MSK

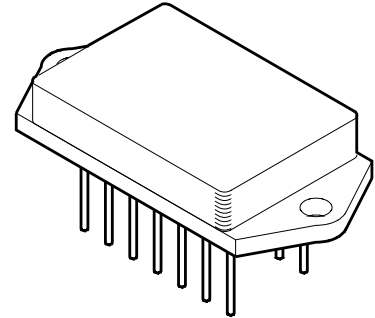# HIGH POWER DUAL OPERATIONAL AMPLIFIER

155

M.S.KENNEDY CORP.

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(315) 701-6751

FEATURES:
- Available to DSCC SMD #5962-02509HX
- Space Efficient Dual Power Amplifier
- Low Cost
- High Voltage Operation: Up to 80V
- Low Quiescent Current: 40mA Typ. Total
- High Output Current: 5A Min. Per Amp
- High Speed: 10V/μS Typ.
- Monolithic Technology
- Replaces obsolete MSK 154 up to 80V

MIL-PRF-38534 QUALIFIED

DESCRIPTION:
The MSK 155 is a high power dual monolithic operational amplifier ideally suited for high power amplification and magnetic deflection applications. With a total supply voltage rating of 80 volts and 5A of available output current per amplifier, the MSK 155 is also an excellent low cost choice for motor drive circuits. With both amplifiers in the same package, thermally induced output offset voltages are eliminated. Power dissipation is kept to a minimum with a total quiescent current rating of only 40mA. The MSK 155 is packaged in a hermetically sealed 14 pin power dip with heat sink bolt down tabs.

EQUIVALENT SCHEMATIC
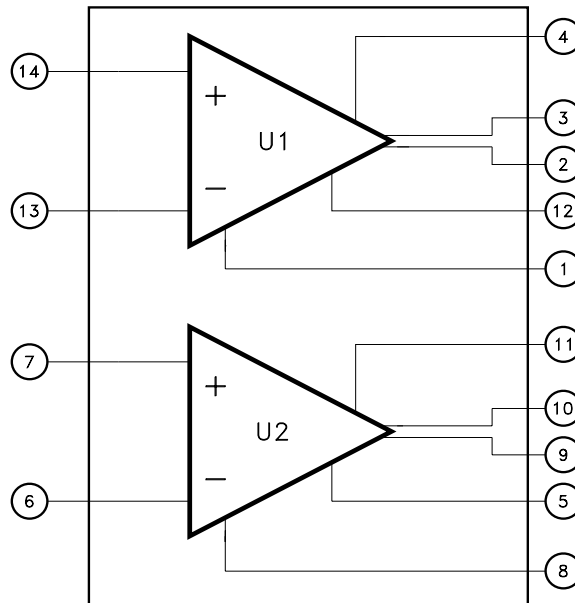
TYPICAL APPLICATIONS
- PA Audio
- Magnetic Deflection
- Motor Drive
- Noise Cancellation
- High Power Bridge Amplifier

PIN-OUT INFORMATION

1	-Vcc1	14	Non Inverting Input 1
2	Output Drive 1B	13	Inverting Input 1
3	Output Drive 1A	12	Current Sense1
4	+Vcc1	11	+Vcc 2
5	Current Sense 2	10	Output Drive 2A
6	Inverting Input 2	9	Output Drive 2B
7	Non Inverting Input 2	8	-Vcc 2

Rev. A 12/01

ABSOLUTE MAXIMUM RATINGS

V_{CC} Total Supply Voltage 80V
$\pm I_{OUT}$ Output Current (within S.O.A.) . . . . $\pm$5A
V_{IND} Input Voltage (Differential) . . . . . . $\pm Vcc$
V_{IN} Input Voltage (Common Mode) . . . . $\pm Vcc$
T_{J} Junction Temperature . . . . .150°C

T_{ST} Storage Temperature . . . . . -65°C to +150°C
T_{LD} Lead Temperature . . . . .300°C
T_{C} Case Operating Temperature
     (MSK155H/E) . . . . -55°C to +125°C
     (MSK155) . . . . -40°C to +85°C
R_{TH} Thermal Resistance (DC)
     Junction to Case . . . . .2.0°C/W

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ①	Group A Subgroup	MSK155H/E Min.	Typ.	Max.	MSK155 ⑤ Min.	Typ.	Max.	Units
STATIC									
Supply Voltage Range ④		-	$\pm$10	$\pm$35	$\pm$40	$\pm$10	$\pm$35	$\pm$40	V
Quiescent Current	Each Amp	1	-	$\pm$20	$\pm$30	-	$\pm$20	$\pm$35	mA
	$V_{IN}=0V$	2	-	$\pm$20	$\pm$30	-	-	-	mA
		3	-	$\pm$20	$\pm$30	-	-	-	mA
INPUT									
Offset Voltage	$V_{IN}=0V$	1	-	$\pm$0.1	$\pm$2	-	$\pm$0.1	$\pm$10	mV
		2,3	-	$\pm$2	$\pm$10	-	-	-	mV
Offset Voltage Drift ④	$V_{IN}=0V$	2,3	-	$\pm$10	$\pm$50	-	$\pm$10	-	μV/°C
Offset Voltage vs $\pm$Vcc ②	$V_{IN}=0V$	-	-	$\pm$5	-	-	$\pm$5	-	μV/V
Input Bias Current ④	$V_{CM}=0V$	1	-	$\pm$20	$\pm$100	-	$\pm$20	$\pm$200	pA
		2, 3	-	-^{12}	$\pm$10	-	-^{12}	-	nA
Input Impedance ②	(DC)	-	-	10	-	-	10	-	Ω
Input Capacitance ②		-	-	5	-	-	5	-	pF
Common Mode Rejection ④	$V_{CM}=\pm$22VDC	4	95	110	-	90	110	-	dB
Noise ②	F = 10Hz to 1KHz	-	-	10	-	-	10	-	μV$_{RMS}$
OUTPUT									
Output Voltage Swing ②	$R_L=10K$	-	-	$\pm$33.5	-	-	$\pm$33.5	-	V
Output Voltage Swing	$I_{OUT}=5A$ Pk	4	$\pm$29	$\pm$30	-	$\pm$29	$\pm$30	-	V
Power Bandwidth ④	$R_L=10\Omega$ $V_{OUT}=20VRMS$	4	45	55	-	40	55	-	KHz
Settling Time to 0.1% ③ ②	2V Step	-	-	2	-	-	2	-	μS
Capacitive Load ④	$A_V=+10V/V$	-	10	-	-	10	-	-	nF
TRANSFER CHARACTERISTICS									
Slew Rate ④	$V_{OUT}=\pm$10V $R_L=10\Omega$	4	6	10	-	6	10	-	V/μS
Open Loop Voltage Gain ④	F=10Hz $R_L=10K\Omega$	4	95	100	-	90	100	-	dB

NOTES:

① Unless otherwise noted $\pm V_{CC}=\pm$35VDC, RCL = 0Ω and specifications apply to each amplifier.
② Typical parameters are for reference only.
③ $A_V=-1V/V$ measured in false summing junction circuit.
④ Devices shall be capable of meeting the parameter, but need not be tested.
⑤ Industrial grade and 'E' suffix devices shall be tested to subgroups 1 and 4 unless otherwise requested.
⑥ Military grade devices ('H' suffix) shall be 100% tested to subgroups 1,2,3 and 4.
⑦ Subgroup 5 and 6 testing available upon request.
⑧ Subgroup 1,4 $T_C=+$25°C
   Subgroup 2,5 $T_C=+$125°C
   Subgroup 3,6 $T_A=-$55°C

CURRENT LIMIT *(SEE TYPICAL CONNECTION DIAGRAM)*

A value of current limit resistance can be calculated as follows:

$$R_{CL} = (0.809V/I_{CL}) - 0.057\Omega$$

Where:

R_{CL} is the current limit resistor value.

I_{CL} is the current limit desired.

0.057Ω is the drop in the current limit path across internal impedances other than the actual current limit resistor.

0.809Ω volts is the voltage drop that must be developed across the current limit connections to activate the current limit circuit at 25°C.

It is recommended the user limit output current to a value as close to the required output current as possible, without clipping output voltage swing. Current limit will vary with case temperature. Refer to the typical performance curves to predict current limit drift. If current limit is not required replace the

STABILITY

It is recommended that the parallel sum of the input and feedback resistor be 1000 ohms or less to minimize phase shift caused by the R-C network formed by the input resistor, feedback resistor and input capacitance. An effective method of checking amplifier stability is to apply the worst case capacitive load to the output of the amplifier and drive a small signal square wave across it. If overshoot is less than 25%, the system will typically be stable.

INPUT PROTECTION

Input protection circuitry within the MSK 155 will clip differential input voltages greater than Vcc. The inputs are also protected against common mode voltages up to the supply rails as well as static discharge. There are current limiting resistors in series with each input. These resistors may become damaged in the event the input overload is capable of driving currents above 1mA. If severe overload conditions are expected, external input current limiting resistors are recommended.

POWER SUPPLY DECOUPLING

A 0.1 microfarad ceramic disc and low ESR capacitor with a value of 10 microfarads per amp of output current should be placed in parallel from each power supply pin to ground. These capacitors must be rated for the full power supply voltage. Since the MSK 155 is commonly used in circuits where the loop gain is greater than 10 V/V, high frequency noise that enters the op-amp through the power supply lines will be amplified and could cause the amplifier to break into oscillation. In addition, without supply bypassing, the inductance of the power supply lines interacts with capacitive loads to form an oscillatory LC tank circuit. The power supply decoupling capacitors will minimize this effect and keep the circuit stable.
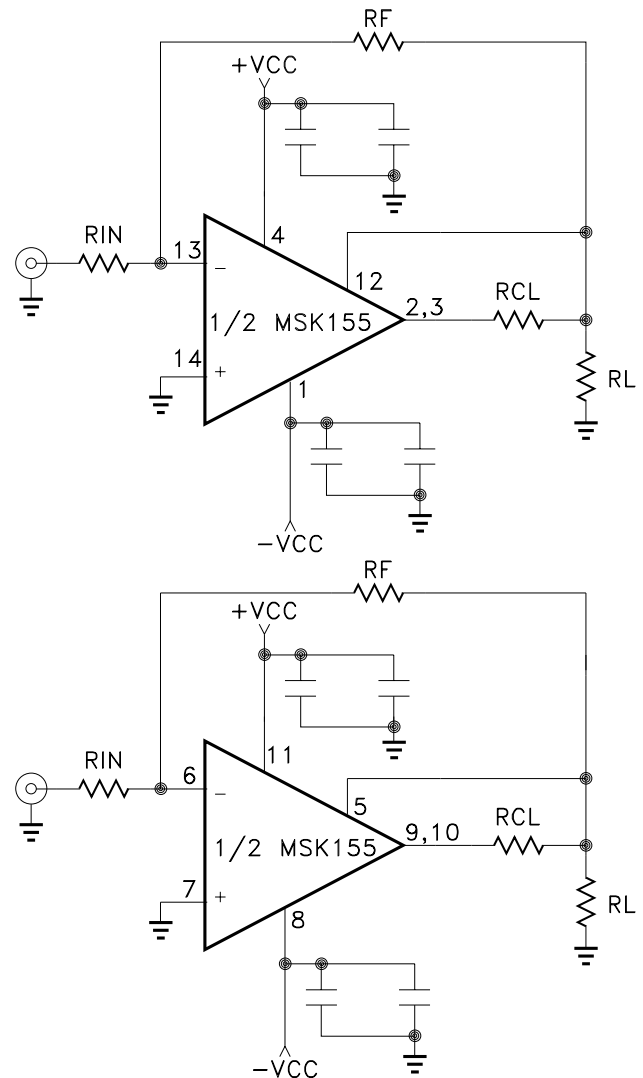
SAFE OPERATING AREA (SOA)

The output stage of this power operational amplifier has three distinct limitations:

1. The current handling capability of the die metallization.
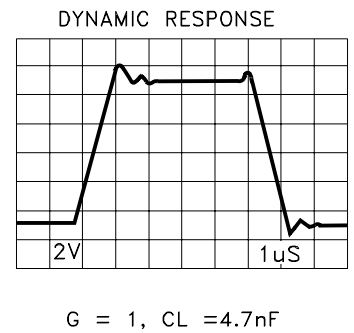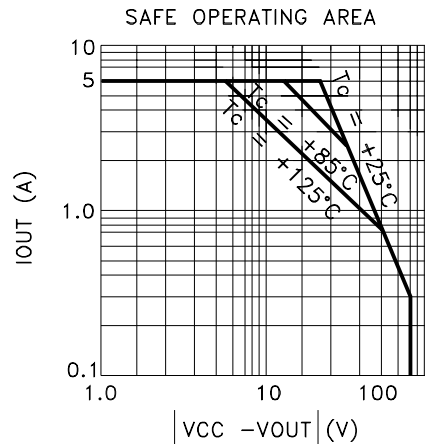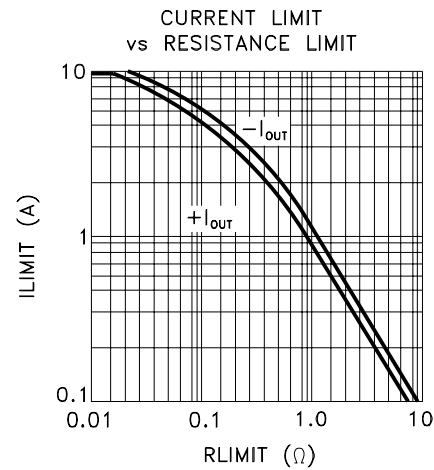2. The junction temperature of the output device's.
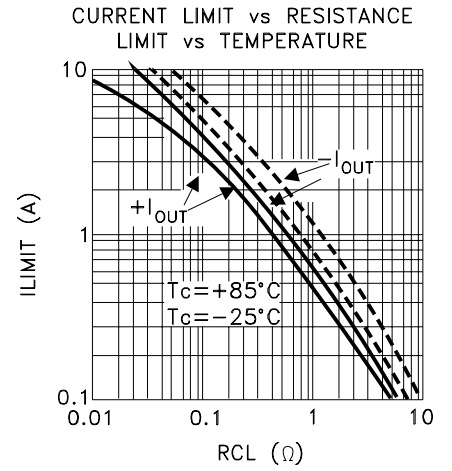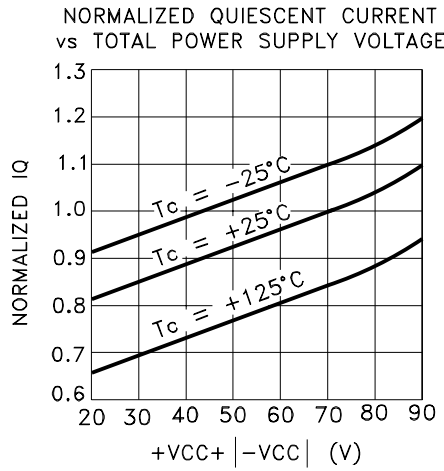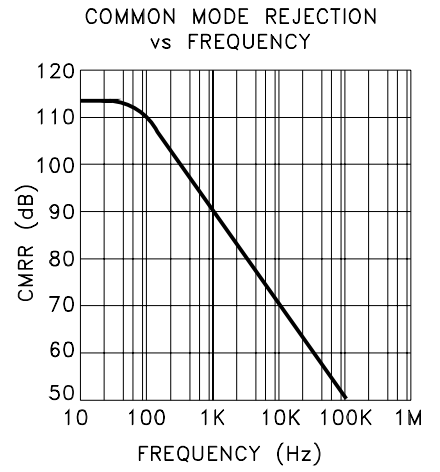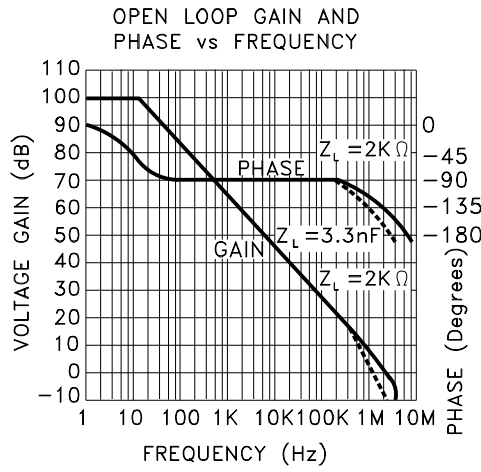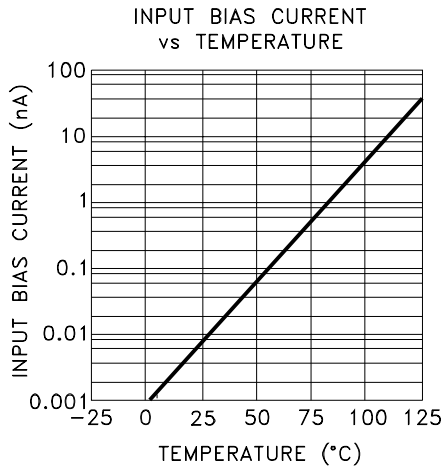3. Secondary breakdown.

All applications should be checked against the SOA curves.

NOTE: The output stage is protected against transient flyback. However, for protection against sustained, high energy flyback, external fast-recovery reverse biased diodes should be connected from the output to ground.
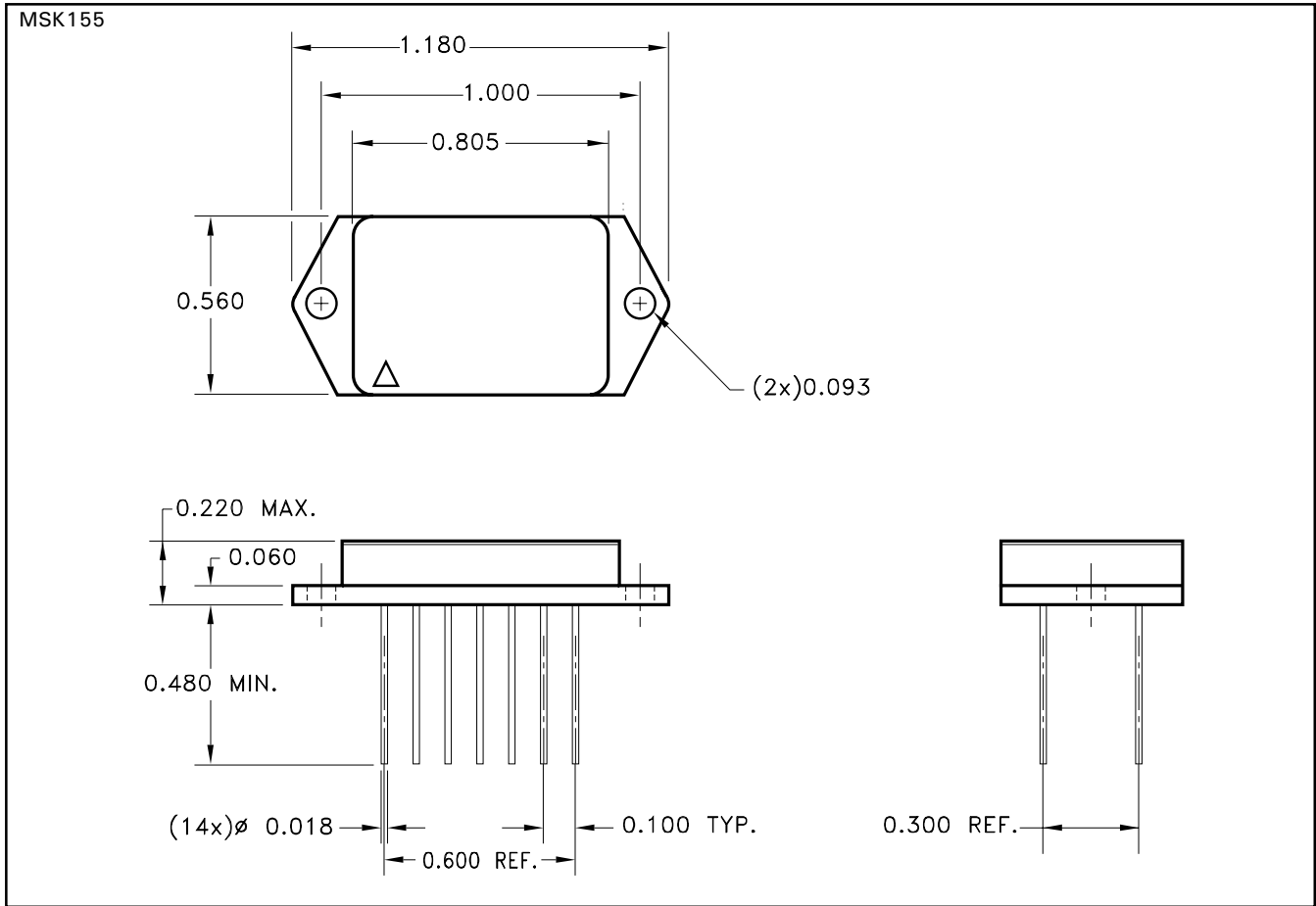

TYPICAL CONNECTION DIAGRAM

TYPICAL PERFORMANCE CURVES

INPUT BIAS CURRENT vs TEMPERATURE

OPEN LOOP GAIN AND PHASE vs FREQUENCY

COMMON MODE REJECTION vs FREQUENCY

NORMALIZED QUIESCENT CURRENT vs TOTAL POWER SUPPLY VOLTAGE

OUTPUT VOLTAGE SWING vs OUTPUT CURRENT

CURRENT LIMIT vs RESISTANCE LIMIT vs TEMPERATURE

CURRENT LIMIT vs RESISTANCE LIMIT

SAFE OPERATING AREA

DYNAMIC RESPONSE

G = 1, CL = 4.7nF
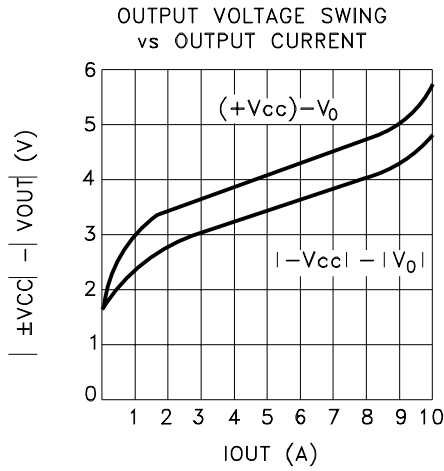
MSK155

ESD TRIANGLE INDICATES PIN 1.
ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED.

ORDERING INFORMATION

Part Number	Screening Level
MSK155	Industrial
MSK155E	Extended Reliability
MSK155H	Mil-PRF-38534
MSK155H	5962-02509HX DSCC SMD

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