



MOTOROLA

Designers Data Sheet

RECTIFIER ASSEMBLY

utilizing individual void-free molded MR2500 Series rectifiers, interconnected and mounted on an electrically isolated aluminum heat sink by a high thermal-conductive epoxy resin.

- 400 Ampere Surge Capability
- Electrically Isolated Base
- Cost Effective in Lower Current Applications

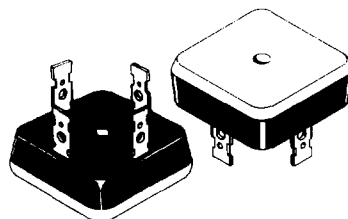
Designers Data for "Worst Case" Conditions

The Designers Data sheets permit the design of most circuits entirely from the information presented. Limit curves - representing boundaries on device characteristics - are given to facilitate "worst case" design.

**MDA980-1 thru
MDA980-6
MDA990-1 thru
MDA990-6**

SINGLE-PHASE FULL-WAVE BRIDGE

**12 and 30 AMPERES
50 thru 600 VOLTS**



3

MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	-1	-2	-3	-4	-5	-6	Unit
Peak Repetitive Reverse Voltage	V_{RRM}							Volts
Working Peak Reverse Voltage	V_{RWM}	50	100	200	300	400	600	
DC Blocking Voltage	V_R							
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	420	Volts
DC Output Voltage								Volts
Resistive Load	V_{dc}	30	62	124	185	250	380	
Capacitive Load	V_{dc}	50	100	200	300	400	600	
Average Rectified Forward Current (Single phase bridge resistive load, 60 Hz, $T_C = 55^\circ\text{C}$)	I_O							Amp
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions)	I_{FSM}	300						Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +175						$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Thermal Resistance, Junction to Case	Each Die MDA980 MDA990	$R_{\theta JC}$	8.5 4.5	$^\circ\text{C/W}$
	Effective Bridge MDA980 MDA990	$R_{\theta (EFF)}$	— 6.05 2.28	$^\circ\text{C/W}$

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (Per Diode)	v_F				Volts
($I_F = 18.9 \text{ A}$)	MDA980	—	0.88	0.97	
($I_F = 47 \text{ A}$)	MDA990	—	0.98	1.07	
($I_F = 18.9 \text{ A}, T_J = 175^\circ\text{C}$)	MDA980	—	—	0.85	
($I_F = 47 \text{ A}, T_J = 175^\circ\text{C}$)	MDA990	—	—	0.98	
Reverse Current (Rated V_{RM} applied to ac terminals, + and - terminals open)	I_R	—	—	0.5	mA

FIGURE 1 – FORWARD VOLTAGE

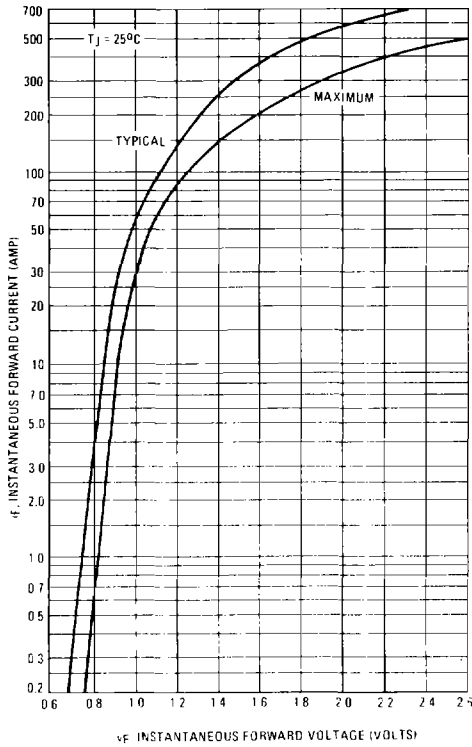


FIGURE 2 – MAXIMUM SURGE CAPABILITY

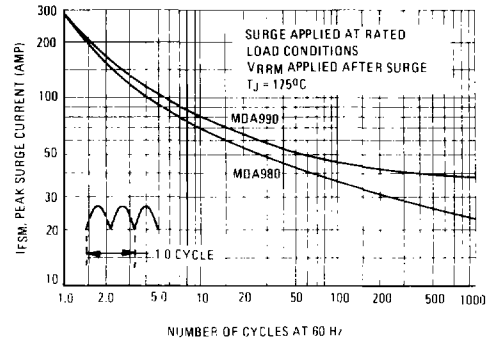


FIGURE 3 – FORWARD VOLTAGE TEMPERATURE COEFFICIENT

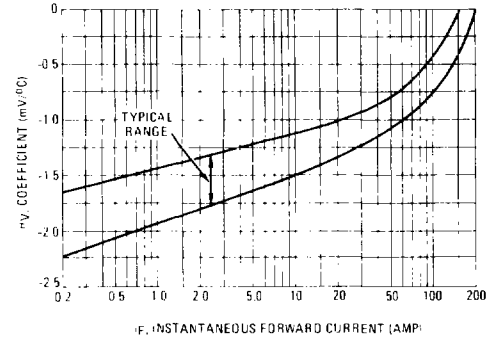
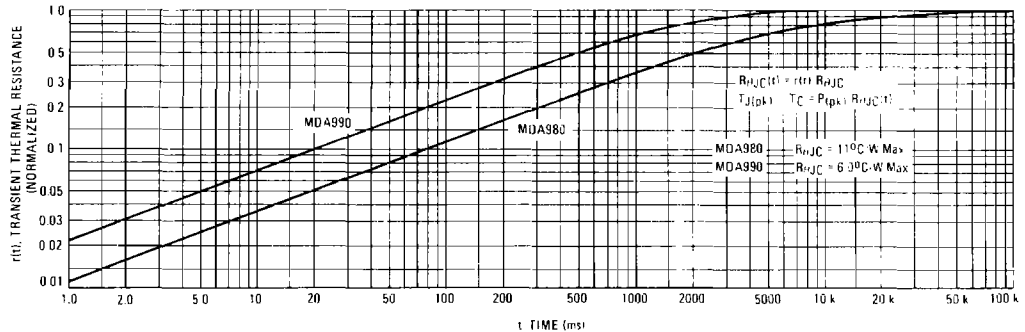


FIGURE 4 – TYPICAL THERMAL RESPONSE



MDA980-1 thru MDA980-6, MDA990-1 thru MDA990-6

MAXIMUM CURRENT RATINGS, BRIDGE OPERATION

FIGURE 5 - MDA980 CURRENT DERATING

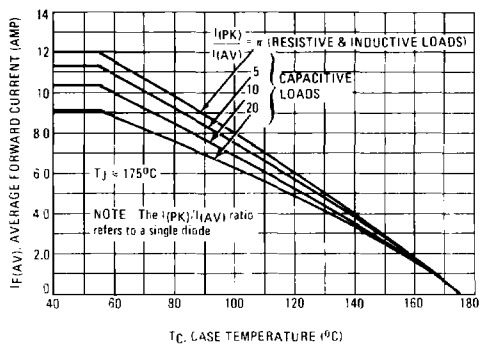
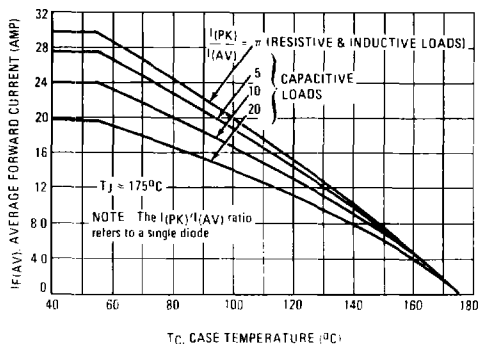


FIGURE 6 - MDA990 CURRENT DERATING



TYPICAL DYNAMIC CHARACTERISTICS (EACH DIODE)

FIGURE 7 - RECTIFICATION EFFICIENCY

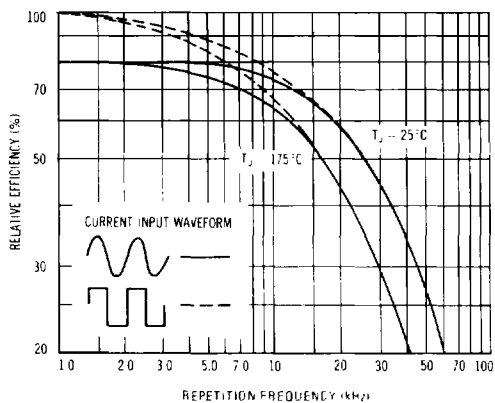


FIGURE 8 - JUNCTION CAPACITANCE

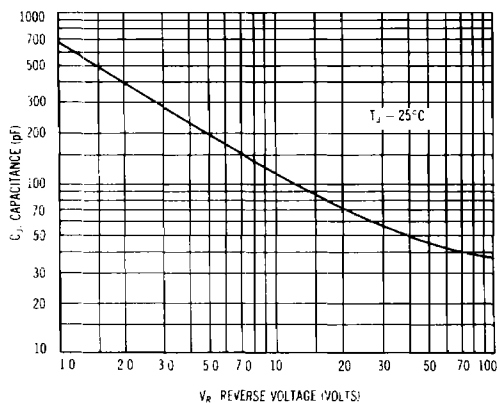


FIGURE 9 - REVERSE RECOVERY TIME

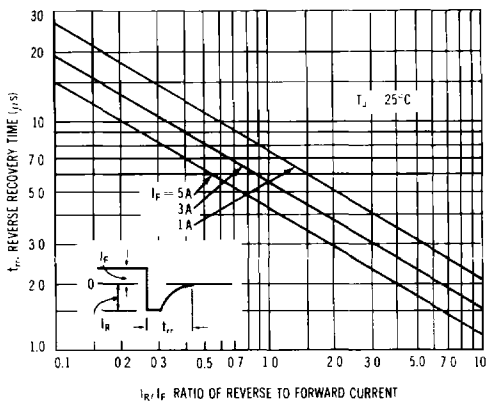


FIGURE 10 - FORWARD RECOVERY TIME

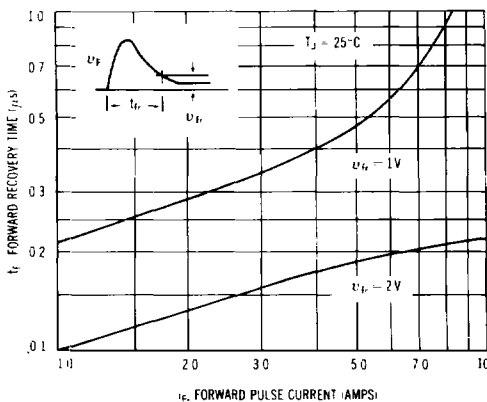


FIGURE 11 – POWER DISSIPATION

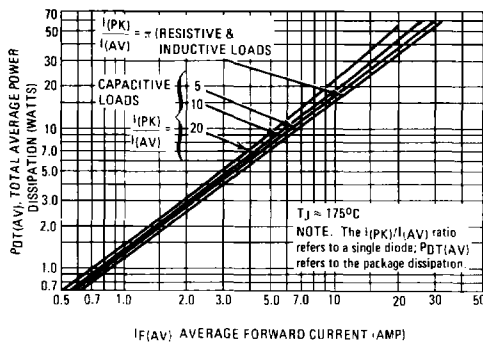
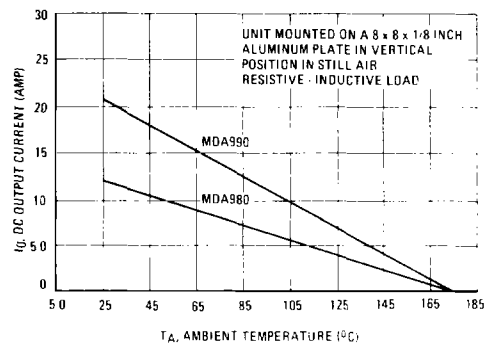


FIGURE 12 – CURRENT VERSUS AMBIENT TEMPERATURE



NOTE 1 – THERMAL COUPLING AND EFFECTIVE THERMAL RESISTANCE

In multiple chip devices where there is coupling of heat between die, the junction temperature can be calculated as follows.

$$(1) \Delta T_{J1} = R_{\theta 1} P_{D1} + R_{\theta 2} K_{\theta 2} P_{D2} + R_{\theta 3} K_{\theta 3} P_{D3} + R_{\theta 4} K_{\theta 4} P_{D4}$$

Where ΔT_{J1} is the change in junction temperature of diode 1

$R_{\theta 1}$ thru 4 is the thermal resistance of diodes 1 through 4.

P_{D1} thru 4 is the power dissipated in diodes 1 through 4

$K_{\theta 2}$ thru 4 is the thermal coupling between diode 1 and diodes 2 through 4.

An effective package thermal resistance can be defined as follows.

$$(2) R_{\theta(EFF)} = \Delta T_{J1} / P_{DT}$$

Where: P_{DT} is the total package power dissipation.

Assuming equal thermal resistance for each die, equation (1) simplifies to

$$(3) \Delta T_{J1} = R_{\theta 1} (P_{D1} + K_{\theta 2} P_{D2} + K_{\theta 3} P_{D3} + K_{\theta 4} P_{D4})$$

For the condition where $P_{D1} = P_{D2} = P_{D3} = P_{D4}$, $P_{DT} = 4P_{D1}$ equation (3) can be further simplified and by substituting into equation (2) results in

$$(4) R_{\theta(EFF)} = R_{\theta 1} (1 + K_{\theta 2} + K_{\theta 3} + K_{\theta 4}) / 4$$

For the MDA980 rectifier assembly, thermal coupling between opposite diodes is 42% and between adjacent diodes is 50% when the case temperature is used as a reference. Similarly for the MDA990, thermal coupling between opposite diodes is 12% and between adjacent diodes is 20%.

NOTE 2 – SPLIT LOAD DERATING INFORMATION

Bridge rectifiers are used in two basic configurations as shown in circuits A and B of Figure 13. The current derating data of Figures 5 and 6 apply to the standard bridge circuit (A) where $I_A = I_B$. For circuit B where $I_A \neq I_B$, derating information can be calculated as follows:

$$(5) T_{R(MAX)} = T_{J(MAX)} - \Delta T_{J1}$$

Where $T_{R(MAX)}$ is the reference temperature (either case or ambient)

ΔT_{J1} can be calculated using equation (3) in Note 1.

For example, to determine $T_{C(MAX)}$ for the MDA990 with the following capacitive load conditions:

- $I_A = 20$ A average with a peak of 86 A
- $I_B = 10$ A average with a peak of 72 A

First calculate the peak to average ratio for I_A . $I(PK)/I(AV) = 86/10 = 8.6$. (Note that the peak to average ratio is on a per diode basis and each diode provides 10A average).

From Figure 11, for an average current of 20 A and an $I(PK)/I(AV) = 8.6$ read $P_{DI(AV)} = 40$ watts or 10 watts/diode. Thus $P_{D1} = P_{D3} = 10$ watts.

Similarly, for a load current I_B of 10 A, diode #2 and diode #4 each see 5.0 A average resulting in an $I(PK)/I(AV) \approx 14.4$

Thus, the package power dissipation for 10 A is 20.2 watts or 5.05 watts/diode. $\therefore P_{D2} = P_{D4} = 5.05$ watts.

The maximum junction temperature occurs in diodes #1 and #3. From equation (3) for diode #1 $\Delta T_{J1} = 5.6 [10 + 0.12 (5.05) + 0.2 (10) + 0.2 (5.05)]$.

$$\Delta T_{J1} \approx 76^\circ\text{C}$$

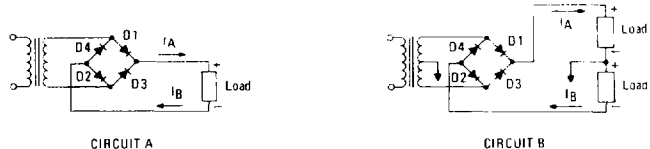
$$\text{Thus } T_{C(MAX)} = 175 - 76 = 99^\circ\text{C}$$

The total package dissipation in this example is:

$$P_J = 2 \times 10 + 2 \times 5.05 \approx 30.1 \text{ watts}$$

(Note that although maximum $R_{\theta JC}$ is 6°C/W , 5.6°C/watt is used in this example and on the derating data as it is unlikely that all four die in a given package would be at the maximum value).

FIGURE 13 – BASIC CIRCUIT USES FOR BRIDGE RECTIFIERS



MECHANICAL CHARACTERISTICS

CASE: Transfer-molded plastic encapsulation

POLARITY: Terminal-designation embossed on case

+DC output

-DC output

AC not marked

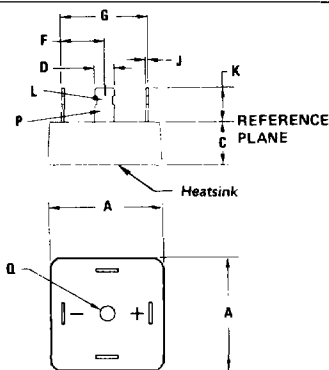
MOUNTING POSITION: Bolt down-highest heat transfer efficiency accomplished through the surface opposite the terminals.

WEIGHT: 40 grams (approx)

TERMINALS: Suitable for fast-on connections, readily solderable connections, corrosion resistant.

MOUNTING TORQUE: 20 in. lb. Max.

OUTLINE DIMENSIONS



- NOTE:
- 1. DIM "Q" SHALL BE MEASURED ON HEATSINK SIDE OF PKG.
 - 2. DIMENSIONS F AND G SHALL BE MEASURED AT THE REFERENCE PLANE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	34.80	35.18	1.370	1.385
C	12.44	13.97	0.490	0.550
D	6.10	6.60	0.240	0.260
F	13.97	14.60	0.550	0.571
G	28.00	29.00	1.100	1.142
J	0.71	0.86	0.028	0.034
K	9.52	11.43	0.375	0.450
L	1.52	2.06	0.060	0.081
P	2.79	2.92	0.110	0.115
Q	4.32	4.83	0.170	0.190

CASE 309A-02