

Comlinear CLC111

Ultra-High Slew Rate, Closed-Loop Buffer

General Description

The Comlinear CLC111 is a high-performance, closed-loop, monolithic buffer designed for applications requiring very high-frequency signals. The CLC111's high performance includes an extremely fast 800MHz small signal bandwidth (0.5V_{pp}) and an ultra high (3500V/μs) slew rate while requiring only 10.5mA quiescent current. Signal fidelity is maintained with low harmonic distortion (-62dBc 2nd and 3rd harmonics at 20MHz). These performance characteristics are for a demanding 100Ω load.

Featuring a patented closed-loop design, the CLC111 offers nearly ideal unity-gain (0.996) with very low (1.4Ω) output impedance. The CLC111 is ideally suited for buffering video signals with its 0.15%/0.04° differential gain and phase performance at 4.43MHz. Power sensitive applications will benefit from the CLC111's excellent performance on reduced or single supply voltages.

Constructed using an advanced, complementary bipolar process and Comlinear's proven high-performance architectures, the CLC111 is available in several versions to meet a variety of requirements.

CLC111AJP	-40°C to +85°C	8-pin Plastic DIP
CLC111AJE	-40°C to +85°C	8-pin Plastic SOIC
CLC111A8B	-55°C to +125°C	8-pin hermetic CERDIP, MIL-STD-883, Level B
CLC111ALC	-40°C to +85°C	dice
CLC111AMC	-55°C to +125°C	dice qualified to Method 5008, MIL-STD-883, Level B

Contact factory for other packages and DESC SMD number.

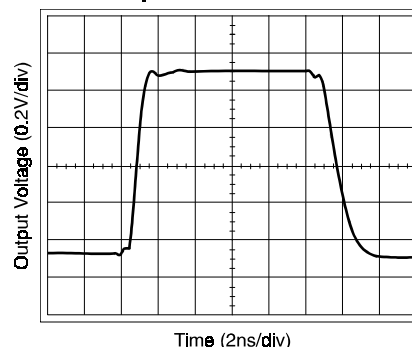
Features

- Very wideband (800MHz)
- Ultra-high (3500V/μs) slew rate
- Very low output impedance (1.4Ω)
- Low (-62dBc) 2nd/3rd harmonics @ 20MHz
- 60mA output current (±5 supplies)
- Single supply operation (0 to 3V supply min.)
- Evaluation boards and Spice models

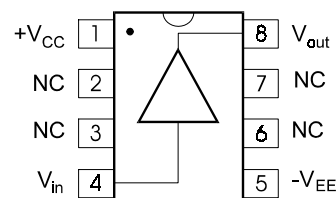
Applications

- Video switch buffers
- Test point drivers
- High frequency active filters
- Wideband DC clamping buffer
- High-speed peak detector circuits

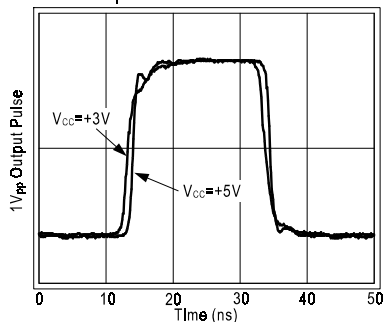
Pulse Response for ±5V



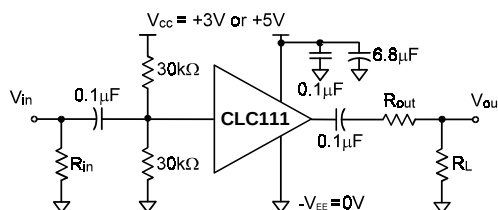
Pinout
DIP & SOIC



Pulse Response

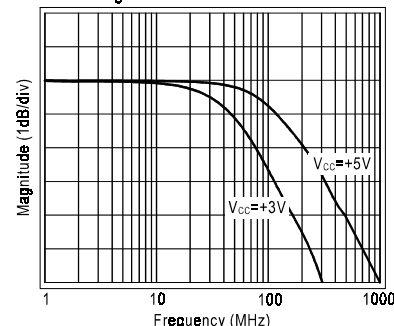


Typical Application



Single-Supply Circuit

Small-Signal Bandwidth



CLC111 Electrical Characteristics ($\pm V_{cc} = \pm 5V$, $R_L = 100\Omega$ unless specified)

PARAMETER	CONDITIONS	TYP	MIN AND MAX RATINGS				UNITS	SYMBOL
Ambient Temperature	CLC109AJ/AI CLC109A8/AM/AL	+25°C +25°C	-40°C -55°C	+25°C +25°C	+85°C +125°C			
FREQUENCY RESPONSE								
†small signal bandwidth	$V_{out} < 0.5V_{pp}$	800	400	400	300	MHz		SSBW
gain flatness ¹	$V_{out} < 4.0V_{pp}$	450	250	250	200	MHz		LSBW
† flatness	$V_{out} < 0.5V_{pp}$ DC-50MHz	0.02	±0.1	±0.1	±0.2	dB		GFL
† peaking	DC-200MHz	0.1	1.0	0.5	0.5	dB		GFPH
† rolloff	DC-200MHz	0.1	0.8	0.8	1.2	dB		GFRH
differential gain	4.43MHz, 150Ω load	0.15	0.4	0.25	0.25	%		DG
differential phase	4.43MHz, 150Ω load	0.04	0.08	0.08	0.08	°		DP
TIME DOMAIN RESPONSE								
rise and fall time	0.5V step	0.6	0.8	0.8	1.1	ns		TRS
	4.0V step	1.0	1.4	1.4	1.7	ns		TRL
settling time to ±0.1%	2.0V step	16	20	20	20	ns		TS
overshoot	4V step	0	8	5	5	%		OS1
slew rate	4V step	3500	2700	2700	2300	V/μsec		SR
DISTORTION AND NOISE PERFORMANCE								
†2nd harmonic distortion	2V _{pp} , 20MHz	-62	-47	-50	-50	dBc		HD2
†3rd harmonic distortion	2V _{pp} , 20MHz	-62	-55	-55	-52	dBc		HD3
equivalent output noise voltage	>1MHz	4.0	4.8	4.8	5.3	nV/√Hz		VN
current	>1MHz	1.6	4.0	3.0	3.0	pA/√Hz		ICN
STATIC DC PERFORMANCE								
small signal gain	no load	0.996	0.994	0.994	0.992	V/V		GA1
	100Ω load	0.98	0.96	0.97	0.97	V/V		GA2
output resistance	DC	1.4	3.0	2.0	2.0	Ω		RO
*output offset voltage		2	17	9	9	mV		VIO
average temperature coefficient		±30	±100		±50	μV/°C		DVIO
*input bias current		5	30	15	15	μA		IBN
average temperature coefficient		50	±187		±100	nA/°C		DIBN
†power supply rejection ratio		-52	-48	-48	-46	dB		PSRR
*supply current	no load	10.5	12	12	12	mA		ICC
MISCELLANEOUS PERFORMANCE								
integral endpoint linearity	±2V, full scale	0.2	1.0	0.5	0.5	%		ILIN
input resistance		1	0.3	0.7	1	MΩ		RIN
input capacitance	CERDIP	2.5	3.5	3.5	3.5	pF		CIN
	Plastic DIP	1.25	2.0	2.0	2.0	pF		CIN
output voltage range	no load	3.9	3.5	3.6	3.6	V		VO
	R _L =100Ω	3.5	+3.1,-2.5	3.2	3.2	V		VOL
	R _L =100Ω, 0°C		±3.1			V		VOL
output current		60	50,25	50	40	mA		IO
	0° - 70°C		50,35	50	50	mA		IO

Min/max ratings are based on product characterization and simulation. Individual parameters are tested as noted. Outgoing quality levels are determined from tested parameters.

Absolute Maximum Ratings

V_{cc}	±7.0V
I_{out} output is short circuit protected to ground, but maximum reliability will be maintained if I_{out} does not exceed...	96mA
input voltage	±V _{cc}
maximum junction temperature	+175°C
operating temperature range	
AJ/AI	-40°C to +85°C
A8/AM/AL	-55°C to +125°C
storage temperature range	-65°C to +150°C
lead temperature (soldering 10 sec)	+300°C

Miscellaneous Ratings

Notes:

- * AJ,AI : 100% tested at +25°C, sample +85°C.
- † AJ : Sample tested at +25°C.
- † AI : 100% tested at +25°C.
- * A8 : 100% tested at +25°C, -55°C, +125°C
- † A8 : 100% tested at +25°C, sample at -55°C, +125°C.
- * AL,AM : 100% wafer probe tested at +25°C to +25°C specifications.

(note 1) : Gain flatness tests are performed from 0.1MHz

Single Supply Electrical Characteristics ($V_{CC}=+3V$ or $V_{CC}=+5V$, $-V_{EE}=0V$, $T_A=+25^{\circ}C$, $R_L = 100\Omega$, unless noted)

PARAMETERS	CONDITIONS	$V_{CC}=3V$	$V_{CC}=5V$	UNITS
FREQUENCY DOMAIN RESPONSE				
-3dB bandwidth	$V_{out} < 0.5V_{pp}$	120	300	MHz
	$V_{out} < 2.0V_{pp}$		210	MHz
gain flatness	$V_{out} < 0.5V_{pp}$			
flatness	DC to 30MHz	0.5	0.1	dB
peaking	DC to 200MHz	0	0	dB
rolloff	DC to 60MHz	1.5	0.25	dB
TIME DOMAIN RESPONSE				
rise and fall time	0.5V step	3.9	1.2	ns
	2.0V step		1.5	ns
overshoot	1.0V step	3	3	%
slew rate	0.5V step	260	425	V/ μ s
DISTORTION AND NOISE RESPONSE				
2 nd harmonic distortion	0.5V _{pp} , 20MHz	-46		dBc
	1.0V _{pp} , 20MHz		-55	dBc
3 rd harmonic distortion	0.5V _{pp} , 20MHz	-44		dBc
	1.0V _{pp} , 20MHz		-64	dBc
STATIC DC PERFORMANCE				
small-signal gain	AC-coupled	0.96	0.97	V/V
supply current	$R_L = \infty$	2.0	4.5	mA
MISCELLANEOUS PERFORMANCE				
output voltage range	$R_L = \infty$	1.5	3.4	V_{pp}
	$R_L = 100\Omega$	1.1	2.6	V_{pp}

Operation

The CLC111 is a low-power, very high-speed unity-gain buffer. It uses a closed-loop topology which allows for accuracy not usually found in high-speed open-loop buffers. A slew enhanced front end allows for low quiescent power while not sacrificing ac performance.

Single Supply Operation

Although the CLC111 is specified to operate from split $\pm 5V$ power supplies, there is no internal ground reference that prevents operation from a single voltage power supply. For single supply operation the input signal should be biased at a DC value of $\frac{1}{2}V_{CC}$. This can be accomplished by AC coupling and rebiasing as shown in Figure 1.

The above electrical specifications provide typical performance specifications for the CLC111 at $25^{\circ}C$ while operating from a single +3V or a single +5V power supply.

Printed Circuit Layout and Supply Bypassing

As with any high-frequency device, a good PCB layout is required for optimum performance. This is especially important for a device as fast as the CLC111.

To minimize capacitive feedthrough, pins 2, 3, 6, and 7 should be connected to the ground plane, as shown in Figure 1. Input and output traces should be laid out as transmission lines with the appropriate termination resistors very near the CLC111. On a 0.065 inch epoxy PCB material, a 50Ω transmission line (commonly called stripline) can be constructed by using a trace width of 0.1" over a complete ground plane.

Figure 1 shows recommended power supply bypassing.

The ferrite beads are optional and are recommended only where additional isolation is needed from high-frequency ($>400MHz$) resonances in the power supply.

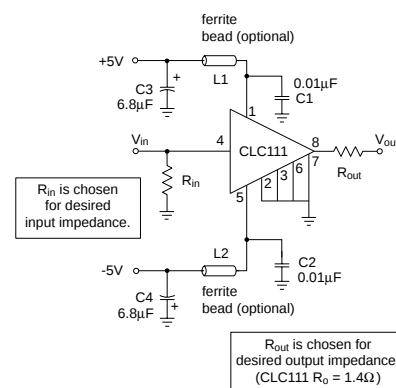


Figure 1: Recommended circuit & evaluation board schematic

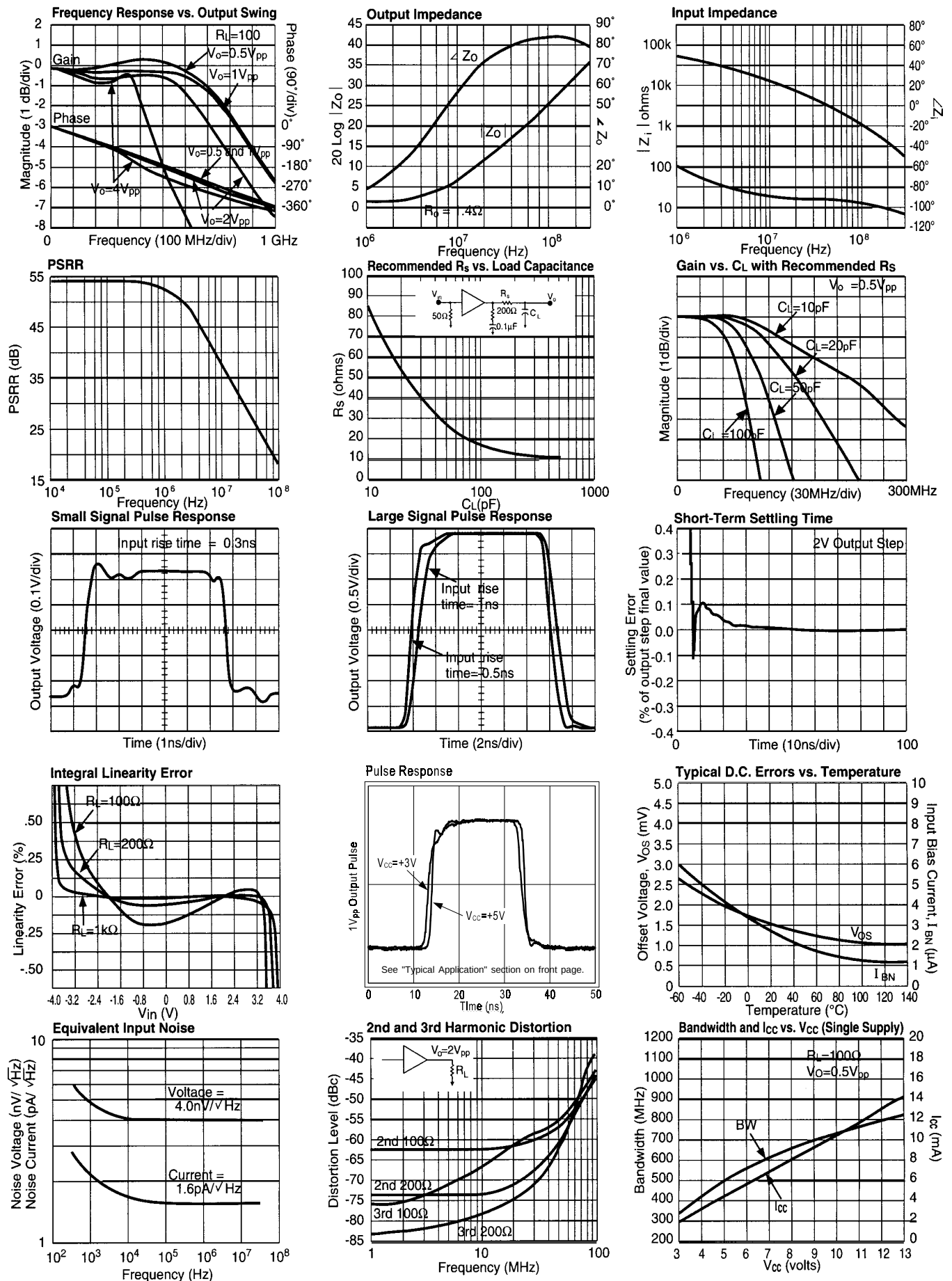
Parasitic or load capacitance directly on the output of the CLC111 will introduce additional phase shift in the device. This phase shift can decrease phase margin and increase frequency response peaking. A small series resistor before the capacitance effectively decouples this effect. The graphs on the following page illustrate the required resistor value and the resulting performance vs. capacitance.

Precision buffered resistors (PRP8351 series from Precision Resistive Products), which have low parasitic reactances, were used to develop the data sheet specifications. Precision carbon composition resistors or standard spirally-trimmed RN55D metal film resistors will work, though they will cause a slight degradation of ac performance due to their reactive nature at high frequencies.

Evaluation Boards

Evaluation boards are available from Comlinear as part #730012 (DIP) and #730045 (SOIC). This board was used in the characterization of the device and provides optimal performance. Designers are encouraged to copy these printed circuit board layouts for their applications.

Typical Performance Characteristics ($T_A = +25^\circ\text{C}$, $V_{CC} = \pm 5\text{V}$, $R_L = 100\Omega$ unless specified)



This page intentionally left blank.

Customer Design Applications Support

National Semiconductor is committed to design excellence. For sales, literature and technical support, call the National Semiconductor Customer Response Group at **1-800-272-9959** or fax **1-800-737-7018**.

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 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.



National Semiconductor Corporation

1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe

Fax: (+49) 0-180-530 85 86
E-mail: europe.support.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Francais Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.

13th Floor, Straight Block
Ocean Centre, 5 Canton Road
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.

Tel: 81-043-299-2309
Fax: 81-043-299-2408

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.