PCA82C251

CAN transceiver for 24 V systems.

GENERAL DESCRIPTION

The PCA82C251 is the interface between the CAN protocol controller and the physical bus.
It is primarily intended for applications (up to 1 Mbaud) in trucks and buses.
The device provides differential transmit capability to the bus and differential receive capability to the CAN controller.

FEATURES

- Fully compatible with the “ISO 11898-24 V” standard
- Slope control to reduce RFI
- Thermally protected
- Short-circuit proof to battery and ground in 24 V powered systems
- Low-current standby mode
- An unpowered node does not disturb the bus lines
- At least 110 nodes can be connected
- High speed (up to 1 Mb)
- High immunity against electromagnetic interference

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
V_{CC}	Supply Voltage		4.5	5.5	V
I_{CC}	Supply Current	Standby Mode	-	275	µA
$1/t_{bit}$	Maximum Transmission Speed	Non Return To Zero	1	-	Mb
V_{CAN}	CANH, CANL In/Out Voltage		-36	+36	V
V_{diff}	Differential Bus Voltage		1.5	3	V
T_{amb}	Ambient Temperature		-40	+125	°C

ORDERING INFORMATION

TYPE NUMBER	DESCRIPTION	PACKAGE
PCA52C251	plastic dual in-line package; 8 leads (300 mil)	DIP8
PCA52C251T	plastic small outline package; 8 leads body width 3.9 mm	SO8

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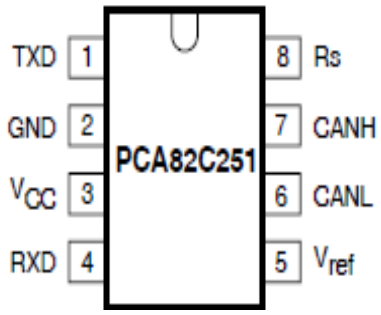
PINNING



PIN	SYMBOL	DESCRIPTION
1	**TXD**	Transmit Data Input
2	**GND**	Ground
3	**V_{CC}**	Supply Voltage
4	**RXD**	Receive Data Output
5	**V_{ref}**	Reference Voltage Output
6	**CANL**	Low-Level CAN Voltage In/Out
7	**CANH**	High-Level CAN Voltage In/Out
8	**R_S**	Slope Resistor Input

FUNCTIONAL DESCRIPTION

The PCA82C251 is the interface between the CAN protocol controller and the physical bus.
It is primarily intended for applications up to 1 Mb in trucks and buses.
The device provides differential transmit capability to the bus and differential receive capability to the CAN controller.
It is fully compatible with the “ISO 11898-24 V” standard.
A current limiting circuit protects the transmitter output stage against short-circuit to positive and negative battery voltage.
Although the power dissipation is increased during this fault condition, this feature will prevent destruction of the transmitter output stage.
If the junction temperature exceeds a value of approximately 160 C, the limiting current of both transmitter outputs is decreased.
Because the transmitter is responsible for the major part of the power dissipation, this will result in a reduced power dissipation and hence a lower chip temperature.
All other parts of the IC will remain operating.
The thermal protection is particularly needed when a bus line is short-circuited.
The CANH and CANL lines are also protected against electrical transients which may occur in an automotive environment.
Pin 8 (Rs) allows three different modes of operation to be selected: high-speed, slope control or standby.
For high-speed operation, the transmitter output transistors are simply switched on and off as fast as possible.
In this mode, no measures are taken to limit the rise and fall slope. Use of a shielded cable is recommended to avoid RFI problems.
The high-speed mode is selected by connecting pin 8 to ground.
The slope control mode allows the use of an unshielded twisted pair or a parallel pair of wires as bus lines. To reduce RFI, the rise and fall slope should be limited.
The rise and fall slope can be programmed with a resistor connected from pin 8 to ground. The slope is proportional to the current output at pin 8.
If a HIGH level is applied to pin 8, the circuit enters a low current standby mode. In this mode, the transmitter is switched off and the receiver is switched to a low current.
If dominant bits are detected (differential bus voltage >0.9 V), RXD will be switched to a LOW level.
The microcontroller should react to this condition by switching the transceiver back to normal operation (via pin 8). Because the receiver is slower in standby mode, the first message will be lost at higher bit rates.

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Table 1 Truth table of the CAN transceiver

V_{CC}	TXT	CANH	CANL	BUS STATE	RXD
4.5 to 5.5 V	0	HIGH	LOW	dominant	0
4.5 to 5.5 V	1 (Floating)	floating	floating	recessive	1(2)
4.5 <V_{CC}< 5.5 V	X(1)	floating if V_{Rs}>0.75 V_{CC}	Floating if V_{Rs}>0.75 V_{CC}	floating	1(2)
0 <V_{CC}< 5.5 V	floating	floating	floating	floating	X(1)

Notes
1. X = don't care.
2. If another bus node is transmitting a dominant bit, then RXD is logic 0.

Table 2 Pin R_S summary

CONDITION FORCED AT PIN R_S	MODE	RESULTING VOLTAGE OR CURRENT AT PIN R_S
V_{Rs} >0.75 V_{CC}	Standby	-I_{Rs} < 10 µA
10 µA < -I_{Rs} < 200 µA	Slope control	0.4 V_{CC} < V_{Rs} < 0.6 V_{CC}
V_{Rs} > 0.3 V_{CC}	High-speed	-I_{Rs} < 500 µA

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134); all voltages are referenced to pin 2; positive input current.

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
V_{CC}	Supply Voltage		-0.3	+7	V
V_N	DC Voltage at Pin 1,4,5 And 8		-0.3	V_{CC}+3	V
V_6	DC Voltage at Pin 6 (CANL)	0V < V_{CC} < 5.5 V TXD High or floating	-36	+36	V
		0V < VCC < 5.5 V No time limit (note1)	-36	+36	V
		0V < VCC < 5.5 V No time limit (note2)	-36	+36	V
V_7	DC Voltage at Pin 7 (CANH)	0V < VCC < 5.5 V No time limit	-36	+36	V
V_{tr}	Transient Voltage Pins 6 And 7		-200	+200	V
T_{stg}	Storage Temperature		-55	+150	°C
T_{amb}	Ambient Temperature		-40	+125	°C
T_{vj}	Virtual Junction Temperature	(note3)	-40	+150	°C
V_{esd}	Electrostatic Discharge Voltage	(note4)	-2500	+2500	V
		(note5)	-250	+250	V

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Notes

1. TXD is LOW. Short-circuit protection provided for slew rates up to 5 V/ms for voltages above +30 V
2. Short-circuit applied when TXD is HIGH, followed by TXD switched to LOW.
3. In accordance with “IEC 60747-1”. An alternative definition of virtual junction temperature is: Tvj = Tamb + Pd ´ Rth(vj-a), where Rth(vj-a) is a fixed value to be used for the calculation of Tvj. The rating for Tvj limits the allowable combinations of power dissipation (Pd) and ambient temperature (Tamb).
4. Classification A: human body model; C = 100 pF; R = 1500 Ω; V = ±2500 V.
5. Classification B: machine model; C = 200 pF; R = 0 Ω; V = ±250 V.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER		CONDITIONS	VALUE	UNIT
$R_{th(j-a)}$	Thermal Resistance From Junction to Ambient	PCA82C251	In free air	100	K/W
		PCA82C251T		160	

CHARACTERISTICS

V_{CC} = 4.5 to 5.5 V; T_{amb} = -40 to +125 °C; R_L = 60 Ω; I_8 > -10 µA; unless otherwise specified; all voltages referenced to ground (pin 2); positive input current; all parameters are guaranteed over the ambient temperature range by design, but only 100% tested at +25 °C.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply						
I_3	Supply Current	Dominant; V_1 = 1 V V_{CC} < 5.1V	-	-	78	mA
		Dominant; V_1 = 1 V V_{CC} < 5.25V	-	-	80	
		Dominant; V_1 = 1 V V_{CC} < 5.5V	-	-	85	
		recessive; V_1 = 4 V R_8 = 47 kΩ	-	-	10	
		Standby, Note1	-	-	275	µA

COMSET SEMICONDUCTORS

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SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
DC bus transmitter						
V_{IH}	High-Level Input Voltage	Output recessive	$0.7V_{CC}$	-	$V_{CC}+0.3$	V
V_{IL}	LOW-Level Input Voltage	Output dominant	-0.3	-	$0.3V_{CC}$	V
I_{IH}	HIGH-Level Input Current	V_1 = 4 V	-200	-	+30	µA
I_{IL}	LOW-Level Input Current	V_1 = 1 V	-100	-	-600	µA
$V_{6,7}$	Recessive Bus Voltage	V_1 = 4 V, no load	2	-	3	V
I_{LO}	Off-State Output Leakage Current	-2 V < (V_6,V_7) < 7 V	-2	-	+2	mA
		-5 V < (V_6,V_7) < 36 V	-10	-	+10	
V_7	CANH Output Voltage	V_1 = 1 V V_{CC} = 4.75 to 5.5 V	3	-	4.5	V
		V_1 = 1 V V_{CC} = 4.5 to 4.75 V	2.75	-	4.5	
V_6	CANL Output Voltage	V_1 = 1 V	0.5	-	2	V
$\Delta V_{6,7}$	Difference Between Output Voltage at Pins 6 And 7	V_1 = 1 V	1.5	-	3	V
		V_1 = 1 V, R_L = 45 Ω	1.5	-	-	
		V_1 = 4 V, no load	-500	-	+50	mA
I_{SC7}	Short-Circuit CANH Current	V_7 = -5 V	-	-	-200	mA
		V_7 = -36 V	-	-100	-	
I_{SC6}	Short-Circuit CANL Current	V_6 = 36 V	-	-	200	mA

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
DC bus receiver [V_1 = 4 V; pins 6 and 7 externally driven; -2 V < (V_6, V_7) < 7 V; unless otherwise specified]						
$V_{diff(r)}$	Differential Input Voltage (Recessive) Note 2		-1	-	+0.5	V
		-7 V < (V_6,V_7) < 12 V	-1	-	+0.4	
$V_{diff(d)}$	Differential Input Voltage (Dominant)		0.9	-	5	V
		-7 V < (V_6,V_7) < 12 V Not standby mode	1	-	5	
		Standby mode	0.97	-	5	
		V_{CC} = 4.5 to 5.1 V Standby mode	0.91	-	5	
$V_{diff(hys)}$	Differential Input Hysteresis		-	150	-	mV
V_{OH}	High-Level Output Voltage (Pin4)	I_4 = 100 µA	$0.8V_{CC}$	-	V_{CC}	V
V_{OL}	LOW-Level Output Voltage (Pin4)	I_4 = 1 mA	0	-	$0.2V_{CC}$	V
		I_4 = 10 mA	0	-	1.5	
R_i	CANH, CANL Input Résistance		5	-	25	KΩ
R_{diff}	Differential Input Resistance		20	-	100	kΩ

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SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Reference output						
Vref	Reference Output Voltage	V_8 = 1 V, $\|I_5\|$ < 50 µA	$0.45V_{CC}$	-	$0.55V_{CC}$	V
		V_8 = 5 V, $\|I_5\|$ < 5 µA	$0.4V_{CC}$	-	$0.6V_{CC}$	

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Timing (R_L = 60 Ω; C_L = 100 pF, unless otherwise specified)						
t_{bit}	Minimum Bit Time	R_8 = 0 Ω	-	-	1	µs
t_{onDXD}	Delay TXD to Bus Active	R_8 = 0 Ω	-	-	50	Ns
t_{offTXD}	Delay TXD to Bus Inactive	R_8 = 0 Ω	-	40	80	Ns
t_{onRXD}	Delay TXD to Receive Active	R_8 = 0 Ω	-	55	120	Ns
t_{offRXD}	Delay TXD to Receive Inactive	R_8 = 0 Ω, Tamb < 85°C VCC = 4.5 to 5.1 V	-	80	150	Ns
		R_8 = 0 Ω VCC = 4.5 to 5.1 V	-	80	170	
		R_8 = 0 Ω, Tamb < 85°C	-	90	170	
		R_8 = 0 Ω	-	90	190	
		R_8 = 47 Ω	-	290	400	
t_{onRXD}	Delay TXD to Receive Active	R_8 = 47 Ω	-	440	550	Ns
|SR|	CANH, CANL Slew Rate	R_8 = 47 Ω	-	7	-	V/µs
t_{WAKE}	Wake-Up Time From Standby (via pin 8)		-	-	20	µs
t_{dRXDL}	Bus Dominant to RXD LOW	V_8 = 4V	-	-	3	µs

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Standby/slope control (pin 8)						
V_{stb}	Input Voltage For Standby Mode		$0.75V_{CC}$	-	-	V
I_{slope}	Slope Control Mode Current		-10	-	-200	µA
V_{slope}	Slope Control Mode Voltage		$0.4V_{CC}$	-	$0.6V_{CC}$	V

Notes

1. $I_1 = I_4 = I_5 = 0$ mA; 0 V < V_6 < V_{CC}; 0 V < V_7 < V_{CC}; $V_8 = V_{CC}$; T_{amb} < 90 °C.
2. This is valid for the receiver in all modes: high-speed, slope control and standby

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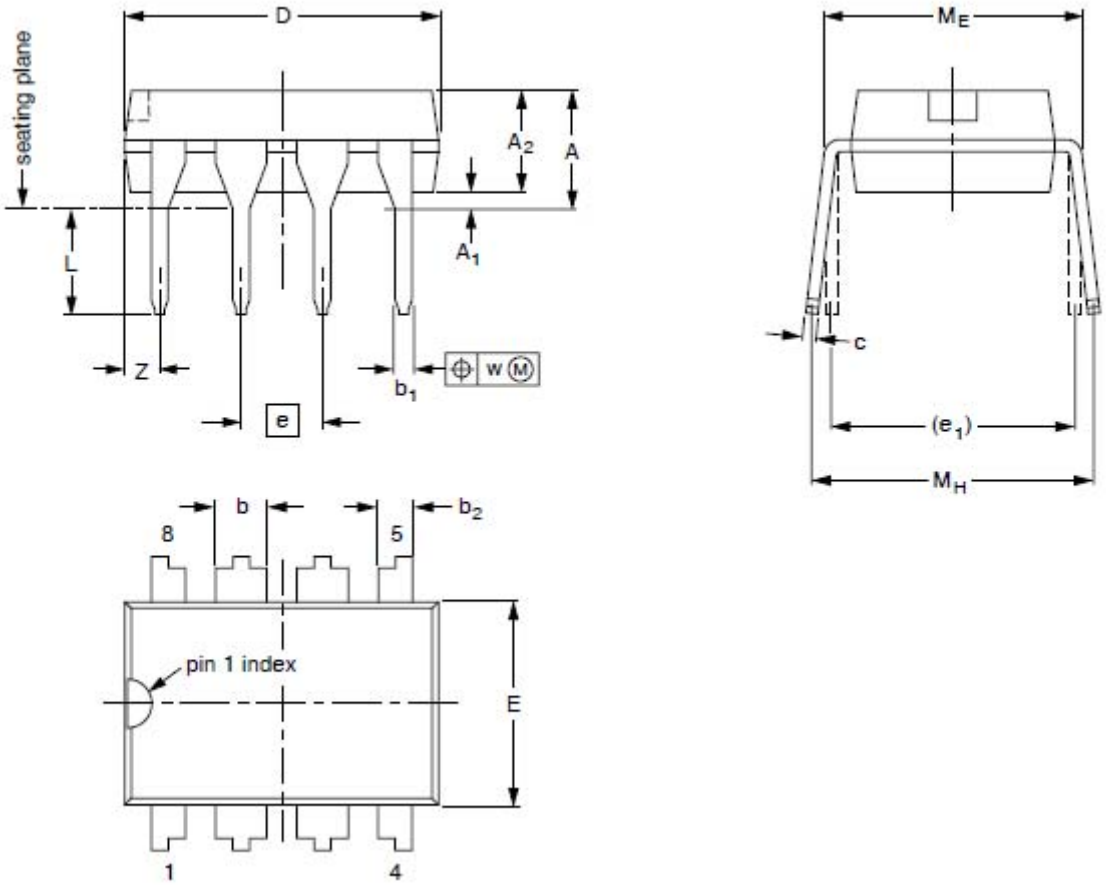
PACKAGE DIP 8



DIMENSIONS

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.14	0.53 0.38	1.07 0.89	0.36 0.23	9.8 9.2	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	1.15
inches	0.17	0.020	0.13	0.068 0.045	0.021 0.015	0.042 0.035	0.014 0.009	0.39 0.36	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.045

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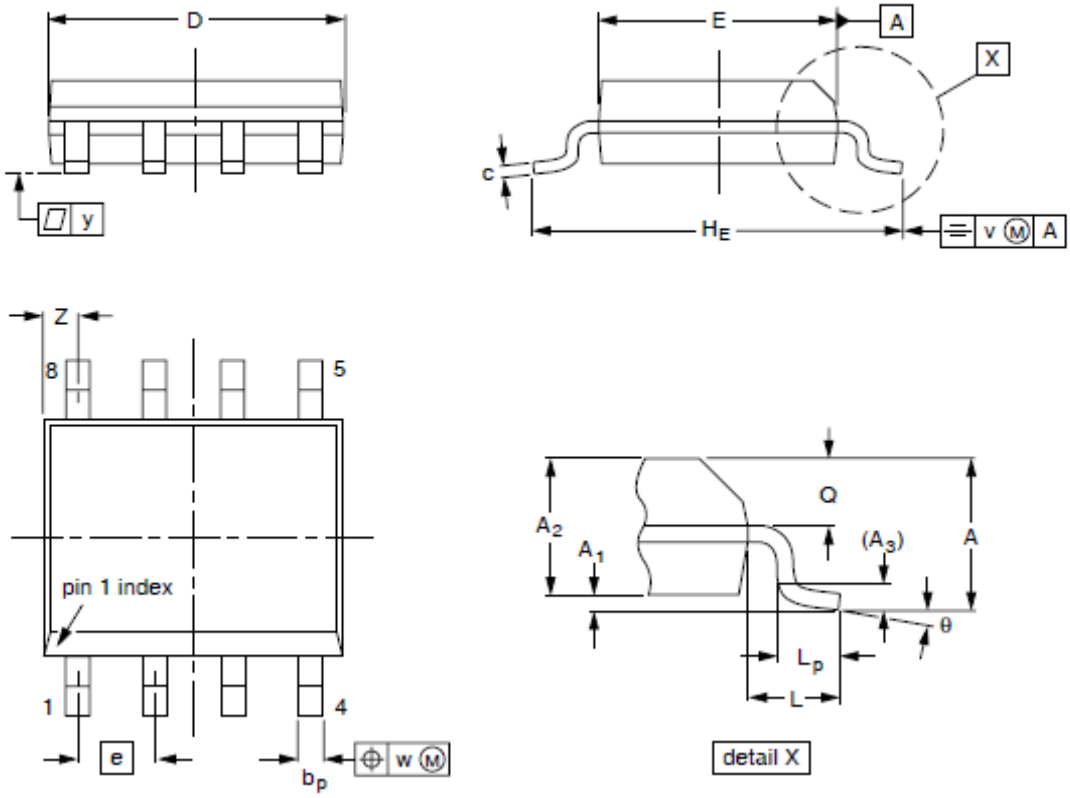
PACKAGE SO 8



DIMENSIONS

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

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