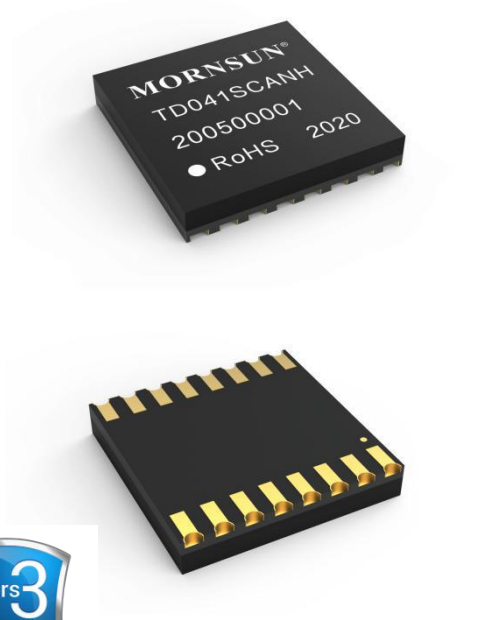
MORNSUN®

TD041SCANH
DFN package isolated CAN Transceiver

Features

- Ultra-small, ultra-thin, chip scale DFN package
- Compatible with the "ISO 11898-2" standard
- I/O power supply range supports 3.3V and 5V microprocessors
- High isolation to 3750Vrms
- Bus-Pin ESD protection up to 15kV(HBM)
- Baud rate up to 1Mbps
- -40V to +40V bus fault protection
- >25kV/μs CMTI
- TXD dominant time-out function
- Low communication delay
- The bus supports maximum 110 nodes
- Industrial operating ambient temperature range:-40℃ to +125℃
- Meet AEC-Q100 standards
- EN62368 approval
- Moisture Sensitivity Level (MSL) 3

Package



Applications

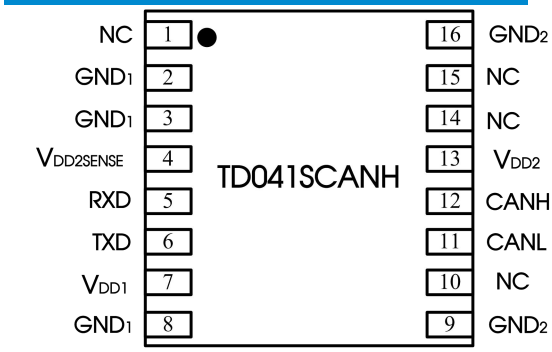
- Industrial automation, control, sensors and drive systems
- Building and greenhouse environmental control(HVAC) automation
- Security system
- Transport
- Medical treatment
- Telecommunication
- Can Bus standard such as CAN open, Device Net, NMEA2000, ARNIC825, ISO11783, CAN Kingdom, CAN aerospace

Functional Description

TD041SCANH is a isolated CAN bus transceiver, which is compliant with ISO11898-2 standard. The TD041SCANH provide differential transmitting and receiving capability between the CAN protocol controller and the physical layer bus. It is capable of running at data rates of up to 1 Mbps. The device has the function of series line, over-voltage, ground loss protection and thermal shutdown so that it is especially suitable for working in harsh environment. The rated operating temperature range of TD041SCANH is –40°C to 125°C.

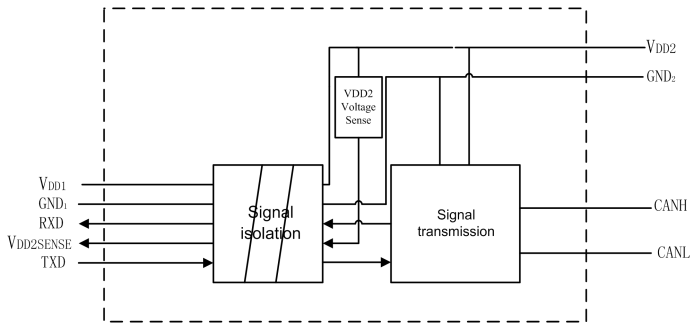
Contents

Pin Connection



Note: All GND_1 pins are internally connected;
All GND_2 pins are internally connected.

Internal Block Diagram



Function Table

Letter	Description
H	High-Level
L	Low-Level
I	Indeterminate
X	Unrelated
Z	High Impedance
NC	No Connection

Table 1. Driver Function table

Power		Input	Output			
V_{DD1}	V_{DD2}	TXD	Bus State	CANH	CANL	$V_{DD2SENSE}$
On	On	L	Dominant	H	L	L
On	On	H	Recessive	Z	Z	L
On	On	left floating	Recessive	Z	Z	L
Off	On	X	Recessive	Z	Z	I
On	Off	L	I	I	I	H

Table 2. Receiver Function table

Power		Input		Output	
V_{DD1}	V_{DD2}	V_{ID} = CANH − CANL	Bus State	RXD	$V_{DD2SENSE}$
On	On	≥0.9 V	Dominant	L	L
On	On	≤0.5 V	Recessive	H	L
On	On	0.5 V < V_{ID} < 0.9 V	I	I	L
On	On	OPEN	Recessive	H	L
Off	On	X	X	I	I
On	Off	X	X	H	H

Pin Descriptions

Pin Number	Pin Name	Pin Functions
1	NC	No Connect.
2	GND_1	Ground(Logic side).
3	GND_1	Ground(Logic side).
4	$V_{DD2SENSE}$	V_{DD2} Voltage Sense.
5	RXD	Receiver Output Data (L: Dominant Bus State; H: Recessive Bus State).
6	TXD	Driver Input Data (L: Dominant Bus State; H: Recessive Bus State).
7	V_{DD1}	Power Supply (Logic Side).
8	GND_1	Ground(Logic side).
9	GND_2	Ground (Bus Side).
10	NC	No Connect.
11	CANL	Low Level CAN Voltage Input/Output.
12	CANH	High Level CAN Voltage Input/Output.
13	V_{DD2}	Power Supply (Bus Side).
14	NC	No Connect.
15	NC	No Connect.
16	GND_2	Ground (Bus Side).

Absolute Maximum Ratings

General test conditions: Free-air, normal operating temperature range (unless otherwise specified).

Parameters		Min.	Max.	UNIT
V_{DD1},V_{DD2}	Power Supply	-0.5	6	V
V_I	Input Voltage(TXD)	-0.5	V_{DD1}+0.5	V
$V_{O(RXD)}$	Output Voltage (RXD)	-0.5	V_{DD1}+0.5	V
$V_{O(SENSE)}$	Output Voltage ($V_{DD2SENSE}$)	-0.5	V_{DD1}+0.5	V
V_{CANH},V_{CANL}	Bus terminal voltage	-40	40	V
V_{REF}	Reference Voltage	-0.5	+6	V
T_A	Operating Temperature Range	-40	125	°C
T_{stg}	Storage Temperature Range	-50	150	°C
Reflow Soldering Temperature		Peak temp. ≤260℃, maximum duration ≤60s at 217℃. Please also refer to IPC/JEDEC J-STD-020D.3.		

Important: Exposure to absolute maximum rated conditions for an extended period may severely affect the device reliability, and stress levels exceeding the “Absolute Maximum Ratings” may result in permanent damage.All voltage values are referenced to the reference ground (GND).

Recommended Operating Conditions

Recommended Operating Conditions			Min.	Nom.	Max.	Unit
V_{DD1}	Power Supply(Logic Side)		2.375	3.3	5.5	V
V_{DD2}	Power Supply(Bus Side)		4.75	5	5.25	
V_I or V_{IC}	Voltage at any bus terminal (common mode)		-40		+40	
V_{IH}	High-level input voltage(TXD)		2			
V_{IL}	Low-level input voltage(TXD)				0.8	
I_{D1}	Input Static Current(Logic Side)	V_{DD1}= 5.5V, V_{DD2}= 5.25V, No Signal			3.5	mA
I_{D2}	Input Static Current(Bus Side)				10	
P_D	Power Dissipation	V_{DD1}= 5.5V, V_{DD2}= 5.25V, TA= 105°C, R_L= 60Ω; TXD Input Signal: f= 500kHz; Duty= 50%			200	mW
P_{D1}	Power Dissipation(Logic Side)				25	
P_{D2}	Power Dissipation(Bus Side)				175	
	Signaling rate		40		1000	kbps

Electrical Characteristics

General test conditions and V_{DD1}=V_{DD2}= 5V, Ta = 25℃ (unless otherwise specified).

Parameters		Conditions	Min.	Nom.	Max.	Unit
Driver						
V_{IH}	Input High Voltage	TXD pins, see Figure 11	2			V
V_{IL}	Input Low Voltage	TXD pins, see Figure 11			0.8	V
I_{IH}, I_{IL}	CMOS Input Current	TXD pins, see Figure 11			2	mA
V_{CANL}, V_{CANH}	Recessive Bus Voltage	V_{TXD} = high, R_L = ∞, see Figure 11	2.0		3.0	V
V_{CANH}	CANH Output Voltage	V_{TXD} = low, see Figure 11	2.75		4.5	V
V_{CANL}	CANL Output Voltage	V_{TXD} = low, see Figure 11	0.5		2	V
V_{OD}	Differential Output Voltage	V_{TXD} = low, R_L = 50 Ω, see Figure 11	1.5		3	V
		V_{TXD} = high, R_L = ∞, see Figure 11	-500		+50	mV
R_{TXD}	Internal TXD Pull up Resistor			9.1		kΩ
Receiver						
V_{IT+}	Positive-going input threshold voltage				900	mV
V_{IT-}	Negative-going input threshold voltage		500			mV
V_{HYS}	Hysteresis Voltage (V_{IT+} – V_{IT-})	See Figure 14		150		mV
R_{DIFF}	Differential input resistance		30		80	kΩ
V_{OL}	RXD Output Low Voltage	I_{OUT} = 1.5 mA		0.2	0.4	V
V_{OH}	RXD Output High Voltage	I_{OUT} = −1.5 mA	V_{DD1}-0.4	V_{DD1} − 0.2		V
C_I	Input capacitance to ground (CANH or CANL)	TXD at 3 V, V_I = 0.4 sin (4E6πt) + 2.5 V		13		pF
C_{ID}	Differential input capacitance	TXD at 3 V, V_I = 0.4 sin (4E6πt)		5		pF
Other						
V_{OL}	VDD2SENSE Output Low Voltage	I_{OSENSE} = 1.5 mA		0.2	0.4	V
V_{OH}	VDD2SENSE Output High Voltage	I_{OSENSE} = −1.5 mA	V_{DD1}-0.4	V_{DD1} − 0.2		V
$V_{TH(SENSE)}$	Bus Voltage Sense Threshold Voltage	V_{DD2}=100Hz	2.0		2.5	V
ESD	HBM	CANH, CANL and GND			±15	kV
		Other pins			±2	kV
EFT	IEC61000-4-4: Perf. Criteria B	CANH, CANL and GND			±2	kV
Surge	IEC61000-4-5: Perf. Criteria B	CANH, CANL and GND(Common Mode)			±2	kV
V_{I-O}	Isolation Test	Leakage current <1mA.			3750	Vrms
R_{I-O}	Insulation Resistance	At 500VDC	1000			MΩ
C_{I-O}	Isolation Capacitor			3		pF
C_I	Input Capacitor			4		pF

CMTI	Common Mode Transient Immunity	TXD = V_{DD1} or 0 V, VCM = 1 kV, transient magnitude = 800 V	25			kV/μs

Transmission Characteristics

General test conditions and V_{DD1}=V_{DD2}= 5V, Ta = 25℃ (unless otherwise specified).

Parameters		Conditions	Min.	Nom.	Max.	Unit
t_{onTXD}	Propagation Delay TXD On to Bus Active	RL = 60 Ω, CL = 100 pF, see Figure 13 and Figure 15			150	ns
t_{offTXD}	Propagation Delay TXD Off to Bus Inactive				200	ns
t_{onRXD}	Propagation Delay TXD On to Receiver Active				300	ns
t_{offRXD}	Propagation Delay TXD Off to Receiver Inactive				250	ns
t_{SE}	Enable Time, VDD2 High to VDD2SENSE Low				100	us
t_{SD}	Disable Time, VDD2 Low to VDD2SENSE High				100	us
t_{TXD_DTO}	Dominant time-out time	C_L = 100 pF	1.2		3.8	ms

Physical Specifications

Parameters	Value	Unit
Weight	0.4(Typ.)	g

Typical Performance Curves

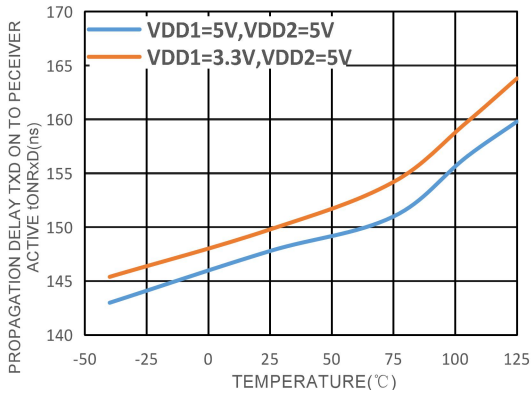


Figure3. Propagation Delay from TXD On to Receiver Active vs. Temperature

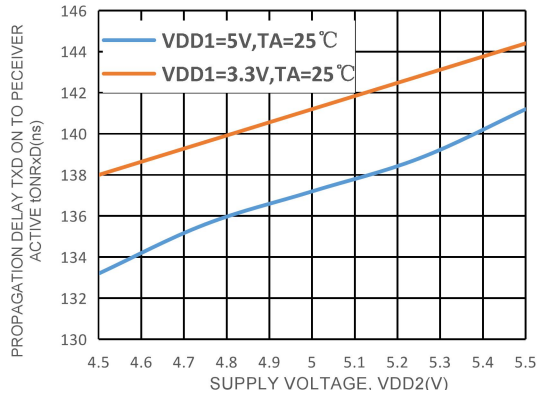


Figure4. Propagation Delay from TXD On to Receiver Active vs. Voltage,VDD2

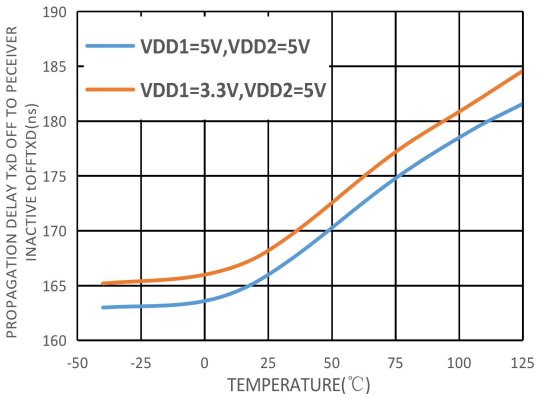


Figure5. Propagation Delay from TXD Off to Receiver Inactive vs. Temperature

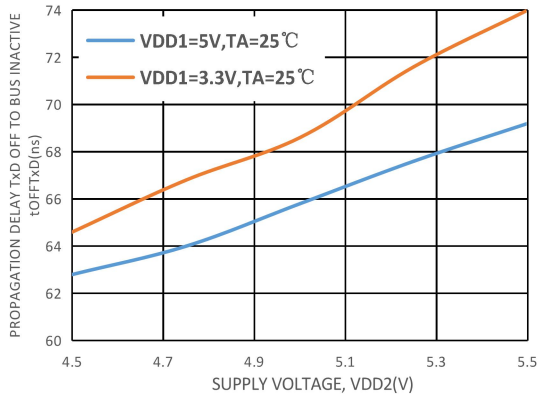


Figure6. Propagation Delay from TxD Off to Bus Inactive vs. Voltage,VDD2

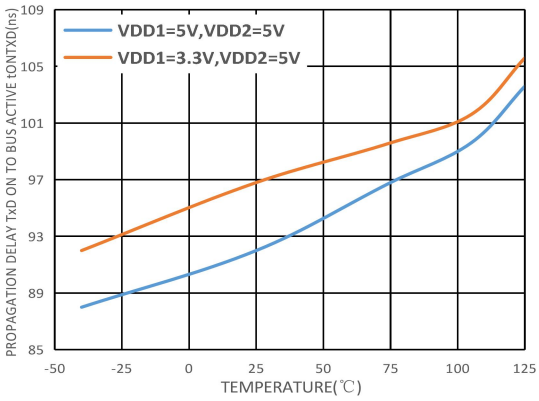


Figure7. Propagation Delay from TXD On to Bus Active vs. Temperature

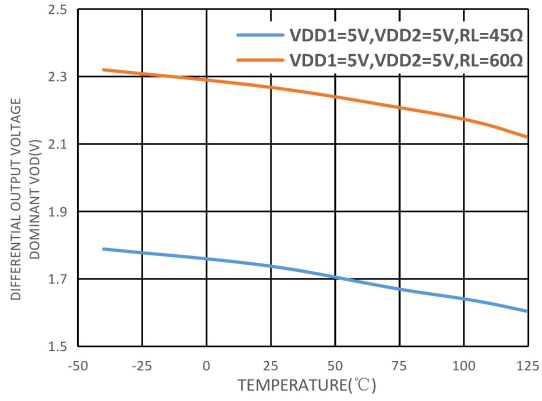


Figure8. Drive Differential Output Voltage Dominant vs. Temperature

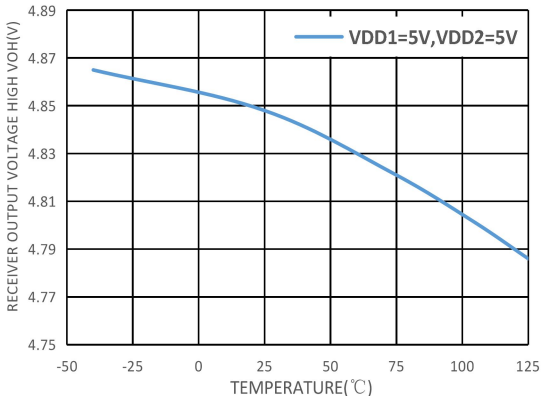


Figure9. Receiver Output High Voltage vs. Temperature

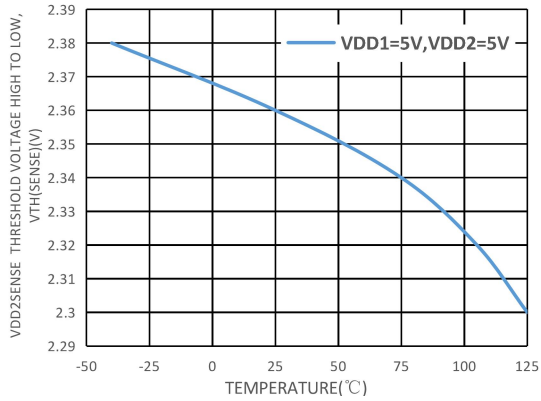


Figure10. VDD2 Voltage Sense Threshold Voltage High to Low vs. Temperature

Test Circuits

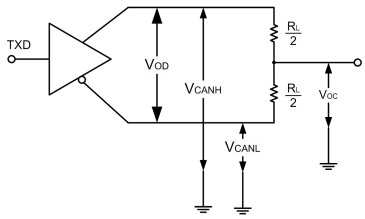


Figure 11. Driver Test Circuit

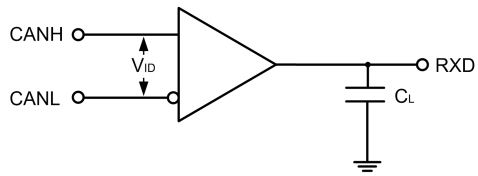


Figure 12. Receiver Test Circuit

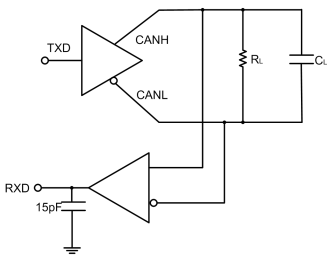


Figure 13. Switching Characteristics Test Circuit

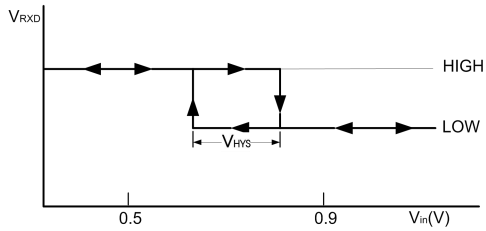


Figure 14. Receiver Input Hysteresis

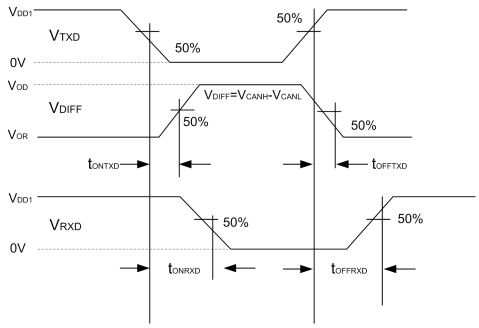


Figure 15. Drive and Receiver Propagation Drive

Detailed Description

TD041SCANH is a isolated CAN bus transceiver with the ability of differential signal transmission between the bus and CAN protocol controller, which is compliant with ISO11898-2 standard.

Short-circuit protection: TD041SCANH has current-limiting protection to prevent the drive circuit from short-circuiting to positive and negative supply voltages. The power dissipation increases when a short circuit occurs. The short-circuit protection function protects the driver stage from damage.

Over-temperature protection: TD041SCANH has over-temperature protection. When the over-temperature protection is triggered, the current in the driver stage will decrease. Because the drive tube is the primary energy consuming component, current reduction can reduce power consumption and reduce chip temperature. At the same time, the rest of the chip remains functional.

Dominant time-out function: TD041SCANH has dominant time-out function to prevent if the pin TXD is forced to a permanent low level due to a hardware or software application failure, the built-in TXD dominant timeout timer circuit prevents the bus line from being driven to a permanent dominant state (blocking all network traffic). The timer is triggered by the negative edge on pin TXD.If the low level on pin TXD lasts longer than the internal timer value (t_{TXD_DTO}), the transmitter will be disabled and the drive bus will enter a recessive state. The timer is reset by the positive edge on pin TXD.

Application circuit

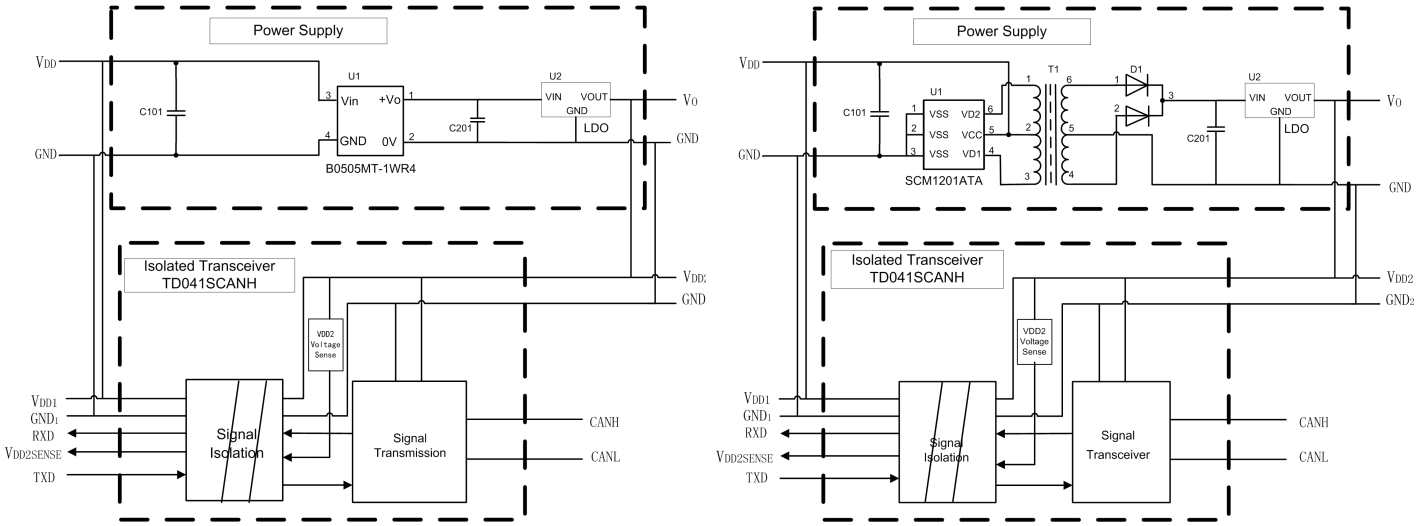


Figure 16. Drive and Receiver Propagation Drive

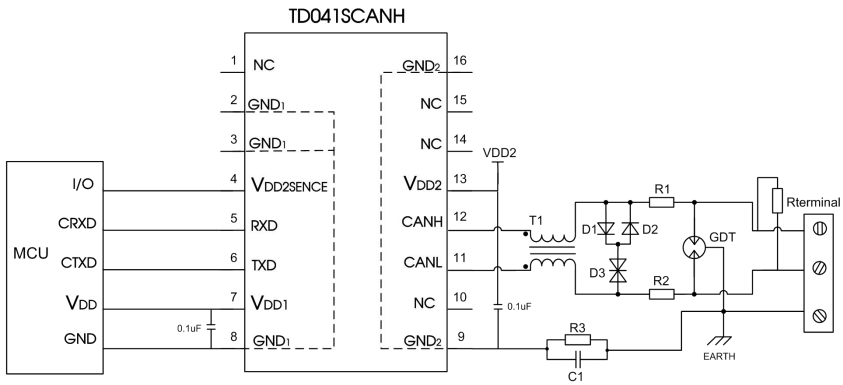


Figure 17. Port protection circuit for harsh environments

Recommended components and values:

Component	Recommended part, value	Component	Recommended part, value
R3	1MΩ	D1、D2	1N4007
C1	1nF, 2kV	D3	SMBJ30CA
T1	ACM2520-301-2P	$R_{terminal}$	120Ω
GDT	B3D090L	R1、R2	2.7Ω/2W

When the module is used in applications with harsh environment, it can be susceptible to large energy like lightning strike, etc. in which case, it is essential to add an adequate protection circuit to the CAN signal ports to protect the system from failure and maintain a reliable bus communication. Figure 17 provides a recommended protection circuit design for high-energy lightning surges, with a degree of protection related to the selected protection device. Parameter description lists a set of recommended circuit parameters, which can be adjusted according to the actual application situation. Also, when using the shielded cable, the reliable single-point grounding of the shield must be achieved.

Note: The recommended components and values is a general guideline only and must be verified for the actual user's application. We recommended using PTC's for R1 and R2 and to use fast recovery diodes for D1 and D2.

Using Suggests

① Hot-swap is not supported.

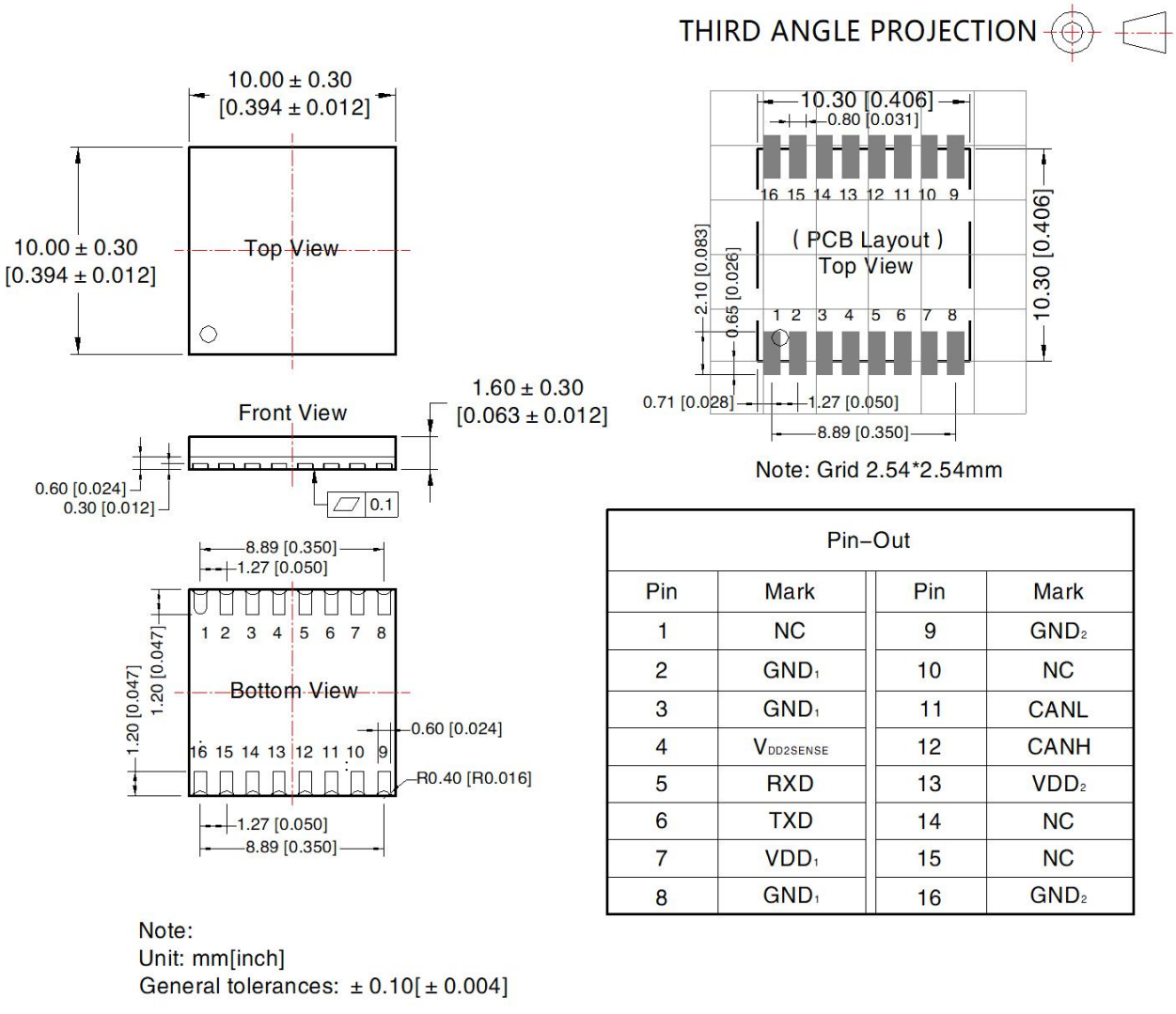
② If the external input of TXD is insufficient, the pull-up resistor should be added according to the situation.

③ Refer to *IPC 7093* for the welding process design of this product. For detailed operation guidance, please refer to *Hot Air Gun Welding Operation Instruction for DFN Package Product* or *Welding Operation Instruction for DFN Package Product*.

Ordering Information

Part number	Package	Number of pins	Product Marking	Tape & Reel
TD041SCANH	DFN	16	TD041SCANH	500/REEL

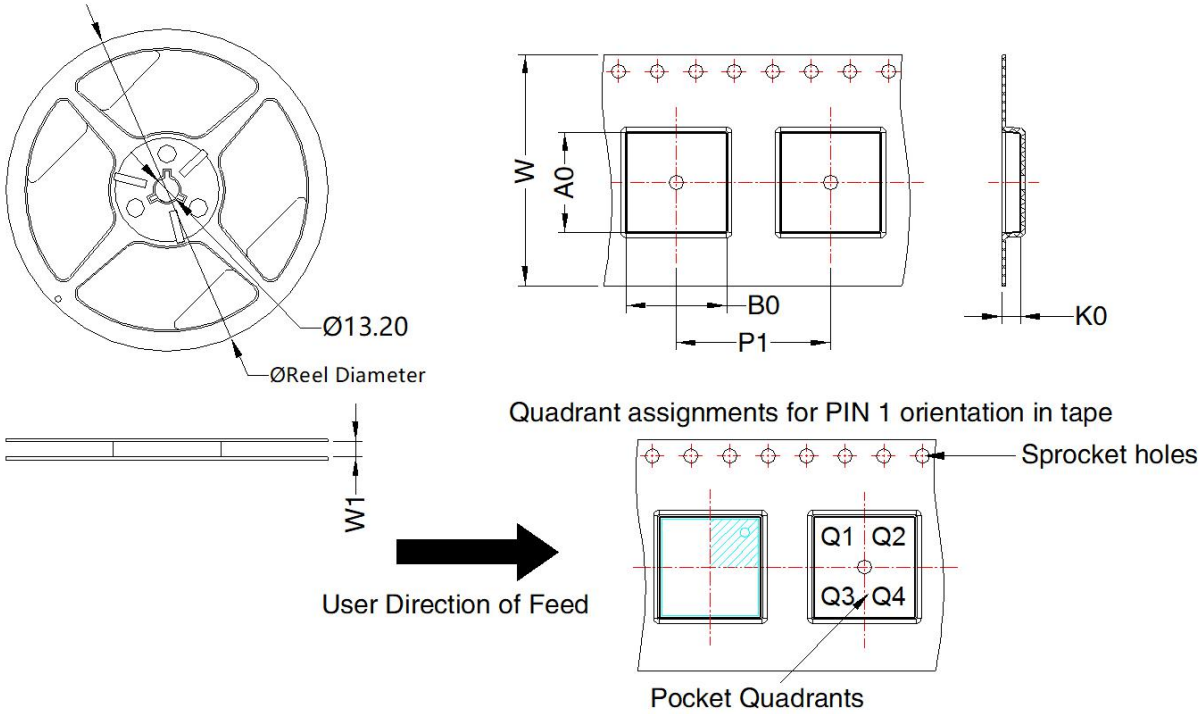
Package Information



Note: Grid 2.54*2.54mm

Note:
Unit: mm[inch]
General tolerances: ± 0.10[± 0.004]

Pin–Out			
Pin	Mark	Pin	Mark
1	NC	9	GND_2
2	GND_1	10	NC
3	GND_1	11	CANL
4	$V_{DD2SENSE}$	12	CANH
5	RXD	13	VDD_2
6	TXD	14	NC
7	VDD_1	15	NC
8	GND_1	16	GND_2



Device	Package Type	Pin	MPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TD041SCANH	DFN 10x10	16	500	180.0	24.4	10.44	10.44	2.0	16.0	24.0	Q2

MORNSUN Guangzhou Science & Technology Co., Ltd.
Address: No. 5, Kehui St. 1, Kehui Development Center, Science Ave., Guangzhou Science City, Huangpu District, Guangzhou, P. R. China
Tel: 86-20-38601850 Fax: 86-20-38601272 E-mail: info@mornsun.cn www.mornsun-power.com