

# 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 and MJ2955.

- 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 MJ2955A	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 $25^\circ\text{C}$	$P_D$	115 0.65	180 1.03	Watts W/°C
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200		°C

## THERMAL CHARACTERISTICS

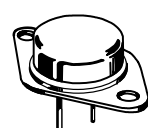
Characteristic	Symbol	Max	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.52	0.98	°C/W

\*Indicates JEDEC Registered Data. (2N3055A)

**NPN**  
**2N3055A**  
  
**MJ15015 \***  
  
**MJ2955A**  
**PNP**  
**MJ15016 \***

\*ON Semiconductor Preferred Device

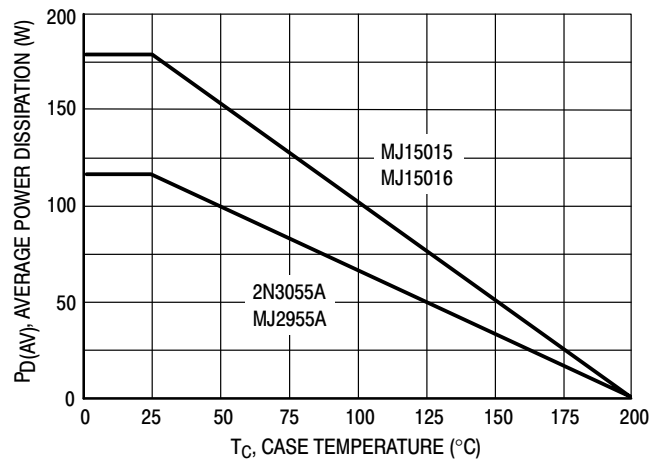
**15 AMPERE**  
**COMPLEMENTARY**  
**SILICON**  
**POWER TRANSISTORS**  
**60, 120 VOLTS**  
**115, 180 WATTS**



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

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

# 2N3055A MJ15015 MJ2955A MJ15016



**Figure 1. Power Derating**

## 2N3055A MJ15015 MJ2955A MJ15016

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

Characteristic	Symbol	Min	Max	Unit
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#### OFF CHARACTERISTICS (1)

*Collector–Emitter Sustaining Voltage ( $I_C = 200\text{ mA}$ , $I_B = 0$ )	2N3055A, MJ2955A 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, MJ2955A MJ15015, MJ15016	$I_{CEO}$	— —	0.7 0.1	mAdc
*Collector Cutoff Current ( $V_{CEV} = \text{Rated Value}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )	2N3055A, MJ2955A MJ15015, MJ15016	$I_{CEV}$	— —	5.0 1.0	mAdc
Collector Cutoff Current ( $V_{CEV} = \text{Rated Value}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	2N3055A, MJ2955A MJ15015, MJ15016	$I_{CEV}$	— —	30 6.0	mAdc
Emitter Cutoff Current ( $V_{EB} = 7.0\text{ Vdc}$ , $I_C = 0$ )	2N3055A, MJ2955A MJ15015, MJ15016	$I_{EBO}$	— —	5.0 0.2	mAdc

#### \*SECOND BREAKDOWN

Second Breakdown Collector Current with Base Forward Biased ( $t = 0.5\text{ s}$ non–repetitive) ( $V_{CE} = 60\text{ Vdc}$ )	2N3055A, MJ2955A MJ15015, MJ15016	$I_{S/b}$	1.95 3.0	— —	Adc
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#### \*ON CHARACTERISTICS (1)

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

#### \*DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	2N3055A, MJ15015 MJ2955A, 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	$(V_{CC} = 30\text{ Vdc}$ , $I_C = 4.0\text{ Adc}$ , $I_{B1} = I_{B2} = 0.4\text{ Adc}$ , $t_p = 25\text{ }\mu\text{s}$ Duty Cycle $\leq 2\%$ )	$t_d$	—	0.5	$\mu\text{s}$
Rise Time		$t_r$	—	4.0	$\mu\text{s}$
Storage Time		$t_s$	—	3.0	$\mu\text{s}$
Fall Time		$t_f$	—	6.0	$\mu\text{s}$

(1) Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

\*Indicates JEDEC Registered Data. (2N3055A)

2N3055A MJ15015 MJ2955A MJ15016

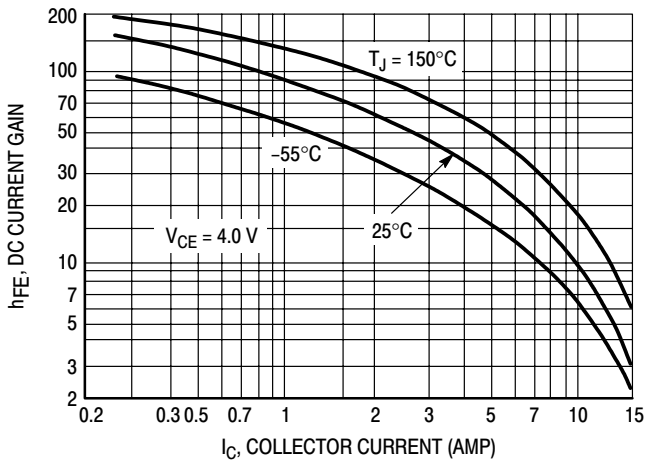


Figure 2. DC Current Gain

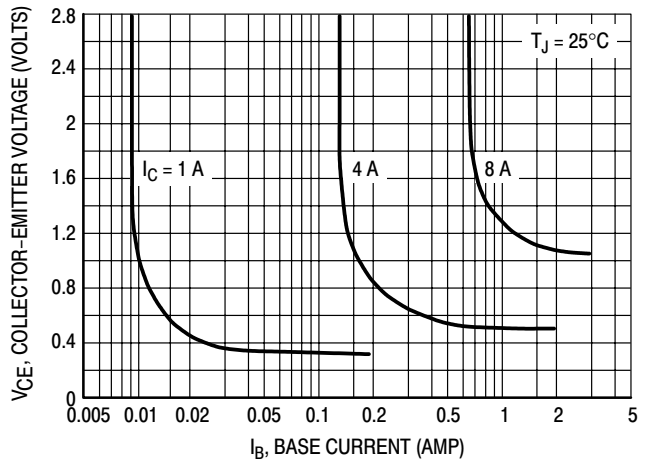


Figure 3. Collector Saturation Region

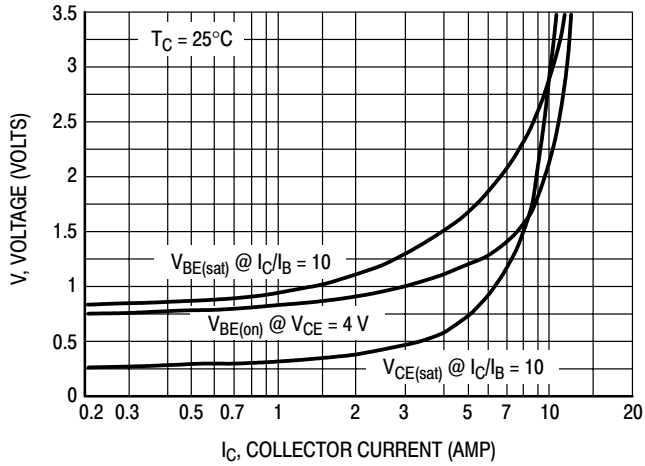


Figure 4. "On" Voltages

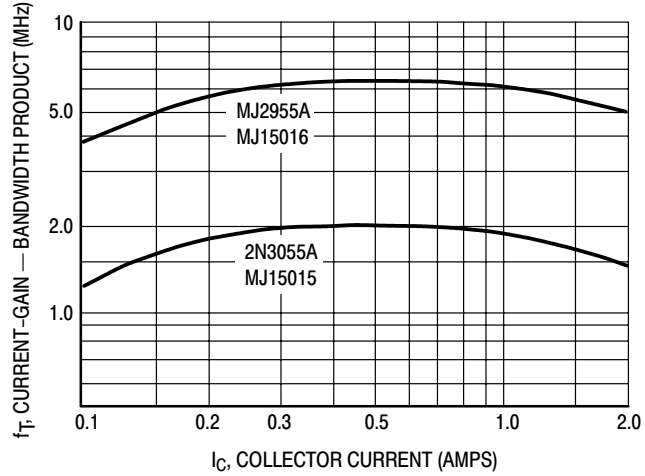


Figure 5. Current-Gain — Bandwidth Product

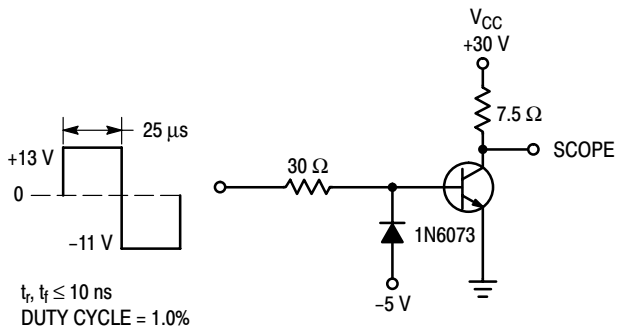


Figure 6. Switching Times Test Circuit (Circuit shown is for NPN)

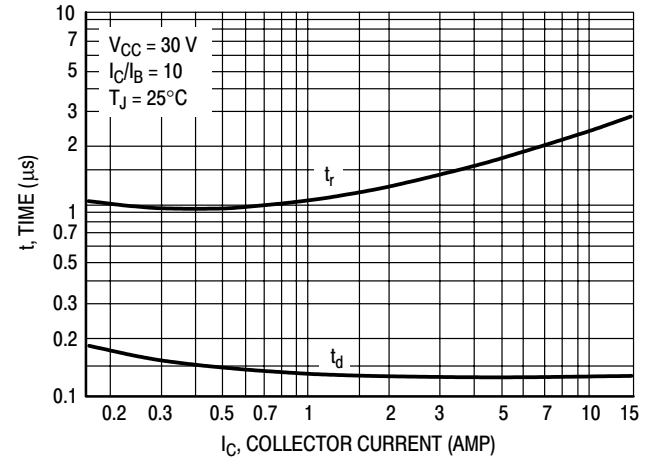


Figure 7. Turn-On Time

2N3055A MJ15015 MJ2955A MJ15016

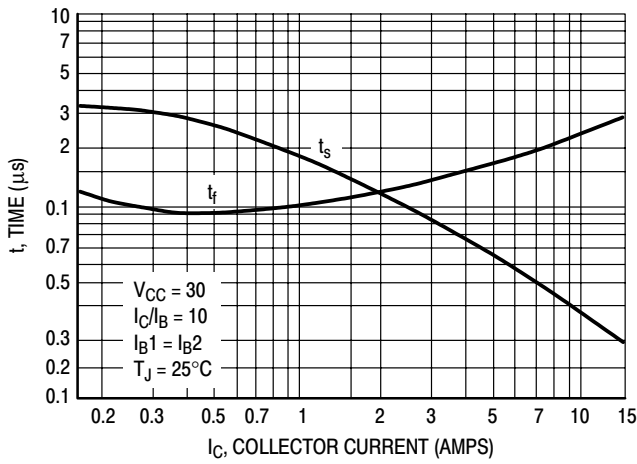


Figure 8. Turn-Off Times

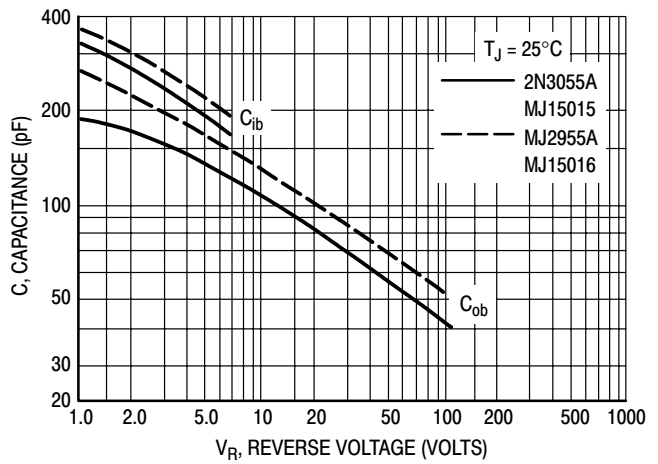


Figure 9. Capacitances

COLLECTOR CUT-OFF REGION

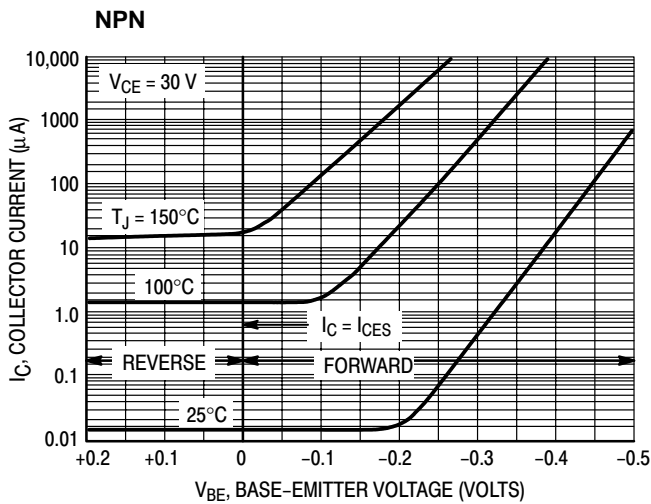


Figure 10. 2N3055A, MJ15015

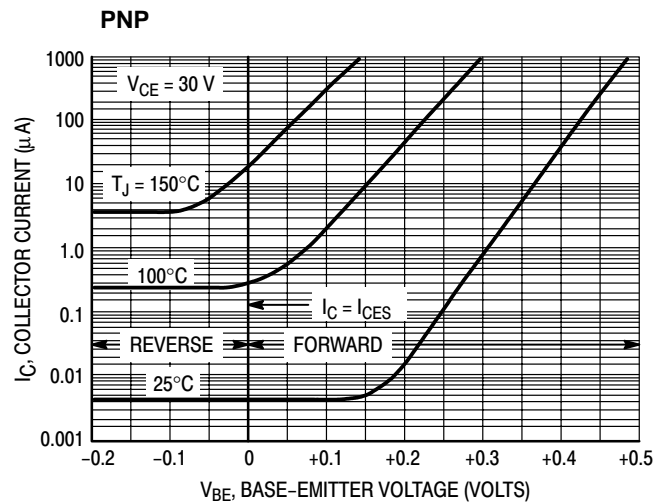


Figure 11. MJ2955A, MJ15016

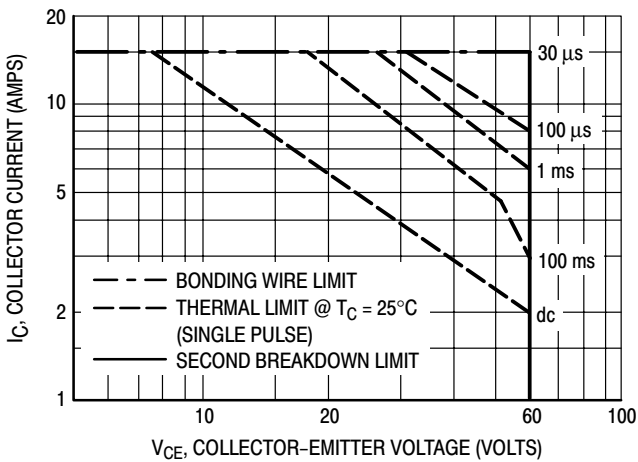


Figure 12. Forward Bias Safe Operating Area  
2N3055A, MJ2955A

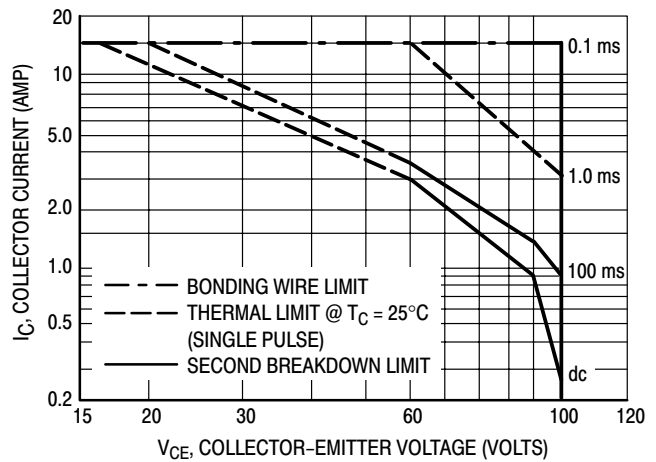


Figure 13. Forward Bias Safe Operating Area  
MJ15015, MJ15016

## 2N3055A MJ15015 MJ2955A MJ15016

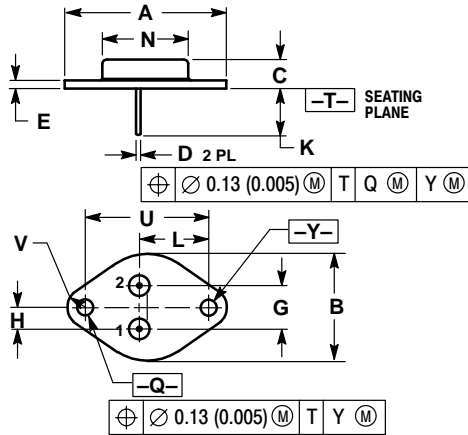
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe Operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater 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 MJ2955A 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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