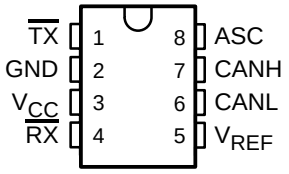
- **SN75LBC031 Meets Standard ISO/DIS 11898 (up to 500 k Baud)**
- **Driver Output Capability at 50 mA**
- **Wide Positive and Negative Input/output Bus Voltage Range**
- **Bus Outputs Short-Circuit-Protected to Battery Voltage and Ground**
- **Thermal Shutdown**

D OR P PACKAGE
(TOP VIEW)



TERMINAL FUNCTIONS

TERMINAL	DESCRIPTION
$\overline{TX}$	Transmitter input
GND	Ground
V_{CC}	Supply voltage
$\overline{RX}$	Receiver output
V_{REF}	Reference output
CANL	Low side bus output driver
CANH	High side bus output driver
ASC	Adjustable slope control

description

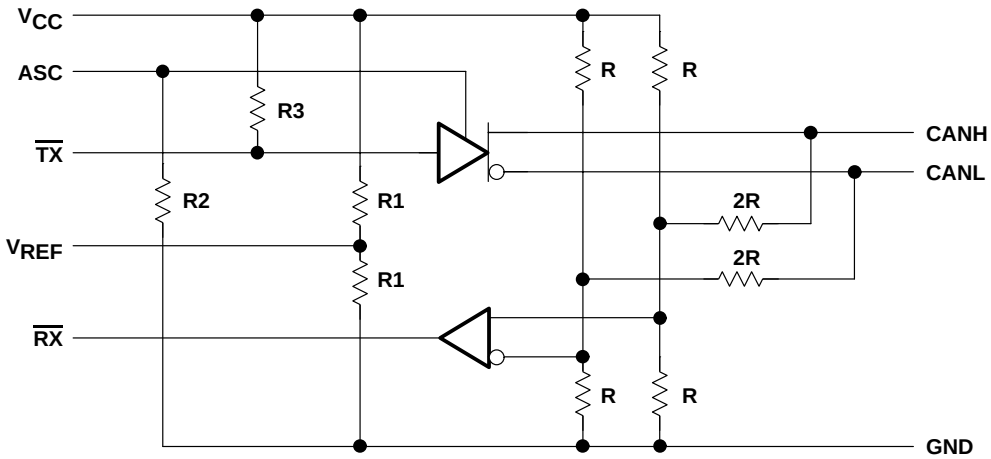
The SN75LBC031 is a CAN transceiver used as an interface between a CAN controller and the physical bus for high speed applications of up to 500 kBaud. The device provides transmit capability to the differential bus and differential receive capability to the controller. The transmitter outputs (CANH and CANL), feature internal transition regulation to provide controlled symmetry resulting in low EMI emissions. Both transmitter outputs are fully protected against battery short circuits and electrical transients that can occur on the bus lines. In the event of excessive device power dissipation the output drivers are disabled by the thermal shutdown circuitry at a junction temperature of approxi-mately 160°C. The inclusion of an internal pullup resistor on the transmitter input ensures a defined output during power up and protocol controller reset. For normal operation at 500 kBaud the ASC terminal is open or tied to GND. For slower speed operation at 125 kBaud the bus output transition times can be increased to reduce EMI by connected the ASC terminal to V_{CC}. The receiver includes an integrated filter that suppresses into pulses less than 30 ns wide.

FUNCTION TABLE

TX	CANH	CANL	BUS STATE	RX
L	H	L	Dominant	L
High or floating	Floating	Floating	Recessive	H

L = low, H = high

logic diagram



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Logic supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Bus terminal voltage . . . . . –5 V to 20 V
Input current at $\overline{TX}$ and ASC terminal, I_I . . . . . ±10 mA
Input current at $\overline{TX}$ and ASC terminal, V_I . . . . . $2xV_{CC}$
Operating free-air temperature range, T_A: SN65LBC031 . . . . . –40°C to+ 85°C
SN75LBC031 . . . . . –40°C to + 125°C
Operating juncation range, T_J . . . . . –40°C to 150°C
Continuous total power dissipation at (or below) 25°C free-air temperature . . See Dissipation Rating Table
Storage temperature range, T_{stg} . . . . . –65°C to 150°C
Case temperature for 10 sec T_C , D package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 sec, P Package . . . . . 260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltage values, except differential bus voltage, are measured with respect to GND.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	OPERATING FACTOR ABOVE $T_C = 25°C$	$T_C = 125°C$ POWER RATING
D	725 mW	5.8 mW/°C	145 mW
P	1000 mW	8.8 mW/°C	200 mW

DISSIPATION DERATING CURVE vs FREE-AIR TEMPERATURE

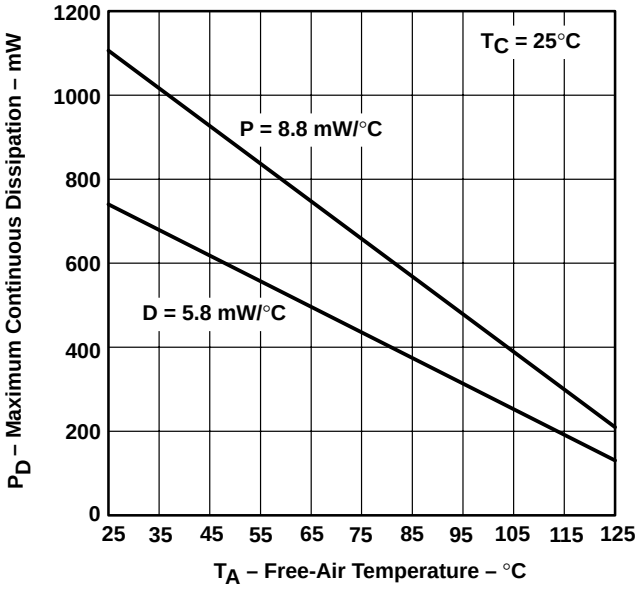


Figure 1

recommended operating conditions

		MIN	NOM	MAX	UNIT
Logic supply voltage, V_{CC}		4.5	5	5.5	V
Voltage at any bus terminal (separately or common mode), V_I or V_{IC} (see Note 3)		–2		7	V
High-level input voltage, V_{IH}	$\overline{TX}$	2		V_{CC}	V
Low-level input voltage, V_{IL}	$\overline{TX}$	0		0.8	V
High-level output current, I_{OH}	Transmitter			–50	mA
	Receiver			–400	
Low-level output current, I_{OL}	Transmitter			50	mA
	Receiver			1	
Operating free-air temperature, T_A	SN75LBC031	–40		85	°C
	SN65LBC031	–40		125	

NOTES: 2. All voltage values, except differential bus voltage, are measured with respect to the ground terminal.
3. For bus voltages for –5 V to –2 V and 7 V to 20 V the receiver output is stable.

SYMBOL DEFINITION

DATA SHEET PARAMETER	DEFINITIOIN
$V_{CANH(R)}$	CANH bus output voltage (recessive state)
$V_{CANL(R)}$	CANL bus output voltage (recessive state)
$V_{CANH(D)}$	CANH bus output voltage (dominant state)
$V_{CANL(D)}$	CANL bus output voltage (dominant state)
$V_{DIFF(R)}$	Bus differential output voltage (recessive state)
$V_{DIFF(D)}$	Bus differential output voltage (dominant state)
V_{ASC}	Adjustable slope control voltage

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{REF}	Reference source output voltage	I_{REF} = +20 μA	45%		55%	V_{CC}
R_{REF}	Reference source output resistance		5		10	kΩ
$I_{CC(REC)}$	Logic supply current, recessive state	See Figure 2, S1 closed		12	20	mA
$I_{CC(DOM)}$	Logic supply current, dominant state			55	80	

transmitter electrical characteristics over recommended ranges of supply and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{CANH(R)}$ $V_{CANL(R)}$	Output voltage (recessive state)	See Figure 2, S1 open	2	0.5 V_{CC}	3	V
$V_{O(DIFFR)}$	Differential output voltage (recessive state)		–500		50	mV
$V_{O(CANHD)}$	Output voltage (dominant state)	See Figure 2, S1 closed	2.75	3.5	4.5	V
$V_{O(CANLD)}$	Output voltage (dominant state)		0.5	1.5	2.25	V
$V_{O(DIFFD)}$	Differential output voltage (dominant state)		1.5	2	3	V
$I_{IH(TX)}$	High-level input current (TX)	V_{IH} = 2.4 V		–100	–185	µA
		V_{IH} = V_{CC}			±2	µA
$I_{IH(ASC)}$	High-level input current (ASC)	V_{IH} = 2.4 V		100	165	µA
		V_{IH} = V_{CC}		200	340	µA
$I_{IL(TX)}$	Low-level input current ($\overline{TX}$)	V_{IL} = 0.4 V		–180	–140	µA
$I_{IL(ASC)}$	Low-level input current (ASC)	V_{IL} = 0.4 V		15	25	µA
$C_{I(TX)}$	$\overline{TX}$ input capacitance			8		pF
$I_{O(ssH)}$	CANH short circuit output current	V_{CANH} = –2 V to 20 V		–95	–200	mA
$I_{O(ssL)}$	CANL short circuit output current	V_{CANL} = 2 V to –20 V		140	250	mA

NOTE 2: All voltage values, except differential bus voltage, are measured with respect to the ground terminal.

transceiver dynamic characteristics over recommended operating free-air temperature range and V_{CC} = 5 V

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{(loop)}$	Loop time	See Figures 2 and 3, S1 closed, S2 open; V_{ASC} = 0 or open circuit			280	ns
		See Figures 2 and 3, S1 closed, S2 closed; V_{ASC} = V_{CC}			400	ns
$SR_{(RD)}$	Differential-output slew rate (recessive to dominant)	See Figures 2 and 4, S1 closed, S2 open; V_{ASC} = 0 or open circuit		35		V/µs
		See Figures 2 and 4, S1 closed, S2 closed; V_{ASC} = V_{CC}		10		V/µs
$SR_{(DR)}$	Differential-output slew rate (dominant to recessive)	See Figures 2 and 4, S1 closed, S2 open; V_{ASC} = 0 or open circuit		10		V/µs
		See Figures 2 and 4, S1 closed, S2 closed; V_{ASC} = V_{CC}		10		V/µs
$t_{d(RD)}$	Differential-output delay time	See Figure 2, S1 closed		55		ns
$t_{d(DR)}$				160		ns
$t_{pd(RECRD)}$	Receiver propagation delay time	See Figures 2 and 5		90		ns
$t_{pd(RECDR)}$				55		ns

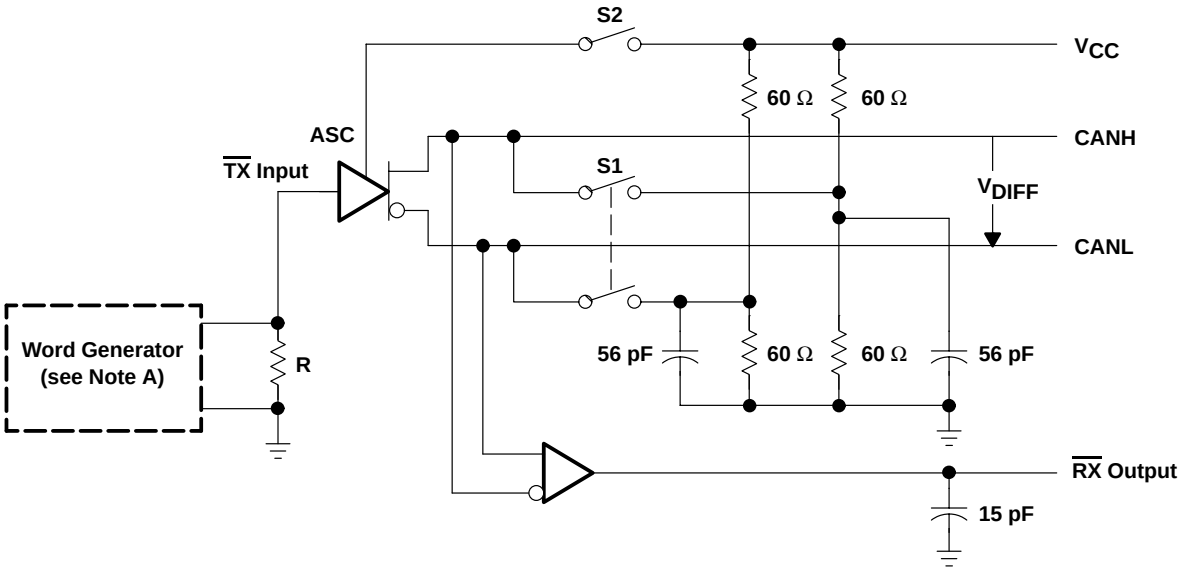
NOTE 4: Receiver input pulse width should be >50 ns. Input pulses of <30 ns are suppressed.

receiver electrical characteristics over recommended ranges of common-mode input voltage, supply voltage, and operating free-air temperature (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{IT(REC)}$	Differential input threshold voltage for recessive state	V_{IC} = –2 V to 7 V			500	mV
$V_{IT(DOM)}$	Differential input threshold voltage for dominant state		900			
V_{hys}	Recessive-dominant input hysteresis		100	180		mV
$V_{OH(RX)}$	High-level output voltage	V_{DIFF} = 500 mV, I_{OH} = –400 μA	V_{CC}–0.5 V		V_{CC}	V
$V_{OL(RX)}$	Low-level output voltage	V_{DIFF} = 900 mV, I_{OL} = 1 mA	0		0.5	V
$r_{I(REC)}$	CANH and CANL input resistance in recessive state	dc, no load	5		50	kΩ
$r_{I(DIFF)}$	Differential CANH and CANL input resistance in recessive state	dc, no load	10		100	kΩ
C_i	CANH and CANL input capacitance			20		pF
$C_{i(DHL)}$	Differential CANH and CANL input capacitance			10		pF

NOTE 2: All voltage values, except differential bus voltage, are measured with respect to the ground terminal.

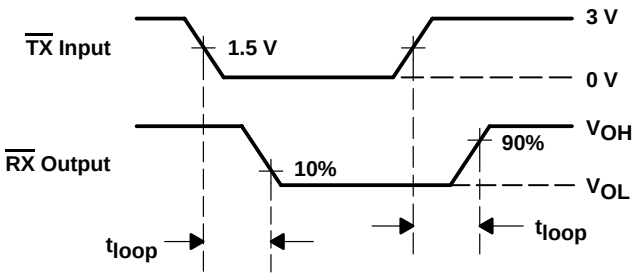
PARAMETER MEASUREMENT INFORMATION



NOTE A: The input pulse is supplied to $\overline{TX}$ by a generator having a t_r and t_f = 5 ns.

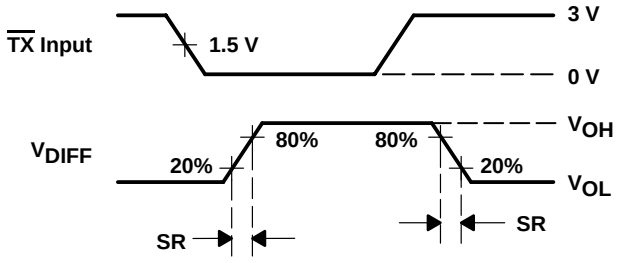
Figure 2. Test Circuit

PARAMETER MEASUREMENT INFORMATION



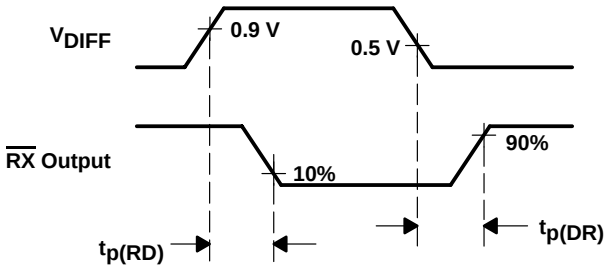
NOTE A: The input pulse is supplied to $\overline{TX}$ by a generator having a t_r and t_f = 5 ns.

Figure 3. Loop Time



NOTE A: The input pulse is supplied to $\overline{TX}$ by a generator having a t_r and t_f = 5 ns.

Figure 4. Slew Rate



NOTE A: The input pulse is supplied as V_{DIFF} using CANH and CANL respectively by a generator having a t_r and t_f = 5 ns.

Figure 5. Receiver Delay Times

PARAMETER MEASUREMENT INFORMATION

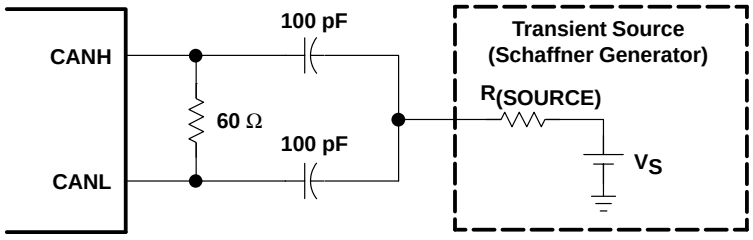


Figure 6. Transient Stress Capability Test Circuit

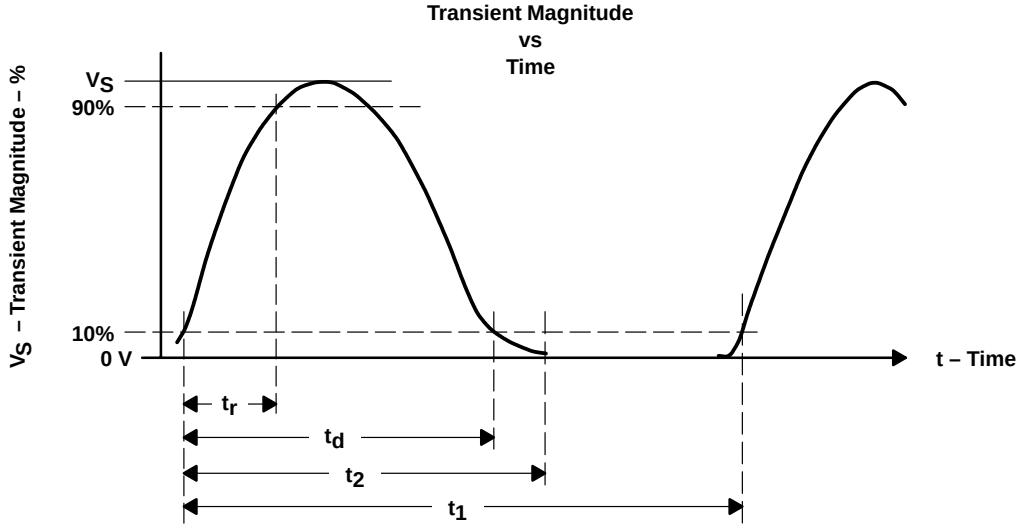


Figure 7. Transient Stress Capability Waveform

Table 1. Test Circuit Results According to DIN 40839

TEST PULSE	TRANSIENT MAGNITUDE $V_{(s)}$	SOURCE IMPEDANCE $RI_{(source)}$	PULSE WIDTH t_d (see Note 5)	PULSE RISE TIME, t_r (see Note 6)	PULSE TIME, t_2 (see Figure 7)	REPETITION PERIOD, t_1 (see Figure 7)	NUMBER OF PULSES
1	–100 V	10 Ω	2 ms	1 µs	200 ms	5 s	5000
2	100 V	10 Ω	50 µs	1 µs	200 ms	5 s	5000
3a	–150 V	50 Ω	0.1 µs	5 ns	100 µs	100 µs	See Note 3
3b	100 V	50 Ω	0.1 µs	5 ns	100 µs	100 µs	See Note 3
5	60 V	1 Ω	400 ms	5 ms	—	—	1

NOTES: 5. Measured from 10% on rising edge to 10% on falling edge
6. Measured from 10% to 90% of pulse
7. Pulse package for a period of 3600 s, 10 ms pulse time, 90 ms stop time

TYPICAL CHARACTERISTICS

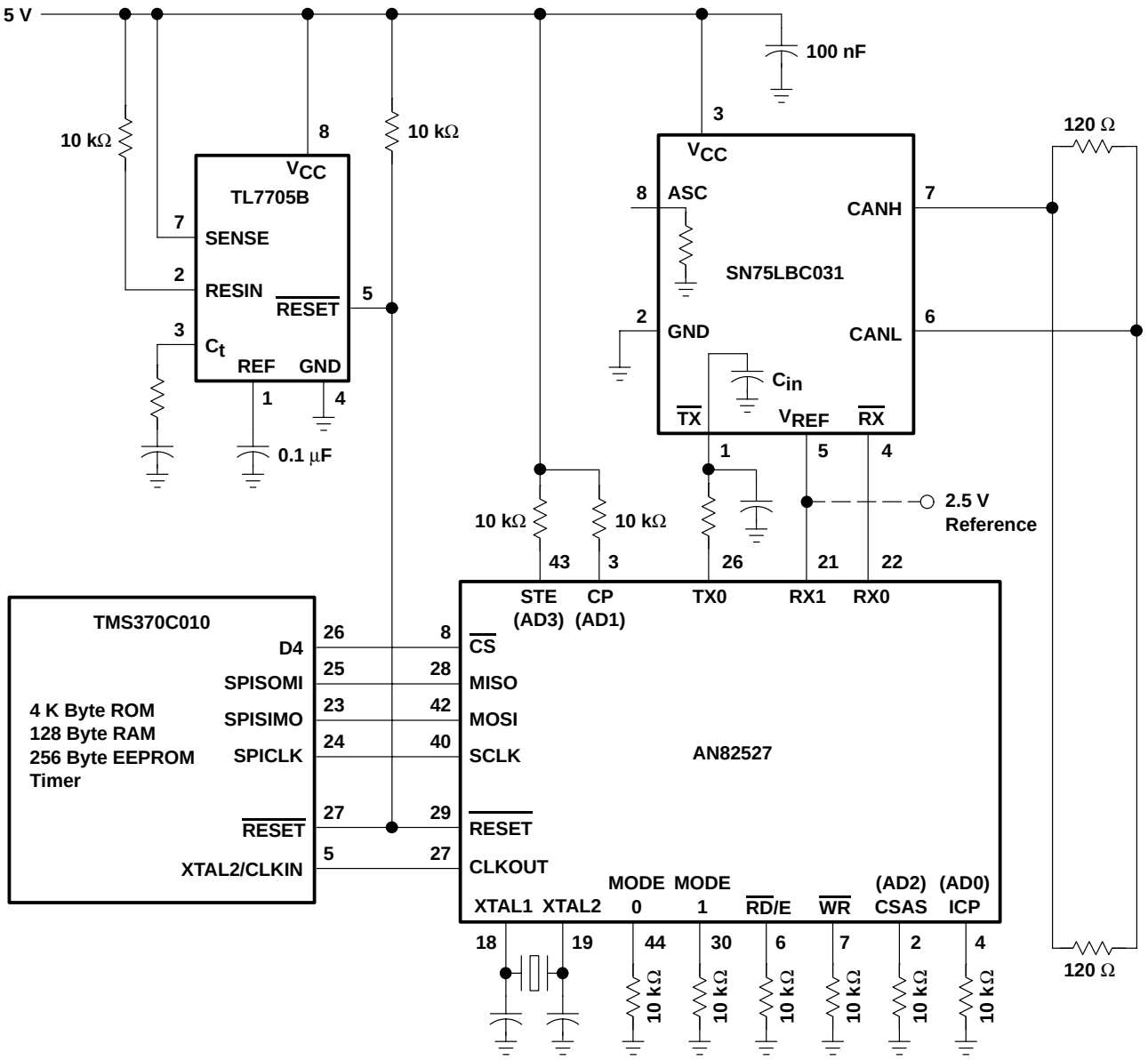


Figure 8. Typical SN75LBC031 Application

IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.