



MOTOROLA

Class B Serial Link Transceiver

The MC33390 is a serial link bus transceiver designed to provide bi-directional half-duplex communication meeting the automotive SAE Standard J-1850 Class B Data Communication Network Interface specification. It is designed to interface directly to on-board vehicle microcontrollers and serves to transmit and receive data on a single wire bus at data rates of 10.4 kb/s using Variable Pulse Width Modulation (VPWM). The MC33390 operates directly from a vehicle's 12 V battery system and functions in a true logic fashion as an I/O interface between the microcontroller's 5.0 V CMOS logic level swings and the required 0 to 7.0 V waveshaped signal swings of the bus. The bus output driver is short circuit current limited.

A tristateable 4X/Loop mode select pin is used to invoke Normal Wave Shaped J-1850 Class B operation (0 V), Disabled Waveshaping high speed operation (5.0 V), or Looped Back transmitted signal (Tx) to the Rx output after having been wave shaped but not transmitted onto the bus operation (high impedance). The Loop Back mode is used to confirm operational integrity independent of the bus.

The MC33390 derives its robustness to temperature and voltage extremes from being built on a SMARTMOS™ process, incorporating CMOS logic, bipolar/MOS analog circuitry, and DMOS power FETs. Though the MC33390 was principally designed for automotive applications requiring SAE J-1850 Class B standards, it is suited for other serial communication applications. It is parametrically specified over an ambient temperature range of $-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ and $7.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$ supply. The economical 8-pin SO-8 surface mount plastic package makes the device a cost effective solution.

- Designed for SAE J-1850 Class B Data Rates
- Full Operational Bus Dynamics Over a Supply Voltage of 9.0 to 16 V
- Ambient Operating Temperature of -40 to 125°C
- Interfaces Directly to Standard 5.0 V CMOS Microcontroller
- Bus Pin Protected Against Shorts to Battery and Ground
- Thermal Shutdown with Hysteresis
- Controlled Voltage and Current Waveshaping of Bus Drive

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MC33390

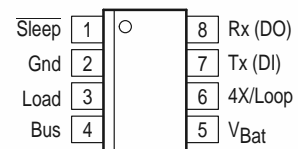
J-1850 SERIAL LINK TRANSCEIVER

SEMICONDUCTOR TECHNICAL DATA



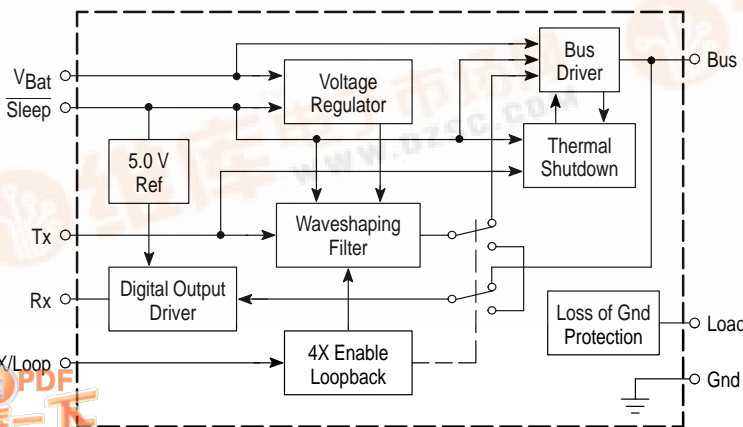
D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)

PIN CONNECTIONS



(Top View)

Simplified Block Diagram

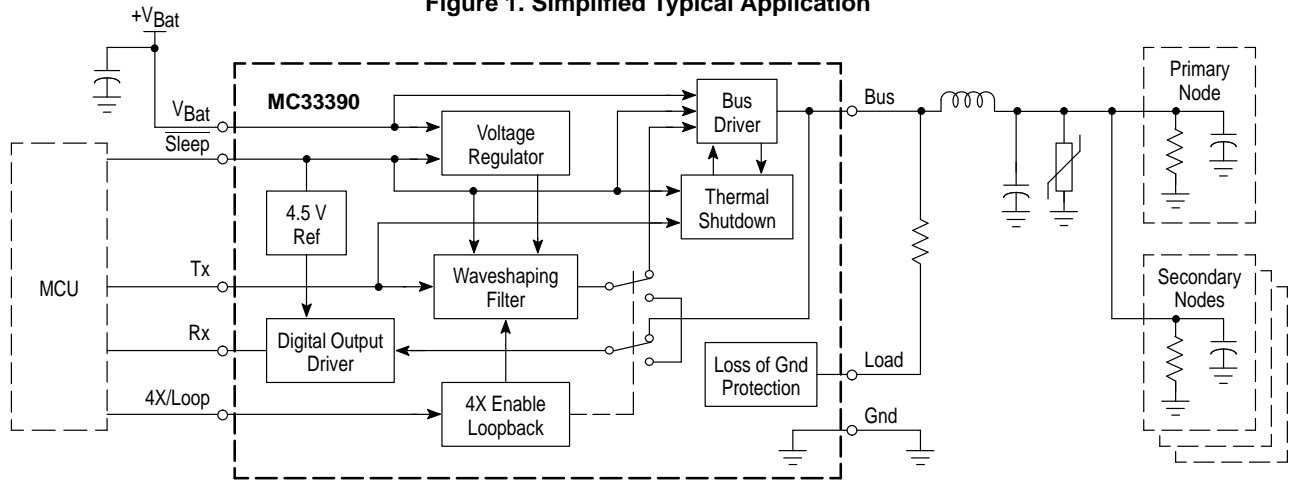


ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC33390D	$T_A = -40$ to 125°C	SO-8

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Figure 1. Simplified Typical Application



This device contains approximately 400 active transistors and 250 gates.

TERMINAL CONNECTIONS

Terminal Number	Terminal Name	Function
1	Sleep	Enables the Transceiver when Logic '1' and Disables the Transceiver when Logic '0'
2	Gnd	Device Ground Terminal
3	Load	Accommodates an External Pull-Down Resistor to Ground to Provide Loss of Ground Protection
4	Bus	Wave-Shaped SAE Standard J-1850 Class B Transmitter Output and Receiver Input
5	VBat	Provides Device Operating Input Power
6	4X/Loop	Tristate Input Mode Control; Logic '0' = Normal Waveshaping, Logic '1' = Waveshaping Disabled for 4X Transmitting, High Impedance = Loopback Mode
7	Tx	Serial Data Input (DI) from the Microcontroller to be Transmitted onto Bus
8	Rx	Bus Received Serial Data Output (DO) Sent to the Microcontroller

MAXIMUM RATINGS (All voltages are with respect to ground unless otherwise noted)

Rating	Symbol	Value	Unit
VBat DC Supply Voltage (Note 1)	VBat	-0.6 to 34	V
Input I/O Terminals (Note 2)	VI/O(CPU)	-0.3 to 7.0	V
Bus and Load Outputs	VBus	-2.0 to 16	V
ESD Voltage			V
Human Body Model	VESD1	2000	
Machine Model	VESD2	200	
Storage Temperature	Tstg	-65 to 150	°C
Operating Ambient Temperature	TA	-40 to 125	°C
Operating Junction Temperature	TJ	-40 to 150	°C
Lead Soldering Temperature (Note 4)	Tsolder	260	°C
Thermal Resistance (Junction-to-Ambient)	RθJA	180	°C/W

- NOTES:**
1. An external series diode must be used to provide reverse battery protection of the device.
 2. Sleep, Tx, Rx, and 4X/Loop are normally connected to a microcontroller.
 3. ESD data available upon request.
 4. Lead soldering temperature limit is for 10 seconds maximum duration; contact Motorola Sales Office for device immersion soldering time/temperature limits.

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ELECTRICAL CHARACTERISTICS (Characteristics noted under conditions of $7.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$, $-40^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$, $\overline{\text{Sleep}} = 5.0\text{ V}$, unless otherwise noted). Typical values reflect the parameter's approximate mid-point average value with $V_{\text{Bat}} = 13\text{ V}$, $T_A = 25^\circ\text{C}$.

Characteristic	Symbol	Min	Typ	Max	Unit
DC CHARACTERISTICS					
Operational Battery Current (Tx = 7.8 kHz square wave) Bus Loading = 1380 Ω to Gnd, 3.6 nF to Gnd., Bus High Bus Loading = 257 Ω to Gnd, 20.2 nF to Gnd., Bus High	$I_{\text{Bat(Op1)}}$ $I_{\text{Bat(Op2)}}$	– –	3.0 22.4	11.5 32	mA
Battery Bus Low Current After $\overline{\text{Sleep}}$ Toggle Low to High; Prior to Tx Toggling After Tx Toggle High to Low	$I_{\text{Bat(Bus L1)}}$ $I_{\text{Bat(Bus L2)}}$	– –	1.1 6.4	3.0 8.5	mA
Sleep State Battery Current ($V_{\overline{\text{Sleep}}} = 0\text{ Vs}$)	$I_{\text{Bat(Sleep)}}$	–	38.2	65	μA
Bus Input Receiver Threshold (Note 1) Threshold High (Bus Increasing until $R_x \geq 3.0\text{ V}$) Threshold Low (Bus Decreasing until $R_x \leq 3.0\text{ V}$) Threshold in Sleep State ($\overline{\text{Sleep}} = 0\text{ V}$) Hysteresis ($V_{\text{Bus(IH)}} - V_{\text{Bus(IL)}}$, $\overline{\text{Sleep}} = 0\text{ V}$)	$V_{\text{Bus(IH)}}$ $V_{\text{Bus(IL)}}$ $V_{\text{BusTH(Sleep)}}$ $V_{\text{Bus(Hyst)}}$	4.25 – 2.4 0.1	3.9 3.7 3.0 0.2	– 3.5 3.4 0.6	V
Bus Out Voltage (Tx = 5.0 V, 257 $\Omega \leq R_{\text{BUS(L)}} \leq 1380\text{ }\Omega$) 8.2 V $\leq V_{\text{Bat}} \leq 16\text{ V}$ 4.25 V $\leq V_{\text{Bat}} \leq 8.2\text{ V}$ Tx = 0 V	$V_{\text{Bus(Out1)}}$ $V_{\text{Bus(Out2)}}$ $V_{\text{Bus(Out3)}}$	6.25 $V_{\text{Bat}} - 1.6$ –	6.9 – 0.27	8.0 V_{Bat} 0.7	V
Bus Short Circuit Current (Tx = 5.0 V, $-2.0\text{ V} \leq V_{\text{BUS}} \leq 4.8\text{ V}$)	$I_{\text{Bus(Short)}}$	60	129	170	mA
Bus Leakage Current $-2.0\text{ V} \leq V_{\text{BUS}} \leq 0\text{ V}$ $0\text{ V} \leq V_{\text{BUS}} \leq V_{\text{Bat}}$	$I_{\text{Bus(Leak1)}}$ $I_{\text{Bus(Leak2)}}$	–500 –	–55 189	– 500	μA
Bus Thermal Shutdown (Note 2) (Tx = 5.0 V, $I_{\text{BUS}} = -0.1\text{ mA}$) Increase Temp until $V_{\text{BUS}} \leq 2.5\text{ V}$	$T_{\text{Bus(Lim)}}$	150	170	190	$^\circ\text{C}$
Bus Thermal Shutdown Hysteresis (Note 3) ($T_{\text{Bus(Lim)}} - T_{\text{Bus(ReEn)}}$)	$T_{\text{Bus(LimHys)}}$	10	12	15	$^\circ\text{C}$
Bus and Load Current with loss of V_{Bat} or Gnd. ($I_{\text{Bat}} = 0\text{ }\mu\text{A}$) (See Figure 7) $-18\text{ V} \leq V_{\text{BUS}} \leq 9.0\text{ V}$ $-18\text{ V} \leq V_{\text{Load}} \leq 9.0\text{ V}$	$I_{\text{Bus(Loss)}}$ $I_{\text{Load(Loss)}}$	– –	0.00 0.00	0.1 0.1	mA
Load Output ($I_L = 6.0\text{ mA}$)	L_{On}	–	0.07	0.2	V
Unpowered Load Output ($V_{\text{Bat}} = 0\text{ V}$, $I_L = 6.0\text{ mA}$)	L_{Dio}	0.3	0.56	0.9	V
Tx Input Voltage $V_{\text{BUS}} \leq 3.875\text{ V}$ $V_{\text{BUS}} \geq 3.875\text{ V}$	$V_{\text{Tx(IL)}}$ $V_{\text{Tx(IH)}}$	– 3.5	2.27 2.27	0.8 –	V
Tx Input Current $V_{\text{Tx}} = 5.0\text{ V}$ $V_{\text{Tx}} = 0\text{ V}$	$I_{\text{Tx(IH)}}$ $I_{\text{Tx(IL)}}$	50 –2.0	106 0.23	200 2.0	μA
4X/Loop Input Current $V_{4\text{X/Loop}} = 0\text{ V}$ (Normal Mode) $V_{4\text{X/Loop}} = 5.0\text{ V}$ (4X Mode)	$I_{4\text{X/Loop(IL)}}$ $I_{4\text{X/Loop(IH)}}$	–200 –200	–60 110	200 200	μA
4X/Loop Input Threshold (Tx = 4096 Hz square wave) Normal Mode to Loopback Mode Loopback Mode to 4X Mode	$V_{4\text{X/Loop(IL)}}$ $V_{4\text{X/Loop(IH)}}$	1.1 3.2	1.31 3.43	1.5 3.6	V
Rx Output Voltage Low ($V_{\text{BUS}} = 0\text{ V}$, $I_{\text{Rx}} = 1.6\text{ mA}$)	$V_{\text{Rx(Low)}}$	0.01	0.18	0.4	V
Rx Output Voltage High ($V_{\text{BUS}} = 7.0\text{ V}$, $I_{\text{Rx}} = -200\text{ }\mu\text{A}$)	$V_{\text{Rx(High)}}$	4.25	4.58	4.75	V
Rx Output Current ($V_{\text{Rx}} = \text{High}$; Short circuit protection limits)	I_{Rx}	2.0	3.67	8.0	mA
Rx Sleep State Output Voltage ($\overline{\text{Sleep}} = 0\text{ V}$, ($0 \leq V_{\text{BUS}} \leq 7.0\text{ V}$))	V_{Rx}	4.25	4.69	4.85	V
Sleep Input Current $V_{\overline{\text{Sleep}}} = 0\text{ V}$ $V_{\overline{\text{Sleep}}} = 5.0\text{ V}$	$I_{\overline{\text{Sleep(IL)}}$ $I_{\overline{\text{Sleep(IH)}}$	– 1.0	–0.23 6.21	–2.0 20	μA

- NOTES**
1. Typical threshold value is the approximate actual occurring switch point value with $V_{\text{Bat}} = 13\text{ V}$, $T_A = 25^\circ\text{C}$.
 2. Device characterized but not production tested for Thermal Shutdown.
 3. Device characterized but not production tested for Thermal Shutdown Hysteresis.

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ELECTRICAL CHARACTERISTICS (Characteristics noted under conditions of $7.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$, $-40^\circ\text{C} \leq T_{\text{C}} \leq 125^\circ\text{C}$, $\overline{\text{Sleep}} = 5.0\text{ V}$, unless otherwise noted). Typical values reflect the parameter's approximate mid-point average value with $V_{\text{Bat}} = 13\text{ V}$, $T_{\text{A}} = 25^\circ\text{C}$.

Characteristic	Symbol	Min	Typ	Max	Unit
AC PERFORMANCE					
Bus Voltage Rise Time ($9.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$, Tx = 7,812 Hz Sq Wave) (See Figure 2) (Bus Load = 3,300 pF and 1.38 k Ω to ground) (Bus Load = 16,500 pF and 300 Ω to ground)	$t_{\text{rise}}(\text{Bus})$	9.0 9.0	11.15 11.86	15 15	μs
Bus Voltage Fall Time ($9.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$, Tx = 7,812 Hz Sq Wave) (See Figure 2) (Bus Load = 3,300 pF and 1.38 k Ω to ground) (Bus Load = 16,500 pF and 300 Ω to ground)	$t_{\text{fall}}(\text{Bus})$	9.0 9.0	10.50 11.17	15 15	μs
Pulse Width Distortion Time ($9.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$, Tx = 7,812 Hz Sq Wave, Bus Load = 3,300 pF and 1.38 k Ω to ground) (See Figure 3)	$t_{\text{pwd}}(\text{Bus})$	35	62	93	μs
Bus Current Rise and Fall Time ($9.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$, Bus Load = 16,500 pF and 300 Ω to -2.0 V) (See Figure 4) (Note 1)	$t_{\text{fall}}(\text{Bus I})$ $t_{\text{rise}}(\text{Bus I})$	4.0 4.0	5.85 8.17	– –	μs
Harmonic Content (Note 2) ($9.0\text{ V} \leq V_{\text{Bat}} \leq 16\text{ V}$, Bus Load = 16,500 pF and 300 Ω to -2.0 V , Peak Spectral Voltage from 0.53 to 1.67 Mhz)	V_{harm}	–	–	80	μV
Propagation Delay (Tx Threshold to Rx Threshold)	$t_{\text{pd}}(\text{Bus})$	–	17.7	25	μs
Tx to Bus Delay Time (Tx = 2.5 V to $V_{\text{Bus}} = 3.875\text{ V}$) 4X Mode Normal Mode	$t_{\text{TxDelay}/4\text{X}}$ $t_{\text{TxDelay}/\text{Norm}}$	– 13	2.6 17.3	4.0 24	μs
Rx Output Delay Time (Tx = 2.5 V to $V_{\text{Bus}} = 3.875\text{ V}$) (See Figure 5) Low-to-Output High High-to-Output Low	$t_{\text{RxDelay}/\text{L-H}}$ $t_{\text{RxDelay}/\text{H-L}}$	– –	0.11 0.38	2.0 2.0	μs
Rx Output Transition Time ($C_{\text{Rx}} = 50\text{ pF}$ to Gnd., 10% and 90% Points) (See Figure 6) Low-to-Output High High-to-Output Low	$t_{\text{RxTrans}/\text{L-H}}$ $t_{\text{RxTrans}/\text{H-L}}$	– –	0.34 0.08	1.0 1.0	μs
Rx Output Transition Time (Note 3) ($C_{\text{Rx}} = 50\text{ pF}$ to Gnd., Sleep = 0 V, 10% and 90% Points) (See Figure 6) Low-to-Output High High-to-Output Low	$t_{\text{RxTrans}/\text{L-H}}$ $t_{\text{RxTrans}/\text{H-L}}$	– –	0.32 0.08	5.0 5.0	μs

- NOTES**
1. Typical is the parameter's approximate average value with $V_{\text{Bat}} = 13\text{ V}$, $T_{\text{A}} = 25^\circ\text{C}$.
 2. Device characterized but not production tested for Harmonic Content.
 3. Rx Output Transition Time from a sleep state.

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Figure 2. Bus Rise and Fall Times

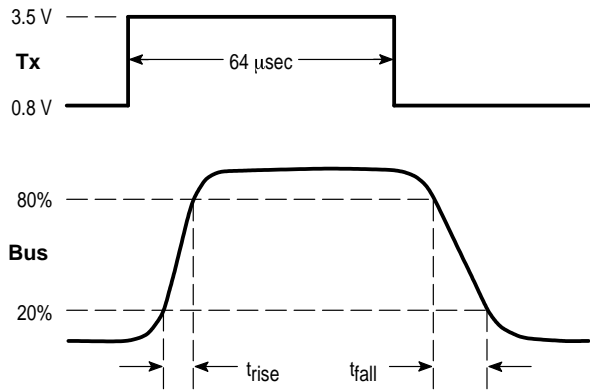


Figure 3. Pulse Width Distortion

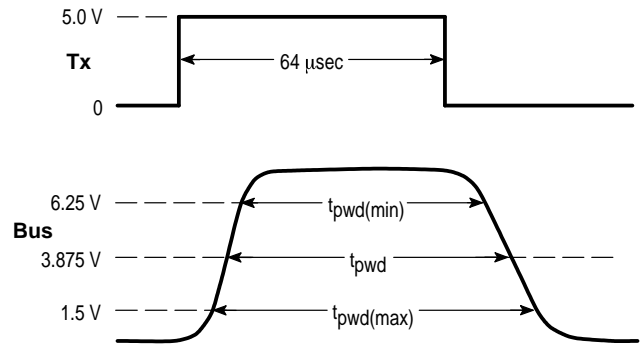
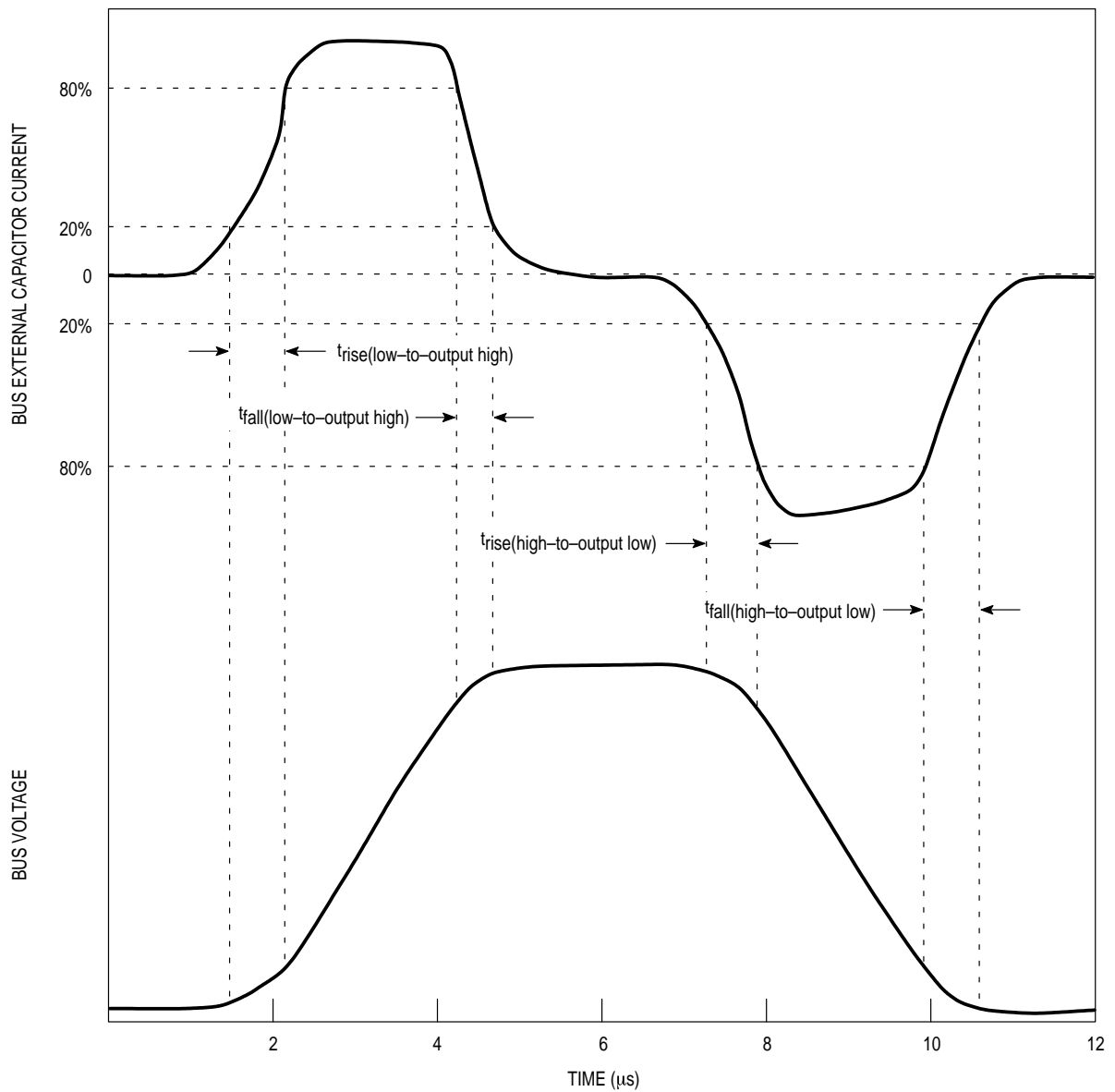


Figure 4. Bus Output External Capacitor Current and Output Voltage versus Time



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Figure 5. Bus-to-Rx Delay Time

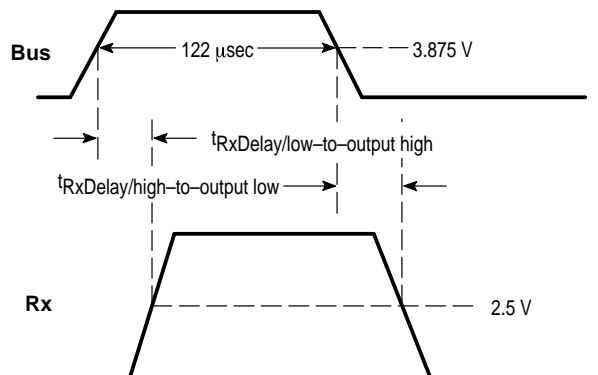


Figure 6. Rx Rise and Fall Time

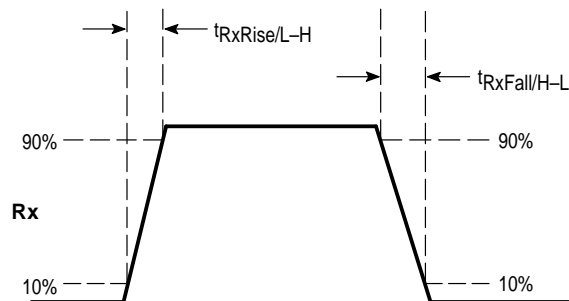


Figure 7. Loss of Gnd or +VBat Test Circuit

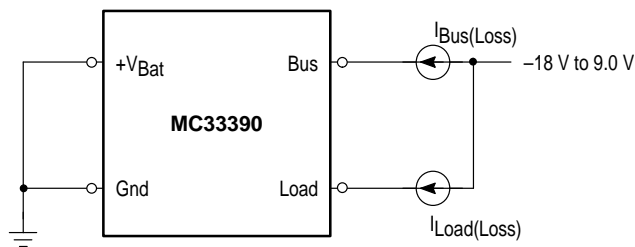
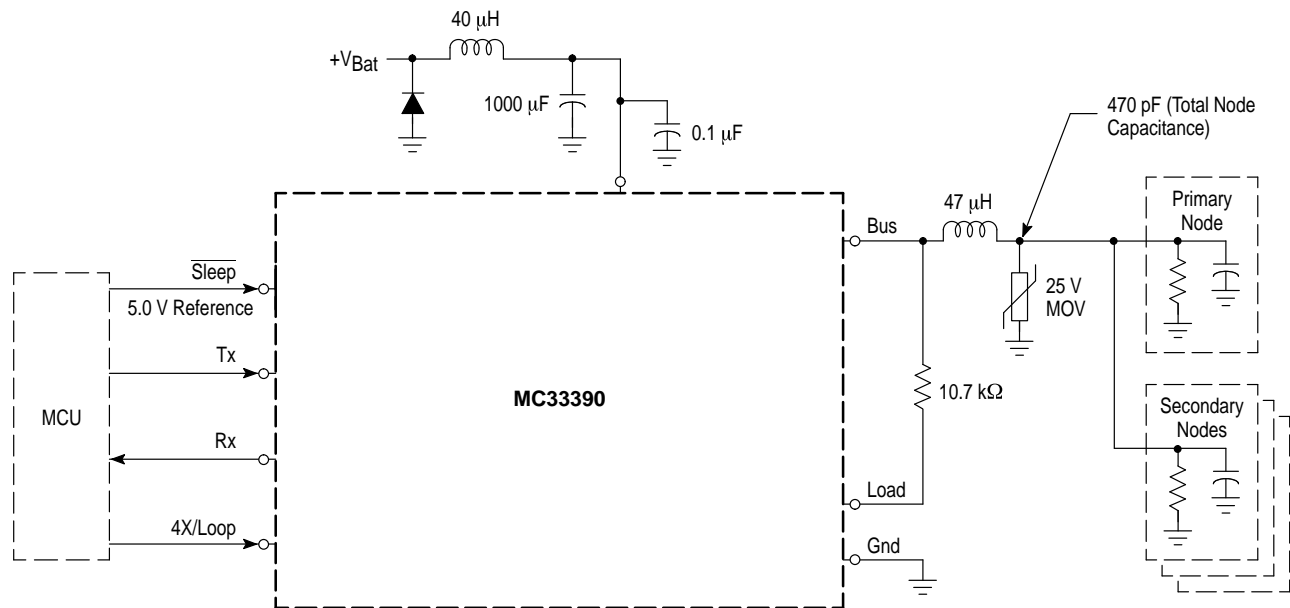


Figure 8. Typical Secondary Node Application Circuit



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Figure 9. Minimum Bus Load

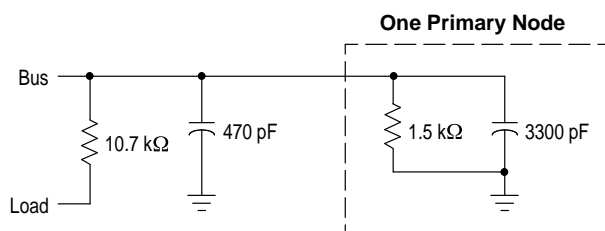


Figure 10. Maximum Bus Load

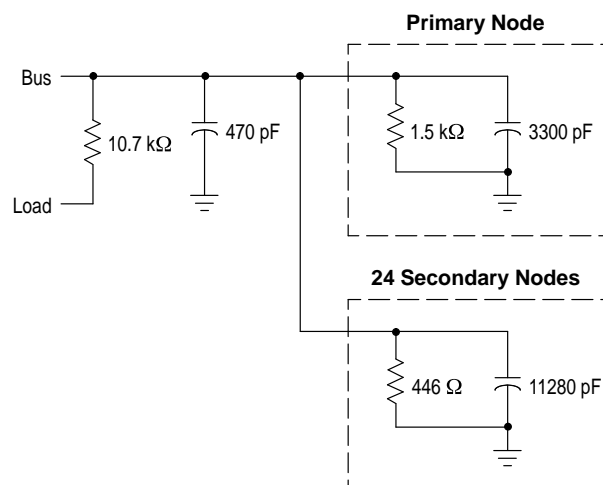
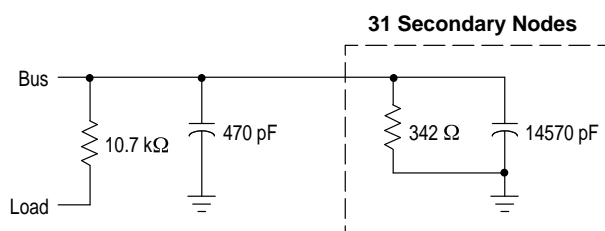


Figure 11. Maximum Number of Nodes



FUNCTIONAL DESCRIPTION

The MC33390 is a serial link bus transceiver device design to meet SAE Standards J1850 Class B performance for bi-directional half-duplex communication. The device is packaged in an economical surface mount SO-8 plastic package. An internal block diagram of the device is shown in Figure 1.

Input Power (V_{Bat} terminal)

This is the only required input power source necessary to operate the MC33390. The internal voltage reference of the MC33390 will remain fully operational with a minimum of 9.0 V on this terminal. Bus transmissions can continue with battery voltages down to 5.0 V; the Bus output voltage will follow the battery voltage down and in doing so, track approximately 1.6 V below the battery voltage. The device will continue to receive and transmit Bus data to the microcontroller with battery voltages as low as 4.25 V. The terminal can withstand voltages from -0.6 V to 34 V. If reverse battery protection is required, an appropriate diode must be placed in series with this terminal to protect the IC.

Sleep Input (\overline{Sleep} terminal)

This input is used to enable and disable the Class B transmitter; the Class B receiver is *always* enabled so long as adequate V_{Bat} terminal voltage is applied. When the \overline{Sleep} terminal voltage is increased to greater than the $V_{Sleep(H)}$ threshold (logic '1'), the Class B transmitter is enabled. If this input is at a voltage below the $V_{Sleep(L)}$ threshold (logic '0') the Class B transmitter will be disabled and less than 30 μA of

current will be drawn by the V_{Bat} terminal. This terminal can be connected either to switched ignition or to a microcontroller output for control. This terminal also provides a 5.0 V reference, internal to the device used to establish the Rx output level and slew rate times.

Class B Functional Description

The transmitter provides an analog wave-shaped 0 to 7.0 V waveform on the Bus output. It also receives waveforms and transmits a digital level signal back to a logic IC. The transmitter can drive up to 32 remote Class B transceivers. These remote nodes may be at ground potentials that are ± 2.0 V relative to the control assembly. Waveshaping will only be maintained during 2 of the 4 corners when the 0 to ± 2.0 V ground potential difference condition exists. The MC33390 is a remote node on the Class B Bus. Each remote transceiver has a $470 \pm 10\%$ pF capacitor on its output for EMI suppression purposes, as well as a $10.6 \text{ k}\Omega \pm 5\%$ pull down resistor to ground. The main node has a $3300 \pm 10\%$ pF capacitor on its output for EMI suppression, as well as a $1.5 \text{ k}\Omega \pm 5\%$ pull down resistor to ground. With more than 26 nodes there is no primary node; all nodes will have a $470 \pm 10\%$ pF capacitor and a $10.6 \text{ k}\Omega \pm 5\%$ pull down resistor. No matter how many remote nodes are on the Class B Bus, the R_C time constant of the Class B Bus is maintained at approximately 5.0 μsec . The minimum and maximum capacitance and resistance on the Class B Bus is given by the expressions shown in Table 1.

Table 1. Class B Bus Capacitance and Resistance Expressions

Level	Capacitance	Resistance to Ground
Minimum	$(3.3 \times 0.9) + (0.47 \times 0.9) = 3.39 \text{ nF}$	$(1.5 \times 0.95) \parallel (10.6 \times 0.95) / 25 = 314 \Omega$
Maximum	$(3.3 \times 1.1) + 25(0.47 \times 1.1) = 16.55 \text{ nF}$	$(1.5 \times 1.05) \parallel (10.6 \times 1.05) = 1.38 \text{ k}\Omega$

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CLASS B MODULE INPUTS

Transmitter Data from the MCU (Tx)

The Tx input is a push-pull (N-channel/P-channel FETs) buffer with hysteresis for noise immunity purposes. This terminal is a 5.0 V CMOS logic level input from the MCU following a true logic protocol. A logic '0' input drives the Bus output to 0 V (via the external pull-down resistor to ground on each node) while a logic '1' input produces a high voltage at the Bus output. A logic '0' input level is guaranteed when the Tx input terminal is open circuited by virtue of an internal 40 k pull down resistor. No external resistor is required for its operation.

Waveshaping and 4X / Loop

This input is a "tri-statable" input; 0 V = Normal waveshaping, 5.0 V = waveshaping is disabled for 4X transmitting, and high impedance = Loopback mode of operation. This is a logic level input used to select whether waveshaping for the Class B output is enabled or disabled; A logic '0' enables waveshaping while a logic '1' disables waveshaping. In the 4X mode, the Bus output rise time less than 2.0 μ s and the fall time is less than 5.0 μ s (due to the external RC pull down to ground). In the Loopback condition the Tx signal is fed back to the Rx output after waveshaping without being transmitted onto the Bus. This mode of operation is useful for system diagnostic purposes.

CLASS B MODULE OUTPUTS

Transceiver Output (Bus)

This is the output driver stage that sources current to the bus. Its output follows the waveshaped waveform input. Its output voltage is limited to 6.25 V to 8.0 V under normal battery level conditions. The limited level is controlled by an internal regulator/clamp circuit. Once the battery voltage drops below 9.0 V, the regulator/clamp circuit saturates, causing the Bus voltage to track the battery voltage. A 1.5 k Ω \pm 5% external resistor (as well as any 10.6 k Ω pull down resistors of any remote nodes) sinks the current to discharge the capacitors during high to low transitions. This sourcing output is short circuit protected (60 to 170 mA) against a short to -2.0 V and sinks less than 1.0 mA when shorted to V_{Bat} . If a short occurs, the over temperature shutdown circuit protects the source driver of the device. In the event battery power is lost to the assembly, the Bus transmitter's output stage will be disabled and the leakage current from the Bus output will not source or sink more than 100 μ A of current. The transceiver will operate with a remote ground offset of \pm 2.0 V but the lower corners of transmission will not be rounded during this condition.

Receiver Output to the Microcontroller (Rx)

This is a 5.0 V CMOS compatible push-pull output used to send received data to the microcontroller. It does not require an external pull-up resistor to be used. The receiver is always enabled and draws less than 65 μ A of current from V_{Bat} . When voltage on the Bus is under 3.5 V, the output is a logic '0'. There is a minimum of 0.1 V of hysteresis between the Bus high and low (and vice versa) transition points. The initial state of this output is always a logic '0' after supply voltage is applied, but before the Sleep terminal goes to a logic '1' state. The MC33390 always goes into normal operation from a Sleep state. The receiver circuitry is able to operate with V_{Bat} voltages as low as 4.25 V and still remains capable of "waking up" the MC33390 when remote Class B activity is detected.

When the MC33390 is in a Sleep state and there occurs message activity is on the Bus; the receiver passes the Bus message through to the microcontroller from the Rx terminal and the microcontroller makes the determination to "wake up" the MC33390 by pulling Sleep to a logic "1" state in preparation for the microcontroller's transmitting data to be presented to the Tx terminal. The MC33390 does not automatically "wake up" from a sleep state when Bus activity occurs; the microcontroller must tell it to do so.

In the specification table; The maximum voltage for Rx is specified as 4.75 V over an operating range of -40 to 125°C temperature and 7.0 to 16 V V_{Bat} . This maximum Rx voltage is compatible with the minimum V_{DD} voltage of microcontrollers to prevent the MC33390's sourcing current to the microcontroller's output.

Switched Ground Output (Load)

Normally, this output is a saturated switch to ground, which pulls down the external resistor between the Bus and Load outputs. In the event ground is lost to the assembly; the Load output will bias itself "off" and will not leak more than 100 μ A of current out of this terminal.

Over Temperature Shutdown

If the Bus output becomes shorted to ground for any duration; an over temperature shutdown circuit "latches off" the output source transistor whenever the die temperature exceeds 150 to 190°C. The output transistor remains latched off until the Tx input is toggled from a logic '0' to a logic '1'; The rising edge provides the clearing function providing the locally sensed temperature is 10 to 15°C below the latch off temperature trip temperature.

Wave-Shaping

Wave-shaping is incorporated into the MC33390 to minimize EMI conducted emissions. The major contributor to EMI emissions in the AM broadcast band is the rise and fall times of current in the capacitive load during output transitions; occurring during the "rounded corners" time of the voltage waveform. In order to provide a controlled rise time, the output voltage is a second order function, $I = C dv/dt$, during this transition time. An internal two stage analog integrator circuit achieves this waveshaping. The final output stage current amplifies this voltage and drives the Bus output.

Receiver Protocol

The Class B communication scheme uses a variable pulse width (VPW) protocol. The microcontroller provides the VPW decoding function. Once the receiver detects a transition on Rx, it starts an internal counter. The initial "start of frame" bit is a logic '1', and lasts 200 μ sec. For subsequent bits, if there is a Bus transition before 96 μ sec, one logic state is inferred. If there is a Bus transition after 96 μ Sec, the other logic state is inferred. The "end of data" bit is a logic '0', and lasts 200 μ sec. If there is no activity on the bus for 280 to 320 μ sec

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following a broadcast message, multiple unit nodes may arbitrate for control of the next message. During an arbitration, after the “start of frame” bit has been transmitted, the remote unit transmitting the most consecutive logic ‘0’ bits will be granted sole transmission access to the bus for that message.

Loss of Assembly Ground Connection

The definition of a loss of assembly ground condition at the device level is that all terminals of the MC33390, except Bus and Load, see a very low impedance to V_{Bat} .

The Load terminal of the device has an internal transistor switch connected to it which is normally saturated to ground; This pulls the Load-side of the external resistor (tied from Bus to Load) to ground under normal conditions. The Load terminal switch essentially that of an “up-side down” FET which is normally biased “on”, so long as module ground is present, and biased “off” when loss-of-ground occurs. When a loss of assembly ground occurs; the Load transistor switch is self-biased “off”, allowing no more than 100 μA of leakage current to flow in the Load terminal. During such a loss of assembly ground condition the Bus and Load terminals exhibit a high impedance to V_{Bat} ; all other terminals will exhibit a low impedance to V_{Bat} . During this condition the Bus terminal is prevented from sourcing any current or

loading the Bus which would cause a corruption of any data being transmitted on the Bus. While a particular assembly is experiencing a loss of ground; all other assembly nodes are permitted to function normally. It should be noted that with other nodes existing on the Bus, the Bus will always have some minimum/maximum impedance to ground as shown in Table 1.

Loss of Assembly Battery Connection

The definition of a loss of assembly battery condition at the device level is that the V_{Bat} terminal of the MC33390 sees an infinite impedance to V_{Bat} , but there is some undefined impedance looking from these terminals to ground.

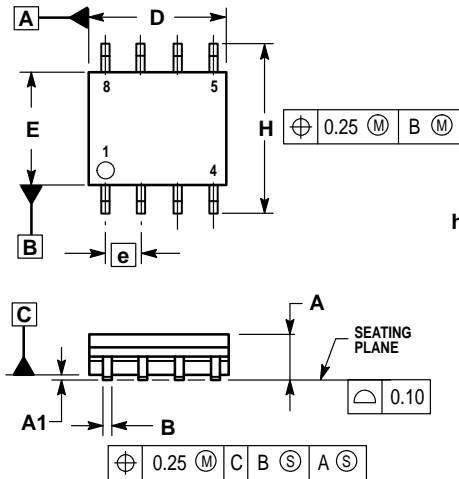
Bulk Current Injection (BCI) and Conducted Sinusoidal Enhancement Circuitry

The Class B output driver of the MC33390 is an active high side switch requiring the use of an external passive pull down to ground resistor; 1.5 k Ω for “Master” units and 10.6 k Ω for “Slave” units. Under capacitive or inductive coupled noise conditions, it takes but a few milli-amperes of induced current to cause the Class B Bus to latch to a “high” state. The MC33390 will operate properly when using the application circuit shown in Figure 8 when exposed to externally induced AC noise conditions as experienced in typical automotive applications.

MC33390

OUTLINE DIMENSIONS


D SUFFIX
PLASTIC PACKAGE
CASE 751-06
ISSUE T
(SO-8)



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS	
	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0°	7°

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