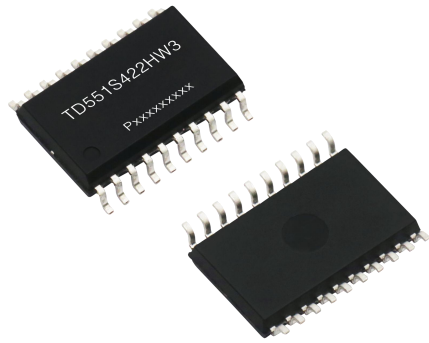
MORNSUN®

TD551S422HW3
SOIC20 package isolated RS485 Full Duplex Transceiver

Features

- Ultra-small, ultra-thin, chip scale SOIC20 package
- Compliant with TIA/EIA-485-A standard
- Power supply 5.0V
- Integrated efficient isolation power supply with overload and short circuit protection
- I/O power supply range supports 5V microprocessors
- High isolation to 5000Vrms
- Bus-Pin ESD protection up to 15kV(HBM)/±4kV(Contact discharge)
- Baud rate up to 20Mbps
- High common mode transient immunity 180kV/μs (typical value)
- Nanosecond level 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 +125℃

Package



Applications

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

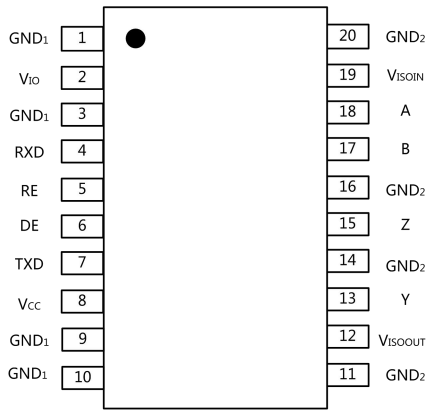
Functional Description

TD551S422HW3 is a full-duplex enhanced transceiver designed for RS-485/RS-422 data bus networks, has high electromagnetic immunity and low radiation characteristics which is fully compliant with TIA/EIA-485-A standard and is suitable for data transmission of up to 20Mbps. 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.

TD551S422HW3 device has high insulation capacity, which helps to prevent noise and surges on the data bus or other circuits from entering the local grounding terminal, thereby interfering or damaging sensitive circuits. High CMTI capability can ensure the correct transmission of digital signals. On the basis of traditional IC, the focus is on strengthening the reliability design of A, B, Y and Z pins, including driver overcurrent protection and enhanced ESD design. The A, B, Y and Z ports can withstand ESD up to ±15kV (HBM) and ±4kV (contact discharge).

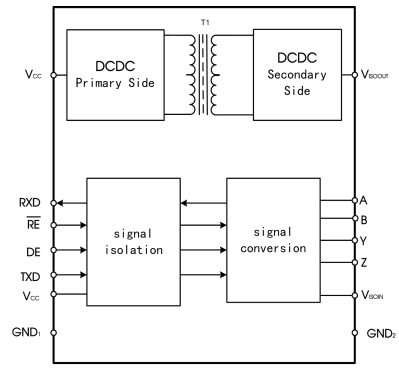
Contents

Pin Connection



Note：All GND_1 Pin are internally connected;
Pin11&14 and Pin16&20 GND_2 are not 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	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

Table 2. Receiver Function table

Difference input $V_{ID} = (V_A - V_B)$	$\overline{RE}$	RXD
–0.02 V ≤ V_{ID}	L	H
–0.22 V < V_{ID} < –0.02V	L	Uncertainty
V_{ID} ≤ –0.22 V	L	L
X	H	Z
Open circuit	L	H

Note:

① When driving status, the DE and $\overline{RE}$ pins are connected to a high level;

② When receiving status, the DE and $\overline{RE}$ pins are connected to a low level.

Pin Descriptions

Pin Number	Pin Name	Pin Functions
1	GND_1	Logic side reference ground.
2	V_{CC}	Power supply. By using 0.1uF and 10uF ceramic capacitance ground (GND_1).
3	GND_1	Logic side reference ground.
4	RXD	Receiver Output Data.
5	$\overline{RE}$	Receiver enable input. When $\overline{RE}$ is low, if (A − B) ≥ −20 mV, then RXD = high. if (A − B) ≤ −220 mV, then RXD = low.
6	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.
7	TXD	Driver Input.
8	V_{CC}	Power supply. By using 0.1uF and 10uF ceramic capacitance ground (GND_1).
9	GND_1	Logic side reference ground.
10	GND_1	Logic side reference ground.
11	GND_2	Bus side reference ground.
12	V_{ISOOUT}	Isolate the power supply V_{ISO} output pin. Close to this pin, 0.1uF and 10uF ceramic capacitors must be connected to the bus side reference ground (GND_2).
13	Y	RS422 Bus Y wire pin.
14	GND_2	Bus side reference ground.
15	Z	RS422 Bus Z wire pin.
16	GND_2	Bus side reference ground. The pin needs to be connected to pin14 in application.
17	B	RS422 Bus B wire pin.
18	A	RS422 Bus A wire pin.
19	V_{ISOIN}	Isolate the power output. Close to this pin, 0.1uF and 10uF ceramic capacitors must be connected to the bus side reference ground (GND_2).
20	GND_2	Bus side reference ground. The pin needs to be connected to pin14 in application.

Absolute Maximum Ratings

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

Parameters	Unit
Supply voltage, V_{CC}	-0.5V to +6V
Output voltage, V_{in}	-0.5V to V_{CC}+0.5V
Output current I_O	-10mA to +10mA
Junction temperature T_J	< 150℃
Operating temperature range	-40°C to +125°C
Storage temperature range	−65°C to +150°C

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	Recommended Operating Condition	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_I	A, B, Y, Z pin voltage	-7	--	12	
V_{ID}	A, B, Y, Z differential input voltage	-12	--	12	
V_{IH}	High-level input voltage	2	--	--	
V_{IL}	Low-level input voltage	--	--	0.8	
T_A	Operating temperature range	-40	25	125	℃
DR	Signaling rate	--	--	20	Mbps

Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Driver						
$\|V_{OD}\|$	Common mode output voltage	No load	4.5	--	5.2	V
		RL=60 Ω	1	--	3	
$\|V_{OD3}\|$	Absolute value of differential output voltage	No load	4.5	--	5.43	V
		RL=60 Ω	1.5	--	3	
ΔV_{OD}	$\Delta\|V_{OD}\|$ for complementary output states	No load , Figure 11	-0.2	--	0.2	V
V_{IH}	High level output voltage	TXD, DE, $\overline{RE}$	2	5	5.5	V
V_{IL}	Low level output voltage	TXD, DE, $\overline{RE}$	0	--	0.8	V
I_A	Driver short-circuit current	--	--	±100	±200	mA
I_B		--	--	±100	±200	
CMTI	Common mode transient immunity	V_{CM} = 1200V; Figure 16	--	180	-	kV/μs
Receiver						
$V_{IT(+)}$	Positive differential input threshold voltage	−7 V ≤ V_{CM} ≤ +12 V	--	--	-20	mV
$V_{IT(-)}$	Negative differential input threshold voltage	−7 V ≤ V_{CM} ≤ +12 V	-220	--	--	mV
V_{hys}	Hysteresis voltage (V_{IT+} – V_{IT-})	−7 V ≤ V_{CM} ≤ +12 V	--	30	--	mV
V_{OH}	RXD high level output voltage	--	Vcc − 0.4	4.8	--	V
V_{OL}	RXD low level output voltage	--	0	0.2	0.4	V
I_A	Receiver output current	--	--	±100	±200	mA
I_B		--	--	±100	±200	
I_{IH}	Input high-level leakage current RE	V_{IH}=2V	--	--	20	uA
I_{IL}	Input low-level leakage current RE	V_{IH}=0.8V	-20	--	--	
R_{ID}	Differential input resistance(A, B)	−7 V ≤ V_{CM} ≤ +12 V	96	--	--	kΩ
Power supply and safeguard characteristic						
V_{ISO}	Isolated power output voltage	VCC=5V, distribution unloaded, signal fully loaded	4.75	5.06	5.30	V
ESD	HBM Mode	Z, Y, A, B ports	--	--	±15	kV
	Contact discharge mode	Z, Y, A, B ports	--	--	±4	kV
V_{IO}	Insulate voltage	V_{TEST}=V_{IO},t=60s V_{TEST}=1.2xV_{IO},t=1s(100%production test)	--	--	5000	VAC
R_{IO}	Insulate impedance		1	--	--	GΩ

Transmission Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
-	Data rate	Duty 40% ~ 60%	--	--	20	Mbps
T_{PHL},T_{PLH}	Driver propagation delay	R_L=60Ω C_{L1}=C_{L2}=50pF Figure12 Figure15	--	50	90	ns
$\|T_{PHL}$-$T_{PLH}\|$	Driver skew ($\|T_{PHL}$ - $T_{PLH}\|$)		--	--	25	ns
T_R,T_F	Driver rise/fall time		--	6	25	ns
t_{PZH}/ t_{PZL}	Drive off enable propagation delay		--	--	80	ns
t_{PHZ}/ t_{PLZ}	Drive Enable Propagation Delay		--	50	80	ns
T_{PHL},T_{PLH}	Receiver propagation delay	R_L=60Ω C_L = 15pF , Figure13	--	70	110	ns
$\|T_{PHL}$-$T_{PLH}\|$	Receiver propagation delay		--	--	25	ns
T_R,T_F	Receiver rise/fall time	R_L=60Ω C_{L1}=C_{L2}=50pF Figure13 Figure14	--	2	10	ns
t_{PLH}	Receive off enable propagation delay, Output low-level to high-level time		--	--	80	ns
t_{PHL}	Receive enable propagation delay time, Output high-level to low-level time		--	--	80	ns

Physical Specifications

Parameters	Value	Unit
Weight	0.6(Typ.)	g

Parameter testing circuit

Note: Test condition load capacitance includes test probe and fixture parasitic capacitance (no special instructions). The rising and falling edges of the test < 6ns. frequency 100kHz. duty50%. resistance Z_O = 54Ω.

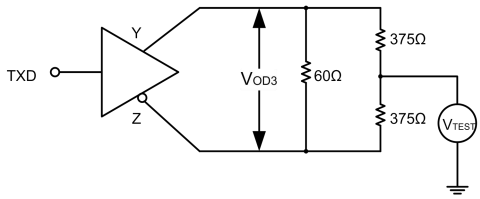


Figure 10.Common mode output test circuit

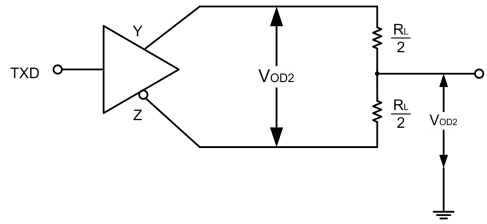
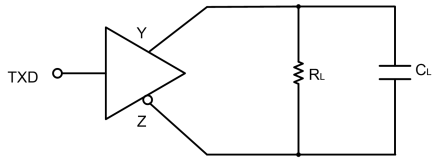


Figure 11. Differential output test circuit



Note: CL includes parasitic capacitance of fixtures and instruments

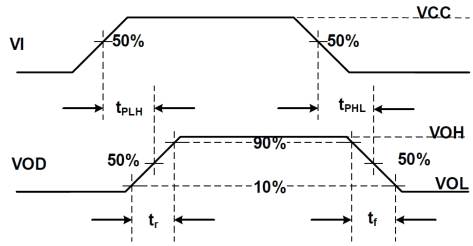
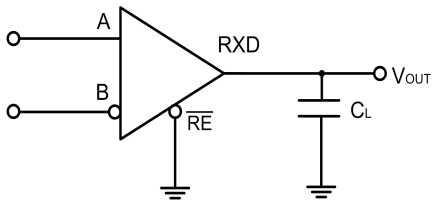


Figure 12. Drive propagation delay test circuit and wave forms



Note: CL includes parasitic capacitance of fixtures and instruments

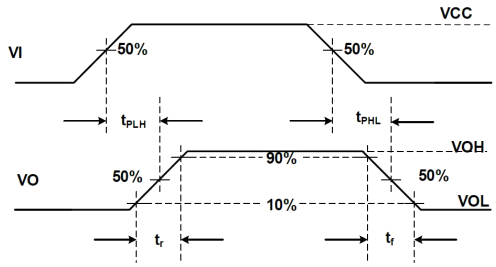
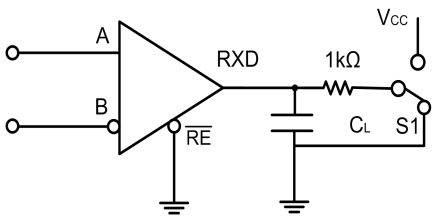


Figure 13. Receiver propagation delay test circuit and wave forms



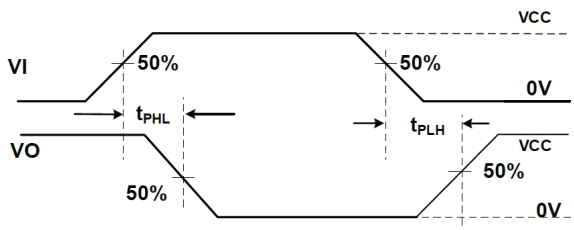
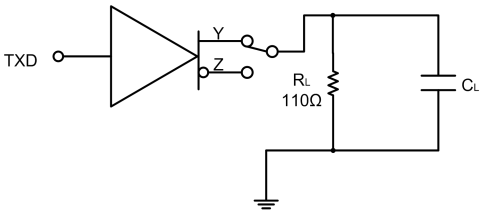
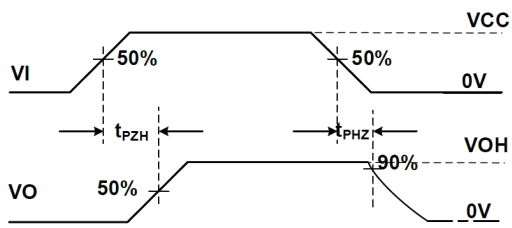
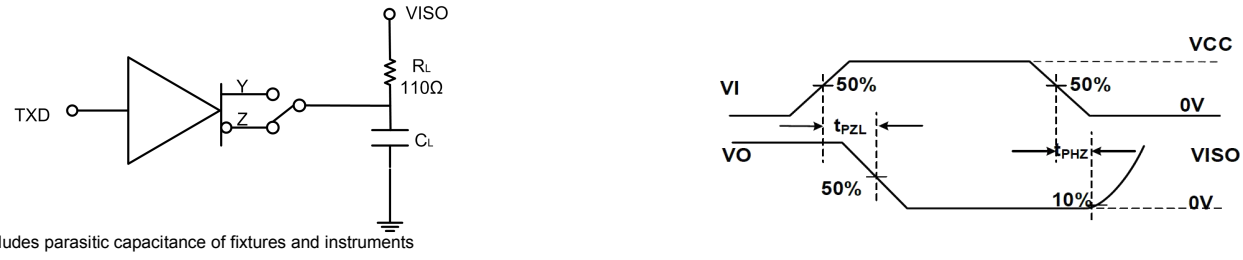


Figure 14. Receiving on/off time test circuit







Note: CL includes parasitic capacitance of fixtures and instruments

Figure 15. Driver On/Off Time Test Circuit

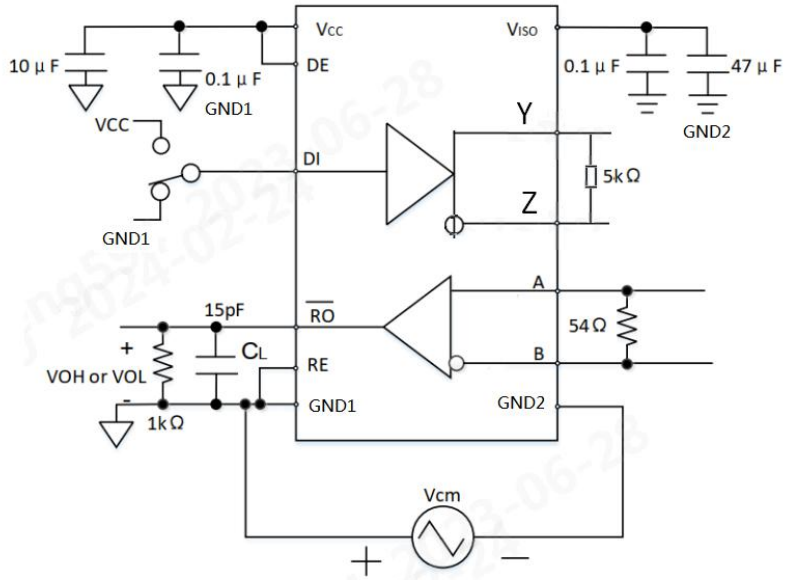


Figure 16. CMTI Test Circuit

Detailed Description

TD551S422HW3 is a full-duplex enhanced RS-485/RS-422 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.equipped with failure safety, overcurrent protection, and overheating protection functions.

Bus failure protection: When the receiver input is short circuited or open, and all drivers hanging on the terminal matching transmission line are disabled (idle), the TD551S422HW3 product can ensure that the receiver output logic is high. This is achieved by setting the input threshold of the receiver to -220mV and -20mV, respectively. If the input voltage (A-B) of the differential receiver is ≥ -20mV, RO is the logic high level; If the voltage (A-B) is ≤ -220mV, RO is the logic low level. When all transmitters connected to the terminal matching bus are disabled, the differential input voltage of the receiver will be pulled to 0V through the terminal resistor. Based on the receiver threshold, a logic high level with a minimum noise tolerance of -20mV can be achieved. The threshold voltage from 220mV to -20mV is in accordance with EIA/TIA-485 standards.

The bus load capacity (256 point): standard RS485 receiver input impedance is defined as 12kΩ (unit load). A standard RS485 driver can drive at least 32 load units. TD551S422HW3 bus receiver designed by 1/8 unit load, the input impedance is greater than 96kΩ. As a result, the bus allows access to more transceivers (up to 256). TD551S422HW3 can also be mixed with the standard RS485 transceiver with 32 unit loads (cumulative receiver load cannot exceed 32 units).

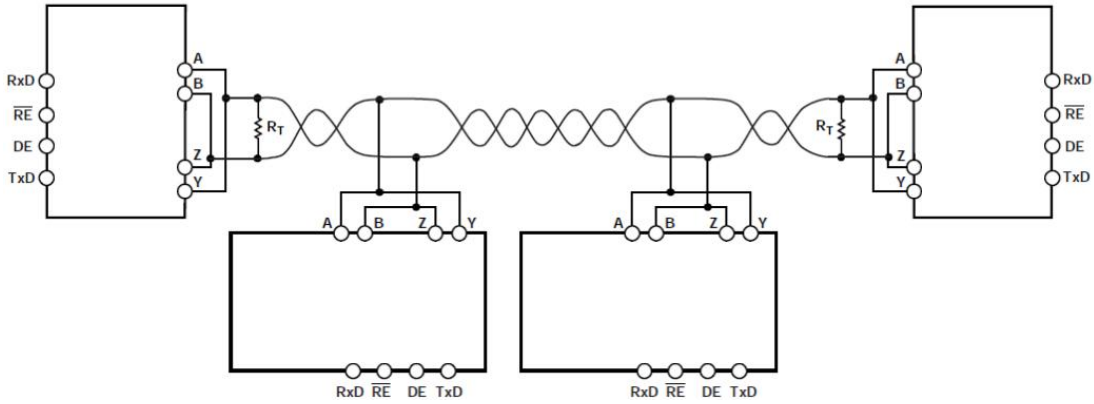


Figure 18. Typical Application Circuit (Half-Duplex Network Topology)

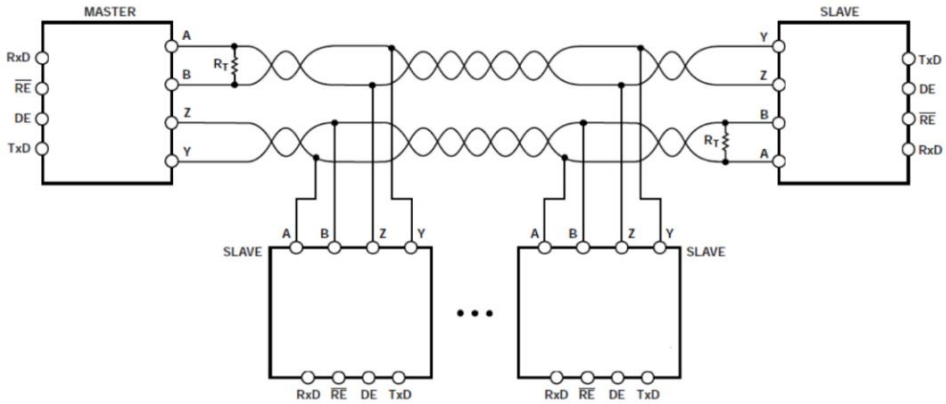


Figure19.Typical application circuit (full-Duplex Network Topology)

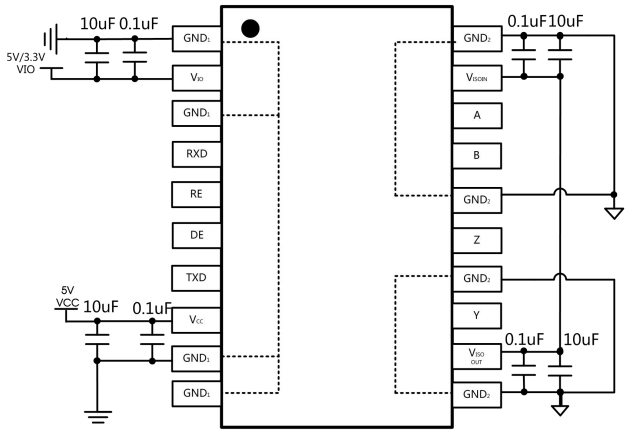


Figure 20. Typical Application Diagram

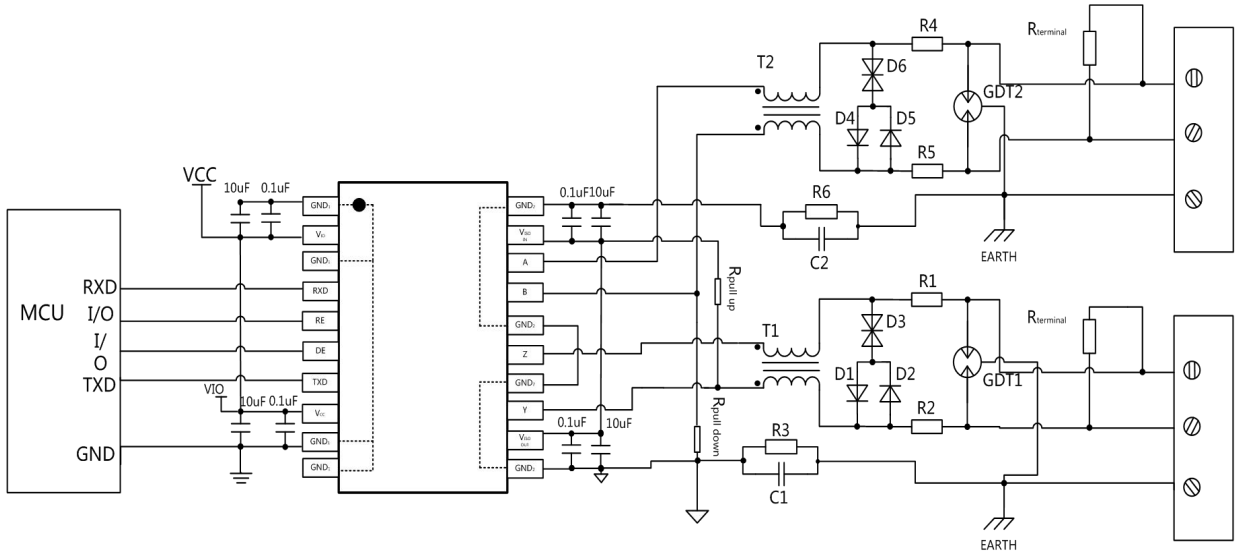


Figure21.Port protection circuit for harsh environments

Parameter Description:

Component	Recommended part, value	Component	Recommended part, value
R3, R6	1MΩ	R1, R2, R4, R5	2.7Ω/2W
C1, C2	1nF, 2kV	D1, D2, D4, D5	1N4007
T1, T2	ACM2520-301-2P	D3, D6	SMBJ8.5CA
GDT1, GDT2	B3D090L	$R_{terminal}$	120Ω

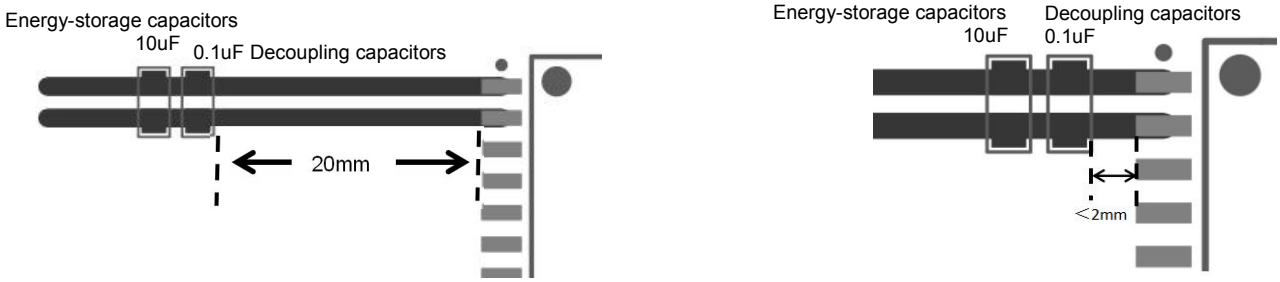
As the modules internal A / B / Z / Y lines come with its own ESD protection, which generally satisfy most application environments without the need for additional ESD protection devices. For harsh and noisy application environments such as motors, high voltage/current switches, lightning and similar however, we recommended that the user protects the module′s A / B / Z / Y lines with additional measures and external components such as TVS tube, common mode inductors, Gas discharge tube, shielded twisted pair of wires with the same single network Earth point. Figure 21 shows our recommended circuit diagram for such type of applications with components and values given in the table above. This recommendation is for reference only and may have to be adapted accordingly with appropriate component values in order to match the actual situation and application.

Note 1: Select the $R_{terminal}$ according to the actual application.

Note 2: When using the port protection circuit, you need to slow down the baud rate.

PCB design description:

1. The decoupling capacitors and energy storage capacitors of VCC and GND1, VISO and GND2 should be placed as close to the chip pins as possible to reduce the loop area and parasitic inductance of PCB wiring. Generally, it should be controlled within 2mm. The decoupling capacitor is placed near the chip, and the energy storage capacitor is placed on the outside. As shown in Figure 23-1.

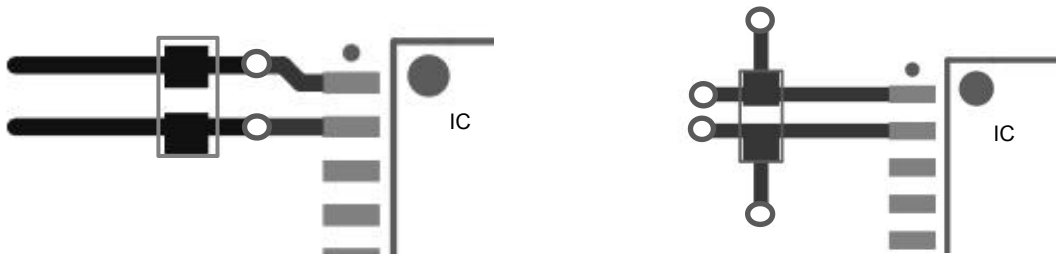


Not recommended

Recommend

Figure 23-1

2. When wiring, the power line width should be designed to be at least 0.5mm.
3. When it is necessary to place vias in the power supply line and ground wire, the position of the vias should be on the outer side of the capacitor relative to the chip pins, rather than between the capacitor and the chip, as shown in Figure 23-2 to reduce the impact of parasitic inductance in the vias.



Not Recommended Recommended

Figure 23-2

Recommendations

① The product does not support hot-plugging.
② TXD external inputs should have pull-up resistors added as appropriate if drive capability is insufficient.
③ In order to maintain the bus idle stability, it is necessary to pull up Y to VISO and pull down Z to GND2 in at least one node at the bus end.

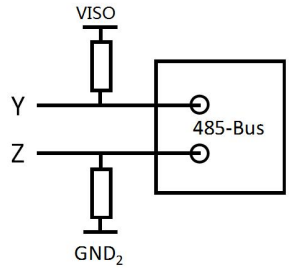
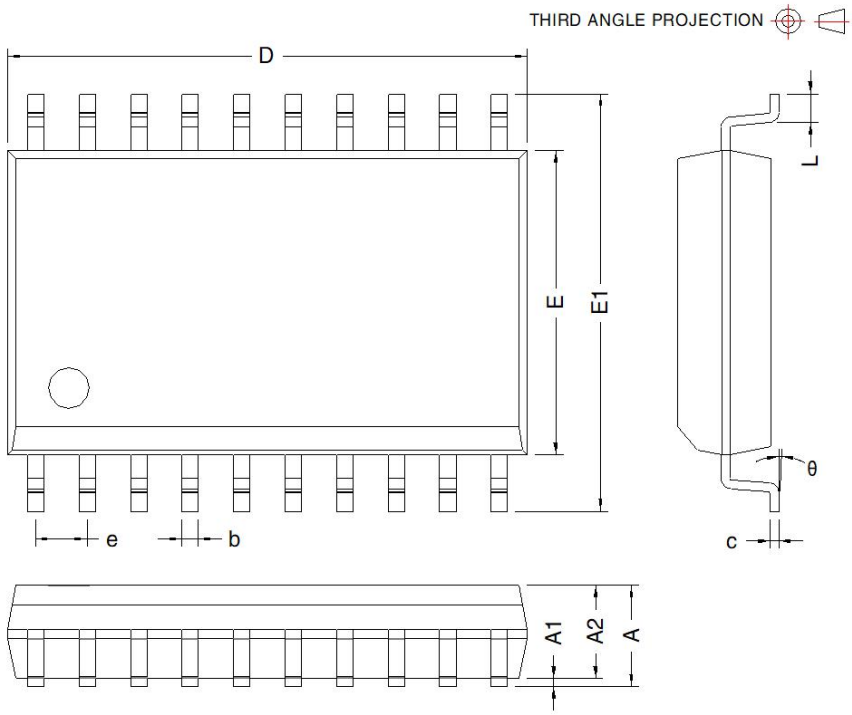


Figure 15. Typical Pull-Up and Pull-Down Resistor Connections

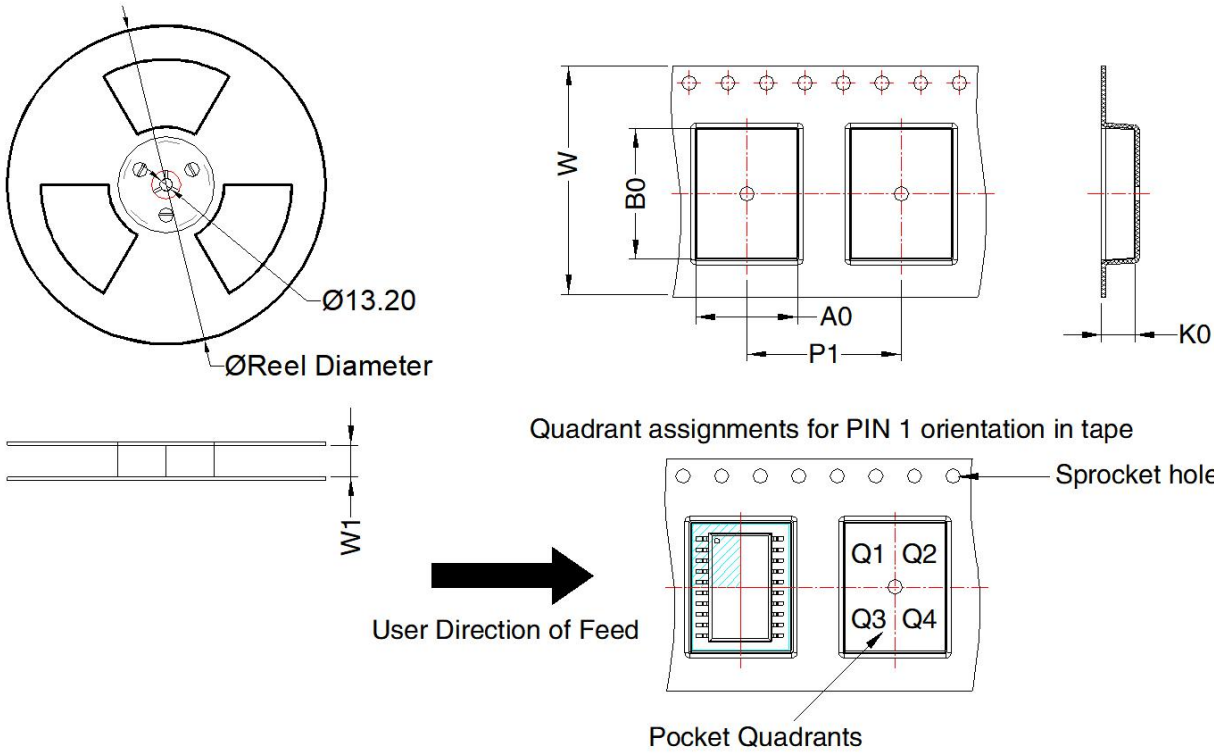
④ DE and $\overline{RE}$ pin do not support dangling. If the pin is not access controller, the recommended by 30 kΩ pulldown resistor pins connect to GND. Keep the node in the receiving state only, not affect the bus.
⑤ DE, $\overline{RE}$, TXD pin is always not allow to set to open drain output state connect the controller, otherwise it will lead to uncertain consequences.

Ordering Information

Part number	Package	Number of pins	Product marking	Tape & Reel
TD551S422HW3	SOIC	20	TD551S422HW3	290/REEL



SOIC-20				
Mark	Dimension(mm)		Dimension(inch)	
	Min	Max	Min	Max
A	—	2.65	—	0.104
A1	0.10	0.30	0.004	0.012
A2	2.25	2.35	0.089	0.093
D	12.70	12.90	0.500	0.508
E	7.40	7.60	0.291	0.299
E1	10.10	10.50	0.398	0.413
L	0.70	1.00	0.028	0.040
b	0.39	0.47	0.015	0.019
e	1.27(BSC)		0.05(BSC)	
c	0.25	0.29	0.010	0.011
θ	0°	8°	0°	8°



Device	Package Type	Pin	MPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TD551S422HW3	SOIC20	20	290	180	25.5	11.1	13.5	3.5	16.0	24	Q1

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