



## High Current - High Power OPERATIONAL AMPLIFIER

### FEATURES

- HIGH OUTPUT POWER  
100 Watts Peak  
40 Watts Continuous
- WIDE SUPPLY RANGE  
 $\pm 10$  to  $\pm 34$  Volts
- HIGH OUTPUT CURRENT  
 $\pm 5$  Amps Peak  
 $\pm 2$  Amps Continuous
- SMALL SIZE: TO-3 PACKAGE
- LOW COST

### APPLICATIONS

- DC MOTORS
- AC MOTORS
- ACTUATORS
- ELECTRONIC VALVES
- SYNCROS

### DESCRIPTION

If you need to supply 100 watts peak or 40 watts continuous, yet must choose a small, easy to use op amp, you'll find the 3573 a logical solution. This hybrid IC delivers  $\pm 5A$  peak minimum at  $\pm 20V$  minimum to the load when operated from  $\pm 28V$  power supplies. The design of this op amp has been optimized for low cost while preserving moderately good input and distortion characteristics.

Output circuitry provides for external current limiting resistors for both positive and negative currents. This allows current limits to be set to values dictated by the op amp's application. 3573 is

internally frequency compensated and is unconditionally stable with capacitive loads to 3300pF.

Housed in a small, rugged, hermetically sealed 8-lead TO-3 package, 3573 will withstand severe environments far better than discrete component amplifiers. The metal case is completely electrically isolated from the amplifier circuitry. Thus, mounting is easier (no isolation washers or spacers) and the hazards of a case connected to the output or supply voltage is eliminated.

# ELECTRICAL SPECIFICATIONS

At  $T_{case} = 25^{\circ}C$  and  $\pm V_{cc} = \pm 28VDC$  unless otherwise noted.

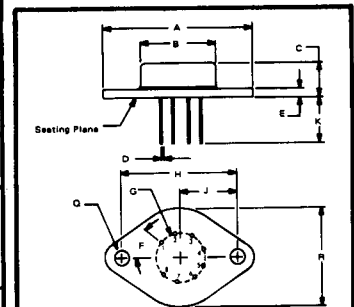
PARAMETER	CONDITIONS	3573AM			UNITS
		MIN	TYP	MAX	
<b>OPEN LOOP GAIN, DC</b>	$R_i \geq 30\Omega$	94	115		dB
<b>RATED OUTPUT</b> Power to Load <sup>(1)</sup> Continuous Peak Output Current Continuous Peak Output Voltage	$I_{out} = \pm 5A^{(4)}$	40 100 $\pm 2$ $\pm 5$ $\pm 20$	115 115 $\pm 23$		W W A A V
<b>DYNAMIC RESPONSE</b> Bandwidth, Unity Gain Full Power Bandwidth Slew Rate	Small Signal	15 1.35	1 23 1.5		MHz kHz V $\mu s$
<b>INPUT OFFSET VOLTAGE</b> Initial Offset vs Temperature vs Supply Voltage	$-25^{\circ}C \leq T_{case} \leq 85^{\circ}C$		$\pm 5$ $\pm 10$ $\pm 35$	$\pm 10$ $\pm 65$	mV $\mu V/^{\circ}C$ $\mu V/V$
<b>INPUT BIAS CURRENT</b> Initial vs Temperature vs Supply Voltage	$T_{case} = 25^{\circ}C$		15 $\pm 0.05$ $\pm 0.02$	40	nA nA $^{\circ}C$ nA V
<b>INPUT DIFFERENCE CURRENT</b> Initial vs Temperature	$T_{case} = 25^{\circ}C$ $-25^{\circ}C \leq T_{case} \leq 85^{\circ}C$		$\pm 5$ $\pm 0.01$	$\pm 10$	nA nA $^{\circ}C$
<b>INPUT IMPEDANCE</b> Differential Common-mode			10 250		M $\Omega$ M $\Omega$
<b>INPUT NOISE</b> Voltage Noise Current Noise	$f_n = 0.3Hz$ to 10kHz $f_n = 10Hz$ to 10kHz $f_n = 0.3Hz$ to 10Hz $f_n = 10Hz$ to 10kHz		3 5 20 4.5		$\mu V$ p-p $\mu V$ rms pA p-p pA rms
<b>INPUT VOLTAGE RANGE</b> Common-mode Voltage Common-mode Rejection	Linear Operation $f = DC, V_{cm} = \pm 22$	$\pm(V_{cc}-6)$ 70	$\pm(V_{cc}-3)$ 110		V dB
<b>POWER SUPPLY</b> Rated Voltage Voltage Range, derated Current, quiescent		$\pm 10$	$\pm 28$ $\pm 2.6$	$\pm 34$ $\pm 5$	V V mA
<b>TEMPERATURE RANGE</b> Specification Operating, derated performance Storage		-25 -25 -65		+85 +85 +150	$^{\circ}C$ $^{\circ}C$ $^{\circ}C$

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage Range	$\pm 34VDC$
Internal Power Dissipation <sup>(1)</sup>	45W
Differential Input Voltage <sup>(2)</sup>	$\pm 62VDC$
Input Voltage Range <sup>(3)</sup>	$\pm 31VDC$
Storage Temperature Range	$-65^{\circ}C$ to $150^{\circ}C$
Lead Temperature (soldering, 10 sec)	$300^{\circ}C$
Output Short-Circuit Duration <sup>(3)</sup>	Continuous
Junction Temperature	$150^{\circ}C$

- Package must be derated based on a junction to case thermal resistance of  $2.8^{\circ}C/W$ , or a junction to ambient thermal resistance of  $30^{\circ}C/W$ .
- For supply voltages less than  $\pm 34VDC$ , the absolute maximum voltage is three volts less than supply voltage.
- Safe Operating Area and Power Derating Curves must be observed.
- With  $R_{SC} = 0$ .

## MECHANICAL

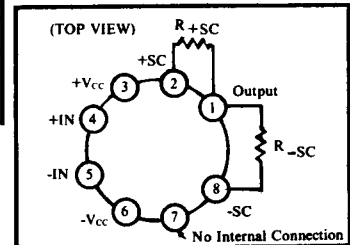


NOTE: Leads in true position within  $.010"$  ( $.25mm$ ) R at MMC at seating plane.

Pin numbers shown for reference only. Numbers may not be marked on package.

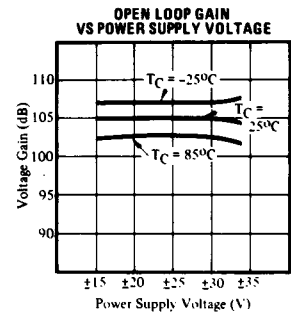
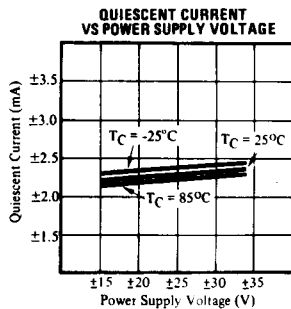
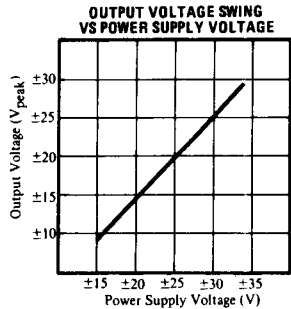
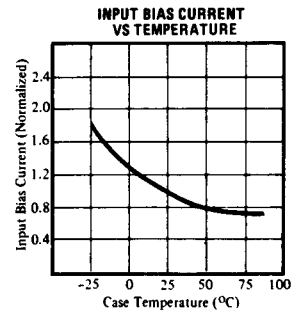
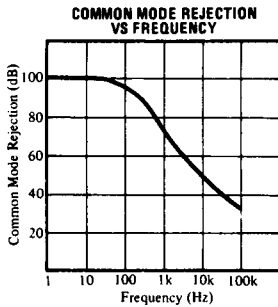
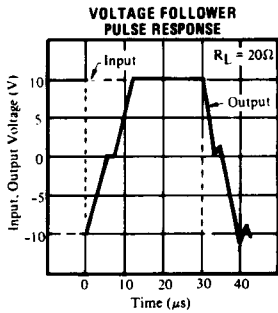
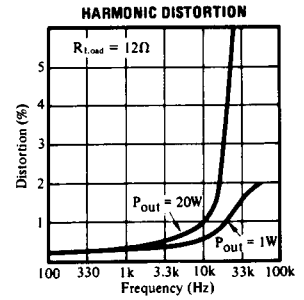
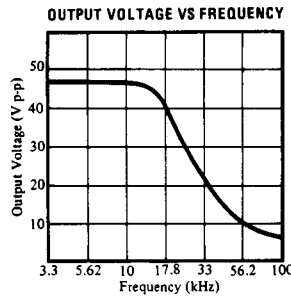
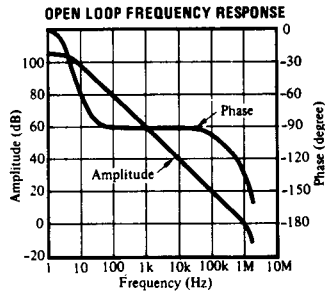
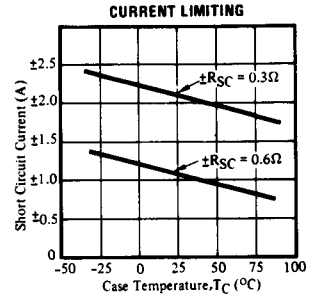
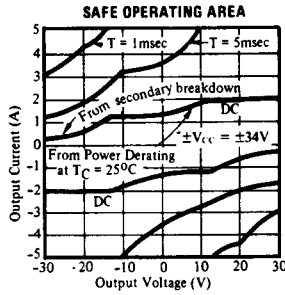
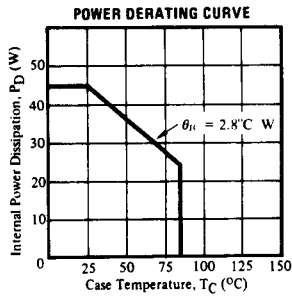
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.510	1.550	38.35	39.37
B	.745	.770	18.92	19.56
C	.260	.300	6.60	7.62
D	.038	.042	0.97	1.07
E	.080	.105	2.03	2.67
F	40° BASIC		40° BASIC	
G	.500 BASIC		12.7 BASIC	
H	1.186 BASIC		30.12 BASIC	
J	.583 BASIC		15.06 BASIC	
K	.400	.500	10.16	12.70
Q	.151	.161	3.84	4.09
R	.980	1.020	24.88	25.91

## CONNECTION DIAGRAM



# TYPICAL PERFORMANCE CURVES

(Typical at 25°C Case and  $\pm V_{CC} = \pm 28$  VDC unless otherwise noted.)



# INSTALLATION AND OPERATING INSTRUCTIONS

## GENERAL PRECAUTIONS

### CURRENT LIMITING

It is recommended that during initial amplifier setup, particularly in breadboarding and when a lack of familiarity with the amplifier exists, that the current limit be set at about 250mA ( $R_{SC} \cong 2.6\Omega$ ). This will allow verification of the circuit and will minimize the possibility of damaging the amplifier. Later, when the circuit configuration and connections have been proven, the current limits can be raised to the desired value.

### PROPER GROUNDING & POWER SUPPLY BYPASSING

Particular attention should be given to proper grounding practices because the large output currents can cause significant ground loop errors. Figure 1 illustrates proper connections.

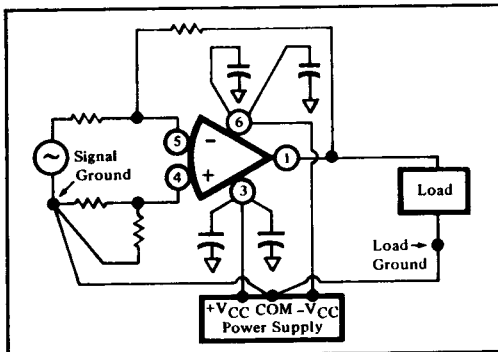


FIGURE 1. Proper Power Supply Connections.

Note that the connections are such that the load current does not flow through the wire connecting the signal ground point to the power supply common. Also, power supply and load leads should be run physically separated from the amplifier input and signal leads.

The amplifier should be power supply bypassed with 50 $\mu$ F tantalum capacitors connected in parallel with 0.01  $\mu$ F ceramic capacitors connected as close to pins 3 and 6 as possible. The capacitors should be connected to the load ground rather than the signal ground.

### CURRENT LIMITS

The amplifier is designed so that both the positive and negative load current limits can be adjusted with external resistors,  $R_{SC}$  and  $R_{-SC}$  respectively. The value of the resistors are given by the following equation:

$$R_{SC} = \frac{0.65 \text{ (volts)}}{I_{\text{limit}} \text{ (amps)}}$$

$I_{\text{limit}}$  is the desired maximum current. The maximum power dissipation of the resistors is  $P_{\text{max}} = R_{SC} (I_{\text{limit}})^2$ . The current limits determined by the equations above are accurate to about  $\pm 10\%$ . The variation of  $I_{\text{limit}}$  vs temperature is shown in the Typical Performance Curves.

The amplifier should be used with as low a current limit as possible for the particular application. This will minimize the chance of damaging the amplifier under abnormal load conditions and increase reliability by limiting the internal power dissipation of the amplifier.

## THERMAL CONSIDERATIONS

The 3573AM is rated for 150°C maximum junction temperature. The thermal resistance from junction to case ( $\theta_{jc}$ ) is 2.8°C/W per watt. The corresponding Power Derating Curve is given in the Typical Performance Curves section.

The internal power dissipation of the amplifier is given by the equation  $P_D = P_{DQ} + P_{DL}$ , where  $P_{DQ}$  is the quiescent power dissipation and  $P_{DL}$  is the power dissipated in the output stage due to the load.

The thermal resistance of the required heat sink ( $\theta_{hs}$ ) can be determined from the equation:

$$\theta_{hs} = \frac{T_J - T_A}{P_D} - \theta_{jc}$$

where  $T_J$  is the desired amplifier junction temperature (+150°C max),  $T_A$  is the ambient temperature,  $P_D$  is the amplifier's dissipation,  $P_D = P_{DQ} + P_{DL}$ , and  $\theta_{jc}$  is the junction to case thermal resistance of the amplifier.

The electrically isolated case of the 3573AM simplifies mounting the amplifiers to the heat sink (and the heat sink to any other assemblies) since there is no need for electrical insulation. Thermal joint compound and lock washers should be used to prevent mechanical relaxation due to thermal stresses.

### SAFE OPERATING AREA

There are additional constraints on the output voltage and current other than those just due to the maximum internal power dissipation of the amplifiers. These are related to the prevention of secondary breakdown in the output stage transistors. These restrictions are shown in the SAFE OPERATING AREA CURVES in the Typical Performance Curves.

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