

**450V NPN HIGH VOLTAGE POWER TRANSISTOR**

**Features**

- $BV_{CEO} > 450V$
- $BV_{CES} > 700V$
- $BV_{EBO} > 9V$
- $I_C = 4A$  High Collector Current
- Integrated Anti-Parallel Diode to act as free-wheeling diode
- Anti-Saturation feature
- **Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

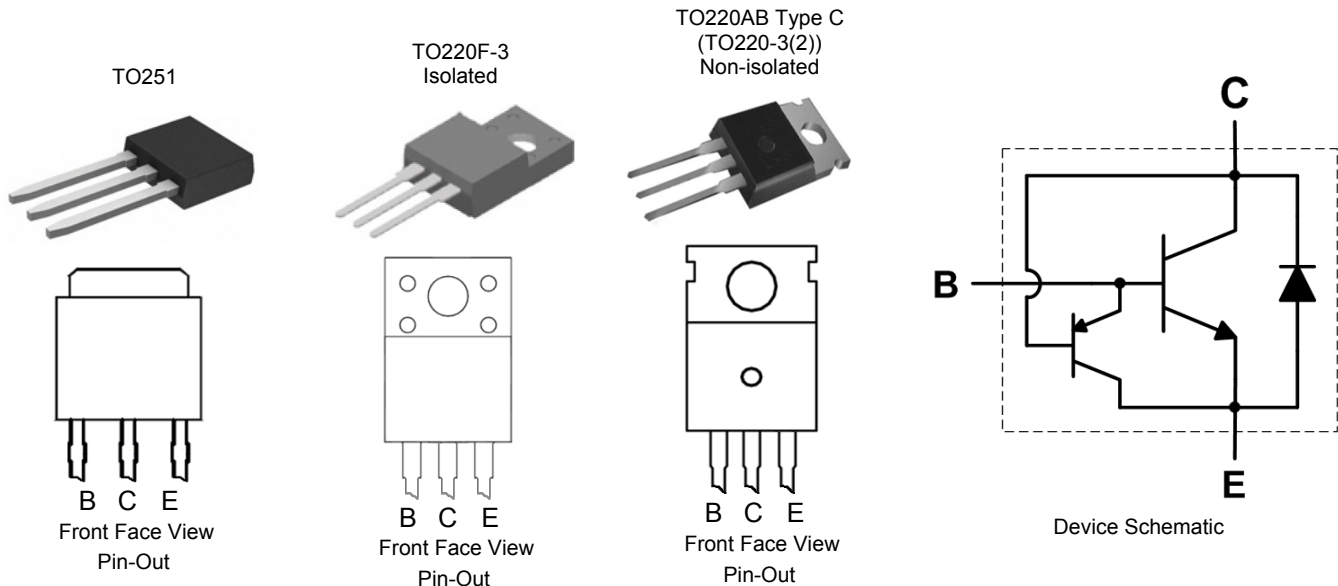
**Mechanical Data**

- Case: TO220F-3, TO251, TO220AB Type C
- Case Material: Molded Plastic, "Green" Molding Compound  
UL Flammability Classification Rating 94V-0
- Terminals: Finish - Matte Tin Finish Leads, Solderable per  
MIL-STD-202, Method 208 **Ⓔ3**
- Weight: TO251: 340mg (Approximate)  
TO220F-3: 1500mg (Approximate)  
TO220AB Type C : 2000mg (Approximate)

**Applications**

Low power AC-DC SMPS for:

- Battery Chargers for Mobile Phone / Tablets / Smartphones
- Power Supply for DVD / STB
- LED lighting

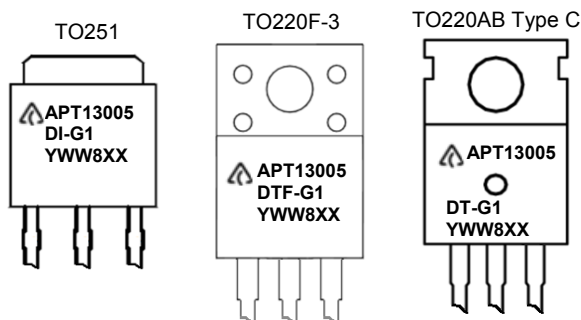



**Ordering Information** (Note 4)

| Product        | Package                     | Marking        | Quantity               |
|----------------|-----------------------------|----------------|------------------------|
| APT13005DI-G1  | TO251                       | APT13005DI-G1  | 3,600 per Box in Tubes |
| APT13005DTF-G1 | TO220F-3                    | APT13005DTF-G1 | 1,000 per Box in Tubes |
| APT13005DT-G1  | TO220AB Type C (TO220-3(2)) | APT13005DT-G1  | 1,000 per Box in Tubes |

- Notes:
1. EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant. All applicable RoHS exemptions applied.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information



 = Manufacturers' code marking  
 For TO251, APT13005DI-G1 = Product Type Marking ID  
 For TO220F-3, APT13005DTF-G1 = Product Type Marking ID  
 For TO220AB Type C, APT13005DT-G1 = Product Type Marking ID  
 YWW = Date Code Marking  
     e.g. 312 = Year 2013, Week 12.  
 8 = Assembly site code  
 XX = Batch Number

## Absolute Maximum Ratings (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic            | Symbol           | Value | Unit |
|---------------------------|------------------|-------|------|
| Collector-Emitter Voltage | V <sub>CES</sub> | 700   | V    |
| Collector-Emitter Voltage | V <sub>CEO</sub> | 450   | V    |
| Emitter-Base Voltage      | V <sub>EBO</sub> | 9     | V    |
| Collector Current         | I <sub>C</sub>   | 4     | A    |
| Peak Collector Current    | I <sub>CM</sub>  | 8     | A    |
| Base Current              | I <sub>B</sub>   | 2     | A    |
| Peak Base Current         | I <sub>BM</sub>  | 4     | A    |

## Thermal Characteristics (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                            | Symbol                            | Value              | Unit |
|---|-----------------------------------|--------------------|------|
| Power Dissipation @T <sub>C</sub> = +25°C | P <sub>D</sub>                    | For TO251          | 25   |
|   |                                   | For TO220F-3       | 28   |
|   |                                   | For TO220AB Type C | 75   |
| Thermal Resistance, Junction to Case      | R <sub>θJC</sub>                  | For TO251          | 5.0  |
|   |                                   | For TO220F-3       | 4.5  |
|   |                                   | For TO220AB Type C | 1.67 |
| Operating and Storage Temperature Range   | T <sub>J</sub> , T <sub>STG</sub> | -65 to +150        | °C   |

## ESD Ratings (Note 5)

| Characteristic                             | Symbol  | Value | Unit | JEDEC Class |
|--|---------|-------|------|-------------|
| Electrostatic Discharge - Human Body Model | ESD HBM | 8,000 | V    | 3B          |
| Electrostatic Discharge - Machine Model    | ESD MM  | 400   | V    | C           |

Note: 5. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

**Safe Operating Areas** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

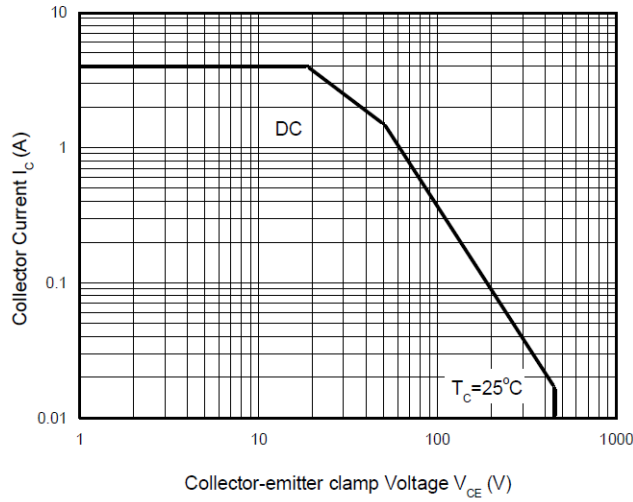


Figure 4. Safe Operating Areas  
(TO-220-3 (2) Package)

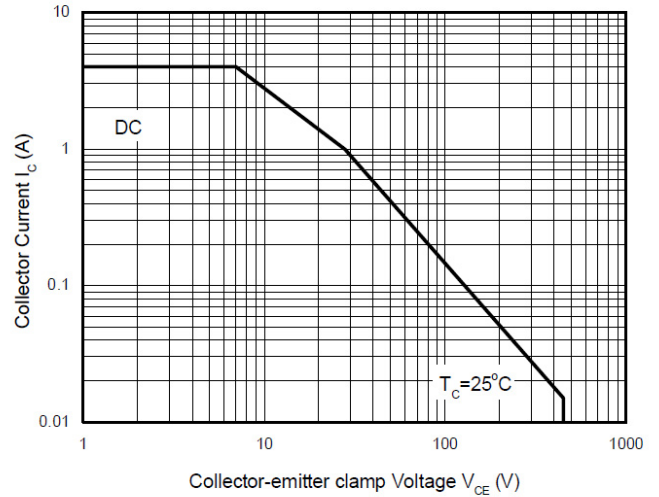


Figure 5. Safe Operating Areas  
(TO-220F-3 Package)

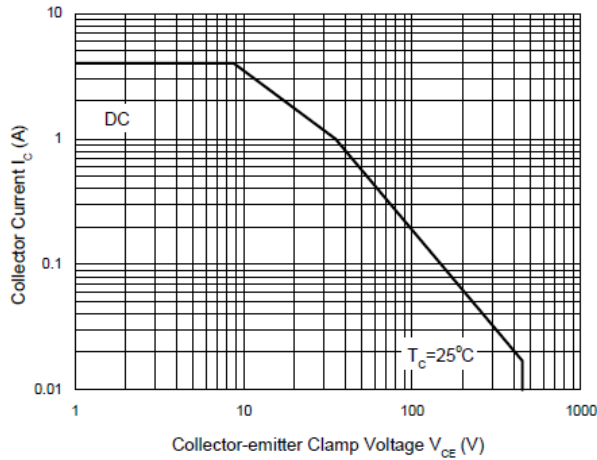


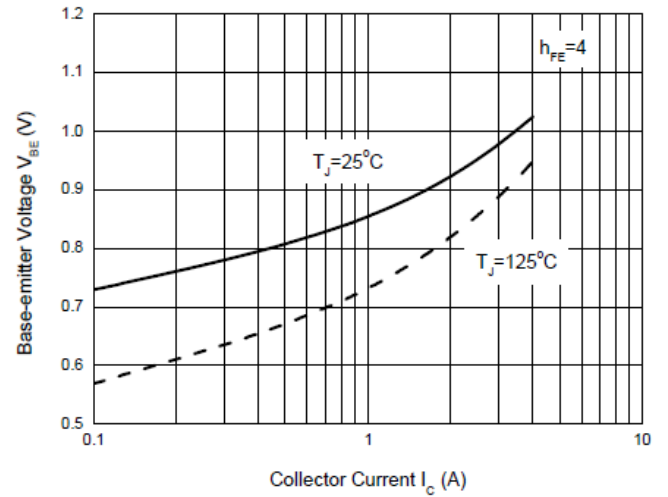
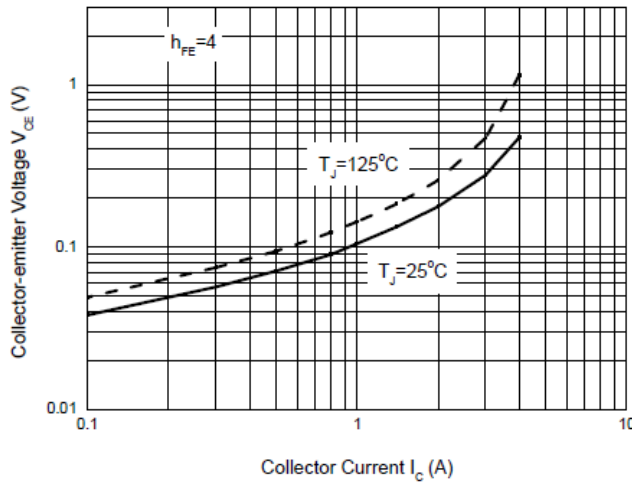
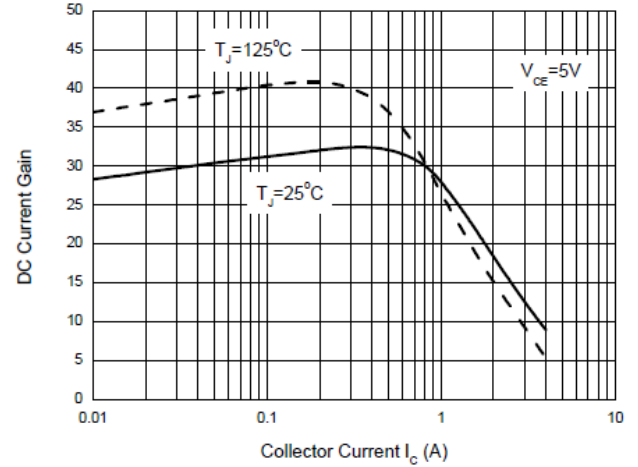
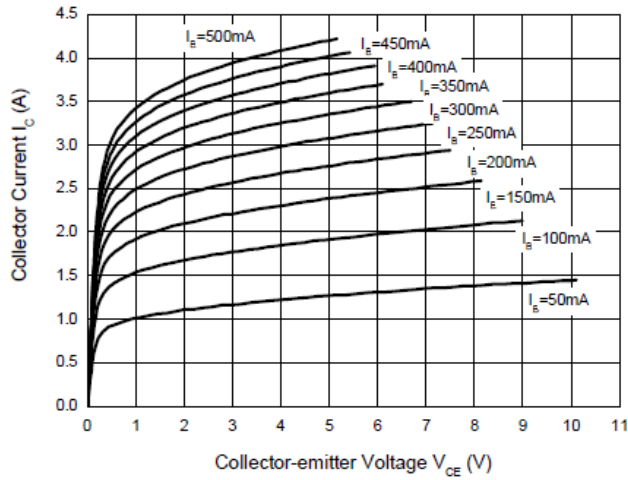
Figure 6. Safe Operating Areas  
(TO-251 Package)

**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                                | Symbol               | Min         | Typ         | Max               | Unit   | Test Condition   |
|---|----------------------|-------------|-------------|-------------------|--------|--|
| Collector-Emitter Breakdown Voltage           | BV <sub>CES</sub>    | 700         | —           | —                 | V      | I <sub>C</sub> = 100μA, V <sub>BE</sub> = 0V   |
| Collector-Emitter Breakdown Voltage           | BV <sub>CEO</sub>    | 450         | —           | —                 | V      | I <sub>C</sub> = 100μA   |
| Emitter-Base Breakdown Voltage                | BV <sub>EBO</sub>    | 9           | —           | —                 | V      | I <sub>E</sub> = 100μA   |
| Collector Cutoff Current                      | I <sub>CEV</sub>     | —           | —           | 10                | μA     | V <sub>CE</sub> = 700V, V <sub>BE</sub> = -1.5V  |
| DC current transfer Static ratio (Note 6)     | h <sub>FE</sub>      | 15<br>8     | —           | 35<br>35          | —<br>— | I <sub>C</sub> = 1A, V <sub>CE</sub> = 5V<br>I <sub>C</sub> = 2A, V <sub>CE</sub> = 5V   |
| Collector-Emitter Saturation Voltage (Note 6) | V <sub>CE(sat)</sub> | —<br>—<br>— | —<br>—<br>— | 0.3<br>0.6<br>0.9 | V      | I <sub>C</sub> = 1A, I <sub>B</sub> = 0.2A<br>I <sub>C</sub> = 2A, I <sub>B</sub> = 0.5A<br>I <sub>C</sub> = 4A, I <sub>B</sub> = 1A |
| Base-Emitter Saturation Voltage (Note 6)      | V <sub>BE(sat)</sub> | —<br>—      | —<br>—      | 1.1<br>1.3        | V      | I <sub>C</sub> = 1A, I <sub>B</sub> = 0.2A<br>I <sub>C</sub> = 2A, I <sub>B</sub> = 0.5A   |
| Output Capacitance                            | C <sub>ob</sub>      | —           | 45          | —                 | pF     | V <sub>CB</sub> = 10V, f = 0.1MHz  |
| Transition Frequency                          | f <sub>T</sub>       | 4           | —           | —                 | MHz    | I <sub>C</sub> = 0.5A, V <sub>CE</sub> = 10V   |
| Turn-on Time with Resistive Load              | t <sub>on</sub>      | —           | —           | 0.7               | μs     | I <sub>C</sub> = 2A, V <sub>CC</sub> = 125V<br>I <sub>B1</sub> = -I <sub>B2</sub> = 0.4A   |
| Storage Time with Resistive Load              | t <sub>s</sub>       | —           | —           | 4.0               |        |  |
| Fall Time with Resistive Load                 | t <sub>f</sub>       | —           | —           | 0.8               |        |  |

Note: 6. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

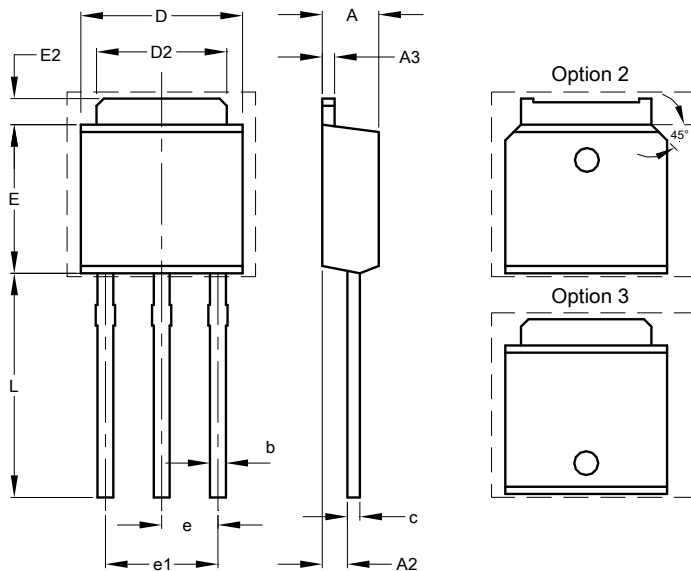
**Typical Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



## Package Outline Dimensions

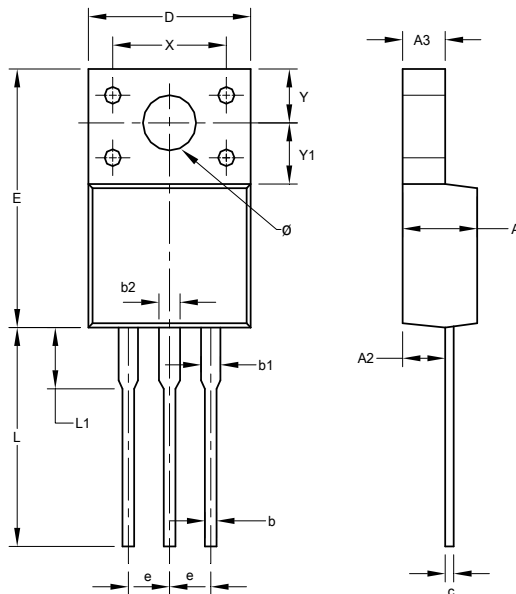
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

### TO251



| TO251                |       |       |
|----------------------|-------|-------|
| Dim                  | Min   | Max   |
| A                    | 2.200 | 2.400 |
| A2                   | 0.890 | 1.150 |
| A3                   | 0.450 | 0.550 |
| b                    | 0.550 | 0.740 |
| c                    | 0.450 | 0.570 |
| D                    | 6.400 | 6.750 |
| D2                   | 5.200 | 5.400 |
| E                    | 5.950 | 6.250 |
| E2                   | 0.900 | 1.250 |
| e                    | 2.240 | 2.340 |
| e1                   | 4.430 | 4.730 |
| L                    | 8.900 | 9.500 |
| All Dimensions in mm |       |       |

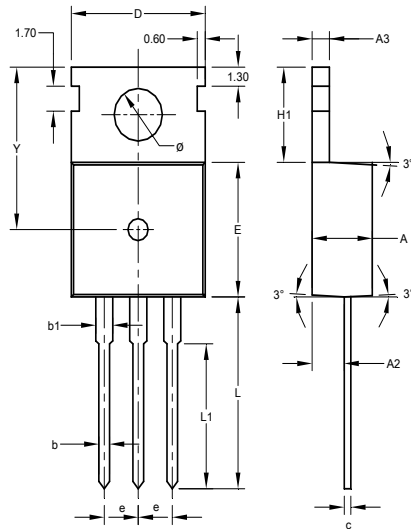
### TO220F-3



| TO220F-3             |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | 4.300 | 4.900 | -     |
| A2                   | 2.520 | 2.920 | -     |
| A3                   | 2.350 | 2.900 | -     |
| b                    | 0.550 | 0.900 | -     |
| b1                   | 1.000 | 1.400 | -     |
| b2                   | 1.100 | 1.500 | -     |
| c                    | 0.450 | 0.600 | -     |
| D                    | 9.70  | 10.30 | -     |
| E                    | 14.70 | 16.00 | -     |
| e                    | -     | -     | 2.540 |
| L                    | 12.50 | 13.50 | -     |
| L1                   | 2.790 | 4.500 | -     |
| X                    | 6.90  | 7.10  | -     |
| Y                    | 3.000 | 3.400 | -     |
| Y1                   | 3.370 | 3.900 | -     |
| ø                    | 3.000 | 3.550 | -     |
| All Dimensions in mm |       |       |       |

Note: For high voltage applications, the appropriate industry sector guidelines should be considered with regards to creepage and clearance distances between device Terminals and PCB tracking.

TO220AB Type C (TO220-3(2))



| TO220AB<br>Type C    |        |        |        |
|----------------------|--------|--------|--------|
| Dim                  | Min    | Max    | Typ    |
| A                    | -      | -      | 4.500  |
| A2                   | -      | -      | 2.400  |
| A3                   | -      | -      | 1.300  |
| b                    | 0.700  | 0.900  | -      |
| b1                   | -      | -      | 1.270  |
| c                    | 0.400  | 0.600  | -      |
| D                    | 9.800  | 10.200 | -      |
| E                    | 9.000  | 9.400  | -      |
| e                    | -      | -      | 2.54   |
| H1                   | 6.300  | 6.700  | -      |
| L                    | 12.600 | 13.600 | -      |
| L1                   | 9.600  | 10.600 | -      |
| Y                    | -      | -      | 11.100 |
| Ø                    | 3.560  | 3.640  | -      |
| All Dimensions in mm |        |        |        |

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