ABSOLUTE MAXIMUM RATINGS

V _{CC} to GND	0.3V to +6V
TXD, RS, SHDN, TERM to GND	0.3V to +6V
RXD to GND	0.3V to +6V
CANH, CANL to GND (MAX3058)	7.5V to +12.5V
CANH, CANL to GND (MAX3059)	0.3V to (V _{CC} + 0.3V)

Continuous Power Dissipation ($T_A = +70^{\circ}C$)	
8-Pin SO (derate 5.9mW/°C above +70°C)	470mW
Operating Temperature Range	40°C to +125°C
Maximum Junction Temperature	+150°C
Storage Temperature Range	
Lead Temperature (soldering, 10s)	+300°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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

 $(V_{CC} = +5V \pm 10\%, T_A = T_{MIN} \text{ to } T_{MAX}, R_L = 60\Omega, C_L = 100 pF. Typical values are at <math>V_{CC} = +5V \text{ and } T_A = +25 ^{\circ}C.)$ (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
Curanhi Currant	1-	Dominant		40	70	A	
Supply Current	Is	Recessive		2	5	- mA	
Quiescent Current Standby Mode	IQ	Standby, MAX3058		15	80	μΑ	
		V _{SHDN} = V _{CC} , MAX3058			5		
Shutdown Current	ISHDN	V _{TERM} = V _{RS} = V _{CC} , MAX3059			10	μΑ	
		V _{TERM} = 0V, V _{RS} = V _{CC} , MAX3059			150		
Thermal-Shutdown Threshold	V _{TSH}			160		°C	
Thermal-Shutdown Hysteresis				25		°C	
TXD INPUT LEVELS							
High-Level Input Voltage	VIH		2			V	
Low-Level Input Voltage	VIL				0.8	V	
Input Capacitance	CIN	(Note 3)		5	20	рF	
Pullup Resistor	RINTXD		50		100	kΩ	
TERM INPUT LEVELS (MAX3059)							
High-Level Input Voltage	V _{TRH}		2			V	
Low-Level Input Voltage	VTRL				0.8	V	
TERM Pullup Resistor	R _{PU}		50		100	kΩ	
CANH, CANL TRANSMITTER							
		V _{TXD} = V _{CC} , no load	2		3	V	
Recessive Bus Voltage	V _{CANH} , V _{CANL}	V _{TXD} = V _{CC} , no load, V _{RS} = V _{CC} (standby mode), MAX3058	-100		+100	mV	
CANH Output Voltage	VCANH	V _{TXD} = 0V	2.75		V _{CC} - 0.8V	V	
CANL Output Voltage	VCANL	$V_{TXD} = 0V$	0.5		2.25	V	
		V _{TXD} = 0V, V _{CC} = 5V ±5%	1.5		3		
Differential Output	ΔV _{CANH} ,	V _{TXD} = 0V, V _{CC} = 5V ±10%	1.5		3.2	V	
(VCANH - VCANL)	VCANL	$V_{TXD} = 0V, R_L = 45\Omega$	1.2		3		
		V _{TXD} = V _{CC} , no load	-500		+50	mV	

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DC ELECTRICAL CHARACTERISTICS (continued)

 $(V_{CC} = +5V \pm 10\%, T_A = T_{MIN} \text{ to } T_{MAX}, R_L = 60\Omega, C_L = 100 pF. \text{ Typical values are at } V_{CC} = +5V \text{ and } T_A = +25^{\circ}C.) \text{ (Note 1)}$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
CANILI Chart Circuit Current	1	-7V ≤ V _{CANH} ≤ 0V, MAX3058	-200		-30	Λ	
CANH Short-Circuit Current	ICANHSC	VCANH = 0V, MAX3059	-200		-30	mA	
CANL Short-Circuit Current	la a a	V _{CC} ≤ V _{CANL} ≤ 12V, MAX3058	30		200	mA	
CANE SHORt-Circuit Current	ICANLSC	V _{CANL} = V _{CC} , MAX3059	30		200	ША	
Termination Resistor	RTERM	V _{TERM} = V _{CC} , MAX3059	108	120	132	Ω	
RXD OUTPUT LEVELS							
RXD High-Output Voltage Level	Vон	Ι = -100μΑ	0.8 x V _C C		Vcc	V	
RXD Low-Output Voltage Level	V _{OL}	I = 1.6mA			0.4	V	
DC BUS RECEIVER (Note 2)							
D:((): 11) / ()		MAX3058	-17		+0.5		
Differential Input Voltage (Recessive)	V _{DIFF}	MAX3058, V _{RS} = V _{CC} (standby mode)	-17		+0.5	V	
(Hecessive)		MAX3059	-Vcc		+0.5		
D:((): 11) / ()		MAX3058	0.9		17		
Differential Input Voltage (Dominant)	V _{DIFF}	MAX3058, V _{RS} = V _{CC} (standby mode)	1.1		17	V	
		MAX3059	0.9		Vcc		
Differential Input Hysteresis	V _{DIFF} (HYST)			100		mV	
CANH and CANL Input Resistance	Rı		5		25	kΩ	
Differential Input Resistance	R _{DIFF}		10		100	kΩ	
MODE SELECTION (RS)							
Input Voltage for High Speed	V _{SLP}				0.3 x V _C C	V	
Inner t Valtage for Chandley	V _{STBY}	MAX3058	0.75 x			V	
Input Voltage for Standby	VsHDN	MAX3059	Vcc			V	
Slope-Control Mode Voltage	VSLOPE	$R_{RS} = 25k\Omega$ to $200k\Omega$	0.4 x V _C C		0.6 x V _C C	V	
Slope-Control Mode Current	ISLOPE	$R_{RS} = 25k\Omega$ to $200k\Omega$	-10		-200	μΑ	
High-Speed Mode Current	lhs	V _{RS} = 0V			-500	μΑ	
SHUTDOWN (MAX3058)							
SHDN Input Voltage High	V _{SHDNH}		2			V	
SHDN Input Voltage Low	V _{SHDNL}				0.8	V	
SHDN Pulldown Resistor	RINDHDN		50		100	kΩ	



TIMING CHARACTERISTICS

 $(V_{CC} = +5V \pm 10\%, R_L = 60\Omega, C_L = 100pF, T_A = T_{MIN}$ to T_{MAX} . Typical values are at $V_{CC} = +5V$ and $T_A = +25^{\circ}C$.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS		
		V _{RS} = 0V (≤ 1Mbps)			50			
Delay TXD to Bus Active, Figure 1	to	R _{RS} = 25kΩ (≤ 500kbps)		125		200		
	tontxd	R _{RS} = 100kΩ (≤ 125kbps)		450		ns		
		$R_{RS} = 200k\Omega (\leq 62.5kbps) $ 700						
		V _{RS} = 0V (≤ 1Mbps)			70]		
Delay TXD to Bus Inactive,		R _{RS} = 25kΩ (≤ 500kbps)		180		ns		
Figure 1	tofftxd	R _{RS} = 100kΩ (≤ 125kbps)		500				
		R _{RS} = 200kΩ (≤ 62.5kbps)		1000		1		
		V _{RS} = 0V (≤ 1Mbps)			80			
Delay Bus to Receiver Active,		R _{RS} = 25kΩ (≤ 500kbps)		150]		
Figure 1	tonrxd	R _{RS} = 100kΩ (≤ 125kbps)		500		ns		
		R _{RS} = 200kΩ (≤ 62.5kbps)		800				
		V _{RS} = 0V (≤ 1Mbps)			100			
Delay Bus to Receiver Inactive, Figure 1	toffrxd	R _{RS} = 25kΩ (≤ 500kbps)		210] _		
		R _{RS} = 100kΩ (≤ 125kbps)		500		ns		
		R _{RS} = 200kΩ (≤ 62.5kbps)		1100				
	SR	V _{RS} = 0V (≤ 1Mbps)	100			V/µs		
Differential Output Slow Bate		$R_{RS} = 25k\Omega \ (\leq 500kbps) $		7				
Differential Output Slew Rate		R _{RS} = 100kΩ (≤ 125kbps)		1.6		ν/μδ		
		R _{RS} = 200kΩ (≤ 62.5kbps)		0.8				
Bus Dominant to RXD Active	tDRXDL	V _{RS} > 0.8 x V _{CC} (standby), MAX3058, Figure 2			1	μs		
Standby to Receiver Active	tsbrxdl	BUS dominant, MAX3058, Figure 2			4	μs		
SHDN to Bus Inactive	toffshdn	TXD = GND, MAX3058, Figure 3 (Note 4)			1	μs		
SHDN to Receiver Active	tonshdn	BUS dominant, MAX3058, Figure 3 (Note 5)			4	μs		
RS to Bus Inactive	toffshdn	TXD = GND, MAX3059, Figure 3 (Note 4)			1	μs		
RS to Receiver Active	tonshdn	BUS dominant, MAX3059, Figure 3 (Note 5)			4	μs		
TERM to Resistor Switched On	tonrt	V _{RS} = V _{CC} (part in shutdown), MAX3059, Figure 4			400	ns		
TERM to Resistor Switched Off	toffrt	V _{RS} = V _{CC} (part in shutdown), MAX3059, Figure 4		400	ns			
ESD Protection		Human Body Model		12		±kV		

- **Note 1:** All currents into device are positive; all currents out of the device are negative. All voltages are referenced to device ground, unless otherwise noted.
- Note 2: (V_{TXD} = V_{CC}; CANH and CANL externally driven; -7V < V_{CANH}, V_{CANL} < 12V for MAX3058; 0V < V_{CANH}, V_{CANL} < V_{CC} for MAX3059, unless otherwise specified).
- Note 3: Specification guaranteed by design, not production tested.
- Note 4: No other devices on the BUS.
- Note 5: BUS externally driven.

Timing Diagrams

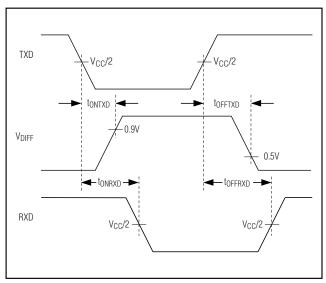


Figure 1. Timing Diagram

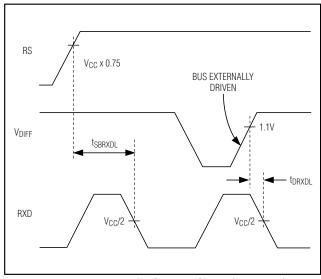


Figure 2. Timing Diagram for Standby Signal (MAX3058)

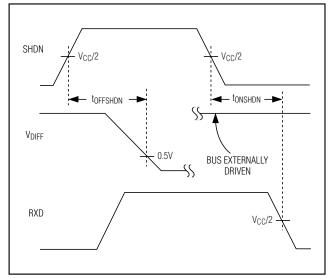


Figure 3. Timing Diagram for Shutdown Signal

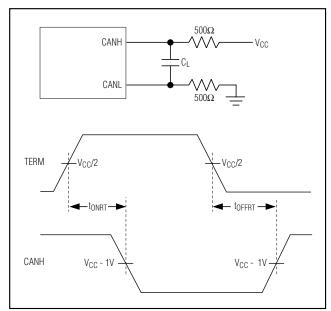
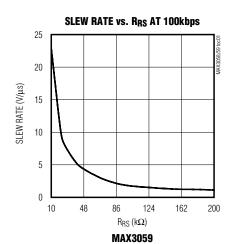
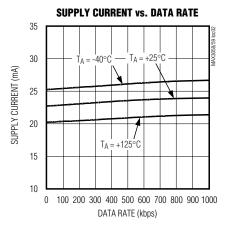


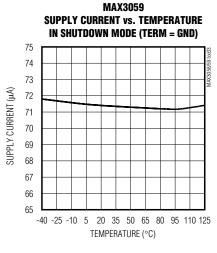
Figure 4. Test Circuit and Diagram for TERM Timing (MAX3059)

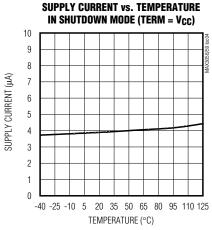
Typical Operating Characteristics

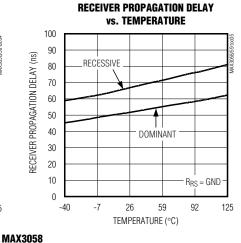
 $(V_{CC} = +5V, R_L = 60\Omega, C_L = 100pF, T_A = +25^{\circ}C, unless otherwise specified.)$

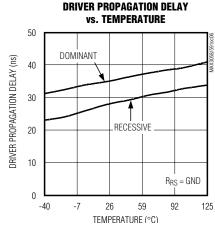


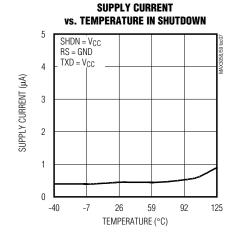


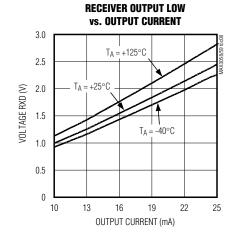






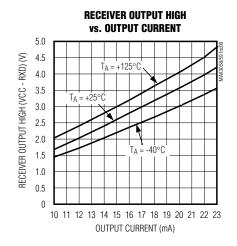


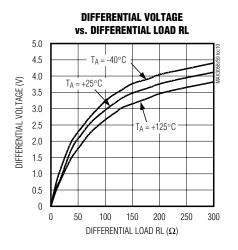


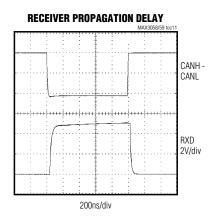


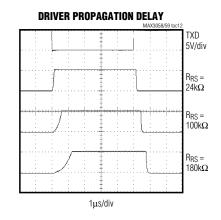
Typical Operating Characteristics (continued)

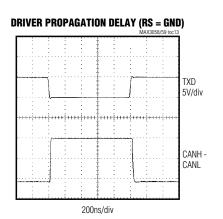
 $(V_{CC} = +5V, R_L = 60\Omega, C_L = 100pF, T_A = +25^{\circ}C, unless otherwise specified.)$

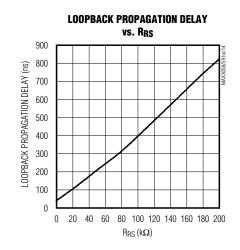








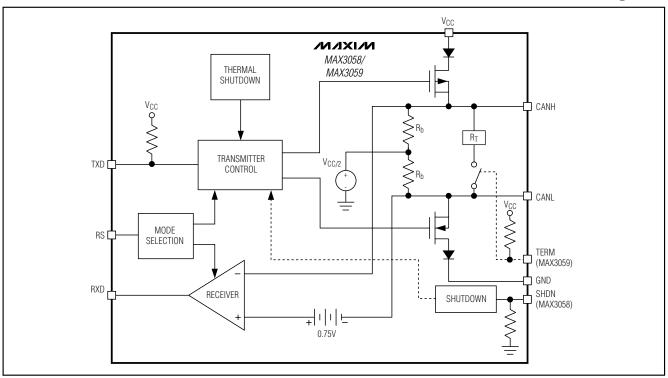




Pin Description

P	IN	NAME	FUNCTION
MAX3058	MAX3059	NAME	FUNCTION
1	1	TXD	Transmit Data Input. TXD is a CMOS/TTL-compatible input from a CAN controller. TXD has an internal $75k\Omega$ pullup resistor.
2	2	GND	Ground
3	3	Vcc	Supply Voltage. Bypass V _{CC} to GND with a 0.1µF capacitor.
4	4	RXD	Receive Data Output. RXD is a CMOS/TTL-compatible output.
5	_	SHDN	Shutdown Input, CMOS/TTL-Compatible Input. Drive SHDN high to put the IC into shutdown mode. SHDN has an internal $75k\Omega$ pulldown resistor to GND.
6	6	CANL	CAN Bus Line Low
7	7	CANH	CAN Bus Line High
8	8	RS	Mode Select Input. Drive RS low or connect to GND for high-speed operation. Connect a resistor between RS and GND to control output slope. For the MAX3058, drive RS high to put into standby mode. (see <i>Mode Selection</i> section). For the MAX3059, drive RS above 0.75 x V _{CC} to select shutdown mode.
_	5	TERM	Terminate Input, CMOS/TTL Compatible. Drive TERM high or leave floating to terminate the device with a 120 Ω across the CANH and CANL. Drive TERM low to disconnect this resistor. TERM has an internal 75k Ω pullup resistor to V _{CC} .

Functional Diagram



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Detailed Description

The MAX3058/MAX3059 interface between the protocol controller and the physical wires of the bus lines in a CAN. They are primarily intended for printer and telecom backplane applications requiring data rates up to 1Mbps. These devices provide differential transmit capability to the bus and differential receive capability to the CAN controller.

The MAX3058 output common-mode range is from -7V to \pm 12V. The MAX3059 output common-mode range is from 0V to VCC. The MAX3059 contains an internal switch termination resistor that makes it ideal for JetLink applications.

The MAX3058 features four different modes of operation: high-speed, slope control, standby, and shutdown. The MAX3059 features three different modes of operation: high speed, slope control, and shutdown. High-speed mode allows data rates up to 1Mbps. In slope-control mode, the slew rate may be optimized for data rates up to 500kbps, so the effects of EMI are reduced, and unshielded twisted or parallel cable can

be used. In standby mode, the transmitters are shut off and the receivers are put into low-current mode. In shutdown mode, the transmitter and receiver are switched off.

The transceivers operate from a single +5V supply and draw 40mA of supply current in dominant state and 2mA in recessive state. In standby mode, supply current is reduced to 15µA. In shutdown mode, supply current is 1µA for the MAX3058 and 5µA for the MAX3059.

CANH and CANL are output short-circuit current limited and are protected against excessive power dissipation by thermal-shutdown circuitry that places the driver outputs into a high-impedance state.

Transmitter

The transmitter converts a single-ended input (TXD) from the CAN controller to differential outputs for the bus lines (CANH, CANL). The truth table for the transmitter and receiver is given in Tables 1 and 2.

Table 1. Transmitter and Receiver Truth Table for MAX3058 When Not Connected to the Bus

TXD	RS	SHDN	CANH	CANL	BUS STATE	RXD
Low	V _{RS} < 0.75 x V _{CC}	Low	High	Low	Dominant	Low
High or float	V _{RS} < 0.75 x V _{CC}	Low	5 k Ω to 25 k Ω to $V_{CC}/2$	5 k Ω to 25k Ω to V _{CC} /2	Recessive	High
X	V _{RS} > 0.75 x V _{CC}	Low	5 k Ω to 25 k Ω to GND	5 k Ω to 25 k Ω to GND	Recessive	High
Х	X	High	Floating	Floating	Floating	High

Table 2. Transmitter and Receiver Truth Table for MAX3059 When Not Connected to the Bus

TXD	RS	TERM	CANH	CANL	BUS STATE	RXD
Low	V _{RS} < 0.75 x V _{CC}	Low	High	Low	Dominant	Low
Low	1 av	High	High	Low	Dominant	Low
LOW	V _{RS} < 0.75 x V _{CC}	High	120Ω terminating	resistor across	Dominant	LOW
High or float	V _{RS} < 0.75 x V _{CC}	Low	5 k Ω to 25 k Ω to $V_{CC}/2$	5 k Ω to 25 k Ω to $V_{CC}/2$	Recessive	High
High or float	V _{RS} < 0.75 x V _{CC}	High	5 k Ω to 25 k Ω to $V_{CC}/2$	5 k Ω to 25 k Ω to $V_{CC}/2$	Recessive	High
			120Ω terminating	resistor across	tor across	
Х	V _{RS} > 0.75 x V _{CC}	Low	Floating	Floating	Floating	High
V 0.75 v.V	High	Floating	Floating	Floating	I II ada	
^	X V _{RS} > 0.75 x V _{CC}		120Ω terminating resistor across		Floating	High



Receiver

The receiver reads differential input from the bus lines (CANH, CANL) and transfers this data as a single-ended output (RXD) to the CAN controller. It consists of a comparator that senses the difference $\Delta V = (CANH - CANL)$ with respect to an internal threshold of 0.7V. If this difference is positive (i.e., $\Delta V > 0.7$), a logic low is present at RXD. If negative (i.e., $\Delta V < 0.7V$), a logic high is present. The receiver always echoes the CAN BUS data.

The CANH and CANL common-mode range is -7V to +12V for the MAX3058, and 0V to VCC for the MAX3059. RXD is logic high when CANH and CANL are either shorted, or terminated and undriven.

Mode Selection High-Speed Mode

Connect RS to ground to set the MAX3058/MAX3059 to high-speed mode. When operating in high-speed mode, the MAX3058/MAX3059 can achieve transmission rates of up to 1Mbps. In high-speed mode, use shielded twisted-pair cable to avoid EMI problems.

Slope-Control Mode

Connect a resistor from RS to ground to select slope-control mode (Table 3). In slope-control mode, CANH and CANL slew rates are controlled by the resistor connected to the RS pin. Maximum transmission speeds are controlled by RRS, and range from 40kbps to 500kbps. Controlling the rise and fall slopes reduces EMI and allows the use of an unshielded twisted pair or a parallel pair of wires as bus lines. The transfer function for selecting the resistor value is given by:

RRS (k Ω) \approx 12,500/(maximum speed in kbps)

See the Slew Rate vs. R_{RS} graph in the *Typical Operating Characteristics*.

Standby Mode

If a logic-high level is applied to RS, the MAX3058 enters a low-current standby mode. In this mode, the transmitter is switched off and the receiver is switched to a low-current/low-speed state. If dominant bits are detected, RXD switches to low level. The microcontroller should react to this condition by switching the transceiver back to normal operation.

When the MAX3058 enters standby mode, RXD goes high for 4µs (max) regardless of the BUS state. However, after 4µs, RXD goes low only when the BUS is dominant; otherwise, RXD remains high (when the BUS is recessive). For proper measurement of standby to receiver active time (tsbrade), the BUS should be in a dominant state (see Figure 2).

Shutdown Mode

Drive SHDN high to enter shutdown mode on the MAX3058. Connect SHDN to ground or leave it floating for normal operation. On the MAX3059, drive RS high to enter shutdown.

TERM

Drive TERM high (to V_{CC}) or leave it floating to terminate the MAX3059 with 120 Ω resistor connected across the CANH and CANL. Connect TERM to ground to disconnect this resistor.

Thermal Shutdown

If the junction temperature exceeds +160°C, the device is switched off. The hysteresis is approximately 25°C, disabling thermal shutdown once the temperature drops to +135°C. In thermal shutdown, CANH and CANL go recessive and all IC functions are disabled.

Table 3. Mode Selection Truth Table

CONDITION FORCED AT PIN RS	MODE	RESULTING CURRENT AT RS (μA)
V _{RS} < 0.3 x V _{CC}	High speed	II _{RS} I < 500
0.4 x V _{CC} <v<sub>RS < 0.6 x V_{CC}</v<sub>	Slope control	10μA < II _{RS} I < 200
V _{RS} > 0.75 x V _{CC}	Standby (MAX3058)	II _{RS} I < 10
V _{RS} > 0.75 x V _{CC}	Shutdown (MAX3059)	II _{RS} I < 10

0 ______ /\/\!\\

Applications Information

Reduced EMI and Reflections

In slope-control mode, the CANH and CANL outputs are slew-rate limited, minimizing EMI and reducing reflections caused by improperly terminated cables.

In multidrop CAN applications, it is important to maintain a direct point-to-point wiring scheme. A single pair of wires should connect each element of the CAN bus, and the two ends of the bus should be terminated with 120Ω resistors. A star configuration should never be used.

Any deviation from the point-to-point wiring scheme creates a stub. The high-speed edge of the CAN data on a stub can create reflections back down the bus. These reflections can cause data errors by eroding the noise margin of the system.

Although stubs are unavoidable in a multidrop system, care should be taken to keep these stubs as small as possible, especially in high-speed mode. In slope-control mode, the requirements are not as rigorous, but stub length should still be minimized.

Power Supply and Bypassing

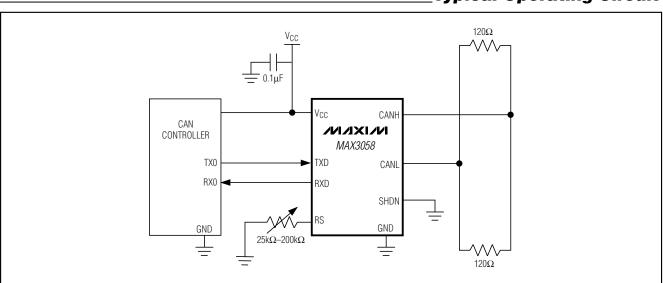
The MAX3058/MAX3059 require no special layout considerations beyond common practices. Bypass V_{CC} to GND with a 0.1µF ceramic capacitor mounted close to the IC with short lead lengths and wide trace widths.

Chip Information

TRANSISTOR COUNT: 1024

PROCESS: BICMOS

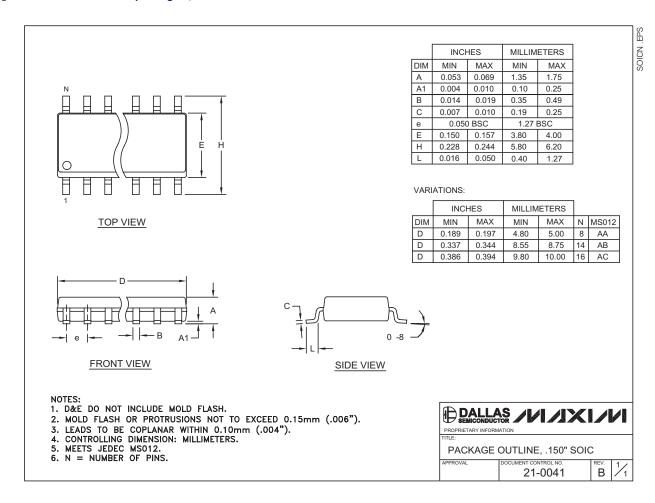
Typical Operating Circuit





Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to www.maxim-ic.com/packages.)



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