钍地半导体
Tudi Semiconductor

Product Specification

TUDI-LTC1687

52Mbps Precision Delay RS485 Fail-Safe Transceivers

网址 www.sztdbdt.com

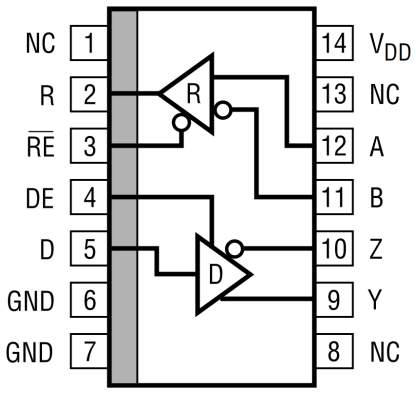
用芯智造·卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

FEATURES

- Precision Propagation Delay Over Temperature: Receiver/Driver: 18.5ns ±3.5ns
- High Data Rate: 52Mbps
- Low tPLH/tPHL Skew: Receiver/Driver: 500ps Typ
- –7V to 12V RS485 Input Common Mode Range
- Guaranteed Fail-Safe Operation Over the Entire Common Mode Range
- High Input Resistance: ≥22k, Even When Unpowered
- Short-Circuit Protected
- Thermal Shutdown Protected
- Driver Maintains High Impedance in Three-State or with Power Off
- Single 5V Supply
- Pin Compatible with LTC490/LTC491
- 45dB CMRR at 26MHz



S PACKAGE
14-LEAD PLASTIC SO

T_{JMAX} = 125 ° C, θ_{JA} = 90 ° C/ W

APPLICATIONS

- High Speed RS485/RS422 Full Duplex Transceivers
- Level Translator
- Backplane Transceiver
- STS-1/OC-1 Data Transceiver
- Signal Repeaters

DESCRIPTION

The LTC1686/LTC1687 are high speed, precision delay, full-duplex RS485 transceivers that can operate at data rates as high as 52Mbps. The devices also meet the requirements of RS422.
A unique architecture provides very stable propagation delays and low skew over a wide common mode and ambient temperature range.
The driver and receiver feature three-state outputs, with disabled driver outputs maintaining high impedance over the entire common mode range. A short-circuit feature detects shorted outputs and substantially reduces driver output current. A similar feature also protects the receiver output from short circuits. Thermal shutdown circuitry protects from excessive power dissipation.
The receiver has a fail-safe feature that guarantees a high output state when the inputs are shorted or are left floating. The LTC1686/LTC1687 RS485 transceivers guarantee receiver fail-safe operation over the entire common mode range (–7V to 12V). Receiver input resistance remains ≥22k when the device is unpowered or disabled.
The LTC1686/LTC1687 operate from a single 5V supply and draw only 7mA of supply current.

PIN FUNCTIONS

LTC1686

V_{DD} (Pin 1): Positive Supply, 5V to ±5%. Bypass with 0.1µF ceramic capacitor.

R (Pin 2): Receiver Output. If A ≥ B by 300mV, then R will be high. If A ≤ B by 300mV, then R will be low.

D (Pin 3): Driver Input. Controls the states of the Y and Z outputs. Do not float.

GND (Pin 4): Ground.

Y (Pin 5): Noninverting Driver Output.

Z (Pin 6): Inverting Driver Output.

B (Pin 7): Inverting Receiver Input.

A (Pin 8): Noninverting Receiver Input.

LTC1687

NC (Pins 1, 8, 13): No Connection.

R (Pin 2): Receiver Output. If A ≥ B by 300mV, then R will be high. If A ≤ B by 300mV, then R will be low.

$\overline{RE}$ (Pin 3): Receiver Enable. $\overline{RE}$ = low enables the receiver. $\overline{RE}$ = high forces receiver output into high impedance state. Do not float.

PIN FUNCTIONS

DE (Pin 4): Driver Enable. DE = high enables the driver. DE = low will force the driver output into a high impedance state. Do not float.

D (Pin 5): Driver Input. Controls the states of the Y and Z outputs when DE = high. Do not float.

GND (Pins 6, 7): Ground.

Y (Pin 9): Noninverting Driver Output.

Z (Pin 10): Inverting Driver Output.

B (Pin 11): Inverting Receiver Input.

A (Pin 12): Noninverting Receiver Input.

V_{DD} (Pin 14): Positive Supply, 5V to ±5%. Bypass with 0.1µF ceramic capacitor.

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage (V_{DD}) 10V
Control Input Currents ..... −100mA to 100mA
Control Input Voltages ..... −0.5V to V_{DD} + 0.5V
Driver Input Voltages ..... −0.5V to V_{DD} + 0.5V
Driver Output Voltages ..... +12V/−7V
Receiver Input Voltages ..... +12V/−7V
Receiver Output Voltages ..... −0.5V to V_{DD} + 0.5V
Receiver Input Differential 10V

Driver Short-Circuit Duration
(V_{OUT}: −7V to 10V) ..... Indefinite
Receiver Short-Circuit Duration
(V_{OUT}: 0V to V_{DD}) ..... Indefinite
Operating Temperature Range
LTC1686C/LTC1687C ..... 0°C to 70°C
LTC1686I/LTC1687I ..... −40°C to 85°C
Storage Temperature Range ..... −65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

DC ELECTRICAL CHARACTERISTICS

V_{DD} = 5V ±5% unless otherwise noted (Notes 2, 3).

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OD1}	Differential Driver Output (Unloaded)	I_{OUT} = 0	●			V_{DD}	V
V_{OD2}	Differential Driver Output (With Load)	R = 50Ω (RS422) R = 27Ω (RS485), Figure 1	 ●	2.0 1.5		 V_{DD}	V V
ΔV_{OD}	Change in Magnitude of Driver Differential Output Voltage for Complementary Output States	R = 27Ω or 50Ω, Figure 1	●			0.2	V
V_{OC}	Driver Common Mode Output Voltage	R = 27Ω or 50Ω, V_{DD} = 5V, Figure 1	●	2		3	V
$\Delta \lvert V_{OC} \rvert$	Change in Magnitude of Driver Common Mode Output Voltage for Complementary Output States	R = 27Ω or 50Ω, Figure 1	●			0.2	V
V_{IH}	Input High Voltage	D, DE, $\overline{RE}$	●	2			V
V_{IL}	Input Low Voltage	D, DE, $\overline{RE}$	●			0.8	V
I_{IN1}	Input Current	D, DE, $\overline{RE}$	●	−1		1	µA
I_{IN2}	Input Current (A, B)	V_A, V_B = 12V, V_{DD} = 0V or 5.25V V_A, V_B = −7V, V_{DD} = 0V or 5.25V	● ●	 −500		500 	µA µA
V_{TH}	Differential Input Threshold Voltage for Receiver	−7V ≤ V_{CM} ≤ 12V	●	−0.3		0.3	V
ΔV_{TH}	Receiver Input Hysteresis	V_{CM} = 0V			25		mV
V_{OH}	Receiver Output High Voltage	I_{OUT} = −4mA, V_{ID} = 300mV	●	3.5	4.8		V

DC ELECTRICAL CHARACTERISTICS

V_{DD} = 5V ±5% unless otherwise noted (Notes 2, 3).

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OL}	Receiver Output Low Voltage	I_{OUT} = 4mA, V_{ID} = −300mV	●			0.4	V
I_{OZR}	Three-State (High Impedance) Output Current at Receiver	0.4V ≤ V_{OUT} ≤ 2.4V	●	−1		1	µA
I_{OZD}	Three-State (High Impedance) Output Current at Driver	V_{OUT} = −7V to 12V	●	−200		200	µA
C_{LOAD}	Receiver and Driver Output Load Capacitance	(Note 4)	●			500	pF
I_{DD}	Supply Current	No Load, Pins D, DE, $\overline{RE}$ = 0V or V_{DD}	●		7	12	mA
I_{OSD1}	Driver Short-Circuit Current, V_{OUT} = HIGH	V_{OUT} = −7V or 10V (Note 5)	●			20	mA
I_{OSD2}	Driver Short-Circuit Current, V_{OUT} = LOW	V_{OUT} = −7V or 10V (Note 5)	●			20	mA
I_{OSR}	Receiver Short-Circuit Current	V_{OUT} = 0V or V_{DD} (Note 5)	●			20	mA
R_{IN}	Input Resistance	−7V ≤ V_{CM} ≤ 12V	●	22			kΩ
C_{IN}	Input Capacitance	A, B, D, DE, $\overline{RE}$ Inputs (Note 4)			3		pF
	Open-Circuit Input Voltage	V_{DD} = 5V (Note 4), Figure 5	●	3.2	3.3	3.4	V
Fail-Safe Time	Time to Detect Fail-Safe Condition				2		µs
CMRR	Receiver Input Common Mode Rejection Ratio	V_{CM} = 2.5V, f = 26MHz			45		dB

SWITCHING CHARACTERISTICS

V_{DD} = 5V, unless otherwise noted (Notes 2, 3).

SYMBOL	PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
t_{PLH}, t_{PHL}	Driver Input-to-Output Propagation Delay	R_{DIFF} = 54Ω, Figures 3, 5 C_{L1} = C_{L2} = 100pF	LTC1686C/LTC1687C LTC1686I/LTC1687I	● ●	15 13	18.5 18.5	22 25	ns ns
t_{SKEW}	Driver Output A-to-Output B Skew	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 3, 5				500		ps
t_r, t_f	Driver Rise/Fall Time	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF, Figures 3, 5				3.5		ns
t_{ZH}	Driver Enable to Output High	C_L = 100pF, S2 Closed, Figures 4, 6		●		25	50	ns
t_{ZL}	Driver Enable to Output Low	C_L = 100pF, S1 Closed, Figures 4, 6		●		25	50	ns
t_{LZ}	Driver Disable from Low	C_L = 15pF, S1 Closed, Figures 4, 6		●		25	50	ns
t_{HZ}	Driver Disable from High	C_L = 15pF, S2 Closed, Figures 4, 6		●		25	50	ns
t_{PLH}, t_{PHL}	Receiver Input-to-Output Propagation Delay	C_L = 15pF, Figures 3, 7	LTC1686C/LTC1687C LTC1686I/LTC1687I	● ●	15 13	18.5 18.5	22 25	ns ns
t_{SQD}	Receiver Skew $\lvert t_{PLH} - t_{PHL} \rvert$	C_L = 15pF, Figures 3, 7				500		ps
t_{ZL}	Receiver Enable to Output Low	C_L = 15pF, S1 Closed, Figures 2, 8		●		25	50	ns
t_{ZH}	Receiver Enable to Output High	C_L = 15pF, S2 Closed, Figures 2, 8		●		25	50	ns
t_{LZ}	Receiver Disable from Low	C_L = 15pF, S1 Closed, Figures 2, 8		●		25	50	ns
t_{HZ}	Receiver Disable from High	C_L = 15pF, S2 Closed, Figures 2, 8		●		25	50	ns
	Maximum Receiver Input Rise/Fall Times	(Note 4)		●			2000	ns
$t_{PKG-PKG}$	Package-to-Package Skew	C_L = 15pF, Same Temperature (Note 4)				1.5		ns

SWITCHING CHARACTERISTICS

V_{DD} = 5V, unless otherwise noted (Notes 2, 3).

SYMBOL	PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
	Minimum Input Pulse Width	V_{DD} = 5V ±5% (Note 4)	LTC1686C/LTC1687C LTC1686I/LTC1687I	● ●		17 20	19.2 25	ns ns
	Maximum Data Rate	V_{DD} = 5V ±5% (Note 4)	LTC1686C/LTC1687C LTC1686I/LTC1687I	● ●	52 40	60 50		Mbps Mbps
	Maximum Input Frequency	V_{DD} = 5V ±5% (Note 4)	LTC1686C/LTC1687C LTC1686I/LTC1687I	● ●	26 20	30 25		MHz MHz

The ● denotes specifications which apply over the full operating temperature range.

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: All currents into the device pins are positive; all currents out of the device pins are negative.

Note 3: All typicals are given for V_{DD} = 5V, T_A = 25°C.

Note 4: Guaranteed by design, but not tested.

Note 5: Short-circuit current does not represent output drive capability. When the output detects a short-circuit condition, output drive current is significantly reduced (from hundreds of mA to 20mA max) until the short is removed.

FUNCTION TABLES (LTC1687)

Transmitting

INPUTS $\overline{RE}$	DE	D	LINE CONDITION	OUTPUTS Z	Y
X	1	1	No Fault	0	1
X	1	0	No Fault	1	0
X	0	X	X	Hi- Z	Hi- Z
X	1	X	Fault	±10mA Current Source	

Receiving

INPUTS $\overline{RE}$	DE	A – B	OUTPUT R
0	X	≥ 300mV	1
0	X	≤ –300mV	0
0	X	Inputs Open	1
0	X	Inputs Shorted Together A = B = –7V to 12V	1
1	X	X	Hi- Z

TEST CIRCUITS

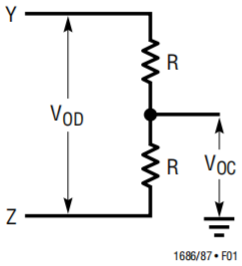


Figure 1. Driver DC Test Load

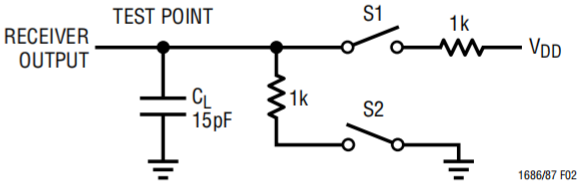


Figure 2. Driver DC Test Load

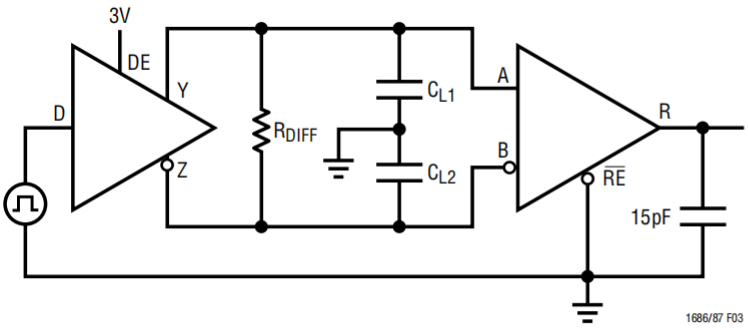


Figure 3. Driver/Receiver Timing Test Circuit

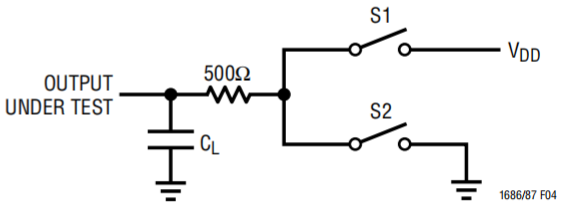


Figure 4. Driver Timing Test Load #2

SWITCHING TIME WAVEFORMS

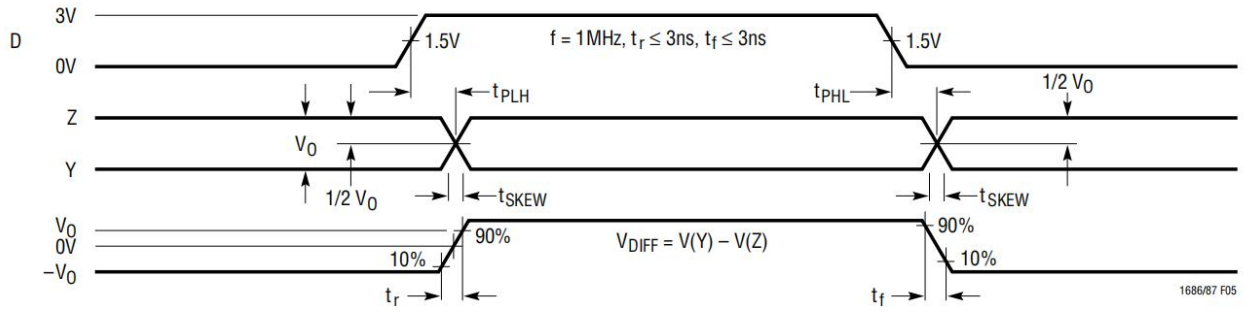


Figure 5. Driver Propagation Delays

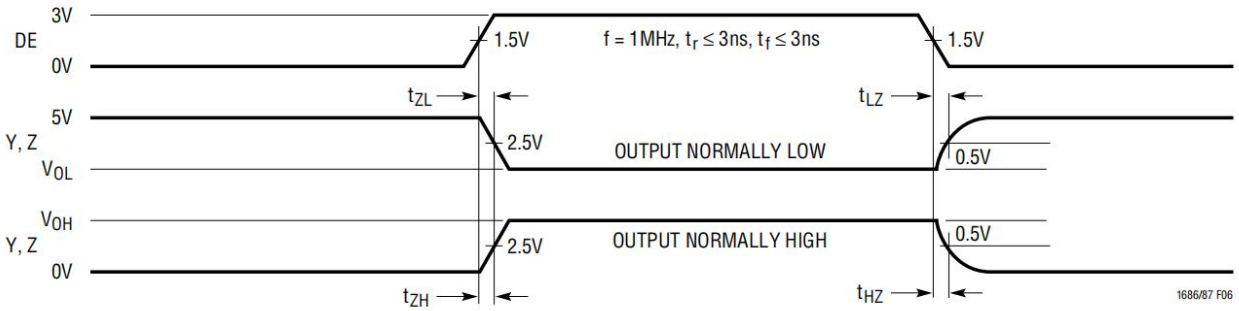


Figure 6. Driver Enable and Disable Times

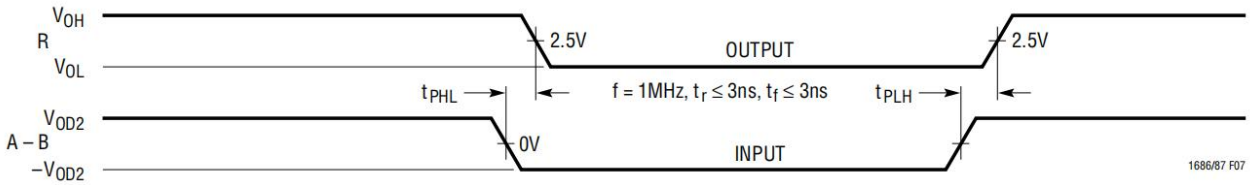


Figure 7. Receiver Propagation Delays

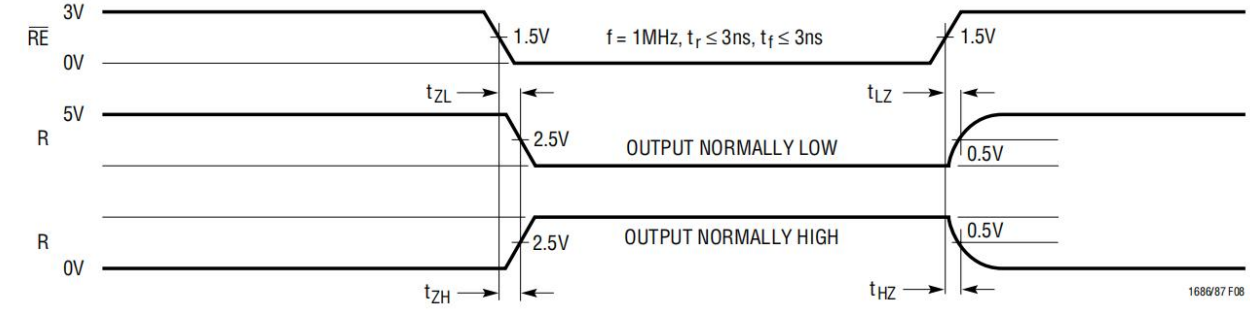


Figure 8. Receiver Enable and Disable Times

EQUIVALENT INPUT NETWORKS

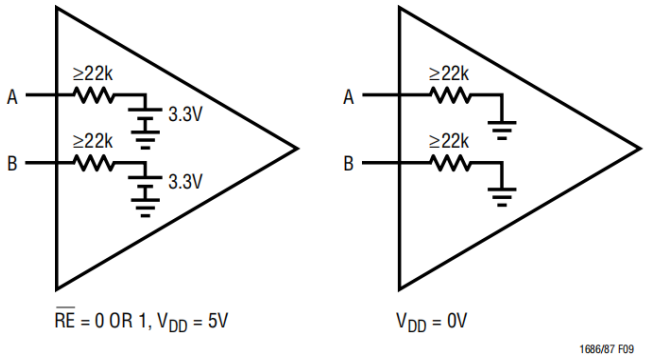
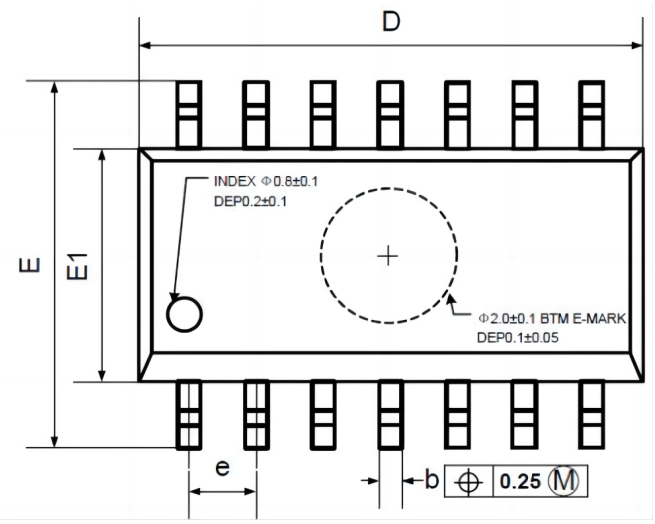


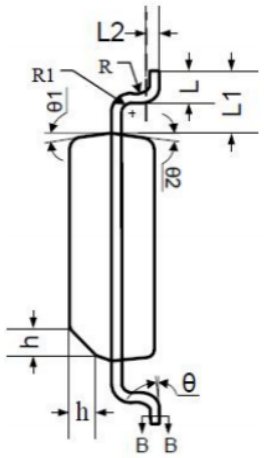
Figure 9. Input Thevenin Equivalent

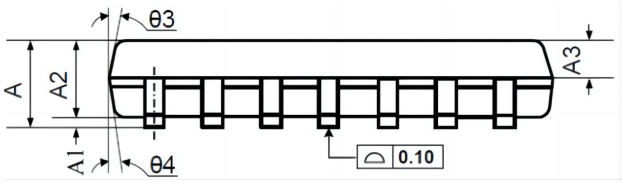
ORDERING INFORMATION

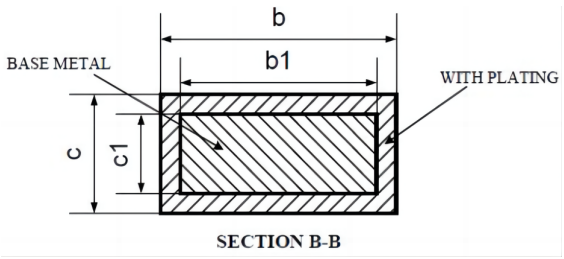
Order Number	Package	Package Quantity	Marking On The park
LTC1687CS-TUDI	SOP14	Tape,Reel,2500	1687CS
LTC1687IS-TUDI	SOP14	Tape,Reel,2500	1687IS

Package SOP14









Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
C	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30	0.40	0.50
θ	0°		8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

Important statement:

●TUDI Semiconductor reserves the right to modify the product manual without prior notice! Before placing an order, customers need to confirm whether the obtained information is the latest version and verify the completeness of the relevant information.

●Any semi-guide product is subject to failure or malfunction under specified conditions. It is the buyer's responsibility to comply with safety standards when using TUDI Semiconductor products for system design and whole machine manufacturing.And take the appropriate safety measures to avoid the potential in the risk of loss of personal injury or loss of property situation!

●TUDI Semiconductor products have not been licensed for life support, military, and aerospace applications,and therefore TUDI Semiconductor is not responsible for any consequences arising from the use of this product in these areas.

●If any or all TUDI Semiconductor products (including technical data, services) described or contained in this document are subject to any applicable local export control laws and regulations, they may not be exported without an export license from the relevant authorities in accordance with such laws.

●The specifications of any and all TUDI Semiconductor products described or contained in this document specify the performance, characteristics, and functionality of said products in their standalone state, but do not guarantee the performance, characteristics, and functionality of said products installed in Customer's products or equipment. In order to verify symptoms and conditions that cannot be evaluated in a standalone device, the Customer should ultimately evaluate and test the device installed in the Customer's product device.

●TUDI Semiconductor documentation is only allowed to be copied without any alteration of the content and with the relevant authorization.TUDI Semiconductor assumes no responsibility or liability for altered documents.

●TUDI Semiconductor is committed to becoming the preferred semiconductor brand for customers, and TUDI Semiconductor will strive to provide customers with better performance and better quallity products.