MSK
M.S.KENNEDY CORP.

NEGATIVE OUTPUT WIDE BANDWIDTH HIGH VOLTAGE AMPLIFIER

604

4707 Dey Road Liverpool, N.Y. 13088

(315) 701-6751

FEATURES:

- Negative Going Output Voltage
- Ultra Low Quiescent Current - ±10mA for High Voltage
- 95V Peak to Peak Output Voltage Swing
- Slew Rate - 3000V/μS Typical
- Full Power Output Frequency - 2 MHz Typical
- Output Current - 250mA Peak
- Adjustable - VHV Power Supply Minimizes Power Dissipation
- Compact Package Offers Superior Power Dissipation.

MIL-PRF-38534 QUALIFIED
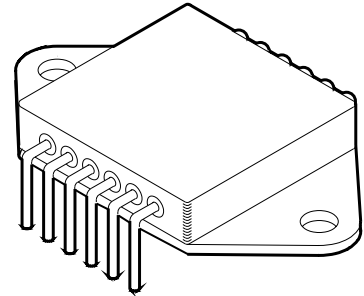
DESCRIPTION:

The MSK 604(B) is a high voltage wideband amplifier designed to provide large negative voltage swings at high slew rates in wideband systems. The true inverting op-amp topology employed in the MSK 604 provides excellent D.C. specifications such as input offset voltage and input bias current. These attributes are important in amplifiers that will be used in high gain configurations since the input error voltages will be multiplied by the system gain. The MSK 604 achieves impressive slew rate specifications by employing a feed forward A.C. path through the amplifier; however, the device is internally configured in inverting mode to utilize this benefit. Internal compensation for gains of -5V/V or greater keeps the MSK 604 stable in this range. The MSK 604 is packaged in a space efficient, hermetically sealed, 12 pin power dual in line package that has a high thermal conductivity for efficient device cooling.

EQUIVALENT SCHEMATIC
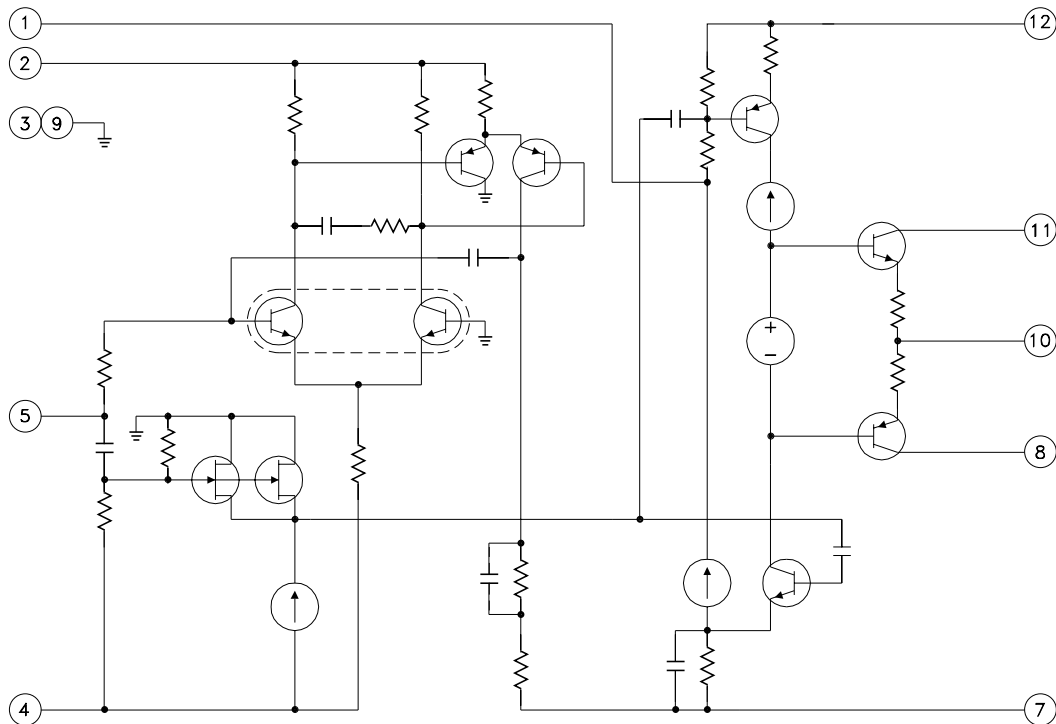
TYPICAL APPLICATIONS

- Wideband High Voltage Amplifier
- High Resolution CRT Monitor Grid Drive
- Ultra High Performance Video Processing
- CRT Beam Intensity Control
- Varactor Tuned VCO Driver
- Automatic Test Equipment

PIN-OUT INFORMATION

1	COMP	12	+VHV
2	+VCC	11	+VSC
3	GROUND	10	OUTPUT
4	-VCC	9	CASE/GROUND
5	-INPUT	8	-VSC
6	NO CONNECTION	7	-VHV

1

Rev. B 8/00

ABSOLUTE MAXIMUM RATINGS

$\pm V_{HV}$ Supply Voltage . . . . +20,-120VDC

$\pm V_{IN}$ Input Voltage Range . . . . $\pm V_{CC}$

$\pm V_{CC}$ Supply Voltage (Input Stage) . . . . . $\pm 18V_{DC}$

θ_{JC} Thermal Resistance . . . . $18°C/W$
(Output Devices)

T_{ST} Storage Temperature Range $-65°C$ to $+150°C$

T_{LD} Lead Temperature Range . . . . $300°C$
(10 Seconds)

T_C Case Operating Temperature
MSK604 . . . . $-40°C$ to $+85°C$
MSK604B . . . . $-55°C$ to $+125°C$

T_J Junction Temperature . . . . $150°C$

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions	Group A Subgroup	MSK 604B ④ Min.	Typ.	Max.	MSK 604 ③ Min.	Typ.	Max.	Units
STATIC									
Quiescent Current	$V_{IN}=0$ @ $+V_{CC}$	1,2,3	-	1.5	2.0	-	1.8	2.5	mA
	$V_{IN}=0$ @ $-V_{CC}$	1,2,3	-	15	25	-	20	30	mA
	$V_{IN}=0$ @ $+V_{HV}$	1	-	10	15	-	10	20	mA
		2,3	-	14	17	-	-	-	mA
	$V_{IN}=0$ @ $-V_{HV}$	1	-	10	15	-	10	20	mA
		2,3	-	14	17	-	-	-	mA
Input Offset Voltage	$V_{IN}=0$	1	-	±1.0	±5.0	-	±1.0	±10	mV
		2,3	-	±2.0	±10.0	-	±2.0	-	mV
Input Bias Current		1	-	50	250	-	50	500	nA
		2,3	-	100	350	-	100	-	nA
Input Offset Voltage Drift ②	$V_{IN}=0$	2,3	-	±10	±50	-	±10	-	$\mu V/°C$
Power Supply Range	$\pm V_{CC}$	-	±12	±15	±18	±12	±15	±18	V
	$+V_{HV}$	-	0	$+15$	$+20$	0	$+15$	$+20$	V
	$-V_{HV}$	-	-50	-100	-120	-50	-100	-120	V
DYNAMIC CHARACTERISTICS									
Output Voltage Swing ②	$f=1KHz$	4	-90/+5	-95/8	-	-90/+5	-95/8	-	V
Peak Output Current ②	$f=1KHz$	-	±100	±250	-	±100	±250	-	mA
Full Power Output ②	$V_O=70V$	-	1	2	-	1	2	-	MHz
Unity Gain Bandwidth	$V_O=1.0V$	-	50	100	-	50	100	-	MHz
Slew Rate ②	$V_O=80V$	4	2000	3000	-	2000	3000	-	V/μS
Voltage Gain ②	$f=1KHz$	-	94	100	-	90	100	-	dB
Settling Time to 1% ②	$A_V=-10V/V$ $V_O=50V$	-	-	200	-	-	200	-	nS
Settling Time to 0.1%	$A_V=-10V/V$ $V_O=50V$	-	-	1000	-	-	1000	-	nS

NOTES:

① Unless otherwise specified, $\pm V_{CC}=\pm15V_{DC}$, $+V_{HV}=+15V_{DC}$, $-V_{HV}=-100V$ $C_L=8pF$ (probe capacitance) and $A_V=-10V/V$.

② This parameter is guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.

③ Industrial grade devices shall be tested to subgroups 1 and 4 unless otherwise specified.

④ Military grade devices ('B' suffix) shall be 100% tested to subgroups 1,2,3 and 4.

⑤ Subgroup 1,4 $T_A=T_C=+25°C$
Subgroup 2,5 $T_A=T_C=+125°C$
Subgroup 3,6 $T_A=T_C=-55°C$

Rev. B 8/00

FEED FORWARD TOPOLOGY

The MSK 604 employs a circuit topology known as "feed forward". This inverting configuration allows the user to realize the excellent D.C. input characteristics of a differential amplifier without losing system bandwidth. The incoming signal is split at the input into it's A.C. and D.C. components. The D.C. component is allowed to run through the differential amplifier where any common mode noise is rejected. The A.C. component is "fed forward" to the output section through a very high speed linear amplifier where it is mixed back together with the D.C. component. The result is an amplifier with most of the benefits of a differential amplifier without the loss in system bandwidth.

INTERNAL COMPENSATION

Since the MSK 604 is a high voltage amplifier, it is commonly used in circuits employing large gains. Therefore, the internal compensation was chosen for gains of -5V/V or greater. In circuits running at gains of less than -5V/V, the user can further compensate the device by adding compensation networks at the input or feedback node. Pin 1 (comp) should be bypassed with a 0.1uF ceramic capacitor to $+V_{HV}$ for all applications.

HIGH VOLTAGE SUPPLIES

The negative high voltage supply on the MSK 604 can be adjusted to reduce power dissipation. The output of the MSK 604 will typically swing to within 5V of the $-V_{HV}$ power supply rail. Therefore, if the system in question only needs the output of the amplifier to swing -40V peak, the power supply rails could be set to -50V safely. For best performance, the minimum value of $-V_{HV}$ should be -50VDC. The high voltage and low voltage power supplies should be decoupled as shown in Figure 1. The $+V_{HV}$ supply can range from ground to $+20V_{DC}$ depending on application requirements.

TRANSITION TIMES

Transition time optimization of the MSK 604 follows the same basic rules as most any other amplifier. Best transition times will be realized with minumum load capacitance, minimum external feedback resistance and lowest circuit gain. Transition times will degrade if the output is driven too close to either supply rail. Feedback and input resistor values will affect transition time as well. See Figure 1 and Table 1 for recommended component values.
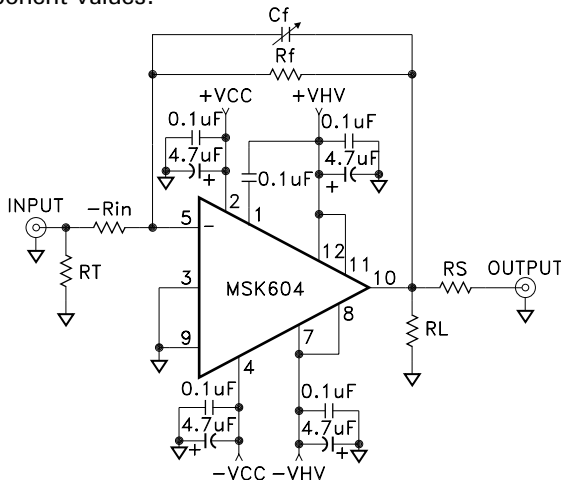
VOLTAGE GAIN	$-R_{IN}$	R_F	C_F
-10V/V	1KΩ	10KΩ	0.5-5pF
-20V/V	499Ω	10KΩ	N/A
-50V/V	402Ω	20KΩ	N/A

Table 1

CURRENT LIMIT

Figure 2 is the recommended active short circuit protection scheme for the MSK 604. The following formula may be used for setting current limit:

$$\text{Current Limit} \approx 0.6V \, / \, R_{SC}$$

R_{BASE} must be selected based on the value of $\pm V_{HV}$ as follows:

$$R_{BASE} = ((+V_{HV} - (-V_{HV})) - 1.2V) \, / \, 4mA$$

This formula guarantees that Q2 and Q4 will always have sufficient base current to be in operation. This circuit can be made tolerant of high frequency output current spikes with the addition of C_{SC}. The corresponding time constant would be:

$$T = (R_{SC})(C_{SC})$$

A common value for C_{SC} is approximately 1000pF. If current limit is unnecessary, short pin 7 to pin 8 and pin 11 to pin 12 as shown in Figure 1.
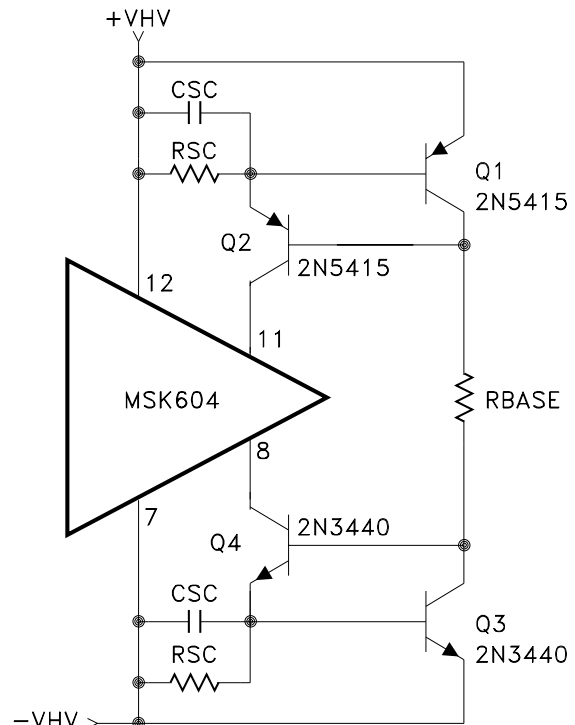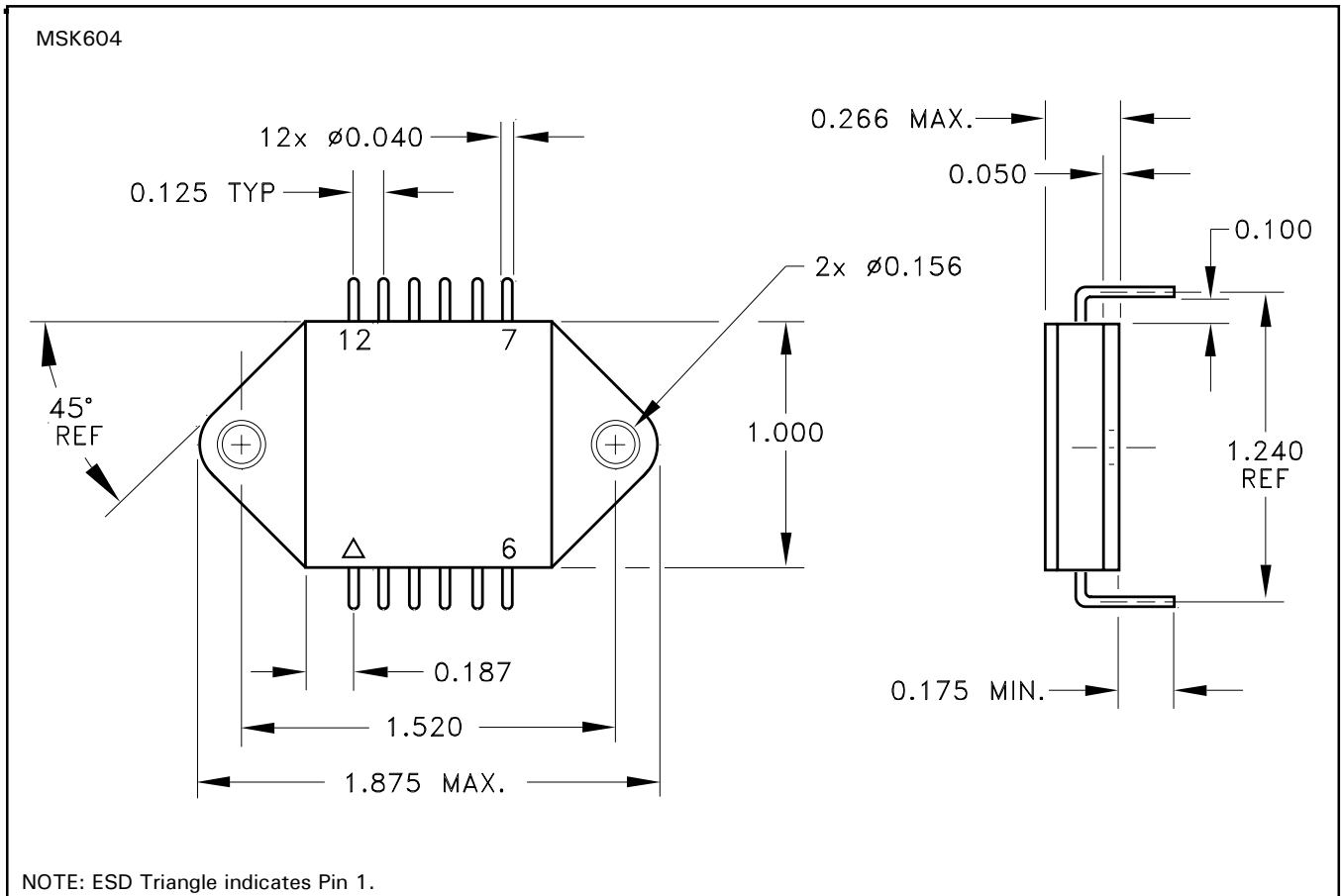

Figure 1

Figure 2

Rev. B 8/00

MSK604

NOTE: ESD Triangle indicates Pin 1.

ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED

ORDERING INFORMATION

Part Number	Screening Level
MSK604	Industrial
MSK604B	Military-Mil-PRF-38534

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