MIL-PRF-38534 CERTIFIED

600V/600A HALF BRIDGE PEM 4803

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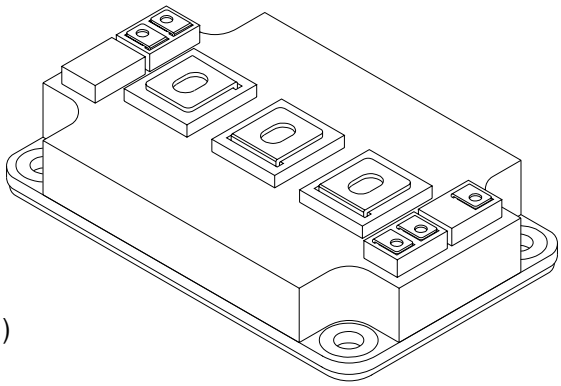
FEATURES:

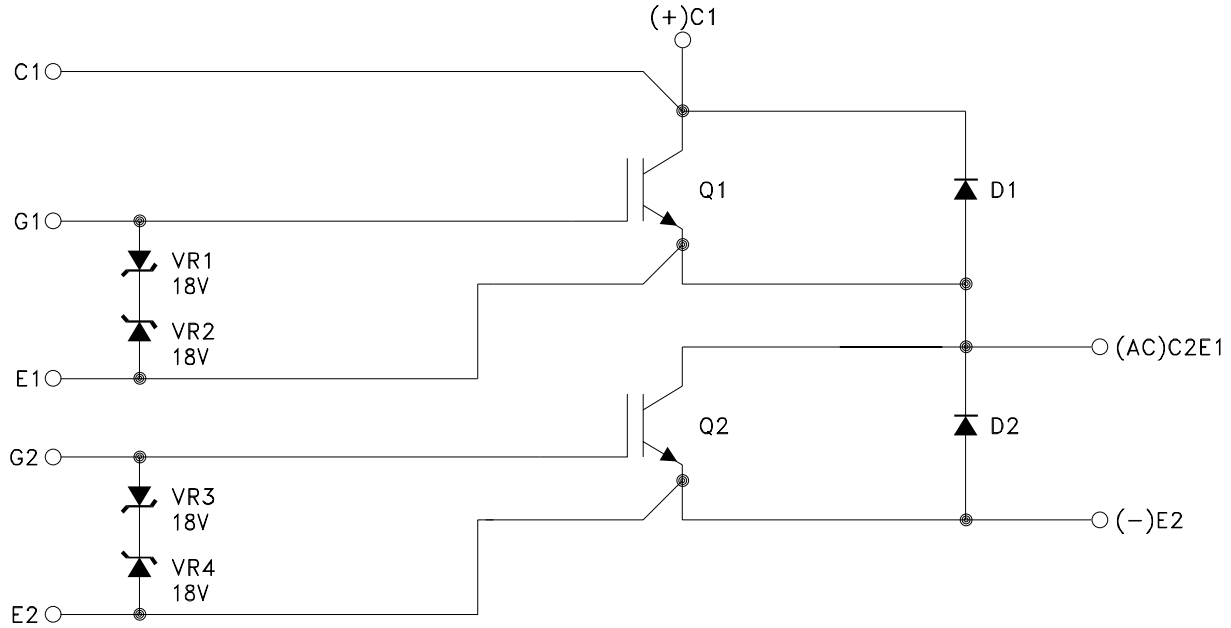
- Half Bridge Configuration
- 600V Rated Voltage
- 600A Continuous Output Current
- Internal Zener Clamps on Gates
- Proprietary Encapsulation Provides Near Hermetic Performance
- MIL-PRF-38534 Screening Available (Modified)
- Light Weight Domed ALSIC Baseplate
- Robust Mechanical Design for Hi-Rel Applications
- 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 MSK 4803 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 MSK 4803 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 . . . -55°C to +125°C
V_{GE}	Gate to Emitter Voltage . . . . . ±20V	T_J	Junction Temperature . . . . . 150°C
I_{OUT}	Current (Continuous) 600A	T_C	Case Operating Temperature Range
I_{OUTP}	Current Pulsed (1mS) 1200A		MSK 4803H/E . . . . . -55°C to +125°C
V_{CASE}	Case Isolation Voltage . . . . . 2500 V		MSK 4803 . . . . . -40°C to +85°C

ELECTRICAL SPECIFICATIONS

Parameter ⑥	Test Conditions	Group A Subgroup	MSK 4803 H/E Min.	MSK 4803 H/E Typ.	MSK 4803 H/E Max.	MSK 4803 Min.	MSK 4803 Typ.	MSK 4803 Max.	Units
Collector-Emitter Saturation Voltage	I_C = 600A, V_{GE} = 15V	1	-	2.55	2.9	-	2.55	3.0	V
		2	-	2.90	3.2	-	-	-	V
		3	-	3.60	4.0	-	-	-	V
Collector-Emitter Leakage Current	V_{CE} = 600V, V_{GE} = 0V	1	-	0.5	1000	-	0.5	1000	uA
		2	-	500	5000	-	-	-	uA
Gate Threshold Voltage	I_C = 60mA, V_{CE} = V_{GE}	1	3.5	4.1	7.5	3.3	4.1	7.8	V
		2	3.0	3.5	7.5	-	-	-	V
		3	4.0	4.5	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	-	1.8	2.5	-	1.8	2.6	V
		2	-	1.8	2.5	-	-	-	V
		3	-	2.0	2.8	-	-	-	V
Total Gate Charge ①	V = 300V, I_C = 600A	4	-	3.2	4.5	-	3.2	4.8	uC
E(on) ①	V = 300V, I_C = 600A, RG = 5Ω, V_{GE} = -7/+15V	4	-	17.5	-	-	17.5	-	mJ
	V = 300V, I_C = 300A, RG = 5Ω, V_{GE} = -7/+15V	4	-	10	15	-	10	18	mJ
	V = 300V, I_C = 600A, RG = 5Ω, V_{GE} = -7/+15V	5	-	22	-	-	-	-	mJ
	V = 300V, I_C = 300A, RG = 5Ω, V_{GE} = -7/+15V	5	-	12	-	-	-	-	mJ
E(off) ①	V = 300V, I_C = 600A, RG = 10Ω, V_{GE} = -7/+15V	4	-	60	-	-	60	-	mJ
	V = 300V, I_C = 300A, RG = 10Ω, V_{GE} = -7/+15V	4	-	26	35	-	26	38	mJ
	V = 300V, I_C = 600A, RG = 10Ω, V_{GE} = -7/+15V	5	-	64	-	-	-	-	mJ
	V = 300V, I_C = 300A, RG = 10Ω, V_{GE} = -7/+15V	5	-	30	-	-	-	-	mJ
Diode Reverse Recovery Time ①	I_E = 600, di/dt = 3500A/uS	4	-	190	-	-	190	-	nS
	I_E = 300, di/dt = 3500A/uS	4	-	185	-	-	185	-	nS
	I_E = 600, di/dt = 3500A/uS	5	-	270	-	-	-	-	nS
	I_E = 300, di/dt = 3500A/uS	5	-	250	-	-	-	-	nS
Diode Reverse Energery ①	I_E = 600, di/dt = 3500A/uS	4	-	7.5	-	-	7.5	-	mJ
	I_E = 300, di/dt = 3500A/uS	4	-	6	8	-	6	-	mJ
	I_E = 600, di/dt = 3500A/uS	5	-	16	-	-	-	-	mJ
	I_E = 300, di/dt = 3500A/uS	5	-	24	-	-	-	-	mJ
Thermal Resistance ①	IGBT @ T_J = 125°C	-	-	0.05	0.07	-	0.05	0.07	°C/W
	DIODE @ T_J = 125°C	-	-	0.09	0.11	-	0.09	0.11	°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 and "E" suffix devices shall be tested to subgroup 1 unless otherwise specified.
③ Military 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 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

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 MSK 4803, V_{CE}(SAT) = 2.9V max., and at 600 amps and a PWM duty cycle of 30%, DC losses equal 522 watts. Switching losses vary proportionally with switching frequency. The MSK 4803 typical switching losses at V_{CE} = 300V and I_{CE} = 600A are about 78mJ, 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 MSK 4803, at 5KHz, will exhibit switching power dissipation of 390 watts. The total losses are the sum of DC losses plus switching losses, or in this case, 912 watts total.

912 watts x 0.07°C/W thermal resistance equals 64 degrees of temperature rise between the case and the junction. Subtracting 64°C from the maximum junction temperature of 150°C equals 86°C maximum case temperature for this example.

V_{CE}(SAT) x IC x PWM duty cycle = 2.9V x 600 amps x 30% = 522 watts DC losses

Turn-on switching loss + Turn-off switching loss = Total switching losses = 17.5 + 60 = 77.5mJ

Total switching loss x PWM frequency = Total switching power dissipation = 78mJ x 5KHz = 390 watts

Total power dissipation = DC losses + switching losses = 522 + 390 = 912 watts

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

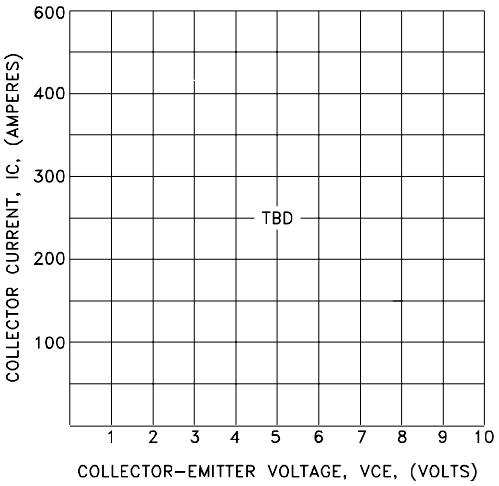
912 watts x 0.07°C/W = 63.8°C temperature rise above case

Maximum junction temperature - junction temperature rise = maximum baseplate temperature

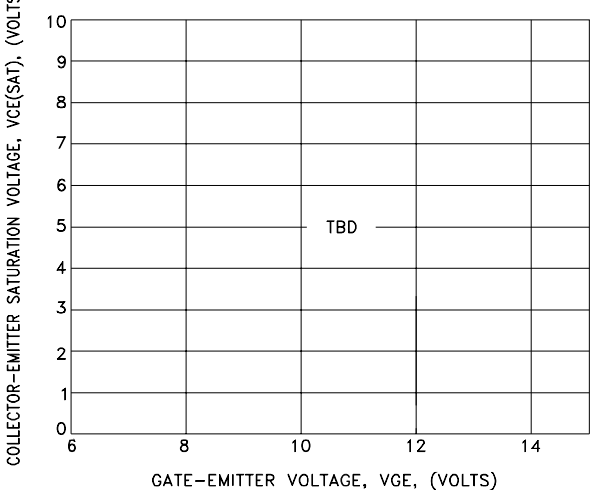
150°C - 64°C = 86°C

TYPICAL PERFORMANCE CURVES

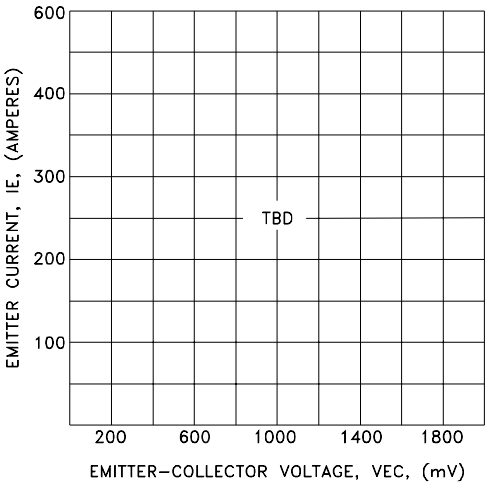
TYPICAL OUTPUT CHARACTERISTICS



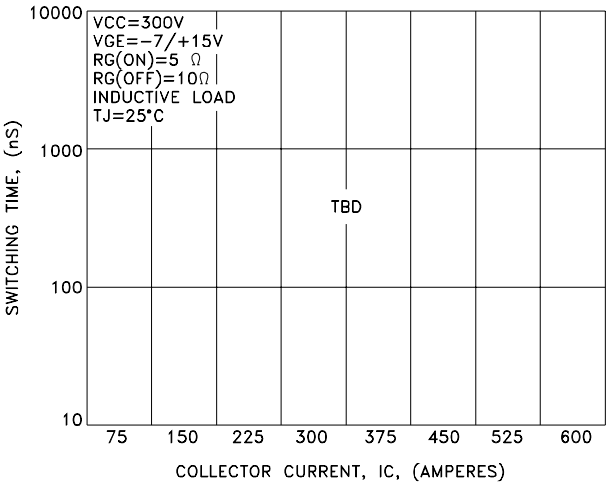
COLLECTOR–EMITTER SATURATION VOLTAGE CHARACTERISTICS



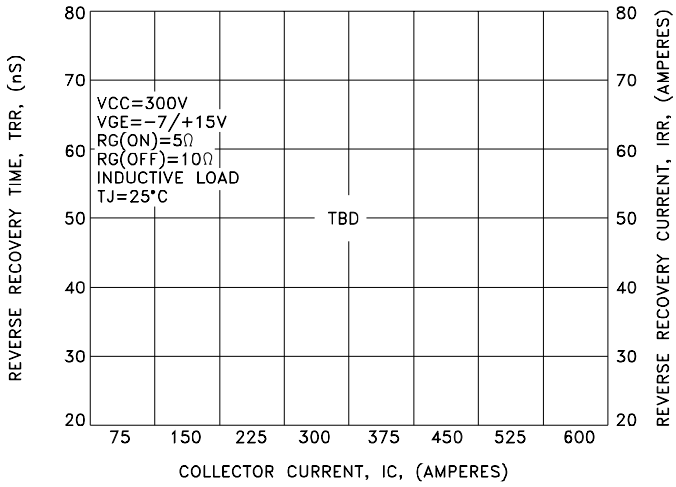
FREE–WHEEL DIODE FORWARD CHARACTERISTICS



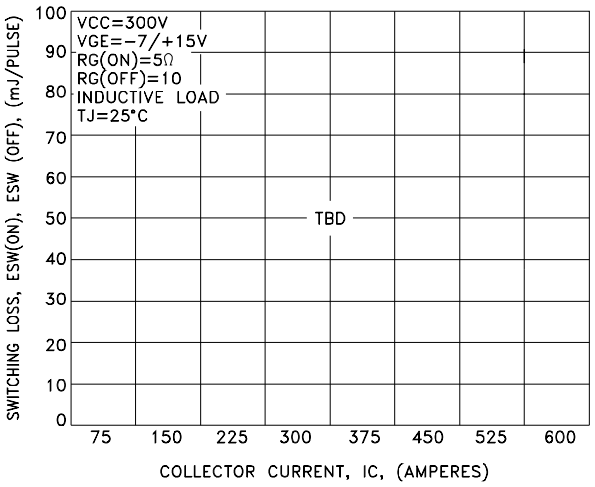
SWITCHING CHARACTERISTICS



REVERSE RECOVERY CHARACTERISTICS



SWITCHING LOSS vs. COLLECTOR CURRENT



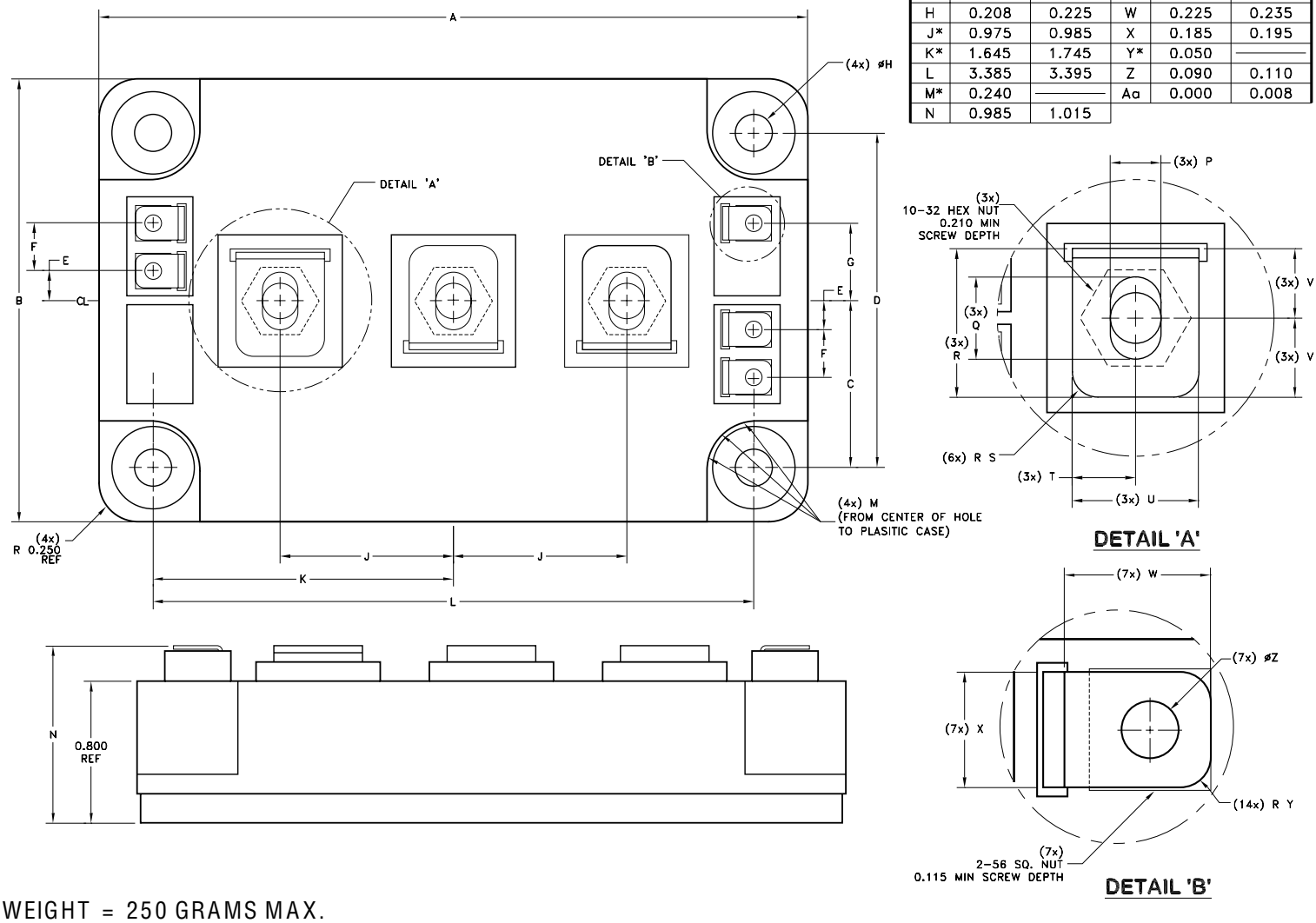
SCREENING CHART

OPERATION IN ACCORDANCE WITH MIL-PRF-38534	INDUSTRIAL	CLASS E	CLASS H
QUALIFICATION (MODIFIED)	NO	NO	YES
ELEMENT EVALUATION	NO	YES	YES
CLEAN ROOM PROCESSING	YES	YES	YES
NON DESTRUCT BOND PULL SAMPLE	YES	YES	YES
CERTIFIED OPERATORS	NO	YES	YES
MIL LINE PROCESSING	YES	YES	YES
MAX REWORK SPECIFIED	NO	YES	YES
ENCAPSULANT	GEL COAT	SEES™	SEES™
PRE-CAP VISUAL	YES - INDUSTRIAL	YES - CLASS H	YES - CLASS H
TEMP CYCLE (-55°C TO +125°C)	NO	YES	YES
BURN-IN	NO	YES - 96 HOURS	YES - 160 HOURS
ELECTRICAL TESTING	YES - 25°C	YES - 25°C	YES - FULL TEMP
EXTERNAL VISUAL	YES - SAMPLE	YES - SAMPLE	YES
XRAY	NO	NO	NO
PIN FINISH	NI	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	3.970	4.020	P	0.195	0.230
B	2.470	2.510	Q	0.310	0.340
C*	0.940	0.950	R	0.500	0.700
D	1.885	1.895	S*	0.100	———
E	0.160	0.170	T	0.200	0.300
F	0.265	0.275	U	0.500	0.550
G	0.430	0.440	V	———	0.400
H	0.208	0.225	W	0.225	0.235
J*	0.975	0.985	X	0.185	0.195
K*	1.645	1.745	Y*	0.050	———
L	3.385	3.395	Z	0.090	0.110
M*	0.240	———	Aa	0.000	0.008
N	0.985	1.015			



DETAIL 'A'

DETAIL 'B'

WEIGHT = 250 GRAMS MAX.

ORDERING INFORMATION

MSK4803 H

SCREENING

BLANK = INDUSTRIAL; E = EXTENDED RELIABILITY;
H = MIL-PRF-38534 CLASS H (MODIFIED)

GENERAL PART NUMBER

THE ABOVE EXAMPLE IS A MILITARY SCREENED MODULE.

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