CAN transceiver for 24 V systems

Description

The TK82C251 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. 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^{O}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.

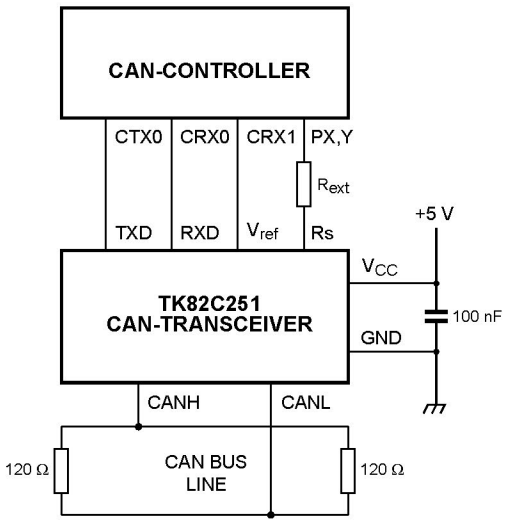
Pin 8 (Rs) allows three different modes of operation to be selected: High-speed, Slope control and Standby. For high-speed operation, the transmitter output transistors are simply switched on and off as fast as possible. In this mode, no measures are taken to limit the rise and fall slopes. A shielded cable is recommended to avoid RFI problems. High-speed mode is selected by connecting pin 8 to ground.

Features

- An unpowered node does not disturb the bus lines
- Slope control to reduce Radio Frequency Interference (RFI)
- High speed (up to 1 MBd)
- High immunity against electromagnetic interference.
- Low-current Standby mode
- Fully compatible with the *"ISO 11898-24 V"* standard
- At least 110 nodes can be connected
- Short-circuit proof to battery and ground in 24 V powered systems

Applications

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



Notes:
(1) The output control register of the P8xC592 should be programmed to 1AH (push-pull operation, dominant = LOW).
(2) If no slope control is desired: Rext =0

Fig1

TK82C251 CAN transceiver application diagram

■ Ordering Information

Part Number	Package	Packing	Operating Temperature	Package Qty	
TK82C251TR	SOIC-8	Reel	-20°C ~ 105°C	2500	

■ Pin Assignment

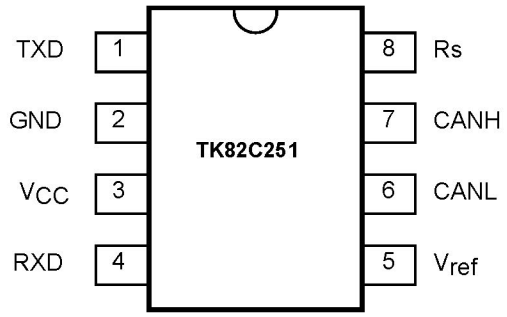


Fig2. SOIC-8 Package

■ 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

■ ABSOLUTE MAXIMUM RATINGS

Supply Voltage	0.3 V ≤ V_{CC} ≤ +7.0V	Electrostatic discharge voltage	2500 ≤V_{ESD} ≤ +2500V
DC voltage at pins 1, 4, 5 and 8	-0.3≤ Vn≤ +0.3 V	Storage temperature	-55 ≤ T_{stg} ≤ +150°C
DC voltage at pin 6 (CANL)	-36≤ V_6≤ +36V	Temperature Range	−20°C ≤ TA ≤ 105°C
DC voltage at pins 7 (CANH)	-36≤ V_7≤ +36V	Supply Temperature	−65°C to +150°C
Transient voltage at pins 6 and 7	-200≤ V_6≤ +200V		

* Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device.
These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.
Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

■ ELECTRICAL CHARACTERISTICS

V_{CC} = 4.5 V to 5.5 V; T_{amb} = −40 °C to +125 °C; R_L = 6 0 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} = 5.1 V		-	-	78	mA
		dominant; V_1 = 1 V; V_{CC} = 5.25 V		-	-	80	mA
		dominant; V_1 = 1 V; V_{CC} = 5.5 V		-	-	85	mA
		recessive; V_1 = 4 V; R_8 = 47 kΩ		-	-	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 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		2.0	-	3.0	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	mA
V_7	CANH output voltage	V_1 = 1 V; V_{CC} = 4.75 V to 5.5 V		3.0	-	4.5	V
		V_1 = 1 V; V_{CC} = 4.5 V to 4.75 V		2.75		4.5	
V_6	CANL output voltage	V_1 = 1 V		0.5	-	2.0	V
$\Delta V_{6,7}$	difference between output voltage at pins 6 and 7	V_1 = 1 V		1.5	-	3.0	V
		V_1 = 1 V; R_L = 45 Ω		1.5	-	-	V
		V_1 = 4 V; no load		−500	-	+50	mV
I_{sc7}	short-circuit CANH current	V_7 = −5 V		-	-	−200	mA
		V_7 = −36 V		-	−100	-	mA
I_{sc6}	short-circuit CANL current	V_6 = 36 V		-	-	200	mA
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)		[2]	−1.0	-	+0.5	V
		−7 V < (V_6, V_7) < 12 V	[2]	−1.0	-	+0.4	V

■ ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{diff(d)}$	differential input voltage (dominant)		0.9	-	5.0	V
		$-7\ V < (V_6, V_7) < 12\ V$; not Standby mode	1.0	-	5.0	V
		Standby mode	0.97	-	5.0	V
		Standby mode; V_{CC} = 4.5 V to 5.10 V	0.91	-	5.0	V
		see Fig 5	-	150	-	mV
V_{OH}	HIGH-level output voltage	pin 4; $I_4 = -100\ \mu A$	$0.8V_{CC}$	-	V_{CC}	V
V_{OL}	LOW-level output voltage	pin 4; I_4 = 1 mA	0	-	$0.2V_{CC}$	V
		I_4 = 10 mA	0	-	1.5	V
R_i	input resistance	CANH, CANL	5	-	25	kΩ
R_{diff}	differential input resistance		20	-	100	kΩ
Reference output						
V_{ref}	reference output voltage	V_8 = 1 V; $\lvert I_5 \rvert < 50\ \mu A$	$0.45V_{CC}$	-	$0.55V_{CC}$	V
		V_8 = 4 V; $\lvert I_5 \rvert < 5\ \mu A$	$0.4V_{CC}$	-	$0.6V_{CC}$	V
Timing (C_L = 100 pF; see Fig3, Fig 4, Fig 6 and Fig 7)						
t_{bit}	minimum bit time	R_{ext} = 0 Ω	-	-	1	µs
t_{onTXD}	delay TXD to bus active	R_{ext} = 0 Ω	-	-	50	ns
t_{offTXD}	delay TXD to bus inactive	R_{ext} = 0 Ω	-	40	80	ns
t_{onRXD}	delay TXD to receiver active	R_{ext} = 0 Ω	-	55	120	ns
t_{offRXD}	delay TXD to receiver inactive	R_{ext} = 0 Ω; T_{amb} < +85 °C V_{CC} = 4.5 V to 5.1 V	-	80	150	ns
		R_{ext} = 0 Ω; V_{CC} = 4.5 V to 5.1 V	-	80	170	ns
		R_{ext} = 0 Ω; T_{amb} < +85 °C	-	90	170	ns
		R_{ext} = 0 kΩ	-	90	190	ns
		R_{ext} = 47 kΩ	-	290	400	ns
t_{onRXD}	delay TXD to receiver active	R_{ext} = 47 kΩ	-	440	550	ns
$\lvert SR \rvert$	CANH, CANL slew rate	R_{ext} = 47 kΩ	-	7	-	V/µs
t_{WAKE}	wake-up time from Standby (via pin 8)	see Fig 6	-	-	20	µs
t_{dRXDL}	bus dominant to RXD LOW	V_8 = 4 V; see Fig 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 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.

■ THERMAL CHARACTERISTICS

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

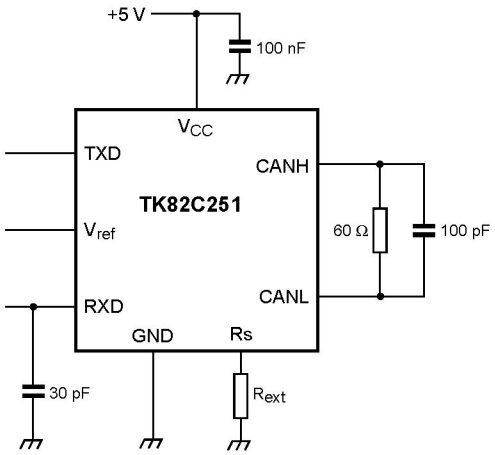


Fig 3. Test circuit for dynamic characteristics.

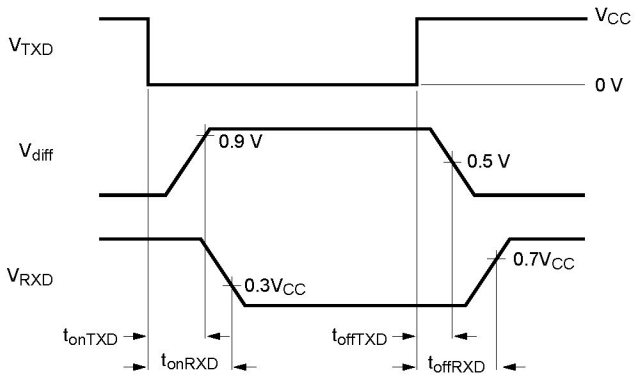


Fig 4. Timing diagram for dynamic characteristics.

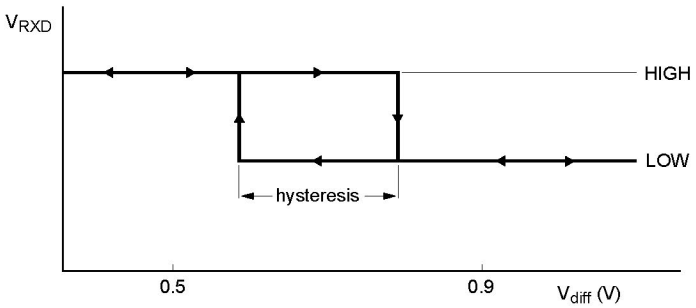
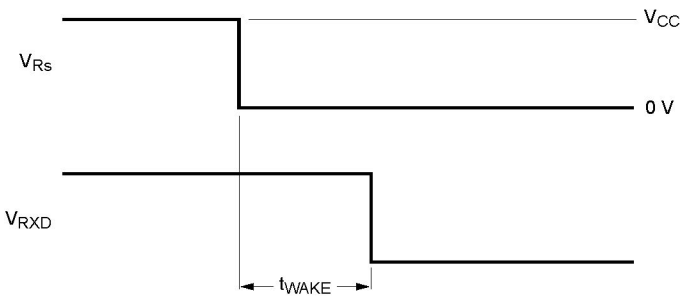
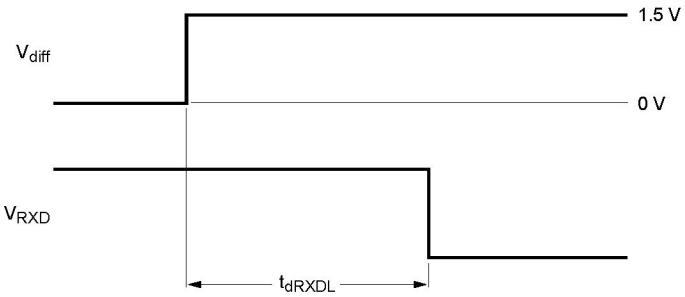


Fig 5. Hysteresis.



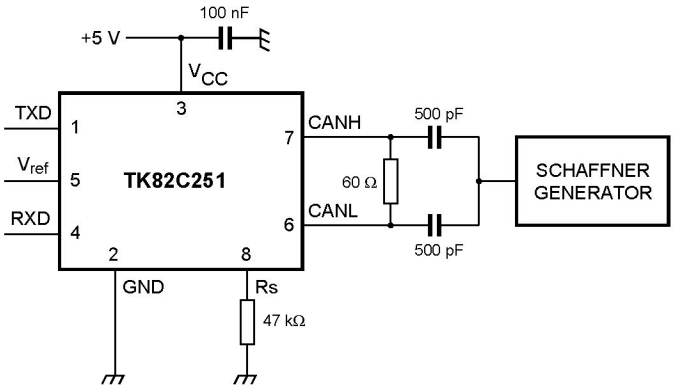
V_{TXD} = 1 V .

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



V_{Rs} = 4 V ; V_{TXD} = 4 V .

Fig 7. 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.

Fig 8. Test circuit for automotive transients.

■ BLOCK DIAGRAM

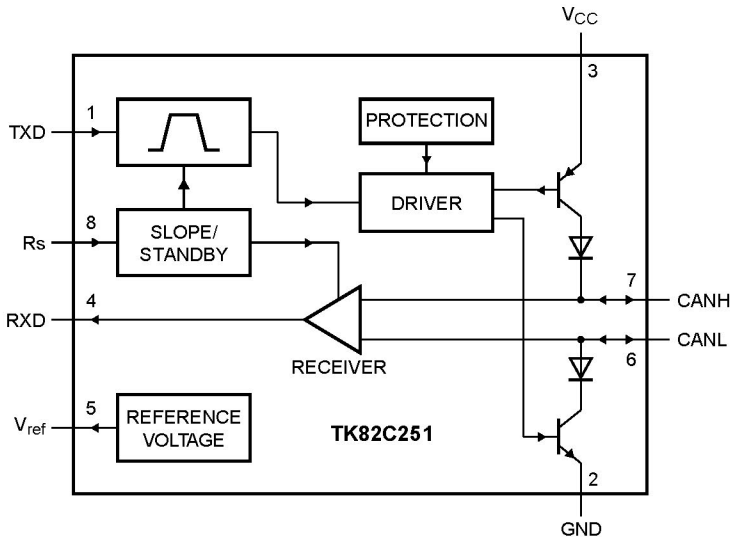
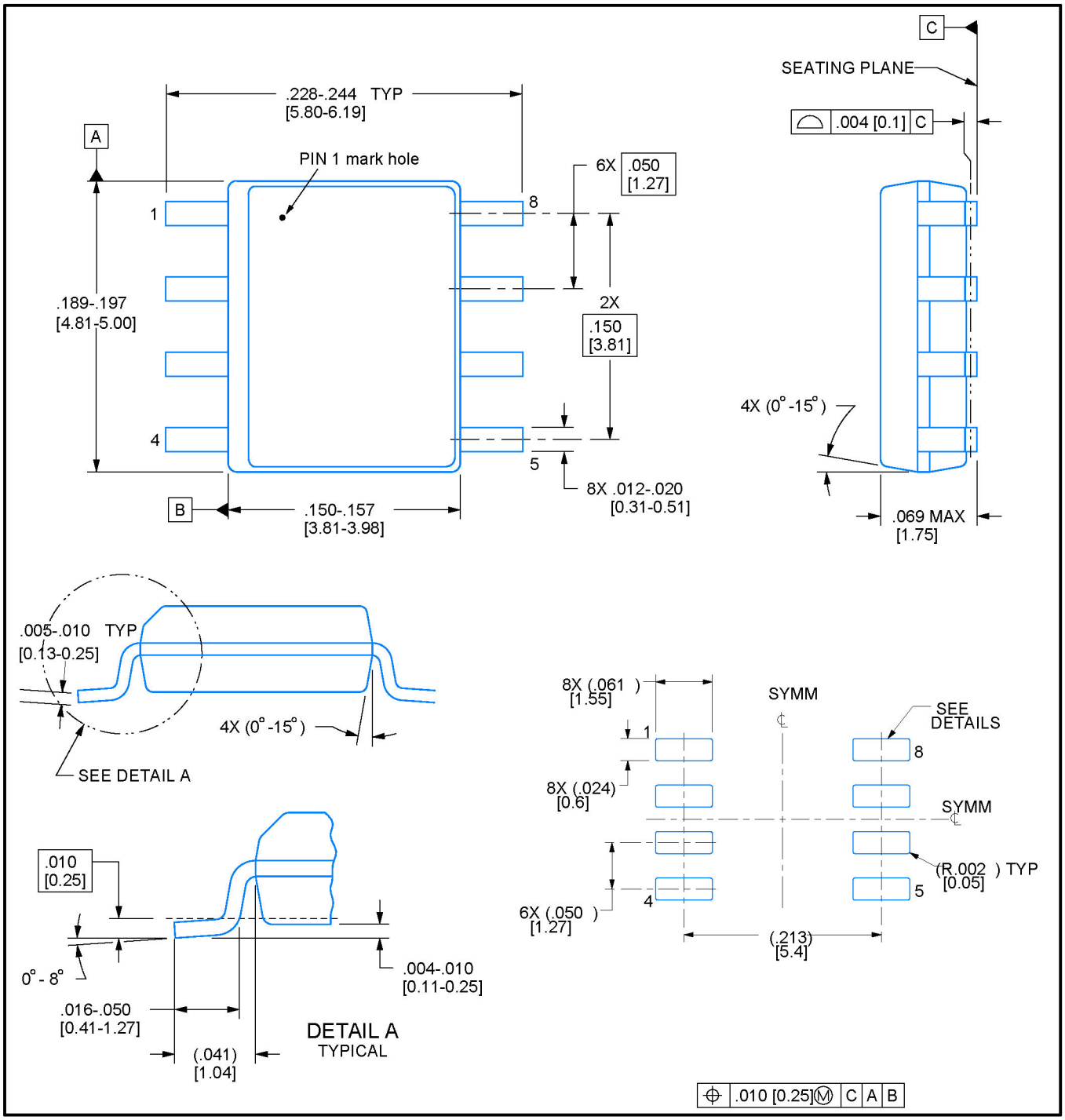


Fig 9. Block diagram

PACKAGE OUTLINE SOIC - 8,1.75 mm max height



NOTES: Linear dimensions are in inches [millimeters]. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.