

Compendio de Hojas de Datos:

Transistores de potencia

Para uso interno de la materia Electrónica II

Indice:

2SC4793
TIP29, A, B, C (NPN), TIP30, A, B, C (PNP)
MJE170/171/172 (PNP), MJE180/181/182 (NPN)
TIP31 A/B/C (NPN), TIP32 A/B/C (PNP)
2N5190/191/192
2SD1135
BD675/A, 677/A, 679/A, 681
2SC3074
TIP120/21/22 (NPN), TIP125/26/27 (PNP)
BD243B/C, 244B/C
MJE2955T (PNP), MJE3055T (NPN)
2N3442
2N3715/16
2N5875/76 (PNP), 2N5877/78 (NPN)
2SC5199
2N5879/80 (PNP), 2N5881/82 (NPN)
2N3055A, MJ15015 (NPN), MJ15016 (PNP)
MJL3281A (NPN), MJL1302A (PNP)

TIP29, A, B, C (NPN), TIP30, A, B, C (PNP)

Complementary Silicon Plastic Power Transistors

Designed for use in general purpose amplifier and switching applications. Compact TO-220 AB package.

Features

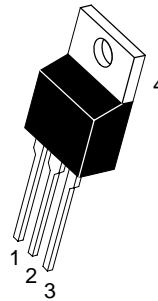
- Pb-Free Packages are Available*



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**1 AMPERE
POWER TRANSISTORS
COMPLEMENTARY SILICON
40, 60, 80, 100 VOLTS,
80 WATTS**



**TO-220AB
CASE 221A
STYLE 1**

MARKING DIAGRAM



TIPxxx = Device Code:
29, 29A, 29B, 29C
30, 30A, 30B, 30C
A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

TIP29, A, B, C (NPN), TIP30, A, B, C (PNP)

MAXIMUM RATINGS

Rating	Symbol	TIP29 TIP30	TIP29A TIP30A	TIP29B TIP30B	TIP29C TIP30C	Unit
Collector – Emitter Voltage	V_{CEO}	40	60	80	100	Vdc
Collector – Base Voltage	V_{CB}	40	60	80	100	Vdc
Emitter – Base Voltage	V_{EB}	5.0				Vdc
Collector Current – Continuous – Peak	I_C	1.0 3.0				Adc
Base Current	I_B	0.4				Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	30 0.24				W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	2.0 0.016				W W/ $^\circ\text{C}$
Unclamped Inductive Load Energy (Note 1)	E	32				mJ
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150				$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	4.167	$^\circ\text{C}/\text{W}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. This rating based on testing with $L_C = 20\text{ mH}$, $R_{BE} = 100\ \Omega$, $V_{CC} = 10\text{ V}$, $I_C = 1.8\text{ A}$, P.R.F = 10 Hz

ORDERING INFORMATION

Device	Package	Shipping
TIP29	TO–220	50 Units / Rail
TIP29G	TO–220 (Pb–Free)	50 Units / Rail
TIP29A	TO–220	50 Units / Rail
TIP29AG	TO–220 (Pb–Free)	50 Units / Rail
TIP29B	TO–220	50 Units / Rail
TIP29BG	TO–220 (Pb–Free)	50 Units / Rail
TIP29C	TO–220	50 Units / Rail
TIP29CG	TO–220 (Pb–Free)	50 Units / Rail
TIP30	TO–220	50 Units / Rail
TIP30G	TO–220 (Pb–Free)	50 Units / Rail
TIP30A	TO–220	50 Units / Rail
TIP30AG	TO–220 (Pb–Free)	50 Units / Rail
TIP30B	TO–220	50 Units / Rail
TIP30BG	TO–220 (Pb–Free)	50 Units / Rail
TIP30C	TO–220	50 Units / Rail
TIP30CG	TO–220 (Pb–Free)	50 Units / Rail

TIP29, A, B, C (NPN), TIP30, A, B, C (PNP)

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage ($I_C = 30\text{ mAdc}$, $I_B = 0$) (Note 2) TIP29, TIP30 TIP29A, TIP30A TIP29B, TIP30B TIP29C, TIP30C	$V_{CEO(sus)}$	40 60 80 100	– – – –	Vdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$) TIP29, TIP29A, TIP30, TIP30A TIP29B, TIP29C, TIP30B, TIP30C	I_{CEO}	– –	0.3 0.3	mAdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 60\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 100\text{ Vdc}$, $V_{EB} = 0$) TIP29, TIP30 TIP29A, TIP30A TIP29B, TIP30B TIP29C, TIP30C	I_{CES}	– – – –	200 200 200 200	μAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	–	1.0	mAdc
ON CHARACTERISTICS (Note 2)				
DC Current Gain ($I_C = 0.2\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 1.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	h_{FE}	40 15	– 75	–
Collector–Emitter Saturation Voltage ($I_C = 1.0\text{ Adc}$, $I_B = 125\text{ mAdc}$)	$V_{CE(sat)}$	–	0.7	Vdc
Base–Emitter On Voltage ($I_C = 1.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	$V_{BE(on)}$	–	1.3	Vdc
DYNAMIC CHARACTERISTICS				
Current–Gain – Bandwidth Product (Note 3) ($I_C = 200\text{ mAdc}$, $V_{CE} = 10\text{ Vdc}$, $f_{test} = 1.0\text{ MHz}$)	f_T	3.0	–	MHz
Small–Signal Current Gain ($I_C = 0.2\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	h_{fe}	20	–	–

2. Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$

3. $f_T = |h_{fe}| \cdot f_{test}$

MJE170, MJE171, MJE172 (PNP), MJE180, MJE181, MJE182 (NPN)

Preferred Device

Complementary Plastic Silicon Power Transistors

The MJE170/180 series is designed for low power audio amplifier and low current, high speed switching applications.

Features

- Collector–Emitter Sustaining Voltage –
 $V_{CEO(sus)} = 40 \text{ Vdc} - \text{MJE170, MJE180}$
 $= 60 \text{ Vdc} - \text{MJE171, MJE181}$
 $= 80 \text{ Vdc} - \text{MJE172, MJE182}$
- DC Current Gain –
 $h_{FE} = 30 \text{ (Min) @ } I_C = 0.5 \text{ Adc}$
 $= 12 \text{ (Min) @ } I_C = 1.5 \text{ Adc}$
- Current–Gain – Bandwidth Product –
 $f_T = 50 \text{ MHz (Min) @ } I_C = 100 \text{ mAdc}$
- Annular Construction for Low Leakages –
 $I_{CBO} = 100 \text{ nA (Max) @ Rated } V_{CB}$
- Epoxy Meets UL 94 V–0 @ 0.125 in
- ESD Ratings: Machine Model, C
Human Body Model, 3B
- Pb–Free Packages are Available*

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Base Voltage MJE170, MJE180 MJE171, MJE181 MJE172, MJE182	V_{CB}	60 80 100	Vdc
Collector–Emitter Voltage MJE170, MJE180 MJE171, MJE181 MJE172, MJE182	V_{CEO}	40 60 80	Vdc
Emitter–Base Voltage	V_{EB}	7.0	Vdc
Collector Current – Continuous – Peak	I_C	3.0 6.0	Adc
Base Current	I_B	1.0	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.5 0.012	W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	12.5 0.1	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150	$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

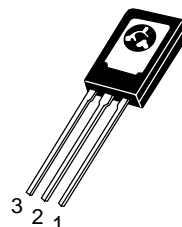
*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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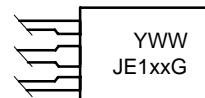
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**3 AMPERES
POWER TRANSISTORS
COMPLEMENTARY SILICON
40 – 60 – 80 VOLTS
12.5 WATTS**



TO–225AA
CASE 77–09
STYLE 1

MARKING DIAGRAM



Y = Year
 WW = Work Week
 JE1xx = Specific Device Code
 x = 70, 71, 72, 80, 81, or 82
 G = Pb–Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

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

MJE170, MJE171, MJE172 (PNP), MJE180, MJE181, MJE182 (NPN)

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	θ_{JC}	10	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	θ_{JA}	83.4	$^{\circ}\text{C}/\text{W}$

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector-Emitter Sustaining Voltage ($I_C = 10 \text{ mAdc}$, $I_B = 0$)	MJE170, MJE180 MJE171, MJE181 MJE172, MJE182	$V_{CEO(sus)}$	40 60 80	- -	Vdc
Collector Cutoff Current ($V_{CB} = 60 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 60 \text{ Vdc}$, $I_E = 0$, $T_C = 150^{\circ}\text{C}$) ($V_{CB} = 80 \text{ Vdc}$, $I_E = 0$, $T_C = 150^{\circ}\text{C}$) ($V_{CB} = 100 \text{ Vdc}$, $I_E = 0$, $T_C = 150^{\circ}\text{C}$)	MJE170, MJE180 MJE171, MJE181 MJE172, MJE182 MJE170, MJE180 MJE171, MJE181 MJE172, MJE182	I_{CBO}	- - - - -	0.1 0.1 0.1 0.1 0.1	μAdc mAdc
Emitter Cutoff Current ($V_{BE} = 7.0 \text{ Vdc}$, $I_C = 0$)		I_{EBO}	-	0.1	μAdc

ON CHARACTERISTICS

DC Current Gain ($I_C = 100 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 500 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 1.5 \text{ Adc}$, $V_{CE} = 1.0 \text{ Vdc}$)		h_{FE}	50 30 12	250 - -	-
Collector-Emitter Saturation Voltage ($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$) ($I_C = 1.5 \text{ Adc}$, $I_B = 150 \text{ mAdc}$) ($I_C = 3.0 \text{ Adc}$, $I_B = 600 \text{ mAdc}$)		$V_{CE(sat)}$	- - -	0.3 0.9 1.7	Vdc
Base-Emitter Saturation Voltage ($I_C = 1.5 \text{ Adc}$, $I_B = 150 \text{ mAdc}$) ($I_C = 3.0 \text{ Adc}$, $I_B = 600 \text{ mAdc}$)		$V_{BE(sat)}$	- -	1.5 2.0	Vdc
Base-Emitter On Voltage ($I_C = 500 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)		$V_{BE(on)}$	-	1.2	Vdc

DYNAMIC CHARACTERISTICS

Current-Gain – Bandwidth Product (Note 1) ($I_C = 100 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f_{test} = 10 \text{ MHz}$)		f_T	50	-	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 0.1 \text{ MHz}$)	MJE171/MJE172 MJE181/MJE182	C_{ob}	- -	60 40	pF

1. $f_T = |h_{fe}| \cdot f_{test}$

TIP31, TIP31A, TIP31B, TIP31C, (NPN), TIP32, TIP32A, TIP32B, TIP32C, (PNP)



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Complementary Silicon Plastic Power Transistors

Designed for use in general purpose amplifier and switching applications.

Features

- Collector–Emitter Saturation Voltage –
 $V_{CE(sat)} = 1.2 \text{ Vdc (Max) @ } I_C = 3.0 \text{ Adc}$
- Collector–Emitter Sustaining Voltage –
 $V_{CEO(sus)} = 40 \text{ Vdc (Min) – TIP31, TIP32}$
 $= 60 \text{ Vdc (Min) – TIP31A, TIP32A}$
 $= 80 \text{ Vdc (Min) – TIP31B, TIP32B}$
 $= 100 \text{ Vdc (Min) – TIP31C, TIP32C}$
- High Current Gain – Bandwidth Product
 $f_T = 3.0 \text{ MHz (Min) @ } I_C = 500 \text{ mAdc}$
- Compact TO–220 AB Package
- Pb–Free Packages are Available*

MAXIMUM RATINGS

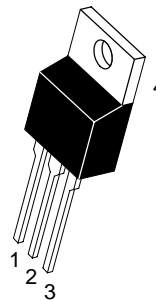
Rating	Symbol	Value	Unit
Collector – Emitter Voltage TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C	V_{CEO}	40 60 80 100	Vdc
Collector–Base Voltage TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C	V_{CB}	40 60 80 100	Vdc
Emitter–Base Voltage	V_{EB}	5.0	Vdc
Collector Current Continuous Peak	I_C	3.0 5.0	Adc
Base Current	I_B	1.0	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	40 0.32	W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	2.0 0.016	W W/ $^\circ\text{C}$
Unclamped Inductive Load Energy (Note 1)	E	32	mJ
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150	$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. $I_C = 1.8 \text{ A}$, $L = 20 \text{ mH}$, P.R.F. = 10 Hz, $V_{CC} = 10 \text{ V}$, $R_{BE} = 100 \Omega$

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

3 AMPERE POWER TRANSISTORS COMPLEMENTARY SILICON 40–60–80–100 VOLTS, 40 WATTS



MARKING DIAGRAM



TO–220AB
CASE 221A
STYLE 1

TIP3xx = Device Code
xx = 1, 1A, 1B, 1C,
2, 2A, 2B, 2C,
A = Assembly Location
Y = Year
WW = Work Week
G = Pb–Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

TIP31, TIP31A, TIP31B, TIP31C, (NPN), TIP32, TIP32A, TIP32B, TIP32C, (PNP)

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	°C/W
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	3.125	°C/W

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector-Emitter Sustaining Voltage (Note 2) ($I_C = 30\text{ mA}$, $I_B = 0$)	TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C	$V_{CE(sus)}$	40 60 80 100	- - - -	Vdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$)	TIP31, TIP32, TIP31A, TIP32A TIP31B, TIP31C, TIP32B, TIP32C	I_{CEO}	- -	0.3 0.3	mAdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 60\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 100\text{ Vdc}$, $V_{EB} = 0$)	TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C	I_{CES}	- - - -	200 200 200 200	μAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)		I_{EBO}	-	1.0	mAdc

ON CHARACTERISTICS (Note 2)

DC Current Gain ($I_C = 1.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)		h_{FE}	25 10	- 50	-
Collector-Emitter Saturation Voltage ($I_C = 3.0\text{ Adc}$, $I_B = 375\text{ mA}$)		$V_{CE(sat)}$	-	1.2	Vdc
Base-Emitter On Voltage ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)		$V_{BE(on)}$	-	1.8	Vdc

DYNAMIC CHARACTERISTICS

Current-Gain – Bandwidth Product ($I_C = 500\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f_{test} = 1.0\text{ MHz}$)		f_T	3.0	-	MHz
Small-Signal Current Gain ($I_C = 0.5\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)		h_{fe}	20	-	-

2. Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

ORDERING INFORMATION

Device	Package	Shipping
TIP31	TO-220	50 Units / Rail
TIP31G	TO-220 (Pb-Free)	50 Units / Rail
TIP31A	TO-220	50 Units / Rail
TIP31AG	TO-220 (Pb-Free)	50 Units / Rail
TIP31B	TO-220	50 Units / Rail
TIP31BG	TO-220 (Pb-Free)	50 Units / Rail
TIP31C	TO-220	50 Units / Rail
TIP31CG	TO-220 (Pb-Free)	50 Units / Rail
TIP32	TO-220	50 Units / Rail
TIP32G	TO-220 (Pb-Free)	50 Units / Rail
TIP32A	TO-220	50 Units / Rail
TIP32AG	TO-220 (Pb-Free)	50 Units / Rail
TIP32B	TO-220	50 Units / Rail
TIP32BG	TO-220 (Pb-Free)	50 Units / Rail
TIP32C	TO-220	50 Units / Rail
TIP32CG	TO-220 (Pb-Free)	50 Units / Rail

2N5190, 2N5191, 2N5192

Silicon NPN Power Transistors

Silicon NPN power transistors are for use in power amplifier and switching circuits, — excellent safe area limits. Complement to PNP 2N5194, 2N5195.

Features

- ESD Ratings: Machine Model, C; > 400 V
Human Body Model, 3B; > 8000 V
- Epoxy Meets UL 94 V-0 @ 0.125 in.
- Pb-Free Packages are Available*

MAXIMUM RATINGS

Rating	Symbol	Value	Unit	
Collector-Emitter Voltage	2N5190 2N5191 2N5192	V_{CE0}	40 60 80	Vdc
Collector-Base Voltage	2N5190 2N5191 2N5192	V_{CBO}	40 60 80	Vdc
Emitter-Base Voltage		V_{EBO}	5.0	Vdc
Collector Current		I_C	4.0	Adc
Base Current		I_B	1.0	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C		P_D	40 320	W mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range		T_J, T_{stg}	-65 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	3.12	$^\circ\text{C}/\text{W}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

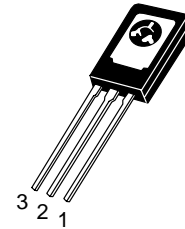
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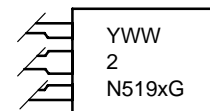
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**4.0 AMPERES
NPN SILICON
POWER TRANSISTORS
40, 60, 80 VOLTS – 40 WATTS**



TO-225AA
CASE 77
STYLE 1

MARKING DIAGRAM



Y = Year
WW = Work Week
2N519x = Device Code
x = 0, 1, or 2
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping†
2N5190	TO-225AA	500 Units/Box
2N5190G	TO-225AA (Pb-Free)	500 Units/Box
2N5191	TO-225AA	500 Units/Box
2N5191G	TO-225AA (Pb-Free)	500 Units/Box
2N5192	TO-225AA	500 Units/Box
2N5192G	TO-225AA (Pb-Free)	500 Units/Box

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

2N5190, 2N5191, 2N5192

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (Note 1) ($I_C = 0.1\text{ Adc}$, $I_B = 0$)	2N5190 2N5191 2N5192	$V_{CEO(sus)}$	40 60 80	– – – Vdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 80\text{ Vdc}$, $I_B = 0$)	2N5190 2N5191 2N5192	I_{CEO}	– – –	1.0 1.0 1.0 mAdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 40\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$, $T_C = 125^\circ\text{C}$) ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$, $T_C = 125^\circ\text{C}$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$, $T_C = 125^\circ\text{C}$)	2N5190 2N5191 2N5192 2N5190 2N5191 2N5192	I_{CEX}	– – – – – –	0.1 0.1 0.1 2.0 2.0 2.0 mAdc
Collector Cutoff Current ($V_{CB} = 40\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 60\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$)	2N5190 2N5191 2N5192	I_{CBO}	– – –	0.1 0.1 0.1 mAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)		I_{EBO}	–	1.0 mAdc
ON CHARACTERISTICS (Note 1)				
DC Current Gain ($I_C = 1.5\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$) ($I_C = 4.0\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$)	2N5190/2N5191 2N5192 2N5190/2N5191 2N5192	h_{FE}	25 20 10 7.0	100 80 – – –
Collector–Emitter Saturation Voltage ($I_C = 1.5\text{ Adc}$, $I_B = 0.15\text{ Adc}$) ($I_C = 4.0\text{ Adc}$, $I_B = 1.0\text{ Adc}$)		$V_{CE(sat)}$	– –	0.6 1.4 Vdc
Base–Emitter On Voltage ($I_C = 1.5\text{ Adc}$, $V_{CE} = 2.0\text{ Vdc}$)		$V_{BE(on)}$	–	1.2 Vdc
DYNAMIC CHARACTERISTICS				
Current–Gain — Bandwidth Product ($I_C = 1.0\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ MHz}$)		f_T	2.0	– MHz

*JEDEC Registered Data.

1. Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

2SD1135

Silicon NPN Triple Diffused

HITACHI

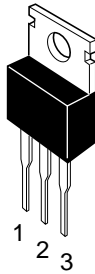
ADE-208-906 (Z)
1st. Edition
Sep. 2000

Application

Low frequency power amplifier complementary pair with 2SB859

Outline

TO-220AB



1. Base
2. Collector (Flange)
3. Emitter

Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Ratings	Unit
Collector to base voltage	V_{CBO}	100	V
Collector to emitter voltage	V_{CEO}	80	V
Emitter to base voltage	V_{EBO}	5	V
Collector current	I_{C}	4	A
Collector peak current	$I_{\text{C(peak)}}$	8	A
Collector power dissipation	P_{C}^{*1}	40	W
Junction temperature	T_{j}	150	$^\circ\text{C}$
Storage temperature	T_{stg}	-45 to +150	$^\circ\text{C}$

Note: 1. Value at $T_{\text{c}} = 25^\circ\text{C}$.

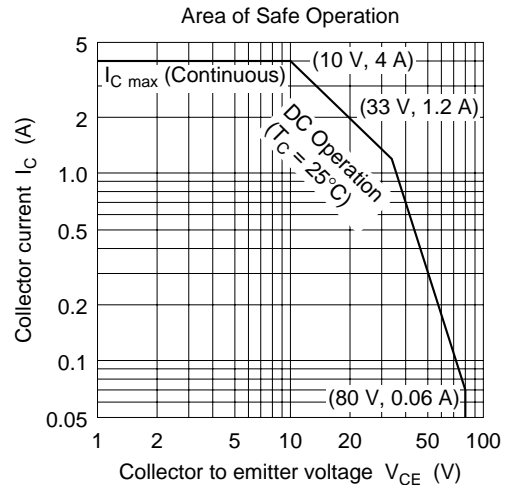
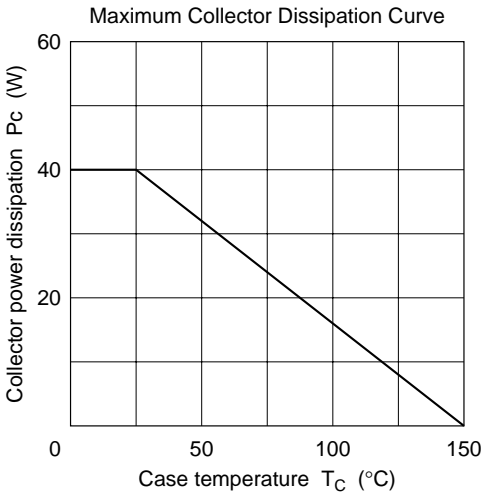
Electrical Characteristics (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions
Collector to emitter breakdown voltage	$V_{(BR)CEO}$	80	—	—	V	$I_C = 50 \text{ mA}, R_{BE} = \infty$
Emitter to base breakdown voltage	$V_{(BR)EBO}$	5	—	—	V	$I_E = 10 \text{ }\mu\text{A}, I_C = 0$
Collector cutoff current	I_{CBO}	—	—	0.1	mA	$V_{CB} = 80 \text{ V}, I_E = 0$
DC current transfer ratio	h_{FE1}^{*1}	60	—	200		$V_{CE} = 5 \text{ V}, I_C = 1 \text{ A}^{*2}$
	h_{FE2}	35	—	—		$V_{CE} = 5 \text{ V}, I_C = 0.1 \text{ A}^{*2}$
Base to emitter voltage	V_{BE}	—	—	1.5	V	$V_{CE} = 5 \text{ V}, I_C = 1 \text{ A}^{*2}$
Collector to emitter saturation voltage	$V_{CE(sat)}$	—	—	2	V	$I_C = 2 \text{ A}, I_B = 0.2 \text{ A}^{*2}$
Gain bandwidth product	f_T	—	10	—	MHz	$V_{CE} = 5 \text{ V}, I_C = 0.5 \text{ A}^{*2}$
Collector output capacitance	Cob	—	40	—	pF	$V_{CB} = 20 \text{ V}, I_E = 0, f = 1 \text{ MHz}$

Notes: 1. The 2SD1135 is grouped by h_{FE1} as follows.

2. Pulse test.

B	C
60 to 120	100 to 200



Plastic Medium-Power Silicon NPN Darlington

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

- High DC Current Gain —
h_{FE} = 750 (Min) @ I_C = 1.5 and 2.0 Adc
- Monolithic Construction
- BD675, 675A, 677, 677A, 679, 679A, 681 are complementary with BD676, 676A, 678, 678A, 680, 680A, 682
- BD 677, 677A, 679, 679A are equivalent to MJE 800, 801, 802, 803

MAXIMUM RATINGS

Rating	Symbol	BD675 BD675A	BD677 BD677A	BD679 BD679A	BD681	Unit
Collector–Emitter Voltage	V _{CEO}	45	60	80	100	Vdc
Collector–Base Voltage	V _{CB}	45	60	80	100	Vdc
Emitter–Base Voltage	V _{EB}	5.0				Vdc
Collector Current	I _C	4.0				Adc
Base Current	I _B	0.1				Adc
Total Device Dissipation @T _C = 25°C Derate above 25°C	P _D	40 0.32				Watts W/°C
Operating and Storage Junction Temperating Range	T _J , T _{stg}	–55 to +150				°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ _{JC}	3.13	°C/W

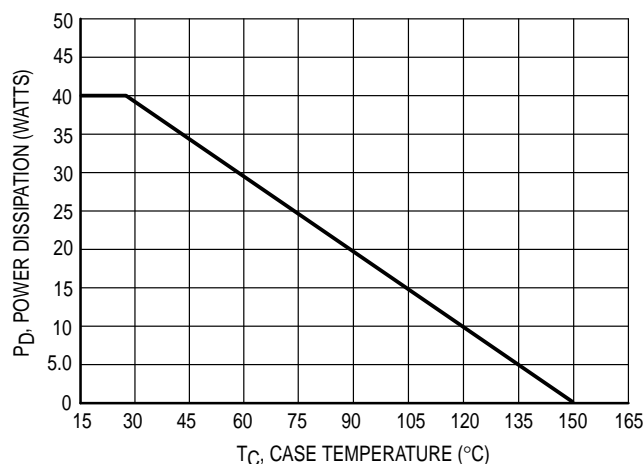


Figure 1. Power Temperature Derating

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

REV 7

BD675
BD675A
BD677
BD677A
BD679
BD679A
BD681*

*Motorola Preferred Device

4.0 AMPERE
DARLINGTON
POWER TRANSISTORS
NPN SILICON
60, 80, 100 VOLTS
40 WATTS

CASE 77-08
TO-225AA TYPE

BD675 BD675A BD677 BD677A BD679 BD679A BD681

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

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector–Emitter Breakdown Voltage ⁽¹⁾ ($I_C = 50\text{ mAdc}$, $I_B = 0$)	BD675, 675A BD677, 677A BD679, 679A BD681	BV_{CEO}	45 60 80 100	— — — —	Vdc
Collector Cutoff Current ($V_{CE} = \text{Half Rated } BV_{CEO}$, $I_B = 0$)		I_{CEO}	—	500	μAdc
Collector Cutoff Current ($V_{CB} = \text{Rated } BV_{CEO}$, $I_E = 0$) ($V_{CB} = \text{Rated } BV_{CEO}$, $I_E = 0$, $T_C = 100^\circ\text{C}$)		I_{CBO}	— —	0.2 2.0	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)		I_{EBO}	—	2.0	mAdc

ON CHARACTERISTICS

DC Current Gain ⁽¹⁾ ($I_C = 1.5\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) ($I_C = 2.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$)	BD675, 677, 679, 681 BD675A, 677A, 679A	h_{FE}	750 750	— —	—
Collector–Emitter Saturation Voltage ⁽¹⁾ ($I_C = 1.5\text{ Adc}$, $I_B = 30\text{ mAdc}$) ($I_C = 2.0\text{ Adc}$, $I_B = 40\text{ mAdc}$)	BD677, 679, 681 BD675A, 677A, 679A	$V_{CE(\text{sat})}$	— —	2.5 2.8	Vdc
Base–Emitter On Voltage ⁽¹⁾ ($I_C = 1.5\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) ($I_C = 2.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$)	BD677, 679, 681 BD675A, 677A, 679A	$V_{BE(\text{on})}$	— —	2.5 2.5	Vdc

DYNAMIC CHARACTERISTICS

Small Signal Current Gain ($I_C = 1.5\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$, $f = 1.0\text{ MHz}$)	h_{fe}	1.0	—	—
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(1) Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

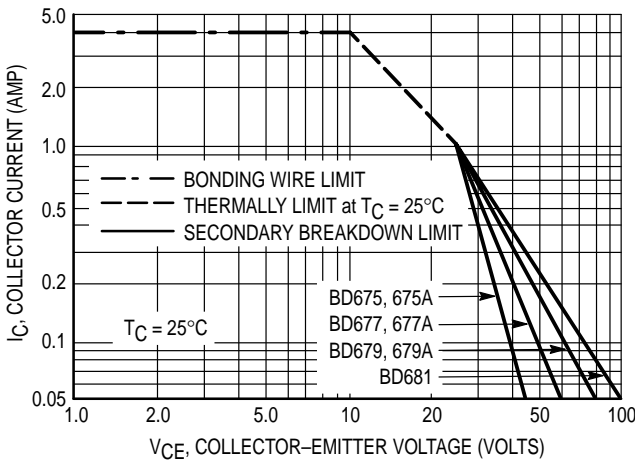


Figure 2. DC Safe Operating Area

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 operation; 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.

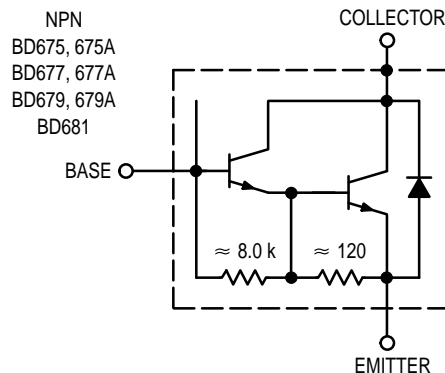


Figure 3. Darlington Circuit Schematic

TOSHIBA Transistor Silicon NPN Epitaxial Type (PCT process)

2SC3074

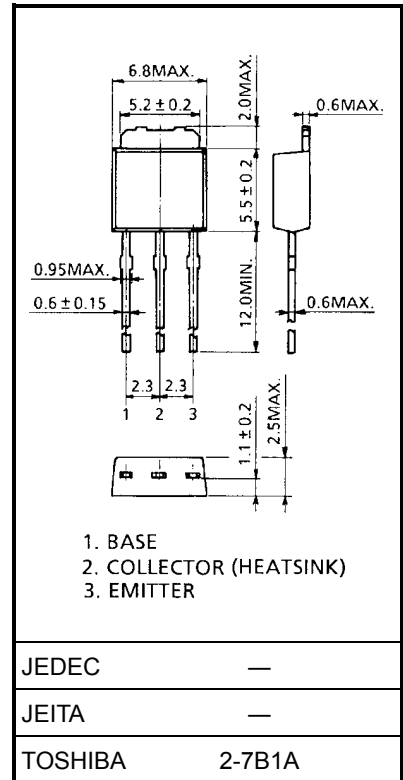
High Current Switching Applications

- Low collector saturation voltage: $V_{CE(sat)} = 0.4 \text{ V (max)} (I_C = 3 \text{ A})$
- High speed switching time: $t_{stg} = 1.0 \mu\text{s (typ)}$
- Complementary to 2SA1244

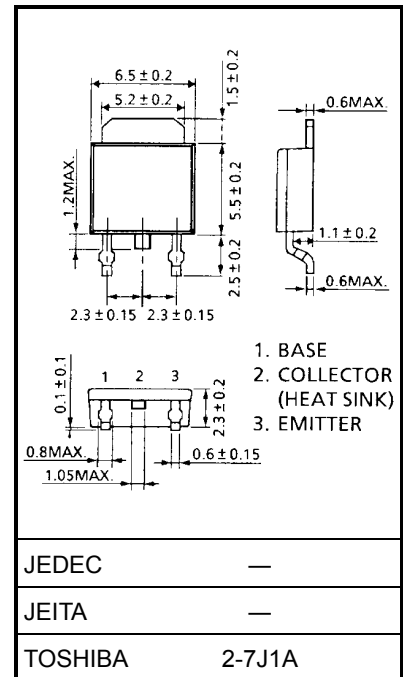
Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Collector-base voltage		V_{CBO}	60	V
Collector-emitter voltage		V_{CEO}	50	V
Emitter-base voltage		V_{EBO}	5	V
Collector current		I_C	5	A
Base current		I_B	1	A
Collector power dissipation	Ta = 25°C	P_C	1.0	W
	Tc = 25°C		20	
Junction temperature		T_j	150	°C
Storage temperature range		T_{stg}	-55 to 150	°C

Unit: mm



Weight: 0.36 g (typ.)



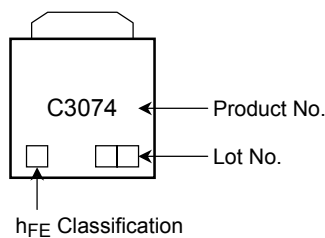
Weight: 0.36 g (typ.)

Electrical Characteristics (Ta = 25°C)

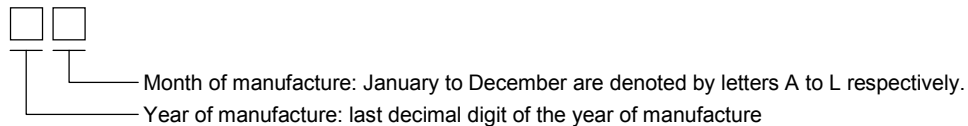
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current		I_{CBO}	$V_{CB} = 50\text{ V}, I_E = 0$	—	—	1	μA
Emitter cut-off current		I_{EBO}	$V_{EB} = 5\text{ V}, I_C = 0$	—	—	1	μA
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	$I_C = 10\text{ mA}, I_B = 0$	50	—	—	V
DC current gain		$h_{FE(1)}$ (Note)	$V_{CE} = 1\text{ V}, I_C = 1\text{ A}$	70	—	240	
		$h_{FE(2)}$	$V_{CE} = 1\text{ V}, I_C = 3\text{ A}$	30	—	—	
Collector-emitter saturation voltage		$V_{CE(sat)}$	$I_C = 3\text{ A}, I_B = 0.15\text{ A}$	—	0.2	0.4	V
Base-emitter saturation voltage		$V_{BE(sat)}$	$I_C = 3\text{ A}, I_B = 0.15\text{ A}$	—	0.9	1.2	V
Transition frequency		f_T	$V_{CE} = 4\text{ V}, I_C = 1\text{ A}$	—	120	—	MHz
Collector output capacitance		C_{ob}	$V_{CB} = 10\text{ V}, I_E = 0, f = 1\text{ MHz}$	—	80	—	pF
Switching time	Turn-on time	t_{on}		—	0.1	—	μs
	Storage time	t_{stg}		—	1.0	—	
	Fall time	t_f		$I_{B1} = -I_{B2} = 0.15\text{ A},$ $\text{DUTY CYCLE} \leq 1\%$	—	0.1	

Note: $h_{FE(1)}$ classification O: 70 to 140, Y: 120 to 240

Marking



Explanation of Lot No.



TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

Preferred Devices

Plastic Medium-Power Complementary Silicon Transistors

Designed for general-purpose amplifier and low-speed switching applications.

Features

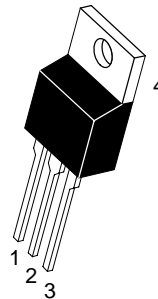
- High DC Current Gain –
 $h_{FE} = 2500$ (Typ) @ $I_C = 4.0$ Adc
- Collector-Emitter Sustaining Voltage – @ 100 mAdc
 $V_{CEO(sus)} = 60$ Vdc (Min) – TIP120, TIP125
 $= 80$ Vdc (Min) – TIP121, TIP126
 $= 100$ Vdc (Min) – TIP122, TIP127
- Low Collector-Emitter Saturation Voltage –
 $V_{CE(sat)} = 2.0$ Vdc (Max) @ $I_C = 3.0$ Adc
 $= 4.0$ Vdc (Max) @ $I_C = 5.0$ Adc
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- Pb-Free Packages are Available*



ON Semiconductor®

<http://onsemi.com>

DARLINGTON 5 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 60–80–100 VOLTS, 65 WATTS



MARKING DIAGRAM



TO-220AB
CASE 221A
STYLE 1

TIP12x = Device Code
x = 0, 1, 2, 5, 6, or 7
A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

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

TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

MAXIMUM RATINGS

Rating	Symbol	TIP120, TIP125	TIP121, TIP126	TIP122, TIP127	Unit
Collector–Emitter Voltage	V_{CEO}	60	80	100	Vdc
Collector–Base Voltage	V_{CB}	60	80	100	Vdc
Emitter–Base Voltage	V_{EB}	5.0			Vdc
Collector Current – Continuous – Peak	I_C	5.0 8.0			Adc
Base Current	I_B	120			mAdc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	65 0.52			W W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	2.0 0.016			W W/ $^\circ\text{C}$
Unclamped Inductive Load Energy (Note 1)	E	50			mJ
Operating and Storage Junction, Temperature Range	T_J, T_{stg}	–65 to +150			$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	1.92	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. $I_C = 1\text{ A}$, $L = 100\text{ mH}$, P.R.F. = 10 Hz, $V_{CC} = 20\text{ V}$, $R_{BE} = 100\ \Omega$

ORDERING INFORMATION

Device	Package	Shipping
TIP120	TO–220	50 Units / Rail
TIP120G	TO–220 (Pb–Free)	50 Units / Rail
TIP121	TO–220	50 Units / Rail
TIP121G	TO–220 (Pb–Free)	50 Units / Rail
TIP122	TO–220	50 Units / Rail
TIP122G	TO–220 (Pb–Free)	50 Units / Rail
TIP125	TO–220	50 Units / Rail
TIP125G	TO–220 (Pb–Free)	50 Units / Rail
TIP126	TO–220	50 Units / Rail
TIP126G	TO–220 (Pb–Free)	50 Units / Rail
TIP127	TO–220	50 Units / Rail
TIP127G	TO–220 (Pb–Free)	50 Units / Rail

TIP120, TIP121, TIP122 (NPN); TIP125, TIP126, TIP127 (PNP)

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (Note 2) ($I_C = 100\text{ mAdc}$, $I_B = 0$)	$V_{CE(sus)}$	60 80 100	– – –	Vdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 50\text{ Vdc}$, $I_B = 0$)	I_{CEO}	– – –	0.5 0.5 0.5	mAdc
Collector Cutoff Current ($V_{CB} = 60\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100\text{ Vdc}$, $I_E = 0$)	I_{CBO}	– – –	0.2 0.2 0.2	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	–	2.0	mAdc

ON CHARACTERISTICS (Note 2)

DC Current Gain ($I_C = 0.5\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$)	h_{FE}	1000 1000	– –	–
Collector–Emitter Saturation Voltage ($I_C = 3.0\text{ Adc}$, $I_B = 12\text{ mAdc}$) ($I_C = 5.0\text{ Adc}$, $I_B = 20\text{ mAdc}$)	$V_{CE(sat)}$	– –	2.0 4.0	Vdc
Base–Emitter On Voltage ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$)	$V_{BE(on)}$	–	2.5	Vdc

DYNAMIC CHARACTERISTICS

Small–Signal Current Gain ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$, $f = 1.0\text{ MHz}$)	h_{fe}	4.0	–	–
Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 0.1\text{ MHz}$)	C_{ob}	– –	300 200	pF

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

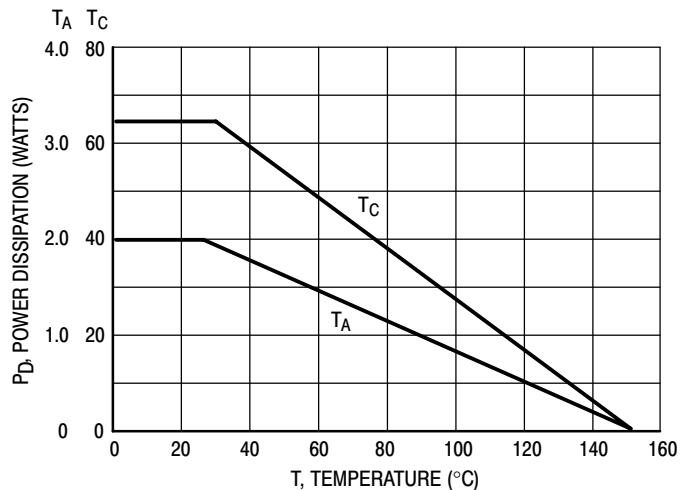


Figure 1. Power Derating

Complementary Silicon Plastic Power Transistors

... designed for use in general purpose amplifier and switching applications.

- Collector – Emitter Saturation Voltage —
 $V_{CE(sat)} = 1.5 \text{ Vdc (Max) @ } I_C = 6.0 \text{ Adc}$
- Collector Emitter Sustaining Voltage —
 $V_{CEO(sus)} = 80 \text{ Vdc (Min) — BD243B, BD244B}$
 $= 100 \text{ Vdc (Min) — BD243C, BD244C}$
- High Current Gain Bandwidth Product
 $f_T = 3.0 \text{ MHz (Min) @ } I_C = 500 \text{ mAdc}$
- Compact TO–220 AB Package

MAXIMUM RATINGS

Rating	Symbol	BD243B BD244B	BD243C BD244C	Unit
Collector–Emitter Voltage	V_{CEO}	80	100	Vdc
Collector–Base Voltage	V_{CB}	80	100	Vdc
Emitter–Base Voltage	V_{EB}	5.0		Vdc
Collector Current — Continuous Peak	I_C	6 10		Adc
Base Current	I_B	2.0		Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	65 0.52		Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150		$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.92	$^\circ\text{C/W}$

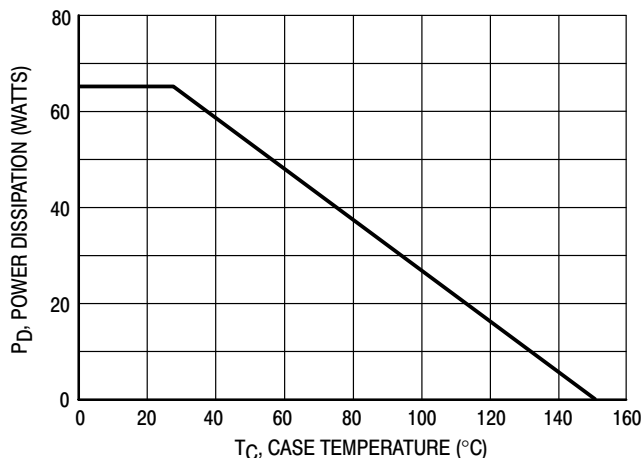


Figure 1. Power Derating

NPN
BD243B

BD243C*
PNP
BD244B

BD244C*

*ON Semiconductor Preferred Device

6 AMPERE
POWER TRANSISTORS
COMPLEMENTARY
SILICON
80–100 VOLTS
65 WATTS

STYLE 1:
 PIN 1. BASE
 2. COLLECTOR
 3. EMITTER
 4. COLLECTOR

CASE 221A–06
TO–220AB

BD243B BD243C BD244B BD244C

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

Characteristic	Symbol	Min	Max	Unit
Collector–Emitter Sustaining Voltage (1) ($I_C = 30\text{ mAdc}$, $I_B = 0$)	$V_{CE(sus)}$	80 100	— —	Vdc
Collector Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$)	I_{CEO}	—	0.7	mAdc
Collector Cutoff Current ($V_{CE} = 80\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 100\text{ Vdc}$, $V_{EB} = 0$)	I_{CES}	— —	400 400	μAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	1.0	mAdc

ON CHARACTERISTICS (1)

DC Current Gain ($I_C = 0.3\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	h_{FE}	30 15	— —	—
Collector–Emitter Saturation Voltage ($I_C = 6.0\text{ Adc}$, $I_B = 1.0\text{ Adc}$)	$V_{CE(sat)}$	—	1.5	Vdc
Base–Emitter On Voltage ($I_C = 6.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	$V_{BE(on)}$	—	2.0	Vdc

DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product (2) ($I_C = 500\text{ mAdc}$, $V_{CE} = 10\text{ Vdc}$, $f_{test} = 1.0\text{ MHz}$)	f_T	3.0	—	MHz
Small–Signal Current Gain ($I_C = 0.5\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	h_{fe}	20	—	—

(1) Pulse Test: Pulsewidth 300 μs , Duty Cycle 2.0%.

(2) $f_T = h_{fe} \cdot f_{test}$

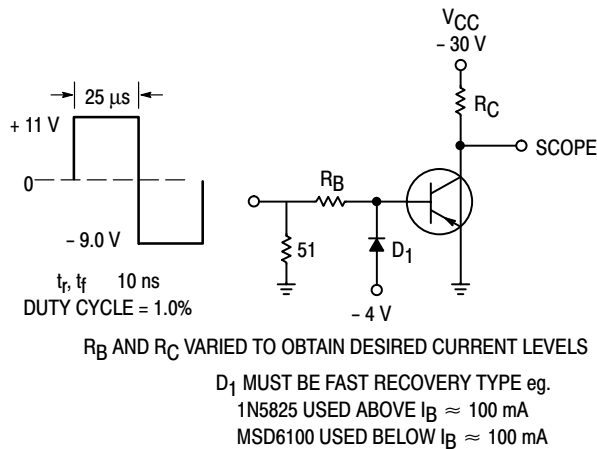


Figure 2. Switching Time Test Circuit

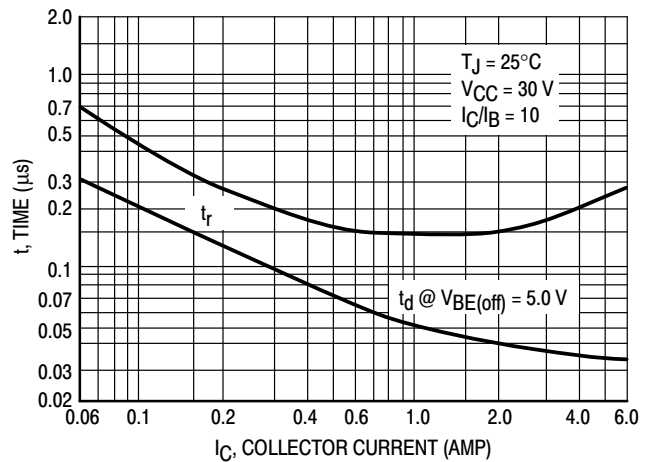


Figure 3. Turn–On Time

Complementary Silicon Plastic Power Transistors

... designed for use in general-purpose amplifier and switching applications.

- DC Current Gain Specified to 10 Amperes
- High Current Gain — Bandwidth Product —
 $f_T = 2.0 \text{ MHz (Min) @ } I_C = 500 \text{ mA}$

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	60	Vdc
Collector–Base Voltage	V_{CB}	70	Vdc
Emitter–Base Voltage	V_{EB}	5.0	Vdc
Collector Current	I_C	10	Adc
Base Current	I_B	6.0	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C MJE3055T, MJE2955T	$P_{D\ddagger}$	75 0.6	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	1.67	$^\circ\text{C/W}$

†Safe Area Curves are indicated by Figure 1. Both limits are applicable and must be observed.

**PNP
MJE2955T*
NPN
MJE3055T***

*ON Semiconductor Preferred Device

**10 AMPERE
COMPLEMENTARY
SILICON
POWER TRANSISTORS
60 VOLTS
75 WATTS**

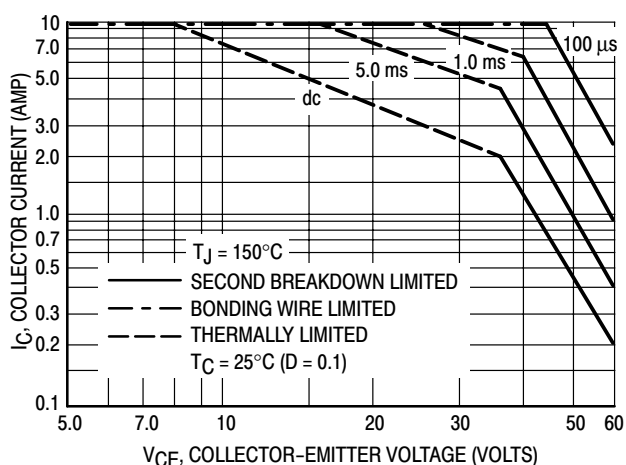
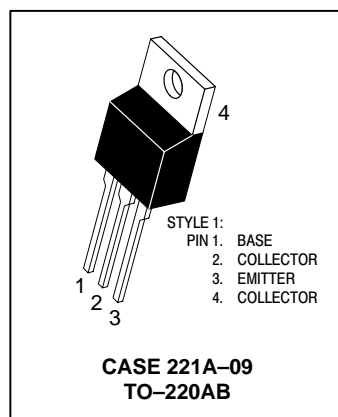


Figure 1. Active-Region Safe Operating Area

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 Figure 1 is based on $T_J(pk) = 150^\circ\text{C}$. T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_J(pk) \approx 150^\circ\text{C}$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. (See AN415A)

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

MJE2955T MJE3055T

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (1) ($I_C = 200\text{ mA}$, $I_B = 0$)	$V_{CEO(sus)}$	60	—	Vdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$)	I_{CEO}	—	700	μA
Collector Cutoff Current ($V_{CE} = 70\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 70\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$)	I_{CEX}	—	1.0 5.0	mAdc
Collector Cutoff Current ($V_{CB} = 70\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 70\text{ Vdc}$, $I_E = 0$, $T_C = 150^\circ\text{C}$)	I_{CBO}	—	1.0 10	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	5.0	mAdc
ON CHARACTERISTICS				
DC Current Gain (1) ($I_C = 4.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 10\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	h_{FE}	20 5.0	100 —	—
Collector–Emitter Saturation Voltage (1) ($I_C = 4.0\text{ Adc}$, $I_B = 0.4\text{ Adc}$) ($I_C = 10\text{ Adc}$, $I_B = 3.3\text{ Adc}$)	$V_{CE(sat)}$	—	1.1 8.0	Vdc
Base–Emitter On Voltage (1) ($I_C = 4.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	$V_{BE(on)}$	—	1.8	Vdc
DYNAMIC CHARACTERISTICS				
Current–Gain–Bandwidth Product ($I_C = 500\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 500\text{ kHz}$)	f_T	2.0	—	MHz

(1) Pulse Test: Pulse Width $\approx 300\ \mu\text{s}$, Duty Cycle $\approx 20\%$.

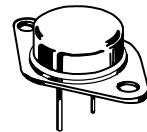
High-Power Industrial Transistors

NPN silicon power transistor designed for applications in industrial and commercial equipment including high fidelity audio amplifiers, series and shunt regulators and power switches.

- Collector–Emitter Sustaining Voltage —
 $V_{CEO(sus)} = 140 \text{ Vdc (Min)}$
- Excellent Second Breakdown Capability

2N3442

**10 AMPERE
POWER TRANSISTOR
NPN SILICON
140 VOLTS
117 WATTS**



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

*MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	140	Vdc
Collector–Base Voltage	V_{CB}	160	Vdc
Emitter–Base Voltage	V_{EB}	7.0	Vdc
Collector Current — Continuous Peak	I_C	10 15**	Adc
Base Current — Continuous Peak	I_B	7.0 —	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	117 0.67	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	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	$^\circ\text{C/W}$

* Indicates JEDEC Registered Data.

** This data guaranteed in addition to JEDEC registered data.

2N3442

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage ($I_C = 200\text{ mAdc}$, $I_B = 0$)	$V_{CEO(sus)}$	140	—	Vdc
Collector Cutoff Current ($V_{CE} = 140\text{ Vdc}$, $I_B = 0$)	I_{CEO}	—	200	mAdc
Collector Cutoff Current ($V_{CE} = 140\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 140\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$)	I_{CEX}	—	5.0 30	mAdc
Emitter Cutoff Current ($V_{BE} = 7.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	5.0	mAdc

ON CHARACTERISTICS (1)

DC Current Gain ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 10\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	h_{FE}	20 7.5	70 —	—
Collector–Emitter Saturation Voltage ($I_C = 10\text{ Adc}$, $I_B = 2.0\text{ Adc}$)	$V_{CE(sat)}$	—	5.0	Vdc
Base–Emitter On Voltage ($I_C = 10\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	$V_{BE(on)}$	—	5.7	Vdc

DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product (2) ($I_C = 2.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$, $f_{test} = 40\text{ kHz}$)	f_T	80	—	kHz
Small–Signal Current Gain ($I_C = 2.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$, $f = 1.0\text{ kHz}$)	h_{fe}	12	72	—

*Indicates JEDEC Registered Data.

NOTES:

1. Pulse Test: Pulse Width = 300 μs , Duty Cycle $\approx 2.0\%$.
2. $f_T = |h_{fe}| \cdot f_{test}$

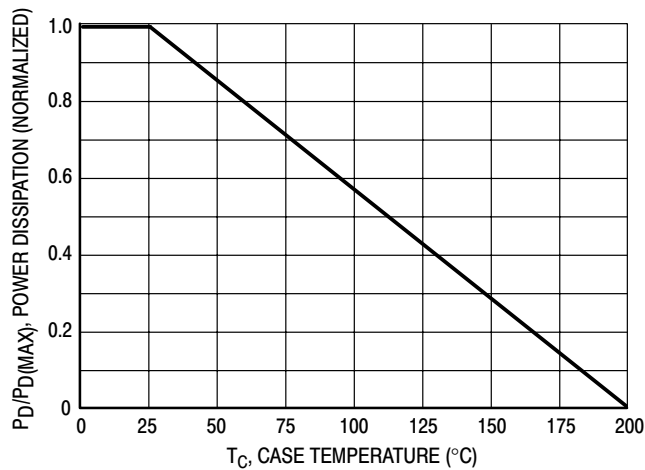


Figure 1. Power Derating

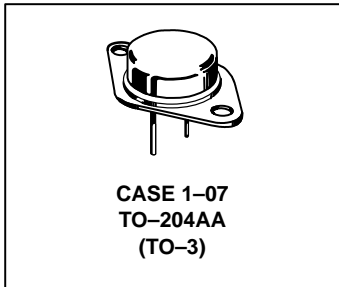
Silicon NPN Power Transistors

... designed for medium-speed switching and amplifier applications. These devices feature:

- Total Switching Time at 3 A typically 1.15 μ s
- Gain Ranges Specified at 1 A and 3 A
- Low $V_{CE(sat)}$: typically 0.5 V at $I_C = 5$ A and $I_B = 0.5$ A
- Excellent Safe Operating Areas
- Complement to 2N3791-92

NPN
2N3715
2N3716

10 AMPERE
POWER TRANSISTORS
SILICON NPN
60-80 VOLTS
150 WATTS



MAXIMUM RATINGS

Rating	Symbol	2N3715	2N3716	Unit
Collector-Emitter Voltage	V_{CEO}	60	80	Volts
Collector-Base Voltage	V_{CB}	80	100	Volts
Emitter-Base Voltage	V_{EB}	7.0	7.0	Volts
Collector Current	I_C	10	10	Amps
Base Current	I_B	4.0	4.0	Amps
Power Dissipation	P_D	150	150	Watts
Thermal Resistance	θ_{JC}	1.17	1.17	$^{\circ}C/W$
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-65 to +200		$^{\circ}C$

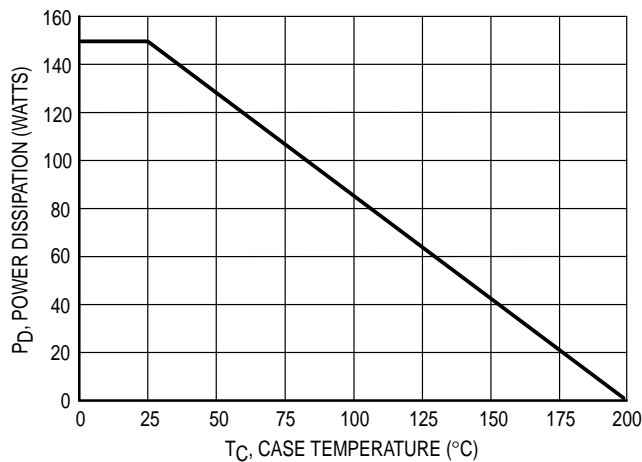


Figure 1. Power-Temperature Derating Curve

Safe Area Limits are indicated by Figures 12, 13. Both limits are applicable and must be observed.

REV 7

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

Characteristic	Symbol	Min	Max	Unit
Emitter-Base Cutoff Current ($V_{EB} = 7.0\text{ Vdc}$)	I_{EBO}	—	5.0	mAdc
Collector-Emitter Cutoff Current ($V_{CE} = 80\text{ Vdc}, V_{BE} = -1.5\text{ Vdc}$) ($V_{CE} = 100\text{ Vdc}, V_{BE} = -1.5\text{ Vdc}$) ($V_{CE} = 60\text{ Vdc}, V_{BE} = -1.5\text{ Vdc}, T_C = 150^\circ\text{C}$) ($V_{CE} = 80\text{ Vdc}, V_{BE} = -1.5\text{ Vdc}, T_C = 150^\circ\text{C}$)	I_{CEX}	—	1.0	mAdc
Collector-Emitter Sustaining Voltage (1) ($I_C = 200\text{ mAdc}, I_B = 0$)	$V_{CEO(sus)}^*$	60	—	Vdc
DC Current Gain (1) ($I_C = 1.0\text{ Adc}, V_{CE} = 2.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}, V_{CE} = 2.0\text{ Vdc}$)	h_{FE}^*	50	150	—
Collector-Emitter Saturation Voltage (1) ($I_C = 5.0\text{ Adc}, I_B = 0.5\text{ Adc}$)	$V_{CE(sat)}^*$	—	0.8	Vdc
Base-Emitter Saturation Voltage (1) ($I_C = 5.0\text{ Adc}, I_B = 0.5\text{ Adc}$)	$V_{BE(sat)}^*$	—	1.5	Vdc
Base-Emitter Voltage (1) ($I_C = 3.0\text{ Adc}, V_{CE} = 2.0\text{ Vdc}$)	V_{BE}^*	—	1.5	Vdc
Small Signal Current Gain ($V_{CE} = 10\text{ Vdc}, I_C = 0.5\text{ Adc}, f = 1.0\text{ MHz}$)	h_{fe}	4.0	—	—
Switching Times (Figure 2) ($I_C = 5.0\text{ A}, I_{B1} = I_{B2} = 0.5\text{ Adc}$) Rise Time Storage Time Fall Time		Typ		μs
	t_r			0.45
	t_s			0.3
	t_f			0.4

(1) Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

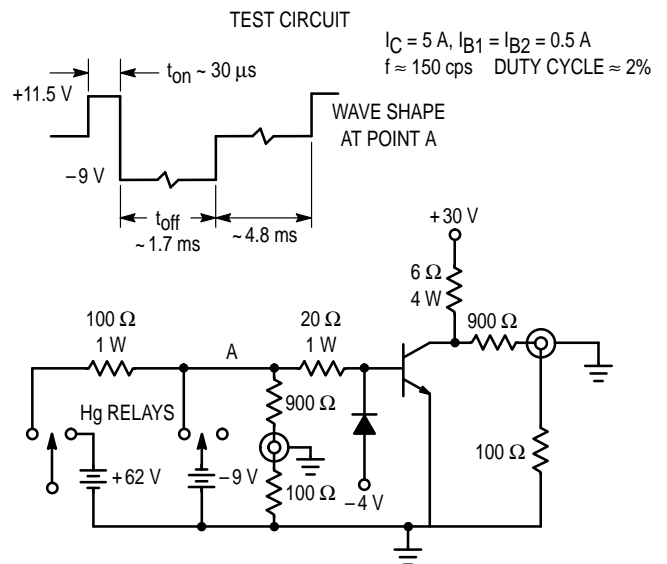
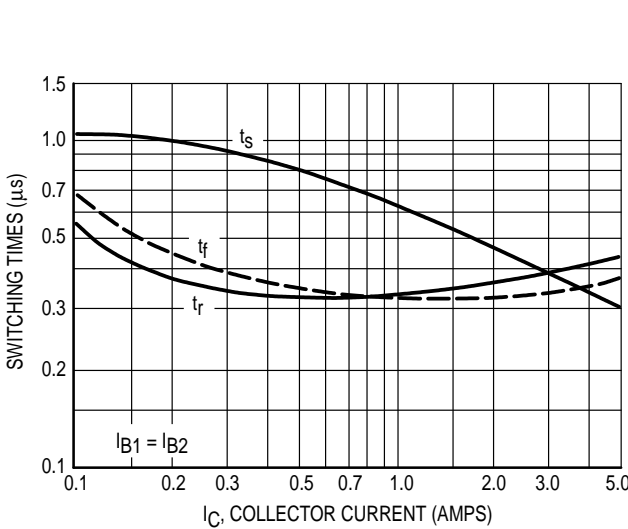


Figure 2. Typical Switching Times

COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

General-purpose power amplifier and switching applications

FEATURES:

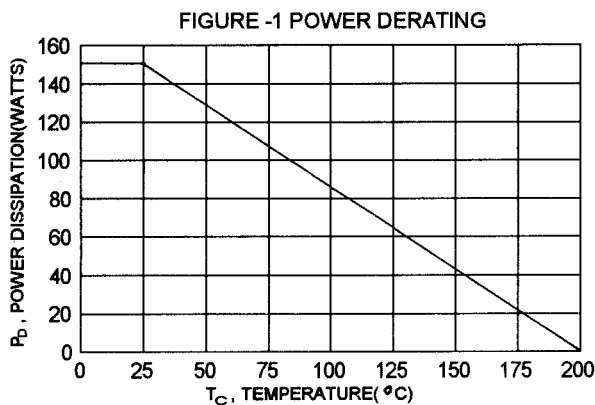
- * Low Collector-Emitter Saturation Voltage -
 $V_{CE(SAT)} = 1.0V(\text{Max.}) @ I_C = 5.0A$
- * Excellent DC Current Gain -
 $hFE = 20 \sim 100 @ I_C = 4.0 A$

MAXIMUM RATINGS

Characteristic	Symbol	2N5875 2N5877	2N5876 2N5878	Unit
Collector-Emitter Voltage	V_{CEO}	60	80	V
Collector-Base Voltage	V_{CBO}	60	80	V
Emitter-Base Voltage	V_{EBO}	5.0		V
Collector Current-Continuous -Peak	I_C I_{CM}	10 20		A
Base Current	I_B	4.0		A
Total Power Dissipation @ $T_C = 25^\circ C$ Derate above $25^\circ C$	P_D	150 0.857		W W/ $^\circ C$
Operating and Storage Junction Temperature Range	T_J, T_{STG}	- 65 to +200		$^\circ C$

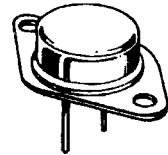
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	$R_{\theta jc}$	1.17	$^\circ C/W$

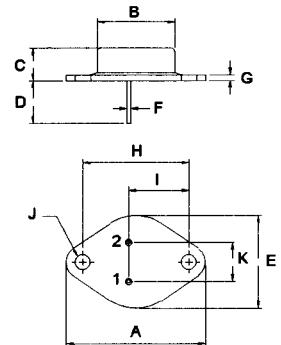


PNP	NPN
2N5875	2N5877
2N5876	2N5878

10 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60 - 80 Volts
150 Watts



TO-3



PIN 1. BASE
2. EMITTER
COLLECTOR(CASE)

DIM	MILLIMETERS	
	MIN	MAX
A	38.75	39.96
B	19.28	22.23
C	7.96	9.28
D	11.18	12.19
E	25.20	26.67
F	0.92	1.09
G	1.38	1.62
H	29.90	30.40
I	16.64	17.30
J	3.88	4.36
K	10.67	11.18

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector - Emitter Sustaining Voltage (1) ($I_c = 200 \text{ mA}$, $I_B = 0$)	2N5875, 2N5877 2N5876, 2N5878	$V_{CE(SUS)}$	60 80	V
Collector Cutoff Current ($V_{CE} = 30 \text{ V}$, $I_B = 0$) ($V_{CE} = 40 \text{ V}$, $I_B = 0$)	2N5875, 2N5877 2N5876, 2N5878	I_{CEO}	1.0 1.0	mA
Collector Cutoff Current ($V_{CE} = 60 \text{ V}$, $V_{BE(off)} = 1.5 \text{ V}$) ($V_{CE} = 80 \text{ V}$, $V_{BE(off)} = 1.5 \text{ V}$) ($V_{CE} = 60 \text{ V}$, $V_{BE(off)} = 1.5 \text{ V}$, $T_c = 150^\circ\text{C}$) ($V_{CE} = 80 \text{ V}$, $V_{BE(off)} = 1.5 \text{ V}$, $T_c = 150^\circ\text{C}$)	2N5875, 2N5877 2N5876, 2N5878 2N5875, 2N5877 2N5876, 2N5878	I_{CEX}	0.5 0.5 5.0 5.0	mA
Collector Cutoff Current ($V_{CB} = 60 \text{ V}$, $I_E = 0$) ($V_{CB} = 80 \text{ V}$, $I_E = 0$)	2N5875, 2N5877 2N5876, 2N5878	I_{CBO}	0.5 0.5	mA
Emitter Cutoff Current ($V_{EB} = 5.0 \text{ V}$, $I_C = 0$)		I_{EBO}	1.0	mA

ON CHARACTERISTICS (1)

DC Current Gain ($I_c = 1.0 \text{ A}$, $V_{CE} = 4.0 \text{ V}$) ($I_c = 4.0 \text{ A}$, $V_{CE} = 4.0 \text{ V}$) ($I_c = 10 \text{ A}$, $V_{CE} = 4.0 \text{ V}$)	h_{FE}	35 20 4.0	100	
Collector-Emitter saturation Voltage ($I_c = 5.0 \text{ A}$, $I_B = 0.5 \text{ A}$) ($I_c = 10 \text{ A}$, $I_B = 2.5 \text{ A}$)	$V_{CE(sat)}$		1.0 3.0	V
Base-Emitter On Voltage ($I_c = 4.0 \text{ A}$, $V_{CE} = 4.0 \text{ V}$)	$V_{BE(on)}$		1.5	V
Base-Emitter Saturation Voltage ($I_c = 10 \text{ A}$, $I_B = 2.5 \text{ A}$)	$V_{BE(sat)}$		2.5	V

DYNAMIC CHARACTERISTICS

Current-Gain-Bandwidth Product (2) ($I_c = 0.5 \text{ A}$, $V_{CE} = 10 \text{ V}$, $f = 1.0 \text{ MHz}$)	f_T	4.0		MHz
Small-Signal Current Gain ($I_c = 1.0 \text{ A}$, $V_{CE} = 4.0 \text{ V}$, $f = 1.0 \text{ KHZ}$)	h_{fe}	20		

(1) Pulse Test: Pulse width $\leq 300 \text{ us}$, Duty Cycle $\leq 2.0\%$

(2) $f_T = |h_{fe}| \cdot f_{test}$

TOSHIBA Transistor Silicon NPN Triple Diffused Type

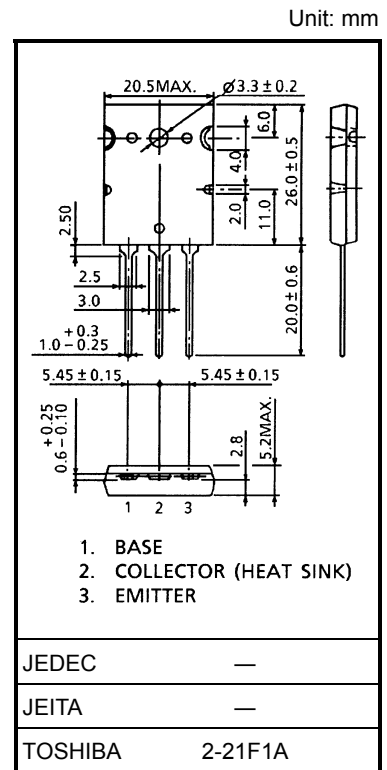
2SC5199

Power Amplifier Applications

- High breakdown voltage: $V_{CEO} = 160\text{ V}$ (min)
- Complementary to 2SA1942
- Suitable for use in 80-W high fidelity audio amplifier's output stage.

Maximum Ratings ($T_c = 25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
Collector-base voltage	V_{CBO}	160	V
Collector-emitter voltage	V_{CEO}	160	V
Emitter-base voltage	V_{EBO}	5	V
Collector current	I_C	12	A
Base current	I_B	1.2	A
Collector power dissipation ($T_c = 25^\circ\text{C}$)	P_C	120	W
Junction temperature	T_j	150	$^\circ\text{C}$
Storage temperature range	T_{stg}	-55 to 150	$^\circ\text{C}$



Weight: 9.75 g (typ.)

Electrical Characteristics ($T_c = 25^\circ\text{C}$)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	$V_{CB} = 160\text{ V}, I_E = 0$	—	—	5.0	μA
Emitter cut-off current	I_{EBO}	$V_{EB} = 5\text{ V}, I_C = 0$	—	—	5.0	μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	$I_C = 50\text{ mA}, I_B = 0$	160	—	—	V
DC current gain	$h_{FE(1)}$ (Note)	$V_{CE} = 5\text{ V}, I_C = 1\text{ A}$	55	—	160	
	$h_{FE(2)}$	$V_{CE} = 5\text{ V}, I_C = 6\text{ A}$	35	74	—	
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 8\text{ A}, I_B = 0.8\text{ A}$	—	0.35	2.5	V
Base-emitter voltage	V_{BE}	$V_{CE} = 5\text{ V}, I_C = 6\text{ A}$	—	1.0	1.5	V
Transition frequency	f_T	$V_{CE} = 5\text{ V}, I_C = 1\text{ A}$	—	30	—	MHz
Collector output capacitance	C_{ob}	$V_{CB} = 10\text{ V}, I_E = 0, f = 1\text{ MHz}$	—	170	—	pF

Note: $h_{FE(1)}$ classification R: 55 to 110, O: 80 to 160

COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS

General-Purpose Power Amplifier and Switching Applications

FEATURES:

- * Low Collector-Emitter Saturation Voltage -
 $V_{CE(SAT)} = 1.0V(\text{Max.}) @ I_C = 7.0A$
- * Excellent DC Current Gain -
 $hFE = 20 \sim 100 @ I_C = 6.0 A$

MAXIMUM RATINGS

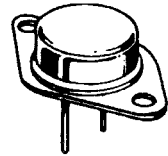
Characteristic	Symbol	2N5879 2N5881	2N5880 2N5882	Unit
Collector-Emitter Voltage	V_{CEO}	60	80	V
Collector-Base Voltage	V_{CBO}	60	80	V
Emitter-Base Voltage	V_{EBO}	5.0		V
Collector Current-Continuous -Peak	I_C I_{CM}		15 30	A
Base Current	I_B	5.0		A
Total Power Dissipation@ $T_C=25^\circ C$ Derate above $25^\circ C$	P_D	160 0.915		W W/ $^\circ C$
Operating and Storage Junction Temperature Range	T_J, T_{STG}	- 65 to +200		$^\circ C$

THERMAL CHARACTERISTICS

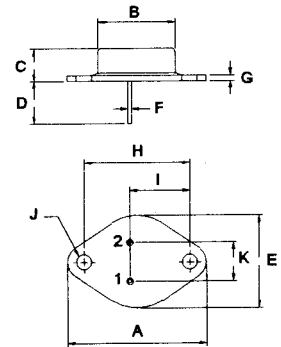
Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	$R_{\theta jc}$	1.1	$^\circ C/W$

PNP	NPN
2N5879	2N5881
2N5880	2N5882

15 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60 - 80 Volts
160 Watts



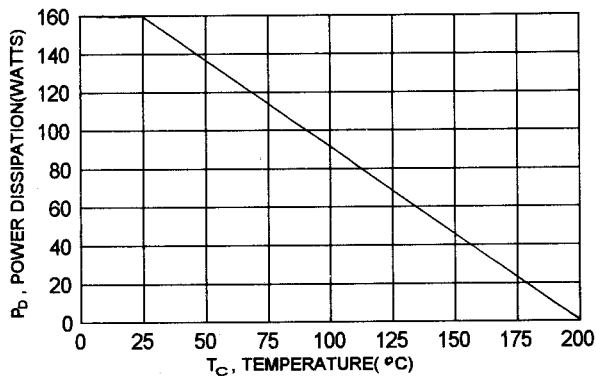
TO-3



PIN 1.BASE
2.EMITTER
COLLECTOR(CASE)

DIM	MILLIMETERS	
	MIN	MAX
A	38.75	39.96
B	19.28	22.23
C	7.96	9.28
D	11.18	12.19
E	25.20	26.67
F	0.92	1.09
G	1.38	1.62
H	29.90	30.40
I	16.64	17.30
J	3.88	4.36
K	10.67	11.18

FIGURE -1 POWER DERATING



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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector - Emitter Sustaining Voltage (1) ($I_c = 200\text{ mA}$, $I_B = 0$) 2N5879, 2N5881 2N5880, 2N5882	$V_{CE(sus)}$	60 80		V
Collector Cutoff Current ($V_{CE} = 30\text{ V}$, $I_B = 0$) ($V_{CE} = 40\text{ V}$, $I_B = 0$) 2N5879, 2N5881 2N5880, 2N5882	I_{CEO}		1.0 1.0	mA
Collector Cutoff Current ($V_{CE} = 60\text{ V}$, $V_{BE(off)} = 1.5\text{ V}$) ($V_{CE} = 80\text{ V}$, $V_{BE(off)} = 1.5\text{ V}$) ($V_{CE} = 60\text{ V}$, $V_{BE(off)} = 1.5\text{ V}$, $T_c = 150^\circ\text{C}$) ($V_{CE} = 80\text{ V}$, $V_{BE(off)} = 1.5\text{ V}$, $T_c = 150^\circ\text{C}$) 2N5879, 2N5881 2N5880, 2N5882 2N5879, 2N5881 2N5880, 2N5882	I_{CEX}		0.5 0.5 5.0 5.0	mA
Collector Cutoff Current ($V_{CB} = 60\text{ V}$, $I_E = 0$) ($V_{CB} = 80\text{ V}$, $I_E = 0$) 2N5879, 2N5881 2N5880, 2N5882	I_{CBO}		0.5 0.5	mA
Emitter Cutoff Current ($V_{EB} = 5.0\text{ V}$, $I_C = 0$)	I_{EBO}		1.0	mA

ON CHARACTERISTICS (1)

DC Current Gain ($I_c = 2.0\text{ A}$, $V_{CE} = 4.0\text{ V}$) ($I_c = 6.0\text{ A}$, $V_{CE} = 4.0\text{ V}$) ($I_c = 15\text{ A}$, $V_{CE} = 4.0\text{ V}$)	hFE	35 20 4.0	100	
Collector-Emitter Saturation Voltage ($I_c = 7.0\text{ A}$, $I_B = 0.7\text{ A}$) ($I_c = 15\text{ A}$, $I_B = 3.75\text{ A}$)	$V_{CE(sat)}$		1.0 4.0	V
Base-Emitter On Voltage ($I_c = 6.0\text{ A}$, $V_{CE} = 4.0\text{ V}$)	$V_{BE(on)}$		1.5	V
Base-Emitter Saturation Voltage ($I_c = 15\text{ A}$, $I_B = 3.75\text{ A}$)	$V_{BE(sat)}$		2.5	V

DYNAMIC CHARACTERISTICS

Current-Gain-Bandwidth Product (2) ($I_c = 1.0\text{ A}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ MHz}$)	f_T	4.0		MHz
Small-Signal Current Gain ($I_c = 2.0\text{ A}$, $V_{CE} = 4.0\text{ V}$, $f = 1.0\text{ KHZ}$)	h_{fe}	20		

(1) Pulse Test: Pulse width $\leq 300\text{ us}$, Duty Cycle $\leq 2.0\%$

(2) $f_T = |h_{fe}| \cdot f_{test}$

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.

- 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	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°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

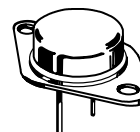
Characteristic	Symbol	Max	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.52	0.98	$^\circ\text{C/W}$

*Indicates JEDEC Registered Data. (2N3055A)

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

*SECOND BREAKDOWN

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

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

*DYNAMIC CHARACTERISTICS

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

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle $\approx 2\%$.

*Indicates JEDEC Registered Data. (2N3055A)

MJL3281A (NPN) MJL1302A (PNP)

Preferred Devices

Complementary Bipolar Power Transistors

Features

- Exceptional Safe Operating Area
- NPN/PNP Gain Matching within 10% from 50 mA to 5 A
- Excellent Gain Linearity
- High BVCEO
- High Frequency
- Pb-Free Packages are Available

Benefits

- Reliable Performance at Higher Powers
- Symmetrical Characteristics in Complementary Configurations
- Accurate Reproduction of Input Signal
- Greater Dynamic Range
- High Amplifier Bandwidth

Applications

- High-End Consumer Audio Products
 - ◆ Home Amplifiers
 - ◆ Home Receivers
- Professional Audio Amplifiers
 - ◆ Theater and Stadium Sound Systems
 - ◆ Public Address Systems (PAs)

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	260	Vdc
Collector-Base Voltage	V_{CBO}	260	Vdc
Emitter-Base Voltage	V_{EBO}	5.0	Vdc
Collector-Emitter Voltage – 1.5 V	V_{CEX}	260	Vdc
Collector Current – Continuous – Peak (Note 1)	I_C	15 25	Adc
Base Current – Continuous	I_B	1.5	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate Above 25°C	P_D	200 1.43	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.625	$^\circ\text{C/W}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. Pulse Test: Pulse Width = 5 ms, Duty Cycle < 10%.

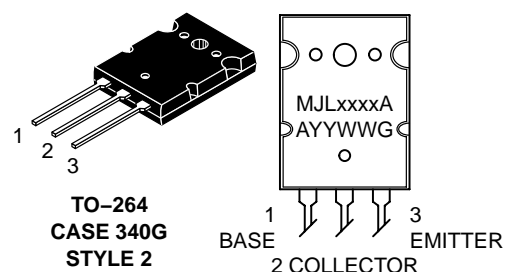


ON Semiconductor®

<http://onsemi.com>

**15 AMPERES
COMPLEMENTARY
SILICON POWER
TRANSISTORS
260 VOLTS
200 WATTS**

MARKING DIAGRAM



xxxx = 3281 or 1302
A = Location Code
YY = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping
MJL3281A	TO-264	25 Units/Rail
MJL3281AG	TO-264 (Pb-Free)	25 Units/Rail
MJL1302A	TO-264	25 Units/Rail
MJL1302AG	TO-264 (Pb-Free)	25 Units/Rail

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

MJL3281A (NPN) MJL1302A (PNP)

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector–Emitter Sustaining Voltage (I _C = 100 mA _{dc} , I _B = 0)	V _{CEO(sus)}	260	–	V _{dc}
Collector Cutoff Current (V _{CB} = 260 V _{dc} , I _E = 0)	I _{CBO}	–	50	μA _{dc}
Emitter Cutoff Current (V _{EB} = 5 V _{dc} , I _C = 0)	I _{EBO}	–	5	μA _{dc}

SECOND BREAKDOWN

Second Breakdown Collector with Base Forward Biased (V _{CE} = 50 V _{dc} , t = 1 s (non–repetitive)) (V _{CE} = 100 V _{dc} , t = 1 s (non–repetitive))	I _{S/b}	4 1	– –	A _{dc}
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ON CHARACTERISTICS

DC Current Gain (I _C = 500 mA _{dc} , V _{CE} = 5 V _{dc}) (I _C = 1 A _{dc} , V _{CE} = 5 V _{dc}) (I _C = 3 A _{dc} , V _{CE} = 5 V _{dc}) (I _C = 5 A _{dc} , V _{CE} = 5 V _{dc}) (I _C = 8 A _{dc} , V _{CE} = 5 V _{dc})	h _{FE}	75 75 75 75 45	150 150 150 150 –	
Collector–Emitter Saturation Voltage (I _C = 10 A _{dc} , I _B = 1 A _{dc})	V _{CE(sat)}	–	3	V _{dc}

DYNAMIC CHARACTERISTICS

Current–Gain – Bandwidth Product (I _C = 1 A _{dc} , V _{CE} = 5 V _{dc} , f _{test} = 1 MHz)	f _T	30	–	MHz
Output Capacitance (V _{CB} = 10 V _{dc} , I _E = 0, f _{test} = 1 MHz)	C _{ob}	–	600	pF