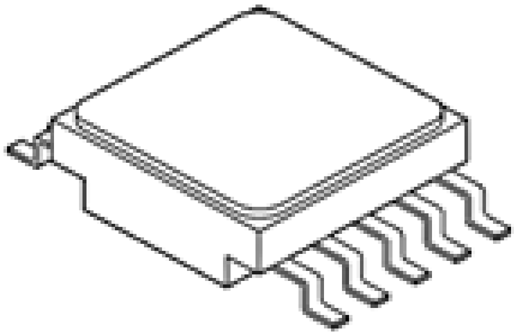
RAD HARD POSITIVE 0.7A, LDO, SINGLE RESISTOR, ADJ VOLTAGE REGULATOR

FEATURES

- Low Dropout to 250mV (VIN - VOUT, with Seperate CTL Supply)
- Output Adjustable to 1.1V
- Internal Short Circuit Current Limit
- Output Voltage is Adjustable with 1 External Resistor
- Output Current Capability up to 0.7A
- Internal Thermal Overload Protection
- Outputs may be Paralleled for Higher Current
- TID Hardened to 100 Krads
- Comparable to MSK5978RH



DESCRIPTION

The JTR5978 has a low dropout of 250mV and an output voltage range of zero volts, as well as radiation endurance for space applications. This, in conjunction with the low θJC, enables higher output current while maintaining outstanding device efficiency. The output voltage is set by the user using one external resistor. Furthermore, the regulator provides integrated short circuit current and thermal protection, ensuring circuit safety while eliminating the need for external components and unnecessary derating. Because of the enhanced efficiency, a compact hermetic 10 pin ceramic flatpack may be utilized to provide optimum performance while taking up the least amount of board area.

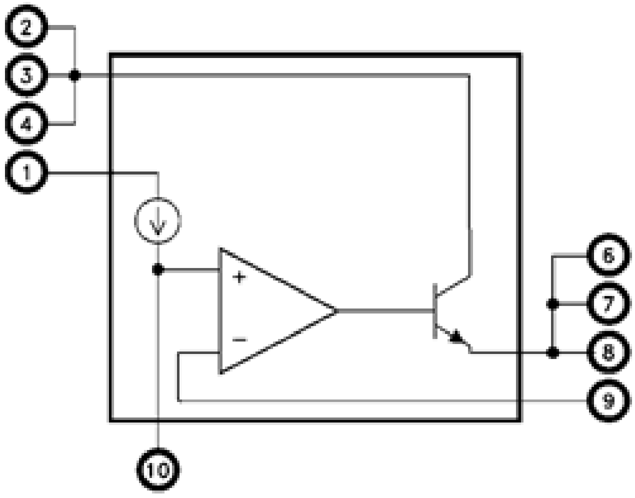
Table 1. Pin description.

PIN	NAME	PIN	NAME
1	CTL	6	VOUT
2	VIN	7	VOUT
3	VIN	8	VOUT
4	VIN	9	VOUT SENSE
5	NC	10	SET
CASE=ISOLATED			

TYPICAL APPLICATIONS

- High Efficiency Linear Regulators
- Constant Voltage/Current Regulators
- Space System Power Supplies
- Switching Power Supply Post Regulators
- Very low Voltage Power Supplies

EQUIVALENT SCHEMATIC



ELECTRICAL SPECIFICATIONS

Table 2. Electrical specifications

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
V_{IN}	V_{IN}		2.3	-	7.5	V
Output Voltage Tolerance	S_T	I_{OUT}=350mA; $V_{IN}=V_{OUT}+1V$	-	-	±2.5	%
Ripple Rejection	PSRR	F=120Hz, I. OUT=50mA	68	-	-	dB
On Resistance	$R_{DS(ON)}$	I_{OUT}=0.5A, V_{CTL}=3.0 V, V_{OUT}=3.3 V	-	450	920	mΩ
Dropout Voltage	V_{DROP}	I_{OUT} = 0.65A, V_{OUT}=1.2 V	-	0.25	0.6	V
Soft Start Time	T_{SS}		-	0.25	-	ms
CTL Pin Logic High Threshold Voltage	V_{CTLL}	Disable	V_{IN}-1	-	-	V
	V_{CTLH}	Enable	-	-	V_{IN}+1	
CTL Pin Pull-Up Current	I_{EN}	CTL=3V	-	-	9	mA
		CTL=GND	-	-	3	
Thermal Shutdown Threshold	T_{SD}		-	135	-	°C
Current Limit	I_{LIM}		0.7	0.85		mA
Quiescent Current	I_Q	No Load	-	6	8	mA
		Full Load	-	13	18	

APPLICATION NOTES

OUTPUT VOLTAGE

The internal Error Amplifier's reference voltage is created by connecting the SET pin to ground through a single resistor (RSET). The JTR5978 SET pin generates the reference voltage by supplying a steady current of 10uA. RSET x 10uA is the output voltage. Because the output is internally powered by a unity-gain amplifier, connecting a high quality reference source to the SET pin offers an alternative to utilizing RSET. The output voltage may be adjusted to near 0V with a minimum load requirement of 1mA on the output. To reduce the output voltage to 0V, connect the load to a slightly negative voltage source and sink the 1mA minimum load current from a power supply.

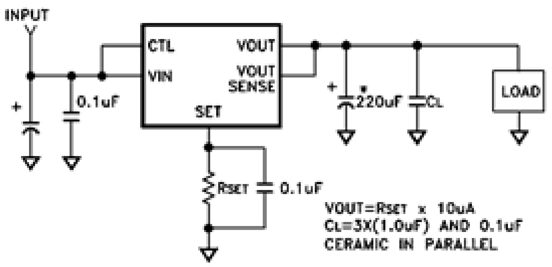


Figure 1

OUTPUT CAPACITANCE

The JTR5978 requires a minimum output capacitor of 10F with an ESR of 0.5Ω or less for stability. It is best to use tantalum or ceramic capacitors. A higher capacitance value improves transient responsiveness to variations in load current. Temperature properties of the capacitors utilized must also be considered.

LOW DROPOUT OPERATION

The use of separate VIN and CTL power supply reduces dropout and improves efficiency. The JTR5978 output transistor collector is linked to the VIN pin in Figure 2. The CTL input powers the regulator control circuitry. The saturation voltage of the output transistor, which is typically 250mV at 0.7A ILOAD, determines the regulator's dropout. The base drive current for the output transistor must be supplied by the CTL supply. The load receives the CTL current minus the 10A SET current. For anticipated VIN dropout voltage, CTL pin dropout voltage, and current needs under various circumstances, refer to the Typical Performance Characteristics charts. Power dissipation is minimized and efficiency increases with separate supply for VIN and CTL.

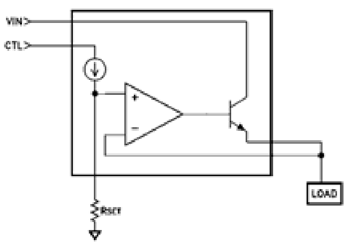


Figure 2

ADDITIONAL STABILITY

A capacitor connected in parallel with the SET pin resistor to ground will enhance the system's output transient responsiveness and filter noise. Typically, less than 100pF is all that is necessary to decrease output noise.

Capacitors up to 1F can be utilized, however the effect the time constant generated will have on starting time must be considered.

LOAD REGULATION

Because the JTR5978 stated load regulation is Kelvin Sensed, the parasitic resistance of the system must be taken into account while designing an appropriate load regulation. As illustrated in Figure 3, the overall load regulation consists of the prescribed JTR5978 load regulation plus the parasitic resistance multiplied by the load current. R_{SO} is the series resistance of all conductors between the JTR5978 output and the load. It will directly increase output load regulation error by a voltage drop of ΔI_O x R_{SO}. RSS is the resistance in series between the SET pin and the load. If the SET pin trace is linked as close to the load as feasible while maintaining the load return current on a separate trace, RSS will have no influence on load control. The series resistance of all wires between the load and the input power source return is denoted by RSR. If the SET pin is linked with a Kelvin Sense type connection, as illustrated in Figure 3, RSR has no influence on load regulation, but it does raise the effective dropout voltage by a factor of IO x RSR. Keeping RSO and RSR as low as feasible ensures that voltage dips and wasted power are kept to a minimum.

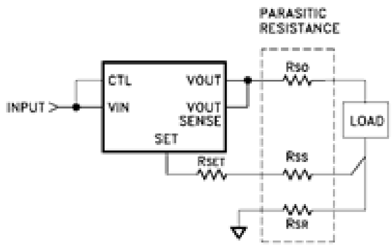


Figure 3

OUTPUT CURRENT/CURRENT LIMIT

The available output current and current limit figures have been calculated using the JTR5978 and a lead length of about 0.1 inch. Because of lead resistance, increasing the length of the lead reduces the current limit. This is especially essential when using the JTR5978, which allows for lead lengths of up to 0.1 inch. As a rough estimate, every 50mil increase in lead length reduces the current limit by 40mA.

ADDING SHUTDOWN

The JTR5978 may be simply turned off by lowering RSET to 0 or attaching a transistor from the SET pin to ground. A low current voltage source is all that is necessary to take the SET pin to ground as well as draw the output voltage to ground by connecting two transistors as illustrated in Figure 4. When there is no load, Q2 pulls the output voltage to ground and just needs to sink 10mA. To minimize overstress during shutdown transitions, use a low leakage switching diode between Vout and Set.

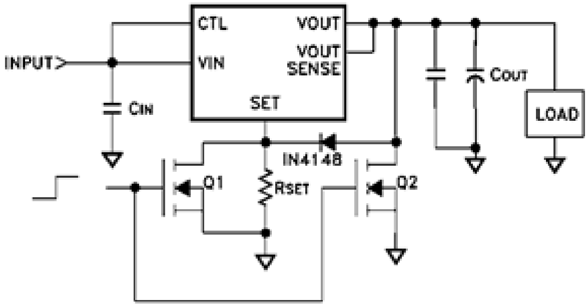


Figure 4

HEAT SINKING

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

Governing Equation: TJ = PD x (RθJC + RθCS + RθSA) + TA
WHERE
TJ = Junction Temperature
PD = Total Power Dissipation
RθJC = Junction to Case Thermal Resistance
RθCS = Case to Heat Sink Thermal Resistance
RθSA = Heat Sink to Ambient Thermal Resistance
TC = Case Temperature
TA = Ambient Temperature

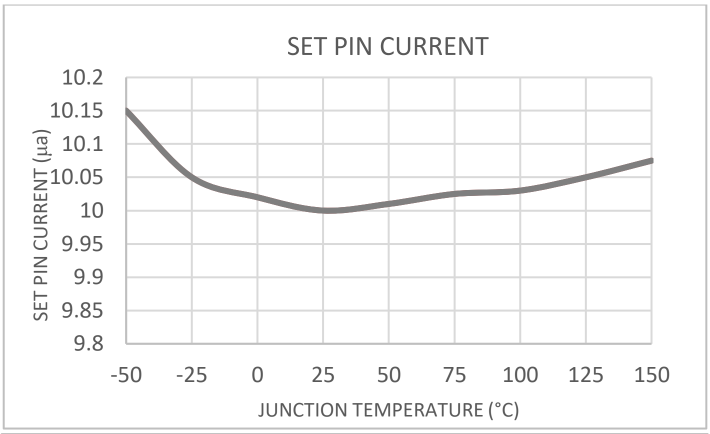
EXAMPLE:

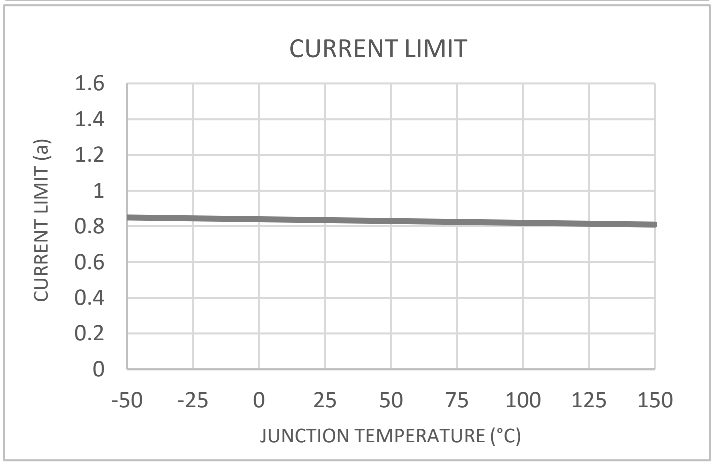
This example shows the thermal calculations for a regulator with a 0.5A output current.

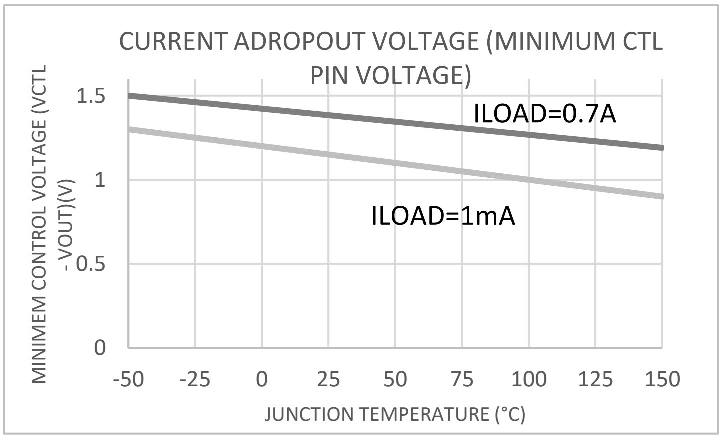
Conditions for JTR5978:
VCTL=VIN = +3.0V; IOUT = +0.50A VOUT=+1.0V
1.) Assume 45° heat spreading model.
2.) Find regulator power dissipation:
PD = (VIN - VOUT)(IOUT)
PD = (3-1)(0.50)
= 1.0W
3.) For conservative design, set TJ = +125°C Max.
4.) For this example, worst case TA = +90°C.
5.) RθJC = 17.0°C/W from the Electrical Specification Table.
6.) RθCS= 0.15°C/W for most thermal greases.
7.) Rearrange governing equation to solve for RθSA:
RθSA= ((TJ - TA/PD - (RθJC) - (RθCS)
=(125°C - 90°C)/1.0W - 17.0°C/W - 0.15°C/W
=17.9°C/W

In this case the result is 17.9°C/W. Therefore, a heat sink with a thermal resistance of no more than 17.9°C/W must be used in this application to maintain regulator circuit junction temperature under 125°C.

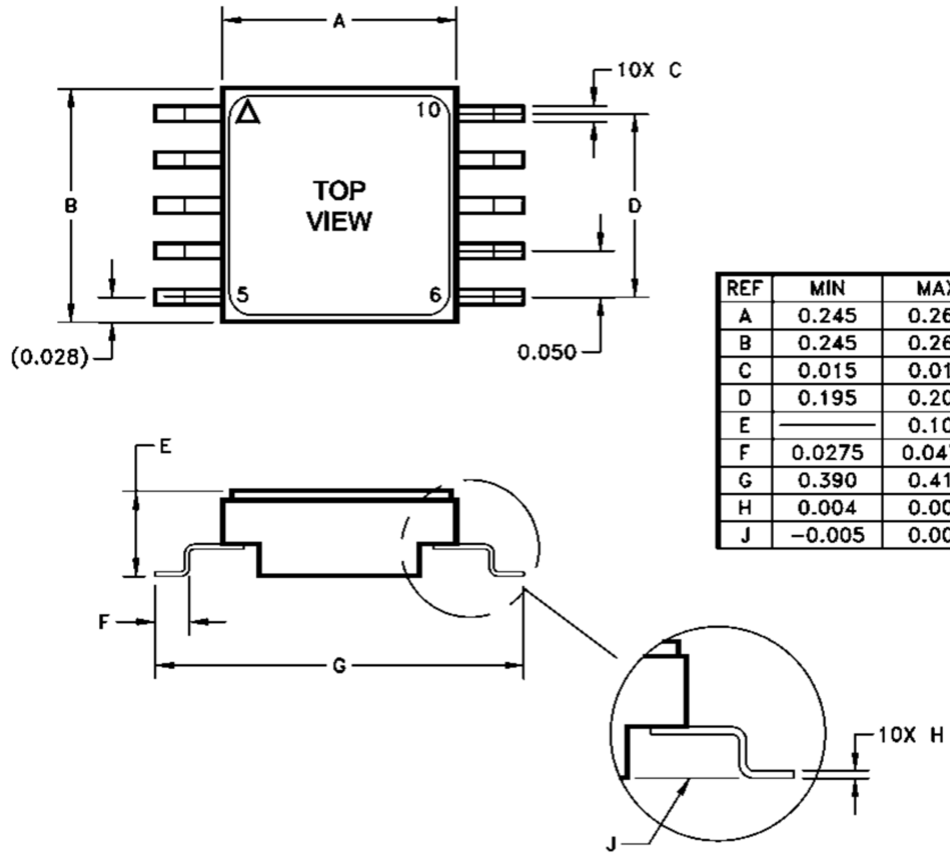
TYPICAL PERFORMANCE CURVES







MECHANICAL SPECIFICATION



REF	MIN	MAX
A	0.245	0.265
B	0.245	0.265
C	0.015	0.019
D	0.195	0.205
E	———	0.105
F	0.0275	0.0475
G	0.390	0.415
H	0.004	0.006
J	−0.005	0.005

ESD TRIANGLE INDICATES PIN 1
WEIGHT=0.35 GRAMS TYPICAL

ALL DIMENSIONS ARE SPECIFIED IN INCHES

