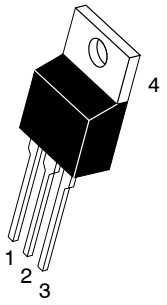
Plastic Medium-Power Complementary Silicon Transistors

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

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*

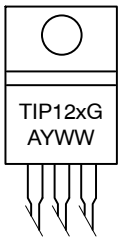


1. Base
2. Collector
3. Emitter
4. Collector

TO−220AB
CASE 221A
STYLE 1

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

MARKING DIAGRAM



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 on page 7 of this data sheet.

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

MAXIMUM RATINGS

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

THERMAL CHARACTERISTICS

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

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

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

Symbol	Characteristic		Min	Max	Unit
OFF CHARACTERISTICS					
$V_{CEO(sus)}$	Collector−Emitter Sustaining Voltage (Note 2) (I_C = 100 mAdc, I_B = 0)	TIP120, TIP125 TIP121, TIP126 TIP122, TIP127	 60 80 100	 − − −	Vdc
I_{CEO}	Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0) (V_{CE} = 40 Vdc, I_B = 0) (V_{CE} = 50 Vdc, I_B = 0)	 TIP120, TIP125 TIP121, TIP126 TIP122, TIP127	 − − −	 0.5 0.5 0.5	mAdc
I_{CBO}	Collector Cutoff Current (V_{CB} = 60 Vdc, I_E = 0) (V_{CB} = 80 Vdc, I_E = 0) (V_{CB} = 100 Vdc, I_E = 0)	 TIP120, TIP125 TIP121, TIP126 TIP122, TIP127	 − − −	 0.2 0.2 0.2	mAdc
I_{EBO}	Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		−	2.0	mAdc
ON CHARACTERISTICS (Note 2)					
h_{FE}	DC Current Gain (I_C = 0.5 Adc, V_{CE} = 3.0 Vdc) (I_C = 3.0 Adc, V_{CE} = 3.0 Vdc)		1000 1000	− −	−
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage (I_C = 3.0 Adc, I_B = 12 mAdc) (I_C = 5.0 Adc, I_B = 20 mAdc)		 − −	 2.0 4.0	Vdc
$V_{BE(on)}$	Base−Emitter On Voltage (I_C = 3.0 Adc, V_{CE} = 3.0 Vdc)		−	2.5	Vdc
DYNAMIC CHARACTERISTICS					
h_{fe}	Small−Signal Current Gain (I_C = 3.0 Adc, V_{CE} = 4.0 Vdc, f = 1.0 MHz)		4.0	−	−
C_{ob}	Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz	TIP125, TIP126, TIP127 TIP120, TIP121, TIP122	− −	300 200	pF

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 μs, Duty Cycle ≤ 2%

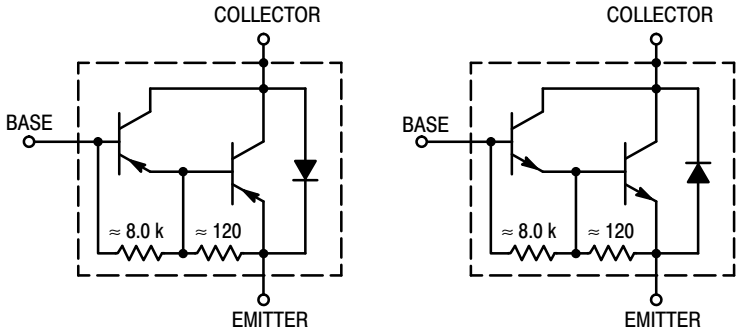


Figure 1. Darlington Circuit Schematic

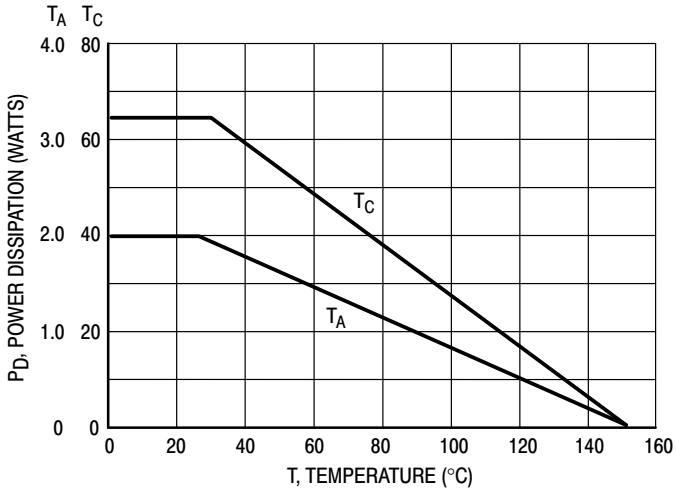


Figure 2. Power Derating

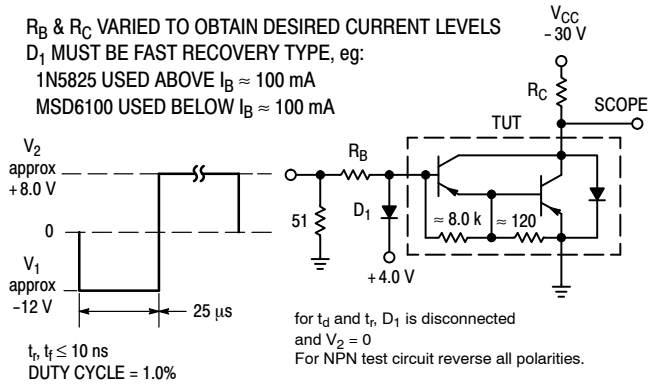


Figure 3. Switching Times Test Circuit

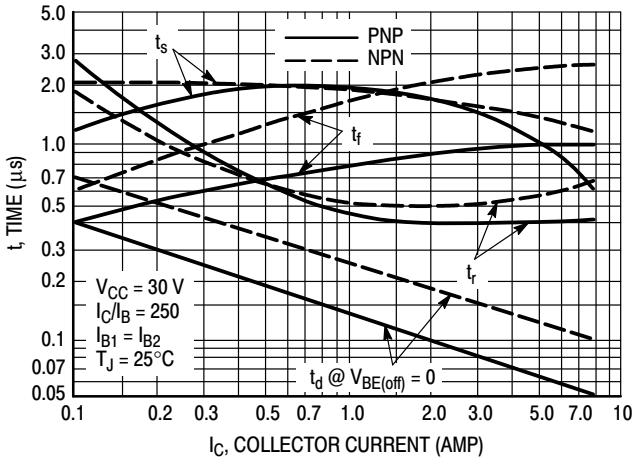


Figure 4. Switching Times

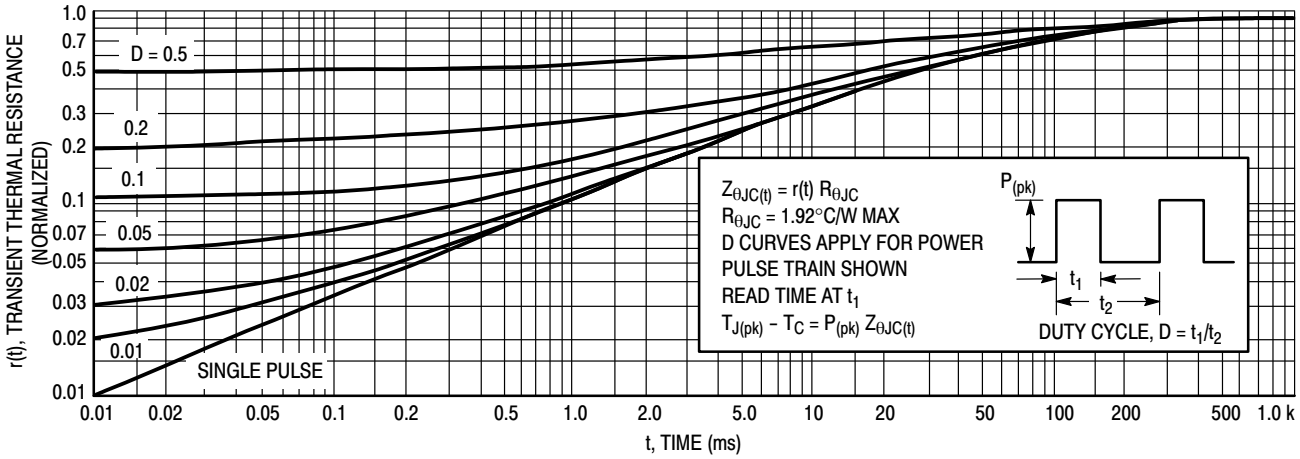


Figure 5. Thermal Response

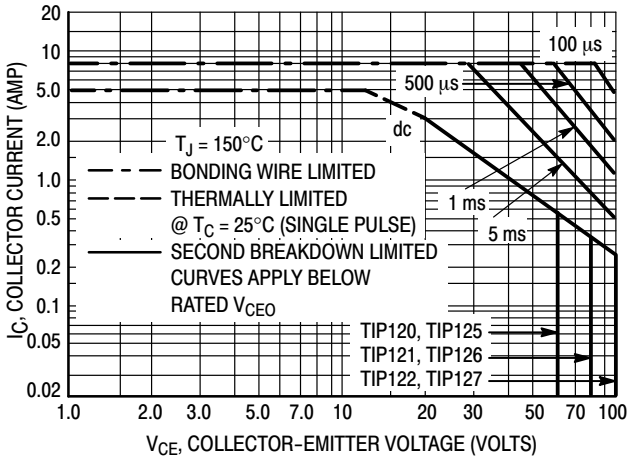


Figure 6. Active−Region Safe Operating Area

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 6 is based on $T_{J(pk)}$ = 150°C; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)}$ < 150°C. $T_{J(pk)}$ may be calculated from the data in Figure 5. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown

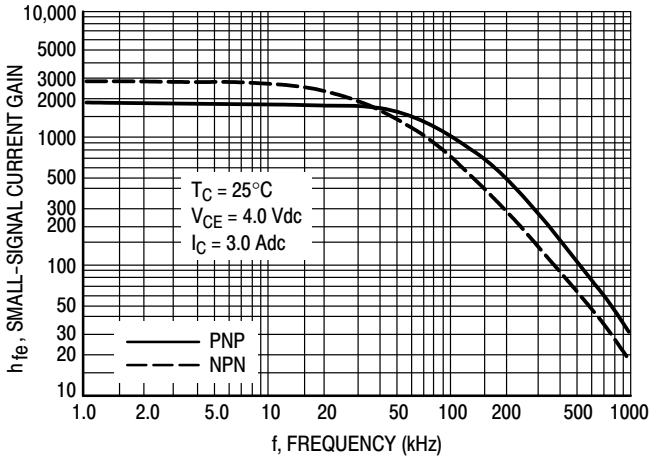


Figure 7. Small−Signal Current Gain

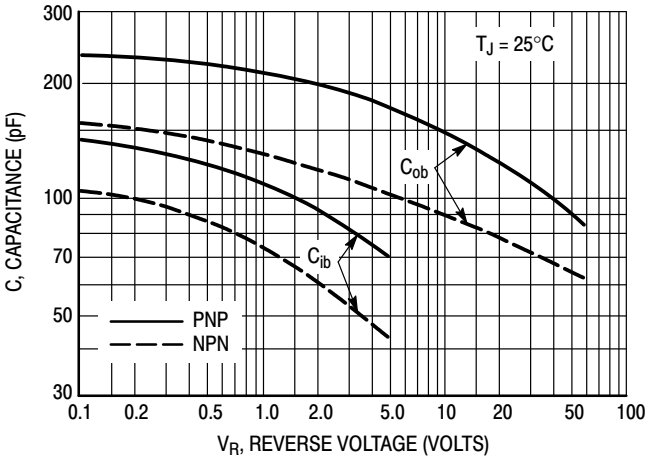
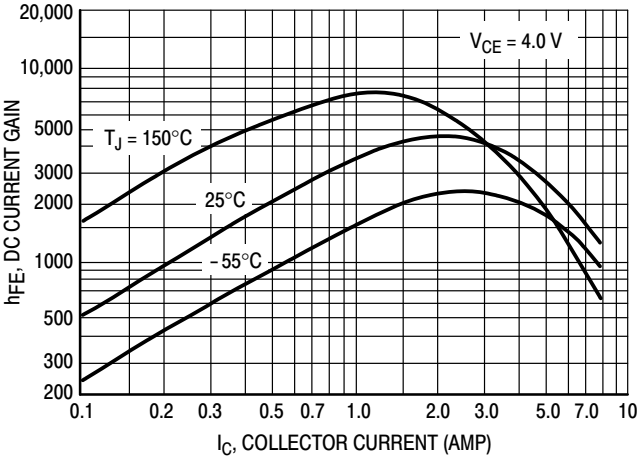


Figure 8. Capacitance

NPN
TIP120, TIP121, TIP122



PNP
TIP125, TIP126, TIP127

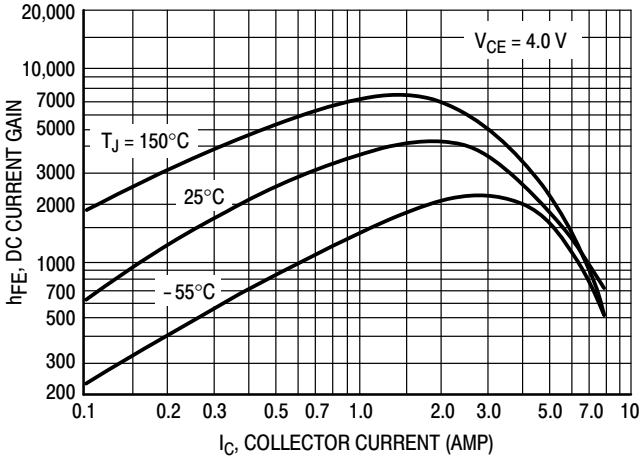
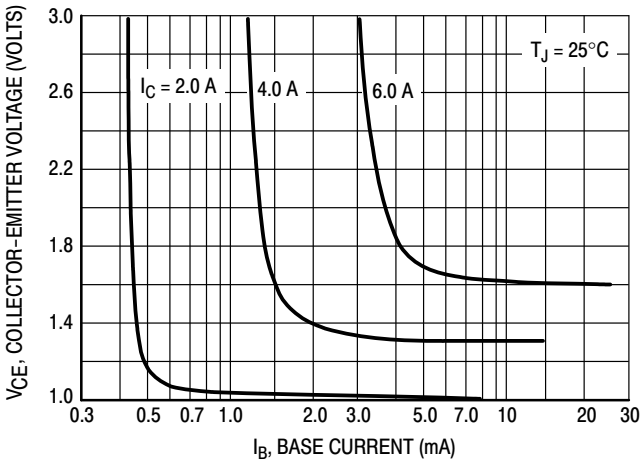


Figure 9. DC Current Gain



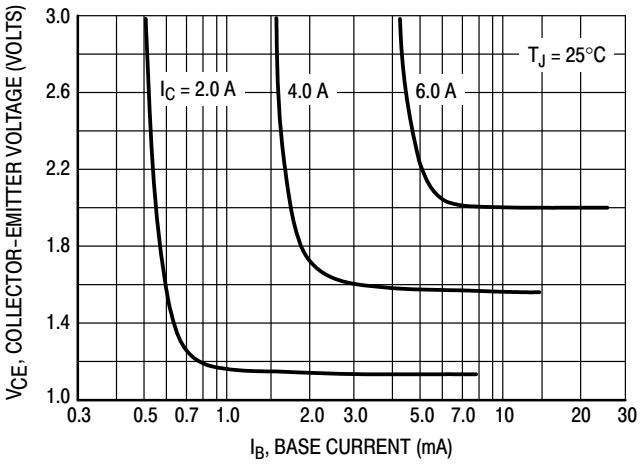
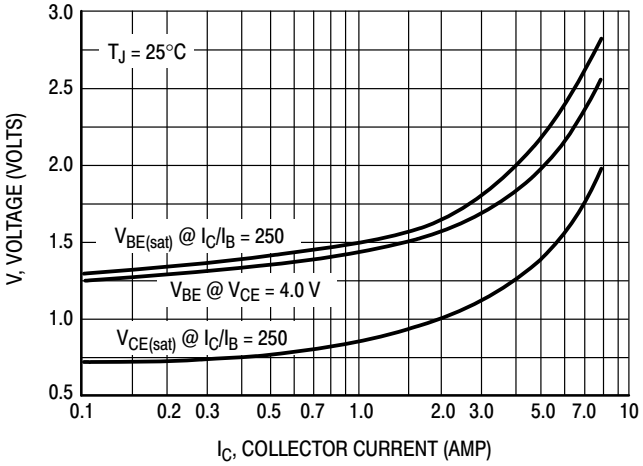


Figure 10. Collector Saturation Region



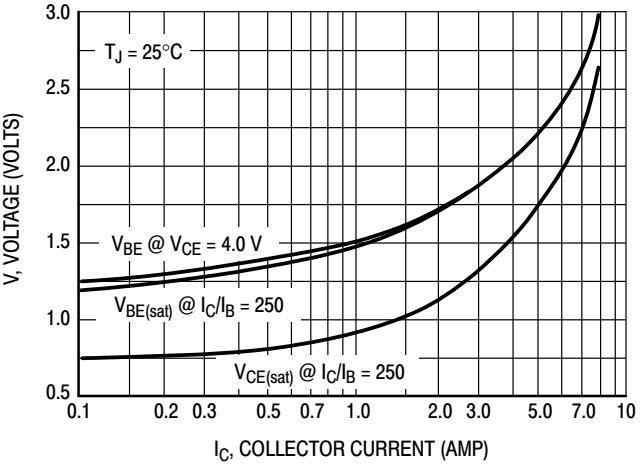


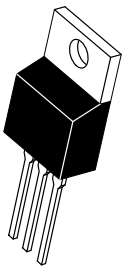
Figure 11. “On” Voltages

ORDERING INFORMATION

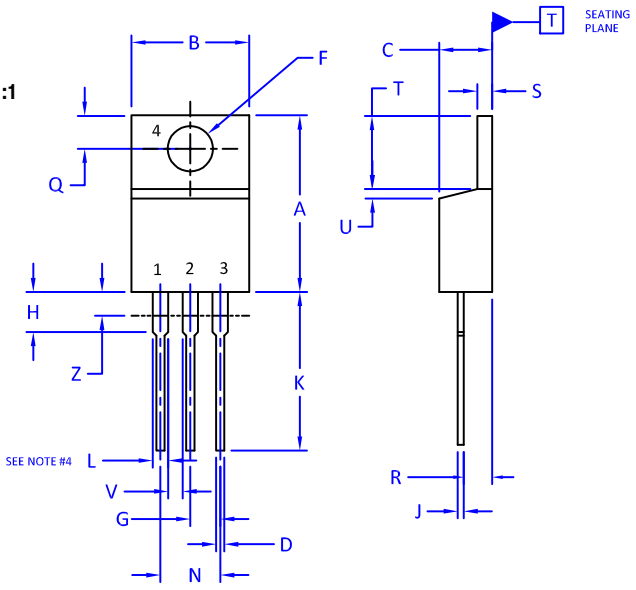
Device	Package	Shipping
TIP120	TO−220	50 Units / Rail
TIP120G	TO−220 (Pb−Free)	50 Units / Rail
TIP121	TO−220	50 Units / Rail
TIP121G	TO−220 (Pb−Free)	50 Units / Rail
TIP122	TO−220	50 Units / Rail
TIP122G	TO−220 (Pb−Free)	50 Units / Rail
TIP125	TO−220	50 Units / Rail
TIP125G	TO−220 (Pb−Free)	50 Units / 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

TO−220
CASE 221A
ISSUE AK

DATE 13 JAN 2022



SCALE 1:1



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.
4. MAX WIDTH FOR F102 DEVICE = 1.35MM

	INCHES		MILLIMETERS	
DIM	MIN.	MAX.	MIN.	MAX.
A	0.570	0.620	14.48	15.75
B	0.380	0.415	9.66	10.53
C	0.160	0.190	4.07	4.83
D	0.025	0.038	0.64	0.96
F	0.142	0.161	3.60	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.161	2.80	4.10
J	0.014	0.024	0.36	0.61
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.41
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	----	1.15	---
Z	----	0.080	---	2.04

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

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

STYLE 3:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 4:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 7:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE

STYLE 8:
PIN 1. CATHODE
2. ANODE
3. EXTERNAL TRIP/DELAY
4. ANODE

STYLE 9:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 10:
PIN 1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

STYLE 11:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. SOURCE

STYLE 12:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. NOT CONNECTED

DOCUMENT NUMBER:	**98ASB42148B**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	**TO−220**	**PAGE 1 OF 1**

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales