ISO 9001 CERTIFIED BY DSCC

M.S.KENNEDY CORP.

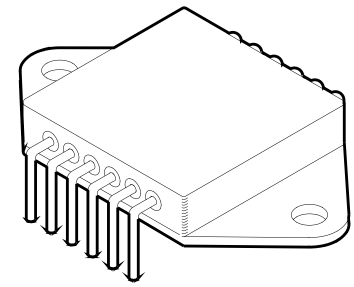
VERY WIDE BANDWIDTH HIGH VOLTAGE AMPLIFIER 610

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

MIL-PRF-38534 QUALIFIED

FEATURES:

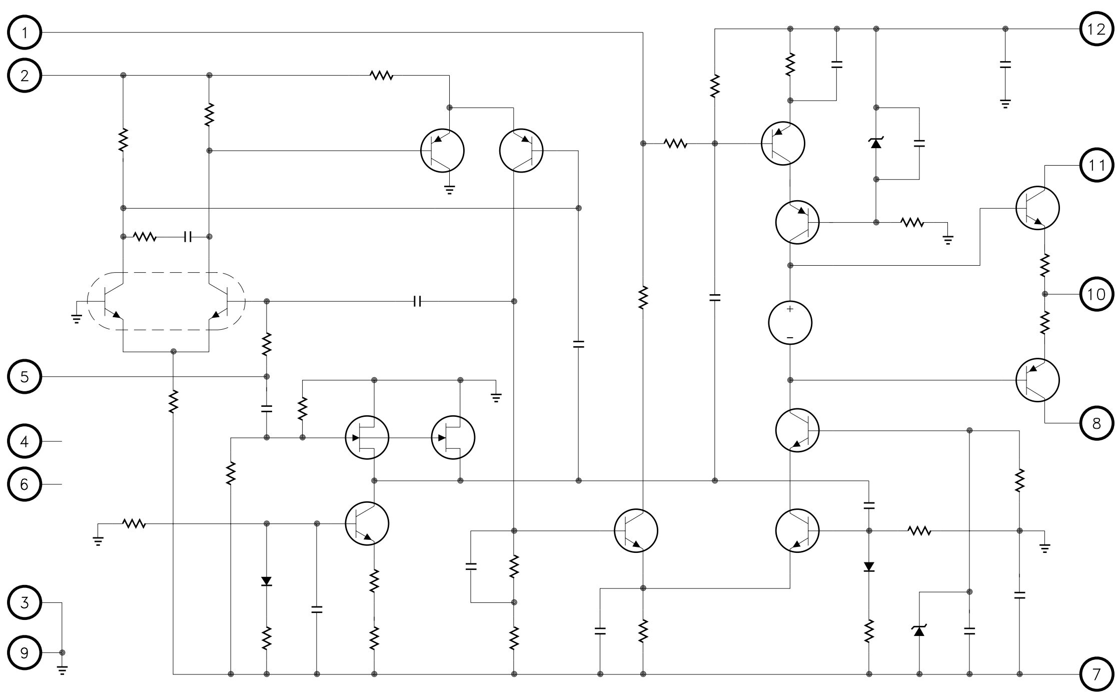
- Ultra Low Quiescent Current - ±12mA for High Voltage Stage
- 110V Peak to Peak Output Voltage Swing
- Slew Rate - 5000V/μS Typical @ 100Vpp
- Gain Bandwidth Product - 550 MHz Typical
- Full Power Output Frequency - 9 MHz Typical
- Output Current - 250mA Peak
- Adjustable VHV Power Supply Minimizes Power Dissipation
- Compact Package Offers Superior Power Dissipation



DESCRIPTION:

The MSK 610 is a high voltage very wideband amplifier designed to provide large voltage swings at high slew rates in wideband systems. The true inverting op-amp topology employed in the MSK 610 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 610 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 610 stable in this range. The MSK 610 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
- 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	N/C	9	CASE/GROUND
5	-INPUT	8	-VSC
6	N/C	7	-VCC

ABSOLUTE MAXIMUM RATINGS

$+V_{HV}, +V_{SC}$	Supply Voltage	$+130V_{DC}$
$-V_{SC}$	Supply Voltage	$-18V_{DC}$
$\pm V_{IN}$	Input Voltage Range	$\pm V_{CC}$
$\pm V_{CC}$	Supply Voltage (Input Stage)	$\pm 18V_{DC}$
θ_{JC}	Thermal Resistance (Output Devices)	30°C/W
T_{ST}	Storage Temperature Range	-65°C to +150°C
T_{LD}	Lead Temperature Range (10 Seconds)	300°C
T_C	Case Operating Temperature	
	MSK610	-40°C to +125°C
	MSK610B	-55°C to +125°C
T_J	Junction Temperature	150°C

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ①		Group A Subgroup	MSK 610B Min.	MSK 610B Typ.	MSK 610B Max.	MSK 610 Min.	MSK 610 Typ.	MSK 610 Max.	Units
STATIC										
Quiescent Current	$V_{IN}=0$	@ $+V_{CC}$	1,2,3	-	1.0	2.0	-	1.0	2.0	mA
		@ $-V_{CC}$	1,2,3	-	12	30	-	12	35	mA
		@ $+V_{HV}$	1,2,3	-	12	25	-	12	28	mA
		@ $-V_{SC}$	1,2,3	-	12	25	-	12	28	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	500	-	100	-	nA
Input Offset Voltage Drift ②	$V_{IN}=0$		2,3	-	±10	±50	-	±10	-	μV/°C
Power Supply Range ②	$\pm V_{CC}$		-	±12	±15	±18	±12	±15	±18	V
	$+V_{HV}$, $+V_{SC}$		-	50	120	130	50	120	130	V
	$-V_{SC}$		-	-18	-15	0	-18	-15	0	V
DYNAMIC CHARACTERISTICS										
Output Voltage Swing ⑥	f=1KHz		4	100	110	-	100	110	-	Vpp
Peak Output Current ②	f=1KHz		4	±200	±250	-	±200	±250	-	mA
Full Power Output Frequency ②	$V_O=100Vpp$		4	2	9	-	1	9	-	MHz
Unity Gain Bandwidth ②	$V_O=1Vpp$		4	80	100	-	80	100	-	MHz
Slew Rate	$V_O=100Vpp$		4	4000	5000	-	4000	5000	-	V/μS
Voltage Gain ②	f=1KHz		4	80	100	-	80	100	-	dB
Settling Time to 1% ②	$A_V=-10V/V$ $V_O=50Vpp$		-	-	200	-	-	200	-	nS
Settling Time to 0.1% ②	$A_V=-10V/V$ $V_O=50Vpp$		-	-	500	-	-	500	-	nS

NOTES:

① Unless otherwise specified, $\pm V_{CC}=\pm 15V_{DC}$, $+V_{HV}=+V_{SC}=+120V_{DC}$, $-V_{SC}=-15V_{DC}$, $C_L=8pF$ (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 $T_C=+25°C$
Subgroup 2,5 $T_J=+125°C$
Subgroup 3,6 $T_A=-55°C$
⑥ The output voltage swing is typically within 8 volts of each V_{SC} supply setting.

APPLICATION NOTES

FEED FORWARD TOPOLOGY

The MSK 610 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 its A.C. and D.C. component. 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 a composite amplifier with most of the benefits of a differential amplifier without the loss in system bandwidth.

INTERNAL COMPENSATION

Since the MSK 610 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 positive and negative high voltage supplies on the MSK 610 can be adjusted to reduce power dissipation. The output of the MSK 610 will typically swing to within 8V of either output voltage power supply rail. Therefore, if the system in question only needs the output of the amplifier to swing 0 to 40V peak, the power supply rails could be set to -15V and +50V safely. For best performance, the minimum value of $+V_{HV}$ should be $+50V_{DC}$. The $-V_{SC}$ pin may be directly connected to ground if the output does not need to swing through zero volts. The high voltage and low voltage power supplies should be decoupled as shown in Figure 1.

TRANSITION TIMES

Transition time optimization of the MSK 610 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.

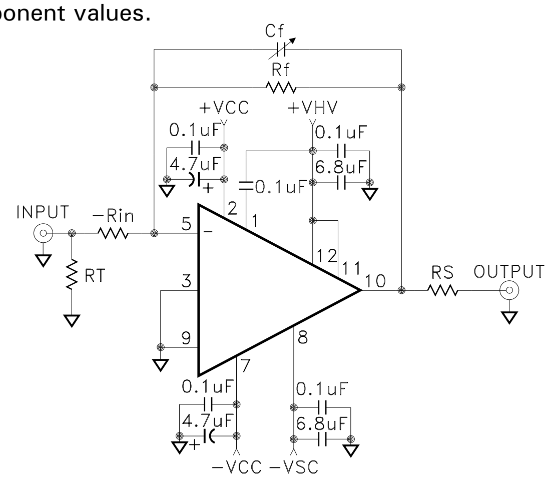


Figure 1

VOLTAGE GAIN	$-R_{IN}$	R_F	C_F
-10V/V	604Ω	6.04KΩ	0.5-2pF
-20V/V	301Ω	6.04KΩ	N/A
-50V/V	100Ω	5KΩ	N/A

Table 1

CURRENT LIMIT

Figure 2 is an active short circuit protection scheme for the MSK 610. 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 $+V_{HV}$ and $-V_{CC}$ as follows:

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

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. Pin 8 can be tied to ground if swing through zero is not desired.

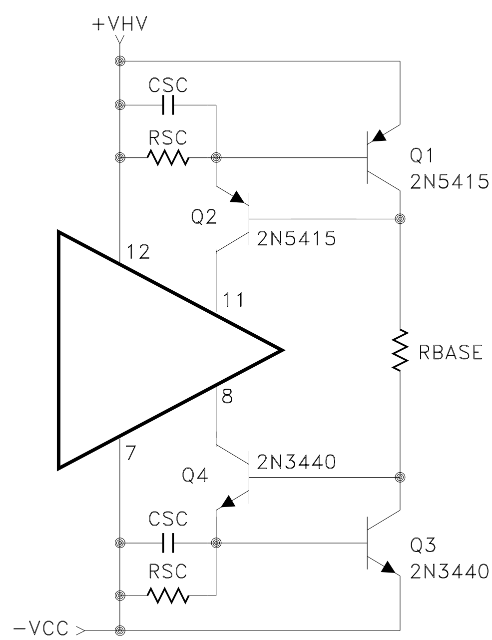
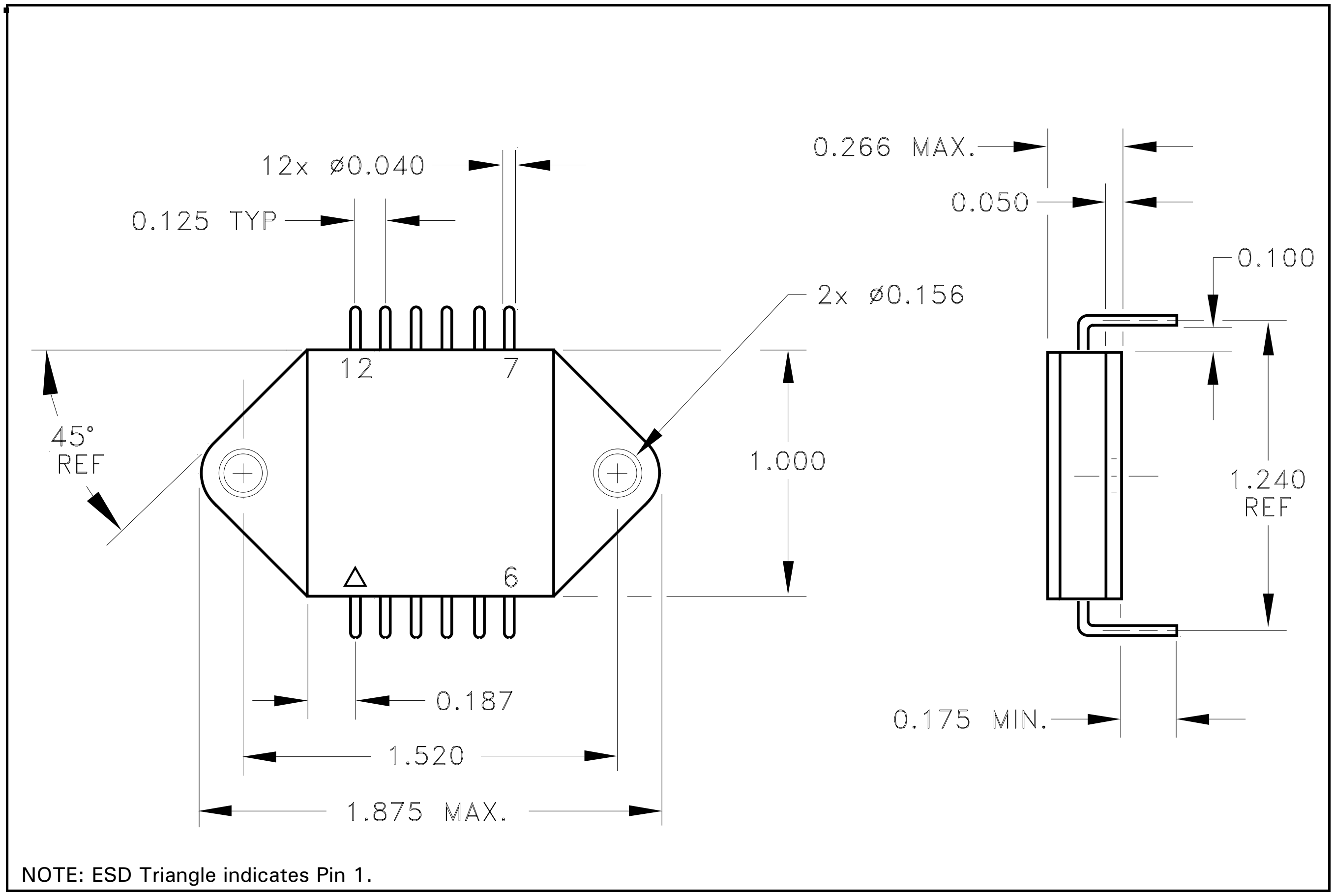


Figure 2

MECHANICAL SPECIFICATIONS



ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED

ORDERING INFORMATION

Part Number	Screening Level
MSK610	Industrial
MSK610B	Military-Mil-PRF-38534

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