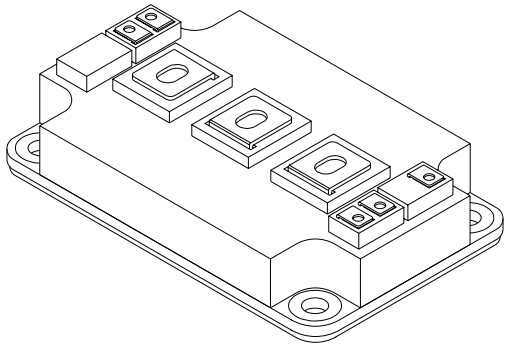
MIL-PRF-38534 CERTIFIED FACILITY

600V / 600A HALF BRIDGE PEM

4803

FEATURES:

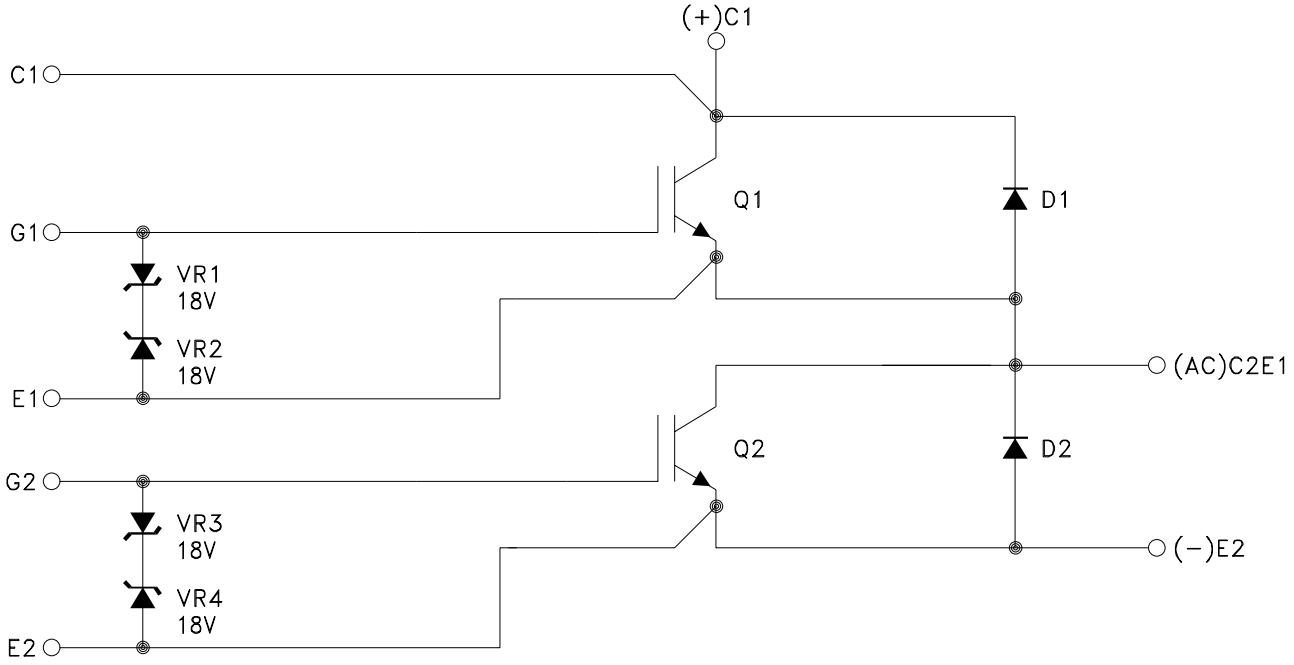
- Half Bridge Configuration
- 600V Rated Voltage
- 600A Continuous Output Current
- Internal Zener Clamps on Gates
- Encapsulation Provides Near Hermetic Performance
- HI-REL Screening Available (Modified 38534)
- Light Weight Domed ALSIC Baseplate
- Robust Mechanical Design for Hi-Rel Applications
- 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 MSK4803 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/600 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 MSK4803 allow high power outputs at elevated baseplate temperatures.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Motor Drives
- Inverters

ABSOLUTE MAXIMUM RATINGS ⑧

V_{CE}	Collector to Emitter Voltage.....600V	T_{ST}	Storage Temperature Range⑨.....-55°C to +125°C
V_{GE}	Gate to Emitter Voltage.....±20A	T_J	Junction Temperature.....150°C
I_{OUT}	Current (Continuous).....600A	T_C	Case Operating Temperature Range
I_{OUTP}	Current Pulsed (1mS).....1200A		MSK4803H.....-55°C to +125°C
V_{CASE}	Case Isolation Voltage.....2500V		MSK4803.....-40°C to +85°C

ELECTRICAL SPECIFICATIONS

Parameter ⑥	Test Conditions	Group A Subgroup	MSK4803H Min.	MSK4803H Typ.	MSK4803H Max.	MSK4803 Min.	MSK4803 Typ.	MSK4803 Max.	Units
Collector-Emitter Saturation Voltage	I_C = 600A, V_{GE} = 15V	1	-	2.1	2.5	-	2.1	2.6	V
		2	-	2.5	2.9	-	-	-	V
		3	-	1.9	2.3	-	-	-	V
Collector-Emitter Leakage Current	V_{CE} = 600V, V_{GE} = 0V	1	-	0.2	10	-	0.2	10	uA
		2	-	0.1	1	-	-	-	mA
Gate Threshold Voltage	I_C = 60mA, V_{CE} = V_{GE}	1	5.0	5.7	6.5	4.7	5.7	6.8	V
		2	3.0	4.6	6.5	-	-	-	V
		3	4.0	6.5	8.5	-	-	-	V
Gate Leakage Current	V_{CE} = 0V, V_{GE} = ±15V	1	-	0.1	10	-	0.1	10	uA
		2	-	0.6	10	-	-	-	uA
		3	-	0.1	10	-	-	-	uA
Diode Forward Voltage	I_C = 600A	1	-	1.9	2.6	-	1.9	2.7	V
		2	-	1.9	2.6	-	-	-	V
		3	-	1.8	2.5	-	-	-	V
Total Gate Charge ①	V = 300V, I_C = 600A	4	-	3.9	5.2	-	3.9	5.5	uC
E(on) ①	V = 300V, I_C = 600A, RG = 5Ω, V_{GE} = -7/+15V	4	-	25	-	-	25	-	mJ
	V = 300V, I_C = 300A, RG = 5Ω, V_{GE} = -7/+15V	4	-	12	17	-	12	20	mJ
E(off) ①	V = 300V, I_C = 600A, RG = 10Ω, V_{GE} = -7/+15V	4	-	73	-	-	73	-	mJ
	V = 300V, I_C = 300A, RG = 10Ω, V_{GE} = -7/+15V	4	-	35	44	-	35	45	mJ
Diode Reverse Recovery Time ①	I_E = 600, di/dt = 2100A/uS	4	-	130	-	-	130	-	nS
	I_E = 300, di/dt = 2100A/uS	4	-	100	-	-	100	-	nS
Diode Reverse Energy ①	I_E = 600, di/dt = 2100A/uS	4	-	6.5	-	-	6.5	-	mJ
	I_E = 300, di/dt = 2100A/uS	4	-	3.0	5.0	-	3.0	5.3	mJ
Thermal Resistance ①	IGBT @ T_J = 125°C	-	-	0.07	0.09	-	0.07	0.9	°C/W
	DIODE @ T_J = 125°C	-	-	0.09	0.10	-	0.09	0.10	°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 subgroups 1 unless otherwise requested.
③ HI-REL grade devices ("H" suffix) shall be 100% tested to subgroups 1, 2 and sample tested to subgroup 3.
④ Subgroups 4 testing available upon request.
⑤ Subgroup 1, 4 TA = +25°C
2 TA = +125°C
3 TA = -55°C
⑥ All specifications apply to both the upper and lower sections of the half bridge.
⑦ VGE=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.

APPLICATION NOTES

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 MSK4803, V_{CE}(SAT) = 2.5V max., and at 600 amps and a PWM duty cycle of 30%, DC losses equal 450 watts. Switching losses vary proportionally with switching frequency. The MSK4803 typical switching losses at V_{CE} = 300V and I_{CE} = 600A are about 98mJ, 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 MSK4803, at 5KHz, will exhibit switching power dissipation of 490 watts. The total losses are the sum of DC losses plus switching losses, or in this case, 940 watts total. 940 watts x 0.09°C/W thermal resistance equals 85 degrees of temperature rise between the case and the junction. Subtracting 85°C from the maximum junction temperature of 150°C equals 65°C maximum case temperature for this example.

V_{CE}(SAT) x IC x PWM duty cycle = 2.5V x 600 amps x 30% = 450 watts DC losses

Turn-on switching loss + Turn-off switching loss = Total switching losses = 2.5 + 73 = 98mJ

Total switching loss x PWM frequency = Total switching power dissipation = 98mJ x 5KHz = 490 watts

Total power dissipation = DC losses + switching losses = 450 + 490 = 940 watts

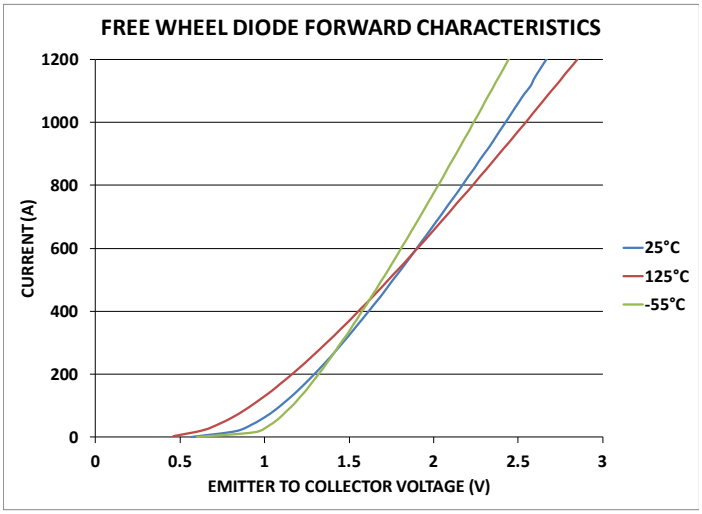
Junction temperature rise above case = Total power dissipation x thermal resistance

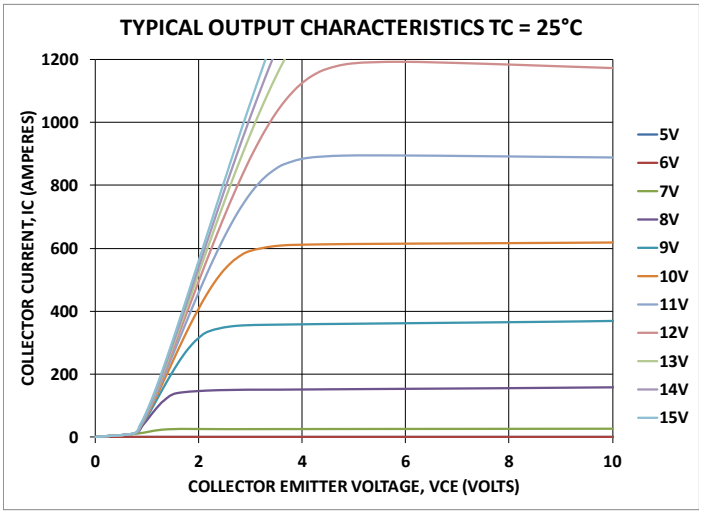
940 watts x 0.09°C/W = 84.6°C temperature rise above case

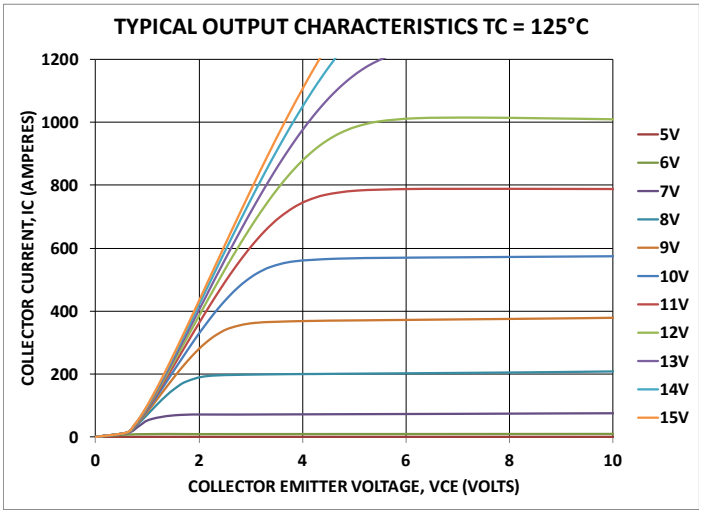
Maximum junction temperature - junction temperature rise = maximum baseplate temperature

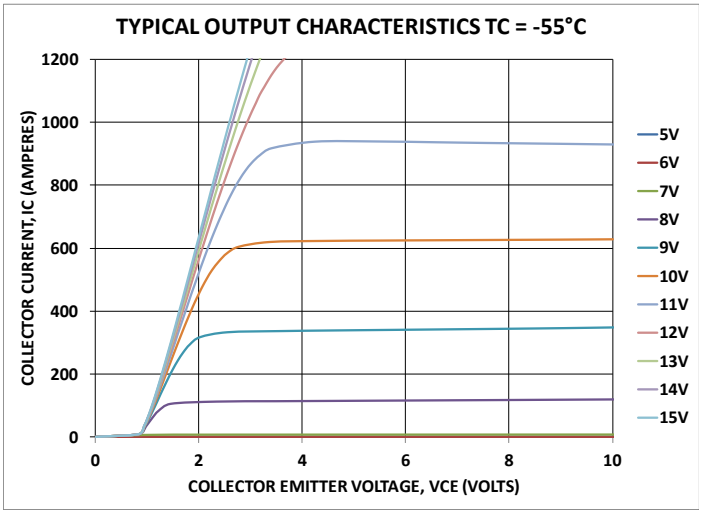
150°C - 85°C = 65°C

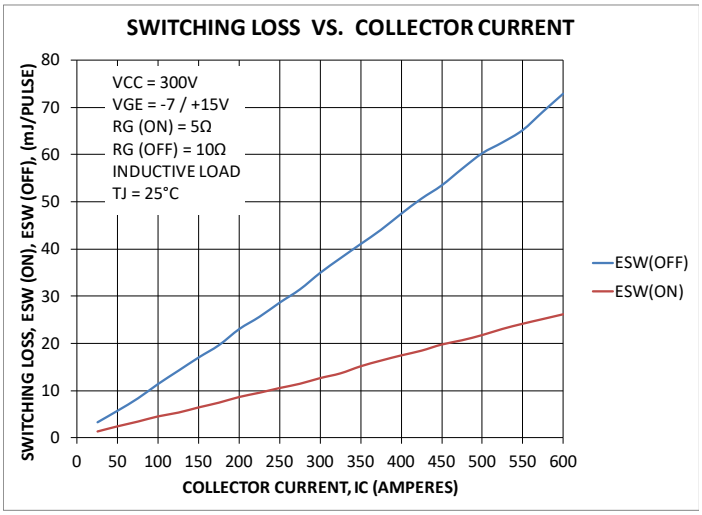
TYPICAL PERFORMANCE CURVES

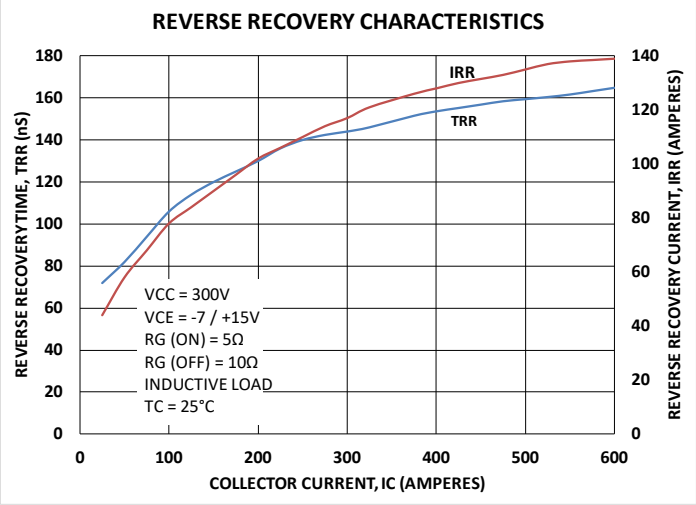








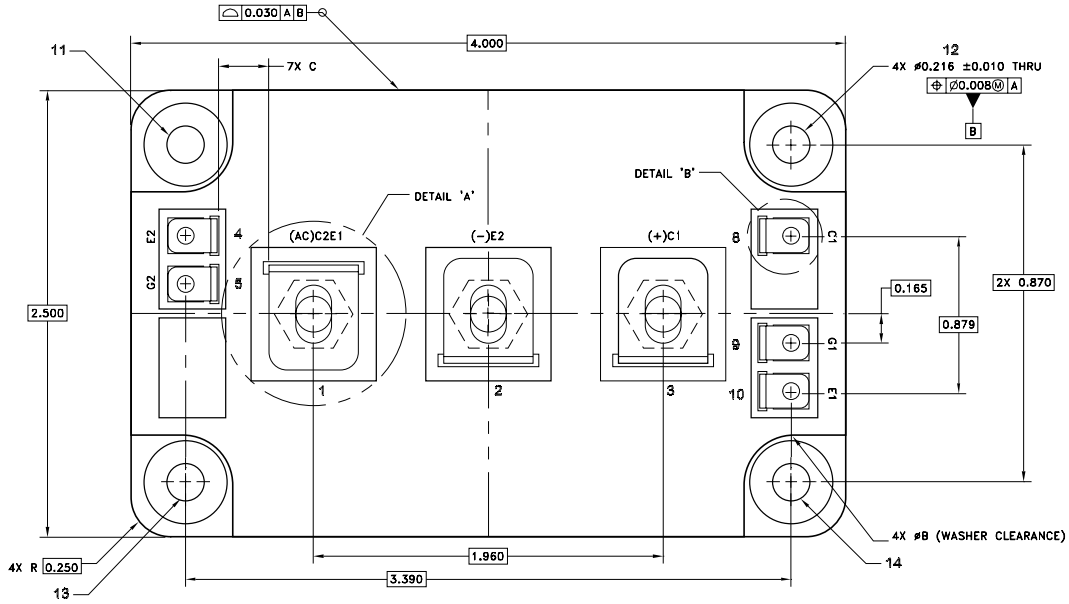


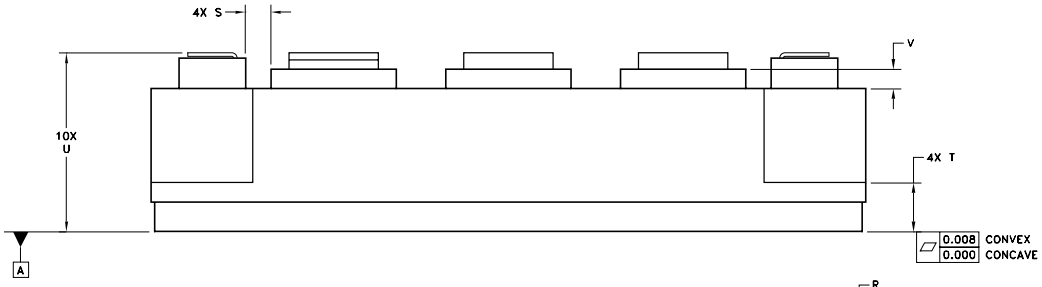


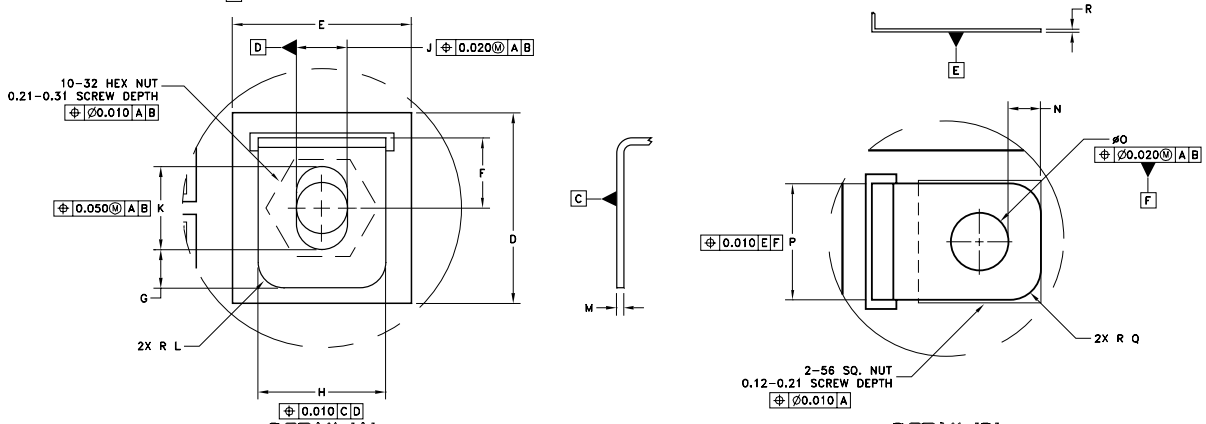
SCREENING CHART

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	GEL COAT
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.







DETAIL 'A'

(3 PLACES)

DETAIL 'B'

(7 PLACES)

TOLERANCES

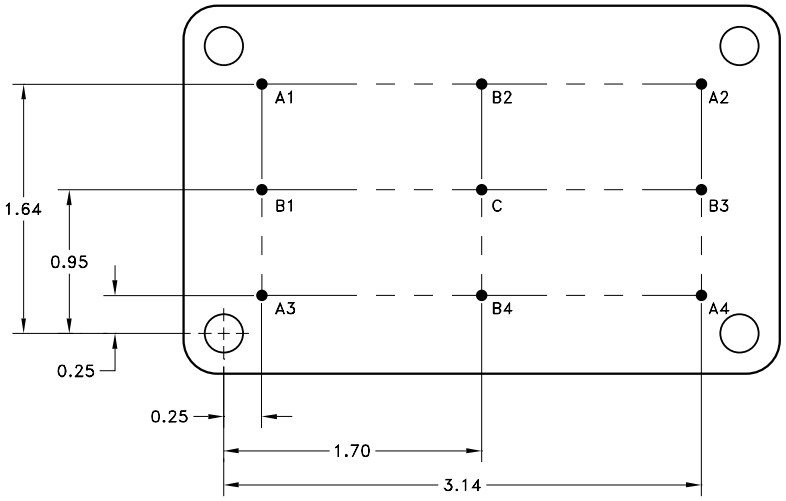
REF	MIN	MAX
12	0.206	0.226
B	0.47	———
C	0.250	———
D	———	1.02
E	———	0.81
F	———	0.380
G	0.120	0.160
H	0.500	0.550
J	0.195	0.230
K	0.310	0.340
L	0.100	———
M	0.035	———
N	0.040	0.080
O	0.090	0.110
P	0.180	0.200
Q	0.040	———
R	0.015	———
S	0.075	———
T	0.255	0.285
U	0.985	1.015
V	0.090	———
WEIGHT	———	272g

TRUE POSITION OF POWER TERMINAL HEX NUTS AND MOUNTING HOLES

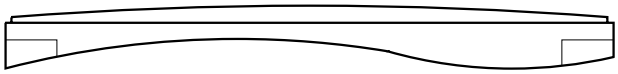
	BASIC	
REF	Z MIN	Z MAX
1	−0.980	0.000
8	1.695	0.435
14	1.695	−0.945

WEIGHT = 250 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 BASE PLATE PROFILE (FROM POINT C)

REF	Z MIN	Z MAX
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

MSK4803 H

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

GENERAL PART NUMBER

THE ABOVE EXAMPLE IS A HI-REL SCREENED MODULE.

REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
B	Released	04/14	Add form number. Update electrical specifications and performance curves for new generation IGBT and diode
C	Released	09/14	Correct outline and add labels
D	Released	08/17	Update ICES subgroup 2 limit
E	Released	07/20	Change maximum limit of Gate Threshold Voltage for subgroup 2 from 5.6V to 6.5V