ISL71026M

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

Description

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 up to 5Mbps. It can drive a 40m cable at 1Mbps per the ISO11898-2 specification. 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

- Qualified to Renesas Rad Tolerant Screening and QCI Flow (R34TB0004EU)
- ESD protection on all pins: 5kV HBM
- Compatible with ISO11898-2
- Operating supply range: 3.0V to 3.6V
- Bus pin fault protection to ±20V
- Three selectable driver rise and fall times
- High data rates up to 5Mbps
- -7V to +12V common mode input voltage range
- Hi Z input allows for 120 nodes on the bus
- Cold spare: powered down devices/nodes will not affect active devices operating in parallel
- 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
- TID Radiation Lot Acceptance Testing (LDR: <0.01rad(Si)/s)
    - ISL71026M30VZ: 30krad(Si)
    - ISL71026M50VZ: 50krad(Si)
- SEE Characterization
    - No DSEE for VCC = 5.5V, CANL = ±20V and CANH = ±20V at 43MeV•cm^2/mg
    - SET < 370μm^2 with fast slew rate at 43MeV•cm^2/mg
    - SET < 14,370μm^2 with medium slew rate at 43MeV•cm^2/mg

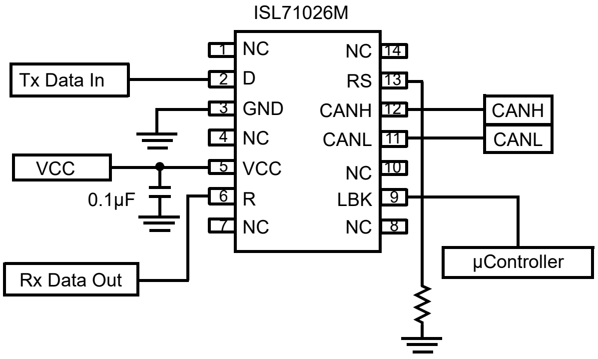

Figure 1. Typical Application

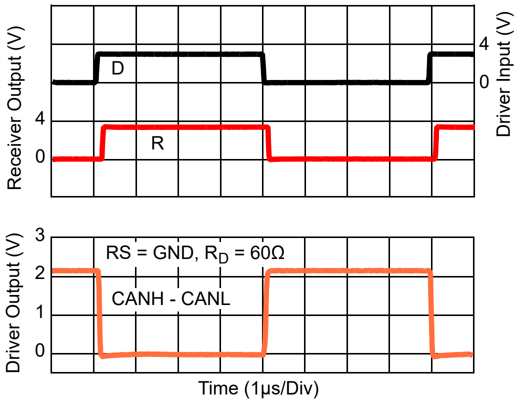

Figure 2. Fast Driver and Receiver Waveforms

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1. Pin Information

1.1 Pin Assignments

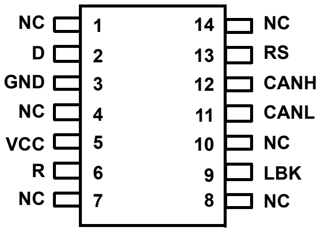


Figure 3. Pin Assignments - Top View

1.2 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

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.

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	
Maximum Junction Temperature	-	+150	°C
Storage Temperature Range	-65	+150	°C
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

2.2 Outgas Testing

Specification (Tested per ASTM E 595, 1.5)	Value	Unit
Total Mass Lost[1]	0.06	%
Collected Volatile Condensible Material[1]	<0.01	%
Water Vapor Recovered	0.03	%

1. Results meet NASA low outgassing requirements of “Total Mass Lost” of <1% and Collected Volatile Condensible Material of <0.1%.

2.3 Thermal Information

Parameter	Package	Symbol	Conditions	Typical Value	Unit
Thermal Resistance	14 Ld TSSOP Package	θ_{JA}[1]	Junction to ambient	92	°C/W
		θ_{JC}[2]	Junction to case	30	°C/W

1. θ_{JA} is measured with the component mounted on a high-effective thermal conductivity test board in free air. See TB379.
2. For θ_{JC}, the case temperature location is taken at the package top center.

2.4 Operating Conditions

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

Parameter	Minimum	Maximum	Unit
I_{OL} Driver (CANH - CANL = 1.5V, V_{CC} = 3.3V)	-	+40	mA
I_{OL} Receiver (V_{OL} = 0.4V)	-	+4	mA

2.5 Electrical Specifications

Test Conditions: V_{CC} = 3.0V to 3.6V;Typicals are at T_A = +25°C; unless otherwise specified[1]. **Boldface limits apply across the operating temperature range, -55°C to +125°C.**

Parameter	Symbol	Test Conditions		Min[2]	Typ[3]	Max[2]	Unit
Driver Electrical Characteristics							
Dominant Bus Output Voltage	$V_{O(DOM)}$	D = 0V, CANH, RS = 0V, Figure 11 and Figure 12	$3.0V \le V_{CC} \le 3.6V$	**2.25**	2.57	**V_{CC}**	V
		D = 0V, CANL, RS = 0V, Figure 11 and Figure 12		**0.1**	0.58	**1.25**	V
Recessive Bus Output Voltage	$V_{O(REC)}$	D = 3V, CANH, RS = 0V, 60Ω and no load, Figure 11 and Figure 12	$3.0V \le V_{CC} \le 3.6V$	**1.80**	2.1	**2.70**	V
		D = 3V, CANL, RS = 0V, 60Ω and no load, Figure 11 and Figure 12		**1.80**	2.1	**2.80**	V
Dominant Output Differential Voltage	$V_{OD(DOM)}$	D = 0V, RS = 0V, $3.0V \le V_{CC} \le 3.6V$, Figure 11 and Figure 12		**1.5**	2.4	**3**	V
		D = 0V, RS = 0V, $3.0V \le V_{CC} \le 3.6V$, Figure 12 and Figure 13		**1.2**	2.0	**3**	V
Recessive Output Differential Voltage	$V_{OD(REC)}$	D = 3V, RS = 0V, $3.0V \le V_{CC} \le 3.6V$, Figure 11 and Figure 12		**-120**	0.2	**12**	mV
		D = 3V, RS = 0V, $3.0V \le V_{CC} \le 3.6V$, no load		**-500**	-30	**50**	mV
Logic Input High Voltage (D, LBK)	V_{IH}	$3.0V \le V_{CC} \le 3.6V$[4]		**2.0**	-	**5.5**	V
Logic Input Low Voltage (D, LBK)	V_{IL}	$3.0V \le V_{CC} \le 3.6V$[4]		**0**	-	**0.8**	V
Logic High Level Input Current (D, LBK)	I_{IH}	D = 2.0V, $3.0V \le V_{CC} \le 3.6V$		**-30**	-3	**30**	µA
Logic Low Level Input Current (D, LBK)	I_{IL}	D = 0.8V, $3.0V \le V_{CC} \le 3.6V$		**-30**	-7	**30**	µA
RS Input Voltage for Listen Mode	$V_{IN(RS)}$	$3.0V \le V_{CC} \le 3.6V$		**0.75 V_{CC}**	1.9	**5.5**	V
Output Short-Circuit Current	I_{OSC}	V_{CANH} = -7V, CANL = Open, $3.0V \le V_{CC} \le 3.6V$, Figure 25		**-250**	-108	-	mA
		V_{CANH} = +12V, CANL = Open, $3.0V \le V_{CC} \le 3.6V$, Figure 25		-	0.4	**1**	mA
		V_{CANL} = -7V, CANH = Open, $3.0V \le V_{CC} \le 3.6V$, Figure 25		**-1**	-0.4	-	mA
		V_{CANL} = +12V, CANH = Open, $3.0V \le V_{CC} \le 3.6V$, Figure 25		-	90	**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), Common Mode Voltage Range: -2V to +7V, Figure 17		-	740	**900**	mV
		LBK = 0V, RS = 0V, 10k, 50k, (recessive to dominant), Common Mode Voltage Range: <-2V to -7V or >+7V to +12V, Figure 17		-	740	**950**	mV

Test Conditions: V_{CC} = 3.0V to 3.6V;Typicals are at T_A = +25°C; unless otherwise specified[1]. **Boldface limits apply across the operating temperature range, -55°C to +125°C. (Cont.)**

Parameter	Symbol	**Test Conditions**	**Min[2]**	Typ[3]	**Max[2]**	Unit
Input Threshold Voltage (Falling)	V_{THF}	LBK = 0V, RS = 0V, 10k, 50k, (dominant to recessive), Common Mode Voltage Range: -2V to +7V, Figure 17	**500**	650	-	mV
		LBK = 0V, RS = 0V, 10k, 50k, (dominant to recessive), Common Mode Voltage Range: <-2V to -7V or >+7V to +12V, Figure 17	**450**	650	-	mV
Input Hysteresis	V_{HYS}	(V_{THR} - V_{THF}), RS = 0V, 10k, 50k	**40**	90	-	mV
Listen Mode Input Threshold Voltage (Rising)	V_{THRLM}	RS = V_{CC}, (recessive to dominant), Figure 17	-	990	**1150**	mV
Listen Mode Input Threshold Voltage (Falling)	V_{THFLM}	RS = V_{CC}, (dominant to recessive), Figure 17	**525**	890	-	mV
Listen Mode Input Hysteresis	V_{HYSLM}	(V_{THR} - V_{THF}), RS = V_{CC}	**50**	100	-	mV
Receiver Output High Voltage	V_{OH}	I_O = -4mA	**2.4**	V_{CC} - 0.2	-	V
Receiver Output Low Voltage	V_{OL}	I_O = +4mA	-	0.15	**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	-	435	**500**	µA
		CANH or CANL at 12V, D = 3V, V_{CC} = 0V, other bus pin at 0V, LBK = RS = 0V	-	150	**250**	µA
		CANH or CANL at -7V, D = 3V, other bus pin at 0V, LBK = RS = 0V	**-400**	-334	-	µA
		CANH or CANL at -7V, D = 3V, V_{CC} = 0V, other bus pin at 0V, LBK = RS = 0V	**-150**	-85	-	µA
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	**20**	40	**50**	kΩ
Differential Input Resistance	R_{IND}	Input to Input, D = 3V, LBK = RS = 0V	**40**	80	**100**	kΩ
Supply Current						
Supply Current, Listen Mode	$I_{CC(L)}$	RS = D = V_{CC}, LBK = 0V, 3.0V≤ V_{CC} ≤ 3.6V	-	1	**2**	mA
Supply Current, Dominant	$I_{CC(DOM)}$	D = LBK = RS = 0V, no load, 3.0V ≤ V_{CC} ≤ 3.6V	-	5	**7**	mA
Supply Current, Recessive	$I_{CC(REC)}$	D = V_{CC}, LBK = RS = 0V, no load, 3.0V ≤ V_{CC} ≤ 3.6V	-	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	**-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	**-25**	-4	**25**	µA
Driver Switching Characteristics						
Propagation Delay LOW to HIGH	t_{PDLH1}	RS = 0V, Figure 14	-	87	**150**	ns
Propagation Delay LOW to HIGH	t_{PDLH2}	RS = 10kΩ, Figure 14	-	535	**850**	ns
Propagation Delay LOW to HIGH	t_{PDLH3}	RS = 50kΩ, Figure 14	-	854	**1400**	ns
Propagation Delay HIGH to LOW	t_{PDHL1}	RS = 0V, Figure 14	-	90	**155**	ns
Propagation Delay HIGH to LOW	t_{PDHL2}	RS = 10kΩ, Figure 14	-	456	**800**	ns

Test Conditions: V_{CC} = 3.0V to 3.6V;Typicals are at T_A = +25°C; unless otherwise specified[1]. **Boldface limits apply across the operating temperature range, -55°C to +125°C. (Cont.)**

Parameter	Symbol	**Test Conditions**	**Min[2]**	Typ[3]	**Max[2]**	Unit
Propagation Delay HIGH to LOW	t_{PDHL3}	RS = 50kΩ, Figure 14	-	719	**1300**	ns
Output Skew	t_{SKEW1}	RS = 0V, ($\lvert t_{PHL} - t_{PLH}\rvert$), Figure 14	-	3	**50**	ns
Output Skew	t_{SKEW2}	RS = 10kΩ, ($\lvert t_{PHL} - t_{PLH}\rvert$), Figure 14	-	79	**510**	ns
Output Skew	t_{SKEW3}	RS = 50kΩ, ($\lvert t_{PHL} - t_{PLH}\rvert$), Figure 14	-	135	**800**	ns
Output Rise Time	t_{r1}	RS = 0V, (fast speed - 1Mbps) Figure 14	**20**	59	**100**	ns
Output Fall Time	t_{f1}		**10**	30	**75**	ns
Output Rise Time	t_{r2}	RS = 10kΩ, (medium speed - 250kbps) Figure 14	**200**	386	**780**	ns
Output Fall Time	t_{f2}		**175**	318	**500**	ns
Output Rise Time	t_{r3}	RS = 50kΩ, (slow speed - 125kbps) Figure 14	**400**	646	**1400**	ns
Output Fall Time	t_{f3}		**300**	627	**1000**	ns
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant	$t_{(LOOP1)}$	RS = 0V, Figure 21	-	126	**210**	ns
		RS = 10kΩ, Figure 21	-	574	**875**	ns
		RS = 50kΩ, Figure 21	-	852	**1400**	ns
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive	$t_{(LOOP2)}$	RS = 0V, Figure 21	-	137	**270**	ns
		RS = 10kΩ, Figure 21	-	494	**825**	ns
		RS = 50kΩ, Figure 21	-	725	**1300**	ns
Listen to Valid Dominant Time	$t_{L\text{-}DOM}$	Figure 19	-	4	**15**	µs
Receiver Switching Characteristics						
Propagation Delay LOW to HIGH	t_{PLH}	Figure 17	-	52	**110**	ns
Propagation Delay HIGH to LOW	t_{PHL}	Figure 17	-	51	**110**	ns
Rx Skew	t_{SKEW1}	$\lvert(t_{PHL} - t_{PLH})\rvert$, Figure 17	-	1	35	ns
Rx Rise Time	t_r	Figure 17	-	2	-	ns
Rx Fall Time	t_f	Figure 17	-	2	-	ns
LBK Delay I/O to Rx Output	t_{LBK}	Figure 23	-	42	**75**	ns
RS Pin Characteristics						
RS Input Current	$I_{RS(H)}$	RS = 0.75 x V_{CC}	**-10**	-0.2	-	µA
	$I_{RS(L)}$	V_{RS} = 0V	**-450**	-125	**0**	µA

1. 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.
2. Compliance to datasheet limits are assured by one or more methods: production test, characterization, and/or design.
3. 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.
4. Parameter included in functional testing.

2.6 Equivalent Input and Output Schematic Diagrams

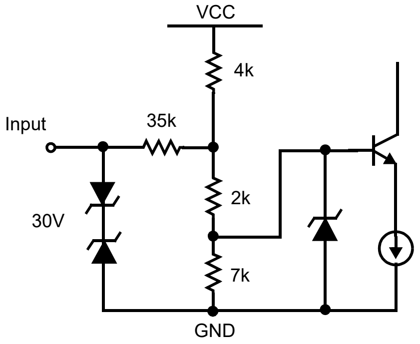


Figure 4. CANH and CANL Inputs

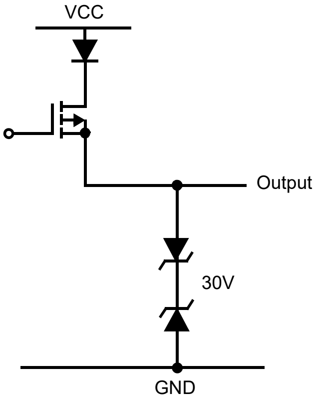


Figure 5. CANH Output

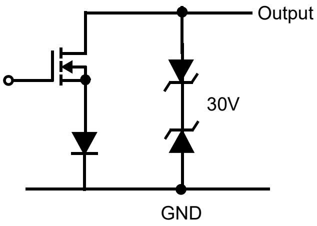


Figure 6. CANL Output

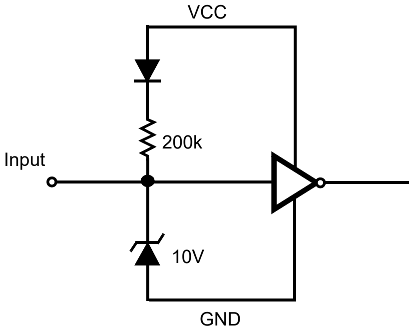


Figure 7. D Input

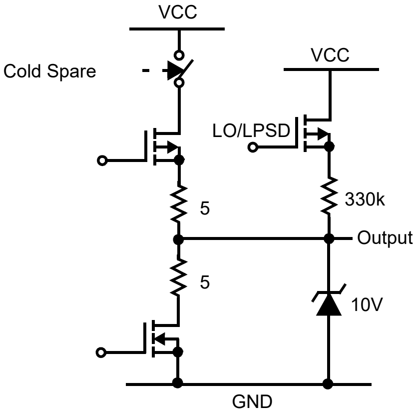


Figure 8. R Output

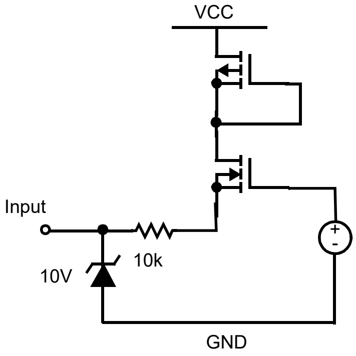


Figure 9. RS Input

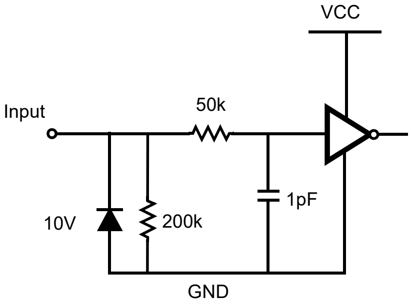


Figure 10. LBK Input

2.7 Test Circuits and Waveforms

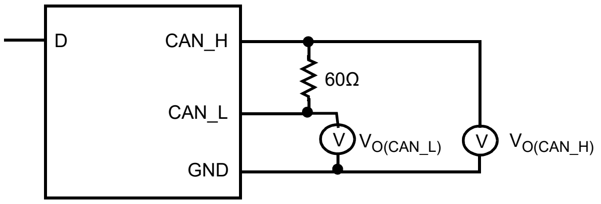


Figure 11. Driver Test Circuit

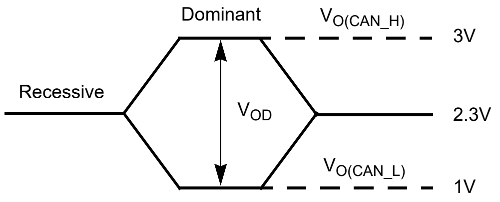


Figure 12. Driver Bus Voltage Definitions

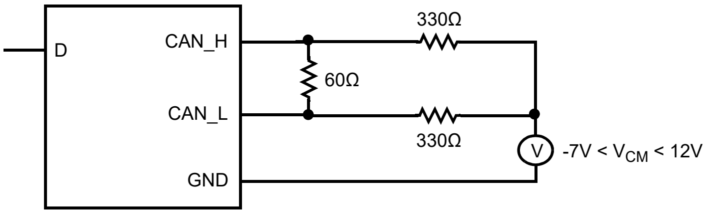
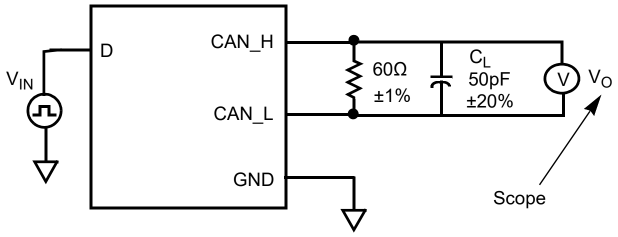


Figure 13. Driver Common-Mode Circuit



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

Figure 14. Driver Timing Test Circuit

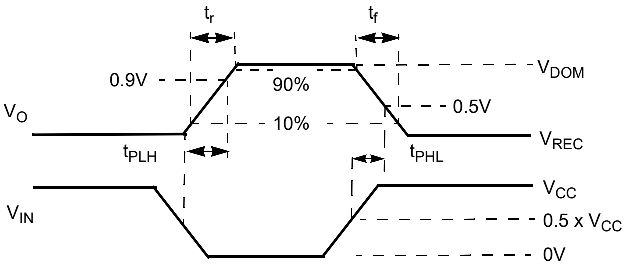


Figure 15. Driver Timing Measurement Points

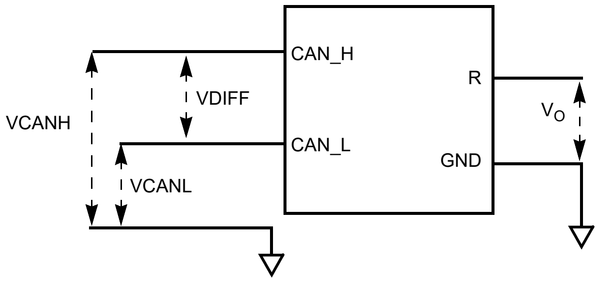
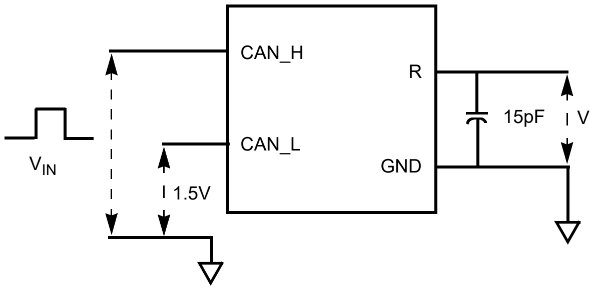


Figure 16. Receiver Voltage Definitions



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

Figure 17. Receiver Test Circuit

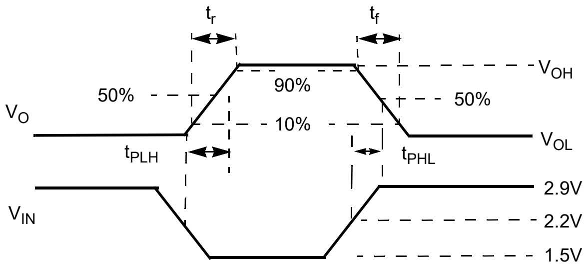
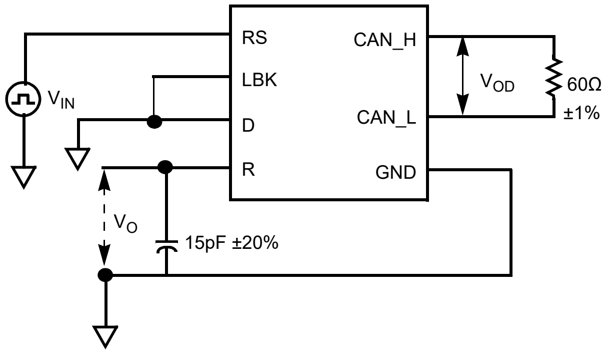


Figure 18. Receiver Test Measurement Points

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

Figure 19. Listen to Valid Dominant Time Test Circuit

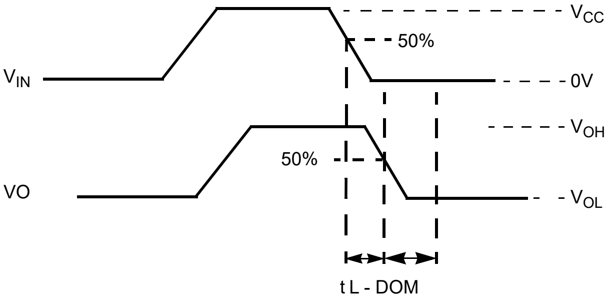


Figure 20. Listen to Valid Dominant Time Measurement Points

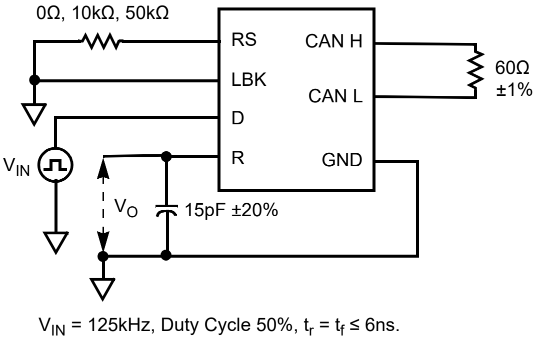


Figure 21. Total Loop Delay Test Circuit

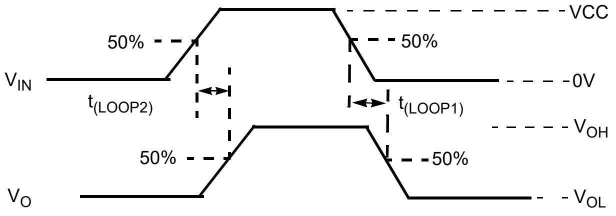


Figure 22. Total Loop Delay Measurement Points

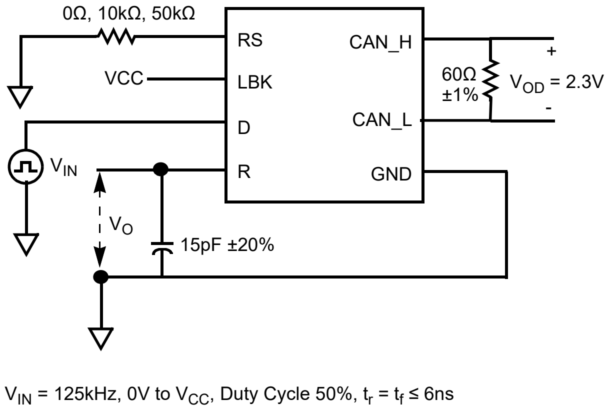


Figure 23. Loop Back Delay to Dominant Time Test Circuit

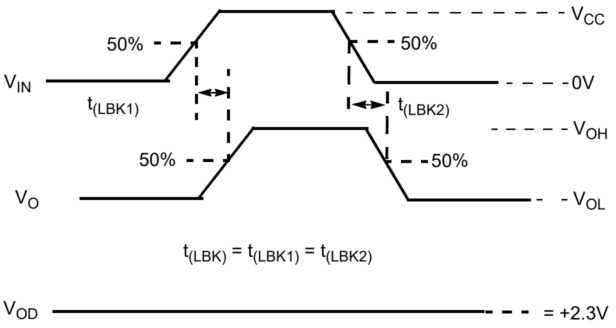


Figure 24. Loop Back Delay to Dominant Measurement Points

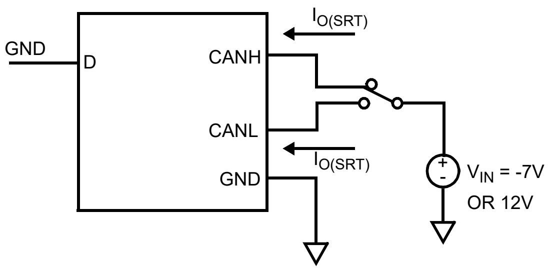


Figure 25. Output Short-Circuit Current Test Circuit

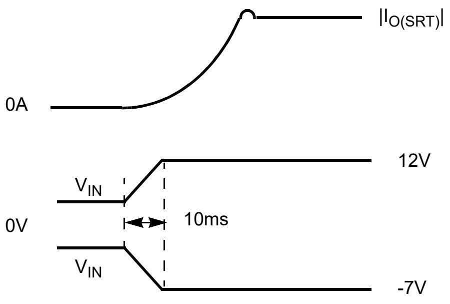


Figure 26. Output Short-Circuit Current Waveforms

3. Typical Performance Curves

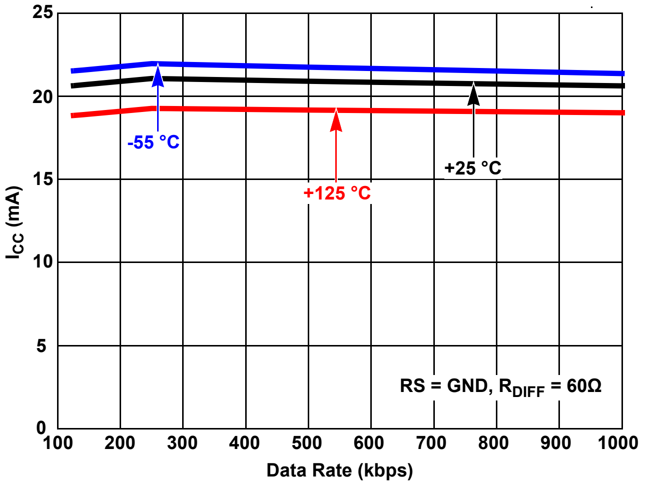


Figure 27. Supply Current vs Fast Data Rate vs Temperature

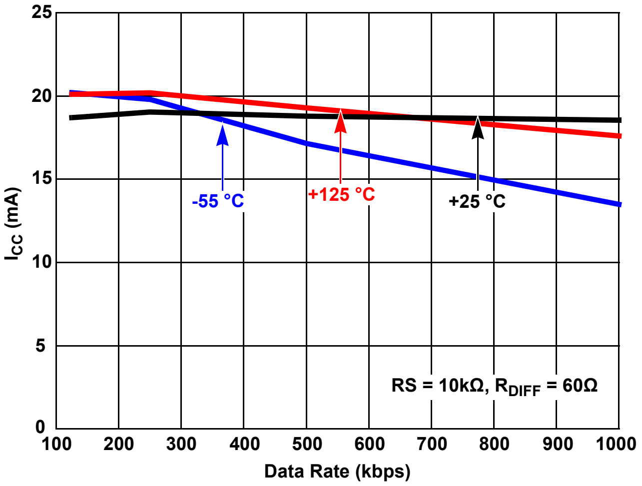


Figure 28. Supply Current vs Medium Data Rate vs Temperature

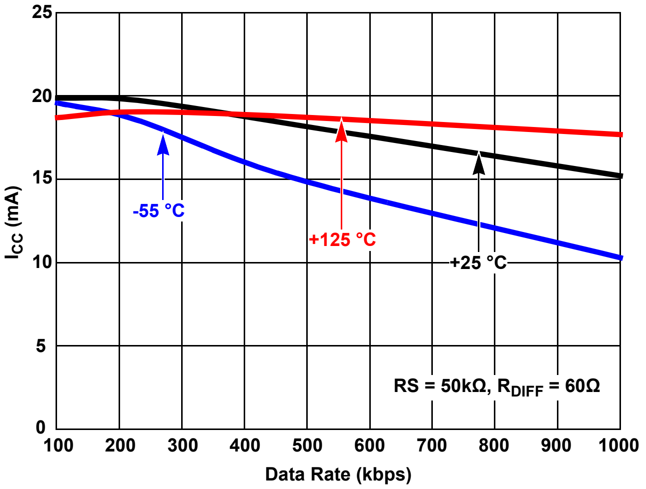


Figure 29. Supply Current vs Slow Data Rate vs Temperature

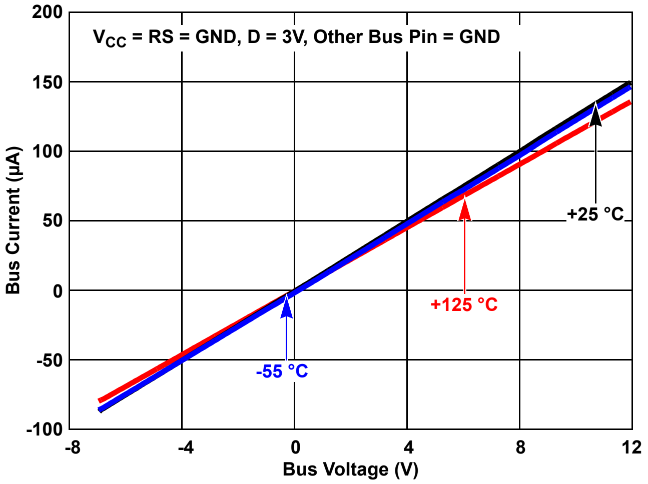


Figure 30. Bus Pin Leakage vs VCM at V_{CC} = 0V

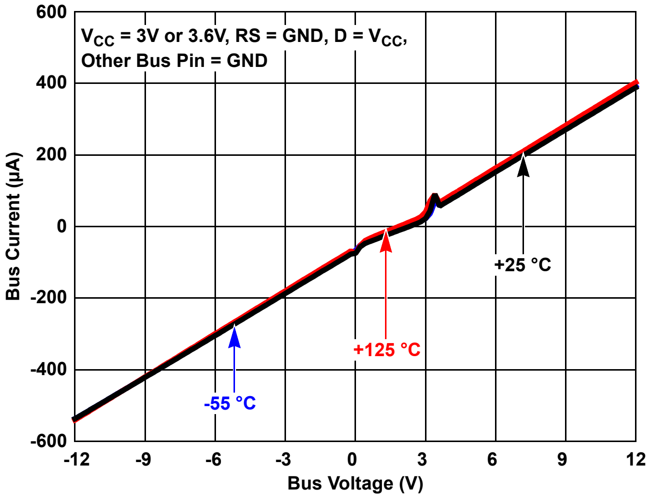


Figure 31. Bus Pin Leakage vs ±12V VCM

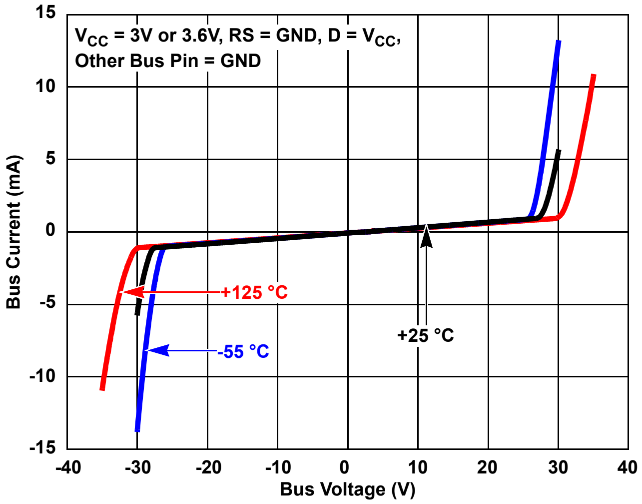


Figure 32. Bus Pin Leakage vs ±35V VCM

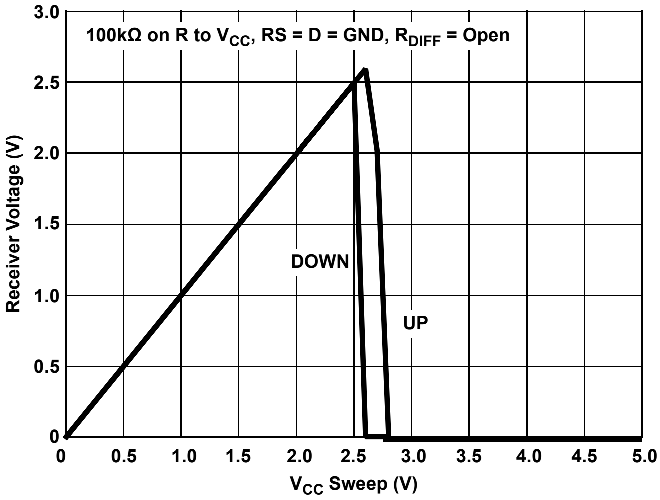


Figure 33. V_{CC} Undervoltage Lockout

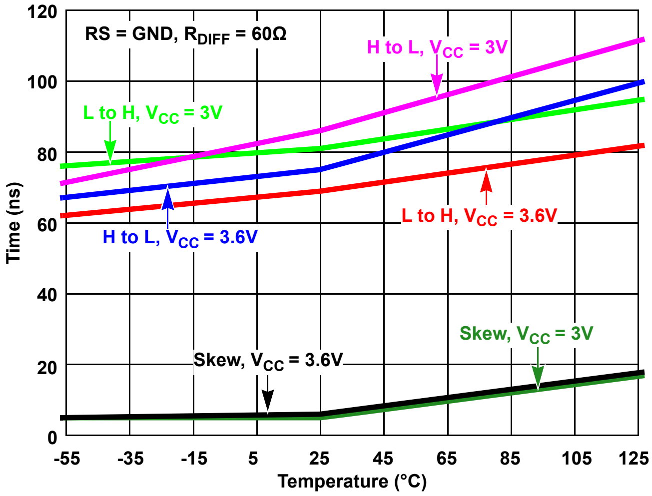


Figure 34. Transmitter Propagation Delay and Skew vs Temperature at Fast Speed

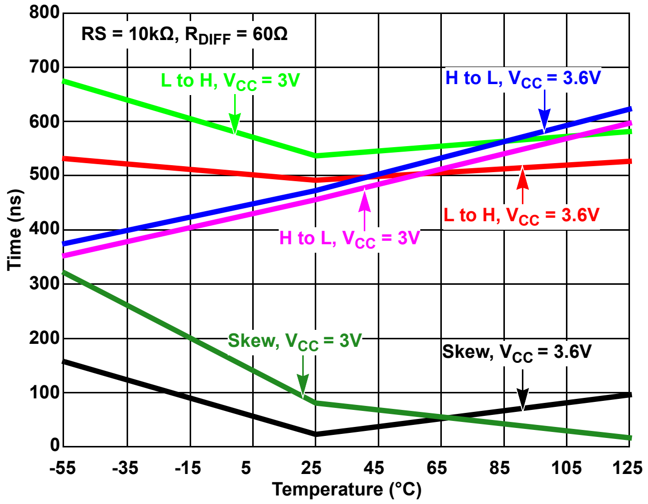


Figure 35. Transmitter Propagation Delay and Skew vs Temperature at Medium Speed

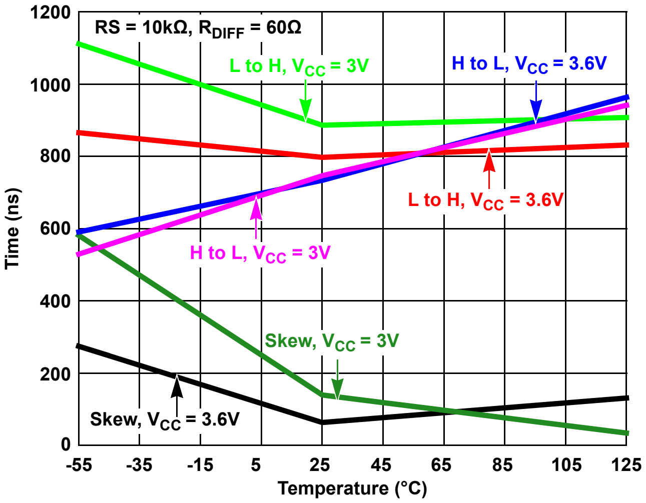


Figure 36. Transmitter Propagation Delay and Skew vs Temperature at Slow Speed

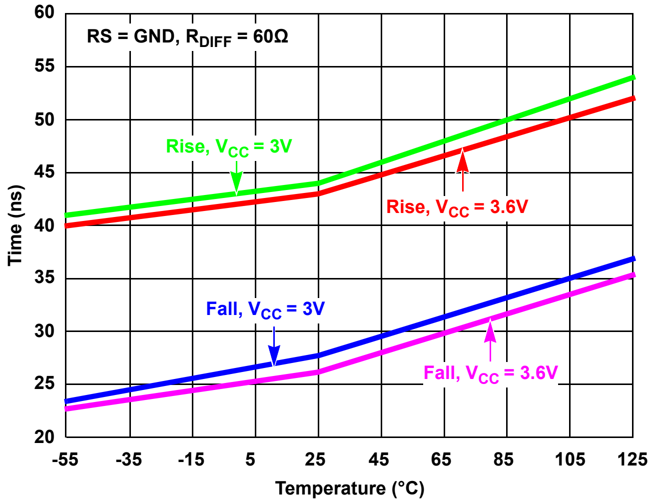


Figure 37. Transmitter Rise and Fall Times vs Temperature at Fast Speed

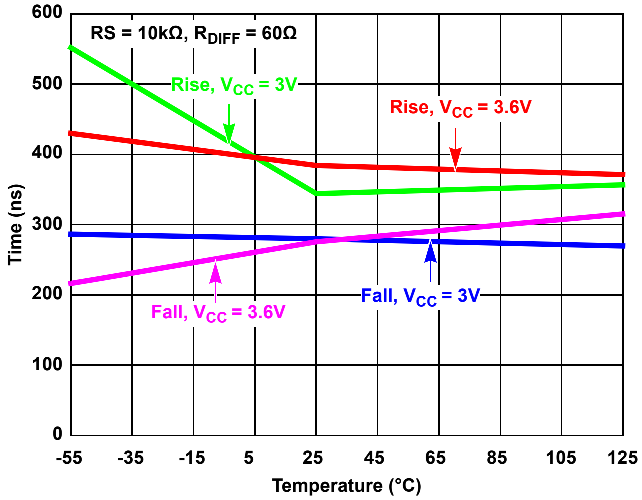


Figure 38. Transmitter Rise and Fall Times vs Temperature at Medium Speed

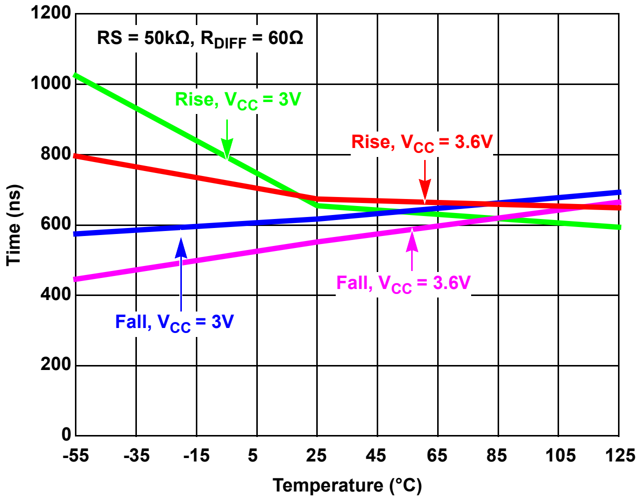


Figure 39. Transmitter Rise and Fall Times vs Temperature at Slow Speed

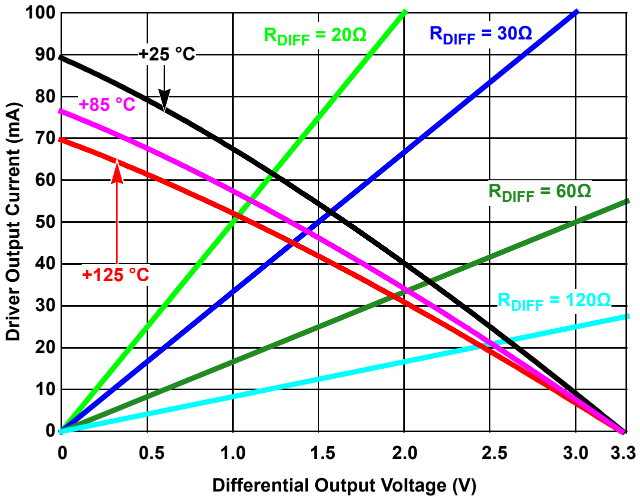


Figure 40. Driver Output Current vs Differential Output Voltage

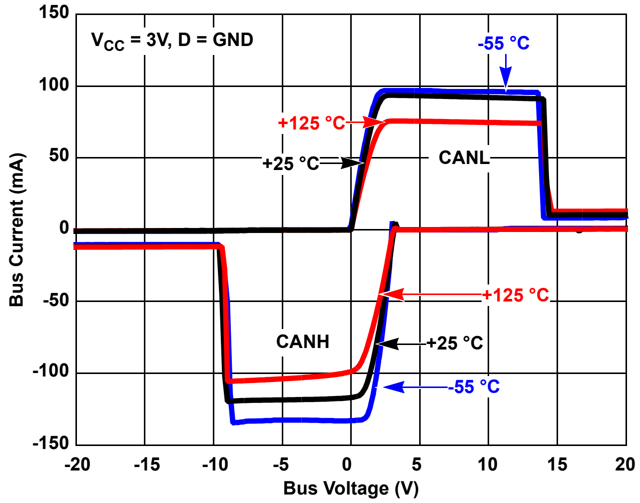


Figure 41. Driver Output Current vs Short-Circuit Voltage vs Temperature

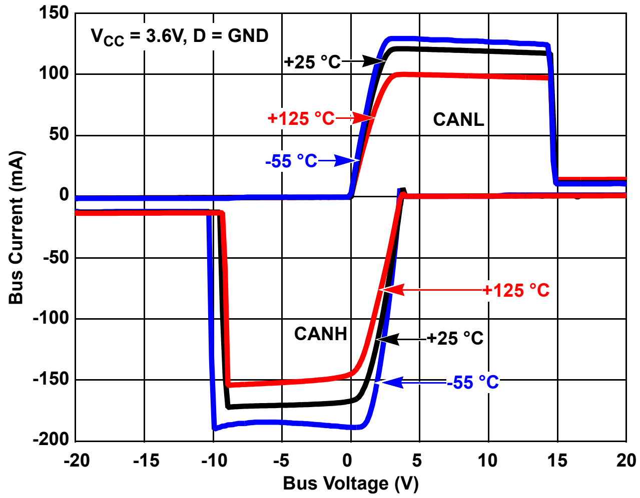


Figure 42. Driver Output Current vs Short-Circuit Voltage vs Temperature

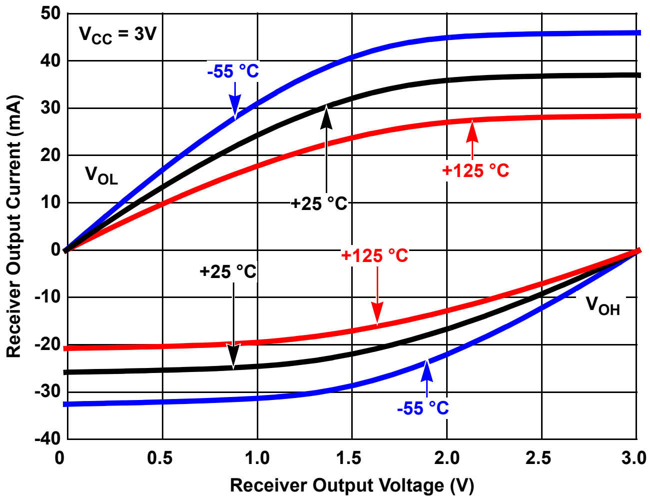


Figure 43. Receiver Output Current vs Receiver Output Voltage at V_{CC} = 3V

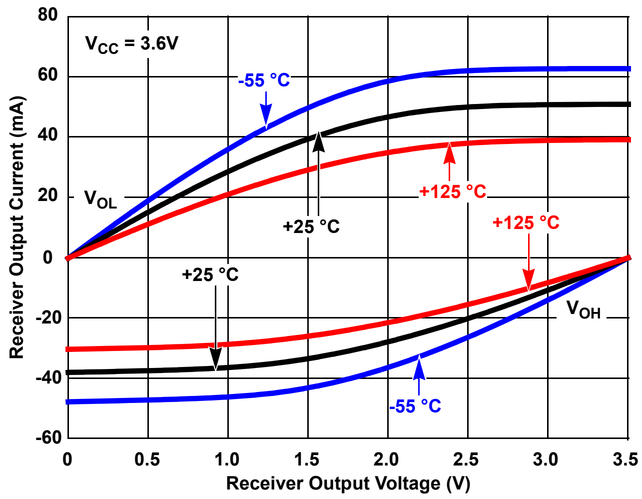


Figure 44. Receiver Output Current vs Receiver Output Voltage at V_{CC} = 3.6V

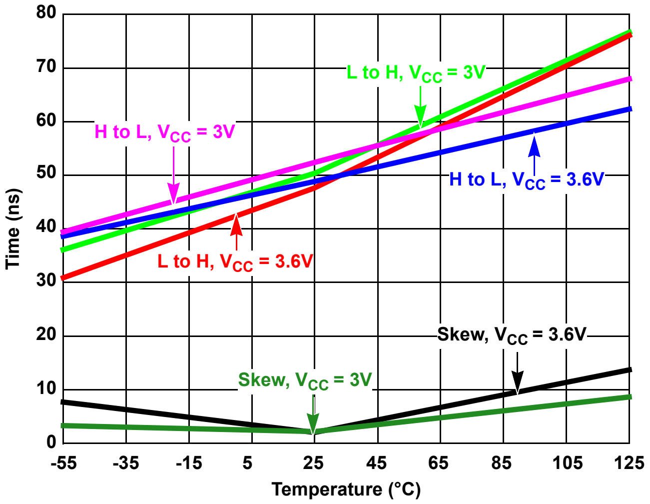


Figure 45. Receiver Propagation Delay and Skew vs Temperature

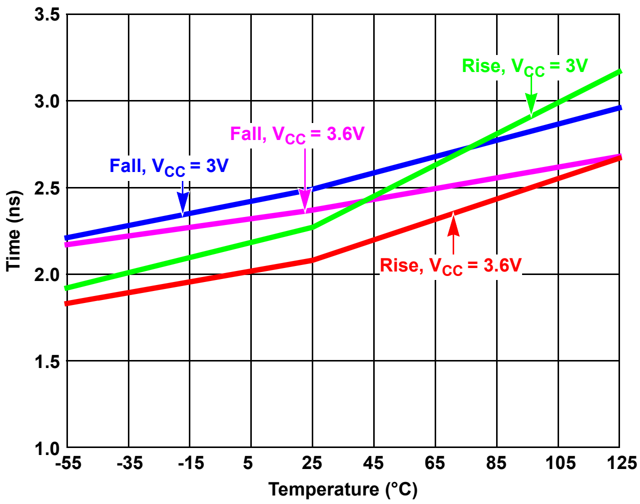


Figure 46. Receiver Rise and Fall Times vs Temperature

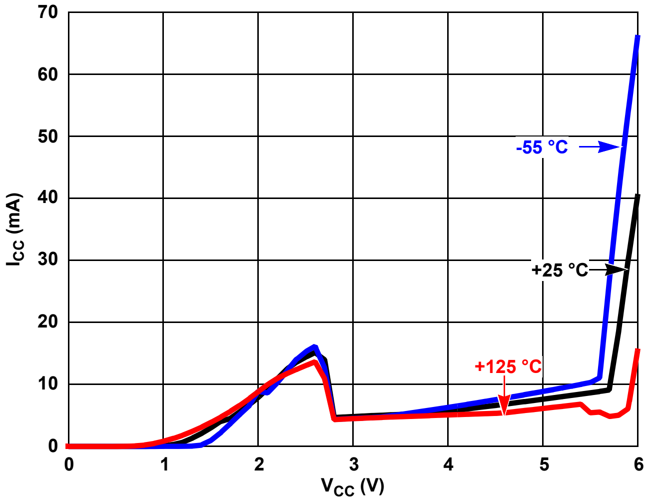


Figure 47. Supply Current vs Supply Voltage vs Temperature

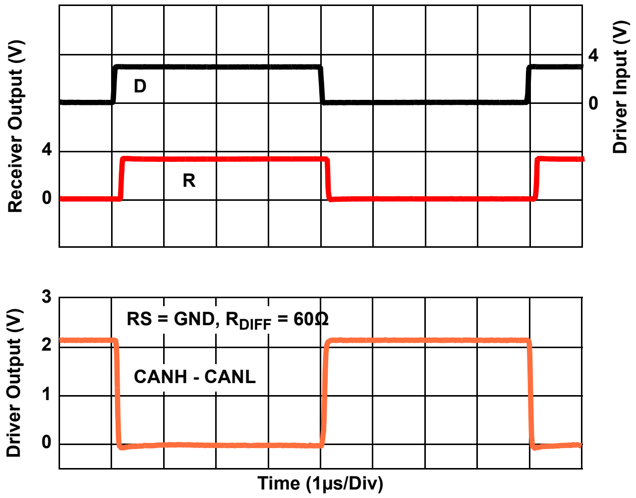


Figure 48. Fast Driver and Receiver Waveforms

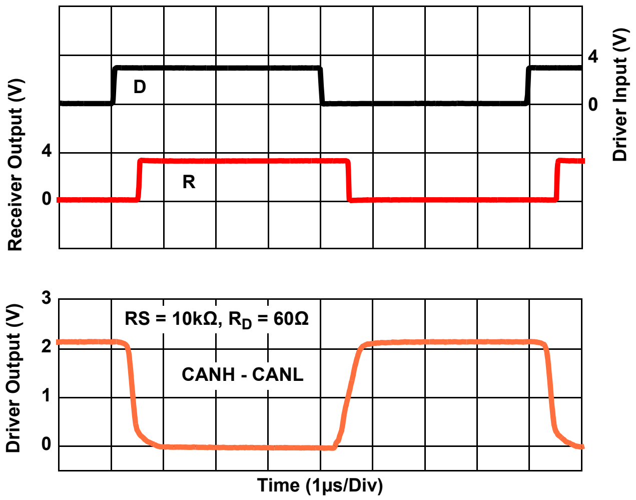


Figure 49. Medium Driver and Receiver Waveforms

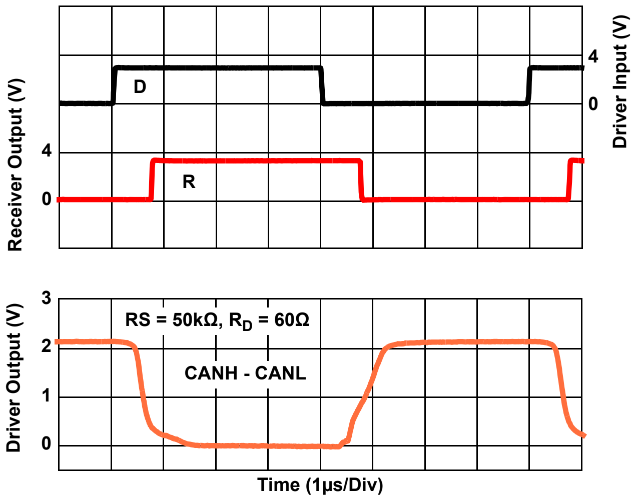


Figure 50. Slow Driver and Receiver Waveforms

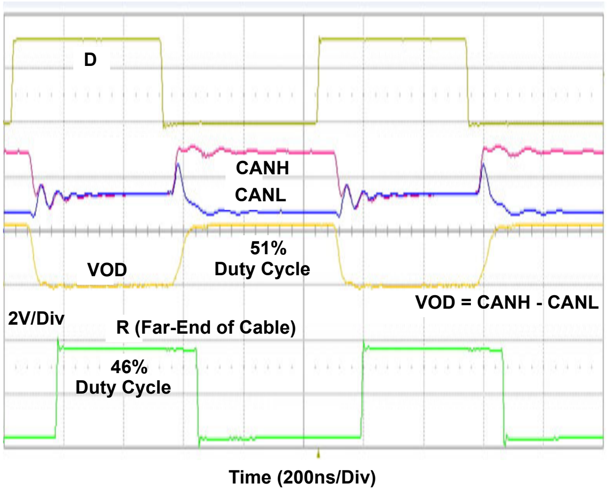


Figure 51. 2Mbps CAN Transceiver Waveforms Over 10ft Cable

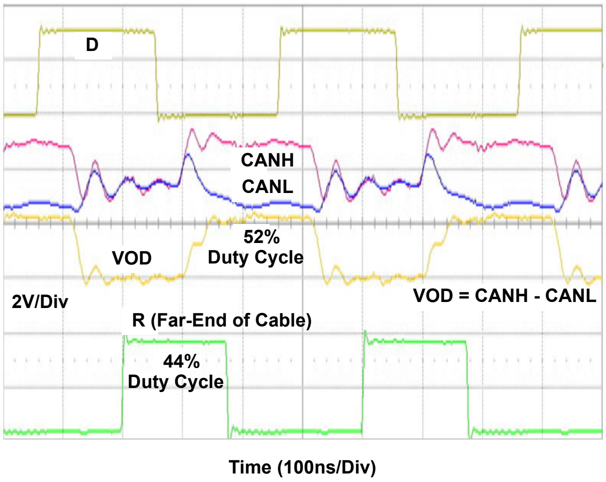


Figure 52. 5Mbps CAN Transceiver Waveforms Over 10ft Cable

4. Functional Description

4.1 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 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 ±20V on the CANH and CANL bus pins.

4.2 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 = 10kΩ provides for a typical slew rate of 8V/µs and RS = 50kΩ provides for a typical slew rate of 4V/µs.

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.

4.3 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 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.

4.4 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 480kΩ with a typical resistance of 2MΩ. The resistance between CANH and CANL of a powered-down transceiver has a typical resistance of 80kΩ.

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.

4.5 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.

4.6 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.

4.7 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.

5. 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. The TID performance of the ISL71026MNZ is not guaranteed through radiation acceptance testing. The ISL71026M30NZ is radiation lot acceptance tested (RLAT) to 30krad(Si), and the ISL71026M50NZ is RLAT to 50krad(Si). The SEE characterized performance is not guaranteed.

5.1 Total Ionizing Dose (TID) Testing

5.1.1 Introduction

This test was conducted to determine the sensitivity of the part to the total dose environment. Down points were 0krad(Si), 10krad(Si), 30krad(Si), and 50krad(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}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 24 samples irradiated under bias and 24 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 53.

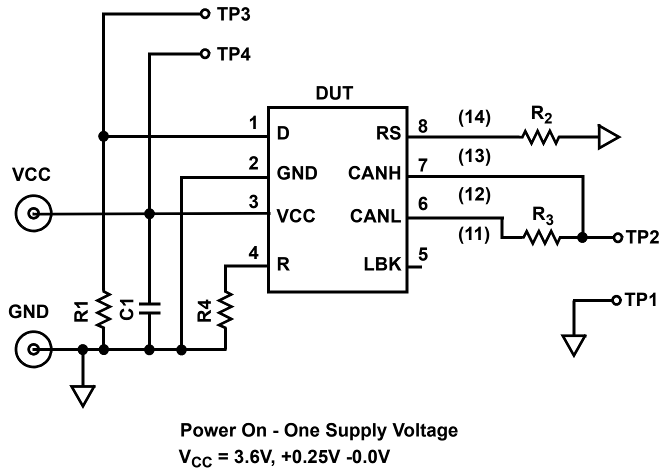


Figure 53. Irradiation Bias Configuration and Power Supply Sequencing for the ISL71026M

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.

5.1.2 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	Figure 53	24	Pre-rad	24	
			10krad(Si)	24	0
			30krad(Si)	24	0
			50krad(Si)	24	0
			Anneal	24	0
8.75	Grounded	24	Pre-rad	24	
			10krad(Si)	24	0
			30krad(Si)	24	0
			50krad(Si)	24	0
			Anneal	24	0

The plots in Figure 54 through Figure 59 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 shows the average of other key parameters with respect to total dose in table form.

5.2 Data Plots

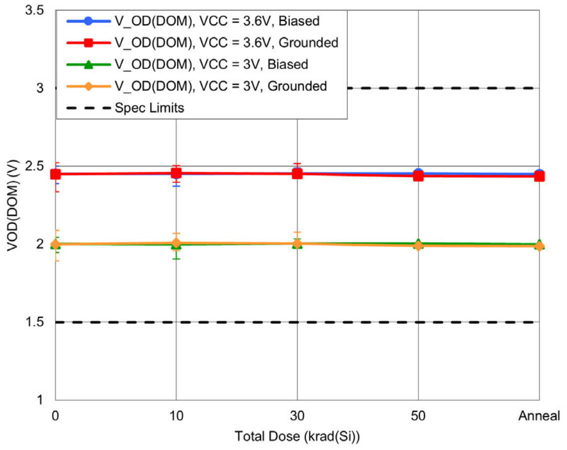


Figure 54. Dominant Output Differential Voltage - VOD(DOM) vs TID

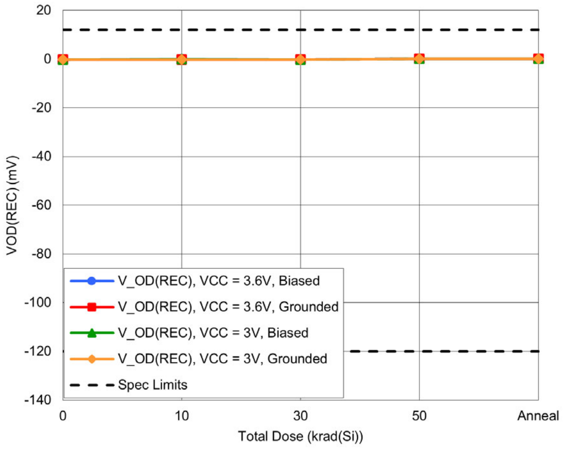


Figure 55. Recessive Output Differential Voltage - VOD(REC) vs TID

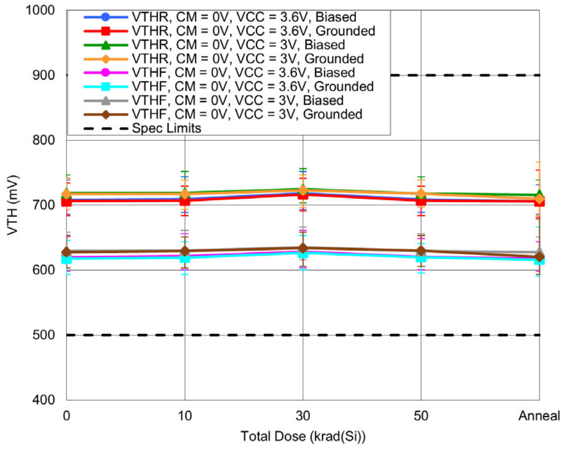


Figure 56. Receiver Input Threshold Voltage Rising/Falling vs TID

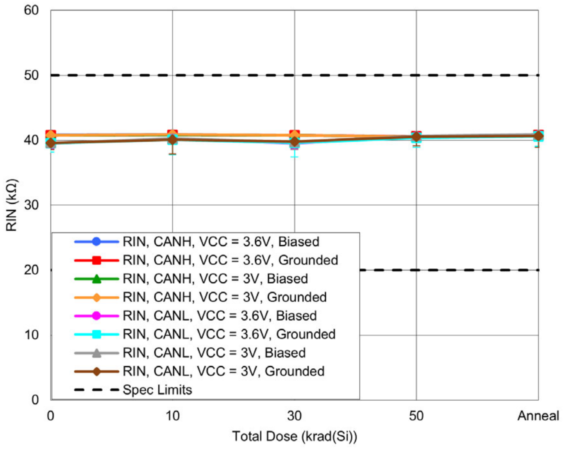


Figure 57. Receiver Input Resistance vs TID

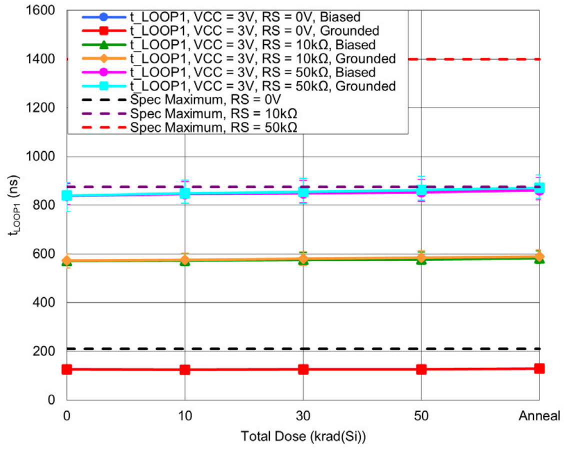


Figure 58. Total Loop Delay (Recessive to Dominant) vs TID

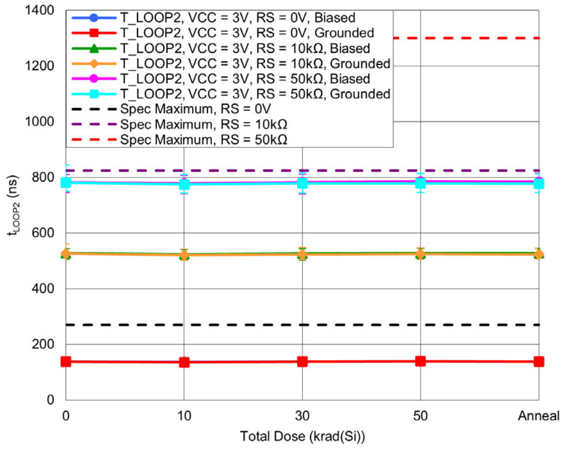


Figure 59. Total Loop Delay (Dominant to Recessive) vs TID

5.2.1 Conclusion

ATE characterization testing showed no rejects to the datasheet limits at all down points. Variables data for selected parameters is presented in Figure 54 through Figure 59. 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	Pre-Rad Value	10krad (Si)	30krad (Si)	50krad (Si)	Anneal	Unit
Dominant Output Differential Voltage D = 0V, RS = 0V	$V_{OD(DOM)}$	VCC = 3.0V	Biased	2.00	2.00	2.00	2.00	2.00	V
			Grounded	2.00	2.01	2.00	1.99	1.99	
		VCC = 3.6V	Biased	2.45	2.45	2.45	2.45	2.45	
			Grounded	2.45	2.46	2.45	2.44	2.43	
		Limit -	-	1.5	1.5	1.5	1.5	1.5	
		Limit +	-	3	3	3	3	3	
Recessive Output Differential Voltage D = 3V, RS = 0V	$V_{OD(REC)}$	VCC = 3.0V	Biased	-0.14	-0.08	-0.17	0.09	0.08	mV
			Grounded	-0.14	-0.12	-0.17	0.11	0.08	
		VCC = 3.6V	Biased	-0.15	-0.07	-0.15	0.09	0.06	
			Grounded	-0.14	-0.12	-0.17	0.08	0.09	
		Limit -	-	-120	-120	-120	-120	-120	
		Limit +	-	12	12	12	12	12	
Recessive Output Differential Voltage D = 3V, RS = 0V, No Load	$V_{OD(REC)}$	VCC = 3.0V	Biased	-45.79	-36.55	-40.40	-27.87	-24.89	mV
			Grounded	-46.09	-39.61	-40.47	-28.54	-24.25	
		VCC = 3.6V	Biased	-42.92	-35.08	-38.61	-25.42	-22.07	
			Grounded	-43.53	-37.31	-38.82	-26.57	-21.96	
		Limit -	-	-500	-500	-500	-500	-500	
		Limit +	-	50	50	50	50	50	
Input Threshold Voltage (Rising) LBK = 0V, RS = 0V, 10k, 50k, (recessive to dominant) CM Voltage Range: (-2V to +7V)	V_{THR}	VCC = 3.0V	Biased	718.63	718.84	724.50	717.69	715.81	mV
			Grounded	716.96	717.06	723.03	717.59	709.74	
		VCC = 3.6V	Biased	708.17	709.42	718.22	708.48	705.97	
			Grounded	706.18	706,80	716.65	707.22	705.76	
		Limit -	-	-	-	-	-	-	
		Limit +	-	900	900	900	900	900	
Input Threshold Voltage (Falling) LBK = 0V, RS = 0V, 10k, 50k, (dominant to recessive) CM Voltage Range: (-2V to +7V)	V_{THF}	VCC = 3.0V	Biased	629.65	630.17	634.99	629.33	627.97	mV
			Grounded	627.97	629.23	634.15	630.17	620.44	
		VCC = 3.6V	Biased	619.81	621.38	628.39	620.23	617.82	
			Grounded	617.40	619.07	626.61	620.12	615.83	
		Limit -	-	500	500	500	500	500	
		Limit +	-	-	-	-	-	-	
Input Hysteresis (V_{THR} - V_{THF}), RS = 0V, 10k, 50k	V_{HYS}	VCC = 3.0V	Biased	88.99	88.67	89.51	88.36	87.83	mV
			Grounded	88.99	87.84	88.88	87.42	89.30	
		VCC = 3.6V	Biased	88.36	88.04	89.82	88.25	88.15	
			Grounded	88.78	87.73	90.03	87.10	89.93	
		Limit -	-	40	40	40	40	40	
		Limit +	-	-	-	-	-	-	

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

Parameter	Symbol	Condition	Bias	Pre-Rad Value	10krad (Si)	30krad (Si)	50krad (Si)	Anneal	Unit
Differential Input Resistance Input to Input, D = 3V, LBK = RS = 0V	R_{IND}	VCC = 3.0V	Biased	78.67	79.35	78.72	79.53	79.77	kΩ
			Grounded	78.48	79.20	78.63	79.47	79.73	
		VCC = 3.6V	Biased	78.56	79.30	78.58	79.50	79.83	
			Grounded	78.51	79.20	78.69	79.44	79.71	
		Limit -	-	40	40	40	40	40	
		Limit +	-	100	100	100	100	100	
Supply Current Dominant D = LBK = RS = 0V, No Load	$I_{CC(DOM)}$	VCC = 3.0V	Biased	4.53	4.52	4.51	4.57	4.47	mA
			Grounded	4.50	4.48	4.51	4.57	4.64	
		VCC = 3.6V	Biased	4.81	4.77	4.78	4.84	4.73	
			Grounded	4.78	4.76	4.78	4.84	4.92	
		Limit -	-	-	-	-	-	-	
		Limit +	-	7	7	7	7	7	
Supply Current Recessive D = V_{CC}, LBK = RS = 0V, No Load	$I_{CC(REC)}$	VCC = 3.0V	Biased	2.36	2.42	2.34	2.37	2.29	mA
			Grounded	2.35	2.45	2.34	2.37	2.13	
		VCC = 3.6V	Biased	2.62	2.71	2.60	2.64	2.54	
			Grounded	2.62	2.71	2.59	2.64	2.40	
		Limit -	-	-	-	-	-	-	
		Limit +	-	5	5	5	5	5	
Propagation Delay LOW to HIGH RS = 0V	t_{PDLH1}	VCC = 3.0V	Biased	87.71	87.81	88.00	87.89	89.68	ns
			Grounded	87.82	87.75	88.14	88.04	90.47	
		VCC = 3.6V	Biased	69.57	69.42	69.62	69.83	70.96	
			Grounded	69.83	69.57	69.82	70.07	71.46	
		Limit -	-	-	-	-	-	-	
		Limit +	-	150	150	150	150	150	
Propagation Delay LOW to HIGH RS = 10kΩ	t_{PDLH2}	VCC = 3.0V	Biased	543.40	544.89	548.12	547.77	552.52	ns
			Grounded	549.16	551.29	553.97	554.96	560.48	
		VCC = 3.6V	Biased	488.29	489.81	492.22	492.49	496.53	
			Grounded	492.76	494.73	497.01	498.83	503.91	
		Limit -	-	-	-	-	-	-	
		Limit +	-	850	850	850	850	850	
Propagation Delay LOW to HIGH RS = 50kΩ	t_{PDLH3}	VCC = 3.0V	Biased	865.93	871.79	876.84	878.36	886.19	ns
			Grounded	874.14	879.34	884.51	889.21	898.50	
		VCC = 3.6V	Biased	776.39	781.80	786.88	786.08	793.68	
			Grounded	786.57	789.70	794.50	795.89	805.88	
		Limit -	-	-	-	-	-	-	
		Limit +	-	1400	1400	1400	1400	1400	
Propagation Delay HIGH to LOW RS = 0V	t_{PDHL1}	VCC = 3.0V	Biased	89.39	88.73	89.06	88.96	88.29	ns
			Grounded	90.14	89.46	89.36	80.26	88.57	
		VCC = 3.6V	Biased	75.19	74.63	74.71	74.54	73.86	
			Grounded	76.14	75.23	74.89	74.70	73.90	
		Limit -	-	-	-	-	-	-	
		Limit +	-	155	155	155	155	155	

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

Parameter	Symbol	Condition	Bias	Pre-Rad Value	10krad (Si)	30krad (Si)	50krad (Si)	Anneal	Unit
Propagation Delay HIGH to LOW RS = 10kΩ	t_{PDHL2}	VCC = 3.0V	Biased	483.56	480.97	482.66	483.33	482.48	ns
			Grounded	481.84	479.45	479.76	480.75	479.69	
		VCC = 3.6V	Biased	499.21	495.94	497.86	498.45	497.09	
			Grounded	497.97	494.49	494.38	495.41	493.63	
		Limit -	-	-	-	-	-	-	
		Limit +	-	800	800	800	800	800	
Propagation Delay HIGH to LOW RS = 50kΩ	t_{PDHL3}	VCC = 3.0V	Biased	767.50	763.91	767.35	770.38	769.30	ns
			Grounded	764.21	761.03	763.26	766.01	763.67	
		VCC = 3.6V	Biased	799.17	795.15	798.96	802.63	801.08	
			Grounded	796.40	792.55	794.86	798.42	794.56	
		Limit -	-	-	-	-	-	-	
		Limit +	-	1300	1300	1300	1300	1300	
Output Skew RS = 0V ($\|t_{PHL}$ - $t_{PLH}\|$)	t_{SKEW1}	VCC = 3.0V	Biased	2.25	1.79	1.88	1.84	1.95	ns
			Grounded	2.69	2.18	1.87	1.86	2.16	
		VCC = 3.6V	Biased	5.62	5.21	5.08	4.71	3.00	
			Grounded	6.31	5.66	5.07	4.64	2.52	
		Limit -	-	-	-	-	-	-	
		Limit +	-	50	50	50	50	50	
Output Skew RS = 10kΩ ($\|t_{PHL}$ - $t_{PLH}\|$)	t_{SKEW2}	VCC = 3.0V	Biased	59.84	63.91	65.46	64.44	70.04	ns
			Grounded	67.32	71.84	74.21	74.21	80.79	
		VCC = 3.6V	Biased	21.74	19.92	20.94	20.92	20.49	
			Grounded	17.77	18.43	19.09	18.86	19.87	
		Limit -	-	-	-	-	-	-	
		Limit +	-	510	510	510	510	510	
Output Skew RS = 50kΩ ($\|t_{PHL}$ - $t_{PLH}\|$)	t_{SKEW3}	VCC = 3.0V	Biased	98.43	107.89	109.49	107.98	116.89	ns
			Grounded	109.93	118.31	121.25	123.20	134.82	
		VCC = 3.6V	Biased	42.22	37.64	39.29	40.31	38.16	
			Grounded	32.29	32.63	33.35	33.86	33.76	
		Limit -	-	-	-	-	-	-	
		Limit +	-	800	800	800	800	800	
Output Rise Time RS = 0V (fast speed - 1Mbps)	t_{r1}	VCC = 3.0V	Biased	60.25	61.06	61.44	60.58	61.23	ns
			Grounded	60.60	61.93	60.72	59.99	61.65	
		VCC = 3.6V	Biased	56.89	57.67	57.92	57.39	58.07	
			Grounded	57.50	58.43	57.24	56.73	58.28	
		Limit -	-	20	20	20	20	20	
		Limit +	-	100	100	100	100	100	
Output Fall Time RS = 0V (fast speed - 1Mbps)	t_{f1}	VCC = 3.0V	Biased	30.43	30.01	30.39	29.55	29.83	ns
			Grounded	30.66	30.47	30.63	29.85	29.98	
		VCC = 3.6V	Biased	21.72	21.62	21.74	21.29	21.48	
			Grounded	22.27	22.03	21.84	21.41	21.49	
		Limit -	-	10	10	10	10	10	
		Limit +	-	75	75	75	75	75	

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

Parameter	Symbol	Condition	Bias	Pre-Rad Value	10krad (Si)	30krad (Si)	50krad (Si)	Anneal	Unit
Output Rise Time RS = 10kΩ (medium speed - 250kbps)	t_{r2}	VCC = 3.0V	Biased	386.08	390.67	393.22	389.08	392.61	ns
			Grounded	393.91	403.52	397.81	394.82	397.64	
		VCC = 3.6V	Biased	381.17	386.91	389.10	386.25	390.60	
			Grounded	389.52	400.11	395.28	396.56	399.20	
		Limit -	-	200	200	200	200	200	
		Limit +	-	780	780	780	780	780	
Output Fall Time RS = 10kΩ (medium speed - 250kbps)	t_{f2}	VCC = 3.0V	Biased	337.18	334.77	338.63	337.28	339.18	ns
			Grounded	342.34	341.87	341.71	341.02	342.71	
		VCC = 3.6V	Biased	329.26	325.31	329.77	328.49	329.85	
			Grounded	334.16	332.57	332.46	332.58	333.25	
		Limit -	-	175	175	175	175	175	
		Limit +	-	500	500	500	500	500	
Output Rise Time RS = 50kΩ (medium speed - 125kbps)	t_{r3}	VCC = 3.0V	Biased	638.00	650.62	653.72	653.28	659.31	ns
			Grounded	644.16	663.74	658.73	662.81	667.09	
		VCC = 3.6V	Biased	661.00	671.23	673.38	672.02	679.24	
			Grounded	671.17	688.78	679.73	681.29	683.95	
		Limit -	-	400	400	400	400	400	
		Limit +	-	1400	1400	1400	1400	1400	
Output Fall Time RS = 50kΩ (medium speed - 125kbps)	t_{f3}	VCC = 3.0V	Biased	665.80	662.78	668.87	668.74	674.34	ns
			Grounded	673.86	673.54	673.97	674.98	679.05	
		VCC = 3.6V	Biased	647.27	641.70	648.63	650.01	655.24	
			Grounded	654.13	652.03	654.43	654.15	659.28	
		Limit -	-	300	300	300	300	300	
		Limit +	-	1000	1000	1000	1000	1000	
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant RS = 0V	$t_{(LOOP1)}$	VCC = 3.0V	Biased	125.65	124.89	126.25	125.79	128.42	ns
			Grounded	125.88	125.09	126.59	126.35	129.56	
		VCC = 3.6V	Biased	105.74	105.66	106.24	106.35	108.01	
			Grounded	105.98	106.03	106.41	106.80	108.77	
		Limit -	-	-	-	-	-	-	
		Limit +	-	210	210	210	210	210	
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant RS = 10kΩ	$t_{(LOOP1)}$	VCC = 3.0V	Biased	570.71	573.33	575.84	577.90	581.75	ns
			Grounded	572.70	575.65	580.15	584.94	589.65	
		VCC = 3.6V	Biased	520.33	522.21	524.40	526.39	529.15	
			Grounded	521.44	523.65	527.54	532.06	535.97	
		Limit -	-	-	-	-	-	-	
		Limit +	-	875	875	875	875	875	
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant RS = 50kΩ	$t_{(LOOP1)}$	VCC = 3.0V	Biased	838.52	846.35	849.28	853.59	860.34	ns
			Grounded	839.81	848.83	854.58	862.59	871.26	
		VCC = 3.6V	Biased	766.14	772.75	774.56	778.21	783.03	
			Grounded	766.26	773.47	777.16	783.00	790.09	
		Limit -	-	-	-	-	-	-	
		Limit +	-	1400	1400	1400	1400	1400	

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

Parameter	Symbol	Condition	Bias	Pre-Rad Value	10krad (Si)	30krad (Si)	50krad (Si)	Anneal	Unit
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive RS = 0V	$t_{(LOOP2)}$	VCC = 3.0V	Biased	137.65	137.15	137.74	139.00	138.52	ns
			Grounded	137.46	135.97	138.16	138.82	138.17	
		VCC = 3.6V	Biased	126.81	126.47	127.08	128.63	127.90	
			Grounded	126.41	124.98	127.38	128.28	127.39	
		Limit -	-	-	-	-	-	-	
		Limit +	-	270	270	270	270	270	
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive RS = 10kΩ	$t_{(LOOP2)}$	VCC = 3.0V	Biased	526.99	523.91	526.19	528.14	527.23	ns
			Grounded	525.65	521.23	524.02	524.55	523.81	
		VCC = 3.6V	Biased	549.05	545.42	547.99	549.64	548.46	
			Grounded	548.21	543.45	545.62	546.02	544.63	
		Limit -	-	-	-	-	-	-	
		Limit +	-	825	825	825	825	825	
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive RS = 50kΩ	$t_{(LOOP2)}$	VCC = 3.0V	Biased	782.96	778.80	782.41	785.17	784.34	ns
			Grounded	780.79	775.15	777.89	777.83	776.54	
		VCC = 3.6V	Biased	819.43	814.79	818.95	821.59	820.53	
			Grounded	817.46	811.79	814.41	814.18	812.39	
		Limit -	-	-	-	-	-	-	
		Limit +	-	1300	1300	1300	1300	1300	
Receiver Propagation Delay LOW to HIGH	t_{PLH}	VCC = 3.0V	Biased	52.08	52.48	52.85	53.35	53.24	ns
			Grounded	51.87	51.97	52.42	52.70	52.71	
		VCC = 3.6V	Biased	49.37	49.85	50.22	50.73	50.58	
			Grounded	49.13	49.38	49.79	50.05	50.03	
		Limit -	-	-	-	-	-	-	
		Limit +	-	110	110	110	110	110	
Receiver Propagation Delay HIGH to LOW	t_{PHL}	VCC = 3.0V	Biased	49.13	49.40	49.54	49.43	49.87	ns
			Grounded	49.40	49.59	49.76	49.75	50.20	
		VCC = 3.6V	Biased	46.03	46.26	46.46	46.38	46.64	
			Grounded	46.20	46.36	46.59	46.55	46.86	
		Limit -	-	-	-	-	-	-	
		Limit +	-	110	110	110	110	110	
Rx Skew $\|t_{PHL} - t_{PLH}\|$	t_{RxSKEW}	VCC = 3.0V	Biased	2.96	3.08	3.31	3.92	3.37	ns
			Grounded	2.47	2.38	2.66	2.96	2.51	
		VCC = 3.6V	Biased	3.34	3.59	3.75	4.35	3.94	
			Grounded	2.93	3.02	3.19	3.49	3.16	
		Limit -	-	-	-	-	-	-	
		Limit +	-	35	35	35	35	35	

5.3 Single-Event Effects Testing

5.3.1 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.

5.3.2 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 60. 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.

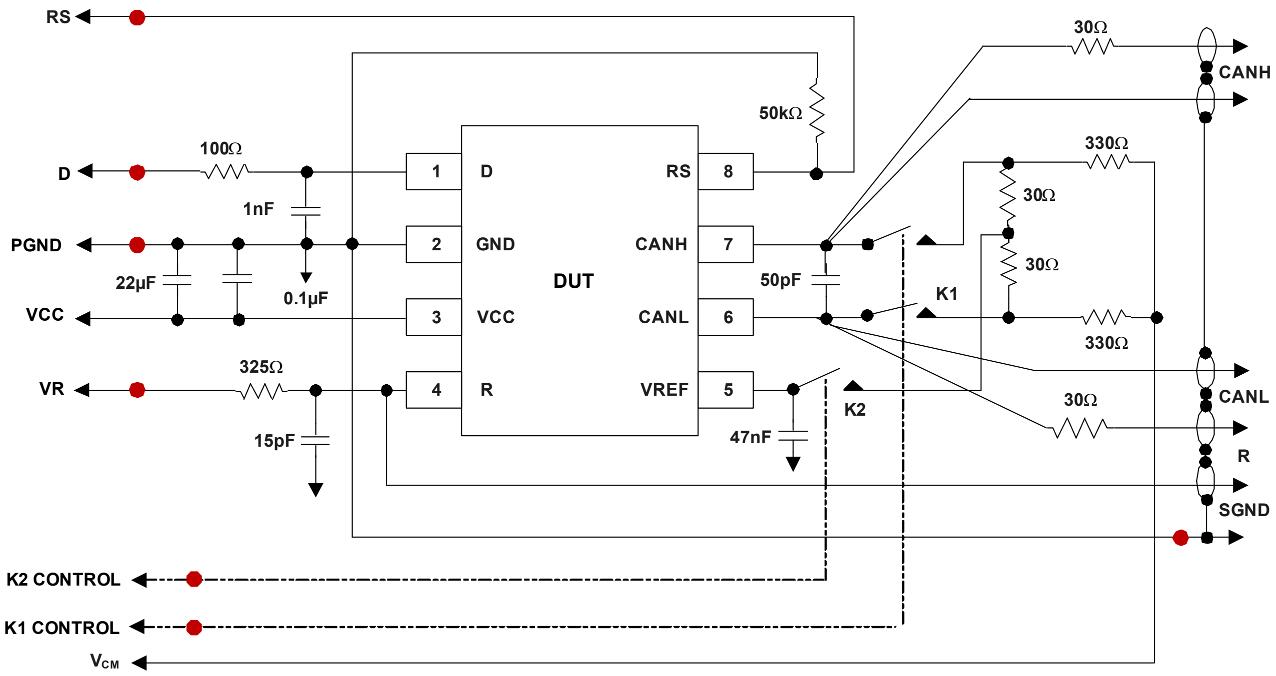


Figure 60. SEE Testing Schematic

5.3.3 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^2/mg. Each irradiation was done to a fluence of 1x10^{7}ion/cm^2 so that each DUT saw a net of 4x10^{7}ion/cm^2.

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 µA and registered changes only up to 7%. These changes in I_{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_{CM} for V_{CM} = -7V, static recessive I_{CM} for V_{CM} = +12V, dynamic unloaded I_{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.

5.3.4 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 1x10^7ion/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 (RS = 0Ω) and the medium slew rate (RS = 10kΩ). The results are summarized in Table 4.

Table 4. SET Results[1]

LET (MeV•cm^2/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

1. SET counts of ±50ns events on a 500kHz square wave signal taken to a fluence of 1x10^7ion/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 ±50ns events when running at medium slew rate, and 2000 years between events when running at the high slew rate.

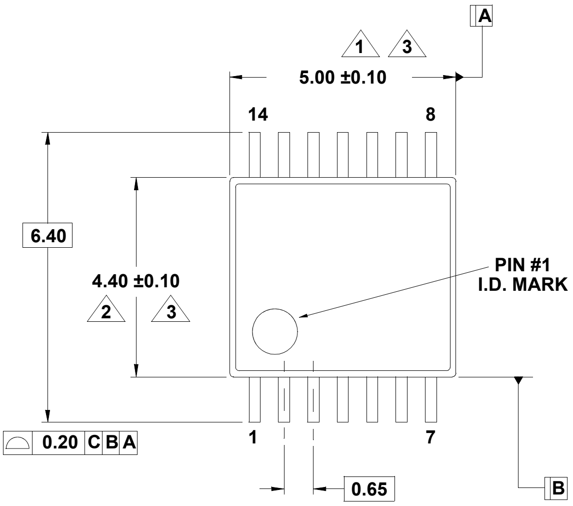
5.3.5 Conclusion

The SEE test results clearly demonstrate that the ISL71026M is robust against SEL, SEB, and SEGR to a LET of 43MeV•cm^2/mg at a supply voltage up to 5.5V, bus voltages to ±20V, and a case temperature up to +125ºC.

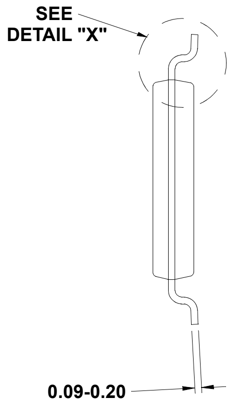
SET characterization showed that relatively benign events of ±50ns timing disruption on a 500kHz signal were rare events when ion abundance is considered. Using a solar minimum geosynchronous orbit with 100 mils of aluminum shielding as a benchmark, events when running at the medium slew rate are roughly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

6. Package Outline Drawing

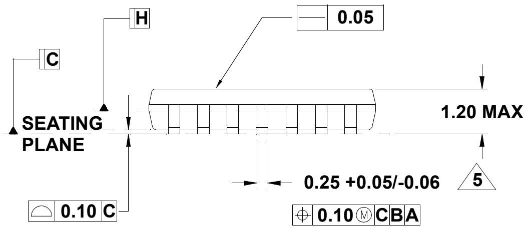
M14.173
14 LEAD THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)
Rev 3, 10/09



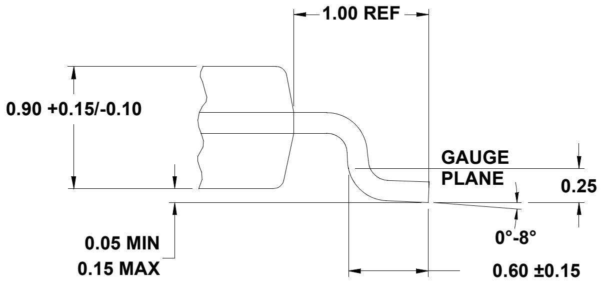
TOP VIEW



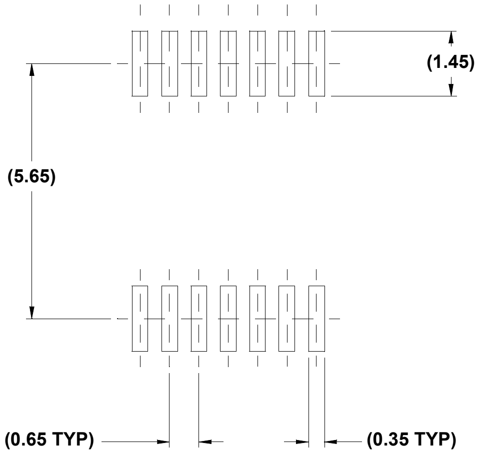
END VIEW



SIDE VIEW



DETAIL "X"



TYPICAL RECOMMENDED LAND PATTERN

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.

7. Ordering Information

Part Number[1][2]	Part Marking	Radiation Lot Acceptance Testing	Package Description[3] (RoHS Compliant)	Pkg. Dwg. #	Carrier Type[4]	Temp Range
ISL71026MVZ	71026 MVZ	N/A	14 Ld TSSOP	M14.173	Tube	-55 to +125°C
ISL71026MVZ-T					Reel 2.5k	
ISL71026MVZ-T7A					Reel, 250	
ISL71026M30VZ		30krad(Si)			Tube	
ISL71026M30VZ-T					Reel 2.5k	
ISL71026M30VZ-T7A					Reel, 250	
ISL71026M50VZ		50krad(Si)			Tube	
ISL71026M50VZ-T					Reel 2.5k	
ISL71026M50VZ-T7A					Reel, 250	
ISL71026MEVAL1Z	Evaluation Board					

1. 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.
2. For Moisture Sensitivity Level (MSL), see the ISL71026M product information page. For more information about MSL, see TB363.
3. For the Pb-Free Reflow Profile, see TB493.
4. Refer to TB347 for details about reel specifications.

8. Revision History

Rev.	Date	Description
2.01	Feb 6, 2025	Updated to the latest template. Updated Features bullets. Added ISL71026M30VZ and ISL71026M50VZ part information throughout document.
2.00	Aug 14, 2020	Changed maximum data rate from 1Mbps to 5Mbps on the following pages: Page 1: Second paragraph and Features section. Page 20: In Overview section. Added curves Figures 50 and 51 in Typical Performance Curves, section 4.
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

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