

# 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 $25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$P_D$	200 1.15			Watts W/ $^\circ\text{C}$
Operating Storage Junction Temperature Range	$T_J, T_{stg}$	-55 to +200			$^\circ\text{C}$

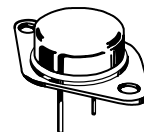
## THERMAL CHARACTERISTICS

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 $\leq 10$ 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)**

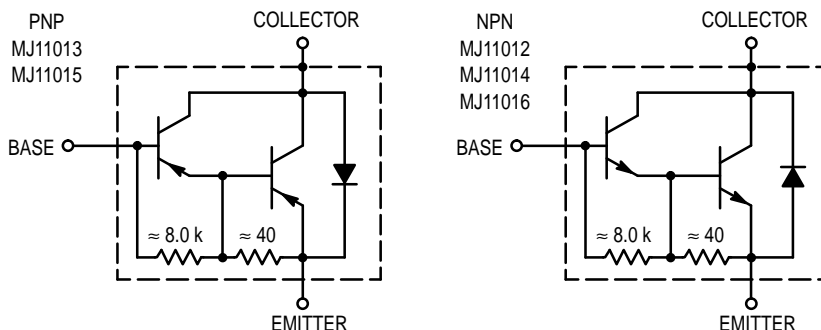


Figure 1. Darlington Circuit Schematic

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
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage(1) ( $I_C = 100\text{ mAdc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	60 90 120	— — —	Vdc
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
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
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(1) Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

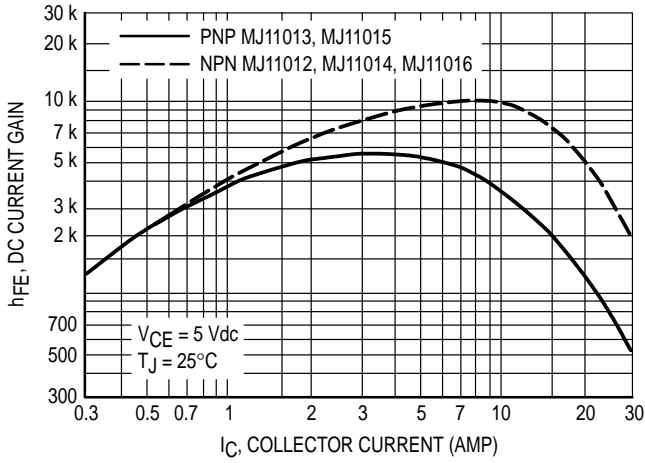


Figure 2. DC Current Gain (1)

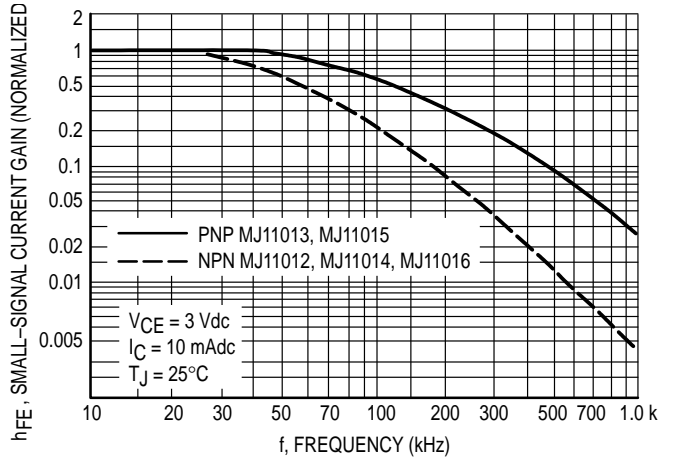


Figure 3. Small-Signal Current Gain

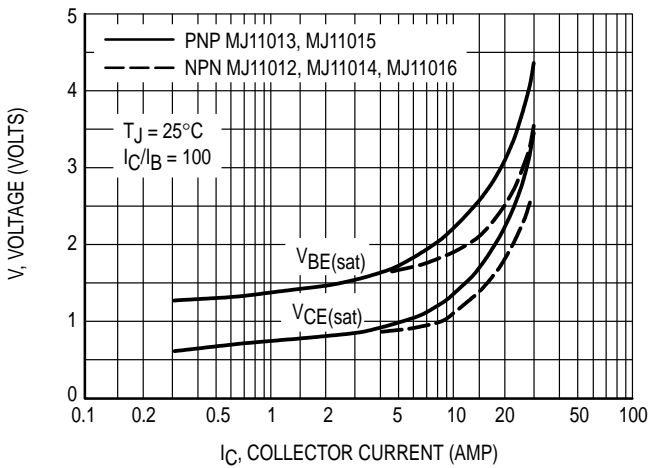


Figure 4. "On" Voltages (1)

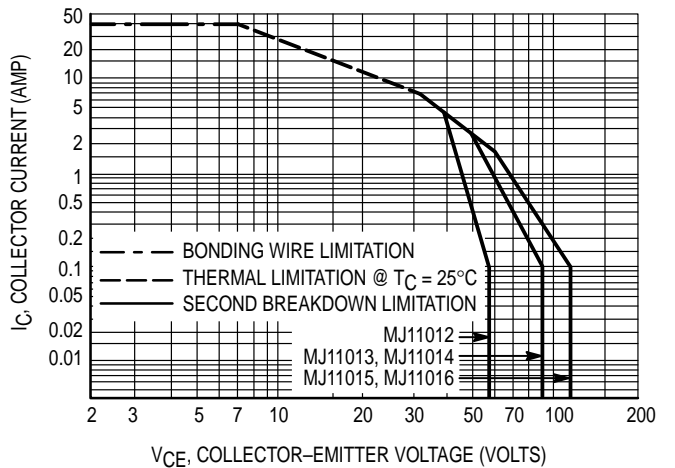


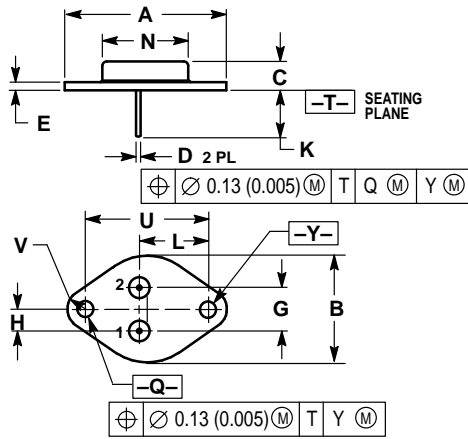
Figure 5. Active Region DC Safe Operating Area

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:  
 PIN 1: BASE  
 2: EMITTER  
 CASE: COLLECTOR

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

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