

High-Current Complementary Silicon Transistors

... for use as output devices in complementary general purpose amplifier applications.

- High DC Current Gain — $h_{FE} = 1000$ (Min) @ $I_C = 20$ Adc
- Monolithic Construction with Built-in Base Emitter Shunt Resistor
- Junction Temperature to $+200^\circ\text{C}$

MAXIMUM RATINGS

| Rating | Symbol | MJ11012 | MJ11013 MJ11014 | MJ11015 MJ11016 | Unit |
|--|----------------|-------------|--------------------|--------------------|------------------------------|
| Collector-Emitter Voltage | V_{CEO} | 60 | 90 | 120 | Vdc |
| Collector-Base Voltage | V_{CB} | 60 | 90 | 120 | Vdc |
| Emitter-Base Voltage | V_{EB} | 5 | | | Vdc |
| Collector Current | I_C | 30 | | | Adc |
| Base Current | I_B | 1 | | | Adc |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C @ $T_C = 100^\circ\text{C}$ | P_D | 200 1.15 | | | Watts W/ $^\circ\text{C}$ |
| Operating Storage Junction Temperature Range | T_J, T_{stg} | -55 to +200 | | | $^\circ\text{C}$ |

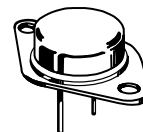
THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|--|-----------------|------|---------------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.87 | $^\circ\text{C}/\text{W}$ |
| Maximum Lead Temperature for Soldering Purposes for ≤ 10 Seconds. | T_L | 275 | $^\circ\text{C}$ |

PNP
MJ11013
MJ11015
NPN
MJ11012
MJ11014
MJ11016*

*Motorola Preferred Device

30 AMPERE
DARLINGTON
POWER TRANSISTORS
COMPLEMENTARY
SILICON
60-120 VOLTS
200 WATTS



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

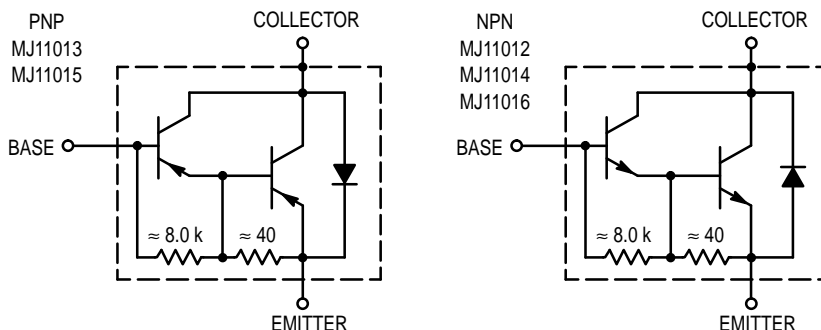


Figure 1. Darlington Circuit Schematic

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

REV 1

MJ11013 MJ11015 MJ11012 MJ11014 MJ11016

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

| Characteristics | Symbol | Min | Max | Unit |
|---|---------------|----------------------------|----------------------------|--|
| OFF CHARACTERISTICS | | | | |
| Collector–Emitter Breakdown Voltage(1) ($I_C = 100\text{ mAdc}$, $I_B = 0$) | $V_{(BR)CEO}$ | 60 90 120 | — | Vdc |
| | | | | MJ11012 MJ11013, MJ11014 MJ11015, MJ11016 |
| Collector–Emitter Leakage Current ($V_{CE} = 60\text{ Vdc}$, $R_{BE} = 1\text{ k ohm}$) ($V_{CE} = 90\text{ Vdc}$, $R_{BE} = 1\text{ k ohm}$) ($V_{CE} = 120\text{ Vdc}$, $R_{BE} = 1\text{ k ohm}$) ($V_{CE} = 60\text{ Vdc}$, $R_{BE} = 1\text{ k ohm}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 90\text{ Vdc}$, $R_{BE} = 1\text{ k ohm}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 120\text{ Vdc}$, $R_{BE} = 1\text{ k ohm}$, $T_C = 150^\circ\text{C}$) | I_{CER} | — — — — — — | 1 1 1 5 5 5 | mAdc |
| | | | | MJ11012 MJ11013, MJ11014 MJ11015, MJ11016 MJ11012 MJ11013, MJ11014 MJ11015, MJ11016 |
| Emitter Cutoff Current ($V_{BE} = 5\text{ Vdc}$, $I_C = 0$) | I_{EBO} | — | 5 | mAdc |
| Collector–Emitter Leakage Current ($V_{CE} = 50\text{ Vdc}$, $I_B = 0$) | I_{CEO} | — | 1 | mAdc |

ON CHARACTERISTICS(1)

| | | | | |
|--|---------------|-------------|----------|-----|
| DC Current Gain ($I_C = 20\text{ Adc}$, $V_{CE} = 5\text{ Vdc}$) ($I_C = 30\text{ Adc}$, $V_{CE} = 5\text{ Vdc}$) | h_{FE} | 1000 200 | — — | — |
| Collector–Emitter Saturation Voltage ($I_C = 20\text{ Adc}$, $I_B = 200\text{ mAdc}$) ($I_C = 30\text{ Adc}$, $I_B = 300\text{ mAdc}$) | $V_{CE(sat)}$ | — — | 3 4 | Vdc |
| Base–Emitter Saturation Voltage ($I_C = 20\text{ A}$, $I_B = 200\text{ mAdc}$) ($I_C = 30\text{ A}$, $I_B = 300\text{ mAdc}$) | $V_{BE(sat)}$ | — — | 3.5 5 | Vdc |

DYNAMIC CHARACTERISTICS

| | | | | |
|--|----------|---|---|-----|
| Current–Gain Bandwidth Product ($I_C = 10\text{ A}$, $V_{CE} = 3\text{ Vdc}$, $f = 1\text{ MHz}$) | h_{fe} | 4 | — | MHz |
|--|----------|---|---|-----|

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle $\leq 2.0\%$.

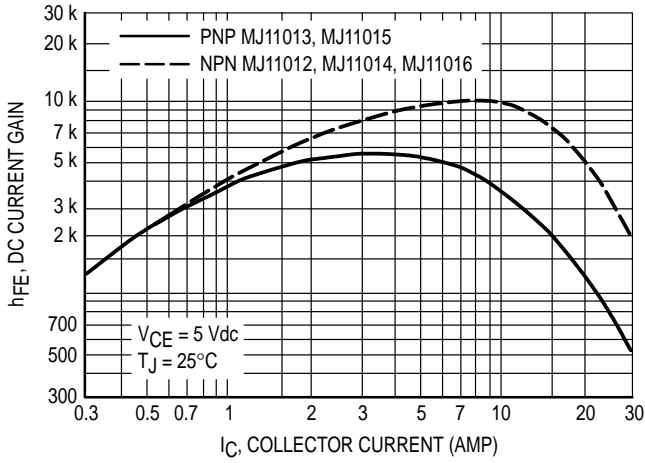


Figure 2. DC Current Gain (1)

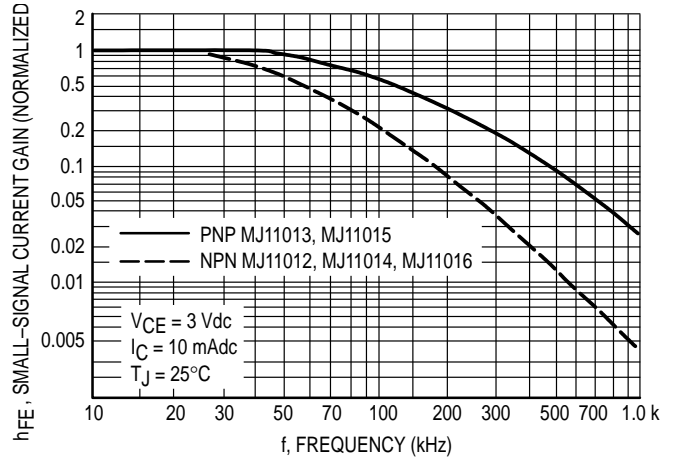


Figure 3. Small-Signal Current Gain

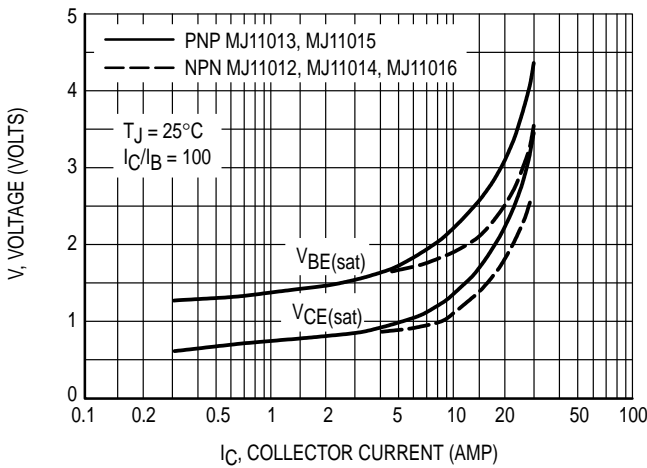


Figure 4. "On" Voltages (1)

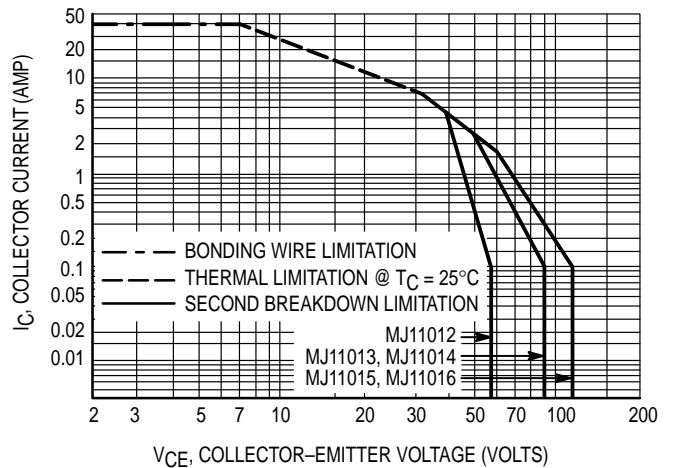


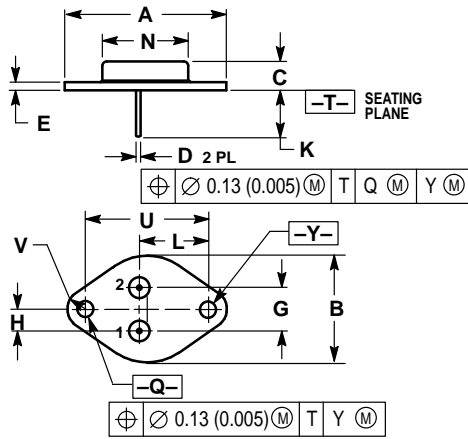
Figure 5. Active Region DC Safe Operating Area

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

dissipation than the curves indicate.

At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by secondary breakdown.

PACKAGE DIMENSIONS



- 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:
1. BASE
 2. EMITTER
- CASE: COLLECTOR

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

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