

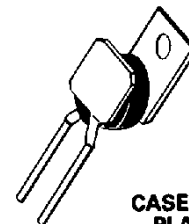
**MR2400F**  
**thru**  
**MR2406F**

 MR2402F and MR2406F are  
 Motorola Preferred Devices

**TAB-MOUNTED FAST RECOVERY**  
**POWER RECTIFIERS**

designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference, sonar power supplies and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

- Same Mounting as a TO-220AB
- Cost Effective in Low Current Applications
- Lead or Chassis Mounted
- High Surge Current Capability

**FAST RECOVERY**  
**POWER RECTIFIERS**
**50-600 VOLTS**  
**24 AMPERES**

**CASE 339-02**  
**PLASTIC**
**MAXIMUM RATINGS**

Rating	Symbol	MR2400F	MR2401F	MR2402F	MR2404F	MR2406F	Unit
Peak Repetitive Reverse Voltage	$V_{RRM}$						Volts
Working Peak Reverse Voltage	$V_{RWM}$	50	100	200	400	600	Volts
DC Blocking Voltage	$V_R$						Volts
Nonrepetitive Peak Reverse Voltage	$V_{RSM}$	75	150	250	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	Volts
Average Rectified Forward Current (Single phase, resistive load, $T_C = 125^\circ\text{C}$ )	$I_O$	←————— 24 —————→					Amp
Nonrepetitive Peak Surge Current (surge applied @ rated load conditions)	$I_{FSM}$	←————— 300 (for 1 cycle) —————→					Amp
Operating Junction Temperature Range	$T_J$	←————— -65 to +150 —————→					$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	←————— -65 to +175 —————→					$^\circ\text{C}$

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Air, PC Board Mount, Perpendicular to Surface	$R_{\theta JA}$	55	$^\circ\text{C}/\text{W}$

**ELECTRICAL CHARACTERISTICS**

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage ( $I_F = 75$ Amp, $T_J = 150^\circ\text{C}$ )	$V_F$	—	1.15	1.29	Volts
Forward Voltage ( $I_F = 24$ Amp, $T_C = 25^\circ\text{C}$ )	$V_F$	—	1.00	1.15	Volts
Reverse Current (rated dc voltage) $T_C = 25^\circ\text{C}$	$I_R$	—	10	25	$\mu\text{A}$
$T_C = 100^\circ\text{C}$		—	0.5	1.0	mA
$T_C = 150^\circ\text{C}$		—	7.0	10	mA

**REVERSE RECOVERY CHARACTERISTICS**

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recover Time — Soft Recovery ( $ I_F  = 1.0$ Amp to $V_R = 30$ Vdc, Figure 19) ( $I_{FM} = 36$ Amp, $di/dt = 25$ A/ $\mu\text{s}$ , Figure 20)	$t_{rr}$	—	150 200	200 300	ns
Reverse Recovery Current ( $I_F = 1.0$ Amp to $V_R = 30$ Vdc, Figure 19)	$I_{RM(REC)}$	—	—	4.0	Amp

FIGURE 1 — MAXIMUM FORWARD VOLTAGE

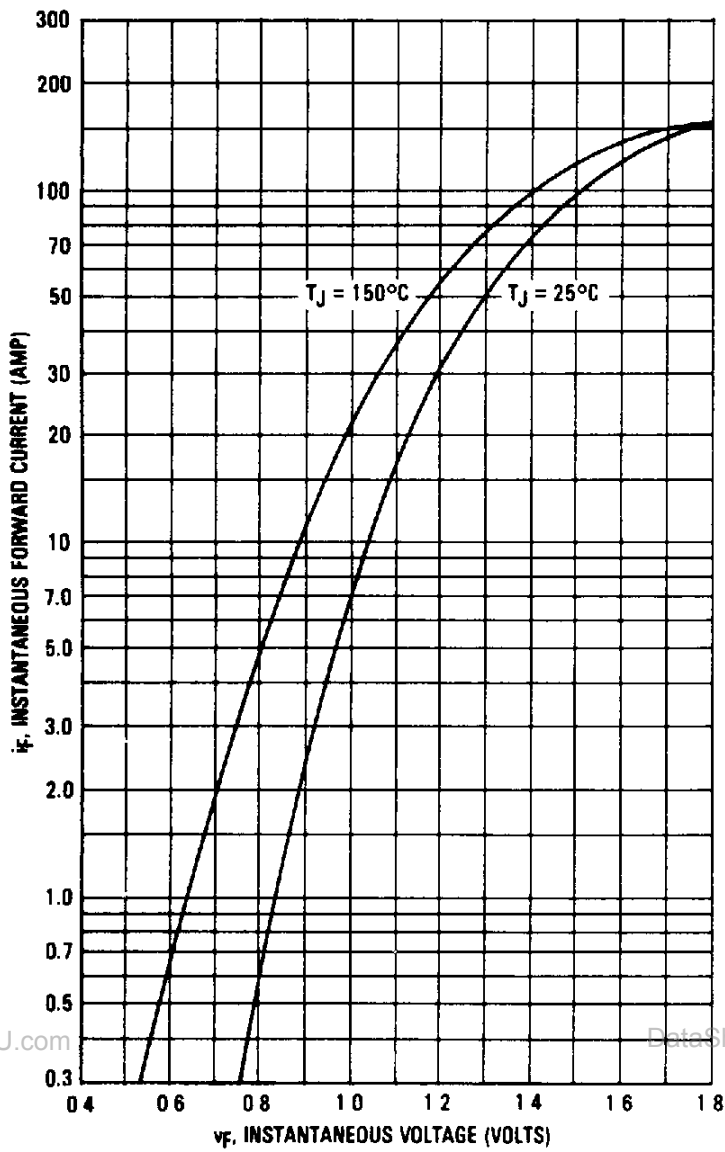
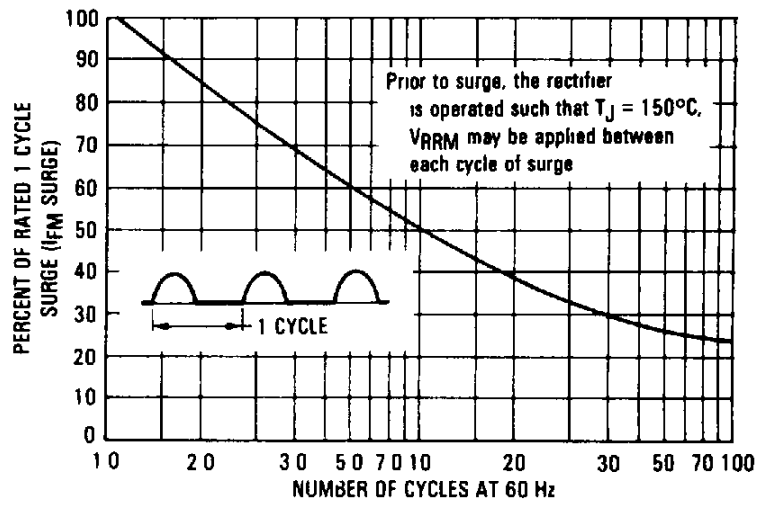
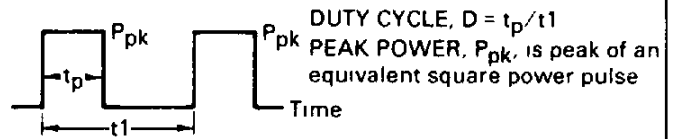


FIGURE 2 — MAXIMUM SURGE CAPABILITY



NOTE 1



To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of  $T_C$ , the junction temperature may be determined by,

$$T_J = T_C + \Delta T_{JC}$$

where  $\Delta T_{JC}$  is the increase in junction temperature above the case temperature. It may be determined by

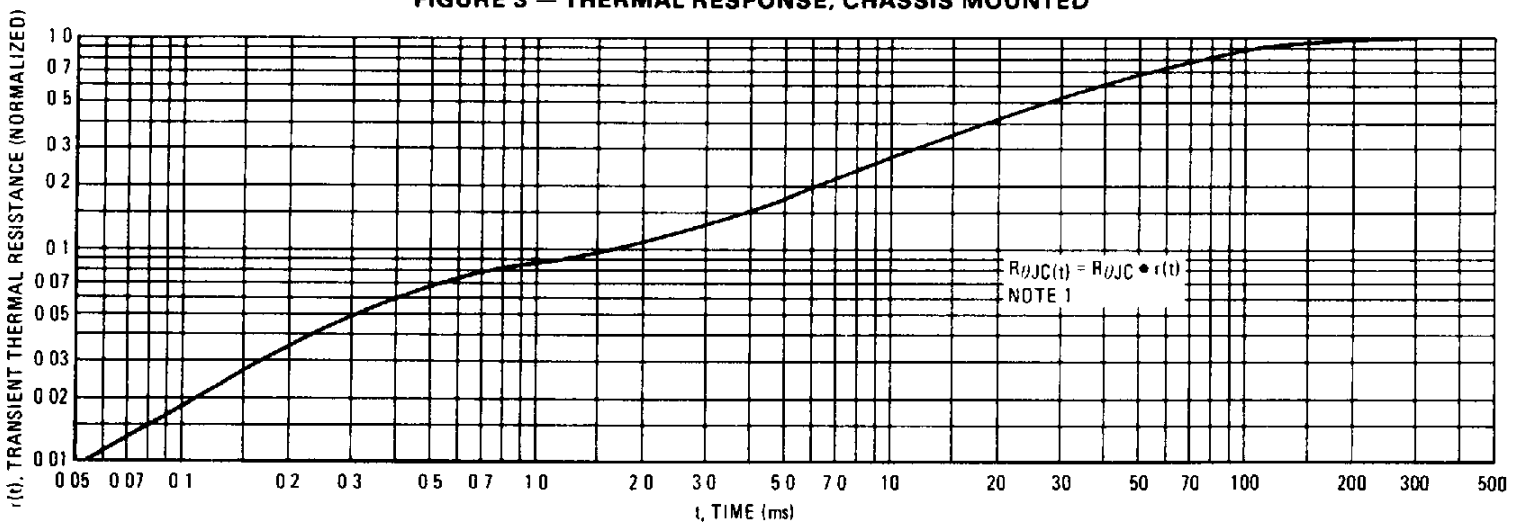
$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$  = normalized value of transient thermal resistance at time,  $t$ , from Figure 3, i.e.

$r(t_1 + t_p)$  = normalized value of transient thermal resistance at time  $t_1 + t_p$

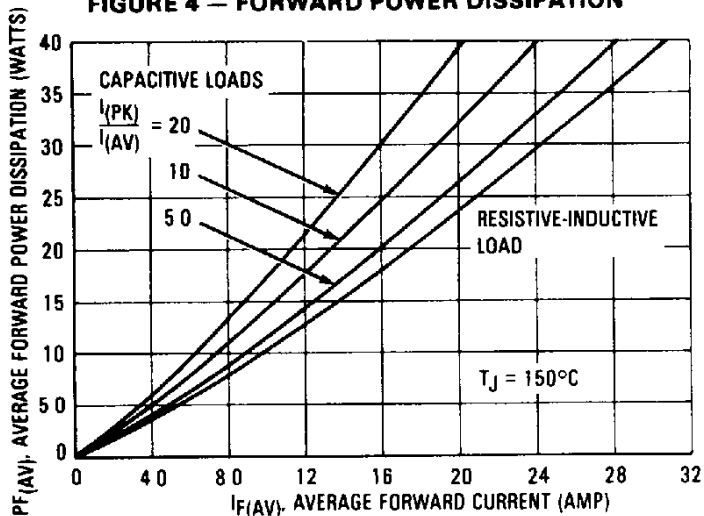
FIGURE 3 — THERMAL RESPONSE, CHASSIS MOUNTED



### CHASSIS MOUNT RATING DATA

#### Sine Wave Input

FIGURE 4 — FORWARD POWER DISSIPATION



#### Square Wave Input

FIGURE 5 — FORWARD POWER DISSIPATION

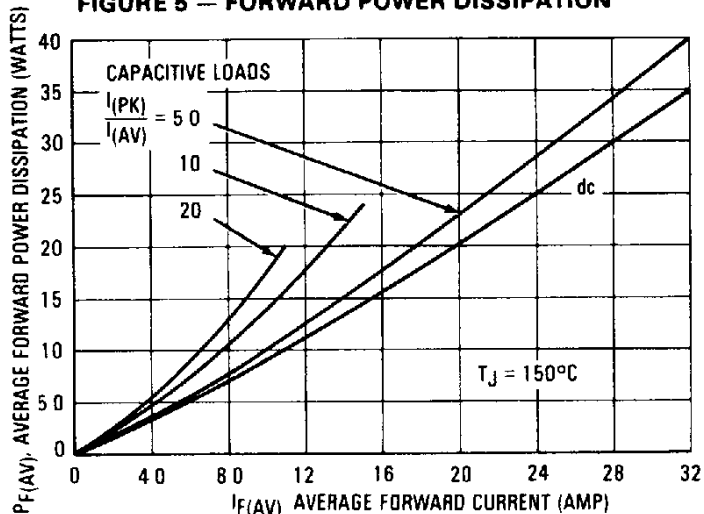


FIGURE 6 — CURRENT DERATING

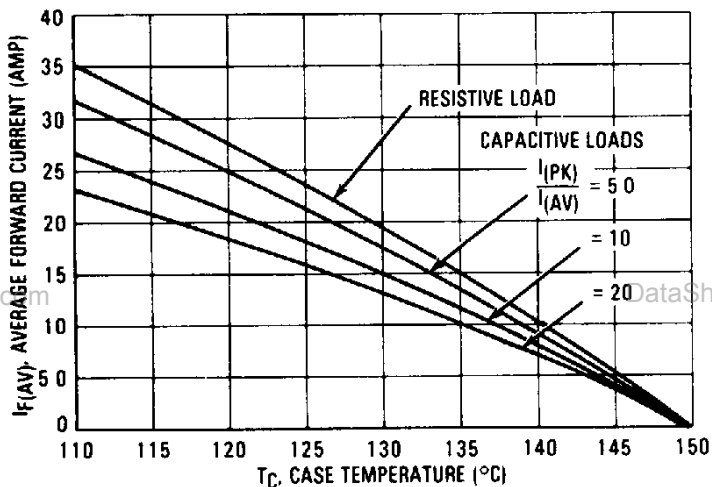
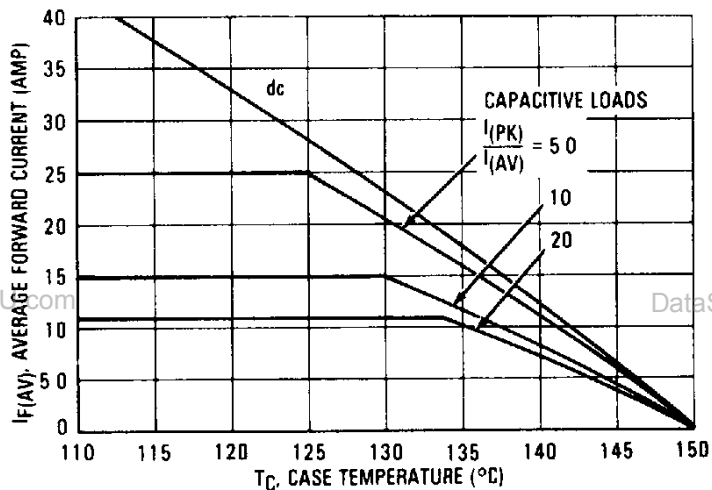


FIGURE 7 — CURRENT DERATING



### PRINTED CIRCUIT BOARD RATING DATA

FIGURE 8 — FORWARD POWER DISSIPATION

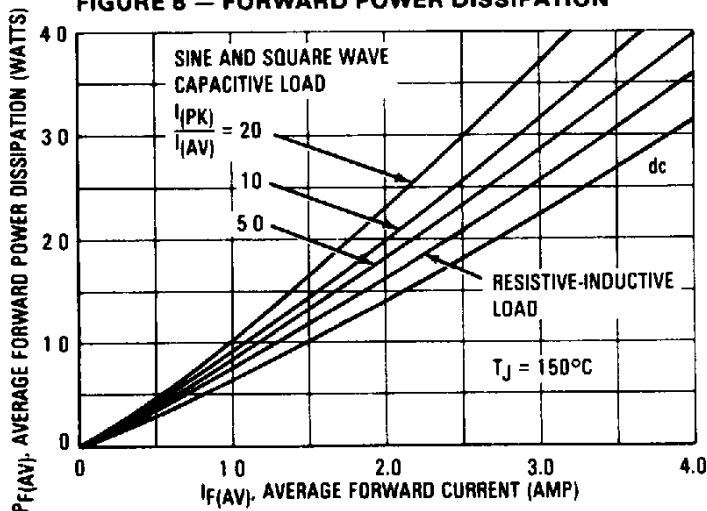


FIGURE 9 — CURRENT DERATING



## TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 10 — FORWARD RECOVERY TIME

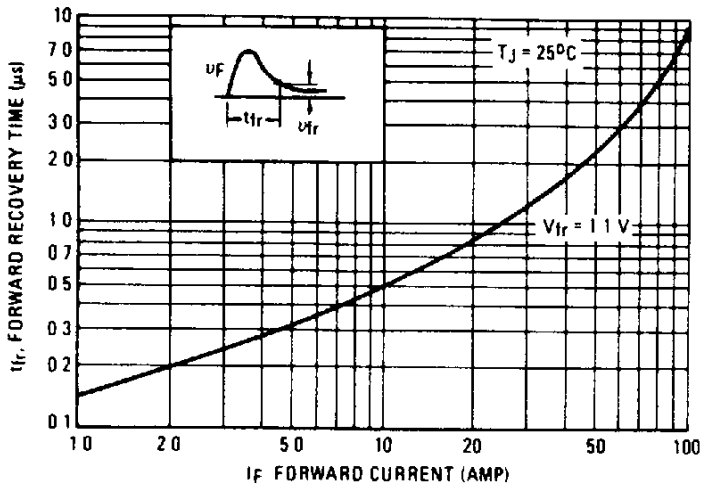


FIGURE 11 — JUNCTION CAPACITANCE

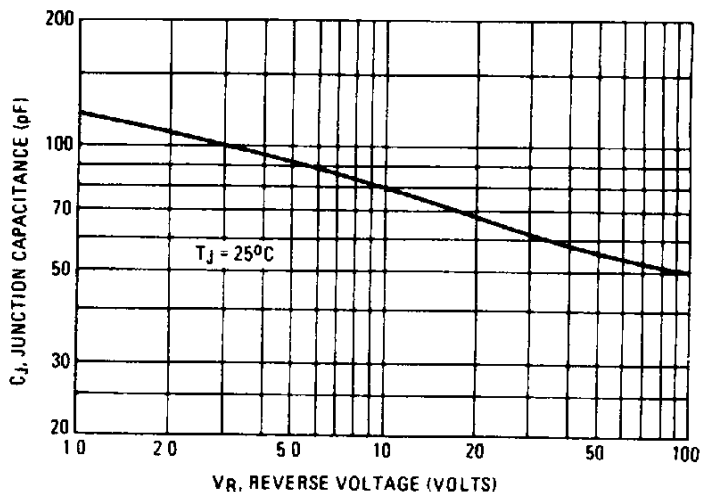


FIGURE 12 — TYPICAL REVERSE CURRENT

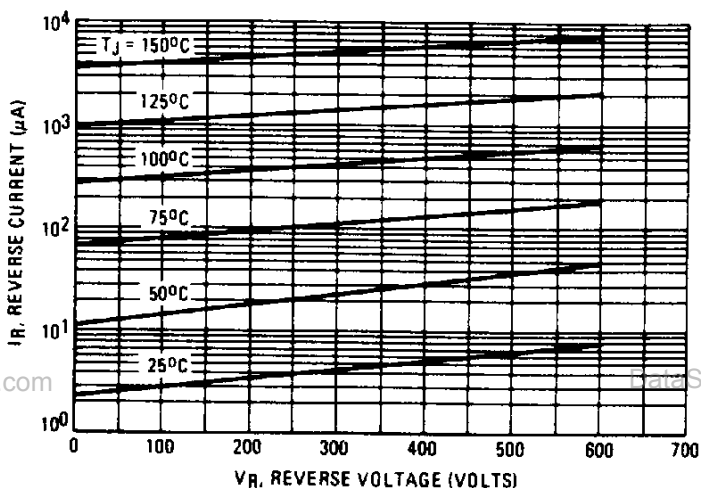
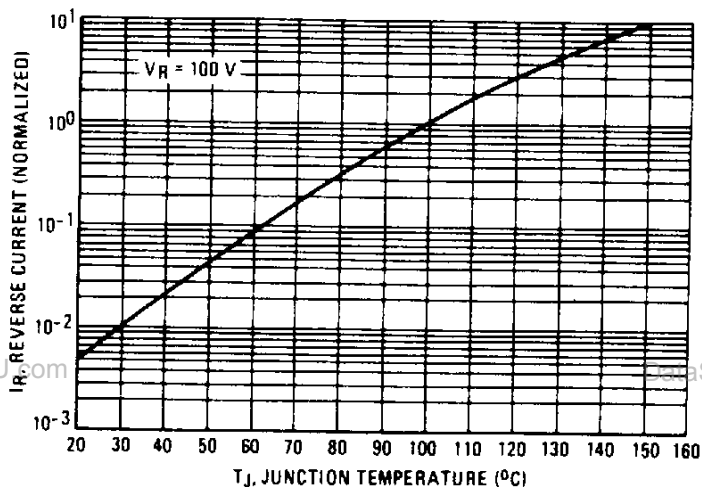
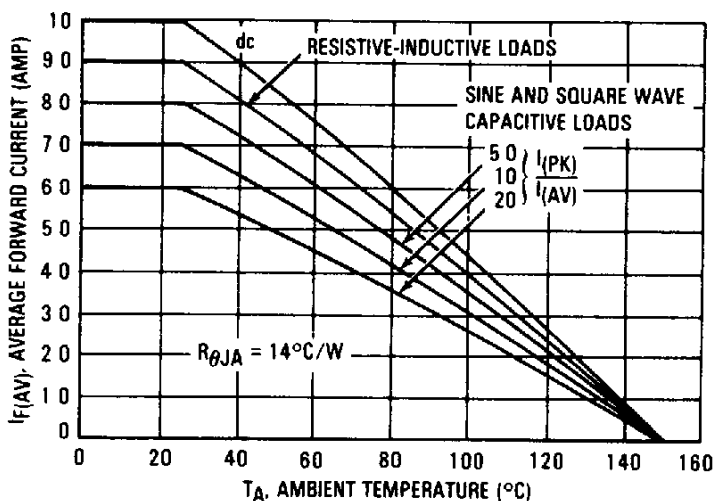


FIGURE 13 — NORMALIZED REVERSE CURRENT



## TYPICAL MOUNTING DATA

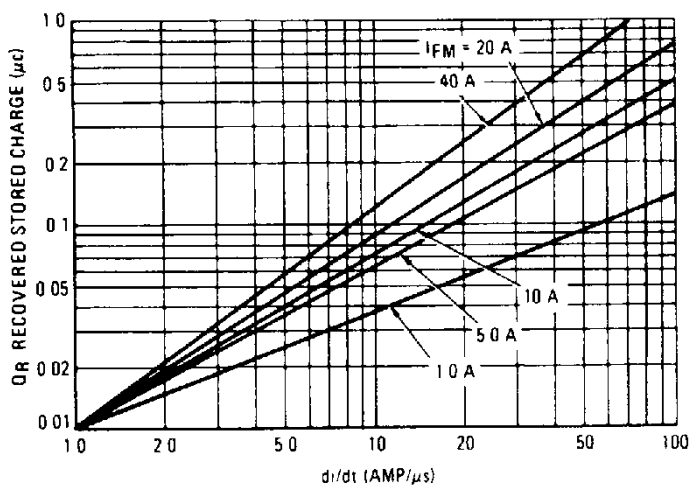
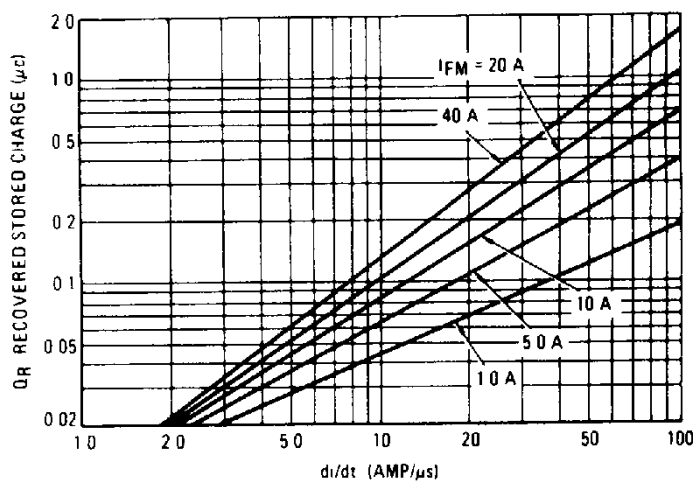
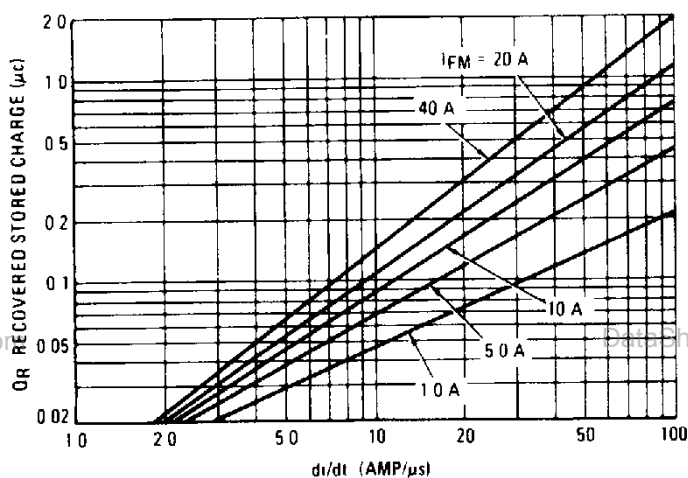
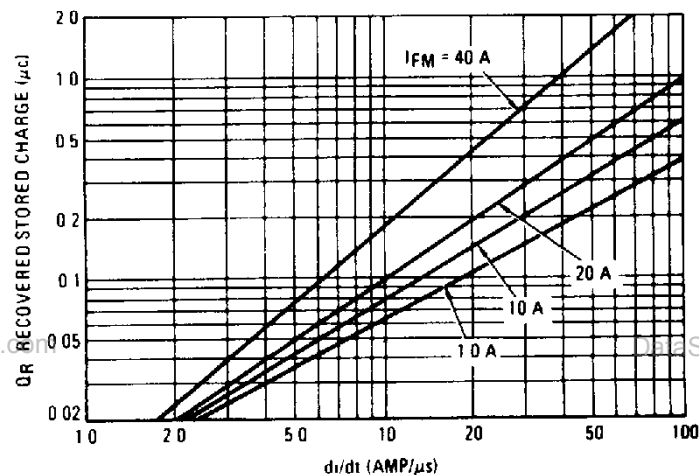
FIGURE 14 — CURRENT DERATING



### NOTE 2

Figure 14 shows the current carrying capability of a device mounted on a printed circuit board with a typical TO-220 type heatsink having a sink-to-air thermal resistance of  $12^\circ\text{C/W}$ . Allowing another  $2^\circ\text{C/W}$  for  $R_{\theta JC}$  plus  $R_{\theta CS}$  (case-to-sink) puts the total at  $14^\circ\text{C/W}$  as indicated. The unit and heatsink were mounted perpendicular to the printed circuit board for this data.

## TYPICAL RECOVERED STORED CHARGE DATA (See Note 3)

FIGURE 15 —  $T_J = 25^\circ\text{C}$ FIGURE 16 —  $T_J = 75^\circ\text{C}$ FIGURE 17 —  $T_J = 100^\circ\text{C}$ FIGURE 18 —  $T_J = 150^\circ\text{C}$ 

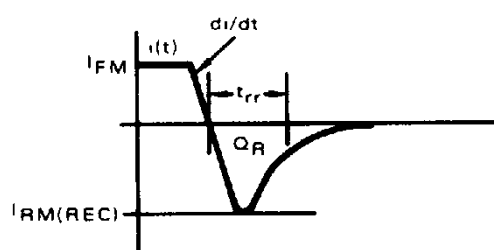
## NOTE 3

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using  $I_F = 10\text{ A}$ ,  $V_R = 30\text{ V}$ . In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation  $di/dt$  for various levels of forward current and for junction temperatures of  $25^\circ\text{C}$ ,  $75^\circ\text{C}$ ,  $100^\circ\text{C}$ , and  $150^\circ\text{C}$ .

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation  $di/dt$ , and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus  $di/dt$ , recovery time ( $t_{rr}$ ) and peak reverse recovery current ( $I_{RM(REC)}$ ) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[ \frac{Q_R}{di/dt} \right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times [Q_R \times di/dt]^{1/2}$$

FIGURE 19 — JEDEC REVERSE RECOVERY CIRCUIT

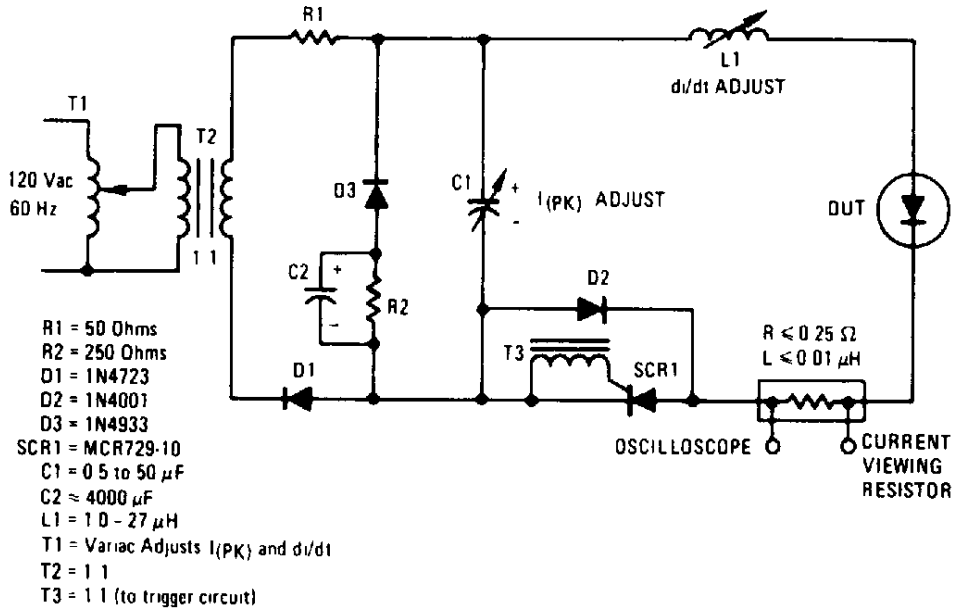
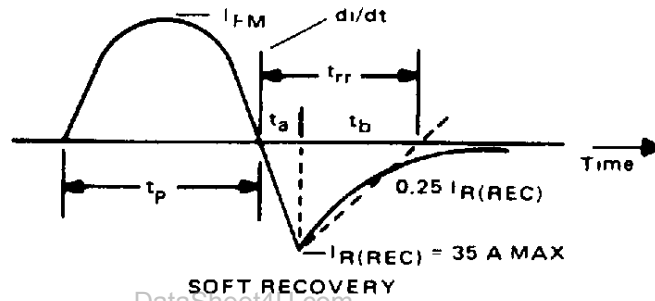


FIGURE 20 — REVERSE RECOVERY CHARACTERISTIC

**MECHANICAL CHARACTERISTICS****CASE:** Plastic Encapsulated, Metal Tabs**FINISH:** All external surfaces are corrosion resistant and are readily solderable.**POLARITY:** Cathode to Tab with hole, Reverse polarity available by adding "R" Suffix, MR2402FR.**WEIGHT:** 3.6 Grams (Approximately)**MOUNTING TORQUE:** 8 in-lbs max.**MAXIMUM TEMPERATURE FOR SOLDERING PURPOSES:** 350°C, 3/8" from case for 10 seconds.