



## SP3486 and SP3487

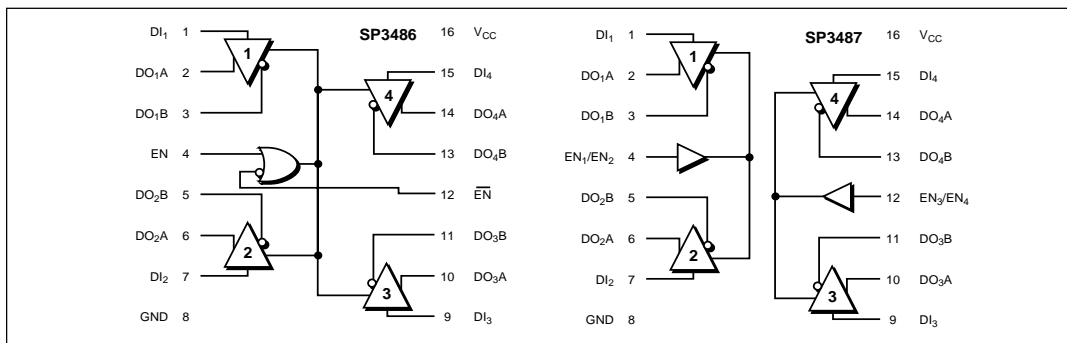
### +3.3V Low Power Quad RS-485/RS-422 Line Drivers

- RS-485 or RS-422 Quad Differential Line Drivers
- Operates from a single +3.3V supply
- Interoperable with +5.0V logic
- Tri-state Output Control
- -7V to +12V Common-Mode Input Voltage Range
- Common Driver Enable Control (**SP3486**)
- Independent Driver Enable Controls for each pair of Drivers (**SP3487**)
- Compatibility with LTC486 and SN75172 (**SP3486**)
- Compatibility with LTC487 and SN75174 (**SP3487**)



#### DESCRIPTION

The **SP3486** and the **SP3487** are +3.3V low power quad drivers that meet the specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with Sipex's SP486 and SP487 devices as well as popular industry standards. The **SP3486** and **SP3487** feature Sipex's BiCMOS process allowing low power operation without sacrificing performance. The **SP3486** and **SP3487** meet the electrical specifications of RS-485 and RS-422 serial protocols up to 10Mbps under load. The SP3486 features a common driver enable control. The **SP3487** provides independent driver enable controls for each pair of drivers. Both devices feature tri-state outputs and a -7V to +12V common-mode input voltage range.



## ABSOLUTE MAXIMUM RATINGS

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

V <sub>CC</sub> .....	+6.0V
Input Voltages	
Logic .....	-0.3V to +6.0V
Drivers .....	-0.3V to +6.0V
Driver Output Voltage .....	±14V
Input Currents	
Logic .....	±25mA
Driver .....	±25mA
Storage Temperature .....	-65°C to +150°C
Power Dissipation	
Plastic DIP .....	375mW
(derate 7mW/°C above +70°C)	
Small Outline .....	375mW
(derate 7mW/°C above +70°C)	
Lead Temperature (soldering, 10 sec) .....	300°C



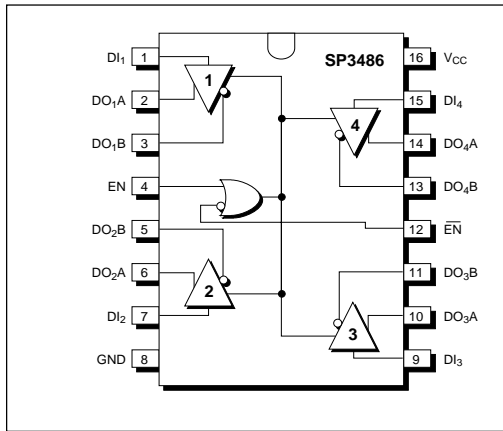
**CAUTION:**  
ESD (ElectroStatic Discharge) sensitive device. Permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. Personnel should be properly grounded prior to handling this device. The protective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

## SPECIFICATIONS

V<sub>CC</sub> = 3.3V±5%; typicals at 25°C; T<sub>MIN</sub> ≤ T<sub>A</sub> ≤ T<sub>MAX</sub> unless otherwise noted.

PARAMETER	MIN.	TYP.	MAX.	UNIT	CONDITIONS
<b>DC CHARACTERISTICS</b>					
Digital Inputs					DI, EN, $\overline{\text{EN}}$ , EN <sub>1</sub> /EN <sub>2</sub> , EN <sub>3</sub> /EN <sub>4</sub>
Voltage			0.8	Volts	
V <sub>IL</sub>	2.0			Volts	
V <sub>IH</sub>				Volts	
Input Current			±2	μA	V <sub>IN</sub> = 0V to V <sub>CC</sub>
<b>DRIVER OUTPUTS</b>					
Differential Voltage	2		V <sub>CC</sub>	Volts	unloaded
	1.5		V <sub>CC</sub>	Volts	R = 50Ω (RS-422)
				Volts	R = 27Ω (RS-485); <i>Figure 1</i>
Common Mode Output Voltage			3	Volts	R = 27Ω or 50Ω; <i>Figure 1</i>
Change in Common Mode Output Magnitude for Complementary Output State			0.2	Volts	R = 27Ω or 50Ω; <i>Figure 1</i>
				Volts	R = 50Ω (RS-422)
				Volts	R = 27Ω (RS-485)
Maximum Data Rate	10			Mbps	
Short-circuit Current			±250	mA	-7V ≤ V <sub>O</sub> ≤ +12V
V <sub>OH</sub>			±250	mA	-7V ≤ V <sub>O</sub> ≤ +12V
V <sub>OL</sub>			1	μA	V <sub>O</sub> = -7V to +12V, T <sub>A</sub> = 25°C
High Impedance Output Current				μA	
<b>POWER REQUIREMENTS</b>					
Supply Voltage	3.00	3.30	3.60	Volts	
Supply Current		3.00		μA	No load, output enabled
		0.10		μA	No load, output disabled
<b>ENVIRONMENTAL AND MECHANICAL</b>					
Operating Temperature					
-C	0		+70	°C	
-E	-40		+85	°C	
Storage Temperature	-65		+150	°C	
Package					
-P	16-pin Plastic DIP				
-T	16-pin SOIC				

## PINOUT — SP3486



### SP3486 PINOUT

**Pin 1 — DI<sub>1</sub> — Driver 1 Input** — If Driver 1 output is enabled, logic 0 on DI<sub>1</sub> forces driver output DO<sub>1A</sub> low and DO<sub>1B</sub> high. A logic 1 on DI<sub>1</sub> with Driver 1 output enabled forces driver DO<sub>1A</sub> high and DO<sub>1B</sub> low.

**Pin 2 — DO<sub>1A</sub> — Driver 1 output A.**

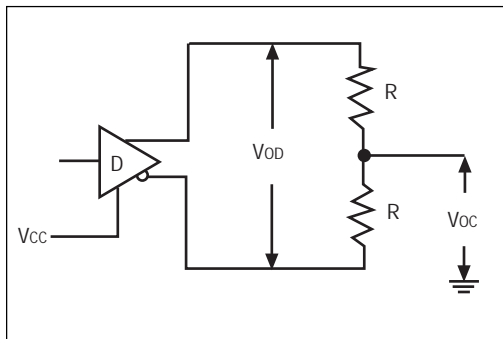
**Pin 3 — DO<sub>1B</sub> — Driver 1 output B.**

**Pin 4 — EN — Driver Output Enable.** Please refer to SP3486 *Truth Table (1)*.

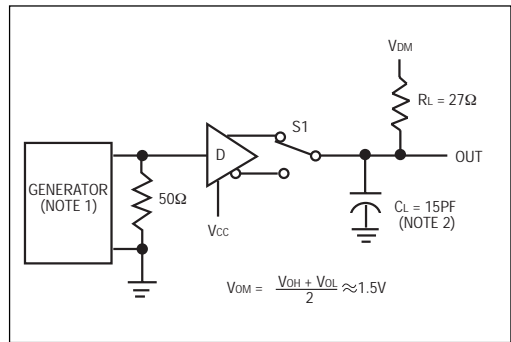
**Pin 5 — DO<sub>2B</sub> — Driver 2 output B.**

**Pin 6 — DO<sub>2A</sub> — Driver 2 output A.**

**Pin 7 — DI<sub>2</sub> — Driver 2 Input** — If Driver 2 output is enabled, logic 0 on DI<sub>2</sub> forces driver output DO<sub>2A</sub> low and DO<sub>2B</sub> high. A logic 1 on DI<sub>2</sub> with Driver 2 output enabled forces driver DO<sub>2A</sub> high and DO<sub>2B</sub> low.



**Figure 1. Driver DC Test Load Circuit**



**Figure 2. Driver Propagation Delay Test Circuit**

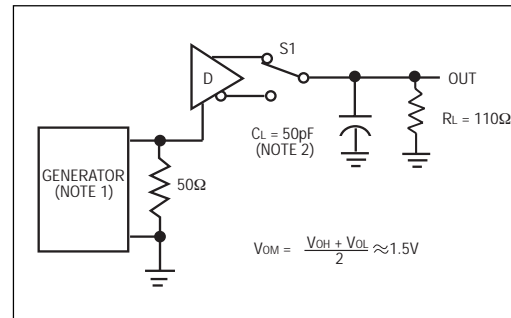
**Pin 8 — GND — Digital Ground.**

**Pin 9 — DI<sub>3</sub> — Driver 3 Input** — If Driver 3 output is enabled, logic 0 on DI<sub>3</sub> forces driver output DO<sub>3A</sub> low and DO<sub>3B</sub> high. A logic 1 on DI<sub>3</sub> with Driver 3 output enabled forces driver DO<sub>3A</sub> high and DO<sub>3B</sub> low.

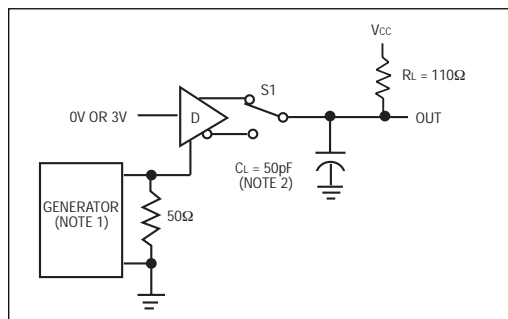
**Pin 10 — DO<sub>3A</sub> — Driver 3 output A.**

**Pin 11 — DO<sub>3B</sub> — Driver 3 output B.**

**Pin 12 —  $\overline{EN}$  — Driver Output Disable.** Please refer to SP486 *Truth Table (1)*.

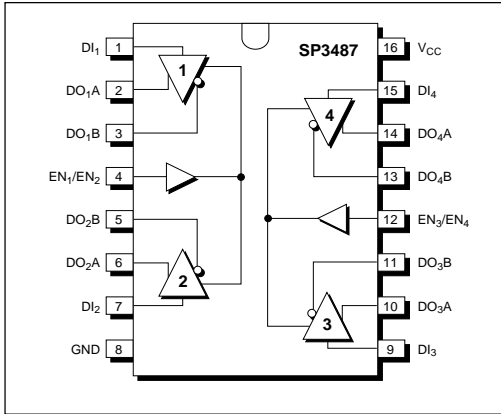


**Figure 3. Driver Enable and Disable Timing Circuit, Output HIGH**



**Figure 4. Driver Enable and Disable Timing Circuit, Output LOW**

## PINOUT — SP3487



Pin 13 — DO<sub>4</sub>B — Driver 4 output B.

Pin 14 — DO<sub>4</sub>A — Driver 4 output A.

Pin 15 — DI<sub>4</sub> — Driver 4 Input — If Driver 4 output is enabled, logic 0 on DI<sub>4</sub> forces driver output DO<sub>4</sub>A low and DO<sub>4</sub>B high. A logic 1 on DI<sub>4</sub> with Driver 4 output enabled forces driver DO<sub>4</sub>A high and DO<sub>4</sub>B low.

Pin 16 — V<sub>CC</sub> — Positive Supply +3.00V < V<sub>CC</sub> < +3.60V

### SP3487 PINOUT

Pin 1 — DI<sub>1</sub> — Driver 1 Input — If Driver 1 output is enabled, logic 0 on DI<sub>1</sub> forces driver output DO<sub>1</sub>A low and DO<sub>1</sub>B high. A logic 1 on DI<sub>1</sub> with Driver 1 output enabled forces driver DO<sub>1</sub>A high and DO<sub>1</sub>B low.

Pin 2 — DO<sub>1</sub>A — Driver 1 output A.

Pin 3 — DO<sub>1</sub>B — Driver 1 output B.

Pin 4 — EN<sub>1</sub>/EN<sub>2</sub> — Driver 1 and 2 Output Enable. Please refer to SP3487 Truth Table (2).

Pin 5 — DO<sub>2</sub>B — Driver 2 output B.

Pin 6 — DO<sub>2</sub>A — Driver 2 output A.

Pin 7 — DI<sub>2</sub> — Driver 2 Input — If Driver 2 output is enabled, logic 0 on DI<sub>2</sub> forces driver output DO<sub>2</sub>A low and DO<sub>2</sub>B high. A logic 1 on DI<sub>2</sub> with Driver 2 output enabled forces driver DO<sub>2</sub>A high and DO<sub>2</sub>B low.

INPUT	ENABLES		OUTPUTS	
DI	EN	$\overline{\text{EN}}$	OUTA	OUTB
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Hi-Z	Hi-Z

Table 1. SP3486 Truth Table

Pin 8 — GND — Digital Ground.

Pin 9 — DI<sub>3</sub> — Driver 3 Input — If Driver 3 output is enabled, logic 0 on DI<sub>3</sub> forces driver output DO<sub>3</sub>A low and DO<sub>3</sub>B high. A logic 1 on DI<sub>3</sub> with Driver 3 output enabled forces driver DO<sub>3</sub>A high and DO<sub>3</sub>B low.

Pin 10 — DO<sub>3</sub>A — Driver 3 output A.

Pin 11 — DO<sub>3</sub>B — Driver 3 output B.

Pin 12 — EN<sub>3</sub>/EN<sub>4</sub> — Driver 3 and 4 Output Enable. Please refer to **SP3487 Truth Table (2)**.

Pin 13 — DO<sub>4</sub>B — Driver 4 output B.

Pin 14 — DO<sub>4</sub>A — Driver 4 output A.

Pin 15 — DI<sub>4</sub> — Driver 4 Input — If Driver 4 output is enabled, logic 0 on DI<sub>4</sub> forces driver output DO<sub>4</sub>A low and DO<sub>4</sub>B high. A logic 1 on DI<sub>4</sub> with Driver 4 output enabled forces driver DO<sub>4</sub>A high and DO<sub>4</sub>B low.

Pin 16 — V<sub>CC</sub> — Positive Supply +3.00V < V<sub>CC</sub> < +3.60V

INPUT	ENABLES	OUTPUTS	
DI	EN1/EN2 or EN3/EN4	OUTA	OUTB
H	H	H	L
L	H	L	H
X	L	Hi-Z	Hi-Z

Table 2. SP3487 Truth Table

## FEATURES

The **SP3486** and the **SP3487** are +3.3V low power quad line drivers that meet the specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with Sipex's SP486 and SP487 devices as well as popular industry standards. The **SP3486** and **SP3487** devices feature Sipex's BiCMOS process allowing low power operation without sacrificing performance.

The RS-485 standard is ideal for multi-drop applications or for long distance interfaces. RS-485 allows up to 32 drivers and 32 receivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, RS-485 transceivers are equipped with a wide (-7V to +12V) common mode range to accommodate ground potential differences. Data is virtually immune to noise in the transmission line because the RS-485 protocol is a differential interface.

## Driver

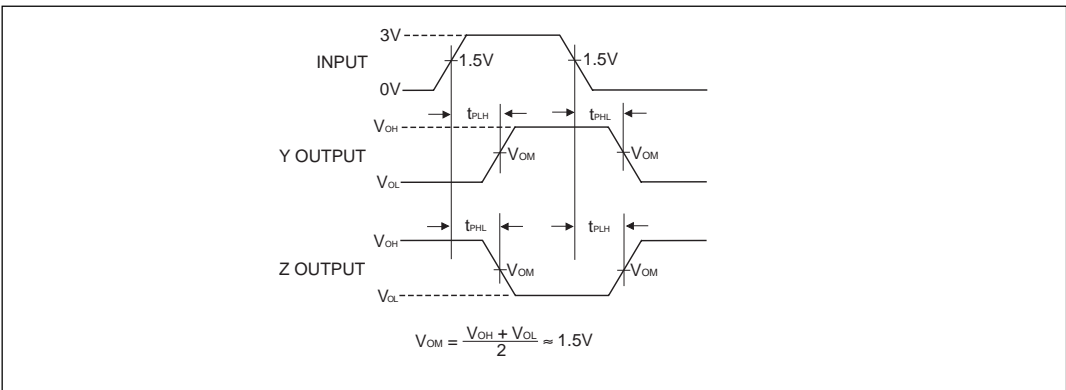
The drivers for both the **SP3486** and **SP3487** have differential outputs. The typical voltage output swing with no load will be 0V to +5V. With worst case loading of 54Ω across the differential outputs, the driver can maintain greater than +1.5V voltage levels.

The drivers of the **SP3486** feature active HIGH and active LOW common driver enable controls. Refer to **SP3486** Truth Table in Table 1. The **SP3487** provides independent, active high driver enable controls for each pair of drivers. Refer to **SP3487** Truth Table in Table 2. The driver outputs are short-circuit limited to 250mA. The **SP3486** and **SP3487** drivers meet the electrical specifications of RS-485 and RS-422 serial protocols up to 10Mbps under load.

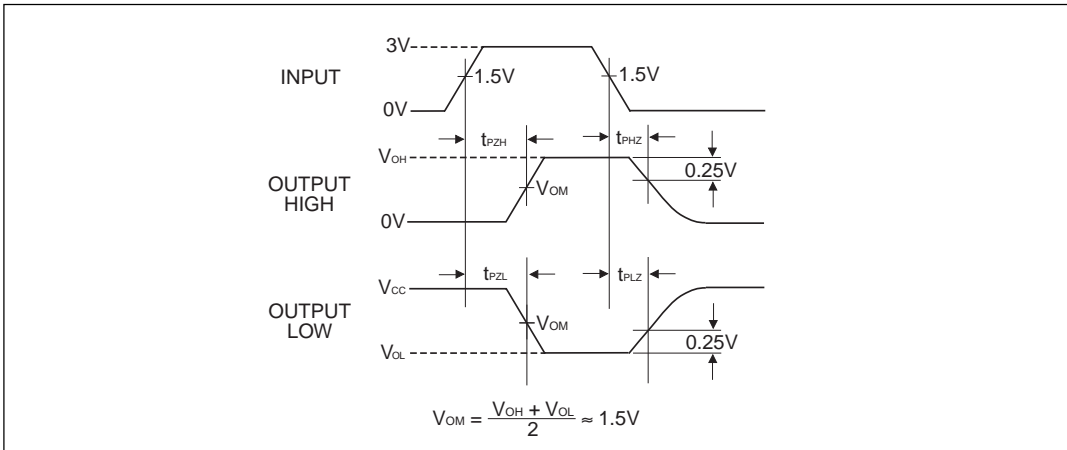
## AC PARAMETERS

$V_{CC} = +3.3V \pm 5\%$ ; typicals at 25°C;  $T_{AMB} = 25^\circ C$  unless otherwise noted.

PARAMETER	MIN.	TYP.	MAX.	UNIT	CONDITIONS
<b>PROPAGATION DELAY</b> Driver Input to Output					<i>Figure 2 and 5</i>
Low to High ( $t_{PLH}$ )	20	40	60	ns	
High to Low ( $t_{PHL}$ )	20	40	60	ns	
Differential Driver Skew		5	10	ns	$ t_{PHL}(Y) - t_{PLH}(Y) ,  t_{PHL}(Z) - t_{PLH}(Z) ,$ <i>Figures 2 and 5</i>
Driver Rise Time ( $t_R$ )					10% to 90% $R_{DIFF} = 60\Omega$
SP3486		10		ns	
SP3487		10		ns	
Driver Fall Time ( $t_F$ )					90% to 10% $R_{DIFF} = 60\Omega$
SP3486		10		ns	
SP3487		10		ns	
<b>DRIVER ENABLE</b> To Output High		110		ns	<i>Figures 3 and 6</i>
To Output Low		110		ns	<i>Figures 4 and 6</i>
<b>DRIVER DISABLE</b> From Output Low		110		ns	<i>Figures 4 and 6</i>
From Output High		110		ns	<i>Figures 3 and 6</i>



**Figure 5. Driver Propagation Delay Waveforms**

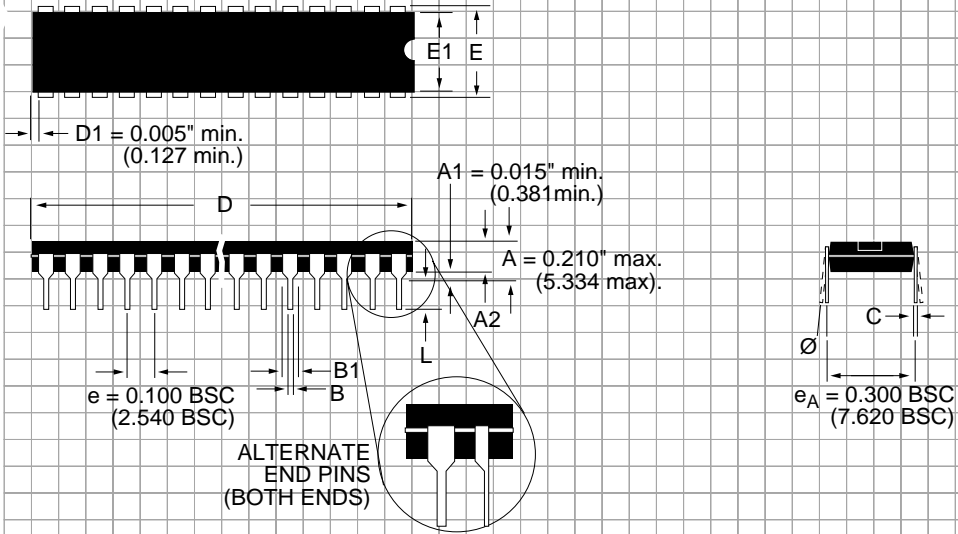


**Figure 6. Driver Enable and Disable Timing Waveforms**

**NOTE 1:** The input pulse is supplied by a generator with the following characteristics:  
 INPUT=250kHz, 50% duty cycle,  $t_r \leq 6.0ns$ ,  $Z_o = 50\Omega$ .

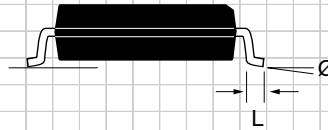
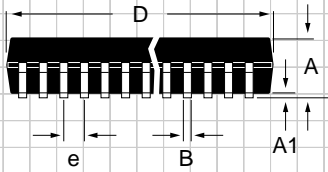
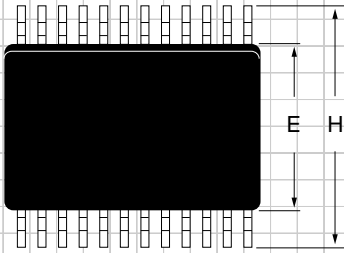
**NOTE 2:**  $C_L$  includes probe and stray capacitance.

# PACKAGE: PLASTIC DUAL-IN-LINE (NARROW)



DIMENSIONS (Inches) Minimum/Maximum (mm)	16-PIN
A2	0.115/0.195 (2.921/4.953)
B	0.014/0.022 (0.356/0.559)
B1	0.045/0.070 (1.143/1.778)
C	0.008/0.014 (0.203/0.356)
D	0.780/0.800 (19.812/20.320)
E	0.300/0.325 (7.620/8.255)
E1	0.240/0.280 (6.096/7.112)
L	0.115/0.150 (2.921/3.810)
$\emptyset$	0° / 15° (0°/15°)

**PACKAGE: PLASTIC  
SMALL OUTLINE (SOIC)  
(WIDE)**



DIMENSIONS (Inches) Minimum/Maximum (mm)	16-PIN
A	0.093/0.104 (2.352/2.649)
A1	0.004/0.012 (0.102/0.300)
B	0.013/0.020 (0.330/0.508)
D	0.398/0.413 (10.10/10.49)
E	0.291/0.299 (7.402/7.600)
e	0.050 BSC (1.270 BSC)
H	0.394/0.419 (10.00/10.64)
L	0.016/0.050 (0.406/1.270)
Ø	0°/8° (0°/8°)



## ORDERING INFORMATION

### Quad RS485 Drivers:

Model	Enable/Disable	Temperature Range	Package
SP3486CP	Common; active Low and Active High	0°C to +70°C	16-pin Plastic DIP
SP3486CT	Common; active Low and Active High	0°C to +70°C	16-pin SOIC
SP3486EP	Common; active Low and Active High	-40°C to +85°C	16-pin Plastic DIP
SP3486ET	Common; active Low and Active High	-40°C to +85°C	16-pin SOIC
SP3487CP	One per driver pair; active High	0°C to +70°C	16-pin Plastic DIP
SP3487CT	One per driver pair; active High	0°C to +70°C	16-pin SOIC
SP3487EP	One per driver pair; active High	-40°C to +85°C	16-pin Plastic DIP
SP3487ET	One per driver pair; active High	-40°C to +85°C	16-pin SOIC

Please consult the factory for pricing and availability on a Tape-On-Reel option.



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