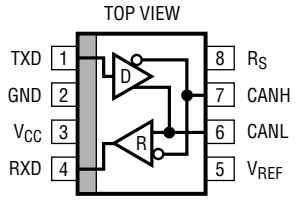
## ABSOLUTE MAXIMUM RATINGS

**(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

## PACKAGE/ORDER INFORMATION




N8 PACKAGE
8-LEAD PDIP
S8 PACKAGE
8-LEAD PLASTIC SO

$T_{JMAX}$ = 150°C, $\theta_{JA}$ = 130°C/W (N8)
$T_{JMAX}$ = 150°C, $\theta_{JA}$ = 150°C/W (S8)

| ORDER PART NUMBER |
|---|
| LT1796CN8<br>LT1796CS8<br>LT1796IN8<br>LT1796IS8 |
| **S8 PART MARKING** |
| 1796<br>1796I |

Consult LTC Marketing for parts specified with wider operating temperature ranges.

## DC ELECTRICAL CHARACTERISTICS

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

| SYMBOL | PARAMETER | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| $V_{CANH}$ | CANH Output Voltage | $V_{TXD}$ = 0V, No Load<br>$V_{TXD}$ = 0V, $R_L$ = 60Ω | ●<br>● | 3.8<br>2.8 | 4.4<br>3.5 | 5.0<br>4.6 | V<br>V |
| $V_{CANL}$ | CANL Output Voltage | $V_{TXD}$ = 0V, No Load<br>$V_{TXD}$ = 0V, $R_L$ = 60Ω | ●<br>● | 0<br>0 | 0.5<br>1.3 | 0.9<br>1.6 | V<br>V |
| $V_{OD}$ | Dominant State Differential Output Voltage | $V_{TXD}$ = 0V, No Load, $V_{CC}$ = 4.75V<br>$V_{TXD}$ = 0V, $R_L$ = 60Ω, $V_{CC}$ = 4.75V<br>$V_{TXD}$ = 0V, $R_L$ = 36Ω, $V_{CC}$ = 4.75V | ●<br>●<br>● | 3.0<br>1.5<br>1.2 | 3.6<br>2.0<br>1.7 | 5.0<br>4.2<br>4.2 | V<br>V<br>V |
| $V_{REC}$ | Recessive State Differential Output Voltage | $V_{TXD}$ = 5V, $R_L$ = 60Ω | ● | –10 | 0 | 10 | mV |
| $V_{CMR}$ | Recessive State Common Mode Output Voltage | $V_{TXD}$ = 5V, $R_L$ = 60Ω, $V_{CC}$ = 5V | ● | 2.7 | 3 | 3.5 | V |
| $V_{CMD}$ | Dominant State Common Mode Output Voltage | $R_L$ = 60Ω, $V_{CC}$ = 5V | ● | 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 | µA |
| $I_{SCH}$ | CANH Short-Circuit Current, Dominant Mode | $V_{CANH}$ = 0V, $V_{CC}$ = 5.25V<br>$V_{CANH}$ = –36V, $V_{CC}$ = 5.25V<br>$V_{CANH}$ = –60V, $V_{CC}$ = 5.25V<br>$V_{CANH}$ = 60V, $V_{CC}$ = 5.25V | ●<br>●<br>●<br>● | –250<br>–10<br>–10<br>0 | <br>–1<br>–1<br>1 | –60<br>0<br>0<br>10 | mA<br>mA<br>mA<br>mA |
| $I_{SCL}$ | CANL Short-Circuit Current, Dominant Mode | $V_{CANL}$ = 5V, $V_{TXD}$ = 0V, $V_{CC}$ = 5.25V<br>$V_{CANL}$ = 36V, $V_{TXD}$ = 0V, $V_{CC}$ = 5.25V<br>$V_{CANL}$ = 60V, $V_{TXD}$ = 0V, $V_{CC}$ = 5.25V<br>$V_{CANL}$ = –60V, $V_{TXD}$ = 0V, $V_{CC}$ = 5.25V | ●<br>●<br>●<br>● | 60<br>0<br>0<br>–10 | <br>1<br>1<br>–1 | 250<br>10<br>10<br>0 | mA<br>mA<br>mA<br>mA |
| $R_{IND}$ | Differential Input Resistance | $V_{TXD}$ = 5V, –7V < $V_{CANH}$, $V_{CANL}$ < 12V | ● | 140 | 240 | 350 | kΩ |
| | CANH, CANL Input Resistance | $V_{TXD}$ = 5V, –7V < $V_{CANH}$, $V_{CANL}$< 12V | ● | 70 | 120 | 175 | kΩ |
| | Input Fault Current (CANH, CANL) | $V_{RS}$ = 5V, –60V < $V_{CANH}$, $V_{CANL}$ < 60V<br>$V_{TXD}$ = 5V, –60V < $V_{CANH}$, $V_{CANL}$ < 60V<br>$V_{CC}$ = 0V, –60V < $V_{CANH}$, $V_{CANL}$ < 60V | ●<br>●<br>● | –3<br>–3<br>–3 | | 3<br>3<br>3 | mA<br>mA<br>mA |

## DC ELECTRICAL CHARACTERISTICS

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

| SYMBOL | PARAMETER | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| $V_{TH}$ | Differential Input Threshold Voltage for Receiver | $V_{RS}$ = 0V, –7V < $V_{CM}$ < 12V<br>$V_{RS}$ = 5V, –7V < $V_{CM}$ < 12V | ●<br>● | 0.5<br>0.5 | | 0.9<br>0.9 | V<br>V |
| $\Delta V_{TH}$ | Receiver Input Hysteresis | –7V < $V_{CM}$ < 12V | | | 70 | | mV |
| $V_{OH}$ | Receiver Output High Voltage | $V_{CC}$ = 4.75V, $I_O$ = –400µA, $V_{ID}$ = 500mV | ● | 3 | 3.6 | | V |
| $V_{OL}$ | Receiver Output Low Voltage | $V_{CC}$ = 4.75V, $I_O$ = 1.6mA, $V_{ID}$ = 900mV | ● | | 0.15 | 0.4 | V |
| $I_{SCR}$ | Receiver Short-Circuit Current | 0V < $V_O$ < $V_{CC}$ , $V_{CC}$ = 5.25V | ● | 7 | 20 | 85 | mA |
| $V_{REF}$ | Reference Output Voltage | –100µA < $I_{REF}$ < 100µA | ● | 2.25 | 2.5 | 2.7 | V |
| $V_{REFSC}$ | Reference Output Short-Circuit Current | 0 < $V_{REF}$ < $V_{CC}$ | ● | –20 | | 20 | mA |
| $V_{RSSB}$ | $R_S$ Pin Standby Threshold | $V_{CC}$ = 5V | ● | 2.5 | 2.8 | 4 | V |
| $I_{RS}$ | $R_S$ Input Current | $V_{RS}$ = 5V, $V_{CC}$ = 5V<br>$V_{RS}$ = 0V, $V_{CC}$ = 5V<br>$R_S$ = 47k, $V_{CC}$ = 5V | ●<br>●<br>● | <br>–270<br>–90 | 0.1<br>–200<br>–60 | 10<br>–140<br>–40 | µA<br>µA<br>µA |
| $I_{CC}$ | Supply Current Dominant<br>Recessive<br>Standby | No Load, $V_{RS}$ = 0V, $V_{TXD}$ = 0V, $V_{CC}$ = 5.25V<br>$R_L$ = 60Ω, $V_{RS}$ = 0V, $V_{TXD}$ = 5V, $V_{CC}$ = 5.25V<br>$R_L$ = 60Ω, $V_{RS}$ = 5V, $V_{CC}$ = 5.25V | ●<br>●<br>● | | 4.3<br>3.8<br>0.8 | 7<br>7<br>1.5 | mA<br>mA<br>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 |
|---|---|---|---|---|---|---|---|---|
| $t_{BIT}$ | Minimum Bit Time | (Note 3) | | ● | | | 8 | µs |
| $F_{MAX}$ | Maximum Data Rate | (Note 3) | | ● | 125 | | | kbps |
| $t_{TXDON}$ | Driver Input to Bus Active | Figures 1, 2 | $R_S$ = 0k | ● | | 300 | 500 | ns |
| | | | $R_S$ = 47k | ● | | 350 | 1000 | ns |
| $t_{TXDOFF}$ | Driver Input to Bus Inactive | Figures 1, 2 | $R_S$ = 0k | ● | | 500 | 1000 | ns |
| | | | $R_S$ = 47k | ● | | 600 | 1500 | ns |
| $t_{LBON}$ | Loopback Delay Active | Figures 1, 3 | | ● | | 0.6 | 1.5 | µs |
| $t_{LBOFF}$ | Loopback Delay Inactive | Figures 1, 3 | | ● | | 1.5 | 3 | µs |
| $t_{RXDOFF}$ | Receiver Delay Off | Figures 1, 4 | | ● | | 400 | 600 | ns |
| $t_{RXDON}$ | Receiver Delay On | Figures 1, 4 | | ● | | 300 | 600 | ns |
| $t_{RXDOFFSB}$ | Receiver Delay Off, Standby | $V_{RS}$ = 4V, Figures 1, 4 | | ● | | 1.5 | 4 | µs |
| $t_{RXDONSB}$ | Receiver Delay On, Standby | $V_{RS}$ = 4V, Figures 1, 4 | | ● | | 1 | 4 | µs |
| $t_{WAKE}$ | Wake-Up Delay from Standby | Figures 1, 5 | | ● | | 1 | 15 | µs |
| $SR^+$ | Positive Slew Rate | $R_S$ = 0k<br>$R_S$ = 47k | | ●<br>● | 5<br>2 | 12<br>7 | 65<br>30 | V/µs<br>V/µs |
| $SR^-$ | Negative Slew Rate | $R_S$ = 0k<br>$R_S$ = 47k | | ●<br>● | 5<br>2 | 36<br>5 | 65<br>15 | V/µs<br>V/µs |

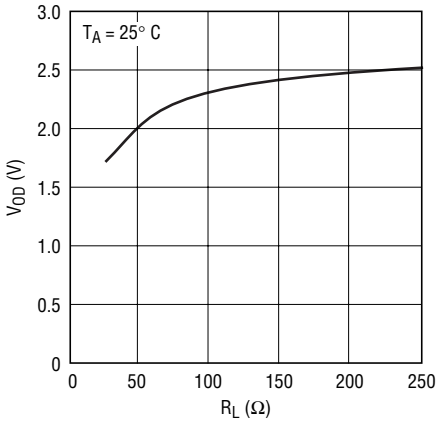
**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

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

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

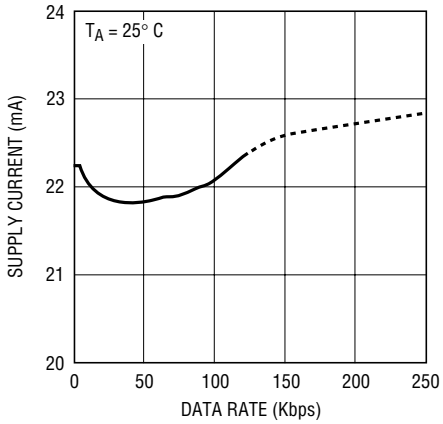
## TYPICAL PERFORMANCE CHARACTERISTICS

**Dominant State Bus Voltage vs $R_L$**



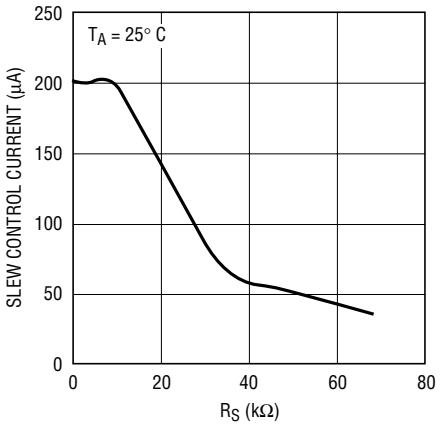

1796 G01

**Supply Current vs Data Rate Transmitting, 50% Duty Cycle**



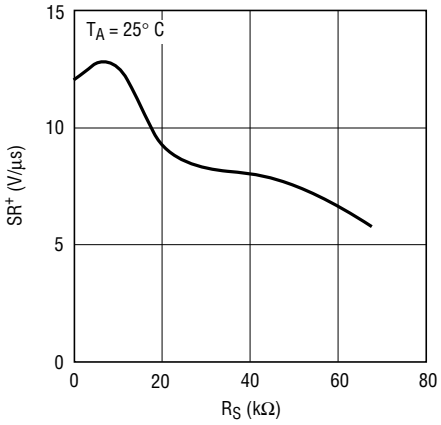

1796 G03

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



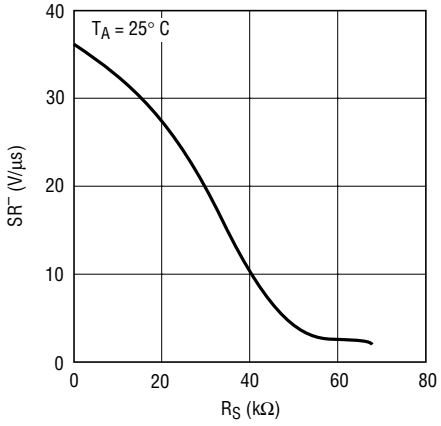

1796 G04

**Positive Slew Rate vs $R_S$**



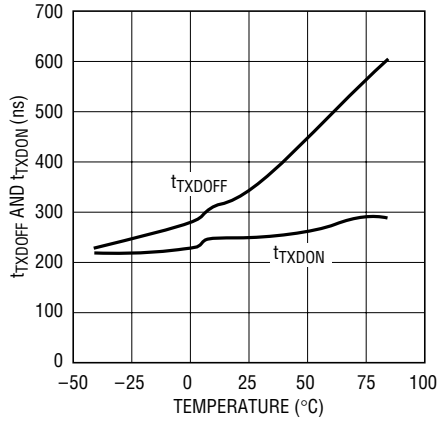

1796 G05

**Negative Slew Rate vs $R_S$**



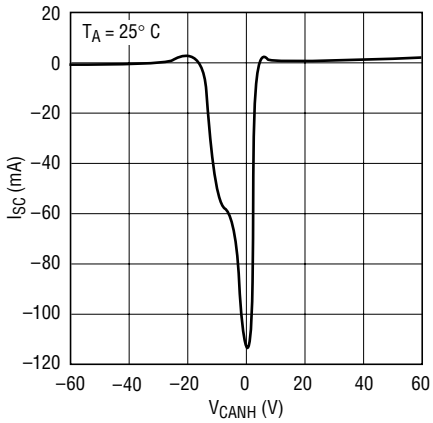

1796 G06

**Transmitter Propagation Delay vs Temperature**



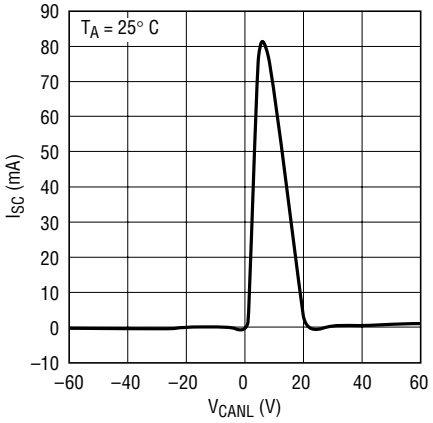

1796 G07

**CANH Short-Circuit Current vs Voltage**




1796 G08

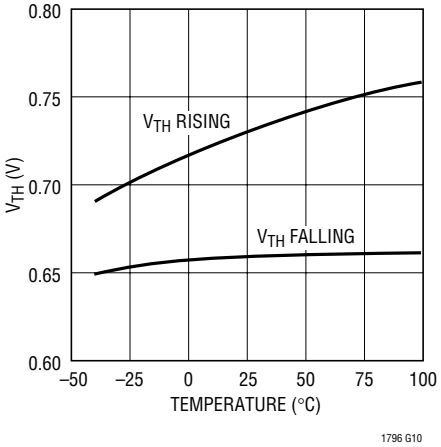
**CANL Short-Circuit Current vs Voltage**



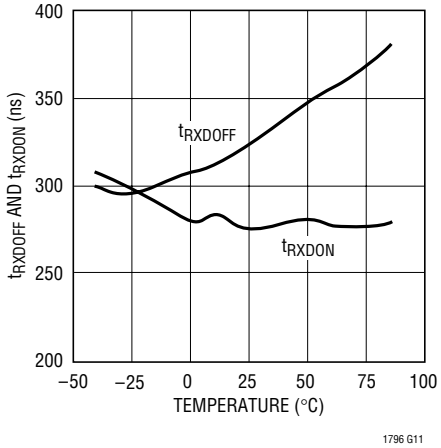

1796 G09

## TYPICAL PERFORMANCE CHARACTERISTICS

**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 0.1µF 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.

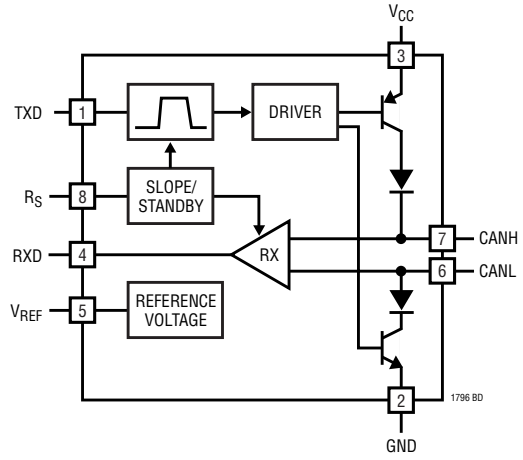
**$V_{REF}$ (Pin 5):** Reference Output. The reference voltage sets the TXD input threshold and the recessive bus common mode voltage at CANH and CANL. $V_{REF}$ is approximately $V_{CC}/2$ for low voltage operation. When $V_{CC}$ > 7.5V, $V_{REF}$ maintains a 3.5V level.

**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 500µA 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

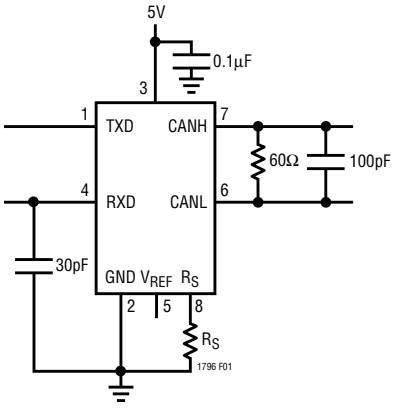



Figure 1. Switching Test Circuit

## TIMING DIAGRAMS

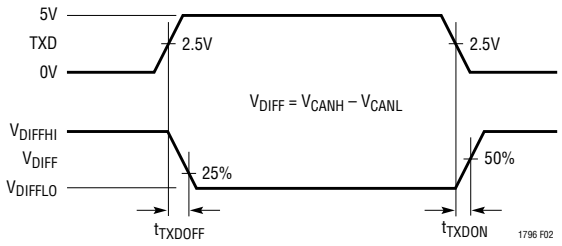



Figure 2. Driver Delay Waveforms

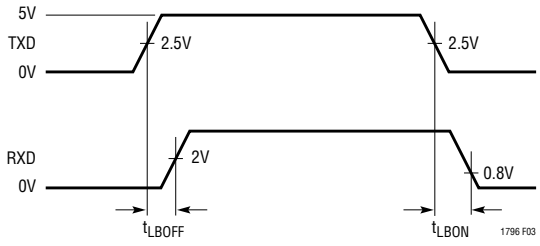



Figure 3. Loopback Delay Waveforms

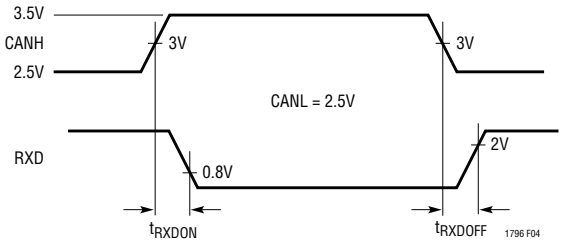



Figure 4. Reciever Delay Waveforms

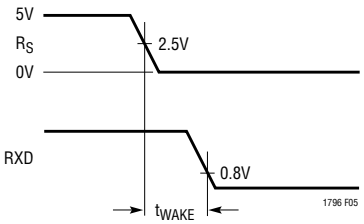



Figure 5. Wake Up from Standby Waveforms

## FUNCTION TABLES

### Driver Output

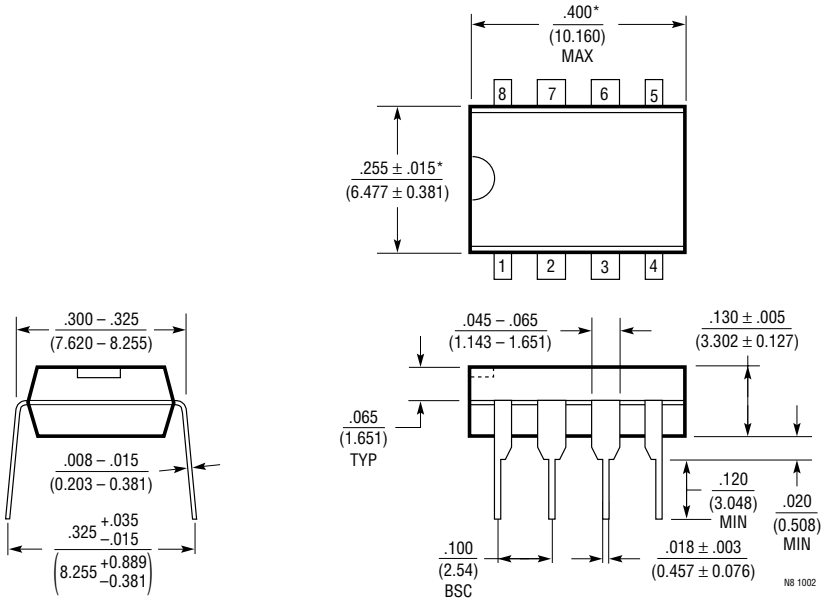
| INPUTS | | BUS TERMINALS | | |
|---|---|---|---|---|
| TXD | $R_S$ | CANH | CANL | OPERATING STATE |
| 0 | $V_{RS} < 3V$ | High | Low | Dominant |
| 0 | $V_{RS} > 4V$ | Hi-Z | Hi-Z | Standby |
| 1 | $V_{RS} < 3V$ | Hi-Z | Hi-Z | Recessive |
| 1 | $V_{RS} > 4V$ | Hi-Z | Hi-Z | Standby |

### Receiver Output

| BUS VOLTAGE $V_{BUS} = V_{CANH} - V_{CANL}$ | $R_S$ | RXD | RESPONSE TIME |
|---|---|---|---|
| $V_{BUS} < 0.5V$ | <3V | High | Fast |
| $0.5V \le V_{BUS} \le 0.9V$ | <3V | Indeterminate | Fast |
| $V_{BUS} > 0.9V$ | <3V | Low | Fast |
| $V_{BUS} < 0.5V$ | >4V | High | Slow |
| $0.5V \le V_{BUS} \le 0.9V$ | >4V | Indeterminate | Slow |
| $V_{BUS} > 0.9V$ | >4V | Low | Slow |

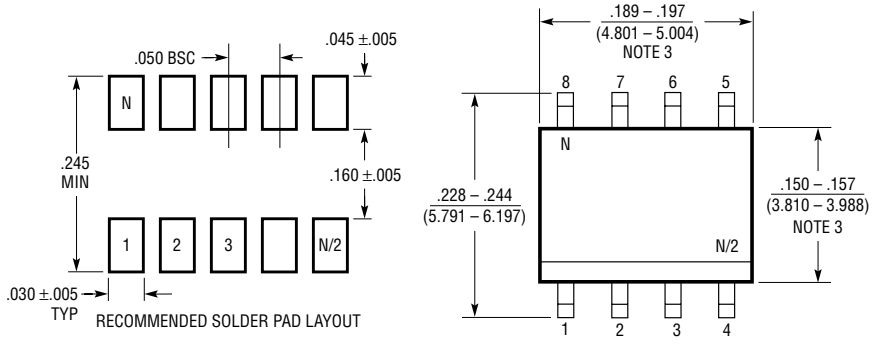
# PACKAGE DESCRIPTION

**N8 Package**
**8-Lead PDIP (Narrow .300 Inch)**
(Reference LTC DWG # 05-08-1510)




NOTE:
1. DIMENSIONS ARE INCHES / MILLIMETERS
*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

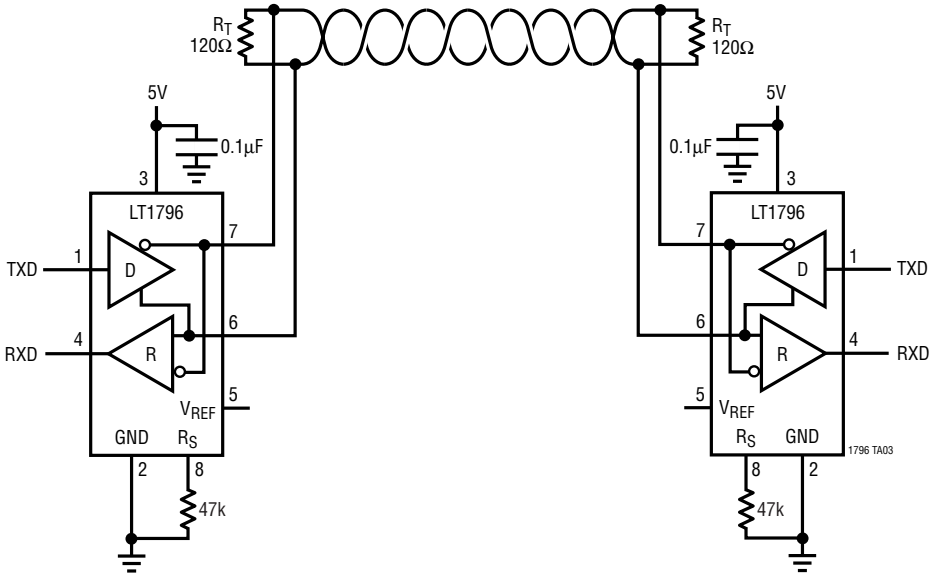
**S8 Package**
**8-Lead Plastic Small Outline (Narrow .150 Inch)**
(Reference LTC DWG # 05-08-1610)




NOTE:
1. DIMENSIONS IN INCHES / (MILLIMETERS)
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

## TYPICAL APPLICATION

**Low EMI, Slew Limited CANBUS Network**




## RELATED PARTS

| PART NUMBER | DESCRIPTION | COMMENTS |
|---|---|---|
| LTC485 | Low Power RS485 Interface Transceiver | $I_{CC}$ = 300µA Typ |
| LTC491 | Differential Driver and Receiver Pair | $I_{CC}$ = 300µA Typ |
| LTC1483 | Ultralow Power RS485 Low EMI Transceiver | Controlled Driver Slew Rate |
| LTC1485 | RS485 Differential Bus Transceiver | 10Mbaud Operation |
| LTC1487 | Ultralow Power RS485 with Low EMI, Shutdown and High Input Impedance | Up to 256 Transceivers On the Bus |
| LT1785/LT1791 | 60V Fault-Protected RS485/RS422 Transceivers | 15kV ESD Protected |



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