

ISL72026BSEH

3.3V Radiation Tolerant CAN Transceiver with Listen Mode and Loopback

FN8900
Rev.1.00
Jan 10, 2020

The [ISL72026BSEH](#) 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. It was 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 loopback test capability.

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 ISL72026BSEH is available in an 8 Ld hermetic ceramic flatpack and die form that operate across the temperature range of -55°C to +125°C. The logic inputs are tolerant with 5V systems.

Other CAN transceivers available are the [ISL72027BSEH](#) 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
- [ISL72026BSEH](#) product page

Applications

- Satellites and aerospace communications
- Telemetry data processing
- High-end industrial 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
- Radiation acceptance testing
 - HDR (50-300rad(Si)/s) 100krad(Si)
 - LDR (0.01rad(Si)/s) 75krad(Si)
- SEE hardness (see SEE report for details)
 - SEL/B immune to LET_{TH}. 86.4MeV • cm²/mg

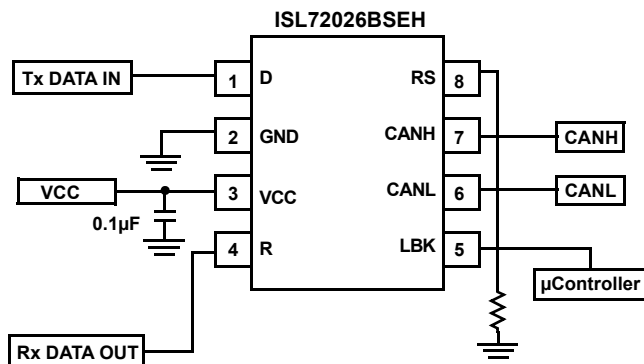


FIGURE 1. TYPICAL APPLICATION

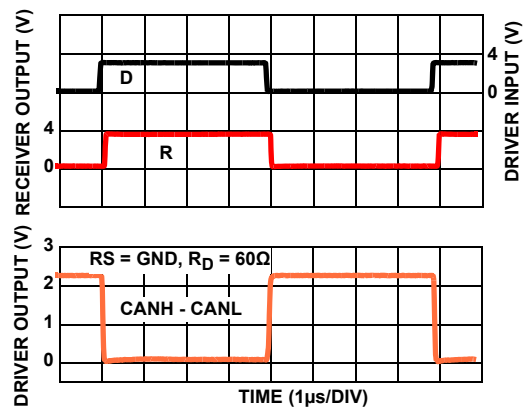


FIGURE 2. FAST DRIVER AND RECEIVER WAVEFORMS

Ordering Information

ORDERING SMD NUMBER (Note 1)	PART NUMBER (Note 2)	TEMPERATURE RANGE (°C)	PACKAGE (RoHS COMPLIANT)	PACKAGE DRAWING #
5962R1522804VXC	ISL72026BSEHVF	-55 to +125	8 Ld Ceramic Flatpack	K8.A
N/A	ISL72026BSEHF/PROTO (Note 4)	-55 to +125	8 Ld Ceramic Flatpack	K8.A
5962R1522804V9A	ISL72026BSEHVX (Note 3)	-55 to +125	Die	
N/A	ISL72026BSEHX/SAMPLE (Notes 3, 4)	-55 to +125	Die	
N/A	ISL72026BSEHEVAL1Z (Note 5)	Evaluation Board		

NOTES:

- Specifications for radiation tolerant QML devices are controlled by the Defense Logistics Agency Land and Maritime (DLA). The SMD numbers 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.
- Die product tested at $T_A = +25^\circ\text{C}$. The wafer probe test includes functional and parametric testing sufficient to make the die capable of meeting the electrical performance outlined in "Electrical Specifications" on page 5.
- The /PROTO and /SAMPLE are not rated or certified for Total Ionizing Dose (TID) or Single Event Effect (SEE) immunity. These parts are intended for engineering evaluation purposes only. The /PROTO parts meet the electrical limits and conditions across temperature specified in the DLA SMD and are in the same form and fit as the qualified device. The /SAMPLE parts are capable of meeting the electrical limits and conditions specified in the DLA SMD. The /SAMPLE parts do not receive 100% screening across temperature to the DLA SMD electrical limits. These part types do not come with a Certificate of Conformance because they are not DLA qualified devices.
- Evaluation board uses the /PROTO parts and /PROTO parts are not rated or certified for Total Ionizing Dose (TID) or Single Event Effect (SEE) immunity.

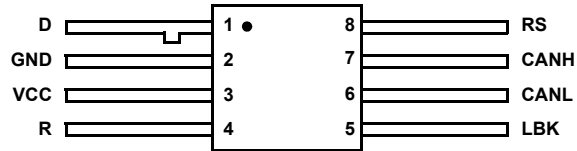
TABLE 1. ISL7202x8BSEH PRODUCT FAMILY FEATURE TABLE

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	50 μ A (Maximum)
VREF Leakage Current	N/A	$\pm 25\mu\text{A}$ (Maximum)	$\pm 25\mu\text{A}$ (Maximum)

N/A: Not Applicable

Pin Configuration

8 LD CERAMIC FLATPACK
TOP VIEW



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	LBK	A HIGH on this pin places CANH and CANL pins in a high impedance state. The rest of the circuit remains active so that the TX and RX can loopback diagnostic information. Internally tied LOW.
6	CANL	CAN bus line for low-level output
7	CANH	CAN bus line for high-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

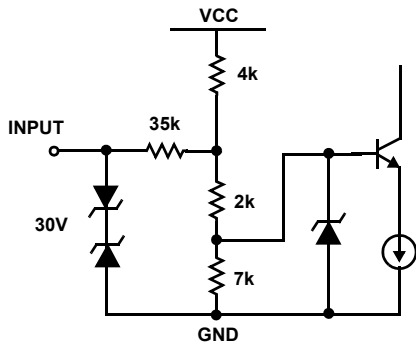


FIGURE 3. CANH AND CANL INPUTS

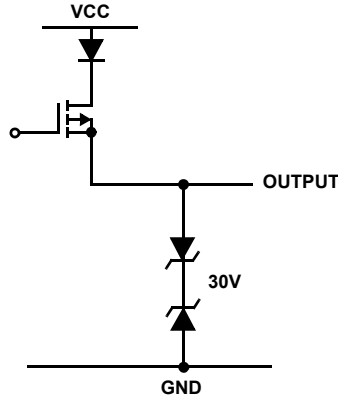


FIGURE 4. CANH OUTPUT

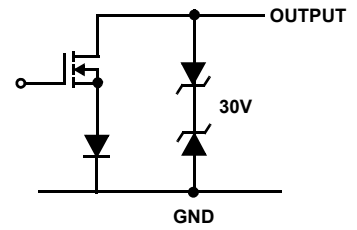


FIGURE 5. CANL OUTPUT

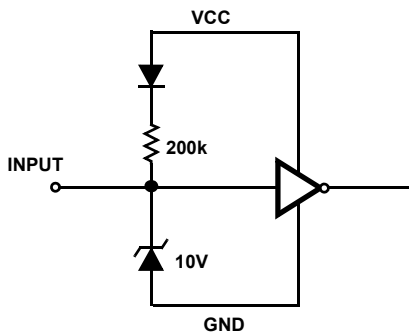


FIGURE 6. D INPUT

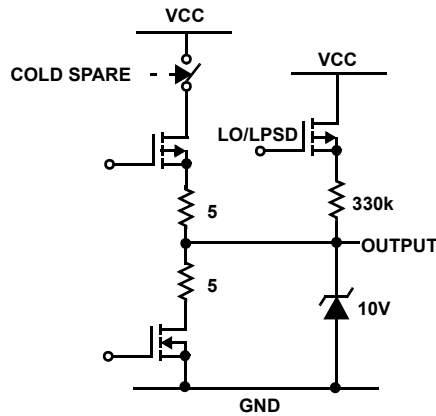


FIGURE 7. R OUTPUT

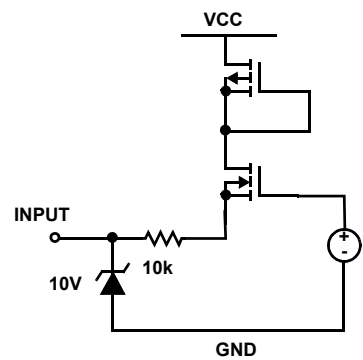


FIGURE 8. RS INPUT

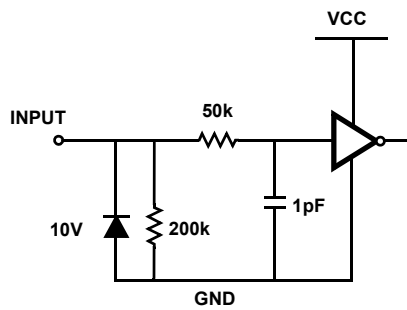


FIGURE 9. LBK INPUT

Absolute Maximum Ratings

VCC to GND with/without Ion Beam	-0.3V to 5.5V
CANH, CANL Under Ion Beam	±18V
CANH, CANL	±20V
I/O Voltages	
D, R, RS, LBK	-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)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
8 Ld FP Package (Notes 6, 7)	39	7
Maximum Junction Temperature	+175°C	
Storage Temperature Range	-65°C to +150°C	

Operating Conditions

Temperature Range	-55°C to +125°C
VCC Supply Voltage	3.0V to 3.6V
Voltage on CAN I/O	-7V to 12V
V _{IH} D Logic Pins (D, LBK)	2V to 5.5V
V _{IL} D Logic Pins (D, LBK)	0V to 0.8V
I _{OH} Driver (CANH - CANL = 1.5V, V _{CC} = 3.3V)	-40mA
I _{OH} Receiver (V _{OH} = 2.4V)	-4mA
I _{OL} Driver (CANH - CANL = 1.5V, V _{CC} = 3.3V)	+40mA
I _{OL} Receiver (V _{OL} = 0.4V)	+4mA

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

- θ_{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 [TB379](#).
- For θ_{JC} , the case temperature location is the center of the package underside.

Electrical Specifications Test Conditions: V_{CC} = 3.0V to 3.6V; typicals are at T_A = +25°C ([Note 10](#)), unless otherwise specified ([Note 8](#)). **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 9)	TYP (Note 10)	MAX (Note 9)	UNIT
DRIVER ELECTRICAL CHARACTERISTICS							
Dominant Bus Output Voltage	V _{O(DOM)}	D = 0V, CANH, RS = 0V, Figures 10 and 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	2.25	2.85	V _{CC}
		D = 0V, CANL, RS = 0V, Figures 10 and 11		Full	0.10	0.65	1.25
Recessive Bus Output Voltage	V _{O(REC)}	D = 3V, CANH, RS = 0V, 60Ω and no load, Figures 10 and 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	1.80	2.30	2.70
		D = 3V, CANL, RS = 0V, 60Ω and no load, Figures 10 and 11		Full	1.80	2.30	2.80
Dominant Output Differential Voltage	V _{OD(DOM)}	D = 0V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, Figures 10 and 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	1.5	2.2	3.0
		D = 0V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, Figures 11 and 12		Full	1.2	2.1	3.0
Recessive Output Differential Voltage	V _{OD(REC)}	D = 3V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, Figures 10 and 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	-120.0	0.2	12.0
		D = 3V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, no load		Full	-500	-34	50
Logic Input High Voltage (D, LBK)	V _{IH}	3.0V ≤ V _{CC} ≤ 3.6V, Note 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	2.0	-	5.5
Logic Input Low Voltage (D, LBK)	V _{IL}	3.0V ≤ V _{CC} ≤ 3.6V, Note 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	0	-	0.8
Logic High-Level Input Current (D, LBK)	I _{IH}	D = 2.0V, 3.0V ≤ V _{CC} ≤ 3.6V, Note 12	3.0V ≤ V _{CC} ≤ 3.6V	Full	-30	-3	30
Logic Low-Level Input Current (D, LBK)	I _{IL}	D = 0.8V, 3.0V ≤ V _{CC} ≤ 3.6V, Note 12	3.0V ≤ V _{CC} ≤ 3.6V	Full	-30	-7	30
RS Input Voltage for Listen Mode	V _{IN(RS)}	3.0V ≤ V _{CC} ≤ 3.6V	3.0V ≤ V _{CC} ≤ 3.6V	Full	0.75 x V_{CC}	1.90	5.50

Electrical Specifications Test Conditions: $V_{CC} = 3.0V$ to $3.6V$; typicals are at $T_A = +25^\circ C$ (Note 10), unless otherwise specified (Note 8). **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 $<10\text{mrad(Si)/s}$; 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 .**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 9)	TYP (Note 10)	MAX (Note 9)	UNIT
Output Short-Circuit Current	I_{OSC}	$V_{CANH} = -7V$, $CANL = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 18	Full	-250	-100	-	mA
		$V_{CANH} = +12V$, $CANL = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 18	Full	-	0.4	1.0	mA
		$V_{CANL} = -7V$, $CANH = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 18	Full	-1.0	-0.4	-	mA
		$V_{CANL} = +12V$, $CANH = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 18	Full	-	100	250	mA
Thermal Shutdown Temperature	T_{SHDN}	$3.0V < V_{IN} < 3.6V$	-	-	163	-	°C
Thermal Shutdown Hysteresis	T_{HYS}	$3.0V < V_{IN} < 3.6V$	-	-	12	-	°C
RECEIVER ELECTRICAL CHARACTERISTICS							
Input Threshold Voltage (Rising)	V_{THR}	LBK = 0V, RS = 0V, 10k, 50k, (recessive to dominant), Figures 14 and 15	Full	-	750	900	mV
Input Threshold Voltage (Falling)	V_{THF}	LBK = 0V, RS = 0V, 10k, 50k, (dominant to recessive), Figures 14 and 15	Full	500	650	-	mV
Input Hysteresis	V_{HYS}	$(V_{THR} - V_{THF})$, RS = 0V, 10k, 50k, Figures 14 and 15	Full	40	90	-	mV
Listen Mode Input Threshold Voltage (Rising)	V_{THRLM}	RS = V_{CC} , (recessive to dominant), Figure 14	Full	-	920	1150	mV
Listen Mode Input Threshold Voltage (Falling)	V_{THFLM}	RS = V_{CC} , (dominant to recessive), Figure 14	Full	525	820	-	mV
Listen Mode Input Hysteresis	V_{HYSLM}	$(V_{THR} - V_{THF})$, RS = V_{CC} , Figure 14	Full	50	100	-	mV
Receiver Output High Voltage	V_{OH}	$I_O = -4mA$	Full	2.4	$V_{CC} - 0.2$	-	V
Receiver Output Low Voltage	V_{OL}	$I_O = +4mA$	Full	-	0.2	0.4	V
Input Current for CAN Bus	I_{CAN}	CANH or CANL at 12V, D = 3V, other bus pin at 0V, LBK = RS = 0V	Full	-	420	500	μA
		CANH or CANL at 12V, D = 3V, $V_{CC} = 0V$, other bus pin at 0V, LBK = RS = 0V	Full	-	150	250	μA
		CANH or CANL at -7V, D = 3V, other bus pin at 0V, LBK = RS = 0V	Full	-400	-300	-	μA
		CANH or CANL at -7V, D = 3V, $V_{CC} = 0V$, other bus pin at 0V, LBK = RS = 0V	Full	-150	-85	-	μA
Input Capacitance (CANH or CANL)	C_{IN}	Input to GND, D = 3V, LBK = RS = 0V	25	-	35	-	pF
Differential Input Capacitance	C_{IND}	Input to Input, D = 3V, LBK = RS = 0V	25	-	15	-	pF
Input Resistance (CANH or CANL)	R_{IN}	Input to GND, D = 3V, LBK = RS = 0V	Full	20	40	50	k Ω
Differential Input Resistance	R_{IND}	Input to Input, D = 3V, LBK = RS = 0V	Full	40	80	100	k Ω
SUPPLY CURRENT							
Supply Current, Listen Mode	$I_{CC(L)}$	RS = D = V_{CC} , LBK = 0V, $3.0V \leq V_{CC} \leq 3.6V$	Full	-	1	2	mA
Supply Current, Dominant	$I_{CC(DOM)}$	D = LBK = RS = 0V, no load, $3.0V \leq V_{CC} \leq 3.6V$	Full	-	5	7	mA
Supply Current, Recessive	$I_{CC(REC)}$	D = V_{CC} , LBK = RS = 0V, no load, $3.0V \leq V_{CC} \leq 3.6V$	Full	-	2.6	5	mA
COLD SPARING BUS CURRENT							
CANH Leakage Current	$I_{L(CANH)}$	$V_{CC} = 0.2V$, CANH = -7V or 12V, CANL = float, D = V_{CC} , RS = 0V	Full	-25	-4	25	μA
CANL Leakage Current	$I_{L(CANL)}$	$V_{CC} = 0.2V$, CANL = -7V or 12V, CANH = float, D = V_{CC} , RS = 0V	Full	-25	-4	25	μA

Electrical Specifications Test Conditions: $V_{CC} = 3.0V$ to $3.6V$; typicals are at $T_A = +25^\circ C$ (Note 10), unless otherwise specified (Note 8). **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 $<10mrads(Si)/s$; 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 $300krad(Si)/s$.**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP ($^\circ C$)	MIN (Note 9)	TYP (Note 10)	MAX (Note 9)	UNIT
DRIVER SWITCHING CHARACTERISTICS							
Propagation Delay LOW to HIGH	t_{PDLH1}	RS = 0V, Figure 13	Full	-	75	150	ns
Propagation Delay LOW to HIGH	t_{PDLH2}	RS = 10k Ω , Figure 13	Full	-	520	850	ns
Propagation Delay LOW to HIGH	t_{PDLH3}	RS = 50k Ω , Figure 13	Full	-	850	1400	ns
Propagation Delay HIGH to LOW	t_{PDHL1}	RS = 0V, Figure 13	Full	-	80	155	ns
Propagation Delay HIGH to LOW	t_{PDHL2}	RS = 10k Ω , Figure 13	Full	-	460	800	ns
Propagation Delay HIGH to LOW	t_{PDHL3}	RS = 50k Ω , Figure 13	Full	-	725	1300	ns
Output Skew	t_{SKEW1}	RS = 0V, ($ t_{PHL} - t_{PLH} $), Figure 13	Full	-	5	50	ns
Output Skew	t_{SKEW2}	RS = 10k Ω , ($ t_{PHL} - t_{PLH} $), Figure 13	Full	-	60	510	ns
Output Skew	t_{SKEW3}	RS = 50k Ω , ($ t_{PHL} - t_{PLH} $), Figure 13	Full	-	110	800	ns
Output Rise Time	t_{r1}	RS = 0V, (fast speed)	Full	20	55	100	ns
Output Fall Time	t_{f1}	Figure 13	Full	10	25	75	ns
Output Rise Time	t_{r2}	RS = 10k Ω , (medium speed - 250kbps)	Full	200	400	780	ns
Output Fall Time	t_{f2}	Figure 13	Full	175	300	500	ns
Output Rise Time	t_{r3}	RS = 50k Ω , (slow speed - 125kbps)	Full	400	700	1400	ns
Output Fall Time	t_{f3}	Figure 13	Full	300	650	1000	ns
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant	$t_{(LOOP1)}$	RS = 0V, Figure 16	Full	-	115	210	ns
		RS = 10k Ω , Figure 16	Full	-	550	875	ns
		RS = 50k Ω , Figure 16	Full	-	850	1400	ns
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive	$t_{(LOOP2)}$	RS = 0V, Figure 16	Full	-	130	270	ns
		RS = 10k Ω , Figure 16	Full	-	500	825	ns
		RS = 50k Ω , Figure 16	Full	-	750	1300	ns
Listen to Valid Dominant Time	t_{L-DOM}	Figure 15	Full	-	5	15	μs
RECEIVER SWITCHING CHARACTERISTICS							
Propagation Delay LOW to HIGH	t_{PLH}	Figure 14	Full	-	50	110	ns
Propagation Delay HIGH to LOW	t_{PHL}	Figure 14	Full	-	50	110	ns
Rx Skew	t_{SKEW1}	$ t_{PHL} - t_{PLH} $, Figure 14	Full	-	2	35	ns
Rx Rise Time	t_r	Figure 14	Full	-	2	-	ns
Rx Fall Time	t_f	Figure 14	Full	-	2	-	ns
LBK Delay I/O to Rx Output	t_{LBK}	Figure 17, Note 12	Full	-	35	75	ns
RS PIN CHARACTERISTICS							
RS Input Current	$I_{RS(H)}$	RS = $0.75 \times V_{CC}$	Full	-10.0	-0.2	-	∞A
	$I_{RS(L)}$	$V_{RS} = 0V$	Full	-450	-125	0	∞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.
- Performed during the 100% screening operations across the full operating temperature range. Not performed as part of TCI Group E and Group C. Radiation characterization testing performed as part of the initial release and any major changes in design.

Test Circuits and Waveforms

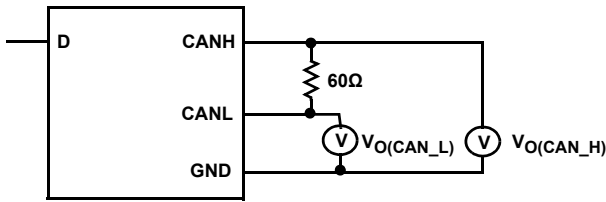


FIGURE 10. DRIVER TEST CIRCUIT

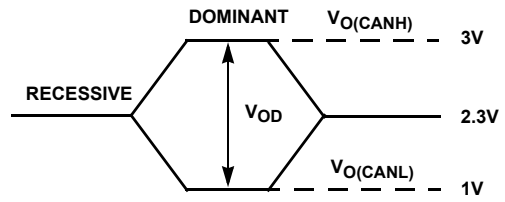


FIGURE 11. DRIVER BUS VOLTAGE DEFINITIONS

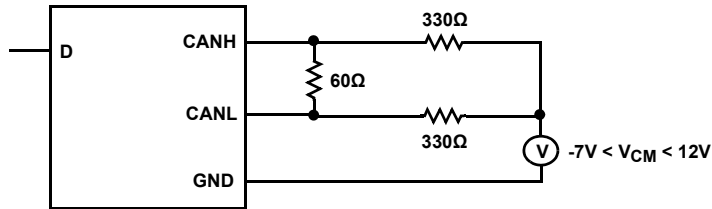
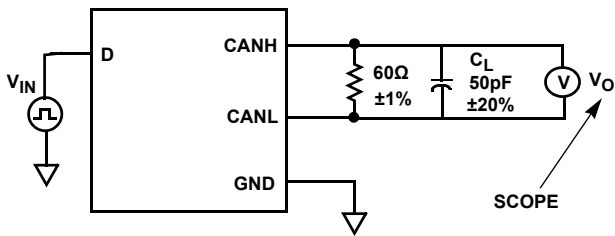


FIGURE 12. DRIVER COMMON-MODE CIRCUIT



$V_{IN} = 125\text{kHz}$, 0V 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

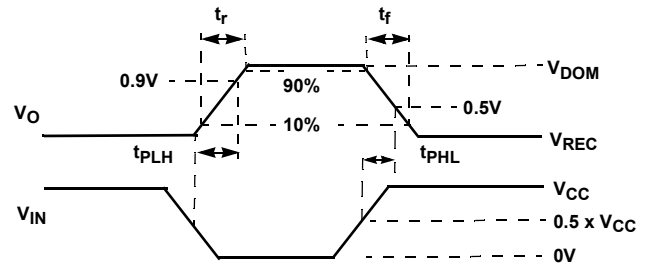


FIGURE 13B. DRIVER TIMING MEASUREMENT POINTS

FIGURE 13. DRIVER TIMING

Test Circuits and Waveforms (Continued)

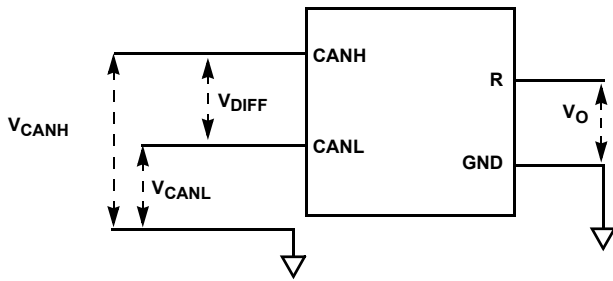
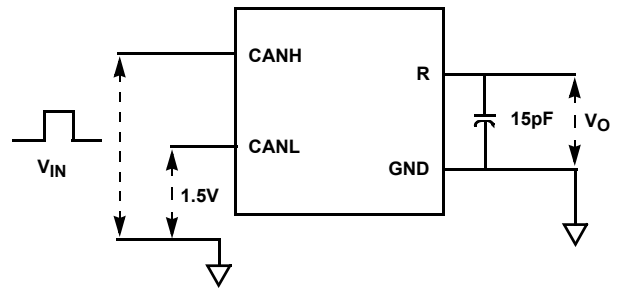


FIGURE 14A. RECEIVER VOLTAGE DEFINITIONS



$V_{IN} = 125\text{kHz}$, 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

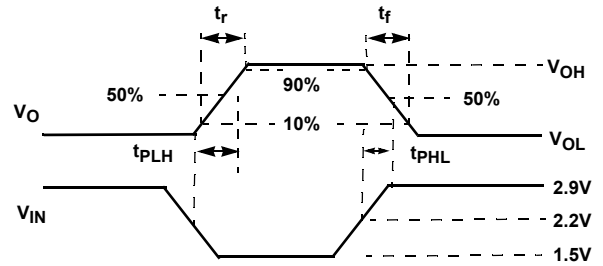


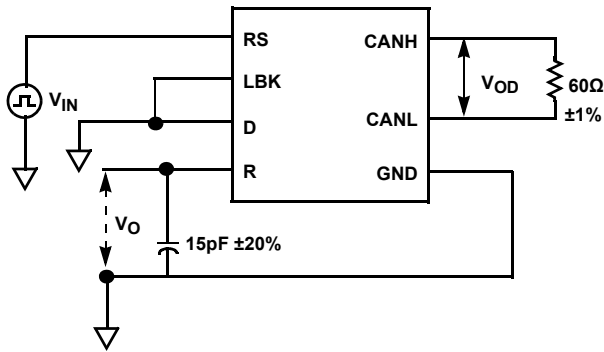
FIGURE 14C. RECEIVER TEST MEASUREMENT POINTS

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)



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

FIGURE 15A. LISTEN TO VALID DOMINANT TIME TEST CIRCUIT

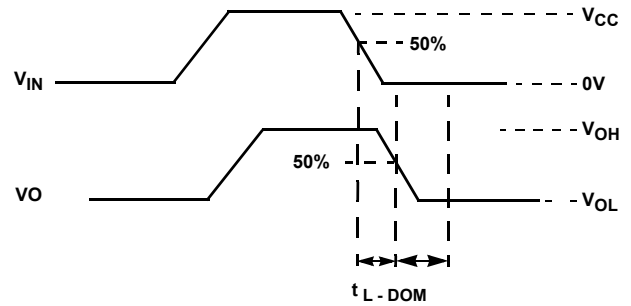
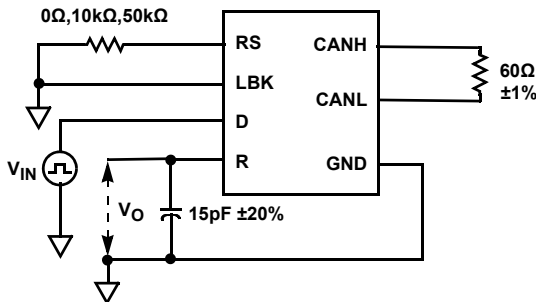


FIGURE 15B. LISTEN TO VALID DOMINANT TIME MEASUREMENT POINTS

FIGURE 15. LISTEN TO VALID DOMINANT TIME



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

FIGURE 16A. TOTAL LOOP DELAY TEST CIRCUIT

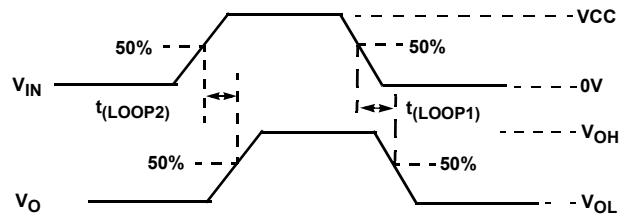
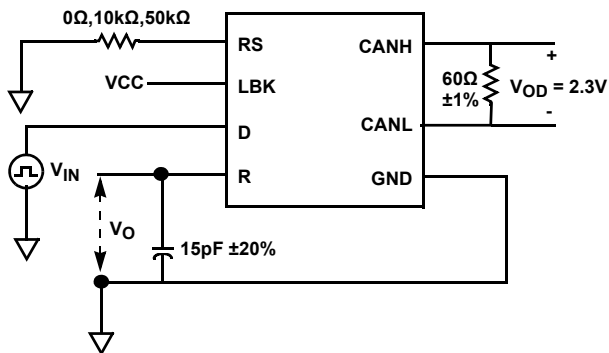


FIGURE 16B. TOTAL LOOP DELAY MEASUREMENT POINTS

FIGURE 16. TOTAL LOOP DELAY



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

FIGURE 17A. LOOP BACK DELAY TO DOMINANT TIME TEST CIRCUIT

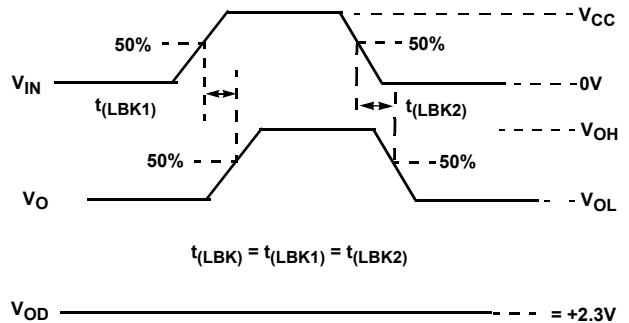


FIGURE 17B. LOOP BACK DELAY TO DOMINANT MEASUREMENT POINTS

FIGURE 17. LOOP BACK DELAY

Test Circuits and Waveforms (Continued)

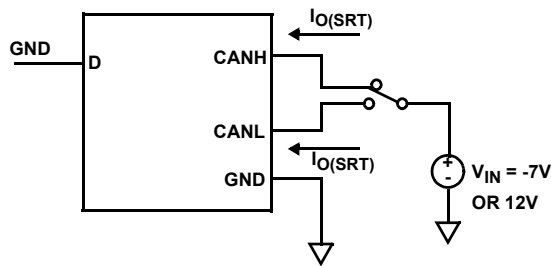


FIGURE 18A. OUTPUT SHORT-CIRCUIT CURRENT TEST CIRCUIT

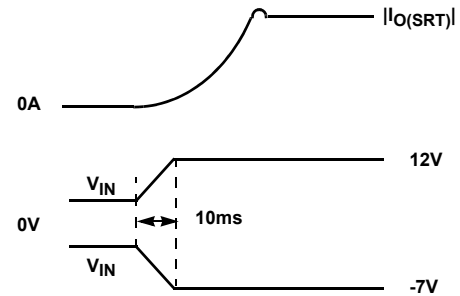


FIGURE 18B. OUTPUT SHORT-CIRCUIT CURRENT WAVEFORMS

FIGURE 18. OUTPUT SHORT-CIRCUIT CURRENT

Functional Description

Overview

The ISL72026BSEH is a 3.3V, radiation tolerant Controller Area Network (CAN) transceiver that is compatible with the ISO11898-2 standard for use in 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 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 120Ω . 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. 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 CANH or CANL bus 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.

Loopback Mode

When a high level is applied to the LBK pin, the device enters the loopback state. The transceiver CANH and CANL pins are disconnected from the bus. The driver and receiver circuitry of the transceiver remains active to allow for diagnostic testing of the node.

Using 3.3V Devices in 5V Systems

Looking at the differential voltages of both the 3.3V and 5V devices, the differential voltage is the same and the recessive common-mode output 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.

Typical Performance Curves

Unless otherwise specified, $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$.

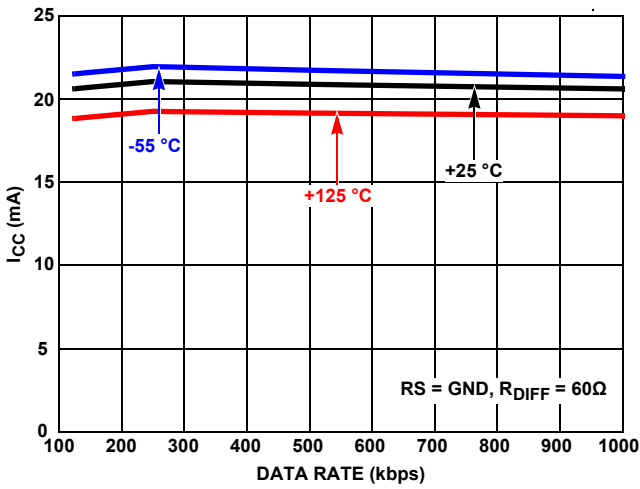


FIGURE 19. SUPPLY CURRENT vs FAST DATA RATE vs TEMPERATURE

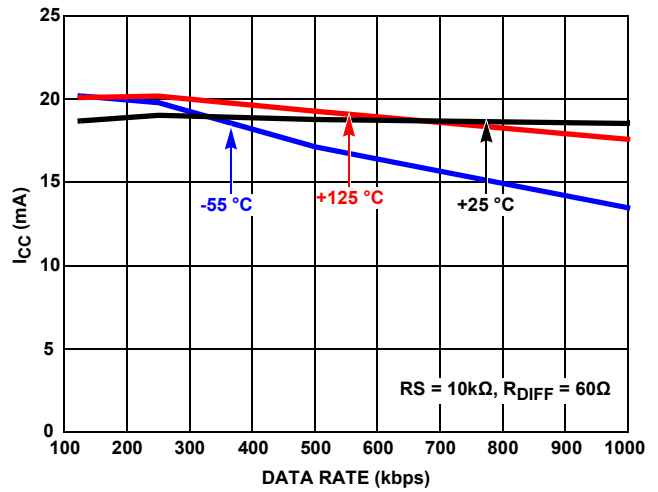


FIGURE 20. SUPPLY CURRENT vs MEDIUM DATA RATE vs TEMPERATURE

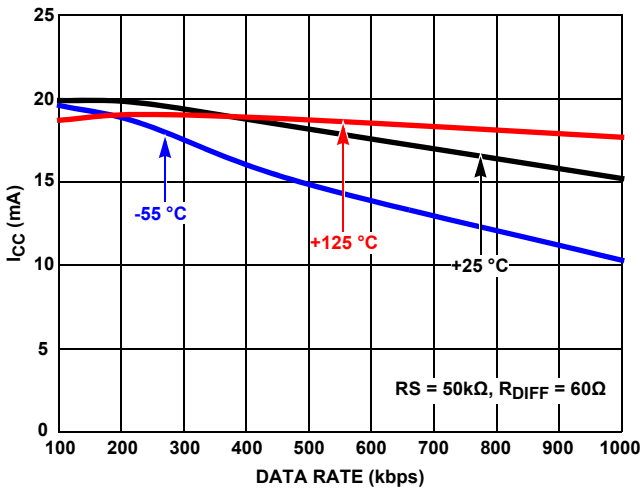


FIGURE 21. SUPPLY CURRENT vs SLOW DATA RATE vs TEMPERATURE

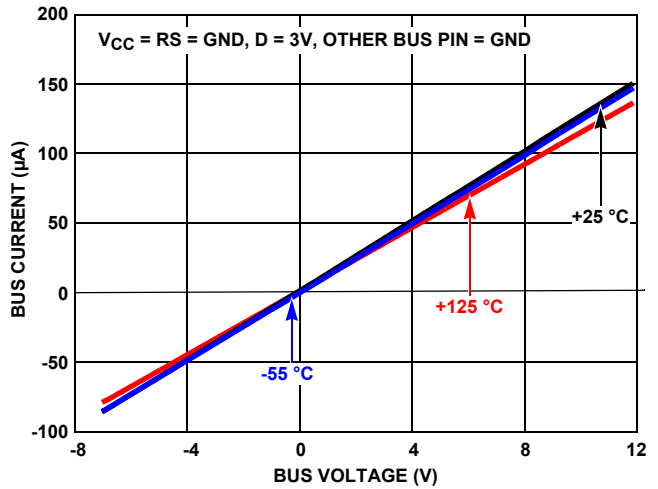


FIGURE 22. BUS PIN LEAKAGE vs VCM AT $V_{CC} = 0\text{V}$

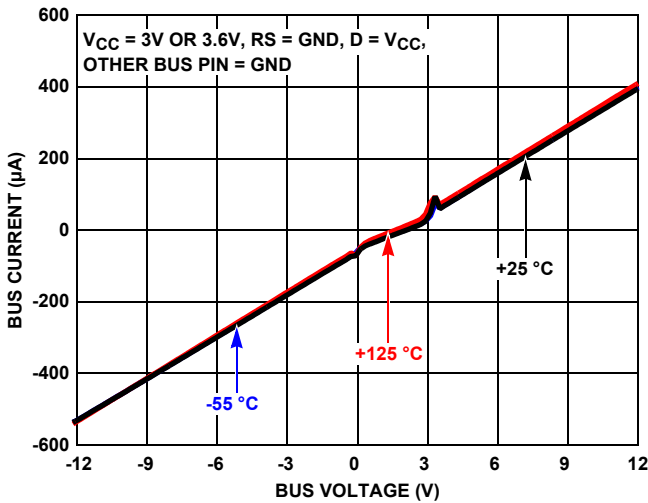


FIGURE 23. BUS PIN LEAKAGE vs $\pm 12\text{V}$ VCM

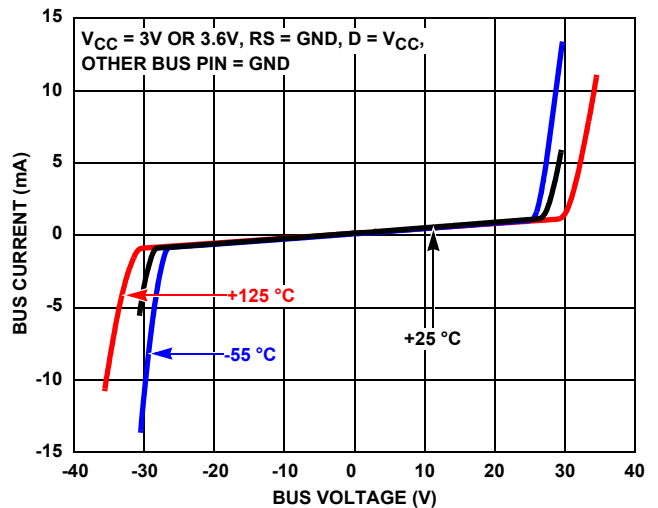


FIGURE 24. BUS PIN LEAKAGE vs $\pm 35\text{V}$ VCM

Typical Performance Curves

Unless otherwise specified, $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$. (Continued)

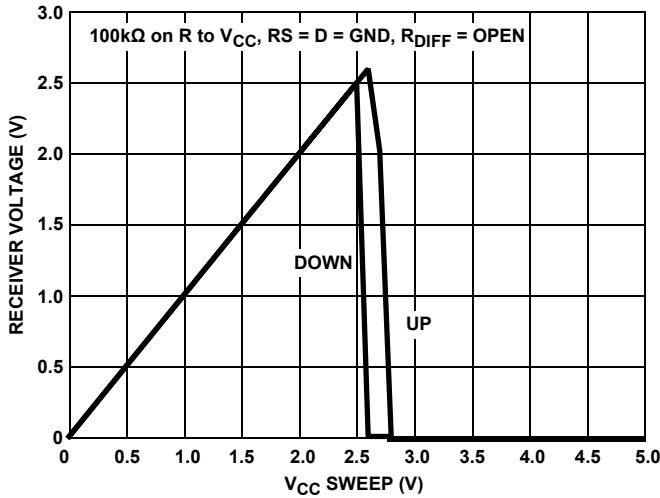


FIGURE 25. V_{CC} UNDERVOLTAGE LOCKOUT

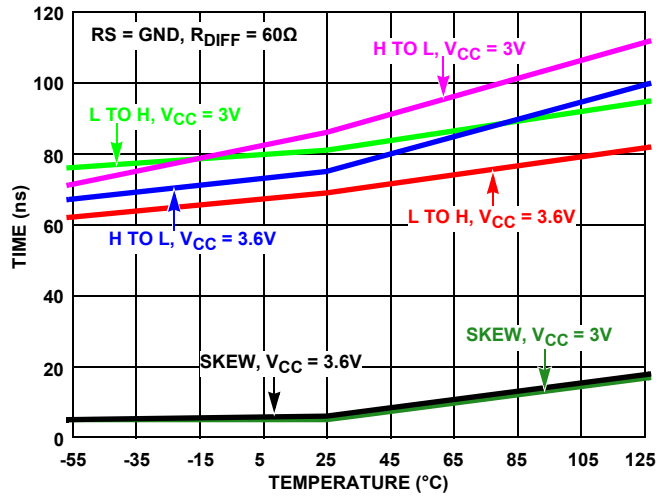


FIGURE 26. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT FAST SPEED

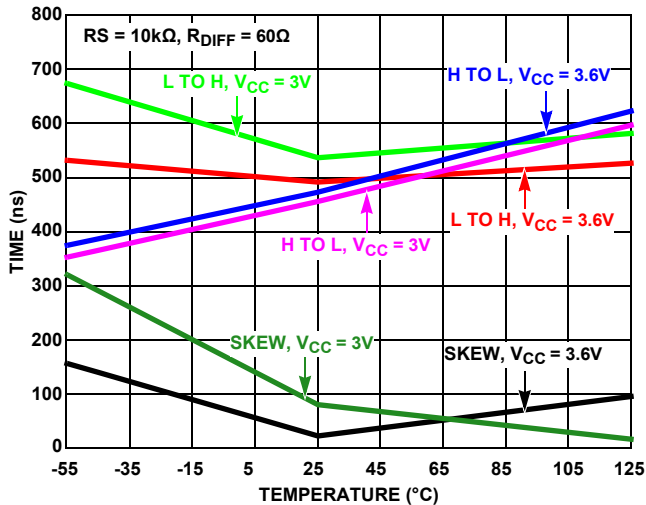


FIGURE 27. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT MEDIUM SPEED

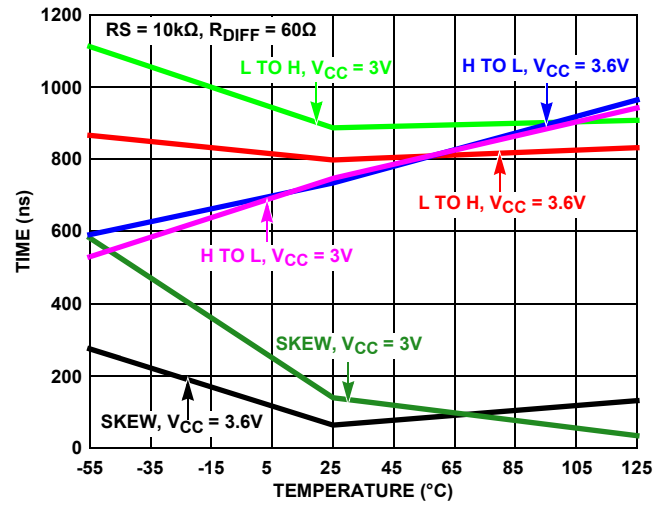


FIGURE 28. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT SLOW SPEED

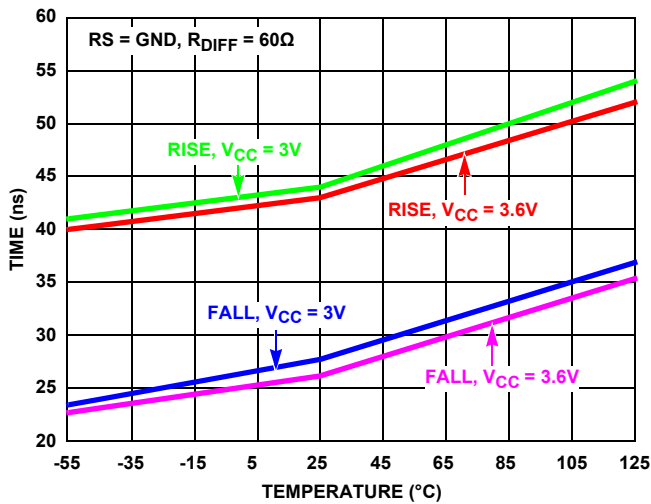


FIGURE 29. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT FAST SPEED

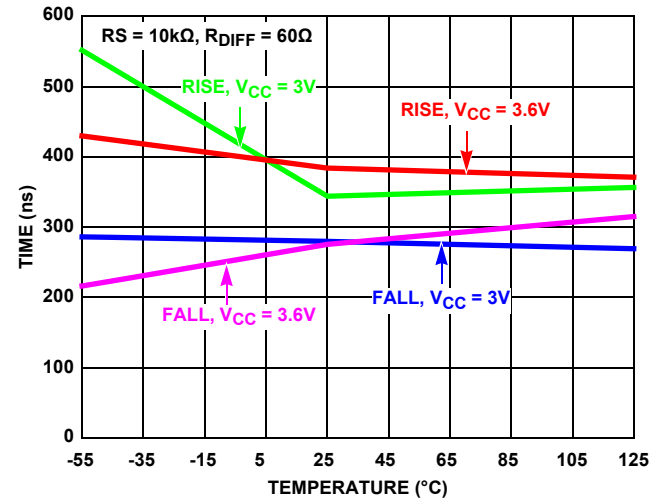


FIGURE 30. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT MEDIUM SPEED

Typical Performance Curves

Unless otherwise specified, $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$. (Continued)

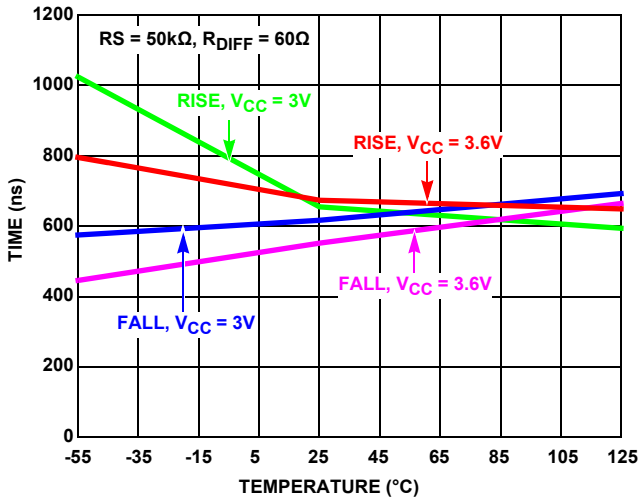


FIGURE 31. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT SLOW SPEED

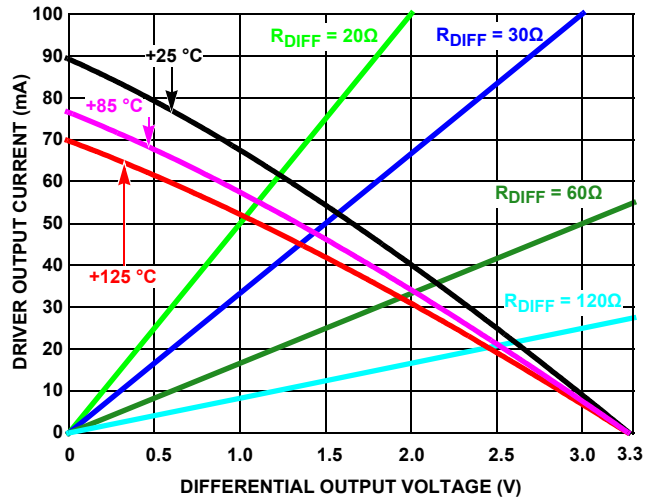


FIGURE 32. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

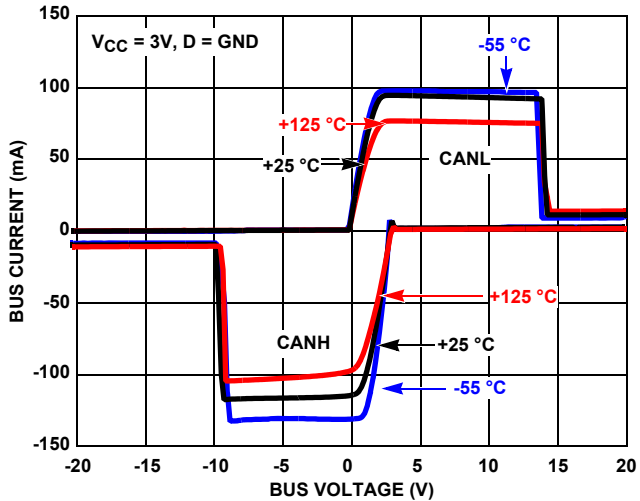


FIGURE 33. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE vs TEMPERATURE

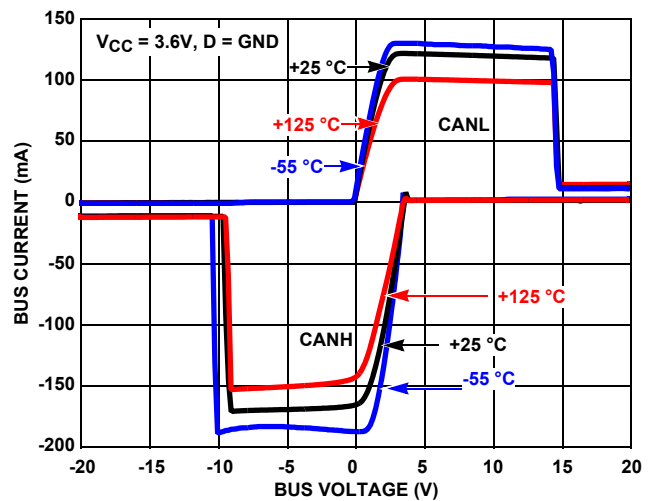


FIGURE 34. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE vs TEMPERATURE

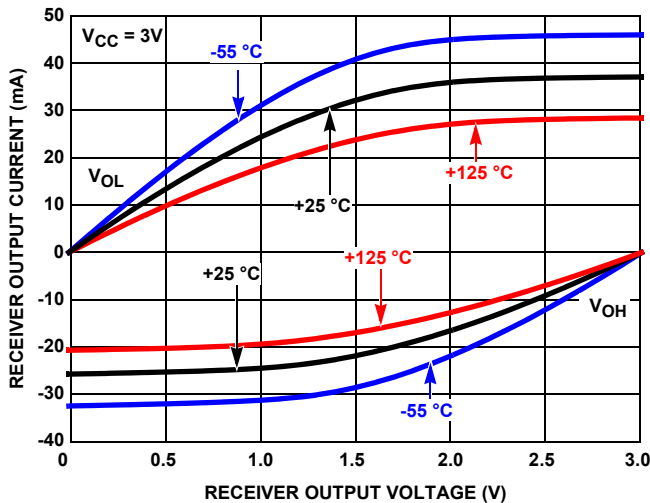


FIGURE 35. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE AT $V_{CC} = 3\text{V}$

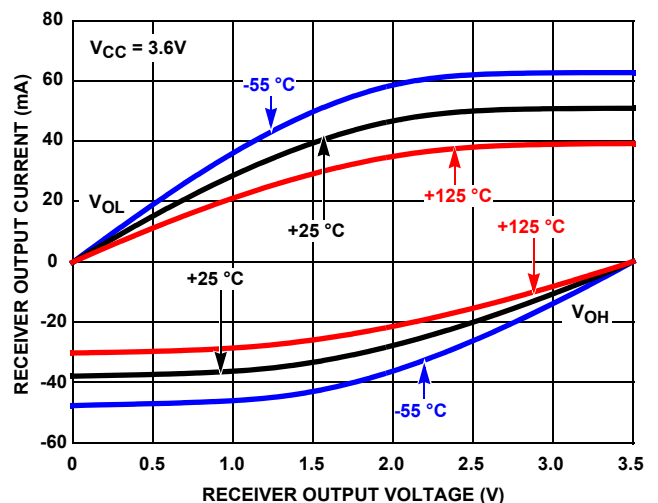


FIGURE 36. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE AT $V_{CC} = 3.6\text{V}$

Typical Performance Curves

Unless otherwise specified, $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$. (Continued)

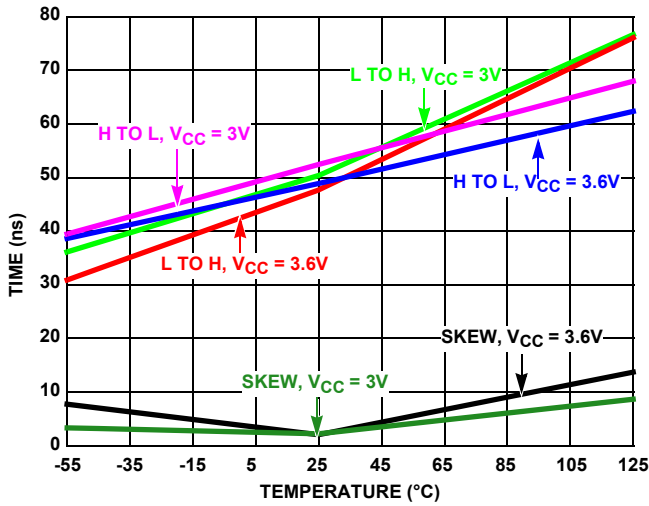


FIGURE 37. RECEIVER PROPAGATION DELAY AND SKEW vs TEMPERATURE

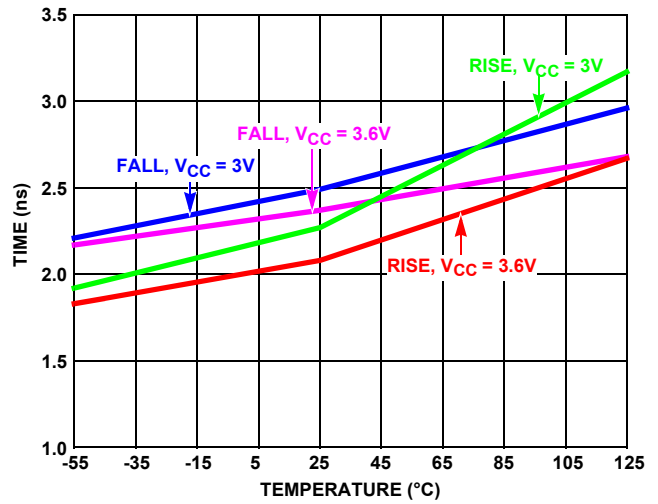


FIGURE 38. RECEIVER RISE AND FALL TIMES vs TEMPERATURE

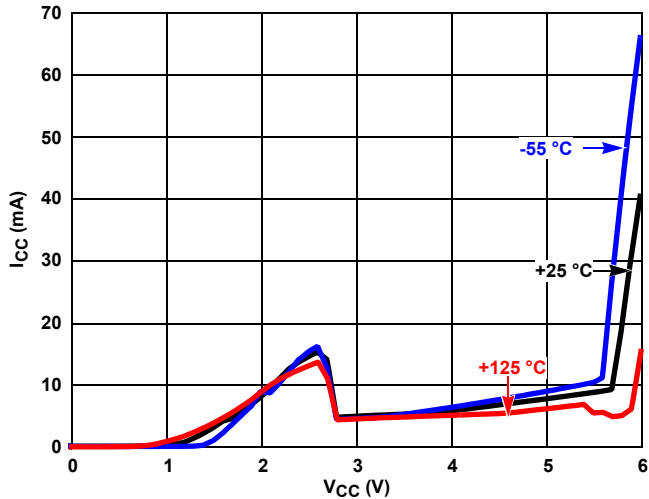


FIGURE 39. SUPPLY CURRENT vs SUPPLY VOLTAGE vs TEMPERATURE

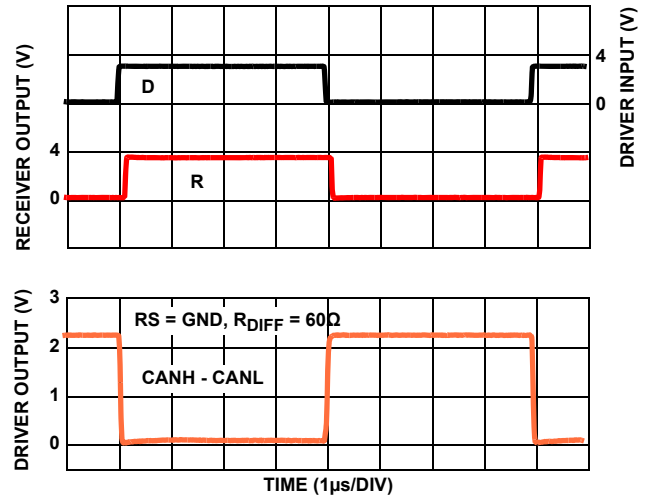


FIGURE 40. FAST DRIVER AND RECEIVER WAVEFORMS

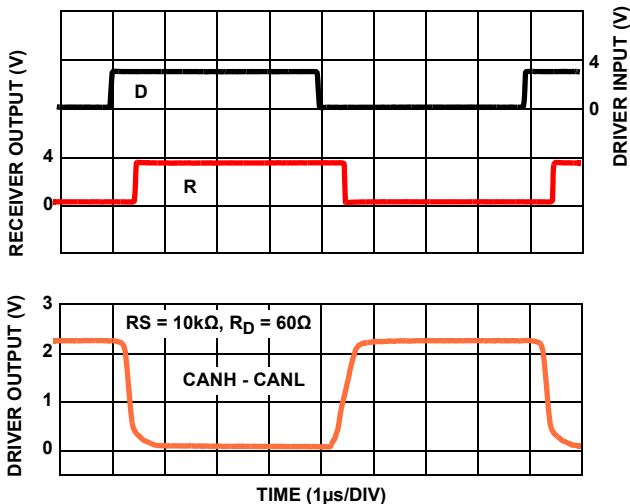


FIGURE 41. MEDIUM DRIVER AND RECEIVER WAVEFORMS

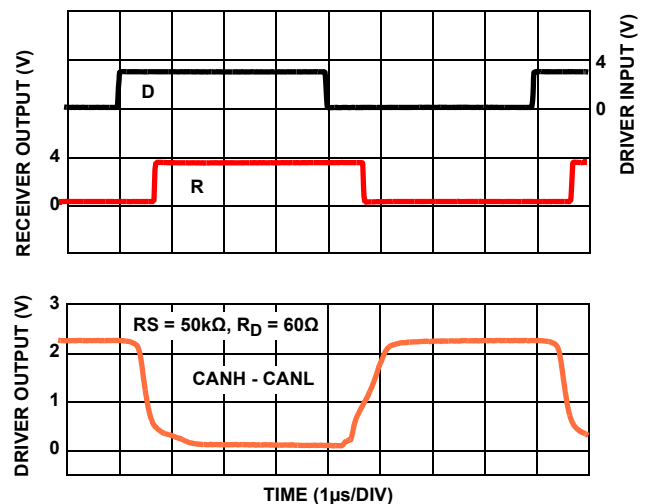


FIGURE 42. SLOW DRIVER AND RECEIVER WAVEFORMS

Die 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

P6SOI

Assembly Related Information

SUBSTRATE POTENTIAL

Floating

Additional Information

WORST CASE CURRENT DENSITY

1.6 x 105A/cm²

TRANSISTOR COUNT

4055

Weight of Packaged Device

0.31 grams

Lid Characteristics

Finish: Gold

Potential: Grounded, tied to package pin 2

Metalization Mask Layout

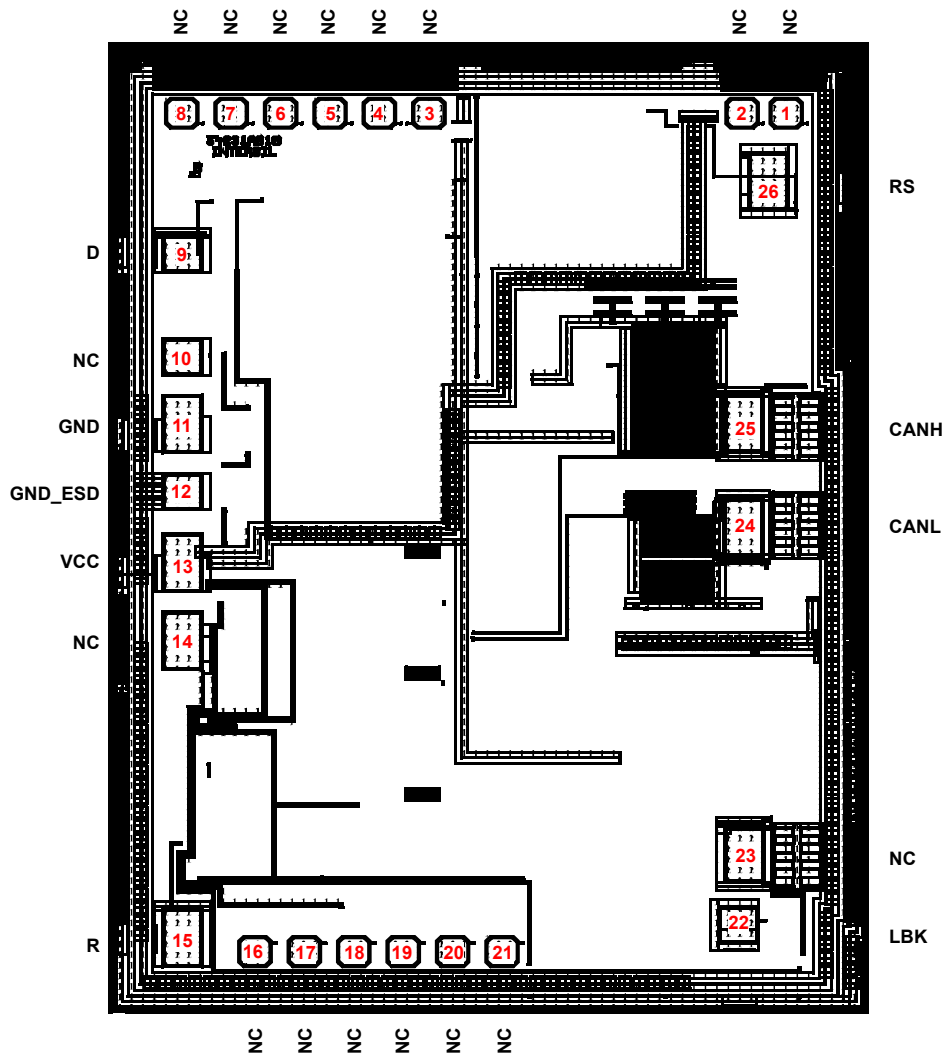


TABLE 3. ISL72026BSEH DIE LAYOUT X-Y COORDINATES

PAD NUMBER	PAD NAME	X (μm)	Y (μm)	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	NC	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	LBK	110.0	110.0	756.9	-1307.3
23	NC	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

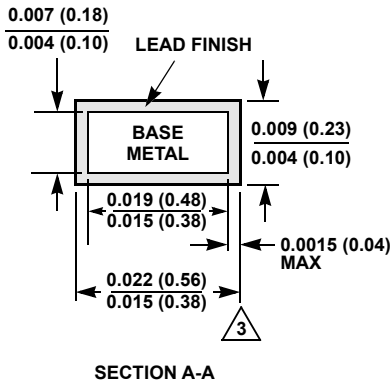
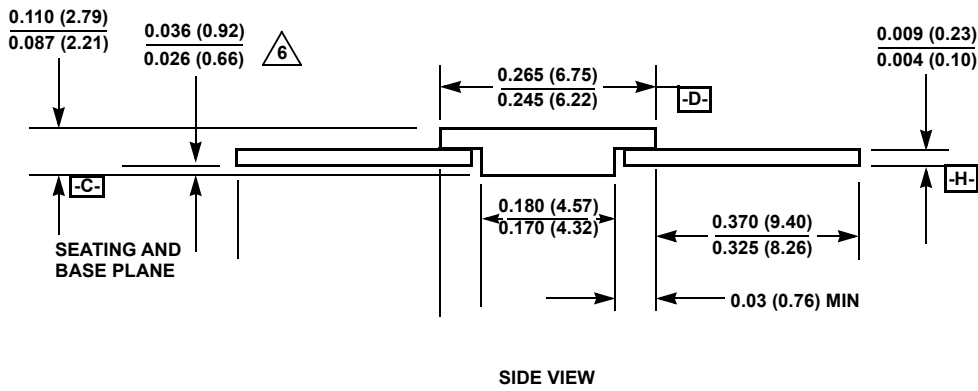
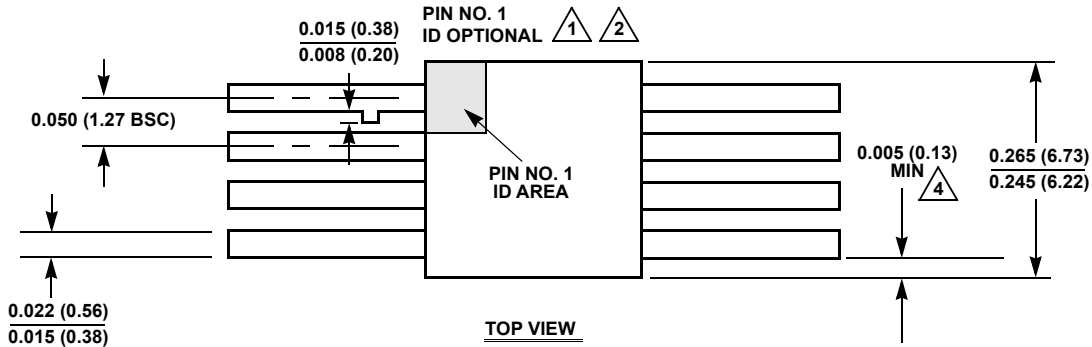
Revision History The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please visit our website to make sure that you have the latest revision.

DATE	REVISION	CHANGE
Jan 10, 2020	FN8900.1	Updated links throughout document. Updated the formatting of the radiation testing feature bullets. Corrected the ordering SMD number for ISL72026BSEHVF. Added Notes 3 and 5. Updated Note 4. Updated disclaimer.
Dec 1, 2016	FN8900.0	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.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
 2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
 3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
 4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
 5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
 - "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
 - "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
 6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
 7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
 8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
 9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
 10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
 11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
 12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
- (Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
- (Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.