

SSC Clock Generator/Buffer

FEATURES

- Part of a Family of Easy to use Clock Generator Devices With Optional SSC
- SSC Capable Clock Generator / Buffer
- SSC Controllable via 3 External Pins
 - $\pm 0\%$ to $\pm 1.5\%$ Center Spread
- 1 External Control Pin for SSC ON / OFF Selection
- 40 MHz to 108 MHz Single-Ended LVCMOS Input
- Single 3.3V Device Power Supply
- Wide Temperature Range – 40°C to 85°C
- Low Space Consumption by 8 Pin TSSOP Package

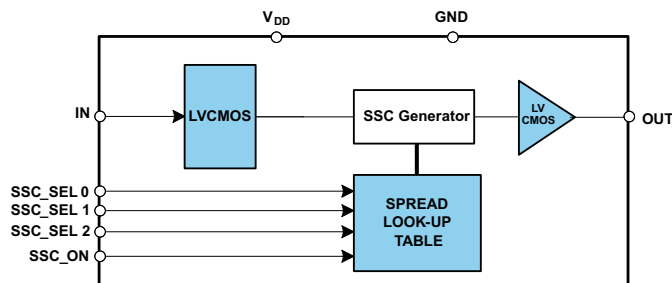
APPLICATIONS

- Consumer and Industrial Applications Requiring EMI Reduction through Spread Spectrum Clocking

PACKAGE

| | | | |
|-----------|---|---|-----------|
| IN | 1 | 8 | VDD |
| SSC_SEL 0 | 2 | 7 | SSC_SEL 2 |
| SSC_SEL 1 | 3 | 6 | OUT |
| GND | 4 | 5 | SSC_ON |

BLOCK DIAGRAM



DESCRIPTION

The CDCS501 is a spread spectrum capable, LVCMOS Input Clock Buffer for EMI reduction.

The device is designed to counter common EMI problems in modern electronic designs.

It accepts a 3.3V LVCMOS signal at the input and spread this signal by a small amount, centered around the input frequency. The amount of spread can be selected via 3 control pins. The Functional Table contains detailed information on the amount of spread. A 4th control pin can be used to activate or deactivate the Spread Spectrum Clock Generator.

Selecting SSC_ON = off will turn the Spread Spectrum Clock Generator off only. The device will still pass the LVCMOS signal that's presented at its input through to its output. This pin is low active.

The wide operating frequency range covers most commonly used midrange Audio and Video frequencies. The CDCS501 operates in 3.3V environment.

It is characterized for operation from –40°C to 85°C, and available in an 8-pin TSSOP package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



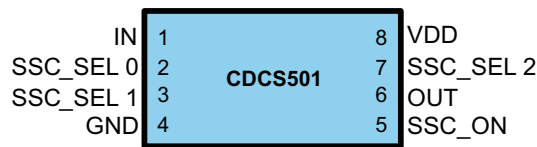
These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

FUNCTION TABLE

| SSC_ON | SSC_SEL 0 | SSC_SEL 1 | SSC_SEL 2 | SPREAD AMOUNT |
|--------|-----------|-----------|-----------|---------------|
| 1 | x | x | X | 0.00% |
| 0 | 0 | 0 | 0 | 1.00% |
| 0 | 0 | 0 | 1 | 1.50% |
| 0 | 0 | 1 | 0 | 1.00% |
| 0 | 0 | 1 | 1 | 1.50% |
| 0 | 1 | 0 | 0 | 0.50% |
| 0 | 1 | 0 | 1 | 0.75% |
| 0 | 1 | 1 | 0 | 0.00% |
| 0 | 1 | 1 | 1 | 0.50% |

DEVICE INFORMATION

PACKAGE



PIN FUNCTIONS

| PIN | | | |
|-----------------|---------|--------|--|
| NAME | NO. | Type | Description |
| IN | 1 | I | LVC MOS Clock Input |
| OUT | 6 | O | LVC MOS Clock Output |
| SSC_SEL 0, 1, 2 | 2, 3, 7 | I | Spread Selection Pins, internal Pull-up |
| SSC_ON | 5 | I | SSC on/off Pin, active low; internal Pull-down |
| VDD | 8 | Power | 3.3V Power Supply |
| GND | 4 | Ground | Ground |

PACKAGE THERMAL RESISTANCE FOR TSSOP (PW) PACKAGE⁽¹⁾

| CDCS501PW 8-PIN TSSOP | | | THERMAL AIRFLOW (CFM) | | | | UNIT |
|-----------------------|--------|----|-----------------------|-----|-----|-----|--------|
| | | | 0 | 150 | 250 | 500 | |
| R _{θJA} | High K | | 149 | 142 | 138 | 132 | °C / W |
| | Low K | | 230 | 185 | 170 | 150 | |
| R _{θJc} | High K | 65 | | | | | °C / W |
| | Low K | 69 | | | | | |

(1) The package thermal impedance is calculated in accordance with JESD 51 and JEDEC2S2P (high-k board).

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

| | | VALUE | UNIT |
|------------------|---|-------------|------|
| V _{DD} | Supply voltage range | –0.5 to 4.6 | V |
| V _{IN} | Input voltage range | –0.5 to 4.6 | V |
| V _{out} | Output voltage range | –0.5 to 4.6 | V |
| I _{IN} | Input current (V _I < 0, V _I > V _{DD}) | 20 | mA |
| I _{out} | Continuous output current | 50 | mA |
| T _{ST} | Storage temperature range | –65 to 150 | °C |
| T _J | Maximum junction temperature | 125 | °C |

- (1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

| | | MIN | NOM | MAX | UNIT |
|----------------------------------|---------------------------------|---------------------|---------------------|---------------------|------|
| V _{DD} | Supply voltage | 3.0 | | 3.6 | V |
| f _{IN} | Input Frequency | 40 | | 108 | MHz |
| V _{IL} | Low level input voltage LVCMOS | | | 0.3 V _{DD} | V |
| V _{IH} | High level input voltage LVCMOS | 0.7 V _{DD} | | | V |
| V _I | Input Voltage threshold LVCMOS | | 0.5 V _{DD} | | V |
| C _L | Output Load Test LVCMOS | | | 15 | pF |
| I _{OH} /I _{OL} | Output Current | | | 12 | mA |
| T _A | Operating free-air temperature | –40 | | 85 | °C |

DEVICE CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|----------------|-----------------------------------|---|-----|------|-----|---------|
| I_{DD} | Device supply current | $f_{IN} = 80 \text{ MHz}$ | | 26 | | mA |
| f_{OUT} | Output frequency | | 40 | | 108 | MHz |
| I_{IH} | LVC MOS input current | $V_I = V_{DD}; V_{DD} = 3.6V$ | | | 10 | μA |
| I_{IL} | LVC MOS input current | $V_I = 0 \text{ V}; V_{DD} = 3.6V$ | | | -10 | μA |
| V_{OH} | LVC MOS high-level output voltage | $I_{OH} = -0.1mA$ | 2.9 | | | V |
| | | $I_{OH} = -8mA$ | 2.4 | | | |
| | | $I_{OH} = -12mA$ | 2.2 | | | |
| V_{OL} | LVC MOS low-level output voltage | $I_{OL} = 0.1mA$ | | | 0.1 | V |
| | | $I_{OL} = 8mA$ | | | 0.5 | |
| | | $I_{OL} = 12mA$ | | | 0.8 | |
| $t_{JIT(C-C)}$ | Cycle to cycle jitter cycles | $f_{out} = 80 \text{ MHz}; SSC = 1\%, 10000 \text{ cycles}$ | | 110 | | ps |
| t_r/t_f | Rise and fall time | 20%–80% | | 0.75 | | ns |
| O_{dc} | Output duty cycle | | 45% | | 55% | |
| f_{MOD} | Modulation frequency | | | 30 | | kHz |

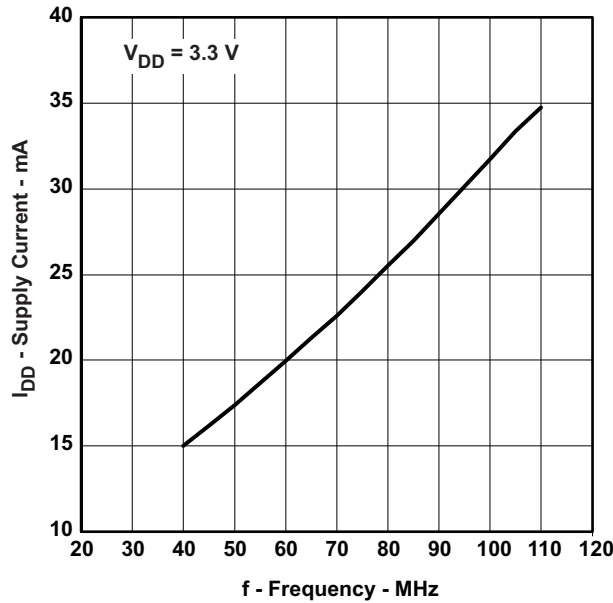


Figure 1. I_{DD} vs. Input Frequency, $V_{DD} = 3.3V$

APPLICATION INFORMATION

SSC MODULATION

The exact implementation of the SSC modulation plays a vital role for the EMI reduction. The CDCS501 uses a triangular modulation scheme implemented in a way that the modulation frequency depends on the VCO frequency of the internal PLL and the spread amount is independent from the VCO frequency.

The modulation frequency can be calculated by using the below formula.

$$f_{\text{mod}} = f_{\text{IN}} / 2480$$

PARAMETER MEASUREMENT INFORMATION

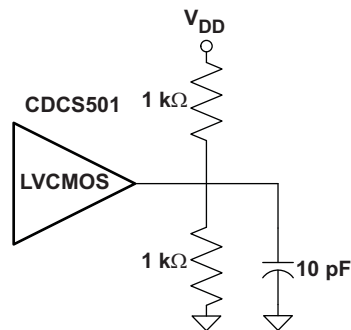


Figure 2. Test Load

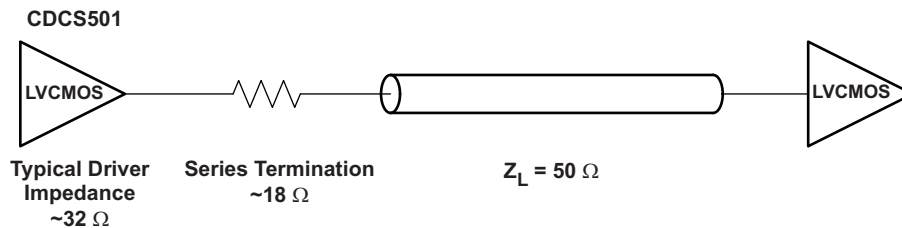


Figure 3. Test Load for 50-Ω Board Environment

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| CDCS501PW | ACTIVE | TSSOP | PW | 8 | 150 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CS501 | Samples |
| CDCS501PWR | ACTIVE | TSSOP | PW | 8 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | CS501 | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

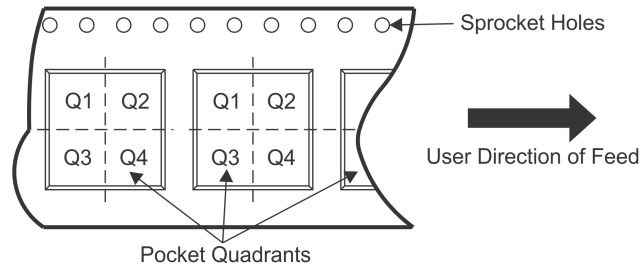
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CDCS501PWR | TSSOP | PW | 8 | 2000 | 330.0 | 12.4 | 7.0 | 3.6 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CDCS501PWR | TSSOP | PW | 8 | 2000 | 853.0 | 449.0 | 35.0 |

PW0008A



PACKAGE OUTLINE

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153, variation AA.

EXAMPLE BOARD LAYOUT

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:10X



SOLDER MASK DETAILS
NOT TO SCALE

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NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:10X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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