# SC113X
# Combination Switching Controller and Low Dropout Regulator



## Description

The SC1131/2/3/4 incorporates a high current low dropout linear regulator section together with a switching voltage-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.

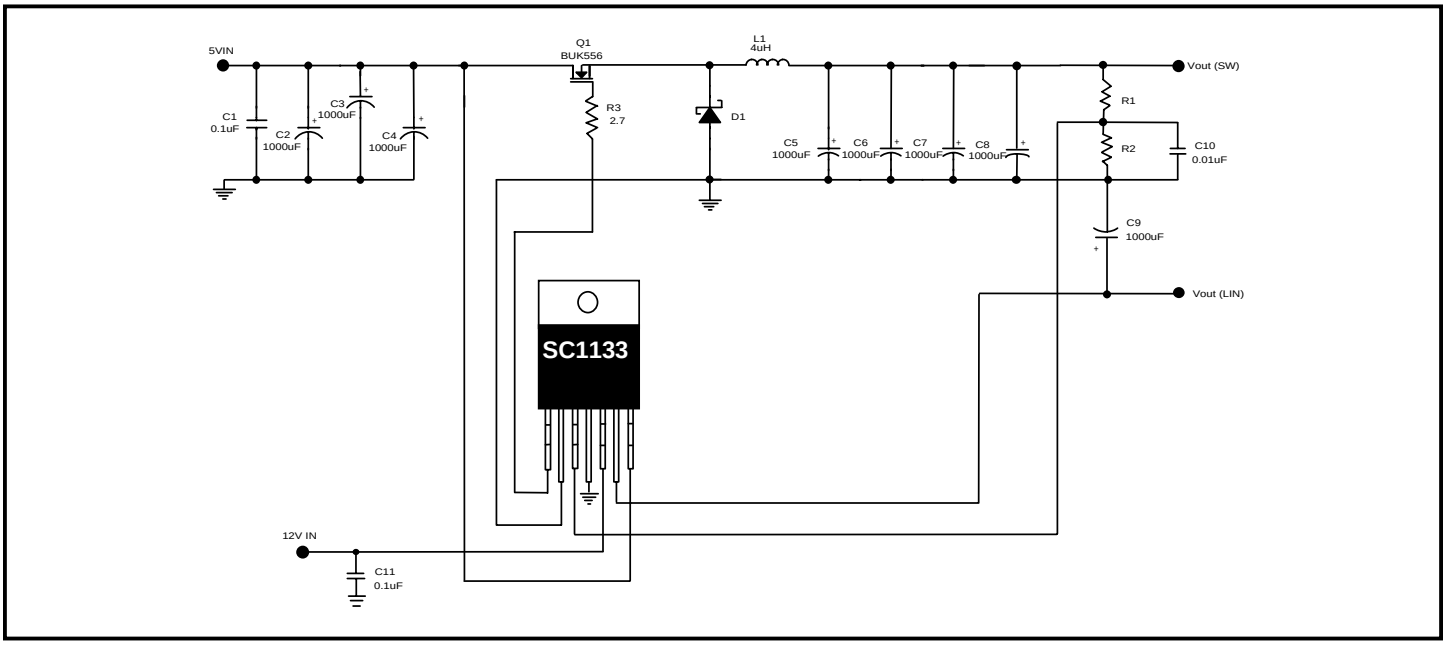
## Features

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

## Applications

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

## Typical Application Circuit



## Absolute Maximum Ratings

| | | |
|---|---|---|
| | $V_{IN}$ to GND | -0.3V, 7V |
| | $V_{CC}$ to GND | -0.3V, 15V |
| Operating Temperature | $T_A$ | 0°C to +70°C |
| Junction Operating Temperature | $T_J$ | 0°C to +125°C |
| Storage Temperature | $T_S$ | -65°C to +125°C |
| Lead Soldering Temperature | $T_L$ | 260°C, 10 sec. |
| Thermal Resistance, Junction to Case | $\theta_{JC}$ | 2°C/W |
| Thermal Resistance, Junction to Ambient | $\theta_{JA}$ | 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 specifi

| 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 | | % |

## Electrical Characteristics (Cont.)

### Linear Section

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

| Parameter | Symbol | $V_{IN}$ | $I_o$ | $T_J$ (4) | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|---|
| Output Voltage Fixed Voltage Version | $V_O$ | 5V | OmA | 25°C | -1% | $V_{OUT}$ | +1% | V |
| | | | | O.T. | -2% | $V_{OUT}$ | +2% | |
| Reference Voltage Adj Voltage Version | $V_{REF}$ | 5V | 10mA | 25°C | 1.238 | 1.250 | 1.262 | V |
| | | | | O.T. | 1.225 | 1.250 | 1.275 | |
| Line Regulation Fixed Voltage Version Adj Voltage Version | $REG_{(LINE)}$ | | | 25°C | | 0.005 | 0.2 | % |
| | | | 0mA | O.T. | | 0.035 | 0.2 | |
| | | | 10mA | | | | | |
| Load Regulation (1) | $REG_{(LOAD)}$ | $I_R$ | | 25°C | | 0.05 | 0.3 | % |
| | | | | O.T. | | 0.2 | 0.4 | |
| Dropout Voltage (2) | $V_D$ | | | 25°C | | 1 | | V |
| | | | | O.T. | | 1.1 | 1.3 | |
| Quiescent Current Fixed Voltage Version | $I_Q$ | 5V | | O.T. | | 10 | 13 | mA |
| Temperature Coefficient | $T_C$ | | | O.T. | | 0.004 | 0.02 | %/°C |

**NOTES:**

(1) $I_R$ = Rated load current per ordering information

(2) Minimum input/output voltage required to maintain 1% regulation

## Pin Configuration

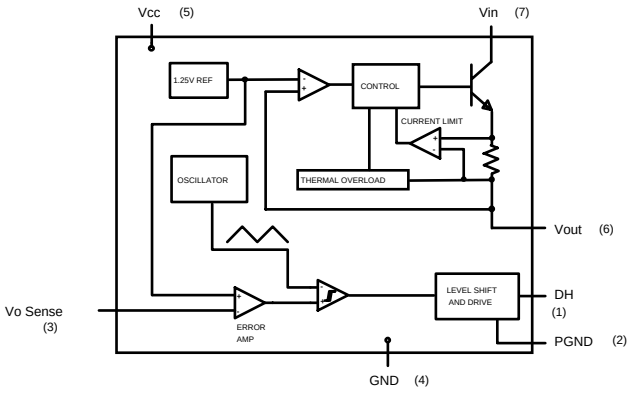

| Pin # | Pin Name | Function |
|---|---|---|
| 1 | DH | MOSFET Driver Output |
| 2 | $P_{GND}$ | Switching Power Ground |
| 3 | $Vo_{SENSE}$ | Error Amplifier Input (Switcher) |
| 4 | GND | Signal Ground |
| 5 | $V_{CC}$ | +12V Input Voltage |
| 6 | $V_{OUT}$ | $V_{OUT}$ (Linerar Section) |
| 7 | $V_{IN}$ | +5V Input Voltage |

## Ordering Information

| Part Number (1) | 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 |

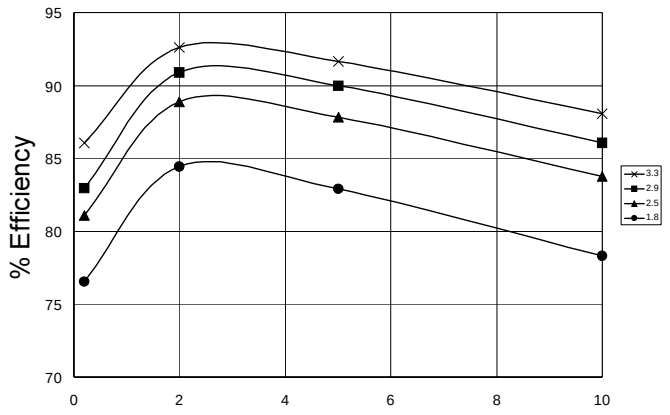
Note:
(1) Where XY denotes voltage options and lead configurations. Available voltages (X) are: 1.5V, 2.5V and 3.3V. Available lead configurations (Y) are dual bend (DB), single bend (SB) and straight leads (leave blank). Sample part number: SC1133CT-2.5DB.

## Block Diagram

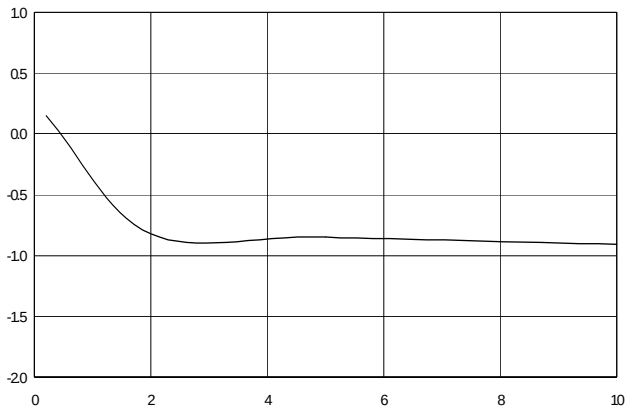


## Typical Characteristics

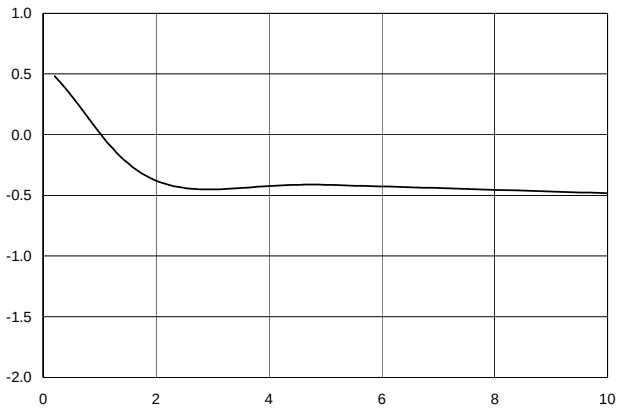
SC113x Efficiency



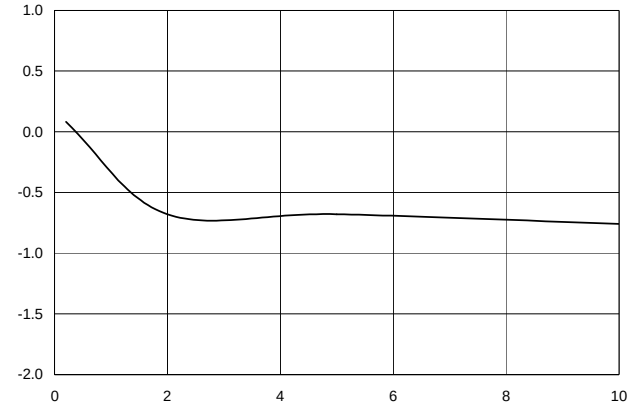

% Load Regulation 3.3V, 0.3 to 10 Amps



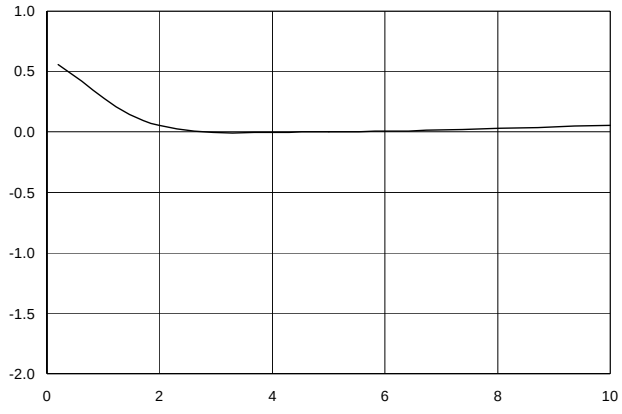

% Load Regulation 2.9V, 0.3 to 10 Amps



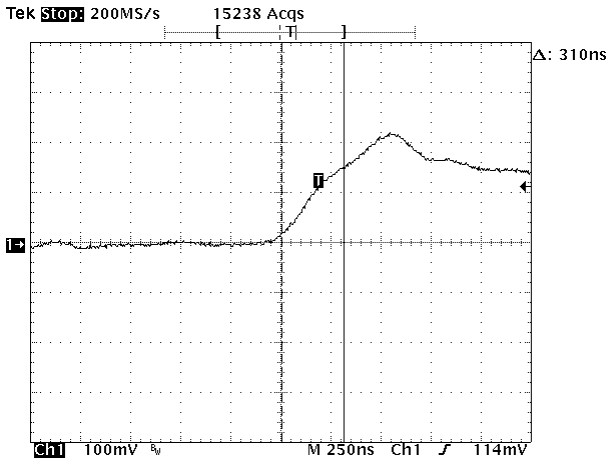

% Load Regulation 2.3V, 0.2 to 10 Amps



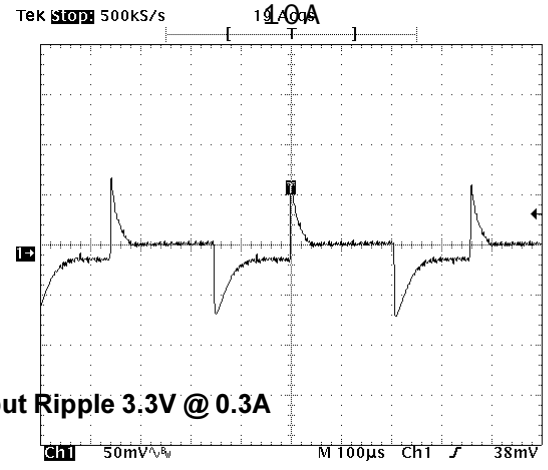

% Load Regulation 1.8V, 0.2 to 10 Amps



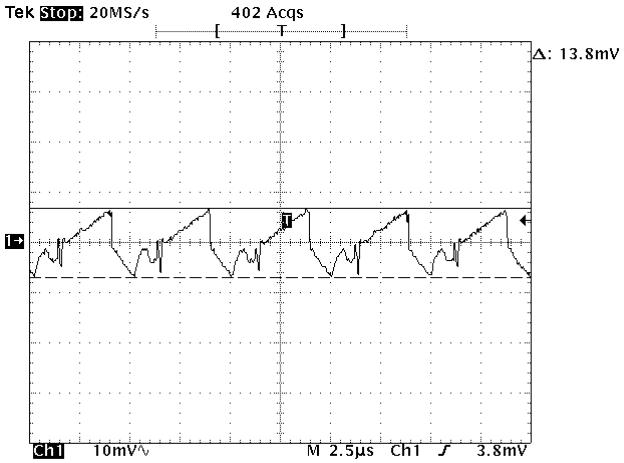

Transient Load Current Rise 3.3V @ 10A



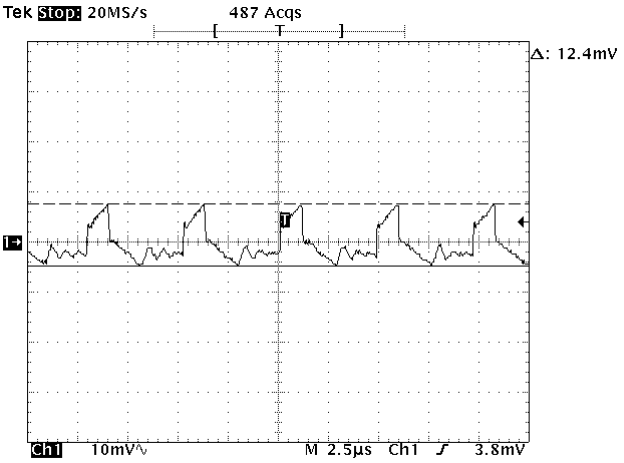
Transient Voltage Response 3.3V From 0.3 to 1.0A



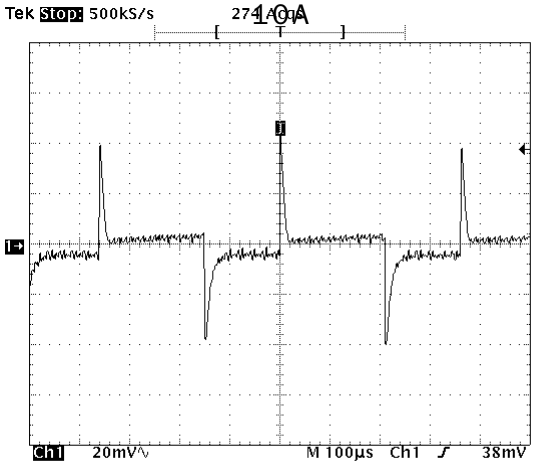

Output Ripple 3.3V @ 0.3A



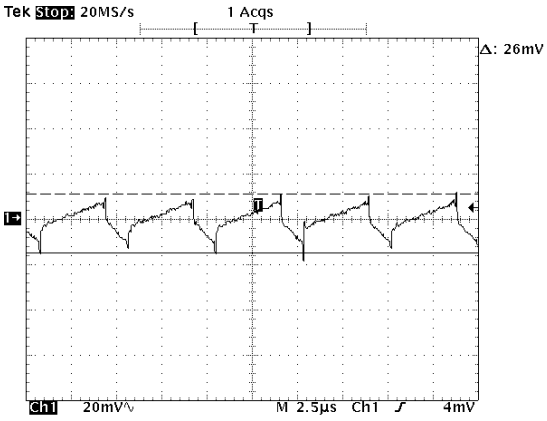

Output Ripple 3.3V @ 10A



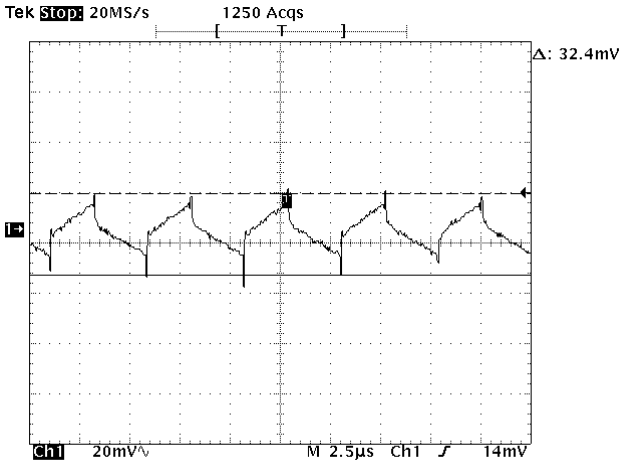

Transient Voltage Response 1.8V From 0.2 to 1.0A




Output Ripple 1.8V @ 0.2A



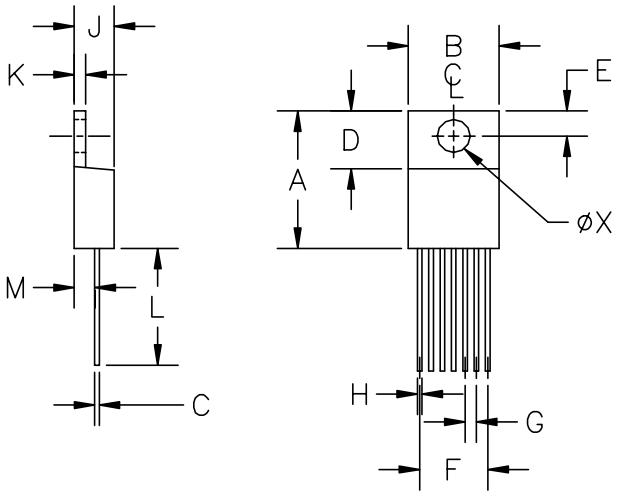

Output Ripple 1.8V @ 10A



## Evaluation Board Bill of Materials

| 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-AX or equiv. LowESR |
| 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 $V_{OUT}$ |
| 1 | R2 | SMT 1% | Various | Value depends on $V_{OUT}$ |
| 1 | R3 | 2.7Ω 1/8W | Various | |

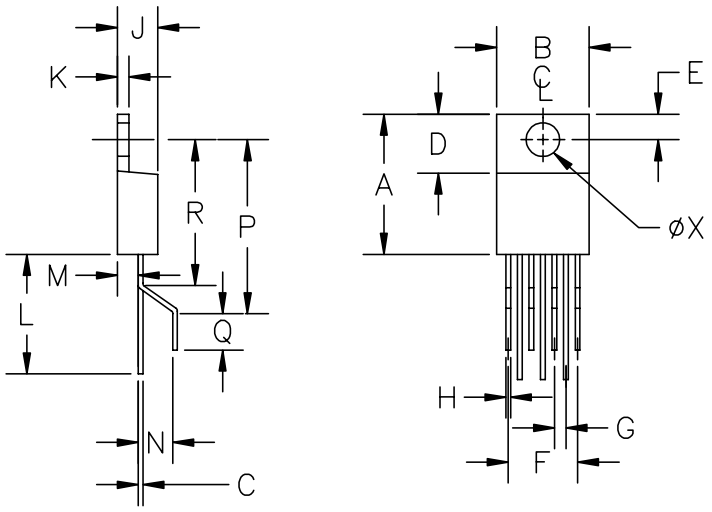
## Outline Drawing - TO-220 (Straight Lead)




| DIMENSIONS | | | | | |
|---|---|---|---|---|---|
| DIM N | 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 | — |

(1) CONTROLLING DIMENSION : INCHES.

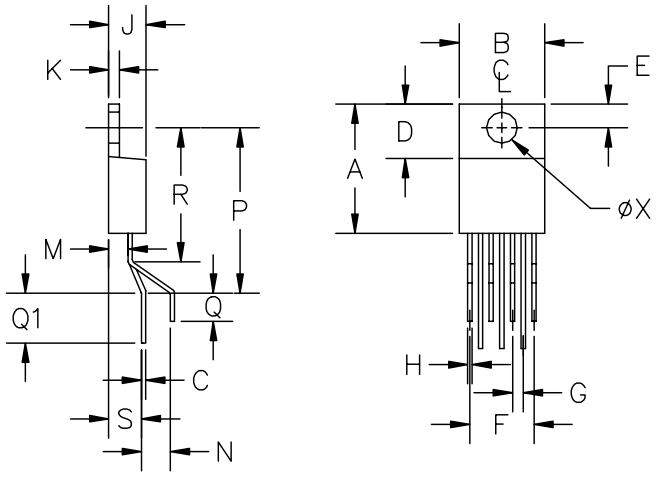
## Outline Drawing - TO-220 (Single Bend Lead)




| DIMENSIONS | | | | | |
|---|---|---|---|---|---|
| DIM | 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 | — |

(1) CONTROLLING DIMENSION : INCHES.

## Outline Drawing - TO-220 (Dual Bend Lead)




| DIMENSIONS | | | | | |
|---|---|---|---|---|---|
| DIM | 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 | — |

(1) CONTROLLING DIMENSION : INCHES.

## Contact Information

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