MBR1520
MBR1530
MBR1540

MOTOROLA

HOT CARRIER POWER RECTIFIER

. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State of the art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- High Surge Capacity

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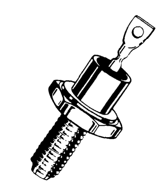
SCHOTTKY BARRIER RECTIFIERS

15 AMPERE
20,30,40 VOLTS



MAXIMUM RATINGS

Rating	Symbol	MBR1520	MBR1530	MBR1540	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	Volts
Non-Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	Volts
Average Rectified Forward Current ($V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $T_C = 80^oC$)	I_O	← 15 →			Amp
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)} = 0$, $R_{\theta JA} = 5.0^oC/W$	T_A	95	90	85	^oC
Non-Repetitive Peak Surge Current (surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	← 500 (for 1 cycle) →			Amp
Operating and Storage Junction Temperature Range (Reverse voltage applied)	T_J, T_{stg}	← -65 to +125 →			^oC
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	← 150 →			^oC

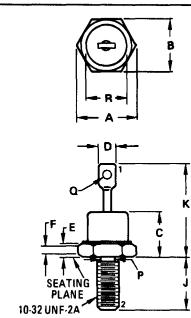
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.5	$^oC/W$

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

Characteristic	Symbol	Min	Typ	Max	Unit
Maximum Instantaneous Forward Voltage (1) ($i_F = 15$ Amp)	v_F	–	–	0.550	Volts
Maximum Instantaneous Reverse Current @ rated dc Voltage (1) $T_C = 100^oC$	i_R	– –	– –	10 75	mA

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



STYLE 2:
TERM 1. ANODE
2. CATHODE

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	11.94	12.83	0.470	0.505
B	10.77	11.10	0.424	0.437
C	–	10.29	–	0.405
D	–	6.35	–	0.250
E	1.91	4.45	0.075	0.175
F	1.52	–	0.060	–
J	10.72	11.51	0.422	0.453
K	–	20.32	–	0.800
P	4.14	4.80	0.163	0.189
Q	1.52	–	0.060	–
R	–	10.77	–	0.424

All JEDEC dimensions and notes apply

CASE 56
D0-4

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed

FINISH: All external surfaces corrosion resistant and terminal lead is readily solderable.

POLARITY: Cathode to Case

MOUNTING POSITION: Any

STUD TORQUE: 15 in. lb. max

NOTE 1: DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above 0.2 V_{RWM}. Proper derating may be accomplished by use of equation (1):

$$T_{A(max)} = T_{J(max)} - R_{\theta JA}\, P_{F(AV)} - R_{\theta JA}\, P_{R(AV)} \quad (1)$$

where

$T_{A(max)}$ = Maximum allowable ambient temperature

$T_{J(max)}$ = Maximum allowable junction temperature (125°C or the temperature at which thermal runaway occurs, whichever is lowest).

$P_{F(AV)}$ = Average forward power dissipation

$P_{R(AV)}$ = Average reverse power dissipation

$R_{\theta JA}$ = Junction-to-ambient thermal resistance

Figures 1, 2 and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2):

$$T_R = T_{J(max)} - R_{\theta JA}\, P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R_{\theta JA}\, P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where T_J = 125°C, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2 and 3 as a difference in the rate of change of the slope in the vicinity of 115°C. The data of Figures 1, 2 and 3 is based upon dc conditions. For use in common rectifier circuits, Table I indicates suggested factors for an equivalent dc voltage to use for conservative design; i.e.:

$$V_{R(equiv)} = V_{in(PK)} \times F \quad (4)$$

The Factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

Example: Find $T_{A(max)}$ for MBR1540 operated in a 12-Volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 10 A ($I_{F(AV)}$ = 5 A), $I_{(PK)}/I_{(AV)}$ = 20, Input Voltage = 10 V(rms), $R_{\theta JA}$ = 5°C/W.

Step 1: Find $V_{R(equiv)}$. Read F = 0.65 from Table I ∴
$V_{R(equiv)} = (1.41)(10)(0.65) = 9.18$ V

Step 2: Find T_R from Figure 3. Read T_R = 121°C @ V_R = 9.18 & $R_{\theta JA}$ = 5°C/W

Step 3: Find $P_{F(AV)}$ from Figure 4. Read $P_{F(AV)}$ = 10.5 W @ $\frac{I_{(PK)}}{I_{(AV)}} = 20$ & $I_{F(AV)}$ = 5 A

Step 4: Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 121-(5)(10.5) = 68.5°C).

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TABLE I – VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped (1)(2)	
Load	Resistive	Capacitive (1)	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1.0	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

(1) Note that $V_{R(PK)} \approx 2\, V_{in(PK)}$

(2) Use line to center tap voltage for V_{in}.

FIGURE 1 – MAXIMUM REFERENCE TEMPERATURE – MBR1520

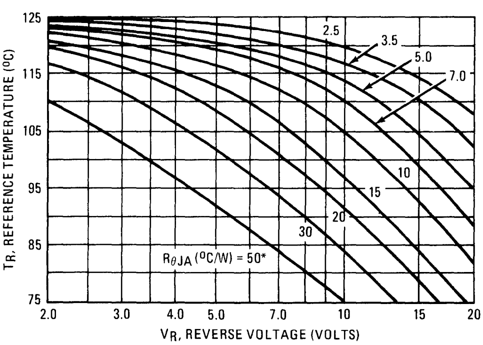


FIGURE 2 – MAXIMUM REFERENCE TEMPERATURE – MBR1530

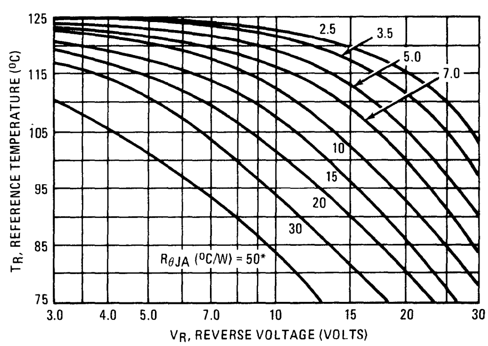
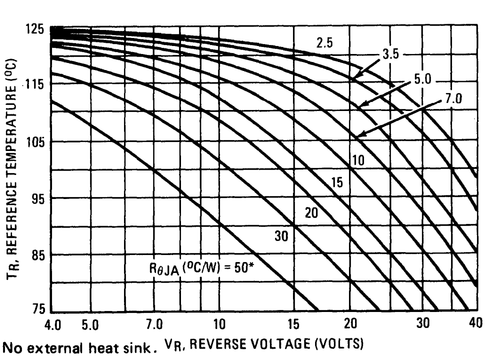


FIGURE 3 – MAXIMUM REFERENCE TEMPERATURE – MBR1540



*No external heat sink.

FIGURE 4 – FORWARD POWER DISSIPATION

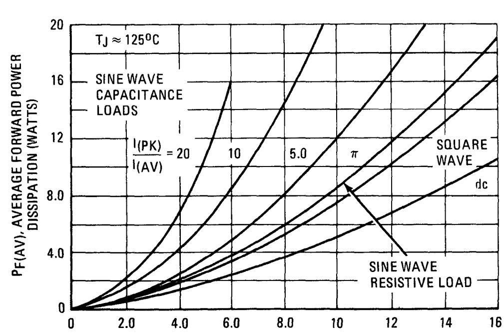


FIGURE 5 — TYPICAL FORWARD VOLTAGE

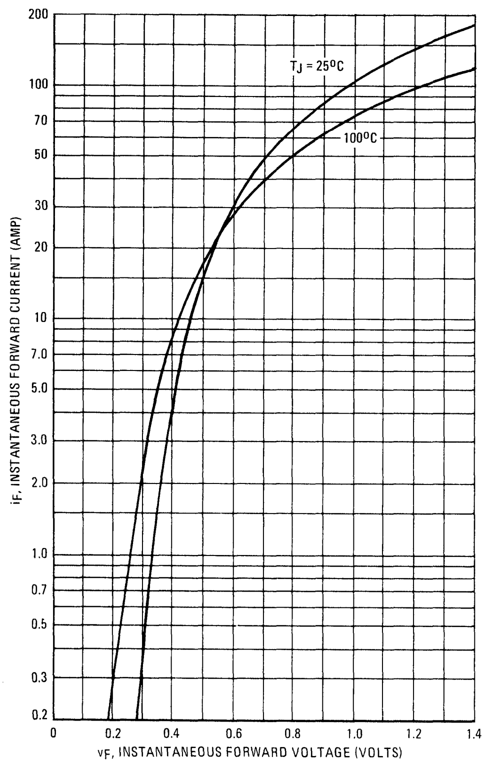


FIGURE 6 — MAXIMUM SURGE CAPABILITY

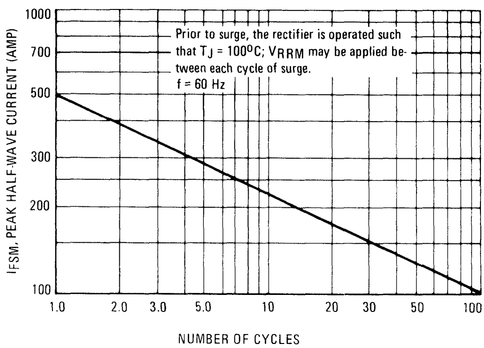


FIGURE 7 — CURRENT DERATING

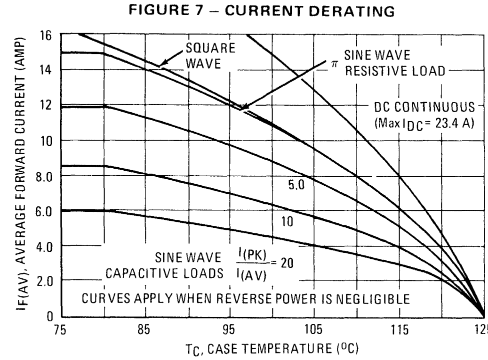


FIGURE 8 — THERMAL RESPONSE

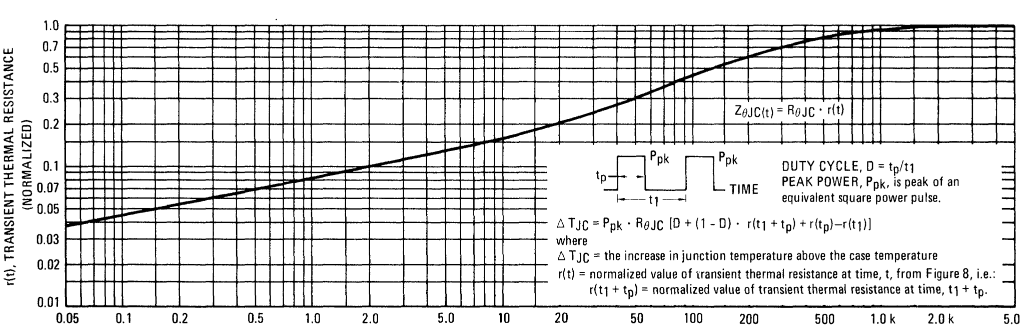


FIGURE 9 – NORMALIZED REVERSE CURRENT

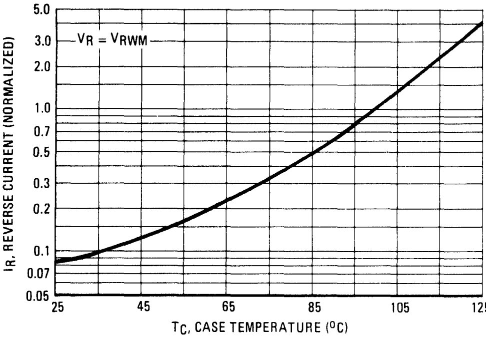


FIGURE 10 – TYPICAL REVERSE CURRENT

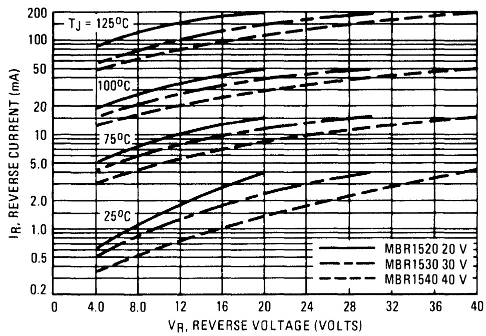
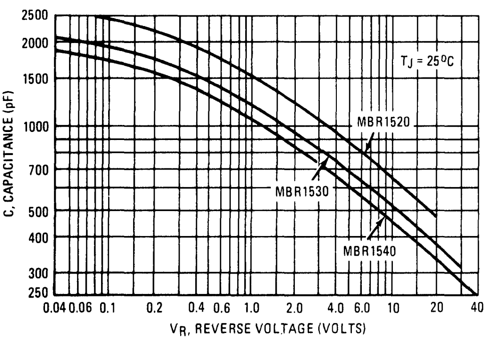


FIGURE 11 – CAPACITANCE



NOTE 2 – HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 11).

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 per cent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.