HX1051-S,HX1051/3-S High-speed CAN transceiver

General Description

The HX1051 is a high-speed CAN transceiver, ideal for automotive networks. It interfaces a CAN controller with the physical bus, offering differential transmit/receive and improved EMC/ESD performance. Compatible with 3V to 5V microcontrollers, it adheres to ISO 11898-2 and SAE J2284 standards, enabling reliable CAN FD communication at up to 5 Mbit/s.

SOP-8

Features

General

- Operating voltage range: VCC = 5V ± 10%
- Fully compliant with the ISO 11898 standard
- Guaranteed timing up to 5 Mbit/s in CAN FD
- Compatible with 12V & 24V systems
- Low EME, high EMI
- Direct 3V-5V MCU interfacing
- EN input for low-power Off mode
- Halogen-free, RoHS compliant
- AEC-Q100 qualified

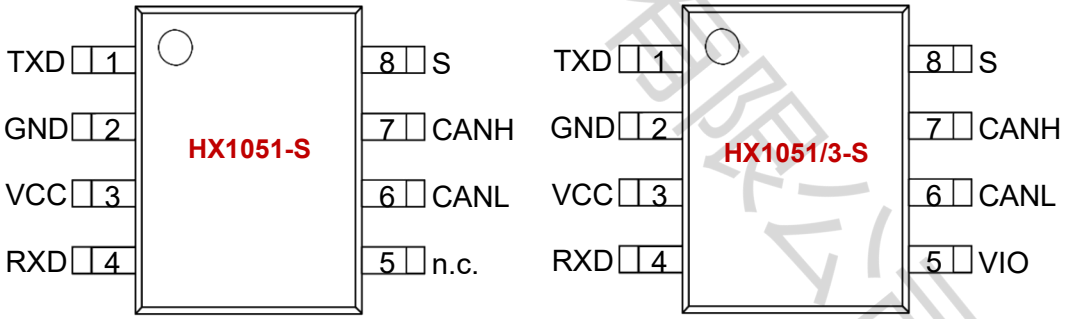
Low-power management

- Predictable functional behavior across all supply conditions
- Disengages from the bus when not powered, minimizing load

Protection

- Robust ESD handling on bus pins
- Transient-protected bus pins for automotive use
- TXD dominant timeout
- Undervoltage detection on VCC/VIO
- Thermal protection included

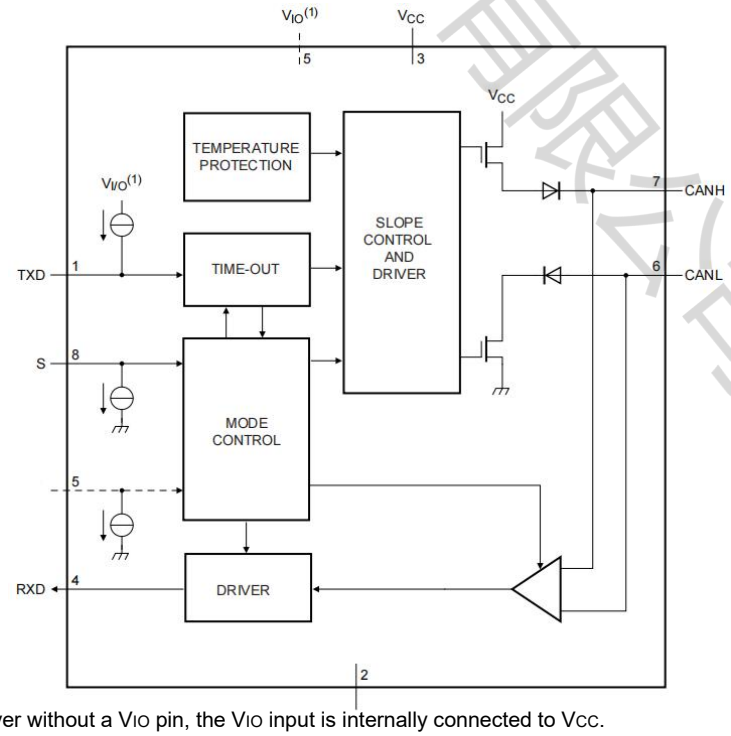
PIN CONFIGURATIONS AND FUNCTIONS



Pin Descriptio		
Pin	**SYMBOL**	**Description**
1	TXD	transmit data input
2	GND	ground
3	VCC	supply voltage
4	RXD	receive data output; reads out data from the bus lines
5	n.c.	not connected; in HX1051 version
5	VIO	supply voltage for I/O level adapter; HX1051T/3 only
6	CANL	LOW-level CAN bus line
7	CANH	HIGH-level CAN bus line
8	S	Silent mode control input

Reference data						
Symbol	**Parameter**	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
V CC	supply voltage		4.5	-	5.5	V
VIO	supply voltage on pin VIO		2.8	-	5.5	V
Vuvd(VCC)	undervoltage detection voltage on pin V CC		3.5	-	4.5	V
Vuvd(VIO)	undervoltage detection voltage on pin VIO		1.3	2.0	2.7	V
ICC	supply current	Silent mode	0.1	1	2.5	mA
		Normal mode; bus recessive	2.5	5	10	mA
		Normal mode; bus dominant	20	50	70	mA
IIO	supply current on pin VIO	Normal/Silent mode				
		recessive; VTXD = VIO	-	80	250	μA
		dominant; VTXD = 0 V	-	350	500	μA
VESD	electrostatic discharge voltage		-8	-	+8	kV
VCANH	voltage on pin CANH		-58	-	+58	V
VCANL	voltage on pin CANL		-58	-	+58	V
	Operation temperature range		-40	-	+125	°C
Tvj	virtual junction temperature		-40	-	+150	°C

Block diagram



1.In a transceiver without a VIO pin, the VIO input is internally connected to VCC.

Operating modes

The HX1051 supports two operating modes, Normal and Silent, which are selected via pin S.

Mode	Inputs		Outputs	
	Pin S	Pin TXD	CAN driver	Pin RXD
Normal	LOW	LOW	dominant	active[1]
	LOW	HIGH	recessive	active[1]
Silent	HIGH	X[2]	recessive	active[1]
Off[1]	X[2]	X[2]	floating	floating

1. LOW if the CAN bus is dominant, HIGH if the CAN bus is recessive.
2. 'X' = don't care.

Functional description

Normal mode

In Normal mode, which is selected by a LOW level on pin S, the transceiver facilitates data transmission and reception over the CANH and CANL bus lines. The differential receiver converts the analog signals on these lines into digital data and outputs it to pin RXD. Internal controls optimize the slopes of the output signals on the bus lines, ensuring minimal Electromagnetic Emission (EME).

Silent mode

A HIGH level on pin S enables Silent mode, disabling the transmitter and releasing the bus pins to a recessive state. All receiver functions remain operational as in Normal mode. This Silent mode serves to prevent a faulty CAN controller from disrupting network communications.

Off mode

Setting pin EN to LOW on the HX1051 activates Off mode, disabling the transceiver completely to conserve power when CAN communication is not needed. In this mode, the bus pins float, rendering the transceiver undetectable by the rest of the network.

Fail-safe features

TXD dominant time-out function

When pin TXD is set LOW, a 'TXD dominant time-out' timer starts. If the LOW state persists beyond tto(dom)TXD, the transmitter disables, releasing the bus to recessive state. This prevents bus lines from staying in a dominant state due to hardware/software failure, blocking network communications. The timer resets when TXD goes HIGH, defining a minimum bit rate of 20 kbit/s.

Internal biasing of TXD, S input pins

Internal biasing for TXD and S pins: TXD has a pull-up to VIO, while S pins have pull-downs to GND. This ensures a safe, predefined state if any of these pins remain unconnected.

Undervoltage detection on pins VCC and VIO

If VCC or VIO fall below their undervoltage detection thresholds (Vuvd(VCC) and Vuvd(VIO)), the transceiver shuts off and disconnects from the bus until VCC and VIO recover.

Overtemperature protection

The output drivers are protected from overheating. If the virtual junction temperature surpasses Tj(sd), the drivers disable until it falls below Tj(sd) and TXD returns to recessive state, preventing oscillations due to temperature fluctuations.

Limiting values

Symbol	Parameter	Conditions	Min	Max	Unit
Vx	voltage on pin x	on pins CANH, CANL	-58	+58	V
		on any other pin	-0.3	+7	V
V(CANH-CANL)	voltage between pin CANH and pin CANL		-27	+27	V
Vtrt	transient voltage	on pins CANH, CANL			
		pulse 1	-100	-	V
		pulse 2a	-	75	V
		pulse 3a	-150	-	V
		pulse 3b	-	100	V
VESD	electrostatic discharge voltage	150 pF, 330 Ω			
		at pins CANH and CANL	-8	+8	kV
		Human Body Model (HBM); 100 pF, 1.5 kΩ			
		at pins CANH and CANL	-8	+8	kV
		at any other pin	-4	+4	kV
		Machine Model (MM); 200 pF, 0.75 µH, 10 Ω			
		at any pin	-300	+300	V
		Charged Device Model (CDM); field Induced charge; 4 pF			
		at corner pins	-750	+750	V
		at any pin	-500	+500	V
Tvj	virtual junction temperature		-40	+150	°C
Tstg	storage temperature		-55	+150	°C

Thermal characteristics

Symbol	Parameter	Conditions	Value	Unit
Rth(vj-a)	thermal resistance from virtual junction to ambient	SOP-8 package; in free air	155	K/W

Static characteristics

Tvj = 40 C to +150 C; VCC = 4.5 V to 5.5 V; VIO = 2.8 V to 5.5 V; RL = 60 unless specified otherwise; All voltages are defined with respect to ground; Positive currents flow into the IC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply; pin VCC						
V CC	supply voltage		4.5	-	5.5	V
ICC	supply current	Off mode	1	5	8	µA
		Silent mode	0.1	1	2.5	mA
		Normal mode				
		recessive; VTXD =VIO	-	5	10	mA
		dominant; VTXD = 0 V	-	50	70	mA
		dominant; VTXD = 0 V; short circuit on bus lines; -3 V < (VCANH = VCANL) < +18 V	2.5	80	110	mA
Vuvd(VCC)	undervoltage detection voltage on pin V CC		3.5	-	4.5	V

I/O level adapter supply; pin VIO						
VIO	supply voltage on pin VIO		2.8	-	5.5	V
IIO	supply current on pin VIO	Normal/Silent mode				
		recessive; VTXD = VIO	-	80	250	µA
		dominant; VTXD = 0 V	-	350	500	µA
Vuvd(VIO)	undervoltage detection voltage on pin VIO		1.3	2.0	2.7	V
Mode control inputs; pins S and EN						
VIH	HIGH-level input voltage		0.7VIO	-	VIO + 0.3	V
VIL	LOW-level input voltage		-0.3	-	0.3VIO	V
IIH	HIGH-level input current	VS = VIO; VEN = VIO	1	4	10	µA
IIL	LOW-level input current	VS = 0 V; VEN = 0 V	-1	0	+1	µA
CAN transmit data input; pin TXD						
VIH	HIGH-level input voltage		0.7VIO	-	VIO + 0.3	V
VIL	LOW-level input voltage		-0.3	-	+0.3 VIO	V
IIH	HIGH-level input current	VTXD = VIO	-5	0	+5	µA
IIL	LOW-level input current	Normal mode; VTXD = 0 V	-260	-150	-30	µA
Ci	input capacitance		-	5	10	pF
CAN receive data output; pin RXD						
I OH	HIGH-level output current	VRXD = VIO - 0.4 V	-8	-3	-1	mA
I OL	LOW-level output current	VRXD = 0.4 V; bus dominant	2	5	12	mA
Bus lines; pins CANH and CANL						
VO(dom)	dominant output voltage	VTXD = 0 V; t < tto(dom)TXD				
		pin CANH; RL = 50 Ω to 65 Ω	2.75	3.5	4.5	V
		pin CANL; RL = 50 Ω to 65 Ω	0.5	1.5	2.25	V
Vdom(TX)sym	transmitter dominant voltage symmetry	V dom(TX)sym = V CC - VCANH - VCANL	-400	-	+400	mV
VTXsym	transmitter voltage symmetry	VTXsym = VCANH+ VCANL; fTXD = 250 kHz, 1 MHz and 2.5 MHz; V CC = 4.75 V to 5.25 V; C SPLIT = 4.7 nF	0.9V CC	-	1.1V CC	V
VO(dif)	differential output voltage	dominant: Normal mode; VTXD = 0 V; t < tto(dom)TXD; V CC = 4.75 V to 5.25 V				
		RL = 45 Ω to 65 Ω	1.5	-	3	V
		RL = 45 Ω to 70 Ω	1.5	-	3.3	V
		RL = 2240 Ω	1.5	-	5	V
		recessive; no load				
		Normal mode: VTXD = VIO	-50	-	+50	mV
VO(rec)	recessive output voltage	Normal/Silent mode; VTXD = VIO; no load	2	0.5 VCC	3	V
V th(RX)dif	differential receiver threshold voltage	Normal/Silent mode; -30 V ≤ VCANL ≤ +30 V; -30 V ≤ VCANH ≤ +30 V	0.5	0.7	0.9	V

Vrec(RX)	receiver recessive voltage	Normal/Silent mode; -30 V ≤ VCANL ≤ +30 V; -30 V ≤ VCANH ≤ +30 V	-4	-	0.5	V
V dom(RX)	receiver dominant voltage	Normal/Silent mode; -30 V ≤ VCANL ≤ +30 V; -30 V ≤ VCANH ≤ +30 V	0.9	-	9.0	V
Vhys(RX)dif	differential receiver hysteresis voltage	Normal/Silent mode; -30 V ≤ VCANL ≤ +30 V; -30 V ≤ VCANH ≤ +30 V	50	120	200	mV
IO(sc)dom	dominant short-circuit output current	VTXD = 0 V; t < tto(dom)TXD; V CC = 5 V				
		pin CANH; VCANH = -15 V to +40 V	-100	-70	-40	mA
		pin CANL; VCANL = -15 V to +40 V	40	70	100	mA
IO(sc)rec	recessive short-circuit output current	Normal/Silent mode; VTXD = VIO; VCANH = VCANL = -27 V to +32 V	-5	-	+5	mA
IL	leakage current	V CC = VIO = 0 V or V CC = VIO = shorted to ground via 47 kΩ; VCANH = VCANL = 5 V	-5	0	+5	µA
Ri	input resistance	-2 V ≤ VCANL ≤ +7 V; -2 V ≤ VCANH ≤ +7 V	9	15	28	kΩ
ΔRi	input resistance deviation	0 V ≤ VCANL ≤ +5 V; 0 V ≤ VCANH ≤ +5 V	-1	-	+1	%
Ri(dif)	differential input resistance	-2 V ≤ VCANL ≤ +7 V; -2 V ≤ VCANH ≤ +7 V	19	30	52	kΩ
Ci(cm)	common-mode input capacitance		-	-	20	pF
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Ci(dif)	differential input capacitance		-	-	10	pF
Temperature protection						
Tj(sd)	shutdown junction temperature		-	190	-	℃

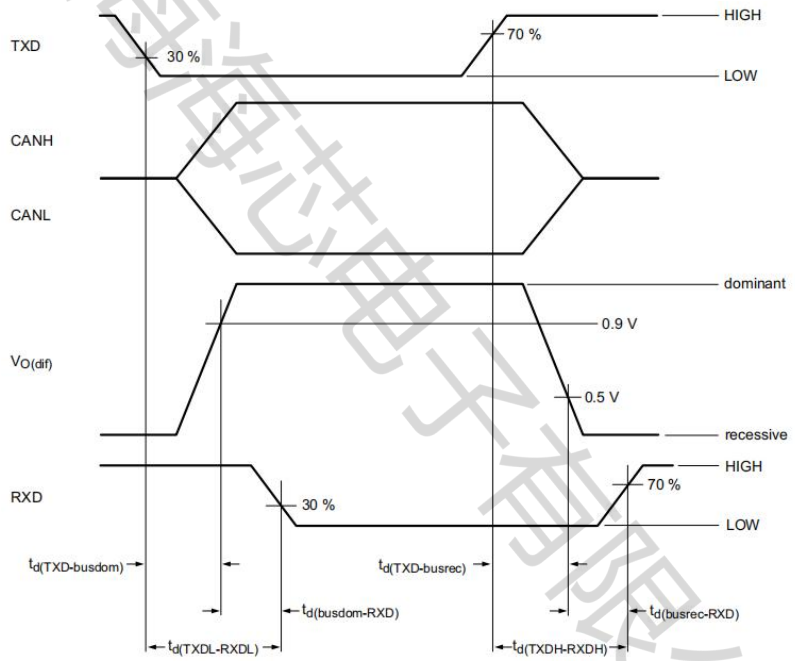
Dynamic characteristics

Tvj = 40 C to +150 C; VCC = 4.5 V to 5.5 V; VIO = 2.8 V to 5.5 V; RL = 60 unless specified otherwise. All voltages are defined with respect to ground. Positive currents flow into the IC.

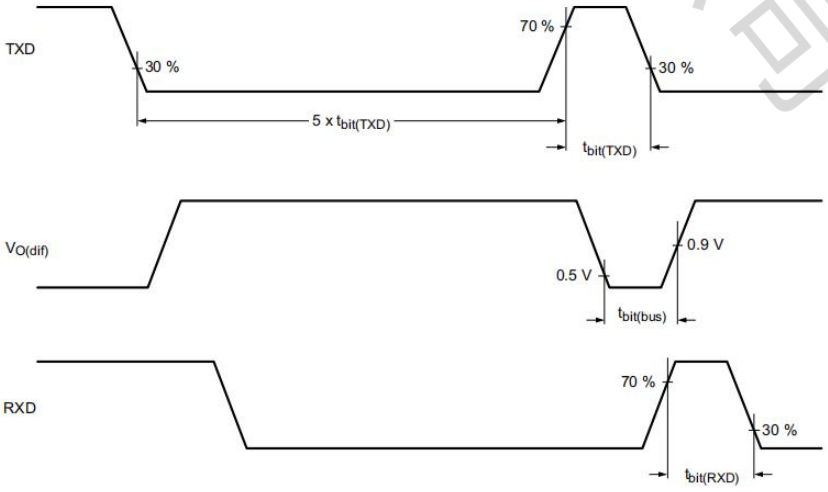
Symbol	Parameter		Min	Typ	Max	Unit
Transceiver timing; pins CANH, CANL, TXD and RXD						
td(TXD-busdom)	delay time from TXD to bus dominant	Normal mode	-	65	-	ns
td(TXD-busrec)	delay time from TXD to bus recessive	Normal mode	-	90	-	ns
td(busdom-RXD)	delay time from bus dominant to RXD	Normal/Silent mode	-	60	-	ns
td(busrec-RXD)	delay time from bus recessive to RXD	Normal/Silent mode	-	65	-	ns
td(TXDL-RXDL)	delay time from TXD LOW to RXD LOW	Normal mode: versions with VIO pin	40	-	250	ns
		Normal mode: other versions	40	-	220	ns
td(TXDH-RXDH)	delay time from TXD HIGH to RXD HIGH	Normal mode: versions with VIO pin	40	-	250	ns

		Normal mode: other versions	40	-	220	ns
tbit(bus)	transmitted recessive bit width	tbit(TXD) = 500 ns	435	-	530	ns
		tbit(TXD) = 200 ns	155	-	210	ns
tbit(RXD)	bit time on pin RXD	tbit(TXD) = 500 ns	400	-	550	ns
		tbit(TXD) = 200 ns	120	-	220	ns
Δtrec	receiver timing symmetry	tbit(TXD) = 500 ns	-65	-	+40	ns
		tbit(TXD) = 200 ns	-45	-	+15	ns
tto(dom)TXD	TXD dominant time-out time	VTXD = 0 V; Normal mode	0.3	1	5	ms

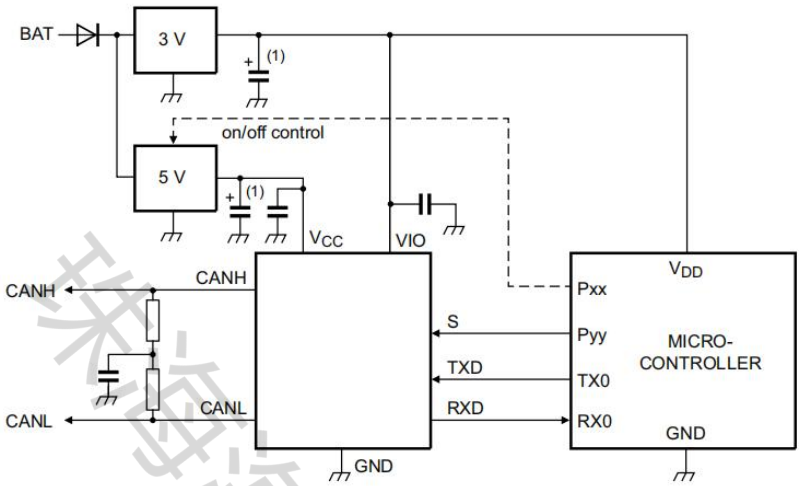
CAN transceiver timing diagram



CAN FD timing definitions according

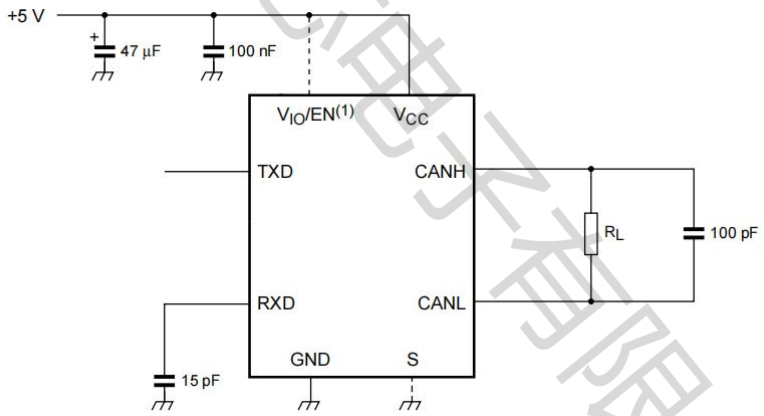


Typical application

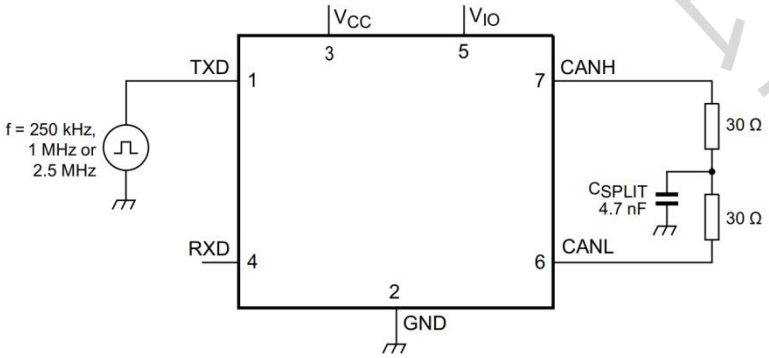


(1) Optional, depends on regulator.

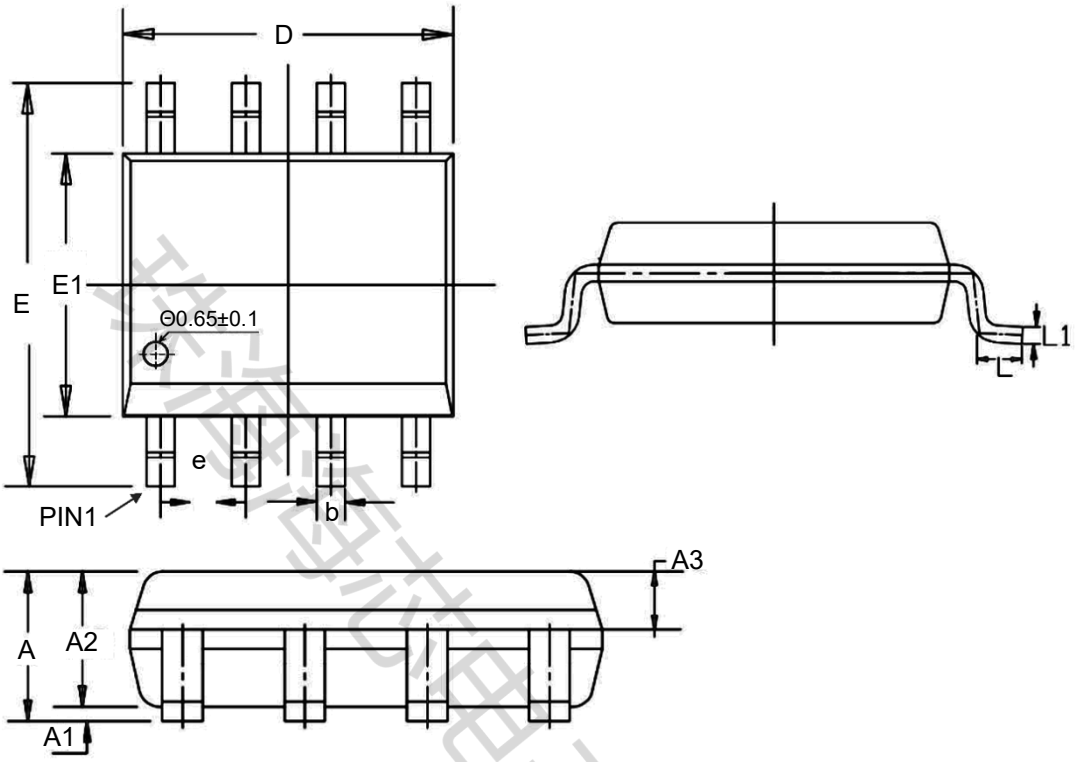
Timing test circuit for CAN transceiver



Test circuit for measuring transceiver driver symmetry



DIMENSIONAL DRAWINGS



SOP-8

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	

Part Number	Package Type	Package	quantity
HX1051-S	SOP-8	Taping	2500
HX1051/3-S	SOP-8	Taping	2500

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