MOTOROLA

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

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.

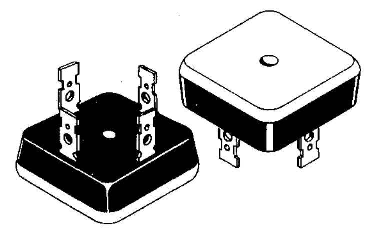
- 400 Ampere Surge Capability
- Electrically Isolated Base
- Fast Recovery Available on Request
- Cost Effective in Lower Current Applications

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.

SINGLE-PHASE
FULL-WAVE BRIDGE

12 and 30 AMPERES
50 thru 600 VOLTS



MAXIMUM RATINGS ($T_C = 25^oC$ unless otherwise noted)

Rating	Symbol	-1	-2	-3	-4	-5	-6	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	300	400	600	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	420	Volts
DC Output Voltage Resistive Load Capacitive Load	 Vdc Vdc	 30 50	 62 100	 124 200	 185 300	 250 400	 380 600	Volts
Average Rectified Forward Current (Single phase bridge resistive load, 60 Hz, $T_C = 55^oC$) MDA980 MDA990	I_O	12 (MDA980) 30 (MDA990)						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						^oC

THERMAL CHARACTERISTICS

Characteristic			Symbol	Typ	Max	Unit
Thermal Resistance, Junction to Case	Each Die	MDA980 MDA990	$R\theta_{JC}$	8.5 4.5	11 6.0	$^oC/W$
	Effective Bridge	MDA980 MDA990	$R\theta_{(EFF)}$	— —	6.05 2.28	$^oC/W$

ELECTRICAL CHARACTERISTICS ($T_C = 25^oC$ unless otherwise noted)

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

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FIGURE 1 — FORWARD VOLTAGE

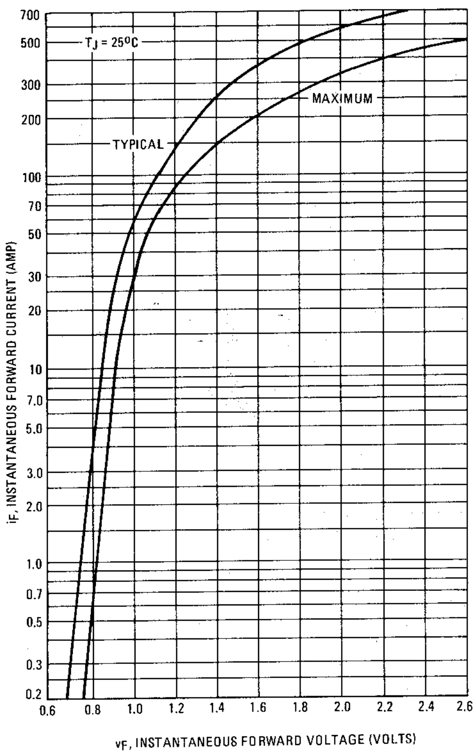


FIGURE 2 — MAXIMUM SURGE CAPABILITY

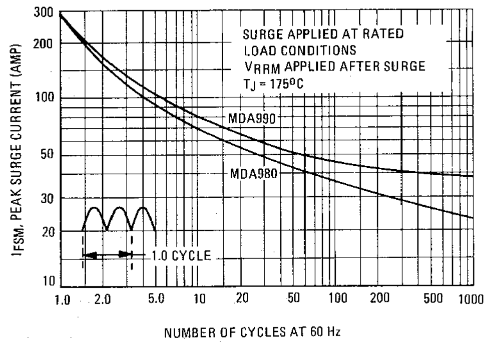


FIGURE 3 — FORWARD VOLTAGE TEMPERATURE COEFFICIENT

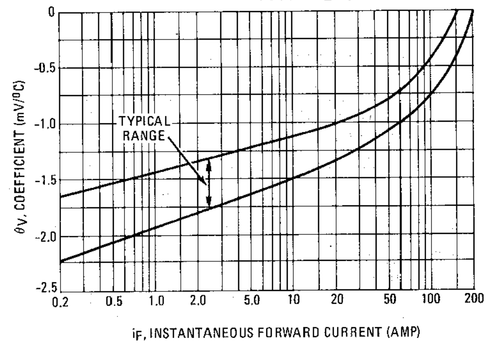
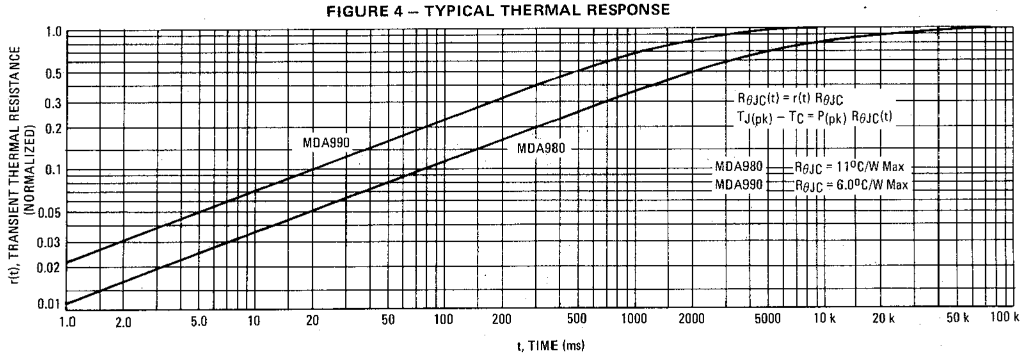


FIGURE 4 — TYPICAL THERMAL RESPONSE



MAXIMUM CURRENT RATINGS, BRIDGE OPERATION

FIGURE 5 – MDA980 CURRENT DERATING

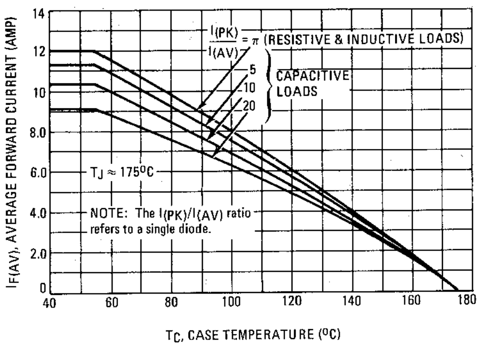
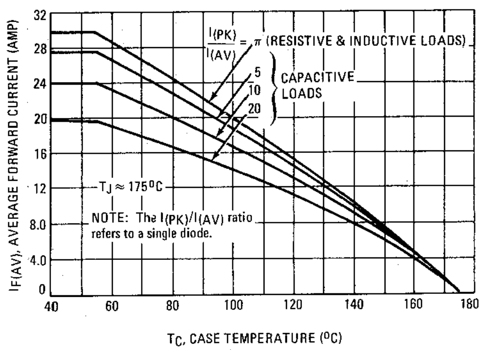


FIGURE 6 – MDA990 CURRENT DERATING



TYPICAL DYNAMIC CHARACTERISTICS (EACH DIODE)

FIGURE 7 – RECTIFICATION EFFICIENCY

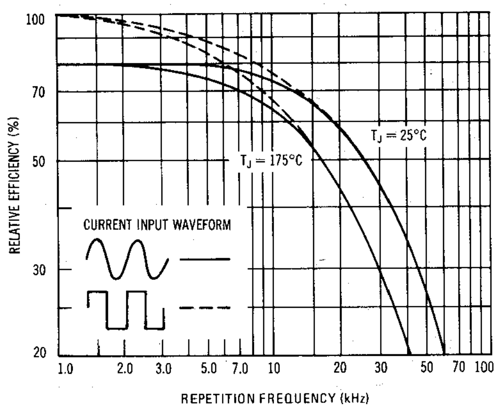


FIGURE 8 – JUNCTION CAPACITANCE

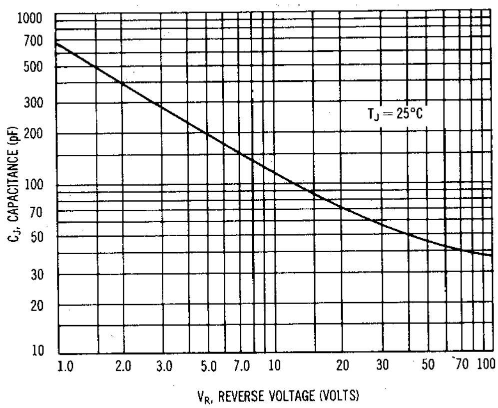


FIGURE 9 – REVERSE RECOVERY TIME

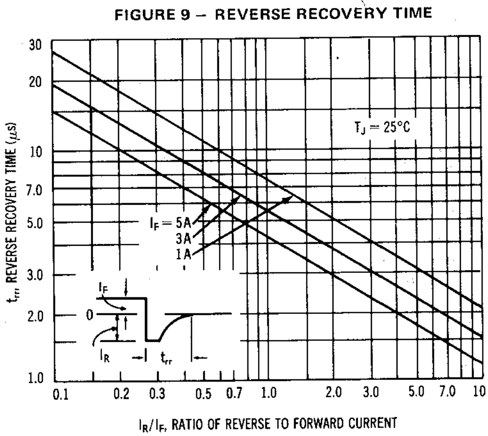


FIGURE 10 – FORWARD RECOVERY TIME

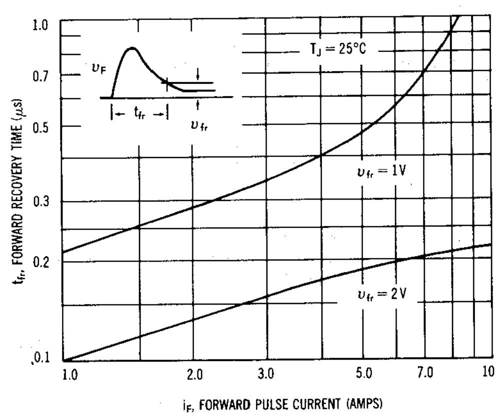


FIGURE 11 – POWER DISSIPATION

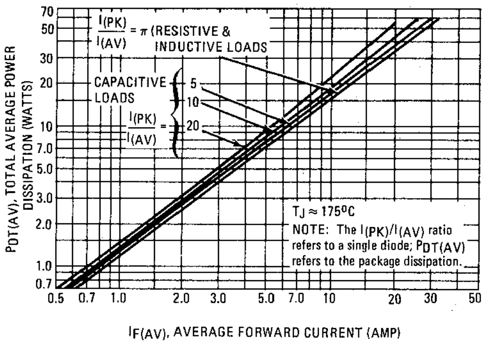
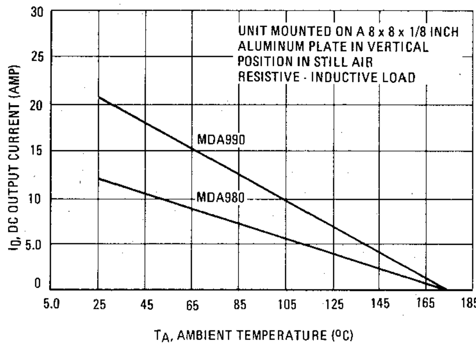


FIGURE 12 – CURRENT VERSUS AMBIENT TEMPERATURE



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

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

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

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

$K_{\theta 2 \text{ thru } 4}$ 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 $P_{DT(AV)}$ = 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 ΔT_{J1} = 5.6 [10 + 0.12 (5.05) + 0.2 (10) + 0.2 (5.05)].

$\Delta T_{J1} \approx 76°C$

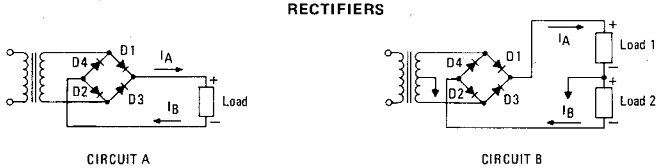
Thus $T_{C(MAX)}$ = 175-76 = 99°C

The total package dissipation in this example is:

$P_J = 2 \times 10 + 2 \times 5.05 \approx 30.1$ 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



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MECHANICAL CHARACTERISTICS

CASE: Transfer-molded plastic encapsulation

POLARITY: Terminal-designation embossed on case
+DC output
-DC output
AC not marked

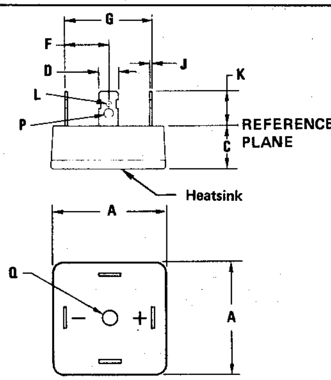
MOUNTING POSITION: Bolt down-highest heat transfer efficiency accomplished through the surface opposite the terminals.

WEIGHT: MDA980 – 21 grams (approx.)
MDA990 – 22.5 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.

	MILLIMETERS		INCHES	
DIM	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	14.50	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

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