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TLE7250G

High Speed CAN Transceiver

Data Sheet

Rev. 1.1, 2013-07-22

Automotive Power

Table of Contents

1 Overview

PG-DSO-8

Features

- Fully compliant with ISO 11898-2
- Wide common mode range for electromagnetic immunity (EMI)
- Very low electromagnetic emission (EME)
- Excellent ESD immunity
- Extended supply range at V_{CC}
- CAN short-circuit proof to ground, battery and V_{CC}
- TxD time-out function
- Low CAN bus leakage current in power-down state
- Overtemperature protection
- Protected against automotive transients
- CAN data transmission rate up to 1 Mbps
- Green Product (RoHS-compliant)
- AEC Qualified
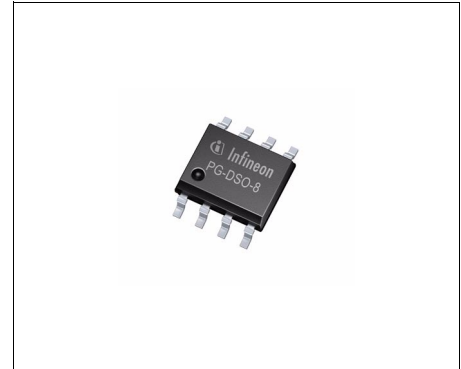
Description

The TLE7250G is a transceiver designed for High Speed CAN networks in automotive and industrial applications. As an interface between the physical bus layer and the CAN protocol controller, the TLE7250G drives the signals to the bus and protects the microcontroller against interferences generated within the network. Based on the high symmetry of the CANH and CANL signals, the TLE7250G provides a very low level of electromagnetic emission (EME) within a wide frequency range. The TLE7250G is integrated in a RoHS compliant PG-DSO-8 package and fulfills or exceeds the requirements of ISO 11898-2.

As a successor to the first generation of HS CAN transceivers, the pin assignment and function of the TLE7250G is fully compatible with its predecessor model, the TLE6250G. The TLE7250G is optimized to provide an excellent passive behavior in the power-down state. This feature makes the TLE7250G extremely suitable for mixed supply CAN networks.

Based on the Infineon Smart Power Technology SPT, the TLE7250G provides excellent ESD immunity together with a very high electromagnetic immunity (EMI). The Infineon Smart Power Technology SPT allows bipolar and CMOS control circuitry in accordance with DMOS power devices to exist on the same monolithic circuit. The TLE7250G and the Infineon SPT technology are AEC qualified and tailored to withstand the harsh conditions of the Automotive Environment.

Three different operating modes, additional fail-safe features like TxD time-out and the optimized output slew rates on the CANH and CANL signals make the TLE7250G the ideal choice for large CAN networks with high data transmission rates.

Type	Package	Marking
TLE7250G	PG-DSO-8	7250G

2 Block Diagram
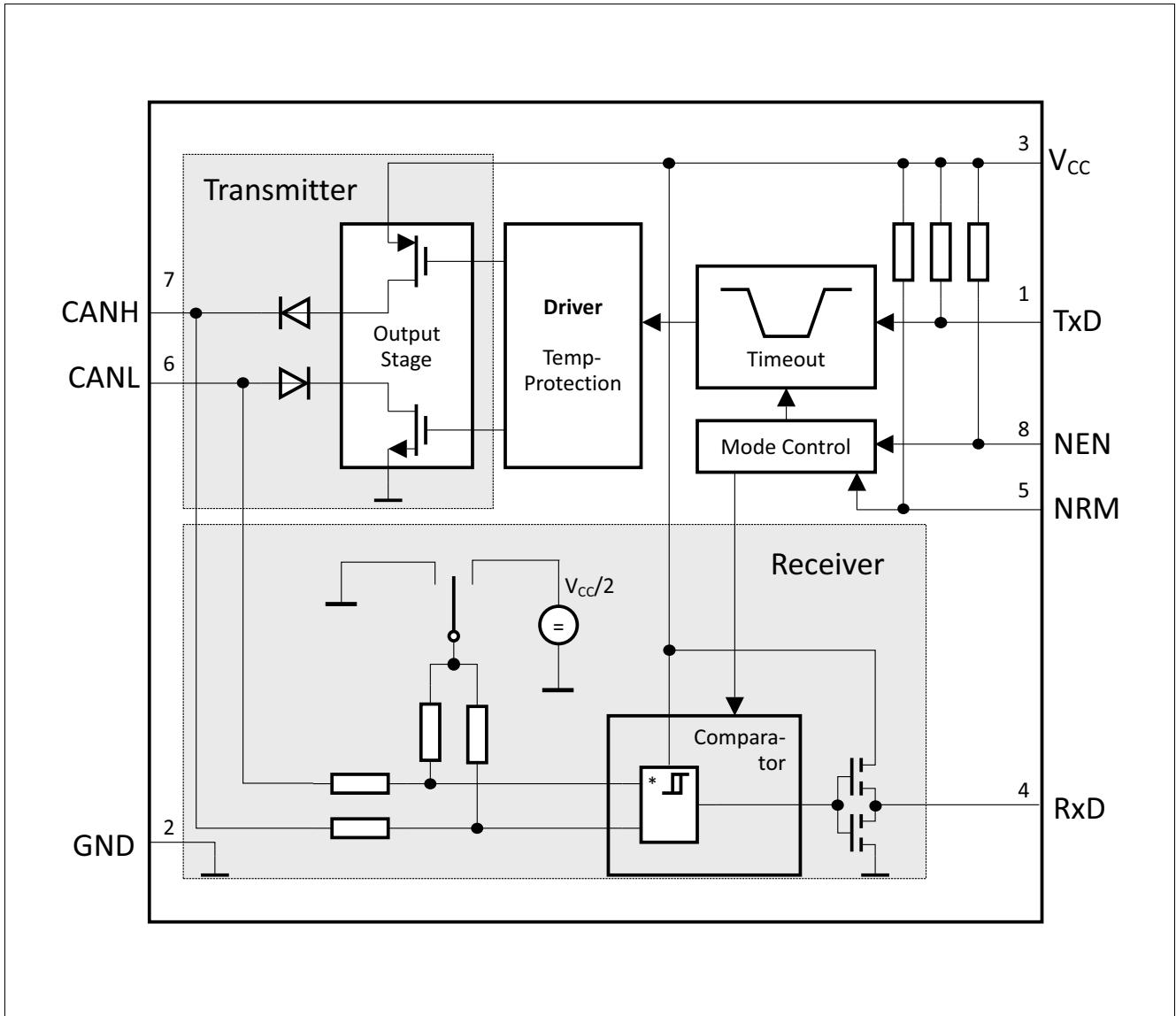
Figure 1   Block diagram

Note: In comparison with the TLE6250G, the pin 8 (INH) was renamed as NEN, but the function remains unchanged. NEN stands for NotENable. The name of pin 5 has been changed from RM (TLE6250G) to NRM on the TLE7250G. The function of pin 5 remains unchanged.

3 Pin Configuration

3.1 Pin Assignment
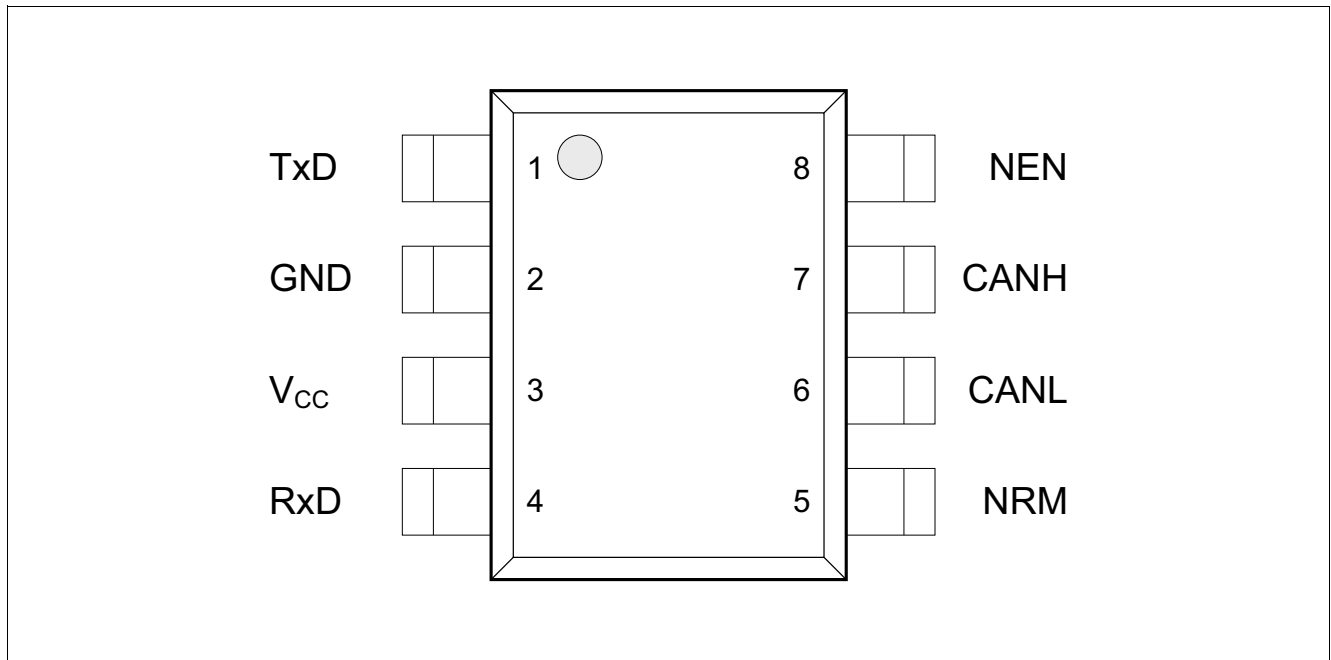
Figure 2   Pin configuration

3.2 Pin Definitions and Functions

Table 1   Pin Definition and Functions

Pin	Symbol	Function
1	TxD	**Transmit Data Input;** internal pull-up to V_{CC}, "low" for "dominant" state.
2	GND	**Ground**
3	V_{CC}	**Transceiver Supply Voltage;** 100 nF decoupling capacitor to GND required.
4	RxD	**Receive Data Output;** "low" in "dominant" state.
5	NRM	**Not Receive-only Mode Input[1);** control input for selecting receive-only mode, internal pull-up, to V_{CC}, "low" for receive-only mode.
6	CANL	**CAN Bus Low Level I/O;** "low" in "dominant" state.
7	CANH	**CAN Bus High Level I/O;** "high" in "dominant" state.
8	NEN	**Not Enable Input[1);** internal pull-up to V_{CC}, "low" to select normal-operation mode or receive-only mode.

1) The designation of pin 8 and pin 5 is different in the TLE7250G and its predecessor, the TLE6250G. The function of pin 8 and pin 5 remains the same.

4 Functional Description

CAN is a serial bus system that connects microcontrollers, sensors and actuators for real-time control applications. The use of the **C**ontrol **A**rea **N**etwork (abbreviated CAN) within road vehicles is described by the international standard ISO 11898. According to the 7-layer OSI reference model, the physical layer of a CAN bus system specifies the data transmission from one CAN node to all other available CAN nodes within the network. The physical layer specification of a CAN bus system includes all electrical and mechanical specifications of a CAN network. The CAN transceiver is part of the physical layer specification. Several different physical layer definitions of CAN networks have been developed in recent years. The TLE7250G is a High Speed CAN transceiver without a dedicated wake-up function. High Speed CAN transceivers without a wake-up function are defined by the international standard ISO 11898-2.

4.1 High Speed CAN Physical Layer

V_{CC} = High Speed CAN power supply
TxD = Input from the microcontroller
RxD = Output to the microcontroller
CANH = Voltage on the CANH input/output
CANL = Voltage on the CANL input/output
V_{DIFF} = Differential voltage between CANH and CANL
$V_{DIFF} = V_{CANH} - V_{CANL}$

V_{DIFF} = ISO level "dominant"

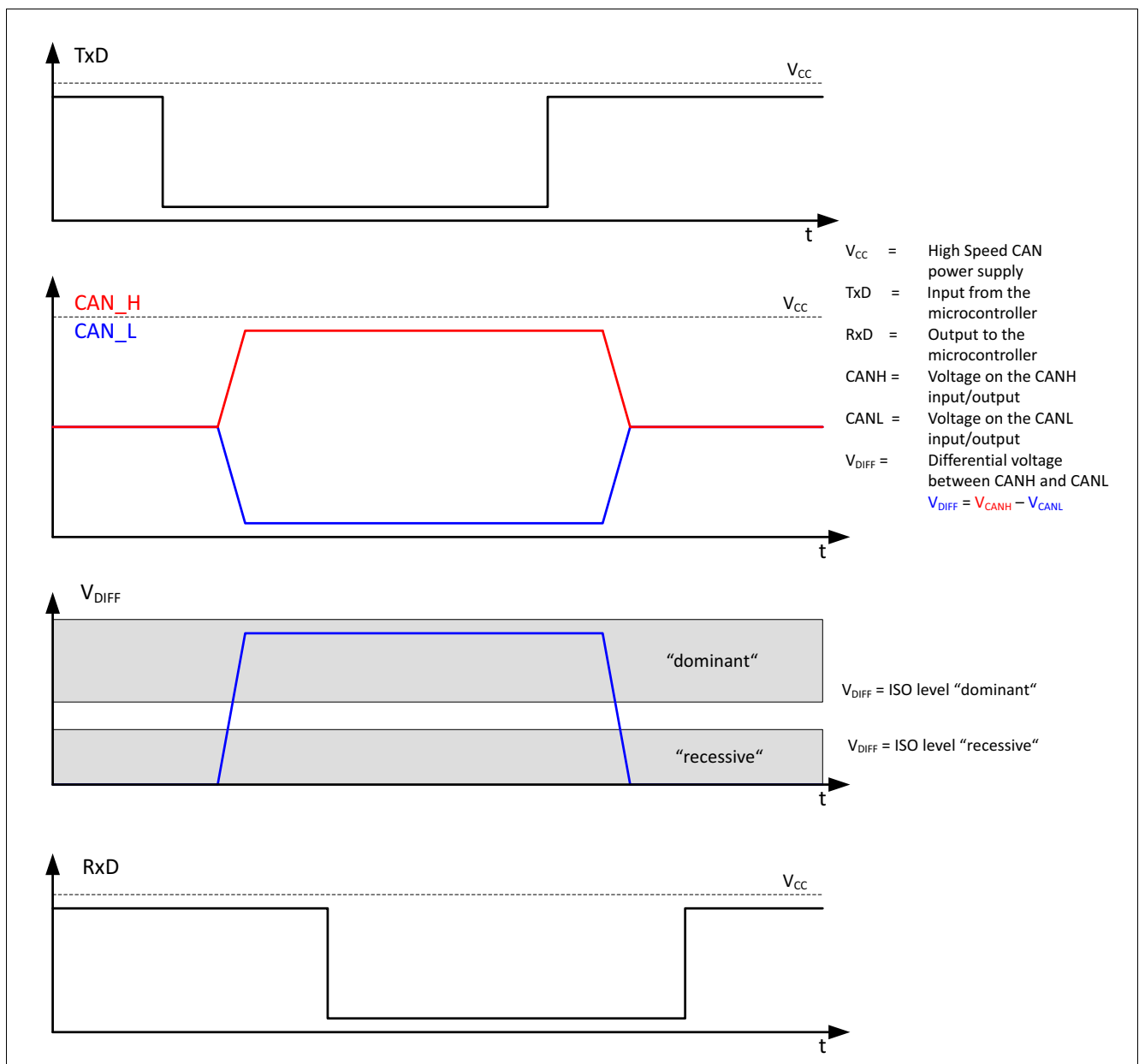V_{DIFF} = ISO level "recessive"

Figure 3   High Speed CAN bus signals and logic signals

The TLE7250G is a High Speed CAN transceiver, operating as an interface between the CAN controller and the physical bus medium. An HS CAN network is a two-wire, differential network, which allows data transmission rates up to 1 Mbps. The characteristics of an HS CAN network are the two signal states on the CAN bus: "dominant" and "recessive" (see **Figure 3**).

The CANH and CANL pins are the interface to the CAN bus and both pins operate as an input and output. The RxD and TxD pins are the interface to the microcontroller. The TxD pin is the serial data input from the CAN controller, and the RxD pin is the serial data output to the CAN controller. As shown in **Figure 1**, the HS CAN transceiver TLE7250G includes a receiver and a transmitter unit, allowing the transceiver to send data to the bus medium and monitor the data from the bus medium at the same time. The HS CAN transceiver TLE7250G converts the serial data stream which is available on the transmit data input TxD, into a differential output signal on the CAN bus, provided by the CANH and CANL pins. The receiver stage of the TLE7250G monitors the data on the CAN bus and converts them to a serial, single-ended signal on the RxD output pin. A logical "low" signal on the TxD pin creates a "dominant" signal on the CAN bus, followed by a logical "low" signal on the RxD pin (see **Figure 3**). The feature of broadcasting data to the CAN bus and listening to the data traffic on the CAN bus simultaneously is essential to support the bit-to-bit arbitration within CAN networks.

The voltage levels for HS CAN transceivers are defined by the ISO 11898-2 and the ISO 11898-5 standards. Whether a data bit is "dominant" or "recessive" depends on the voltage difference between the CANH and CANL pins:

$V_{DIFF} = V_{CANH} - V_{CANL}$.

In comparison with other differential network protocols, the differential signal on a CAN network can only be larger than or equal to 0 V. To transmit a "dominant" signal to the CAN bus, the differential signal V_{DIFF} is larger than or equal to 1.5 V. To receive a "recessive" signal from the CAN bus, the differential V_{DIFF} is smaller than or equal to 0.5 V.

"Partially-supplied" High Speed CAN networks are those where the CAN bus nodes of one common network have different power supply conditions. Some nodes are connected to the common power supply, while other nodes are disconnected from the power supply and in power-down state. Regardless of whether the CAN bus subscriber is supplied or not, each subscriber connected to the common bus media must not interfere with the communication. The TLE7250G is designed to support "partially-supplied" networks. In power-down state, the receiver input resistors are switched off and the transceiver input has a high resistance.

4.2 Modes of Operation

Three different modes of operation are available on the TLE7250G. Each mode has specific characteristics in terms of quiescent current or data transmission. NEN and NRM are used as the digital input pins for mode selection. **Figure 4** illustrates the different mode changes depending on the status of the NEN and NRM pins. After supplying V_{CC} to the HS CAN transceiver, the TLE7250G starts in stand-by mode. The internal pull-up resistors set the TLE7250G to stand-by mode by default. If the microcontroller is up and running, the TLE7250G can switch to any mode of operation within the time period for mode change t_{Mode}.
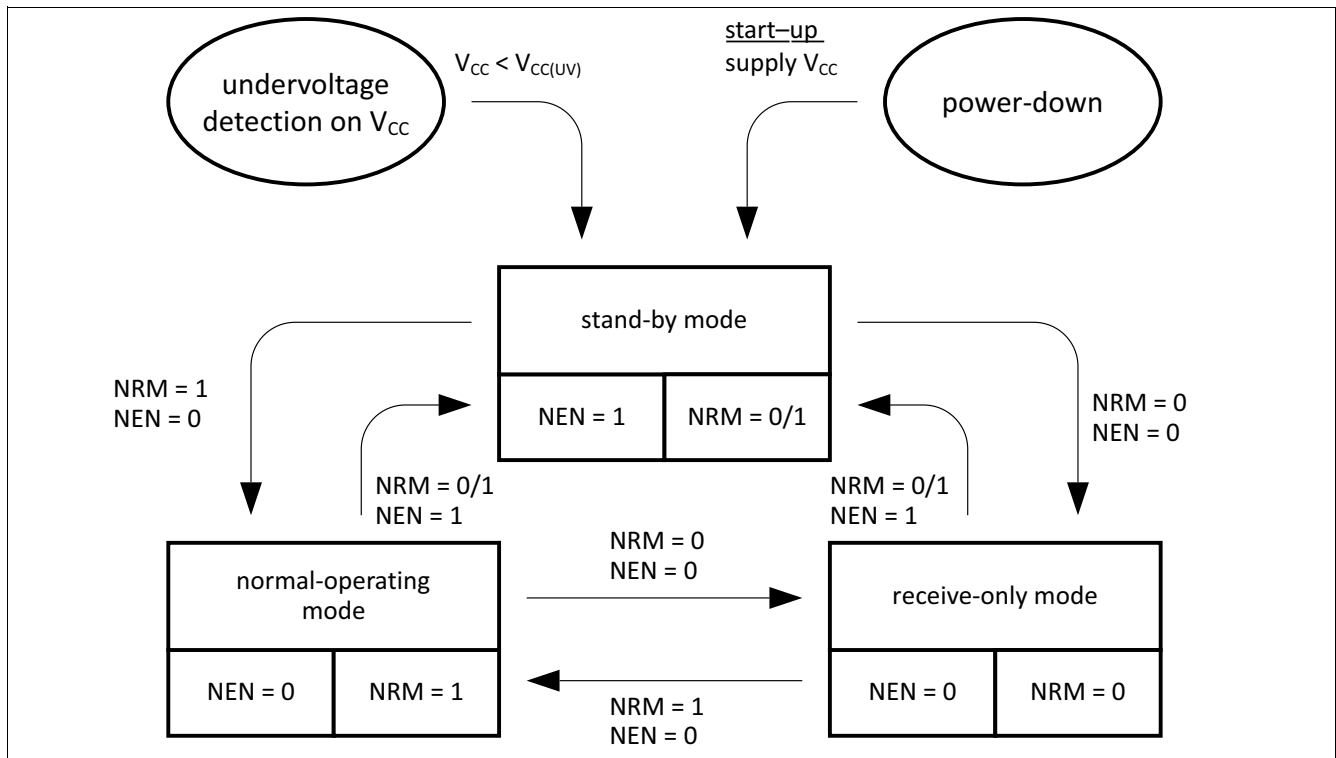
Figure 4   Modes of operation

The TLE7250G has 3 major modes of operation:

*   Stand-by mode
*   Normal-operating mode
*   Receive-only mode

Table 2   Modes of Operation

Mode	NRM	NEN	Bus Bias	Comments
Normal-operating mode	"high"	"low"	$V_{CC}/2$	The transmitter is active. The receiver is active.
Stand-by	"low" or "high"	"high"	GND	The transmitter is disabled. The receiver is disabled.
Receive-only	"low"	"low"	$V_{CC}/2$	The transmitter is disabled. The receiver is active.
V_{CC} off	"low" or "high"	"low" or "high"	floating	The transmitter is disabled. The receiver is disabled.

4.3 Normal-operating Mode

In the normal-operating mode, the HS CAN transceiver TLE7250G sends the serial data stream on the TxD pin to the CAN bus. The data on the CAN bus is displayed at the RxD pin simultaneously. In the normal-operating mode, all functions of the TLE7250G are active:

- The transmitter is active and drives data from the TxD to the CAN bus.
- The receiver is active and provides the data from the CAN bus to the RxD pin.
- The bus biasing is set to $V_{CC}/2$.
- The undervoltage monitoring at the power supply V_{CC} is active.

To enter the normal-operating mode, set the pin NRM to logical "high" and the pin NEN to logical "low" (see **Table 2** or **Figure 4**). Both pins, the NEN pin and the NRM pin have internal pull-up resistors to the power-supply V_{CC}.

4.4 Receive-only Mode

The receive-only mode can be used to test the connection of the bus medium. The TLE7250G can still receive data form the bus, but the transmitter is disabled and hence, no data can be sent to the CAN bus. All other functions are active:

- The transmitter is disabled and data, which is available on the TxD pin, is blocked and not sent to the CAN bus.
- The receiver is active and provides the data from the CAN bus to the RxD output pin.
- The bus biasing is set to $V_{CC}/2$.
- The undervoltage monitoring on the power supply V_{CC} is active.

To enter the receive-only mode, set the pin NRM to logical "low" and the pin NEN to logical "low" (see **Table 2** or **Figure 4**). In case the receive-only mode is not used, the NRM pin can be left open.

4.5 Stand-by Mode

The stand-by mode is an idle mode of the TLE7250G with optimized power consumption. In the stand-by mode, the TLE7250G can not send or receive any data. The transmitter and the receiver are disabled. Both CAN bus pins, CANH and CANL are connected to GND via the input resistors.

- The transmitter is disabled.
- The receiver is disabled.
- The input resistors of the receiver unit are connected to GND.
- The undervoltage monitoring at the power supply V_{CC} is active.

To enter the stand-by mode, set the pin NEN to logical "high", the logical state of the NRM pin has no influence on the mode selection (see **Table 2** or **Figure 4**). Both pins, the NEN and the NRM pin have an internal pull-up resistor to the power-supply V_{CC}. If the stand-by mode is not used in the application, the NEN pin needs to be connected to GND.

In case the NRM pin is set to logical "low" in the stand-by mode, the internal pull-up resistor causes an additional quiescent current from V_{CC} to GND, therefore it is recommended to set the NRM pin to logical "high" in stand-by mode or leave the pin open, if the receive-only mode is not used in the application.

4.6 Power-down state

The power-down state means that the TLE7250G is not supplied. In power-down state, the differential input resistors of the receiver stage are switched off. The CANH and CANL bus interface of the TLE7250G acts as high-impedance input with a very small leakage current. The high-ohmic input does not influence the "recessive" level of the CAN network and allows an optimized EME performance of the entire CAN network.

5 Fail-safe Functions

5.1 Short-circuit Protection

The CANH and CANL bus outputs are short-circuit proof, either against GND or a positive supply voltage. A current limiting circuit protects the transceiver against damage. If the device heats up due to a continuous short on the CANH or CANL, the internal overtemperature protection switches off the transmitter.

5.2 Unconnected Logic Pins

All logic input pins have an internal pull-up resistor to V_{CC}. In case the V_{CC} supply is activated and the logical pins are open or floating, the TLE7250G enters into the stand-by mode by default. In stand-by mode, the transmitter of the TLE7250G is disabled, the bus bias is connected to GND and the HS CAN TLE7250G transceiver does not influence the data on the CAN bus.

5.3 TxD Time-out Function

The TxD time-out feature protects the CAN bus against permanent blocking in case the logical signal on the TxD pin is continuously "low". A continuous "low" signal on the TxD pin can have its root cause in a locked-up microcontroller or in a short on the printed circuit board for example. In normal-operating mode, a logical "low" signal on the TxD pin for the time $t > t_{TxD}$ enables the TxD time-out and the TLE7250G disables the transmitter (see **Figure 5**). The receiver is still active and the data on the bus continues to be monitored by the RxD output pin.
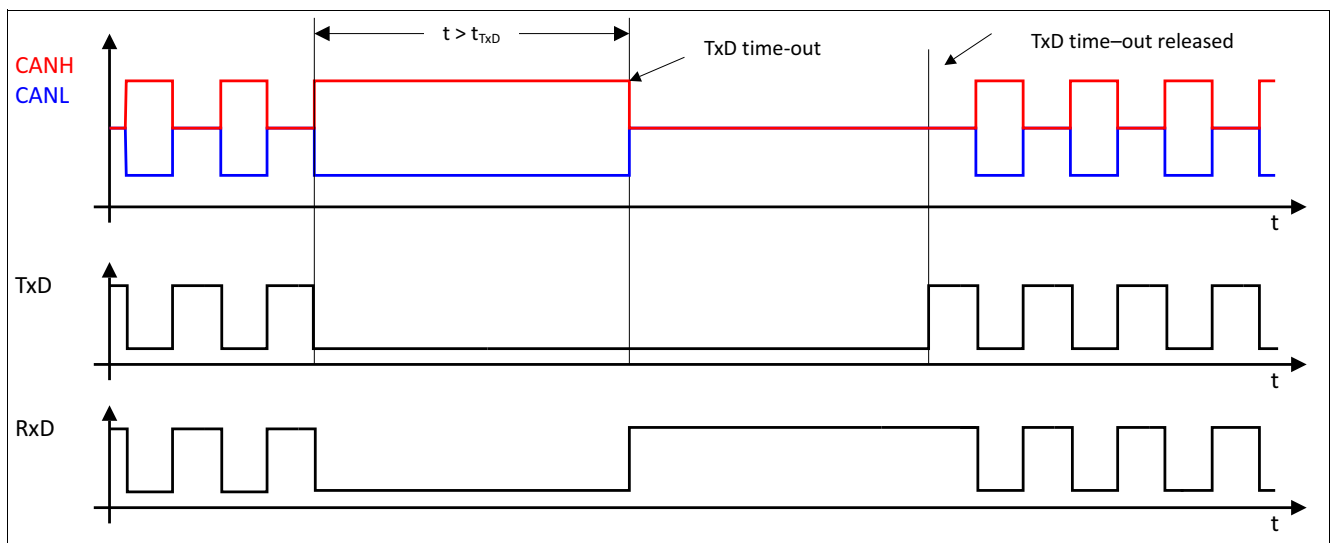

Figure 5   TxD Time-out function

Figure 5 illustrates how the transmitter is deactivated and activated again. A permanent "low" signal on the TxD input pin activates the TxD time-out function and deactivates the transmitter. To release the transmitter after a TxD time-out event, the TLE7250G requires a signal change on the TxD input pin from logical "low" to logical "high".

5.4 Undervoltage Detection

The HS CAN Transceiver TLE7250G is provided with undervoltage detection at the power supply V_{CC}. In case of an undervoltage event on V_{CC}, the undervoltage detection changes the operating mode of TLE7250G to the stand-by mode, regardless of the logical signal on the NEN and NRM pins (see **Figure 6**). If the transceiver TLE7250G recovers from the undervoltage condition, the operating mode is restored to the programmed mode by the logical pins NEN and NRM.
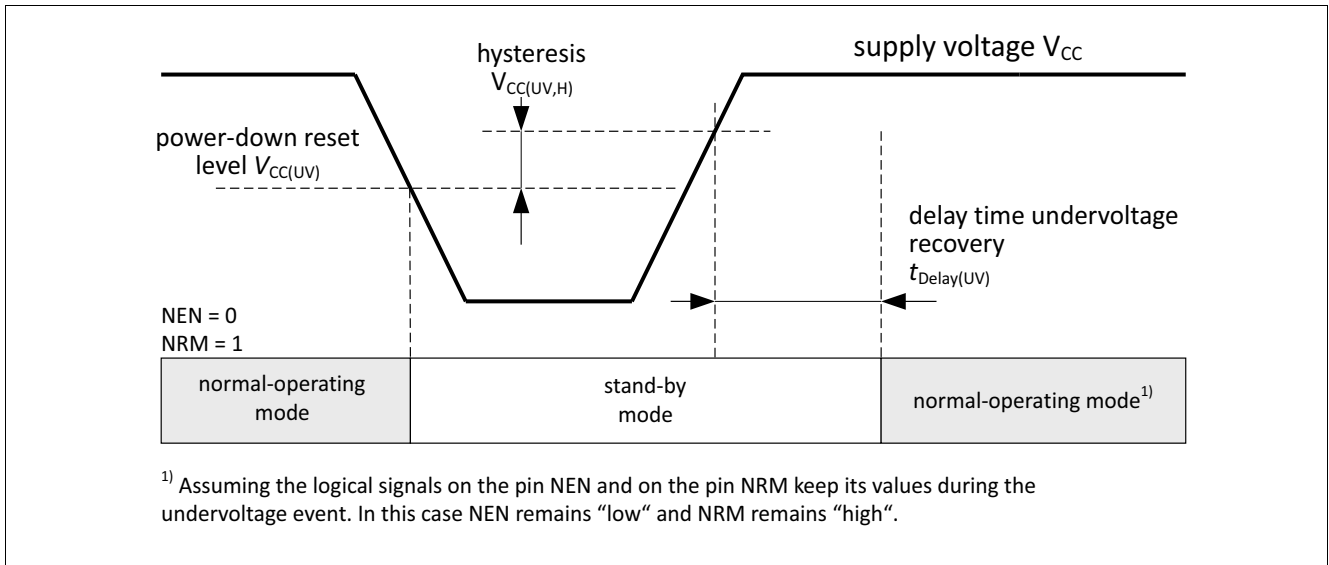
Figure 6   Undervoltage detection on V_{CC}
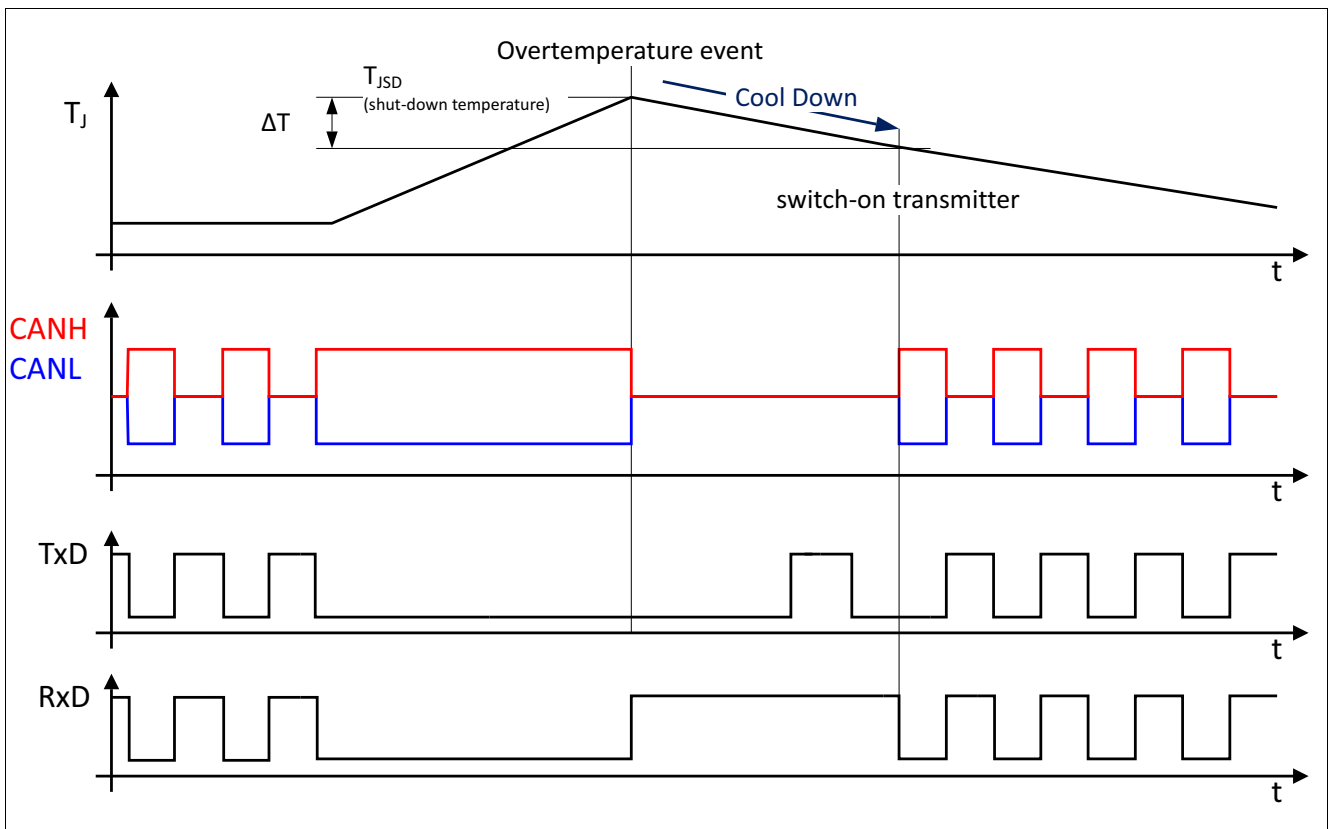
5.5   Overtemperature Protection

Figure 7   Overtemperature protection

The TLE7250G has an integrated overtemperature detection circuit to protect the device against thermal overstress of the transmitter. In case of an overtemperature condition, the temperature sensor will disable the transmitter (see **Figure 1**). After the device cools down, the transmitter is activated again (see **Figure 7**). A hysteresis is implemented within the temperature sensor.

6 General Product Characteristics

6.1 Absolute Maximum Ratings

Table 3 Absolute Maximum Ratings of Voltage, Current and Temperatures[1]

All voltages with respect to ground; positive current flowing into the pin;

(unless otherwise specified)

Pos.	Parameter	Symbol	Limit Values		Unit	Remarks
			Min.	**Max.**		
Voltage						
6.1.1	Supply voltage	V_{CC}	-0.3	6.0	V	–
6.1.2	CANH DC voltage against GND	V_{CANH}	-40	40	V	–
6.1.3	CANL DC voltage against GND	V_{CANL}	-40	40	V	–
6.1.4	Differential voltage between CANH and CANL	$V_{CAN\,diff}$	-40	40	V	
6.1.5	Logic voltage logic input pins NEN, NRM, TxD	V_{Max_In}	-0.3	6.0	V	–
6.1.6	Logic voltage at logic output RxD	V_{Max_Out}	-0.3	V_{CC}	V	–
Temperature						
6.1.7	Junction temperature	T_j	-40	150	°C	–
6.1.8	Storage temperature	T_S	- 55	150	°C	–
ESD Immunity						
6.1.9	ESD immunity at CANH, CANL against GND	$V_{ESD\_HBM\_CAN}$	-8	8	kV	HBM (100pF via 1.5 kΩ)[2]
6.1.10	ESD immunity at all other pins	$V_{ESD\_HBM\_All}$	-2	2	kV	HBM (100pF via 1.5 kΩ)[2]
6.1.11	ESD immunity to GND (all pins)	V_{ESD_CDM}	-750	750	V	CDM[3]

1) Not subject to production test, specified by design

2) ESD susceptibility Human Body Model "HBM" according to ANSI/ESDA/JEDEC JS-001

3) ESD susceptibility, Charged Device Model "CDM" according to EIA/JESD22-C101 or ESDA STM5.3.1

Note: Within the functional range the IC operates as described in the circuit description. The electrical characteristics are specified within the conditions given in the associated electrical characteristics table.

6.2 Functional Range

Table 4 Operating Range

Pos.	Parameter	Symbol	Limit Values		Unit	Conditions
			Min.	**Max.**		
Supply Voltage						
6.2.1	Transceiver supply voltage	V_{CC}	4.5	5.5	V	–
Thermal Parameter						
6.2.2	Junction temperature	T_J	-40	150	°C	[1]

1) Not subject to production test, specified by design

Note: Within the functional range the IC operates as described in the circuit description. The electrical characteristics are specified within the conditions given in the associated electrical characteristics table.

6.3 Thermal Characteristics

*Note: This thermal data was generated in accordance with JEDEC JESD51 standards. For more information, please visit **www.jedec.org**.*

Table 5 Thermal Resistance[1]

Pos.	Parameter	Symbol	Limit Values			Unit	Remarks
			Min.	**Typ.**	**Max.**		
Thermal Resistance							
6.3.1	Junction to ambient[1]	R_{thJA}	–	130	–	K/W	[2]
Thermal Shut-down Junction Temperature							
6.3.2	Thermal shut-down temperature.	T_{JSD}	150	175	200	°C	–
6.3.3	Thermal shut-down hysteresis	ΔT	–	10	–	K	–

1) Not subject to production test, specified by design
2) The R_{thJA} value specified, is according to Jedec JESD51-2,-7 at natural convection on the FR4 2s2p board; The product (TLE7250G) was simulated on a 76.2 x 114.3 x 1.5 mm board with 2 inner copper layers (2 x 70 μm Cu, 2 x 35 μm Cu).

7 Electrical Characteristics

7.1 Functional Device Characteristics

Table 6 **Electrical Characteristics**

4.5 V < V_{CC} < 5.5 V; R_L = 60 Ω; -40 °C < T_j < +150 °C; all voltages with respect to ground; positive current flowing into the pin; unless otherwise specified.

Pos.	Parameter	Symbol	Limit Values			Unit	Remarks
			Min.	Typ.	Max.		
Current Consumption							
7.1.1	Current consumption	I_{CC}	–	2	6	mA	"recessive" state; V_{TxD} = V_{CC}
7.1.2	Current consumption	I_{CC}	–	35	60	mA	"dominant" state; V_{TxD} = "low"
7.1.3	Current consumption	$I_{CC(ROM)}$	–	2	6	mA	receive-only mode; NEN = NRM = "low"
7.1.4	Current consumption	$I_{CC(STB)}$	–	7	15	μA	stand-by mode; TxD = NRM = NEN = "high"
Supply Resets							
7.1.5	V_{CC} undervoltage monitor	$V_{CC(UV)}$	1.3	3.2	4.3	V	–
7.1.6	V_{CC} undervoltage monitor hysteresis	$V_{CC(UV,H)}$	–	400	–	mV	[1]
7.1.7	V_{CC} undervoltage delay time	$t_{Delay(UV)}$	–	–	50	μs	[1] (see **Figure 6**)
Receiver Output: RxD							
7.1.8	"High" level output current	$I_{RD,H}$	–	-4	-2	mA	V_{RxD} = V_{CC} - 0.4 V, V_{DIFF} < 0.5 V
7.1.9	"Low" level output current	$I_{RD,L}$	2	4	–	mA	V_{RxD} = 0.4 V, V_{DIFF} > 0.9 V
Transmission Input: TxD							
7.1.10	"High" level input voltage threshold	$V_{TD,H}$	–	0.5 × V_{CC}	0.7 × V_{CC}	V	"recessive" state
7.1.11	"Low" level input voltage threshold	$V_{TD,L}$	0.3 × V_{CC}	0.4 × V_{CC}	–	V	"dominant" state
7.1.12	TxD pull-up resistance	R_{TD}	10	25	50	kΩ	–
7.1.13	TxD input hysteresis	$V_{HYS(TxD)}$	–	800	–	mV	[1]
7.1.14	TxD permanent "dominant" disable time	t_{TxD}	0.3	–	1.0	ms	–
Not Enable Input NEN							
7.1.15	"High" level input voltage threshold	$V_{NEN,H}$	–	0.5 × V_{CC}	0.7 × V_{CC}	V	stand-by mode
7.1.16	"Low" level input voltage threshold	$V_{NEN,L}$	0.3 × V_{CC}	0.4 × V_{CC}	–	V	normal-operating mode
7.1.17	NEN pull-up resistance	R_{NEN}	10	25	50	kΩ	–
7.1.18	NEN input hysteresis	$V_{HYS(NEN)}$	–	200	–	mV	[1]

Table 6   Electrical Characteristics (cont'd)

4.5 V < V_{CC} < 5.5 V; R_L = 60 Ω; -40 °C < T_j < +150 °C; all voltages with respect to ground; positive current flowing into the pin; unless otherwise specified.

Pos.	Parameter	Symbol	Limit Values			Unit	Remarks
			Min.	Typ.	Max.		
Receive-only Input NRM							
7.1.19	"High" level input voltage threshold	$V_{NRM,H}$	–	$0.5 \times V_{CC}$	$0.7 \times V_{CC}$	V	normal-operating mode
7.1.20	"Low" level input voltage threshold	$V_{NRM,L}$	$0.3 \times V_{CC}$	$0.4 \times V_{CC}$	–	V	receive-only mode
7.1.21	NRM pull-up resistance	R_{NRM}	10	25	50	kΩ	–
7.1.22	NRM input hysteresis	$V_{NRM(Hys)}$	–	200	–	mV	[1]–
Bus Receiver							
7.1.23	Differential receiver threshold "dominant"	$V_{DIFF,(D)}$	–	0.75	0.9	V	–
7.1.24	Differential receiver threshold "recessive"	$V_{DIFF,(R)}$	0.5	0.65	–		–
7.1.25	Differential receiver input range "dominant"	$V_{diff,rdN}$	0.9	–	5.0	V	[1]
7.1.26	Differential receiver input range "recessive"	$V_{diff,drN}$	-1.0	–	0.5	V	[1]
7.1.27	Common mode range	CMR	-12	–	12	V	V_{CC} = 5 V
7.1.28	Differential receiver hysteresis	$V_{diff,hys}$	–	100	–	mV	[1]
7.1.29	CANH, CANL input resistance	R_i	10	20	30	kΩ	"recessive" state
7.1.30	Differential input resistance	R_{diff}	20	40	60	kΩ	"recessive" state
7.1.31	Input resistance deviation between CANH and CANL	ΔR_i	-3	–	3	%	[1] "recessive" state
7.1.32	Input capacitance CANH, CANL versus GND	C_{IN}	–	20	40	pF	[1] V_{TxD} = V_{CC}
7.1.33	Differential input capacitance	C_{InDiff}	–	10	20	pF	[1] V_{TxD} = V_{CC}
Bus Transmitter							
7.1.34	CANL/CANH "recessive" output voltage	$V_{CANL/H}$	2.0	2.5	3.0	V	V_{TxD} = V_{CC}, no load
7.1.35	CANH, CANL "recessive" output voltage difference	V_{diff}	-500	–	50	mV	V_{TxD} = V_{CC}, no load
7.1.36	CANL "dominant" output voltage	V_{CANL}	0.5	–	2.25	V	4,75 V ≤ V_{CC} ≤ 5.25 V, V_{TxD} = "low", 50 Ω < R_L < 65 Ω
7.1.37	CANH "dominant" output voltage	V_{CANH}	2.75	–	4.5	V	4,75 V ≤ V_{CC} ≤ 5.25 V, V_{TxD} = "low", 50 Ω < R_L < 65 Ω
7.1.38	CANH, CANL "dominant" output voltage difference V_{diff} = V_{CANH} - V_{CANL}	V_{diff}	1.5	–	3.0	V	4,75 V ≤ V_{CC} ≤ 5.25 V, V_{TxD} = "low", 50 Ω < R_L < 65 Ω
7.1.39	Driver symmetry V_{SYM} = V_{CANH} + V_{CANL}	V_{SYM}	4.5	–	5.5	V	V_{TxD} = 0 V, V_{CC} = 5 V, 50 Ω < R_L < 65 Ω

Table 6   Electrical Characteristics (cont'd)

4.5 V < V_{CC} < 5.5 V; R_L = 60 Ω; -40 °C < T_j < +150 °C; all voltages with respect to ground; positive current flowing into the pin; unless otherwise specified.

Pos.	Parameter	Symbol	Limit Values			Unit	Remarks
			Min.	Typ.	Max.		
7.1.40	CANL short-circuit current	I_{CANLsc}	40	80	100	mA	V_{TxD} = 0 V, V_{CC} = 5 V, t < t_{TxD}, $V_{CANLshort}$ = 18 V
7.1.41	CANH short-circuit current	I_{CANHsc}	-100	-80	-40	mA	V_{TxD} = 0 V, V_{CC} = 5 V, t < t_{TxD}, $V_{CANHshort}$ = 0 V
7.1.42	Leakage current CANH	$I_{CANH,lk}$	-5	0	5	μA	V_{CC} = 0 V, V_{CANH} = V_{CANL}, 0 V < $V_{CANH,}$ < 5 V
7.1.43	Leakage current CANL	$I_{CANL,lk}$	-5	0	5	μA	V_{CC} = 0 V, V_{CANH} = V_{CANL}, 0 V < V_{CANL} < 5 V
Dynamic CAN Transceiver Characteristics							
7.1.44	Propagation delay TxD to RxD "low" ("recessive" to "dominant")	$t_{d(L),TR}$	30	170	255	ns	C_L = 100 pF, V_{CC} = 5 V, C_{RxD} = 15 pF
7.1.45	Propagation delay TxD to RxD "high" ("dominant" to "recessive")	$t_{d(H),TR}$	30	200	255	ns	C_L = 100 pF, V_{CC} = 5 V, C_{RxD} = 15 pF
7.1.46	Propagation delay TxD "low" to bus "dominant"	$t_{d(L),T}$	–	90	–	ns	[1] C_L = 100 pF, V_{CC} = 5 V, C_{RxD} = 15 pF
7.1.47	Propagation delay TxD "high" to bus "recessive"	$t_{d(H),T}$	–	90	–	ns	[1] C_L = 100 pF, V_{CC} = 5 V, C_{RxD} = 15 pF
7.1.48	Propagation delay bus "dominant" to RxD "low"	$t_{d(L),R}$	–	80	–	ns	[1] C_L = 100 pF, V_{CC} = 5 V, C_{RxD} = 15 pF
7.1.49	Propagation delay bus "recessive" to RxD "high"	$t_{d(H),R}$	–	110	–	ns	[1] C_L = 100 pF, V_{CC} = 5 V, C_{RxD} = 15 pF
7.1.50	Time for mode change	t_{Mode}	–	–	10	μs	[1]

1) Not subject to production test, specified by design
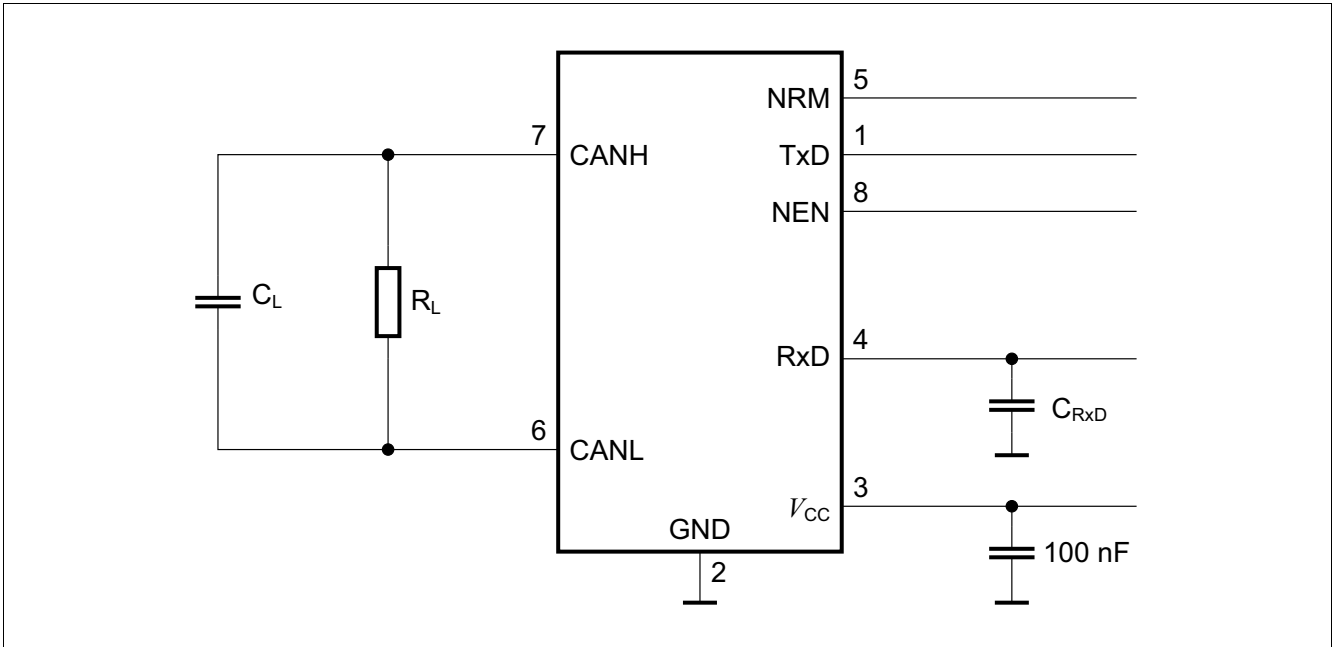
7.2 Diagrams
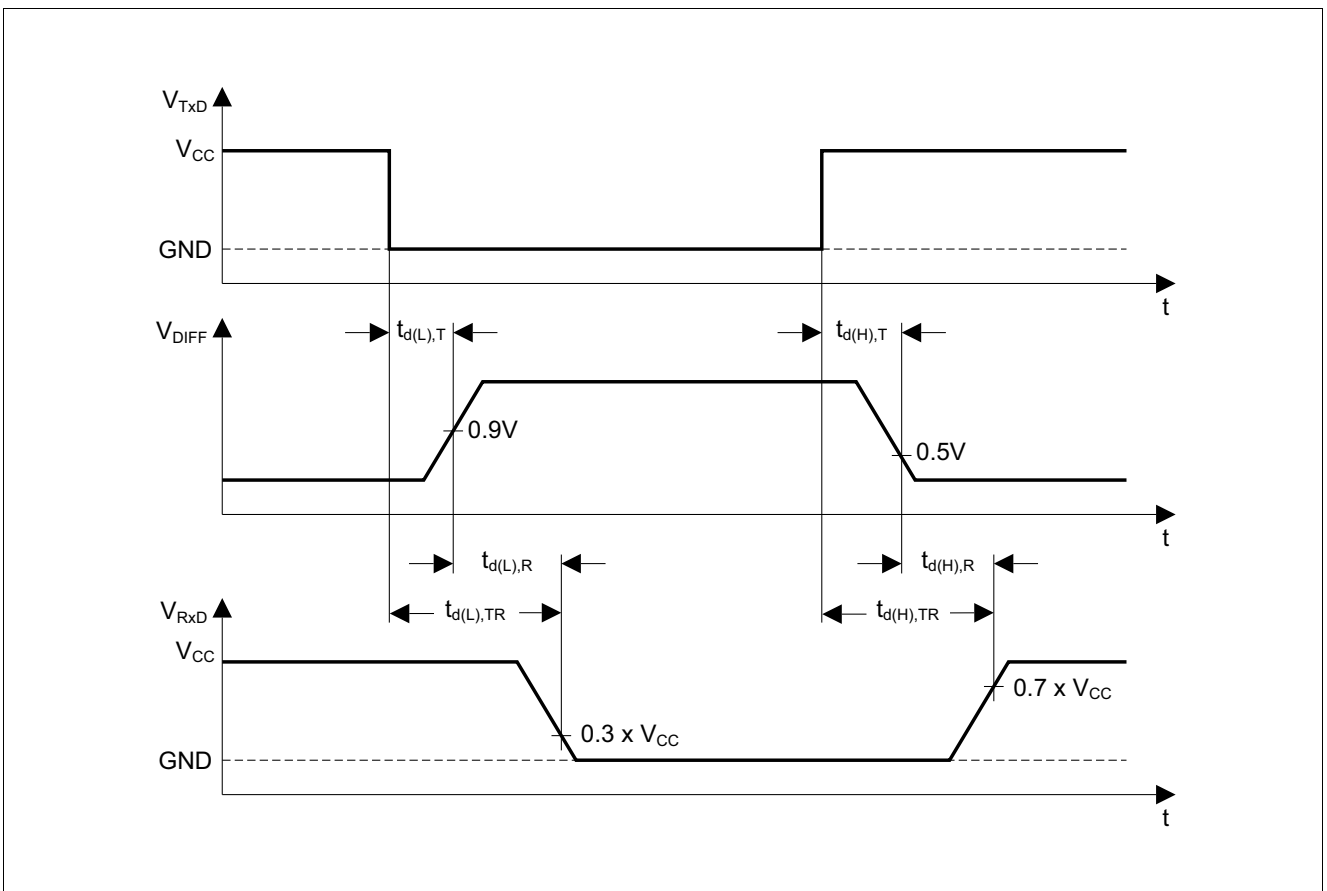

Figure 8   Simplified test circuit

Figure 9   Timing diagram for dynamic characteristics

8 Application Information

8.1 ESD Immunity According to IEC61000-4-2

Tests for ESD immunity according to IEC61000-4-2, "Gun test" (150 pF, 330 Ω), have been performed. The results and test conditions are available in a separate test report.

Table 7   ESD Immunity according to IEC61000-4-2

Test performed	Result	Unit	Remarks
Electrostatic discharge voltage at CANH and CANL pins against GND	≥ +8	kV	[1]Positive pulse
Electrostatic discharge voltage at CANH and CANL pins against GND	≤ -8	kV	[1]Negative pulse

1) ESD susceptibility "ESD GUN" according to Gift / ICT paper: "EMC Evaluation of CAN Transceivers, version 03/02/ IEC TS 62228", section 4.3. (DIN EN 61000-4-2)
Tested by external test house (IBEE Zwickau, EMC test report no.: 03-01-12).

8.2 Application Example
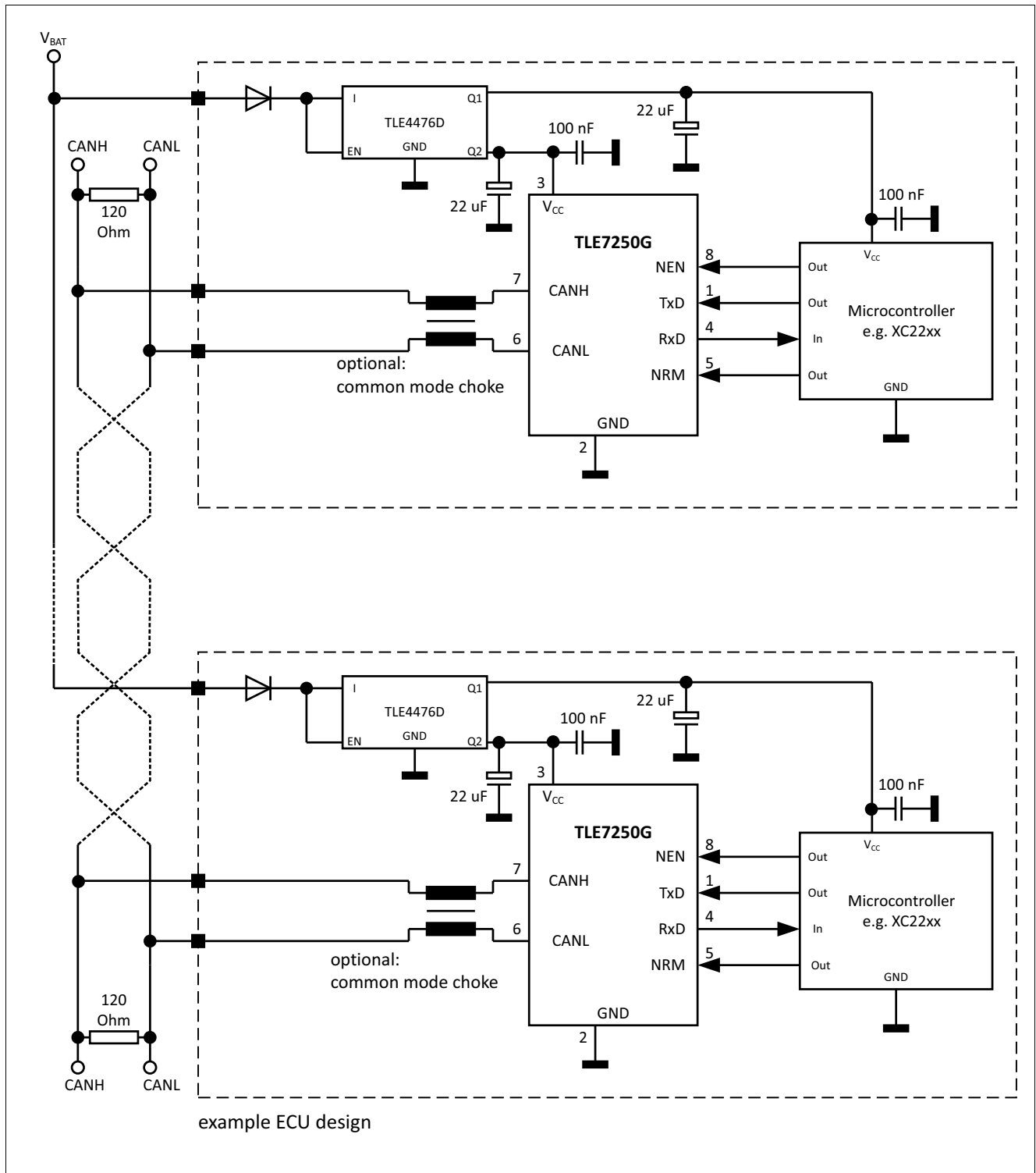
Figure 10   Simplified application for the TLE7250G

8.3 Further Application Information

- Please contact us for information regarding the FMEA pin.
- For further information you may visit **http://www.infineon.com/**

9 Package Outlines

1) Does not include plastic or metal protrusion of 0.15 max. per side
2) Lead width can be 0.61 max. in dambar area

GPS01181
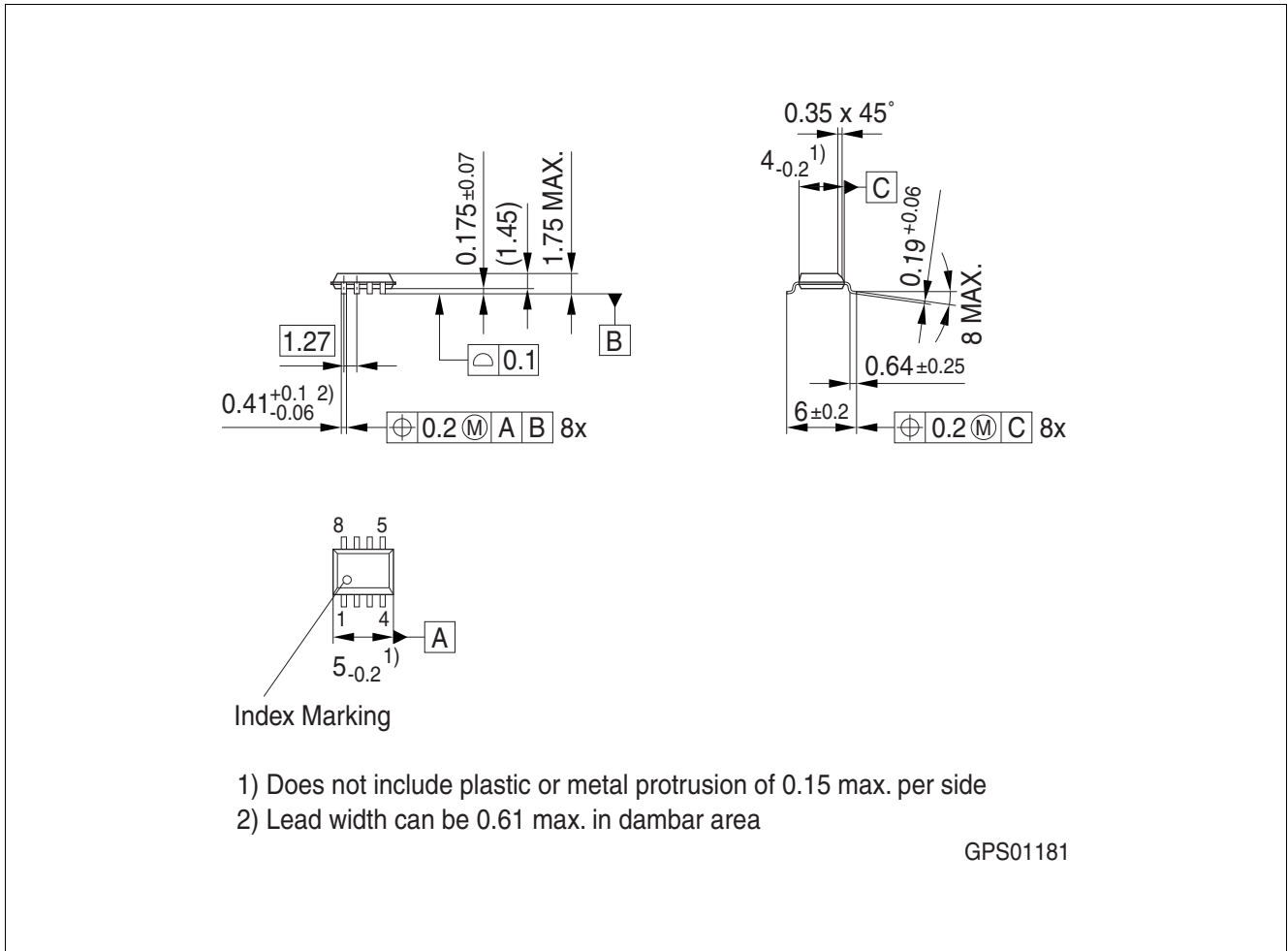
Figure 11 **PG-DSO-8** (Plastic dual small outline PG-DSO-8-16)

Green Product (RoHS-compliant)

The device has been designed as a green product to meet the world-wide customer requirements for environment-friendly products and to be compliant with government regulations. Green products are RoHS-compliant (i.e Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

For further information on alternative packages, please visit our website:
http://www.infineon.com/packages.

Dimensions in mm

10 Revision History

Revision	Date	Changes
1.1	2013-07-22	Update from Data Sheet Rev. 1.0: • All pages: Revision and date updated. • **Page 3**, Overview: Feature list updated ("Extended supply range at V_{CC}"). • **Page 13**, **Table 4**, **Parameter 6.2.1**: Supply range updated (4.5 V < V_{CC} < 5.5V). • **Page 14**, **Table 6**: Table header update (4.5 V < V_{CC} < 5.5V). • **Page 15**, **Table 6**, **Parameter 7.1.23**: Remark removed "normal-operating mode". • **Page 15**, **Table 6**, **Parameter 7.1.24**: Remark removed "normal-operating mode". • **Page 15**, **Table 6**, **Parameter 7.1.25**: Remark removed "normal-operating mode". • **Page 15**, **Table 6**, **Parameter 7.1.26**: Remark removed "normal-operating mode". • **Page 15**, **Table 6**, **Parameter 7.1.36**: Remark added "4,75 V ≤ V_{CC} ≤ 5.25 V". • **Page 15**, **Table 6**, **Parameter 7.1.37**: Remark added "4,75 V ≤ V_{CC} ≤ 5.25 V". • **Page 15**, **Table 6**, **Parameter 7.1.38**: Remark added "4,75 V ≤ V_{CC} ≤ 5.25 V". • **Page 19**, **Figure 10**: Picture updated. • **Page 21**: Revision history updated.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.