THE DATASHEET OF

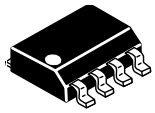
MCZ33990EFR2

Document Number: MC33990
Rev 4.0, 10/2008

Enhanced Class B Serial Transceiver

33990

J-1850 SERIAL TRANSCEIVER



D SUFFIX
EF SUFFIX (PB-FREE)
98ASB42564B
8-PIN SOICN

The 33990 is a serial 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 kbps using Variable Pulse Width Modulation (VPWM). The 33990 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 V to 7.0 V waveshaped signal swings of the bus. The bus output driver is short circuit current limited.

Features

- Designed for SAE J-1850 Class B Data Rates
- Full Operational Bus Dynamics Over a Supply Voltage of 9.0 V to 16 V
- Ambient Operating Temperature of -40°C 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
- Voltage Waveshaping of Bus Output Driver
- Internally Reverse Battery Protected
- 40 V Max V_{BAT} Capability
- Pb-Free Packaging Designated by Suffix Code EF

ORDERING INFORMATION

Device	Temperature Range (T_A)	Package
MC33990D/DR2	-40°C to 125°C	8 SOICNN
MCZ33990EF/R2		

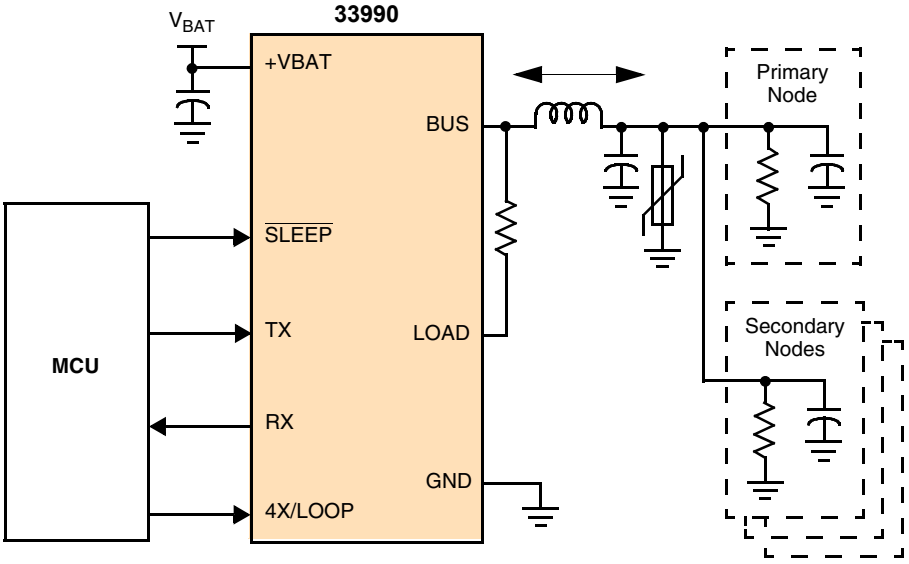
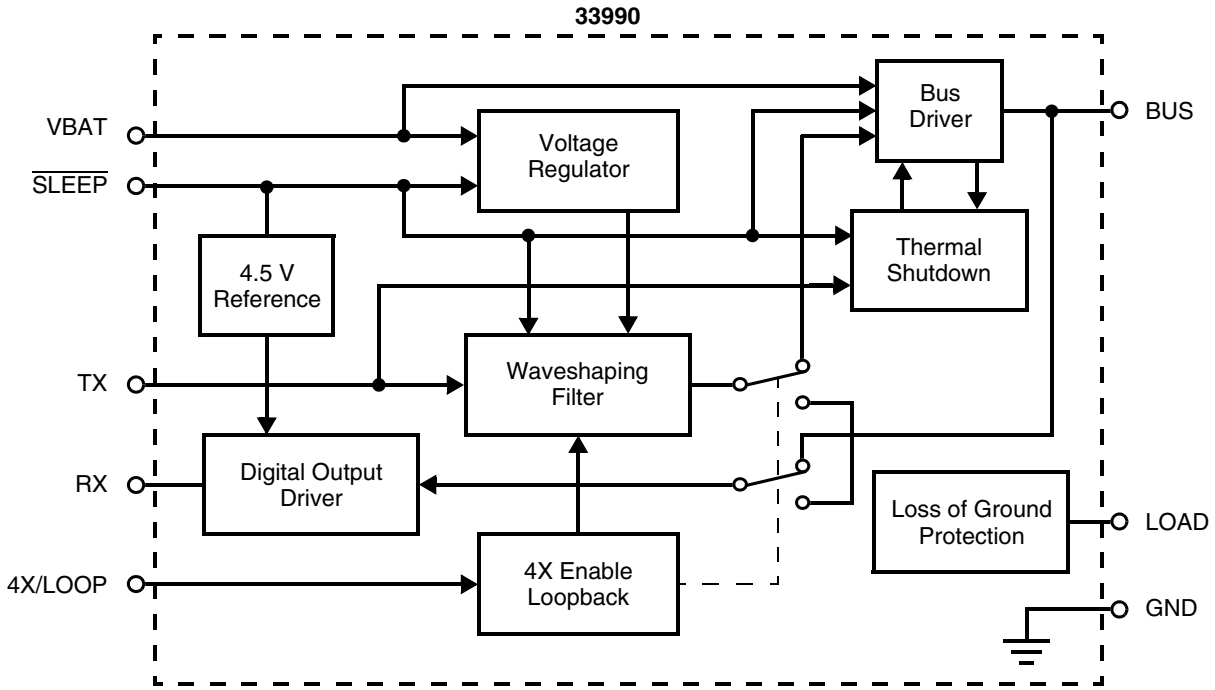


Figure 1. 33990 Simplified Application Diagram

INTERNAL BLOCK DIAGRAM



Note This device contains approximately 400 active transistors and 250 gates.

Figure 2. 33990 Simplified Internal Block Diagram

PIN CONNECTIONS

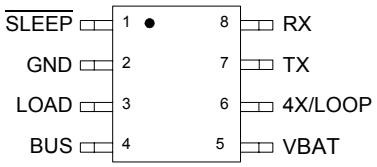


Figure 3. 33990 Pin Connections

Table 1. 33990 Pin Definitions

Pin Number	Pin Name	Definition
1	$\overline{\text{SLEEP}}$	Enables the transceiver when Logic 1 and disables the transceiver when Logic 0.
2	GND	Device ground pin.
3	LOAD	Accommodates an external pull-down resistor to ground to provide loss of ground protection.
4	BUS	Waveshaped 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.

ELECTRICAL CHARACTERISTICS

MAXIMUM RATINGS

Table 2. Maximum Ratings

All voltages are with respect to ground unless otherwise noted.

Rating	Symbol	Value	Unit
VBAT DC Supply Voltage (1)	V_{BAT}	-16 to 40	V
Input I/O Pins (2)	$V_{I/O(CPU)}$	-0.3 to 7.0	V
BUS and LOAD Outputs	V_{BUS}	-2.0 to 16	V
ESD Voltage Human Body Model (3) Machine Model (4)	 V_{ESD1} V_{ESD2}	 ±2000 ±200	V
Storage Temperature	T_{STG}	-65 to 150	°C
Operating Ambient Temperature	T_A	-40 to 125	°C
Operating Junction Temperature	T_J	-40 to 150	°C
Peak Package Reflow Temperature During Reflow (5), (6)	T_{PPRT}	Note 6.	°C
Thermal Resistance (Junction-to-Ambient)	$R_{\theta J-A}$	180	°C/W

Notes

1. An external series diode must be used to provide reverse battery protection of the device.
2. $\overline{\text{SLEEP}}$, TX, RX, and 4X/LOOP are normally connected to a microcontroller.
3. ESD1 testing is performed in accordance with the Human Body Model (C_{ZAP}=100 pF, R_{ZAP}=1500 Ω).
4. ESD2 testing is performed in accordance with the Machine Model (C_{ZAP}=200 pF, R_{ZAP}=0 Ω).
5. Pin soldering temperature limit is for 10 seconds maximum duration. Not designed for immersion soldering. Exceeding these limits may cause malfunction or permanent damage to the device.
6. Freescale's Package Reflow capability meets Pb-free requirements for JEDEC standard J-STD-020C. For Peak Package Reflow Temperature and Moisture Sensitivity Levels (MSL),
Go to www.freescale.com, search by part number [e.g. remove prefixes/suffixes and enter the core ID to view all orderable parts. (i.e. MC33xxxD enter 33xxx), and review parametrics.

STATIC ELECTRICAL CHARACTERISTICS

Table 3. Static Electrical Characteristics

Characteristics noted under conditions of 7.0 V ≤ V_{BAT} ≤ 16 V, -40°C ≤ T_A ≤ 125°C, $\overline{SLEEP}$ = 5.0 V unless otherwise noted. Typical values reflect the parameter's approximate midpoint average value with V_{BAT} = 13 V, T_A = 25°C. All positive currents are into the pin. All negative currents are out of the pin.

Characteristic	Symbol	Min	Typ	Max	Unit
POWER CONSUMPTION					
Operational Battery Current (RMS with Tx = 7.812 kHz Square Wave)					mA
BUS Load = 1380 Ω to GND, 3.6 nF to GND	$I_{BAT(OP1)}$	–	3.0	11.5	
BUS Load = 257 Ω to GND, 20.2 nF to GND	$I_{BAT(OP2)}$	–	22.4	32	
Battery Bus Low Input Current					mA
After $\overline{SLEEP}$ Toggle Low to High; Prior to Tx Toggling	$I_{BAT(BUS\ L1)}$	–	1.1	3.0	
After Tx Toggle High to Low	$I_{BAT(BUS\ L2)}$	–	6.4	8.5	
Sleep State Battery Current	$I_{BAT(SLEEP)}$				µA
$V_{\overline{SLEEP}}$ = 0 V		–	38.2	65	
BUS					
BUS Input Receiver Threshold (7)					V
Threshold High (Bus Increasing until Rx ≥ 3.0 V)	$V_{BUS(IH)}$	4.25	3.9	–	
Threshold Low (Bus Decreasing until Rx ≤ 3.0 V)	$V_{BUS(IL)}$	–	3.7	3.5	
Threshold in Sleep State ($\overline{SLEEP}$ = 0 V)	$BUS_{TH(SLEEP)}$	2.4	3.0	3.4	
Hysteresis ($V_{BUS(IH)}$ - $V_{BUS(IL)}$, $\overline{SLEEP}$ = 0 V)	$V_{BUS(HYST)}$	0.1	0.2	0.6	
BUS-Out Voltage (Tx = 5.0 V, 257 Ω ≤ $R_{BUS(L)}$ to GND ≤ 1380 Ω)					V
8.2 V ≤ V_{BAT} ≤ 16 V	$V_{BUS(OUT1)}$	6.25	6.9	8.0	
4.25 V ≤ V_{BAT} ≤ 8.2 V	$V_{BUS(OUT2)}$	V_{BAT} - 1.6	–	V_{BAT}	
Tx = 0 V	$V_{BUS(OUT3)}$	–	0.27	0.7	
BUS Short Circuit Output Current	$I_{BUS(SHORT)}$				mA
Tx = 5.0 V, -2.0 V ≤ V_{BUS} ≤ 4.8 V		60	129	170	
BUS Leakage Current					mA
-2.0 V ≤ V_{BUS} ≤ 0 V (≥ 2.0 ms after Tx Falls to 0 V)	$I_{BUS(LEAK1)}$	-0.5	-0.055	0.5	
0 V ≤ V_{BUS} ≤ V_{BAT}	$I_{BUS(LEAK2)}$	-0.5	0.5	1.0	
0 V ≤ V_{BUS} ≤ 8.0 V	$I_{BUS(LEAK3)}$	–	0.25	0.5	
BUS Thermal Shutdown (8) (Tx = 5.0 V, I_{BUS} = -0.1 mA)	$T_{BUS(LIM)}$				°C
Increase Temperature until V_{BUS} ≤ 2.5 V		150	170	190	
BUS Thermal Shutdown Hysteresis (9)	$T_{BUS(LIMHYS)}$				°C
$T_{BUS(LIM)}$ - $T_{BUS(REEN)}$		10	12	15	
LOAD Input Current with Loss of Ground	$I_{LOAD(LOG)}$				mA
V_{LOAD} = -18 V (see Figure 4)		-1.0	–	0.1	
BUS Input Current with Loss of Ground	$I_{BUS(LOG)}$				mA
V_{BUS} = -18 V (see Figure 4)		-1.0	–	0.1	

Notes

7. Typical threshold value is the approximate actual occurring switch point value with V_{BAT} = 13 V, T_A = 25°C.
8. Device characterized but not production tested for thermal shutdown.
9. Device characterized but not production tested for thermal shutdown hysteresis.

Table 4. Static Electrical Characteristics (continued)

Characteristics noted under conditions of 7.0 V ≤ V_{BAT} ≤ 16 V, -40°C ≤ T_A ≤ 125°C, $\overline{SLEEP}$ = 5.0 V unless otherwise noted. Typical values reflect the parameter's approximate midpoint average value with V_{BAT} = 13 V, T_A = 25°C. All positive currents are into the pin. All negative currents are out of the pin.

Characteristic	Symbol	Min	Typ	Max	Unit
BUS (CONTINUED)					
BUS Input Current with Loss of V_{BAT} V_{BUS} = 9.0 V (see Figure 5)	$I_{BUS(LOB)}$	–	–	0.5	mA
LOAD Output I_L = 6.0 mA	L_{ON}	–	0.07	0.2	V
Unpowered LOAD Output V_{BAT} = 0 V, I_L = 6.0 mA	L_{DIO}	0.3	0.67	0.9	V
TX					
TX Input Voltage V_{BUS} ≤ 3.875 V V_{BUS} ≥ 3.875 V	 $V_{Tx(IL)}$ $V_{Tx(IH)}$	 – 3.5	 2.27 2.27	 0.8 –	V
TX Input Current V_{Tx} = 5.0 V V_{Tx} = 0 V	 $I_{Tx(IH)}$ $I_{Tx(IL)}$	 50 -2.0	 120 -0.1	 200 2.0	µA
LOOP					
4X/LOOP Input Current $V_{4X/LOOP}$ = 0 V (Normal Mode) $V_{4X/LOOP}$ = 5.0 V (4X Mode)	 $I_{4X/LOOP(IL)}$ $I_{4X/LOOP(IH)}$	 -200 –	 -95 95	 – 200	µA
4X/LOOP Input Threshold (Tx = 4096 Hz square wave) Normal Mode to Loopback Mode Loopback Mode to 4X Mode	 $V_{4X/LOOP(IL)}$ $V_{4X/LOOP(IH)}$	 1.4 3.2	 1.6 3.43	 1.8 3.6	V
RX					
RX Output Voltage Low V_{BUS} = 0 V, I_{Rx} = 1.6 mA	$V_{Rx(LOW)}$	0.01	0.18	0.4	V
RX Output Voltage High V_{BUS} = 7.0 V, I_{Rx} = -200 µA	$V_{Rx(HIGH)}$	4.25	4.48	4.75	V
RX Output Current V_{Rx} = High; Short Circuit Protection Limits	I_{Rx}	2.0	5.9	8.0	mA
RX Sleep State Output Voltage $\overline{SLEEP}$ = 0 V, 0 ≤ V_{BUS} ≤ 7.0 V	V_{Rx}	4.25	4.56	4.85	V
$\overline{SLEEP}$ Input Current V_{SLEEP} = 0 V V_{SLEEP} = 5.0 V	 $I_{SLEEP(IL)}$ $I_{SLEEP(IH)}$	 – 1.0	 -0.003 9.5	 -2.0 20	µA

DYNAMIC ELECTRICAL CHARACTERISTICS

Table 5. Dynamic Electrical Characteristics

Characteristics noted under conditions of 7.0 V ≤ V_{BAT} ≤ 16 V, -40°C ≤ T_A ≤ 125°C, $\overline{SLEEP}$ = 5.0 V unless otherwise noted. Typical values reflect the parameter's approximate midpoint average value with V_{BAT} = 13 V, T_A = 25°C. All positive currents are into the pin. All negative currents are out of the pin.

Characteristic	Symbol	Min	Typ	Max	Unit
BUS					
BUS Voltage Rise Time [10] (9.0 V ≤ V_{BAT} ≤ 16 V, Tx = 7.812 kHz Square Wave) (see Figure 6)	$t_{rise(BUS)}$				µs
BUS Load = 3,300 pF and 1.38 kΩ to GND		9.0	11.15	15	
BUS Load = 16,500 pF and 300 Ω to GND		9.0	11.86	15	
BUS Voltage Fall Time [10] (9.0 V ≤ V_{BAT} ≤ 16 V, Tx = 7.812 kHz Square Wave) (see Figure 6)	$t_{fall(BUS)}$				µs
BUS Load = 3,300 pF and 1.38 kΩ to GND		9.0	10.50	15	
BUS Load = 16,500 pF and 300 Ω to GND		9.0	11.17	15	
Pulse Width Distortion Time (9.0 V ≤ V_{BAT} ≤ 16 V, Tx = 7.812 kHz Square Wave) (see Figure 7)	$t_{pwd(BUS)}$				µs
BUS Load = 3,300 pF and 1.38 kΩ to GND		35	62	93	
Propagation Delay	$t_{pd(BUS)}$				µs
TX Threshold to RX Threshold		–	17.7	25	
TX					
TX to BUS Delay Time (Tx = 2.5 V to V_{BUS} = 3.875 V) (Figure 8)	$t_{TxDelay}$				µs
4X Mode		–	2.6	4.0	
Normal Mode		13	17.3	24	
$\overline{SLEEP}$ to Tx Setup Time (Figure 8)	$t_{SLEEPTxSU}$	80	40	–	µs
RX					
RX Output Delay Time (TX = 2.5 V to V_{BUS} = 3.875 V) (see Figure 9)					µs
Low-to-Output High	$t_{RxDelay/L–H}$	–	0.11	2.0	
High-to-Output Low	$t_{RxDelay/H–L}$	–	0.38	2.0	
RX Output Transition Time (C_{Rx} = 50 pF to GND, 10% and 90% Points) (see Figure 10)					µs
Low-to-Output High	$t_{RxTrans/L–H}$	–	0.34	1.0	
High-to-Output Low	$t_{RxTrans/H–L}$	–	0.08	1.0	
Rx Output Transition Time [11] (C_{Rx} = 50 pF to GND, $\overline{SLEEP}$ = 0 V, 10% and 90% Points) (see Figure 10)					µs
Low-to-Output High	$t_{RxTrans/L–H}$	–	0.32	5.0	
High-to-Output Low	$t_{RxTrans/H–L}$	–	0.08	5.0	

Notes

10. Typical is the parameter's approximate average value with V_{BAT} = 13 V, T_A = 25°C.
11. RX Output Transition Time from a sleep state.

ELECTRICAL PERFORMANCE CURVES

TEST FIGURES

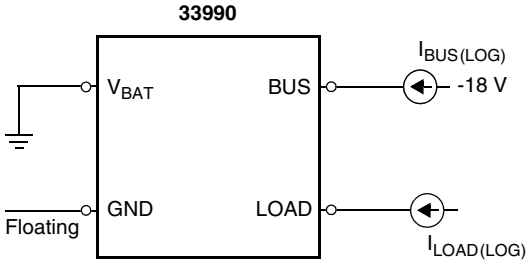


Figure 4. Loss of Ground Test Circuit

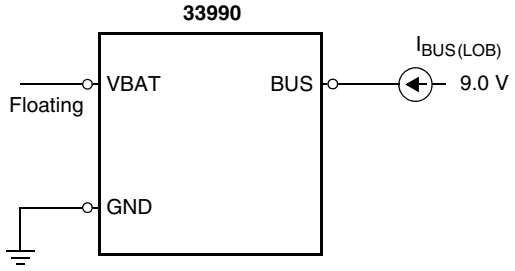


Figure 5. Loss of V_{BAT} Test Circuit

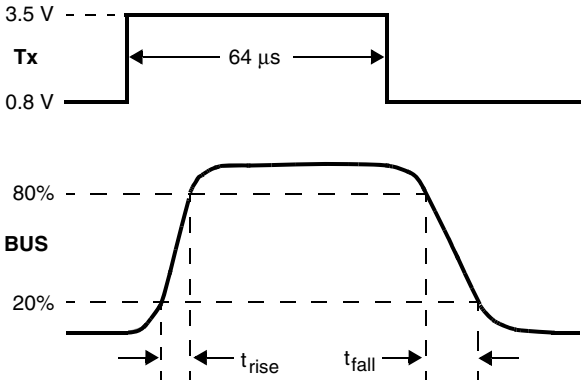


Figure 6. BUS Rise and Fall Times

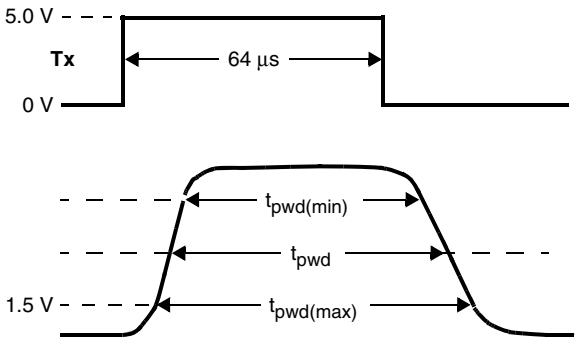


Figure 7. Pulse Width Distortion

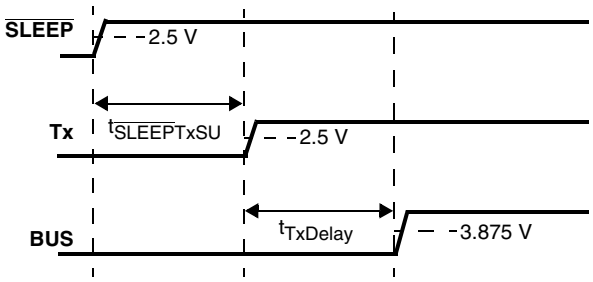


Figure 8. $\overline{\text{SLEEP}}$ to Tx Delay Times

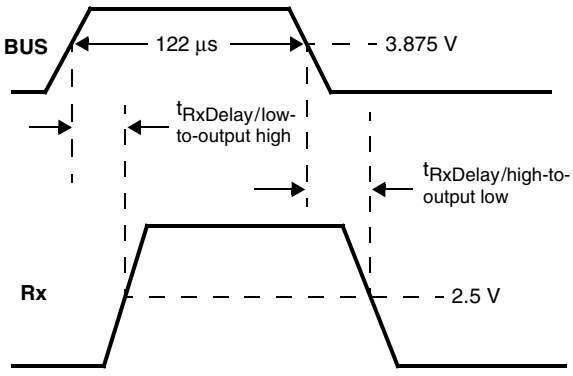


Figure 9. BUS-to-Rx Delay Time

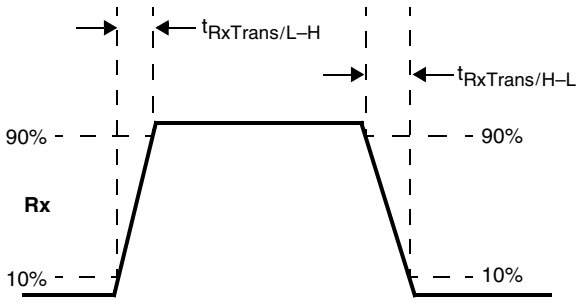


Figure 10. Rx Rise and Fall Time

FUNCTIONAL DESCRIPTION

INTRODUCTION

The 33990 is a serial transceiver device designed to meet the SAE Standard J-1850 Class B performance for bi-directional half-duplex communication. The device is packaged in an economical surface-mount SOIC plastic package. An internal block diagram of the device is shown in Figure 2.

The 33990 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 33990 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°C ≤ T_A ≤ 125°C and 7.0 V ≤ V_{BAT} ≤ 16 V supply. The economical 8-pin SOICN surface mount plastic package makes the device a cost-effective solution.

FUNCTIONAL PIN DESCRIPTION

Input Power (VBAT Pin)

This is the only required input power source necessary to operate the 33990. The internal voltage reference of the 33990 will remain fully operational with a minimum of 9.0 V on this pin. 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 pin can withstand voltages from -16 V to 40 V.

Sleep Input ($\overline{\text{SLEEP}}$ Pin)

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} pin voltage is applied. When the $\overline{\text{SLEEP}}$ pin voltage is 5.0 V, the Class B transmitter is enabled. If this input is logic low, the Class B transmitter will be disabled and less than 65 µA of current will be drawn by the V_{BAT} pin. The pin 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 waveshaped 0 V 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 secondary Class B transceivers (see Figures 11 and 12). These secondary 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 33990 is a secondary node on the Class B bus. Each secondary transceiver has a 470 ±10% pF capacitor on its output for EMI suppression purposes, as well as a 10.6 kΩ ±5% pull-down resistor to ground. The primary node has a 3300 ±10% pF capacitor on its output for EMI suppression, as well as a 1.5 kΩ ±5% pull-down resistor to ground. With more than 26 nodes, there is no primary node (see Figure 13). All nodes will have a 470 ±10% pF capacitor and a 10.6 kΩ ±5% pull-down resistor. No matter how many secondary nodes are on the Class B bus, the RC time constant of the Class B bus is maintained at approximately 5.0 µs. The minimum and maximum capacitance and resistance on the Class B bus is given by the expressions shown in Table 6.

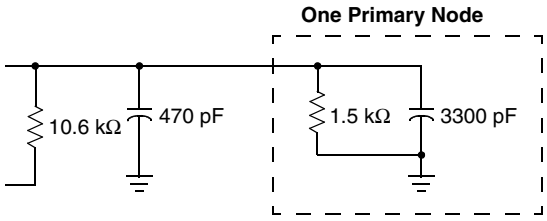


Figure 11. Minimum Bus Load

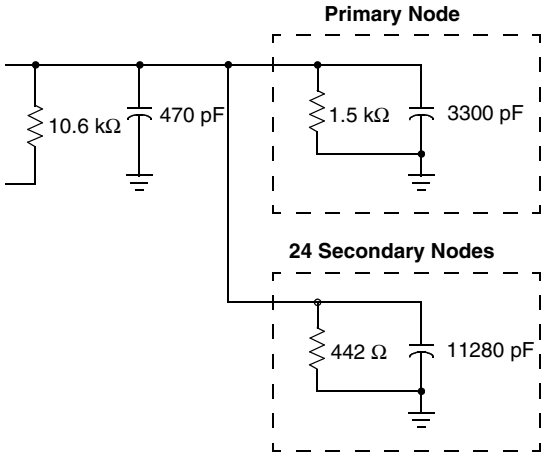


Figure 12. Maximum Number of Nodes

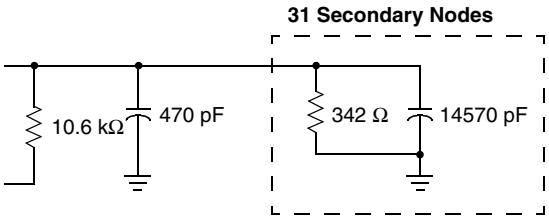


Figure 13. Maximum Bus Load

Table 6. Class B Bus Capacitance and Resistance Expressions

Level	Capacitance	Resistance to Ground
Minimum	(3.3 x 0.9) + (0.47 x 0.9) = 3.39 nF	(1.5 x 0.95) || (10.6 x 0.95) / 25 = 314 Ω
Maximum	(3.3 x 1.1) + 25(0.47 x 1.1) = 16.55 nF	(1.5 x 1.05) || (10.6 x 1.05) = 1.38 kΩ

TYPICAL APPLICATIONS

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 pin 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 pin is an open-circuit by virtue of an internal 40 kΩ pull-down resistor. No external resistor is required for its operation.

Waveshaping and 4X/Loop

This input is a tristateable 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 is less than 2.0 µs and the fall time is less than 5.0 µs (owing 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 kΩ ±5% external resistor (as well as any 10.6 kΩ pull-down resistors of any secondary nodes) sinks the current to discharge the capacitors during high-to-low transitions. This sourcing output is short circuit-protected (60 mA 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 overtemperature 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 mA of current. The transceiver will operate with a remote ground offset of ±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 µA of current from V_{BAT}. The receive threshold is dependent on the state of the $\overline{SLEEP}$ pin. The initial state of this output is always a logic [0] after supply voltage is applied, but before the $\overline{SLEEP}$ pin goes to a logic [1] 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 33990 when remote Class B activity is detected.

When the $\overline{SLEEP}$ pin is low and message activity occurs on the bus, the receiver passes the bus message through to the microcontroller. The 33990 does not automatically “wake up” from a sleep state when bus activity occurs: the microcontroller must tell it to do so.

In the Static Electrical Characteristics table, the maximum voltage for Rx is specified as 4.75 V over an operating range of -40°C to 125°C temperature and 7.0 V to 16 V V_{BAT}. This maximum Rx voltage is compatible with the minimum V_{DD} voltage of microcontrollers to prevent the 33990 from 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 µA of current out of this pin.

Overtemperature Shutdown

If the BUS output becomes shorted to ground for any duration, an overtemperature shutdown circuit “latches off” the output source transistor whenever the die temperature exceeds 150°C 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, provided the locally sensed temperature is 10°C to 15°C below the latch-off temperature trip temperature.

Waveshaping

Waveshaping is incorporated into the 33990 to minimize radiated EMI emissions.

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 µs. For subsequent bits, if there is a bus

transition before 96 µs, one logic state is inferred. If there is a bus transition after 96 µs, the other logic state is inferred. The "end of data" bit is a logic [0] and lasts 200 µs. If there is no activity on the bus for 280 µs to 320 µs 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 secondary node 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 pins of the 33990, with the exception of BUS and LOAD, see a very low impedance to V_{BAT}.

The LOAD pin of the device has an internal transistor switch connected to it that 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 pin switch is essentially that of an "upside 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 pin. During such a loss of assembly ground condition, the BUS and LOAD pins exhibit a high impedance to V_{BAT}; all other pins will exhibit a low impedance to V_{BAT}. During this condition the BUS pin 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 6, page 11.

Loss of Assembly Battery Connection

The definition of a loss of assembly battery condition at the device level is that the V_{BAT} pin of the 33990 sees an infinite impedance to V_{BAT}, but there is some undefined impedance between these pins and ground.

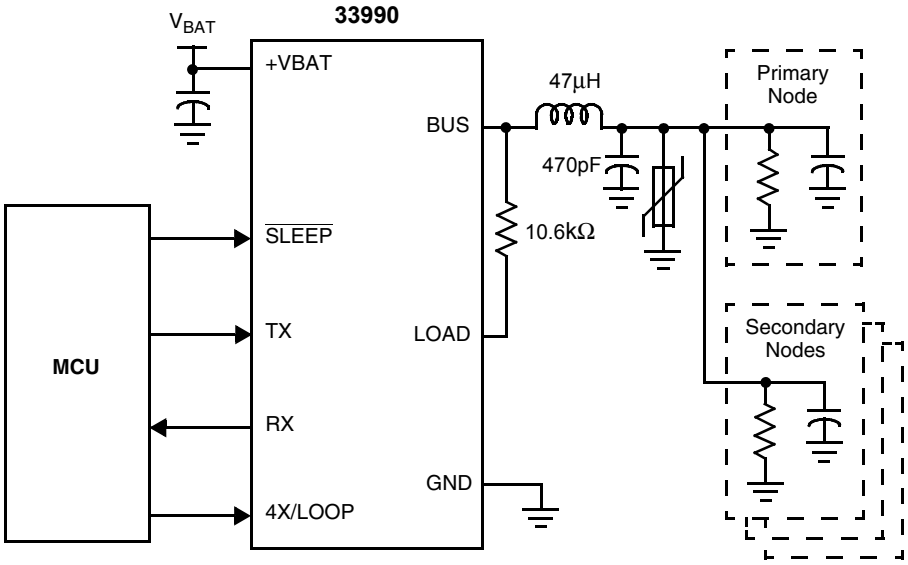
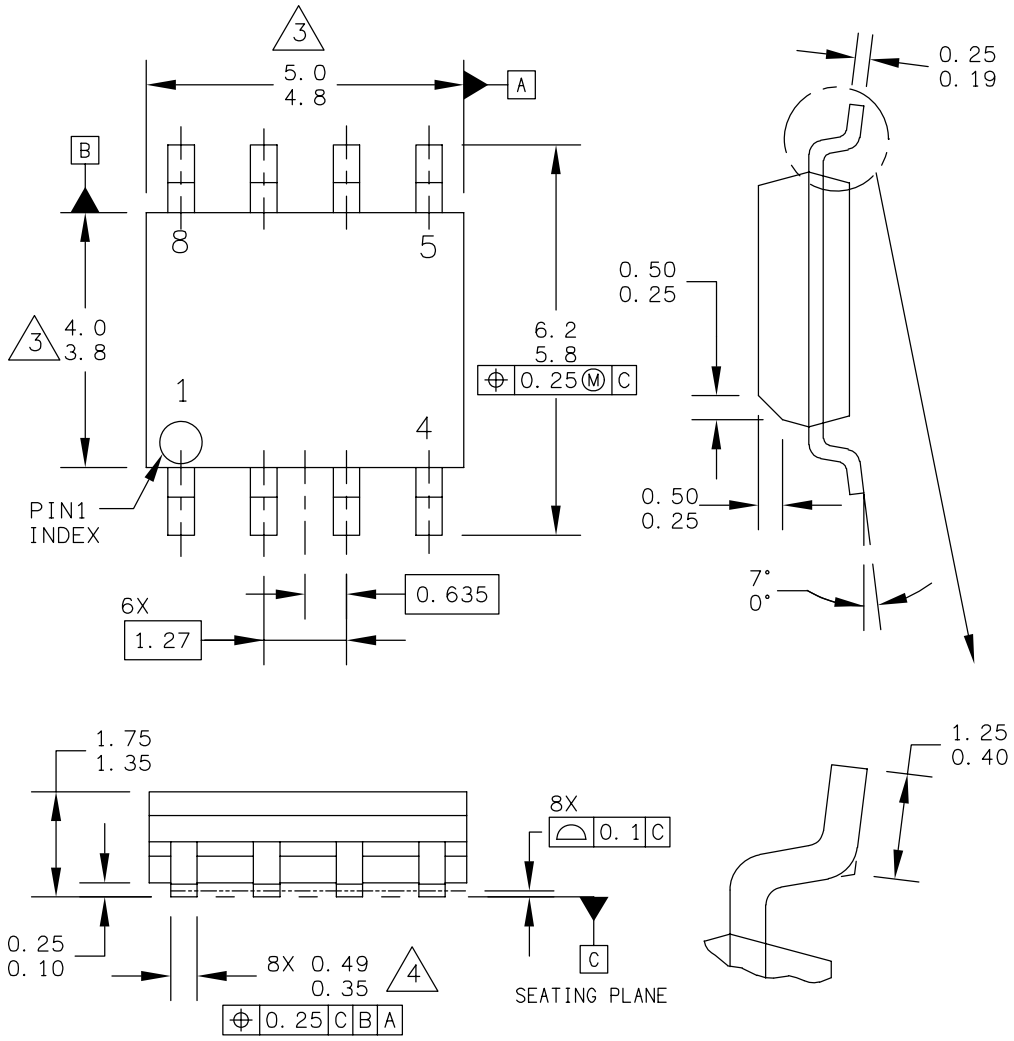


Figure 14. Typical Application

PACKAGING

PACKAGE DIMENSIONS

For the most current package revision, visit **www.freescale.com** and perform a keyword search using the “98A” listed below.



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	CASE NUMBER: 751-07	07 APR 2005
	STANDARD: JEDEC MS-012AA	

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EF SUFFIX (PB-FREE)
8-PIN
PLASTIC PACKAGE
98ASB42564B

REVISION HISTORY

REVISION	DATE	DESCRIPTION OF CHANGES
2.0	10/2006	• Implemented Revision History page • Converted to Freescale format
3.0	11/2006	• Removed Peak Package Reflow Temperature During Reflow (solder reflow) parameter from Maximum Ratings on page 4. Added note with instructions to obtain this information from www.freescale.com.
4.0	10/2008	• Changed status to final, “Technical Data” thereby removing the “Advance Information” watermark on page 1. No Technical Changes.

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