MIL-PRF-38534 CERTIFIED FACILITY

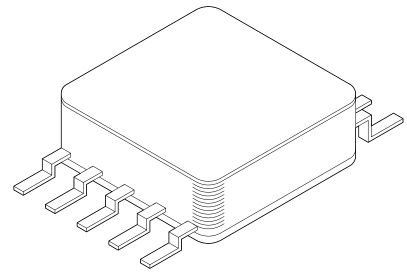
TTM Technologies

HIGH CURRENT, LOW DROPOUT VOLTAGE REGULATOR

5101

FEATURES:

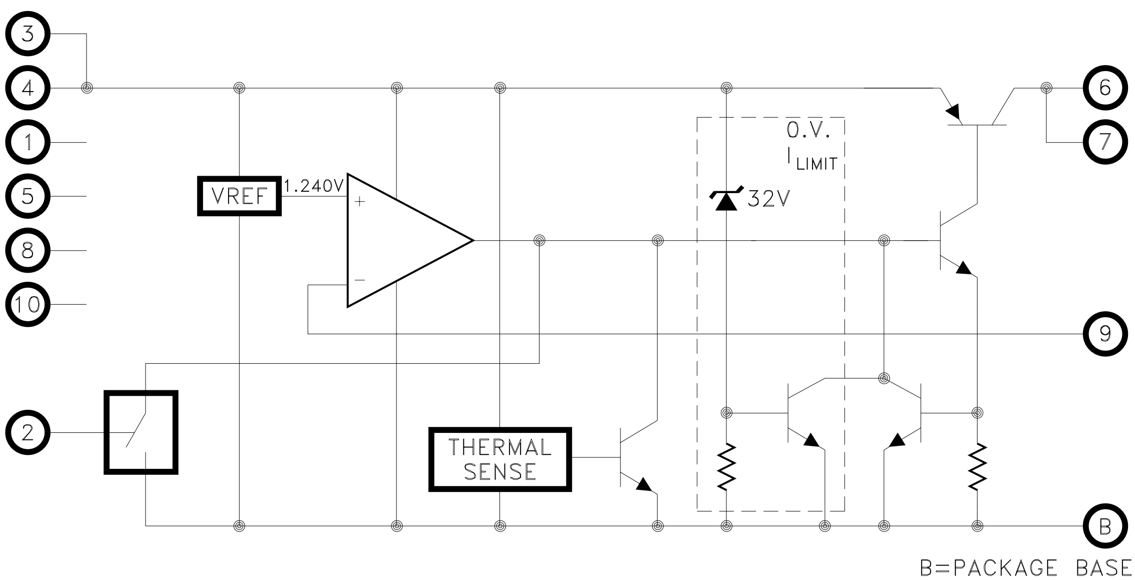
- Extremely Compact 10 Pin Flatpack With Metal Base
- Extremely Low Dropout Voltage: 350mV @ 1.5 Amps
- Available in Adjustable Version only
- TTL Level Enable Pin: Zero Current Shutdown Mode
- Reverse Battery and Load Dump Protection
- Low Ground Current: 22mA Typical at Full Load
- 1% Guaranteed Accuracy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



DESCRIPTION:

The MSK5101 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 MSK5101 is packaged in a space efficient 10 pin glass 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	6	VOUT A
2	ENABLE	7	VOUT B
3	VIN A	8	NC
4	VIN B	9	ADJ
5	NC	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
VIN	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 Range (10 Seconds Soldering)	300°C
T_J	Operating Temperature MSK5101	-40°C to +85°C
	MSK5101H	-55°C to +125°C
	ESD Rating	Class 1B

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ① ③	Group A Subgroup	MSK5101H Min.	MSK5101H Typ.	MSK5101H Max.	MSK5101 Min.	MSK5101 Typ.	MSK5101 Max.	Units
Dropout Voltage ②	ΔVOUT = -1%; I_{OUT} = 100mA	1	-	80	200	-	80	225	mV
	ΔVOUT = -1%; I_{OUT} = 1.5A	1	-	350	600	-	350	625	mV
Load Regulation ⑦	VIN = VOUT +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	(VOUT + 1V) ≤ VIN ≤ 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	VOUT = 0V; VIN = VOUT +1V	-	-	2.1	3.5	-	2.1	3.5	A
Ground Current ②	VIN = VOUT +1V; I_{OUT} = 0.75A	-	-	8	20	-	8	20	mA
	VIN = VOUT +1V; I_{OUT} = 1.5A	-	-	22	-	-	22	-	mA
Output Noise ②	CL = 10UF; 10Hz ≤ f ≤ 100KHz	-	-	400	-	-	400	-	uA
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	uA
	LOW/OFF	1	-	-	2	-	-	2	uA
Shutdown Output Current ②	VENABLE ≤ 0.8V	-	-	1 0	500	-	10	500	uA
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; VIN = V0UT + 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	TJ	-	-	135	-	-	135	-	°C

NOTES:

① Output decoupled to ground using 10μF 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°C
Subgroup 2 T_J = +125°C
Subgroup 3 T_A = -55°C

⑦ Due to current limit, maximum output current may not be available at all values of VIN-VOUT and temperatures. See typical performance curves for clarification.

⑧ Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle.

APPLICATION NOTES

REGULATOR PROTECTION

The MSK5101 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 MSK5101 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 10μF is recommended for optimum performance. Transient load response can also be improved by placing a capacitor directly across the load.

LOAD CONNECTIONS

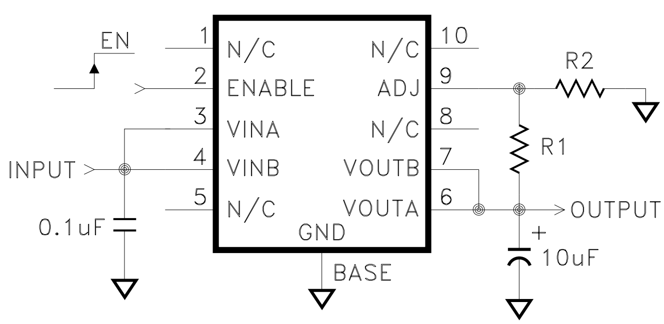
In voltage regulator applications where very large load currents are present, the load connection is very important. The path con necting the output of the regulator to the load must be extremely low impedance to avoid affecting the load regulation specifications. Any impedance in this path will form a voltage divider with the load. The MSK5101 requires a minimum of 10mA of load current to stay in regulation.

ENABLE PIN

The MSK5101 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 10μA 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.



VOUT=1.240V x [1+(R1/R2)]

HEAT SINK SELECTION

To select a heat sink for the MSK5101, the following formula for convective heat flow may be used.

Governing Equation:

$$Tj = Pd \times (R\theta jc + R\theta cs + R\theta sa) + Ta$$

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
Ta = Ambient Temperature

First, the power dissipation must be calculated as follows:

Power Dissipation = (VIN - VOUT) x Iout

Next, the user must select a maximum junction temperature. The maximum allowable junction temperature is 125°C. The equation may now be rearranged to solve for the required heat sink to ambient thermal resistance (Rθsa).

EXAMPLE:

An MSK5101 is configured for VIN = +5V and VOUT = +3.3V. Iout is a continuous 1A DC level. The ambient temperature is +25°C. The maximum desired junction temperature is 125°C.

Rθjc = 6°C/W and Rθcs = 0.5°C/W typically.

Power Dissipation = (5V - 3.3V) x (1A)
= 1.7 Watts

Solve for Rθsa:

$$R\theta sa = \left[\frac{125°C - 25°C}{1.7W} \right] - 6°C/W - 0.5°C/W$$

$$= 52.3°C/W$$

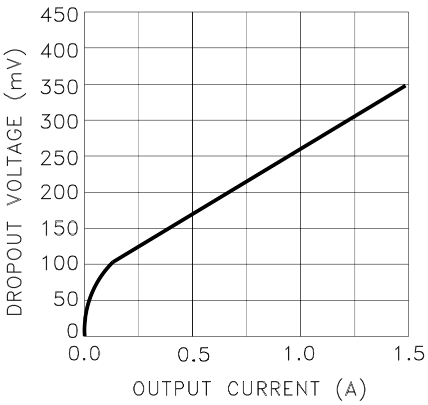
In this example, a heat sink with a thermal resistance of no more than 52°C/W must be used to maintain a junction temperature of no more than 125°C.

DEVICE SOLDERING/CASE CONNECTION

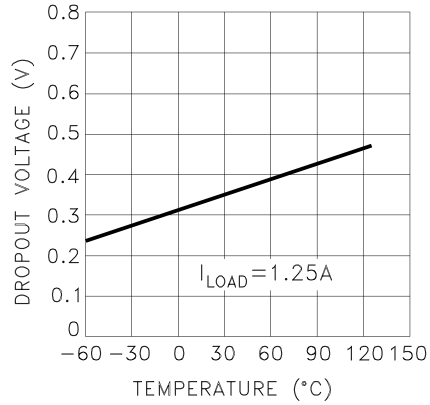
The MSK5101 is a highly thermally conductive device, and the thermal path from the package base to the internal junctions is very short. Standard surface mount techniques should be used when soldering the device into a circuit board.The external heat sink/pad needs to be connected to ground because the base of the MSK5101 is also electrically connected to ground. The user is urged to keep this in mind when designing the printed circuit board for the MSK5101. 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

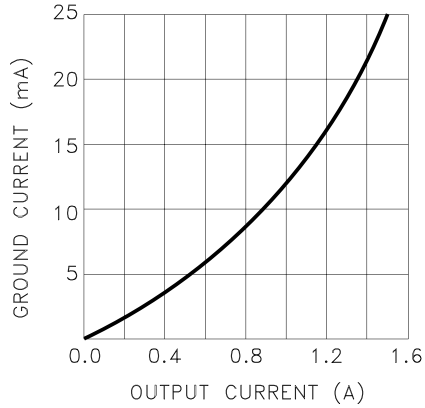
DROPOUT vs OUTPUT CURRENT



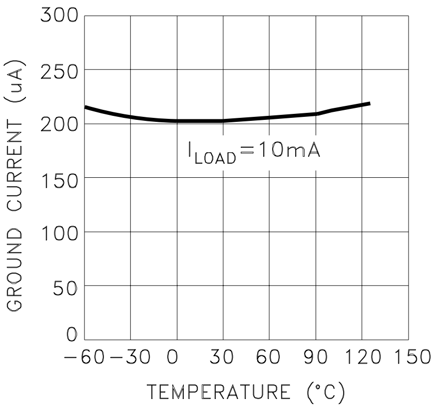
DROPOUT vs TEMPERATURE



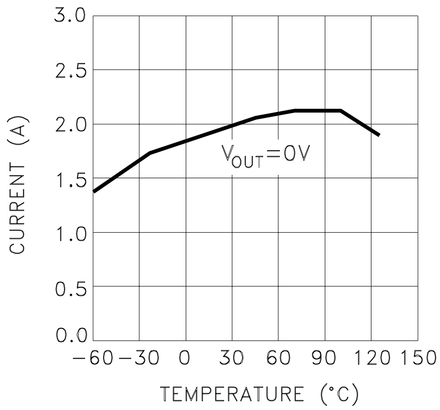
GROUND CURRENT vs. OUTPUT CURRENT



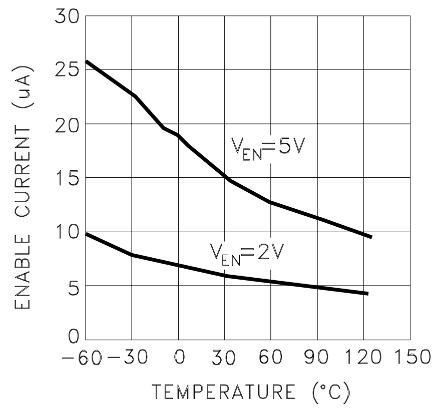
GROUND CURRENT vs. TEMPERATURE



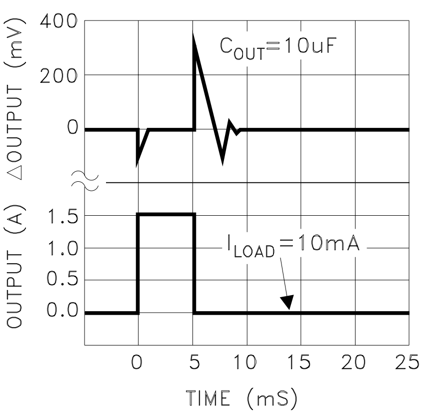
SHORT CIRCUIT CURRENT vs. TEMP.



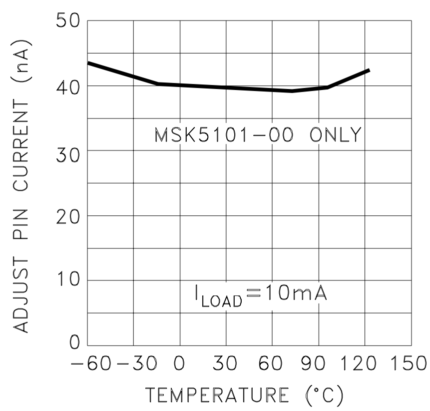
ENABLE CURRENT vs. TEMPERATURE



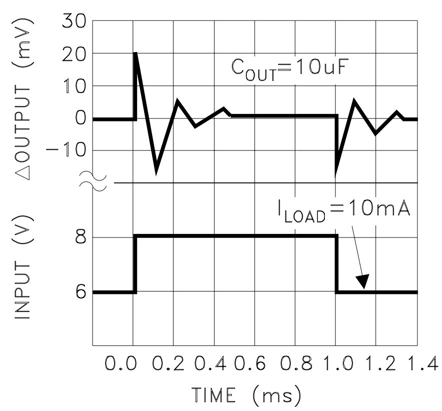
LOAD TRANSIENT RESPONSE



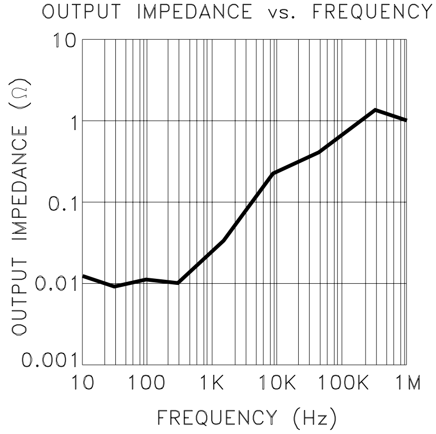
ADJUST PIN CURRENT vs. TEMP.



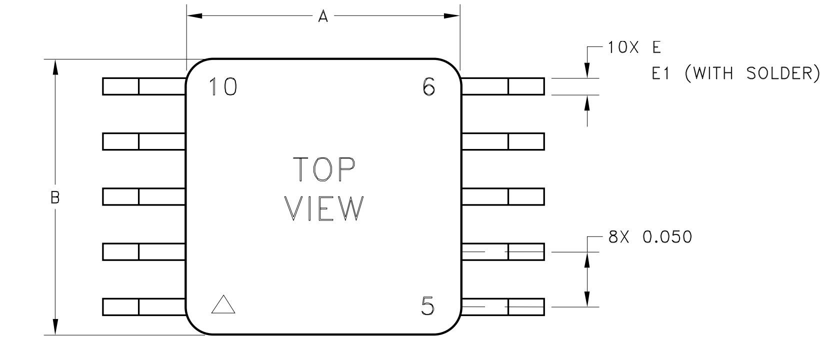
LINE TRANSIENT RESPONSE



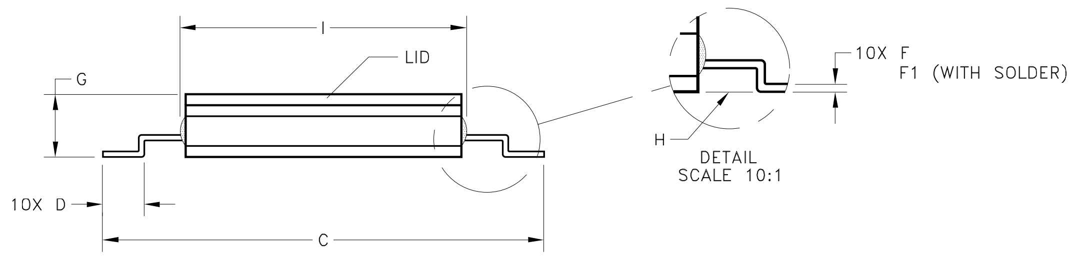
OUTPUT IMPEDANCE vs. FREQUENCY



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
W/SOLDER	E1	———	0.021
	F	0.003	0.006
W/SOLDER	F1	———	0.008
	G	———	0.085
	H	−0.005	0.005
	I	———	0.270



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

ESD TRIANGLE INDICATES PIN 1
WEIGHT = 0.36 GRAMS TYPICAL

ALL DIMENSIONS ARE SPECIFIED IN INCHES

ORDERING INFORMATION

MSK5101-00 H

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

OUTPUT VOLTAGE
00 = Adjustable

GENERAL PART NUMBER

REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
K	Released	07/15	Add ESD rating to absolute maximum ratings and update format
L	Released	04/17	Change load regulation note from 9 to 7
M	Released	01/22	Update lead position and description; remove MIL-PRF-38535; update company name, address and website

TTM Technologies
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