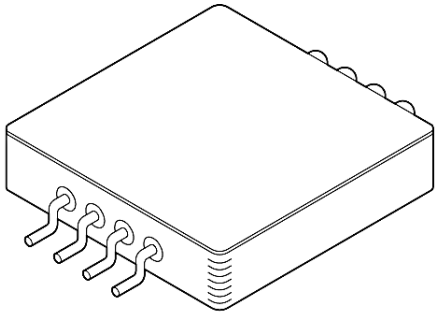
RAD HARD ULTRA LOW DROPOUT POSITIVE ADJUSTABLE LINEAR REGULATOR

FEATURES



- Ultra Low Dropout for Reduced Power Consumption
- External Shutdown Function
- Latching Overload Protection
- Optimized for 3.3V Input
- 1.265V to (VIN-0.4V) Output Voltage Range
- Output Current Limit
- Available in Gullwing Lead Form
- TID Hardened to 300 Krads
- Neutron Tested to $1.0x10^{12}$ n/cm²
- Comparable to MSK5824RH, OMR9604 and IRUH33PA13A

DESCRIPTION

The JTR5824 is a rad hard adjustable linear regulator with a 3.0 amp output current capability. With a 3 amp load, the typical dropout is only 0.30 volts. For power supply sequencing, an external shutdown function is ideal. Internal latching overload protection is also included in this device. The JTR5824 is developed for space/satellite applications and it is radiation resistant. The device is housed in a hermetically sealed, space-saving 8-pin flatpack that is electrically separated from the internal circuitry and allows for direct heat dissipation.

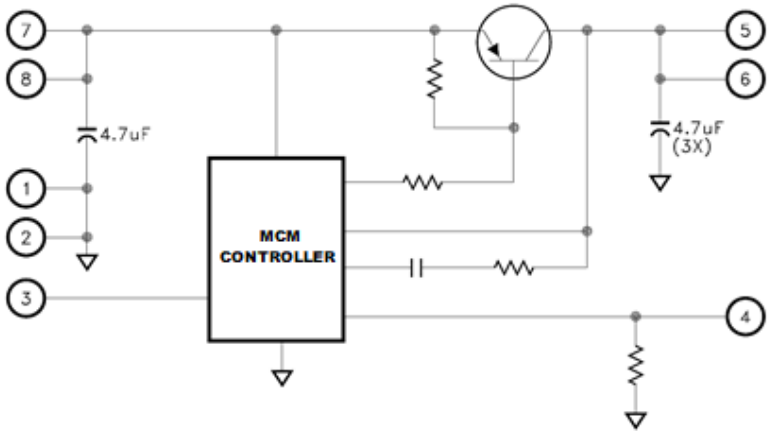
Table 1. Pin description.

Pin Number	Name	Function
1, 2	GND	GND
3	SHUTDOWN	SHUTDOWN
4	ADJUST	ADJUST
8,7	VIN	VIN
6,5	VOUT	VOUT
CASE	CASE	ISOLATED

TYPICAL APPLICATIONS

Satellite System Power Supplies, Switching Power Supply Post Regulators, Constant Voltage/Current Regulators, Microprocessor Power Supplies

EQUIVALENT SCHEMATIC



ELECTRICAL SPECIFICATIONS

Table 2. Electrical specifications

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
V_{IN}	V_{IN}		2.9	-	6.5	V
Output Voltage Tolerance	S_T	I_{OUT}=1A; $V_{IN}=V_{OUT}$+1V	-	-	±2.5	%
Ripple Rejection	PSRR	F=120Hz, I. OUT=50mA	65	-	-	dB
On Resistance	$R_{DS(ON)}$	I_{OUT}=2.5A, V_{EN}=5.0 V, V_{OUT}=3.3 V	-	-	200	mΩ
Dropout Voltage	V_{DROP}	I_{OUT} = 2.5A, V_{OUT}=3.3 V	-	-	0.5	V
Soft Start Time	T_{SS}		-	0.32	-	ms
SHDN Pin Logic High Threshold Voltage	V_{ENH}	Disable	1.0	-	-	V
	V_{ENL}	Enable	-	-	1.6	
SHDN Pin Pull-Up Current	I_{EN}	SHDN=5V	-	-	200	uA
		SHDN=GND	-	-	145	
Thermal Shutdown Threshold	T_{SD}		-	135	-	°C
Quiescent Current	I_Q	No Load	-	15	26	mA
		Full Load	-	21	59	

APPLICATION NOTES

PIN FUNCTIONS

VIN- All internal circuitry, including bias, start-up, temperature limit, and overcurrent latch, is powered by these pins. The JTR5824 has a 2.9V to 6.5V input voltage range, however it is optimized for 3.3V input. For a 5V input variant, see JTR5824.

GND - These pins, which are internally linked to ground, should be connected externally to the circuit ground by the user.

SHUTDOWN - The SHUTDOWN pin performs two tasks. It can be used to reset a present latch state or deactivate the output voltage. The user must supply a voltage greater than 1.6V to the SHUTDOWN pin to trigger the shutdown/reset functionality. The input voltage can be larger than the voltage supplied to the SHUTDOWN pin. When the SHUTDOWN pin is pushed below the threshold voltage, the output voltage will switch on. If the SHUTDOWN pin isn't being utilized, it should be grounded. It should be noted that a present latch situation can only be reset by cycling power off and on with the shutdown pin connected to ground. The output voltage ripple of the JTR5824 series voltage regulators can be reduced by connecting the output to ground with a filter capacitor. The best value for this capacitor varies depending on the application, however a minimum of 10F is advised for best results. Placing a capacitor directly across the load can help increase transient load responsiveness.

VOUT - These are the device's output pins.

ADJUST - The output voltage is set using this pin. To fix the output voltage at the appropriate value, connect a resistor between the adjust pin (4) and the output pins (5 and 6). Calculate the nominal value of the adjust resistor using the formulae below (RADJ).

$$VOUT = VREF \times (1 + RADJ/1K\Omega)$$

$$RADJ = (VOUT/VREF - 1) \times 1K\Omega$$

OVERCURRENT LATCH

Through the use of a timed latch off circuit, the JTR5824 series provides overcurrent protection. An overcurrent condition

triggers the internal latch timeout. At 25°C, the delay is roughly 22mS to allow for start-up surge currents. The regulator will latch off until the latch is reset if the overcurrent condition persists at the conclusion of the timeout cycle. Toggle the shutdown pin high and low to reset the latch, or cycle VIN off and back on. The device may simply restrict the output current without triggering the latch function at high temperatures or input voltages. With no timeout wait, a thermal limit situation will activate the latch.

INPUT POWER SUPPLY BYPASSING

An inbuilt 4.7F tantalum input capacitor, type CWR19HB475CBB, is included in the JTR5824. The capacitor is rated for a maximum applied voltage of 15 volts and has been surge tested in line with MIL-PRF-55365 condition B. According to their system requirements, the system designer must assure adequate de-rating. Two 47F tantalum capacitors should be connected between VIN and ground to optimize transient responsiveness and decrease power supply transients. For high frequency bypassing, a 0.1F ceramic capacitor should also be utilized. See an example of an application circuit.

OUTPUT CAPACITOR SELECTION

Three internal 4.7F tantalum output capacitors, type CWR19HB475KCBB, are found in the JTR5824. The capacitors are rated for a maximum applied voltage of 15 volts and have been surge tested in line with MIL-PRF-55365 condition B. According to their system requirements, the system designer must assure adequate de-rating. To ensure regulation and stability, low ESR output capacitors are necessary. For most applications, four CWR29FB227 tantalum capacitors (AVX PN TAZH227K010L) in parallel with ceramic decoupling capacitors (0.1F common) offer sufficient gain and phase margin. The CWR29FB227 capacitor has a maximum ESR of 180m at 100kHz, which is suitable for many applications. JTR discovered through complete WCCA that screening for a maximum ESR of 57m guarantees EOL stability standards are satisfied for many of the most demanding applications. The TAZH227K010L from AVX has a typical ESR of 49mΩ. It is suggested that the final design be subjected to analysis to ensure that the stability criteria are satisfied.

THERMAL LIMITING

The thermal shutdown temperature of the JTR5824 control circuitry is around 150°C. This thermal shutdown can be utilized as a safety feature, however the junction temperature of the pass transistor must be kept below 150°C for continuous operation. To keep these conditions, you'll need to choose the right heat sink. Exceeding the thermal limit activates the latch feature of the JTR5824. To reset the latch, toggle the shutdown pin high and low or cycle the power. For additional details, see the shutdown pin and overcurrent latch descriptions.

HEAT SINK SELECTION

The following formula for convective heat flow can be used to choose a heat sink for the JTR5824.

Governing Equation:

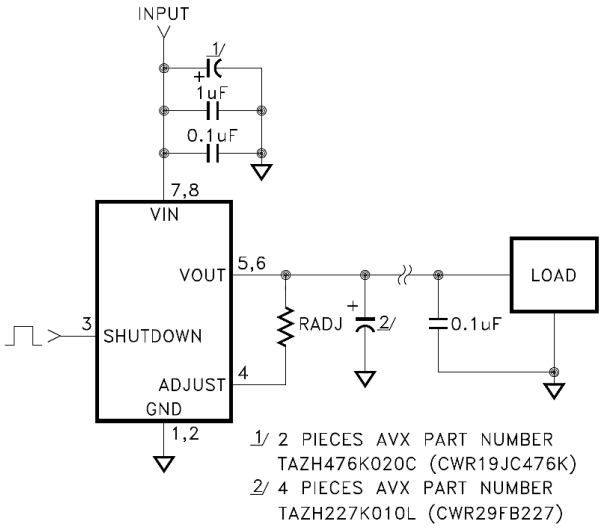
$$T_J = P_D X (R_{\theta JC} + R_{\theta CS} + R_{\theta SA}) + T_A$$

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_A = Ambient Temperature

$$\text{Power Dissipation}=(V_{IN}-V_{OU}T) \times I_{OUT}$$

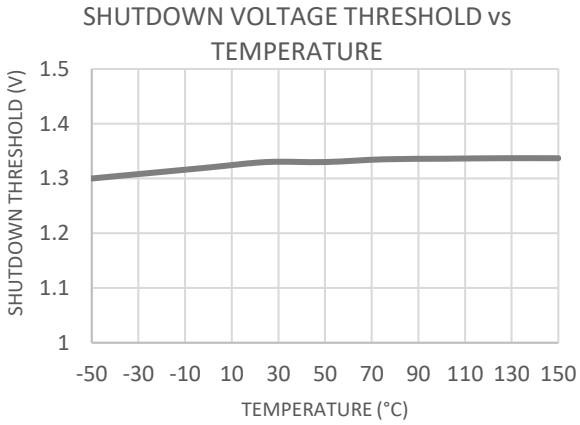
The next step is for the user to choose a maximum junction temperature. The absolute maximum temperature for a junction is 150°C. To solve for the necessary heat sink to ambient thermal resistance ($R_{\theta SA}$), rearrange the equation.

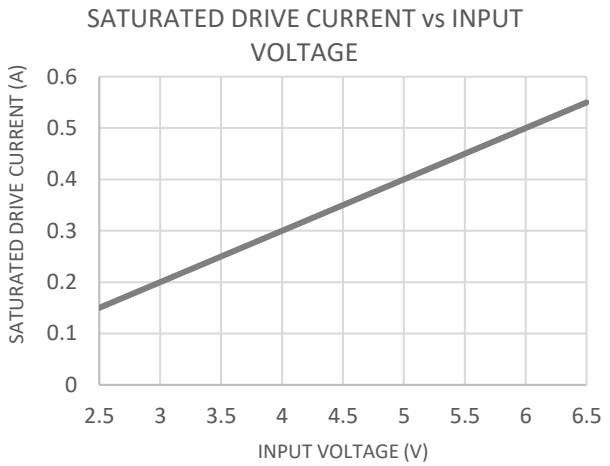


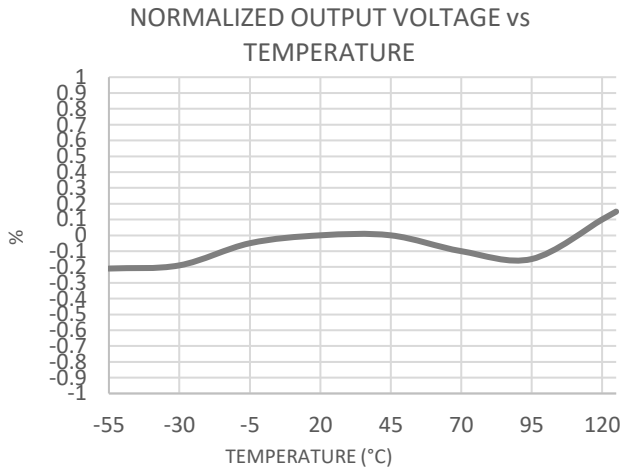
START UP CURRENT

During startup, the JTR5824 drains more current to raise the output voltage. For more information, see the "Saturated Drive Current vs. Input Voltage graph" in this data sheet's typical performance curves and the "Understanding Startup Surge Current With JT's MCM Based Rad Hard LDO Regulators" application note.

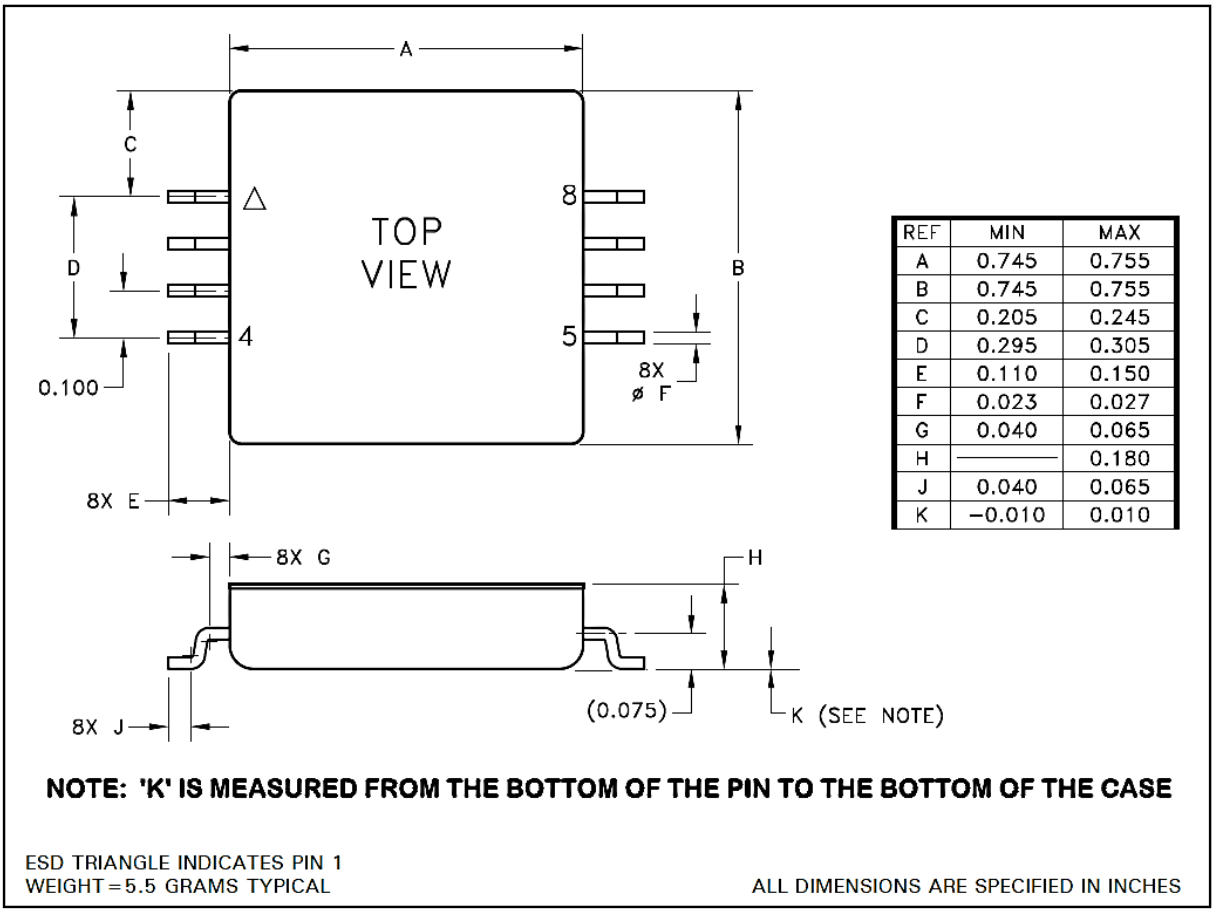
TYPICAL PERFORMANCE CURVES







MECHANICAL SPECIFI CATION



REF	MIN	MAX
A	0.745	0.755
B	0.745	0.755
C	0.205	0.245
D	0.295	0.305
E	0.110	0.150
F	0.023	0.027
G	0.040	0.065
H	———	0.180
J	0.040	0.065
K	−0.010	0.010

NOTE: 'K' IS MEASURED FROM THE BOTTOM OF THE PIN TO THE BOTTOM OF THE CASE

ESD TRIANGLE INDICATES PIN 1
WEIGHT = 5.5 GRAMS TYPICAL

ALL DIMENSIONS ARE SPECIFIED IN INCHES