



M. S. KENNEDY CORP.

HIGH CURRENT, LOW DROPOUT VOLTAGE REGULATOR

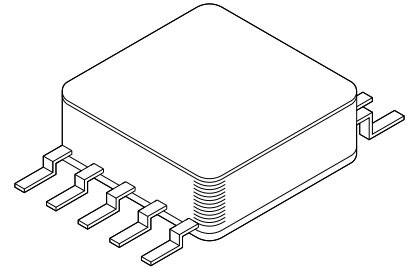
5101

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(315) 701-6751

FEATURES:

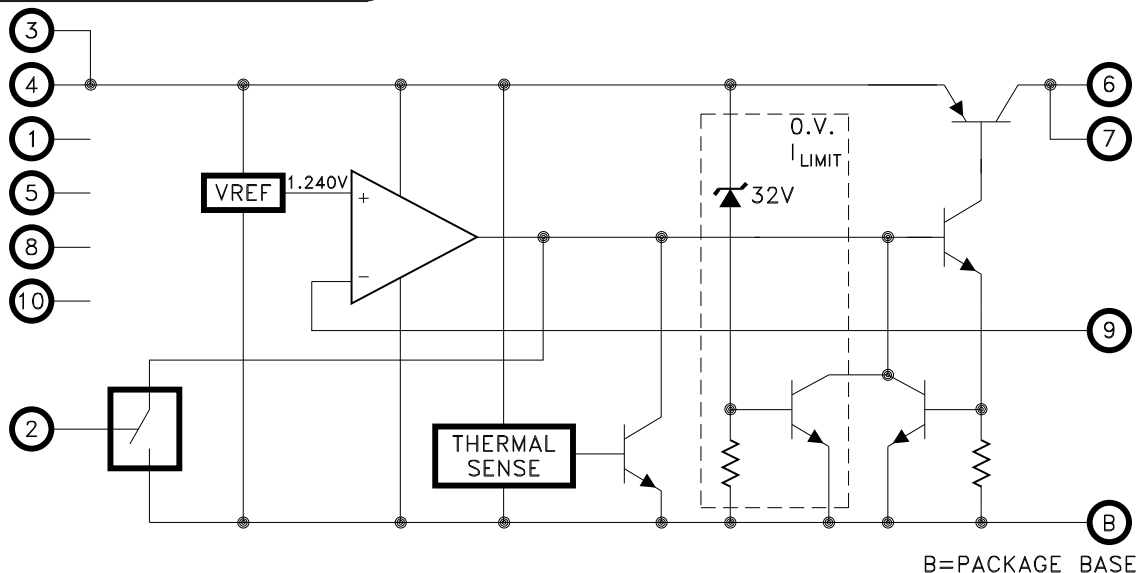
- Extremely Compact 10 Pin Flatpack With Metal Base
- Extremely Low Dropout Voltage: 350mV @ 1.5 Amps
- Available in Adjustable Version only
- TTL Level Enable Pin: Zero Current Shutdown Mode
- Reverse Battery and Load Dump Protection
- Low Ground Current: 22mA Typical at Full Load
- 1% Guaranteed Accuracy
- Output Current to 1.5 Amps



DESCRIPTION:

The MSK 5101 voltage regulator is available in the adjustable output configuration only. The ultra low dropout specification is due to the utilization of a super PNP output pass transistor with monolithic technology. Dropout voltages of 350mV at 1.5 amps are typical in this configuration, which drives efficiency up and power dissipation down. The device also offers a TTL/CMOS compatible on/off enable function. The MSK 5101 is packaged in a space efficient 10 pin ceramic flatpack with a built in metal base.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- High Efficiency, High Current Linear Regulators
- Constant Voltage/Current Regulators
- System Power Supplies
- Switching Power Supply Post Regulators
- Battery Powered Equipment

PIN-OUT INFORMATION

MSK5101-00

- 1 NC
- 2 Enable
- 3 Vin A
- 4 Vin B
- 5 NC
- 6 Vout A
- 7 Vout B
- 8 NC
- 9 Adj
- 10 NC

BASE

The base of the package is electrically connected to ground.

ABSOLUTE MAXIMUM RATINGS ^⑧

V_{INP} Input Voltage (100mS 1%D.C.) -20V to +60V
 V_{IN} Input Voltage 26V
 V_{EN} Enable Voltage -0.3V to 26V
 I_{OUT} Output Current 3.5A

T_{ST} Storage Temperature Range -65°C to +150°C
 T_{LD} Lead Temperature 300°C
 (10 Seconds Soldering)
 T_J Operating Temperature
 MSK5101. -40°C to +85°C
 MSK5101H. -55°C to +125°C

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ^① ^③	Group A Subgroup	MSK 5101H			MSK 5101			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Dropout Voltage ^②	$\Delta V_{OUT} = -1\%$; $I_{OUT} = 100mA$	1	-	80	200	-	80	225	mV
	$\Delta V_{OUT} = -1\%$; $I_{OUT} = 1.5A$	1	-	350	600	-	350	625	mV
Load Regulation ^⑨	$V_{IN} = V_{OUT} + 1V$ $10mA < I_{OUT} < 1.25A$	1	-	± 0.2	± 1.0	-	± 0.2	± 1.2	%
		2,3	-	± 0.3	± 2.0	-	± 0.3	-	%
Line Regulation	$(V_{OUT} + 1V) < V_{IN} < 26V$ $I_{OUT} = 10mA$	1	-	± 0.05	± 0.5	-	± 0.05	± 0.6	%
		2,3	-	± 0.5	± 1.0	-	± 0.5	-	%
Output Current Limit ^②	$V_{OUT} = 0V$; $V_{IN} = V_{OUT} + 1V$	-	-	2.1	3.5	-	2.1	3.5	A
Ground Current ^②	$V_{IN} = V_{OUT} + 1V$; $I_{OUT} = 0.75A$	-	-	8	20	-	8	20	mA
	$V_{IN} = V_{OUT} + 1V$; $I_{OUT} = 1.5A$	-	-	22	-	-	22	-	mA
Output Noise ^②	$C_L = 10\mu F$; $10Hz < f < 100KHz$	-	-	400	-	-	400	-	μV
Enable Input Voltage ^②	HIGH/ON	1	2.4	-	-	2.4	-	-	V
	LOW/OFF	1	-	-	0.8	-	-	0.8	V
Enable Input Current ^②	HIGH/ON	1	-	100	600	-	100	600	μA
	LOW/OFF	1	-	-	2	-	-	2	μA
Shutdown Output Current ^②	$V_{ENABLE} < 0.8V$	-	-	10	500	-	10	500	μA
Reference Voltage	Normal Operation	1	1.22	1.24	1.26	1.22	1.24	1.26	V
Reference Voltage Temp Drift ^②	Normal Operation	-	-	20	-	-	20	-	ppm/°C
Adjust Pin Bias Current ^②	Full Temp; $V_{IN} = V_{OUT} + 1V$	-	-	40	120	-	40	150	nA
Thermal Resistance ^②	Junction to Case @ 125°C	-	-	5.6	6.0	-	5.6	7	°C/W
Thermal Shutdown	T_J	-	-	135	-	-	135	-	°C

NOTES:

- ① Output decoupled to ground using 10 μF minimum capacitor unless otherwise specified.
- ② This parameter is guaranteed by design but need not be tested.
Typical parameters are representative of actual device performance but are for reference only.
- ③ All output parameters are tested using a low duty cycle pulse to maintain $T_J = T_c$.
- ④ Industrial grade shall be tested to subgroups 1 and 4 unless otherwise specified.
- ⑤ Military grade devices ('H' suffix) shall be 100% tested to subgroups 1,2,3 and 4.
- ⑥ Subgroup 1,4 $T_c = +25^\circ C$
Subgroup 2 $T_J = +125^\circ C$
Subgroup 3 $T_A = -55^\circ C$
- ⑦ Due to current limit, maximum output current may not be available at all values of V_{IN} - V_{OUT} and temperatures. See typical performance curves for clarification.
- ⑧ Continuous operation at or above absolute maximum ratings may adversely effect the device performance and/or life cycle.

APPLICATION NOTES

REGULATOR PROTECTION:

The MSK 5101 is fully protected against reversed input polarity, overcurrent faults, overtemperature conditions (Pd) and transient voltage spikes of up to 60V. If the regulator is used in dual supply systems where the load is returned to a negative supply, the output voltage must be diode clamped to ground.

OUTPUT CAPACITOR:

The output voltage ripple of the MSK 5101 voltage regulator can be minimized by placing a filter capacitor from the output to ground. The optimum value for this capacitor may vary from one application to the next, but a minimum of 10 μ F is recommended for optimum performance. Transient load response can also be improved by placing a capacitor directly across the load.

LOAD CONNECTIONS:

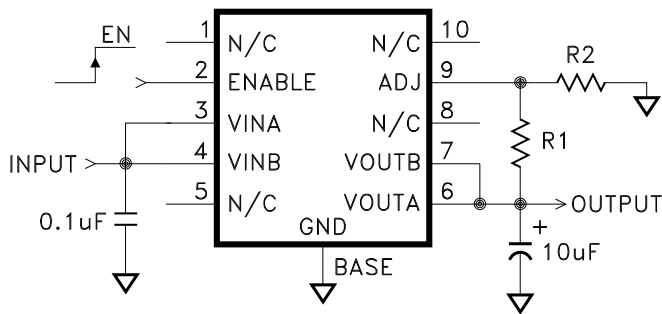
In voltage regulator applications where very large load currents are present, the load connection is very important. The path connecting the output of the regulator to the load must be extremely low impedance to avoid affecting the load regulation specifications. Any impedance in this path will form a voltage divider with the load. The MSK 5101 requires a minimum of 10mA of load current to stay in regulation.

ENABLE PIN:

The MSK 5101 voltage regulator is equipped with a TTL compatible ENABLE pin. A TTL high level on this pin activates the internal bias circuit and powers up the device. A TTL low level on this pin places the controller in shutdown mode and the device draws approximately 10 μ A of quiescent current. If the enable function is not used, simply connect the enable pin to the input.

MSK5101-00 OUTPUT ADJUSTMENT:

The diagram below illustrates proper adjustment technique for the output voltage. The series resistance of R1 + R2 should be selected to pass the minimum regulator output current requirement of 10mA.



$$V_{OUT} = 1.240V \times [1 + (R1/R2)]$$

HEAT SINK SELECTION:

To select a heat sink for the MSK 5101, the following formula for convective heat flow may be used.

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_a = Ambient Temperature

First, the power dissipation must be calculated as follows:

$$\text{Power Dissipation} = (V_{in} - V_{out}) \times I_{out}$$

Next, the user must select a maximum junction temperature. The maximum allowable junction temperature is 125 $^{\circ}$ C. The equation may now be rearranged to solve for the required heat sink to ambient thermal resistance ($R_{\theta sa}$).

EXAMPLE:

An MSK 5101 is configured for $V_{in} = +5V$ and $V_{out} = +3.3V$. I_{out} is a continuous 1A DC level. The ambient temperature is +25 $^{\circ}$ C. The maximum desired junction temperature is 125 $^{\circ}$ C.

$R_{\theta jc} = 6^{\circ}\text{C/W}$ and $R_{\theta cs} = 0.5^{\circ}\text{C/W}$ typically.

$$\begin{aligned} \text{Power Dissipation} &= (5V - 3.3V) \times (1A) \\ &= 1.7 \text{ Watts} \end{aligned}$$

Solve for $R_{\theta sa}$:

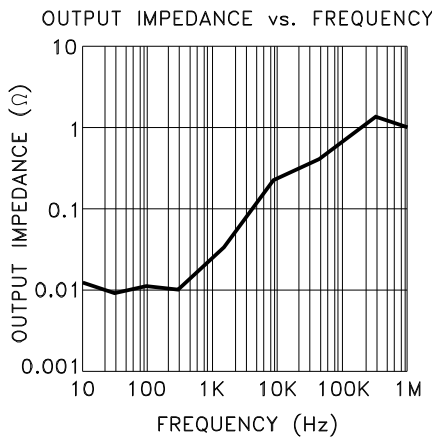
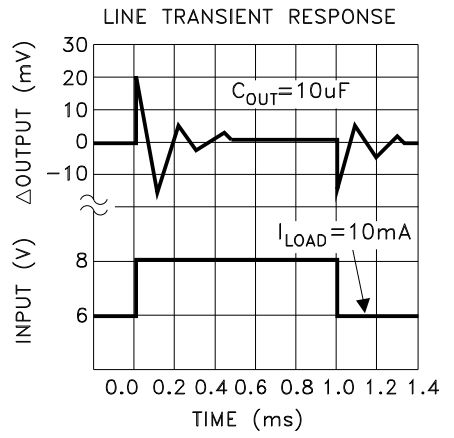
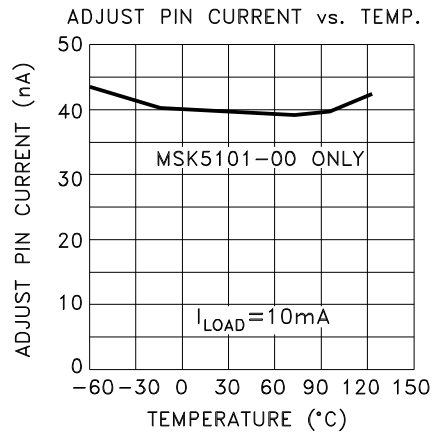
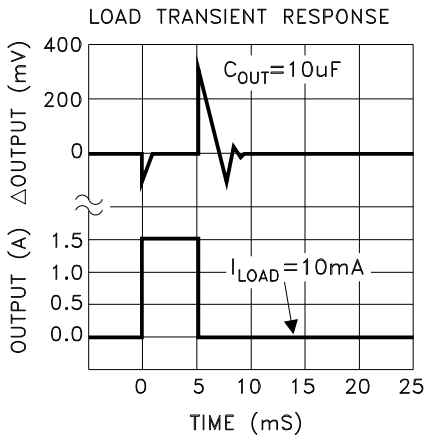
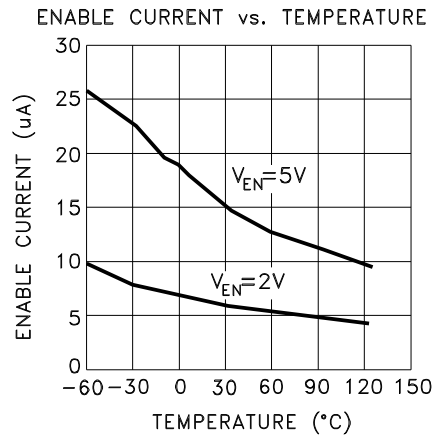
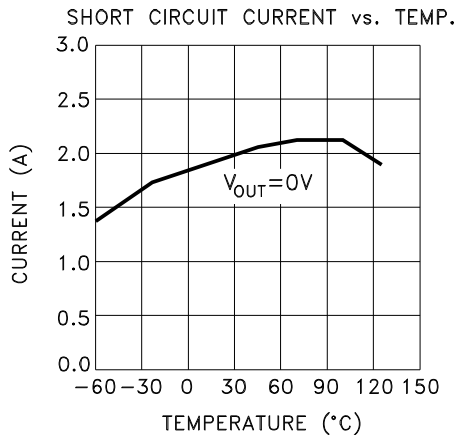
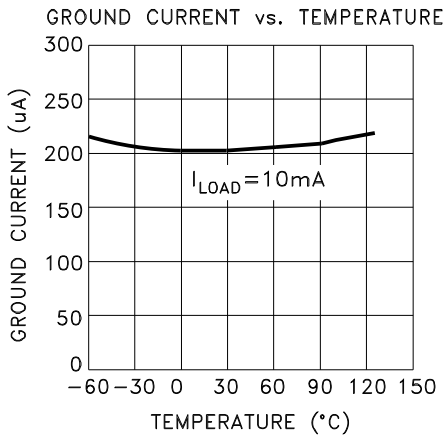
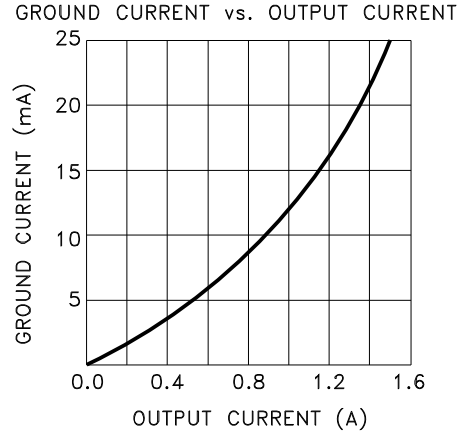
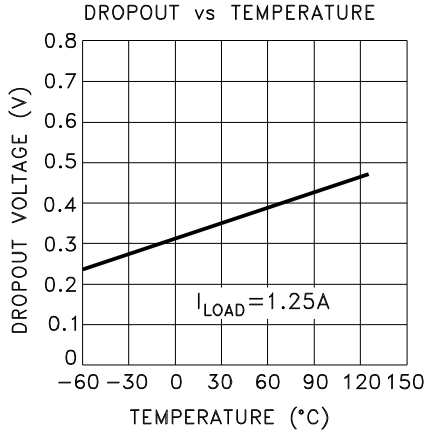
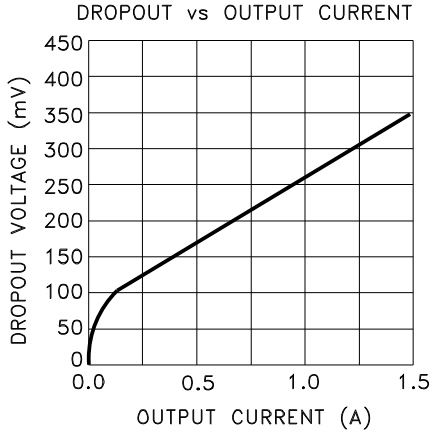
$$\begin{aligned} R_{\theta sa} &= \left[\frac{125^{\circ}\text{C} - 25^{\circ}\text{C}}{1.7\text{W}} \right] - 6^{\circ}\text{C/W} - 0.5^{\circ}\text{C/W} \\ &= 52.3^{\circ}\text{C/W} \end{aligned}$$

In this example, a heat sink with a thermal resistance of no more than 52 $^{\circ}$ C/W must be used to maintain a junction temperature of no more than 125 $^{\circ}$ C.

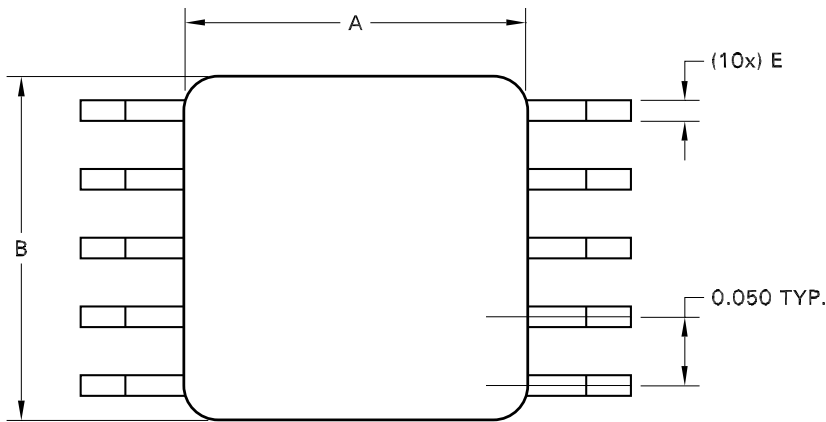
DEVICE SOLDERING/CASE CONNECTION:

The MSK 5101 is a highly thermally conductive device, and the thermal path from the package base to the internal junctions is very short. Standard surface mount techniques should be used when soldering the device into a circuit board. The external heat sink/pad needs to be connected to ground because the base of the MSK 5101 is also electrically connected to ground. The user is urged to keep this in mind when designing the printed circuit board for the MSK 5101. There should be no printed circuit traces making contact with the base of the device except for ground. The ground plane can be used to pull heat away from the device.

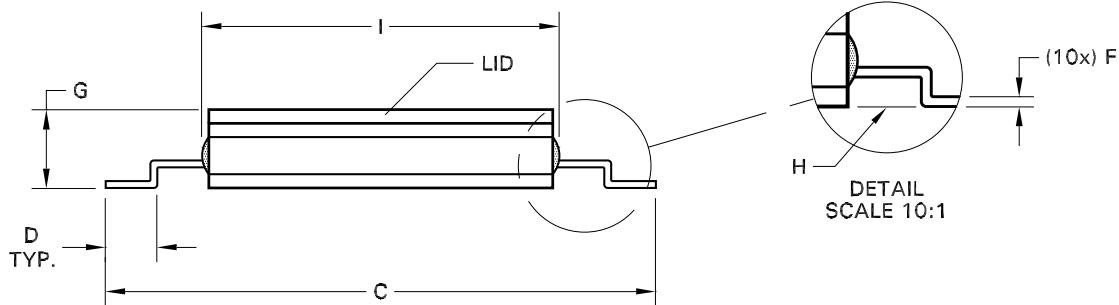
TYPICAL PERFORMANCE CURVES



MECHANICAL SPECIFICATIONS



REF	MIN	MAX
A	0.240	0.260
B	0.240	0.260
C	0.390	0.415
D	0.0275	0.0475
E	0.011	0.019
F	0.003	0.006
G		0.085
H	-0.005	0.005
I		0.270



NOTE: LEADS SHALL BE COPLANAR (H) WITH THE PACKAGE BASE.

WEIGHT = 0.3 GRAMS TYPICAL

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

ORDERING INFORMATION

MSK5101-00 H

SCREENING

BLANK = INDUSTRIAL; H = MIL-PRF-38534 CLASS H

OUTPUT VOLTAGE

00 = Adjustable

GENERAL PART NUMBER

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