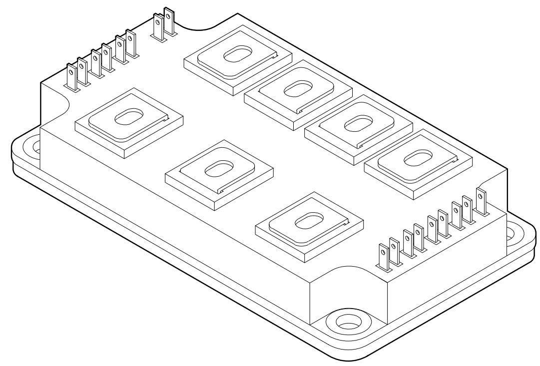
MIL-PRF-38534 AND 38535 CERTIFIED FACILITY

600V/150A THREE PHASE BRIDGE PEM WITH BRAKE

4853

FEATURES:

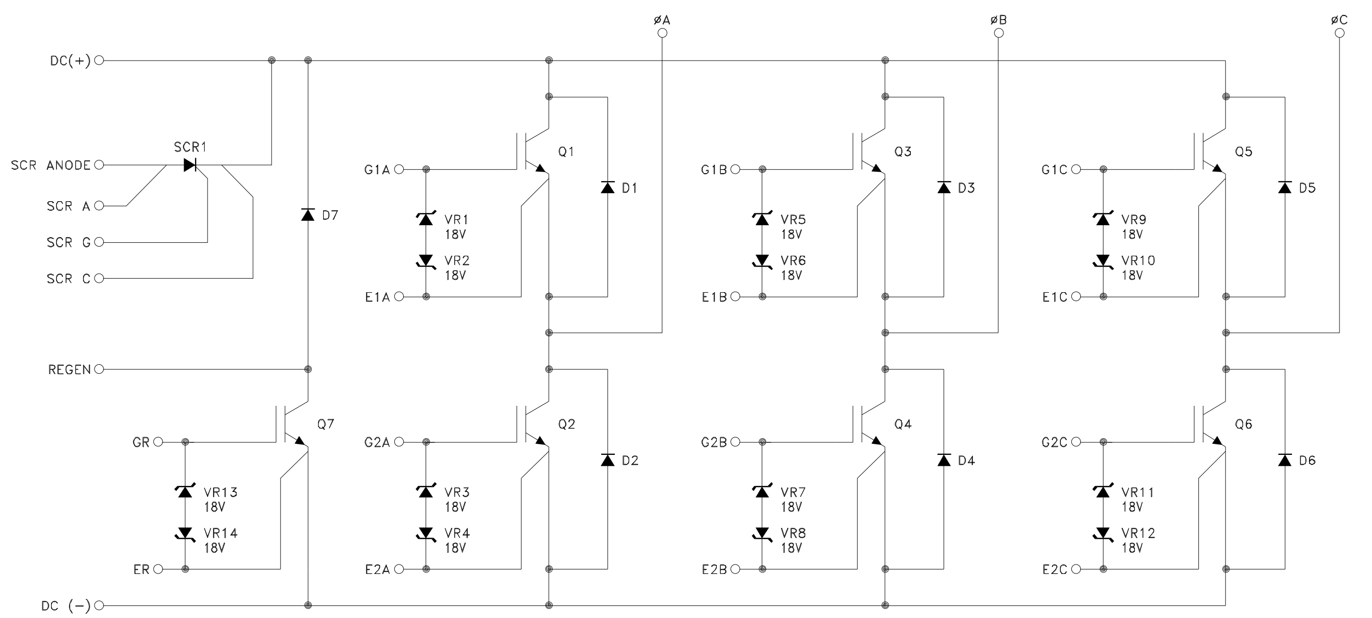
- Replaces MSK4850
- Full Three Phase Bridge Configuration with SCR/IGBT Brake
- 600V Rated Voltage
- 150A Continuous Output Current
- Internal Zener Clamps on Gates
- Proprietary Encapsulation Provides Near Hermetic Performance
- HI-REL Screening Available (Modified 38534)
- Light Weight Domed ALSIC 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)



DESCRIPTION:

The MSK4853 is one of a family of plastic encapsulated modules (PEM) developed specifically for use in military, aerospace and other severe environment applications. The Three Phase Bridge configuration along with the SCR/IGBT brake circuit and 600 volt/150 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 MSK4853 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
V_{GE}	Gate to Emitter Voltage	±20V
I_{OUT}	Current (Continuous)	150A
I_{OUTP}	Current Pulsed (1mS)	300A
V_{CASE}	Case Isolation Voltage	2500 V
T_{ST}	Storage Temperature Range ⑨	-55°C to +125°C
T_J	Junction Temperature	150°C
T_C	Case Operating Temperature Range	
	MSK4853H	-55°C to +125°C
	MSK4853	-40°C to +85°C

ELECTRICAL SPECIFICATIONS

Parameter ⑥	Test Conditions	Group A Subgroup	MSK4853H Min.	MSK4853H Typ.	MSK4853H Max.	MSK4853 Min.	MSK4853 Typ.	MSK4853 Max.	Units
Collector-Emitter Saturation Voltage	I_C=150A, V_{GE}=15V	1	-	1.4	1.9	-	1.4	2.0	V
		2	-	1.5	2.1	-	-	-	V
		3	-	2.4	2.7	-	-	-	V
Collector-Emitter Leakage Current	V_{CE}=600V, V_{GE}=0V	1	-	0.5	350	-	0.5	400	uA
		2	-	400	1700	-	-	-	uA
Gate Threshold Voltage	I_C=60mA, V_{CE}=V_{GE}	1	5.0	6.0	6.5	4.8	6.0	6.8	V
		2	4.0	5.0	6.5	-	-	-	V
		3	5.0	6.5	7.5	-	-	-	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=150A	1	-	1.5	1.9	-	1.5	2.1	V
		2	-	1.2	1.9	-	-	-	V
		3	-	1.6	2.2	-	-	-	V
SCR Reverse Leakage	V_{RRM}=600V	1	-	0.01	15	-	0.01	18	mA
		2	-	0.01	15	-	-	-	mA
		3	-	0.01	15	-	-	-	mA
SCR On Voltage	I_F=100A	1	-	1.0	1.35	-	1.0	1.4	V
		2	-	1.0	1.35	-	-	-	V
		3	-	1.0	1.35	-	-	-	V
SCR Holding Current		1	-	100	300	-	100	325	mA
		2	-	90	300	-	-	-	mA
		3	-	110	300	-	-	-	mA
Regen Diode Forward Voltage	I_F=50A	1	-	1.3	1.9	-	1.3	2.0	V
Total Gate Charge ①	V=300V, I_C=150A	4	-	1.3	2.5	-	1.3	2.6	uC
E(on) ①	V=300V, I_C=150A, RG=5Ω, V_{GE}=-7/+15V	4	-	2.5	-	-	2.5	-	mJ
	V=300V, I_C=75A, RG=5Ω, V_{GE}=-7/+15V	4	-	1.2	3	-	1.2	4	mJ
E(off) ①	V=300V, I_C=150A, RG=10Ω, V_{GE}=-7/+15V	4	-	6.5	-	-	6.5	-	mJ
	V=300V, I_C=75A, RG=10Ω, V_{GE}=-7/+15V	4	-	3.5	6	-	3.5	7	mJ
Diode Reverse Recovery Time ①	I_E=150, di/dt=2600A/uS	4	-	50	-	-	50	-	nS
	I_E=75, di/dt=2600A/uS	4	-	45	-	-	45	-	nS
Diode Reverse Recovery Charge ①	I_E=150, di/dt=2600A/uS	4	-	2.0	-	-	2.0	-	uC
	I_E=75, di/dt=2600A/uS	4	-	1.5	2.5	-	1.5	-	uC
Thermal Resistance ①	IGBT @ T_J=125°C	-	-	0.22	0.26	-	0.22	0.26	°C/W
	DIODE @ T_J=125°C	-	-	0.35	0.41	-	0.35	0.41	°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 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 MSK4853, V_{CE}(SAT)=1.9V max., and at 150 amps and a PWM duty cycle of 30%, DC losses equal 86 watts. Switching losses, in milli-joules, vary proportionally with switching frequency. The MSK4853 typical switching losses at V_{CE}=300V and I_{CE}=150A are about 9mJ, 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 MSK4853, at 15KHz, will exhibit switching power dissipation of 135 watts. The total losses are the sum of DC losses plus switching losses, or in this case, 221 watts total.
221 watts x 0.26°C/W thermal resistance equals 57.5 degrees of temperature rise between the case and the junction. Subtracting 57.5°C from the maximum junction temperature of 150°C equals 92.5°C maximum case temperature for this example.

V_{CE}(SAT) x IC x PWM duty cycle = 1.9V x 150 amps x 30% = 86 watts DC losses

Turn-on switching loss + Turn-off switching loss = Total switching losses = 2.5mJ + 6.5mJ = 9mJ

Total switching loss x PWM frequency = Total switching power dissipation = 9mJ x 15KHz = 135 watts

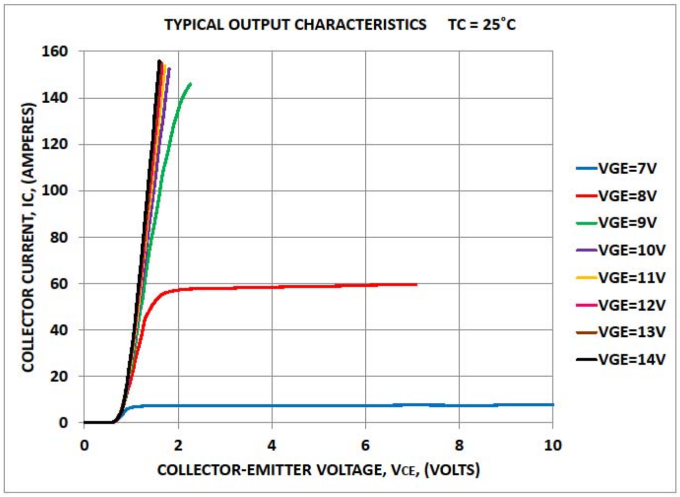
Total power dissipation = DC losses + switching losses = 86 + 135 = 221 watts

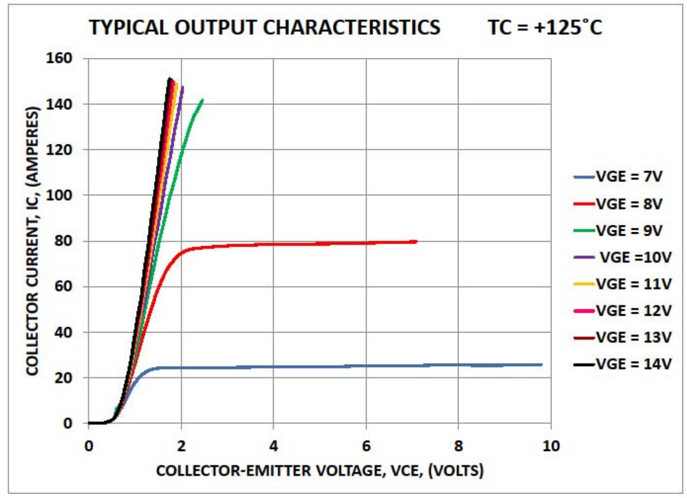
Junction temperature rise above case = Total power dissipation x thermal resistance

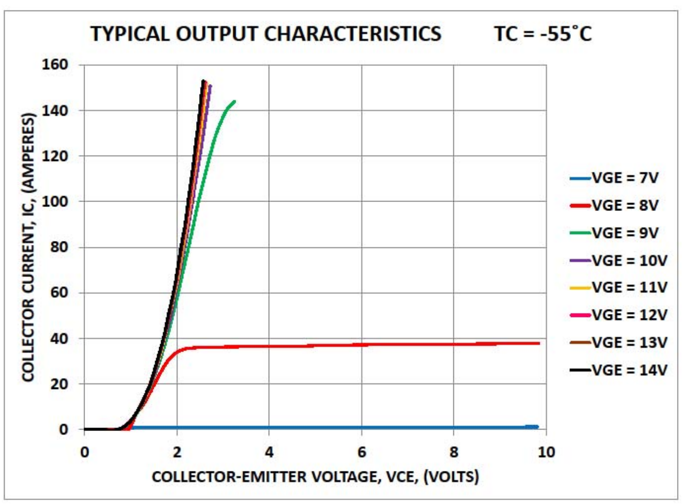
221 watts x 0.26°C/W = 57.5°C temperature rise above case

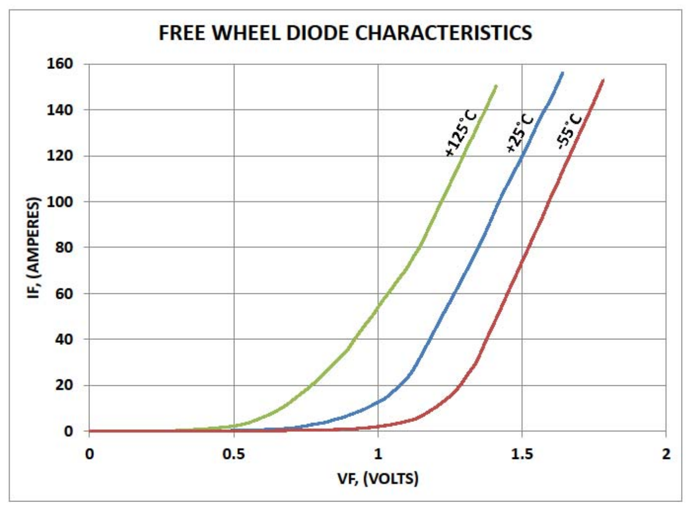
Maximum junction temperature - junction temperature rise = maximum baseplate temperature

150°C - 57.5°C = 92.5°C

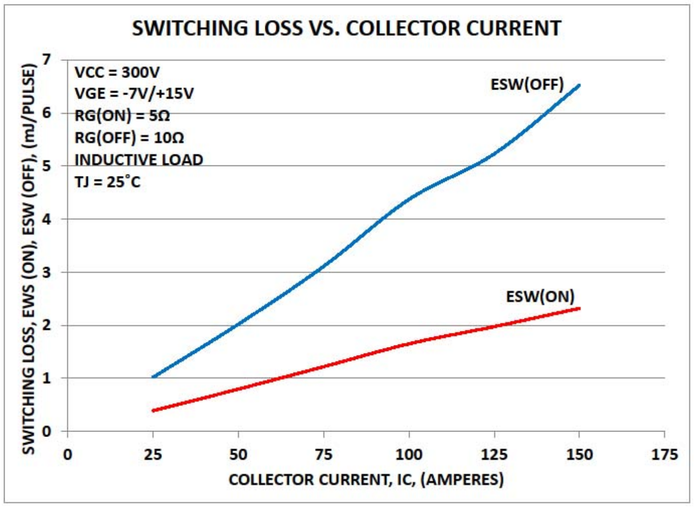

TYPICAL OUTPUT CHARACTERISTICS TC = 25˚C
COLLECTOR CURRENT, IC, (AMPERES)
COLLECTOR-EMITTER VOLTAGE, VCE, (VOLTS)
VGE=7V
VGE=8V
VGE=9V
VGE=10V
VGE=11V
VGE=12V
VGE=13V
VGE=14V

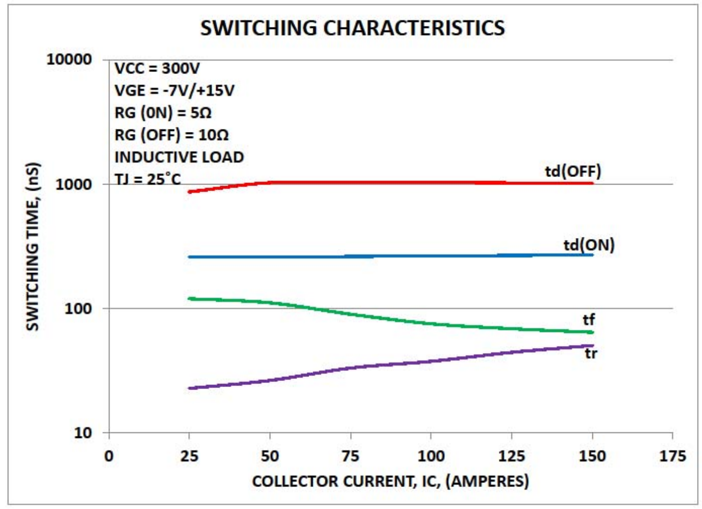

TYPICAL OUTPUT CHARACTERISTICS TC = +125˚C
COLLECTOR CURRENT, IC, (AMPERES)
COLLECTOR-EMITTER VOLTAGE, VCE, (VOLTS)
VGE = 7V
VGE = 8V
VGE = 9V
VGE =10V
VGE = 11V
VGE = 12V
VGE = 13V
VGE = 14V

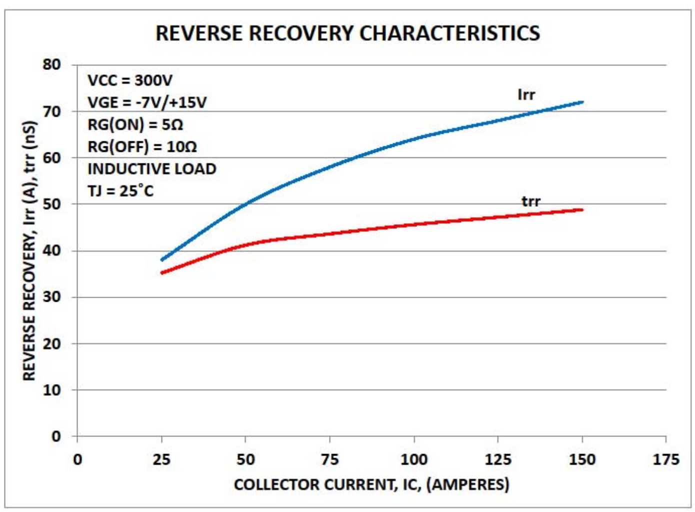

TYPICAL OUTPUT CHARACTERISTICS TC = -55˚C
COLLECTOR CURRENT, IC, (AMPERES)
COLLECTOR-EMITTER VOLTAGE, VCE, (VOLTS)
VGE = 7V
VGE = 8V
VGE = 9V
VGE = 10V
VGE = 11V
VGE = 12V
VGE = 13V
VGE = 14V


FREE WHEEL DIODE CHARACTERISTICS
IF, (AMPERES)
VF, (VOLTS)
+125˚C
+25˚C
-55˚C

TYPICAL PERFORMANCE CURVES CONT'D





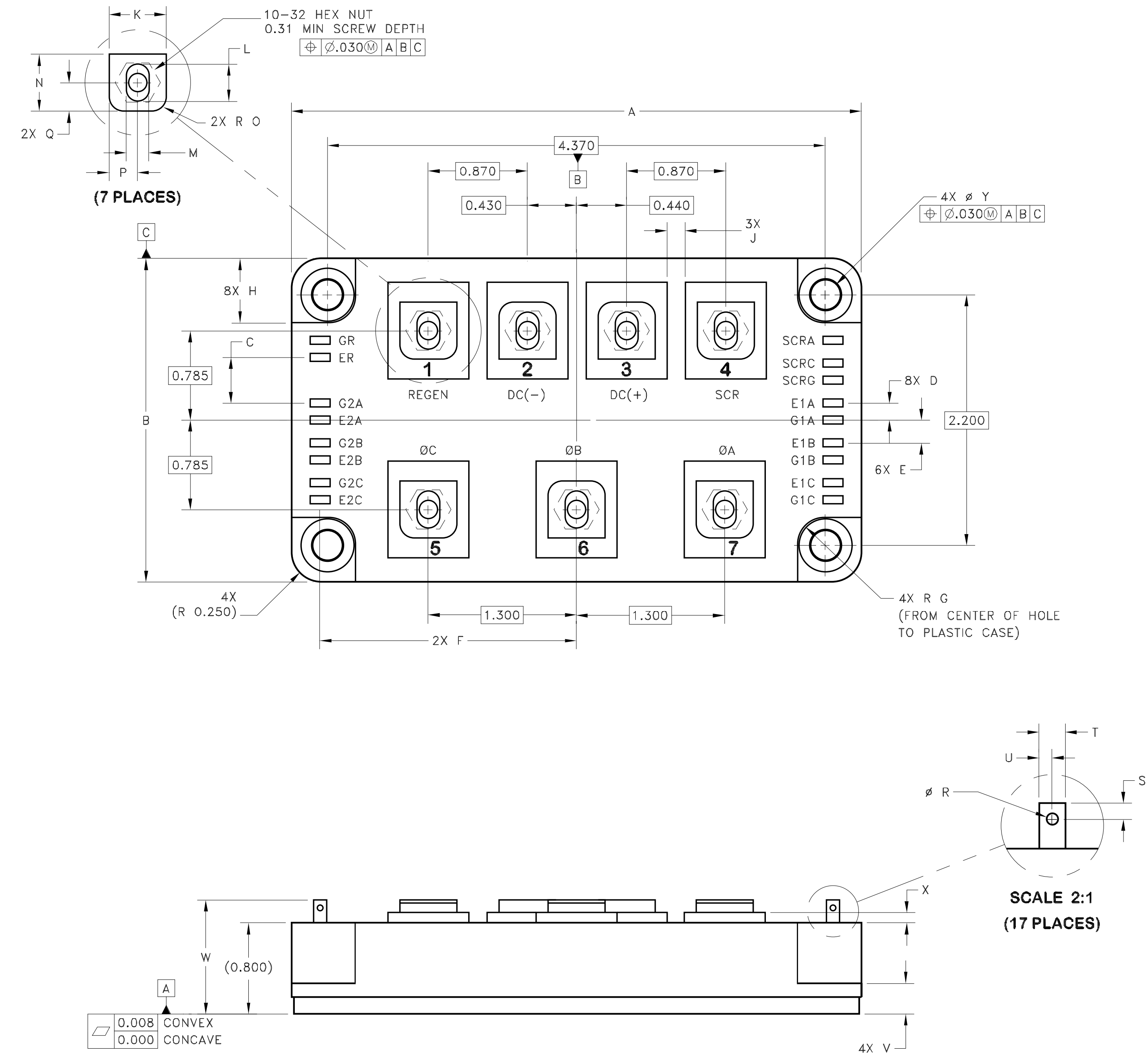


SCREENING CHART

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
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
PIN FINISH	NI	NI

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

MECHANICAL SPECIFICATIONS



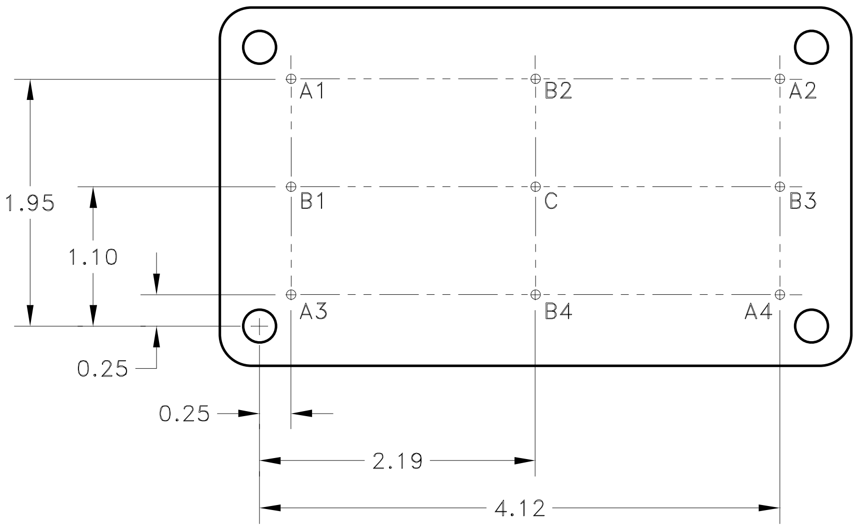
REF	MIN	MAX	REF	MIN	MAX
A	4.97	5.03	N	0.50	0.70
B	2.81	2.85	O	0.10	———
C	0.39	0.41	P	0.20	0.30
D	0.14	0.16	Q	———	0.40
E	0.19	0.21	R	0.040	0.060
F	2.22	2.28	S	0.060	0.080
G	0.235	———	T	0.105	0.125
H	0.52	———	U	0.048	0.068
J	0.150	———	V	0.255	0.285
K	0.500	0.550	W	0.980	1.020
L	0.310	0.340	X	0.09	———
M	0.195	0.230	Y	0.259	0.270

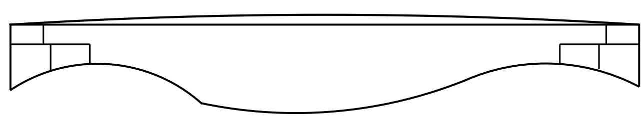
WEIGHT = 410 GRAMS MAX.

ALL DIMENSIONS ARE SPECIFIED IN INCHES

FOR CONVEX BASEPLATE PROFILE SEE SHEET 8

POWER MODULE BOTTOM VIEW
(NOT TO SCALE)





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

REF	ZMIN	ZMAX
A1	0.000	0.010
A2	0.000	0.010
A3	0.000	0.010
A4	0.000	0.010
B1	0.000	0.010
B2	0.000	0.010
B3	0.000	0.010
B4	0.000	0.010

NOTES:
1. (A1, A2, A3, B1, B2, B3 & B4) REFERENCED TO POINT C.

ORDERING INFORMATION

MSK4853 H

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

GENERAL PART NUMBER

REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
F	Released	12/14	Add internal note and clarify mechanical specifications.

MSK
Phone (315) 701-6751
FAX (315) 701-6752
www.mskennedy.com