



**THE DATASHEET OF
CLC001AJE-TR13/NOPB**



CLC001

CLC001 Serial Digital Cable Driver with Adjustable Outputs



Literature Number: SNLS066B

CLC001

Serial Digital Cable Driver with Adjustable Outputs

General Description

The CLC001 is a monolithic, high-speed cable driver designed for use in SMPTE 259M serial digital video and ITU-T G.703 serial digital data transmission applications. The CLC001 drives 75Ω transmission lines (Belden 8281 or equivalent) at data rates up to 622 Mbps. Controlled output rise and fall times (400 ps typical) minimize transition-induced jitter. The output voltage swing is adjustable from 800 mV_{p-p} to 1.0 V_{p-p} using an external resistor.

The CLC001's output stage consumes less power than other designs. The differential inputs accept LVDS signal levels, LVPECL levels directly or PECL with attenuation networks.

All these make the CLC001 an excellent general purpose high speed driver for high-speed, long distance data transmission applications.

The CLC001 is powered from a single +3.3V supply and comes in a small 8-pin SOIC package.

Key Specifications

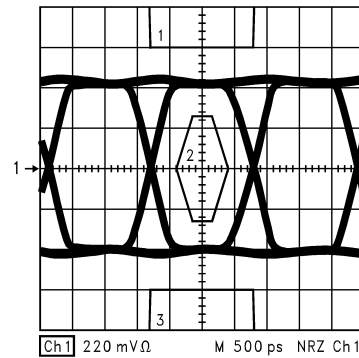
- 400 ps rise and fall times
- Data rates to 622 Mbps
- 100 mV differential input threshold
- Low residual jitter

Features

- Adjustable output amplitude
- Differential input and output
- Accepts LVPECL or LVDS input swings
- Low power dissipation
- Single +3.3V supply

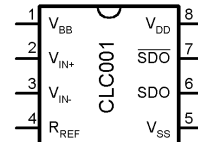
Applications

- Digital routers and distribution amplifiers
- Coaxial cable driver for digital transmission lines
- Twisted pair driver
- Serial digital video interfaces for the commercial and broadcast industry
- SMPTE, Sonet/SDH, and ATM compatible driver
- Buffer applications



622 Mbps Eye Pattern with STM-4 Signal Mask

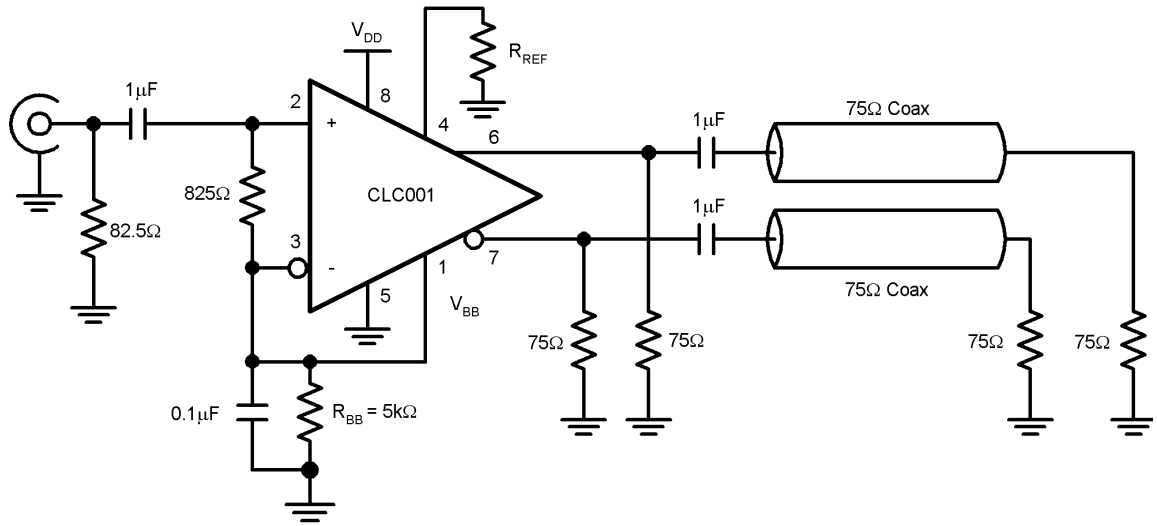
Connection Diagram (8-Pin SOIC)



10132902

Order Number CLC001AJE
See NS Package Number M08A

Typical Application



10132901

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	4V
Output Current	27 mA
Maximum Junction Temperature	+125°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering 10 seconds)	+300°C
ESD Rating (HBM)	≥ 7 kV
ESD Rating (MM)	≥ 500V
Package Thermal Resistance θ_{JA} Surface Mount AJE	125°C/W

 θ_{JC} Surface Mount AJE

105°C/W

Reliability Information

Transistor count

291

Recommended Operating Conditions

Supply Voltage Range ($V_{DD} - V_{SS}$)	+3.0V to +3.6V
Operating Free Air Temperature (T_A)	-40°C to +85°C
R_{BB} Range (applied to V_{BB} input) (Note 6)	1.3k Ω to 11.5k Ω

Electrical Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified (Notes 2 and 3)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
OUTPUT DC SPECIFICATIONS						
V_{SDO}	Serial Driver Output Voltage	$R_L = 75\Omega$ 1%, $R_{REF} = 1.91$ k Ω 1% (for 800 mV _{p-p}), Figure 1	720	800	880	mV
		$R_L = 75\Omega$ 1%, $R_{REF} = 1.5$ k Ω 1% (for 1.0 V _{p-p}), Figure 1	900	1000	1100	mV
INPUT DC SPECIFICATIONS						
V_{TH}	Differential Input High Threshold	$V_{CM} = +0.05V$ or +1.2V or +3.25V,		0	+100	mV
V_{TL}	Differential Input Low Threshold	$V_{DD} = 3.3V$	-100	0		mV
V_{CMR}	Common Mode Voltage Range	$V_{ID} = 100mV$, $V_{DD} = 3.3V$	0.05		3.25	V
I_{IN}	Input Current	$V_{IN} = 0V$ or +3.0V, $V_{DD} = 3.6V$ or 0V		±1	±10	μA
I_{INB}	Input Current Balance	$V_{IN} = 0V$ or +3.0V, $V_{DD} = 3.6V$ or 0V, (Note 8)		0.23		μA
SUPPLY CURRENT						
I_{DD}	Total Dynamic Power Supply Current (includes load current)	$R_L = 75\Omega$, $R_{REF} = 1.91$ k Ω 1% ($V_{SDO} = 800$ mV _{p-p} @ 270 Mbps)		70	115	mA
		$R_L = 75\Omega$, $R_{REF} = 1.5$ k Ω 1% ($V_{SDO} = 1.0$ V _{p-p} @ 622 Mbps)		85	130	mA
MISCELLANEOUS PARAMETERS						
L_{GEN}	Output Inductance			6		nH
R_{GEN}	Output Resistance			25		k Ω
I_{BB}	V_{BB} Current	$R_{REF} = 1.91$ k Ω 1%, (Note 6)		250		μA
		$R_{REF} = 1.5$ k Ω 1%, (Note 6)		315		μA

AC Electrical Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified (Note 3)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_r, t_f	Rise time, Fall time	20%–80%, (Notes 4, 5)		400	800	ps
t_{os}	Output overshoot			5		%
t_{jit}	Output jitter	(Note 7)		25		ps
t_{pd}	Propagation delay	(Note 5)		1.9		ns

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" specifies conditions of device operation.

Note 2: Current flow into device pins is defined as positive. Current flow out of device pins is defined as negative. All voltages are stated referenced to $V_{SS} = 0V$.

Note 3: Typical values are at 25°C and 3.3V.

Note 4: This parameter is Guaranteed by Design.

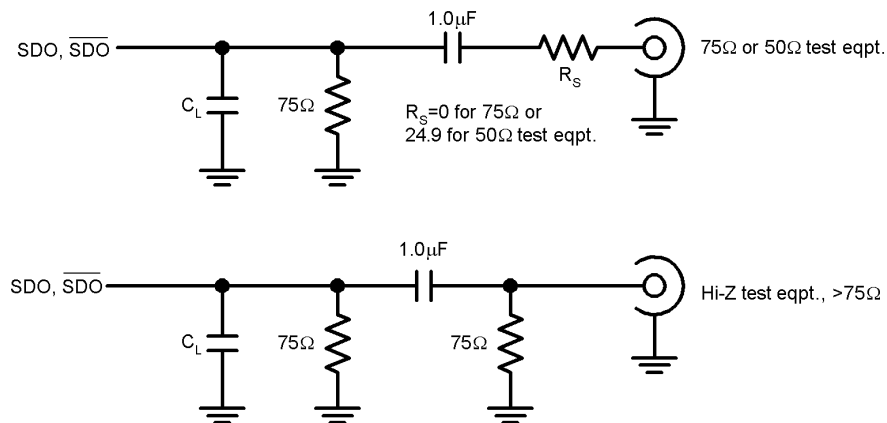
Note 5: $R_L = 75\Omega$, AC-coupled at 270 Mbps, $R_{REF} = 1.91\text{ k}\Omega$ 1% (for $V_{SDO} = 800\text{ mV}_{p-p} \pm 10\%$), C_L not greater than 5pF (See Figure 1)

Note 6: The V_{BB} output is intended as a bias supply pin for the inputs of this device only. It is not designed as a power supply output and should not be used to power other devices.

Note 7: $R_L = 75\Omega$, AC-coupled at 622 Mbps, $R_{REF} = 1.5\text{ k}\Omega$ 1% (for $V_{SDO} = 1.0\text{ V}_{p-p} \pm 10\%$), clock pattern input.

Note 8: Input Current Balance (I_{INB}) is the difference between the Input Current (I_{IN}) on V_{IN+} and V_{IN-} for the same bias condition.

Test Loads

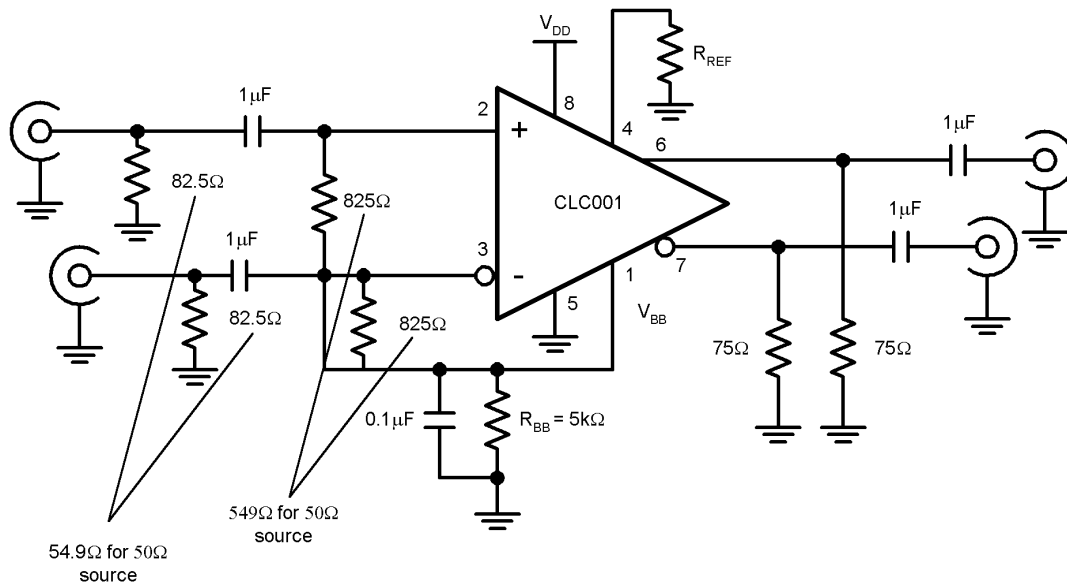


C_L represents probe and test fixture capacitance and is not greater than 5pF.

10132904

FIGURE 1. Test Loads

Test Loads (Continued)



10132903

FIGURE 2. Test Circuit

Pin Descriptions

Pin #	Name	Description
1	V_{BB}	Optional, bias voltage (may be used to bias inputs) - see device operation section for details. If unused leave as no connect (NC).
2	V_{IN+}	Positive input pin
3	V_{IN-}	Negative input pin
4	R_{REF}	Output driver level control. Connect a resistor to ground to set output voltage swing.
5	V_{SS}	Negative power supply
6	SDO	Serial data true output
7	\overline{SDO}	Serial data complement output
8	V_{DD}	Positive power supply

Device Operation

INPUT INTERFACING

Numerous input configurations exist for applying PECL, LVPECL, and LVDS signals to the input of the CLC001. Inputs may be single-ended or differential, AC or DC coupled.

The V_{BB} pin may be used to provide a DC bias voltage to the inputs. Leave this pin as a no connect when no bias is needed. Note that DC-coupled inputs such as direct LVDS and LVPECL connections are self-biasing and do not require use of the V_{BB} pin. I_{BB} , the current produced by the V_{BB} pin, depends on R_{REF} . For a given R_{REF} , the I_{BB} current will remain constant, and the bias voltage is determined by the value of resistance, R_{BB} , between the V_{BB} pin and ground. *Figure 3* and *Figure 4* show how R_{BB} corresponds to some common V_{BB} values with R_{REF} held at 1.91 k Ω and 1.5 k Ω , respectively. Some common input configurations are shown in *Figure 5* through *Figure 9*.

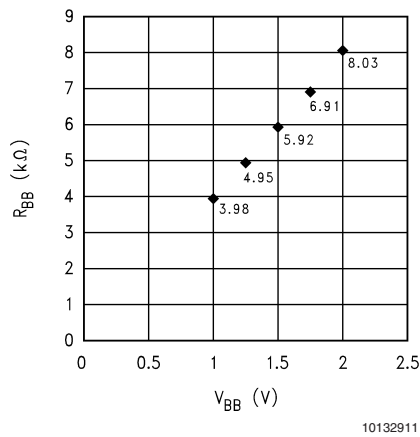


FIGURE 3. R_{BB} vs. V_{BB} for $R_{REF} = 1.91$ k Ω

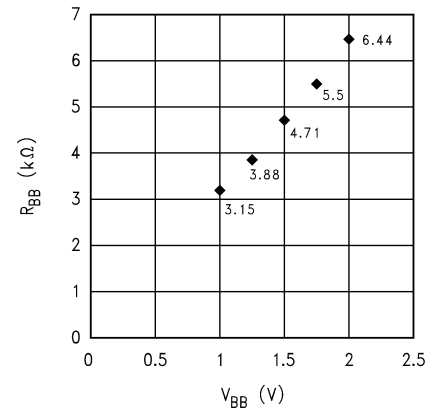
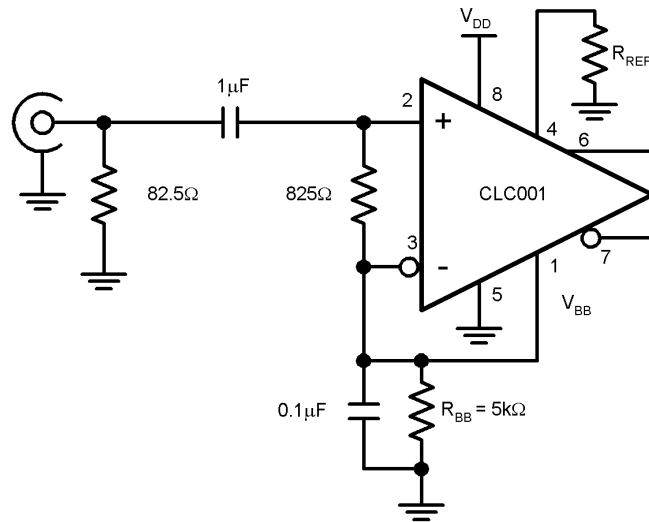


FIGURE 4. R_{BB} vs. V_{BB} for $R_{REF} = 1.5$ k Ω

Device Operation (Continued)

Figure 5 shows the CLC001 with an AC-coupled, single ended input connection. The 82.5Ω resistor in parallel with

825Ω gives the equivalent termination resistance of 75Ω . R_{BB} set at $5k\Omega$ provides $1.25V$ of DC bias to the input.

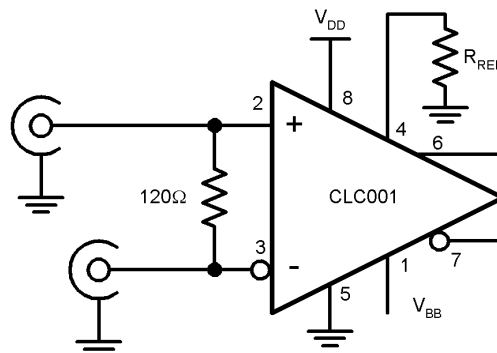


10132905

FIGURE 5. Single Ended 75Ω Coaxial Cable, AC-coupled

A typical DC-coupled, twisted pair cable connection is shown in Figure 6. The CLC001 is driven differentially. The line is terminated with a termination resistor equal to the impedance of the line being driven. The actual resistor value is

media specific, but typically is between 100 and 120Ω depending upon the cable. This resistor should be located close to the CLC001 inputs pins to minimize the resulting stub length between the resistor and device pads.



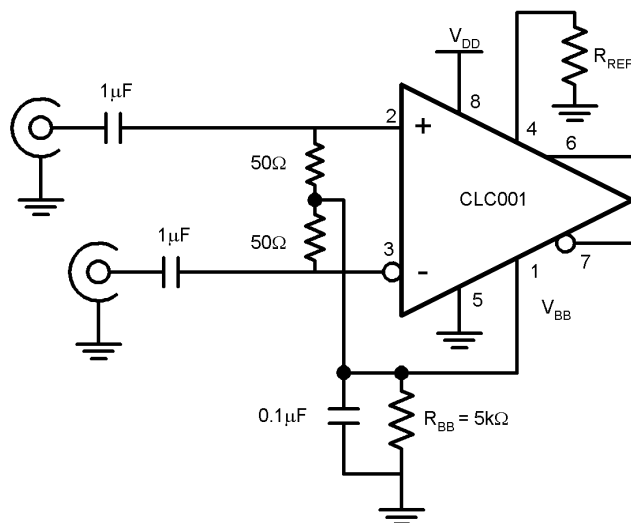
10132906

FIGURE 6. Twisted Pair Cable, DC-coupled

Device Operation (Continued)

Figure 7 shows an AC-coupled, twisted pair cable application. It implements a center tap capacitance termination

used in conjunction with two 50Ω resistors to filter common mode noise. R_{BB} set at $5k\Omega$ provides $1.25V$ of DC bias to each input.

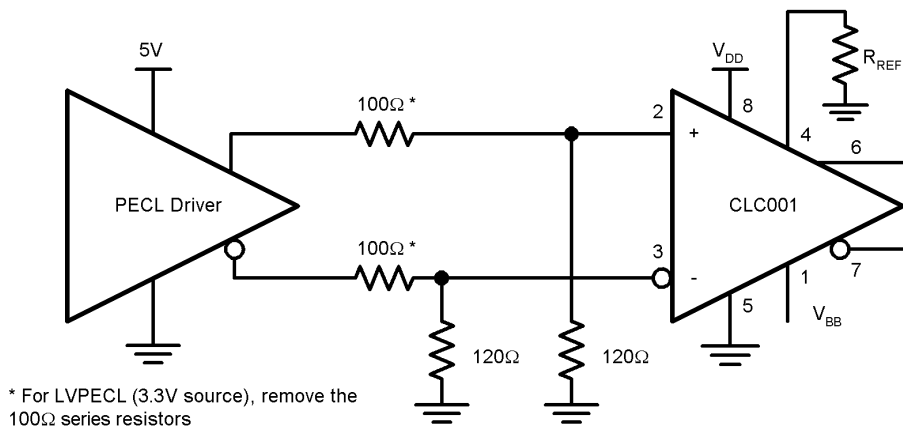


10132907

FIGURE 7. Twisted Pair Cable, AC-coupled

PECL or LVPECL drivers may be interfaced to the CLC001 as shown in Figure 8. The voltage divider network will reduce the PECL output to the proper levels. For LVPECL, the 100Ω series resistors should be removed, since the common

mode range inputs of the CLC001 are wide enough to accept LVPECL levels directly. No external DC biasing is required for PECL/LVPECL connections.



* For LVPECL (3.3V source), remove the 100Ω series resistors

10132908

FIGURE 8. PECL, DC-coupled

Device Operation (Continued)

A typical LVDS input connection is shown in *Figure 9*. The media is driven differentially by an LVDS driver. The line is terminated with a termination resistor equal to the impedance of the line being driven. The actual resistor value is

media specific, but typically is between 100 and 120 Ω . This resistor should be located close to the CLC001 inputs pins to minimize the resulting stub length between the resistor and device pads. The CLC001 supports $\pm 100\text{mV}$ thresholds across the entire LVDS common mode range of 0.1V to 2.3V for a 200mV differential signal.

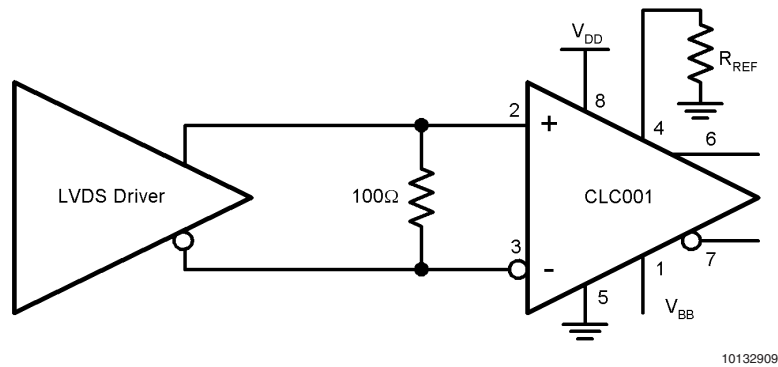


FIGURE 9. LVDS, DC-coupled

Device Operation (Continued)

OUTPUT INTERFACING

The CLC001 has two complementary, ground referenced outputs designed to drive AC-coupled and terminated 75Ω coaxial cables. The outputs are single ended; however, they could be treated as a single differential output as long as current paths from each output go to ground.

The output of the CLC001 is a high impedance current source. It expects to see a 75Ω shunt resistor before driving cable to convert the current output to a voltage and provide proper back-matching. No series back-matching resistors should be used. Refer to *Section Typical Application* for an illustration.

Output levels range from 800 mV_{p-p} to 1.0 V_{p-p} ±10% into 75Ω AC-coupled, back-matched loads. Output level is controlled by the value of R_{REF} connected to pin 4. R_{REF} is 1.91 kΩ ±1% for 800 mV_{p-p}, and 1.5 kΩ ±1% for 1.0 V_{p-p}. Refer to *Figure 10* for the output level's sensitivity to R_{REF}.

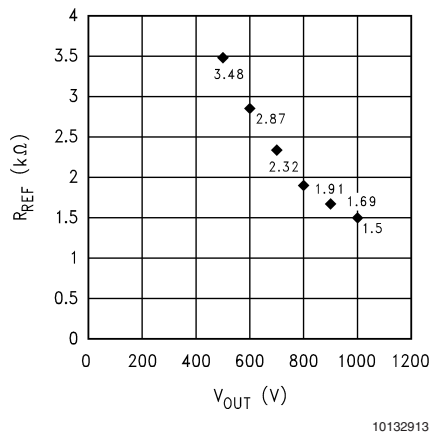


FIGURE 10. Output level's sensitivity to R_{REF}

Evaluation Board

Evaluation boards are available for a nominal charge that demonstrate the basic operation of the SDI/SDV/SDH de-

VICES. The evaluation boards can be ordered through National's Distributors. Supplies are limited, please check for current availability.

The SD001EVK evaluation kit for the CLC001, Serial Digital Cable Driver with Adjustable Outputs, provides an operating environment in which the cable driver can be evaluated by system / hardware designers. The evaluation board has all the needed circuitry and connectors for easy connection and checkout of the device circuit options as discussed in the CLC001 datasheet. A schematic, parts list and pictorial drawing are provided with the board.

From the WWW, the following information may be viewed / downloaded for most evaluation boards: www.national.com/appinfo/interface

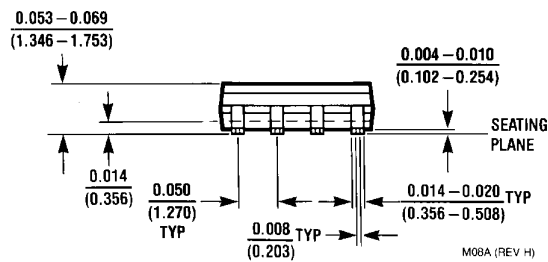
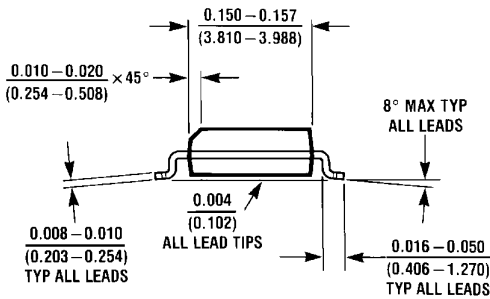
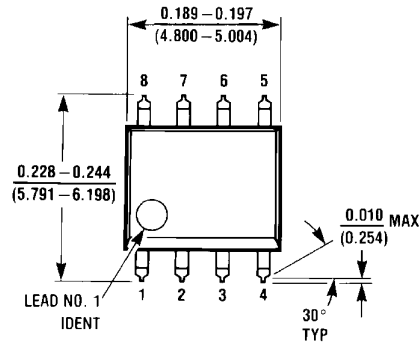
- Device Datasheet and / or EVK User Manual
- View a picture of the EVK
- View the EVK Schematic
- View the top assembly drawing and BOM
- View the bottom assembly drawing and BOM

PCB Layout Recommendations

Printed circuit board layout affects the performance of the CLC001. The following guidelines will aid in achieving satisfactory device performance.

- Use a ground plane or power/ground plane sandwich design for optimum performance.
- Bypass device power with a 0.01 μF monolithic ceramic capacitor in parallel with a 6.8 μF tantalum electrolytic capacitor located no more than 0.1" (2.5 mm) from the device power pins.
- Provide short, symmetrical ground return paths for:
 - inputs,
 - supply bypass capacitors and
 - the output load.
- Provide short, grounded guard traces located
 - under the centerline of the package,
 - 0.1" (2.5 mm) from the package pins
 - on both top and bottom of the board with connecting vias.

Physical Dimensions inches (millimeters) unless otherwise noted



Order Number CLC001AJE
NS Package Number M08A

M08A (REV H)

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.
For the most current product information visit us at www.national.com.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor manufactures products and uses packing materials that meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.

Leadfree products are RoHS compliant.



National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated







Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View CLC001AJE-TR13/NOPB on WIN SOURCE](#)

 [Texas Instruments](#) Information

Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management