

Power Operational Amplifier

FEATURES

- ◆ LOW COST
- ◆ HIGH VOLTAGE - 100 VOLTS
- ◆ HIGH OUTPUT CURRENT - 30 AMPS
- ◆ 210 WATT DISSIPATION CAPABILITY

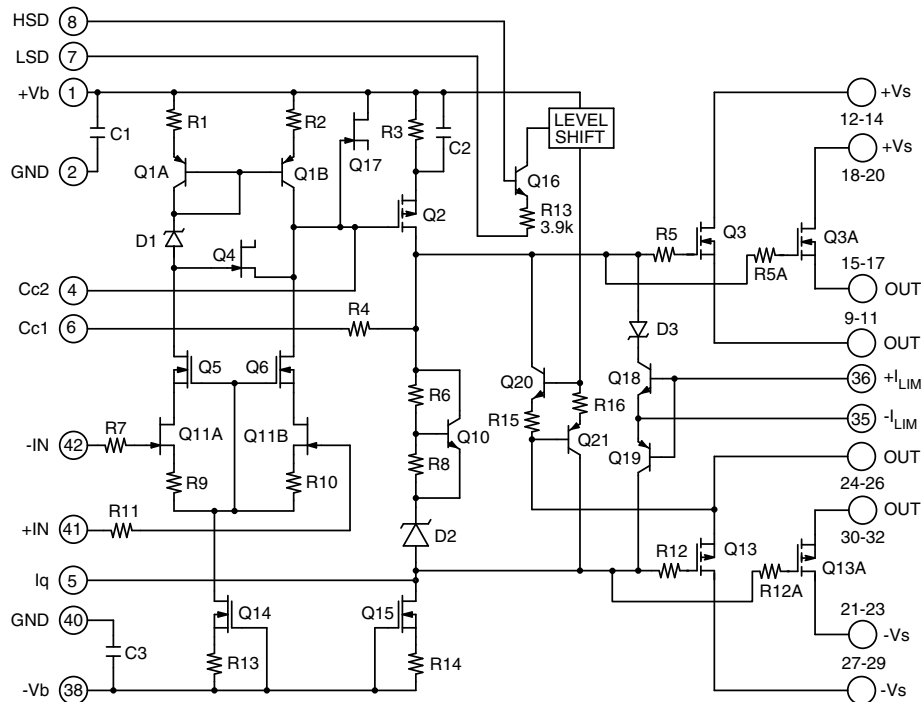
APPLICATIONS

- ◆ MOTOR DRIVE
- ◆ MAGNETIC DEFLECTION
- ◆ PROGRAMMABLE POWER SUPPLIES
- ◆ INDUSTRIAL AUDIO AMPLIFIER

GENERAL DESCRIPTION

The MP230 operational amplifier is a surface mount constructed component that provides a cost effective solution in many industrial applications. The MP230 offers outstanding performance that rivals many much more expensive hybrid components yet has a footprint of only 4.7 sq in. The MP230 has many optional features such as four-wire current limit sensing, a shut-down control and external compensation. In addition, the class A/B output stage biasing can be turned off for lower quiescent current with class C operation in applications where crossover distortion is less important such as when driving motors, for example. A boost voltage feature biases the output stage for close linear swings to the supply rail for extra efficient operation. The MP230 is built on a thermally conductive but electrically insulating substrate that can be mounted to a heat sink.

EQUIVALENT CIRCUIT DIAGRAM



CHARACTERISTICS AND SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Units
SUPPLY VOLTAGE, $+V_S$ to $-V_S$			100	V
SUPPLY VOLTAGE, $+V_B$ (BOOST) (Note 6)			$+V_S + 15$	V
SUPPLY VOLTAGE, $-V_B$ (BOOST) (Note 6)			$-V_S - 15V$	V
OUTPUT CURRENT, peak, within SOA			40	A
POWER DISSIPATION, internal, DC			210	W
INPUT VOLTAGE			$+V_B$ to $-V_B$	V
TEMPERATURE, pin solder, 10s			225	°C
TEMPERATURE, junction (Note 2)			175	°C
TEMPERATURE RANGE, storage		-40	105	°C
OPERATING TEMPERATURE, case		-40	85	°C

SPECIFICATIONS

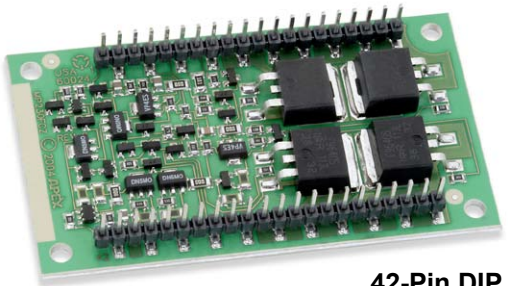
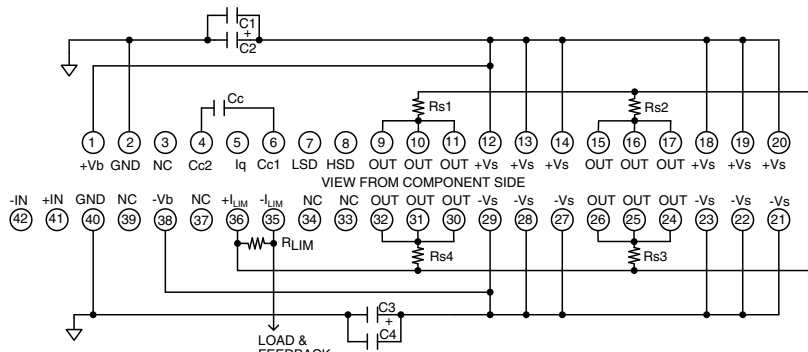
Parameter	Test Conditions	Min	Typ	Max	Units
INPUT					
OFFSET VOLTAGE			1	5	mV
OFFSET VOLTAGE vs. temperature	Full temperature range		20	50	$\mu\text{V}/^\circ\text{C}$
OFFSET VOLTAGE vs. supply				20	$\mu\text{V}/\text{V}$
BIAS CURRENT, initial (Note 3)				100	pA
BIAS CURRENT vs. supply				0.1	pA/V
OFFSET CURRENT, initial				50	pA
INPUT IMPEDANCE, DC			100		$\text{G}\Omega$
INPUT CAPACITANCE			4		pF
COMMON MODE VOLTAGE RANGE				$+V_S - 13$	V
COMMON MODE VOLTAGE RANGE				$-V_S + 13$	V
COMMON MODE REJECTION, DC		92			dB
NOISE	100kHz bandwidth, $1\text{k}\Omega R_S$		5		$\mu\text{V RMS}$
SHUTDOWN, active	HSD - LSD	4.5	5	5.5	V
SHUTDOWN, inactive	HSD - LSD	-0.5	0	0.25	V
GAIN					
OPEN LOOP @ 15Hz	$R_L = 1\text{k}\Omega$, $C_C = 100\text{pF}$	96			dB
GAIN BANDWIDTH PRODUCT @ 1MHz	$C_C = 100\text{pF}$		2		MHz
PHASE MARGIN	Full temperature range	60			°
OUTPUT					
VOLTAGE SWING	$I_O = 30\text{mA}$	$+V_S - 10$	$+V_S - 7$		V
VOLTAGE SWING	$I_O = -30\text{mA}$	$-V_S + 10$	$-V_S + 8$		V
VOLTAGE SWING	$I_O = 30\text{A}$, $+V_B = +V_S + 10\text{V}$	$+V_S - 1.5$			V
VOLTAGE SWING	$I_O = -30\text{A}$, $-V_B = -V_S - 10\text{V}$	$-V_S + 3.0$			V
CURRENT, continuous, DC		30			A
SLEW RATE, $A_V = -10$	$C_C = 100\text{pF}$	12	15		$\text{V}/\mu\text{S}$

Parameter	Test Conditions	Min	Typ	Max	Units
SETTLING TIME, to 0.1%	$A_V = -1$, 10V Step, $C_C = 470\text{pF}$		2.5		μS
RESISTANCE, open loop	DC, 10A Load		0.1		Ω
POWER SUPPLY					
VOLTAGE		± 15	± 45	± 50	V
CURRENT, quiescent, total			27	35	mA
CURRENT, boost supply			17		mA
CURRENT, shutdown or class C quiescent			17		mA
THERMAL					
RESISTANCE, AC, junction to case (Note 5)	Full temp range, $f \geq 60\text{Hz}$			0.6	$^{\circ}\text{C/W}$
RESISTANCE, DC, junction to case	Full temp range, $f < 60\text{Hz}$			0.7	$^{\circ}\text{C/W}$
RESISTANCE, junction to air	Full temp range			14	$^{\circ}\text{C/W}$
TEMPERATURE RANGE, case		-40		85	$^{\circ}\text{C}$

NOTES:

1. Unless otherwise noted: $T_C = 25^{\circ}\text{C}$, compensation $C_C = 470\text{pF}$, DC input specifications are \pm value given, power supply voltage is typical rating. Amplifier operated without boost feature.
2. Long term operation at the maximum junction temperature will result in reduced product life. Derate internal power dissipation to achieve high MTBF.
3. Doubles for every 10°C of case temperature increase.
4. $+V_S$ and $-V_S$ denote the + and - output stage supply voltages. $+V_B$ and $-V_B$ denote the + and - input stage supply voltages (boost voltages).
5. Rating applies if the output current alternates between both output transistors at a rate faster than 60Hz.
6. Power supply voltages $+V_B$ and $-V_B$ must not be less than $+V_S$ and $-V_S$ respectively.

EXTERNAL CONNECTIONS

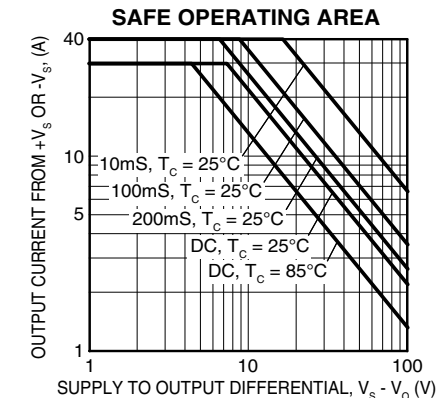
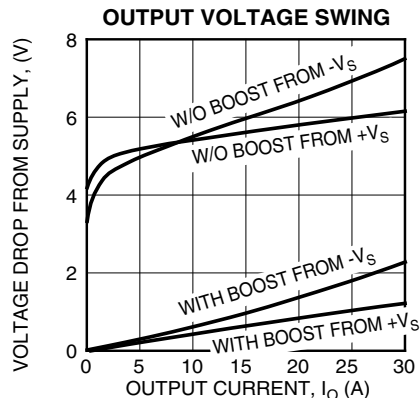
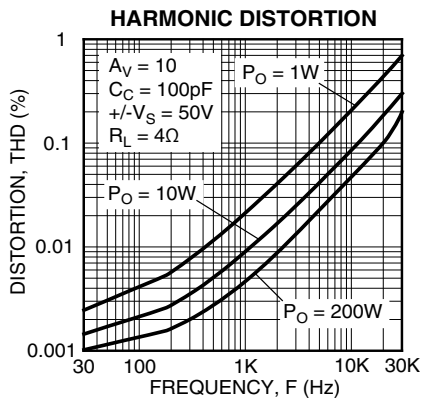
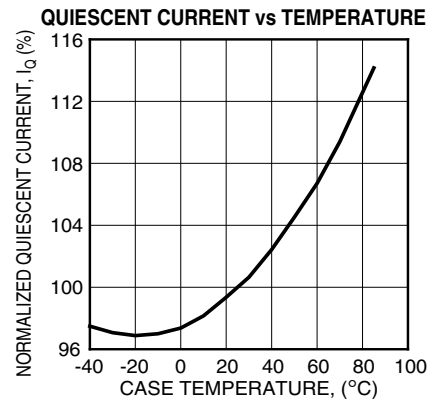
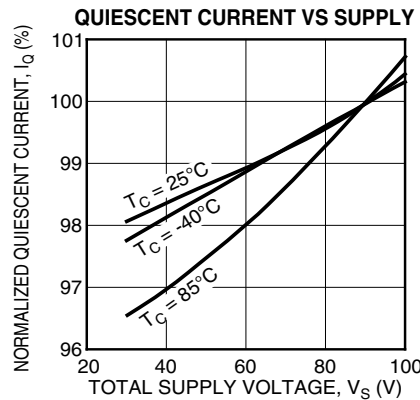
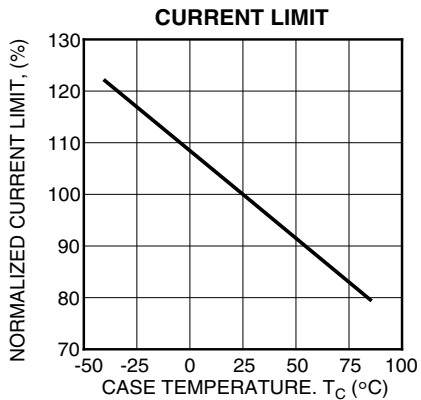
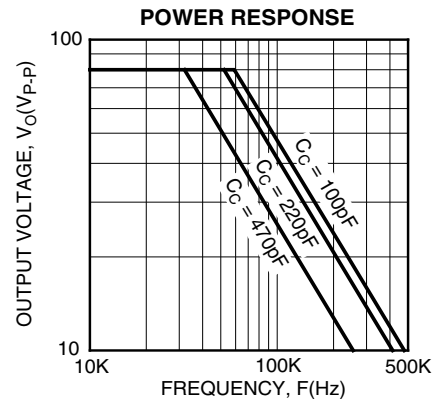
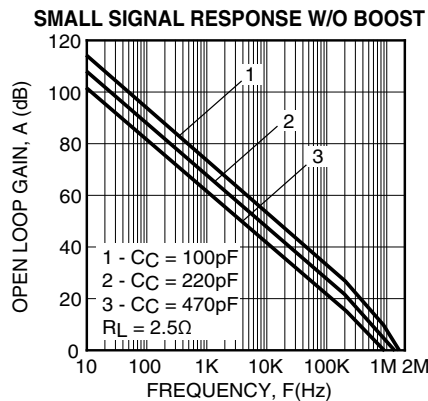
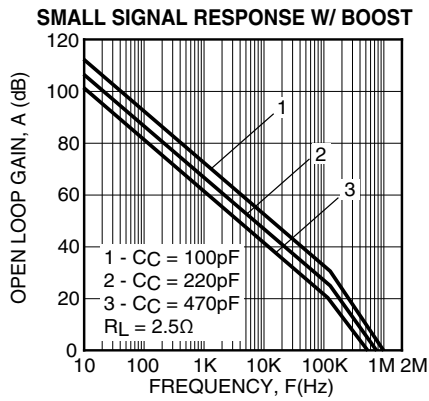
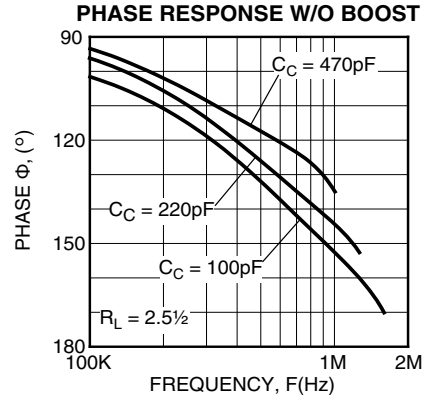
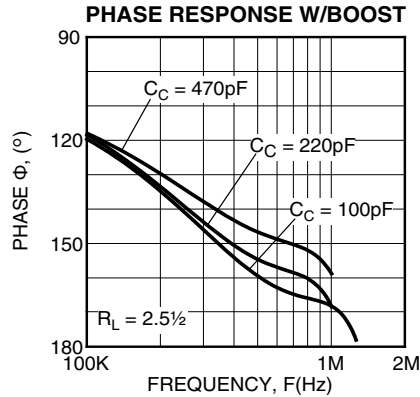
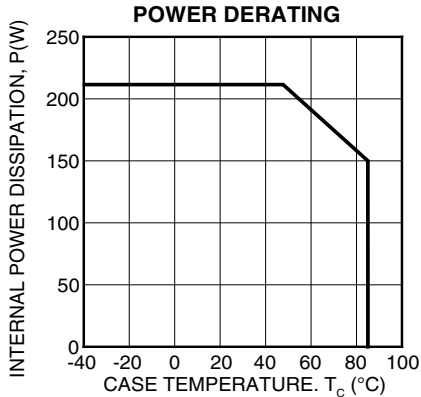


**42-Pin DIP
Package Style FC**

NOTES:

C_C IS NPO (COG) RATED FOR FULL SUPPLY VOLTAGE $+V_S$ TO $-V_S$. BOTH PINS 2 AND 40 REQUIRED CONNECTED TO SIGNAL GROUND. C2 AND C3 ELECTROLYTIC $\leq 10\mu\text{F}$ PER AMP OUTPUT CURRENT. C1 AND C4 HIGH QUALITY CERAMIC $\leq 0.1\mu\text{F}$. SEE TEXT FOR SELECTION OF VALUES FOR $R_{S1} - R_{S4}$.

C_C	PHASE COMPENSATION		TYP. SLEW RATE
	GAIN W/O BOOST	GAIN W/BOOST	
470pF	≤ 1	≤ 8	8V/ μS
220pF	≤ 4	≤ 15	12V/ μS
100pF	≤ 10	≤ 30	15V/ μS



OVERVOLTAGE PROTECTION

Although the MP230 can withstand differential input voltages up to $\pm 25V$, in some applications additional external protection may be needed. 1N4148 signal diodes connected anti-parallel across the input pins is usually sufficient. In more demanding applications where bias current is important diode connected JFETs such as 2N4416 will be required. See Q1 and Q2 in Figure 1. In either case the differential input voltage will be clamped to $\pm 0.7V$. This is sufficient overdrive to produce the maximum power bandwidth. Some applications will also need over-voltage protection devices connected to the power supply rails. Unidirectional zener diode transient suppressors are recommended. The zeners clamp transients to voltages within the power supply rating and also clamp power supply reversals to ground. Whether the zeners are used or not the system power supply should be evaluated for transient performance including power-on overshoot and power-off polarity reversals as well as line regulation. See Z1 and Z2 in Figure 1.

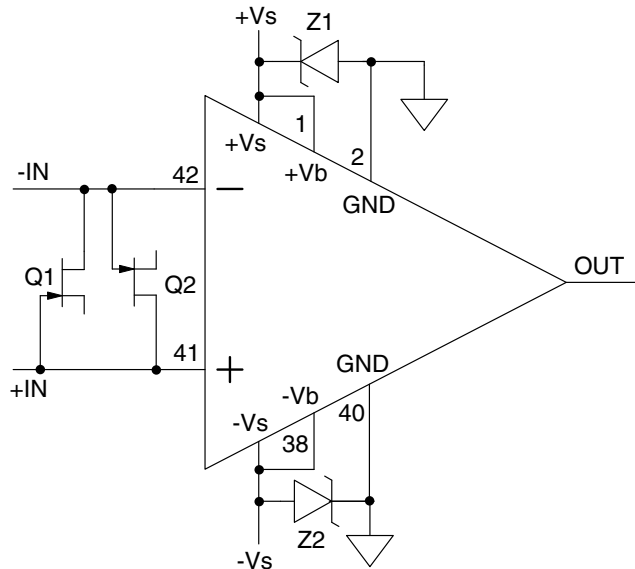


FIGURE 1: OVERVOLTAGE PROTECTION

POWER SUPPLY BYPASSING

Bypass capacitors to power supply terminals $+V_s$ and $-V_s$ must be connected physically close to the pins to prevent local parasitic oscillation in the output stage of the MP230. Use electrolytic capacitors at least $10\mu F$ per output amp required. Bypass the electrolytic capacitors with high quality ceramic capacitors $0.1\mu F$ or greater. In most applications power supply terminals $+V_b$ and $-V_b$ will be connected to $+V_s$ and $-V_s$ respectively. Although $+V_b$ and $-V_b$ are bypassed internally it is recommended to bypass $+V_b$ and $-V_b$ with $0.1\mu F$ externally. Additionally, ground pins 2 and 40 must be connected to the system signal ground.

CURRENT LIMIT

The two current limit sense lines are to be connected directly across the current limit sense resistor. For the current limit to work correctly pin 36 must be connected to the amplifier output side and pin 35 connected to the load side of the current limit resistor R_{LIM} as shown in Figure 2. This connection will bypass any parasitic resistances R_P , formed by socket and solder joints as well as internal amplifier losses. The current limiting resistor may not be placed anywhere in the output circuit except where shown in Figure 2. The value of the current limit resistor can be calculated as follows: $R_{LIM} = .65/I_{LIMIT}$

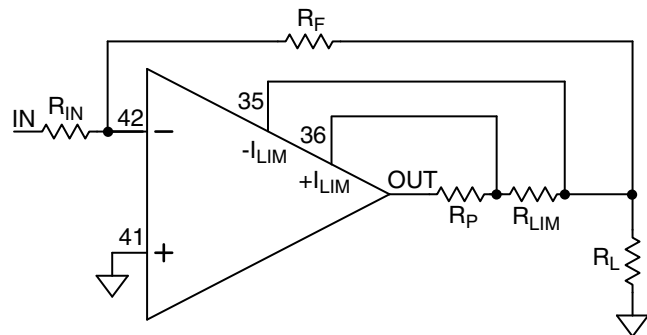


FIGURE 2: 4 WIRE CURRENT LIMIT

BOOST OPERATION

With the boost feature the small signal stages of the amplifier are operated at a higher supply voltages than the amplifier's high current output stage. $+V_b$ (pin 1) and $-V_b$ (pin 38) are connected to the small signal stages. An additional 10V on the $+V_b$ and $-V_b$ pin is sufficient to allow the small signal stages to drive the output stage into the triode region and improve the output voltage swing for extra efficient operation when required. When the boost feature is not needed $+V_s$ and $-V_s$ are connected to $+V_b$ and $-V_b$ respectively. $+V_b$ and $-V_b$ must not be operated at supply voltages less than $+V_s$ and $-V_s$ respectively.

SHUTDOWN

The output stage is turned off by applying a 5V level to HSD (pin 8) relative to LSD (pin 7). This is a non-latching circuit. As long as HSD remains high relative to LSD the output stage will be turned off. LSD will normally be tied to signal ground but LSD may float from $-V_B$ to $+V_B - 15V$. Shutdown can be used to lower quiescent current for standby operation or as part of a load protection circuit.

BIAS CLASS OPTION

Normally pin 5 (Iq) is left open. But when pin 5 is connected to pin 6 (Cc1) the quiescent current in the output stage is disabled. This results in lower quiescent power, but also class C operation of the output stage and the resulting crossover distortion. In many applications, such as driving motors, the distortion may be unimportant and lower standby power dissipation is an advantage.

CONTACTING CIRRUS LOGIC SUPPORT

For all Apex Precision Power product questions and inquiries, call toll free 800-546-2739 in North America.

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