HARRIS
Semiconductor

CA3440

OBSOLETE PRODUCT
POSSIBLE SUBSTITUTE PRODUCT
ICL7611, ICL7612

January 1999

**63kHz, Nanopower,
BiMOS Operational Amplifiers**

Features

- **High Input Resistance** . . . . **2TΩ (Typ)**

- **Standby Power at V+ = 5V** . . . . **300nW (Typ)**

- **Supply Current, BW, Slew Rate Programmable Using External Resistor**

- **Input Current** . . . . **10pA (Typ)**

- **5V to 15V Supply**

- **Output Drives Typical Bipolar Type Loads**

Part Number Information

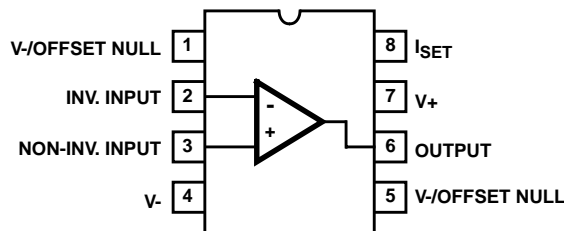| PART NUMBER (BRAND)	TEMP. RANGE (^{o}C)	PACKAGE	PKG. NO.
CA3440M (3440)	-55 to 125	8 Ld SOIC	M8.15

Description

The CA3440 is an integrated circuit operational amplifier that combines the advantages of MOS and bipolar transistors on a single monolithic chip.

The CA3440 BiMOS op amp features gate protected PMOS transistors in the input circuit to provide very high input impedance, very low input currents (less than 10pA). This device operates at total supply voltages from 5V to 15V and can be operated over the temperature range from -55°C to 125°C. The virtues are programmability and very low standby power consumption (300nW). This operational amplifier is internally phase compensated to achieve stable operation in the unity gain follower configuration. Terminals are also provided for use in applications requiring input offset voltage nulling. The use of PMOS in the input stage results in common mode input voltage capability down to 0.5V below the negative supply terminals, an important attribute for single supply applications. The output stage uses MOS complementary source follower form which permits moderate load driving capability (10kΩ) at very low standby currents (50nA).

The CA3440 has the same 8 lead pinout as the "741" and other industry standard op amps with two exceptions: terminals one and five must be connected to the negative supply or to a potentiometer if nulling is required. Terminal 8 must be programmed through an external resistor returned to the negative supply.

Pinout

**CA3440
(SOIC)**
TOP VIEW

V-/OFFSET NULL	1	8	I_{SET}
INV. INPUT	2	7	V+
NON-INV. INPUT	3	6	OUTPUT
V-	4	5	V-/OFFSET NULL

File Number **1318.5**

CA3440

Absolute Maximum Ratings

Supply Voltage (V+ to V-) 25V
Differential Input Voltage. 9V
DC Input Voltage . . . . (V+ +8V) to (V- -0.5V)
Input Current. 1mA
Output Short Circuit Duration (Note 1) . . . . Indefinite

Operating Conditions

Temperature Range . . . . -55°C to 125°C

Thermal Information

Thermal Resistance (Typical, Note 2) θ_{JA} (^{o}C/W)
  SOIC Package 165
Maximum Junction Temperature (Die). . . . . .175°C
Maximum Junction Temperature (Plastic Package) . . . . .150°C
Maximum Storage Temperature Range . . . .-65°C to 150°C
Maximum Lead Temperature (Soldering 10s) . . . . 300°C
  (SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. Short circuit may be applied to ground or to either supply.

2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications   Typical Values Intended Only for Design Guidance, $V_{SUPPLY} = \pm5V$, $R_{SET} = 10M\Omega$, $T_A = 25^oC$

PARAMETER	SYMBOL	TEST CONDITIONS		CA3440	UNITS
Input Resistance	R_I			2	TΩ
Input Capacitance	C_I			3.5	pF
Output Resistance	R_O			450	Ω
Equivalent Input	e_N	f = 1kHz	$R_S = 100\Omega$	110	nV/$\sqrt{Hz}$
Noise Voltage		f = 10kHz		110	nV/$\sqrt{Hz}$
Short-Circuit Current Source	$I_{OM}+$			15	mA
To Opposite Supply Sink	$I_{OM}-$			4.5	mA
Gain Bandwidth Product	f_T			63	kHz
Slew Rate	SR			0.03	V/μs
Transient Response Rise Time	t_R	$R_L = 10k\Omega$, $C_L = 100pF$		5.6	μs
Overshoot	OS			10	%

Electrical Specifications   For Equipment Design, At $V_{SUPPLY} = \pm5V$; $R_{SET} = 10M\Omega$, $T_A = 25^oC$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	CA3440 MIN	CA3440 TYP	CA3440 MAX	UNITS
Input Offset Voltage	$|V_{IO}|$		-	5	10	mV
Input Offset Current	$|I_{IO}|$		-	2.5	30	pA
Input Current	$|I_I|$		-	10	50	pA
Large Signal Voltage Gain	A_{OL}	$R_L = 10k\Omega$	10	100	-	kV/V
			80	100	-	dB
Common Mode Rejection Ratio	CMRR		-	100	320	μV/V
			70	80	-	dB
Common Mode Input Voltage Range	$V_{ICR}+$		+3.5	+3.7	-	V
	$V_{ICR}-$		-5.0	-5.3	-	V
Power Supply Rejection Ratio	PSRR		-	32	320	μV/V
			70	90	-	dB
Max Output Voltage	$V_{OM}+$		+3	+3.2	-	V
	$V_{OM}-$		-3	-3.2	-	V
Supply Current	I+		-	10	17	μA
Device Dissipation	P_D		-	100	170	μW
Input Offset Voltage Temperature Drift	$\Delta V_{IO}/\Delta T$		-	4	-	μV/^oC

Schematic Diagram
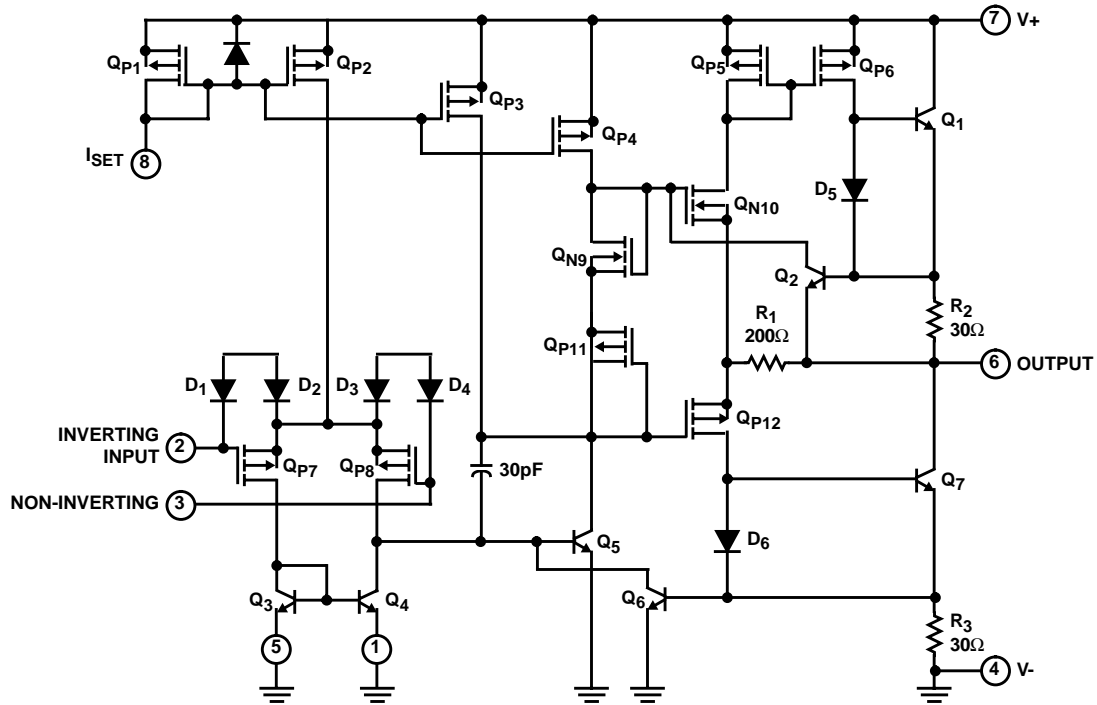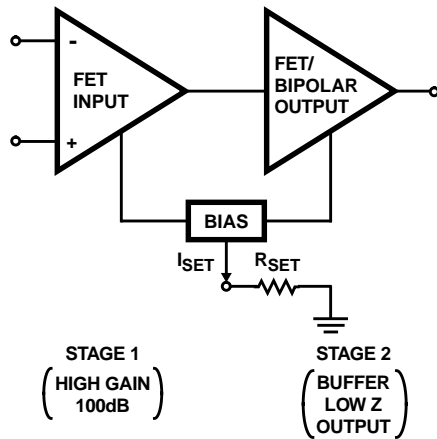

Application Information

FIGURE 1. NANOPOWER OP AMP (SUPPLY CURRENT PRO-GRAMMABLE USING R_{SET}), 1pA TYPICAL INPUT BIAS CURRENT, 4.0V TO 15V SUPPLY
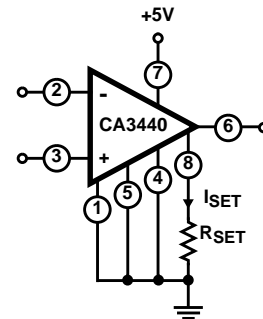

**FIGURE 2. NANOPOWER OP AMP (USABLE STANDBY POWER vs PROGRAMMING RESISTOR R_{SET})**

As R_{SET} is increased, I_{SET} and the standby power decrease while the BW/SR also decrease.

Operating at a +5V single supply, the CA3440 exhibits the following characteristics:

R_{SET}	STANDBY POWER	BW	SR
1MΩ	250μW	164kHz	0.17V/μs
10MΩ	25μW	27kHz	0.017V/μs
100MΩ	2.5μW	2.6kHz	0.0017V/μs
1GΩ	250nW	78kHz	0.00017V/μs

The CA3440 is pin compatible with the 741 except that pins 1 and 5 (typical negative nulling pins) must be connected either directly to pin 4 or to a negative nulling potentiometer. In addition, pin 8, the I_{SET} terminal, must be returned to either ground or -V via R_{SET}.

Typical Applications
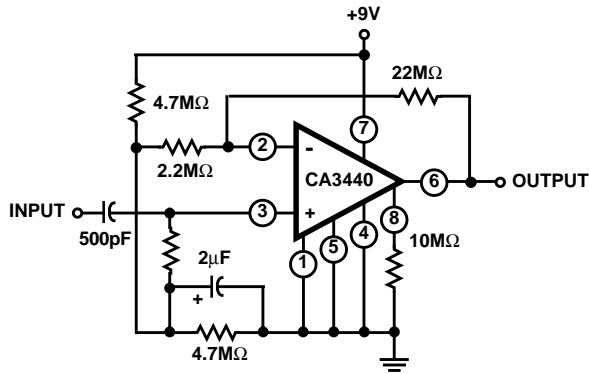
R$_{IN}$ >20MΩ
Standby Power = 90μW
Gain = 20dB
BW: 20Hz to 3kHz
SR = 0.016V/μs

FIGURE 3. HIGH INPUT IMPEDANCE AMPLIFIER
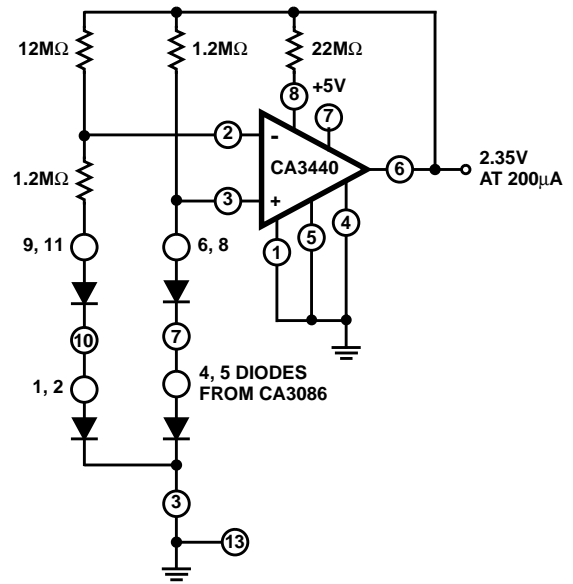
FIGURE 4. MICROPOWER BANDGAP REFERENCE

Typical Performance Curves
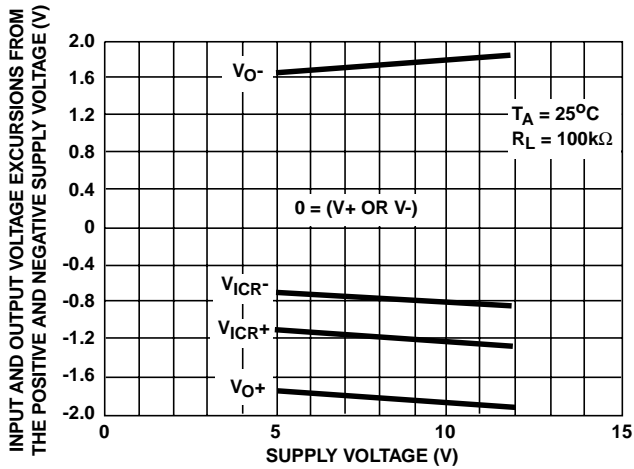
**FIGURE 5. OUTPUT VOLTAGE SWING AND COMMON MODE
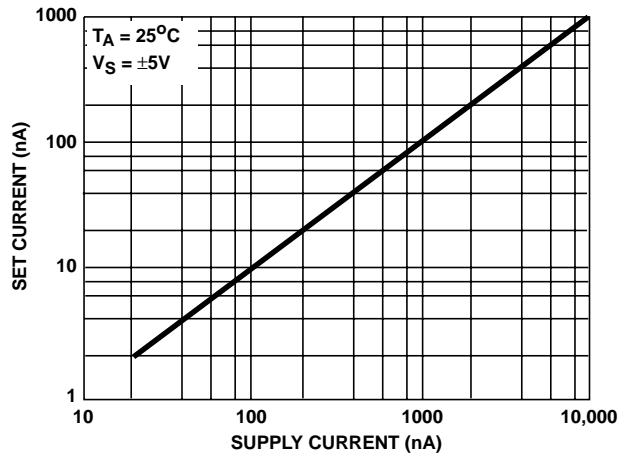INPUT VOLTAGE RANGE vs SUPPLY VOLTAGE**

FIGURE 6. SET CURRENT vs SUPPLY CURRENT
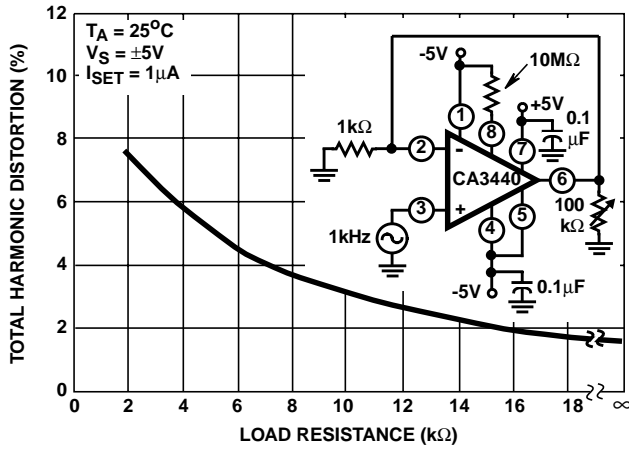
Typical Performance Curves (Continued)
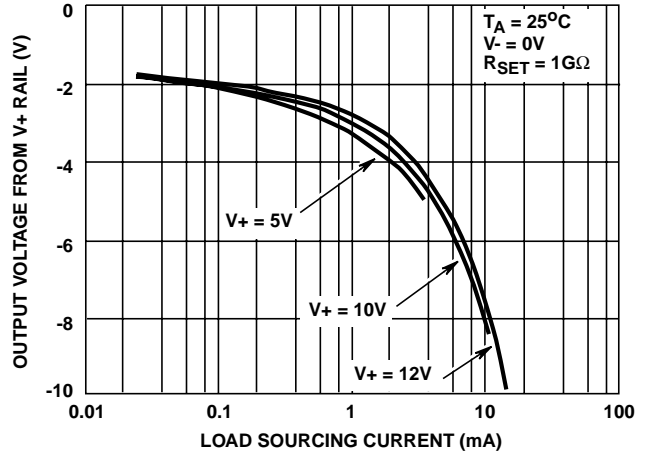

FIGURE 7. TOTAL HARMONIC DISTORTION vs LOAD RESISTANCE

FIGURE 8. OUTPUT VOLTAGE vs SOURCING LOAD CURRENT
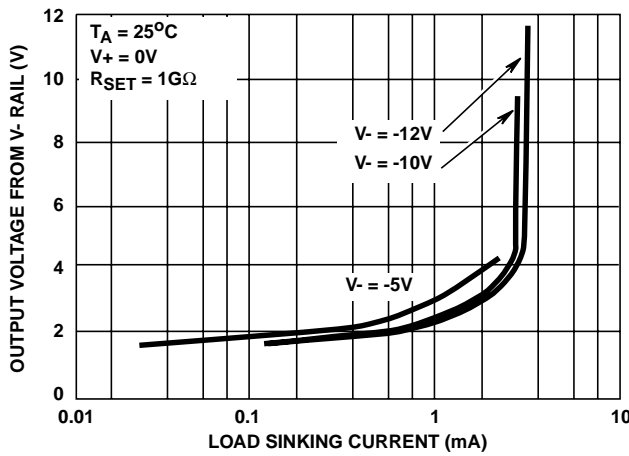
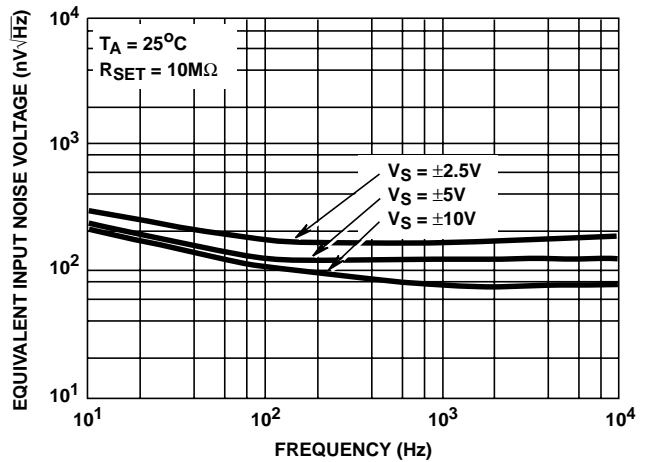FIGURE 9. OUTPUT VOLTAGE vs SINKING LOAD CURRENT
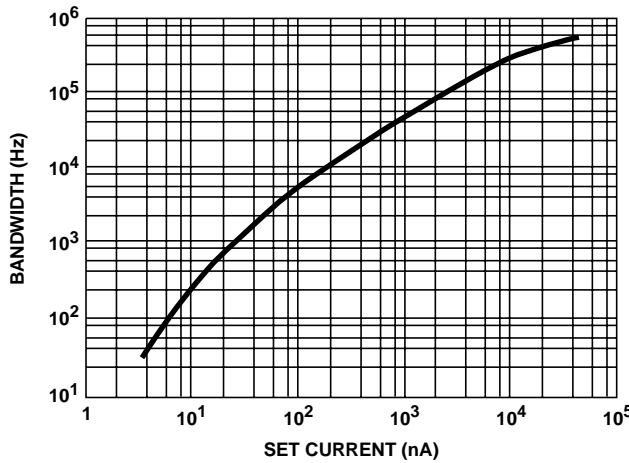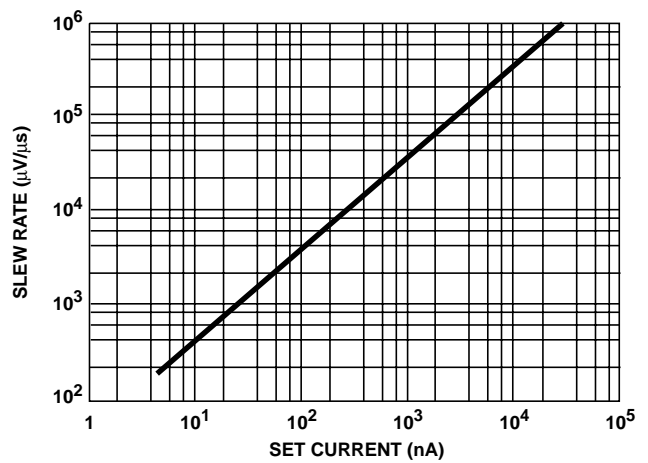

FIGURE 10. INPUT NOISE VOLTAGE vs FREQUENCY

FIGURE 11. BANDWIDTH vs SET CURRENT

FIGURE 12. SLEW RATE vs SET CURRENT