LTC1992

Fully Differential Input/Output Amplifier/Driver

July 2003

FEATURES

- **Fully Differential Input and Output**
- **C_{LOAD} Stable up to 10,000pF**
- **Adjustable Output Common Mode Voltage**
- Rail-to-Rail Output Swing
- Low Supply Current: 1.2mA (Max)
- High Output Current: 10mA (Min)
- Specified on a Single 2.7V to ±5V Supply
- DC Offset Voltage <2.5mV (Max)
- MSOP 8-Lead Package

APPLICATIONS

- Differential Driver/Receiver
- Differential Amplification
- Single-Ended to Differential Conversion
- Level Shifting
- Trimmed Phase Response for Multichannel Systems

DESCRIPTION

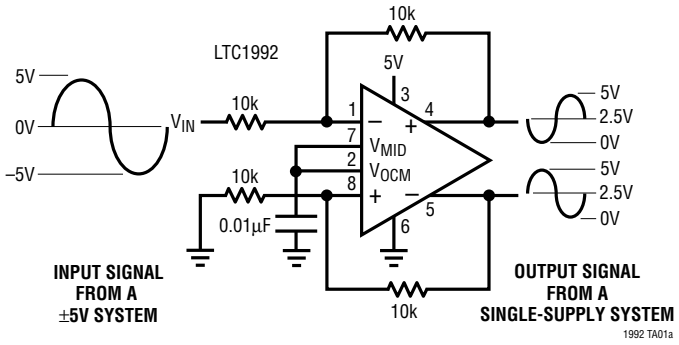
The LTC®1992 is a fully differential low power amplifier. The LTC1992 has a separate internal common mode feedback path for outstanding output phase balancing and reduced second order harmonics. The V_{OCM} pin sets the output common mode level independent of the input common mode level. This feature makes level shifting of signals easy.

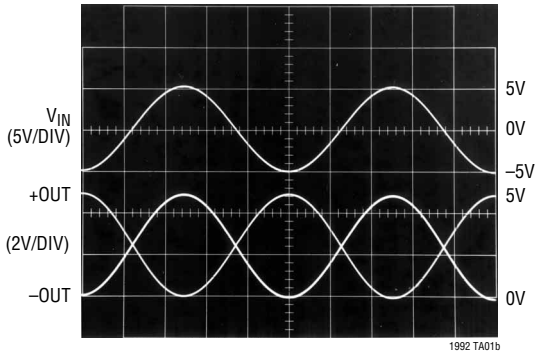
The differential inputs operate with signals ranging from rail-to-rail with a common mode level from the negative supply up to 1.3V from the positive supply. The differential input DC offset is typically 250µV. The rail-to-rail outputs sink and source 10mA. The LTC1992 is stable for all capacitive loads up to 10,000pF.

The LTC1992 can be used in single-supply applications with supply voltages as low as 2.7V. It can also be used with dual supplies up to ±5V. The LTC1992 is available in an 8 pin MSOP package.

TYPICAL APPLICATION

Single-Ended to Differential Conversion



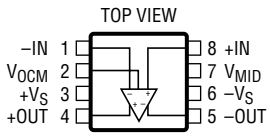


ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage ($+V_S$ to $-V_S$) 12V
Maximum Voltage
on any Pin ..... $(-V_S - 0.3V) \le V_{PIN} \le (+V_S + 0.3V)$
Output Short-Circuit Duration (Note 3) ..... Indefinite
Operating Temperature Range (Note 5)
LTC1992CMS8/LTC1992IMS8 .....–40°C to 85°C
LTC1992HMS8 .....–40°C to 125°C
Specified Temperature Range (Note 6)
LTC1992CMS8/LTC1992IMS8 .....–40°C to 85°C
LTC1992HMS8 .....–40°C to 125°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec)..... 300°C

PACKAGE/ORDER INFORMATION



MS8 PACKAGE
8-LEAD PLASTIC MSOP

T_{JMAX} = 150°C, θ_{JA} = 250°C/W

ORDER PART NUMBER
LTC1992CMS8 LTC1992IMS8 LTC1992HMS8
MS8 PART MARKING
LTYU LTZC LTAGR

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. $+V_S$ = 5V, $-V_S$ = 0V, $V_{INCM} = V_{OUTCM} = V_{OCM}$ = 2.5V, unless otherwise noted. V_{OCM} is the voltage on the V_{OCM} pin. V_{OUTCM} is defined as $(V_{+OUT} + V_{–OUT})/2$. V_{INCM} is defined as $(V_{+IN} + V_{–IN})/2$. V_{INDIFF} is defined as $(V_{+IN} – V_{–IN})$. $V_{OUTDIFF}$ is defined as $(V_{+OUT} – V_{–OUT})$.

SYMBOL	PARAMETER	CONDITIONS		LTC1992CMS8 LTC1992ISM8 MIN	TYP	MAX	LTC1992HMS8 MIN	TYP	MAX	UNITS
V_{OSDIFF}	Differential Offset Voltage (Input Referred)	V_S = 2.7V	●		±0.25	±2.5		±0.25	±4	mV
		V_S = 5V	●		±0.25	±2.5		±0.25	±4	mV
		V_S = ±5V	●		±0.25	±2.5		±0.25	±4	mV
$\Delta V_{OSDIFF}/\Delta T$	Differential Offset Voltage Drift (Input Referred)	V_S = 2.7V	●		10			10		µV/°C
		V_S = 5V	●		10			10		µV/°C
		V_S = ±5V	●		10			10		µV/°C
I_B	Input Bias Current	V_S = 2.7V to ±5V	●		2	250		2	400	pA
I_{OS}	Input Offset Current	V_S = 2.7V to ±5V	●		0.1	100		0.1	150	pA
R_{IN}	Input Resistance		●		500			500		MΩ
C_{IN}	Input Capacitance		●		3			3		pF
e_n	Input Referred Noise Voltage Density	f = 10Hz			100			100		$nV/\sqrt{Hz}$
		f = 1kHz			18			18		$nV/\sqrt{Hz}$
i_n	Input Noise Current Density	f = 10Hz			1			1		$pA/\sqrt{Hz}$
		f = 1kHz			1			1		$pA/\sqrt{Hz}$
V_{INCMR}	Input Signal Common Mode Range		●	$(-V_S)-0.1V$		$(+V_S)-1.3V$	$(-V_S)-0.1V$		$(+V_S)-1.3V$	V
CMRR	Common Mode Rejection Ratio (Input Referred)	V_{INCM} = –0.1V to 3.7V	●	69	90		69	90		dB
PSRR	Power Supply Rejection Ratio (Input Referred)	V_S = 2.7V to ±5V	●	75	80		72	80		dB
G_{CM}	Common Mode Gain(V_{OUTCM}/V_{OCM})		●		1			1		
	Common Mode Gain Error		●		±0.1	±0.3		±0.1	±0.35	%
	Output Balance ($\Delta V_{OUTCM}/(V_{OUTDIFF})$	$V_{OUTDIFF}$ = –2V to +2V	●		–85	–60		–85	–60	dB
V_{OSCM}	Common Mode Offset Voltage ($V_{OUTCM} – V_{OCM}$)	V_S = 2.7V	●		±0.5	±12		±0.5	±15	mV
		V_S = 5V	●		±1	±15		±1	±17	mV
		V_S = ±5V	●		±2	±18		±2	±20	mV
$\Delta V_{OSCM}/\Delta T$	Common Mode Offset Voltage Drift	V_S = 2.7V	●		10			10		µV/°C
		V_S = 5V	●		10			10		µV/°C
		V_S = ±5V	●		10			10		µV/°C

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. $+V_S$ = 5V, $-V_S$ = 0V, V_{INCM} = V_{OUTCM} = V_{OCM} = 2.5V, unless otherwise noted. V_{OCM} is the voltage on the V_{OCM} pin. V_{OUTCM} is defined as $(V_{+OUT} + V_{–OUT})/2$. V_{INCM} is defined as $(V_{+IN} + V_{–IN})/2$. V_{INDIFF} is defined as $(V_{+IN} – V_{–IN})$. $V_{OUTDIFF}$ is defined as $(V_{+OUT} – V_{–OUT})$.

SYMBOL	PARAMETER	CONDITIONS		LTC1992CMS8 LTC1992ISM8 MIN	TYP	MAX	LTC1992HMS8 MIN	TYP	MAX	UNITS
V_{OUTCMR}	Output Signal Common Mode Range (Voltage Range for the V_{OCM} Pin)		●	$(–V_S)+0.5V$		$(+V_S)–1.3V$	$(–V_S)+0.5V$		$(+V_S)–1.3V$	V
R_{INVOCM}	Input Resistance, V_{OCM} Pin		●		500			500		MΩ
I_{BVOCM}	Input Bias Current, V_{OCM} Pin	V_S = 2.7V to ±5V	●		±2			2		pA
V_{MID}	Voltage at the V_{MID} Pin		●	2.44	2.50	2.56	2.43	2.50	2.57	V
V_{OUT}	Output Voltage, High (Note 2)	V_S = 2.7V, Load = 10k	●	2.60	2.69		2.60	2.69		V
		V_S = 2.7V, Load = 5mA	●	2.50	2.61		2.50	2.61		V
		V_S = 2.7V,Load = 10mA	●	2.29	2.52		2.29	2.52		V
	Output Voltage, Low (Note 2)	V_S = 2.7V, Load = 10k	●		0.02	0.10		0.02	0.10	V
		V_S = 2.7V, Load = 5mA	●		0.10	0.25		0.10	0.25	V
		V_S = 2.7V, Load = 10mA	●		0.20	0.35		0.20	0.41	V
	Output Voltage, High (Note 2)	V_S = 5V, Load = 10k	●	4.90	4.99		4.90	4.99		V
		V_S = 5V, Load = 5mA	●	4.85	4.90		4.80	4.90		V
		V_S = 5V, Load = 10mA	●	4.75	4.81		4.70	4.81		V
	Output Voltage, Low (Note 2)	V_S = 5V, Load = 10k	●		0.02	0.10		0.02	0.10	V
		V_S = 5V, Load = 5mA	●		0.10	0.25		0.10	0.30	V
		V_S = 5V, Load = 10mA	●		0.20	0.35		0.20	0.42	V
	Output Voltage, High (Note 2)	V_S = ±5V, Load = 10k	●	4.90	4.99		4.85	4.99		V
		V_S = ±5V, Load = 5mA	●	4.85	4.89		4.80	4.89		V
		V_S = ±5V, Load = 10mA	●	4.65	4.80		4.60	4.80		V
	Output Voltage, Low (Note 2)	V_S = ±5V, Load = 10k	●		–4.99	–4.90		–4.98	–4.85	V
		V_S = ±5V, Load = 5mA	●		–4.90	–4.75		–4.90	–4.75	V
		V_S = ±5V, Load = 10mA	●		–4.80	–4.65		–4.80	–4.55	V
I_{SC}	Output Short-Circuit Current Sourcing (Notes 2,3)	V_S = 2.7V, V_{OUT} = 1.35V	●	20	30		20	30		mA
		V_S = 5V, V_{OUT} = 2.5V	●	20	30		20	30		mA
		V_S = ±5V, V_{OUT} = 0V	●	20	30		20	30		mA
	Output Short-Circuit Current Sinking (Notes 2,3)	V_S = 2.7V, V_{OUT} =1.35V	●	13	30		13	30		mA
		V_S = 5V, V_{OUT} = 2.5V	●	13	30		13	30		mA
		V_S = ±5V, V_{OUT} = 0V	●	13	30		13	30		mA
SR	Slew Rate (Note 4)		●	0.25	0.75		0.25	0.75		V/µs
GBW	Gain-Bandwidth Product (f_{TEST} = 100kHz)	T_A = 25°C		3.0	3.2	3.5	3.0	3.2	3.5	MHz
		LTC1992CMS8	●	2.5	3.0	4.0				MHz
		LTC1992IMS8/LTC1992HMS8	●	1.9		4.0	1.9		4.0	MHz
A_{VOL}	Large-Signal Voltage Gain		●		80			80		dB
V_S	Supply Voltage Range		●	2.7		11	2.7		11	V
I_S	Supply Current	V_S = 2.7V to 5V			0.65	1.0		0.65	1	mA
			●		0.75	1.2		0.8	1.5	mA
		V_S = ±5V			0.7	1.2		0.7	1.2	mA
			●		0.8	1.5		0.9	1.8	mA

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: Output load is connected to the midpoint of the $+V_S$ and $–V_S$ potentials. Measurement is taken single-ended, one output loaded at a time.

Note 3: A heat sink may be required to keep the junction temperature below the absolute maximum when the output is shorted indefinitely.

Note 4: Slew Rate is measured single-ended. The numbers listed are also single-ended and the differential slew rate would double the listed numbers.

Note 5: The LTC1992CMS8 and LTC1992IMS8 are guaranteed functional over an operating temperature of –40°C to 85°C. The LTC1992HMS8 is guaranteed functional over the extended operating temperature of –40°C to 125°C.

Note 6: The LTC1992CMS8 is guaranteed to meet the specified performance limits over the 0°C to 70°C temperature range and is designed, characterized and expected to meet the specified performance limits over the –40°C to 85°C temperature range but is not tested or QA sampled at these temperatures. The LTC1992IMS8 is guaranteed to meet the specified performance limits over the –40°C to 85°C temperature range. The LTC1992HMS8 is guaranteed to meet the specified performance limits over the –40°C to 125°C temperature range.

PIN FUNCTIONS

–IN, +IN (Pins 1, 8): Inverting and Noninverting Inputs of the Amplifier.

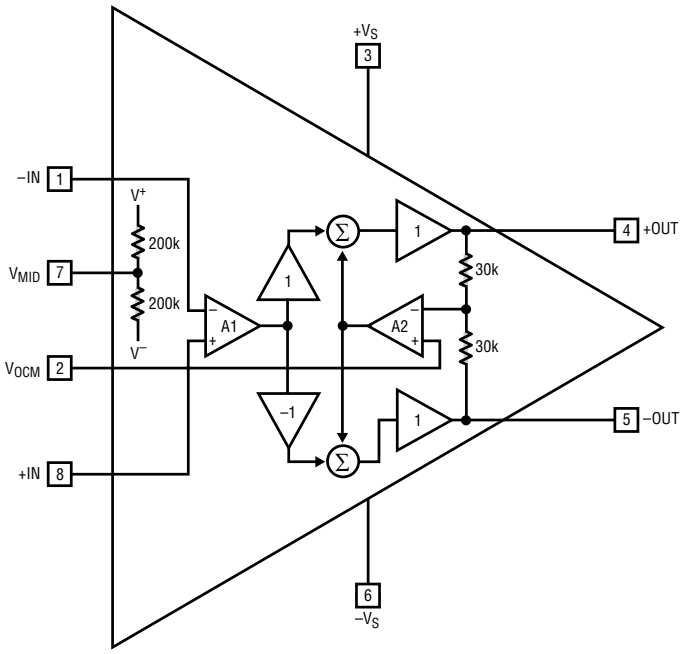
V_{OCM} (Pin 2): Output Common Mode Voltage Set Pin. The voltage on this pin sets the output signal's common mode voltage level. The output common mode level is set independent of the input common mode level. This is a high impedance input and must be connected to a known and controlled voltage. It must never be left floating.

$+V_S$, $-V_S$ (Pins 3, 6): The $+V_S$ and $-V_S$ power supply pins should be bypassed with 0.1µF capacitors to an adequate analog ground or ground plane. The bypass capacitors should be located as closely as possible to the supply pins.

+OUT, –OUT (Pins 4, 5): The Positive and Negative Outputs of the Amplifier. These rail-to-rail outputs are designed to drive capacitive loads as high as 10,000pF.

V_{MID} (Pin 7): Mid-Supply Reference. This pin is connected to an on-chip resistive voltage divider to provide a mid-supply reference. This provides a convenient way to set the output common mode level at half-supply. If used for this purpose, Pin 2 will be shorted to Pin 7, Pin 7 should be bypassed with a 0.1µF capacitor to ground. If this reference voltage is not used, leave the pin floating.

BLOCK DIAGRAM



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1167	Precision Instrumentation Amplifier	Single Resistor Sets the Gain
LTC1992-2	Differential In/Out Amplifier with Gain of 2	Trimmed Phase Response, Rail-to-Rail Output
LT6600-20	Differential In/Out Amplifier and 20MHz Lowpass Filter	Very Low Noise, Standard Differential Amplifier Pinout

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