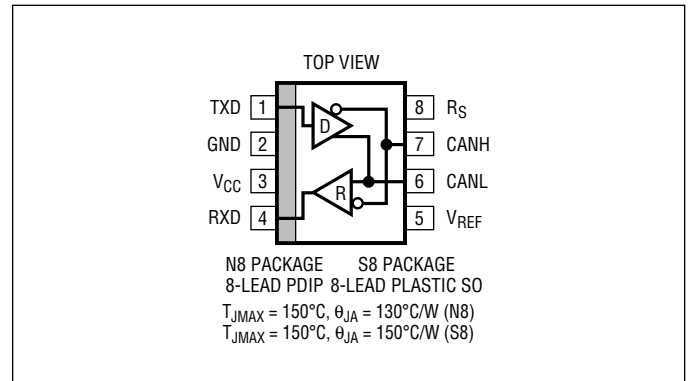


## ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage ( $V_{CC}$ )	44V
$R_S$ Slope Control Input Voltage	-0.3V to 44V
$V_{REF}$ Reference Output Pin	-0.3V to 7V
Driver Input Voltage	-0.3V to 44V
CANH, CANL Data Line Pins	-80V to 80V
Receiver Output Voltages	-0.3V to 7V
Operating Temperature Range	
LT1796C	0°C to 70°C
LT1796I	-40°C to 85°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

## PIN CONFIGURATION



## ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING*	PACKAGE DESCRIPTION	TEMPERATURE RANGE
LT1796CN8#PBF	LT1796CN8#TRPBF	LT1796 CN8	8-Lead PDIP	0°C to 70°C
LT1796CS8#PBF	LT1796CS8#TRPBF	1796	8-Lead Plastic SO	0°C to 70°C
LT1796IN8#PBF	LT1796IN8#TRPBF	LT1796I IN8	8-Lead PDIP	-40°C to 85°C
LT1796IS8#PBF	LT1796IS8#TRPBF	1796I	8-Lead Plastic SO	-40°C to 85°C

Consult LTC Marketing for parts specified with wider operating temperature ranges. \*The temperature grade is identified by a label on the shipping container.

Consult LTC Marketing for information on nonstandard lead based finish parts.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandreel/>

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^{\circ}\text{C}$ .  $V_{CC} = 4.75\text{V}$  to  $5.25\text{V}$ ,  $V_{RS} = 0\text{V}$  unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{CANH}$	CANH Output Voltage	$V_{TXD} = 0\text{V}$ , No Load	● 3.8	4.4	5.0	V
		$V_{TXD} = 0\text{V}$ , $R_L = 60\Omega$	● 2.8	3.5	4.6	V
$V_{CANL}$	CANL Output Voltage	$V_{TXD} = 0\text{V}$ , No Load	● 0	0.5	0.9	V
		$V_{TXD} = 0\text{V}$ , $R_L = 60\Omega$	● 0	1.3	1.6	V
$V_{OD}$	Dominant State Differential Output Voltage	$V_{TXD} = 0\text{V}$ , No Load, $V_{CC} = 4.75\text{V}$	● 3.0	3.6	5.0	V
		$V_{TXD} = 0\text{V}$ , $R_L = 60\Omega$ , $V_{CC} = 4.75\text{V}$	● 1.5	2.0	4.2	V
		$V_{TXD} = 0\text{V}$ , $R_L = 36\Omega$ , $V_{CC} = 4.75\text{V}$	● 1.2	1.7	4.2	V
$V_{REC}$	Recessive State Differential Output Voltage	$V_{TXD} = 5\text{V}$ , $R_L = 60\Omega$	● -10	0	10	mV
$V_{CMR}$	Recessive State Common Mode Output Voltage	$V_{TXD} = 5\text{V}$ , $R_L = 60\Omega$ , $V_{CC} = 5\text{V}$	● 2.7	3	3.5	V

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{CC} = 4.75\text{V}$  to  $5.25\text{V}$ ,  $V_{RS} = 0\text{V}$  unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$V_{CMD}$	Dominant State Common Mode Output Voltage	$R_L = 60\Omega$ , $V_{CC} = 5\text{V}$	●	2	2.5	3	V
$V_{IH}$	TXD Input High Voltage		●	2.8			V
$V_{IL}$	TXD Input Low Voltage		●			2	V
$I_{IN1}$	TXD Input Current	$0 < V_{TXD} < V_{CC}$	●	-5		5	$\mu\text{A}$
$I_{SCH}$	CANH Short-Circuit Current, Dominant Mode	$V_{CANH} = 0\text{V}$ , $V_{CC} = 5.25\text{V}$	●	-250		-60	$\text{mA}$
		$V_{CANH} = -36\text{V}$ , $V_{CC} = 5.25\text{V}$	●	-10	-1	0	$\text{mA}$
		$V_{CANH} = -60\text{V}$ , $V_{CC} = 5.25\text{V}$	●	-10	-1	0	$\text{mA}$
		$V_{CANH} = 60\text{V}$ , $V_{CC} = 5.25\text{V}$	●	0	1	10	$\text{mA}$
$I_{SCL}$	CANL Short-Circuit Current, Dominant Mode	$V_{CANL} = 5\text{V}$ , $V_{TXD} = 0\text{V}$ , $V_{CC} = 5.25\text{V}$	●	60		250	$\text{mA}$
		$V_{CANL} = 36\text{V}$ , $V_{TXD} = 0\text{V}$ , $V_{CC} = 5.25\text{V}$	●	0	1	10	$\text{mA}$
		$V_{CANL} = 60\text{V}$ , $V_{TXD} = 0\text{V}$ , $V_{CC} = 5.25\text{V}$	●	0	1	10	$\text{mA}$
		$V_{CANL} = -60\text{V}$ , $V_{TXD} = 0\text{V}$ , $V_{CC} = 5.25\text{V}$	●	-10	-1	0	$\text{mA}$
$R_{IND}$	Differential Input Resistance	$V_{TXD} = 5\text{V}$ , $-7\text{V} < V_{CANH}$ , $V_{CANL} < 12\text{V}$	●	140	240	350	$\text{k}\Omega$
	CANH, CANL Input Resistance	$V_{TXD} = 5\text{V}$ , $-7\text{V} < V_{CANH}$ , $V_{CANL} < 12\text{V}$	●	70	120	175	$\text{k}\Omega$
	Input Fault Current (CANH, CANL)	$V_{RS} = 5\text{V}$ , $-60\text{V} < V_{CANH}$ , $V_{CANL} < 60\text{V}$	●	-3		3	$\text{mA}$
		$V_{TXD} = 5\text{V}$ , $-60\text{V} < V_{CANH}$ , $V_{CANL} < 60\text{V}$	●	-3		3	$\text{mA}$
		$V_{CC} = 0\text{V}$ , $-60\text{V} < V_{CANH}$ , $V_{CANL} < 60\text{V}$	●	-3		3	$\text{mA}$

## DC ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_{CC} = 4.75\text{V}$  to  $5.25\text{V}$ ,  $V_{RS} = 0\text{V}$  unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$V_{TH}$	Differential Input Threshold Voltage for Receiver	$V_{RS} = 0\text{V}$ , $-7\text{V} < V_{CM} < 12\text{V}$	●	0.5		0.9	V
		$V_{RS} = 5\text{V}$ , $-7\text{V} < V_{CM} < 12\text{V}$	●	0.5		0.9	V
$\Delta V_{TH}$	Receiver Input Hysteresis	$-7\text{V} < V_{CM} < 12\text{V}$			70		mV
$V_{OH}$	Receiver Output High Voltage	$V_{CC} = 4.75\text{V}$ , $I_O = -400\mu\text{A}$ , $V_{ID} = 500\text{mV}$	●	3	3.6		V
$V_{OL}$	Receiver Output Low Voltage	$V_{CC} = 4.75\text{V}$ , $I_O = 1.6\text{mA}$ , $V_{ID} = 900\text{mV}$	●		0.15	0.4	V
$I_{SCR}$	Receiver Short-Circuit Current	$0\text{V} < V_O < V_{CC}$ , $V_{CC} = 5.25\text{V}$	●	7	20	85	$\text{mA}$
$V_{REF}$	Reference Output Voltage	$-100\mu\text{A} < I_{REF} < 100\mu\text{A}$	●	2.25	2.5	2.7	V
$V_{REFSC}$	Reference Output Short-Circuit Current	$0 < V_{REF} < V_{CC}$	●	-20		20	$\text{mA}$
$V_{RSSB}$	$R_S$ Pin Standby Threshold	$V_{CC} = 5\text{V}$	●	2.5	2.8	4	V
$I_{RS}$	$R_S$ Input Current	$V_{RS} = 5\text{V}$ , $V_{CC} = 5\text{V}$	●	-270	0.1	10	$\mu\text{A}$
		$V_{RS} = 0\text{V}$ , $V_{CC} = 5\text{V}$	●	-90	-200	-140	$\mu\text{A}$
		$R_S = 47\text{k}$ , $V_{CC} = 5\text{V}$	●		-60	-40	$\mu\text{A}$
$I_{CC}$	Supply Current	Dominant	●		4.3	7	$\text{mA}$
		Recessive	●		3.8	7	$\text{mA}$
		Standby	●		0.8	1.5	$\text{mA}$

## SWITCHING CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range.  $V_{RS} = 0V$  unless otherwise noted. (Note 2)

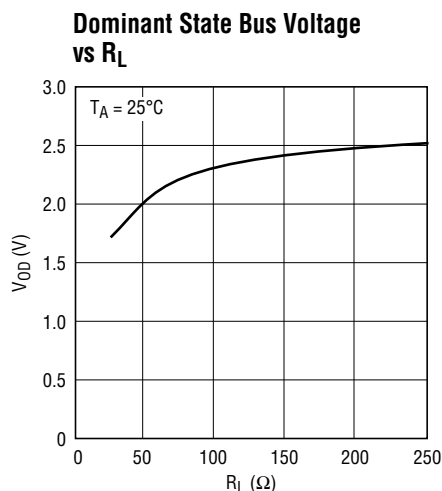
SYMBOL	PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
t <sub>BIT</sub>	Minimum Bit Time	(Note 3)		●	8			μs
F <sub>MAX</sub>	Maximum Data Rate	(Note 3)		●	125			kbps
t <sub>TXDON</sub>	Driver Input to Bus Active	Figures 1, 2	R <sub>S</sub> = 0k	●	300	500	ns	
			R <sub>S</sub> = 47k	●	350	1000	ns	
t <sub>TXDOFF</sub>	Driver Input to Bus Inactive	Figures 1, 2	R <sub>S</sub> = 0k	●	500	1200	ns	
			R <sub>S</sub> = 47k	●	600	1500	ns	
t <sub>LBON</sub>	Loopback Delay Active	Figures 1, 3			●	0.6	1.5	μs
t <sub>LBOFF</sub>	Loopback Delay Inactive	Figures 1, 3			●	1.5	3	μs
t <sub>RXDOFF</sub>	Receiver Delay Off	Figures 1, 4			●	400	600	ns
t <sub>RXDON</sub>	Receiver Delay On	Figures 1, 4			●	300	600	ns
t <sub>RXDOFFSB</sub>	Receiver Delay Off, Standby	V <sub>RS</sub> = 4V, Figures 1, 4			●	1.5	4	μs
t <sub>RXDONSb</sub>	Receiver Delay On, Standby	V <sub>RS</sub> = 4V, Figures 1, 4			●	1	4	μs
t <sub>WAKE</sub>	Wake-Up Delay from Standby	Figures 1, 5			●	1	15	μs
SR <sup>+</sup>	Positive Slew Rate	R <sub>S</sub> = 0k	●	5	12	65	V/μs	
		R <sub>S</sub> = 47k	●	2	7	30	V/μs	
SR <sup>−</sup>	Negative Slew Rate	R <sub>S</sub> = 0k	●	5	36	65	V/μs	
		R <sub>S</sub> = 47k	●	2	5	15	V/μs	

**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

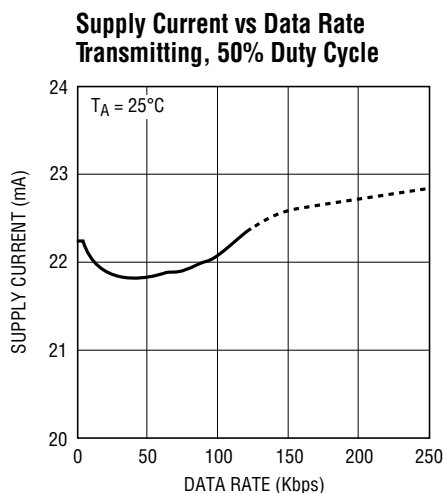
**Note 2:** Unless otherwise specified, testing done at  $V_{CC} = 5V$ ,  $T_A = 25^\circ C$ .

**Note 3:** Bit time and data rate specifications are guaranteed by driver and receiver delay time measurements.

## TYPICAL PERFORMANCE CHARACTERISTICS



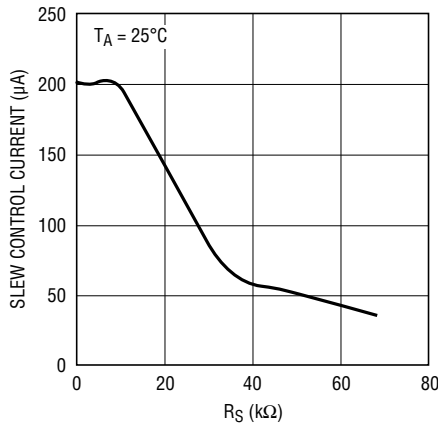
1796 G01



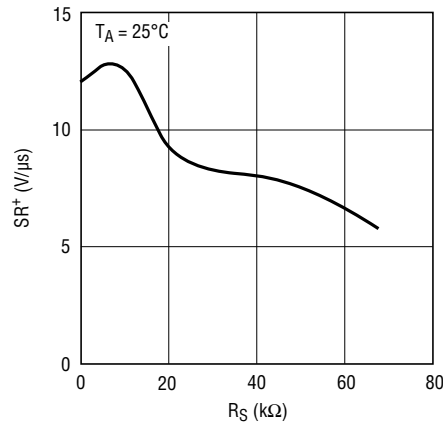
1796 G03

# TYPICAL PERFORMANCE CHARACTERISTICS

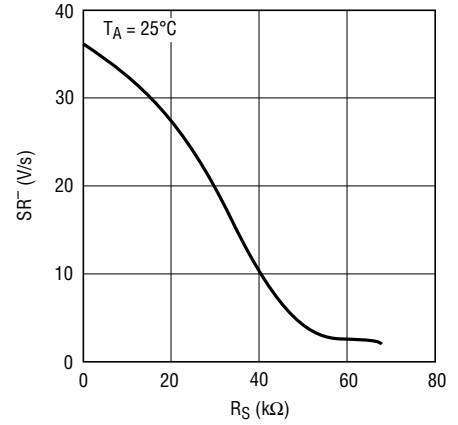
**$R_S$  Pin Current vs  $R_S$**



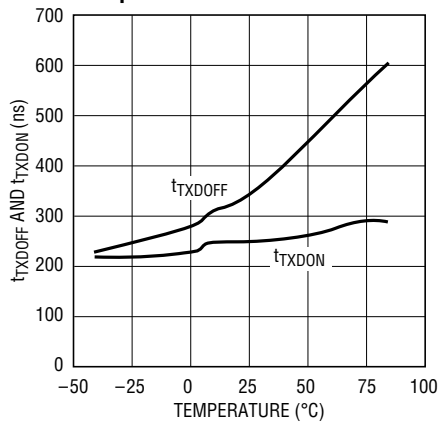
**Positive Slew Rate vs  $R_S$**



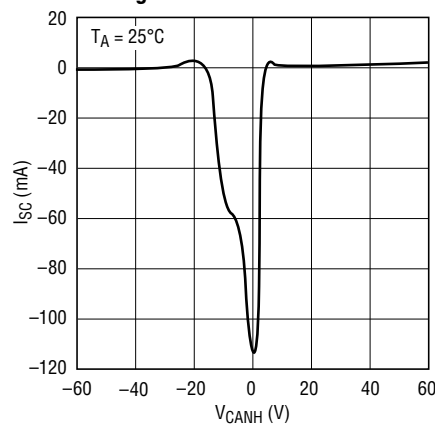
**Negative Slew Rate vs  $R_S$**



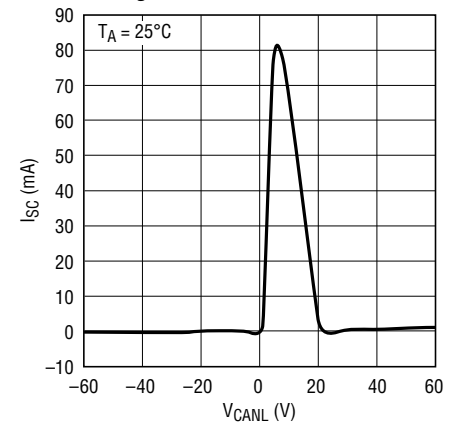
**Transmitter Propagation Delay vs Temperature**



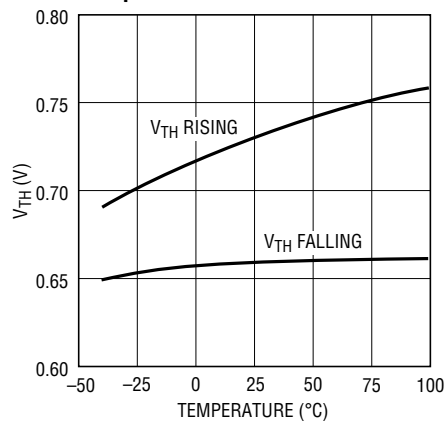
**CANH Short-Circuit Current vs Voltage**



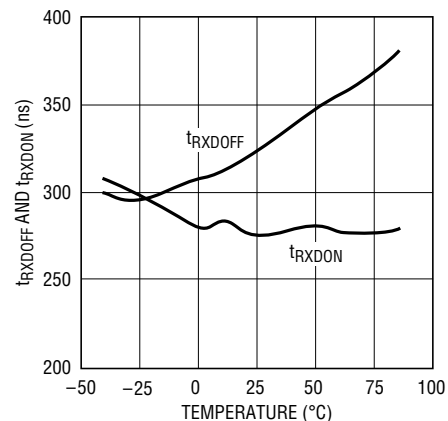
**CANL Short-Circuit Current vs Voltage**



**Receiver Thresholds vs Temperature**



**Receiver Propagation Delay vs Temperature**



## PIN FUNCTIONS

**TXD (Pin 1):** Driver Input. Logic-level thresholds are set by  $V_{REF}$ . A logic input level higher than  $V_{REF}$  turns the driver outputs off, releasing control of the CANH and CANL lines. A logic input less than  $V_{REF}$  turns the driver outputs on, pulling CANH high and CANL low. An open TXD input will float high, turning the driver outputs off. The TXD input pin can withstand voltages from  $-0.3V$  to  $44V$  with no damage.

**GND (Pin 2):** Ground.

**$V_{CC}$  (Pin 3):** Positive Supply Input. Normal operation is with a  $4.75V$  to  $5.25V$  supply. Operation with supplies up to  $44V$  is possible with unterminated bus lines. Operation at high voltages with normally terminated busses will result in excessive power dissipation and activation of the thermal shutdown circuit.  $V_{CC}$  should be decoupled with a  $0.1\mu F$  low ESR capacitor placed as close to the supply pin as possible.

**RXD (Pin 4):** Receiver TTL Level-Logic Output. A high level output indicates a recessive state (zero-volt differential) bus. A dominant state forces a low receiver output.

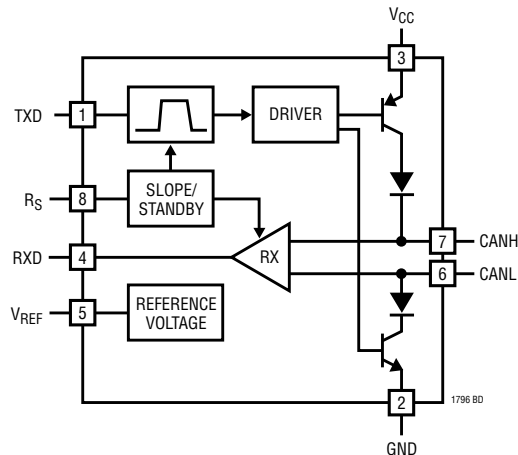
**$V_{REF}$  (Pin 5):** Reference Output. The reference voltage sets the TXD input threshold and the recessive bus common mode voltage at CANH and CANL.  $V_{REF}$  is approximately  $V_{CC}/2$  for low voltage operation. When  $V_{CC} > 7.5V$ ,  $V_{REF}$  maintains a  $3.5V$  level.

**CANL (Pin 6):** CAN Bus Low Data Line. The CANL pin is one input to the receiver and the low driver output. In the dominant state (TXD low), the driver pulls the CANL pin to within  $1V$  of GND. In the recessive state (TXD high), the driver output stays high impedance. The CANL pin is protected from voltage faults from  $-60V$  to  $60V$  in dominant, recessive, standby or powered off modes. On-chip ESD protection meets IEC-1000-4-2 levels.

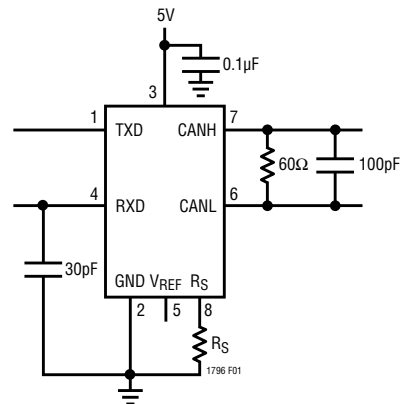
**CANH (Pin 7):** CAN Bus High Data Line. The CANH pin is one input to the receiver and the high driver output. In the dominant state (TXD low), the driver pulls the CANH pin to within  $1V$  of  $V_{CC}$ . In the recessive state (TXD high), the driver output stays high impedance. The CANH pin is protected from voltage faults from  $-60V$  to  $60V$  in dominant, recessive, standby or powered off modes. On-chip ESD protection meets IEC-1000-4-2 levels.

**$R_S$  (Pin 8):** Slope Control. This pin is a multifunction control pin. When  $R_S$  is high ( $V_{RS} > 4V$ ), the circuit goes into a low power standby mode. In standby, the driver always stays in a high impedance (recessive) state. The receiver operates in a low power (slow) monitoring mode. Received data may be used to “wake-up” the system to full functionality. Full speed normal operation occurs if  $R_S$  is tied low through a resistance of less than  $3k$ . The current out of  $R_S$  will be limited to about  $500\mu A$  in the low state. Controlling the current out of  $R_S$  with a resistor greater than  $3k$  or by using a current source allows slew rate control of the data output onto CANH and CANL.

## BLOCK DIAGRAM

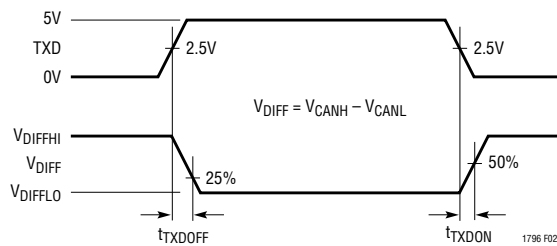


## TEST CIRCUIT

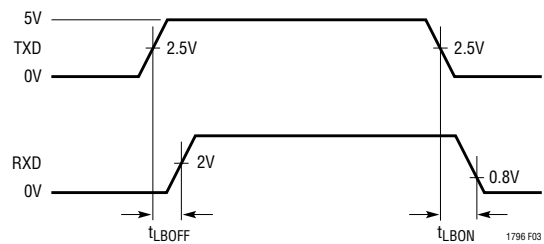


### Figure 1. Switching Test Circuit

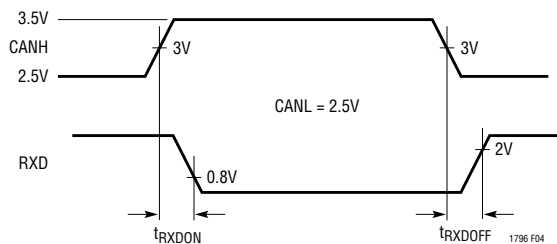
## TIMING DIAGRAM



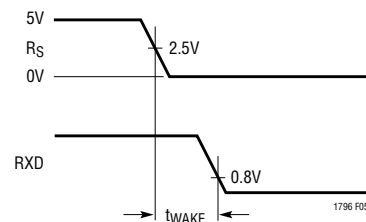
### Figure 2. Driver Delay Waveforms



### Figure 3. Loopback Delay Waveforms



### Figure 4. Receiver Delay Waveforms



### Figure 5. Wake Up from Standby Waveforms

## FUNCTION TABLES

## Driver Output

INPUTS		BUS TERMINALS		
TXD	R <sub>S</sub>	CANH	CANL	OPERATING STATE
0	V <sub>RS</sub> < 3V	High	Low	Dominant
0	V <sub>RS</sub> > 4V	Hi-Z	Hi-Z	Standby
1	V <sub>RS</sub> < 3V	Hi-Z	Hi-Z	Recessive
1	V <sub>RS</sub> > 4V	Hi-Z	Hi-Z	Standby

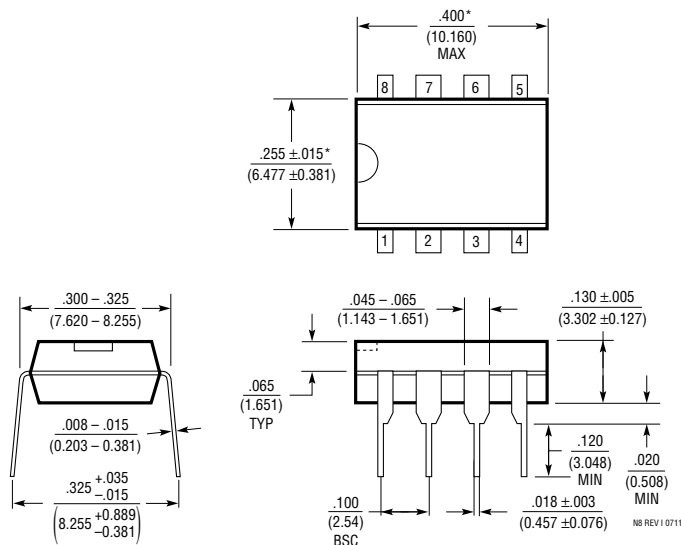
### Receiver Output

<b>BUS VOLTAGE</b> $V_{BUS} = V_{CANH} - V_{CANL}$	<b>R<sub>S</sub></b>	<b>R<sub>XD</sub></b>	<b>RESPONSE TIME</b>
$V_{BUS} < 0.5V$	<3V	High	Fast
$0.5V \leq V_{BUS} \leq 0.9V$	<3V	Indeterminate	Fast
$V_{BUS} > 0.9V$	<3V	Low	Fast
$V_{BUS} < 0.5V$	>4V	High	Slow
$0.5V \leq V_{BUS} \leq 0.9V$	>4V	Indeterminate	Slow
$V_{BUS} > 0.9V$	>4V	Low	Slow

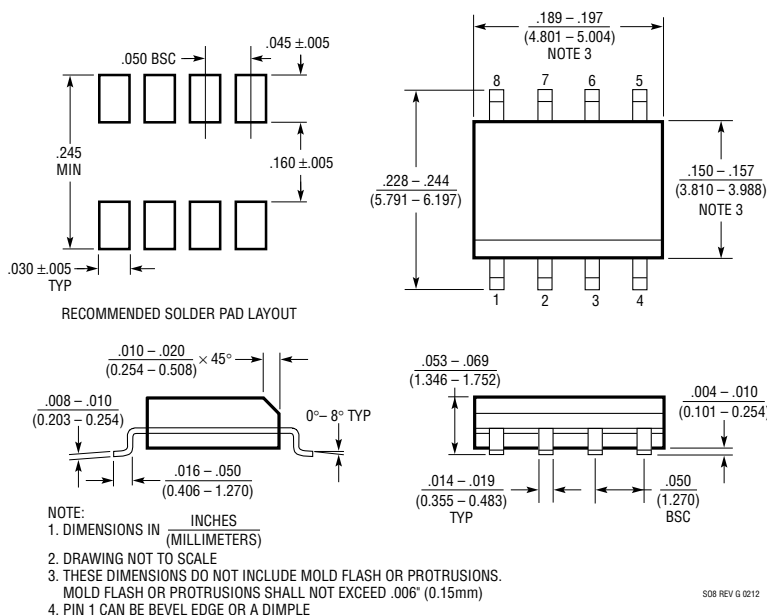
## PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

### N Package 8-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510 Rev I)



### S8 Package 8-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610 Rev G)



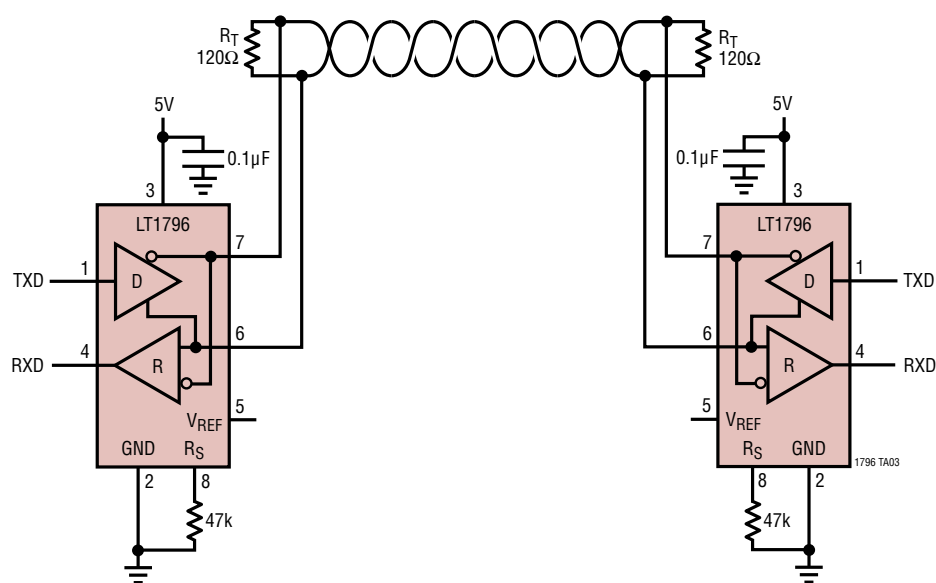
## REVISION HISTORY

REV	DATE	DESCRIPTION	PAGE NUMBER
A	8/15	Increased $t_{TXDFF}$ max limit	4



TYPICAL APPLICATION

Low EMI, Slew Limited CANBUS Network



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
<a href="#">LTC485</a>	Low Power RS485 Interface Transceiver	$I_{CC} = 300\mu A$ Typ
<a href="#">LTC491</a>	Differential Driver and Receiver Pair	$I_{CC} = 300\mu A$ Typ
<a href="#">LTC1483</a>	Ultralow Power RS485 Low EMI Transceiver	Controlled Driver Slew Rate
<a href="#">LTC1485</a>	RS485 Differential Bus Transceiver	10Mbaud Operation
<a href="#">LTC1487</a>	Ultralow Power RS485 with Low EMI, Shutdown and High Input Impedance	Up to 256 Transceivers On the Bus
<a href="#">LT1785/LT1791</a>	60V Fault-Protected RS485/RS422 Transceivers	15kV ESD Protected
<a href="#">LTC2875</a>	±60V CAN Transceiver	3.3V or 5V Supply, 4Mbps Operation, 25kV ESD