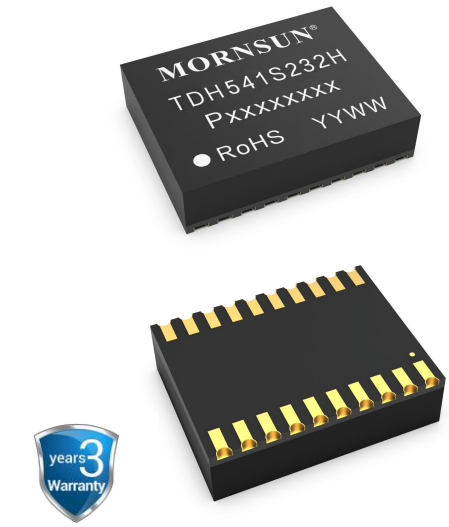
MORNSUN®

TDH541S232H
DFN package isolated RS232 Transceiver

Features

- Ultra-small, ultra-thin, chip scale DFN package
- Compliant with TIA/EIA-232 standard
- Integrated isolated 5V power
- I/O power supply range supports 3.3V and 5V microprocessors(RXD can be directly connected when using 5V microprocessor; When using 3.3V microprocessor, please refer to point ③ in "Suggestions for Power Supply".)
- High isolation to 5000VDC
- Bus-Pin ESD protection up to 15kV(HBM)
- Baud rate up to 120kbps
- >25kV/us CMTI
- Industrial operating ambient temperature range: -40℃ to +85℃
- Moisture Sensitivity Level (MSL) 3

Package



Applications

- Industrial Automation
- Building Automation
- Smart Electricity Meter

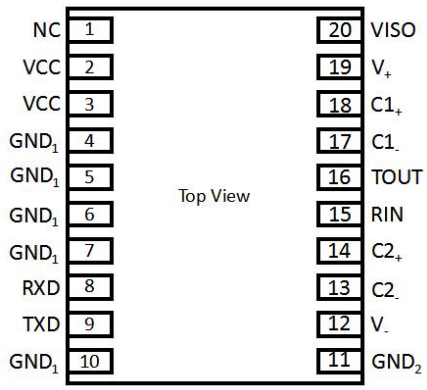
Functional Description

TDH541S232H is a RS232 transceiver with low power consumption and high electrostatic protection and ESD protection, and it is fully compliant with TIA/EIA-232 standards. The main function of the product will be to convert the TTL level to the level of the RS232 protocol to achieve signal isolation. And the product comes with a constant voltage isolation power supply, which can achieve 5000VDC electrical isolation, and can also be easily embedded in user equipment, so that the equipment can easily realize the connection function of the RS232 protocol network.

TDH541S232H focuses on strengthening the reliability design of TOUT and RIN pins and enhanced ESD design on the basis of traditional IC. Its TOUT and RIN port ESD tolerance is as high as 15kV (Human Body Model).

Contents

Pin Connection



Note：All GND1 pins are internally connected.
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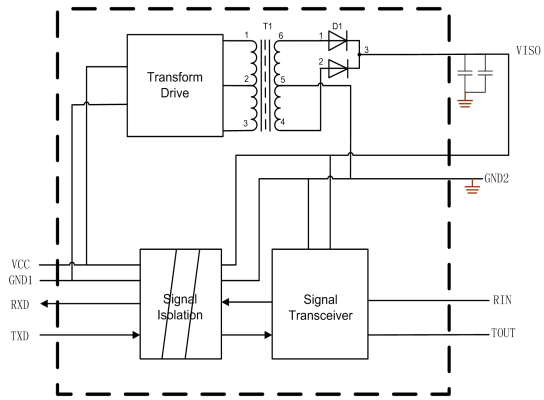
Internal Block



Function Table

Letter	Description
H	High-Level
L	Low-Level

Table 1. Driver Function table

Transceiver function	Input	Output
Send function	TXD	T_OUT
	L	H
	H	L

Table 2. Receiver Function table

Transceiver function	Input	Output
Receive function①	R_IN	RXD
	≥2.4V	L
	≤0.6V	H
	0.6V≤RXD≤2.4V	Uncertainty
Note：①The receiving threshold varies slightly with Vcc.		

Pin Descriptions

Pin Number	Pin Name	Pin Functions
1	NC	No function pin, can be left floating.
2	V_{CC}	Power supply. By using 0.1uF ceramic capacitance ground(GND_1).
3	V_{CC}	Power supply. By using 0.1uF ceramic capacitance ground(GND_1).
4	GND_1	Logic side reference ground.
5	GND_1	Logic side reference ground.
6	GND_1	Logic side reference ground.
7	GND_1	Logic side reference ground.
8	RXD	Receiver signal output pin.
9	TXD	Driver input pin.
10	GND_1	Logic side reference ground.
11	GND_2	Isolated output reference ground.
12	V-	Negative power generated internally,this pin is recommended to be connected to the isolated output reference ground(GND_2) through a 0.1uF capacitor.
13,14	C2-,C2+	The positive and negative connections of the charge pump capacitor. These two pins are connected to an external capacitor C2, 0.1uF capacitor is recommended.
15	RIN	Receiver input. This input accepts RS-232 signal level.
16	TOUT	Drive output. This pin outputs the RS-232 signal level.
17,18	C1-,C1+	The positive and negative connections of the charge pump capacitor. These two pins are connected to an external capacitor C1, and a 0.1uF capacitor is recommended.
19	V+	Positive power generated internally,this pin is recommended to be connected to the isolated output reference ground(GND_2) through a 0.1uF capacitor.
20	V_{ISO}	Isolated power output terminal, this pin must be connected to the isolated output reference ground(GND_2) through a 0.1uF capacitor.

Absolute Maximum Ratings

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

Parameters	Unit
Supply voltage	-0.3V to +6V
Driver input pin,TXD	-0.3V to +6V
Driver output pin,TOUT	-13.2V to +13.2V
Receiver input pin,RIN	-25V to +25V
Receiver output pin,RXD	-0.3V to +6V
Operating Temperature Range	-40°C to +105°C
Storage Temperature Range	−50°C to +150°C
Reflow Soldering Temperature	Peak temp. ≤250℃, 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 based on the reference ground(GND).

Recommended Operating Conditions

Symbol	Recommend an operate condition		Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		4.5	5	5.5	V
V_{IH}	High-level input voltage(TXD)		2		V_{CC}	
V_{IL}	Low-level input voltage(TXD)		0		0.8	
I_{OS}	Output current	Driver	2			mA
		Receiver			10	
R_L	Output load resistance			3000		Ω
T_A	Operating temperature range		-40		85	℃
-	Signaling rate				120	Kbps

Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Driver						
V_{TOUT}	Drive output high level	R_L=3kΩ to GND2	5	6.5		V
	Drive output low level	R_L=3kΩ to GND2		-6.5	-5	V
R_{TOUT}	Driver output impedance		300			Ω
I_{tsc}	Driver short circuit current				60	mA
R_{TXD}	Internal TXD Pull up Resistor			5.1		kΩ
Receiver						
V_{RIN}	Receiver input range		-25		25	V
V_{RIL}	Receiver input low threshold voltage		0.6	0.9		V
V_{RIH}	Receiver input high threshold voltage			1.5	2.4	V
	Receiver input hysteresis			0.4		V
R_{RIN}	Receiver input impedance		3	5	7	kΩ
V_{ROH}	RXD high level output voltage		Vcc − 0.4	Vcc − 0.1		V
V_{ROL}	RXD low level output voltage				0.4	V
Power supply and safeguard characteristic						
I_{CC}	Supply current			15	30	mA
I_{CC}	Working current	No load		20	45	mA
		R_L=3kΩ to GND2		20	45	mA
ESD	HBM	TOUT、RIN to GND2			±15	kV
		Other pin			±2	kV
	Contact	TOUT、RIN to GND2			±8	kV
EFT	IEC61000-4-4	TOUT、RIN to GND2			±2	kV
SURGE	IEC61000-4-5	TOUT、RIN to GND2			±2	kV
VI-O	Insulate voltage				5000	VDC
	Insulate impedance		1			GΩ
	Insulate capacitance			50		pF
CMTI	Common mode transient immunity	TXD = V_{CC} or 0 V, V_{CM} = 1 kV, transient magnitude = 800 V	25			kV/us

Note：ESD indicators are non-charged test specifications, GND2 need to be connected to the earth during testing.

Transmission Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
-	Maximum data rate	Duty 40% ~ 60%			120	kbps
T_{PHL}, T_{PLH}	Driver propagation delay	R_L = 3kΩ to 7kΩ , C_L = 50pF			2	us
T_{PHL}, T_{PLH}	Receiver propagation delay	C_L = 15pF			2	us

Physical Specifications

Parameters	Value	Unit
Weight	0.9(Typ.)	g

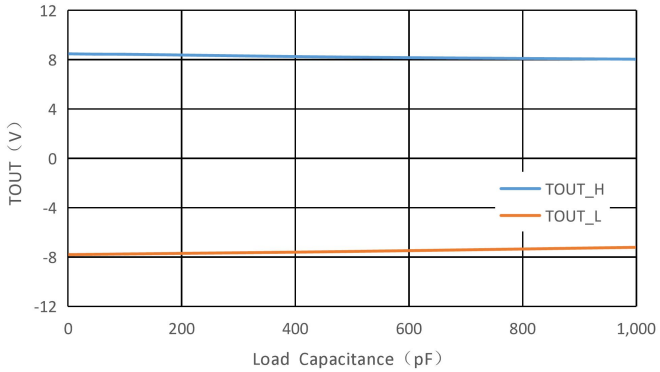


Figure 1. Transmitter Output Voltage High/Low VS Load Capacitance (120 kbps)

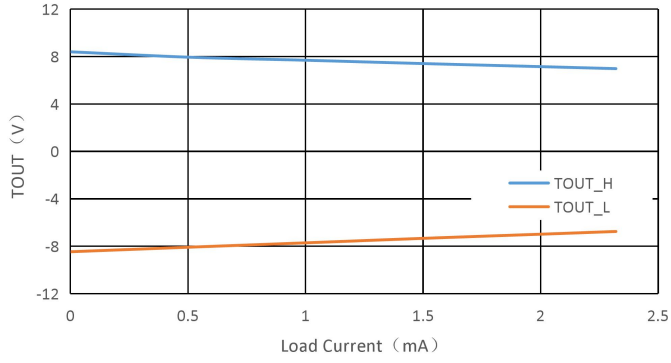


Figure 2. Transmitter Output Voltage High/Low VS Load Current

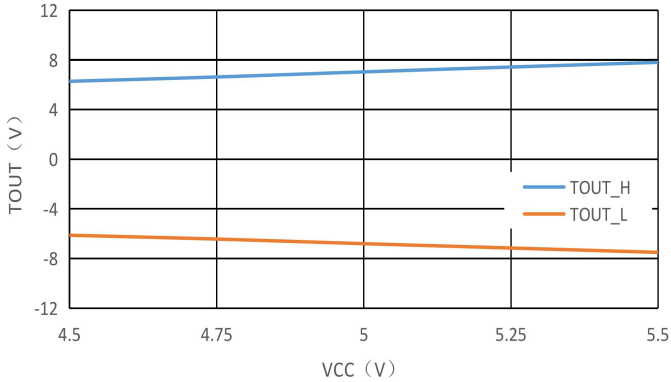


Figure 3. Transmitter Output Voltage High/Low VS VCC (R_L=3 kΩ)

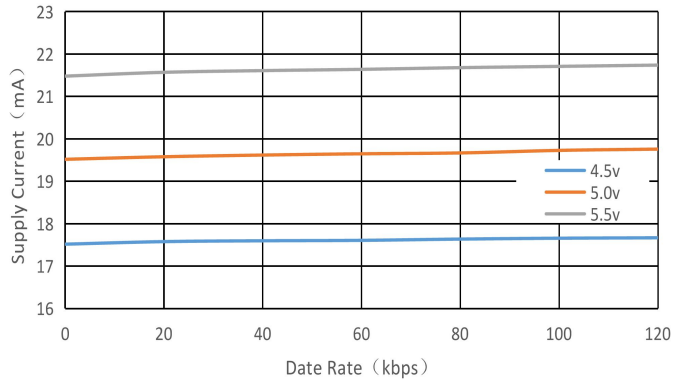


Figure 4. Supply current VS Data rate

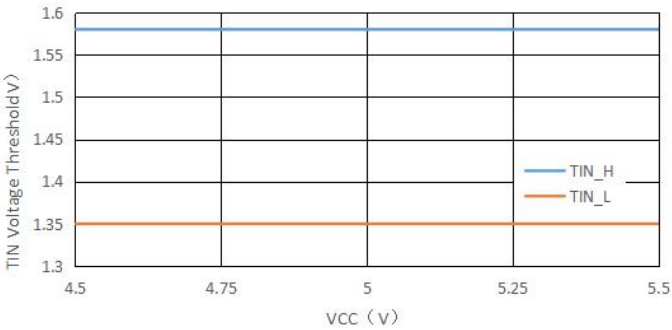


Figure 5. TIN Voltage Threshold VS VCC

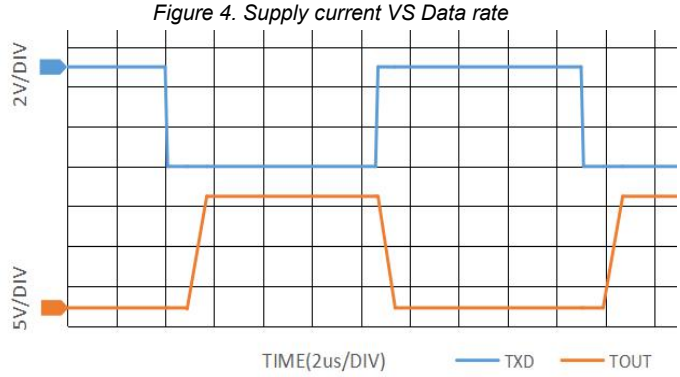


Figure 6. 120kbps Date Transmission(VCC=5V, R_L=3 kΩ)

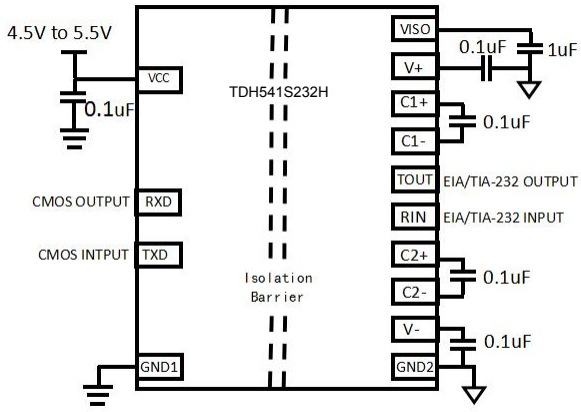


Figure7. The typical model applies telephone

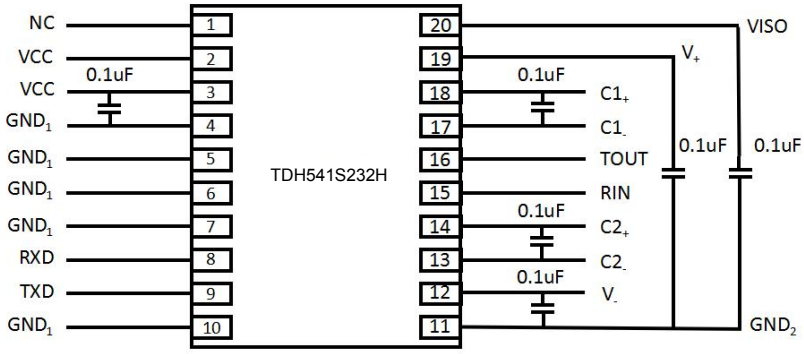


Figure8. Type PCB layout

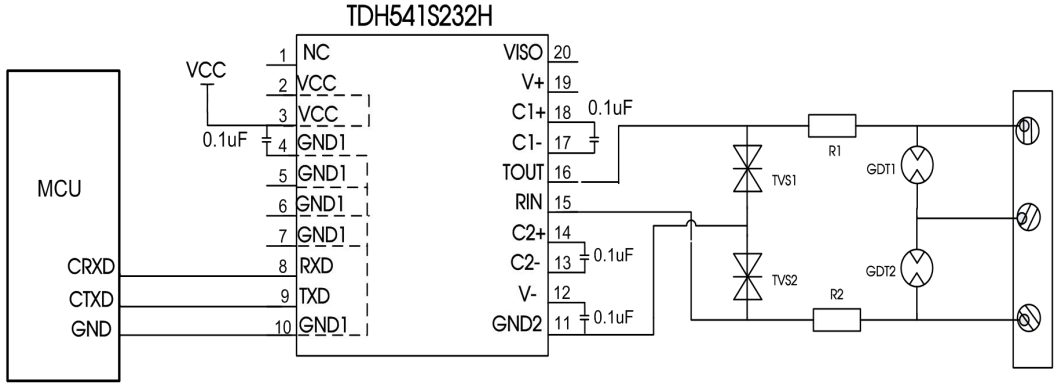


Figure9. Port protection circuit for harsh environments

Recommended components and values:

Components	TDH541S232H
TVS1, TVS2	SMCJ15CA
R1, R2	12Ω/2W(Wire-wound resistor)
GDT1, GDT2	S30-A90X

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 232 signal ports to protect the system from failure and maintain a reliable bus communication. Figure 9 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.

Recommendations

①The 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.

②Hot-swap is not supported.

③The output of TDH541S232H to RXD is only compatible with 5V system, if the I/O port is 3.3V level and does not support 5V input, please refer to the following recommended circuit：

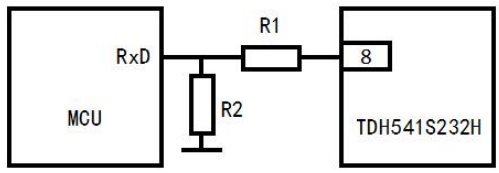


Figure10. Match MCU system connection

The calculation formula of resistance partial voltage of conventional step-down-circuit is

$$R1 = \frac{V_{out} - V_{in}}{V_{in}} R2$$

Where R1,R2 is piezoelectric resistance value of the connected part, Vout is TDH541S232H output voltage,Vin is MCU RXD input voltage.The commend value is R1=1kΩ, R2=2kΩ.

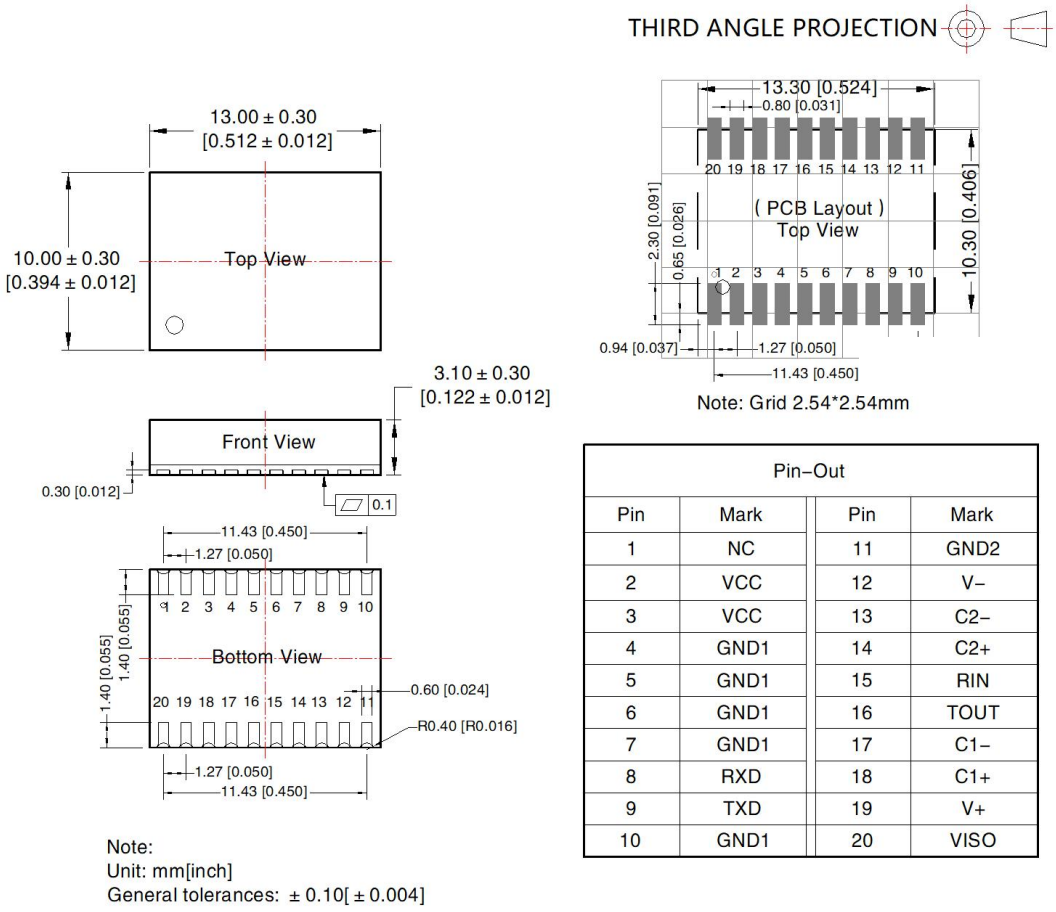
④If the external input of TXD is insufficient, the pull-up resistor should be added according to the situation.

⑤Refer 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
TDH541S232H	DFN	20	TDH541S232H	300/REEL

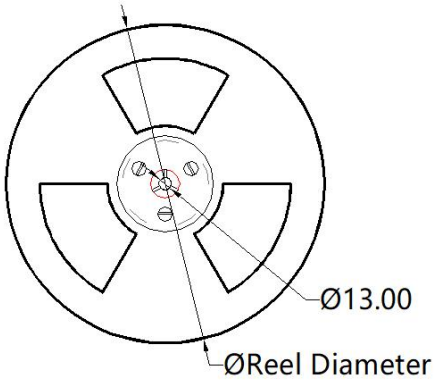
Package Information

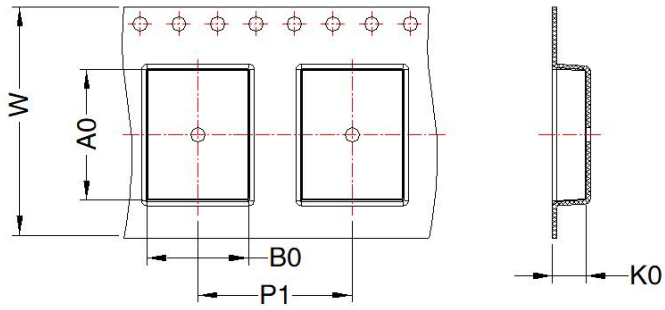


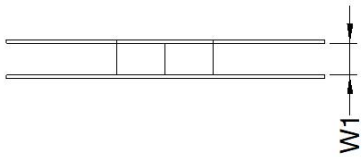
Note: Grid 2.54*2.54mm

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

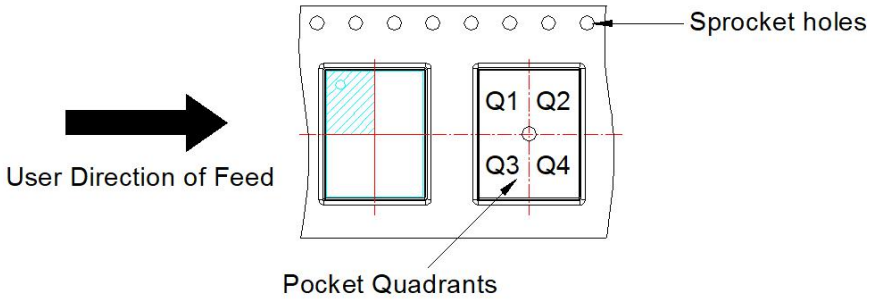
Pin-Out			
Pin	Mark	Pin	Mark
1	NC	11	GND2
2	VCC	12	V−
3	VCC	13	C2−
4	GND1	14	C2+
5	GND1	15	RIN
6	GND1	16	TOUT
7	GND1	17	C1−
8	RXD	18	C1+
9	TXD	19	V+
10	GND1	20	VISO







Quadrant assignments for PIN 1 orientation in tape



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)541S232H	DFN 10x13	20	1000	330.0	24.4	13.52	10.52	3.5	16.0	24.0	Q1

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