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

25574
25591

Designers Data Sheet

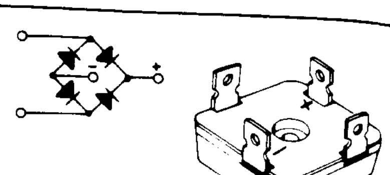
INTEGRAL DIODE ASSEMBLIES

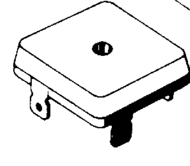
. . . passivated, diffused silicon dice interconnected and transfer molded into voidless hybrid rectifier circuit assemblies. The MDA990 series incorporates an electrically insulated aluminum disc for improved heat dissipation when mounted directly on a metal chasis or heat sink.

- Large surge capability – 300 A
- Efficient Thermal Management Provides Maximum Power Handling In Minimum Space

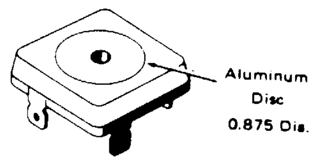
SINGLE-PHASE
FULL-WAVE BRIDGE

12 and 30 AMPERES
50 thru 600 VOLTS





CASE 179-01
MDA980 Series



CASE 179-02
MDA 990 Series

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.

MAXIMUM RATINGS ($T_C = 25^{\circ}C$ 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, $T_C = 55^{\circ}C$) MDA980 MDA990	I_O	← 12 → ← 30 →						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 →						°C

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	°C/W
	Effective Bridge MDA980 MDA990	$R\theta_{(EFF)}$	– –	6.05 2.28	°C/W

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

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (Per Diode) (i_F = 18.9 A) MDA980 (i_F = 47 A) MDA990 (i_F = 18.9 A, $T_J = 175^{\circ}C$) MDA980 (i_F = 47 A, $T_J = 175^{\circ}C$) MDA990	v_F	– – – –	0.88 0.96 – –	0.97 1.07 0.85 0.96	Volts
Reverse Current (Rated V_{RM} applied to ac terminals, + and – terminals open)	I_R	–	–	0.5	mA

MECHANICAL CHARACTERISTICS

CASE: Transfer-molded plastic encapsulation

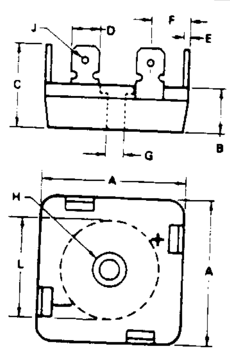
POLARITY: Terminal-designation embossed on case
+DC output
-DC output
AC not marked

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.



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.235	1.255	31.370	31.880
B	0.365	0.385	9.270	9.780
C	0.660	0.760	16.760	19.300
D	0.245	0.255	6.220	6.480
E	0.029	0.034	0.737	0.864
F	0.340	0.400	8.640	10.160
G	0.140	0.155	3.560	3.940
H	0.060	0.110	1.520	2.790
J	0.085	0.100	2.160	2.540
L	0.860	0.938	21.820	23.820

NOTES:
1. HOLE IS COUNTER SUNK FOR #6 SOCKET HEAD SCREW
2. DIM "H" IS DEPTH MEASUREMENT, NOT DIAMETER
3. DIM "C", "D", "E" & "J" ARE TYPICAL.
4. DIM "L" APPLIES TO-02 ONLY

CASE 179-01-02

MDA980-1 thru MDA980-6, MDA990-1 thru MDA990-6 (continued)

FIGURE 1 – FORWARD VOLTAGE

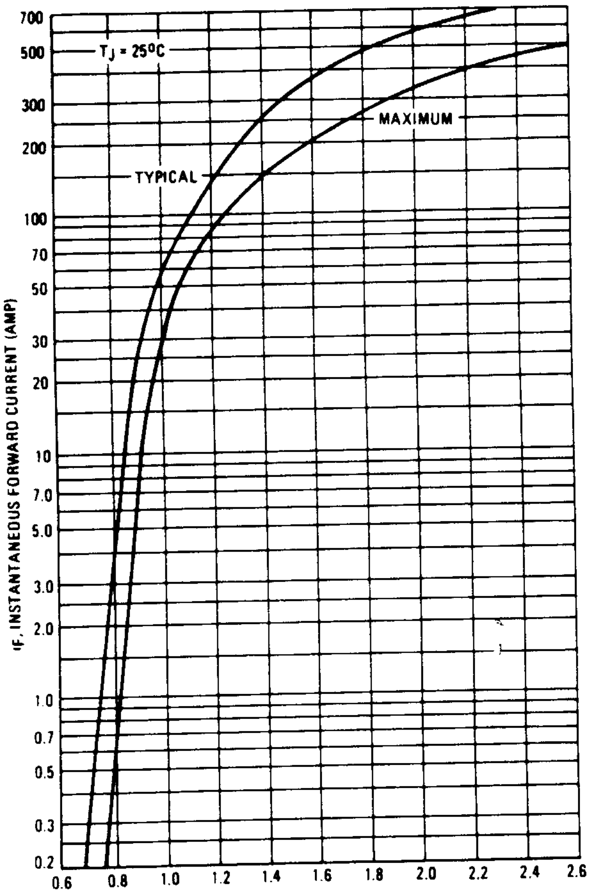


FIGURE 2 – MAXIMUM SURGE CAPABILITY

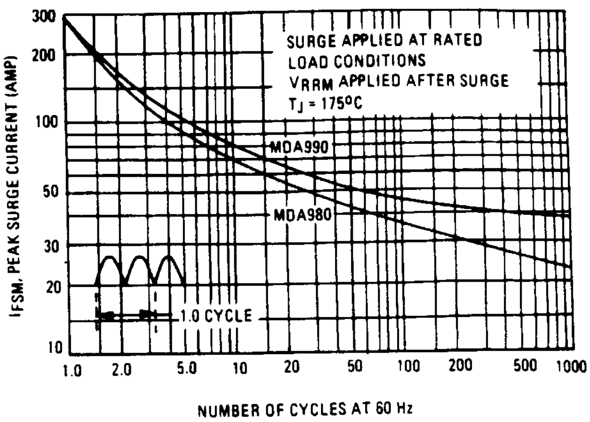


FIGURE 3 – FORWARD VOLTAGE TEMPERATURE COEFFICIENT

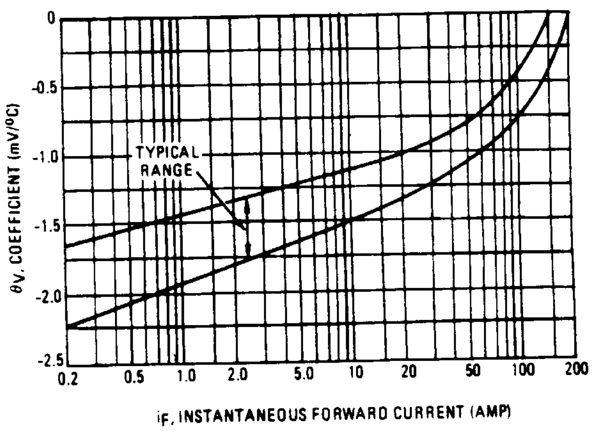
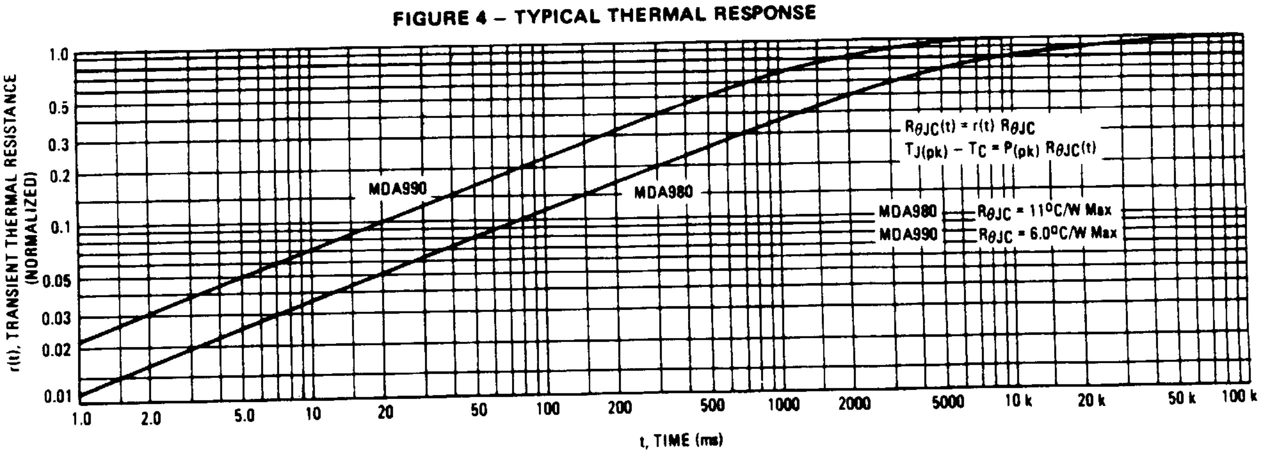


FIGURE 4 – TYPICAL THERMAL RESPONSE



MAXIMUM CURRENT RATINGS, BRIDGE OPERATION

FIGURE 5 – MDA980 CURRENT DERATING

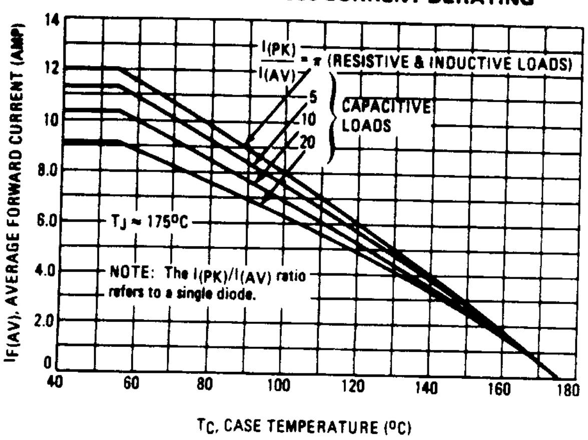
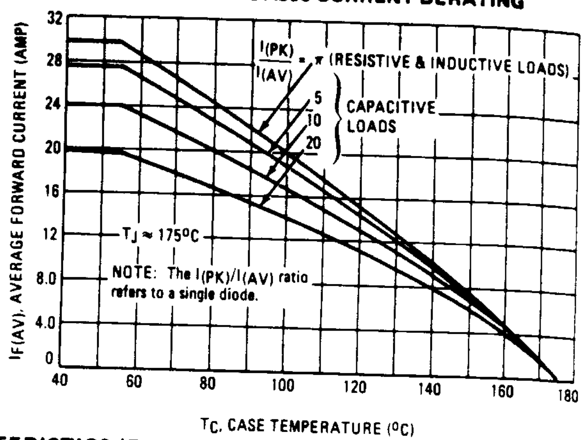


FIGURE 6 – MDA990 CURRENT DERATING



TYPICAL DYNAMIC CHARACTERISTICS (EACH DIODE)

FIGURE 7 – RECTIFICATION EFFICIENCY

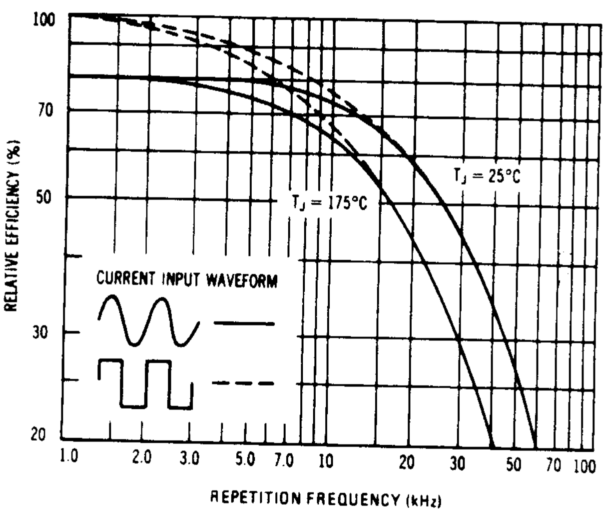


FIGURE 8 – JUNCTION CAPACITANCE

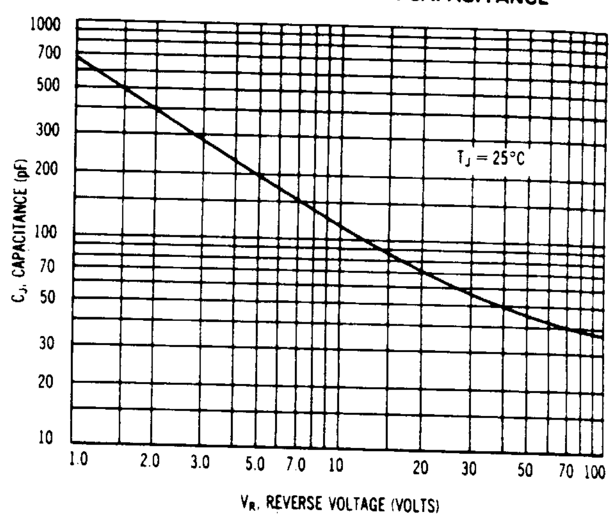


FIGURE 9 – REVERSE RECOVERY TIME

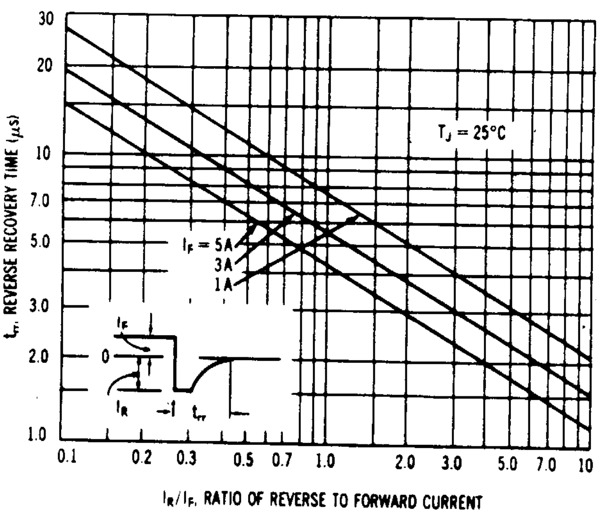


FIGURE 10 – FORWARD RECOVERY TIME

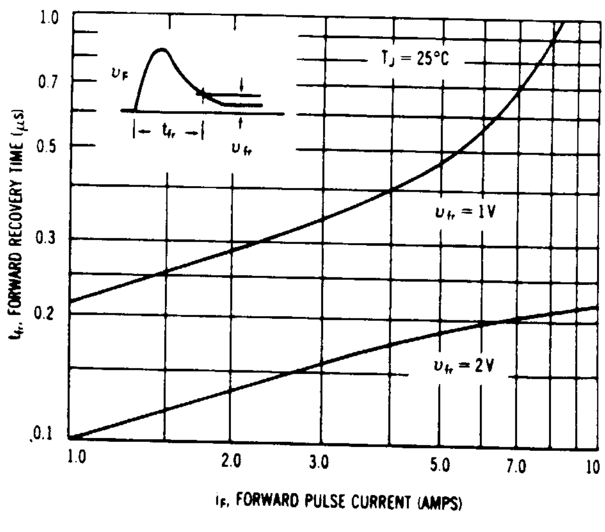


FIGURE 11 – POWER DISSIPATION

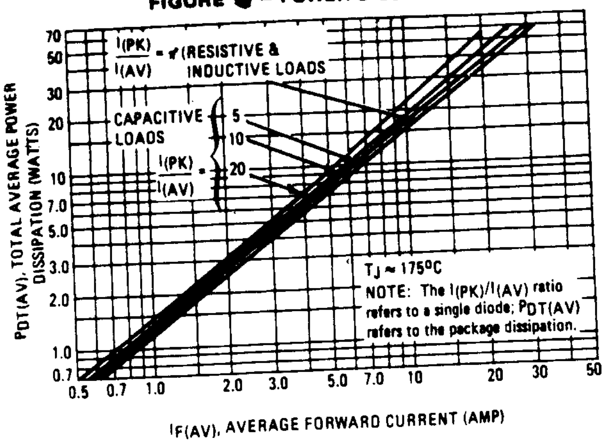
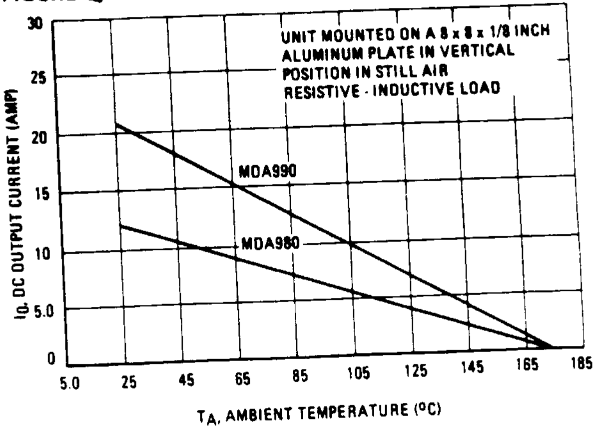


FIGURE 12 – CURRENT VERSUS AMBIENT TEMPERATURE



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

$R_{\theta 1}$ 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 $P_{DT(AV)}$ = 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. ∴ $P_{D2} = P_{D4}$ = 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