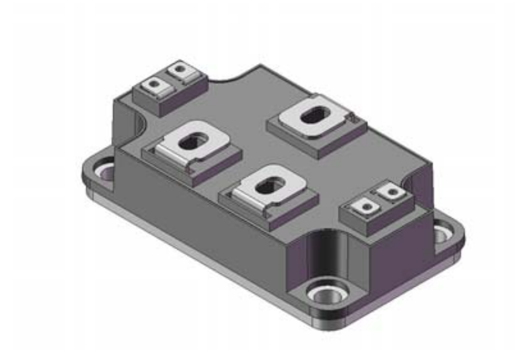
M.S.KENNEDY CORP.

HIGH TEMPERATURE 1200V/100A SiC HALF BRIDGE PEM

4805

FEATURES:

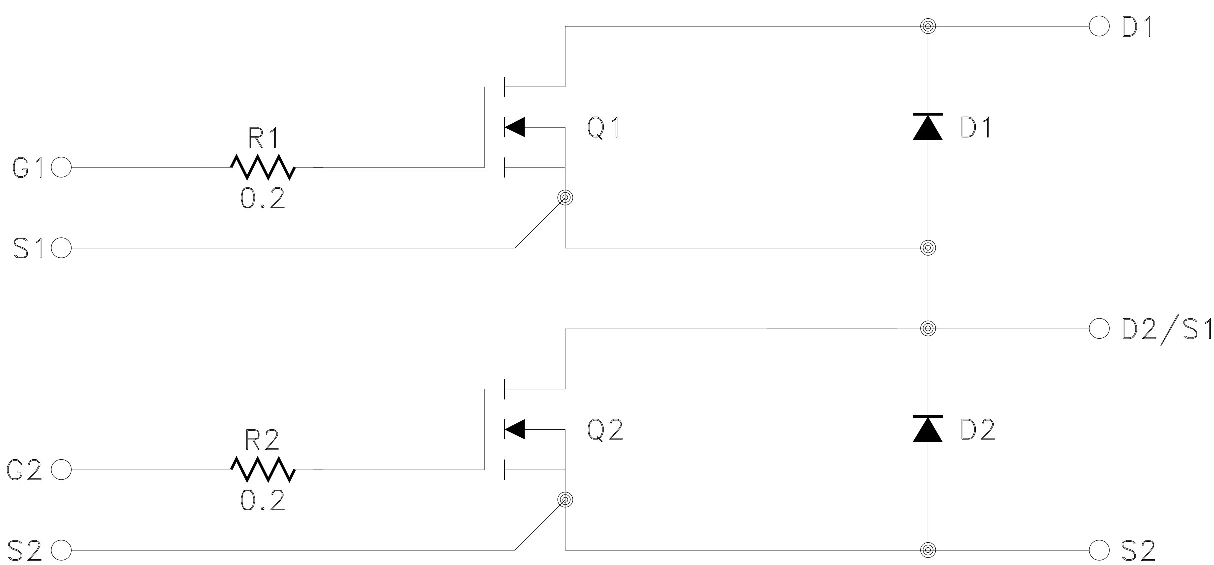
- Operation to +175°C Case
- Designed for High Temperature Applications
- Half Bridge Configuration
- Silicon Carbide Mosfet Provides Ultra Fast Switching
- Silicon Carbide Diode Provides Near Zero Recovery
- 1200V Rated Voltage
- 100A Continuous Output Current
- HI-REL Screening Available (Modified 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)
- Contact MSK for MIL-PRF-38534 (Modified) Qualification Status



DESCRIPTION:

The MSK4805 is one of a family of plastic encapsulated modules (PEM) developed specifically for use in high temperature military, aerospace, Oil/Gas and other severe environment applications. The SiC(Silicon Carbide) technology has superior switching performance compared to Si-Based modules. The half bridge configuration and 1200V/100A 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 copper or copper alloys found in most high power plastic modules. The high thermal conductivity materials used to construct the MSK4805 allow high power outputs at elevated baseplate temperatures.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Motor Drives
- Inverters

ABSOLUTE MAXIMUM RATING ⑧

V_{DS}	Collector to Emitter Voltage	1200V
V_{GS}	Gate to Emitter Voltage	+25/-10V
I_{OUT}	Current (Continuous)	100A
I_{OUTP}	Current Pulsed (1mS)	200A
V_{CASE}	Case Isolation Voltage	2500 V
T_{ST}	Storage Temperature Range	-55°C to +200°C
T_J	Junction Temperature	+200°C
T_C	Case Operating Temperature Range	
	MSK4805H	-55°C to +175°C
	MSK4805	-40°C to +175°C

ELECTRICAL SPECIFICATIONS

Parameter ⑥	Test Conditions	Group A Subgroup	MSK4805H			MSK4805			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Drain-Source Voltage	I_D=100A, V_{GS}=20V	1	-	1.44	2.10	-	1.44	2.20	V
		2	-	TBD	TBD	-	-	-	V
		3	-	1.82	2.45	-	-	-	V
Drain-Source Leakage Current	V_{DS}=1000V, V_{GS}=0V	1	-	0.006	1	-	0.006	1.2	mA
		2	-	TBD	TBD	-	-	-	mA
Gate Threshold Voltage	I_D=1mA, V_{DS}=V_{GS}	1	1.0	1.66	3.5	0.8	1.6	3.5	V
		2	TBD	TBD	TBD	-	-	-	V
		3	1.0	2.47	3.5	-	-	-	V
Diode Forward Voltage	I_D=100A	1	-	1.88	2.20	-	1.88	2.30	V
		2	-	TBD	TBD	-	-	-	V
		3	-	1.67	2.20	-	-	-	V
Total Gate Charge ①	V=600V, I_D=100A	4	-	500	570	-	500	590	nC
E(on) ①	V=600V, I_D=100A, R_G=5Ω, V_{GS}=-5/+20V	4	-	1.99	3.3	-	1.99	3.4	mJ
	V=600V, I_D=50A, R_G=5Ω, V_{GS}=-5/+20V	4	-	1.50	-	-	1.50	-	mJ
	V=600V, I_D=100A, R_G=5Ω, V_{GS}=-5/+20V	5	-	TBD	-	-	-	-	mJ
	V=600V, I_D=50A, R_G=5Ω, V_{GS}=-5/+20V	5	-	TBD	-	-	-	-	mJ
E(off) ①	V=600V, I_D=100A, R_G=5Ω, V_{GS}=-5/+20V	4	-	1.72	2.4	-	1.72	2.5	mJ
	V=600V, I_D=50A, R_G=5Ω, V_{GS}=-5/+20V	4	-	637	-	-	637	-	uJ
	V=600V, I_D=100A, R_G=5Ω, V_{GS}=-5/+20V	5	-	TBD	-	-	-	-	mJ
	V=600V, I_D=50A, R_G=5Ω, V_{GS}=-5/+20V	5	-	TBD	-	-	-	-	uJ
Diode Reverse Recovery Time ①	I_S=100, di/dt=2200A/uS	4	-	47	-	-	47	-	nS
	I_S=50, di/dt=2200A/uS	4	-	52	-	-	52	-	nS
	I_S=100, di/dt=2200A/uS	5	-	TBD	-	-	-	-	nS
	I_S=50, di/dt=2200A/uS	5	-	TBD	-	-	-	-	nS
Diode Reverse Energy ①	I_S=100, di/dt=2200A/uS	4	-	460	790	-	460	800	uJ
	I_S=50, di/dt=2200A/uS	4	-	470	-	-	470	-	uJ
	I_S=100, di/dt=2200A/uS	5	-	TBD	-	-	-	-	uJ
	I_S=50, di/dt=2200A/uS	5	-	TBD	-	-	-	-	uJ
Thermal Resistance ①	MOSFET @ T_J=200°C	-	-	TBD	TBD	-	TBD	TBD	°C/W
	DIODE @ T_J=200°C	-	-	TBD	TBD	-	TBD	TBD	°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_C = +25°C
2, 5 T_C = +175°C
3, T_C = -55°C
⑥ All specifications apply to both the upper and lower sections of the half bridge.
⑦ V_{GS}=20V unless otherwise specified.
⑧ Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle.

THERMAL CALCULATIONS

Power dissipation and maximum allowable temperature rise involve many variables working together. Drain current, PWM duty cycle and switching frequency all factor into power dissipation. DC losses or "ON-TIME" losses are simply V_{DS} x Drain Current x PWM duty cycle. For the MSK4805, V_{DS}=TBDV max., and at 100 amps and a PWM duty cycle of 30%, DC losses equal TBD watts. Switching losses vary proportionally with switching frequency. The MSK4805 typical switching losses at V_{DS}=600V and I_{DS}=100A are about TBDmJ, 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 MSK4805, at 5KHz, will exhibit switching power dissipation of TBD watts. The total losses are the sum of DC losses plus switching losses, or in this case, TBD watts total.
TBD watts x TBD°C/W thermal resistance equals TBD degrees of temperature rise between the case and the junction. Subtracting TBD°C from the maximum junction temperature of TBD°C equals TBD°C maximum case temperature for this example.

V_{DS} x I_D x PWM duty cycle = TBDV x 100 amps x 30% =TBD watts DC losses

Turn-on switching loss + Turn-off switching loss = Total switching losses = TBDmJ + TBDmJ = TBDmJ

Total switching loss x PWM frequency = Total switching power dissipation = TBDmJ x 5KHz = TBD watts

Total power dissipation = DC losses + switching losses =TBDW + TBDW = TBD watts

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

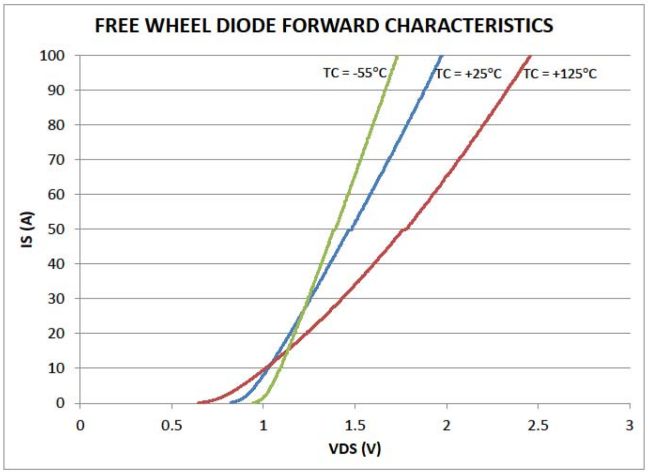
TBD watts x TBD°C/W = TBD°C temperature rise above case

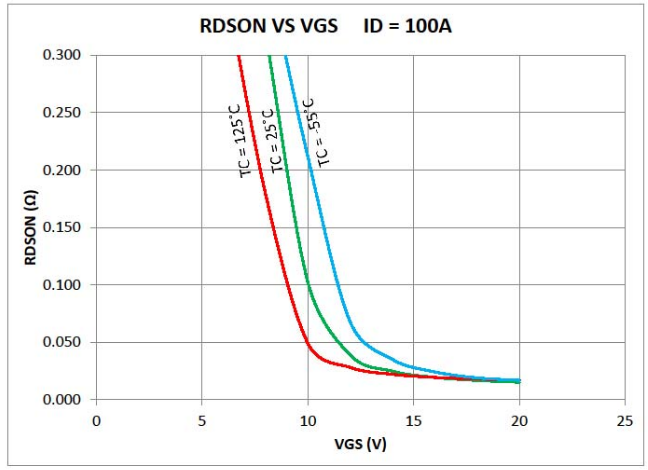
Maximum junction temperature - junction temperature rise = maximum baseplate temperature

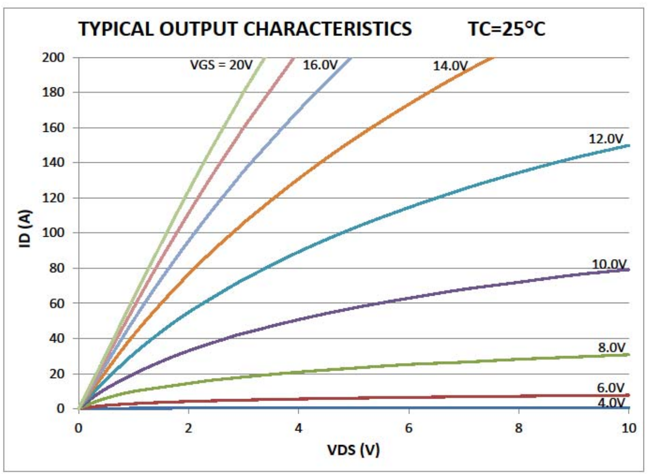
TBD°C - TBD°C = TBD°C

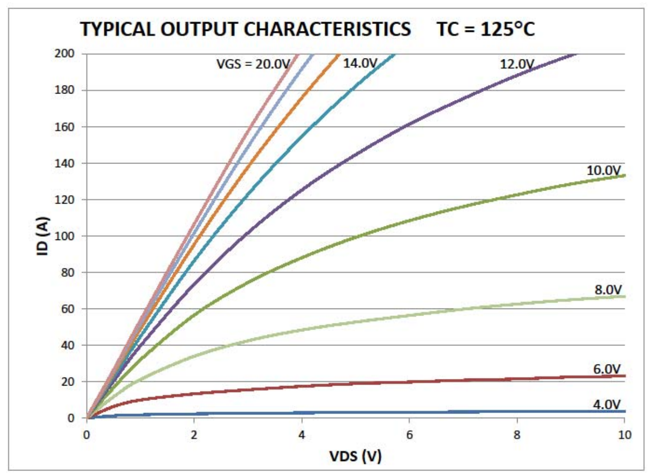
TYPICAL PERFORMANCE CURVES

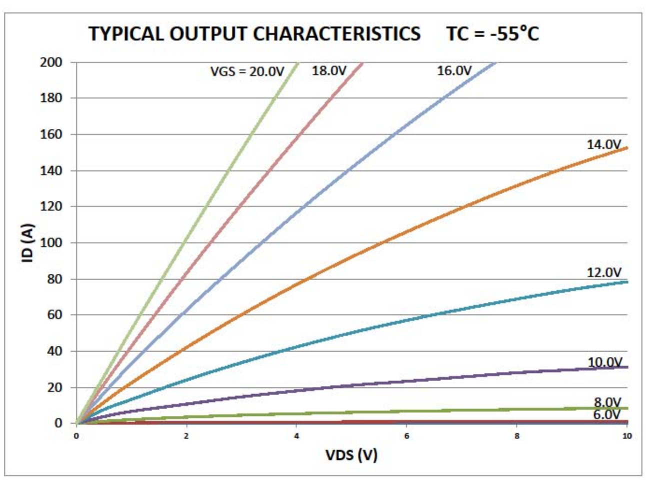
CHARACTERIZATION AT $T_J = 200°C$ IN PROCESS





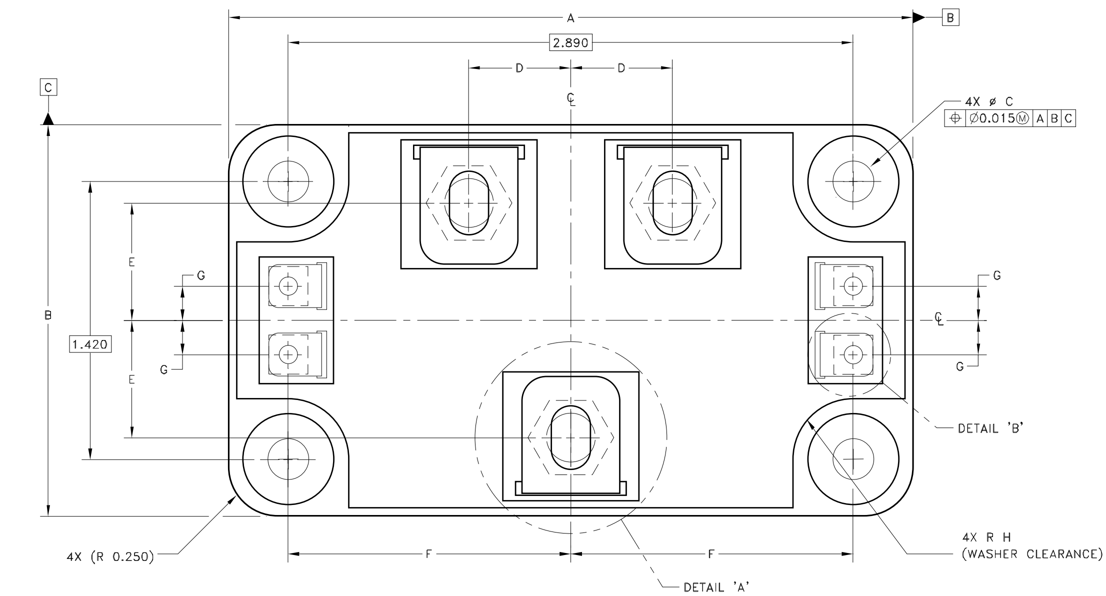


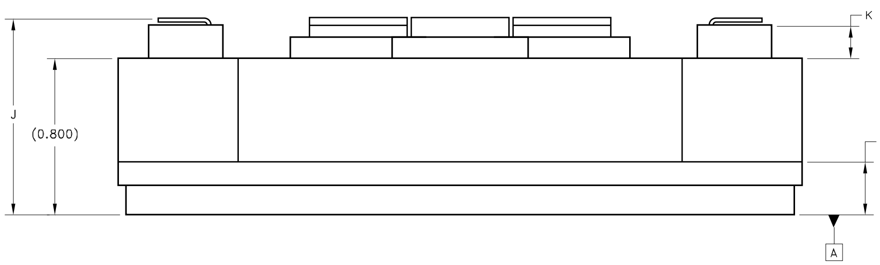




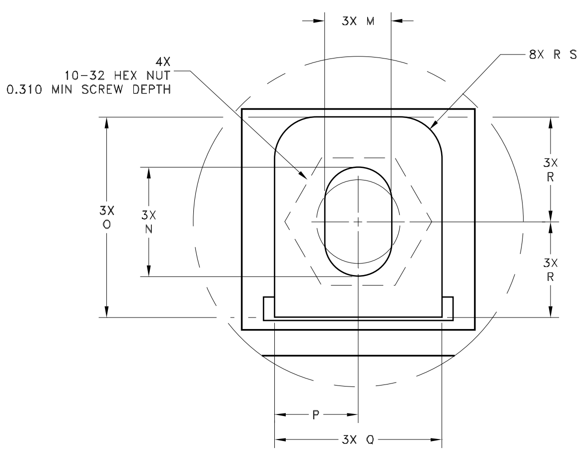
OPERATION	INDUSTRIAL	H SUFFIX
QUALIFICATION (MODIFIED)	NO	YES
ELEMENT EVALUATION	NO	YES
CLEAN ROOM PROCESSING	YES	YES
NON DESTRUCT BOND PULL SAMPLE	YES	YES
CERTIFIED OPERATORS	NO	YES
MIL LINE PROCESSING	YES	YES
MAX REWORK SPECIFIED	NO	YES
PRE-CAP VISUAL	YES - INDUSTRIAL	YES - CLASS H
TEMP CYCLE (-55°C 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.

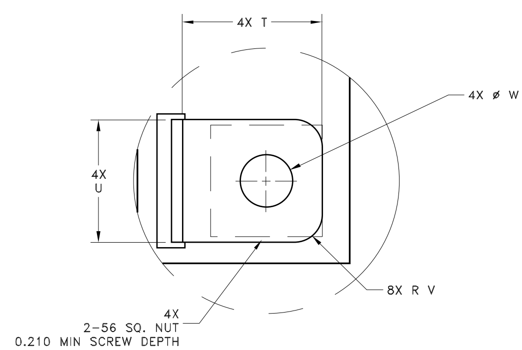




REF	MIN	MAX
A	3.470	3.510
B	1.970	2.010
C	0.208	0.225
C⌖	⌖ Ø0.015Ⓜ A B C	
D*	0.496	0.546
E*	0.575	0.625
F*	1.420	1.470
G*	0.150	0.200
H*	0.240	—
J	0.985	1.015
K	0.090	—
L	0.255	0.285
M	0.195	0.230
N	0.310	0.340
O	0.500	0.700
P	0.200	0.300
Q	0.500	0.550
R	—	0.400
S*	0.100	—
T	—	0.250
U	—	0.220
V	0.050	—
W	0.090	0.110
WEIGHT	—	200g

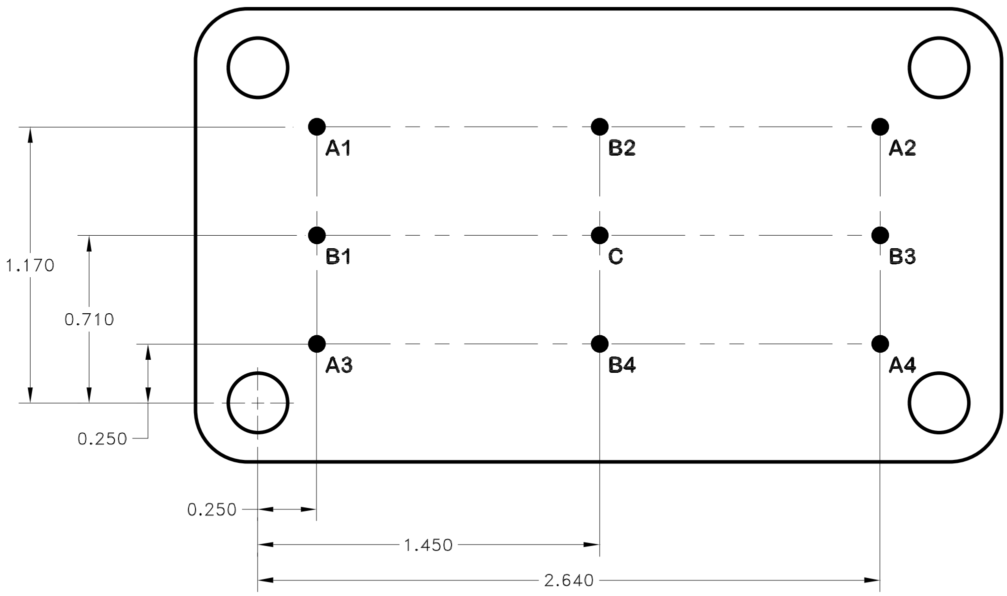


DETAIL 'A'
SCALE 3:1

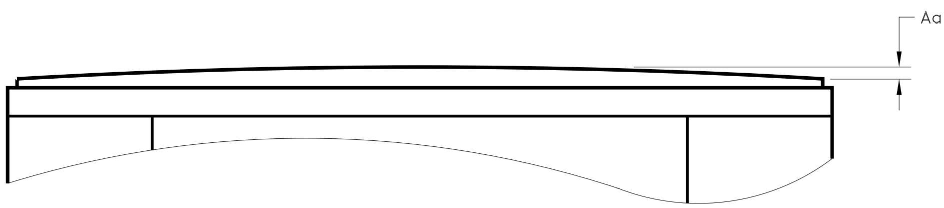


DETAIL 'B'
SCALE 5:1

WEIGHT = 200 GRAMS MAX.



POWER MODULE (BOTTOM VIEW)
(NOT TO SCALE)



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

CONVEX BASEPLATE PROFILE (FROM POINT C)

REF	Z MIN	Z MAX
A1	0.000	0.007
A2	0.000	0.007
A3	0.000	0.007
A4	0.000	0.007
B1	0.000	0.007
B2	0.000	0.007
B3	0.000	0.007
B4	0.000	0.007

ORDERING INFORMATION

MSK4805 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
-	Preliminary	02/14	Initial Release

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