1. DESCRIPTION

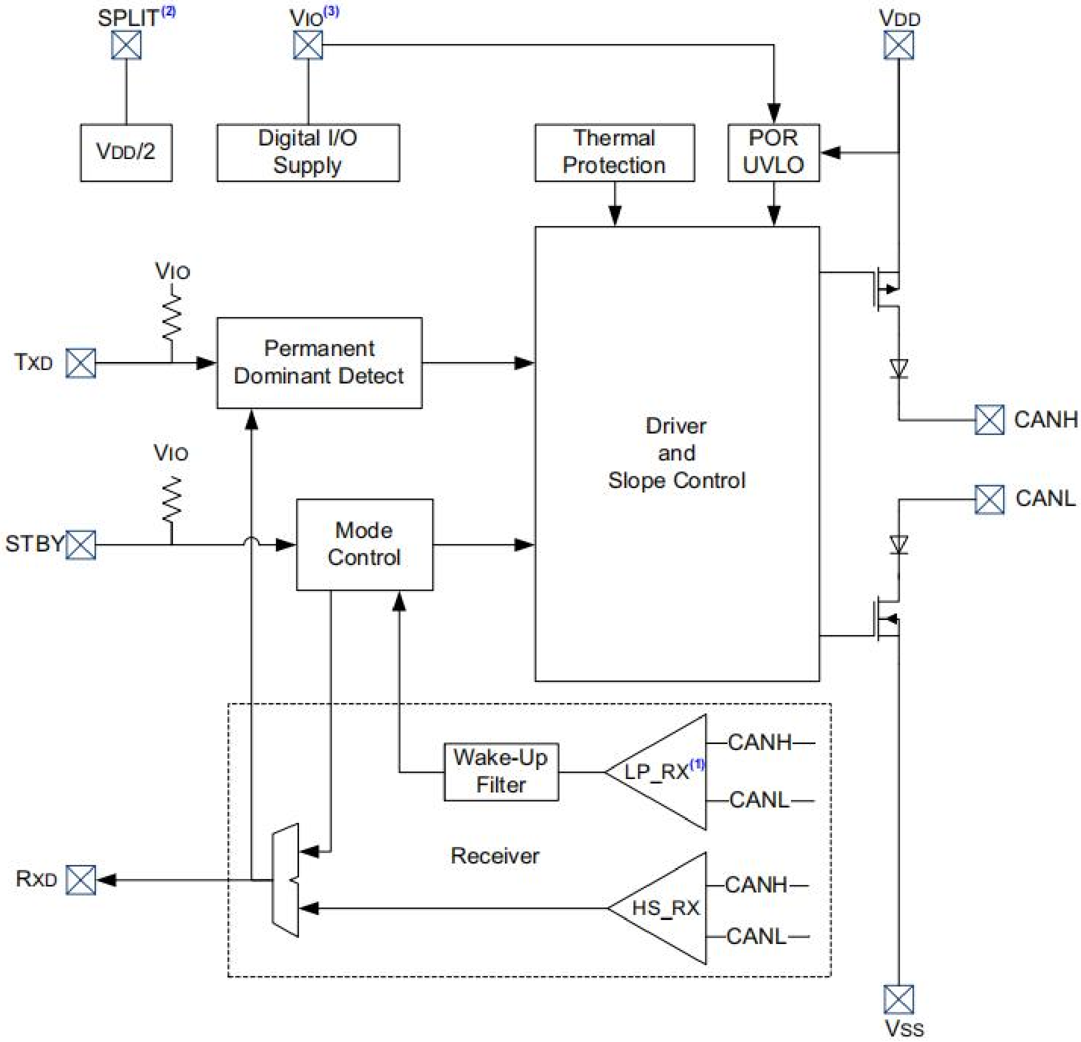
The XL2562 is a secondgeneration high-speed CAN transceiver. It serves as aninterface between a CAN protocol controller and the physical two-wire CAN bus.

The device meets the automotive requirements for high-speed (up to 1 Mb/s), low quiescent current,electromagnetic compatibility (EMC) and electrostatic discharge (ESD).

2. FEATURES

- Supports 1 Mb/s Operation
- Implements ISO-11898-2 and ISO-11898-5 Standard Physical Layer Requirements
- Very Low Standby Current (5 pA, typical)
- Vio Supply Pin to Interface Directly to CAN Controllers and Microcontrollers with 2.1V to 5.5V I/O
- SPLIT Output Pin to Stabilize Common Mode in Biased Split Termination Schemes
- CAN Bus Pins are Disconnected when Device is Unpowered:
  - An Unpowered Node or Brown-Out Event will Not Load the CAN Bus
- Detection of Ground Fault:
  - Permanent Dominant Detection on TxD
  - Permanent Dominant Detection on Bus
- Power-on Reset and Voltage Brown-Out Protection on VoD Pin
- Protection Against Damage Due to Short-Circuit Conditions (Positive or Negative Battery Voltage)
- Protection Against High-Voltage Transients in Automotive Environments
- Automatic Thermal Shutdown Protection
- Suitable for 12V and 24V Systems
- High-Noise Immunity Due to Differential Bus Implementation
- High Electrostatic Discharge (ESD) Protection on CANH and CANL, meeting the lEC61000-4-2 up to±14 kV
- Available in DIP-8, SOP-8 and 3x3 DFN-8
- Temperature ranges:-40°C to +125°C

3. BLOCK DIAGRAM



Note 1: There is only one receiver implemented.The receiver can operate in Low-Power or High-Speed mode.

2: XL2562 has the VIO pin

4. DEVOCE OVERVIEW

The XL2562 is a high-speed CAN, fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. The XL2562 device provides differential transmit and receive capability for the CAN protocol controller, and is fully compatible with the ISO-11898-2 and ISO-11898-5 standards. It will operate at speeds of up to 1 Mb/s.

Typically, each node in a CAN system must have a device to convert the digital signals generated by a CAN controller to signals suitable for transmission over the bus cabling (differential output). It also provides a buffer between the CAN controller and the high-voltage spikes that can be generated on the CAN bus by outside sources.

4.1. Mode Control Block

The XL2562 supports two modes of operation:Nomal and Standby.

These modes are summarized in Table 1-1

TABLE1-1: MODES OF OPERATION

Mode	STBY Pin	RXD Pin	
		LOW	HIGH
Normal	LOW	Bus is dominant	Bus is recessive
Stangdby	HIGH	Wake-up request is detected	No wake-up request detected

4.1.1. NORMAL MODE

Normal mode is selected by applying a low-level to the STBY pin. The driver block is operational and can drive the bus pins. The slopes of the output signals on CANH and CANL are optimized to produce minimal electromagnetic emissions (EME).

The high-speed differential receiver is active.

4.1.2. STANDBY MODE

The device may be placed in Standby mode by applying a high-level to the STBY pin.In Standby mode, the transmitter and the high-speed part of the receiver are switched off to minimize power consumption. The low-power receiver and the wake-up filter blocks are enabled in order to monitor the bus for activity. The receive pin (RXD) will show a delayed representation of the CAN bus, due to the wake-up filter.

The CAN controller gets interrupted by anegative edge on the RXD pin (dominant state on the CAN bus). The CAN controller must put the XL2562 back into Normal mode using the STBY pin, in order to enable high-speed data communication.

The CAN bus wake-up function requires both supply voltages, V_{DD} and V_{IO}, to be in valid range.

4.2. TRANSMITTER FUNCTION

The CAN bus has two states:Dominant and Recessive. A Dominant state occurs when the differential voltage between CANH and CANL is greater than $V_{DIFF(D)(I)}$. A Recessive state occurs when the differential voltage is less than $V_{DIFF(R)(I)}$. The Dominant and Recessive states correspond to the Low and High state of the TXD input pin, respectively. However, a Dominant state initiated by another CAN node will override a Recessive state on the CAN bus.

4.3. RECEIVER FUNCTION

In Normal mode, the RXD output pin reflects the differential bus voltage between CANH and CANL. The Low and High states of the RXD output pin correspond to the Dominant and Recessive states of the CAN bus,respectively.

4.4. INTERNAL PROTECTION

CANH and CANL are protected against battery shortcircuits and electrical transients that can occur on the CAN bus. This feature prevents destruction of the transmitter output stage during such a Fault condition.

The device is further protected from excessive current loading by thermal shutdown circuitry that disables the loutput drivers when the junction temperature exceeds a nominal limit of +175°C. All other parts of the chip remain operational, and the chip temperature is lowered due to the decreased power dissipation in the transmitter outputs. This protection is essential to protect against bus line short-circuit-induced damage.

4.5. PERMANENT DOMINANT DETECTION

The XL2562 device prevents two conditions:

- Permanent dominant condition on TXD
- Permanent dominant condition on the bus

In Normal mode, if the XL2562 detects an extended Low state on the TXD input, it will disable the CANH and CANL output drivers in order to prevent the corruption of data on the CAN bus. The drivers will remain disabled until TXD goes High.

In Standby mode, if the XL2562 detects anextended dominant condition on the bus, it will set the RXD pin to Recessive state. This allows the attached controller to go to Low-Power mode until the dominant issue is corrected. RXD is latched High until a Recessive state is detected on the bus, and the wake-up function is enabled again.

Both conditions have a time-out of 1.25 ms (typical).This implies a maximum bit time of 69.44 µs (14.4 kHz), allowing up to 18 consecutive dominant bits on the bus.

4.6. POWER-ON RESET(POR) AND UNDERVOLTAGE DETECTION

The XL2562 has undervoltage detection on both supply pins: VDD and Vio. Typical undervoltage thresholds are 1.2V for Vio and 4V for VDD.

When the device is powered on, CANH and CANL remain in a high-impedance state until both VDD and VIO exceed their undervoltage levels. Once powered on, CANH and CANL will enter a high-impedance state if the voltage level at VDD drops below the undervoltage level, providing voltage brown-out protection during normal operation.

In Normal mode, the receiver output is forced to Recessive state during an undervoltage condition on VDD. In Standby mode, the low-power receiver is only enabled when both VDD and VIO supply voltages rise above their respective undervoltage thresholds. Once these threshold voltages are reached, the low-power receiver is no longer controlled by the POR comparator and remains operational down to about 2.5V on the VDD supply . The XL2562 transfers data to the RXD pin down to 2.1V on the VIO supply.

4.7. PIN DESCRIPTIONS

Table 1-2 describes the pinout.

TABLE 1-2:XL2562 PINOUT

XL2562 DFN	XL2562 DIP,SOP	SYMBOL	PIN FUNCTION
1	1	TXD	Transmit Data Input
2	2	VSS	Ground
3	3	VDD	Supply Voltage
4	4	RXD	Receive Data Output
5	5	VIO	Digital I/O Supply Pin
6	6	CANL	CAN Low-Level Voltage I/O
7	7	CANH	CAN High-Level Voltage I/O
8	8	STBY	Standby Mode Input
9	—	EP	Exposed Thermal Pad

4.7.1. TRANSMITTER DATA INPUT PIN (TXD)

The CAN transceiver drives the differential output pins CANH and CANL according to TXD. It is usually connected to the transmitter data output of the CAN controller device.When TXD is Low, CANH and CANL are in the Dominant state.When TXD is High, CANH and CANL are in the Recessive state, provided that another CAN node is not driving the CAN bus with a Dominant state. TXD is connected to an internal pull-up resistor (nominal 33 kO) to VDD or VIO, in the XL2562, respectively.

4.7.2. GROUND SUPPLY PIN (V_{SS})

Ground supply pin.

4.7.3. SUPPLY VOLTAGE PIN (V_{DD})

Positive supply voltage pin. Supplies transmitter and receiver, including the wake-up receiver.

4.7.4. RECEIVER DATA OUTPUT PIN (RXD)

RXD is a CMOS-compatible output that drives High or Low depending on the differential signals on the CANH and CANL pins, and is usually connected to the receiver data input of the CAN controller device. RXD is High when the CAN bus is Recessive, and Low in the Dominant state. RXD is supplied by V_{DD} or V_{IO}, in the XL2562,respectively.

4.7.5. V_{IO} PIN

Supply for digital I/O pins.

4.7.6. CAN LOW PIN (CANL)

The CANL output drives the Low side of the CAN differential bus. This pin is also tied internally to the receive input comparator. CANL disconnects from the bus when XL2562 is not powered.

4.7.7. CAN HIGH PIN (CANH)

The CANH output drives the high-side of the CAN differential bus. This pin is also tied internally to the receive input comparator. CANH disconnects from the bus when XL2562 is not powered.

4.7.8. STANDBY MODE INPUT PIN (STBY)

This pin selects between Normal or Standby mode. In Standby mode, the transmitter, high speed receiver and SPLIT are turned off, only the low power receiver and wake-up filter are active. STBY is connected to an internal MOS pull-up resistor to V_{DD} or V_{IO}, in the XL2562, respectively. The value of the MOS pul-up resistor depends on the supply voltage. Typical values are 660 kΩ for 5V, 1.1 Mo for 3.3V and 4.4 Mo for 2 .1V.

4.7.9. EXPOSED THERMAL PAD (EP)

It is recommended to connect this pad to Vss to enhance electromagnetic immunity and thermal resistance.

4.8. TYPICAL APPLICATIONS

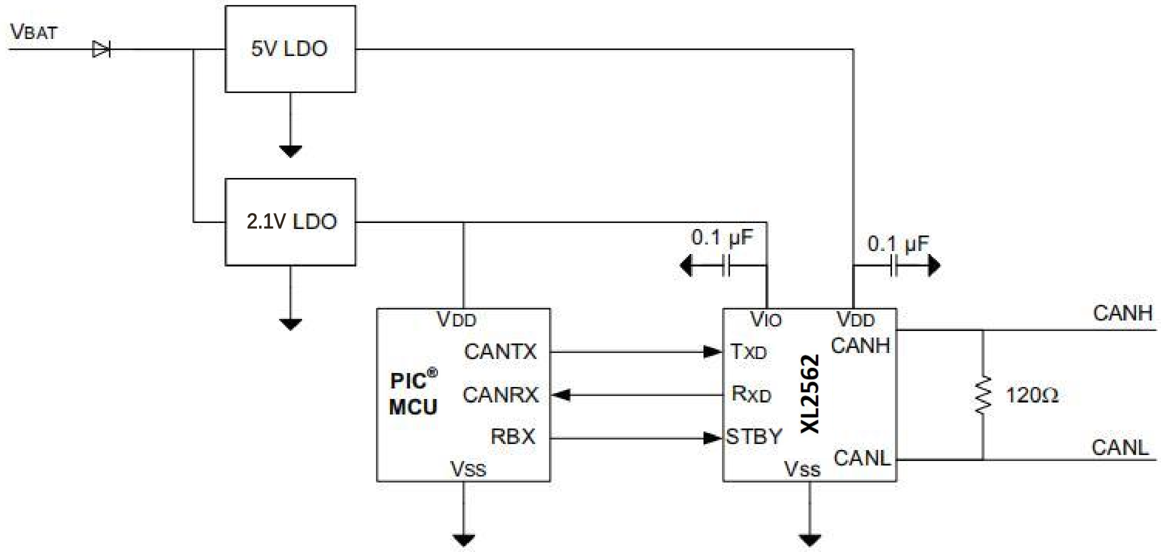


FIGURE 1-1 XL2562 WITH VIO PIN

5. ELECTRICAL CHARACTERISTICS

5.1. TERMS AND DEFINITIONS

A number of terms are defined in ISO-11898 that are used to describe the electrical characteristics of a CAN transceiver device. These terms and definitions are summarized in this section.

5.1.1 BUS VOLTAGE

V_{CANL} and V_{CANH} denote the voltages of the bus line wires CANL and CANH relative to ground of each individual CAN node.

5.1.2 COMMON MODE BUS VOLTAGE RANGE

Boundary voltage levels of V_{CANL} and V_{CANH} with respect to ground, for which proper operation will occur,if up to the maximum number of CAN nodes are connected to the bus.

5.1.3 DIFFERENTIALINTERNAL CAPACITANCE, CDIFF (OF A CAN NODE)

Capacitance seen between CANL and CANH during the Recessive state, when the CAN node is disconnected from the bus (see Figure 2-1).

5.1.4 DIFFERENTIALINTERNAL RESISTANCE,RDIFF (OF A CAN NODE)

Resistance seen between CANL and CANH during the Recessive state when the CAN node is disconnected from the bus (see Figure 2-1).

5.1.5 DIFFERENTIAL VOLTAGE, VDIFF (OF CAN BUS)

Differential voltage of the two-wire CAN bus, value $V_{DIFF} = V_{CANH} - V_{CANL}$.

5.1.6 INTERNAL CAPACITANCE, CIN (OF A CAN NODE)

Capacitance seen between CANL (or CANH) and ground during the Recessive state, when the CAN node is disconnected from the bus (see Figure 2-1).

5.1.7 INTERNAL RESISTANCE,RIN (OF A CAN NODE)

Resistance seen between CANL (or CANH) and ground during the Recessive state, when the CAN node is disconnected from the bus (see Figure 2-1).

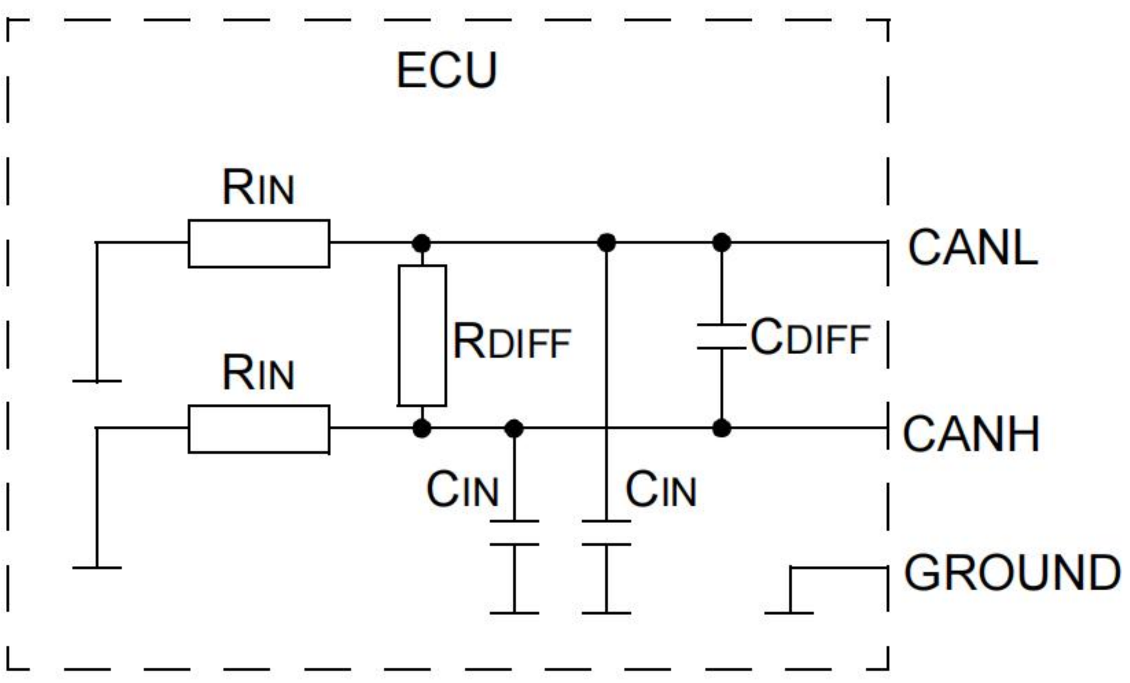


FIGURE 2-1: PHYSICAL LAYER DEFINITIONS

5.2. DC CHARACTERISTICS

Electrical Characteristics: Extended (E): TAMB = -40°C to +125°C and High (H): T_{AMB} = -40°C to +125°
V_{DD} = 4.5V to 5.5V, V_{IO} = 2.1V to 5.5V (Note 2), R_L = 60Ω; unless otherwise specified.

Characteristic	Sym	Min	Typ	Max	Units	Conditions
SUPPLY						
V_{DD} Pin						
Voltage Range	V_{DD}	4.5	—	5.5		
Supply Current	I_{DD}	—	5	10	mA	Recessive; V_{TXD} = V_{DD}
		—	45	70		Dominant; V_{TXD} = 0V
Standby Current	I_{DDS}	—	5	15	µA	Includes IIo
High Level of the POR Comparator	V_{PORH}	3.8	—	4.3	V	
Low Level of the POR Comparator	V_{PORL}	3.4	—	4.0	V	
Hysteresis of POR Comparator	V_{PORD}	0.3	—	0.8	V	
V_{IO} PIN						
Digital Supply Voltage Range	V_{IO}	2.1	—	5.5	V	
Supply Current on Vio	I_{IO}	—	4	30	µA	Recessive; V_{TXD} = V_{IO}
		—	85	500		Dominant; V_{TXD} = 0V
Standby Current	I_{DDS}	—	0.3	1	µA	(Note 1)
Undervoltage detection on Vio	$V_{UVD(IO)}$	—	1.2	—	V	(Note 1)
BUS LINE (CANH;CANL) TRANSMITTER						
CANH; CANL: Recessive Bus Output Voltage	$V_{O(R)}$	2.0	0.5 V_{DD}	3.0	V	V_{TXD} = V_{DD}; No load
CANH; CANL: Bus Output Voltage in Standby	$V_{O(S)}$	-0.1	0.0	+0.1	V	STBY = V_{TXD} = V_{DD}; No load
Recessive Output Current	$I_{O(R)}$	-5	—	+5	mA	-24V <V_{CAN} < +24V
CANH: Dominant Output Voltage	$V_{O(D)}$	2.75	3.50	4.50	V	T_{XD} = 0; R_L = 50 to 650
CANL: Dominant Output Voltage		0.50	1.50	2.25		R_L = 50 to 65Ω
Symmetry of Dominant Output Voltage (V_{DD} -V_{CANH} -V_{CANL})	$V_{O(D)(M)}$	-400	0	+400	mV	V_{TXD} = Vss (Note 1)
Dominant: Differential Output Voltage	$V_{O(DIFF)}$	1.5	2.0	3.0	V	V_{TXD} = Vss; R_L = 50 to 659 Figure 2-2, Figure 2-4
Recessive: Differential Output Voltage		-120	0	12	mV	V_{TXD} =V_{DD} Figure 2-2, Figure 2-4
		-500	0	50	mV	V_{TXD} = V_{DD},no load. Figure 2-2, Figure 2-4

Note 1: Characterized; not 100% tested.
2: XL2562 has V_{IO} pin.
3: -12V to 12V is ensured by characterization, tested from-2.1V to 7V.

Electrical Characteristics: Extended (E): T_{AMB} = -40°C to +125°C and High (H): T_{AMB} = -40°C to +125°C; V_{DD} = 4.5V to 5.5V, V_{IO} = 2.1V to 5.5V (Note 2), R_L = 60Ω; unless otherwise specified.

Characteristic	Sym	Min	Typ	Max	Units	Conditions
CANH: Short Circuit Output Current	$I_{O(SC)}$	-120	-85	—	mA	V_{TXD} = V_{SS}; V_{CANH} = 0V; CANL: floating
		-100	—	—	mA	same as above, but V_{DD}=5V, T_{AMB} = +25°C (Note 1)
CANL: Short Circuit Output Current		—	75	+120	mA	V_{TXD} = V_{SS}; V_{CANL} = 18V; CANH: floating
		—	—	+100	mA	same as above, but V_{DD}=5V, T_{AMB} = +25°C (Note 1)
BUSLINE(CANH;CANL)RECEIVER						
Recessive Differential Input Voltage	$V_{DIFF(R)(I)}$	-1.0	—	+0.5	V	Normal Mode; -12V < $V_{(CANH,CANL)}$ < +12V; See Figure 2-6 (Note 3)
		-1.0	—	+0.4		Standby Mode; -12V < $V_{(CANH, CANL)}$ < +12V; See Figure 2-6 (Note 3)
Dominant Differential Input Voltage	$V_{DIFF(D)(I)}$	0.9	—	VDD	V	Normal Mode; -12V < $V_{(CANH,CANL)}$ < +12V; See Figure 2-6 (Note 3)
		1.0	—	VDD		Standby Mode; -12V < $V_{(CANH,CANL)}$ < +12V; See Figure 2-6 (Note 3)
Differential Receiver Threshold	$V_{TH(DIFF)}$	0.5	0.7	0.9	V	Normal Mode; -12V < $V_{(CANH,CANL)}$ < +12V; See Figure 2-6 (Note 3)
		0.4	—	1.15		Standby Mode; -12V < $V_{(CANH,CANL)}$ < +12V; See Figure 2-6 (Note 3)
Differential Input Hysteresis	$V_{HYS(DIFF)}$	50	—	200	mV	Normal mode, see Figure 2-6, (Note 1)
Common Mode Input Resistance	R_{IN}	10	—	30	kΩ	(Note 1)
Common Mode Resistance Matching	$R_{IN(M)}$	-1	0	+1	%	V_{CANH} = V_{CANL},(Note 1)
Differential Input Resistance	$R_{IN(DIFF)}$	10	—	100	kΩ	(Note 1)
Common Mode Input Capacitance	$C_{IN(CM)}$	—	—	20	pF	V_{TXD} = V_{DD}; (Note 1)
Differential Input Capacitance	$C_{IN(DIFF)}$	—	—	10		V_{TXD} = V_{DD}; (Note 1)
CANH, CANL: Input Leakage	I_{LI}	-5	—	+5	μA	V_{DD} = V_{TXD} = V_{STBY} = OV. V_{IO} = OV. V_{CANH} = V_{CANL} = 5 V.

Note 1: Characterized; not 100% tested.
2: XL2562 has V_{IO} pin.
3: -12V to 12V is ensured by characterization, tested from -2V to 7V.

Electrical Characteristics: Extended (E): TAMB = -40°C to +125°C and High (H): T_{AMB} = -40°C to +125°C; V_{DD} = 4.5V to 5.5V, V_{IO} = 2.1V to 5.5V (Note 2), R_L = 60Ω; unless otherwise specified.

Characteristic	Sym	Min	Typ	Max	Units	Conditions
COMMONMODESTABILIZATIONOUTPUT(SPLIT)						
Output Voltage	V_O	0.3V_{DD}	0.5V_{DD}	0.7V_{DD}	V	Normal mode; I_{SPLIT} = -500 µA to +500 µA
		0.45V_{DD}	0.5V_{DD}	0.55V_{DD}	V	Normal mode; RL > 1 MΩ
Leakage Current	I_L	-5	—	+5	µA	Standby mode; V_{SPLIT} =-24V to + 24V (ISO11898:-12V~+12V)
DIGITAL INPUT PINS (TXD, STBY)						
High-Level Input Voltage	V_{IH}	0.7V_{IO}	—	V_{IO}+0.3	V	
Low-Level Input Voltage	V_{IL}	-1	—	0.3V_{IO}	V	
High-Level Input Current	I_{IH}	-1	—	+1	µA	
TXD: Low-Level Input Current	$I_{IL(TXD)}$	-270	-150	-30	µA	
STBY: Low-Level Input Current	$I_{IL(STBY)}$	-30	—	-1	µA	
RECEIVE DATA (RXD) OUTPUT						
High-Level Output Voltage	V_{OH}	V_{IO}-0.4	—	—	V	I_{OH}= -1 mA (XL2562); typical-2 mA
Low-Level Output Voltage	V_{OL}	—	—	0.4	V	I_{OL} = 4 mA; typical 8 mA
THERMAL SHUTDOWN						
Shutdown Junction Temperature	$T_{J(SD)}$	165	175	185	°C	-12V < V(CANH, CANL) < +12V, (Note 1)
Shutdown Temperature Hysteresis	$T_{J(HYST)}$	20	—	30	°C	-12V < V(CANH, CANL) < +12V, (Note 1)

Note 1: Characterized; not 100% tested.

2: XL2562 has Vio pin

3: -12V to 12V is ensured by characterization, tested from -2V to 7V.

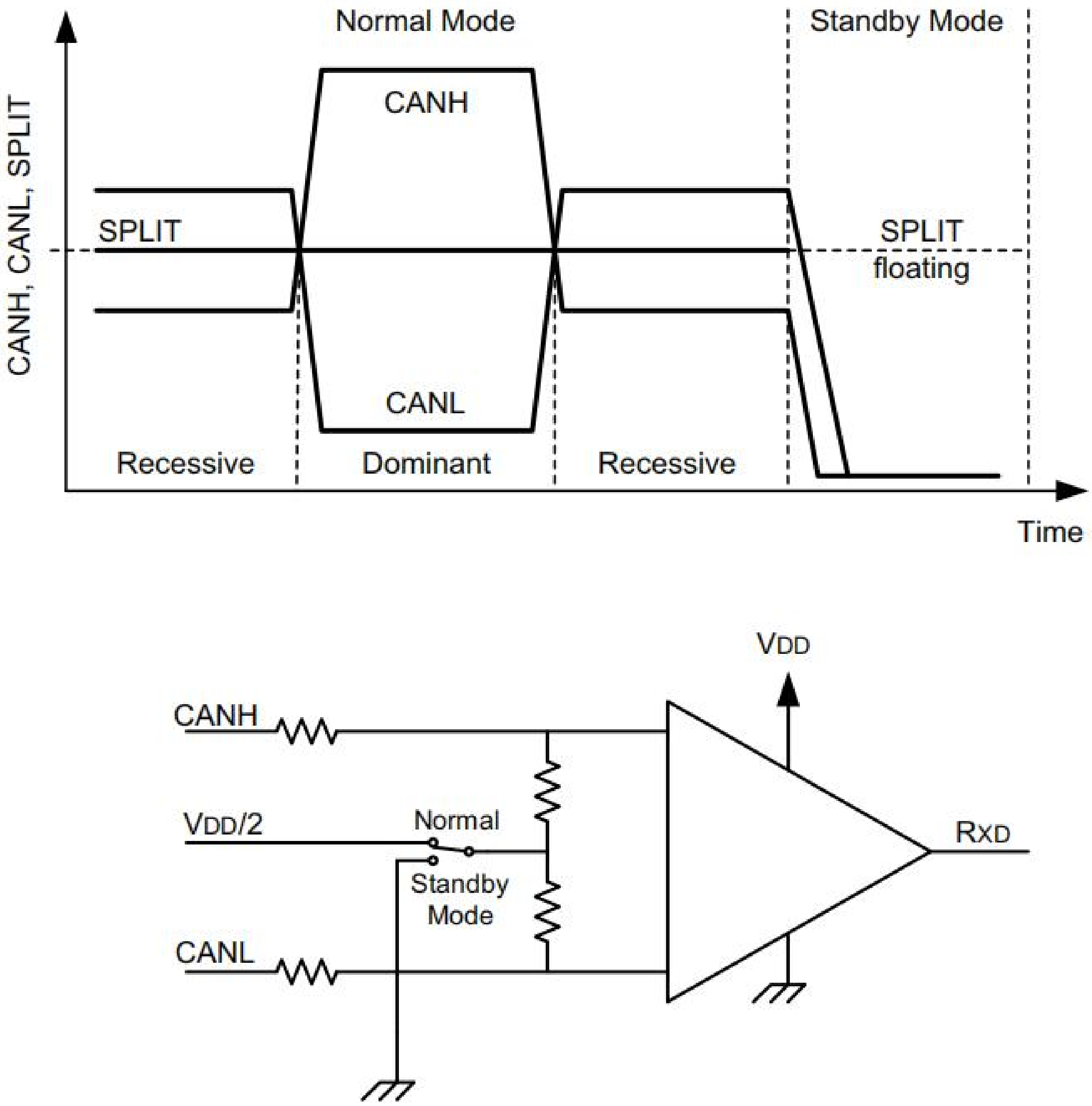


FIGURE 2-2:PHYSICALBITREPRESENTATION ANDSIMPLIFIED BIASIMPLEMENTATION

5.3. AC CHARACTERISTICS

Electrical Characteristics: Extended (E): T_{AMB} = -40°C to +125°C and High (H): T_{AMB} = -40°C to +125°C; V_{DD} = 4.5V to 5.5V, V_{IO} = 2.1V to 5.5V (Note 2), R_L = 60Ω; unless otherwise specified.

Param No	Sym	Characteristic	Min	Typ	Max	Units	Conditions
1	tBIT	Bit Time	1	—	69.44	µs	
2	fBIT	Bit Frequency	14.4	—	1000	kHZ	
3	tTXD-BUSON	Delay TXD Low to Bus Dominant	—	—	70	ns	
4	tTXD-BUSOFF	Delay TXD High to Bus Recessive	—	—	125	ns	
5	tBUSON-RXD	Delay Bus Dominant to RXD	—	—	70	ns	
6	tBUSOFF-RXD	Delay Bus Recessive to RXD	—	—	110	ns	
7	tTXD-RXD	Propagation Delay TXD to RXD	—	—	125	ns	Negative edge on TXD
8			—	—	235		Positive edge on TXD
9	tFLTR(WAKE)	Delay Bus Dominant to RXD (Standby mode)	0.5	1	4	µs	Standby mode
10	tWAKE	Delay Standby to Normal Mode	5	25	40	µs	Negative edge on STBY
11	tPDT	Permanent Dominant Detect Time	—	1.25	—	ms	TXD = OV
12	tPDTR	Permanent Dominant Timer Reset	—	100	—	ns	The shortest recessive pulse on TXD or CAN busto reset Permanent Dominant Timer

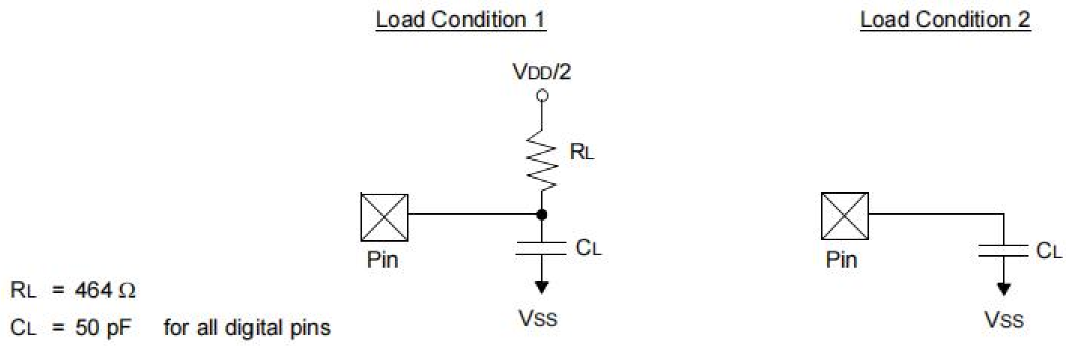
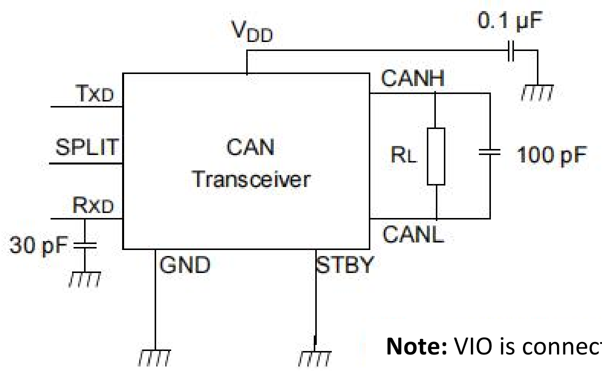
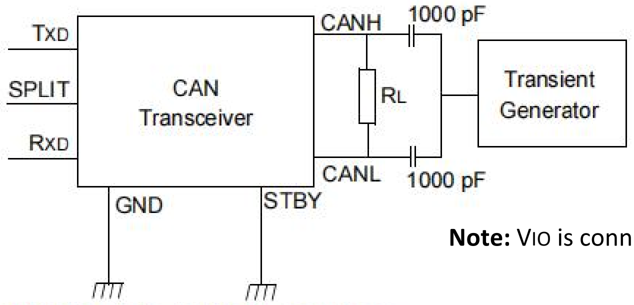


FIGURE2-3:TESTLOADCONDITIONS



Note: VIO is connected to VDD.

FIGURE 2-4:TEST CIRCUCHARACTERISTICS



Note: VIO is connected to VDD.

The wave forms of the applied transients shall be in accordance with ISO-7637, Part 1, test pulses 1, 2, 3a and 3b.

FIGURE 2-5:TEST CIRCUIT FOR AUTOMOTIVE TRANSIENTS

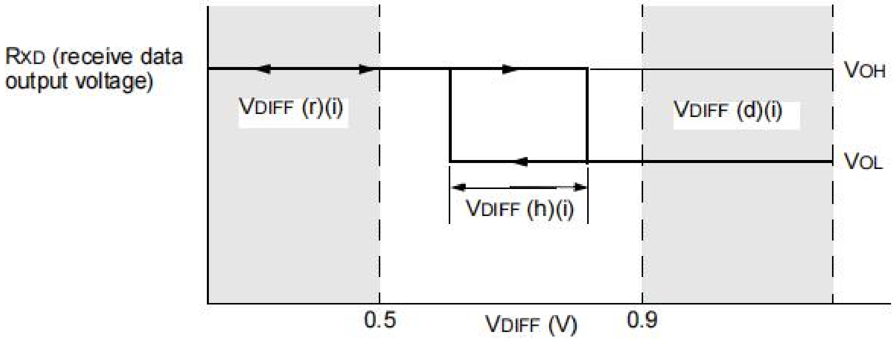


FIGURE 2-6:HYSTERESIS OF THE RECEIVER

5.4. TIMING DIAGRAMS AND SPECIFICATIONS

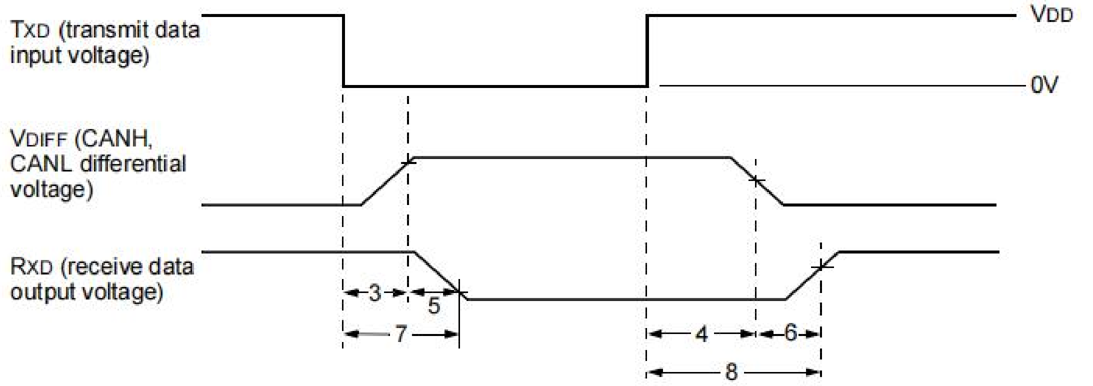


FIGURE 2-7:TIMING DIAGRAM FOR AC CHARACTERISTICS

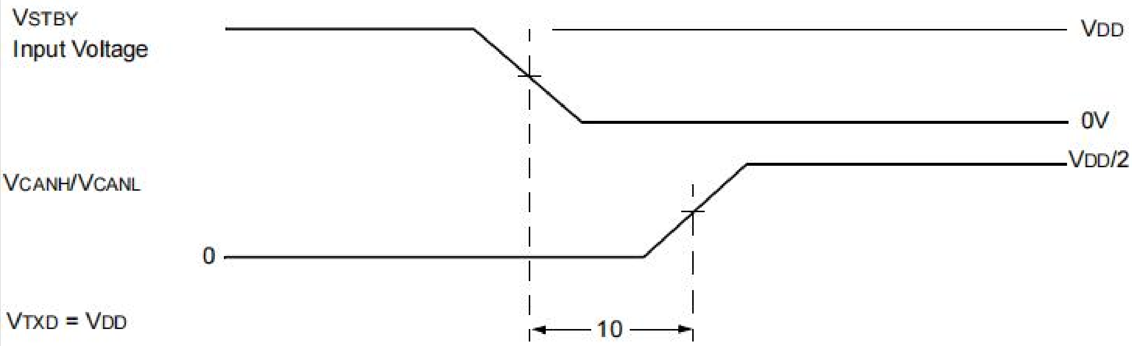


FIGURE 2-8:TIMINGDIAGRAMFORWAKE-UPFROMSTANDBY

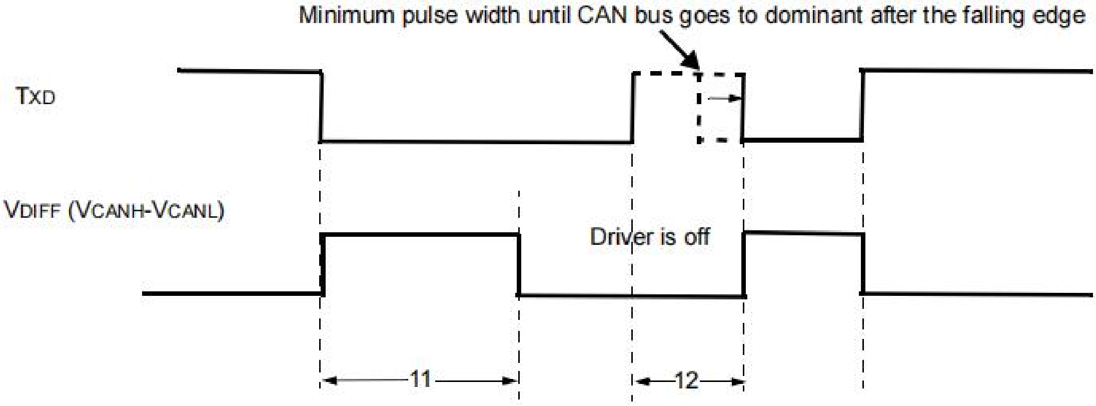


FIGURE2-9:PERMANENTDOMINANTTIMERRESETDETECT

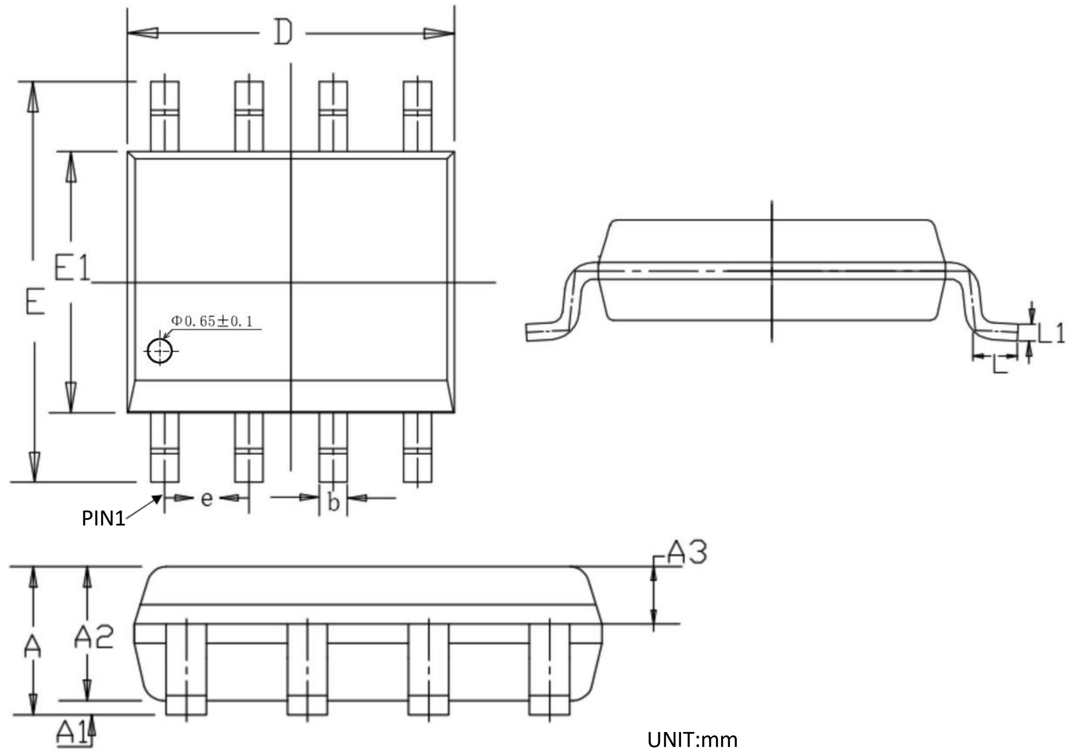
6. ORDERING INFORMATION

Ordering Information

Part Number	Device Making	Package type	Body size (mm)	Temperate (°C)	MSL	Transpo Rt	Package Quantit
XL2562T-E/SN	XL2562T	SOP-8	4.90*3.90	-40 to +125	MSL3	T&R	2500
XL2562-E/P	XL2562P	DIP-8			MSL3	Tube 50	2000
XL2562T-E/M	XL2561	DFN8(3*3)			MSL3	Tube 50	3300

7. DIMENSIONAL DRAWINGS

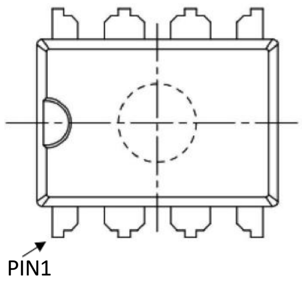
SOP8

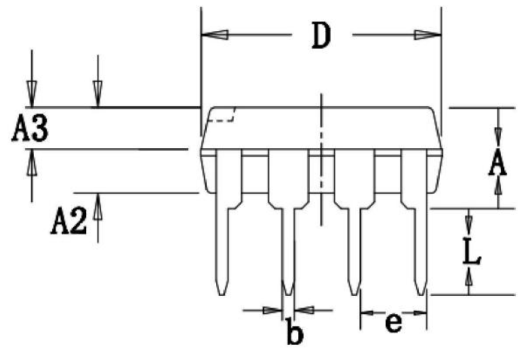


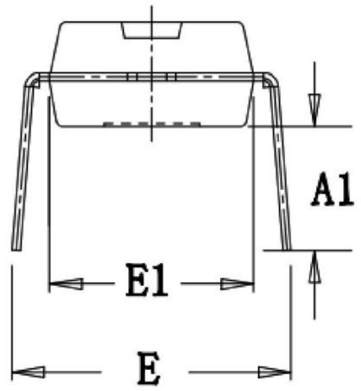
UNIT:mm

	MIN	NOM	MAX
A	1.450	1.550	1.650
A1	0.100	0.150	0.200
A2	1.300	1.400	1.500
A3	0.600	0.650	0.700
b	0.380	–	0.510
e	1.240	1.270	1.300
D	4.800	4.900	5.000
E	5.800	6.000	6.200
E1	3.800	3.900	4.000
L	0.450	0.600	0.750
L1	—	0.25BSC	—

DIP8







UNIT:mm

	MIN	NOM	MAX
A	3.600	3.800	4.000
A1	3.786	3.886	3.986
A2	3.200	3.300	3.400
A3	1.550	1.600	1.650
b	0.440	–	0.490
e	2.510	2.540	2.570
D	9.150	9.250	9.350
E	7.800	8.500	9.200
E1	6.280	6.380	6.480
L	3.000	–	–