## RS-232/RS-485/RS-422 TRANSCEIVER WITH INTERNAL TERMINATION

APRIL 2020 REV. 1.0.3

#### GENERAL DESCRIPTION

The SP339B is an advanced multiprotocol transceiver supporting RS-232, RS-485, and RS-422 serial standards in a 40 pin QFN package. Integrated cable termination and four configuration modes allow all three protocols to be used interchangeably over a single cable or connector with no additional switching components. Full operation requires only four external charge pump capacitors.

The RS-485/422 modes feature one driver and one receiver (1TX/1RX) in both half and full duplex configurations. The RS-232 mode (3TX/5RX) provides full support of all eight signals commonly used with the DB9 RS-232 connector. A dedicated diagnostic loopback mode is also provided.

The high speed drivers operate up to 20Mbps in RS-485/422 modes, and up to 1Mbps in RS-232 mode. All drivers can be slew limited to 250kbps in any mode to minimize electromagnetic interference (EMI).

All transmitter outputs and receiver inputs feature robust electrostatic discharge (ESD) protection to ±15kV IEC-61000-4-2 Air Gap, ±8kV IEC-61000-4-2 Contact, and ±15kV Human Body Model (HBM). Each receiver output has full fail-safe protection to avoid system lockup, oscillation, or indeterminate states by defaulting to logic-high output level when the inputs are open, shorted, or terminated but undriven. No external biasing resistors are required.

The RS-232 receiver inputs include a  $5 \mathrm{k}\Omega$  pull-down to ground. The RS-485/422 receiver inputs are high impedance (>96 k $\Omega$  when termination is disabled), allowing up to 256 devices on a single communication bus (1/8th unit load).

The SP339B operates from a single power supply, either 3.3V or 5V, with low idle current (2mA typical in all modes). The shutdown mode consumes less than  $10\mu\text{A}$  for low power standby operation.

#### **FEATURES**

- Rx enabled during Tx short circuit condition
- Pin selectable Cable Termination
- No external resistors required for RS-485/422 termination and biasing
- 3.3V or 5V Single Supply Operation
- Robust ESD Protection on bus pins
  - ±15kV IEC 61000-4-2 (Air Gap)
  - ± 8kV IEC 61000-4-2 (Contact)
  - ±15kV Human Body Model (HBM)
- Max Data Rate of 20Mbps in RS-485/422 Modes and up to 1Mbps in RS-232 Modes
- Pin selectable 250kbps Slew Limiting
- 3 Drivers, 5 Receivers RS-232/V.28
- 1 Driver, 1 Receiver RS-485/422
  - □ Full and Half Duplex Configuration
  - □ 1/8th Unit Load, up to 256 receivers on bus
- RS-485/422 Enhanced Failsafe for open, shorted, or terminated but idle inputs
- Space saving 6mm x 6mm QFN-40 Package
- Pin compatible with SP339E and SP338E

# TYPICAL APPLICATIONS

- Dual Protocol Serial Ports (RS-232 or RS-485/422)
- Industrial Computers
- Industrial and Process Control Equipment
- Point-Of-Sale Equipment
- Networking Equipment
- HVAC Controls Equipment
- Building Security and Automation Equipment

## ORDERING INFORMATION(1)

PART NUMBER	OPERATING TEMPERATURE RANGE	PACKAGE	PACKAGING METHOD	LEAD-FREE <sup>(2)</sup>				
SP339BER1-L	-40°C to +85°C	40-pin QFN	Tray	Yes				
SP339BER1-L/TR	-40°C to +85°C	C 40-pin QFN Tape and Reel Yes						
XR21B1420IL28-0A-EVB	The XR21B1420 Evalua	The XR21B1420 Evaluation Board includes the SP339E transceiver.						

#### NOTES:

- 1. Refer to.www.maxlinear.com/SP339B for most up-to-date Ordering Information.
- 2. Visit www.maxlinear.com for additional information on Environmental Rating.



## **ABSOLUTE MAXIMUM RATINGS**

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections to the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability and cause permanent damage to the device.

Supply Voltage V <sub>CC</sub>	-0.3V to +6.0V
Receiver Input Voltage (from Ground)	±18V
Driver Output Voltage (from Ground)	±18V
Short Circuit Duration, TX out to Ground	Continuous
Voltage at TTL Input Pins	-0.3V to (V <sub>CC</sub> + 0.5V)
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10s)	+300°C

# OPERATING CONDITIONS

Thermal Resistance	from junction to ambient $(\Theta_{JA})$	31.6°C/W
Thermal Resistance	from junction to ambient $(\Theta_{JC})$	12.4°C/W
Maximum Junction Temperature		125°C
Power Dissipation 40-pin QFN (derate 17mW/°C above +70°C)		500mW

## **ESD RATINGS**

Tower Dissipation 40-pin Qi N (derate 17111VI) G above 170 C)	30011177
bo or b	h
ESD RATINGS	no Chillia
HBM - Human Body Model (Tx Output & Rx Input pins, R1-R9)	±15kV
HBM - Human Body Model (All other pins)	±4kV
IEC 61000-4-2 Airgap Discharge (Tx Output & Rx Input pins, R1-R9)	±15kV
IEC61000-4-2 Contact Discharge (Tx Output & Rx Input pins, R1-R9)	±8kV S

#### **CAUTION:**

ESD (ElectroStatic Discharge) sensitive device. Permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. Personnel should be properly grounded prior to handling this device. The protective foam should be discharged to the destination socket before devices are removed.

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# RS-232/RS-485/RS-422 TRANSCEIVER WITH INTERNAL TERMINATION

# PIN DESCRIPTIONS BY MODE (MODE1, MODE0)

Pin	Name	<b>00</b> , Figure 1	<b>01</b> , Figure 2	<b>10,</b> Figure 3	<b>11</b> , Figure 4	
1	L1	R1 O	utput	1	1	
2	L2	R2 O	utput	R1 Output	R1 Output	
3	L3	T1 lr	nput	T1 Input	T1 Input	
4	L4	T2 lr	nput			
5	L6	R3 O	utput	1	1	
6	L7 <b>(2)</b>	T3 lr	nput			
7	L8	She Oly R4 0	utput	1	1	
8	L9	9h 850	utput	1	1	
9	VCC	The Note Vec				
10	GND	3r 1				
11	SLEW	70,	CC enables 250kbps sle	ew limiting		
12	DIR1		or being	T1 Enable, R1 Disable	T1 Enable	
13	N/C	This pin is not used and is not connected internally				
14	MODE0	0	1 0	nux doin	1	
15	MODE1	0	0	) SCALANIS	1	
16	N/C	This pin is not used and is not connected internally				
17	TERM			Enables RS-485/422	receiver termination	
18	N/C	This pin is not used and is not connected internally				
19	ENABLE	ENABLE = V <sub>CC</sub> for operation, ENABLE = 0V for shutdown				
20	VCC		V	cc		





# PIN DESCRIPTIONS BY MODE (MODE1, MODE0)

Pin	Name	<b>00</b> , Figure 1	<b>00</b> , Figure 1 <b>01</b> , Figure 2 <b>10</b> , Figure 3 <b>11</b> , Figure 4							
21	R9		R5 Input							
22	R8		R4 Input							
23	GND		Gro	ound						
24	R7		T3 Output							
25	R6	<b>&gt;</b>	R3 Input							
26	GND	, 1	Gro	ound						
27	R4	Shootic,	T2 Output		R1 Input B					
28	R3	The duck	T1 Output		R1 Input A					
29	GND	8h 8	Ground							
30	R2	Marie I	T1 Out A							
31	R1	R1 Input R1 Input B, T1 Out B								
32	VCC	V <sub>CC</sub> -	1.0μF to ground recom	mended for supply deco	upling					
33	VSS	V <sub>SS</sub>	V <sub>SS</sub> - Charge pump negative supply, 0.1μF from ground							
34	C2-		C <sub>2+</sub> - Charge pump	cap 2 negative lead						
35	C1-		C <sub>1-</sub> - Charge pump cap 1 negative lead							
36	GND	Ground								
37	C1+	C <sub>1+</sub> - Charge pump cap 1 positive lead, 0.1µF								
38	VCC	V <sub>CC</sub>								
39	C2+	C <sub>2+</sub> - Charge pump cap 2 positive lead, 0.1μF								
40	VDD	$V_{DD}$ - Charge pump positive supply, $0.1 \mu F$ to ground								



## SUGGESTED DB9 CONNECTOR PINOUT

DB9 Pin	RS-232	RS-485/422 Full Duplex	RS-485 Half Duplex
1	DCD	TX-	Data-
2	RXD	TX+	Data+
3	TXD	RX+	
4	DTR	RX-	
5		Ground	
6	DSR		
7	RTS		
8	CTS		
90	RI		

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# **ELECTRICAL CHARACTERISTICS**

## UNLESS OTHERWISE NOTED:

 $V_{CC}$  = +3.3V ±5% or +5.0V ±5%, C1-C4 = 0.1 $\mu$ F;  $T_A$  =  $T_{MIN}$  to  $T_{MAX}$ . Typical values are at  $V_{CC}$  = 3.3V,  $T_A$  = +25°C.

SYMBOL	PARAMETERS	MIN.	TYP.	Max.	Units	Conditions		
DC CHARAC	DC CHARACTERISTICS							
I <sub>CC</sub>	Supply Current (RS-232)		2	8	mA	No load, idle inputs		
I <sub>CC</sub>	Supply Current (RS-485)		2	8	mA	No load, idle inputs		
I <sub>CC</sub>	Vcc Shutdown Current		1	10	μА	ENABLE = 0V		
TRANSMITTI	TRANSMITTER and LOGIC INPUT PINS: Pins 3, 4, 6, 11, 12, 14, 15, 17-19							
$V_{IH}$	Logic Input Voltage High	2.0			٧	V <sub>CC</sub> = 3.3V		
$V_{IH}$	Logic Input Voltage High	2.4			V	V <sub>CC</sub> = 5.0V		
V <sub>IL</sub>	Logic Input Voltage Low			0.8	٧			
I <sub>IL</sub>	Logic Input Leakage Current Low			1	μА	Input Low (V <sub>IN</sub> = 0V)		
I <sub>IH</sub>	Logic Input Leakage Current High	Por		1	μΑ	Input High (V <sub>IN</sub> = V <sub>CC</sub> ), pins 3, 4 and 6		
I <sub>PD</sub>	Logic Input Pull-down Current	10n	Oly Cx	50	μА	Input High ( $V_{IN} = V_{CC}$ ), pins 11, 12, 14, 15, 17-19		
V <sub>HYS</sub>	Logic Input Hysteresis	5	200	ソ	mV			
RECEIVER OUTPUTS: Pins 1, 2, 5, 7, 8								
V <sub>OH</sub>	Receiver Output Voltage High	V <sub>CC</sub> -0.6	O <sub>A</sub>	9	V	I <sub>OUT</sub> = -1.5mA		
V <sub>OL</sub>	Receiver Output Voltage Low		0	0.4	V	l <sub>OUT</sub> = 2.5mA		
I <sub>OSS</sub>	Receiver Output Short Circuit Current		±20	±60	mA	$0 \le V_O \le V_{CC}$		
I <sub>OZ</sub>	Receiver Output Leakage Current		±0.1	±1	μΑ	0 ≤ V <sub>O</sub> ≤ V <sub>CC,</sub> Receivers disabled		

## RS-232/RS-485/RS-422 TRANSCEIVER WITH INTERNAL TERMINATION

# **ELECTRICAL CHARACTERISTICS (Continued)**

## **UNLESS OTHERWISE NOTED:**

 $V_{CC} = +3.3V \pm 5\% \text{ or } +5.0V \pm 5\%, \text{ C1-C4} = 0.1 \mu\text{F}; \text{ } T_{A} = T_{MIN} \text{ to } T_{MAX}. \text{ Typical values are at } V_{CC} = 3.3V, T_{A} = +25 ^{\circ}\text{C}.$ 

	SYMBOL	PARAMETERS	Min.	TYP.	Max.	Units	Conditions
$V_{\text{IL}}  \text{Input Threshold Low}  \begin{array}{c ccccccccccccccccccccccccccccccccccc$	INGLE-ENI	DED RECEIVER INPUTS (RS-232)					-
V <sub>IL</sub> Input Threshold Low     0.8     1.5     V     V <sub>CC</sub> = 5.0V       V <sub>IH</sub> Input Threshold High     1.5     2.0     V     V <sub>CC</sub> = 3.3V       V <sub>HYS</sub> Input Hysteresis     0.3     V       R <sub>IN</sub> Input Resistance     3     5     7     kΩ     -15V ≤ V <sub>IN</sub> ≤ +15V       INGLE-ENDED DRIVER OUTPUTS (RS-232)       V <sub>O</sub> Output Voltage Swing     ±5.0     ±5.5     V     Output loaded with 3kΩ to Gr	V <sub>IN</sub>	Input Voltage Range	-15		+15	V	
$V_{\text{IH}}  \begin{array}{c ccccccccccccccccccccccccccccccccccc$		lancet Three should Lave	0.6	1.2		V	V <sub>CC</sub> = 3.3V
VIH     Input Threshold High     1.8     2.4     V     V <sub>CC</sub> = 5.0V       V <sub>HYS</sub> Input Hysteresis     0.3     V       R <sub>IN</sub> Input Resistance     3     5     7     kΩ     -15V ≤ V <sub>IN</sub> ≤ +15V       INGLE-ENDED DRIVER OUTPUTS (RS-232)       V <sub>O</sub> Output Voltage Swing     ±5.0     ±5.5     V     Output loaded with $3kΩ$ to Grant of the control of th	۷IL	input inresnoid Low	0.8	1.5		V	V <sub>CC</sub> = 5.0V
	VIII	Input Threshold High		1.5	2.0	V	V <sub>CC</sub> = 3.3V
R <sub>IN</sub> Input Resistance 3 5 7 $k\Omega$ -15V $\leq$ V <sub>IN</sub> $\leq$ +15V INGLE-ENDED DRIVER OUTPUTS (RS-232)  V <sub>O</sub> Output Voltage Swing $\pm 5.0$ $\pm 5.5$ V Output loaded with $3k\Omega$ to Gi	VIH	input meshad nigh		1.8	2.4	V	V <sub>CC</sub> = 5.0V
INGLE-ENDED DRIVER OUTPUTS (RS-232)  V <sub>O</sub> Output Voltage Swing ±5.0 ±5.5 V Output loaded with 3kΩ to Gr	V <sub>HYS</sub>	Input Hysteresis		0.3		V	
V <sub>O</sub> Output Voltage Swing ±5.0 ±5.5 V Output loaded with 3kΩ to Gr	R <sub>IN</sub>	Input Resistance	3	5	7	kΩ	-15V ≤ V <sub>IN</sub> ≤ +15V
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		100 9/2	±5.0	±5.5		V	Output loaded with $3k\Omega$ to Gr
$I_{SC}$ Short Circuit Current $\pm 60$ mA $V_O = 0V$ $R_{OFF}$ Power Off Impedance       300       10M $\Omega$ $V_{CC} = 0V$ , $V_O = \pm 2V$	Vo	Output Voltage Swing	· .		±7.0		
Roff Power Off Impedance 300 10M $\Omega$ $V_{CC}$ = 0V, $V_{O}$ = ±2V	I <sub>SC</sub>	Short Circuit Current	6 %		±60	mA	V <sub>O</sub> = 0V
be ordered manufacting the	R <sub>OFF</sub>	Power Off Impedance	300	10M		Ω	$V_{CC} = 0V, V_{O} = \pm 2V$
	ordered manufacting this						



# **ELECTRICAL CHARACTERISTICS (Continued)**

## UNLESS OTHERWISE NOTED:

 $V_{CC}$  = +3.3V ±5% or +5.0V ±5%, C1-C4 = 0.1 $\mu$ F;  $T_A$  =  $T_{MIN}$  to  $T_{MAX}$ . Typical values are at  $V_{CC}$  = 3.3V,  $T_A$  = +25°C.

SYMBOL	PARAMETERS	Min.	Typ.	Max.	Units	Conditions		
DIFFERENTI	DIFFERENTIAL RECEIVER INPUTS (RS-485 / RS-422)							
R <sub>IN</sub>	Receiver Input Resistance	96			kΩ	TERM = 0V, $-7V \le V_{IN} \le +12V$		
V <sub>TH</sub>	Receiver Differential Threshold Voltage	-200	-125	-50	mV			
$\Delta V_{TH}$	Receiver Input Hysteresis		25		mV	V <sub>CM</sub> = 0V		
I <sub>IN</sub>	Receiver Input Current			125	μА	V <sub>IN</sub> = +12V		
'IN	receiver input durient			-100	μА	V <sub>IN</sub> = -7V		
R <sub>TERM</sub>	Termination Resistance	100	120	155	Ω	TERM = $V_{CC}$ , Figure 5 -7V $\leq V_{CM} \leq +12V$		
R <sub>TERM</sub>	Termination Resistance	100	120	140	Ω	TERM = V <sub>CC</sub> , Figure 5 V <sub>CM</sub> = 0V		
DIFFERENTI	DIFFERENTIAL DRIVER OUTPUTS (RS-4851 RS-422)							
	0,1	20		V <sub>CC</sub>	٧	$R_L = 100\Omega$ (RS-422), Figure 6		
V <sub>OD</sub>	Differential Driver Output	1.5	6	Vcc	٧	$R_L = 54\Omega$ (RS-485), Figure 6		
- OB	Sinoronial Sirvor Sarpat	1.5	~ 0	V <sub>CC</sub>	V	-7V ≤ V <sub>CM</sub> ≤ +12V, Figure 7		
			O <sub>A</sub>	V <sub>CC</sub>	V	No Load		
ΔV <sub>OD</sub>	Change In Magnitude of Differential Output Voltage	-0.2	0	+0.2	٧	$R_L$ = 54 $\Omega$ or 100 $\Omega$ , Figure 6		
V <sub>CM</sub>	Driver Common Mode Output Voltage			3	Vo	$R_L$ = 54Ω or 100Ω, Figure 6		
ΔV <sub>CM</sub>	Change In Magnitude of Common Mode Output Voltage			0.2	٧	$R_L$ = 54Ω or 100Ω, Figure 6		
I <sub>OSD</sub>	Driver Output Short Circuit Current	-250		250	mA	-7V ≤ V <sub>O</sub> ≤ +12V, Figure 8		
I <sub>O</sub>	Driver Output Leakage Current			100	μА	DIR1 = 0V in Mode 11, or ENABLE = 0V, $V_O = +12V$ , $V_{CC} = 0V$ or 5.25V		
.0	Driver Output Leakage Current	-100			μА	DIR1 = 0V in Mode 11, or ENABLE = 0V, $V_O = -7V$ , $V_{CC} = 0V$ or 5.25V		



# **TIMING CHARACTERISTICS**

## UNLESS OTHERWISE NOTED:

 $V_{CC} = +3.3V \pm 5\% \text{ or } +5.0V \pm 5\%, \text{ C1-C4} = 0.1 \mu\text{F}; \text{ } T_{A} = T_{MIN} \text{ to } T_{MAX}. \text{ Typical values are at } V_{CC} = 3.3V, T_{A} = +25 ^{\circ}\text{C}.$ 

SYMBOL	PARAMETERS	MIN.	TYP.	Max.	Units	Conditions		
ALL MODES								
t <sub>ENABLE</sub>	Enable from Shutdown		1000		ns			
tshutdown	Enable to Shutdown		1000		ns			
RS-232, DATA	RS-232, DATA RATE = 250kbps (SLEW = Vcc), ONE TRANSMITTER SWITCHING							
	Maximum Data Rate	250			kbps	$R_L = 3k\Omega$ , $C_L = 1000pF$		
t <sub>RHL</sub> , t <sub>RLH</sub>	Receiver Propagation Delay		100		ns	C <sub>1</sub> = 150pF, Figure 9		
t <sub>RHL</sub> -t <sub>RLH</sub>	Receiver Propagation Delay Skew			100	ns	- ο <sub>L</sub> = 130μι, πigure 9		
t <sub>DHL</sub> , t <sub>DLH</sub>	Driver Propagation Delay		1400		ns	$R_L = 3k\Omega, C_L = 2500pF,$		
t <sub>DHL</sub> -t <sub>DLH</sub>	Driver Propagation Delay Skew			600	ns	Figure 10		
	TO AFO OF	<b>A</b>	1.	•				
t <sub>SHL,</sub> t <sub>SLH</sub>	Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V	(150)	C.	30	V/μs	$V_{CC}$ = 3.3V, $R_L$ = 3k $\Omega$ to 7k $\Omega$ , $C_L$ = 150pF to 2500pF, Figure 10		
<sup>t</sup> shl, <sup>t</sup> slh	Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V	6	CIN	30	V/μs	$V_{CC}$ = 3.3V, R <sub>L</sub> = 3kΩ to 7kΩ, C <sub>L</sub> = 150pF to 2500pF, T <sub>A</sub> = 25°C, Figure 10		
RS-232, DATA	A RATE = 1Mbps (SLEW = 0V), ONE TI	RANSMI	TTER S	WITCHIN	GO			
	Maximum Data Rate	1	(	170	Mbps	$R_L = 3k\Omega$ , $C_L = 250pF$		
t <sub>RHL</sub> , t <sub>RLH</sub>	Receiver Propagation Delay		100	35	ons	C <sub>L</sub> = 150pF, Figure 9		
t <sub>RHL</sub> -t <sub>RLH</sub>	Receiver Propagation Delay Skew			100	ns	Spr, rigure s		
t <sub>DHL</sub> , t <sub>DLH</sub>	Driver Propagation Delay		300		ns	$R_L = 3k\Omega$ , $C_L = 1000pF$ ,		
t <sub>DHL</sub> -t <sub>DLH</sub>	Driver Propagation Delay Skew			150	ns	Figure 10		
				•				
<sup>t</sup> shl, <sup>t</sup> slh	Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V	15		150	V/μs	$V_{CC}$ = 3.3V, $R_L$ = 3k $\Omega$ to 7k $\Omega$ , $C_L$ = 150pF to 1000pF, Figure 10		
t <sub>SHL,</sub> t <sub>SLH</sub>	Transition Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V	24		150	V/μs	$V_{CC}$ = 3.3V, R <sub>L</sub> = 3kΩ to 7kΩ, C <sub>L</sub> = 150pF to 1000pF, T <sub>A</sub> = 25°C, Figure 10		



# **TIMING CHARACTERISTICS (Continued)**

## UNLESS OTHERWISE NOTED:

 $V_{CC}$  = +3.3V ±5% or +5.0V ±5%, C1-C4 = 0.1 $\mu$ F;  $T_A$  =  $T_{MIN}$  to  $T_{MAX}$ . Typical values are at  $V_{CC}$  = 3.3V,  $T_A$  = +25°C.

PARAMETERS	Min.	TYP.	Max.	Units	Conditions		
RS-485/RS-422, DATA RATE = 250kbps (SLEW = Vcc), ONE TRANSMITTER SWITCHING							
Maximum Data Rate	250			kbps	$R_L = 54\Omega, C_L = 50pF$		
Receiver Propagation Delay		50	150	ns	C <sub>L</sub> = 15pF, Figure 11		
Receiver Propagation Delay Skew			20	ns	o copi, riguio ri		
Driver Propagation Delay		500	1000	ns	D = 540 0 = 50 F		
Driver Propagation Delay Skew			100	ns	$R_L = 54\Omega$ , $C_L = 50pF$ , Figure 12		
Driver Rise and Fall Time	300	650	1200	ns	<del>g</del> a <u>_</u>		
\%\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\							
Receiver Output Enable Time			200	ns	C <sub>1</sub> = 15pF, Figure 13		
Receiver Output Disable Time			200	ns	or repriringuis re		
Driver Output Enable Time	DA		1000	ns	$R_L = 500\Omega, C_L = 50pF,$		
Driver Output Disable Time	, 0	X	200	ns	Figure 14		
, DATA RATE = 20Mbps (SLEW=0V)	, ONE I	RANSMI	TTER SI	WITCHIN	NG		
Maximum Data Rate	20	6	3	Mbps	$R_L = 54\Omega, C_L = 50pF$		
Receiver Propagation Delay	0,0	50	150	ns	C <sub>L</sub> = 15pF, Figure 11		
Receiver Propagation Delay Skew		9,	10	ns			
Driver Propagation Delay		30	100	ns	7 . 540 0 . 50 5		
Driver Propagation Delay Skew			<b>C</b> 10	ns	$R_L = 54\Omega$ , $C_L = 50pF$ , Figure 12		
Driver Rise and Fall Time		10	20	ns			
					The state of the s		
Receiver Output Enable Time			200	ns	C <sub>1</sub> = 15pF, Figure 13		
Receiver Output Disable Time			200	ns	SL .SPI, I ISSUE TO		
Driver Output Enable Time			200	ns	$R_L = 500\Omega, C_L = 50pF,$		
Driver Output Disable Time			200	ns	Figure 14		
	Maximum Data Rate Receiver Propagation Delay Receiver Propagation Delay Skew Driver Propagation Delay Skew Driver Propagation Delay Skew Driver Propagation Delay Skew Driver Rise and Fall Time  Receiver Output Enable Time Driver Output Enable Time Driver Output Disable Time Receiver Propagation Delay Receiver Propagation Delay Skew Driver Propagation Delay Skew Driver Propagation Delay Skew Driver Propagation Delay Skew Driver Rise and Fall Time  Receiver Output Enable Time Receiver Output Enable Time Driver Output Enable Time	Maximum Data Rate 250kbps (SLEW = Vcc), ONE  Maximum Data Rate 250  Receiver Propagation Delay  Receiver Propagation Delay Skew  Driver Propagation Delay Skew  Driver Rise and Fall Time 300  Receiver Output Enable Time  Driver Output Disable Time  Driver Output Disable Time  Driver Output Disable Time  Driver Output Disable Time  Priver Output Disable Time  Driver Propagation Delay  Receiver Propagation Delay  Receiver Propagation Delay Skew  Driver Propagation Delay Skew  Driver Propagation Delay Skew  Driver Rise and Fall Time  Receiver Output Enable Time  Receiver Output Enable Time  Receiver Output Enable Time  Receiver Output Enable Time	Maximum Data Rate 250 Receiver Propagation Delay 50 Receiver Propagation Delay Skew Driver Propagation Delay Skew Driver Propagation Delay Skew Driver Propagation Delay Skew Driver Rise and Fall Time 300 650  Receiver Output Enable Time Priver Output Enable Time Driver Output Disable Time Driver Output Disable Time Driver Propagation Delay Maximum Data Rate 20 Receiver Propagation Delay Skew Driver Propagation Delay Skew	Maximum Data Rate 250 Receiver Propagation Delay 50 150 Priver Propagation Delay 500 1000 Priver Propagation Delay Skew 100 Priver Propagation Delay Skew 100 Priver Propagation Delay Skew 100 Priver Rise and Fall Time 300 650 1200  Receiver Output Enable Time 200 Priver Output Disable Time 200 Priver Output Disable Time 200  Pattern Output Disable Time 200  Pattern Output Disable Time 200  Priver Output Disable Time 200  Priver Output Disable Time 200  Priver Propagation Delay Skew 100  Priver Rise and Fall Time 100  Receiver Output Enable Time 100  Priver Rise and Fall Time 100  Receiver Output Enable Time 200  Receiver Output Enable Time 200  Priver Output Enable Time 200	A DATA RATE = 250kbps (SLEW = Vcc), ONE TRANSMITTER SWITCH Maximum Data Rate		



# **BLOCK DIAGRAM BY MODE (MODE1, MODE0)**

FIGURE 1. MODE 00 - LOOPBACK

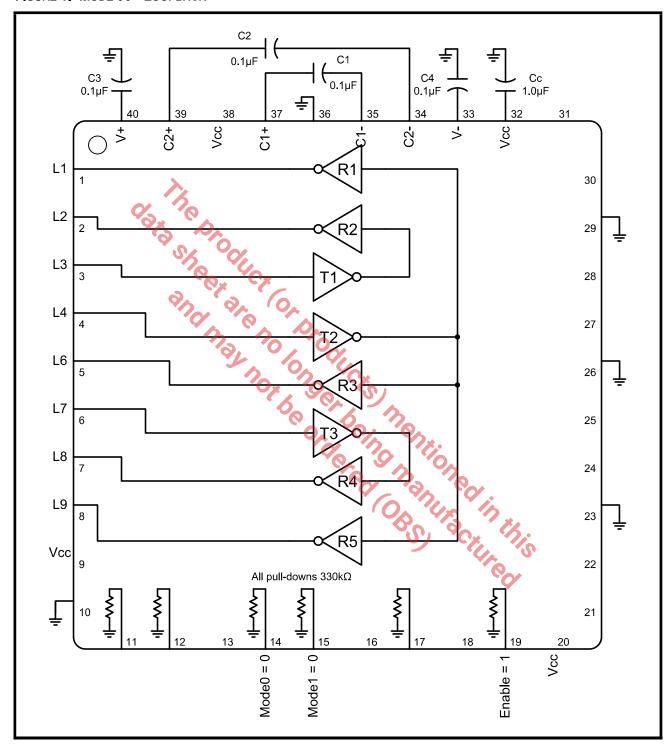




FIGURE 2. MODE 01 - RS-232

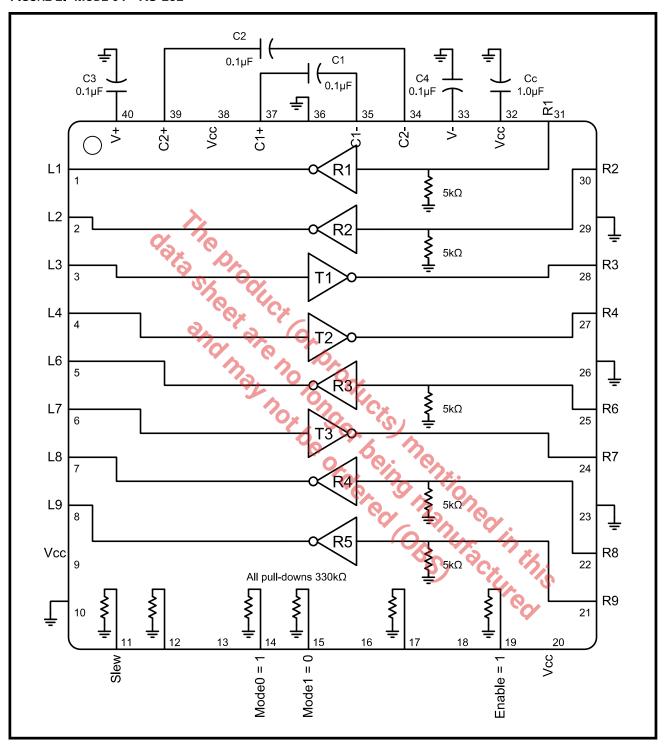




FIGURE 3. MODE 10 - RS-485 HALF DUPLEX

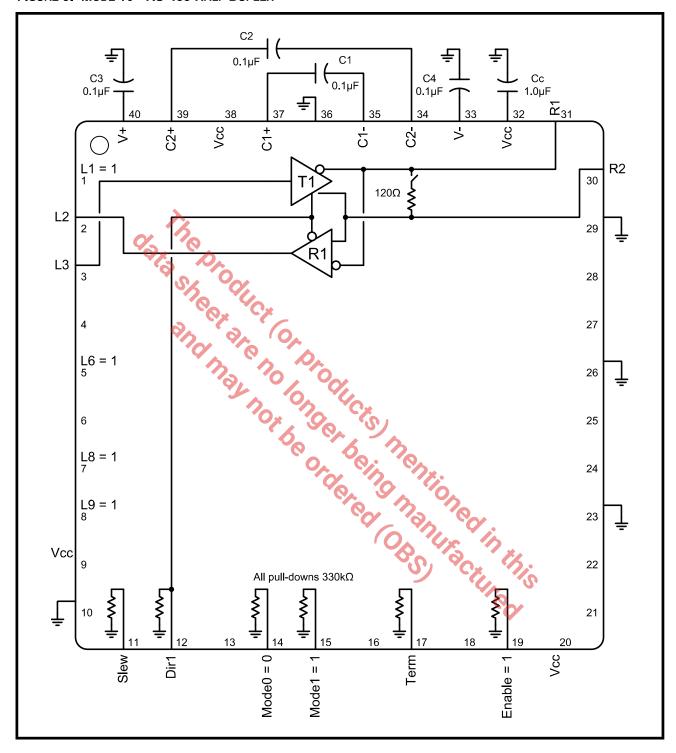
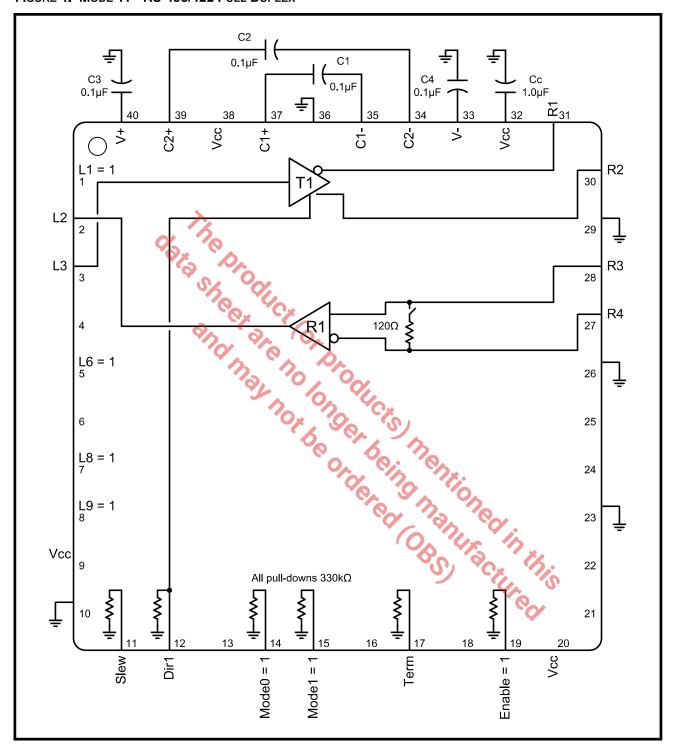




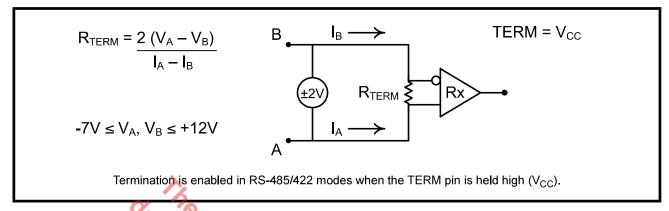
FIGURE 4. MODE 11 - RS-485/422 FULL DUPLEX





## **TEST CIRCUITS**

#### FIGURE 5. RS-485/422 RECEIVER TERMINATION RESISTANCE



## FIGURE 6. RS-485/422 DIFFERENTIAL DRIVER OUTPUT VOLTAGE

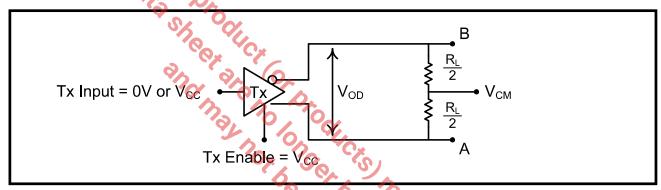


FIGURE 7. RS-485/422 DIFFERENTIAL DRIVER OUTPUT VOLTAGE OVER COMMON MODE

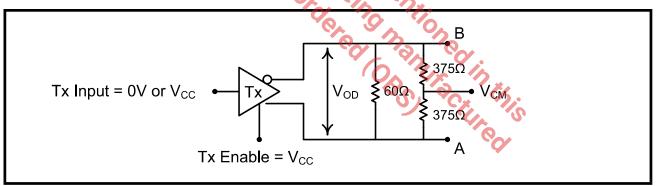


FIGURE 8. RS-485/422 DRIVER OUTPUT SHORT CIRCUIT CURRENT

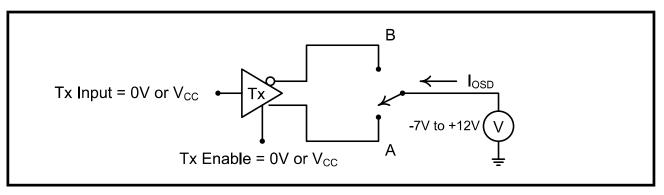




FIGURE 9. RS-232 RECEIVER PROPAGATION DELAY

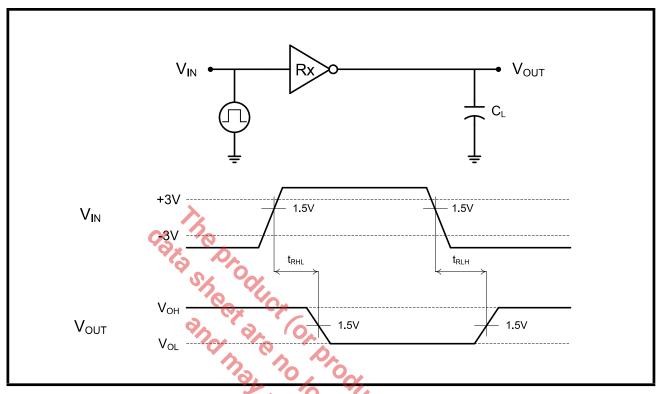


FIGURE 10. RS-232 DRIVER PROPAGATION DELAY

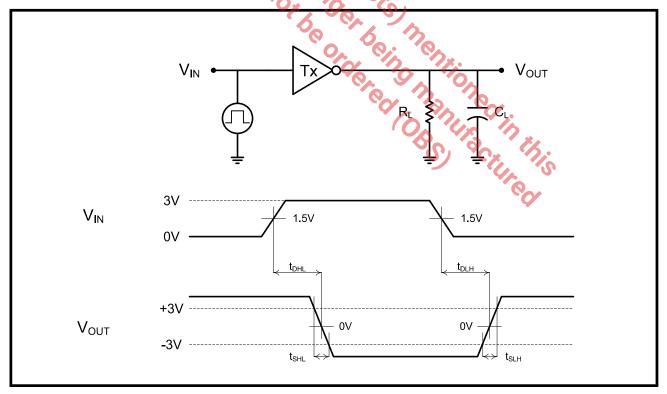




FIGURE 11. RS-485/422 RECEIVER PROPAGATION DELAY

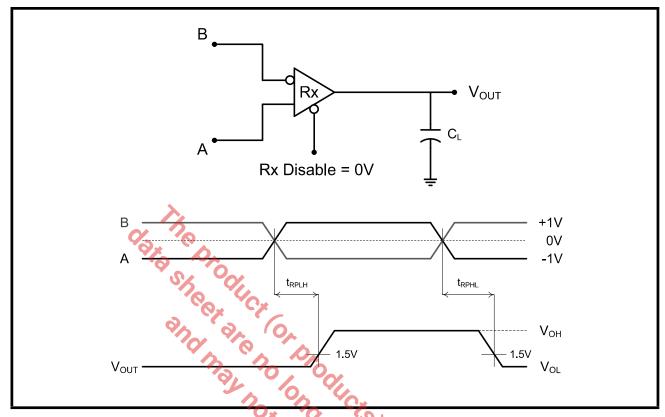


FIGURE 12. RS-485/422 DRIVER PROPAGATION DELAY AND RISE/FALL TIMES

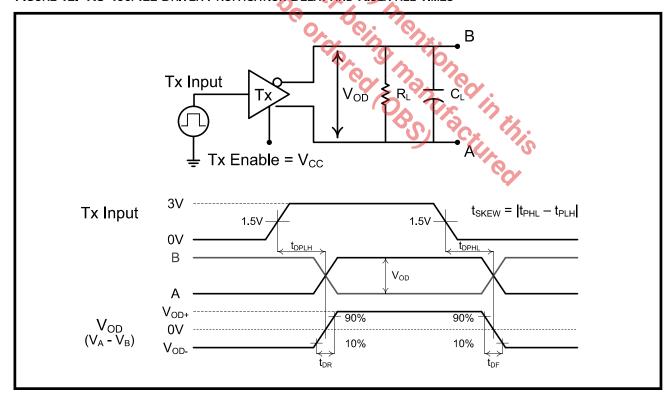




FIGURE 13. RS-485/422 RECEIVER OUTPUT ENABLE/DISABLE TIMES

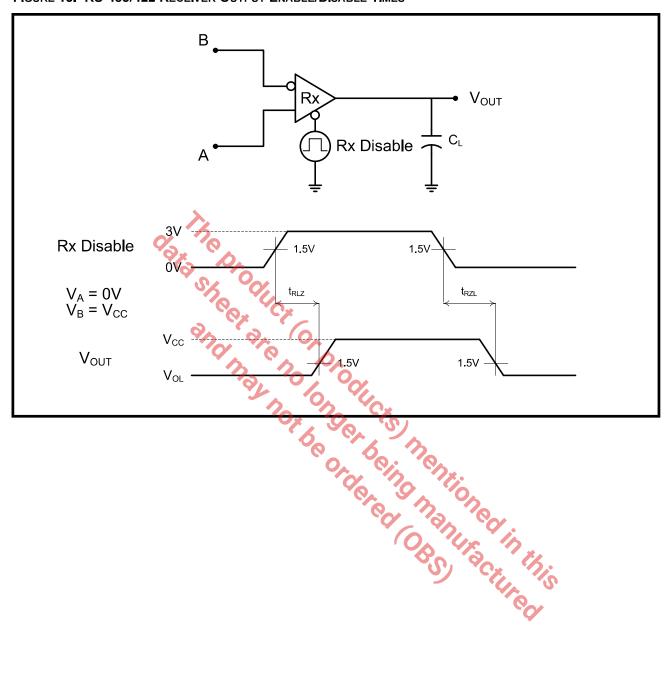
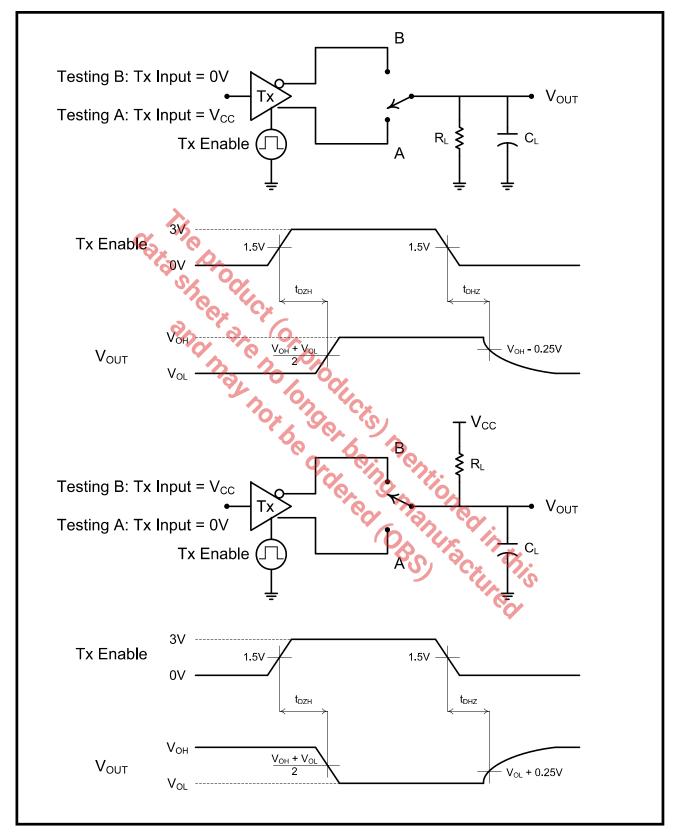




FIGURE 14. RS-485/422 DRIVER OUTPUT ENABLE/DISABLE TIMES



## PRODUCT SUMMARY

The SP339B is an advanced multiprotocol transceiver supporting RS-232, RS-485, and RS-422 serial standards in a 40 pin QFN package. Integrated cable termination and four configuration modes allow all three protocols to be used interchangeably over a single cable or connector with no additional switching components. The RS-485/422 modes feature one driver and one receiver (1TX/1RX) in both half and full duplex configurations. The RS-232 mode (3TX/5RX) provides full support of all eight signals commonly used with the DB9 RS-232 connector. A dedicated mode is also available for diagnostic loopback testing.

#### **INTERNALLY SWITCHED CABLE TERMINATION**

Enabling and disabling the RS-485/422 termination resistor is one of the largest challenges system designers face when sharing a single connector or pair of lines across multiple serial protocols. A termination resistor may be necessary for accurate RS-485/422 communication, but must be removed when the lines are used for RS-232. SP339B provides an elegant solution to this problem by integrating the termination resistor and switching control, and allowing it to be switched in and out of the circuit with a single pin. No external switching components are required.

#### **ENHANCED FAILSAFE**

Ordinary RS-485 differential receivers will be in an indeterminate state whenever the data bus is not being actively driven. The enhanced failsafe feature of the SP339B guarantees a logic-high receiver output when the receiver inputs are open, shorted, or terminated but idle/undriven. The enhanced failsafe interprets 0V differential as a logic high with a minimum 50mV noise margin, while maintaining compliance with the EIA/TIA-485 standard of ±200mV. No external biasing resistors are required, further easing the usage of multiple protocols over a single connector.

#### ±15kV ESD PROTECTION

ESD protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The bus pins (driver outputs and receiver inputs) have extra protection structures, which have been tested up to ±15kV without damage. These structures withstand high ESD in all states: normal operation, shutdown and powered down.

ESD protection is be tested in various ways. MaxLinear uses the following methods to qualify the protection structures designed into SP339B:

- ±15kV using the Human Body Model (HBM)
- ± 8kV using IEC 61000-4-2 Contact Discharge
- ± 15kV using IEC 61000-4-2 Air Gap Discharge

The IEC 61000-4-2 standard is more rigorous than HBM, resulting in lower voltage levels compared with HBM for the same level of ESD protection. Because IEC 61000-4-2 specifies a lower series resistance, the peak current is higher than HBM. The SP339B has passed both HBM and IEC 61000-4-2 testing without damage.

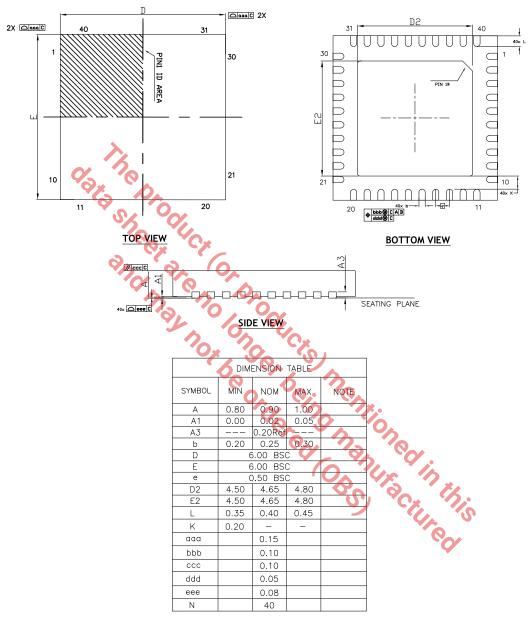
#### **DIAGNOSTIC LOOPBACK MODE**

The SP339B includes a diagnostic digital loop back mode for system testing as shown in Figure 1. The loopback mode connects the TTL driver inputs to the TTL receiver outputs, bypassing the analog driver and receiver circuitry. The analog/bus pins are internally disconnected in this mode.



## **MECHANICAL DIMENSIONS**

## FIGURE 15. QFN-40 PACKAGE OUTLINE DRAWING



#### **TERMINAL DETAILS**

- ALL DIMENSIONS ARE IN MILLIMETERS, ANGLES ARE IN DEGREES.
- DIMENSIONS AND TOLERANCE PER JEDEC MO-220.

Drawing No.: POD-00000041

Revision: B.3



## RECOMMENDED LAND PATTERN AND STENCIL

## FIGURE 16. QFN-40 RECOMMENDED PCB LAND PATTERN AND STENCIL

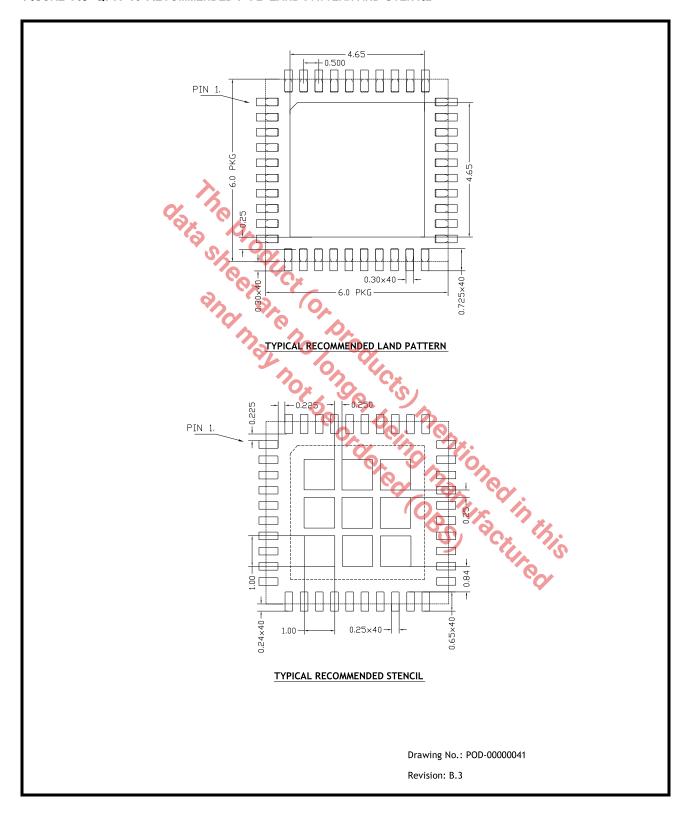
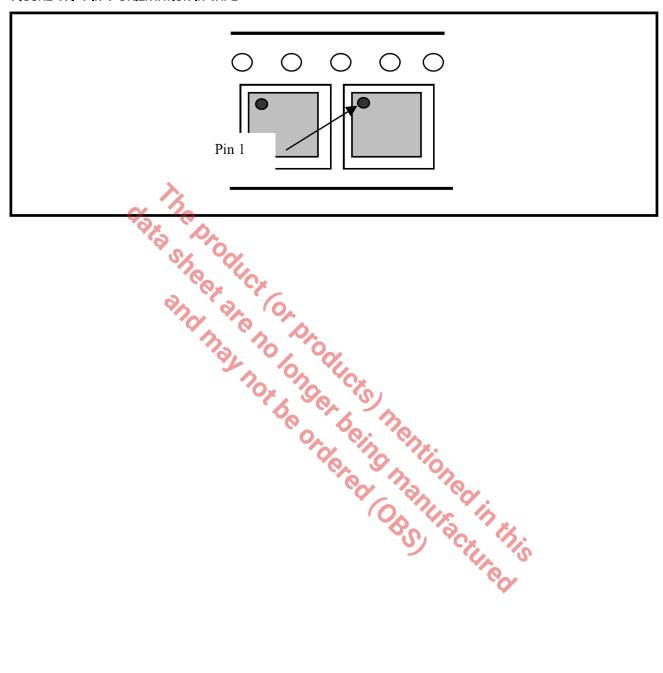




FIGURE 17. PIN 1 ORIENTATION IN TAPE





#### REVISION HISTORY

DATE	REVISION	DESCRIPTION
November 2014	1.0.0	Initial release
February 2018	1.0.1	Update to MaxLinear logo. Update format and Ordering Information. Corrected typo for pin 28, Mode 11 in Pin Description. Moved ESD ratings on page 2.
January 2019	1.0.2	Corrected typo in recommended stencil.
April 2020	1.0.3	Added Operating Conditions table and added additional thermal data. Split out ESD Ratings table.

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