

ISL71026M

3.3V CAN Transceiver, 1Mbps, Listen Mode, Loopback

FN8915  
Rev.1.00  
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The [ISL71026M](#) 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 of up to 1Mbps. The device is designed to operate across 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.

The ISL71026M is available in a plastic 14 Ld TSSOP package. It operates across the temperature range of -55°C to +125°C. The logic inputs are tolerant with 5V systems.

**Applications**

- Telemetry data processing in commercial satellites
- Low earth orbits (LEO) applications
- Launch vehicles and high altitude avionics

**Features**

- ESD protection on all pins: 5kV HBM
- Bus pin fault protection to ±20V
- Cold spare: powered down devices/nodes will not affect active devices operating in parallel
- Three selectable driver rise and fall times
- Full fail-safe (open, short, terminated/undriven) receiver
- Quiescent supply current: 7mA (max), Listen mode supply current: 2mA (max)
- Tin (Sn) free lead finish with Ni/Pd/Au-Ag lead finish
- Passes NASA Low Outgassing Specifications
- Characterized Radiation Level:
  - 30krad(Si) at a low dose rate
  - Single event effects at LET = 43MeV•cm<sup>2</sup>/mg

**Related Literature**

For a full list of related documents, visit our website

- [ISL71026M](#) product page

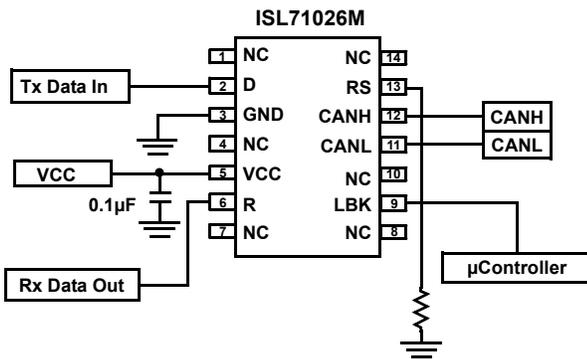


Figure 1. Typical Application

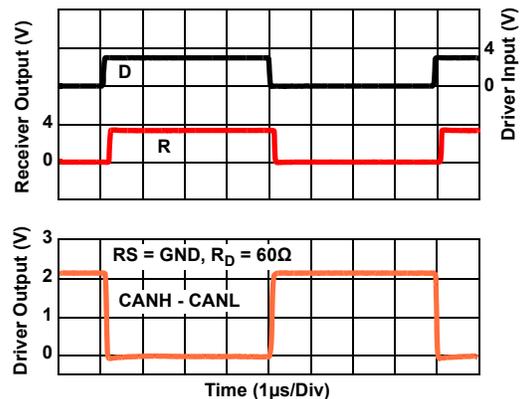


Figure 2. Fast Driver and Receiver Waveforms

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## 1. Overview

### 1.1 Ordering Information

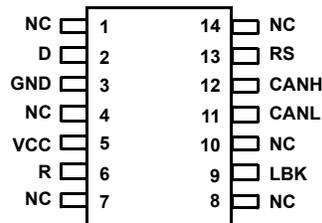
Part Number (Notes 2, 3)	Part Marking	Temperature Range (°C)	Tape and Reel (Units)	Package (RoHS Compliant)	Package Drawing #
ISL71026MVZ	71026 MVZ	-55 to +125	-	14 Ld TSSOP	M14.173
ISL71026MVZ-T (Note 1)	71026 MVZ	-55 to +125	2.5k	14 Ld TSSOP	M14.173
ISL71026MVZ-T7A (Note 1)	71026 MVZ	-55 to +125	250	14 Ld TSSOP	M14.173
ISL71026MEVAL1Z	Evaluation Board				

Notes:

- Refer to [TB347](#) for details about reel specifications.
- These Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and NiPdAu-Ag plate -e4 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
- For Moisture Sensitivity Level (MSL), see the [ISL71026M](#) product information page. For more information about MSL, see [TB363](#).

### 1.2 Pin Configuration

ISL71026M  
14 Ld TSSOP  
Top View



### 1.3 Pin Descriptions

Pin Number	Pin Name	Function
1, 4, 7, 8, 10, 14	NC	No connect.
2	D	CAN driver digital input. The bus states are LOW = Dominant and HIGH = Recessive. Internally tied HIGH.
3	GND	Ground connection.
5	VCC	System power supply input (3.0V to 3.6V). The typical voltage for the device is 3.3V.
6	R	CAN Data Receiver Output. The bus states are LOW = Dominant and HIGH = Recessive.
9	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.
11	CANL	CAN bus line for low level output.
12	CANH	CAN bus line for high level output.
13	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.

## 2. Specifications

### 2.1 Absolute Maximum Ratings

Parameter	Minimum	Maximum	Unit
VCC to GND	-0.3V	5.5	V
CANH, CANL, VREF		±20	V
I/O Voltages D, R, RS	-0.5	7	V
Receiver Output Current	-10	10	mA
Output Short-Circuit Duration		Continuous	
<b>ESD Rating</b>	<b>Value</b>		<b>Unit</b>
Human Body Model (Tested per JS-001-2014)	5		kV
Charged Device Model (Tested per JS-002-2014)	2		kV
Machine Model (Tested per JESD22-A115-C)	300		V
Latch-up (Tested per JESD-78E; Class 2, Level A) at +125°C	100		mA

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.

### 2.2 Outgas Testing

Specification (Tested per ASTM E 595, 1.5)	Value	Unit
Total Mass Lost ( <a href="#">Note 4</a> )	0.06	%
Collected Volatile Condensable Material ( <a href="#">Note 4</a> )	<0.01	%
Water Vapor Recovered	0.03	%

Note:

4. Results meet NASA low outgassing requirements of "Total Mass Lost" of <1% and "Collected Volatile Condensable Material" of <0.1%.

### 2.3 Thermal Information

Thermal Resistance (Typical)	$\theta_{JA}$ (°C/W)	$\theta_{JC}$ (°C/W)
14 Ld TSSOP Package ( <a href="#">Notes 5, 6</a> )	92	30

Notes:

5.  $\theta_{JA}$  is measured with the component mounted on a high-effective thermal conductivity test board in free air. See [TB379](#).  
 6. For  $\theta_{JC}$ , the "case temp" location is taken at the package top center.

Parameter	Minimum	Maximum	Unit
Maximum Junction Temperature		+150	°C
Storage Temperature Range	-65	+150	°C
Pb-Free Reflow Profile	Refer to <a href="#">TB493</a>		

## 2.4 Operating Conditions

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

## 2.5 Electrical Specifications

Test Conditions: V<sub>CC</sub> = 3.0V to 3.6V; Typicals are at T<sub>A</sub> = +25°C (Note 9); unless otherwise specified (Note 7). **Boldface limits apply across the operating temperature range, -55°C to +125°C.**

Parameter	Symbol	Test Conditions	Min (Note 8)	Typ (Note 9)	Max (Note 8)	Unit	
<b>Driver Electrical Characteristics</b>							
Dominant Bus Output Voltage	V <sub>O(DOM)</sub>	D = 0V, CANH, RS = 0V, Figures 10 and 11	3.0V ≤ V <sub>CC</sub> ≤ 3.6V	<b>2.25</b>	2.57	V <sub>CC</sub>	V
		D = 0V, CANL, RS = 0V, Figures 10 and 11		<b>0.1</b>	0.58	<b>1.25</b>	V
Recessive Bus Output Voltage	V <sub>O(REC)</sub>	D = 3V, CANH, RS = 0V, 60Ω and no load, Figures 10 and 11	3.0V ≤ V <sub>CC</sub> ≤ 3.6V	<b>1.80</b>	2.1	<b>2.70</b>	V
		D = 3V, CANL, RS = 0V, 60Ω and no load, Figures 10 and 11		<b>1.80</b>	2.1	<b>2.80</b>	V
Dominant Output Differential Voltage	V <sub>OD(DOM)</sub>	D = 0V, RS = 0V, 3.0V ≤ V <sub>CC</sub> ≤ 3.6V, Figures 10 and 11		<b>1.5</b>	2.4	<b>3</b>	V
		D = 0V, RS = 0V, 3.0V ≤ V <sub>CC</sub> ≤ 3.6V, Figures 11 and 12		<b>1.2</b>	2.0	<b>3</b>	V
Recessive Output Differential Voltage	V <sub>OD(REC)</sub>	D = 3V, RS = 0V, 3.0V ≤ V <sub>CC</sub> ≤ 3.6V, Figures 10 and 11		<b>-120</b>	0.2	<b>12</b>	mV
		D = 3V, RS = 0V, 3.0V ≤ V <sub>CC</sub> ≤ 3.6V, no load		<b>-500</b>	-30	<b>50</b>	mV
Logic Input High Voltage (D, LBK)	V <sub>IH</sub>	3.0V ≤ V <sub>CC</sub> ≤ 3.6V, Note 10	<b>2.0</b>	-	<b>5.5</b>	V	
Logic Input Low Voltage (D, LBK)	V <sub>IL</sub>	3.0V ≤ V <sub>CC</sub> ≤ 3.6V, Note 10	<b>0</b>	-	<b>0.8</b>	V	
Logic High Level Input Current (D, LBK)	I <sub>IH</sub>	D = 2.0V, 3.0V ≤ V <sub>CC</sub> ≤ 3.6V	<b>-30</b>	-3	<b>30</b>	μA	
Logic Low Level Input Current (D, LBK)	I <sub>IL</sub>	D = 0.8V, 3.0V ≤ V <sub>CC</sub> ≤ 3.6V	<b>-30</b>	-7	<b>30</b>	μA	
RS Input Voltage for Listen Mode	V <sub>IN(RS)</sub>	3.0V ≤ V <sub>CC</sub> ≤ 3.6V	<b>0.75 V<sub>CC</sub></b>	1.9	<b>5.5</b>	V	

Test Conditions:  $V_{CC} = 3.0V$  to  $3.6V$ ; Typicals are at  $T_A = +25^\circ C$  (Note 9); unless otherwise specified (Note 7). **Boldface limits apply across the operating temperature range,  $-55^\circ C$  to  $+125^\circ C$ .** (Continued)

Parameter	Symbol	Test Conditions	Min (Note 8)	Typ (Note 9)	Max (Note 8)	Unit
Output Short-Circuit Current	$I_{OSC}$	$V_{CANH} = -7V$ , CANL = Open, $3.0V \leq V_{CC} \leq 3.6V$ , <a href="#">Figure 24</a>	<b>-250</b>	-108	-	mA
		$V_{CANH} = +12V$ , CANL = Open, $3.0V \leq V_{CC} \leq 3.6V$ , <a href="#">Figure 24</a>	-	0.4	<b>1</b>	mA
		$V_{CANL} = -7V$ , CANH = Open, $3.0V \leq V_{CC} \leq 3.6V$ , <a href="#">Figure 24</a>	<b>-1</b>	-0.4	-	mA
		$V_{CANL} = +12V$ , CANH = Open, $3.0V \leq V_{CC} \leq 3.6V$ , <a href="#">Figure 24</a>	-	90	<b>250</b>	mA
Thermal Shutdown Temperature	$T_{SHDN}$	$3.0V < V_{IN} < 3.6V$	-	163	-	$^\circ C$
Thermal Shutdown Hysteresis	$T_{HYS}$	$3.0V < V_{IN} < 3.6V$	-	12	-	$^\circ C$
<b>Receiver Electrical Characteristics</b>						
Input Threshold Voltage (Rising)	$V_{THR}$	LBK = 0V, RS = 0V, 10k, 50k, (recessive to dominant), Common Mode Voltage Range: -2V to +7V, <a href="#">Figure 16</a>	-	740	<b>900</b>	mV
		LBK = 0V, RS = 0V, 10k, 50k, (recessive to dominant), Common Mode Voltage Range: <-2V to -7V or >+7V to +12V, <a href="#">Figure 16</a>	-	740	<b>950</b>	mV
Input Threshold Voltage (Falling)	$V_{THF}$	LBK = 0V, RS = 0V, 10k, 50k, (dominant to recessive), Common Mode Voltage Range: -2V to +7V, <a href="#">Figure 16</a>	<b>500</b>	650	-	mV
		LBK = 0V, RS = 0V, 10k, 50k, (dominant to recessive), Common Mode Voltage Range: <-2V to -7V or >+7V to +12V, <a href="#">Figure 16</a>	<b>450</b>	650	-	mV
Input Hysteresis	$V_{HYS}$	$(V_{THR} - V_{THF})$ , RS = 0V, 10k, 50k	<b>40</b>	90	-	mV
Listen Mode Input Threshold Voltage (Rising)	$V_{THRLM}$	RS = $V_{CC}$ , (recessive to dominant), <a href="#">Figure 16</a>	-	990	<b>1150</b>	mV
Listen Mode Input Threshold Voltage (Falling)	$V_{THFLM}$	RS = $V_{CC}$ , (dominant to recessive), <a href="#">Figure 16</a>	<b>525</b>	890	-	mV
Listen Mode Input Hysteresis	$V_{HYSLM}$	$(V_{THR} - V_{THF})$ , RS = $V_{CC}$	<b>50</b>	100	-	mV
Receiver Output High Voltage	$V_{OH}$	$I_O = -4mA$	<b>2.4</b>	$V_{CC} - 0.2$	-	V
Receiver Output Low Voltage	$V_{OL}$	$I_O = +4mA$	-	0.15	<b>0.4</b>	V
Input Current for CAN Bus	$I_{CAN}$	CANH or CANL at 12V, D = 3V, other bus pin at 0V, LBK = RS = 0V	-	435	<b>500</b>	$\mu A$
		CANH or CANL at 12V, D = 3V, $V_{CC} = 0V$ , other bus pin at 0V, LBK = RS = 0V	-	150	<b>250</b>	$\mu A$
		CANH or CANL at -7V, D = 3V, other bus pin at 0V, LBK = RS = 0V	<b>-400</b>	-334	-	$\mu A$
		CANH or CANL at -7V, D = 3V, $V_{CC} = 0V$ , other bus pin at 0V, LBK = RS = 0V	<b>-150</b>	-85	-	$\mu A$
Input Capacitance (CANH or CANL)	$C_{IN}$	Input to GND, D = 3V, LBK = RS = 0V	-	35	-	pF
Differential Input Capacitance	$C_{IND}$	Input to Input, D = 3V, LBK = RS = 0V	-	15	-	pF
Input Resistance (CANH or CANL)	$R_{IN}$	Input to GND, D = 3V, LBK = RS = 0V	<b>20</b>	40	<b>50</b>	k $\Omega$
Differential Input Resistance	$R_{IND}$	Input to Input, D = 3V, LBK = RS = 0V	<b>40</b>	80	<b>100</b>	k $\Omega$

Test Conditions:  $V_{CC} = 3.0V$  to  $3.6V$ ; Typicals are at  $T_A = +25^\circ C$  (Note 9); unless otherwise specified (Note 7). **Boldface limits apply across the operating temperature range,  $-55^\circ C$  to  $+125^\circ C$ .** (Continued)

Parameter	Symbol	Test Conditions	Min (Note 8)	Typ (Note 9)	Max (Note 8)	Unit
<b>Supply Current</b>						
Supply Current, Listen Mode	$I_{CC(L)}$	$RS = D = V_{CC}$ , $LBK = 0V$ , $3.0V \leq V_{CC} \leq 3.6V$	-	1	<b>2</b>	mA
Supply Current, Dominant	$I_{CC(DOM)}$	$D = LBK = RS = 0V$ , no load, $3.0V \leq V_{CC} \leq 3.6V$	-	5	<b>7</b>	mA
Supply Current, Recessive	$I_{CC(REC)}$	$D = V_{CC}$ , $LBK = RS = 0V$ , no load, $3.0V \leq V_{CC} \leq 3.6V$	-	2.6	<b>5</b>	mA
<b>Cold Spring Bus Current</b>						
CANH Leakage Current	$I_{L(CANH)}$	$V_{CC} = 0.2V$ , $CANH = -7V$ or $12V$ , $CANL = \text{float}$ , $D = V_{CC}$ , $RS = 0V$	<b>-25</b>	-4	<b>25</b>	$\mu A$
CANL Leakage Current	$I_{L(CANL)}$	$V_{CC} = 0.2V$ , $CANL = -7V$ or $12V$ , $CANH = \text{float}$ , $D = V_{CC}$ , $RS = 0V$	<b>-25</b>	-4	<b>25</b>	$\mu A$
<b>Driver Switching Characteristics</b>						
Propagation Delay LOW to HIGH	$t_{PDLH1}$	$RS = 0V$ , <a href="#">Figure 13</a>	-	87	<b>150</b>	ns
Propagation Delay LOW to HIGH	$t_{PDLH2}$	$RS = 10k\Omega$ , <a href="#">Figure 13</a>	-	535	<b>850</b>	ns
Propagation Delay LOW to HIGH	$t_{PDLH3}$	$RS = 50k\Omega$ , <a href="#">Figure 13</a>	-	854	<b>1400</b>	ns
Propagation Delay HIGH to LOW	$t_{PDHL1}$	$RS = 0V$ , <a href="#">Figure 13</a>	-	90	<b>155</b>	ns
Propagation Delay HIGH to LOW	$t_{PDHL2}$	$RS = 10k\Omega$ , <a href="#">Figure 13</a>	-	456	<b>800</b>	ns
Propagation Delay HIGH to LOW	$t_{PDHL3}$	$RS = 50k\Omega$ , <a href="#">Figure 13</a>	-	719	<b>1300</b>	ns
Output Skew	$t_{SKEW1}$	$RS = 0V$ , $(t_{PHL} - t_{PLH})$ , <a href="#">Figure 13</a>	-	3	<b>50</b>	ns
Output Skew	$t_{SKEW2}$	$RS = 10k\Omega$ , $(t_{PHL} - t_{PLH})$ , <a href="#">Figure 13</a>	-	79	<b>510</b>	ns
Output Skew	$t_{SKEW3}$	$RS = 50k\Omega$ , $(t_{PHL} - t_{PLH})$ , <a href="#">Figure 13</a>	-	135	<b>800</b>	ns
Output Rise Time	$t_{r1}$	$RS = 0V$ , (fast speed - 1Mbps) <a href="#">Figure 13</a>	<b>20</b>	59	<b>100</b>	ns
Output Fall Time	$t_{f1}$		<b>10</b>	30	<b>75</b>	ns
Output Rise Time	$t_{r2}$	$RS = 10k\Omega$ , (medium speed - 250kbps) <a href="#">Figure 13</a>	<b>200</b>	386	<b>780</b>	ns
Output Fall Time	$t_{f2}$		<b>175</b>	318	<b>500</b>	ns
Output Rise Time	$t_{r3}$	$RS = 50k\Omega$ , (slow speed - 125kbps) <a href="#">Figure 13</a>	<b>400</b>	646	<b>1400</b>	ns
Output Fall Time	$t_{f3}$		<b>300</b>	627	<b>1000</b>	ns
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant	$t_{(LOOP1)}$	$RS = 0V$ , <a href="#">Figure 20</a>	-	126	<b>210</b>	ns
		$RS = 10k\Omega$ , <a href="#">Figure 20</a>	-	574	<b>875</b>	ns
		$RS = 50k\Omega$ , <a href="#">Figure 20</a>	-	852	<b>1400</b>	ns
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive	$t_{(LOOP2)}$	$RS = 0V$ , <a href="#">Figure 20</a>	-	137	<b>270</b>	ns
		$RS = 10k\Omega$ , <a href="#">Figure 20</a>	-	494	<b>825</b>	ns
		$RS = 50k\Omega$ , <a href="#">Figure 20</a>	-	725	<b>1300</b>	ns
Listen to Valid Dominant Time	$t_{L-DOM}$	<a href="#">Figure 18</a>	-	4	<b>15</b>	$\mu s$

Test Conditions:  $V_{CC} = 3.0V$  to  $3.6V$ ; Typicals are at  $T_A = +25^\circ C$  (Note 9); unless otherwise specified (Note 7). **Boldface limits apply across the operating temperature range,  $-55^\circ C$  to  $+125^\circ C$ .** (Continued)

Parameter	Symbol	Test Conditions	Min (Note 8)	Typ (Note 9)	Max (Note 8)	Unit
<b>Receiver Switching Characteristics</b>						
Propagation Delay LOW to HIGH	$t_{PLH}$	Figure 16	-	52	<b>110</b>	ns
Propagation Delay HIGH to LOW	$t_{PHL}$	Figure 16	-	51	<b>110</b>	ns
Rx Skew	$t_{SKEW1}$	$ (t_{PHL} - t_{PLH}) $ , Figure 16	-	1	<b>35</b>	ns
Rx Rise Time	$t_r$	Figure 16	-	2	-	ns
Rx Fall Time	$t_f$	Figure 16	-	2	-	ns
LBK Delay I/O to Rx Output	$t_{LBK}$	Figure 22	-	42	<b>75</b>	ns
<b>RS Pin Characteristics</b>						
RS Input Current	$I_{RS(H)}$	$RS = 0.75 \times V_{CC}$	<b>-10</b>	-0.2	-	$\mu A$
	$I_{RS(L)}$	$V_{RS} = 0V$	<b>-450</b>	-125	<b>0</b>	$\mu A$

## Notes:

7. 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.
8. Compliance to datasheet limits are assured by one or more methods: production test, characterization, and/or design.
9. 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.
10. Parameter included in functional testing.

## 2.6 Equivalent Input and Output Schematic Diagrams

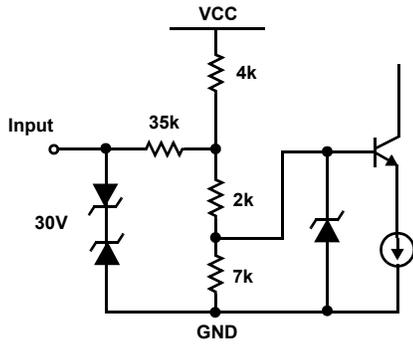


Figure 3. CANH and CANL Inputs

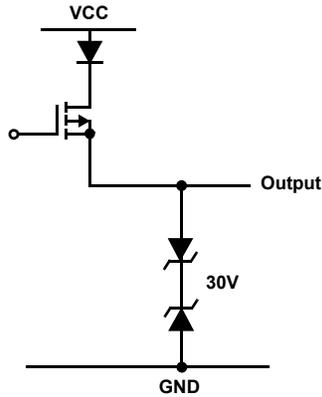


Figure 4. CANH Output

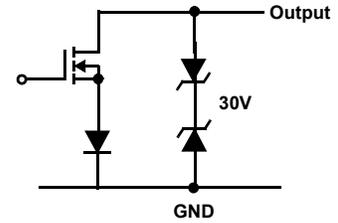


Figure 5. CANL Output

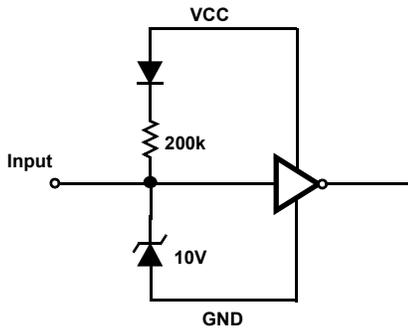


Figure 6. D Input

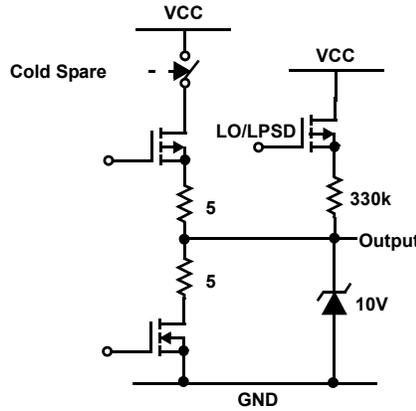


Figure 7. R Output

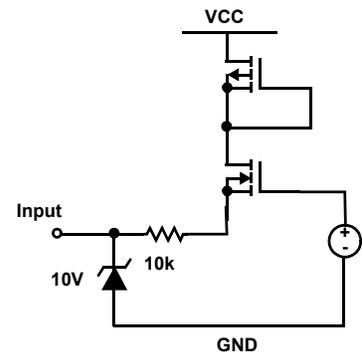


Figure 8. RS Input

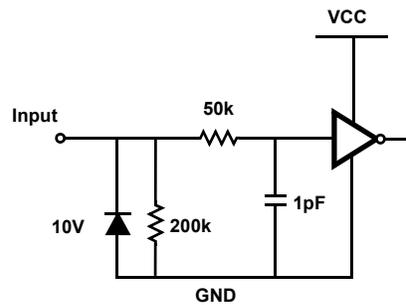


Figure 9. LBK Input

### 3. Test Circuits and Waveforms

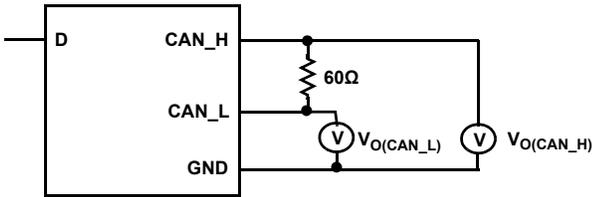


Figure 10. Driver Test Circuit

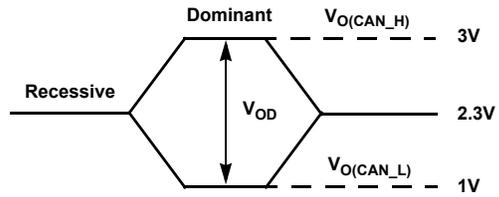


Figure 11. Driver Bus Voltage Definitions

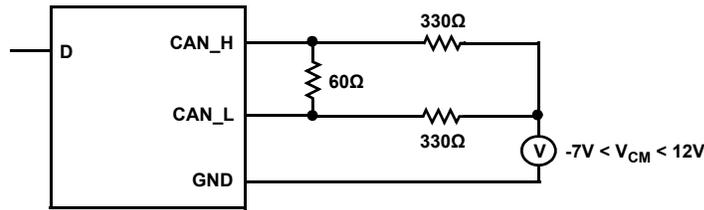
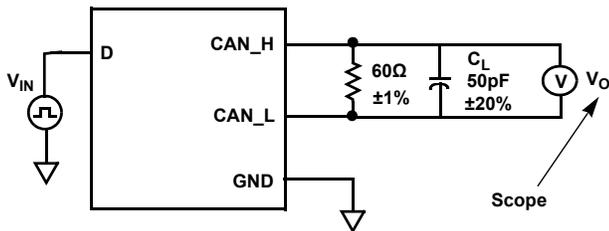


Figure 12. Driver Common-Mode Circuit



$V_{IN} = 125\text{kHz}$ ,  $0\text{V}$  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 13. Driver Timing Test Circuit

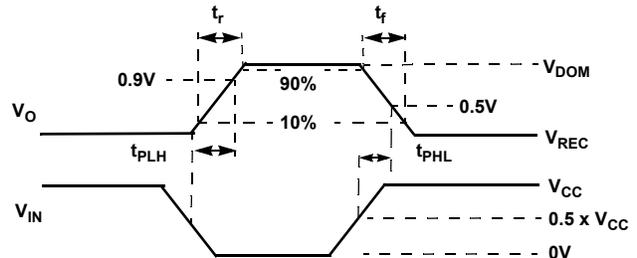


Figure 14. Driver Timing Measurement Points

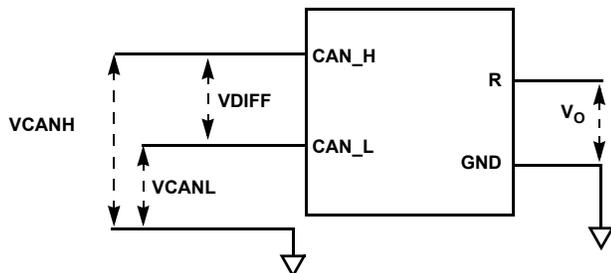
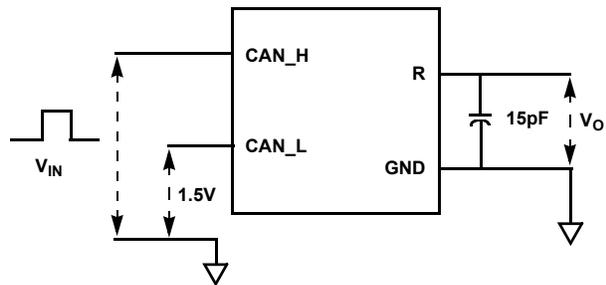


Figure 15. Receiver Voltage Definitions



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

Figure 16. Receiver Test Circuit

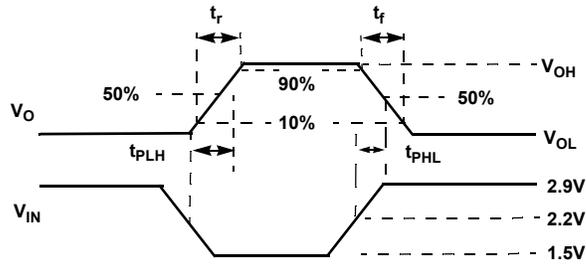
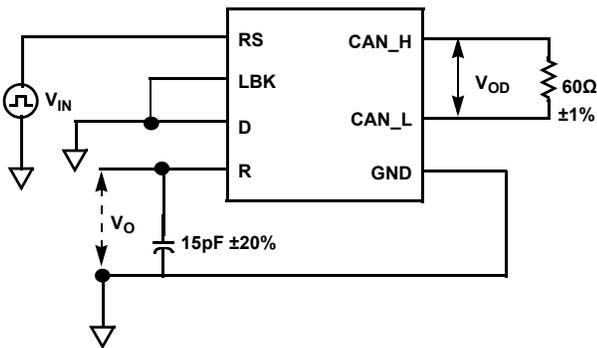


Figure 17. Receiver Test Measurement Points

Table 1. Differential Input Voltage Threshold Test

Input		Output	Measured
VCANH	VCANL	R	VDIFF
-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



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

Figure 18. Listen to Valid Dominant Time Test Circuit

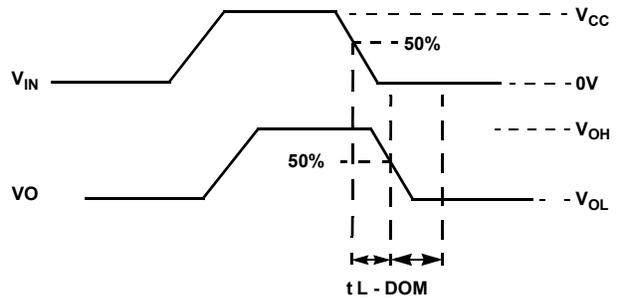


Figure 19. Listen to Valid Dominant Time Measurement Points

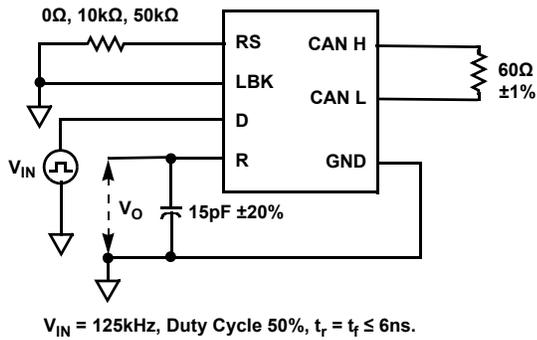


Figure 20. Total Loop Delay Test Circuit

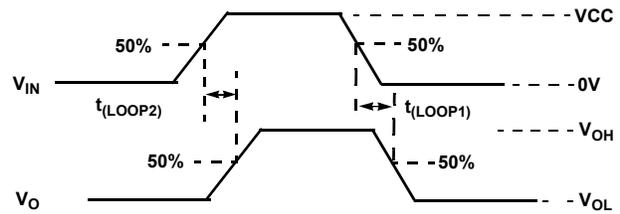


Figure 21. Total Loop Delay Measurement Points

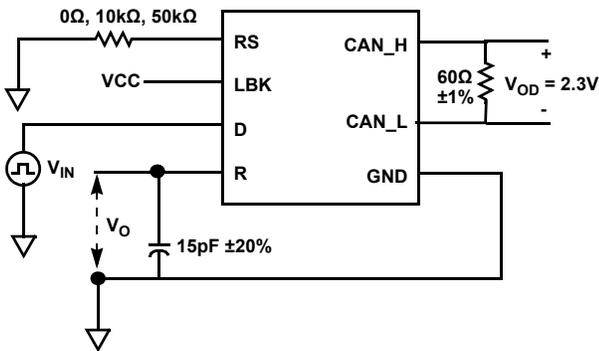


Figure 22. Loop Back Delay to Dominant Time Test Circuit

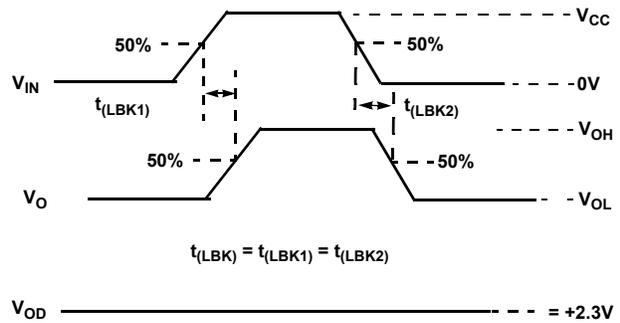


Figure 23. Loop Back Delay to Dominant Measurement Points

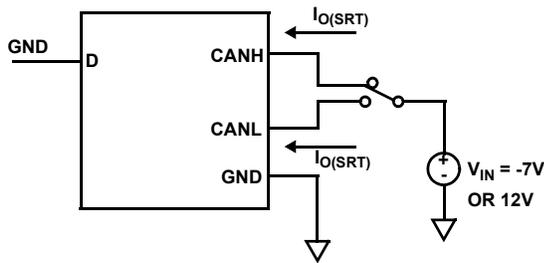


Figure 24. Output Short-Circuit Current Test Circuit

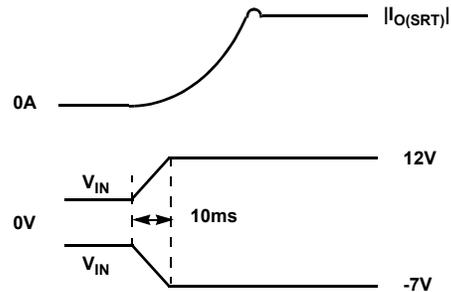


Figure 25. Output Short-Circuit Current Waveforms

### 4. Typical Performance Curves

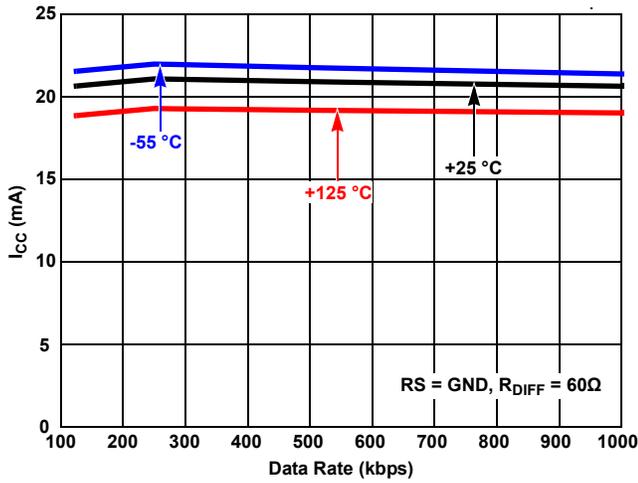


Figure 26. Supply Current vs Fast Data Rate vs Temperature

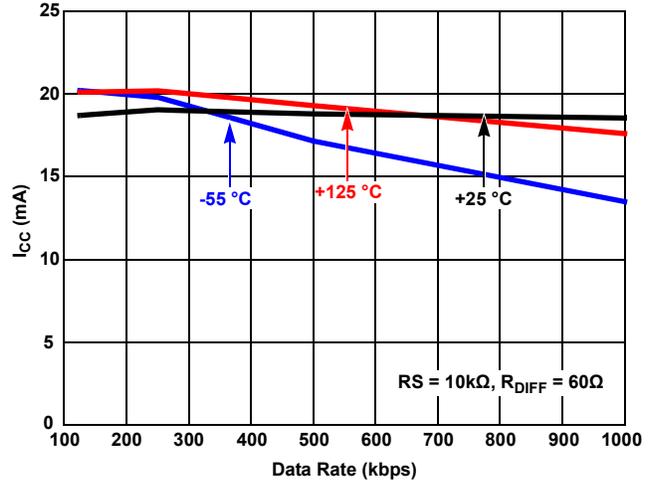


Figure 27. Supply Current vs Medium Data Rate vs Temperature

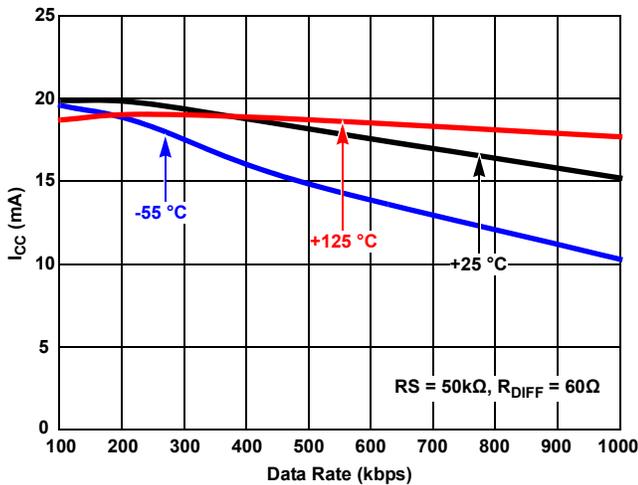


Figure 28. Supply Current vs Slow Data Rate vs Temperature

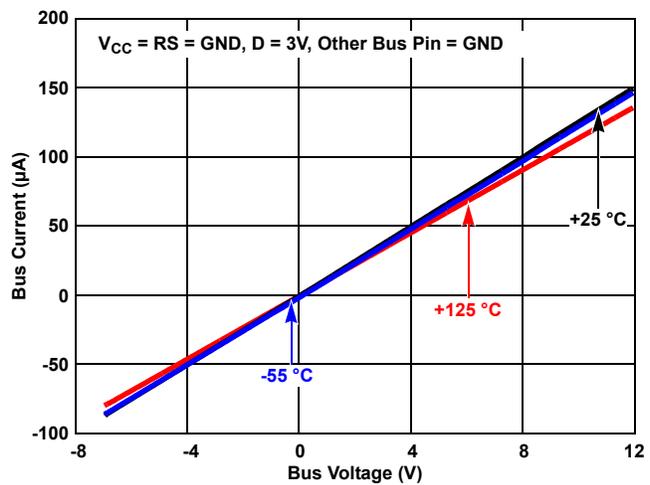


Figure 29. Bus Pin Leakage vs VCM at  $V_{CC} = 0V$

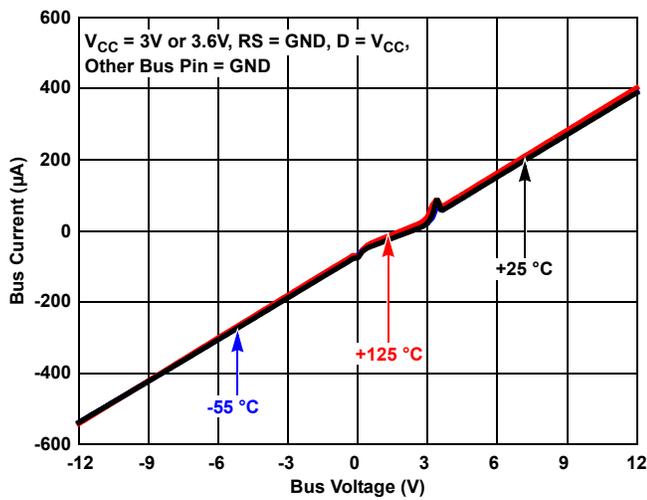


Figure 30. Bus Pin Leakage vs ±12V VCM

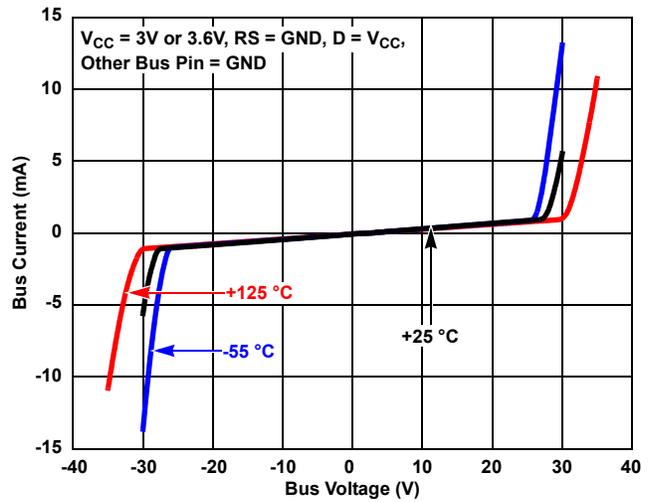


Figure 31. Bus Pin Leakage vs ±35V VCM

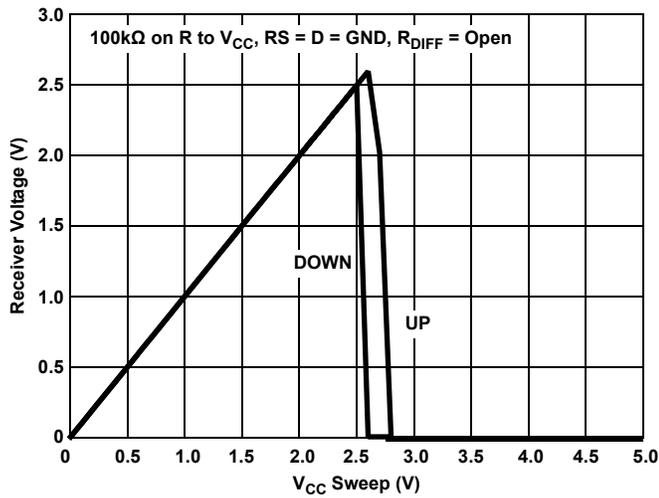


Figure 32. V<sub>CC</sub> Undervoltage Lockout

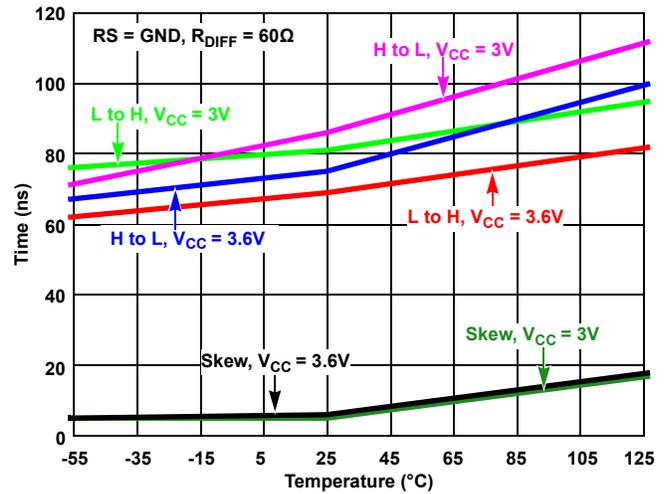


Figure 33. Transmitter Propagation Delay and Skew vs Temperature at Fast Speed

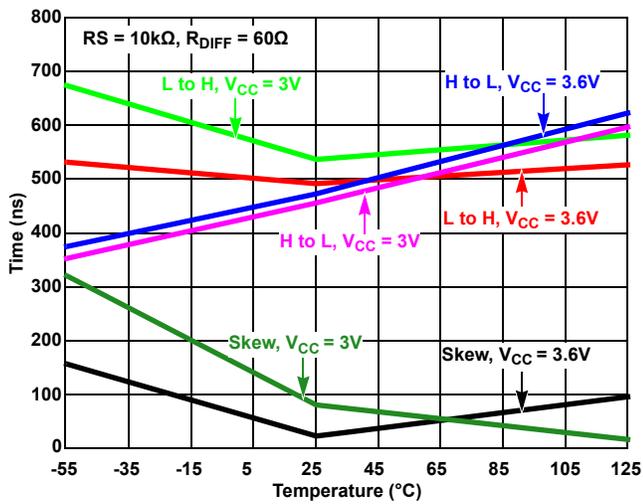


Figure 34. Transmitter Propagation Delay and Skew vs Temperature at Medium Speed

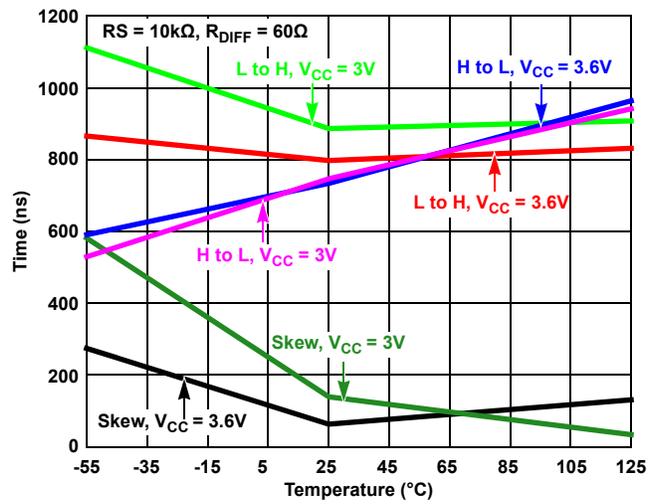


Figure 35. Transmitter Propagation Delay and Skew vs Temperature at Slow Speed

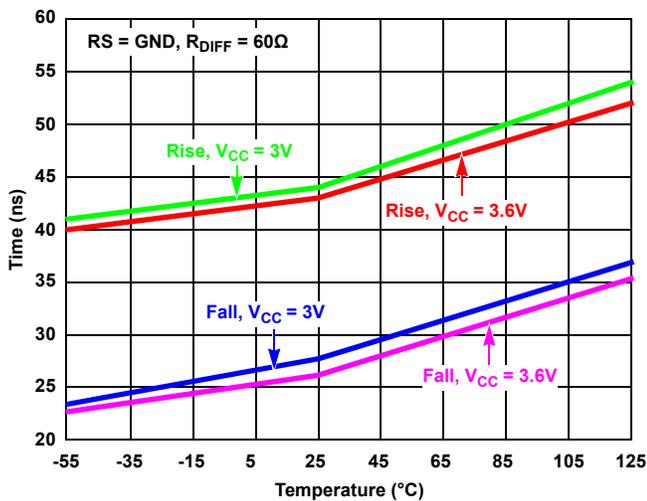


Figure 36. Transmitter Rise and Fall Times vs Temperature at Fast Speed

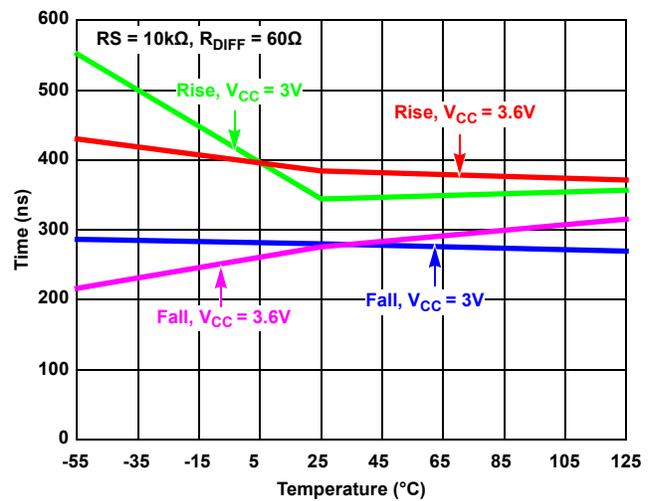


Figure 37. Transmitter Rise and Fall Times vs Temperature at Medium Speed

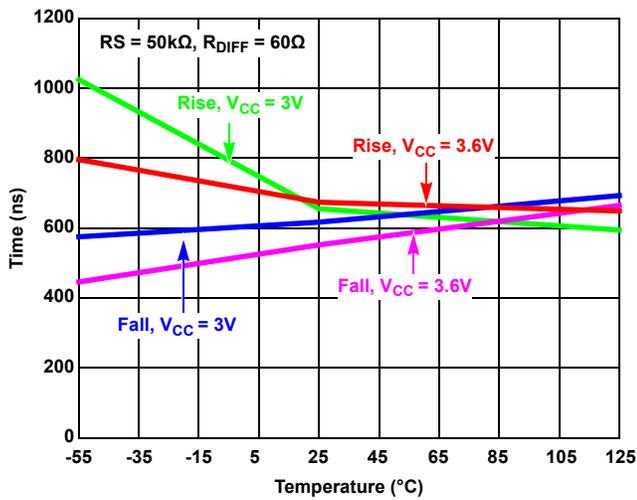


Figure 38. Transmitter Rise and Fall Times vs Temperature at Slow Speed

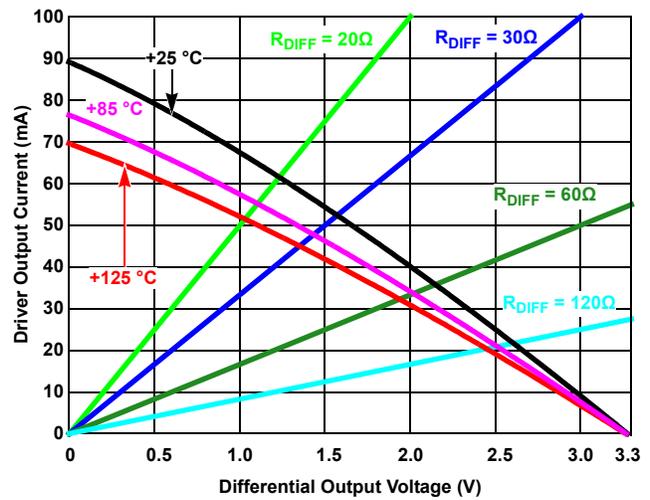


Figure 39. Driver Output Current vs Differential Output Voltage

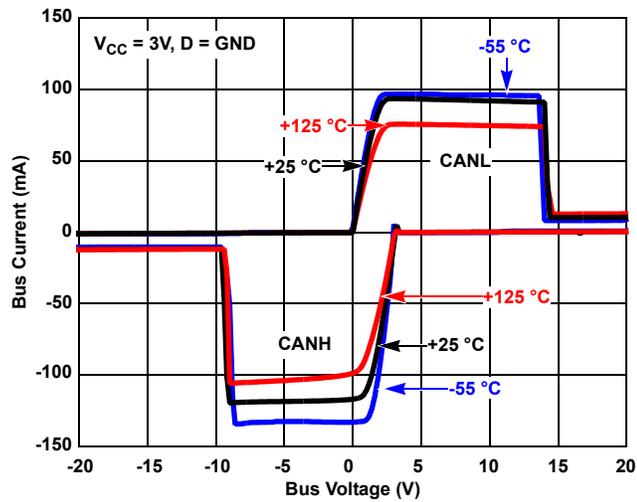


Figure 40. Driver Output Current vs Short-Circuit Voltage vs Temperature

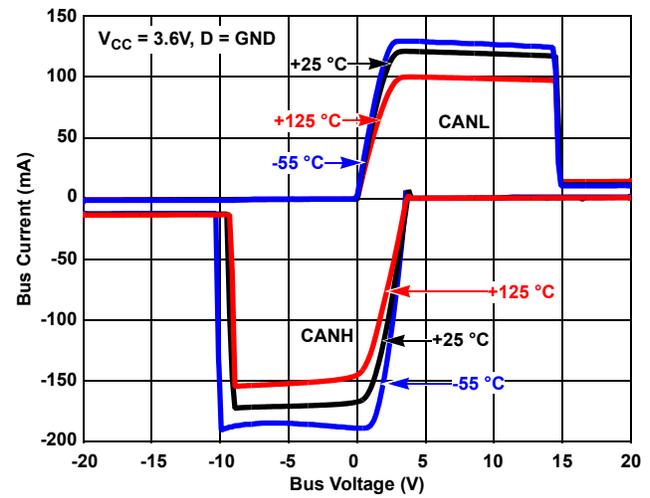


Figure 41. Driver Output Current vs Short-Circuit Voltage vs Temperature

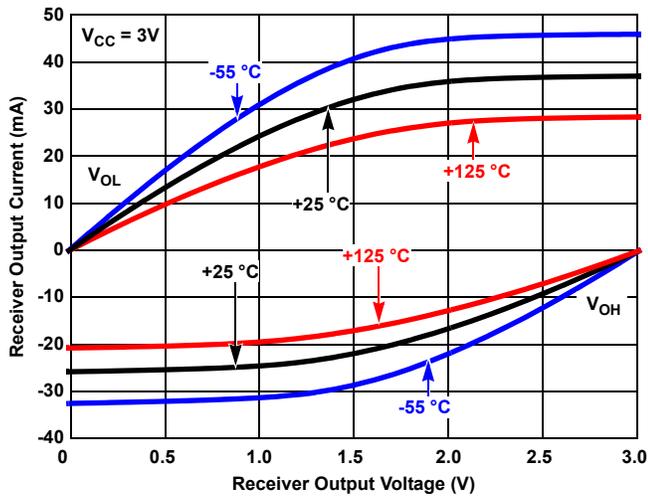


Figure 42. Receiver Output Current vs Receiver Output Voltage at  $V_{CC} = 3V$

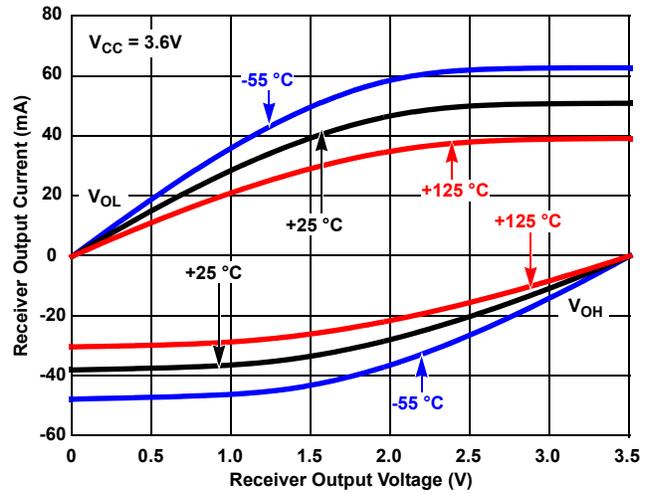


Figure 43. Receiver Output Current vs Receiver Output Voltage at  $V_{CC} = 3.6V$

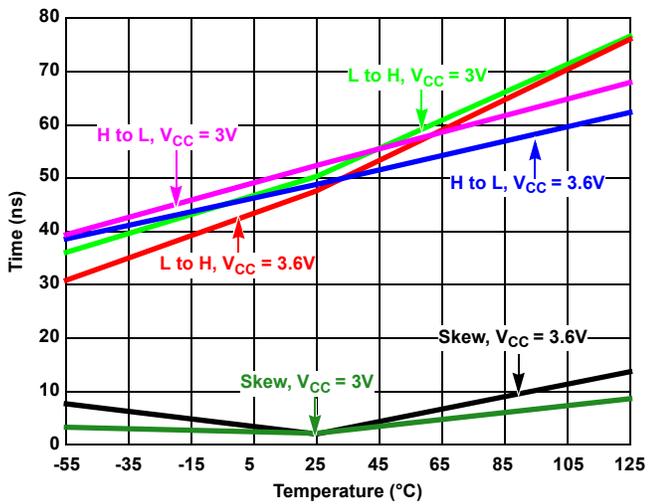


Figure 44. Receiver Propagation Delay and Skew vs Temperature

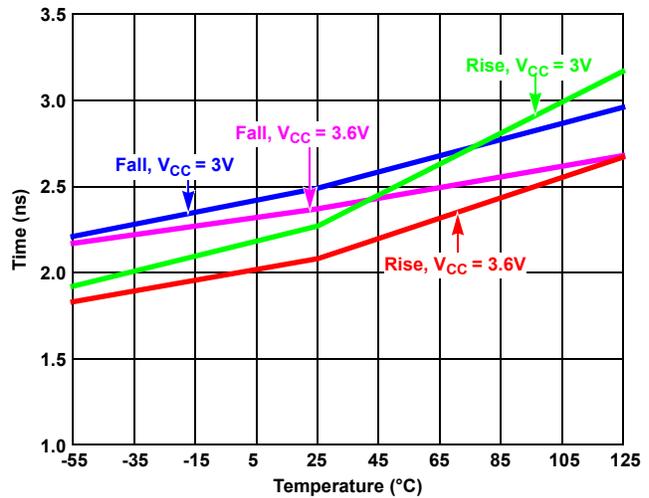


Figure 45. Receiver Rise and Fall Times vs Temperature

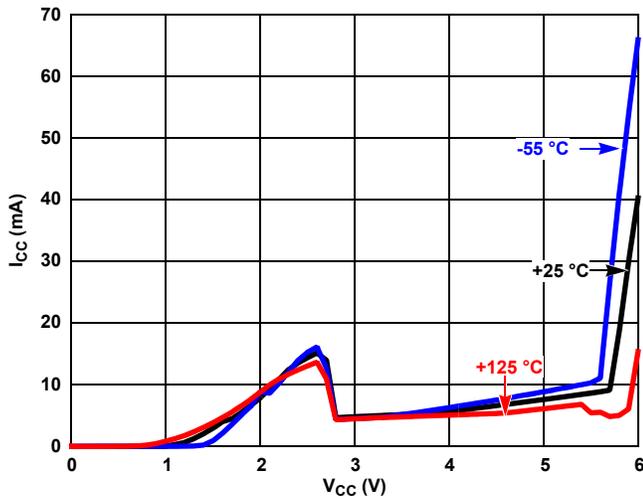


Figure 46. Supply Current vs Supply Voltage vs Temperature

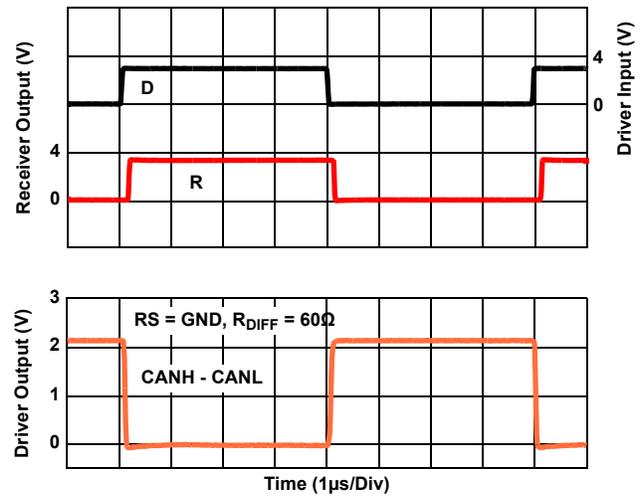


Figure 47. Fast Driver and Receiver Waveforms

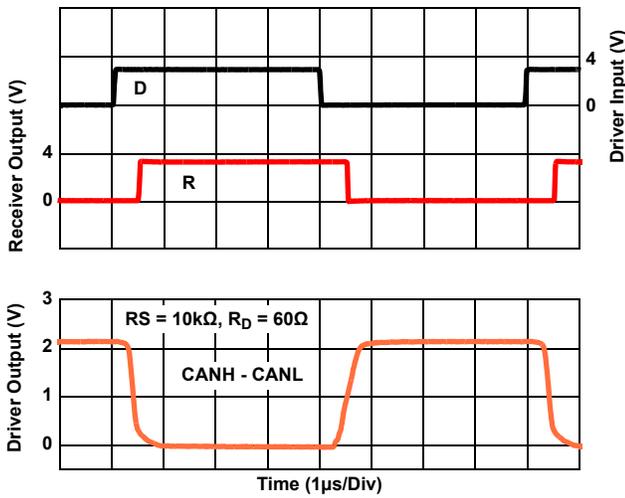


Figure 48. Medium Driver and Receiver Waveforms

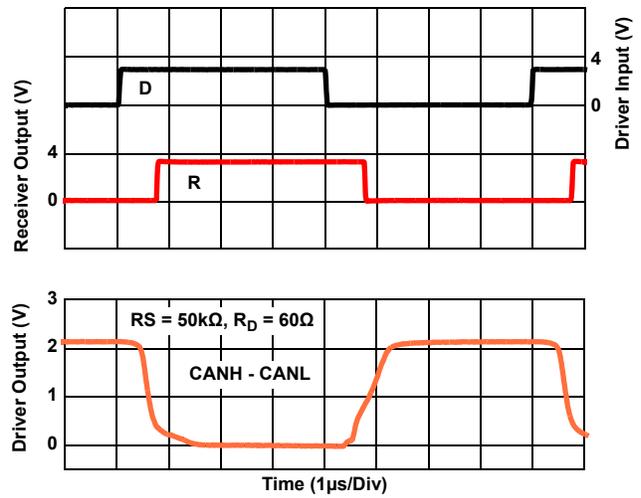


Figure 49. Slow Driver and Receiver Waveforms

## 5. Functional Description

### 5.1 Overview

The ISL71026M 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 1Mbps. 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.

### 5.2 Slope Adjustment

The output driver rise and fall time has three distinct selections that can 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.

### 5.3 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 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.

### 5.4 Cold Spare

High reliability system designers implementing data communications must be sensitive to the potential for single point failures. To mitigate the risk of a failure they 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.

The powered down transceiver ( $V_{CC} < 200mV$ ) has a resistance between the CANH or CANL bus pin and the  $V_{CC}$  supply rail of at least  $480k\Omega$  with a typical resistance of  $2M\Omega$ . The resistance between CANH and CANL of a powered-down transceiver has a typical resistance of  $80k\Omega$ .

The receiver output (R pin) of a powered-down transceiver ( $V_{CC} < 200mV$ ) is internally connected to ground. Therefore, the receiver outputs of an active transceiver and a cold spare transceiver cannot be connected together in the redundant application.

### 5.5 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.

### 5.6 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 remain active to allow for diagnostic testing of the node.

## 5.7 Using 3.3V Devices in 5V Systems

The differential voltage of the 3.3V and 5V devices, 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.

## 6. Radiation Tolerance

The ISL71026M is a radiation tolerant device for commercial space applications, Low Earth Orbit (LEO) applications, high altitude avionics, launch vehicles, and other harsh environments. This device's response to Total Ionizing Dose (TID) radiation effects and Single-Event Effects (SEE) has been measured, characterized, and reported in the following sections. However, TID performance is not guaranteed through radiation acceptance testing, nor is the SEE characterized performance guaranteed.

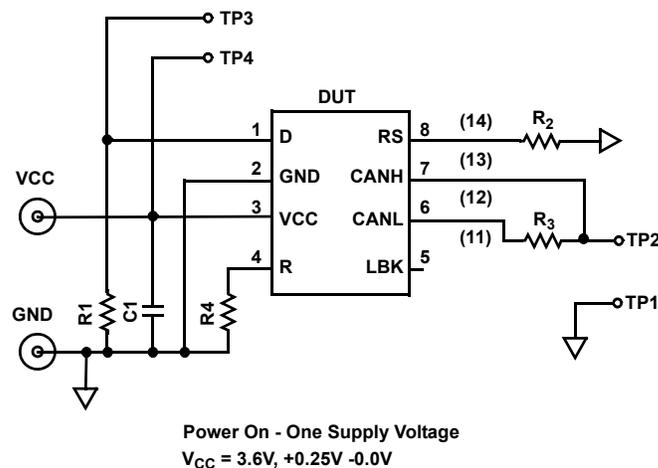
### 6.1 Total Ionizing Dose (TID) Testing

#### 6.1.1 Introduction

This test was conducted to determine the sensitivity of the part to the total dose environment. Down points were 0krad(Si), 10krad(Si), 20krad(Si), and 30krad(Si). The irradiations were followed by a biased anneal for 168 hours at +100°C.

Total dose testing was performed using a Hopewell Designs N40 panoramic  $^{60}\text{Co}$  irradiator. The irradiations were performed at 0.00875rad(Si)/s. A PbAl box was used to shield the test fixture and devices under test against low energy secondary gamma radiation.

The characterization matrix consisted of 30 samples irradiated under bias and 30 samples irradiated with all pins grounded. Six control units were used to ensure repeatable data. Three different wafers were used. The bias configuration is shown in [Figure 50](#).



**Figure 50. Irradiation Bias Configuration and Power Supply Sequencing for the ISL71026M**

All electrical testing was performed outside the irradiator using the production Automated Test Equipment (ATE), with data logging at each down point (including anneal). Downpoint electrical testing was performed at room temperature.

### 6.1.2 Results

Table 2 summarizes the attributes data. “Bin 1” indicates a device that passes all datasheet specification limits.

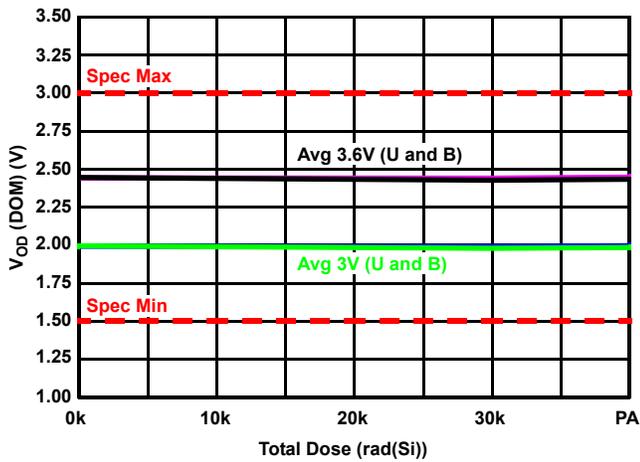
**Table 2. ISL71026M Total Dose Test Attributes Data**

Dose Rate (mrad(Si)/s)	Bias	Sample Size	Down Point	Bin 1	Rejects
8.75	<a href="#">Figure 50</a>	30	Pre-rad	30	
			10krad(Si)	30	0
			20krad(Si)	30	0
			30krad(Si)	30	0
			Anneal	30	0
8.75	Grounded	30	Pre-rad	30	
			10krad(Si)	30	0
			20krad(Si)	30	0
			30krad(Si)	30	0
			Anneal	30	0

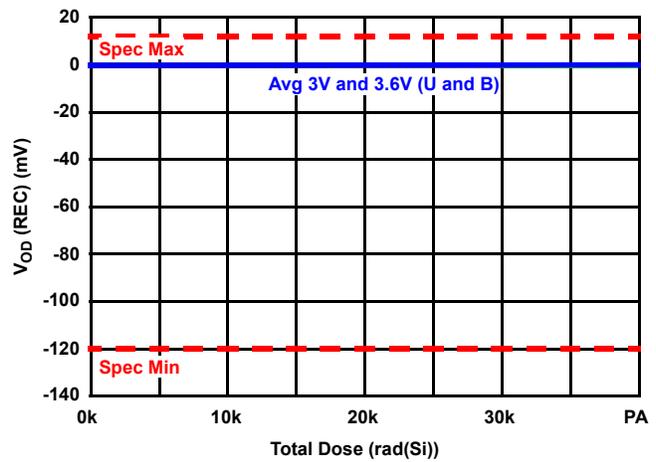
The plots in Figures 51 through 56 show data for key parameters at all down points. The plots show the average as a function of total dose for each of the irradiation conditions; we chose to use the average because of the relatively large sample sizes. All parts showed excellent stability over irradiation.

Table 3 on page 23 shows the average of other key parameters with respect to total dose in table form.

### 6.2 Data Plots



**Figure 51. Dominant Output Differential Voltage - VOD(DOM) vs TID**



**Figure 52. Recessive Output Differential Voltage - VOD(REC) vs TID**

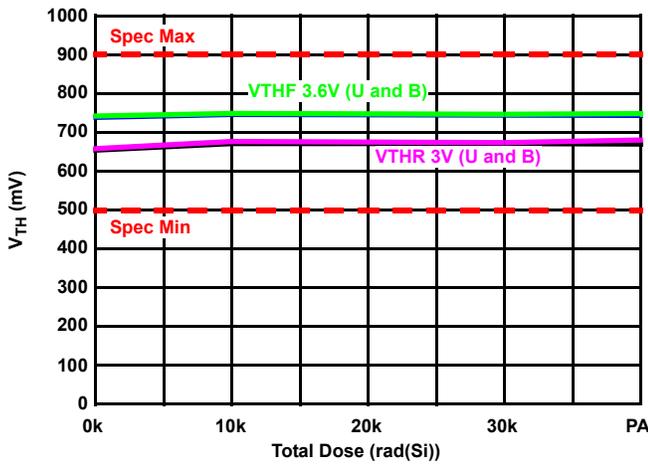


Figure 53. Receiver Input Threshold Voltage Rising/Falling vs TID

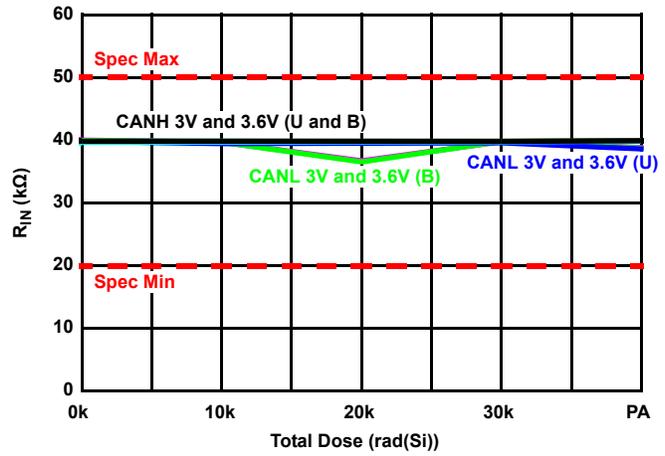


Figure 54. Receiver Input Resistance vs TID

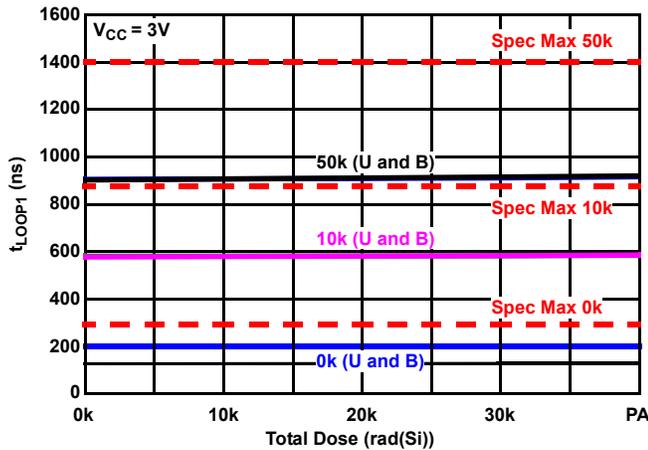


Figure 55. Total Loop Delay (Recessive to Dominant) vs TID

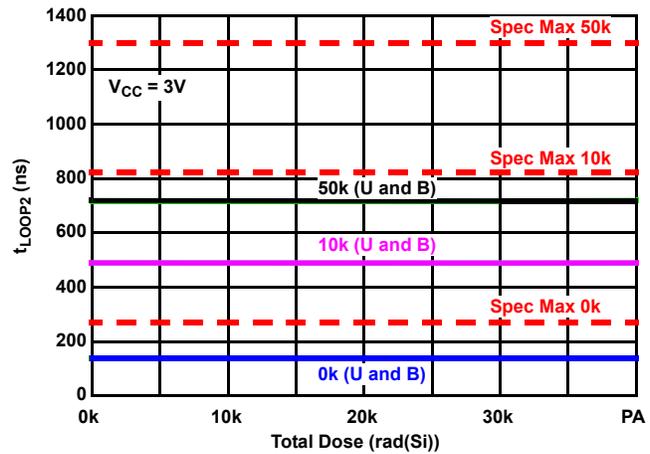


Figure 56. Total Loop Delay (Dominant to Recessive) vs TID

### 6.2.1 Conclusion

ATE characterization testing showed no rejects to the datasheet limits at all down points. Variables data for selected parameters is presented in [Figures 51](#) through [56](#). No differences between biased and unbiased irradiation were noted, and the part is not considered bias sensitive.

Table 3. ISL71026M Response of Key Parameters vs TID

Parameter	Symbol	Condition	Bias	0krad (Si)	10krad (Si)	20krad (Si)	30krad (Si)	Anneal	Unit
Dominant Output Differential Voltage D = 0V, RS = 0V	V <sub>OD(DOM)</sub>	3.0V	Biased	1.993	1.997	1.998	1.991	1.996	V
			Grounded	1.995	1.990	1.989	1.979	1.985	
		3.6V	Biased	2.444	2.448	2.450	2.441	2.448	
			Grounded	2.446	2.441	2.439	2.428	2.435	

Table 3. ISL71026M Response of Key Parameters vs TID (Continued)

Parameter	Symbol	Condition	Bias	0krad (Si)	10krad (Si)	20krad (Si)	30krad (Si)	Anneal	Unit
Recessive Output Differential Voltage D = 3V, RS = 0V	V <sub>OD(REC)</sub>	3.0V	Biased	-0.155	-0.065	-0.171	-0.028	-0.008	mV
			Grounded	-0.149	-0.071	-0.061	-0.056	-0.002	
		3.6V	Biased	-0.147	-0.041	-0.142	-0.056	-0.010	
			Grounded	-0.167	-0.031	-0.042	-0.012	0.005	
Recessive Output Differential Voltage D = 3V, RS = 0V, No Load	V <sub>OD(REC)</sub>	3.0V	Biased	-32.01	-40.23	-46.55	-39.08	-35.74	mV
			Grounded	-34.10	-40.82	-38.53	-38.70	-36.95	
		3.6V	Biased	-29.14	-37.75	-44.86	-36.27	-32.60	
			Grounded	-29.90	-37.84	-36.57	-36.06	-33.27	
Input Threshold Voltage (Rising) LBK = 0V, RS = 0V, 10k, 50k, (recessive to dominant) CM Voltage Range: (-2V to +7V)	V <sub>THR</sub>	3.0V	Biased	654.36	671.02	671.52	670.69	670.02	mV
			Grounded	657.96	676.13	677.55	673.62	679.98	
		3.6V	Biased	667.00	665.24	664.32	664.74	662.98	
			Grounded	671.02	669.68	670.10	667.17	668.43	
Input Threshold Voltage (Falling) LBK = 0V, RS = 0V, 10k, 50k, (dominant to recessive) CM Voltage Range: (-2V to +7V)	V <sub>THF</sub>	3.0V	Biased	738.61	745.73	745.23	744.05	743.22	mV
			Grounded	741.62	748.16	748.33	746.23	747.91	
		3.6V	Biased	742.13	743.13	741.88	741.54	740.03	
			Grounded	744.81	744.81	744.72	743.13	743.80	
Input Hysteresis (V <sub>THR</sub> - V <sub>THF</sub> ), RS = 0V, 10k, 50k	V <sub>HYS</sub>	3.0V	Biased	90.87	90.45	90.70	90.45	90.03	mV
			Grounded	90.87	90.62	90.03	90.12	89.87	
		3.6V	Biased	91.96	91.12	91.21	91.21	90.95	
			Grounded	91.71	90.95	90.45	90.79	90.95	
Differential Input Resistance Input to Input, D = 3V, LBK = RS = 0V	R <sub>IND</sub>	3.0V	Biased	78.83	78.17	74.48	78.36	76.88	kΩ
			Grounded	78.51	77.89	78.05	78.12	76.72	
		3.6V	Biased	78.80	78.06	74.35	78.35	76.86	
			Grounded	78.49	77.83	77.95	78.10	76.66	
Supply Current Dominant D = LBK = RS = 0V, No Load	I <sub>CC(DOM)</sub>	3.0V	Biased	4.89	4.85	4.85	4.88	4.84	mA
			Grounded	4.92	4.87	4.87	4.90	4.86	
		3.6V	Biased	5.18	5.15	5.15	5.17	5.13	
			Grounded	5.21	5.17	5.17	5.20	5.15	
Supply Current Recessive D = V <sub>CC</sub> , LBK = RS = 0V, No Load	I <sub>CC(REC)</sub>	3.0V	Biased	2.19	2.23	2.22	2.19	2.20	mA
			Grounded	2.20	2.24	2.23	2.20	2.21	
		3.6V	Biased	2.47	2.51	2.50	2.47	2.48	
			Grounded	2.49	2.52	2.51	2.48	2.49	
Propagation Delay LOW to HIGH RS = 0V	t <sub>PDLH1</sub>	3.0V	Biased	87.56	86.00	89.28	87.08	88.38	ns
			Grounded	87.24	86.27	89.53	87.29	89.06	
		3.6V	Biased	67.84	66.75	69.91	68.49	69.41	
			Grounded	67.66	66.86	70.08	68.76	69.89	

Table 3. ISL71026M Response of Key Parameters vs TID (Continued)

Parameter	Symbol	Condition	Bias	0krad (Si)	10krad (Si)	20krad (Si)	30krad (Si)	Anneal	Unit
Propagation Delay LOW to HIGH RS = 10kΩ	t <sub>PDLH2</sub>	3.0V	Biased	535.47	541.96	547.49	537.91	548.58	ns
			Grounded	531.22	540.96	546.24	537.88	548.44	
		3.6V	Biased	482.03	487.28	491.07	483.79	492.03	
			Grounded	478.10	485.66	489.31	482.52	491.06	
Propagation Delay LOW to HIGH RS = 50kΩ	t <sub>PDLH3</sub>	3.0V	Biased	851.90	876.20	881.60	860.33	887.66	ns
			Grounded	843.39	875.14	880.20	859.79	887.94	
		3.6V	Biased	759.87	778.48	782.65	766.33	785.68	
			Grounded	751.46	773.70	777.78	762.10	781.86	
Propagation Delay HIGH to LOW RS = 0V	t <sub>PDHL1</sub>	3.0V	Biased	89.49	85.82	89.53	89.56	88.39	ns
			Grounded	89.91	86.41	90.23	90.08	88.65	
		3.6V	Biased	74.95	70.90	75.32	75.33	74.40	
			Grounded	75.46	71.56	76.01	75.83	74.60	
Propagation Delay HIGH to LOW RS = 10kΩ	t <sub>PDHL2</sub>	3.0V	Biased	455.41	445.97	450.51	454.97	449.91	ns
			Grounded	456.22	445.80	450.26	454.90	449.26	
		3.6V	Biased	471.11	460.43	464.49	470.08	464.13	
			Grounded	472.12	460.42	464.38	470.08	463.21	
Propagation Delay HIGH to LOW RS = 50kΩ	t <sub>PDHL3</sub>	3.0V	Biased	718.42	704.13	707.88	717.48	709.15	ns
			Grounded	720.61	704.48	708.56	719.29	709.04	
		3.6V	Biased	748.06	731.84	736.81	747.92	739.35	
			Grounded	750.20	733.14	738.25	749.29	739.69	
Output Skew RS = 0V ( t <sub>PHL</sub> - t <sub>PLH</sub>  )	t <sub>SKEW1</sub>	3.0V	Biased	2.68	2.07	2.09	3.12	2.08	ns
			Grounded	2.99	1.55	1.75	3.03	1.64	
		3.6V	Biased	7.11	4.40	5.48	6.84	5.08	
			Grounded	7.80	4.70	5.93	7.07	4.71	
Output Skew RS = 10kΩ ( t <sub>PHL</sub> - t <sub>PLH</sub>  )	t <sub>SKEW2</sub>	3.0V	Biased	80.07	95.99	96.98	82.94	98.67	ns
			Grounded	75.01	95.16	95.98	82.97	99.18	
		3.6V	Biased	17.92	27.78	27.82	18.91	29.05	
			Grounded	16.05	27.86	27.51	19.34	30.92	
Output Skew RS = 50kΩ ( t <sub>PHL</sub> - t <sub>PLH</sub>  )	t <sub>SKEW3</sub>	3.0V	Biased	133.48	172.07	173.72	142.86	178.51	ns
			Grounded	122.79	170.66	171.64	140.51	178.89	
		3.6V	Biased	31.40	49.41	48.79	33.03	50.85	
			Grounded	30.02	46.64	45.82	32.26	49.98	
Output Rise Time RS = 0V (fast speed - 1Mbps)	t <sub>r1</sub>	3.0V	Biased	59.79	61.63	60.03	59.97	60.46	ns
			Grounded	59.22	61.27	59.61	59.44	60.34	
		3.6V	Biased	56.35	58.17	56.41	56.89	57.37	
			Grounded	55.73	57.64	55.94	56.38	57.21	
Output Fall Time RS = 0V (fast speed - 1Mbps)	t <sub>f1</sub>	3.0V	Biased	29.48	30.38	29.74	29.47	29.95	ns
			Grounded	29.66	30.86	29.87	29.91	30.24	
		3.6V	Biased	21.12	22.14	21.01	21.46	21.49	
			Grounded	21.25	22.60	21.28	21.85	21.74	

Table 3. ISL71026M Response of Key Parameters vs TID (Continued)

Parameter	Symbol	Condition	Bias	0krad (Si)	10krad (Si)	20krad (Si)	30krad (Si)	Anneal	Unit
Output Rise Time RS = 10kΩ (medium speed - 250kbps)	t <sub>r2</sub>	3.0V	Biased	389.93	392.13	388.60	391.52	392.40	ns
			Grounded	389.00	393.23	392.95	394.49	396.29	
		3.6V	Biased	385.73	387.04	385.73	387.62	389.67	
			Grounded	384.09	387.86	387.48	389.82	392.11	
Output Fall Time RS = 10kΩ (medium speed - 250kbps)	t <sub>f2</sub>	3.0V	Biased	314.20	313.88	309.04	313.97	310.85	ns
			Grounded	315.57	315.26	314.27	315.69	312.88	
		3.6V	Biased	305.94	305.38	299.82	304.98	300.86	
			Grounded	307.09	306.19	305.43	306.24	301.95	
Output Rise Time RS = 50kΩ (medium speed - 125kbps)	t <sub>r3</sub>	3.0V	Biased	652.70	656.53	655.85	657.91	663.89	ns
			Grounded	647.42	655.41	656.53	659.30	665.93	
		3.6V	Biased	673.51	676.19	675.85	678.60	683.52	
			Grounded	671.94	679.14	679.78	682.38	687.19	
Output Fall Time RS = 50kΩ (medium speed - 125kbps)	t <sub>f3</sub>	3.0V	Biased	621.05	620.55	613.96	622.15	617.19	ns
			Grounded	623.62	624.32	623.98	625.82	621.57	
		3.6V	Biased	601.04	601.55	592.35	600.95	595.26	
			Grounded	603.43	604.70	604.35	605.92	598.67	
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant RS = 0V	t <sub>(LOOP1)</sub>	3.0V	Biased	127.39	127.35	127.89	127.70	127.62	ns
			Grounded	127.13	127.57	129.25	128.29	128.73	
		3.6V	Biased	106.62	106.93	106.65	106.86	107.07	
			Grounded	106.43	107.16	107.59	107.27	107.87	
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant RS = 10kΩ	t <sub>(LOOP1)</sub>	3.0V	Biased	580.38	580.60	582.24	582.28	584.53	ns
			Grounded	577.46	579.88	582.41	583.10	585.60	
		3.6V	Biased	527.15	527.32	528.76	529.20	530.98	
			Grounded	523.48	525.60	527.47	528.40	530.46	
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant RS = 50kΩ	t <sub>(LOOP1)</sub>	3.0V	Biased	863.22	866.43	869.15	869.23	873.72	ns
			Grounded	857.81	864.93	869.43	870.38	875.17	
		3.6V	Biased	785.92	789.47	790.11	790.72	794.02	
			Grounded	779.39	785.16	787.03	787.42	791.65	
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive RS = 0V	t <sub>(LOOP2)</sub>	3.0V	Biased	137.26	137.37	138.20	137.70	137.51	ns
			Grounded	137.54	137.43	138.54	138.07	137.55	
		3.6V	Biased	126.53	127.24	127.82	127.06	126.86	
			Grounded	126.83	127.69	128.06	127.44	126.90	
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive RS = 10kΩ	t <sub>(LOOP2)</sub>	3.0V	Biased	489.70	489.58	490.43	489.50	489.78	ns
			Grounded	489.90	488.79	488.74	488.70	488.37	
		3.6V	Biased	510.01	508.92	510.21	509.30	509.52	
			Grounded	510.33	508.36	508.86	508.74	508.02	
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive RS = 50kΩ	t <sub>(LOOP2)</sub>	3.0V	Biased	718.32	717.89	719.75	718.57	719.32	ns
			Grounded	718.75	717.09	717.58	717.93	717.48	
		3.6V	Biased	752.16	751.79	753.36	752.17	752.95	
			Grounded	752.78	751.42	751.50	751.81	751.16	

Table 3. ISL71026M Response of Key Parameters vs TID (Continued)

Parameter	Symbol	Condition	Bias	0krad (Si)	10krad (Si)	20krad (Si)	30krad (Si)	Anneal	Unit
Receiver Propagation Delay LOW to HIGH	$t_{PLH}$	3.0V	Biased	52.16	55.03	51.67	52.47	51.72	ns
			Grounded	52.03	54.71	51.60	52.32	51.47	
		3.6V	Biased	48.98	51.97	48.64	49.39	48.80	
			Grounded	48.83	51.70	48.54	49.21	48.54	
Receiver Propagation Delay HIGH to LOW	$t_{PHL}$	3.0V	Biased	52.16	54.02	51.48	52.13	51.56	ns
			Grounded	52.48	54.15	52.09	52.53	51.99	
		3.6V	Biased	48.82	50.79	48.14	48.86	48.21	
			Grounded	49.07	50.68	48.75	49.16	48.56	
Rx Skew $ t_{PHL} - t_{PLH} $	$t_{RXSKEW}$	3.0V	Biased	0.87	1.14	0.77	0.80	0.77	ns
			Grounded	0.83	0.91	0.90	0.81	0.85	
		3.6V	Biased	0.82	1.30	0.82	0.83	0.88	
			Grounded	0.76	1.21	0.83	0.79	0.76	

## 6.3 Single-Event Effects Testing

### 6.3.1 Introduction

The intense heavy ion environment encountered in space applications can cause a variety of Single-Event Effects (SEE). SEE can lead to system-level performance issues including disruption, degradation, and destruction. For predictable and reliable space system operation, individual electronic components should be characterized to determine their SEE response. The following is a summary of the SEE testing of the ISL71026M.

### 6.3.2 SEE Test Setup

Testing was performed at the Texas A&M University (TAMU) Cyclotron Institute heavy ion facility. This facility is coupled to a K500 super-conducting cyclotron, which is capable of generating a wide range of test particles with the various energy, flux, and fluence levels needed for advanced radiation testing.

A schematic of the SEE test circuit is shown in [Figure 57 on page 29](#). The cabling connected to the CANH/CANL pins presents 700pF to GND due to the 20 foot cable connecting the DUT to the oscilloscopes in the control room for SET testing. Other supplies and signals indicated by arrows were also cabled to the control room. Two instantiations of the schematic on a single board allowed two devices to be simultaneously irradiated for SEE testing. The two parts were monitored separately. Digital multimeters and oscilloscopes were used to monitor voltages and currents and to capture SET events.

### 6.3.3 SEL, SEB, and SEGR Testing Results

Testing for Single Event Latch-Up (SEL), Single Event Burnout (SEB), and Single Event Gate Rupture (SEGR) proceeded with biasing  $V_{CC}$  at both 0V and 5.5V (the supply absolute maximum), and the bus pins (CANL and CANH) alternately set to -20V and +20V (the absolute maximum for the bus terminals). This yielded four conditions for irradiations testing for damaging SEE. For the two powered cases the data input was a 50kHz square wave to exercise both the transmitter and receiver at approximately +25°C (ambient) case temperature. DUTs were irradiated with Ag ions at a 0° incident angle, resulting in an LET of 43MeV•cm<sup>2</sup>/mg. Each irradiation was done to a fluence of 1x10<sup>7</sup>ion/cm<sup>2</sup> so that each DUT saw a net of 4x10<sup>7</sup>ion/cm<sup>2</sup>.

Operating supply current ( $I_{CC}$ ) and common-mode current ( $I_{CM}$ ) were measured pre-radiation and post-radiation for each irradiation. The changes in current for the powered cases ( $V_{CC} = 5.5V$ ) were less than 0.5% and so were considered to indicate no damaging SEE. For the unpowered cases ( $V_{CC} = 0V$ ) the  $I_{CM}$

currents were in the low  $\mu\text{A}$  and registered changes only up to 7%. These changes in  $I_{\text{CM}}$  were interpreted as within the noise on the measurements and again did not indicate damaging SEE.

Before and after each sequence of four irradiations on a DUT a set of four operating currents were measured to characterize the part. These monitor currents were: static recessive  $I_{\text{CM}}$  for  $V_{\text{CM}} = -7\text{V}$ , static recessive  $I_{\text{CM}}$  for  $V_{\text{CM}} = +12\text{V}$ , dynamic unloaded  $I_{\text{CC}}$  for data at 250kHz, and dynamic loaded ICC for data at 250kHz. All of these operating currents registered less than 1% change as a result of the four irradiations. This was again interpreted as an indication of no damaging SEE.

### 6.3.4 Single-Event Transient Testing

Single Event Transient (SET) testing was conducted with a supply of 3.0V, data input of a 500kHz square wave, and +25°C (ambient) case temperature. Irradiation was done with various ions (Ag, Kr, Cu, Ar, Ne) at normal incidence to  $1 \times 10^7 \text{ion/cm}^2$  for each test. SET were counted for every received pulse deviating by 50ns from the nominal 1000ns. The SET were captured and counted by an oscilloscope. SET testing was done for both the high slew rate ( $\text{RS} = 0\Omega$ ) and the medium slew rate ( $\text{RS} = 10\text{k}\Omega$ ). The results are summarized in [Table 4](#).

**Table 4. SET Results**

LET (MeV·cm <sup>2</sup> /mg) (Species)	Fast Slew, RS = 0Ω				Medium Slew, RS = 10kΩ			
	DUT1	DUT2	DUT3	DUT4	DUT1	DUT2	DUT3	DUT4
43 (Ag)	31	8	30	6	1378	990	912	1437
28 (Kr)	3	0	8	0	415	928	867	525
20 (Cu)	0	0	0	0	535	275	226	598
8.5 (Ar)	-	-	-	-	6	34	39	14
2.7 (Ne)	-	-	-	-	0	0	0	0

Note: SET counts of  $\pm 50\text{ns}$  events on a 500kHz square wave signal taken to a fluence of  $1 \times 10^7 \text{ion/cm}^2$  at each test.

The data in [Table 4](#) can be reduced to generate Weibull parameters to run CRÈME96 simulations to get approximate times between events in a solar minimum geosynchronous orbit with 100 mils of aluminum shielding. Carrying out these simulations predicts about 10.7 years between  $\pm 50\text{ns}$  events when running at medium slew rate, and 2000 years between events when running at the high slew rate.

### 6.3.5 Conclusion

The SEE test results clearly demonstrate that the ISL71026M is robust against SEL, SEB, and SEGR to a LET of  $43 \text{MeV}\cdot\text{cm}^2/\text{mg}$  at a supply voltage up to 5.5V, bus voltages to  $\pm 20\text{V}$ , and a case temperature up to +125°C.

SET characterization showed that relatively benign events of  $\pm 50\text{ns}$  timing disruption on a 500kHz signal were rare events when ion abundance is considered. Using a solar minimum geosynchronous orbit with 100 mils of aluminum shielding as a benchmark, events when running at the medium slew rate are roughly once every 10.7 years, and events when running at the fast slew rate occur roughly once every 2000 years.

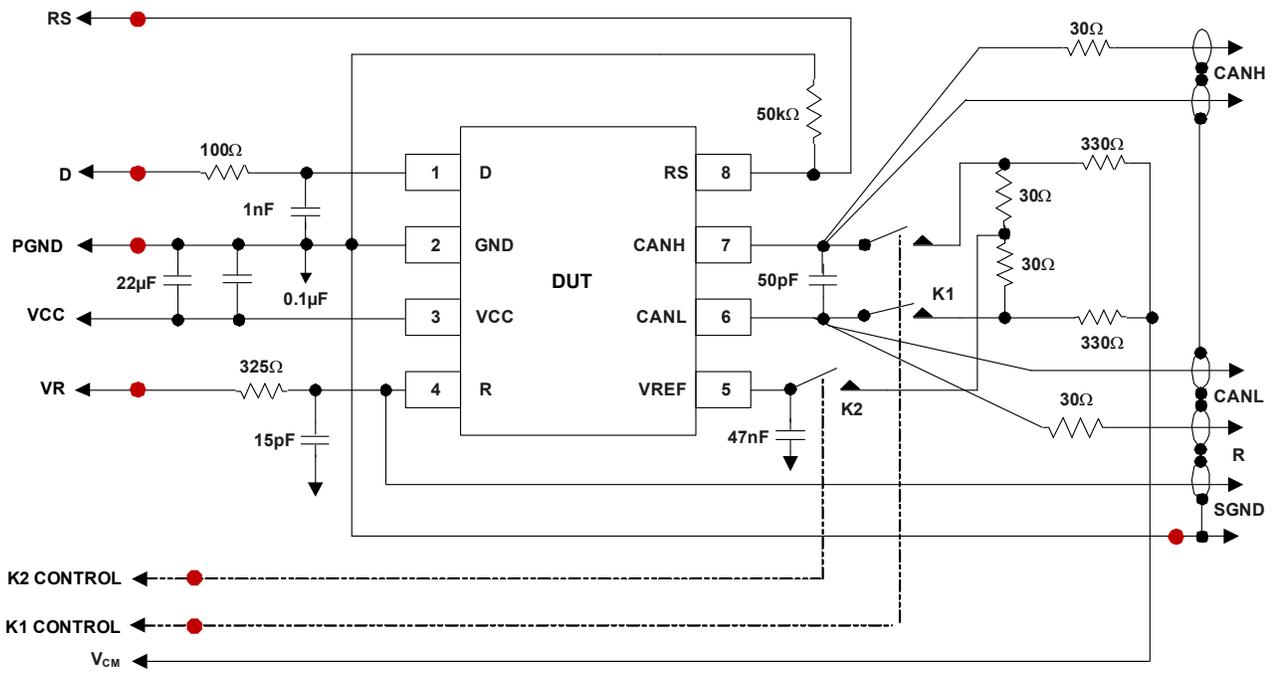


Figure 57. SEE Testing Schematic

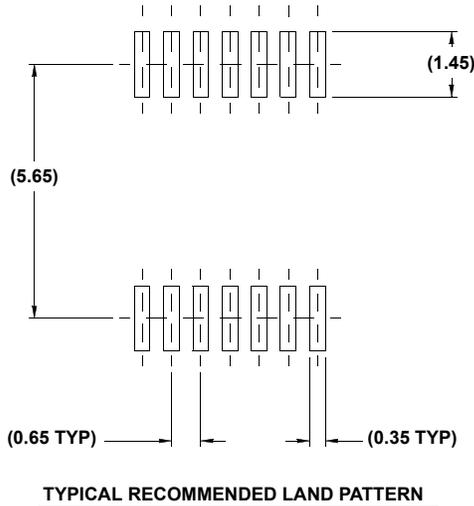
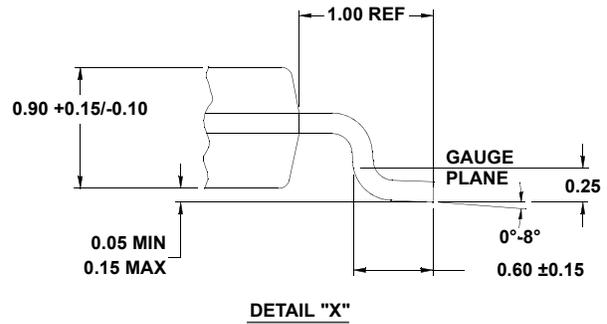
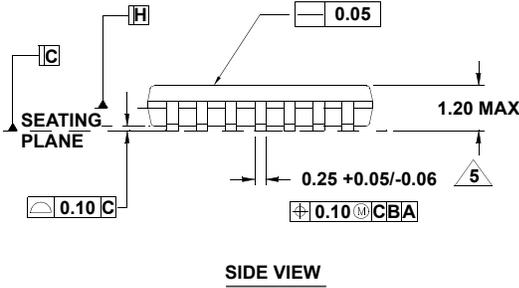
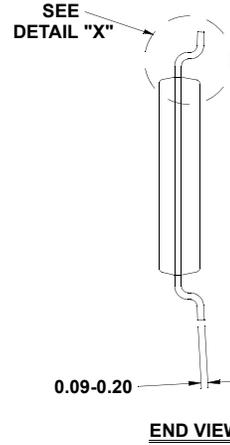
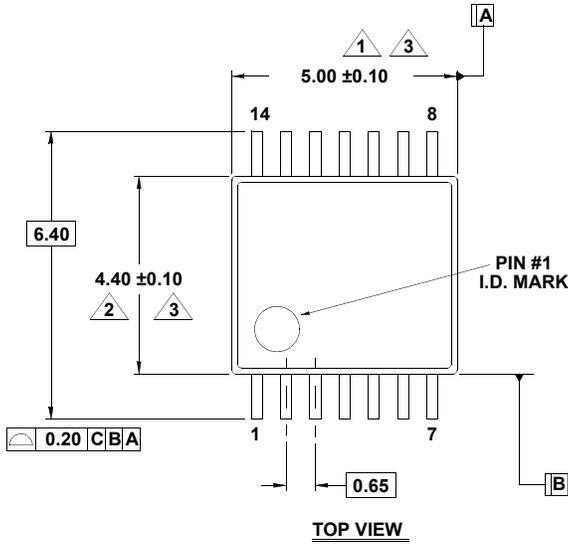
## 7. Revision History

Rev.	Date	Description
1.00	Mar 26, 2018	Updated to latest layout. Added Outgassing Feature bullet. Updated Ordering information by adding -T and -T7 parts to table and updated Note 1. Added Outgassing specification information. Removed About Intersil section and updated disclaimer.
0.00	May 3, 2017	Initial release

# 8. Package Outline Drawing

For the most recent package outline drawing, see [M14.173](#).

M14.173  
 14 LEAD THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)  
 Rev 3, 10/09



**NOTES:**

1. Dimension does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 per side.
2. Dimension does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25 per side.
3. Dimensions are measured at datum plane H.
4. Dimensioning and tolerancing per ASME Y14.5M-1994.
5. Dimension does not include dambar protrusion. Allowable protrusion shall be 0.80mm total in excess of dimension at maximum material condition. Minimum space between protrusion and adjacent lead is 0.07mm.
6. Dimension in ( ) are for reference only.
7. Conforms to JEDEC MO-153, variation AB-1.

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