Advanced Serial Multiprotocol Transceivers

Supporting RS232, RS422 or RS485

SB300

Revision 1.03

SystemBase Co., Ltd.

Contents

1. General Description

1.1 General Information

SB300 is an advanced serial multiprotocol transceiver. It is not only compact but also supports the RS422 and RS485 communication standards. It can be switched between the RS232, RS422 and RS485 interfaces using one connector and communication cable without an additional switching circuit.

SB300 has an RS232 transceiver with 3 transmitters and 5 receivers with a speed up to 1Mbps. It can be connected to the full modem signals on the DB9 connector.

SB300 also has an RS422 transceiver and an RS485 transceiver with a communication speed of up to 10 Mbps. It supports the full- and half-duplex communication modes on 4-wire RS422 and the half-duplex communication mode on 2-wire RS485. The RS422 and RS485 transceivers have an auto direction control function as a special feature on the RS422 and RS485 lines. So it can control the output enable of the transmitter and the input enable of the receiver automatically. It also has a slew rate limit and internal termination functions. The slew rate function minimizes EMI by limiting the high frequency of the waveform; however, the communication speed is limited to 250 kbps. It can control whether to install an internal termination resistor or not through the input setting of the chip.

SB300 has an ESD protection function for all transmitters and receivers. It can be protected from ESD shock ±4kV(Contact) for reliability.

1.2 Applications

- Utility Meters
- Industrial Controls
- Industrial Motor Drives
- Lighting Systems
- Telecom
- Security Systems
- Instrumentation

2. Features

2.1 Overview

SB300 is a serial multiprotocol transceiver with RS232, RS422, and RS485 transceivers in one chip. The RS232 transceiver consists of 3 line-drivers, 5 line-receivers, and charge-pump circuits, and it can be connected with full modem signals of RS232. The RS232 transceiver supports communication speeds up to 1Mbps. The RS422/RS485 transceiver consists of 1 differential driver and 1 differential receiver, and it can support full-duplex and half-duplex mode communication. The RS422/RS485 transceiver supports communication speeds up to 10Mbps. If it uses the slew rate function, the communication speed is limited to 250 kbps. The RS422/RS485 transceiver has a 1/8-unit load as the receiver input impedance, and therefore, up to 256 devices can be connected on the bus. SB300 has three serial interface modes and can be switched between RS232, RS422, and RS485 with input logic selection on MODE [1:0] pins.

2.2 RS232 Interface

- Max Data Rate of 1Mbp (RS232)
- 3 Drivers, 5 Receivers for RS232 Full Modem
- Large Output Swing (±10V, No Load, 5V)

2.3 RS422/RS485 Interface

- Max Data Rate of 10Mbps (RS485/422)
- 1 Driver, 1 Receiver for RS485(Half)/422(Full)
- Selectable 250kbps for EMI to use Slew Rate Limit function
- Pin Selectable Termination Resistor (RS485/422)
- 1/8th Unit Load, up to 256 receivers on bus
- Support Manual or Auto Direction Control for RS485/RS422 bus control

2.4 Electrical & Mechanical Information

- 3.3V or 5V Single Supply Operation
- ESD Protection

  ±8kV HBM on the serial interface pins

  ±2kV HBM on all other pins except serial interface pins

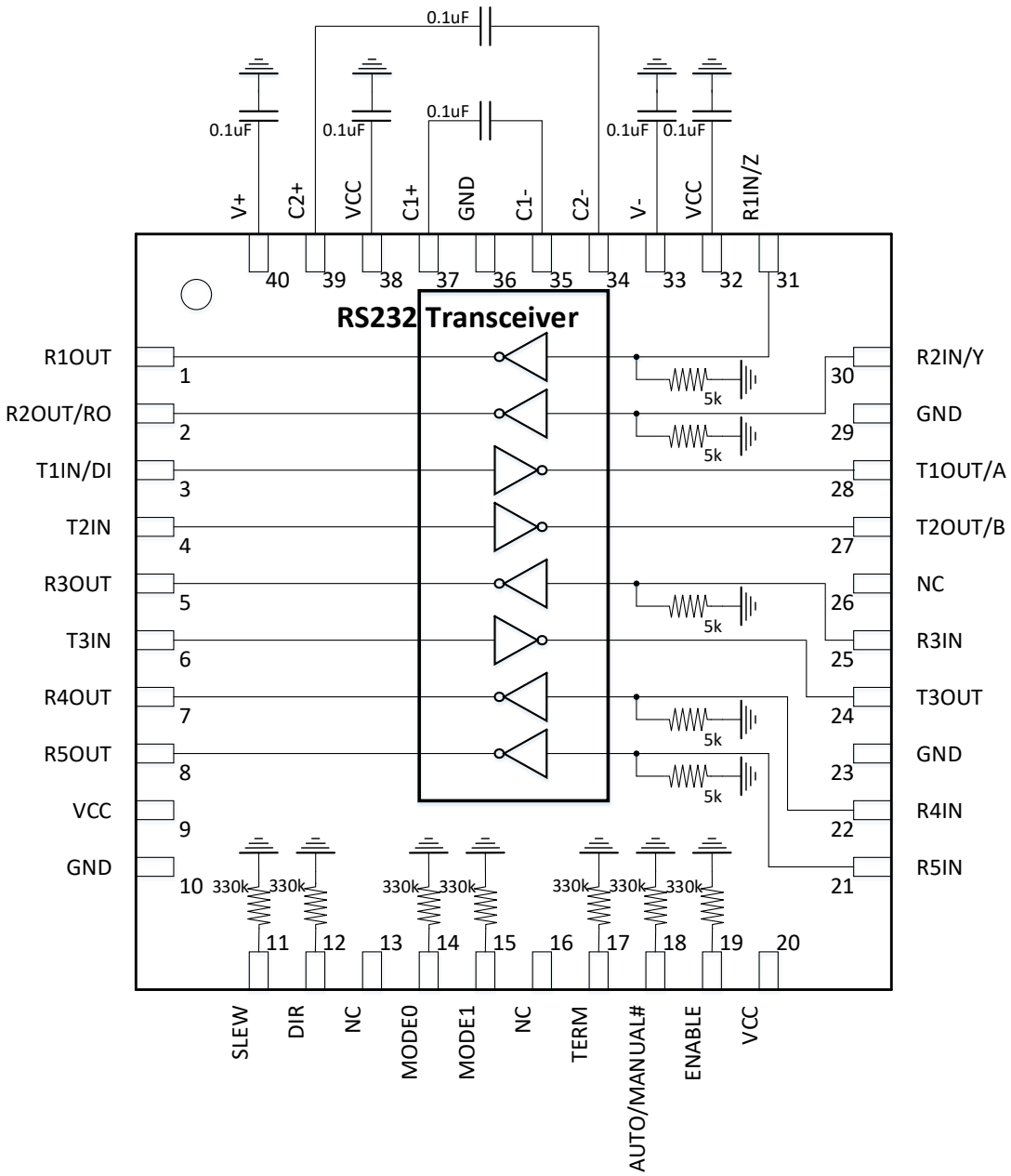
  ±4kV IEC 61000-4-2 (Contact & Air Gap) on the serial interface pins
- 6mm x 6mm QFN-40 Package (QFN: Quad Flat No-lead)
- Pin compatible with SP339E of MAXLINEAR

3. Ordering Information

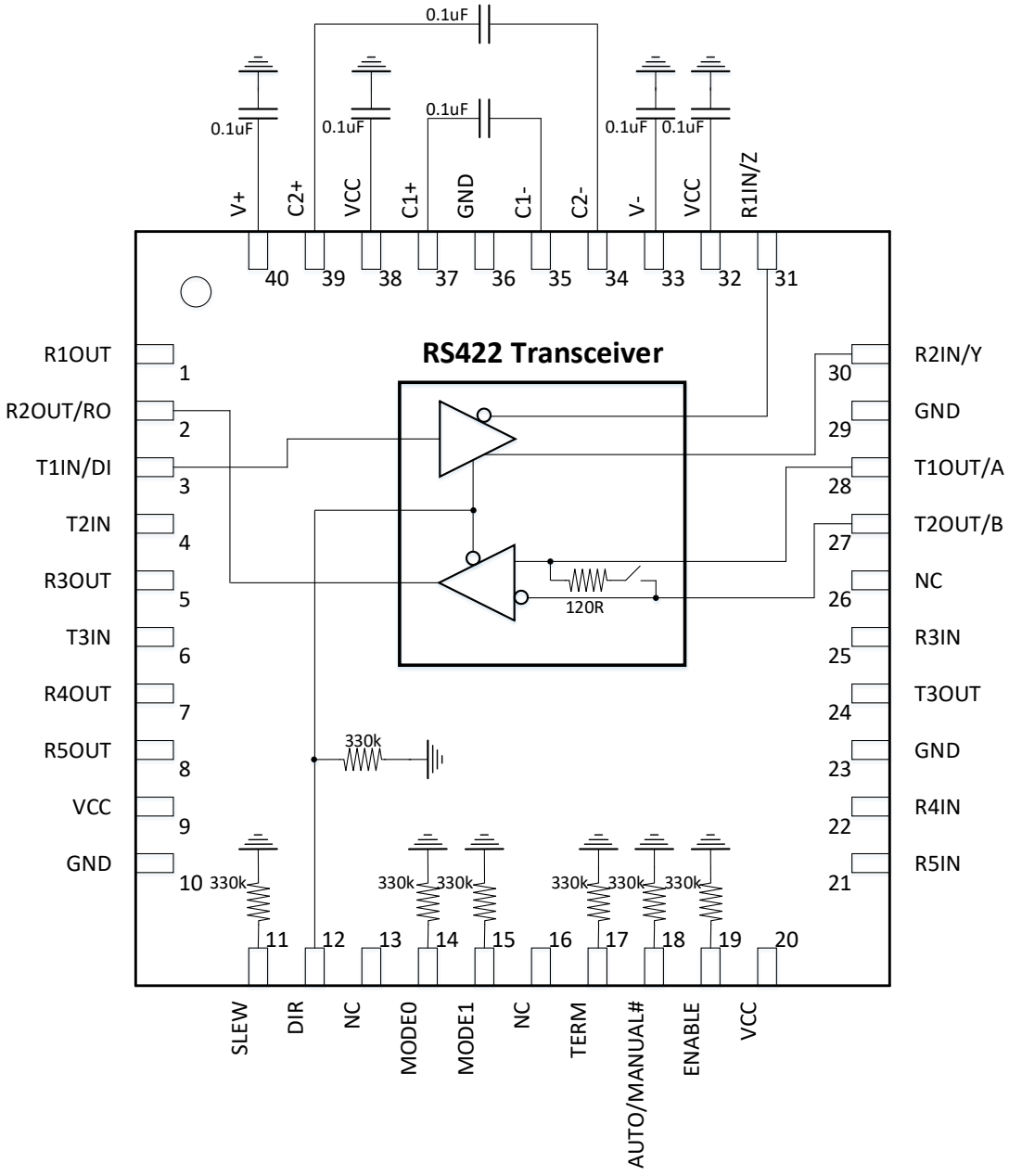
Part Number	Operating Temperature	RoHS	Package	Packaging
SB300	-40°C ~ +85°C	Y	40-pin QFN (6mm x 6mm)	Tray

4. Block Diagram

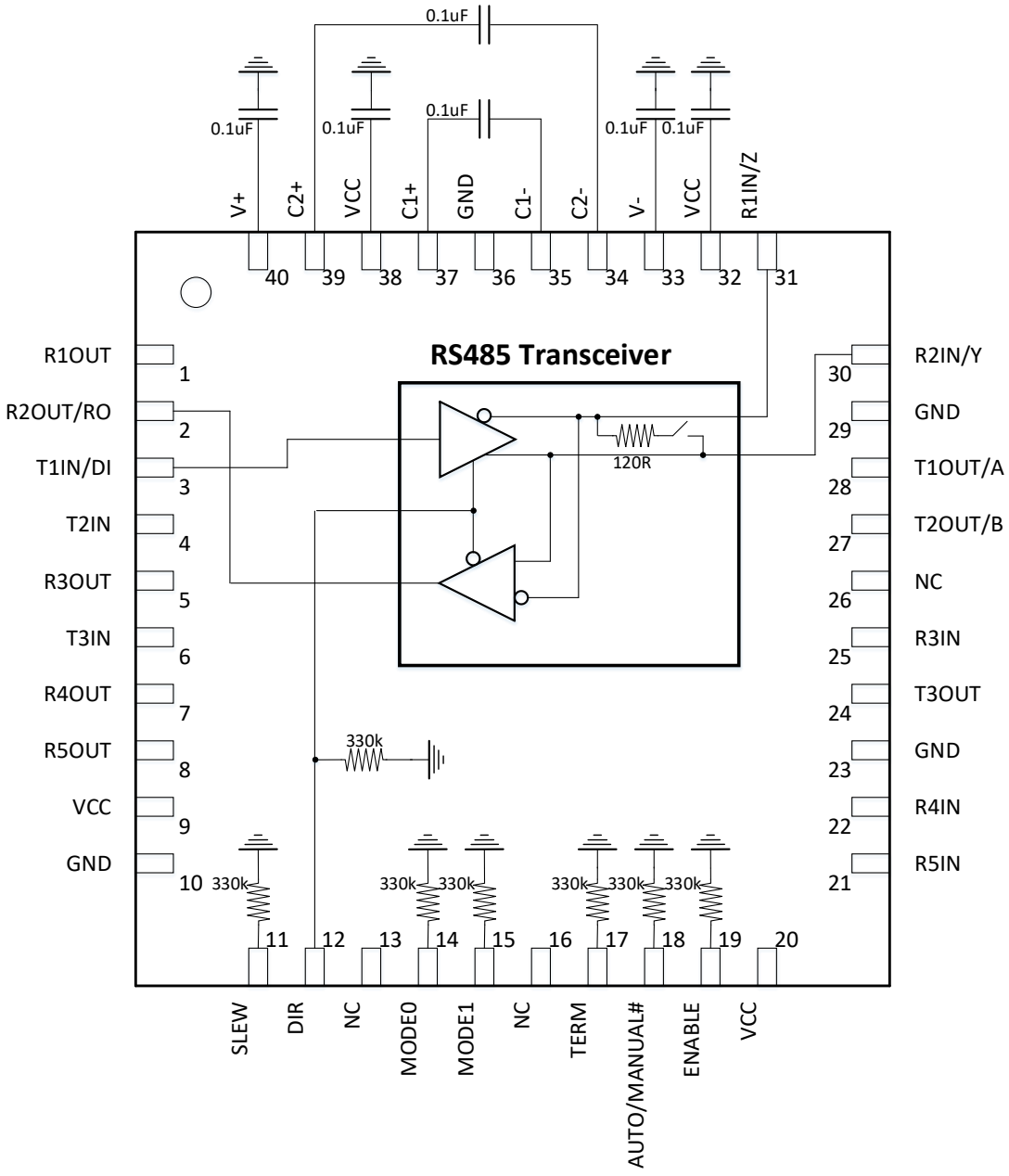
4.1 RS232 Block Diagram



4.2 RS422 Block Diagram

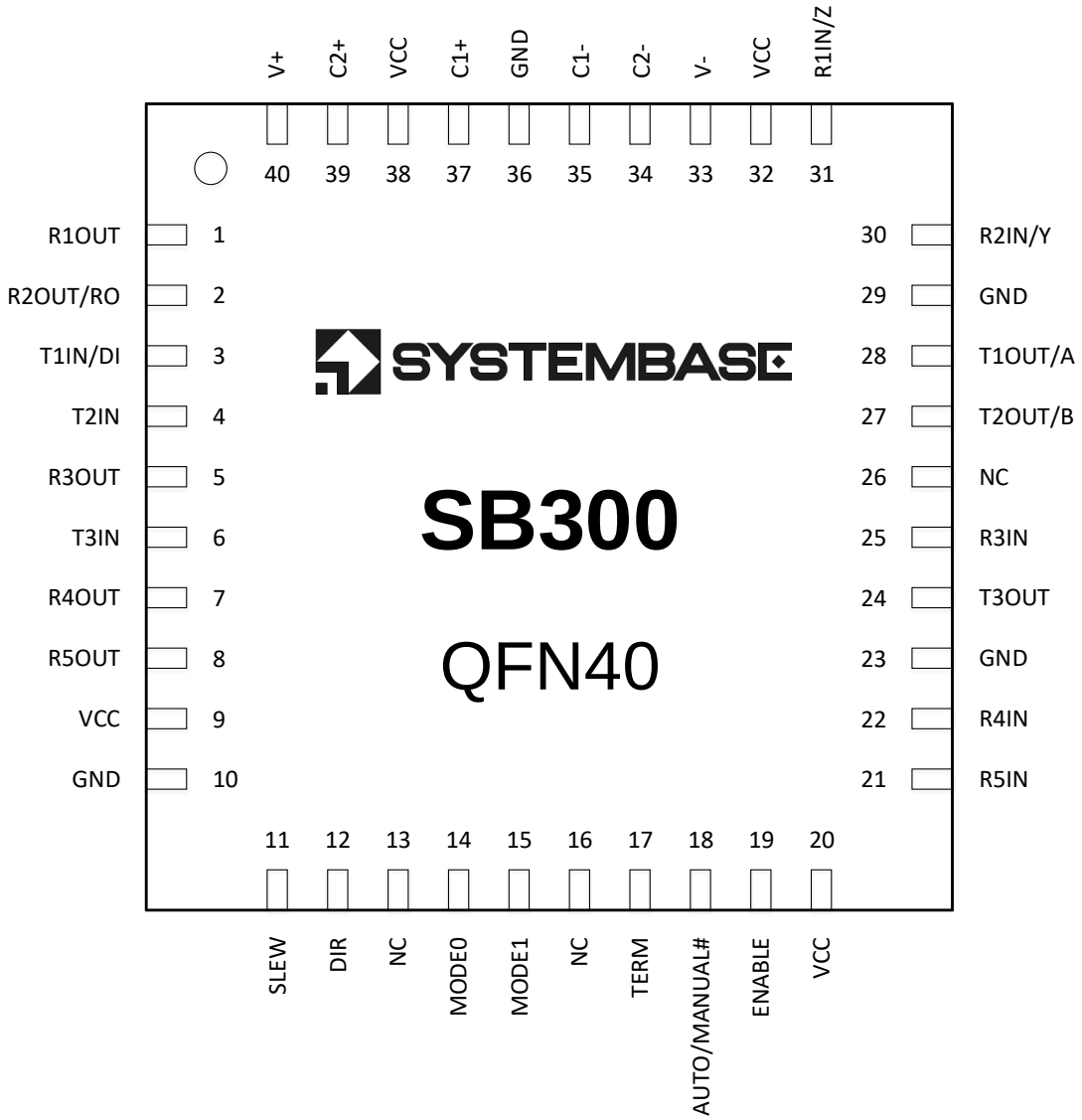


4.3 RS485 Block Diagram



5. Pin Configuration

5.1 Pin Configuration for 40-pin QFN Package



5.2 Pin Description

5.2.1 Pin Description

No.	Name	Description
1	R1OUT	TTL/CMOS Receiver Output(RS232)
2	R2OUT/RO	TTL/CMOS Receiver Output(RS232) or Receiver Output. When DIR is low and if (A - B) ≥ -50mV, RO is high; if (A - B) ≤ -200mV, RO is low.
3	T1IN/DI	TTL/CMOS Transmitter Input(RS232) or Driver Input. With DIR high, a low on DI forces noninverting output low and inverting output high. Similarly, a high on DI forces noninverting output high and inverting output low
4	T2IN	TTL/CMOS Transmitter Input(RS232)
5	R3OUT	TTL/CMOS Receiver Output(RS232)
6	T3IN	TTL/CMOS Transmitter Input(RS232),
7	R4OUT	TTL/CMOS Receiver Output(RS232)
8	R5OUT	TTL/CMOS Receiver Output(RS232)
9	VCC	+3.3V to +5.0V Supply Voltage.
10	GND	Ground
11	SLEW	Slew-Rate Limit Selector Pin. Connect SLEW to ground for 10Mbps communication rate; connect to VCC for 250kbps communication rate.
12	DIR	Driver/Receiver Output Enable. Drive DIR high to enable driver outputs. Drive DIR low to enable RO. This Pin only function RS422/485 not RS232
13	NC	No connect
14	MODE0	Pin-Selectable Mode Functionality Input with MODE0 and MODE1. Operates as RS232/ 422/ 485Nonecho/ 485Echo. MODE[1:0] = 00, RS485 Echo mode MODE[1:0] = 01, RS232 mode MODE[1:0] = 10, RS485 Non Echo mode MODE[1:0] = 11, RS422 mode
15	MODE1	
16	NC	No connect
17	TERM	Active-High Termination 120Ω Resistor Enable. Drive TERM high to enable the internal termination resistor. This Pin only function RS422/485 not RS232

No.	Name	Description
18	AUTO/MANUAL#	This input pin provides to select the automatic switching (Internal DI, RE) function during RS422/485 transmitting or receiving. This Pin only function RS422/485 not RS232. When high is inputted, DE and RE# of RS422/RS485 transceiver is toggled automatically. Default setting is Manual Toggle with internal pull-down resistor.
19	ENABLE	Active high. Drive low to shut down transmitters, receivers and on-board charge pump. This overrides all.
20	VCC	+3.3V to +5.0V Supply Voltage.
21	R5IN	TTL/CMOS Transmitter Input(RS232)
22	R4IN	TTL/CMOS Transmitter Input(RS232)
23	GND	Ground
24	T3OUT	TTL/CMOS Receiver Output(RS232)
25	R3IN	TTL/CMOS Transmitter Input(RS232)
26	NC	No Connect
27	T2OUT/B	TTL/CMOS Receiver Output(RS232), Inverting Receiver Input It is required to use proper external pull-up & pull-down resistors for fail-safe on RS422 mode.
28	T1OUT/A	TTL/CMOS Receiver Output(RS232), Noninverting Receiver Input It is required to use proper external pull-up & pull-down resistors for fail-safe on RS422 mode.
29	GND	Ground
30	R2IN/Y	Noninverting Driver Output It is required to use proper external pull-up & pull-down resistors for fail-safe on RS485 mode.
31	R1IN/Z	Inverting Driver Output It is required to use proper external pull-up & pull-down resistors for fail-safe on RS485 mode.
32	VCC	+3.3V to +5.0V Supply Voltage.
33	V-	-5.5V generated by the charge pump. This Pin must be connected capacitor of 0.1 µF capacitors to GND
34	C2-	Negative terminal of inverting Charge-Pump Capacitor. This Pin must be connected capacitor of 0.1 µF capacitors to C2+
35	C1-	Negative terminal of inverting Charge-Pump Capacitor. This Pin must be connected capacitor of 0.1 µF capacitors to C1+

No.	Name	Description
36	GND	Ground
37	C1+	Positive terminal of inverting Charge-Pump Capacitor
38	VCC	+3.3V to +5.0V Supply Voltage.
39	C2+	Positive terminal of inverting Charge-Pump Capacitor
40	V+	+5.5V generated by the charge pump. This Pin must be connected capacitor of 0.1 µF capacitors to ground.

5.2.2 Pin Description by MODE

Pin	Name	01 (RS232)	11 (RS422)	10 (RS485NonEcho)	00 (RS485Echo)
1	R1OUT	R1OUT	-		
2	R2OUT/RO	R2OUT	RO		
3	T1IN/DI	T1IN	DI		
4	T2IN	T2IN	-		
5	R3OUT	R3OUT	-		
6	T3IN/AUTO	T3IN	-		
7	R4OUT	R4OUT	-		
8	R5OUT	R5OUT	-		
9	VCC	VCC			
10	GND	GND			
11	SLEW	SLEW			
12	DIR	-	DIR		
13	NC	NC			
14	MODE0	**1**	**1**	**0**	**0**
15	MODE1	**0**	**1**	**1**	**0**
16	NC	NC			
17	TERM	-	TERM		
18	Auto/Manual#	-	AUTO/MANUAL#		
19	ENABLE	ENABLE			
20	VCC	VCC			
21	R5IN	R5IN	-		
22	R4IN	R4IN	-		
23	GND	GND			
24	T3OUT	T3OUT	-		
25	R3IN	R3IN	-		
26	NC	NC			

Pin	Name	01 (RS232)	11 (RS422)	10 (RS485NonEcho)	00 (RS485Echo)
27	T2OUT/B	T2OUT	B	-	
28	T1OUT/A	T1OUT	A	-	
29	GND	GND			
30	R2IN/Y	R2IN	Y		
31	R1IN/Z	R1IN	Z		
32	VCC	VCC			
33	V-	V-			
34	C2-	C2-			
35	C1-	C1-			
36	GND	GND			
37	C1+	C1+			
38	VCC	VCC			
39	C2+	C2+			
40	V+	V+			

5.3 Recommended DB9 Connector Pin Map

DB9	RS232	RS422	RS485
1	DCD	TXD-	TRXD-
2	RXD	TXD+	TRXD+
3	TXD	RXD+	
4	DTR	RXD-	
5	GND		
6	DSR		
7	RTS	(RXD-)	
8	CTS		
9	RI		

※ Upper DB9 Connector Pin Map is for DTE mode.

6. Electrical Information

6.1 Absolute Maximum Ratings

over operation free-air temperature range, T_A=25℃ (unless otherwise noted)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.3~6.0	V
Receiver Input Voltage (from Ground)	V_{RI}	±18	V
Driver Output Voltage (from Ground)	V_O	±18	V
Voltage at TLL Input/output Pins		-0.3~6.0	V
Short Circuit Duration, TX out to Ground		Continuous	
Operating Junction Temperature Range	T_J	-40~85	℃
Storage Temperature Range	T_{STG}	-65~150	℃
Power Dissipation		500	mW

Notice

1) Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied.

2) Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

3) This product is sensitive to ESD, so care must be taken when handling it. In addition, this product should be stored in an appropriate storage environment using dedicated storage materials.

6.2 Recommended Operating Conditions

Parameter	Symbol	Value		Unit
		Min	Max	
Supply voltage	V_{CC}	3.0	5.5	V
High-level input voltage※1	V_{IH} (V_{CC}=3.3V)	2.0		V
	V_{IH} (V_{CC}=5.0V)	2.4		V
Low-level input voltage※2	V_{IL}		0.8	V
Operating free-air temperature	T_A	-40	85	℃

※1 TTL/ CMOS input and output pin(TxIN, RxOUT, SLEW, MODE[1:0], ENABLE).

※2 RS232, RS422, RS485 and power pins are not applicable.

6.3 ESD Characteristics

Mode	Characteristic			Unit
	min	typ	max	
HBM (Human Body Model) - Serial interface pins	-8	-	+8	kV
HBM (Human Body Model) - All other pins	-2	-	+2	kV
IEC61000-4-2 Air Gap Discharge - Serial interface pins	-4	-	+4	kV
IEC61000-4-2 Contact Discharge - Serial interface pins	-4	-	+4	kV

※ Serial interface pins are RS232 and RS422/485 signal pins

6.4 DC Characteristics

V_{CC}=3.3V±5% or 5.0V±5%, T_A=Tmin to Tmax, (Unless otherwise noted) Typical values are at V_{CC} =3.3V, T_A=25℃

Characteristics	Symbol	Condition	Value			Unit
			Min	Typ	Max	
DC Characteristics						
Supply Voltage Range	V_{CC}		3.0		5.5	V
Supply Current (No load) @ 3.3V	I_{CC}	RS232 Mode		2.5	5	mA
		RS422 Mode		1.5	4	mA
		RS485 Mode		1	3	mA
Supply Current (No load) @ 5.0V		RS232 Mode		3.0	5	mA
		RS422 Mode		2.0	5	mA
		RS485 Mode		1.5	4	mA
Transmitter and Logic Input: Pins 3,4,6,11,12,14,15,17,19						
High-level input voltage	V_{IH}	V_{CC} =3.0V	2.0			V
		V_{CC} =5.0V	2.4			V
Low-level input voltage	V_{IL}				0.8	V
Logic Input Leakage Current Low	I_{IL}	Input Low (V_{IN}=0V)			1	uA
Logic Input Leakage Current High	I_{IH}	Input High (V_{IN}= V_{CC}), Pins 3, 4 and 6			1	uA
Pull-down Input Current	I_{PD}	Input Low(Vin=VCC), Pins 11,12,14,15,17,19			50	uA
Logic Input Hysteresis	V_{HYS}			200		mV
Receiver Outputs: Pins 1,2,5,7,8						
Receiver Output Voltage High	V_{OH}	I_{OUT}= -1.5mA	V_{CC}- 0.6			V
Receiver Output Voltage Low	V_{OL}	I_{OUT}= 2.5mA			0.4	V
Output Short-Circuit Current	O_{SCC}			±20		mA

Characteristics	Symbol	Condition	Value			Unit
			Min	Typ	Max	
RS232 Receiver Inputs						
Input Voltage Range	V_{IN}		-15		15	V
Input Threshold Low	V_{IL}	V_{CC}=3.3V	0.6	1.2		V
		V_{CC}=5.0V	0.8	1.5		V
Input Threshold High	V_{IH}	V_{CC}=3.3V		1.5	2.0	V
		V_{CC}=5.0V		1.8	2.4	V
Input Hysteresis	V_{HYS}			0.3		V
Input Resistance	R_{IN}		3	5	7	kΩ
RS232 Driver Outputs						
Output Voltage Swing	V_O	Output loaded with 3kΩ to GND ,V_{CC}=3.3V	±5.0	±5.5		V
		No load, V_{CC}=3.3V			±6.6	V
		Output loaded with 3kΩ to GND ,V_{CC}=5V	±6.0	±7		V
		No load, V_{CC}=5V			±10	
Short Circuit Current	I_{SC}				±60	mA
Output Resistance	Ro	V_{CC}=0V, V_O=±2V	300	10M		Ω
RS422/485 Receiver Inputs						
Receiver Input Resistance	R_{IN}	TERM=0V, -7V ≤ V_{IN} ≤ 12V	96			kΩ
Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{IN} ≤ 12V	-200	-125	-50	mV
Receiver Input Hysteresis	ΔV_{TH}			25		mV
Receiver Input Current	I_{IN}	V_{IN}=+12V			125	uA
		V_{IN}=-7V	-100			uA
Tri-State Output Current at Receiver	I_{OZR}	0V ≤ V_O ≤ V_{CC}			±1	uA
Receiver Output Short-Circuit Current	I_{OSR}	0V ≤ V_O ≤ V_{CC}			±80	mA
Termination Resistance	R_{TERM}			120		Ω

Characteristics	Symbol	Condition	Value			Unit
			Min	Typ	Max	
RS422/485 Driver Outputs						
Differential Driver Output	V_{OD}	R_L=100Ω (RS422)	2		V_{CC}	V
		R_L =54Ω (RS485)	1.5		V_{CC}	V
		-7V ≤ V_{CM} ≤ +12V	1.5		V_{CC}	V
		No load			V_{CC}	V
Change in Magnitude of Driver Differential Output Voltage	ΔV_{OD}	R_L=54Ω or 100Ω	-0.2		0.2	V
Driver Common-Mode Output Voltage	V_{OC}	R_L=54Ω or 100Ω		V_{CC}/2	3	V
Change in magnitude of Common mode output voltage	ΔV_{OD}	R_L =54Ω or 100Ω			0.2	V
Driver Output Short Circuit Current	I_{OSD}	0V ≤ V_O ≤ +12	50		250	mA
		-7V ≤ V_O ≤ 0V	-250		-50	mA

6.5 Timing Characteristics

V_{CC}=3.3V±5% or 5.0V±5%, T_A=Tmin to Tmax, (Unless otherwise noted) Typical values are at V_{CC} =3.3V, T_A=25℃

Characteristics	Symbol	Condition	Value			Unit
			Min	Typ	Max	
RS232, Data Rate = 250kbps (SLEW=V_{CC})						
Maximum Data Rate		R_L=3kΩ, C_L=1000pF	250			kbps
Receiver Propagation Delay	t_{RHL}, t_{RLH}	C_L=150pF		100		ns
Receiver Propagation Delay Skew	$\|t_{RHL}-t_{RLH}\|$				100	ns
Driver Propagation Delay	t_{DHL},t_{DLH}	R_L=3kΩ, C_L=2500pF		1400		ns
Driver Propagation Delay Skew	$\|t_{DHL}-t_{DLH}\|$				600	ns
Transition Region Slew Rate from 3V to -3V or -3V to 3V	Ts	R_L=3kΩ to 7kΩ, C_L=150pF to 2500pF	6		30	V/us
RS232, Data Rate = 1Mbps (SLEW=0)						
Maximum Data Rate		R_L=3kΩ, C_L=250pF	1			Mbps
Receiver Propagation Delay	t_{RHL},t_{RLH}	C_L=150pF		100		ns
Receiver Propagation Delay Skew	$\|t_{RHL}-t_{RLH}\|$				100	ns
Driver Propagation Delay	t_{DHL},t_{DLH}	R_L=3kΩ, C_L=1000pF		300		ns
Driver Propagation Delay Skew	$\|t_{DHL}-t_{DLH}\|$				150	ns
Transition Region Slew Rate from 3V to -3V or -3V to 3V	T_S	R_L=3kΩ to 7kΩ, C_L=150pF to 1000pF	24		150	V/us
RS485/RS422, Data Rate = 250kbps (SLEW=V_{CC})						
Maximum Data Rate		R_L=54Ω, C_L=50pF	250			kbps
Receiver Propagation Delay	t_{RHL},t_{RLH}	C_L=15pF		50	150	ns
Receiver Propagation Delay Skew	$\|t_{RHL}-t_{RLH}\|$				20	ns

Characteristics	Symbol	Condition	Value			Unit
			Min	Typ	Max	
RS485/RS422, Data Rate = 250kbps (SLEW=V_{CC})						
Receiver Output Enable Time	t_{REN}	C_L=15pF			200	ns
Receiver Output Disable Time	t_{RDIS}				200	ns
Driver Propagation Delay	t_{DHL},t_{DLH}	R_L=54Ω, C_L=50pF		500	1000	ns
Driver Propagation Delay Skew	$\|t_{DHL}-t_{DLH}\|$				100	ns
Driver Rise and Fall Time	t_{DR},t_{DF}		300	650	1200	ns
Driver Output Enable Time	t_{DEN}	R_L=500Ω, C_L=50pF (Receiver enabled)			1000	ns
Driver Output Disable Time	t_{DDIS}				200	ns
RS-485/RS-422, Data Rate = 10Mbps (SLEW=0)						
Maximum Data Rate		R_L=54Ω, C_L=50pF	10			Mbps
Receiver Propagation Delay	t_{RHL},t_{RLH}	CL=15pF		50	150	ns
Receiver Propagation Delay Skew	$\|t_{RHL}-t_{RLH}\|$				10	ns
Receiver Output Enable Time	t_{REN}	CL=15pF			200	ns
Receiver Output Disable Time	t_{RDIS}				200	ns
Driver Propagation Delay	t_{DHL},t_{DLH}	RL=54Ω, CL=50pF		30	100	ns
Driver Propagation Delay Skew	$\|t_{DHL}-t_{DLH}\|$				10	ns
Driver Rise and Fall Time	t_{DR},t_{DF}			10	20	ns
Driver Output Enable Time	t_{DEN}	RL=500Ω, CL=50pF			200	ns
Driver Output Disable Time	t_{DDIS}				200	ns

7. Application Note

7.1 Detailed Description

The SB300 is a high-speed RS232, RS422, RS485 transceiver that includes several drivers and receivers. It can be used more usefully than other devices because it operates by selecting one of RS232 (Full-Duplex), RS422 (Full-Duplex), and RS485 (Half-Duplex) according to the mode signal. It can be selected point-to-point and multidrop modes on RS422 and non-echo and echo modes on RS485. In particular, it can be used in the loopback function on the RS485 echo mode for self-diagnosis. The transceiver supports high ESD protection. It also has a slew rate limiting function of the driver through which EMI can be minimized. When this function is used, the maximum speed is limited to 250 kbps.

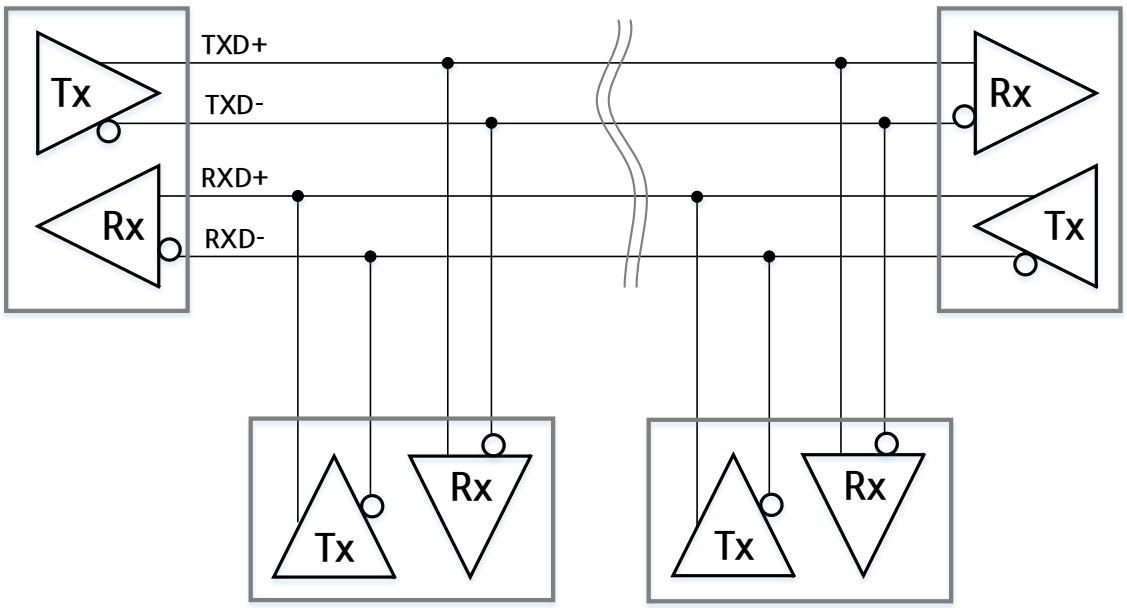
7.2 Application Information

RS232 Transceiver

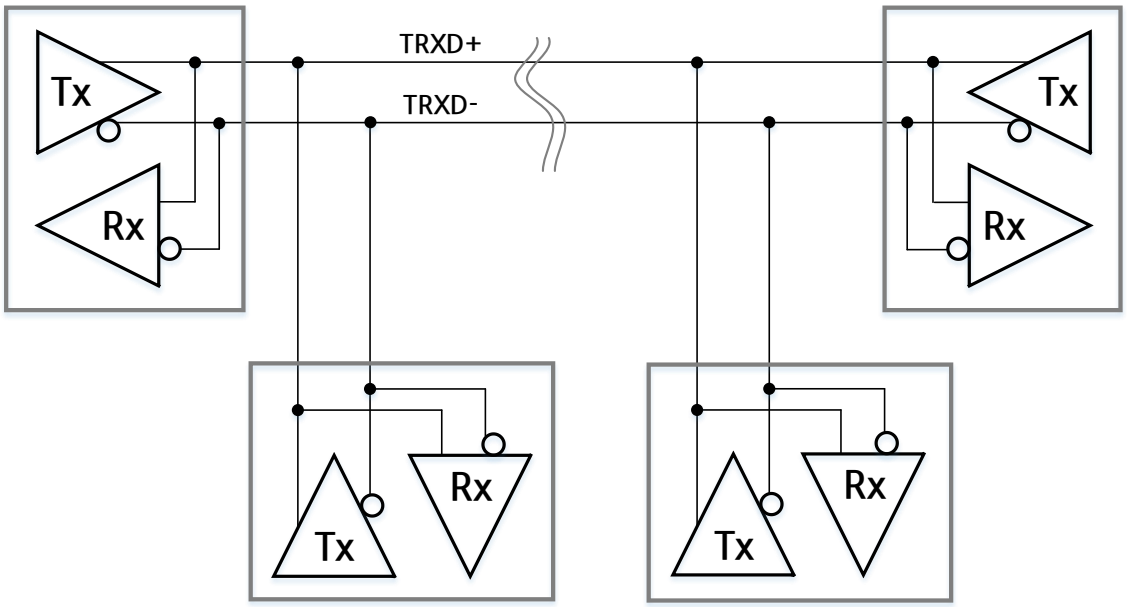
The SB300 is an asynchronous serial communication RS232 transceiver that meets the TIA/EIA-232-F specifications. It consists of 3 transmitters and 5 receivers and provides RS232 full signal. It contains a charge pump circuit inside.

RS422/RS485 Transceiver

SB300 is an RS422 and RS485 transceiver. It consists of 1 differential driver and 1 differential receiver, and it can support full-duplex and half-duplex mode communication. Thus, RS422 can operate in point-to-point and multidrop modes, and RS485 can operate in bidirectional data communication using one channel.



RS422 Network Connection



RS485 Network Connection

256 Transceivers on the Bus

The receiver of SB300 has 1/8-unit load, so it can communicate with up to 256 receivers on the bus. It is an ideal calculation, but it can be connected up to 32 receivers normally in a real field.

Receiver Input Impedance according to Unit Load

Unit Load	No. of Multi-drop Nodes	Min. Receiver Input Impedance
1	32	12kΩ
1/2	64	24kΩ
1/4	128	48kΩ
1/8	256	96kΩ

Reduced EMI and Reflections

The SB300 has a reduced slew-rate driver function to minimize EMI. It reduces reflections caused by improperly terminated cables. When the slew rate is limited with SLEW=VCC, error-free data transmission is allowed up to 250 kbps data rate speed. When the slew rate is not limited with SLEW=GND, it works in the normal mode up to 10Mbps data rate speed.

Mode Selective RS232/422/485

A combination of MODE0 and MODE1 pins provides the function of setting the motion of the SB300 transceiver.

When MODE0 is high and MODE1 is low, SB300 operates as an RS232 transceiver, and when both MODE pins are high, it operates as RS422(full duplex). MODE0 is low and MODE1 is high, it operates as RS485(half duplex) Non-Echo. Both MODE0 and MODE1 are low; SB300 operates in the RS485 Echo mode.

MODE[1:0]: 01 (RS232/ Full duplex)
MODE[1:0]: 11 (RS422/ Full duplex or 4 wire RS485)
MODE[1:0]: 10 (RS485 Non Echo/ Half duplex)
MODE[1:0]: 00 (RS485 Echo/ Half duplex)

Termination Resistor

The SB300 has a selectable internal termination resistor. When TERM is high, the termination resistor is enabled in the RS422/RS485 operation mode with internal 120Ω resistor. This function is meaningful only in the RS422/RS485 operation mode. When TERM is low, the termination resistor is disabled.

Bus Control for RS485/RS422 network

SB300 supports two bus control modes for RS485/RS422 network. One is Manual mode. The other is Auto mode. This mode can be set via pin 18, AUTO/MANUAL#. Pin 18 is only relevant when the SB300 operates in RS485 or RS422 mode. When operating in RS232 mode, it has no meaning, and any value applied does not matter. When logic '0' is applied to the AUTO/MANUAL# pin, the RS485/RS422 Transceiver operates in Manual mode. when logic '1' is applied to the AUTO/MANUAL# pin, the RS485/RS422 Transceiver operates in Auto Direction Control mode. Manual mode is an operation mode that directly controls the DE (Driver Enable) pin and RE# (Receiver Enable) pin from the outside, like a general RS485/RS422 Transceiver. Auto mode is an operation mode that does not require separate external control for RS485/RS422 Bus connection control and automatically controls the DE and RE# signals according to the data information applied through DI (Driver Input). In Auto mode, it is also called Auto Toggle mode or Auto Direction Control mode. When operating SB300 in Auto mode, you must use appropriate external pull-up resistors and pull-down resistors. In the case of RS485, use a pull-up resistor for TRXD+ and a pull-down resistor for TRXD-. In the case of RS422, use a pull-up resistor for TXD+ and a pull-down resistor for TXD-.

Fail-Safe

A standard RS485 receiver will be guaranteed a logic-high receiver output(RO) when the receiver differential inputs are open or Hi-Z(undriven from opposite driver) regarding EIA/TIA-485 standard Fail-Safe, have ±200mV. However, there are no internal pull-up and pull-down resistors in SB300 that are fail-safe. It is necessary to guarantee logic-high input data when the receiver inputs are open. In this case, it is easily affected by external cable noise; therefore, it is required to use proper external pull-up and pull-down resistors outside of SB300 for Fail-Safe. The value of the external pull-up and pull-down resistors is related to the idle voltage value on the bus (A-B). It also depends on how the line is terminated and how many nodes are on the bus. The value of the fail-safe resistor must guarantee that the idle voltage on the bus (A-B) is greater than the standard RS-485 receiver threshold voltage (±200mV).

ESD Protection

ESD protection structures were incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The driver outputs and receiver inputs of SB300 have extra protection against static electricity. The ESD structures withstand high ESD in all states: normal operation, shutdown, and power down. After an ESD event, the SB300 keeps working without latch-up or damage. ESD protection can be tested in various ways. The transmitter outputs and receiver inputs of SB300 are characterized for protection to the following limits:

- ±4kV using the contact discharge method specified in IEC 61000-4-2

Human Body Model

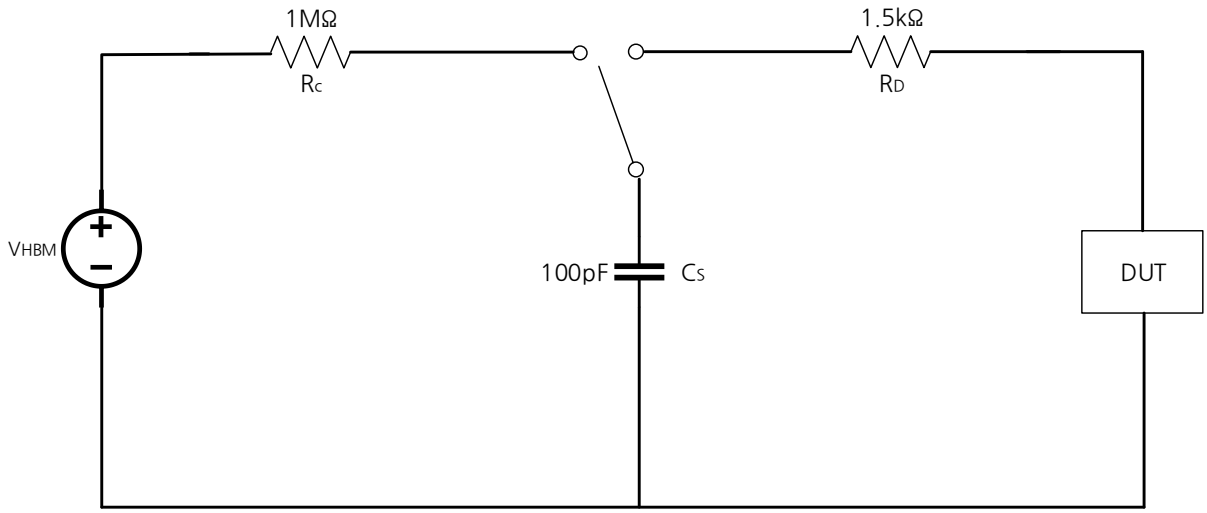


Figure 1

When ESD (Electro Static Discharge) is discharged, the human body is usually modeled with a 100pF, 1.5kΩ resistor. So, the energy charged in 100pF of the human body is discharged through 1.5kΩ. Figure 1 shows the Human Body Model related to ESD.

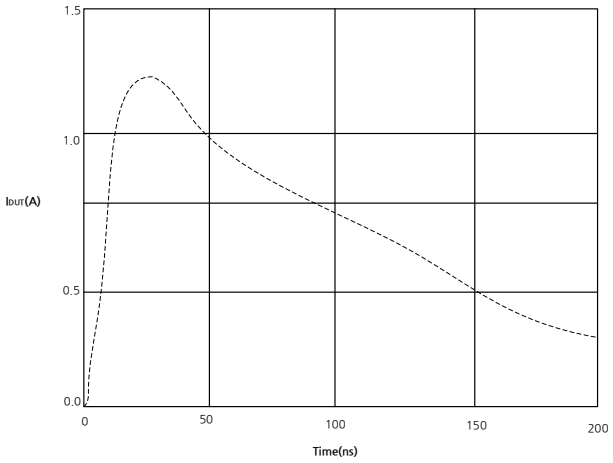


Figure 2

Figure 2 shows the discharge graph, which is the waveform of the discharge current over time. As you can see from the discharge graph, the discharge ends within 200ns.

IEC 61000-4-2

The IEC 61000-4-2 standard covers the ESD testing and performance of the finished equipment. However, it does not specifically refer to integrated circuits. SB300 helps equipment designs meet IEC 61000-4-2 without the need for additional ESD protection components. The major difference between tests performed using the Human Body Model and IEC 61000-4-2 is the higher peak current in IEC 61000-4-2 because the series resistance is lower in the IEC 61000-4-2 model. Hence, the ESD withstand voltage measured to IEC 61000-4-2 is generally lower than that measured using the human body model. Figure 3 shows the IEC 61000-4-2 model, and Figure 4 shows the current waveform for the IEC 61000-4-2 ESD Contact Discharge test

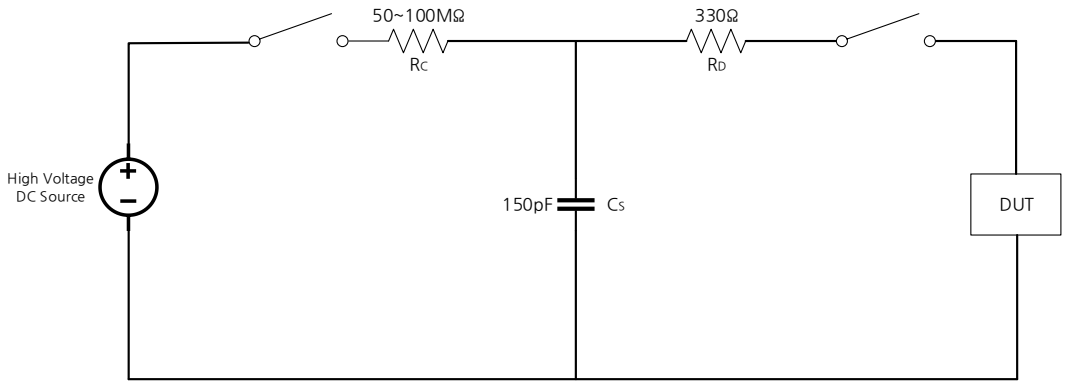


Figure 3

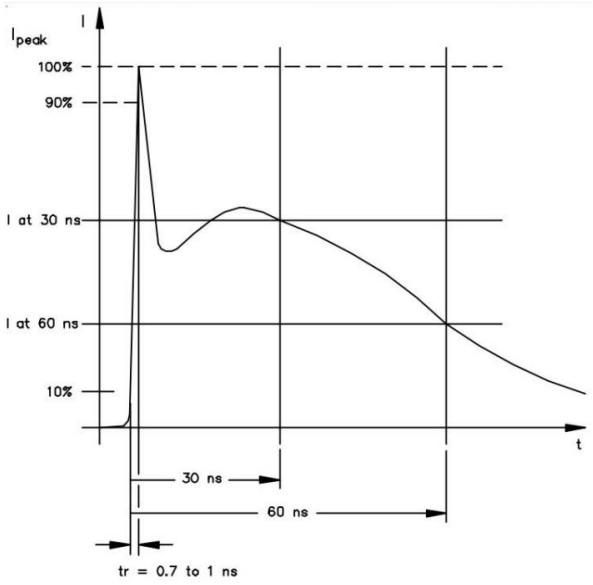
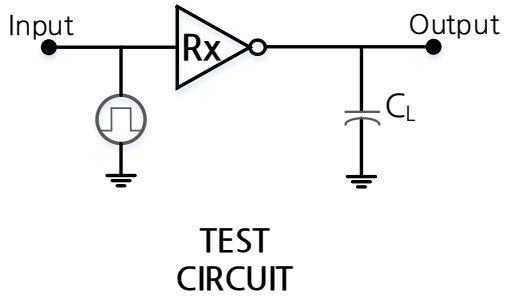


Figure 4

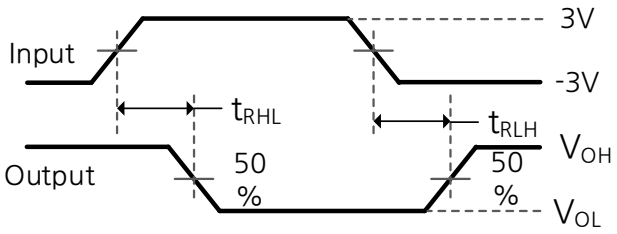
7.3 Test Circuits

7.3.1 RS232 Test Circuits

RS232 Receiver Propagation delay

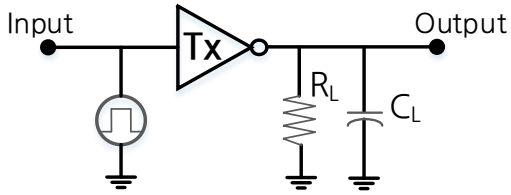


TEST CIRCUIT

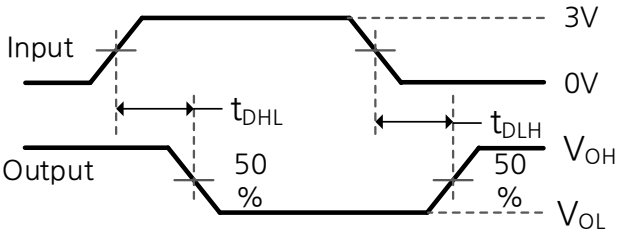


WAVEFORMS

RS232 Driver Propagation delay



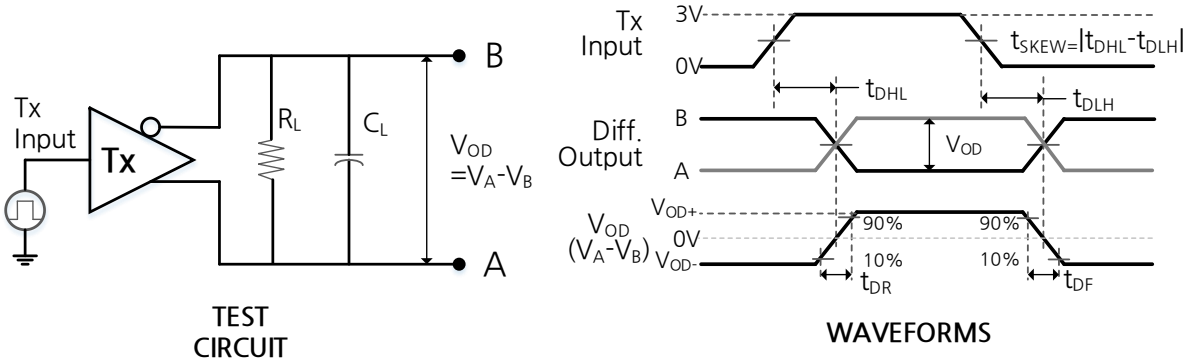
TEST CIRCUIT



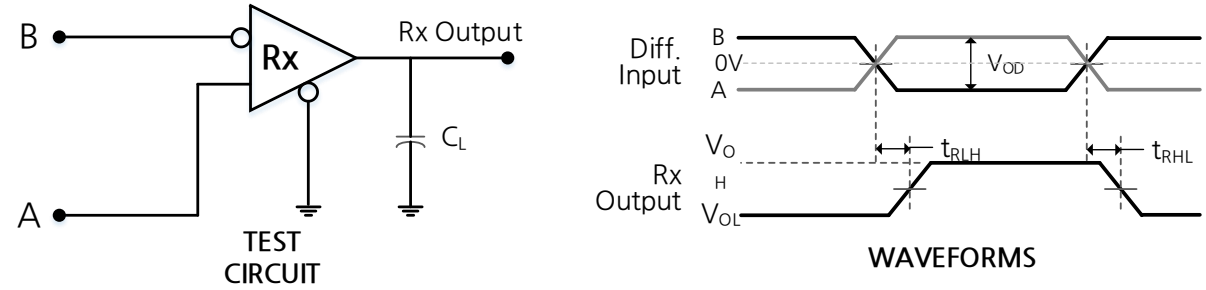
WAVEFORMS

7.3.2 RS422/RS485 Test Circuits

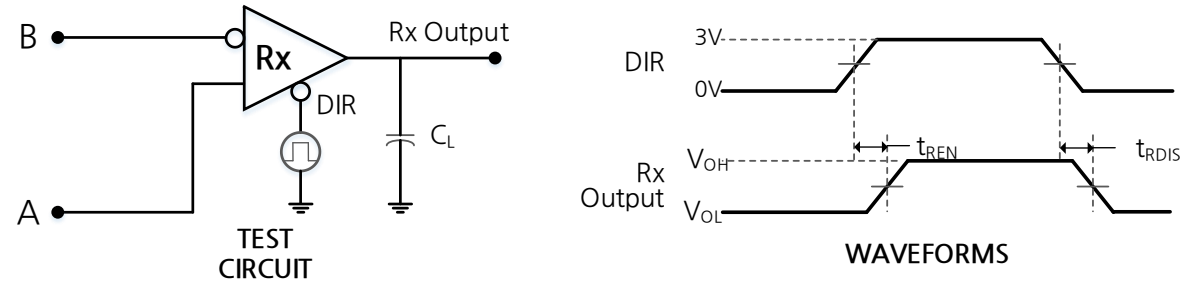
RS422/RS485 Driver Propagation delay and rise/fall time



RS422/RS485 Receiver Propagation delay

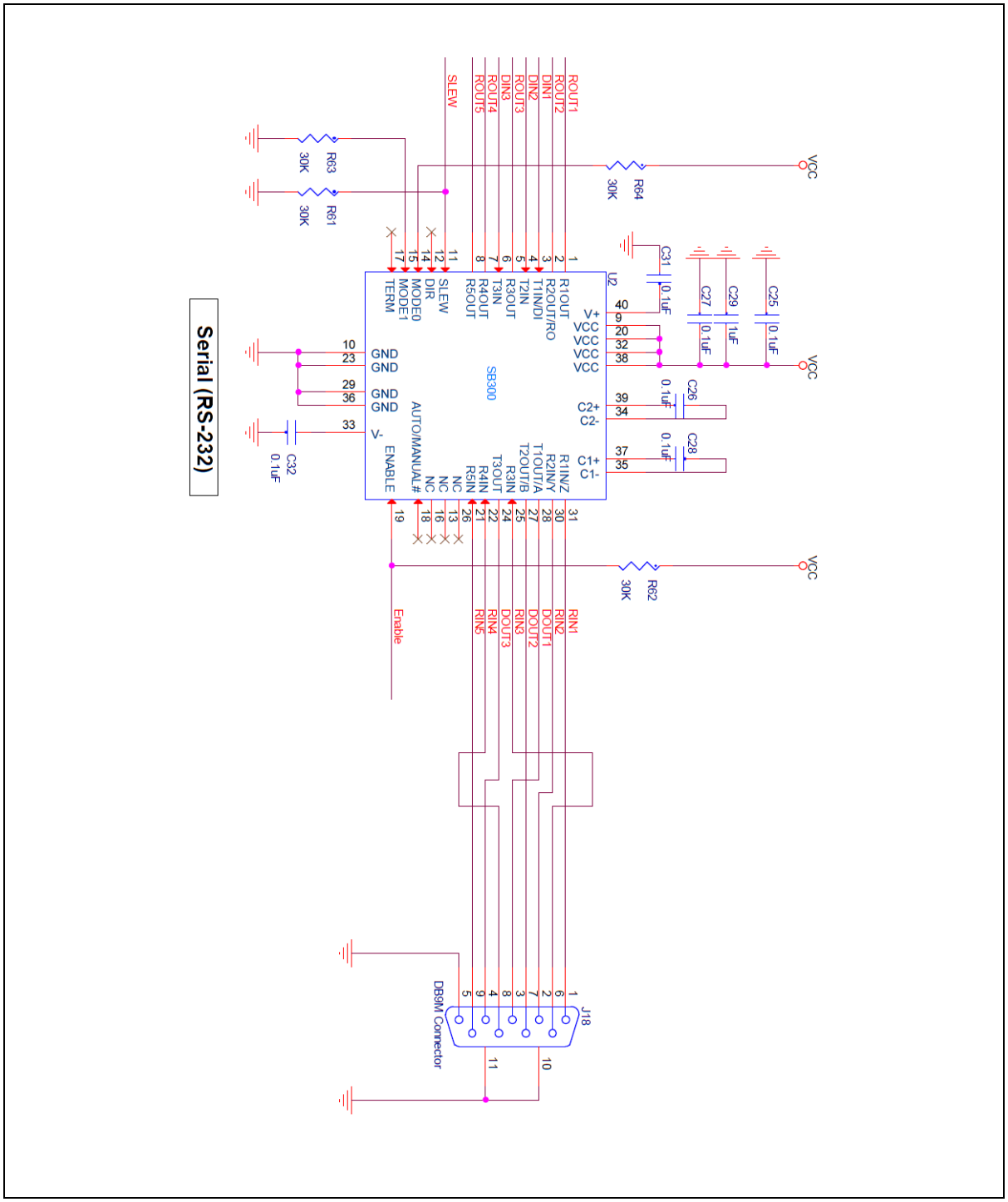


RS422/RS485 Receiver Output Enable enable/disable time

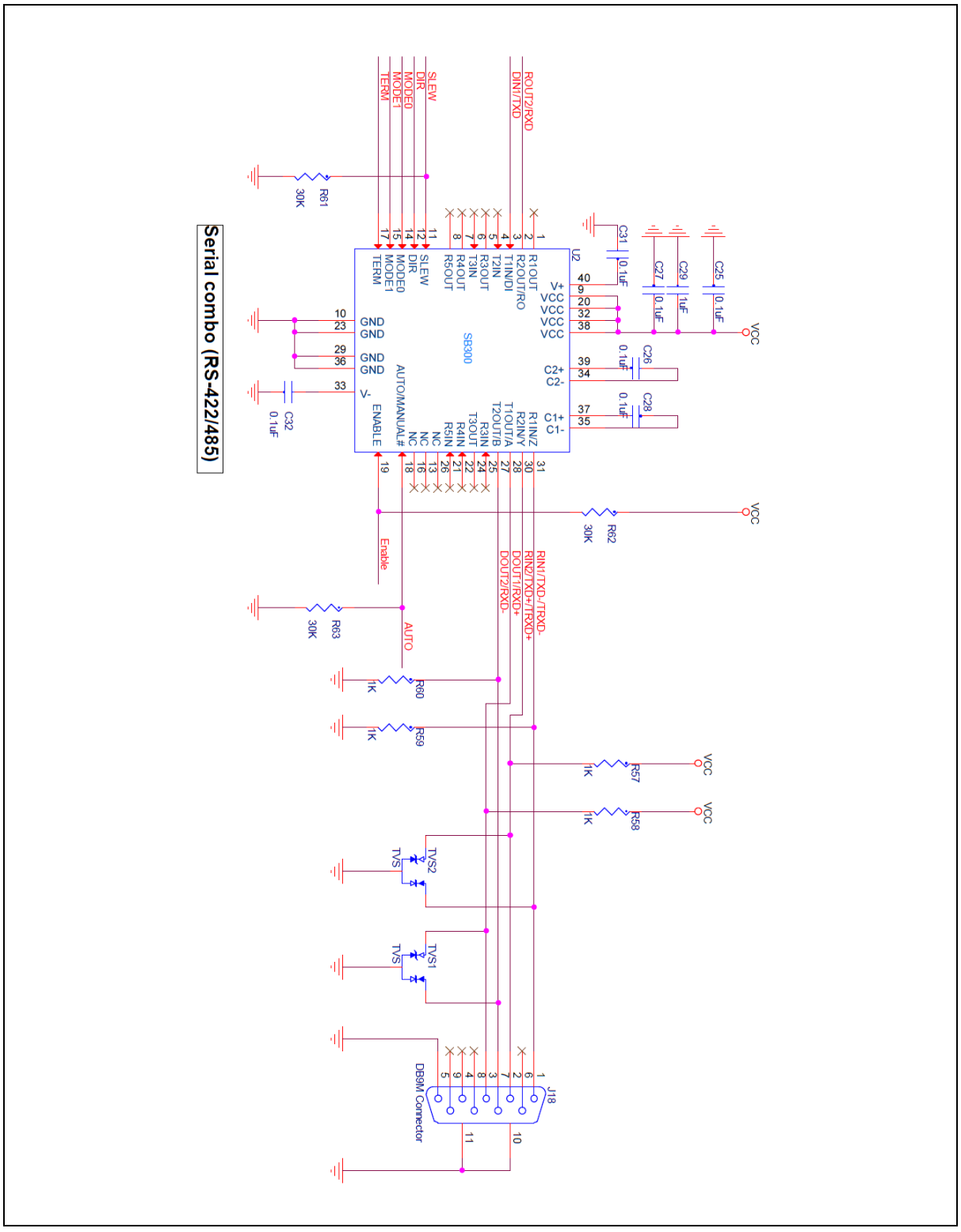


7.4 Reference Circuits

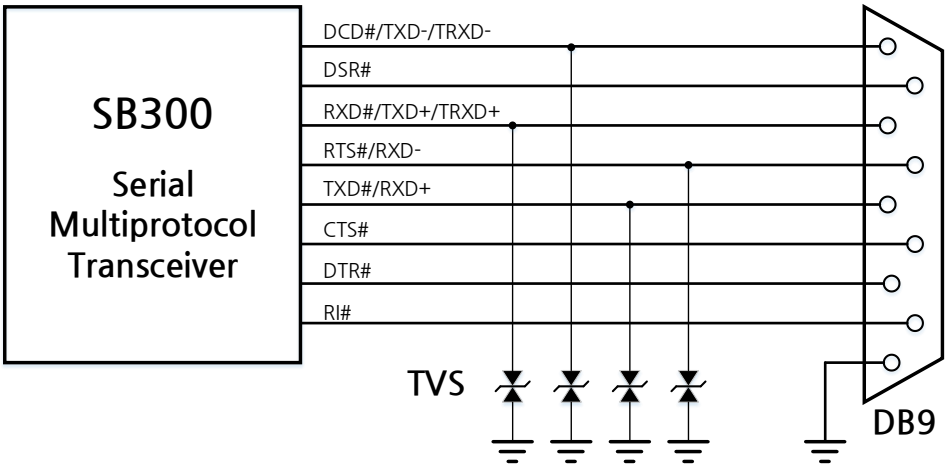
7.4.1 RS232 Transceiver Reference Circuits



7.4.2 RS422/RS485 Transceiver Reference Circuits



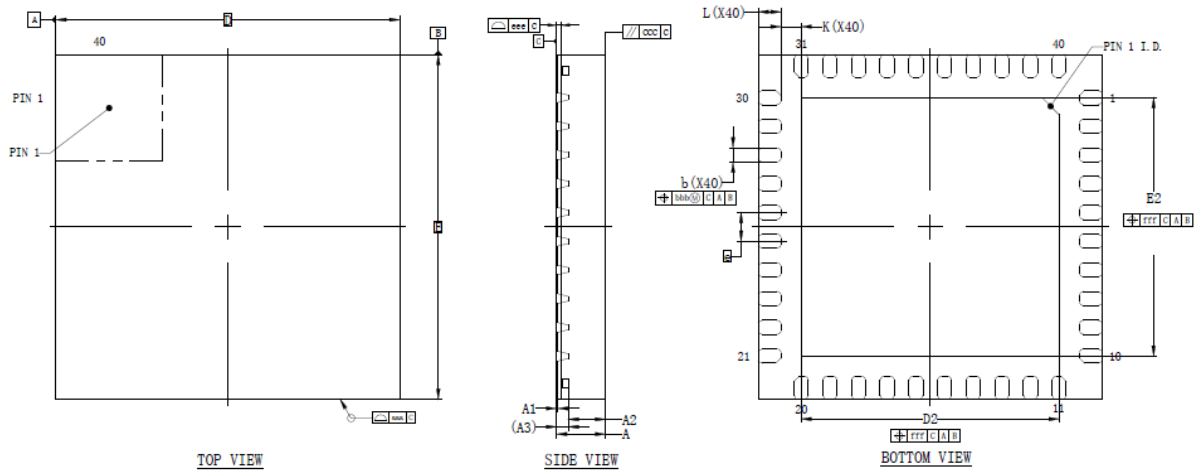
7.4.3 How to build up Surge Protection



Users can build up the surge protection of SB300 using TVS(Transient Voltage Suppressor) components. In the RS422 and RS485 modes, TVS components are used on the RS422 and RS485 bus like an upper reference circuit.

8. Mechanical Dimensions

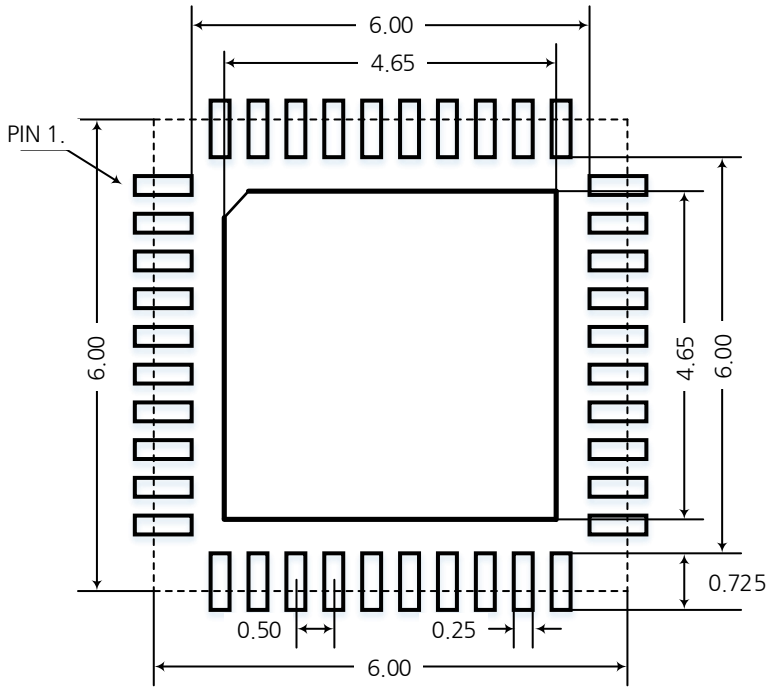
8.1 QFN-40 foot print



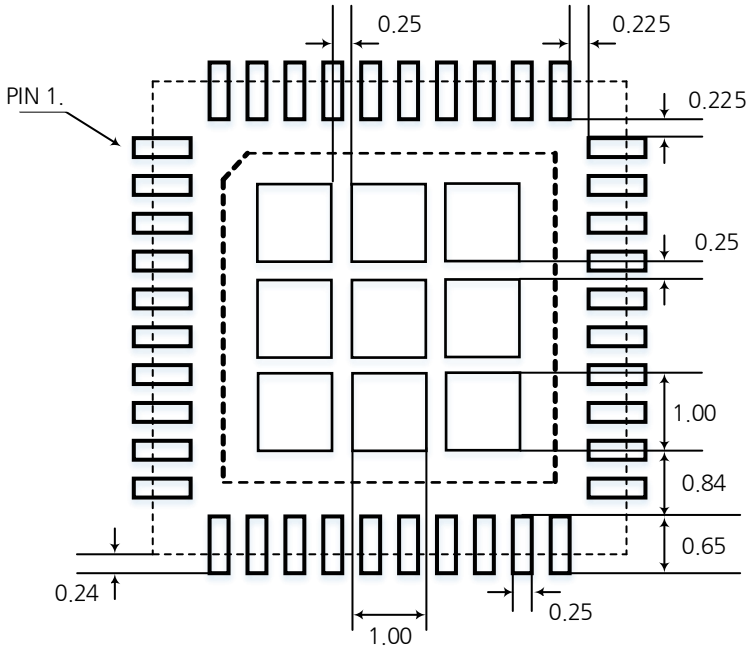
Item		Symbol	Minimum	Normal	Maximum
Body Size	X	D		6.0 BSC	
	Y	E		6.0 BSC	
Exposed Pad Size	X	D2	4.40	4.50	4.60
	Y	E2	4.40	4.50	4.60
Total Thickness		A	0.80	0.85	0.90
Stand Off		A1	0	0.02	0.05
Molding Thickness		A2		0.65	
LF Thickness		A3		0.203 REF	
Lead Width		b	0.20	0.25	0.30
Lead Length		L	0.30	0.40	0.50
Lead Pitch		e		0.5 BSC	
Lead tip to Exposed Pad		K		0.35 REF	
Package Edge Tolerance		aaa		0.10	
Lead Offset		bbb		0.10	
Molding Flatness		ccc		0.10	
Coplanarity		eee		0.08	
Exposed Pad Offset		fff		0.10	

Note :
1.Refer to JEDEC Standard MO-220 WJJD-4

8.2 Artwork Guideline for QFN-40 package



TYPICAL RECOMMENDED LAND PATTERN



TYPICAL RECOMMENDED STENCIL

Revision History		
Data	Revision	Description
Oct 17 2024	Ver 1.00	Initial release
Nov 11 2024	Ver 1.01	Revised mechanical dimensions
Dec 11 2024	Ver 1.02	Modifying Content
Mar 31 2025	Ver 1.03	Modifying Content