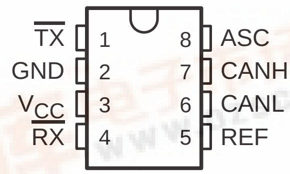
- **SN65LBC031Q Meets Standard ISO/DIS 11898 (up to 500 k Baud)**
- **Driver Output Capability at 50 mA**
- **Wide Positive and Negative Input/output Bus Voltage Range**
- **Bus Outputs Short-Circuit-Protected to Battery Voltage and Ground**
- **Thermal Shutdown**
- **Available in Q-Temp Automotive**
  - **High Reliability Automotive Applications**
  - **Configuration Control/Print Support**
  - **Qualification to Automotive Standards**

D PACKAGE
(TOP VIEW)



TERMINAL FUNCTIONS

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

FUNCTION TABLE

$\overline{TX}$	CANH	CANL	BUS STATE	$\overline{RX}$
L	H	L	Dominant	L
High or floating	Floating	Floating	Recessive	H

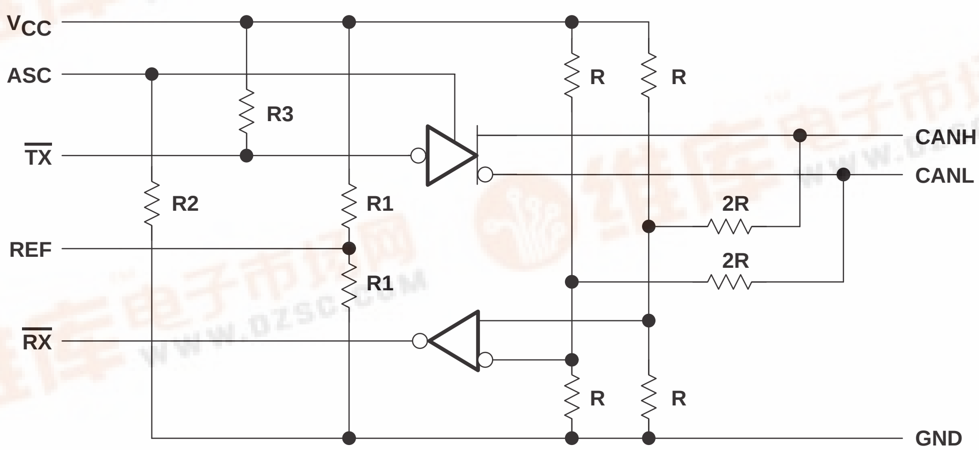
L = low, H = high

description

The SN65LBC031Q is a CAN transceiver used as an interface between a CAN controller and the physical bus for high speed applications of up to 500 k Baud. 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 approximately 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 k Baud the ASC terminal is open or tied to GND. For slower speed operation at 125 k Baud the bus output transition times can be increased to reduce EMI by connecting the ASC terminal to V_{CC}. The receiver includes an integrated filter that suppresses the signal into pulses less than 30 ns wide.

The SN65LBC031Q is characterized for operation over the automotive temperature range of –40°C to 125°C.

logic diagram



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TEXAS INSTRUMENTS

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 voltage at $\overline{TX}$ and ASC terminal, V_I . . . . 2 × V_{CC}
Operating free-air temperature range, T_A . . . . –40°C to125°C
Operating junction temperature 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

† 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

DISSIPATION DERATING CURVE
vs
FREE-AIR TEMPERATURE

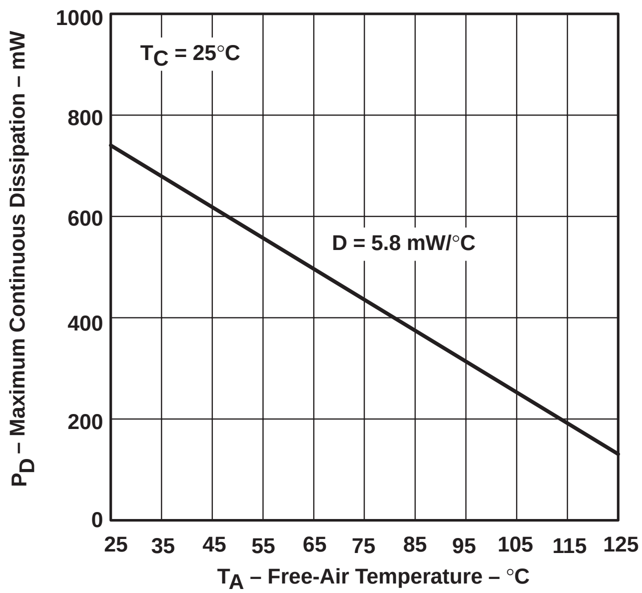


Figure 1

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	µA
Low-level output current, I_{OL}	Transmitter			50	mA
	Receiver			1	
Operating free-air temperature, T_A		–40		125	°C

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

SYMBOL DEFINITION

DATA SHEET PARAMETER	DEFINITION
$V_{O(CANHR)}$	CANH bus output voltage (recessive state)
$V_{O(CANLR)}$	CANL bus output voltage (recessive state)
$V_{O(CANHD)}$	CANH bus output voltage (dominant state)
$V_{O(CANLD)}$	CANL bus output voltage (dominant state)
$V_{O(DIFFR)}$	Bus differential output voltage (recessive state)
$V_{O(DIFFD)}$	Bus differential output voltage (dominant state)
$V_{I(ASC)}$	Adjustable slope control input voltage

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{O(REF)}$	Reference source output voltage	$I_{REF} = \pm 20$ µA	$0.45 V_{CC}$		$0.55 V_{CC}$	V
$R_{O(REF)}$	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
$V_{O(CANHR)}$ $V_{O(CANLR)}$	Output voltage (recessive state)	See Figure 2, S1 open	2	$0.5V_{CC}$	3	V
$V_{O(DIFFR)}$	Differential output voltage (recessive state)	See Figure 2, S1 open	–500	0	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)	See Figure 2, S1 closed	0.5	1.5	2.25	V
$V_{O(DIFFD)}$	Differential output voltage (dominant state)	See Figure 2, S1 closed	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	
$I_{IH(ASC)}$	High-level input current (ASC)	V_{IH} = 2.4 V		100	165	µA
		$V_{IH} = V_{CC}$		200	340	
$I_{IL(TX)}$	Low-level input current ($\overline{TX}$)	V_{IL} = 0.4 V		–180	–400	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	$V_{O(CANH)}$ = –2 V to 20 V		–95	–200	mA
$I_{O(ssL)}$	CANL short circuit output current	$V_{O(CANL)}$ = 20 V to –2 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,	$V_{I(ASC)}$ = 0 V or open circuit, S2 open			280	ns
		See Figures 2 and 3, S1 closed,	$V_{I(ASC)} = V_{CC}$, S2 closed			400	ns
$SR_{(RD)}$	Differential-output slew rate (recessive to dominant)	See Figures 2 and 4, S1 closed,	$V_{I(ASC)}$ = 0 or open circuit, S2 open		35		V/µs
		See Figures 2 and 4, S1 closed,	$V_{I(ASC)} = V_{CC}$, S2 closed		10		V/µs
$SR_{(DR)}$	Differential-output slew rate (dominant to recessive)	See Figures 2 and 4, S1 closed,	$V_{I(ASC)}$ = 0 or open circuit, S2 open		10		V/µs
		See Figures 2 and 4, S1 closed,	$V_{I(ASC)} = V_{CC}$, S2 closed		10		V/µs
$t_{d(RD)}$	Differential-output delay time	See Figure 2,	S1 closed		55		ns
$t_{d(DR)}$	Differential-output delay time	See Figure 2,	S1 closed		160		ns
$t_{pd(RECRD)}$	Receiver propagation delay time	See Figures 2 and 5			90		ns
$t_{pd(RECDR)}$	Receiver propagation delay time	See Figures 2 and 5			55		ns

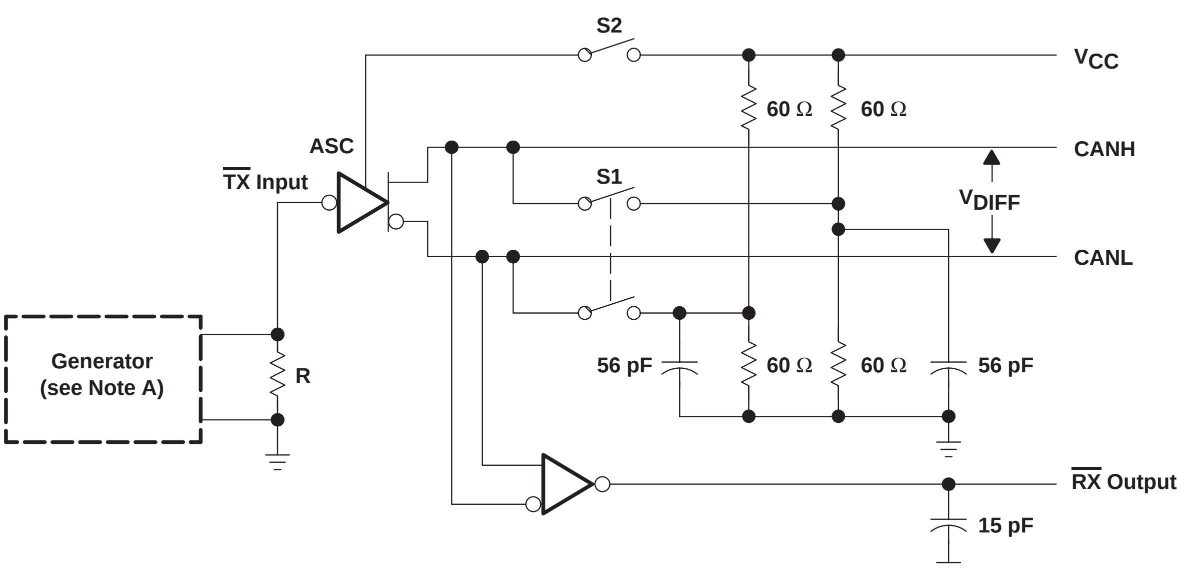
NOTE 4: Receiver input pulse width should be >50 ns. Input pulses of <30 ns are suppressed.

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	$V_{O(DIFF)}$ = 500 mV, I_{OH} = –400 µA	V_{CC}–0.5 V		V_{CC}	V
$V_{OL(RX)}$	Low-level output voltage	$V_{O(DIFF)}$ = 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

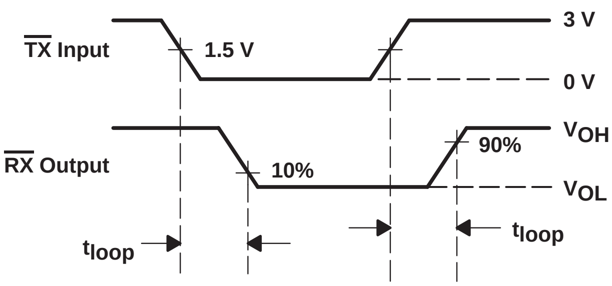


Figure 3. Loop Time

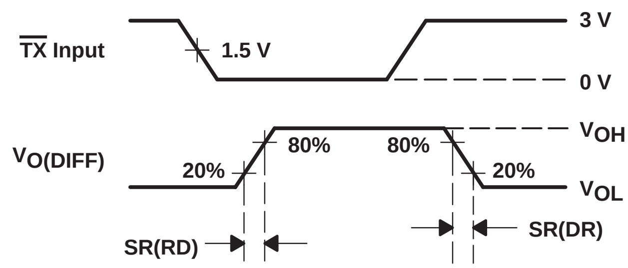
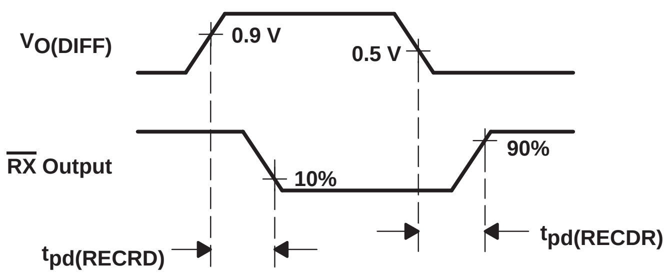


Figure 4. Slew Rate

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



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

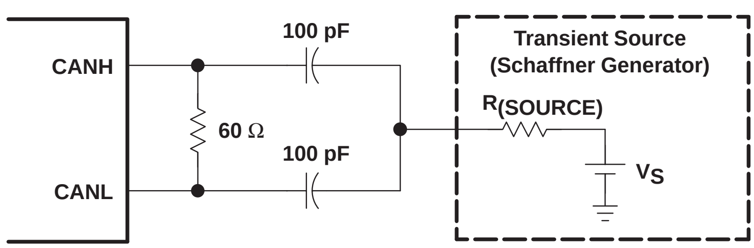


Figure 6. Transient Stress Capability Test Circuit

PARAMETER MEASUREMENT INFORMATION

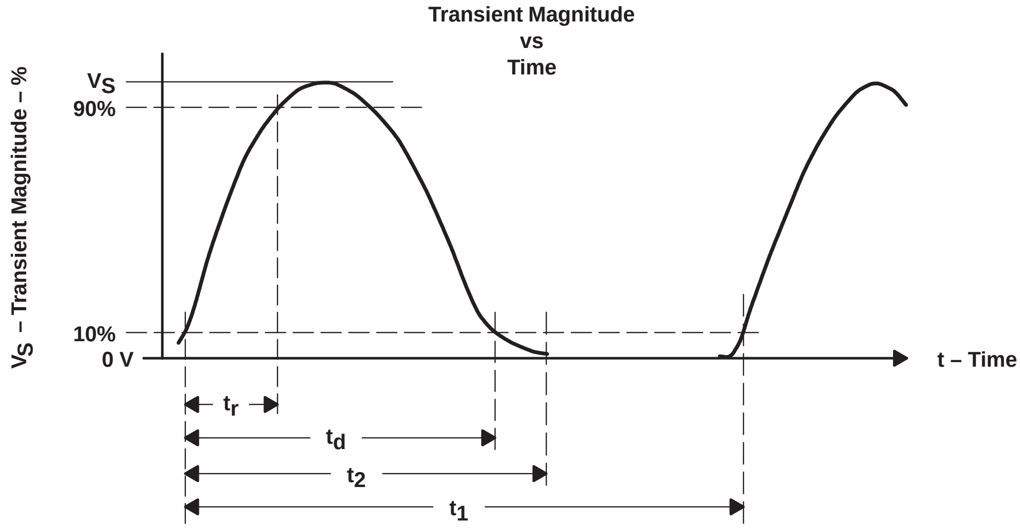


Figure 7. Transient Stress Capability Waveform

Table 1. Test Circuit Results According to DIN 40839

TEST PULSE	TRANSIENT MAGNITUDE V_S	SOURCE IMPEDANCE R_{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 7
3b	100 V	50 Ω	0.1 µs	5 ns	100 µs	100 µs	See Note 7
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

APPLICATION INFORMATION

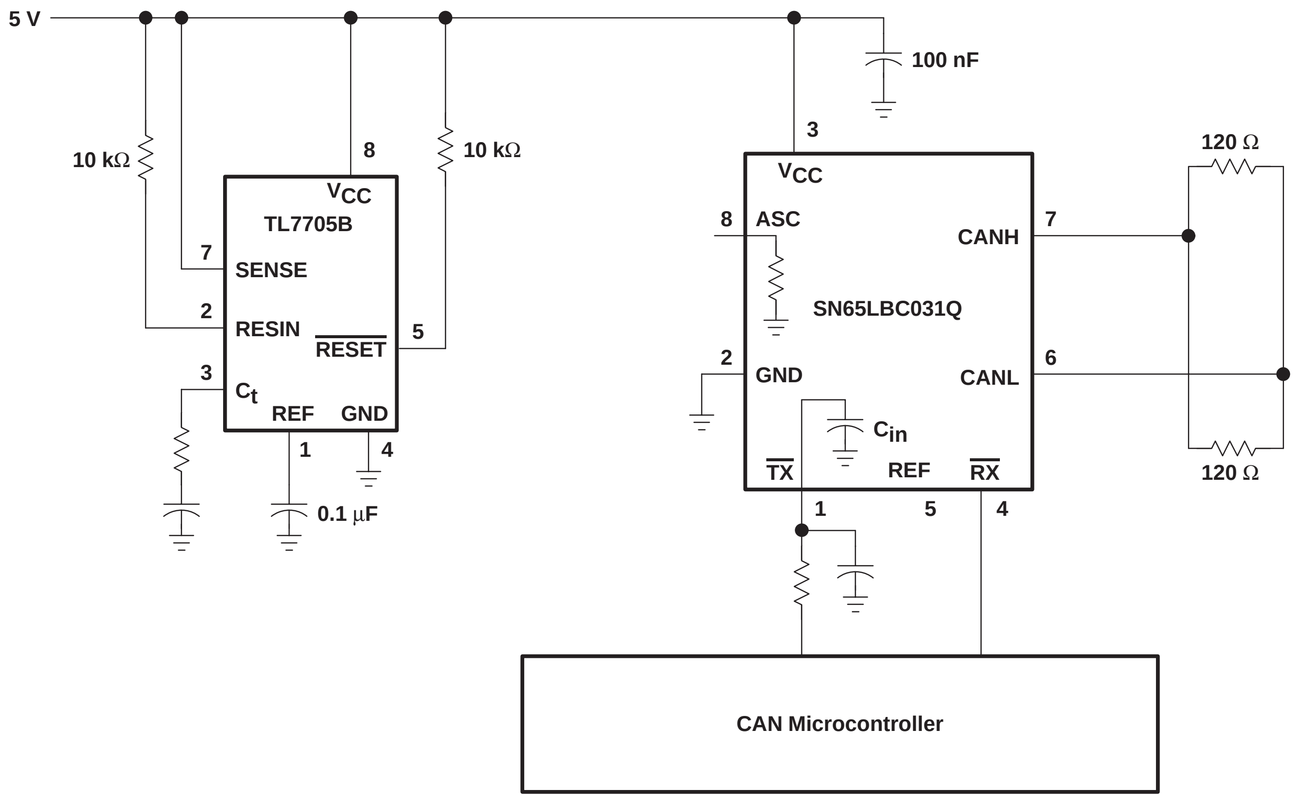
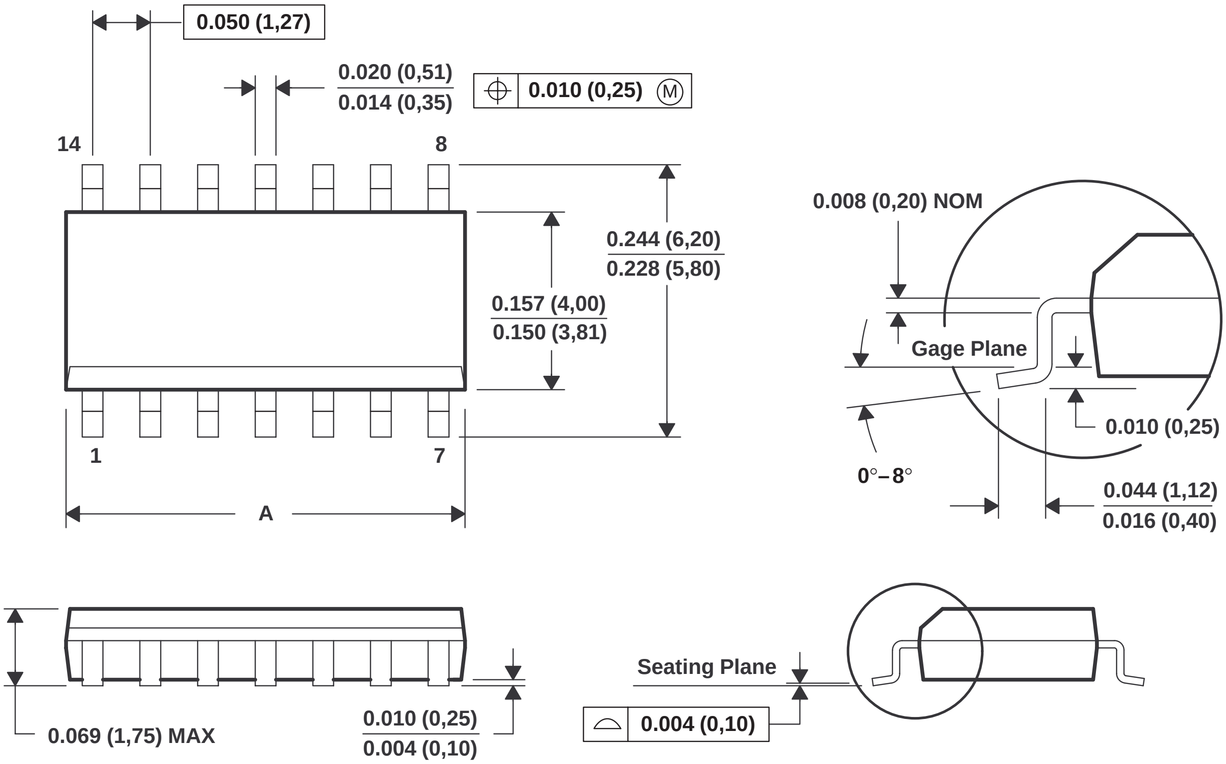


Figure 8. Typical SN65LBC031Q Application

MECHANICAL DATA

D (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

4040047 / D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

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