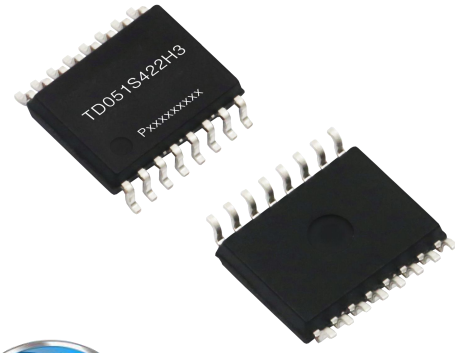
MORNSUN®

TD051S422H3
SOIC package isolated RS485 Transceiver

Features

- Ultra-small, ultra-thin, chip scale SOIC package
- Compliant with TIA/EIA-485-A standard
- I/O power supply range supports 3.3V and 5V microprocessors
- High isolation to 5000Vrms
- Bus-Pin ESD protection up to 15kV(HBM)
- Baud rate up to 20Mbps
- 180kV/μs CMTI(Typ.)
- Low communication delay
- full duplex mode
- 1/8 unit load—up to 256 nodes on a Bus fail-safe
- Bus failure protection
- Bus driver short circuit protection
- Industrial operating ambient temperature range: -40℃ to +125℃
- Moisture Sensitivity Level (MSL) 3

Package



Applications

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

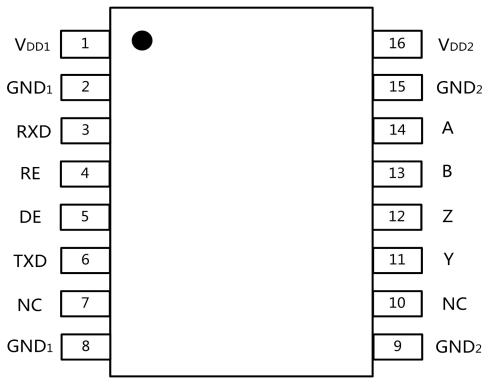
Functional Description

The TD051S422H3 is a full-duplex enhanced transceiver designed for RS-485 bus networks and is fully compliant with the TIA/EIA-485-A standard. The logic side supports 3.3V and 5V logic level conversion, and the bus receiver adopts 1/8 unit load design, its bus load capacity is up to 256 node units to meet the demand of multi-node design. The bus transfer rate is up to 20Mbps.

TD051S422H3 also focuses on strengthening the reliability design of A, B, Z and Y pins on the basis of traditional IC, including driver overcurrent protection, enhanced ESD design, etc. Its ESD withstand capacity of A, B, Z and Y ports is up to 15kV (Human Body Model).

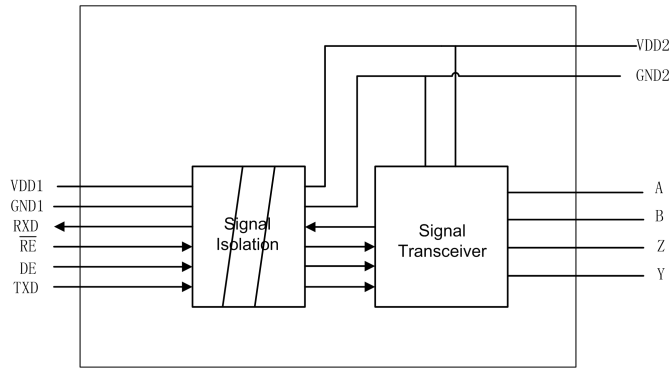
Contents

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
X	Unrelated
Z	High Impedance
NC	Connectionless

Table 1. Driver truth table

Supply status		Input		Output	
V_{DD1}	V_{DD2}	DE	TXD	Y	Z
On	On	H	H	H	L
On	On	H	L	L	H
On	On	L	X	Z	Z
On	Off	X	X	Z	Z
Off	Off	L	L	Z	Z
Off	Off	X	X	Z	Z

Table 2. Receiver truth table

Supply status		Input		Output
V_{DD1}	V_{DD2}	A−B (V)	$\overline{RE}$	RXD
On	On	≥−0.02	L	H
On	On	≤−0.22	L	L
On	On	−0.02 < A − B < −0.22	L	Uncertainty
On	On	Open	L	H
On	On	X	H	Z
On	Off	X	L	H
Off	Off	X	L	L

Pin Descriptions

Pin Number	Pin Name	Pin Functions
1	VDD1	Logic Side Supply Pins
2	GND1	logic side reference ground
3	RXD	Receiver signal output pin
4	$\overline{RE}$	Receiver enable pin: $\overline{RE}$ is low, RO output is high when (A-B) ≥ -20mV, RO output is low when (A-B) ≤ -220mV
5	DE	Driver enable pin. When DE is high, the driver output is enabled; when DE is low, the driver output is high impedance; when DE is low and $\overline{RE}$ is high, it enters shutdown mode
6	TXD	Driver Input Pin
7	NC	No Function Pin, Dangling
8	GND1	logic side reference ground
9	GND2	Bus Side Reference Ground
10	NC	No Function Pin, Dangling
11	Y	Drive in-phase output
12	Z	Driver Inverted Output
13	B	Receiver Inverted Output
14	A	Receiver in-phase output
15	GND2	Bus Side Reference Ground
16	VDD2	Bus Side Power Pins

Absolute Maximum Ratings

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

Parameters	Unit
V_{DD1}	−0.5 V to +7 V
V_{DD2}	−0.5 V to +6 V
Digital Input Voltage (DE, $\overline{RE}$, TXD)	-0.3V to +6V
Digital Output Voltage(RXD)	-0.3V to +6V
Driver Output/Receiver Input Voltage	−7 V to +12 V
Operating Temperature Range	−40°C to +125°C
Storage Temperature Range	−65°C to +150°C
Reflow Soldering Temperature	Peak temp. ≤260℃, 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

Recommend an operate condition		Min.	Typ.	Max.	Unit
V_{DD1}	Logic side supply voltage	2.375	3.3	5.5	V
V_{DD2}	Bus-side supply voltage	4.5	5	5.5	
V_{OC}	Either bus termination pin voltage (differential mode, common mode)	-7		12	
V_{IH}	High Level Input Voltage (TXD , DE, $\overline{RE}$)	2		V_{DD1}	
V_{IL}	Low Level Input Voltage (TXD , DE, $\overline{RE}$)	0		0.8	
V_{ID}	Differential Input Voltage	-7		+12	
R_L	Differential Output Load Resistance	54	60		Ω

Electrical Characteristics

All typical values are measured at 25°C with VDD1 = VDD2 = 5V (unless otherwise noted).

Parameters		Conditions		Min.	Typ.	Max.	Unit
Driver Characteristics							
$\|V_{OD}\|$	Differential drive output	R_L = ∞, Refer to Figure 7		2			V
		R_L = 27 Ω (RS-485), Refer to Figure 7		1.5			V
$\Delta\|V_{OD}\|$	Amplitude of change of differential output	R_L = 27 Ω , Refer to Figure 9				±0.2	V
$V_{OC(SS)}$	Steady state common mode output voltage	Refer to Figure8		1		3	V
I_{OS}	Driver short-circuit current	-7V ≤ V_{OUT} ≤ 12V			±110	±200	mA
V_{IH}	Input High Level	TXD, DE, $\overline{RE}$		2			V
V_{IL}	Input Low Level	TXD, DE, $\overline{RE}$				0.8	V
Receiver Characteristics							
$V_{IT(+)}$	Forward differential input threshold voltage	−7 V ≤ VCM ≤ +12 V				–20	mV
$V_{IT(-)}$	Negative differential input threshold voltage	−7 V ≤ VCM ≤ +12 V		–220			mV
V_{hys}	hysteresis voltage (V_{IT+} – V_{IT-})	−7 V ≤ VCM ≤ +12 V			20		mV
R_{ID}	Differential Input Impedance(A,B)	−7 V ≤ VCM ≤ +12 V		96			kΩ
I_I	Input current (A,B pins)	DE = 0 , $\overline{RE}$= 0	V_{OUT} = 12V			280	uA
			V_{OUT} = -7V	-100			uA
V_{OH}	RXD high output voltage	I_{OUT} = 20 μA, V_A − V_B = 0.2 V		V_{DD1} − 0.1			V
		I_{OUT} = 4 mA, V_A − V_B = 0.2 V		V_{DD1} − 0.4	V_{DD1} − 0.2		V
V_{OL}	RXD low output 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			0.2	0.4	V
Power supply and protection characteristics							
I_{DD1}	Logic side supply current	2.375 V ≤ V_{DD1} ≤ 5.5 V, Output without load,$\overline{RE}$ = 0 V				6	mA
I_{DD2}	Bus-side supply current	Output without load,DE = 5 V				10	mA
		Output without load, DE = 0 V				10	mA
		Output with load 54Ω,TXD input Signal: f=20Mbps; Duty=50%				110	mA
ESD	HBM Mode	A, B, Z, Y pins to GND				±15	kV
	IEC/EN 61000-4-2 (Contact) Perf. Criteria B	A, B, Z, Y Pin to GND				±4	kV
V_{I-O}	Isolated Withstand Voltage	V_{TEST}=V_{I-O},t=60s V_{TEST}=1.2 x V_{I-O},t=1s(100%production test)				5000	VDC
R_{I-O}	Insulation impedance	500VDC		1000			MΩ
C_{I-O}	Isolation Capacitors				5.5		pF
CMTI	common mode transient immunity	TXD = V_{DD1} or 0 V, VCM = 1 kV, transient magnitude = 800 V			180		kV/μs

Transmission Characteristics

General test conditions and V_{DD1}=V_{DD2}=5V, Ta = 25℃ (unless otherwise specified).

Parameters		Conditions	Min.	Typ.	Max.	Unit
transmission rate					20	Mbps
Drives						
t_{PLH}, t_{PHL}	Drive Transfer Delay	R_L = 54 Ω, C_{L1} = C_{L2} = 100 pF, Reference Figure 9		50	90	ns
t_{SKEW}	Driver Differential Output Delay Offset ($\|t_{PHL} - t_{PLH}\|$)				25	ns
t_r, t_f	Driver output rise delay, fall delay			6	25	ns
Refraction						
t_{PLH}, t_{PHL}	Receiver transmission delay	C_L = 15 pF, Reference Figure10		80	110	ns
t_r, t_f	Receiver output rise delay, fall delay			5	10	ns

Physical Specifications

Parameters	Value	Unit
Weight	0.4(Typ.)	g

Test Circuits

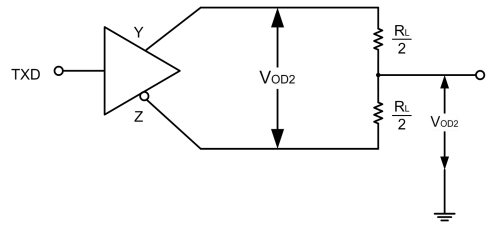


Figure 7. Differential Output Test Circuit

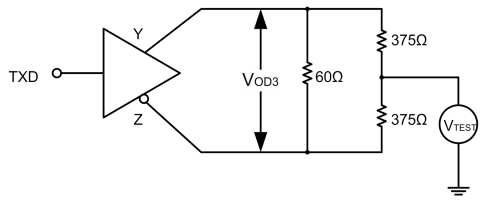
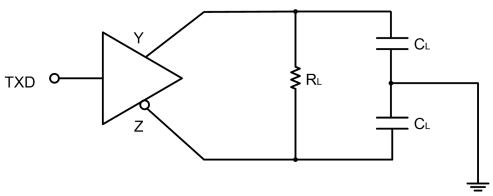


Figure 8. common mode output test circuit



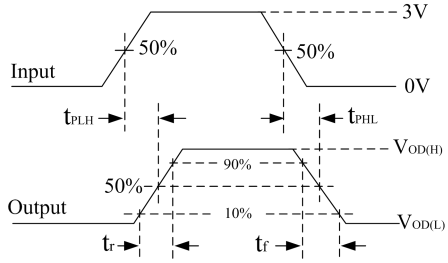
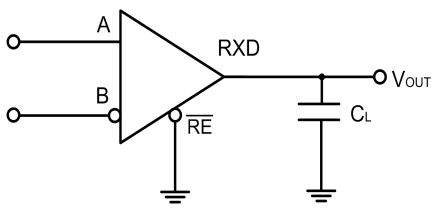


Figure 9. Transmit Delay Test Circuit



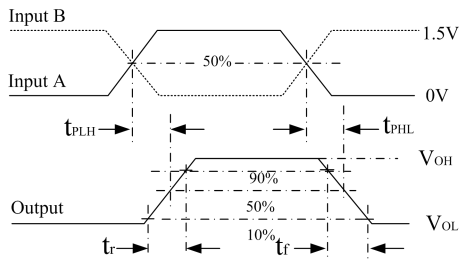


Figure 10. Receive Delay Test Circuit

Detailed Description

The TD051S422H3 is a full duplex enhanced RS485 transceiver. Each transceiver contains a driver and a receiver. The transceiver is equipped with a bus failure protection function, which ensures that the receiver output is high when the receiver input is open or shorted, or when the bus is in an idle state.The TD051S422H3 adopts a two-terminal power supply, and the logic side supports the conversion of 3.3V and 5V logic levels, and the whole machine can monitor the overall working status of the module, and limit the output current to prevent the bus from causing irreversible damage to the transceiver due to overloading or short-circuit. transceiver from irreversible damage caused by bus overload or short circuit.Receiver input filter:

TD051S422H3 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, the bus receiver will be in an indeterminate state when -220mV < A-B < -20mV. This phenomenon will occur when the bus is idle. The bus fail protection ensures that the receiver output is high when the receiver input is open or shorted, or when the bus is connected to a matching resistor on the port. the TD051S422H3 receiver threshold voltage is relatively accurate, and the threshold voltage has at least 10mV margin to the reference ground. This feature ensures that the receiver output level is high even when the bus differential voltage is 0V and complies with the EIA/TIA ±200mV requirement.

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. TD051S422H3 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). TD051S422H3 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 $\overline{RE}$ input is high and DE input is low, the transceiver enters the shutdown mode. When the transceiver enters the SHUTDOWN mode, its supply current is as low as 6 mA. $\overline{RE}$ and DE can be shorted and controlled through the same I/O. If the $\overline{RE}$ input goes high and the DE input goes low for a hold time of less than 50ns, the transceiver will not be able to enter into shutdown mode, and if the hold time can be maintained for at least 600ns, the transceiver will reliably enter into shutdown mode.

Drive output protection: TD051S422H3 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

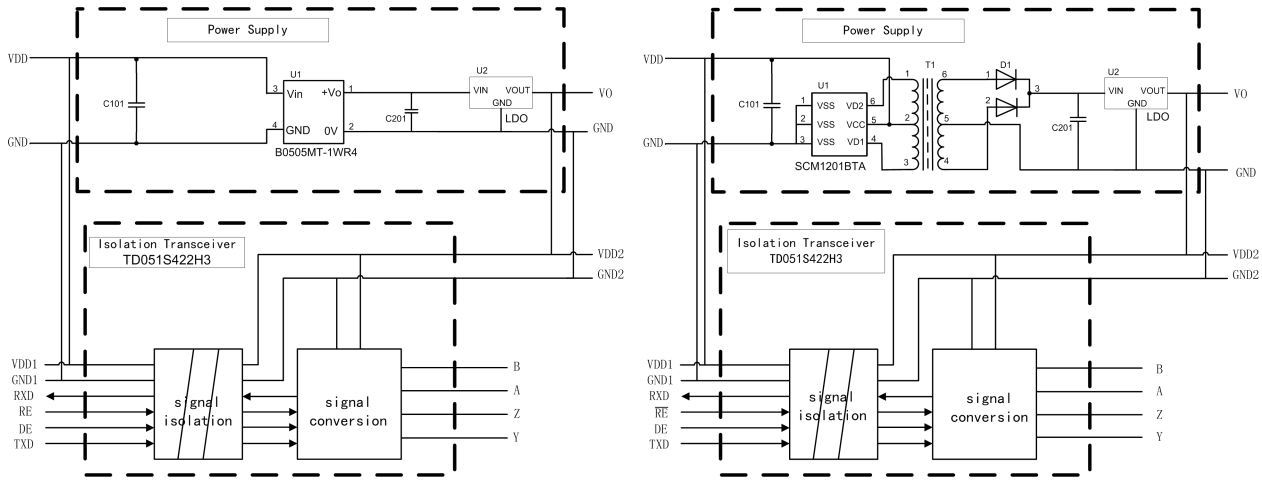


Figure 11. Typical Application Circuit

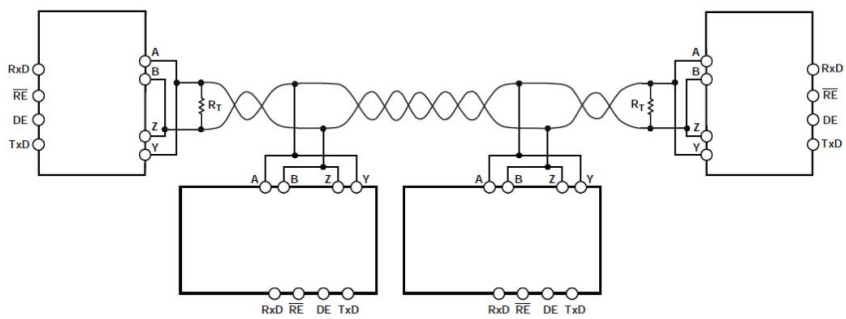


Figure 12. Typical Application Circuit (Half-Duplex Network Topology)

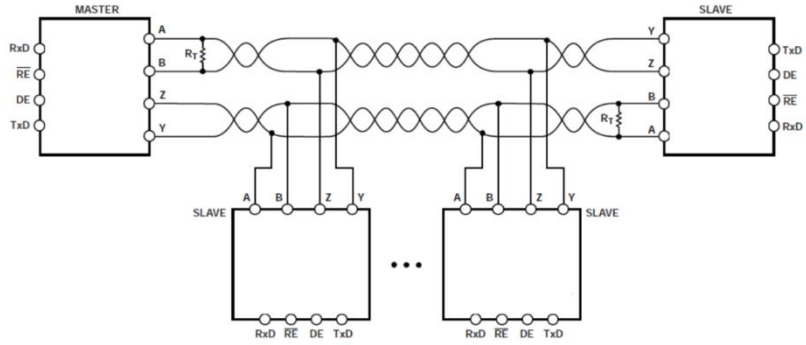


Figure 13. Typical Application Circuit (Full-Duplex Network Topology)

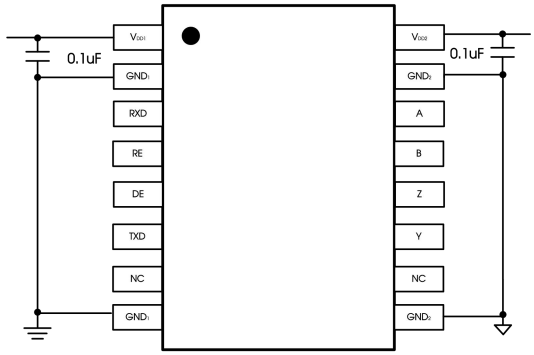


Figure 14. Typical application PCB layout

Using Suggests

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 VDD2 and pull down Z to GND2 in at least one node at the bus end.

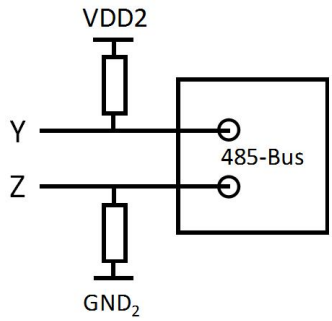


Figure 15. Typical Pull-Up and Pull-Down Resistor Connections

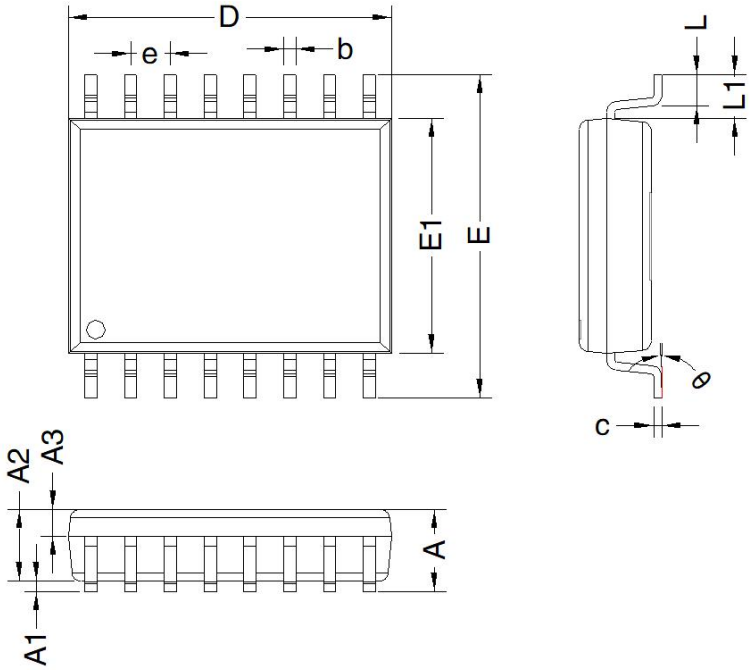
④ DE and $\overline{RE}$ pin do not support dangling. If the pin is not access controller, the recommended by 30 kΩ pulldown resistor pins connect to GND. Keep the node in the receiving state only, not affect the bus.

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.

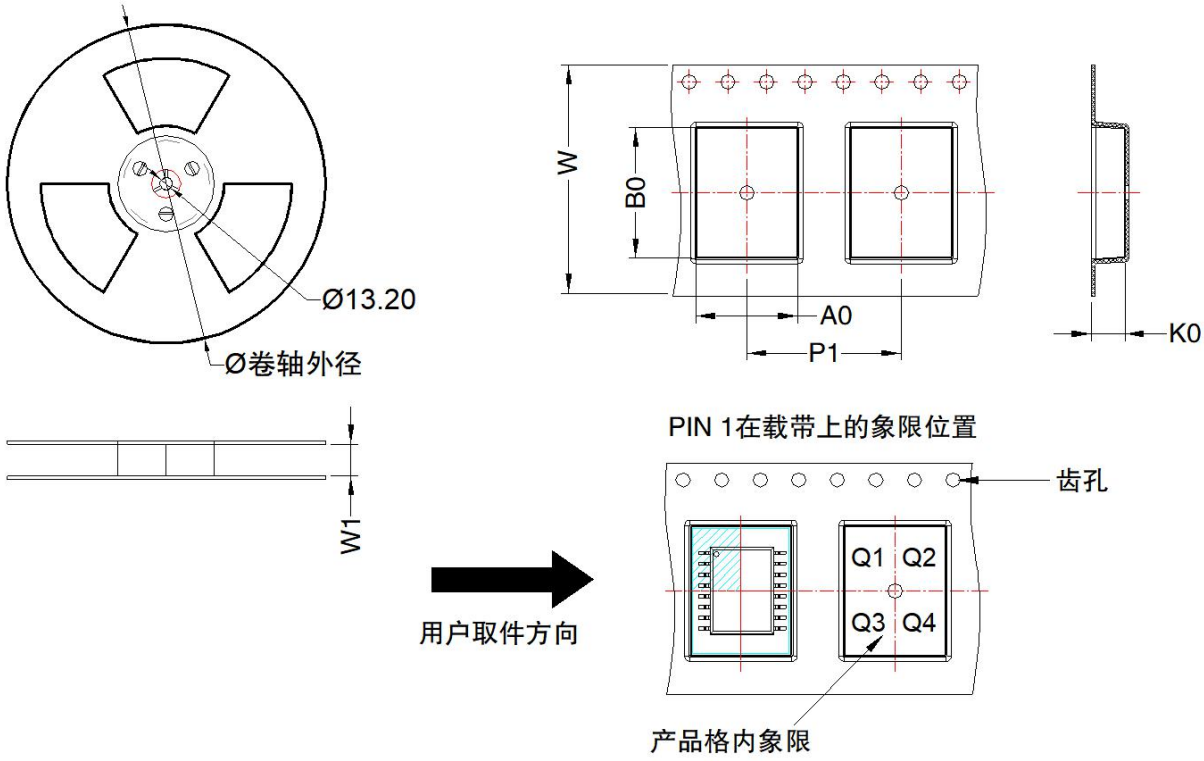
Ordering Information

Part number	Package	Number of pins	Product marking	Tape & Reel
TD051S422H3	SOIC	16	TD051S422H3	340/REEL

THIRD ANGLE PROJECTION



Mark	Dimension(mm)	
	Min	Max
A	–	2.65
A1	0.10	0.30
A2	2.25	2.35
A3	0.97	1.07
b	0.35	0.43
c	0.24	0.29
D	10.20	10.40
e	1.27 BSC	
E	10.10	10.50
E1	7.40	7.60
L	0.55	0.85
L1	1.40 BSC	
θ	0°	8°



器件型号	封装类型	Pin	MPQ	卷轴外径 (mm)	卷轴宽度 W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 象限
TD051S422H3	SOIC16	16	340	180	16.4	10.74	10.65	3.5	16.0	16.0	Q1

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