MIL-PRF-38534 CERTIFIED

1200V/100A SiC HALF BRIDGE 4804

M.S.KENNEDY CORP.
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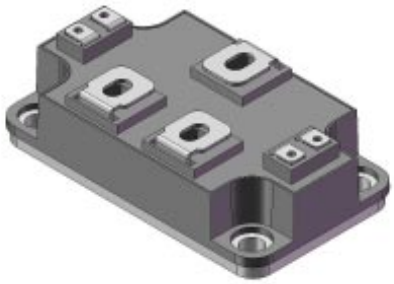
FEATURES:

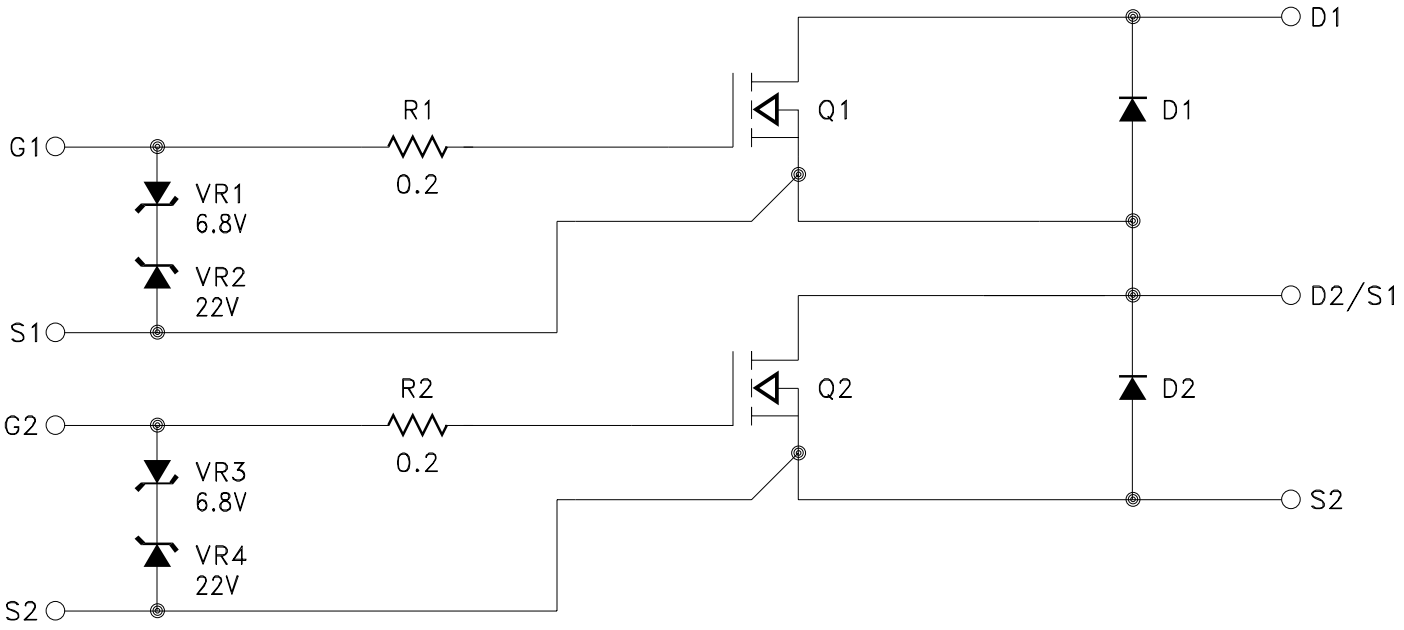
- Half Bridge Configuration
- Silicon Carbide Mosfet Provides Ultra Fast Switching
- Silicon Carbide Diode Provides Near Zero Recovery
- 1200V Rated Voltage
- 100A Continuous Output Current
- Internal Zener Clamps on Gates
- Proprietary Encapsulation Provides Near Hermetic Performance
- MIL-PRF-38534 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)



DESCRIPTION:

The MSK 4804 is one of a family of plastic encapsulated modules (PEM) developed specifically for use in military, aerospace 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 MSK 4804 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_{DS}	Collector to Emitter Voltage 1200V	T_{ST}	Storage Temperature Range . . . -55°C to +125°C
V_{GS}	Gate to Emitter Voltage . . . . . .+25/-10V	T_J	Junction Temperature . . . . . .175°C
I_{OUT}	Current (Continuous) 100A	T_C	Case Operating Temperature Range
I_{OUTP}	Current Pulsed (1mS) 200A		MSK 4804H/E . . . . . -55°C to +125°C
V_{CASE}	Case Isolation Voltage . . . . . .2500 V		MSK 4804 . . . . . -40°C to +85°C

ELECTRICAL SPECIFICATIONS

Parameter ⑥	Test Conditions	Group A Subgroup	MSK 4804 H/E Min.	MSK 4804 H/E Typ.	MSK 4804 H/E Max.	MSK 4804 Min.	MSK 4804 Typ.	MSK 4804 Max.	Units
Drain-Source Voltage	I_D = 100A, V_{GS} = 20V	1	-	2.4	TBD	-	2.4	TBD	V
		2	-	-	TBD	-	-	TBD	V
		3	-	-	TBD	-	-	TBD	V
Drain-Source Leakage Current	V_{DS} = 1000V, V_{GS} = 0V	1	-	-	1	-	-	1.2	mA
		2	-	-	5	-	-	-	mA
Gate Threshold Voltage	I_D = 1mA, V_{DS} = V_{GS}	1	1.0	1.6	3.5	0.8	1.6	3.5	V
		2	1.0	-	3.5	-	-	-	V
		3	1.0	-	3.5	-	-	-	V
Diode Forward Voltage	I_D = 100A	1	-	2.1	2.6	-	2.1	2.8	V
		2	-	-	TBD	-	-	-	V
		3	-	-	TBD	-	-	-	V
Total Gate Charge ①	V = 600V, I_D = 100A	4	-	400	TBD	-	400	TBD	nC
E(on) ①	V = 600V, I_D = 100A, RG = 5Ω, V_{GS} = -5/+20V	4	-	150	TBD	-	150	TBD	uJ
	V = 600V, I_D = 50A, RG = 5Ω, V_{GS} = -5/+20V	4	-	TBD	-	-	TBD	-	uJ
	V = 600V, I_D = 100A, RG = 5Ω, V_{GS} = -5/+20V	5	-	TBD	-	-	-	-	uJ
	V = 600V, I_D = 50A, RG = 5Ω, V_{GS} = -5/+20V	5	-	TBD	-	-	-	-	uJ
E(off) ①	V = 600V, I_D = 100A, RG = 5Ω, V_{GS} = -5/+20V	4	-	120	TBD	-	120	TBD	uJ
	V = 600V, I_D = 50A, RG = 5Ω, V_{GS} = -5/+20V	4	-	TBD	-	-	TBD	-	uJ
	V = 600V, I_D = 100A, RG = 5Ω, V_{GS} = -5/+20V	5	-	TBD	-	-	-	-	uJ
	V = 600V, I_D = 50A, RG = 5Ω, V_{GS} = -5/+20V	5	-	TBD	-	-	-	-	uJ
Diode Reverse Recovery Time ①	I_S = 100, di/dt = TBDA/uS	4	-	TBD	-	-	TBD	-	nS
	I_S = 50, di/dt = TBDA/uS	4	-	TBD	-	-	TBD	-	nS
	I_S = 100, di/dt = TBDA/uS	5	-	TBD	-	-	-	-	nS
	I_S = 50, di/dt = TBDA/uS	5	-	TBD	-	-	-	-	nS
Diode Reverse Energy ①	I_S = 100, di/dt = TBDA/uS	4	-	TBD	TBD	-	TBD	TBD	uJ
	I_S = 50, di/dt = TBDA/uS	4	-	TBD	-	-	TBD	-	uJ
	I_S = 100, di/dt = TBDA/uS	5	-	TBD	-	-	-	-	uJ
	I_S = 50, di/dt = TBDA/uS	5	-	TBD	-	-	-	-	uJ
Thermal Resistance ①	IGBT @ T_J = 125°C	-	-	0.160	0.190	-	0.160	0.190	°C/W
	DIODE @ T_J = 125°C	-	-	0.350	0.370	-	0.350	0.370	°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 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_{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 MSK 4804, V_{DS} = TBD 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 MSK 4804 typical switching losses at V_{DS} = 600V and I_{DS} = 100A are about TBDuJ, 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 4804, 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 0.190°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 150°C equals TBD°C maximum case temperature for this example.

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

Turn-on switching loss + Turn-off switching loss = Total switching losses = TBD + TBD = TBDuJ

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

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

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

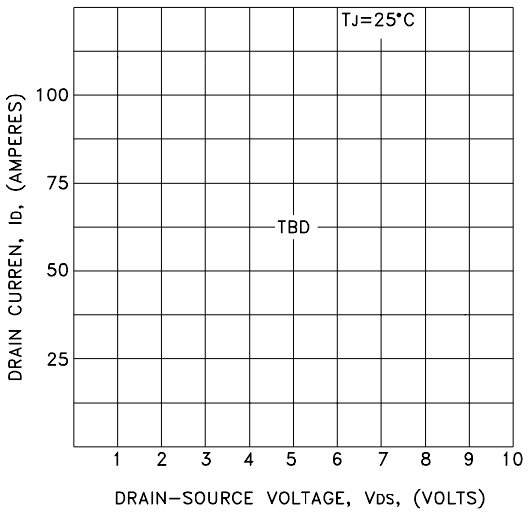
TBD watts x 0.190°C/W = TBD°C temperature rise above case

Maximum junction temperature - junction temperature rise = maximum baseplate temperature

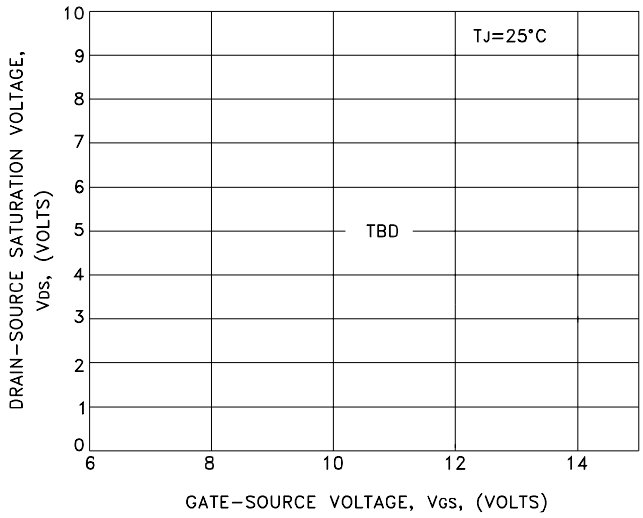
150°C - TBD°C = TBD°C

TYPICAL PERFORMANCE CURVES

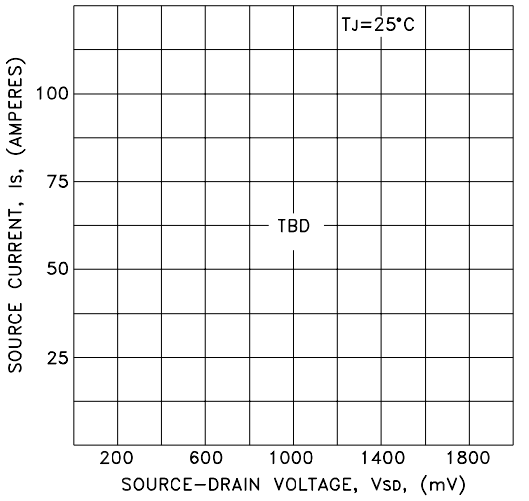
TYPICAL OUTPUT CHARACTERISTICS



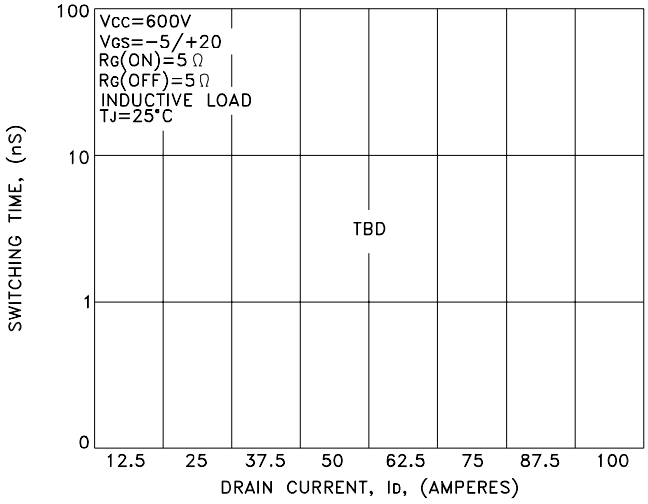
DRAIN–SOURCE VOLTAGE CHARACTERISTICS



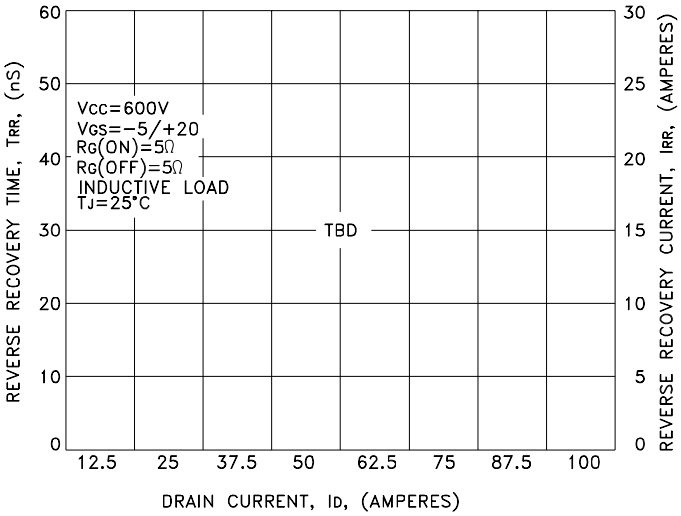
FREE–WHEEL DIODE FORWARD CHARACTERISTICS



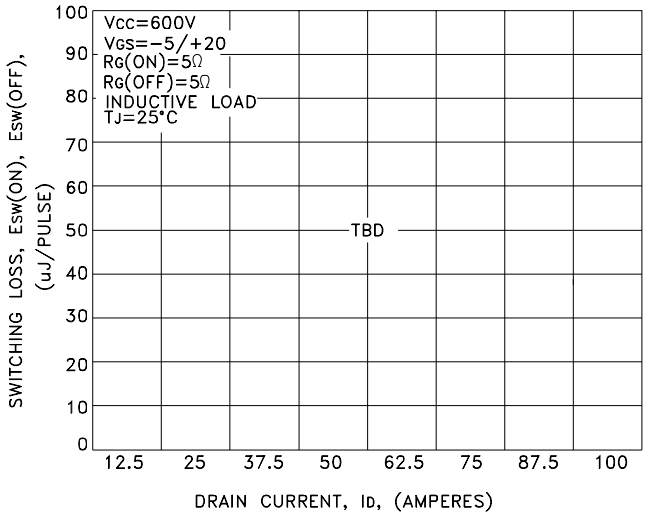
SWITCHING CHARACTERISTICS



REVERSE RECOVERY CHARACTERISTICS



SWITCHING LOSS vs. DRAIN CURRENT

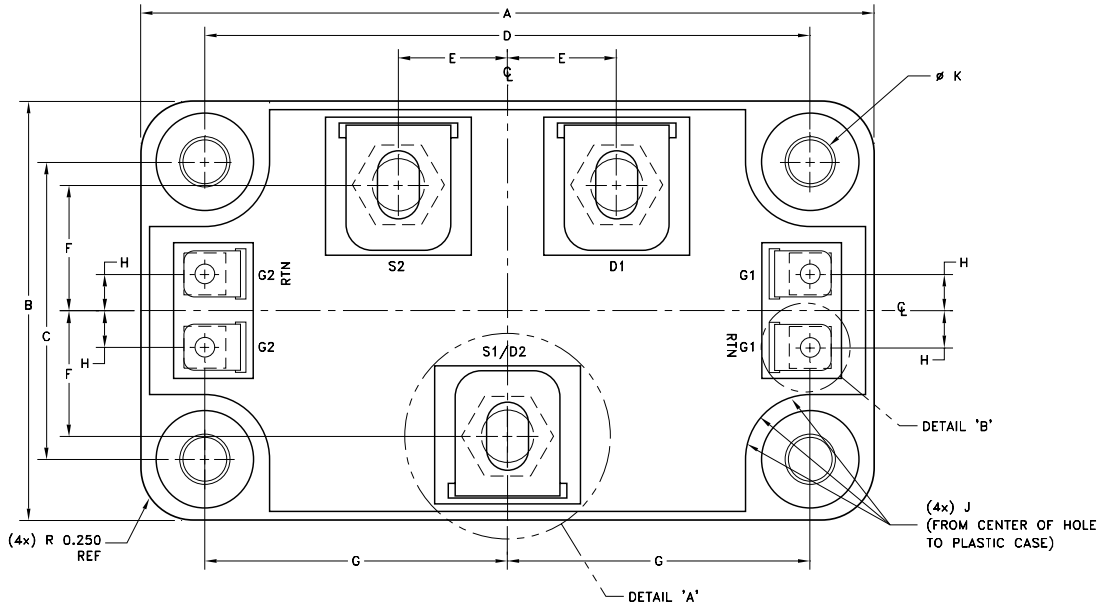


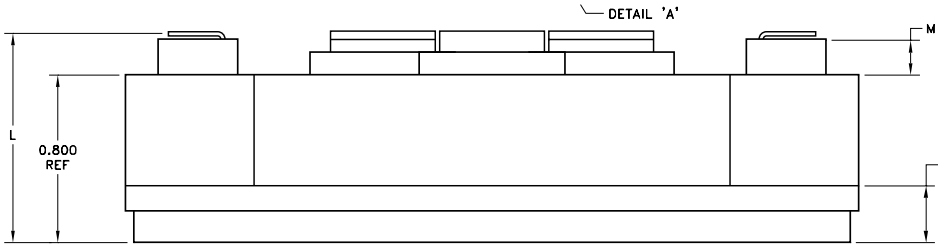
SCREENING CHART

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

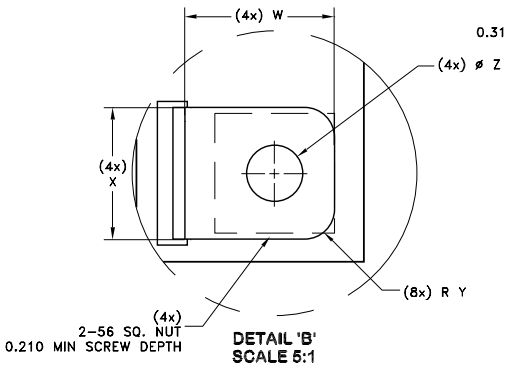
NOTE: ADDITIONAL SCREENING IS AVAILABLE SUCH AS XRAY, CSAM, MECHANICAL SHOCK, ETC. CONTACT FACTORY FOR QUAL STATUS.

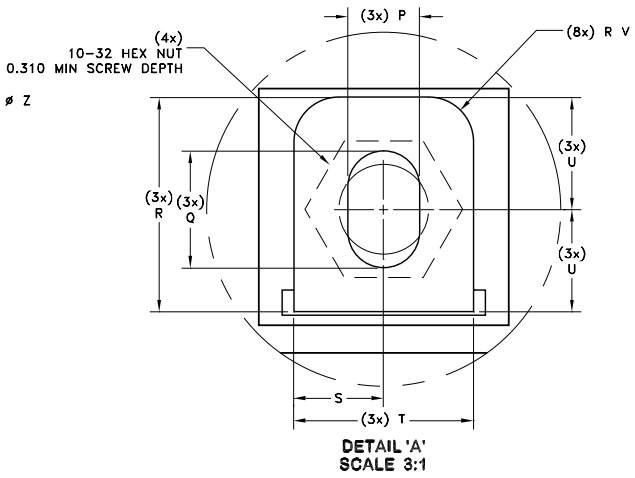
MECHANICAL SPECIFICATIONS





REF	MIN	MAX
A	3.470	3.510
B	1.970	2.010
C	1.410	1.430
D	2.880	2.900
E	0.496	0.546
F	0.575	0.625
G	1.420	1.470
H	0.150	0.200
J	0.240	———
K	0.208	0.225
L	0.985	1.015
M	0.090	———
N	0.255	0.285
P	0.195	0.230
Q	0.310	0.340
R	0.500	0.700
S	0.200	0.300
T	0.500	0.550
U	———	0.400
V	0.100	———
W	———	0.250
X	———	0.220
Y	0.050	———
Z	0.090	0.110
Aa	0.000	0.007





WEIGHT = 200 GRAMS MAX.

ORDERING INFORMATION

MSK4804 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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