

PCA82C251

CAN transceiver for 24 V systems

Rev. 04 — 25 August 2011

Product data sheet

1. General description

The PCA82C251 is the interface between a CAN protocol controller and the physical bus. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller.

2. Features and benefits

- Fully compatible with the "ISO 11898-24 V" standard
- Slope control to reduce Radio Frequency Interference (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 MBd)
- High immunity against electromagnetic interference.

3. Applications

- High-speed applications (up to 1 MBd) in trucks and busses.

4. Quick reference data

Table 1. 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	μ A
$1/t_{bit}$	maximum transmission speed	non-return-to-zero	1	-	MBd
V_{CAN}	CANH, CANL input/output voltage		-36	+36	V
V_{diff}	differential bus voltage		1.5	3.0	V
t_{PD}	propagation delay	High-speed mode	-	50	ns
T_{amb}	ambient temperature		-40	+125	$^{\circ}$ C



5. Ordering information

Table 2. Ordering information

Type number	Package		Version
	Name	Description	
PCA82C251T	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1

6. Block diagram

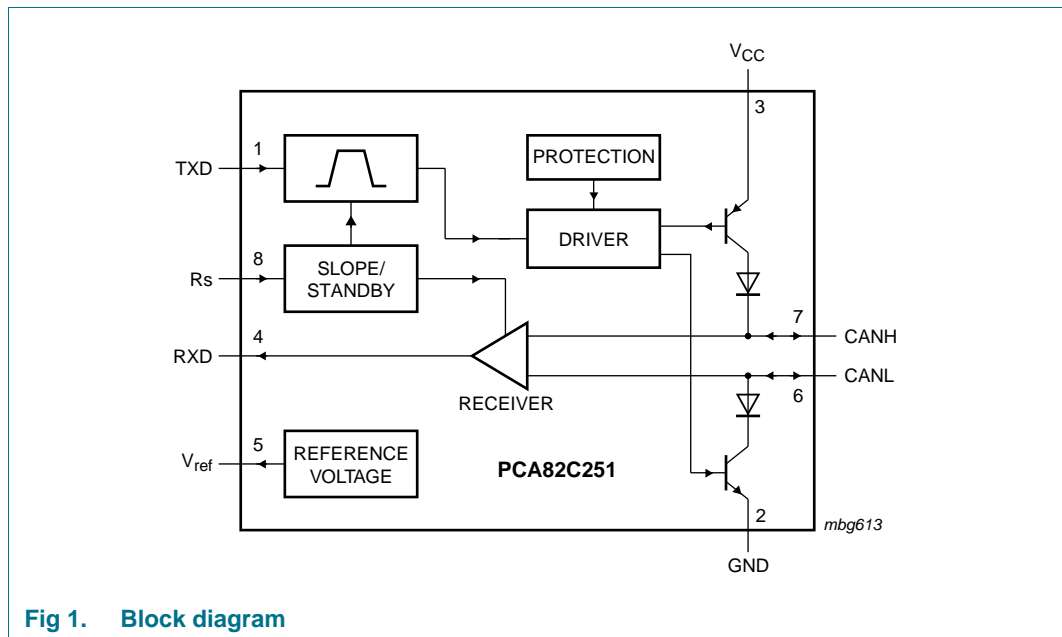


Fig 1. Block diagram

7. Pinning information

7.1 Pinning

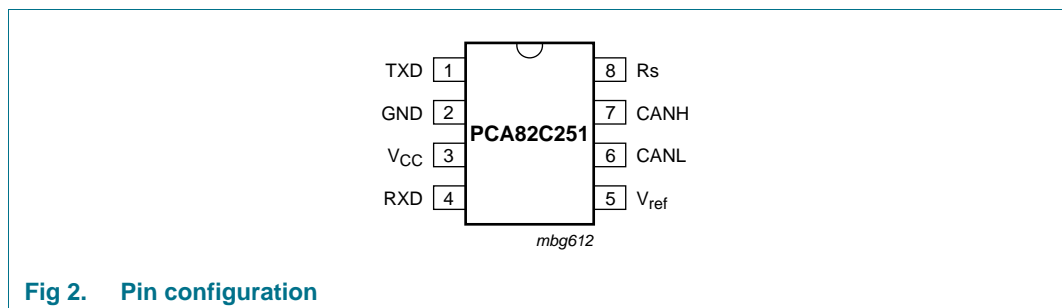


Fig 2. Pin configuration

7.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
TXD	1	transmit data input
GND	2	ground
V _{CC}	3	supply voltage
RXD	4	receive data output
V _{ref}	5	reference voltage output
CANL	6	LOW-level CAN voltage input/output
CANH	7	HIGH-level CAN voltage input/output
Rs	8	slope resistor input

8. Functional description

The PCA82C251 is the interface between a CAN protocol controller and the physical bus. It is primarily intended for applications up to 1 MBd 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-circuits to positive and negative battery voltage. Although power dissipation will increase as a result of a short circuit fault condition, this feature will prevent destruction of the transmitter output stage.

If the junction temperature exceeds approximately 160 °C, the limiting current of both transmitter outputs is decreased. Because the transmitter is responsible for most of the power dissipated, this will result in reduced power dissipation and hence a lower chip temperature. All other parts of the IC will remain operational. The thermal protection is needed, in particular, 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 and 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 slopes. A shielded cable is recommended to avoid RFI problems. High-speed mode is selected by connecting pin 8 to ground.

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 slopes should be limited. The rise and fall slopes 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.

Table 4. Truth table of the CAN transceiver

Supply	TXD	CANH	CANL	Bus state	RXD
4.5 V to 5.5 V	0	HIGH	LOW	dominant	0
4.5 V to 5.5 V	1 (or floating)	floating	floating	recessive	1 ^[1]
4.5 V < V _{CC} < 5.5 V	X ^[2]	floating if V _{Rs} > 0.75V _{CC}	floating if V _{Rs} > 0.75V _{CC}	floating	X ^[1]
0 V < V _{CC} < 4.5 V	floating	floating	floating	floating	X ^[2]

[1] If another bus node is transmitting a dominant bit, then RXD is logic 0.

[2] X = don't care.

Table 5. Pin Rs summary

Condition forced at pin Rs	Mode	Resulting voltage or current at pin Rs
V _{Rs} > 0.75V _{CC}	Standby	-I _{Rs} < 10 μA
10 μA < -I _{Rs} < 200 μA	Slope control	0.4V _{CC} < V _{Rs} < 0.6V _{CC}
V _{Rs} < 0.3V _{CC}	High-speed	-I _{Rs} < 500 μA

9. Limiting values

Table 6. 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	+7.0	V
V _n	DC voltage at pins 1, 4, 5 and 8		-0.3	V _{CC} + 0.3	V
V ₆	DC voltage at pin 6 (CANL)	0 V < V _{CC} < 5.5 V; TXD HIGH or floating	-36	+36	V
		0 V < V _{CC} < 5.5 V; no time limit	^[1] -36	+36	V
		0 V < V _{CC} < 5.5 V; no time limit	^[2] -36	+36	V
V ₇	DC voltage at pins 7 (CANH)	0 V < V _{CC} < 5.5 V; no time limit	-36	+36	V
V _{tt}	transient voltage at pins 6 and 7	see Figure 8	-200	+200	V
T _{stg}	storage temperature		-55	+150	°C
T _{amb}	ambient temperature		-40	+125	°C
T _{vj}	virtual junction temperature		^[3] -40	+150	°C
V _{ESD}	electrostatic discharge voltage		^[4] -2500	+2500	V
			^[5] -250	+250	V

[1] TXD is LOW. Short-circuit protection provided for slew rates up to 5 V/μs 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: $T_{vj} = T_{amb} + P_d \times R_{th(vj-a)}$, where $R_{th(j-a)}$ is a fixed value to be used for the calculation of T_{vj} . The rating for T_{vj} limits the allowable combinations of power dissipation (P_d) and ambient temperature (T_{amb}).

[4] Classification A: human body model; C = 100 pF; R = 1500 Ω; V = ±2000 V.

[5] Classification B: machine model; C = 200 pF; R = 25 Ω; V = ±200 V.

10. Thermal characteristics

Table 7. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	160	K/W

11. Characteristics

Table 8. Characteristics

$V_{CC} = 4.5\text{ V to }5.5\text{ V}$; $T_{amb} = -40\text{ }^{\circ}\text{C to }+125\text{ }^{\circ}\text{C}$; $R_L = 60\ \Omega$; $I_B > -10\ \mu\text{A}$; 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; $V_1 = 1\text{ V}$; $V_{CC} = 5.1\text{ V}$	-	-	78	mA	
		dominant; $V_1 = 1\text{ V}$; $V_{CC} = 5.25\text{ V}$	-	-	80	mA	
		dominant; $V_1 = 1\text{ V}$; $V_{CC} = 5.5\text{ V}$	-	-	85	mA	
		recessive; $V_1 = 4\text{ V}$; $R_8 = 47\text{ k}\Omega$	-	-	10	mA	
		Standby	[1]	-	-	275	μA
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	$V_1 = 4\text{ V}$	-200	-	+30	μA	
I_{IL}	LOW-level input current	$V_1 = 1\text{ V}$	-100	-	-600	μA	
$V_{6,7}$	recessive bus voltage	$V_1 = 4\text{ V}$; no load	2.0	-	3.0	V	
I_{LO}	off-state output leakage current	$-2\text{ V} < (V_6, V_7) < 7\text{ V}$	-2	-	+2	mA	
		$-5\text{ V} < (V_6, V_7) < 36\text{ V}$	-10	-	+10	mA	
V_7	CANH output voltage	$V_1 = 1\text{ V}$; $V_{CC} = 4.75\text{ V to }5.5\text{ V}$	3.0	-	4.5	V	
		$V_1 = 1\text{ V}$; $V_{CC} = 4.5\text{ V to }4.75\text{ V}$	2.75	-	4.5		
V_6	CANL output voltage	$V_1 = 1\text{ V}$	0.5	-	2.0	V	
$\Delta V_{6,7}$	difference between output voltage at pins 6 and 7	$V_1 = 1\text{ V}$	1.5	-	3.0	V	
		$V_1 = 1\text{ V}$; $R_L = 45\ \Omega$	1.5	-	-	V	
		$V_1 = 4\text{ V}$; no load	-500	-	+50	mV	
I_{sc7}	short-circuit CANH current	$V_7 = -5\text{ V}$	-	-	-200	mA	
		$V_7 = -36\text{ V}$	-	-100	-	mA	
I_{sc6}	short-circuit CANL current	$V_6 = 36\text{ V}$	-	-	200	mA	
DC bus receiver: $V_1 = 4\text{ V}$; pins 6 and 7 externally driven; $-2\text{ V} < (V_6, V_7) < 7\text{ V}$; unless otherwise specified							
$V_{diff(r)}$	differential input voltage (recessive)		[2]	-1.0	-	+0.5	V
		$-7\text{ V} < (V_6, V_7) < 12\text{ V}$	[2]	-1.0	-	+0.4	V
$V_{diff(d)}$	differential input voltage (dominant)			0.9	-	5.0	V
		$-7\text{ V} < (V_6, V_7) < 12\text{ V}$; not Standby mode		1.0	-	5.0	V
		Standby mode		0.97	-	5.0	V
		Standby mode; $V_{CC} = 4.5\text{ V to }5.10\text{ V}$		0.91	-	5.0	V

Table 8. Characteristics ...continued

$V_{CC} = 4.5\text{ V to }5.5\text{ V}$; $T_{amb} = -40\text{ }^{\circ}\text{C to }+125\text{ }^{\circ}\text{C}$; $R_L = 60\ \Omega$; $I_8 > -10\ \mu\text{A}$; 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
$V_{diff(hys)}$	differential input hysteresis	see Figure 5	-	150	-	mV
V_{OH}	HIGH-level output voltage	pin 4; $I_4 = -100\ \mu\text{A}$	$0.8V_{CC}$	-	V_{CC}	V
V_{OL}	LOW-level output voltage	pin 4; $I_4 = 1\ \text{mA}$	0	-	$0.2V_{CC}$	V
		$I_4 = 10\ \text{mA}$	0	-	1.5	V
R_i	input resistance	CANH, CANL	5	-	25	k Ω
R_{diff}	differential input resistance		20	-	100	k Ω
Reference output						
V_{ref}	reference output voltage	$V_8 = 1\ \text{V}$; $ I_5 < 50\ \mu\text{A}$	$0.45V_{CC}$	-	$0.55V_{CC}$	V
		$V_8 = 4\ \text{V}$; $ I_5 < 5\ \mu\text{A}$	$0.4V_{CC}$	-	$0.6V_{CC}$	V
Timing ($C_L = 100\ \text{pF}$; see Figure 3, Figure 4, Figure 6 and Figure 7)						
t_{bit}	minimum bit time	$R_{ext} = 0\ \Omega$	-	-	1	μs
t_{onTXD}	delay TXD to bus active	$R_{ext} = 0\ \Omega$	-	-	50	ns
t_{offTXD}	delay TXD to bus inactive	$R_{ext} = 0\ \Omega$	-	40	80	ns
t_{onRXD}	delay TXD to receiver active	$R_{ext} = 0\ \Omega$	-	55	120	ns
t_{offRXD}	delay TXD to receiver inactive	$R_{ext} = 0\ \Omega$; $T_{amb} < +85\text{ }^{\circ}\text{C}$ $V_{CC} = 4.5\ \text{V to }5.1\ \text{V}$	-	80	150	ns
		$R_{ext} = 0\ \Omega$; $V_{CC} = 4.5\ \text{V to }5.1\ \text{V}$	-	80	170	ns
		$R_{ext} = 0\ \Omega$; $T_{amb} < +85\text{ }^{\circ}\text{C}$	-	90	170	ns
		$R_{ext} = 0\ \text{k}\Omega$	-	90	190	ns
		$R_{ext} = 47\ \text{k}\Omega$	-	290	400	ns
t_{onRXD}	delay TXD to receiver active	$R_{ext} = 47\ \text{k}\Omega$	-	440	550	ns
$ SR $	CANH, CANL slew rate	$R_{ext} = 47\ \text{k}\Omega$	-	7	-	V/ μs
t_{WAKE}	wake-up time from Standby (via pin 8)	see Figure 6	-	-	20	μs
t_{dRXDL}	bus dominant to RXD LOW	$V_8 = 4\ \text{V}$; see Figure 7	-	-	3	μs
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

[1] $I_1 = I_4 = I_5 = 0\ \text{mA}$; $0\ \text{V} < V_6 < V_{CC}$; $0\ \text{V} < V_7 < V_{CC}$; $V_8 = V_{CC}$; $T_{amb} < 90\text{ }^{\circ}\text{C}$.

[2] This is valid for the receiver in all modes: High-speed, Slope control and Standby.

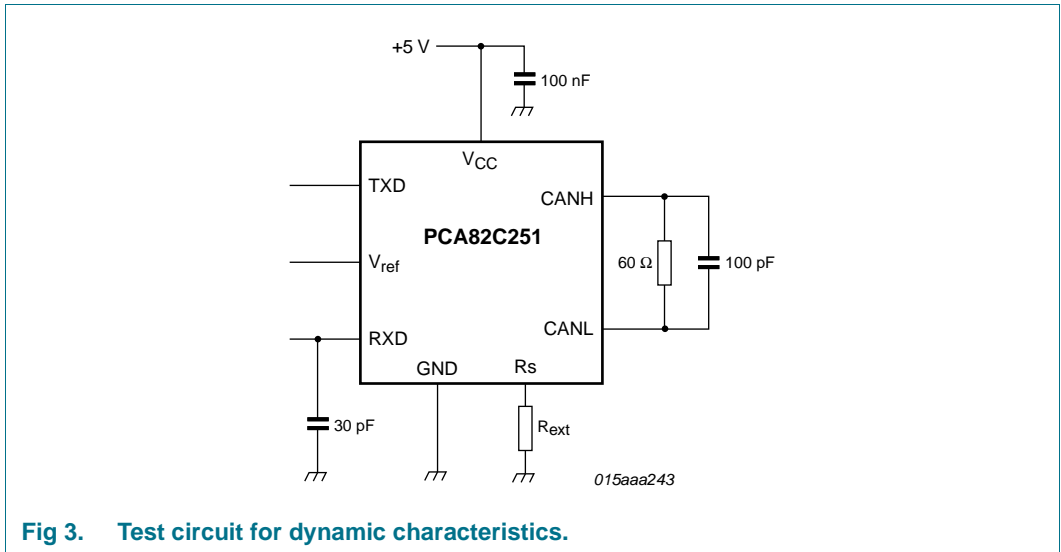


Fig 3. Test circuit for dynamic characteristics.

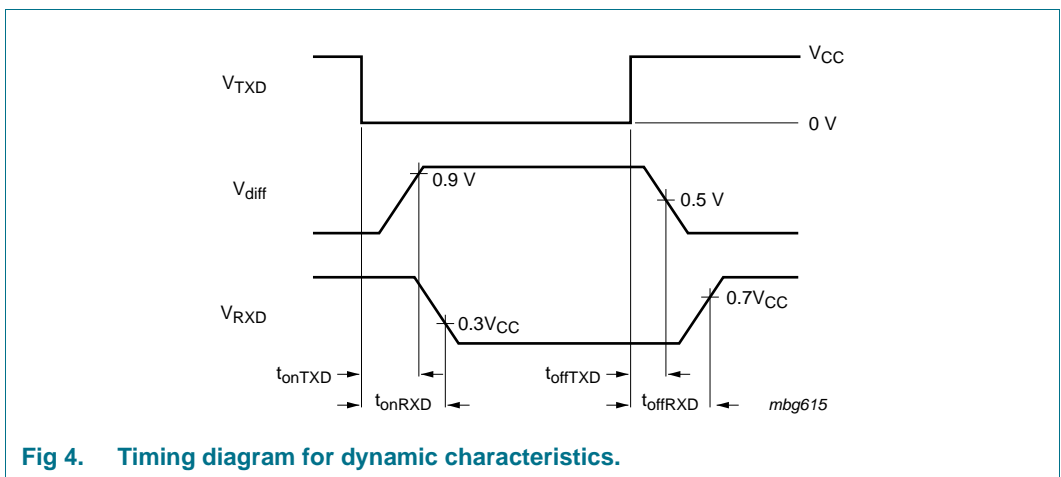


Fig 4. Timing diagram for dynamic characteristics.

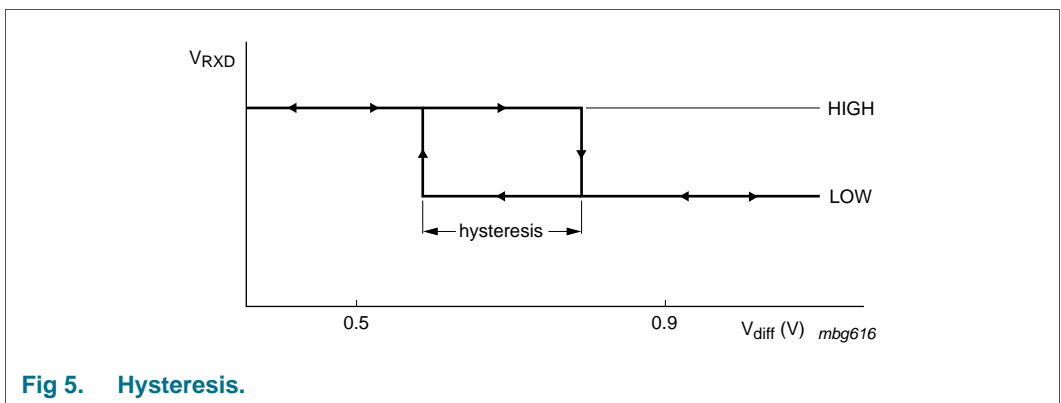
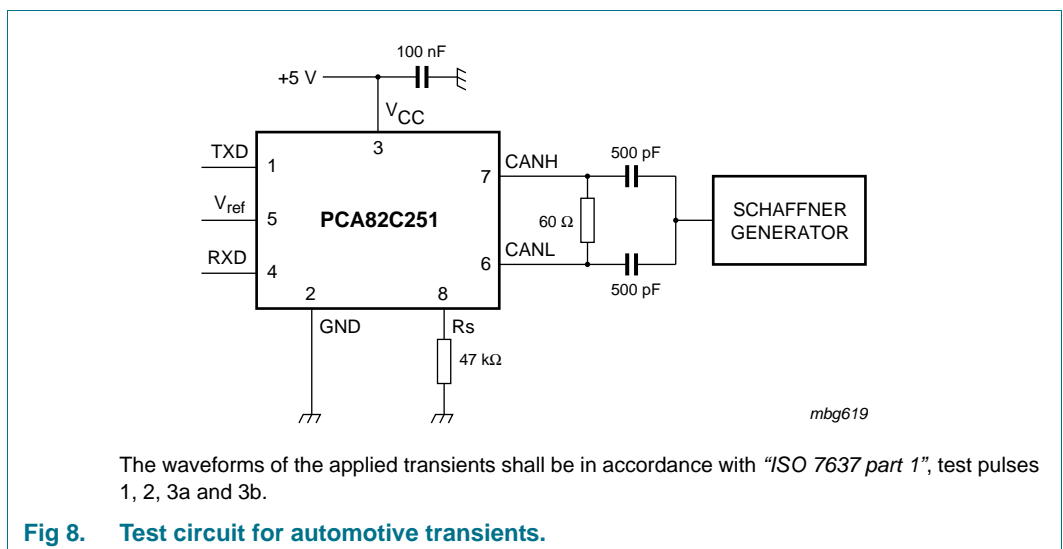
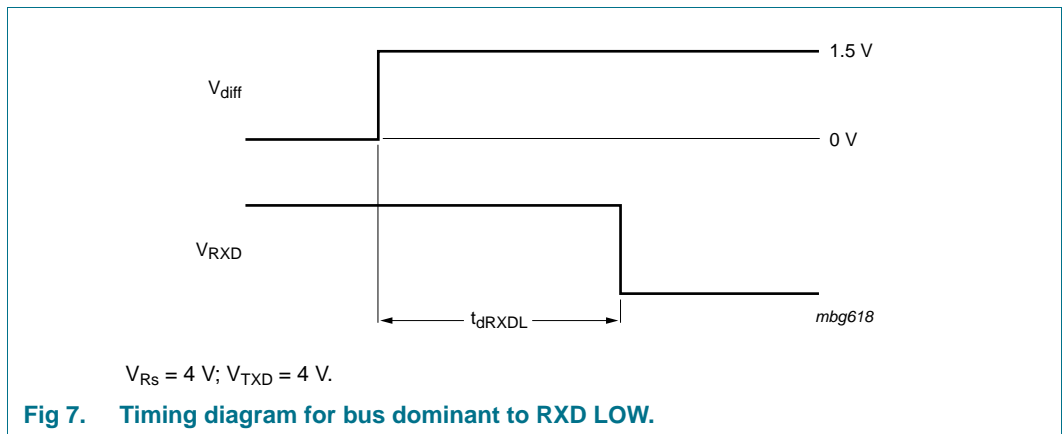
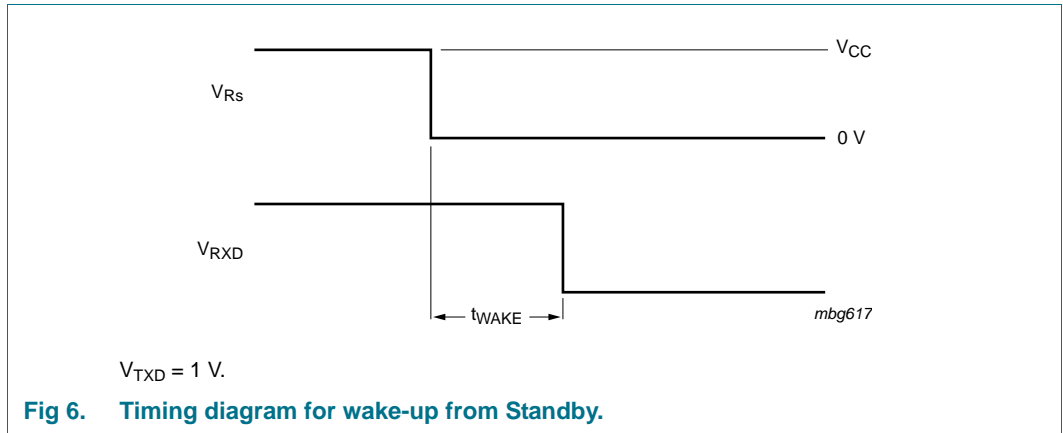
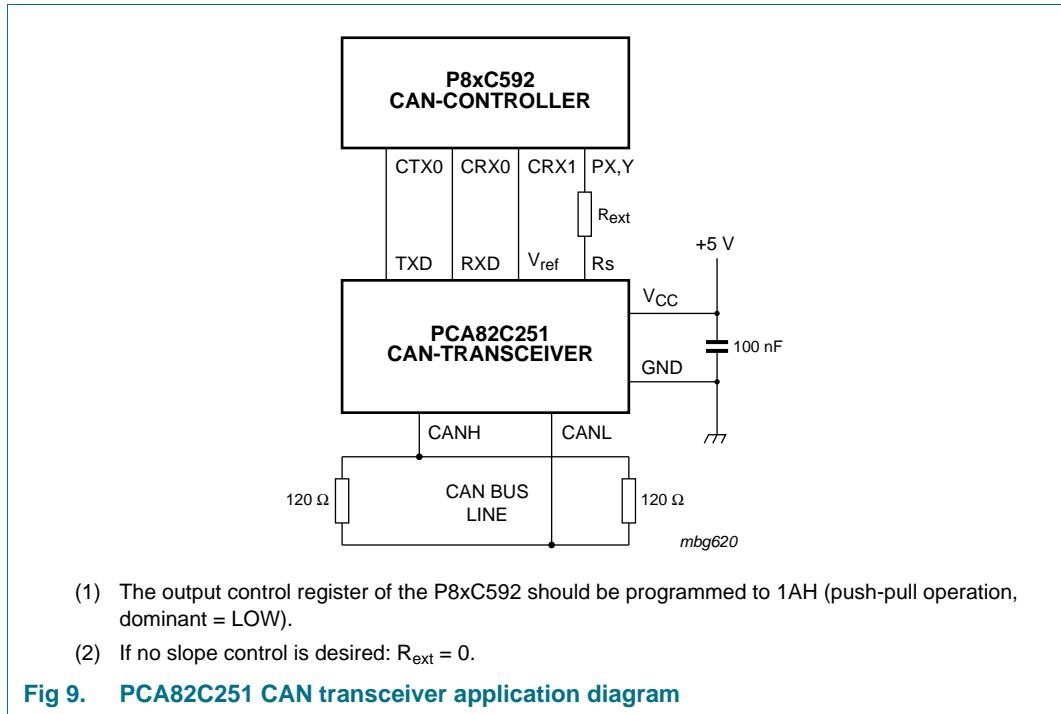


Fig 5. Hysteresis.



12. Application information



13. Package outline

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1

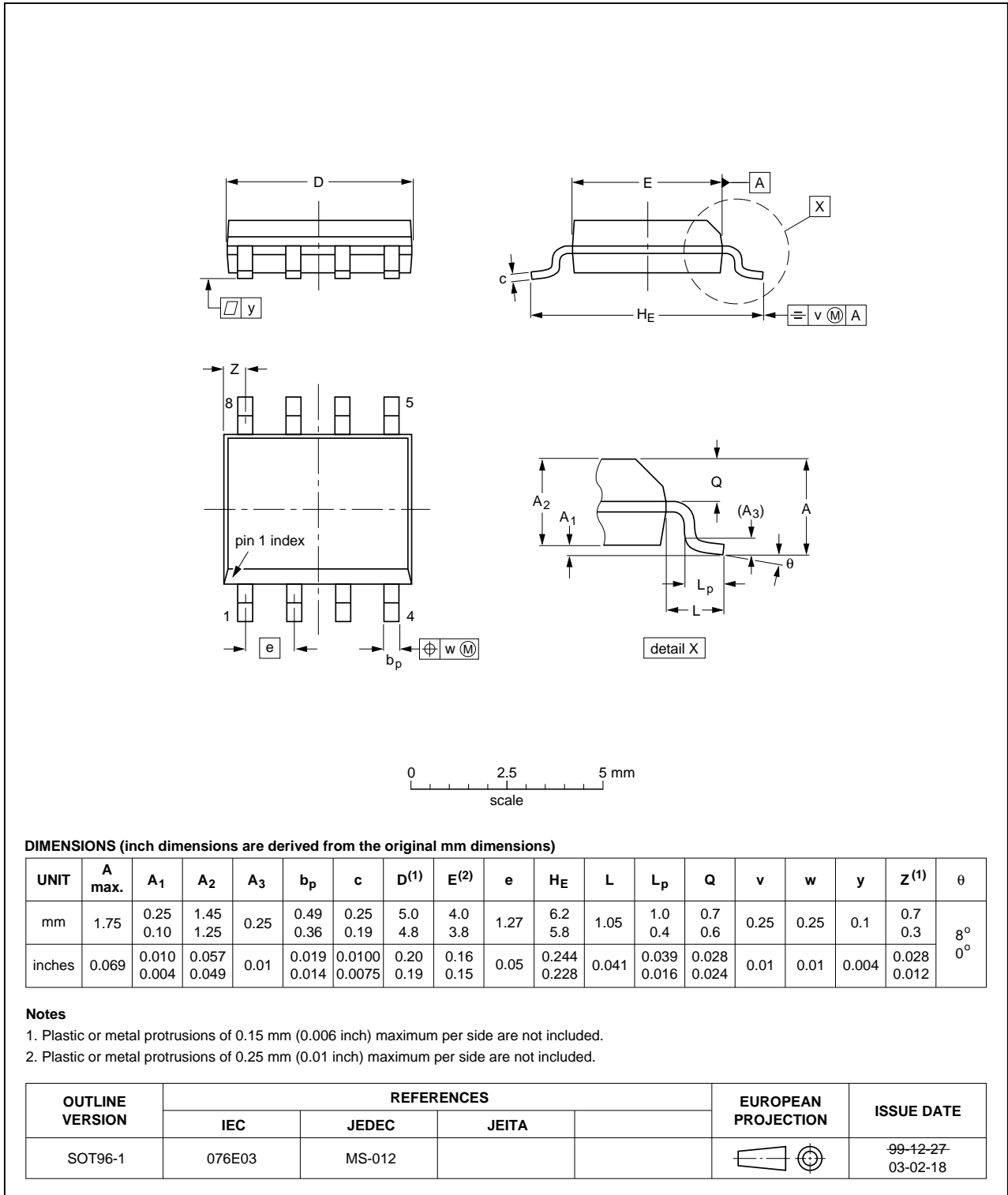


Fig 10. Package outline SOT96-1 (SO8)