M.S.KENNEDY CORP.

# HIGH SPEED, BUFFER AMPLIFIER AMP 0002

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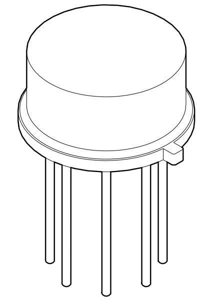
*MIL-PRF-38534 CERTIFIED*

## *FEATURES:*

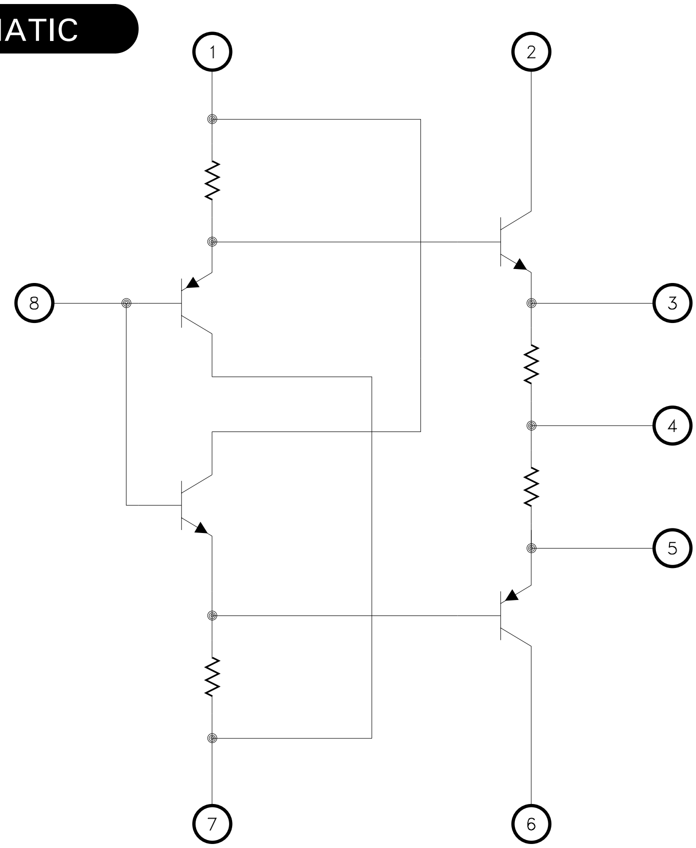


- Industry Wide LH0002 Replacement
- High Input Impedance-180KΩ Min
- Low Output Impedance-10Ω Max
- Low Harmonic Distortion
- DC to 30 MHz Bandwidth
- Slew Rate is Typically 400 V/μS
- Operating Range from ±5V to ±20V
- Available to DSCC SMD5962-7801301XC

## *DESCRIPTION:*

The MSK 0002 is a general purpose current amplifier. It is the industry wide replacement for the LH0002. The device is ideal for use with an operational amplifier in a closed loop configuration to increase current output. The MSK 0002 is designed with a symmetrical output stage that provides low output impedances to both the positive and negative portions of output pulses. The MSK 0002 is packaged in a hermetic 8 lead low profile T0-5 header and is specified over the full military temperature range.

## EQUIVALENT SCHEMATIC




## TYPICAL APPLICATIONS

- High Speed D/A Conversion
- 30MHz Buffer
- Line Driver
- Precision Current Source

## PIN-OUT INFORMATION

| | | | |
|---|---|---|---|
| 1 | V1+ | 5 | E4 |
| 2 | V2+ | 6 | V2- |
| 3 | E3 | 7 | V1- |
| 4 | Output | 8 | Input |

## ABSOLUTE MAXIMUM RATINGS

| | | |
|---|---|---|
| $\pm V_{CC}$ | Supply Voltage | ±22V |
| $V_{IN}$ | Input Voltage | ±22V |
| $P_d$ | Power Dissipation | 600mW |
| $T_C$ | Case Operating Temperature | |
| | (MSK 0002H) | -55°C to +125°C |
| | (MSK 0002) | -40°C to +85°C |
| $T_{ST}$ | Storage Temperature Range | -65°C to +150°C |
| $T_{LD}$ | Lead Temperature Range (10 Seconds) | +300°C |
| $T_J$ | Junction Temperature | +175°C |
| $\theta_{jC}$ | Thermal Resistance | 40°C/W |

## ELECTRICAL SPECIFICATIONS

| Parameter | Test Conditions ① | Group A Subgroup | MSK 0002H ④ Min. | Typ. | Max. | MSK 0002 Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|---|---|
| Quiescent Current | $V_{IN}$=0V $R_S$=10KΩ $R_L$=1.0KΩ | 1 | - | ±6.3 | ±10 | - | ±6.3 | ±10 | mA |
| Input Offset Current | $R_S$=10KΩ $R_L$=1.0KΩ | 1 | - | ±2 | ±10 | - | ±2 | ±10 | μA |
| | | 2,3 | - | ±2 | ±10 | - | - | - | μA |
| Input Offset Voltage | $R_S$=300Ω $R_L$=1.0KΩ | 1 | - | ±6 | ±30 | - | ±6 | ±30 | mV |
| | | 2,3 | - | ±10 | ±30 | - | - | - | mV |
| Input Impedance ③ | $V_{IN}$=1.0$V_{RMS}$ $R_S$=200KΩ $R_L$=1KΩ f=1.0KHz | 4 | 180 | - | - | 180 | - | - | KΩ |
| Output Impedance ③ | $V_{IN}$=1.0$V_{RMS}$ $R_s$=10KΩ $R_L$=50Ω f=1.0KHz | 4 | - | - | 10 | - | - | 10 | Ω |
| Output Voltage Swing | $V_{IN}$=±12Vp $R_L$=1.0KΩ f=1.0KHz | 4 | ±10 | ±11 | - | ±10 | ±11 | - | Vp |
| | $V_{IN}$=±10Vp $R_L$=100Ω $+V_{CC}$=±15V f=1.0KHz | 4 | ±9.5 | - | - | ±9.5 | - | - | Vp |
| Voltage Gain ② | $V_{IN}$=3.0$V_{PP}$ f=1.0KHz $R_S$=10KΩ $R_L$=1.0KΩ | 4 | 0.95 | 0.97 | - | 0.95 | 0.97 | - | V/V |
| | | 5,6 | 0.95 | - | - | - | - | - | V/V |
| Rise Time | $V_{OUT}$=2.5$V_{PP}$ f=10KHz $R_S$=100Ω $R_L$=50Ω | 4 | - | 8 | 12 | - | 8 | 12 | nS |

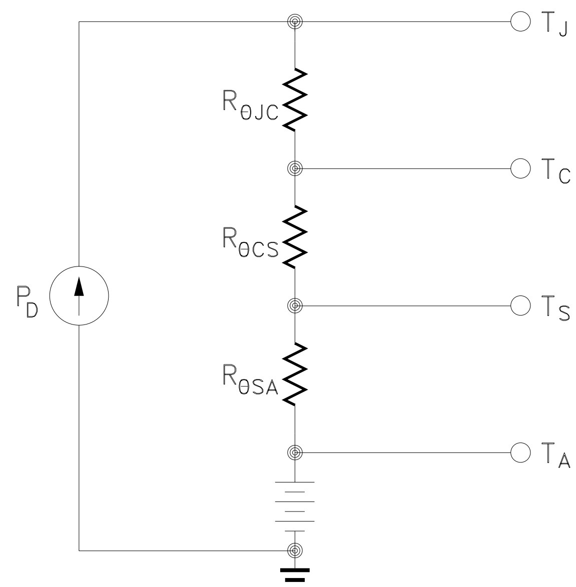
*NOTES:*

① Unless otherwise specified $\pm V_{CC}=\pm 12V_{DC}$
② Subgroups 5 & 6 shall be tested as part of device initial characterization and after design and process changes. Parameter shall be guaranteed to the limits specified for subgroups 5 & 6 for all lots not specifically tested.
③ Devices shall be capable of meeting the parameter, but need not be tested.
④ Subgroup 1,4 $T_A=T_C=+25°C$
Subgroup 2,5 $T_A=T_C=+125°C$
Subgroup 3,6 $T_A=T_C=-55°C$

## *HEAT SINKING*

To determine if a heat sink is necessary for your application and if so, what type, refer to the thermal model and governing equation below.

### *Thermal Model:*




### *Governing Equation:*

$T_J = P_D \times (R_{\Theta JC} + R_{\Theta CS} + R_{\Theta SA}) + T_A$

Where

$T_J$ = Junction Temperature
PD = Total Power Dissipation
$R_{\Theta JC}$ = Junction to Case Thermal Resistance
$R_{\Theta CS}$ = Heat Sink to Ambient Thermal Resistance
$T_C$ = Case Temperature
$T_A$ = Ambient Temperature
$T_S$ = Sink Temperature

### *Example:*

This example demonstrates a worst case analysis for the buffer output stage. This occurs when the output voltage is 1/2 the power supply voltage. Under this condition, maximum power transfer occurs and the output is under maximum stress.

Conditions:

VCC = ±12VDC
Vo = ±6Vp Sine Wave, Freq. = 1KHz
RL = 100Ω

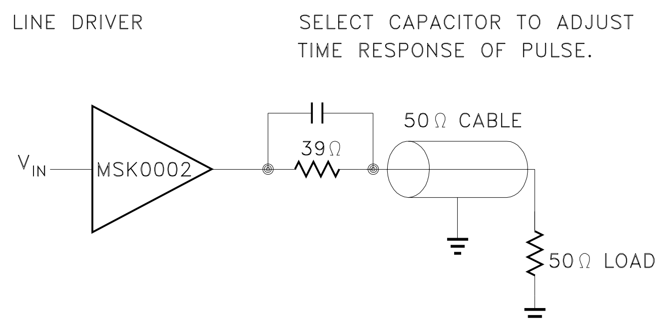
For a worst case analysis we will treat the ±6Vp sine wave as an 6 VDC output voltage.

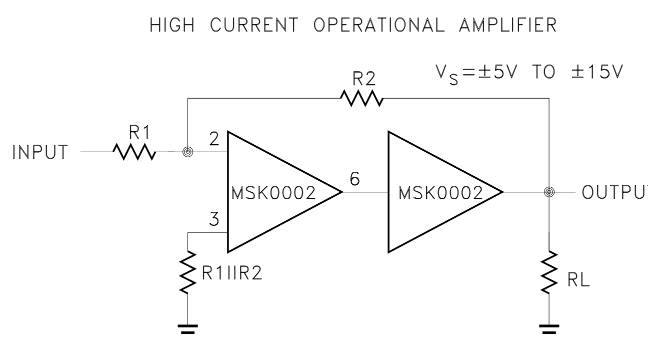
1.) Find Driver Power Dissipation
PD = (Vcc-Vo) (Vo/$R_L$)
= (12V-6V) (6V/100Ω)
= 360mW
2.) For conservative design, set $T_J$ = +125°C Max.
3.) For this example, worst case $T_A$ = +80°C
4.) $R_{\Theta JC}$ = 40° C/W from MSK 0002H Data Sheet
5.) $R_{\Theta CS}$ = 0.15° C/W for most thermal greases
6.) Rearrange governing equation to solve for $R_{\Theta SA}$

$R_{\Theta SA}$ = $((T_J - T_A)/P_D) - (R_{\Theta JC}) - (R_{\Theta CS})$
= ((125°C - 80°C) / 0.36W) - 40°C/W - 0.15°C/W
= 125 - 40.15
= 84.9°C/W

This heat sink in this example must have a thermal resistance of no more than 84.9°C/W to maintain a junction temperature of no more than +125°C.

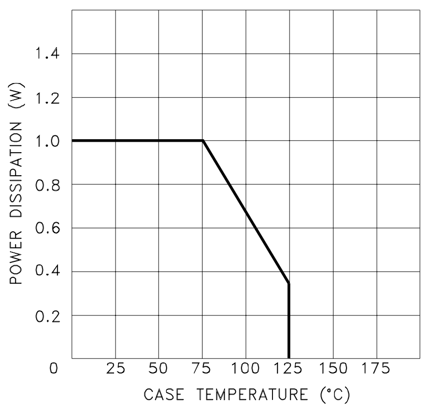
### *Typical Applications:*



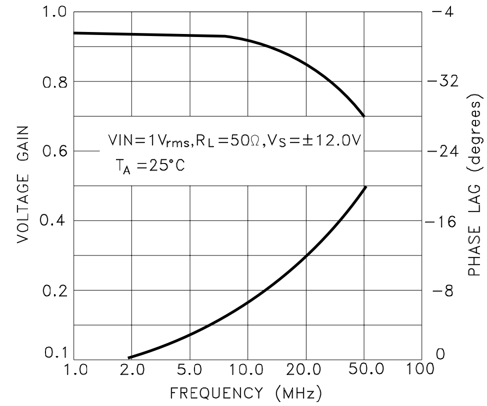



# TYPICAL PERFORMANCE CURVES

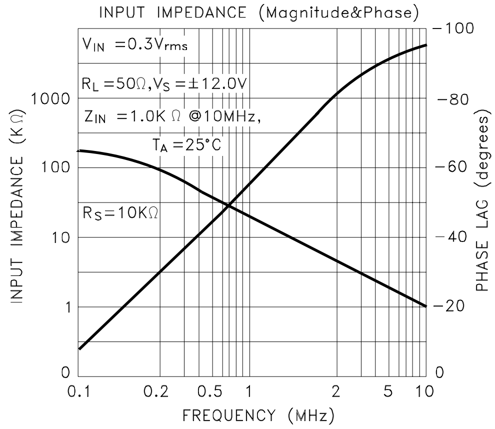
MAXIMUM POWER DISSIPATION



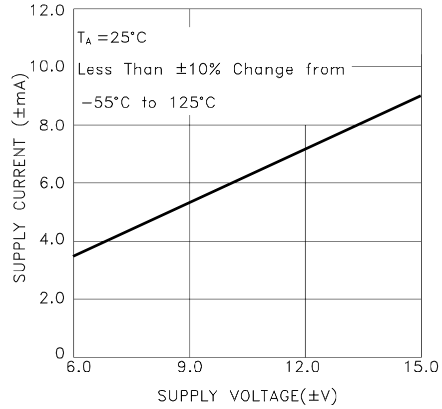

FREQUENCY RESPONSE



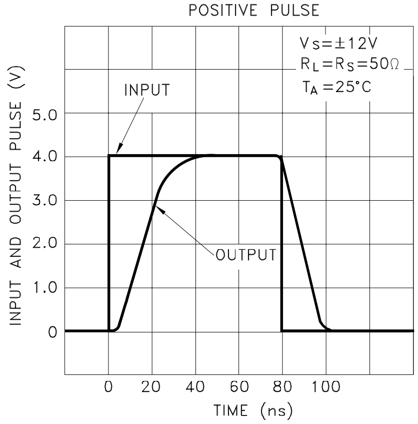

INPUT IMPEDANCE (Magnitude&Phase)



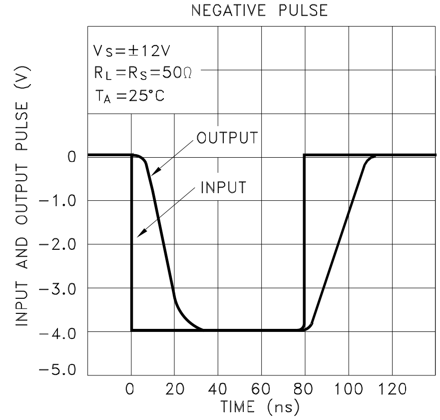

SUPPLY CURRENT



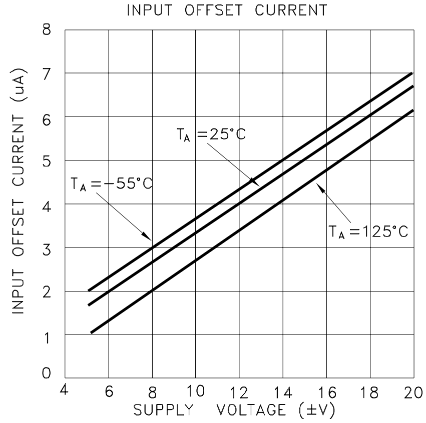

POSITIVE PULSE

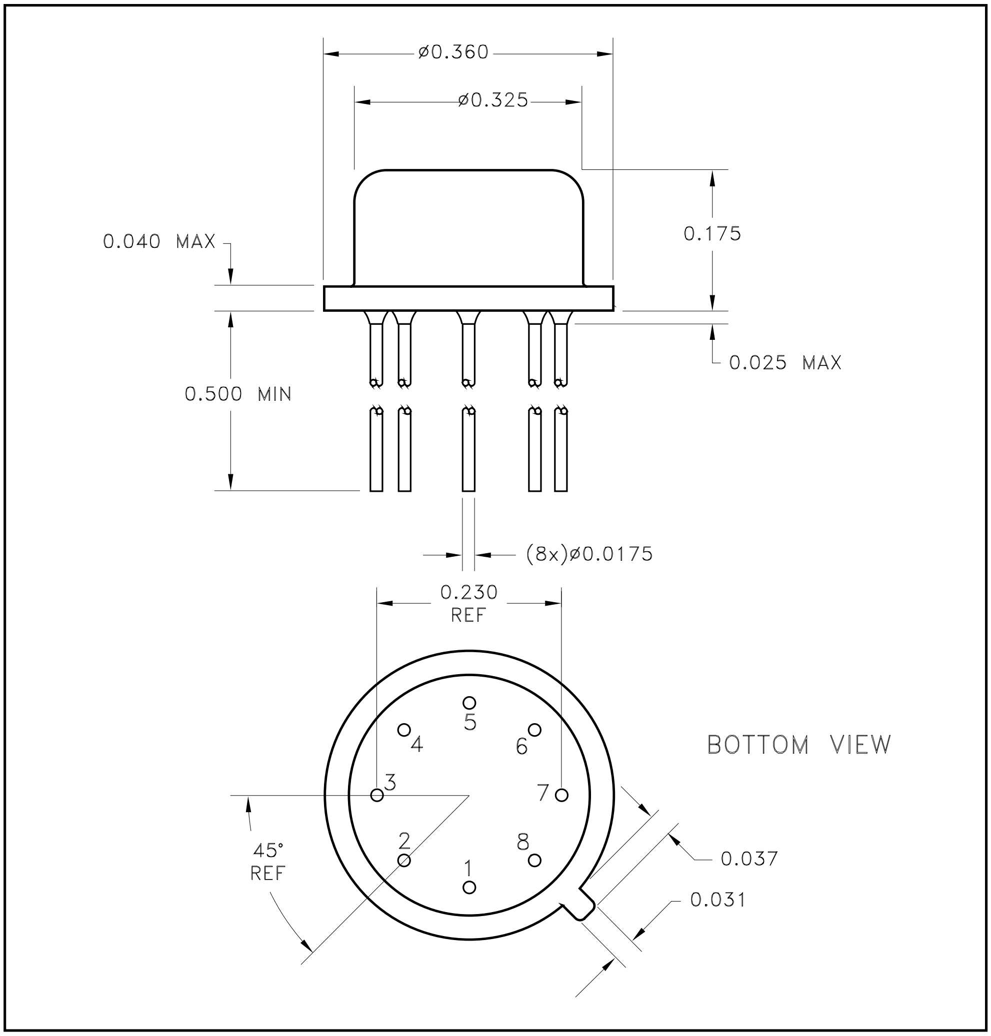



NEGATIVE PULSE




INPUT OFFSET CURRENT






ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED

## *ORDERING INFORMATION*

| Part Number | Screening Level |
|---|---|
| MSK0002 | Industrial |
| MSK0002H | Military-Mil-PRF-38534 |
| 7801-301XC | DSCC-SMD |

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