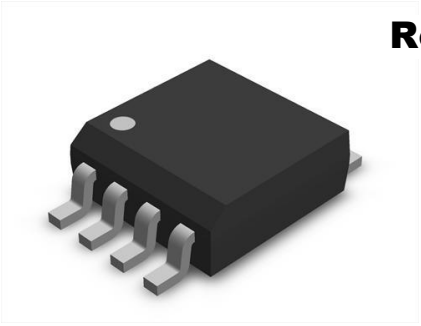
TC1040

High Speed CAN Transceivers

RoHS



Features

- Fully compatible with the ISO 11898 standard
- High speed (up to 1 MBaud)
- At least 110 nodes can be connected
- Very low ElectroMagnetic Emission (EME)
- Transmit Data (TXD) dominant time-out function
- Input levels compatible with 3.3 V and 5 V devices
- Very low-current standby mode with remote wake-up capability via the bus
- Bus pins protected against transients in automotive Environments
- Bus pins and pin SPLIT short-circuit proof to battery and ground
- Transceiver in unpowered state disengages from the bus
- Thermally protected.

Description

The TC1040 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.

Mechanical Data

- SOP8 package
- Molding compound flammability rating: UL 94V-0
- Packaging: Tape and Reel
- RoHS/WEEE Compliant

Applications

- Automotive
- Industrial process control
- Transportation
- Field Transmitter & Sensor Networks

Quick Reference Data

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage	operating range	4.75	5.25	V
I_{CC}	supply current	standby mode	8	25	μA
V_{CANH}	DC voltage on pin CANH	$0 < V_{CC} < 5.25$ V; no time limit	-27	+40	V
V_{CANL}	DC voltage on pin CANL	$0 < V_{CC} < 5.25$ V; no time limit	-27	+40	V
V_{SPLIT}	DC voltage on pin SPLIT	$0 < V_{CC} < 5.25$ V; no time limit	-27	+40	V
V_{esd}	electrostatic discharge voltage	Human Body Model (HBM) pins CANH, CANL and SPLIT all other pins	 -6 -4	 +6 +4	 kV kV
$t_{PD(TXD-RXD)}$	propagation delay TXD to RXD	$V_{STB} = 0$ V	40	255	ns
T_{vj}	virtual junction temperature		-40	+150	℃

Bolck diagram

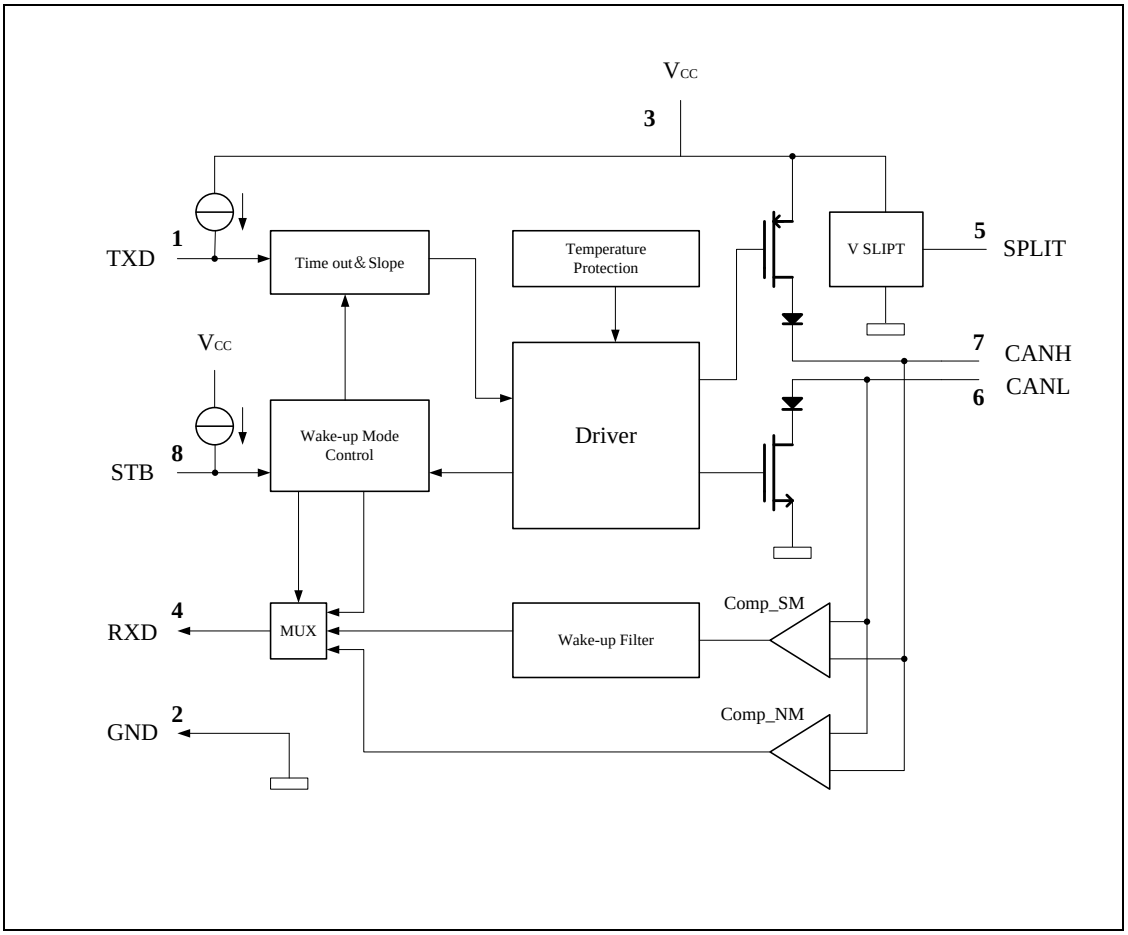


Fig.1 Bolck diagram

Pinning

Pin	Symbol	Description
1	TXD	transmit data input
2	GND	ground supply
3	V_{CC}	supply voltage
4	RXD	receive data output; reads out data
5	SPLIT	common-mode stabilization output
6	CANL	LOW-level CAN bus line
7	CANH	HIGH-level CAN bus line
8	STB	standby mode control input

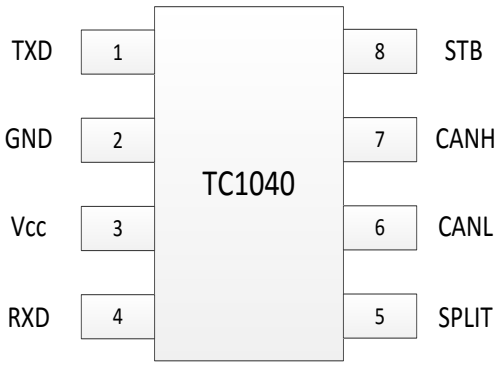


Fig.2 Pin configuration

Operating Modes

The TC1040 provides two modes of operation which are selectable via pin STB. The one is normal mode, in this mode the transceiver is able to transmit and receive data via the bus lines CANH and CANL. The other is standby mode, in this mode the transmitter and receiver are switched off, and the low-power differential receiver will monitor the bus lines. See Fig.3 for a description of the modes of operation.

MODE	PIN STB	PIN RXD	
		LOW	HIGH
Normal	LOW	Bus dominant	Bus recessive
Standby	HIGH	Wake-up request detected	No wake-up request detected

Fig.3 Operating modes

Absolute Maximum Rating

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage	no time limit	-0.3	+6	V
		operating range	4.75	5.25	V
V_{TXD}	DC voltage on pin TXD		-0.3	V_{CC} + 0.3	V
V_{RXD}	DC voltage on pin RXD		-0.3	V_{CC} + 0.3	V
V_{STB}	DC voltage on pin STB		-0.3	V_{CC} + 0.3	V
V_{CANH}	DC voltage on pin CANH	0 < V_{CC} < 5.25 V; no time limit	-27	+40	V
V_{CANL}	DC voltage on pin CANL	0 < V_{CC} < 5.25 V; no time limit	-27	+40	V
V_{SPLIT}	DC voltage on pin SPLIT	0 < V_{CC} < 5.25 V; no time limit	-27	+40	V
V_{trt}	transient voltages on pins CANH, CANL and SPLIT	according to ISO 7637;	-200	+200	V
V_{esd}	electrostatic discharge voltage	Human Body Model (HBM) pins CANH, CANL and SPLIT all other pins	 -6 -4	 +6 +4	 kV kV
$t_{PD(TXD-RXD)}$	propagation delay TXD to RXD	V_{STB} = 0 V	40	255	ns
T_{vj}	virtual junction temperature	note 3	-40	+150	℃
T_{stg}	storage temperature		-55	+150	℃

Notes

1. Equivalent to discharging a 100 pF capacitor via a 1.5 kΩ series resistor.
2. Equivalent to discharging a 200 pF capacitor via a 0.75 μH series inductor and a 10 Ω series resistor.
3. Junction temperature in accordance with IEC 60747-1. An alternative definition of T_{vj} is: $T_{vj} = T_{amb} + P \times R_{th}(vj\text{-}amb)$, where $R_{th}(vj\text{-}amb)$ is a fixed value to be used for the calculating of T_{vj}. The rating for T_{vj} limits the allowable combinations of power dissipation (P) and ambient temperature (T_{amb}).

Characteristics

（V_{CC} = 4.75 to 5.25 V, T_{vj} = -40 to +150 ℃and R_L = 60 Ω unless specified otherwise. Note 1）

Parameter	Symbol	Conditions	MIN	TYP	MAX	UNIT
Supply (pin VCC)						
supply current	I_{CC}	standby mode	8	17	25	µA
		normal mode recessive; $V_{TXD} = V_{CC}$ dominant; V_{TXD} = 0 V	 2.5 30	 6.5 50	 10 70	 mA mA
Transmit data input (pin TXD)						
HIGH-level input voltage	V_{IH}		2	-	V_{CC}+0.3	V
LOW-level input voltage	V_{IL}		-0.3	-	+0.8	V
HIGH-level input current	I_{IH}	$V_{TXD} = V_{CC}$	-5	0	+5`	µA
LOW-level input current	I_{IL}	normal mode; V_{TXD} = 0 V	-100	-160	-300	µA
Standby mode control input (pin STB)						
HIGH-level input voltage	V_{IH}		2	-	V_{CC}+0.3	V
LOW-level input voltage	V_{IL}		-0.3	-	+0.8	V
HIGH-level input current	I_{IH}	$V_{STB} = V_{CC}$	-1	0	+1	µA
LOW-level input current	I_{IL}	V_{STB} = 0 V	-	0	-10	µA
Receive data output (pin RXD)						
HIGH-level output voltage	V_{OH}	standby mode; I_{RXD} = -100 µA	V_{CC}-1.1	V_{CC}-0.7	V_{CC}-0.4	V
HIGH-level output current	I_{OH}	normal mode; $V_{RXD} = V_{CC}$ - 0.4 V	-0.1	-0.4	-1	mA
LOW-level output current	I_{OL}	V_{RXD} = 0.4 V	2	5.5	12	mA
Common-mode stabilization output (pin SPLIT)						
output voltage	V_O	normal mode; -500 µA < I_O < +500 µA	0.3V_{CC}	0.5V_{CC}	0.7V_{CC}	V
leakage current	$\lvert I_L \rvert$	standby mode; -22 V < V_{SPLIT} < +35 V	-	0	5	µA
Bus lines (pins CANH and CANL)						
dominant output voltage	$V_{O(dom)}$	V_{TXD} = 0 V pin CANH pin CANL	 3.2 0.7	 3.9 1.2	 4.3 1.8	 V V
matching of dominant output voltage (V_{CC} - V_{CANH} - V_{CANL})	$V_{O(dom)(m)}$		-100	0	+150	mV
differential bus output voltage ($V_{CANH} - V_{CANL}$)	$V_{O(dif)(bus)}$	V_{TXD} = 0 V; dominant; 45 Ω < R_L < 65 Ω	1.5	-	3.0	V
		$V_{TXD} = V_{CC}$; recessive; no load	−50	-	+50	mV
recessive output voltage	$V_{O(reces)}$	normal mode; $V_{TXD} = V_{CC}$; no load	2	0.5V_{CC}	3	V
		standby mode; no load	-0.1	0	0.1	V
short-circuit output current	$I_{O(sc)}$	V_{TXD} = 0 V pin CANH; V_{CANH} = 0 V pin CANL; V_{CANL} = 40 V	 -40 40	 -42 41	 -95 100	 mA mA

Parameter	Symbol	Conditions	MIN	TYP	MAX	UNIT
recessive output current	$I_{O(reces)}$	-27 V < V_{CAN} < +32 V	-2.5	-	+2.5	mA
differential receiver threshold voltage	$V_{dif(th)}$	-12 V < V_{CANL} < +12 V; -12 V < V_{CANH} < +12 V normal mode (see Fig.7) standby mode	 0.5 0.4	 0.7 0.8	 1.0 1.15	 V V
differential receiver hysteresis voltage	$V_{hys(dif)}$	normal mode; -12 V < V_{CANL} < +12 V; -12 V < V_{CANH} < +12 V	50	80	160	mV
input leakage current	I_{LI}	V_{CC} = 0 V; V_{CANH} = V_{CANL} = 5 V	-5	2	+5	μA
common-mode input resistance	$R_{i(cm)}$	normal mode	15	27	35	kΩ
		standby mode	15	27	35	kΩ
differential input resistance	$R_{i(dif)}$	standby or normal mode	25	35	75	kΩ
Timing characteristics; see Fig.9						
delay TXD to bus active	$t_{d(TXD-BUSon)}$	normal mode	25	35	110	ns
delay TXD to bus inactive	$t_{d(TXD-BUSoff)}$		10	60	95	ns
delay bus active to RXD	$t_{d(BUSon-RXD)}$		15	55	115	ns
delay bus inactive to RXD	$t_{d(BUSoff-RXD)}$		35	70	160	ns
propagation delay TXD to RXD	$t_{PD(TXD-RXD)}$	V_{STB} = 0 V	40	-	255	ns
TXD dominant time-out	$t_{dom(TXD)}$	V_{TXD} = 0 V	300	575	1000	μs
dominant time for wake-up via bus	t_{BUS}	standby mode	0.75	2.2	5	μs
delay standby mode to normal mode	$t_{d(stb-norm)}$	normal mode	7	10	12	μs
Thermal shutdown						
shutdown junction temperature	$T_{j(sd)}$		155	165	180	℃

Note

1. All parameters are guaranteed over the virtual junction temperature range by design, but only 100% tested at 125 ℃ ambient temperature for dies on wafer level, and in addition to this 100% tested at 25 ℃ambient temperature for cased products; unless specified otherwise. For bare dies, all parameters are only guaranteed with the backside of the die connected to ground.

Application and Test information

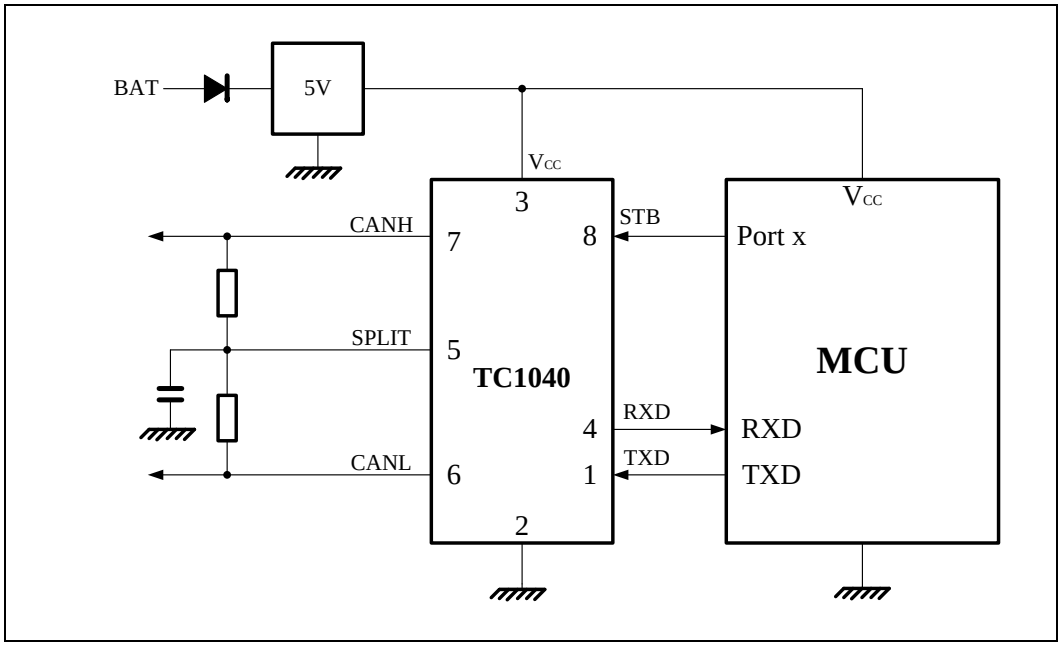


Fig.4 Typical application for 5 V microcontroller

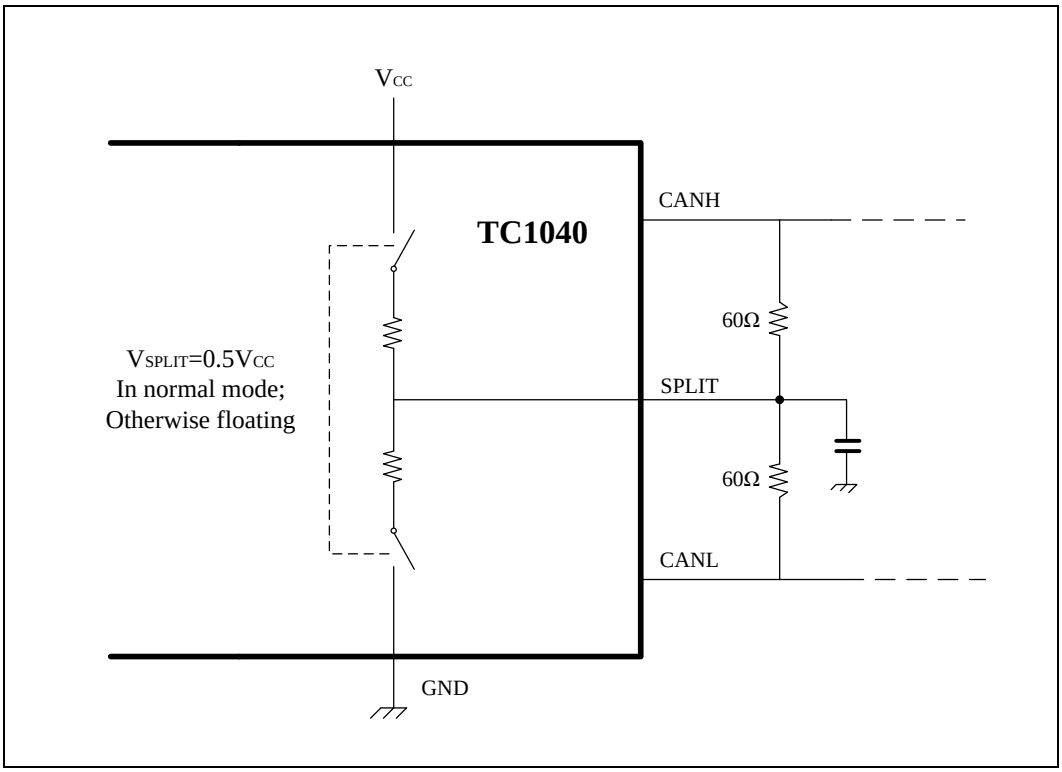


Fig.5 Stabilization circuitry and application

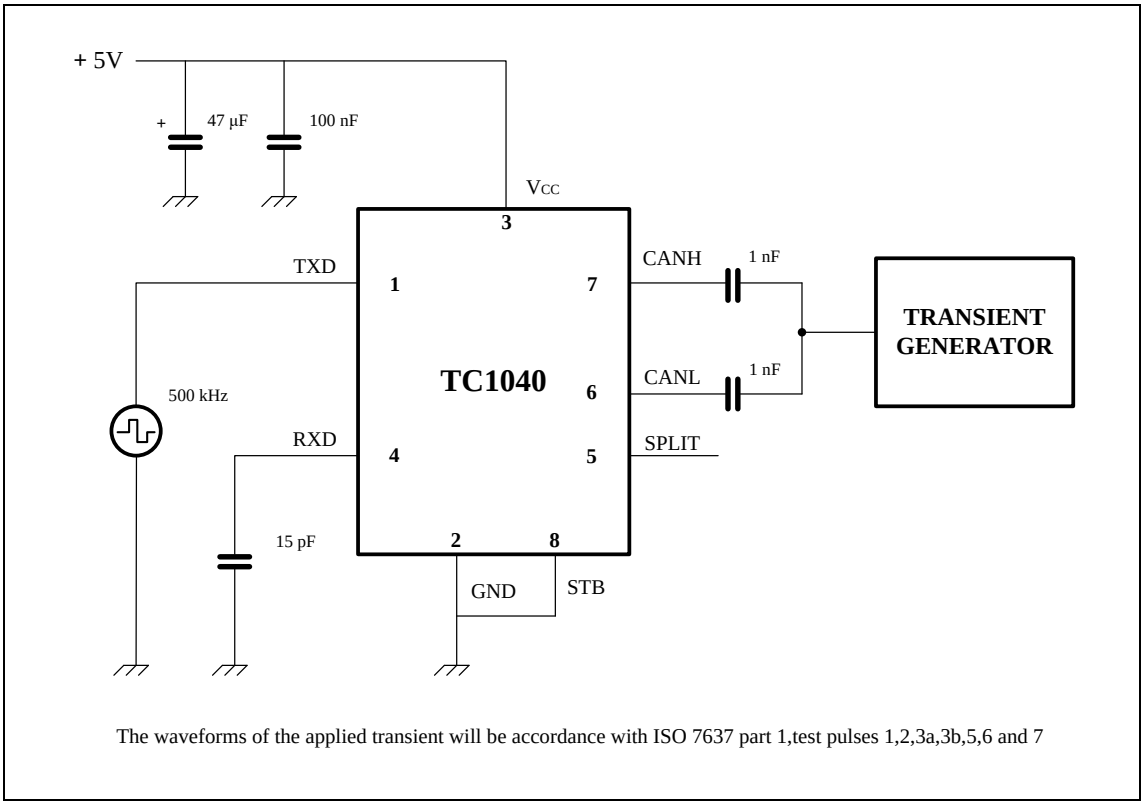


Fig.6 Test circuit for automotive transients

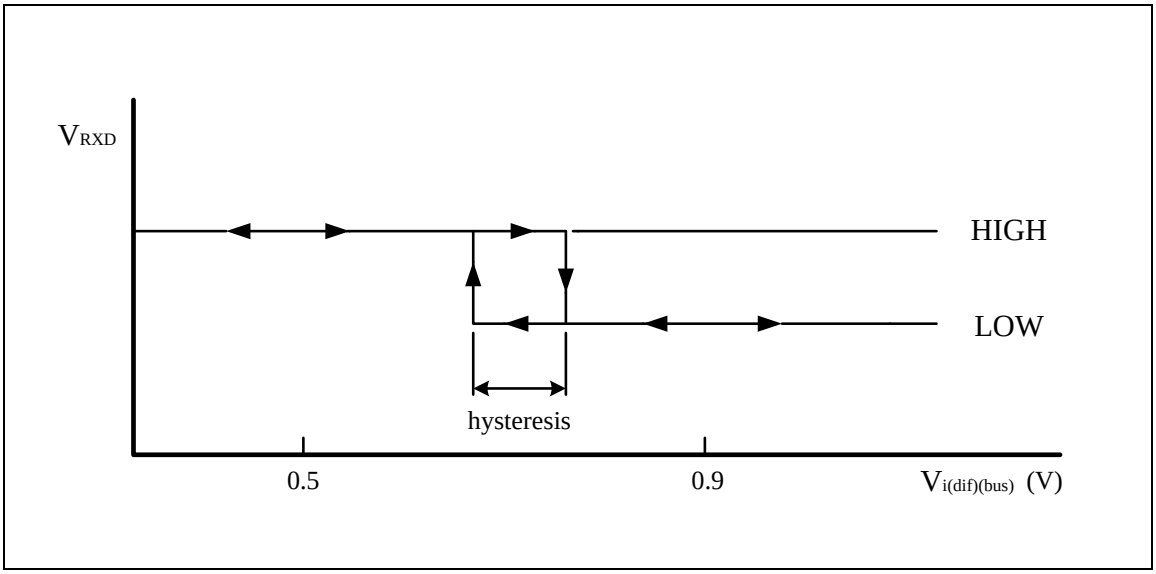


Fig.7 Hysteresis of the receiver

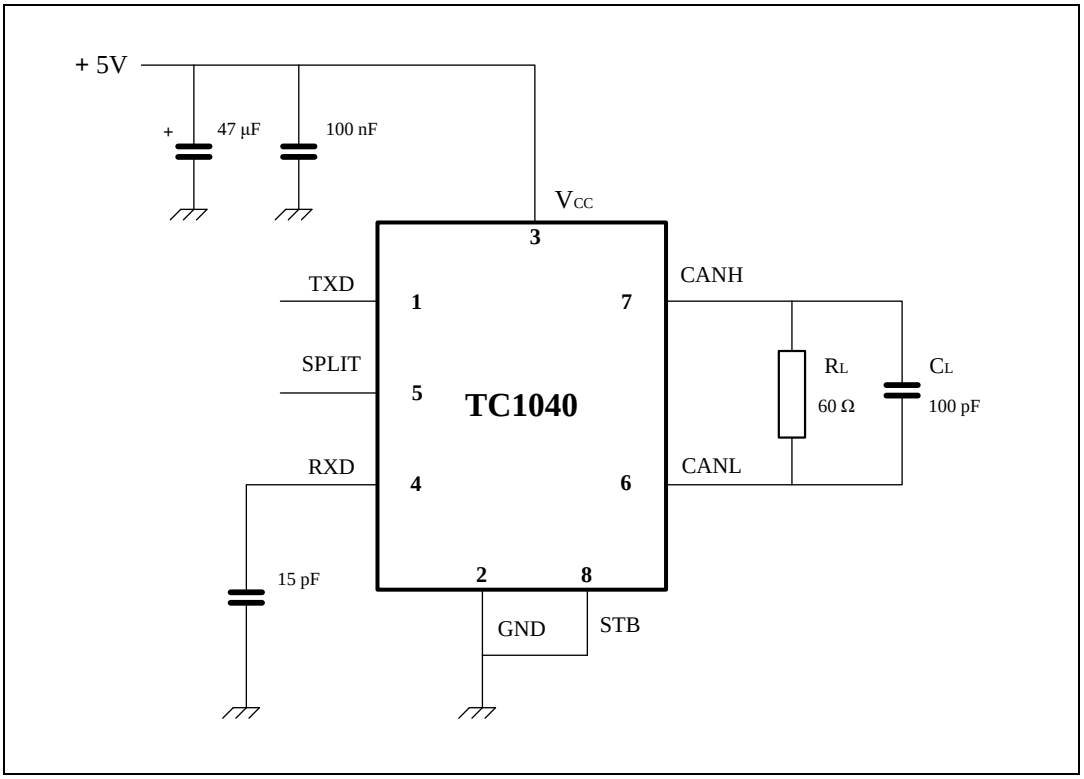


Fig.8 Test circuit for timing characteristics.

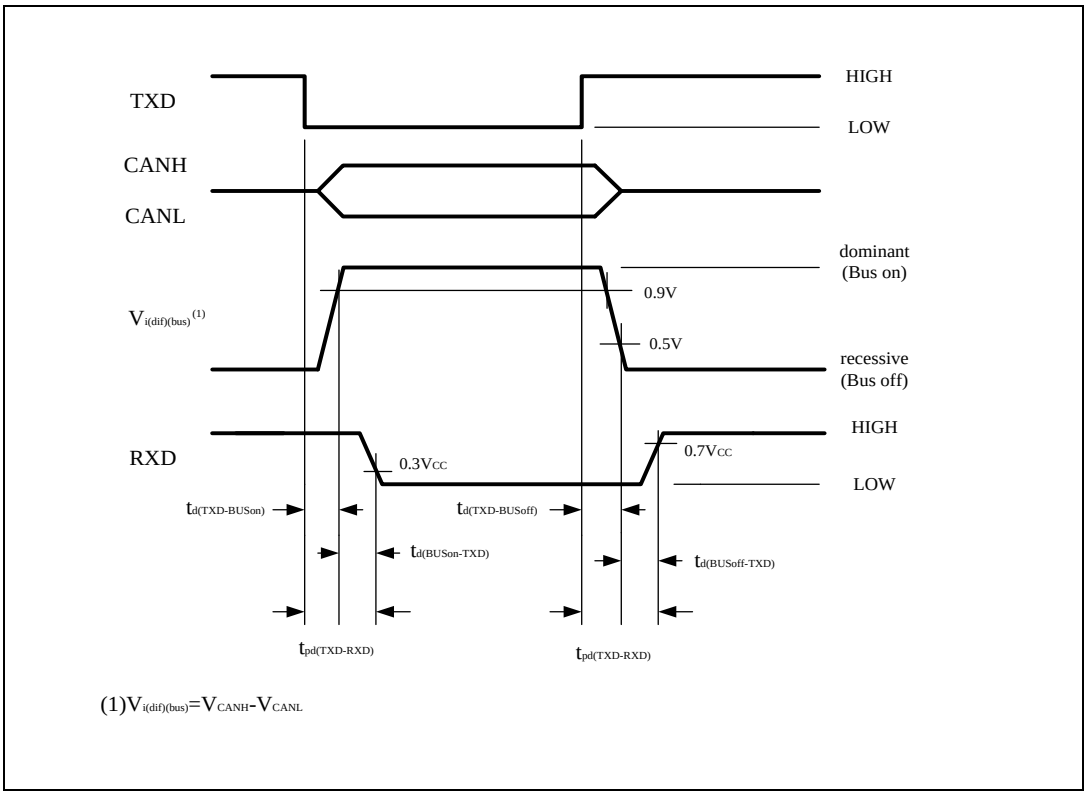
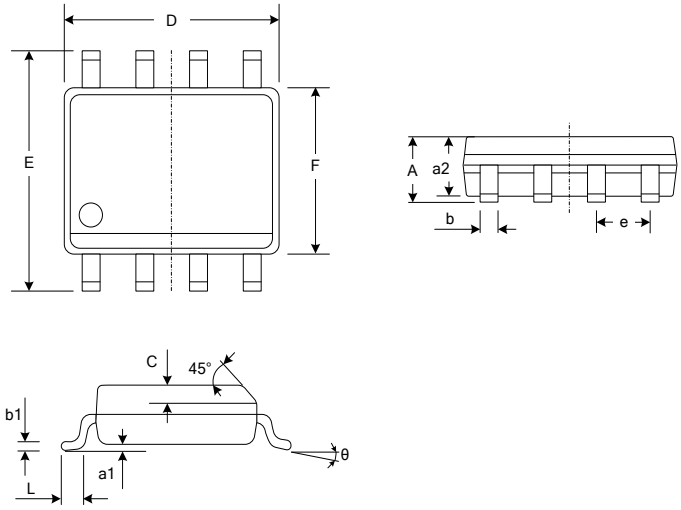


Fig.9 Timing diagram

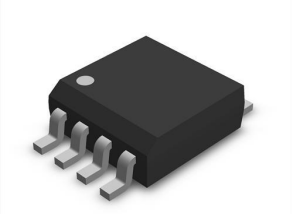
Outline Drawing – SOP8

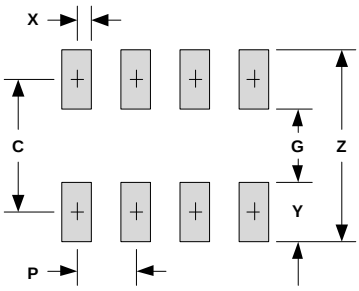
PACKAGE OUTLINE



DIMENSIONS

SYMBOL	INCHES		MILIMETER	
	MIN	MAX	MIN	MAX
A	0.054	0.068	1.35	1.75
a1	0.004	0.008	0.10	0.25
a2	0.050	0.060	1.25	1.50
D	0.189	0.196	4.80	5.00
F	0.150	0.157	3.80	4.00
E	0.229	0.244	5.80	6.20
b	0.014	0.022	0.35	0.56
b1	0.007	0.010	0.18	0.25
C	0.010	0.020	0.25	0.50
e	0.05BSC		1.27BSC	
L	0.016	0.049	0.40	1.25
θ	0°	10°	0°	10°





DIMENSIONS

DIM	INCHES	MILLIMETERS
C	0.205	5.20
G	0.160	4.06
P	0.050	1.27
X	0.015	0.38
Y	0.045	1.14
Z	0.291	7.40

Notes

1. This land pattern is for reference purposes only consult your manufacturing group to ensure your company's manufacturing guidelines are met. Reference ipc-sm-782a..

Ordering information

Order code	Marking	Package	Base qty	Delivery mode
TC1040	TC1040	SOP8	3000	Tape and reel