

ISL72028BSEH

3.3V Radiation Tolerant CAN Transceiver, with Low-Power Shutdown, Split Termination Output

The [ISL72028BSEH](#) is a radiation tolerant 3.3V CAN transceiver that is compatible with the ISO11898-2 standard for applications calling for Controller Area Network (CAN) serial communication in satellites and aerospace communications, and telemetry data processing in harsh industrial environments.

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

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

The ISL72028BSEH is available in an 8 Ld hermetic ceramic flatpack and die form that operate across the temperature range of -55°C to +125°C. The logic inputs are tolerant with 5V systems.

Other CAN transceivers available are the [ISL72026BSEH](#) and [ISL72027BSEH](#). For a list of differences see [Table 1 on page 2](#).

Applications

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

Features

- Electrically screened to SMD [5962-15228](#)
- ESD protection on all pins.....4kV HBM
- Compatible with ISO11898-2
- Operating supply range..... 3.0V to 3.6V
- Bus pin fault protection to ±20V
- Undervoltage lockout
- Cold spare: powered-down devices/nodes will not affect active devices operating in parallel
- Three selectable driver rise and fall times
- Glitch free bus I/O during power-up and power-down
- Full fail-safe (open, short, terminated/undriven) receiver
- Hi-Z input allows for 120 nodes on the bus
- High data rates..... up to 5Mbps
- Quiescent supply current 7mA (maximum)
- Low-Power Shutdown mode..... 50µA (maximum)
- -7V to +12V common-mode input voltage range
- 5V tolerant logic inputs
- Thermal shutdown
- Acceptance tested to 75krad(Si) (LDR) wafer-by-wafer
- Radiation tolerance
 - SEL/B immune to LET_{TH}..... 86.4MeV•cm²/mg
 - Low dose rate (0.01rad(Si)/s)75krad(Si)
 - High dose rate (50-300rad(Si)/s)..... 100krad(Si)

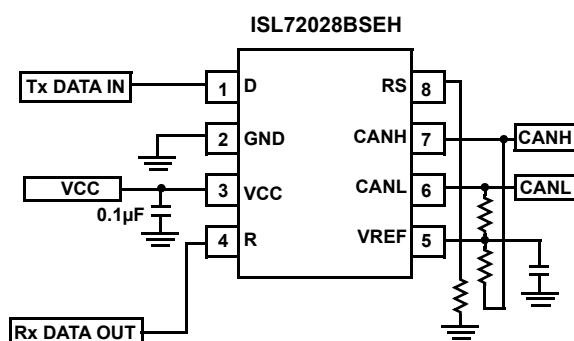


FIGURE 1. TYPICAL APPLICATION

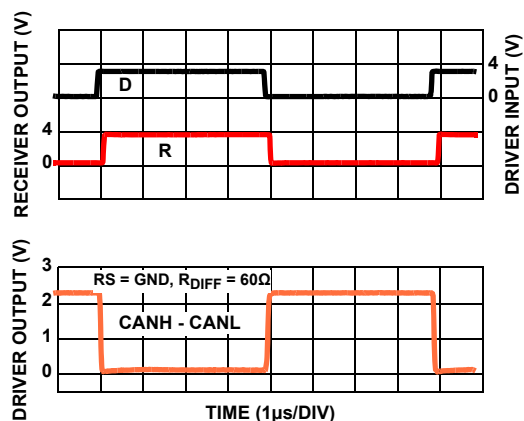


FIGURE 2. FAST DRIVER AND RECEIVER WAVEFORMS

Ordering Information

ORDERING SMD NUMBER (Note 1)	PART NUMBER (Note 2)	TEMPERATURE RANGE (°C)	PACKAGE (RoHS COMPLIANT)	PKG DWG #
5962R1522806VXC	ISL72028BSEHVF	-55 to +125	8 Ld Ceramic Flatpack	K8.A
N/A	ISL72028BSEHF/PROTO, Note 3	-55 to +125	8 Ld Ceramic Flatpack	K8.A
5962R1522806V9A	ISL72028BSEHVX	-55 to +125	Die	
N/A	ISL72028BSEHX/SAMPLE, Note 3	-55 to +125	Die	
N/A	ISL72028BSEHEVAL1Z, Note 4	Evaluation Board		

NOTES:

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

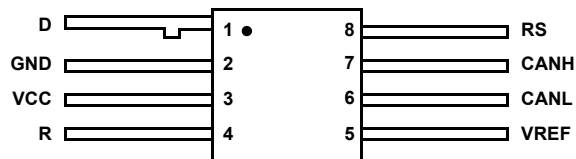
TABLE 1. ISL7202xBSEH PRODUCT FAMILY FEATURES TABLE

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

N/A: Not Applicable

Pin Configuration

ISL72028BSEH
(8 LD CERAMIC FLATPACK)
TOP VIEW



Note: The package lid is tied to ground.

Pin Descriptions

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

Equivalent Input and Output Schematic Diagrams

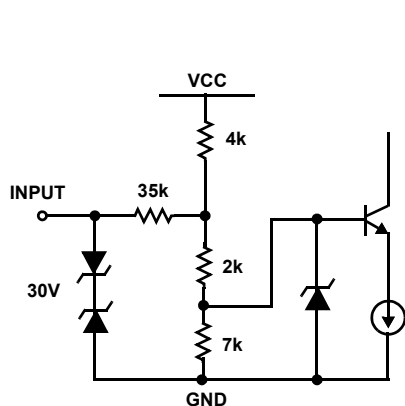


FIGURE 3. CANH AND CANL INPUTS

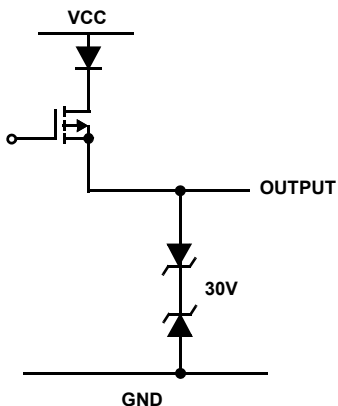


FIGURE 4. CANH OUTPUT

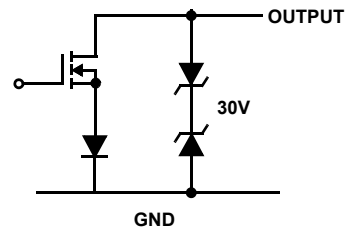


FIGURE 5. CANL OUTPUT

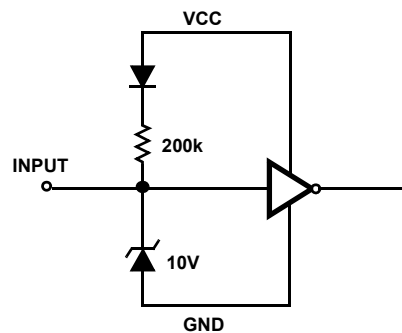


FIGURE 6. D INPUT

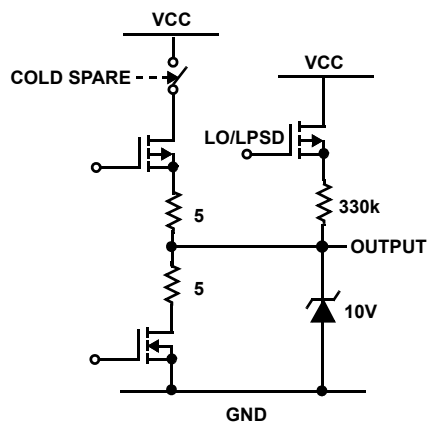


FIGURE 7. R OUTPUT

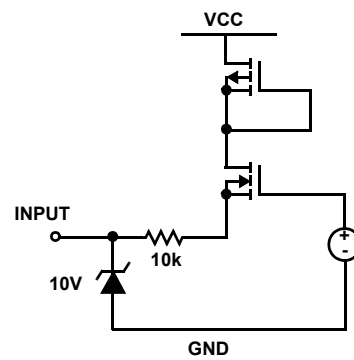


FIGURE 8. RS INPUT

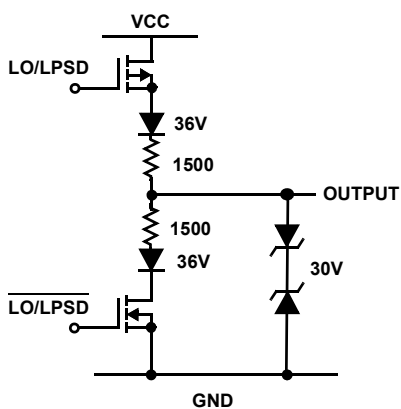


FIGURE 9. VREF

Absolute Maximum Ratings

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

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
8 Ld FP Package (Notes 5, 6)	39	7
Maximum Junction Temperature	+175°C	
Storage Temperature Range	-65°C to +150°C	

Recommended Operating Conditions

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

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

NOTES:

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

Electrical Specifications Test Conditions: V_{CC} = 3.0V to 3.6V; typicals are at T_A = +25°C (Note 9); unless otherwise specified (Note 7). **Boldface limits apply across the operating temperature range, -55°C to +125°C; over a total ionizing dose of 75krad(Si) at +25°C with exposure at a low dose rate of <10mrads(Si)/s; and over a total ionizing dose of 100krad(Si) at +25°C with exposure of a high dose rate of 50krad(Si)/s. to 300krad(Si)/s.**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 8)	TYP (Note 9)	MAX (Note 8)	UNIT
DRIVER ELECTRICAL CHARACTERISTICS							
Dominant Bus Output Voltage	V _{O(DOM)}	D = 0V, CANH, RS = 0V, Figures 10 and 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	2.25	2.85	V_{CC} V
		D = 0V, CANL, RS = 0V, Figures 10 and 11		Full	0.10	0.65	1.25 V
Recessive Bus Output Voltage	V _{O(REC)}	D = 3V, CANH, RS = 0V, 60Ω and no load, Figures 10 and 11	3.0V ≤ V _{CC} ≤ 3.6V	Full	1.80	2.30	2.70 V
		D = 3V, CANL, RS = 0V, 60Ω and no load, Figures 10 and 11		Full	1.80	2.30	2.80 V
Dominant Output Differential Voltage	V _{OD(DOM)}	D = 0V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, Figures 10 and 11		Full	1.5	2.2	3.0 V
		D = 0V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, Figures 11 and 12		Full	1.2	2.1	3.0 V
Recessive Output Differential Voltage	V _{OD(REC)}	D = 3V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, Figures 10 and 11		Full	-120	0.2	12 mV
		D = 3V, RS = 0V, 3.0V ≤ V _{CC} ≤ 3.6V, no load		Full	-500	-34	50 mV
Logic Input High Voltage (D)	V _{IH}	3.0V ≤ V _{CC} ≤ 3.6V, Note 10		Full	2.0	-	5.5 V
Logic Input Low Voltage (D)	V _{IL}	3.0V ≤ V _{CC} ≤ 3.6V, Note 10		Full	0	-	0.8 V
High-Level Input Current (D)	I _{IH}	D = 2.0V, 3.0V ≤ V _{CC} ≤ 3.6V		Full	-30	-3	30 μA
Low-Level Input Current (D)	I _{IL}	D = 0.8V, 3.0V ≤ V _{CC} ≤ 3.6V		Full	-30	-7	30 μA
RS Input Voltage for Low-Power Shutdown Mode	V _{IN(RS)}	3.0V ≤ V _{CC} ≤ 3.6V		Full	0.75 x V_{CC}	1.9	5.5 V

Electrical Specifications 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 $+125^\circ C$; over a total ionizing dose of $75krad(Si)$ at $+25^\circ C$ with exposure at a low dose rate of $<10mrad(Si)/s$; and over a total ionizing dose of $100krad(Si)$ at $+25^\circ C$ with exposure of a high dose rate of $50krad(Si)/s$ to $300krad(Si)/s$. (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP ($^\circ C$)	MIN (Note 8)	TYP (Note 9)	MAX (Note 8)	UNIT
Output Short-Circuit Current	I_{OSC}	$V_{CANH} = -7V$, $CANL = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 17	Full	-250	-100	-	mA
		$V_{CANH} = +12V$, $CANL = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 17	Full	-	0.4	1.0	mA
		$V_{CANL} = -7V$, $CANH = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 17	Full	-1.0	-0.4	-	mA
		$V_{CANL} = +12V$, $CANH = OPEN$, $3.0V \leq V_{CC} \leq 3.6V$, Figure 17	Full	-	100	250	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	-	$^\circ C$
RECEIVER ELECTRICAL CHARACTERISTICS							
Input Threshold Voltage (Rising)	V_{THR}	$RS = 0V$, 10k, 50k, (recessive to dominant), Figures 14 and 15	Full	-	750	900	mV
Input Threshold Voltage (Falling)	V_{THF}	$RS = 0V$, 10k, 50k, (dominant to recessive), Figures 14 and 15	Full	500	650	-	mV
Input Hysteresis	V_{HYS}	$(V_{THR} - V_{THF})$, $RS = 0V$, 10k, 50k, Figures 14 and 15	Full	40	90	-	mV
Receiver Output High Voltage	V_{OH}	$I_O = -4mA$	Full	2.4	$V_{CC} - 0.2$	-	V
Receiver Output Low Voltage	V_{OL}	$I_O = +4mA$	Full	-	0.2	0.4	V
Input Current for CAN Bus	I_{CAN}	$CANH$ or $CANL$ at 12V, $D = 3V$, other bus pin at 0V, $RS = 0V$	Full	-	420	500	μA
		$CANH$ or $CANL$ at 12V, $D = 3V$, $V_{CC} = 0V$, other bus pin at 0V, $RS = 0V$	Full	-	150	250	μA
		$CANH$ or $CANL$ at -7V, $D = 3V$, other bus pin at 0V, $RS = 0V$	Full	-400	-300	-	μA
		$CANH$ or $CANL$ at -7V, $D = 3V$, $V_{CC} = 0V$, other bus pin at 0V, $RS = 0V$	Full	-150	-85	-	μA
Input Capacitance (CANH or CANL)	C_{IN}	Input to GND, $D = 3V$, $RS = 0V$	25	-	35	-	pF
Differential Input Capacitance	C_{IND}	Input to input, $D = 3V$, $RS = 0V$	25	-	15	-	pF
Input Resistance (CANH or CANL)	R_{IN}	Input to GND, $D = 3V$, $RS = 0V$	Full	20	40	50	k Ω
Differential Input Resistance	R_{IND}	Input to input, $D = 3V$, $RS = 0V$	Full	40	80	100	k Ω
SUPPLY CURRENT							
Supply Current, Low-Power Shutdown Mode	$I_{CC(LPS)}$	$RS = D = V_{CC}$, $3.0V \leq V_{CC} \leq 3.6V$, Note 11	Full	-	20	50	μA
Supply Current, Dominant	$I_{CC(DOM)}$	$D = RS = 0V$, no load, $3.0V \leq V_{CC} \leq 3.6V$	Full	-	5	7	mA
Supply Current, Recessive	$I_{CC(REC)}$	$D = V_{CC}$, $RS = 0V$, no load, $3.0V \leq V_{CC} \leq 3.6V$	Full	-	2.6	5.0	mA
COLD SPARING BUS CURRENT							
CANH Leakage Current	$I_{L(CANH)}$	$V_{CC} = 0.2V$, $CANH = -7V$ or 12V, $D = V_{CC}$, $CANL = float$, $RS = 0V$	Full	-25	-4	25	μA
CANL Leakage Current	$I_{L(CANL)}$	$V_{CC} = 0.2V$, $CANL = -7V$ or 12V, $D = V_{CC}$, $CANH = float$, $RS = 0V$	Full	-25	-4	25	μA
VREF Leakage Current	$I_{L(VREF)}$	$V_{CC} = 0.2V$, $V_{REF} = -7V$ or 12V, $D = V_{CC}$	Full	-25.00	0.01	25.00	μA
DRIVER SWITCHING CHARACTERISTICS							
Propagation Delay LOW to HIGH	t_{PDLH1}	$RS = 0V$, Figure 13	Full	-	75	150	ns
Propagation Delay LOW to HIGH	t_{PDLH2}	$RS = 10k\Omega$, Figure 13	Full	-	520	850	ns
Propagation Delay LOW to HIGH	t_{PDLH3}	$RS = 50k\Omega$, Figure 13	Full	-	850	1400	ns
Propagation Delay HIGH to LOW	t_{PDHL1}	$RS = 0V$, Figure 13	Full	-	80	155	ns

Electrical Specifications 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 $+125^\circ C$; over a total ionizing dose of $75krad(Si)$ at $+25^\circ C$ with exposure at a low dose rate of $<10mrad(Si)/s$; and over a total ionizing dose of $100krad(Si)$ at $+25^\circ C$ with exposure of a high dose rate of $50krad(Si)/s$ to $300krad(Si)/s$. (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP ($^\circ C$)	MIN (Note 8)	TYP (Note 9)	MAX (Note 8)	UNIT
Propagation Delay HIGH to LOW	t_{PDHL2}	$RS = 10k\Omega$, Figure 13	Full	-	460	800	ns
Propagation Delay HIGH to LOW	t_{PDHL3}	$RS = 50k\Omega$, Figure 13	Full	-	725	1300	ns
Output Skew	t_{SKEW1}	$RS = 0V$, ($ t_{PHL} - t_{PLH} $), Figure 13	Full	-	5	50	ns
Output Skew	t_{SKEW2}	$RS = 10k\Omega$, ($ t_{PHL} - t_{PLH} $), Figure 13	Full	-	60	510	ns
Output Skew	t_{SKEW3}	$RS = 50k\Omega$, ($ t_{PHL} - t_{PLH} $), Figure 13	Full	-	110	800	ns
Output Rise Time	t_{r1}	$RS = 0V$, (fast speed) Figure 13	Full	20	55	100	ns
Output Fall Time	t_{f1}		Full	10	25	75	ns
Output Rise Time	t_{r2}	$RS = 10k\Omega$, (medium speed - 250Kbps) Figure 13	Full	200	400	780	ns
Output Fall Time	t_{f2}		Full	175	300	500	ns
Output Rise Time	t_{r3}	$RS = 50k\Omega$, (slow speed - 125Kbps) Figure 13	Full	400	700	1400	ns
Output Fall Time	t_{f3}		Full	300	650	1000	ns
Total Loop Delay, Driver Input to Receiver Output, Recessive to Dominant	$t_{(LOOP1)}$	$RS = 0V$, Figure 15	Full	-	115	210	ns
		$RS = 10k\Omega$, Figure 15	Full	-	550	875	ns
		$RS = 50k\Omega$, Figure 15	Full	-	850	1400	ns
Total Loop Delay, Driver Input to Receiver Output, Dominant to Recessive	$t_{(LOOP2)}$	$RS = 0V$, Figure 15	Full	-	130	270	ns
		$RS = 10k\Omega$, Figure 15	Full	-	500	825	ns
		$RS = 50k\Omega$, Figure 15	Full	-	750	1300	ns
Low-Power Shutdown to Valid Dominant Time	t_{LPS_DOM}	Figure 16, Note 11	Full	-	6	15	μs
RECEIVER SWITCHING CHARACTERISTICS							
Propagation Delay LOW to HIGH	t_{PLH}	Figure 14	Full	-	50	110	ns
Propagation Delay HIGH to LOW	t_{PHL}	Figure 14	Full	-	50	110	ns
Rx Skew	t_{SKEW1}	$ t_{PHL} - t_{PLH} $, Figure 14	Full	-	2	35	ns
Rx Rise Time	t_r	Figure 14	Full	-	2	-	ns
Rx Fall Time	t_f	Figure 14	Full	-	2	-	ns
VREF/RS PIN CHARACTERISTICS							
VREF Pin Voltage	VREF	$-5\mu A < I_{REF} < 5\mu A$	Full	$0.45 \times V_{CC}$	1.6	$0.55 \times V_{CC}$	V
		$-50\mu A < I_{REF} < 50\mu A$	Full	$0.40 \times V_{CC}$	1.6	$0.60 \times V_{CC}$	V
RS Pin Input Current	$I_{RS(H)}$	$RS = 0.75 \times V_{CC}$	Full	-10.0	-0.2	-	μA
	$I_{RS(L)}$	$V_{RS} = 0V$	Full	-450	-125	0	μA

NOTES:

- All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
- Parameters with MIN and/or MAX limits are 100% tested at $-55^\circ C$, $+25^\circ C$ and $+125^\circ C$, unless otherwise specified.
- Typical values are at 3.3V. Parameters with a single entry in the "TYP" column apply to 3.3V. Typical values shown are not guaranteed.
- Parameter included in functional testing.
- Performed during the 100% screening operations across the full operating temperature range. Not performed as part of TCI Group E and Group C. Radiation characterization testing performed as part of the initial release and any major changes in design.

Test Circuits and Waveforms

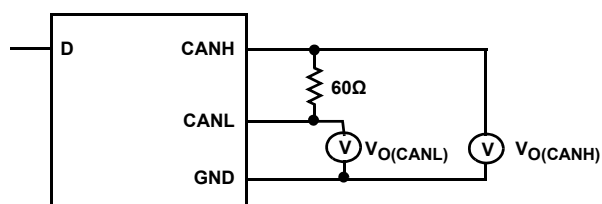


FIGURE 10. DRIVER TEST CIRCUIT

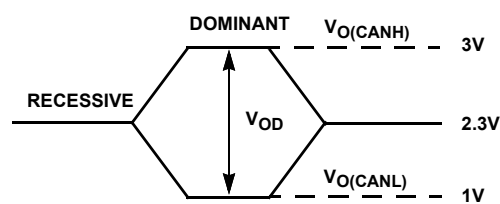


FIGURE 11. DRIVER BUS VOLTAGE DEFINITIONS

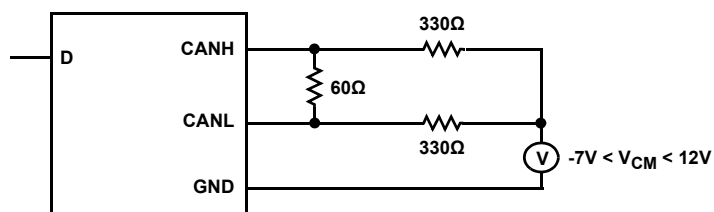
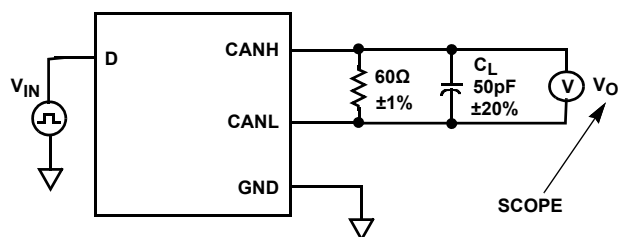


FIGURE 12. DRIVER COMMON-MODE CIRCUIT



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

FIGURE 13A. DRIVER TIMING TEST CIRCUIT

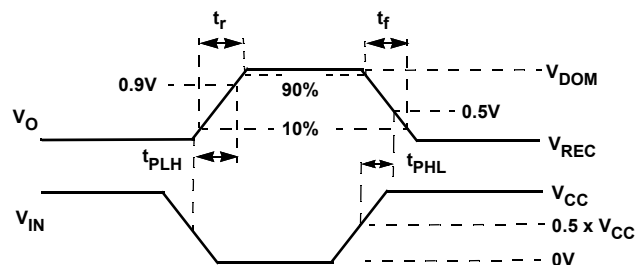


FIGURE 13B. DRIVER TIMING MEASUREMENT POINTS

FIGURE 13. DRIVER TIMING

Test Circuits and Waveforms (Continued)

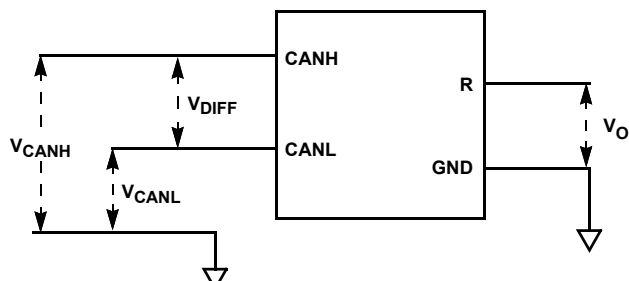
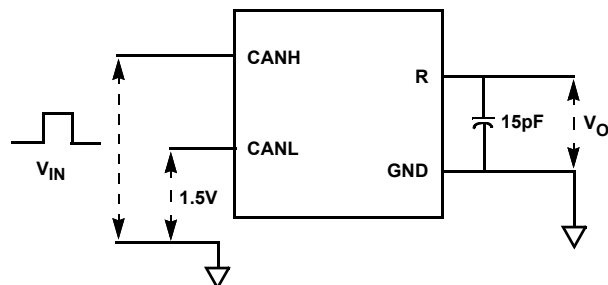


FIGURE 14A. RECEIVER VOLTAGE DEFINITIONS



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

FIGURE 14B. RECEIVER TEST CIRCUIT

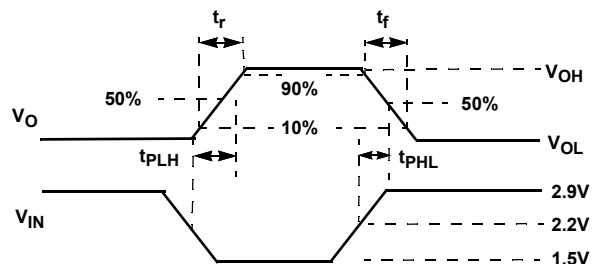


FIGURE 14C. RECEIVER TEST MEASUREMENT POINTS

FIGURE 14. RECEIVER TEST

TABLE 2. DIFFERENTIAL INPUT VOLTAGE THRESHOLD TEST

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

Test Circuits and Waveforms (Continued)

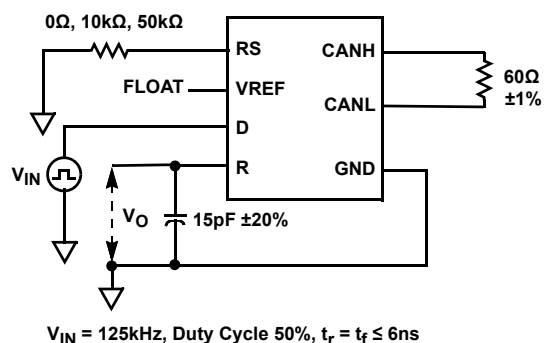


FIGURE 15A. TOTAL LOOP DELAY TEST CIRCUIT

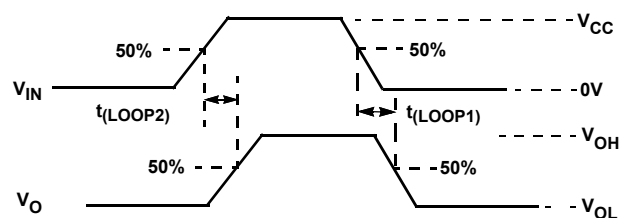


FIGURE 15B. TOTAL LOOP DELAY MEASUREMENT POINTS

FIGURE 15. TOTAL LOOP DELAY

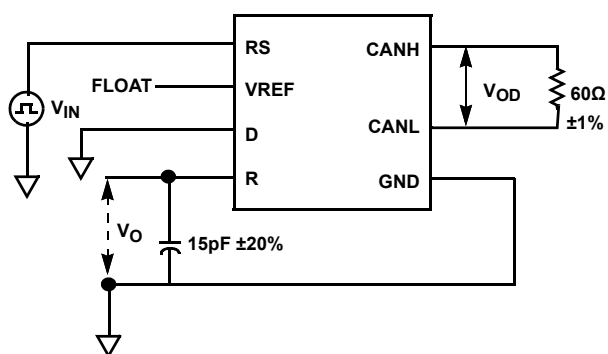


FIGURE 16A. LOW-POWER SHUTDOWN TO DOMINANT TIME CIRCUIT

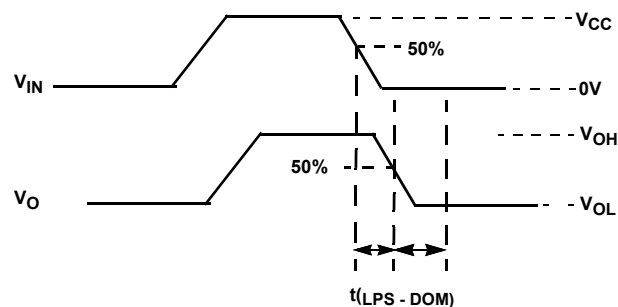


FIGURE 16B. LOW-POWER SHUTDOWN TO DOMINANT TIME MEASUREMENT POINTS

FIGURE 16. LOW-POWER SHUTDOWN TO DOMINANT TIME

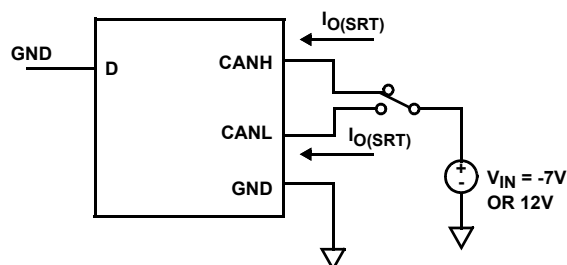


FIGURE 17A. OUTPUT SHORT-CIRCUIT CURRENT CIRCUIT

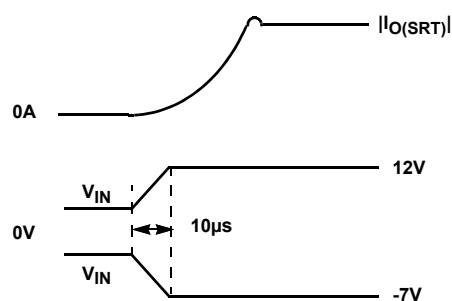


FIGURE 17B. OUTPUT SHORT-CIRCUIT CURRENT WAVEFORMS

FIGURE 17. OUTPUT SHORT-CIRCUIT

Functional Description

Overview

The ISL72028BSEH is a 3.3V radiation tolerant CAN transceiver that is compatible with the ISO11898-2 standard for use in Controller Area Network (CAN) serial communication systems.

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

Slope Adjustment

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

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

Cable Length

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

Cold Spare

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

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

Low-Power Shutdown Mode

When a high level is applied to the RS pin, the device enters the Low-Power Shutdown mode in which the driver and receiver are switched off to conserve power. The bus pins are at High Z and the R pin will be at logic high. In Low-Power Shutdown the transceiver draws $50\mu A$ (max) of current.

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

Using 3.3V Devices in 5V Systems

Looking at the differential voltage of both the 3.3V and 5V devices, the differential voltage is the same, 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.

Split Mode Termination

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

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

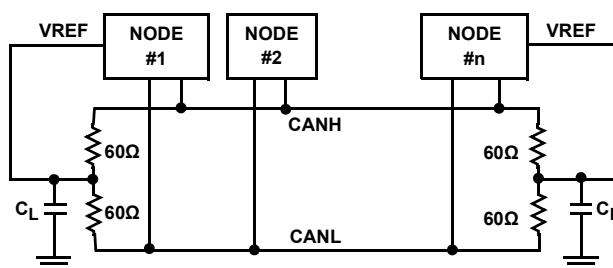


FIGURE 18. SPLIT TERMINATION

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

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

Typical Performance Curves $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$; unless otherwise specified.

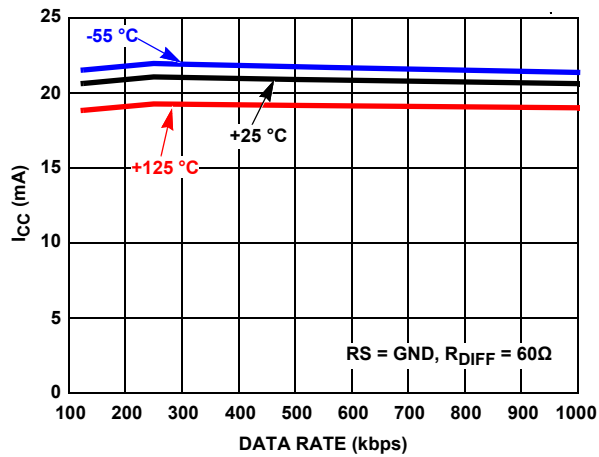


FIGURE 19. SUPPLY CURRENT vs FAST DATA RATE vs TEMPERATURE

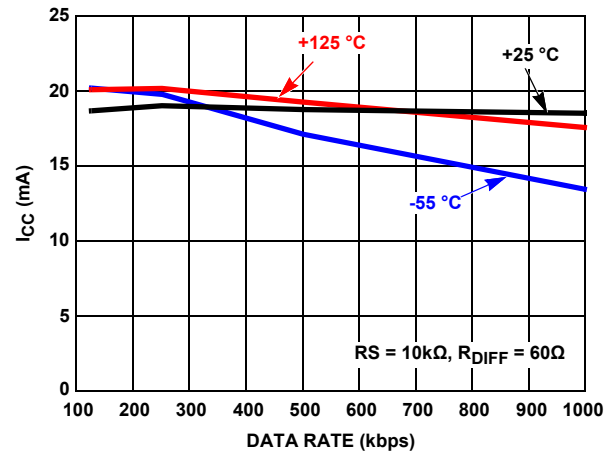


FIGURE 20. SUPPLY CURRENT vs MEDIUM DATA RATE vs TEMPERATURE

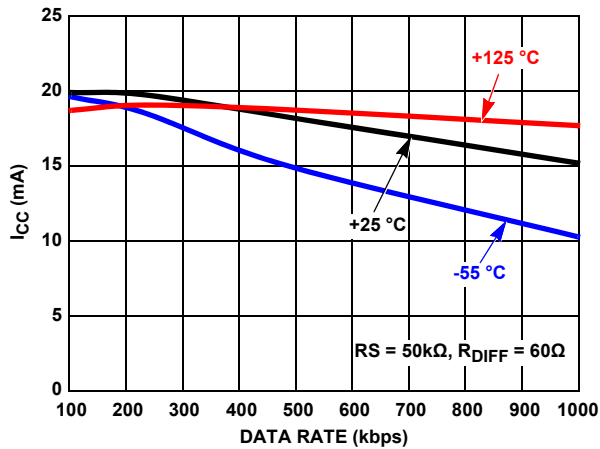


FIGURE 21. SUPPLY CURRENT vs SLOW DATA RATE vs TEMPERATURE

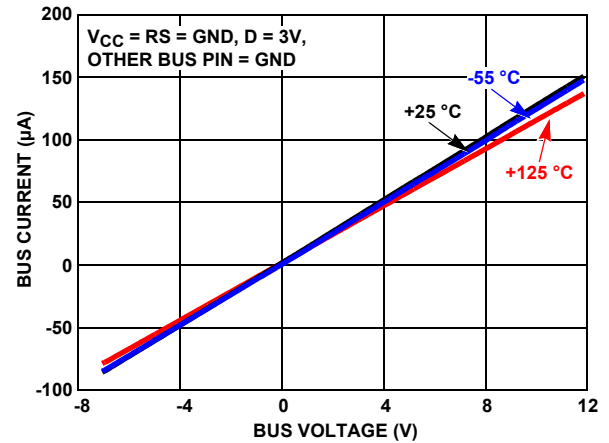


FIGURE 22. BUS PIN LEAKAGE vs V_{CM} AT $V_{CC} = 0\text{V}$

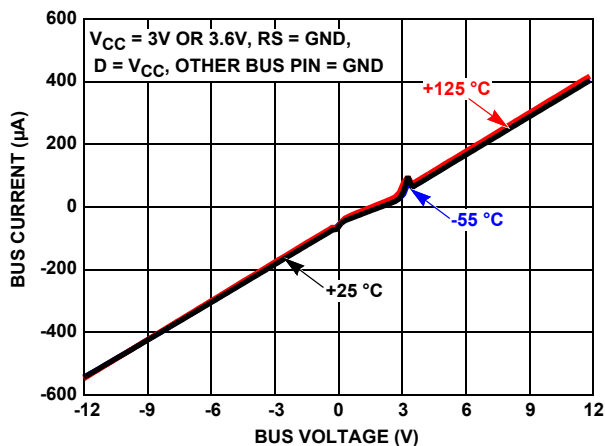


FIGURE 23. BUS PIN LEAKAGE vs $\pm 12\text{V VCM}$

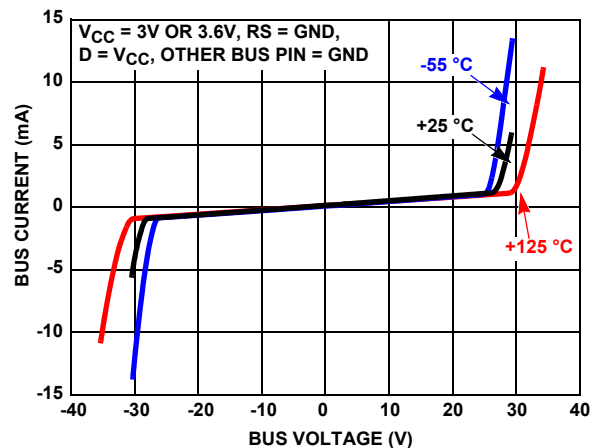


FIGURE 24. BUS PIN LEAKAGE vs $\pm 35\text{V VCM}$

Typical Performance Curves

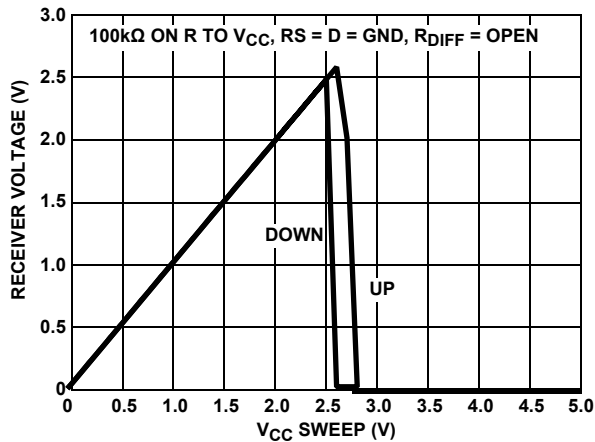
 $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$; unless otherwise specified. (Continued)


FIGURE 25. V_{CC} UNDERVOLTAGE LOCKOUT

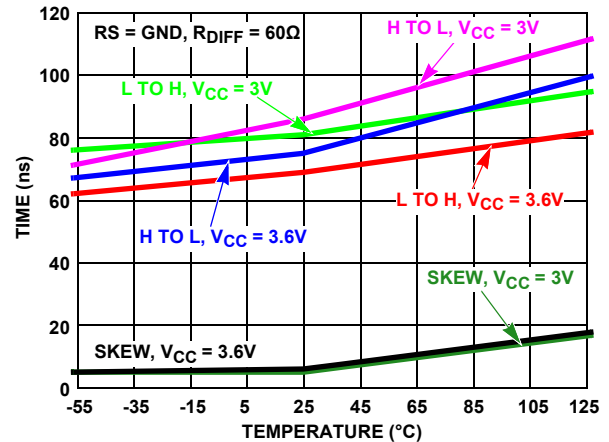


FIGURE 26. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT FAST SPEED

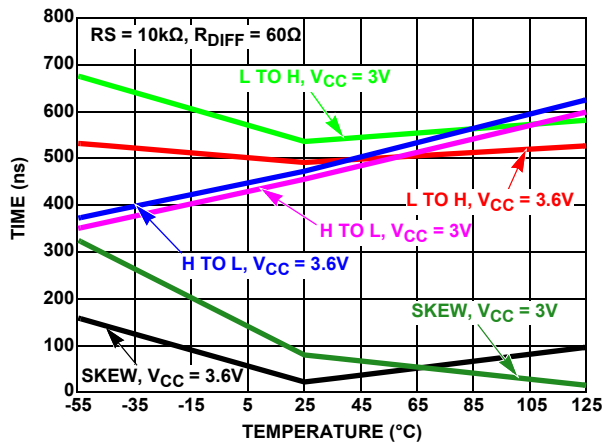


FIGURE 27. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT MEDIUM SPEED

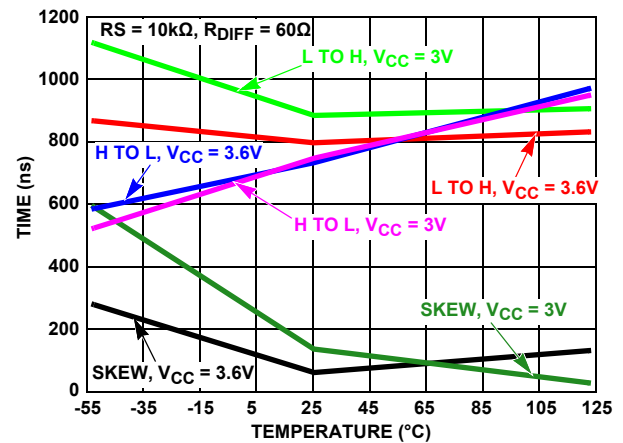


FIGURE 28. TRANSMITTER PROPAGATION DELAY AND SKEW vs TEMPERATURE AT SLOW SPEED

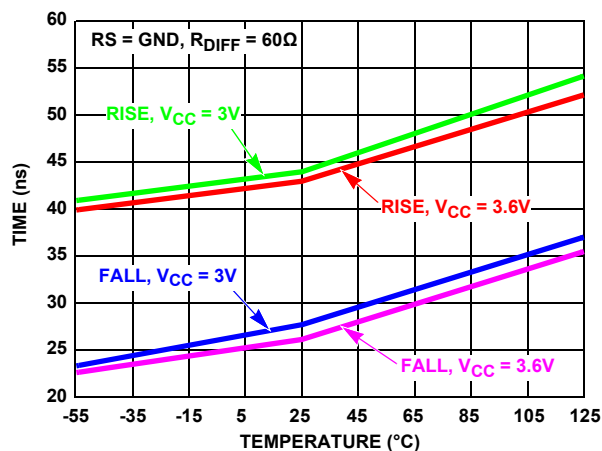


FIGURE 29. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT FAST SPEED

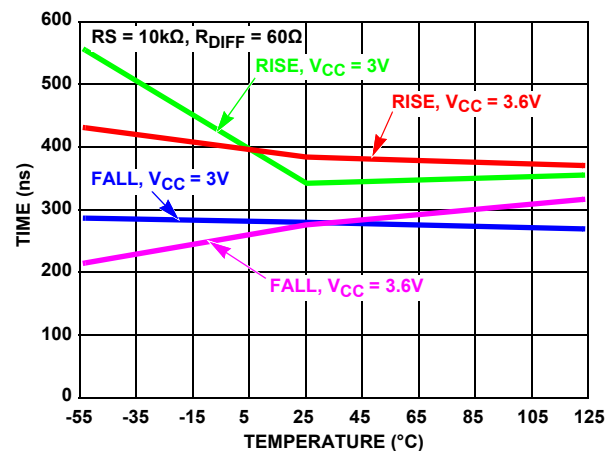


FIGURE 30. TRANSMITTER RISE AND FALL TIMES vs TEMPERATURE AT MEDIUM SPEED

Typical Performance Curves

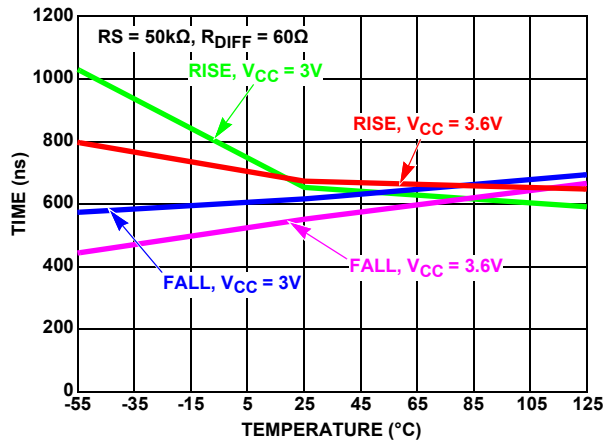
 $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$; unless otherwise specified. (Continued)


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

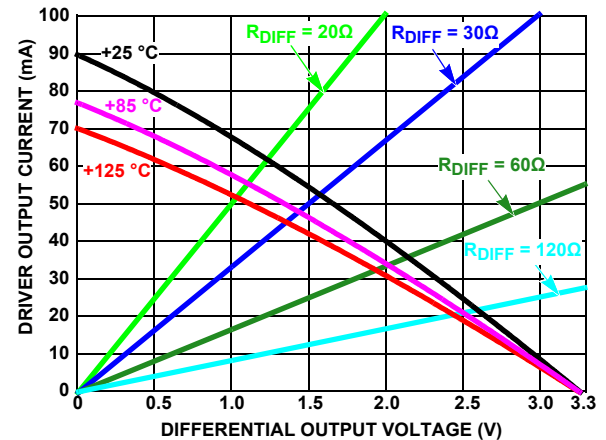


FIGURE 32. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

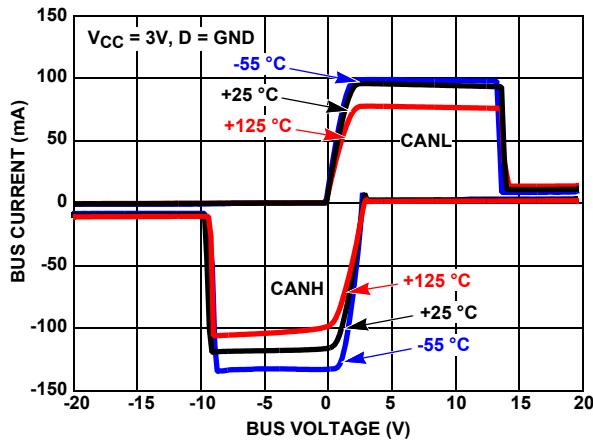


FIGURE 33. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE vs TEMPERATURE

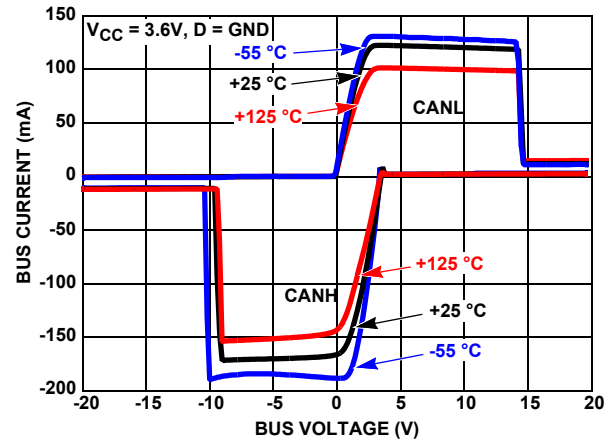


FIGURE 34. DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE vs TEMPERATURE

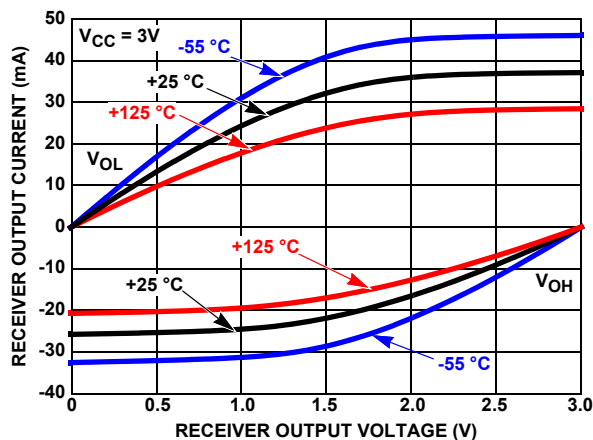


FIGURE 35. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE AT $V_{CC} = 3\text{V}$

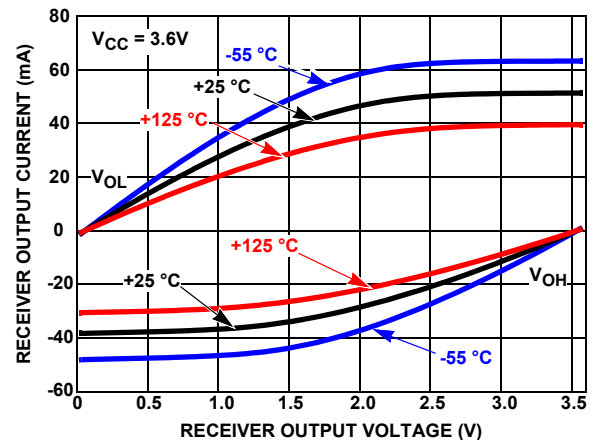


FIGURE 36. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE AT $V_{CC} = 3.6\text{V}$

Typical Performance Curves

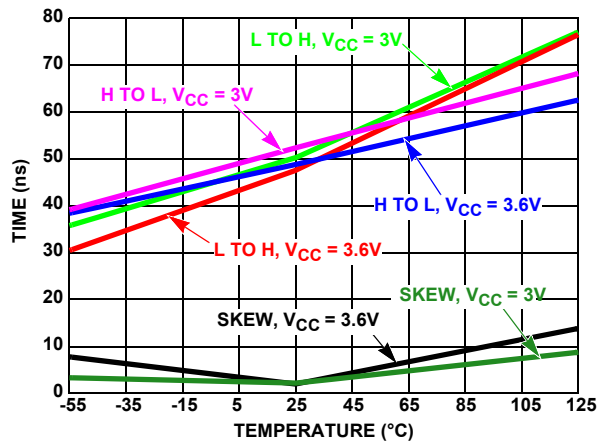
 $C_L = 15\text{pF}$, $T_A = +25^\circ\text{C}$; unless otherwise specified. (Continued)


FIGURE 37. RECEIVER PROPAGATION DELAY AND SKEW vs TEMPERATURE

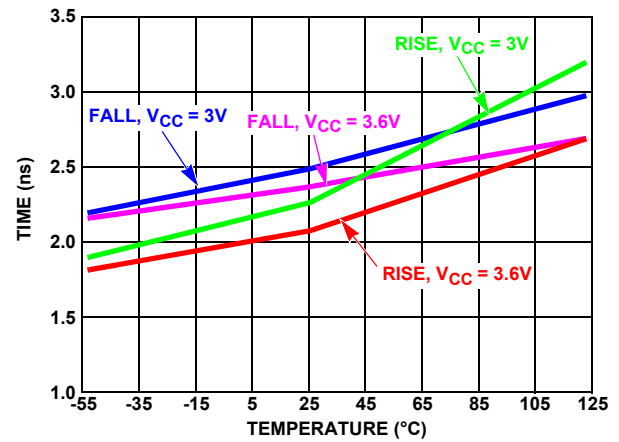


FIGURE 38. RECEIVER RISE AND FALL TIMES vs TEMPERATURE

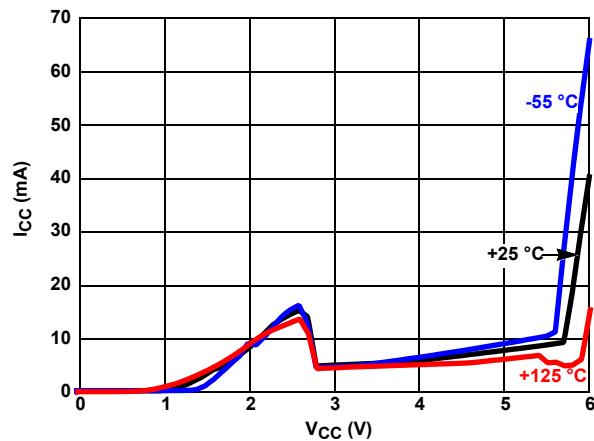


FIGURE 39. SUPPLY CURRENT vs SUPPLY VOLTAGE vs TEMPERATURE

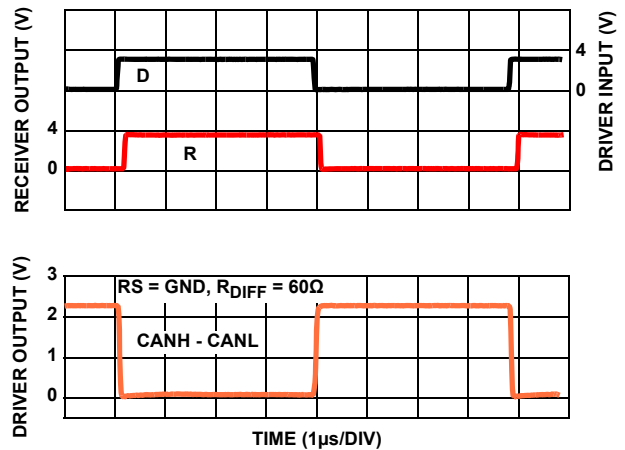


FIGURE 40. FAST DRIVER AND RECEIVER WAVEFORMS

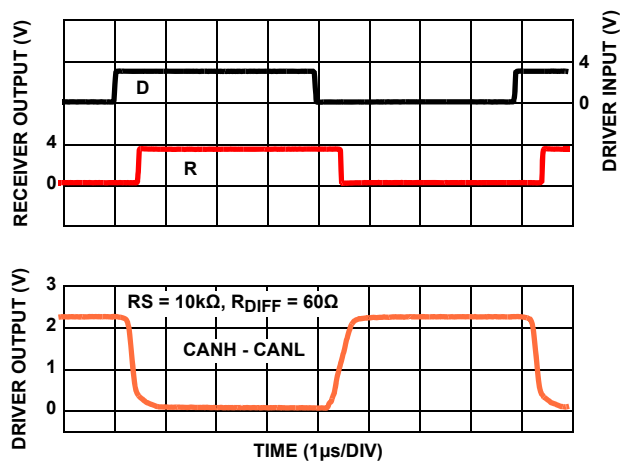


FIGURE 41. MEDIUM DRIVER AND RECEIVER WAVEFORMS

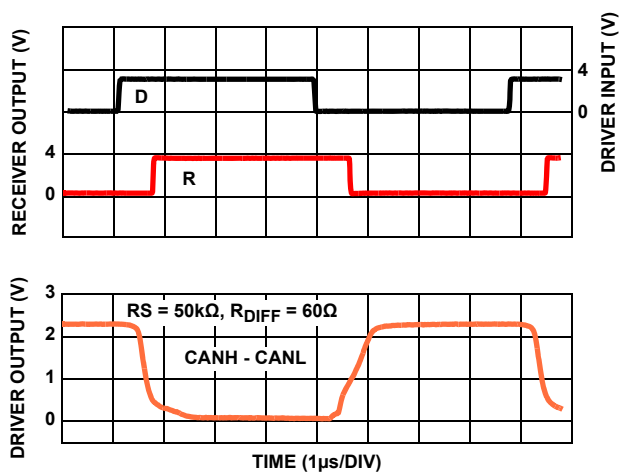


FIGURE 42. SLOW DRIVER AND RECEIVER WAVEFORMS

Die Characteristics

Die Dimensions

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

Interface Materials

GLASSIVATION

Type: 12kÅ Silicon Nitride on 3kÅ Oxide

TOP METALLIZATION

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

BACKSIDE FINISH

Silicon

PROCESS

P6S0I

Assembly Related Information

SUBSTRATE POTENTIAL

Floating

Additional Information

WORST CASE CURRENT DENSITY

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

TRANSISTOR COUNT

4055

Weight of Packaged Device

0.31 grams

Lid Characteristics

Finish: Gold

Potential: Grounded, tied to package pin 2

Metalization Mask Layout

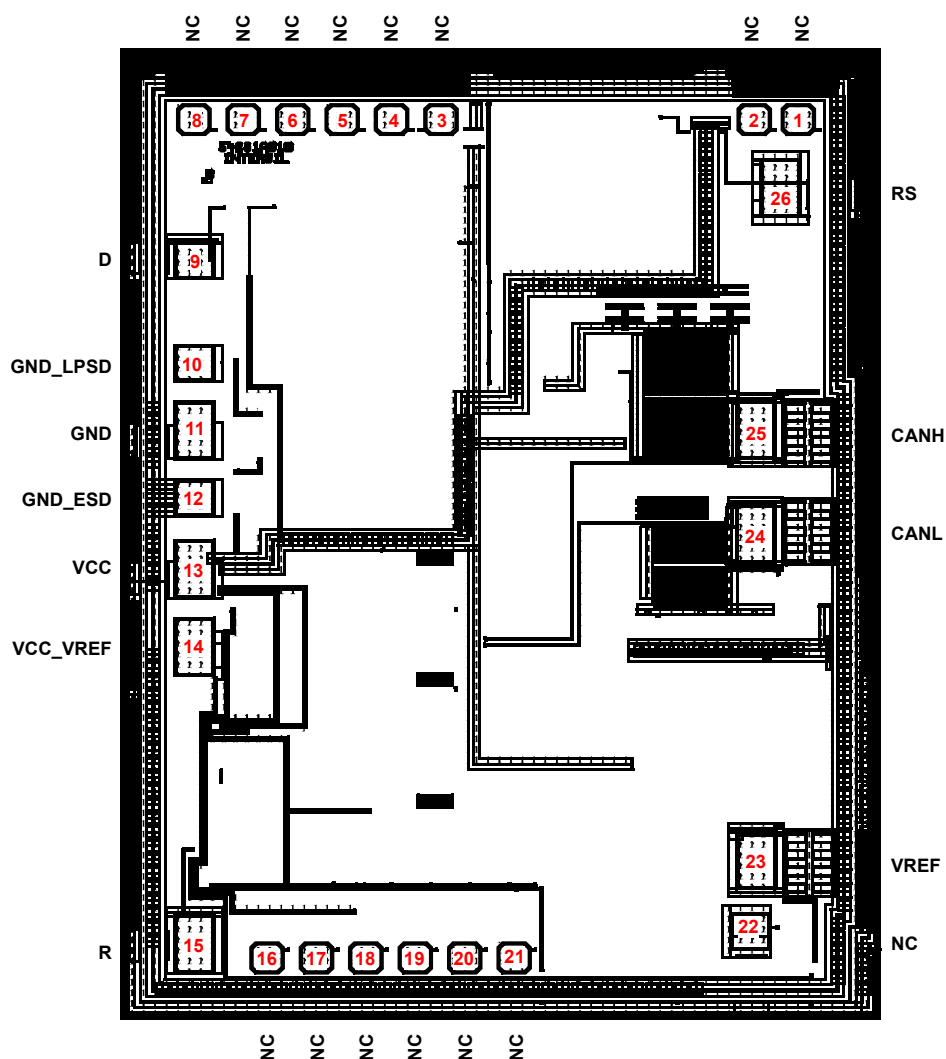


TABLE 3. ISL72028BSEH DIE LAYOUT X-Y COORDINATES

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

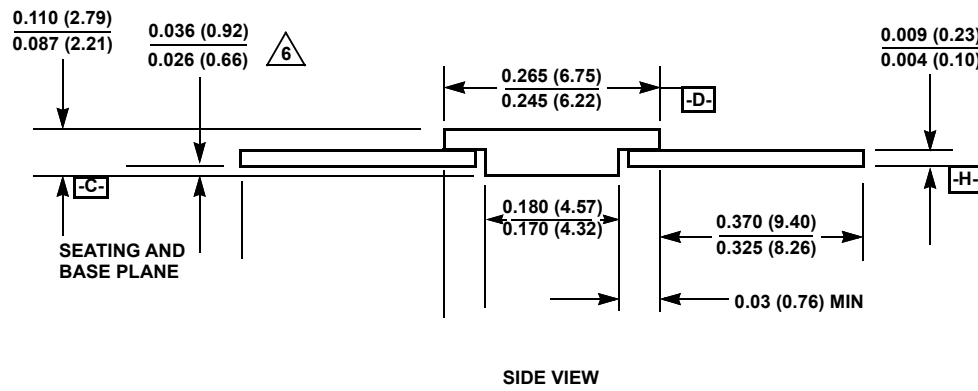
NOTE: Origin of coordinates is the center of the die. NC - No Connect

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

DATE	REVISION	CHANGE
Aug 17, 2026	1.00	Corrected Pin Descriptions for CANL and CANH. Removed Related Literature section. Fixed links throughout.
Nov 30, 2016	0.00	Initial Release

K8.A

Rev 4, 12/14



- Page 18 of 18

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

Corporate Headquarters

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

Contact Information

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

Trademarks

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