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# 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 @  $I_C = 1.0$  Adc  
 $f_T = 0.8$  MHz (Min) — NPN  
 $= 2.2$  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/ $^\circ\text{C}$
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	$^\circ\text{C}/\text{W}$

\*Indicates JEDEC Registered Data. (2N3055A)

**NPN**  
**2N3055A**

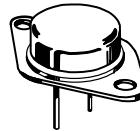
**MJ15015 \***

**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

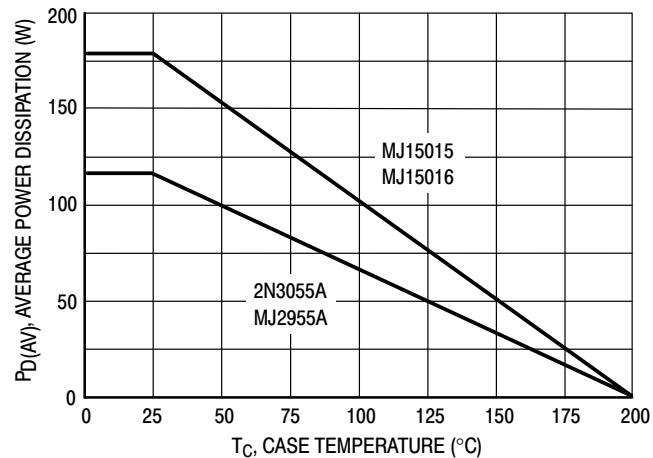


Figure 1. Power Derating

# 2N3055A MJ15015 MJ2955A MJ15016

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

Characteristic	Symbol	Min	Max	Unit	
<b>OFF CHARACTERISTICS (1)</b>					
*Collector-Emitter Sustaining Voltage ( $I_C = 200 \text{ mA DC}$ , $I_B = 0$ )	$V_{CEO(\text{sus})}$	60 120	—	Vdc	
Collector Cutoff Current ( $V_{CE} = 30 \text{ Vdc}$ , $V_{BE(\text{off})} = 0 \text{ Vdc}$ ) ( $V_{CE} = 60 \text{ Vdc}$ , $V_{BE(\text{off})} = 0 \text{ Vdc}$ )	$I_{CEO}$	— —	0.7 0.1	mA DC	
*Collector Cutoff Current ( $V_{CEV}$ = Rated Value, $V_{BE(\text{off})} = 1.5 \text{ Vdc}$ )	$I_{CEV}$	— —	5.0 1.0	mA DC	
Collector Cutoff Current ( $V_{CEV}$ = Rated Value, $V_{BE(\text{off})} = 1.5 \text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	$I_{CEV}$	— —	30 6.0	mA DC	
Emitter Cutoff Current ( $V_{EB} = 7.0 \text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	— —	5.0 0.2	mA DC	
<b>*SECOND BREAKDOWN</b>					
Second Breakdown Collector Current with Base Forward Biased ( $t = 0.5 \text{ s}$ non-repetitive) ( $V_{CE} = 60 \text{ Vdc}$ )	$I_{S/b}$	1.95 3.0	— —	Adc	
<b>*ON CHARACTERISTICS (1)</b>					
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 ( $I_C = 4.0 \text{ Adc}$ , $I_B = 400 \text{ mA DC}$ ) ( $I_C = 10 \text{ Adc}$ , $I_B = 3.3 \text{ Adc}$ ) ( $I_C = 15 \text{ Adc}$ , $I_B = 7.0 \text{ Adc}$ )	$V_{CE(\text{sat})}$	— — —	1.1 3.0 5.0	Vdc	
Base-Emitter On Voltage ( $I_C = 4.0 \text{ Adc}$ , $V_{CE} = 4.0 \text{ Vdc}$ )	$V_{BE(\text{on})}$	0.7	1.8	Vdc	
<b>*DYNAMIC CHARACTERISTICS</b>					
Current-Gain — Bandwidth Product ( $I_C = 1.0 \text{ Adc}$ , $V_{CE} = 4.0 \text{ Vdc}$ , $f = 1.0 \text{ MHz}$ )	$f_T$	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	
<b>*SWITCHING CHARACTERISTICS (2N3055A only)</b>					
<b>RESISTIVE LOAD</b>					
Delay Time	( $V_{CC} = 30 \text{ Vdc}$ , $I_C = 4.0 \text{ Adc}$ , $I_{B1} = I_{B2} = 0.4 \text{ Adc}$ , $t_p = 25 \mu\text{s}$ 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

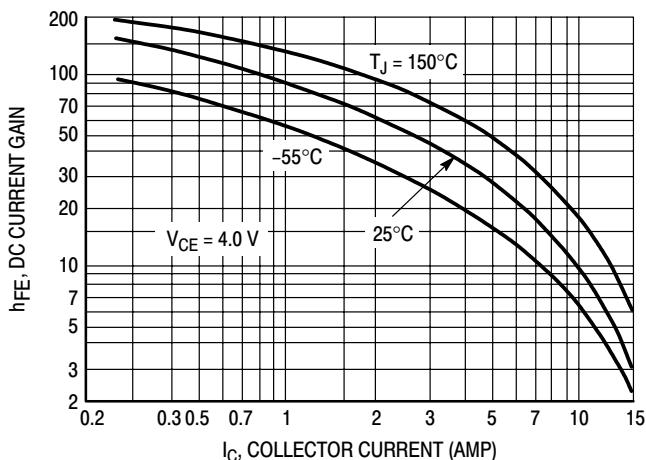


Figure 2. DC Current Gain

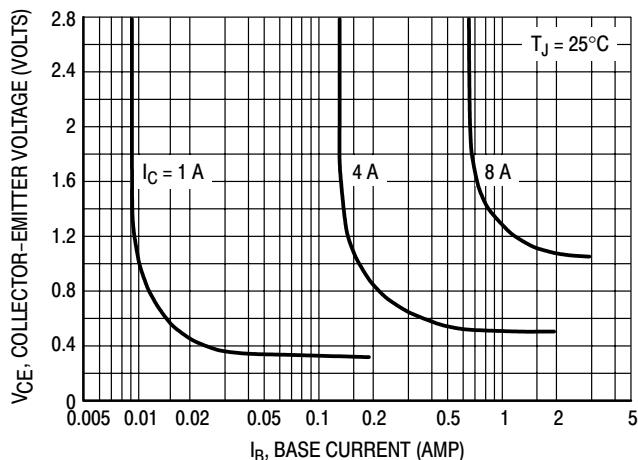


Figure 3. Collector Saturation Region

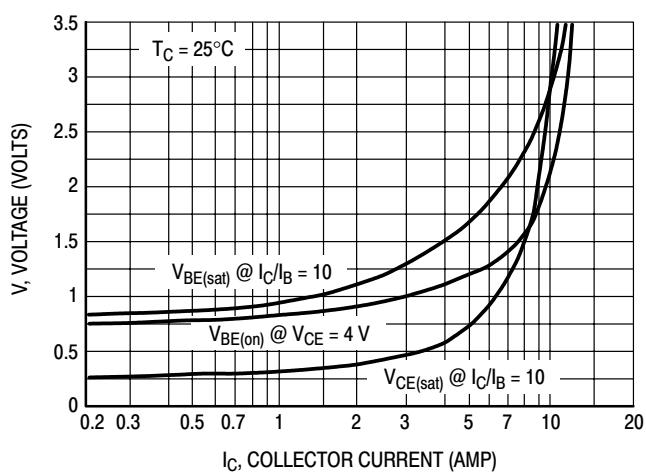


Figure 4. "On" Voltages

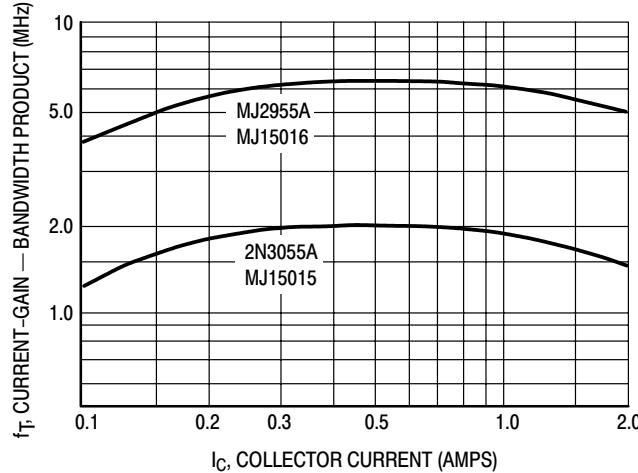


Figure 5. Current-Gain — Bandwidth Product

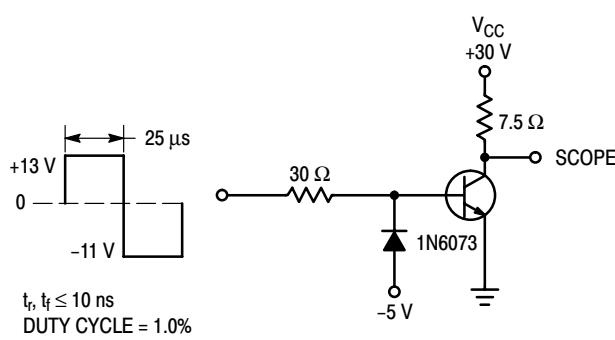


Figure 6. Switching Times Test Circuit  
(Circuit shown is for NPN)

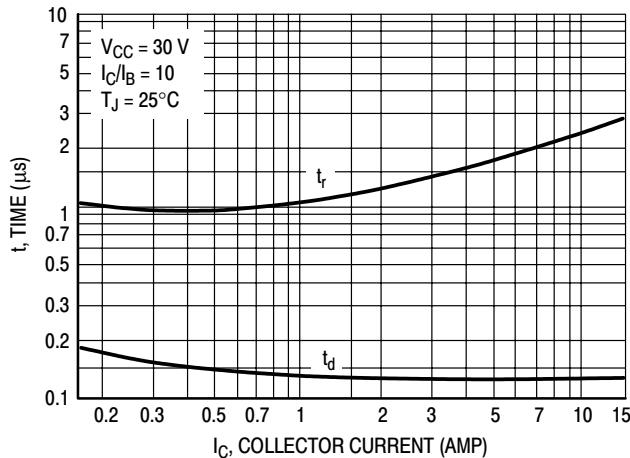


Figure 7. Turn-On Time

# 2N3055A MJ15015 MJ2955A MJ15016

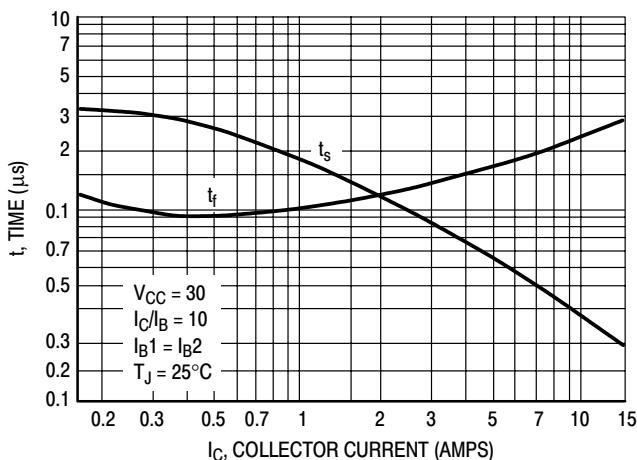


Figure 8. Turn-Off Times

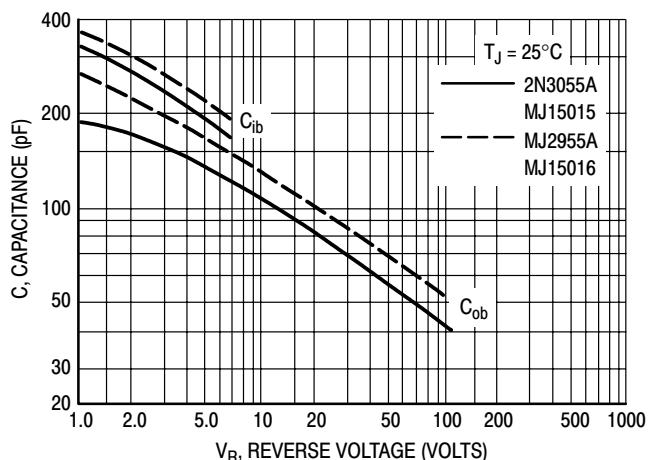


Figure 9. Capacitances

## COLLECTOR CUT-OFF REGION

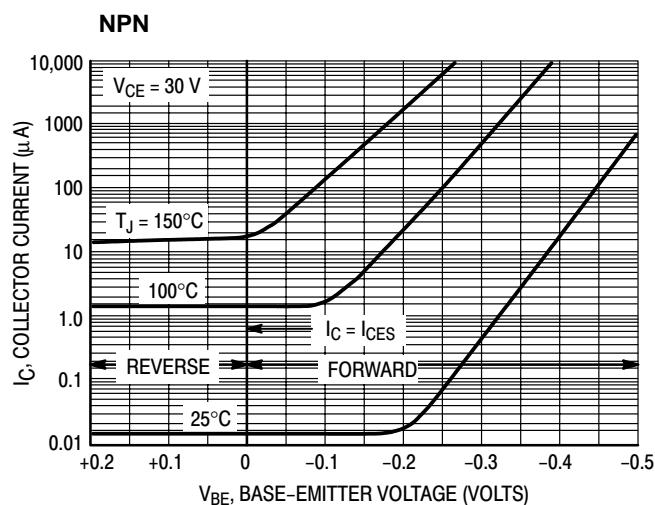


Figure 10. 2N3055A, MJ15015

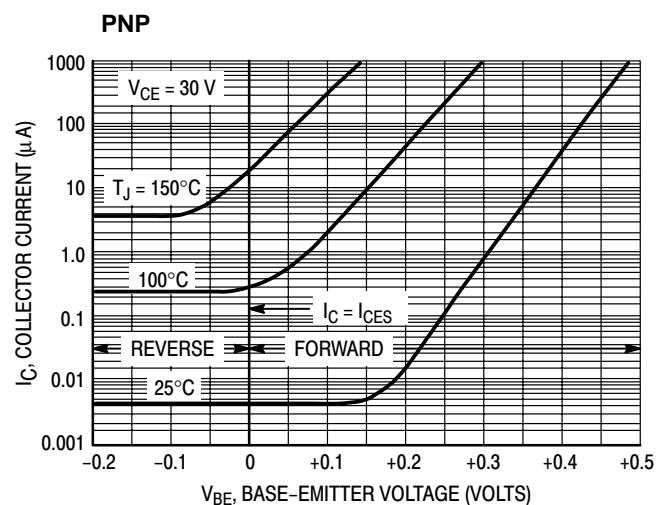


Figure 11. MJ2955A, MJ15016

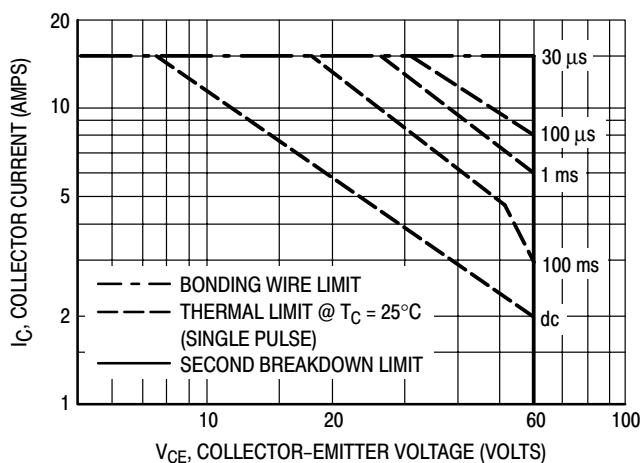


Figure 12. Forward Bias Safe Operating Area  
2N3055A, MJ2955A

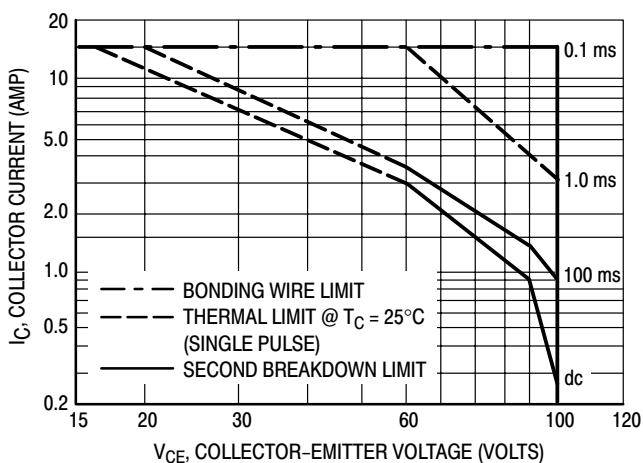


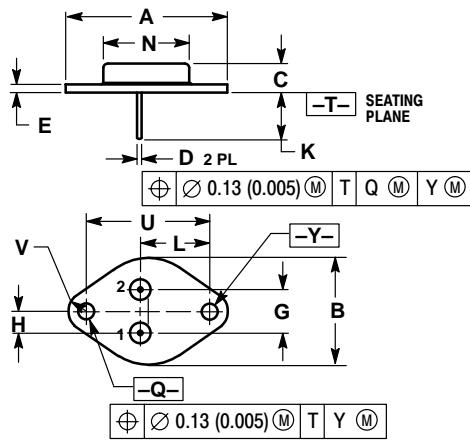
Figure 13. Forward Bias Safe Operating Area  
MJ15015, MJ15016

## 2N3055A MJ15015 MJ2955A MJ15016

7There 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.

## 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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