

**ISL72027BSEH**

3.3V Radiation Tolerant CAN Transceiver, with Listen Mode and Split Termination Output

FN8901  
Rev 0.00  
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The [ISL72027BSEH](#) is a radiation tolerant 3.3V CAN transceiver that is compatible with the ISO11898-2 standard for applications calling for Controller Area Network (CAN) serial communication in satellites and aerospace communications and telemetry data processing in harsh industrial environments.

The transceiver can transmit and receive at bus speeds up to 5Mbps. It can drive a 40m cable at 1Mbps per the ISO11898-2 specification. The device is designed to operate over a common-mode range of -7V to +12V with a maximum of 120 nodes. The device has three discrete selectable driver rise/fall time options, a listen mode feature, and a split termination output.

Receiver (Rx) inputs feature a “full fail-safe” design, which ensures a logic high Rx output if the Rx inputs are floating, shorted, or terminated but undriven.

The ISL72027BSEH is available in an 8 Ld hermetic ceramic flatpack and die form that operate across the temperature range of -55°C to +125°C.

Other CAN transceivers available are the [ISL72026BSEH](#) and [ISL72028BSEH](#). For a list of differences see [Table 1 on page 2](#).

**Related Literature**

- For a full list of related documents, visit our website [ISL72027BSEH](#) product page”

**Applications**

- Satellites and aerospace communications
- Telemetry data processing
- High-end industrial environments and harsh environments

**Features**

- Electrically screened to SMD [5962-15228](#)
- ESD protection on all pins. . . . . 4kV HBM
- Compatible with ISO11898-2
- Operating supply range . . . . . 3.0V to 3.6V
- Bus pin fault protection to ±20V
- Undervoltage lockout
- Cold spare: powered down devices/nodes will not affect active devices operating in parallel
- Three selectable driver rise and fall times
- Glitch free bus I/O during power-up and power-down
- Full fail-safe (open, short, terminated/undriven) receiver
- Hi-Z input allows for 120 nodes on the bus
- High data rates. . . . . up to 5Mbps
- Quiescent supply current . . . . . 7mA (maximum)
- Listen mode supply current . . . . . 2mA (maximum)
- -7V to +12V common-mode input voltage range
- 5V tolerant logic inputs
- Thermal shutdown
- Acceptance tested to 75krad(Si) (LDR) wafer-by-wafer
- Radiation tolerance
  - SEL/B immune to LET<sub>TH</sub>. . . . . 86.4MeV • cm<sup>2</sup>/mg
  - Low dose rate (0.01rad(Si)/s) . . . . . 75krad(Si)
  - High dose rate (50-300rad(Si)/s) . . . . . 100krad(Si)

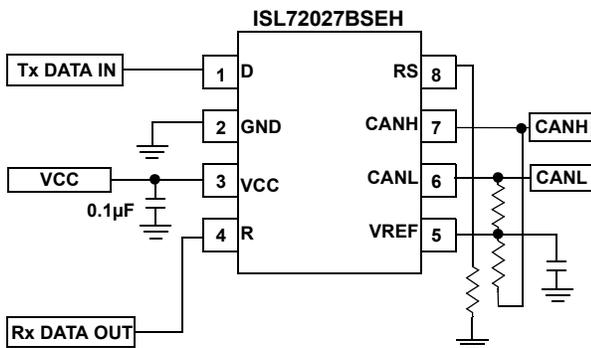


FIGURE 1. TYPICAL APPLICATION

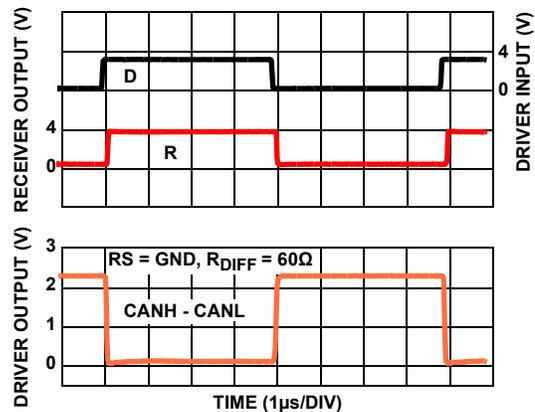


FIGURE 2. FAST DRIVER AND RECEIVER WAVEFORMS

## Ordering Information

ORDERING/SMD NUMBER (Note 1)	PART NUMBER (Note 2)	TEMP RANGE (°C)	PACKAGE (RoHS COMPLIANT)	PKG. DWG. #
5962R1522805VXC	ISL72027BSEHVF	-55 to +125	8 Ld Ceramic Flatpack	K8.A
N/A	ISL72027BSEHF/PROTO (Note 3)	-55 to +125	8 Ld Ceramic Flatpack	K8.A
5962R1522805V9A	ISL72027BSEHVX	-55 to +125	Die	
N/A	ISL72027BSEHX/SAMPLE (Note 3)	-55 to +125	Die	
N/A	ISL72027BSEHEVAL1Z	Evaluation Board		

### NOTES:

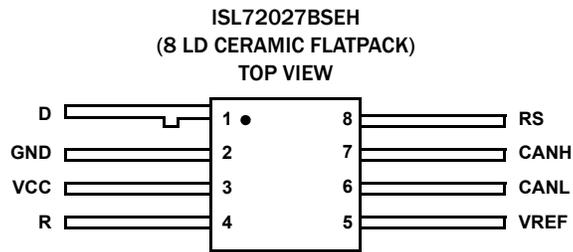
- Specifications for radiation tolerant QML devices are controlled by the Defense Logistics Agency Land and Maritime (DLA). The SMD numbers listed must be used when ordering.
- These Pb-free Hermetic packaged products employ 100% Au plate - e4 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations.
- The /PROTO and /SAMPLE (Die) have no traceability and are intended for engineering evaluation purposes only. The /PROTO parts meet the electrical limits and conditions across temperature range of (-55 °C to +125 °C) specified in the datasheet or DLA SMD, and is in the same form and fit as the flight devices (Class V parts). The SAMPLE die is capable of meeting the electrical limits and conditions specified in the datasheet or DLA SMD. The /SAMPLE is a die and as such, does not receive 100% screening over temperature to the datasheet or DLA SMD requirements, so some level of fallout should be expected. These part types do not come with a Certificate of Conformance because there is no Radiation Assurance testing or items such as TCI/QCI, Burn-in, X-ray, SEM, etc.

TABLE 1. ISL7202xBSEH PRODUCT FAMILY FEATURE TABLE

SPECIFICATION	ISL72026BSEH	ISL72027BSEH	ISL72028BSEH
Loopback Feature	Yes	No	No
VREF Output	No	Yes	Yes
Listen Mode	Yes	Yes	No
Shutdown Mode	No	No	Yes
VTHRLM	1150mV (maximum)	1150mV (maximum)	N/A
VTHFLM	525mV (minimum)	525mV (minimum)	N/A
VHYSLM	50mV (minimum)	50mV (minimum)	N/A
Supply Current, Listen Mode	2mA (maximum)	2mA (maximum)	N/A
Supply Current, Shutdown Mode	N/A	N/A	50µA (maximum)
VREF Leakage Current	N/A	±25µA (maximum)	±25µA (maximum)

N/A: Not Applicable

## Pin Configuration



Note: The package lid is tied to ground.

## Pin Descriptions

PIN NUMBER	PIN NAME	FUNCTION
1	D	CAN driver digital input. The bus states are LOW = dominant and HIGH = recessive. Internally tied HIGH.
2	GND	Ground connection.
3	VCC	System power supply input (3.0V to 3.6V). The typical voltage for the device is 3.3V.
4	R	CAN data receiver output. The bus states are LOW = dominant and HIGH = recessive.
5	VREF	VCC/2 reference output for split mode termination.
6	CANL	CAN bus line for high level output.
7	CANH	CAN bus line for low level output.
8	RS	A resistor to GND from this pin controls the rise and fall time of the CAN output waveform. Drive RS HIGH to put into Listen mode.

## Equivalent Input and Output Schematic Diagrams

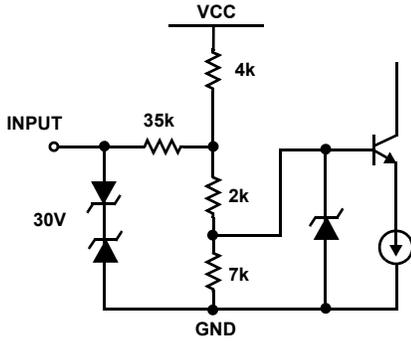


FIGURE 3. CANH AND CANL INPUTS

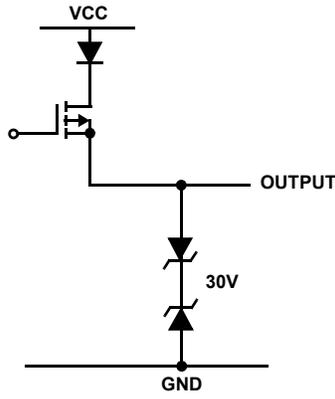


FIGURE 4. CANH OUTPUT

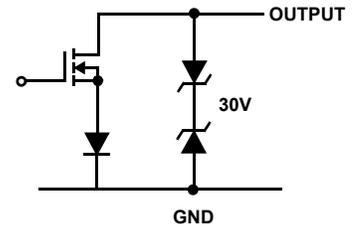


FIGURE 5. CANL OUTPUT

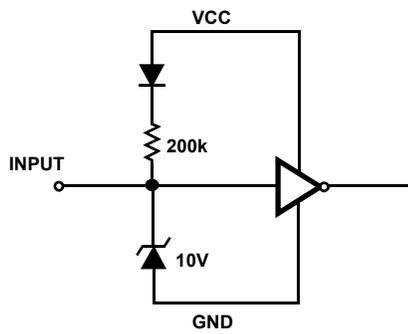


FIGURE 6. D INPUT

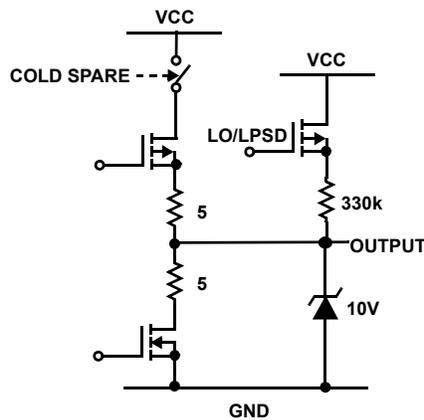


FIGURE 7. R OUTPUT

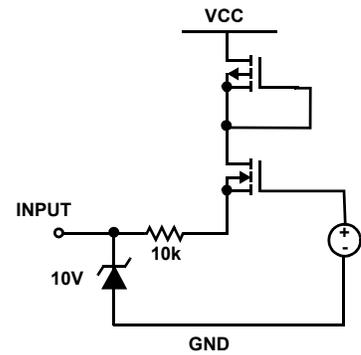


FIGURE 8. RS INPUT

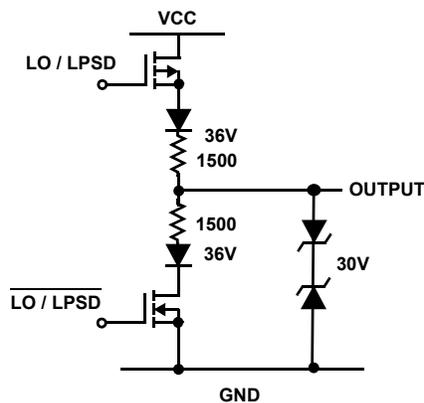


FIGURE 9. VREF

## Absolute Maximum Ratings

VCC to GND with/without Ion Beam	-0.3V to 5.5V
CANH, CANL, VREF Under Ion Beam	±18V
CANH, CANL, VREF	±20V
I/O Voltages	
D, R, RS	-0.5V to 7V
Receiver Output Current	-10mA to 10mA
Output Short-Circuit Duration	Continuous
ESD Rating:	
Human Body Model (Tested per MIL-PRF-883 3015.7)	
CANH, CANL Bus Pins	4kV
All Other Pins	4kV
Charged Device Model (Tested per JESD22-C101D)	750V
Machine Model (Tested per JESD22-A115-A)	200V

## Thermal Information

Thermal Resistance (Typical)	$\theta_{JA}$ (°C/W)	$\theta_{JC}$ (°C/W)
8 Ld FP Package (Notes 4, 5) Direct Attach	39	7
Maximum Junction Temperature	+175°C	
Storage Temperature Range	-65°C to +150°C	

## Recommended Operating Conditions

Temperature Range	-55°C to +125°C
VCC Supply Voltage	3V to 3.6V
Voltage on CAN I/O	-7V to 12V
V <sub>IH</sub> D Logic Pin	2V to 5.5V
V <sub>IL</sub> D Logic Pin	0V to 0.8V
I <sub>OH</sub> Driver (CANH - CANL = 1.5V, V <sub>CC</sub> = 3.3V)	-40mA
I <sub>OH</sub> Receiver (V <sub>OH</sub> = 2.4V)	-4mA
I <sub>OL</sub> Driver (CANH - CANL = 1.5V, V <sub>CC</sub> = 3.3V)	+40mA
I <sub>OL</sub> Receiver (V <sub>OL</sub> = 0.4V)	+4mA

**CAUTION:** Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

- $\theta_{JA}$  is measured with the component mounted on a high-effective thermal conductivity test board (two buried 1oz copper planes) with “direct attach” features package base mounted to PCB thermal land with a 10 mil gap fill material having a k of 1W/m-K. See Tech Brief [TB379](#).
- For  $\theta_{JC}$ , the “case temp” location is the center of the package underside.

**Electrical Specifications** Test Conditions: V<sub>CC</sub> = 3V to 3.6V, typicals are at T<sub>A</sub> = +25°C (Note 8); unless otherwise specified (Note 6). **Boldface limits apply across the operating temperature range, -55°C to +125°C; over a total ionizing dose of 75krad(Si) at +25°C with exposure at a low dose rate of <10mrad(Si)/s; and over a total ionizing dose of 100krad(Si) at +25°C with exposure of a high dose rate of 50krad(Si)/s to 300krad(Si)/s.**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 7)	TYP (Note 8)	MAX (Note 7)	UNIT
<b>DRIVER ELECTRICAL CHARACTERISTICS</b>							
Dominant Bus Output Voltage	V <sub>O(DOM)</sub>	D = 0V, CANH, RS = 0V, <a href="#">Figures 10</a> and <a href="#">11</a>	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>2.25</b>	2.85	V <sub>CC</sub>
		D = 0V, CANL, RS = 0V, <a href="#">Figures 10</a> and <a href="#">11</a>		Full	<b>0.10</b>	0.65	<b>1.25</b>
Recessive Bus Output Voltage	V <sub>O(REC)</sub>	D = 3V, CANH, RS = 0V, 60Ω and no load, <a href="#">Figures 10</a> and <a href="#">11</a>	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>1.80</b>	2.30	<b>2.70</b>
		D = 3V, CANL, RS = 0V, 60Ω and no load, <a href="#">Figures 10</a> and <a href="#">11</a>		Full	<b>1.80</b>	2.30	<b>2.80</b>
Dominant Output Differential Voltage	V <sub>OD(DOM)</sub>	D = 0V, RS = 0V, 3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Figures 10</a> and <a href="#">11</a>	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>1.5</b>	2.2	<b>3.0</b>
		D = 0V, RS = 0V, 3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Figures 11</a> and <a href="#">12</a>		Full	<b>1.2</b>	2.1	<b>3.0</b>
Recessive Output Differential Voltage	V <sub>OD(REC)</sub>	D = 3V, RS = 0V, 3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Figures 10</a> and <a href="#">11</a>	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>-120</b>	0.2	<b>12</b>
		D = 3V, RS = 0V, 3.0V ≤ V <sub>CC</sub> ≤ 3.6V, no load		Full	<b>-500</b>	-34	<b>50</b>
Logic Input High Voltage (D)	V <sub>IH</sub>	3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Note 9</a>	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>2.0</b>	-	<b>5.5</b>
Logic Input Low Voltage (D)	V <sub>IL</sub>	3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Note 9</a>	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>0</b>	-	<b>0.8</b>
High-Level Input Current (D)	I <sub>IH</sub>	D = 2V, 3V ≤ V <sub>CC</sub> ≤ 3.6V	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>-30</b>	-3	<b>30</b>
Low-Level Input Current (D)	I <sub>IL</sub>	D = 0.8V, 3V ≤ V <sub>CC</sub> ≤ 3.6V	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>-30</b>	-7	<b>30</b>
RS Input Voltage for Listen Mode	V <sub>IN(RS)</sub>	3V ≤ V <sub>CC</sub> ≤ 3.6V	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>0.75 x V<sub>CC</sub></b>	1.90	<b>5.5</b>
Output Short-Circuit Current	I <sub>OSC</sub>	V <sub>CANH</sub> = -7V, CANL = OPEN, 3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Figure 17</a>	3V ≤ V <sub>CC</sub> ≤ 3.6V	Full	<b>-250</b>	-100	-
		V <sub>CANH</sub> = +12V, CANL = OPEN, 3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Figure 17</a>		Full	-	0.4	<b>1.0</b>
		V <sub>CANL</sub> = -7V, CANH = OPEN, 3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Figure 17</a>		Full	<b>-1.0</b>	-0.4	-
		V <sub>CANL</sub> = +12V, CANH = OPEN, 3V ≤ V <sub>CC</sub> ≤ 3.6V, <a href="#">Figure 17</a>		Full	-	100	<b>250</b>

**Electrical Specifications** Test Conditions:  $V_{CC} = 3V$  to  $3.6V$ , typicals are at  $T_A = +25^\circ C$  (Note 8); unless otherwise specified (Note 6). **Boldface limits apply across the operating temperature range,  $-55^\circ C$  to  $+125^\circ C$ ; over a total ionizing dose of  $75krad(SI)$  at  $+25^\circ C$  with exposure at a low dose rate of  $<10mrad(SI)/s$ ; and over a total ionizing dose of  $100krad(SI)$  at  $+25^\circ C$  with exposure of a high dose rate of  $50krad(SI)/s$  to  $300krad(SI)/s$ . (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP ( $^\circ C$ )	MIN (Note 7)	TYP (Note 8)	MAX (Note 7)	UNIT
Thermal Shutdown Temperature	$T_{SHDN}$	$3V < V_{IN} < 3.6V$	-	-	163	-	$^\circ C$
Thermal Shutdown Hysteresis	$T_{HYS}$	$3V < V_{IN} < 3.6V$	-	-	12	-	$^\circ C$
<b>RECEIVER ELECTRICAL CHARACTERISTICS</b>							
Input Threshold Voltage (Rising)	$V_{THR}$	$RS = 0V, 10k, 50k$ , (recessive to dominant), Figures 14 and 2	Full	-	750	<b>900</b>	mV
Input Threshold Voltage (Falling)	$V_{THF}$	$RS = 0V, 10k, 50k$ , (dominant to recessive), Figures 14 and 2	Full	<b>500</b>	650	-	mV
Input Hysteresis	$V_{HYS}$	$(V_{THR} - V_{THF})$ , $RS = 0V, 10k, 50k$ , Figures 14 and 2	Full	<b>40</b>	90	-	mV
Listen Mode Input Threshold Voltage (Rising)	$V_{THRLM}$	$RS = V_{CC}$ , (recessive to dominant), Figure 14	Full	-	920	<b>1150</b>	mV
Listen Mode Input Threshold Voltage (Falling)	$V_{THFLM}$	$RS = V_{CC}$ , (dominant to recessive), Figure 14	Full	<b>525</b>	820	-	mV
Listen Mode Input Hysteresis	$V_{HYSLM}$	$(V_{THR} - V_{THF})$ , $RS = V_{CC}$ , Figure 14	Full	<b>50</b>	100	-	mV
Receiver Output High Voltage	$V_{OH}$	$I_O = -4mA$	Full	<b>2.4</b>	$V_{CC} - 0.2$	-	V
Receiver Output Low Voltage	$V_{OL}$	$I_O = +4mA$	Full	-	0.2	<b>0.4</b>	V
Input Current for CAN Bus	$I_{CAN}$	CANH or CANL at 12V, D = 3V, other bus pin at 0V, RS = 0V	Full	-	420	<b>500</b>	$\mu A$
		CANH or CANL at 12V, D = 3V, $V_{CC} = 0V$ , other bus pin at 0V, RS = 0V	Full	-	150	<b>250</b>	$\mu A$
		CANH or CANL at -7V, D = 3V, other bus pin at 0V, RS = 0V	Full	<b>-400</b>	-300	-	$\mu A$
		CANH or CANL at -7V, D = 3V, $V_{CC} = 0V$ , other bus pin at 0V, RS = 0V	Full	<b>-150</b>	-85	-	$\mu A$
Input Capacitance (CANH or CANL)	$C_{IN}$	Input to GND, D = 3V, RS = 0V	25	-	35	-	pF
Differential Input Capacitance	$C_{IND}$	Input to Input, D = 3V, RS = 0V	25	-	15	-	pF
Input Resistance (CANH or CANL)	$R_{IN}$	Input to GND, D = 3V, RS = 0V	Full	<b>20</b>	40	<b>50</b>	k $\Omega$
Differential Input Resistance	$R_{IND}$	Input to Input, D = 3V, RS = 0V	Full	<b>40</b>	80	<b>100</b>	k $\Omega$
<b>SUPPLY CURRENT</b>							
Supply Current, Listen Mode	$I_{CC(L)}$	$RS = D = V_{CC}, 3V \leq V_{CC} \leq 3.6V$	Full	-	1	<b>2</b>	mA
Supply Current, Dominant	$I_{CC(DOM)}$	$D = RS = 0V$ , no load, $3V \leq V_{CC} \leq 3.6V$	Full	-	5	<b>7</b>	mA
Supply Current, Recessive	$I_{CC(REC)}$	$D = V_{CC}$ , $RS = 0V$ , no load, $3V \leq V_{CC} \leq 3.6V$	Full	-	2.6	<b>5.0</b>	mA
<b>COLD SPARING BUS CURRENT</b>							
CANH Leakage Current	$I_{L(CANH)}$	$V_{CC} = 0.2V$ , CANH = -7V or 12V, CANL = float, D = $V_{CC}$ , RS = 0V	Full	<b>-25</b>	-4	<b>25</b>	$\mu A$
CANL Leakage Current	$I_{L(CANL)}$	$V_{CC} = 0.2V$ , CANL = -7V or 12V, CANH = float, D = $V_{CC}$ , RS = 0V	Full	<b>-25</b>	-4	<b>25</b>	$\mu A$
VREF Leakage Current	$I_{L(VREF)}$	$V_{CC} = 0.2V$ , $V_{REF} = -7V$ or 12V, D = $V_{CC}$	Full	<b>-25.00</b>	0.01	<b>25.00</b>	$\mu A$
<b>DRIVER SWITCHING CHARACTERISTICS</b>							
Propagation Delay LOW to HIGH	$t_{PDLH1}$	$RS = 0V$ , Figure 13	Full	-	75	<b>150</b>	ns
Propagation Delay LOW to HIGH	$t_{PDLH2}$	$RS = 10k\Omega$ , Figure 13	Full	-	520	<b>850</b>	ns
Propagation Delay LOW to HIGH	$t_{PDLH3}$	$RS = 50k\Omega$ , Figure 13	Full	-	850	<b>1400</b>	ns
Propagation Delay HIGH to LOW	$t_{PDHL1}$	$RS = 0V$ , Figure 13	Full	-	80	<b>155</b>	ns
Propagation Delay HIGH to LOW	$t_{PDHL2}$	$RS = 10k\Omega$ , Figure 13	Full	-	460	<b>800</b>	ns
Propagation Delay HIGH to LOW	$t_{PDHL3}$	$RS = 50k\Omega$ , Figure 13	Full	-	725	<b>1300</b>	ns

**Electrical Specifications** Test Conditions:  $V_{CC} = 3V$  to  $3.6V$ , typicals are at  $T_A = +25^\circ C$  (Note 8); unless otherwise specified (Note 6). **Boldface** limits apply across the operating temperature range,  $-55^\circ C$  to  $+125^\circ C$ ; over a total ionizing dose of  $75krad(Si)$  at  $+25^\circ C$  with exposure at a low dose rate of  $<10mrad(Si)/s$ ; and over a total ionizing dose of  $100krad(Si)$  at  $+25^\circ C$  with exposure of a high dose rate of  $50krad(Si)/s$  to  $300krad(Si)/s$ . (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 7)	TYP (Note 8)	MAX (Note 7)	UNIT
Output Skew	$t_{SKEW1}$	RS = 0V, ( $ t_{PHL} - t_{PLH} $ ), <a href="#">Figure 13</a>	Full	-	5	<b>50</b>	ns
Output Skew	$t_{SKEW2}$	RS = 10k $\Omega$ , ( $ t_{PHL} - t_{PLH} $ ), <a href="#">Figure 13</a>	Full	-	60	<b>510</b>	ns
Output Skew	$t_{SKEW3}$	RS = 50k $\Omega$ , ( $ t_{PHL} - t_{PLH} $ ), <a href="#">Figure 13</a>	Full	-	110	<b>800</b>	ns
Output Rise Time	$t_{r1}$	RS = 0V, (fast speed) <a href="#">Figure 13</a>	Full	<b>20</b>	55	<b>100</b>	ns
Output Fall Time	$t_{f1}$	<a href="#">Figure 13</a>	Full	<b>10</b>	25	<b>75</b>	ns
Output Rise Time	$t_{r2}$	RS = 10k $\Omega$ , (medium speed - 250Kbps) <a href="#">Figure 13</a>	Full	<b>200</b>	400	<b>780</b>	ns
Output Fall Time	$t_{f2}$	<a href="#">Figure 13</a>	Full	<b>175</b>	300	<b>500</b>	ns
Output Rise Time	$t_{r3}$	RS = 50k $\Omega$ , (slow speed - 125Kbps) <a href="#">Figure 13</a>	Full	<b>400</b>	700	<b>1400</b>	ns
Output Fall Time	$t_{f3}$	<a href="#">Figure 13</a>	Full	<b>300</b>	650	<b>1000</b>	ns
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant	$t_{(LOOP1)}$	RS = 0V, <a href="#">Figure 15</a>	Full	-	115	<b>210</b>	ns
		RS = 10k $\Omega$ , <a href="#">Figure 15</a>	Full	-	550	<b>875</b>	ns
		RS = 50k $\Omega$ , <a href="#">Figure 15</a>	Full	-	850	<b>1400</b>	ns
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive	$t_{(LOOP2)}$	RS = 0V, <a href="#">Figure 15</a>	Full	-	130	<b>270</b>	ns
		RS = 10k $\Omega$ , <a href="#">Figure 15</a>	Full	-	500	<b>825</b>	ns
		RS = 50k $\Omega$ , <a href="#">Figure 15</a>	Full	-	750	<b>1300</b>	ns
Listen to Valid Dominant Time	$t_{L-DOM}$	<a href="#">Figure</a>	Full	-	5	<b>15</b>	us
<b>RECEIVER SWITCHING CHARACTERISTICS</b>							
Propagation Delay LOW to HIGH	$t_{PLH}$	<a href="#">Figure 14</a>	Full	-	50	<b>110</b>	ns
Propagation Delay HIGH to LOW	$t_{PHL}$	<a href="#">Figure 14</a>	Full	-	50	<b>110</b>	ns
Rx Skew	$t_{SKEW1}$	$ t_{PHL} - t_{PLH} $ , <a href="#">Figure 14</a>	Full	-	2	<b>35</b>	ns
Rx Rise Time	$t_r$	<a href="#">Figure 14</a>	Full	-	2	-	ns
Rx Fall Time	$t_f$	<a href="#">Figure 14</a>	Full	-	2	-	ns
<b>VREF/RS PIN CHARACTERISTICS</b>							
VREF Pin Voltage	VREF	$-5\mu A < I_{REF} < 5\mu A$	Full	<b><math>0.45 \times V_{CC}</math></b>	1.60	<b><math>0.55 \times V_{CC}</math></b>	V
		$-50\mu A < I_{REF} < 50\mu A$	Full	<b><math>0.4 \times V_{CC}</math></b>	1.6	<b><math>0.6 \times V_{CC}</math></b>	V
RS Pin Input Current	IRS(H)	RS = $0.75 \times V_{CC}$	Full	<b>-10.0</b>	-0.2	-	$\mu A$
	IRS(L)	$V_{RS} = 0V$	Full	<b>-450</b>	-125	<b>0</b>	$\mu A$

## NOTES:

- All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
- Parameters with MIN and/or MAX limits are 100% tested at  $-55^\circ C$ ,  $+25^\circ C$  and  $+125^\circ C$ , unless otherwise specified.
- Typical values are at 3.3V. Parameters with a single entry in the "TYP" column apply to 3.3V. Typical values shown are not guaranteed.
- Parameter included in functional testing.

## Test Circuits and Waveforms

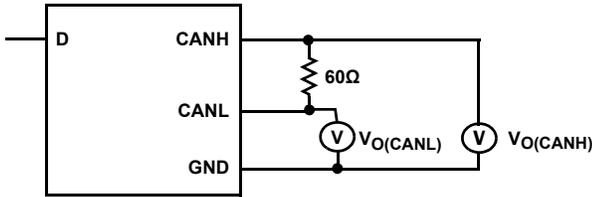


FIGURE 10. DRIVER TEST CIRCUIT

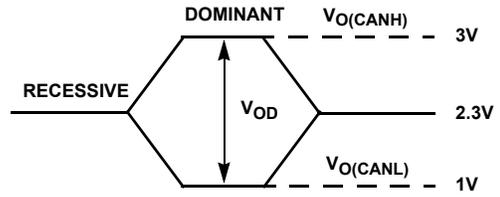


FIGURE 11. DRIVER BUS VOLTAGE DEFINITIONS

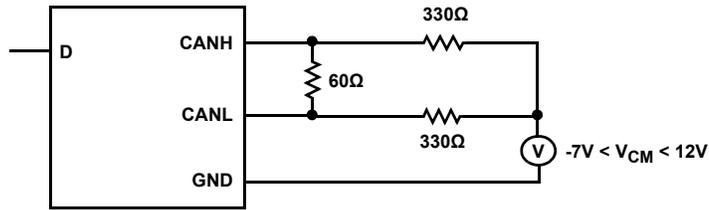
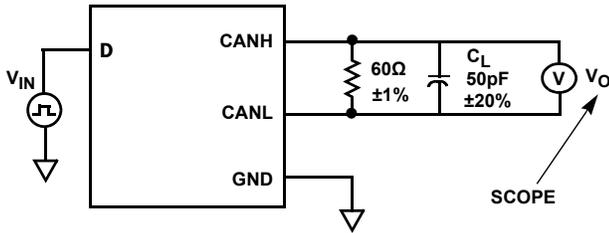


FIGURE 12. DRIVER COMMON-MODE CIRCUIT



$V_{IN} = 125\text{kHz}$ ,  $0\text{V}$  to  $V_{CC}$ , Duty Cycle 50%,  $t_r = t_f \leq 6\text{ns}$ ,  $Z_O = 50\Omega$   
 $C_L$  includes fixture and instrumentation capacitance.

FIGURE 13A. DRIVER TIMING TEST CIRCUIT

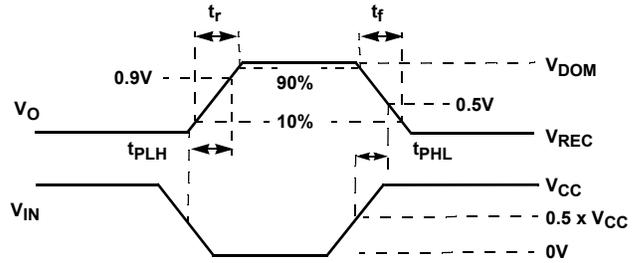


FIGURE 13B. DRIVER TIMING MEASUREMENT POINTS

FIGURE 13. DRIVER TIMING

**Test Circuits and Waveforms (Continued)**

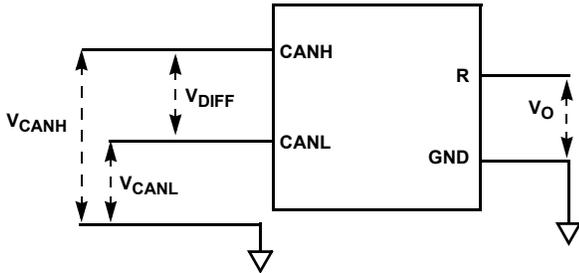
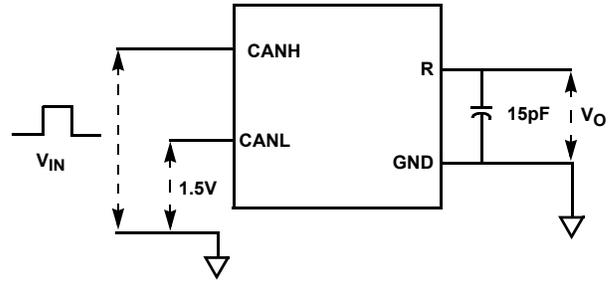


FIGURE 14A. RECEIVER VOLTAGE DEFINITIONS



$V_{IN} = 125\text{kHz}$ , Duty Cycle 50%,  $t_r = t_f = 6\text{ns}$ ,  $Z_O = 50\Omega$   
 $C_L$  includes test setup capacitance

FIGURE 14B. RECEIVER TEST CIRCUIT

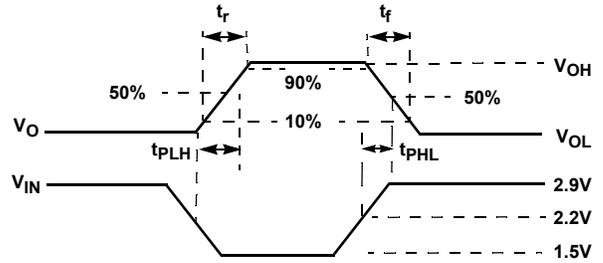


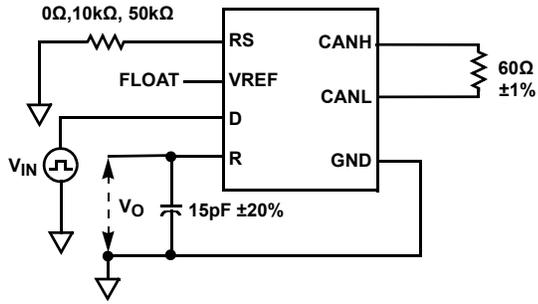
FIGURE 14C. RECEIVER TEST MEASUREMENT POINTS

FIGURE 14. RECEIVER TEST

TABLE 2. DIFFERENTIAL INPUT VOLTAGE THRESHOLD TEST

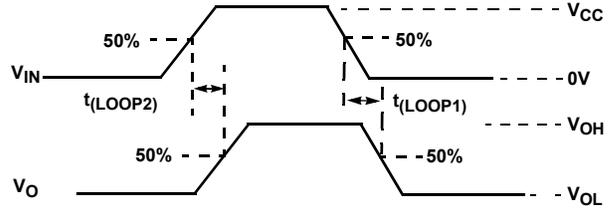
INPUT		OUTPUT	MEASURED
$V_{CANH}$	$V_{CANL}$	R	$V_{DIFF}$
-6.1V	-7V	L	900mV
12V	11.1V	L	900mV
-1V	-7V	L	6V
12V	6V	L	6V
-6.5V	-7V	H	500mV
12V	11.5V	H	500mV
-7V	-1V	H	6V
6V	12V	H	6V
Open	Open	H	X

**Test Circuits and Waveforms (Continued)**



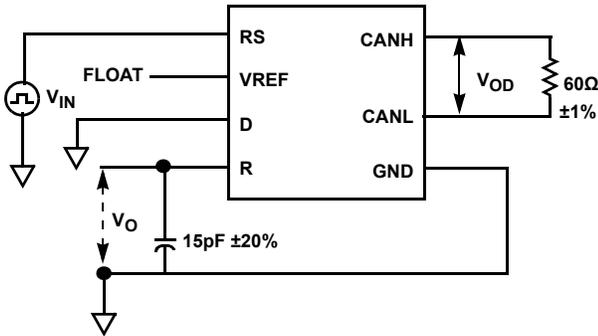
$V_{IN} = 125\text{kHz}$ , Duty Cycle 50%,  $t_r = t_f \leq 6\text{ns}$

**FIGURE 15A. TOTAL LOOP DELAY TEST CIRCUIT**



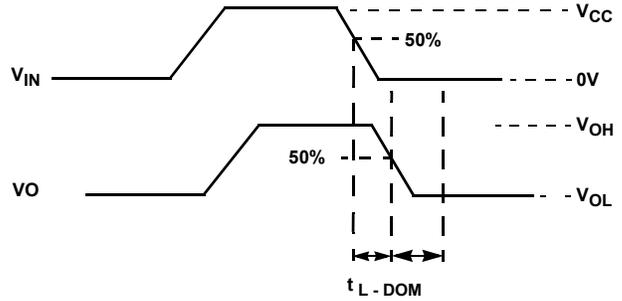
**FIGURE 15B. TOTAL LOOP DELAY MEASUREMENT POINTS**

**FIGURE 15. TOTAL LOOP DELAY**



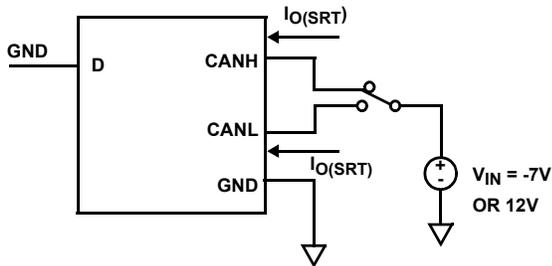
$V_{IN} = 125\text{kHz}$ , 0V to  $V_{CC}$ , Duty Cycle 50%,  $t_r = t_f \leq 6\text{ns}$

**FIGURE 16A. LISTEN TO VALID DOMINANT TIME CIRCUIT**

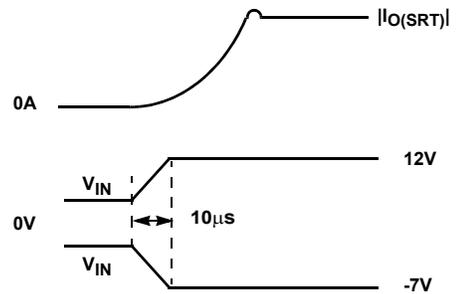


**FIGURE 16B. LISTEN TO VALID DOMINANT TIME MEASUREMENT POINTS**

**FIGURE 16. LISTEN TO VALID DOMINANT TIME**



**FIGURE 17A. OUTPUT SHORT-CIRCUIT CURRENT CIRCUIT**



**FIGURE 17B. OUTPUT SHORT-CIRCUIT CURRENT WAVEFORMS**

**FIGURE 17. OUTPUT SHORT-CIRCUIT**

## Functional Description

### Overview

The ISL72027BSEH is a 3.3V radiation tolerant CAN transceiver that is compatible with the ISO11898-2 standard for use in Controller Area Network (CAN) serial communication systems.

The device performs transmit and receive functions between the CAN controller and the CAN differential bus. It can transmit and receive at bus speeds of up to 5Mbps. It is designed to operate over a common-mode range of -7V to +12V with a maximum of 120 nodes. The device is capable of withstanding  $\pm 20V$  on the CANH and CANL bus pins outside of ion beam and  $\pm 16V$  under ion beam.

### Slope Adjustment

The output driver rise and fall time has three distinct selections that may be chosen by using a resistor from the RS pin to GND. Connecting the RS pin directly to GND results in output switching times that are the fastest, limited only by the drive capability of the output stage.  $RS = 10k\Omega$  provides for a typical slew rate of  $8V/\mu s$  and  $RS = 50k\Omega$  provides for a typical slew rate of  $4V/\mu s$ .

Putting a high logic level to the RS pin places the device in a low-Current Listen mode. The protocol controller uses this mode to switch between Low-Power Listen mode and a Normal Transmit mode.

### Cable Length

The device can work per ISO11898 specification with a 40m cable and stub length of 0.3m and 60 nodes at 1Mbps. This is greater than the ISO requirement of 30 nodes. The cable type specified is a twisted pair (shielded or unshielded) with a characteristic impedance of  $120\Omega$ . Resistors equal to this are to be terminated at both ends of the cable. Stubs should be kept as short as possible to prevent reflections.

### Cold Spare

High reliability system designers implementing data communications have to be sensitive to the potential for single point failures. To mitigate the risk of a failure they will use redundant bus transceivers in parallel. Space systems call for high reliability in data communications that are resistant to single point failures. This is achieved by using a redundant bus transceiver in parallel. In this arrangement, both active and quiescent devices can be present simultaneously on the bus. The quiescent devices are powered down for cold spare and do not affect the communication of the other active nodes.

To achieve this, a powered down transceiver ( $V_{CC} < 200mV$ ) has a resistance between the VREF pin, the CANH pin, or the CANL pin and the  $V_{CC}$  supply rail of  $>480k\Omega$  (maximum) with a typical resistance  $>2M\Omega$ . The resistance between CANH and CANL of a powered down transceiver has a typical resistance of  $80k\Omega$ .

### Listen Mode

When a high level is applied to the RS pin, the device enters a Low-Power Listen mode. The driver of the transceiver is switched off to conserve power while the receiver remains active. In Listen mode the transceiver draws 2mA (max) of current.

A low level on the RS pin brings the device back to normal operation.

### Using 3.3V Devices in 5V Systems

Looking at the differential voltage of both the 3.3V and 5V devices, the differential voltage is the same, and the recessive common-mode output voltage is the same. The dominant common-mode output voltage is slightly lower than the 5V counterparts. The receiver specifications are also the same. Though the electrical parameters appear compatible, it is advised that necessary system testing be performed to verify interchangeable operation.

### Split Mode Termination

The VREF pin provides a  $V_{CC}/2$  output voltage for Split mode termination. The VREF pin has the same ESD protection, short-circuit protection, and common-mode operating range as the bus pins.

The Split mode termination technique is shown in [Figure 18](#).

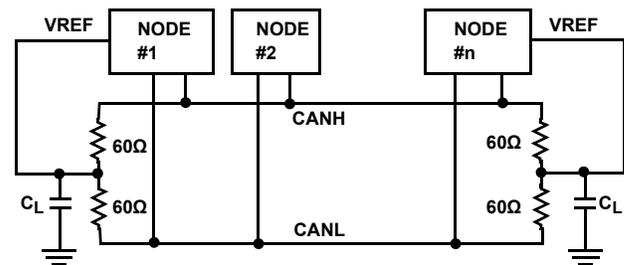


FIGURE 18. SPLIT TERMINATION

It is used to stabilize the bus voltage at  $V_{CC}/2$  and prevent it from drifting to a high common-mode voltage during periods of inactivity. The technique improves the electromagnetic compatibility of a network. The Split mode termination is put at each end of the bus.

The  $C_L$  capacitor between the two  $60\Omega$  resistors filters unwanted high frequency noise to ground. The resistors should have a tolerance of 1% or better and the two resistors should be carefully matched to provide the most effective EMI immunity. A typical value of  $C_L$  for a high speed CAN network is 4.7nF, which generates a 3dB point at 1.1Mbps. The capacitance value used is dependent on the signaling rate of the network.

# Typical Performance Curves

$V_{CC} = 3.3V, C_L = 15pF, T_A = +25^\circ C$ ; unless otherwise specified.

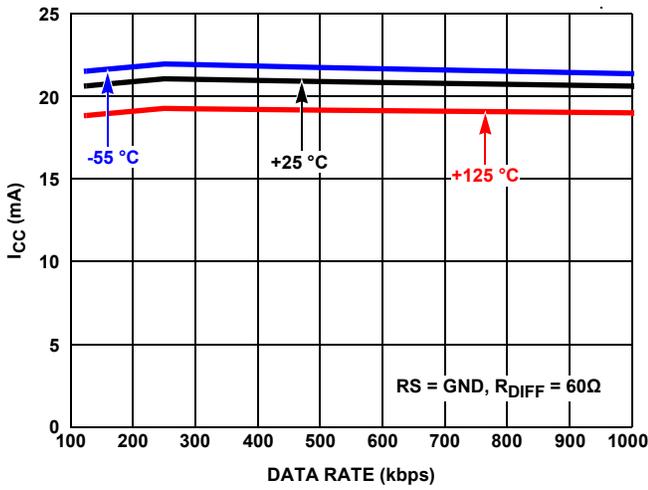


FIGURE 19. SUPPLY CURRENT vs FAST DATA RATE vs TEMPERATURE

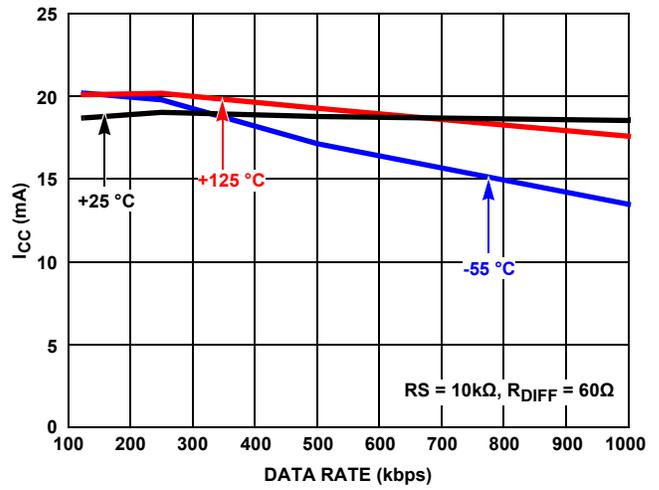


FIGURE 20. SUPPLY CURRENT vs MEDIUM DATA RATE vs TEMPERATURE

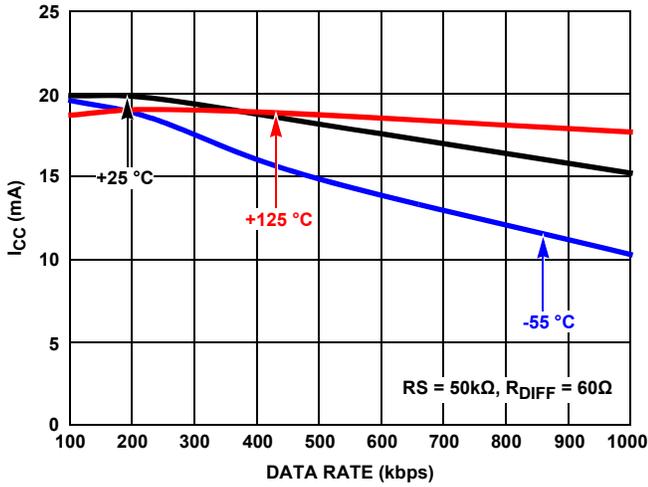


FIGURE 21. SUPPLY CURRENT vs SLOW DATA RATE vs TEMPERATURE

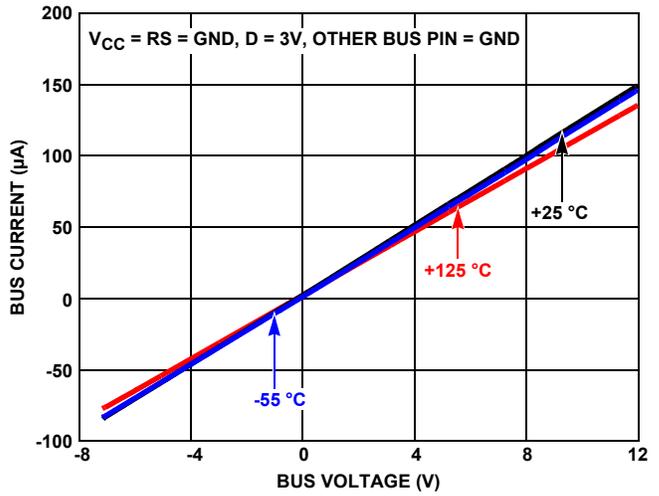


FIGURE 22. BUS PIN LEAKAGE vs VCM AT  $V_{CC} = 0V$

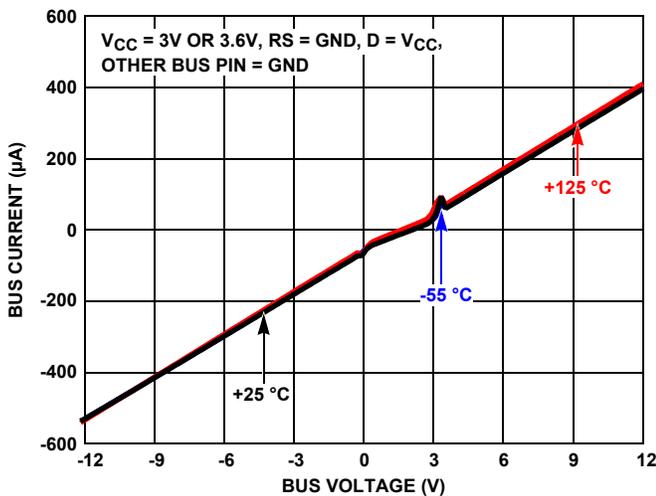


FIGURE 23. BUS PIN LEAKAGE vs  $\pm 12V$  VCM

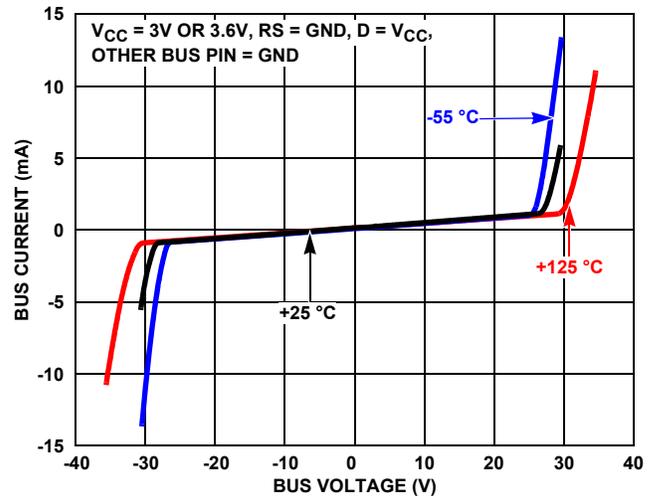


FIGURE 24. BUS PIN LEAKAGE vs  $\pm 35V$  VCM

**Typical Performance Curves**  $V_{CC} = 3.3V, C_L = 15pF, T_A = +25^\circ C$ ; unless otherwise specified. (Continued)

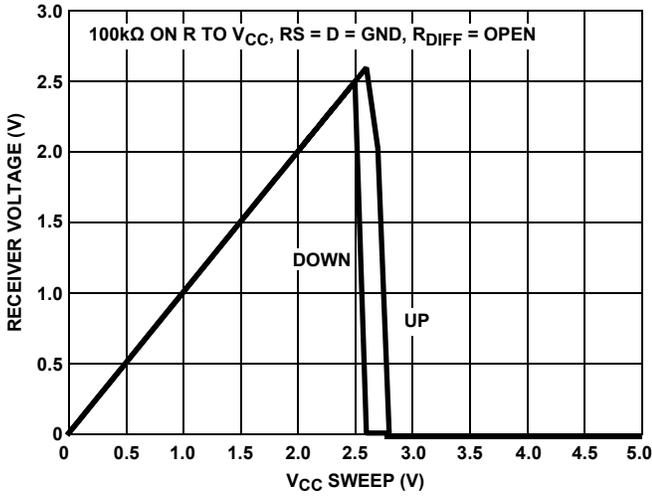


FIGURE 25.  $V_{CC}$  UNDERVOLTAGE LOCKOUT

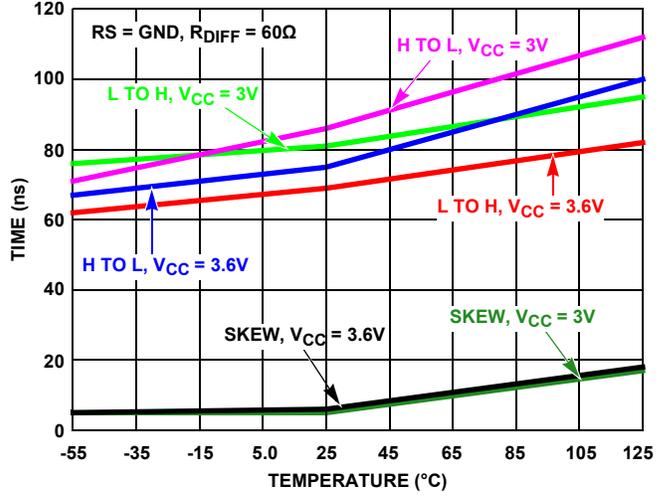


FIGURE 26. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT FAST SPEED

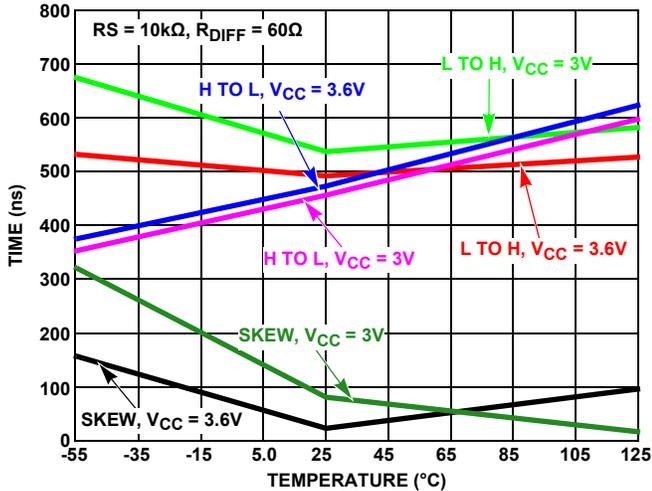


FIGURE 27. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT MEDIUM SPEED

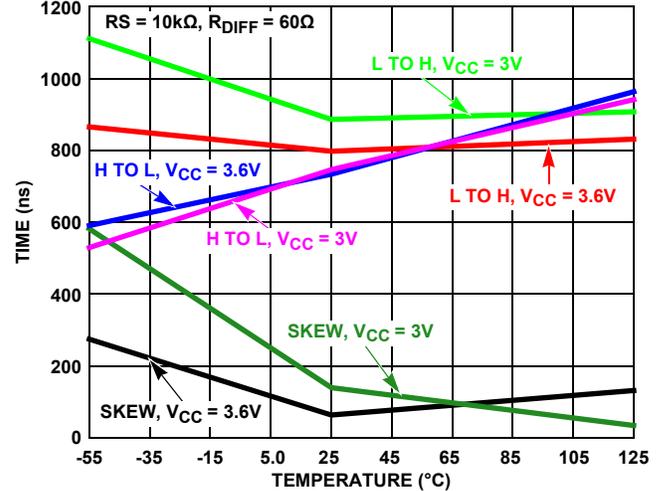


FIGURE 28. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT SLOW SPEED

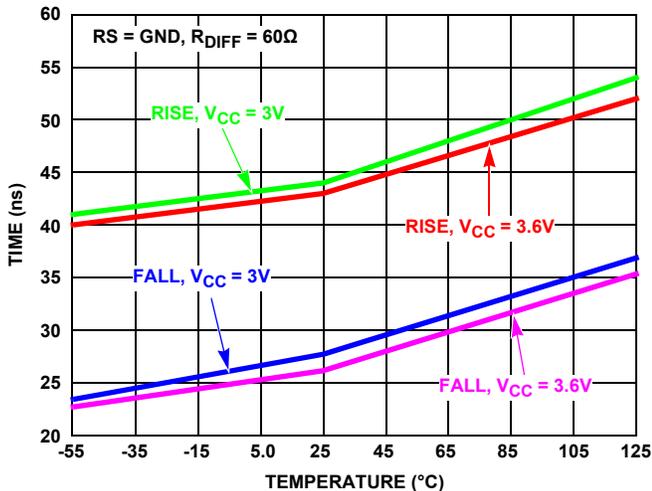


FIGURE 29. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT FAST SPEED

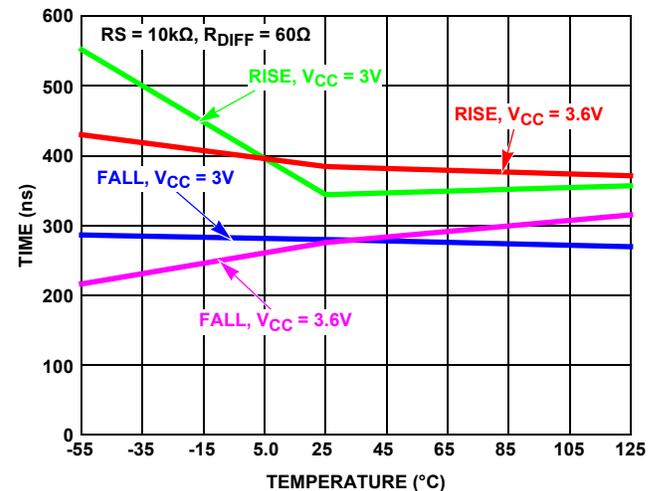


FIGURE 30. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT MEDIUM SPEED

**Typical Performance Curves**  $V_{CC} = 3.3V, C_L = 15pF, T_A = +25^\circ C$ ; unless otherwise specified. (Continued)

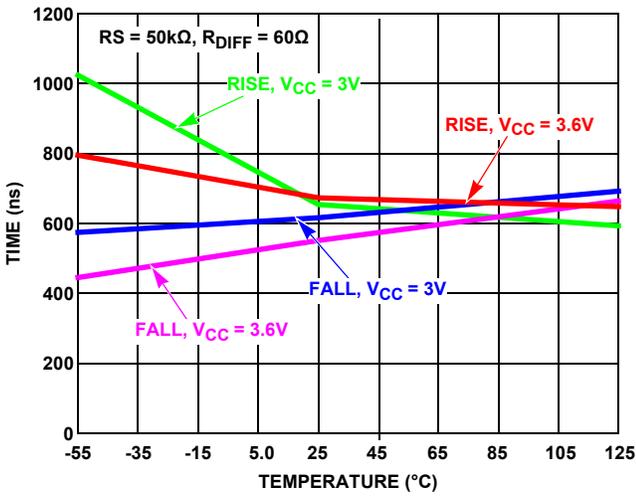


FIGURE 31. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT SLOW SPEED

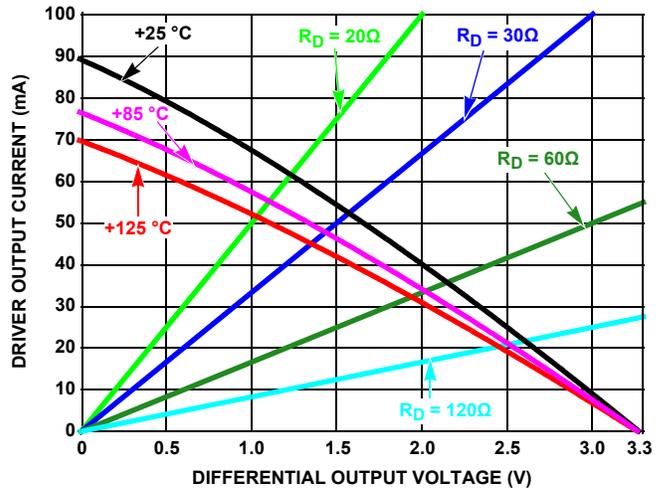


FIGURE 32. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

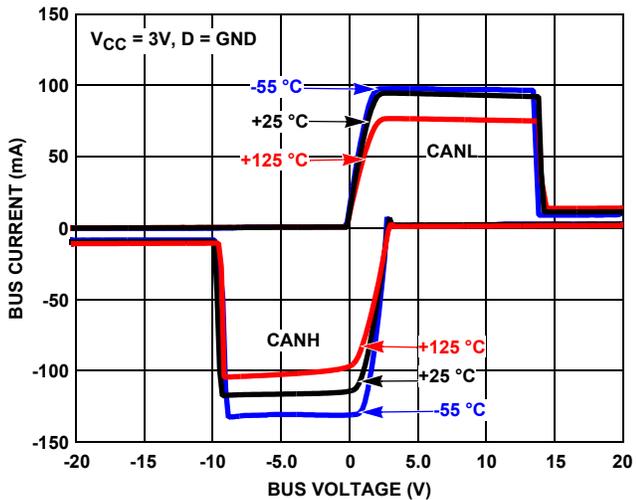


FIGURE 33. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE vs TEMPERATURE

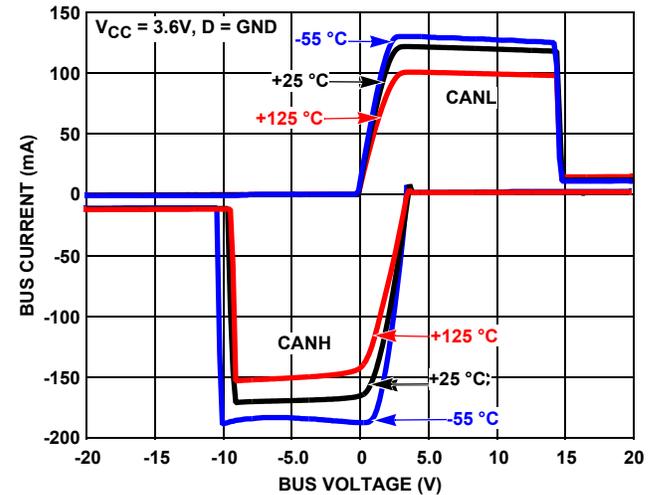


FIGURE 34. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE vs TEMPERATURE

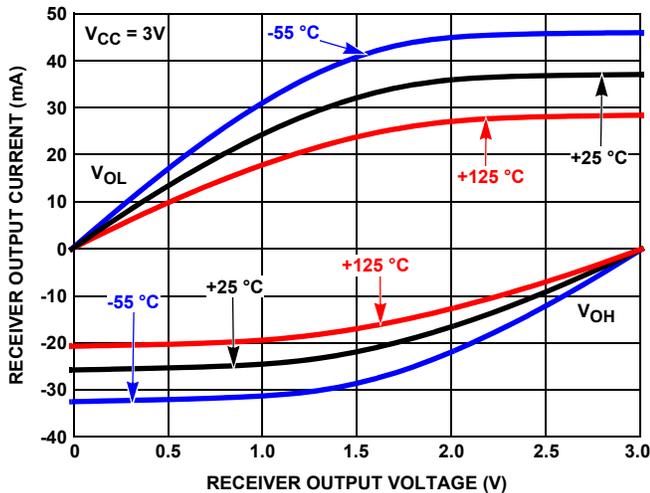


FIGURE 35. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE AT  $V_{CC} = 3V$

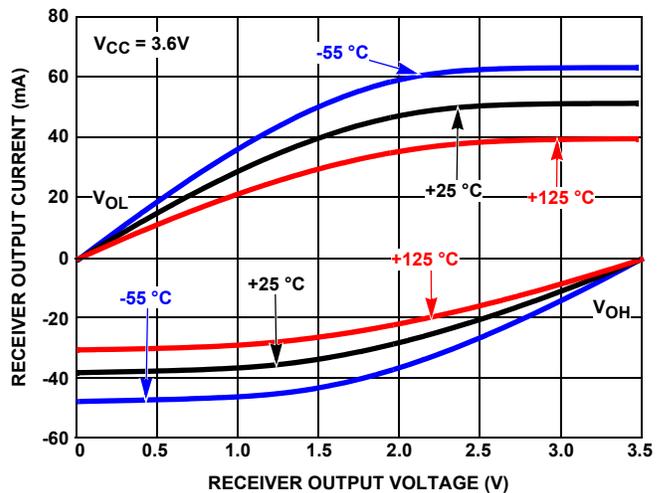
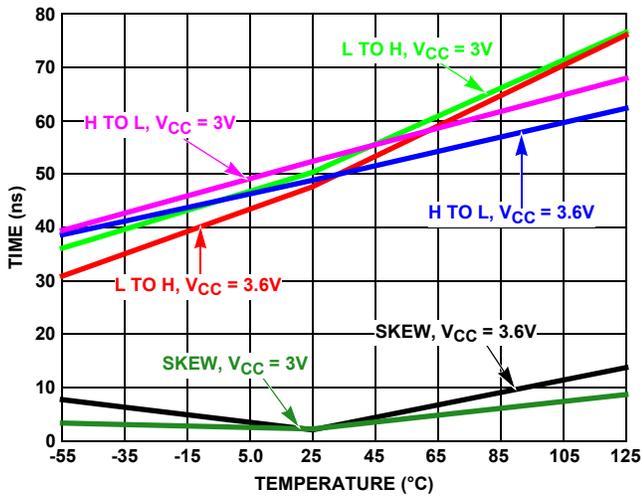
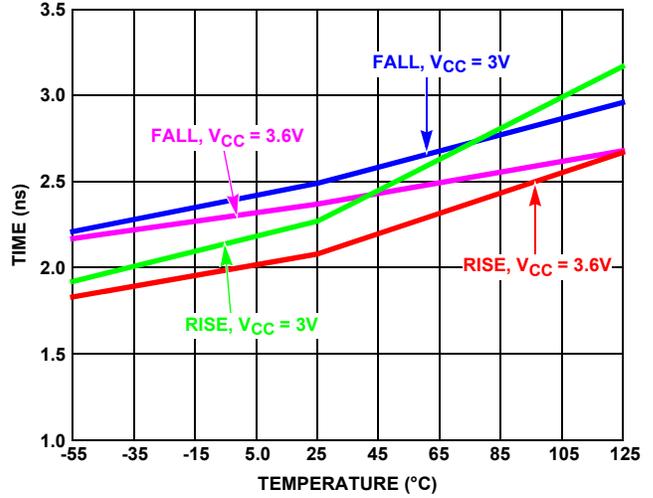


FIGURE 36. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE AT  $V_{CC} = 3.6V$

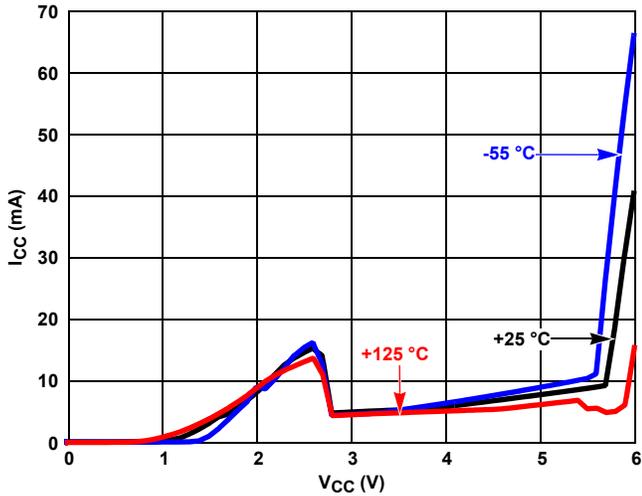
**Typical Performance Curves**  $V_{CC} = 3.3V, C_L = 15pF, T_A = +25^\circ C$ ; unless otherwise specified. (Continued)



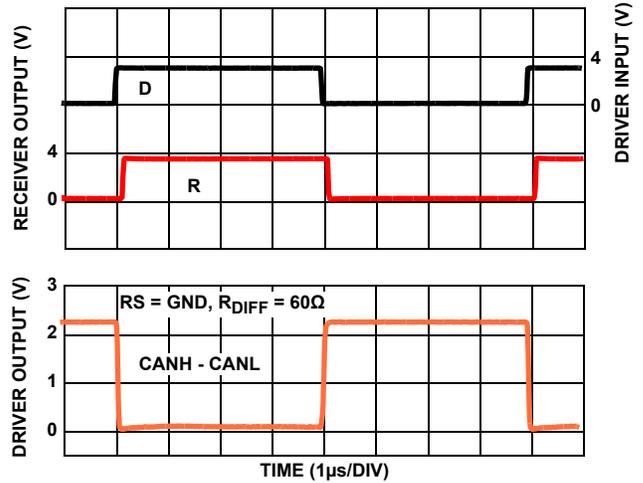
**FIGURE 37. RECEIVER PROPAGATION DELAY AND SKEW vs TEMPERATURE**



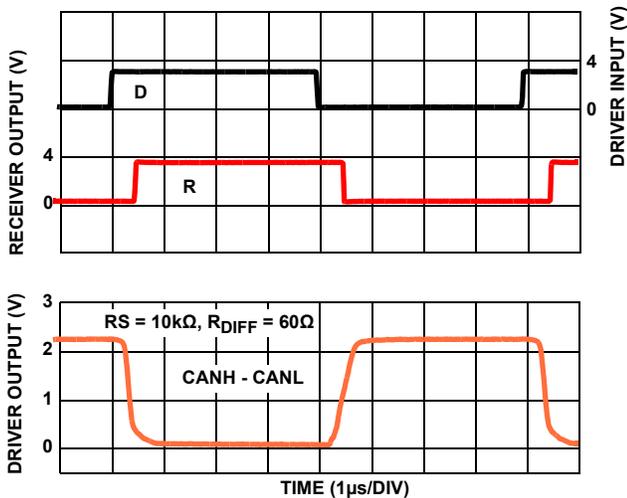
**FIGURE 38. RECEIVER RISE AND FALL TIMES vs TEMPERATURE**



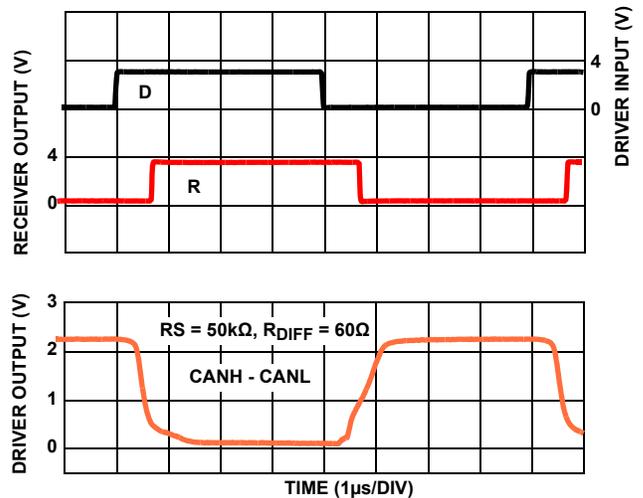
**FIGURE 39. SUPPLY CURRENT vs SUPPLY VOLTAGE vs TEMPERATURE**



**FIGURE 40. FAST DRIVER AND RECEIVER WAVEFORMS**



**FIGURE 41. MEDIUM DRIVER AND RECEIVER WAVEFORMS**



**FIGURE 42. SLOW DRIVER AND RECEIVER WAVEFORMS**

## Die Characteristics

### Die Dimensions

2413µm x 3322µm (95 mils x 130.79 mils)  
 Thickness: 305µm ±25µm (12 mils ±1 mil)

### Interface Materials

#### GLASSIVATION

Type: 12kÅ Silicon Nitride on 3kÅ Oxide

#### TOP METALLIZATION

Type: 300Å TiN on 2.8µm AlCu  
 In Bondpads, TiN has been removed.

#### BACKSIDE FINISH

Silicon

#### PROCESS

P6S0I

## Assembly Related Information

### SUBSTRATE POTENTIAL

Floating

### Additional Information

#### WORST CASE CURRENT DENSITY

$1.6 \times 10^5 \text{ A/cm}^2$

#### TRANSISTOR COUNT

4055

### Weight of Packaged Device

0.31 grams

### Lid Characteristics

Finish: Gold

Potential: Grounded, tied to package pin 2

## Metalization Mask Layout

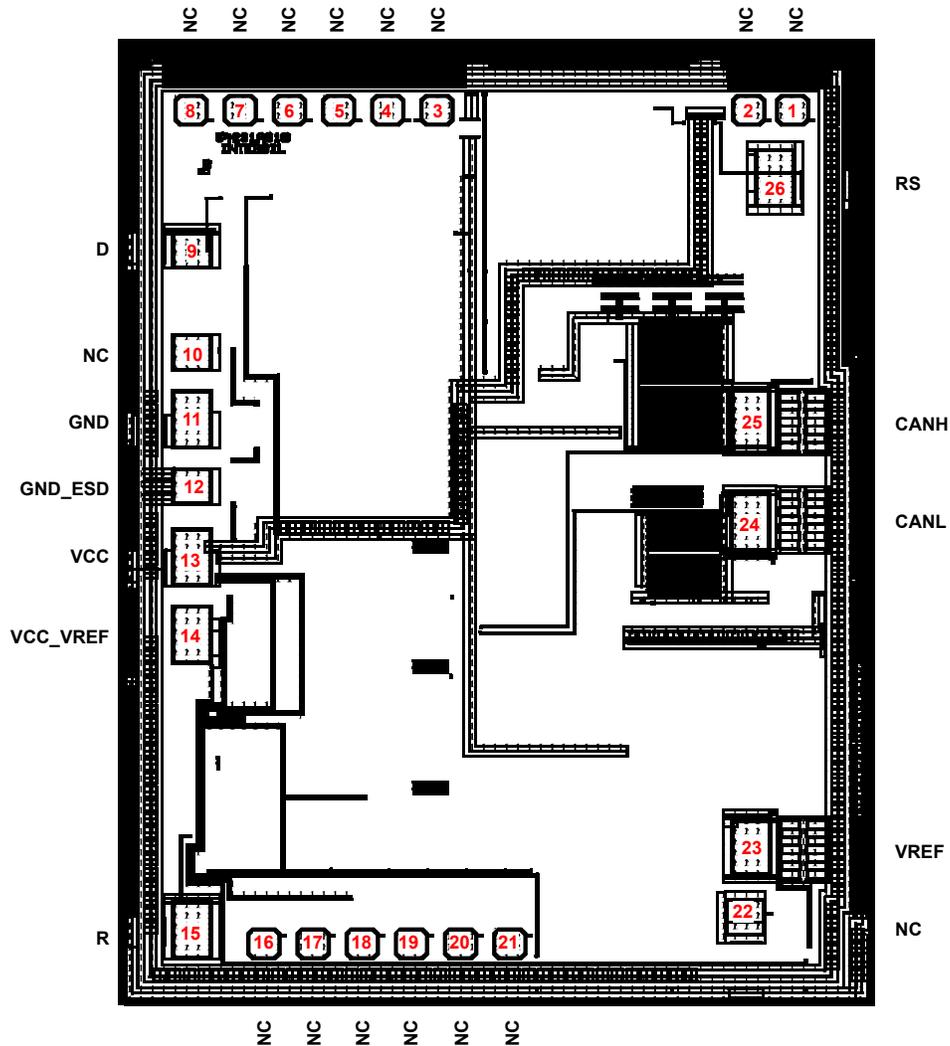


TABLE 3. ISL72027BSEH DIE LAYOUT X-Y COORDINATES

PAD NUMBER	PAD NAME	X ( $\mu\text{m}$ )	Y ( $\mu\text{m}$ )	X	Y
1	NC	90.0	90.0	901.4	1365.6
2	NC	90.0	90.0	767.4	1365.6
3	NC	90.0	90.0	-183.23	1365.6
4	NC	90.0	90.0	-333.25	1365.6
5	NC	90.0	90.0	-483.25	1365.6
6	NC	90.0	90.0	-633.25	1365.6
7	NC	90.0	90.0	-783.25	1365.6
8	NC	90.0	90.0	-933.25	1365.6
9	D	110.0	110.0	-931.1	901.85
10	NC	110.0	110.0	-931.1	563.25
11	GND	110.0	180.0	-931.1	342.25
12	GND_ESD	110.0	110.05	-931.1	119.42
13	VCC	110.0	180.0	-931.1	-115.05
14	VCC_VREF	110.0	180.05	-931.1	-371.08
15	R	110.0	180.0	-931.1	-1350.0
16	NC	90.0	90.0	-711.1	-1394.95
17	NC	90.0	90.0	-561.1	-1394.95
18	NC	90.0	90.0	-411.1	-1394.95
19	NC	90.0	90.0	-261.1	-1394.95
20	NC	90.0	90.0	-111.1	-1394.95
21	NC	90.0	90.0	38.9	-1394.95
22	NC	110.0	110.0	756.9	-1307.3
23	VREF	110.0	180.0	775.3	-1072.3
24	CANL	110.0	180.0	772.1	2.15
25	CANH	110.0	180.05	772.1	343.33
26	RS	110.0	180.0	848.1	1140.6

NOTE: Origin of coordinates is the center of the die. NC - No Connect

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**Revision History** The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to the web to make sure that you have the latest revision.

DATE	REVISION	CHANGE
November 30, 2016	FN8901.0	Initial Release

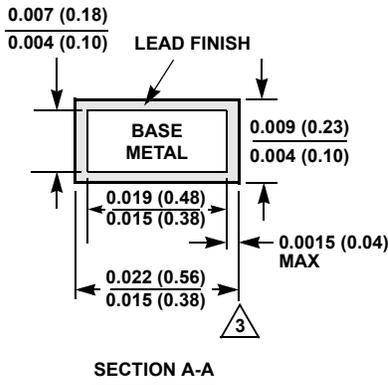
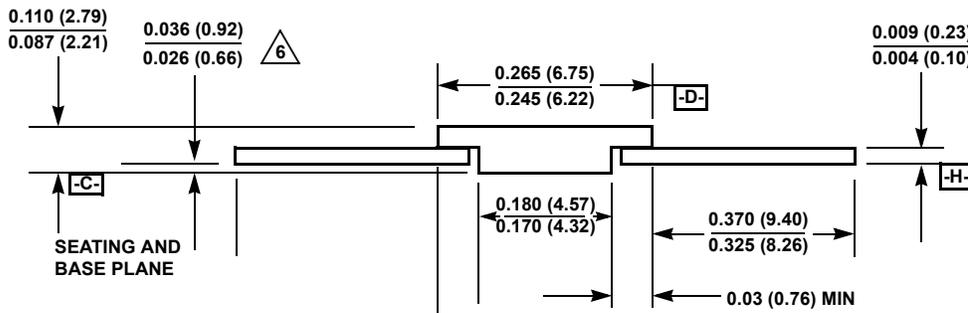
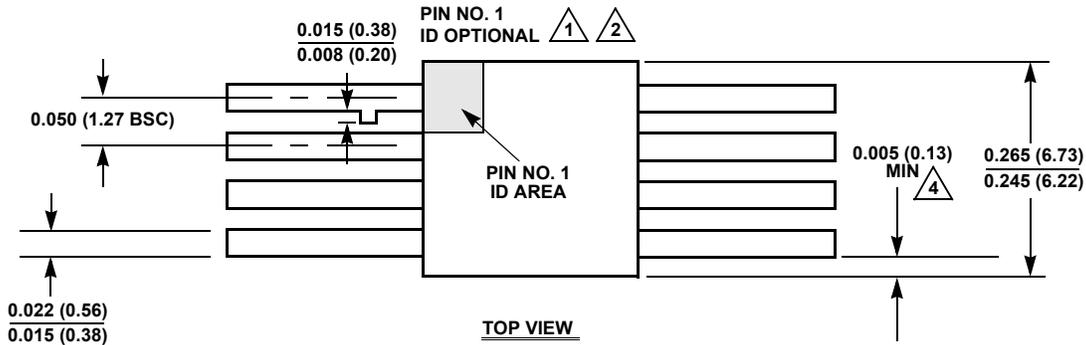
# Package Outline Drawing

For the most recent package outline drawing, see [K8.A](#).

## K8.A

### 8 LEAD CERAMIC METAL SEAL FLATPACK PACKAGE

Rev 4, 12/14



**NOTES:**

1. Index area: A notch or a pin one identification mark shall be located adjacent to pin one and shall be located within the shaded area shown. The manufacturer's identification shall not be used as a pin one identification mark. Alternately, a tab may be used to identify pin one.
2. If a pin one identification mark is used in addition to or instead of a tab, the limits of the tab dimension do not apply.
3. The maximum limits of lead dimensions (section A-A) shall be measured at the centroid of the finished lead surfaces, when solder dip or tin plate lead finish is applied.
4. Measure dimension at all four corners.
5. For bottom-brazed lead packages, no organic or polymeric materials shall be molded to the bottom of the package to cover the leads.
6. Dimension shall be measured at the point of exit (beyond the meniscus) of the lead from the body. Dimension minimum shall be reduced by 0.0015 inch (0.038mm) maximum when solder dip lead finish is applied.
7. Dimensioning and tolerancing per ANSI Y14.5M - 1982.
8. Controlling dimension: INCH.

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