

**CAN controller interface****PCA82C250****FEATURES**

- Fully compatible with the "ISO/DIS 11898" standard
- High speed (up to 1 Mbaud)
- 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 applications (up to 1 Mbaud) in cars.

**GENERAL DESCRIPTION**

The PCA82C250 is the interface between the CAN protocol controller and the physical bus. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller.

**QUICK REFERENCE DATA**

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CC}$	supply voltage		4.5	5.5	V
$I_{CC}$	supply current		–	170	$\mu$ A
$1/t_{bit}$	maximum transmission speed	non-return-to-zero	1	–	Mbaud
$V_{CAN}$	CANH, CANL input/output voltage		–8	+18	V
$\Delta V$	differential bus voltage		1.5	3.0	V
$t_{pd}$	propagation delay	high-speed mode	–	50	ns
$T_{amb}$	operating ambient temperature		–40	+125	$^{\circ}$ C

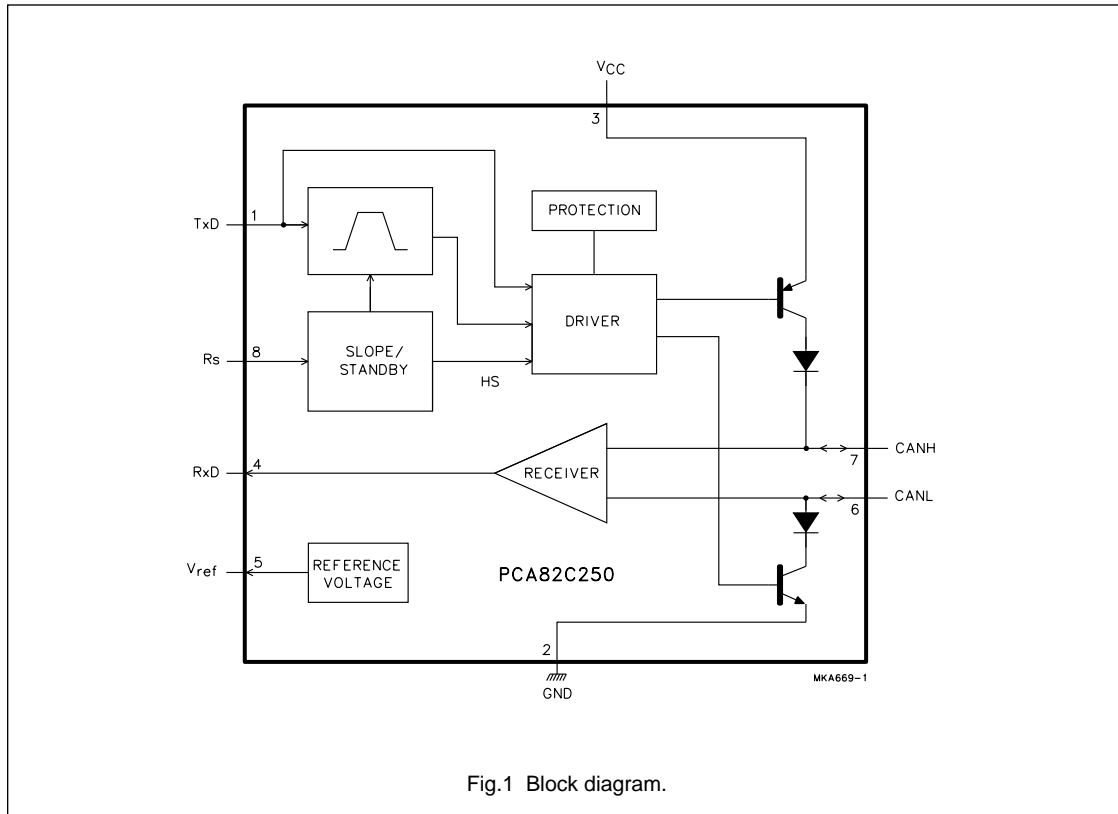
**ORDERING INFORMATION**

TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
PCA82C250	8	DIP8	plastic	SOT97-1
PCA82C250T	8	SO8	plastic	SOT96-1

## CAN controller interface

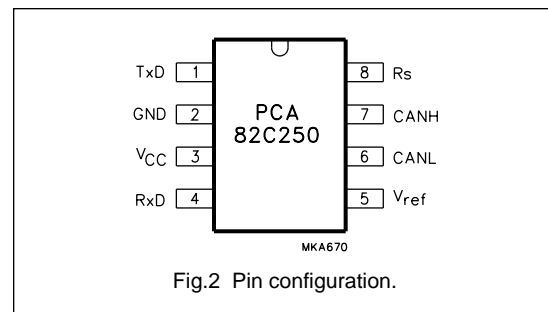
## PCA82C250

## BLOCK DIAGRAM



## PINNING

SYMBOL	PIN	DESCRIPTION
TxD	1	transmit data input
GND	2	ground
V <sub>CC</sub>	3	supply voltage
RxD	4	receive data output
V <sub>ref</sub>	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



## CAN controller interface

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**FUNCTIONAL DESCRIPTION**

The PCA82C250 is the interface between the CAN protocol controller and the physical bus. It is primarily intended for high-speed applications (up to 1 Mbaud) in cars. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller. It is fully compatible with the "ISO/DIS 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 a reduced power dissipation and hence a lower chip temperature. All other parts of the IC will remain in operation. 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.

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 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 1** Truth table of CAN transceiver.

SUPPLY	TxD	CANH	CANL	BUS STATE	RxD
4.5 to 5.5 V	0	HIGH	LOW	dominant	0
4.5 to 5.5 V	1 (or floating)	floating	floating	recessive	1
<2 V (not powered)	X	floating	floating	recessive	X
2 V < V <sub>CC</sub> < 4.5 V	>0.75V <sub>CC</sub>	floating	floating	recessive	X
2 V < V <sub>CC</sub> < 4.5 V	X	floating if V <sub>Rs</sub> > 0.75V <sub>CC</sub>	floating if V <sub>Rs</sub> > 0.75V <sub>CC</sub>	recessive	X

**Table 2** Rs (pin 8) summary.

CONDITION FORCED AT Rs	MODE	RESULTING VOLTAGE OR CURRENT AT Rs
V <sub>Rs</sub> > 0.75V <sub>CC</sub>	standby	I <sub>Rs</sub> <  10 µA
-10 µA < I <sub>Rs</sub> < -200 µA	slope control	0.4V <sub>CC</sub> < V <sub>Rs</sub> < 0.6V <sub>CC</sub>
V <sub>Rs</sub> < 0.3V <sub>CC</sub>	high-speed	I <sub>Rs</sub> < -500 µA

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**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134). 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	$0\text{ V} < V_{CC} < 5.5\text{ V}$ ; no time limit	-8.0	+18.0	V
$V_{trt}$	transient voltage at pins 6 and 7	see Fig.8	-150	+100	V
$T_{stg}$	storage temperature		-55	+150	°C
$T_{amb}$	operating ambient temperature		-40	+125	°C
$T_{vj}$	virtual junction temperature	note 1	-40	+150	°C

**Note**

1. In accordance with "IEC 747-1".

An alternative definition of virtual junction temperature  $T_{vj}$  is:  $T_{vj} = T_{amb} + P_d \times R_{th\text{ }vj\text{-}amb}$ ,

where  $R_{th\text{ }vj\text{-}amb}$  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 ( $T_{amb}$ ).

**HANDLING**

Classification A: human body model; C = 100 pF; R = 1500  $\Omega$ ; V =  $\pm 2000\text{ V}$ .

Classification B: machine model; C = 200 pF; R = 0  $\Omega$ ; V =  $\pm 200\text{ V}$ .

**QUALITY SPECIFICATION**

Quality specification "SNW-FQ-611 part E" is applicable and can be found in the "Quality reference pocket-book" (ordering number 9398 510 34011).

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\text{ }j\text{-}a}$	thermal resistance from junction to ambient in free air		
	PCA82C250	100	K/W
	PCA82C250T	160	K/W

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## CHARACTERISTICS

$V_{CC} = 4.5$  to  $5.5$  V;  $T_{amb} = -40$  to  $+125$  °C;  $R_L = 60$   $\Omega$ ;  $I_B > -10$   $\mu$ 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 <sub>3</sub>	supply current	dominant; V <sub>1</sub> = 1 V	–	–	70	mA
		recessive; V <sub>1</sub> = 4 V; R <sub>8</sub> = 47 kΩ	–	–	14	mA
		recessive; V <sub>1</sub> = 4 V; V <sub>8</sub> = 1 V	–	–	18	mA
		standby; T <sub>amb</sub> < 90 °C; note 1	–	100	170	μA
DC bus transmitter						
V <sub>IH</sub>	HIGH level input voltage	output recessive	0.7V <sub>CC</sub>	–	V <sub>CC</sub> + 0.3	V
V <sub>IL</sub>	LOW level input voltage	output dominant	–0.3	–	0.3V <sub>CC</sub>	V
I <sub>IH</sub>	HIGH level input current	V <sub>1</sub> = 4 V	–200	–	+30	μA
I <sub>IL</sub>	LOW level input voltage	V <sub>1</sub> = 1 V	100	–	600	μA
V <sub>6,7</sub>	recessive bus voltage	V <sub>1</sub> = 4 V; no load	2.0	–	3.0	V
I <sub>LO</sub>	off-state output leakage current	–2 V < (V <sub>6</sub> , V <sub>7</sub> ) < 7 V	–2	–	+1	mA
		–5 V < (V <sub>6</sub> , V <sub>7</sub> ) < 18 V	–5	–	+12	mA
V <sub>7</sub>	CANH output voltage	V <sub>1</sub> = 1 V	2.75	–	4.5	V
V <sub>6</sub>	CANL output voltage	V <sub>1</sub> = 1 V	0.5	–	2.25	V
ΔV <sub>6,7</sub>	difference between output voltage at pins 6 and 7	V <sub>1</sub> = 1 V	1.5	–	3.0	V
		V <sub>1</sub> = 1 V; R <sub>L</sub> = 45 Ω; V <sub>CC</sub> ≥ 4.9 V	1.5	–	–	V
		V <sub>1</sub> = 4 V; no load	–500	–	+50	mV
I <sub>sc7</sub>	short-circuit CANH current	V <sub>7</sub> = –5 V; V <sub>CC</sub> ≤ 5 V	–	–	105	mA
		V <sub>7</sub> = –5 V; V <sub>CC</sub> = 5.5 V	–	–	120	mA
I <sub>sc6</sub>	short-circuit CANL current	V <sub>6</sub> = 18 V	–	–	160	mA
DC bus receiver: V <sub>1</sub> = 4 V; pins 6 and 7 externally driven; –2 V < (V <sub>6</sub> , V <sub>7</sub> ) < 7 V; unless otherwise specified						
V <sub>diff(r)</sub>	differential input voltage (recessive)		–1.0	–	0.5	V
		–7 V < (V <sub>6</sub> , V <sub>7</sub> ) < 12 V; not standby mode	–1.0	–	0.4	V
V <sub>diff(d)</sub>	differential input voltage (dominant)		0.9	–	5.0	V
		–7 V < (V <sub>6</sub> , V <sub>7</sub> ) < 12 V; not standby mode	1.0	–	5.0	V
V <sub>diff(hys)</sub>	differential input hysteresis	see Fig.5	–	150	–	mV
V <sub>OH</sub>	HIGH level output voltage (pin 4)	I <sub>4</sub> = –100 μA	0.8V <sub>CC</sub>	–	V <sub>CC</sub>	V
V <sub>OL</sub>	LOW level output voltage (pin 4)	I <sub>4</sub> = 1 mA	0	–	0.2V <sub>CC</sub>	V
		I <sub>4</sub> = 10 mA	0	–	1.5	V
R <sub>i</sub>	CANH, CANL input resistance		5	–	25	kΩ

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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
R <sub>diff</sub>	differential input resistance		20	—	100	kΩ
C <sub>i</sub>	CANH, CANL input capacitance		—	—	20	pF
C <sub>diff</sub>	differential input capacitance		—	—	10	pF
Reference output						
V <sub>ref</sub>	reference output voltage	V <sub>8</sub> = 1 V; −50 μA < I <sub>5</sub> < 50 μA	0.45V <sub>CC</sub>	—	0.55V <sub>CC</sub>	V
		V <sub>8</sub> = 4 V; −5 μA < I <sub>5</sub> < 5 μA	0.4V <sub>CC</sub>	—	0.6V <sub>CC</sub>	V
Timing (see Figs 4, 6 and 7)						
t <sub>bit</sub>	minimum bit time	V <sub>8</sub> = 1 V	—	—	1	μs
t <sub>onTxD</sub>	delay TxD to bus active	V <sub>8</sub> = 1 V	—	—	50	ns
t <sub>offTxD</sub>	delay TxD to bus inactive	V <sub>8</sub> = 1 V	—	40	80	ns
t <sub>onRxD</sub>	delay TxD to receiver active	V <sub>8</sub> = 1 V	—	55	120	ns
t <sub>offRxD</sub>	delay TxD to receiver inactive	V <sub>8</sub> = 1 V; V <sub>CC</sub> < 5.1 V; T <sub>amb</sub> < +85 °C	—	82	150	ns
		V <sub>8</sub> = 1 V; V <sub>CC</sub> < 5.1 V; T <sub>amb</sub> < +125 °C	—	82	170	ns
		V <sub>8</sub> = 1 V; V <sub>CC</sub> < 5.5 V; T <sub>amb</sub> < +85 °C	—	90	170	ns
		V <sub>8</sub> = 1 V; V <sub>CC</sub> < 5.5 V; T <sub>amb</sub> < +125 °C	—	90	190	ns
t <sub>onRxD</sub>	delay TxD to receiver active	R <sub>8</sub> = 47 kΩ	—	390	520	ns
		R <sub>8</sub> = 24 kΩ	—	260	320	ns
t <sub>offRxD</sub>	delay TxD to receiver inactive	R <sub>8</sub> = 47 kΩ	—	260	450	ns
		R <sub>8</sub> = 24 kΩ	—	210	320	ns
SR	differential output voltage slew rate	R <sub>8</sub> = 47 kΩ	—	14	—	V/μs
t <sub>WAKE</sub>	wake-up time from standby (via pin 8)		—	—	20	μs
t <sub>dRxDL</sub>	bus dominant to RxD LOW	V <sub>8</sub> = 4 V; standby mode	—	—	3	μs
Standby/slope control (pin 8)						
V <sub>8</sub>	input voltage for high-speed		—	—	0.3V <sub>CC</sub>	V
I <sub>8</sub>	input current for high-speed	V <sub>8</sub> = 0 V	—	—	−500	μA
V <sub>stb</sub>	input voltage for standby mode		0.75V <sub>CC</sub>	—	—	V
I <sub>slope</sub>	slope control mode current		−10	—	−200	μA
V <sub>slope</sub>	slope control mode voltage		0.4V <sub>CC</sub>	—	0.6V <sub>CC</sub>	V

**Note**

1.  $I_1 = I_4 = I_5 = 0\text{ mA}$ ;  $0\text{ V} < V_6 < V_{CC}$ ;  $0\text{ V} < V_7 < V_{CC}$ ;  $V_8 = V_{CC}$ .

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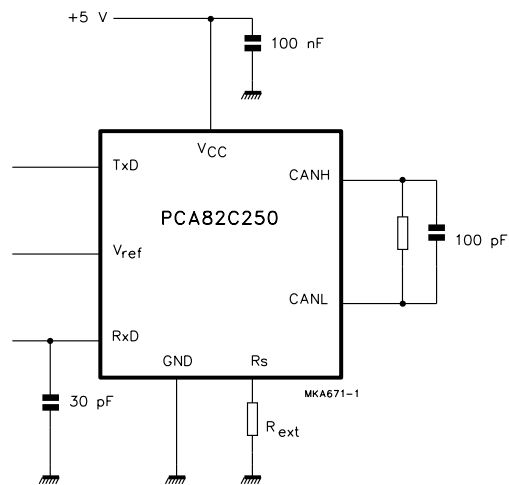


Fig.3 Test circuit for characteristics.

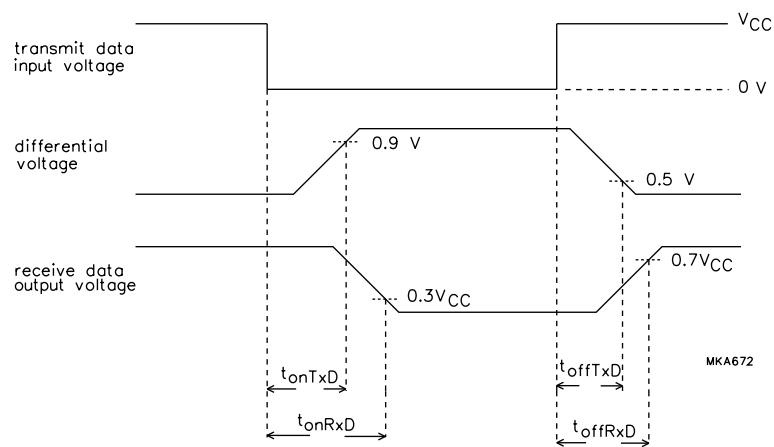


Fig.4 Timing diagram for dynamic characteristics.

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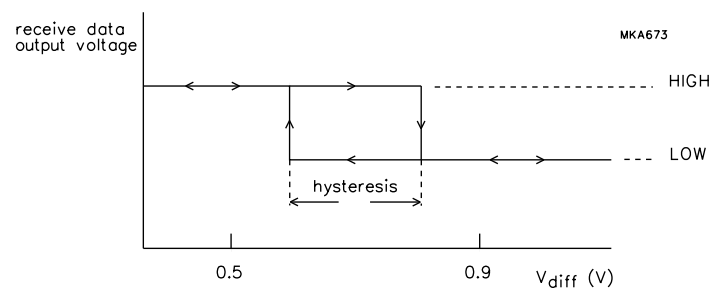


Fig.5 Hysteresis.

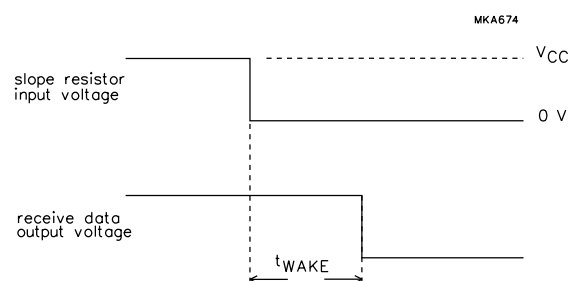
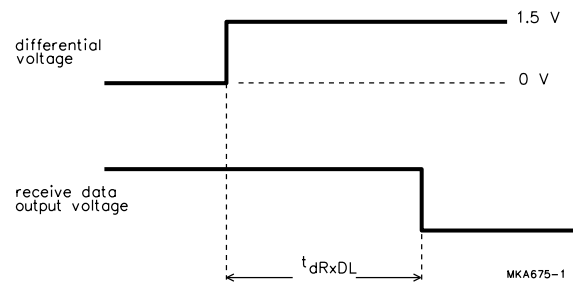
 $V_1 = 1$  V.

Fig.6 Timing diagram for wake-up from standby.



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$V_1 = 4\text{ V}$ ;  $V_0 = 4\text{ V}$ .

Fig.7 Timing diagram for bus dominant to RxD LOW.

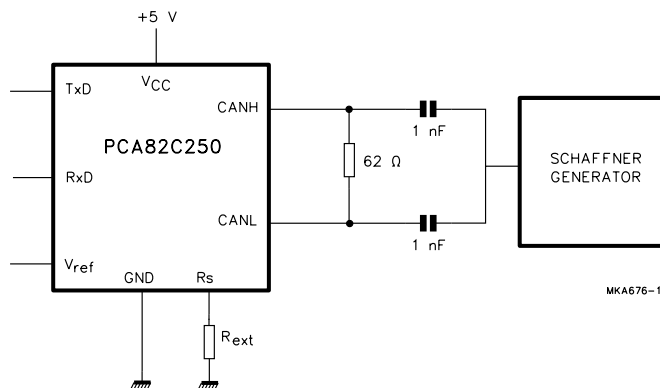


Fig.8 Test circuit for Schaffner pulses.

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## APPLICATION INFORMATION

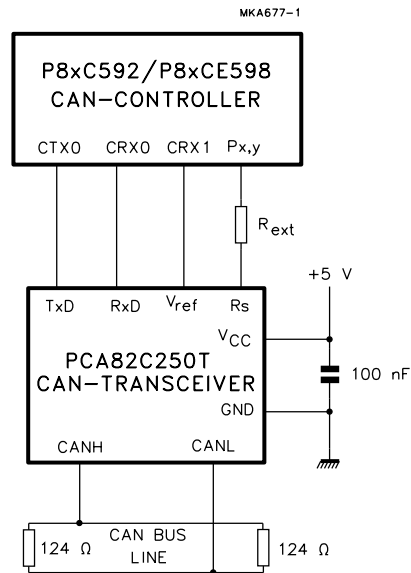


Fig.9 Application of the CAN transceiver.

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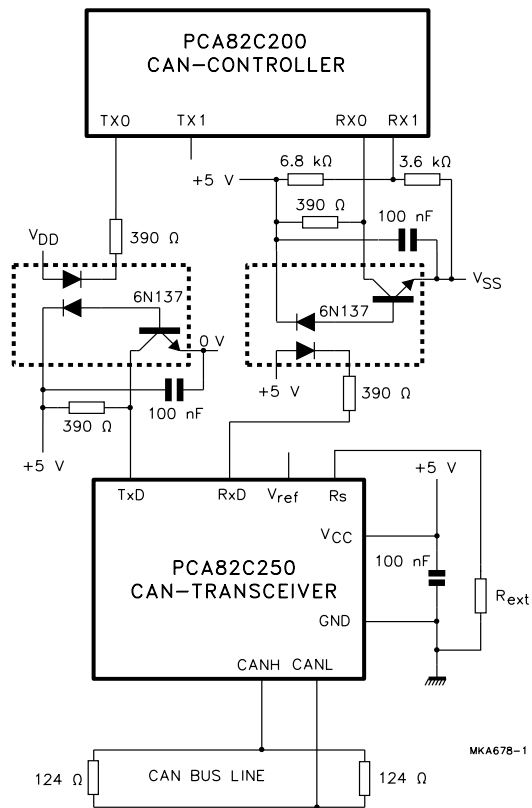


Fig.10 Application with galvanic isolation.

## CAN controller interface

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## INTERNAL PIN CONFIGURATION

