MIL-PRF-38534 AND 38535 CERTIFIED FACILITY

M.S.KENNEDY CORP.

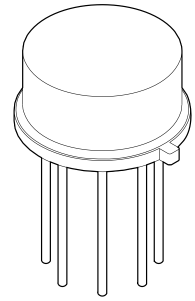
RAD HARD, HIGH SPEED, BUFFER AMPLIFIER

0002RH

4707 Dey Road Liverpool, N.Y. 13088 (315) 701-6751

FEATURES:

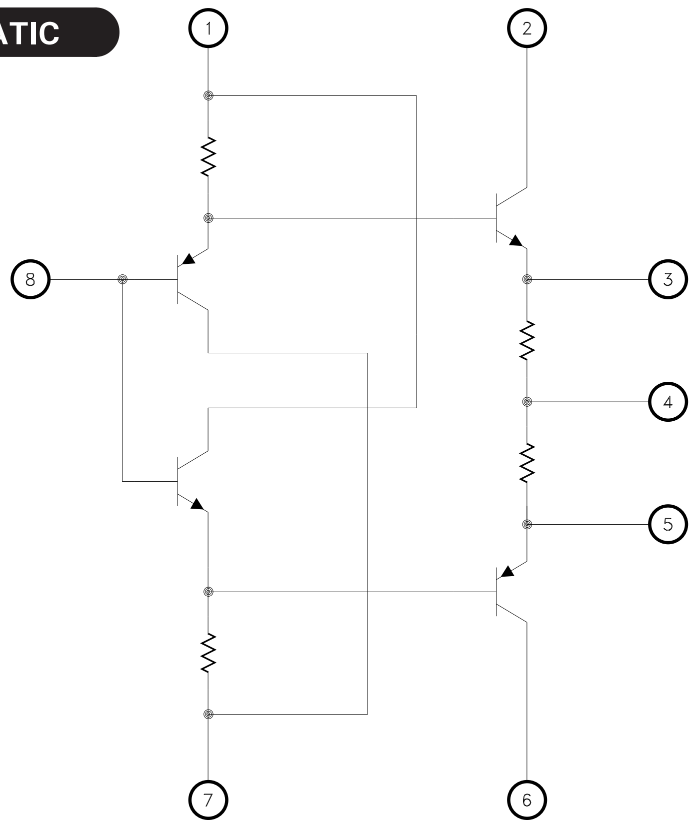
- Radiation Hardened to 100 Krads(Si) (Method 1019.7 Condition A)
- Radiation Hardened LH0002 Replacement
- High Input Impedance-180KΩ Min
- Low Output Impedance-10Ω Max
- Low Harmonic Distortion
- DC to 30 MHz Bandwidth
- Slew Rate is Typically 400 V/μS
- Operating Range from ±5V to ±20V
- Available to DSCC SMD 5962-78013
- Equivalent Non Rad Hard Device MSK 0002



DESCRIPTION:

The MSK 0002RH is a general purpose current amplifier. It is the industry wide RAD tolerant 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 0002RH is designed with a symmetrical output stage that provides low output impedances to both the positive and negative portions of output pulses. The MSK 0002RH 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

CASE=ISOLATED

ABSOLUTE MAXIMUM RATINGS ⑦

$\pm V_{CC}$	Supply Voltage	±20V
V_{IN}	Input Voltage	±20V
P_d	Power Dissipation	600mW
T_C	Case Operating Temperature (MSK 0002K/H RH)	-55°C to +125°C
	(MSK 0002RH)	-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
θ_{JC}	Thermal Resistance @ TC=125°C Output Devices	55°C/W

ELECTRICAL SPECIFICATIONS

Parameter ⑥	Test Conditions ① ⑧	Group A Subgroup	MSK 0002K/H RH ④ Min.	Typ.	Max.	MSK 0002RH Min.	Typ.	Max.	Units
Quiescent Current	VIN=0V RS=10KΩ RL=1.0KΩ	1	-	±6.3	±10	-	±6.3	±12	mA
Input Current	RS=10KΩ RL=1.0KΩ	1	-	±5	±15	-	±5	±20	uA
		2,3	-	±10	±20	-	-	-	uA
	Post Radiation	1	-	-	±30	-	-	±30	uA
Output Offset Voltage	RS=300Ω RL=1.0KΩ	1	-	±6	±30	-	±6	±35	mV
		2,3	-	±10	±30	-	-	-	mV
Input Impedance ③	VIN=1.0VRMS RS=200KΩ RL=1KΩ f=1.0KHz	4	180	-	-	180	-	-	KΩ
Output Impedance ③	VIN=1.0VRMS RS=10KΩ RL=50Ω f=1.0KHz	4	-	-	10	-	-	10	Ω
Ouput Voltage Swing	RL=1.0KΩ f=1.0KHz	4	±10	±11	-	±10	±11	-	Vp
	RL=100Ω f=1.0KHz	4	±9.5	-	-	±9.5	-	-	Vp
	Post Radiation	4	±8.4	-	-	±8.4	-	-	Vp
Voltage Gain ②	VIN=3.0Vpp f=1.0KHz	4	0.95	0.97	-	0.95	0.97	-	V/V
	RS=10KΩ RL=1.0KΩ	5,6	0.92	-	-	0.92	-	-	V/V
	Post Radiation	4	0.90	-	-	0.90	-	-	V/V
Rise Time	VOUT=2.5Vpp f=10KHz RS=100Ω RL=50Ω	4	-	6	12	-	6	15	nS

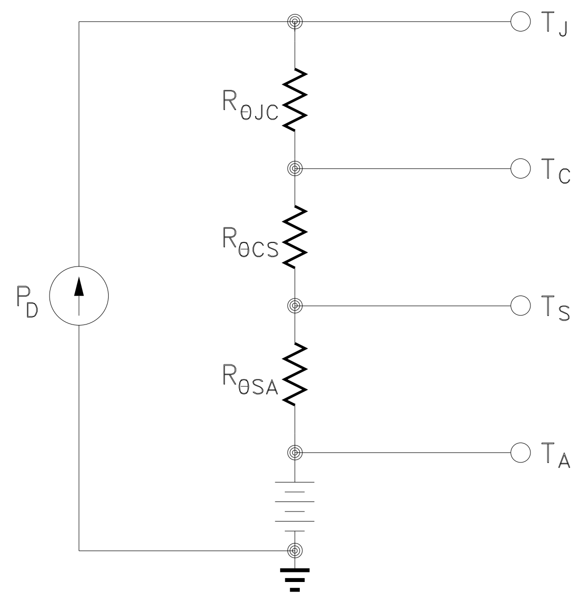
NOTES:

① Unless otherwise specified ±VCC=±12VDC, RL=1KΩ.
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 $T_A=T_C=-55°C$
⑤ Refer to SMD 5962-78013 for electrical parameters for devices purchased as such.
⑥ Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle.
⑦ Pre and post irradiation limits at 25°C, up to 100Krad TID, are identical unless otherwise specified.

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
V_O = ±6Vp Sine Wave, Freq. = 1KHz
RL = 100Ω

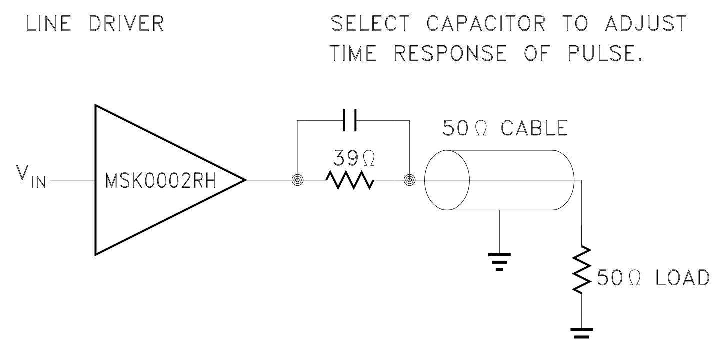
For a worst case analysis we will treat the ±6Vp sine wave as an 6 VDC output voltage.

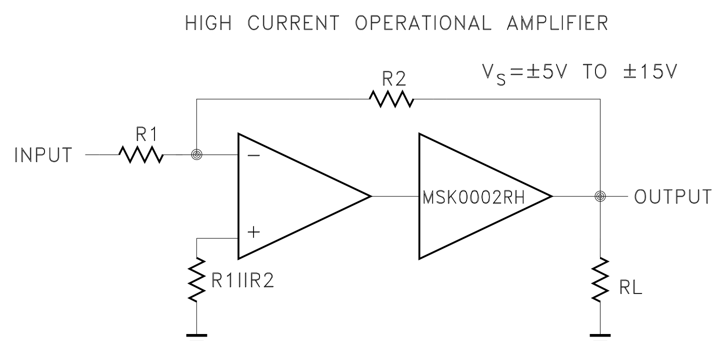
1.) Find Driver Power Dissipation
$PD = (V_{CC} - V_O)(V_O/R_L)$
$= (12V - 6V)(6V/100\Omega)$
$= 360mW$
2.) For conservative design, set $T_J = +125°C$ Max.
3.) For this example, worst case $T_A = +80°C$
4.) $R_{\Theta JC}$ = 55° C/W from MSK 0002RH Data Sheet
5.) $R_{\Theta CS}$ = 0.15° C/W for most thermal greases
6.) Rearrange governing equation to solve for $R_{\Theta SA}$

$$
\begin{aligned}
R_{\Theta SA} &= ((T_J - T_A)/P_D) - (R_{\Theta JC}) - (R_{\Theta CS}) \\
&= ((125°C - 80°C) / 0.36W) - 55°C/W - 0.15°C/W \\
&= 125 - 55.15 \\
&= 69.9°C/W
\end{aligned}
$$

This heat sink in this example must have a thermal resistance of no more than 69.9°C/W to maintain a junction temperature of no more than +125°C.

Typical Applications:



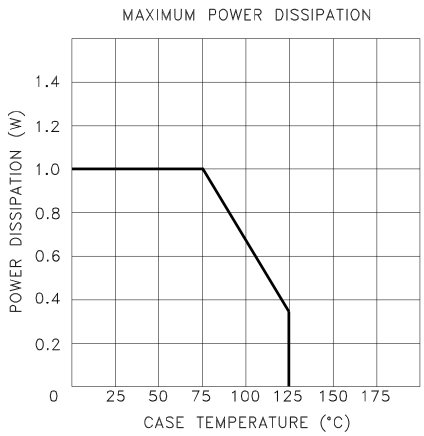


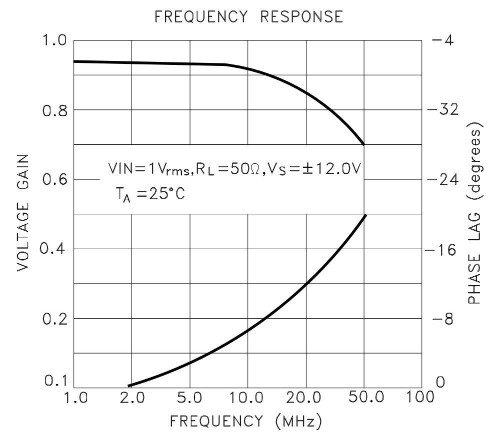
TOTAL DOSE RADIATION TEST PERFORMANCE

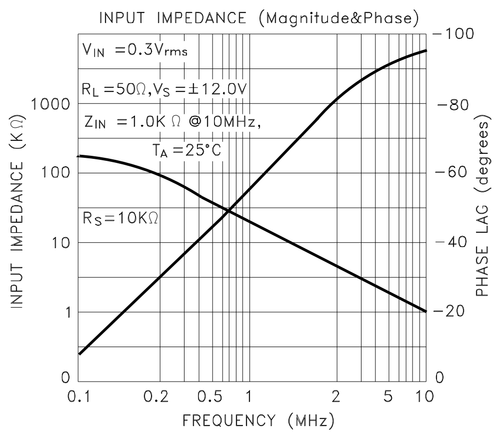
Radiation performance curves for TID testing have been generated for all radiation testing performed by MS Kennedy. These curves show performance trends throughout the TID test process and can be located in the MSK 0002RH radiation test report. The complete radiation test report is available in the RAD HARD PRODUCTS section on the MSK website.

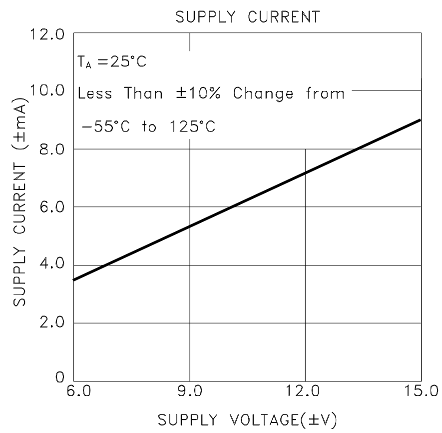
http://www.mskennedy.com/store.asp?pid=9951&catid=19680

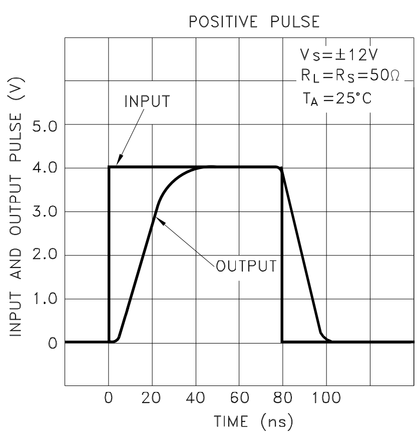
TYPICAL PERFORMANCE CURVES

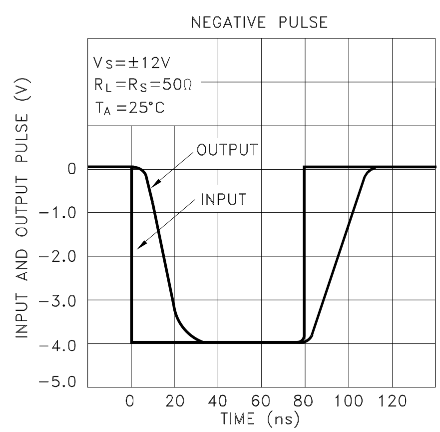


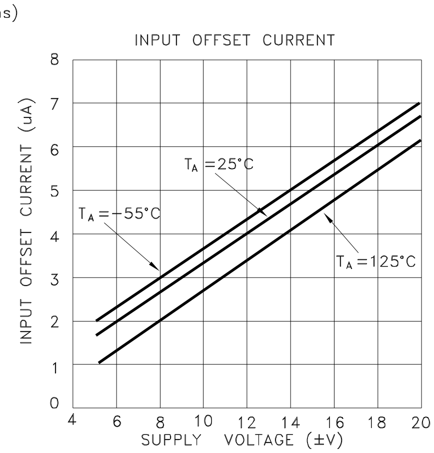




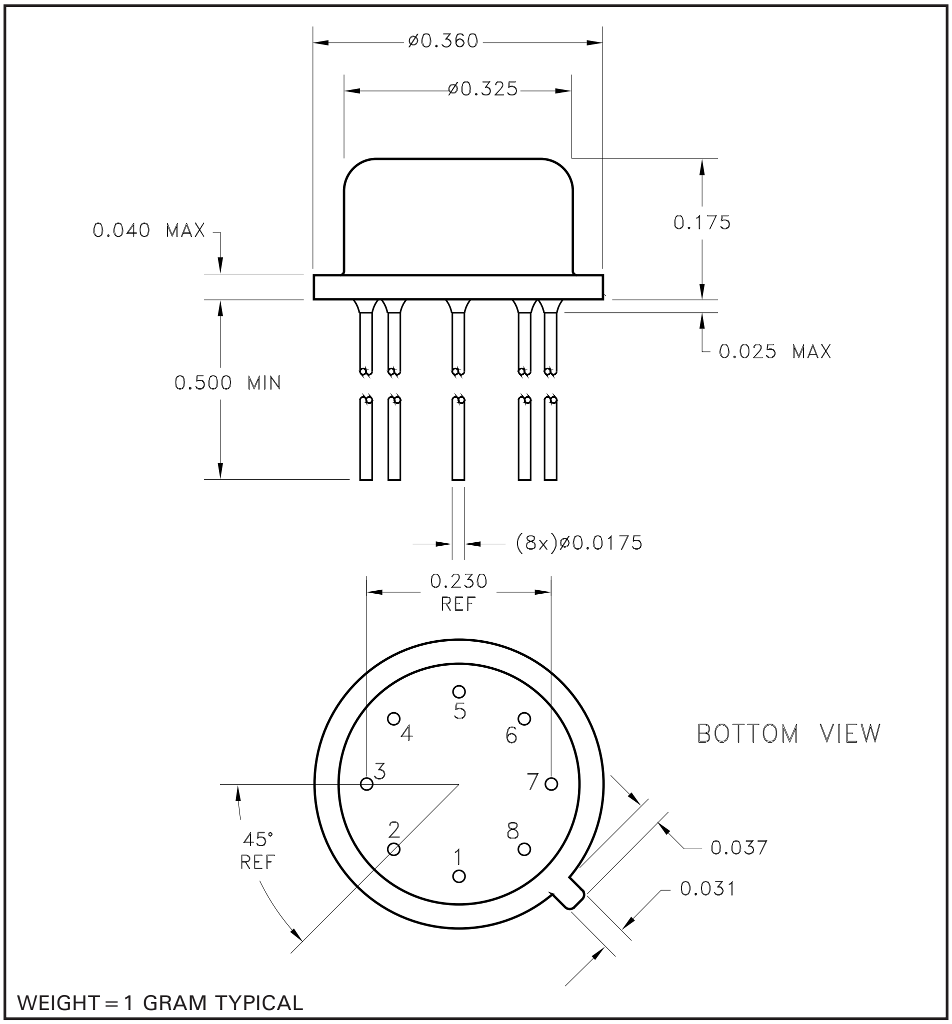








MECHANICAL SPECIFICATIONS



ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED

ORDERING INFORMATION

Part Number	Screening Level
MSK0002RH	Industrial
MSK0002HRH	MIL-PRF-38534 Class H
MSK0002KRH	MIL-PRF-38534 Class K
5962-78013	DSCC SMD

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