

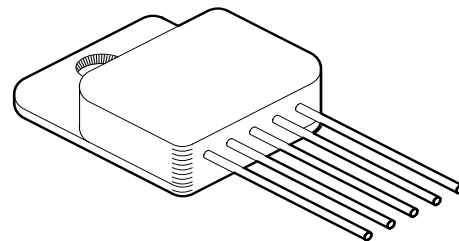


# HIGH CURRENT, LOW DROPOUT VOLTAGE REGULATOR

# 5115

## FEATURES:

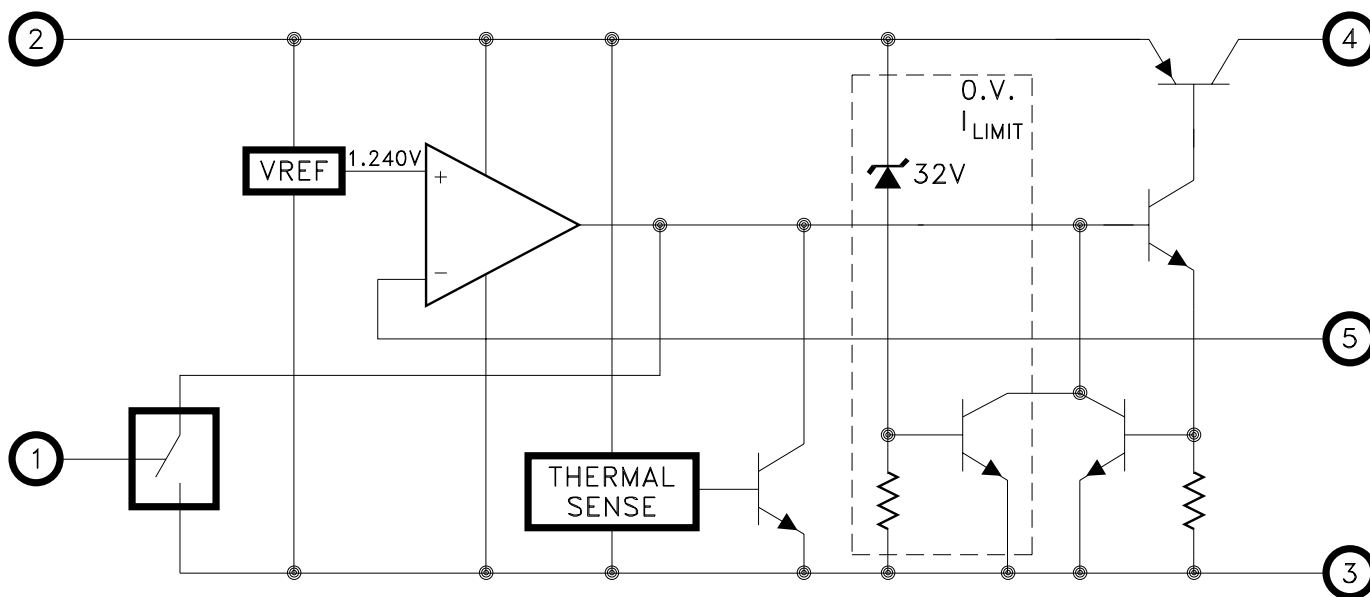
- Electrically Isolated Top Tab or Z Tab SIP
- Extremely Low Dropout Voltage: 350mV @ 1.5 Amps
- Available Adjustable Version only
- TTL Level Enable Pin: Zero Current Shutdown Mode
- Reverse Battery and Load Dump Protection
- Low Ground Current: 22mA Typical at Full Load
- 1% Maximum Guaranteed Accuracy
- Output Current to 1.5 Amps



## DESCRIPTION:

The MSK5115 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 MSK5115 is packaged in a space efficient 5 pin power SIP available in two styles with three lead bend options.

## 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

MSK5115-00

- 1 ENABLE
- 2 VIN
- 3 GROUND
- 4 VOUT
- 5 ADJUST

CASE=ISOLATED

## ABSOLUTE MAXIMUM RATINGS

⑨

V<sub>INP</sub> Input Voltage (100mS 1%D.C.).....-20V to +60V  
V<sub>IN</sub> Input Voltage.....26V  
V<sub>EN</sub> Enable Voltage.....-0.3V to 26V  
I<sub>OUT</sub> Output Current.....3.5A

T<sub>ST</sub> Storage Temperature Range.....-65°C to +150°C  
T<sub>LD</sub> Lead Temperature  
(10 Seconds Soldering).....300°C  
T<sub>J</sub> Operating Temperature  
MSK 5115.....-40°C to +85°C  
MSK 5115B .....-55°C to +125°C  
ESD Rating.....Class 1B

## ELECTRICAL SPECIFICATIONS

| Parameter                      | Test Conditions ① ③                                                   | Group A  | MSK5115B SERIES |       |      | MSK5115 SERIES |       |      | Units  |
|--------------------------------|-----------------------------------------------------------------------|----------|-----------------|-------|------|----------------|-------|------|--------|
|                                |                                                                       | Subgroup | Min.            | Typ.  | Max. | Min.           | Typ.  | Max. |        |
| Reference Voltage              | Normal Operation                                                      | 1        | 1.22            | 1.24  | 1.26 | 1.22           | 1.24  | 1.26 | V      |
|                                |                                                                       | 2,3      | 1.21            | —     | 1.27 | 1.21           | —     | 1.27 | V      |
| Dropout Voltage ②              | $\Delta V_{OUT} = -1\%$ ; I <sub>OUT</sub> =100mA                     | 1        | —               | 80    | 200  | —              | 80    | 225  | mV     |
|                                | $\Delta V_{OUT} = -1\%$ ; I <sub>OUT</sub> =1.5A                      | 1        | —               | 350   | 600  | —              | 350   | 625  | mV     |
| Load Regulation ⑧              | V <sub>IN</sub> =V <sub>OUT</sub> +1V<br>10mA≤I <sub>OUT</sub> ≤1.25A | 1        | —               | ±0.2  | ±1.0 | —              | ±0.2  | ±1.2 | %      |
|                                |                                                                       | 2,3      | —               | ±0.3  | ±2.0 | —              | ±0.3  | —    | %      |
| Line Regulation                | (V <sub>OUT</sub> +1V)≤V <sub>IN</sub> ≤26V<br>I <sub>OUT</sub> =10mA | 1        | —               | ±0.05 | ±0.5 | —              | ±0.05 | ±0.6 | %      |
|                                |                                                                       | 2,3      | —               | ±0.5  | ±1.0 | —              | ±0.5  | —    | %      |
| Output Current Limit ②         | V <sub>OUT</sub> =0V; V <sub>IN</sub> =V <sub>OUT</sub> +1V           | —        | —               | 2.1   | 3.5  | —              | 2.1   | 3.5  | A      |
| Ground Current ②               | V <sub>IN</sub> =V <sub>OUT</sub> +1V; I <sub>OUT</sub> =0.75A        | —        | —               | 8     | 20   | —              | 8     | 20   | mA     |
|                                | V <sub>IN</sub> =V <sub>OUT</sub> +1V; I <sub>OUT</sub> =1.5A         | —        | —               | 22    | —    | —              | 22    | —    | mA     |
| Output Noise ②                 | C <sub>L</sub> =10uF; 10Hz≤f≤100KHz                                   | —        | —               | 400   | —    | —              | 400   | —    | uA     |
| Enable Input Voltage ②         | HIGH/ON                                                               | 1        | 2.4             | 1.2   | —    | 2.4            | 1.2   | —    | V      |
|                                | LOW/OFF                                                               | 1        | —               | 1.2   | 0.8  | —              | 1.2   | 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      | V <sub>ENABLE</sub> ≤0.8V                                             | —        | —               | 10    | 500  | —              | 10    | 500  | uA     |
| Reference Voltage Temp Drift ② | Normal Operation                                                      | —        | —               | 20    | —    | —              | 20    | —    | ppm/°C |
| Adjust Pin Bias Current ②      | Full Temp; V <sub>IN</sub> =V <sub>OUT</sub> +1V                      | —        | —               | 40    | 120  | —              | 40    | 150  | nA     |
| Thermal Resistance ②           | Junction to Case @ 125°C                                              | —        | —               | 3.1   | 3.6  | —              | 3.1   | 3.7  | °C/W   |
| Thermal Shutdown ②             | T <sub>J</sub>                                                        | —        | —               | 130   | —    | —              | 130   | —    | °C     |

## NOTES:

① Output decoupled to ground using 28μF 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<sub>J</sub> = T<sub>C</sub>.

④ Industrial grade devices shall be tested to subgroup 1 unless otherwise specified.

⑤ Military grade devices ('B' 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 current limit, 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 Continuous operation at or above absolute maximum ratings may adversely effect the device performance and/or life cycle.

⑩ Internal solder reflow temperature is 180°C, do not exceed.

## APPLICATION NOTES

### REGULATOR PROTECTION:

The MSK5115 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 MSK5115 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. This capacitor need not be an expensive low ESR type: aluminum electrolytics are adequate. In fact, extremely low ESR capacitors may contribute to instability. Tantalum capacitors are recommended for systems where fast load transient response is important. 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 MSK5115 requires a minimum of 10mA of load current to stay in regulation.

### ENABLE PIN

The MSK 5115 of 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.

### DEVICE/CASE CONNECTION:

The MSK5115 is a highly thermally conductive device, and the thermal path from the package heat sink to the internal junction is very short. Since the case is electrically isolated from the internal circuitry, the package can be directly connected to a heat sink.

### HEAT SINK SELECTION:

To select a heat sink for the MSK5115, 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 MSK5115 is configured for  $V_{IN}=+5V$  and  $V_{OUT}=+3.3V$ .  $I_{out}$  is a continuous 1A DC level. The ambient temperature is +25°C. The maximum desired junction temperature is 125°C.

$R_{\theta jc} = 3.6^\circ\text{C/W}$  and  $R_{\theta cs} = 0.15^\circ\text{C/W}$  for most thermal greases

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

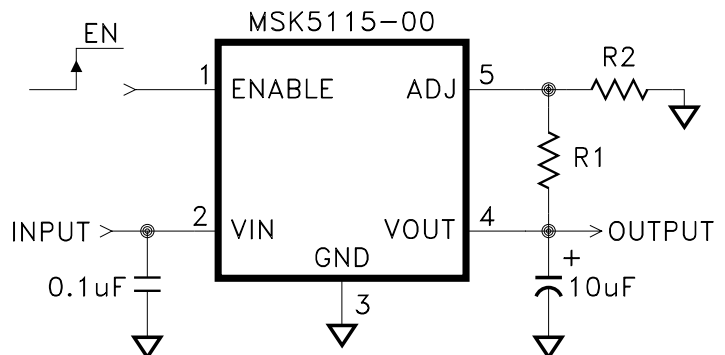
Solve for  $R_{\theta sa}$ :

$$\begin{aligned} R_{\theta sa} &= \left[ \frac{125^\circ\text{C} - 25^\circ\text{C}}{1.7\text{W}} \right] - 3.6^\circ\text{C/W} - 0.15^\circ\text{C/W} \\ &= 55.07^\circ\text{C/W} \end{aligned}$$

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.

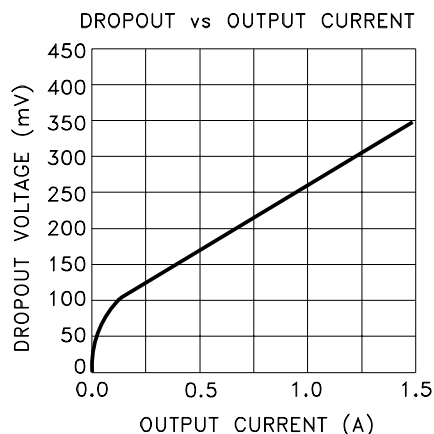
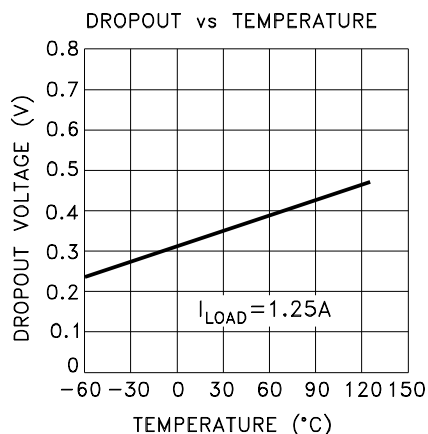
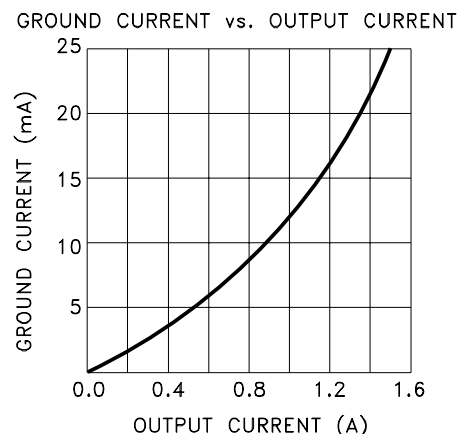
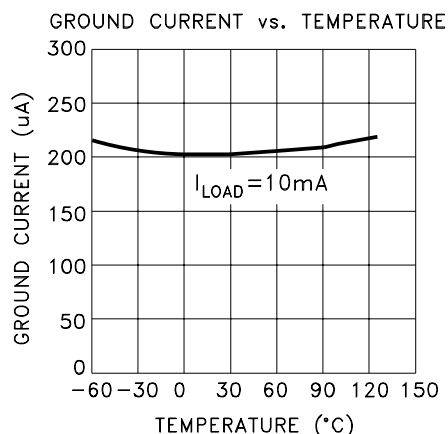
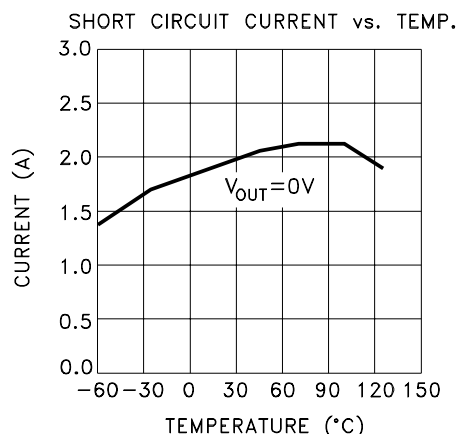
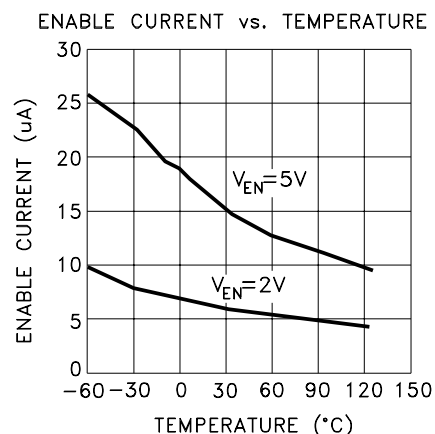
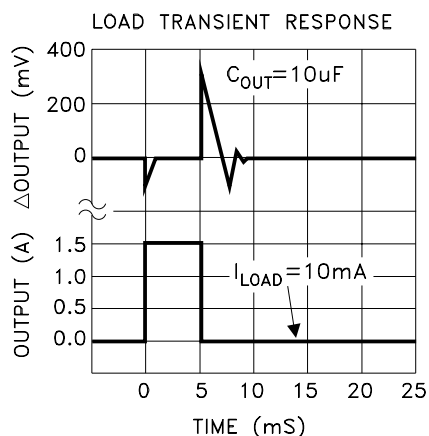
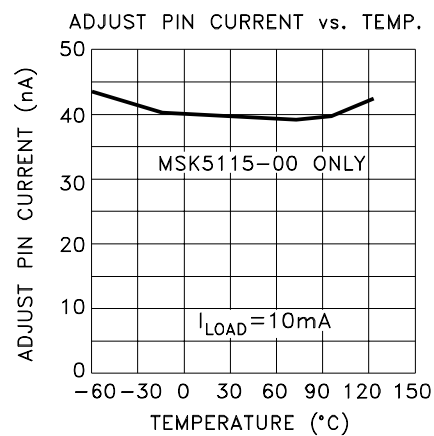
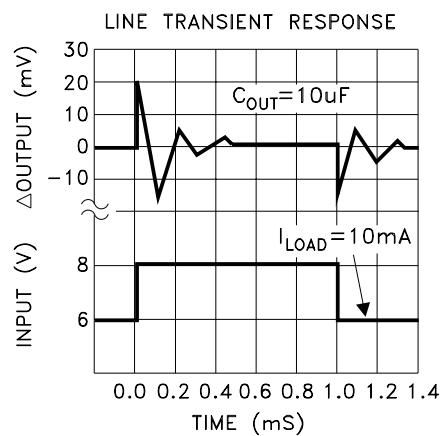
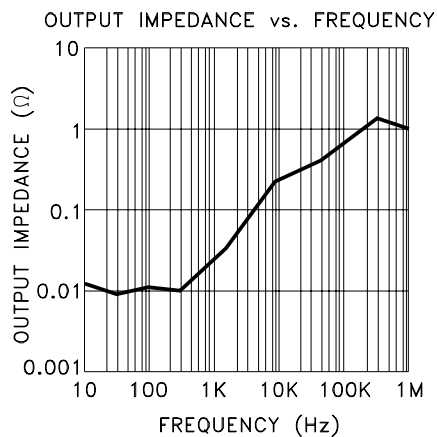
### MSK5115-00 OUTPUT ADJUSTMENT:

The diagram below illustrates proper adjustment technique for the output voltage. The series resistance of  $R_1+R_2$  should be selected to pass the minimum regulator output current requirement of 10mA.

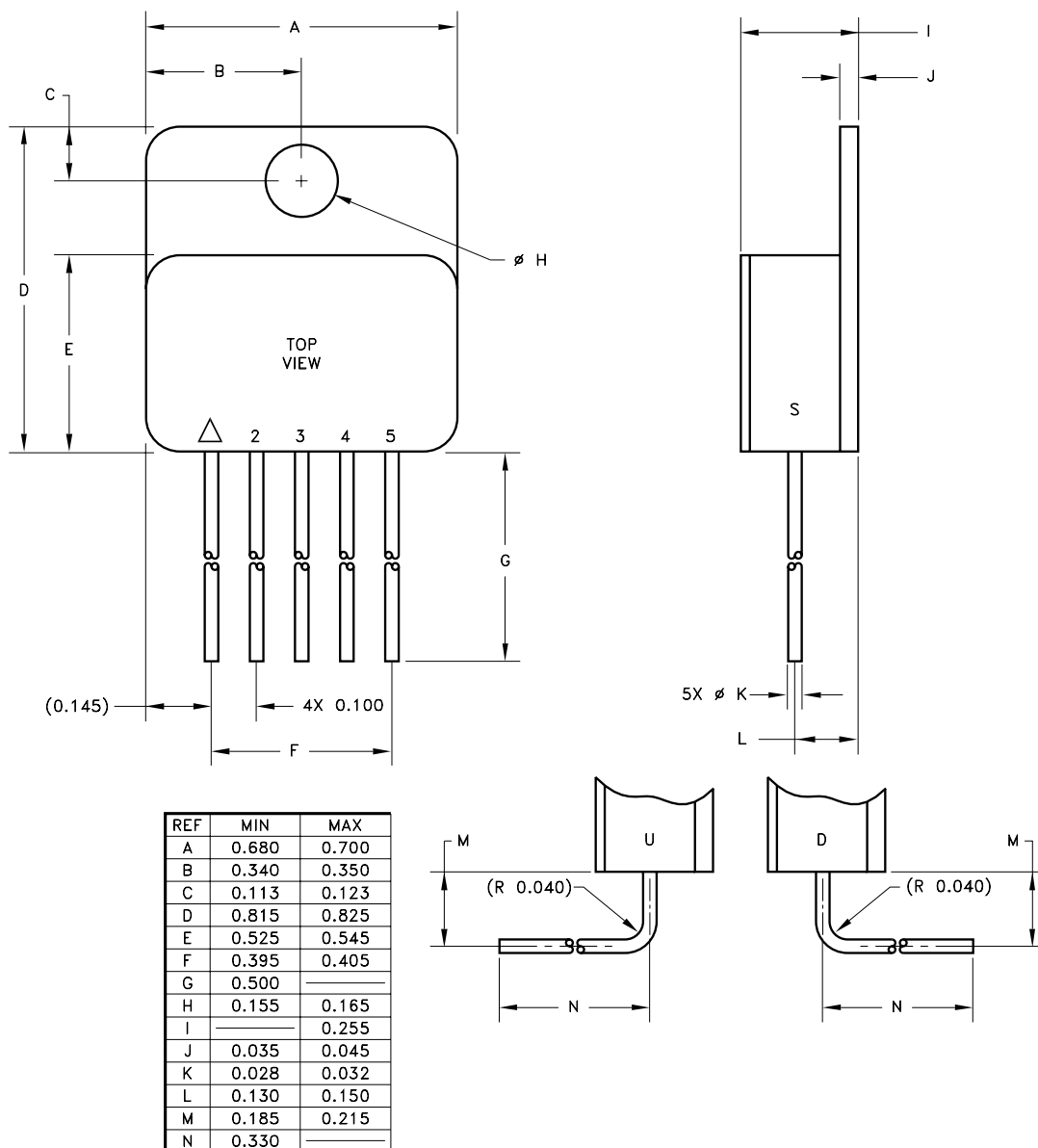


$$V_{OUT} = 1.240V \times \left[ 1 + (R_1/R_2) \right]$$

# TYPICAL PERFORMANCE CURVES



## MECHANICAL SPECIFICATIONS



ESD TRIANGLE INDICATES PIN 1  
WEIGHT=7.7 GRAMS TYPICAL

ALL DIMENSIONS ARE SPECIFIED IN INCHES

## ORDERING INFORMATION

MSK5115-00 B T U

LEAD CONFIGURATIONS

S= STRAIGHT; U= BENT UP; D= BENT DOWN

PACKAGE STYLE

T= TOP TAB

SCREENING

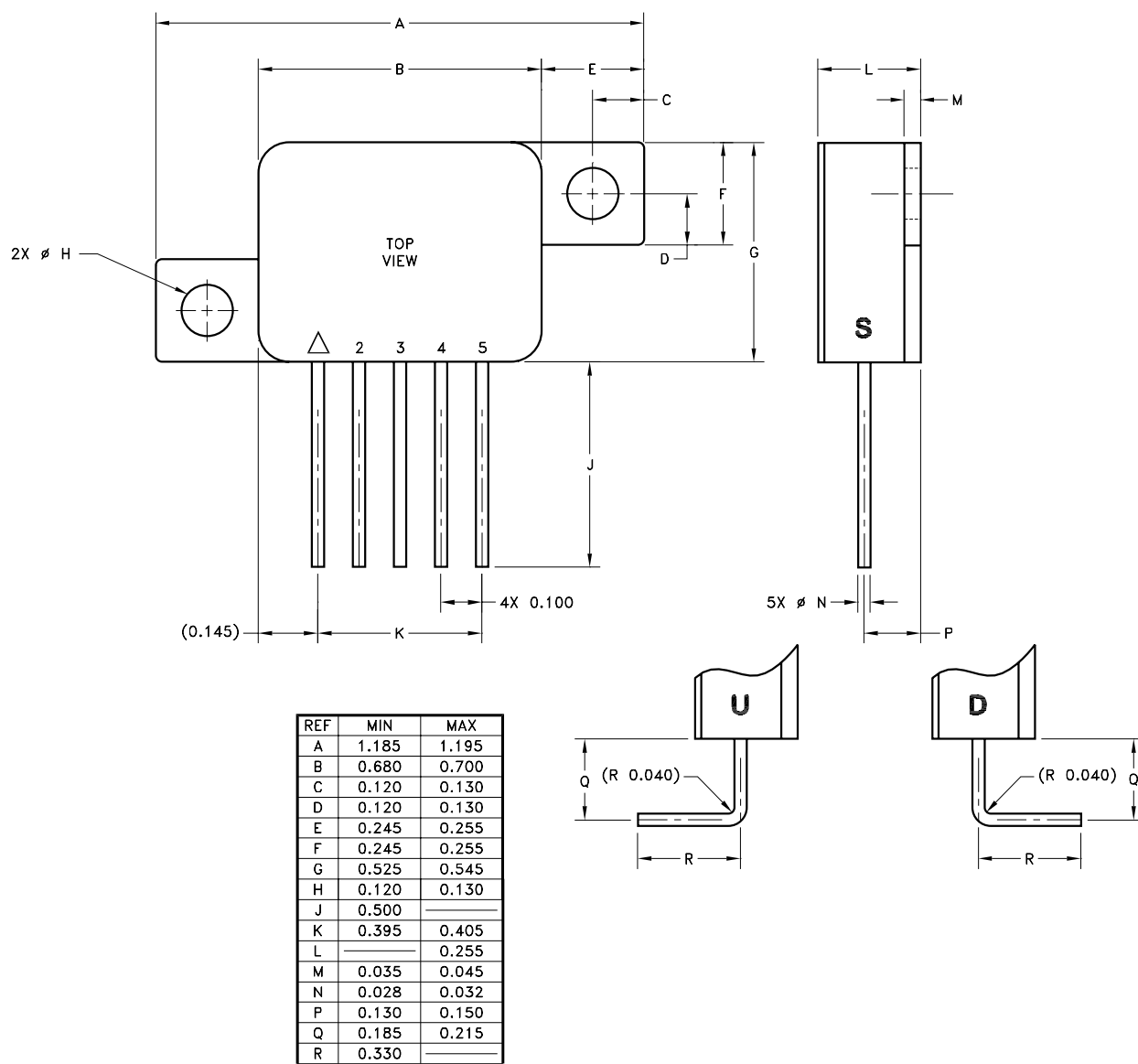
BLANK= INDUSTRIAL; B=MIL-PRF 38534 CLASS H

OUTPUT VOLTAGE

00=ADJ

GENERAL PART NUMBER

## MECHANICAL SPECIFICATIONS



ESD TRIANGLE INDICATES PIN 1  
WEIGHT=8.1 GRAMS TYPICAL

ALL DIMENSIONS ARE SPECIFIED IN INCHES

## ORDERING INFORMATION

**MSK5115-00 B Z U**

LEAD CONFIGURATIONS

S= STRAIGHT; U= BENT UP; D= BENT DOWN

PACKAGE STYLE

Z= Z PACK

SCREENING

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

OUTPUT VOLTAGE

00=ADJ

GENERAL PART NUMBER

## REVISION HISTORY

| REV | STATUS   | DATE  | DESCRIPTION                                                   |
|-----|----------|-------|---------------------------------------------------------------|
| K   | Released | 07/15 | Add ESD rating to absolute maximum ratings and update format. |

MSK  
[www.anaren.com/msk](http://www.anaren.com/msk)

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