MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR2400F thru MR2406F

MR2402F and MR2406F are Motorola Preferred Devices

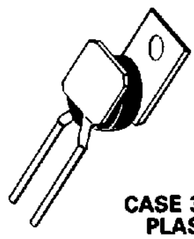
TAB-MOUNTED FAST RECOVERY POWER RECTIFIERS

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 Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	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, $T_C = 125°C$)	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 →					°C
Storage Temperature Range	T_{stg}	← -65 to +175 →					°C

THERMAL CHARACTERISTICS

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

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage ($I_F = 75$ Amp, $T_J = 150°C$)	v_F	—	1.15	1.29	Volts
Forward Voltage ($I_F = 24$ Amp, $T_C = 25°C$)	V_F	—	1.00	1.15	Volts
Reverse Current (rated dc voltage) $T_C = 25°C$	I_R	—	10	25	μA
$T_C = 100°C$		—	0.5	1.0	mA
$T_C = 150°C$		—	7.0	10	mA

REVERSE RECOVERY CHARACTERISTICS

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

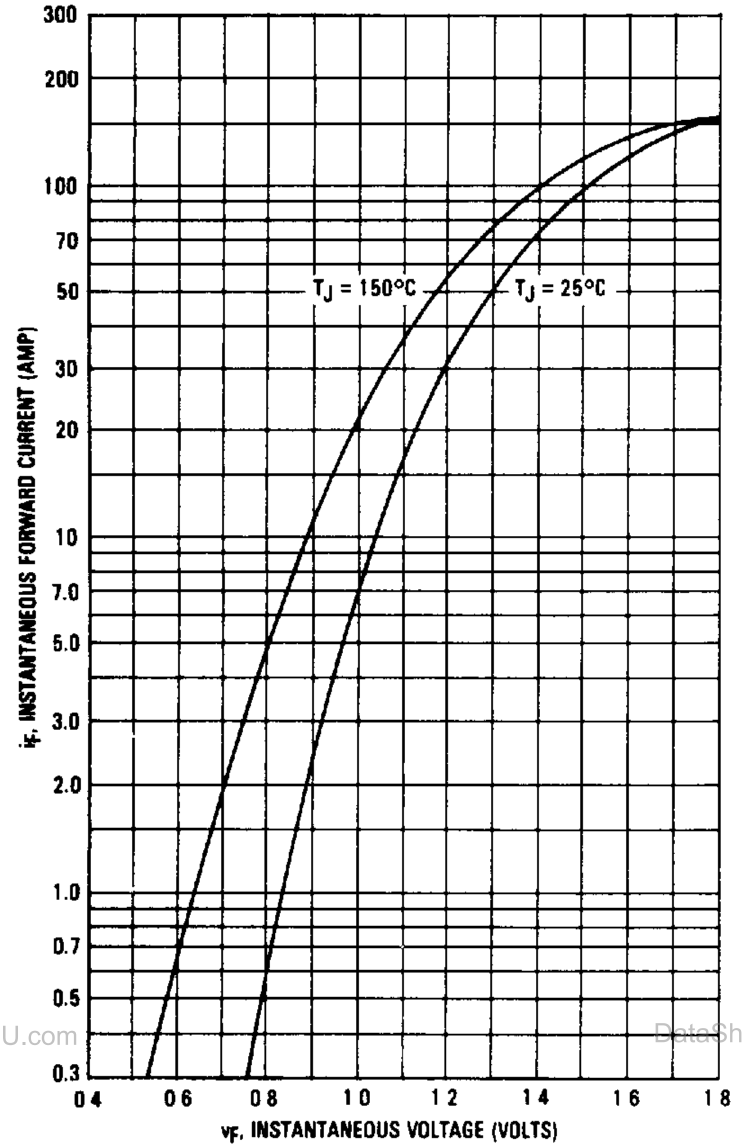
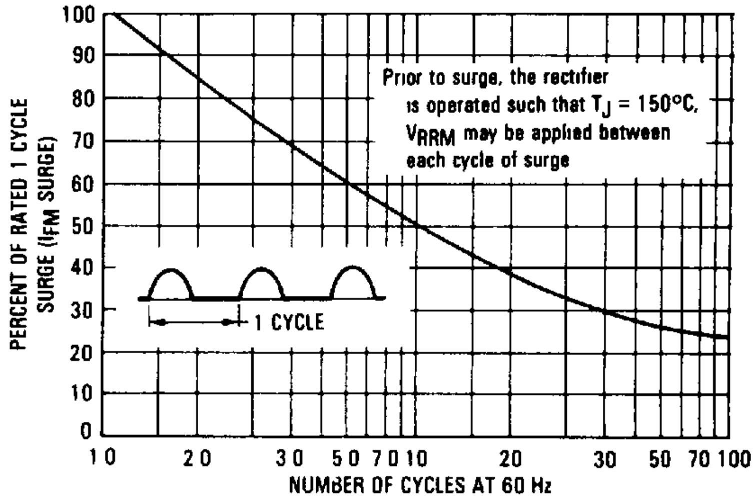
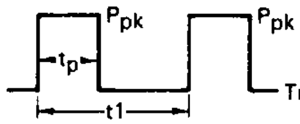


FIGURE 2 — MAXIMUM SURGE CAPABILITY



NOTE 1



DUTY CYCLE, $D = t_p/t1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

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

The temperature of the case should be measureed 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 ΔT_{JC} is the increase in junction temperature above the case temperature. It may be determined by

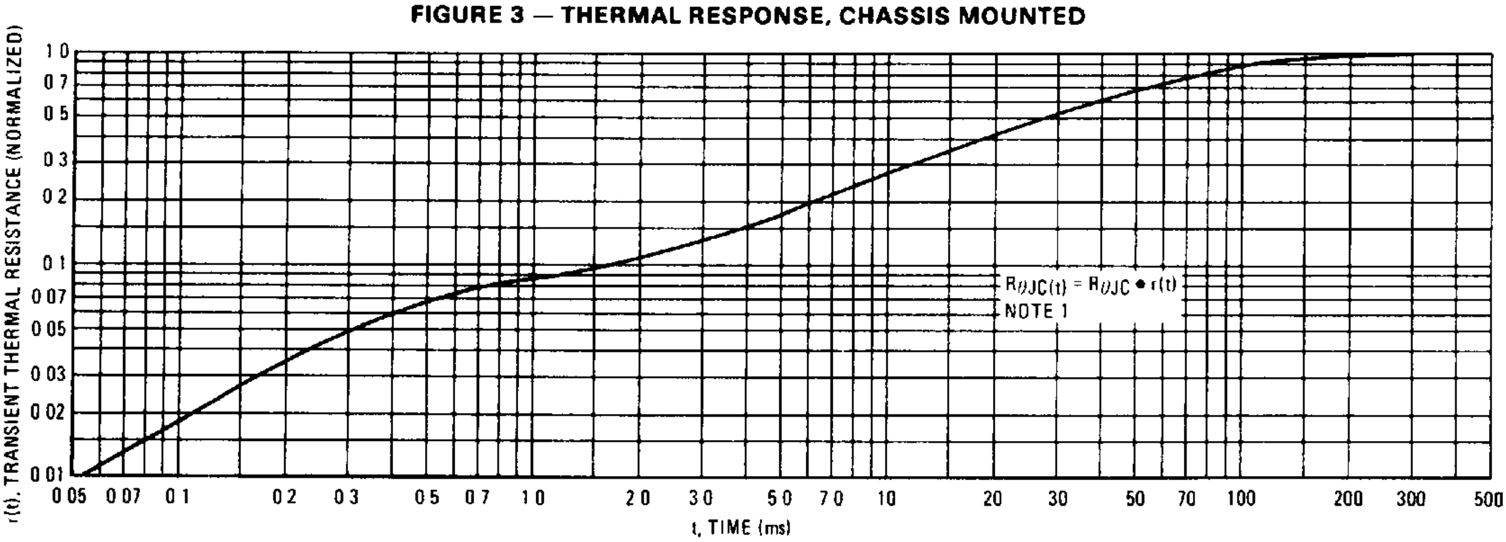
$$\Delta T_{JC} = P_{pk} \bullet R_{\theta JC} [D + (1 - D) \bullet r(t1 + t_p) + r(t_p) - r(t1)]$$

where

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

$r(t1 + t_p)$ = normalized value of transient thermal resistance at time $t1 + t_p$

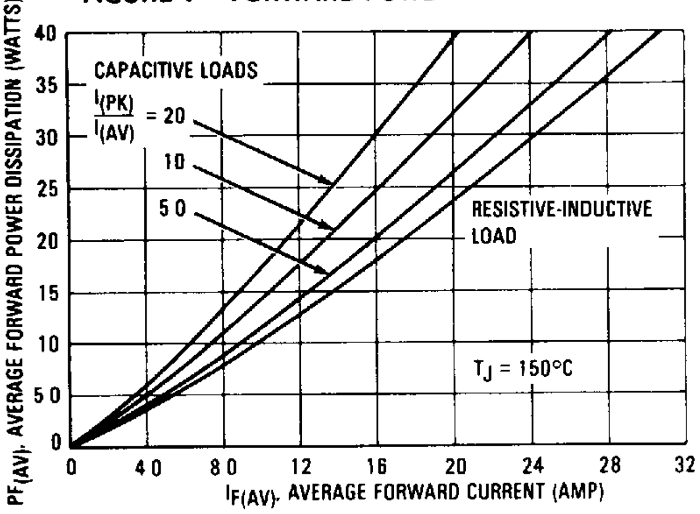
FIGURE 3 — THERMAL RESPONSE, CHASSIS MOUNTED



CHASSIS MOUNT RATING DATA

Sine Wave Input

FIGURE 4 — FORWARD POWER DISSIPATION



Square Wave Input

FIGURE 5 — FORWARD POWER DISSIPATION

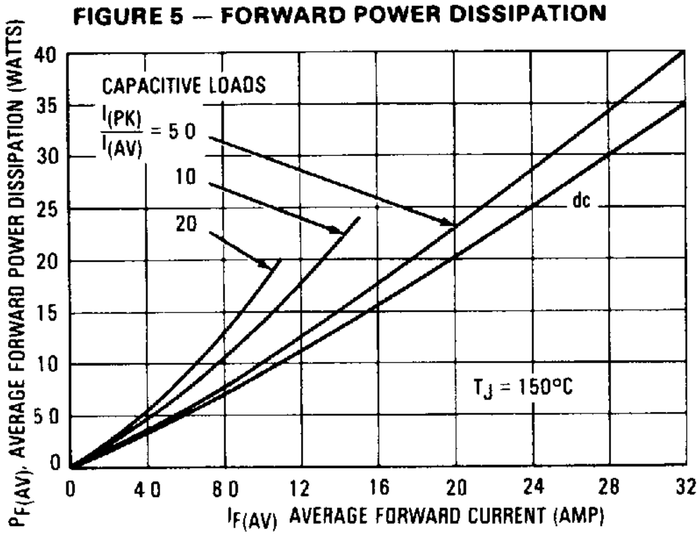


FIGURE 6 — CURRENT DERATING

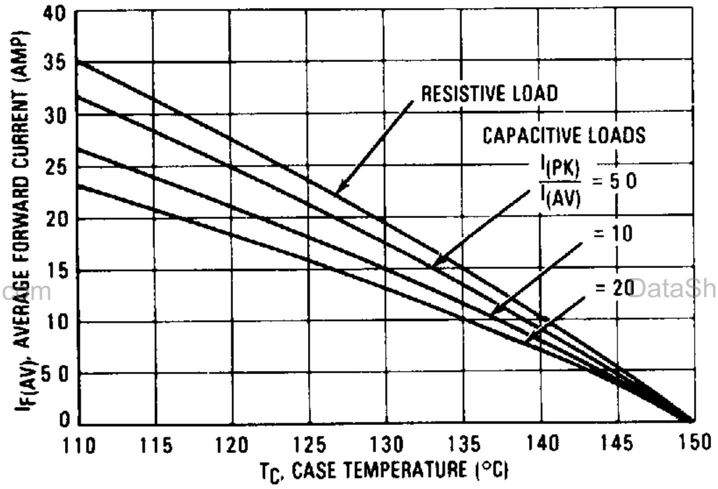
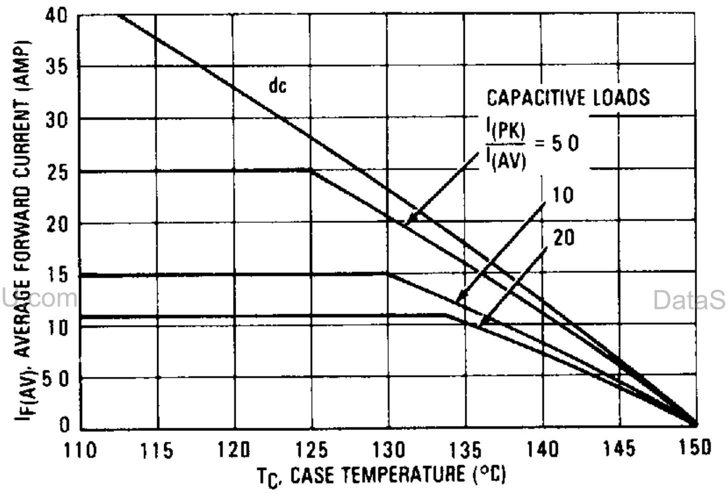


FIGURE 7 — CURRENT DERATING



PRINTED CIRCUIT BOARD RATING DATA

FIGURE 8 — FORWARD POWER DISSIPATION

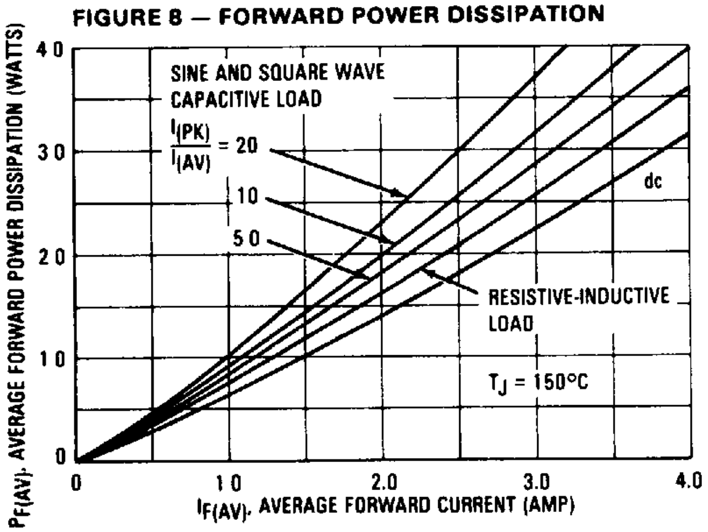
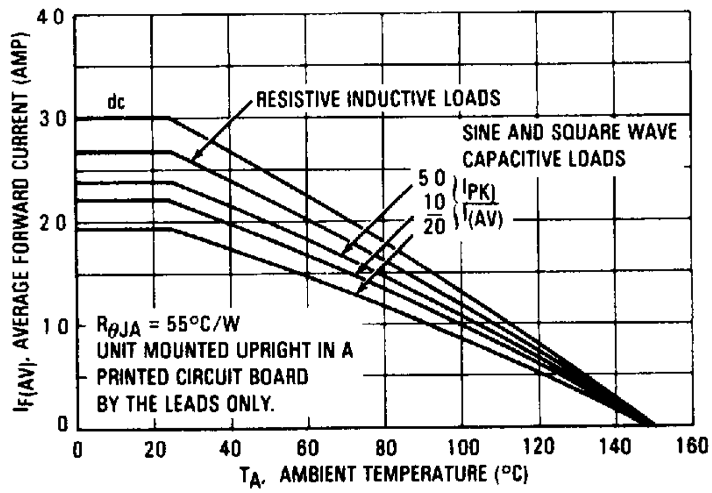


FIGURE 9 — CURRENT DERATING



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 10 — FORWARD RECOVERY TIME

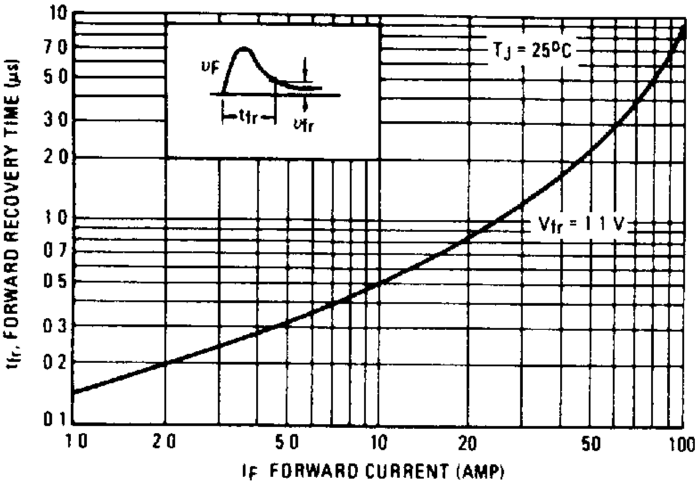


FIGURE 11 — JUNCTION CAPACITANCE

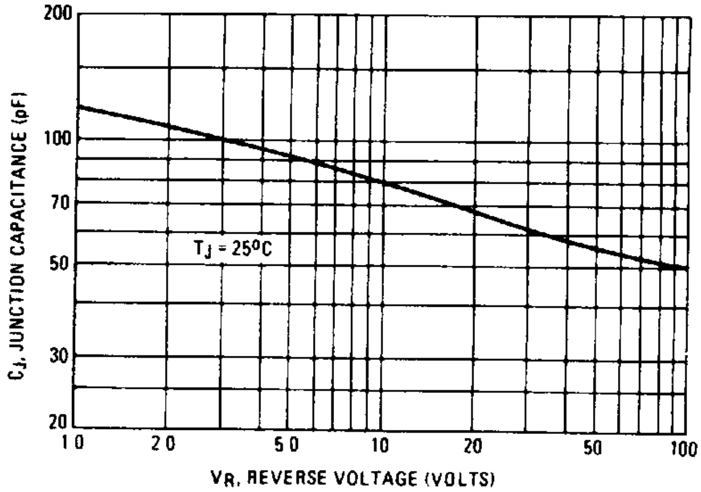


FIGURE 12 — TYPICAL REVERSE CURRENT

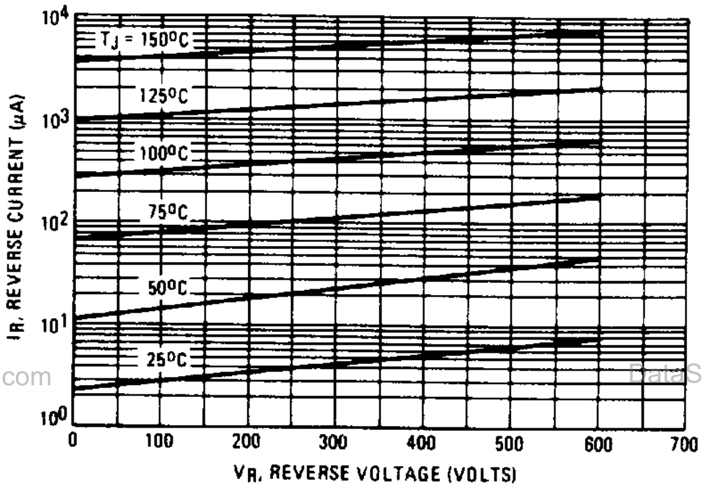
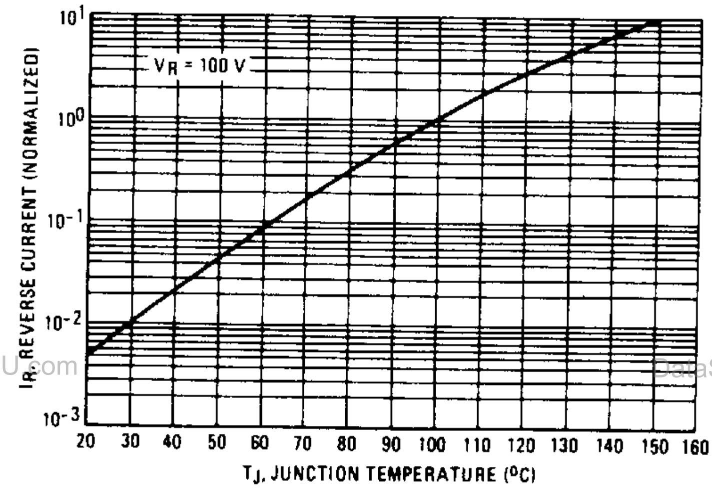
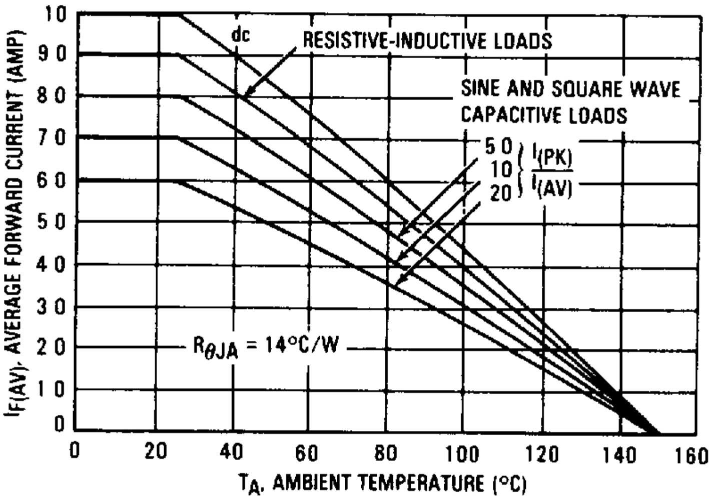


FIGURE 13 — NORMALIZED REVERSE CURRENT



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°C/W Allowing another 2°C/W for $R_{\theta JC}$ plus $R_{\theta CS}$ (case-to-sink) puts the total at 14°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 — $T_J = 25°C$

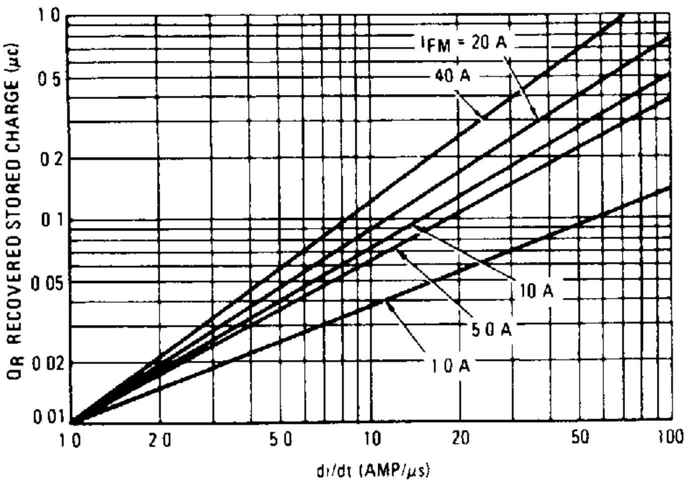


FIGURE 16 — $T_J = 75°C$

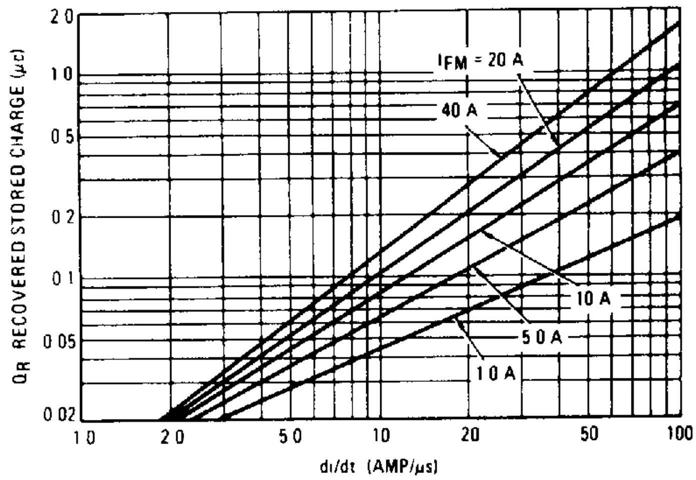


FIGURE 17 — $T_J = 100°C$

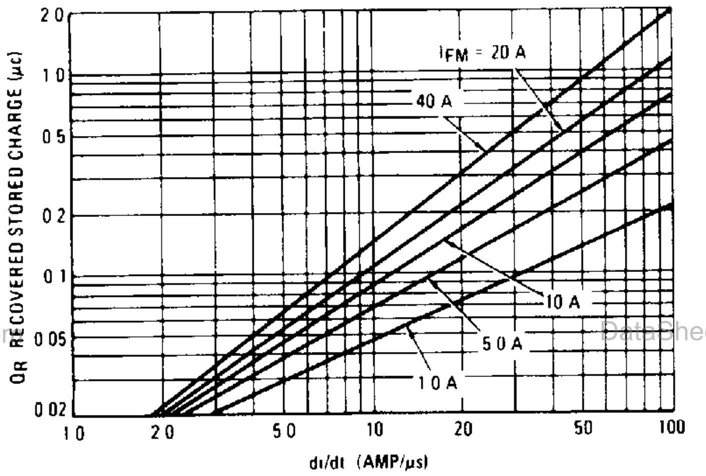
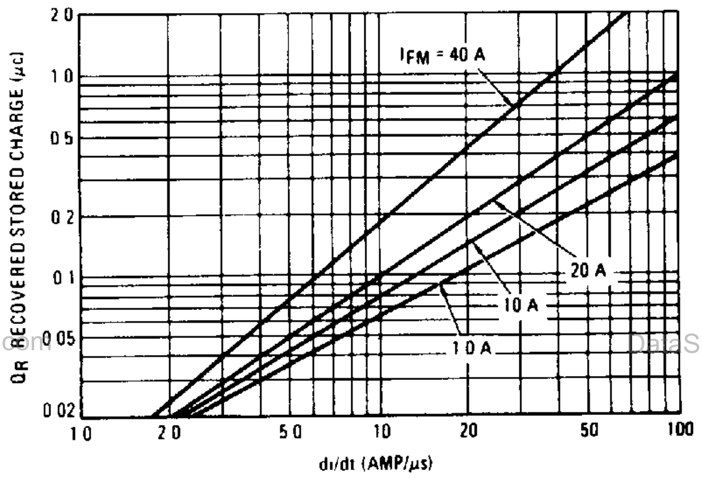


FIGURE 18 — $T_J = 150°C$



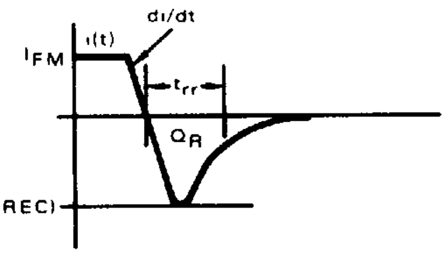
NOTE 3

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 $I_F = 1\ 0$ A, $V_R = 30$ 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°C, 75°C, 100°C, and 150°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.

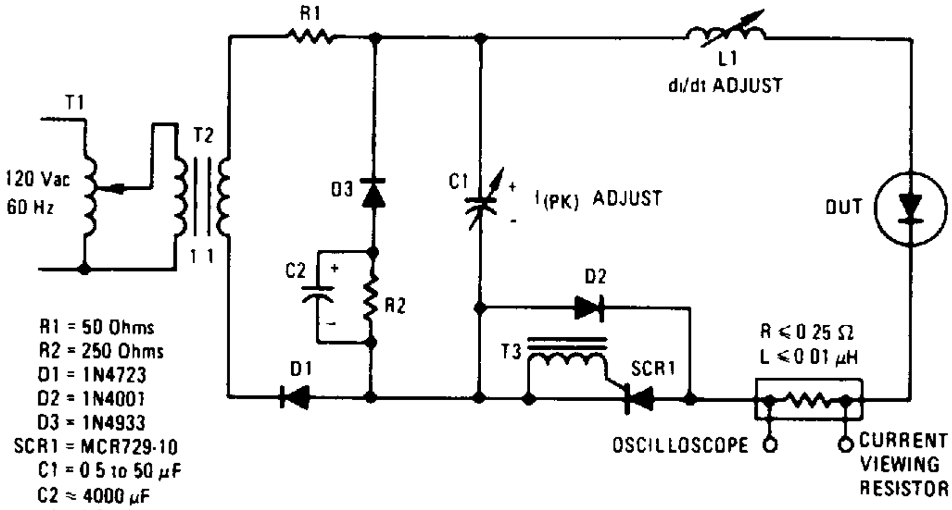


From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas

$$t_{rr} = 1\ 41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

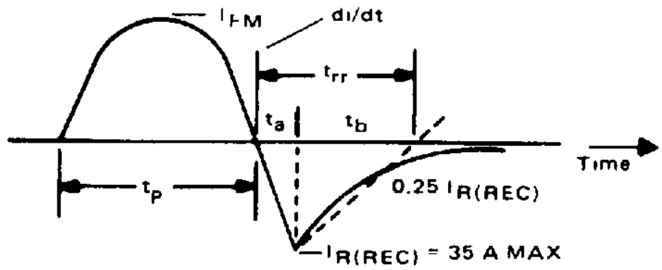
$$I_{RM(REC)} = 1\ 41 \times \left[Q_R \times di/dt\right]^{1/2}$$

FIGURE 19 — JEDEC REVERSE RECOVERY CIRCUIT



R1 = 50 Ohms
R2 = 250 Ohms
D1 = 1N4723
D2 = 1N4001
D3 = 1N4933
SCR1 = MCR729-10
C1 = 0 5 to 50 μF
C2 ≈ 4000 μF
L1 = 1 0 - 27 μH
T1 = Variac Adjusts $I_{(PK)}$ and di/dt
T2 = 1 1
T3 = 1 1 (to trigger circuit)

FIGURE 20 — REVERSE RECOVERY CHARACTERISTIC



SOFT RECOVERY

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.