MIL-PRF-38534 CERTIFIED FACILITY

DUAL RAD HARD +/- VOLTAGE REGULATOR

5911RH SERIES

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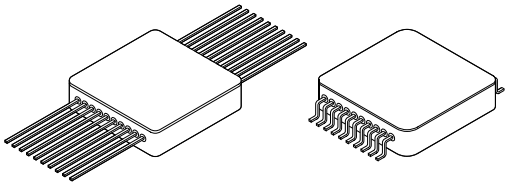
FEATURES:

- Manufactured using LINEAR TECHNOLOGY Space Qualified RH117 and RH137 Die
- Total Dose Hardened to 100K RAD(Si) (Method 1019.7 Condition A)
- Internal Thermal Overload Protection
- Output Current to 1.5 Amps
- Output Voltage Internally Trimmed to ±1% Accuracy
- Lead Form Options: Straight and Gull Wing
- Alternate Voltage Combinations Available
- Contact MSK for MIL-PRF-38534 Qualification Status

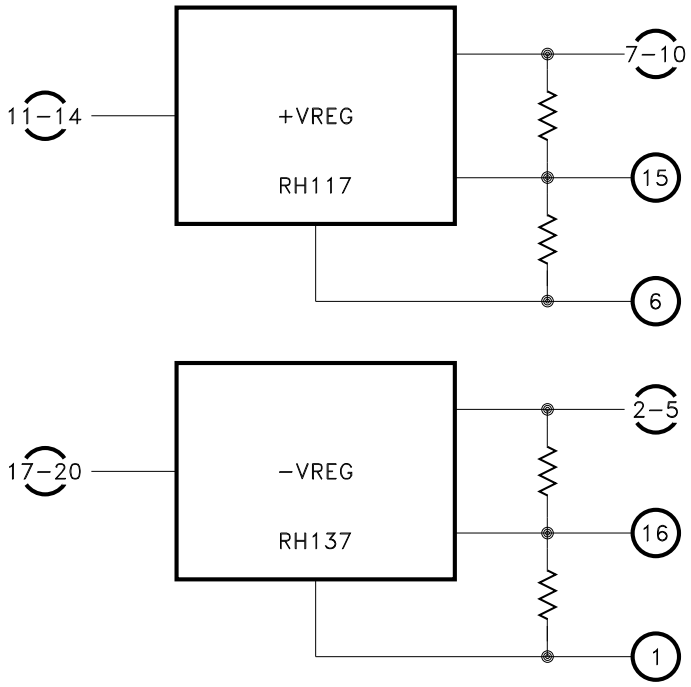


MSK591XRH **MSK591XRHG**

DESCRIPTION:

The MSK 5911RH series are dual Radiation Hardened +/- voltage regulators offering low dropout and output accuracy to ±1% maximum. Excellent line and load regulation characteristics ensure highly accurate performance. The MSK 5911RH 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 ⑦

$+V_{IN}$	+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}) . . . . . -30VDC	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 5911RH-5919RH . . . . . -40°C to +85°C
$-I_{OUT}$	-Output Current 1.5A		MSK 5911RH-5919RH(K/H). . . -55°C to +125°C
T_J	Junction Temperature . . . . . +150°C		

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ⑧	Group A Subgroup ④	MSK 591XRH K/H ③ Min.	Typ.	Max.	MSK 591XRH 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	-	-	-	%
	Post Irradiation	1	-	±0.8	±1.5	-	±0.8	±2.0	%
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	-	-	9.0	11.5	-	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	-	-	-	%
	Post Irradiation	1	-	±1.0	±2.0	-	±1.0	±2.5	%
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	-	-	10.5	14.2	-	TBD	TBD	°C/W

PART NUMBER ⑤	OUTPUT VOLTAGES	
	POSITIVE	NEGATIVE
MSK5911	5.0	5.0
MSK5912	5.0	5.2
MSK5913	12.0	5.0
MSK5914	12.0	12.0
MSK5915	15.0	15.0
MSK5916	15.0	5.0
MSK5917	5.0	12.0
MSK5918	5.0	15.0
MSK5919	10.0	10.0

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 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 Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle.
⑧ Pre and post irradiation limits at 25°C, up to 100Krad TID, are identical unless otherwise specified.

APPLICATION NOTES

CAPACITOR SELECTION

INPUT CAPACITOR:

Input bypass capacitors are recommenced when using the MSK 5911 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 for each input will be suitable.

OUTPUT CAPACITOR:

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

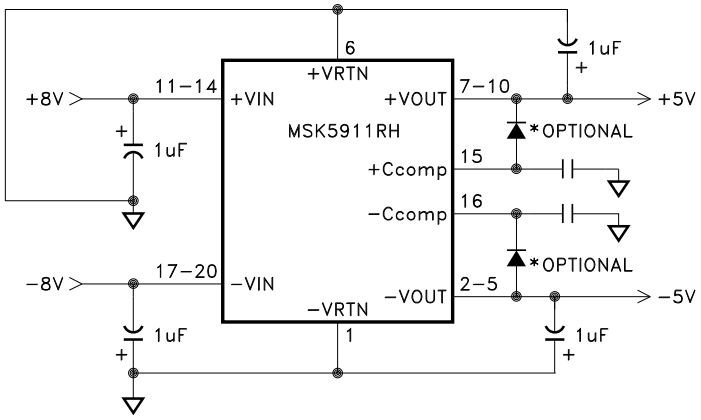
+CCOMP CAPACITOR; POSITIVE REGULATOR:

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.

-CCOMP CAPACITOR; NEGATIVE REGULATOR:

For improved ripple rejection, -Ccomp can be bypassed to ground with a 10μF tantalum capacitor. This bypass capacitor will provide 66dB 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 5911RH:

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

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

$P_d = (V_{in} - V_{out})(I_{out})$
$P_d = (+8V-5V)(0.5A)$
$P_d = 1.5W$

3.) For conservative design, set T_j = +125°C Max.
4.) For this example, worst case T_a = +90°C.
5.) $R_{\theta jc}$ = 11.5°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 - 11.5°C/W - 0.15°C/W
= 11.7°C/W

The same exercise must be performed for the negative regulator.

TOTAL DOSE RADIATION TEST PERFORMANCE

Radiation performance curves for TID testing have been generated for all radiation testing performed by MS Kennedy. These curves show performance trends throughout the TID test process and can be located in the MSK 5911RH radiation test report. The complete radiation test report is available in the RAD HARD PRODUCTS section on the MSK website.

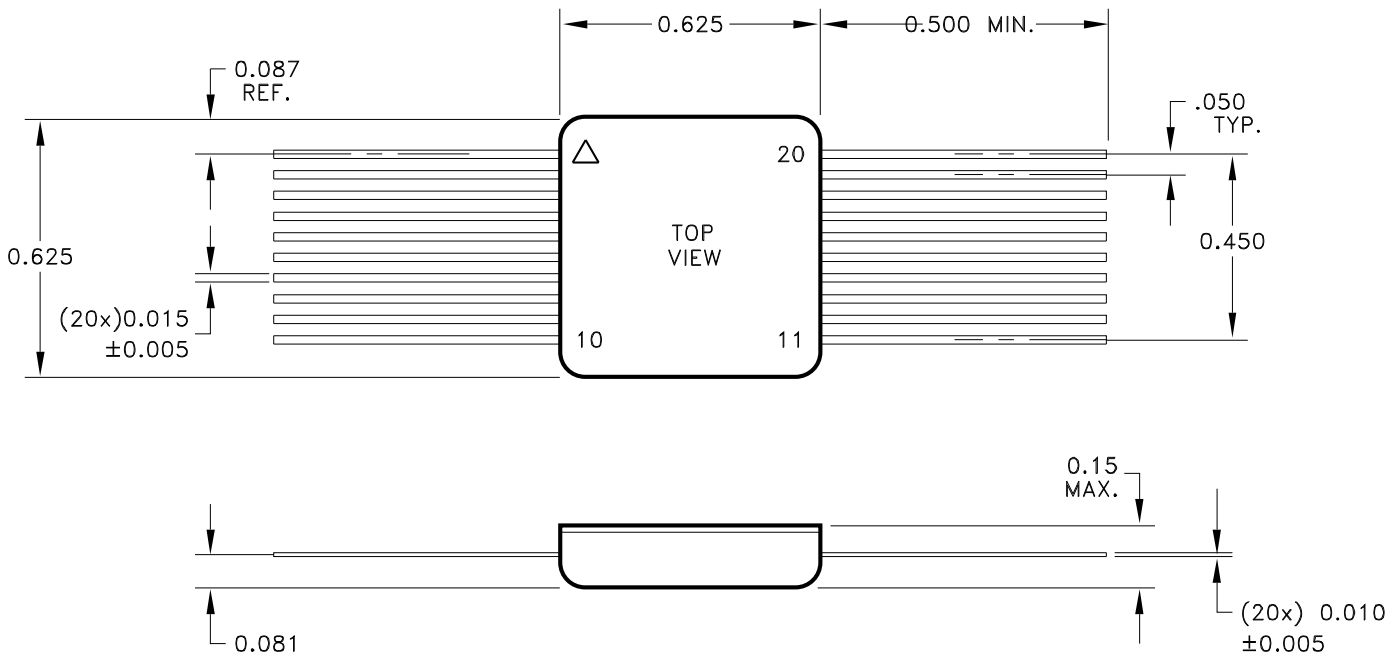
http://www.mskennedy.com/store.asp?pid=9951&catid=19680

ADDITIONAL APPLICATION INFORMATION

For additional applications information, please reference Linear Technology Corporation's® LT117, RH117, LT137 and RH137 data sheets.

MECHANICAL SPECIFICATIONS

MSK591XRH



Weight = 4.3 Grams Typical

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

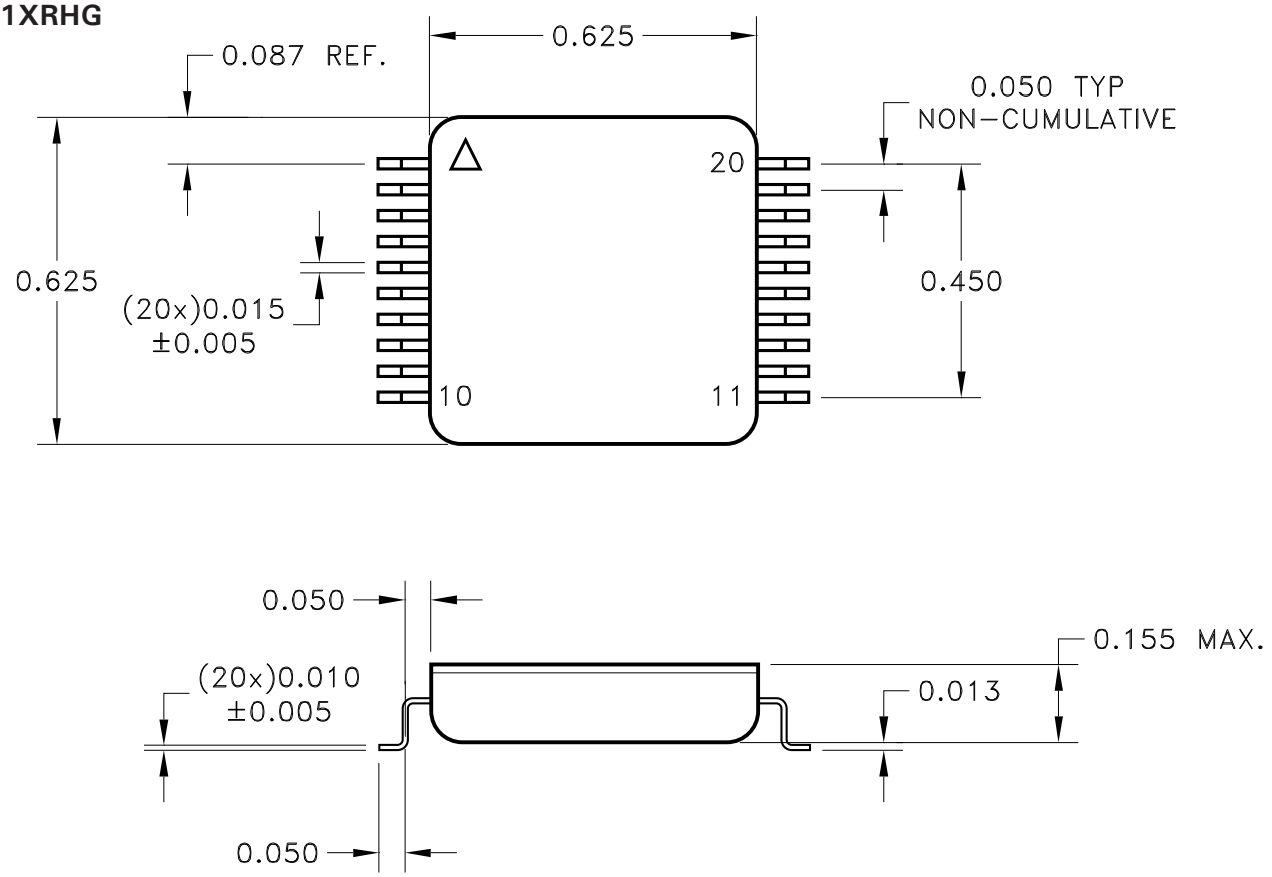
ORDERING INFORMATION

Part Number	Screening Level
MSK591XRH	Industrial
MSK591XHRH	MIL-PRF-38534 CLASS H
MSK591XKRH	MIL-PRF-38534 CLASS K

X - Designates voltage selection (MSK 5911-5919) See Page 2

MECHANICAL SPECIFICATIONS CONTINUED

MSK591XRHG



Weight = 4.2 Grams Typical

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

ORDERING INFORMATION

Part Number	Screening Level
MSK591XRHG	Industrial
MSK591XHRHG	MIL-PRF-38534 CLASS H
MSK591XKRHG	MIL-PRF-38534 CLASS K

X - Designates voltage selection (MSK 5911-5919) See Page 2

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