ISO 9001 CERTIFIED BY DSCC

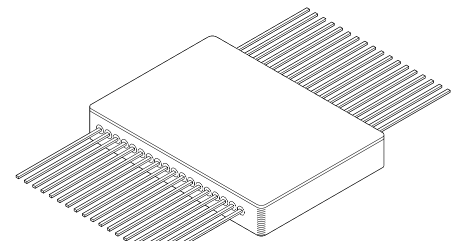
MSK

M.S.KENNEDY CORP.

HIGH VOLTAGE/HIGH SPEED SURFACE MOUNT AMPLIFIER 613

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

MIL-PRF-38534 QUALIFIED



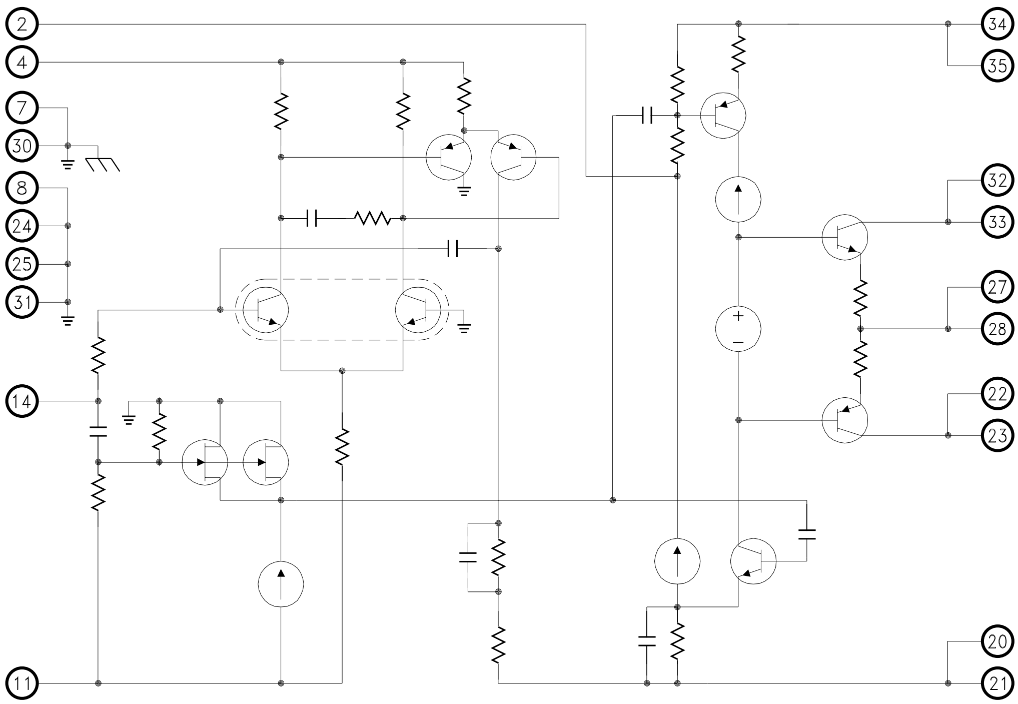
FEATURES:

- Ultra Low Quiescent Current - ±10mA for High Voltage
- 80V Peak to Peak Output Voltage Swing
- Slew Rate - 3500V/μS Typical
- Input Offset Voltage Only - ±1mV Typ.
- Output Current - 150mA Peak Typ.
- Adjustable VHV Power Supply Minimizes Power Dissipation

DESCRIPTION:

The MSK 613 is a high voltage/high speed amplifier designed to provide large voltage swings at high slew rates in wideband systems. The true inverting op-amp topology employed in the MSK 613 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 613 achieves impressive settling time 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 613 stable in this range. The MSK 613 is packaged in a space efficient, hermetically sealed, 36 pin flatpack.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Fast Settling 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	N/C	10	N/C	19	N/C	28	VOUT
2	COMP	11	-VCC	20	-VHV	29	N/C
3	N/C	12	N/C	21	-VHV	30	CASE GND
4	+VCC	13	N/C	22	-VSC	31	GND
5	N/C	14	INPUT	23	-VSC	32	+VSC
6	N/C	15	N/C	24	GND	33	+VSC
7	CASE GND	16	N/C	25	GND	34	+VHV
8	GND	17	N/C	26	N/C	35	+VHV
9	N/C	18	N/C	27	VOUT	36	N/C

ABSOLUTE MAXIMUM RATINGS

$\pm V_{HV}$	Supply Voltage	$\pm 65V_{DC}$
$\pm V_{IN}$	Input Voltage Range	$\pm V_{CC}$
$\pm V_{CC}$	Supply Voltage (Input Stage)	$\pm 18V_{DC}$
θ_{JC}	Thermal Resistance (Output Devices)	25°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	
	MSK613	-40 °C to +85°C
	MSK613H	-55°C to +125°C
T_J	Junction Temperature	150°C

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ①	Group A Subgroup	MSK 613H Min.	MSK 613H Typ.	MSK 613H Max.	MSK 613 ③ Min.	MSK 613 ③ Typ.	MSK 613 ③ Max.	Units
STATIC									
Quiescent Current	$V_{IN}=0$ @ $+V_{CC}$	1,2,3	-	1.0	3.5	-	1.0	4.0	mA
	$V_{IN}=0$ @ $-V_{CC}$	1,2,3	-	12	30	-	15	32	mA
	$V_{IN}=0$ @ $+V_{HV}$	1,2,3	-	10	15	-	10	15	mA
	$V_{IN}=0$ @ $-V_{HV}$	1,2,3	-	12	15	-	10	15	mA
Input Offset Voltage	$V_{IN}=0$	1	-	±0.2	±5.0	-	±1.0	±5.0	mV
		2,3	-	±1.0	±10.0	-	±2.0	-	mV
Input Bias Current ②		1	-	50	250	-	50	500	nA
		2,3	-	100	500	-	100	-	nA
Input Offset Voltage Drift ②	$V_{IN}=0$	2,3	-	±15	±50	-	±15	-	μV/°C
Power Supply Range ②	$\pm V_{CC}$	-	±12	±15	±18	±12	±15	±18	V
	$\pm V_{HV}$	-	±40	±55	±65	±40	±55	±65	V
DYNAMIC CHARACTERISTICS									
Output Voltage Swing	f=1KHz	4	±40	±45	-	±40	±45	-	V
Peak Output Current ②	f=1KHz	-	±100	±150	-	±100	±150	-	mA
Full Power Output ②	$V_O=\pm 40V$	-	5	12	-	4	12	-	MHz
Unity Gain Bandwidth ②	$V_O=\pm 1.0V$	-	80	100	-	80	100	-	MHz
Slew Rate	$V_O=\pm 40V$	4	2000	3500	-	2000	3500	-	V/μS
Voltage Gain ②	$V_O=\pm 40V$ f=1KHz	4	90	100	-	90	100	-	dB
Settling Time to 1% ②	$A_V=-10V/V$ $V_O=\pm 40V$	-	-	100	-	-	100	-	nS
Settling Time to 0.1% ②	$A_V=-10V/V$ $V_O=\pm 40V$	-	-	400	-	-	400	-	nS
Settling Time to 0.05% ②	$A_V=-10V/V$ $V_O=\pm 40V$	-	-	750	1.5	-	750	1.6	μS

NOTES:

① Unless otherwise specified, $\pm V_{CC}=\pm 15V_{DC}$, $\pm V_{HV}=\pm 55V_{DC}$, $C_L=8pF$ (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 ('H' 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 $T_A=T_C=-55°C$

APPLICATION NOTES

FEED FORWARD TOPOLOGY

The MSK 613 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 an amplifier with most of the benefits of a differential amplifier without the loss in system bandwidth.

INTERNAL COMPENSATION

Since the MSK 613 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 2 (comp) should be bypassed with a 1.0uF ceramic capacitor to $+V_{HV}$ for all applications.

HIGH VOLTAGE SUPPLIES

The positive and negative high voltage supplies on the MSK 613 can be adjusted to reduce power dissipation. The output of the MSK 613 will typically swing to within 8V of either high voltage 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 $\pm V_{HV}$ should be $\pm 40V_{DC}$. Unbalanced power supply rails are also allowed as long as one or the other is not decreased to below 30V or above 80V. The high voltage and low voltage power supplies should be decoupled as shown in Figure 1.

TRANSITION TIMES

Transition time optimization of the MSK 613 follows the same basic rules as most any other amplifier. Best transition times will be realized with minimum 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.

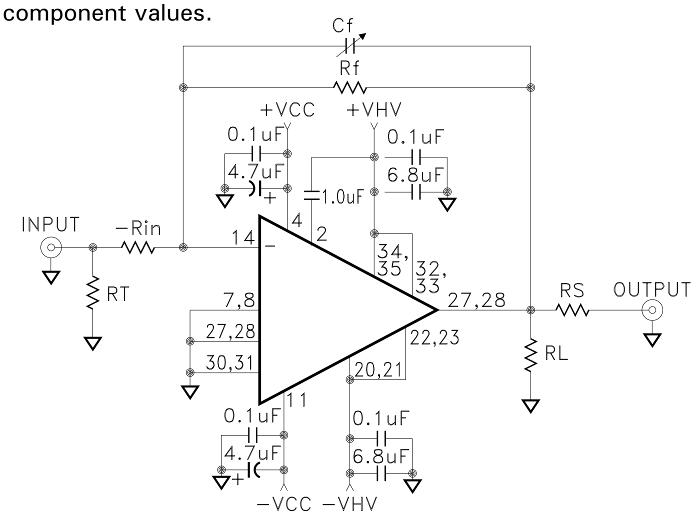


Figure 1

VOLTAGE GAIN	$-R_{IN}$	R_F	C_F
-10V/V	1KΩ	10KΩ	0.5-5pF
-20V/V	249Ω	5KΩ	N/A
-50V/V	100Ω	5KΩ	N/A

Table 1

CURRENT LIMIT

Figure 2 is a possible active short circuit protection scheme for the MSK 613. 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 pins20 & 21 to pins 22 & 23 and pins 34 & 35 to pins 32 & 33 as shown in Figure 1.

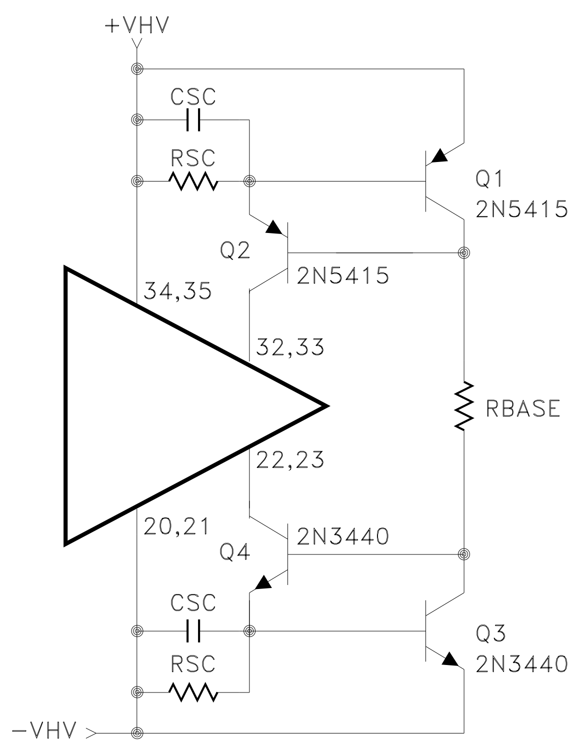
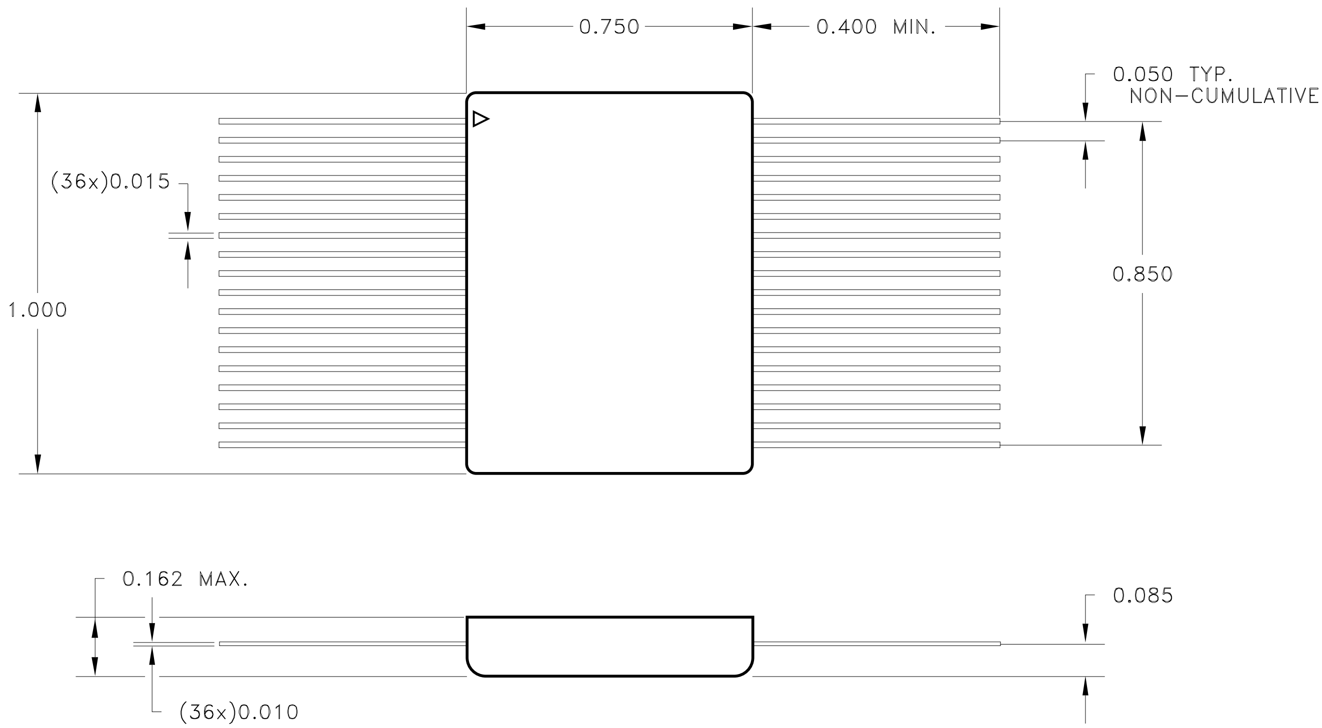


Figure 2

MECHANICAL SPECIFICATIONS



NOTE: ESD Triangle indicates Pin 1.

ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED

ORDERING INFORMATION

Part Number	Screening Level
MSK613	Industrial
MSK613H	Military-Mil-PRF-38534

PLEASE CONTACT FACTORY FOR LEAD FORM OPTIONS IF DESIRED

M.S. Kennedy Corp.

4707 Dey Road, Liverpool, New York 13088

Phone (315) 701-6751

FAX (315) 701-6752

www.mskennedy.com