ISO-9001 CERTIFIED BY DSCC

MSK ULTRA HIGH SPEED/VOLTAGE VIDEO AMPLIFIER 1922 SERIES

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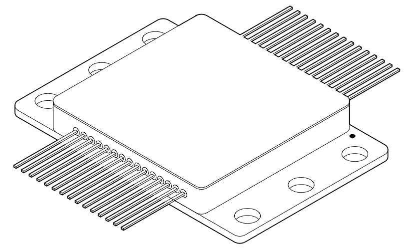
FEATURES:

MIL-PRF-38534 CERTIFIED

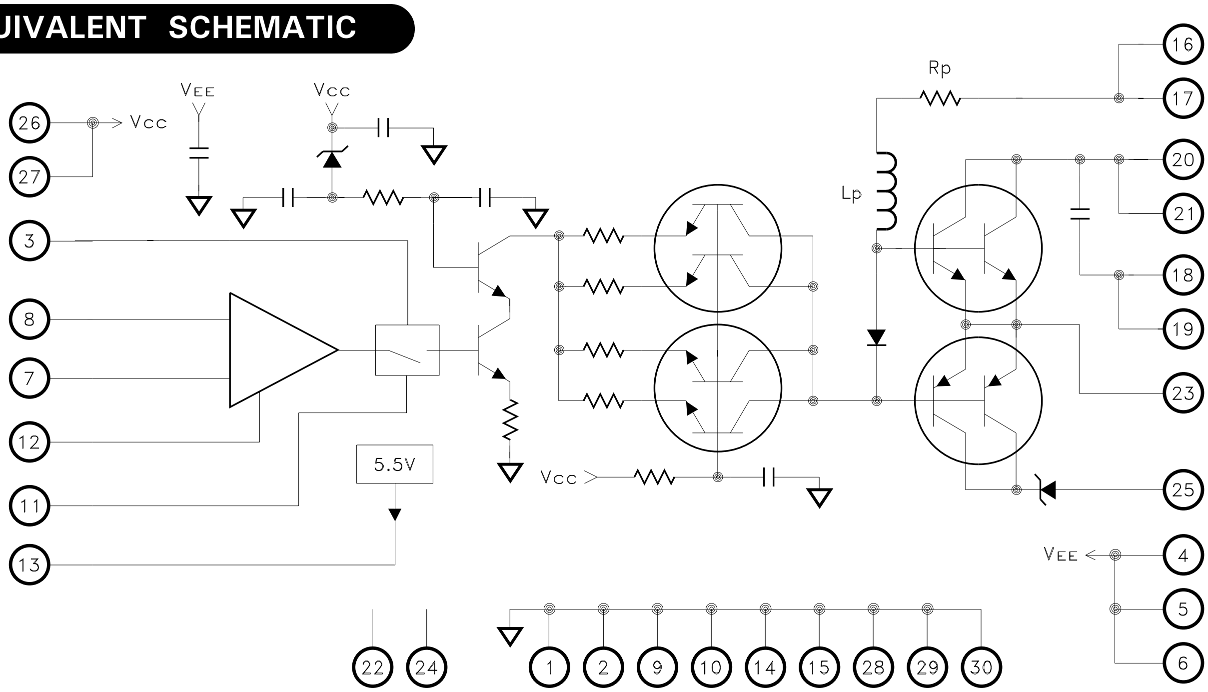
- Ultra High Performance Complete Amplifier System
- 50Vpp Output Signal Into 10pF
- Ultra Fast Transition Times: 1.5nS @ 50Vpp
- User Adjustable Contrast and Brightness
- TTL Compatible Blanking
- On Board DC Reference Output
- Customized Versions Readily Available



DESCRIPTION:

The MSK 1922 High Speed, High Voltage Video Amplifier is designed to directly drive the cathode of today's high performance CRT's. The MSK 1922 has user adjustable contrast and brightness levels and also comes with a blanking function. The MSK 1922 can be directly connected to many video sources including RS170, RS343 and high speed video D/A converters. The MSK 1922 has an internal resistor-inductor designed for optimum bandwith. The MSK 1922 is packaged in a hermetic 30 pin power flatpack that can be directly connected to a heat sink using standard 4-40 screws.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Helmet Mounted Displays
- High Resolution RGB Displays
- High Resolution Monochrome Displays
- Automatic Test Equipment
- Medical Monitors
- CAE/CAD Station Monitors

PIN-OUT INFORMATION

1	GND	11	VGAIN	21	VHV
2	GND	12	VOFF	22	NC
3	Blank	13	VREF	23	Output
4	VEE	14	GND	24	NC
5	VEE	15	GND	25	Cath. RTN/GND
6	VEE	16	VHV RES	26	VCC
7	-Input	17	VHV RES	27	VCC
8	+Input	18	GND	28	GND
9	GND	19	GND	29	GND
10	GND	20	VHV	30	GND

ABSOLUTE MAXIMUM RATINGS

- $+V_{HV}$ High Voltage Supply . . . . +75V
- V_{CC} Positive Supply Voltage . . . .+17V
- V_{EE} Negative Supply Voltage . . . .-12V
- V_{IN} Differential Input Voltage 2V
- V_{IC} Common Mode Input Voltage . . . . . .±2V
- V_{GAIN} Gain Adjust Input Voltage . . . .-0.6 to +6V
- V_{OFF} Offset Adjust Input Voltage . . .-0.6 to +6V
- V_{BLANK} Blank Input Voltage . . . .-0.6 to +6V
- I_{REF} Reference Output Current 5mA
- T_{ST} Storage Temperature Range -40°C to +150°C
- T_{LD} Lead Temperature Range . . . . .300°C (10 Seconds)
- T_J Junction Temperature . . . . .175°C
- I_{RP} Current Through Rp 290mA
- T_C Case Operating Temperature -40°C to +125°C

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ①	MSK1922 Min.	Typ.	Max.	Units
STATIC					
Quiescent Current ④	VCM=0V @ +15V	-	75	100	mA
	VCM=0V @ -10.5V	-	-75	-100	mA
High Voltage Supply ②		30	70	75	V
Thermal Resistance to Case ②	QOUT and QCAS	-	24	26	°C/W
INPUT					
Input Bias Current ②	VCM=0V	-	±1	±50	μA
Blank Input Current ②	VBLANK=0.4V	-	500	600	μA
	VBLANK=2.4V	-	300	400	μA
Offset Adjust Input Current ②	VOFF=1V	-	2	10	μA
Gain Adjust Input Current ②	VGAIN=5V	-	2	10	μA
Blank Input Pulse Width ②	Normal Operation	30	-	-	nS
Common Mode Rejection Ratio ②	VCM=±0.5V F=10Hz	-	40	-	dB
Input Impedance ②	Either Input F=DC	10K	20K	-	Ω
Input Capacitance ②	Either Input	-	2	-	pF
Blank Mode Input Rejection ΔV ② ③	VBLANK=2.4V VIN=0.3V ΔV=VHV-VOUT	-	-	±2xRp	mV
Gain Adjust Rejection ΔV ② ③	ΔVGAIN=5V	-	-	±10xRp	mV
Power Supply Rejection Ratio ②	+VCC and -VEE=Nom ±5%	25	30	-	dB
Internal Rp ② ③		140	150	160	Ω
OUTPUT					
Reference Output Voltage ④	IOUT<2mA	5.2	5.5	5.8	V
ΔV Blank Mode ③	ΔV=VHV-VOUT VOFF=1V VBLANK=2.4V VGAIN=5V	-3xRp	Rp	3xRp	mV
ΔV Min Offset ③	ΔV=VHV-VOUT VOFF=0V VGAIN=3V	0	2	6	V
ΔV Max Offset ③	ΔV=VHV-VOUT VOFF=5V	11	16	21	V
Voltage Gain ④	VIN=0.6V F=10KHz VGAIN=4V Both Inputs	40	54	64	V/V
Output Voltage High ④	VGAIN=4V F=10KHz	65	68	-	V
Output Voltage Low ④	VGAIN=4V F=10KHz	-	10	20	V
Transition Times ②	VIN=0.6V TR=TF<0.2nS (input)	-	1.5	-	nS
Linearity Error ②	VGAIN =4V VOFF=1V VCM=0.5V	-	-	±2	%GS
Gain Linearity ②	VOFF=1V VIN=2.0V VCM=0.5V	-	-	±2	%
Thermal Distortion ②		-	-	±2	%GS

NOTES:

① $+V_{CC}$ = +15V, $-V_{EE}$ = -10.5V, V_{BLANK} = V_{GAIN} = V_{OFF} = $\pm V_{IN}$ = 0V, C_L=10pF, T_C=25°C unless otherwise specified.
② This parameter is guaranteed by design but need not be tested. Typical parameters are representative of actual device performance but are for reference only.
③ ΔV is defined as the difference between $+V_{HV}$ and the output.
④ Parameter is 100% tested on production devices.

APPLICATION NOTES

POWER SUPPLIES

The input stage of the MSK 1922 requires power supplies of +15V and -10.5V for optimum operation. The negative power supply can be increased to -12V if -10.5V is not available, but additional power dissipation will cause the internal temperature to rise. Both low voltage power supplies should be effectively decoupled with tantalum capacitors (at least 4.7μF) connected as close to the amplifier's pins as possible. The MSK 1922 has internal 0.01μF capacitors that also improve high frequency performance. In any case, it is also recommended to put 0.1μF decoupling capacitors on the +15V and -10.5V supplies as well.

The high voltage power supply ($+V_{HV}$) is connected to the amplifier's output stage and must be kept as stable as possible. The internal Rp is connected to $+V_{HV}$ and as such, the amplifier's DC output is directly related to the high voltage value. The $+V_{HV}$ pins of the hybrid should be decoupled to ground with as large a capacitor as possible to improve output stability.

SUPPLY SEQUENCING

The power supply sequence is V_{HV}, V_{CC}, V_{EE} followed by the other DC control inputs. If power supply sequencing is not possible, the time difference between each supply should be less than five milliseconds. If the DC control signals are being generated from a low impedance source other than the V_{REF} output, reverse biased diodes should be connected from each input (V_{GAIN}, V_{OFF}) to the V_{CC} pin. This will protect the inputs until V_{CC} is turned on.

VIDEO OUTPUT

When power is first applied and $V_{IN}=V_{GAIN}=V_{OFF}=0V$, the output will be practically at the $+V_{HV}$ rail voltage. The output voltage is a function of the value of Rp and also the V_{GAIN} and V_{OFF} DC inputs. The maximum output voltage swing for the MSK 1922 is determined by (Rp). The bandwidth of the amplifier largely depends on both Rp and Lp.

Hybrid pins 16 and 17 are directly connected to Rp. Additional external resistance can be added to reduce power dissipation, but slower transition times will result. If an additional resistor is used, it must be low capacitance and the layout should minimize capacitive coupling to ground (ie: no ground plane under Rp).

The MSK 1922 is specified with no external Lp which yields about 10% overshoot. Additional peaking can be obtained by using a high self-resonant frequency inductor in series with pins 16 & 17. Since this value of inductance can be very dependent on circuit layout, it is best to determine its value by experimentation. A good starting point is typically 0.0047μH.

If external resistors or inductors are not used, be sure to connect high frequency bypass capacitors directly from pins 16 and 17 to ground.

VIDEO INPUTS

The video input signals should be kept below $\pm 2V_{MAX}$ total, including both common mode offset and signal levels. The input structure of the MSK 1922 was designed for ±0.714Vpp RS343 signals. If either input is not used it should be connected directly to the analog ground or through a 25Ω resistor to ground if input offset currents are to be minimized.

OUTPUT PROTECTION

The output pin of the MSK 1922 should be protected from transients by connecting reversed biased ultra-low capacitance diodes from the output pin to both $+V_{HV}$ and ground. The output can also be protected from arc voltages by inserting a small value (25-50Ω) resistor in series with the amplifier. This resistor will reduce system bandwidth along with the load capacitance, but a series inductor can reduce the problem substantially.

V_{GAIN} CONTROL INPUT

The V_{GAIN} control (contrast) input is designed to allow the user to vary the video gain. By simply applying a DC voltage from 0V to V_{REF}, the video gain can be linearly adjusted from 0 to 73V/V. The V_{GAIN} input should be connected to the V_{REF} pin through a 5KΩ pot to ground. For convenient stable gain adjustment, a 0.1μF bypass capacitor should be connected near the V_{GAIN} input pin to prevent output instability due to noisy sources. Digital gain control can be accomplished by connecting a D/A converter to the V_{GAIN} pin. However, some temperature tracking performance may be lost when using an external DC voltage source other than V_{REF} for gain adjustment. The bandwidth of the V_{GAIN} input is approximately 1MHz.

The overall video output of the MSK 1922 can be characterized using the following expression:

$$Vpp = V_{HV} - V_{OUT}$$

$$V_{HV} - V_{OUT} = (V_{IN})(V_{GAIN})(Rp)(0.09)$$

(or)

$$\text{Voltage Gain} = V_{OUT}/V_{IN} = (V_{GAIN})(Rp)(0.09)$$

Here is a sample calculation for the MSK 1922:
Given information

- $V_{IN}=0.7V$
- $V_{GAIN}=1VDC$
- $Rp=150\Omega$ (internal)
- $V_{HV}=70VDC$

$V_{HV}-V_{OUT}=(0.7V)(1V)(150\Omega)(0.09)$
$V_{HV}-V_{OUT}=9.5V$ Nominal

The expected video output would swing from approximately +70V to +60.5 V assuming that $V_{OFF}=0V$. This calculation should be used as a nominal result because the overall gain may vary as much as ±20% due to internal high speed device variations. Changing ambient conditions can also effect the video gain of the amplifier by as much as 150 PPM/°C. It is wise to connect all video amplifiers to a common heat sink to maximize thermal tracking when multiple amplifiers are used in applications such as RGB systems. Additionally, only one of the V_{REF} outputs should be shared by all three amplifiers. This voltage should be buffered with a suitable low drift op-amp for best tracking performance.

V_{OFF} CONTROL INPUT

The brightness (output offset) can be linearly adjusted by applying a 0 to V_{REF} DC voltage to the V_{OFF} input pin. The output quiescent voltage range is from approximately (5μA)(Rp) to (100mA)(Rp) from $+V_{HV}$. This control voltage is normally generated by connecting the V_{OFF} control pin to a 5K potentiometer between V_{REF} and ground. The V_{OFF} input pin should be bypassed with a 0.1μF capacitor to ground placed as close as possible to the hybrid. This DC voltage can be any stable system source. The bandwidth of the V_{OFF} pin is approximately 1MHz.

Keep hybrid power dissipation in mind when adjusting the output quiescent voltage. Practically all of the voltage is seen across Rp! This power must be taken into account when high Rp currents are used. If the quiescent level is set too close to $+V_{HV}$, the power dissipation will be minimal but the rise time will suffer slightly. If the quiescent level is set too far from $+V_{HV}$, the power dissipation will increase dramatically and the output fall time will be limited. The output black level is obviously dependent on system requirements but a little experimentation will strike the optimum balance between power dissipation and bandwidth. The gain adjust alone can set the AC current to 333mA (ie: 333mApp=50Vpp/150Ω). Typically, most applications use about 5V from $+V_{HV}$ for a black level.

BLANK INPUT

The video input can be electrically disconnected from the ampliifer by applying a TTL high input to the blank pin. When this occurs, the output will be set to approximately $+V_{HV}$. The V_{GAIN} and V_{OFF} control pins have little or no effect on the output when it is in blank mode.

When the TTL compatible blank input is not used, the pin must be connected to ground to enable the amplifier. The blank input will float high when left unconnected which will disable the video.

V_{REF} OUTPUT

The MSK 1922 has an on board buffered DC zener reference output. The V_{REF} output is nominally 5.5V DC and has full temperature test limits of 5.2V to 5.8V DC. This output is provided for gain and offset adjustment and can source up to 4mA of current.

THERMAL MANAGEMENT

The MSK 1922 package has mounting holes that allow the user to connect the amplifier to a heat sink or chassis. Since the package is electrically isolated from the internal circuitry, mounting insulators are not required or desired for best thermal performance.

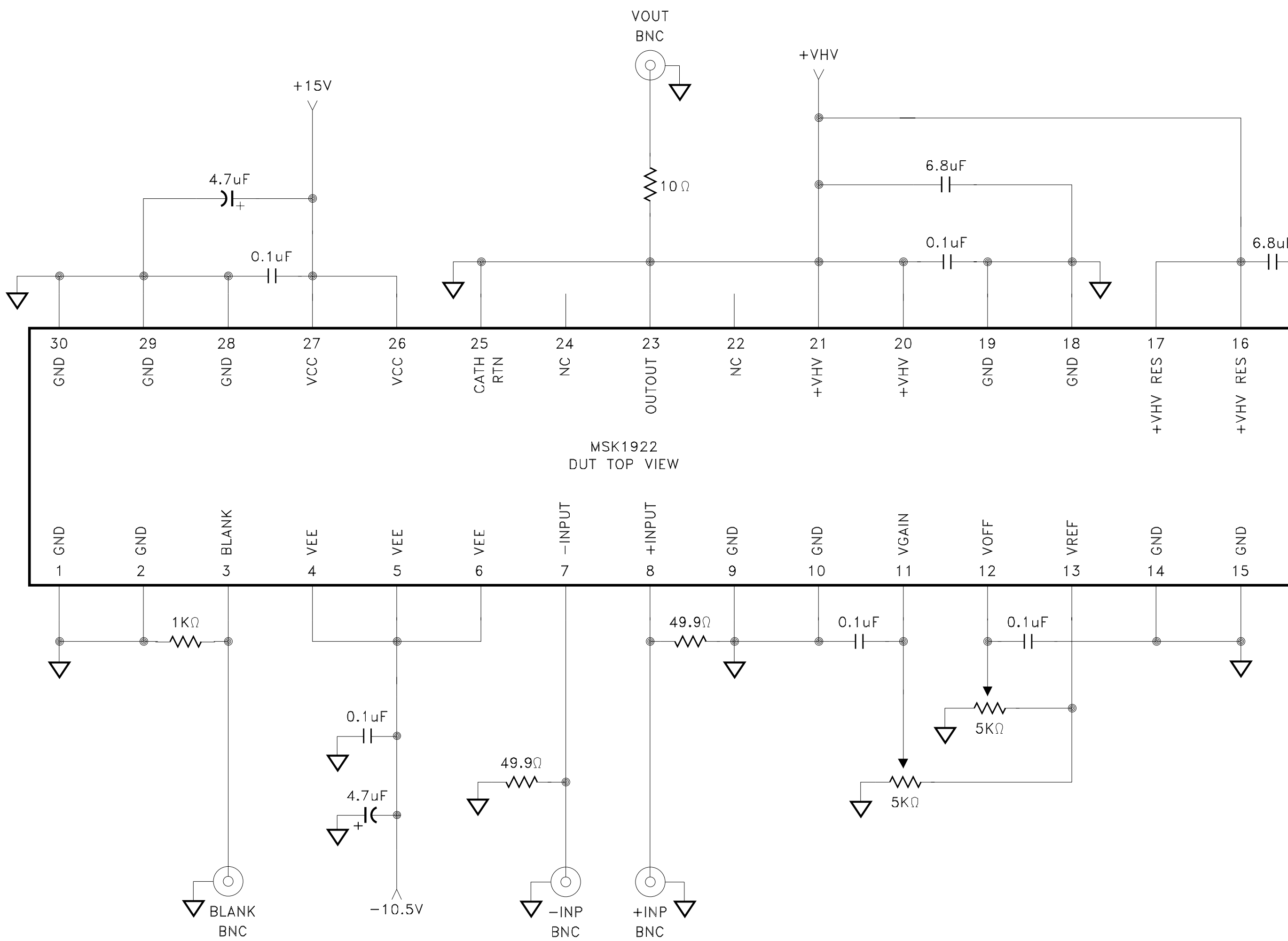
The power dissipation of the amplifier depends mainly on the load requirements, bandwidth, pixel size, black level and the value of Rp.

RESOLUTION TABLE FOR TYPICAL CRT'S

Display Resolution	Maximun Pixel Time	Minimum Pixel Clock Frequency	Required Rise Time at CRT Cathode	Required System Bandwidth (F_{-3dB})
320 x 200	182nS	5MHz	60nS	6MHz
640 x 350	52nS	19MHz	17nS	20MHz
640 x 480	38nS	26MHz	12.5nS	28MHz
800 x 560	26nS	38MHz	8.6nS	41MHz
1024 x 900	12.6nS	80MHz	4.2nS	84MHz
1024 x 1024	11nS	90MHz	3.7nS	95MHz
1280 x 1024	8.9nS	112MHz	2.9nS	120MHz
1664 x 1200	5.8nS	170MHz	1.9nS	180MHz
2048 x 2048	2.8nS	360MHz	1nS	380MHz
4096 x 3300	860pS	1.2GHz	280pS	1.23GHz

All data assumes retrace time equal to 30% of frame time and a 60Hz refresh rate.

TYPICAL CONNECTION CIRCUIT

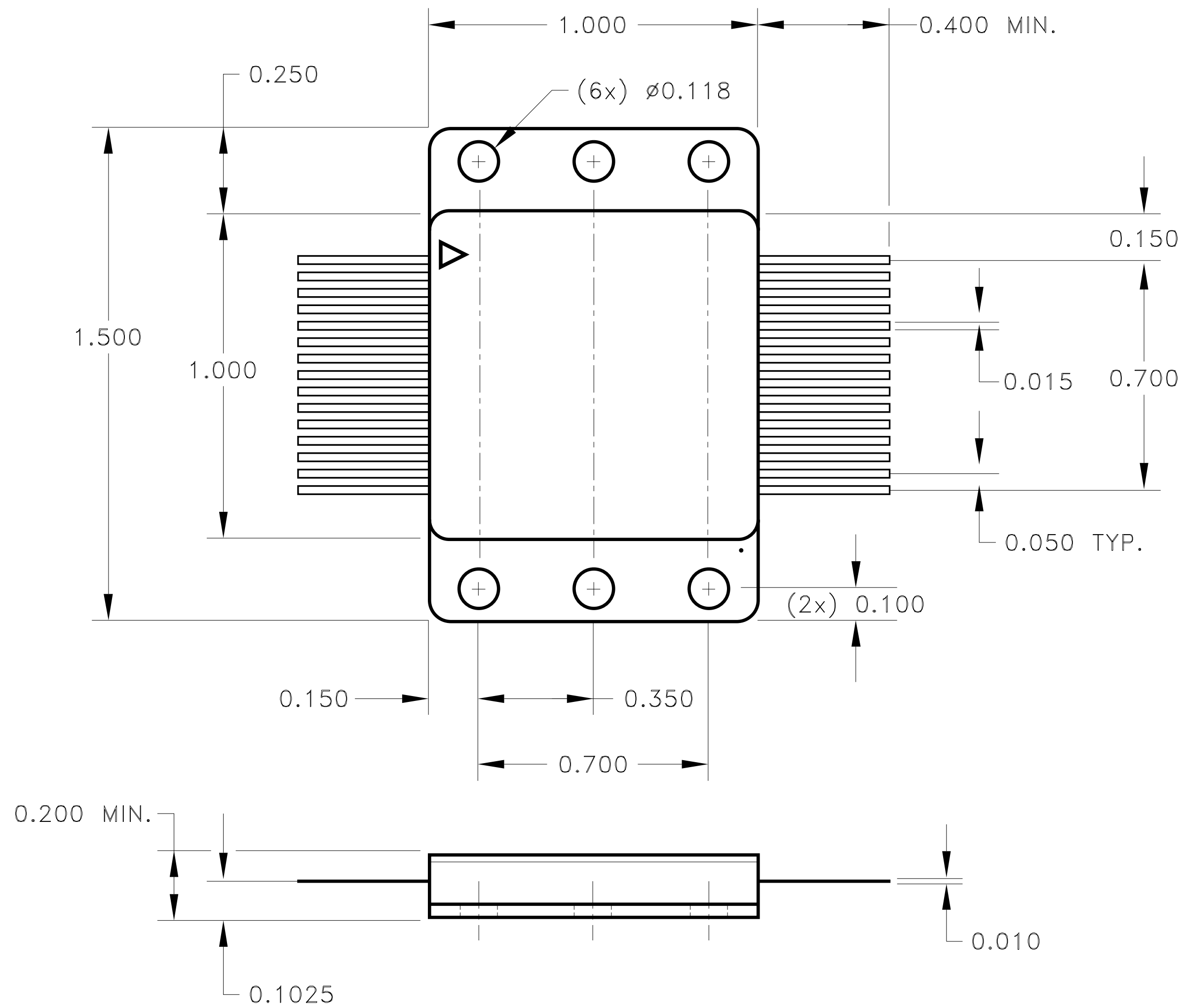


The connection circuit shown above is for the MSK 1922 evaluation board.

For additional applications information, please contact the factory. Evaluation amplifiers with test boards are readily available from MSK.

NOTES:

MECHANICAL SPECIFICATIONS



ESD TRIANGLE INDICATES PIN 1.

ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED.

ORDERING INFORMATION

PART NUMBER	SCREENING LEVEL
MSK 1922	Industrial

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