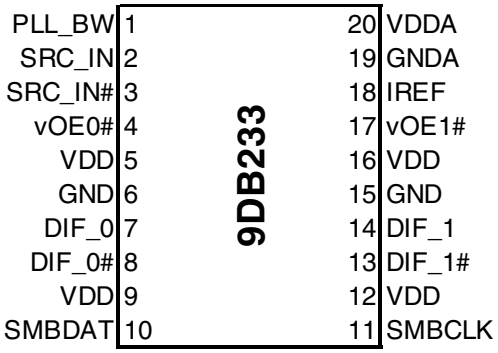
Pin Configuration



Note: Pins preceeded by ' v ' have internal 120K ohm pull down resistors

Power Distribution Table

Pin Number		Description
VDD	GND	
5,9,12,16	6,15	Differential Outputs
9	6	SMBUS
20	19	IREF
20	19	Analog VDD & GND for PLL core

Pin Descriptions

PIN #	PIN NAME	PIN TYPE	DESCRIPTION
1	PLL_BW	IN	3.3V input for selecting PLL Band Width 0 = low, 1= high
2	SRC_IN	IN	0.7 V Differential SRC TRUE input
3	SRC_IN#	IN	0.7 V Differential SRC COMPLEMENTARY input
4	vOE0#	IN	Active low input for enabling DIF pair 0. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs
5	VDD	PWR	Power supply, nominal 3.3V
6	GND	PWR	Ground pin.
7	DIF_0	OUT	0.7V differential true clock output
8	DIF_0#	OUT	0.7V differential Complementary clock output
9	VDD	PWR	Power supply, nominal 3.3V
10	SMBDAT	I/O	Data pin of SMBUS circuitry, 5V tolerant
11	SMBCLK	IN	Clock pin of SMBUS circuitry, 5V tolerant
12	VDD	PWR	Power supply, nominal 3.3V
13	DIF_1#	OUT	0.7V differential Complementary clock output
14	DIF_1	OUT	0.7V differential true clock output
15	GND	PWR	Ground pin.
16	VDD	PWR	Power supply, nominal 3.3V
17	vOE1#	IN	Active low input for enabling DIF pair 1. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs
18	IREF	OUT	This pin establishes the reference for the differential current-mode output pairs. It requires a fixed precision resistor to ground. 475ohm is the standard value for 100ohm differential impedance. Other impedances require different values. See data sheet.
19	GNDA	PWR	Ground pin for the PLL core.
20	VDDA	PWR	3.3V power for the PLL core.

Note:
Pins preceeded by ' v ' have internal 120K ohm pull down resistors

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the 9DB233. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
3.3V Core Supply Voltage	VDDA				4.6	V	1,2
3.3V Logic Supply Voltage	VDD				4.6	V	1,2
Input Low Voltage	V_{IL}		GND-0.5			V	1
Input High Voltage	V_{IH}	Except for SMBus interface			V_{DD}+0.5V	V	1
Input High Voltage	V_{IHSMB}	SMBus clock and data pins			5.5V	V	1
Storage Temperature	Ts		-65		150	°C	1
Junction Temperature	Tj				125	°C	1
Input ESD protection	ESD prot	Human Body Model	2000			V	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] Operation under these conditions is neither implied nor guaranteed.

Electrical Characteristics–DIF_IN Clock Input Parameters

T_{AMB}=T_{COM} or T_{IND} unless otherwise indicated, Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Input Crossover Voltage - DIF_IN	V_{CROSS}	Cross Over Voltage	150	375	900	mV	1
Input Swing - DIF_IN	V_{SWING}	Differential value	300			mV	1
Input Slew Rate - DIF_IN	dv/dt	Measured differentially	1		8	V/ns	1,2
Input Leakage Current	I_{IN}	V_{IN} = V_{DD} , V_{IN} = GND	-5		5	uA	
Input Duty Cycle	d_{tin}	Measurement from differential wavefrom	45		55	%	1
Input Jitter - Cycle to Cycle	J_{DIFIn}	Differential Measurement	0		125	ps	1

[1] Guaranteed by design and characterization, not 100% tested in production.

[2]Slew rate measured through +/-75mV window centered around differential zero

Electrical Characteristics–Current Consumption

TA = T_{COM} or $T_{IND;}$ Supply Voltage VDD = 3.3 V +/-5%

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Operating Supply Current	$I_{DD3.3OP}$	All outputs active @100MHz, C_L = Full load;		70	80	mA	1
Powerdown Current	$I_{DD3.3PD}$	All diff pairs driven			N/A	mA	1
	$I_{DD3.3PDZ}$	All differential pairs tri-stated			N/A	mA	1

[1]Guaranteed by design and characterization, not 100% tested in production.

Electrical Characteristics–Input/Supply/Common Parameters

TA = T_{COM} or T_{IND}; Supply Voltage VDD = 3.3 V +/-5%

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Ambient Operating Temperature	T_{COM}	Commmercial range	0		70	°C	1
	T_{IND}	Industrial range	-40		85	°C	1
Input High Voltage	V_{IH}	Single-ended inputs, except SMBus, low threshold and tri-level inputs	2		V_{DD} + 0.3	V	1
Input Low Voltage	V_{IL}	Single-ended inputs, except SMBus, low threshold and tri-level inputs	GND - 0.3		0.8	V	1
Input Current	I_{IN}	Single-ended inputs, V_{IN} = GND, V_{IN} = VDD	-5		5	uA	1
	I_{INP}	Single-ended inputs V_{IN} = 0 V; Inputs with internal pull-up resistors V_{IN} = VDD; Inputs with internal pull-down resistors	-200		200	uA	1
Input Frequency	F_{ibyp}	V_{DD} = 3.3 V, Bypass mode	10		110	MHz	2
	F_{ipll}	V_{DD} = 3.3 V, 100MHz PLL mode	33	100.00	110	MHz	2
Pin Inductance	L_{pin}				7	nH	1
Capacitance	C_{IN}	Logic Inputs, except DIF_IN	1.5		5	pF	1
	C_{INDIF_IN}	DIF_IN differential clock inputs	1.5		2.7	pF	1,4
	C_{OUT}	Output pin capacitance			6	pF	1
Clk Stabilization	T_{STAB}	From V_{DD} Power-Up and after input clock stabilization or de-assertion of PD# to 1st clock		0.800	1.8	ms	1,2
Input SS Modulation Frequency	f_{MODIN}	Allowable Frequency (Triangular Modulation)	30		33	kHz	1
OE# Latency	$t_{LATOE\#}$	DIF start after OE# assertion DIF stop after OE# deassertion	1		3	cycles	1,3
Tdrive_PD#	t_{DRVPD}	DIF output enable after PD# de-assertion			300	us	1,3
Tfall	t_F	Fall time of control inputs			5	ns	1,2
Trise	t_R	Rise time of control inputs			5	ns	1,2
SMBus Input Low Voltage	V_{ILSMB}				0.8	V	1
SMBus Input High Voltage	V_{IHSMB}		2.1		V_{DDSMB}	V	1
SMBus Output Low Voltage	V_{OLSMB}	@ I_{PULLUP}			0.4	V	1
SMBus Sink Current	I_{PULLUP}	@ V_{OL}	4			mA	1
Nominal Bus Voltage	V_{DDSMB}	3V to 5V +/- 10%	2.7		5.5	V	1
SCLK/SDATA Rise Time	t_{RSMB}	(Max VIL - 0.15) to (Min VIH + 0.15)			1000	ns	1
SCLK/SDATA Fall Time	t_{FSMB}	(Min VIH + 0.15) to (Max VIL - 0.15)			300	ns	1
SMBus Operating Frequency	f_{MAXSMB}	Maximum SMBus operating frequency			100	kHz	1,5

[1]Guaranteed by design and characterization, not 100% tested in production.

[2]Control input must be monotonic from 20% to 80% of input swing.

[3]Time from deassertion until outputs are >200 mV

[4]DIF_IN input

[5]The differential input clock must be running for the SMBus to be active

Electrical Characteristics–DIF 0.7V Current Mode Differential Outputs

$T_A = T_{COM}$ or $T_{IND;}$ Supply Voltage VDD = 3.3 V +/-5%

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Slew rate	Trf	Scope averaging on	0.6	2	4	V/ns	1, 2, 3
Slew rate matching	ΔTrf	Slew rate matching, Scope averaging on		4.2	20	%	1, 2, 4
Voltage High	VHigh	Statistical measurement on single-ended signal using oscilloscope math function. (Scope averaging on)	660	791	850	mV	1
Voltage Low	VLow		-150	13	150		1
Max Voltage	Vmax	Measurement on single ended signal using absolute value. (Scope averaging off)		801	1150	mV	1
Min Voltage	Vmin		-300	5			1
Vswing	Vswing	Scope averaging off	300	1557		mV	1, 2
Crossing Voltage (abs)	Vcross_abs	Scope averaging off	250	367	550	mV	1, 5
Crossing Voltage (var)	Δ-Vcross	Scope averaging off		46	140	mV	1, 6

[1]Guaranteed by design and characterization, not 100% tested in production. IREF = VDD/(3xR_R). For R_R = 475Ω (1%), I_{REF} = 2.32mA. I_{OH} = 6 x I_{REF} and V_{OH} = 0.7V @ Z_O=50Ω (100Ω differential impedance).

[2] Measured from differential waveform

[3] Slew rate is measured through the Vswing voltage range centered around differential 0V. This results in a +/-150mV window around differential 0V.

[4] Matching applies to rising edge rate for Clock and falling edge rate for Clock#. It is measured using a +/-75mV window centered on the average cross point where Clock rising meets Clock# falling. The median cross point is used to calculate the voltage thresholds the oscilloscope is to use for the edge rate calculations.

[5] Vcross is defined as voltage where Clock = Clock# measured on a component test board and only applies to the differential rising edge (i.e. Clock rising and Clock# falling).

[6] The total variation of all Vcross measurements in any particular system. Note that this is a subset of V_cross_min/max (V_cross absolute) allowed. The intent is to limit Vcross induced modulation by setting V_cross_delta to be smaller than V_cross absolute.

Electrical Characteristics–Output Duty Cycle, Jitter, Skew and PLL Characteristics

TA = T_{COM} or $T_{IND;}$ Supply Voltage VDD = 3.3 V +/-5%

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PLL Bandwidth	BW	-3dB point in High BW Mode	2	2.2	4	MHz	1
		-3dB point in Low BW Mode	0.4	0.5	1	MHz	1
PLL Jitter Peaking	t_{JPEAK}	Peak Pass band Gain		0.6	1.5	dB	1
Duty Cycle	t_{DC}	Measured differentially, PLL Mode	45	48	55	%	1
Duty Cycle Distortion	t_{DCD}	Measured differentially, Bypass Mode @100MHz	-2	0.4	2	%	1,4
Skew, Input to Output	t_{pdBYP}	Bypass Mode, V_T = 50%	2500	3660	4500	ps	1
	t_{pdPLL}	Hi BW PLL Mode V_T = 50%	-50	136	350	ps	1
Skew, Output to Output	t_{sk3}	V_T = 50%		16	50	ps	1
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	PLL mode		29	50	ps	1,3
		Additive Jitter in Bypass Mode		0.2	50	ps	1,3

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] I_{REF} = V_{DD}/(3xR_R). For R_R = 475Ω (1%), I_{REF} = 2.32mA. I_{OH} = 6 x I_{REF} and V_{OH} = 0.7V @ Z_O=50Ω.

[3] Measured from differential waveform

[4] Duty cycle distortion is the difference in duty cycle between the output and the input clock when the device is operated in bypass mode.

Electrical Characteristics–PCIe Phase Jitter Parameters

TA = T_{COM} or $T_{IND;}$ Supply Voltage VDD = 3.3 V +/-5%

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	Notes
Phase Jitter, PLL Mode	$t_{jphPCIeG1}$	PCIe Gen 1		34	86	ps (p-p)	1,2,3
	$t_{jphPCIeG2}$	PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz		1	3	ps (rms)	1,2
		PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz)		2	3.1	ps (rms)	1,2
	$t_{jphPCIeG3}$	PCIe Gen 3 (PLL BW of 2-4MHz, CDR = 10MHz)		1	1	ps (rms)	1,2,4
Additive Phase Jitter, Bypass Mode	$t_{jphPCIeG1}$	PCIe Gen 1		2	5	ps (p-p)	1,2,3
	$t_{jphPCIeG2}$	PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz		0.2	0.3	ps (rms)	1,2
		PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz)		0.1	0.2	ps (rms)	1,2
	$t_{jphPCIeG3}$	PCIe Gen 3 (PLL BW of 2-4MHz, CDR = 10MHz)		0.1	0.2	ps (rms)	1,2,4

[1] Applies to all outputs.

[2] See http://www.pcisig.com for complete specs

[3] Sample size of at least 100K cycles. This figures extrapolates to 108ps pk-pk @ 1M cycles for a BER of 1-12.

[4] Subject to final ratification by PCI SIG.

SRC Reference Clock			
Common Recommendations for Differential Routing	Dimension or Value	Unit	Figure
L1 length, route as non-coupled 50ohm trace	0.5 max	inch	1
L2 length, route as non-coupled 50ohm trace	0.2 max	inch	1
L3 length, route as non-coupled 50ohm trace	0.2 max	inch	1
Rs	33	ohm	1
Rt	49.9	ohm	1

Down Device Differential Routing			
L4 length, route as coupled microstrip 100ohm differential trace	2 min to 16 max	inch	1
L4 length, route as coupled stripline 100ohm differential trace	1.8 min to 14.4 max	inch	1

Differential Routing to PCI Express Connector			
L4 length, route as coupled microstrip 100ohm differential trace	0.25 to 14 max	inch	2
L4 length, route as coupled stripline 100ohm differential trace	0.225 min to 12.6 max	inch	2

Figure 1: Down Device Routing

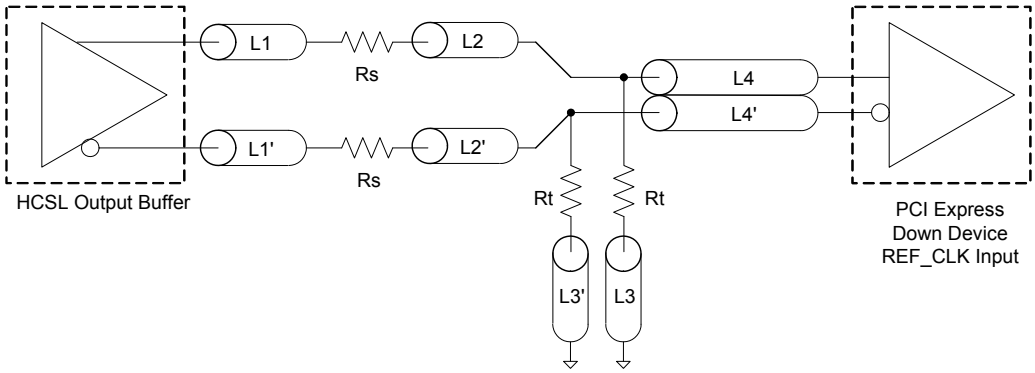
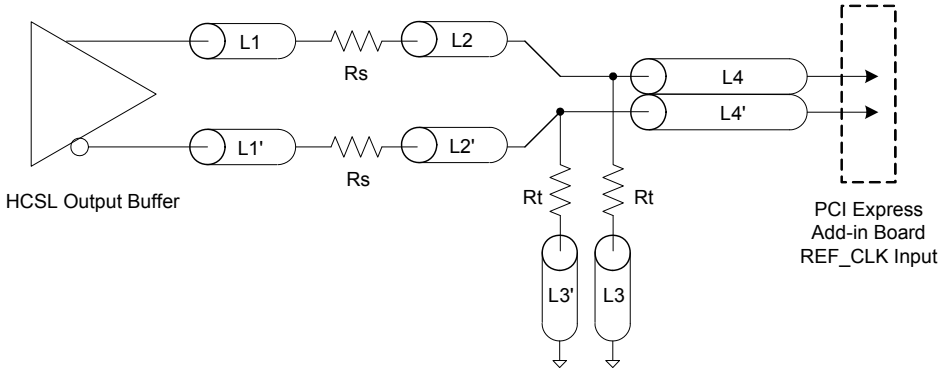


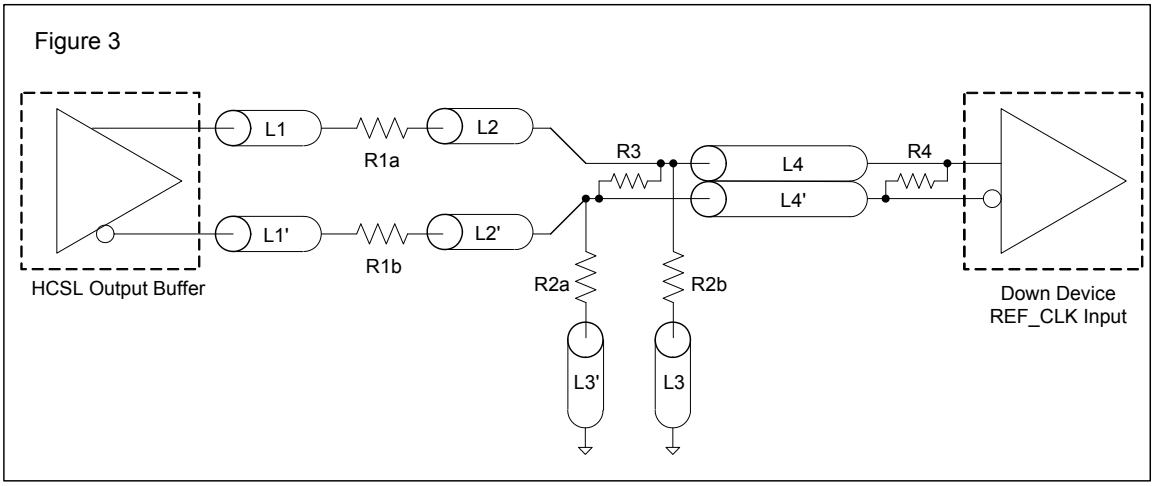
Figure 2: PCI Express Connector Routing



Alternative Termination for LVDS and other Common Differential Signals (figure 3)							
Vdiff	Vp-p	Vcm	R1	R2	R3	R4	Note
0.45v	0.22v	1.08	33	150	100	100	
0.58	0.28	0.6	33	78.7	137	100	
0.80	0.40	0.6	33	78.7	none	100	ICS874003i-02 input compatible
0.60	0.3	1.2	33	174	140	100	Standard LVDS

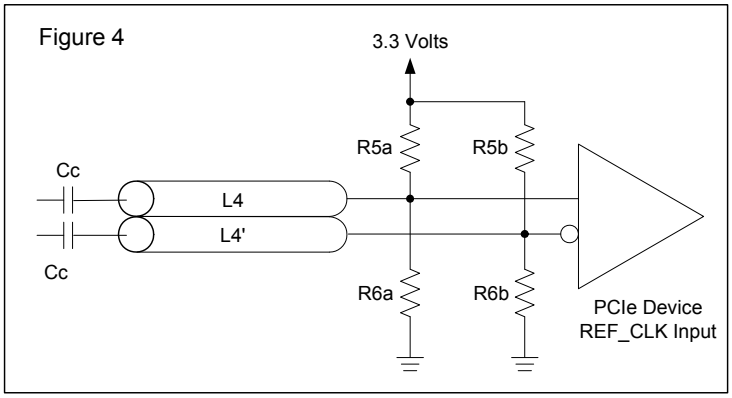
R1a = R1b = R1
R2a = R2b = R2

Figure 3



Cable Connected AC Coupled Application (figure 4)		
Component	Value	Note
R5a, R5b	8.2K 5%	
R6a, R6b	1K 5%	
Cc	0.1 µF	
Vcm	0.350 volts	

Figure 4



General SMBus Serial Interface Information for 9DB233

How to Write

- Controller (host) sends a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) sends the byte count = X
- IDT clock will **acknowledge**
- Controller (host) starts sending Byte **N through Byte N+X-1**
- IDT clock will **acknowledg**e each byte **one at a time**
- Controller (host) sends a Stop bit

Index Block Write Operation			
Controller (Host)			**IDT (Slave/Receiver)**
T	starT bit		
Slave Address			
WR	WRite		
			ACK
Beginning Byte = N			
			ACK
Data Byte Count = X			
			ACK
Beginning Byte N		X Byte	
			ACK
O			
O			O
O			O
			O
Byte N + X - 1			
			ACK
P	stoP bit		

Read Address	Write Address
$D5_{(H)}$	$D4_{(H)}$

How to Read

- Controller (host) will send a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) will send a separate start bit
- Controller (host) sends the read address
- IDT clock will **acknowledge**
- IDT clock will send the data byte count = X
- IDT clock sends Byte **N+X-1**
- IDT clock sends **Byte 0 through Byte X (if $X_{(H)}$ was written to Byte 8)**
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

Index Block Read Operation			
Controller (Host)			**IDT (Slave/Receiver)**
T	starT bit		
Slave Address			
WR	WRite		
			ACK
Beginning Byte = N			
			ACK
RT	Repeat starT		
Slave Address			
RD	ReaD		
			ACK
			Data Byte Count=X
ACK			
		X Byte	Beginning Byte N
ACK			
			O
O			O
O			O
O			
			Byte N + X - 1
N	Not acknowledge		
P	stoP bit		

SMBus Table: Device Control Register, READ/WRITE ADDRESS (D5/D4)

Byte 0	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	-	SW_EN	Enables SMBus Control of bite 1 and 0	RW	PLL Functions controlled by SMBus registers	PLL Functions controlled by device pins	1
Bit 6	-	RESERVED		RW	-		X
Bit 5	-	RESERVED		RW	-		X
Bit 4	-	RESERVED		RW	-		X
Bit 3	-	RESERVED		RW	-		X
Bit 2	-	RESERVED		RW	-		X
Bit 1	-	PLL BW #adjust	Selects PLL Bandwidth	RW	Low BW	High BW	1
Bit 0	-	PLL Enable	Bypasses PLL for board test	RW	PLL bypassed (fan out mode)	PLL enabled (ZDB mode)	1

SMBus Table: Output Enable Register

Byte 1	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	-	RESERVED		RW	-		X
Bit 6	-	RESERVED		RW	-		X
Bit 5	-	RESERVED		RW	-		X
Bit 4	-	RESERVED		RW	-		X
Bit 3	-	RESERVED		RW	-		X
Bit 2	-	RESERVED		RW	-		X
Bit 1	-	RESERVED		RW	-		X
Bit 0	-	RESERVED		RW	-		X

SMBus Table: Function Select Register

Byte 2	Pin #	Name	Control Function	Type	0	1	Default
Bit 7		RESERVED		RW	-		X
Bit 6		RESERVED		RW	-		X
Bit 5	-	RESERVED		RW	-		X
Bit 4	-	RESERVED		RW	-		X
Bit 3	-	RESERVED		RW	-		X
Bit 2	-	RESERVED		RW	-		X
Bit 1	-	RESERVED		RW	-		X
Bit 0	-	RESERVED		RW	-		X

SMBus Table: Vendor & Revision ID Register

Byte 3	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	-	RID3	REVISION ID	R	-	-	0
Bit 6	-	RID2		R	-	-	0
Bit 5	-	RID1		R	-	-	0
Bit 4	-	RID0		R	-	-	1
Bit 3	-	VID3	VENDOR ID	R	-	-	0
Bit 2	-	VID2		R	-	-	0
Bit 1	-	VID1		R	-	-	0
Bit 0	-	VID0		R	-	-	1

SMBus Table: DEVICE ID

Byte 4	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	-			R	-		0
Bit 6	-			R	-		0
Bit 5	-			R	-		0
Bit 4	-		Device ID	R	-		0
Bit 3	-		= 06 Hex	R	-		0
Bit 2	-			R	-		1
Bit 1	-			R	-		1
Bit 0	-			R	-		0

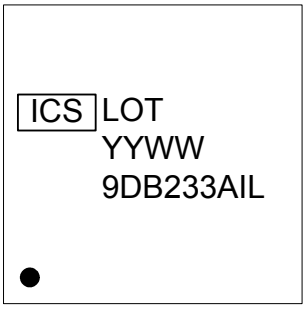
SMBus Table: Byte Count Register

Byte 5	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	-	BC7		RW	-	-	0
Bit 6	-	BC6	Writing to this	RW	-	-	0
Bit 5	-	BC5	register will	RW	-	-	0
Bit 4	-	BC4	configure how	RW	-	-	0
Bit 3	-	BC3	many bytes will be	RW	-	-	0
Bit 2	-	BC2	read back, default	RW	-	-	1
Bit 1	-	BC1	is 06 = 6 bytes.	RW	-	-	1
Bit 0	-	BC0		RW	-	-	0

Marking Diagrams

20-pin SSOP

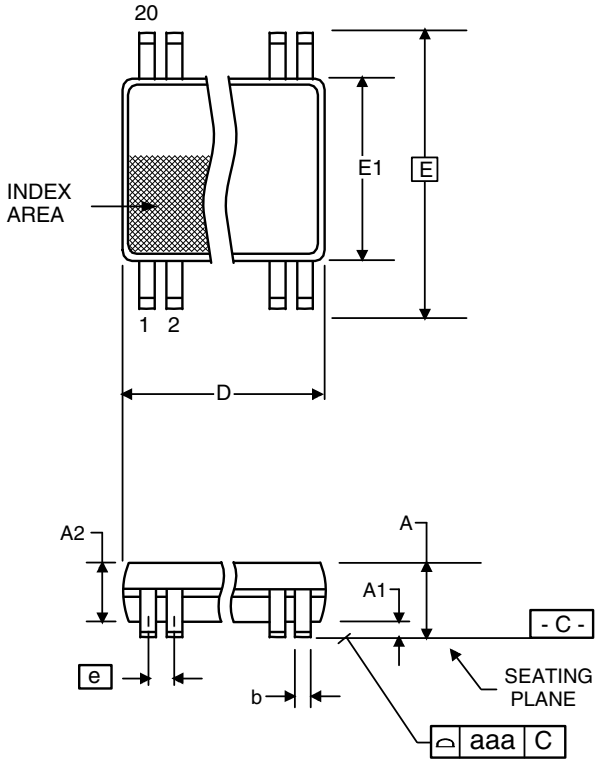
20-pin TSSOP



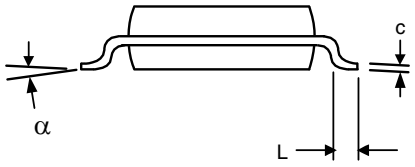
Notes:

1. “LOT” is the lot number.
2. “YYWW” is the last two digits of the year and week that the part was assembled.
3. “L” or “LF” denotes RoHS compliant package.
4. “I” denotes industrial temperature.
5. Bottom marking: country of origin if not USA.

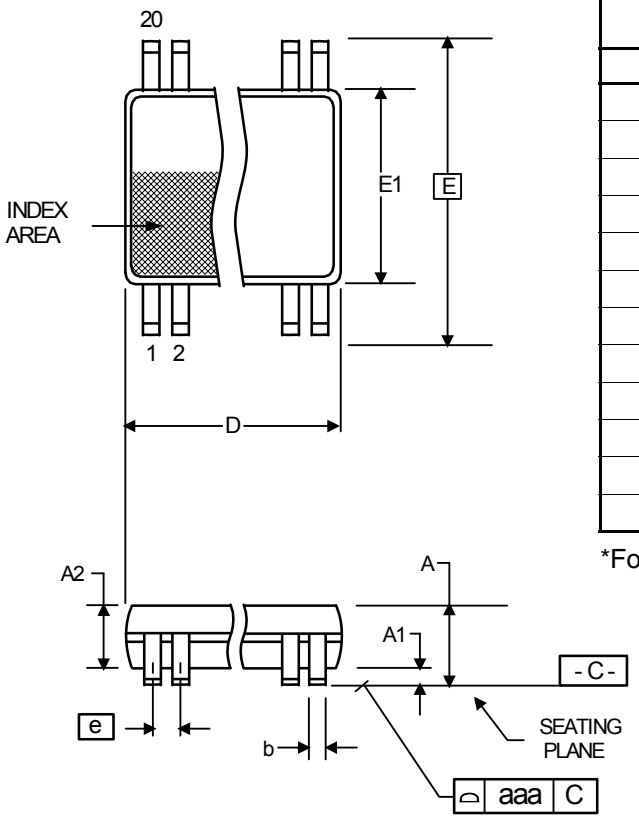
Package Outline and Package Dimensions (20-pin SSOP, 150 Mil. Wide Body)



	Millimeters		Inches	
Symbol	**Min**	**Max**	**Min**	**Max**
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	--	1.50	--	0.059
b	0.20	0.30	0.008	0.012
c	0.18	0.25	0.007	0.010
D	8.55	8.75	0.337	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	.635 Basic		.025 Basic	
L	0.40	1.27	0.016	0.050
α	0°	8°	0°	8°
aaa	--	0.10	--	0.004



Package Outline and Package Dimensions (20-pin TSSOP, 4.4mm Narrow Body)



	Millimeters		Inches*	
Symbol	**Min**	**Max**	**Min**	**Max**
A	--	1.20	--	0.047
A1	0.05	0.15	0.002	0.006
A2	0.80	1.05	0.032	0.041
b	0.19	0.30	0.007	0.012
C	0.09	0.20	0.0035	0.008
D	6.40	6.60	0.252	0.260
E	6.40 BASIC		0.252 BASIC	
E1	4.30	4.50	0.169	0.177
e	0.65 Basic		0.0256 Basic	
L	0.45	0.75	0.018	0.030
α	0°	8°	0°	8°
aaa	--	0.10	--	0.004

*For reference only. Controlling dimensions in mm.

Ordering Information

Part / Order Number	Shipping Packaging	Package	Temperature
9DB233AFLF	Tubes	20-pin SSOP	0 to +70°C
9DB233AFLFT	Tape and Reel	20-pin SSOP	0 to +70°C
9DB233AFILF	Tubes	20-pin SSOP	-40 to +85°C
9DB233AFILFT	Tape and Reel	20-pin SSOP	-40 to +85°C
9DB233AGLF	Tubes	20-pin TSSOP	0 to +70°C
9DB233AGLFT	Tape and Reel	20-pin TSSOP	0 to +70°C
9DB233AGILF	Tubes	20-pin TSSOP	-40 to +85°C
9DB233AGILFT	Tape and Reel	20-pin TSSOP	-40 to +85°C

"LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

"A" is the device revision designator (will not correlate with the datasheet revision).

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Revision History

Rev.	Who	Issue Date	Description	Page #
A	RDW	6/30/2010	Released to final	
B	RDW	7/12/2010	1. Changed PWD to Default in SMBus tables.	10,11
C	RDW	4/14/2011	Changed pull down indicator from '**' to ' v '.	
D	RDW	4/9/2012	1. Updated typical electrical characteristics to reflect improved performance	3-6
E	RDW	2/19/2014	1. Corrected typo for Read/Write address from D4/D5 to D5/D4 respectively. 2. Added device marking diagrams.	Various
F	RDW	10/20/2016	Updated input clock electrical table to latest format. No change to form, fit or function of the device	4

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