



钜地半导体
Tudi Semiconductor

Product Specification

TUDI-PCA82C250

CAN controller interface

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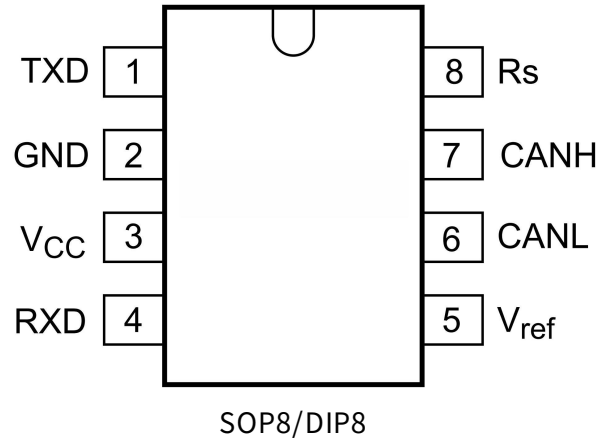
**semiconductor device
manufacturer**

- Design
- research and development
- production
- and sales



Features

- Fully compatible with the “ISO 11898 ” standard
- High speed (up to 1 MBd)
- Bus lines protected against transients in an automotive environment
- Slope control to reduce Radio Frequency Interference (RFI)
- Differential receiver with wide common-mode range for high immunity against ElectroMagnetic Interference (EMI)
- Thermally protected
- Short-circuit proof to battery and ground
- Low-current Standby mode
- An unpowered node does not disturb the bus lines
- At least 110 nodes can be connected



Applications

- High-speed automotive applications (up to 1 MBd).

Description

The PCA82C250 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.



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		170	μA
$1/t_{bit}$	maximum transmission speed	non-return-to-zero	1	-	MBd
V_{CAN}	CANH,CANL input/output voltage		-8	+18	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	$^{\circ}C$

Block diagram

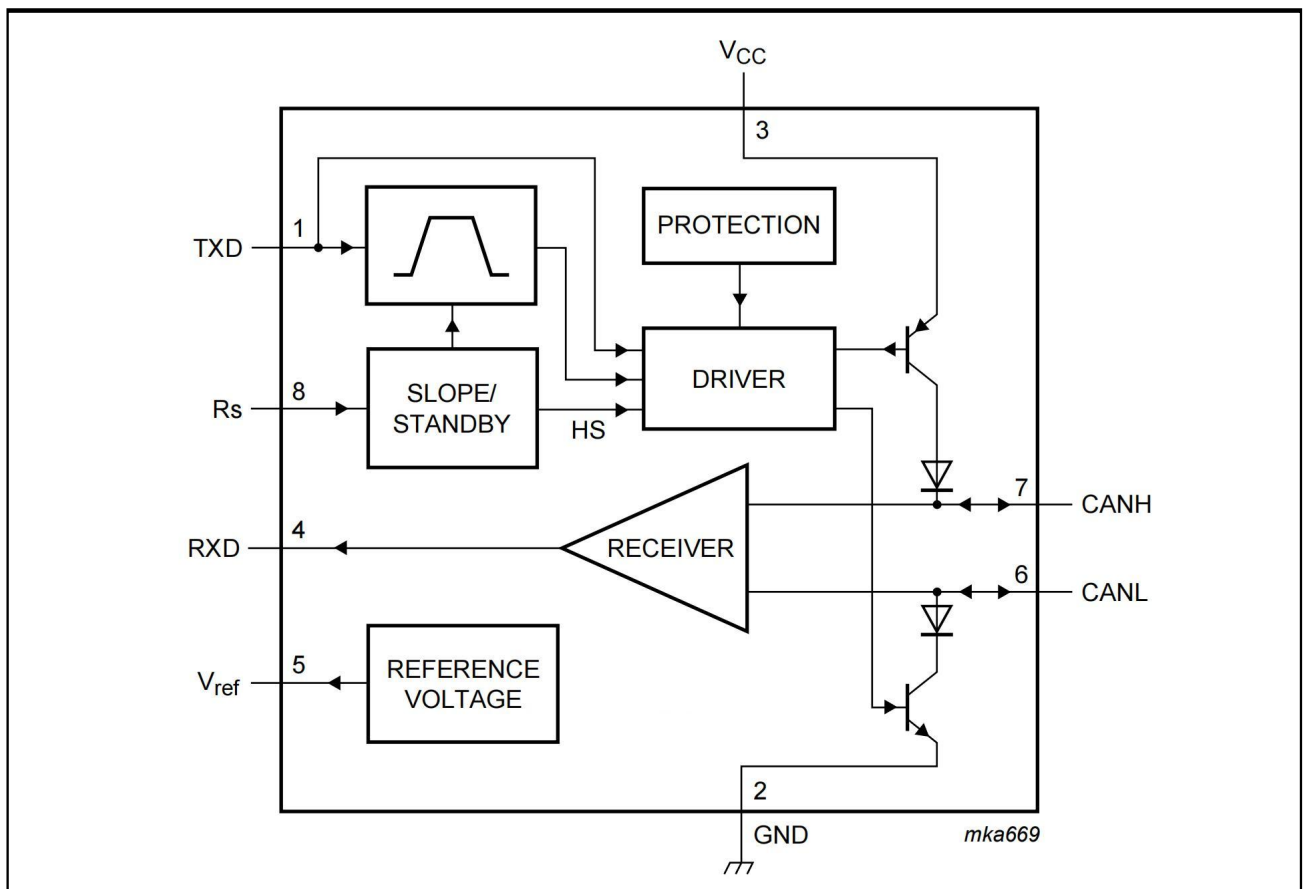




Table 2. Pin description

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
R _s	8	slope resistor input

Functional description

The PCA82C250 is the interface between a CAN protocol controller and the physical bus. It is primarily intended for high-speed automotive applications (up to 1 MBd). 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 ” 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 reduced power dissipation and hence a lower chip temperature. All other parts of the PCA82C250 will remain in operation. 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 (R_s) 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 slope. Use of a shielded cable is recommended to avoid RFI problems. The High-speed mode is selected by connecting pin 8 to ground.



For lower speeds or shorter bus length, an unshielded twisted pair or a parallel pair of wires can be used for the bus. 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 $>0.9\text{ V}$), 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 slow in Standby mode, the first message will be lost.

Table 3. Truth table of the CAN transceiver

Supply	TXD	CANH	CANL	Bus state	RXD
4.5V to 5.5V	0	HIGH	LOW	dominant	0
4.5V to 5.5V	1(or floating)	floating	floating	recessive	1
$<2\text{V}$ (not powered)	X(1)	floating	floating	recessive	X[1]
$2\text{V} < V_{CC} < 4.5\text{V}$	$>0.75V_{CC}$	floating	floating	recessive	X[1]
$2\text{V} < V_{CC} < 4.5\text{V}$	X ^[1]	floating if $V_{RS} > 0.75V_{CC}$	floating if $V_{RS} > 0.75V_{CC}$	recessive	X[1]

(1) X = don't care.

Table 4. 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\mu\text{A} $
$-10\mu\text{A} < I_{RS} < -200\mu\text{A}$	Slope control	$0.4V_{CC} < V_{RS} < 0.6V_{CC}$
$V_{RS} < 0.3V_{CC}$	High-speed	$I_{RS} < -500\mu\text{A}$



Table 5. 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	+9.0	V
V_n	DC voltage at pins 1,4,5 and 8		-0.3	$V_{cc}+0.3$	V
$V_{6,7}$	DC voltage at pins 6 and 7	$0V < V_{cc} < 5.5V$; no time limit	-8.0	+18.0	V
V_{trt}	transient voltage at pins 6 and 7	see Figure 6	-150	+100	V
T_{stg}	storage temperature		-55	+150	°C
T_{amb}	ambient temperature		-40	+125	C
T_{vj}	virtual junction temperature		⁽¹⁾ -40	+150	°C
V_{esd}	electrostatic discharge voltage		⁽²⁾ -2000	+2000	V
			⁽³⁾ -200	+200	V

(1) In accordance with “IEC 60747-1”. An alternative definition of virtual junction temperature is:

$T_{vj} = T_{amb} + P_d \times R_{th(j-a)}$, 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}).

(2) Classification A: human body model; C = 100 pF; R = 1500Ω ; V = ±2000 V.

(3) Classification B: machine model; C = 200 pF; R = 25Ω ; V = ±200 V.

Table 6. Thermal characteristics

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



Table 7. Characteristics

$V_{CC} = 4.5$ to 5.5 V; $T_{amb} = -40$ to $+125$ °C; $R_L = 60\Omega$; $I_b > -10$ A; unless otherwise specified; all voltages referenced to ground (pin 2);

Symbol	Parameter	Conditions			Max	
Supply						
I ₃	supply current	dominant;V ₁ =1V			70	
		recessive;V ₁ =4V;R ₈ =47kΩ			14	
		recessive;V ₁ =4V;V ₈ =1V			18	
		Standby;T _{amb} <90°C			170	
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 =4V	-200	—	+30	μA
I _{IL}	LOW-level input current	V ₁ =1V	-100	1	-600	μA
V _{6,7}	recessive bus voltage	V ₁ =4V;no load	2.0	-	3.0	V
I _{Lo}	off-state output leakage curent	-2V<(V ₆ ,V ₇)<7V	-2	—	+1	mA
		-5V<(V ₆ ,V ₇)<18V	-5	-	+12	mA
V ₇	CANH output voltage	V ₁ =1V	2.75	-	4.5	V
V ₆	CANL output voltage	V ₁ =1V	0.5	-	2.25	V
ΔV _{6,7}	difference between output	V ₁ =1V	1.5	-	3.0	V
	voltage at pins 6 and 7	V ₁ =1V;R _L =45Ω;V _{cc} ≥4.9V	1.5	—		V
		V ₁ =4V;no load	-500	—	+50	mV
I _{sc7}	short-circuit CANH current	V ₇ = -5V;V _{cc} ≤5V	-	-	-105	mA
		V ₇ = -5V;V _{cc} =5.5V	-	-	-120	mA
I _{sc6}	short-circuit CANL current	V ₆ =18V			160	mA
V _{diff(r)}	differential input voltage		-1.0		+0.5	V
	(recessive)	-7V<(V ₆ ,V ₇)<12V;	-1.0	-	+0.4	V
		not Standby mode				
V _{diff(d)}	differential input voltage		0.9	—	5.0	V
	(dominant)	-7V<(V ₆ ,V ₇)<12V;not Standby mode	1.0	-	5.0	V
V _{diff(hys)}	differential input hysteresis	see Figure 3		150	-	mV
V _{OH}	HIGH-level output voltage	pin 4;I ₄ = -100μA	0.8V _{cc}	-	V _{cc}	V



Table 7. Characteristics (Continued)

$V_{CC} = 4.5$ to 5.5 V; $T_{amb} = -40$ to $+125$ °C; $R_L = 60$; $I_8 > -10$ 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_{OL}	LOW-level output voltage	pin 4;14=1 mA	0		$0.2V_{CC}$	V
		$I_4 = 10$ mA	0	-	1.5	V
R_i	input resistance	CANH,CANL	5	-	25	k Ω
R_{diff}	differential input resistance		20	-	100	k Ω
C_i	input capacitance	CANH,CANL		-	20	pF
C_{diff}	differential input capacitance		-	-	10	pF
Reference output						
V_{ref}	reference output voltage	$V_8 = 1V; -50\mu A < I_5 < 50\mu A$	$0.45V_{CC}$	-	$0.55V_{CC}$	V
		$V_8 = 4V; -5\mu A < I_5 < 5\mu A$	$0.4V_{CC}$	-	$0.6V_{CC}$	V
Timing($C_L = 100$ pF; see Figure 1, Figure 2, Figure 4 and Figure 5)						
t_{bit}	minimum bit time	$R_{ext} = 0\Omega$	-	-	1	μ S
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	$R_{ext} = 0\Omega; V_{CC} < 5.1V; T_{amb} < +85^\circ C$	-	82	150	ns
		$R_{ext} = 0\Omega; V_{CC} < 5.1V; T_{amb} < +125^\circ C$	-	82	170	ns
		$R_{ext} = 0\Omega; V_{CC} < 5.5V; T_{amb} < +85^\circ C$	-	90	170	ns
		$R_{ext} = 0\Omega; V_{CC} < 5.5V; T_{amb} < +125^\circ C$	-	90	190	ns
t_{onRXD}	delay TXD to receiver active	$R_{ext} = 47$ k Ω	-	390	520	ns
		$R_{ext} = 24$ k Ω	-	260	320	ns
t_{offRXD}	delay TXD to receiver inactive	$R_{ext} = 47$ k Ω	-	260	450	ns
		$R_{ext} = 24$ k Ω	-	210	320	ns
$ SR $	differential output voltageslew rate	$R_{ext} = 47$ k Ω	-	14	-	V/ μ s
t_{WAKE}	wake-up time from Standby	via pin 8	-	-	20	μ s
t_{dRXDL}	bus dominant to RXD LOW	$V_8 = 4V$; Standby mode	-	-	3	μ s
Standby/Slope Control (pin 8)						
V_8	input voltage for high-speed		-		$0.3V_{CC}$	V
I_8	input current for high-speed	$V_8 = 0V$	-		-500	μ A
V_{stb}	input voltage for Standby mode		$0.75V_{CC}$	-		V
I_{slope}	slope control mode current		-10		-200	μ A
V_{slope}	slope control mode voltage		$0.4V_{CC}$	-	$0.6V_{CC}$	V

(1) $I_1 = I_4 = I_5 = 0$ mA; $0V < V_6 < V_{CC}$; $0V < V_7 < V_{CC}$; $V_8 = V_{CC}$

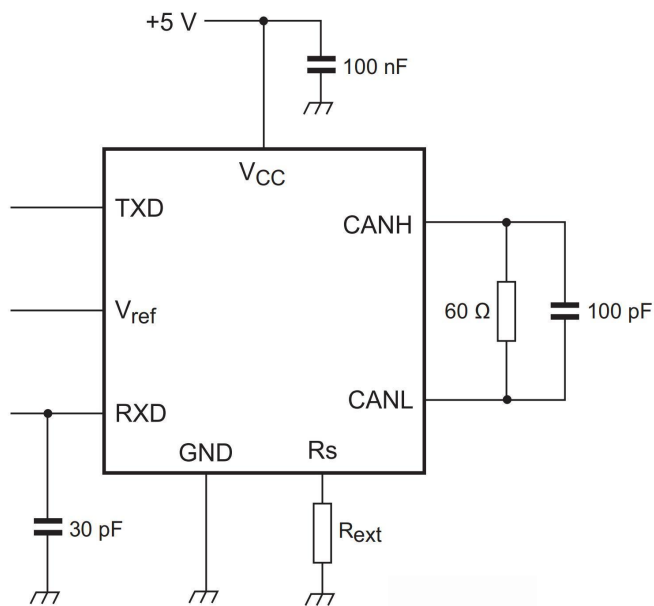


Figure 1. Test circuit for dynamic characteristics.

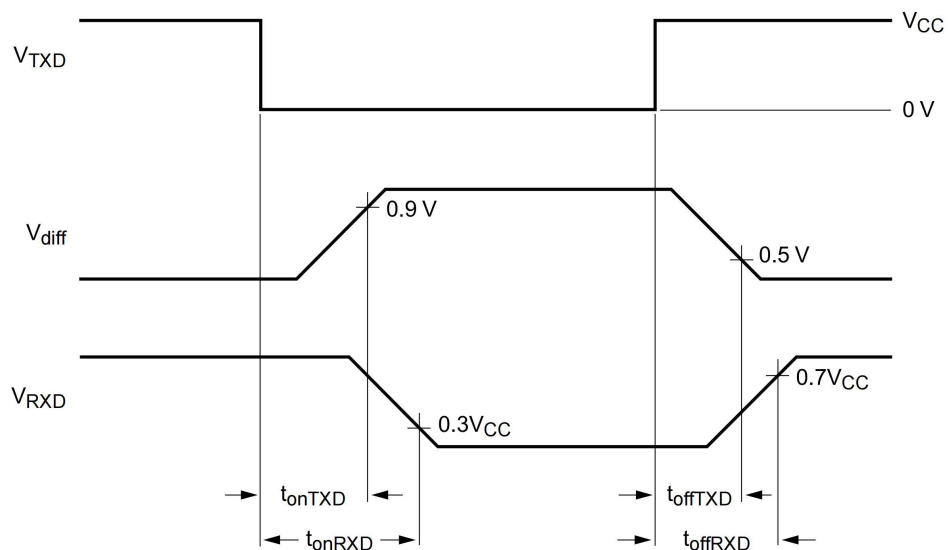


Figure 2. Timing diagram for dynamic characteristics.

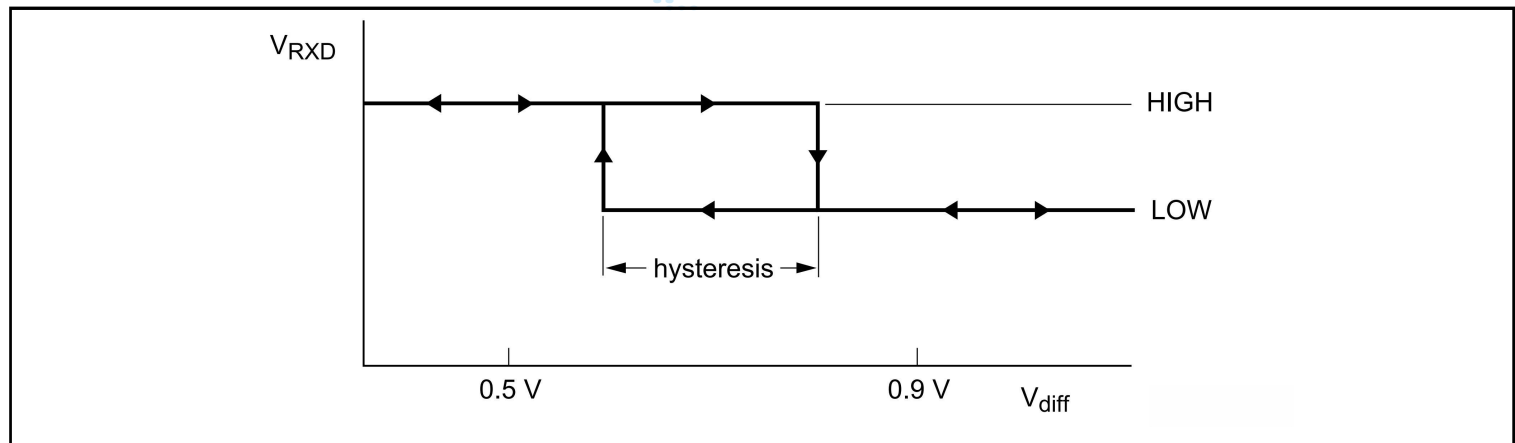


Figure 3. Hysteresis.

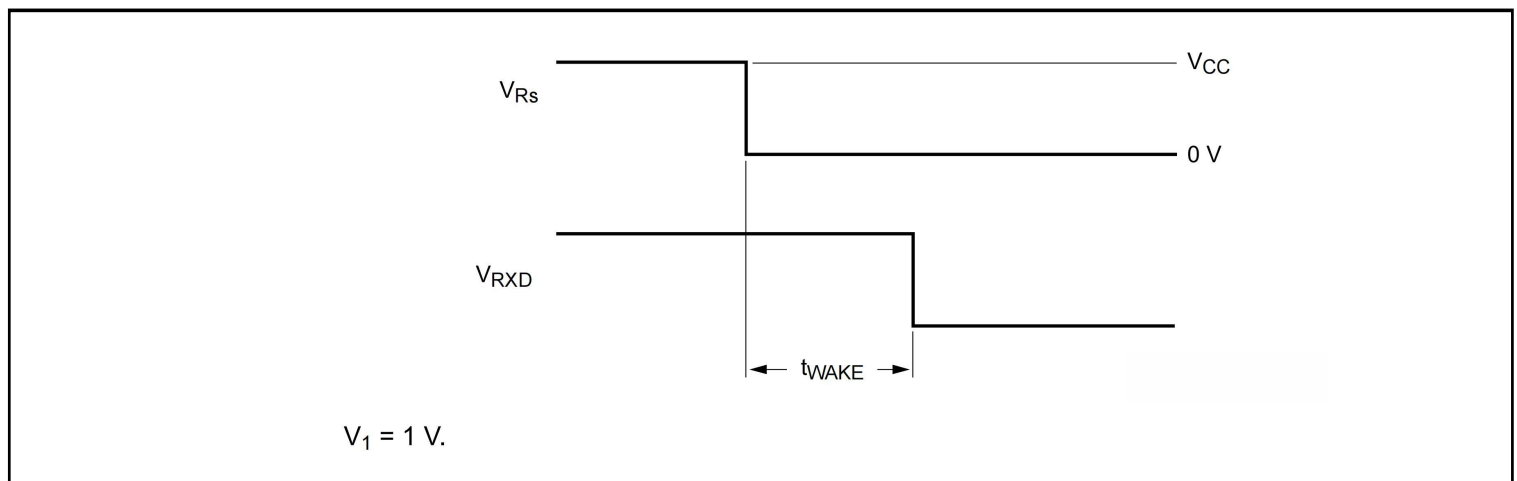


Figure 4. Timing diagram for wake-up from Standby.

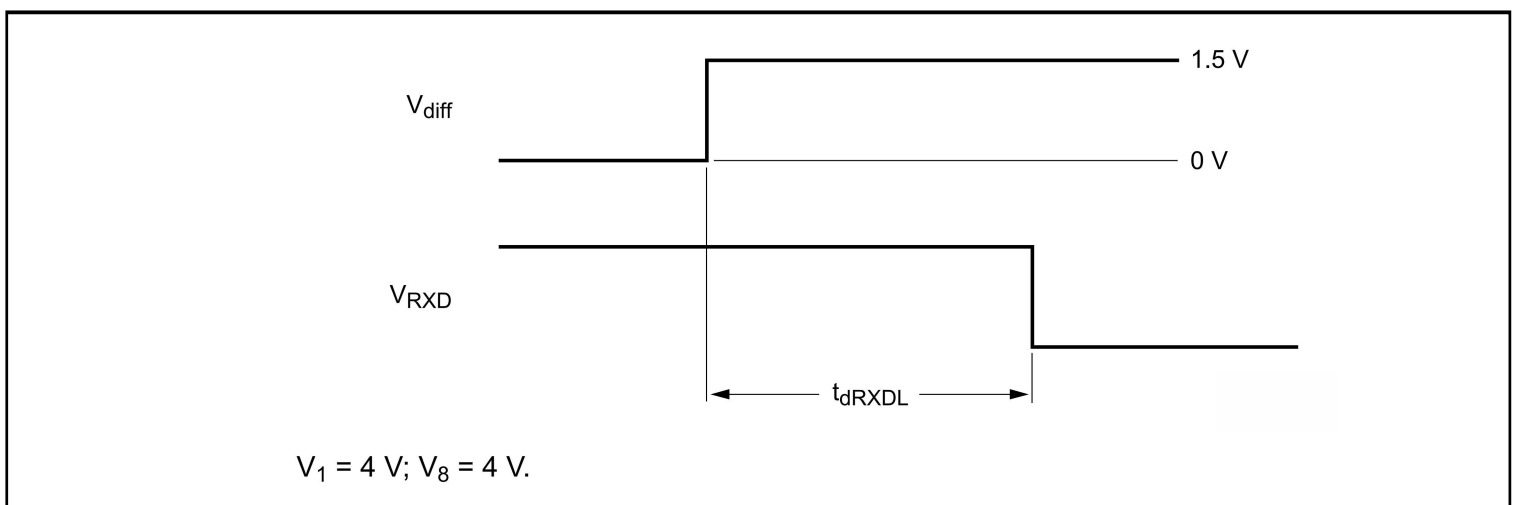
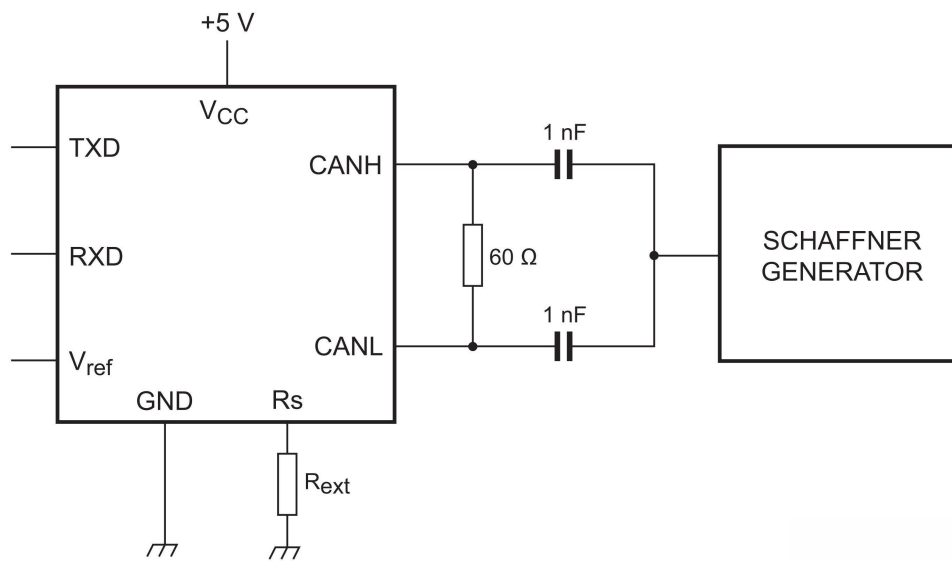


Figure 5. Timing diagram for bus dominant to RXD LOW.



The waveforms of the applied transients shall be in accordance with “ISO 7637 part 1”, test pulses 1, 2, 3a and 3b.

Figure 6. Test circuit for automotive transients.

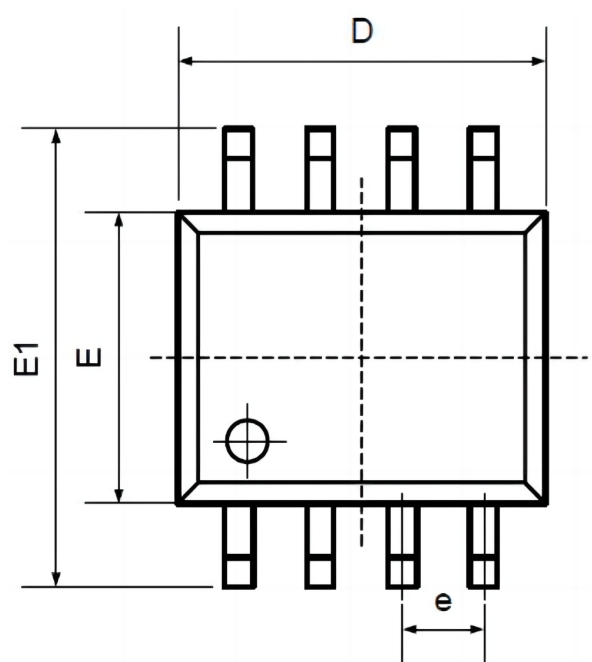
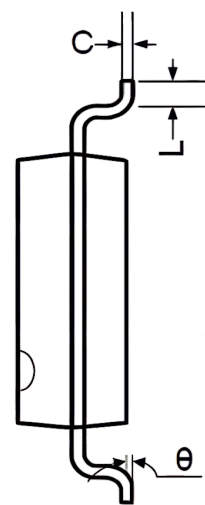
Order information

Order Number	Package	Package Quantity	Marking On The park	Temperature
PCA82C250T/YM-TUDI	SOP8	Tape,Reel,4000	82C250Y	-40°C to +125 °C
PCA82C250N-TUDI	DIP8	Tube,50,A box of 2000	PCA82C250N	

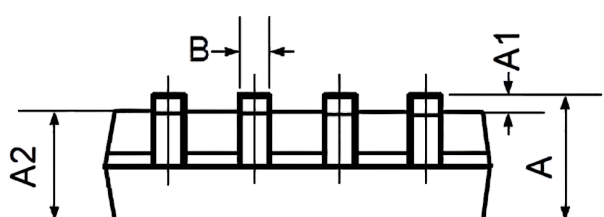
Revision history

	Date	Revision	Page
V1.0	2020/9	New	1-12
V1.1	2025-4	Update model and PDF template	1-15

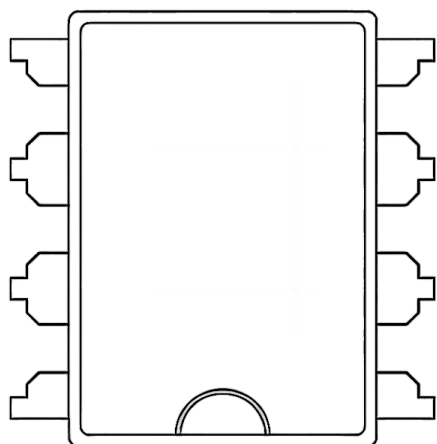
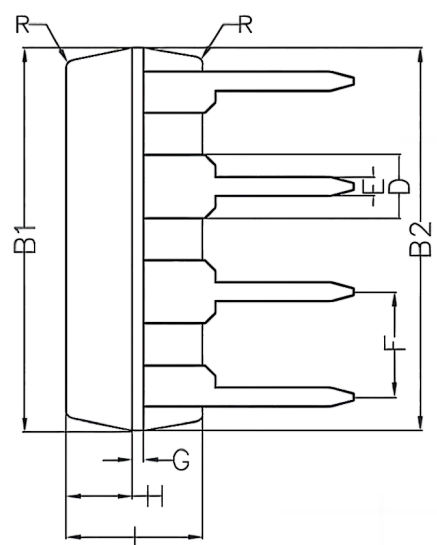
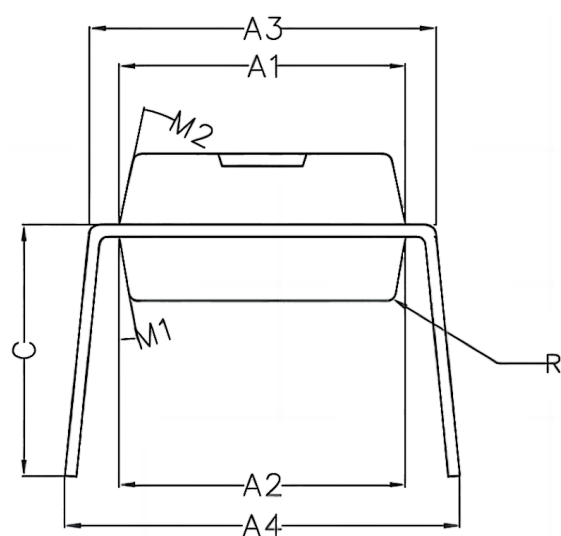
Package SOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°



Package DIP8



Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
I	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°



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