# Complementary Silicon Plastic Power Transistors for Isolated Package Applications

# MJF31C (NPN), MJF32C (PNP)

Designed for use in general purpose amplifier and switching applications.

### Features

- Collector−Emitter Saturation Voltage −
  $V_{CE(sat)}$ = 1.2 Vdc (Max) @ $I_C$ = 3.0 Adc
- Collector−Emitter Sustaining Voltage −
  $V_{CEO(sus)}$ = 100 Vdc (Min)
- High Current Gain − Bandwidth Product
  $f_T$ = 3.0 MHz (Min) @ $I_C$ = 500 mAdc
- UL Recognized, File #E69369, to 3500 $V_{RMS}$ Isolation
- Pb−Free Packages are Available*

### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector−Emitter Voltage | $V_{CEO}$ | 100 | Vdc |
| Collector−Base Voltage | $V_{CB}$ | 100 | Vdc |
| Emitter−Base Voltage | $V_{EB}$ | 5.0 | Vdc |
| Collector CurrentUnclamped Inductive Load Energy (Note 1)<br>− Continuous<br>− Peak | $I_C$ | <br>3.0<br>5.0 | Adc |
| Base Current | $I_B$ | 1.0 | Adc |
| Total Power Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 28<br>0.22 | W<br>W/°C |
| Total Power Dissipation @ $T_A$ = 25°C<br>Derate above 25°C | $P_D$ | 2.0<br>0.016 | W<br>W/°C |
| Unclamped Inductive Load Energy (Note 1) | E | 32 | mJ |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | −65 to +150 | °C |

### THERMAL CHARACTERISTICS

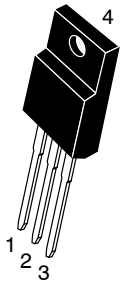
| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction−to−Ambient | $R_{\theta JC}$ | 62.5 | °C/W |
| Thermal Resistance, Junction−to−Case | $R_{\theta JC}$ | 4.46 | °C/W |

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

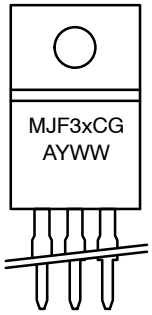
*For additional information on our Pb−Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## 3.0 AMPERE POWER TRANSISTORS COMPLEMENTARY SILICON 100 VOLTS, 28 WATTS




**TO−220 FULLPAK**
**CASE 221D**
**STYLE 2**

### MARKING DIAGRAM




x = 1 or 2
G = Pb−Free Package
A = Assembly Location
Y = Year
WW = Work Week

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| MJF31C | TO−220 FULLPAK | 50 Units/Rail |
| MJF31CG | TO−220 FULLPAK (Pb−Free) | 50 Units/Rail |
| MJF32C | TO−220 FULLPAK | 50 Units/Rail |
| MJF32CG | TO−220 FULLPAK (Pb−Free) | 50 Units/Rail |

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

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

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | |
| Collector−Emitter Sustaining Voltage (Note 2) ($I_C$ = 30 mAdc, $I_B$ = 0) | $V_{CEO(sus)}$ | 100 | – | Vdc |
| Collector Cutoff Current ($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc) | $I_{CEO}$ | – | 0.3 | mAdc |
| Collector Cutoff Current | $I_{CES}$ | – | 200 | μAdc |
| Emitter Cutoff Current ($V_{BE}$ = 5.0 Vdc, $I_C$ = 0) | $I_{EBO}$ | – | 1.0 | mAdc |
| **ON CHARACTERISTICS** (Note 2) | | | | |
| DC Current Gain ($I_C$ = 1.0 Adc, $V_{CE}$ = 4.0 Vdc) ($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc) | $h_{FE}$ | 25<br>10 | –<br>50 | – |
| Collector−Emitter Saturation Voltage ($I_C$ = 3.0 Adc, $I_B$ = 375 mAdc) | $V_{CE(sat)}$ | – | 1.2 | Vdc |
| Base−Emitter On Voltage ($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc) | $V_{BE(on)}$ | – | 1.8 | Vdc |
| **DYNAMIC CHARACTERISTICS** | | | | |
| Current−Gain − Bandwidth Product ($I_C$ = 500 mAdc, $V_{CE}$ = 10 Vdc, $f_{test}$ = 1.0 MHz) | $f_T$ | 3.0 | – | MHz |
| Small−Signal Current Gain ($I_C$ = 0.5 Adc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | $h_{fe}$ | 20 | – | – |

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 ≤ 2.0%.

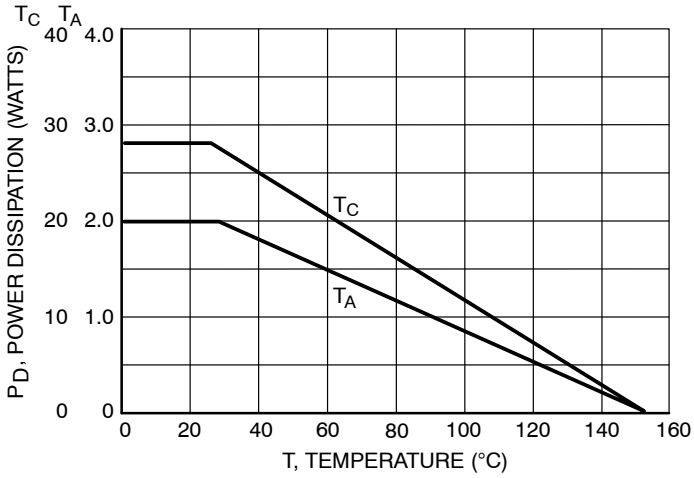



**Figure 1. Power Derating**



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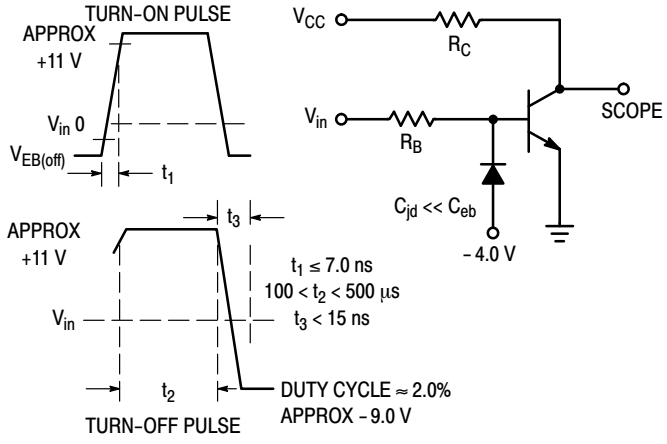



**Figure 2. Switching Time Equivalent Circuit**

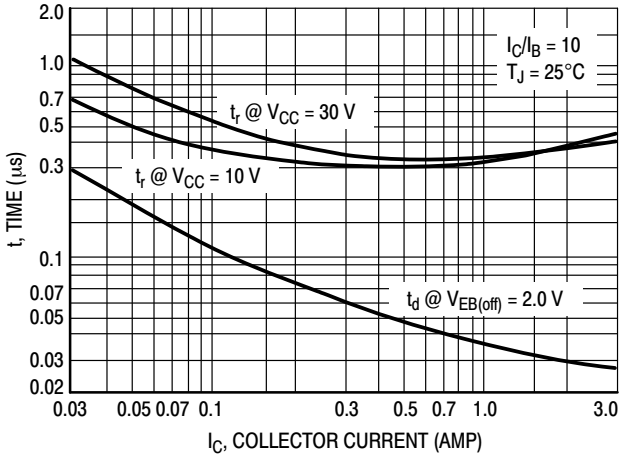



**Figure 3. Turn−On Time**

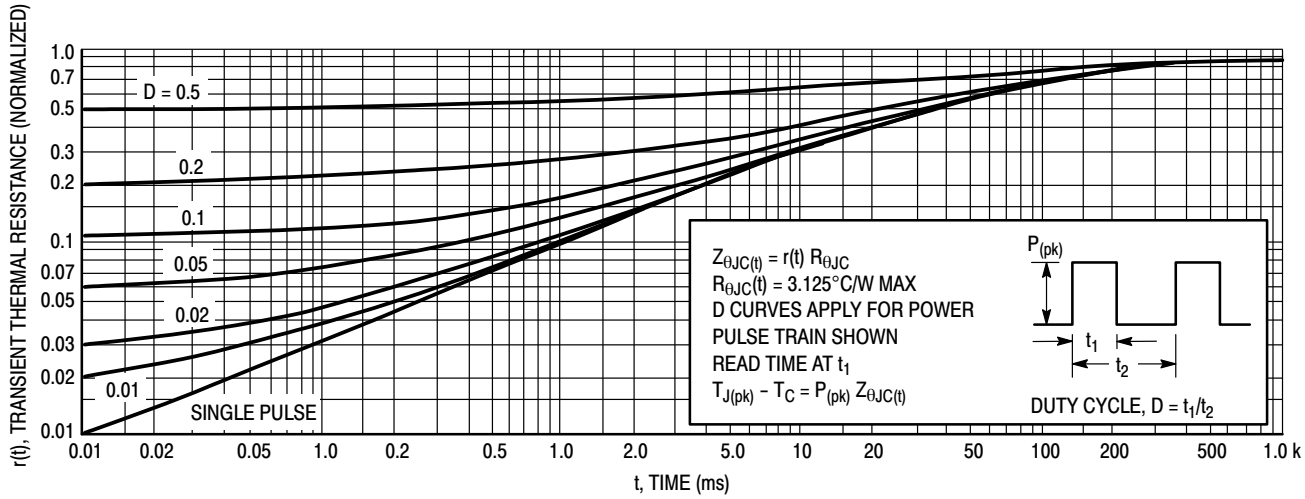



**Figure 4. Thermal Response**

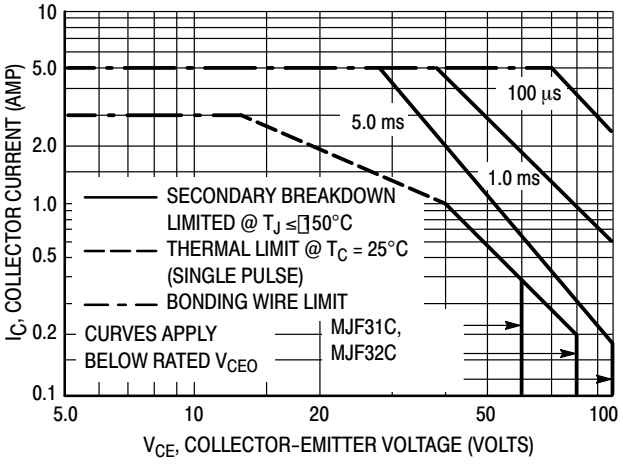



**Figure 5. Active Region Safe Operating Area**

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 5 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 $T_{J(pk)} \leq 150°C$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.



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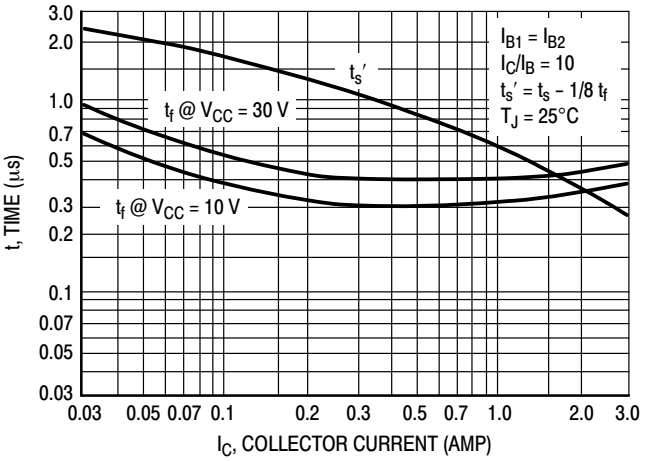



**Figure 6. Turn−Off Time**

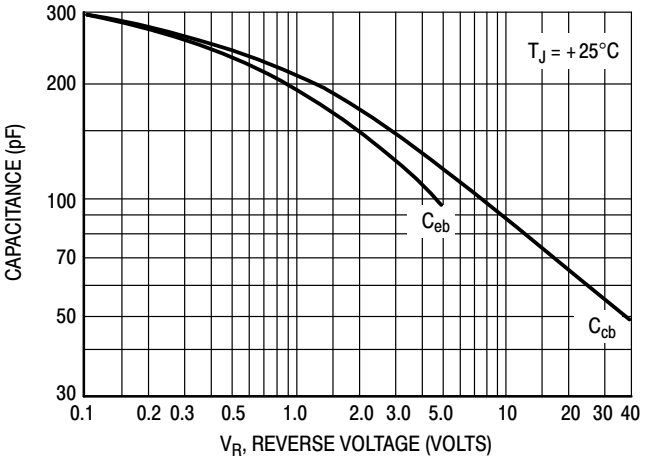



**Figure 7. Capacitance**

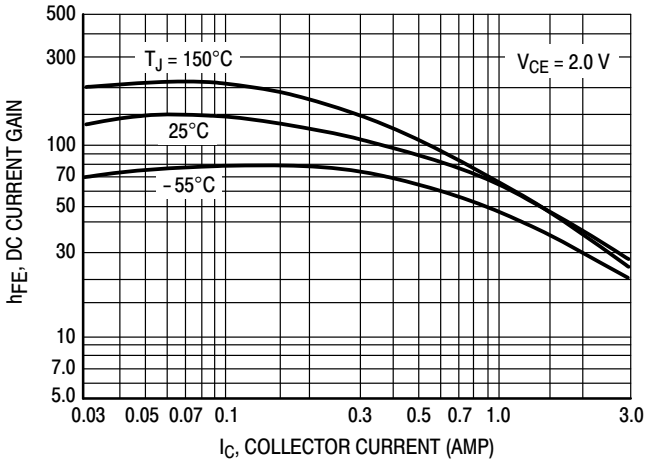



**Figure 8. DC Current Gain**

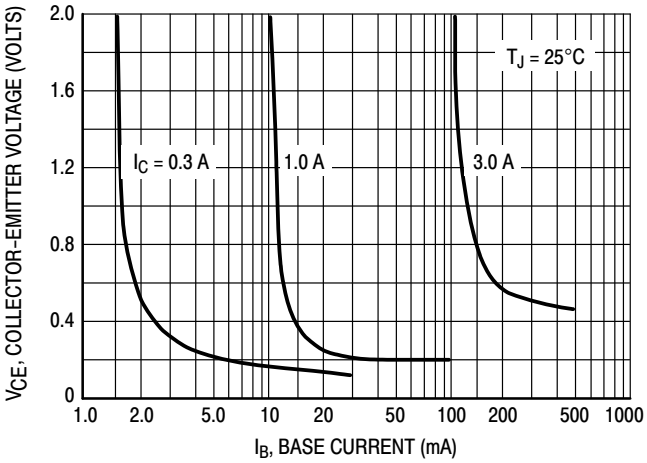



**Figure 9. Collector Saturation Region**

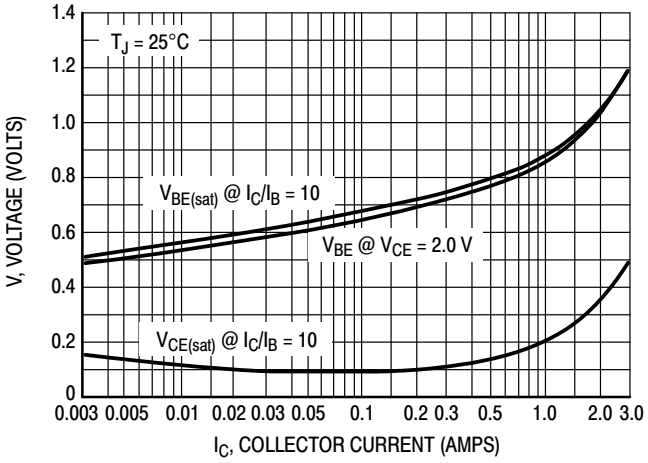



**Figure 10. “On” Voltages**

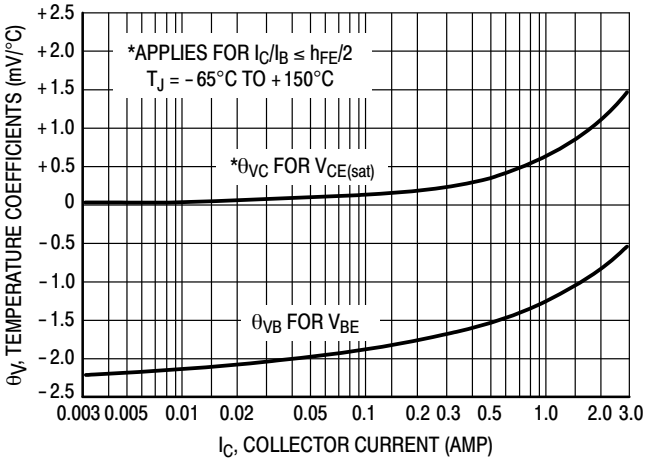



**Figure 11. Temperature Coefficients**



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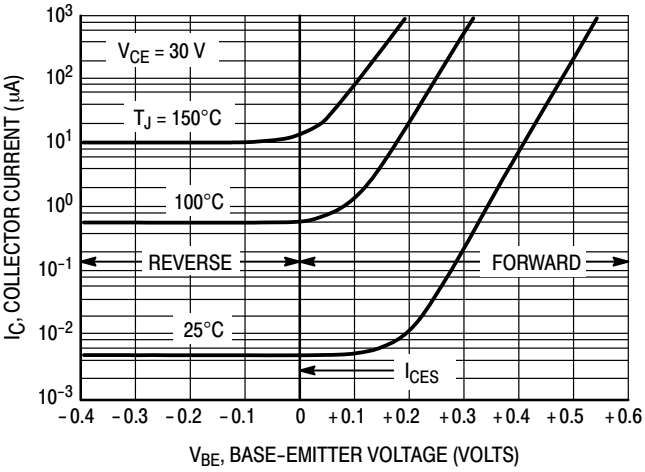



**Figure 12. Collector Cut−Off Region**

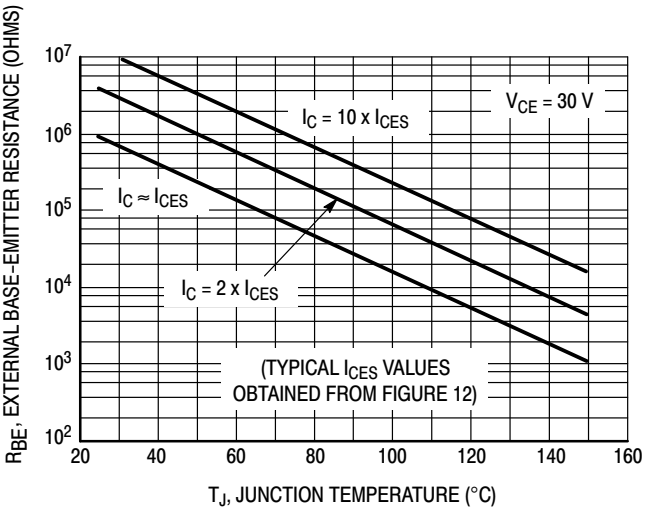
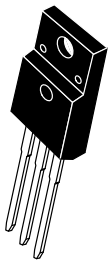



**Figure 13. Effects of Base−Emitter Resistance**



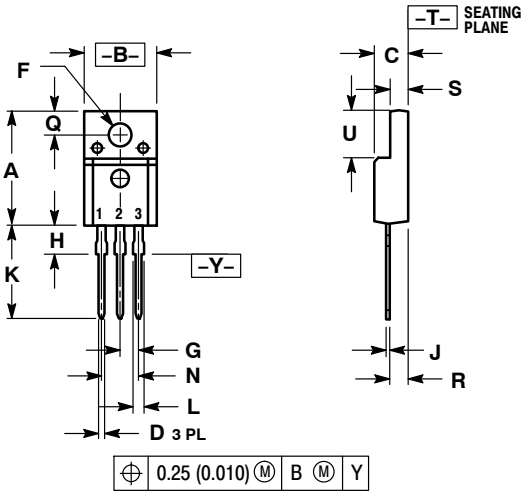
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SCALE 1:1

## TO−220 FULLPAK
CASE 221D−03
ISSUE K

DATE 27 FEB 2009




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. 221D−01 THRU 221D−02 OBSOLETE, NEW STANDARD 221D−03.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.617 | 0.635 | 15.67 | 16.12 |
| B | 0.392 | 0.419 | 9.96 | 10.63 |
| C | 0.177 | 0.193 | 4.50 | 4.90 |
| D | 0.024 | 0.039 | 0.60 | 1.00 |
| F | 0.116 | 0.129 | 2.95 | 3.28 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.118 | 0.135 | 3.00 | 3.43 |
| J | 0.018 | 0.025 | 0.45 | 0.63 |
| K | 0.503 | 0.541 | 12.78 | 13.73 |
| L | 0.048 | 0.058 | 1.23 | 1.47 |
| N | 0.200 BSC | | 5.08 BSC | |
| Q | 0.122 | 0.138 | 3.10 | 3.50 |
| R | 0.099 | 0.117 | 2.51 | 2.96 |
| S | 0.092 | 0.113 | 2.34 | 2.87 |
| U | 0.239 | 0.271 | 6.06 | 6.88 |

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

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

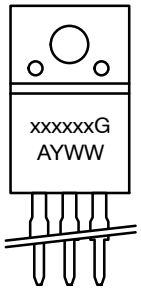
STYLE 3:
PIN 1. ANODE
2. CATHODE
3. ANODE

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

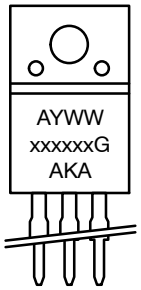
STYLE 5:
PIN 1. CATHODE
2. ANODE
3. GATE

STYLE 6:
PIN 1. MT 1
2. MT 2
3. GATE

## MARKING DIAGRAMS




**Bipolar**




**Rectifier**

| | |
|---|---|
| xxxxxx | = Specific Device Code |
| G | = Pb−Free Package |
| A | = Assembly Location |
| Y | = Year |
| WW | = Work Week |

| | |
|---|---|
| A | = Assembly Location |
| Y | = Year |
| WW | = Work Week |
| xxxxxx | = Device Code |
| G | = Pb−Free Package |
| AKA | = Polarity Designator |

| | | |
|---|---|---|
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| **DESCRIPTION:** | **TO−220 FULLPAK** | **PAGE 1 OF 1** |

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