MDA1200 MDA1201 MDA1202 MDA1204 MDA1206

MOTOROLA

Designers Data Sheet

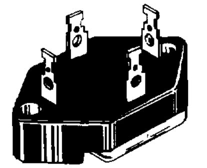
FULL-WAVE BRIDGE RECTIFIER ASSEMBLIES

. . . utilizing individual MR2500 Series plastic button rectifiers interconnected and then enclosed in plastic to provide a single rugged package. Devices are available with voltages from 50 to 600 Volts with these additional features.

- Slip-on Terminals
- High Surge Capability
- Output Current Ratings for both Case and Ambient Conditions

SINGLE-PHASE FULL-WAVE BRIDGE

12 AMPERE
50 thru 600 VOLTS



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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°C unless otherwise noted)

Rating	Symbol	MDA 1200	MDA 1201	MDA 1202	MDA 1204	MDA 1206	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	Volts
DC Output Voltage Resistive Load Capacitive Load	Vdc	 30 50	 62 100	 124 200	 250 400	 380 600	Volts
Average Rectified Forward Current (Single-phase bridge, resistive load 60 Hz) T_A = 55°C (unmounted) T_A = 55°C (7" x 7" AL Chassis) T_C = 100°C	I_O	← 4.5 → ← 10 → ← 12 →					Amp
Nonrepetitive 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 →					°C

THERMAL CHARACTERISTICS

Characteristic		Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	Each Die	$R_{\theta JA}$	28	°C/W
	Effective Bridge	$R_{\theta JA(EFF)}$	17.15	°C/W
Thermal Resistance, Junction to Case	Each Die	$R_{\theta JC}$	10	°C/W
	Effective Bridge	$R_{\theta JC(EFF)}$	3.75	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Typ	Max	Unit
Instantaneous Forward Voltage (Per Diode) (1) (i_F = 18.9 A) (i_F = 18.9 A, T_J = 175°C)	v_F	 0.94 —	 1.05 0.9	Volts
Reverse Current (Rated V_R applied to ac terminals, + and − terminals open)	I_R	—	0.5	mA

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

MECHANICAL CHARACTERISTICS

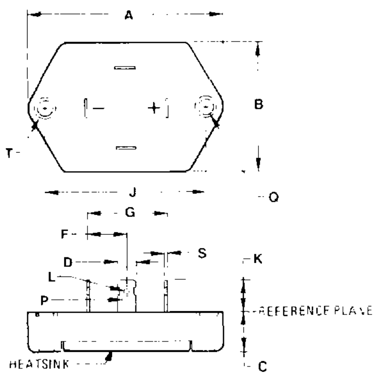
CASE Transfer molded plastic case

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

MOUNTING POSITION: Any, highest heat transfer efficiency accomplished through the surface opposite the terminals

WEIGHT: 41 grams (approx.)

TERMINALS Readily solderable, corrosion resistant, suitable for slip-on terminals



NOTE
1. MOUNTING HOLES WITHIN 0.25 mm (0.010) DIA OF TRUE POSITION AT MAXIMUM MATERIAL CONDITION.
2. COUNTERSUNK MOUNTING HOLES FOR 321-02 ONLY: 3.18 (0.125) DEEP.
3. DIMENSIONS F AND G SHALL BE MEASURED AT THE REFERENCE PLANE.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	53.98	55.12	2.125	2.170
B	34.80	35.18	1.370	1.385
C	12.45	13.49	0.490	0.531
D	6.10	6.60	0.240	0.260
F	14.00	14.50	0.550	0.571
G	28.00	29.00	1.100	1.142
J	43.94 BSC		1.730 BSC	
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	3.81	4.32	0.150	0.170
S	0.71	0.86	0.028	0.034

CASE 321-01

FIGURE 1 – FORWARD VOLTAGE

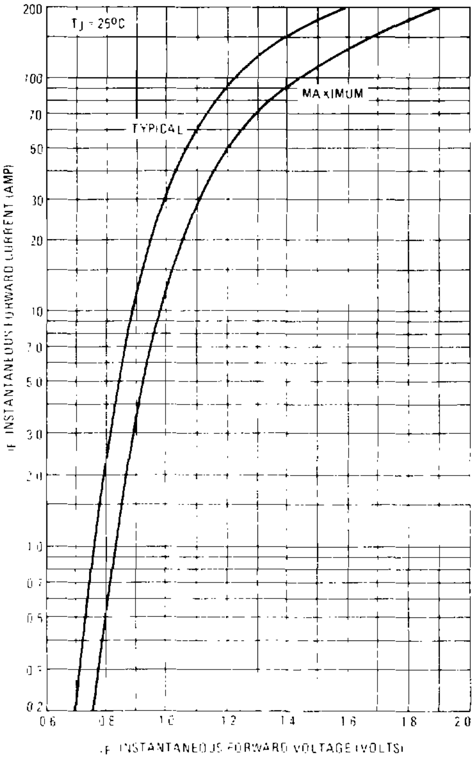


FIGURE 2 – NON-REPETITIVE SURGE CURRENT

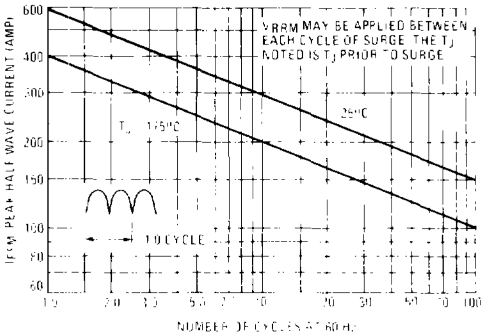


FIGURE 3 – FORWARD VOLTAGE TEMPERATURE COEFFICIENT

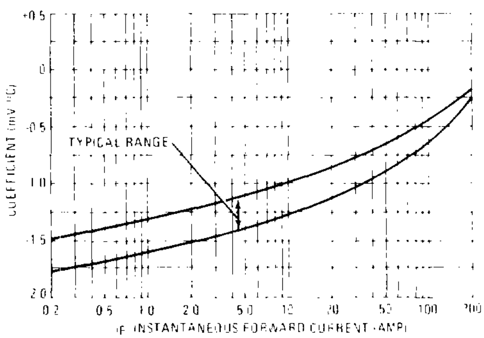


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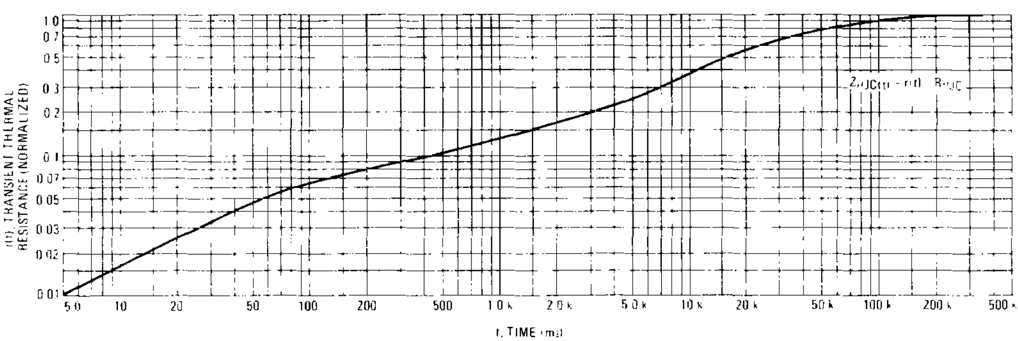
FIGURE 4 – TYPICAL THERMAL RESPONSE



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MAXIMUM CURRENT RATINGS, BRIDGE OPERATION

FIGURE 5 – AMBIENT TEMPERATURE DERATING

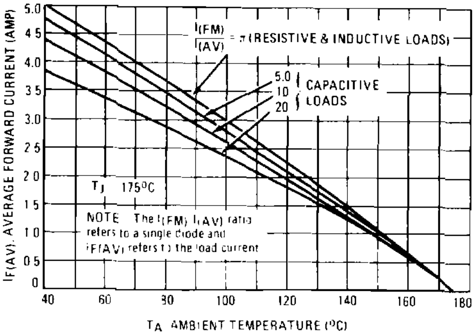
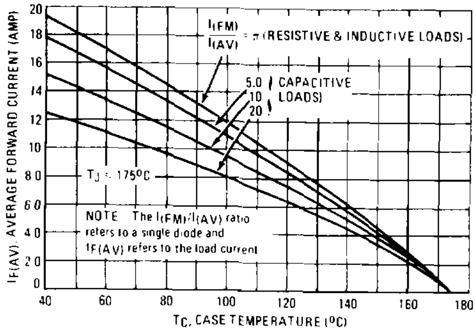


FIGURE 6 – CASE TEMPERATURE DERATING



TYPICAL DYNAMIC CHARACTERISTICS (EACH DIODE)

FIGURE 7 – RECTIFICATION WAVEFORM EFFICIENCY

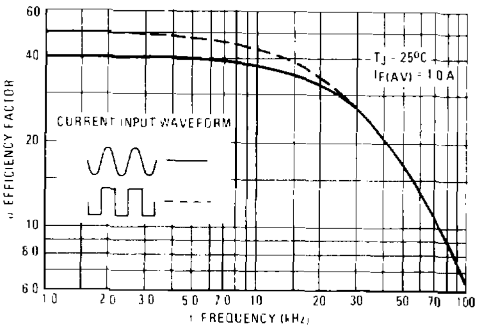


FIGURE 8 – CAPACITANCE

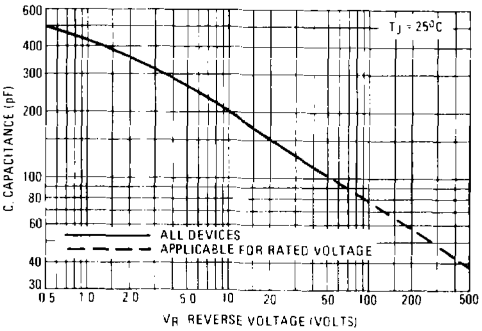


FIGURE 9 – REVERSE RECOVERY TIME

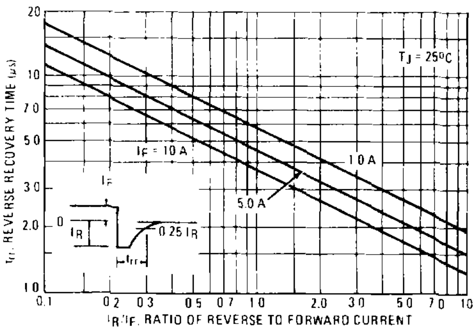


FIGURE 10 – FORWARD RECOVERY TIME

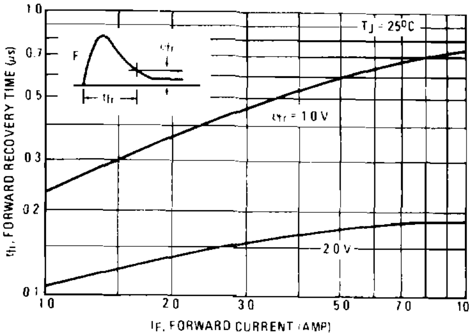
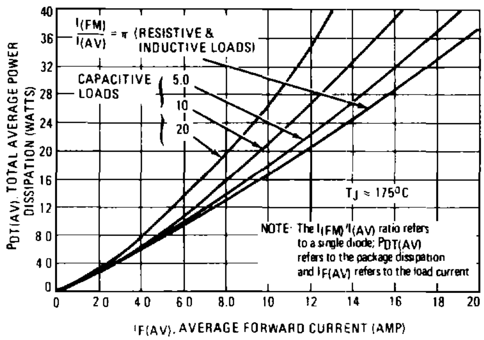


FIGURE 11 – POWER DISSIPATION



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 T_{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 MDA1200 rectifier assembly, thermal coupling between opposite diodes is 10% and between adjacent diodes is 20% when the case temperature is used as a reference. Similarly for ambient mounting, thermal coupling between opposite diodes is 45% and between adjacent diodes is 50%.

NOTE 2 – SPLIT LOAD DERATING INFORMATION

Bridge rectifiers are used in two basic configurations as shown in circuits A and B of Figure 12. 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 MDA1200 with the following capacitive load conditions:

I_A = 10 A average with a peak of 46 A

I_B = 5 0 A average with a peak of 35 A

First calculate the peak to average ratio for I_A. $I_{(FM)}/I_{(AV)}$ = 46/5.0 = 9.2. (Note that the peak to average ratio is on a per diode basis and each diode provides 5 0 A average).

From Figure 11, for an average current of 10 A and an $I_{(FM)}/I_{(AV)}$ = 9.2 read $P_{DT(AV)}$ = 21 watts or 5 25 watts/diode Thus $P_{D1} = P_{D3}$ = 5 25 watts.

Similarly, for a load current I_B of 5 0 A, diode #2 and diode #4 each see 2 5 A average resulting in an $I_{(FM)}/I_{(AV)}$ = 14

Thus, the package power dissipation for 5 0 A is 10 watts or 2 5 watts/diode. . $P_{D2} = P_{D4}$ = 2.5 watts.

The maximum junction temperature occurs in diodes #1 and #3 From equation (3) for diode #1 ΔT_{J1} = 10 [5.25 + 0 1 (2 5) + 0 2 (5.25) + 0.2 (2 5)].

$\Delta T_{J1} \approx 70°C$

Thus $T_{C(MAX)}$ = 175 - 65 = 105°C

The total package dissipation in this example is

P_{DT} = 2 x 5 25 + 2 x 2.5 = 15 5 watts

FIGURE 12 – BASIC CIRCUIT USES FOR BRIDGE RECTIFIERS