DUAL RAD TOLERANT +/- VOLTAGE REGULATOR

5901RH SERIES

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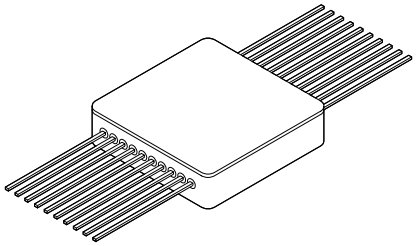
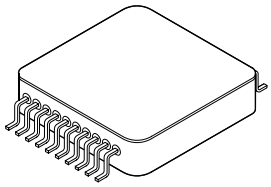
FEATURES:

- 25KRAD(SI) Total Dose Performance
- Internal Thermal Overload Protection
- Output Current to 1.5 Amps
- Output Voltage Internally Trimmed to ±1% Accuracy
- Available to DSCC SMD #TBD
- Lead Form Options: Straight and Gull Wing
- Alternate Voltage Combinations Available

MIL-PRF-38534 CERTIFIED



MSK590XRH

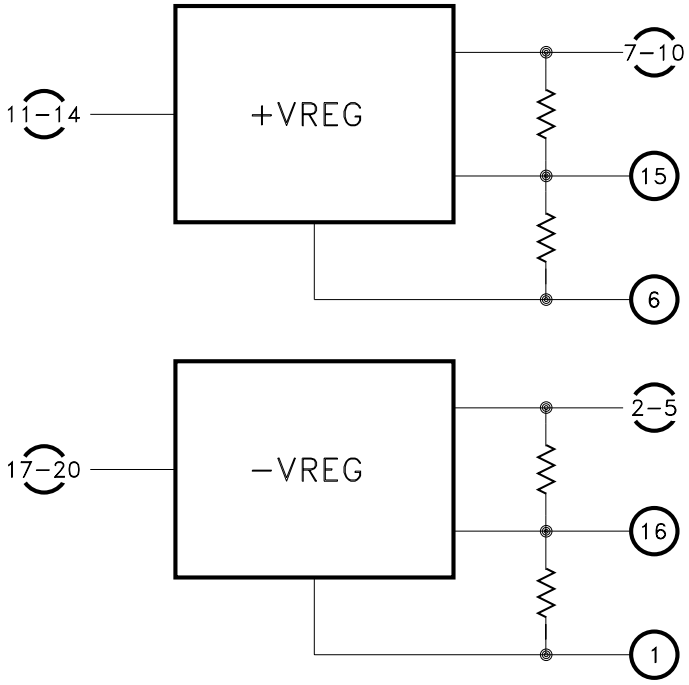


MSK590XRHG

DESCRIPTION:

The MSK 5901RH series are dual Radiation Tolerant +/- voltage regulators offering low dropout and output accuracy to ±1% maximum. Excellent line and load regulation characteristics ensure highly accurate performance. In radiation environments, a total dose rating of 25KRAD(SI) provides highly reliable performance. The MSK 5901RH series regulators are equipped with internal thermal overload protection. The devices are packaged in a space efficient 20 pin flatpack with two lead form options, straight and gull wing.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Switching Power Supply Post Regulators
- Constant Voltage/Current Regulators
- High Efficiency Linear Regulators

PIN-OUT INFORMATION

1	-VRTN	20	-VIN
2	-VOUT	19	-VIN
3	-VOUT	18	-VIN
4	-VOUT	17	-VIN
5	-VOUT	16	-Ccomp
6	+VRTN	15	+Ccomp
7	+VOUT	14	+VIN
8	+VOUT	13	+VIN
9	+VOUT	12	+VIN
10	+VOUT	11	+VIN

ABSOLUTE MAXIMUM RATINGS ⑧

$+V_{IN}$	+Input Voltage (V_{IN}-V_{OUT}) . . . . . +40VDC	T_{ST}	Storage Temperature Range . . . . -65°C to +150°C
$-V_{IN}$	-Input Voltage (V_{IN}-V_{OUT}) . . . . . -40VDC	T_{LD}	Lead Temperature Range . . . . . 300°C (10 Seconds)
P_D	Power Dissipation . . . . . Internally Limited	T_C	Case Operating Temperature
$+I_{OUT}$	+Output Current 1.5A		MSK 5901RH-5909RH . . . . . -40°C to +85°C
$-I_{OUT}$	-Output Current 1.5A		MSK 5901RH-5909RH(K/H/E) . . -55°C to +125°C
T_J	Junction Temperature . . . . . +150°C		

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ⑦	Group A Subgroup ④	MSK 590XRH K/H/E ③ Min.	Typ.	Max.	MSK 590XRH ② Min.	Typ.	Max.	Units
POSITIVE OUTPUT REGULATORS:									
Output Voltage Tolerance	I_{OUT}=10mA; V_{IN}=V_{OUT}+3V	1	-	±0.2	±1.0	-	±0.2	±1.5	%
		2,3	-	±0.8	±3.0	-	-	-	%
Dropout Voltage	I_{OUT}=0.5A; ΔV_{OUT}=1%	1	-	1.6	3.0	-	1.6	3.5	V
		2,3	-	1.9	3.0	-	-	-	V
Load Regulation	10mA≤I_{OUT}≤0.5A	1	-	±0.2	±2.0	-	±0.2	±2.5	%
	V_{IN}=V_{OUT}+3V	2,3	-	±0.4	±2.5	-	-	-	%
Line Regulation	I_{OUT}=10mA	1	-	±0.6	±1.5	-	±0.6	±2.0	%
	V_{OUT}+3V≤V_{IN}≤35V	2,3	-	±1.0	±2.5	-	-	-	%
Thermal Resistance ①	JUNCTION TO CASE @ 125°C	-	-	9.5	10.5	-	9.5	11.0	°C/W
NEGATIVE OUTPUT REGULATORS:									
Output Voltage Tolerance	I_{OUT}=10mA; V_{IN}=V_{OUT} -3V	1	-	±0.2	±1.0	-	±0.2	±1.5	%
		2,3	-	±0.8	±3.0	-	-	-	%
Dropout Voltage	I_{OUT}=0.5A; ΔV_{OUT}=1%	1	-	1.9	3.0	-	1.9	3.0	V
		2,3	-	1.5	3.0	-	-	-	V
Load Regulation	10mA≤I_{OUT}≤0.5A	1	-	±0.2	±2.0	-	±0.2	±2.5	%
	V_{IN}=V_{OUT} -3V	2,3	-	±0.4	±2.5	-	-	-	%
Line Regulation	I_{OUT}=10mA	1	-	±0.1	±1.5	-	±0.1	±2.0	%
	-30V≤V_{IN}≤V_{OUT}-3V	2,3	-	±0.2	±2.5	-	-	-	%
Thermal Resistance ①	JUNCTION TO CASE @ 125°C	-	-	11.5	12.5	-	11.5	13.0	°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 shall be 100% tested to subgroups 1,2 and 3.
④ Subgroup 1 T_A=T_C=+25°C
Subgroup 2 T_A=T_C=+125°C
Subgroup 3 T_A=T_C=-55°C
⑤ Please consult the factory if alternate output voltages are required.
⑥ For positive regulator, output decoupled to ground using 1μF minimum tantalum capacitor unless otherwise specified. For negative regulator, output decoupled to ground using 1μF minimum tantanlum capacitor.
⑦ For complete radiation test data, consult "MSK 5901RH Total Dose Test Report".
⑧ Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle.

PART NUMBER ⑤	OUTPUT VOLTAGES	
	POSITIVE	NEGATIVE
MSK5901	5.0	5.0
MSK5902	5.0	5.2
MSK5903	12.0	5.0
MSK5904	12.0	12.0
MSK5905	15.0	15.0
MSK5906	15.0	5.0
MSK5907	5.0	12.0
MSK5908	5.0	15.0
MSK5909	10.0	10.0

APPLICATION NOTES

CAPACITOR SELECTION

POSITIVE REGULATOR

INPUT CAPACITOR:

An input bypass capacitor is recommenced when using the MSK 5901 series regulators. This is especially true if the regulator is located farther than 6 inches from the power supply filter capacitors. For most applications a 1μF solid tantalum capacitor will be suitable.

OUTPUT CAPACITOR:

A minimum of a 1μF solid tantalum capacitor should also be used at the output to insure stability. Any increase of this output capacitor larger than 10μF will only improve output impedance.

+CCOMP CAPACITOR:

For improved ripple rejection, +Ccomp can be bypassed to ground with a 10μF tantalum capacitor. This bypass capacitor will provide 80dB ripple rejection. Increased capacitance above 10μF does not improve the ripple rejection at frequencies above 120Hz. If the Ccomp bypass capacitor is used, it may be necessary to add a protection diode to protect the regulator from capacitor discharge damage. See Typical Applications Circuit for clarification. If the bypass capacitor is not used, it should be left open since it is internally connected to the regulator.

NEGATIVE REGULATOR

INPUT CAPACITOR:

Once again, if the regulator will be farther than 6 inches from power supply filter capacitors, then an input capacitor will be required on the negative regulator. It is recommended that a 1μF solid tantalum capacitor be used.

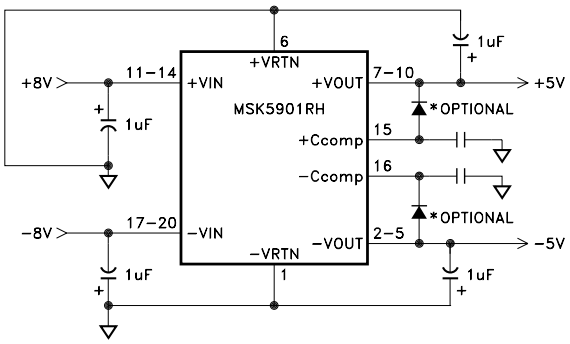
OUTPUT CAPACITOR:

A minimum of a 1μF solid tantalum capacitor should also be used at the output to insure stability. Any increase of this output capacitor larger than 10μF will only improve output impedance.

-CCOMP CAPACITOR:

For improved ripple rejection, -Ccomp can be bypassed to ground with a 10μF tantalum capacitor. This bypass capacitor will provide 80dB ripple rejection. Increased capacitance above 10μF does not improve the ripple rejection at frequencies above 120Hz. If the Ccomp bypass capacitor is used, it may be necessary to add a protection diode to protect the regulator from capacitor discharge damage. See Typical Applications Circuit for clarification. If the bypass capacitor is not used, it should be left open since it is internally connected to the regulator.

TYPICAL APPLICATION CIRCUIT



LOAD REGULATION

It is important to keep the output connection between the regulator and the load as short as possible since this directly affects the load regulation. For example, if 20 gauge wire were used which has a resistance of about 0.008 ohms per foot, this would result in a drop of 8mV/ft at 1Amp of load current. It is also important to follow the capacitor selection guidelines to achieve best performance.

HEAT SINKING

To determine if a heat sink is required for your application and if so, what type, refer to the thermal model and governing equation below.

Governing Equation: $T_j = P_d \times (R_{\theta jc} + R_{\theta cs} + R_{\theta sa}) + T_a$

WHERE

T_j = Junction Temperature
P_d = Total Power Dissipation
$R_{\theta jc}$ = Junction to Case Thermal Resistance
$R_{\theta cs}$ = Case to Heat Sink Thermal Resistance
$R_{\theta sa}$ = Heat Sink to Ambient Thermal Resistance
T_c = Case Temperature
T_a = Ambient Temperature
T_s = Heat Sink Temperature

EXAMPLE:

This example demonstrates an analysis where the output currents are at 0.5 amp each and both inputs are 8V.

Conditions for MSK 5901RH:

+Vin = +8.0V; Iout = 0.5A Positive Regulator

1.) Assume 45° heat spreading model.
2.) Find positive regulator power dissipation:

P_d = (Vin - Vout)(Iout)
P_d = (+8V-5V)(0.5A)
P_d = 1.5W

3.) For conservative design, set T_j = +125°C Max.
4.) For this example, worst case T_a = +90°C.
5.) $R_{\theta jc}$ = 10.5°C/W from the Electrical Specification Table.
6.) $R_{\theta cs}$ = 0.15°C/W for most thermal greases.
7.) Rearrange governing equation to solve for $R_{\theta sa}$:

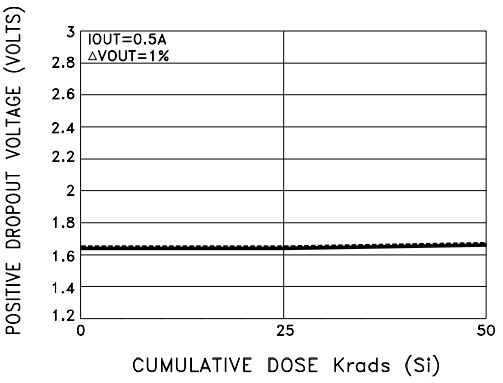
$R_{\theta sa}$ = ((Tj - Ta)/Pd) - ($R_{\theta jc}$) - ($R_{\theta cs}$)
= (125°C-90°C)/1.5W - 10.5°C/W - 0.15°C/W
= 12.7°C/W

The same exercise must be performed for the negative regulator.

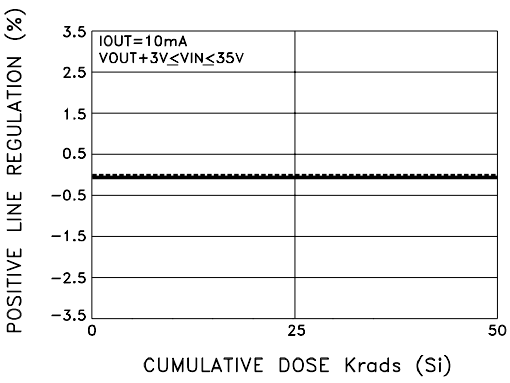
TYPICAL PERFORMANCE CURVES

POSITIVE

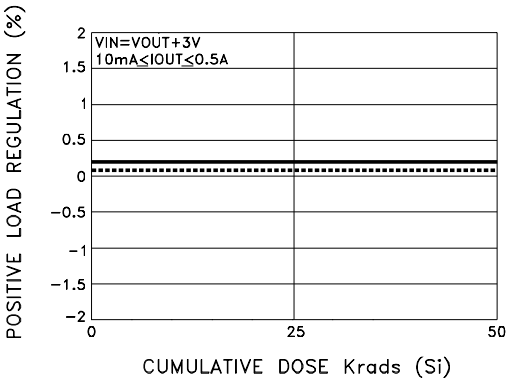
POSITIVE DROPOUT VOLTAGE



POSITIVE LINE REGULATION

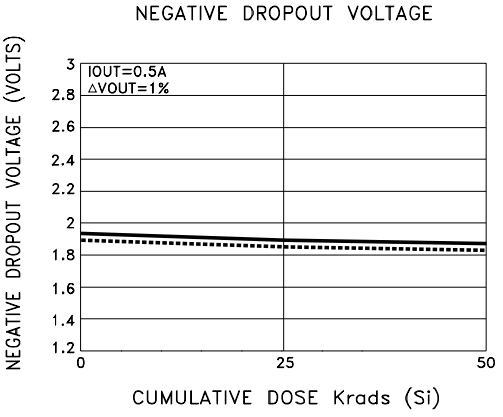


POSITIVE LOAD REGULATION

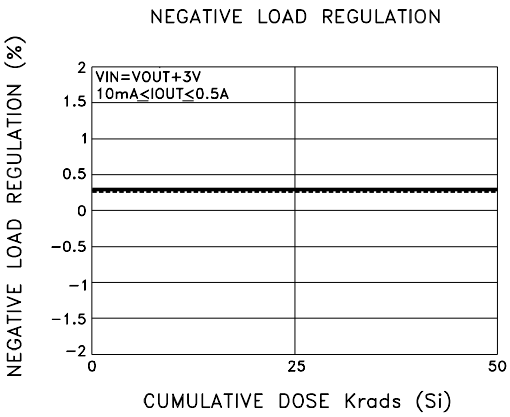


NEGATIVE

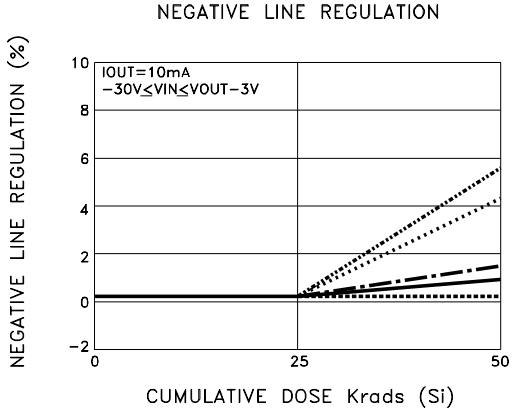
NEGATIVE DROPOUT VOLTAGE

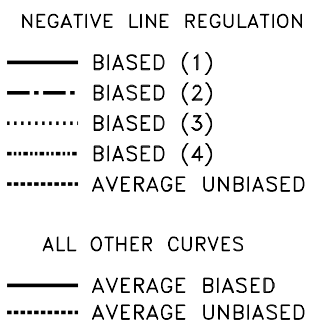


NEGATIVE LOAD REGULATION



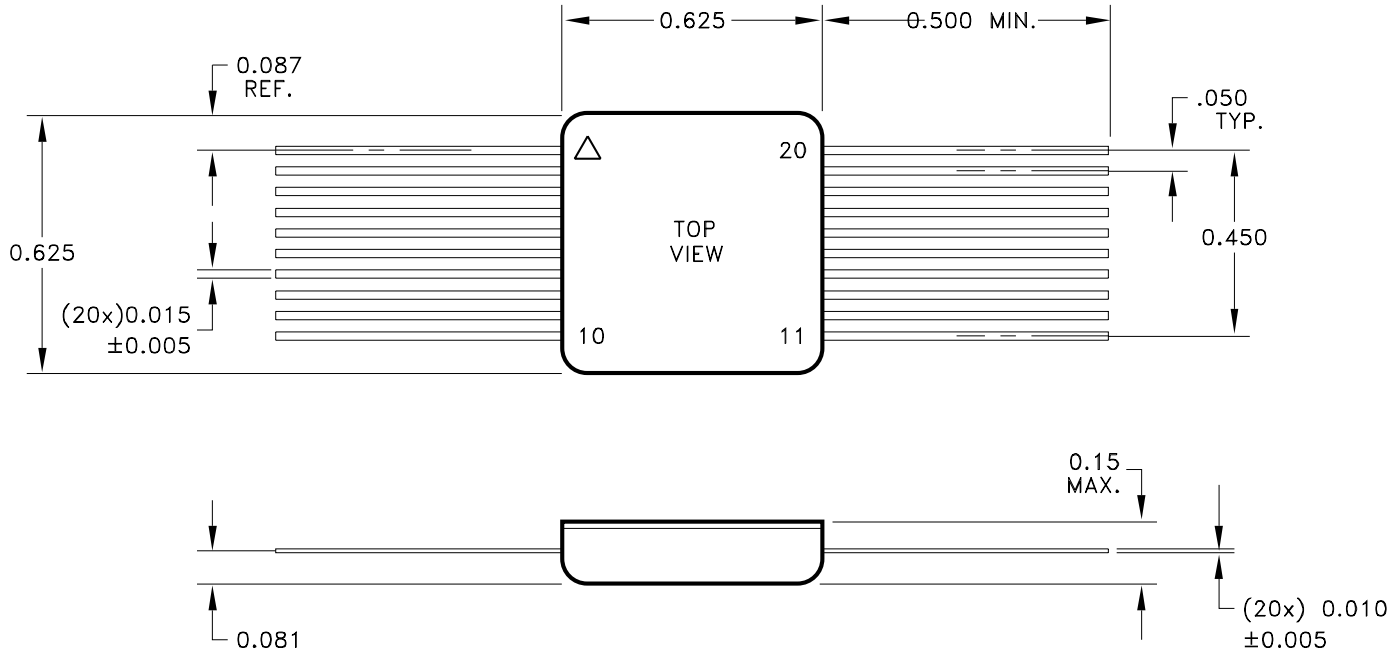
NEGATIVE LINE REGULATION





MECHANICAL SPECIFICATIONS

MSK590XRH



WEIGHT = 3.3 GRAMS TYPICAL

NOTE: ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED.
ESD Triangle indicates pin 1.

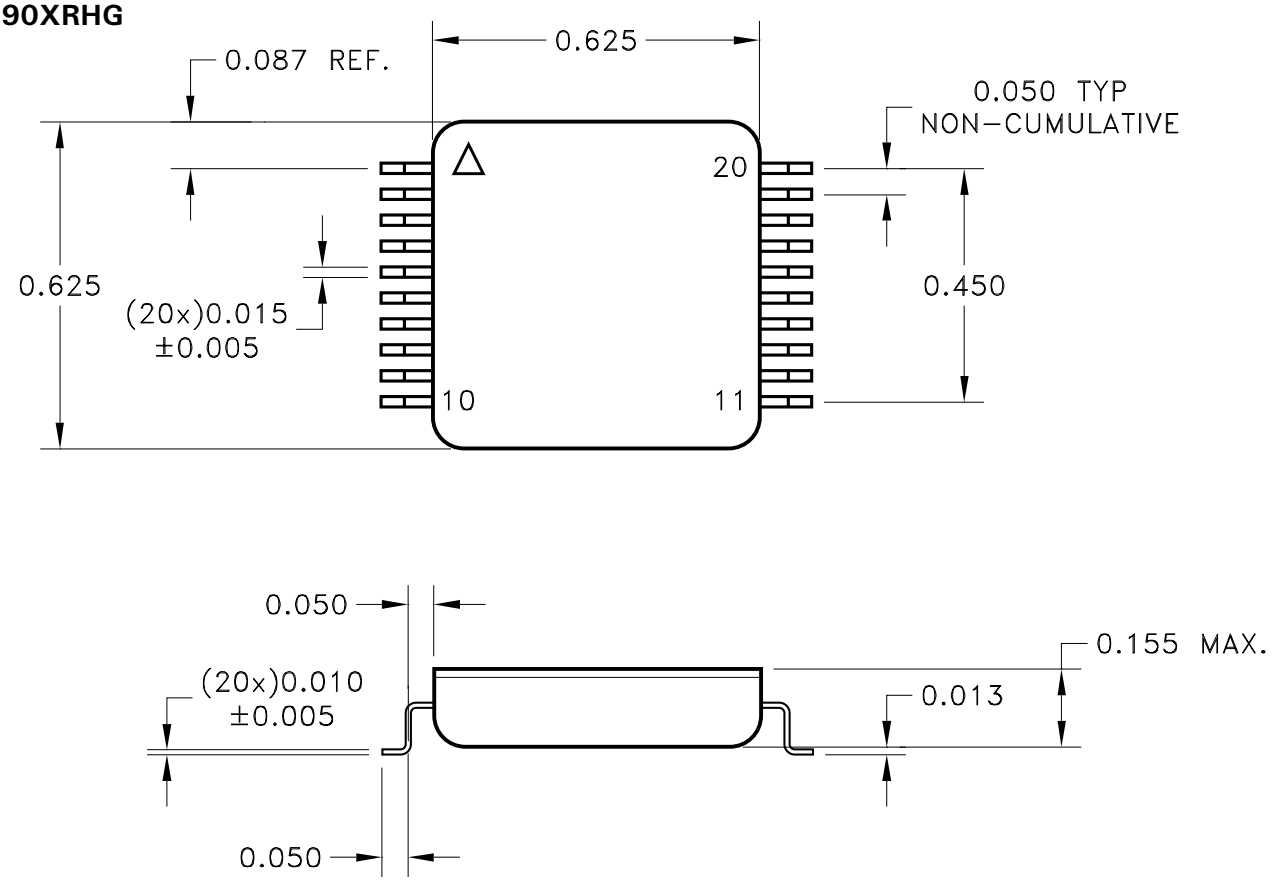
ORDERING INFORMATION

Part Number	Screening Level
MSK590XRH	Industrial
MSK590XHRH	MIL-PRF-38534 CLASS H
MSK590XKRH	MIL-PRF-38534 CLASS K
MSK590XERH	EXTENDED RELIABILITY
DSCC SMD TBD	TBD

X - Designates voltage selection (MSK 5901-5909)

MECHANICAL SPECIFICATIONS CONTINUED

MSK590XRHG



WEIGHT = 3.3 GRAMS TYPICAL

NOTE: ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED.
ESD Triangle indicates pin 1.

ORDERING INFORMATION

Part Number	Screening Level
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MSK590XHRHG	MIL-PRF-38534 CLASS H
MSK590XKRHG	MIL-PRF-38534 CLASS K
MSK590XERHG	EXTENDED RELIABILITY
DSCC SMD TBD	TBD

X - Designates voltage selection (MSK 5901-5909)

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