

## TD041SCANFD DFN package isolated CANFD 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 5Mbps
- -58V to +58V 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°C to +125°C
- Meet AEC-Q100 standards
- EN62368 approval

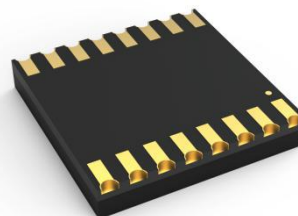
### Applications

- 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

TD041SCANFD is a isolated CAN bus transceiver, which is compliant with ISO11898-2 standard. The TD041SCANFD provide differential transmitting and receiving capability between the CANFD protocol controller and the physical layer bus. It is capable of running at data rates of up to 5 Mbps. The device has the function of series line, over-voltage, ground loss protection(-58V to +58V) and thermal shutdown so that it is especially suitable for working in harsh environment. The rated operating temperature range of TD041SCANFD is -40°C to 125°C.

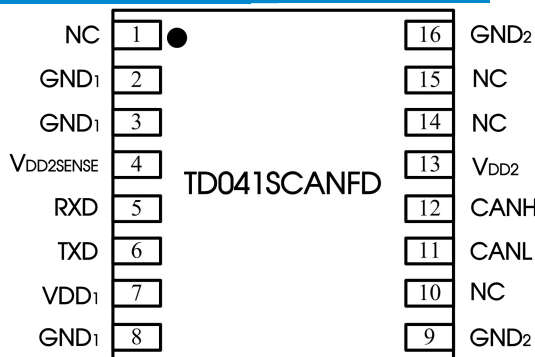
### Package



## Contents

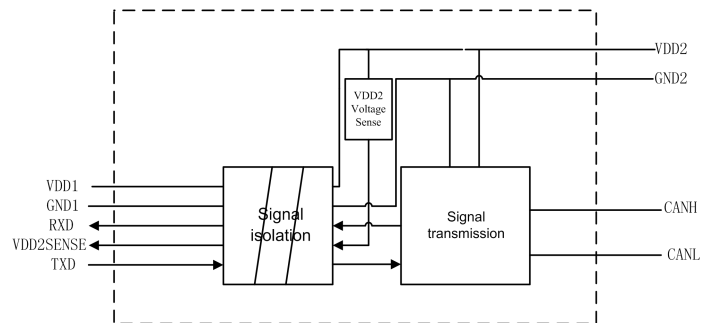
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### Pin Connection



Note: All GND1 pins are internally connected;  
All GND2 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			
VDD1	VDD2	TXD	Bus State	CANH	CANL	VDD2SENSE
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	
VDD1	VDD2	VID = CANH - CANL	Bus State	RXD	VDD2SENSE
On	On	≥ 0.9 V	Dominant	L	L

On	On	$\leq 0.5\text{ V}$	Recessive	H	L
On	On	$0.5\text{ V} < \text{VID} < 0.9\text{ V}$	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	GND1	Ground(Logic side).
3	GND1	Ground(Logic side).
4	VDD2SENSE	VDD2 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	VDD1	Power Supply (Logic Side).
8	GND1	Ground(Logic side).
9	GND2	Ground (Bus Side).
10	NC	No Connect.
11	CANL	Low Level CAN Voltage Input/Output.
12	CANH	High Level CAN Voltage Input/Output.
13	VDD2	Power Supply (Bus Side).
14	NC	No Connect.
15	NC	No Connect.
16	GND2	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 (VDD2SENSE)	-0.5	$V_{DD1} + 0.5$	V
$V_{CANH}, V_{CANL}$	Bus terminal voltage(CANH, CANL)	-58	58	V
$T_A$	Operating Temperature Range	-40	125	°C
$T_{stg}$	Storage Temperature Range	-50	150	°C
Reflow Soldering Temperature		Peak temp. $\leq 260^\circ\text{C}$ , maximum duration $\leq 60\text{s}$ at $217^\circ\text{C}$ . 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.

## 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)	4.5	5	5.5	
$V_i$ or $V_{ic}$	Voltage at any bus terminal (common mode)	-12		+12	
$V_{IH}$	High-level input voltage(TXD)	2			
$V_{IL}$	Low-level input voltage(TXD)			0.8	
$I_{D1}$	Input Static Current(Logic Side)	$V_{DD1}= 5.5\text{V}, V_{DD2}= 5.25\text{V},$ No Signal		3.5	mA
$I_{D2}$	Input Static Current(Bus Side)			13.5	

Recommended Operating Conditions		Min.	Nom.	Max.	Unit
P <sub>D</sub>	Power Dissipation	V <sub>DD1</sub> = 5.5V, V <sub>DD2</sub> = 5.25V, T <sub>A</sub> = 105°C, R <sub>L</sub> = 60Ω; TXD Input Signal: f= 500kHz; Duty= 50%		200	mW
P <sub>D1</sub>	Power Dissipation(Logic Side)			25	
P <sub>D2</sub>	Power Dissipation(Bus Side)			175	
Signaling rate		40		5000	kbps

## Electrical Characteristics

General test conditions and V<sub>DD1</sub>=V<sub>DD2</sub>= 5V, Ta = 25°C (unless otherwise specified).

PARAMETERS		CONDITIONS	Min.	Nom.	Max.	Unit
<b>DRIVER</b>						
V <sub>IH</sub>	Input High Voltage	TXD pin, see Figure 13	2			V
V <sub>IL</sub>	Input Low Voltage	TXD pin, see Figure 13			0.8	V
I <sub>IH</sub> , I <sub>IL</sub>	CMOS Input Current	TXD pin, see Figure 13			500	uA
V <sub>CANL</sub> , V <sub>CANH</sub>	Recessive Bus Voltage	V <sub>TXD</sub> = high, R <sub>L</sub> = ∞, see Figure 13	2.0		3.0	V
V <sub>CANH</sub>	CANH Output Voltage	V <sub>TXD</sub> = low, see Figure 13	2.75		4.5	V
V <sub>CANL</sub>	CANL Output Voltage	V <sub>TXD</sub> = low, see Figure 13	0.5		2	V
V <sub>OD</sub>	Differential Output Voltage	V <sub>TXD</sub> = low, R <sub>L</sub> = 45 Ω, see Figure 13	1.5		3	V
		V <sub>TXD</sub> = high, R <sub>L</sub> = ∞, see Figure 13	-500		+50	mV
R <sub>TXD</sub>	Internal TXD Pull up Resistor			9.1		kΩ
<b>RECEIVER</b>						
V <sub>IT+</sub>	Positive-going input threshold voltage				900	mV
V <sub>IT-</sub>	Negative-going input threshold voltage		500			mV
V <sub>HYS</sub>	Hysteresis Voltage (V <sub>IT+</sub> – V <sub>IT-</sub> )	See Figure 12		150		mV
R <sub>IN</sub>	Differential Input Resistance		19	30	52	kΩ
V <sub>OL</sub>	RXD Output Low Voltage	I <sub>OUT</sub> = 1.5 mA		0.2	0.4	V
V <sub>OH</sub>	RXD Output High Voltage	I <sub>OUT</sub> = -1.5 mA	V <sub>DD1</sub> -0.4	V <sub>DD1</sub> -0.2		V
C <sub>I</sub>	Input capacitance to ground (CANH or CANL)	TXD at 3 V, V <sub>i</sub> = 0.4 sin(4E6πt) + 2.5 V		26		pF
C <sub>ID</sub>	Differential input capacitance	TXD at 3 V, V <sub>i</sub> = 0.4 sin(4E6πt)		5		pF
<b>Other</b>						
V <sub>OL</sub>	VDD2SENSE Output Low Voltage	I <sub>SENSE</sub> = 1.5 mA		0.2	0.4	V
V <sub>OH</sub>	VDD2SENSE Output High Voltage	I <sub>SENSE</sub> = -1.5 mA	V <sub>DD1</sub> -0.4	V <sub>DD1</sub> -0.2		V
V <sub>TH(SENSE)</sub>	Bus Voltage Sense Threshold Voltage		2.0		2.5	V
ESD	HBM	CANH, CANL and GND			±15	KV
		Other pins			±2	KV
	IEC/EN 61000-4-2 ( Contact ) Perf. Criteria B	CANH, CANL and GND			±4	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 <sub>I-O</sub>	Isolation Test	Leakage current <1mA.			3750	Vrms
R <sub>I-O</sub>	Insulation Resistance	At 500VDC	1000			MΩ
C <sub>I-O</sub>	Isolation Capacitor			3		pF
C <sub>I</sub>	Input Capacitor			4		pF
CMTI	Common Mode Transient Immunity	TXD = V <sub>DD1</sub> or 0 V, V <sub>CM</sub> = 1 kV, transient magnitude = 800 V	25			kV/μs

## Transmission Characteristics

General test conditions and V<sub>DD1</sub>=V<sub>DD2</sub>= 5V, Ta = 25°C (unless otherwise specified).

PARAMETERS		CONDITIONS	Min.	Nom.	Max.	Unit
t <sub>onTXD</sub>	Propagation Delay TXD On to Bus Active	R <sub>L</sub> = 60 Ω, C <sub>L</sub> = 100 pF, see Figure 11			150	ns

PARAMETERS		CONDITIONS	Min.	Nom.	Max.	Unit
$t_{offTXD}$	Propagation Delay TXD Off to Bus Inactive	and Figure 13			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	$C_L = 100 \text{ pF}$	0.3	2	5	ms

## Physical Specifications

PARAMETERS	Value	Unit
Weight	0.4(Typ.)	g

## Typical Performance Curves

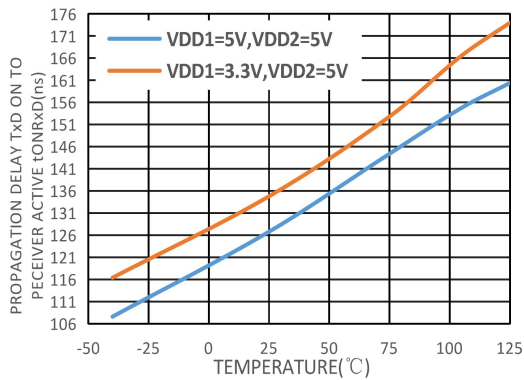


Figure3. Propagation Delay from TxD On to receiver active vs. Temperature

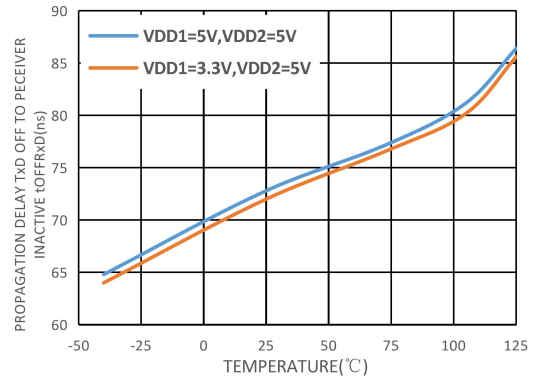


Figure4. Propagation Delay from TxD Off to Receiver Inactive vs. Temperature

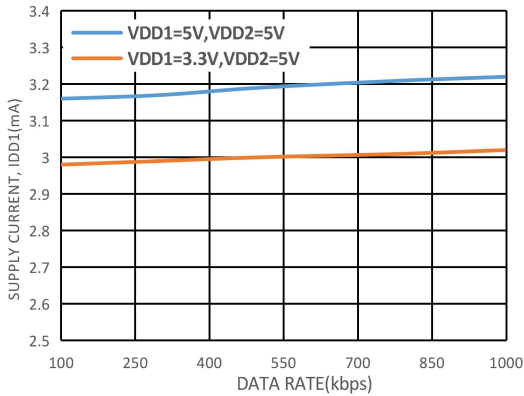


Figure5. Supply Current(IDD1) vs. Data Rate

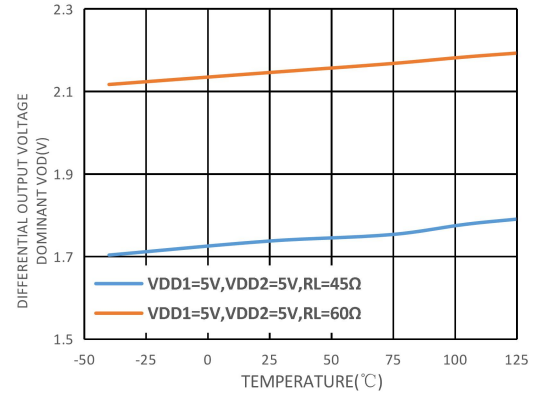


Figure6. Drive Differential Output Voltage Dominant vs. Temperature

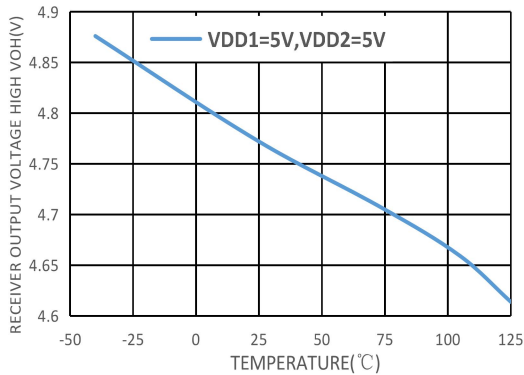


Figure7. Receiver Output High Voltage vs. Temperature

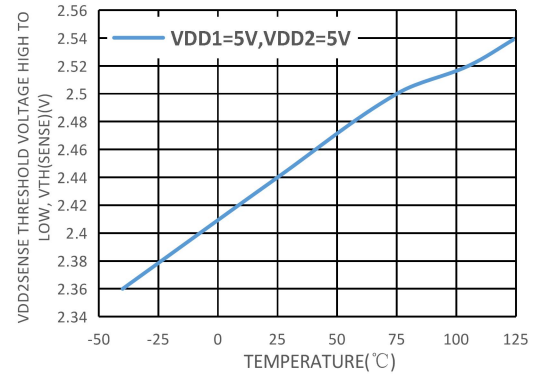


Figure8. VDD2 Voltage Sense Threshold Voltage High to Low vs. Temperature

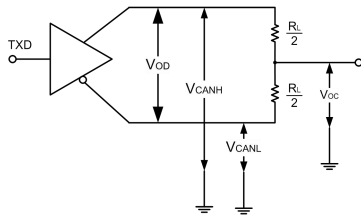


Figure 9. Driver Test Circuit

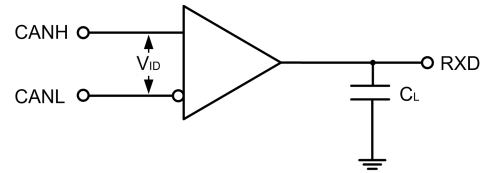


Figure 10. Receiver Test Circuit

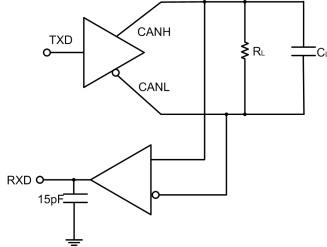


Figure 11. Switching Characteristics Test Circuit

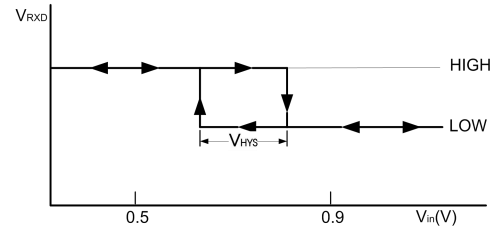


Figure 12. Receiver Input Hysteresis

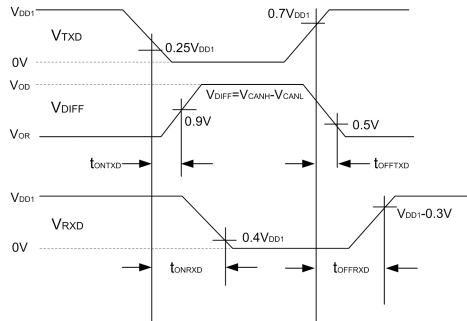


Figure 13. Drive and Receiver Propagation Drive

## Detailed Description

TD041SCANFD 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. TD041SCANFD is an upgraded version of CAN. The main feature of the isolated CAN transceiver is to further enhance its data transmission performance that successfully achieves a data transfer rate of up to 5Mbit/s.

**Short-circuit protection:** TD041SCANFD 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:** TD041SCANFD 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:** TD041SCANFD 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.

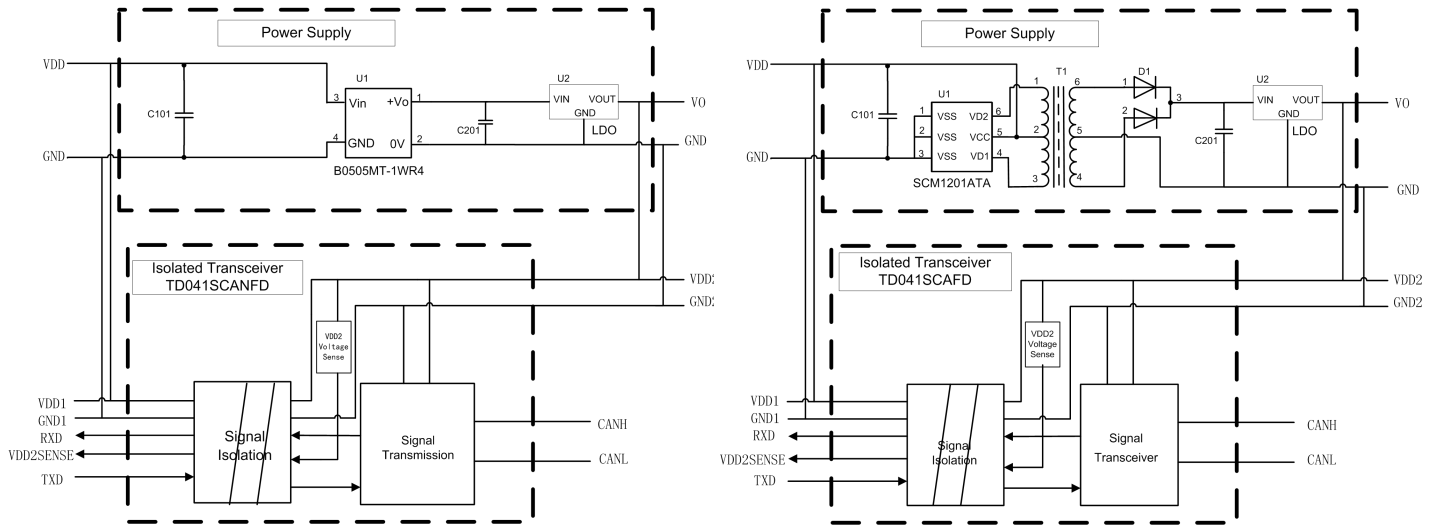


Figure 14. Drive and Receiver Propagation Drive

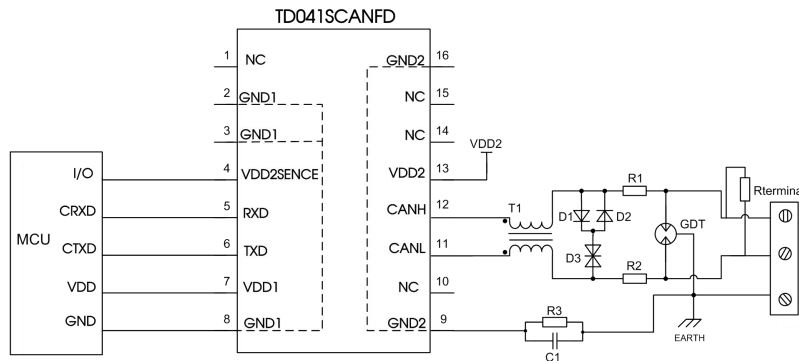


Figure 15. Port protection circuit for harsh environments

Recommended components and values:

Component	Recommended part, value	Component	Recommended part, value
R3	1M $\Omega$	D1、D2	1N4007
C1	1nF, 2kV	D3	SMBJ30CA
T1	ACM2520-301-2P	R <sub>terminal</sub>	120 $\Omega$
GDT	B3D090L	R1、R2	2.7 $\Omega$ /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 15 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

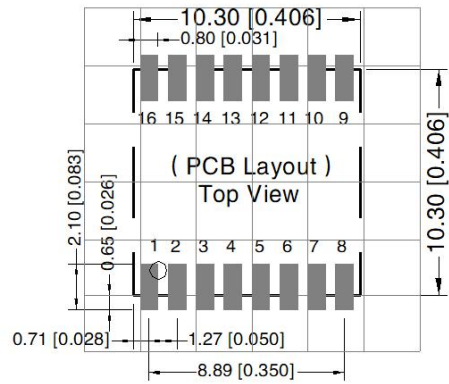
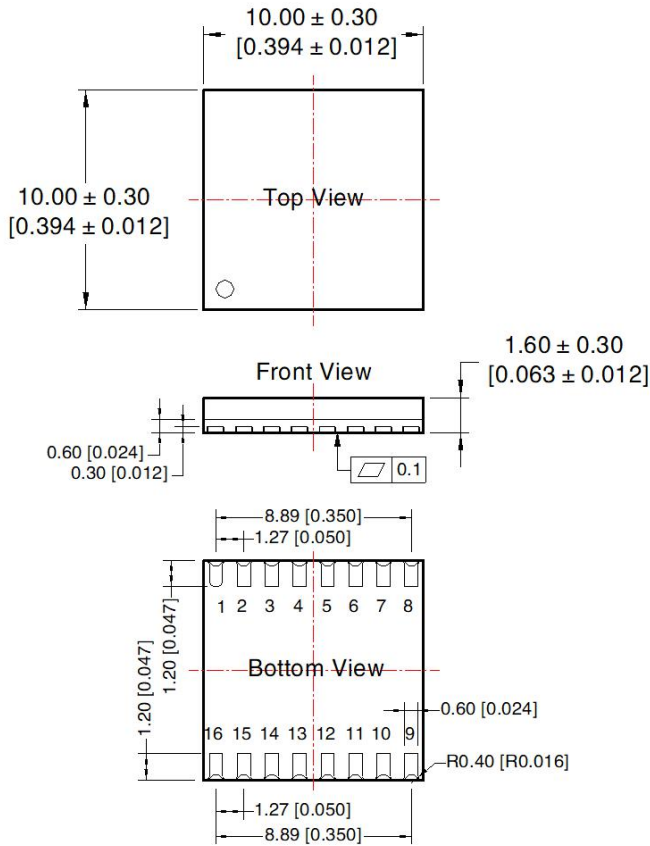
- ① Hot-swap is not supported.
- ② If the external input of TXD is insufficient, the pull-up resistor should be added according to the situation.
- ③ Refer to IPC 7093 for the welding process design of this product. For detailed operation guidance, please refer to *Hot Air Gun Welding Operation Instruction for DFN Package Product* or *Welding Operation Instruction for DFN Package Product*.

### Ordering Information

Part number	Package	Number of pins	Product Marking	Tape & Reel
TD041SCANFD	DFN	16	TD041SCANFD	500/REEL



THIRD ANGLE PROJECTION 

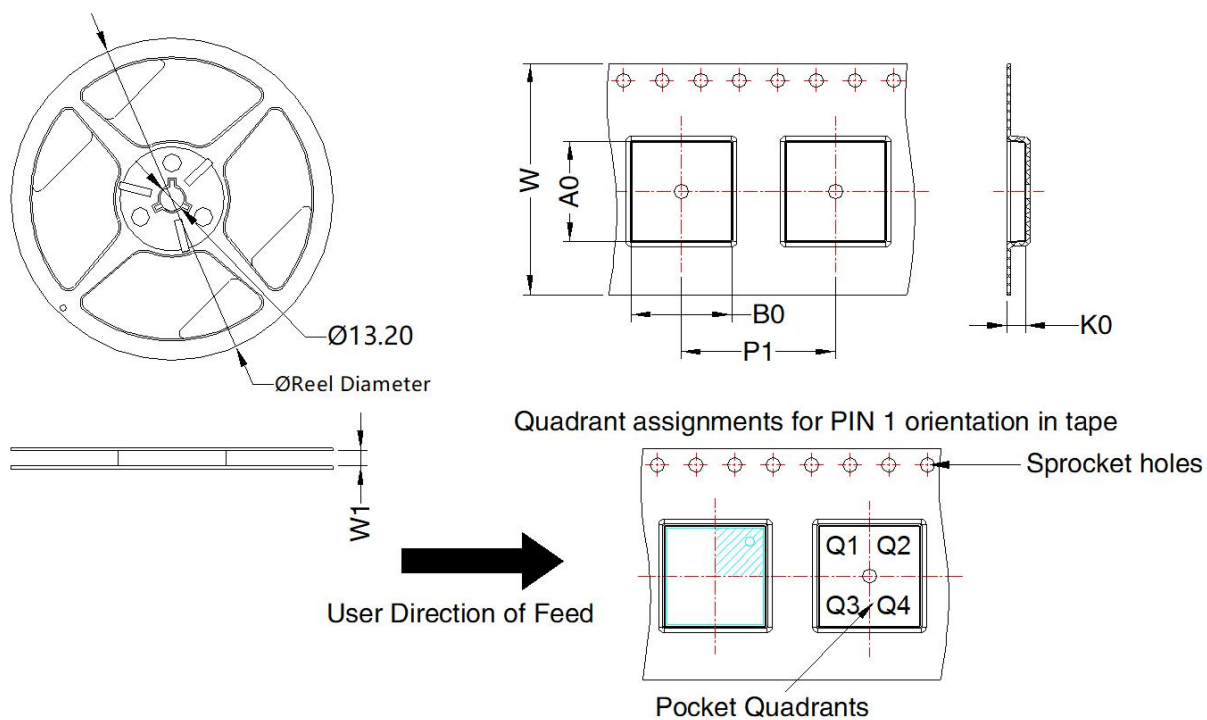


Note: Grid 2.54\*2.54mm

Pin-Out			
Pin	Mark	Pin	Mark
1	NC	9	GND <sub>2</sub>
2	GND <sub>1</sub>	10	NC
3	GND <sub>1</sub>	11	CANL
4	V <sub>DD2SENSE</sub>	12	CANH
5	RXD	13	VDD <sub>2</sub>
6	TXD	14	NC
7	VDD <sub>1</sub>	15	NC
8	GND <sub>1</sub>	16	GND <sub>2</sub>

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





Device	Package Type	Pin	MPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TD(H)041SCANFD	DFN 10x10	16	500	180.0	24.4	10.44	10.44	2.0	16.0	24.0	Q2

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