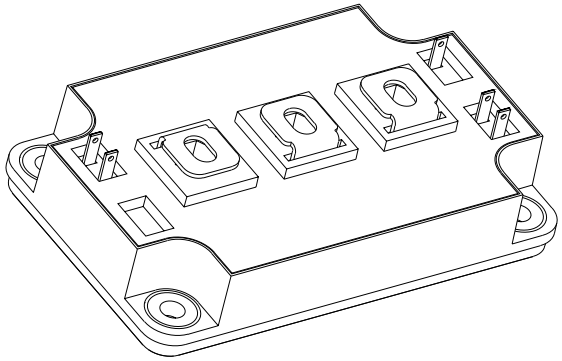
MIL-PRF-38534 AND 38535 CERTIFIED FACILITY

M.S.KENNEDY CORP.

600V/450A HALF BRIDGE PEM 4800

FEATURES:

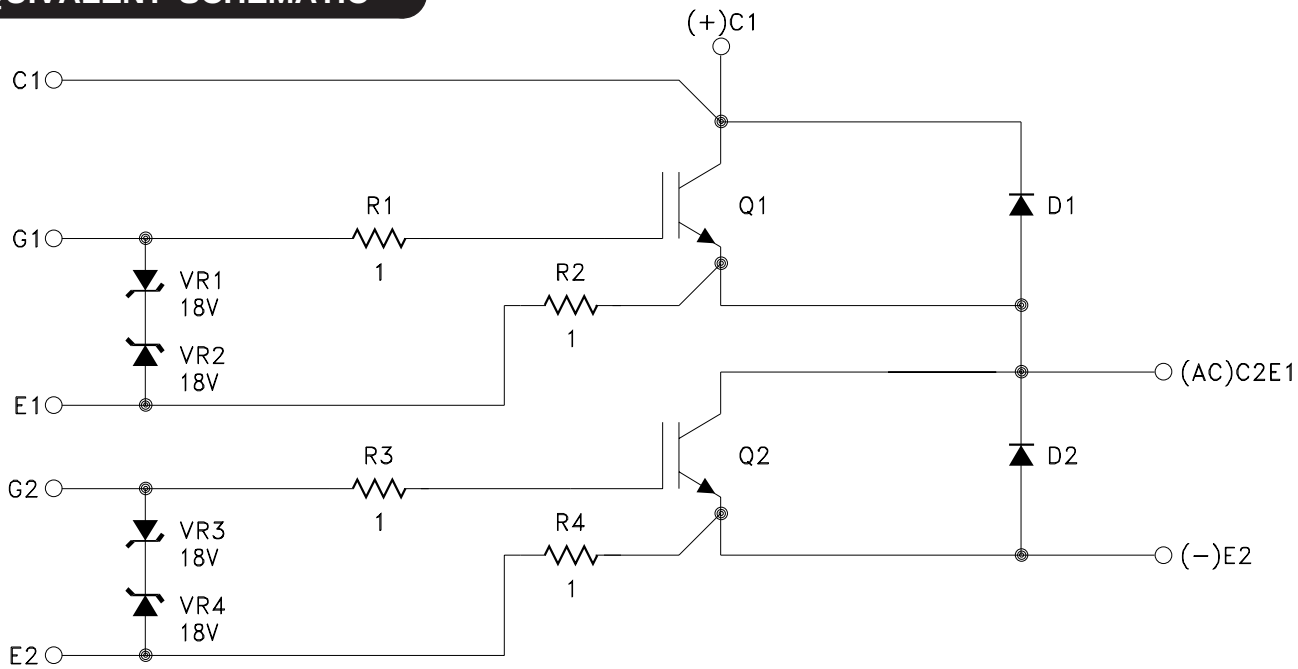
- Half Bridge Configuration
- 600V Rated Voltage
- 450A Continuous Output Current
- Internal Zener Clamps on Gates
- Proprietary Encapsulation Provides Near Hermetic Performance
- HI-REL Screening Available (Modified 38534)
- Light Weight Domed ALSIC Baseplate
- Robust Mechanical Design for Hi-Rel Applications
- Ultra-Low Inductance Internal Layout
- Withstands 96 Hours HAST and Thermal Cycling (-55°C to +125°C)
- High Side Collector Sense Pin for De-Sat Detection



DESCRIPTION:

The MSK4800 is one of a family of plastic encapsulated modules (PEM) developed specifically for use in military, aerospace and other severe environment applications. The half bridge configuration and 600 volt/450 amp rating make it ideal for use in high current motor drive and inverter applications. The Aluminum Silicon Carbide (AlSiC) baseplate offers superior flatness and light weight; far better than the copper or copper alloys found in most high power plastic modules. The high thermal conductivity materials used to construct the MSK4800 allow high power outputs at elevated baseplate temperatures. Our proprietary coating, SEES™ - Severe Environment Encapsulation System - protects the internal circuitry of MSK PEM's from moisture and contamination, allowing them to pass the rugged environmental screening requirements of military and aerospace applications. MSK PEM's are also available with industry standard silicone gel coatings for a lower cost option.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Motor Drives
- Inverters

ABSOLUTE MAXIMUM RATING ⑧

V_{CE}	Collector to Emitter Voltage 600V	T_{ST}	Storage Temperature Range ⑨ . . -55°C to +125°C
V_{GE}	Gate to Emitter Voltage . . . . . ±20V	T_J	Junction Temperature . . . . . 150°C
I_{OUT}	Current (Continuous) 450A	T_C	Case Operating Temperature Range
I_{OUTP}	Current Pulsed (1mS) 900A		MSK4800H . . . . . -55°C to +125°C
V_{CASE}	Case Isolation Voltage . . . . . 2500 V		MSK4800 . . . . . -40°C to +85°C

ELECTRICAL SPECIFICATIONS

Parameter ⑥	Test Conditions	Group A Subgroup	MSK4800H Min.	MSK4800H Typ.	MSK4800H Max.	MSK4800 Min.	MSK4800 Typ.	MSK4800 Max.	Units
Collector-Emitter Saturation Voltage	IC = 450A, VGE = 15V	1	-	1.9	2.6	-	1.9	2.7	V
		2	-	1.8	2.6	-	1.8	2.7	V
		3	-	2.1	2.8	-	2.1	2.9	V
Collector-Emitter Leakage Current	VCE = 600V, VGE = 0V	1	-	0.05	1.5	-	0.05	2.0	mA
		2	-	2.5	18	-	2.5	18	mA
		① 3	-	0.05	1.5	-	0.05	2.0	mA
Gate Threshold Voltage	IC = 45mA, VCE = VGE	1	4.0	5.3	8.1	4.0	5.3	8.5	V
		2	4.0	4.5	7.5	4.0	4.5	7.5	V
		3	4.0	6.0	8.1	4.0	6.0	8.5	V
Gate Leakage Current	VCE = 0V, VGE = ±15V	1	-10	0.2	10	-12	0.2	12	uA
		2	-10	0.4	10	-12	0.4	12	uA
		3	-10	0.1	10	-12	0.1	12	uA
Diode Forward Voltage	IC = 450A	1	-	1.5	2.6	-	1.5	2.7	V
		2	-	1.3	2.6	-	1.3	2.7	V
		3	-	1.6	2.8	-	1.6	2.9	V
Total Gate Charge ①	V = 300V, IC = 450A	4	-	2500	4300	-	2500	4300	nC
Turn-On Delay ①	V = 300V, IC = 450A, RG = 20Ω	4	-	790	900	-	790	900	nS
Rise Time ①	V = 300V, IC = 450A, RG = 20Ω	4	-	400	700	-	400	700	nS
E(on)	V = 300V, IC = 450A, RG = 20Ω, VGE = -7/+12V	4	-	87.2	-	-	87.2	-	mJ
	V = 300V, IC = 450A, RG = 20Ω, VGE = -7/+15V	4	-	50.5	-	-	50.5	-	mJ
	V = 300V, IC = 450A, RG = 20Ω, VGE = -7/+12V	5	-	89.2	-	-	89.2	-	mJ
	V = 300V, IC = 450A, RG = 20Ω, VGE = -7/+15V	5	-	51.3	-	-	51.3	-	mJ
E(off)	V = 300V, IC = 450A, RG = 10Ω, VGE = -7/+12V	4	-	30.5	-	-	30.5	-	mJ
	V = 300V, IC = 450A, RG = 10Ω, VGE = -7/+12V	5	-	39.7	-	-	39.7	-	mJ
Turn-Off Delay ①	V = 300V, IC = 450A, RG = 10Ω	4	-	1.5	2.1	-	1.5	2.5	uS
Fall Time ①	V = 300V, IC = 450A, RG = 10Ω	4	-	120	300	-	120	300	nS
Diode Reverse Recovery Time ①	IE = 450A, di/dt = 900A/uS	4	-	75	170	-	75	170	nS
Diode Reverse Recovery Charge ①	IE = 450A, di/dt = 900A/uS	4	-	3.0	6.0	-	3.0	6.0	uC
Thermal Resistance ①	IGBT @ TJ = 125°C	4	-	0.06	0.08	-	0.06	0.09	°C/W
	DIODE @ TJ = 125°C	4	-	0.1	0.15	-	0.1	0.16	°C/W

NOTES:

① Guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.
② Industrial grade devices shall be tested to subgroup 1 unless otherwise specified.
③ HI-REL grade devices ("H" suffix) shall be 100% tested to subgroups 1, 2 and sample tested to subgroup 3.
④ Subgroup 4 testing available upon request.
⑤ Subgroup 1, 4 T_A = +25°C
2, 5 T_A = +125°C
3, 6 T_A = -55°C
⑥ All specifications apply to both the upper and lower sections of the half bridge.
⑦ V_{GE}=15V unless otherwise specified.
⑧ Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle
⑨ Internal solder reflow temperature is 180°C, do not exceed.

THERMAL CALCULATIONS

Power dissipation and maximum allowable temperature rise involve many variables working together. Collector current, PWM duty cycle and switching frequency all factor into power dissipation. DC losses or "ON-TIME" losses are simply V_{CE}(SAT) x Collector Current x PWM duty cycle. For the MSK4800, V_{CE}(SAT)=2.6V max., and at 450 amps and a PWM duty cycle of 30%, DC losses equal 351 watts. Switching losses vary proportionally with switching frequency. The MSK4800 typical switching losses at V_{CE}=300V and I_{CE}=450A are about 117.7mJ, which is simply the sum of the turn-on switching loss and the turn-off switching loss. Multiplying the switching frequency times the switching losses will result in a power dissipation number for switching. The MSK4800, at 5KHz, will exhibit switching power dissipation of 589 watts. The total losses are the sum of DC losses plus switching losses, or in this case, 940 watts total.
940 watts x 0.08°C/W thermal resistance equals 75 degrees of temperature rise between the case and the junction. Subtracting 75°C from the maximum junction temperature of 150°C equals 75°C maximum case temperature for this example.

V_{CE}(SAT) x IC x PWM duty cycle = 2.6V x 450 amps x 30% = 357 watts DC losses

Turn-on switching loss + Turn-off switching loss = Total switching losses = 30.5 + 87.2 = 117.7mJ

Total switching loss x PWM frequency = Total switching power dissipation = 117.7mJ x 5KHz = 589 watts

Total power dissipation = DC losses + switching losses = 351 + 589 = 940 watts

Junction temperature rise above case = Total power dissipation x thermal resistance

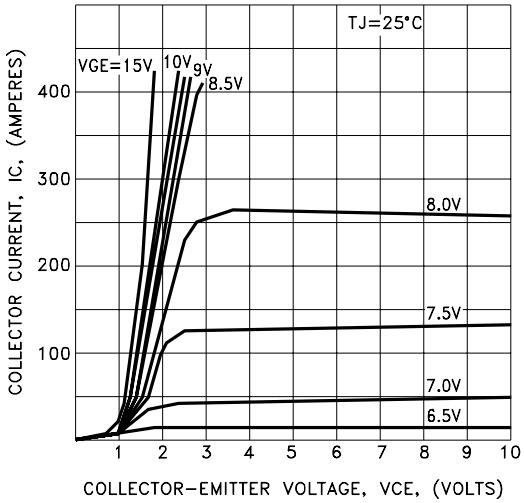
940 watts x 0.08°C/W = 75°C temperature rise above case

Maximum junction temperature - junction temperature rise = maximum baseplate temperature

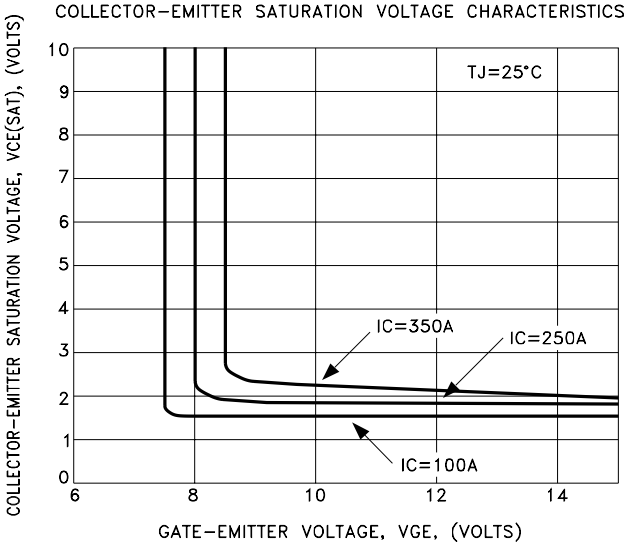
150°C - 75°C = 75°C

TYPICAL PERFORMANCE CURVES

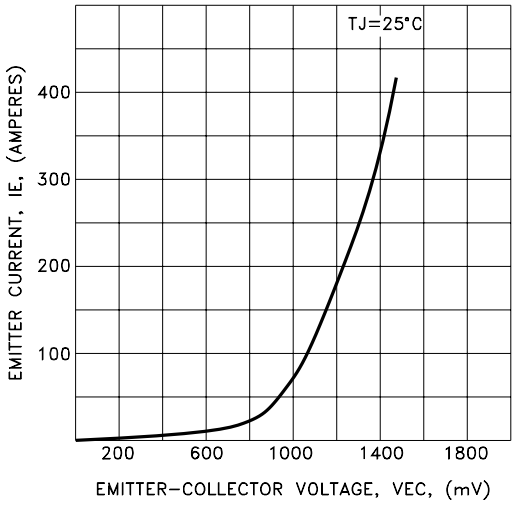
TYPICAL OUTPUT CHARACTERISTICS



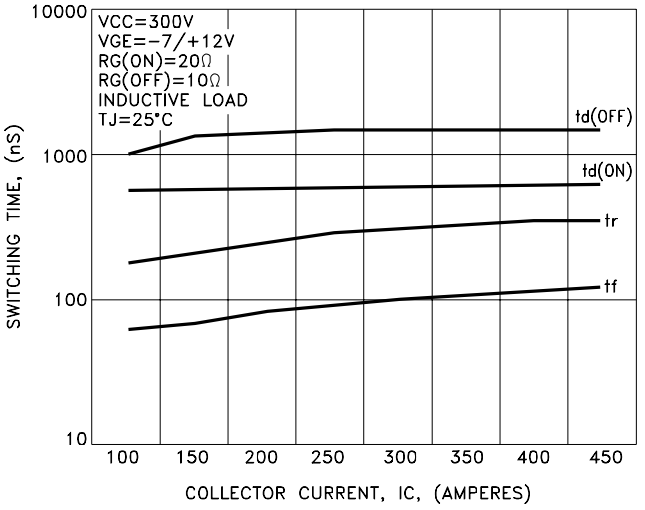
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS



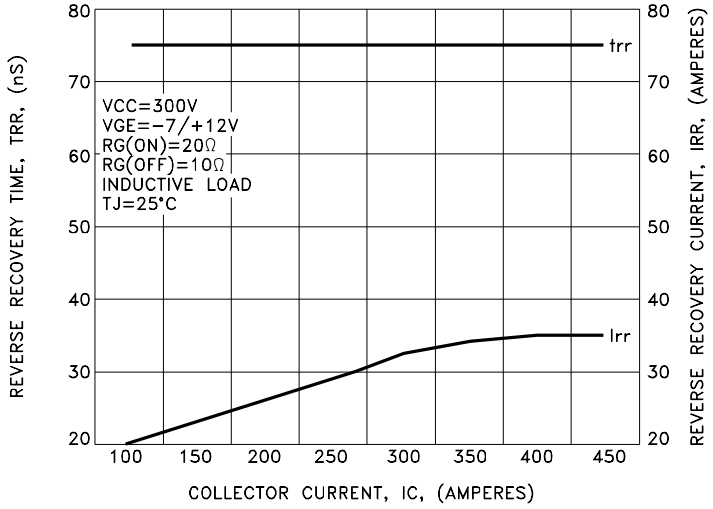
FREE-WHEEL DIODE FORWARD CHARACTERISTICS



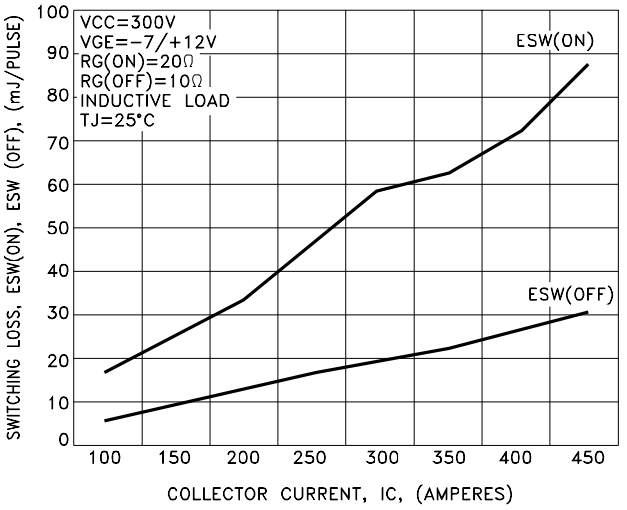
SWITCHING CHARACTERISTICS



REVERSE RECOVERY CHARACTERISTICS



SWITCHING LOSS vs. COLLECTOR CURRENT

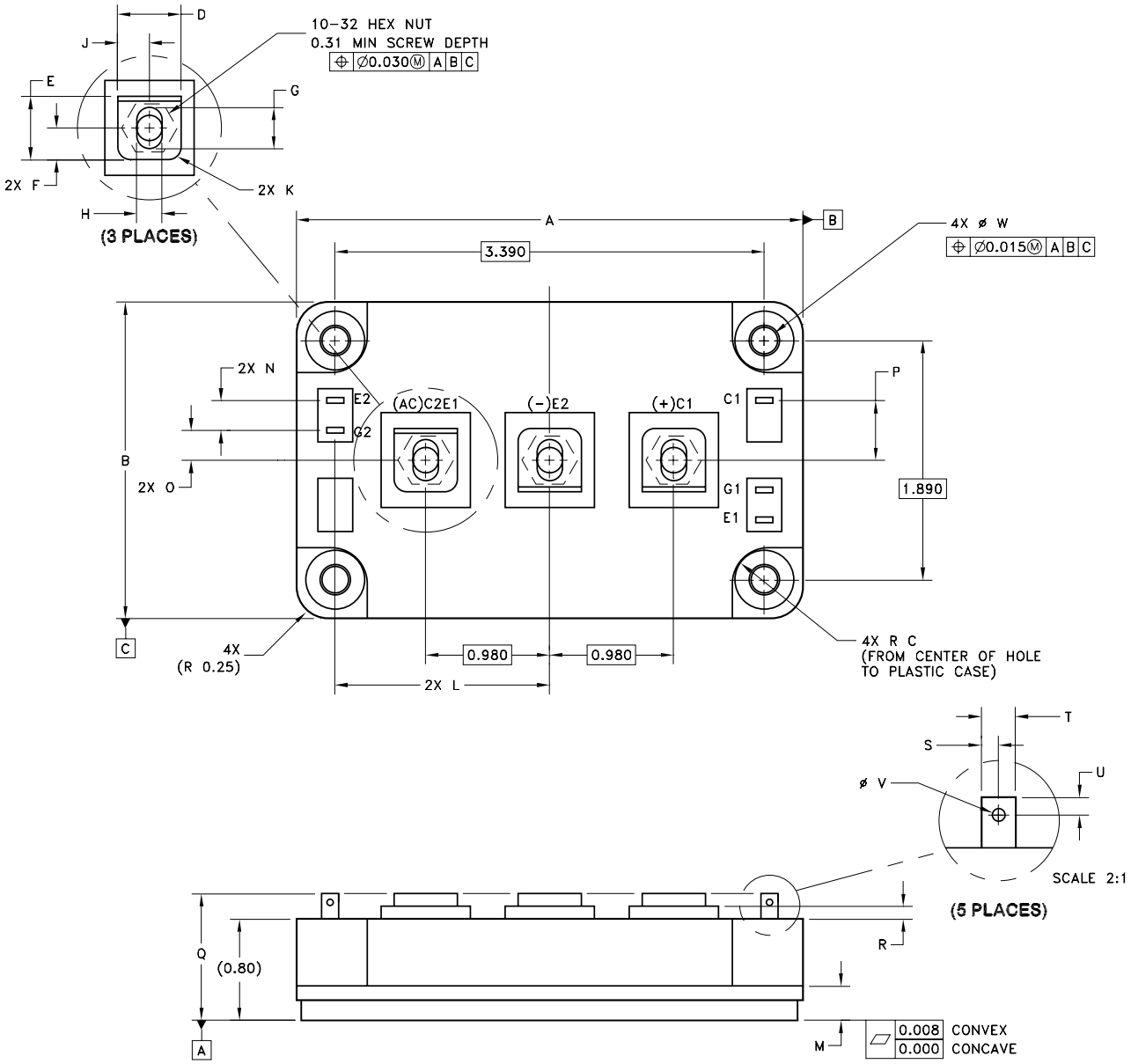


SCREENING CHART

OPERATION	INDUSTRIAL	H SUFFIX
QUALIFICATION (MODIFIED)	NO	YES
ELEMENT EVALUATION	NO	YES
CLEAN ROOM PROCESSING	YES	YES
NON DESTRUCT BOND PULL SAMPLE	YES	YES
CERTIFIED OPERATORS	NO	YES
MIL LINE PROCESSING	YES	YES
MAX REWORK SPECIFIED	NO	YES
ENCAPSULANT	GEL COAT	SEES ™
PRE-CAP VISUAL	YES - INDUSTRIAL	YES - CLASS H
TEMP CYCLE (-55°C TO +125°C)	NO	YES
BURN-IN	NO	YES - 160 HOURS
ELECTRICAL TESTING	YES - 25°C	YES - FULL TEMP
EXTERNAL VISUAL	YES - SAMPLE	YES
XRAY	NO	NO
PIN FINISH	NI	NI

NOTE: ADDITIONAL SCREENING IS AVAILABLE SUCH AS XRAY, CSAM, MECHANICAL SHOCK, ETC. CONTACT FACTORY FOR QUAL STATUS.

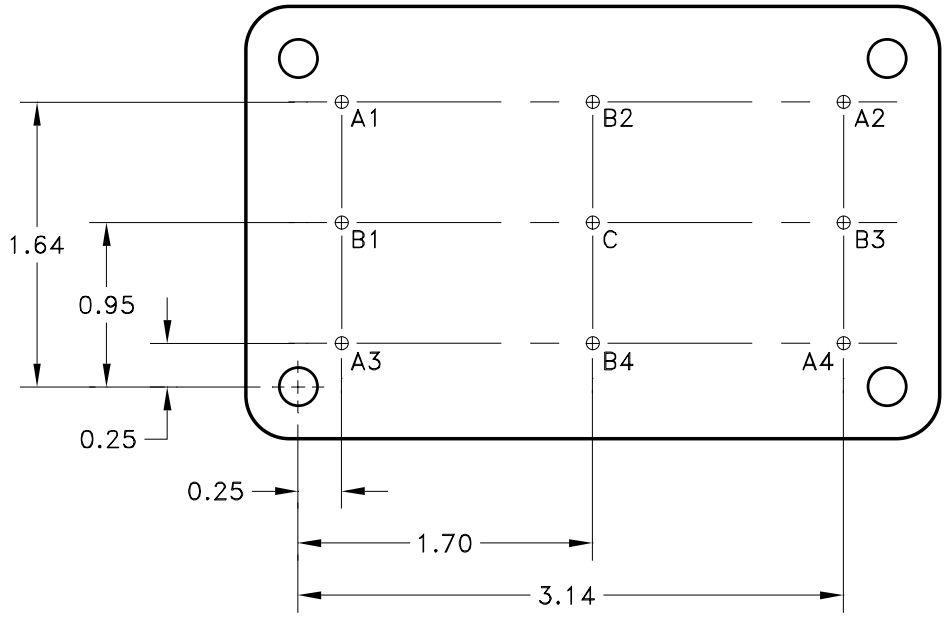
MECHANICAL SPECIFICATIONS



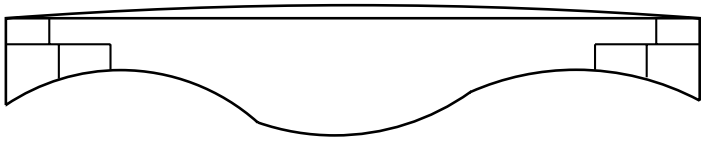
REF	MIN	MAX
A	3.97	4.02
B	2.47	2.51
C	0.24	———
D	0.50	0.55
E	0.50	0.70
F	———	0.40
G	0.310	0.340
H	0.195	0.230
J	0.20	0.30
K	0.10	———
L	1.645	1.745
M	0.255	0.285
N	0.186	0.286
O	0.186	0.286
P	0.422	0.522
Q	0.985	1.015
R	0.090	———
S	0.048	0.068
T	0.105	0.125
U	0.060	0.080
V	0.040	0.060
W	0.208	0.225

WEIGHT = 272 GRAMS MAX.

ALL DIMENSIONS ARE SPECIFIED IN INCHES



POWER MODULE
BOTTOM VIEW
(NOT TO SCALE)



POWER MODULE SIDE VIEW
(EXAGGERATED DOME)
(NOT TO SCALE)

CONVEX BASEPLATE PROFILE (FROM POINT C)

REF	ZMIN.	ZMAX.
A1	0.000	0.008
A2	0.000	0.008
A3	0.000	0.008
A4	0.000	0.008
B1	0.000	0.008
B2	0.000	0.008
B3	0.000	0.008
B4	0.000	0.008

ALL DIMENSIONS ARE SPECIFIED IN INCHES

ORDERING INFORMATION

MSK4800 H

SCREENING
BLANK=INDUSTRIAL; H=HI-REL (MODIFIED 38534)

GENERAL PART NUMBER

THE ABOVE EXAMPLE IS A MILITARY SCREENED MODULE.

REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
H	Released	11/14	Format update, add internal note and clarify mechanical specifications.

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