

DATA SHEET

PDIUSBP11

Universal Serial Bus transceiver

Product specification

1997 Sep 16

Universal Serial Bus transceiver

PDIUSBP11

FEATURES

- Utilizes digital inputs and outputs to transmit and receive USB cable data
- Supports 12Mbit/s "Full Speed" and 1.5Mbit/s "Low Speed" serial data transmission
- Compatible with the VHDL "Serial Interface Engine" from USB developer's conference
- Available in SO, 14 pin package
- Hysteresis on D+, D-, V_{MO} inputs

DESCRIPTION

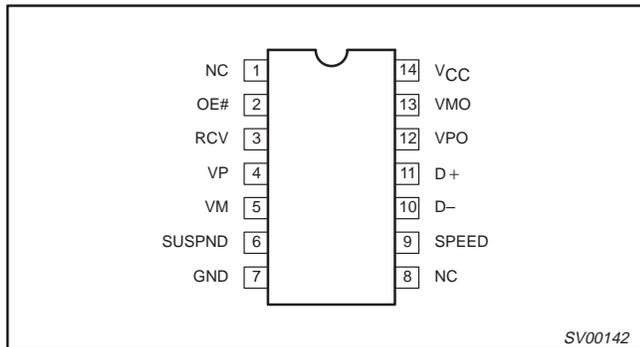
The PDIUSBP11 is a one chip generic USB transceiver. It is designed to allow 5.0V or 3.3V programmable and standard logic to interface with the physical layer of the Universal Serial Bus. It is capable of transmitting and receiving serial data at both full speed (12Mbit/s) and low speed (1.5Mbit/s) data rates. The outputs from the serial interface engine (inputs VPO and VMO on the PDIUSBP11) are driven by the host. The gated inputs (outputs VP and VM on the PDIUSBP11) are to be decoded by the host.

Implementation of the Serial Interface Engine along with the USB transceiver allow the designer to make flexible USB compatible devices with widely available logic components.

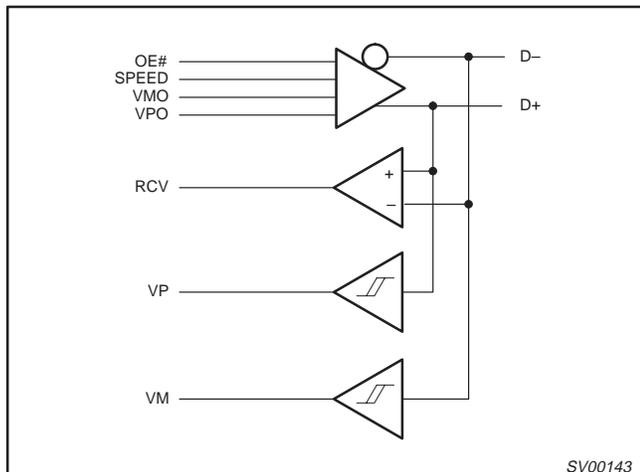
ORDERING INFORMATION

| PACKAGES | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | PKG. DWG. # |
|----------------------|-------------------|-----------------------|----------------|-------------|
| 14-pin plastic SO | 0°C to +70°C | PDIUSBP11 D | PDIUSBP11 D | SOT108-1 |
| 14-pin plastic SSOP | 0°C to +70°C | PDIUSBP11 DB | PDIUSBP11 DB | SOT337-1 |
| 14-pin plastic TSSOP | 0°C to +70°C | PDIUSBP11 PW | PDUSBP11 PW DH | SOT402-1 |

PIN CONFIGURATION



FUNCTIONAL DIAGRAM



PIN DESCRIPTION

| PIN No. | PIN SYMBOL | I/O | NAME AND FUNCTION | | | | | | | | | | | | | | | |
|---------|-----------------|------------|--|-----|-----|--------|---|---|-----|---|---|-----------|---|---|------------|---|---|-----------|
| 3 | RCV | O | Receive data. CMOS level output for USB differential input | | | | | | | | | | | | | | | |
| 2 | OE# | I | Output Enable. Active LOW, enables the transceiver to transmit data on the bus. When not active the transceiver is in receive mode | | | | | | | | | | | | | | | |
| 12, 13 | VPO, VMO | I | Inputs to differential driver. (Outputs from SIE). <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>VPO</th> <th>VMO</th> <th>RESULT</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>SE0</td> </tr> <tr> <td>0</td> <td>1</td> <td>Logic "0"</td> </tr> <tr> <td>1</td> <td>0</td> <td>Logic "1"</td> </tr> <tr> <td>1</td> <td>1</td> <td>Undefined</td> </tr> </tbody> </table> | VPO | VMO | RESULT | 0 | 0 | SE0 | 0 | 1 | Logic "0" | 1 | 0 | Logic "1" | 1 | 1 | Undefined |
| VPO | VMO | RESULT | | | | | | | | | | | | | | | | |
| 0 | 0 | SE0 | | | | | | | | | | | | | | | | |
| 0 | 1 | Logic "0" | | | | | | | | | | | | | | | | |
| 1 | 0 | Logic "1" | | | | | | | | | | | | | | | | |
| 1 | 1 | Undefined | | | | | | | | | | | | | | | | |
| 4, 5 | VP, VM | O | Gated version of D- and D+. Outputs are logic "0" and logic "1". Used to detect single ended zero (SE0#), error conditions, and interconnect speed. (Inputs to SIE). <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>VP</th> <th>VM</th> <th>RESULT</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>SE0</td> </tr> <tr> <td>0</td> <td>1</td> <td>Low Speed</td> </tr> <tr> <td>1</td> <td>0</td> <td>Full Speed</td> </tr> <tr> <td>1</td> <td>1</td> <td>Error</td> </tr> </tbody> </table> | VP | VM | RESULT | 0 | 0 | SE0 | 0 | 1 | Low Speed | 1 | 0 | Full Speed | 1 | 1 | Error |
| VP | VM | RESULT | | | | | | | | | | | | | | | | |
| 0 | 0 | SE0 | | | | | | | | | | | | | | | | |
| 0 | 1 | Low Speed | | | | | | | | | | | | | | | | |
| 1 | 0 | Full Speed | | | | | | | | | | | | | | | | |
| 1 | 1 | Error | | | | | | | | | | | | | | | | |
| 11, 10 | D+, D- | I/O | Data+, Data-. Differential data bus conforming to the Universal Serial Bus standard. | | | | | | | | | | | | | | | |
| 6 | SUSPND | I | Suspend. Enables a low power state while the USB bus is inactive. While the suspdn pin is active it will drive the RCV pin to a logic "0" state. | | | | | | | | | | | | | | | |
| 9 | SPEED | I | Edge rate control. Logic "1" operates at edge rates for "full speed". Logic "0" operates edge rates for "low speed". | | | | | | | | | | | | | | | |
| 14 | V _{CC} | | 3.0V to 3.6V power supply | | | | | | | | | | | | | | | |
| 7 | GND | | Ground reference | | | | | | | | | | | | | | | |

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RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | LIMITS | | UNIT |
|-----------|---|---|--------|----------|------|
| | | | MIN. | MAX. | |
| V_{CC} | DC supply voltage | | 3.0 | 3.6 | V |
| V_I | DC Input voltage range | | 0 | 5.5 | V |
| $V_{I/O}$ | DC input range for I/O's | | 0 | V_{CC} | V |
| V_O | DC output voltage range | | 0 | V_{CC} | V |
| T_{amb} | Operating ambient temperature range in free air | See DC and AC characteristics for individual device | 0 | +70 | °C |

ABSOLUTE MAXIMUM RATINGS^{1, 2}

In accordance with the Absolute Maximum Rating System (IEC 134) Voltages are referenced to GND (ground = 0V)

| SYMBOL | PARAMETER | CONDITIONS | LIMITS | | UNIT |
|-------------------|--|-----------------------------|--------|----------------|------|
| | | | MIN | MAX | |
| V_{CC} | DC supply voltage | | -0.5 | +6.5 | V |
| I_{IK} | DC input diode current | $V_I < 0$ | - | -50 | mA |
| V_I | DC input voltage | Note 3 | -0.5 | +5.5 | V |
| $V_{I/O}$ | DC input voltage range for I/O's | | -0.5 | $V_{CC} + 0.5$ | V |
| I_{OK} | DC output diode current | $V_O > V_{CC}$ or $V_O < 0$ | - | ±50 | mA |
| V_O | DC output voltage | Note 3 | -0.5 | $V_{CC} + 0.5$ | V |
| I_O | DC output source or sink current for VP/VM, RCV pins | $V_O = 0$ to V_{CC} | - | ±15 | mA |
| I_O | DC output source or sink current for D+/D- pins | $V_O = 0$ to V_{CC} | - | ±50 | mA |
| I_{GND}, I_{CC} | DC V_{CC} or GND current | | - | ±100 | mA |
| T_{stg} | Storage temperature range | | -60 | +150 | °C |
| P_{tot} | Power dissipation per package | | | | mW |

NOTES:

- Stresses beyond those listed 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 under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
- The input and output voltage ratings may be exceeded if the input and output clamp current ratings are observed.

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DC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions

Voltages are referenced to GND (ground = 0V)

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | UNIT |
|-------------------|------------------------------------|--|---------------------|------------------|-----|------|
| | | | Temp = 0°C to +70°C | | | |
| | | | MIN | TYP ¹ | MAX | |
| V _{IH} | HIGH level input | V _{CC} = 3.0V to 3.6V ³ | 2.0 | | | V |
| V _{IL} | LOW level input | V _{CC} = 3.0V to 3.6V ³ | | | 0.8 | V |
| R _D H | Output impedance (HIGH state) | Note 2 | 28 | 34 | 43 | Ω |
| R _D L | Output impedance (LOW state) | Note 2 | 28 | 35 | 51 | Ω |
| V _{OH} | HIGH level output ³ | V _{CC} = 3.0V; I _O = 6mA | 2.2 | 2.7 | | V |
| | | V _{CC} = 3.0V; I _O = 4mA | 2.4 | | | |
| | | V _{CC} = 3.0V; I _O = 100μA | 2.8 | – | | |
| V _{OL} | LOW level output ³ | V _{CC} = 3.0V; I _O = 6mA | | 0.3 | 0.8 | V |
| | | V _{CC} = 3.0V; I _O = 4mA | | | 0.5 | |
| | | V _{CC} = 3.0V; I _O = 100μA | | – | 0.2 | |
| I _{CCQ} | Quiescent supply current | V _{CC} = 3.6V; V _I = V _{CC} or GND; I _O = 0 | | 330 | 600 | μA |
| I _{CCS} | Supply current in Suspend | V _{CC} = 3.6V; V _I = V _{CC} or GND; I _O = 0 | | – | 65 | μA |
| I _{CCFS} | Active supply current (Full Speed) | V _{CC} = 3.3V | | 10 | 30 | mA |
| I _{CCLS} | Active supply current (Low Speed) | V _{CC} = 3.3V | | 2 | 25 | mA |
| I _I | Input leakage current | V _{CC} = 3.6V; V _I = 5.5V or GND; not for I/O pins | | ±0.1 | ±5 | μA |
| I _{OZ} | 3-State output OFF-state current | V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND ² | | | ±10 | μA |

NOTES:

- All typical values are at V_{CC} = 3.3V and T_{amb} = 25°C.
- This value includes an external resistor of 24Ω ± 1%. See "Load D+ and D–" diagram for testing details.
- All signals except D+ and D–.

AC CHARACTERISTICSGND = 0V, t_R = t_F = 3.0ns, C_L = 50pF, R_L = 500Ω, V_{CC} = 3.3V

| SYMBOL | PARAMETER | TEST CONDITIONS | WAVEFORMS | LIMITS | | | | | UNIT |
|-------------------|-----------------------------------|-----------------|-----------|-------------------------|-----|-----|---------------------------------|-----|------|
| | | | | T _{amb} = 25°C | | | T _{amb} = 0°C to +70°C | | |
| | | | | MIN | TYP | MAX | MIN | MAX | |
| t _{pLH} | VMO/VPO to D+/D– Full Speed | | 1 | 0 | | 12 | 0 | 15 | ns |
| t _{pHL} | | | | 0 | | 12 | 0 | 15 | |
| t _{rise} | Rise and Fall Times Full Speed | | 2 | 4 | | 20 | 4 | 20 | ns |
| t _{fall} | | | | 4 | | 20 | 4 | 20 | |
| t _{pLH} | VMO/VPO to D+/D– Low Speed | | 1 | 30 | | 300 | 30 | 300 | ns |
| t _{pHL} | | | | 30 | | 300 | 30 | 300 | |
| t _{rise} | Rise and Fall Times Low Speed | | 2 | 75 | | 300 | 75 | 300 | ns |
| t _{fall} | | | | 75 | | 200 | 75 | 200 | |
| t _{pLH} | D+/D– to RCV | | 3 | | | 16 | | 16 | ns |
| t _{pHL} | | | | | | 16 | | 20 | |
| t _{pLH} | D+/D– to VP/VM | | 1 | | | 8 | | 8 | ns |
| t _{pHL} | | | | | | 8 | | 12 | |
| t _{pHZ} | OE# to D+/D– RL = 500Ω | | 4 | | | 12 | | 12 | ns |
| t _{pZH} | | | | | | 12 | | 15 | |
| t _{pLZ} | | | | | | 10 | | 10 | |
| t _{pZL} | | | | | | 10 | | 15 | |
| t _{su} | Setup for SPEED | | 5 | 0 | | | | | ns |
| V _{cr} | Crossover point | Note 1 | 3 | 1.3 | | 2.0 | 1.3 | 2.0 | V |

NOTE:

- The crossover point is in the range of 1.3V to 2.5V for the low speed mode with a 50pF capacitance. In the low-speed mode with a 100pF or greater capacitance, the crossover point is in the range of 1.3V to 2.0V.

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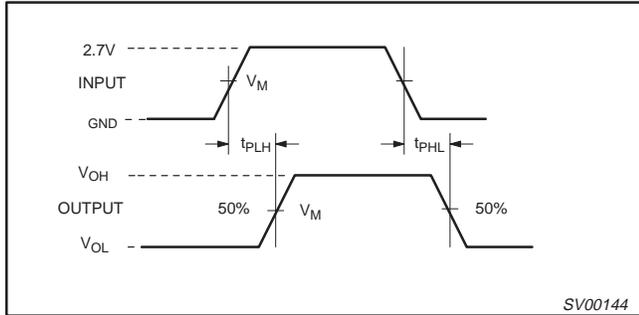
AC WAVEFORMS

$V_M = 1.5V$

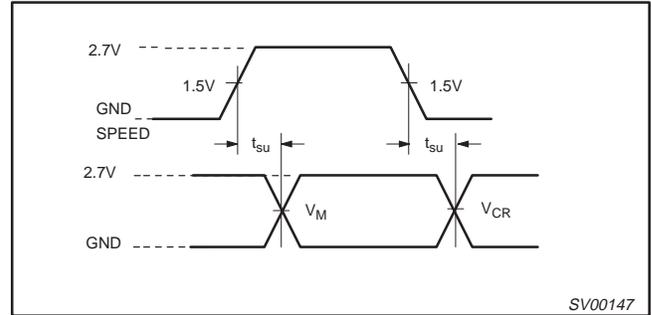
$V_X = V_{OL} + 0.3V$

$V_Y = V_{OH} - 0.3V$

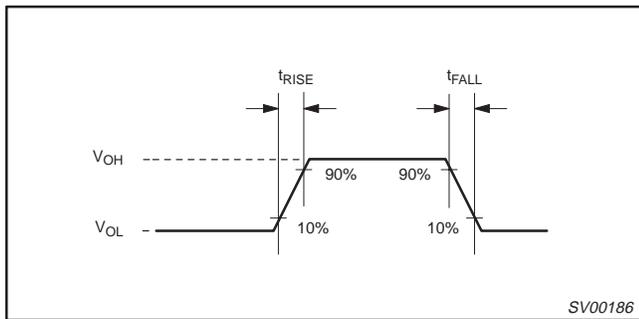
V_{OL} and V_{OH} are the typical output voltage drops that occur with the output load. (V_{CC} never goes below 3.0V).



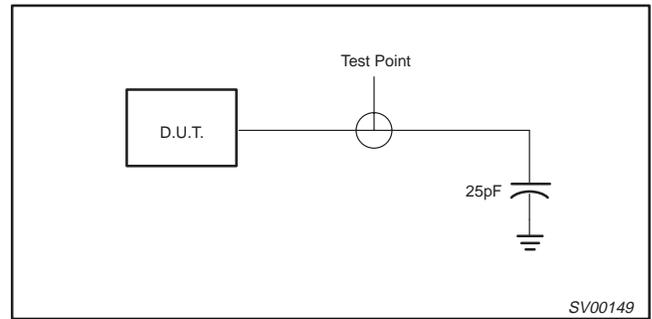
Waveform 1. D+/D- to VP/VM or VPO/VMO to D+/D-



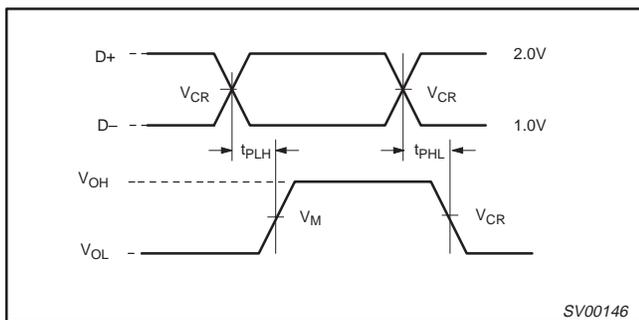
Waveform 5. Setup for Speed



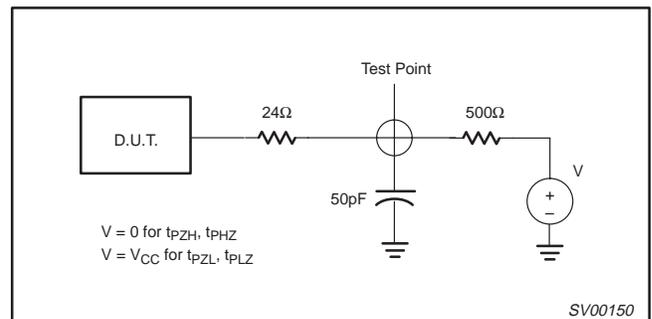
Waveform 2. Rise and Fall Times



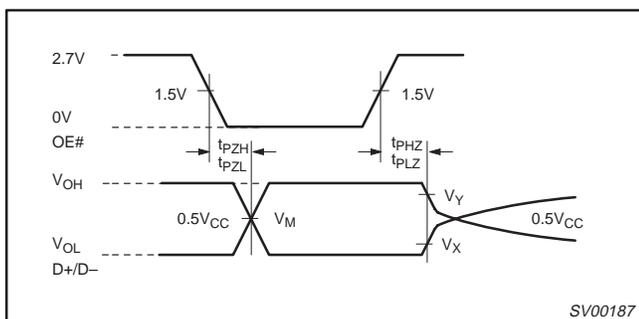
Load for VM/VP and RCV



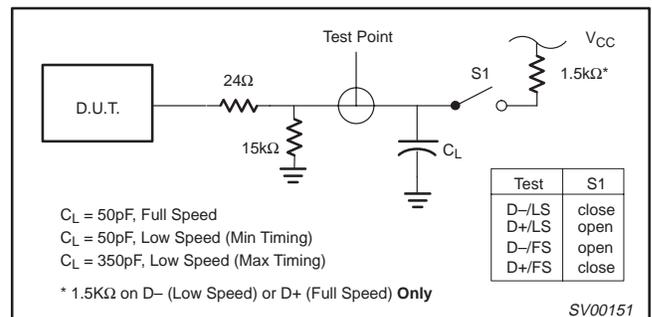
Waveform 3. D+/D- to RCV



Load for Enable and Disable Times



Waveform 4. OE# to D+/D-



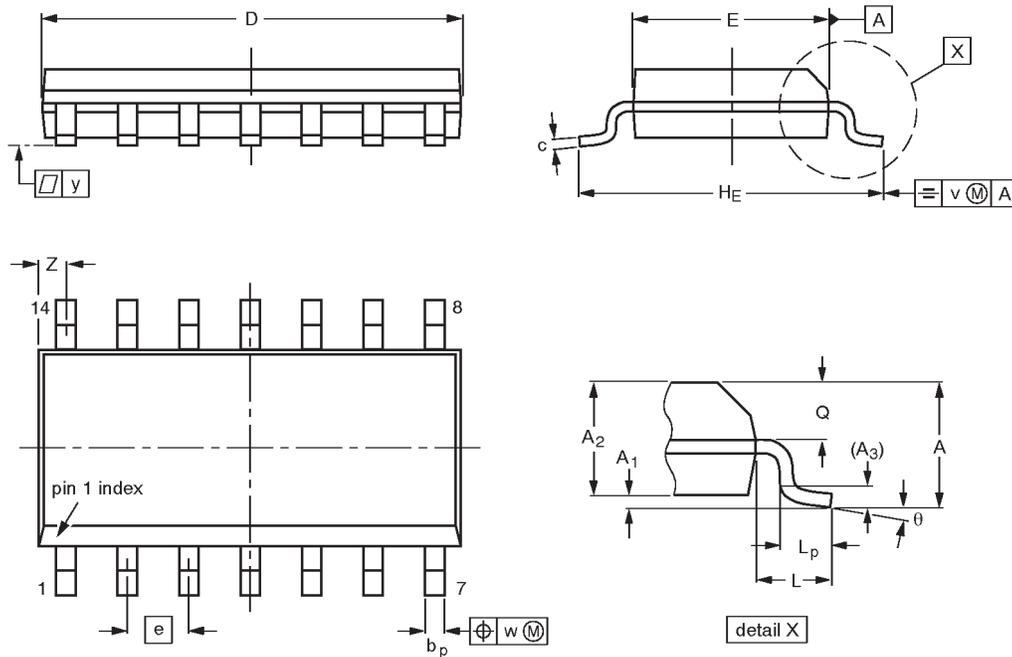
Load for D+/D-

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SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|--------|-----------------|-----------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm | 1.75 0.10 | 0.25 1.25 | 1.45 1.25 | 0.25 | 0.49 0.36 | 0.25 0.19 | 8.75 8.55 | 4.0 3.8 | 1.27 | 6.2 5.8 | 1.05 | 1.0 0.4 | 0.7 0.6 | 0.25 | 0.25 | 0.1 | 0.7 0.3 | 8° 0° |
| inches | 0.069 0.0039 | 0.0098 0.049 | 0.057 0.049 | 0.01 | 0.019 0.014 | 0.0098 0.0075 | 0.35 0.34 | 0.16 0.15 | 0.050 | 0.24 0.23 | 0.041 | 0.039 0.016 | 0.028 0.024 | 0.01 | 0.01 | 0.004 | 0.028 0.012 | |

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

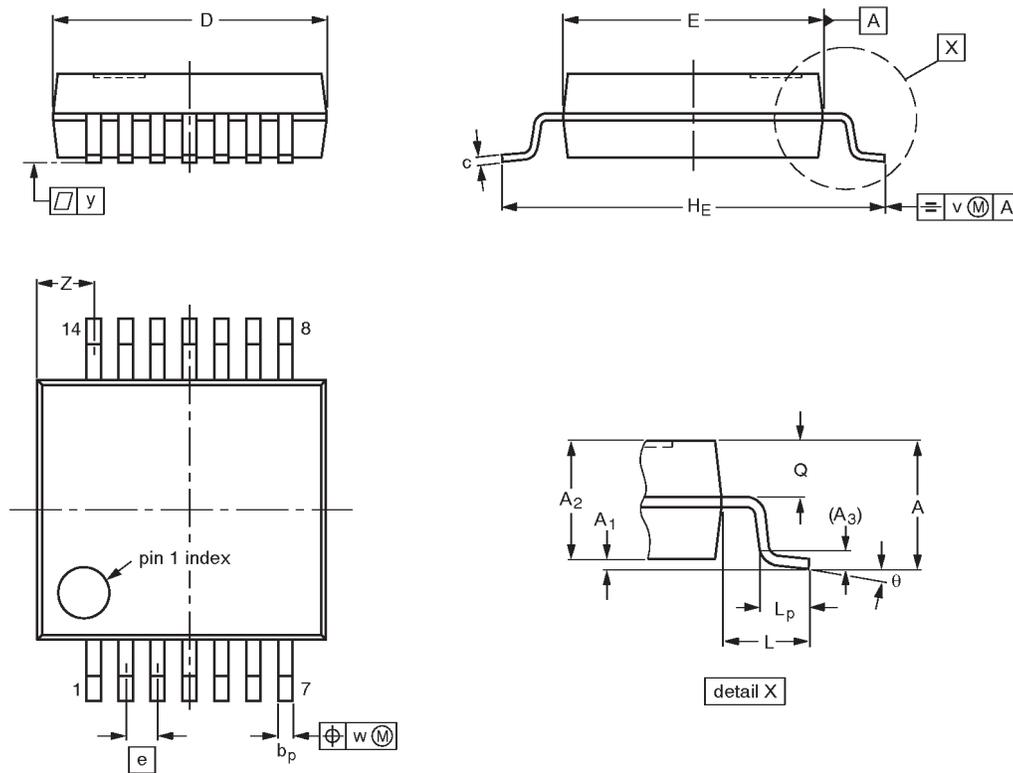
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|----------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT108-1 | 076E06S | MS-012AB | | | | 91-08-13 95-01-23 |

Universal Serial Bus transceiver

PDIUSBP11

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|------|----------------|------|----------------|------------|-----|------|-----|------------------|----------|
| mm | 2.0 | 0.21 0.05 | 1.80 1.65 | 0.25 | 0.38 0.25 | 0.20 0.09 | 6.4 6.0 | 5.4 5.2 | 0.65 | 7.9 7.6 | 1.25 | 1.03 0.63 | 0.9 0.7 | 0.2 | 0.13 | 0.1 | 1.4 0.9 | 8° 0° |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

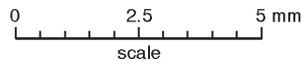
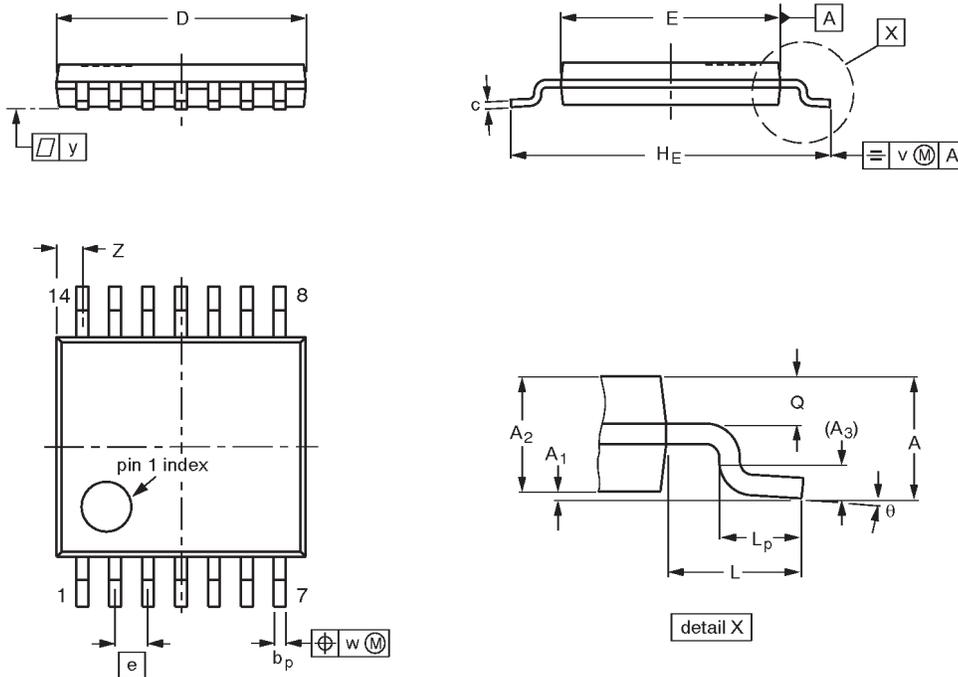
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|----------|------|--|---------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT337-1 | | MO-150AB | | | | 95-02-04 96-01-18 |

Universal Serial Bus transceiver

PDIUSBP11

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|-----|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.10 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 5.1 4.9 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1.0 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.72 0.38 | 8° 0° |

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|------|--|---------------------|-----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT402-1 | | MO-153 | | | | -94-07-12 95-04-04 |

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NOTES

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DEFINITIONS

| Data Sheet Identification | Product Status | Definition |
|----------------------------------|-------------------------------|--|
| <i>Objective Specification</i> | Formative or in Design | This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice. |
| <i>Preliminary Specification</i> | Preproduction Product | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
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