2:12 LOW POWER DIFFERENTIAL Z-BUFFER MUX FOR PCIE AND QPI/UPI 9ZML1232

General Description

The 9ZML1232 is a 2-input/12-output differential mux for use in servers. It meets the demanding DB1200ZL performance specifications and utilizes Low-Power HCSL-compatible outputs to reduce power consumption and termination components. It is suitable for PCI-Express Gen1/2/3 or QPI/UPI applications, and uses a fixed external feedback to maintain low drift for demanding QPI applications.

Recommended Application

Clock Mux for Romley, Grantley and Purley Servers

Output Features

- 12 - Low-Power (LP) HCSL Output Pairs

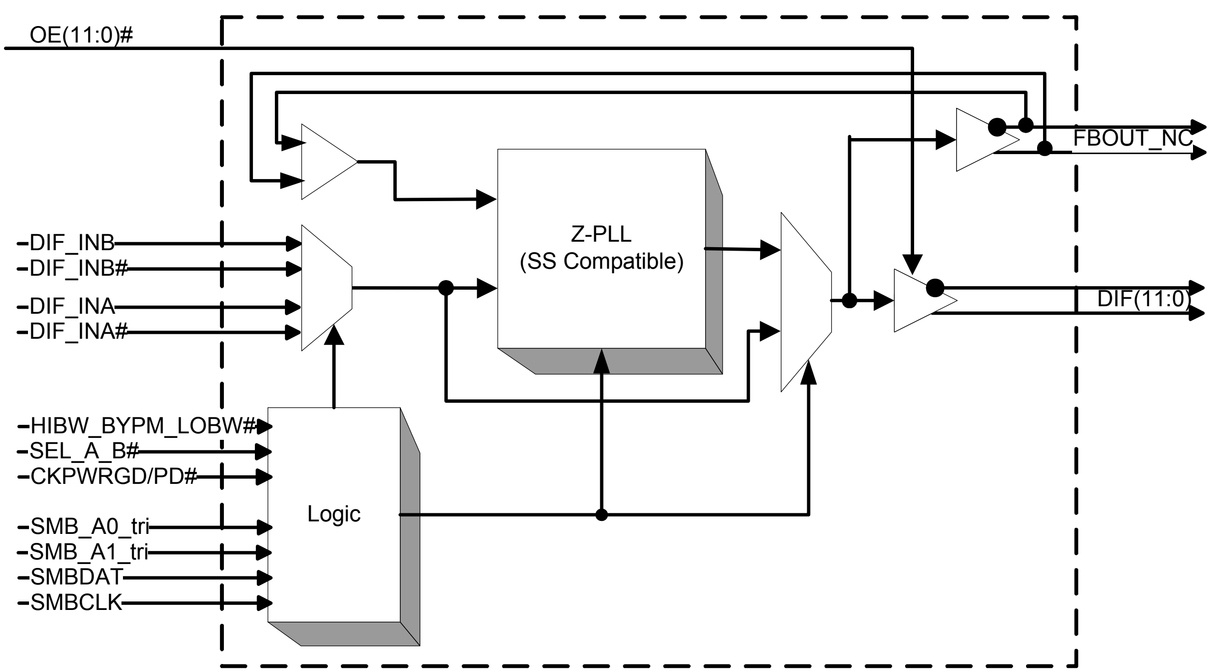
Features/Benefits

- Fixed feedback path; 0ps input-to-output delay
- 9 Selectable SMBus addresses; multiple devices can share same SMBus segment
- Separate VDDIO for outputs; allows maximum power savings
- PLL or bypass mode; PLL can dejitter incoming clock
- Hardware or Software-selectable PLL BW; minimizes jitter peaking in downstream PLL's
- Spread spectrum compatible; tracks spreading input clock for EMI reduction
- SMBus Interface; unused outputs can be disabled
- Differential outputs are Low/Low in power down; maximum power savings

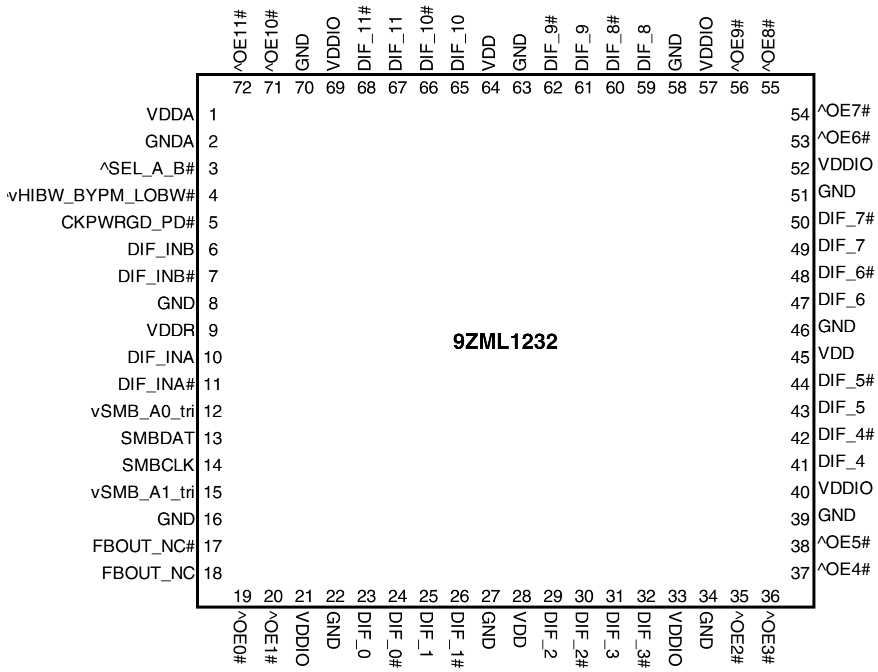
Key Specifications

- Cycle-to-cycle jitter <50ps
- Output-to-output skew <65 ps
- Input-to-output delay: Fixed at 0 ps
- Input-to-output delay variation <50ps
- Phase jitter: PCIe Gen3 <1ps rms
- Phase jitter: QPI/UPI 9.6GB/s <0.2ps rms

Block Diagram



Pin Configuration



^ prefix indicates internal 120Kohm Pull Up
v prefix indicates internal 120Kohm Pull down
10mm x 10mm 72-MLF, 0.5mm pin pitch

Power Management Table

Inputs		Control Bits	Outputs		PLL State
CKPWRGD_PD#	DIF_IN/ DIF_IN#	SMBus EN bit	DIFx/ DIFx#	FBOUT_NC/ FB_OUT_NC#	
0	X	X	Low/Low	Low/Low	OFF
1	Running	0	Low/Low	Running	ON
		1	Running	Running	ON

PLL Operating Mode Table

HiBW_BypM_LoBW#	Byte0, bit (7:6)
Low (PLL Low BW)	00
Mid (Bypass)	01
High (PLL High BW)	11

NOTE: PLL is off in Bypass mode

Power Connections

Pin Number			Description
VDD	VDDIO	GND	
1		2	Analog PLL
9		8	Analog Input
28, 45, 64	21, 33, 40, 52, 57, 69	16, 22, 27, 34, 39, 46, 51, 58, 63, 70	DIF clocks

Tri-Level Input Thresholds

Level	Voltage
Low	<0.8V
Mid	1.2<Vin<1.8V
High	Vin > 2.2V

9ZML1232 SMBus Addressing

SMB_A(1:0)_tri	SMBus Address (Rd/Wrt bit = 0)
00	D8
0M	DA
01	DE
M0	C2
MM	C4
M1	C6
10	CA
1M	CC
11	CE

Pin Descriptions

PIN #	PIN NAME	PIN TYPE	DESCRIPTION
1	VDDA	PWR	3.3V power for the PLL core.
2	GNDA	PWR	Ground pin for the PLL core.
3	^SEL_A_B#	IN	Input to select differential input clock A or differential input clock B. This input has an internal pull-up resistor. 0 = Input B selected, 1 = Input A selected.
4	^vHIBW_BYPM_LOBW#	LATCHED IN	Trilevel input to select High BW, Bypass or Low BW mode. See PLL Operating Mode Table for Details.
5	CKPWRGD_PD#	IN	3.3V Input notifies device to sample latched inputs and start up on first high assertion, or exit Power Down Mode on subsequent assertions. Low enters Power Down Mode.
6	DIF_INB	IN	0.7 V HCSL-Compatible Differential True input
7	DIF_INB#	IN	0.7 V HCSL-Compatible Differential Complement Input
8	GND	PWR	Ground pin.
9	VDDR	PWR	3.3V power for differential input clock (receiver). This VDD should be treated as an analog power rail and filtered appropriately.
10	DIF_INA	IN	0.7 V HCSL-Compatible Differential True input
11	DIF_INA#	IN	0.7 V HCSL-Compatible Differential Complement Input
12	vSMB_A0_tri	IN	SMBus address bit. This is a tri-level input that works in conjunction with the SMB_A1 to decode 1 of 9 SMBus Addresses. It has an internal 120Kohm pull down resistor.
13	SMBDAT	I/O	Data pin of SMBUS circuitry, 5V tolerant
14	SMBCLK	IN	Clock pin of SMBUS circuitry, 5V tolerant
15	vSMB_A1_tri	IN	SMBus address bit. This is a tri-level input that works in conjunction with the SMB_A0 to decode 1 of 9 SMBus Addresses. It has an internal 120Kohm pull down resistor.
16	GND	PWR	Ground pin.
17	FBOUT_NC#	OUT	Complementary half of differential feedback output. This pin should NOT be connected to anything outside the chip. It exists to provide delay path matching to get 0 propagation delay.
18	FBOUT_NC	OUT	True half of differential feedback output. This pin should NOT be connected to anything outside the chip. It exists to provide delay path matching to get 0 propagation delay.
19	^OE0#	IN	Active low input for enabling DIF pair 0. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
20	^OE1#	IN	Active low input for enabling DIF pair 1. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
21	VDDIO	PWR	Power supply for differential outputs
22	GND	PWR	Ground pin.
23	DIF_0	OUT	0.7V differential true clock output
24	DIF_0#	OUT	0.7V differential Complementary clock output
25	DIF_1	OUT	0.7V differential true clock output
26	DIF_1#	OUT	0.7V differential Complementary clock output
27	GND	PWR	Ground pin.
28	VDD	PWR	Power supply, nominal 3.3V
29	DIF_2	OUT	0.7V differential true clock output
30	DIF_2#	OUT	0.7V differential Complementary clock output
31	DIF_3	OUT	0.7V differential true clock output
32	DIF_3#	OUT	0.7V differential Complementary clock output
33	VDDIO	PWR	Power supply for differential outputs
34	GND	PWR	Ground pin.

Pin Descriptions (cont.)

PIN #	PIN NAME	PIN TYPE	DESCRIPTION
35	^OE2#	IN	Active low input for enabling DIF pair 2. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
36	^OE3#	IN	Active low input for enabling DIF pair 3. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
37	^OE4#	IN	Active low input for enabling DIF pair 4. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
38	^OE5#	IN	Active low input for enabling DIF pair 5. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
39	GND	PWR	Ground pin.
40	VDDIO	PWR	Power supply for differential outputs
41	DIF_4	OUT	0.7V differential true clock output
42	DIF_4#	OUT	0.7V differential Complementary clock output
43	DIF_5	OUT	0.7V differential true clock output
44	DIF_5#	OUT	0.7V differential Complementary clock output
45	VDD	PWR	Power supply, nominal 3.3V
46	GND	PWR	Ground pin.
47	DIF_6	OUT	0.7V differential true clock output
48	DIF_6#	OUT	0.7V differential Complementary clock output
49	DIF_7	OUT	0.7V differential true clock output
50	DIF_7#	OUT	0.7V differential Complementary clock output
51	GND	PWR	Ground pin.
52	VDDIO	PWR	Power supply for differential outputs
53	^OE6#	IN	Active low input for enabling DIF pair 6. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
54	^OE7#	IN	Active low input for enabling DIF pair 7. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
55	^OE8#	IN	Active low input for enabling DIF pair 8. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
56	^OE9#	IN	Active low input for enabling DIF pair 9. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
57	VDDIO	PWR	Power supply for differential outputs
58	GND	PWR	Ground pin.
59	DIF_8	OUT	0.7V differential true clock output
60	DIF_8#	OUT	0.7V differential Complementary clock output
61	DIF_9	OUT	0.7V differential true clock output
62	DIF_9#	OUT	0.7V differential Complementary clock output
63	GND	PWR	Ground pin.
64	VDD	PWR	Power supply, nominal 3.3V
65	DIF_10	OUT	0.7V differential true clock output
66	DIF_10#	OUT	0.7V differential Complementary clock output
67	DIF_11	OUT	0.7V differential true clock output
68	DIF_11#	OUT	0.7V differential Complementary clock output
69	VDDIO	PWR	Power supply for differential outputs
70	GND	PWR	Ground pin.
71	^OE10#	IN	Active low input for enabling DIF pair 10. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
72	^OE11#	IN	Active low input for enabling DIF pair 11. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the 9ZML1232. 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, R				4.6	V	1,2
3.3V Logic Supply Voltage	VDD				4.6	V	1,2
I/O Supply Voltage	VDDIO				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

TA = T_{COM}; Supply Voltage VDD/VDDA = 3.3 V +/-5%, VDDIO = 1.05 to 3.3V +/-5%. 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		900	mV	1
Input Swing - DIF_IN	V_{SWING}	Differential value	300			mV	1
Input Slew Rate - DIF_IN	dv/dt	Measured differentially	0.4		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–Input/Supply/Common Output Parameters

TA = T_{COM}; Supply Voltage VDD/VDDA = 3.3 V +/-5%, VDDIO = 1.05 to 3.3V +/-5%. See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Ambient Operating Temperature	T_{COM}	Commmercial range	0	25	70	°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	-0.12	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	-0.02	200	uA	1
Input Frequency	F_{ibyp}	V_{DD} = 3.3 V, Bypass mode	33		150	MHz	2
	F_{ipll}	V_{DD} = 3.3 V, 100MHz PLL mode	90	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			1	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	4		12	clocks	1
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			400	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 Low Power Differential Outputs

TA = T_{COM}; Supply Voltage VDD/VDDA = 3.3 V +/-5%, VDDIO = 1.05 to 3.3V +/-5%. See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Slew rate	Trf	Scope averaging on	1	3.3	4	V/ns	1, 2, 3
Slew rate matching	ΔTrf	Slew rate matching, Scope averaging on		2	20	%	1, 2, 4
Voltage High	VHigh	Statistical measurement on single-ended signal using oscilloscope math function. (Scope averaging on)	660	804	850	mV	1
Voltage Low	VLow		-150	19	150		1
Max Voltage	Vmax	Measurement on single ended signal using absolute value. (Scope averaging off)		885	1150	mV	1
Min Voltage	Vmin		-300	-29			1
Vswing	Vswing	Scope averaging off	300	1569		mV	1, 2
Crossing Voltage (abs)	Vcross_abs	Scope averaging off	300	465	550	mV	1, 5
Crossing Voltage (var)	Δ-Vcross	Scope averaging off		12	140	mV	1, 6

[1]Guaranteed by design and characterization, not 100% tested in production. C_L = 2pF with R_S = 27Ω for Zo = 85Ω differential trace 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 Vcross_min/max (Vcross absolute) allowed. The intent is to limit Vcross induced modulation by setting Δ-Vcross to be smaller than Vcross absolute.

Electrical Characteristics–Current Consumption

TA = T_{COM}; Supply Voltage VDD/VDDA = 3.3 V +/-5%, VDDIO = 1.05 to 3.3V +/-5%. See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Operating Supply Current	I_{DDVDD}	All outputs @100MHz, C_L = 2pF; Zo=85 Ω		13	35	mA	1
	$I_{DDVDDA/R}$	All outputs @100MHz, C_L = 2pF; Zo=85 Ω		14	20	mA	1
	$I_{DDVDDIO}$	All outputs @100MHz, C_L = 2pF; Zo=85 Ω		86	100	mA	1
Powerdown Current	$I_{DDVDDPD}$	All differential pairs low/low		0.7	4	mA	1,2
	$I_{DDVDDA/RPD}$	All differential pairs low/low			5	mA	1,2
	$I_{DDVDDIOPD}$	All differential pairs low/low			0.2	mA	1,2

[1] Guaranteed by design and characterization, not 100% tested in production.
[2] With input clock running. Stopping the input clock will result in lower numbers.

Electrical Characteristics–Skew and Differential Jitter Parameters

TA = T_{COM}; Supply Voltage VDD/VDDA = 3.3 V +/-5%, VDDIO = 1.05 to 3.3V +/-5%. See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
CLK_IN, DIF[x:0]	t_{SPO_PLL}	Input-to-Output Skew in PLL mode nominal value @ 25°C, 3.3V	-325	-225	-125	ps	1,2,4,5,8
CLK_IN, DIF[x:0]	t_{PD_BYP}	Input-to-Output Skew in Bypass mode nominal value @ 25°C, 3.3V	3	3.8	4.5	ns	1,2,3,5,8
CLK_IN, DIF[x:0]	t_{DSPO_PLL}	Input-to-Output Skew Varation in PLL mode across voltage and temperature	-50	0	50	ps	1,2,3,5,8
CLK_IN, DIF[x:0]	t_{DSPO_BYP}	Input-to-Output Skew Varation in Bypass mode across voltage and temperature	-250		250	ps	1,2,3,5,8
CLK_IN, DIF[x:0]	t_{DTE}	Random Differential Tracking error beween two 9ZM devices in Hi BW Mode			5	ps (rms)	1,2,3,5,8
CLK_IN, DIF[x:0]	t_{DSSTE}	Random Differential Spread Spectrum Tracking error beween two 9ZM devices in Hi BW Mode			75	ps	1,2,3,5,8
DIF{x:0]	t_{SKEW_ALL}	Output-to-Output Skew across all outputs (Common to Bypass and PLL mode)		40	65	ps	1,2,3,8
PLL Jitter Peaking	$j_{peak-hibw}$	LOBW#_BYPASS_HIBW = 1	0		2.5	dB	7,8
PLL Jitter Peaking	$j_{peak-lobw}$	LOBW#_BYPASS_HIBW = 0	0		2	dB	7,8
PLL Bandwidth	pll_{HIBW}	LOBW#_BYPASS_HIBW = 1	2		4	MHz	8,9
PLL Bandwidth	pll_{LOBW}	LOBW#_BYPASS_HIBW = 0	0.7		1.4	MHz	8,9
Duty Cycle	t_{DC}	Measured differentially, PLL Mode	45	50.2	55	%	1
Duty Cycle Distortion	t_{DCD}	Measured differentially, Bypass Mode @100MHz	-2	0.8	2	%	1,10
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	PLL mode		10	50	ps	1,11
		Additive Jitter in Bypass Mode		0.1	50	ps	1,11

Notes for preceding table:

[1] Measured into fixed 2 pF load cap. Input to output skew is measured at the first output edge following the corresponding input.

[2] Measured from differential cross-point to differential cross-point. This parameter can be tuned with external feedback path, if present.

[3] All Bypass Mode Input-to-Output specs refer to the timing between an input edge and the specific output edge created by it.

[4] This parameter is deterministic for a given device

[5] Measured with scope averaging on to find mean value.

[6.] t is the period of the input clock

[7] Measured as maximum pass band gain. At frequencies within the loop BW, highest point of magnification is called PLL jitter peaking.

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

[9] Measured at 3 db down or half power point.

[10] Duty cycle distortion is the difference in duty cycle between the output and the input clock when the device is operated in bypass mod

[11] Measured from differential waveform

Electrical Characteristics–Phase Jitter Parameters

TA = T_{COM}; Supply Voltage VDD/VDDA = 3.3 V +/-5%, VDDIO = 1.05 to 3.3V +/-5%. See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	INDUSTRY LIMIT	UNITS	Notes
Phase Jitter, PLL Mode	$t_{jphPCIeG1}$	PCIe Gen 1	23	36	44	86	ps (p-p)	1,2,3
	$t_{jphPCIeG2}$	PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz	0.84	1.18	1.41	3	ps (rms)	1,2
		PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz)	1.44	2.01	2.48	3.1	ps (rms)	1,2
	$t_{jphPCIeG3}$	PCIe Gen 3 (PLL BW of 2-4MHz, CDR = 10MHz)	0.37	0.49	0.59	1	ps (rms)	1,2,4
	t_{jphQPI_SMI}	QPI & SMI (100MHz or 133MHz, 4.8Gb/s, 6.4Gb/s 12UI)	0.20	0.25	0.35	0.5	ps (rms)	1,5
		QPI & SMI (100MHz, 8.0Gb/s, 12UI)	0.08	0.16	0.28	0.3	ps (rms)	1,5
		QPI & SMI (100MHz, 9.6Gb/s, 12UI)	0.07	0.12	0.19	0.2	ps (rms)	1,5
Additive Phase Jitter, Bypass mode	$t_{jphPCIeG1}$	PCIe Gen 1	0	3	10	N/A	ps (p-p)	1,2,3
	$t_{jphPCIeG2}$	PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz	0.09	0.13	0.30	N/A	ps (rms)	1,2,6
		PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz)	0.00	0.10	0.70	N/A	ps (rms)	1,2,6
	$t_{jphPCIeG3}$	PCIe Gen 3 (PLL BW of 2-4MHz, CDR = 10MHz)	0.00	0.10	0.30	N/A	ps (rms)	1,2,4,6
	t_{jphQPI_SMI}	QPI & SMI (100MHz or 133MHz, 4.8Gb/s, 6.4Gb/s 12UI)	0.00	0.10	0.30	N/A	ps (rms)	1,5,6
		QPI & SMI (100MHz, 8.0Gb/s, 12UI)	0.04	0.05	0.10	N/A	ps (rms)	1,5,6
		QPI & SMI (100MHz, 9.6Gb/s, 12UI)	0.04	0.05	0.10	N/A	ps (rms)	1,5,6

[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.

[5] Calculated from Intel-supplied Clock Jitter Tool v 1.6.3

[6] For RMS figures, additive jitter is calculated by solving the following equation: (Additive jitter)^2 = (total jittter)^2 - (input jitter)^2

Clock Periods–Differential Outputs with Spread Spectrum Disabled

SSC OFF	Center Freq. MHz	Measurement Window							Units	Notes
		1 Clock	1us	0.1s	0.1s	0.1s	1us	1 Clock		
		-c2c jitter AbsPer Min	-SSC Short-Term Average Min	- ppm Long-Term Average Min	0 ppm Period Nominal	+ ppm Long-Term Average Max	+SSC Short-Term Average Max	+c2c jitter AbsPer Max		
DIF	100.00	9.94900		9.99900	10.00000	10.00100		10.05100	ns	1,2,3

Clock Periods–Differential Outputs with Spread Spectrum Enabled

SSC ON	Center Freq. MHz	Measurement Window							Units	Notes
		1 Clock	1us	0.1s	0.1s	0.1s	1us	1 Clock		
		-c2c jitter AbsPer Min	-SSC Short-Term Average Min	- ppm Long-Term Average Min	0 ppm Period Nominal	+ ppm Long-Term Average Max	+SSC Short-Term Average Max	+c2c jitter AbsPer Max		
DIF	99.75	9.94906	9.99906	10.02406	10.02506	10.02607	10.05107	10.10107	ns	1,2,3

Notes:

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

[2] All Long Term Accuracy specifications are guaranteed with the assumption that the input clock complies with CK420BQ accuracy requirements (+/-100ppm). The 9ZML1232 itself does not contribute to ppm error.

[3] Driven by SRC output of main clock, 100 MHz PLL Mode or Bypass mode

[4] Driven by CPU output of main clock, 133 MHz PLL Mode or Bypass mode

DIF 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 (100 ohm differential traces)	33	ohm	1
Rs (85 ohm differential traces)	27	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

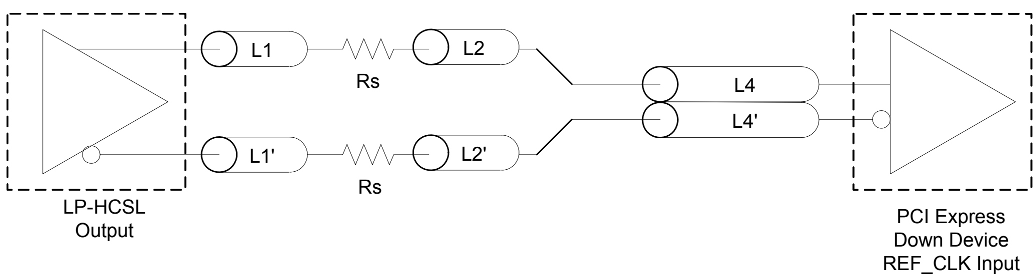
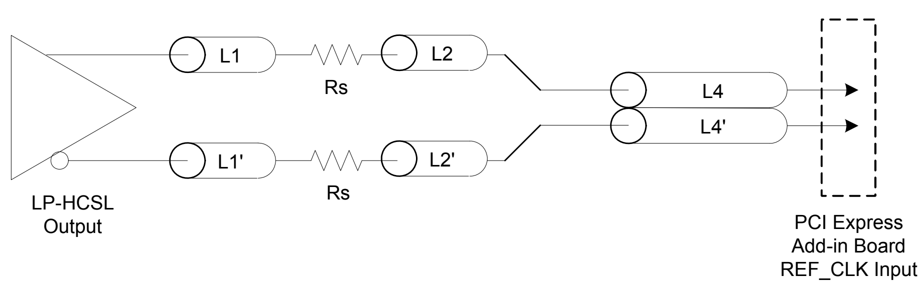


Figure 2: PCI Express Connector Routing



Cable Connected AC Coupled Application (Figure 3)		
Component	Value	Note
R5a, R5b	8.2K 5%	
R6a, R6b	1K 5%	
Cc	0.1 µF	
Vcm	0.350 volts	

Figure 3

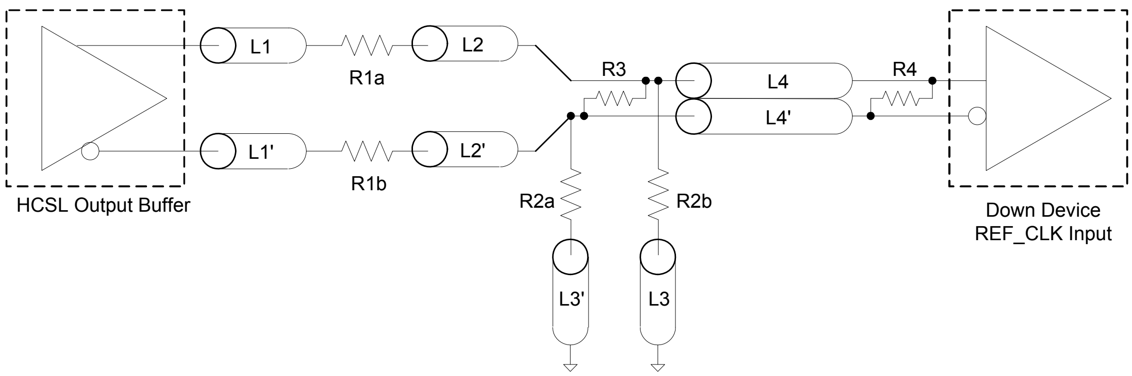
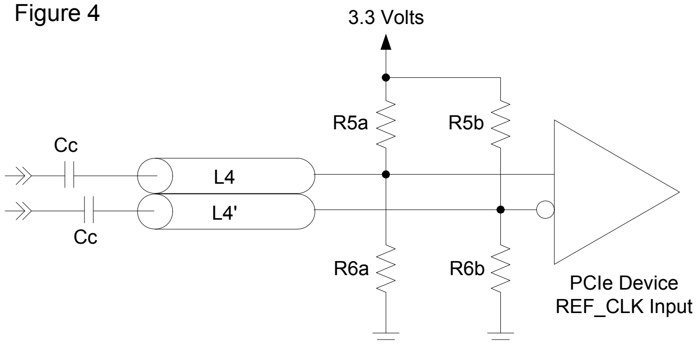


Figure 4



General SMBus Serial Interface Information for 9ZML1232

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		

9ZML1232 SMBus Addressing

SMB_A(1:0)_tri	SMBus Address (Rd/Wrt bit = 0)
00	D8
0M	DA
01	DE
M0	C2
MM	C4
M1	C6
10	CA
1M	CC
11	CE

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		

SMBusTable: PLL Mode, and Frequency Select Register

Byte 0	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	4	PLL Mode 1	PLL Operating Mode Rd back 1	R	See PLL Operating Mode Readback Table		Latch
Bit 6	4	PLL Mode 0	PLL Operating Mode Rd back 0	R			Latch
Bit 5	3	SEL_A_B#	Input Select Readback	R	DIF_INA	DIF_INB	Latch
Bit 4		Reserved					0
Bit 3		Software_EN	Enable S/W control of PLL BW and Input Select	RW	HW Latch	SMBus Control	0
Bit 2		PLL Mode 1	PLL Operating Mode 1	RW	See PLL Operating Mode Readback Table		1
Bit 1		PLL Mode 0	PLL Operating Mode 1	RW			1
Bit 0		SEL_A_B#	Input Select	RW	DIF_INB	DIF_INA	1

Note: Setting bit 3 to '1' allows the user to overide the Latch value from pins 4 and 5 via use of bits [2:0]. Use the values from the PLL Operating Mode Readback Table. Note that Bits [7:5] will keep the value originally latched on pins 4 and 5. A warm reset of the system will have to accomplished if the user changes Bits [2:0] bits.

SMBusTable: Output Control Register

Byte 1	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	49/50	DIF_7_En	Output Control - '0' overrides OE# pin	RW	Low/Low	Enable	1
Bit 6	47/48	DIF_6_En	Output Control - '0' overrides OE# pin	RW			1
Bit 5	43/44	DIF_5_En	Output Control - '0' overrides OE# pin	RW			1
Bit 4	41/42	DIF_4_En	Output Control - '0' overrides OE# pin	RW			1
Bit 3	31/32	DIF_3_En	Output Control - '0' overrides OE# pin	RW			1
Bit 2	29/30	DIF_2_En	Output Control - '0' overrides OE# pin	RW			1
Bit 1	25/26	DIF_1_En	Output Control - '0' overrides OE# pin	RW			1
Bit 0	23/24	DIF_0_En	Output Control - '0' overrides OE# pin	RW			1

SMBusTable: Output Control Register

Byte 2	Pin #	Name	Control Function	Type	0	1	Default
Bit 7		Reserved					0
Bit 6		Reserved					0
Bit 5		Reserved					0
Bit 4		Reserved					0
Bit 3	67/68	DIF_11_En	Output Control - '0' overrides OE# pin	RW	Low/Low	Enable	1
Bit 2	65/66	DIF_10_En	Output Control - '0' overrides OE# pin	RW			1
Bit 1	61/62	DIF_9_En	Output Control - '0' overrides OE# pin	RW			1
Bit 0	59/60	DIF_8_En	Output Control - '0' overrides OE# pin	RW			1

SMBusTable: Output Amplitude Control Register

Byte 3	Pin #	Name	Control Function	Type	0	1	Default
Bit 7		Reserved					0
Bit 6		Reserved					0
Bit 5		Reserved					0
Bit 4		Reserved					0
Bit 3		Reserved					0
Bit 2		AMP2	Output Amplitude	RW	000=350mV, 001=450mV, 010=550mV, 011=650mV, 100=750mV 101=850mV, 110=950mV, 111=Reserved		1
Bit 1		AMP1		RW			0
Bit 0		AMP0		RW			0

SMBusTable: Reserved Register

Byte 4	Pin #	Name	Control Function	Type	0	1	Default
Bit 7		Reserved					0
Bit 6		Reserved					0
Bit 5		Reserved					0
Bit 4		Reserved					0
Bit 3		Reserved					0
Bit 2		Reserved					0
Bit 1		Reserved					0
Bit 0		Reserved					0

SMBusTable: Vendor & Revision ID Register

Byte 5	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	-	RID3	REVISION ID	R	A rev = 0000 B rev = 0001		X
Bit 6	-	RID2		R			X
Bit 5	-	RID1		R			X
Bit 4	-	RID0		R			X
Bit 3	-	VID3	VENDOR ID	R	-	-	0
Bit 2	-	VID2		R	-	-	0
Bit 1	-	VID1		R	-	-	0
Bit 0	-	VID0		R	-	-	1

SMBusTable: DEVICE ID

Byte 6	Pin #	Name	Control Function	Type	0	1	Default
Bit 7	-	Device ID 7 (MSB)		R	9ZML1231 = F1 hex		1
Bit 6	-	Device ID 6		R			1
Bit 5	-	Device ID 5		R			1
Bit 4	-	Device ID 4		R			1
Bit 3	-	Device ID 3		R			0
Bit 2	-	Device ID 2		R			0
Bit 1	-	Device ID 1		R			0
Bit 0	-	Device ID 0		R			1

SMBusTable: Byte Count Register

Byte 7	Pin #	Name	Control Function	Type	0	1	Default
Bit 7		Reserved					0
Bit 6		Reserved					0
Bit 5		Reserved					0
Bit 4	-	BC4	Writing to this register configures how many bytes will be read back.	RW	Default value is 8 hex, so 9 bytes (0 to 8) will be read back by default.		0
Bit 3	-	BC3		RW			1
Bit 2	-	BC2		RW			0
Bit 1	-	BC1		RW			0
Bit 0	-	BC0		RW			0

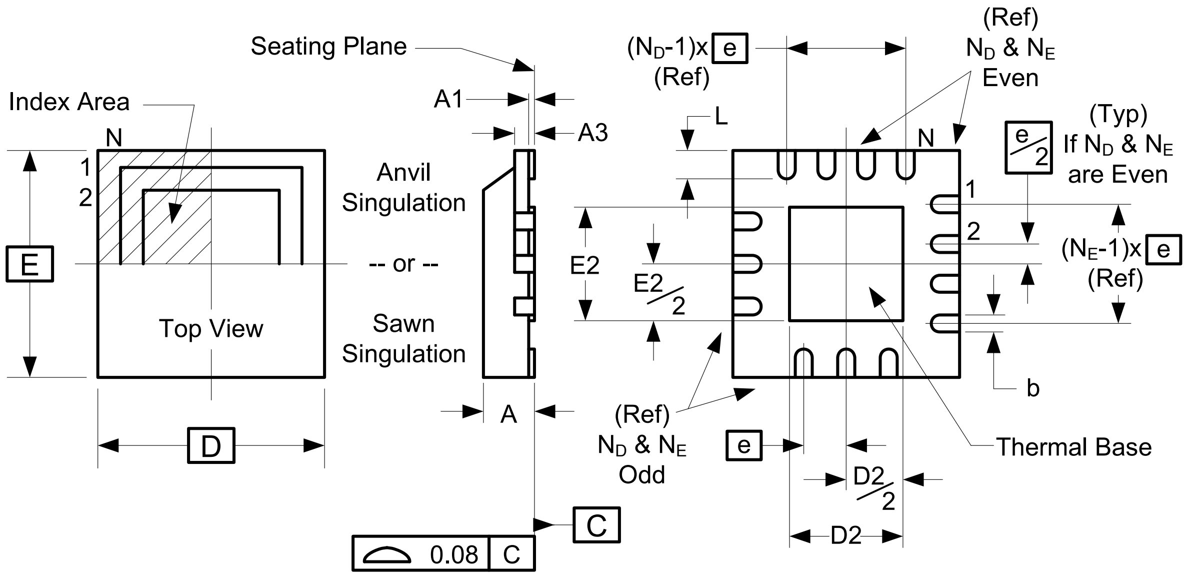
SMBusTable: Reserved Register

Byte 8	Pin #	Name	Control Function	Type	0	1	Default
Bit 7		Reserved					0
Bit 6		Reserved					0
Bit 5		Reserved					0
Bit 4		Reserved					0
Bit 3		Reserved					0
Bit 2		Reserved					0
Bit 1		Reserved					0
Bit 0		Reserved					0

Marking Diagram

Notes:
1. “L” denotes RoHS compliant package.
2. ‘LOT’ denotes the lot number.
3. “COO”: country of origin.
4. YYWW is the last two digits of the year and week that the part was assembled.

Package Outline and Package Dimensions (72-pin MLF)



	Millimeters	
Symbol	**Min**	**Max**
A	0.8	1.0
A1	0	0.05
A3	0.25 Reference	
b	0.18	0.3
e	0.50 BASIC	
D x E BASIC	10.00 x 10.00	
D2 MIN./MAX.	5.75	6.15
E2 MIN./MAX.	5.75	6.15
L MIN./MAX.	0.30	0.50
N	72	
N_D	18	
N_E	18	

Ordering Information

Part Number	Shipping Package	Package	Temperature
9ZML1232BKLF	Trays	72-pin QFN	0 to +70°C
9ZML1232BKLFT	Tape and Reel	72-pin QFN	0 to +70°C

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

“B” is the device revision designator (will not correlate with the datasheet revision).

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Revision History

Rev.	Issuer	Issue Date	Description	Page #
A	RDW	8/17/2012	Updated electrical characteristics and move to final.	
B	RDW	10/2/2012	Corrected Phase Jitter Parameters	9
C	RDW	3/24/2014	1. Corrected pin references in Byte 0, bits (7:5) from 4 and 5 to 3 and 4.	14
D	RDW	9/16/2015	Corrected typo in general description; changed DB1900Z to DB1200ZL	1
E	RDW	11/20/2015	1. Updated QPI references to QPI/UPI 2. Updated DIF_IN table to match PCI SIG specification, no silicon change	1,5

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