

12-OUTPUT DIFFERENTIAL Z-BUFFER FOR PCIE GEN2/3 AND QPI 9ZX21201

General Description

The IDT9ZX21201 is a 12-output DB1200Z suitable for PCI-Express Gen3 or QPI applications. The part is backwards compatible to PCIe Gen1 and Gen2. A fixed external feedback maintains low drift for critical QPI applications. In bypass mode, the IDT9ZX21201 can provide outputs up to 150MHz.

Recommended Application

12-output PCIe Gen3/ QPI differential buffer for Romley and newer platforms

Key Specifications

- Cycle-to-cycle jitter <50ps
- Output-to-output skew < 65 ps
- Input-to-output delay variation <50ps
- PCIe Gen3 phase jitter < 1.0ps RMS
- QPI 9.6GT/s 12UI phase jitter < 0.2ps RMS

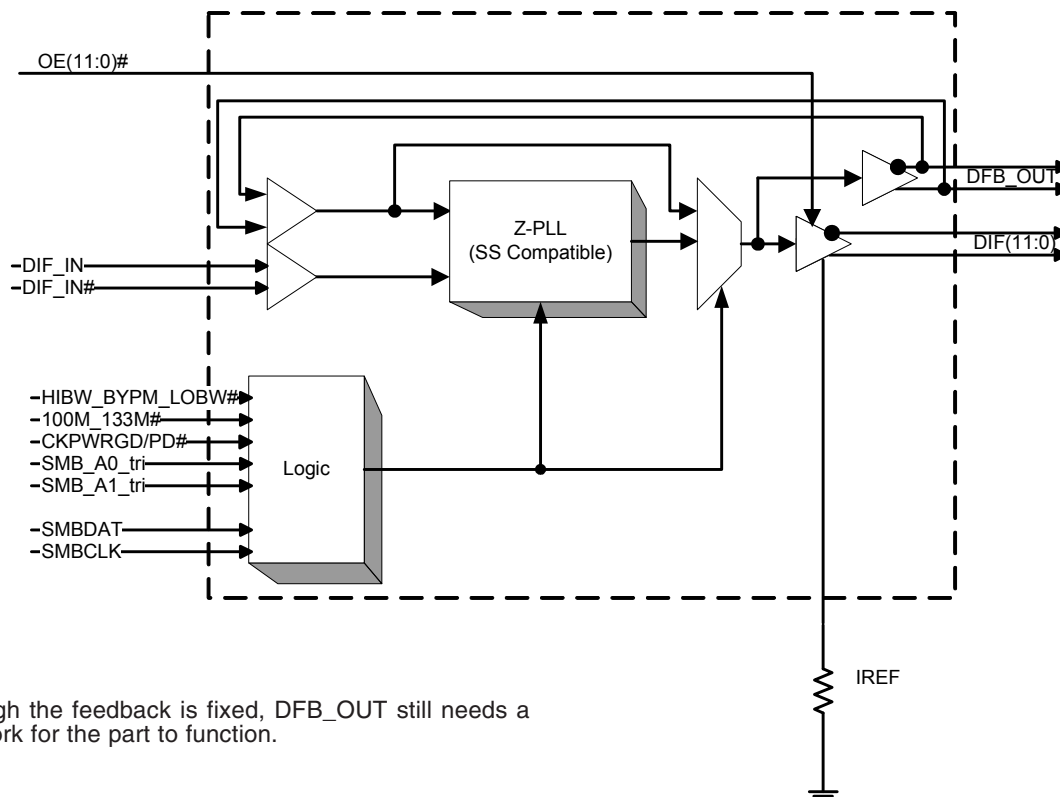
Features/Benefits

- Space-saving 64-pin packages
- Fixed feedback path/ 0ps input-to-output delay
- 9 Selectable SMBus Addresses/Multiple devices can share the same SMBus Segment
- 12 OE# pins/Hardware control of each output
- PLL or bypass mode/PLL can dejitter incoming clock
- 100MHz or 133MHz PLL mode operation/supports PCIe and QPI applications
- Selectable PLL bandwidth/minimizes jitter peaking in downstream PLL's
- Spread Spectrum Compatible/tracks spreading input clock for low EMI
- Software control of PLL Bandwidth and Bypass Settings/ PLL can dejitter incoming clock (B Rev only)

Output Features

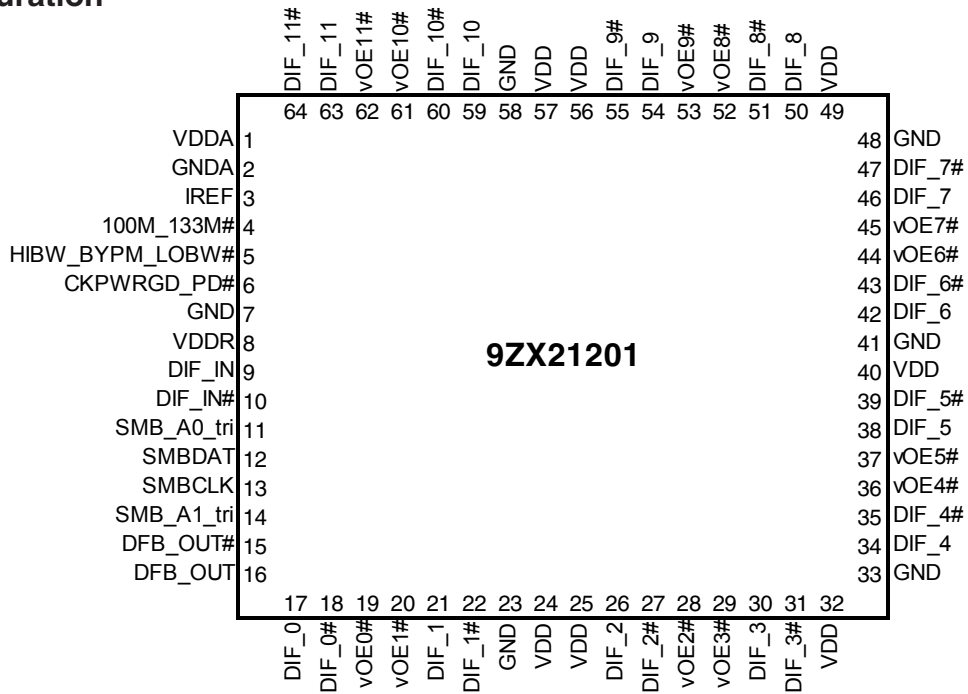
- 12 - 0.7V differential HCSL output pairs

Functional Block Diagram



Note: Even though the feedback is fixed, DFB_OUT still needs a termination network for the part to function.

Pin Configuration



Notes: Pins with ^ prefix have internal ~100K pullup
Pins with v prefix have internal ~100K pulldown.

Tri-level Input Thresholds

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

Functionality at Power Up (PLL Mode)

| 100M_133M# | DIF_IN (MHz) | DIF |
|------------|--------------|--------|
| 1 | 100.00 | DIF_IN |
| 0 | 133.33 | DIF_IN |

PLL Operating Mode Readback Table

| HiBW_BypM_LoBW# | Byte0, bit 7 | Byte 0, bit 6 |
|-----------------|--------------|---------------|
| Low (Low BW) | 0 | 0 |
| Mid (Bypass) | 0 | 1 |
| High (High BW) | 1 | 1 |

PLL Operating Mode

| HiBW_BypM_LoBW# | MODE |
|-----------------|-----------|
| Low | PLL Lo BW |
| Mid | Bypass |
| High | PLL Hi BW |

NOTE: PLL is OFF in Bypass Mode

MLF Power Connections

| Pin Number | | | Description |
|------------|-------------|----------------|--------------|
| VDD | VDD | GND | |
| 1 | | 2 | Analog PLL |
| 8 | | 7 | Analog Input |
| 24,40,57 | 25,32,49,56 | 23,33,41,48,58 | DIF clocks |

9ZX21201 SMBus Addressing

| Pin | | SMBus Address (Rd/Wrt bit = 0) |
|------------|------------|-----------------------------------|
| SMB_A1_tri | SMB_A0_tri | |
| 0 | 0 | D8 |
| 0 | M | DA |
| 0 | 1 | DE |
| M | 0 | C2 |
| M | M | C4 |
| M | 1 | C6 |
| 1 | 0 | CA |
| 1 | M | CC |
| 1 | 1 | CE |

Pin Description

| PIN # | PIN NAME | TYPE | DESCRIPTION |
|-------|-----------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | VDDA | PWR | 3.3V power for the PLL core. |
| 2 | GNDA | PWR | Ground pin for the PLL core. |
| 3 | 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. |
| 4 | 100M_133M# | IN | 3.3V Input to select operating frequency See Functionality Table for Definition |
| 5 | HIBW_BYPM_LOBW# | IN | Trilevel input to select High BW, Bypass or Low BW mode. See PLL Operating Mode Table for Details. |
| 6 | CKPWRGD_PD# | IN | 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. |
| 7 | GND | PWR | Ground pin. |
| 8 | VDDR | PWR | 3.3V power for differential input clock (receiver). This VDD should be treated as an analog power rail and filtered appropriately. |
| 9 | DIF_IN | IN | 0.7 V Differential TRUE input |
| 10 | DIF_IN# | IN | 0.7 V Differential Complementary Input |
| 11 | SMB_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. |
| 12 | SMBDAT | I/O | Data pin of SMBUS circuitry, 5V tolerant |
| 13 | SMBCLK | IN | Clock pin of SMBUS circuitry, 5V tolerant |
| 14 | SMB_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. |
| 15 | DFB_OUT# | OUT | Complementary half of differential feedback output, provides feedback signal to the PLL for synchronization with input clock to eliminate phase error. |
| 16 | DFB_OUT | OUT | True half of differential feedback output, provides feedback signal to the PLL for synchronization with the input clock to eliminate phase error. |
| 17 | DIF_0 | OUT | 0.7V differential true clock output |
| 18 | DIF_0# | OUT | 0.7V differential Complementary clock output |
| 19 | vOE0# | IN | Active low input for enabling DIF pair 0. 1 =disable outputs, 0 = enable outputs |
| 20 | vOE1# | IN | Active low input for enabling DIF pair 1. 1 =disable outputs, 0 = enable outputs |
| 21 | DIF_1 | OUT | 0.7V differential true clock output |
| 22 | DIF_1# | OUT | 0.7V differential Complementary clock output |
| 23 | GND | PWR | Ground pin. |
| 24 | VDD | PWR | Power supply, nominal 3.3V |
| 25 | VDD | PWR | Power supply, nominal 3.3V |
| 26 | DIF_2 | OUT | 0.7V differential true clock output |
| 27 | DIF_2# | OUT | 0.7V differential Complementary clock output |
| 28 | vOE2# | IN | Active low input for enabling DIF pair 2. 1 =disable outputs, 0 = enable outputs |
| 29 | vOE3# | IN | Active low input for enabling DIF pair 3. 1 =disable outputs, 0 = enable outputs |
| 30 | DIF_3 | OUT | 0.7V differential true clock output |
| 31 | DIF_3# | OUT | 0.7V differential Complementary clock output |
| 32 | VDD | PWR | Power supply, nominal 3.3V |

Pin Description (continued)

| | | | |
|----|---------|-----|-------------------------------------------------------------------------------------------------------------------------|
| 33 | GND | PWR | Ground pin. |
| 34 | DIF_4 | OUT | 0.7V differential true clock output |
| 35 | DIF_4# | OUT | 0.7V differential Complementary clock output |
| 36 | vOE4# | IN | Active low input for enabling DIF pair 4 1 =disable outputs, 0 = enable outputs |
| 37 | vOE5# | IN | Active low input for enabling DIF pair 5. This pin has an internal pull-down 1 =disable outputs, 0 = enable outputs |
| 38 | DIF_5 | OUT | 0.7V differential true clock output |
| 39 | DIF_5# | OUT | 0.7V differential Complementary clock output |
| 40 | VDD | PWR | Power supply, nominal 3.3V |
| 41 | GND | PWR | Ground pin. |
| 42 | DIF_6 | OUT | 0.7V differential true clock output |
| 43 | DIF_6# | OUT | 0.7V differential Complementary clock output |
| 44 | vOE6# | IN | Active low input for enabling DIF pair 6. This pin has an internal pull-down 1 =disable outputs, 0 = enable outputs |
| 45 | vOE7# | IN | Active low input for enabling DIF pair 7. This pin has an internal pull-down 1 =disable outputs, 0 = enable outputs |
| 46 | DIF_7 | OUT | 0.7V differential true clock output |
| 47 | DIF_7# | OUT | 0.7V differential Complementary clock output |
| 48 | GND | PWR | Ground pin. |
| 49 | VDD | PWR | Power supply, nominal 3.3V |
| 50 | DIF_8 | OUT | 0.7V differential true clock output |
| 51 | DIF_8# | OUT | 0.7V differential Complementary clock output |
| 52 | vOE8# | IN | Active low input for enabling DIF pair 8. This pin has an internal pull-down 1 =disable outputs, 0 = enable outputs |
| 53 | vOE9# | IN | Active low input for enabling DIF pair 9. This pin has an internal pull-down 1 =disable outputs, 0 = enable outputs |
| 54 | DIF_9 | OUT | 0.7V differential true clock output |
| 55 | DIF_9# | OUT | 0.7V differential Complementary clock output |
| 56 | VDD | PWR | Power supply, nominal 3.3V |
| 57 | VDD | PWR | Power supply, nominal 3.3V |
| 58 | GND | PWR | Ground pin. |
| 59 | DIF_10 | OUT | 0.7V differential true clock output |
| 60 | DIF_10# | OUT | 0.7V differential Complementary clock output |
| 61 | vOE10# | IN | Active low input for enabling DIF pair 10. This pin has an internal pull-down 1 =disable outputs, 0 = enable outputs |
| 62 | vOE11# | IN | Active low input for enabling DIF pair 11. This pin has an internal pull-down 1 =disable outputs, 0 = enable outputs |
| 63 | DIF_11 | OUT | 0.7V differential true clock output |
| 64 | DIF_11# | OUT | 0.7V differential Complementary clock output |

Electrical Characteristics - Absolute Maximum Ratings

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|--------------------------|--------------------|----------------------------|---------|-----|-----------------------|-------|-------|
| 3.3V Core Supply Voltage | VDD, VDDA | VDD for core logic and PLL | | | 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 | T _s | | -65 | | 150 | °C | 1 |
| Junction Temperature | T _j | | | | 125 | °C | 1 |
| Input ESD protection | ESD prot | Human Body Model | 2000 | | | V | 1 |

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

²Operation under these conditions is neither implied nor guaranteed.

Electrical Characteristics - Input/Supply/Common Parameters

T_A = T_{COM}; Supply Voltage V_{DD}/V_{DDA} = 3.3 V +/-5%

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|-------------------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------|-----------------------|--------|-------|
| Ambient Operating Temperature | T _{COM} | Commercial range | 0 | | 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 | | 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 | 33 | | 150 | MHz | 2 |
| | F _{ipll} | V _{DD} = 3.3 V, 100MHz PLL mode | 90 | 100.00 | 110 | MHz | 2 |
| | F _{ipll} | V _{DD} = 3.3 V, 133.33MHz PLL mode | 120 | 133.33 | 147 | 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 | | 0.300 | 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 | 6 | 12 | clocks | 1 |
| Tdrive_PD# | t _{DRVPD} | DIF output enable after PD# de-assertion | | 16 | 300 | us | 1,3 |
| Tfall | t _F | Fall time of control inputs | | | 10 | ns | 1,2 |
| Trise | t _R | Rise time of control inputs | | | 10 | 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 V _{IL} - 0.15) to (Min V _{IH} + 0.15) | | | 1000 | ns | 1 |
| SCLK/SDATA Fall Time | t _{FSMB} | (Min V _{IH} + 0.15) to (Max V _{IL} - 0.15) | | | 300 | ns | 1 |
| SMBus Operating Frequency | f _{MAXSMB} | Maximum SMBus operating frequency | | | 100 | kHz | 1,5 |

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

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

³Time from deassertion until outputs are >200 mV

⁴DIF_IN input

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

Electrical Characteristics - Clock Input Parameters

$T_A = T_{COM}$; Supply Voltage $V_{DD}/V_{DDA} = 3.3\text{ V} \pm 5\%$

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|------------------------------------|-------------|------------------------------------------------|----------------|-----|------|-------|-------|
| Input High Voltage - DIF_IN | V_{IHDIF} | Differential inputs (single-ended measurement) | 600 | 800 | 1150 | mV | 1 |
| Input Low Voltage - DIF_IN | V_{ILDIF} | Differential inputs (single-ended measurement) | $V_{SS} - 300$ | 0 | 300 | mV | 1 |
| Input Common Mode Voltage - DIF_IN | V_{COM} | Common Mode Input Voltage | 300 | | 1000 | mV | 1 |
| Input Amplitude - DIF_IN | V_{SWING} | Peak to Peak value | 300 | | 1450 | 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 | 1 |
| Input Duty Cycle | d_{in} | Measurement from differential waveform | 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 $\pm 75\text{mV}$ window centered around differential zero

Electrical Characteristics - DIF 0.7V Current Mode Differential Outputs

$T_A = T_{COM}$; Supply Voltage $V_{DD}/V_{DDA} = 3.3\text{ V} \pm 5\%$

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|------------------------|--------------------|-------------------------------------------------------------------------------------------------------|------|------|------|-------|---------|
| Slew rate | Trf | Scope averaging on | 1 | 2 | 4 | V/ns | 1, 2, 3 |
| Slew rate matching | ΔTrf | Slew rate matching, Scope averaging on | | 8 | 20 | % | 1, 2, 4 |
| Voltage High | V_{High} | Statistical measurement on single-ended signal using oscilloscope math function. (Scope averaging on) | 660 | 705 | 850 | mV | 1 |
| Voltage Low | V_{Low} | | -150 | 1 | 150 | | 1 |
| Max Voltage | V_{max} | Measurement on single ended signal using absolute value. (Scope averaging off) | | 725 | 1150 | mV | 1 |
| Min Voltage | V_{min} | | -300 | -22 | | | 1 |
| Vswing | V_{swing} | Scope averaging off | 300 | 1407 | | mV | 1, 2 |
| Crossing Voltage (abs) | V_{cross_abs} | Scope averaging off | 250 | 309 | 550 | mV | 1, 5 |
| Crossing Voltage (var) | ΔV_{cross} | Scope averaging off | | 22 | 140 | mV | 1, 6 |

¹ Guaranteed by design and characterization, not 100% tested in production. $I_{REF} = V_{DD}/(3 \times R_R)$. For $R_R = 412\Omega$ (1%), $I_{REF} = 2.7\text{mA}$.

$I_{OH} = 6.4 \times I_{REF}$ and $V_{OH} = 0.7\text{V}$ @ $Z_O = 85\Omega$ differential impedance.

² Measured from differential waveform

³ Slew rate is measured through the V_{swing} voltage range centered around differential 0V. This results in a $\pm 150\text{mV}$ window around differential 0V.

⁴ Matching applies to rising edge rate of Clock / falling edge rate of Clock#. It is measured in a $\pm 75\text{mV}$ 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 uses for the edge rate calculations.

⁵ V_{cross} 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 V_{cross} 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 V_{cross} induced modulation by setting V_{cross_delta} to be smaller than V_{cross} absolute.

Electrical Characteristics - Current Consumption

$T_A = T_{COM}$; Supply Voltage $V_{DD}/V_{DDA} = 3.3\text{ V} \pm 5\%$

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|-------------------|----------------|---------------------------------------------------------------|-----|-----|-----|-------|-------|
| Operating Current | I_{DDVDD} | 133MHz, $C_L = \text{Full load}$; VDD rail, $Z_O = 85\Omega$ | | 260 | 275 | mA | 1 |
| | I_{DDVDDA} | 133MHz, $C_L = \text{Full load}$; VDD rail, $Z_O = 85\Omega$ | | 13 | 20 | mA | 1 |
| Powerdown Current | $I_{DDVDDPD}$ | Power Down, VDD rail, $Z_O = 85\Omega$ | | 2 | 6 | mA | 1 |
| | $I_{DDVDDAPD}$ | Power Down, VDD rail, $Z_O = 85\Omega$ | | 1.3 | 2 | mA | 1 |

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

Electrical Characteristics - Skew and Differential Jitter ParametersT_A = T_{COM}; Supply Voltage V_{DD}/V_{DDA} = 3.3 V +/-5%

| 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 | -100 | 29 | 100 | 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 | 2.5 | 3.7 | 4.5 | ns | 1,2,3,5,8 |
| CLK_IN, DIF[x:0] | t _{DSPO_PLL} | Input-to-Output Skew Variation in PLL mode across voltage and temperature | -50 | | 50 | ps | 1,2,3,5,8 |
| CLK_IN, DIF[x:0] | t _{DSPO_BYP} | Input-to-Output Skew Variation 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 between two 9ZX devices in Hi BW Mode | | 2.9 | 5 | ps (rms) | 1,2,3,5,8 |
| CLK_IN, DIF[x:0] | t _{DSSTE} | Random Differential Spread Spectrum Tracking error between two 9ZX devices in Hi BW Mode | | 14 | 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) | | 32 | 65 | ps | 1,2,3,8 |
| PLL Jitter Peaking | j _{peak-hibw} | LOBW#_BYPASS_HIBW = 1 | 0 | 1.8 | 2.5 | dB | 7,8 |
| PLL Jitter Peaking | j _{peak-lobw} | LOBW#_BYPASS_HIBW = 0 | 0 | 0.7 | 2 | dB | 7,8 |
| PLL Bandwidth | pll _{HIBW} | LOBW#_BYPASS_HIBW = 1 | 2 | 3.1 | 4 | MHz | 8,9 |
| PLL Bandwidth | pll _{LOBW} | LOBW#_BYPASS_HIBW = 0 | 0.7 | 1.1 | 1.4 | MHz | 8,9 |
| Duty Cycle | t _{DC} | Measured differentially, PLL Mode | 45 | 49.6 | 55 | % | 1 |
| Duty Cycle Distortion | t _{DCD} | Measured differentially, Bypass Mode @100MHz | -2 | -0.2 | 2 | % | 1,10 |
| Jitter, Cycle to cycle | t _{jycyc-cyc} | PLL mode | | 15.7 | 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 mode.
- ¹¹ Measured from differential waveform

Electrical Characteristics - Phase Jitter ParametersT_A = T_{COM}; Supply Voltage V_{DD}/V_{DDA} = 3.3 V +/-5%

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | Notes |
|---------------------------------------|-------------------------|--------------------------------------------------------|-----|------|-----|----------|---------|
| Phase Jitter, PLL Mode | t _{jphPCIeG1} | PCIe Gen 1 | | 32 | 86 | ps (p-p) | 1,2,3 |
| | t _{jphPCIeG2} | PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz | | 0.8 | 3 | ps (rms) | 1,2 |
| | | PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz) | | 1.9 | 3.1 | ps (rms) | 1,2 |
| | t _{jphPCIeG3} | PCIe Gen 3 (PLL BW of 2-4MHz, CDR = 10MHz) | | 0.45 | 1 | ps (rms) | 1,2,4 |
| | t _{jphQPI_SMI} | QPI & SMI (100MHz or 133MHz, 4.8Gb/s, 6.4Gb/s 12UI) | | 0.20 | 0.5 | ps (rms) | 1,5 |
| | | QPI & SMI (100MHz, 8.0Gb/s, 12UI) | | 0.14 | 0.3 | ps (rms) | 1,5 |
| | | QPI & SMI (100MHz, 9.6Gb/s, 12UI) | | 0.12 | 0.2 | ps (rms) | 1,5 |
| Additive Phase Jitter, Bypass mode | t _{jphPCIeG1} | PCIe Gen 1 | | 0.10 | 10 | ps (p-p) | 1,2,3 |
| | t _{jphPCIeG2} | PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz | | 0.13 | 0.3 | ps (rms) | 1,2,6 |
| | | PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz) | | 0.10 | 0.7 | ps (rms) | 1,2,6 |
| | t _{jphPCIeG3} | PCIe Gen 3 (PLL BW of 2-4MHz, CDR = 10MHz) | | 0.10 | 0.3 | ps (rms) | 1,2,4,6 |
| | t _{jphQPI_SMI} | QPI & SMI (100MHz or 133MHz, 4.8Gb/s, 6.4Gb/s 12UI) | | 0.09 | 0.3 | ps (rms) | 1,5,6 |
| | | QPI & SMI (100MHz, 8.0Gb/s, 12UI) | | 0.09 | 0.1 | ps (rms) | 1,5,6 |
| | | QPI & SMI (100MHz, 9.6Gb/s, 12UI) | | 0.09 | 0.1 | ps (rms) | 1,5,6 |

¹ Applies to all outputs.² See <http://www.pcisig.com> for complete specs³ 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 radification by PCI SIG.⁵ Calculated from Intel-supplied Clock Jitter Tool v 1.6.4⁶ For RMS figures, additive jitter is calculated by solving the following equation: (Additive jitter)² = (total jitter)² - (input jitter)²**Power Management Table**

| Inputs | | Control Bits/Pins | | | Outputs | PLL State |
|--------------|--------------------|-------------------|---------|--------------------------|----------------------|-----------|
| CKPWRGD•/PD# | DIF_IN/ DIF_IN# | SMBus EN bit | OE# Pin | DIF(11:0)/ DIF(11:0)# | DFB_OUT/ DFB_OUT# | |
| 0 | X | X | X | Hi-Z ¹ | Hi-Z ¹ | OFF |
| 1 | Running | 0 | X | Hi-Z ¹ | Running | ON |
| | | 1 | 0 | Running | Running | ON |
| | | 1 | 1 | Hi-Z ¹ | Running | ON |

NOTE:

1. Due to external pull down resistors, HI-Z results in Low/Low on the True/Complement outputs

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 |
| | 133.33 | 7.44925 | | 7.49925 | 7.50000 | 7.50075 | | 7.55075 | ns | 1,2,4 |

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 |
| | 133.00 | 7.44930 | 7.49930 | 7.51805 | 7.51880 | 7.51955 | 7.53830 | 7.58830 | ns | 1,2,4 |

Notes:

¹Guaranteed 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/CK410B+ accuracy requirements (+/-100ppm). The 9ZX21201 itself does not contribute to ppm error.

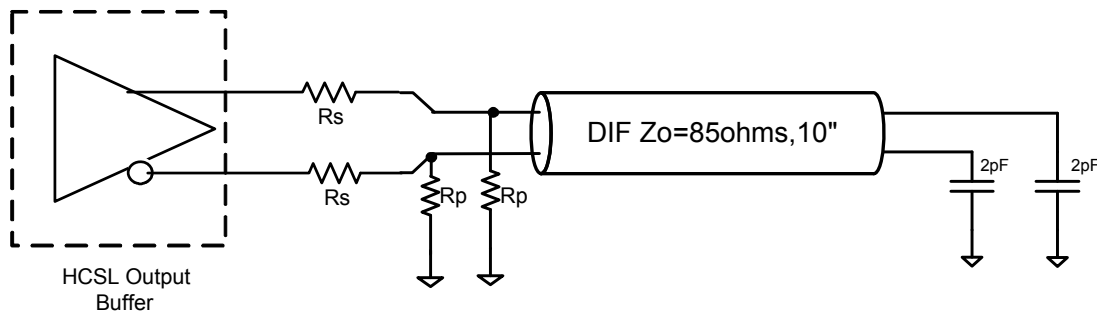
³ Driven by SRC output of main clock, 100 MHz PLL Mode or Bypass mode

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

Differential Output Termination Table

| DIF Zo (Ω) | Iref (Ω) | Rs (Ω) | Rp (Ω) |
|---------------------|-------------------|-----------------|-----------------|
| 100 | 475 | 33 | 50 |
| 85 | 412 | 27 | 42.2 or 43.2 |

9ZX21201 Differential Test Loads



General SMBus serial interface information for the 9ZX21201

How to Write:

- Controller (host) sends a start bit.
- Controller (host) sends the write address $XX_{(H)}$
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) sends the data byte count = X
- IDT clock will **acknowledge**
- Controller (host) starts sending **Byte N through Byte N + X - 1**
- IDT clock will **acknowledge** each byte **one at a time**
- Controller (host) sends a Stop bit

How to Read:

- Controller (host) will send start bit.
- Controller (host) sends the write address $XX_{(H)}$
- 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 $YY_{(H)}$
- 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 Write Operation | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------------------|
| Controller (Host) | | IDT (Slave/Receiver) |
| T | starT bit | |
| Slave Address $XX_{(H)}$ | | |
| WR | WRite | |
| Beginning Byte = N | | ACK |
| Data Byte Count = X | | ACK |
| Beginning Byte N | | ACK |
| <div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> </div> | | ACK |
| | | ◇ |
| | | ◇ |
| | | ◇ |
| Byte N + X - 1 | | ACK |
| P | stoP bit | |

Note: $XX_{(H)}$ is defined by SMBus address select pins.

| Index Block Read Operation | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|
| Controller (Host) | | IDT (Slave/Receiver) |
| T | starT bit | |
| Slave Address $XX_{(H)}$ | | |
| WR | WRite | |
| Beginning Byte = N | | ACK |
| Data Byte Count = X | | ACK |
| RT | Repeat starT | |
| Slave Address $YY_{(H)}$ | | |
| RD | ReaD | |
| ACK | | ACK |
| ACK | | Data Byte Count = X |
| <div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> </div> | | Beginning Byte N |
| | | ◇ |
| | | ◇ |
| | | ◇ |
| | | 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 | 5 | PLL Mode 1 | PLL Operating Mode Rd back 1 | R | See PLL Operating Mode Readback Table | | Latch |
| Bit 6 | 5 | PLL Mode 0 | PLL Operating Mode Rd back 0 | R | | | Latch |
| Bit 5 | | Reserved | | | | | 0 |
| Bit 4 | | Reserved | | | | | 0 |
| Bit 3 | These bits available in B rev only. | PLL_SW_EN | Enable S/W control of PLL BW | RW | HW Latch | S/W Control | 0 |
| Bit 2 | | PLL Mode 1 | PLL Operating Mode 1 | RW | See PLL Operating Mode | | 1 |
| Bit 1 | | PLL Mode 0 | PLL Operating Mode 1 | RW | Readback Table | | 1 |
| Bit 0 | 4 | 100M 133M# | Frequency Select Readback | R | 133MHz | 100MHz | Latch |

SMBusTable: Output Control Register

| Byte 1 | Pin # | Name | Control Function | Type | 0 | 1 | Default |
|--------|-------|----------|----------------------------------------|------|---------|--------|---------|
| Bit 7 | 47/46 | DIF_7_En | Output Control - '0' overrides OE# pin | RW | Low/Low | Enable | 1 |
| Bit 6 | 43/42 | DIF_6_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 5 | 39/38 | DIF_5_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 4 | 35/34 | DIF_4_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 3 | 30/31 | DIF_3_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 2 | 26/27 | DIF_2_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 1 | 21/22 | DIF_1_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 0 | 17/18 | 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 | 64/63 | DIF_11_En | Output Control - '0' overrides OE# pin | RW | Low/Low | Enable | 1 |
| Bit 2 | 59/60 | DIF_10_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 1 | 54/55 | DIF_9_En | Output Control - '0' overrides OE# pin | RW | | | 1 |
| Bit 0 | 50/51 | DIF_8_En | Output Control - '0' overrides OE# pin | RW | | | 1 |

SMBusTable: Reserved 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 | | Reserved | | | | | 0 |
| Bit 1 | | Reserved | | | | | 0 |
| Bit 0 | | Reserved | | | | | 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 | 0001 for IDT/ICS | | 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 | 1201 is 201 decimal or C9 hex | | 1 |
| Bit 6 | - | | Device ID 6 | R | | | 1 |
| Bit 5 | - | | Device ID 5 | R | | | 0 |
| Bit 4 | - | | Device ID 4 | R | | | 0 |
| Bit 3 | - | | Device ID 3 | R | | | 1 |
| 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 |

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

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

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

Figure 1: Down Device Routing

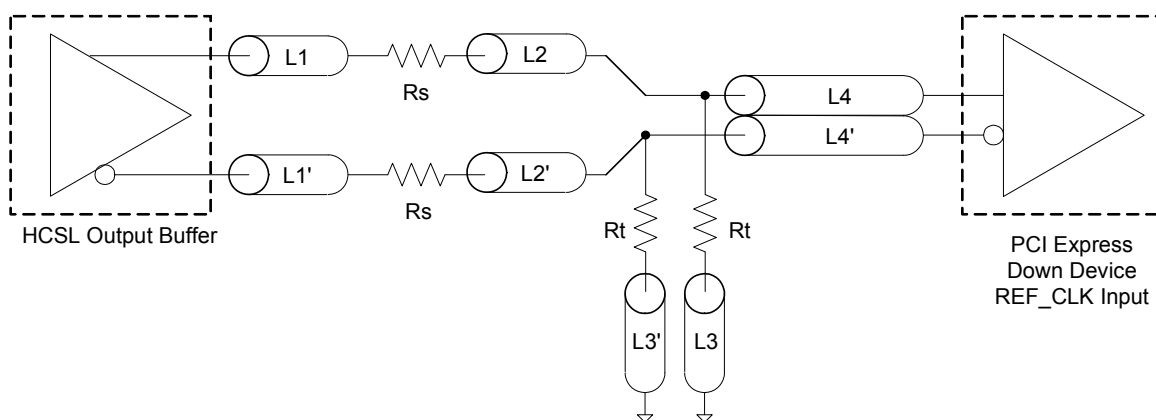
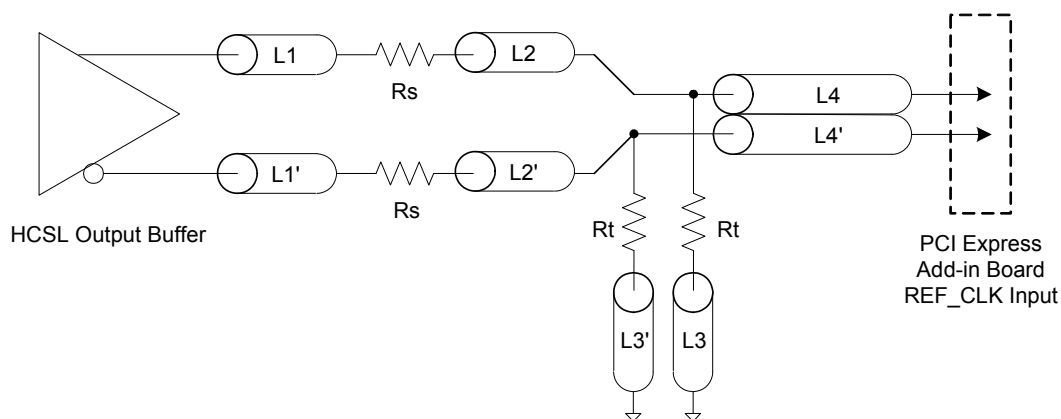


Figure 2: PCI Express Connector Routing

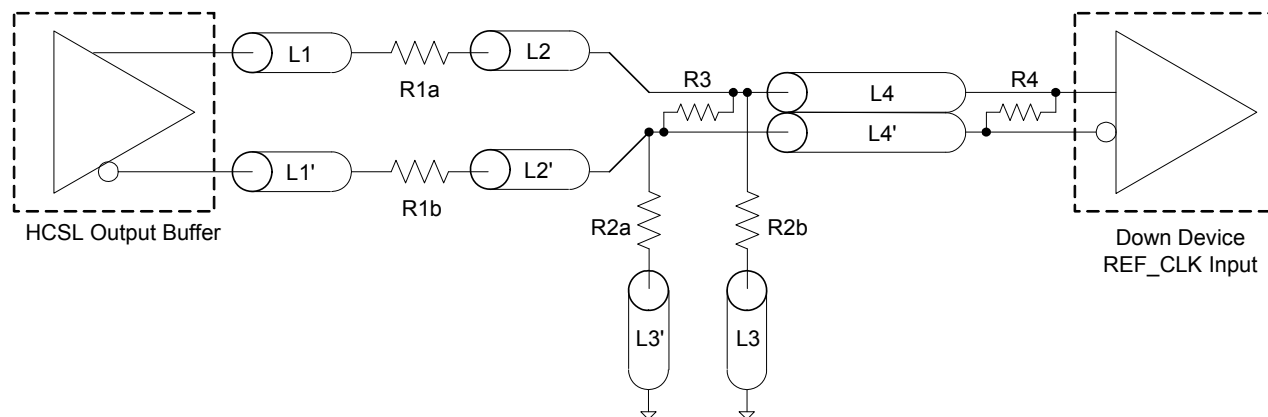


| Alternative Termination for LVDS and other Common Differential Signals (figure 3) | | | | | | | |
|-----------------------------------------------------------------------------------|------------------|-----------------|----|------|------|-----|--------------------------------|
| V _{diff} | V _{p-p} | V _{cm} | 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

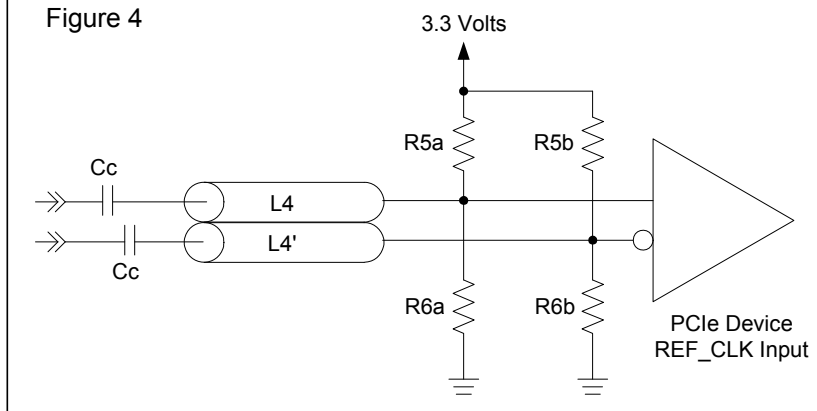
R2a = R2b = R2

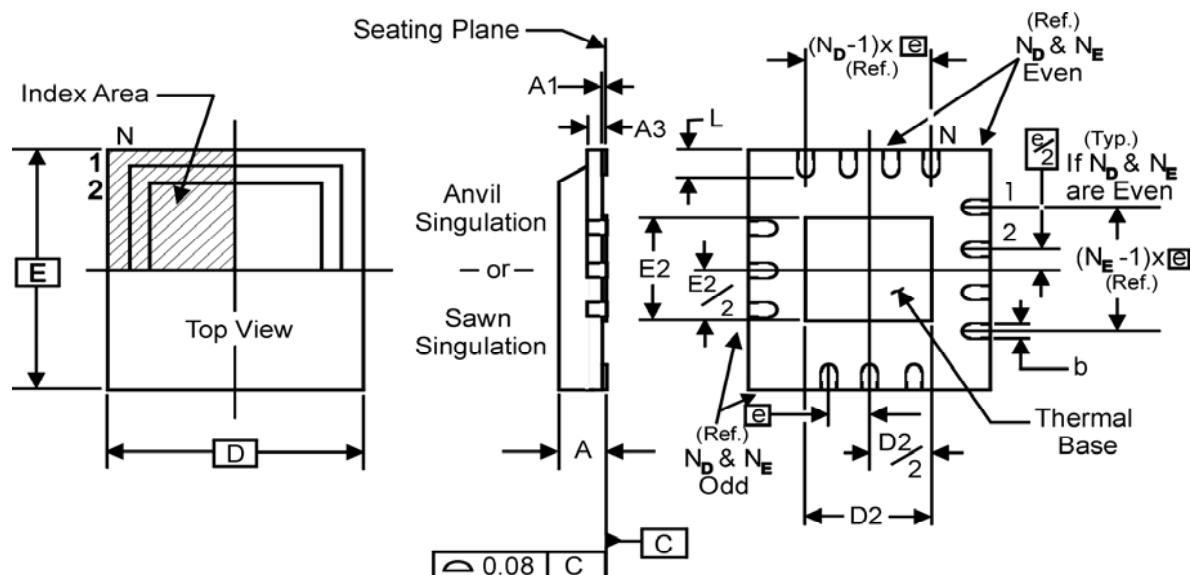
Figure 3



| Cable Connected AC Coupled Application (figure 4) | | |
|---------------------------------------------------|-------------|------|
| Component | Value | Note |
| R5a, R5b | 8.2K 5% | |
| R6a, R6b | 1K 5% | |
| Cc | 0.1 μ F | |
| V _{cm} | 0.350 volts | |

Figure 4





**THERMALLY ENHANCED, VERY THIN, FINE PITCH
QUAD FLAT / NO LEAD PLASTIC PACKAGE**

DIMENSIONS

| | |
|----------------|----|
| | |
| N | 64 |
| N _D | 16 |
| N _E | 16 |

DIMENSIONS (mm)

| 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 | 9.00 x 9.00 | |
| D2 MIN. / MAX. | 6.00 | 6.25 |
| E2 MIN. / MAX. | 6.00 | 6.25 |
| L MIN. / MAX. | 0.30 | 0.50 |

Ordering Information

| Part / Order Number | Shipping Package | Package | Temperature | Difference |
|---------------------|------------------|------------|-------------|------------------------------|
| 9ZX21201AKLF | Trays | 64-pin MLF | 0 to +70°C | W/O Byte 0 PLL Control |
| 9ZX21201AKLFT | Tape and Reel | 64-pin MLF | 0 to +70°C | |
| 9ZX21201BKLF | Trays | 64-pin MLF | 0 to +70°C | With Byte 0 PLL Mode Control |
| 9ZX21201BKLFT | Tape and Reel | 64-pin MLF | 0 to +70°C | |

"LF" designates PB-free configuration, RoHS compliant.

"A and B" are the device revision designators (will not correlate with the datasheet revision).

Revision History

| Rev. | Issuer | Issue Date | Description | Page # |
|------|--------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| A | RDW | 9/13/2011 | 1. Updated electrical tables with char data 2. Fixed minor typographical errors 3. Moved to final | Various |
| B | RDW | 12/8/2011 | 1. Added B rev functionality description to Features, Benefits 2. Updated tDSPO_BYP parameter from +/-350ps to +/-250ps 3. Updated SMBus Byte 0 with B rev functionality 4. Updated ordering information to include B rev | 1,7,11,15 |
| C | RDW | 4/18/20112 | 1. Updated Power connections table to be consistent with 9ZXL1231. 2. Updated Rp value for 85 ohm differential Zo from 43.2ohms to 42.2 OR 43.2 ohms to be consistent with Intel recommendations. | 2,9 |

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Corporate Headquarters

Integrated Device Technology, Inc.
6024 Silver Creek Valley Road
San Jose, CA 95138
United States
800 345 7015
+408 284 8200 (outside U.S.)

Asia Pacific and Japan

IDT Singapore Pte. Ltd.
1 Kallang Sector #07-01/06
KolamAyer Industrial Park
Singapore 349276
Phone: 65-6-744-3356
Fax: 65-6-744-1764

Europe

IDT Europe Limited
321 Kingston Road
Leatherhead, Surrey
KT22 7TU
England
Phone: 44-1372-363339
Fax: 44-1372-378851

