Universal Serial Bus transceiver PDIUSBP11A

FEATURES

- Complies with Universal Serial Bus specification 1.1
- 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 Implementers' Forum
- Supports single-ended data interface
- Single 3.3V supply
- Available in SO-14, SSOP-14 and TSSOP-14 packages

DESCRIPTION

The PDIUSBP11A 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.

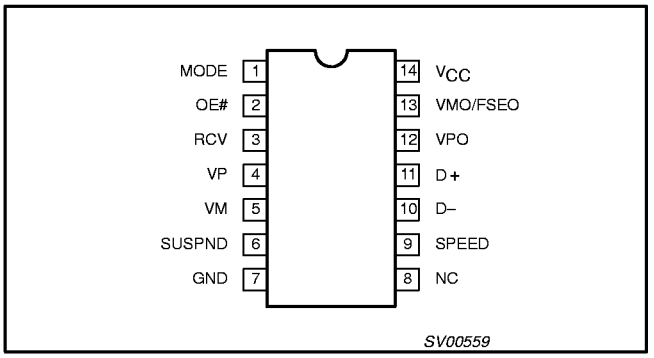
The pinout conforms with the "Serial Interface Engine". Implementation of the Serial Interface Engine along with the USB transceiver allows the designer to make USB compatible devices with off-the-shelf logic and easily modify and update the application.

The PDIUSBP11A is backward compatible to the PDIUSBP11 and allows for single-ended data interfacing.

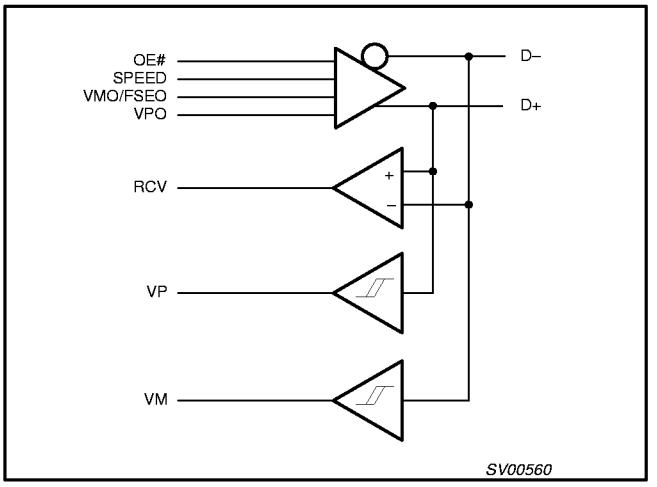
ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	OUTSIDE NORTH AMERICA	NORTH AMERICA	PKG. DWG. #
14-pin plastic SO	–40°C to +85°C	PDIUSBP11A D	PDIUSBP11A D	SOT108-1
14-pin plastic SSOP	–40°C to +85°C	PDIUSBP11A DB	PDIUSBP11A DB	SOT337-1
14-pin plastic TSSOP	–40°C to +85°C	PDIUSBP11APW	PDUSBP11APW DH	SOT402-1

PIN CONFIGURATION



FUNCTIONAL DIAGRAM



PIN DESCRIPTION

<table>
<tr><th>PIN No.</th><th>PIN SYMBOL</th><th>I/O</th><th>NAME AND FUNCTION</th></tr>
<tr><td>3</td><td>RCV</td><td>O</td><td>Receive data. CMOS level output for USB differential input</td></tr>
<tr><td>2</td><td>OE#</td><td>I</td><td>Output Enable. Active LOW, enables the transceiver to transmit data on the bus. When not active the transceiver is in receive mode</td></tr>
<tr><td>1</td><td>MODE</td><td>I</td><td>Mode. When left unconnected, a weak pull-up transistor pulls it to V_{CC} and in this mode, the PDIUSBP11A is backward compatible to PDIUSBP11. When connected to GND, the VMO/FSEO pin takes the function of FSEO (Force SEO).</td></tr>
<tr><td>12, 13</td><td>V_{PO}, V_{MO}/F_{SEO}</td><td>I</td><td>Inputs to differential driver. (Outputs from SIE).
<table>
<tr><th>MODE</th><th>VPO</th><th>VMO/FSEO</th><th>RESULT</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Logic “0”</td></tr>
<tr><td></td><td>0</td><td>1</td><td>SE0#</td></tr>
<tr><td></td><td>1</td><td>0</td><td>Logic “1”</td></tr>
<tr><td></td><td>1</td><td>1</td><td>SEO#</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>SE0#</td></tr>
<tr><td></td><td>0</td><td>1</td><td>Logic “0”</td></tr>
<tr><td></td><td>1</td><td>0</td><td>Logic “1”</td></tr>
<tr><td></td><td>1</td><td>1</td><td>Illegal code</td></tr>
</table></td></tr>
<tr><td>4, 5</td><td>V_P, V_M</td><td>O</td><td>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>
<tr><th>VP</th><th>VM</th><th>RESULT</th></tr>
<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>
</table></td></tr>
<tr><td>11, 10</td><td>D+, D–</td><td>AI/O</td><td>Data+, Data–. Differential data bus conforming to the Universal Serial Bus standard.</td></tr>
<tr><td>6</td><td>SUSPND</td><td>I</td><td>Suspend. Enables a low power state while the USB bus is inactive. While the suspnd pin is active it will drive the RCV pin to a logic “0” state. Both D+ and D– are tri-stated.</td></tr>
<tr><td>9</td><td>SPEED</td><td>I</td><td>Edge rate control. Logic “1” operates at edge rates for “full speed”. Logic “0” operates edge rates for “low speed”.</td></tr>
<tr><td>14</td><td>V_{CC}</td><td></td><td>3.0V to 3.6V power supply</td></tr>
<tr><td>7</td><td>GND</td><td></td><td>Ground reference</td></tr>
</table>

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
$V_{AI/O}$	DC input range for AI/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 per device	–40	+85	°C

ABSOLUTE MAXIMUM RATINGS[1]

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
$I_{latchup}$	Latchup current	$V_I < 0$ or $V_I > V_{CC}$	–	200	mA
V_I	DC input voltage	Note 2	–0.5	+5.5	V
$V_{I/O}$	DC input voltage range for I/O's		–0.5	V_{CC} +0.5	V
V_O	DC output voltage	Note 2	–0.5	V_{CC} +0.5	V
I_{CC}, I_{GND}	DC V_{CC} or GND current		–	±100	mA
T_{STO}	Storage temperature range		–60	+150	°C
P_{TOT}	Power dissipation per package				mW

NOTES:

1. 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.
2. The input and output voltage ratings may be exceeded if the input and output clamp current ratings are observed.

DC CHARACTERISTICS (DIGITAL PINS)

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			Temp = –40°C to +85°C			
			MIN	TYP	MAX	
INPUT LEVELS						
V_{IL}	LOW level input voltage				0.8	V
V_{IH}	HIGH level input voltage		2.0			V
OUTPUT LEVELS						
V_{OL}	LOW level output voltage	I_{OL} = 4mA			0.4	V
		I_{OL} = 20µA			0.1	
V_{OH}	HIGH level output voltage	I_{OH} = 4mA	2.4			V
		I_{OH} = 20µA	V_{CC}–0.1			
LEAKAGE CURRENT						
I_L	Input leakage current				±5	µA
I_{CCS}	Supply current in Suspend			–	5	µA
SUPPLY CURRENT						
I_{CC}	Operating supply current		–	6	–	mA

DC CHARACTERISTICS (AI/O PINS)

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS		UNIT
			Temp = –40°C to +85°C		
			MIN	MAX	
INPUT LEVELS					
V_{DI}	Differential input sensitivity	|(D+) – (D–)|	0.2		V
V_{CM}	Differential common mode range	Includes V_{DI} range	0.8	2.5	V
V_{SE}	Single ended receiver threshold		0.8	2.0	V
OUTPUT LEVELS					
V_{OL}	Static output LOW voltage	R_L of 1.5 kΩ to 3.6V		0.3	V
V_{OH}	Static output HIGH voltage	R_L of 15 kΩ to GND	2.8	3.6	V
LEAKAGE CURRENT					
I_{LO}	Hi-Z State data line leakage current	$0V < V_{IN} < 3.3V$		±10	µA
CAPACITANCE					
C_{IN}	Transceiver capacitance	Pin to GND		20	pF
OUTPUT RESISTANCE					
Z_{DRV}[1]	Driver output resistance	Steady state drive	6	18	Ω

NOTE:
1. Excludes external resistor. In order to comply with USB Specifications 1.1, external series resistors of 24Ω ±1% each on D+ and D– are recommended.

AC CHARACTERISTICS (AI/O PINS. FULL SPEED)

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			T_{amb} = –40°C to +85°C			
			MIN	TYP	MAX	
Driver Characteristics		C_L = 50pF; R_{pu} = 1.5kΩ on D+ to V_{CC}				
	Transition Time:	Between 10% and 90%				
t_R	Rise time	Waveform 1	4[1]		20	ns
t_F	Fall time	Waveform 1	4[1]		20	ns
t_{RFM}	Rise / Fall time matching	(t_R/t_F)	90		111.1	%
V_{CRS}	Output signal crossover voltage		1.3		2.0	V
Driver Timings						
tp_{LH}	Driver propagation delay	Waveform 2			18	ns
tp_{HL}	(VPO, VMO/FSEO to D+/D–)	Waveform 2			19	ns
tp_{HZ}	Driver disable delay	Waveform 4			13	ns
tp_{LZ}	(OE# to D+/D–)	Waveform 4			13	ns
tp_{ZH}	Driver enable delay	Waveform 4			17	ns
tp_{ZL}	(OE# to D+/D–)	Waveform 4			17	ns
Receiver Timings						
tp_{LH}	Receiver propagation delay	Waveform 3			16	ns
tp_{HL}	(D+, D– to RCV)	Waveform 3			19	ns
tp_{LH}	Single-ended receiver delay	Waveform 3			8	ns
tp_{HL}	(D+, D– to VP, VM)	Waveform 3			8	ns

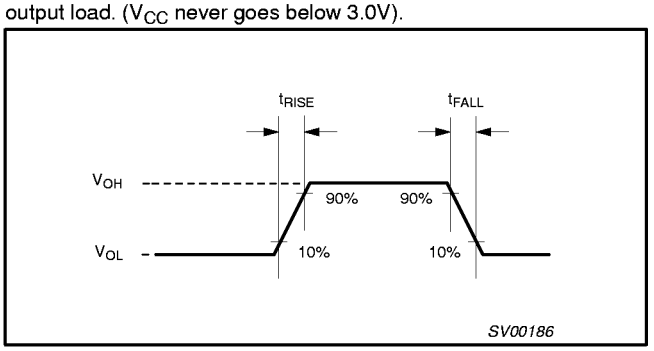
NOTE:
1. The 4ns specification is only for 0°C to +85°C.

AC CHARACTERISTICS (AI/O PINS. LOW SPEED)

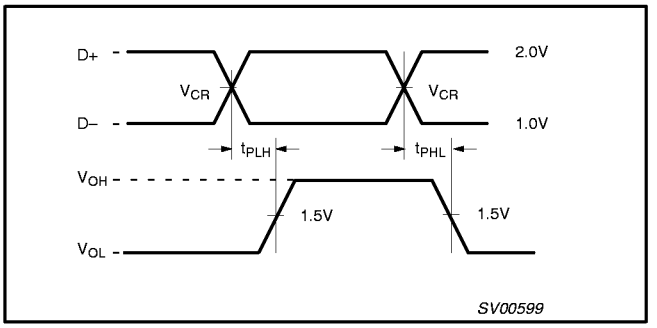
SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			T_{amb} = –40°C to +85°C			
			MIN	TYP	MAX	
Driver Characteristics		C_L = 200pF and 600pF; R_{pu} = 1.5kΩ on D– to V_{CC}				
	Transition Time:	Between 10% and 90%				
t_{LR}	Rise time	C_L = 200pF. Waveform 1	75			ns
		C_L = 600pF. Waveform 1			300	ns
t_{LF}	Fall time	C_L = 200pF. Waveform 1	75			ns
		C_L = 600pF. Waveform 1			300	ns
t_{LRFM}	Rise / Fall time matching	(t_{LR}/t_{LF})	80		125	%
V_{LCRS}	Output signal crossover voltage		1.3		2.0	V
Driver Timings						
tp_{LH}	Driver propagation delay	Waveform 2			300	ns
tp_{HL}	(VPO, VMO/FSEO to D+/D–)	Waveform 2			300	ns
tp_{HZ}	Driver disable delay	Waveform 4			13	ns
tp_{LZ}	(OE# to D+/D–)	Waveform 4			13	ns
tp_{ZH}	Driver enable delay	Waveform 4			205	ns
tp_{ZL}	(OE# to D+/D–)	Waveform 4			205	ns
Receiver Timings						
tp_{LH}	Receiver propagation delay	Waveform 3			18	ns
tp_{HL}	(D+, D– to RCV)	Waveform 3			18	ns
tp_{LH}	Single-ended receiver delay	Waveform 3			28	ns
tp_{HL}	(D+, D– to VP, VM)	Waveform 3			28	ns

AC WAVEFORMS

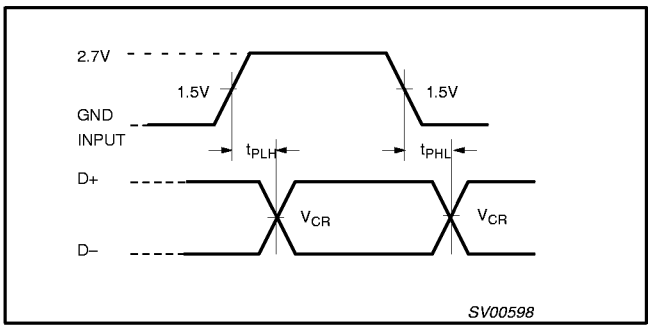
V_{OL} and V_{OH} are the typical output voltage drops that occur with the output load. (V_{CC} never goes below 3.0V).



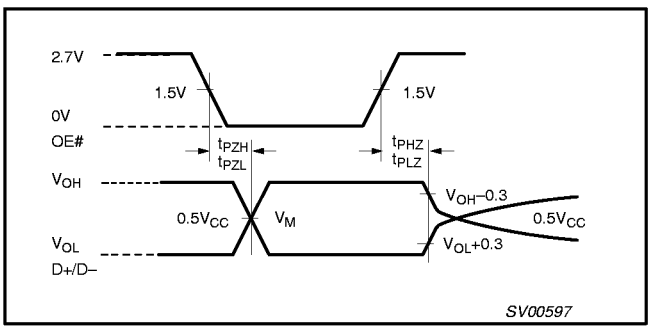
Waveform 1. Rise and Fall Times



Waveform 3. D+/D– to RCV, VP/VM

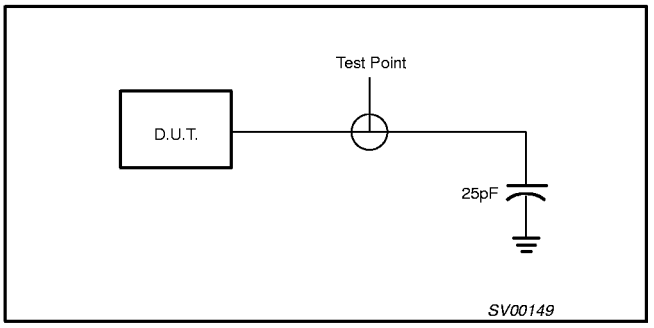


Waveform 2. VPO, VMO/FSEO to D+/D–

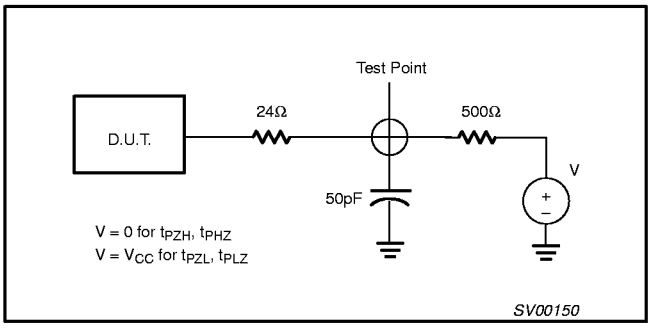


Waveform 4. OE# to D+/D–

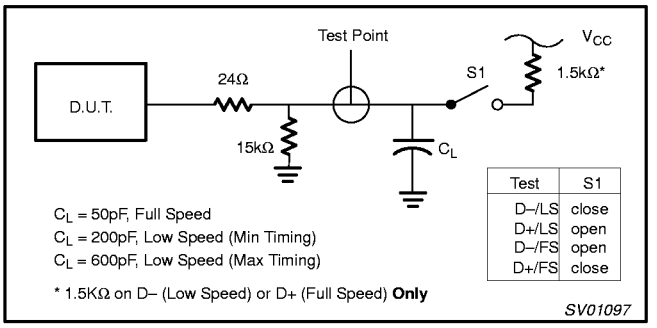
TEST CIRCUITS AND WAVEFORMS



Load for VM/VP and RCV

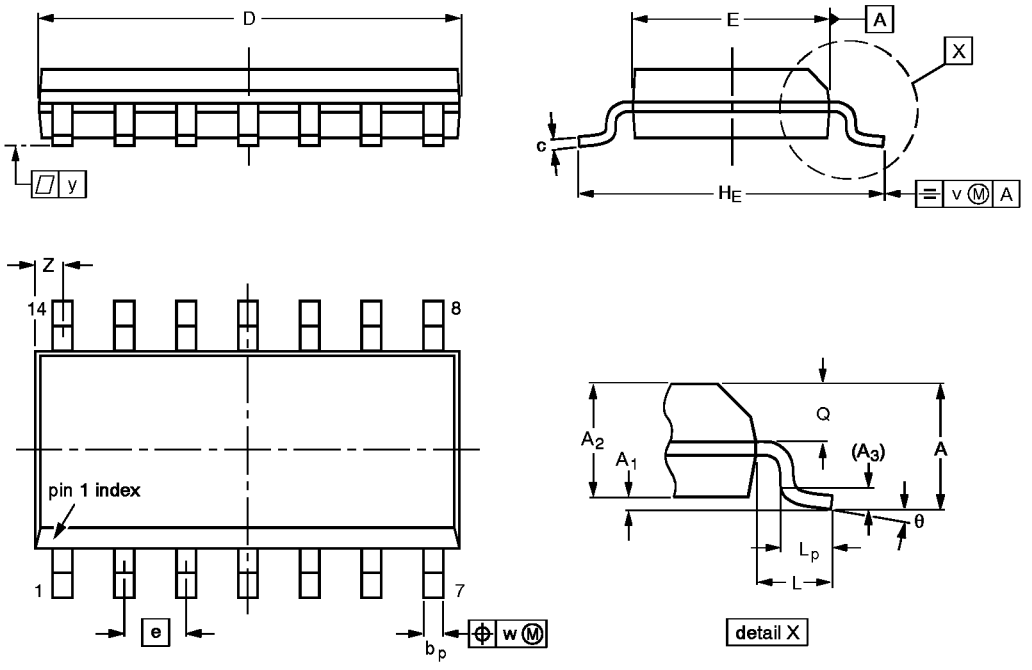


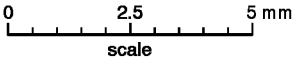
Load for Enable and Disable Times



Load for D+/D–

SO14: plastic small outline package; 14 leads; body width 3.9 mm SOT108-1





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

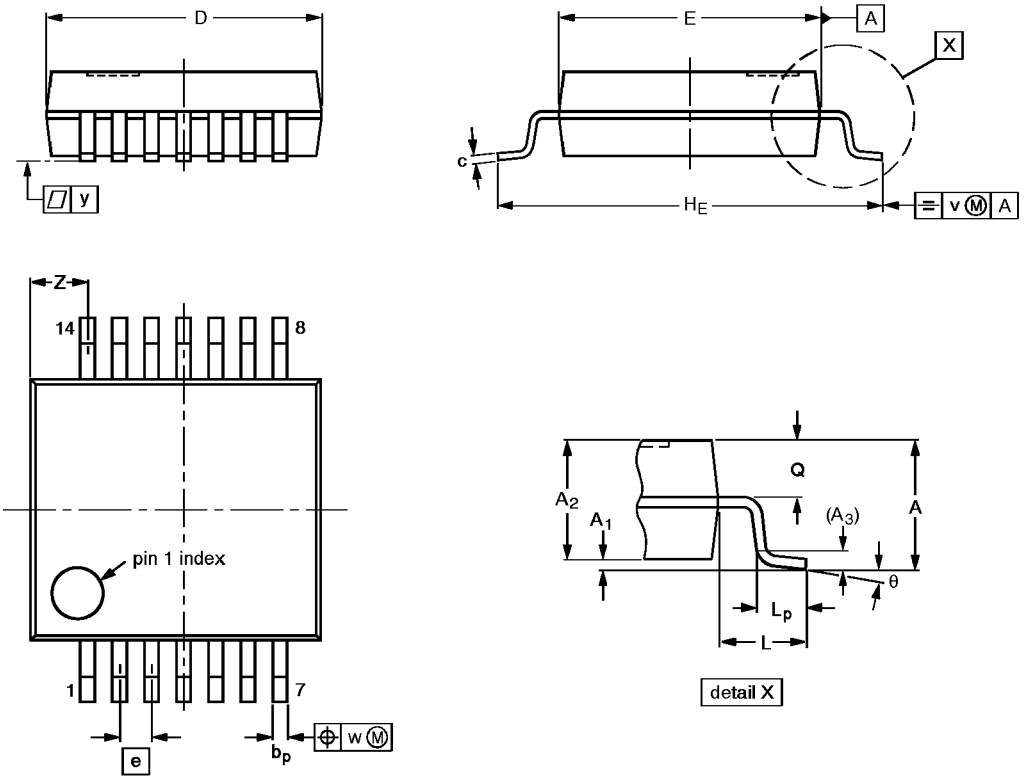
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.35 0.34	0.16 0.15	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

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm **SOT337-1**



DIMENSIONS (mm are the original dimensions)

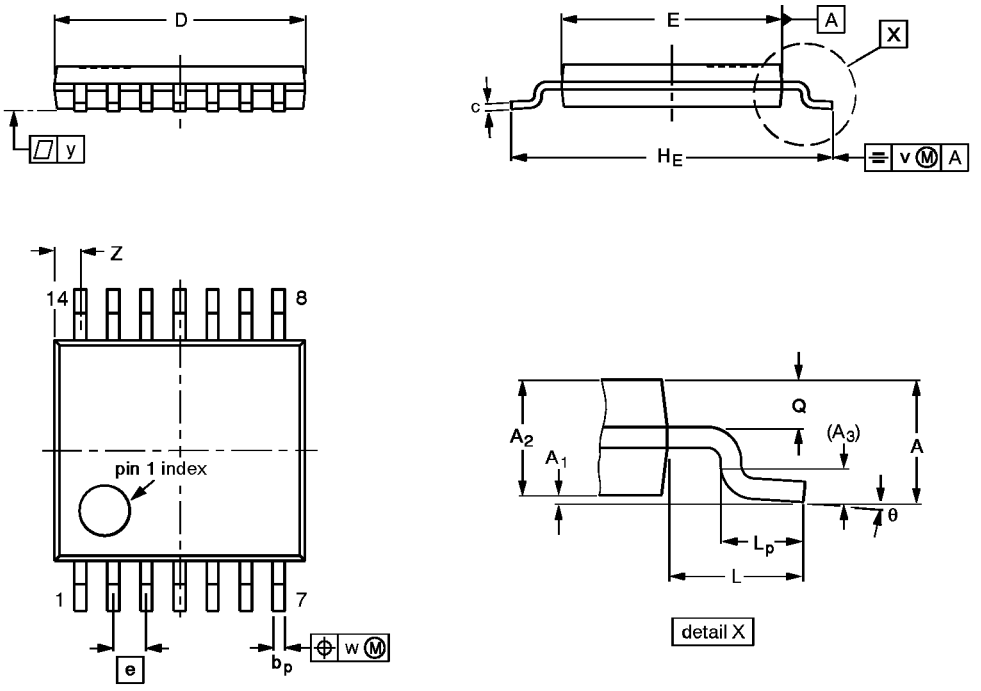
UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.0	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8° 0°

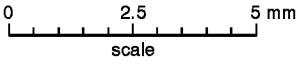
Note

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

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

NOTES

Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
Preliminary specification	Qualification	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make chages at any time without notice in order to improve design and supply the best possible product.
Product specification	Production	This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

[1] Please consult the most recently issued datasheet before initiating or completing a design.

Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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