

General Description

The IDT6V31021 is a 4-output low-power differential buffer. Each output has its own OE# pin. It has a maximum operating frequency of 167 MHz and supports all SERDES clock frequencies for Freescale QorIQ CPUs.

Recommended Application

PCIe Gen1/2/3 or Ethernet Fanout Buffer, or any application requiring low additive phase jitter.

Output Features

- 4 - low power differential output pairs
- Individual OE# control of each output pair

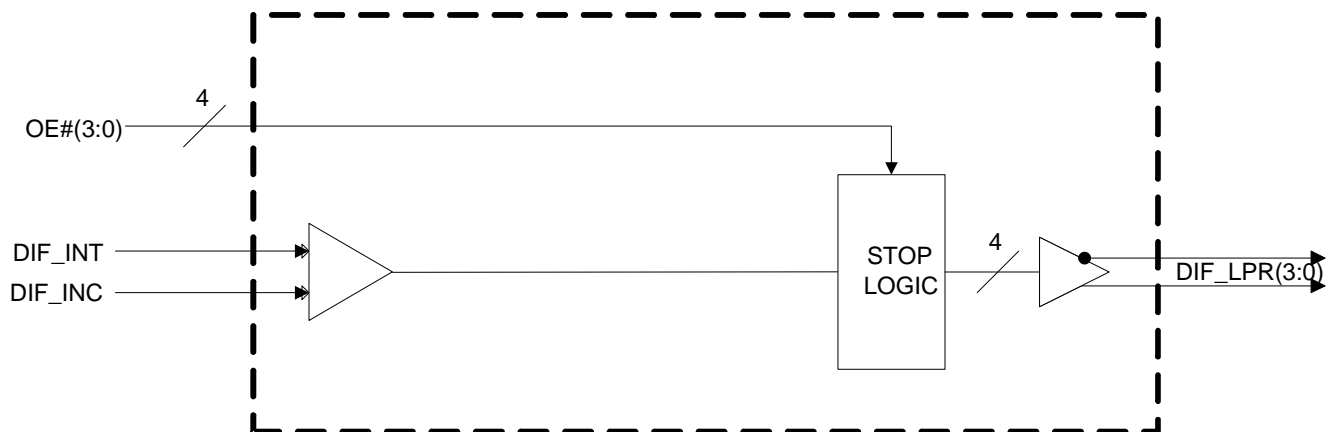
Features/Benefits

- Low power differential outputs; power efficient
- Power down mode when all OE# are high; reduces system standby power
- Industrial temperature range; can be used in demanding environments
- 20-pin MFL; space savings

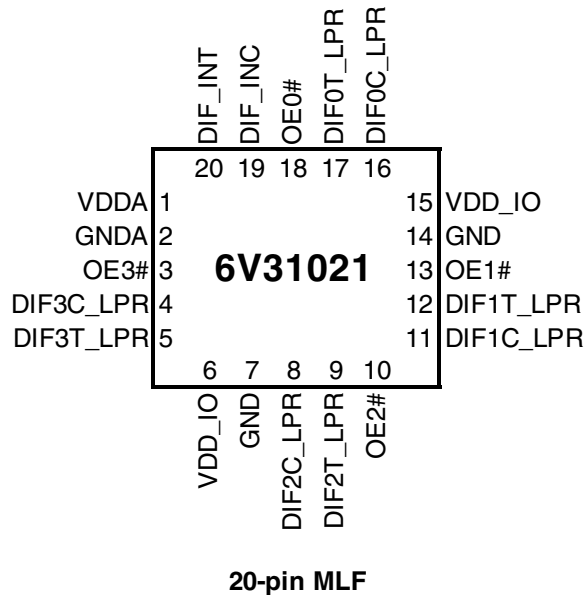
Key Specifications

- Output cycle-cycle jitter <15ps additive
- Output to Output skew: <50ps
- PCIe Gen3 additive phasejitter <0.3ps rms
- 10.3125G/64 additive phase jitter <100fs rms

Block Diagram



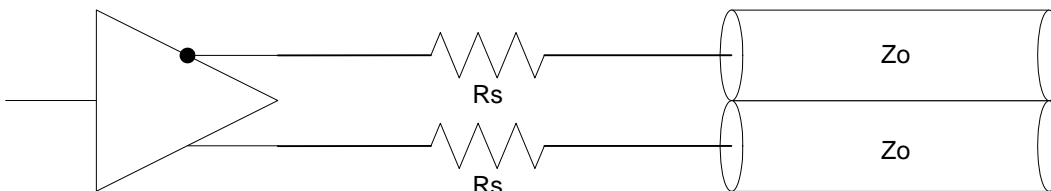
Pin Configuration



Power Connections

| Pin Number (MLF) | | Description |
|------------------|------|-----------------------|
| VDD | GND | |
| 6,15 | 7,14 | VDD_IO for DIF(3:0) |
| 1 | 2 | 3.3V Analog VDD & GND |

Terminations



$Z_o - 17 = R_s$ (ohms), where Z_o is the single-ended intrinsic impedance of the board transmission line. Single-ended intrinsic impedance is $\frac{1}{2}$ that of the differential impedance.

| Single Ended Impedance (Z_o) | R_s 5% tolerance | R_s 2% tolerance | Notes |
|----------------------------------|-----------------------|-----------------------|---|
| 50 | 33 | 33.2 | In general, 5% resistors may be used. All values are in ohms. |
| 45 | 27 | 27.4 | |
| 42.5 | 24 or 27 | 24.9 | |

Pin Descriptions

| PIN # | PIN NAME | PIN TYPE | DESCRIPTION |
|-------|-----------|----------|--|
| 1 | VDDA | PWR | 3.3V Power for the Analog Core |
| 2 | GND | GND | Ground for the Analog Core |
| 3 | OE3# | IN | Output Enable for DIF3 output. Control is as follows: 0 = enabled, 1 = Low-Low |
| 4 | DIF3C_LPR | OUT | Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 5 | DIF3T_LPR | OUT | True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 6 | VDD_IO | PWR | Power supply for low power differential outputs, nominal 1.05V to 3.3V |
| 7 | GND | GND | Ground pin |
| 8 | DIF2C_LPR | OUT | Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 9 | DIF2T_LPR | OUT | True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 10 | OE2# | IN | Output Enable for DIF2 output. Control is as follows: 0 = enabled, 1 = Low-Low |
| 11 | DIF1C_LPR | OUT | Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 12 | DIF1T_LPR | OUT | True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 13 | OE1# | IN | Output Enable for DIF1 output. Control is as follows: 0 = enabled, 1 = Low-Low |
| 14 | GND | GND | Ground pin |
| 15 | VDD_IO | PWR | Power supply for low power differential outputs, nominal 1.05V to 3.3V |
| 16 | DIF0C_LPR | OUT | Complement clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 17 | DIF0T_LPR | OUT | True clock of low power differential clock pair. (no 50ohm shunt resistor to GND needed) |
| 18 | OE0# | IN | Output Enable for DIF0 output. Control is as follows: 0 = enabled, 1 = Low-Low |
| 19 | DIF_INC | IN | Complement side of differential input clock |
| 20 | DIF_INT | IN | True side of differential input clock |

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the IDT6V31021. 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 |
|------------------------|----------------------|------------------------------|-----------------------|-----|-----|-------|-------|
| Maximum Supply Voltage | VDDA | Core Supply Voltage | | | 4.6 | V | 1,7 |
| Maximum Supply Voltage | VDD_IO | Low-Voltage Differential I/O | 0.99 | | 3.8 | V | 1,7 |
| Maximum Input Voltage | V _{IH} | 3.3V LVCMOS Inputs | | | 4.6 | V | 1,7,8 |
| Minimum Input Voltage | V _{IL} | Any Input | V _{SS} - 0.5 | | | V | 1,7 |
| Ambient Operating Temp | T _{amb} IND | Industrial Range | -40 | | 85 | °C | 1 |
| Storage Temperature | T _s | - | -65 | | 150 | °C | 1,7 |
| Input ESD protection | ESD prot | Human Body Model | 2000 | | | V | 1,7 |

Electrical Characteristics—Input/Supply/Common Output Parameters

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | Notes |
|--|-------------------------|--|-----------------------|----------|-----------------------|---------|-------|
| Supply Voltage | VDDA | Supply Voltage | 3.000 | 3.3 | 3.600 | V | 1 |
| Supply Voltage | VDD _{xx} _IO | Low-Voltage Differential I/O Supply | 0.99 | 1.05-3.3 | 3.600 | V | 1 |
| Input High Voltage | V _{IHSE} | Single-ended inputs | 2 | | V _{DD} + 0.3 | V | 1 |
| Input Low Voltage | V _{ILSE} | Single-ended inputs | V _{SS} - 0.3 | | 0.8 | V | 1 |
| Differential Input High Voltage | V _{IHDIF} | Differential inputs (single-ended measurement) | 600 | | 1.15 | V | 1 |
| Differential Input Low Voltage | V _{ILDIF} | Differential inputs (single-ended measurement) | V _{SS} - 0.3 | | 300 | V | 1 |
| Input Slew Rate - DIF_IN | dv/dt | Measured differentially | 0.4 | | 8 | V/ns | 2 |
| Input Leakage Current | I _{IN} | V _{IN} = V _{DD} , V _{IN} = GND | -5 | | 5 | uA | 1 |
| Operating Supply Current | I _{DD_3.3V} | VDDA supply current | | 15 | 20 | mA | 1 |
| | I _{DD_IO_133M} | VDD_IO supply @ fOP = 133MHz | | 12 | 20 | mA | 1 |
| Power Down Current (All OE# pins High) | I _{DD_SB_3.3V} | VDDA supply current, Input stopped, OE# pins all high | | 500 | 750 | uA | 1 |
| | I _{DD_SBIO} | VDD_IO supply, Input stopped, OE# pins all high | | 100 | 150 | uA | 1 |
| Input Frequency | F _i | V _{DD} = 3.3 V | 15 | | 167 | MHz | 2 |
| Pin Inductance | L _{pin} | | | | 7 | nH | 1 |
| Input Capacitance | C _{IN} | Logic Inputs | 1.5 | | 5 | pF | 1 |
| | C _{OUT} | Output pin capacitance | | | 6 | pF | 1 |
| OE# latency (at least one OE# is low) | T _{OE#LAT} | Number of clocks to enable or disable output from assertion/deassertion of OE# | 1 | 2 | 3 | periods | 1 |
| Clock stabilization time (from all OE# high to first OE# low). | T _{STAB} | Delay from assertion of first OE# to first clock out (assumes input clock running and device in power down state)) | | | 150 | ns | 1 |
| Tdrive_OE# | T _{DROE#} | Output enable after OE# de-assertion | | | 10 | ns | 1 |
| Tfall_OE# | T _{FALL} | Fall/rise time of OE# inputs | | | 5 | ns | 1 |
| Trise_OE# | T _{RISE} | | | | 5 | ns | 1 |

AC Electrical Characteristics–DIF Low Power Differential Outputs

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|--|-------------------------|---|------|------|------|-------------|-------|
| Rising/Falling Edge Slew Rate | t_{SLR} | Differential Measurement | 1.5 | 2.2 | 4 | V/ns | 1,2 |
| Slew Rate Variation | t_{SLVAR} | Single-ended Measurement | | 13 | 20 | % | 1 |
| Maximum Output Voltage | V_{HIGH} | Includes overshoot | | 783 | 1150 | mV | 1 |
| Minimum Output Voltage | V_{LOW} | Includes undershoot | -300 | -22 | | mV | 1 |
| Differential Voltage Swing | V_{SWING} | Differential Measurement | 1200 | | | mV | 1 |
| Crossing Point Voltage | V_{XABS} | Single-ended Measurement | 250 | 336 | 550 | mV | 1,3,4 |
| Crossing Point Variation | $V_{XABSVAR}$ | Single-ended Measurement | | 14 | 140 | mV | 1,3,5 |
| Duty Cycle Distortion | $D_{CYCDISO}$ | Differential Measurement, $f_{IN} \leq 133.33\text{MHz}$ | | 1.6 | 3 | % | 1,6 |
| Additive Cycle-to-Cycle Jitter | $DIFJ_{C2CADD}$ | Differential Measurement, Additive | | 2.1 | 7 | ps | 1 |
| DIF[3:0] Skew | DIF_{SKEW} | Differential Measurement | | 19 | 50 | ps | 1, 11 |
| Propagation Delay | t_{PD} | Input to output Delay | 2.5 | 3.3 | 3.8 | ns | 1 |
| Additive Phase Jitter - PCIe Gen1 | $t_{phase_addPCIG1}$ | 1.5MHz < 22MHz | | 1.6 | 6 | ps Pk-Pk | 1,9 |
| Additive Phase Jitter - PCIe Gen2 High Band | $t_{phase_addPCIG2HI}$ | High Band is 1.5MHz to Nyquist (50MHz) | | 0.1 | 0.3 | ps rms | 1,9 |
| Additive Phase Jitter - PCIe Gen2 Low Band | $t_{phase_addPCIG2LO}$ | Low Band is 10KHz to 1.5MHz | | 0.5 | 0.8 | ps rms | 1,9 |
| Additive Phase Jitter - PCIe Gen3 | $t_{phase_addPCIG3}$ | 2MHz - 4MHz, 2MHz - 5MHz | | 0.19 | 0.3 | ps rms | 1,9 |
| Additive Phase Jitter 161.1328125MHz = 10.3125G/64 | $t_{phase_add10G/64}$ | 12KHz to 100MHz | | 60 | 100 | fs rms | 1,10 |

Notes on Electrical Characteristics (all measurements use $R_S=33\text{ohms}/C_L=2\text{pF}$ test load):

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

² Slew rate measured through V_{swing} centered around differential zero

³ V_{xabs} is defined as the voltage where $CLK = CLK\#$

⁴ Only applies to the differential rising edge (CLK rising and CLK# falling)

⁵ Defined as the total variation of all crossing voltages of CLK rising and CLK# falling. Matching applies to rising edge rate of CLK and falling edge of CLK#. It is measured using a +/-75mV window centered on the average cross point where CLK meets CLK#.

⁶ This figure refers to the maximum distortion of the input wave form.

⁷ Operation under these conditions is neither implied, nor guaranteed.

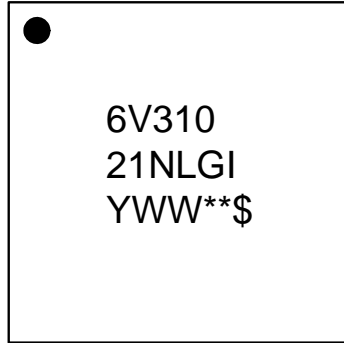
⁸ Maximum input voltage is not to exceed maximum VDD

⁹ The 6V31021 has no PLL, so the part itself contributes very little jitter to the input clock. But this also means that the 9DBL411 cannot 'de-jitter' a noisy input clock. Values calculated per PCI SIG and per Intel Clock Jitter tool version 1.6.6. For PCIe RMS figures, additive jitter is calculated by solving the following equation: Additive jitter = $\text{SQRT}[(\text{total jitter})^2 - (\text{input jitter})^2]$

¹⁰ Calculated from Agilent E5052A phase noise machine.

¹¹ Mean value not including cycle-to-cycle jitter

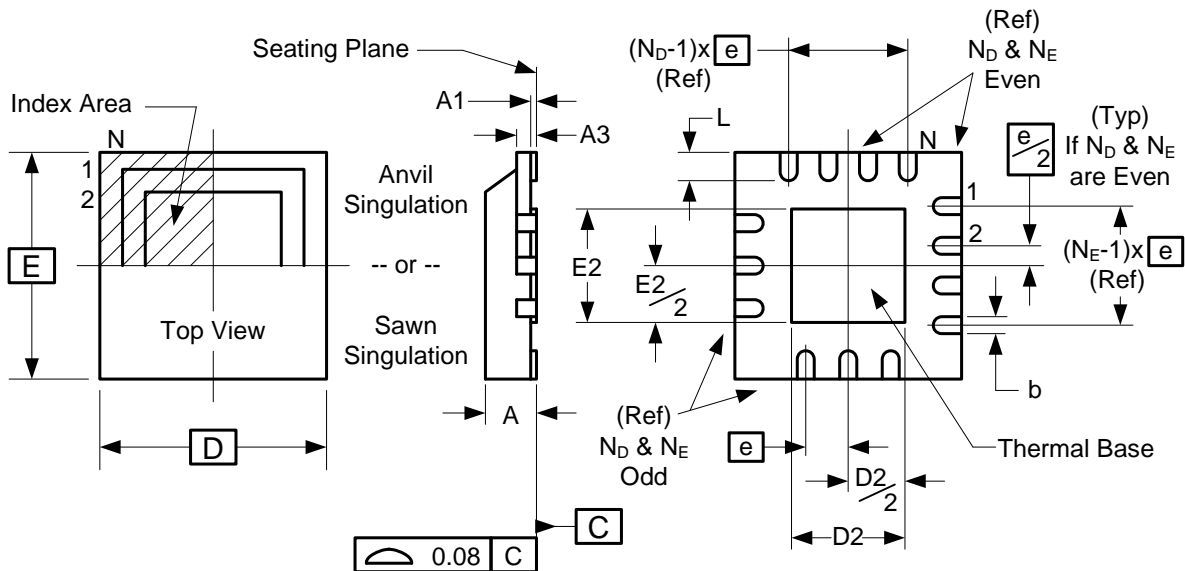
Marking Diagram



Notes:

1. '**' is the lot sequence.
2. '\$' is the mark code.
3. 'YWW' is the year and week that the part was assembled.
4. 'G' denotes RoHS compliant package.
5. 'I' denotes industrial temperature range.
6. Bottom marking: country of origin if not USA.

Package Outline and Package Dimensions (20-pin MLF)



| Symbol | Millimeters | |
|----------------|----------------|------|
| | Min | Max |
| A | 0.8 | 1.0 |
| A1 | 0 | 0.05 |
| A3 | 0.20 Reference | |
| b | 0.18 | 0.3 |
| e | 0.50 BASIC | |
| D x E BASIC | 4.00 x 4.00 | |
| D2 MIN./MAX. | 2.00 | 2.25 |
| E2 MIN./MAX. | 2.00 | 2.25 |
| L MIN./MAX. | 0.45 | 0.65 |
| N | 20 | |
| N _D | 5 | |
| N _E | 5 | |

Ordering Information

| Part / Order Number | Shipping Packaging | Package | Temperature |
|---------------------|--------------------|------------|--------------|
| 6V31021NLGI | Trays | 20-pin MLF | -40 to +85°C |
| 6V31021NLGI8 | Tape and Reel | 20-pin MLF | -40 to +85°C |

"G" after the twoletetr package code indicates Pb-Free configuration, RoHS compliant.

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Revision History

| Rev. | Originator | Issue Date | Description | Page # |
|------|------------|------------|--|--------|
| 0.1 | RDW | 10/18/2011 | Initial Release | |
| A | RDW | 12/12/2011 | 1. Updated General Description and Key Specifications 2. Added Mark Spec 3. Moved to Final | 1, 6 |
| | | | | |

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