MIL-PRF-38534 CERTIFIED FACILITY

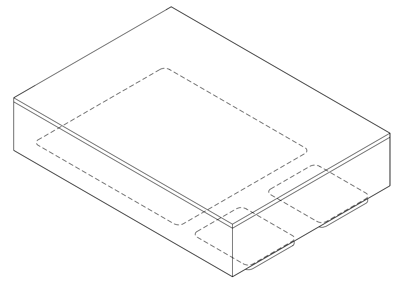
TTM Technologies
Time-To-Market Interconnect Solutions

HIGH CURRENT, LOW DROPOUT SURFACE MOUNT VOLTAGE REGULATORS

5230 SERIES

FEATURES:

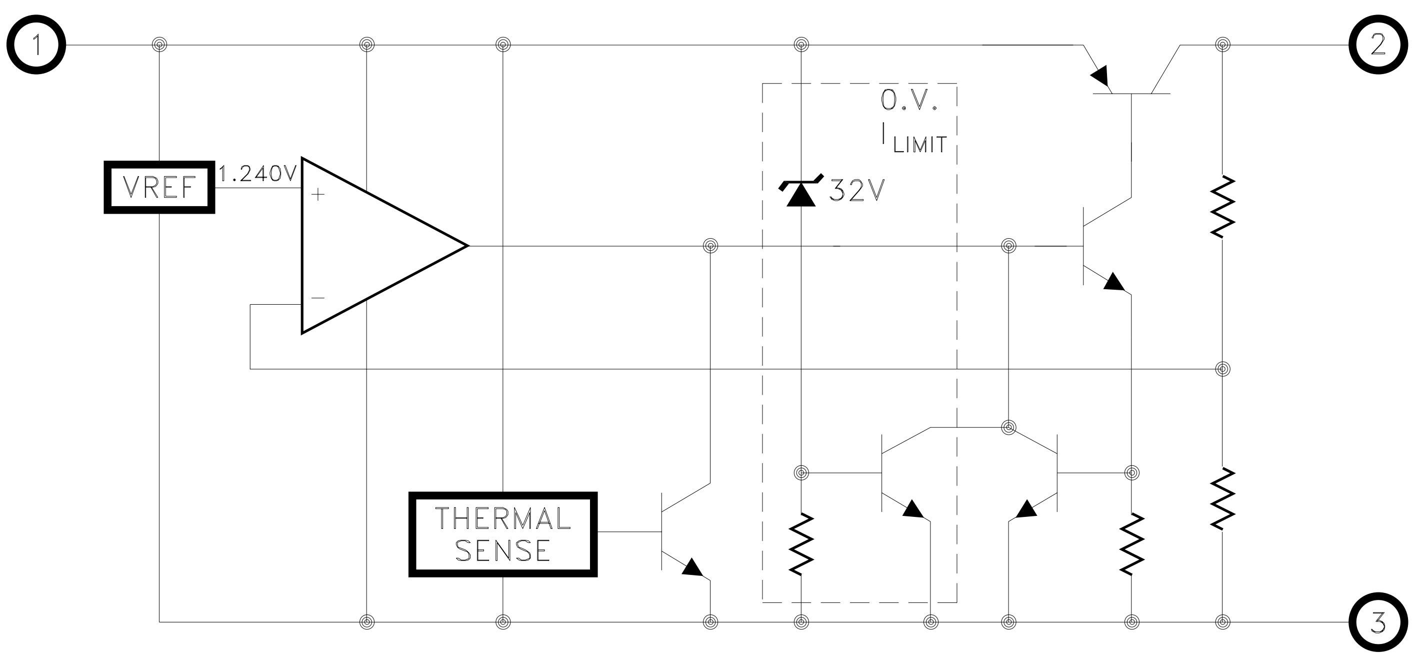
- Hermetic Surface Mount Package
- Extremely Low Dropout Voltage: 350mV @ 3 Amps
- Available in 1.5V, 1.7V, 1.8V, 1.9V, 2.5V, 3.3V, 5.0V and 12.0V
- On Board Thermal Shut Down
- Reverse Battery and Load Dump Protection
- Low Ground Current: 42mA Typical at Full Load
- 1% Maximum Guaranteed Accuracy
- Output Current to 3 Amps
- Alternate Output Voltages Available



DESCRIPTION:

The MSK5230 series voltage regulators are available in +1.5V, +1.7V, +1.8V, +1.9V, +2.5V, +3.3V, +5.0V, and +12.0V output configurations. All boast ultra low dropout specifications due to the utilization of a super PNP output pass transistor with monolithic technology. Dropout voltages of 350mV at 3 amps are typical in this configuration, which drives efficiency up and power dissipation down. Accuracy is guaranteed with a 1% maximum output voltage tolerance. The MSK5230 series is packaged in a space efficient 3 pin power surface mount ceramic package.

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

1 VIN
2 VOUT
3 GROUND

LID = ISOLATED

ABSOLUTE MAXIMUM RATINGS (10)

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..3.0A

T_{ST} Storage Temperature Range ....-65°C to +150°C
T_{LD} Lead Temperature
(10 Seconds Soldering)...300°C
T_C Case Operating Temperature Range
MSK5230 Series..-40°C to +85°C
MSK5230H Series.....................................-55°C to +125°C
ESD Rating .... Class 2

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions (1)(3)	Group A Subgroup	MSK5230H SERIES Min.	MSK5230H SERIES Typ.	MSK5230H SERIES Max.	MSK5230 SERIES Min.	MSK5230 SERIES Typ.	MSK5230 SERIES Max.	Units
Output Voltage Tolerance	I_{OUT} = 10mA; VIN = VOUT +1V	1	-	±0.5	±1.0	-	±0.5	±1.0	%
		2, 3	-	±1.0	±2.0	-	-	-	%
Dropout Voltage (2)	ΔV_{OUT} = -1%; I_{OUT} = 100mA	1	-	80	200	-	80	225	mV
	ΔV_{OUT} = -1%; I_{OUT} = 3A	1	-	350	600	-	350	625	mV
Load Regulation (8)	10mA ≤ I_{OUT} ≤ 2.5A	1	-	±0.2	±1.0	-	±0.2	±1.2	%
		2, 3	-	±0.3	±2.0	-	±0.3	-	%
Line Regulation	(VOUT +1V) ≤ VIN ≤ 26V	1	-	±0.05	±0.5	-	±0.05	±0.6	%
	I_{OUT} = 10mA	2, 3	-	±0.5	±1.0	-	±0.5	-	%
Output Current Limit (2)(9)	VOUT = 0V; VIN = VOUT +1V	-	-	4.5	5.0	-	4.5	5.0	A
Ground Current (2)(8)	VIN = VOUT +1V; I_{OUT} = 1.5A	-	-	20	45	-	20	45	mA
	VIN = VOUT +1V; I_{OUT} = 3A	-	-	42	-	-	42	-	mA
Output Noise (2)	C_L = 20μF; 10Hz ≤ f ≤ 100KHz	-	-	400	-	-	400	-	μV
Thermal Resistance (2)	Junction to Case @ 125°C	-	-	3.3	3.7	-	3.3	3.9	°C/W
Thermal Shutdown (2)	T_J	-	-	130	-	-	130	-	°C

PART NUMBER	OUTPUT VOLTAGE (7)
MSK5230-1.5	+1.5V
MSK5230-1.7	+1.7V
MSK5230-1.8	+1.8V
MSK5230-1.9	+1.9V
MSK5230-2.5	+2.5V
MSK5230-3.3	+3.3V
MSK5230-5.0	+5.0V
MSK5230-12	+12.0V

NOTES:

1. Output decoupled to ground using 47μF minimum capacitance 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 devices shall be tested to subgroup 1 unless otherwise specified.
5. Military grade devices ("H" suffix) shall be 100% tested to subgroups 1, 2 and 3.
6. Subgroup 1 T_C = +25°C
Subgroup 2 T_J = +125°C
Subgroup 3 T_A = -55°C
7. Please consult the factory if alternate output voltages are required.
8. 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.
9. The output current limit function provides protection from transient overloads but it may exceed the maximum continuous rating. Continuous operation in current limit may damage the device.
10. Continuous operation at or above absolute maximum ratings may adversely effect the device performance and/or life cycle.

APPLICATION NOTES

REGULATOR PROTECTION

The MSK5230 series 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

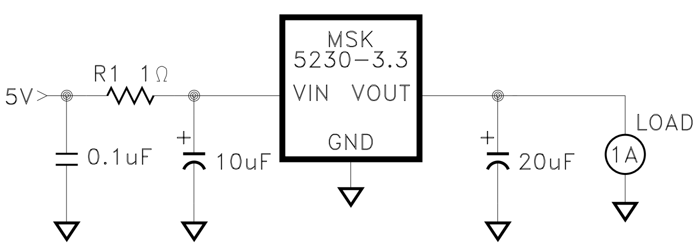
The output voltage ripple of the MSK5230 series voltage regulators can be minimized by placing a filter capacitor from the output to ground. The optimum value for this capacitor may vary from one application to the next, but a minimum of 20µF is recommended for optimum performance. Transient load response can also be improved by placing a capacitor directly across the load. The capacitor should not be an ultra-low ESR type. Tantalum capacitors are best for fast load transients but aluminum electrolytics will work fine in most applications.

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.

MINIMIZING POWER DISSIPATION

Many applications can not take full advantage of the extremely low dropout specifications of the regulator due to large input to output voltage differences. The simple circuit below illustrates a method to reduce the input voltage at the regulator to just over the dropout specification to keep the internal power dissipation minimized:



For a given continuous maximum load of 1 amp, R1 can be selected to drop the voltage seen at the regulator to 4V. This allows for the output tolerance and dropout specifications. Input voltage variations (5V) also should be included in the calculations. The resistor should be sized according to the power levels required for the application.

PACKAGE CONNECTIONS

The MSK5230 series are highly thermally conductive devices and the thermal path from the package heat sink to the internal junctions is very short. Standard surface mount soldering techniques should be used when mounting the device. Some applications may require additional heat sinking of the device.

HEAT SINK SELECTION

To select a heat sink for the MSK5230, 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 absolute maximum allowable junction temperature is 125°C. The equation may now be rearranged to solve for the required heat sink to ambient thermal resistance ($R\theta_{SA}$).

Example:

An MSK5230-3.3 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.

$R\theta_{JC}$ = 3.3°C/W and $R\theta_{CS}$ = 0.5°C/W typically.

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

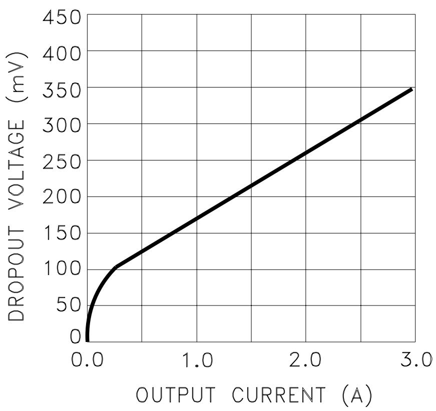
Solve for $R\theta_{SA}$:

$$R\theta_{SA} = \left[\frac{125°C - 25°C}{1.7W}\right] - 3.3°C/W - 0.5°C/W$$

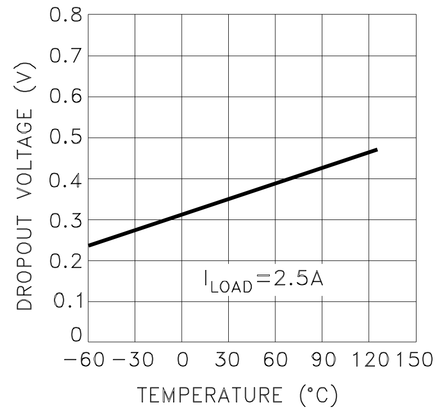
In this example, a heat sink with a thermal resistance of no more than 55°C/W must be used to maintain a junction temperature of no more than 125°C.

TYPICAL PERFORMANCE CURVES

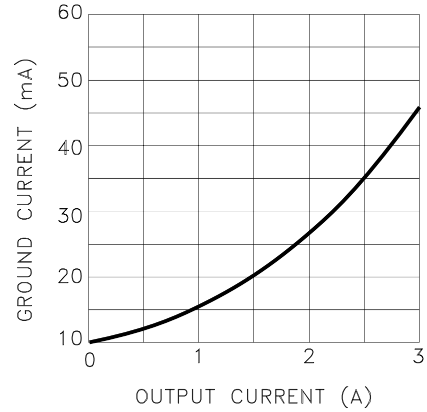
DROPOUT vs OUTPUT CURRENT



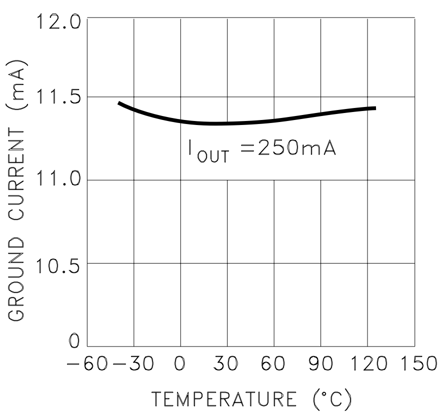
DROPOUT vs TEMPERATURE



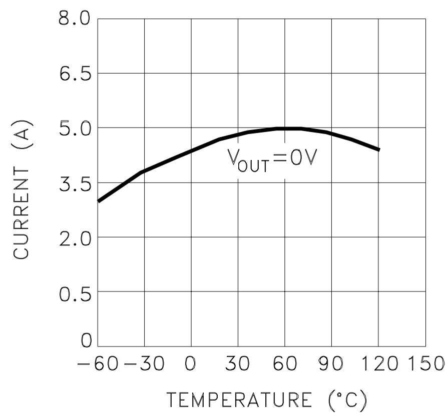
GROUND CURRENT vs. OUTPUT CURRENT



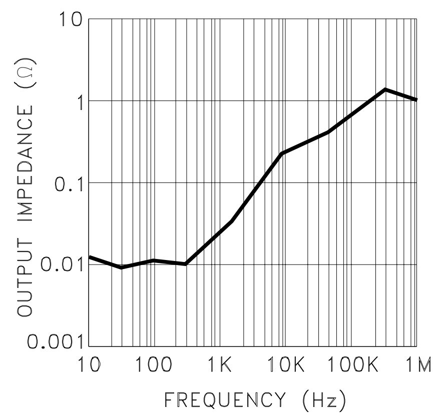
GROUND CURRENT vs. TEMPERATURE



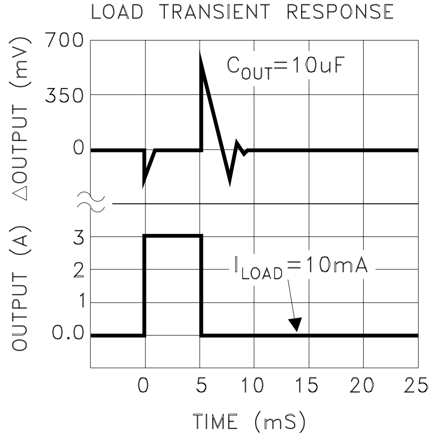
SHORT CIRCUIT CURRENT vs. TEMP.



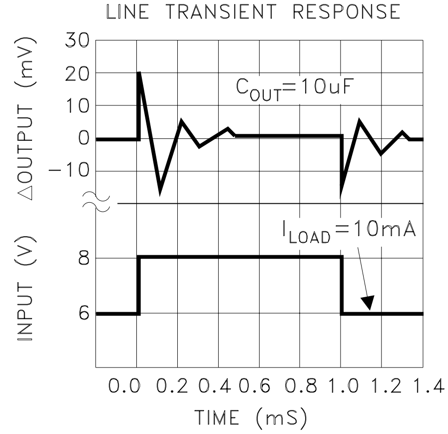
OUTPUT IMPEDANCE vs. FREQUENCY



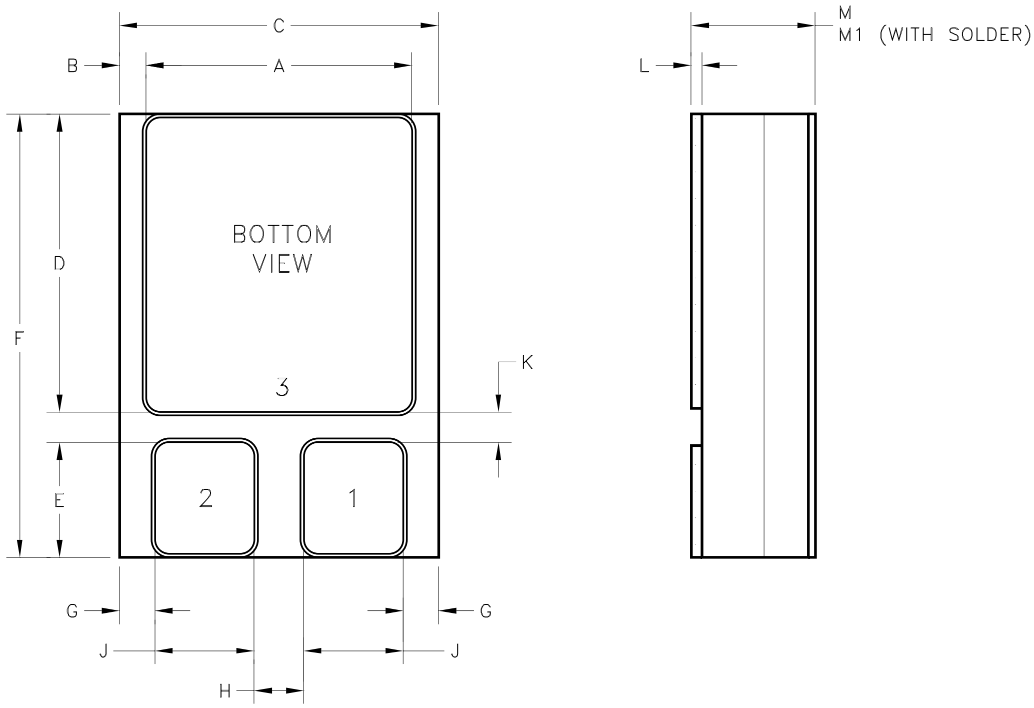
LOAD TRANSIENT RESPONSE



LINE TRANSIENT RESPONSE



MECHANICAL SPECIFICATIONS



	REF	MIN	MAX
	A	0.365	0.385
	B	0.032	0.042
	C	0.440	0.460
	D	0.405	0.425
	E	0.152	0.162
	F	0.615	0.635
	G	0.045	0.055
	H	0.035	———
	J	0.130	0.150
	K	0.030	———
	L	0.012	0.018
	M	———	0.130
W/SOLDER	M1	———	0.135

WEIGHT = 2.3 GRAMS TYPICAL

ALL DIMENSIONS ARE SPECIFIED IN INCHES

ORDERING INFORMATION

MSK5230-3.3 H

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

OUTPUT VOLTAGE
1.5 = +1.5V; 1.7 = +1.7V; 1.8 =+1.8V; 1.9 = +1.9V;
2.5 = +2.5V; 3.3 = +3.3V; 5.0 =+5.0V; 12 =+12.0V

GENERAL PART NUMBER

The above example is a +3.3V, Military regulator.

REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
J	Released	04/15	Updated format and add ESD rating.
K	Released	04/23	Remove MIL-PRF-38535 and update company name and website