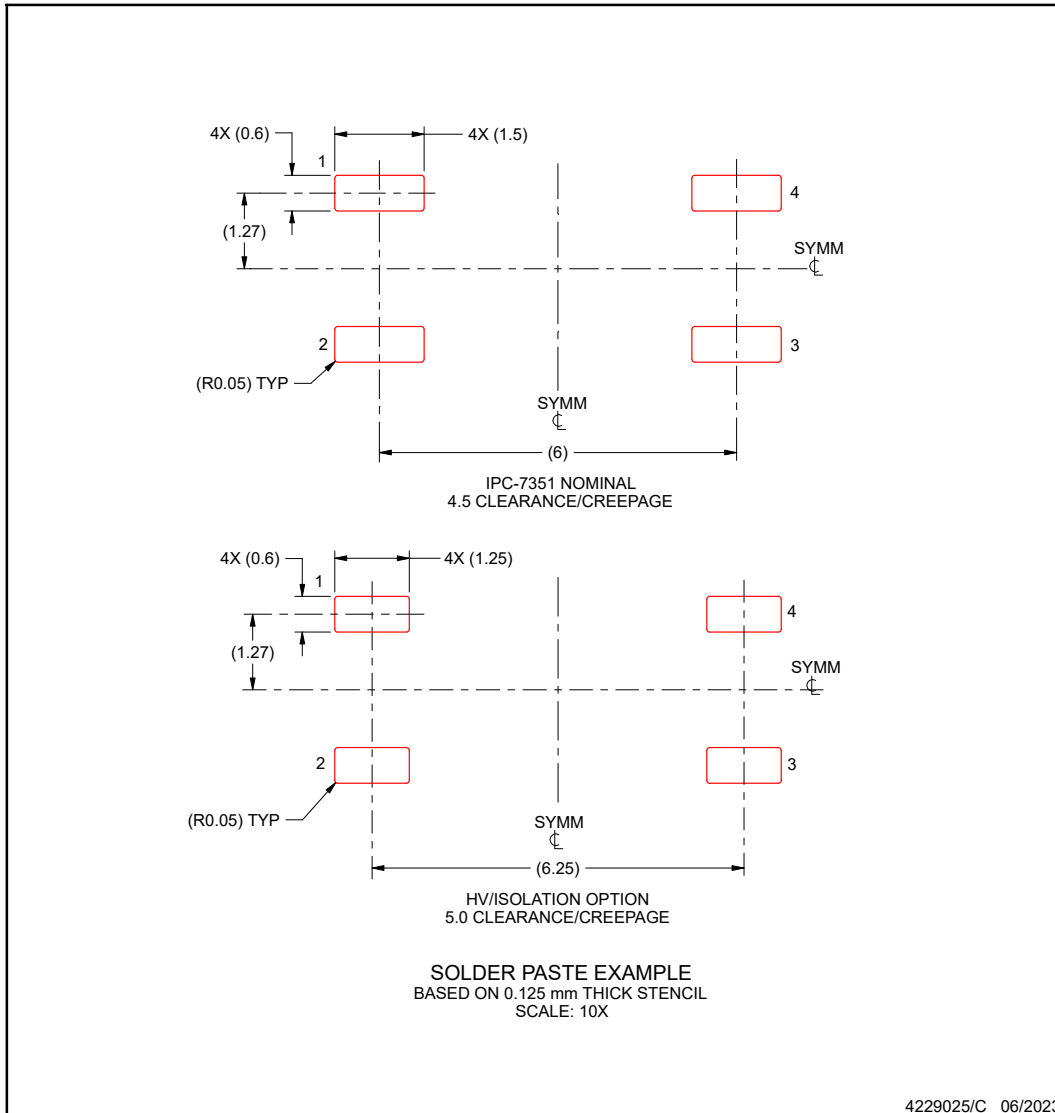
- Publication IPC-7351 may have alternate designs.
- Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

**DFG0004A-C01**

**SOIC - 2.65 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

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



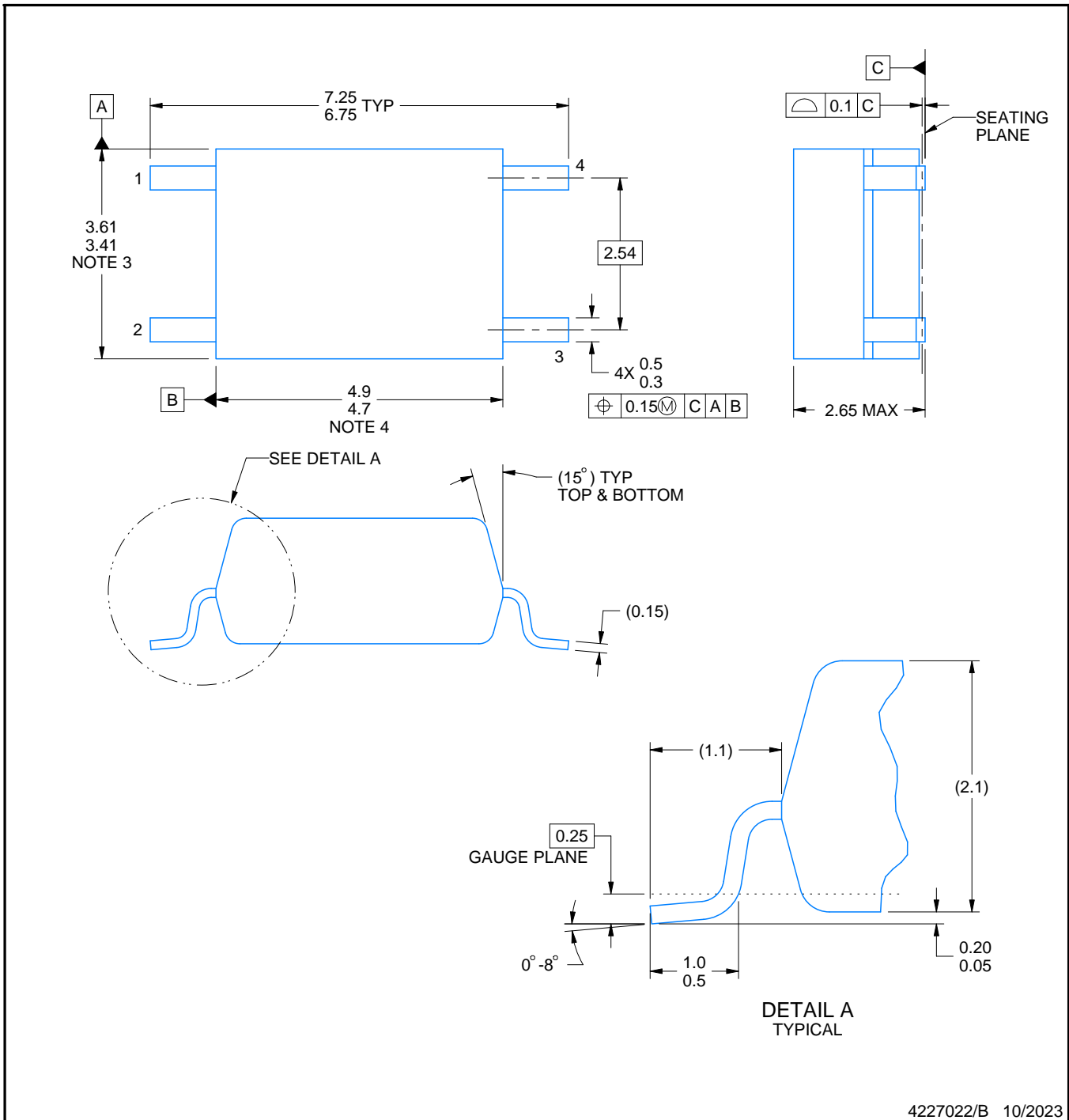
# DFG0004A



## PACKAGE OUTLINE

SOIC - 2.65 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4227022/B 10/2023

### NOTES:

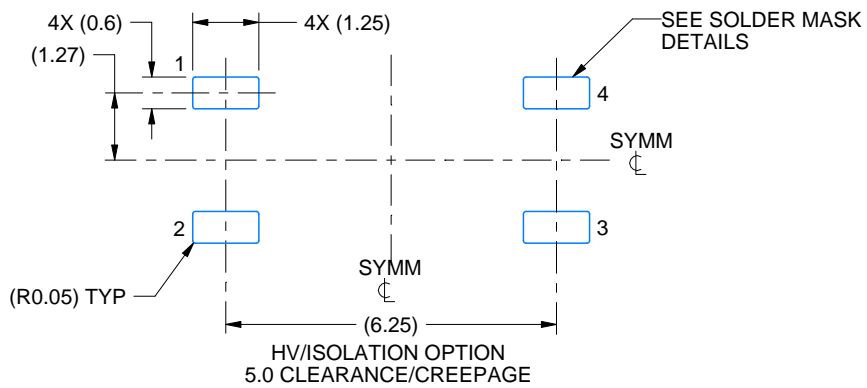
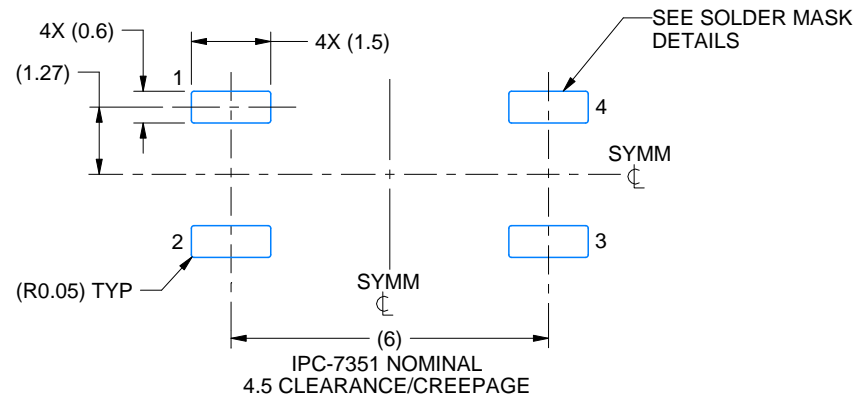
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 mm per side.
4. This dimension does not include interlead flash.

# EXAMPLE BOARD LAYOUT

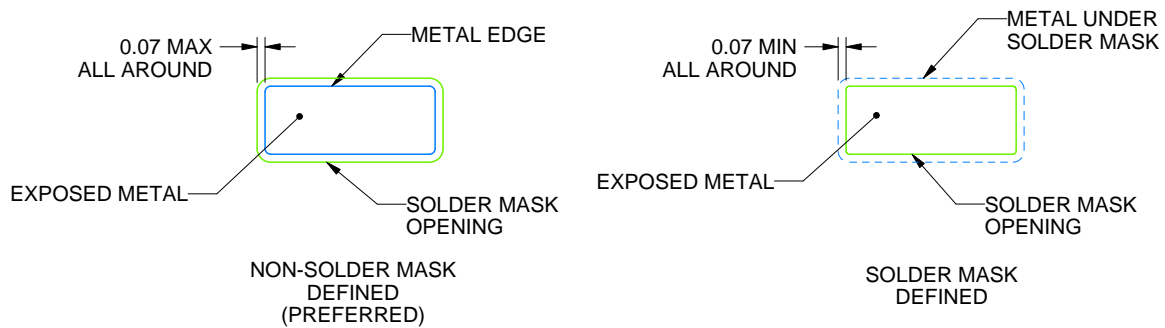
DFG0004A

SOIC - 2.65 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
 EXPOSED METAL SHOWN  
 SCALE: 7X



SOLDER MASK DETAILS

4227022/B 10/2023

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

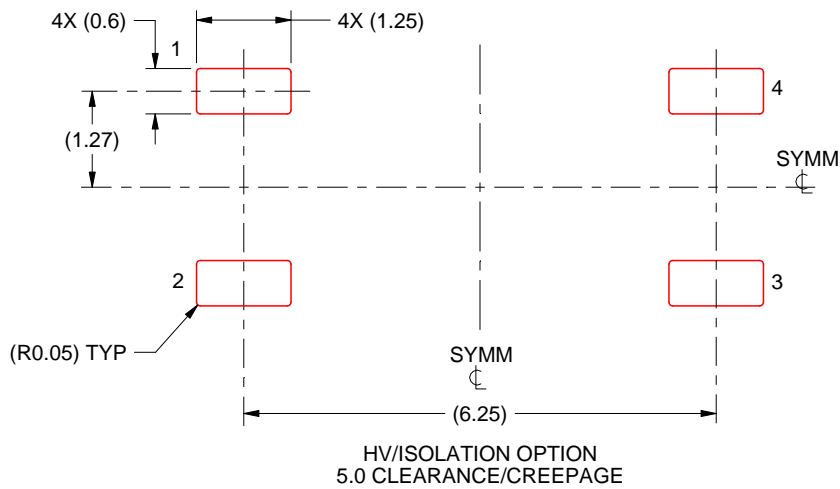
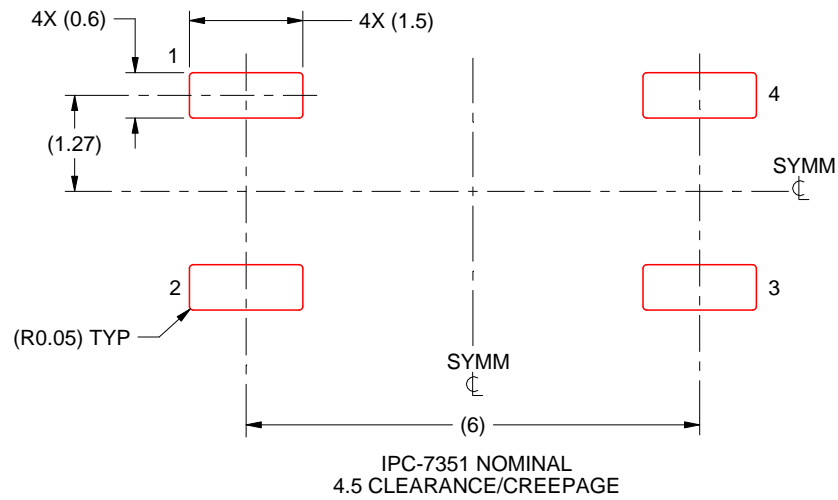
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DFG0004A

SOIC - 2.65 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4227022/B 10/2023

NOTES: (continued)

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

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