

April 8, 1998

TEL:805-498-2111 FAX:805-498-3804 WEB:<http://www.semtech.com>

## DESCRIPTION

The SC1131/2/3/4 incorporates a high current low dropout linear regulator section together with a switching buck mode controller. This unique combination is well suited for high current low voltage power supply applications such as the Intel Pentium™ P55, AMD K6 and the Cyrix M2 processors. The SC113X was designed to reduce the number of components required to design a dual power supply for multivoltage processor applications.

**Switching Controller Section:** The switching control section is a voltage mode controller designed for high current, low voltage power supply applications. Key features include a temperature compensated voltage reference, triangular oscillator and an internally compensated transconductance error amplifier. The switching controller operates at a fixed frequency of 200kHz, providing an optimum compromise between size, efficiency and cost in the intended application areas.

**Linear Section:** The linear portion is a high performance positive voltage regulator designed for use in applications requiring "very low dropout performance" at 1.5, 3, 5 and 7.5 amps. Additionally, the linear section provides excellent regulation over variations due to changes in line, load or temperature.

## PIN CONFIGURATION



| Pin # | Pin Name             | Pin Function                      |
|-------|----------------------|-----------------------------------|
| 1     | DH                   | MOSFET Driver Output              |
| 2     | P <sub>GND</sub>     | Switching Power Ground            |
| 3     | V <sub>O SENSE</sub> | Error Amplifier Input (Switcher)  |
| 4     | GND                  | Signal Ground                     |
| 5     | V <sub>CC</sub>      | +12V Input Voltage                |
| 6     | V <sub>OUT</sub>     | V <sub>OUT</sub> (Linear Section) |
| 7     | V <sub>IN</sub>      | +5V Input Voltage                 |

## FEATURES

- 85% typical efficiency for switching section
- Grounded tab
- 1.5, 2.5 or 3.3V @ 1% for linear
- Thermal shutdown
- Internal short circuit protection
- 7 pin TO-220 package

## APPLICATIONS

- Microprocessor supplies
- Modules supplies
- 1.3V to 3.5V power supplies
- Dual power supplies from 5V source

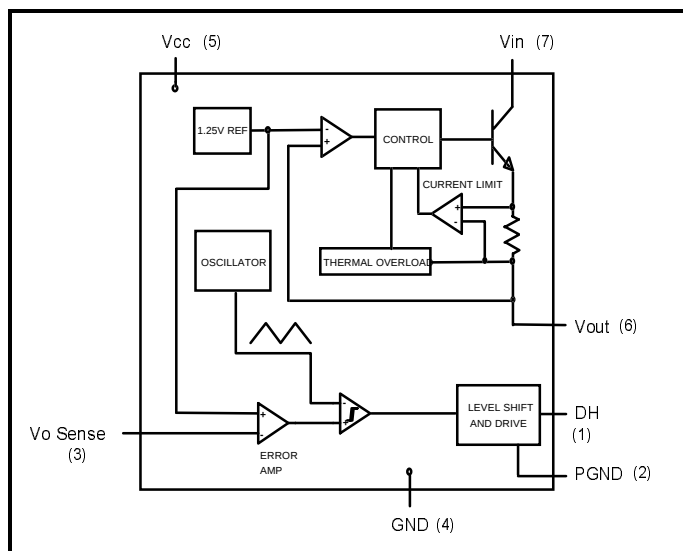
## ORDERING INFORMATION

| PART NUMBER <sup>(1)</sup> | PACKAGE | OUTPUT CURRENT |
|----------------------------|---------|----------------|
| SC1131CT-XY                | TO-220  | 1.5A           |
| SC1132CT-XY                | TO-220  | 3.0A           |
| SC1133CT-XY                | TO-220  | 5.0A           |
| SC1134CT-XY                | TO-220  | 7.5A           |

Note:

(1) Where XY denotes voltage options and lead configurations. Available voltages (X) are: 1.5V, 2.5V and 3.3V. Available lead configurations (Y) are dual bend (DB), single bend (SB) and straight leads (leave blank). Sample part number: SC1133CT-2.5DB.

## BLOCK DIAGRAM



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## ABSOLUTE MAXIMUM RATINGS

|                 |                                         |                 |
|-----------------|-----------------------------------------|-----------------|
| $V_{IN}$ to GND |                                         | -0.3V, 7V       |
| $V_{CC}$ to GND |                                         | -0.3V, 15V      |
| $T_J$           | Junction Operating Temperature          | 0°C to +125°C   |
| $T_S$           | Storage Temperature                     | -65°C to +125°C |
| $T_L$           | Lead Soldering Temperature              | 260°C, 10 sec.  |
| $\theta_{JC}$   | Thermal Resistance, Junction to Case    | 2°C/W           |
| $\theta_{JA}$   | Thermal Resistance, Junction to Ambient | 50°C/W          |

## ELECTRICAL CHARACTERISTICS

### SWITCHING CONTROL SECTION

$V_{CC} = 12V$ ;  $V_{IN} = 5.0V$ ;  $GND = P_{GND} = 0V$ ;  $V_{OUT} = 2.8V$ . Per application circuit unless otherwise specified.

| SYMBOL       | PARAMETER                    | CONDITIONS                       | TEMP     | MIN   | TYP   | MAX   | UNITS |
|--------------|------------------------------|----------------------------------|----------|-------|-------|-------|-------|
| $I_{CC}$     | Total Quiescent Current      | Linear out = No Load             | 25° C    |       | 15    | 25    | mA    |
| $V_{REF}$    | Reference Voltage            |                                  | 25° C    | 1.238 | 1.250 | 1.263 | V     |
|              |                              |                                  | 0-125° C | 1.225 | 1.250 | 1.275 |       |
| $Reg_{LOAD}$ | Load Regulation              |                                  | 25° C    |       |       | 1     | %     |
| $Reg_{LINE}$ | Line Regulation              |                                  | 25° C    |       | 0.5   |       | %     |
| $DH_{HI}$    | MOSFET Driver Source Voltage | $V_{CC} - DH$ ; $I_{DH} = 0.5A$  | 25° C    |       | 1.6   |       | V     |
| $DH_{LOW}$   | MOSFET Driver Sink Voltage   | $DH - P_{GND}$ ; $I_{DH} = 0.5A$ | 25° C    |       | 1.1   |       | V     |
| $f_{OSC}$    | Oscillator Frequency         |                                  | 25° C    | 180   | 200   | 220   | kHz   |
| dc           | Duty Cycle (maximum)         |                                  | 25° C    | 90    | 95    |       | %     |

### LINEAR SECTION

$V_{CC} = 12V$ ;  $V_{IN} = 5.0V$ ;  $GND = P_{GND} = 0V$ ;  $V_{OUT} = 3.3V$ . Per application circuit unless otherwise specified.

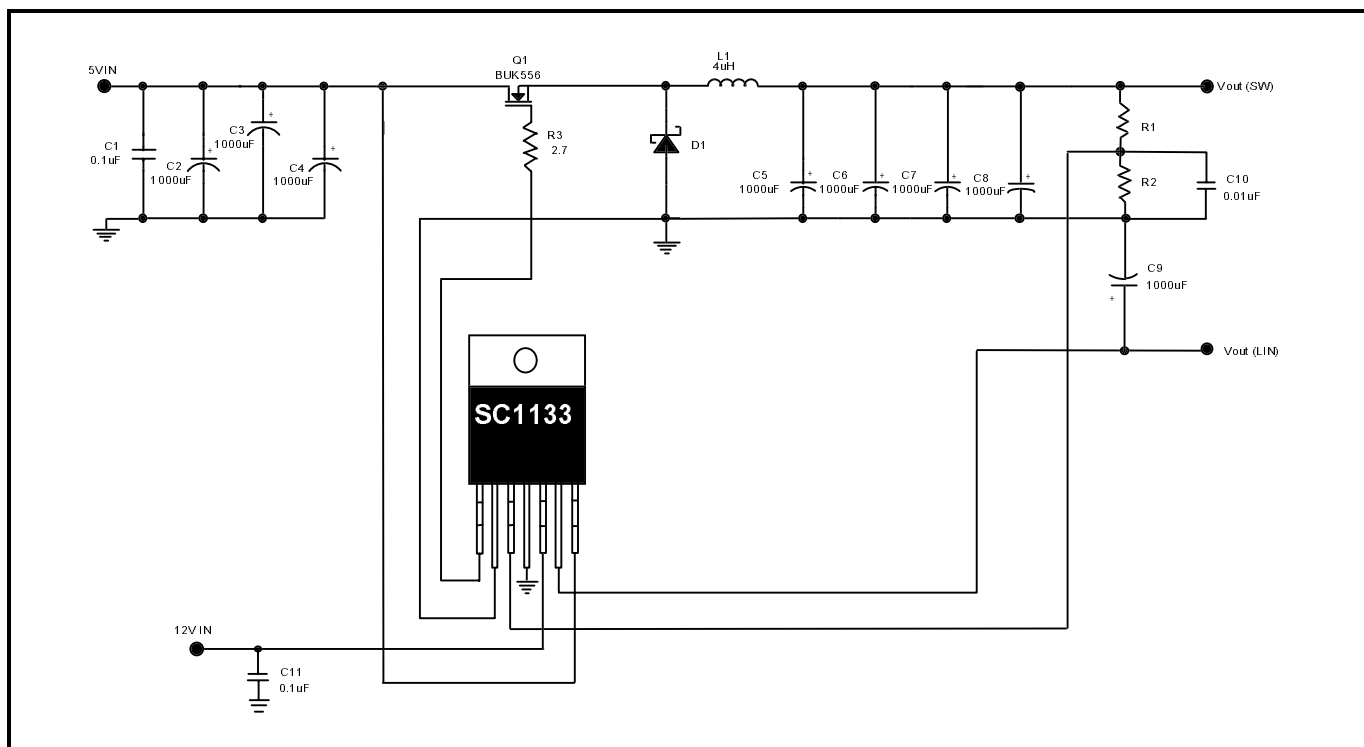
| SYMBOL       | PARAMETER                         | CONDITIONS                                        | TEMP         | MIN         | TYP   | MAX   | UNITS |
|--------------|-----------------------------------|---------------------------------------------------|--------------|-------------|-------|-------|-------|
| $V_{OUT}$    | Output Voltage                    | $V_{IN} = 5.0V$ , $I_{OUT} = I_R$                 | 25° C        | 3.267       | 3.300 | 3.333 | V     |
|              |                                   | $V_{IN} = 4.75-5.55V$ , $I_{OUT} = 10mA$ to $I_R$ | 0-125° C     | 3.234       | 3.300 | 3.366 |       |
| $Reg_{LOAD}$ | Load Regulation                   | $V_{IN} = 5.0V$ $I_{OUT} = 10mA$ to $I_R$         | 25° C        |             |       | 1     | %     |
|              |                                   |                                                   | 0-125 C      |             |       | 1.5   |       |
| $Reg_{LINE}$ | Line Regulation                   | $V_{IN} = 4.75-5.55V$ , $I_{OUT} = I_R$           | 25° C        |             | 0.5   |       | %     |
|              |                                   |                                                   | 0-125 C      |             | 1     |       |       |
| $I_{LIMIT}$  | Current Limit                     |                                                   | 25° C        | $I_R + 0.1$ |       |       | A     |
| $R_A$        | Ripple Rejection <sup>(1)</sup>   | $V_{IN} = 5.0V$ , $I_{OUT} = I_R/2$               | 25° C        | 60          | 80    |       | dB    |
| $T_{REG}$    | Thermal Regulation <sup>(2)</sup> |                                                   | 25° C        |             | 0.002 | 0.02  | %/°C  |
| $V_{DO}$     | Dropout Voltage <sup>(3)</sup>    | $I_{OUT} = I_R$                                   | SC1131, 2, 3 | 25° C       | 0.8   | 0.9   | V     |
|              |                                   |                                                   | SC1134       | 25° C       | 1.3   | 1.4   |       |
| $V_{IN}$     | Minimum $V_{IN}$                  | $I_{OUT} = I_R$                                   | SC1131, 2, 3 | 25° C       | 0.8   | 0.9   | V     |
|              |                                   |                                                   | SC1134       | 25° C       | 1.3   | 1.4   |       |

### NOTES:

- $V_{CC} = V_{IN} = 5.0V$  Avg;  $V_{RIPPLE} = 1V_{PK-PK}$ , 120 Hz.
- 30ms pulse
- Minimum input/output voltage required to maintain 1% regulation
- $I_R$  = Rated load current per ordering information

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## APPLICATION CIRCUIT

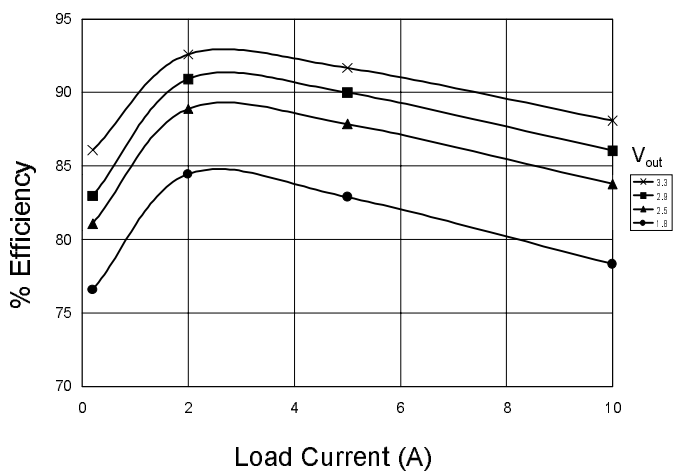


## MATERIALS LIST

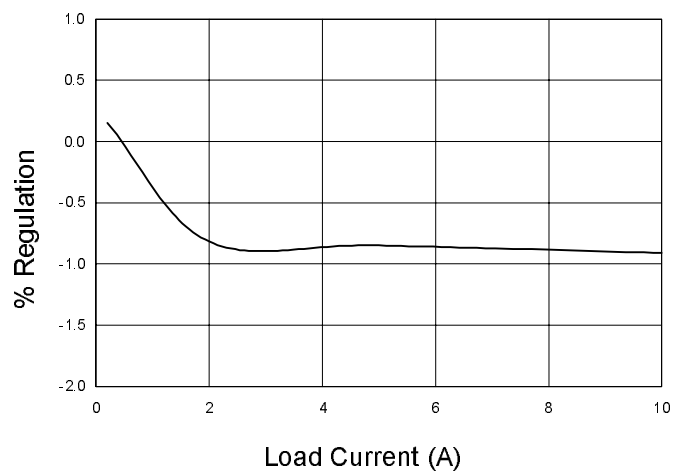
| Quantity | Reference | Part/Description | Vendor  | Notes                                         |
|----------|-----------|------------------|---------|-----------------------------------------------|
| 1        | C1,C11    | 0.1μF Ceramic    | Various |                                               |
| 1        | C10       | 0.01μF Ceramic   | Various |                                               |
| 8        | C2-C9     | 1000μF/6.3V      | SANYO   | MV-GX or equiv. Low ESR                       |
| 1        | D1        | 32CTQ030         | Various | 16A, 30V Schottky, TO-220                     |
| 1        | L1        | 4μH              |         | 8 Turns 16AWG on MICROMETALS T50-52D core     |
| 1        | Q1        | BUK556           | PHILIPS | Logic level FET, ≤ 22mΩ, 30V                  |
| 1        | U1        | SC1133T-XY       | SEMTECH | 5A Linear Regulator with Switching Controller |
| 1        | R1        | SMT 1%           | Various | Value depends on V <sub>OUT</sub>             |
| 1        | R2        | SMT 1%           | Various | Value depends on V <sub>OUT</sub>             |
| 1        | R3        | 2.7Ω 1/8W        | Various |                                               |

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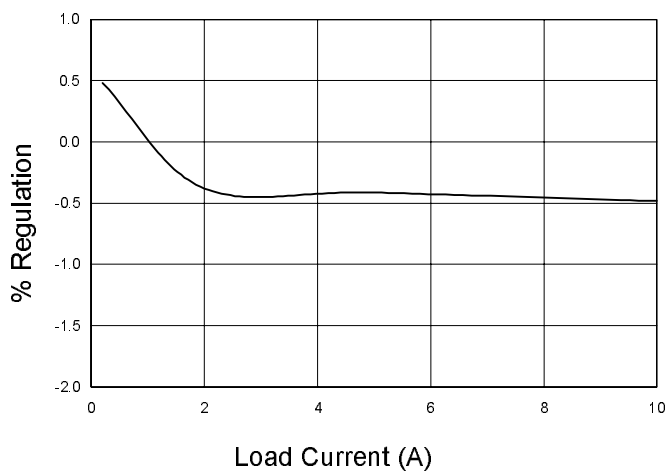
**SC113x Efficiency**



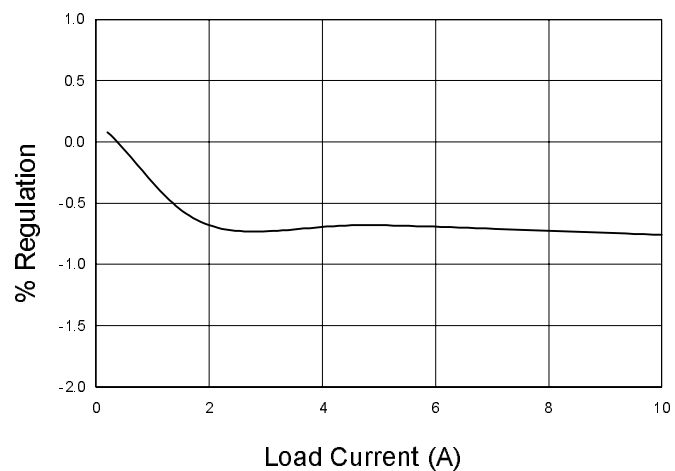
**% Load Regulation 3.3V, 0.3 to 10 Amps**



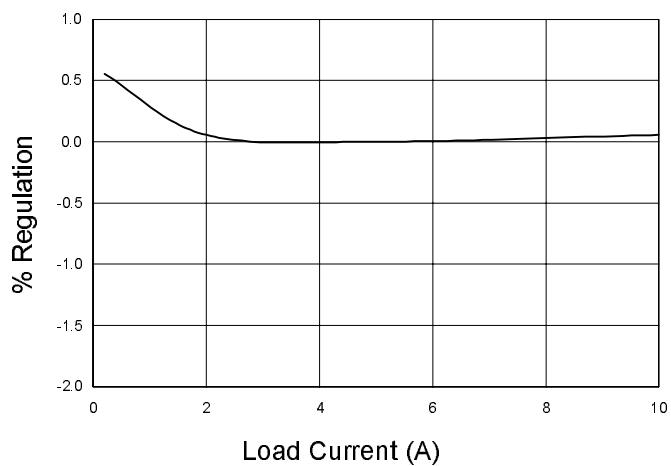
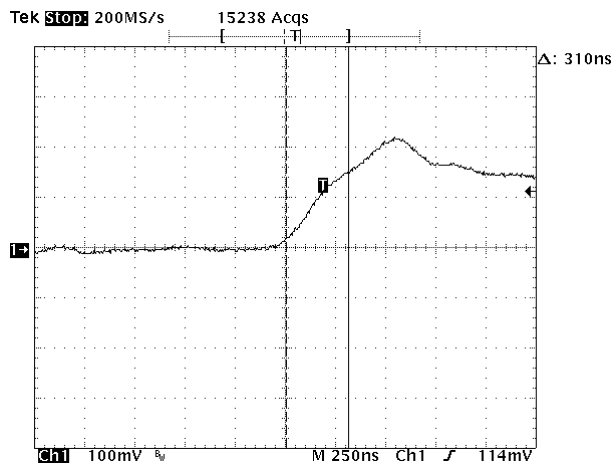
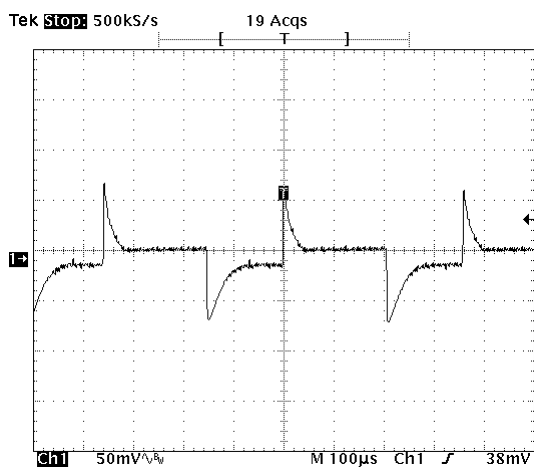
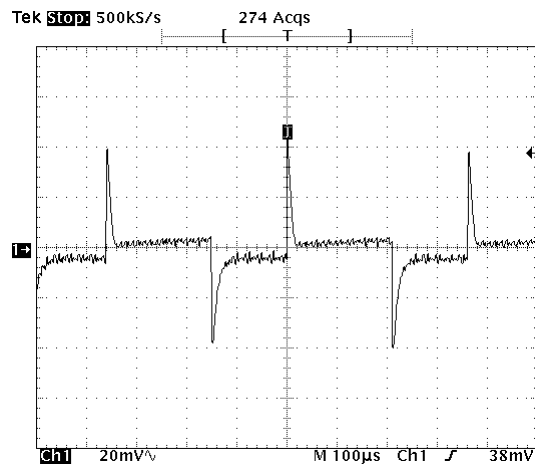
**% Load Regulation 2.9V, 0.3 to 10 Amps**



**% Load Regulation 2.3V, 0.2 to 10 Amps**

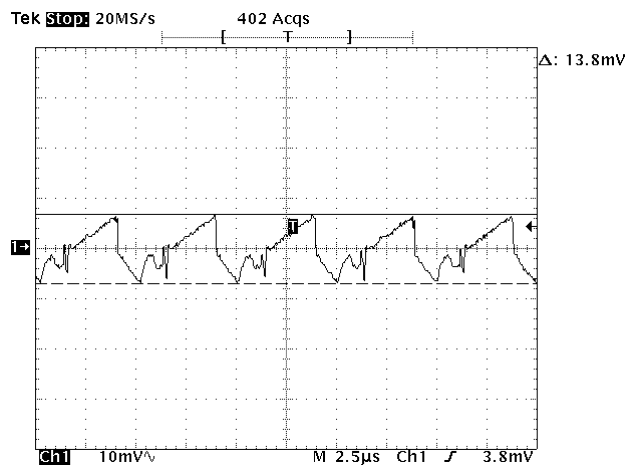


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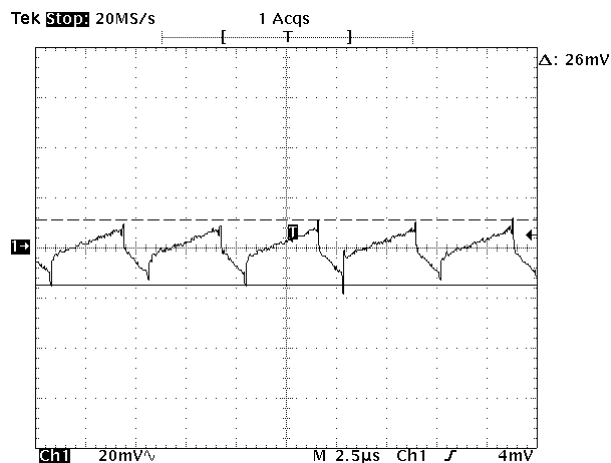
**% Load Regulation 1.8V, 0.2 to 10 Amps**

**Transient Load Current Rise 3.3V @ 10A**

**Transient Voltage Response 3.3V From 0.3 to 10A**

**Transient Voltage Response 1.8V From 0.2 to 10A**


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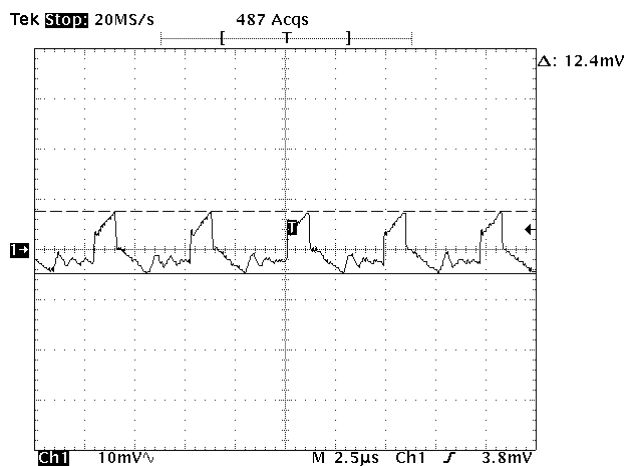
**Output Ripple 3.3V @ 0.3A**



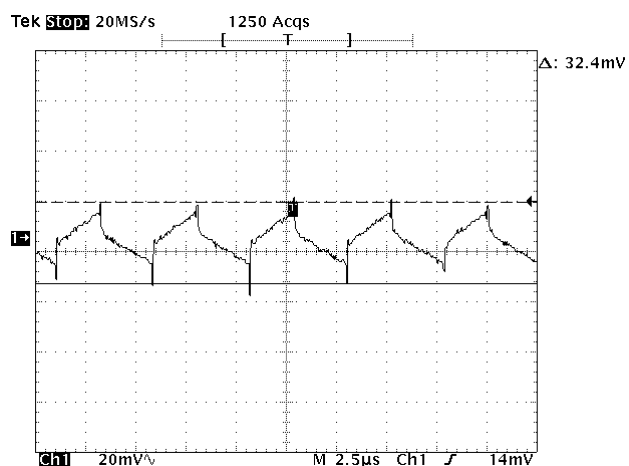
**Output Ripple 1.8V @ 0.2A**



**Output Ripple 3.3V @ 10A**

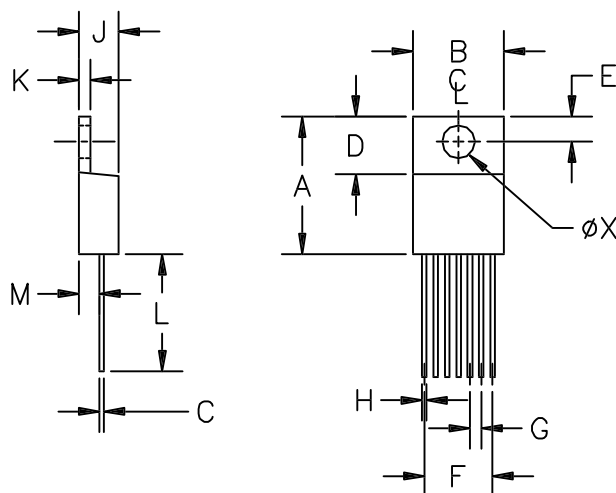


**Output Ripple 1.8V @ 10A**



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## OUTLINE TO-220 (STRAIGHT LEAD)

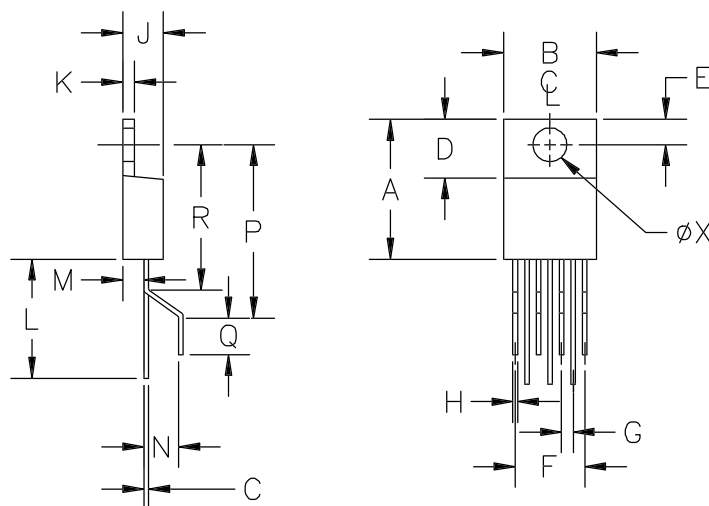


① CONTROLLING DIMENSION : INCHES.

| DIM <sup>N</sup> | INCHES |      | MM    |       | NOTE |
|------------------|--------|------|-------|-------|------|
|                  | MIN    | MAX  | MIN   | MAX   |      |
| A                | .590   | .660 | 14.22 | 14.99 | —    |
| B                | .385   | .415 | 9.78  | 10.54 | —    |
| C                | .015   | .022 | 0.38  | 0.56  | —    |
| D                | .234   | .258 | 5.94  | 6.55  | —    |
| E                | .103   | .113 | 2.62  | 2.87  | —    |
| F                | .295   | .305 | 7.49  | 7.75  | —    |
| G                | .045   | .055 | 1.14  | 1.40  | —    |
| H                | .023   | .037 | .058  | 0.94  | —    |
| J                | .160   | .190 | 4.06  | 4.83  | —    |
| K                | .045   | .055 | 1.14  | 1.40  | —    |
| L                | .580   | .640 | 13.72 | 14.22 | —    |
| M                | .090   | .115 | 2.29  | 2.92  | —    |
| ØX               | .146   | .156 | 3.71  | 3.96  | —    |

JEDEC TO-220

## OUTLINE: TO-220-SB (SINGLE BEND LEAD)

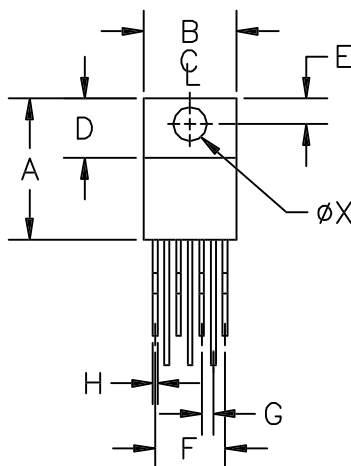
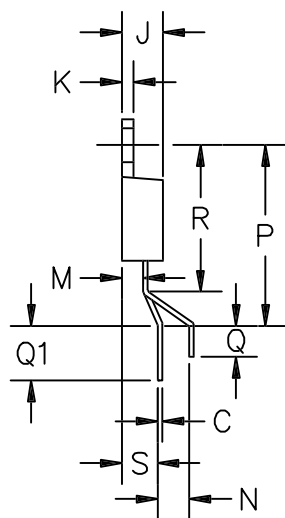


① CONTROLLING DIMENSION : INCHES.

| DIM <sup>N</sup> | INCHES |      | MM    |       | NOTE |
|------------------|--------|------|-------|-------|------|
|                  | MIN    | MAX  | MIN   | MAX   |      |
| A                | .560   | .590 | 14.22 | 14.99 | —    |
| B                | .385   | .415 | 9.78  | 10.54 | —    |
| C                | .015   | .022 | 0.38  | 0.56  | —    |
| D                | .234   | .258 | 5.94  | 6.55  | —    |
| E                | .103   | .113 | 2.62  | 2.87  | —    |
| F                | .295   | .305 | 7.49  | 7.75  | —    |
| G                | .045   | .055 | 1.14  | 1.40  | —    |
| H                | .023   | .035 | .058  | 0.89  | —    |
| J                | .160   | .190 | 4.06  | 4.83  | —    |
| K                | .045   | .055 | 1.14  | 1.40  | —    |
| L                | .540   | .560 | 13.72 | 14.22 | —    |
| M                | .090   | .115 | 2.29  | 2.92  | —    |
| N                | .205   | .225 | 5.21  | 5.72  | —    |
| P                | .745   | .765 | 18.92 | 19.43 | —    |
| Q                | .155   | .175 | 3.94  | 4.45  | —    |
| R                | .605   | .625 | 15.37 | 15.88 | —    |
| ØX               | .146   | .156 | 3.71  | 3.96  | —    |

JEDEC TO-220 (BODY ONLY)

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**OUTLINE: TO-220-DB (DUAL BEND LEAD)**


| DIMENSIONS       |        |      |       |       |      |
|------------------|--------|------|-------|-------|------|
| DIM <sup>N</sup> | INCHES |      | MM    |       | NOTE |
|                  | MIN    | MAX  | MIN   | MAX   |      |
| A                | .560   | .590 | 14.22 | 14.99 | —    |
| B                | .385   | .415 | 9.78  | 10.54 | —    |
| C                | .015   | .022 | 0.38  | 0.56  | —    |
| D                | .234   | .258 | 5.94  | 6.55  | —    |
| E                | .103   | .113 | 2.62  | 2.87  | —    |
| F                | .295   | .305 | 7.49  | 7.75  | —    |
| G                | .045   | .055 | 1.14  | 1.40  | —    |
| H                | .023   | .035 | .058  | 0.89  | —    |
| J                | .160   | .190 | 4.06  | 4.83  | —    |
| K                | .045   | .055 | 1.14  | 1.40  | —    |
| M                | .095   | .115 | 2.413 | 2.921 | —    |
| N                | .135   | .165 | 3.429 | 4.191 | —    |
| P                | .700   | .728 | 17.78 | 18.49 | —    |
| Q                | .152   | .202 | 3.861 | 5.130 | —    |
| Q1               | .260   | .320 | 6.604 | 8.128 | —    |
| R                | .620   | —    | 15.75 | —     | TYP  |
| S                | .155   | .190 | 3.937 | 4.826 | —    |
| ØX               | .146   | .156 | 3.71  | 3.96  | —    |

JEDEC TO-220 (BODY ONLY)

① CONTROLLING DIMENSION : INCHES.