

## 400W, 6.8V - 440V Transient Voltage Suppressor

### FEATURES

- AEC-Q101 qualified available
- Excellent clamping capability
- Low impedance
- 400W surge capability at 10/1000 $\mu$ s waveform
- Fast response time: Typically less than 1.0ps from 0 volt to  $V_{BR}$  for unidirectional and 5.0ns for bidirectional
- Typical  $I_R$  less than 1 $\mu$ A above 10V
- UL recognized file # E-326243
- RoHS Compliant
- Halogen-free according to IEC 61249-2-21

### APPLICATIONS

- Protect sensitive circuit from damage by high voltage transients
- Lighting, ESD transient voltage protection of IC, system
- Inductive switching load protection of IC, system
- Electrical Fast Transient Immunity protection of IC, system

### MECHANICAL DATA

- Case: DO-204AL (DO-41)
- Molding compound meets UL 94V-0 flammability rating
- Terminal: Pure tin plated leads, solderable per J-STD-002
- Meet JESD 201 class 2 whisker test
- Polarity: As marked
- Weight: 0.300g (approximately)

| KEY PARAMETERS               |                  |              |
|------------------------------|------------------|--------------|
| PARAMETER                    | VALUE            | UNIT         |
| $V_{WM}$                     | 5.5 - 376        | V            |
| $V_{BR}$ (uni - directional) | 6.12 - 484       | V            |
| $V_{BR}$ (bi - directional)  | 6.12 - 484       | V            |
| $P_{PK}$                     | 400              | W            |
| $T_{J\ MAX}$                 | 175              | $^{\circ}$ C |
| Package                      | DO-204AL (DO-41) |              |



DO-204AL (DO-41)

### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^{\circ}$ C unless otherwise noted)

| PARAMETER                                                                                             | SYMBOL    | VALUE       | UNIT         |
|-------------------------------------------------------------------------------------------------------|-----------|-------------|--------------|
| Peak power dissipation at $T_A = 25^{\circ}$ C, $T_p = 1ms^{(1)}$                                     | $P_{PK}$  | 400         | W            |
| Steady state power dissipation at $T_L = 75^{\circ}$ C<br>lead lengths .375", 9.5mm <sup>(2)</sup>    | $P_D$     | 1           | W            |
| Peak forward surge current, 8.3 ms single half sine-wave<br>superimposed on rated load <sup>(3)</sup> | $I_{FSM}$ | 40          | A            |
| Forward voltage at 25A for Unidirectional only <sup>(4)</sup>                                         | $V_F$     | 3.5/6.5     | V            |
| Operating junction temperature range                                                                  | $T_J$     | -55 to +175 | $^{\circ}$ C |
| Storage temperature range                                                                             | $T_{STG}$ | -55 to +175 | $^{\circ}$ C |

#### Note:

1. Non-repetitive current pulse per Fig.3 and Derated above  $T_A = 25^{\circ}$ C per Fig.2
2. Mounted on 5 x 5 mm copper pads to each terminal
3. 8.3ms single half sine-wave or equivalent square wave, duty cycle = 4 pulses per minute maximum
4.  $V_F = 3.5V$  for devices of  $V_{BR} \leq 200V$  and  $V_F = 6.5V$  max. for device  $V_{BR} > 200V$

Devices for bipolar applications

1. For bidirectional use C or CA suffix for types P4KE6.8 - types P4KE440
2. Electrical characteristics apply in both directions

**MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS** (TA=25°C unless otherwise noted)

| Part Number | Nominal voltage | Breakdown voltage<br>$V_{BR}@I_T$<br>(V) <sup>(1)</sup> |       | Test current<br>$I_T$<br>(mA) | Working stand-off voltage<br>$V_{WM}$<br>(V) | Reverse leakage<br>@ $V_{WM}$<br>$I_D$<br>( $\mu$ A) | Maximum peak pulse current<br>$I_{PPM}$<br>(A) <sup>(2)</sup> | Maximum clamping voltage<br>$V_C@I_{PPM}$<br>(V) | Maximum temperature coefficient |
|-------------|-----------------|---------------------------------------------------------|-------|-------------------------------|----------------------------------------------|------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------|---------------------------------|
|             |                 | $V_{BR}$                                                |       | $I_T$                         | $V_{WM}$                                     | $I_D$                                                | $I_{PPM}$                                                     | $V_C$                                            | $V_{BR}$                        |
|             |                 | V                                                       |       | mA                            | V                                            | $\mu$ A                                              | A                                                             | V                                                | %/°C                            |
|             |                 | Min                                                     | Max   |                               |                                              |                                                      |                                                               |                                                  |                                 |
| P4KE6.8     | 6.8             | 6.12                                                    | 7.48  | 10                            | 5.50                                         | 1000                                                 | 38.0                                                          | 10.8                                             | 0.057                           |
| P4KE6.8A    | 6.8             | 6.46                                                    | 7.14  | 10                            | 5.80                                         | 1000                                                 | 40.0                                                          | 10.5                                             | 0.057                           |
| P4KE7.5     | 7.5             | 6.75                                                    | 8.25  | 10                            | 6.05                                         | 500                                                  | 35.0                                                          | 11.7                                             | 0.061                           |
| P4KE7.5A    | 7.5             | 7.13                                                    | 7.88  | 10                            | 6.40                                         | 500                                                  | 37.0                                                          | 11.3                                             | 0.061                           |
| P4KE8.2     | 8.2             | 7.38                                                    | 9.02  | 10                            | 6.63                                         | 200                                                  | 33.0                                                          | 12.5                                             | 0.065                           |
| P4KE8.2A    | 8.2             | 7.79                                                    | 8.61  | 10                            | 7.02                                         | 200                                                  | 34.0                                                          | 12.1                                             | 0.065                           |
| P4KE9.1     | 9.1             | 8.19                                                    | 10.00 | 1                             | 7.37                                         | 50                                                   | 30.0                                                          | 13.8                                             | 0.068                           |
| P4KE9.1A    | 9.1             | 8.65                                                    | 9.55  | 1                             | 7.78                                         | 50                                                   | 31.0                                                          | 13.4                                             | 0.068                           |
| P4KE10      | 10              | 9.00                                                    | 11.00 | 1                             | 8.10                                         | 10                                                   | 28.0                                                          | 15.0                                             | 0.073                           |
| P4KE10A     | 10              | 9.50                                                    | 10.5  | 1                             | 8.55                                         | 10                                                   | 29.0                                                          | 14.5                                             | 0.073                           |
| P4KE11      | 11              | 9.90                                                    | 12.1  | 1                             | 8.92                                         | 1                                                    | 26.0                                                          | 16.2                                             | 0.075                           |
| P4KE11A     | 11              | 10.5                                                    | 11.6  | 1                             | 9.40                                         | 1                                                    | 27.0                                                          | 15.6                                             | 0.075                           |
| P4KE12      | 12              | 10.8                                                    | 13.2  | 1                             | 9.72                                         | 1                                                    | 24.0                                                          | 17.3                                             | 0.078                           |
| P4KE12A     | 12              | 11.4                                                    | 12.6  | 1                             | 10.2                                         | 1                                                    | 25.0                                                          | 16.7                                             | 0.078                           |
| P4KE13      | 13              | 11.7                                                    | 14.3  | 1                             | 10.5                                         | 1                                                    | 22.0                                                          | 19.0                                             | 0.081                           |
| P4KE13A     | 13              | 12.4                                                    | 13.7  | 1                             | 11.1                                         | 1                                                    | 23.0                                                          | 18.2                                             | 0.081                           |
| P4KE15      | 15              | 13.5                                                    | 16.5  | 1                             | 12.1                                         | 1                                                    | 19.0                                                          | 22.0                                             | 0.084                           |
| P4KE15A     | 15              | 14.3                                                    | 15.8  | 1                             | 12.8                                         | 1                                                    | 20.0                                                          | 21.2                                             | 0.084                           |
| P4KE16      | 16              | 14.4                                                    | 17.6  | 1                             | 12.9                                         | 1                                                    | 17.8                                                          | 23.5                                             | 0.086                           |
| P4KE16A     | 16              | 15.2                                                    | 16.8  | 1                             | 13.6                                         | 1                                                    | 18.6                                                          | 22.5                                             | 0.086                           |
| P4KE18      | 18              | 16.2                                                    | 19.8  | 1                             | 14.5                                         | 1                                                    | 16.0                                                          | 26.5                                             | 0.088                           |
| P4KE18A     | 18              | 17.1                                                    | 18.9  | 1                             | 15.3                                         | 1                                                    | 16.5                                                          | 25.5                                             | 0.088                           |
| P4KE20      | 20              | 18.0                                                    | 22.0  | 1                             | 16.2                                         | 1                                                    | 14.0                                                          | 29.1                                             | 0.090                           |
| P4KE20A     | 20              | 19.0                                                    | 21.0  | 1                             | 17.1                                         | 1                                                    | 15.0                                                          | 27.7                                             | 0.090                           |
| P4KE22      | 22              | 19.8                                                    | 24.2  | 1                             | 17.8                                         | 1                                                    | 13.0                                                          | 31.9                                             | 0.092                           |
| P4KE22A     | 22              | 20.9                                                    | 23.1  | 1                             | 18.8                                         | 1                                                    | 13.7                                                          | 30.6                                             | 0.092                           |
| P4KE24      | 24              | 21.6                                                    | 26.4  | 1                             | 19.4                                         | 1                                                    | 12.0                                                          | 34.7                                             | 0.094                           |
| P4KE24A     | 24              | 22.8                                                    | 25.2  | 1                             | 20.5                                         | 1                                                    | 12.6                                                          | 33.2                                             | 0.094                           |
| P4KE27      | 27              | 24.3                                                    | 29.7  | 1                             | 21.8                                         | 1                                                    | 10.7                                                          | 39.1                                             | 0.096                           |
| P4KE27A     | 27              | 25.7                                                    | 28.4  | 1                             | 23.1                                         | 1                                                    | 11.0                                                          | 37.5                                             | 0.096                           |
| P4KE30      | 30              | 27.0                                                    | 33.0  | 1                             | 24.3                                         | 1                                                    | 9.6                                                           | 43.5                                             | 0.097                           |
| P4KE30A     | 30              | 28.5                                                    | 31.5  | 1                             | 25.6                                         | 1                                                    | 10.0                                                          | 41.4                                             | 0.097                           |
| P4KE33      | 33              | 29.7                                                    | 36.3  | 1                             | 26.8                                         | 1                                                    | 8.8                                                           | 47.7                                             | 0.098                           |
| P4KE33A     | 33              | 31.4                                                    | 34.7  | 1                             | 28.2                                         | 1                                                    | 9.0                                                           | 45.7                                             | 0.098                           |
| P4KE36      | 36              | 32.4                                                    | 39.6  | 1                             | 29.1                                         | 1                                                    | 8.0                                                           | 52.0                                             | 0.099                           |
| P4KE36A     | 36              | 34.2                                                    | 37.8  | 1                             | 30.8                                         | 1                                                    | 8.4                                                           | 49.9                                             | 0.099                           |

**MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS** (TA=25°C unless otherwise noted)

| Part Number | Nominal voltage | Breakdown voltage<br>$V_{BR}@I_T$<br>(V) <sup>(1)</sup> |      | Test current<br>$I_T$<br>(mA) | Working stand-off voltage<br>$V_{WM}$<br>(V) | Reverse leakage<br>@ $V_{WM}$<br>$I_D$<br>( $\mu$ A) | Maximum peak pulse current<br>$I_{PPM}$<br>(A) <sup>(2)</sup> | Maximum clamping voltage<br>$V_C@I_{PPM}$<br>(V) | Maximum temperature coefficient |
|-------------|-----------------|---------------------------------------------------------|------|-------------------------------|----------------------------------------------|------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------|---------------------------------|
|             |                 | $V_{BR}$                                                |      | $I_T$                         | $V_{WM}$                                     | $I_D$                                                | $I_{PPM}$                                                     | $V_C$                                            | $V_{BR}$                        |
|             |                 | V                                                       |      | mA                            | V                                            | $\mu$ A                                              | A                                                             | V                                                | %/°C                            |
|             |                 | Min                                                     | Max  |                               |                                              |                                                      |                                                               |                                                  |                                 |
| P4KE39      | 39              | 35.1                                                    | 42.9 | 1                             | 31.6                                         | 1                                                    | 7.4                                                           | 56.4                                             | 0.100                           |
| P4KE39A     | 39              | 37.1                                                    | 41.0 | 1                             | 33.3                                         | 1                                                    | 7.7                                                           | 53.9                                             | 0.100                           |
| P4KE43      | 43              | 38.7                                                    | 47.3 | 1                             | 34.8                                         | 1                                                    | 6.7                                                           | 61.9                                             | 0.101                           |
| P4KE43A     | 43              | 40.9                                                    | 45.2 | 1                             | 36.8                                         | 1                                                    | 7.0                                                           | 59.3                                             | 0.101                           |
| P4KE47      | 47              | 42.3                                                    | 51.7 | 1                             | 38.1                                         | 1                                                    | 6.2                                                           | 67.8                                             | 0.101                           |
| P4KE47A     | 47              | 44.7                                                    | 49.4 | 1                             | 40.2                                         | 1                                                    | 6.4                                                           | 64.8                                             | 0.101                           |
| P4KE51      | 51              | 45.9                                                    | 56.1 | 1                             | 41.3                                         | 1                                                    | 5.7                                                           | 73.5                                             | 0.102                           |
| P4KE51A     | 51              | 48.5                                                    | 53.6 | 1                             | 43.6                                         | 1                                                    | 6.0                                                           | 70.1                                             | 0.102                           |
| P4KE56      | 56              | 50.4                                                    | 61.6 | 1                             | 45.4                                         | 1                                                    | 5.2                                                           | 80.5                                             | 0.103                           |
| P4KE56A     | 56              | 53.2                                                    | 58.8 | 1                             | 47.8                                         | 1                                                    | 5.4                                                           | 77.0                                             | 0.103                           |
| P4KE62      | 62              | 55.8                                                    | 68.2 | 1                             | 50.2                                         | 1                                                    | 4.7                                                           | 89                                               | 0.104                           |
| P4KE62A     | 62              | 58.9                                                    | 65.1 | 1                             | 53.0                                         | 1                                                    | 5.0                                                           | 85                                               | 0.104                           |
| P4KE68      | 68              | 61.2                                                    | 74.8 | 1                             | 55.1                                         | 1                                                    | 4.2                                                           | 98                                               | 0.104                           |
| P4KE68A     | 68              | 64.6                                                    | 71.4 | 1                             | 58.1                                         | 1                                                    | 4.5                                                           | 92                                               | 0.104                           |
| P4KE75      | 75              | 67.5                                                    | 82.5 | 1                             | 60.7                                         | 1                                                    | 3.8                                                           | 108                                              | 0.105                           |
| P4KE75A     | 75              | 71.3                                                    | 78.8 | 1                             | 64.1                                         | 1                                                    | 4.0                                                           | 103                                              | 0.105                           |
| P4KE82      | 82              | 73.8                                                    | 90.2 | 1                             | 66.4                                         | 1                                                    | 3.5                                                           | 118                                              | 0.105                           |
| P4KE82A     | 82              | 77.9                                                    | 86.1 | 1                             | 70.1                                         | 1                                                    | 3.7                                                           | 113                                              | 0.105                           |
| P4KE91      | 91              | 81.9                                                    | 100  | 1                             | 73.7                                         | 1                                                    | 3.2                                                           | 131                                              | 0.106                           |
| P4KE91A     | 91              | 86.5                                                    | 95.5 | 1                             | 77.8                                         | 1                                                    | 3.3                                                           | 125                                              | 0.106                           |
| P4KE100     | 100             | 90                                                      | 110  | 1                             | 81.0                                         | 1                                                    | 2.9                                                           | 144                                              | 0.106                           |
| P4KE100A    | 100             | 95                                                      | 105  | 1                             | 85.5                                         | 1                                                    | 3.0                                                           | 137                                              | 0.106                           |
| P4KE110     | 110             | 99                                                      | 121  | 1                             | 89.2                                         | 1                                                    | 2.6                                                           | 158                                              | 0.107                           |
| P4KE110A    | 110             | 105                                                     | 116  | 1                             | 94.0                                         | 1                                                    | 2.7                                                           | 152                                              | 0.107                           |
| P4KE120     | 120             | 108                                                     | 132  | 1                             | 97.2                                         | 1                                                    | 2.4                                                           | 173                                              | 0.107                           |
| P4KE120A    | 120             | 114                                                     | 126  | 1                             | 102                                          | 1                                                    | 2.5                                                           | 165                                              | 0.107                           |
| P4KE130     | 130             | 117                                                     | 143  | 1                             | 105                                          | 1                                                    | 2.2                                                           | 187                                              | 0.107                           |
| P4KE130A    | 130             | 124                                                     | 137  | 1                             | 111                                          | 1                                                    | 2.3                                                           | 179                                              | 0.107                           |
| P4KE150     | 150             | 135                                                     | 165  | 1                             | 121                                          | 1                                                    | 1.9                                                           | 215                                              | 0.108                           |
| P4KE150A    | 150             | 143                                                     | 158  | 1                             | 128                                          | 1                                                    | 2.0                                                           | 207                                              | 0.108                           |
| P4KE160     | 160             | 144                                                     | 176  | 1                             | 130                                          | 1                                                    | 1.8                                                           | 230                                              | 0.108                           |
| P4KE160A    | 160             | 152                                                     | 168  | 1                             | 136                                          | 1                                                    | 1.9                                                           | 219                                              | 0.108                           |
| P4KE170     | 170             | 153                                                     | 187  | 1                             | 138                                          | 1                                                    | 1.7                                                           | 244                                              | 0.108                           |
| P4KE170A    | 170             | 162                                                     | 179  | 1                             | 145                                          | 1                                                    | 1.8                                                           | 234                                              | 0.108                           |
| P4KE180     | 180             | 162                                                     | 198  | 1                             | 146                                          | 1                                                    | 1.6                                                           | 258                                              | 0.108                           |

| <b>MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS</b> (TA=25°C unless otherwise noted) |                 |                                                         |     |                               |                                              |                                                      |                                                               |                                                  |                                 |
|----------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------|-----|-------------------------------|----------------------------------------------|------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------|---------------------------------|
| Part Number                                                                            | Nominal voltage | Breakdown voltage<br>$V_{BR}@I_T$<br>(V) <sup>(1)</sup> |     | Test current<br>$I_T$<br>(mA) | Working stand-off voltage<br>$V_{WM}$<br>(V) | Reverse leakage<br>@ $V_{WM}$<br>$I_D$<br>( $\mu$ A) | Maximum peak pulse current<br>$I_{PPM}$<br>(A) <sup>(2)</sup> | Maximum clamping voltage<br>$V_C@I_{PPM}$<br>(V) | Maximum temperature coefficient |
|                                                                                        |                 | $V_{BR}$                                                |     | $I_T$                         | $V_{WM}$                                     | $I_D$                                                | $I_{PPM}$                                                     | $V_C$                                            | $V_{BR}$                        |
|                                                                                        |                 | V                                                       |     | mA                            | V                                            | $\mu$ A                                              | A                                                             | V                                                | %/°C                            |
|                                                                                        |                 | Min                                                     | Max |                               |                                              |                                                      |                                                               |                                                  |                                 |
| P4KE180A                                                                               | 180             | 171                                                     | 189 | 1                             | 154                                          | 1                                                    | 1.7                                                           | 246                                              | 0.108                           |
| P4KE200                                                                                | 200             | 180                                                     | 220 | 1                             | 162                                          | 1                                                    | 1.4                                                           | 287                                              | 0.108                           |
| P4KE200A                                                                               | 200             | 190                                                     | 210 | 1                             | 171                                          | 1                                                    | 1.51                                                          | 274                                              | 0.108                           |
| P4KE220                                                                                | 220             | 198                                                     | 242 | 1                             | 175                                          | 1                                                    | 1.20                                                          | 344                                              | 0.108                           |
| P4KE220A                                                                               | 220             | 209                                                     | 231 | 1                             | 185                                          | 1                                                    | 1.30                                                          | 328                                              | 0.108                           |
| P4KE250                                                                                | 250             | 225                                                     | 275 | 1                             | 202                                          | 1                                                    | 1.10                                                          | 360                                              | 0.110                           |
| P4KE250A                                                                               | 250             | 237                                                     | 263 | 1                             | 214                                          | 1                                                    | 1.20                                                          | 344                                              | 0.110                           |
| P4KE300                                                                                | 300             | 270                                                     | 330 | 1                             | 243                                          | 1                                                    | 0.97                                                          | 430                                              | 0.110                           |
| P4KE300A                                                                               | 300             | 285                                                     | 315 | 1                             | 256                                          | 1                                                    | 1.00                                                          | 414                                              | 0.110                           |
| P4KE350                                                                                | 350             | 315                                                     | 385 | 1                             | 284                                          | 1                                                    | 0.83                                                          | 504                                              | 0.110                           |
| P4KE350A                                                                               | 350             | 332                                                     | 368 | 1                             | 300                                          | 1                                                    | 0.87                                                          | 482                                              | 0.110                           |
| P4KE400                                                                                | 400             | 360                                                     | 440 | 1                             | 324                                          | 1                                                    | 0.73                                                          | 574                                              | 0.110                           |
| P4KE400A                                                                               | 400             | 380                                                     | 420 | 1                             | 342                                          | 1                                                    | 0.76                                                          | 548                                              | 0.110                           |
| P4KE440                                                                                | 440             | 396                                                     | 484 | 1                             | 356                                          | 1                                                    | 0.66                                                          | 631                                              | 0.110                           |
| P4KE440A                                                                               | 440             | 418                                                     | 462 | 1                             | 376                                          | 1                                                    | 0.69                                                          | 600                                              | 0.110                           |

**Notes:**

1. Pulse test :  $t_p < 50\text{ms}$
2. All terms and symbols are consistent with ANSI/IEEE C62.35
3. For bipolar types having  $V_{WM}$  of 10 volts and less, the  $I_D$  limit is doubled.

| <b>ORDERING INFORMATION</b>            |                  |                     |
|----------------------------------------|------------------|---------------------|
| <b>ORDERING CODE</b> <sup>(1)(2)</sup> | <b>PACKAGE</b>   | <b>PACKING</b>      |
| P4KE $x$                               | DO-204AL (DO-41) | 5,000 / Tape & Reel |
| P4KE $x$ A0G                           | DO-204AL (DO-41) | 3,000 / Ammo box    |
| P4KE $x$ H                             | DO-204AL (DO-41) | 5,000 / Tape & Reel |
| P4KE $x$ HA0G                          | DO-204AL (DO-41) | 3,000 / Ammo box    |

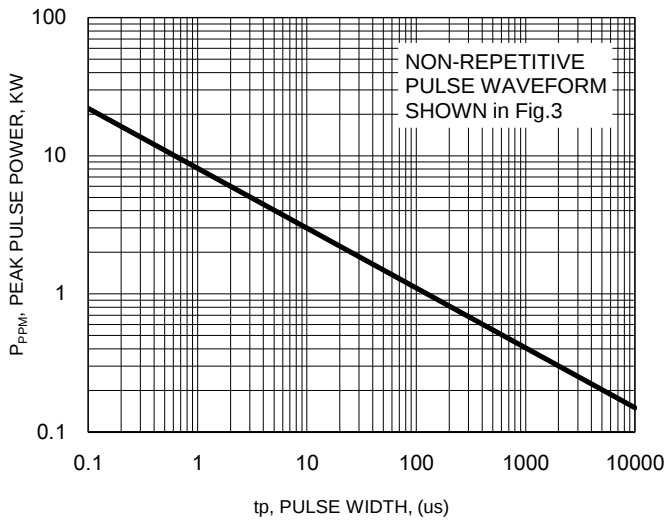
**Notes:**

1. “x” defines voltage from 6.8V (P4KE6.8) to 440V (P4KE440A)
2. “H” means AEC-Q101 qualified

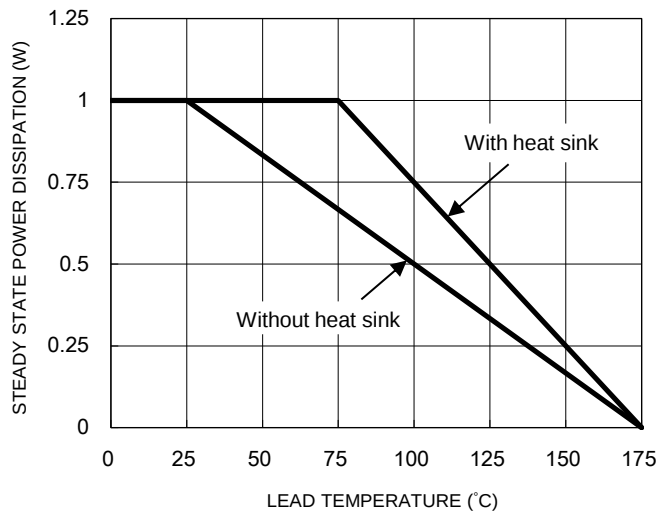
## CHARACTERISTICS CURVES

( $T_A = 25^\circ\text{C}$  unless otherwise noted)

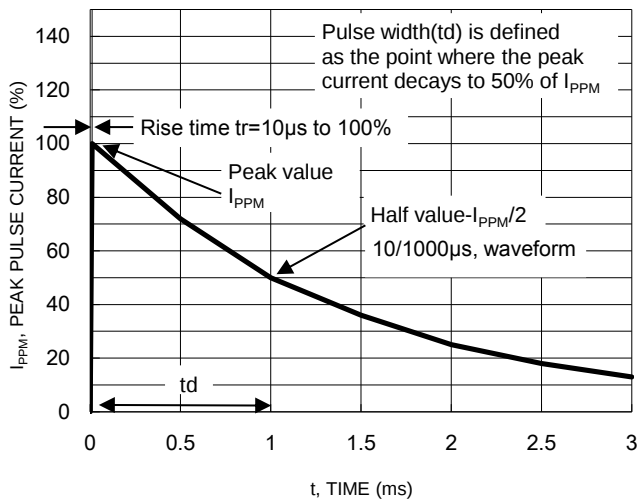
**Fig.1 Peak Pulse Power Rating Curve**



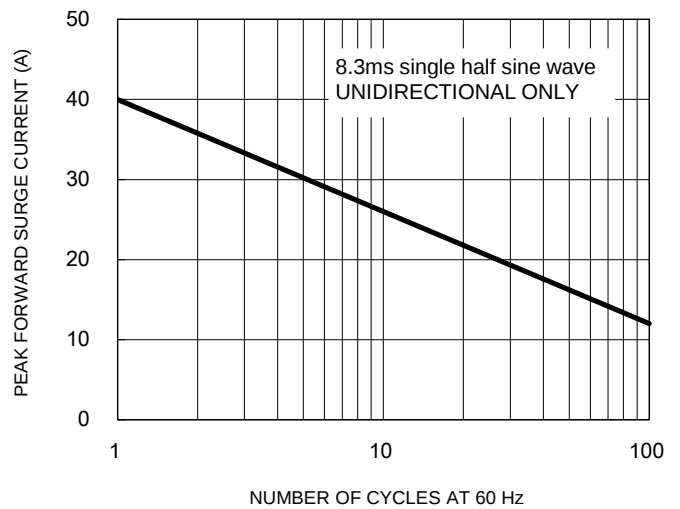
**Fig.2 Steady State Power Derating Curve**



**Fig.3 Clamping Power Pulse Waveform**



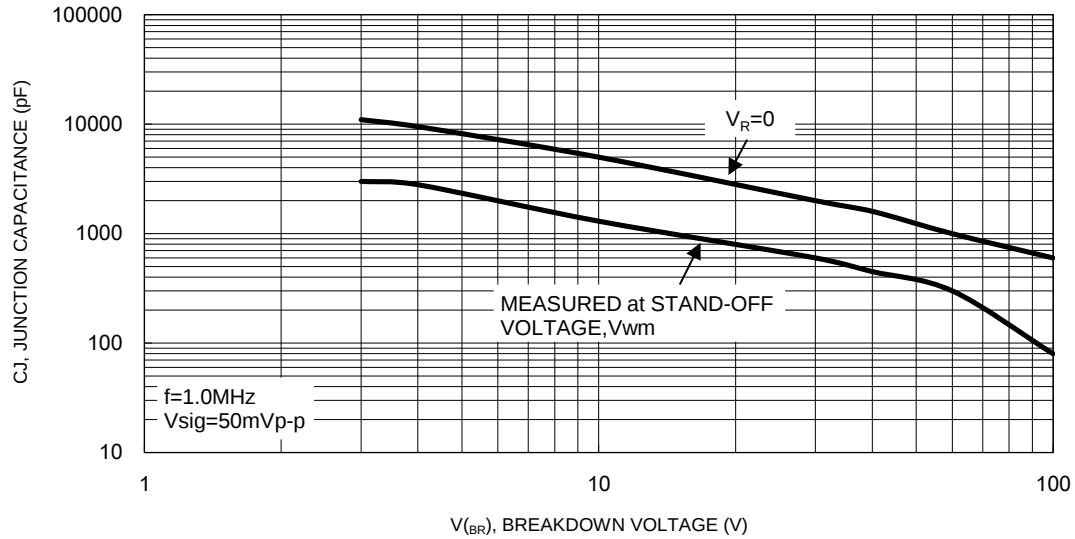
**Fig.4 Maximum Non-Repetitive Forward Surge Current**



## CHARACTERISTICS CURVES

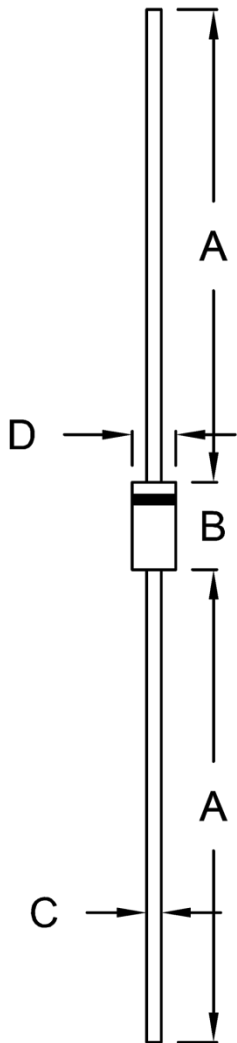
( $T_A = 25^\circ\text{C}$  unless otherwise noted)

**Fig.5 Typical Junction Capacitance**



## PACKAGE OUTLINE DIMENSIONS

DO-204AL (DO-41)



| DIM. | Unit (mm) |      | Unit (inch) |       |
|------|-----------|------|-------------|-------|
|      | Min.      | Max. | Min.        | Max.  |
| A    | 25.40     | -    | 1.000       | -     |
| B    | 4.20      | 5.20 | 0.165       | 0.205 |
| C    | 0.71      | 0.86 | 0.028       | 0.034 |
| D    | 2.00      | 2.70 | 0.079       | 0.106 |

## MARKING DIAGRAM

Cathode band for uni-directional products only



P/N = Marking Code  
G = Green Compound  
YWW = Date Code  
F = Factory Code

## **Notice**

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