

### THREE PHASE AC SWITCH

### Power Modules

#### Features

- Package fully compatible with the industry standard INT-A-pak power modules series
- High thermal conductivity package, electrically insulated case
- Outstanding number of power encapsulated components
- Excellent power volume ratio
- 4000 V<sub>RMS</sub> isolating voltage
- UL E78996 approved 

50 A  
90 A  
100 A

#### Description

A range of extremely compact, encapsulated three phase AC-switches offering efficient and reliable operation. They are intended for use in general purpose and heavy duty applications as control motor starter.

#### Major Ratings and Characteristics

| Parameters       | 54MT.KB     | 94MT.KB | 104MT.KB | Units             |
|------------------|-------------|---------|----------|-------------------|
| $I_O$            | 50          | 90      | 100      | A                 |
| @ $T_C$          | 80          | 80      | 80       | °C                |
| $I_{FSM}$ @ 50Hz | 390         | 950     | 1130     | A                 |
| @ 60Hz           | 410         | 1000    | 1180     | A                 |
| $I^2_t$ @ 50Hz   | 770         | 4525    | 6380     | A <sup>2</sup> s  |
| @ 60Hz           | 700         | 4130    | 5830     | A <sup>2</sup> s  |
| $I^2\sqrt{t}$    | 7700        | 45250   | 63800    | A <sup>2</sup> √s |
| $V_{RRM}$ range  | 800 to 1600 |         |          | V                 |
| $T_{STG}$ range  | -40 to 125  |         |          | °C                |
| $T_J$ range      | -40 to 125  |         |          | °C                |

## 54-94-104MT..KB Series

Bulletin I27504 08/97

International  
**IR** Rectifier

### ELECTRICAL SPECIFICATIONS

#### Voltage Ratings

| Type number  | Voltage Code | $V_{RRM}$ ' maximum repetitive peak reverse voltage<br>V | $V_{RSM}$ ' maximum non-repetitive peak reverse voltage<br>V | $V_{DRM}$ ' max. repetitive peak off-state voltage, gate open circuit<br>V | $I_{RRM}/I_{DRM}$ max.<br>@ $T_J = 125^\circ\text{C}$<br>mA |
|--------------|--------------|----------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------|
| 54MT..KB     | 80           | 800                                                      | 900                                                          | 800                                                                        | 20 *                                                        |
|              | 100          | 1000                                                     | 1100                                                         | 1000                                                                       |                                                             |
|              | 120          | 1200                                                     | 1300                                                         | 1200                                                                       |                                                             |
|              | 140          | 1400                                                     | 1500                                                         | 1400                                                                       |                                                             |
|              | 160          | 1600                                                     | 1700                                                         | 1600                                                                       |                                                             |
| 94/104MT..KB | 80           | 800                                                      | 900                                                          | 800                                                                        | 40 *                                                        |
|              | 100          | 1000                                                     | 1100                                                         | 1000                                                                       |                                                             |
|              | 120          | 1200                                                     | 1300                                                         | 1200                                                                       |                                                             |
|              | 140          | 1400                                                     | 1500                                                         | 1400                                                                       |                                                             |
|              | 160          | 1600                                                     | 1700                                                         | 1600                                                                       |                                                             |

\* For single AC switch

#### Forward Conduction

| Parameter                                                                               | 54MT.KB | 94MT.KB | 104MT.KB | Units             | Conditions                                                                                                                                                             |                       |                                                 |  |
|-----------------------------------------------------------------------------------------|---------|---------|----------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------|--|
| I <sub>O</sub> Maximum I <sub>RMS</sub> output current @ Case temperature               | 50      | 90      | 100      | A                 | For all conduction angle                                                                                                                                               |                       |                                                 |  |
|                                                                                         | 80      | 80      | 80       | °C                |                                                                                                                                                                        |                       |                                                 |  |
| I <sub>TSM</sub> Maximum peak, one-cycle forward, non-repetitive on state surge current | 390     | 950     | 1130     | A                 | t = 10ms                                                                                                                                                               | No voltage            | Initial<br>T <sub>J</sub> = T <sub>J</sub> max. |  |
|                                                                                         | 410     | 1000    | 1180     |                   | t = 8.3ms                                                                                                                                                              | reapplied             |                                                 |  |
|                                                                                         | 330     | 800     | 950      |                   | t = 10ms                                                                                                                                                               | 100% V <sub>RRM</sub> |                                                 |  |
|                                                                                         | 345     | 840     | 1000     |                   | t = 8.3ms                                                                                                                                                              | reapplied             |                                                 |  |
| I <sup>2</sup> t Maximum I <sup>2</sup> t for fusing                                    | 770     | 4525    | 6380     | A <sup>2</sup> s  | t = 10ms                                                                                                                                                               | No voltage            |                                                 |  |
|                                                                                         | 700     | 4130    | 5830     |                   | t = 8.3ms                                                                                                                                                              | reapplied             |                                                 |  |
|                                                                                         | 540     | 3200    | 4510     |                   | t = 10ms                                                                                                                                                               | 100% V <sub>RRM</sub> |                                                 |  |
|                                                                                         | 500     | 2920    | 4120     |                   | t = 8.3ms                                                                                                                                                              | reapplied             |                                                 |  |
| I <sup>2</sup> /t Maximum I <sup>2</sup> /t for fusing                                  | 7700    | 45250   | 63800    | A <sup>2</sup> /s | t = 0.1 to 10ms, no voltage reapplied                                                                                                                                  |                       |                                                 |  |
| V <sub>T(TO)1</sub> Low level value of threshold voltage                                | 1.16    | 0.99    | 0.99     | V                 | (16.7% × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), @ T <sub>J</sub> max.                                                                                  |                       |                                                 |  |
| V <sub>T(TO)2</sub> High level value of threshold voltage                               | 1.44    | 1.19    | 1.15     |                   | (I > π × I <sub>T(AV)</sub> ), @ T <sub>J</sub> max.                                                                                                                   |                       |                                                 |  |
| r <sub>t1</sub> Low level value on-state slope resistance                               | 12.54   | 4.16    | 3.90     | mΩ                | (16.7% × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), @ T <sub>J</sub> max.                                                                                  |                       |                                                 |  |
| r <sub>t2</sub> High level value on-state slope resistance                              | 11.00   | 3.56    | 3.48     |                   | (I > π × I <sub>T(AV)</sub> ), @ T <sub>J</sub> max.                                                                                                                   |                       |                                                 |  |
| V <sub>TM</sub> Maximum on-state voltage drop                                           | 2.68    | 1.55    | 1.53     | V                 | I <sub>pk</sub> = 150A, T <sub>J</sub> = 25°C<br>t <sub>p</sub> = 400μs single junction                                                                                |                       |                                                 |  |
| di/dt Max. non-repetitive rate of rise of turned on current                             | 150     |         |          | A/μs              | T <sub>J</sub> = 25°C, from 0.67 V <sub>DRM</sub> , I <sub>TM</sub> = π × I <sub>T(AV)</sub><br>I <sub>g</sub> = 500mA, t <sub>r</sub> < 0.5 μs, t <sub>p</sub> > 6 μs |                       |                                                 |  |
| I <sub>H</sub> Max. holding current                                                     | 200     |         |          | mA                | T <sub>J</sub> = 25°C, anode supply = 6V, resistive load, gate open circuit                                                                                            |                       |                                                 |  |
| I <sub>L</sub> Max. latching current                                                    | 400     |         |          |                   | T <sub>J</sub> = 25°C, anode supply = 6V, resistive load                                                                                                               |                       |                                                 |  |

### Blocking

| Parameter                                                   | 54MT.KB | 94MT.KB | 104MT.KB | Units            | Conditions                                                                           |
|-------------------------------------------------------------|---------|---------|----------|------------------|--------------------------------------------------------------------------------------|
| $V_{INS}$ RMS isolation voltage                             | 4000    |         |          | V                | $T_J = 25^\circ\text{C}$ all terminal shorted<br>$f = 50\text{Hz}$ , $t = 1\text{s}$ |
| $dv/dt$ Max. critical rate of rise of off-state voltage (*) | 500     |         |          | V/ $\mu\text{s}$ | $T_J = T_J \text{ max.}$ , linear to $0.67 V_{DRM}$<br>gate open circuit             |

(\*) Available with  $dv/dt = 1000\text{V}/\mu\text{s}$ , to complete code add S90 i.e. 104MT160KBS90.

### Triggering

| Parameter                                                | 54MT.KB | 94MT.KB | 104MT.KB | Units | Conditions                                                            |                                   |
|----------------------------------------------------------|---------|---------|----------|-------|-----------------------------------------------------------------------|-----------------------------------|
| P <sub>GM</sub> Max. peak gate power                     | 10      |         |          | W     | T <sub>J</sub> = T <sub>J</sub> max.                                  |                                   |
| P <sub>G(AV)</sub> Max. average gate power               | 2.5     |         |          |       |                                                                       |                                   |
| I <sub>GM</sub> Max. peak gate current                   | 2.5     |         |          | A     |                                                                       |                                   |
| -V <sub>GT</sub> Max. peak negative gate voltage         | 10      |         |          | V     |                                                                       |                                   |
| V <sub>GT</sub> Max. required DC gate voltage to trigger | 4.0     |         |          | V     | T <sub>J</sub> = - 40°C                                               | Anode supply = 6V, resistive load |
|                                                          | 2.5     |         |          |       | T <sub>J</sub> = 25°C                                                 |                                   |
|                                                          | 1.7     |         |          |       | T <sub>J</sub> = 125°C                                                |                                   |
| I <sub>GT</sub> Max. required DC gate current to trigger | 270     |         |          | mA    | T <sub>J</sub> = - 40°C                                               | Anode supply = 6V, resistive load |
|                                                          | 150     |         |          |       | T <sub>J</sub> = 25°C                                                 |                                   |
|                                                          | 80      |         |          |       | T <sub>J</sub> = 125°C                                                |                                   |
| V <sub>GD</sub> Max. gate voltage that will not trigger  | 0.25    |         |          | V     | @ T <sub>J</sub> = T <sub>J</sub> max., ratedV <sub>DRM</sub> applied |                                   |
| I <sub>GD</sub> Max. gate current that will not trigger  | 6       |         |          | mA    |                                                                       |                                   |

### Thermal and Mechanical Specifications

| Parameter         |                                           | 54MT.KB    | 94MT.KB | 104MT.KB | Units | Conditions                                                                                                                               |
|-------------------|-------------------------------------------|------------|---------|----------|-------|------------------------------------------------------------------------------------------------------------------------------------------|
| T <sub>J</sub>    | Max. junction operating temperature range | -40 to 125 |         |          | °C    |                                                                                                                                          |
| T <sub>stg</sub>  | Max. storage temperature range            | -40 to 125 |         |          | °C    |                                                                                                                                          |
| R <sub>thJC</sub> | Max. thermal resistance, junction to case | 0.52       | 0.39    | 0.34     | K/W   | DC operation per single AC switch                                                                                                        |
|                   |                                           | 1.05       | 0.77    | 0.69     |       | DC operation per junction                                                                                                                |
|                   |                                           | 0.56       | 0.40    | 0.36     |       | 180° Sine cond. angle per single AC switch                                                                                               |
|                   |                                           | 1.12       | 0.80    | 0.72     |       | 180° Sine cond. angle per junction                                                                                                       |
| R <sub>thCS</sub> | Max. thermal resistance, case to heatsink | 0.03       |         |          | K/W   | Per module<br>Mounting surface smooth, flat and greased                                                                                  |
| T                 | Mounting torque ± 10%                     | 4 to 6     |         |          | Nm    | A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound. |
|                   |                                           | 3 to 4     |         |          |       |                                                                                                                                          |
| wt                | Approximate weight                        | 225        |         |          | g     | Lubricated threads.                                                                                                                      |

54-94-104MT.KB Series

Bulletin I27504 08/97

ΔR Conduction (per Junction)

(The following table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC)

| Devices  | Sinusoidal conduction @ $T_j$ max. |       |       |       |       | Rectangular conduction @ $T_j$ max. |       |       |       |       | Units |
|----------|------------------------------------|-------|-------|-------|-------|-------------------------------------|-------|-------|-------|-------|-------|
|          | 180°                               | 120°  | 90°   | 60°   | 30°   | 180°                                | 120°  | 90°   | 60°   | 30°   |       |
| 54MT.KB  | 0.072                              | 0.085 | 0.108 | 0.152 | 0.233 | 0.055                               | 0.091 | 0.117 | 0.157 | 0.236 | K/W   |
| 94MT.KB  | 0.033                              | 0.039 | 0.051 | 0.069 | 0.099 | 0.027                               | 0.044 | 0.055 | 0.071 | 0.100 |       |
| 104MT.KB | 0.027                              | 0.033 | 0.042 | 0.057 | 0.081 | 0.023                               | 0.037 | 0.046 | 0.059 | 0.082 |       |

Ordering Information Table

Device Code

|    |   |    |     |   |   |     |
|----|---|----|-----|---|---|-----|
| 10 | 4 | MT | 160 | K | B | S90 |
| ①  | ② | ③  | ④   |   | ⑤ | ⑥   |

**1** - Current rating code: 5 = 50 A (Avg)  
9 = 90 A (Avg)  
10 = 100 A (Avg)

**2** - AC Switch

**3** - Essential part number

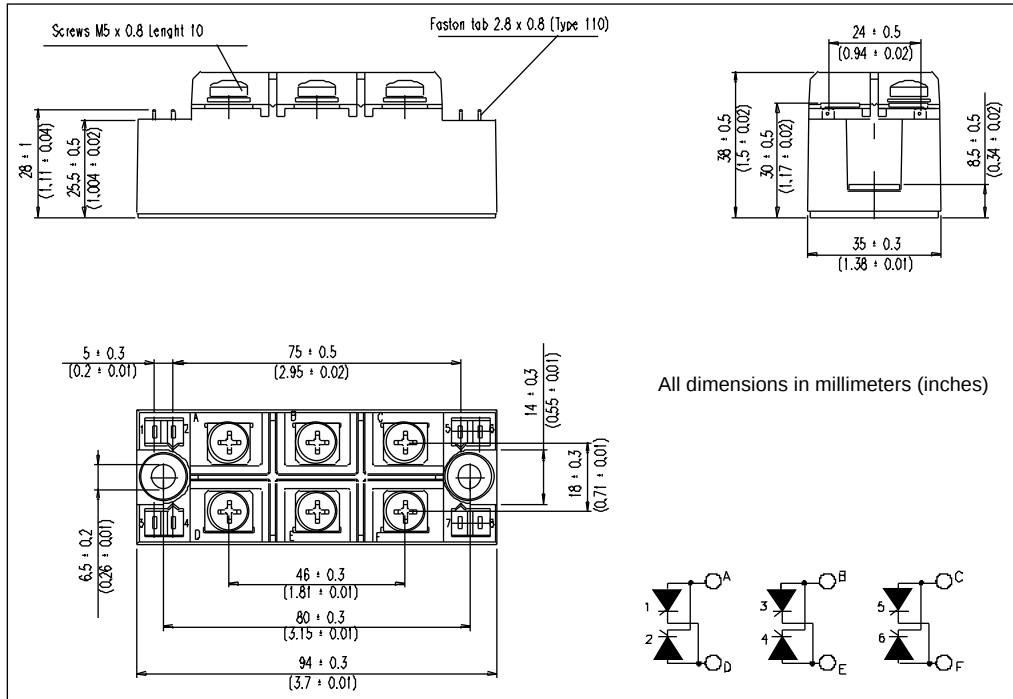
**4** - Voltage code: Code x 10 =  $V_{RRM}$  (See Voltage Ratings Table)

**5** - Generation II

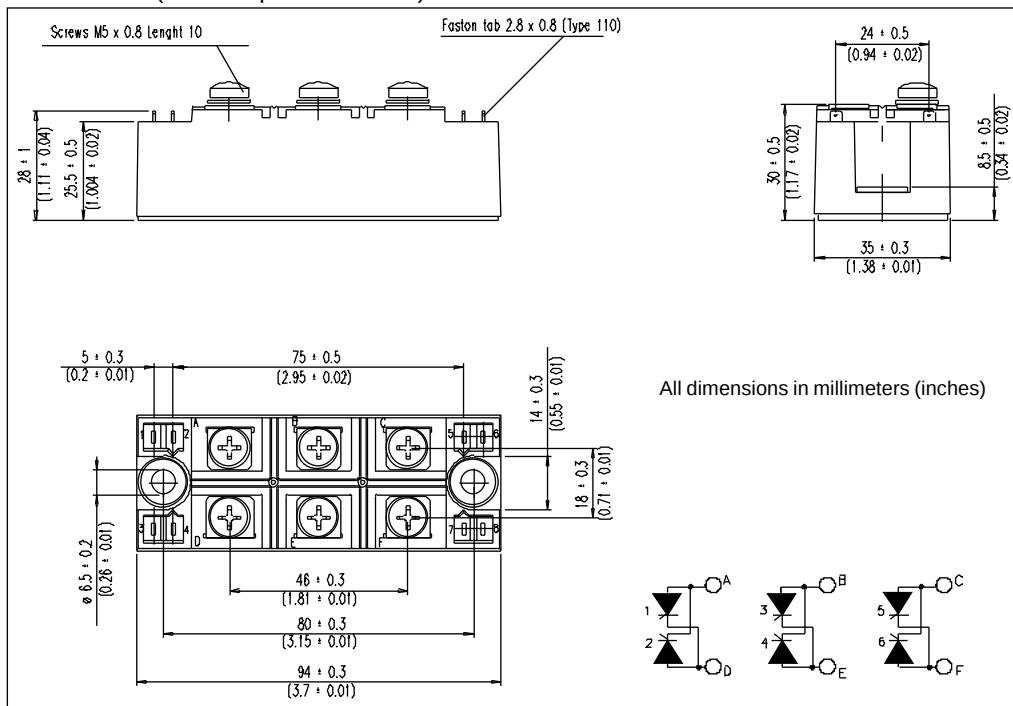
**6** - Critical dv/dt: None = 500V/μs (Standard value)  
S90 = 1000V/μs (Special selection)

**NOTE:** To order the Optional Hardware see Bulletin I27900

Outline Table (with optional barriers)



Outline Table (without optional barriers)



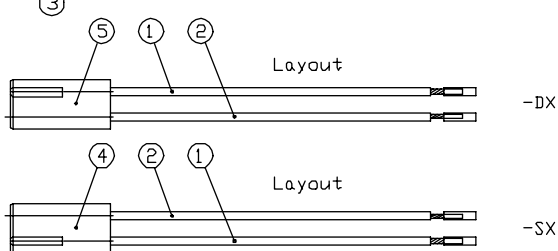
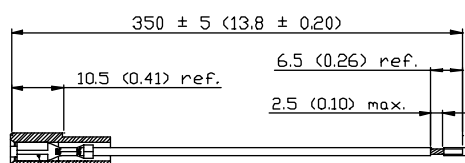
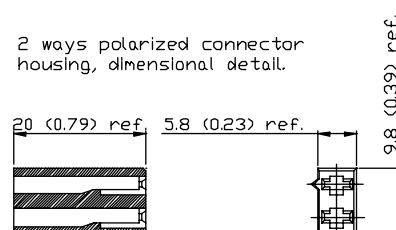
### GATE LEADS

| Ident No.    | Device Series                          | Description                                        |
|--------------|----------------------------------------|----------------------------------------------------|
| 6443.2112.AA | 51, 91, 111MT..KB                      | 2 DX connectors with yellow and white leads        |
| 6443.2113.AA | 52, 92, 112MT..KB                      | 1 SX + 1 DX connectors with yellow and white leads |
| 6443.2114.AA | 53, 93, 113MT..KB<br>54, 94, 104MT..KB | 1 SX + 2 DX connectors with yellow and white leads |

#### Components

- 1) Tinned copper stranded cable, UL 758, Style 1558, AWG 22 (0.32 sqmm) lay 19 x 0.16, ETFE insulation yellow colour, ext. dia. 1.25 mm, temp. rating 125°C.
- 2) Same as point 1, but with white colour insulation. Concerning the configurations in which white cable is requested, it must be connected where is not placed the polarization key.
- 3) Receptacle faston terminal with locking lance, for 2.8 x 0.8 tab (series 110) ref. PN. AMP 150571-2 or equivalent.
- 4) 2 ways polarized connector housing, as shown on dimensional detail (the represented version refers to left 'SX' conn. housing). Raw material: PBT Ciba Crastine SK645FR, black colour.
- 5) Connector housing as point 4), right 'DX' version.

2 ways polarized connector housing, dimensional detail.



All dimensions are in millimeters (inches)

### BARRIERS

**Ident No. 6444.0211.AA** for all MT..KB Series

**Barriers Mounting Instructions**  
Coat uniformly the groove on the plastic box with a silicon adhesive. Insert the barriers into the groove on the plastic box. Cure the silicon adhesive according to its technical notes. We suggest the use of DOW CORNING Silastic 744RTV (time curing 30 min. at room temperature).

All dimensions are in millimeters (inches)

## 54-94-104MT..KB Series

Bulletin I27504 08/97

International  
**IRF** Rectifier

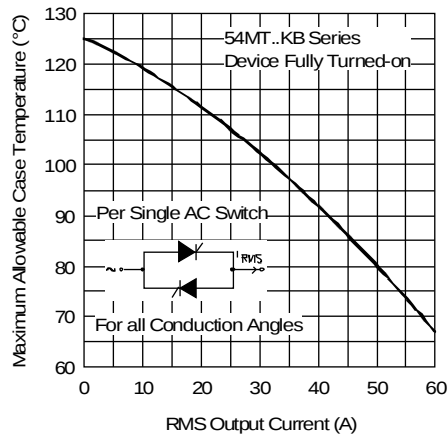


Fig. 1 - Current Ratings Characteristic

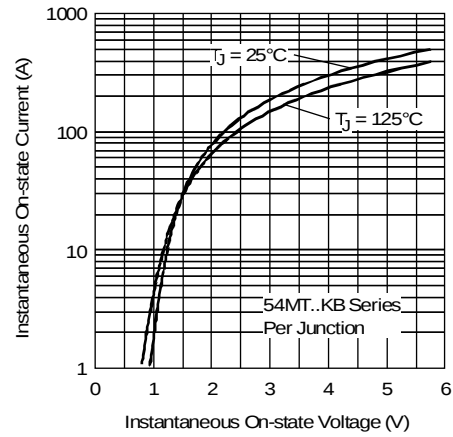


Fig. 2 - Forward Voltage Drop Characteristics

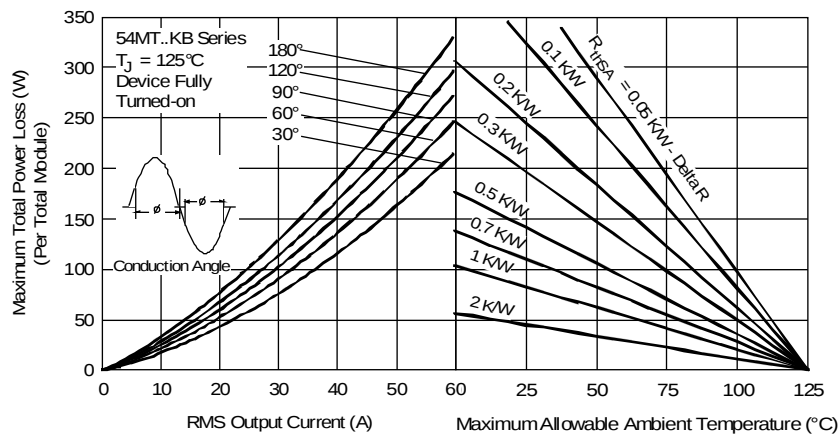


Fig. 3 - Total Power Loss Characteristics

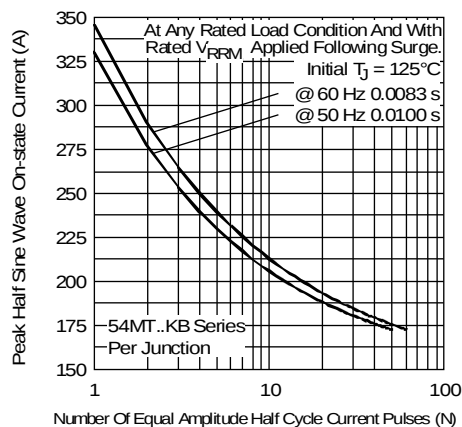


Fig. 4 - Maximum Non-Repetitive Surge Current

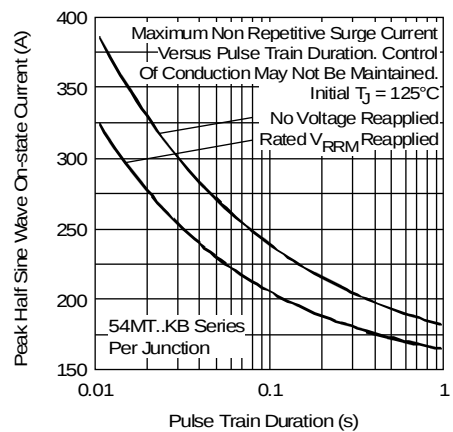


Fig. 5 - Maximum Non-Repetitive Surge Current

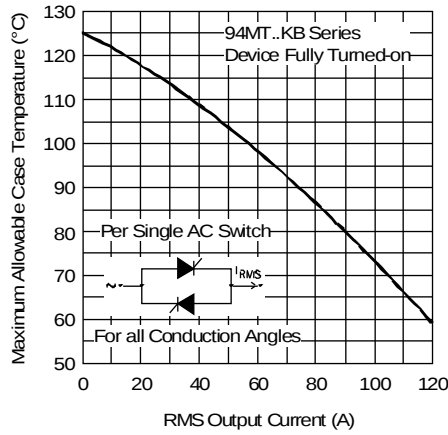


Fig. 6 - Current Ratings Characteristic

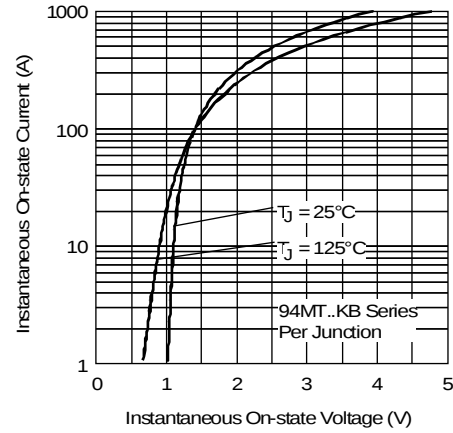


Fig. 7 - Forward Voltage Drop Characteristics

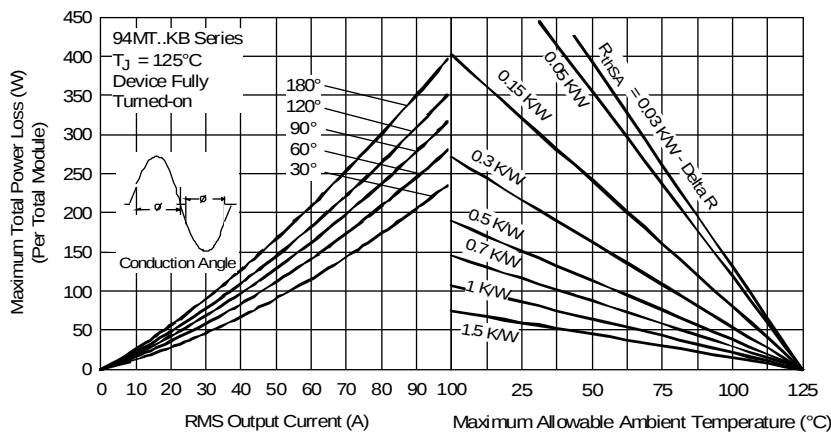


Fig. 8 - Total Power Loss Characteristics

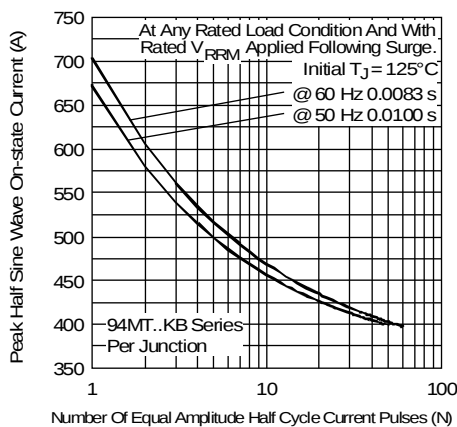


Fig. 9 - Maximum Non-Repetitive Surge Current

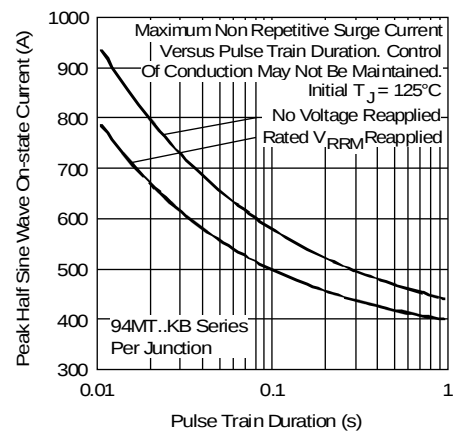


Fig. 10 - Maximum Non-Repetitive Surge Current

## 54-94-104MT..KB Series

Bulletin I27504 08/97

International  
**IRF** Rectifier

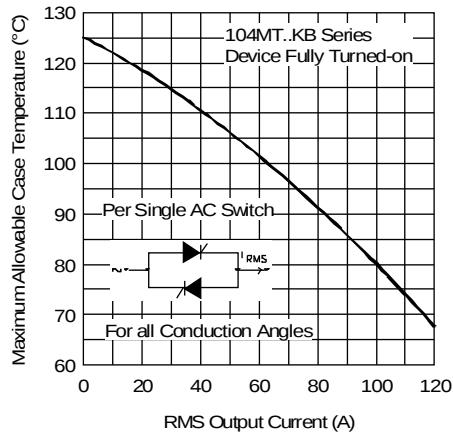


Fig. 11 - Current Ratings Characteristic

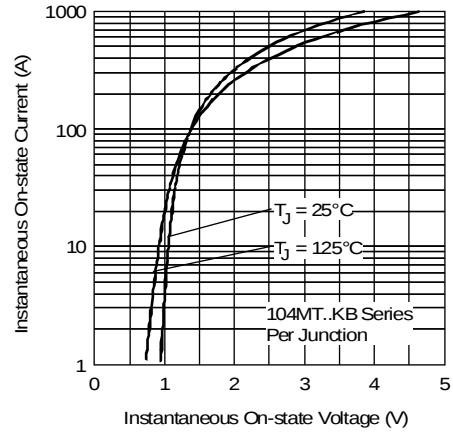


Fig. 12 - Forward Voltage Drop Characteristics

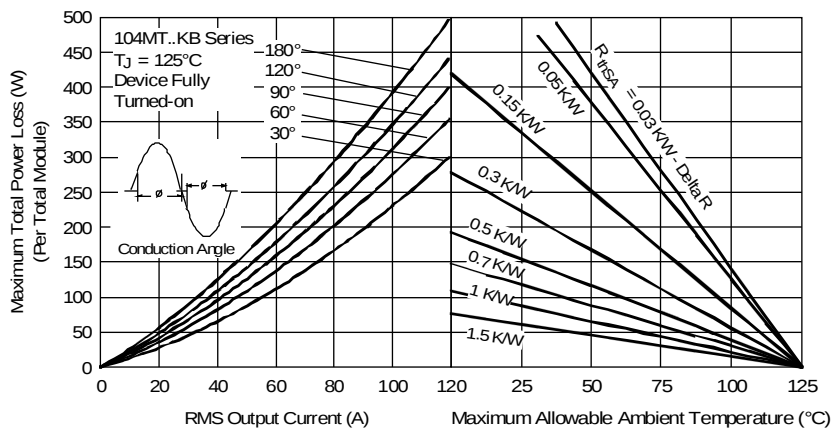


Fig. 13 - Total Power Loss Characteristics

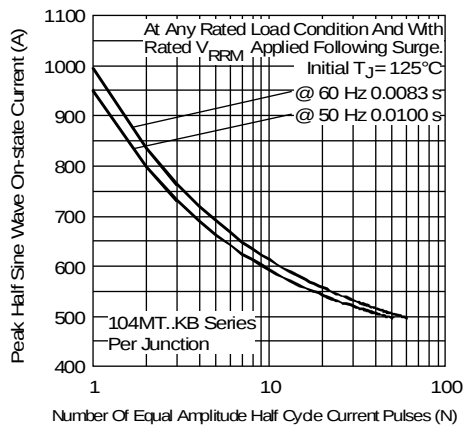


Fig. 14 - Maximum Non-Repetitive Surge Current

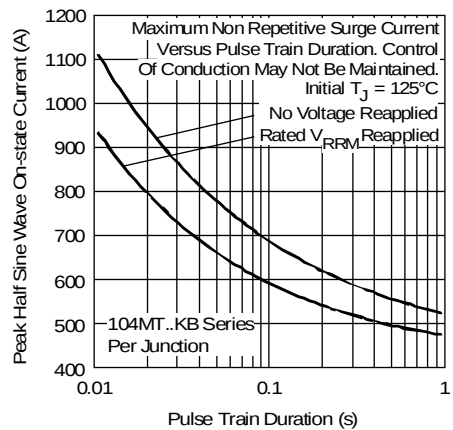


Fig. 15 - Maximum Non-Repetitive Surge Current

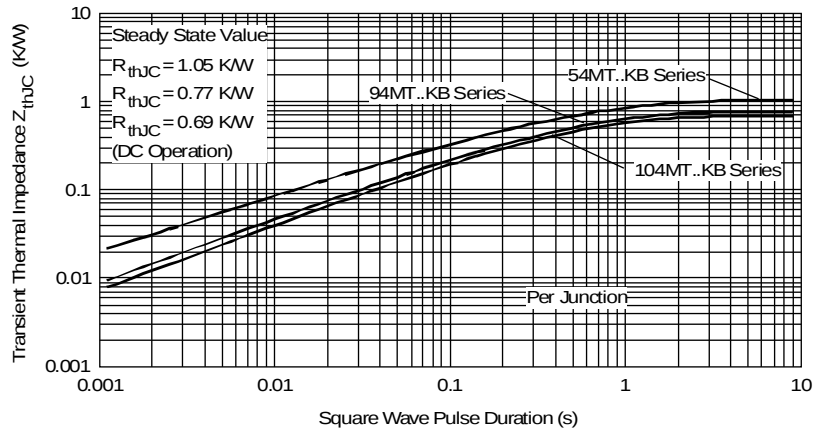


Fig. 16 - Thermal Impedance  $Z_{thJC}$  Characteristics

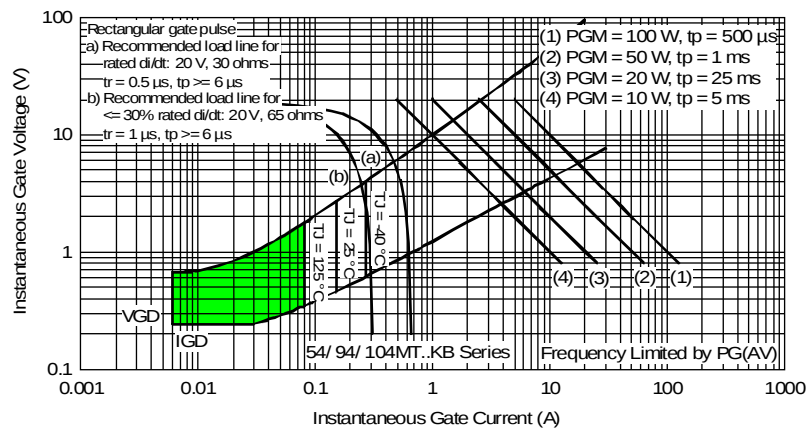


Fig. 17 - Gate Characteristics