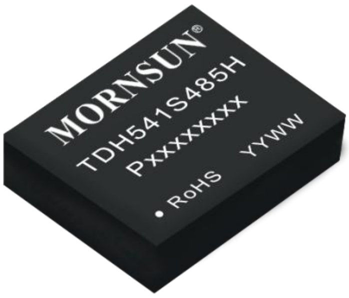
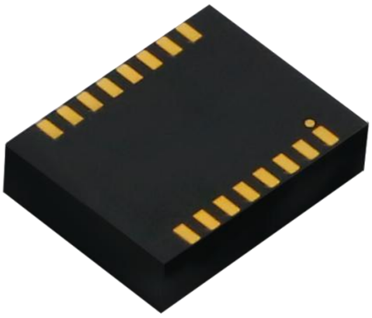
TD(H)541S485H
DFN package isolated RS485 Transceiver

Features

- Ultra-small, ultra-thin, chip scale DFN package
- Compliant with TIA/EIA-485A standard
- Integrated isolated 5V power
- I/O power supply range supports 3.3V and 5V microprocessors
- High isolation to 3000VDC (TDH541S485H 5000VDC)
- Bus-Pin ESD protection up to 15kV(HBM)
- Baud rate up to 1Mbps
- >25kV/us CMTI
- Low communication delay
- 1/8 unit load—up to 256 nodes on a bus
- Bus fail-safe
- Bus driver short circuit protection
- Industrial operating ambient temperature range: -40℃ to +105℃
- Meet AEC-Q100 standards
- EN62368 approval
- Moisture Sensitivity Level (MSL) 3

Package





Applications

- Industrial Automation
- Building Automation
- Smart Electricity Meter
- Remote Signal Interaction, Transmission

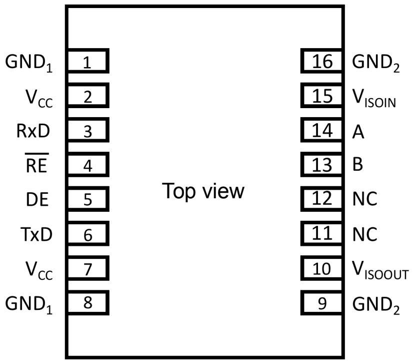
Functional Description

TD(H)541S485H is a half-duplex enhanced transceiver designed for RS–485 data bus networks, which is fully compliant with TIA/EIA-485A standard and is suitable for data transmission of up to 1 Mbps. Their logic side supports 3.3V and 5V logic level conversion. Receivers have an exceptionally high input impedance, which places only 1/8 of the standard load on a shared bus and up to 256 transceivers.

The reliability design of A and B pin is emphasized, including driver output over current protection and enhanced ESD design. The ESD protection level of A, B pin can be up to 15KV (Human Body Model).

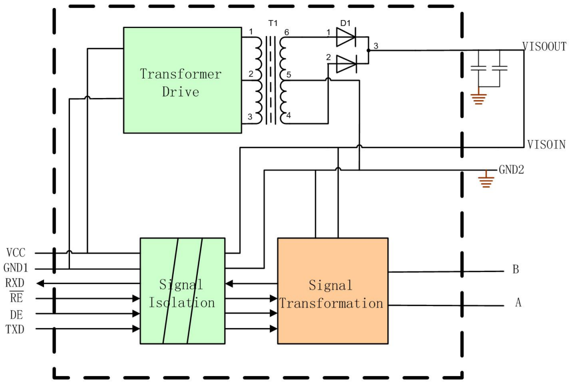
Contents

Pin Connection



Note：All GND1 pins are internally connected.
All GND2 pins are internally connected.

Internal Block



Function Table

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

Table 1. Driver Function table

TXD	DE	Output	
		A	B
H	H	H	L
L	H	L	H
X	L	Z	Z
OPEN	H	H	L

Table 2. Receiver Function table

Difference input $V_{ID} = (V_A - V_B)$	$\overline{RE}$	RXD
$-0.01\ V \leqslant V_{ID}$	L	H
$-0.2\ V < V_{ID} < -0.01\ V$	L	Uncertainty
$V_{ID} \leqslant -0.2\ V$	L	L
X	H	Z
Open circuit	L	H
Short circuit	L	H

Pin Descriptions

Pin Number	Pin Name	Pin Functions
1	GND$_1$	Ground(Logic side).
2	V$_{CC}$	Power supply. By using 0.1uF and 10nF ceramic capacitance ground(GND1).
3	RXD	Receiver output pin.
4	$\overline{RE}$	Receiver enable input. When $\overline{RE}$ is low, if (A − B) ≥ −10 mV, then RXD = high. if (A − B) ≤ −200 mV, then RXD = low.
5	DE	Driver enable input. When DE is high, outputs are enabled. When DE is low, outputs are high impedance. Drive DE low and $\overline{RE}$ high to enter shutdown mode.
6	TXD	Driver input pin.
7	Vcc	Power supply. By using 0.1uF and 10uF ceramic capacitance ground(GND1).
8	GND$_1$	Ground(Logic side).
9	GND$_2$	Ground (Bus Side).
10	V$_{ISOOUT}$	Insulation power output. By using 0.1uF and 10uF Ceramic capacitance ground(GND2, pin9).
11	NC	No Connect.
12	NC	No Connect.
13	B	RS485 Bus A Line.
14	A	RS485 Bus B Line.
15	V$_{ISOIN}$	Insulation power input. By using 0.1uF and 10nF ceramic capacitance ground(GND2, pin16).
16	GND$_2$	Ground (Bus Side).

Absolute Maximum Ratings

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

Parameters	Unit
Supply voltage	-0. 3V to +6V
Bus voltage	-8V to+13V
Digital Input Voltage (DE, $\overline{RE}$, TXD, RXD)	-0. 3V to+6V
Operating Temperature Range	40°C to +105°C
Storage Temperature Range	−50°C to +125°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.

Recommended Operating Conditions

Symbol	Recommend an operate condition		Min.	Typ.	Max.	Unit
V$_{CC}$	Supply voltage		4.75	5	5.25	V
V$_I$	Voltage at any bus terminal (differential or common mode)		-7		12	
V$_{IH}$	High-level input voltage(TXD, DE, $\overline{RE}$)		2		V$_{CC}$	
V$_{IL}$	Low-level input voltage(TXD, DE, $\overline{RE}$)		0		0.8	
I$_{OS}$	Output current	Driver	-60		60	mA
		Receiver	-8		8	
R$_{IN}$	Differential output load resistance		54	60		Ω
T$_A$	Operating temperature range		-40		105	℃
-	Signaling rate				1000	Kbps

Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Driver						
V_{OD}	Differential driver output	No load	3.5			V
		R_L=54Ω, Figure 7	1.5	2.0		V
		R_L=100Ω, Figure 7	2.0			
ΔV_{OD}	$\Delta\|V_{OD}\|$ for complementary output states	R_L=54Ω, Figure 7			±0.2	V
V_{OC}	Common-Mode output voltage	Figure 6	1		3	V
$\Delta V_{OC(SS)}$	$\Delta\|V_{OC}\|$ for complementary output states	Figure 6	-0.1		0.1	V
I_{OS}	Output short-circuit current	$-7V \le V_{OUT} \le 12V$		±110	±250	mA
Receiver						
$V_{IT(+)}$	Positive differential input threshold voltage	$-7\ V \le V_{CM} \le +12\ V$			–10	mV
$V_{IT(-)}$	Negative differential input threshold voltage	$-7\ V \le V_{CM} \le +12\ V$	–200			mV
V_{hys}	Hysteresis voltage ($V_{IT+} - V_{IT-}$)	$-7\ V \le V_{CM} \le +12\ V$		20		mV
R_{ID}	Differential input resistance(A, B)	$-7\ V \le V_{CM} \le +12\ V$	96			kΩ
I_I	Input current (A, B)	DE=0, $\overline{RE}$=0, V_{CC}=0 or 5.5V; V_{OUT}=12V		190	250	uA
		DE=0, $\overline{RE}$=0, V_{CC}=0 or 5.5V; V_{OUT}= -7V	-200	-110		uA
V_{OH}	RXD output high voltage	I_{OUT} = 20 μA, $V_A - V_B$ = 0.2 V	V_{CC} − 0.1			V
		I_{OUT} = 4 mA, $V_A - V_B$ = 0.2 V	V_{CC} − 0.4	V_{CC} − 0.2		V
V_{OL}	RXD output low voltage	I_{OUT} = −20 μA, $V_A - V_B$ = −0.2 V			0.1	V
		I_{OUT} = −4 mA, $V_A - V_B$ = −0.2 V			0.4	V
Power supply and safeguard characteristic						
I_{CC}	Supply current	DE=$\overline{RE}$=0V		15	30	mA
I_{CC}	Working current	Between A, B 100Ω load		60	80	mA
		Between A, B 54Ω load		75	105	mA
ESD	HBM	A, B to GND			±15	KV
		Other pin			±2	KV
	Contact	A, B to GND			±4	KV
EFT	IEC61000-4-4	A, B and GND			±2	KV
SURGE	IEC61000-4-5	A, B and GND(Common Mode)			±2	KV
VI-O	Insulate voltage	TD541S485H			3000	VDC
		TDH541S485H			5000	VDC
	Insulate impedance		1			GΩ
	Insulate capacitance			3		pF
CMTI	Common mode transient immunity	TXD = V_{CC} or 0 V, V_{CM} = 1 kV, transient magnitude = 800 V	25			kV/us

Transmission Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
-	Maximum data rate	Duty 40% ~ 60%			1000	Kbps
T_{PHL}, T_{PLH}	Driver propagation delay	R_L = 54Ω, C_L = 50pF, Figure 8		100	200	ns
$\|T_{PHL}$-$T_{PLH}\|$	Driver skew ($\|T_{PHL}$ - $T_{PLH}\|$)			30	100	ns
T_R, T_F	Driver rise/fall time		30	50	100	ns
T_{PHL}, T_{PLH}	Receiver propagation delay	C_L = 15pF Figure 9		50	150	ns
$\|T_{PHL}$-$T_{PLH}\|$	Receiver skew ($\|T_{PLH}$ - $T_{PHL}\|$)			15	50	ns
T_R, T_F	Receiver rise/fall time	C_L = 15pF Figure 9		15		ns

Physical Specifications

Parameters	Value	Unit
Weight	0.9(Typ.)	g

Typical Performance Curves

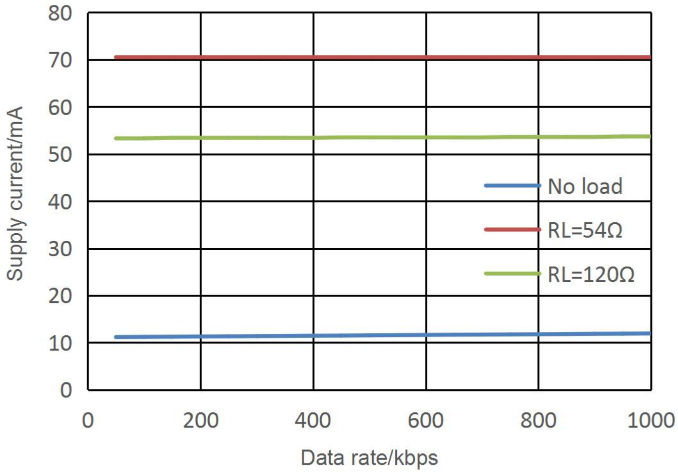


Figure 1 Supply current VS Data rate

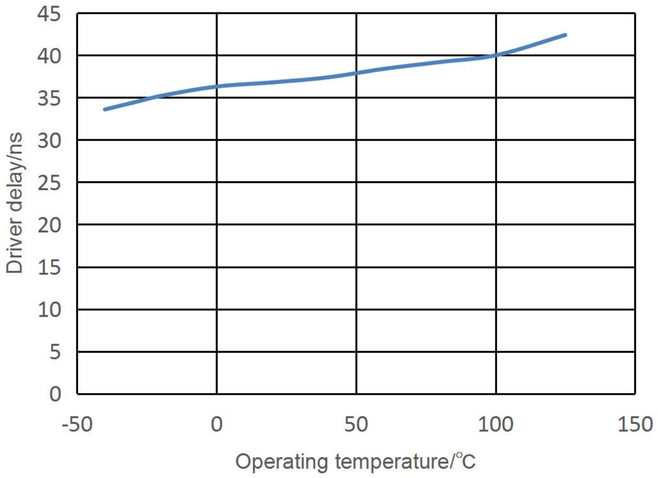


Figure 2 Driver delay VS Operating temperature

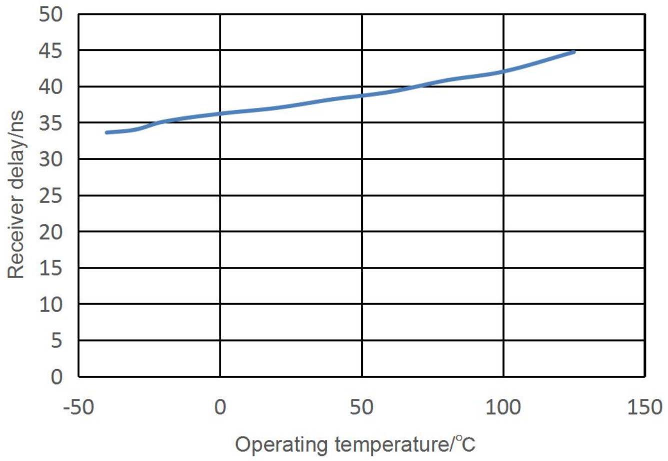


Figure 3 Receiver delay VS Operating temperature

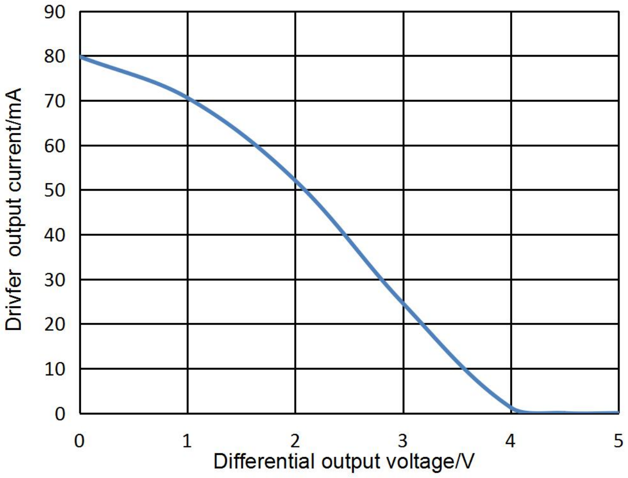


Figure 4 Driver output current vs. Differential output voltage

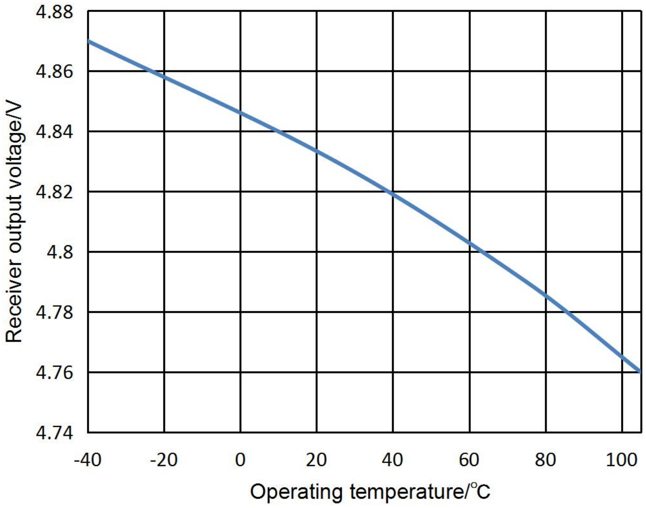


Figure 5 Receiver output high voltage VS Operating temperature

Test Circuits

Note:Testing the condition burden capacitance including test to stretch forward and testing fixture parasitic capacitance. Testing semaphore upswing and droop to follow < 6nS, frequency100KHz, duty50%. resistance ZO = 54Ω.

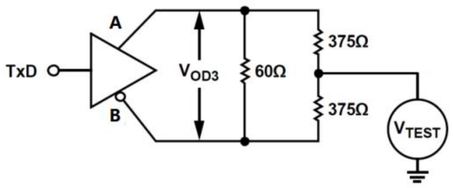


Figure 6 Driver test circuit, VOD with common-mode loading

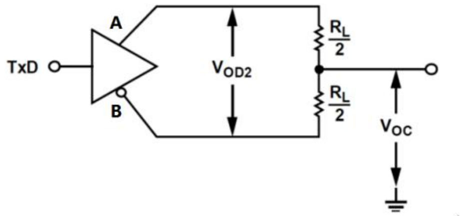


Figure 7 Driver test circuit

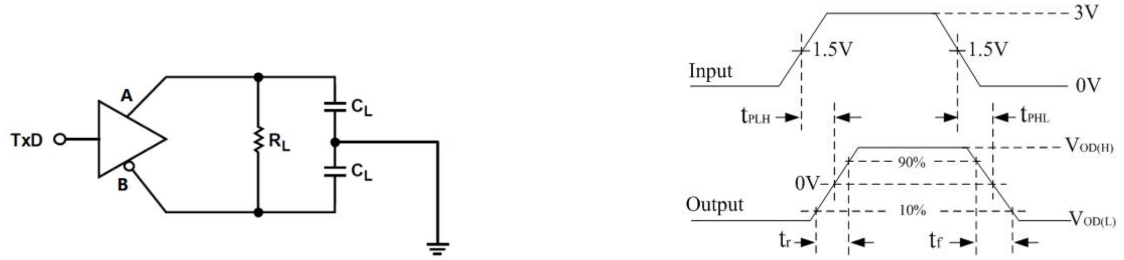


Figure 8 Drive propagation delay test circuit and wave forms

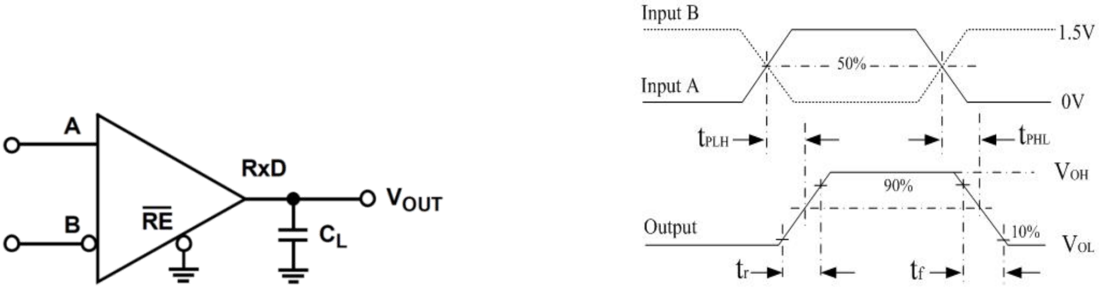


Figure 9 Receiver propagation delay test circuit and wave forms

Detailed Description

TD(H)541S485H is a semi-duplex enhanced RS485 isolated transceiver with isolated power supply. In addition to an isolated power supply, each transceiver contains a drive and a receiver. The transceiver has a standby bus failure protection function to ensure that the receiver output is high when the receiver input is open, short, or when the bus is idle. TD(H)541S485H adopts 5VDC single power supply. The whole machine can monitor the overall working state of the module and limit the output high current, so as to prevent the bus overload or short circuit from causing non-recoverable damage to the transceiver.

Receiver input filter: TD(H)541S485H receiver integrated high performance input filter, the filter can greatly enhance the receiver's noise suppression ability to high speed differential signal. Therefore, the transmission delay of the receiver is also caused by this reason.

Bus failure protection: In general, when -200mV < A - B < -10mV, the bus receiver will be in an indeterminate state.This phenomenon occurs when the bus is idle. Bus failure protection ensures that the receiver outputs a high level when the receiver input is open, short, or when the bus access port matches the resistance. TD(H)541S485H receiver threshold voltage is relatively accurate, and the threshold voltage to the reference ground has a margin of at least 10mV, which can ensure that even if the bus differential voltage is 0V, the receiver output level is high, and meets the requirements of EIA/TIA-485 standard ±200mV.

The bus load capacity (256 point) : standard RS485 receiver input impedance is defined as 12 kΩ (unit load). A standard RS485 driver can drive at least 32 load units. TD(H)541S485H bus receiver designed by 1/8 unit load, the input impedance is greater than 96 kΩ. As a result, the bus allows access to more transceivers (up to 256). TD(H)541S485H can also be mixed with the standard RS485 transceiver with 32 unit loads (cumulative receiver load cannot exceed 32 units).

Low power SHUTDOWN mode: When high level is input and low power is input, the transceiver enters SHUTDOWN mode. When the transceiver enters off mode, its overall standby power consumption decreases, DE can be short-connected and controlled by the same I/O. If the high level is input and the holding time of DE low level is less than 50ns, the transceiver cannot enter the off mode. If the holding time can be maintained at least 600ns, the transceiver will reliably enter the off mode.

Drive output protection: TD(H)541S485H internal integrated drive short circuit (or overcurrent) protection module. In case of bus error or driver short circuit, the module can limit the output current of the driver within a certain limit.

Application Circuit

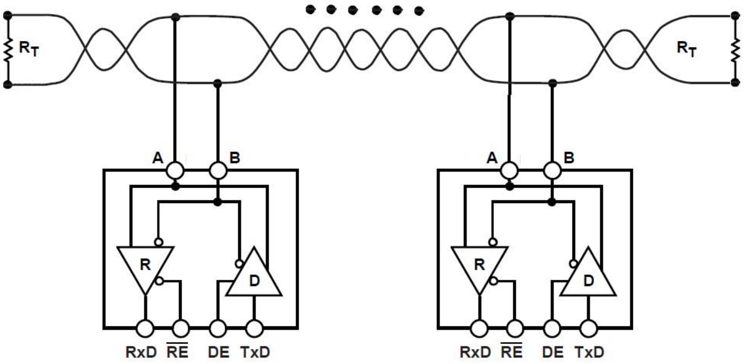


Figure10 The typical model applies telephone

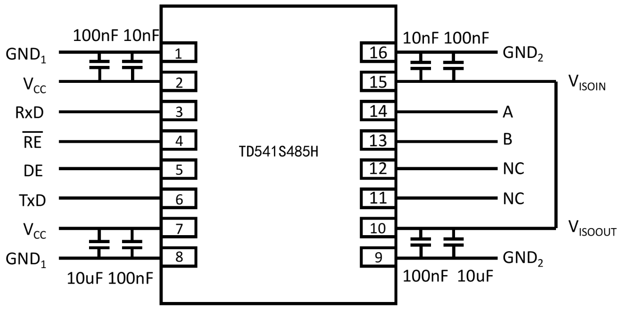


Figure11 Type PCB layout

Using Suggests

① Power isolation V_{ISOOUT} need through a series of capacitors connected to the output pin V_{ISOIN}, in addition to the mentioned in article 4 of the pull up and down function, 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 DE and $\overline{RE}$ pin do not support dangling. If the pin is not access controller, the recommended by 30 kΩ pulldown resistor pins connect to GND. Keep the node in the receiving state only, not affect the bus.

③ DE, $\overline{RE}$, TXD pin is always not allow to set to open drain output state connect the controller, otherwise it will lead to uncertain consequences.

④ To maintain A - B bus idle stability, we need at least one node will pull up A to V_{ISOIN} and drop down B to GND2 on the bus. Overall network at the same time pull up and drop down resistance of the parallel value must around 400Ω(0.2W).

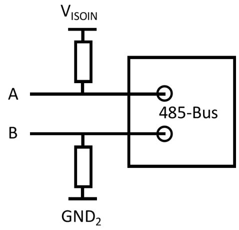


Figure12 Pull up and drop down resistance connect

⑤ The output of TD(H)541S485H 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 :

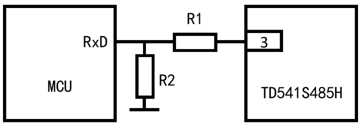


Figure13 Match MCU system connection

$$R1=\frac{5.27}{3.1\times(I_L+3.1/R2)}\times R2$$

R1, R2 are resistance value, I_L is system RxDor other current load. When R2 is 800Ω, the table of R1value are recommended:

I_L/mA	0	1	2	3	4	5	6	7	8
R1/Ω	439	349	289	247	216	192	172	156	143

If it is only used for communication (no other wiring such as LED), IL defaults to 0.

⑥ Hot-swap is not supported.

⑦ If the external input of TXD is insufficient, the pull-up resistor should be added according to the situation.

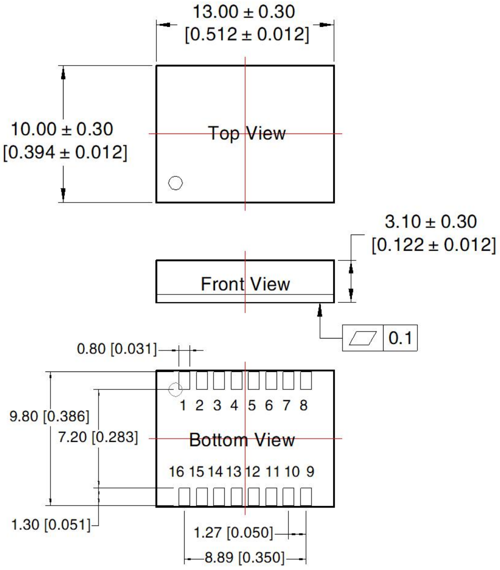
⑧ The welding specs for this product meets standard *IPC 7093*. Refer to *DFN package product hot air gun welding operation guide* or *DFN package product welding operation guide for details*.

Ordering Information

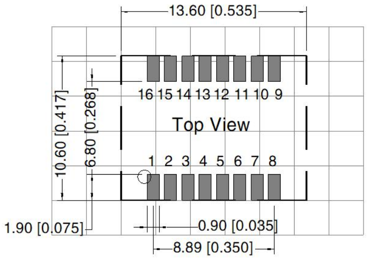
Part number	Package	Number of pins	Product marking	Tape & Reel
TD541S485H	DFN	16	TD541S485H	1K/REEL
TDH541S485H	DFN	16	TDH541S485H	1K/REEL

Package Information

THIRD ANGLE PROJECTION



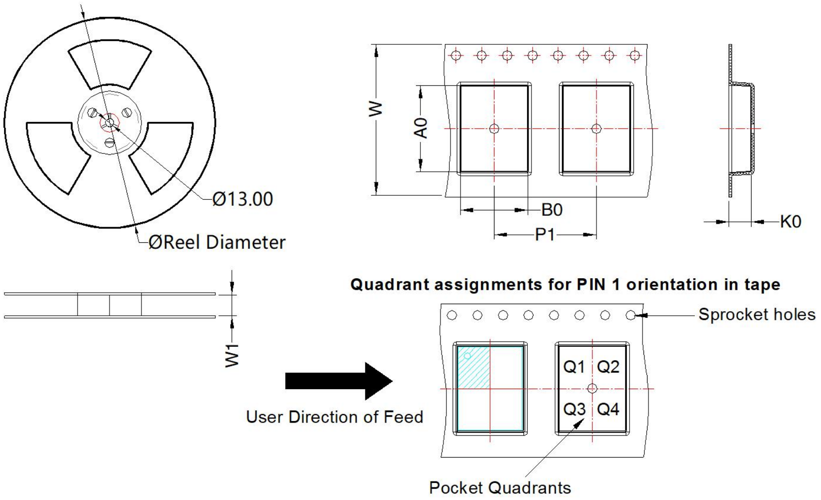
Note:
Unit :mm[inch]
Pin diameter tolerances : ± 0.10[± 0.004]



Note: Grid 2.54*2.54mm

Pin-Out			
Pin	Function	Pin	Function
1	GND1	9	GND2
2	VCC	10	VISOOUT
3	RXD	11	NC
4	RE	12	NC
5	DE	13	B
6	TXD	14	A
7	VCC	15	VISOIN
8	GND1	16	GND2

Tape & Reel Information



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)541S485H	DFN 10x13	16	1000	330.0	24.4	13.52	10.52	3.5	16.0	24.0	Q1
TD(H)541SCANH		20									
TD(H)541SCANFD											

Note: The product will be available after July 30th .

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