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High-Voltage - High Power Transistors

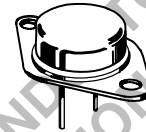
High-voltage – high power transistors designed for use in high power audio amplifier applications and high voltage switching regulator circuits.

- High Collector Emitter Sustaining Voltage –
 $V_{CE(sus)} = 140 \text{ Vdc}$
- High DC Current Gain – @ $I_C = 8.0 \text{ Adc}$
 $h_{FE} = 15 \text{ (Min)}$
- Low Collector–Emitter Saturation Voltage –
 $V_{CE(sat)} = 1.0 \text{ Vdc (Max) @ } I_C = 10 \text{ Adc}$

MAXIMUM RATINGS (1)

| Rating | Symbol | Value | Unit |
|--|----------------|-------------|--------------------------|
| Collector–Emitter Voltage | V_{CEO} | 140 | Vdc |
| Collector–Base Voltage | V_{CB} | 140 | Vdc |
| Emitter–Base Voltage | V_{EB} | 7.0 | Vdc |
| Collector Current – Continuous Peak | I_C | 16 20 | Adc |
| Base Current – Continuous | I_B | 5.0 | Adc |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 200 1.14 | W W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | –65 to +200 | $^\circ\text{C}$ |

**16 AMPERE
POWER TRANSISTORS
COMPLEMENTARY SILICON
140 VOLTS, 200 WATTS**



CASE 1-07
TO-204AA
(TO-3)

THERMAL CHARACTERISTICS (1)

| Characteristic | Symbol | Max | Unit |
|--------------------------------------|---------------|-------|--------------------|
| Thermal Resistance, Junction to Case | θ_{JC} | 0.875 | $^\circ\text{C/W}$ |

(1) Indicates JEDEC Registered Data.

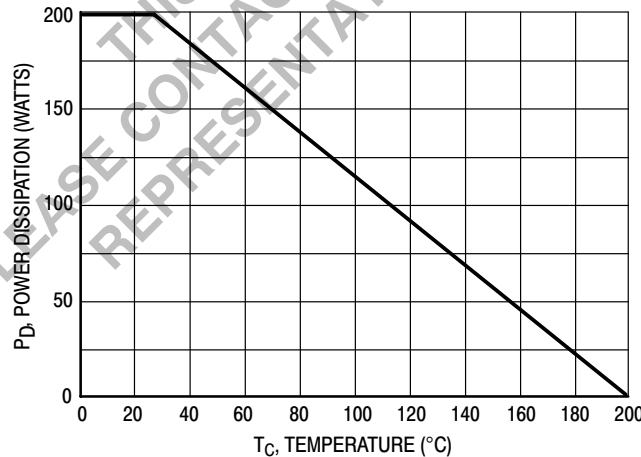


Figure 1. Power Derating

Safe Area Curves are indicated by Figure 5. All Limits are applicable and must be observed.

2N5631

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|--|-----------------------|-----|------------|------|
| OFF CHARACTERISTICS | | | | |
| Collector-Emitter Sustaining Voltage (2) (I _C = 200 mA, I _B = 0) | V _{CEO(sus)} | 140 | - | Vdc |
| Collector-Emitter Cutoff Current (V _{CE} = 70 Vdc, I _B = 0) | I _{CEO} | - | 2.0 | mA |
| Collector-Emitter Cutoff Current (V _{CE} = Rated V _{CB} , V _{EB(off)} = 1.5 Vdc) (V _{CE} = Rated V _{CB} , V _{EB(off)} = 1.5 Vdc, T _C = 150°C) | I _{CEX} | - | 2.0 7.0 | mA |
| Collector-Base Cutoff Current (V _{CB} = Rated V _{CB} , I _E = 0) | I _{CBO} | - | 2.0 | mA |
| Emitter-Base Cutoff Current (V _{BE} = 7.0 Vdc, I _C = 0) | I _{EBO} | - | 5.0 | mA |

ON CHARACTERISTICS (2)

| | | | | |
|--|----------------------|-----------|------------|-----|
| DC Current Gain (I _C = 8 mA, V _{CE} = 2.0 Vdc) (I _C = 16 mA, V _{CE} = 2.0 Vdc) | h _{FE} | 15 4.0 | 60 - | - |
| Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA) (I _C = 16 mA, I _B = 4.0 mA) | V _{CE(sat)} | - - | 1.0 2.0 | Vdc |
| Base-Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA) | V _{BE(sat)} | - | 1.8 | Vdc |
| Base-Emitter On Voltage (I _C = 8.0 mA, V _{CE} = 2.0 Vdc) | V _{BE(on)} | - | 1.5 | Vdc |

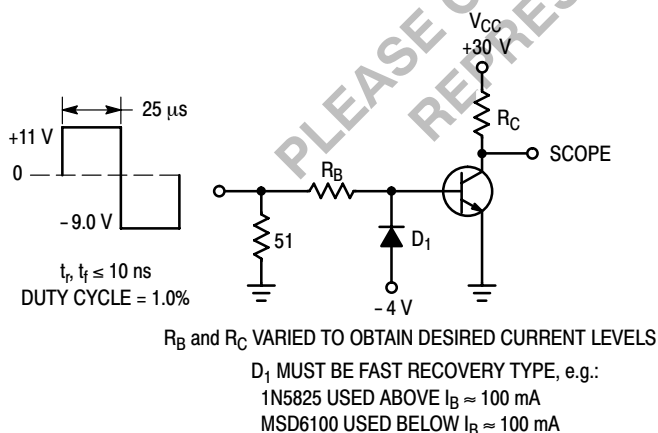
DYNAMIC CHARACTERISTICS

| | | | | |
|--|-------------------------------------|--------|-------------|-----|
| Current-Gain - Bandwidth Product (3) (I _C = 1.0 mA, V _{CE} = 20 Vdc, f _{test} = 0.5 MHz) | f _T | 1.0 | - | MHz |
| Output Capacitance (V _{CB} = 10 Vdc, I _E = 0, f = 0.1 MHz) | 2N5631 2N6031 C _{ob} | - - | 500 1000 | pF |
| Small-Signal Current Gain (I _C = 4.0 mA, V _{CE} = 10 Vdc, f = 1.0 kHz) | h _{fe} | 15 | - | - |

*Indicates JEDEC Registered Data.

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≥ 2.0%.

(2) f_T = |h_{fe}| • f_{test}



For PNP test circuit, reverse all polarities and D1.

Figure 2. Switching Times Test Circuit

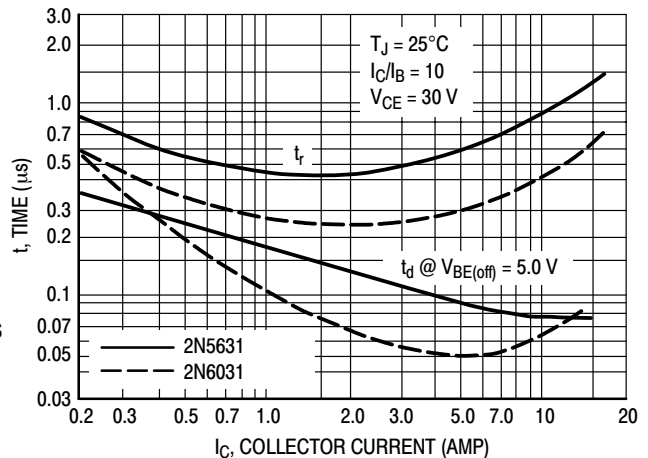


Figure 3. Turn-On Time

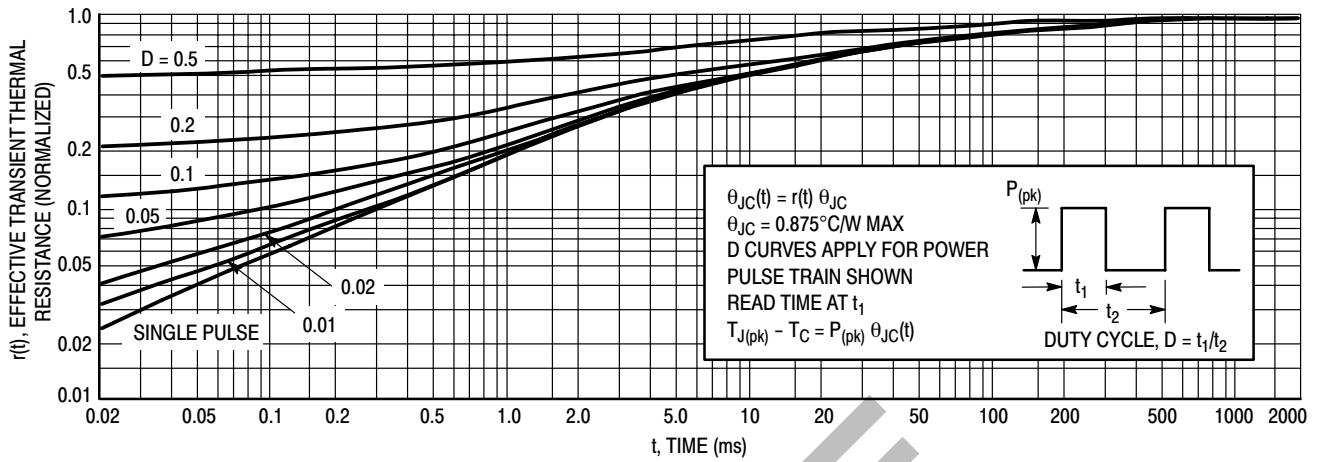


Figure 4. Thermal Response

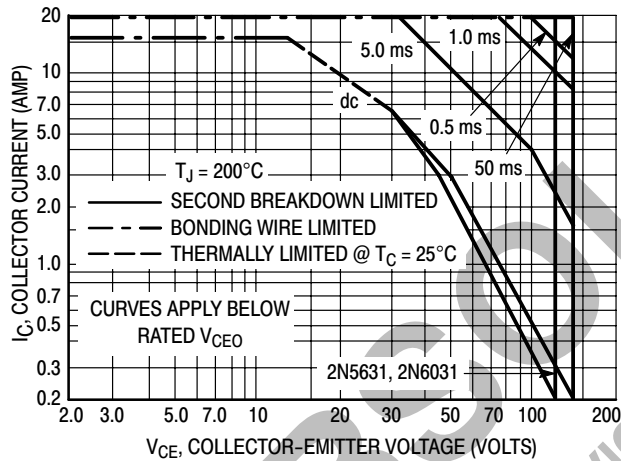
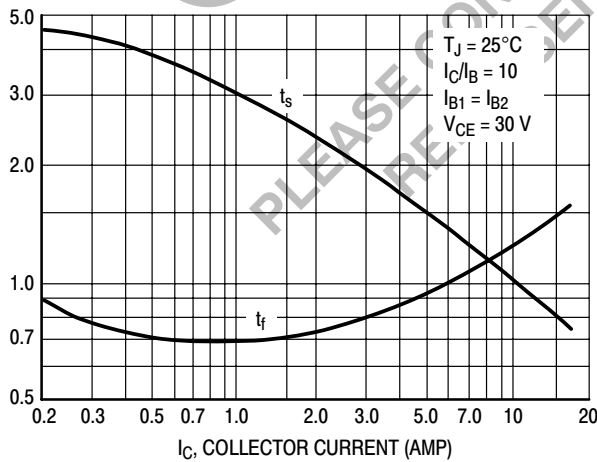


Figure 5. Active-Region Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)} = 200^\circ\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200^\circ\text{C}$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

NPN
2N5631



PNP
2N6031

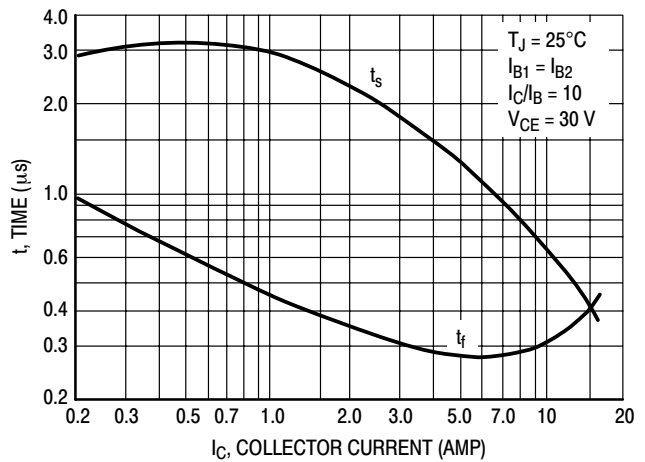


Figure 6. Turn-Off Time

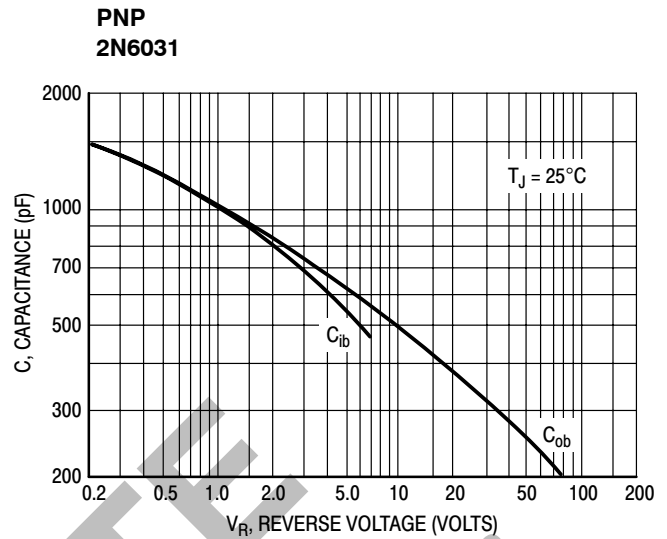
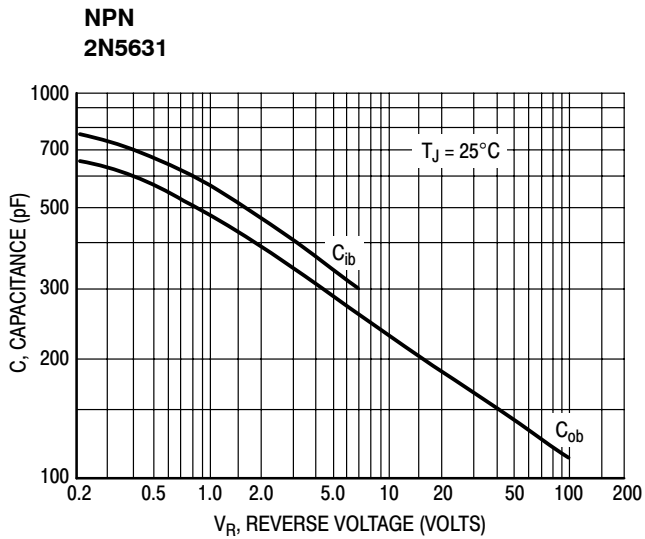


Figure 7. Capacitance

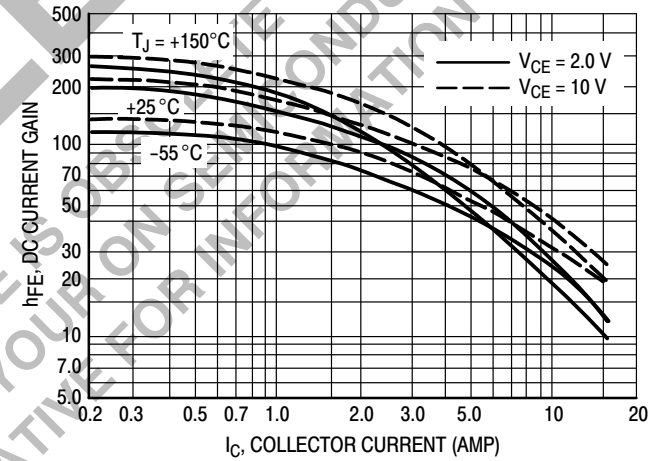
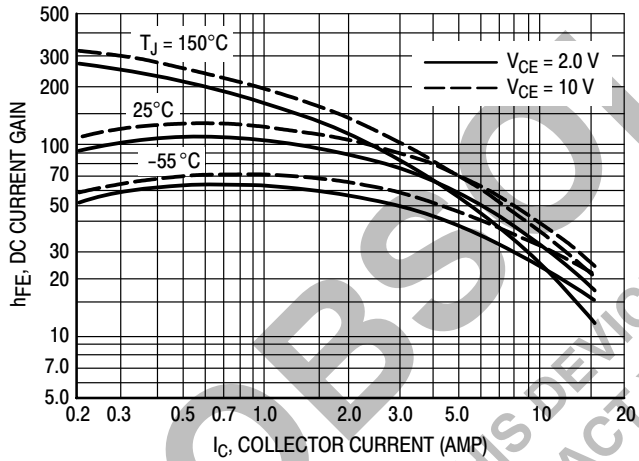


Figure 8. DC Current Gain

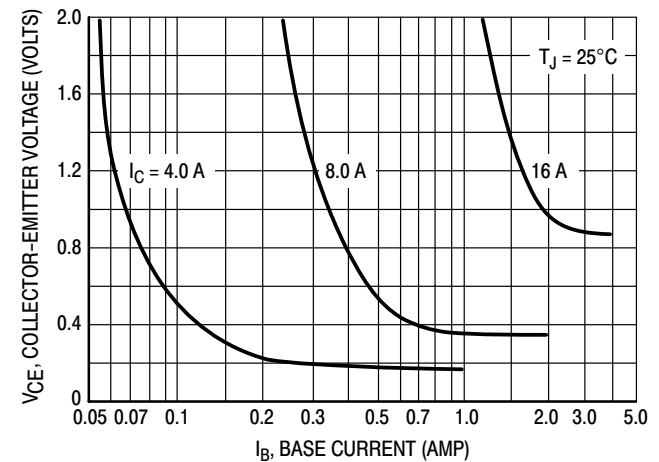
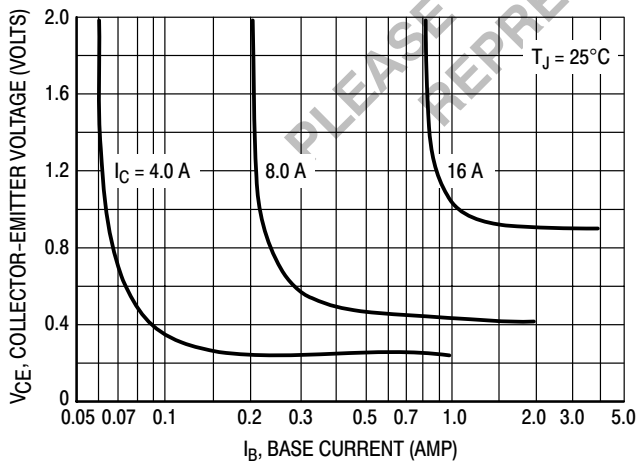
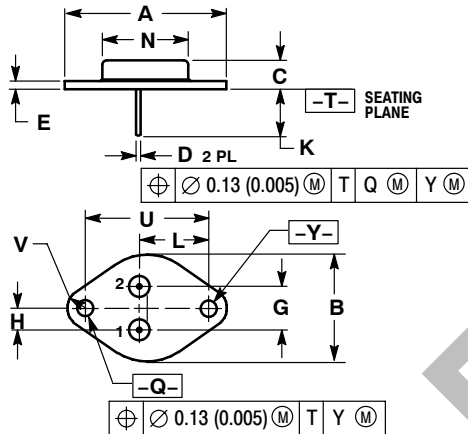


Figure 9. Collector Saturation Region

2N5631

PACKAGE DIMENSIONS

CASE 1-07 TO-204AA (TO-3) ISSUE Z



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.550 REF | | 39.37 REF | |
| B | --- | 1.050 | --- | 26.67 |
| C | 0.250 | 0.335 | 6.35 | 8.51 |
| D | 0.038 | 0.043 | 0.97 | 1.09 |
| E | 0.055 | 0.070 | 1.40 | 1.77 |
| G | 0.430 BSC | | 10.92 BSC | |
| H | 0.215 BSC | | 5.46 BSC | |
| K | 0.440 | 0.480 | 11.18 | 12.19 |
| L | 0.665 BSC | | 16.89 BSC | |
| N | --- | 0.630 | --- | 21.08 |
| Q | 0.151 | 0.165 | 3.84 | 4.19 |
| U | 1.187 BSC | | 30.15 BSC | |
| V | 0.131 | 0.188 | 3.33 | 4.77 |

STYLE 1:

1. BASE
 2. EMITTER
- CASE: COLLECTOR

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