A Product Line of
Diodes Incorporated

PI6C20400A

1:4 Clock Driver for Intel PCIe® Chipsets

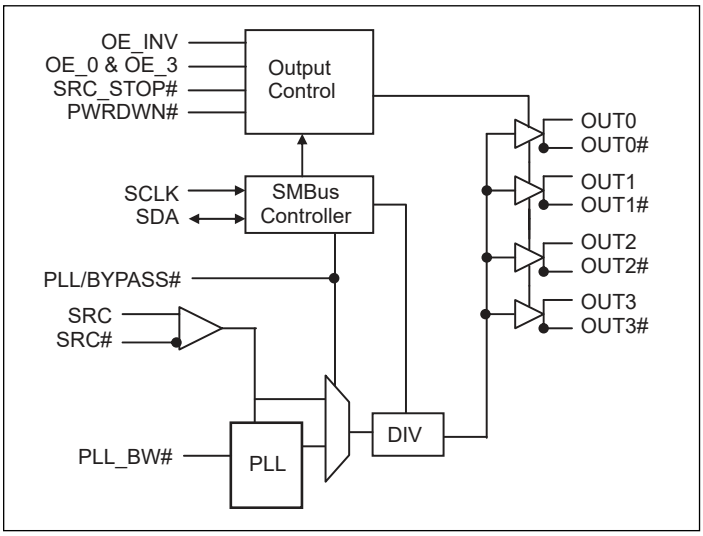
Features

- Phase jitter filter for PCIe® 2.0 application
- Four Pairs of Differential Clocks
- Low skew < 50ps
- Low jitter < 50ps cycle-to-cycle
- < 1 ps additive RMS phase jitter
- Output Enable for all outputs
- Outputs tristate control via SMBus
- Programmable PLL Bandwidth
- 100 MHz PLL Mode operation
- 100 - 400 MHz Bypass Mode operation
- 3.3V Operation
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.
  https://www.diodes.com/quality/product-definitions/
- Packaging (Pb-free and Green):
  - 28-Pin SSOP (H28)
  - 28-Pin TSSOP (L28)

Description

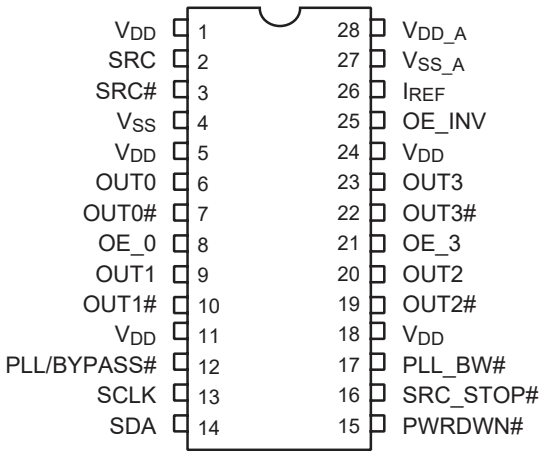
The PI6C20400A is a PCIe® 2.0 compliant high-speed, low-noise differential clock buffer designed to be companion to PI6C410BS. The device distributes the differential SRC clock from PI6C410BS to four differential pairs of clock outputs either with or without PLL. The clock outputs are controlled by input selection of SRC_STOP#, PWRDWN# and SMBus, SCLK and SDA. When input of either SRC_STOP# or PWRDWN# is low, the output clocks are Tristated. When PWRDWN# is low, the SDA and SCLK inputs must be Tri-stated.

Block Diagram



Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Pin Configuration



Pin Descriptions

Pin#	Pin Name	Type	Description
2, 3	SRC, SRC#	Input	0.7V Differential SRC input from PI6C410 clock synthesizer
8, 21	OE_0, OE_3	Input	3.3V LVTTL input for enabling outputs, active high. OE_0 for OUT0 / OUT0# OE_3 for OUT3 / OUT3#
25	OE_INV	Input	3.3V LVTTL input for inverting the OE, SRC_STOP# and PWRDWN# pins. When 0 = same stage When 1 = OE_0, OE_3, SRC_STOP#, PWRDWN# inverted.
6, 7, 9, 10, 19, 20, 22, 23	OUT[0:3] & OUT[0:3]#	Output	0.7V Differential outputs
12	PLL/BYPASS#	Input	3.3V LVTTL input for selecting fan-out of PLL operation.
13	SCLK	Input	SMBus compatible SCLOCK input
14	SDA	I/O	SMBus compatible SDATA
26	IREF	Input	External resistor connection to set the differential output current
16	SRC_STOP#	Input	3.3V LVTTL input for SRC stop, active low
17	PLL_BW#	Input	3.3V LVTTL input for selecting the PLL bandwidth
15	PWRDWN#	Input	3.3V LVTTL input for Power Down operation, active low
1, 5, 11, 18, 24	V_{DD}	Power	3.3V Power Supply for Outputs
4	VSS	Ground	Ground for Outputs
27	VSS_A	Ground	Ground for PLL
28	VDD_A	Power	3.3V Power Supply for PLL

Serial Data Interface (SMBus)

This part is a slave only SMBus device that supports indexed block read and indexed block write protocol using a single 7-bit address and read/write bit as shown below.

Address Assignment

A6	A5	A4	A3	A2	A1	A0	W/R
1	1	0	1	1	1	0	0/1

Data Protocol

1 bit	7 bits	1	1	8 bits	1	8 bits	1	8 bits	1		8 bits	1	1 bit
Start bit	Slave Addr	R/W	Ack	Register offset	Ack	Byte Count = N	Ack	Data Byte 0	Ack	…	Data Byte N - 1	Ack	Stop bit

Notes:

1. Register offset for indicating the starting register for indexed block write and indexed block read. Byte Count in write mode cannot be 0.

Data Byte 0: Control Register

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Source Pin
0	Outputs Mode 0 = Divide by 2 1 = Normal	RW	1 = Normal	OUT[0:3], OUT[0:3]#	NA
1	PLL/BYPASS# 0 = Fanout 1 = PLL	RW	1 = PLL	OUT[0:3], OUT[0:3]#	NA
2	PLL Bandwidth 0 = High Bandwidth, 1 = Low Bandwidth	RW	1 = Low	OUT[0:3], OUT[0:3]#	NA
3	Reserved				NA
4	Reserved				NA
5	Reserved				NA
6	SRC_STOP# 0 = Driven when stopped 1 = Tristate	RW	0 = Driven when stopped	OUT[0:3], OUT[0:3]#	NA
7	PWRDWN# 0 = Driven when stopped 1 = Tristate	RW	0 = Driven when stopped	OUT[0:3], OUT[0:3]#	NA

Data Byte 1: Control Register

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Source Pin
0	Reserved				NA
1	OUTPUTS enable 1 = Enabled 0 = Disabled	RW	1 = Enabled	OUT0, OUT0#	NA
2		RW	1 = Enabled	OUT1, OUT1#	NA
3	Reserved				NA
4	Reserved				NA
5	OUTPUTS enable 1 = Enabled 0 = Disabled	RW	1 = Enabled	OUT2, OUT2#	NA
6		RW	1 = Enabled	OUT3, OUT3#	NA
7	Reserved				NA

Data Byte 2: Control Register

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Source Pin
0	Reserved				NA
1	Allow control of OUTPUTS with assertion of SRC_STOP# 0 = Free running 1 = Stopped with SRC_Stop#	RW	0 = Free running	OUT0, OUT0#	NA
2		RW	0 = Free running	OUT1, OUT1#	NA
3	Reserved				NA
4	Reserved				NA
5	Allow control of OUTPUTS with assertion of SRC_STOP# 0 = Free running 1 = Stopped with SRC_Stop#	RW	0 = Free running	OUT2, OUT2#	NA
6		RW	0 = Free running	OUT3, OUT3#	NA
7	Reserved				NA

Data Byte 3: Control Register

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Source Pin
0	Reserved	RW			
1		RW			
2		RW			
3		RW			
4		RW			
5		RW			
6		RW			
7		RW			

Data Byte 4: Pericom ID Register

Bit	Descriptions	Type	Power Up Condition	Output(s) Affected	Pin
0	Pericom ID	R	0	NA	NA
1		R	0	NA	NA
2		R	0	NA	NA
3		R	0	NA	NA
4		R	0	NA	NA
5		R	1	NA	NA
6		R	0	NA	NA
7		R	0	NA	NA

Functionality

PWRDWN#	OUT	OUT#	SRC_Stop#	OUT	OUT#
1	Normal	Normal	1	Normal	Normal
0	$I_{REF} \times 2$ or Float	Low	0	$I_{REF} \times 6$ or Float	Low

Power Down (PWRDWN# assertion)

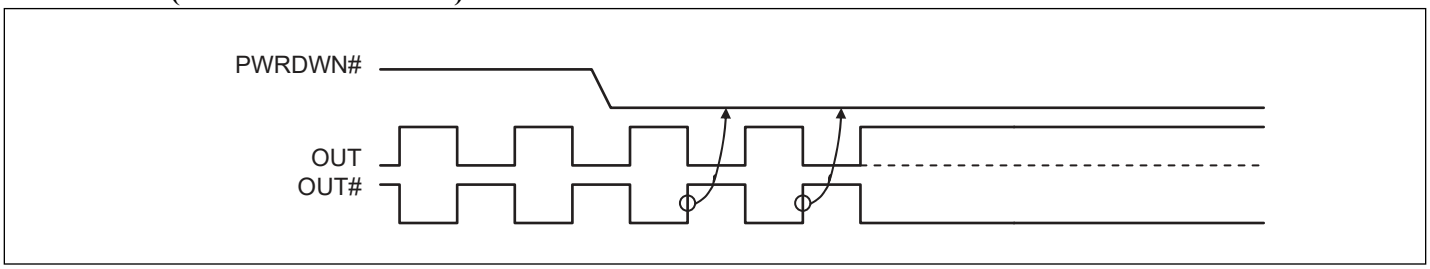


Figure 1. Power Down Sequence

Power Down (PWRDWN# De-assertion)

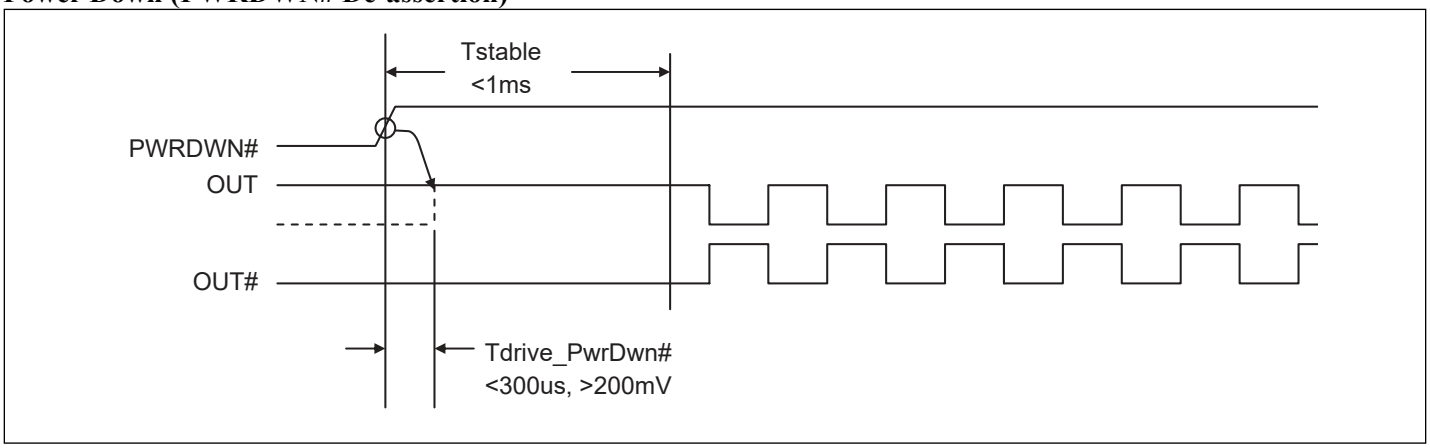


Figure 2. Power Down De-assert Sequence

Current-mode Output Buffer Characteristics of OUT[0:3], OUT[0:3]#

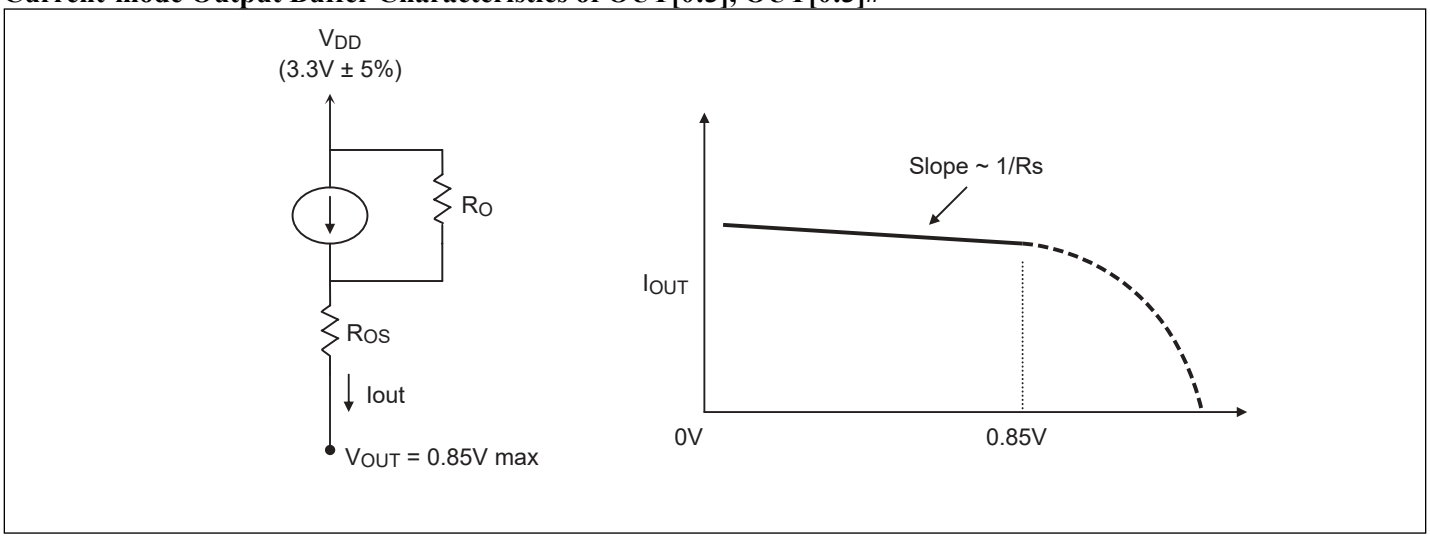


Figure 3. Simplified Diagram of Current-mode Output Buffer

Differential Clock Buffer Characteristics

Symbol	Minimum	Maximum
R_O	3000Ω	N/A
R_{OS}	unspecified	unspecified
V_{OUT}	N/A	850mV

Current Accuracy

Symbol	Conditions	Configuration	Load	Min.	Max.
I_{OUT}	V_{DD} = 3.30 ±5%	R_{REF} = 475Ω 1% I_{REF} = 2.32mA	Nominal test load for given configuration	-12% $I_{NOMINAL}$	+12% $I_{NOMINAL}$

Note:

1. $I_{NOMINAL}$ refers to the expected current based on the configuration of the device.

Differential Clock Output Current

Board Target Trace/Term Z	Reference R, Iref = V_{DD}/(3xRr)	Output Current	V_{OH} @ Z
100Ω (100Ω differential ≈ 15% coupling ratio)	R_{REF} = 475Ω 1%, I_{REF} = 2.32mA	I_{OH} = 6 x I_{REF}	0.7V @ 50

Absolute Maximum Ratings

(Over operating free-air temperature range)

Symbol	Parameters	Min.	Max.	Units
V_{DD_A}	3.3V Core Supply Voltage	-0.5	4.6	V
V_{DD}	3.3V I/O Supply Voltage	-0.5	4.6	
V_{IH}	Input High Voltage		4.6	
V_{IL}	Input Low Voltage	-0.5		
Ts	Storage Temperature	-65	150	°C
V_{ESD}	ESD Protection	2000		V
T_J	Junction Temperature		125	°C

Note:

1. Stress beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

DC Electrical Characteristics (V_{DD} = 3.3±5%, V_{DD_A} = 3.3±5%)

Symbol	Parameters	Condition	Min.	Max.	Units
V_{DD_A}	3.3V Core Supply Voltage		3.135	3.465	V
V_{DD}	3.3V I/O Supply Voltage		3.135	3.465	
V_{IH}	3.3V Input High Voltage	V_{DD}	2.0	V_{DD} + 0.3	
V_{IL}	3.3V Input Low Voltage		V_{SS} – 0.3	0.8	
I_{IL}	Input Leakage Current	0 < V_{IN} < V_{DD}	-5	+5	µA
V_{OH}	3.3V Output High Voltage	I_{OH} = -1mA	2.4		V
V_{OL}	3.3V Output Low Voltage	I_{OL} = 1mA		0.4	
I_{OH}	Output High Current	I_{OH} = 6 x I_{REF},	12.2		mA
		I_{REF} = 2.32mA		15.6	
C_{IN}	Input Pin Capacitance		2	5	pF
C_{OUT}	Output Pin Capacitance			6	
L_{PIN}	Pin Inductance			7	nH
$I_{DD(BYPASS)}$	Power Supply Current (PLL Bypass)	V_{DD} = 3.465V, F_{CPU} = 100MHz		90	mA
I_{DD}	Power Supply Current	V_{DD} = 3.465V	Bypass mode	100	
		F_{CPU} = 100MHz	PLL mode	130	
I_{SS}	Power Down Current	Driven outputs		40	
I_{SS}	Power Down Current	Tristate outputs		12	
T_A	Ambient Temperature		-40	85	°C

HCSL Input (SRC, SRC#) Characteristics(1)

Temperature = T_A; Supply voltages per normal operation conditions; See test circuits for the load conditions

Symbol	Parameters	Conditions	Min.	Typ.	Max.	Units
V_{COM}	Diff. Input Common Mode Voltage		150		900	mV
V_{SWING}	Diff. Input Swing Voltage	Peak to peak value (V_{IHDIF} - V_{ILDIF})	300		1000	mV
f_{INBP}	Input Frequency	PLL Bypass mode	100		400	MHz
f_{IN100}	Input Frequency	PLL mode	95	100	105	MHz
$f_{MODI-PCIe}$	Input SS Modulation Freq. PCIe	Allowable frequency for PCIe applications (Triangular Modulation)	30		33	kHz
$f_{MODIN-non-PCIe}$	Input SS Modulation Freq. non-PCIe	Allowable frequency for non-PCIe applications (Triangular Modulation)	0		46	kHz
t_{RF}	Diff. Input Slew Rate(2)	Measured differentially	0.4			V/ns
I_{IN}	Diff. Input Leakage Current	V_{IN} = V_{DD}, V_{IN} = GND	-5	0.01	5	uA
t_{DC}	Diff. Input Duty Cycle	Measured differentially	45		55	%
tj_{c-c}	Diff. Input Cycle to cycle jitter	Measured differentially			125	ps

Note:

1. Guaranteed by design and characterization, not 100% tested in production
2. Slew rate measured through +/-75mV window centered around differential zero

HCSL Output AC Switching Characteristics (V_{DD} = 3.3±5%, V_{DD_A} = 3.3±5%)

Symbol	Parameters	Condition	Min.	Max.	Units	Notes
T_{rise} / T_{fall}	Rise and Fall Time	Measured between 0.175V to 0.525V	175	700	ps	2
DT_{rise} / DT_{fall}	Rise and Fall Time Variation			125	ps	2
T_{pd}	Propogation delay	PLL Mode		±250	ps	6
		Bypass Mode	2.5	6.5	ns	
T_{jitter}	Cycle – Cycle Jitter	OUT[0:3] & OUT[0:3]#		50	ps	3, 4
V_{HIGH}	Voltage High including overshoot	OUT[0:3] & OUT[0:3]#	660	1150	mV	2
V_{LOW}	Voltage Low including undershoot	OUT[0:3] & OUT[0:3]#	-300		mV	2
V_{cross}	Absolute crossing point voltages	OUT[0:3] & OUT[0:3]#	250	550	mV	2
DV_{cross}	Total Variation of Vcross	Over all edges		140	mV	2
T_{DC}	Duty Cycle	OUT[0:3] & OUT[0:3]#	45	55	%	3
T_{jadd}	Additive RMS phase jitter	For PCIe 2.0	<0	1	ps	5

Notes:

1. Test configuration is R_s = 33.2Ω, Rp = 49.9Ω, and 2pF.
2. Measurement taken from Single Ended waveform.
3. Measurement taken from Differential waveform.
4. Measurement taken using M1 data capture analysis tool.
5. Additive jitter is calculated from input and output RMS phase jitter by using PCIe 2.0 filter. ($T_{jadd} = \sqrt{(\text{output jitter})^2 - (\text{input jitter})^2}$
6. Using the test configuration and data is taken at the probe pads

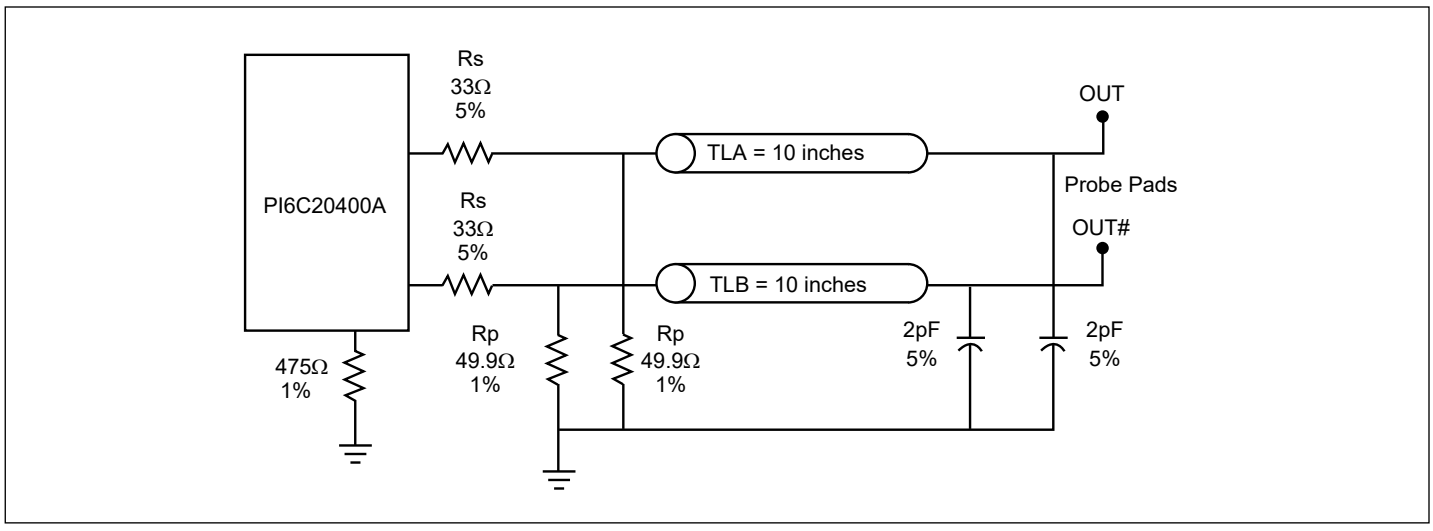


Figure 4. Test Configuration

Application Information

Termination for DC-Coupled Differential Operation

For DC-coupled operation of an HCSL driver, terminate with 50 Ω to ground near the driver output as shown in Figure 5. Series resistors, Rs, are used to limit overshoot due to the fast transient current. Because HCSL drivers require a DC path to ground, AC coupling is not allowed between the output drivers and the 50Ω termination resistors.

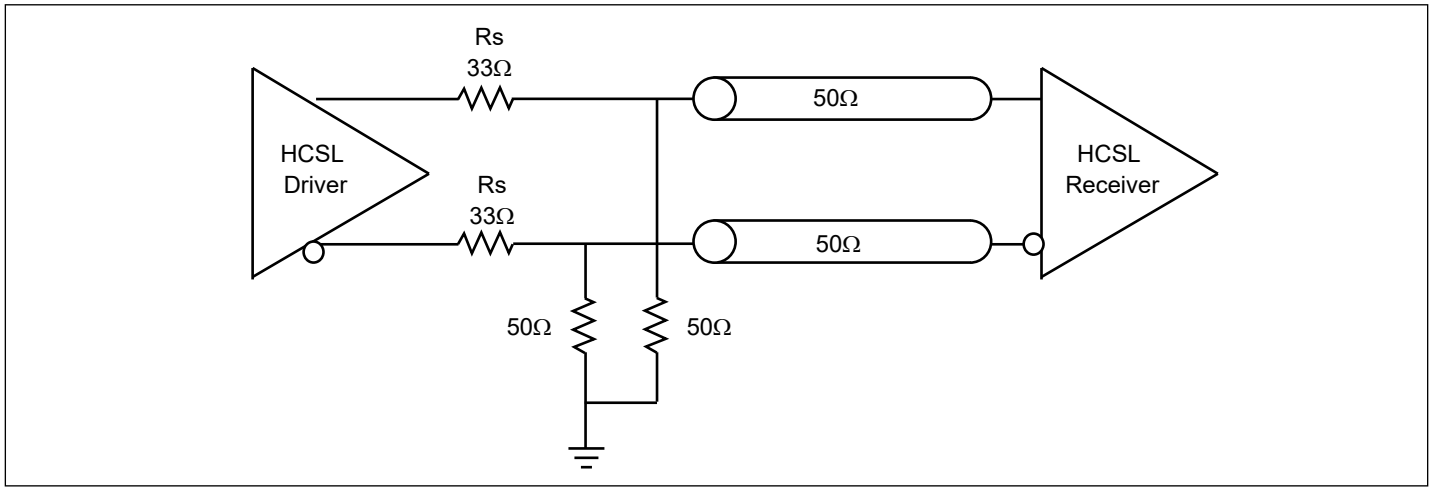


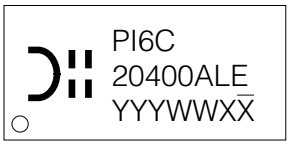
Figure 5. DC Coupled HCSL Operation

Termination for AC-Coupled Differential Operation

AC coupling allows for shifting the DC bias level (common-mode voltage) when driving different receiver standards. Because AC-coupling prevents the driver from providing a DC bias voltage at the receiver, it is important to ensure the receiver is biased to its ideal DC level. The PI6C20400A does not have an internal DC bias, therefore an external DC bias circuit to around 350mV is needed when PI6C20400A is the receiver in the AC-coupled operation.

Part Marking

L Package



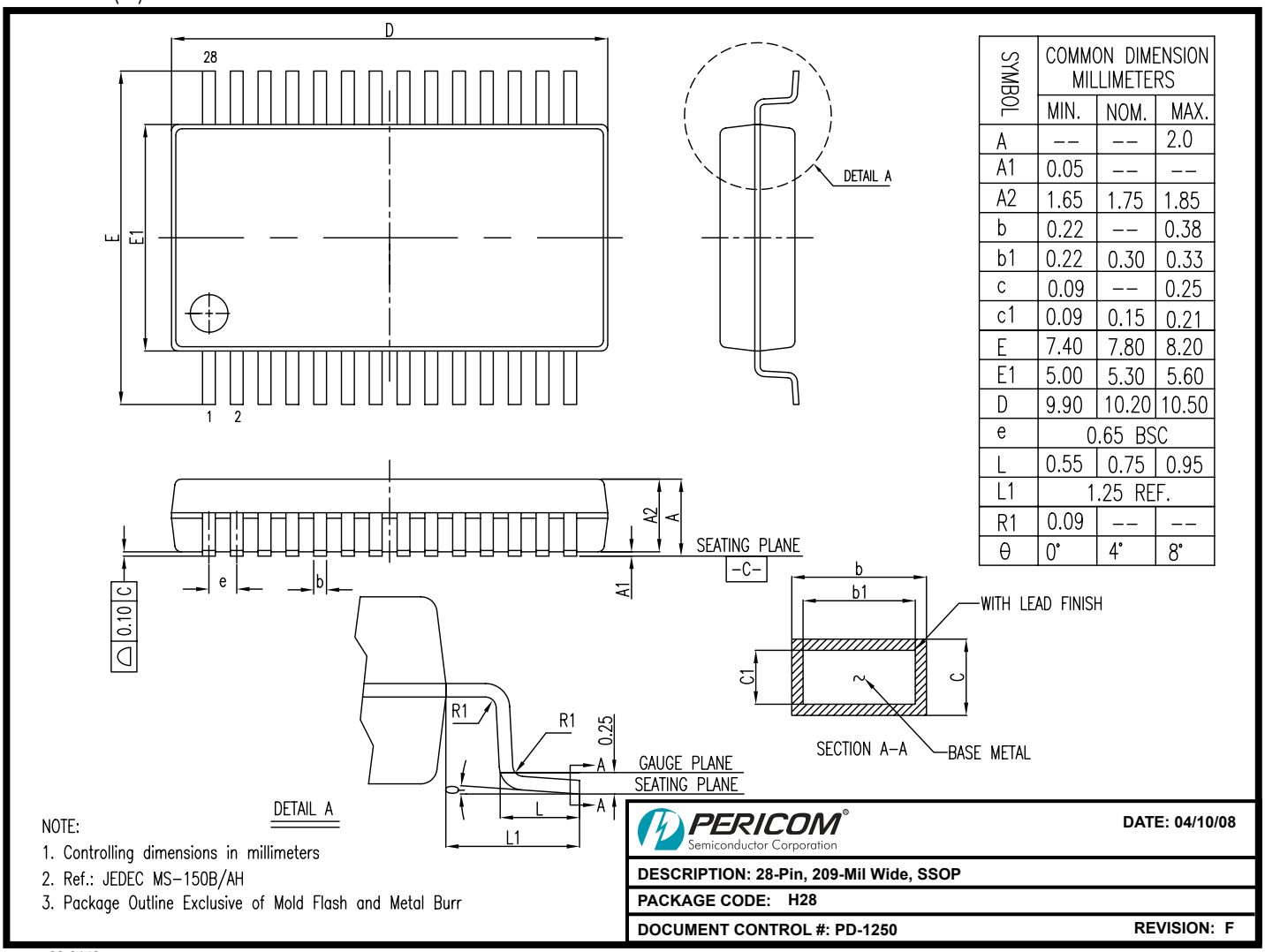
Y: Die Rev
YY: Year
WW: Workweek
1st X: Assembly Code
2nd X: Fab Code

H Package

YY: Year
WW: Workweek
1st X: Assembly Code
2nd X: Fab Code

Packaging Mechanical

28-SSOP (H)



SYMBOL	COMMON DIMENSION MILLIMETERS		
	MIN.	NOM.	MAX.
A	--	--	2.0
A1	0.05	--	--
A2	1.65	1.75	1.85
b	0.22	--	0.38
b1	0.22	0.30	0.33
c	0.09	--	0.25
c1	0.09	0.15	0.21
E	7.40	7.80	8.20
E1	5.00	5.30	5.60
D	9.90	10.20	10.50
e	0.65 BSC		
L	0.55	0.75	0.95
L1	1.25 REF.		
R1	0.09	--	--
θ	0°	4°	8°

NOTE:
1. Controlling dimensions in millimeters
2. Ref.: JEDEC MS-150B/AH
3. Package Outline Exclusive of Mold Flash and Metal Burr

PERICOM Semiconductor Corporation

DATE: 04/10/08

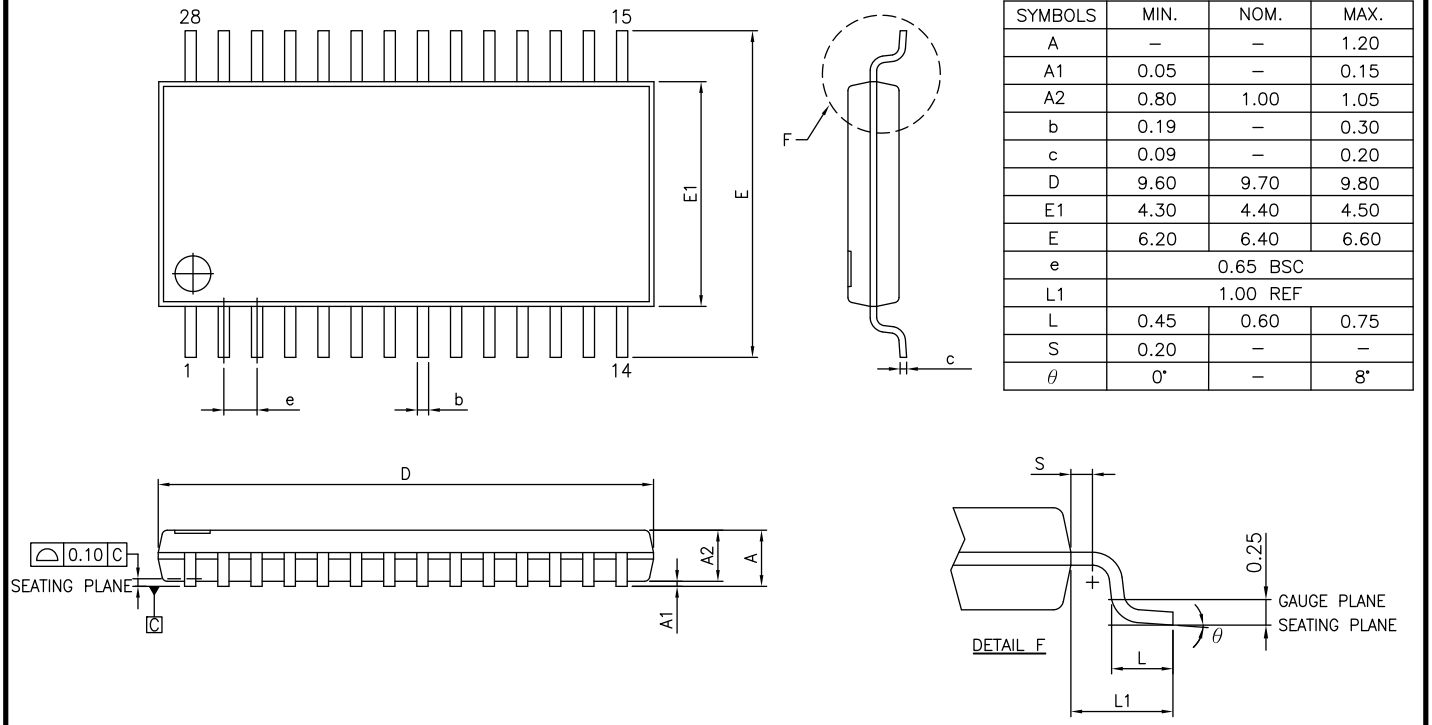
DESCRIPTION: 28-Pin, 209-Mil Wide, SSOP

PACKAGE CODE: H28

DOCUMENT CONTROL #: PD-1250 **REVISION: F**

08-0143

28-TSSOP (L)



SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.20
A1	0.05	–	0.15
A2	0.80	1.00	1.05
b	0.19	–	0.30
c	0.09	–	0.20
D	9.60	9.70	9.80
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65 BSC		
L1	1.00 REF		
L	0.45	0.60	0.75
S	0.20	–	–
θ	0°	–	8°

NOTES:
1. ALL DIMENSIONS IN MILLIMETERS. ANGLES IN DEGREES.
2. JEDEC MO–153F
3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

PERICOM Enabling Serial Connectivity

DATE: 03/31/16

DESCRIPTION: 28-Pin, 173mil Wide TSSOP

PACKAGE CODE: L (L28)

DOCUMENT CONTROL #: PD-1313 REVISION: F

16-0076

For latest package info.

please check: http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/

Ordering Information

Ordering Code	Package Code	Package Description
PI6C20400AHEX	H	28-pin, 209-mil wide (SSOP)
PI6C20400ALEX	L	28-pin, 173-mil wide (TSSOP)

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

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