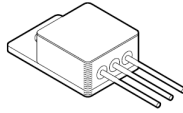


MSK5970RH Evaluation Board User's Guide – Preliminary

By Bob Abel & Paul Musil, MS Kennedy Corp.; Revised 12/19/2013

**Introduction**

The MSK 5970RH offers low dropout voltage while offering radiation tolerance for space applications. This, combined with the low θ_{J-C} , allows increased output current while providing exceptional device efficiency. Because of the increased efficiency, a small hermetic 3 pin package can be used providing maximum performance while occupying minimal board space. Output voltage is selected by the user through the use of 2 external resistors. Additionally, the regulator offers internal short circuit current and thermal limiting, which allows circuit protection and eliminates the need for external components and excessive derating. The MSK 5970RH is packaged in two space saving options; the 3 pin power surface mount ceramic SMD-1 or the TO-257 package with 3 lead form options: straight, up and down.

The evaluation board provides a platform from which to evaluate new designs with ample real estate to make changes and evaluate results. Evaluation early in the design phase reduces the likelihood of noise, instability, or other issues, becoming a problem at the application PCB level.

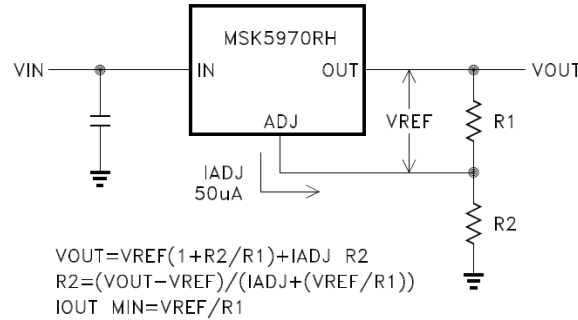
This application note is intended to be used in conjunction with the MSK5977RH data sheet and the LT3080 data sheet. Reference those documents for additional application information and specifications.

Setup

Use the standard turret terminals to connect to the power supply and test equipment. Connect the input power supply across the V_{IN} and GND1 terminals. Connect the output load between the V_{OUT} and GND2 terminals. Use separate or Kelvin connections to connect input and output monitoring equipment. When measuring output voltage with an oscilloscope probe, the wire from the probe to the ground clip will act as an antenna, picking up excessive noise. For improved results, the test hook should be removed from the tip of the probe. The tip should be touched against the output turret, with the bare ground shield pressed against the ground turret. This reduces the noise induced from external sources. See the Typical Performance Characteristics curves in the data sheet for expected dropout voltage.

Output Voltage Programming

The MSK 5970RH develops a 1.250 Volt reference between the output pin and the adjust pin. A resistor, R1, is placed between the output and adjust pins, causing current to flow through R1 and down through R2, setting the output voltage. R1 may be chosen to sink the minimum required load current of 10mA.



Efficiency

The efficiency of a typical linear regulator is approximated by V_{out}/V_{in} . The actual efficiency of an LDO regulator is slightly lower because of bias supplies and ground pin currents. Three terminal regulators are unique because the bias current flows to the output improving efficiency. The only ground current flows through R1 and R2. For most applications the $50\mu A$ adjust pin current can be ignored for calculating efficiency.

$$\text{Efficiency} = 100\% \times P_{OUT} / (P_{R1,R2} + P_{IN})$$

Given:

$$P_{OUT} = V_{OUT} \times I_{OUT}$$

$$P_{IN} = V_{IN} \times I_{IN}$$

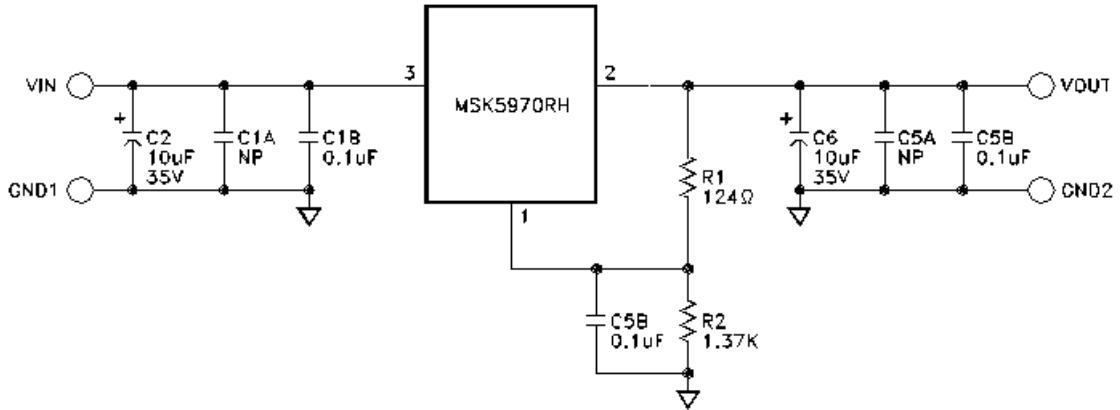
$$P_{R1,R2} \approx (V_{OUT})^2 / (R1 + R2)$$

(Reference the control pin current curves in the MSK5977RH data sheet for more detail)

Input/Output Capacitors

The MSK5970RH requires a minimum output capacitor of $10\mu F$ with an ESR of 0.5Ω or less. Tantalum or ceramic capacitors are recommended. A larger capacitance value will decrease the amplitude of transients, but will also decrease the bandwidth. The MSK evaluation board utilizes an AVX TAZ series $10\mu F$ tantalum output capacitor for increased gain and phase margin across a wide range of applications. The AVX TAZ series was chosen to provide a design starting point using high reliability MIL-PRF-55365/4 qualified capacitors. The input capacitor lowers the input bus impedance as seen by the regulator. The input capacitor requirements increase with increasing input bus impedance and decrease with decreasing impedance. Consideration must also be given to temperature characteristics of the capacitors used. A worst case circuit analysis is recommended for all applications to ensure end of life stability margins are sufficient.

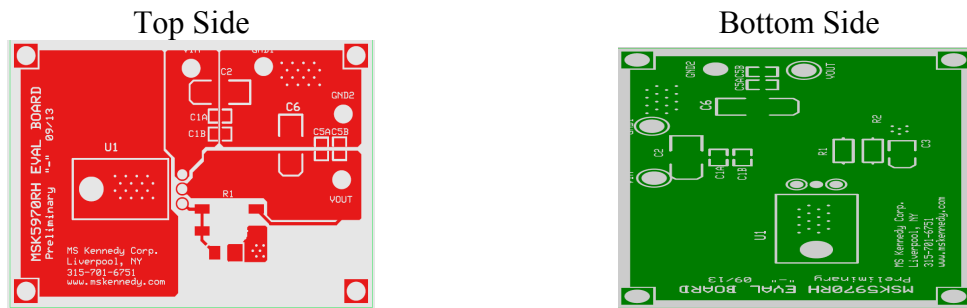
MSK5970RH Evaluation Board Schematic



NOTES:

1. "NP" - NOT POPULATED COMPONENTS ARE NOT POPULATED SPACES PROVIDED FOR EVALUATION OF DIFFERENT ELECTRICAL CONFIGURATIONS.
2. SEE BOM FOR SPECIFIC COMPONENT INFORMATION.

PCB Artwork



Bill of Materials

Ref Des	Description	Manufacturer	Part Number
U1	Linear Regulator	MS Kennedy Corp.	MSK5970RH
C1A	N/A		
C1B	8050 Ceramic cap 0.1uF	AVX	08051C104KAT
C2	10 uF 35V Low ESR Tant.	AVX	TAZH106K035L (CWR29FC106K)
C5A	N/A		
C5B	8050 Ceramic cap 0.1uF	AVX	08051C104KAT
C6	10 uF 35V Low ESR Tant.	AVX	TAZH106K035L (CWR29FC106K)
C9	8050 Ceramic cap 0.1uF	AVX	08051C104KAT
R2	Resistor 1.37K, 1/8W	AVX	08051C104KAT
R1	Resistor 124 Ohm, 1/8W		