

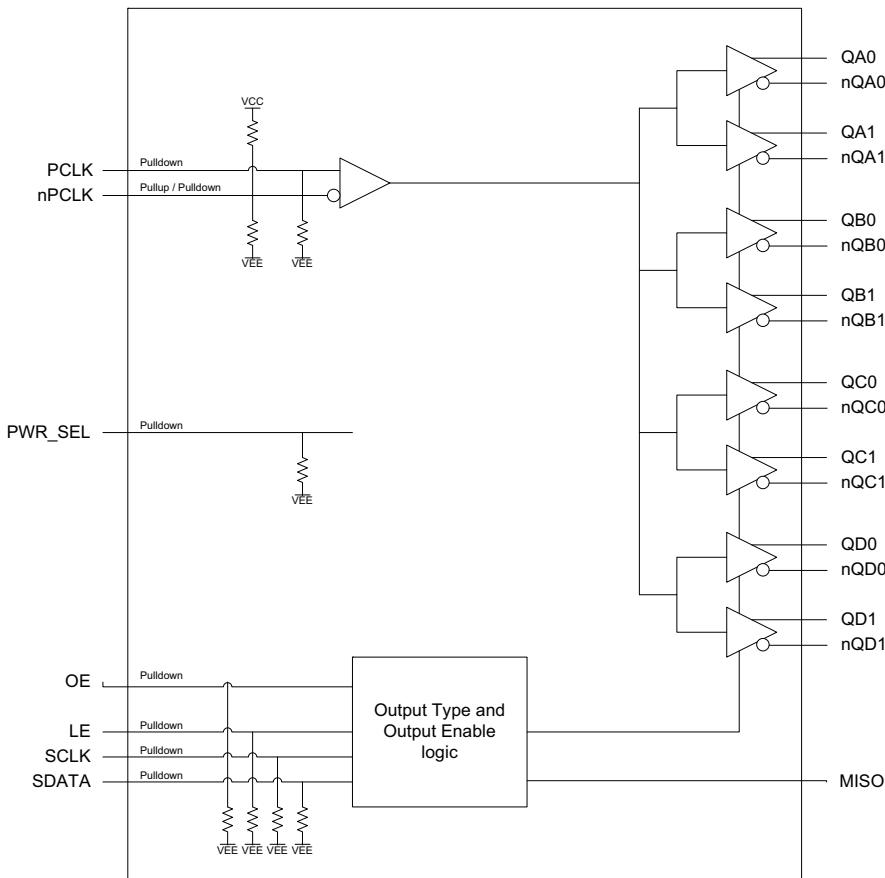
General Description

The IDT8T79S838-08I is a high performance, 1-to-8, differential input to universal output fanout buffer. The device is designed for signal fanout of high-frequency clock signals in applications requiring output frequencies generated simultaneously. The IDT8T79S838-08I is optimized for 3.3V and 2.5V supply voltages and a temperature range of -40°C to 85°C. The device is packaged in a space-saving 32 lead VFQFN package.

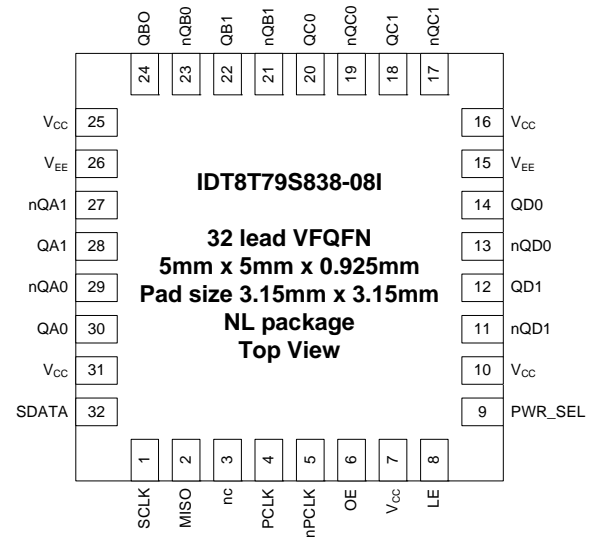
Features

- Four banks of two output pairs
- Individual output type control, LVDS or LVPECL, via serial interface
- Individual outputs remain enabled while serial loading new device configurations
- One differential PCLK, nPCLK input
- PCLK, nPCLK input pair can accept the following differential input levels: LVPECL, LVDS levels
- Maximum input frequency: 1.5GHz
- LVCMOS control inputs
- Individual output enable/disable control via serial interface
- 2.375V to 3.465V supply voltage operation
- -40°C to 85°C ambient operating temperature
- Lead-free (RoHS 6) packaging

Block Diagram



Pin Assignment



Pin Description and Pin Characteristic Tables

Table 1. Pin Descriptions

| Number | Name | Type | | Description |
|-------------------|-----------|--------|-------------------|---|
| 1 | SCLK | Input | Pulldown | Serial Control Port Mode Data Input. LVCMOS/LVTTL interface levels. |
| 2 | MISO | Output | | Serial Control Port Mode Data Output. LVCMOS/LVTTL interface levels. |
| 3 | nc | Unused | | No connect. |
| 4 | PCLK | Input | Pulldown | Non-inverting differential clock input. |
| 5 | nPCLK | Input | Pullup / Pulldown | Inverting differential clock input. $V_{CC} / 2$ by default when left floating. |
| 6 | OE | Input | Pulldown | Default output disable. LVCMOS/LVTTL interface levels. See "Table 3B. OE Truth Table". |
| 7, 10, 16, 25, 31 | V_{CC} | Power | | Power supply voltage pin. |
| 8 | LE | Input | Pulldown | Serial Control Port Mode Enable. Latches data when the pin gets a high level. Outputs remain enabled when LE is low. LVCMOS/LVTTL interface levels. |
| 9 | PWR_SEL | Input | Pulldown | Power supply selection. See "Table 3A. PWR_SEL Truth Table". |
| 11, 12 | nQD1, QD1 | Output | | Differential Bank D output pair. |
| 13, 14 | nQD0, QD0 | Output | | Differential Bank D output pair. |
| 15, 26 | V_{EE} | Power | | Negative power supply pins. |
| 17, 18 | nQC1, QC1 | Output | | Differential Bank C output pair. LVPECL or LVDS interface levels. |
| 19, 20 | nQC0, QC0 | Output | | Differential Bank C output pair. LVPECL or LVDS interface levels. |
| 21, 22 | nQB1, QB1 | Output | | Differential Bank B output pair. LVPECL or LVDS interface levels. |
| 23, 24 | nQB0, QB0 | Output | | Differential Bank B output pair. LVPECL or LVDS interface levels. |
| 27, 28 | nQA1, QA1 | Output | | Differential Bank A output pair. LVPECL or LVDS interface levels. |
| 29, 30 | nQA0, QA0 | Output | | Differential Bank A output pair. LVPECL or LVDS interface levels. |
| 32 | SDATA | Input | Pulldown | Serial Control Port Mode Data Input. LVCMOS/LVTTL interface levels. |

NOTE: Pullup and Pulldown refer to internal input resistors. See "Table 2. Pin Characteristics" for typical values.

Table 2. Pin Characteristics

| Symbol | Parameter | | Test Conditions | Minimum | Typical | Maximum | Units |
|----------------|-------------------------|------|-----------------|---------|---------|---------|------------|
| C_{IN} | Input Capacitance | | | | 2 | | pF |
| $R_{PULLDOWN}$ | Input Pulldown Resistor | | | | 51 | | k Ω |
| R_{PULLUP} | Input Pullup Resistor | | | | 51 | | k Ω |
| R_{OUT} | Output Impedance | MISO | $V_{CC} = 3.3V$ | | 125 | | Ω |
| | | | $V_{CC} = 2.5V$ | | 125 | | Ω |

Function Tables

Table 3A. PWR_SEL Truth Table

| PWR_SEL | Function |
|---------------------------------|-------------------|
| L (Connect to V _{EE}) | 2.5V power supply |
| H (Connect to V _{CC}) | 3.3V power supply |

Table 3B. OE Truth Table

| OE | Function |
|-------------|---|
| L (default) | All outputs disabled (Low/High static mode), regardless of individual OE registers set by Serial Interface. |
| H | Outputs enabled according to individual OE registers set by Serial Interface (see “ Table 3E. Configuration Table ”). |

Output Type Control and Start-up Status

Two output types are available: LVDS and LVPECL. The part features four modes of output type control:

- Eight LVDS outputs
- Eight LVPECL outputs
- Two LVDS (QAx) + six LVPECL (QBx, QCx, QDx)
- Two LVPECL (QAx) + six LVDS (QBx, QCx, QDx)

At startup, the outputs are in static Low/High LVDS mode until the part has been configured. Disabled outputs are in static Low/High mode. A global hardware Output Enable (OE pin #6) enables or disables all outputs at once. The global hardware OE has priority over a serial interface configuration.

Table 3C. Output Type Control

| Control Bits | | Output Configuration |
|--------------|------|---|
| D2 | D1 | |
| LOW | LOW | 8 LVDS Outputs |
| HIGH | HIGH | 8 LVPECL Outputs |
| HIGH | LOW | 2 LVDS (QAx) + 6 LVPECL (QBx, QCx, QDx) Outputs |
| LOW | HIGH | 2 LVPECL (QAx) + 6 LVDS (QBx, QCx, QDx) Outputs |

Serial Interface

Configuration of the IDT8T79S838I-08 is achieved by writing 10 configuration bits over serial interface. All 10 bits have to be written in sequence.

After writing the 10 configuration bits, the LE pin must remain at high level for outputs to toggle.

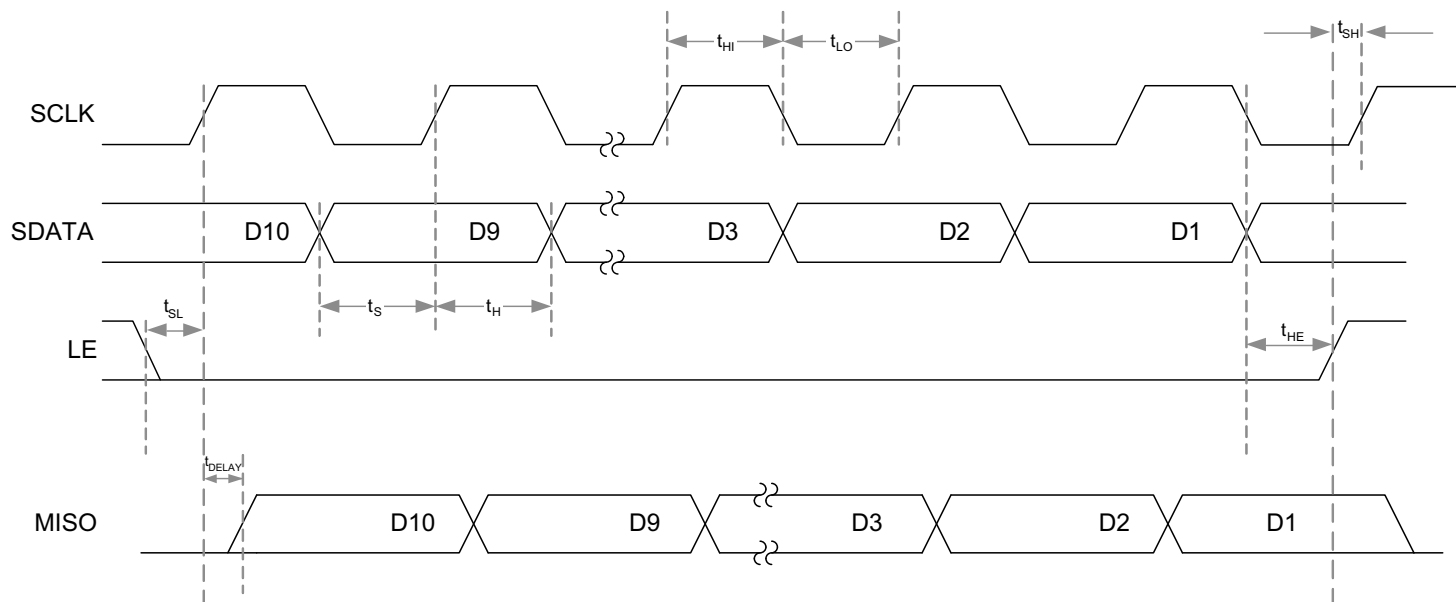


Figure 1. Serial Interface Timing Diagram for Write and Read Access

Table 3D. Timing AC Characteristics

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-------------|--------------------------|-----------------|---------|---------|---------|-------|
| t_S | Data to Clock Setup Time | | 10 | | | ns |
| t_H | Data to Clock Hold Time | | 10 | | | ns |
| t_{HE} | Clock to LE Hold Time | | 10 | | | ns |
| t_{HI} | Clock High Duration | | 25 | | | ns |
| t_{LO} | Clock Low Duration | | 25 | | | ns |
| t_{SL} | LE to Clock Setup Time | | 10 | | | ns |
| t_{SH} | LE to SCLK Setup Time | | 10 | | | ns |
| t_{DELAY} | Clock to MISO Delay Time | | | | 10 | ns |

NOTE: Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500 lpm. The device will meet specifications after thermal equilibrium has been reached under these conditions.

Table 3E. Configuration Table

| Bit | Name | Function | Truth Table |
|-----|------|------------------------------|--------------------------------|
| D10 | oed1 | Output Enable QD1 | Low: Disabled High: Enabled |
| D9 | oed0 | Output Enable QD0 | |
| D8 | oec1 | Output Enable QC1 | |
| D7 | oec0 | Output Enable QC0 | |
| D6 | oeb1 | Output Enable QB1 | |
| D5 | oeb0 | Output Enable QB0 | |
| D4 | oea1 | Output Enable QA1 | |
| D3 | oea0 | Output Enable QA0 | |
| D2 | ot1 | Banks QB, QC, QD Output Type | Low: LVDS High: LVPECL |
| D1 | ot0 | Bank QA Output Type | |

Absolute Maximum Ratings

NOTE: Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics* or *AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

| Item | Rating |
|--|--------------------------|
| Supply Voltage, V_{CC} | 4.6V |
| Inputs, V_I | -0.5V to $V_{CC} + 0.5V$ |
| Outputs, V_O (LVCMOS) | -0.5V to $V_{CC} + 0.5V$ |
| Outputs, I_O (LVPECL) Continuous Current Surge Current | 50mA 100mA |
| Outputs, I_O (LVDS) Continuous Current Surge Current | 10mA 15mA |
| Package Thermal Impedance, θ_{JA} | 48.9°C/W (0 mps) |
| Storage Temperature, T_{STG} | -65°C to 150°C |

DC Electrical Characteristics

Table 4A. Power Supply DC Characteristics, $V_{CC} = 3.3V \pm 5\%$, $V_{EE} = 0V$, $T_A = -40^\circ C$ to $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|----------------------|------------------------------------|---------|---------|---------|-------|
| V_{CC} | Power Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| I_{EE} | Power Supply Current | D[10:1] = HIGH, LVPECL | | 120 | 135 | mA |
| I_{CC} | Power Supply Current | D[10:3] = HIGH; D[2:1] = LOW, LVDS | | 215 | 235 | mA |

Table 4B. Power Supply DC Characteristics, $V_{CC} = 2.5V \pm 5\%$, $V_{EE} = 0V$, $T_A = -40^\circ C$ to $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|----------------------|------------------------------------|---------|---------|---------|-------|
| V_{CC} | Power Supply Voltage | | 2.375 | 2.5 | 2.625 | V |
| I_{EE} | Power Supply Current | D[10:1] = HIGH, LVPECL | | 114 | 125 | mA |
| I_{CC} | Power Supply Current | D[10:3] = HIGH; D[2:1] = LOW, LVDS | | 210 | 230 | mA |

Table 4C. LVCMOS/LVTTL DC Characteristics, $V_{CC} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$, $V_{EE} = 0V$, $T_A = -40^\circ C$ to $85^\circ C$

| Symbol | Parameter | | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|---------------------|------------------------------|--|---------|---------|----------------|---------|
| V_{IH} | Input High Voltage | | $V_{CC} = 3.3V$ | 2.2 | | $V_{CC} + 0.3$ | V |
| | | | $V_{CC} = 2.5V$ | 1.7 | | $V_{CC} + 0.3$ | V |
| V_{IL} | Input Low Voltage | | $V_{CC} = 3.3V$ | -0.3 | | 0.8 | V |
| | | | $V_{CC} = 2.5V$ | -0.3 | | 0.7 | V |
| I_{IH} | Input High Current | OE, LE, PWR_SEL, SCLK, SDATA | $V_{CC} = V_{IN} = 3.465V$ or $2.625V$ | | | 150 | μA |
| I_{IL} | Input Low Current | OE, LE, PWR_SEL, SCLK, SDATA | $V_{CC} = 3.465V$ or $2.625V$, $V_{IN} = 0V$ | -10 | | | μA |
| V_{OH} | Output High Voltage | MISO | $V_{CC} = 3.465V$, $I_{OH} = -1mA$ | 2.6 | | | V |
| | | | $V_{CC} = 2.625V$, $I_{OH} = -1mA$ | 1.8 | | | V |
| V_{OL} | Output Low Voltage | MISO | $V_{CC} = 3.465V$ or $2.625V$, $I_{OL} = 1mA$ | | | 0.5 | V |

Table 4D. Differential Input DC Characteristics, $V_{CC} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$, $V_{EE} = 0V$, $T_A = -40^\circ C$ to $85^\circ C$

| Symbol | Parameter | | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------------------|-------------|---|---------|---------|----------------|---------|
| I_{IH} | Input High Current | PCLK, nPCLK | $V_{CC} = V_{IN} = 3.465V$ or $2.625V$ | | | 150 | μA |
| I_{IL} | Input Low Current | PCLK | $V_{CC} = 3.465V$ or $2.625V$, $V_{IN} = 0V$ | -10 | | | μA |
| | | nPCLK | $V_{CC} = 3.465V$ or $2.625V$, $V_{IN} = 0V$ | -150 | | | μA |
| V_{PP} | Peak-to-Peak Voltage | | | 0.15 | | 1.3 | V |
| V_{CMR} | Common Mode Input Voltage; NOTE 1 | | | 1.0 | | $V_{CC} - 0.5$ | V |

NOTE 1: Common mode input voltage is defined at the cross point.

Table 4E. LVPECL DC Characteristics, $V_{CC} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$, $V_{EE} = 0V$, $T_A = -40^\circ C$ to $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-------------|-----------------------------------|-----------------|----------------|---------|-----------------|-------|
| V_{OH} | Output High Voltage; NOTE 1 | | $V_{CC} - 1.3$ | | $V_{CC} - 0.75$ | V |
| V_{OL} | Output Low Voltage; NOTE 1 | | $V_{CC} - 2.0$ | | $V_{CC} - 1.6$ | V |
| V_{SWING} | Peak-to-Peak Output Voltage Swing | | 0.6 | | 1.0 | V |

NOTE 1: Outputs terminated with 50Ω to $V_{CC} - 2V$.

Table 4F. LVDS DC Characteristics, $V_{CC} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$, $V_{EE} = 0V$, $T_A = -40^\circ C$ to $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------------|-----------------------------|-----------------|---------|---------|---------|-------|
| V_{OD} | Differential Output Voltage | | 247 | | 454 | mV |
| ΔV_{OD} | V_{OD} Magnitude Change | | | | 50 | mV |
| V_{OS} | Offset Voltage | | 1.125 | | 1.45 | V |
| ΔV_{OS} | V_{OS} Magnitude Change | | | | 50 | mV |

AC Electrical Characteristics

Table 5. AC Characteristics, $V_{CC} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$, $V_{EE} = 0V$, $T_A = -40^\circ C$ to $85^\circ C$

| Symbol | Parameter | | Test Conditions | Minimum | Typical | Maximum | Units |
|--------------|---------------------------------|----------------|-----------------|---------|---------|---------|-------|
| f_{IN} | Input Frequency | PCLK, nPCLK | | | | 1.5 | GHz |
| f_{OUT} | Output Frequency | Qx, nQx | | | | 1.5 | GHz |
| t_{PD} | Propagation Delay; NOTE 5 | LVPECL | | 200 | | 650 | ps |
| | | LVDS | | 200 | | 650 | ps |
| $t_{sk(o)}$ | Output Skew; NOTE 1, 2 | LVPECL | | | | 80 | ps |
| | | LVDS | | | | 80 | ps |
| $t_{sk(b)}$ | Bank Skew; NOTE 1, 3 | LVPECL | | | | 55 | ps |
| | | LVDS | | | | 55 | ps |
| $t_{sk(pp)}$ | Part-to-Part Skew; NOTE 1, 4 | LVPECL | | | | 450 | ps |
| | | LVDS | | | | 450 | ps |
| t_R / t_F | Output Rise/Fall Time | LVPECL | 20% to 80% | 50 | | 300 | ps |
| | | LVDS | 20% to 80% | 50 | | 300 | ps |
| odc | Output Duty Cycle | LVPECL | | 40 | | 60 | % |
| | | LVDS | | 40 | | 60 | % |

NOTE: Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500 lpm. The device will meet specifications after thermal equilibrium has been reached under these conditions.

NOTE 1: This parameter is defined in accordance with JEDEC Standard 65.

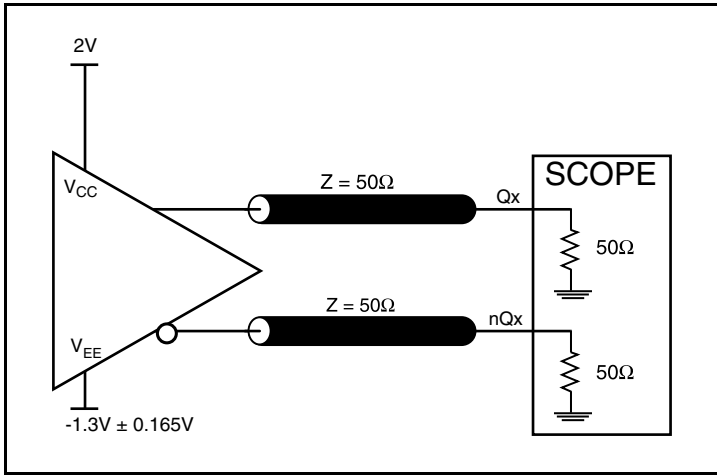
NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at the differential crosspoints.

NOTE 3: Defined as skew within a bank of outputs at the same voltage and with equal load conditions.

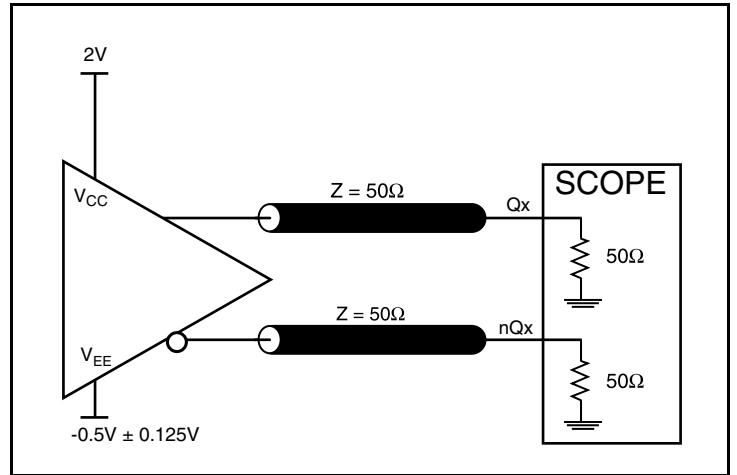
NOTE 4: Defined as skew between outputs on different devices operating at the same supply voltage, same frequency, same temperature and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential crosspoints.

NOTE 5: Measured from the differential input crosspoint to the differential output crosspoint.

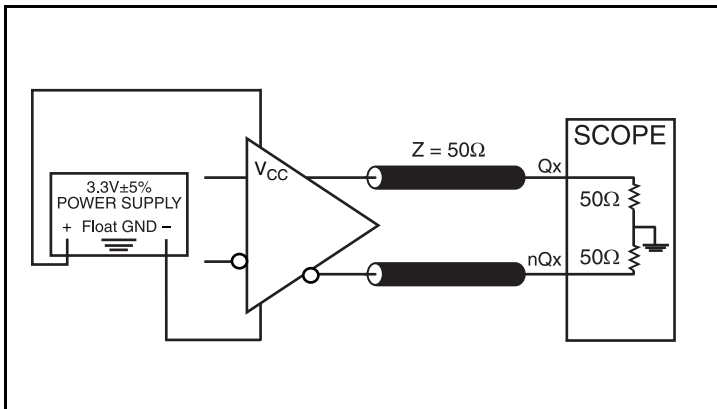
Parameter Measurement Information



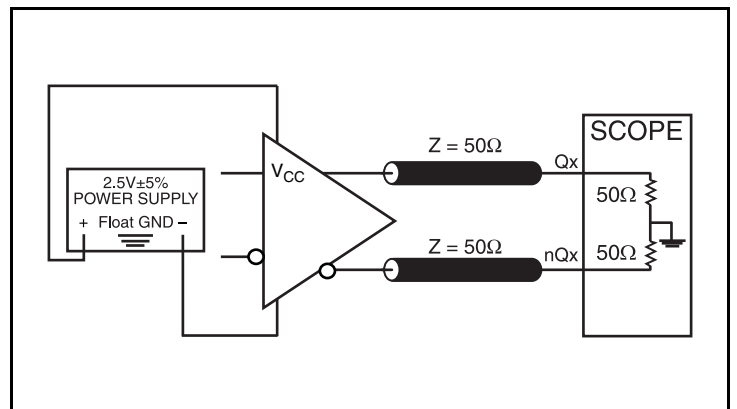
3.3V LVPECL Output Load Test Circuit



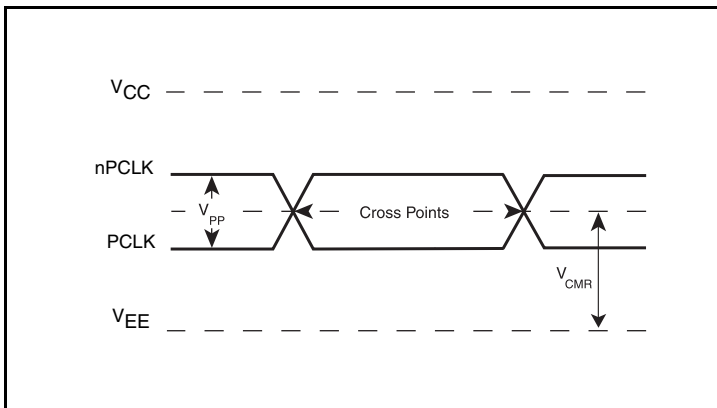
2.5V LVPECL Output Load Test Circuit



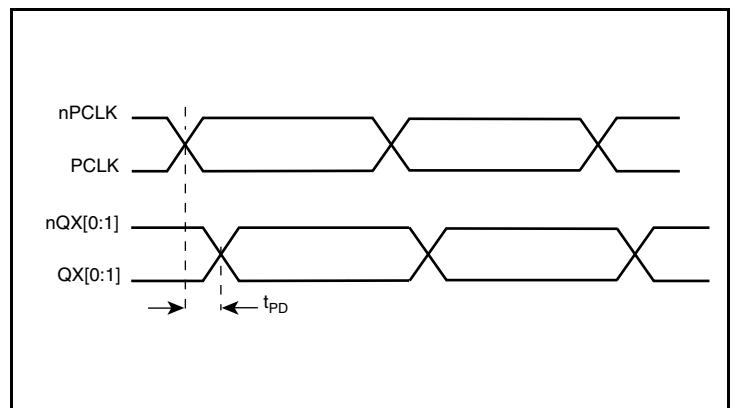
3.3V LVDS Output Load Test Circuit



2.5V LVDS Output Load Test Circuit

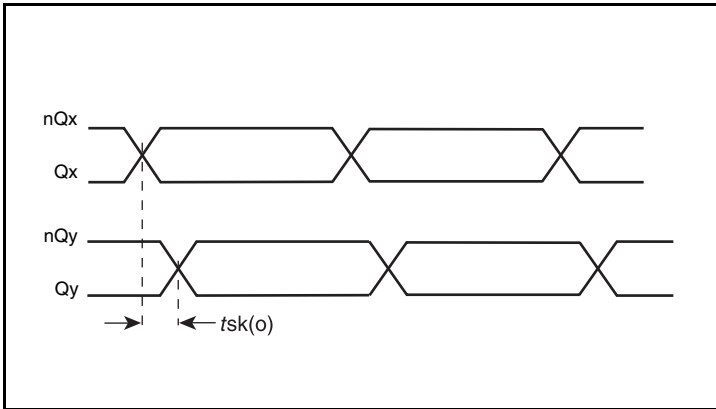


Differential Input Levels

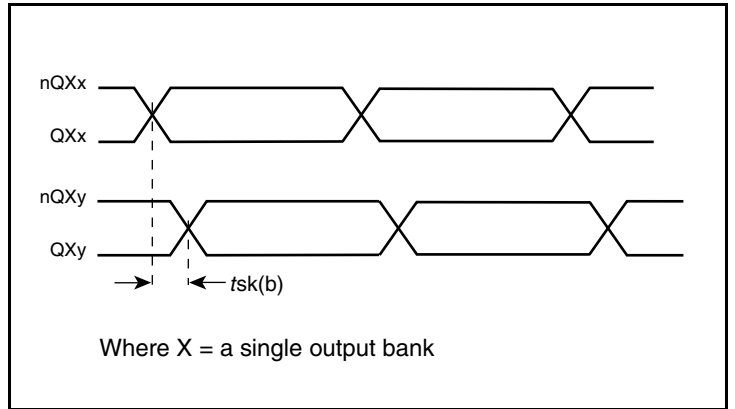


Propagation Delay

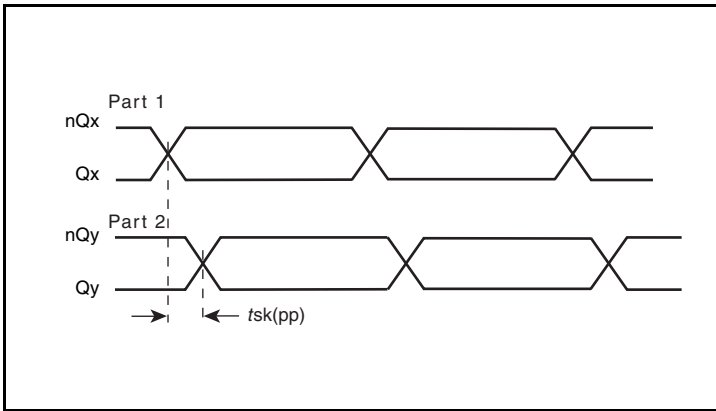
Parameter Measurement Information, continued



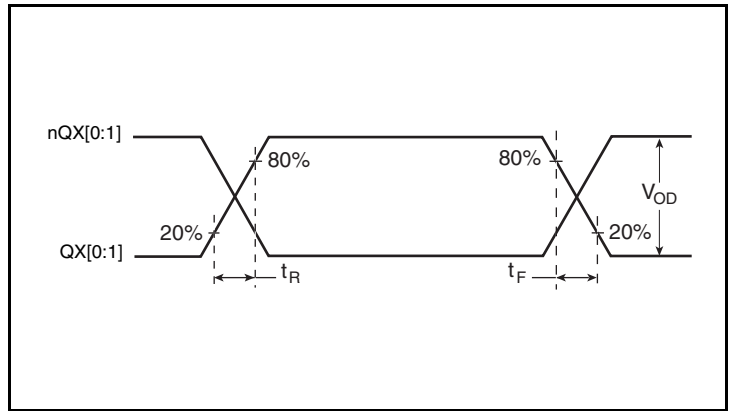
Output Skew



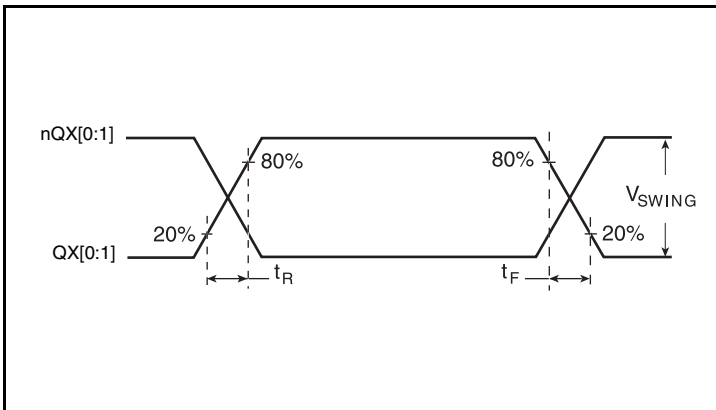
Bank Skew



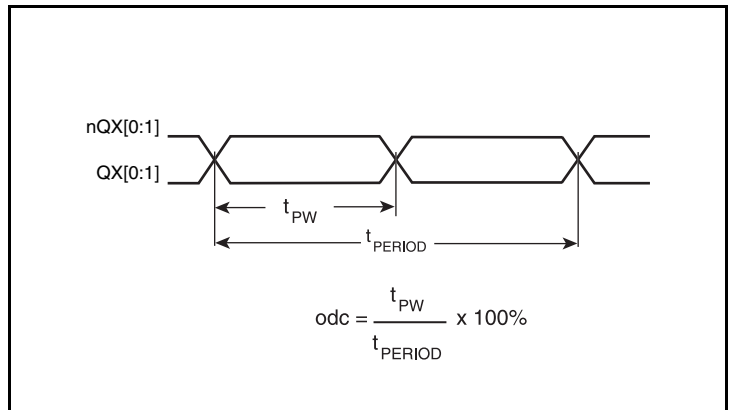
Part-to-Part Skew



LVDS Output Rise/Fall Time

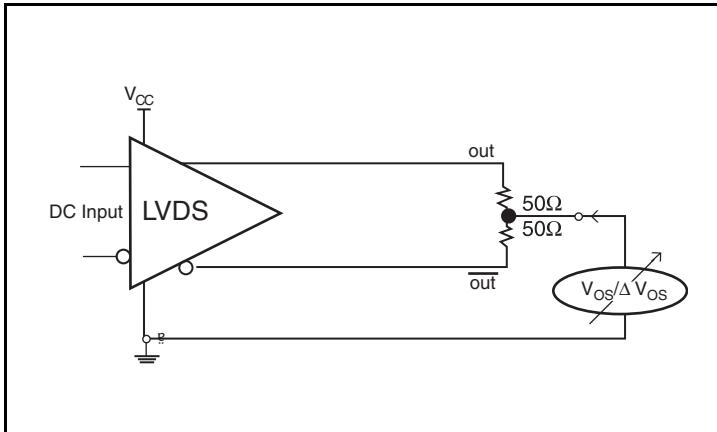


LVPECL Output Rise/Fall Time

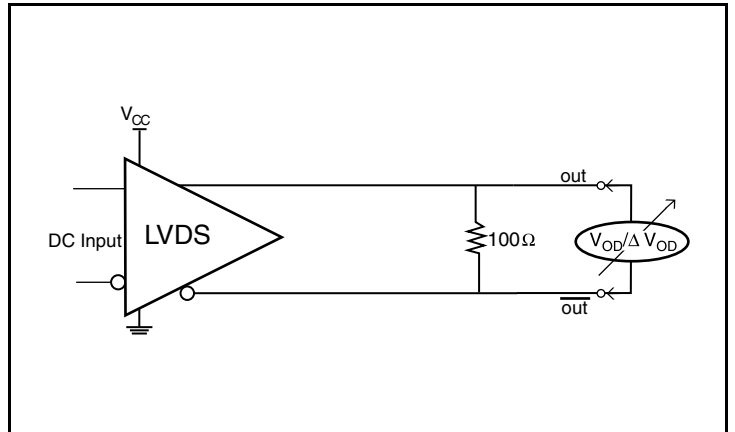


Output Duty Cycle/Pulse Width/Period

Parameter Measurement Information, continued



Offset Voltage Setup



Differential Output Voltage Setup

Applications Information

Recommendations for Unused Input and Output Pins

Inputs:

LVC MOS Control Pins

All control pins have internal pulldowns; additional resistance is not required but can be added for additional protection. A $1k\Omega$ resistor can be used.

Outputs:

LVPECL Outputs

Any unused LVPECL output pairs can be left floating. We recommend that there is no trace attached. Both sides of the differential output pair should either be left floating or terminated.

LVDS Outputs

All unused LVDS output pairs can be either left floating or terminated with 100Ω across. If they are left floating, there should be no trace attached.

LVC MOS Outputs

The unused LVC MOS output can be left floating. There should be no trace attached.

Wiring the Differential Input to Accept Single-Ended Levels

Figure 2 shows how a differential input can be wired to accept single ended levels. The reference voltage $V_1 = V_{CC}/2$ is generated by the bias resistors R1 and R2. The bypass capacitor (C1) is used to help filter noise on the DC bias. This bias circuit should be located as close to the input pin as possible. The ratio of R1 and R2 might need to be adjusted to position the V_1 in the center of the input voltage swing. For example, if the input clock swing is 2.5V and $V_{CC} = 3.3V$, R1 and R2 value should be adjusted to set V_1 at 1.25V. The values below are for when both the single ended swing and V_{CC} are at the same voltage. This configuration requires that the sum of the output impedance of the driver (R_o) and the series resistance (R_s) equals the transmission line impedance. In addition, matched termination at the input will attenuate the signal in half. This can be done in one of two ways. First, R3 and R4 in parallel should equal the transmission line impedance.

For most 50Ω applications, R3 and R4 can be 100Ω. The values of the resistors can be increased to reduce the loading for slower and weaker LVCMOS driver. When using single-ended signaling, the noise rejection benefits of differential signaling are reduced. Even though the differential input can handle full rail LVCMOS signaling, it is recommended that the amplitude be reduced. The datasheet specifies a lower differential amplitude, however this only applies to differential signals. For single-ended applications, the swing can be larger, however V_{IL} cannot be less than -0.3V and V_{IH} cannot be more than $V_{CC} + 0.3V$. Though some of the recommended components might not be used, the pads should be placed in the layout. They can be utilized for debugging purposes. The datasheet specifications are characterized and guaranteed by using a differential signal.

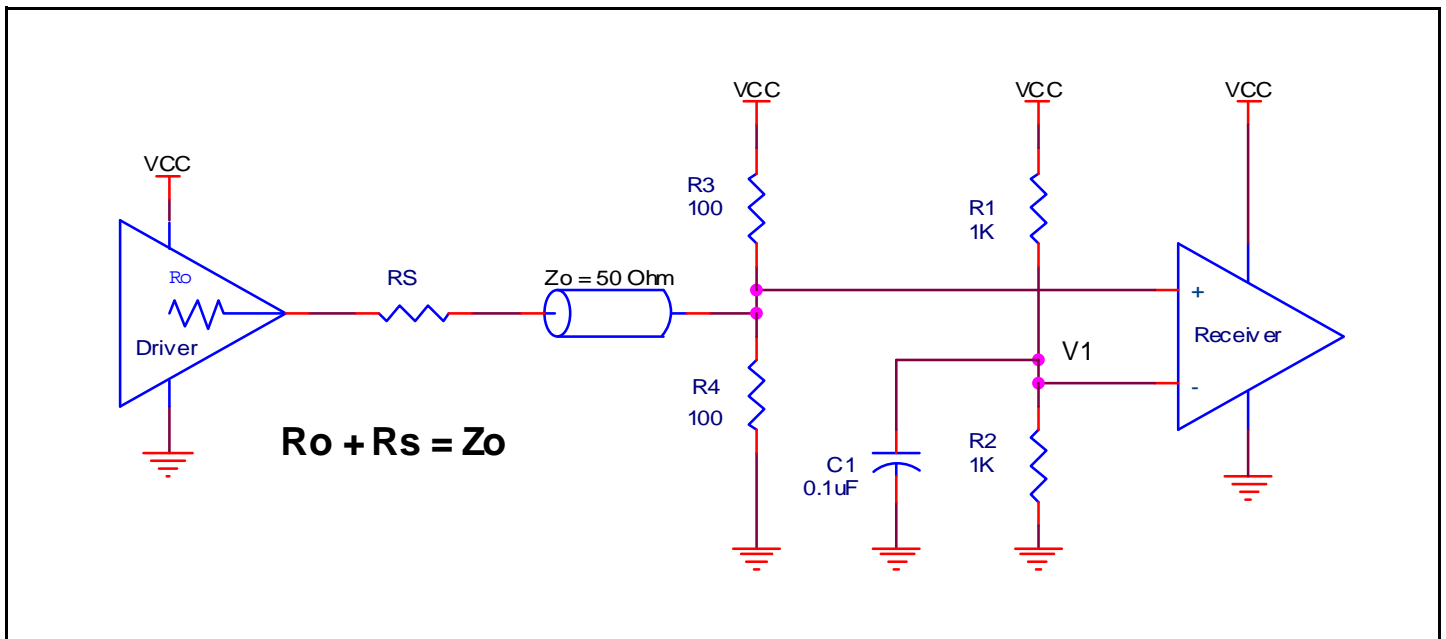


Figure 2. Recommended Schematic for Wiring a Differential Input to Accept Single-ended Levels

3.3V LVPECL Clock Input Interface

The PCLK/nPCLK accepts LVPECL, LVDS and other differential signals. Both V_{SWING} and V_{OH} must meet the V_{PP} and V_{CMR} input requirements. Figures 3A to 3C show interface examples for the PCLK/nPCLK input driven by the most common driver types. The input in-

terfaces suggested here are examples only. If the driver is from another vendor, use their termination recommendation. Please consult with the vendor of the driver component to confirm the driver termination requirements.

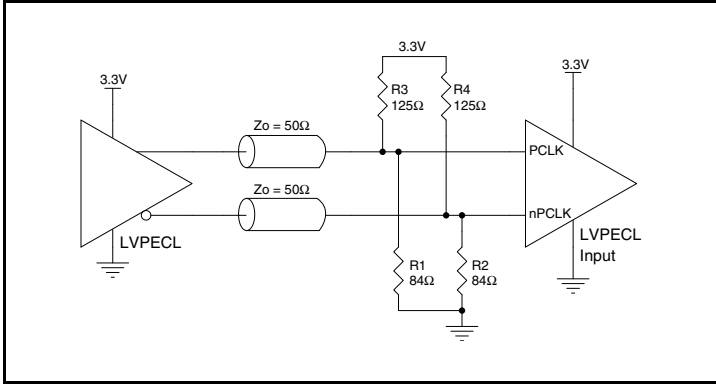


Figure 3A. PCLK/nPCLK Input Driven by a 3.3V LVPECL Driver

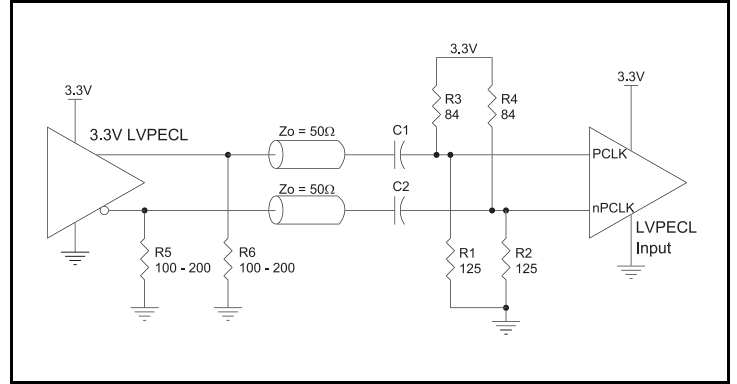


Figure 3B. PCLK/nPCLK Input Driven by a 3.3V LVPECL Driver with AC Couple

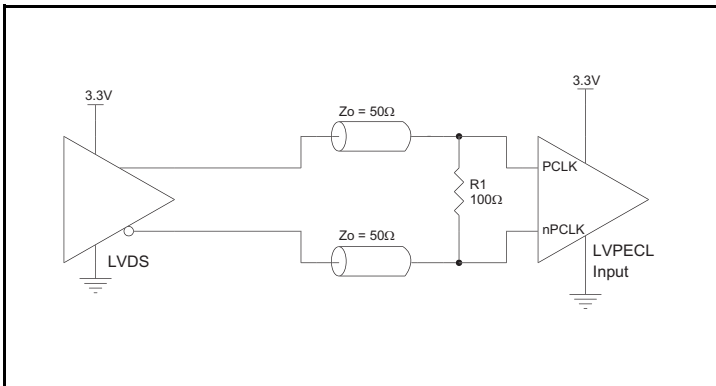


Figure 3C. PCLK/nPCLK Input Driven by a 3.3V LVDS Driver

2.5V LVPECL Clock Input Interface

The PCLK /nPCLK accepts LVPECL, LVDS and other differential signals. Both V_{SWING} and V_{OH} must meet the V_{PP} and V_{CMR} input requirements. *Figures 4A to 4C* show interface examples for the PCLK/nPCLK input driven by the most common driver types. The input in-

terfaces suggested here are examples only. If the driver is from another vendor, use their termination recommendation. Please consult with the vendor of the driver component to confirm the driver termination requirements.

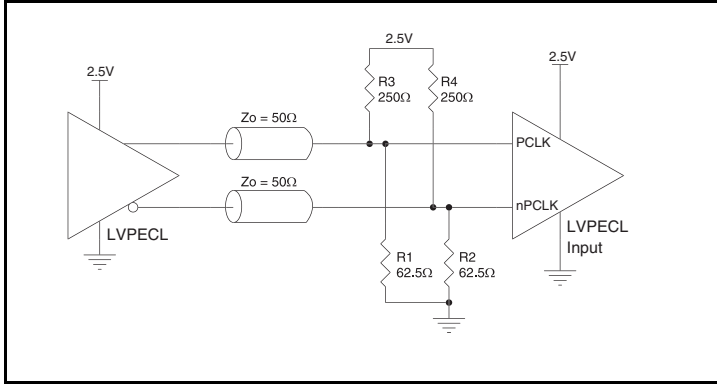


Figure 4A. PCLK/nPCLK Input Driven by a 2.5V LVPECL Driver

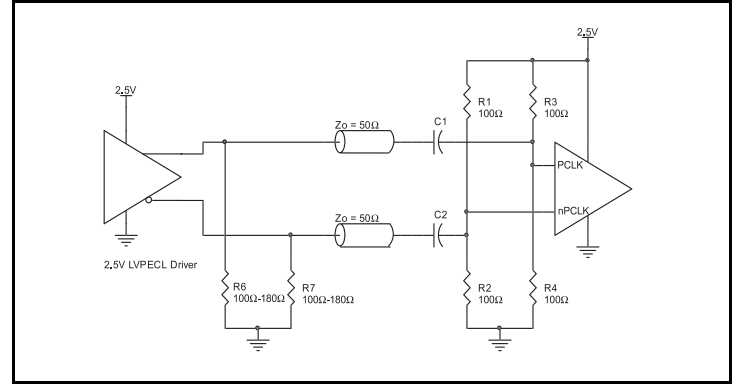


Figure 4B. PCLK/nPCLK Input Driven by a 2.5V LVPECL Driver with AC Couple

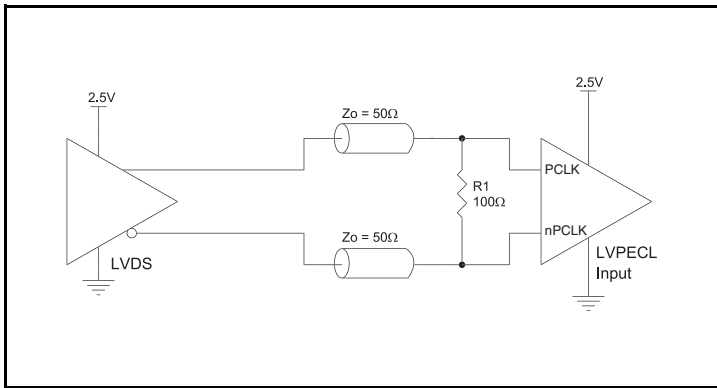
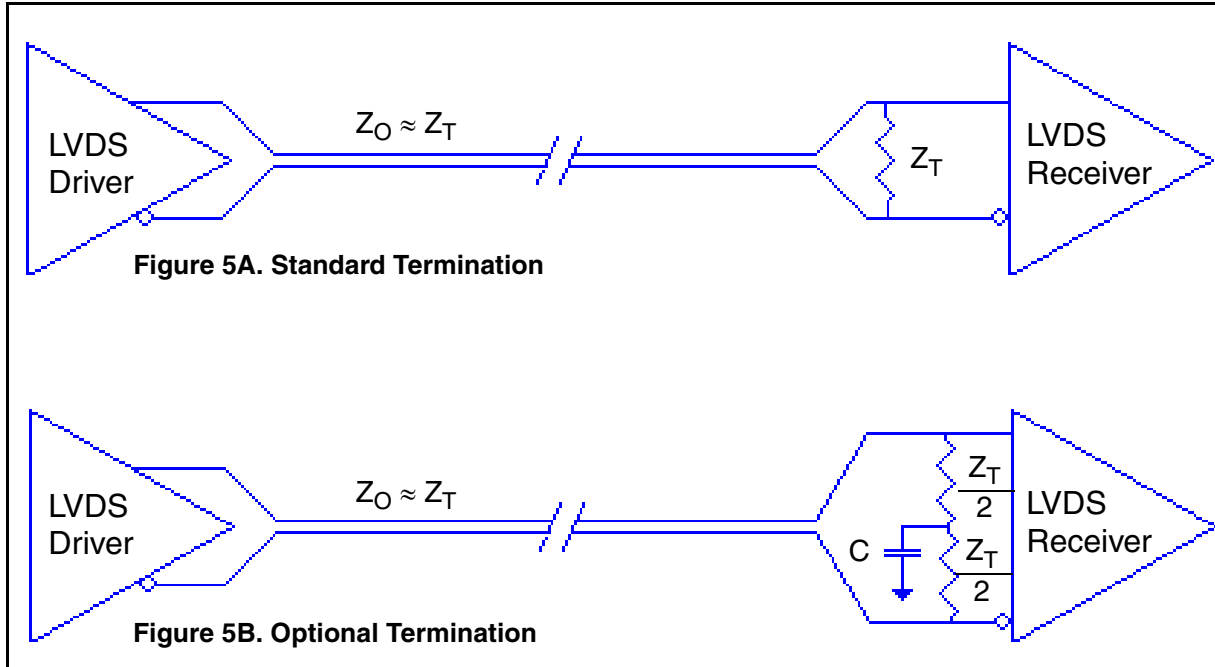


Figure 4C. PCLK/nPCLK Input Driven by a 2.5V LVDS Driver

LVDS Driver Termination

For a general LVDS interface, the recommended value for the termination impedance (Z_T) is between 90Ω and 132Ω . The actual value should be selected to match the differential impedance (Z_0) of your transmission line. A typical point-to-point LVDS design uses a 100Ω parallel resistor at the receiver and a 100Ω differential transmission-line environment. In order to avoid any transmission-line reflection issues, the components should be surface mounted and must be placed as close to the receiver as possible. IDT offers a full line of LVDS compliant devices with two types of output structures: current source and voltage source. The

standard termination schematic as shown in *Figure 5A* can be used with either type of output structure. *Figure 5B*, which can also be used with both output types, is an optional termination with center tap capacitance to help filter common mode noise. The capacitor value should be approximately 50pF . If using a non-standard termination, it is recommended to contact IDT and confirm if the output structure is current source or voltage source type. In addition, since these outputs are LVDS compatible, the input receiver's amplitude and common-mode input range should be verified for compatibility with the output.



LVDS Termination

Termination for 3.3V LVPECL Outputs

The clock layout topology shown below is a typical termination for LVPECL outputs. The two different layouts mentioned are recommended only as guidelines.

The differential outputs are low impedance follower outputs that generate ECL/LVPECL compatible outputs. Therefore, terminating resistors (DC current path to ground) or current sources must be used for

functionality. These outputs are designed to drive 50Ω transmission lines. Matched impedance techniques should be used to maximize operating frequency and minimize signal distortion. *Figures 6A and 6B* show two different layouts which are recommended only as guidelines. Other suitable clock layouts may exist and it would be recommended that the board designers simulate to guarantee compatibility across all printed circuit and clock component process variations.

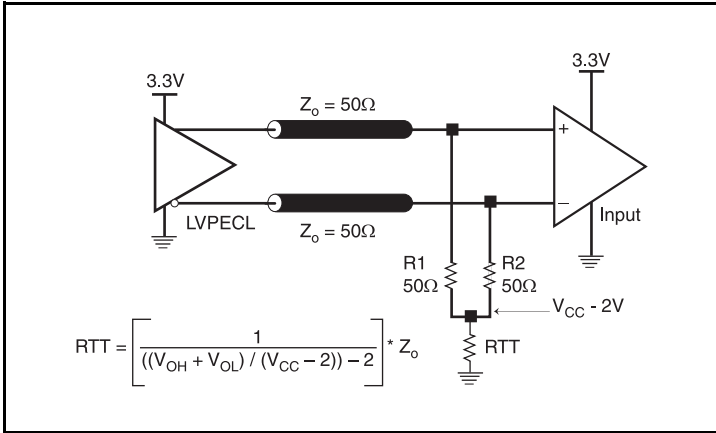


Figure 6A. 3.3V LVPECL Output Termination

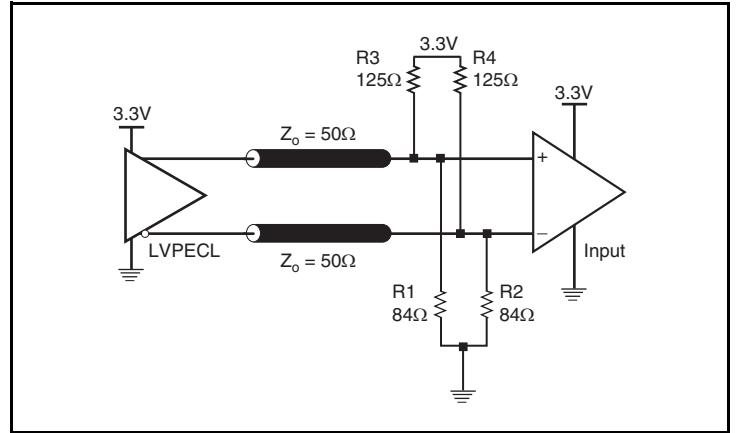


Figure 6B. 3.3V LVPECL Output Termination

Termination for 2.5V LVPECL Outputs

Figure 7A and Figure 7B show examples of termination for 2.5V LVPECL driver. These terminations are equivalent to terminating 50Ω to $V_{CC} - 2V$. For $V_{CC} = 2.5V$, the $V_{CC} - 2V$ is very close to ground

level. The R3 in Figure 7B can be eliminated and the termination is shown in Figure 7C.

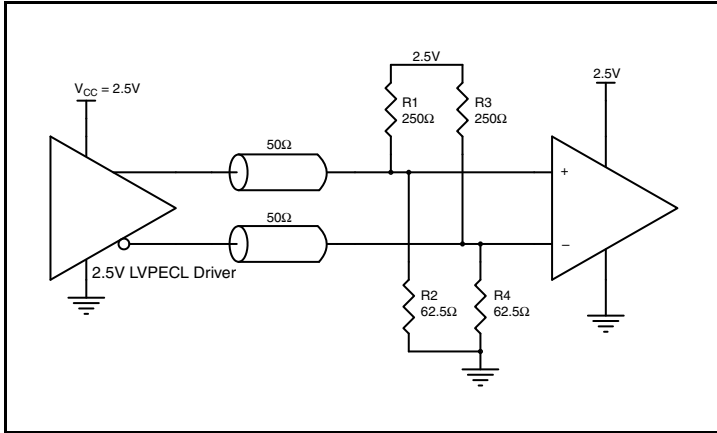


Figure 7A. 2.5V LVPECL Driver Termination Example

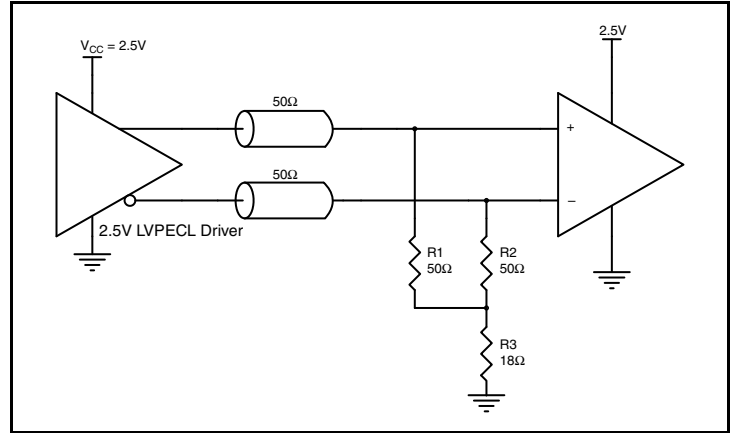


Figure 7B. 2.5V LVPECL Driver Termination Example

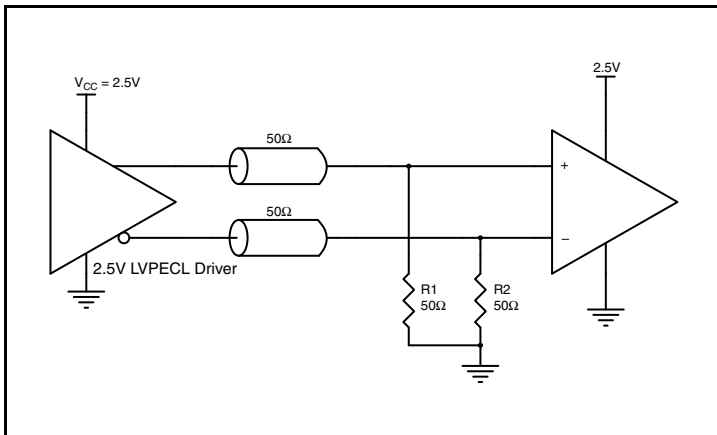


Figure 7C. 2.5V LVPECL Driver Termination Example

VFQFN EPAD Thermal Release Path

In order to maximize both the removal of heat from the package and the electrical performance, a land pattern must be incorporated on the Printed Circuit Board (PCB) within the footprint of the package corresponding to the exposed metal pad or exposed heat slug on the package, as shown in *Figure 8*. The solderable area on the PCB, as defined by the solder mask, should be at least the same size/shape as the exposed pad/slug area on the package to maximize the thermal/electrical performance. Sufficient clearance should be designed on the PCB between the outer edges of the land pattern and the inner edges of pad pattern for the leads to avoid any shorts.

While the land pattern on the PCB provides a means of heat transfer and electrical grounding from the package to the board through a solder joint, thermal vias are necessary to effectively conduct from the surface of the PCB to the ground plane(s). The land pattern must be connected to ground through these vias. The vias act as “heat pipes”. The number of vias (i.e. “heat pipes”) are application specific and de-

pendent upon the package power dissipation as well as electrical conductivity requirements. Thus, thermal and electrical analysis and/or testing are recommended to determine the minimum number needed. Maximum thermal and electrical performance is achieved when an array of vias is incorporated in the land pattern. It is recommended to use as many vias connected to ground as possible. It is also recommended that the via diameter should be 12 to 13mils (0.30 to 0.33mm) with 1oz copper via barrel plating. This is desirable to avoid any solder wicking inside the via during the soldering process which may result in voids in solder between the exposed pad/slug and the thermal land. Precautions should be taken to eliminate any solder voids between the exposed heat slug and the land pattern. Note: These recommendations are to be used as a guideline only. For further information, please refer to the Application Note on the Surface Mount Assembly of Amkor’s Thermally/ Electrically Enhance Leadframe Base Package, Amkor Technology.

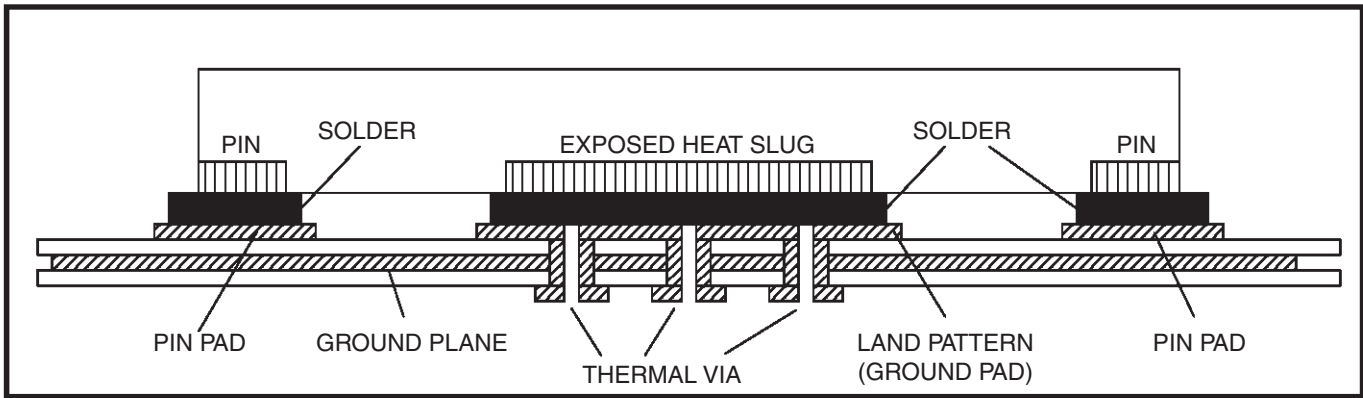


Figure 8. P.C. Assembly for Exposed Pad Thermal Release Path – Side View (drawing not to scale)

3.3V LVDS Power Considerations

This section provides information on power dissipation and junction temperature for the IDT8T79S838-08I. Equations and example calculations are also provided.

1. Power Dissipation.

The total power dissipation for the IDT8T79S838-08I is the sum of the core power plus the power dissipated due to the load. The following is the power dissipation for $V_{CC} = 3.3V + 5\% = 3.465V$, which gives worst case results.

- Power (core)_{MAX} = $V_{CC_MAX} * I_{CC_MAX} = 3.465V * 235mA = \mathbf{814.3mW}$

2. Junction Temperature.

Junction temperature, T_j , is the temperature at the junction of the bond wire and bond pad directly affects the reliability of the device. The maximum recommended junction temperature is 125°C. Limiting the internal transistor junction temperature, T_j , to 125°C ensures that the bond wire and bond pad temperature remains below 125°C.

The equation for T_j is as follows: $T_j = \theta_{JA} * Pd_total + T_A$

T_j = Junction Temperature

θ_{JA} = Junction-to-Ambient Thermal Resistance

Pd_total = Total Device Power Dissipation (example calculation is in section 1 above)

T_A = Ambient Temperature

In order to calculate junction temperature, the appropriate junction-to-ambient thermal resistance θ_{JA} must be used. Assuming no air flow and a multi-layer board, the appropriate value is 48.9°C/W per Table 6 below.

Therefore, T_j for an ambient temperature of 85°C with all outputs switching is:

$$85^\circ\text{C} + 0.814\text{W} * 48.9^\circ\text{C/W} = 124.8^\circ\text{C}. \text{ This is below the limit of } 125^\circ\text{C}.$$

This calculation is only an example. T_j will obviously vary depending on the number of loaded outputs, supply voltage, air flow and the type of board (multi-layer).

Table 6. Thermal Resistance θ_{JA} for 32-lead VFQFN Package

| Meters per Second | θ_{JA} by Velocity | | |
|---|---------------------------|--------|----------|
| | 0 | 1 | 2 |
| Multi-Layer PCB, JEDEC Standard Test Boards | 48.9°C/W | 42°C/W | 39.4°C/W |

3.3V LVPECL Power Considerations

This section provides information on power dissipation and junction temperature for the IDT8T79S838-08I, for all outputs that are configured to LVPECL. Equations and example calculations are also provided.

1. Power Dissipation.

The total power dissipation for the IDT8T79S838-08I is the sum of the core power plus the power dissipated due to loading. The following is the power dissipation for $V_{CC} = 3.3V + 5\% = 3.465V$, which gives worst case results.

NOTE: Please refer to Section 3 for details on calculating power dissipated due to loading.

- Power (core)_{MAX} = $V_{CC_MAX} * I_{EE_MAX} = 3.465V * 135mA = \mathbf{467.8mW}$
- Power (outputs)_{MAX} = **31.55mW/Loaded Output pair**
If all outputs are loaded, the total power is $8 * 31.55mW = \mathbf{252.4mW}$

Total Power_{MAX} (3.465V, with all outputs switching) = $467.8mW + 252.4mW = \mathbf{720.2mW}$

2. Junction Temperature.

Junction temperature, T_j , is the temperature at the junction of the bond wire and bond pad directly affects the reliability of the device. The maximum recommended junction temperature is 125°C. Limiting the internal transistor junction temperature, T_j , to 125°C ensures that the bond wire and bond pad temperature remains below 125°C.

The equation for T_j is as follows: $T_j = \theta_{JA} * Pd_total + T_A$

T_j = Junction Temperature

θ_{JA} = Junction-to-Ambient Thermal Resistance

Pd_total = Total Device Power Dissipation (example calculation is in section 1 above)

T_A = Ambient Temperature

In order to calculate junction temperature, the appropriate junction-to-ambient thermal resistance θ_{JA} must be used. Assuming no airflow and a multi-layer board, the appropriate value is 48.9°C/W per Table 7 below.

Therefore, T_j for an ambient temperature of 85°C with all outputs switching is:

$$85^\circ\text{C} + 0.720\text{W} * 48.9^\circ\text{C/W} = 120.2^\circ\text{C}. \text{ This is below the limit of } 125^\circ\text{C}.$$

This calculation is only an example. T_j will obviously vary depending on the number of loaded outputs, supply voltage, air flow and the type of board (multi-layer).

Table 7. Thermal Resistance θ_{JA} for 32-lead VFQFN Package

| θ_{JA} by Velocity | | | |
|---|----------|--------|----------|
| Meters per Second | 0 | 1 | 2 |
| Multi-Layer PCB, JEDEC Standard Test Boards | 48.9°C/W | 42°C/W | 39.4°C/W |

3. Calculations and Equations.

The purpose of this section is to calculate the power dissipation for the LVPECL output pairs.

LVPECL output driver circuit and termination are shown in *Figure 9*.

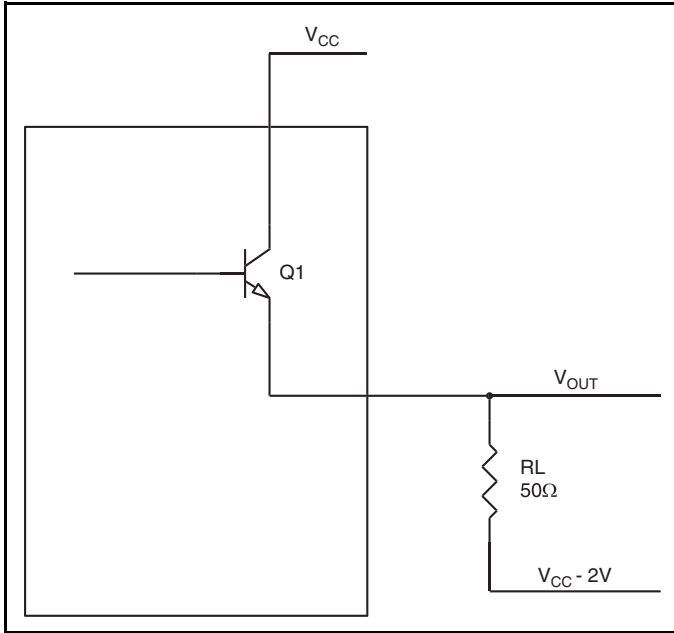


Figure 9. LVPECL Driver Circuit and Termination

To calculate power dissipation per output pair due to loading, use the following equations which assume a 50Ω load, and a termination voltage of $V_{CC} - 2V$.

- For logic high, $V_{OUT} = V_{OH_MAX} = V_{CC_MAX} - 0.75V$
 $(V_{CC_MAX} - V_{OH_MAX}) = 0.75V$
- For logic low, $V_{OUT} = V_{OL_MAX} = V_{CC_MAX} - 1.6V$
 $(V_{CC_MAX} - V_{OL_MAX}) = 1.6V$

Pd_H is power dissipation when the output drives high.

Pd_L is the power dissipation when the output drives low.

$$Pd_H = [(V_{OH_MAX} - (V_{CC_MAX} - 2V))/R_L] * (V_{CC_MAX} - V_{OH_MAX}) = [(2V - (V_{CC_MAX} - V_{OH_MAX}))/R_L] * (V_{CC_MAX} - V_{OH_MAX}) = [(2V - 0.75V)/50\Omega] * 0.75V = 18.75mW$$

$$Pd_L = [(V_{OL_MAX} - (V_{CC_MAX} - 2V))/R_L] * (V_{CC_MAX} - V_{OL_MAX}) = [(2V - (V_{CC_MAX} - V_{OL_MAX}))/R_L] * (V_{CC_MAX} - V_{OL_MAX}) = [(2V - 1.6V)/50\Omega] * 1.6V = 12.80mW$$

$$\text{Total Power Dissipation per output pair} = Pd_H + Pd_L = 31.55mW$$

Reliability Information

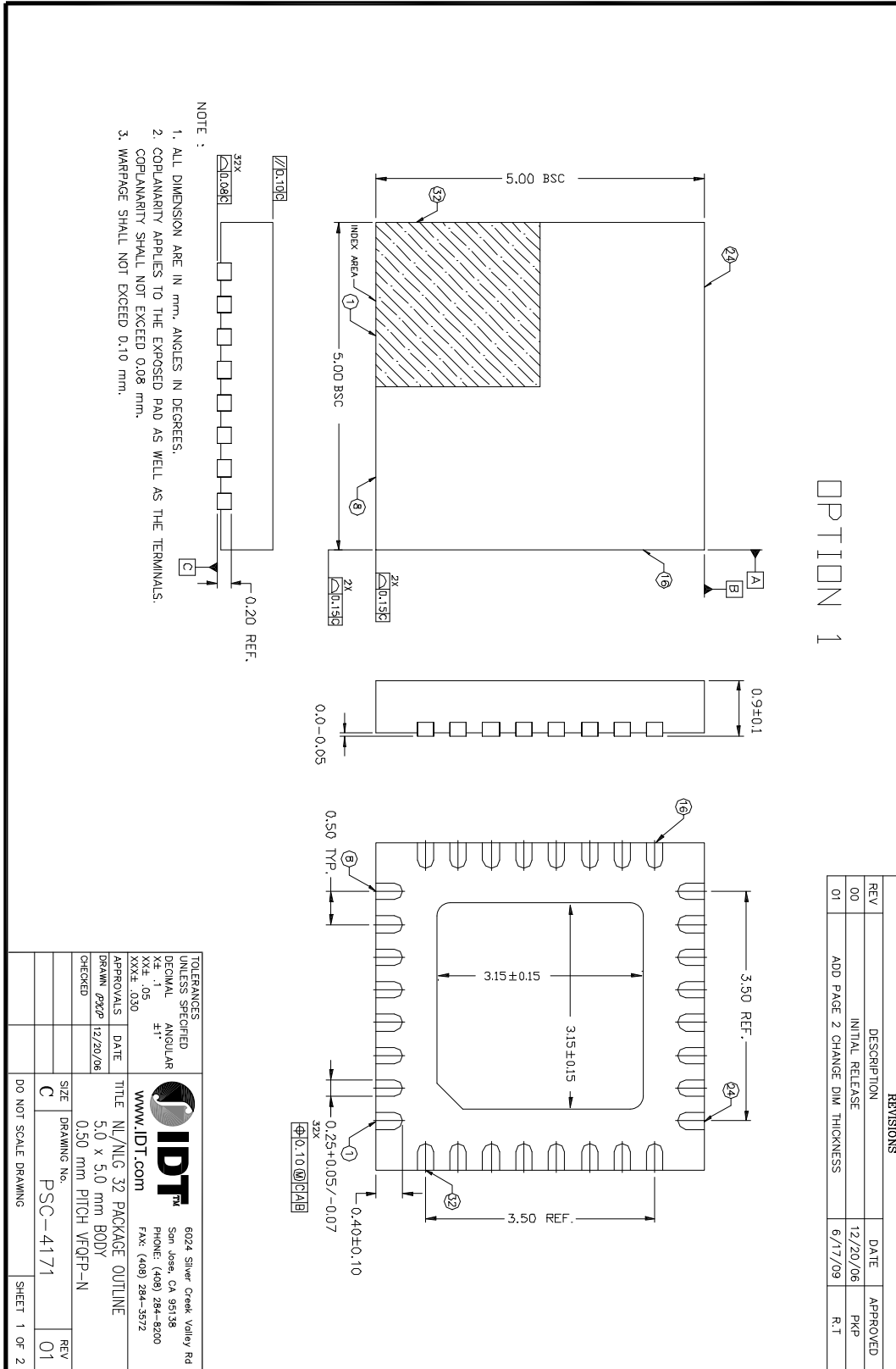
Table 8. θ_{JA} vs. Air Flow Table for a 32-lead VFQFN Package

| θ_{JA} vs. Air Flow | | | |
|---|----------|----------|----------|
| Meters per Second | 0 | 1 | 2 |
| Multi-Layer PCB, JEDEC Standard Test Boards | 48.9°C/W | 42.0°C/W | 39.4°C/W |

Transistor Count

The transistor count for IDT8T79S838-08I is: 2618

32 Lead VFQFN Package Outline and Package Dimensions



Ordering Information

Table 9. Ordering Information

| Part/Order Number | Marking | Package | Shipping Packaging | Temperature |
|-------------------|--------------------|---------------------------|--------------------|---------------|
| 8T79S838-08NLGI | IDT8T79S838-08NLGI | "Lead-Free" 32 Lead VFQFN | Tray | -40°C to 85°C |
| 8T79S838-08NLGI8 | IDT8T79S838-08NLGI | "Lead-Free" 32 Lead VFQFN | Tape & Reel | -40°C to 85°C |

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(Rev.4.0-1 November 2017)

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