

Complementary Silicon High-Power Transistors

...PowerBase™ complementary transistors designed for high power audio, stepping motor and other linear applications. These devices can also be used in power switching circuits such as relay or solenoid drivers, dc-to-dc converters, inverters, or for inductive loads requiring higher safe operating area than the 2N3055.

- Current-Gain — Bandwidth-Product @ $I_C = 1.0 \text{ Adc}$
 $f_T = 0.8 \text{ MHz (Min) - NPN}$
 $= 2.2 \text{ MHz (Min) - PNP}$
- Safe Operating Area — Rated to 60 V and 120 V, Respectively

*MAXIMUM RATINGS

| Rating | Symbol | 2N3055A | MJ15015 MJ15016 | Unit |
|--|----------------|-------------|--------------------|------------------------------|
| Collector-Emitter Voltage | V_{CEO} | 60 | 120 | Vdc |
| Collector-Base Voltage | V_{CBO} | 100 | 200 | Vdc |
| Collector-Emitter Voltage Base Reversed Biased | V_{CEV} | 100 | 200 | Vdc |
| Emitter-Base Voltage | V_{EBO} | 7.0 | | Vdc |
| Collector Current — Continuous | I_C | 15 | | Adc |
| Base Current | I_B | 7.0 | | Adc |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 115 0.65 | 180 1.03 | Watts W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | -65 to +200 | | $^\circ\text{C}$ |

THERMAL CHARACTERISTICS

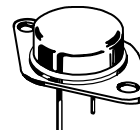
| Characteristic | Symbol | Max | Max | Unit |
|--------------------------------------|-----------------|------|------|--------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.52 | 0.98 | $^\circ\text{C/W}$ |

*Indicates JEDEC Registered Data. (2N3055A)

NPN
2N3055A
MJ15015 *
PNP
MJ15016 *

*ON Semiconductor Preferred Device

15 AMPERE
COMPLEMENTARY
SILICON
POWER TRANSISTORS
60, 120 VOLTS
115, 180 WATTS



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

Preferred devices are ON Semiconductor recommended choices for future use and best overall value.

2N3055A MJ15015 MJ15016

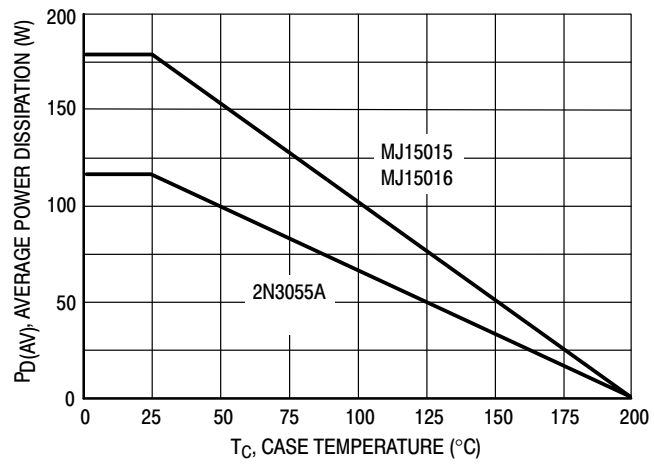


Figure 1. Power Derating

2N3055A MJ15015 MJ15016

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

OFF CHARACTERISTICS (1)

| | | | | | |
|--|-----------------------------|----------------|-----------|------------|-----|
| *Collector–Emitter Sustaining Voltage ($I_C = 200\text{ mA}$, $I_B = 0$) | 2N3055A MJ15015, MJ15016 | $V_{CEO(sus)}$ | 60 120 | — — | Vdc |
| Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $V_{BE(off)} = 0\text{ Vdc}$) ($V_{CE} = 60\text{ Vdc}$, $V_{BE(off)} = 0\text{ Vdc}$) | 2N3055A MJ15015, MJ15016 | I_{CEO} | — — | 0.7 0.1 | mA |
| *Collector Cutoff Current ($V_{CEV} = \text{Rated Value}$, $V_{BE(off)} = 1.5\text{ Vdc}$) | 2N3055A MJ15015, MJ15016 | I_{CEV} | — — | 5.0 1.0 | mA |
| Collector Cutoff Current ($V_{CEV} = \text{Rated Value}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$) | 2N3055A MJ15015, MJ15016 | I_{CEV} | — — | 30 6.0 | mA |
| Emitter Cutoff Current ($V_{EB} = 7.0\text{ Vdc}$, $I_C = 0$) | 2N3055A MJ15015, MJ15016 | I_{EBO} | — — | 5.0 0.2 | mA |

*SECOND BREAKDOWN

| | | | | | |
|---|-----------------------------|-----------|-------------|--------|---|
| Second Breakdown Collector Current with Base Forward Biased ($t = 0.5\text{ s}$ non-repetitive) ($V_{CE} = 60\text{ Vdc}$) | 2N3055A MJ15015, MJ15016 | $I_{S/b}$ | 1.95 3.0 | — — | A |
|---|-----------------------------|-----------|-------------|--------|---|

*ON CHARACTERISTICS (1)

| | | | | |
|--|---------------|-----------------|-------------------|-----|
| DC Current Gain ($I_C = 4.0\text{ A}$, $V_{CE} = 2.0\text{ Vdc}$) ($I_C = 4.0\text{ A}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 10\text{ A}$, $V_{CE} = 4.0\text{ Vdc}$) | h_{FE} | 10 20 5.0 | 70 70 — | — |
| Collector–Emitter Saturation Voltage ($I_C = 4.0\text{ A}$, $I_B = 400\text{ mA}$) ($I_C = 10\text{ A}$, $I_B = 3.3\text{ A}$) ($I_C = 15\text{ A}$, $I_B = 7.0\text{ A}$) | $V_{CE(sat)}$ | — — — | 1.1 3.0 5.0 | Vdc |
| Base–Emitter On Voltage ($I_C = 4.0\text{ A}$, $V_{CE} = 4.0\text{ Vdc}$) | $V_{BE(on)}$ | 0.7 | 1.8 | Vdc |

*DYNAMIC CHARACTERISTICS

| | | | | | |
|---|-----------------------------|----------|------------|-----------|-----|
| Current–Gain — Bandwidth Product ($I_C = 1.0\text{ A}$, $V_{CE} = 4.0\text{ Vdc}$, $f = 1.0\text{ MHz}$) | 2N3055A, MJ15015 MJ15016 | f_T | 0.8 2.2 | 6.0 18 | MHz |
| Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) | | C_{ob} | 60 | 600 | pF |

*SWITCHING CHARACTERISTICS (2N3055A only)

| RESISTIVE LOAD | | | | | |
|----------------|---|-------|---|-----|---------------|
| Delay Time | $(V_{CC} = 30\text{ Vdc}$, $I_C = 4.0\text{ A}$, $I_{B1} = I_{B2} = 0.4\text{ A}$, $t_p = 25\text{ }\mu\text{s}$ Duty Cycle $\leq 2\%$) | t_d | — | 0.5 | μs |
| Rise Time | | t_r | — | 4.0 | μs |
| Storage Time | | t_s | — | 3.0 | μs |
| Fall Time | | t_f | — | 6.0 | μs |

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle $\leq 2\%$.

*Indicates JEDEC Registered Data. (2N3055A)

2N3055A MJ15015 MJ15016

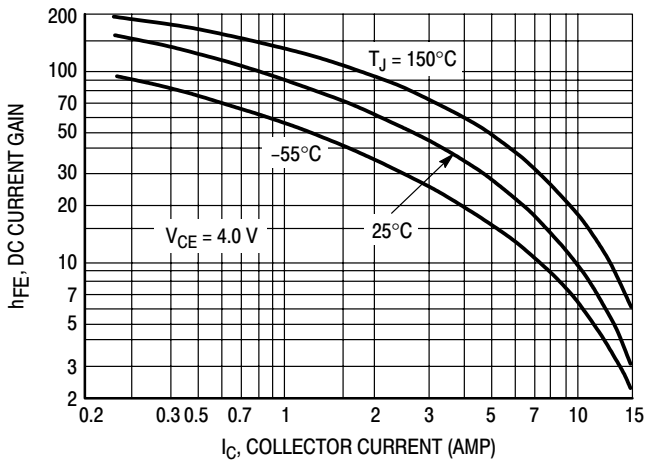


Figure 2. DC Current Gain

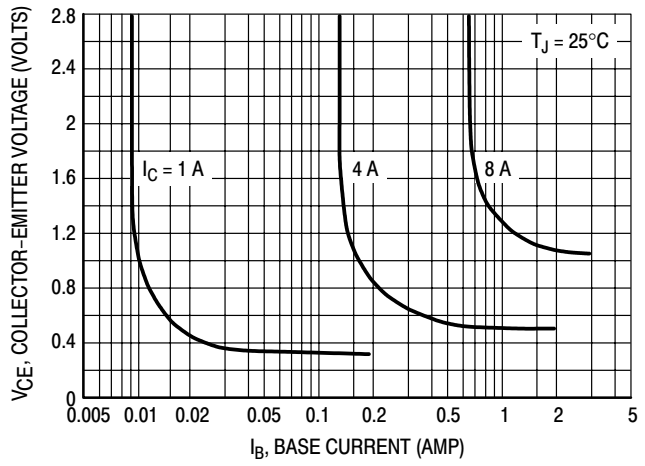


Figure 3. Collector Saturation Region

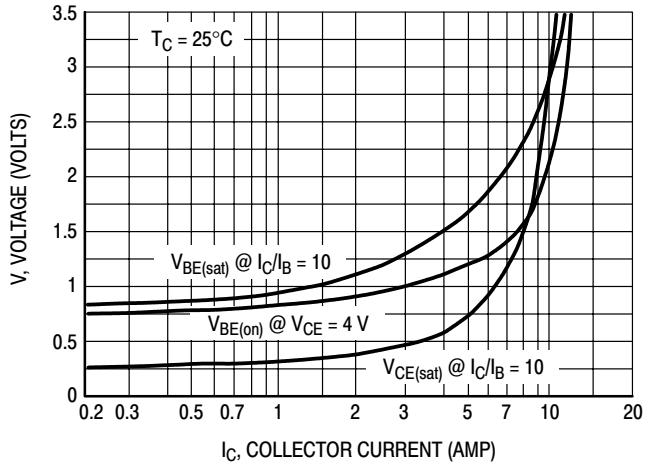


Figure 4. "On" Voltages

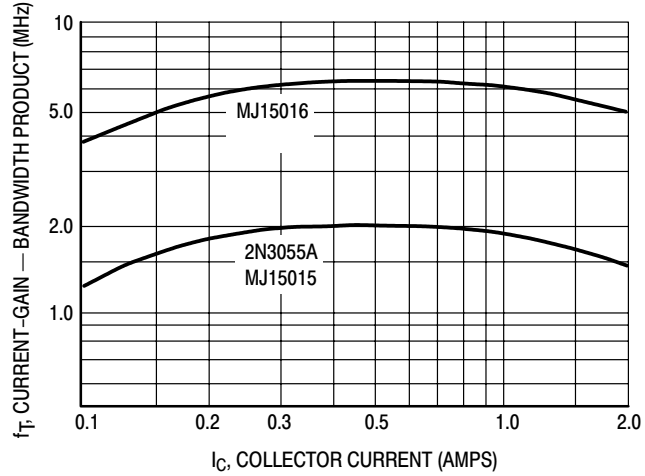


Figure 5. Current-Gain — Bandwidth Product

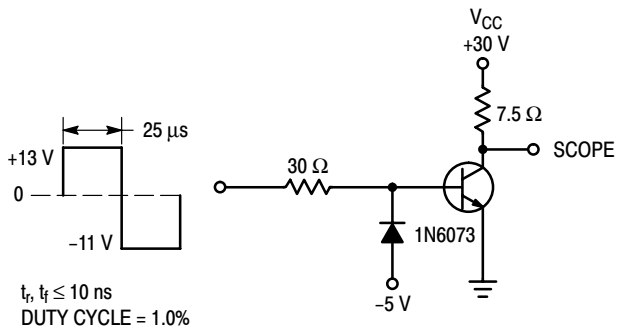


Figure 6. Switching Times Test Circuit (Circuit shown is for NPN)

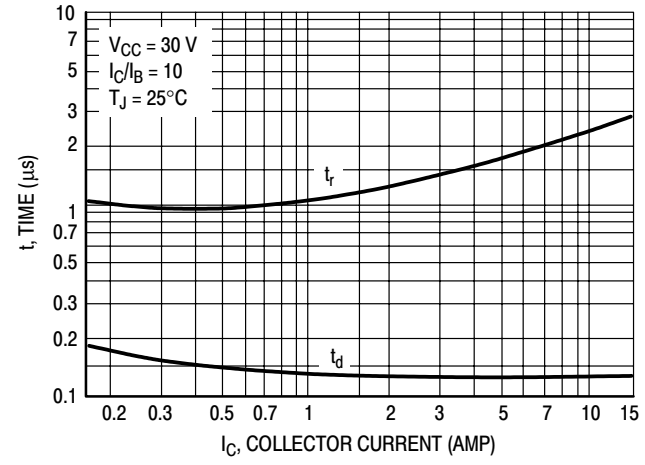


Figure 7. Turn-On Time

2N3055A MJ15015 MJ15016

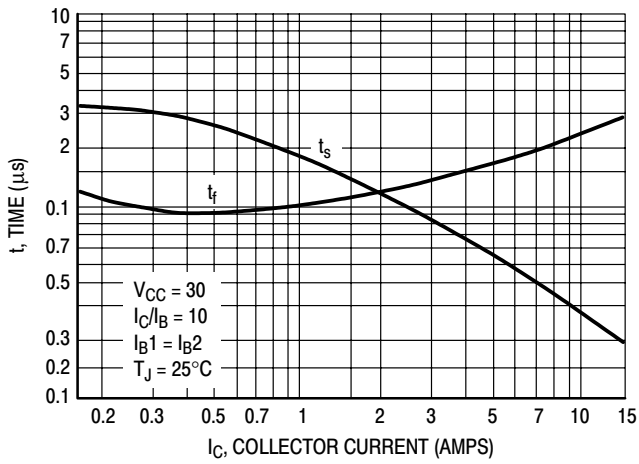


Figure 8. Turn-Off Times

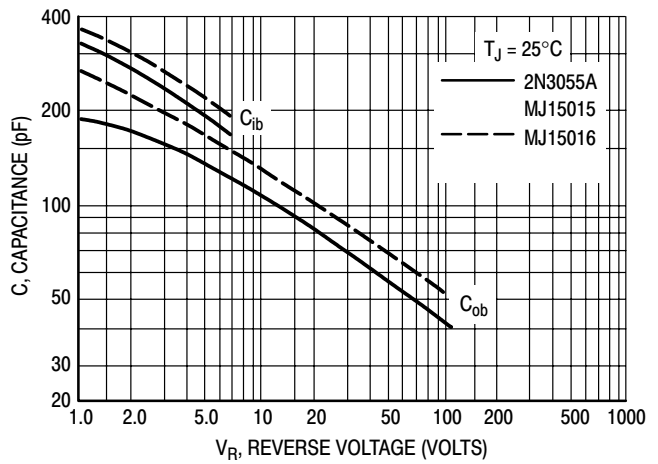


Figure 9. Capacitances

COLLECTOR CUT-OFF REGION

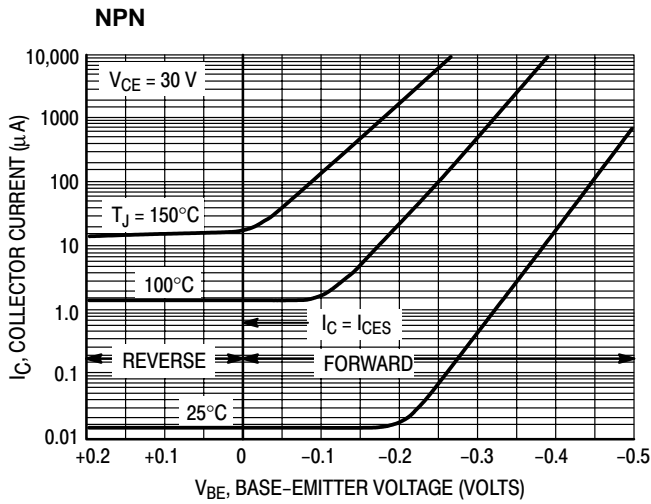


Figure 10. 2N3055A, MJ15015

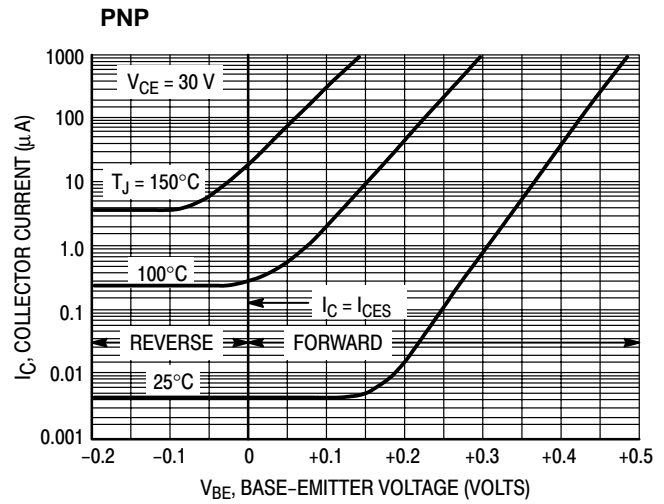
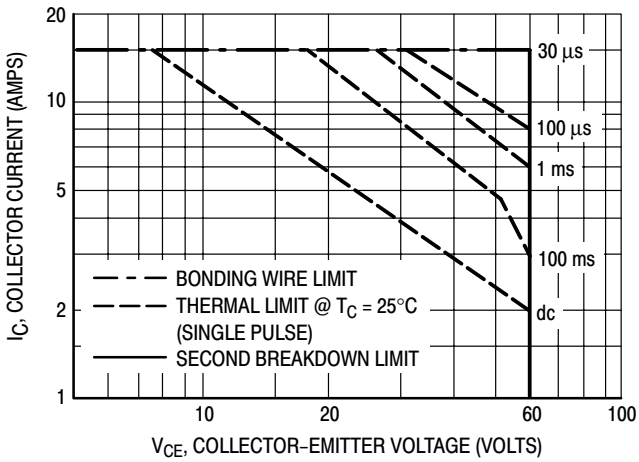
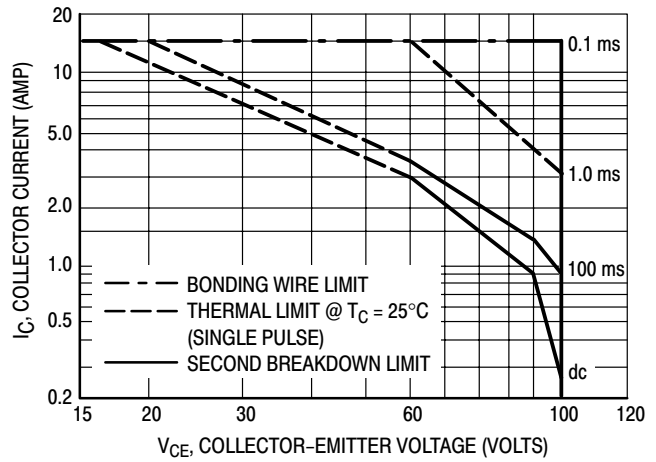


Figure 11. MJ15016



**Figure 12. Forward Bias Safe Operating Area
2N3055A**



**Figure 13. Forward Bias Safe Operating Area
MJ15015, MJ15016**

2N3055A MJ15015 MJ15016

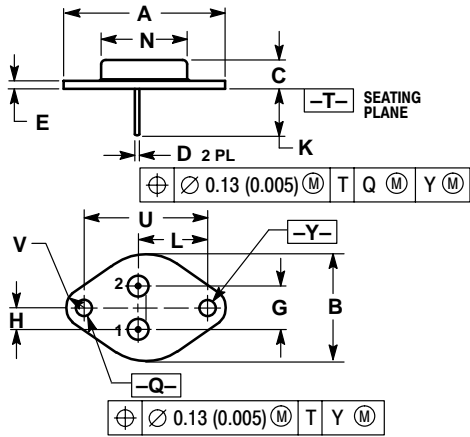
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe Operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation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

The data of Figures 12 and 13 is based on $T_C = 25^\circ\text{C}$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated for temperature according to Figure 1.

2N3055A MJ15015 MJ15016

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 | --- | 0.830 | --- | 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:
PIN 1. BASE
2. EMITTER
CASE: COLLECTOR

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