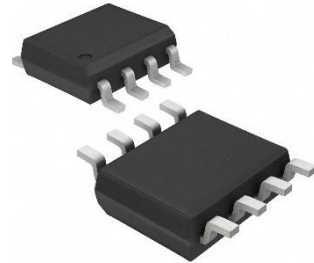


## TJA1050T/CM-HX CAN Bus Transceiver

### General Description

The TJA1050T/CM-HX serves as the interface between the Controller Area Network (CAN) protocol controller and the physical bus. It is designed for high-speed applications, specifically in passenger cars, supporting speeds of up to 1Mbaud. This device enables differential transmission to the bus and differential reception to the CAN controller.



SOP-8

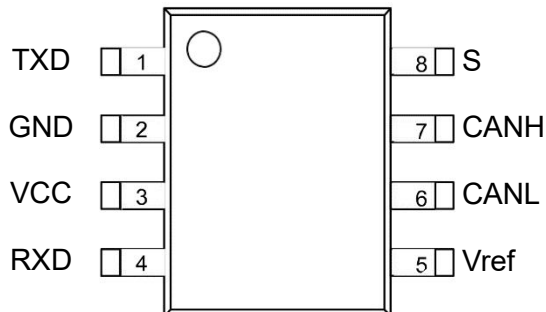
### Features

- High speed (up to 1 Mbaud)
- Silent mode
- Transceiver in unpowered state disengages from the bus (zero load)
- Differential receiver with high common-mode range for ElectroMagnetic Immunity (EMI)
- At least 110 nodes can be connected
- Transmit Data (TXD) dominant time-out function
- Bus pins protected against transients in automotive environments
- Thermally protected

### Applications

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

### PIN CONFIGURATIONS AND FUNCTIONS



| Pin Descriptio |      |                                                              |
|----------------|------|--------------------------------------------------------------|
| Pin            | Name | Description                                                  |
| 1              | TXD  | transmit data input                                          |
| 2              | GND  | ground supply                                                |
| 3              | VCC  | supply voltage                                               |
| 4              | RXD  | receive dataoutput;readsoutdata from the bus lines           |
| 5              | Vref | Reference Voltage Output                                     |
| 6              | CANL | LOW-level CAN bus line                                       |
| 7              | CANH | HIGH-level CAN busline                                       |
| 8              | S    | High speed and mute mode selection, low level for high speed |

| Absolute Maximum Rating |                            |      |         |      |
|-------------------------|----------------------------|------|---------|------|
| SYMBOL                  | PARAMETER                  | MIN  | MAX     | UNIT |
| VCC                     | Supply voltage range       | 4.75 | 5.25    | V    |
| TXD, RXD, STB, Vref     | MCU Side Port              | -0.3 | VCC+0.3 | V    |
| CANL, CANH              | Bus-side port voltage      | -60  | +60     | V    |
| Vtr                     | Pin 6, 7 Transient Voltage | -200 | +200    | V    |
|                         | storage temperature        | -55  | 150     | °C   |
|                         | ambient temperature        | -40  | 125     | °C   |
|                         | Welding temperature range  | -    | 300     | °C   |

## SPECIFICATIONS

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

| Bus Transmitter DC Character          |                                                                |                                |        |      |       |      |
|---------------------------------------|----------------------------------------------------------------|--------------------------------|--------|------|-------|------|
| SYMBOL                                | PARAMETER                                                      | TEST CONDITIONS                | MIN    | MAX  | UNIT  | SYMB |
| VOH(D)                                | CANH output voltage (dominant)                                 | VI=0V, STB=0V, RL=60Ω<br>F1、 2 | 2.9    | 3.4  | 4.5   |      |
| VOL(D)                                | CANL output voltage (dominant)                                 |                                | 0.8    |      | 1.5   |      |
| VO(R)                                 | Bus Output Differential Voltage(implicit)                      | VI=3V, STB=0V, RL=60Ω, F1、 2   | 2      | 2.5  | 3     | V    |
| VOD(D)                                | Bus Output Differential Voltage (dominant)                     | VI=0V, STB=0V, RL=60Ω, F1、 2   | 1.5    |      | 3     | V    |
| VOD(R)                                | Bus Output Differential Voltage<br>(implicit)                  | VI=3V, S=0V, F1、 2             | -0.012 |      | 0.012 | V    |
|                                       |                                                                | VI=3V, STB=0V, NO LOAD         | -0.5   |      | 0.05  | V    |
| Vdom(TX)sym                           | dominant output voltage symmetry                               | Vdom(TX)sym=VCC- VCANH         | -400   |      | 400   | mV   |
| VTXsym                                | Output Voltage Symmetry                                        | VTXsym= VCANH + VCANL          | 0.9VC  |      | 1.1VC | V    |
| VOC                                   | Common mode output voltage                                     | STB=0V, F 8                    | 2      | 2.5  | 3     | V    |
| △VOC                                  | Explicit and implicit common mode output<br>voltage difference |                                |        | 30   |       | mV   |
| IOS                                   | Short-circuit output current                                   | CANH=-12V,                     | -105   | -72  |       | mA   |
| VIL                                   | Low Level Input                                                |                                |        | 0.36 | 1     |      |
| Ios<br>Io(R)                          | Short-circuit output current Hidden output<br>current          | CANH=-12V, CANL=open, F 11     | -1     | 0.5  |       |      |
|                                       |                                                                | CANH=12V, CANL=open, F 11      |        | 71   | 105   |      |
|                                       |                                                                | -27V<CANH<32V 0<VCC<5.25V      | -2.0   |      | 2.5   | mA   |
| Bus Transmitter Switch Characteristic |                                                                |                                |        |      |       |      |
| tPLH                                  | Transmission delay (low to high)                               | STB=0V, F 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   |
| tEN                                   | Enable time from listen mode to dominant                       | F 7                            |        |      | 1     | μs   |
| tdom                                  | Explicit timeout                                               | F 10                           | 300    | 450  | 700   | μs   |
| tBUS                                  | Bus wake-up time                                               |                                | 0.7    |      | 5     | μs   |
|                                       |                                                                |                                |        |      |       |      |

| Bus Receiver DC Paramete           |                                                                     |                               |                    |     |                    |       |
|------------------------------------|---------------------------------------------------------------------|-------------------------------|--------------------|-----|--------------------|-------|
| SYMBOL                             | PARAMETER                                                           | TESTCONDITIONS                | MIN                | MAX | UNIT               | SYMB  |
|                                    | Positive Input Threshold                                            | S=0V                          |                    | 800 | 900                | mV    |
| V <sub>IT-</sub>                   | Negative Input Threshold                                            |                               | 500                | 650 |                    |       |
| V <sub>HYS</sub>                   | Comparator Threshold Hysteresis                                     |                               | 100                | 125 |                    |       |
| V <sub>OH</sub>                    | High Level Output Voltage                                           | IO=-2mA                       | 4                  | 4.6 |                    | V     |
| V <sub>OL</sub>                    | Low Level Output Voltage                                            | IO=2mA                        |                    | 0.2 | 0.4                | V     |
| I <sub>(OFF)</sub>                 | Bus input current at power down                                     | CANH or CANL=5V, Other pin=0V |                    | 165 | 125                | μA    |
| C <sub>I</sub>                     | CANH, CANL input capacitance to                                     |                               |                    | 13  |                    | pF    |
| C <sub>ID</sub>                    | CANH, CANL Differential Input                                       |                               |                    | 5   |                    | pF    |
| R <sub>IN</sub>                    | CANH, CANL Input Resistance                                         | TXD=3V, STB=0V                | 15                 | 30  | 40                 | KΩ    |
| R <sub>ID</sub>                    | CANH, CANL Differential Input                                       |                               | 30                 |     | 80                 | KΩ    |
| R <sub>Imatch</sub>                | RI(CANH), RIN(CANL) mismatches                                      | CANH=CANL                     | -3%                |     | 3%                 |       |
| V <sub>COM</sub>                   | Common mode voltage range                                           |                               | -12                |     | 12                 | V     |
| Bus Receiver Switching Characteris |                                                                     |                               |                    |     |                    |       |
| t <sub>PLH</sub>                   | Propagation delay (low to high)                                     | STB=0V or VCC                 | 60                 | 100 | 130                | ns    |
| t <sub>PHL</sub>                   | Propagation delay (high to low)                                     |                               | 45                 | 70  | 90                 | ns    |
| t <sub>r</sub>                     | RXD signal rise time                                                |                               |                    | 8   |                    | ns    |
| t <sub>f</sub>                     | RXD signal fall time                                                |                               |                    | 8   |                    | ns    |
| Device Switching Character         |                                                                     |                               |                    |     |                    |       |
| Td(LOOP1)                          | Loop delay 1, driver input to receiver output, implicit to explicit | STB=0V                        | 90                 |     | 190                | ns    |
| Td(LOOP2)                          | Loop Delay 2, Driver Input to Receiver Output, Explicit to Implicit |                               | 90                 |     | 190                | ns    |
| Over-temperature protectio         |                                                                     |                               |                    |     |                    |       |
| T <sub>J</sub> (sd)                | Over temperature shutdown                                           |                               | 155                | 165 | 180                | ℃     |
| TXD Pin Characteristi              |                                                                     |                               |                    |     |                    |       |
| I <sub>IH</sub> (TXD)              | TXD port high level input current                                   | VI=VCC                        | -2                 |     | 2                  | μA    |
| I <sub>IL</sub> (TXD)              | TXD Port Low Level Input Current                                    | VI=0                          | -50                |     | -10                | μA    |
| I <sub>O(off)</sub>                | Current in TXD when VCC=0V                                          | VCC=0V.                       |                    |     | 1                  | μA    |
| V <sub>IH</sub>                    | Input High LowerLimit                                               |                               | 2                  |     | VCC+0.             | V     |
| V <sub>IL</sub>                    | Input Low Limit                                                     |                               | -0.3               |     | 0.8                | V     |
| TXDO                               | TXD Port Dangle Voltage                                             |                               |                    | H   |                    | logic |
| Vref pin reference voltage output  |                                                                     |                               |                    |     |                    |       |
| V <sub>ref</sub>                   | Reference Output Voltage                                            | -50uA<I <sub>o</sub> <50uA    | 0.4V <sub>CC</sub> |     | 0.6V <sub>CC</sub> | V     |
| Power consumption characteristic   |                                                                     |                               |                    |     |                    |       |
| ICC                                | Silent Mode Power Consumption                                       | S=VCC, VI=VCC                 |                    | 6   | 10                 | μA    |
|                                    | Dominant power consumption                                          | VI=0V, S=0V<br>LOAD=60Ω       |                    | 50  | 70                 | mA    |
|                                    | Implicit power consumption                                          | VI=VCC, S=0V<br>NO LOAD       |                    | 6   | 10                 | mA    |

**Menu** (1)H=high; L=low; X=no care**Table 1 CAN Transceiver Truth**

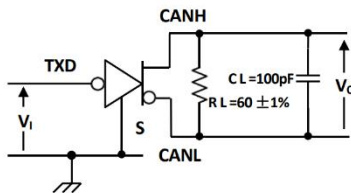
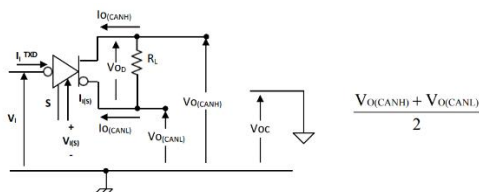
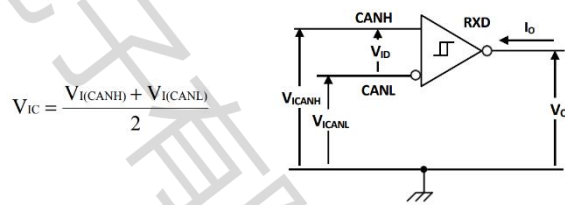
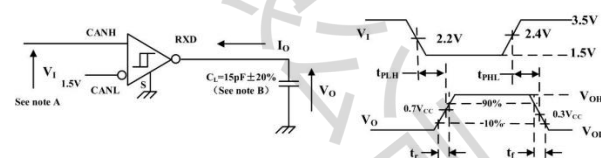
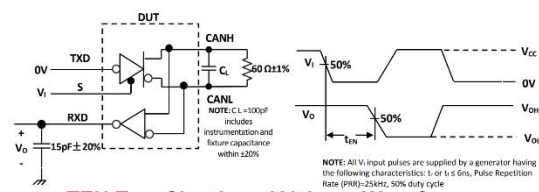
| VCC        | TXD(1)       | STB(1)      | CANH <sup>(1)</sup> | CANL <sup>(1)</sup> | BUS STATE | RXD(1) |
|------------|--------------|-------------|---------------------|---------------------|-----------|--------|
| 4.5V~5.5V  | L            | L(or float) | H                   | L               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

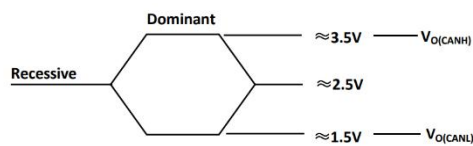
**Table 2 Driver Function**

| INPUTS      |             | OUTPUTS             |                     | Bus State           |
|-------------|-------------|---------------------|---------------------|---------------------|
| TXD(1)      | STB(1)      | CANH <sup>(1)</sup> | CANL <sup>(1)</sup> |                     |
| L           | L(or float) | H                   | L                   | Dominate(dominant)  |
| H (or floa) | X           | Z                   | Z                   | Recessive(implicit) |
| X           | H           | Z                   | Z                   | Recessive(implicit) |

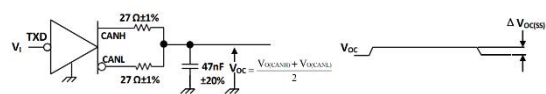
**Table 3 Receiver Functio**

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

**Driver Test Circuit and Voltage Waveforms****Driver Voltage, Current Test Definition****Receiver Voltage and Current Definitions****Receiver test circuit and voltage wave****TEN Test Circuit and Voltage Waveforms**

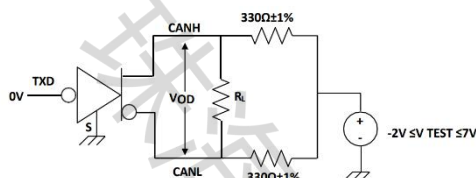


**Bus Logic Voltage Definit**

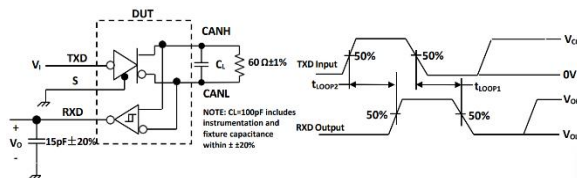


Note: V<sub>I</sub> from 0~V<sub>CC</sub>, input pulse generator characteristics: PRR≤125KHz, 50% duty cycle, t<sub>r</sub>≤6ns, t<sub>f</sub>≤6ns, Z<sub>o</sub>=50Ω.

**Common Mode Output Voltage Test and Wave**



**Driver VOD Test Circuit**



**t(LOOP) Test Circuit and Waveform**

## DESCRIPTION

The TJA1050T/CM-HX is a chip that serves as an interface between a CAN protocol controller and the physical bus invarious applications such as trucks, buses, cars, and industrial control systems. It is designed to comply with the ISO 11898 standard and can achieve a speed of 1Mbps.

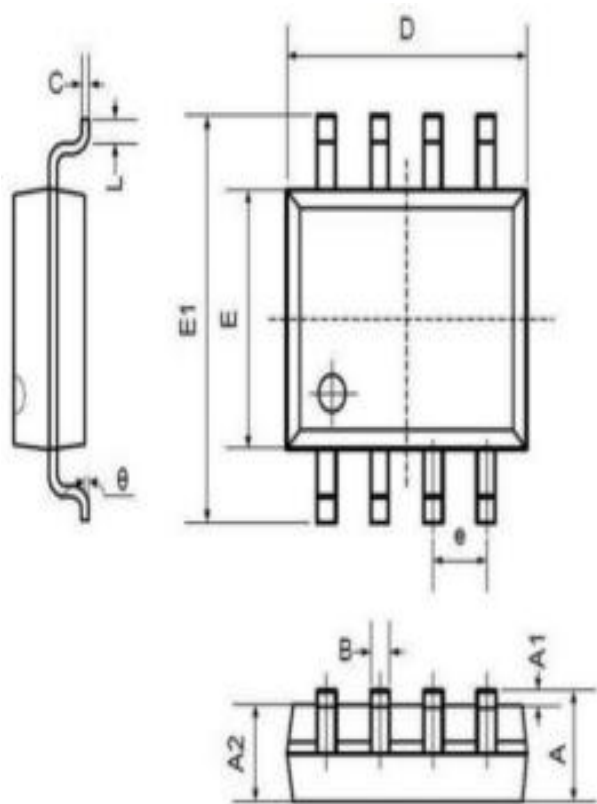
One of the key features of the TJA1050T/CM-HX is its short circuit protection, which prevents the driver circuit from short-circuiting to positive and negative supply voltages. This protection mechanism limits the current flow and safeguards the driver stage from damage.

Additionally, the TJA1050T/CM-HX incorporates an over-temperature protection function. When triggered, this function reduces the current in the driver stage, which helps to lower the chip's temperature. Meanwhile, the rest of the chip continues to function normally.

Another important feature is the built-in TXD dominant timeout timer circuit. This circuit prevents the bus line from being permanently driven to a dominant state, which could block all network communications, in case of a hardware or software failure that keeps the TXD pin low for an extended period. The timer is triggered by a negative edge on the TXD pin, and if the low level duration exceeds the internal timer value, the transmitter is disabled, causing the bus to enter a recessive state. The timer can be reset by a positive edge on the TXD pin.

Package Information

SOP8 (Package Outline Dimensions)



| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | Min                          | Max   | Min                     | Max   |
| A      | 1.350                        | 1.750 | 0.053                   | 0.069 |
| A1     | 0.100                        | 0.250 | 0.004                   | 0.010 |
| A2     | 1.350                        | 1.550 | 0.053                   | 0.061 |
| B      | 0.330                        | 0.510 | 0.013                   | 0.020 |
| C      | 0.190                        | 0.250 | 0.007                   | 0.010 |
| D      | 4.780                        | 5.000 | 0.188                   | 0.197 |
| E      | 3.800                        | 4.000 | 0.150                   | 0.157 |
| E1     | 5.800                        | 6.300 | 0.228                   | 0.248 |
| e      | 1.270TYP                     |       | 0.050TYP                |       |
| L      | 0.400                        | 1.270 | 0.016                   | 0.050 |
| θ      | 0°                           | 8°    | 0°                      | 8°    |

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