



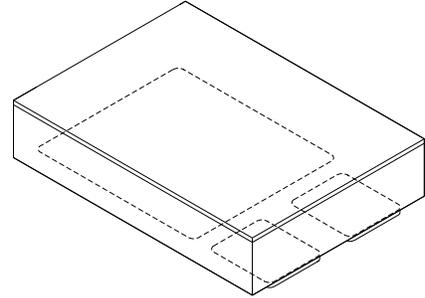
**HIGH CURRENT, VERY LOW OUTPUT  
SURFACE MOUNT  
VOLTAGE REGULATORS**

**5450  
SERIES**

M.S.KENNEDY CORP.

**FEATURES:**

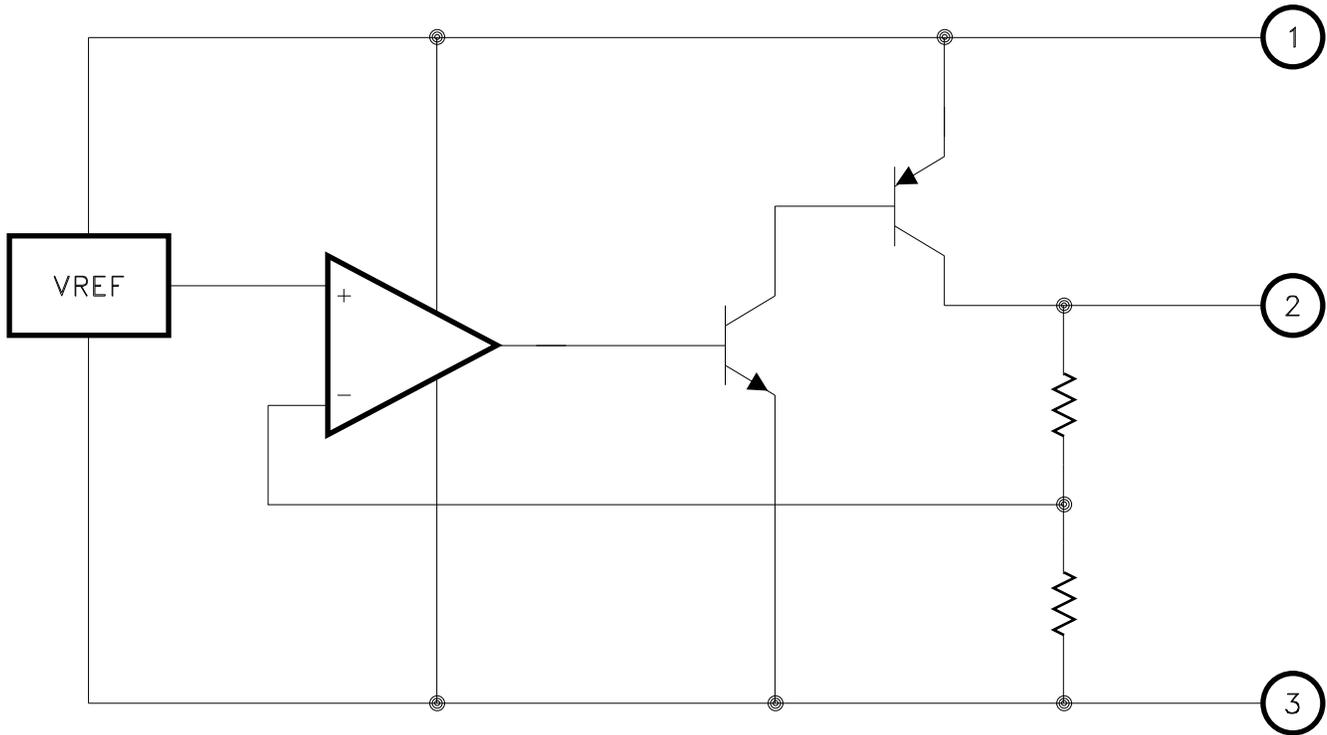
- Very Low Output Voltage
- Available in 0.7V, 0.8V, 0.9V, 1.0V, 1.2V, 1.3V and 1.5V
- On Board Thermal Shut Down and Current Limit
- 1% Maximum Guaranteed Accuracy
- Output Current to 5 Amps
- Alternate Output Voltages Available
- Contact MSK for MIL-PRF-38534 Qualification Status



**DESCRIPTION:**

The MSK5450 series voltage regulators offer high current and low output voltage capability ideal for use with low voltage microprocessors. Low output impedance and minimal output capacitance requirements make the MSK 5450 an excellent choice for ASIC and FPGA core voltage supplies. The device is available in +0.7V, +0.8V, +0.9V, +1.0V, +1.2V, +1.3V and +1.5V output configurations with output accuracy guaranteed to 1% maximum. The MSK5450 series is packaged in a 3 pin hermetically sealed power surface mount ceramic package.

**EQUIVALENT SCHEMATIC**



**TYPICAL APPLICATIONS**

- PLD/FPGA Core Power Supply
- ASIC Core Voltage Regulator
- System Power Supplies
- Switching Power Supply Post Regulators
- Linear Point-of-Load Conversion

**PIN-OUT INFORMATION**

- 1 VIN
- 2 VOUT
- 3 Ground

## ABSOLUTE MAXIMUM RATINGS <sup>⑩</sup>

V<sub>IN</sub> Input Voltage . . . . . +6.0V  
 P<sub>D</sub> Power Dissipation . . . . . Internally Limited

T<sub>ST</sub> Storage Temperature Range . . -65°C to +150°C  
 T<sub>LD</sub> Lead Temperature  
 (10 Seconds) . . . . . 300°C  
 T<sub>J</sub> Operating Temperature  
 MSK5450 Series . . . . . -40°C to +85°C  
 MSK5450H Series . . . . . -55°C to +125°C

## ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions <sup>①</sup> <sup>③</sup>	Group A Subgroup	MSK5450H SERIES			MSK5450 SERIES			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Voltage Range		-	+1.65	-	+5.5	+1.65	-	+5.5	V
Ground Current <sup>②</sup>	I <sub>L</sub> = 10mA	1	-	1	5	-	1	7	mA
	I <sub>L</sub> = 5.0A	1	-	55	150	-	55	170	mA
Output Voltage Tolerance	V <sub>IN</sub> = 5V; I <sub>OUT</sub> = 10mA	1	-	±0.5	±1.0	-	±0.5	±1.2	%
		2,3	-	±1.0	±2.0	-	-	-	%
Dropout Voltage <sup>②</sup> <sup>⑨</sup>	ΔV <sub>OUT</sub> = -2%; I <sub>OUT</sub> = 2.5A	1	-	160	300	-	160	350	mV
	ΔV <sub>OUT</sub> = -2%; I <sub>OUT</sub> = 5A	1	-	250	500	-	250	600	mV
Load Regulation <sup>⑧</sup>	10mA ≤ I <sub>OUT</sub> ≤ 5.0A	1	-	±0.2	±1.0	-	±0.2	±1.2	%
		2,3	-	±0.3	±2.0	-	±0.3	-	%
Line Regulation	V <sub>IN</sub> = V <sub>OUT</sub> + 1 to +5.5V I <sub>OUT</sub> = 10mA	1	-	±0.05	±0.65	-	±0.05	±0.75	%
		2,3	-	±0.5	±1.0	-	±0.5	-	%
Output Current Limit <sup>②</sup> <sup>⑧</sup>	V <sub>OUT</sub> = 0V	-	5.5	-	10	5.5	-	10	A
Thermal Resistance <sup>②</sup>	Junction to Case @ 125°C	-	-	1.6	2.0	-	1.6	2.2	°C/W
Turn On Time <sup>②</sup>	C <sub>OUT</sub> = 10μF	4	-	50	150	-	50	200	μS

PART NUMBER	OUTPUT VOLTAGE <sup>⑦</sup>
MSK5450-0.7	+0.7V
MSK5450-0.8	+0.8V
MSK5450-0.9	+0.9V
MSK5450-1.0	+1.0V
MSK5450-1.2	+1.2V
MSK5450-1.3	+1.3V
MSK5450-1.5	+1.5V

### 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<sub>J</sub> = T<sub>C</sub>.
- 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 1,2,3.
- ⑥ Subgroup 1 T<sub>C</sub> = +25°C  
Subgroup 2 T<sub>J</sub> = +125°C  
Subgroup 3 T<sub>A</sub> = -55°C
- ⑦ Please consult the factory if alternate output voltages are required.
- ⑧ Due to internal thermal shutdown, maximum output current may not be available at all values of V<sub>IN</sub>-V<sub>OUT</sub> and temperatures.  
See typical performance curves for clarification.
- ⑨ Not applicable to versions where V<sub>IN</sub> = V<sub>IN</sub> min.
- ⑩ Continuous operation at or above absolute maximum ratings may adversely effect the device performance and/or life cycle.

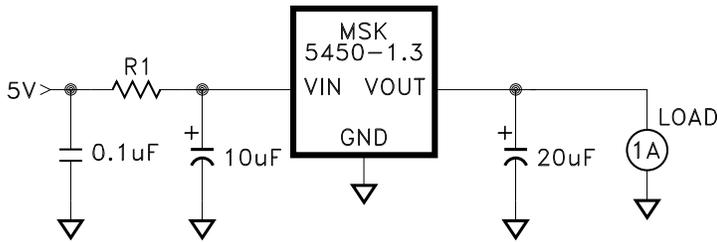
## APPLICATION NOTES

### REGULATOR PROTECTION:

The MSK5450 series are high performance linear regulators for high current, low voltage applications requiring fast transient response. The devices are fully protected from damage due to fault conditions, offering constant current limiting and thermal shutdown. The thermal shutdown junction temperature is typically 150°C.

### MINIMIZING POWER DISSIPATION:

To maximize the performance and reduce power dissipation of the MSK5450 series devices, VIN should be maintained as close to dropout or at VIN minimum when possible. See Input Supply Voltage requirements. A series resistor can be used to lower VIN close to the dropout specification, lowering the input to output voltage differential. In turn, this will decrease the power that the device is required to dissipate. Knowing peak current requirements and worst case voltages, a resistor can be selected that will drop a portion of the excess voltage and help to distribute the heating. The circuit below illustrates this method.



The maximum resistor value can be calculated from the following:

$$R1 \text{ max} = \frac{VIN \text{ min} - (VOUT \text{ max} + V_{DROPT})}{I_{OUT \text{ peak}} + \text{Quiescent Current}}$$

Where:

VIN min = Minimum input voltage

VOUT max = Maximum output voltage across the full temperature range

V<sub>DROPT</sub> = Worst case dropout voltage (Typically 500mV)

I<sub>OUT peak</sub> = Maximum load current

Quiescent Current = Max. quiescent current at I<sub>out peak</sub>

### INPUT CAPACITOR:

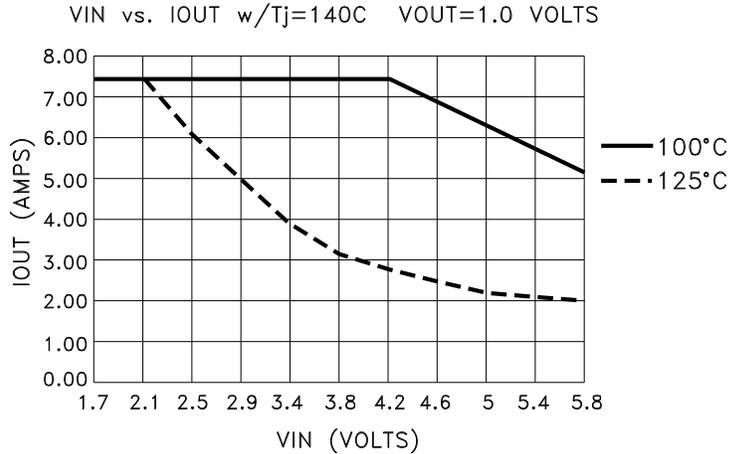
If the device is to be located more than 4 inches from the bulk supply capacitance, a minimum 1µF capacitor should be placed as close to the input pin as possible for proper bypassing. A smaller value capacitor such as 0.01µF should be placed in parallel with the larger value capacitor. Larger input capacitor values will help to improve ripple rejection.

### OUTPUT CAPACITOR:

The MSK5450 series devices require a minimum of external components to maintain stability. A minimum of output capacitance is necessary for stable operation. Due to the wide bandwidth design, the device will operate with a wide range of capacitance and ESR values. For most applications, a 10µF ceramic capacitor will suffice. Ideally, this should be an X7R ceramic capacitor or a tantalum capacitor due to their thermal performance. There is no upper limit to the amount of output capacitance that may be used.

### THERMAL SHUTDOWN:

The MSK5450 series of devices is equipped with a thermal shutdown circuit that will turn off the device when the junction temperature reaches approximately 150°C. It is important for the user to be aware that high temperature operation will limit the current capability of the device due to this thermal shutdown protection. In cases of maximum input voltage and high case temperature, the output current available may be less than 3 Amps. See curve below for clarification.



### PACKAGE CONNECTIONS:

The MSK5450 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 MSK5450, the following formula for convective heat flow may be used:

First, the power dissipation must be calculated as follows:

$$\text{Power Dissipation} = (VIN - VOUT) \times I_{OUT} + VIN \times \text{Quiescent Current}$$

Next, the user must select a maximum junction temperature. The equation may now be arranged to solve for the required heat sink to ambient thermal resistance (R<sub>θsa</sub>).

### EXAMPLE:

An MSK5450-1.3 is configured for VIN = +1.8V and VOUT = +1.3V. I<sub>out</sub> is a continuous 5Amp DC level. Under these conditions the maximum ground current would be 150mA. The ambient temperature is +100°C and the maximum junction temperature is 125°C.

$$R_{\theta jc} = 2.0^{\circ}\text{C/W} \text{ and } R_{\theta cs} = 0.5^{\circ}\text{C/W} \text{ typically.}$$

$$\text{Power Dissipation} = (1.8\text{V} - 1.3\text{V}) \times 5\text{A} + (1.8 \times 150\text{mA})$$

$$\text{Solve for } R_{\theta sa} \text{ given } P_D = 2.77 \text{ Watts}$$

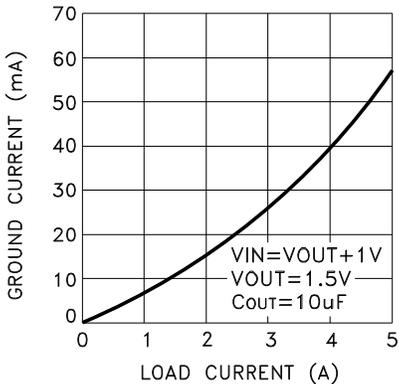
$$R_{\theta sa} = \left[ \frac{125^{\circ}\text{C} - 100^{\circ}\text{C}}{2.77\text{W}} \right] - 2.0^{\circ}\text{C/W} - 0.5^{\circ}\text{C/W}$$

$$= 6.53^{\circ}\text{C/W}$$

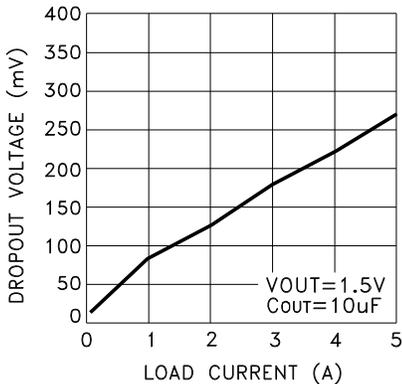
In this example, a heat sink with a thermal resistance of no more than 6.5°C/W must be used to maintain a junction

# TYPICAL PERFORMANCE CURVES

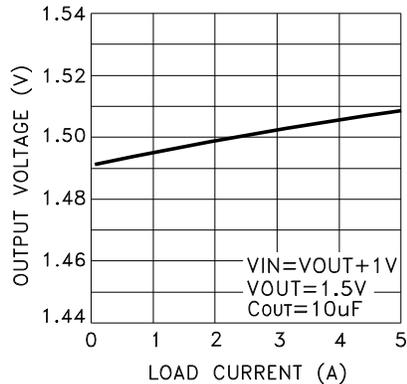
GROUND CURRENT vs LOAD CURRENT



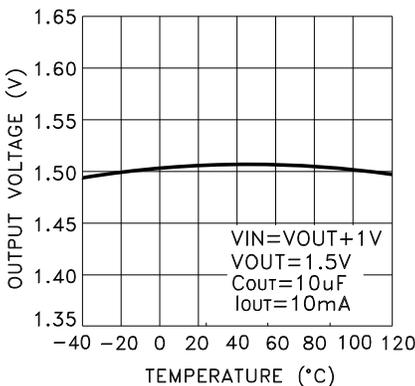
DROPOUT VOLTAGE vs LOAD CURRENT



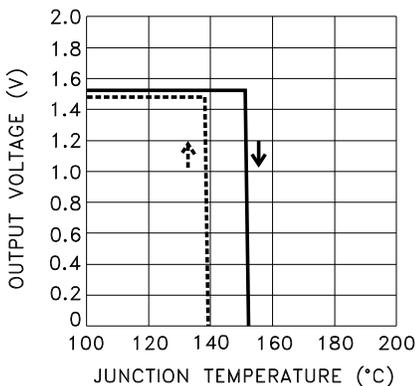
OUTPUT VOLTAGE vs LOAD CURRENT



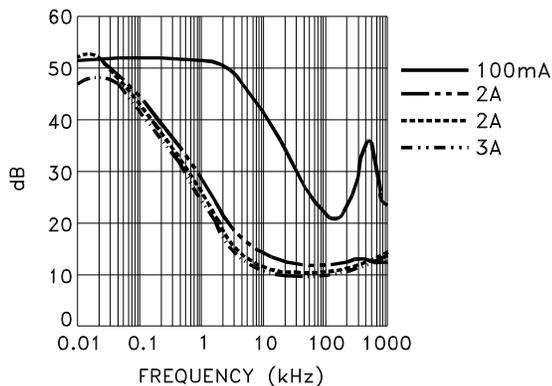
OUTPUT VOLTAGE vs TEMPERATURE



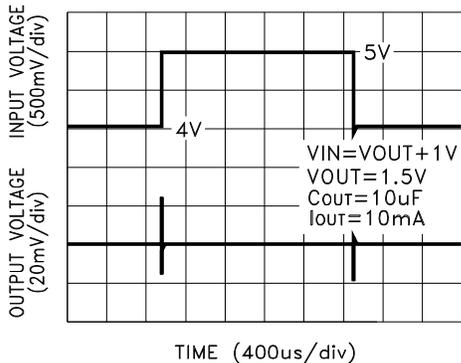
THERMAL SHUTDOWN



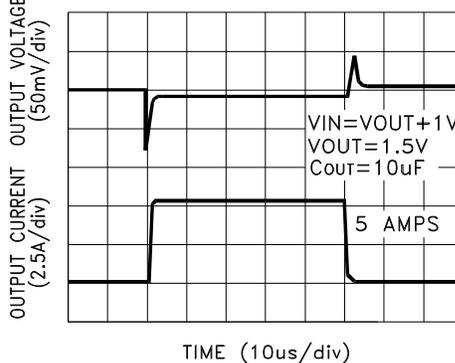
POWER SUPPLY REJECTION RATIO



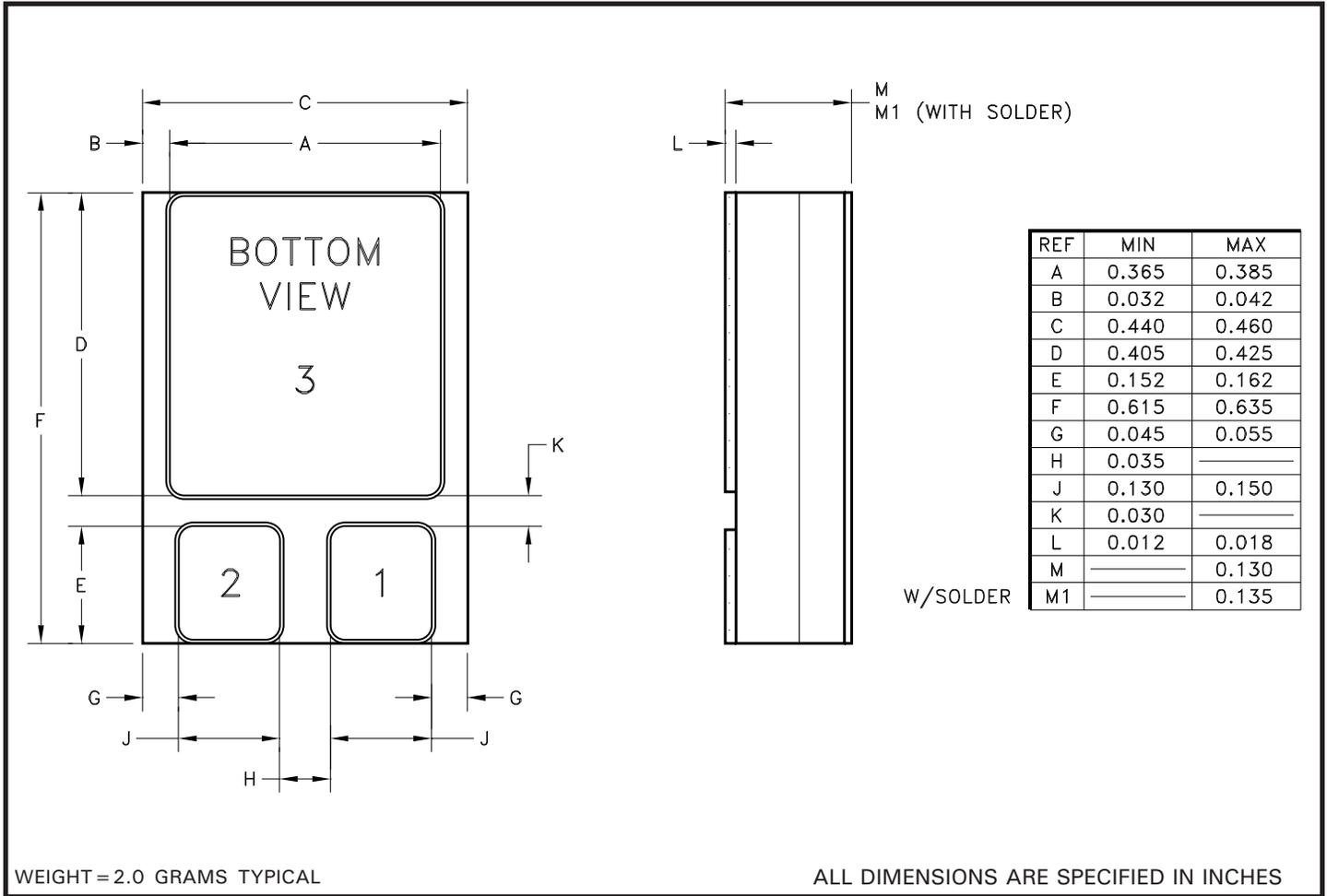
LINE TRANSIENT



LOAD TRANSIENT



## MECHANICAL SPECIFICATIONS



## ORDERING INFORMATION

MSK5450-1.3 H

**SCREENING**

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

**OUTPUT VOLTAGE**

0.7 = +0.7V; 0.8 = +0.8V; 0.9 = +0.9V; 1.0 = +1.0V;  
1.2 = +1.2V; 1.3 = +1.3V; 1.5 = +1.5V

**GENERAL PART NUMBER**

The above example is a +1.3V, Military regulator.

## REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
B	Released	05/14	Add form number, remove class E, update line regulation and mechanical outline.

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