

2:1, DIFFERENTIAL-TO-LVPECL MULTIPLEXER

ICS85301

GENERAL DESCRIPTION

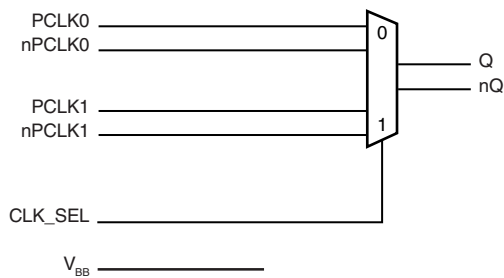


The ICS85301 is a high performance 2:1 Differential-to-LVPECL Multiplexer and a member of the HiPerClockS™ family of High Performance Clock Solutions from IDT. The ICS85301 can also perform differential translation because the differential inputs accept LVPECL, CML as well as LVDS levels. The ICS85301 is packaged in a small 3mm x 3mm 16 VFQFN package, making it ideal for use on space constrained boards.

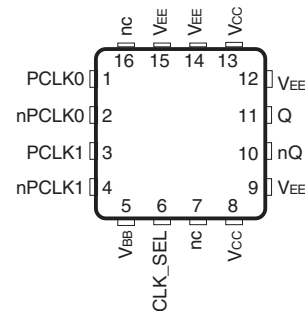
FEATURES

- 2:1 LVPECL MUX
- One LVPECL output
- Two differential clock inputs can accept: LVPECL, LVDS, CML
- Maximum input/output frequency: 3GHz
- Translates LVCMOS/LVTTL input signals to LVPECL levels by using a resistor bias network on nPCLK0, nPCLK0
- Propagation delay: 490ps (maximum)
- Part-to-part skew: 150ps (maximum)
- Additive phase jitter, RMS: 0.009ps (typical)
- Full 3.3V or 2.5V operating supply
- -40°C to 85°C ambient operating temperature
- Available in both standard (RoHS 5) and lead-free (RoHS 6) packages

BLOCK DIAGRAM



PIN ASSIGNMENT



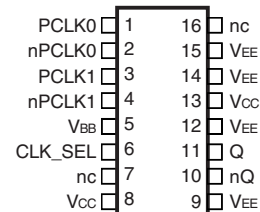
ICS85301

16-Lead VFQFN

3mm x 3mm x 0.95 package body

K Package

Top View



ICS85301

16-Lead TSSOP

4.4mm x 5.0mm x 0.92mm package body

G Package

Top View

TABLE 1. PIN DESCRIPTIONS

| Number | Name | Type | | Description |
|---------------|----------|--------|---------------------|--|
| 1 | PCLK0 | Input | Pulldown | Non-inverting differential LVPECL clock input. |
| 2 | nPCLK0 | Input | Pullup/ Pulldown | Inverting differential LVPECL clock input. $V_{CC}/2$ default when left floating. |
| 3 | PCLK1 | Input | Pulldown | Non-inverting differential LVPECL clock input. |
| 4 | nPCLK1 | Input | Pullup/ Pulldown | Inverting differential LVPECL clock input. $V_{CC}/2$ default when left floating. |
| 5 | V_{BB} | Output | | Bias voltage. |
| 7, 16 | nc | Unused | | No connect. |
| 6 | CLK_SEL | Input | Pulldown | Clock select input. When HIGH, selects PCLK1, nPCLK1 inputs. When LOW, selects PCLK0, nPCLK0 inputs. LVCMOS / LVTTTL interface levels. |
| 8, 13 | V_{CC} | Power | | Positive supply pins. |
| 9, 12, 14, 15 | V_{EE} | Power | | Negative supply pins. |
| 10, 11 | nQ, Q | Output | | Differential output pair. LVPECL 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 | | | 1 | | pF |
| R_{PULLUP} | Input Pullup Resistor | | | 37 | | k Ω |
| $R_{PULLDOWN}$ | Input Pulldown Resistor | | | 37 | | k Ω |

TABLE 3. CONTROL INPUT FUNCTION TABLE

| Input | Input Selected |
|---------|----------------|
| CLK_SEL | PCLK |
| 0 | PCLK0, nPCLK0 |
| 1 | PCLK1, nPCLK1 |

ABSOLUTE MAXIMUM RATINGS

| | |
|--|---------------------------|
| Supply Voltage, V_{CC} | 4.6V |
| Inputs, V_I | -0.5V to $V_{CC} + 0.5 V$ |
| Outputs, I_O | |
| Continuous Current | 50mA |
| Surge Current | 100mA |
| Package Thermal Impedance, θ_{JA} | |
| 16 VFQFN | 51.5°C/W (0 lfpm) |
| 16 TSSOP | 89°C/W (0 lfpm) |
| Storage Temperature, T_{STG} | -65°C to 150°C |

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.

TABLE 4A. POWER SUPPLY DC CHARACTERISTICS, $V_{CC} = 3.3V \pm 5\%$, $T_A = -40^\circ C$ TO $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|-------------------------|-----------------|---------|---------|---------|-------|
| V_{CC} | Positive Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| I_{EE} | Power Supply Current | | | | 26 | mA |

TABLE 4B. POWER SUPPLY DC CHARACTERISTICS, $V_{CC} = 2.5V \pm 5\%$, $T_A = -40^\circ C$ TO $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|-------------------------|-----------------|---------|---------|---------|-------|
| V_{CC} | Positive Supply Voltage | | 2.375 | 2.5 | 2.625 | V |
| I_{EE} | Power Supply Current | | | | 24 | mA |

TABLE 4C. LVCMOS / LVTTTL DC CHARACTERISTICS, $V_{CC} = 3.3V \pm 5\%$ OR $2.5V \pm 5\%$, $T_A = -40^\circ C$ TO $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|--------------------|-----------------|---|---------|----------------|---------|
| V_{IH} | Input High Voltage | CLK_SEL | 2 | | $V_{CC} + 0.3$ | V |
| V_{IL} | Input Low Voltage | CLK_SEL | -0.3 | | 0.8 | V |
| I_{IH} | Input High Current | CLK_SEL | $V_{CC} = V_{IN} = 3.465V$ or $2.625V$ | | 150 | μA |
| I_{IL} | Input Low Current | CLK_SEL | $V_{CC} = 3.465V$ or $2.625V$, $V_{IN} = 0V$ | -150 | | μA |

NOTE: Outputs terminated with 50Ω to $V_{CC}/2$. See Parameter Measurement Information, "Output Load Test Circuit".

TABLE 4D. LVPECL DC CHARACTERISTICS, $V_{CC} = 3.3V \pm 5\%$, $T_A = -40^\circ C$ TO $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-------------|--------------------------------------|---------------------------------|-----------------------------------|---------|-----------------|---------|
| I_{IH} | Input High Current | PCLK0, nPCLK0, PCLK1, nPCLK1 | $V_{CC} = V_{IN} = 3.465$ | | 150 | μA |
| I_{IL} | Input Low Current | PCLK0, PCLK1 | $V_{CC} = 3.465V$, $V_{IN} = 0V$ | -10 | | μA |
| | | nPCLK0, nPCLK1 | $V_{CC} = 3.465V$, $V_{IN} = 0V$ | -150 | | μA |
| V_{PP} | Peak-to-Peak Input Voltage | | 150 | | 1200 | mV |
| V_{CMR} | Common Mode Input Voltage; NOTE 1, 2 | | 1.2 | | 3.3 | V |
| V_{OH} | Output High Voltage; NOTE 3 | | $V_{CC} - 1.125$ | | $V_{CC} - 0.93$ | V |
| V_{OL} | Output Low Voltage; NOTE 3 | | $V_{CC} - 1.895$ | | $V_{CC} - 1.62$ | V |
| V_{swing} | Peak-to-Peak Output Voltage Swing | | 0.495 | | 0.975 | V |
| V_{BB} | Bias Voltage | | 1.695 | | 2.145 | V |

NOTE 1: Common mode voltage is defined as V_{IH} .

NOTE 2: For single ended applications, the maximum input voltage for PCLKx, nPCLKx is $V_{CC} + 0.3V$.

NOTE 3: Outputs terminated with 50Ω to $V_{CC} - 2V$.

TABLE 4E. LVPECL DC CHARACTERISTICS, $V_{CC} = 2.5V \pm 5\%$, $T_A = -40^\circ C$ TO $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-------------|--------------------------------------|---------------------------------|--------------------------------|---------|-----------------|---------|
| I_{IH} | Input High Current | PCLK0, nPCLK0, PCLK1, nPCLK1 | $V_{CC} = V_{IN} = 2.625V$ | | 150 | μA |
| I_{IL} | Input Low Current | PCLK0, PCLK1 | $V_{CC} = 2.625V, V_{IN} = 0V$ | -10 | | μA |
| | | nPCLK0, nPCLK1 | $V_{CC} = 2.625V, V_{IN} = 0V$ | -150 | | μA |
| V_{PP} | Peak-to-Peak Input Voltage | | 150 | | 1200 | mV |
| V_{CMR} | Common Mode Input Voltage; NOTE 1, 2 | | 1.2 | | 2.5 | V |
| V_{OH} | Output High Voltage; NOTE 3 | | $V_{CC} - 1.125$ | | $V_{CC} - 0.93$ | V |
| V_{OL} | Output Low Voltage; NOTE 3 | | $V_{CC} - 1.895$ | | $V_{CC} - 1.62$ | V |
| V_{swing} | Peak-to-Peak Output Voltage Swing | | 0.495 | | 0.975 | V |
| V_{BB} | Bias Voltage | | 0.935 | | 1.305 | V |

NOTE 1: Common mode voltage is defined as V_{IH} .

NOTE 2: For single ended applications, the maximum input voltage for PCLKx, nPCLKx is $V_{CC} + 0.3V$.

NOTE 3: Outputs terminated with 50Ω to $V_{CC} - 2V$.

TABLE 5A. AC CHARACTERISTICS, $V_{CC} = 3.3V \pm 5\%$, $T_A = -40^\circ C$ TO $85^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|--------------|--|--|---------|---------|---------|-------|
| f_{MAX} | Output Frequency | | | | 3 | GHz |
| t_{PD} | Propagation Delay; NOTE 1 | | 240 | | 490 | ps |
| $tsk(pp)$ | Part-to-Part Skew; NOTE 2, 3 | | | | 150 | ps |
| $tsk(i)$ | Input Skew | | | | 25 | ps |
| f_{jit} | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter section | 622MHz (Integration Range: 12kHz - 20MHz) | | 0.009 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 100 | | 200 | ps |
| odc | Output Duty Cycle | | 48 | | 52 | % |
| MUX_{ISOL} | MUX Isolation | $f = 622MHz$ | | -55 | | dBm |

All parameters measured at $f \leq 1.7GHz$ unless otherwise noted.

NOTE 1: Measured from the differential input crossing point to the differential output crossing point.

NOTE 2: Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.

NOTE 3: This parameter is defined in accordance with JEDEC Standard 65.

TABLE 5B. AC CHARACTERISTICS, $V_{CC} = 2.5V \pm 5\%$, $T_A = -40^\circ C$ TO $85^\circ C$

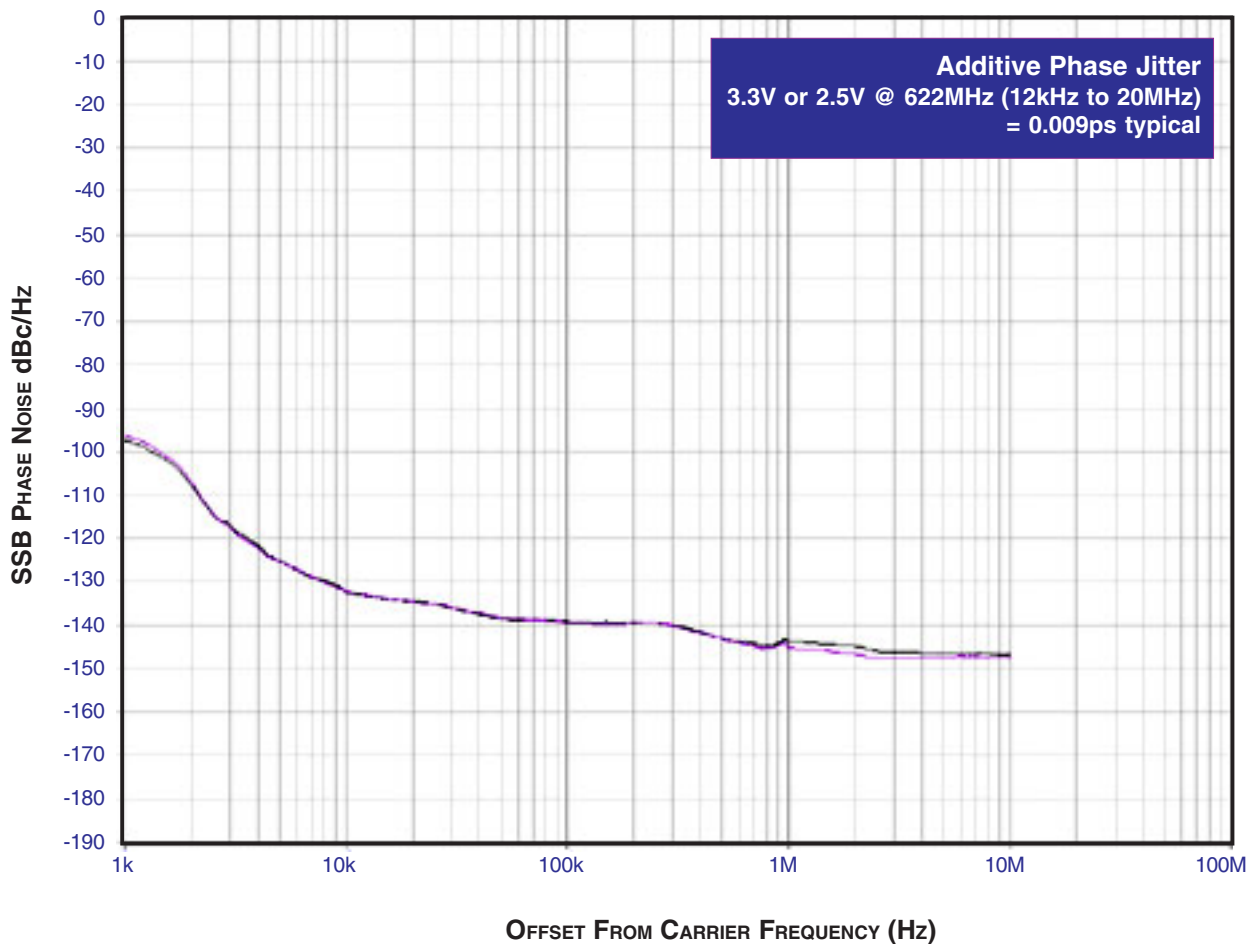
| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|--------------|--|--|---------|---------|---------|-------|
| f_{MAX} | Output Frequency | | | | 3 | GHz |
| t_{PD} | Propagation Delay; NOTE 1 | | 240 | | 490 | ps |
| $tsk(pp)$ | Part-to-Part Skew; NOTE 2, 3 | | | | 150 | ps |
| $tsk(i)$ | Input Skew | | | | 25 | ps |
| f_{jit} | Buffer Additive Phase Jitter, RMS; refer to Additive Phase Jitter section | 622MHz (Integration Range: 12kHz - 20MHz) | | 0.009 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 100 | | 200 | ps |
| odc | Output Duty Cycle | | 47 | | 53 | % |
| MUX_{ISOL} | MUX Isolation | $f = 622MHz$ | | -55 | | dBm |

For notes, see Table 5A above.

ADDITIVE PHASE JITTER

The spectral purity in a band at a specific offset from the fundamental compared to the power of the fundamental is called the ***dBc Phase Noise***. This value is normally expressed using a Phase noise plot and is most often the specified plot in many applications. Phase noise is defined as the ratio of the noise power present in a 1Hz band at a specified offset from the fundamental frequency to the power value of the fundamental. This ratio is expressed in decibels (dBm) or a ratio of the power in the 1Hz

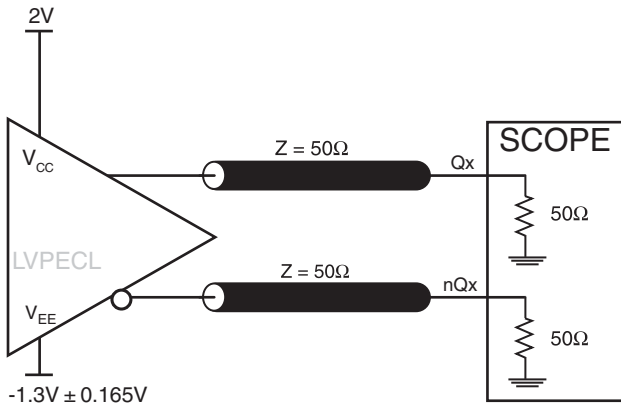
band to the power in the fundamental. When the required offset is specified, the phase noise is called a ***dBc*** value, which simply means dBm at a specified offset from the fundamental. By investigating jitter in the frequency domain, we get a better understanding of its effects on the desired application over the entire time record of the signal. It is mathematically possible to calculate an expected bit error rate given a phase noise plot.



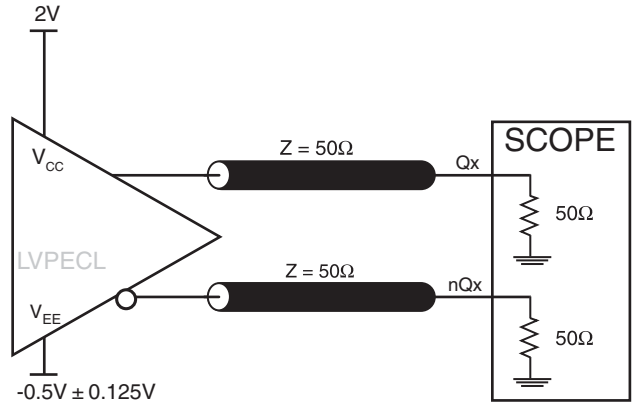
As with most timing specifications, phase noise measurements have issues. The primary issue relates to the limitations of the equipment. Often the noise floor of the equipment is higher than the noise floor of the device. This is illustrated above. The device

meets the noise floor of what is shown, but can actually be lower. The phase noise is dependant on the input source and measurement equipment.

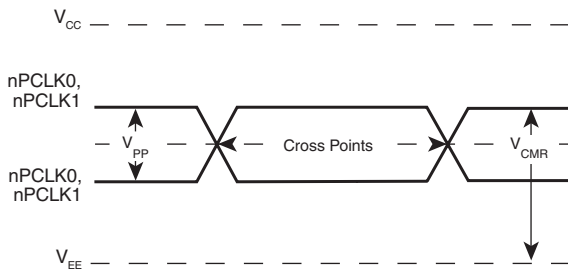
PARAMETER MEASUREMENT INFORMATION



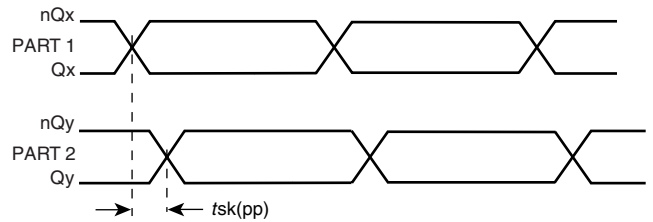
3.3V OUTPUT LOAD AC TEST CIRCUIT



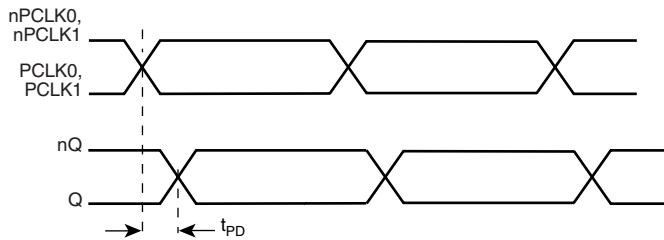
2.5V OUTPUT LOAD AC TEST CIRCUIT



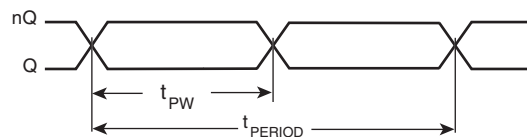
DIFFERENTIAL INPUT LEVEL



PART-TO-PART SKEW

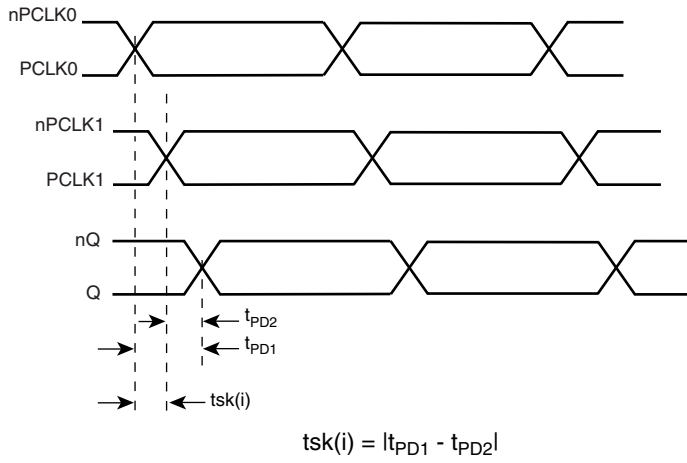


PROPAGATION DELAY

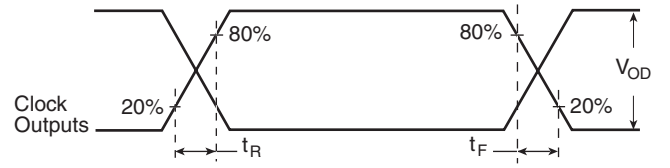


$$\text{odc} = \frac{t_{PW}}{t_{PERIOD}} \times 100\%$$

OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD



INPUT SKEW



OUTPUT RISE/FALL TIME

APPLICATION INFORMATION

WIRING THE DIFFERENTIAL INPUT TO ACCEPT SINGLE ENDED LEVELS

Figure 1A shows an example of the differential input that can be wired to accept single ended LVCMOS levels. The reference voltage level V_{REF} generated from the device is connected to the

negative input. The C1 capacitor should be located as close as possible to the input pin.

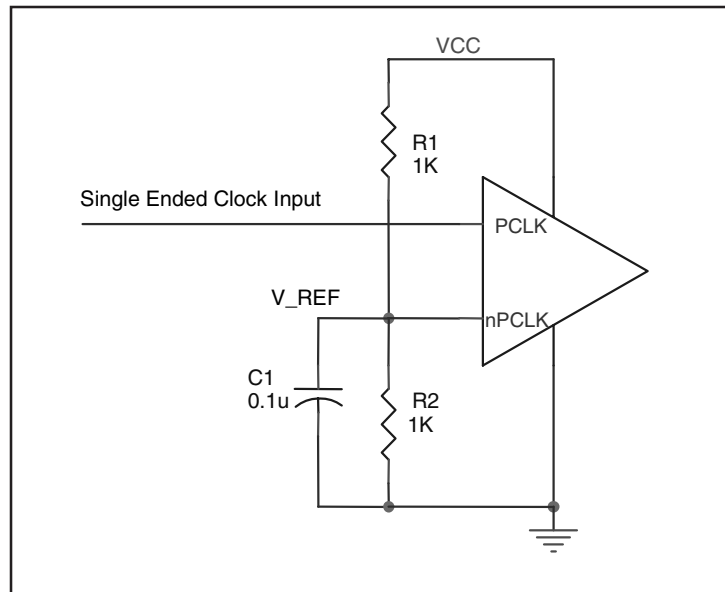


FIGURE 1A. SINGLE ENDED SIGNAL DRIVING DIFFERENTIAL INPUT

WIRING THE DIFFERENTIAL INPUT TO ACCEPT SINGLE ENDED LVPECL LEVELS

Figure 1B shows an example of the differential input that can be wired to accept single ended LVPECL levels. The reference

voltage level V_{BB} generated from the device is connected to the negative input.

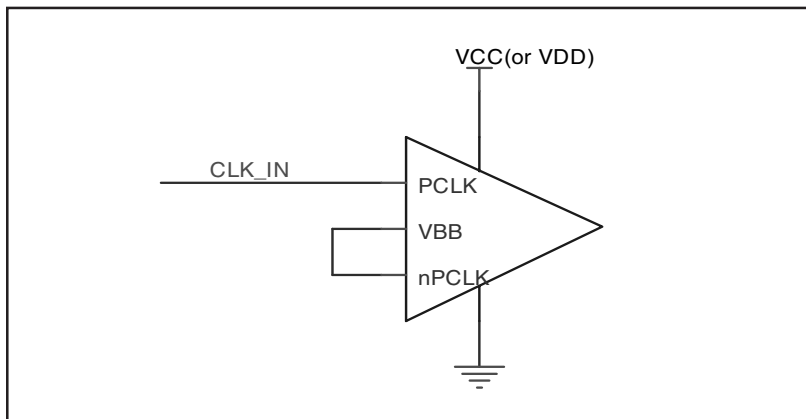


FIGURE 1B. SINGLE ENDED LVPECL SIGNAL DRIVING DIFFERENTIAL INPUT

LVPECL CLOCK INPUT INTERFACE

The PCLK /nPCLK accepts LVPECL, CML, SSTL and other differential signals. Both V_{SWING} and V_{OH} must meet the V_{PP} and V_{CMR} input requirements. Figures 2A to 2F show interface examples for the HiPerClockS PCLK/nPCLK input driven by the most common driver types. The input interfaces 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.

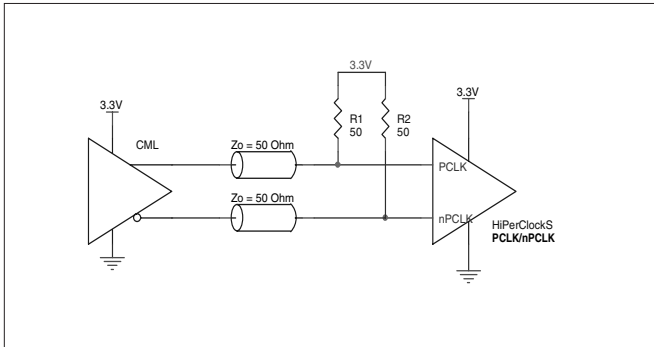


FIGURE 2A. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY AN OPEN COLLECTOR CML DRIVER

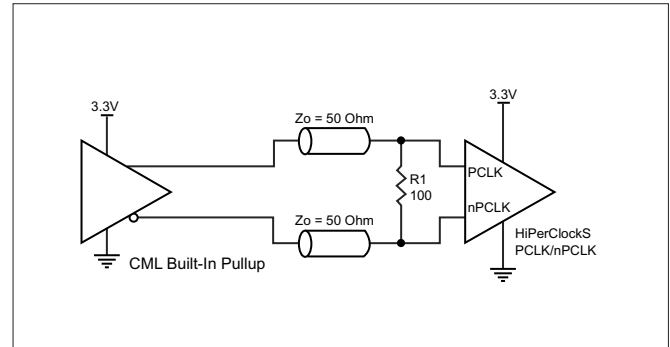


FIGURE 2B. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A BUILT-IN PULLUP CML DRIVER

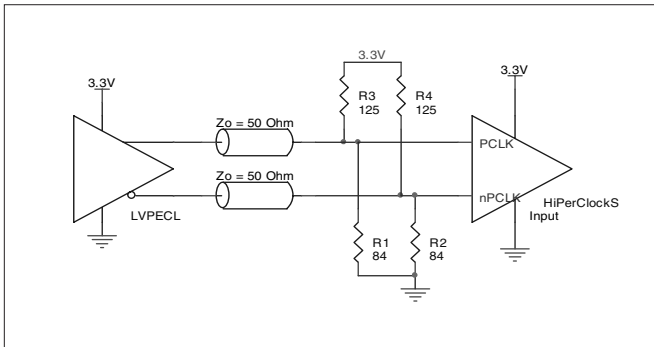


FIGURE 2C. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER

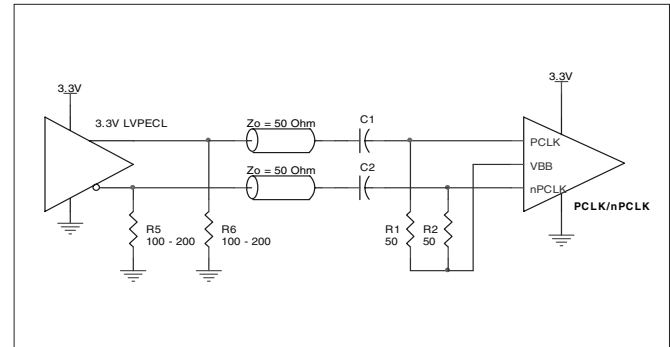


FIGURE 2D. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVPECL DRIVER WITH AC COUPLE

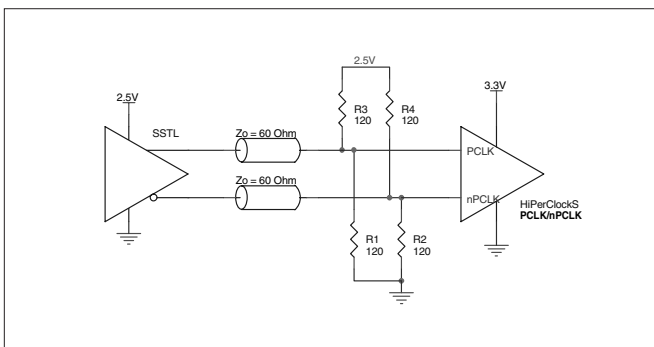


FIGURE 2E. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY AN SSTL DRIVER

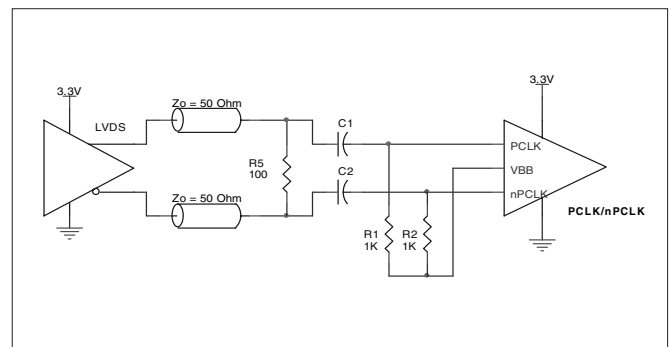


FIGURE 2F. HiPerClockS PCLK/nPCLK INPUT DRIVEN BY A 3.3V LVDS DRIVER

RECOMMENDATIONS FOR UNUSED INPUT PINS

INPUTS:

PCLK/nPCLK INPUT:

For applications not requiring the use of a differential input, both the PCLK and nPCLK pins can be left floating. Though not required, but for additional protection, a 1kΩ resistor can be tied from PCLK to ground.

TERMINATION FOR 3.3V LVPECL OUTPUT

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

FOUT and nFOUT 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 3A and 3B* 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.

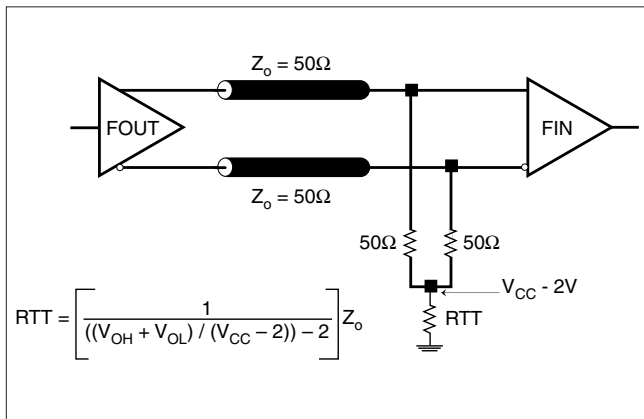


FIGURE 3A. LVPECL OUTPUT TERMINATION

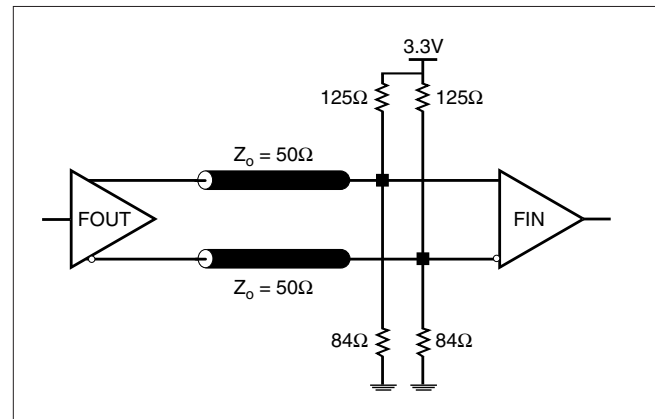


FIGURE 3B. LVPECL OUTPUT TERMINATION

TERMINATION FOR 2.5V LVPECL OUTPUT

Figure 4A and Figure 4B 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 4B can be eliminated and the termination is shown in Figure 4C.

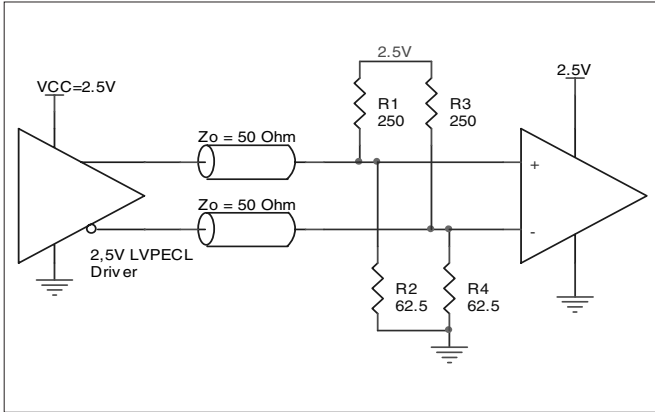


FIGURE 4A. 2.5V LVPECL DRIVER TERMINATION EXAMPLE

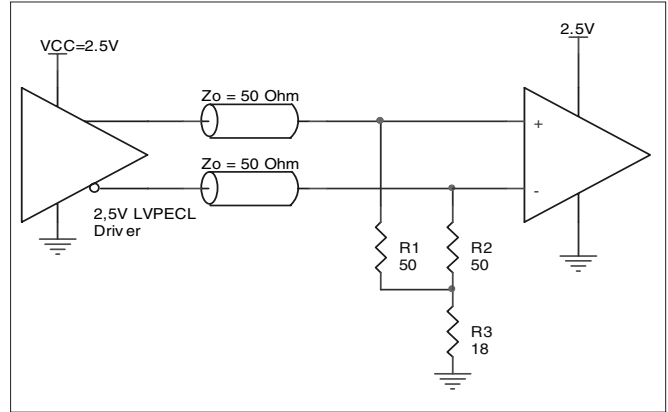


FIGURE 4B. 2.5V LVPECL DRIVER TERMINATION EXAMPLE

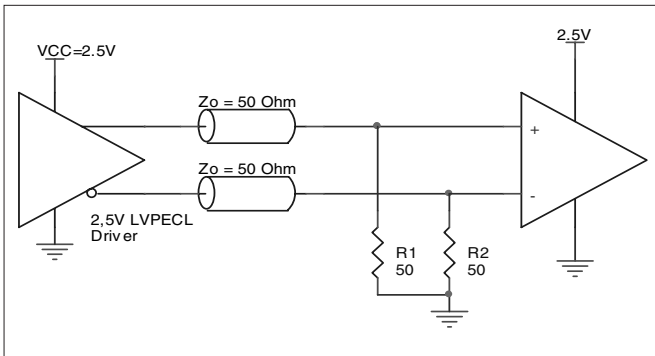


FIGURE 4C. 2.5V LVPECL TERMINATION EXAMPLE

THERMAL RELEASE PATH

The expose metal pad provides heat transfer from the device to the P.C. board. The expose metal pad is ground pad connected to ground plane through thermal via. The exposed pad on the device to the exposed metal pad on the PCB is contacted through

solder as shown in Figure 5. For further information, please refer to the Application Note on Surface Mount Assembly of Amkor's Thermally /Electrically Enhance Leadframe Base Package, Amkor Technology.

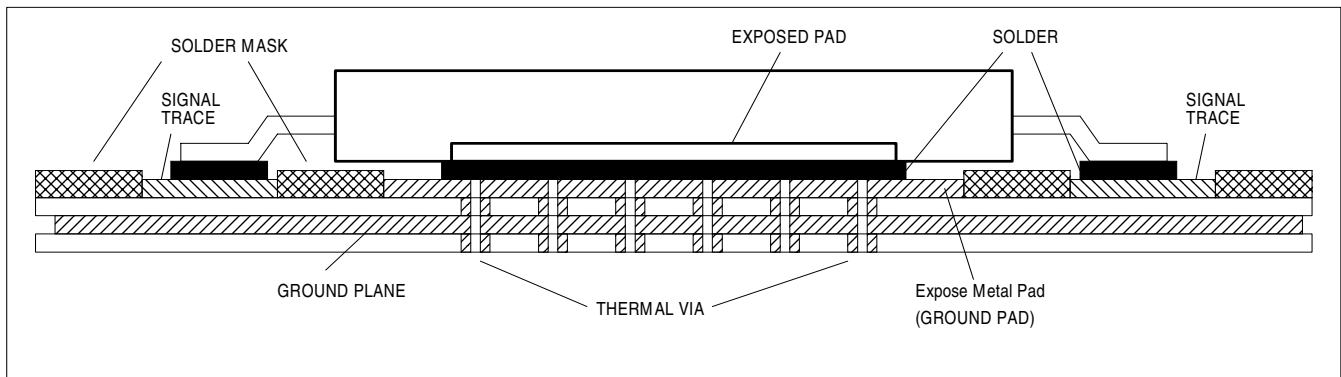


FIGURE 5. P.C. BOARD FOR EXPOSED PAD THERMAL RELEASE PATH EXAMPLE

APPLICATION SCHEMATIC EXAMPLE

Figure 6 shows an example of ICS85301 application schematic. This device can accept different types of input signal. In this example, the input is driven by a LVDS driver. The decoupling

capacitor should be located as close as possible to the power pin.

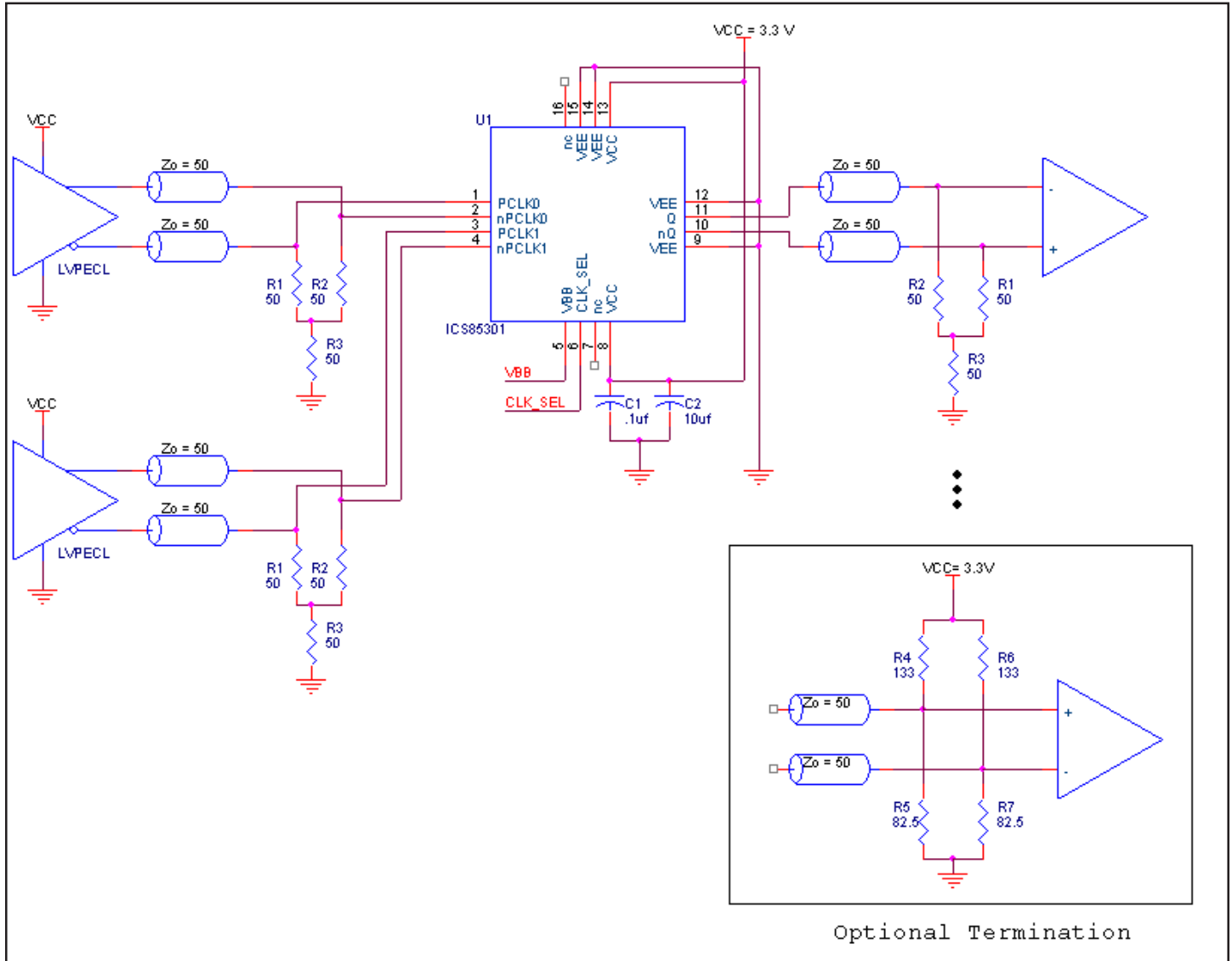


FIGURE 6. ICS85301 APPLICATION SCHEMATIC EXAMPLE

POWER CONSIDERATIONS

This section provides information on power dissipation and junction temperature for the ICS85301. Equations and example calculations are also provided.

1. Power Dissipation.

The total power dissipation for the ICS85301 is the sum of the core power plus the power dissipated in the load(s). The following is the power dissipation for $V_{CC} = 3.465V$, which gives worst case results.

NOTE: Please refer to Section 3 for details on calculating power dissipated in the load.

- Power (core)_{MAX} = $V_{CC,MAX} * I_{EE,MAX} = 3.465V * 26mA = 90.09mW$
- Power (outputs)_{MAX} = **32.2mW/Loaded Output pair**

$$\text{Total Power}_{MAX} (3.465, \text{ with all outputs switching}) = 90.09mW + 32.2mW = \mathbf{122.3mW}$$

2. Junction Temperature.

Junction temperature, T_j , is the temperature at the junction of the bond wire and bond pad and directly affects the reliability of the device. The maximum recommended junction temperature for HiPerClockS™ devices is 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 a moderate air flow of 0 linear feet per minute and a multi-layer board, the appropriate value is 51.5°C/W per Table 6A below.

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

$$85^\circ\text{C} + 0.122\text{W} * 51.5^\circ\text{C/W} = 91.3^\circ\text{C}. \text{ This is well below the limit of } 125^\circ\text{C}.$$

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 (single layer or multi-layer).

TABLE 6A. THERMAL RESISTANCE θ_{JA} FOR 16-PIN VFQFN, FORCED CONVECTION

| θ_{JA} vs. 0 Air Flow (Linear Feet per Minute) | |
|---|----------|
| | 0 |
| Multi-Layer PCB, JEDEC Standard Test Boards | 51.5°C/W |

TABLE 6B. THERMAL RESISTANCE θ_{JA} FOR FOR 16 LEAD TSSOP

| θ_{JA} by Velocity (Linear Feet per Minute) | | | |
|--|-----------|-----------|-----------|
| | 0 | 200 | 500 |
| Single-Layer PCB, JEDEC Standard Test Boards | 137.1°C/W | 118.2°C/W | 106.8°C/W |
| Multi-Layer PCB, JEDEC Standard Test Boards | 89.0°C/W | 81.8°C/W | 78.1°C/W |

NOTE: Most modern PCB designs use multi-layered boards. The data in the second row pertains to most designs.

3. Calculations and Equations.

The purpose of this section is to derive the power dissipated into the load.

LVPECL output driver circuit and termination are shown in *Figure 7*.

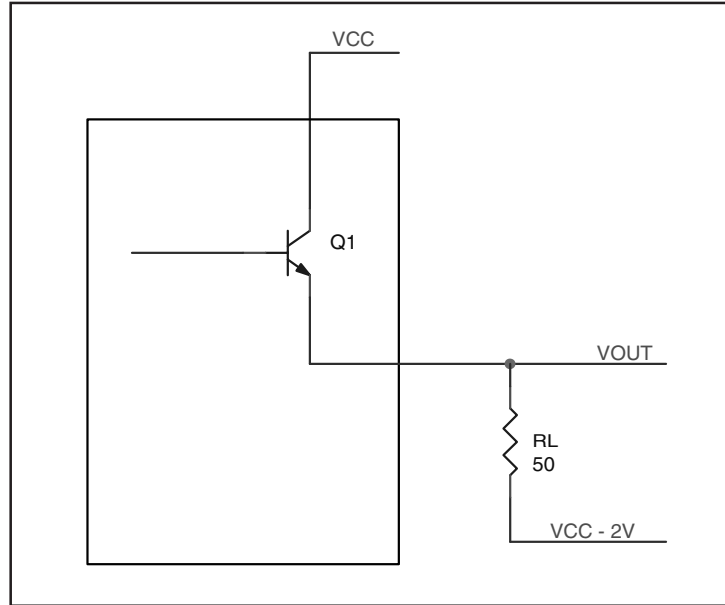


FIGURE 7. LVPECL DRIVER CIRCUIT AND TERMINATION

To calculate worst case power dissipation into the load, use the following equations which assume a 50Ω load, and a termination voltage of $V_{CC} - 2V$.

- For logic high, $V_{OUT} = V_{OH_MAX} = V_{CC_MAX} - 0.93V$

$$(V_{CC_MAX} - V_{OH_MAX}) = 0.93$$

- For logic low, $V_{OUT} = V_{OL_MAX} = V_{CC_MAX} - 1.62V$

$$(V_{CC_MAX} - V_{OL_MAX}) = 1.62V$$

Pd_H is power dissipation when the output drives high.

Pd_L is the power dissipation when the output drives low.

$$Pd_H = [(V_{OH_MAX} - (V_{CC_MAX} - 2V))/R_L] * (V_{CC_MAX} - V_{OH_MAX}) = [(2V - (V_{CC_MAX} - V_{OH_MAX}))/R_L] * (V_{CC_MAX} - V_{OH_MAX}) = [(2V - 0.93V)/50\Omega] * 0.93V = 19.9mW$$

$$Pd_L = [(V_{OL_MAX} - (V_{CC_MAX} - 2V))/R_L] * (V_{CC_MAX} - V_{OL_MAX}) = [(2V - (V_{CC_MAX} - V_{OL_MAX}))/R_L] * (V_{CC_MAX} - V_{OL_MAX}) = [(2V - 1.62V)/50\Omega] * 1.62V = 12.3mW$$

Total Power Dissipation per output pair = $Pd_H + Pd_L = 32.2mW$

RELIABILITY INFORMATION

TABLE 7A. θ_{JA} vs. AIR FLOW TABLE FOR 16 LEAD VFQFN

| θ_{JA} at 0 Air Flow (Linear Feet per Minute) | |
|--|----------|
| | 0 |
| Multi-Layer PCB, JEDEC Standard Test Boards | 51.5°C/W |

TABLE 7B. θ_{JA} vs. AIR FLOW TABLE FOR FOR 16 LEAD TSSOP

| | θ_{JA} by Velocity (Linear Feet per Minute) | | |
|--|--|-----------|-----------|
| | 0 | 200 | 500 |
| Single-Layer PCB, JEDEC Standard Test Boards | 137.1°C/W | 118.2°C/W | 106.8°C/W |
| Multi-Layer PCB, JEDEC Standard Test Boards | 89.0°C/W | 81.8°C/W | 78.1°C/W |

NOTE: Most modern PCB designs use multi-layered boards. The data in the second row pertains to most designs.

TRANSISTOR COUNT

The transistor count for ICS85301 is: 137

PACKAGE OUTLINE - K SUFFIX FOR 16 LEAD VFQFN

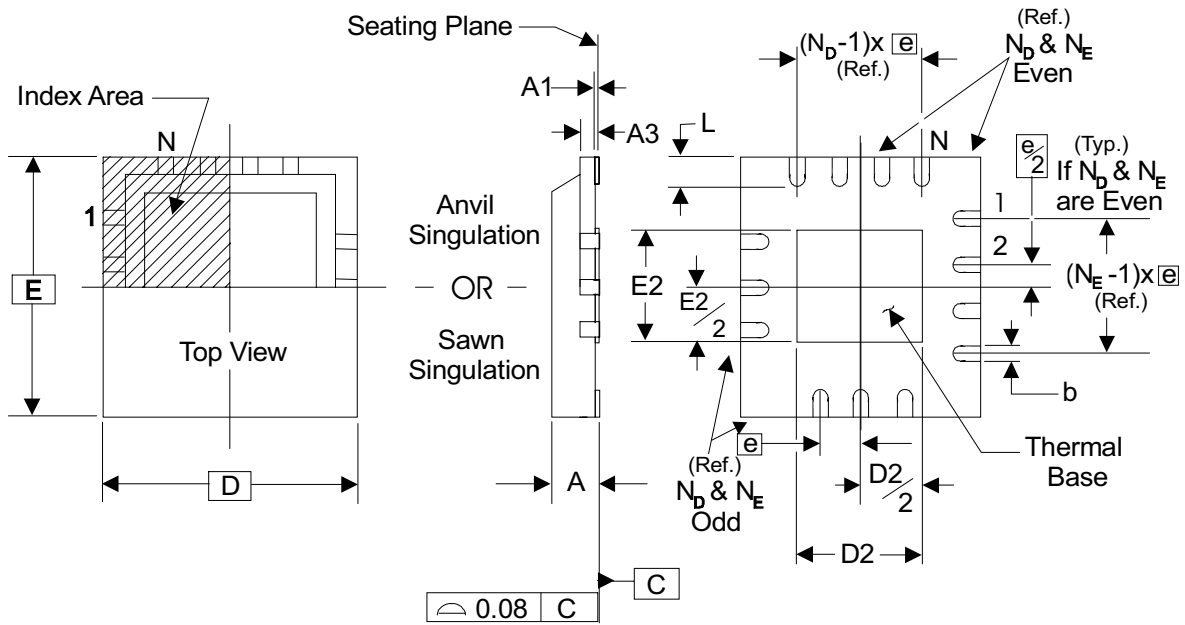


TABLE 8A. PACKAGE DIMENSIONS

| JEDEC VARIATION ALL DIMENSIONS IN MILLIMETERS | | |
|--|----------------|---------|
| SYMBOL | MINIMUM | MAXIMUM |
| N | 16 | |
| A | 0.80 | 1.0 |
| A1 | 0 | 0.05 |
| A3 | 0.25 Reference | |
| b | 0.18 | 0.30 |
| e | 0.50 BASIC | |
| N _D | 4 | |
| N _E | 4 | |
| D | 3.0 | |
| D2 | 1.0 | 1.8 |
| E | 3.0 | |
| E2 | 1.0 | 1.8 |
| L | 0.30 | 0.50 |

Reference Document: JEDEC Publication 95, MO-220

PACKAGE OUTLINE - G SUFFIX FOR 16 LEAD TSSOP

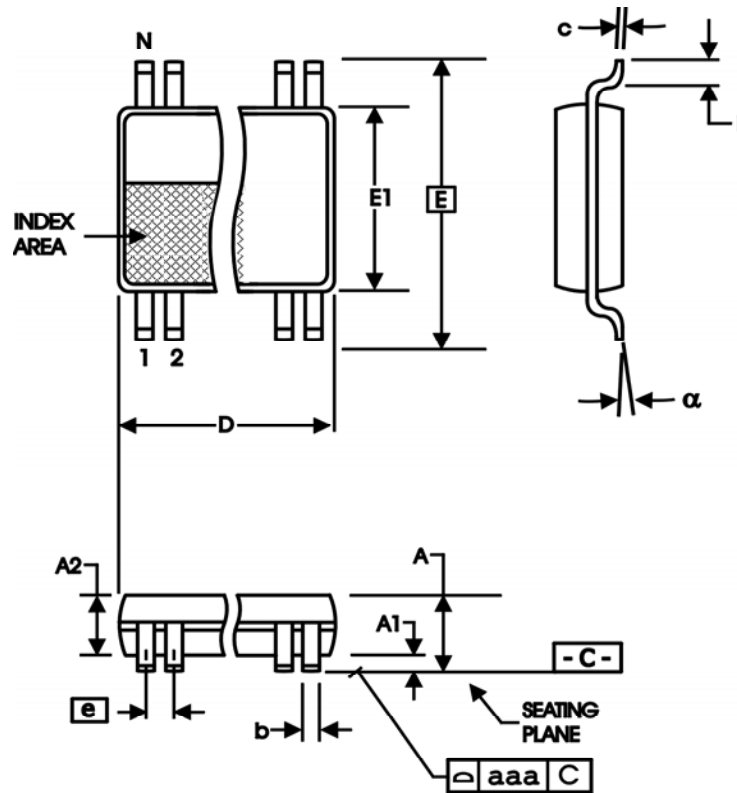


TABLE 8B. PACKAGE DIMENSIONS

| SYMBOL | Millimeters | |
|----------|-------------|---------|
| | Minimum | Maximum |
| N | 16 | |
| A | -- | 1.20 |
| A1 | 0.05 | 0.15 |
| A2 | 0.80 | 1.05 |
| b | 0.19 | 0.30 |
| c | 0.09 | 0.20 |
| D | 4.90 | 5.10 |
| E | 6.40 BASIC | |
| E1 | 4.30 | 4.50 |
| e | 0.65 BASIC | |
| L | 0.45 | 0.75 |
| α | 0° | 8° |
| aaa | -- | 0.10 |

Reference Document: JEDEC Publication 95, MO-153

TABLE 9. ORDERING INFORMATION

| Part/Order Number | Marking | Package | Shipping Packaging | Temperature |
|-------------------|----------|---------------------------|--------------------|---------------|
| ICS85301AK | 301A | 16 Lead VFQFN | Tube | -40°C to 85°C |
| ICS85301AKT | 301A | 16 Lead VFQFN | 2500 Tape & Reel | -40°C to 85°C |
| ICS85301AKLF | 01AL | 16 Lead "Lead-Free" VFQFN | Tube | -40°C to 85°C |
| ICS85301AKLFT | 01AL | 16 Lead "Lead-Free" VFQFN | 2500 Tape & Reel | -40°C to 85°C |
| ICS85301AG | 85301AG | 16 Lead TSSOP | Tube | -40°C to 85°C |
| ICS85301AGT | 85301AG | 16 Lead TSSOP | 2500 tape & reel | -40°C to 85°C |
| ICS85301AGLF | 85301AGL | 16 Lead "Lead-Free" TSSOP | Tube | -40°C to 85°C |
| ICS85301AGLFT | 85301AGL | 16 Lead "Lead-Free" TSSOP | 2500 Tape & Reel | -40°C to 85°C |

NOTE: Parts that are ordered with an "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

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| REVISION HISTORY SHEET | | | | |
|------------------------|-------|----------|---|----------|
| Rev | Table | Page | Description of Change | Date |
| A | T9 | 17 | Ordering Information Table - corrected count. | 11/17/04 |
| A | | | Added 16 Lead TSSOP package throughout the datasheet. | 5/23/05 |
| A | T9 | 10 18 | Added <i>Recommendations for Unused Input Pins</i> . Ordering Information Table - added lead-free marking to ICS85301AGLF part number. | 1/16/06 |
| A | T9 | 18 | Ordering Information Table - corrected Shipping Packaging for 16 lead VFQFN from Tray to Tube. | 3/14/06 |
| B | T4D | 3 | 3.3V LVPECL DC Characteristic Table - added V_{SWING} . Changed V_{OH} from 2.01V min/2.535V max to $V_{CC}-1.125V$ min/ $V_{CC}-0.93V$ max. Changed V_{OL} from 1.24V min/1.845V max to $V_{CC}-1.895V$ min/ $V_{CC}-1.62V$ max. | 4/5/06 |
| | T4E | 4 | 2.5V LVPECL DC Characteristic Table - added V_{SWING} . Changed V_{OH} from 1.25V min/1.705V max to $V_{CC}-1.125V$ min/ $V_{CC}-0.93V$ max. Changed V_{OL} from 0.48V min/1.005V max to $V_{CC}-1.895V$ min/ $V_{CC}-1.62V$ max. | |
| | | 13 - 14 | Power Considerations - corrected power dissipation. | |
| B | T8A | 12 | Added <i>Thermal Release Path</i> . | 12/22/06 |
| | | 12 | Updated Application Schematic Layout Example. | |
| | | 16 | VFQFN Package Dimensions - corrected D2/E2 dimensions. | |

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For Sales

800-345-7015
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Fax: 408-284-2775

For Tech Support

netcom@idt.com
480-763-2056

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

Integrated Device Technology
Singapore (1997) Pte. Ltd.
Reg. No. 199707558G
435 Orchard Road
#20-03 Wisma Atria
Singapore 238877
+65 6 887 5505

Europe

IDT Europe, Limited
321 Kingston Road
Leatherhead, Surrey
KT22 7TU
England
+44 (0) 1372 363 339
Fax: +44 (0) 1372 378851



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