

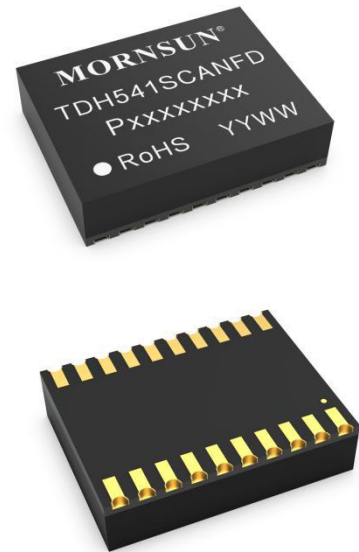
## TDH541SCANFD

### DFN package isolated CAN Transceiver

#### Features

- Ultra-small, ultra-thin, chip scale DFN package
- Compliant with ISO11898-2 standard
- Integrate 5V efficiently power supply
- I/O power supply range supports 3.3V and 5V microprocessors
- High isolation to 5000VDC
- Bus-Pin ESD protection up to 15kV(HBM)
- Baud rate up to 5Mbps
- -58V to +58V bus fault protection
- >25kV/us CMTI
- TXD dominant time-out function
- Low communication delay
- The bus supports maximum 110 nodes
- Industrial operating ambient temperature range: -40℃ to +125℃
- 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

TDH541SCANFD is a isolated CANFD Bus transceiver, which is compliant with ISO11898-2 standard. Their logic side supports 3.3V and 5V logic level conversion. TDH541SCANFD integrate 5V efficiently power. The TDH541SCANFD 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(-58V to 58V), ground loss protection and thermal shutdown so that it is especially suitable for working in harsh environment.

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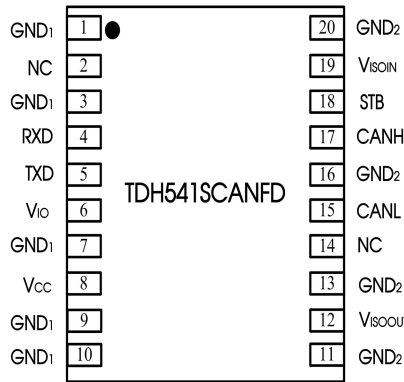
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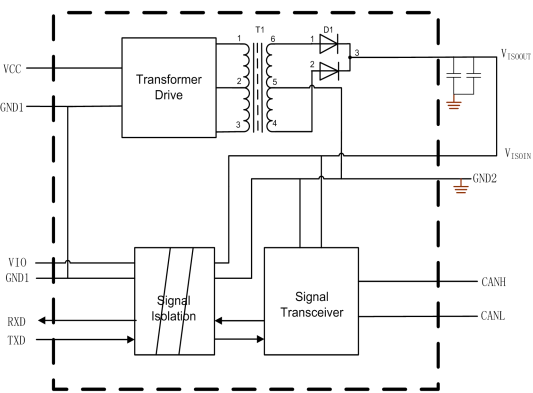
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Internal Block Diagram



Function Table

Letter	Description
H	High-Level
L	Low-Level
X	Unrelated
Z	High Impedance

Table 1. Driver Function table

Inputs		Outputs		Bus State
TXD	STB	CANH	CANL	
L	L	H	L	Dominant
H ( Or No Connection )	L	Z	Z	Recessive
X	H	Z	Z	Recessive

Table 2. Receiver Function table

VID=CANH-CANL	RXD	Bus State
VID≥0.9V	L	Dominant
0.5< VID<0.9V	Uncertainty	Uncertainty
VID≤0.5V	H	Recessive
Open	H	Recessive

## Pin Descriptions

Pin Number	Pin Name	Pin Functions
1	GND <sub>1</sub>	Ground(Logic side)
2	NC	No connect
3	GND <sub>1</sub>	Ground(Logic side)
4	RXD	Receiver output pin.
5	TXD	Driver input pin
6	V <sub>IO</sub>	Isolation power supply pin. By using 0.1uF ceramic capacitance ground GND <sub>1</sub> .
7	GND <sub>1</sub>	Ground(Logic side)
8	V <sub>CC</sub>	Power supply pin. By using 1uF ceramic capacitance ground GND <sub>1</sub> .
9	GND <sub>1</sub>	Ground(Logic side)
10	GND <sub>1</sub>	Ground(Logic side)
11	GND <sub>2</sub>	Ground (Bus side)
12	V <sub>ISOOUT</sub>	Insulation power output. By using 1uF ceramic capacitance ground GND <sub>2</sub> . The pin needs to be connected to pin19 in application.
13	GND <sub>2</sub>	Ground (Bus side)
14	NC	No connect
15	CANL	CANL pin
16	GND <sub>2</sub>	Ground (Bus side)
17	CANH	CANH pin
18	STB	Standby mode takes control input, this pin connect to ground GND <sub>2</sub> .
19	V <sub>ISOIN</sub>	Insulation power input. By using 0.1uF ceramic capacitance ground GND <sub>2</sub> . The pin needs to be connected to pin12 in application.
20	GND <sub>2</sub>	Ground (Bus side)

## Absolute Maximum Ratings

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

Parameters	Unit
Supply voltage, (V <sub>CC</sub> )	-0.3V to +5.6V
Digital input voltage TXD, RXD	-0.3V to +6V
Bus voltage (CANH, CANL)	-58 to 58V
Receiver output current	-15 to 15mA
Operating temperature range	-40°C to +125°C
Storage temperature range	-50°C to +130°C
Reflow soldering temperature	Peak temp. ≤250°C, maximum duration ≤60s at 217°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

Parameters			Min.	Nom.	Max.	Unit
V <sub>CC</sub>	Power supply		4.75	5	5.25	V
V <sub>IO</sub>	Power supply(Logic Side)		2.75		5.25	V
V <sub>I</sub> or V <sub>IC</sub>	Voltage at any bus terminal (differential mode)		-12		12	V
V <sub>IH</sub>	High-level input voltage	TXD	2			V
V <sub>IL</sub>	Low-level input voltage	TXD			0.8	V
I <sub>OH</sub>	High-level output current	Driver	-70			mA
		Receiver V <sub>CC</sub> =5V	-4			
I <sub>OL</sub>	Low-level output current	Driver			70	mA
		Receiver V <sub>CC</sub> =5V			4	
T <sub>A</sub>	Operating temperature range		-40		125	°C
I <sub>CC</sub>	Recessive mode current			20	35	mA

$I_{CC}$	Working current	$V_{CC}=5V, R_L=60\Omega$ ; TXD signal : $f=500kHz$ ; Duty=50%		35	55	mA
	Signaling rate		40		5000	kbps

## Electrical Characteristics

General test conditions and  $V_{CC}=V_{IO}=5V$ ,  $T_a=25^{\circ}C$  (unless otherwise specified).

Parameters		Conditions	Min.	Nom.	Max.	Unit
Driver						
$ V_{O(D)} $	Dominant CANH output voltage	Figure 8, $V_{TXD}=0V$ , $R_L=60\Omega$	2.75	3.5	4.5	V
	Dominant CANL output voltage		0.5	1.5	2.25	
$V_{O(R)}$	Recessive bus voltage	Figure 8, $V_{TXD}=2V$ , $R_L=60\Omega$	2	2.5	3	V
$V_{OD(D)}$	Differential output voltage	Figure 8 $V_{TXD}=0V$ , $t < t_{to(dom)TXD}$ , $V_{CC}=4.75V$ to $5.25V$ , $R_L=50$ to $65\Omega$	1.5		3	V
$V_{OD(R)}$	Recessive differential output voltage	Figure 8 $V_{TXD}=5V$ , $R_L=60\Omega$	-0.12		0.012	V
		$V_{TXD}=5V$ , No load	-0.5		0.05	
$I_{IH}$	TXD High-level input current	$V_{TXD}=2V$			4	$\mu A$
$I_{IL}$	TXD Low-level input current	$V_{TXD}=0.8V$	-4			$\mu A$
$R_{TXD}$	Internal TXD Pull up Resistor			9.1		$k\Omega$
Receiver						
$V_{IT+}$	Positive-going input threshold voltage	Figure 11		750	900	mV
$V_{IT-}$	Negative-going input threshold voltage		500	650		mV
$V_{hys}$	Hysteresis voltage ( $V_{IT+} - V_{IT-}$ )			120		mV
$V_{OH}$	High-level output voltage	$I_{OH}=-4mA$ , Figure 9	$V_{IO}-0.4$	$V_{IO}-0.2$		V
		$I_{OH}=-20\mu A$ , Figure 9	$V_{IO}-0.1$			
$V_{OL}$	Low-level output voltage	$I_{OL}=4mA$ , Figure 9		0.2	0.4	V
		$I_{OL}=20\mu A$ , Figure 9		0	0.1	
$C_i$	Input capacitance to ground (CANH or CANL)	$V_{TXD}=5V$ , $V_i=0.4\sin(4E6\pi t)+2.5V$		13		pF
$C_{ID}$	Differential input capacitance	$V_{TXD}=5V$ , $V_i=0.4\sin(4E6\pi t)$		5		pF
$R_{ID}$	Differential input resistance	$V_{TXD}=5V$	19	30	52	$k\Omega$
$R_{IN}$	Input resistance (CANH or CANL)	$V_{TXD}=5V$	9	15	28	$k\Omega$
$R_{I(m)}$	Input resistance matching: $[1 - R_{IN(CANH)} / R_{IN(CANL)}] \times 100\%$	$V_{CANH}=V_{CANL}$	-1%	0%	1%	
ESD	HBM	CANH, CANL pin to GND			$\pm 15$	kV
		Other pins			$\pm 2$	kV
EFT	IEC61000-4-4 : Perf. Criteria B	CANH, CANL and GND			$\pm 2$	kV
Surge	IEC61000-4-5 : Perf. Criteria B	CANH, CANL and GND(Common Mode)			$\pm 2$	kV
Insulation characteristics	Isolation voltage				5000	VDC
	Insulation resistance		1			$G\Omega$
	Isolation capacitor			3		pF
CMTI	Common Mode Transient Immunity	$V_{TXD}=V_{CC}$ or $0V$ , $V_{CM}=1kV$ , transient magnitude = 800 V	25			kV/us

Parameters		Conditions	Min.	Nom.	Max.	Unit
$t_{onTXD}$	Propagation delay TXD On to bus active	$R_L = 60\ \Omega$ , $C_L = 100\ pF$ , see Figure 10 and Figure 12		80	150	ns
$t_{offTXD}$	Propagation delay TXD Off to bus inactive			80	200	ns
$t_{onRXD}$	Propagation delay RXD On to receiver active			60	300	ns
$t_{offRXD}$	Propagation delay RXD Off to receiver inactive			60	250	ns
$t_{TXD\_OTD}$	Dominant time-out time	$C_L=100\ pF$		2	5	ms

## Physical Specifications

Parameters	Value	Unit
Weight	0.9(Typ.)	g

## Typical Performance Curves

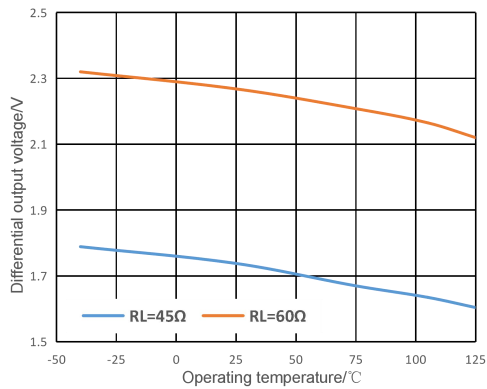


Figure 1. Drive differential output voltage dominant VS Temperature

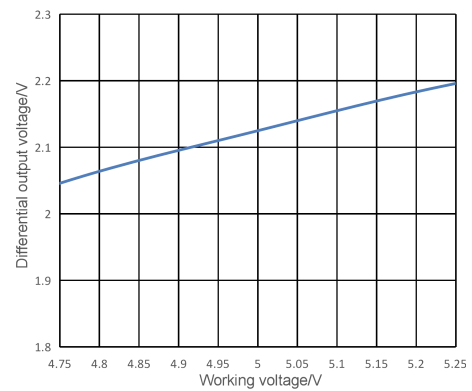


Figure 2. Drive differential output voltage dominant VS Working voltage

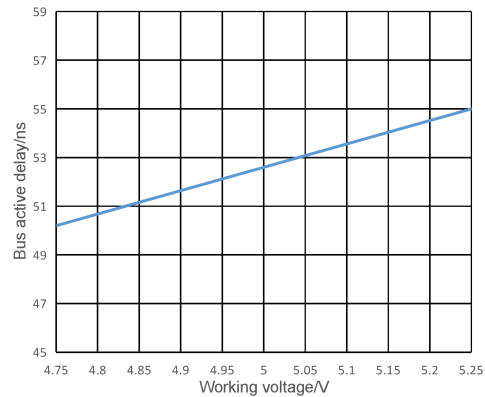


Figure 3. Propagation delay from TXD On to bus active VS Working voltage

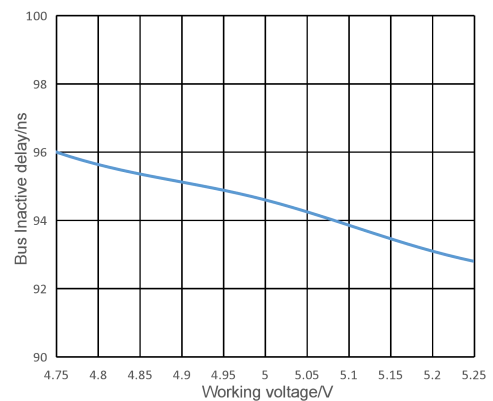


Figure 4. Propagation delay from TXD Off to bus inactive VS Working voltage

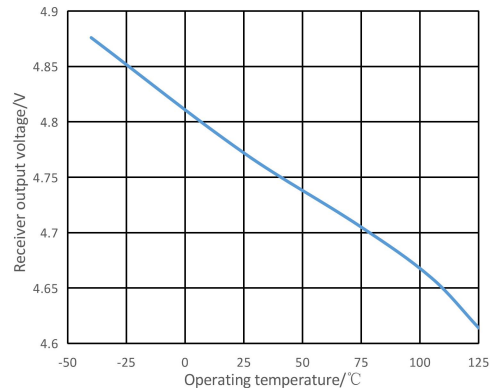


Figure 5. Propagation delay from TXD On to receiver active VS Temperature

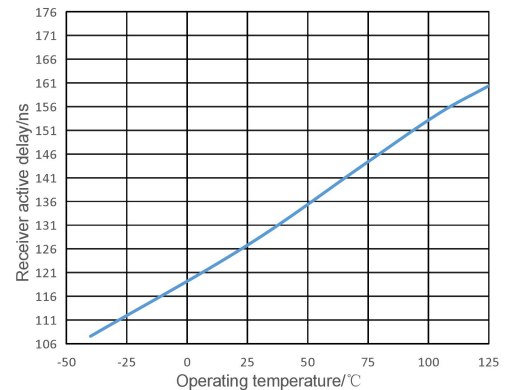


Figure 6. Receiver active delay VS Operating Temperature

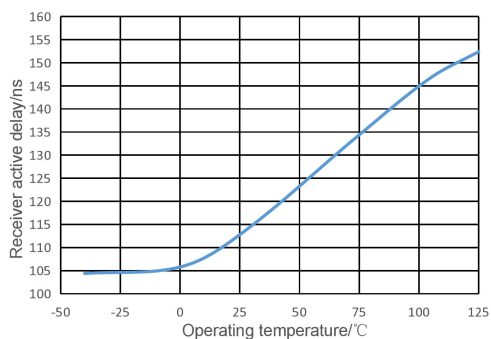


Figure 7. Receiver inactive delay VS Operating Temperature

## Test Circuits

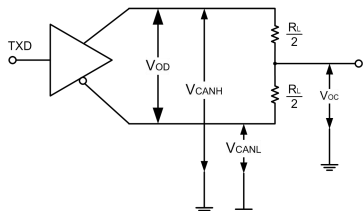


Figure 8. Driver test circuit

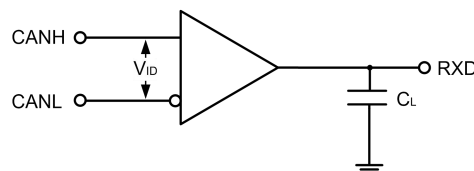


Figure 9. Receiver test circuit

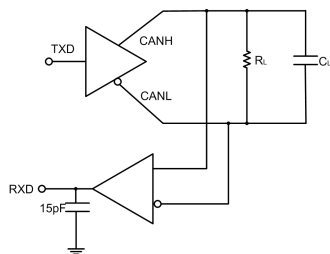


Figure 10. Switching characteristics test circuit

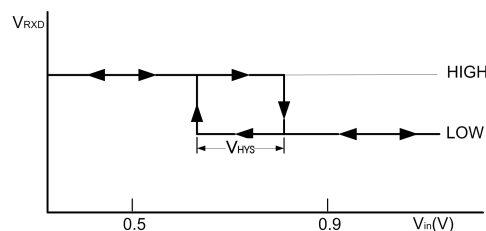


Figure 11. Receiver input hysteresis

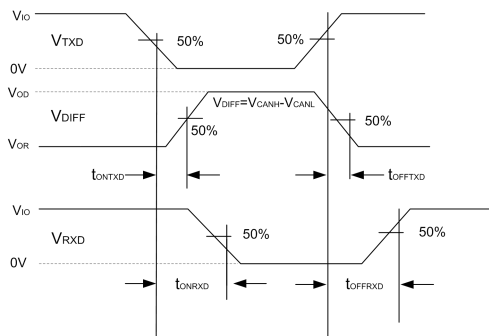


Figure 12. Drive and receiver propagation delay

## Detailed Description

TDH541SCANFD is a CAN of a style of separation transceiver with the ability of differential signal transmission between the bus and CAN protocol controller, it the inner integration insulate DC/DC power supply.which is compliant with ISO11898-2 standard.

**Short-circuit protection:** TDH541SCANFD 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:** TDH541SCANFD has over-temperature protection. When the junction temperature exceeds 160°C, 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:** TDH541SCANFD 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 ( $t_{TXD\_OTD}$ ), 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.

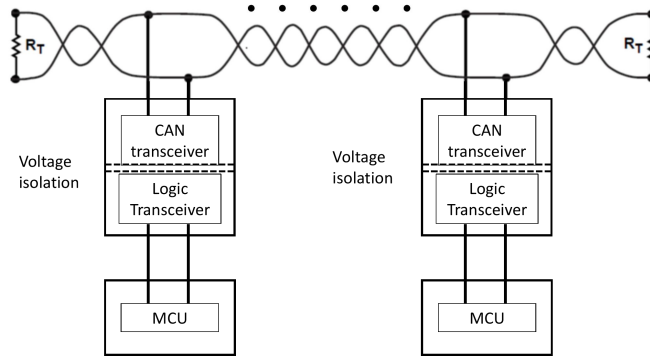


Figure13. Typical application circuit

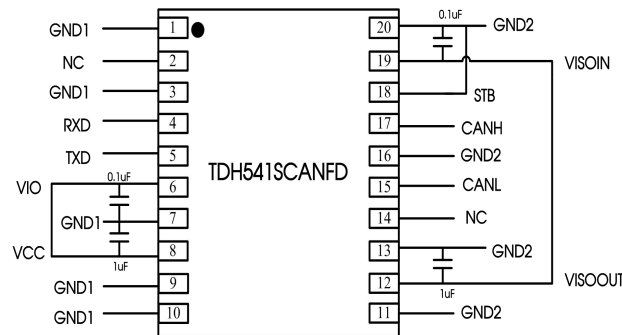


Figure14. Typical Application of PCB layout

In General,  $V_{CC}$  and  $V_{IO}$  can be shorted(Figure 14) if the controller doesn't support 5V signal input, it can power 3.3V for  $V_{IO}$ . When the module is in normal condition attach STB feet to GND<sub>2</sub>

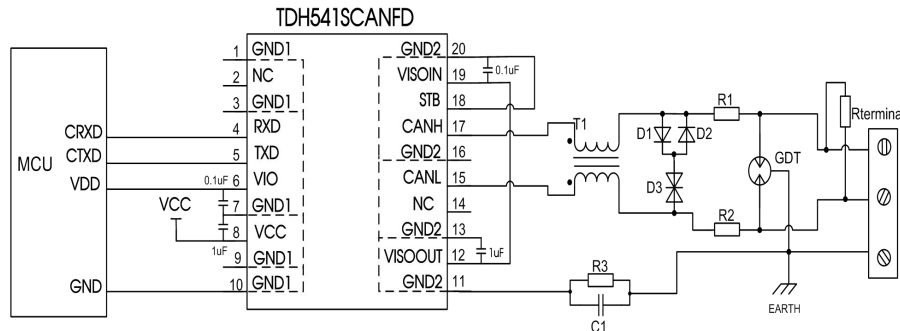


Figure15. Port protection circuit for harsh environments

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 <sub>terminal</sub>	120 Ω
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 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.



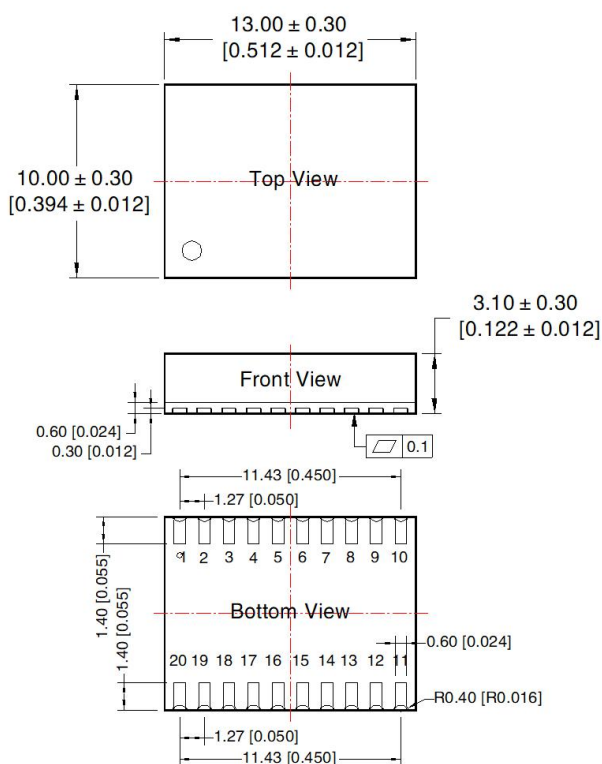
## Using Suggests

- ① Power isolation  $V_{ISOOUT}$  need through a series of capacitors connected to the output pin  $V_{ISOIN}$ , the power supply is not recommended for other purposes, otherwise it may cause the bus voltage did not meet the requirements of communication, causes the communication failure.
- ② Hot-swap is not supported.
- ③ If the external input of TXD is insufficient, the pull-up resistor should be added according to the situation.
- ④ 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

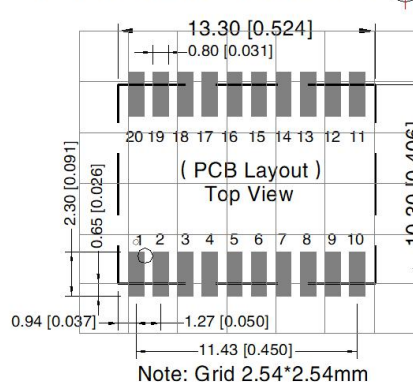
Part number	Package	Number of pins	Product marking	Tape & Reel
TDH541SCANFD	DFN	20	TDH541SCANFD	300/REEL

## Package Information



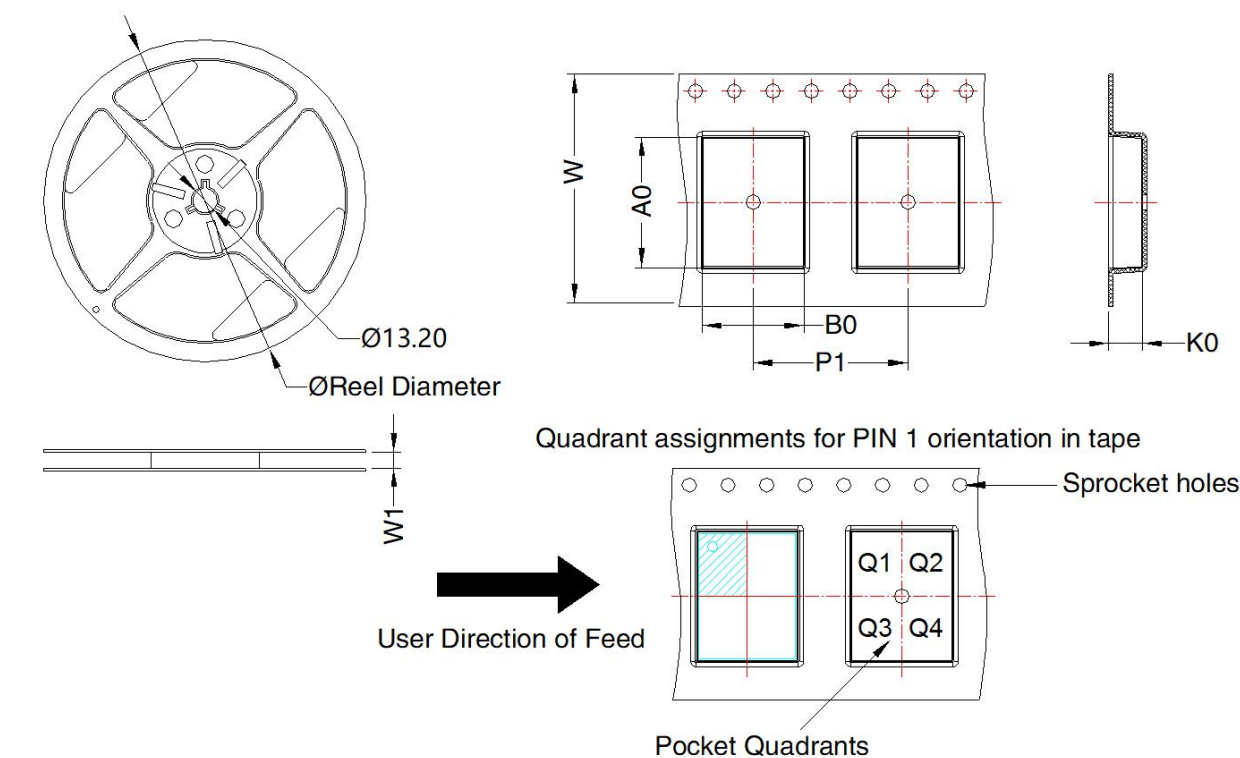
Note:  
 Unit: mm[inch]  
 Pin diameter tolerances:  $\pm 0.10$  [ $\pm 0.004$ ]

## THIRD ANGLE PROJECTION



Pin-Out			
Pin	Mark	Pin	Mark
1	GND <sub>1</sub>	11	GND <sub>2</sub>
2	NC	12	$V_{ISOOUT}$
3	GND <sub>1</sub>	13	GND <sub>2</sub>
4	RXD	14	NC
5	TXD	15	CANL
6	$V_{IO}$	16	GND <sub>2</sub>
7	GND <sub>1</sub>	17	CANH
8	$V_{CC}$	18	S
9	GND <sub>1</sub>	19	$V_{ISOIN}$
10	GND <sub>1</sub>	20	GND <sub>2</sub>





Device	Package Type	Pin	MPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TDH541SCANFD	DFN 10x13	20	300	180.0	24.4	13.52	10.52	3.5	16.0	24.0	Q1

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