



3A Low Dropout Regulator

Features

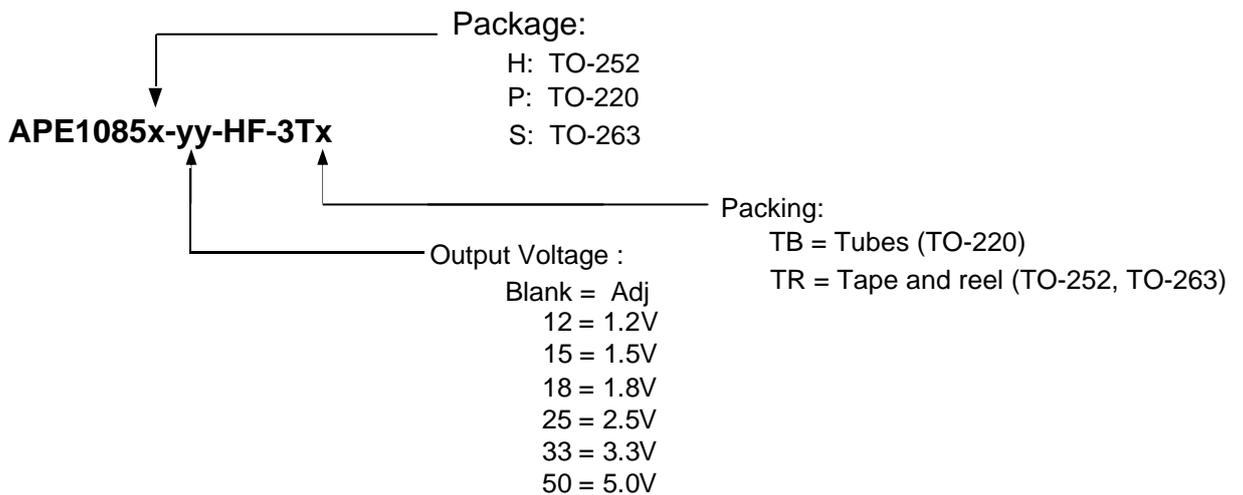
- 3-Terminal Adjustable or Fixed 1.2V, 1.5V, 1.8V, 2.5V, 3.3V or 5.0V Output
- Maximum Dropout 1.4V at Full Load Current
- Fast Transient Response
- Built-in Thermal Shutdown
- Output Current Limiting
- Good Noise Rejection
- Packages: TO-220, TO-252, TO-263
- RoHS-compliant halogen-free packages

Description

The APE1085 is a low dropout positive adjustable or fixed-mode regulator with minimum output current capability of 3.0A. The product is specifically designed to provide a well-regulated supply for low-voltage IC applications such as high-speed bus termination and low current 3.3V logic supplies.

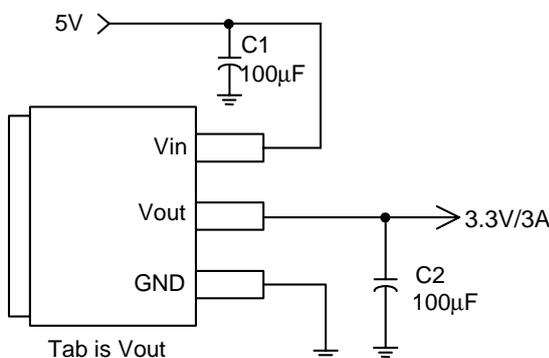
The APE1085 is also well suited for other applications such as VGA cards, and is guaranteed to have less than 1.4V dropout at full load current, making it ideal for providing well-regulated outputs of 1.2V to 5.0V from inputs up to 12V inputs.

Ordering Information

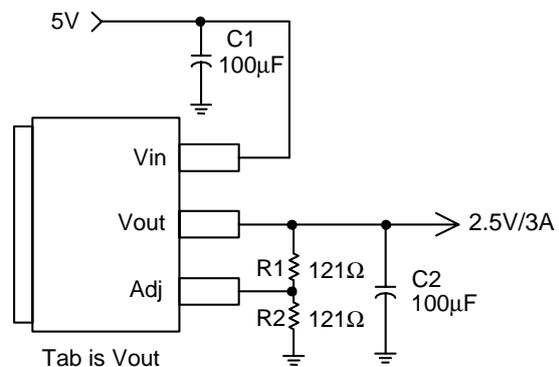


Typical Applications

5.0V to 3.3V Fixed Mode Regulator



Adjustable Regulator



Note: $V_O = V_{REF} * (1 + \frac{R_2}{R_1})$



Absolute Maximum Ratings

| Symbol | Parameter | Rating | Unit |
|-----------------|--------------------------------------|--------------------|------|
| V _{IN} | DC Supply Voltage | -0.3 to 12 | V |
| P _D | Power Dissipation | Internally Limited | |
| T _{ST} | Storage Temperature | -65 to +150 | °C |
| T _{OP} | Operating Junction Temperature Range | 0 to +150 | °C |

Electrical Specifications

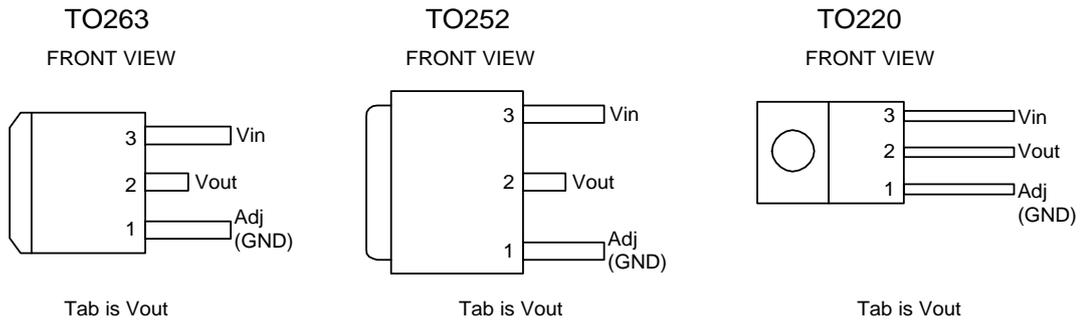
| Sym. | Parameter | Conditions (Notes) | Min. | Typ. | Max. | Unit |
|------------------|--|--|-------|----------------------------|-------|------|
| V _{REF} | Reference Voltage | I _O =10mA, T _J =25°C, (V _{IN} -V _{OUT})=1.5V | 1.225 | 1.250 | 1.275 | V |
| Line Regulation | APE1085-XX | I _O =10mA, V _{OUT} +1.5V<V _{IN} <12V, T _J =25°C | | 0.2 | 0.5 | % |
| | APE1085-12 | I _{OUT} = 10mA, T _J = 25°C, 3V<V _{IN} <12V | 1.176 | 1.200 | 1.224 | V |
| | APE1085-15 | I _{OUT} = 10mA, T _J = 25°C, 3V<V _{IN} <12V | 1.470 | 1.500 | 1.530 | V |
| | APE1085-18 | I _{OUT} = 10mA, T _J = 25°C, 3.3V<V _{IN} <12V | 1.764 | 1.800 | 1.836 | V |
| | APE1085-25 | I _{OUT} = 10mA, T _J = 25°C, 4V<V _{IN} <12V | 2.450 | 2.500 | 2.550 | V |
| | APE1085-33 | I _{OUT} = 10mA, T _J = 25°C, 4.8V<V _{IN} <12V | 3.235 | 3.300 | 3.365 | V |
| | APE1085-50 | I _{OUT} = 10mA, T _J = 25°C, 6.5V<V _{IN} <12V | 4.900 | 5.000 | 5.100 | V |
| Load Regulation | APE1085-Adj | V _N =3.3V, 0mA<I _O <3A, T _J =25°C (Note 1,2) | | | 1 | % |
| | APE1085-12 | V _N =3V, 0mA<I _O <3A, T _J =25°C (Note 1,2) | | 10 | 12 | mV |
| | APE1085-15 | V _N =3V, 0mA<I _O <3A, T _J =25°C (Note 1,2) | | 12 | 15 | mV |
| | APE1085-18 | V _N =3.3V, 0mA<I _O <3A, T _J =25°C (Note 1,2) | | 15 | 18 | mV |
| | APE1085-25 | V _N =4V, 0mA<I _O <3A, T _J =25°C (Note 1,2) | | 20 | 25 | mV |
| | APE1085-33 | V _N = 5V, 0mA<I _O <3A, T _J =25°C (Note 1,2) | | 26 | 33 | mV |
| | APE1085-50 | V _N = 8V, 0mA<I _O <3A, T _J =25°C (Note 1,2) | | 40 | 50 | mV |
| ΔV _O | Dropout Voltage | I _O =3.0A (ΔV _{OUT} = 1% V _{OUT}) | | 1.3 | 1.4 | V |
| | Current Limit | V _{IN} -V _{OUT} =5V | 5.1 | | | A |
| | Minimum Load Current | | | 5 | 10 | mA |
| | Temperature Stability | I _O =10mA | | 0.5 | | % |
| θ _{JA} | Thermal Resistance Junction-to-Ambient (No heat sink ;No air flow) | TO-252 TO-263 TO-220 | | 98 83 83 | | °C/W |
| θ _{JC} | Thermal Resistance Junction-to-Case | TO-252: Control Circuitry/Power Transistor TO-263: Control Circuitry/Power Transistor TO-220: Control Circuitry/Power Transistor | | 10 0.65/2.7 0.65/2.7 | | °C/W |

Note 1: See thermal regulation specifications for changes in output voltage due to heating effects. Line and load regulation are measured at a constant junction temperature by low duty cycle pulse testing. Load regulation is measured at the output lead = 1/18" from the package.

Note 2: Line and load regulation are guaranteed up to the maximum power dissipation of 15W. Power dissipation is determined by the difference in input and output and the output current. Guaranteed maximum power dissipation will not be available over the full input/output range.



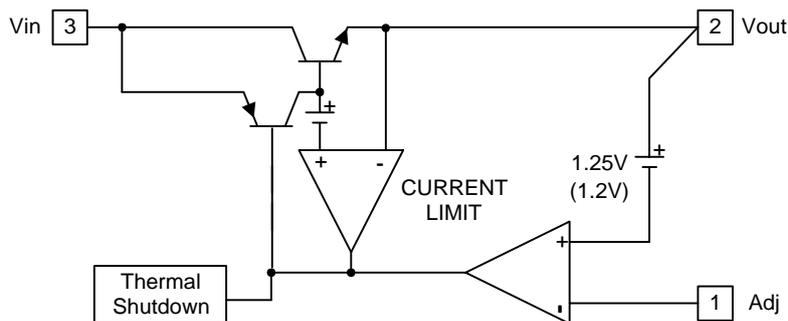
Pin Configuration



Pin Descriptions

| Name | I/O | Pin No. | Function |
|-----------|-----|---------|--|
| Adj (GND) | I | 1 | Adjustable (Ground only for fixed mode) A resistor divider from this pin to the Vout pin and ground sets the output voltage. |
| Vout | O | 2 | The output of the regulator. A capacitor of at least 10uF with $(0.15\Omega < ESR < 20\Omega)$ must be connected from this pin to ground to ensure stability. |
| Vin | I | 3 | The input pin of regulator. Typically a large storage capacitor with $(0.15\Omega < ESR < 20\Omega)$ is connected from this pin to ground to ensure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be 1.4V (1.3V) higher than Vout in order for the device to regulate properly. |

Block Diagram



THIS PRODUCT IS SENSITIVE TO ELECTROSTATIC DISCHARGE, PLEASE HANDLE WITH CAUTION.

USE OF THIS PRODUCT AS A CRITICAL COMPONENT IN LIFE SUPPORT OR OTHER SIMILAR SYSTEMS IS NOT AUTHORIZED.

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Application Information

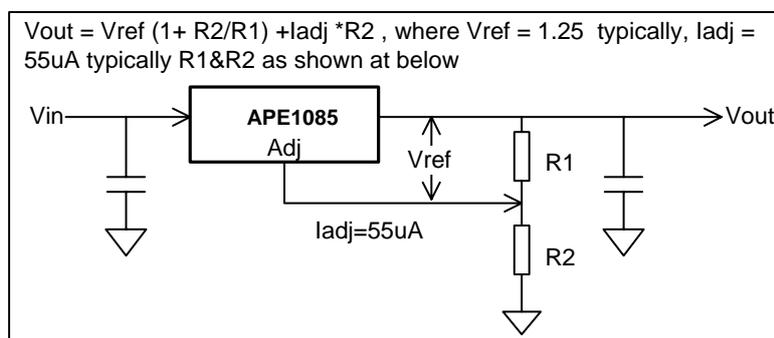
Introduction

The APE1085 adjustable Low Dropout (LDO) regulator is a 3-terminal device that can easily be programmed with the addition of two external resistors to any voltage within the range of 1.20V to $V_{in}-1.4V$. The APE1085 only needs 1.4V differential between V_{in} and V_{out} to maintain output regulation. In addition, the output voltage tolerances are also extremely tight and they include the transient response as part of the specification. For example, Intel VRE specification calls for a total of +/- 100mV including initial tolerance, load regulation and 0 to 3.0A load step.

The APE1085 is specifically designed to meet the fast current transient needs as well as providing an accurate initial voltage, reducing the overall system cost with the need for fewer output capacitors.

Output Voltage Setting

The APE1085 can be programmed to any voltages in the range of 1.20V to $V_{in}-1.4V$ with the addition of R1 and R2 external resistors according to the following formula:



The APE1085 keeps a constant 1.25V between the output pin and the adjust pin. By placing a resistor R1 across these two pins a constant current flows through R1, adding to the I_{adj} current and into the R2 resistor producing a voltage equal to the $(1.25/R1) * R2 + I_{adj} * R2$ which will be added to the 1.25V to set the output voltage. This is summarized in the above equation. Since the minimum load current requirement of the APE1085 is 10mA, R1 is typically selected to be 121 Ω resistor so that it automatically satisfies the minimum current requirement. Notice that since I_{adj} is typically in the range of 55 μA it only adds a small error to the output voltage and should only be considered when a very precise output voltage setting is required. For example, in a typical 3.3V application where $R1=121\Omega$ and $R2=200\Omega$ the error due to I_{adj} is only 0.3% of the nominal set point.

Load Regulation

Since the APE1085 is only a 3-terminal device, it is not possible to provide true remote sensing of the output voltage at the load. The best load regulation is achieved when the bottom side of R2 is connected to the load and the top-side of R1 resistor is connected directly to the case or the V_{out} pin of the regulator and not to the load. It is important to note that for high current applications, this can represent a significant percentage of the overall load regulation and one must

keep the path from the regulator to the load as short as possible to minimize this effect.

Stability

The APE1085 requires the use of an output capacitor as part of the frequency compensation in order to make the regulator stable. For most applications an aluminum electrolytic capacitor of at least 10 μF ensures both stability and good transient response.

Thermal Design

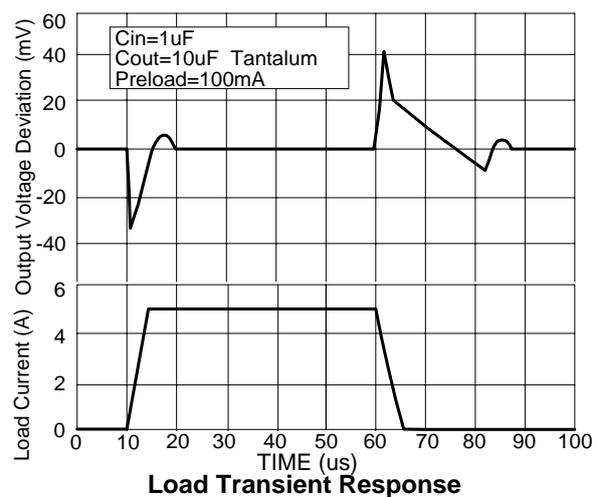
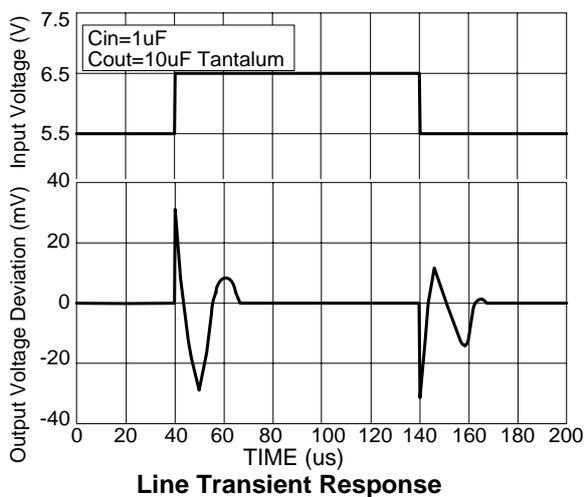
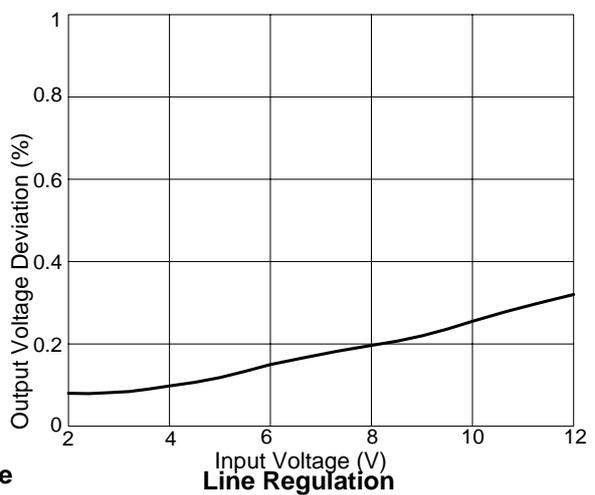
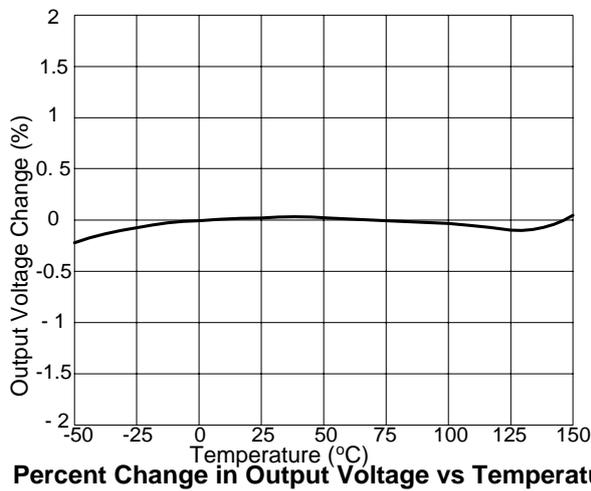
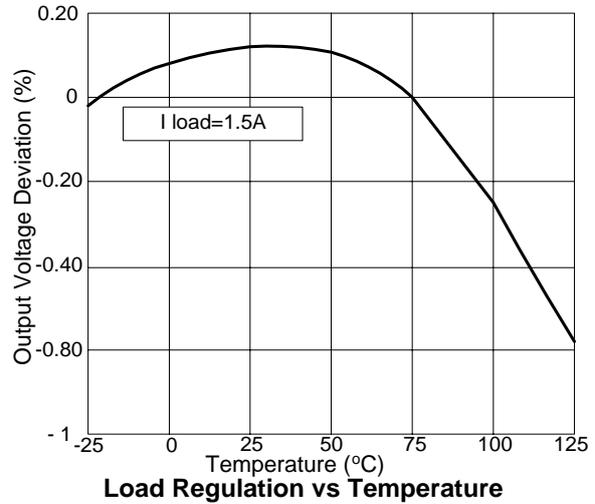
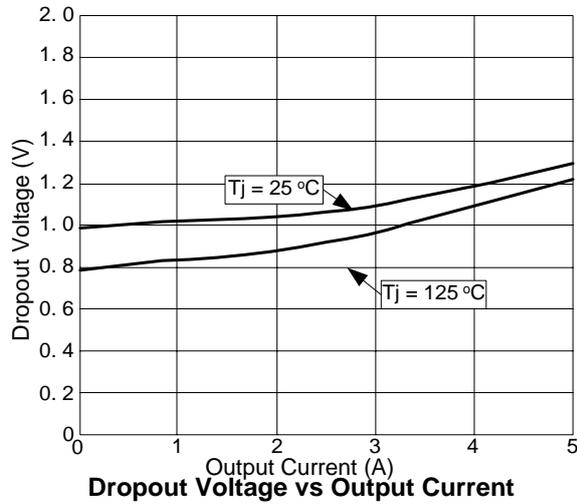
The APE1085 incorporates an internal thermal shutdown that protects the device when the junction temperature exceeds the maximum allowable junction temperature. Although this device can operate with junction temperatures in the range of 150 $^{\circ}C$, it is recommended that the selected heat sink be chosen such that during maximum continuous load operation the junction temperature is kept below this temperature.

Layout Consideration

The output capacitors must be located as close to the V_{out} terminal of the device as possible. It is recommended to use a section of a layer of the PC board as a plane to connect the V_{out} pin to the output capacitors to prevent any high frequency oscillation that may result due to excessive trace inductance.

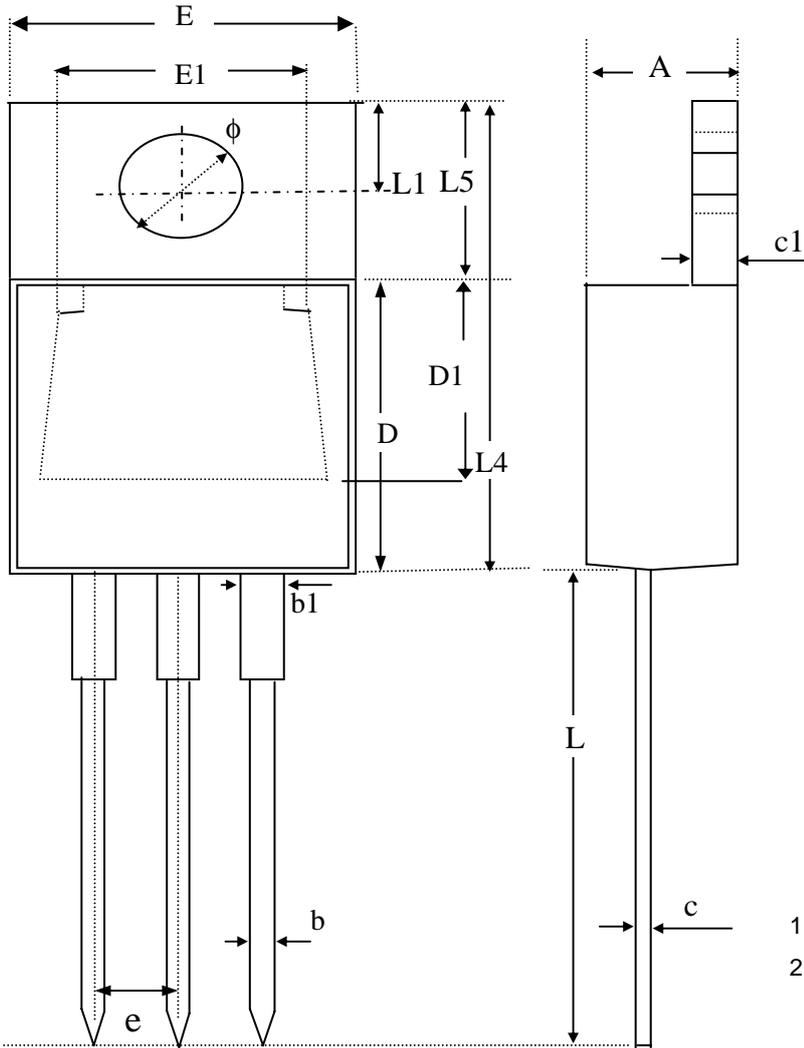


Typical Performance Characteristics





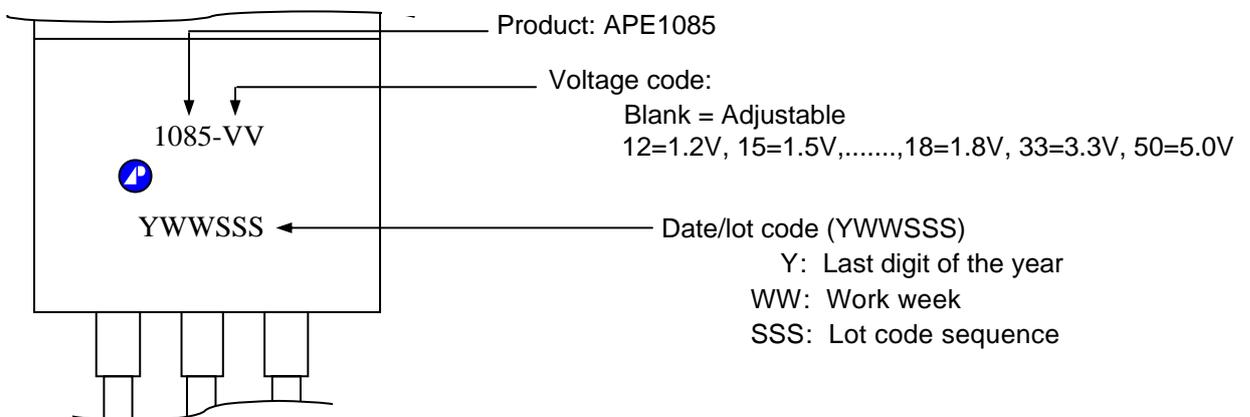
Package Dimensions: TO-220



| SYMBOLS | Millimeters | | |
|---------|-------------|-------|-------|
| | MIN | NOM | MAX |
| A | 4.40 | 4.60 | 4.80 |
| b | 0.76 | 0.88 | 1.00 |
| D | 8.60 | 8.80 | 9.00 |
| c | 0.36 | 0.43 | 0.50 |
| E | 9.80 | 10.10 | 10.40 |
| L4 | 14.70 | 15.00 | 15.30 |
| L5 | 6.20 | 6.40 | 6.60 |
| D1 | 5.10 REF. | | |
| c1 | 1.25 | 1.35 | 1.45 |
| b1 | 1.17 | 1.32 | 1.47 |
| L | 13.25 | 13.75 | 14.25 |
| e | 2.54 REF. | | |
| L1 | 2.60 | 2.75 | 2.89 |
| phi | 3.71 | 3.84 | 3.96 |
| E1 | 7.4 REF. | | |

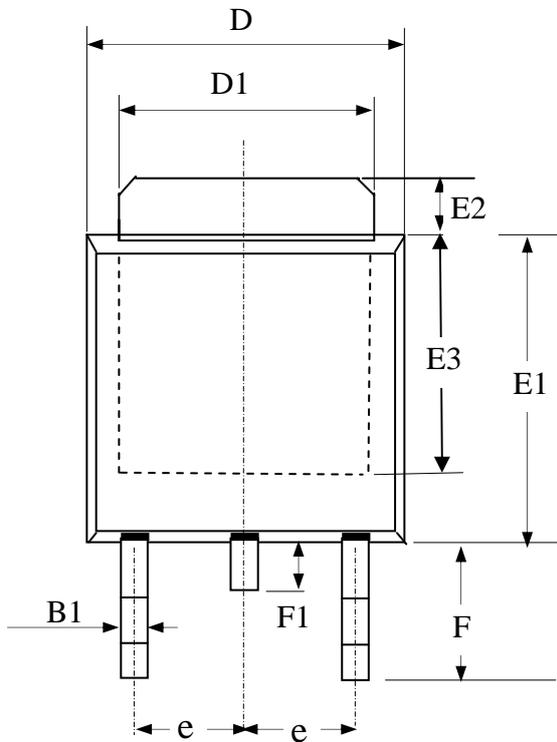
1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

Marking Information: TO-220



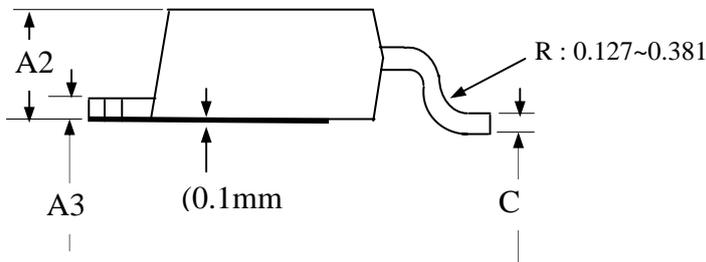


Package Dimensions: TO-252



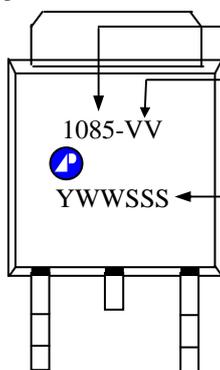
| SYMBOLS | Millimeters | | |
|---------|-------------|------|------|
| | MIN | NOM | MAX |
| A2 | 1.80 | 2.30 | 2.80 |
| A3 | 0.40 | 0.50 | 0.60 |
| B1 | 0.40 | 0.70 | 1.00 |
| D | 6.00 | 6.50 | 7.00 |
| D1 | 4.80 | 5.35 | 5.90 |
| E3 | 3.50 | 4.00 | 4.50 |
| F | 2.20 | 2.63 | 3.05 |
| F1 | 0.50 | 0.85 | 1.20 |
| E1 | 5.10 | 5.70 | 6.30 |
| E2 | 0.50 | 1.10 | 1.80 |
| e | -- | 2.30 | -- |
| C | 0.35 | 0.50 | 0.65 |

1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.



Marking Information: TO-252

Laser Marking



Product: APE1085

Voltage code

Blank = Adjustable

12=1.2V, 15=1.5V,.....,18=1.8V, 33=3.3V, 50=5.0V

Date/lot code (YWWSSS)

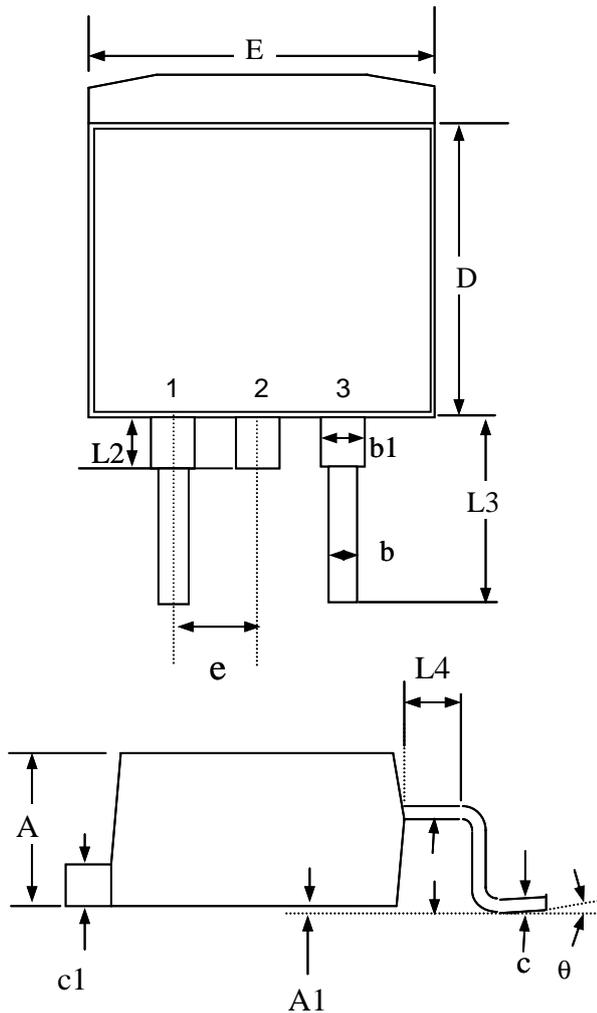
Y: Last digit of the year

WW: Work week

SSS: Lot code sequence



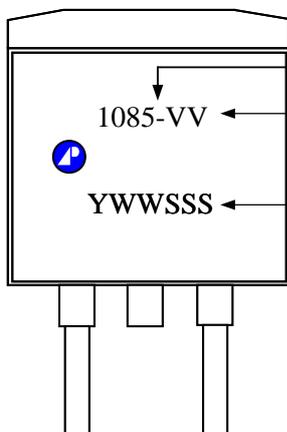
Package Dimensions: TO-263



| SYMBOLS | Millimeters | | |
|---------|-------------|-------|-------|
| | MIN | NOM | MAX |
| A | 4.25 | 4.75 | 5.20 |
| A1 | 0.00 | 0.15 | 0.30 |
| A2 | 2.20 | 2.45 | 2.70 |
| b | 0.70 | 0.90 | 1.10 |
| b1 | 1.07 | 1.27 | 1.47 |
| c | 0.30 | 0.45 | 0.60 |
| c1 | 1.15 | 1.30 | 1.45 |
| D | 8.30 | 8.90 | 9.40 |
| E | 9.70 | 10.10 | 10.50 |
| e | 2.04 | 2.54 | 3.04 |
| L2 | ----- | 1.50 | ----- |
| L3 | 4.50 | 4.90 | 5.30 |
| L4 | ----- | 1.50 | ---- |

1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

Marking Information: TO-263



Product: APE1085

Voltage code:
Blank = Adjustable
12=1.2V, 15=1.5V,.....,18=1.8V, 33=3.3V, 50=5.0V

Date Code (YWWSSS)
Y : Last digit of the year
WW : Work week
SSS : Lot code sequence