

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

MDA3500 Series

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 — 1800 Volts
- UL Recognized
- Cost Effective in Lower Current Applications



SINGLE-PHASE FULL-WAVE BRIDGE

35 AMPERES
50-1000 VOLTS

MAXIMUM RATINGS

Rating (Per Diode)	Symbol	MDA							Unit
		3500	3501	3502	3504	3506	3508	3510	
Peak Repetitive Reverse Voltage	V_{RRM}	50	100	200	400	600	800	1000	Volts
Working Peak Reverse Voltage	V_{RWM}								
DC Blocking Voltage	V_R								
DC Output Voltage									
Resistive Load	V_{dc}	30	62	124	250	380	500	630	Volts
Capacitive Load	V_{dc}	50	100	200	400	600	800	1000	Volts
Sine Wave RMS Input Voltage	V_R (RMS)	35	70	140	280	420	560	700	Volts
Average Rectified Forward Current (Single phase bridge resistive load, 60 Hz, $T_C = 55^\circ\text{C}$)	I_O	35							Amp
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions)	I_{FSM}	400							Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +175							$^\circ\text{C}$

THERMAL CHARACTERISTICS (Total Bridge)

Characteristic	Symbol	Typ	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	1.87	$^\circ\text{C/W}$

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

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (Per Diode) ($I_F = 55\text{ A}$) [*]	V_F	—	1.0	1.1	Volts
Reverse Current (Per Diode) (Rated V_R)	I_R	—	—	10	μA

MECHANICAL CHARACTERISTICS

CASE: Plastic case with an electrically isolated aluminum base.

POLARITY: Terminal designation embossed on case:

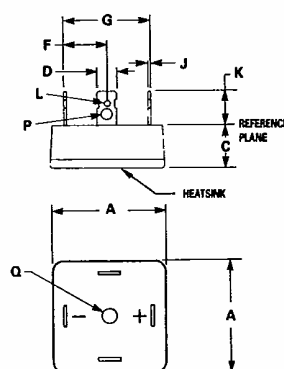
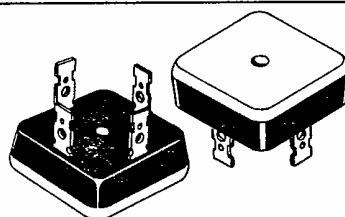
- + DC output
- DC output
- AC not marked

MOUNTING POSITION: Bolt down. Highest heat transfer efficiency accomplished through the surface opposite the terminals. Use silicone grease on mounting surface for maximum heat transfer.

WEIGHT: 40 grams (approx.)

TERMINALS: Suitable for fast-on connections. Readily solderable, corrosion resistant. Soldering recommended for applications greater than 15 amperes.

MOUNTING TORQUE: 20 in-lb max



NOTES:

1. DIMENSION "Q" SHALL BE MEASURED ON HEATSINK SIDE OF PACKAGE.
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	14.50	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

^{*}Pulse Width = 100 ms, Duty Cycle ≤ 2%.

FIGURE 1 — FORWARD VOLTAGE

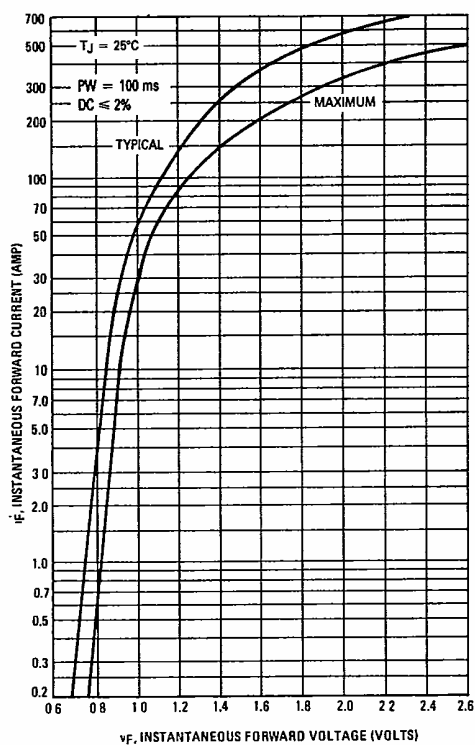


FIGURE 2 — NON REPETITIVE SURGE CURRENT

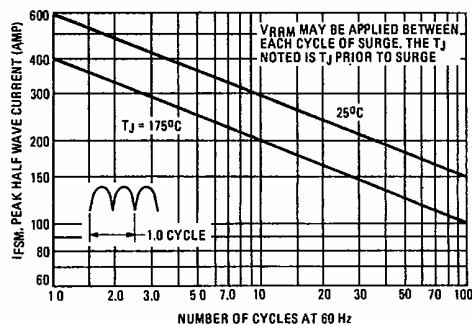


FIGURE 3 — FORWARD VOLTAGE TEMPERATURE COEFFICIENT

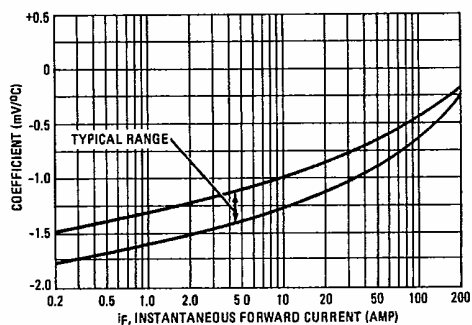


FIGURE 4 — CURRENT DERATING

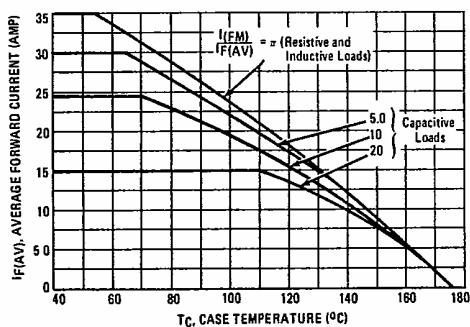


FIGURE 5 — FORWARD POWER DISSIPATION

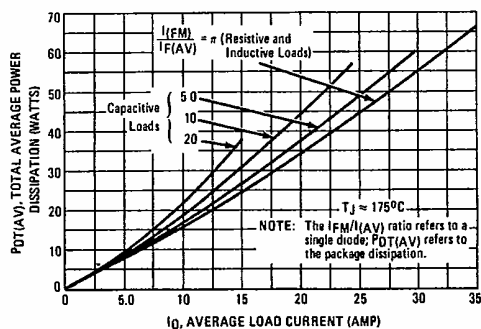
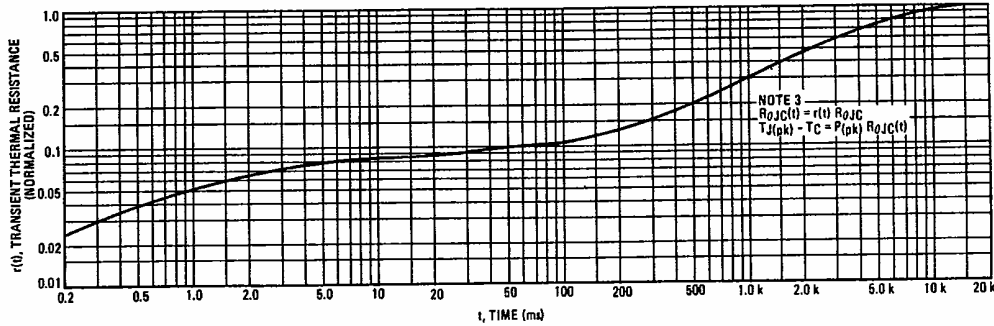


FIGURE 6 -- TYPICAL THERMAL RESPONSE



NOTE 1

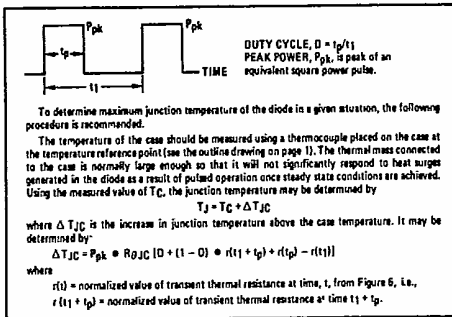


FIGURE 7 -- CAPACITANCE

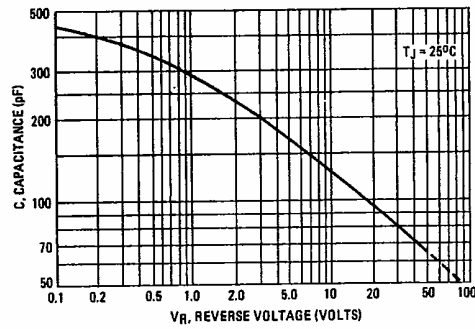


FIGURE 8 -- FORWARD RECOVERY TIME

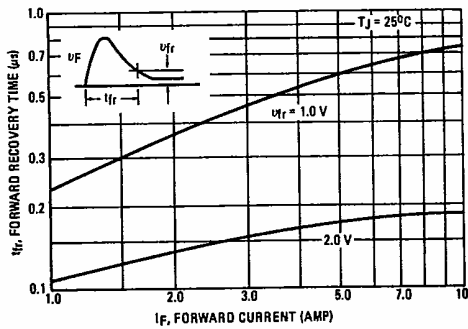


FIGURE 9 -- REVERSE RECOVERY TIME

AMBIENT TEMPERATURE DERATING INFORMATION

FIGURE 10A — THERMALLOY HEATSINK 6005B

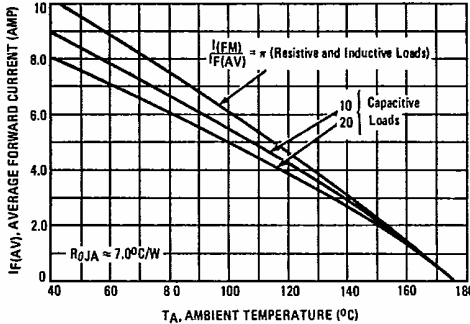
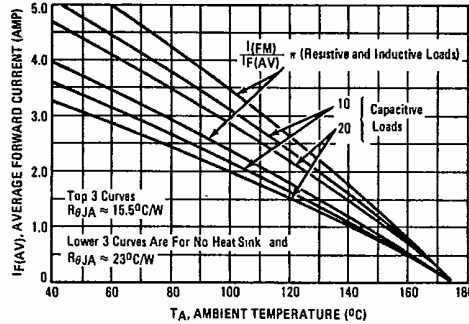


FIGURE 10B — IERC HEATSINK UP3 AND NO HEATSINK



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

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

When the case is used as a reference point, coupling between die is negligible for the MDA3500. When the bridge is used without a heatsink, coupling between die is approximately 70% and $R_{\theta 1}$ is 30°C/W.

$$\therefore R_{\theta(EFF)} = 30 [1 + (3)(.7)] / 4 = 23^\circ\text{C/W}$$

NOTE 3: SPLIT LOAD DERATING INFORMATION

Bridge rectifiers are used in two basic configurations as shown by circuits A and B of Figure 11. The current derating data of Figure 4 applies 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:

$$(6) T_R(\text{Max}) = T_J(\text{Max}) - \Delta T_{J1}$$

Where $T_R(\text{Max})$ is the reference temperature (either case or ambient)

ΔT_{J1} can be calculated using equation (3) in Note 2.

For example, to determine $T_C(\text{Max})$ for the MDA3500 with the following capacitive load conditions.

$I_A = 20$ A average with a peak of 60 A

$I_B = 10$ A average with a peak of 70 A

First calculate the peak to average ratio for I_A . $I(pK)/I(AV) = 60/20 = 3.0$. (Note that the peak to average ratio is on a per diode basis and each diode provides 10 A average).

From Figure 5, for an average current of 20 A and an $I(pK)/I(AV) = 3.0$ 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 $I(pK)/I(AV) = 14$.

Thus, the package power dissipation for 10 A is 20 watts or 5.0 watts/diode $\therefore P_{D2} = P_{D4} = 5.0$ watts.

The maximum junction temperature occurs in diode #1 and #3. From equation (3) for diode #1 $\Delta T_{J1} = (7.5)(10)$, since coupling is negligible.

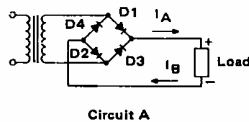
$$\Delta T_{J1} \approx 75^\circ\text{C}$$

$$\text{Thus } T_C(\text{Max}) = 175 - 75 = 100^\circ\text{C}$$

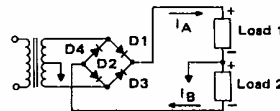
The total package dissipation in this example is:

$P_{DT(AV)} = 2 \times 10 + 2 \times 5.0 = 30$ watts, which must be considered when selecting a heat sink.

FIGURE 11— BASIC CIRCUIT USES FOR BRIDGE RECTIFIERS



Circuit A



Circuit B