1. DESCRIPTION

The XL1040 is the interface between the Controller Area Network (CAN) protocol controller and the physical bus. It is primarily intended for high speed applications, up to 1 MBaud, in passenger cars. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller.

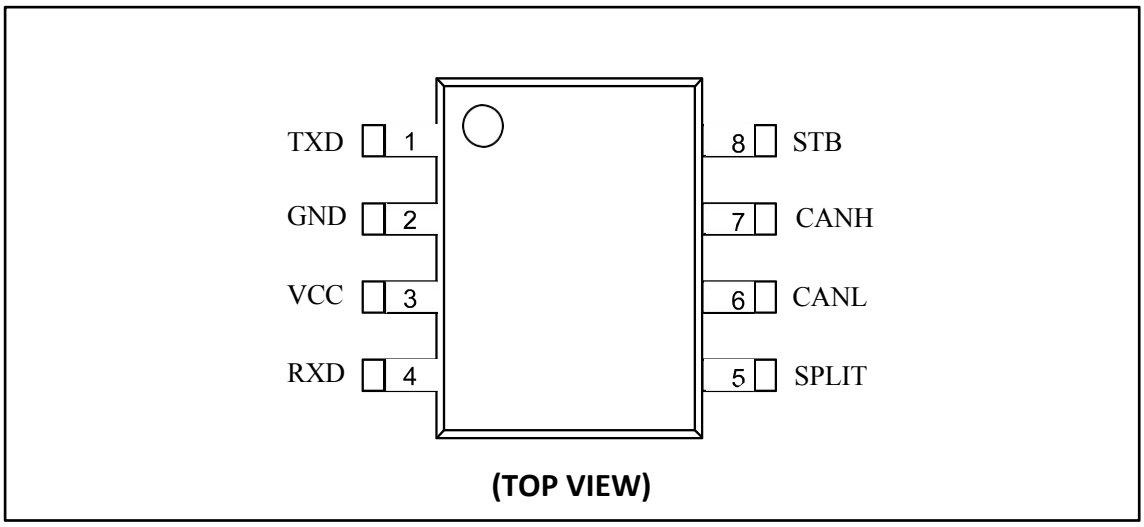
2. FEATURES

- Fully compatible with the ISO 11898 standard
- High speed (up to 1 MBaud)
- Very low-current standby mode with remote wake-up capability via the bus
- Differential receiver with high common-mode range for ElectroMagnetic Immunity (EMI)
- Transceiver in unpowered state disengages from the bus (zero load)
- At least 110 nodes can be connected
- Transmit Data (TXD) dominant time-out function
- Bus pins protected against transients in automotive environments
- Thermally protected
- Operating voltage range: VCC = 5V ± 10%

3. APPLICATIONS

- Automotive electronics
- Point-to-point and point-to-multipoint communications
- Industrial control automation
- Security systems
- Intelligent instrumentation
- Road traffic control automation
- Building automation systems
- Serial servers
- Level converter

4. PIN CONFIGURATIONS AND FUNCTIONS

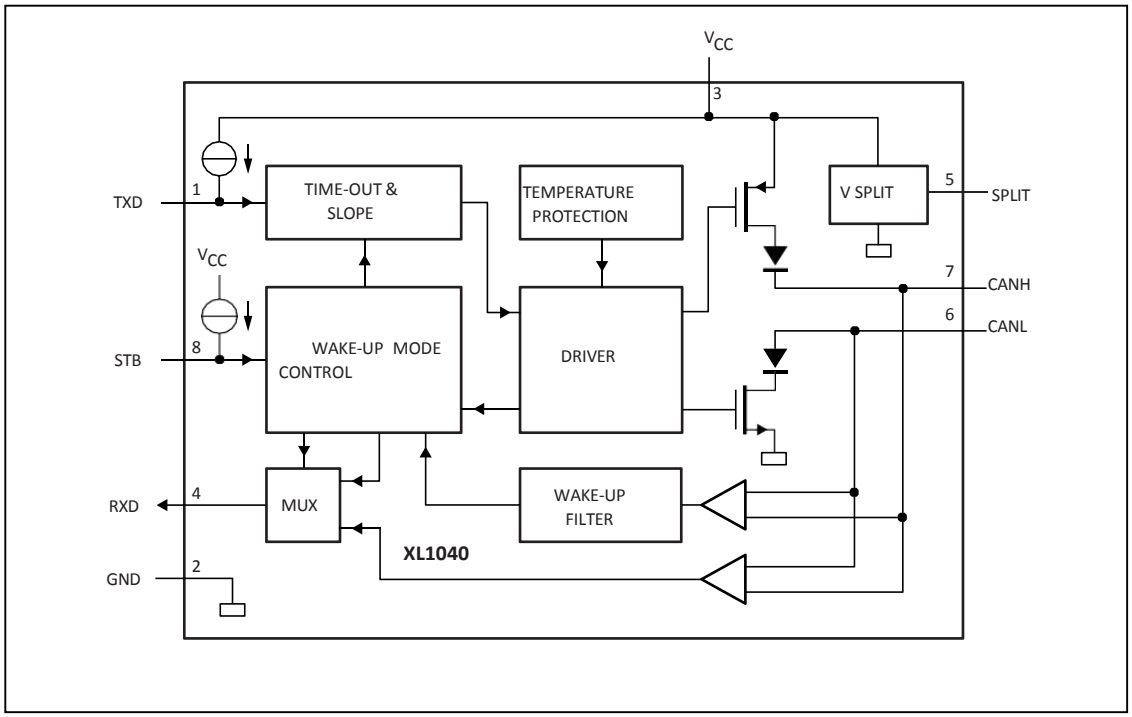


(TOP VIEW)

Pin Functions

Pin	SYMBOL	Description
1	TXD	transmit data input
2	GND	ground supply
3	V_{CC}	supply voltagev, VCC=5V±10%
4	RXD	receive data output; reads out data from the bus lines
5	SPLIT	common-mode stabilization output
6	CANL	LOW-level CAN bus line
7	CANH	HIGH-level CAN bus line
8	STB	High speed and standby mode selection, low for high speed

5. FUNCTIONAL BLOCK DIAGRAM



Block Diagram

6. SPECIFICATIONS

6.1. Absolute Maximum Ratings

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{CC}	Supply voltage range	-0.3	+6	V
TXD, RXD, STB	MCU Side Port	-0.3	VCC+0.3	V
CANL, CANH, SPLIT	Bus-side port voltage	-60	+60	V
V_{tr}	Pin 6, 7 Transient Voltage	-200	+200	V
	storage temperature	-55	150	℃
	ambient temperature	-40	85	℃
	Welding temperature range	-	300	℃
SOP8	Continuous power consumption	-	400	mW

[1] Maximum Limit Parameter values are values above which irrecoverable damage to the device may occur. Under these conditions it is detrimental to the normal operation of the device, and continuous operation of the device at the maximum permissible ratings may affect the reliability of the device. the reference point for all voltages is ground.

6.2. Bus Transmitter DC Characteristics

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
$V_{OH(D)}$	CANH output voltage (dominant)	VI=0V，S=0V，RL=60Ω，Figure 1、Figure 2	2.9	3.4	4.5	
$V_{OL(D)}$	CANL output voltage (dominant)		0.8		1.5	
$V_{O(R)}$	Bus output voltage (implicit)	VI=3V，STB=0V，RL=60Ω，Figure 1、Figure 2	2	2.5	3	V
$V_{OD(D)}$	Bus Output Differential Voltage (dominant)	VI=0V，STB=0V，RL=60Ω，Figure 1、Figure 2	1.5		3	V
$V_{OD(R)}$	Bus Output Differential Voltage (implicit)	VI=3V，S=0V，Figure 1、Figure 2	-0.012		0.012	V
		VI=3V，STB=0V，NO LOAD	-0. 5		0.05	V
$V_{dom(TX)sym}$	dominant output voltage symmetry	Vdom(TX)sym=VCC- VCANH - VCANL	-400		400	mV
V_{TXsym}	Output Voltage Symmetry	VTXsym= VCANH + VCANL	$0.9V_{CC}$		$1.1V_{CC}$	V
V_{OC}	Common mode output voltage	STB=0V，Figure 8	2	2.5	3	V
$\triangle V_{OC}$	Explicit and implicit common mode output voltage difference			30		mV
I_{OS}	Short-circuit output current	CANH=-12V，CANL=open，Figure 11	-105	-72		mA
		CANH=12V，CANL=open，Figure 11		0.36	1	
		CANL=-12V，CANH=open，Figure 11	-1	0.5		
		CANL=12V，CANH=open，Figure 11		71	105	
$I_{O(R)}$	Hidden output current	-27V<CANH<32V 0<VCC<5.25V	-2.0		2.5	mA

6.3. Bus Transmitter Switch Characteristics

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
tPLH	Transmission delay (low to high)	STB=0V，Figure 4	25	65	120	ns
tPHL	Transmission delay (high to low)		25	45	90	ns
tr	Differential output rise delay time			25		ns
tf	Differential output fall delay time			50		ns
t_{EN}	Enable time from listen mode to dominant	Figure 7			10	μs
t_{dom}	Explicit timeout	Figure 10	300	450	700	μs
t_{BUS}	Bus wake-up time		0.7		5	μs

6.4. Bus Receiver DC Parameters

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
VIT+	Positive Input Threshold	STB=0V，Figure 5		800	900	mV
VIT-	Negative Input Threshold		500	650		
VHYS	Comparator Threshold Hysteresis Interval		100	125		
VOH	High Level Output Voltage	IO=-2mA，Figure 6	4	4.6		V
VOL	Low Level Output Voltage	IO=2mA，Figure 6		0.2	0.4	V
I(OFF)	Bus input current at power down	CANH or CANL=5V，Other pin=0V			5	μA
CI	CANH, CANL input capacitance to ground			13		pF
CID	CANH, CANL Differential Input Capacitors			5		pF
RIN	CANH, CANL Input Resistance	TXD=3V，STB=0V	15	30	40	KΩ
RID	CANH, CANL Differential Input Resistors		30		80	KΩ
RImatch	RI(CANH), RIN(CANL) mismatches	CANH=CANL	-3%		3%	
VCOM	Common mode voltage range		-12		12	V

6.5. Bus Receiver Switching Characteristics

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
tPLH	Propagation delay (low to high)	STB=0V or VCC, Figure 6	60	100	130	ns
tPHL	Propagation delay (high to low)		45	70	90	ns
tr	RXD signal rise time			8		ns
tf	RXD signal fall time			8		ns

6.6. Device Switching Characteristics

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
Td(LOOP1)	Loop delay 1, driver input to receiver output, implicit to explicit	STB=0V，Figure9	90		190	ns
Td(LOOP2)	Loop Delay 2, Driver Input to Receiver Output, Explicit to Implicit		90		190	ns

6.7. Over-temperature protection

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
Tj(sd)	Overtemperature shutdown		155	165	180	℃

6.8. TXD Pin Characteristics

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
V_O	Common mode stabilised output voltage	-500uA<I_O<500uA	0.3V_{CC}		0.7V_{CC}	V
$I_{O(stb)}$	leakage current	STB=2V，-12V<V_O<12V	-5		5	μA
$I_{IH(TXD)}$	TXD port high level input current	VI=VCC	-2		2	μA
$I_{IL(TXD)}$	TXD Port Low Level Input Current	VI=0	-50		-10	μA
$I_{O(off)}$	Current in TXD when VCC=0V	VCC=0V，TXD=5V			1	μA
V_{IH}	Input High Lower Limit		2		VCC+0.3	V
V_{IL}	Input Low Limit		-0.3		0.8	V
TXD_O	TXD Port Dangle Voltage		H			logic

6.9. Power consumption characteristics

(VCC=5V±10%, Temp=TMIN~TMAX, typical values at VCC=+5V, Temp=25°C, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT	SYMBOL
ICC	Standby mode power consumption	STB=VCC，VI=VCC		5	12	μA
	Dominant power consumption	VI=0V，STB=0V，LOAD=60Ω		50	70	mA
	Implicit power consumption	VI=VCC，STB=0V，NO LOAD		6	10	mA

6.10. Menu

Table 1 CAN Transceiver Truth

VCC	TXD(1)	STB(1)	CANH(1)	CANL(1)	BUS STATE	RXD(1)
4.5V~5.5V	L	L	H	L	dominant	L
4.5V~5.5V	H (or float)	X	0.5VCC	0.5VCC	implicit	H
4.5V~5.5V	X	H (or float)	0.5VCC	0.5VCC	implicit	H
0<VCC<4.5V	X	X	0V<VCANH<VCC	0V<VCANL<VCC	implicit	X

[1] H=high; L=low; X=no care

Table 2 Driver Function

INPUTS		OUTPUTS		Bus State
L	L	H	L	Dominate(dominant)
H (or floa)	X	Z	Z	Recessive(implicit)
X	H(or float)	Z	Z	Recessive(implicit)

[1] H=high; L=low; X=no care

Table 3 Receiver Function

VID=CANH-CANL	RXD(1)	Bus State(1)
VID≥0.9V	L	Dominate(dominant)
0.5< VID<0.9V	?	?
VID≤0.5V	H	Recessive (implicit)
Open	H	Recessive (implicit)

6.11. Parameter Test Circuit Diagram

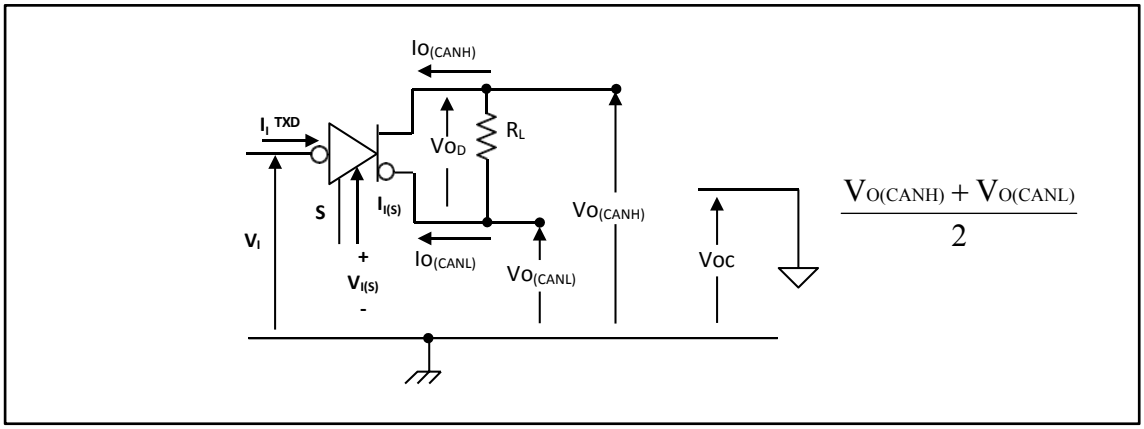


Figure 6-1. Driver Voltage, Current Test Definitions

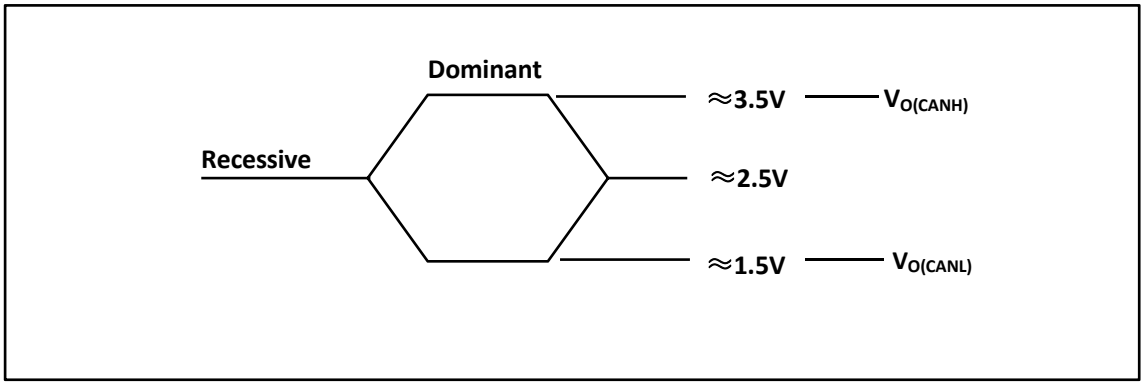


Figure 6-2. Bus Logic Voltage Definition

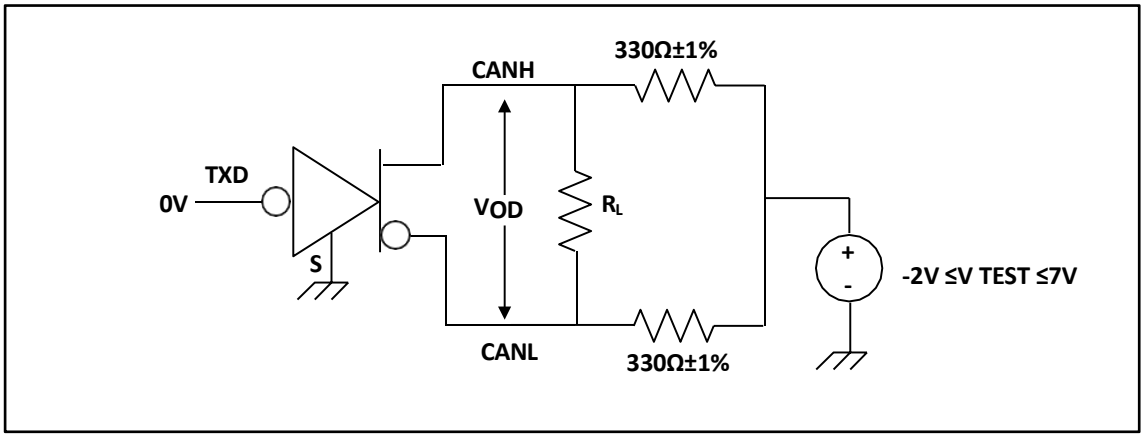


Figure 6-3. Driver VOD Test Circuit

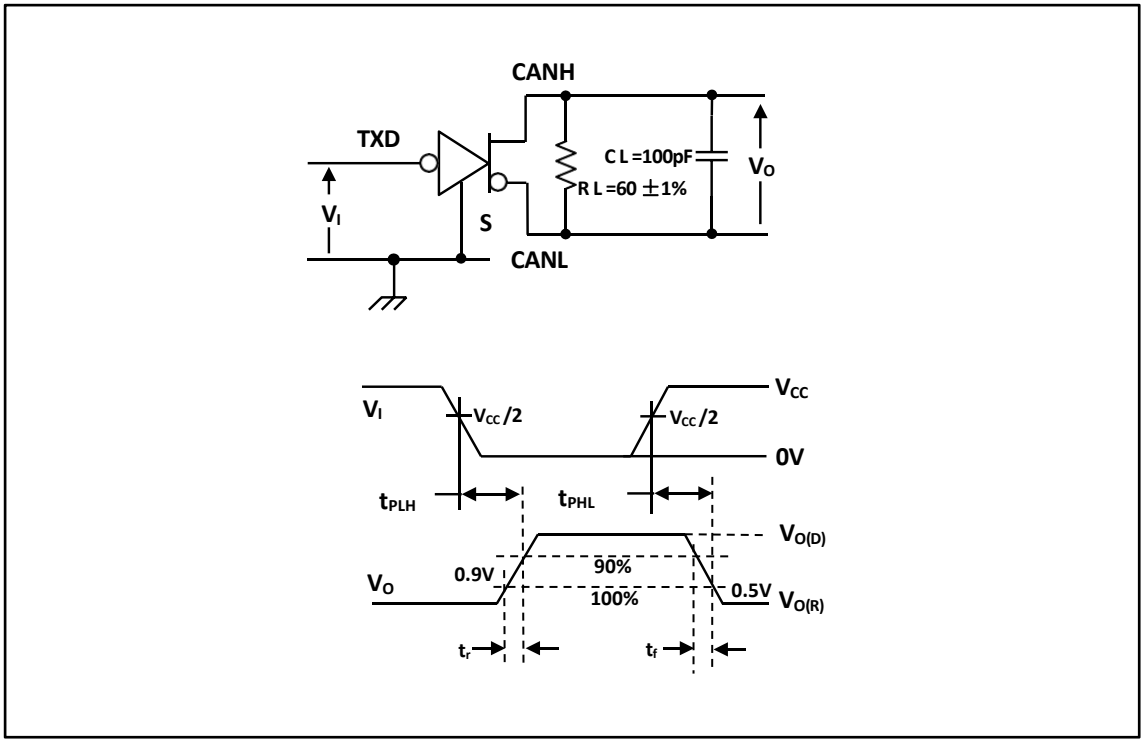


Figure 6-4. Driver Test Circuit and Voltage Waveforms

$$V_{IC} = \frac{V_{I(CANH)} + V_{I(CANL)}}{2}$$

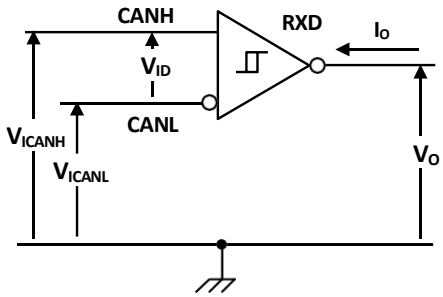
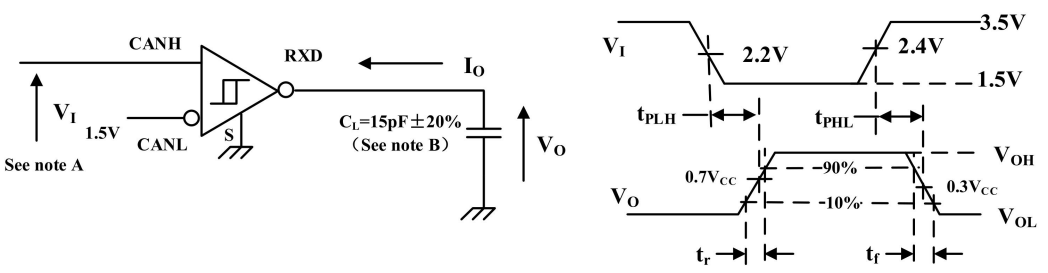


Figure 6-5. Receiver Voltage and Current Definitions



A. Input pulse generator characteristics: PRR≤125KHz, 50% duty cycle, tr<6ns, tf<6ns, Zo=50Ω;

B. CL includes instrumentation and fixed capacitance within 20% error;

Figure 6-6. Receiver test circuit and voltage waveform

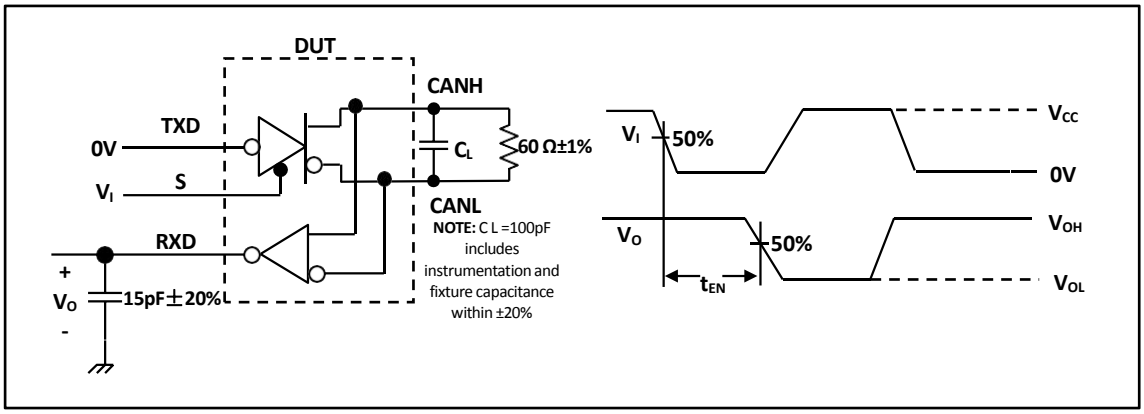


Figure 6-7. tEN Test Circuit and Voltage Waveforms

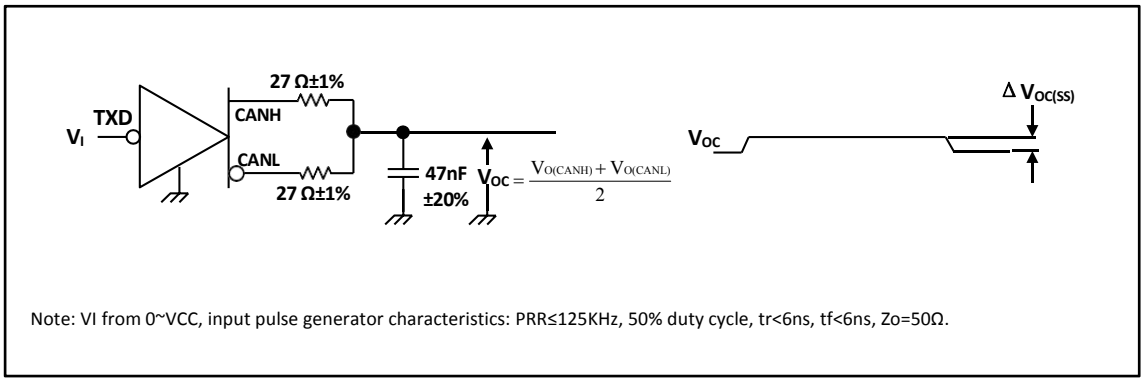


Figure 6-8. Common Mode Output Voltage Test and Waveforms

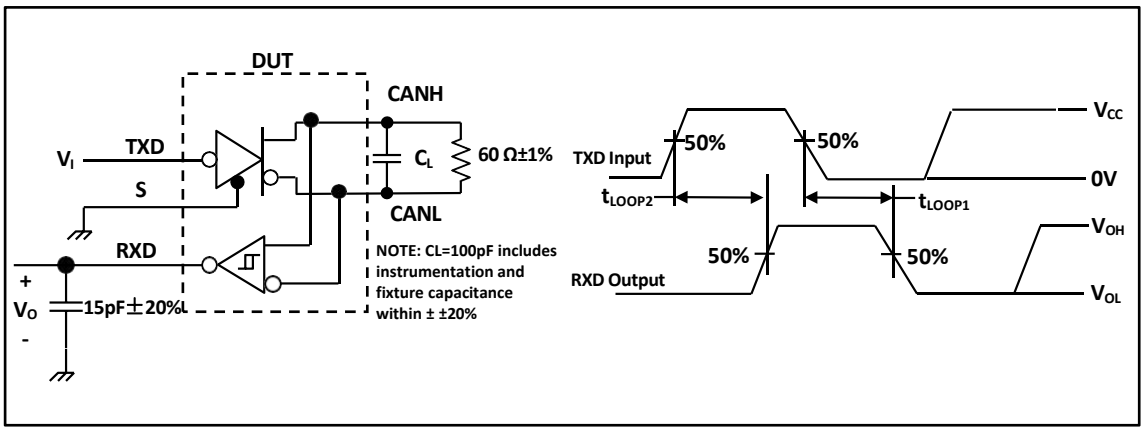


Figure 6-9. t(LOOP) Test Circuit and Waveforms

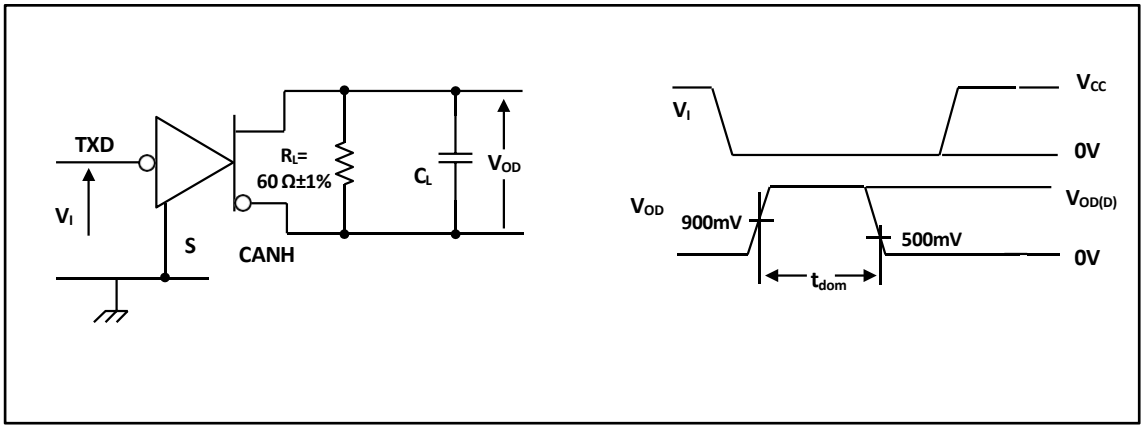


Figure 6-10. Revealed Timeout Test Circuit and Waveforms

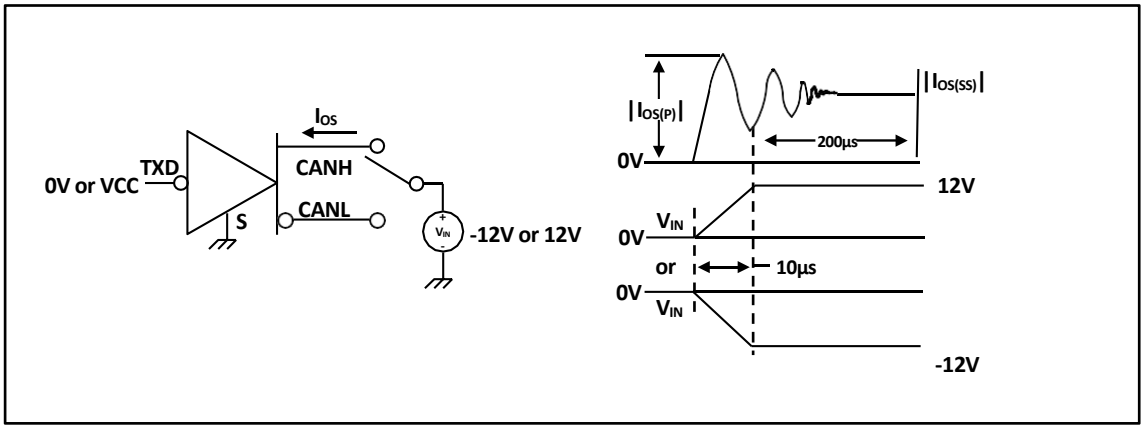


Figure 6-11. Driver Short Circuit Current Test Circuit and Waveforms

7. DESCRIPTION

7.1. Brief description

The XL1040 is an interface chip between the CAN protocol controller and the physical bus, which can be used in trucks, buses, cars, industrial control, etc. It can reach 1Mbps, and has the ability to transmit differential signals between the bus and the CAN protocol controller, and is fully compliant with the "ISO 11898" standard.

7.2. Short circuit protection

The driver stage of XL1040 has a current limit protection function to prevent the driver circuit from short-circuiting to the positive and negative supply voltage, the power consumption will increase when short-circuit occurs, and the short-circuit protection function can protect the driver stage from being damaged.

7.3. Fail Safe

The TXD pin provides a pull-up to VCC path to ensure that the bus is in a recessive state when TXD is not connected to power.

The STB pin provides a pull-up to VCC pass-through to ensure that the transceiver is in the standby state when STB is not connected to power.

When the VCC power supply is dropped, the TXD, STB and RXD pins will become floating to prevent reverse power through these pins.

7.4. Over Temperature Protection

The XL1040 has an over-temperature protection function. When the junction temperature exceeds 160°C, the current of the driver stage will be reduced because the driver tube is the main energy-consuming part, and the current reduction can reduce the power consumption and thus the chip temperature. At the same time, other parts of the chip still maintain normal operation.

7.5. Significant Timeout Function

The built-in TXD dominant timeout timer circuit prevents the bus line from being driven to a permanently dominant state (blocking all network communications) if pin TXD is forced permanently low due to a hardware and/or software application failure. The timer is triggered by a negative edge on pin TXD.

If a low level on pin TXD lasts longer than the internal timer value (tdom), the transmitter is disabled, driving the bus into a recessive state. The timer is reset by a positive edge on pin TXD.

7.6. Control Modes

The control pin STB allows two modes of operation to be selected: high speed mode or standby mode.

High-speed mode is the normal operating mode and is selected by grounding pin STB. The transceiver is capable of sending and receiving data over the buses CANH and CANL. The differential receiver converts the analogue data on the bus to digital data and outputs it via a multiplexer (MUX) to pin RXD.

If pin STB is connected high or not connected, it operates in standby mode. In standby mode, the transmitter and receiver are turned off and the bus line is monitored by a low-power differential comparator. A high level on pin STB activates this low-power receiver and wake-up filter, and pin RXD goes low as soon as the low-power differential comparator detects a dominant bus level above the tBUS.

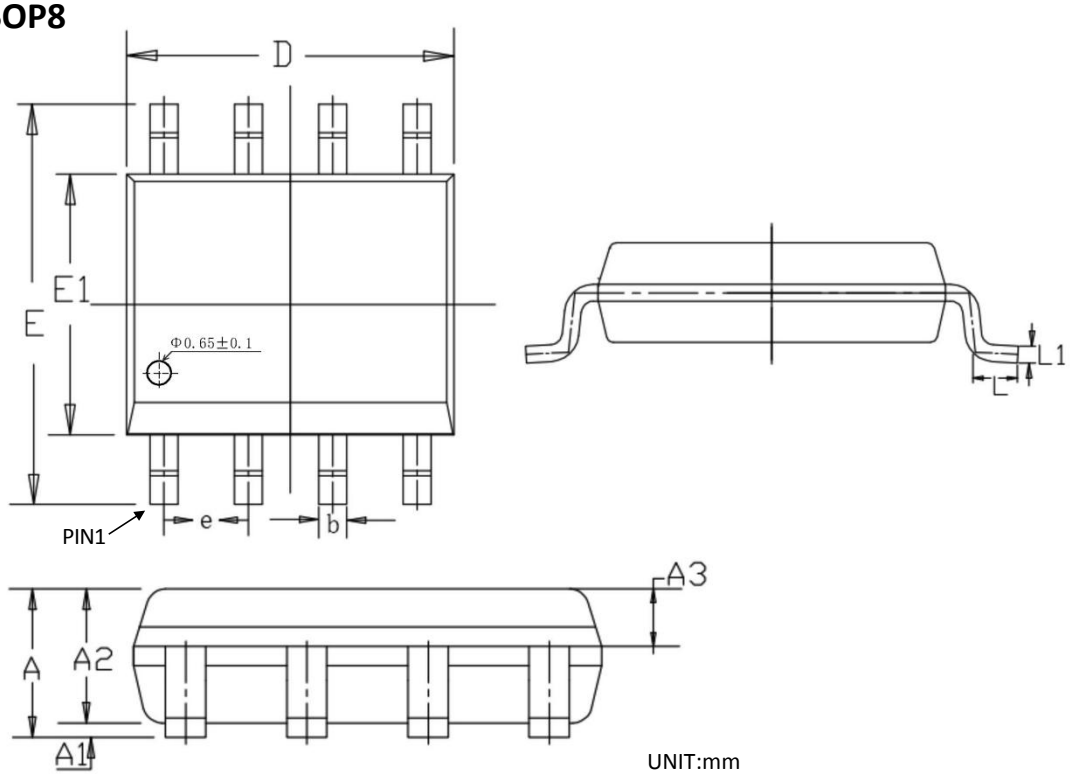
8. ORDERING INFORMATION

Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL1040	XL1040	SOP8	4.90 * 3.90	-40 to +85	MSL3	T&R	2500

9. 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	—