

# Complementary Silicon High-Power Transistors

## 2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

These PowerBase complementary transistors are 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.

### Features

- High Current-Gain – Bandwidth
- Safe Operating Area
- These Devices are Pb-Free and are RoHS Compliant\*

### MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage 2N3055AG MJ15015G, MJ15016G	$V_{CEO}$	60 120	Vdc
Collector-Base Voltage 2N3055AG MJ15015G, MJ15016G	$V_{CBO}$	100 200	Vdc
Collector-Emitter Voltage Base Reversed Biased 2N3055AG MJ15015G, MJ15016G	$V_{CEV}$	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 @ $T_C = 25^\circ\text{C}$ 2N3055AG MJ15015G, MJ15016G Derate above $25^\circ\text{C}$ 2N3055AG MJ15015G, MJ15016G	$P_D$	115 180 0.65 1.03	W W W/ $^\circ\text{C}$ W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

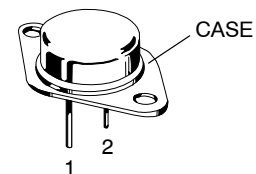
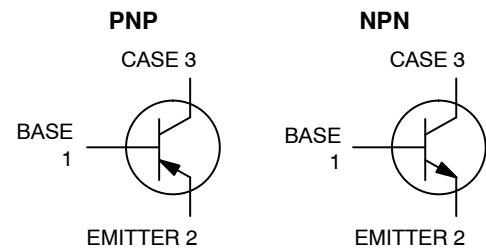
1. Indicates JEDEC Registered Data. (2N3055A)

### THERMAL CHARACTERISTICS

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

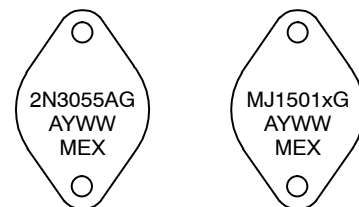
\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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



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

### MARKING DIAGRAMS



2N3055A = Device Code  
MJ1501x = Device Code  
x = 5 or 6  
G = Pb-Free Package  
A = Assembly Location  
Y = Year  
WW = Work Week  
MEX = Country of Origin

### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

## 2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

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

Characteristic	Symbol	Min	Max	Unit
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#### OFF CHARACTERISTICS (Note 2)

Collector-Emitter Sustaining Voltage (Note 3) ( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )	2N3055AG MJ15015G, MJ15016G	$V_{CEO(sus)}$	60 120	– –	Vdc
Collector Cutoff Current ( $V_{CE} = 30\text{ Vdc}$ , $V_{BE(off)} = 0\text{ Vdc}$ ) ( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 0\text{ Vdc}$ )	2N3055AG MJ15015G, MJ15016G	$I_{CEO}$	– –	0.7 0.1	mAdc
Collector Cutoff Current (Note 3) ( $V_{CEV} = \text{Rated Value}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )	2N3055AG MJ15015G, MJ15016G	$I_{CEV}$	– –	5.0 1.0	mAdc
Collector Cutoff Current ( $V_{CEV} = \text{Rated Value}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	2N3055AG MJ15015G, MJ15016G	$I_{CEV}$	– –	30 6.0	mAdc
Emitter Cutoff Current ( $V_{EB} = 7.0\text{ Vdc}$ , $I_C = 0$ )	2N3055AG MJ15015G, MJ15016G	$I_{EBO}$	– –	5.0 0.2	mAdc

#### SECOND BREAKDOWN (Note 3)

Second Breakdown Collector Current with Base Forward Biased ( $t = 0.5\text{ s non-repetitive}$ ) ( $V_{CE} = 60\text{ Vdc}$ )	2N3055AG MJ15015G, MJ15016G	$I_{S/b}$	1.95 3.0	– –	Adc
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#### ON CHARACTERISTICS (Note 2 and 3)

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 ( $I_C = 4.0\text{ Adc}$ , $I_B = 400\text{ mAdc}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 3.3\text{ Adc}$ ) ( $I_C = 15\text{ Adc}$ , $I_B = 7.0\text{ Adc}$ )	$V_{CE(sat)}$	– – –	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 (Note 3)

Current-Gain – Bandwidth Product ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	2N3055AG, MJ15015G MJ15016G	$f_T$	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 (2N3055AG only) (Note 3)

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	$\mu\text{s}$

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

3. Indicates JEDEC Registered Data. (2N3055A)

## 2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

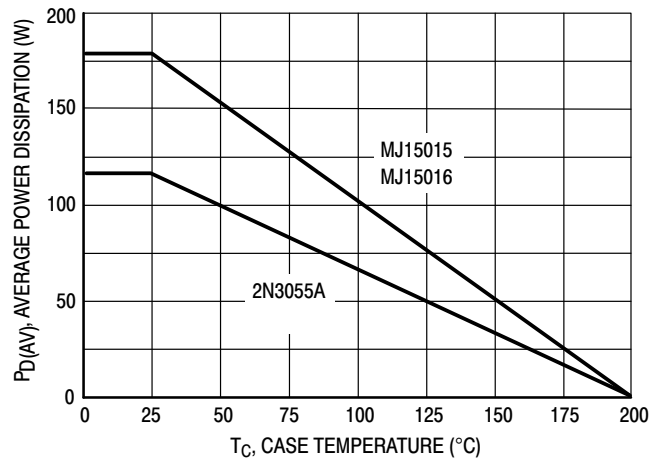


Figure 1. Power Derating

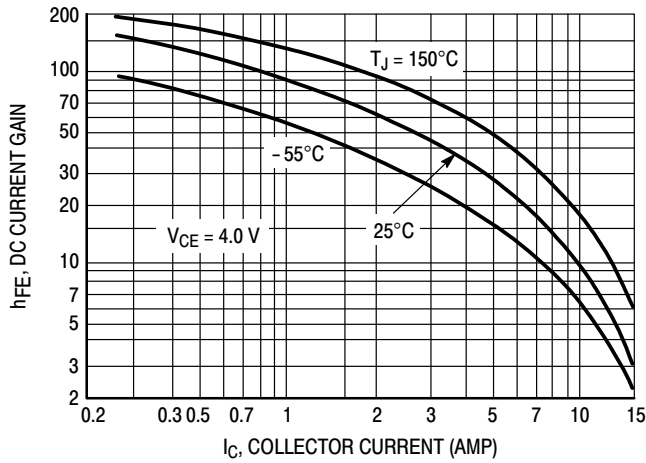


Figure 2. DC Current Gain

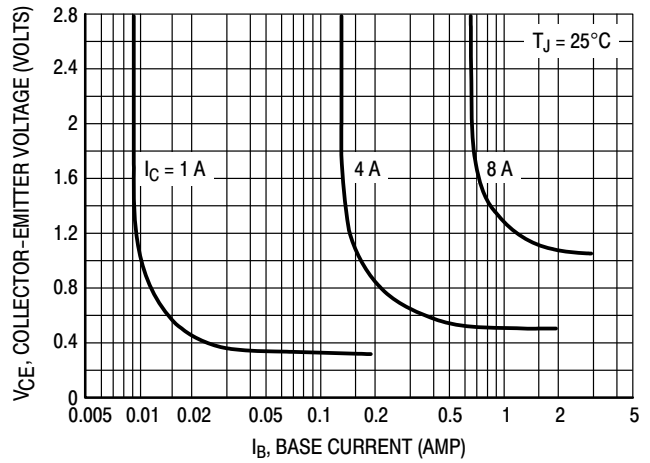


Figure 3. Collector Saturation Region

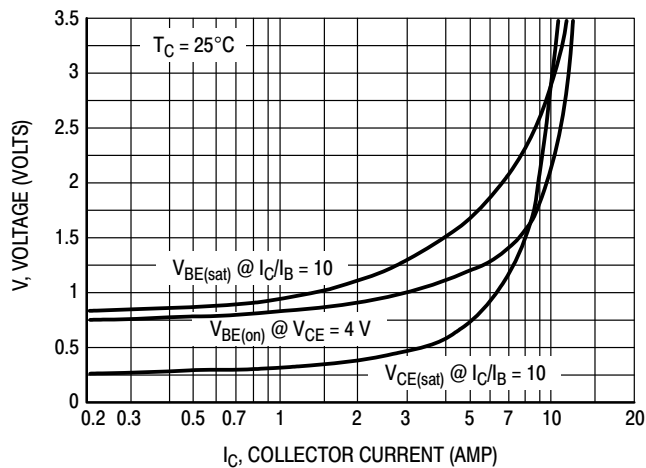


Figure 4. "On" Voltages

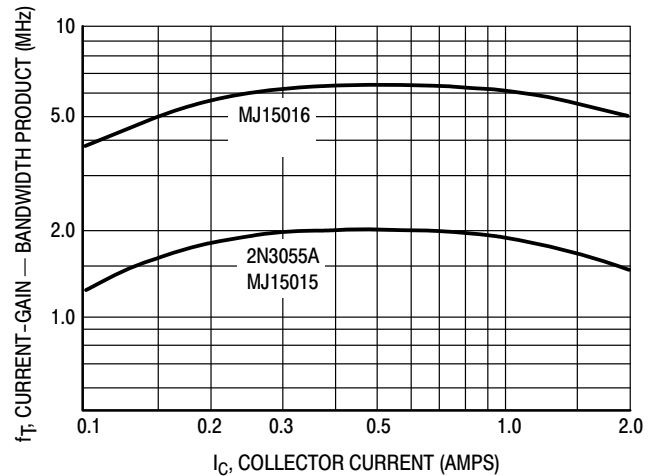
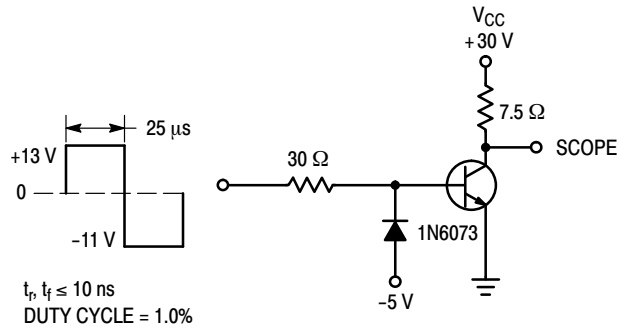
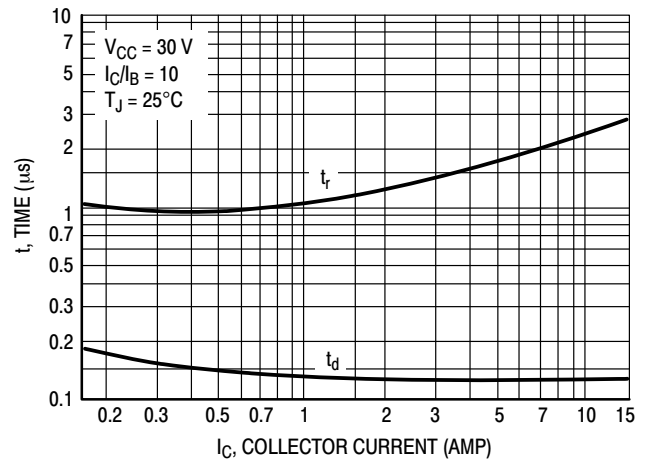


Figure 5. Current-Gain - Bandwidth Product

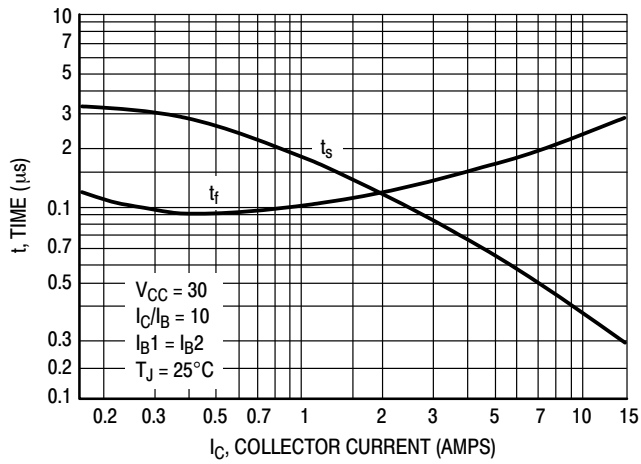
## 2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)



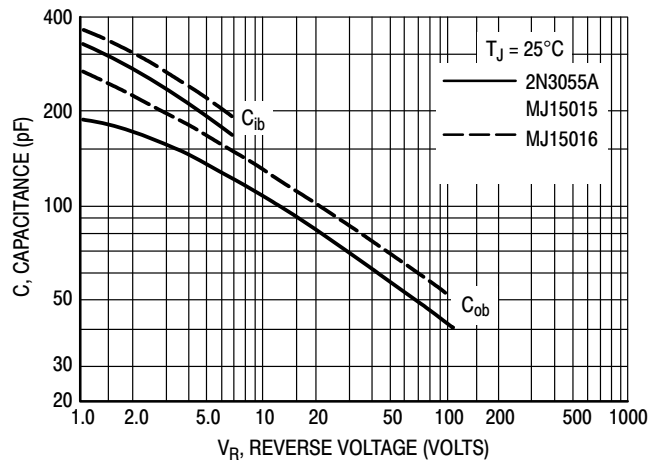
**Figure 6. Switching Times Test Circuit**  
(Circuit shown is for NPN)



**Figure 7. Turn-On Time**



**Figure 8. Turn-Off Times**



**Figure 9. Capacitances**

## 2N3055AG (NPN), MJ15015G (NPN), MJ15016G (PNP)

### COLLECTOR CUT-OFF REGION

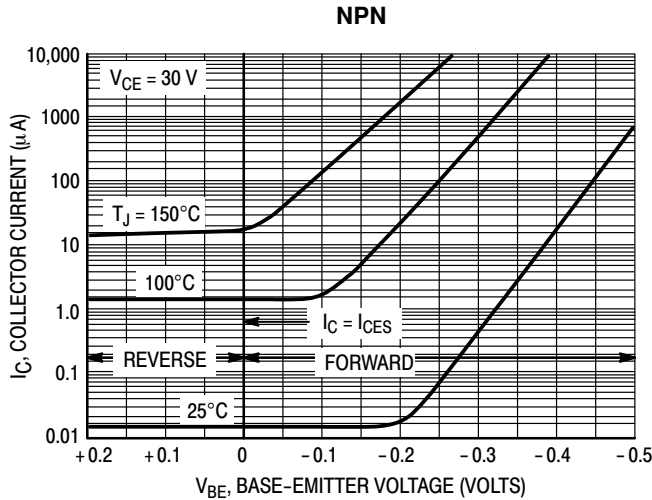


Figure 10. 2N3055A, MJ15015

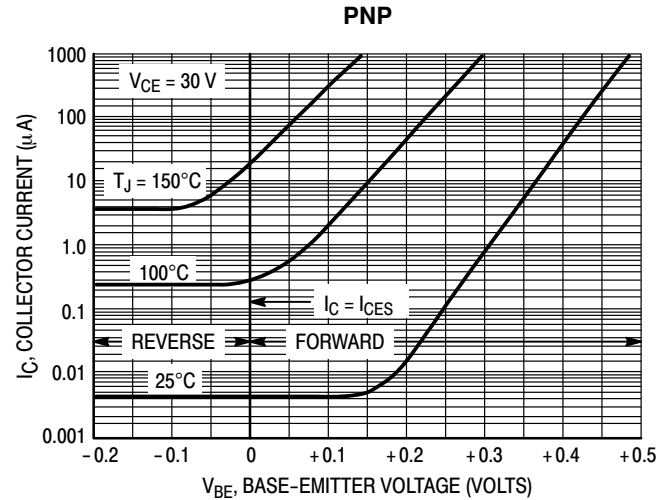


Figure 11. MJ15016

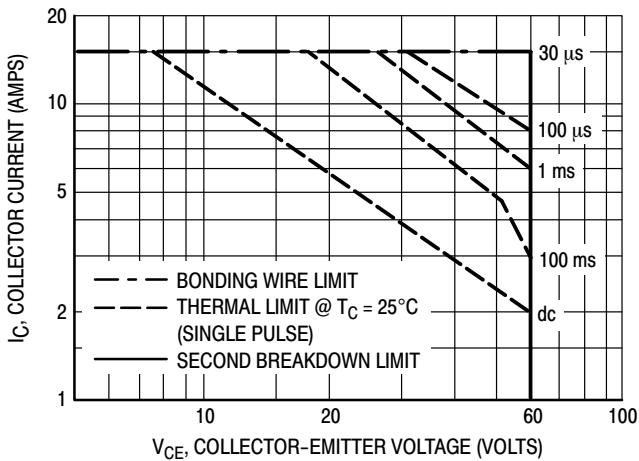


Figure 12. Forward Bias Safe Operating Area  
2N3055A

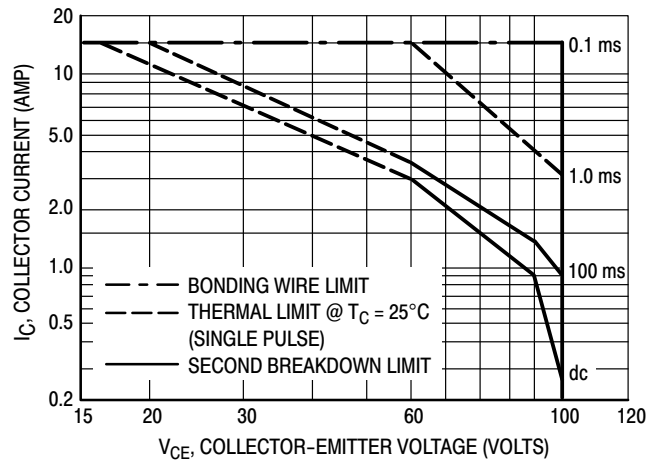


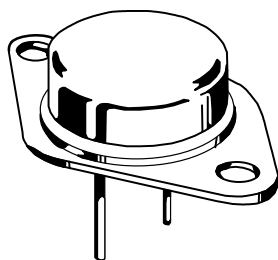
Figure 13. Forward Bias Safe Operating Area  
MJ15015, MJ15016

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.

### ORDERING INFORMATION

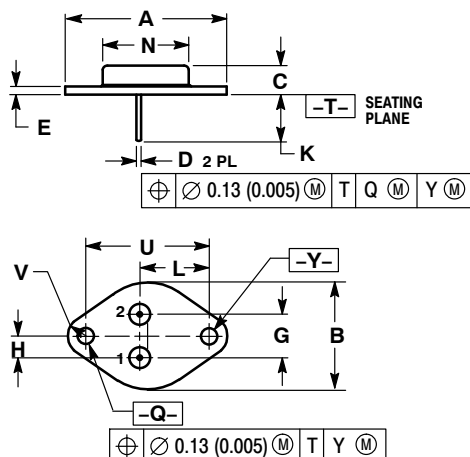
Device	Package	Shipping
2N3055AG	TO-204 (Pb-Free)	100 Units / Tray
MJ15015G	TO-204 (Pb-Free)	100 Units / Tray
MJ15016G	TO-204 (Pb-Free)	100 Units / Tray



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

DATE 10 MAR 2000

SCALE 1:1



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

STYLE 2:  
PIN 1. BASE  
2. COLLECTOR  
CASE: EMITTER

STYLE 3:  
PIN 1. GATE  
2. SOURCE  
CASE: DRAIN

STYLE 4:  
PIN 1. GROUND  
2. INPUT  
CASE: OUTPUT

STYLE 5:  
PIN 1. CATHODE  
2. EXTERNAL TRIP/DELAY  
CASE: ANODE

STYLE 6:  
PIN 1. GATE  
2. EMITTER  
CASE: COLLECTOR

STYLE 7:  
PIN 1. ANODE  
2. OPEN  
CASE: CATHODE

STYLE 8:  
PIN 1. CATHODE #1  
2. CATHODE #2  
CASE: ANODE

STYLE 9:  
PIN 1. ANODE #1  
2. ANODE #2  
CASE: CATHODE

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