



DSO3001 —High Performance All-silicon Oscillator

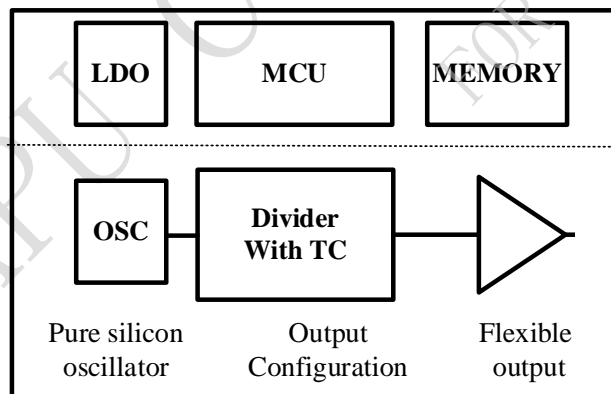
Key Features

- All-silicon without quartz and MEMS
- Total frequency stability : ± 50 ppm
- Single ended output: 10 kHz ~ 212.5MHz
- Differential output: 10 kHz ~ 350 MHz
- Operating temperature : $-40^{\circ}\text{C}\sim 85^{\circ}\text{C}$
- Power supply: 1.8V/2.5V/3.3V
- Output: LVDS, LVPECL, HCSL, CML, LVCMOS or dual LVCMOS
- Package: 3225 and 5032
- Low jitter: 350 fs Typ RMS (12 kHz – 20 MHz bandwidth)
- Built-in LDO and power filter circuit
- RoHS Compliant

Application

- Automotive electronics
- Intelligent terminal
- Ethernet
- Consumer electronics
- Communication equipment

Block Diagram



Overview

Dapu all silicon oscillator adopts unique frequency synthesis and sensor technology, which can output any clock from 10 kHz to 350 MHz without quartz and MEMS devices. The product can keep low jitter and frequency stability in the whole working range, and has high reliability in harsh environment and strong vibration.



Revision History

| Version | Change Contents | Prepared by | Revised Date |
|---------|-----------------|--------------|--------------|
| V1.0.0 | First Issued | <i>David</i> | 2021.05.8 |
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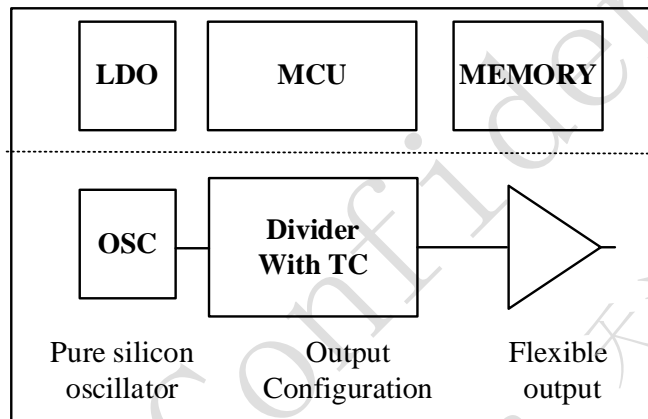
1 Overview

DSO3001 series all silicon oscillator is a clock free oscillator without quartz and MEMS devices. It is a high reliable clock oscillator which can still work normally under harsh environment and strong vibration. The chips can be manufactured to achieve multi-frequency and multi-format output from 10KHz to 350MHz, and maintain low jitter and frequency stability throughout the operation range.



Thanks to the built-in temperature and stress sensors, the DSO3001 all silicon oscillator can adapt to the harsh working environment. The built-in LDO and filter circuit greatly enhance the power supply noise suppression ability of the chip. Flexible clock frequency configuration and output format configuration provide maximum convenience for customer product design.

2 Block Diagram

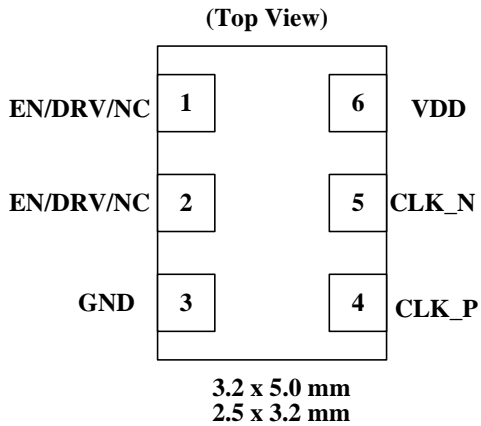


3 Features

- All-silicon without quartz and MEMS
- Total frequency stability: ± 50 ppm
- Single ended output: 10 kHz ~ 212.5MHz
- Differential output: 10 kHz ~ 350 MHz
- Operating temperature: $-40^{\circ}\text{C} \sim 85^{\circ}\text{C}$
- Power supply: 1.8V/2.5V/3.3V
- Output: LVDS, LVPECL, HCSL, CML, LVCMOS or dual LVCMOS
- Package: 3225 and 5032
- Low jitter: 350 fs Typ RMS (12 kHz – 20 MHz bandwidth)
- Built-in LDO and power filter circuit
- RoHS Compliant



4 Pin Definition



| PIN | Description |
|-----|---|
| 1 | Optional function EN = Output Enable, active high DRV = Output Driver Enable, active high NC = Not Connect |
| 2 | Optional function (refer to PIN1) |
| 3 | GND |
| 4 | CLK_P |
| 5 | CLK_N |
| 6 | VDD |

5 Electrical Specifications

Table 5.1 Absolute Maximum Ratings¹

| Parameter | Symbol | Rating | Unit |
|---|-------------------|-------------------------------|------|
| Operating Temperature | T _A | -40 to 85 | °C |
| Storage Temperature | T _S | -55 to 105 | °C |
| Supply Voltage | V _{DD} | -0.5 to 3.8 | V |
| Input Voltage | V _{IN} | -0.5 to V _{DD} + 0.3 | V |
| ESD HBM (JESD22-A114) | HBM | 4.0 | kV |
| Solder Temperature ² | T _{PEAK} | 260 | °C |
| Solder Time at T _{PEAK} ² | T _P | 20 - 40 | sec |

Notes:

1. Stresses beyond those listed in this table may cause permanent damage to the device. Functional operation specification compliance is not implied at these conditions. Exposure to maximum rating conditions for extended periods may affect device reliability.

2. The device is compliant with JEDEC J-STD-020.

Table 5.2 Recommended Operating Conditions

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition/Comment |
|---|-----------------|-------|-----|-------|------|--|
| Supply Voltage | V _{DD} | 1.71 | 1.8 | 1.89 | V | V _{DD} = 1.8 V |
| | | 2.375 | 2.5 | 2.625 | V | V _{DD} = 2.5 V |
| | | 3.135 | 3.3 | 3.47 | V | V _{DD} = 3.3 V |
| Supply Current (F _{CLK} = 50 MHz) | I _{DD} | | 40 | 50 | mA | Tristate Hi-Z (EN = 0, output disabled) |
| | | | 1 | 2 | mA | Ready State |



| | | | | | | |
|-----------------------|----|-----|----|----|----|-------------------------|
| | | | | | | (DRV = 0, standby mode) |
| | | | 70 | 80 | mA | LVPECL (DC-Coupled) |
| | | | 60 | 70 | mA | LVPECL (AC-Coupled) |
| | | | 45 | 55 | mA | LVDS |
| | | | 60 | 70 | mA | HCSL |
| | | | 60 | 70 | mA | CML |
| | | | 40 | 55 | mA | CMOS |
| | | | 50 | 60 | mA | Dual CMOS |
| Operating Temperature | TA | -40 | | 85 | °C | |

Table5.3 Input Electrical Specifications

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition/Comment |
|----------------------------------|-------------------|---------------------|-----|---------------------|------|---|
| Output Enable (EN) ¹ | V _{IH} | 0.7×V _{DD} | | | V | |
| | V _{IL} | | | 0.3×V _{DD} | V | |
| | T _D | | | 3 | μs | Output Disable Time, F _{CLK} >10 MHz |
| | T _E | | | 20 | μs | Output Enable Time, F _{CLK} >10 MHz |
| Output Enable (DRV) ¹ | V _{IH} ' | 0.7×V _{DD} | | | V | |
| | V _{IL} ' | | | 0.3×V _{DD} | V | |
| | T _D ' | | | 3 | μs | Output Disable Time. Within 40us, the current drops to less than 1.5mA F _{CLK} >10 MHz |
| | T _E ' | | | 400 | μs | Output Enable Time, F _{CLK} >10 MHz |

Notes:

1. EN/DRV includes a 50 kΩ pull-up to V_{DD} for EN active high. Includes a 50 kΩ pull-down to GND for EN/DRV active low. NC (No Connect) pins include a 50 kΩ pull-down to GND.

Table 5.4 Output Electrical Specifications

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition/Comment |
|--|--------------------------------|-----------------------|-----|-----------------------|-----------------|--|
| Frequency Range | F _{CLK} | 0.01 | | 350 | MHz | LVDS, LVPECL, CML, HCSL |
| | | 0.01 | | 212.5 | MHz | CMOS, Dual CMOS |
| Total Stability ¹ | F _{STAB} | -50 | | 50 | ppm | Frequency stability |
| Rise/Fall Time (20% to 80% V _{PP}) | T _R /T _F | | | 350 | ps | LVPECL/LVDS/CML |
| | | | 0.5 | 1.5 | ns | CMOS / Dual CMOS (C _L = 5 pF) |
| | | | | 550 | ps | HCSL, F _{CLK} >50 MHz |
| Powerup Time | t _{OSC} | | | 4 | ms | Time from 0.9 × V _{DD} until output frequency (F _{CLK}) within spec |
| Duty Cycle | DC | 45 | | 55 | % | |
| LVPECL Output Option ² (DC-Coupled) | V _{OC} | V _{DD} -1.55 | | V _{DD} -1.25 | V | Mid-level |
| | V _O | 1.4 | | 1.85 | V _{PP} | Swing (diff ⁶) |
| LVPECL Output Option ² | V _O | 1.4 | | 1.85 | V _{PP} | Swing (diff ⁶) |



| | | | | | | |
|---|-----------------|----------------------|------|----------------------|-----------------|---|
| (AC-Coupled) | | | | | | |
| LVDS Output Option ³ (DC-Coupled) | V _{OC} | 1.125 | 1.20 | 1.275 | V | Mid-level (2.5 V, 3.3 V V _{DD}) |
| | | 0.795 | 0.85 | 0.905 | V | Mid-level (1.8 V V _{DD}) |
| | V _O | 0.5 | 0.82 | 0.96 | V _{PP} | Swing (diff ⁶) |
| | V _{OL} | 0 | 5 | 10 | mV | Output voltage low |
| HCSL Output Option ⁴ (R _{term} = 50 Ω; DC-Coupled) | V _{OH} | 695 | 815 | 935 | mV | Output voltage high |
| HCSL Output Option ⁵ (R _{term} = 42.5 Ω; DC-Coupled) | V _{OH} | 695 | 820 | 945 | mV | Output voltage high |
| | V _{OL} | 0 | 5 | 10 | mV | Output voltage low |
| CML Output Option (AC-Coupled) | V _O | 0.725 | 0.8 | 0.89 | V _{PP} | Swing (diff ⁶) |
| CMOS Output Option | V _{OH} | 0.83×V _{DD} | | | V | I _{OH} = 8/6/4 mA for 3.3/2.5/1.8V V _{DD} |
| | V _{OL} | | | 0.17×V _{DD} | V | I _{OL} = 8/6/4 mA for 3.3/2.5/1.8V V _{DD} |

Notes:

1. Total Stability, includes temperature stability, initial accuracy, load pulling, V_{DD} variation, and aging for 10 years at 40°C.
2. R_{term} = 50 Ω to V_{DD} – 2.0 V (Refer to Appendix figure3).
3. R_{term} = 100 Ω (differential) (Refer to Appendix figure4)
4. R_{term} = 50 Ω to GND (Refer to Appendix figure5).
5. R_{term} = 42.5 Ω to GND (Refer to Appendix figure5).
6. “diff” means differential signal

Table 5.5 Clock Output Phase Jitter and PSRR

| Parameter | Symbol | Min | Typ | Max | Test Condition/Comment |
|---|----------------|-----|-----|-----|------------------------|
| Phase Jitter (RMS, 12 kHz - 20 MHz) ^{1,2} F _{CLK} ≥ 10 MHz | φ _J | | 350 | 750 | Differential Formats |
| | | | 350 | | CMOS, Dual CMOS |
| Phase Jitter (RMS, 50 kHz - 20 MHz) F _{CLK} ≥ 156.25 MHz | φ _J | | 150 | 250 | Differential Formats |
| | | | 100 | | CMOS, Dual CMOS |
| Spurs Induced by External Power Supply Noise, 50 mV _{pp} Ripple. LVDS 156.25 MHz Output V _{DD} = 1.8 V | PSRR | | -76 | | 100 kHz sine wave |
| | | | -75 | | 200 kHz sine wave |
| | | | -75 | | 500 kHz sine wave |
| | | | -75 | | 1 MHz sine wave |
| Spurs Induced by External Power Supply Noise, 50 mV _{pp} Ripple. LVDS 156.25 MHz Output V _{DD} = 2.5 or 3.3 V | PSRR | | -83 | | 100 kHz sine wave |
| | | | -83 | | 200 kHz sine wave |
| | | | -83 | | 500 kHz sine wave |
| | | | -82 | | 1 MHz sine wave |

Notes:

1. Applies to output frequency: 50, 100, 156.25, 212.5, 350 MHz.
2. Guaranteed by characterization. Jitter inclusive of any spurs.



6 Environmental Conditions

Table 6.1. Environmental Conditions

| Package | Symbol | Parameter | Test Condition | Value | Unit |
|-------------------|---------------|--|----------------|-------|------|
| | MSL | Moisture Sensitivity Level | 1 | | |
| 5032 6-pin DFN | Θ_{JA} | Thermal Resistance Junction to Ambient | Still Air | 105 | °C/W |
| | Θ_{JB} | Thermal Resistance Junction to Board | Still Air | 81 | °C/W |
| | T_J | Max Junction Temperature | Still Air | 125 | °C |
| 3225 6-pin DFN | Θ_{JA} | Thermal Resistance Junction to Ambient | Still Air | 108 | °C/W |
| | Θ_{JB} | Thermal Resistance Junction to Board | Still Air | 84 | °C/W |
| | T_J | Max Junction Temperature | Still Air | 125 | °C |

7 Dimension and Package

7.1 Dimension (5032)



Table 7.1. Package Diagram Dimensions (mm)

| Dimension | Min | Nom | Max |
|-----------|------|-----------|------|
| A | | 3.2 BSC | |
| B | | 4 BSC | |
| C | 0.8 | 0.85 | 0.9 |
| C1 | 0 | 0.035 | 0.05 |
| C2 | | 0.203 REF | |
| D | | 1.27 BSC | |
| E | 0.59 | 0.64 | 0.69 |
| F | 0.7 | 0.75 | 0.8 |
| G | 0.59 | 0.64 | 0.69 |
| H | | 0.85 REF | |
| aaa | | 0.1 | |
| bbb | | 0.1 | |
| ccc | | 0.08 | |
| ddd | | 0.1 | |
| eee | | 0.1 | |

Figure 7.1. DSO3001 (5032) Outline Diagram



Notes:

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.

7.2 Dimension (3225)



Table 7.2. Package Diagram Dimensions (mm)

| Dimension | Min | Nom | Max |
|-----------|------|-----------|------|
| A | | 2.5 BSC | |
| B | | 3.2 BSC | |
| C | 0.8 | 0.85 | 0.9 |
| C1 | 0 | 0.035 | 0.05 |
| C2 | | 0.203 REF | |
| D | | 1.175 BSC | |
| E | 0.6 | 0.65 | 0.7 |
| F | 0.65 | 0.7 | 0.75 |
| G | 0.45 | 0.5 | 0.55 |
| H | | 0.8 REF | |
| aaa | | 0.1 | |
| bbb | | 0.1 | |
| ccc | | 0.08 | |
| ddd | | 0.07 | |
| eee | | 0.05 | |

Figure 7.2. DSO3001 (5032) Outline Diagram

Notes:

1. The dimensions in parentheses are reference.
2. All dimensions in millimeters (mm).
3. Dimensioning and Tolerancing per ANSI Y14.5M-1994.



7.3 PCB

The figure below illustrates the PCB land pattern for the DSO3001. The table below lists the values for the dimensions shown in the illustration.



Figure 7.3. DSO3001 (5032 and 3225) PCB Land Pattern

Table 7.3. PCB Land Pattern Dimensions (mm)

| Dimension | 5032(mm) | 3225(mm) |
|-----------|----------|----------|
| X1 | 0.75 | 0.7 |
| Y1 | 0.64 | 0.65 |
| Y2 | 0.64 | 0.5 |
| D1 | 2.25 | 1.6 |
| E1 | 1.27 | 1.05 |

7.4 Marking

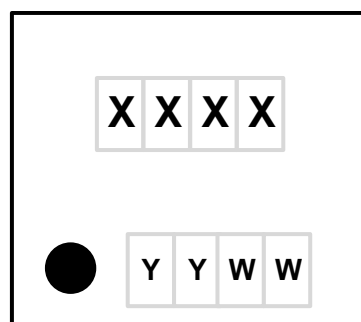


Figure 7.4 DSO3001 Top Mark

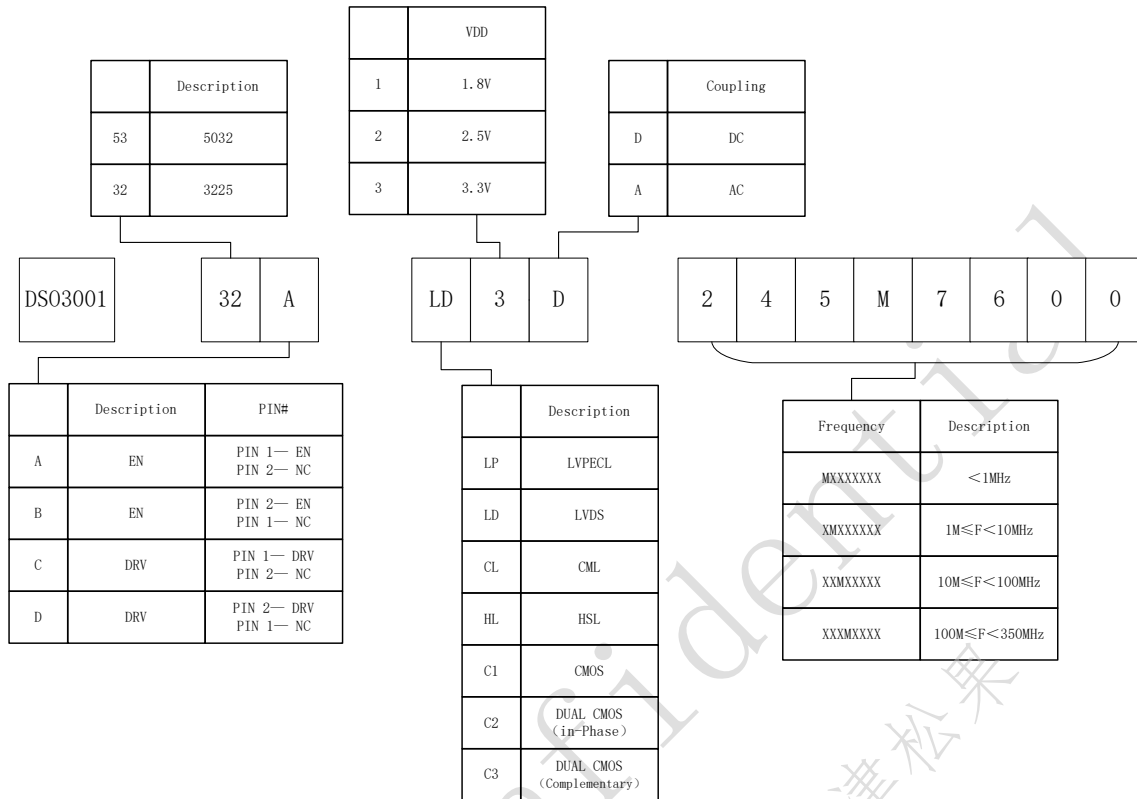
Table 7.4 Top Mark Description

| Line | Print | Description |
|------|-------|-------------|
| 1 | XXXX | LOGO |
| 2 | YYWW | DATE |



8 Ordering Guide

The naming rules and definitions of DSO3001 are as follows:



Notes:

- DSO3001-32A-LD3D-245M7600 means a silicon crystal with 3225 package, 1 pin defined as EN, input voltage 3.3V, output 245.76M DC-coupled LVDS signal.
- Recommended Signal Formats and Voltage Combinations

| Signal Format | VDD | Coupling |
|--------------------------|----------------|----------|
| LVPECL | 2.5V/3.3V | DC/AC |
| LVDS | 1.8V/2.5V/3.3V | DC |
| CML | 1.8V/2.5V/3.3V | AC |
| HCSL(50 Ω termination) | 1.8V/2.5V/3.3V | DC |
| HCSL(42.5 Ω termination) | 1.8V/2.5V/3.3V | DC |
| CMOS/Dual CMOS | 1.8V/2.5V/3.3V | DC |



Appendix

Recommended Output Terminations

CMOS

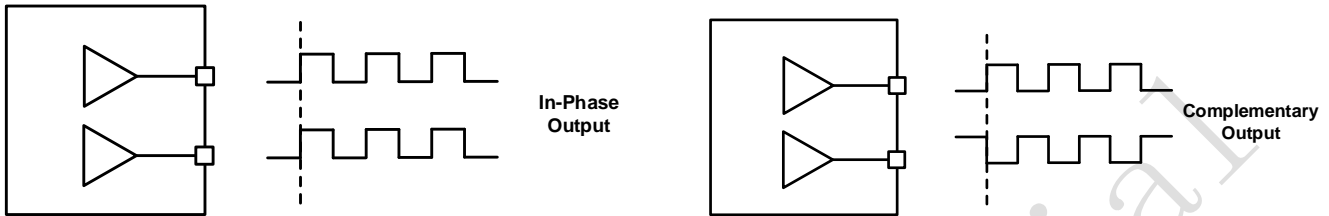


Figure 1 Dual CMOS Output

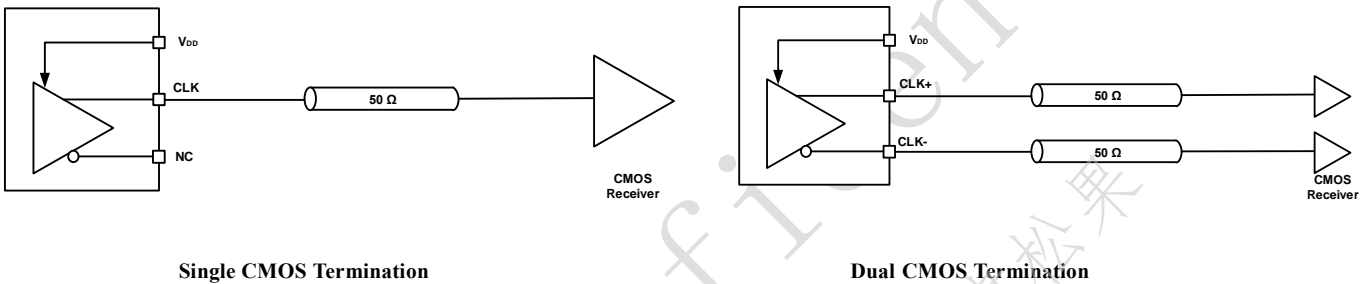
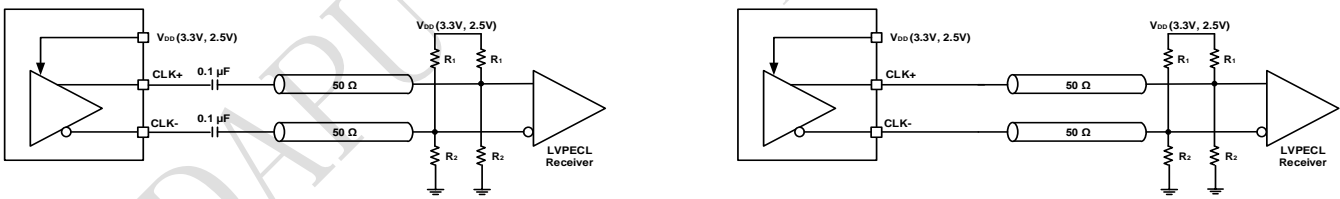


Figure 2. CMOS Output Termination

LVPECL

The output drivers support AC-coupled or DC-coupled terminations as shown in figures below.

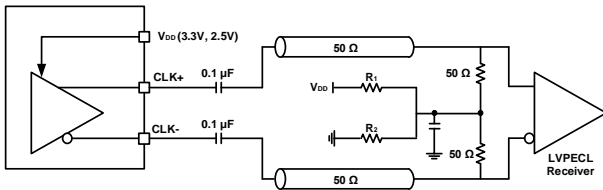


AC-Coupled LVPECL – Thevenin Termination

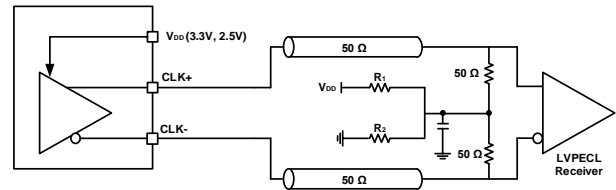
DC-Coupled LVPECL – Thevenin Termination

Table 1. Termination Resistor Values

| V _{DD} | R ₁ | R ₂ |
|-----------------|----------------|----------------|
| 3.3 V | 127 Ω | 82.5 Ω |
| 2.5 V | 250 Ω | 62.5 Ω |



AC-Coupled LVPECL – 50 Ω w/ VTT Bias



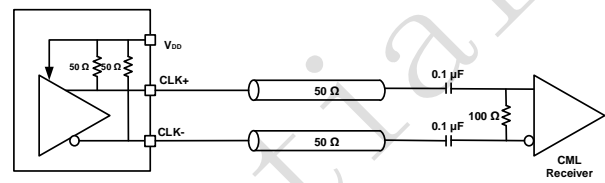
DC-Coupled LVPECL – 50 Ω w/ VTT Bias

Figure 3. LVPECL Output Terminations

LVDS/CML



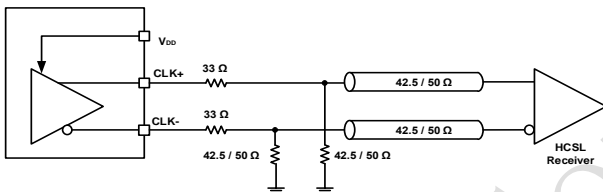
DC-Coupled LVDS



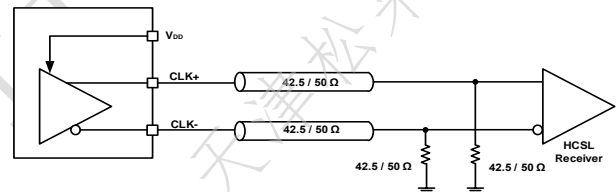
AC-Coupled CML

Figure 4. LVDS / CML Output Terminations

HCSL



Source Terminated HCSL



Destination Terminated HCSL

Figure 5. HCSL Output Terminations