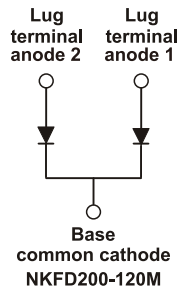


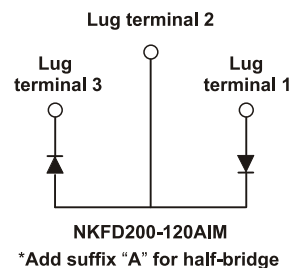
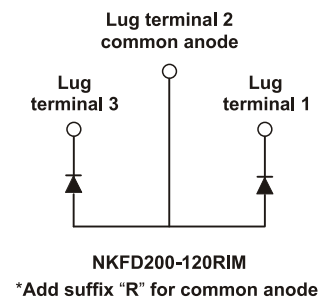
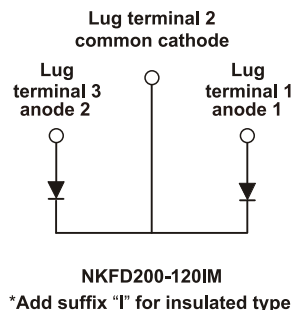
## FRED Ultrafast Soft Recovery Diode Module 100A x 2 / 1200V



TO-244M (non-insulated)



TO-244M (insulated)



### FEATURES

- Very low  $Q_{rr}$  and  $t_{rr}$
- Lead (Pb)-free
- Designed and qualified for industrial level
- Reduced RFI and EMI
- Reduced snubbing
- Planar FRED Chip
- Epoxy molding structure (TO-244M)

### DESCRIPTION

FRED diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems .  
An extensive characterization of the recovery behavior for different values of current, temperature and  $di/dt$  simplifies the calculations of losses in the operating conditions. The softness of the recovery eliminates the need for a snubber in most applications.

### TYPICAL APPLICATIONS

- Power converters
- Motor drives
- Welders
- Switching power supplies
- Battery chargers
- DC choppers
- Inverters

### PRODUCT SUMMARY

|                                |                |
|--------------------------------|----------------|
| $I_{F(AV)}$                    | 200A           |
| $V_R$                          | 1200V          |
| $I_{F(AV)}$ at $T_C$ per diode | 100A at 110 °C |

### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                        | SYMBOL         | TEST CONDITIONS                                       | MAX.        | UNIT             |
|--------------------------------------------------|----------------|-------------------------------------------------------|-------------|------------------|
| Cathode to anode voltage                         | $V_R$          |                                                       | 1200        | V                |
| Average forward current                          | $I_{F(AV)}$    | $T_C = 110^\circ\text{C}$<br>per module<br>per leg    | 200<br>100  | A                |
| Single pulse forward current                     | $I_{FSM}$      | Limited by junction temperature,<br>per leg           | 1000        |                  |
| Maximum power dissipation                        | $P_D$          | $T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$ | 440<br>260  | W                |
| Operating junction and storage temperature range | $T_J, T_{Stg}$ |                                                       | - 55 to 175 | $^\circ\text{C}$ |

### ELECTRICAL SPECIFICATIONS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

| PARAMETER                                           | SYMBOL    | TEST CONDITIONS                                                                                  | MIN.        | TYP.                 | MAX.                   | UNIT                |
|-----------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------|-------------|----------------------|------------------------|---------------------|
| Cathode to anode breakdown voltage                  | $V_{BR}$  | $I_R = 100 \mu\text{A}$                                                                          | 1200        | -                    | -                      |                     |
| Maximum forward voltage                             | $V_{FM}$  | $I_F = 100 \text{ A}$<br>$I_F = 200 \text{ A}$<br>$I_F = 100 \text{ A}, T_J = 125^\circ\text{C}$ | -<br>-<br>- | 2.00<br>2.30<br>1.80 | 2.20<br>-<br>-         | V                   |
| Maximum reverse leakage current per leg             | $I_{RM}$  | $T_J = 125^\circ\text{C}, V_R = 1200\text{V}$<br>$T_J = 25^\circ\text{C}, V_R = 1200\text{V}$    | -<br>-      | -<br>0.5             | 1.0<br>10              | mA<br>$\mu\text{A}$ |
| Junction capacitance                                | $C_T$     | $V_R = 200\text{V}$                                                                              | -           | 120                  | -                      | pF                  |
| Series inductance                                   | $L_S$     | From top of terminal hole to mounting plane                                                      | -           | 6.0                  | -                      | nH                  |
| Maximum RMS insulation voltage (for insulated type) | $V_{INS}$ | 50Hz                                                                                             | -           | -                    | 2500(1min)<br>3000(1s) | V                   |

### DYNAMIC RECOVERY CHARACTERISTICS PER LEG ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

| PARAMETER                     | SYMBOL           | TEST CONDITIONS                                                                                                                                                                                    | MIN.             | TYP.                  | MAX.                   | UNIT             |
|-------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------|------------------------|------------------|
| Reverse recovery time         | $t_{rr}$         | $I_F = 0.5\text{A}, I_R = 1.0\text{A}, I_{RR} = 0.25\text{A}$<br>$I_F = 1.0\text{A}, dI_F/dt = 200\text{A}/\mu\text{s}, V_R = 30\text{V}$<br>$T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$ | -<br>-<br>-<br>- | 110<br>70<br>150<br>- | 140<br>-<br>200<br>320 | ns               |
| Peak recovery current         | $I_{RRM}$        | $T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$                                                                                                                                              | -<br>-           | 20<br>-               | 22<br>40               | A                |
| Reverse recovery charge       | $Q_{rr}$         | $T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$                                                                                                                                              | -<br>-           | 2000<br>-             | 2400<br>6200           | nC               |
| Peak rate of recovery current | $dI_{(rec)M}/dt$ | $T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$                                                                                                                                              | -<br>-           | -<br>-                | 300<br>210             | A/ $\mu\text{s}$ |

| THERMAL AND MECHANICAL SPECIFICATIONS           |                         |                |          |           |          |                 |
|-------------------------------------------------|-------------------------|----------------|----------|-----------|----------|-----------------|
| PARAMETER                                       |                         | SYMBOL         | MIN.     | TYP.      | MAX.     | UNIT            |
| Maximum junction and storage temperature range  |                         | $T_J, T_{stg}$ | -55      | -         | 175      | °C              |
| Thermal resistance, junction to case per leg    | TO-244M (non-insulated) | $R_{thJC}$     | -        | -         | 0.12     | °C/W            |
|                                                 | TO-244M (insulated)     |                | -        | -         | 0.20     |                 |
| Thermal resistance, junction to case per module | TO-244M (non-insulated) | $R_{thJC}$     | -        | -         | 0.060    |                 |
|                                                 | TO-244M (insulated)     |                | -        | -         | 0.10     |                 |
| Typical thermal resistance, case to heatsink    |                         | $R_{thCS}$     | -        | 0.10      | -        |                 |
| Weight                                          | TO-244M (non-insulated) |                | -        | 80 (2.82) | -        | g (oz.)         |
|                                                 | TO-244M (insulated)     |                | -        | 95 (3.36) | -        |                 |
| Mounting torque <sup>(1)</sup>                  |                         |                | 30 (3.4) | -         | 40 (4.6) | lbf·in<br>(N·m) |
| Mounting torque center hole                     |                         |                | 12 (1.4) | -         | 18 (2.1) |                 |
| Terminal torque                                 |                         |                | 30 (3.4) | -         | 40 (4.6) |                 |
| Vertical pull                                   |                         |                | -        | -         | 80       | lbf·in          |
| 2" lever pull                                   |                         |                | -        | -         | 35       |                 |

Note

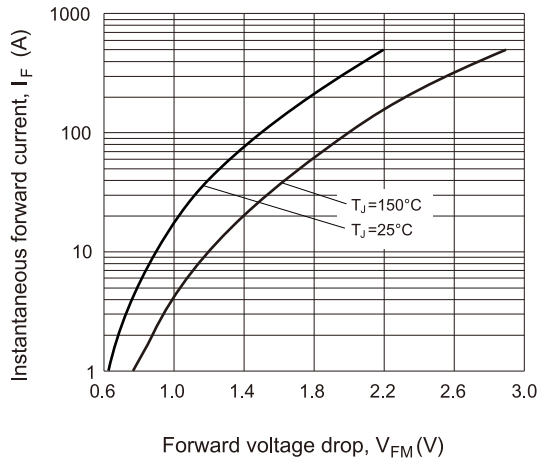
(1) Mounting surface must be smooth, flat, free of burrs or other protrusions. Apply a thin even film of thermal grease to mounting surface. Gradually tighten each mounting bolt in 5 to 10 lbf. in steps until desired or maximum torque limits are reached

## Ordering Information Table

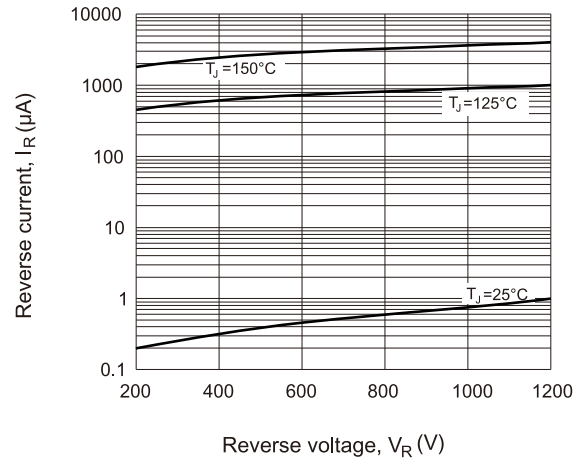
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |          |            |          |            |          |          |          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|------------|----------|------------|----------|----------|----------|
| Device code | <b>NK</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>F</b> | <b>D</b> | <b>200</b> | <b>—</b> | <b>120</b> | <b>R</b> | <b>I</b> | <b>M</b> |
|             | ①                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ②        | ③        | ④          |          | ⑤          | ⑥        | ⑦        | ⑧        |
|             | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2        | 3        | 4          |          | 5          | 6        | 7        | 8        |
|             | <ul style="list-style-type: none"> <li>1 - Nell's power module</li> <li>2 - F for Ultrafast soft recovery diode</li> <li>3 - D for Dual Diodes, TO-244 Package</li> <li>4 - Maximum average forward current, 200 = 100A x 2</li> <li>5 - Voltage rating (120 = 1200V)</li> <li>6 - None for common cathode configuration<br/>"R" for common anode configuration,<br/>"A" for half bridge configuration</li> <li>7 - None for non-insulated type<br/>"I" for insulated type</li> <li>8 - M for Molding structure</li> </ul> |          |          |            |          |            |          |          |          |

## Nell High Power Products

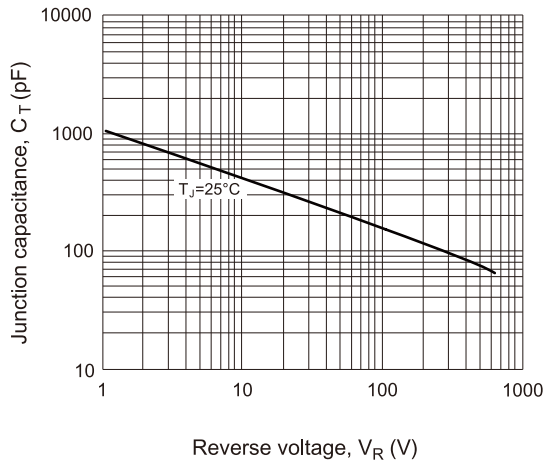
**Fig.1 Typical forward voltage drop vs. Instantaneous forward current (per leg)**



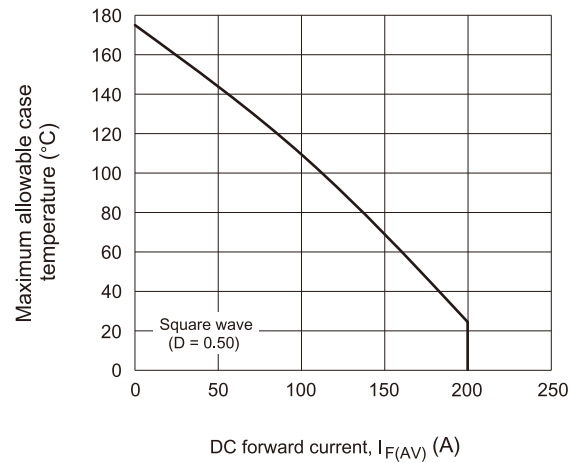
**Fig.2 Typical reverse current vs. reverse voltage (per leg)**



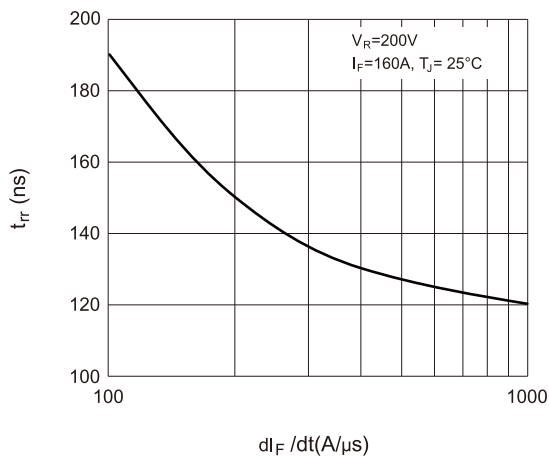
**Fig.3 Typical junction capacitance vs. reverse voltage (per leg)**



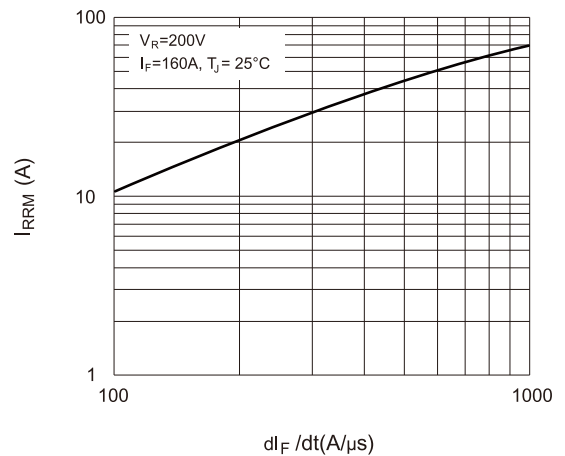
**Fig.4 Maximum allowable case temperature vs. average forward current (per leg)**



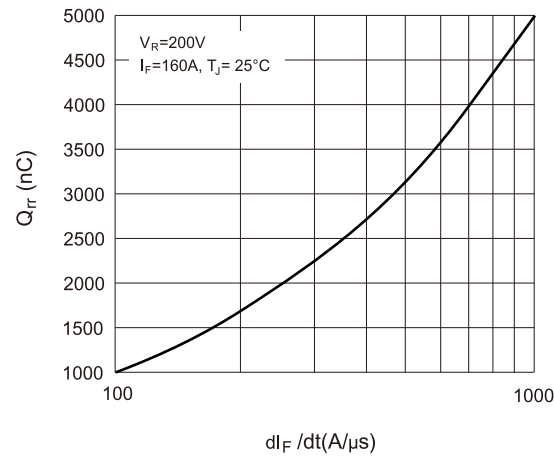
**Fig.5 Typical reverse recovery time vs.  $di_F/dt$  (per leg)**



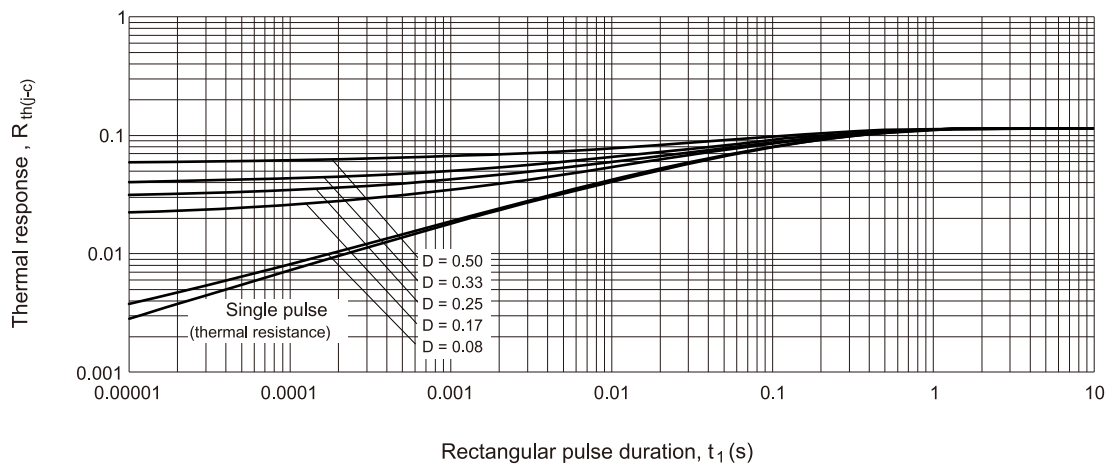
**Fig.6 Typical recovery current vs.  $di_F/dt$  (per leg)**



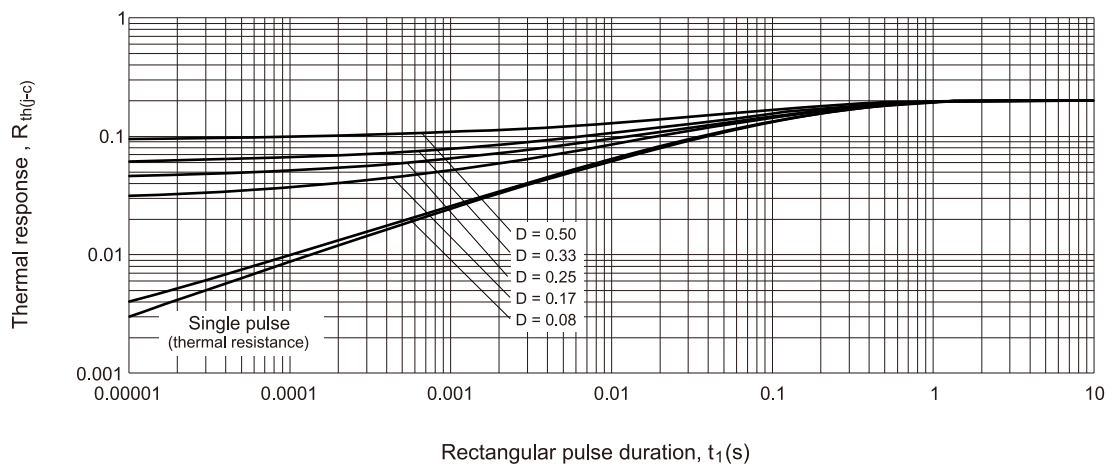
**Fig.7 Typical stored charge vs.  $dI_F/dt$  (per leg)**



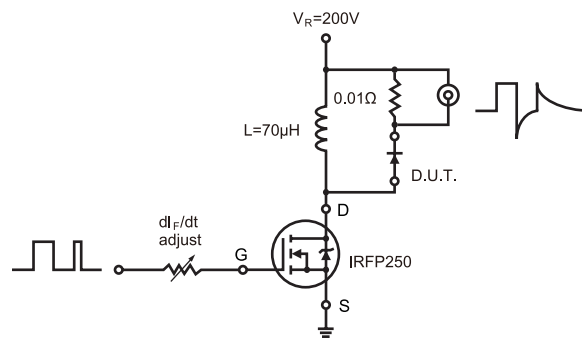
**Fig.8-1 Maximum thermal impedance  $R_{th(j-c)}$  characteristics (per leg, for TO-244M non-insulated)**



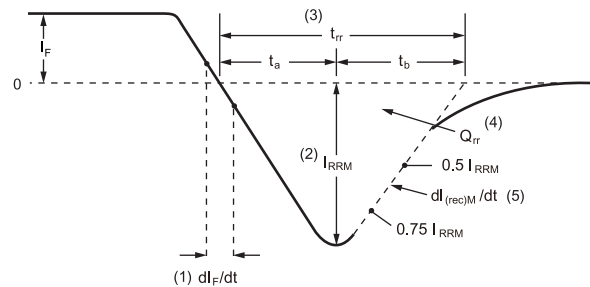
**Fig.8-2 Maximum thermal impedance  $R_{th(j-c)}$  characteristics (per leg, for TO-244M insulated)**



**Fig.9 Reverse recovery parameter test circuit**



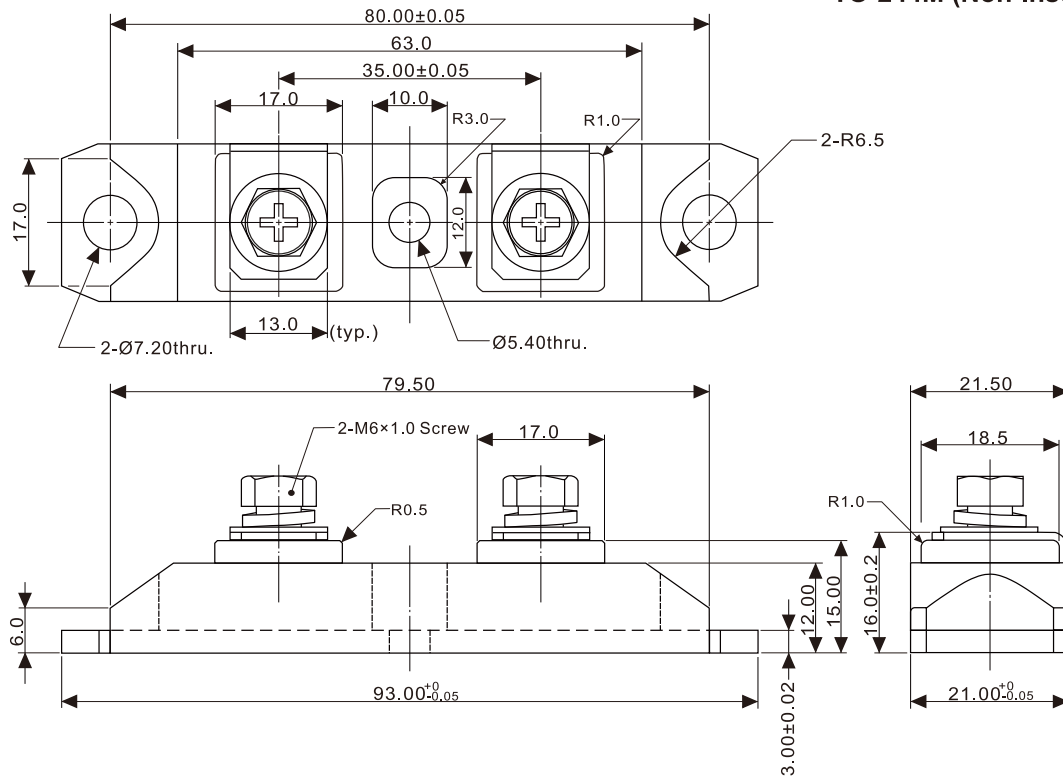
**Fig.10 Reverse recovery waveform and definitions**



- (1)  $dl_F/dt$  - rate of change of current through zero crossing
- (2)  $I_{RRM}$  - peak reverse recovery current
- (3)  $t_{rr}$  - reverse recovery time measured from zero crossing point of negative going  $I_F$  to point where a line passing through  $0.75 I_{RRM}$  and  $0.50 I_{RRM}$  extrapolated to zero current.
- (4)  $Q_{rr}$  - area under curve defined by  $t_{rr}$  and  $I_{RRM}$
- (5)  $dl_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

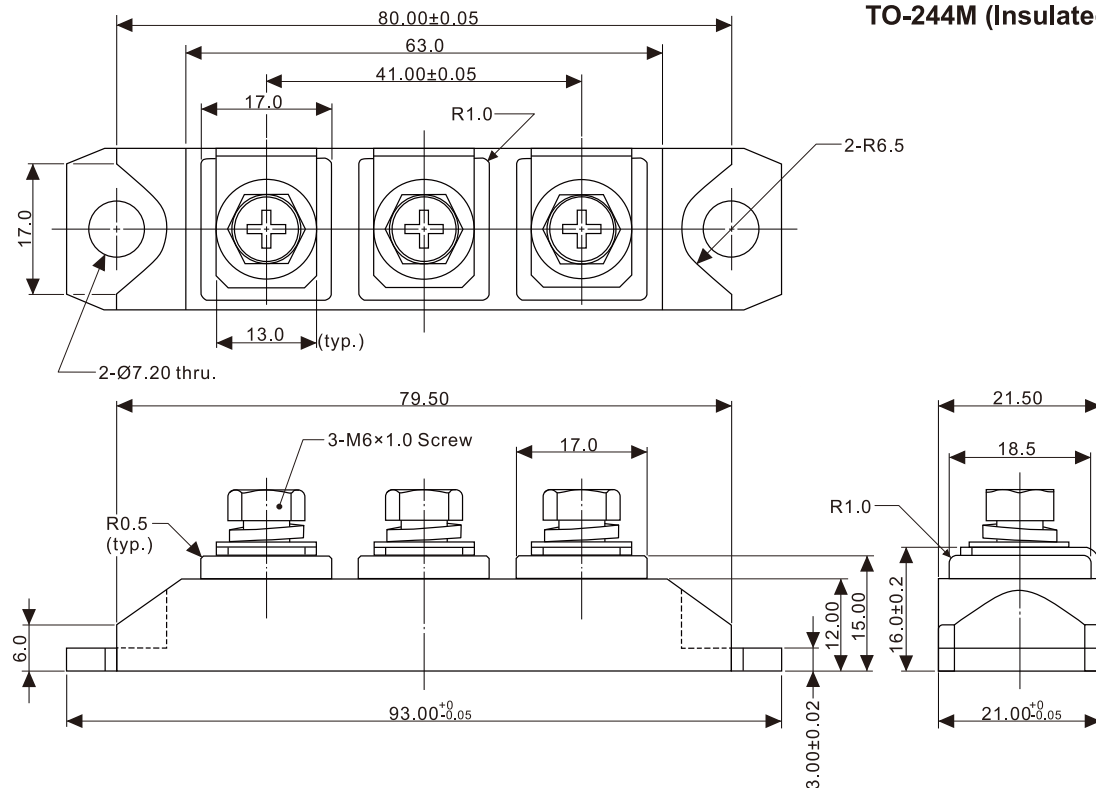
$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

**TO-244M (Non-Insulated)**



All dimensions in millimeters

**TO-244M (Insulated)**



All dimensions in millimeters