MOTOROLA

DL151/D

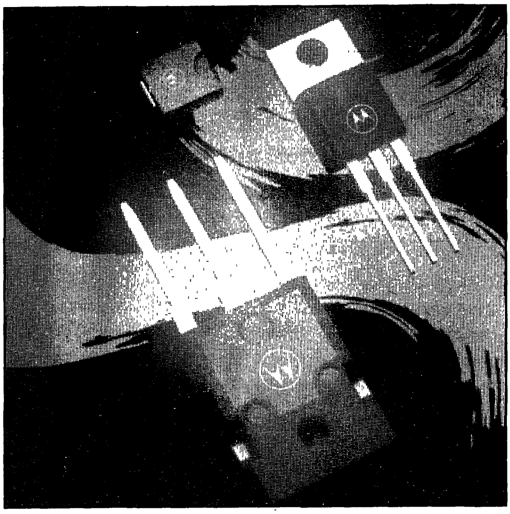
Rectifier

Device Data

Replaces DL125/D

MOTOROLA RECTIFIER DEVICE DATA

Q4/92
DL151



MOTOROLA

RECTIFIER DEVICE DATA

This book presents technical data for Motorola's broad line of rectifiers. Complete specifications are provided in the form of data sheets and accompanying selection guides provide a quick comparison of characteristics to simplify the task of choosing the best device for a circuit.

The information in this book has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies.

1st Edition

Printed in U.S.A.

MOTOROLA DEVICE CLASSIFICATIONS

In an effort to provide up-to-date information to the customer regarding the status of any given device, Motorola has classified all devices into three categories: Preferred devices, Current products and Not Recommended for New Design products.

A Preferred type is a device which is recommended as a first choice for future use. These devices are "preferred" by virtue of their performance, price, functionality, or combination of attributes which offer the overall "best" value to the customer. This category contains both advanced and mature devices which will remain available for the foreseeable future.

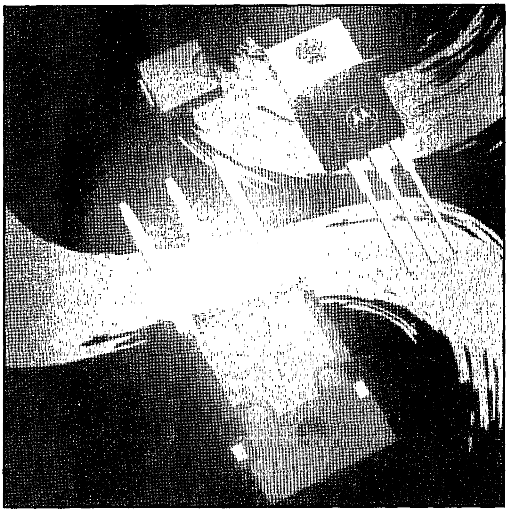
"Preferred devices" are identified in the Selector Guide Section and the Data Sheet Section.

Device types identified as "current" may not be a first choice for **new** designs, but will continue to be available because of the popularity and/or standardization or volume usage in current production designs. These products can be acceptable for new designs but the preferred types are considered better alternatives for long term usage.

Any device that has not been identified as a "preferred device" is a "current" device.

Products designated as "Not Recommended for New Design" may become obsolete as dictated by poor market acceptance, or a technology or package that is reaching the end of its life cycle. Devices in this category have an uncertain future and do not represent a good selection for new device designs or long term usage.

"Not Recommended for New Design" devices are identified as such within the appropriate table in the Selector Guide Section of this data book.



Index and Cross Reference

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INDEX AND CROSS REFERENCE

The following table represents an index and cross-reference guide for all rectifier devices which are either manufactured directly by Motorola or for which Motorola manufactures a suitable equivalent. Where the Motorola part number differs from the industry part number, the Motorola device is a "form, fit and function" replacement for the industry type number — however, subtle differences in characteristics and/or specifications may exist. Where multiple replacement parts appear for a given industry part number, the page number represents the first replacement device listed.

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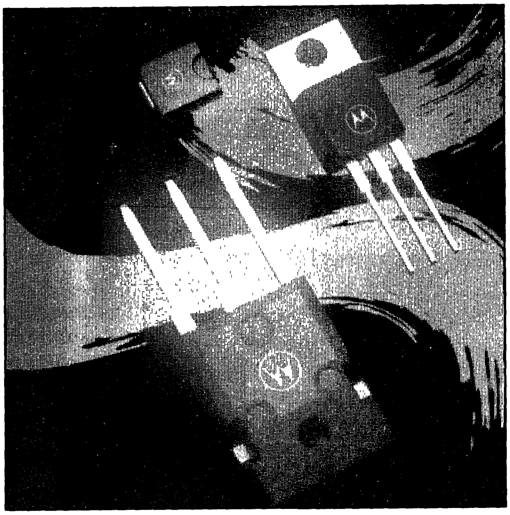
VSK920		MBR1535CT	3-96
VSK935		MBR1535CT	3-96
VSK945		MBR1545CT	3-96



Selector Guide 2

Continuing investment in research and development for discrete products has led to a rectifier manufacturing facility that matches the precision and versatility of the most advanced integrated circuits. As a result, Motorola's silicon rectifiers span all applications categories with quality levels capable of passing the most stringent environmental tests – including those for automotive under-hood applications.

Product Highlights:

- Application specific rectifiers — SCANSWITCH™ devices for high resolution monitors, MEGAHERTZ™ series rectifiers for high frequency switching power supplies and automotive transient suppressors.
- Schottky rectifiers for low voltage (15 to 200 volts), high current (to 600 amps) requirements in switching power supplies.
- Fast and Ultrafast rectifiers with reverse recovery times as low as 25 ns to complement the Schottky devices for higher voltage requirements in high frequency applications.
- A full line of low-cost, general-purpose rectifiers with forward currents from 1 to 50 amps and breakdown voltages from 50 to 1000 volts.
- A wide variety of package options to match virtually any potential requirement.

Contents

Application Specific Rectifiers

The focus for Rectifier Products continues to be on Schottky and Ultrafast technologies, with process and packaging improvements to achieve greater efficiency in high frequency switching power supplies, high current mainframe supplies, and high resolution monitors. Our new product thrust is intended to be more "application specific" than in the past, while continuing to strive for broad market acceptance.

MEGAHERTZ Series — This group of Schottky and Ultrafast rectifiers are designed to provide improved efficiency in very high frequency switching power supplies with low V_F (0.41 volts), high voltage (to 200 volts) Schottkys and faster Ultrafast (t_{rr} = 28 nsec.).

Table 1 — MEGAHERTZ

Device	I_O (Amps)	V_{RRM} (Volts)	Maximum		t_{rr} (Nanosecond)
			V_F @ Rated I_O and Temp. (Volts)	I_R @ Rated V_{RRM} / 25°C (mAmps)	
MBR2030CTL	20	30	0.48	5	(5)
MBR2535CTL	25	35	0.41	20	(5)
MBR20200CT	20	200	0.9	1	(5)
MURH840CT	8	400	1.7	0.01	28
MURH860CT	8	600	2.0	0.01	28

(5) Schottky barrier device.

2

SCANSWITCH Series — This group of Fast and Ultrafast rectifiers are designed for improved performance in very high resolution monitors and work stations where forward recovery time (t_{fr}) and high voltage (1200–1500 volts) are primary considerations.

Table 2 — SCANSWITCH

Device	I_O (Amps)	V_{RRM} (Volts)	Maximum		
			t_{fr} (Nanosecond)	t_{rr} (Nanosecond)	V_{RFM}(6) (Volts)
MUR5150E	5	1500	225	175	20
MR10120E	10	1200	175	1000	14
MUR10120E	10	1200	175	175	14
MR10150E	10	1500	175	1000	16
MUR10150E	10	1500	175	175	16

(6) V_{RFM} = Maximum Transient Overshoot Voltage.

Automotive transient suppressors are designed for protection against over-voltage conditions in the auto electrical system including the "LOAD DUMP" phenomenon that occurs when the battery open circuits while the car is running.

Table 3 — Automotive Transient Suppressors

Device	I_O (Amps)	V_{RRM} (Volts)	$V_{(BR)}$ (Volts)	I_{RSM}(7) (Amps)	T (°C)
MR2535L	35	20	24–32	110	175

(7) Time constant = 10 ms, Duty Cycle ≤ 1%, T_C = 25°C.

Devices listed in bold, italic are Motorola preferred devices.

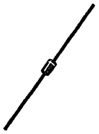
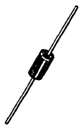
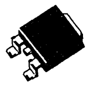
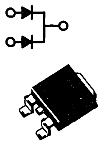
Schottky Rectifiers

SWITCHMODE™ Schottky power rectifiers with the high speed and low forward voltage drop characteristic of Schottky's metal/silicon junctions are produced with ruggedness and temperature performance comparable to silicon-junction rectifiers. Ideal for use in low-voltage, high-frequency power supplies, and as very fast clamping diodes, these devices feature switching times less than 10 ns, and are offered in current ranges from 1 to 600 amperes, and reverse voltages to 200 volts.

In some current ranges, devices are available with junction temperature specifications of 125°C, 150°C, 175°C. Devices with higher T_J ratings can have significantly lower leakage currents, but higher forward-voltage specifications. These parameter tradeoffs should be considered when selecting devices for applications that can be satisfied by more than one device type number.

All devices are connected cathode-to-case or cathode-to-heatsink, where applicable. Reverse polarity may be available on some devices upon special request. Contact your Motorola representative for more information.

Table 4 — Schottky Rectifiers

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)							
	1		3				5	6
	59-04 Plastic Cathode = Polarity Band	403A-03 SMB Cathode = Notch	267-03 Plastic Cathode = Polarity Band		403-03 SMC Cathode = Notch	369A-11 DPAK Style 3	60-01 Metal Style 1	369A-11 DPAK Style 3
V_{RRM} (Volts)								
20	1N5817		1N5820	MBR320		MBRD320	1N5823	MBRD620CT
25								
30	1N5818		1N5821	MBR330		MBRD330	1N5824	MBRD630CT
35								
40	***1N5819***	***MBRS140T3***	***1N5822***	***MBR340***	***MBRS340T3***	***MBRD340***	***1N5825***	***MBRD640CT***
45								
50	MBR150			MBR350		MBRD350		MBRD650CT
60	***MBR160***			***MBR360***		***MBRD360***		***MBRD660CT***
70	MBR170			MBR370				
80	MBR180			MBR380				
90	MBR190			MBR390				
100	***MBR1100***	***MBRS1100T3***		***MBR3100***				
I_{FSM} (Amperes)	25	40	80	80	80	75	500	75
Max V_F @ $I_{FM} = I_O$	0.6(2) $T_L = 25°C$	0.6(2) $T_C = 25°C$	0.525(2) $T_L = 25°C$	0.74(2) $T_L = 25°C$	0.525(2) $T_L = 25°C$	0.45 $T_C = 125°C$	0.38(2) $T_C = 25°C$	0.85 $T_C = 125°C$
T_J (Max) °C	125	125	125	150	125	150	125	150

(1) I_O is total device output current.
(2) Values are for 40 volt units, lower voltage parts exhibit lower V_F.

Devices listed in bold, italic are Motorola preferred devices.

SCHOTTKY RECTIFIERS (continued)

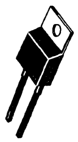
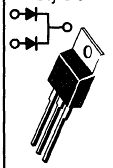
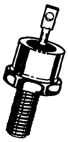
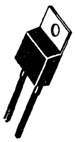
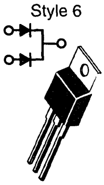
There are many other standard features in Motorola Schottky rectifiers that give added performance and reliability.

1. GUARDRINGS are included in all Schottky die for reverse voltage stress protection from high rates of dv/dt to virtually eliminate the need for snubber networks. The guardring also operates like a zener and avalanches when subjected to voltage transients.

2. MOLYBDENUM DISCS on both sides of the die minimize fatigue from power cycling in all metal products. The plastic TO-220 devices have a special solder formulation for the same purpose.

3. QUALITY CONTROL monitors all critical fabrication operations and performs selected stress tests to assure constant processes.

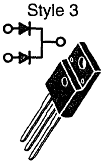
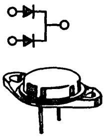
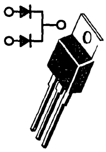
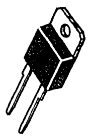
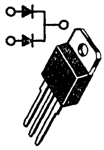
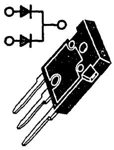
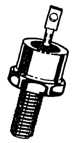
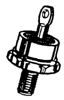
Table 4 — Schottky Rectifiers (continued)

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)							
	7.5	**10**	**15**		**16**	**20**	**25**	
V_{RRM} (Volts)	221B-02 (TO-220AC) Style 1 		221A-06 (TO-220AB) Style 6 	56-03 (DO-203AA) Style 2 	221B-02 (TO-220AC) Style 1 	221A-06 (TO-220AB) Style 6 	56-03 (DO-203AA) Style 2 	
15						MBR2015CTL		
20				1N5826			1N5829	
30				1N5827		***MBR2030CTL***	1N5830	1N6095
35	MBR735	MBR1035	MBR1535CT		MBR1635	MBR2035CT ***MBR2535CTL***		
40				***1N5828***			***1N5831***	***1N6096***
45	***MBR745***	***MBR1045***	***MBR1545CT***		***MBR1645***	***MBR2045CT***		***SD41***
50								
60		***MBR1060***				***MBR2060CT***		
70		MBR1070				MBR2070CT		
80		MBR1080				MBR2080CT		
90		MBR1090				MBR2090CT		
100		***MBR10100***				***MBR20100CT***		
200						***MBR20200CT***		
I_{FSM} (Amperes)	150	150	150	500	150	150	800	400
Max V_F @ $I_{FM} = I_O$	0.57 T_C = 125°C	0.57 T_C = 125°C	0.72 T_C = 125°C	0.5 T_C = 125°C	0.57 T_C = 125°C	0.72(2) T_C = 125°C	0.48(2) T_C = 25°C	0.86 @ 78.5 A T_C = 70°C
T_J (Max) °C	150	150	150	150	150	150	125	150

(1) I_O is total device output current.
(2) Values are for 40 volt units, lower voltage parts exhibit lower V_F.

Devices listed in bold, italic are Motorola preferred devices.

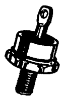
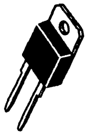
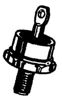
Table 4 — Schottky Rectifiers (continued)

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)							
	25	30					35	40
V_{RRM} (Volts)	221D-02 ISOLATED TO-220 Style 3 	11-03 (TO-204AA) Style 4 	221A-06 (TO-220AB) Style 6 	340E-01 (TO-218) Style 1 	340D-01 (TO-218AC) Style 2 	340F-03 (TO-247) Style 2 	56-03 (DO-203AA) Style 2 	257-01 (DO-203AB) Style 2 
15								
20		MBR3020CT					MBR3520	1N5832
25								
30								1N5833
35	MBRF2535CT	MBR3035CT	MBR2535CT		MBR3035PT	MBR3035WT	MBR3535	
40								***1N5834***
45	***MBRF2545CT***	***MBR3045CT*** ***SD241***	***MBR2545CT***	***MBR3045***	***MBR3045PT***	***MBR3045WT***	***MBR3545***	
50								
60								
70								
80								
90								
100								
I_{FSM} (Amperes)	150	400	300	300	400	350	600	800
Max V_F @ $I_{FM} = I_O$	0.62 @ 12.5 A T_C = 125°C	0.72 T_C = 125°C	0.73 T_C = 125°C	0.62 T_C = 100°C	0.72 T_C = 125°C	0.72 T_C = 125°C	0.55 T_C = 25°C	0.59 T_C = 25°C
T_J (Max) °C	150	150	150	150	150	150	150	125

(1) I_O is total device output current.

Devices listed in bold, italic are Motorola preferred devices.

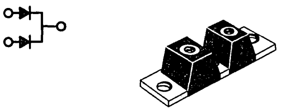
Table 4 — Schottky Rectifiers (continued)

V_{RRM} (Volts)	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)						
	50		60		65	75	80
	257-01 (DO-203AB) Style 2 	340E-01 (TO-218) Style 1 	257-01 (DO-203AB) Style 2 				
15				MBR6015L			
20				MBR6020L			
25		***MBR5025L***		MBR6025L			
30	1N6097			***MBR6030L***			
35			MBR6035		MBR6535	MBR7535	MBR8035
40	***1N6098***						
45	***SD51***		***MBR6045***		***MBR6545***	***MBR7545***	***MBR8045***
50							
60							
70							
80							
90							
100							
I_{FSM} (Amperes)	800	500	800	1000	800	1000	1000
Max V_F @ $I_{FM} = I_O$	0.86 @ 157 A T_C = 70°C	0.65(2) T_C = 150°C	0.6(2) T_C = 125°C	0.38 T_C = 150°C	0.62 T_C = 150°C	0.6(2) T_C = 125°C	0.59 T_C = 150°C
T_J (Max) °C	125	150	150	150	175	150	175

(1) I_O is total device output current.
(2) Values are for 40 volt units, lower voltage parts exhibit lower V_F.

Devices listed in bold, italic are Motorola preferred devices.

Table 4 — Schottky Rectifiers (continued)

V_{RRM} (Volts)	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)[1]			
	120	200	300	600
	357C-03 POWERTAP™ Cathode = Mounting Plate Anode = Terminal 			
15		MBR20015CTL		
20		MBR20020CTL		
25		MBR20025CTL		
30		***MBR20030CTL***		
35	MBR12035CT	MBR20035CT	MBR30035CT	MBR60035CTL
40				
45	***MBR12045CT***	***MBR20045CT***	***MBR30045CT***	
50	MBR12050CT	MBR20050CT	MBR30050CT	
60	***MBR12060CT***	***MBR20060CT***	***MBR30060CT***	
70				
80				
90				
100				
I_{FSM} (Amperes)	800	1500	2500	4000
Max V_F @ $I_{FM} = I_O$	0.62 T_C = 175°C	0.48 T_C = 150°C	0.64 T_C = 125°C	0.50 T_C = 100°C
T_J (Max) °C	175	175	175	150

(1) I_O is total device output current.

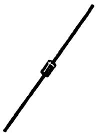
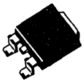
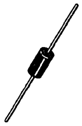
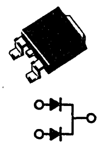
Devices listed in bold, italic are Motorola preferred devices.

Ultrafast Recovery Rectifiers

The Ultrafast Recovery Rectifiers, with reverse times of 25 to 100 nanoseconds, are expanding the SWITCHMODE rectifier family. They complement the broad array of Schottky devices for use in the higher voltage outputs and internal circuitry of switching power supplies as operating frequencies increase from 20 kHz to 250 kHz and beyond. Additional package styles and operating current levels are planned.

All devices are connected cathode-to-case or cathode-to-heatsink, except where noted. Contact your Motorola representative for more information.

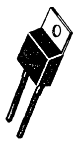
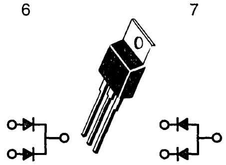
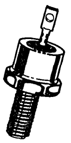
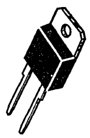
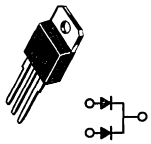
Table 5 — Ultrafast Recovery Rectifiers

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)[1]							
	1		3		4	6		8
	59-04 Plastic Cathode = Polarity Band	403A-03 SMB Cathode = Notch	403-03 SMC Cathode = Notch	369A-11 DPAK Style 3	267-03 Plastic Cathode = Polarity Band	369A-11 DPAK Style 3	221A-06 (TO-220AB) Style 6	221B-02 (TO-220AC) Style 1
V_{RRM} (Volts)								
50	MUR105			MURD305	MUR405	MURD605CT	MUR605CT	MUR805
100	MUR110			MURD310	MUR410	MURD610CT	MUR610CT	MUR810
150	MUR115			MURD315	MUR415	MURD615CT	MUR615CT	MUR815
200	***MUR120***	***MURS120T3***	***MURS320T3***	***MURD320***	***MUR420***	***MURD620CT***	***MUR620CT***	***MUR820***
300	MUR130				MUR430			MUR830
400	MUR140				MUR440			MUR840
500	MUR150				MUR450			MUR850
600	***MUR160***	***MURS160T3***	***MURS360T3***		***MUR460***			***MUR860***
700	MUR170E				MUR470E			MUR870E
800	MUR180E				MUR480E			MUR880E
900	MUR190E				MUR490E			MUR890E
1000	***MUR1100E***				***MUR4100E***			***MUR8100E***
I_{FSM} (Amperes)	35	40	75	75	125	63	75	100
t_{rr} nsec	25/50/75	25/50	25/50	35	25/50/75	35	35	35/60/100
T_J (Max) °C	175	175	175	175	175	175	175	175

(1) I_O is total device output current.

Devices listed in bold, italic are Motorola preferred devices.

Table 5 — Ultrafast Recovery Rectifiers (continued)

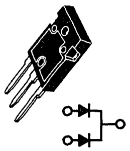
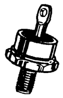
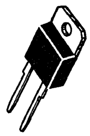
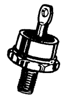
	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)							
	8	15	16		25	30		
	221A-06 (TO-220AB)	221B-02 (TO-220AC) Style 1	221A-06 (TO-220AB) Style 6	Style 7	56-03 (DO-203AA) Style 2	340E-01 (TO-218) Style 1	340D-01 (TO-218AC) Style 2	
V_{RRM} (Volts)								
50		MUR1505	MUR1605CT	MUR1605CTR	MUR2505		R710XPT	MUR3005PT
100		MUR1510	MUR1610CT	MUR1610CTR	MUR2510		R711XPT	MUR3010PT
150		MUR1515	MUR1615CT	MUR1615CTR	MUR2515			MUR3015PT
200		***MUR1520***	***MUR1620CT***	***MUR1620CTR***	***MUR2520***	***MUR3020***	***R712XPT***	***MUR3020PT***
300		MUR1530	MUR1630CT			MUR3030		MUR3030PT
400	***MURH840CT***	MUR1540	MUR1640CT			***MUR3040***	R714XPT	MUR3040PT
500		MUR1550	MUR1650CT					MUR3050PT
600	***MURH860CT***	***MUR1560***	***MUR1660CT***					***MUR3060PT***
700								
800								
900								
1000								
I_{FSM} (Amperes)	100	200	200	100	500	300	150	400
t_{rr} nsec	28	35/60	35	35	50	100	100	35
T_J (Max) °C	175	175	175	175	175	175	150	175

(1) I_O is total device output current.

Devices listed in bold, italic are Motorola preferred devices.

ULTRAFAST RECOVERY RECTIFIERS (continued)

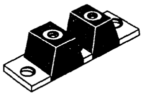
Table 5 — Ultrafast Recovery Rectifiers (continued)

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)[1]			
	30	**50**	**60**	**70**
V_{RRM} (Volts)	340F-01 (TO-247) 	257-01 (DO-203AB) Style 2 	340E-01 (TO-218) Style 1 	257-01 (DO-203AB) Style 2 
50		MUR5005		MUR7005
100		MUR5010		MUR7010
150		MUR5015		MUR7015
200	MUR3020WT	***MUR5020***	***MUR6020***	***MUR7020***
300			MUR6030	
400	MUR3040WT		***MUR6040***	
500				
600	MUR3060WT			
700				
800				
900				
1000				
I_{FSM} (Amperes)	350	600	600	1000
t_{rr} nec	60	50	100	50
T_J (Max) °C	175	175	175	175

(1) I_O is total device output current.

Devices listed in bold, italic are Motorola preferred devices.

Table 5 — Ultrafast Recovery Rectifiers (continued)

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)	
	100	**200**
V_{RRM} (Volts)	357C-03 POWERTAP Cathode = Mounting Plate Anode = Terminal 	
50		
100		
150		
200	***MUR10020CT***	***MUR20020CT***
300		
400		***MUR20040CT***
500		
600		
700		
800		
900		
1000		
I_{FSM} (Amperes)	400	800
t_{rr} nec	50	50
T_J (Max) °C	175	175

(1) I_O is total device output current.

Devices listed in bold, italic are Motorola preferred devices.

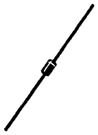
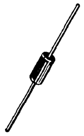
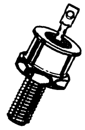
2

Fast Recovery Rectifiers

Fast Recovery Rectifiers are available for designs that require a power rectifier with maximum switching times ranging from 200 ns to 750 ns. These devices are offered in current ranges of 1 to 30 amperes and in voltages to 600 volts.

All devices are connected cathode-to-case or cathode-to-heatsink, where applicable. Reverse polarity may be available on some devices upon special request. Contact your Motorola representative for more information.

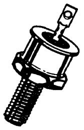
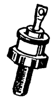
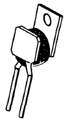
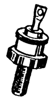
Table 6 — Fast Recovery Rectifiers

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)				
	1	3		5	6
V_{RRM} (Volts)	59-03 Plastic Cathode = Polarity Band 	60-01 Metal Style 1 	267-03 Plastic Cathode = Polarity Band 	194-04 Plastic Style 1 	245A-02 (DO-203AA) Metal Style 2 
50	1N4933(3)	MR830	MR850	MR820	1N3879
100	1N4934(3)	MR831	MR851	MR821	1N3880
200	***1N4935***(3)	***MR832***	***MR852***	***MR822***	***1N3881***
400	1N4936(3)	MR834	MR854	MR824	1N3883
600	***1N4937***(3)	***MR836***	***MR856***	***MR826***	***MR1366***
I_{FSM} (Amps)	30	100	100	300	150
T_A @ Rated I_O (°C)	75		90(8)	55(8)	
T_C @ Rated I_O (°C)		100			100
T_J (Max) °C	150	150	175	175	150
t_{rr} (µs)	0.2	0.2	0.2	0.2	0.2

(1) I_O is total device output.
(3) Package Size: 0.120″ max diameter by 0.260″ max length.
(8) Must be derated for reverse power dissipation. See data sheet.

Devices listed in bold, italic are Motorola preferred devices.

Table 6 — Fast Recovery Rectifiers (continued)

V_{RRM} (Volts)	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)(1)			
	12	20	24	30
	245A-02 (DO-203AA) Metal Style 2 	42A-01 (DO-203AB) Metal Style 2 	339-02 Plastic(4) Style 1  *	42A-01 (DO-203AB) Metal Style 2 
50	1N3889	1N3899	MR2400F	1N3909
100	1N3890	1N3900	MR2401F	1N3910
200	***1N3891***	***1N3901***	***MR2402F***	***1N3911***
400	1N3893	1N3903	MR2404F	1N3913
600	***MR1376***	***MR1386***	***MR2406F***	***MR1396***
I_{FSM} (Amps)	200	250	300	300
T_A @ Rated I_O (°C)				
T_C @ Rated I_O (°C)	100	100	125	100
T_J (Max) °C	150	150	175	150
t_{rr} (µs)	0.2	0.2	0.2	0.2

(1) I_O is total device output.
(4) Meets mounting configuration of TO-220 outline.

Devices listed in bold, italic are Motorola preferred devices.

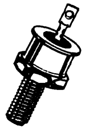
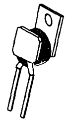
* Not recommended for new designs.

General-Purpose Rectifiers

Motorola offers a wide variety of low-cost devices, packaged to meet diverse mounting requirements. Avalanche capability is available in the axial lead 1.5, 3.0 and 6.0 amp packages, shown below, to provide protection from transients.

All devices are connected cathode-to-case or cathode-to-heatsink, where applicable. Reverse polarity may be available on some devices upon special request. Contact your Motorola representative for more information.

Table 7 — General-Purpose Rectifiers

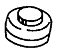
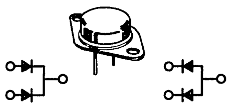
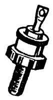
	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)[1]						
	1	3		6	12	20	24
V_{RRM} (Volts)	59-03 (DO-41) Plastic Cathode = Polarity Band 	60-01 Metal Style 1 	267-03 Plastic Cathode = Polarity Band 	194-04 Plastic Style 1 	245A-02 (DO-203AA) Metal Style 2 		339-02 Plastic[4] Style 1  *
50	1N4001[3]	1N4719	1N5400	MR750	MR1120 1N1199,A,B	MR2000	MR2400
100	1N4002[3]	1N4720	1N5401	MR751	MR1121 1N1200,A,B	MR2001	MR2401
200	1N4003[3]	1N4721	1N5402	MR752	MR1122 1N1202,A,B	MR2002	MR2402
400	***1N4004***[3]	***1N4722***	***1N5404***	***MR754***	***MR1124*** ***1N1204,A,B***	***MR2004***	***MR2404***
600	1N4005[3]	1N4723	***1N5406***	MR756	MR1126 1N1206,A,B	MR2006	***MR2406***
800	1N4006[3]	1N4724		MR758	MR1128	MR2008	
1000	***1N4007***[3]	***1N4725***		***MR760***	***MR1130***	***MR2010***	
I_{FSM} (Amps)	30	300	200	400	300[9]	400	400
T_A @ Rated I_O (°C)	75	75	T_L = 105	60			
T_C @ Rated I_O (°C)					150	150	125
T_J (Max) °C	175	175	175	175	190	175	175

(1) I_O is total device output.
(3) Package Size: 0.120″ max diameter by 0.260″ max length.
(4) Meets mounting configurations of TO-220 outline.
(9) IFSM is for MR1120 series, 1N1199 = 100, -A = 240, -B = 250.

Devices listed in bold, italic are Motorola preferred devices.

* Not recommended for new designs.

Table 7 — General-Purpose Rectifiers (continued)

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)[1]			
	25	30		40
V_{RRM} (Volts)	193-04 Plastic[10] Cathode = Polarity Band 	1-07 (TO-204AA) Metal Styles 8 and 9 		42A-01 (DO-203AB) Metal Style 1 
50	MR2500			1N1183A
100	MR2501	***MR4422CT***	***MR4422CTR***	1N1184A
200	MR2502			1N1186A
400	***MR2504***			1N1188A
600	MR2506			***1N1190A***
800	MR2508			
1000	***MR2510***			
I_{FSM} (Amps)	400	400	400	800
T_A @ Rated I_O (°C)				
T_C @ Rated I_O (°C)	150			150
T_J (Max) °C	175	150	150	190

(1) I_O is total device output.
(10) Request data sheet for mounting information.

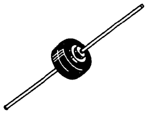
Devices listed in bold, italic are Motorola preferred devices.

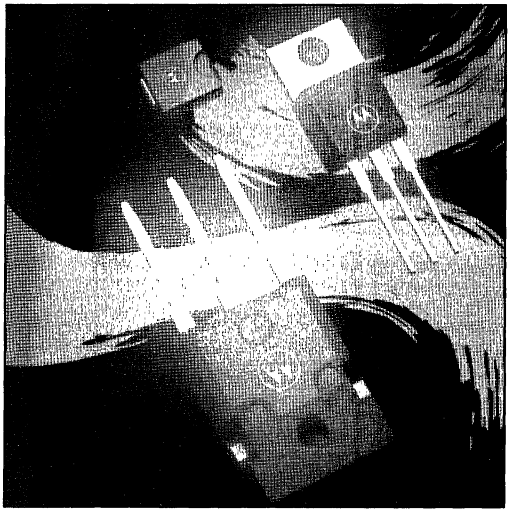
Automotive Transient Supressors

Automotive Transient Suppressors are designed for protection against over-voltage conditions in the auto electrical system including the "LOAD DUMP" phenomenon that occurs when the battery open circuits while the car is running.

AUTOMOTIVE TRANSIENT SUPPRESSOR	
	CASE 194-01 MR2535L
V_{RRM} (Volts)	20
I_O (Amp)	35
$V_{(BR)}$ (Volts)	24–32
I_{RSM}* (Amp)	62
T_C @ Rated I_O (°C)	150
T (°C)	175

194-01





Data Sheets

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N1183A thru 1N1190A

1N1190A is a Motorola Preferred Device

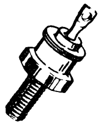
MEDIUM-CURRENT RECTIFIERS

. . . for applications requiring low forward voltage drop and rugged construction.

- High Surge Handling Ability
- Rugged Construction
- Reverse Polarity Available; Eliminates Need for Insulating Hardware in Many Cases
- Hermetically Sealed

40-AMP RECTIFIERS

SILICON
DIFFUSED-JUNCTION



CASE 42A-01
DO-203AB
METAL

3

***MAXIMUM RATINGS**

Rating	Symbol	1N1183A	1N1184A	1N1186A	1N1188A	1N1190A	Unit
Peak Repetitive Reverse Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Average Half-Wave Rectified Forward Current With Resistive Load @ T_A = 150°C	I_O	40	40	40	40	40	Amp
Peak One Cycle Surge Current (60 Hz and 150°C Case Temperature)	I_{FSM}	800	800	800	800	800	Amp
Operating Junction Temperature	T_J	−65 to +200					°C
Storage Temperature	T_{stg}	−65 to +200					°C

***ELECTRICAL CHARACTERISTICS** (All Types) at 25°C Case Temperature

Characteristic	Symbol	Value	Unit
Maximum Forward Voltage at 100 Amp DC Forward Current	V_F	1.1	Volts
Maximum Reverse Current at Rated DC Reverse Voltage	I_R	5.0	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typical	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

*Indicates JEDEC registered data.

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction
FINISH: All external surfaces corrosion-resistant and the terminal lead is readily solderable
WEIGHT: 25 grams (approx.)
POLARITY: Cathode connected to case (reverse polarity available denoted by Suffix R, i.e.: 1N1183RA
MOUNTING POSITION: Any
MOUNTING TORQUE: 25 in-lb max

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N1199 thru 1N1206

1N1204 is a Motorola Preferred Device

MEDIUM-CURRENT SILICON RECTIFIERS

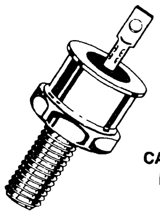
Silicon rectifiers for medium-current applications requiring:

- High Current Surge — 240 Amperes @ T_J = 190°C
- Peak Performance at Elevated Temperature — 12 Amperes @ T_C = 150°C

MEDIUM-CURRENT SILICON RECTIFIERS

50-600 VOLTS
12 AMPERES

DIFFUSED JUNCTION



CASE 245A-02
DO-203AA
METAL

*MAXIMUM RATINGS

Characteristic	Symbol	1N 1199	1N 1200	1N 1202	1N 1204	1N 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
Average Rectified Forward Current (Single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	12					Amp
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, half wave, single phase, 60 Hz)	I_{FSM}	240 (for 1 cycle)					Amp
Operating Junction Temperature Range	T_J	-65 to +190					°C

*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2 0	°C/W

*ELECTRICAL CHARACTERISTICS

Characteristic and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (i_F = 40 A, T_C = 25°C)	v_F	1 8	Volts
Maximum Instantaneous Reverse Current (Rated voltage, T_C = 150°C)	I_R	10	mA

*Indicates JEDEC registered data

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction
FINISH: All external surfaces are corrosion-resistant and the terminal lead is readily solderable
POLARITY: Cathode to case (reverse polarity units are available and denoted by an "R" suffix, i.e., 1N1202R)
MOUNTING POSITION. Any
MOUNTING TORQUE: 15 in-lb max
MAXIMUM TERMINAL TEMPERATURE FOR SOLDERING PURPOSES: 275°C for 10 seconds at 3 kg tension.
WEIGHT: 6 grams (approx.)

3

1N1199A thru 1N1206A

1N1204A is a
Motorola Preferred Device

MEDIUM-CURRENT SILICON RECTIFIERS

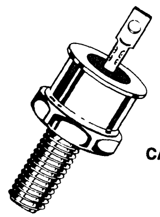
Silicon rectifiers for medium-current applications requiring:

- High Current Surge — 240 Amperes @ T_J = 200°C
- Peak Performance at Elevated Temperature — 12 Amperes @ T_C = 150°C

MEDIUM-CURRENT SILICON RECTIFIERS

50-600 VOLTS
12 AMPERES

DIFFUSED JUNCTION



CASE 245A-02
DO-203AA
METAL

3

*MAXIMUM RATINGS

Characteristic	Symbol	1N 1199A	1N 1200A	1N 1202A	1N 1204A	1N 1206A	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Non-Repetitive Peak Reverse Voltage (Halfwave, single phase, 60 Hz peak)	V_{RSM}	100	200	350	600	800	Volts
Average Rectified Forward Current (Single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	12					Amp
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, half wave, single phase, 60 Hz)	I_{FSM}	240 (for 1 cycle)					Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200					°C

*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

*ELECTRICAL CHARACTERISTICS

Characteristic and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (i_F = 40 A, T_C = 25°C)	v_F	1.35	Volts
Maximum Average Reverse Current at Rated Conditions	I_{RO}		mA
1N1199A		3.0	
1N1200A		2 5	
1N1202A		2 0	
1N1204A		1.5	
1N1206A		1.0	

*Indicates JEDEC registered data.

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction
FINISH: All external surfaces are corrosion-resistant and the terminal lead is readily solderable
POLARITY: Cathode to case (reverse polarity units are available and denoted by an "R" suffix, i.e., 1N1202RA)
MOUNTING POSITION: Any
MOUNTING TORQUE: 15 in-lb max
MAXIMUM TERMINAL TEMPERATURE FOR SOLDERING PURPOSES: 275°C for 10 seconds at 3 kg tension.
WEIGHT: 6 grams (approx.)

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N1199B thru 1N1206B

1N1204B is a Motorola Preferred Device

MEDIUM-CURRENT SILICON RECTIFIERS

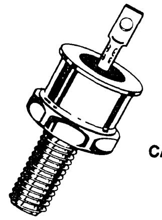
Compact, highly efficient silicon rectifiers for medium-current applications requiring:

- High Current Surge — 250 Amperes @ T_J = 200°C
- Peak Performance at Elevated Temperature — 12 Amperes @ T_C = 150°C

MEDIUM-CURRENT SILICON RECTIFIERS

50-600 VOLTS
12 AMPERES

DIFFUSED JUNCTION



CASE 245A-02
DO-203AA
METAL

*MAXIMUM RATINGS

Characteristic	Symbol	1N 1199B	1N 1200B	1N 1202B	1N 1204B	1N 1206B	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Non-Repetitive Peak Reverse Voltage (Halfwave, single phase, 60 Hz peak)	V_{RSM}	100	200	350	600	800	Volts
Average Rectified Forward Current (Single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	12					Amp
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, half wave, single phase, 60 Hz)	I_{FSM}	250 (for 1 cycle)					Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200					°C

*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

*ELECTRICAL CHARACTERISTICS

Characteristic and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (i_F = 40 A, T_C = 25°C)	v_F	1.2	Volts
Maximum Reverse Current (Rated dc voltage, T_C = 150°C)	I_R	1 0	mA
Maximum Average Reverse Current at Rated Conditions	I_{RO}	0.9	mA
DC Forward Voltage (I_F = 12 A, T_C = 25°C)	V_F	1.1	Volts
Reverse Recovery Time (I_{FM} = 40 A, di/dt = 25 A/μs to I_{FM} = 0, $t_p \geq$ 4 0 μs, 60 pulses/second, 25°C)	t_{rr}	5.0	μs

*Indicates JEDEC registered data

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction
FINISH: All external surfaces are corrosion-resistant and the terminal lead is readily solderable
POLARITY: Cathode to case (reverse polarity units are available and denoted by an "R" suffix, i.e., 1N1202RB)
MOUNTING POSITION: Any
MOUNTING TORQUE: 15 in-lb max
MAXIMUM TERMINAL TEMPERATURE FOR SOLDERING PURPOSES: 275°C for 10 seconds at 3 kg tension.
WEIGHT: 6 grams (approx.)

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N3208 thru 1N3212

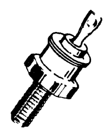
MEDIUM-CURRENT RECTIFIERS

. . . for applications requiring low forward voltage drop and rugged construction.

- High Surge Handling Ability
- Rugged Construction
- Reverse Polarity Available; Eliminates Need for Insulating Hardware in Many Cases
- Hermetically Sealed

15-AMP RECTIFIERS

SILICON
DIFFUSED-JUNCTION



CASE 42A-01
DO-203AB
METAL

3

***MAXIMUM RATINGS**

Rating	Symbol	1N3208 1N3208R	1N3209 1N3209R	1N3210 1N3210R	1N3211 1N3211R	1N3212 1N3212R	Unit
DC Blocking Voltage	V_R	50	100	200	300	400	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	Volts
Average Half-Wave Rectified Forward Current With Resistive Load @ T_C = 150°C	I_O	15	15	15	15	15	Amp
Peak One Cycle Surge Current (60 Hz and 25°C Case Temperature)	I_{FSM}	250	250	250	250	250	Amp
Operating Junction Temperature	T_J	← −65 to +175 →					°C
Storage Temperature	T_{stg}	← −65 to +175 →					°C

***ELECTRICAL CHARACTERISTICS** (All Types) at 25°C Case Temperature

Characteristic	Symbol	Value	Unit
Maximum Forward Voltage at 40 Amp DC Forward Current	V_F	1.5	Volts
Maximum Reverse Current at Rated DC Reverse Voltage	I_R	1.0	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typical	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.7	°C/W

*Indicates JEDEC registered data.

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction
FINISH: All external surfaces corrosion-resistant and the terminal lead is readily solderable
WEIGHT: 25 grams (approx.)
POLARITY: Cathode connected to case (reverse polarity available denoted by Suffix R, i.e.: 1N3212R)
MOUNTING POSITION: Any
MOUNTING TORQUE: 25 in-lb max

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N3879 thru 1N3883
MR1366

1N3881 and MR1366 are Motorola Preferred Devices

Designers Data Sheet

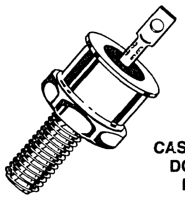
STUD MOUNTED FAST RECOVERY POWER RECTIFIERS

. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference, sonar power supplies and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

Designer's 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.

FAST RECOVERY POWER RECTIFIERS
50-600 VOLTS
6 AMPERES



CASE 245A-02
DO-203AA
METAL

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion resistant and readily solderable
POLARITY: Cathode to Case
WEIGHT: 5.6 Grams (approximately)
MOUNTING TORQUE: 15 in-lbs max.

*MAXIMUM RATINGS

Rating	Symbol	1N3879	1N3880	1N3881	1N3882	1N3883	MR1366	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
Non-Repetitive Peak Reverse Voltage	V_{RSM}	75	150	250	350	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	420	Volts
Average Rectified Forward Current (Single phase, resistive load, T_C = 100°C)	I_O	← 6.0 →						Amps
Non-Repetitive Peak Surge Current (surge applied at rated load continuous)	I_{FSM}	← 150 (one cycle) →						Amps
Operating Junction Temperature Range	T_J	← -65 to +150 →						°C
Storage Temperature Range	T_{stg}	← -65 to +175 →						°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

Motorola guarantees the listed value, although parts having higher values of thermal resistance will meet the current rating. Thermal resistance is not required by the JEDEC registration.

*ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (i_F = 19 Amp, T_J = 150°C)	v_F	–	1.2	1.5	Volts
Forward Voltage (I_F = 6.0 Amp, T_C = 25°C)	V_F	–	1.0	1.4	Volts
Reverse Current (rated dc voltage) T_C = 25°C T_C = 100°C	I_R	– –	10 0.5	15 1.0	μA mA

REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time *(I_{FM} = 1.0 Amp to V_R = 30 Vdc, Figure 16) (I_{FM} = 36 Amp, di/dt = 25 A/μs, Figure 17)	t_{rr}	 – –	 150 200	 200 400	ns
Reverse Recovery Current *(I_F = 1.0 Amp to V_R = 30 Vdc, Figure 16)	$I_{RM(REC)}$	–	–	2.0	Amp

*Indicates JEDEC Registered Data for 1N3879 Series.

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FIGURE 1 – FORWARD VOLTAGE

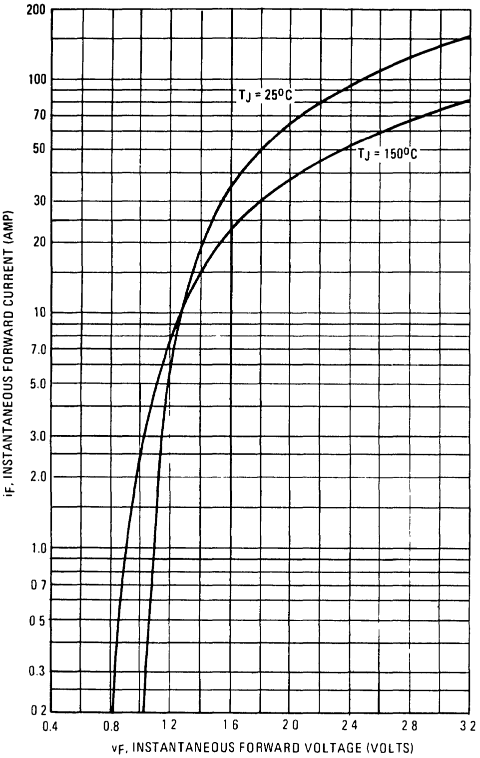
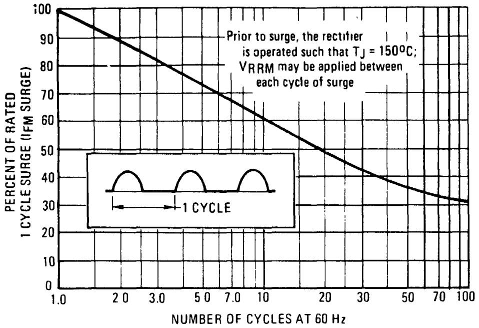
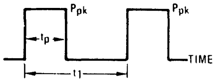


FIGURE 2 – MAXIMUM SURGE CAPABILITY



NOTE 1



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see Note 3) The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady state conditions are achieved Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature It may be determined by

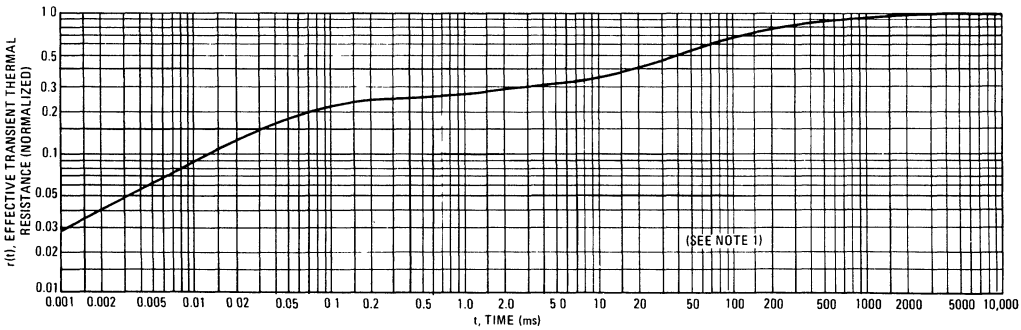
$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 3, i e

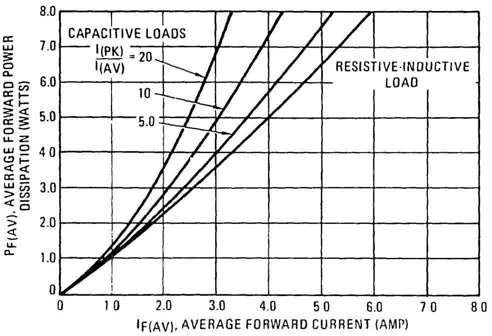
$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

FIGURE 3 – THERMAL RESPONSE



SINE WAVE INPUT

FIGURE 4 — FORWARD POWER DISSIPATION



SQUARE WAVE INPUT

FIGURE 5 — FORWARD POWER DISSIPATION

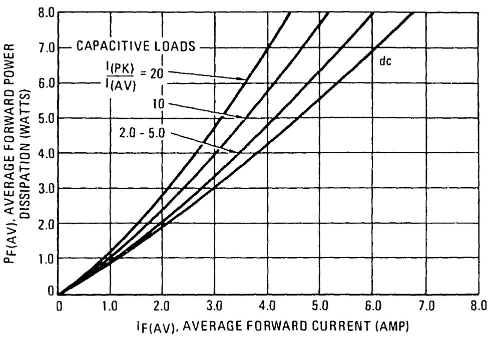


FIGURE 6 — CURRENT DERATING

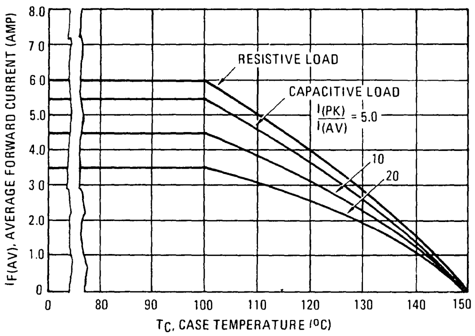


FIGURE 7 — CURRENT DERATING

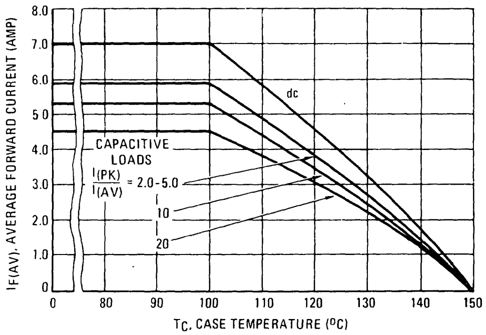


FIGURE 8 — TYPICAL REVERSE CURRENT

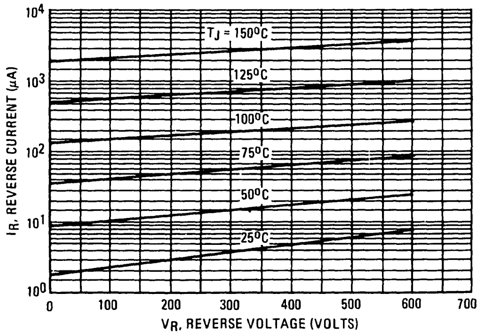
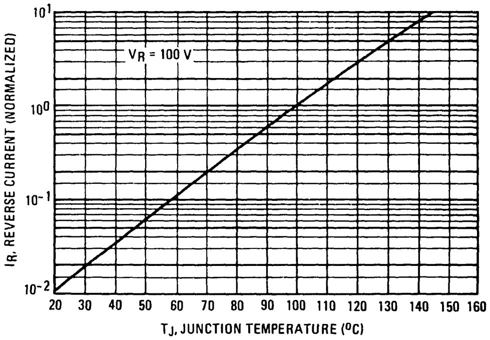


FIGURE 9 — NORMALIZED REVERSE CURRENT



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TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 10 – FORWARD RECOVERY TIME

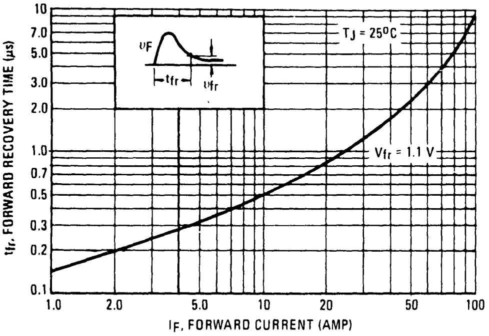
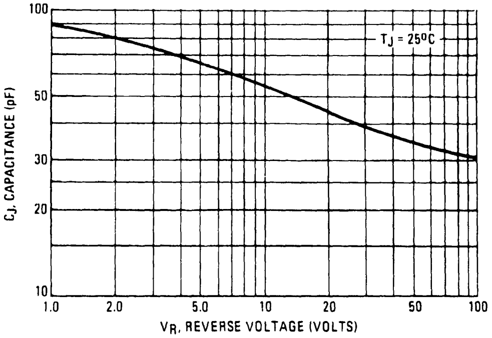


FIGURE 11 – JUNCTION CAPACITANCE



TYPICAL RECOVERED STORED CHARGE DATA

(See Note 2)

FIGURE 12 – $T_J = 25°C$

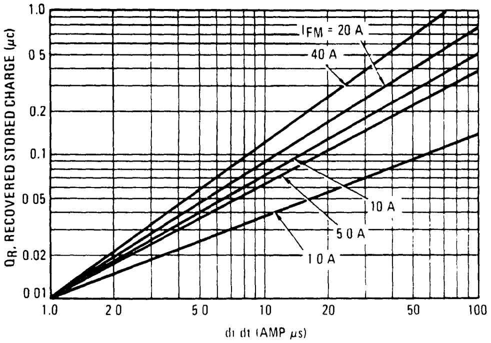


FIGURE 13 – $T_J = 75°C$

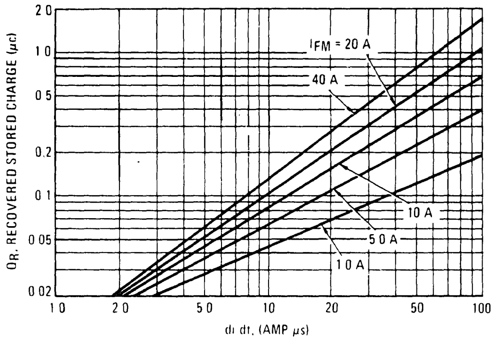


FIGURE 14 – $T_J = 100°C$

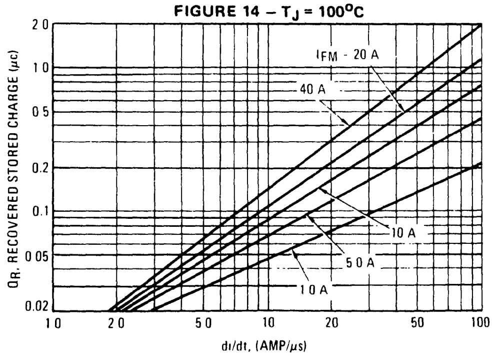


FIGURE 15 – $T_J = 150°C$

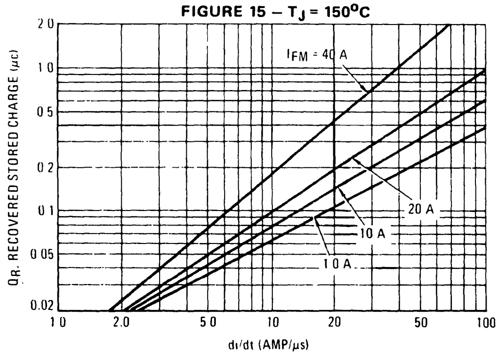
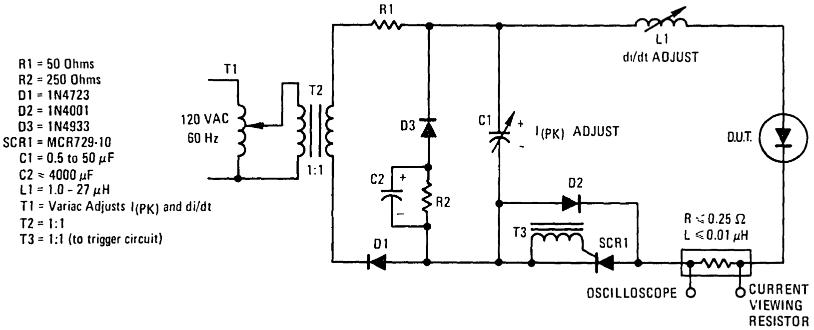


FIGURE 16 — JEDEC REVERSE RECOVERY CIRCUIT



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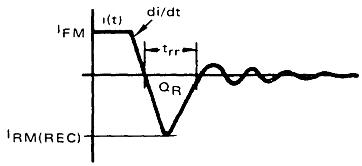
NOTE 2

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using I_F = 1.0 A, V_R = 30 V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, 100°C, and 150°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times \left[Q_R \times di/dt\right]^{1/2}$$

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N3889 thru 1N3893
MR1376

Designers Data Sheet

1N3891 and MR1376
are Motorola Preferred Devices

STUD MOUNTED
FAST RECOVERY POWER RECTIFIERS

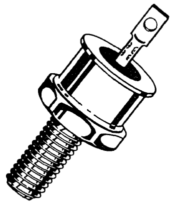
. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference, sonar power supplies and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

Designer's 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.

FAST RECOVERY POWER RECTIFIERS

50-600 VOLTS
12 AMPERES



CASE 245A-02
DO-203AA
METAL

MECHANICAL CHARACTERISTICS
CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion resistant and readily solderable
POLARITY: Cathode to Case
WEIGHT: 5.6 grams (approximately)
MOUNTING TORQUE: 15 in-lb max

3

*MAXIMUM RATINGS

Rating	Symbol	1N3889	1N3890	1N3891	1N3892	1N3893	MR1376	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
Non-Repetitive Peak Reverse Voltage	V_{RSM}	75	150	250	350	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	420	Volts
Average Rectified Forward Current (Single phase, resistive load, $T_C = 100°C$)	I_O	← 12 →						Amps
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions)	I_{FSM}	← 200 → (one cycle)						Amp
Operating Junction Temperature Range	T_J	← -65 to +150 →						°C
Storage Temperature Range	T_{stg}	← -65 to +175 →						°C

THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

Motorola guarantees the listed value, although parts having higher values of thermal resistance will meet the current rating. Thermal resistance is not required by the JEDEC registration.

*ELECTRICAL CHARACTERISTICS

Characteristic		Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (i_F = 38 Amp, $T_J = 150°C$)		v_F	–	1.2	1.5	Volts
Forward Voltage (I_F = 12 Amp, $T_C = 25°C$)		V_F	–	1.0	1.4	Volts
Reverse Current (rated dc voltage)	$T_C = 25°C$	I_R	–	10	25	μA
	$T_C = 100°C$		–	0.5	3.0	mA

*REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	t_{rr}				ns
(I_F = 1.0 Amp to V_R = 30 Vdc, Figure 16)		–	150	200	
(I_{FM} = 36 Amp, di/dt = 25 A/μs, Figure 17)		–	200	400	
Reverse Recovery Current (I_F = 1.0 Amp to V_R = 30 Vdc, Figure 16)	$I_{RM(REC)}$	–	–	2.0	Amp

*Indicates JEDEC Registered Data for 1N3889 Series.

FIGURE 1 — FORWARD VOLTAGE

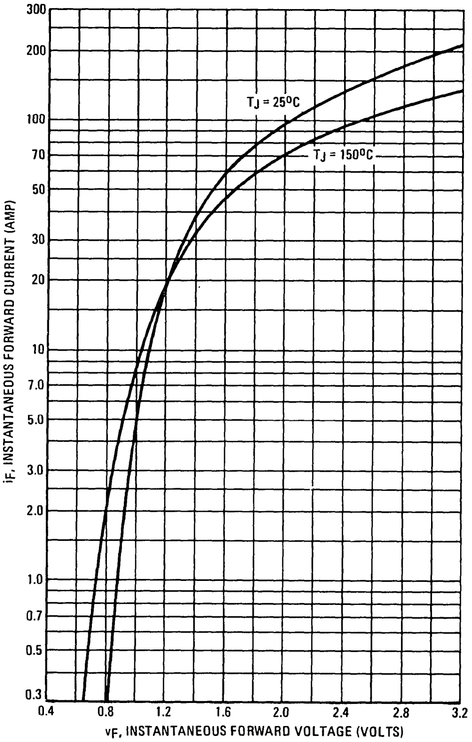
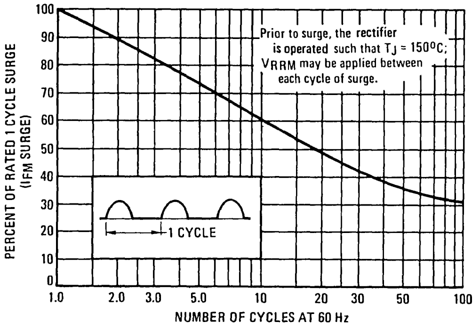
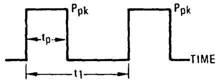


FIGURE 2 — MAXIMUM SURGE CAPABILITY



NOTE 1



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended.

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see Note 3) The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where T_{JC} is the increase in junction temperature above the case temperature. It may be determined by.

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

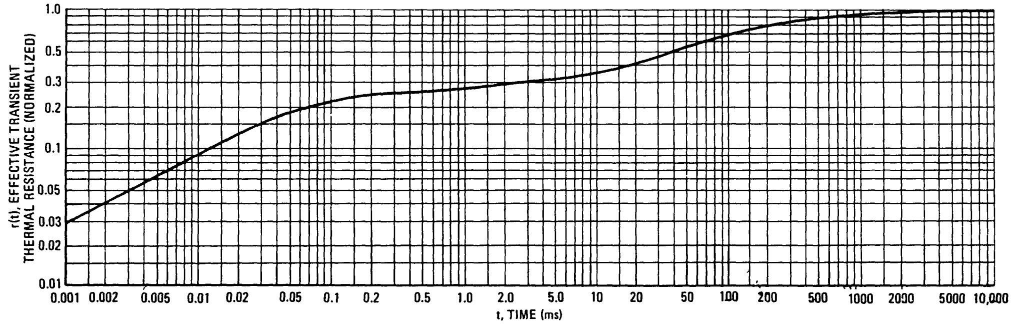
where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 3, i.e

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

3

FIGURE 3 — THERMAL RESPONSE



3

SINE WAVE INPUT

FIGURE 4 – FORWARD POWER DISSIPATION

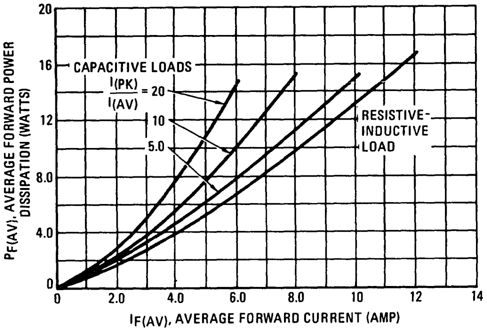


FIGURE 6 – CURRENT DERATING

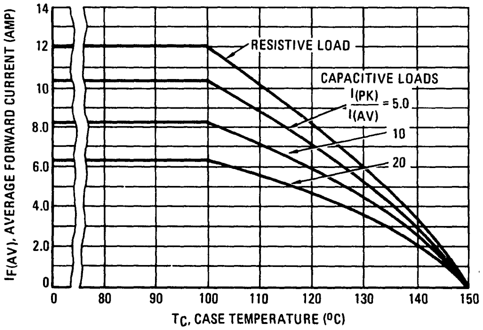
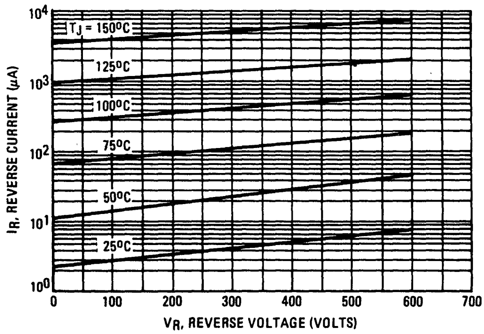


FIGURE 8 – TYPICAL REVERSE CURRENT



SQUARE WAVE INPUT

FIGURE 5 – FORWARD POWER DISSIPATION

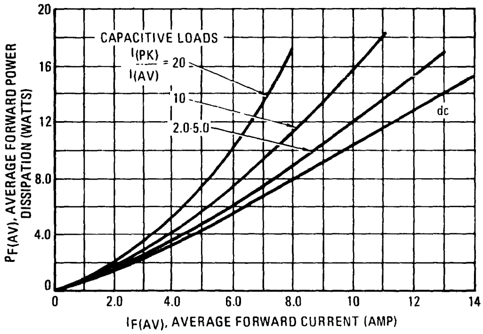


FIGURE 7 – CURRENT DERATING

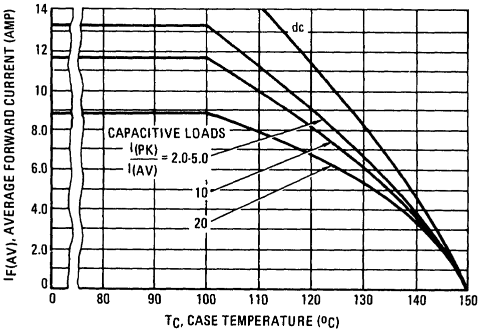
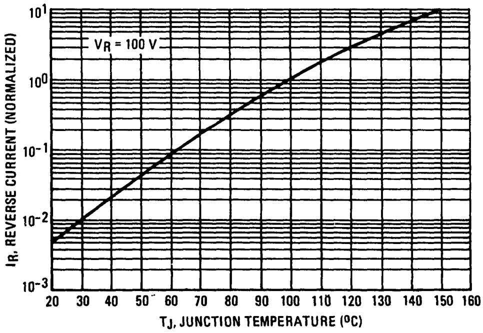


FIGURE 9 – NORMALIZED REVERSE CURRENT



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 10 – FORWARD RECOVERY TIME

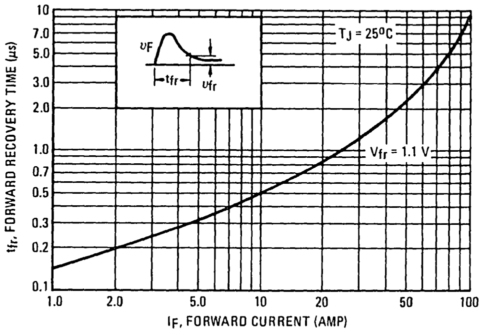
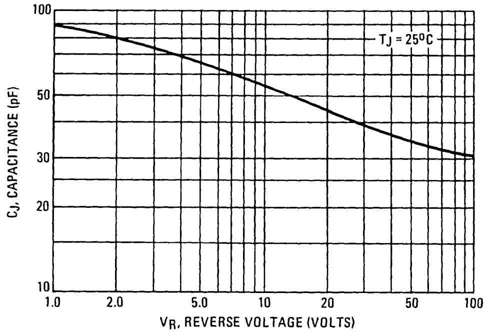


FIGURE 11 – JUNCTION CAPACITANCE



3

TYPICAL RECOVERED STORED CHARGE DATA

(See Note 2)

FIGURE 12 – $T_J = 25°C$

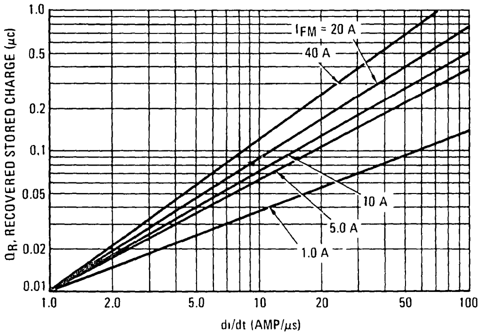


FIGURE 13 – $T_J = 75°C$

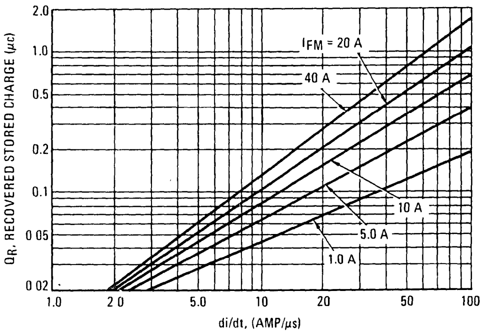


FIGURE 14 – $T_J = 100°C$

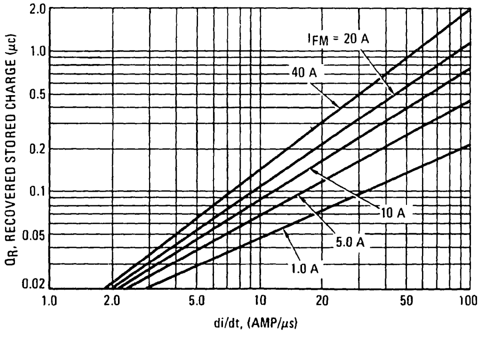


FIGURE 15 – $T_J = 150°C$

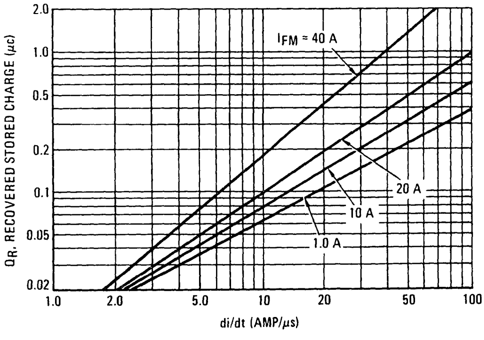
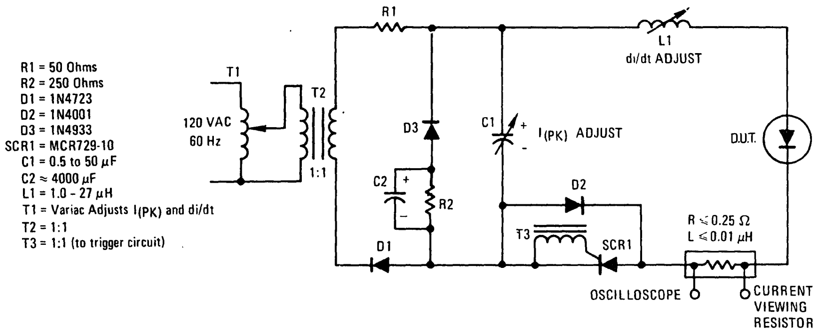


FIGURE 16 — JEDEC REVERSE RECOVERY CIRCUIT



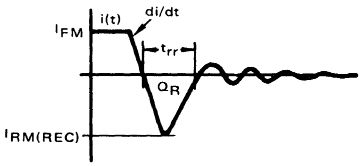
NOTE 2

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using I_F = 1.0 A, V_R = 30 V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, 100°C, and 150°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times \left[Q_R \times di/dt\right]^{1/2}$$

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N3899 thru 1N3903
MR1386

1N3901 and MR1386 are
Motorola Preferred Devices

Designers Data Sheet

STUD MOUNTED
FAST RECOVERY POWER RECTIFIERS

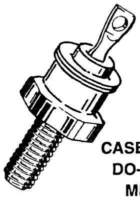
. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference, sonar power supplies and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

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.

FAST RECOVERY
POWER RECTIFIERS

50-600 VOLTS
20 AMPERES



CASE 42A-01
DO-203AB
METAL

MECHANICAL CHARACTERISTICS
CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion resistant and readily solderable
POLARITY: Cathode to Case
WEIGHT: 17 grams (approximately)
MOUNTING TORQUE: 25 in-lb max

3

***MAXIMUM RATINGS**

Rating	Symbol	1N3899	1N3900	1N3901	1N3902	1N3903	MR1386	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
Non-Repetitive Peak Reverse Voltage	V_{RSM}	75	150	250	350	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	420	Volts
Average Rectified Forward Current (Single phase, resistive load, $T_C = 100°C$)	I_O	← 20 →						Amps
Non-Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	← 250 → (one cycle)						Amps
Operating Junction Temperature Range	T_J	← -65 to +150 →						°C
Storage Temperature Range	T_{stg}	← -65 to +175 →						°C

***THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.8	°C/W

***ELECTRICAL CHARACTERISTICS**

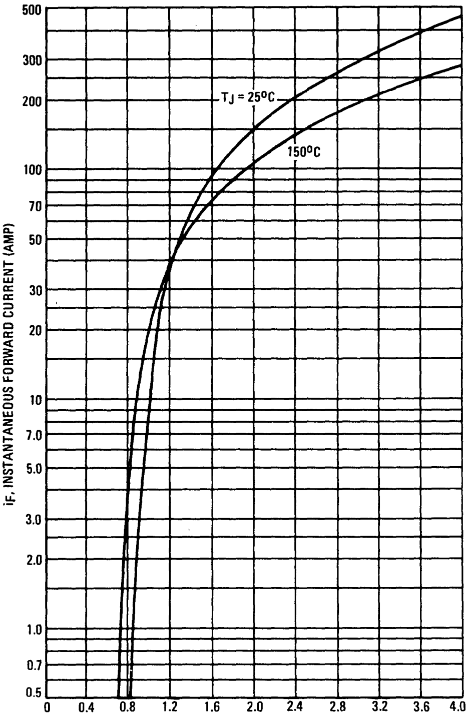
Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage ($i_F = 63$ Amp, $T_J = 150°C$)	v_F	–	1.2	1.5	Volts
Forward Voltage ($I_F = 20$ Amp, $T_C = 25°C$)	V_F	–	1.1	1.4	Volts
Reverse Current (rated dc voltage) $T_C = 25°C$	I_R	–	10	50	μA
$T_C = 100°C$		–	0.5	6.0	mA

***REVERSE RECOVERY CHARACTERISTICS**

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time ($I_F = 1.0$ Amp to $V_R = 30$ Vdc, Figure 16)	t_{rr}	–	150	200	ns
($I_{FM} = 36$ Amp, di/dt = 25 A/μs, Figure 17)		–	200	400	
Reverse Recovery Current ($I_F = 1.0$ Amp to $V_R = 30$ Vdc, Figure 16)	$I_{RM(REC)}$	–	–	3.0	Amp

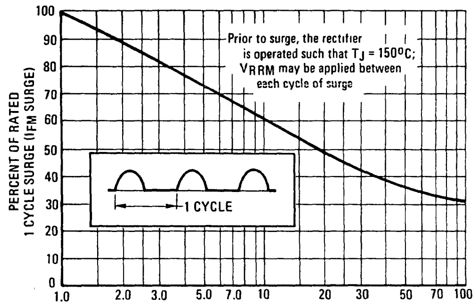
*Indicates JEDEC Registered Data for 1N3899 Series.

FIGURE 1 — FORWARD VOLTAGE



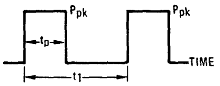
v_F, INSTANTANEOUS FORWARD VOLTAGE (VOLTS)

FIGURE 2 — MAXIMUM SURGE CAPABILITY



NUMBER OF CYCLES AT 60 Hz

NOTE 1



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see Note 3). The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature. It may be determined by:

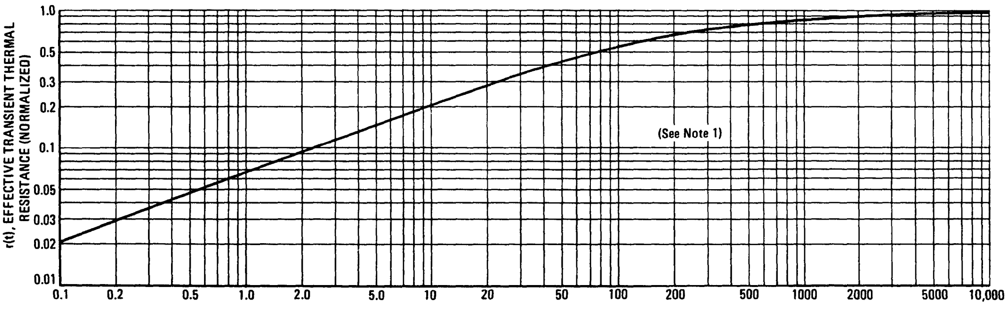
$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 3, i.e.

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

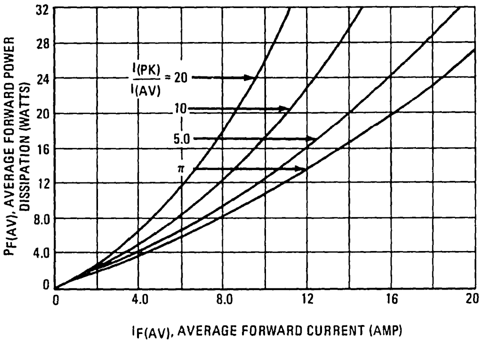
FIGURE 3 — THERMAL RESPONSE



t, TIME (ms)

SINE WAVE INPUT

FIGURE 4 — FORWARD POWER DISSIPATION



SQUARE WAVE INPUT

FIGURE 5 — FORWARD POWER DISSIPATION

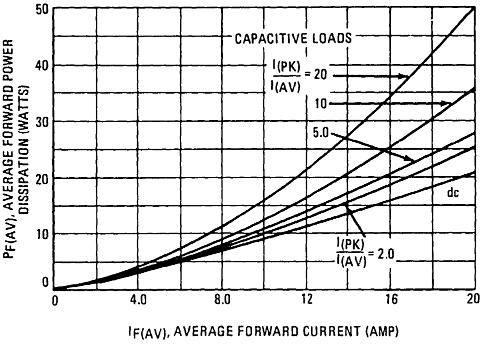


FIGURE 6 — CURRENT DERATING

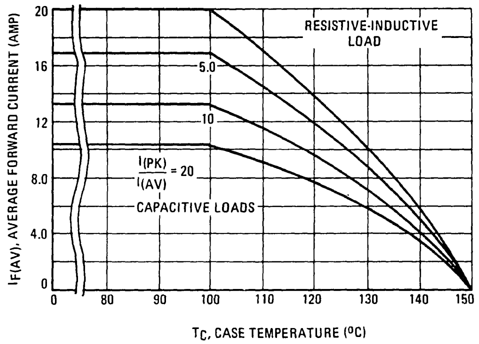


FIGURE 7 — CURRENT DERATING

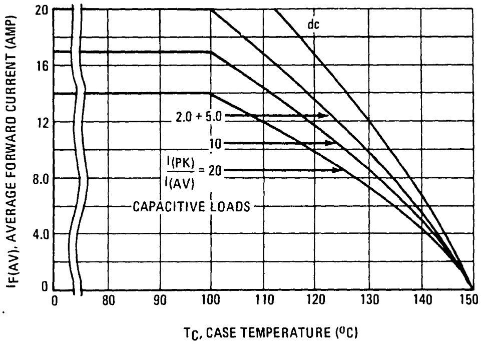


FIGURE 8 — TYPICAL REVERSE CURRENT

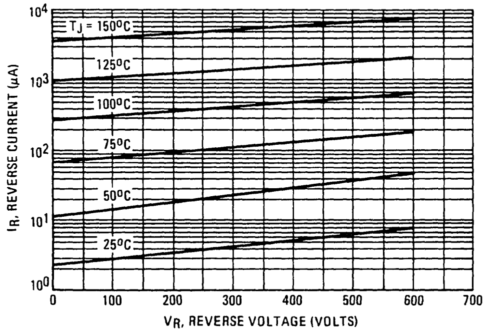
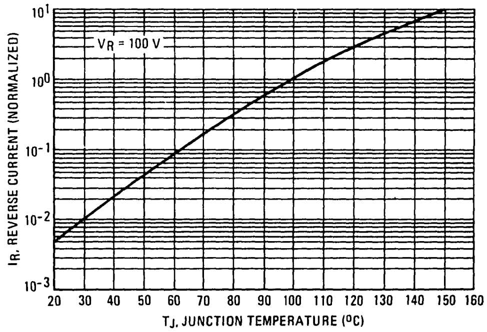


FIGURE 9 — NORMALIZED REVERSE CURRENT



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 10 – FORWARD RECOVERY TIME

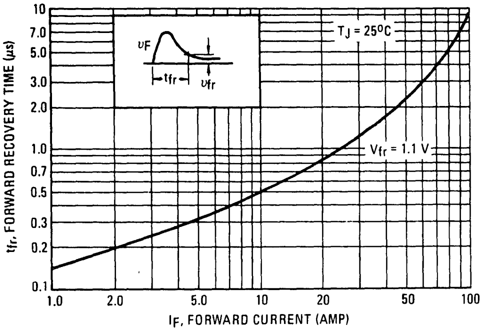
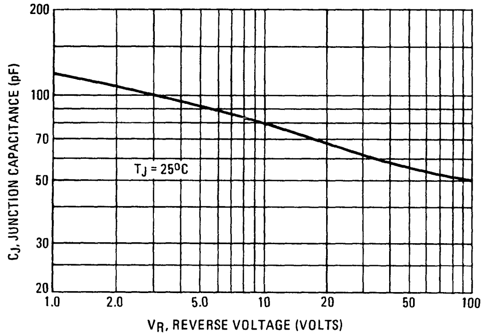


FIGURE 11 – JUNCTION CAPACITANCE



TYPICAL RECOVERED STORED CHARGE DATA

(See Note 2)

FIGURE 12 – $T_J = 25^oC$

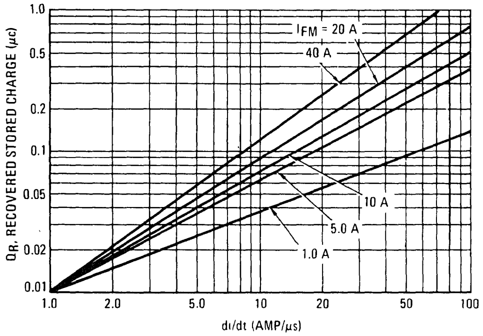
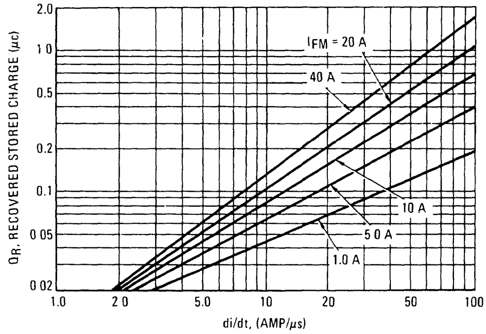


FIGURE 13 – $T_J = 75^oC$



STORED CHARGE DATA

FIGURE 14 – $T_J = 100^oC$

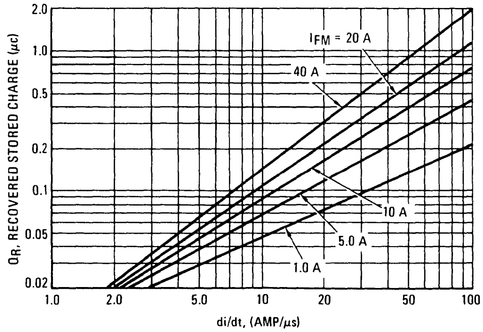


FIGURE 15 – $T_J = 150^oC$

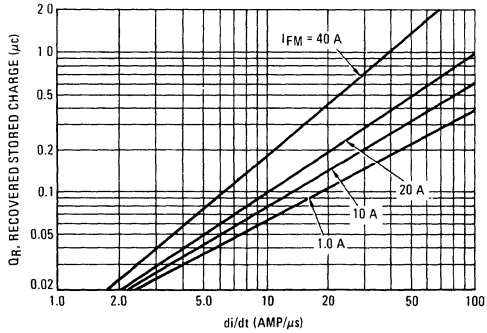
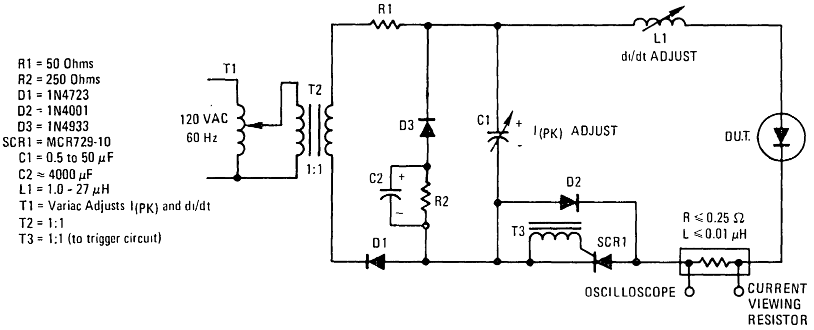


FIGURE 16 — JEDEC REVERSE RECOVERY CIRCUIT



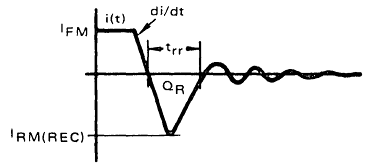
NOTE 2

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using I_F = 1.0 A, V_R = 30 V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, 100°C, and 150°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times \left[Q_R \times di/dt\right]^{1/2}$$

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N3909 thru 1N3913
MR1396

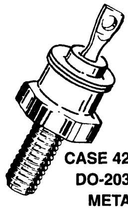
1N3911 and MR1396 are Motorola Preferred Devices

Designers Data Sheet

STUD MOUNTED FAST RECOVERY POWER RECTIFIERS

. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference, sonar power supplies and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

FAST RECOVERY POWER RECTIFIERS
50-600 VOLTS
30 AMPERES



CASE 42A-01
DO-203AB
METAL

Designer's 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.

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion resistant and readily solderable
POLARITY: Cathode to Case
WEIGHT: 17 Grams (Approximately)
MOUNTING TORQUE: 25 in-lbs max.

*MAXIMUM RATINGS

Rating	Symbol	1N3909	1N3910	1N3911	1N3912	1N3913	MR1396	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
Non-Repetitive Peak Reverse Voltage	V_{RSM}	75	150	250	350	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	420	Volts
Average Rectified Forward Current (Single phase, resistive load, $T_C = 100°C$)	I_O	← 30 →						Amps
Non-Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	← 300 →						Amp
Operating Junction Temperature Range	T_J	← -65 to +150 →						°C
Storage Temperature Range	T_{stg}	← -65 to +175 →						°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.2	°C/W

*ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage ($i_F = 93$ Amp, $T_J = 150°C$)	v_F	–	1.2	1.5	Volts
Forward Voltage ($I_F = 30$ Amp, $T_C = 25°C$)	V_F	–	1.1	1.4	Volts
Reverse Current (rated dc voltage) $T_C = 25°C$ $T_C = 100°C$	I_R	– –	10 0.5	25 1.0	μA mA

*REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time ($I_F = 1.0$ Amp to $V_R = 30$ Vdc, Figure 16) ($I_{FM} = 36$ Amp, di/dt = 25 A/μs, Figure 17)	t_{rr}	 – –	 150 200	 200 400	ns
Reverse Recovery Current ($I_F = 1.0$ Amp to $V_R = 30$ Vdc, Figure 16)	$I_{RM(REC)}$	–	1.5	2.0	Amp

*Indicates JEDEC Registered Data for 1N3909 Series.

FIGURE 1 — FORWARD VOLTAGE

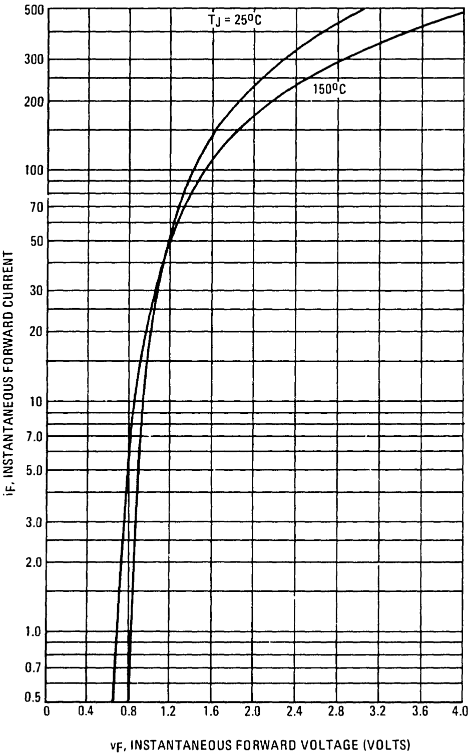
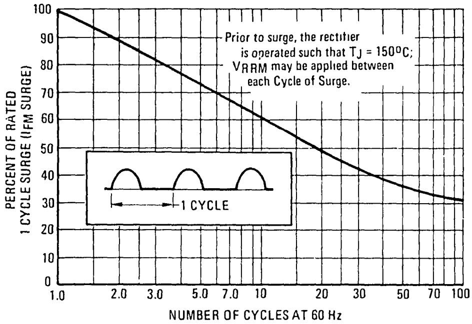
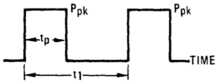


FIGURE 2 — MAXIMUM SURGE CAPABILITY



NOTE 1



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended.

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see Note 3). The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature It may be determined by:

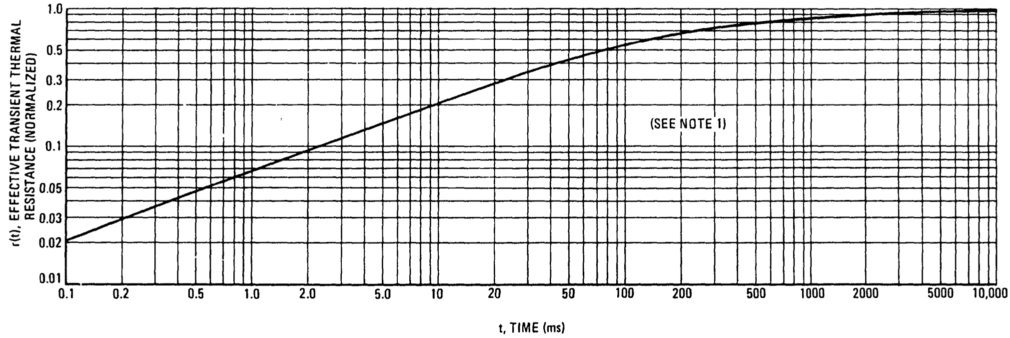
$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 3, i.e..

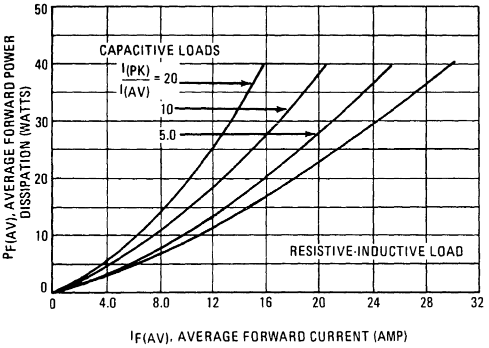
$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

FIGURE 3 — THERMAL RESPONSE



SINE WAVE INPUT

FIGURE 4 – FORWARD POWER DISSIPATION



SQUARE WAVE INPUT

FIGURE 5 – FORWARD POWER DISSIPATION

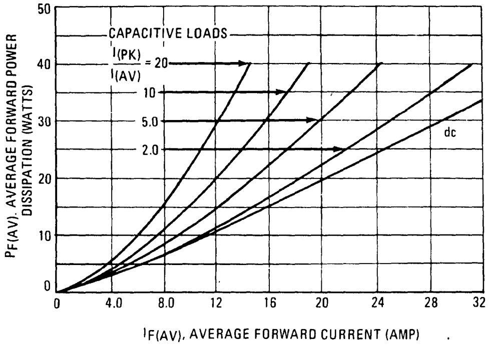


FIGURE 6 – CURRENT DERATING

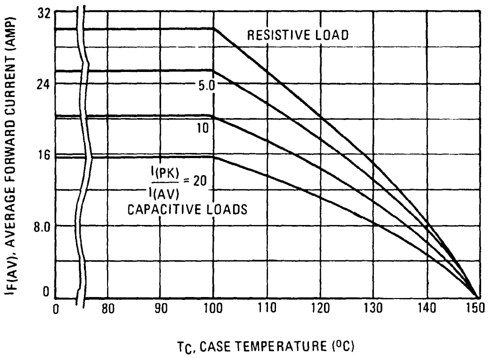


FIGURE 7 – CURRENT DERATING

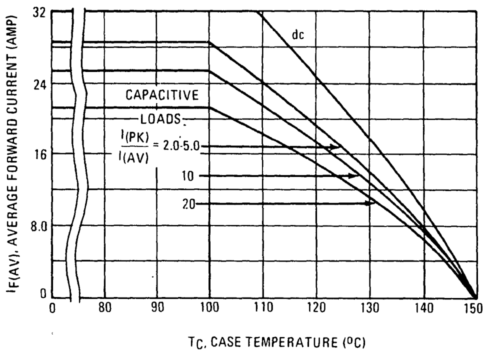


FIGURE 8 – TYPICAL REVERSE CURRENT

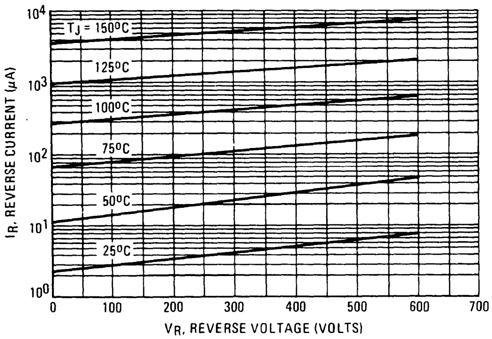
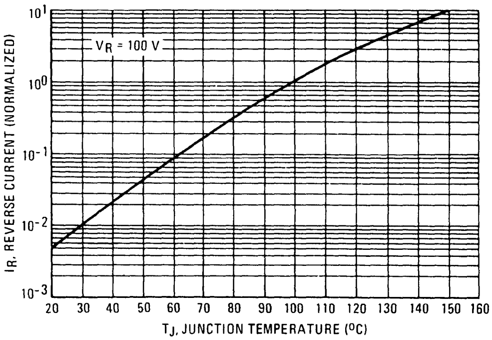


FIGURE 9 – NORMALIZED REVERSE CURRENT



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 10 — FORWARD RECOVERY TIME

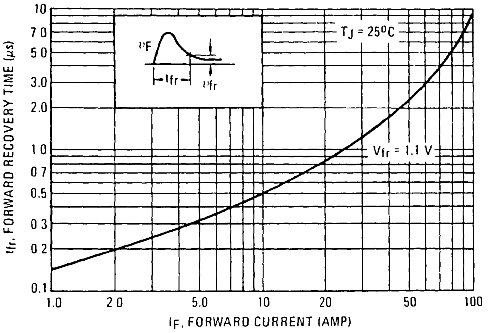
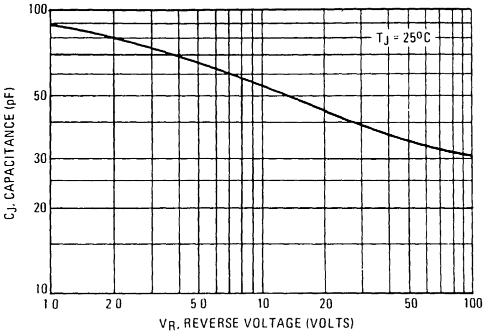


FIGURE 11 — JUNCTION CAPACITANCE



TYPICAL RECOVERED STORED CHARGE DATA

(SEE NOTE 2)

FIGURE 12 — $T_J = 25^oC$

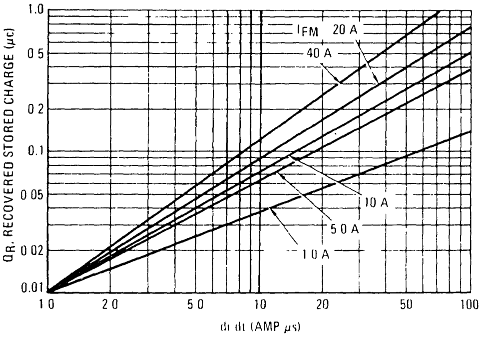


FIGURE 13 — $T_J = 75^oC$

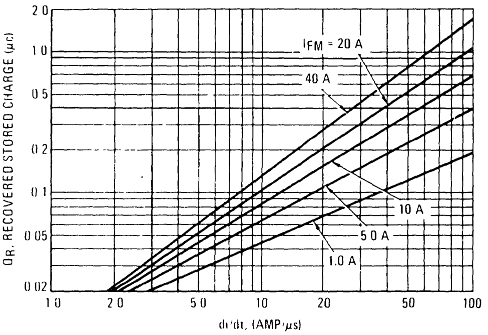


FIGURE 14 — $T_J = 100^oC$

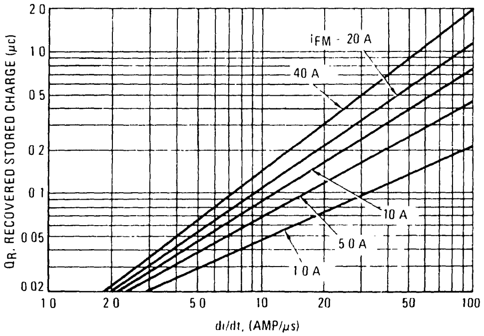


FIGURE 15 — $T_J = 150^oC$

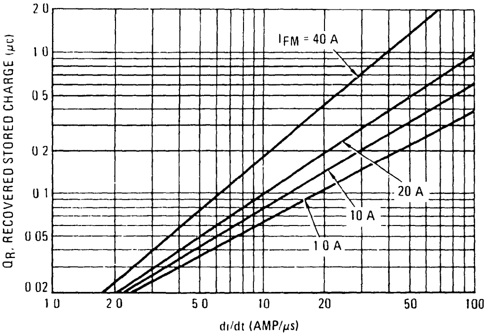


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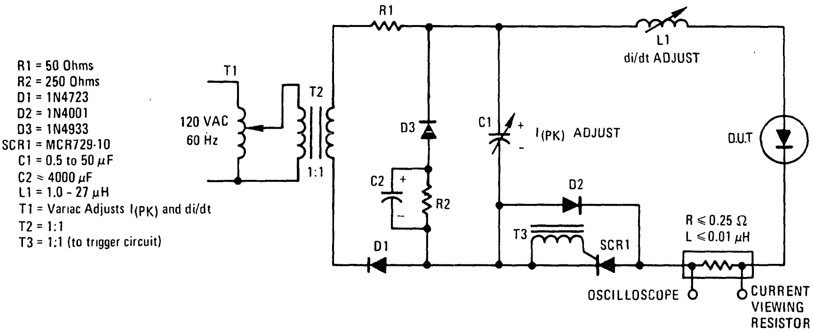
FIGURE 16 — JEDEC REVERSE RECOVERY CIRCUIT



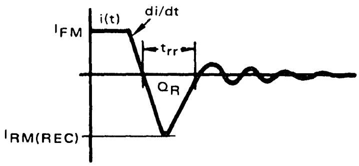
NOTE 3

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using I_F = 1.0 A, V_R = 30 V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, 100°C, and 150°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times \left[Q_R \times di/dt\right]^{1/2}$$

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

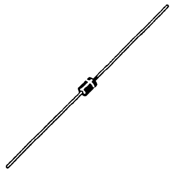
Axial-Lead Standard Recovery Rectifiers

This data sheet provides information on subminiature size, axial lead mounted rectifiers for general-purpose low-power applications.

1N4001 thru 1N4007

1N4004 and 1N4007 are Motorola Preferred Devices

LEAD MOUNTED RECTIFIERS
50-1000 VOLTS
DIFFUSED JUNCTION



CASE 59-03
DO-41

Mechanical Characteristics

Case: Void free, Transfer Molded
Maximum Lead Temperature For Soldering Purposes: 350°C, 3/8″ from case for 10 seconds at 5 lbs. tension
Finish: All external surfaces are corrosion-resistant, leads are readily solderable
Polarity: Cathode indicated by color band
Weight: 0.33 Grams (approximately)

MAXIMUM RATINGS

Rating	Symbol	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	Unit
*Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
*Non-Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz)	V_{RSM}	60	120	240	480	720	1000	1200	Volts
*RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	Volts
*Average Rectified Forward Current (single phase, resistive load, 60 Hz, see Figure 8, T_A = 75°C)	I_O	1.0							Amp
*Non-Repetitive Peak Surge Current (surge applied at rated load conditions, see Figure 2)	I_{FSM}	30 (for 1 cycle)							Amp
Operating and Storage Junction Temperature Range	T_J T_{stg}	– 65 to +125 – 65 to +150							°C

*Indicates JEDEC Registered Data
Preferred devices are Motorola recommended choices for future use and best overall value.

3

ELECTRICAL CHARACTERISTICS*

Rating	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage Drop (i_F = 1.0 Amp, T_J = 25°C) Figure 1	v_F	0.93	1.1	Volts
Maximum Full-Cycle Average Forward Voltage Drop (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$V_{F(AV)}$	—	0.8	Volts
Maximum Reverse Current (rated dc voltage) (T_J = 25°C) (T_J = 100°C)	I_R	0.05 1.0	10 50	μA
Maximum Full-Cycle Average Reverse Current (I_O = 1.0 Amp, T_L = 75°C, 1 inch leads)	$I_{R(AV)}$	—	30	μA

3

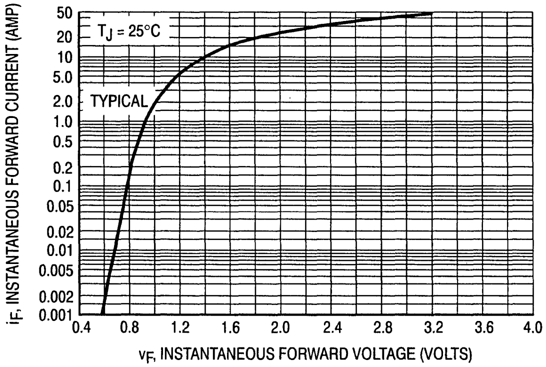


Figure 1. Forward Voltage

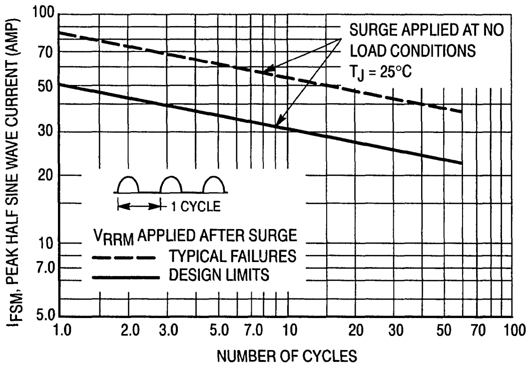


Figure 2. Non-Repetitive Surge Capability

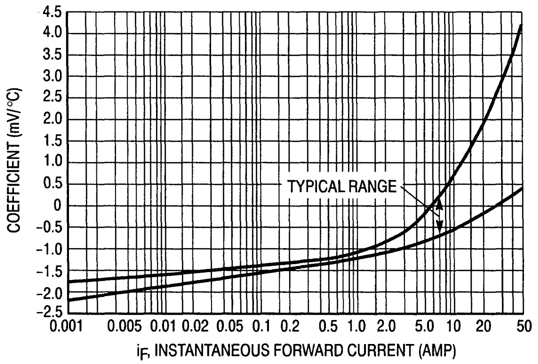


Figure 3. Forward Voltage Temperature Coefficient

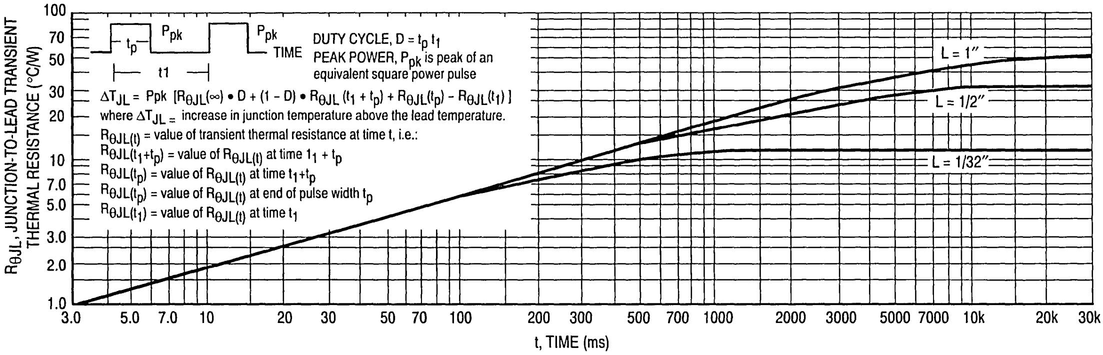


Figure 4. Thermal Response

The temperature of the lead should be measured using a thermocouple placed on the lead as close as possible to the tie point. The thermal mass connected to the tie point is normally large enough so that it will not significantly respond to heat surges generated in the diodes as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_L, the junction temperature may be determined by:

$$T_J = T_L + \Delta T_{JL}.$$

3

CURRENT DERATING DATA

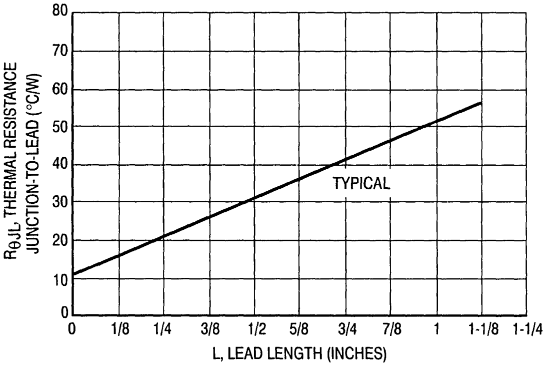


Figure 5. Steady-State Thermal Resistance

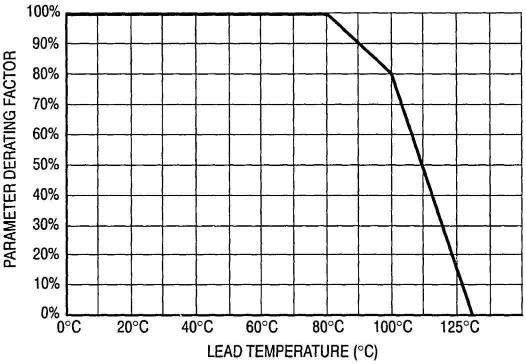
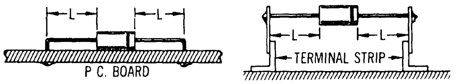


Figure 6. Parametric Derating Curve

NOTE 1

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR



MOUNTING METHOD 1 **MOUNTING METHOD 2**

MOUNTING METHOD	LEAD LENGTH, L (IN.)			$R_{\theta JA}$
	1/32	3/8	1	
1	—	75	85	°C/W
2	55	72	85	°C/W

TYPICAL DYNAMIC CHARACTERISTICS

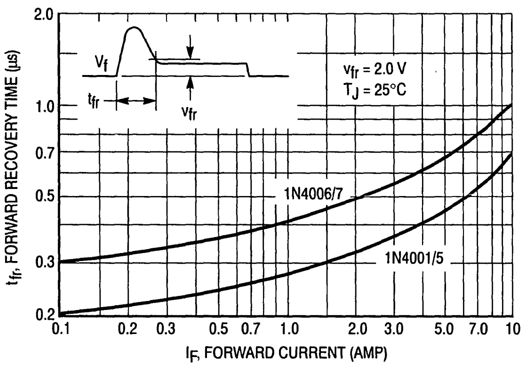


Figure 7. Forward Recovery Time

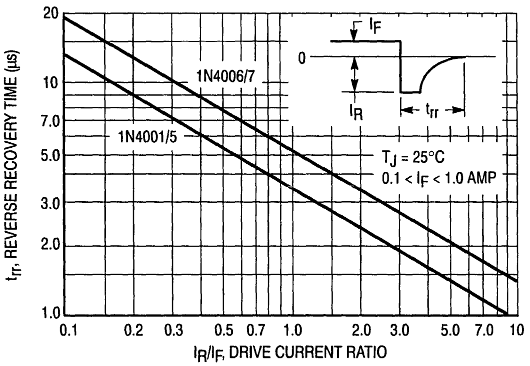


Figure 8. Reverse Recovery Time

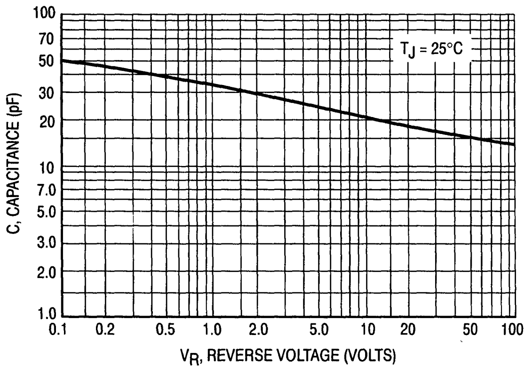


Figure 9. Typical Junction Capacitance

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N4719 thru 1N4725

1N4722 and 1N4725 are Motorola Preferred Devices

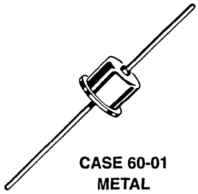
LEAD MOUNTED POWER RECTIFIERS

. . . having low forward voltage drop and hermetic metal packages. High surge current capability and good thermal characteristics provide reliable operation.

- $R_{\theta JA}$ = 30°C/W

SILICON RECTIFIERS

3.0 AMPERES
50-1000 VOLTS
DIFFUSED JUNCTION



CASE 60-01
METAL

3

***MAXIMUM RATINGS** (Both Package Types) T_A = 25°C unless otherwise noted

Rating	Symbol	1N4719	1N4720	1N4721	1N4722	1N4723	1N4724	1N4725	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
Nonrepetitive Peak Reverse Voltage (one half-wave, single phase, 60 cycle peak)	V_{RSM}	100	200	300	500	720	1000	1200	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	Volts
Average Rectified Forward Current (single phase, resistive load, 60 Hz, T_A = 75°C)	I_O	← 3.0 →							Amp
Nonrepetitive Peak Surge Current (superimposed on rated current at rated voltage, T_A = 75°C)	I_{FSM}	← 300 (for 1/2 cycle) →							Amp
Operating and Case Temperature	T_J, T_{stg}	← -65 to +175 →							°C

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Max Limit	Unit
*Instantaneous Forward Voltage (i_F = 3.0 A, T_J = 75°C, Half Wave Rectifier)	v_F	1.0	Volts
*Full Cycle Average Reverse Current (I_O = 3.0 Amps and Rated V_R, T_A = 75°C, Half Wave Rectifier)	$I_{R(AV)}$	1.5	mA
DC Reverse Current (Rated V_R, T_A = 25°C)	I_R	0.5	mA

*Indicates JEDEC Registered Data

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction
FINISH: All external surfaces corrosion-resistant and leads readily solderable
POLARITY: CATHODE TO CASE
MOUNTING POSITIONS: Any.

Axial-Lead Fast-Recovery Rectifiers

1N4933 thru 1N4937

1N4935 and 1N4937 are Motorola Preferred Devices

**FAST RECOVERY RECTIFIERS
50–600 VOLTS
1.0 AMPERE**

CASE 59-03
DO-41

Axial-lead, fast-recovery rectifiers are designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

Mechanical Characteristics

Case: Void free, Transfer Molded
Finish: External leads are readily solderable
Polarity: Cathode indicated by polarity band
Weight: 0.4 Gram (approximately)

3

MAXIMUM RATINGS

Rating	Symbol	1N4933	1N4934	1N4935	1N4936	1N4937	Unit
*Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
*Non-Repetitive Peak Reverse Voltage RMS Reverse Voltage	V_{RSM} $V_{R(RMS)}$	75 35	150 70	250 140	450 280	650 420	Volts
*Average Rectified Forward Current (Single phase, resistive load, $T_A = 75°C$)	I_O	1.0					Amp
*Non-Repetitive Peak Surge Current (Surge applied at rated load conditions)	I_{FSM}	30					Amps
Operating Junction Temperature Range Storage Temperature Range	T_J T_{stg}	– 65 to +125 – 65 to +150					°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (Typical Printed Circuit Board Mounting)	$R_{\theta JC}$	65	°C/W

*Indicates JEDEC Registered Data for 1N4933 Series.

Preferred devices are Motorola recommended choices for future use and best overall value.

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (I_F = 3.14 Amp, T_J = 125°C)	v_F	—	1.0	1.2	Volts
Forward Voltage (I_F = 1.0 Amp, T_A = 25°C)	V_F	—	1.0	1.1	Volts
*Reverse Current (Rated dc Voltage) T_A = 25°C	I_R	—	1.0	5.0	µA
T_A = 100°C		—	50	100	

*REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	t_{rr}				ns
(I_F = 1.0 Amp to V_R = 30 Vdc) (Figure 13)		—	150	200	
(I_{FM} = 15 Amp, di/dt = 10 A/µs) (Figure 14)		—	175	300	
Reverse Recovery Current (I_F = 1.0 Amp to V_R = 30 Vdc) (Figure 13)	$I_{RM(REC)}$	—	1.0	2.0	Amp

*Indicates JEDEC Registered Data for 1N4933 Series.

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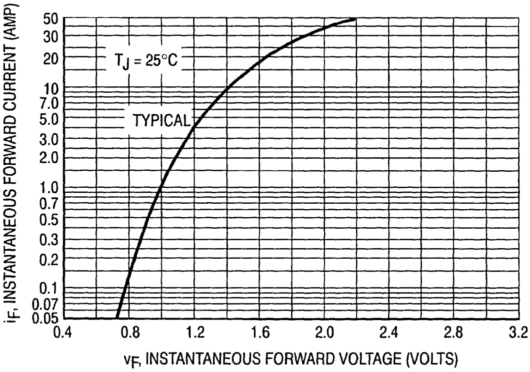


Figure 1. Forward Voltage

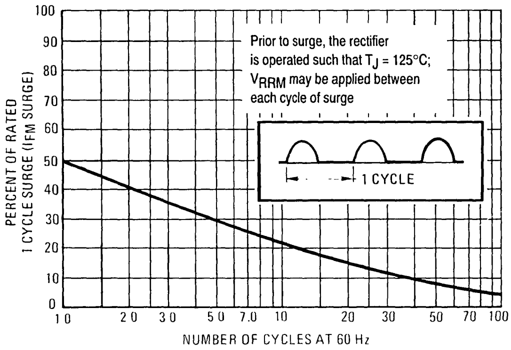


Figure 2. Maximum Surge Capability

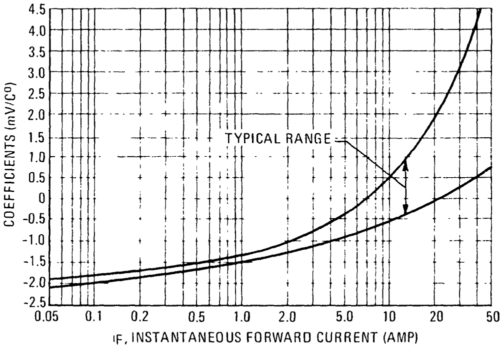


Figure 3. Forward Voltage Temperature Coefficient

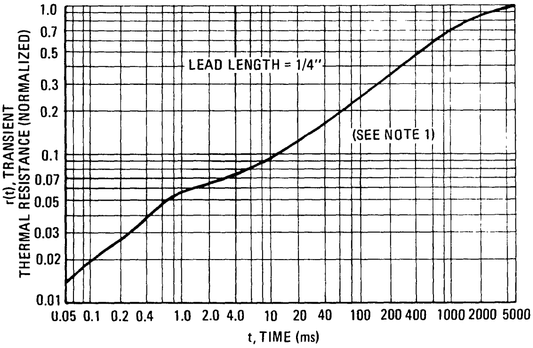


Figure 4. Thermal Response

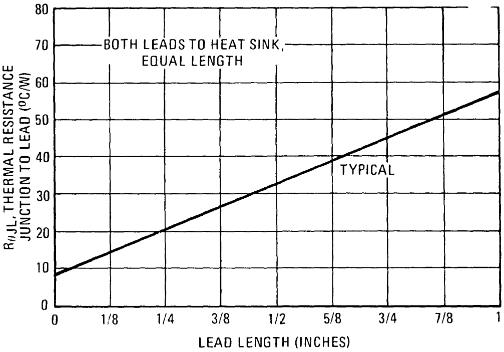
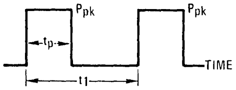


Figure 5. Thermal Resistance

NOTE 1



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended.

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see Note 3) The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \quad T_{JC}$$

where $\quad T_{JC}$ is the increase in junction temperature above the case temperature It may be determined by

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) \quad r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 3, i e

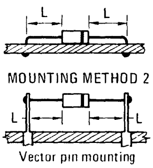
$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

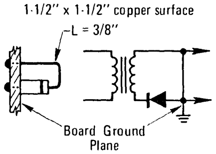
NOTE 2

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR θ_{JA} IN STILL AIR

MOUNTING METHOD	LEAD LENGTH, L (IN) 1/8	1/4	1/2	3/4	$R_{\theta JA}$
1	65	72	82	92	°C/W
2	74	81	91	101	°C/W
3	40				°C/W





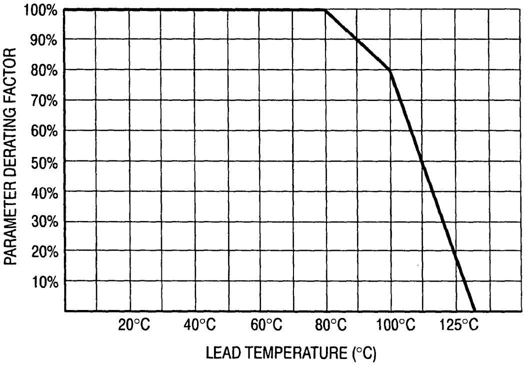
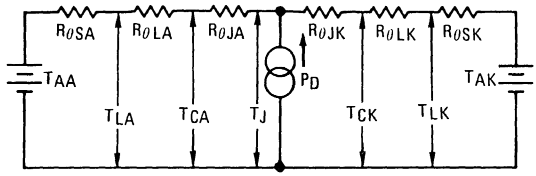


Figure 6. Parametric Derating Curve



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature $R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
T_L = Lead Temperature $R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
T_C = Case Temperature $R_{\theta J}$ = Thermal Resistance, Junction to Case
T_J = Junction Temperature P_D = Power Dissipation
(Subscripts A and K refer to anode and cathode sides respectively.)
Values for thermal resistance components are:
$R_{\theta L}$ = 112°C/W/IN. Typically and 128°C/W/IN Maximum
$R_{\theta J}$ = 18°C/W Typically and 30°C/W Maximum
The maximum lead temperature may be calculated as follows:
$T_L = 150° - \Delta T_{JL}$
ΔT_{JL} can be calculated as shown in NOTE 1 or it may be approximated as follows:
$\Delta T_{JL} \approx R_{\theta JL} \bullet P_F$; P_F may be formulated for sine-wave operation from Figure 3.

Figure 7. Thermal Circuit Model
(For Heat Conduction Through The Leads)

TYPICAL DYNAMIC CHARACTERISTICS

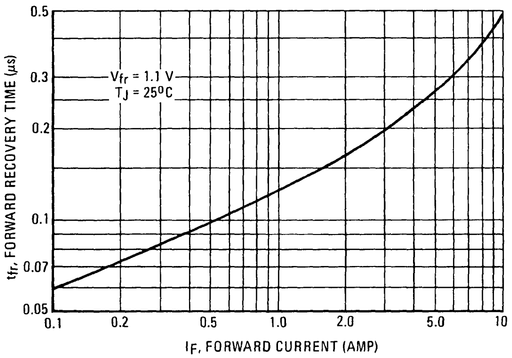


Figure 8. Forward Recovery Time

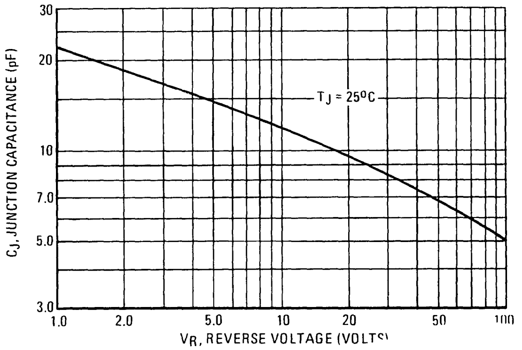


Figure 9. Typical Junction Capacitance

TYPICAL RECOVERED STORED CHARGED DATA

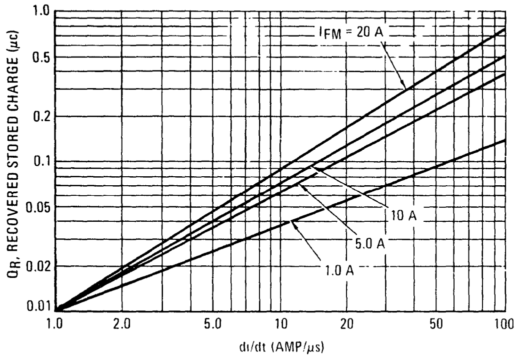


Figure 10. T_J = 25°C

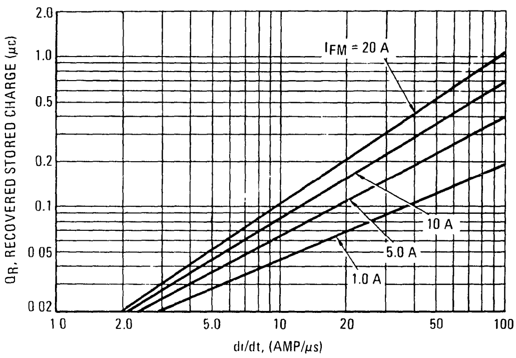


Figure 11. T_J = 75°C

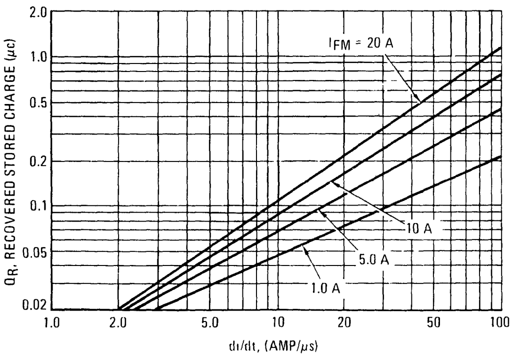


Figure 12. T_J = 100°C

RECOVERY TIME

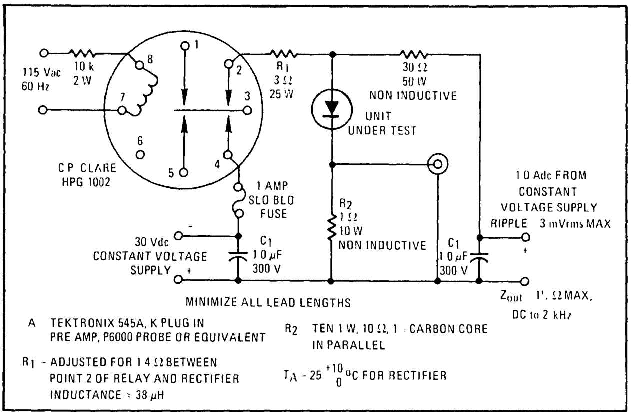


Figure 13. Reverse Recovery Circuit

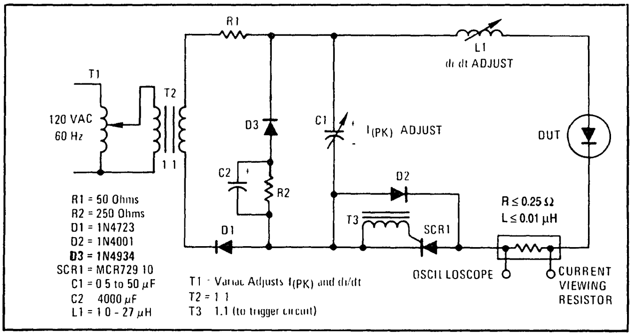


Figure 14. JEDEC Reverse Recovery Circuit

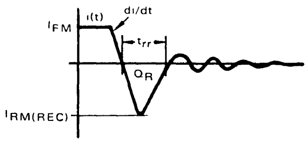
NOTE 3

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using I_F = 1.0 A, V_R = 30 V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, 100°C, and 150°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times \left[Q_R \times di/dt\right]^{1/2}$$

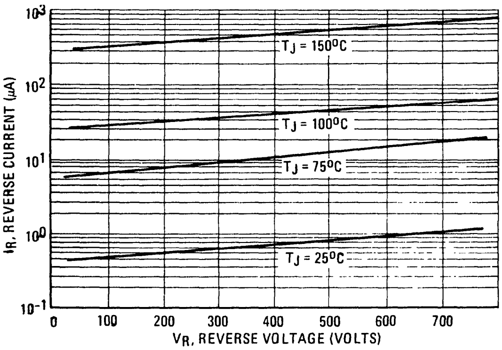


Figure 15. Typical Reverse Leakage

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5400 thru 1N5408

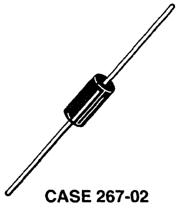
1N5404 and 1N5406 are Motorola Preferred Devices

Axial-Lead Standard Recovery Rectifiers

STANDARD RECOVERY RECTIFIERS 50–1000 VOLTS 3.0 AMPERE

Lead mounted standard recovery rectifiers are designed for use in power supplies and other applications having need of a device with the following features:

- High Current to Small Size
- High Surge Current Capability
- Low Forward Voltage Drop
- Void-Free Economical Plastic Package
- Available in Volume Quantities



CASE 267-02

Mechanical Characteristics

Case: Void free, Transfer Molded
Finish: External Leads are Plated, Leads are readily Solderable
Polarity: Indicated by Cathode Band
Weight: 1.1 Grams (Approximately)
Maximum Lead Temperature for Soldering Purposes: 240°C, 1/8″ from case for 10 s at 5.0 lb. tension

3

MAXIMUM RATINGS

Rating	Symbol	1N5400	1N5401	1N5402	1N5404	1N5406	1N5407	1N5408	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
Non-repetitive Peak Reverse Voltage	V_{RSM}	100	200	300	525	800	1000	1200	Volts
Average Rectified Forward Current (Single Phase Resistive Load, 1/2″ Leads, T_L = 105°C)	I_O	3.0							Amp
Non-repetitive Peak Surge Current (Surge Applied at Rated Load Conditions)	I_{FSM}	200 (one cycle)							Amp
Operating and Storage Junction Temperature Range	T_J T_{stg}	– 65 to +125 – 65 to +150							°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typ	Unit
Thermal Resistance, Junction to Ambient (PC Board Mount, 1/2″ Leads)	$R_{\theta JA}$	53	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
*Instantaneous Forward Voltage (1) (i_F = 9.4 Amp)	v_F	—	—	1.2	Volts
Average Reverse Current (1) DC Reverse Current (Rated dc Voltage, T_L = 80°C)	$I_{R(AV)}$ I_R	— —	— —	500 500	µA

*JEDEC Registered Data.

(1) Measured in a single phase halfwave circuit such as shown in Figure 6.25 of EIA RS-282, November 1963. Operated at rated load conditions T_L = 80°C, I_O = 3.0 A, V_r = V_{RWM}.

Preferred devices are Motorola recommended choices for future use and best overall value.

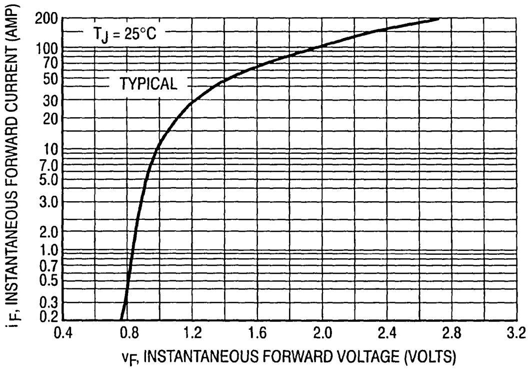


Figure 1. Forward Voltage

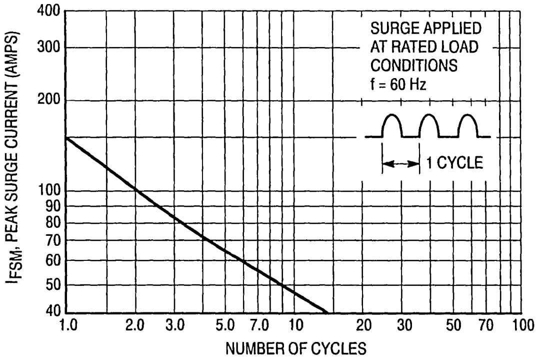


Figure 2. Maximum Non-repetitive Surge Current

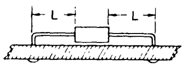
Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD	LEAD LENGTH, L (IN)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3	28				°C/W

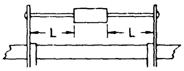
MOUNTING METHOD 1

P.C. Board Where Available Copper Surface area is small.



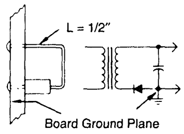
MOUNTING METHOD 2

Vector Push-In Terminals T-28



MOUNTING METHOD 3

P.C. Board with 1-1/2″ x 1-1/2″ Copper Surface



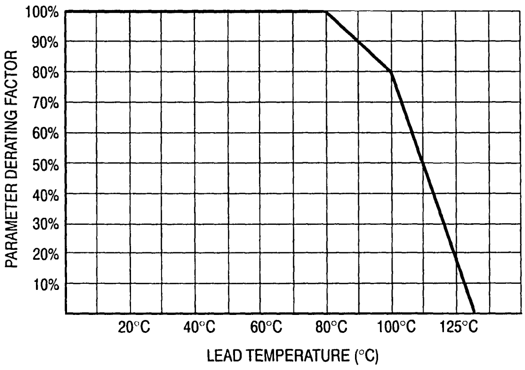


Figure 3. Parametric Derating Curve

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5817
1N5818
1N5819

1N5819 is a
Motorola Preferred Device

Axial Lead Rectifiers

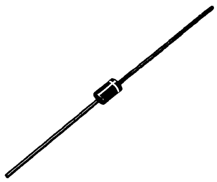
. . .employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes,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

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

Mechanical Characteristics

CASE: Void free, transfer molded
FINISH: All external surfaces corrosion-resistant and the terminal leads are readily solderable
POLARITY: Cathode indicated by polarity band
MOUNTING POSITIONS: Any
SOLDERING: 220°C 1/16″ from case for ten seconds

SCHOTTKY BARRIER RECTIFIERS
1 AMPERE
20, 30 and 40 VOLTS



CASE 59-04

3

MAXIMUM RATINGS

Rating	Symbol	1N5817	1N5818	1N5819	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	V
Non-Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	V
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	V
Average Rectified Forward Current (2) ($V_{R(equiv)} \leq 0.2\ V_R(dc)$, T_L = 90°C, $R_{\theta JA}$ = 80°C/W, P.C. Board Mounting, see Note 2, T_A = 55°C)	I_O		1.0		A
Ambient Temperature (Rated V_R(dc), $P_{F(AV)}$ = 0, $R_{\theta JA}$ = 80°C/W)	T_A	85	80	75	°C
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase 60 Hz, T_L = 70°C)	I_{FSM}		25 (for one cycle)		A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}		–65 to +125		°C
Peak Operating Junction Temperature (Forward Current applied)	$T_{J(pk)}$		150		°C

THERMAL CHARACTERISTICS (Note 2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS (T_L = 25°C unless otherwise noted) (2)

Characteristic	Symbol	1N5817	1N5818	1N5819	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 0.1 A) (i_F = 1.0 A) (i_F = 3.0 A)	v_F	0.32 0.45 0.75	0.33 0.55 0.875	0.34 0.6 0.9	V
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1) (T_L = 25°C) (T_L = 100°C)	i_R	1.0 10	1.0 10	1.0 10	mA

(1) Pulse Test. Pulse Width = 300 μs, Duty Cycle = 2.0%
(2) Lead Temperature reference is cathode lead 1/32″ from case.

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 0.1 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 1 indicates suggested factors for an equivalent dc voltage to use for conservative design, that is:

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

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 1N5818 operated in a 12-volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 0.4 A ($I_{F(AV)}$ = 0.5 A), $I_{(FM)}/I_{(AV)}$ = 10, Input Voltage = 10 $V_{(rms)}$, $R_{\theta JA}$ = 80°C/W.

Step 1. Find $V_{R(equiv)}$. Read F = 0.65 from Table 1,
$\therefore V_{R(equiv)} = (1.41)(10)(0.65) = 9.2$ V.

Step 2. Find T_R from Figure 2. Read T_R = 109°C
@ V_R = 9.2 V and $R_{\theta JA}$ = 80°C/W.

Step 3. Find $P_{F(AV)}$ from Figure 4. **Read $P_{F(AV)}$ = 0.5 W
@ $\frac{I_{(FM)}}{I_{(AV)}}$ = 10 and $I_{F(AV)}$ = 0.5 A.

Step 4. Find $T_{A(max)}$ from equation (3).
$T_{A(max)} = 109 - (80)(0.5) = 69$°C.

**Values given are for the 1N5818. Power is slightly lower for the 1N5817 because of its lower forward voltage, and higher for the 1N5819.

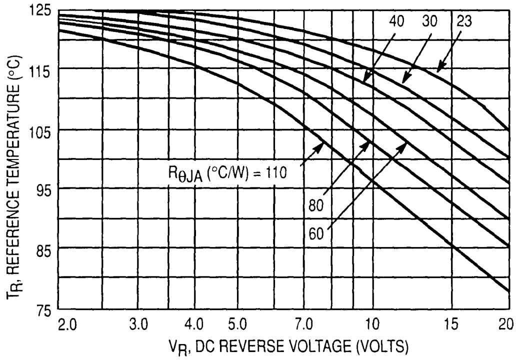


Figure 1. Maximum Reference Temperature 1N5817

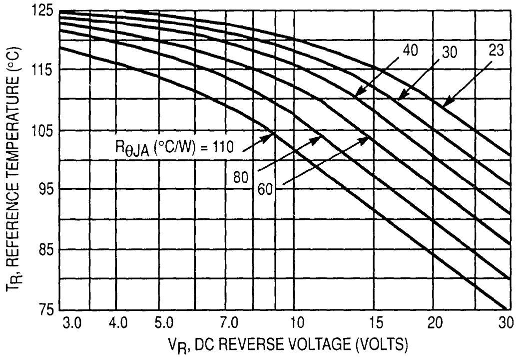


Figure 2. Maximum Reference Temperature 1N5818

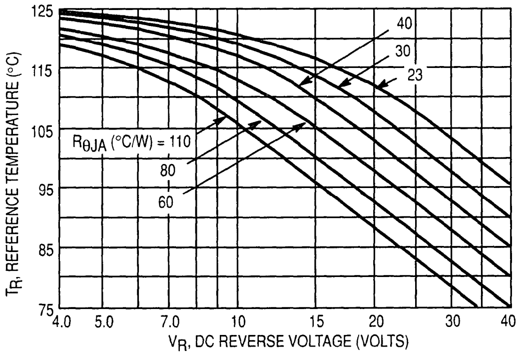


Figure 3. Maximum Reference Temperature 1N5819

3

Table 1. Values for Factor F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped*†	
Load	**Resistive**	**Capacitive***	**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

*Note that $V_{R(PK)} \approx 2.0\, V_{in(PK)}$ † Use line to center tap voltage for V_{in}

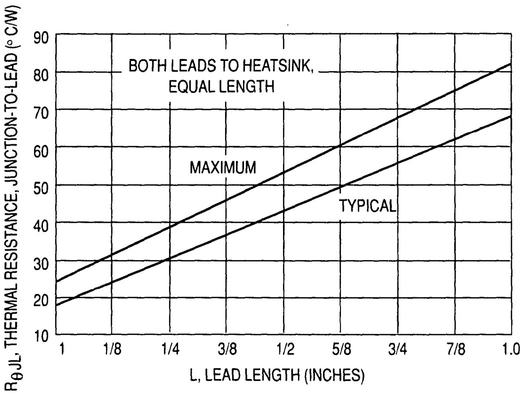


Figure 4. Steady-State Thermal Resistance

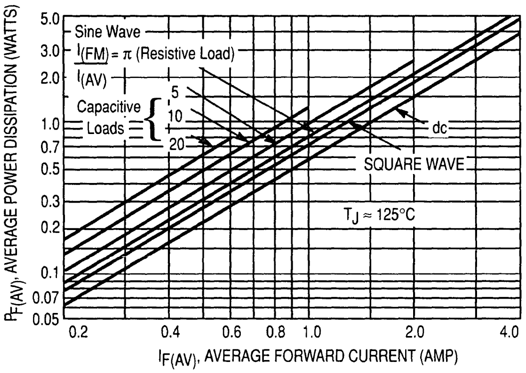


Figure 5. Forward Power Dissipation 1N5817-19

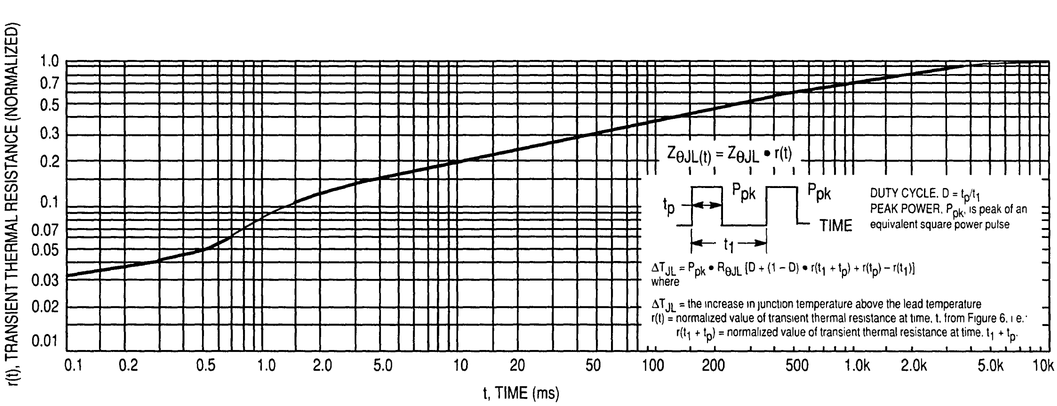


Figure 6. Thermal Response

NOTE 2 — MOUNTING DATA

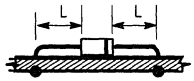
Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

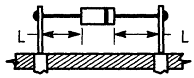
Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	52	65	72	85	°C/W
2	67	80	87	100	°C/W
3	50				°C/W

Mounting Method 1

P.C. Board with 1-1/2″ x 1-1/2″ copper surface.



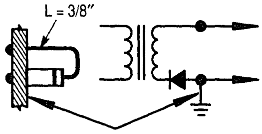
Mounting Method 2



VECTOR PIN MOUNTING

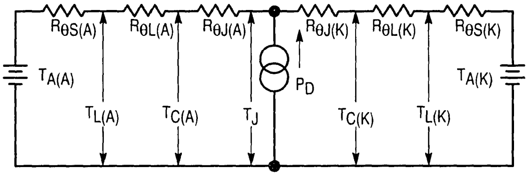
Mounting Method 3

P.C. Board with 1-1/2″ x 1-1/2″ copper surface.



BOARD GROUND PLANE

NOTE 3 — THERMAL CIRCUIT MODEL
(For heat conduction through the leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heatsink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heatsink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heatsink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Power Dissipation

(Subscripts A and K refer to anode and cathode sides, respectively.) Values for thermal resistance components are:

$R_{\theta L}$ = 100°C/W/in typically and 120°C/W/in maximum
$R_{\theta J}$ = 36°C/W typically and 46°C/W maximum.

3

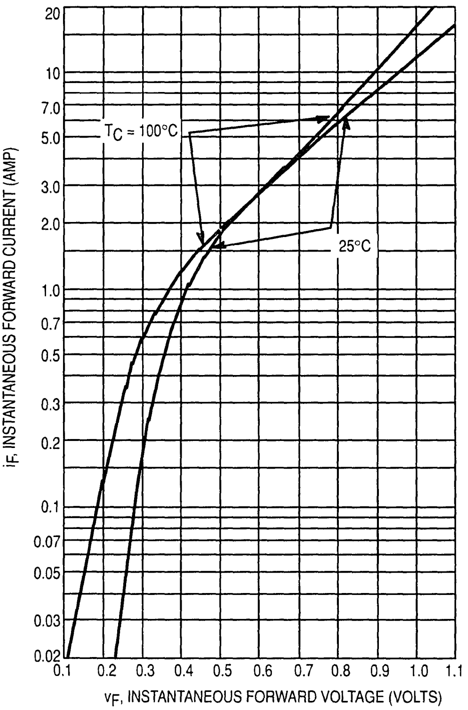


Figure 7. Typical Forward Voltage

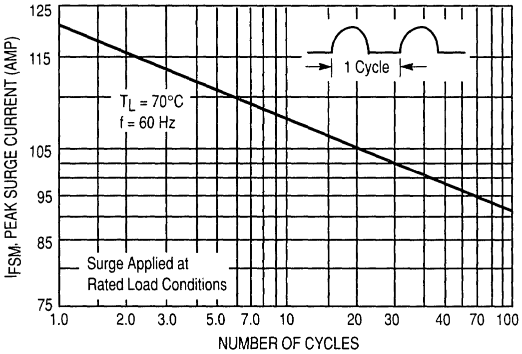


Figure 8. Maximum Non-Repetitive Surge Current

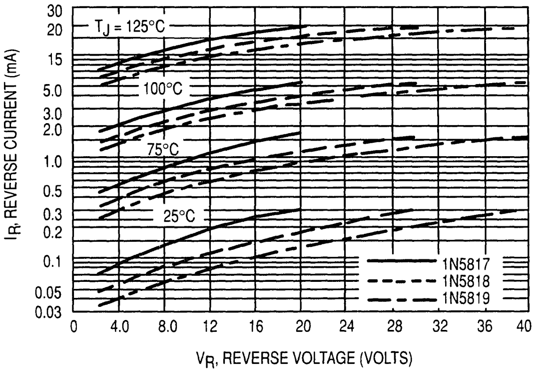


Figure 9. Typical Reverse Current

NOTE 4 — 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 10.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent 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.

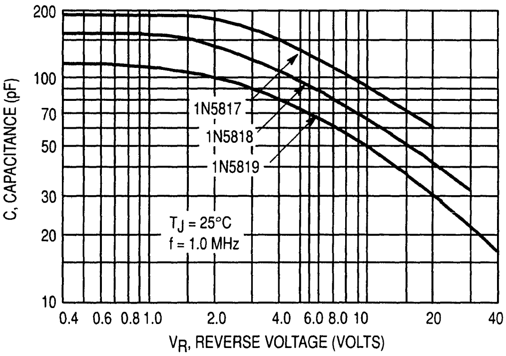


Figure 10. Typical Capacitance

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5820
1N5821
1N5822

1N5822 is a Motorola Preferred Device

Designers Data Sheet

AXIAL LEAD RECTIFIERS

. . . 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.

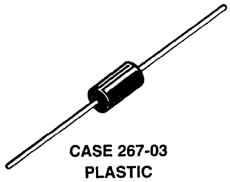
- Extremely Low v_F
- Low Power Loss/High Efficiency
- Low Stored Charge, Majority Carrier Conduction

Designer's 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.

SCHOTTKY BARRIER RECTIFIERS

3.0 AMPERES
20, 30, 40 VOLTS



CASE 267-03
PLASTIC

MECHANICAL CHARACTERISTICS

CASE . . . . Transfer molded plastic
FINISH . . . . All external surfaces corrosion-resistant and the terminal leads are readily solderable
POLARITY . . . . Cathode indicated by polarity band
MOUNTING POSITIONS . . . . Any
SOLDERING . . . . . . 220°C 1/16" from case for ten seconds

*MAXIMUM RATINGS

Rating	Symbol	1N5820	1N5821	1N5822	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	V
Non-Repetitive Peak Reverse Voltage	V_{RSM}	24	36	48	V
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	V
Average Rectified Forward Current (2) $V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $T_L = 95°C$ ($R_{\theta JA} = 28°C/W$, P.C. Board Mounting, see Note 2)	I_O	← 3.0 →			A
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)} = 0$ $R_{\theta JA} = 28°C/W$	T_A	90	85	80	°C
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, half wave, single phase 60 Hz, $T_L = 75°C$)	I_{FSM}	← 80 (for one cycle) →			A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	← −65 to +125 →			°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	← 150 →			°C

*THERMAL CHARACTERISTICS (Note 2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	28	°C/W

*ELECTRICAL CHARACTERISTICS ($T_L = 25°C$ unless otherwise noted) (2)

Characteristic	Symbol	1N5820	1N5821	1N5822	Unit
Maximum Instantaneous Forward Voltage (1)	v_F				V
($i_F = 1.0$ Amp)		0.370	0.380	0.390	
($i_F = 3.0$ Amp)		0.475	0.500	0.525	
($i_F = 9.4$ Amp)		0.850	0.900	0.950	
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1)	i_R				mA
$T_L = 25°C$		2.0	2.0	2.0	
$T_L = 100°C$		20	20	20	

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.
(2) Lead Temperature reference is cathode lead 1/32" from case.
*Indicates JEDEC Registered Data for 1N5820-22.

3

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 0.1 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 ($125^{o}C$ 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 $T_J = 125^{o}C$, 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 $115^{o}C$. The data of Figures 1, 2, and 3 is based upon dc conditions. For use in common rectifier circuits, Table 1 indicates suggested factors for an equivalent dc voltage to use for conservative design, that is:

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

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 1N5821 operated in a 12-volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 2.0 A ($I_{F(AV)}$ = 1.0 A), $I_{(FM)}/I_{(AV)}$ = 10, Input Voltage = 10 $V_{(rms)}$, $R_{\theta JA} = 40^{o}C/W$.

Step 1. Find $V_{R(equiv)}$. Read F = 0.65 from Table 1,
$\therefore V_{R(equiv)}$ = (1.41)(10)(0.65) = 9.2 V.
Step 2. Find T_R from Figure 2. Read $T_R = 108^{o}C$ @ V_R = 9.2 V and $R_{\theta JA} = 40^{o}C/W$.
Step 3. Find $P_{F(AV)}$ from Figure 6. **Read $P_{F(AV)}$ = 0.85 W @ $\frac{I_{(FM)}}{I_{(AV)}}$ = 10 and $I_{F(AV)}$ = 1.0 A.
Step 4. Find $T_{A(max)}$ from equation (3).
$T_{A(max)} = 108 - (0.85)(40) = 74^{o}C$.

**Values given are for the 1N5821. Power is slightly lower for the 1N5820 because of its lower forward voltage, and higher for the 1N5822. Variations will be similar for the MBR-prefix devices, using $P_{F(AV)}$ from Figure 7.

3

TABLE 1 — VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped*†	
Load	Resistive	Capacitive*	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

*Note that $V_{R(PK)} \approx 2.0\ V_{in(PK)}$. †Use line to center tap voltage for V_{in}.

FIGURE 1 — MAXIMUM REFERENCE TEMPERATURE 1N5820

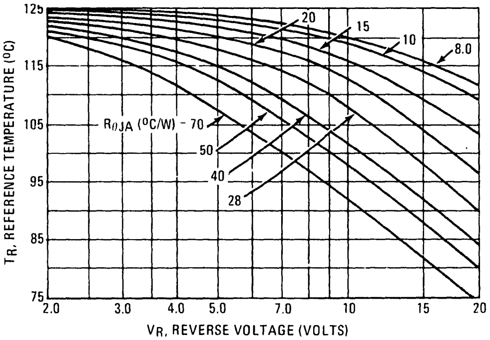


FIGURE 2 — MAXIMUM REFERENCE TEMPERATURE 1N5821

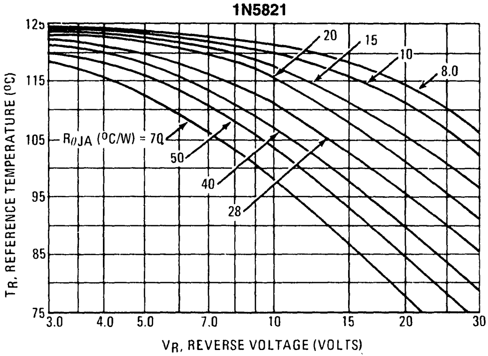


FIGURE 3 — MAXIMUM REFERENCE TEMPERATURE 1N5822

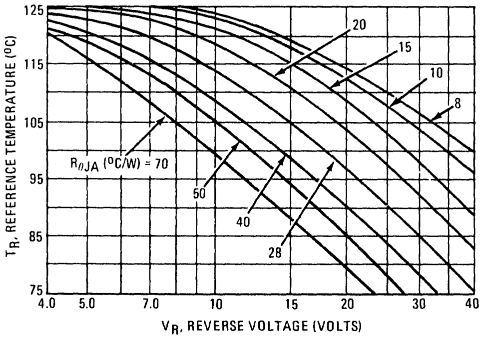


FIGURE 4 — STEADY-STATE THERMAL RESISTANCE

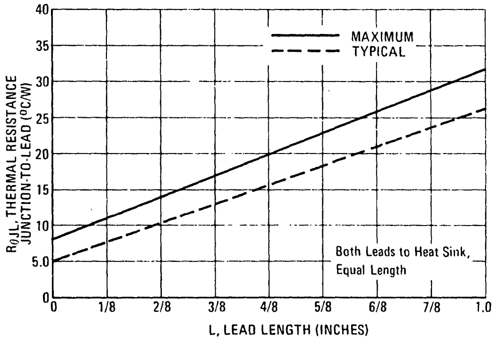


FIGURE 5 – THERMAL RESPONSE

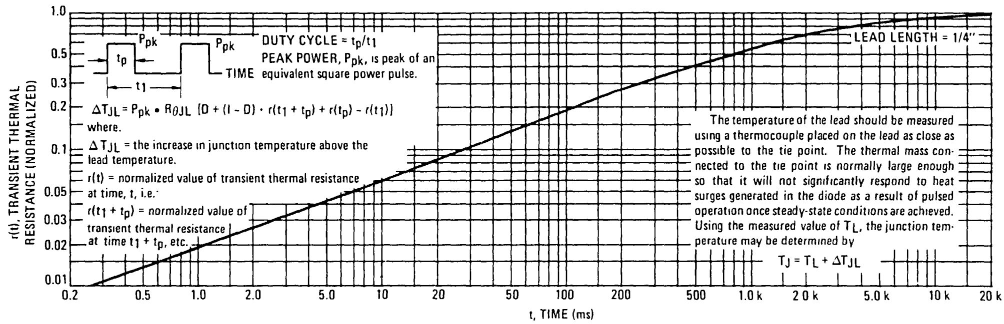
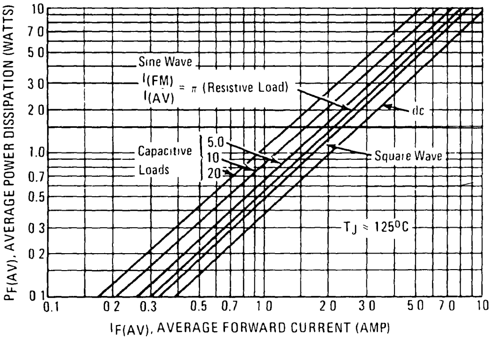
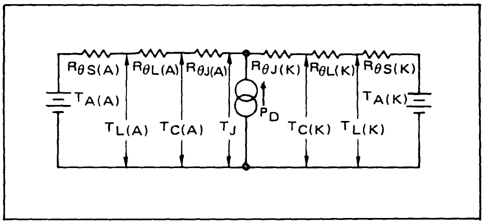


FIGURE 6 – FORWARD POWER DISSIPATION 1N5820-22



NOTE 3 – APPROXIMATE THERMAL CIRCUIT MODEL



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Total Power Dissipation = $P_F + P_R$
P_F = Forward Power Dissipation
P_R = Reverse Power Dissipation

(Subscripts (A) and (K) refer to anode and cathode sides, respectively.) Values for thermal resistance components are:
$R_{\theta L}$ = 42°C/W/in typically and 48°C/W/in maximum
$R_{\theta J}$ = 10°C/W typically and 16°C/W maximum

The maximum lead temperature may be found as follows:

$$T_L = T_{J(max)} - \Delta T_{JL}$$

where $\Delta T_{JL} \approx R_{\theta JL} \cdot P_D$

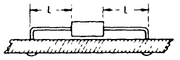
NOTE 2 – MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

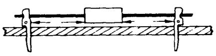
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

Mounting Method	Lead Length, L (in) 1/8	1/4	1/2	3/4	$R_{\theta JA}$
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3	·		28		°C/W

Mounting Method 1
P.C. Board where available copper surface is small.



Mounting Method 2
Vector Push-In Terminals T-28



Mounting Method 3
P.C. Board with with 2-1/2″ X 2-1/2″ copper surface

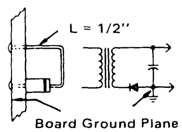


FIGURE 8 – TYPICAL FORWARD VOLTAGE

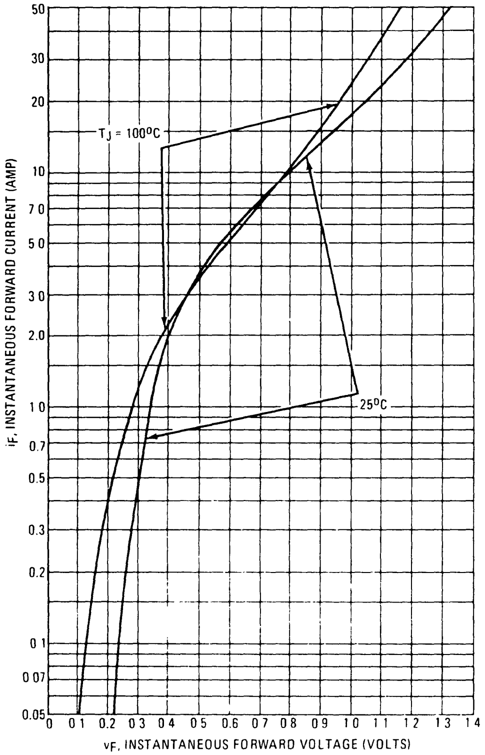


FIGURE 9 – MAXIMUM NON-REPETITIVE SURGE CURRENT

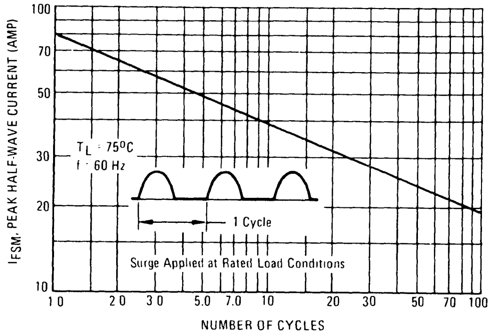


FIGURE 10 – TYPICAL REVERSE CURRENT

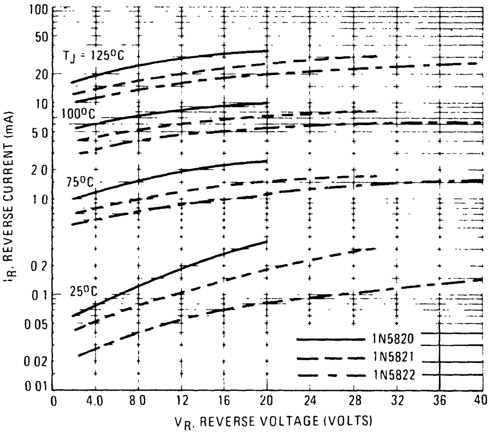
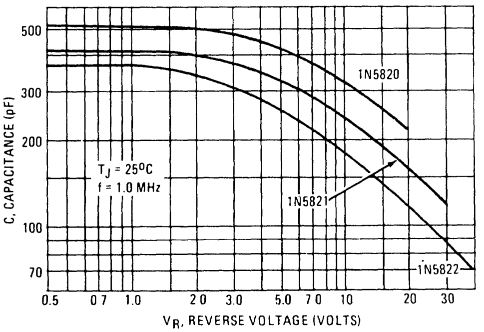


FIGURE 11 – TYPICAL CAPACITANCE



NOTE 4 – 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.)

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5823, 1N5824
1N5825
MBR5825,H,H1

1N5825 is a
Motorola Preferred Device

Designers Data Sheet

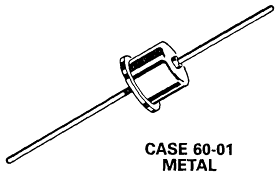
HOT CARRIER POWER RECTIFIERS

. . . 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
- "H" & "H1" Version Available Similar to TX Processing

SCHOTTKY BARRIER RECTIFIERS

5 AMPERE
20, 30, 40 VOLTS



CASE 60-01
METAL

Designer's 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.

3

*MAXIMUM RATINGS

Rating	Symbol	1N5823	1N5824	1N5825 MBR5825H, H1	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
RMS Reverse Voltage	$V_{R(RMS)}$	14	21	28	Volts
Average Rectified Forward Current $V_{R(equiv)} \leq 0.2\ V_{R\ (dc)}$, $T_C = 75°C$ $V_{R(equiv)} \leq 0.2\ V_{R\ (dc)}$, $T_L = 80°C$ $R_{\theta JA} = 25°C/W$, P.C. Board Mounting, See Note 3)	I_O	← 15 → ← 5.0 →			Amp
Ambient Temperature Rated $V_{R\ (dc)}$, $P_{F(AV)} = 0$ $R_{\theta JA} = 25°C/W$	T_A	65	60	55	°C
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 →			°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	← 150 →			°C

*THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

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

Characteristic	Symbol	1N5823	1N5824	1N5825 MBR5825H, H1	Unit
Maximum Instantaneous Forward Voltage (1) ($i_F = 3.0$ Amp) ($i_F = 5.0$ Amp) ($i_F = 15.7$ Amp)	v_F	 0.330 0.360 0.470	 0.340 0.370 0.490	 0.350 0.380 0.520	Volts
Maximum Instantaneous Reverse Current @ rated dc Voltage $T_C = 25°C$ $T_C = 100°C$	i_R	 10 100	 10 125	 10 150	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0% *Indicates JEDEC Registered Data for 1N5823–1N5825

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 0.1 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 1N5825 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), $I_{(PK)}/I_{(AV)}$ = 10, Input Voltage = 10 V(rms), $R_{\theta JA}$ = 10°C/W.

Step 1: Find $V_{R(equiv)}$. Read F = 0.65 from Table I ∴ $V_{R(equiv)}$ = (1.41)(10)(0.65) = 9.2 V

Step 2: Find T_R from Figure 3. Read T_R = 113°C @ V_R = 9.2 V & $R_{\theta JA}$ = 10°C/W.

Step 3: Find $P_{F(AV)}$ from Figure 4. **Read $P_{F(AV)}$ = 5.5 W @ $\frac{I_{(PK)}}{I_{(AV)}}$ = 10 & $I_{F(AV)}$ = 5 A

Step 4. Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 113-(10)(5.5) = 58°C.

**Value given are for the 1N5825. Power is slightly lower for the other units because of their lower forward voltage.

3

TABLE I — VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped *†	
Load	Resistive	Capacitive*	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

*Note that $V_{R(PK)} \approx 2 V_{in(PK)}$ †Use line to center tap voltage for V_{in}.

FIGURE 1 — MAXIMUM REFERENCE TEMPERATURE — 1N5823

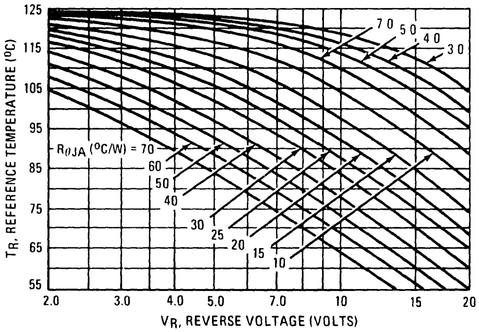


FIGURE 2 — MAXIMUM REFERENCE TEMPERATURE — 1N5824

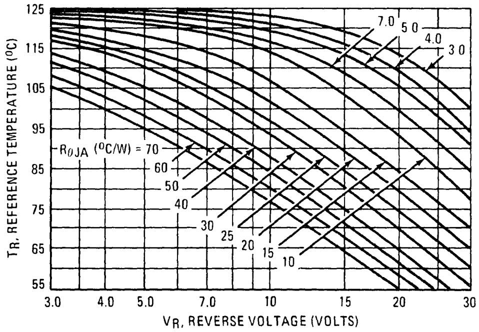


FIGURE 3 — MAXIMUM REFERENCE TEMPERATURE 1N5825 AND MBR5825H, H1

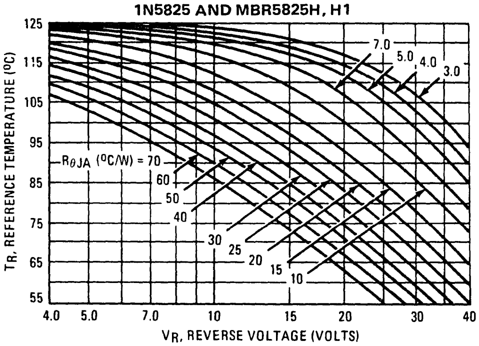
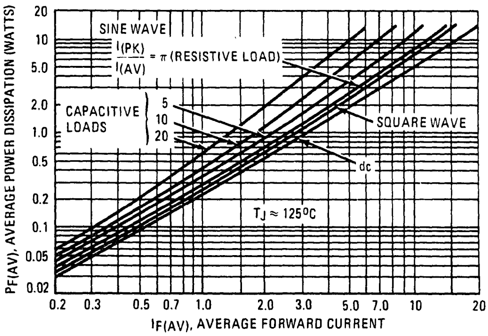
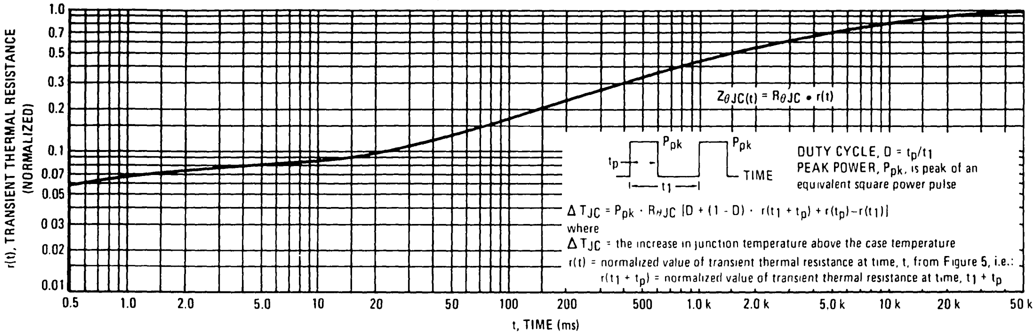


FIGURE 4 — FORWARD POWER DISSIPATION

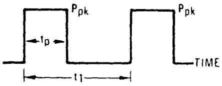


THERMAL CHARACTERISTICS

FIGURE 5 – THERMAL RESPONSE



NOTE 2 – FINDING JUNCTION TEMPERATURE



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk} is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see Note 3). The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady state conditions are achieved. Using the measured value of T_C the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature. It may be determined by

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC} [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time t, from Figure 5 i.e.

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

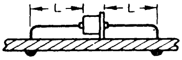
NOTE 3 – MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering.

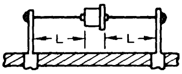
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD	LEAD LENGTH, L (IN) 1/4	1	$R_{\theta JA}$
1	55	60	°C/W
2	65	70	°C/W
3	25		°C/W

MOUNTING METHOD 1



MOUNTING METHOD 2



Vector pin mounting

MOUNTING METHOD 3

P. C. Board with 2 1/2" x 2 1/2" copper surface

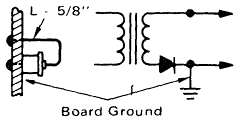
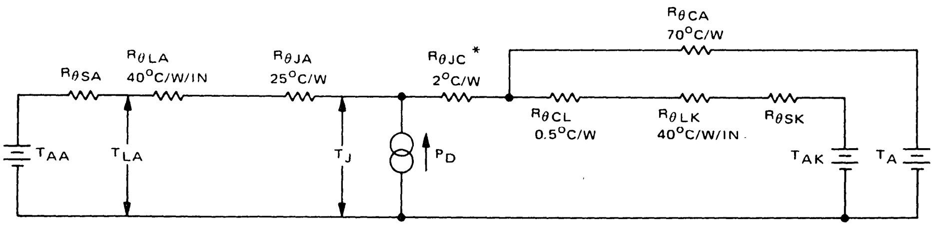


FIGURE 6 – APPROXIMATE THERMAL CIRCUIT MODEL



Use of the above model permits calculation of average junction temperature for any mounting situation. Lowest values of thermal resistance will occur when the cathode lead is brought as close as possible to a heat dissipator; as heat conduction through the anode lead is small. Terms in the model are defined as follows:

*Case temperature reference is at cathode end.

TEMPERATURES

T_A = Ambient
T_{AA} = Anode Heat Sink Ambient
T_{AK} = Cathode Heat Sink Ambient
T_{LA} = Anode Lead
T_{LK} = Cathode Lead
T_J = Junction

THERMAL RESISTANCES

$R_{\theta CA}$ = Case to Ambient
$R_{\theta SA}$ = Anode Lead Heat Sink to Ambient
$R_{\theta SK}$ = Cathode Lead Heat Sink to Ambient
$R_{\theta LA}$ = Anode Lead
$R_{\theta LK}$ = Cathode Lead
$R_{\theta CL}$ = Case to Cathode Lead
$R_{\theta JC}$ = Junction to Case
$R_{\theta JA}$ = Junction to Anode Lead (S bend)

FIGURE 7 – TYPICAL FORWARD VOLTAGE

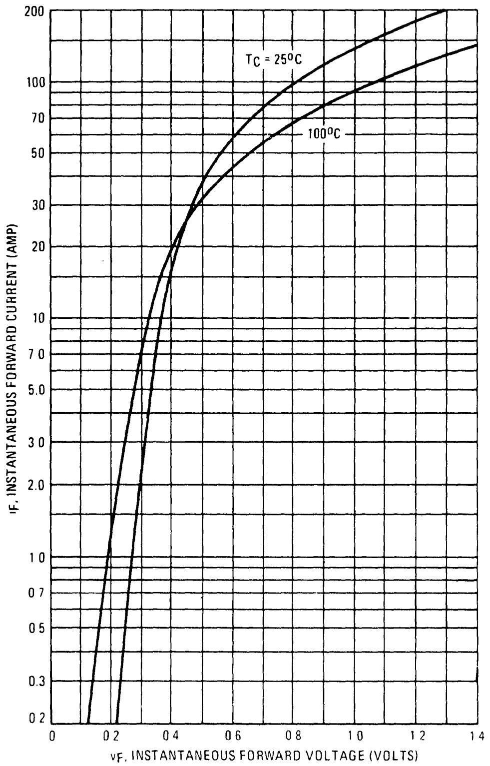


FIGURE 8 – MAXIMUM SURGE CAPABILITY

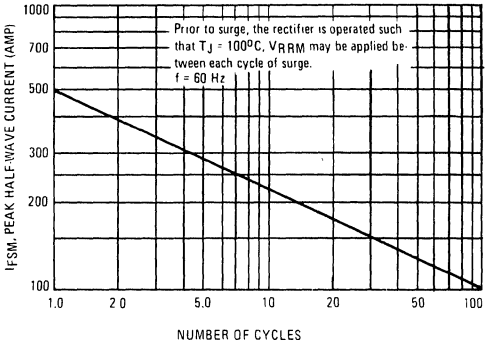


FIGURE 9 – TYPICAL REVERSE CURRENT

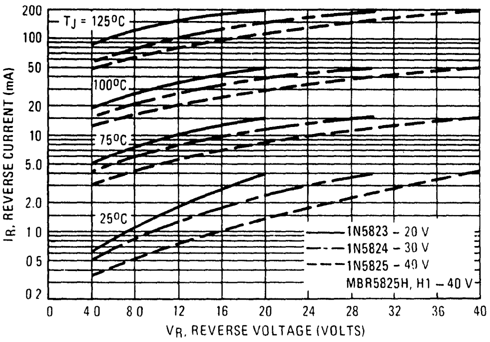
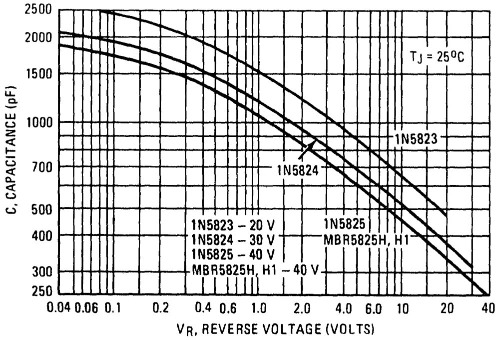


FIGURE 10 – CAPACITANCE

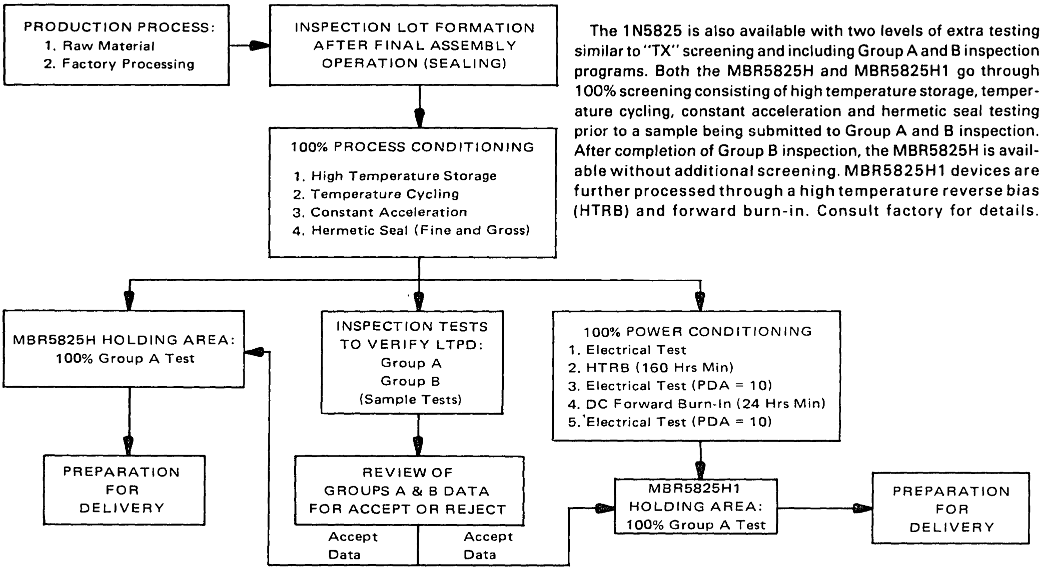


NOTE 4 – HIGH FREQUENCY OPERATION

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 10).

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.

NOTE 5 – HI-REL PROGRAM OPTIONS



The 1N5825 is also available with two levels of extra testing similar to "TX" screening and including Group A and B inspection programs. Both the MBR5825H and MBR5825H1 go through 100% screening consisting of high temperature storage, temperature cycling, constant acceleration and hermetic seal testing prior to a sample being submitted to Group A and B inspection. After completion of Group B inspection, the MBR5825H is available without additional screening. MBR5825H1 devices are further processed through a high temperature reverse bias (HTRB) and forward burn-in. Consult factory for details.

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction.
FINISH: All external surfaces corrosion-resistant and the terminal leads are readily solderable.
WEIGHT: 2.4 grams (approximately).
POLARITY: Cathode to case.
MOUNTING POSITONS: Any

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5826
1N5827
1N5828

1N5828 is a
Motorola Preferred Device

Designers Data Sheet

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.

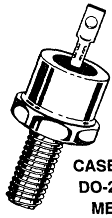
- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- High Surge Capacity

SCHOTTKY BARRIER RECTIFIERS

15 AMPERE
20,30,40 VOLTS

Designer's 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.



CASE 56-03
DO-203AA
METAL

3

*MAXIMUM RATINGS

Rating	Symbol	1N5826	1N5827	1N5828	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 $V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $T_C = 85^oC$	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

MECHANICAL CHARACTERISTICS
CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion resistant and terminal leads are readily solderable
POLARITY: Cathode to Case
MOUNTING POSITION: Any
MOUNTING TORQUE: 15 in-lb max

*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	1N5826	1N5827	1N5828	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp) (i_F = 15 Amp) (i_F = 47.1 Amp)	v_F	 0.380 0.440 0.670	 0.400 0.470 0.770	 0.420 0.500 0.870	Volts
Maximum Instantaneous Reverse Current @ rated dc Voltage (1) $T_C = 100^oC$	i_R	10 75	10 75	10 75	mA

*Indicates JEDEC Registered Data.
(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

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 1N5828 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 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) = 71°C

** Value given are for the 1N5828. Power is slightly lower for the other units because of their lower forward voltage.

TABLE I — VALUES FOR FACTOR F

Circuit	Half Wave		Full Wave, Bridge		Full Wave, Center Tapped *†	
Load	Resistive	Capacitive*	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

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

*†Use line to center tap voltage for V_{in}.

FIGURE 1 — MAXIMUM REFERENCE TEMPERATURE — 1N5826

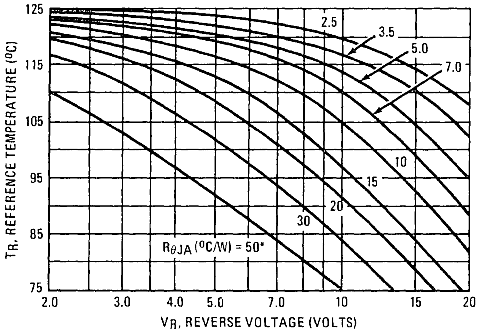


FIGURE 2 — MAXIMUM REFERENCE TEMPERATURE — 1N5827

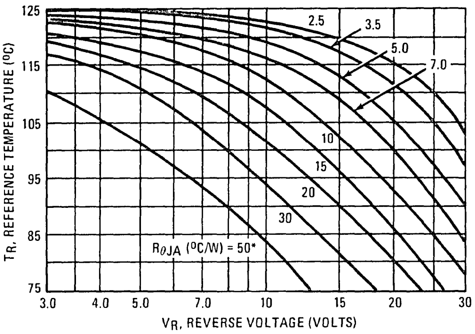


FIGURE 3 — MAXIMUM REFERENCE TEMPERATURE — 1N5828

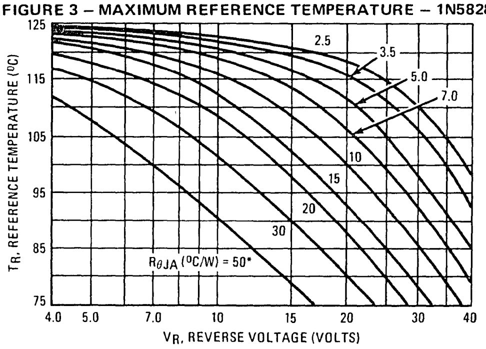
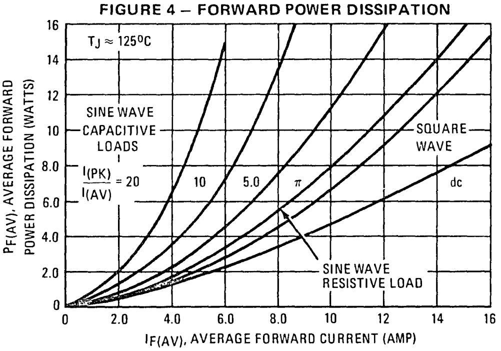


FIGURE 4 — FORWARD POWER DISSIPATION



*No external heat sink.

FIGURE 5 – TYPICAL FORWARD VOLTAGE

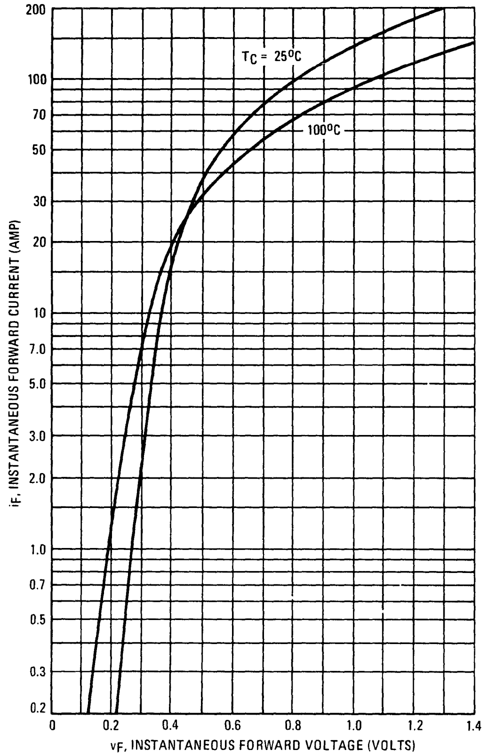


FIGURE 6 – MAXIMUM SURGE CAPABILITY

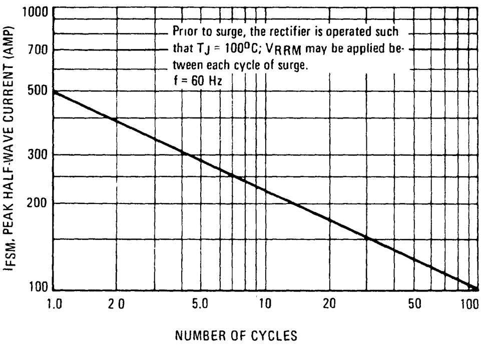


FIGURE 7 – CURRENT DERATING

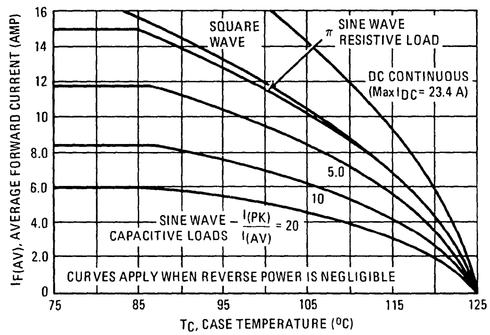


FIGURE 8 – THERMAL RESPONSE

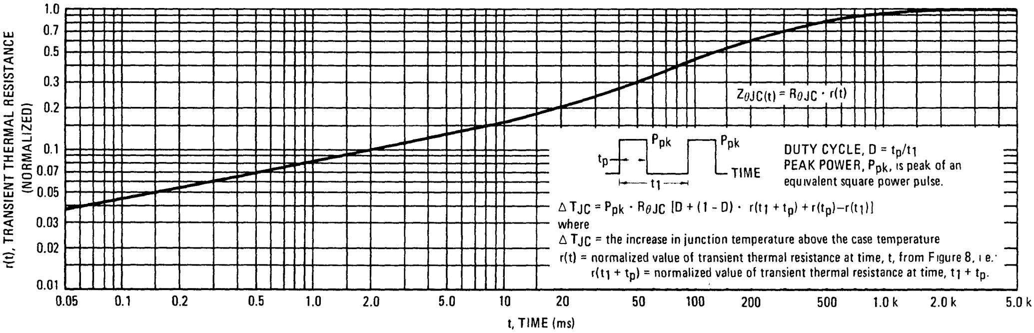


FIGURE 9 – NORMALIZED REVERSE CURRENT

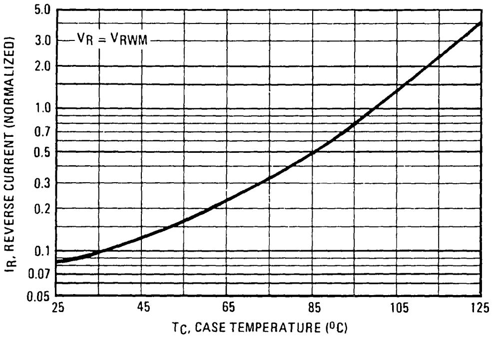


FIGURE 10 – TYPICAL REVERSE CURRENT

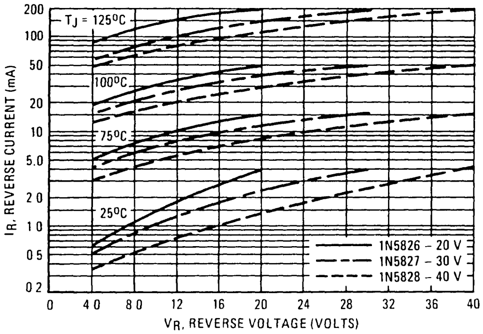
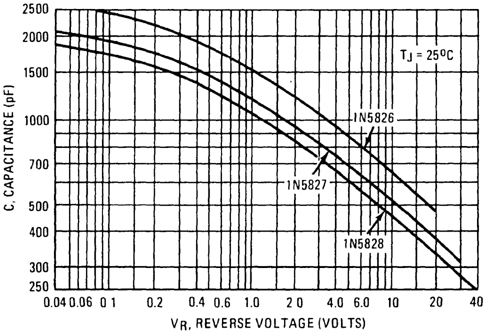


FIGURE 11 – CAPACITANCE



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.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5829
1N5830
1N5831
MBR5831H, H1

1N5831 is a
Motorola Preferred Device

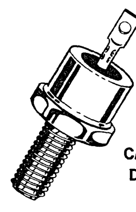
Designer's Data Sheet

Switchmode Power Rectifiers

. . . 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
- High Reliability Processing Similar to JAN,JTX Processing Available (See Note 3)

25 AMPERE
20, 30, 40 VOLTS



CASE 56-03
DO-203AA
METAL

3

MAXIMUM RATINGS

Rating	Symbol	*1N5829	*1N5830	*1N5831 MBR5831H,H1	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	Volts
Nonrepetitive Peak Reverse Voltage	V_{RSM}	24	36	48	Volts
Average Rectified Forward Current $V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $T_C = 85°C$	I_O	25			Amps
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)} = 0$, $R_{\theta JA} = 3.5°C/W$	T_A	90	85	80	°C
Nonrepetitive Peak Surge Current (surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	800 (for 1 cycle)			Amps
Operating and Storage Junction Temperature Range (Reverse voltage applied)	T_J, T_{stg}	−65 to +125			°C
Peak Operating Junction Temperature (Foward Current Applied)	$T_{J(pk)}$	150			°C

MECHANICAL CHARACTERISTICS
CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion resistant and terminal leads are readily solderable.
POLARITY: Cathode to Case
MOUNTING POSITION: Any
MOUNTING TORQUE: 15 in-lb max

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.75	°C/W

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

Characteristic	Symbol	*1N5829	*1N5830	*1N5831 MBR5831H,H1	Unit
Maximum Instantaneous Forward Voltage(1) (i_F = 10 Amps) (i_F = 25 Amps) (i_F = 78.5 Amps)	v_F	 0.360 0.440 0.720	 0.370 0.460 0.770	 0.380 0.480 0.820	Volts
Maximum Instantaneous Reverse Current @ Rated dc Voltage(1) (T_C = 100°C)		20 150	20 150	20 150	mA

*Indicates JEDEC Registered Data.
(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.
Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

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
- $R_{\theta JC}$ = 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 91) 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 1 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 1N5831 operated in a 12-Volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 16 A ($I_{F(AV)}$ = 8 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 1
$V_{R(equiv)}$ = (1.41)(10)(0.65) = 9.18 V

Step 2: Find T_R from Figure 3. Read T_R = 113°C @ V_R = 9.18 & $R_{\theta JA}$ = 5°C/W

Step 3: Find $P_{F(AV)}$ from Figure 4.** Read $P_{F(AV)}$ = 12.8 W @ $\frac{I_{(PK)}}{I_{(AV)}}$ = 20 & $I_{F(AV)}$ = 8 A

Step 4: Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 113-(5) (12.8) = 49°C

**Value given are for the 1N5828. Power is slightly lower for the other units because of their lower forward voltage.

Table 1. Values for Factor F

Circuit Load	Half Wave		Full Wave, Bridge		Full Wave Center Tapped††	
	Resistive	Capacitive†	Resistive	Capacitive	Resistive	Capacitive
Sine Wave	0.5	1.3	0.5	0.65	1	1.3
Square Wave	0.75	1.5	0.75	0.75	1.5	1.5

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

††Use line to center tape voltage for V_{in}.

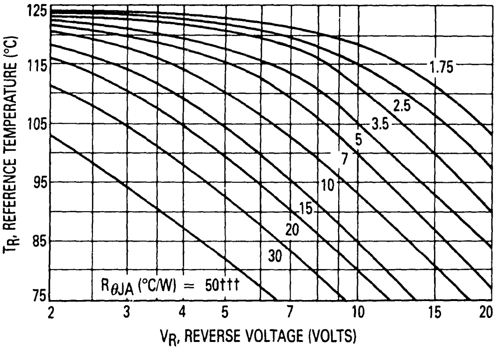


Figure 1. Maximum Reference Temperature — 1N5829

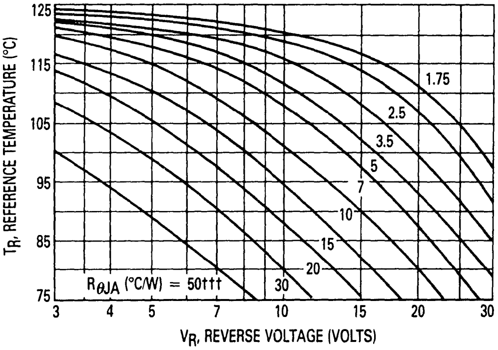
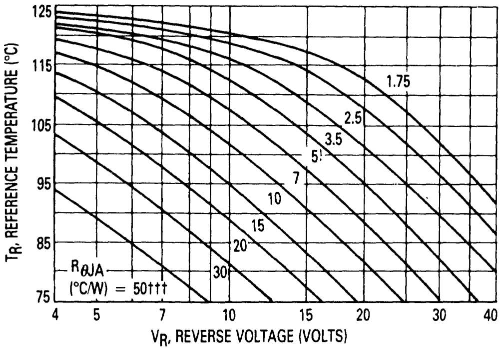


Figure 2. Maximum Reference Temperature — 1N5830

†††NO EXTERNAL HEAT SINK



†††NO EXTERNAL HEAT SINK.

Figure 3. Maximum Reference Temperature — 1N5831

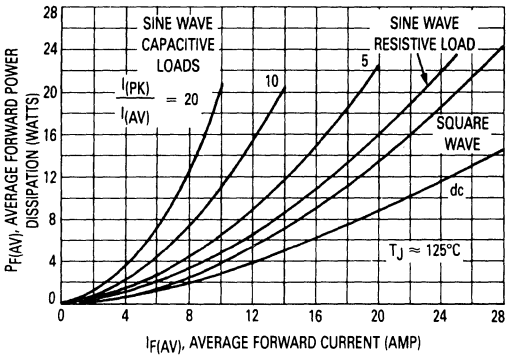


Figure 4. Forward Power Dissipation

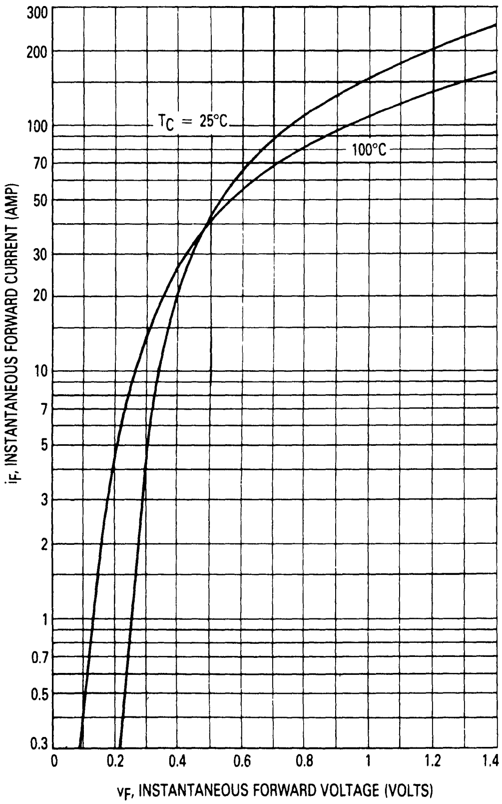


Figure 5. Typical Forward Voltage

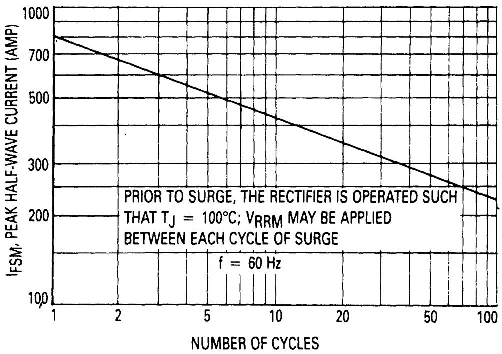


Figure 6. Maximum Surge Capability

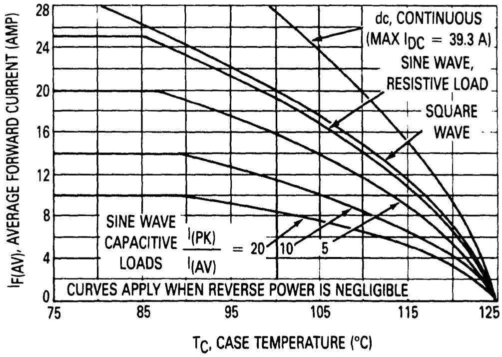


Figure 7. Current Derating

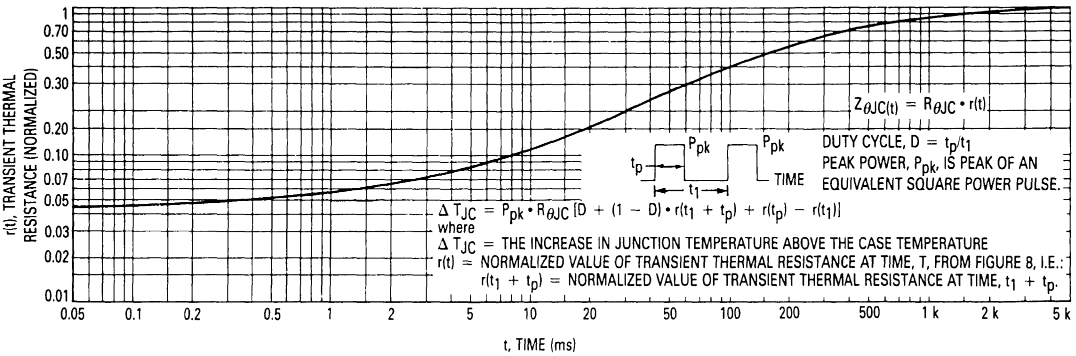


Figure 8. Thermal Response

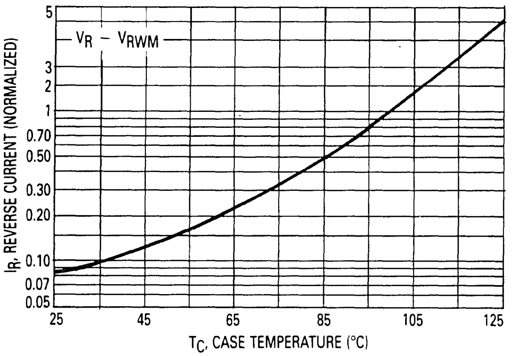


Figure 9. Normalized Reverse Current

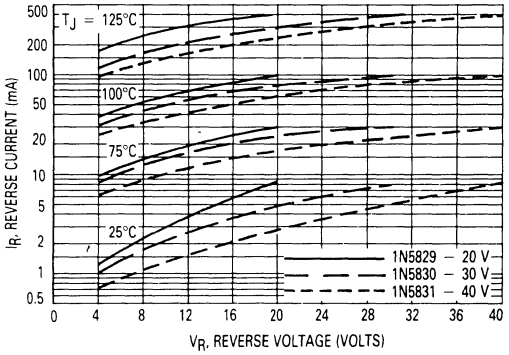


Figure 10. Typical Reverse Current

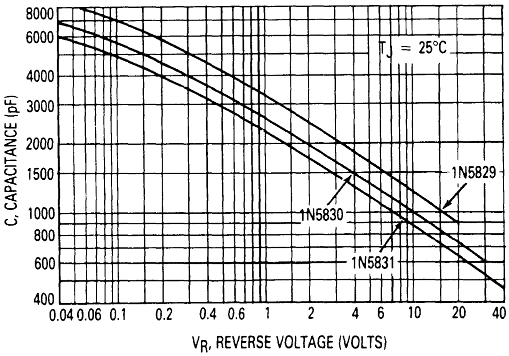


Figure 11. Capacitance

3

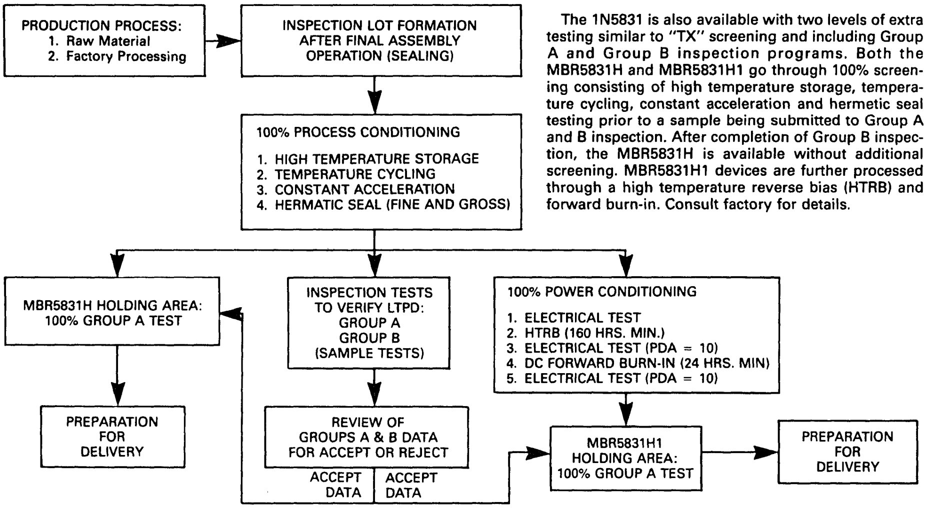
NOTE 2 — HIGH FREQUENCY OPERATION

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 percent at 2 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 indicate of power loss; it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

NOTE 3 — HI-REL PROGRAM OPTIONS

The 1N5831 is also available with two levels of extra testing similar to "TX" screening and including Group A and Group B inspection programs. Both the MBR5831H and MBR5831H1 go through 100% screening consisting of high temperature storage, temperature cycling, constant acceleration and hermetic seal testing prior to a sample being submitted to Group A and B inspection. After completion of Group B inspection, the MBR5831H is available without additional screening. MBR5831H1 devices are further processed through a high temperature reverse bias (HTRB) and forward burn-in. Consult factory for details.



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N5832
1N5833
1N5834

1N5834 is a
Motorola Preferred Device

Designers Data Sheet

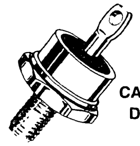
SWITCHMODE POWER RECTIFIER

. . . 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

SCHOTTKY BARRIER RECTIFIERS

40 AMPERE
20,30,40 VOLTS



CASE 257-01
DO-203AB
METAL

Designer's 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.

3

*MAXIMUM RATINGS

Rating	Symbol	1N5832	1N5833	1N5834	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 $V_{R(equiv)} \leq 0.2\ V_{R(dc)}, T_C = 75^oC$	I_O	← 40 →			Amp
Ambient Temperature Rated $V_{R(dc)}$, $P_{F(AV)} = 0$, $R_{\theta JA} = 2.0^oC/W$	T_A	100	95	90	^oC
Non-Repetitive Peak Surge Current (surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	← 800 (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	$R_{\theta JC}$	1.0	$^oC/W$

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

Characteristic	Symbol	1N5832	1N5833	1N5834	Unit
Maximum Instantaneous Forward Voltage(1)	v_F				Volts
(i_F = 10 Amp)		0.360	0.370	0.380	
(i_F = 40 Amp)		0.520	0.550	0.590	
(i_F = 125 Amp)		0.980	1.080	1.180	
Maximum Instantaneous Reverse Current @ rated dc Voltage (1)	i_R	20	20	20	mA
$T_C = 100^oC$		150	150	150	

*Indicates JEDEC Registered Data.

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

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

$R_{\theta JC}$ = 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 1N5834 operated in a 12-Volt dc supply using a bridge circuit with capacitive filter such that I_{DC} = 30 A ($I_{F(AV)}$ = 15 A), $I_{(PK)}/I_{(AV)}$ = 10, Input Voltage = 10 V(rms), $R_{\theta JA}$ = 3°C/W.

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

Step 2: Find T_R from Figure 3. Read T_R = 118°C @ V_R = 9.18 V & $R_{\theta JA}$ = 3°C/W

Step 3: Find $P_{F(AV)}$ from Figure 4.†Read $P_{F(AV)}$ = 20 W @ $\frac{I_{(PK)}}{I_{(AV)}}$ = 10 & $I_{F(AV)}$ = 15 A

Step 4: Find $T_{A(max)}$ from equation (3). $T_{A(max)}$ = 118-(3)(20) = 58°C

†Values given are for the 1N5834. Power is slightly lower for the other units because of their lower forward voltage.

3

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 – 1N5832

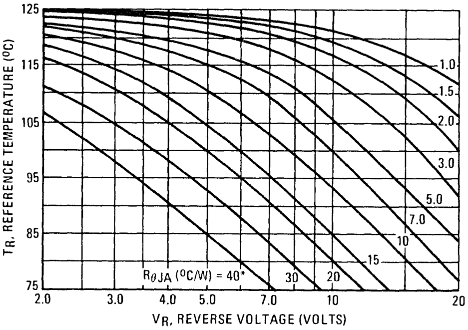


FIGURE 2 – MAXIMUM REFERENCE TEMPERATURE – 1N5833

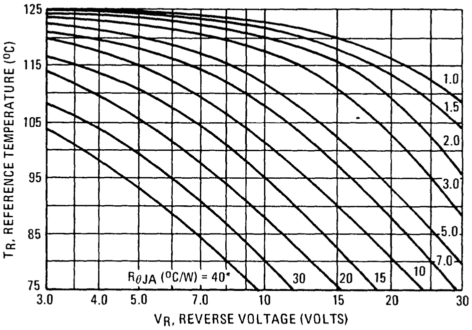


FIGURE 3 – MAXIMUM REFERENCE TEMPERATURE – 1N5834

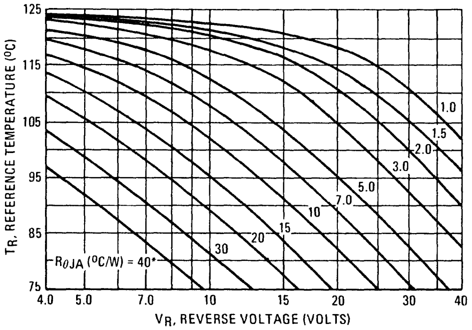
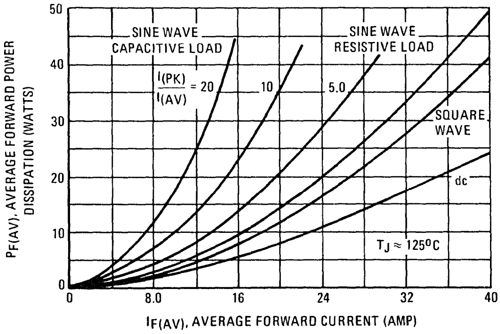


FIGURE 4 – FORWARD POWER DISSIPATION



*No external heat sink.

FIGURE 5 – TYPICAL FORWARD VOLTAGE

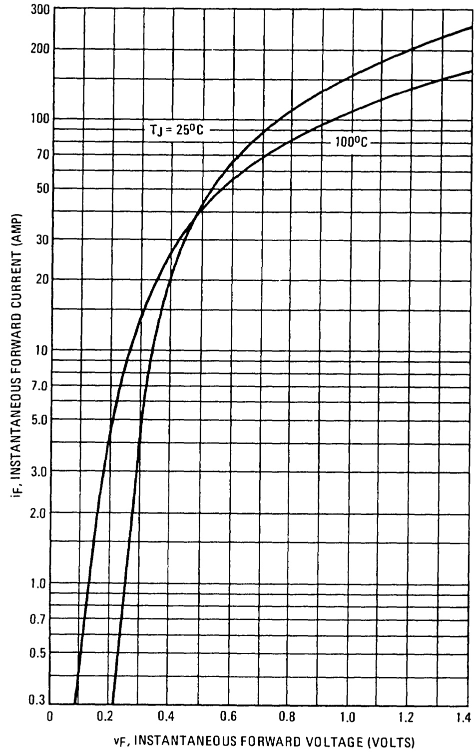


FIGURE 6 – MAXIMUM SURGE CAPABILITY

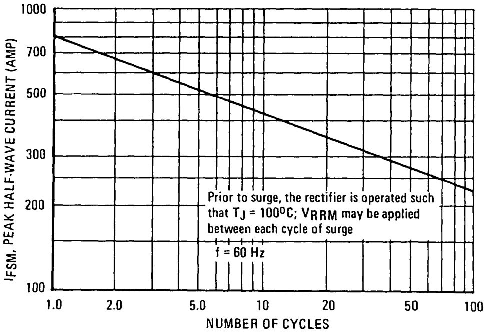
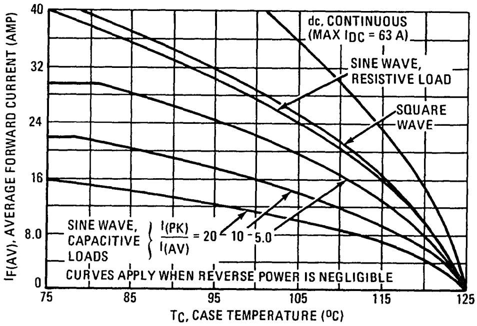
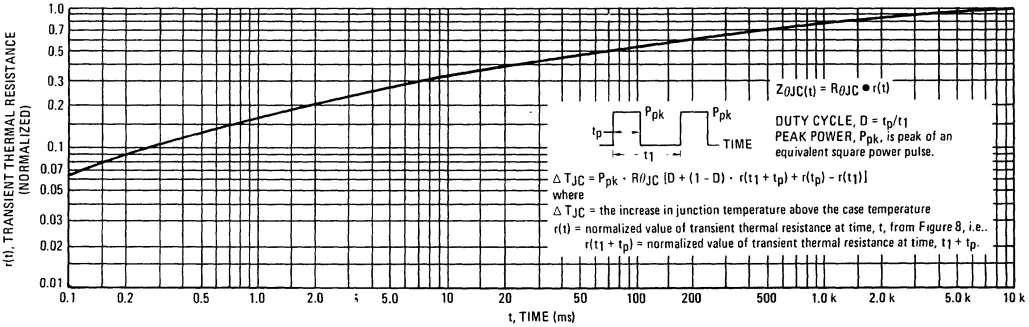


FIGURE 7 – CURRENT DERATING



3

FIGURE 8 – THERMAL RESPONSE



3

FIGURE 9 – NORMALIZED REVERSE CURRENT

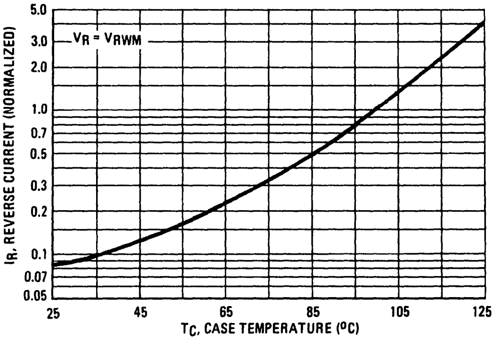


FIGURE 10 – TYPICAL REVERSE CURRENT

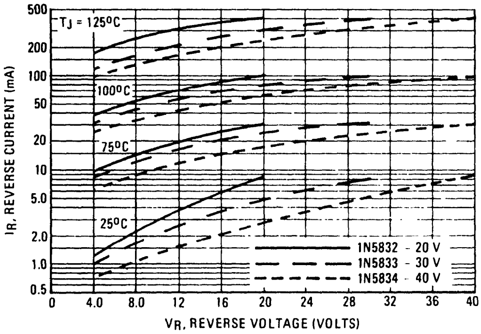
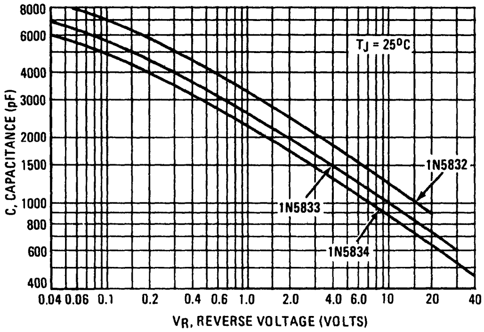


FIGURE 11 – CAPACITANCE



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.

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
MOUNTING TORQUE: 25 in-lb max
SOLDER HEAT: See Note 3

NOTE 3: SOLDER HEAT

The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N6095
1N6096
SD41

1N6096 and SD41 are Motorola Preferred Devices

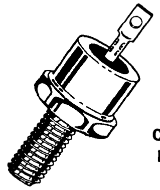
SWITCHMODE POWER RECTIFIERS

... using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature Capability
- Guaranteed Reverse Avalanche
- Mounting Torque: 15 in-lb max

SCHOTTKY BARRIER RECTIFIERS

25 and 30 AMPERES
30 to 45 VOLTS



CASE 56-03
DO-203AA
METAL

3

MAXIMUM RATINGS

Rating	Symbol	1N6095*	1N6096*	SD41	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	40	45 35 45	Volts
Average Rectified Forward Current (Rated V_R)	I_O	25 $T_C = 70°C$	25 $T_C = 70°C$	30 $T_C = 105°C$	Amps
Case Temperature (Rated V_R)	T_C	105	105	—	°C
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	400	600	Amp
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 10. (1)	I_{RRM}	2.0	2.0	2.0	Amps
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to + 125	-65 to + 125	-55 to + 150°C	°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	150	150	150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	—	—	700	V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	1N6095*	1N6096*	SD41	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	←	2.0	→	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	1N6095*	1N6096*	SD41	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 30 Amp, T_C = 125°C) (i_F = 78.5 Amp, T_C = 70°C)	v_F	 — 0.86	 — 0.86	 0.55 —	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 125°C)	i_R	250	250	125 @ V_R = 35 V	mA
Capacitance (100 kHz ≥ f ≥ 1.0 MHz)	C_t	6000 V_R = 1.0 V	6000 V_R = 1.0 V	2000 V_R = 5.0 V	pF

*Indicates JEDEC Registered Data.
(1) Not JEDEC requirement, but a Motorola product capability.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%

FIGURE 1 — TYPICAL FORWARD VOLTAGE

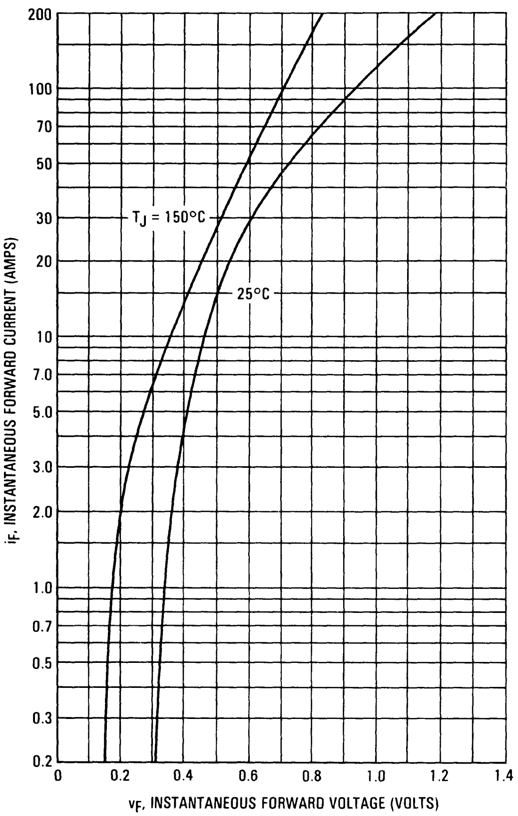


FIGURE 2 — TYPICAL REVERSE CURRENT

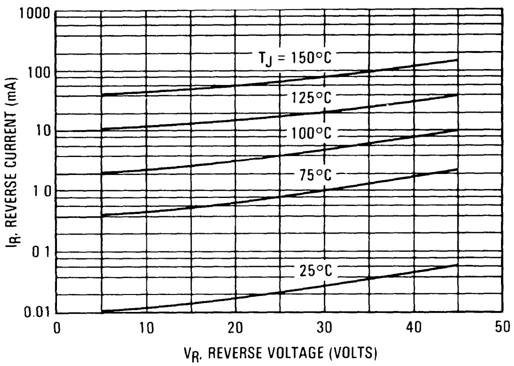


FIGURE 3 — MAXIMUM SURGE CAPABILITY

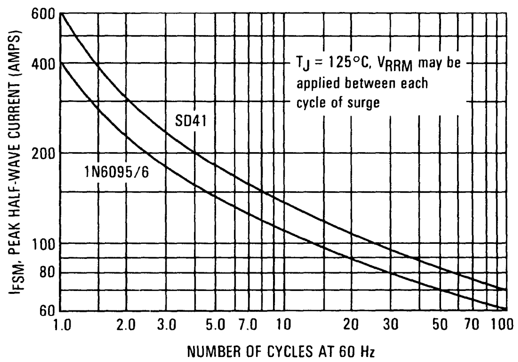
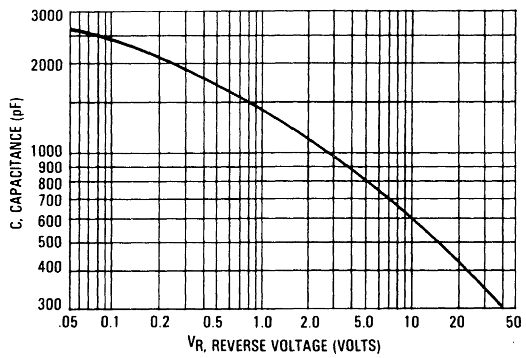


FIGURE 4 — CAPACITANCE



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 4.)

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 efficieny 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.

FIGURE 5 — SD41 CURRENT DERATING

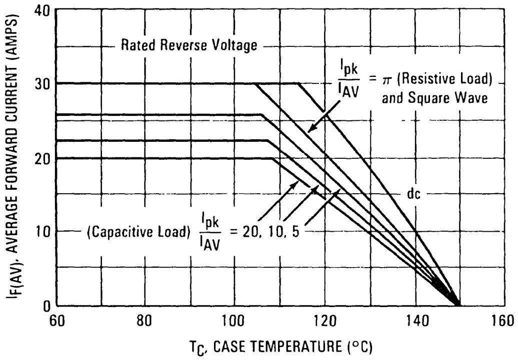


FIGURE 6 — 1N6095/6 CURRENT DERATING

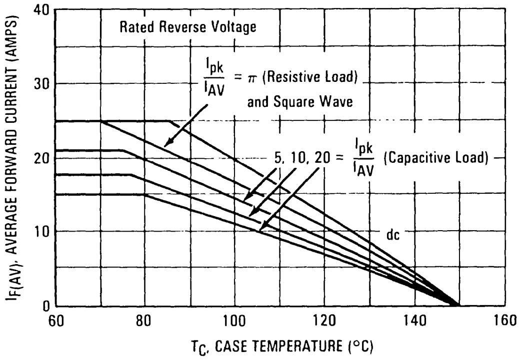


FIGURE 7 — FORWARD POWER DISSIPATION

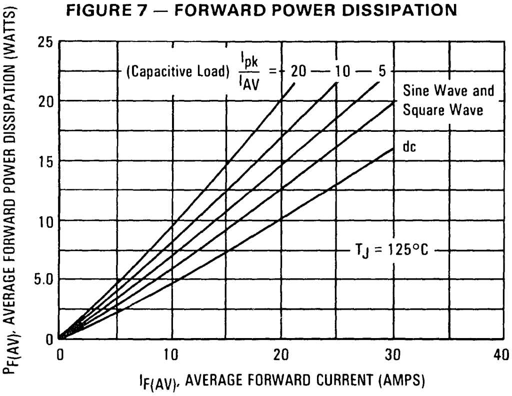


FIGURE 8 — THERMAL RESPONSE

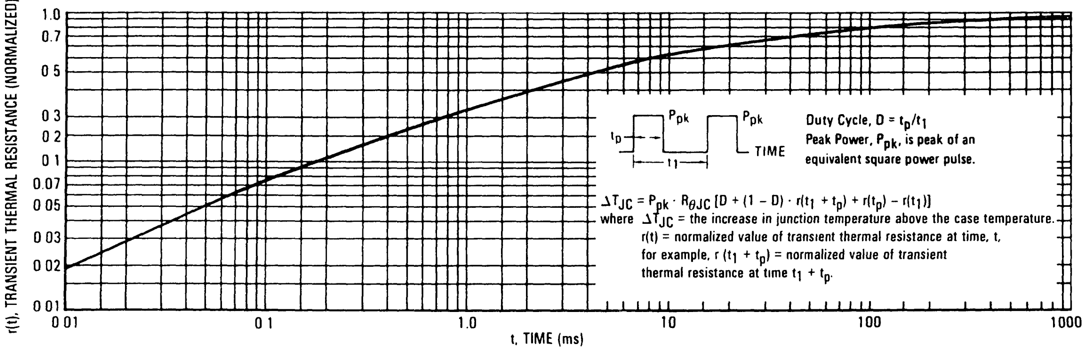
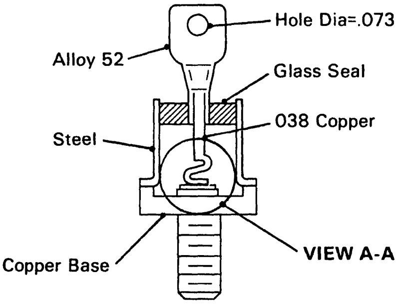
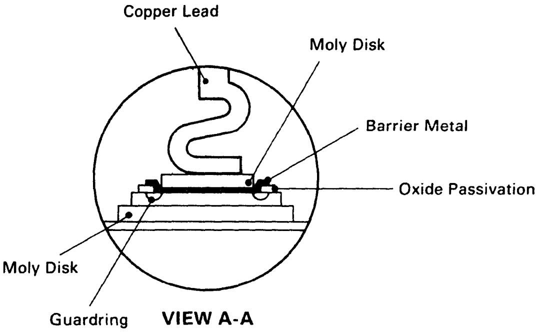


FIGURE 9 — SCHOTTKY RECTIFIER





3

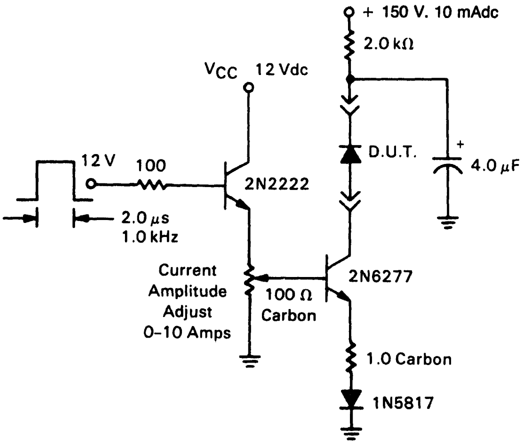
Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not required. The guardring also operates like a zener to absorb over-voltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead is also stress-reliefed. These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

FIGURE 10 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

1N6097
1N6098
SD51

1N6098 and SD51 are Motorola Preferred Devices

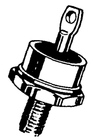
SWITCHMODE POWER RECTIFIERS

. . . using a platinum barrier metal 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.

- Guaranteed Reverse Avalanche
- Extremely Low v_F
- Low Stored Charge, Majority Carrier Conduction
- Guardring for Stress Protection
- Low Power Loss/High Efficiency
- 150°C Operating Junction Temperature Capability
- High Surge Capacity

SCHOTTKY BARRIER RECTIFIERS

60 AMPERES
20 to 45 VOLTS



CASE 257-01
DO-203AB
METAL

3

MAXIMUM RATINGS

Rating	Symbol	1N6097*	1N6098*	SD51	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	40	45 35 45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	—	—	120 T_C = 90°C	Amps
Average Rectified Forward Current (Rated V_R)	I_O	50 T_C = 70°C	50 T_C = 70°C	—	Amps
Case Temperature (Rated V_R)	T_C	115	115	—	°C
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	←	800	→	Amps
Peak Repetitive Reverse Surge Current (2) (2.0 μs, 1.0 kHz) See Figure 10.	I_{RRM}	←	2.0	→	Amps
Operating Junction Temperature Range (Reverse Voltage Applied)	T_J	-65 to +125	-65 to +125	-65 to +150	°C
Storage Temperature Range	T_{stg}	-65 to +125	-65 to +125	-65 to +165	°C
Voltage Rate of Change (Rated V_R)	dv/dt	—	—	700	V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	1N6097*	1N6098*	SD51	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	←	1.0	→	°C/W

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

Characteristic	Symbol	1N6097*	1N6098*	SD51	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 157 Amp, T_C = 70°C) (i_F = 60 Amp) (i_F = 60 Amp, T_C = 125°C) (i_F = 120 Amp, T_C = 125°C)	v_F	 0.86 — — —	 0.86 — — —	 — 0.70 0.60 0.84	Volts
Maximum Instantaneous Reverse Current (2) (Rated Voltage, T_C = 125°C) (Rated Voltage, T_C = 25°C)	i_R	 250 —	 250 —	200 50 @ V_R = 35 V	mA
DC Reverse Current (Rated Voltage, T_C = 115°C)	I_R	250	250	—	mA
Maximum Capacitance (100 kHz ≤ f ≤ 1.0 MHz)	C_t	7000 V_R = 1.0 Vdc	7000 V_R = 1.0 Vdc	4000 V_R = 5.0 Vdc	pF

*Indicates JEDEC Registered Data.
(1) Not a JEDEC requirement, but of Motorola product capability.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.

FIGURE 1 — TYPICAL FORWARD VOLTAGE

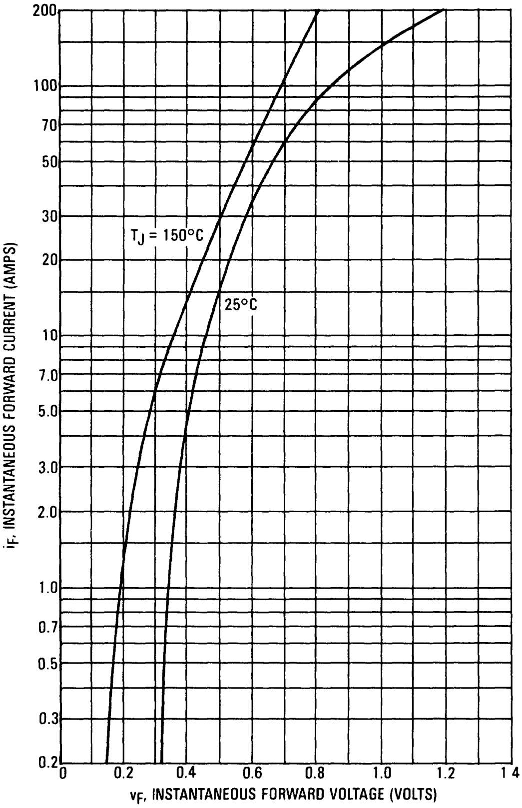


FIGURE 2 — TYPICAL REVERSE CURRENT

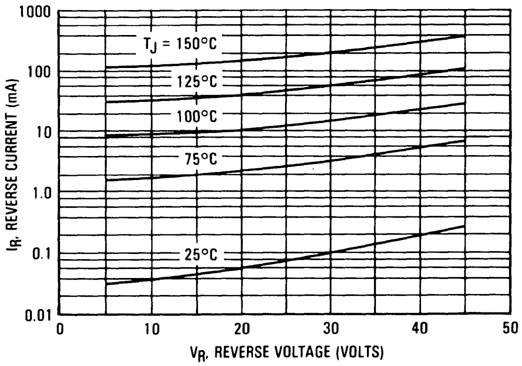
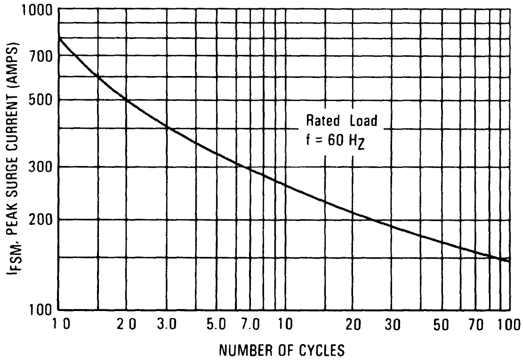


FIGURE 3 — TYPICAL SURGE CAPABILITY



NOTE 1
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FIGURE 4 — CAPACITANCE

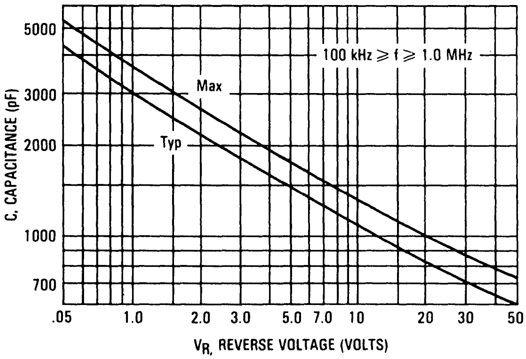


FIGURE 5 — CURRENT DERATING (SD51)

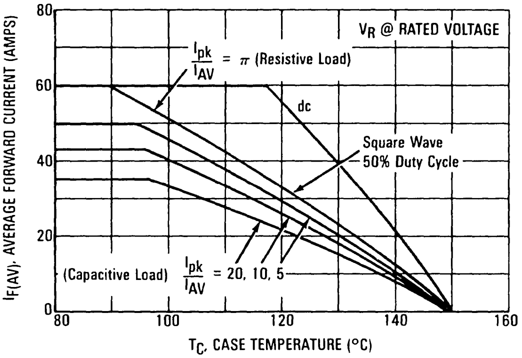


FIGURE 6 — CURRENT DERATING (1N6097/1N6098)

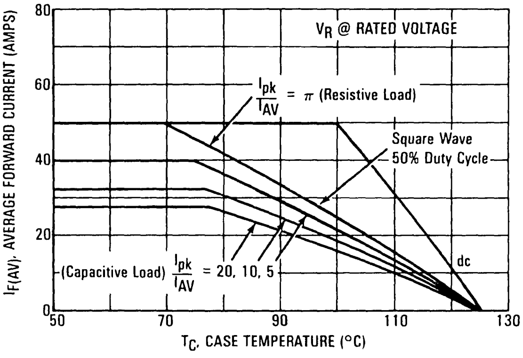
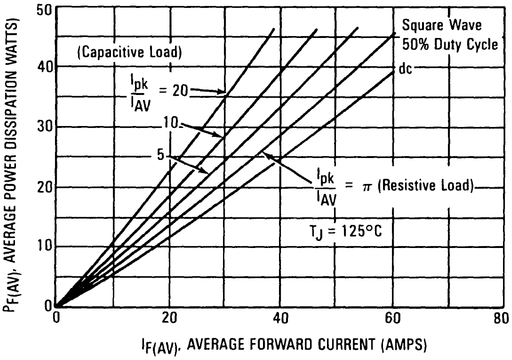
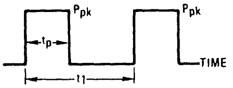


FIGURE 7 — POWER DISSIPATION



NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

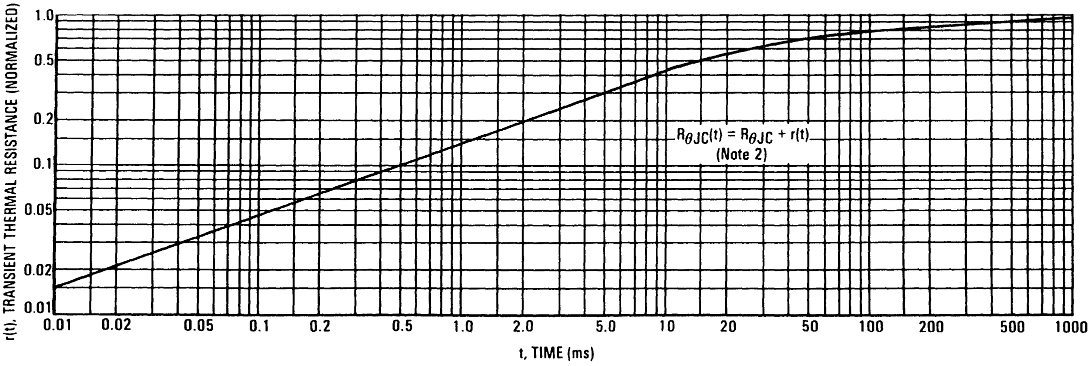
The temperature of the case should be measured using a thermocouple placed on the case. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature. It may be determined by:

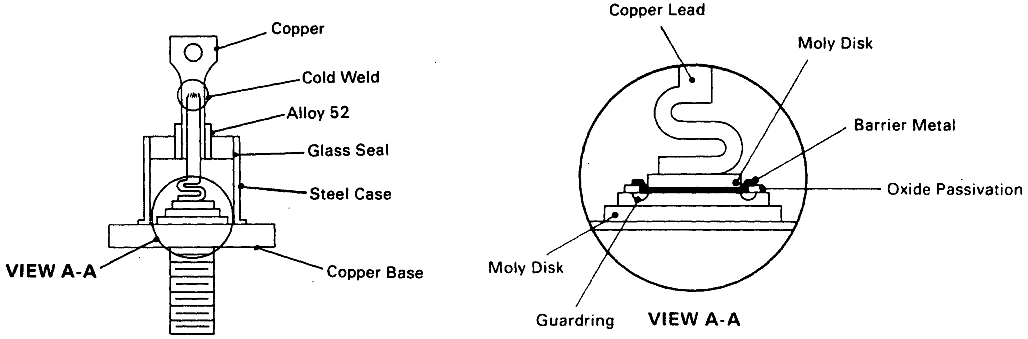
$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$ where
$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 8, i.e.:
$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.

FIGURE 8 — THERMAL RESPONSE



3

FIGURE 9 — SCHOTTKY RECTIFIER



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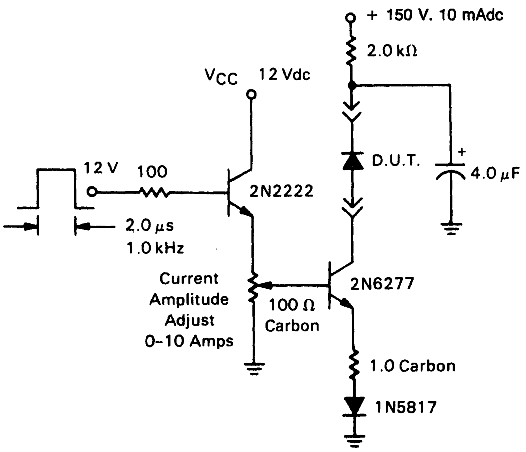
Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

FIGURE 10 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



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
MOUNTING TORQUE: 25 in-lb max
SOLDER HEAT: The excellent heat transfer property of the heavy dutv copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR150
MBR160

MBR160 is a
Motorola Preferred Device

Axial Lead Rectifiers

. . . 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.

- Low Reverse Current
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction

Mechanical Characteristics:

Case: Void free, transfer molded
Finish: All external surfaces corrosion-resistant and the terminal leads are readily solderable
Polarity: Cathode indicated by polarity band
Mounting Positions: Any
Soldering: 220°C 1/16″ from case for ten seconds

SCHOTTKY BARRIER RECTIFIERS
1 AMPERE
50, 60 VOLTS

CASE 59-04
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MBR150	MBR160	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	60	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	42	Volts
Average Rectified Forward Current (2) ($V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, T_L = 90°C, $R_{\theta JA}$ = 80°C/W, P.C. Board Mounting, see Note 3, T_A = 55°C)	I_O	1		Amp
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase, 60 Hz, T_L = 70°C)	I_{FSM}	25 (for one cycle)		Amps
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	−65 to +150		°C
Peak Operating Junction Temperature (Forward Current applied)	$T_{J(pk)}$	150		°C

THERMAL CHARACTERISTICS (Notes 3 and 4)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS (T_L = 25°C unless otherwise noted) (2)

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 0.1 A) (i_F = 1 A) (i_F = 3 A)	v_F	 0.550 0.750 1.000	Volt
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1) (T_L = 25°C) (T_L = 100°C)	i_R	 0.5 5	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.

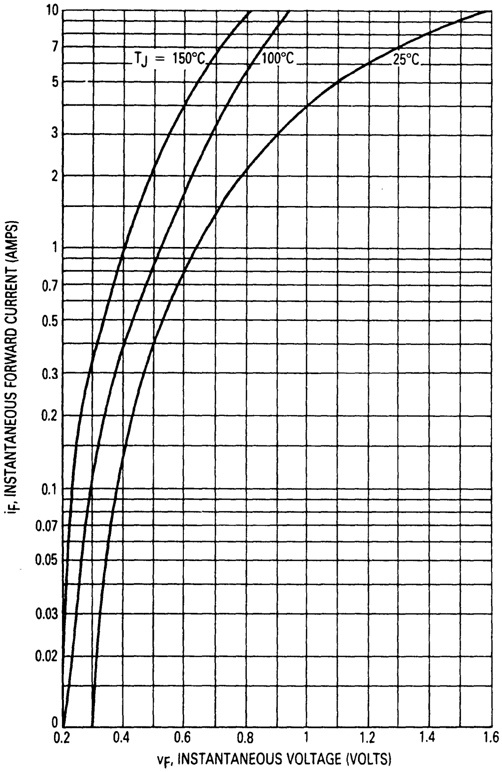


Figure 1. Typical Forward Voltage

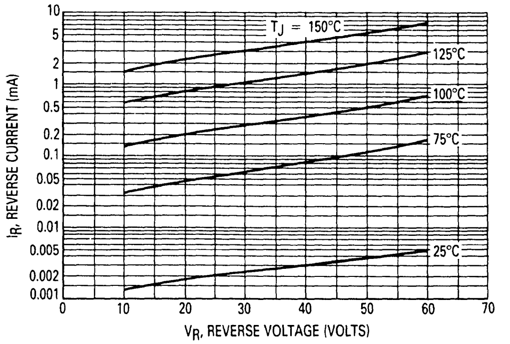


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

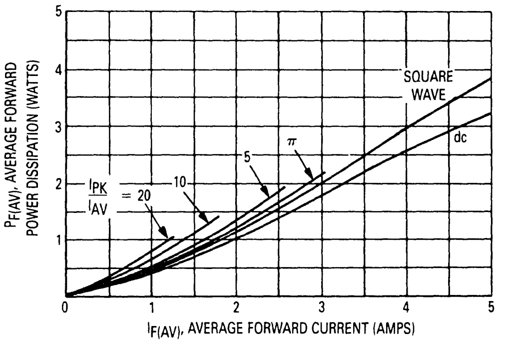


Figure 3. Forward Power Dissipation

THERMAL CHARACTERISTICS

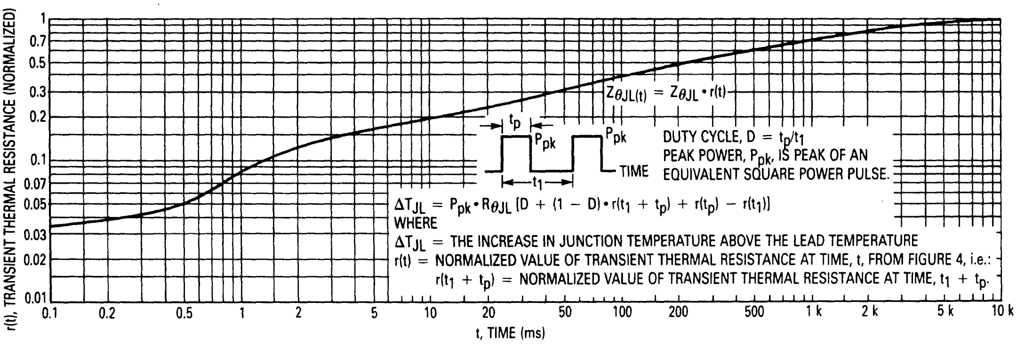


Figure 4. Thermal Response

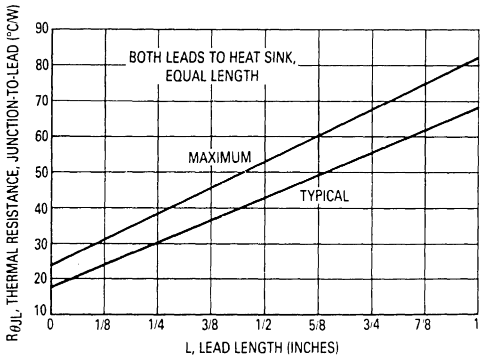


Figure 5. Steady-State Thermal Resistance

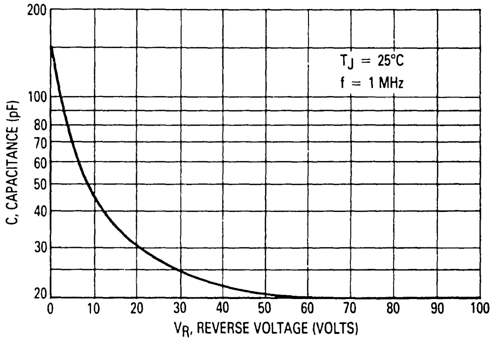


Figure 6. Typical Capacitance

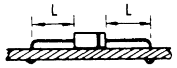
NOTE 3 — MOUNTING DATA:

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mounting shown is to be used as a typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

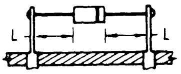
Typical Values for $R_{\theta JA}$ in Still Air

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	52	65	72	85	°C/W
2	67	80	87	100	°C/W
3			50		°C/W

Mounting Method 1
P.C. Board with
1-1/2" x 1-1/2"
copper surface.

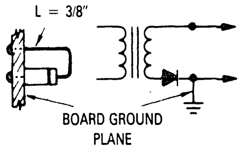


Mounting Method 2

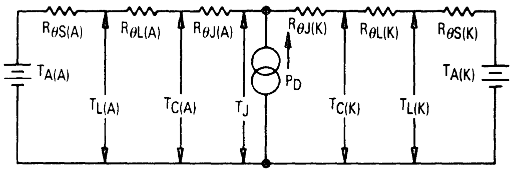


VECTOR PIN MOUNTING

Mounting Method 3
P.C. Board with
1-1/2" x 1-1/2"
copper surface.



NOTE 4 — THERMAL CIRCUIT MODEL:
(For heat conduction through the leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Power Dissipation

(Subscripts A and K refer to anode and cathode sides, respectively.) Values for thermal resistance components are:
$R_{\theta L}$ = 100°C/W/in typically and 120°C/W/in maximum.
$R_{\theta J}$ = 36°C/W typically and 46°C/W maximum.

NOTE 5 — 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 6.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximatley 70 percent at 2 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.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR170
MBR180
MBR190
MBR1100

MBR1100 is a
Motorola Preferred Device

Axial Lead Rectifiers

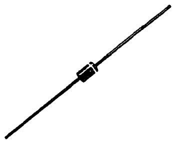
. . . employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes,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

- Low Reverse Current
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction
- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- High Surge Capacity

Mechanical Characteristics:

Case: Void free, transfer molded
Finish: All external surfaces corrosion-resistant and the terminal leads are readily solderable
Polarity: Cathode indicated by polarity band
Mounting Positions: Any
Soldering: 220°C 1/16″ from case for ten seconds

SCHOTTKY BARRIER RECTIFIERS
1 AMPERE
70, 80, 90, 100 VOLTS



CASE 59-04
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR170	MBR180	MBR190	MBR1100	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	70	80	90	100	Volts
Average Rectified Forward Current ($V_{R(equiv)} \leq 0.2\ V_{R(dc)}$, $R_{\theta JA}$ = 50°C/W, P.C. Board Mounting, see Note 1, T_A = 120°C)	I_O	1				Amp
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase, 60 Hz)	I_{FSM}	50				Amps
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +150				°C
Voltage Rate of Change (Rated V_R)	dv/dt	10				V/ns

THERMAL CHARACTERISTICS (See Note 2)

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

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

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage* (i_F = 1 A, T_L = 25°C) (i_F = 1 A, T_L = 100°C)	v_F	 0.79 0.69	Volt
Maximum Instantaneous Reverse Current @ Rated dc Voltage* (T_L = 25°C) (T_L = 100°C)	i_R	 0.5 5	mA

*Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

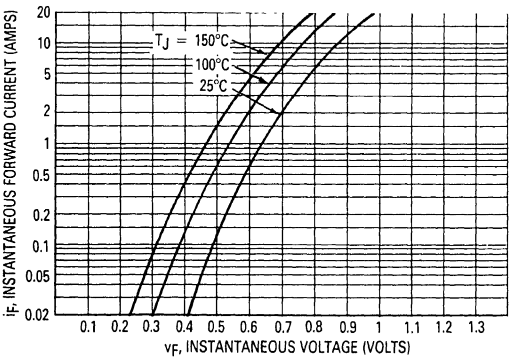


Figure 1. Typical Forward Voltage

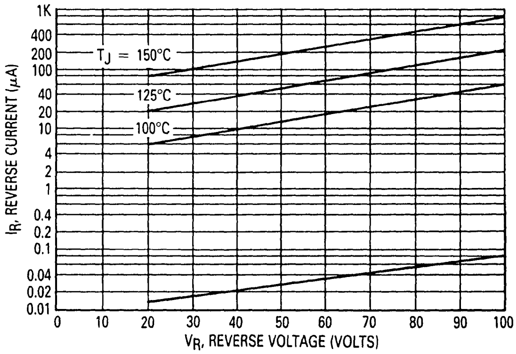


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

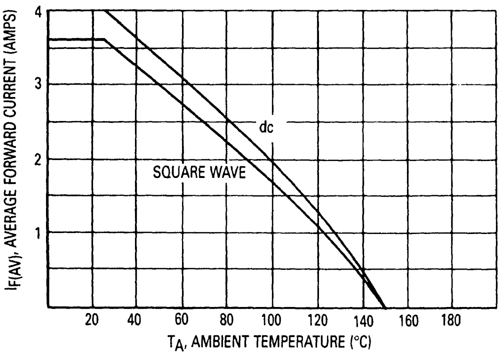


Figure 3. Current Derating (Mounting method 3 per note 1.)

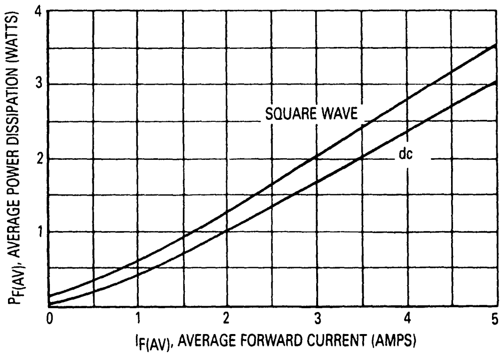


Figure 4. Power Dissipation

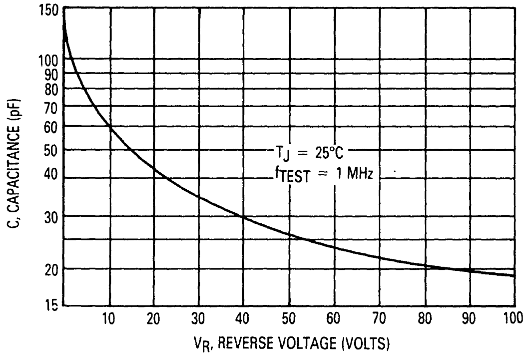


Figure 5. Typical Capacitance

3

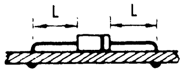
NOTE 1 — MOUNTING DATA:

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

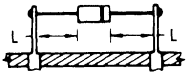
Typical Values for $R_{\theta JA}$ in Still Air

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	52	65	72	85	°C/W
2	67	80	87	100	°C/W
3			50		°C/W

Mounting Method 1
P.C. Board with
1-1/2" x 1-1/2"
copper surface.

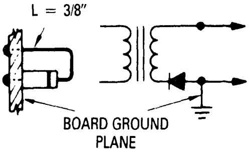


Mounting Method 2

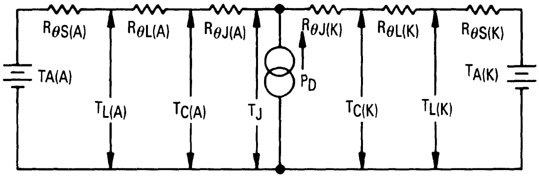


VECTOR PIN MOUNTING

Mounting Method 3
P.C. Board with
1-1/2" x 1-1/2"
copper surface.



NOTE 2 — THERMAL CIRCUIT MODEL:
(For heat conduction through the leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature T_C = Case Temperature
T_L = Lead Temperature T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Power Dissipation

(Subscripts A and K refer to anode and cathode sides, respectively.) Values for thermal resistance components are:
$R_{\theta L}$ = 100°C/W/in typically and 120°C/W/in maximum.
$R_{\theta J}$ = 36°C/W typically and 46°C/W maximum.

NOTE 3 — 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 5.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent 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.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR320 MBR340 MBR330 MBR350 MBR360

MBR340 and MBR360 are Motorola Preferred Devices

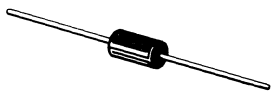
AXIAL LEAD RECTIFIERS

. . . 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 Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction
- Low Stored Charge, Majority Carrier Conduction

SCHOTTKY BARRIER RECTIFIERS

3.0 AMPERES
20, 30, 40, 50, 60 VOLTS



CASE 267-03
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR320	MBR330	MBR340	MBR350	MBR360	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	50	60	V
Average Rectified Forward Current $T_A = 65°C$ ($R_{\theta JA}$ = 28°C/W, P.C. Board Mounting, see Note 3)	I_O	3.0					A
Nonrepetitive Peak Surge Current (2) (Surge applied at rated load conditions, half wave, single phase 60 Hz, T_L = 75°C)	I_{FSM}	80					A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	−65 to 150°C					°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	150					°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient, (see Note 3, Mounting Method 3)	$R_{\theta JA}$	28	°C/W

ELECTRICAL CHARACTERISTICS (T_L = 25°C unless otherwise noted)(2)

Characteristic	Symbol	MBR320	MBR330	MBR340	MBR350	MBR360	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 Amp) (i_F = 3.0 Amp) (i_F = 9.4 Amp)	v_F	 0.500 0.600 0.850			 0.600 0.740 1.080		V
Maximum Instantaneous Reverse Current @ Rated dc Voltage (1) T_L = 25°C T_L = 100°C	i_R	 0.60 20					mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.
(2) Lead Temperature reference is cathode lead 1/32″ from case.

3

MBR320, 330 AND 340

FIGURE 1 — TYPICAL FORWARD VOLTAGE

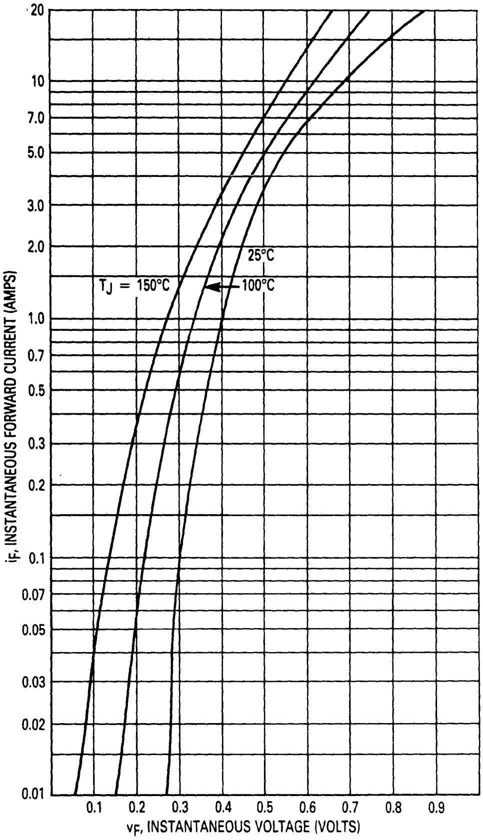
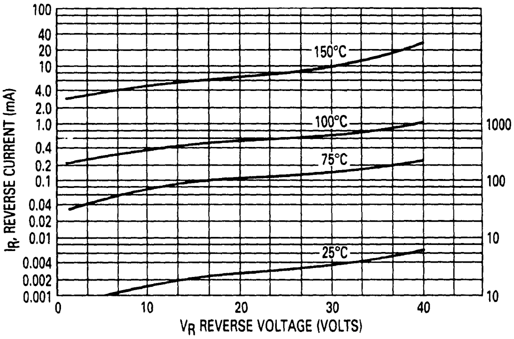


FIGURE 2 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

FIGURE 3 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 3)

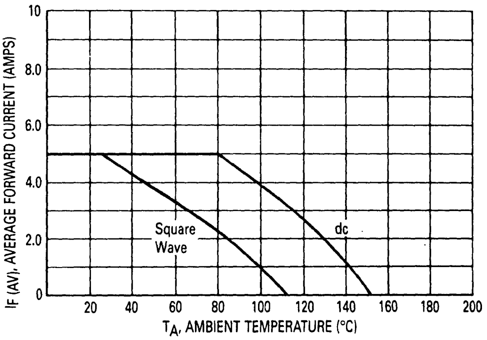


FIGURE 4 — POWER DISSIPATION

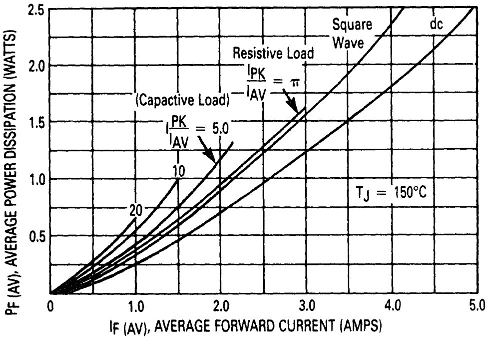
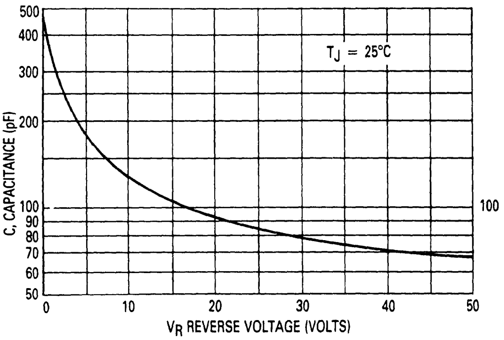


FIGURE 5 — TYPICAL CAPACITANCE



MBR350 AND 360

FIGURE 6 — TYPICAL FORWARD VOLTAGE

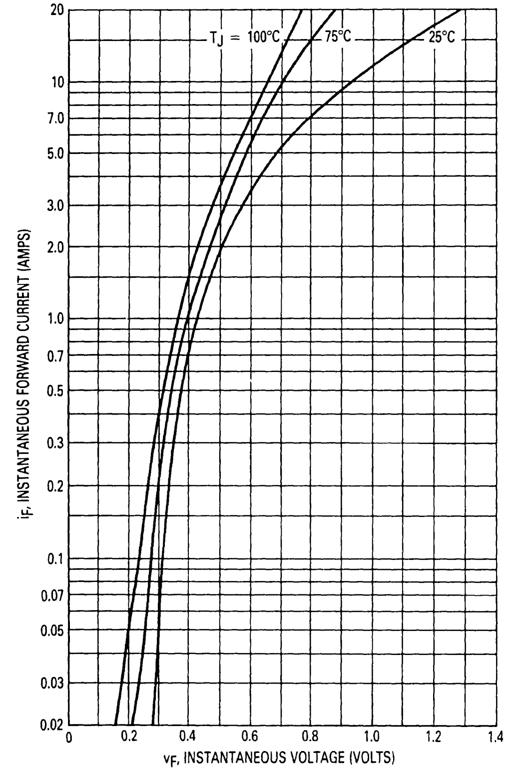


FIGURE 7 — TYPICAL REVERSE CURRENT*

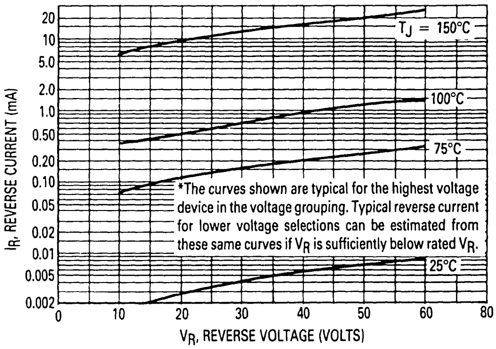


FIGURE 8 — CURRENT DERATING AMBIENT (MOUNTING METHOD #3 PER NOTE 3)

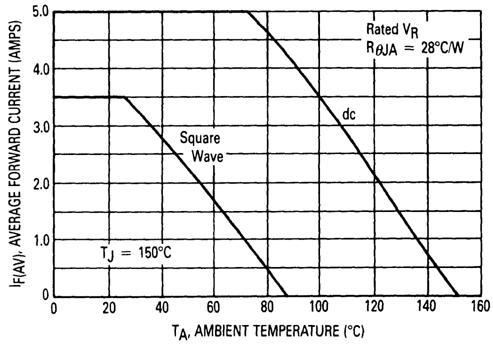


FIGURE 9 — POWER DISSIPATION

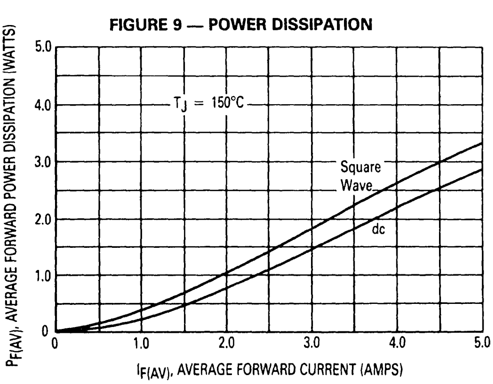
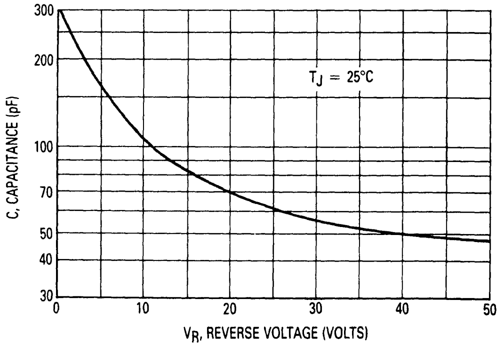


FIGURE 10 — TYPICAL CAPACITANCE



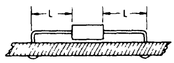
NOTE 3 — MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

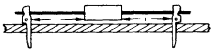
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3	28				°C/W

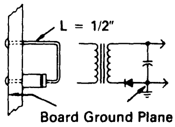
Mounting Method 1
P.C. Board where
available copper surface
is small.



Mounting Method 2
Vector Push-In
Terminals T-28



Mounting Method 3
P.C. Board with
2-1/2" × 2-1/2"
copper surface.



MECHANICAL CHARACTERISTICS

CASE. . . . . Void free, transfer molded
FINISH. . . . . All external surfaces corrosion-resistant and the terminal leads are readily solderable
POLARITY. . . . . Cathode indicated by polarity band
MOUNTING POSITIONS. . . . . Any
SOLDERING . . . . . . 220°C 1/16" from case for ten seconds

Axial Lead Rectifiers

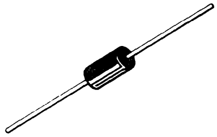
MBR370
MBR380
MBR390
MBR3100

MBR3100 is a Motorola Preferred Device

. . . 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.

- Low Reverse Current
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency
- Highly Stable Oxide Passivated Junction
- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- High Surge Capacity

SCHOTTKY BARRIER RECTIFIERS
3 AMPERES
70, 80, 90, 100 VOLTS



CASE 267-03
PLASTIC

Mechanical Characteristics:

Case: Void free, transfer molded
Finish: All external surfaces corrosion-resistant and the terminal leads are readily solderable
Polarity: Cathode indicated by polarity band
Mounting Positions: Any
Soldering: 220°C 1/16″ from case for ten seconds

3

MAXIMUM RATINGS

Rating	Symbol	MBR370	MBR380	MBR390	MBR3100	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	70	80	90	100	V
Average Rectified Forward Current T_A = 100°C ($R_{\theta JA}$ = 28°C/W, P.C. Board Mounting, see Note 1)	I_O	3				A
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase, 60 Hz)	I_{FSM}	150				A
Operating and Storage Junction Temperature Range (Reverse Voltage applied)	T_J, T_{stg}	−65 to +150				°C
Voltage Rate of Change (Rated V_R)	dv/dt	10				V/ns

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (see Note 1, Mounting Method 3)	$R_{\theta JA}$	28	°C/W

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

Characteristic	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage* (i_F = 3 Amps, T_L = 25°C) (i_F = 3 Amps, T_L = 100°C)	v_F	 0.79 0.69	V
Maximum Instantaneous Reverse Current @ Rated dc Voltage* (T_L = 25°C) (T_L = 100°C)	i_R	 0.6 20	mA

*Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

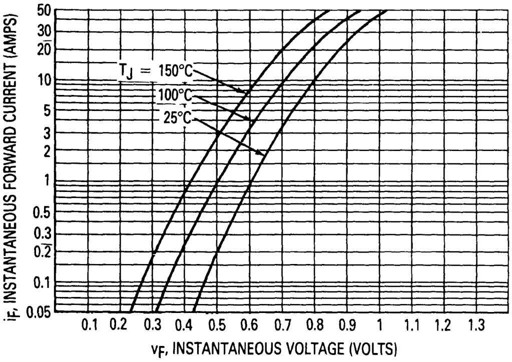


Figure 1. Typical Forward Voltage

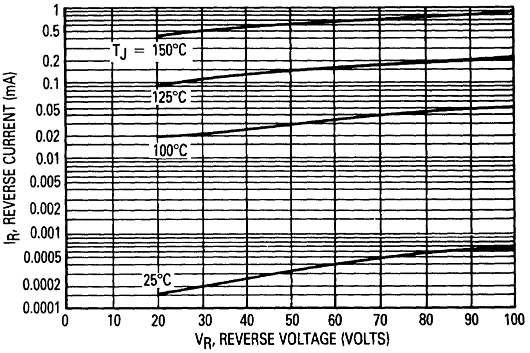


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

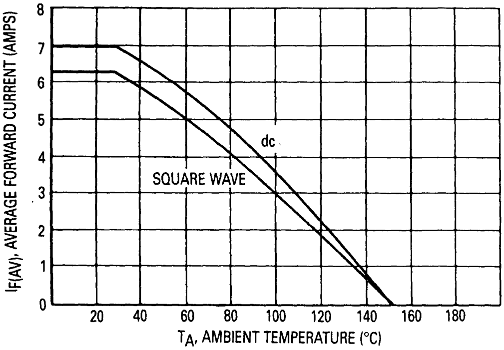


Figure 3. Current Derating (Mounting method 3 per note 1.)

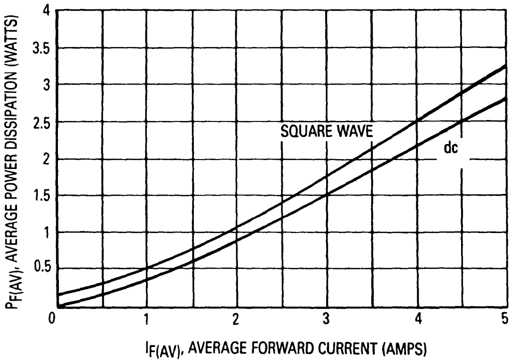


Figure 4. Power Dissipation

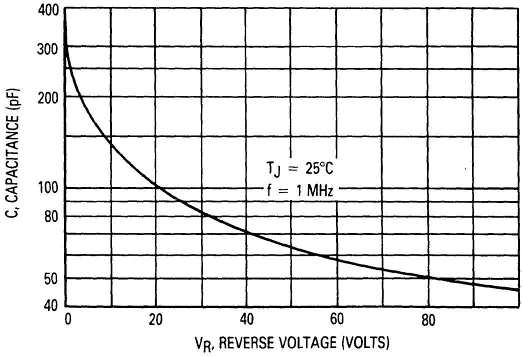


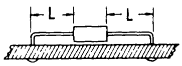
Figure 5. Typical Capacitance

NOTE 1 — MOUNTING DATA:
Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

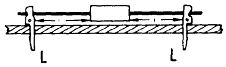
Typical Values for $R_{\theta JA}$ in Still Air

Mounting Method	Lead Length, L (in)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3		28			°C/W

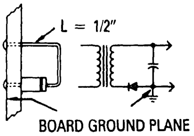
Mounting Method 1
P.C. Board where
available copper surface
is small.



Mounting Method 2
Vector Push-In
Terminals T-28



Mounting Method 3
P.C. Board with
2-1/2" x 2-1/2"
copper surface.



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR735
MBR745

MBR745 is a
Motorola Preferred Device

SWITCHMODE POWER RECTIFIERS

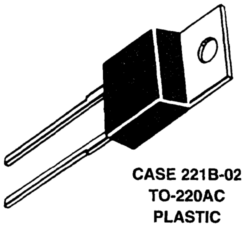
. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″

SCHOTTKY BARRIER RECTIFIERS

7.5 AMPERES
35 and 45 VOLTS

3



CASE 221B-02
TO-220AC
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MBR735	MBR745	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C	$I_{F(AV)}$	7.5	7.5	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 105°C	I_{FRM}	15	15	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	-65 to +150	-65 to +150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	3.0	°C/W
Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	60	60	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 7.5 Amp, T_C = 125°C) (i_F = 15 Amp, T_C = 125°C) (i_F = 15 Amp, T_C = 25°C)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 15 0.1	 15 0.1	mA

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

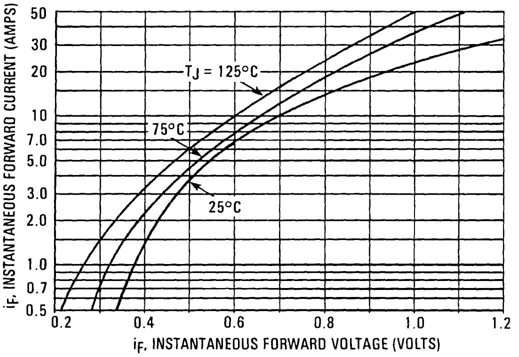


FIGURE 2 — TYPICAL REVERSE CURRENT

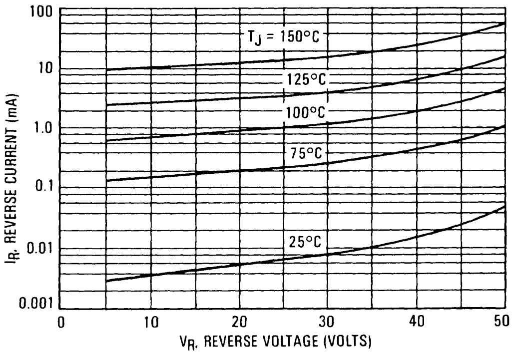


FIGURE 3 — CURRENT DERATING, CASE

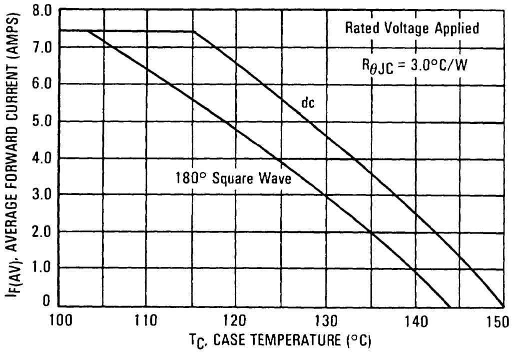


FIGURE 4 — CURRENT DERATING, AMBIENT

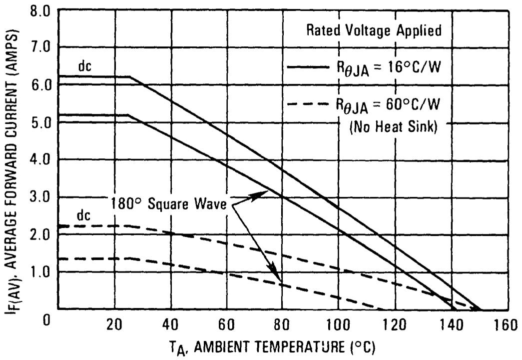
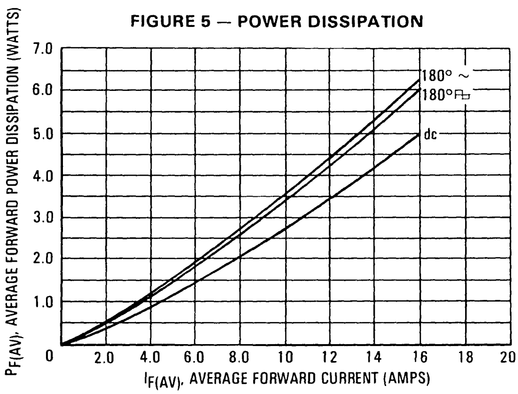


FIGURE 5 — POWER DISSIPATION



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR1035
MBR1045

MBR1045 is a Motorola Preferred Device

SWITCHMODE POWER RECTIFIERS

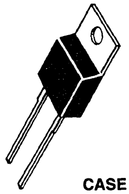
. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, V0 at 1/8″

3

SCHOTTKY BARRIER RECTIFIERS

10 AMPERES
20 to 45 VOLTS



CASE 221B-02
TO-220AC
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MBR1035	MBR1045	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 135°C	$I_{F(AV)}$	10	10	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 135°C	I_{FRM}	20	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 12	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	-65 to + 150	-65 to + 150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	MBR1035	MBR1045	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MBR1035	MBR1045	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 10 A, T_C = 125°C) (i_F = 20 A, T_C = 125°C) (i_F = 20 A, T_C = 25°C)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 15 0.1	 15 0.1	mA

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

FIGURE 1 —MAXIMUM FORWARD VOLTAGE

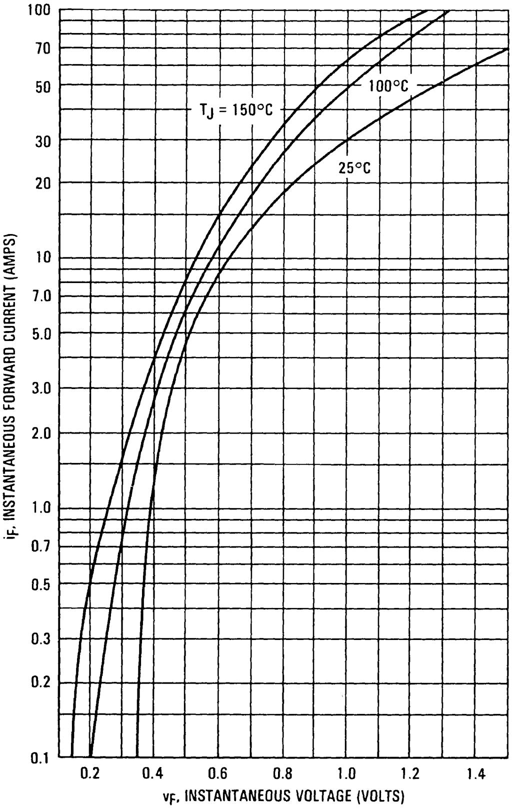


FIGURE 2 —TYPICAL FORWARD VOLTAGE

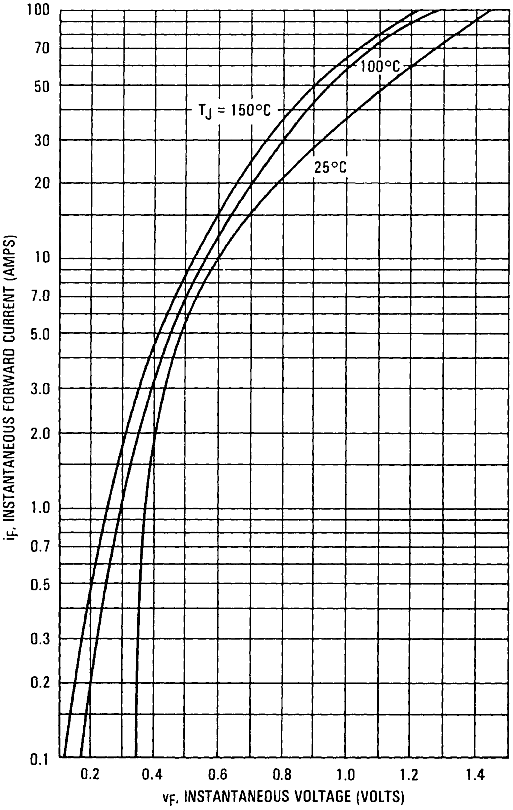


FIGURE 3 — MAXIMUM REVERSE CURRENT

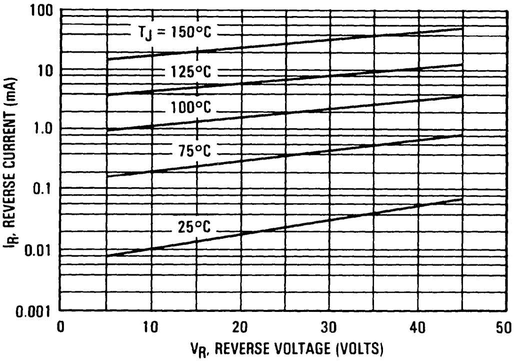
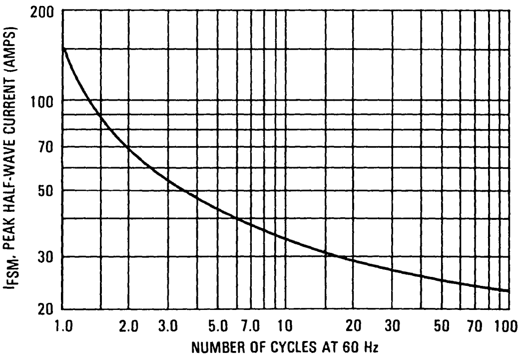


FIGURE 4 — MAXIMUM SURGE CAPABILITY



3

3

FIGURE 5 — CURRENT DERATING, INFINITE HEATSINK

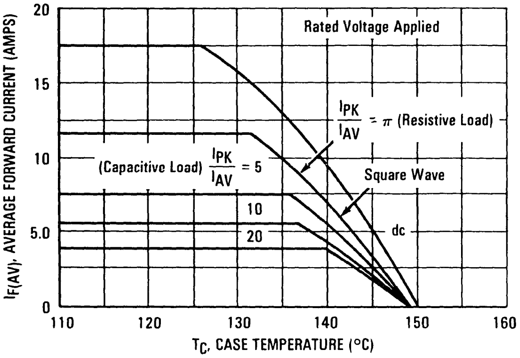


FIGURE 6 — CURRENT DERATING, $R_{\theta JA}$ = 16° C/W

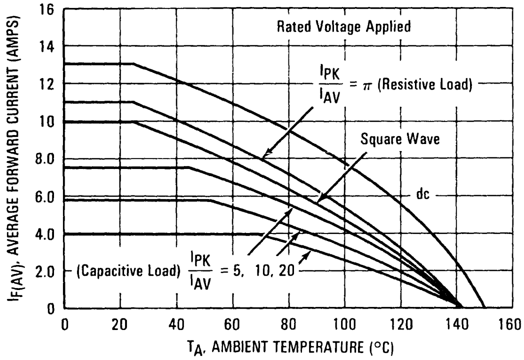


FIGURE 7 — FORWARD POWER DISSIPATION

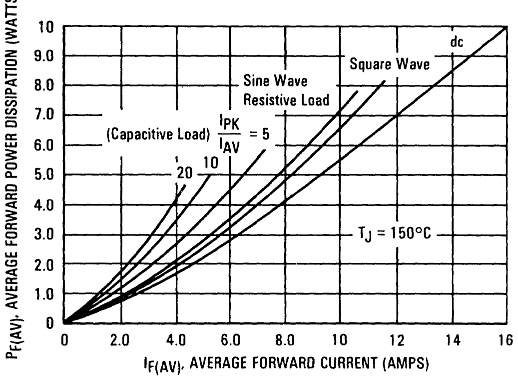


FIGURE 8 — CURRENT DERATING, FREE AIR

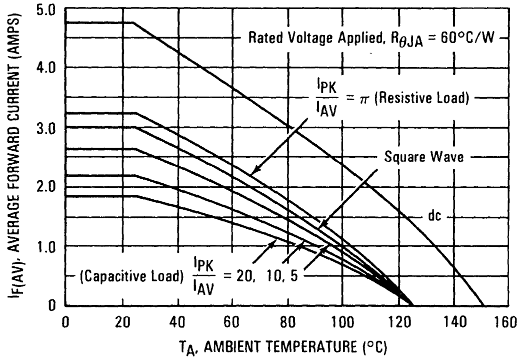
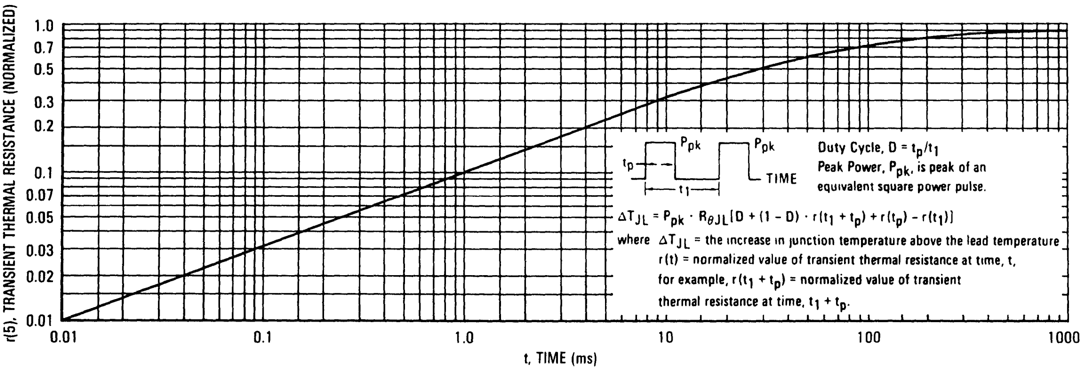


FIGURE 9 — THERMAL RESPONSE



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 10.)

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 efficieny 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.

FIGURE 10 — CAPACITANCE

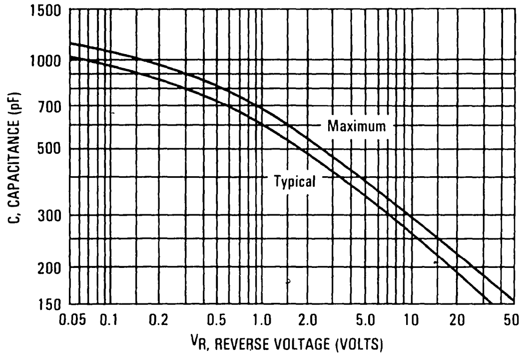
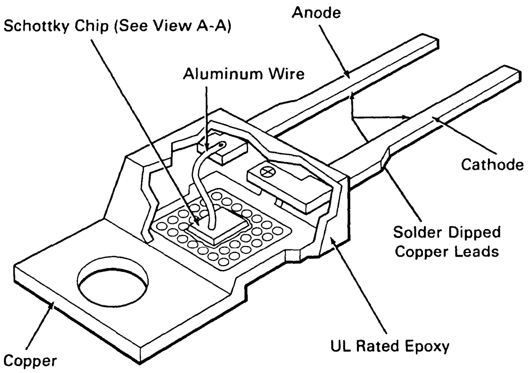
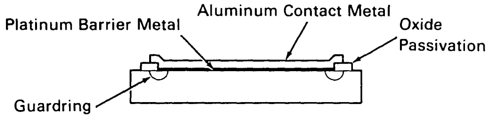


FIGURE 11 — SCHOTTKY RECTIFIER



Schottky Chip — View A-A



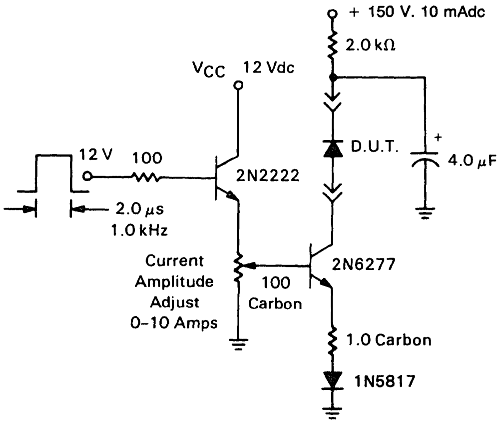
Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the barrier metal and aluminum-contact metal to eliminate any possible interaction between the two. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb over-voltage transients.

Second is the package. The Schottky chip is bonded to the copper heat sink using a specially formulated solder. This gives the unit the capability of passing 10,000 operating thermal-fatigue cycles having a ΔT_J of 100°C. The epoxy molding compound is rated per UL 94, V0 @ 1/8″. Wire bonds are 100% tested in assembly as they are made.

Third is the electrical testing, which includes 100% dv/dt at 1600 V/μs and reverse avalanche as part of device characterization.

FIGURE 12 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



MBR1060
MBR1070
MBR1080
MBR1090
MBR10100

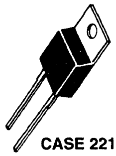
MBR1060 and MBR10100 are Motorola Preferred Devices

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″
- Low Power Loss/High Efficiency
- High Surge Capacity
- Low Stored Charge Majority Carrier Conduction

SCHOTTKY BARRIER RECTIFIERS
10 AMPERES
60–100 VOLTS



CASE 221B-02
TO-220AC
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MBR 1060	MBR 1070	MBR 1080	MBR 1090	MBR 10100	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	70	80	90	100	Volts
Average Rectified Forward Current (Rated V_R) T_C = 133°C	$I_{F(AV)}$	10					Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 133°C	I_{FRM}	20					Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150					Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)	I_{RRM}	0.5					Amp
Operating Junction Temperature	T_J	−65 to +150					°C
Storage Temperature	T_{stg}	−65 to +175					°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000					V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Maximum Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	2 60	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 10 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C)	v_F	 0.7 0.8 0.85 0.95	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 150 0.15	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

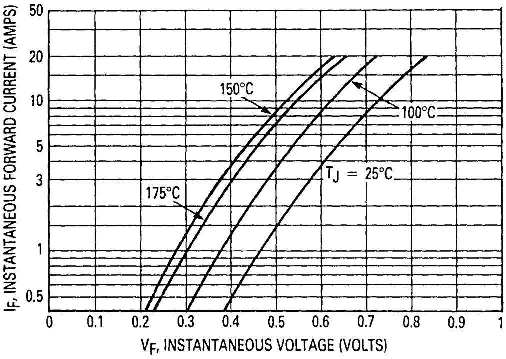


Figure 1. Typical Forward Voltage

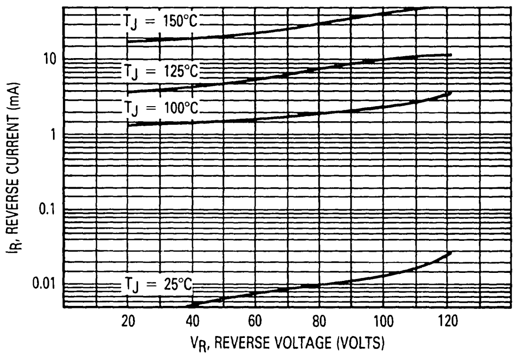


Figure 2. Typical Reverse Current

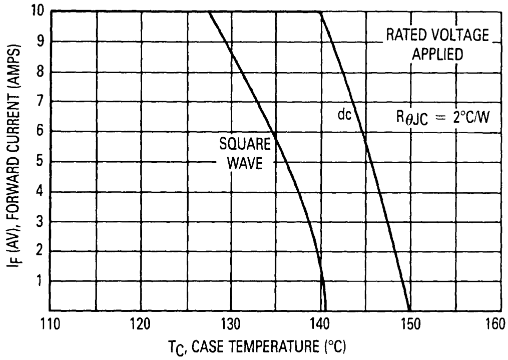


Figure 3. Current Derating, Case

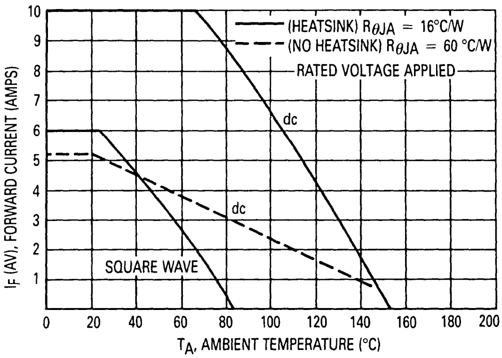


Figure 4. Current Derating, Ambient

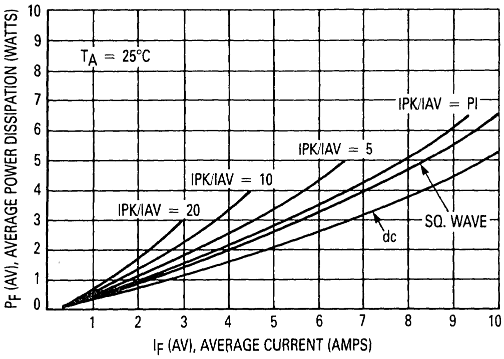


Figure 5. Forward Power Dissipation

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR1535CT
MBR1545CT

MBR1545CT is a
Motorola Preferred Device

3

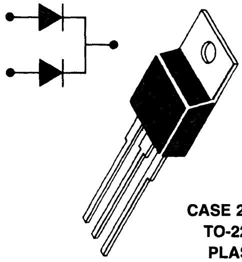
SWITCHMODE POWER RECTIFIERS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8"

SCHOTTKY BARRIER RECTIFIERS

15 AMPERES
35 and 45 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

MAXIMUM RATINGS

Rating		Symbol	MBR1535CT	MBR1545CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current T_C = 105°C (Rated V_R)	Per Diode Per Device	$I_{F(AV)}$	7.5 15	7.5 15	Amps
Peak Repetitive Forward Current, T_C = 105°C (Rated V_R, Square Wave, 20 kHz) Per Diode		I_{FRM}	15	15	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)		I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature		T_J	-65 to +150	-65 to +150	°C
Storage Temperature		T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS PER DIODE

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	3.0	°C/W
Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	60	60	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Maximum Instantaneous Forward Voltage (1) (i_F = 7.5 Amp, T_C = 125°C) (i_F = 15 Amp, T_C = 125°C) (i_F = 15 Amp, T_C = 25°C)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 15 0.1	 15 0.1	mA

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

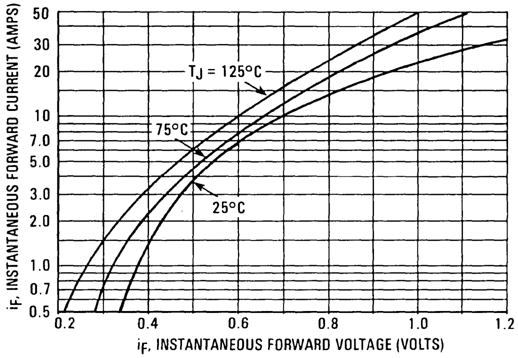


FIGURE 2 — TYPICAL REVERSE CURRENT

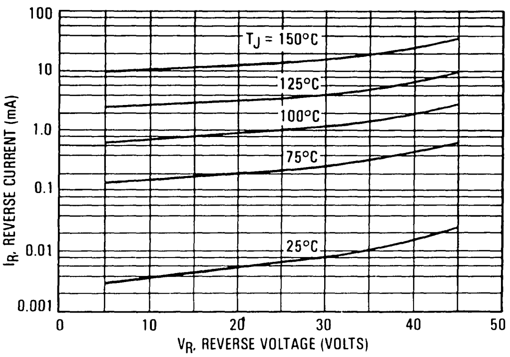


FIGURE 3 — CURRENT DERATING, CASE

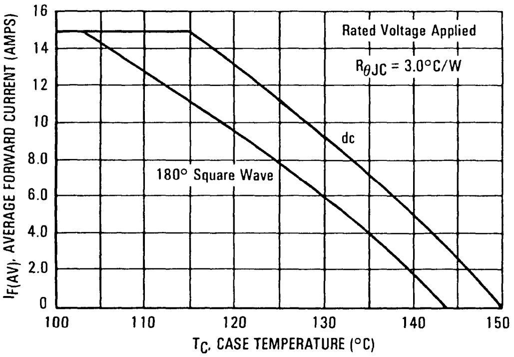


FIGURE 4 — CURRENT DERATING, AMBIENT

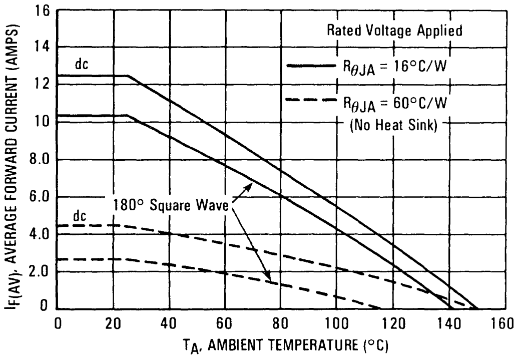
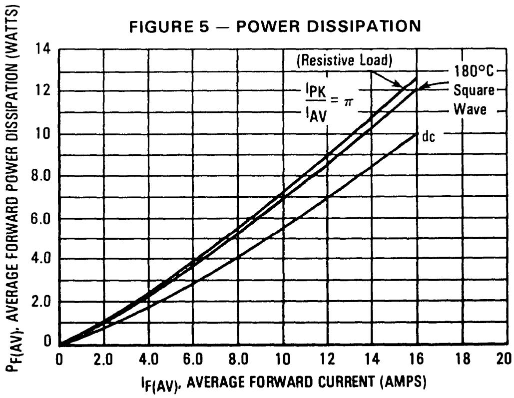


FIGURE 5 — POWER DISSIPATION



3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR1635
MBR1645

MBR1645 is a
Motorola Preferred Device

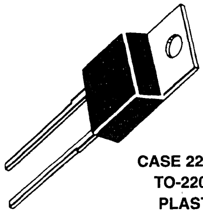
SWITCHMODE POWER RECTIFIERS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

SCHOTTKY BARRIER RECTIFIERS

16 AMPERES
35 and 45 VOLTS



CASE 221B-02
TO-220AC
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR1635	MBR1645	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	$I_{F(AV)}$	16	16	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 125°C	I_{FRM}	32	32	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	1 0	Amps
Operating Junction Temperature	T_J	-65 to +150	-65 to +150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	1.5	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 16 Amp, T_C = 125°C) (i_F = 16 Amp, T_C = 25°C)	v_F	 0.57 0.63	 0.57 0.63	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 40 0.2	 40 0.2	mA

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

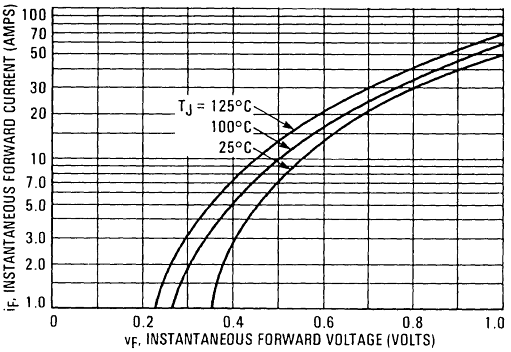


FIGURE 2 — TYPICAL REVERSE CURRENT

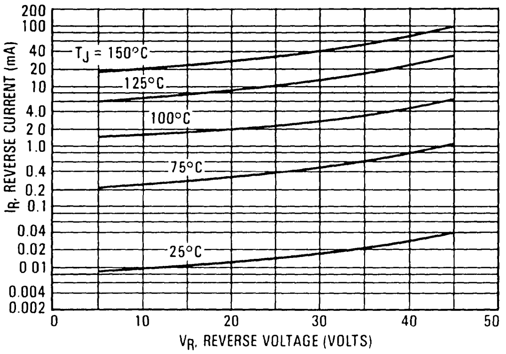


FIGURE 3 — CURRENT DERATING, CASE

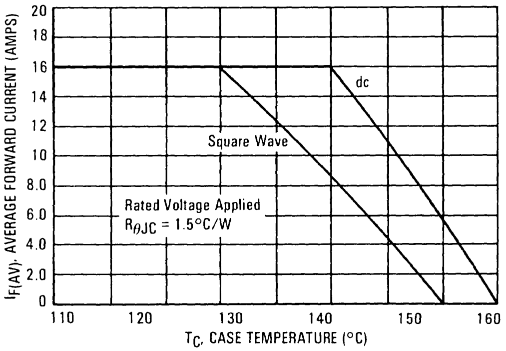


FIGURE 4 — CURRENT DERATING, AMBIENT

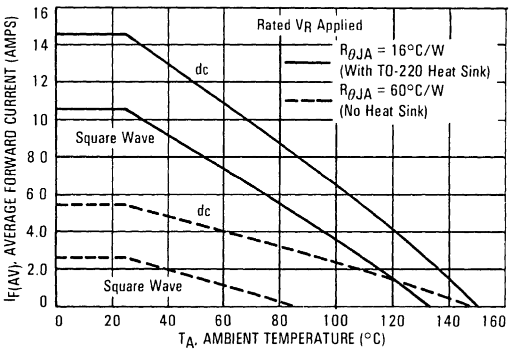
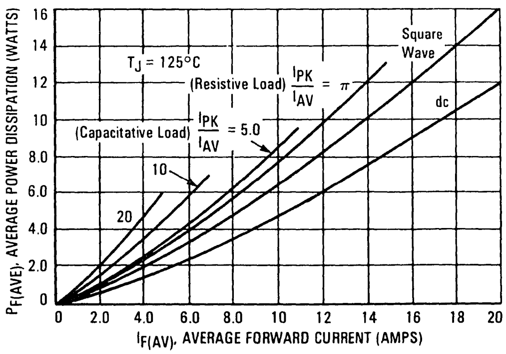


FIGURE 5 — FORWARD POWER DISSIPATION



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

SWITCHMODE Dual Schottky Power Rectifiers

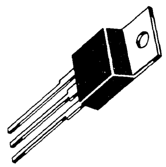
MBR2015CTL
MBR2030CTL

MBR2030CTL is a Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS
20 AMPERES
15 and 30 VOLTS

. . . 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 overlay contact. Ideally suited for use as rectifiers in very low-voltage, high-frequency switching power supplies, free wheeling diodes and polarity protection diodes.

- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop (0.4 Max @ 10 A, T_C = 150°C)
- Matched Dual Die Construction (10 A per Leg or 20 A per Package)
- High Junction Temperature Capability
- High dv/dt Capability
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection
- Epoxy Meets UL94, VO at 1/8″



CASE 221A-06
TO-220AB

3

MAXIMUM RATINGS (Per Leg)

Rating	Symbol	MBR2015CTL	MBR2030CTL	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	15	30	Volts
Average Rectified Forward Current	$I_{F(AV)}$	10		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150		Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0		Amp
Operating Junction Temperature	T_J	−65 to +150		°C
Storage Temperature	T_{stg}	−65 to +175		°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000		V/μs

THERMAL CHARACTERISTICS (Per Leg)

Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS (Per Leg)

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 25°C) (i_F = 10 Amp, T_C = 150°C) (i_F = 20 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 150°C)	v_F	 0.52 0.40 0.58 0.48	Volts
Maximum Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C) (Rated DC Voltage, T_C = 125°C)	i_R	 5.0 40 75	mA

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle ≤ 10%.
SWITCHMODE is a trademark of Motorola Inc.

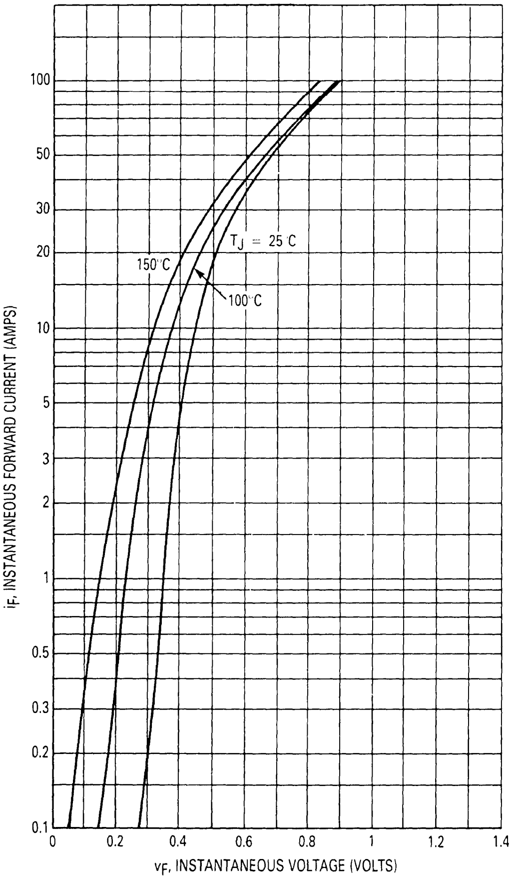


Figure 1. Typical Forward Voltage (Per Leg)

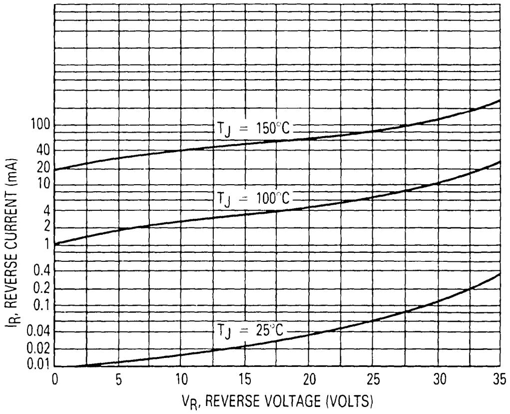


Figure 2. Typical Reverse Current (Per Leg)

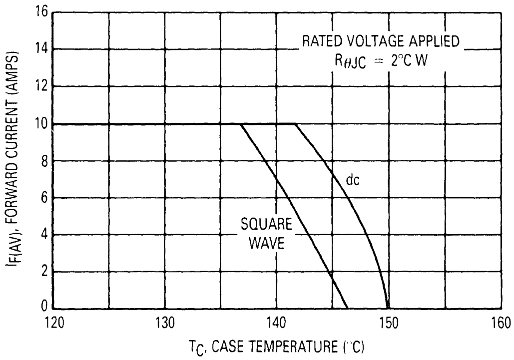


Figure 3. Current Derating, Case

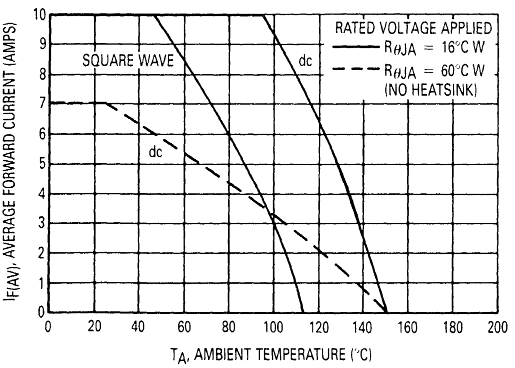


Figure 4. Current Derating, Ambient

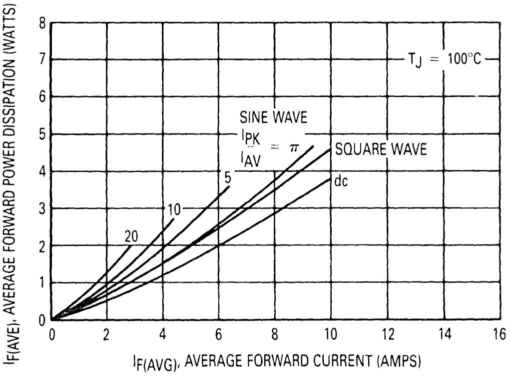


Figure 5. Forward Power Dissipation

3

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 6.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent 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.

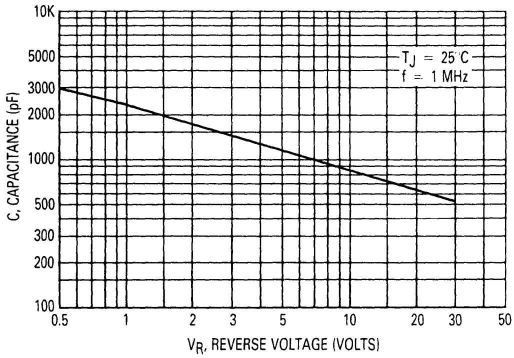


Figure 6. Typical Capacitance

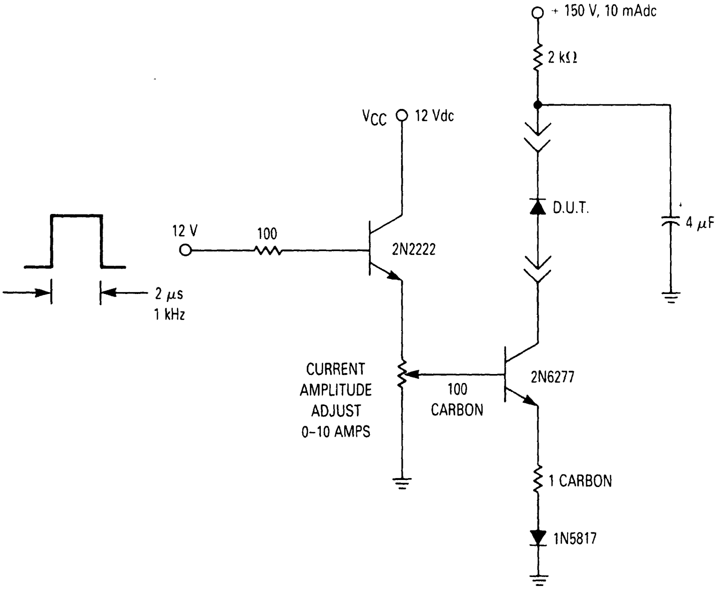


Figure 7. Test Circuit for dv/dt and Reverse Surge Current

MBR2035CT
MBR2045CT

MBR2045CT is a
Motorola Preferred Device

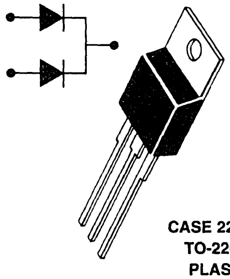
SWITCHMODE POWER RECTIFIERS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, V0 at 1/8″

SCHOTTKY BARRIER RECTIFIERS

20 AMPERES
35 and 45 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR2035CT	MBR2045CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) $T_C = 135°C$	$I_{F(AV)}$	20	20	Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz) $T_C = 135°C$	I_{FRM}	20	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 11	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	-65 to +150	-65 to +150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS

Rating	Symbol	MBR2035CT	MBR2045CT	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MBR2035CT	MBR2045CT	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C)	v_F	 0.57 0.72 0.84	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 15 0.1	 15 0.1	mA

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

3

FIGURE 1 — MAXIMUM FORWARD VOLTAGE

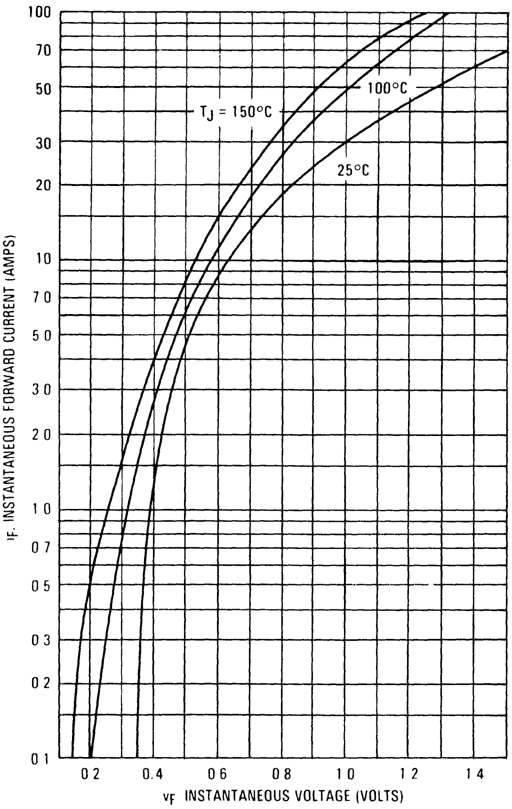


FIGURE 2 — TYPICAL FORWARD VOLTAGE

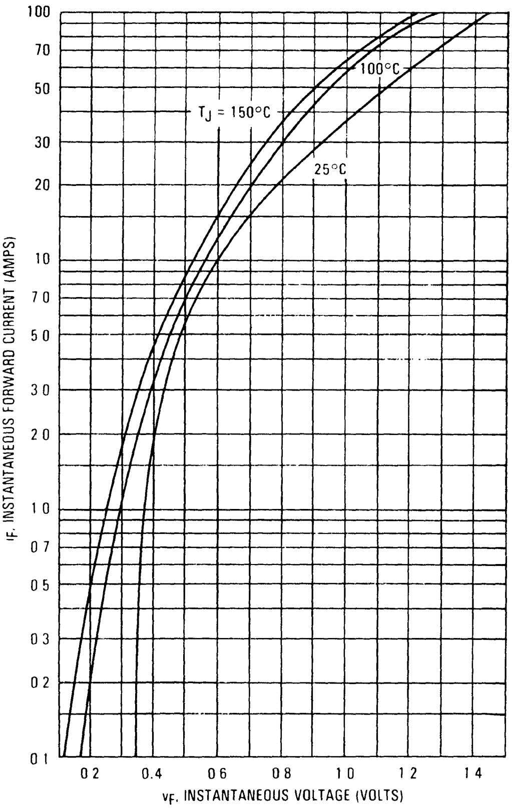


FIGURE 3 — MAXIMUM REVERSE CURRENT

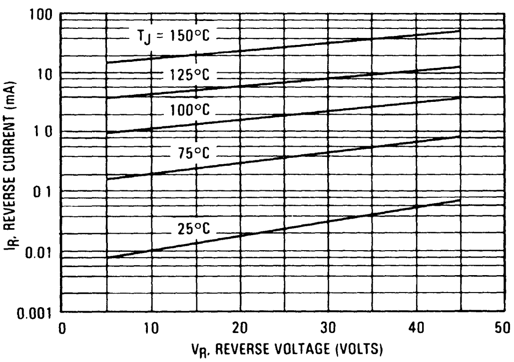


FIGURE 4 — MAXIMUM SURGE CAPABILITY

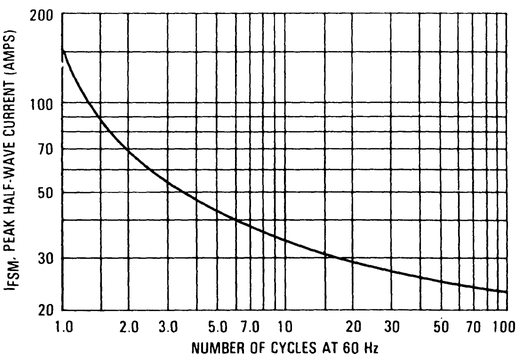


FIGURE 5 — CURRENT DERATING, INFINITE HEATSINK

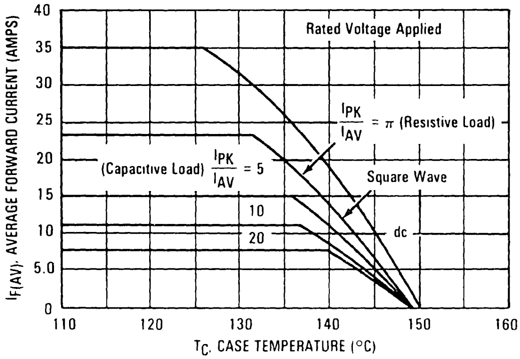


FIGURE 6 — CURRENT DERATING, $R_{\theta JA}$ = 16° C/W

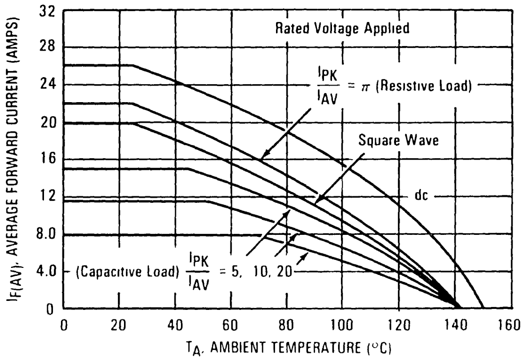


FIGURE 7 — FORWARD POWER DISSIPATION

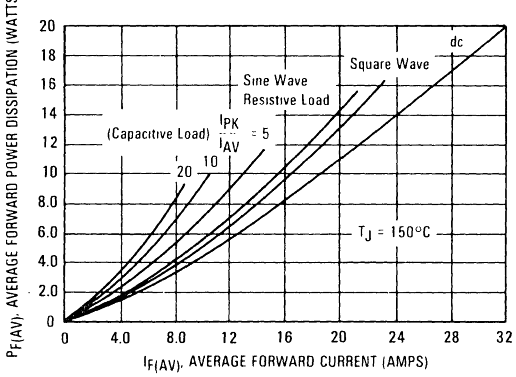


FIGURE 8 — CURRENT DERATING, FREE AIR

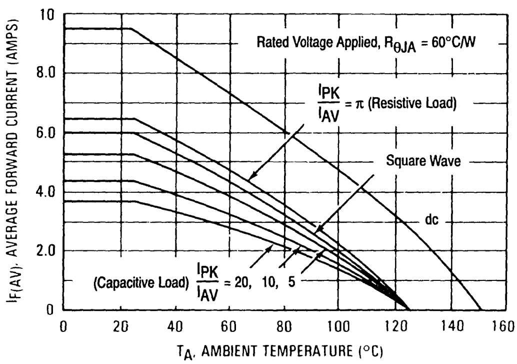
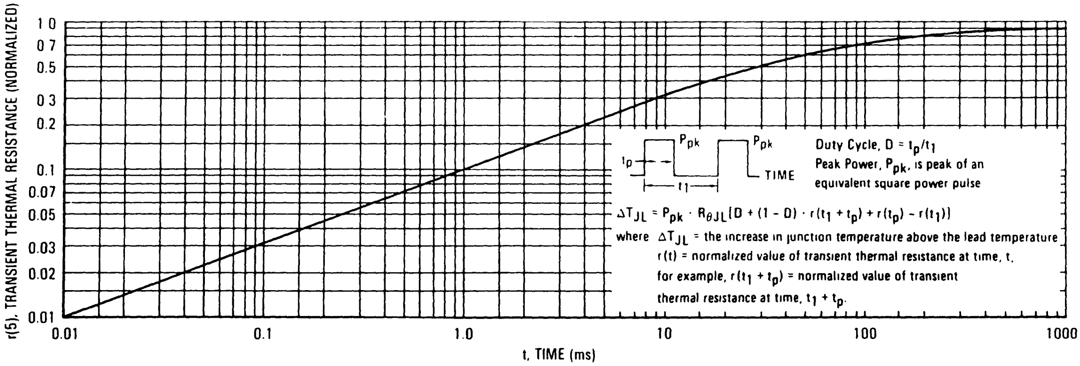


FIGURE 9 — THERMAL RESPONSE



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 10.)

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 efficieny 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

FIGURE 10 — CAPACITANCE

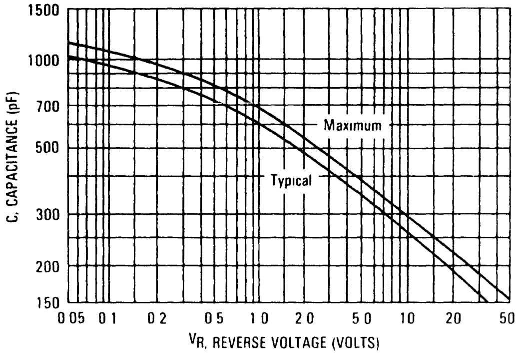


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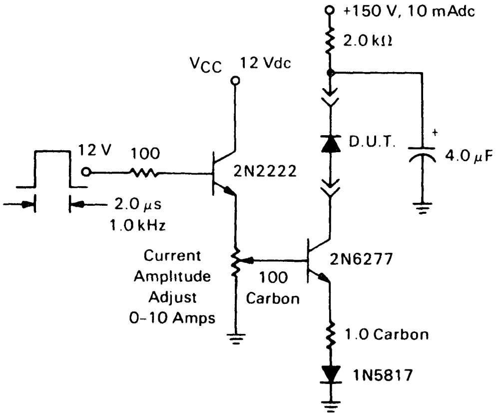
FIGURE 11 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Switchmode Power Rectifiers

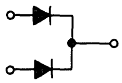
MBR2060CT
MBR2070CT
MBR2080CT
MBR2090CT
MBR20100CT

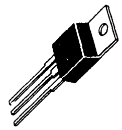
MBR2060CT and MBR20100CT are Motorola Preferred Devices

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- 20 Amps Total (10 Amps Per Diode Leg)
- Guard-Ring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Epoxy Meets UL94, VO at 1/8″
- Low Power Loss/High Efficiency
- High Surge Capacity
- Low Stored Charge Majority Carrier Conduction

SCHOTTKY BARRIER RECTIFIERS
20 AMPERES
60–100 VOLTS





CASE 221A-06
TO-220AB
PLASTIC

3

MAXIMUM RATINGS PER DIODE LEG

Rating	Symbol	MBR					Unit
		2060CT	2070CT	2080CT	2090CT	20100CT	
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	70	80	90	100	Volts
Average Rectified Forward Current (Rated V_R) $T_C = 133°C$	$I_{F(AV)}$	10					Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) $T_C = 133°C$	I_{FRM}	20					Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150					Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)	I_{RRM}	0.5					Amp
Operating Junction Temperature	T_J	−65 to +150					°C
Storage Temperature	T_{stg}	−65 to +175					°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000					V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	2 60	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE LEG

Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 10 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C)	v_F	 0.75 0.85 0.85 0.95	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 150 0.15	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

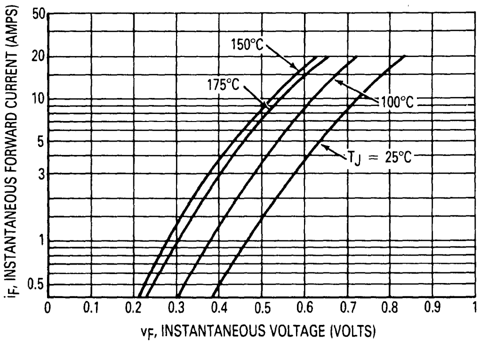


Figure 1. Typical Forward Voltage Per Diode

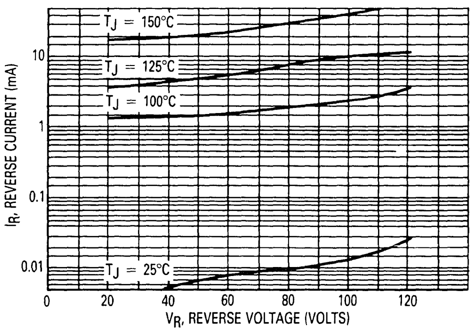


Figure 2. Typical Reverse Current Per Diode

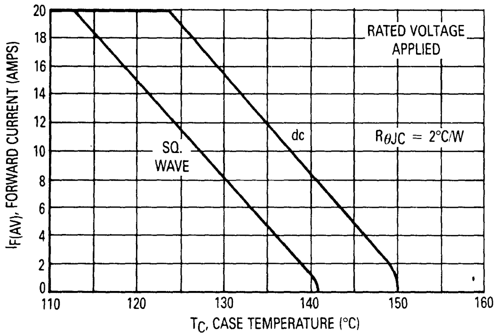


Figure 3. Current Derating, Case

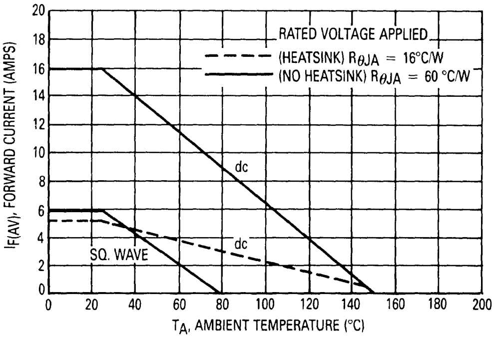


Figure 4. Current Derating, Ambient

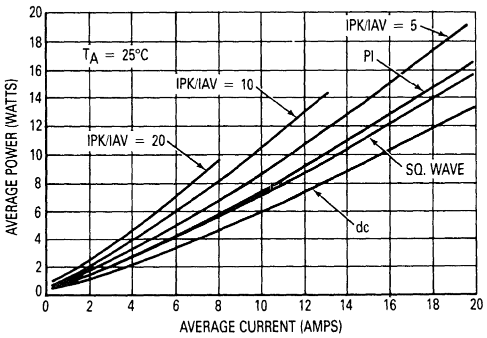


Figure 5. Average Power Dissipation and Average Current

MBR2535CT
MBR2545CT

MBR2545CT is a
Motorola Preferred Device

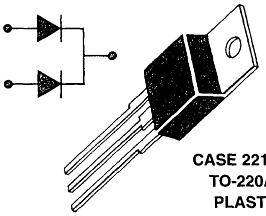
SWITCHMODE POWER RECTIFIERS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

SCHOTTKY BARRIER RECTIFIERS

30 AMPERES
35 and 45 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBR2535CT	MBR2545CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 130°C	$I_{F(AV)}$	30	30	Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz) T_C = 130°C	I_{FRM}	30	30	Amps
Nonrepetitive Peak Surge Current per Diode Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	1.0	Amps
Operating Junction Temperature	T_J	-65 to + 150	-65 to + 150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS PER DIODE LEG

Rating	Symbol	MBR2535CT	MBR2545CT	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	1.5	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE LEG

Rating	Symbol	MBR2535CT	MBR2545CT	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 30 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 25°C)	v_F	 0.73 0.82	 0.73 0.82	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 40 0.2	 40 0.2	mA

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

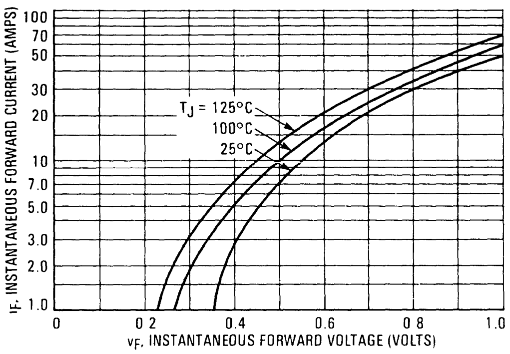


FIGURE 2 — TYPICAL REVERSE CURRENT

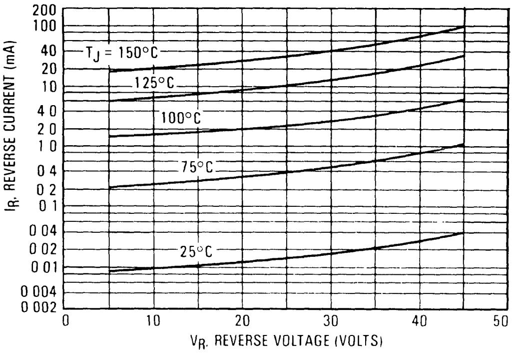


FIGURE 3 — CURRENT DERATING, CASE

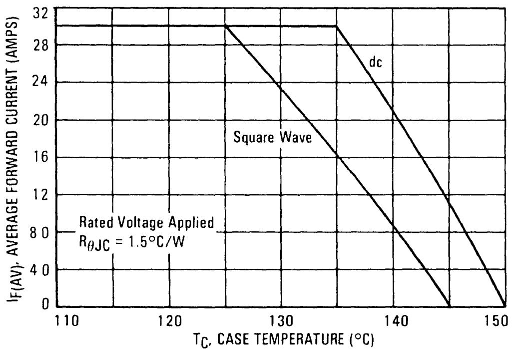


FIGURE 4 — CURRENT DERATING, AMBIENT

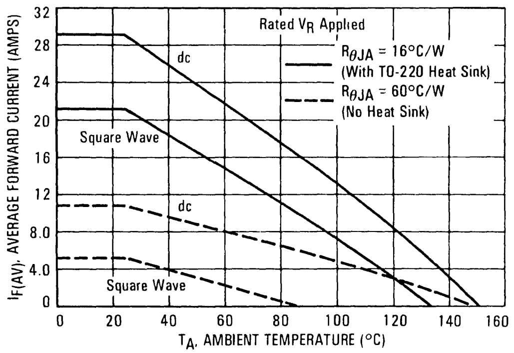
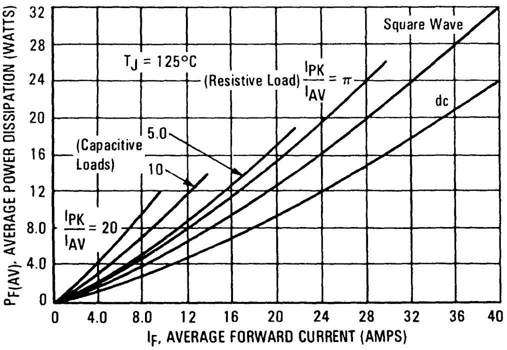


FIGURE 5 — FORWARD POWER DISSIPATION



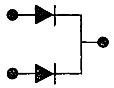
Switchmode Power Rectifiers

MBR2535CTL

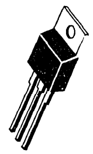
Motorola Preferred Device

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

- Very Low Forward Voltage (0.55 V Maximum @ 25 Amps)
- Matched Dual Die Construction (12.5 A per Leg or 25 A per Package)
- Guardring for Stress Protection
- Highly Stable Oxide Passivated Junction (125°C Operating Junction Temperature)
- Epoxy Meets UL94, VO at 1/8″



**SCHOTTKY BARRIER RECTIFIERS
25 AMPERES
30 and 35 VOLTS**



CASE 221A-06
(TO-220AC)

3

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35 30 30	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C	$I_{F(AV)}$	12.5	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 95°C	I_{FRM}	25	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Operating Junction Temperature	T_J	–65 to +125	°C
Storage Temperature	T_{stg}	–65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/µs
Controlled Avalanche Energy	W_{aval}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (I_F = 25 Amps, T_J = 25°C) (I_F = 12.5 Amps, T_J = 25°C) (I_F = 12.5 Amps, T_J = 125°C)	v_F	 0.55 0.47 0.41	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 125°C)	i_R	 5.0 500	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤2 0%.

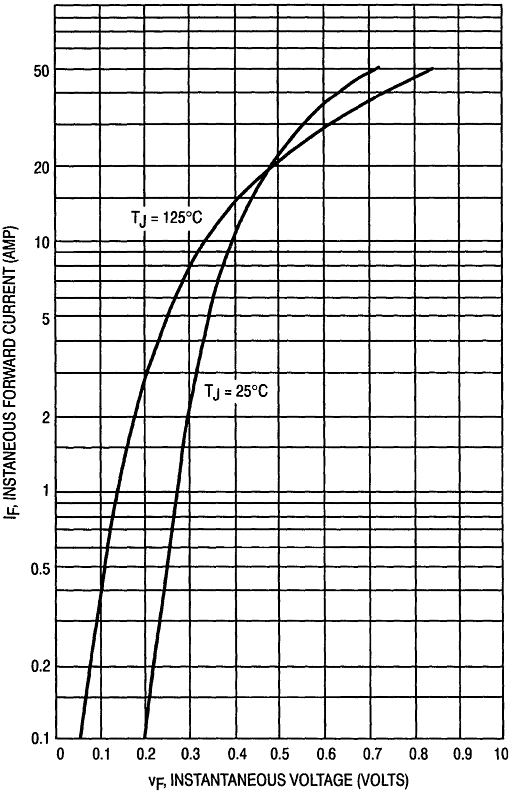


Figure 1. Typical Forward Voltage, Per Leg

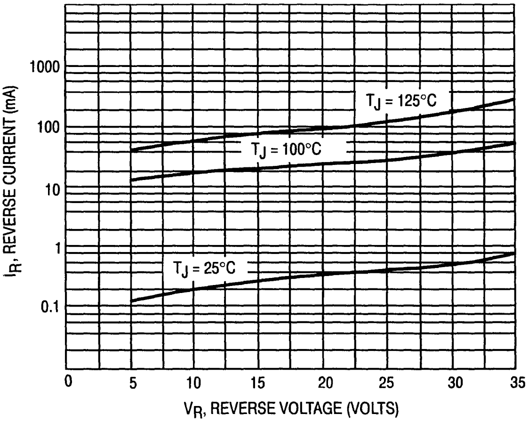


Figure 2. Typical Reverse Current, Per Leg

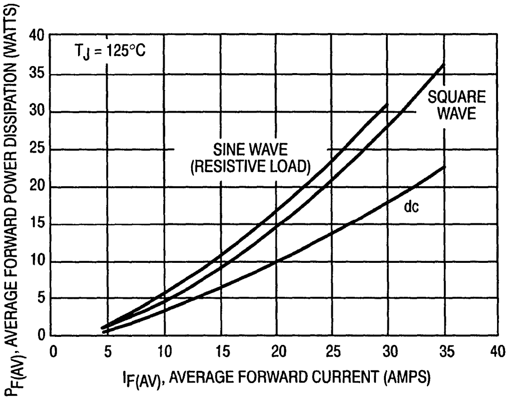


Figure 3. Forward Power Dissipation, Per Leg

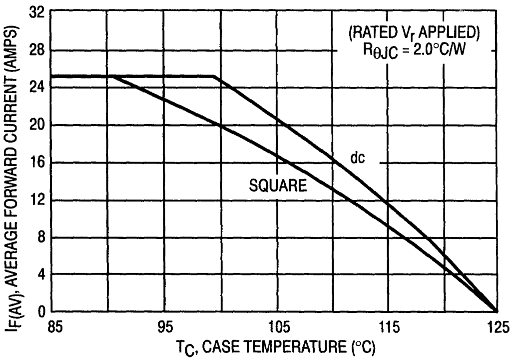


Figure 4. Current Derating

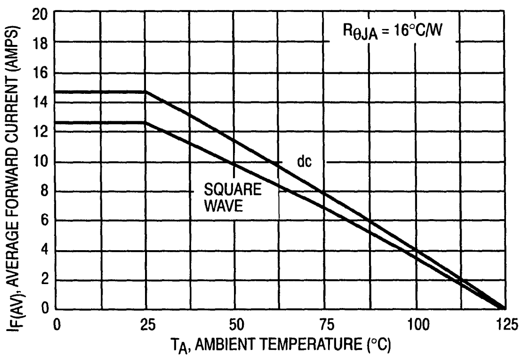


Figure 5. Current Derating Ambient, Per Leg

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3020CT
MBR3035CT
MBR3045CT
SD241

MBR3045CT and SD241 are Motorola Preferred Devices

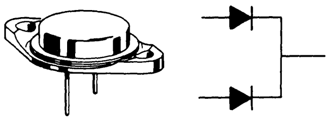
SWITCHMODE POWER RECTIFIERS

... using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

SCHOTTKY BARRIER RECTIFIERS

30 AMPERES
20 to 45 VOLTS



CASE 11-03
TO-204AA
METAL

3

MAXIMUM RATINGS

Rating	Symbol	MBR3020CT	MBR3035CT	MBR3045CT	SD241	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	35	45	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C — Per Device Per Diode	I_O	30 15	30 15	30 15	30 15	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	30	30	30	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	400	400	400	Amps
Peak Repetitive Reverse Current, Per Diode (2.0 μs, 1.0 kHz) See Figure 8	I_{RRM}	2.0	2.0	2.0	2.0	Amps
Operating Junction Temperature	T_J	-65 to + 150	-65 to + 150	-65 to + 150	-65 to +150	°C
Storage Temperature	T_{stg}	-65 to +175	-65 to +175	-65 to +175	-65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	175	175	175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	1000	1000	V/μs

THERMAL CHARACTERISTICS PER DIODE

Rating	Symbol	MBR3020CT	MBR3035CT	MBR3045CT	SD241	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	1.4	1.4	1.4	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Rating	Symbol	MBR3020CT	MBR3035CT	MBR3045CT	SD241	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 25°C)	v_F	 — 0.60 0.72 0.76	 — 0.60 0.72 0.76	 — 0.60 0.72 0.76	 0.47 0.60 — —	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 60 1.0	 60 1.0	 60 1.0	 100 V_R = 35 V	mA
Capacitance	C_t	2000	2000	2000	2000	pF

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

3

FIGURE 1 — TYPICAL FORWARD VOLTAGE

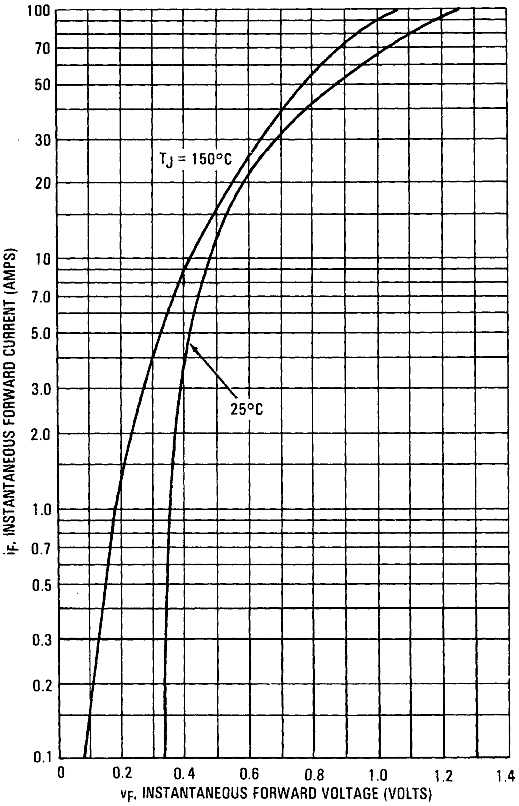


FIGURE 2 — TYPICAL REVERSE CURRENT

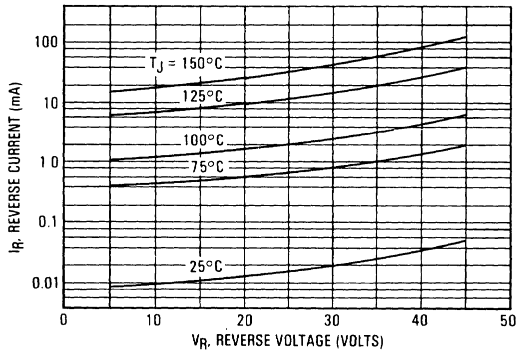


FIGURE 3 — MAXIMUM SURGE CAPABILITY

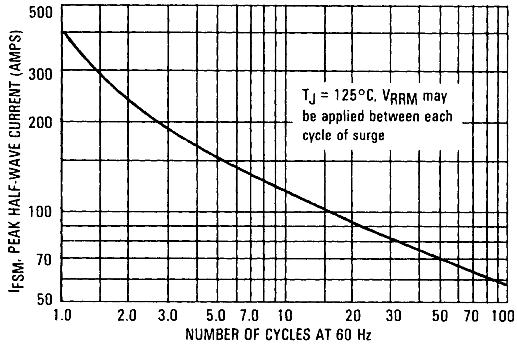


FIGURE 4 — CURRENT DERATING

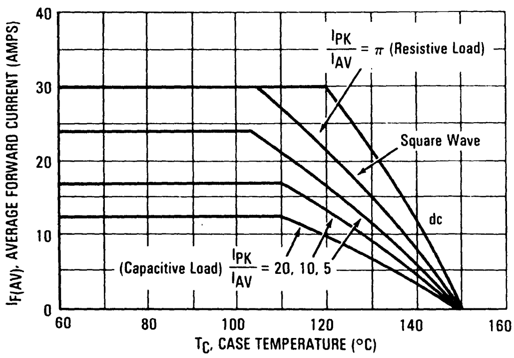


FIGURE 5 — FORWARD POWER DISSIPATION

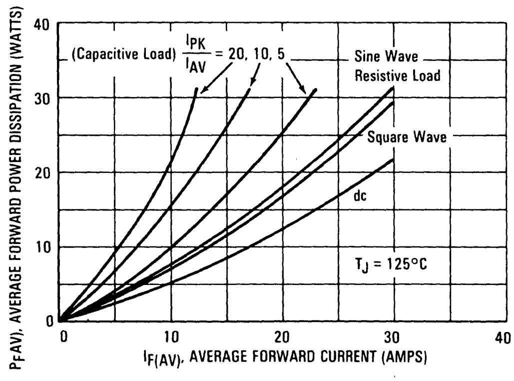
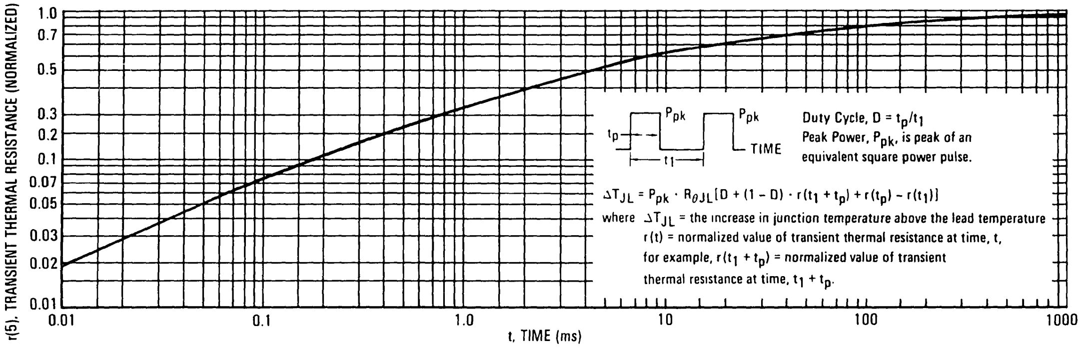


FIGURE 6 — THERMAL RESPONSE PER DIODE LEG



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 7.)

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 efficieny 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.

FIGURE 7 — CAPACITANCE

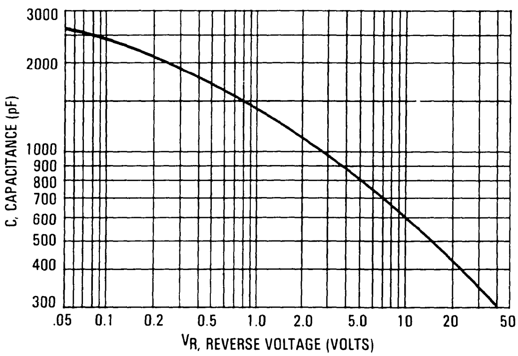


FIGURE 8 — TEST CIRCUIT FOR REPETITIVE REVERSE CURRENT

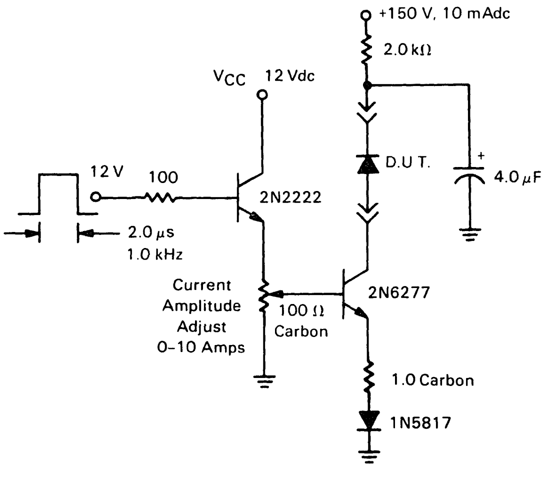
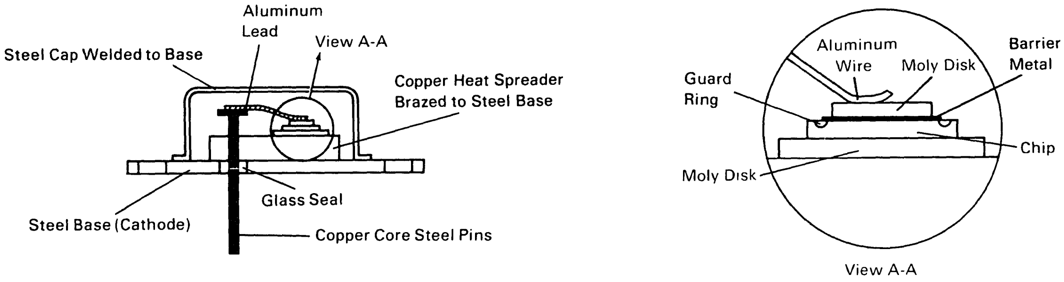


FIGURE 9 — SCHOTTKY RECTIFIER



Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not required. The guardring also operates like a zener to absorb over-voltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The pin-to-chip aluminum leadwire provides stress relief. These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. Copper-core steel pins match the expansion coefficient of the glass and are long enough (0.440 in. min.) to reach through a heat sink to a printed circuit board.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

3

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.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3035PT
MBR3045PT

MBR3045PT is a Motorola Preferred Device

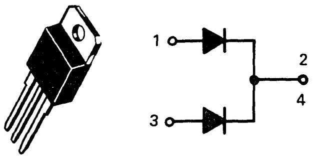
SWITCHMODE POWER RECTIFIERS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — Terminals 1 and 3 May Be Connected For Parallel Operation At Full Rating
- Guardring For Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

SCHOTTKY BARRIER RECTIFIERS

30 AMPERES
35 to 45 VOLTS



CASE 340D-01
TO-218AC

3

RATINGS

Rating		Symbol	Maximum	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR3035PT MBR3045PT	V_{RRM} V_{RWM} V_R	35 45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C	Per Device Per Diode	$I_{F(AV)}$	30 15	Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz)		I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge Applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	200	Amps
Peak Repetitive Reverse Current, Per Diode (2.0 μs, 1.0 kHz) See Figure 6		I_{RRM}	2.0	Amps
Operating Junction Temperature		T_J	-65 to +150	°C
Storage Temperature		T_{stg}	-65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)		$T_{J(pk)}$	175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	V/μs

THERMAL CHARACTERISTICS PER DIODE

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	40	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Instantaneous Forward Voltage (1) (i_F = 20 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 25°C)	v_F	 0.60 0.72 0.76	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 100 1.0	mA

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

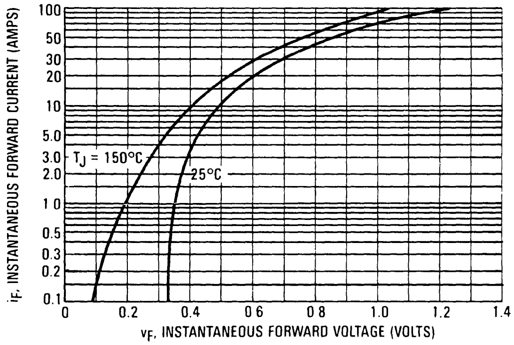


FIGURE 2 — TYPICAL REVERSE CURRENT

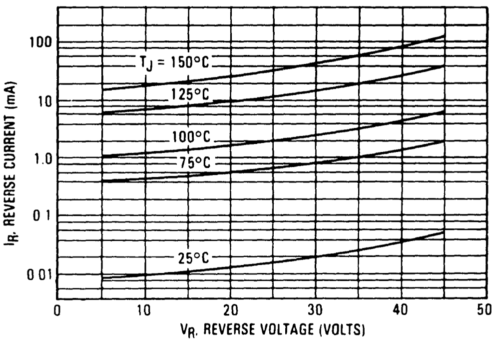


FIGURE 3 — CURRENT DERATING PER LEG

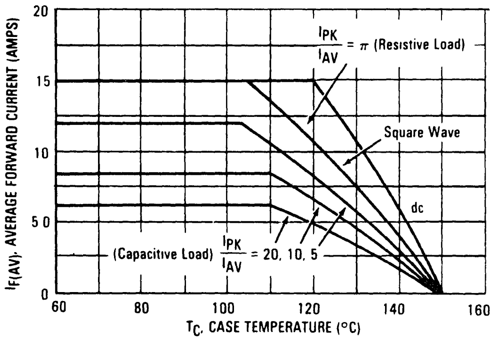


FIGURE 4 — FORWARD POWER DISSIPATION PER LEG

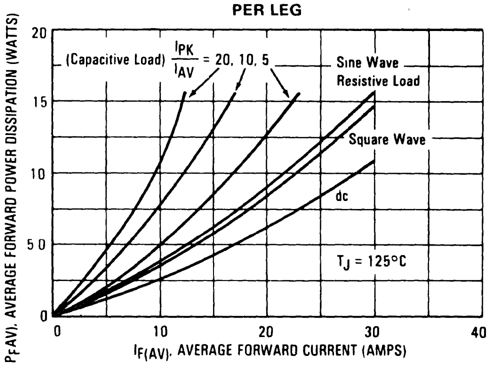


FIGURE 5 — CAPACITANCE

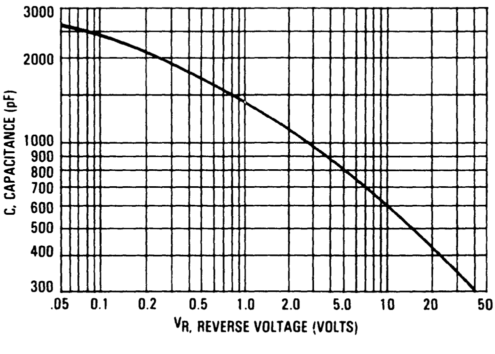
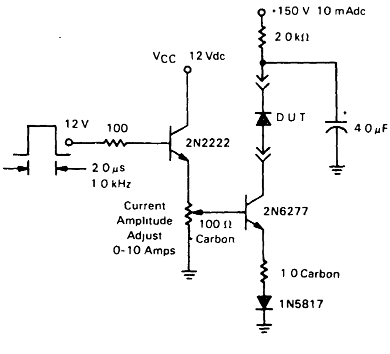


FIGURE 6 — TEST CIRCUIT FOR REPETITIVE REVERSE CURRENT

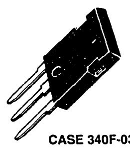


MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3035WT
MBR3045WT

MBR3045WT is a Motorola Preferred Device

**SCHOTTKY BARRIER RECTIFIERS
30 AMPERES
35–45 VOLTS**



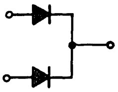
CASE 340F-03
TO-247AC

3

Switchmode Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — Terminals 1 and 3 May Be Connected For Parallel Operation At Full Rating
- Guardring For Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche
- Popular TO-247 Package



MAXIMUM RATINGS

Rating	Symbol	MBR 3035WT	MBR 3045WT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C — Per Device Per Diode	$I_{F(AV)}$	30 15		Amps
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	30		Amps
Nonrepetitive Peak Surge Current (Surge Applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	200		Amps
Peak Repetitive Reverse Current, Per Diode (2.0 μs, 1.0 kHz) See Figure 6	I_{RRM}	2.0		Amps
Operating Junction Temperature	T_J	−65 to +150		°C
Storage Temperature	T_{stg}	−65 to +175		°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175		°C
Voltage Rate of Change (Rated V_R)	dv/dt	10		V/ns

THERMAL CHARACTERISTICS (Per Diode)

Characteristic	Symbol	Value	Unit
Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.4 40	°C/W

ELECTRICAL CHARACTERISTICS (Per Diode)

Characteristic	Symbol	Value	Unit
Instantaneous Forward Voltage (1) (i_F = 20 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 125°C) (i_F = 30 Amp, T_C = 25°C)	v_F	 0.6 0.72 0.76	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 100 1.0	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.
Switchmode is a trademark of Motorola Inc.

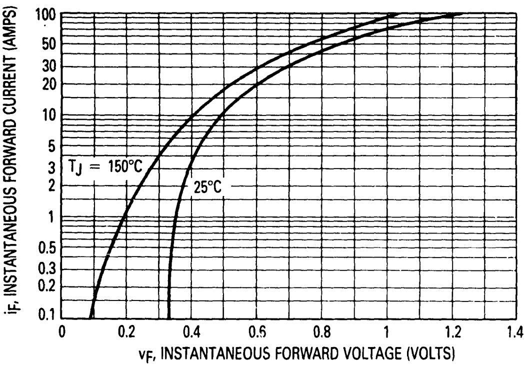


Figure 1. Typical Forward Voltage

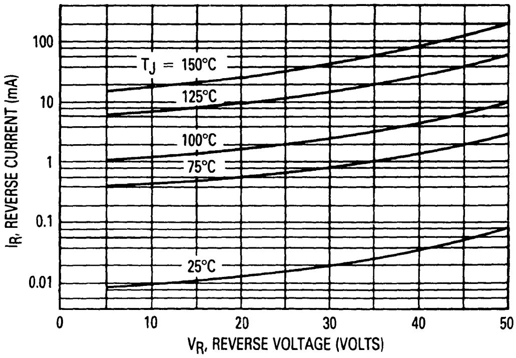


Figure 2. Typical Reverse Current

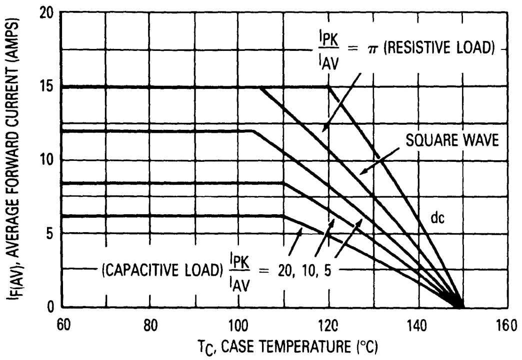


Figure 3. Current Derating (Per Leg)

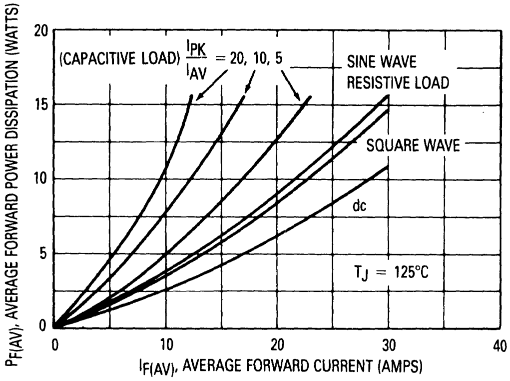


Figure 4. Forward Power Dissipation (Per Leg)

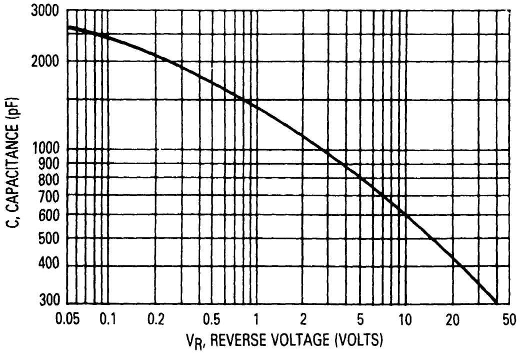


Figure 5. Capacitance

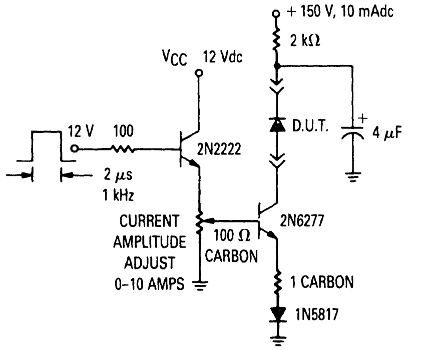


Figure 6. Test Circuit For Repetitive Reverse Current

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR3520
MBR3535
MBR3545, H, H1

MBR3545 is a Motorola Preferred Device

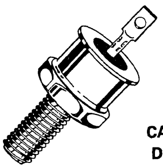
SWITCHMODE POWER RECTIFIERS

. . . using a platinum barrier metal 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.

- Guardring for dv/dt Stress Protection
- Guaranteed Reverse Surge Current/Avalanche
- 150°C Operating Junction Temperature
- Mounting Torque: 15 in-lb max

SCHOTTKY BARRIER RECTIFIERS

35 AMPERES
20 to 45 VOLTS



CASE 56-03
DO-203AA
METAL

3

MAXIMUM RATINGS

Rating	Symbol	MBR3520	MBR3535	MBR3545, H, H1*	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz, T_C = 110°C)	I_{FRM}		70		Amps
Average Rectified Forward Current (Rated V_R, T_C = 110°C)	$I_{F(AV)}$		35		Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 8	I_{RRM}		2.0		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}		600		Amps
Operating Junction Temperature	T_J		-65 to + 150		°C
Storage Temperature	T_{stg}		-65 to +175		°C
Voltage Rate of Change (Rated V_R)	dv/dt		1000		V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.3	1.5	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Characteristic	Symbol	Typ	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 35 Amp, T_C = 125°C) (i_F = 35 Amp, T_C = 25°C) (i_F = 70 Amp, T_C = 125°C)	v_F	 0.49 0.55 0.60	 0.55 0.63 0.69	Volts
Instantaneous Reverse Current (1) (Rated Voltage, T_C = 125°C) (Rated Voltage, T_C = 25°C)	i_R	 60 0.1	 100 0.3	mA
Capacitance (V_R = 1.0 Vdc, 100 kHz > f > 1.0 MHz, T_C = 25°C)	C_t	3000	3700	pF

*H and H1 devices include extra testing. See Figure 10.
(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%

FIGURE 1 — MAXIMUM FORWARD VOLTAGE

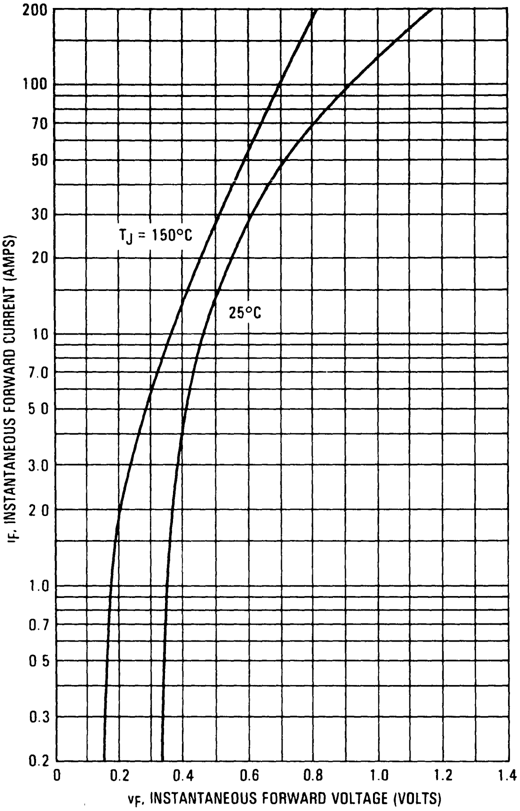


FIGURE 2 — MAXIMUM REVERSE CURRENT

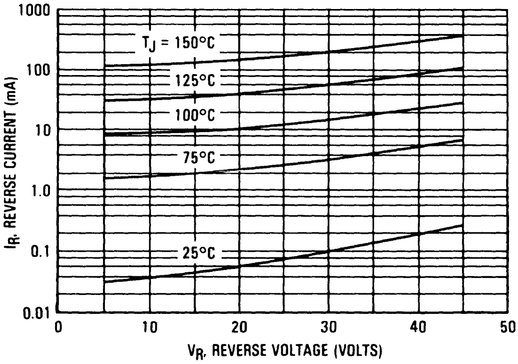


FIGURE 3 — MAXIMUM SURGE CAPABILITY

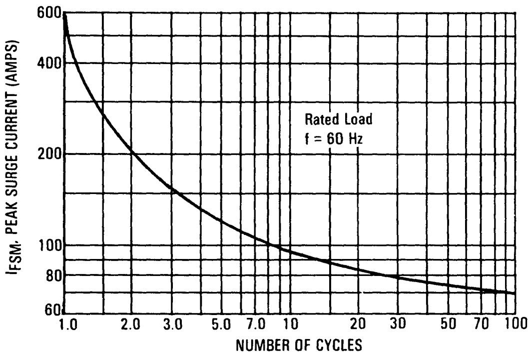


FIGURE 4 — CURRENT DERATING

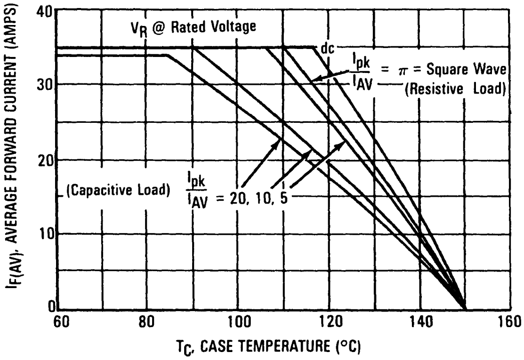


FIGURE 5 — POWER DISSIPATION

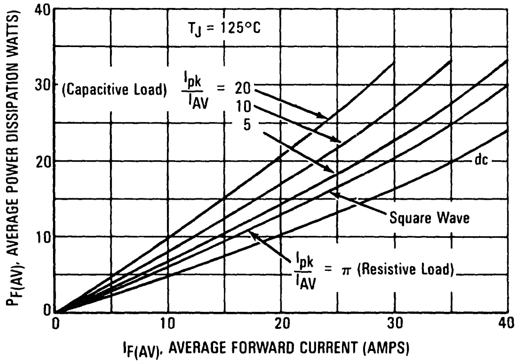
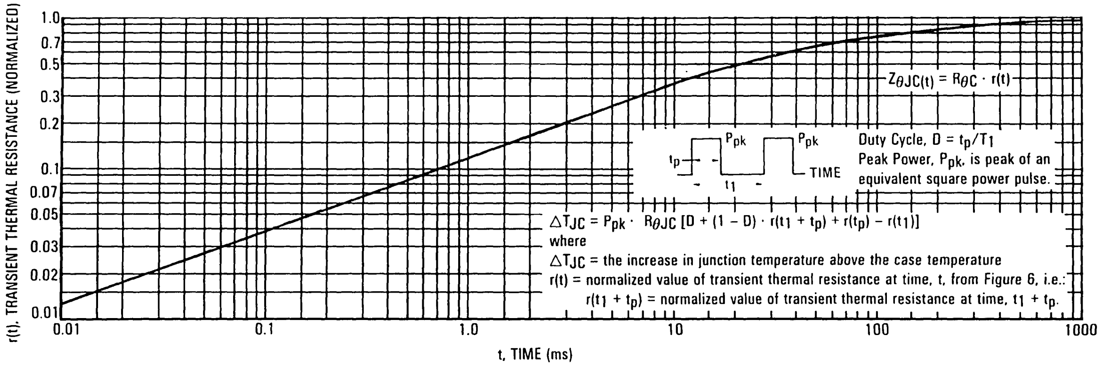


FIGURE 6 — THERMAL RESPONSE



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 7.)

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.

FIGURE 7 — CAPACITANCE

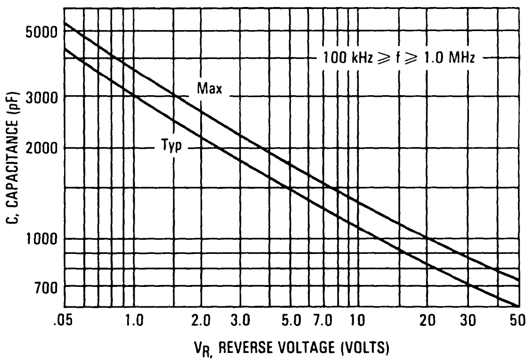


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FIGURE 8 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT

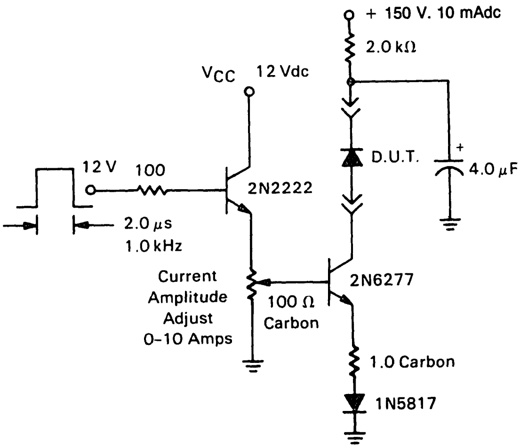
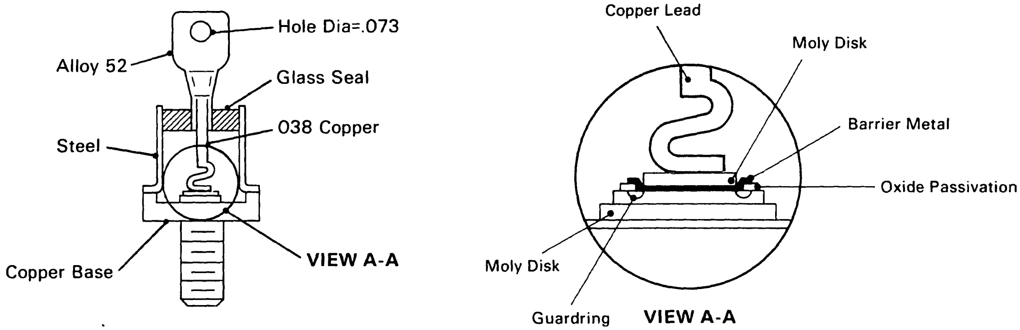


FIGURE 9 — SCHOTTKY RECTIFIER



3

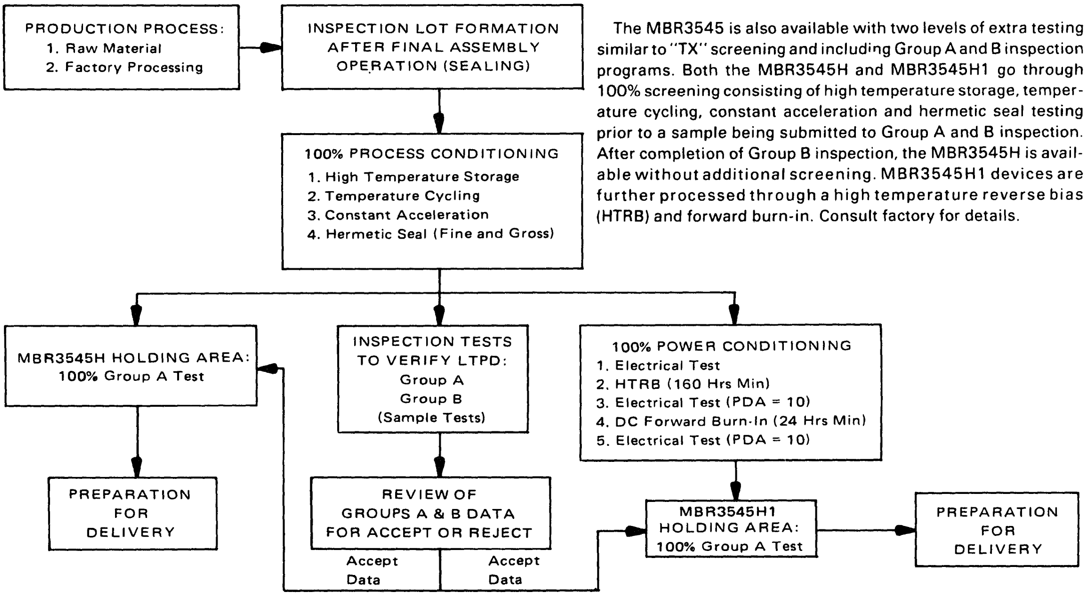
Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead is also stress-reliefed to prevent damage during assembly. These two features give the unit the capability of passing powered thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche. Devices are also 100% reverse scope tested for trace anomalies.

FIGURE 10 — HI-REL PROGRAM OPTIONS



The MBR3545 is also available with two levels of extra testing similar to "TX" screening and including Group A and B inspection programs. Both the MBR3545H and MBR3545H1 go through 100% screening consisting of high temperature storage, temperature cycling, constant acceleration and hermetic seal testing prior to a sample being submitted to Group A and B inspection. After completion of Group B inspection, the MBR3545H is available without additional screening. MBR3545H1 devices are further processed through a high temperature reverse bias (HTRB) and forward burn-in. Consult factory for details.

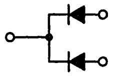
SWITCHMODE Power Rectifier

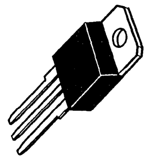
MBR4045PT

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (> 10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

**SCHOTTKY BARRIER RECTIFIER
40 AMPERES
45 VOLTS**





CASE 340D-01
TO-218 Atlas

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C — Total Device	$I_{F(AV)}$	20 40	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	40	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	Amp
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Instantaneous Forward Voltage (1) (i_F = 20 Amps, T_C = 25°C) (i_F = 20 Amps, T_C = 125°C) (i_F = 40 Amps, T_C = 25°C) (i_F = 40 Amps, T_C = 125°C)	v_F	 0.70 0.60 0.80 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

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

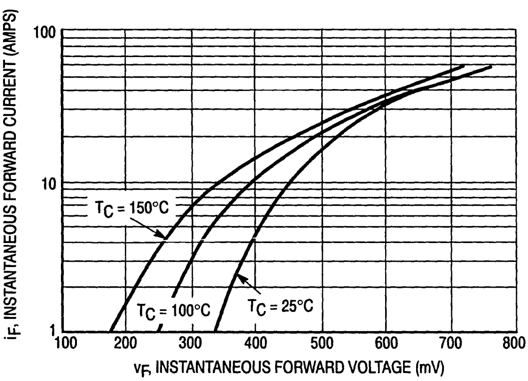


Figure 1. Typical Forward Voltage

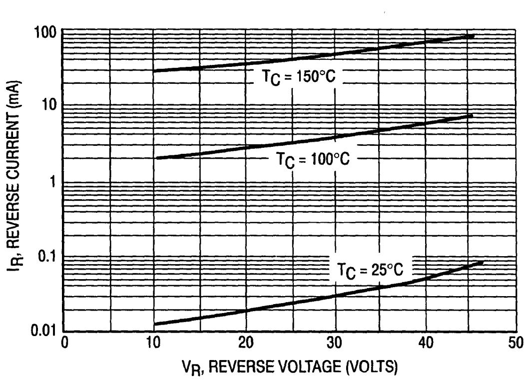


Figure 2. Typical Reverse Current

3

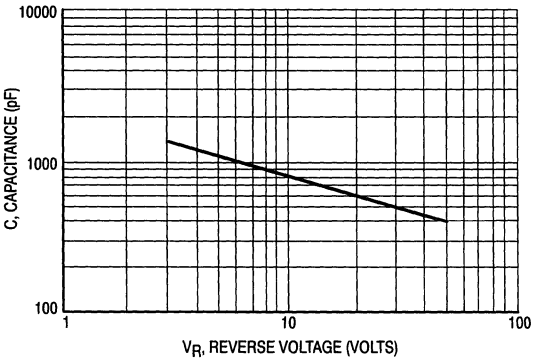


Figure 3. Typical Capacitance Per Leg

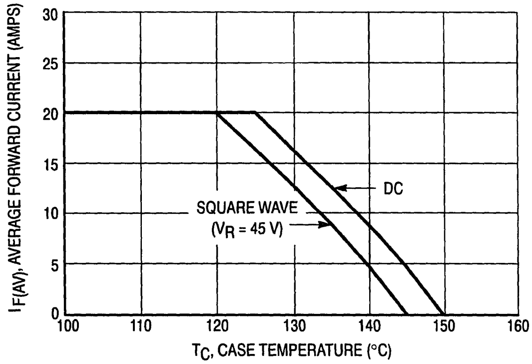


Figure 4. Current Derating Per Leg

SWITCHMODE
Schottky Power Rectifier

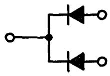
MBR4045WT

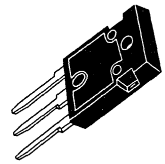
Motorola Preferred Device

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (> 10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

SCHOTTKY BARRIER RECTIFIER
40 AMPERES
45 VOLTS





CASE 340F-03
TO-247

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C Total Device	$I_{F(AV)}$	20 40	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	40	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	Amp
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.4	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Instantaneous Forward Voltage (1) (i_F = 20 Amps, T_C = 25°C) (i_F = 20 Amps, T_C = 125°C) (i_F = 40 Amps, T_C = 25°C) (i_F = 40 Amps, T_C = 125°C)	v_F	 0.70 0.60 0.80 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

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

Preferred devices are Motorola recommended choices for future use and best overall value.

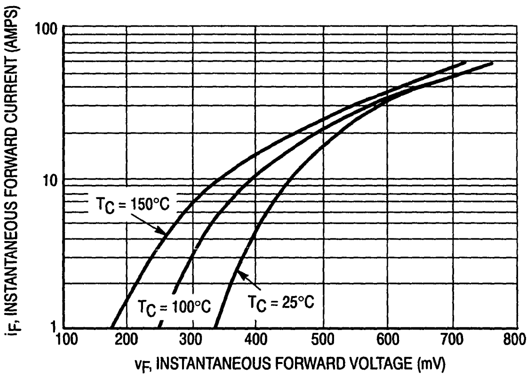


Figure 1. Typical Forward Voltage

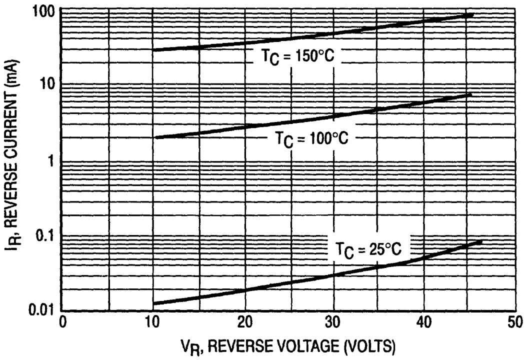


Figure 2. Typical Reverse Current

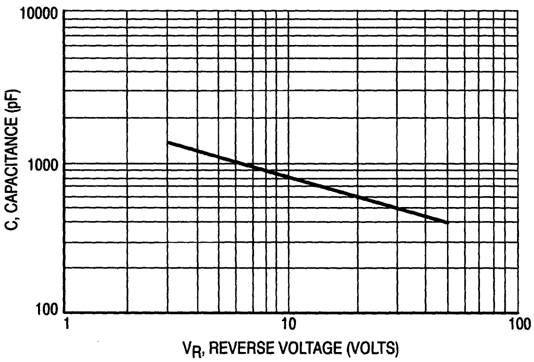


Figure 3. Typical Capacitance Per Leg

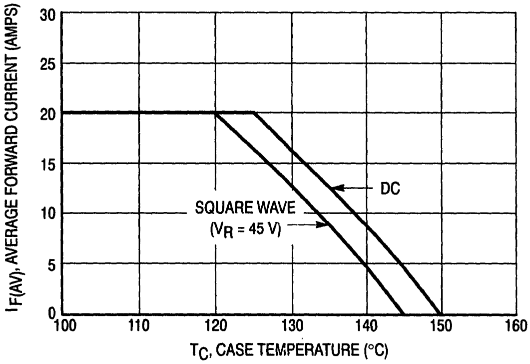


Figure 4. Current Derating Per Leg

SWITCHMODE Power Rectifier

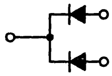
MBR5025L

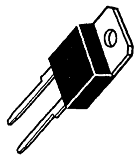
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
LOW V_F
50 AMPERES
25 VOLTS

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Very Low Forward Voltage Drop (Max 0.58 V @ 100°C)
- Guardring for Stress Protection and High dv/dt Capability (10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature
- Specially Designed for SWITCHMODE Power Supplies with Operating Frequency up to 300 kHz
- High Quality TO-218 ATLAS Single Plastic Package





CASE 340E-01
SINGLE TO-218 Atlas

MAXIMUM RATINGS

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	25	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	$I_{F(AV)}$	50	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 90°C	I_{FRM}	150	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	300	Amps
Peak Repetitive Reverse Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	Amps
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/µs

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.75	°C/W

ELECTRICAL CHARACTERISTICS

Instantaneous Forward Voltage (1) (i_F = 50 Amps, T_C = 25°C) (i_F = 50 Amps, T_C = 100°C) (i_F = 30 Amps, T_C = 25°C)	v_F	 0.62 0.58 0.54	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 0.5 60	mA

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

Preferred devices are Motorola recommended choices for future use and best overall value.

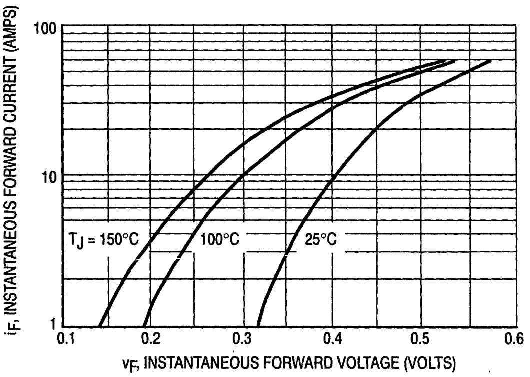


Figure 1. Typical Forward Voltage

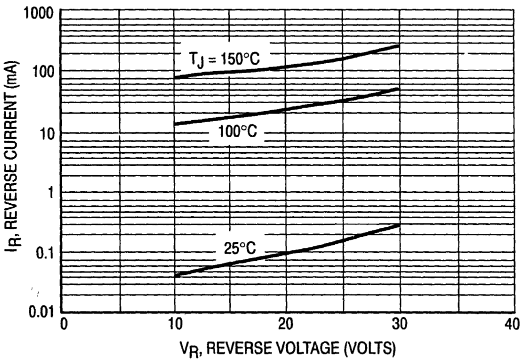


Figure 2. Typical Reverse Current

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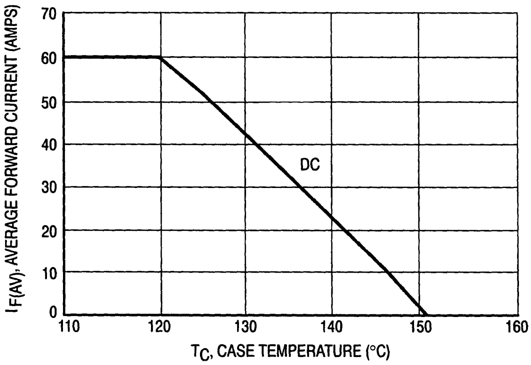


Figure 3. Current Derating, Case

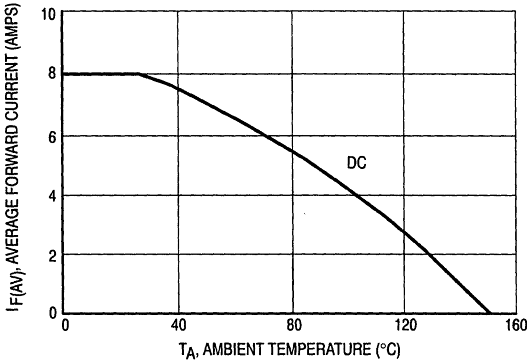


Figure 4. Current Derating, Ambient

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR6015L
MBR6020L
MBR6025L
MBR6030L

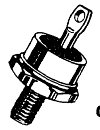
MBR6030L is a
Motorola Preferred Device

Switchmode Power Rectifiers

. . . using a platinum barrier metal 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.

- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 175°C Operating Junction Temperature
- Extremely Low Forward Voltage

SCHOTTKY RECTIFIERS
60 AMPERES
15 TO 30 VOLTS



CASE 257-01
DO-203AB
METAL

3

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR6015L MBR6020L MBR6025L MBR6030L	V_{RRM} V_{RWM} V_R	15 20 25 30	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) $T_C = 90°C$		I_{FRM}	150	Amps
Average Rectified Forward Current (Rated V_R) $T_C = 120°C$		I_O	60	Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz) See Figure 7		I_{RRM}	2	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	1000	Amps
Operating Junction Temperature		T_J	−65 to +150	°C
Storage Temperature Range		T_{stg}	−65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 30 Amps, T_C = 25°C) (i_F = 60 Amps, T_C = 25°C) (i_F = 30 Amps, T_C = 150°C) (i_F = 60 Amps, T_C = 150°C)	v_F	 0.42 0.48 0.30 0.38	Volts
Maximum Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 125°C)	i_R	 50 280	mA
Capacitance (V_R = 1 Vdc, 100 kHz ≤ f ≤ 1 MHz)	C_t	6000	pF

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

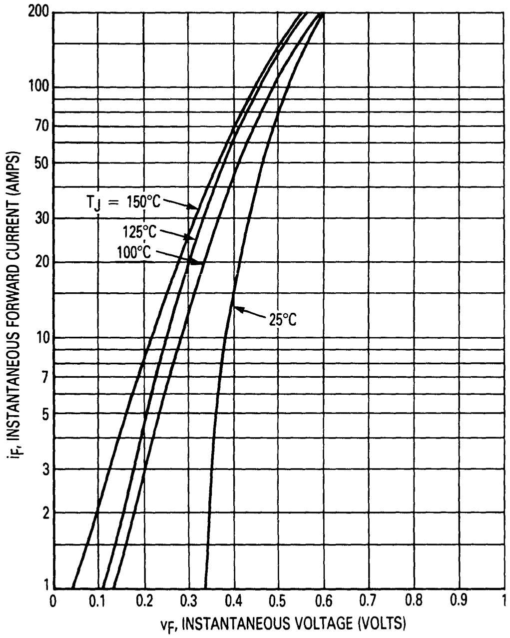


Figure 1. Typical Forward Voltage

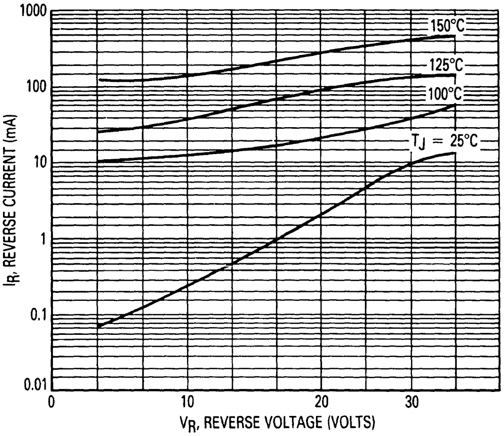


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

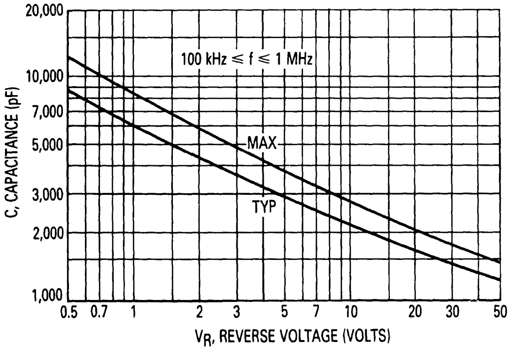


Figure 3. Capacitance

NOTE 1

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 4.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2 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.

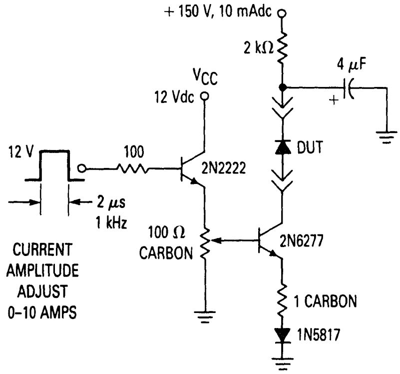


Figure 4. Test Circuit for dv/dt and Reverse Surge Current

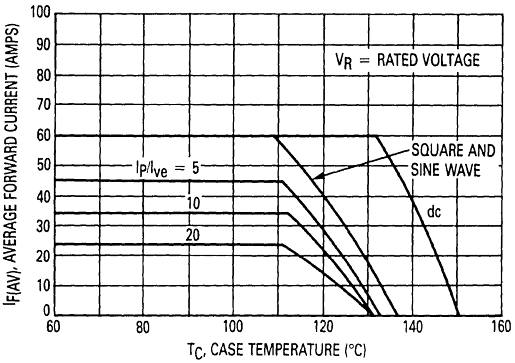


Figure 5. Forward Current Derating

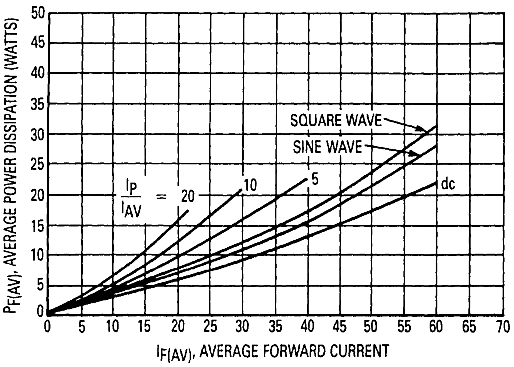
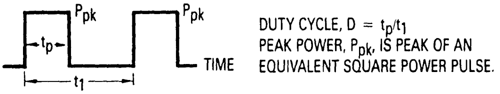


Figure 6. Power Dissipation

NOTE 2



To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the case should be measured using a thermocouple placed on the case. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature. It may be determined by:

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 7, i.e.:

$r(t_1 - t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.

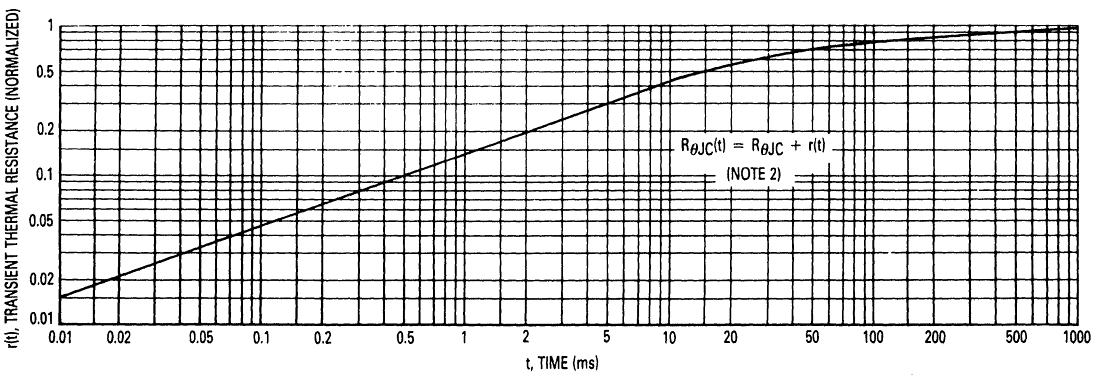
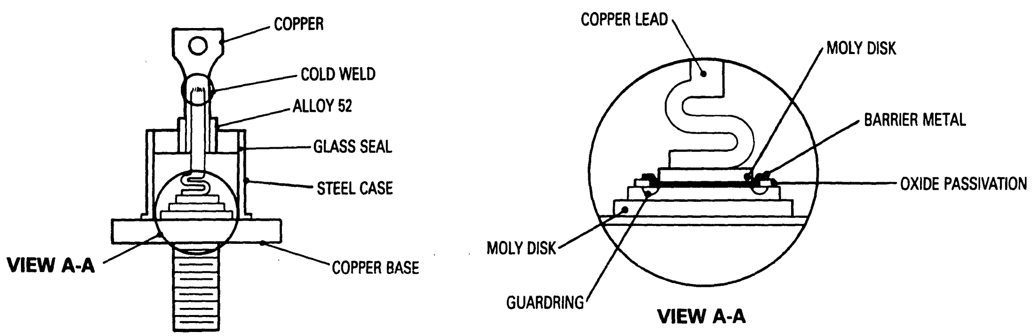


Figure 7. Thermal Response



Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead has a stress relief feature which protects the die during assembly. These two features give the unit the capability of passing stringent thermal fatique tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/µs and reverse avalanche.

Figure 8. Schottky Rectifier

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
MOUNTING TORQUE: 25 in-lb max
SOLDER HEAT: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR6035
MBR6045, H, H1

MBR6045 is a
Motorola Preferred Device

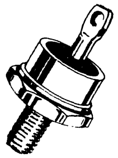
SWITCHMODE POWER RECTIFIERS

. . . using a platinum barrier metal 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.

- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 150°C Operating Junction Temperature
- Low Forward Voltage

SCHOTTKY RECTIFIERS

60 AMPERES
35 AND 45 VOLTS



CASE 257-01
DO-203AB
METAL

MAXIMUM RATINGS

Rating	Symbol	MBR6035 MBR6035B	MBR6045, H, H1* MBR6045B	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 100°C	I_{FRM}	← 120 →		Amps
Average Rectified Forward Current (Rated V_R) T_C = 100°C	I_O	← 60 →		Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 7	I_{RRM}	← 2.0 →		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	← 800 →		Amps
Operating Junction Temperature	T_J	← -65 to + 150 →		°C
Storage Temperature	T_{stg}	← -65 to +175 →		°C
Voltage Rate of Change (Rated V_R)	dv/dt	← 1000 →		V/μs

THERMAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.85	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 60 Amp, T_C = 25°C) (i_F = 60 Amp, T_C = 125°C) (i_F = 120 Amp, T_C = 125°C)	v_F	 0.65 0.57 0.70	 0.70 0.60 0.76	Volts
Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 125°C)	i_R	 0.1 55	 0.3 100	mA
Capacitance (V_R = 1.0 Vdc, 100 kHz ≤ 1.0 MHz)	C_t	3000	3700	pF

*H and H1 devices include extra testing.
(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%

FIGURE 1 — TYPICAL FORWARD VOLTAGE

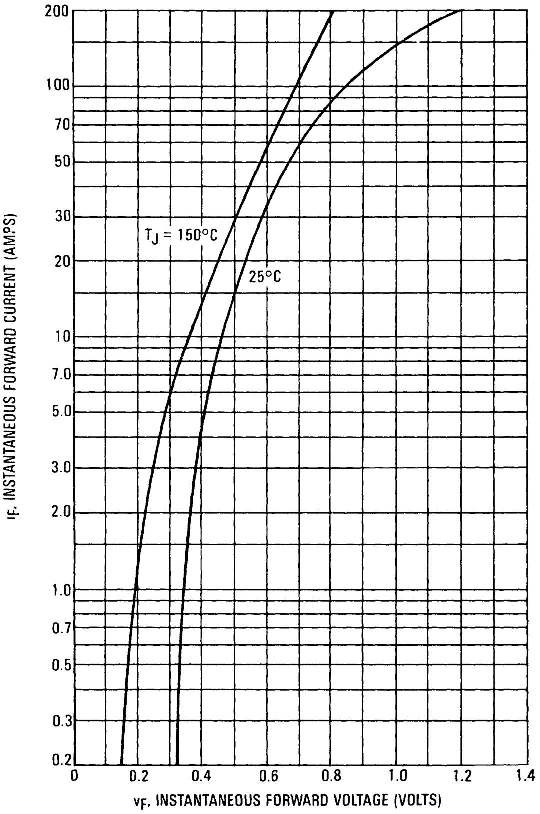


FIGURE 2 — TYPICAL REVERSE CURRENT

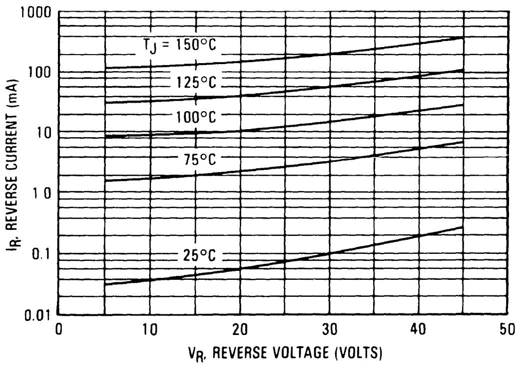
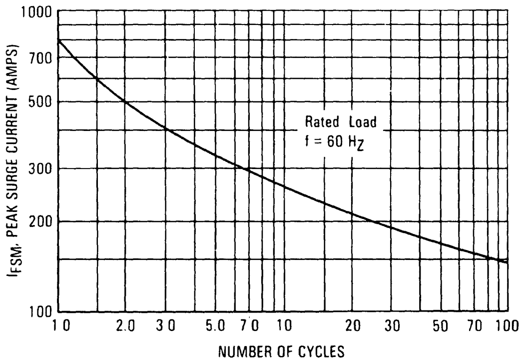


FIGURE 3 — MAXIMUM SURGE CAPABILITY



NOTE 1
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 4.)

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.

FIGURE 4 — CAPACITANCE

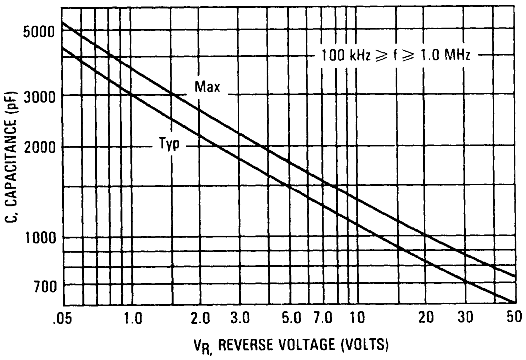


FIGURE 5 — FORWARD CURRENT DERATING

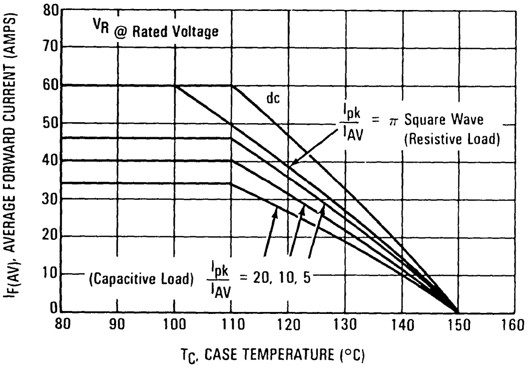


FIGURE 6 — POWER DISSIPATION

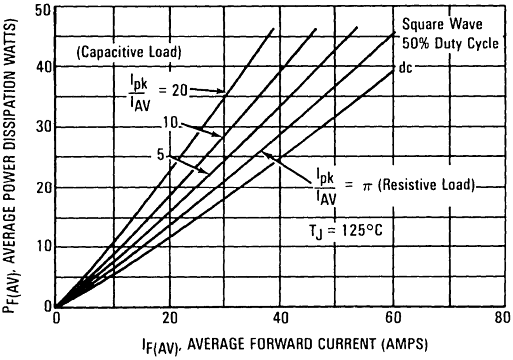
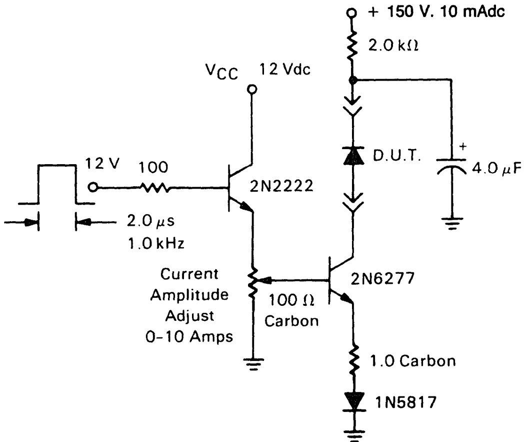
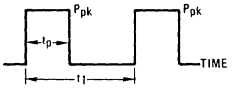


FIGURE 7 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT



NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the case should be measured using a thermocouple placed on the case. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by.

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature. It may be determined by:

$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$ where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 8, i.e.:

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.

FIGURE 8 — THERMAL RESPONSE

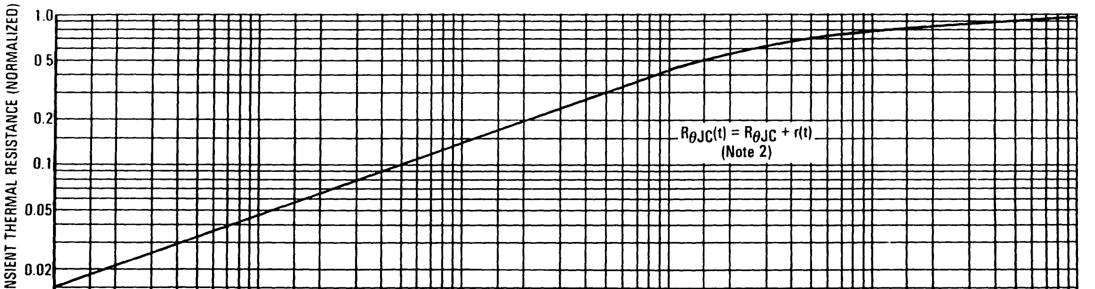
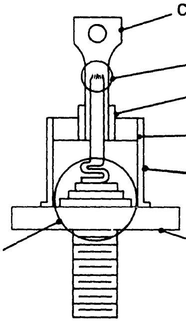
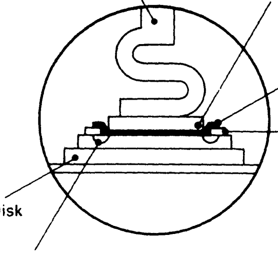


FIGURE 9 — SCHOTTKY RECTIFIER





Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead has a stress relief feature which protects the die during assembly. These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

HI-REL PROGRAM OPTIONS

The MBR6045 is also available with two levels of extra testing similar to "TX" screening and including Group A and B inspection programs. Both the MBR6045H and MBR6045H1 go through 100% screening consisting of high temperature storage, temperature cycling, constant acceleration and hermetic seal testing prior to a sample being submitted to Group A and B inspection. After completion of Group B inspection, the MBR6045H is available without additional screening. MBR6045H1 devices are further processed through a high temperature reverse bias (HTRB) and forward burn-in. Consult factory for details.

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

MOUNTING TORQUE: 25 in-lb max

SOLDER HEAT: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between eyelet and the body during any soldering operation.

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

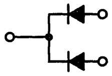
SWITCHMODE Power Rectifier

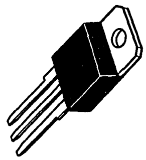
MBR6045PT

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (> 10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

SCHOTTKY BARRIER RECTIFIER
60 AMPERES
45 VOLTS





CASE 340D-01
TO-218 Atlas

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C Total Device	$I_{F(AV)}$	30 60	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	60	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	500	Amp
Peak Repetitive Reverse Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/µs

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 30 Amps, T_C = 25°C) (i_F = 30 Amps, T_C = 125°C) (i_F = 60 Amps, T_C = 25°C)	v_F	 0.62 0.55 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

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

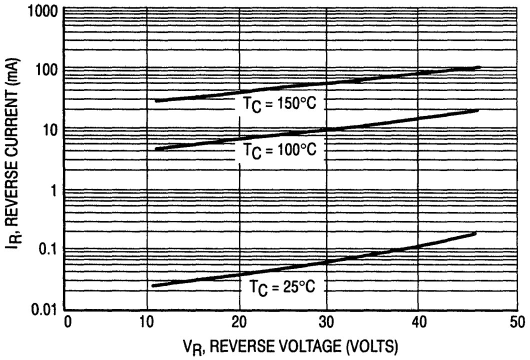


Figure 1. Typical Reverse Current

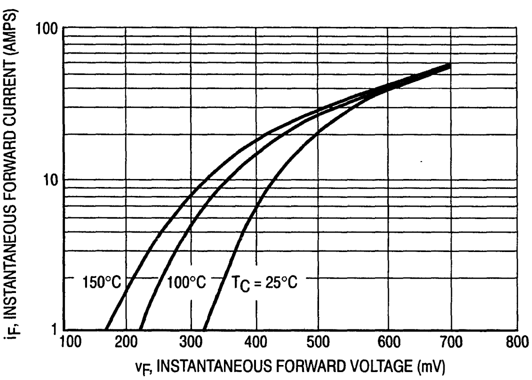


Figure 2. Typical Forward Voltage

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

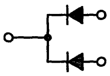
SWITCHMODE Power Rectifier

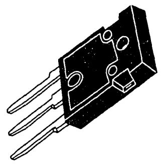
MBR6045WT

The SWITCHMODE power rectifier employs the use of the Schottky Barrier principle with a Platinum barrier metal. This state-of-the-art device has the following features:

- Dual Diode Construction — Terminals 1 and 3 may be connected for Parallel Operation at Full Rating
- 45 Volt Blocking Voltage
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (> 10 V/ns)
- Guaranteed Reverse Avalanche
- 150°C Operating Junction Temperature

SCHOTTKY BARRIER RECTIFIER 60 AMPERES 45 VOLTS





CASE 340F-03
TO-247

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volt
Average Rectified Forward Current (Rated V_R) @ T_C = 125°C — Total Device	$I_{F(AV)}$	30 60	Amp
Peak Repetitive Forward Current, Per Diode (Rated V_R, Square Wave, 20 kHz) @ T_C = 90°C	I_{FRM}	60	Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	500	Amp
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz)	I_{RRM}	2.0	Amp
Operating Junction Temperature	T_J	−65 to +150	°C
Storage Temperature	T_{stg}	−65 to +175	°C
Peak Surge Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175	°C
Voltage Rate of Change	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Instantaneous Forward Voltage (1) (i_F = 30 Amps, T_C = 25°C) (i_F = 30 Amps, T_C = 125°C) (i_F = 60 Amps, T_C = 25°C)	v_F	 0.62 0.55 0.75	Volts
Instantaneous Reverse Current (1) (Rated DC Voltage, T_C = 25°C) (Rated DC Voltage, T_C = 100°C)	i_R	 1.0 50	mA

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

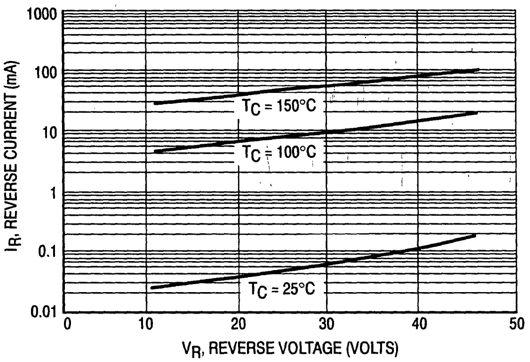


Figure 1. Typical Reverse Current

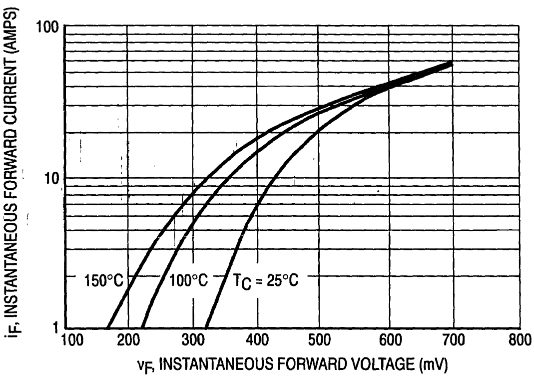


Figure 2. Typical Forward Voltage

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR6535
MBR6545

MBR6545 is a Motorola Preferred Device

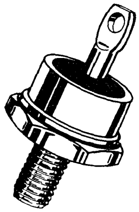
SWITCHMODE POWER RECTIFIERS

. . . using a platinum barrier metal 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.

- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 175°C Operating Junction Temperature
- Low Forward Voltage

HIGH TEMPERATURE SCHOTTKY RECTIFIERS

65 AMPERES
35 and 45 VOLTS



CASE 257-01
DO-203AB
METAL

3

MAXIMUM RATINGS

Rating	Symbol	MBR6535	MBR6545	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 120°C	I_{FRM}	130	130	Amps
Average Rectified Forward Current (Rated V_R) T_C = 120°C	I_O	65	65	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 7	I_{RRM}	2.0	2.0	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	800	800	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 65 Amp, T_C = 25°C) (i_F = 65 Amp, T_C = 150°C) (i_f = 130 Amp, T_C = 150°C)	v_F	 0.78 0.62 0.73	 0.78 0.62 0.73	Volts
Maximum Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 150°C)	i_R	 0.07 125	 0.07 125	mA
Capacitance (V_R = 1.0 Vdc, 100 kHz ≤ f ≤ 1.0 MHz)	C_t	3700	3700	pF

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

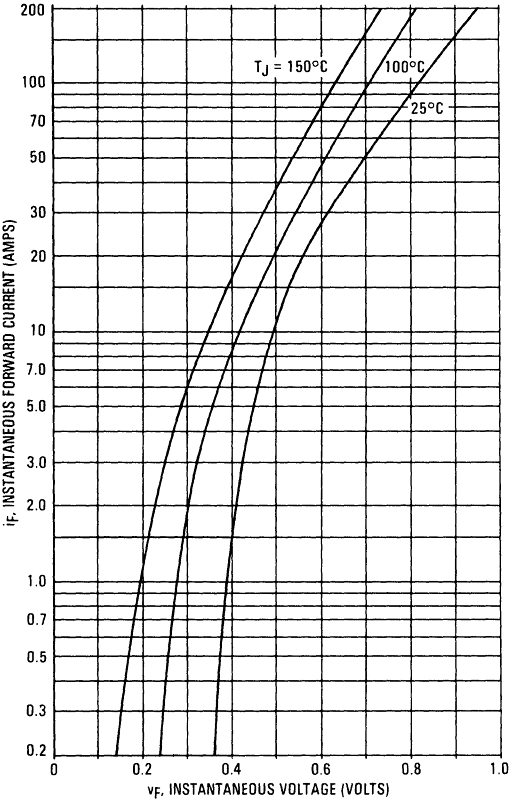


FIGURE 2 — TYPICAL REVERSE CURRENT

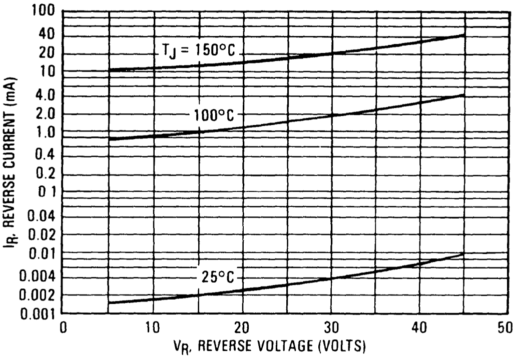


FIGURE 3 — MAXIMUM SURGE CAPABILITY

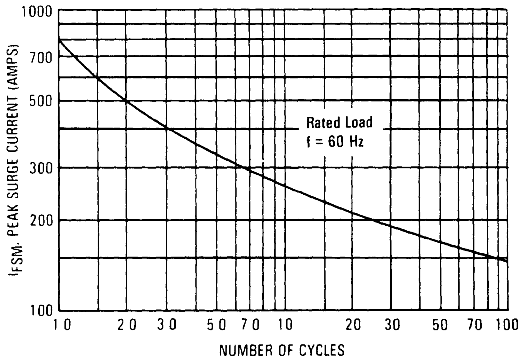
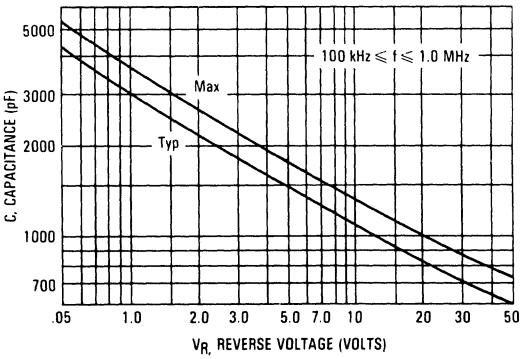


FIGURE 4 — CAPACITANCE



NOTE 1
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 4.)

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.

FIGURE 5 — FORWARD CURRENT DERATING

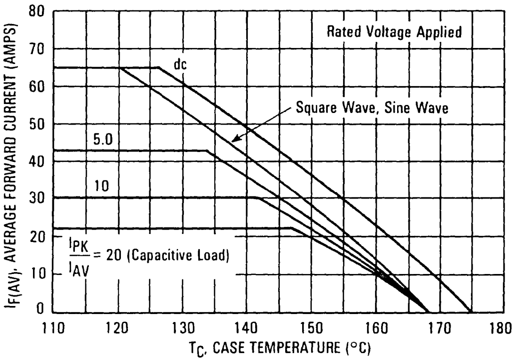
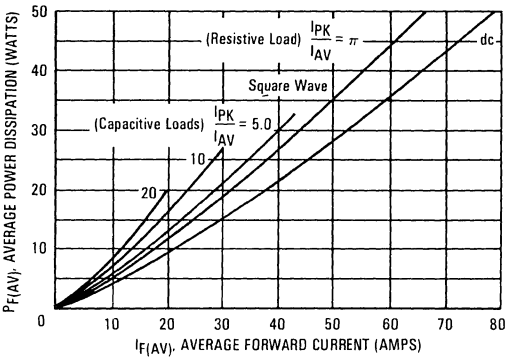
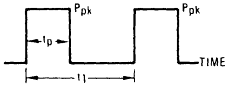


FIGURE 6 — POWER DISSIPATION



NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the case should be measured using a thermocouple placed on the case. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature. It may be determined by

$$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$ where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 8, i.e.

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

FIGURE 7 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT

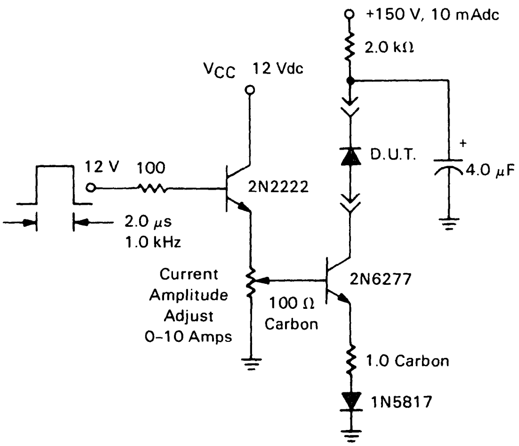


FIGURE 8 — THERMAL RESPONSE

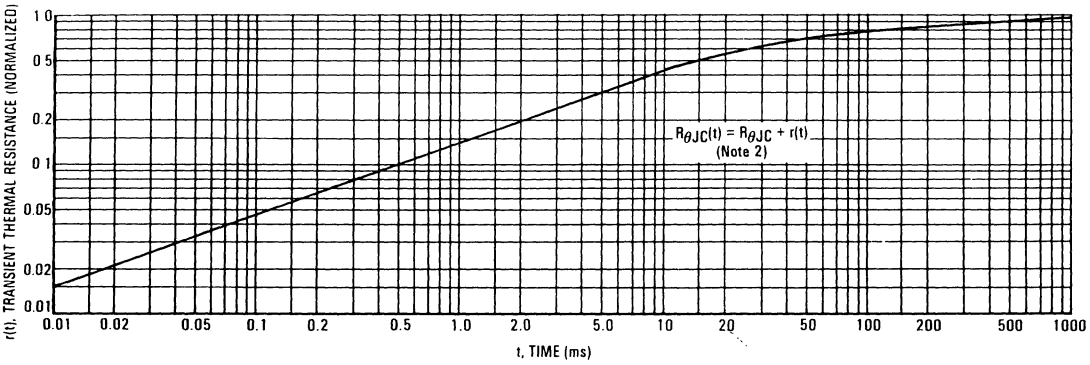
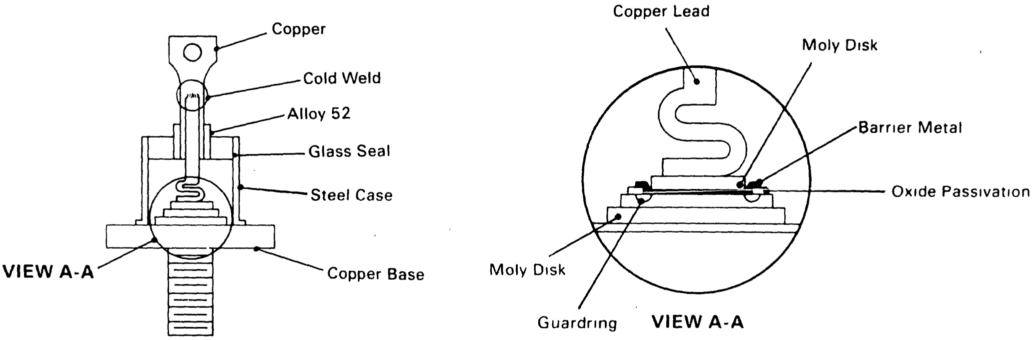


FIGURE 9 — SCHOTTKY RECTIFIER



Motorola builds quality and reliability into its Schottky Rectifiers.

First is the chip, which has an interface metal between the platinum-barrier metal and nickel-gold ohmic-contact metal to eliminate any possible interaction with the barrier. The indicated guardring prevents dv/dt problems, so snubbers are not mandatory. The guardring also operates like a zener to absorb overvoltage transients.

Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead has a stress relief feature which protects the die during assembly. These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

Third is the redundant electrical testing. The device is tested before assembly in "sandwich" form, with the chip between the moly disks. It is tested again after assembly. As part of the final electrical test, devices are 100% tested for dv/dt at 1,600 V/μs and reverse avalanche.

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
MOUNTING TORQUE: 25 in-lb max
SOLDER HEAT: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR7535
MBR7545

MBR7545 is a Motorola Preferred Device

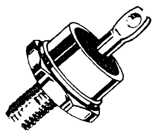
SWITCHMODE POWER RECTIFIERS

. . . 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

SCHOTTKY BARRIER RECTIFIERS

75 AMPERES
35 AND 45 VOLTS



CASE 257-01
DO-203AB
METAL

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion-resistant and terminal lead is readily solderable.
POLARITY: Cathode to Case
MOUNTING POSITIONS: Any
MOUNTING TORQUE: 25 in-lb max

3

MAXIMUM RATINGS

Rating	Symbol	MBR7535	MBR7545	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	150 $T_C = 90°C$		Amp
Average Rectified Forward Current (Rated V_R)	I_O	75 $T_C = 90°C$		Amp
Non-repetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	1000		Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +150		°C
Peak Operating Junction Temperature (Forward Current Applied)	$T_{J(pk)}$	175		°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000		V/µs

THERMAL CHARACTERISTICS

Rating	Symbol	MBR7535	MBR7545	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8		°C/W

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

Rating	Symbol	MBR7535	MBR7545	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 60 Amp, T_C = 125°C) (i_F = 220 Amp, T_C = 125°C)	v_F	 0.60 0.90		Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C)	i_R	150	250	mA
Capacitance (V_R = 5.0 Vdc, 100 kHz ≤ f ≤ 1.0 MHz)	C_t	4000		pF

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

FIGURE 1 – TYPICAL FORWARD VOLTAGE

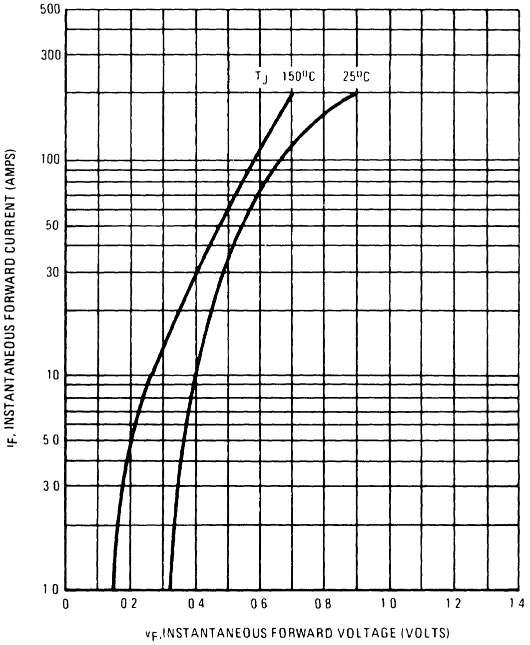


FIGURE 2 – CURRENT DERATING

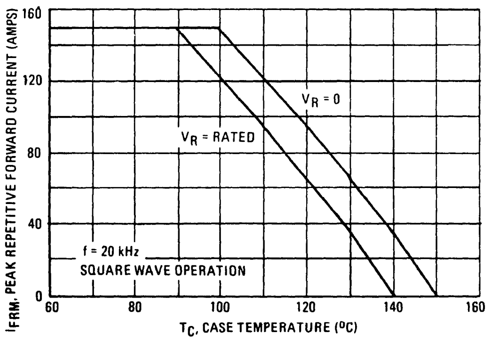
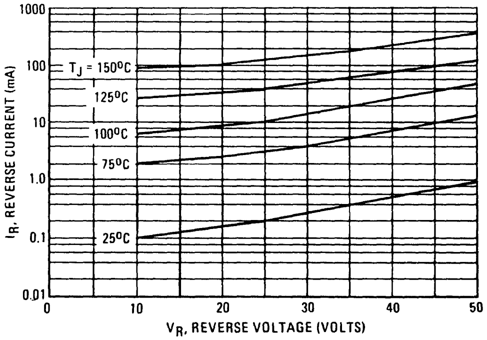


FIGURE 3 – TYPICAL REVERSE OPERATION



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR8035
MBR8045

MBR8045 is a Motorola Preferred Device

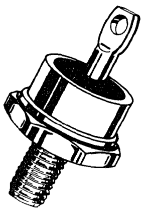
SWITCHMODE POWER RECTIFIERS

. . . using a platinum barrier metal 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.

- Guaranteed Reverse Avalanche
- Guardring for dv/dt Stress Protection
- 175°C Operating Junction Temperature
- Low Forward Voltage

SCHOTTKY RECTIFIERS

80 AMPERES
35 and 45 VOLTS



CASE 257-01
DO-203AB
METAL

3

MAXIMUM RATINGS

Rating	Symbol	MBR8035	MBR8045	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 120°C	I_{FRM}	160	160	Amps
Average Rectified Forward Current (Rated V_R) T_C = 120°C	I_O	80	80	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz) See Figure 7	I_{RRM}	2.0	2.0	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	1000	1000	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	-65 to +175	-65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	1000	V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.80	0.80	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 80 Amp, T_C = 25°C) (i_F = 80 Amp, T_C = 150°C) (i_F = 160 Amp, T_C = 150°C)	v_F	 0.72 0.59 0.67	 0.72 0.59 0.67	Volts
Maximum Instantaneous Reverse Current (1) (Rated Voltage, T_C = 25°C) (Rated Voltage, T_C = 150°C)	i_R	 1.0 150	 1.0 150	mA
Capacitance (V_R = 1.0 Vdc, 100 kHz ≤ f ≤ 1.0 MHz)	C_t	5000	5000	pF

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

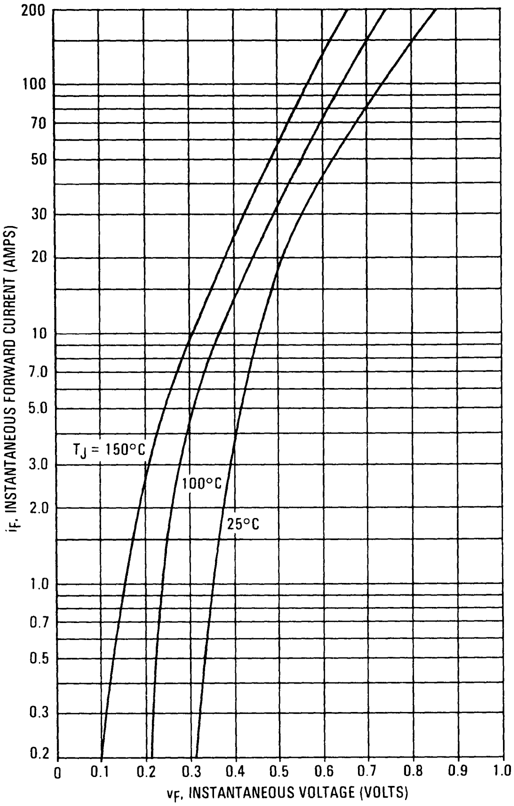


FIGURE 2 — TYPICAL REVERSE CURRENT

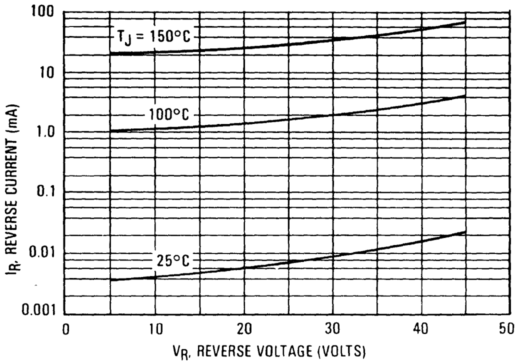
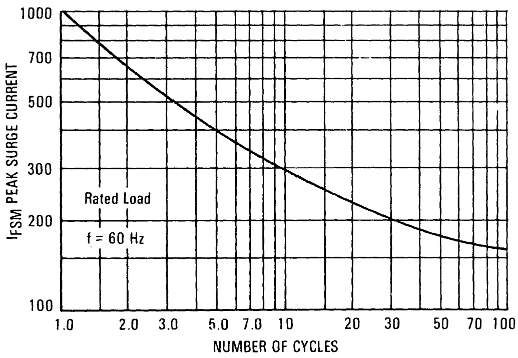


FIGURE 3 — MAXIMUM SURGE CAPABILITY



NOTE 1
HIGH FREQUENCY OPERATION

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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.

FIGURE 4 — CAPACITANCE

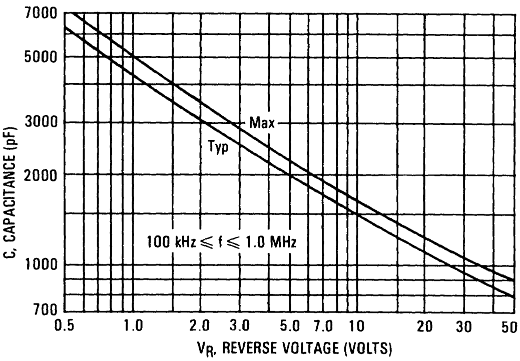


FIGURE 5 — FORWARD CURRENT DERATING

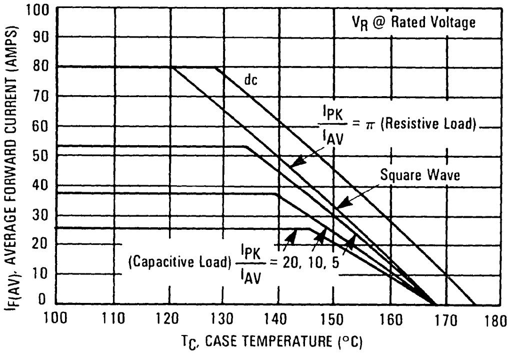
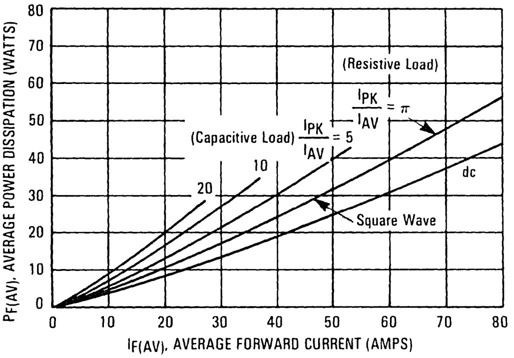
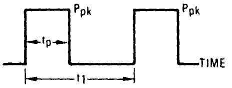


FIGURE 6 — POWER DISSIPATION



NOTE 2



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

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$$T_J = T_C + \Delta T_{JC}$$

where ΔT_C is the increase in junction temperature above the case temperature It may be determined by:

$\Delta T_{JC} = P_{pk} \cdot R_{\theta JC}[D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$ where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 8, i e

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

FIGURE 7 — TEST CIRCUIT FOR dv/dt AND REVERSE SURGE CURRENT

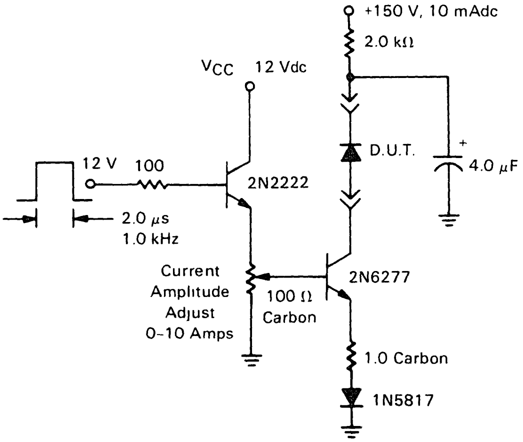

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FIGURE 8 — THERMAL RESPONSE

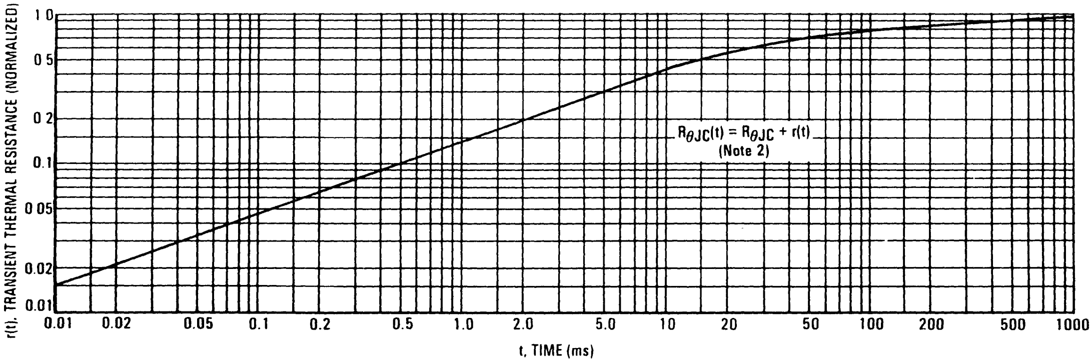
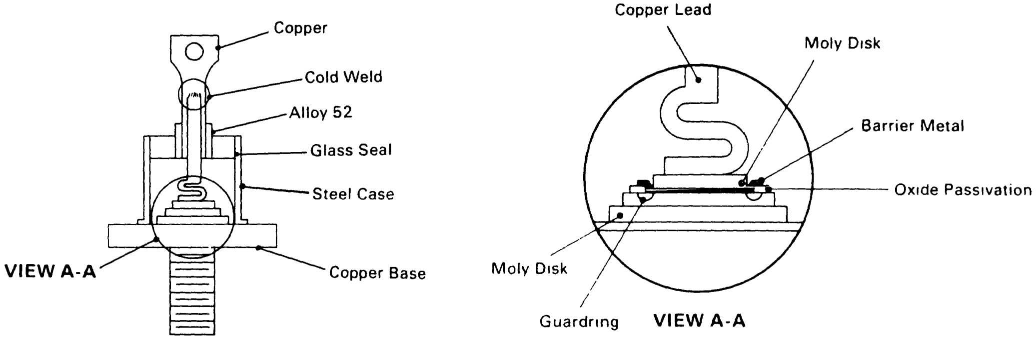


FIGURE 9 — SCHOTTKY RECTIFIER



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Second is the package. There are molybdenum disks which closely match the thermal coefficient of expansion of silicon on each side of the chip. The top copper lead has a stress relief feature which protects the die during assembly. These two features give the unit the capability of passing stringent thermal fatigue tests for 5,000 cycles. The top copper lead provides a low resistance to current and therefore does not contribute to device heating; a heat sink should be used when attaching wires.

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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

MOUNTING TORQUE: 25 in-lb max

SOLDER HEAT: The excellent heat transfer property of the heavy duty copper anode terminal which transmits heat away from the die requires that caution be used when attaching wires. Motorola suggests a heat sink be clamped between the eyelet and the body during any soldering operation.

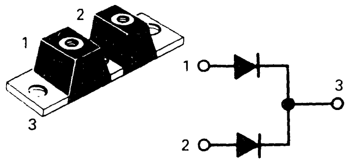
MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR12035CT
MBR12045CT
MBR12050CT
MBR12060CT

MBR12045CT and MBR12060CT are Motorola Preferred Devices

SCHOTTKY BARRIER RECTIFIERS

120 AMPERES
35 to 60 VOLTS



CASE 357C-03
POWERTAP

Terminal Penetration:	0.280 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:*	30–40 in-lb max
*Center Hole Must be Torqued First:	8–10 in-lb max

SWITCHMODE POWER RECTIFIERS

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — May Be Paralleled For Higher Current Output
- Guardring For Stress Protection
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR12035CT MBR12045CT MBR12050CT MBR12060CT	V_{RRM} V_{RWM} V_R	35 45 50 60	Volts
Average Rectified Forward Current (Rated V_R) T_C = 140°C	Per Device Per Leg	$I_{F(AV)}$	120 60	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 140°C		I_{FRM}	120	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	800	Amps
Peak Repetitive Reverse Current, Per Leg (2.0 μs, 1.0 kHz) See Figure 6		I_{RRM}	2.0	Amps
Operating Junction and Storage Temperature		T_J, T_{stg}	−65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	V/μs

THERMAL CHARACTERISTICS PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.85	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 60 Amp, T_J = 125°C) (i_F = 120 Amp, T_J = 175°C) (i_F = 120 Amp, T_J = 125°C) (i_F = 120 Amp, T_J = 25°C)	v_F	 0.590 0.620 0.680 0.830	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 25 0.25	mA

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

3

3

FIGURE 1 — TYPICAL FORWARD VOLTAGE PER LEG

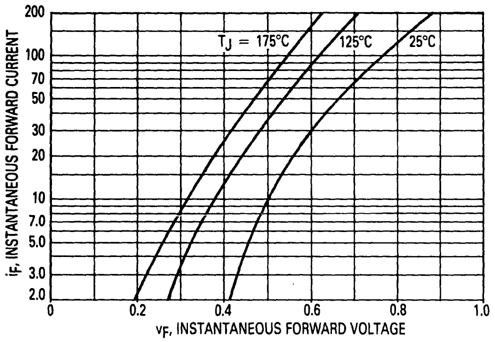


FIGURE 2 — TYPICAL REVERSE CURRENT, PER LEG*

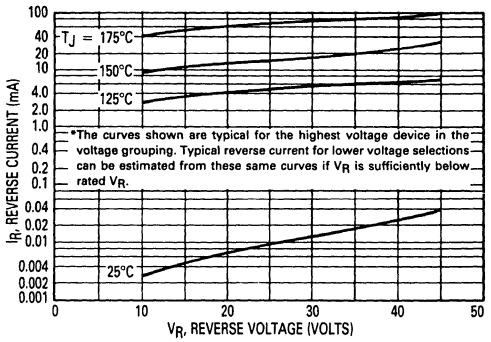


FIGURE 3 — FORWARD CURRENT DERATING, PER LEG

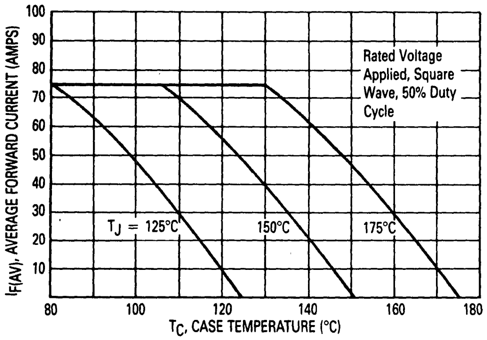


FIGURE 4 — POWER DISSIPATION PER LEG

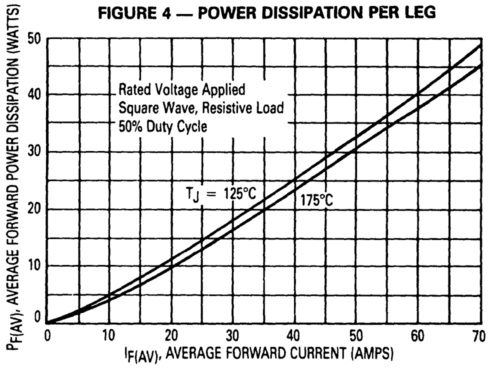


FIGURE 5 — TYPICAL CAPACITANCE, PER LEG

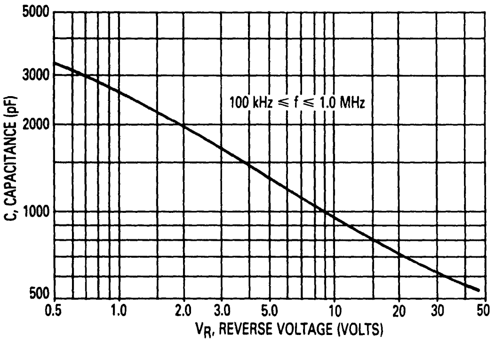
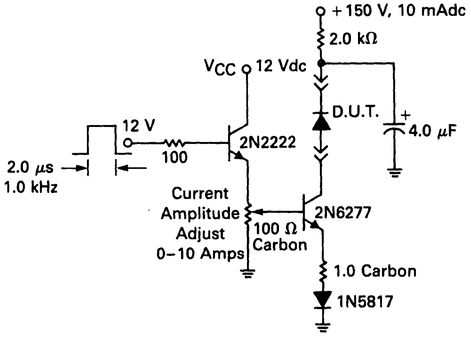


FIGURE 6 — TEST CIRCUIT FOR REPETITIVE REVERSE CURRENT



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

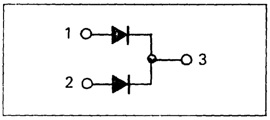
MBR20015CTL
MBR20020CTL
MBR20025CTL
MBR20030CTL

MBR20030CTL is a
Motorola Preferred Device

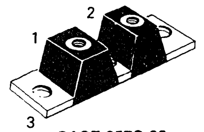
POWERTAP
SWITCHMODE Power Rectifiers

. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — May Be Paralleled For Higher Current Output
- Guardring For Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Guaranteed Reverse Avalanche



LOW V_F
SCHOTTKY BARRIER
RECTIFIERS
200 AMPERES
15 to 30 VOLTS



CASE 357C-03
POWERTAP

3

Terminal Penetration:	0.280 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:*	30–40 in-lb max
*Center Hole Must be Torqued First:	8–10 in-lb max

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR20015CTL MBR20020CTL MBR20025CTL MBR20030CTL	V_{RRM} V_{RWM} V_R	15 20 25 30	Volts
Average Rectified Forward Current (Rated V_R) T_C = 140°C	Per Device Per Leg	$I_{F(AV)}$	200 100	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C 140 C		I_{FRM}	200	Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	1500	Amps
Peak Repetitive Reverse Current, Per Leg (2 μs, 1.0 kHz) See Figure 6		I_{RRM}	2	Amps
Storage Temperature		T_{stg}	65 to +175	°C
Operating Junction and Storage Temperature		T_J, T_{stg}	65 to +150	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	V/μs

THERMAL CHARACTERISTICS PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.4	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 100 Amp, T_J = 150°C) (i_F = 200 Amp, T_J = 150°C) (i_F = 100 Amp, T_J = 25°C) (i_F = 200 Amp, T_J = 25°C)	v_F	 0.39 0.48 0.46 0.55	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 100°C) (Rated dc Voltage, T_J = 25°C)	i_R	 500 5	mA

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

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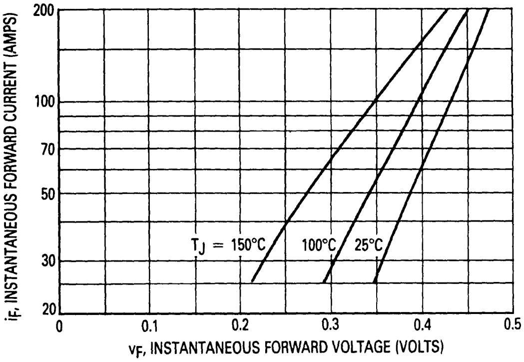
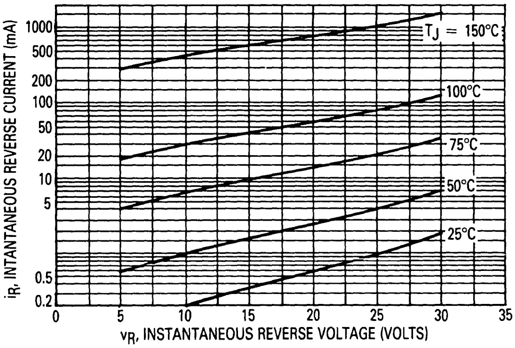


Figure 1. Typical Forward Voltage



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 2. Typical Instantaneous Reverse Current, Per Leg*

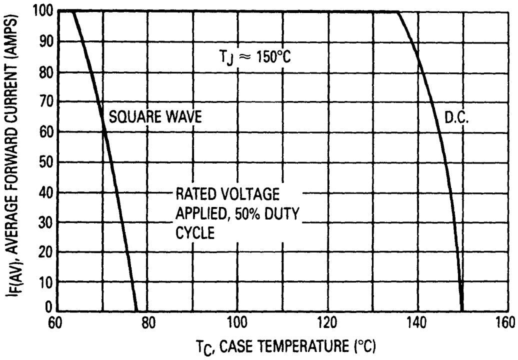


Figure 3. Forward Current Derating, Per Leg

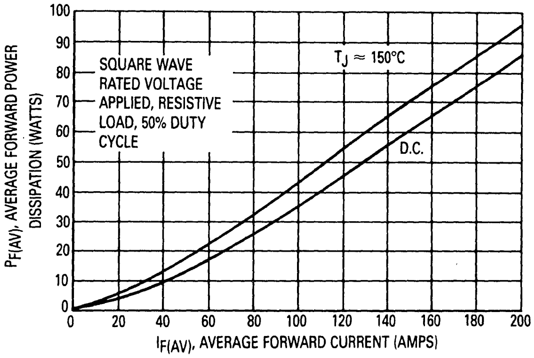


Figure 4. Power Dissipation Per Leg

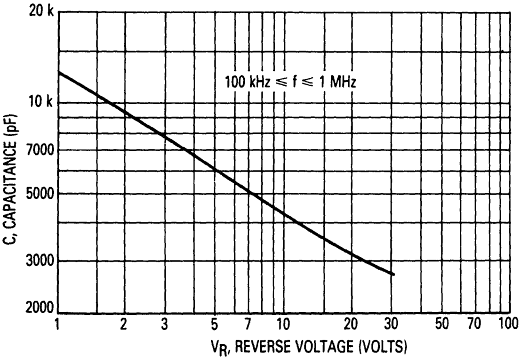


Figure 5. Typical Capacitance, Per Leg

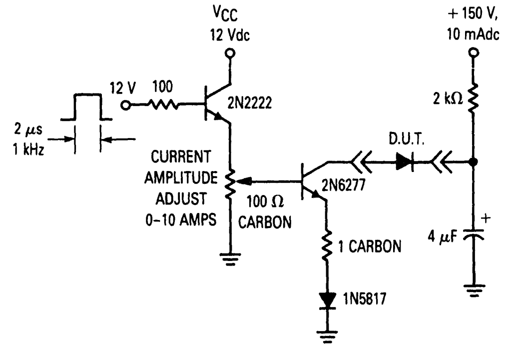


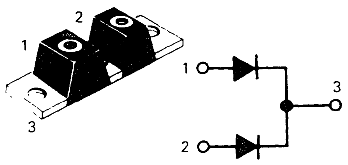
Figure 6. Test Circuit For Repetitive Reverse Current

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBR20035CT
MBR20045CT
MBR20050CT
MBR20060CT

SCHOTTKY BARRIER RECTIFIERS

200 AMPERES
35 to 60 VOLTS



CASE 357C-03
POWERTAP

Terminal Penetration:	0.280 mx
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:*	30–40 in-lb max
*Center Hole Must be Torqued First:	8–10 in-lb max

3

SWITCHMODE POWER RECTIFIERS

... using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — May Be Paralleled For Higher Current Output
- Guardring For Stress Protection
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR20035CT MBR20045CT MBR20050CT MBR20060CT	V_{RRM} V_{RWM} V_R	35 45 50 60	Volts
Average Rectified Forward Current (Rated V_R) T_C = 140°C	Per Device Per Leg	$I_{F(AV)}$	200 100	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 140°C		I_{FRM}	200	Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	1500	Amps
Peak Repetitive Reverse Current, Per Leg (2.0 μs, 1.0 kHz) See Figure 6		I_{RRM}	2.0	Amps
Operating Junction and Storage Temperature		T_J, T_{stg}	−65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	V/μs

THERMAL CHARACTERISTICS PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.5	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 200 Amp, T_J = 175°C) (i_F = 200 Amp, T_J = 125°C) (i_F = 100 Amp, T_J = 125°C) (i_F = 100 Amp, T_J = 25°C)	v_F	 0.650 0.825 0.710 0.800	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 50 0.5	mA

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE, PER LEG

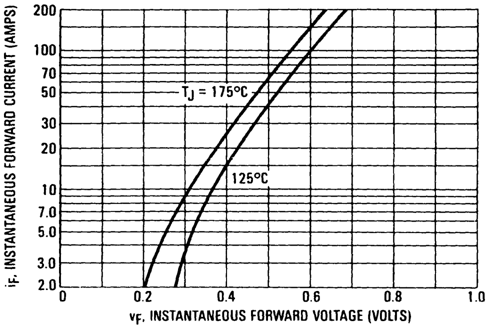


FIGURE 2 — TYPICAL REVERSE CURRENT, PER LEG

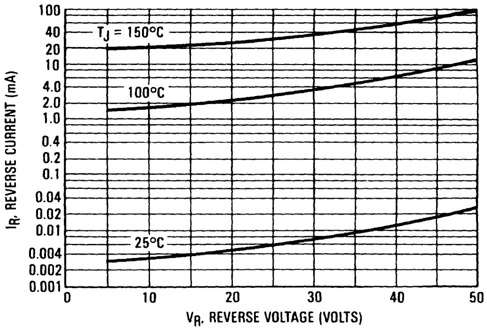


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FIGURE 3 — FORWARD CURRENT DERATING, PER LEG

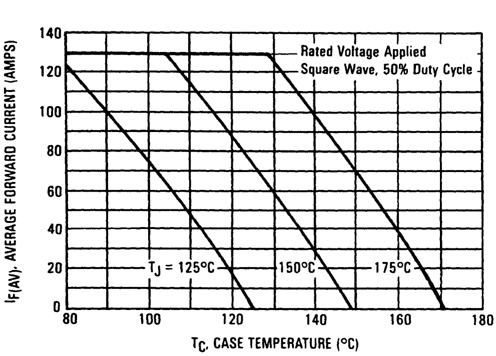


FIGURE 4 — POWER DISSIPATION, PER LEG

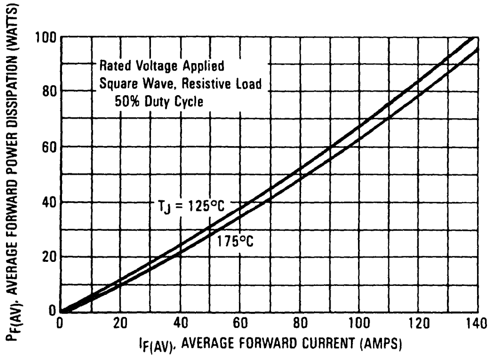


FIGURE 5 — CAPACITANCE, PER LEG

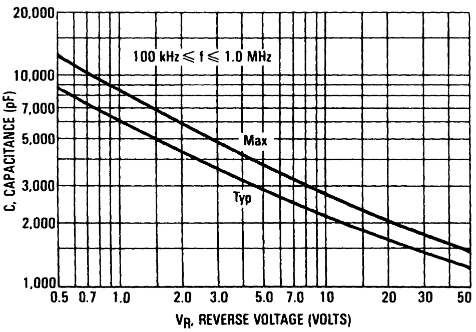
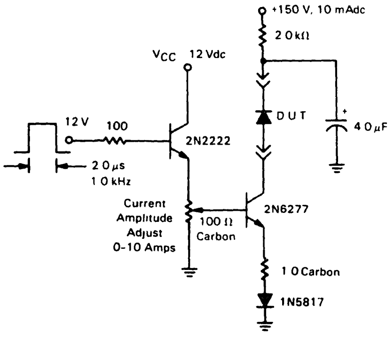


FIGURE 6 — TEST CIRCUIT FOR REPETITIVE REVERSE CURRENT



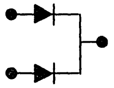
MEGAHERTZ™ Series SWITCHMODE™ Power
Dual Schottky Rectifier

MBR20200CT

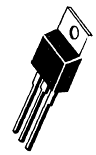
Motorola Preferred Device

. . . using Schottky Barrier technology with a platinum barrier metal. This state-of-the-art device is designed for use in high frequency switching power supplies and converters with up to 48 volt outputs. They block up to 200 volts and offer improved Schottky performance at frequencies from 250 kHz to 5.0 MHz.

- **200 Volt Blocking Voltage**
- Low Forward Voltage Drop
- Guardring for Stress Protection and High dv/dt Capability (10,000 V/μs)
- Dual Diode Construction — Terminals 1 and 3 Must be Connected for Parallel Operation at Full Rating



**SCHOTTKY BARRIER RECTIFIER
20 AMPERES
200 VOLTS**



CASE 221A-06
(TO-220)

3

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C — Per Leg Per Package	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 90°C	I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	1.0	Amp
Operating Junction Temperature	T_J	–65 to +150	°C
Storage Temperature	T_{stg}	–65 to +175	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/μs

THERMAL CHARACTERISTICS (PER LEG)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS (PER LEG)

Maximum Instantaneous Forward Voltage (1) (I_F = 10 Amps, T_C = 25°C) (I_F = 10 Amps, T_C = 125°C) (I_F = 20 Amps, T_C = 25°C) (I_F = 20 Amps, T_C = 125°C)	V_F	0.9 0.8 1.0 0.9	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	I_R	1.0 50	mA

DYNAMIC CHARACTERISTICS (PER LEG)

Capacitance (V_R = –5.0 V, T_C = 25°C, Frequency = 1.0 MHz)	C_T	500	pF

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

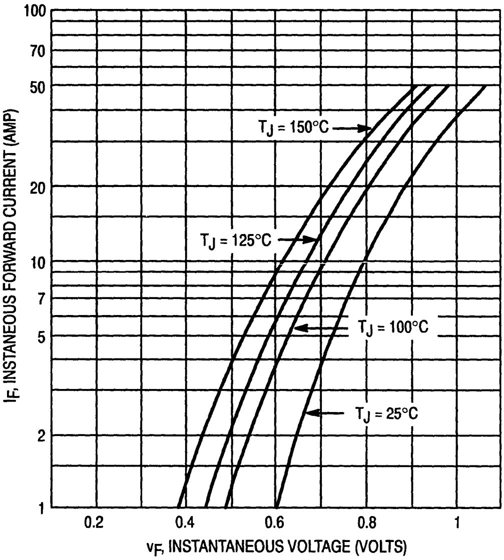


Figure 1. Typical Forward Voltage (Per Leg)

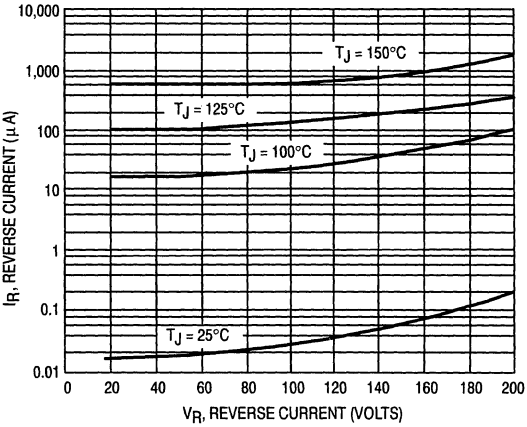


Figure 2. Typical Reverse Current (Per Leg)

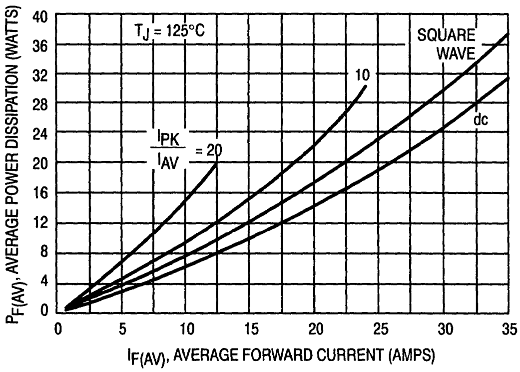


Figure 3. Forward Power Dissipation

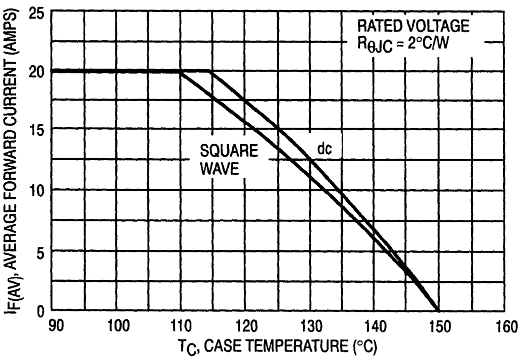


Figure 4. Current Derating, Case

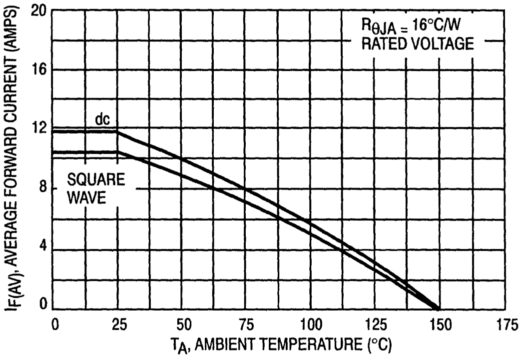


Figure 5. Current Derating, Ambient

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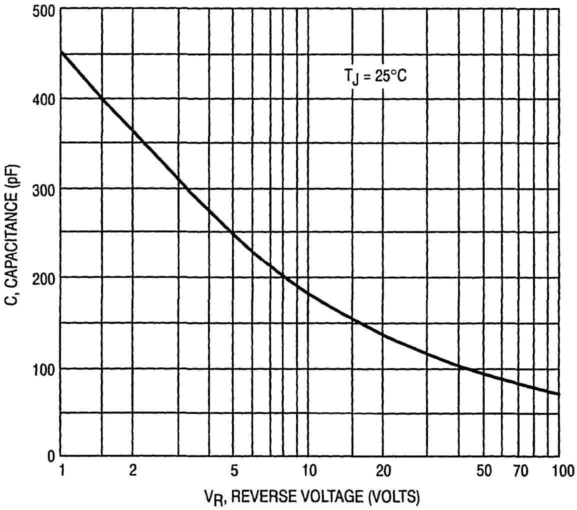


Figure 6. Typical Capacitance (Per Leg)

MBR30035CT
MBR30045CT
MBR30050CT
MBR30060CT

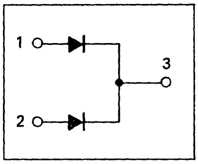
MBR30045CT and MBR30060CT are Motorola Preferred Devices

POWERTAP
SWITCHMODE Power Rectifiers

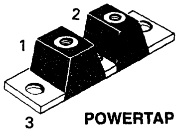
. . . using the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Dual Diode Construction — May Be Paralleled For Higher Current Output
- Guardring For Stress Protection
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Guaranteed Reverse Avalanche

SCHOTTKY BARRIER RECTIFIERS
300 AMPERES
35 TO 60 VOLTS



Terminal Penetration:	0.280 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:*	30–40 in-lb max
*Center Hole Must be Torqued First:	8–10 in-lb max



POWERTAP
CASE 357C-03

3

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MBR30035CT MBR30045CT MBR30050CT MBR30060CT	V_{RRM} V_{RWM} V_R	35 45 50 60	Volts
Average Rectified Forward Current (Rated V_R) $T_C = 140°C$	Per Device Per Leg	$I_{F(AV)}$	300 150	Amps
Peak Repetitive Forward Current, Peg Leg (Rated V_R, Square Wave, 20 kHz), $T_C = 140°C$		I_{FRM}	300	Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	2500	Amps
Peak Repetitive Reverse Current, Per Leg (2 µs, 1 kHz) See Figure 6		I_{RRM}	2	Amps
Operating Junction and Storage Temperature		T_J, T_{stg}	−65 to +175	°C
Voltage Rate of Change (Rated V_R)		dv/dt	1000	V/µs

THERMAL CHARACTERISTICS PER LEG

Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.4	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 150 Amps, T_C = 175°C) (i_F = 150 Amps, T_C = 125°C) (i_F = 150 Amps, T_C = 25°C) (i_F = 300 Amps, T_C = 125°C) (i_F = 300 Amps, T_C = 25°C)	v_F	 0.57 0.64 0.74 0.78 0.82	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 75 0.8	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

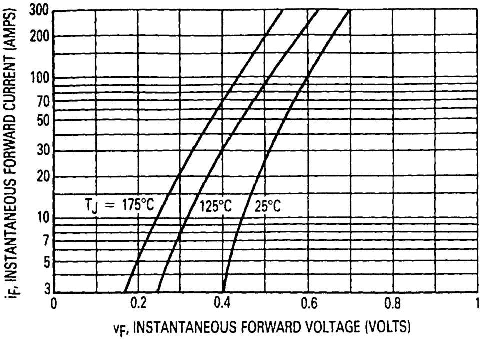


Figure 1. Typical Forward Voltage (Per Leg)

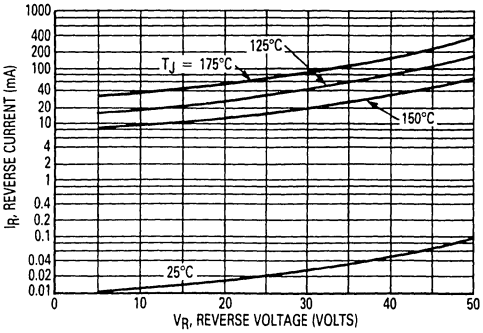


Figure 2. Typical Reverse Current (Per Leg)*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

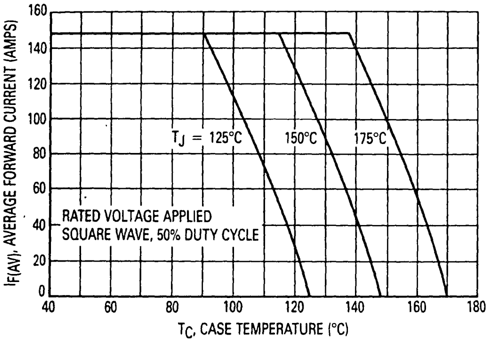


Figure 3. Current Derating (Per Leg)

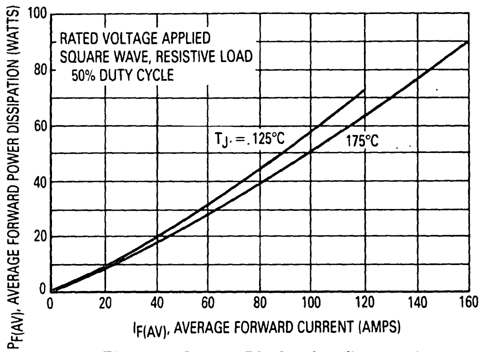


Figure 4. Power Dissipation (Per Leg)

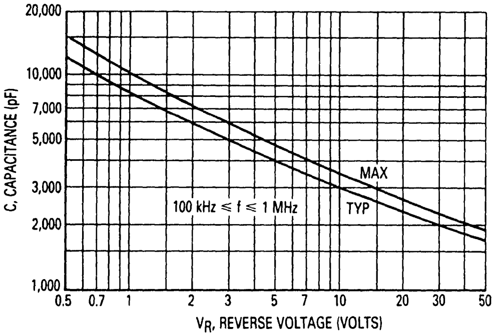


Figure 5. Capacitance (Per Leg)

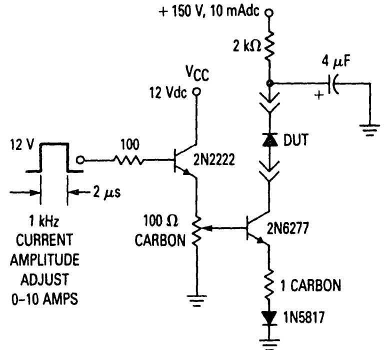


Figure 6. Test Circuit For Repetitive Reverse Current

Product Preview

POWERTAP™ Package
SWITCHMODE™ Power Rectifier

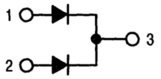
MBR60035CTL

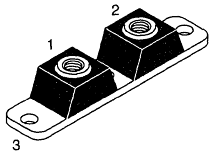
Motorola Preferred Device

**LOW V_F
SCHOTTKY BARRIER
RECTIFIER
600 AMPERES
35 VOLTS**

Employs the use of Schottky Barrier technology with a platinum barrier metal. These state-of-the-art devices offer the following features:

- Dual Diode Construction — May be Paralleled for Higher Current Output
- Guardring for Stress Protection
- Low Forward Voltage Drop
- Guaranteed Reverse Avalanche Energy Capability
- 150°C Operating Junction Temperature
- Improved Mechanical Ratings





**CASE 357C-03
POWERTAP**

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage	V_{RRM} V_{RWM}	40	Volts
DC Blocking Voltage (T_C = 100°C)	V_R	35	Volts
Average Rectified Forward Current (Rated V_R) T_C = 100°C — Per Device Per Leg	$I_{F(AV)}$	600 300	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	4000	Amps
Peak Repetitive Reverse Current (2.0 μs, 1.0 kHz) See Figure 6	I_{RRM}	2.0	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	– 55 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000	V/μs
Controlled Avalanche Energy (Maximum)	W_{AVAL}	40	mJ

THERMAL CHARACTERISTICS (PER LEG)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	0.4	°C/W

ELECTRICAL CHARACTERISTICS (PER LEG)

Maximum Instantaneous Forward Voltage (1) (i_F = 300 Amps, T_C = 25°C) (i_F = 300 Amps, T_C = 100°C)	v_F	 0.57 0.50	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 100°C)	i_R	 10 250	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

POWERTAP and SWITCHMODE are trademarks of Motorola, Inc.
This document contains information on a product under development. Motorola reserves the right to change or discontinue this product without notice.

Preferred devices are Motorola recommended choices for future use and best overall value.

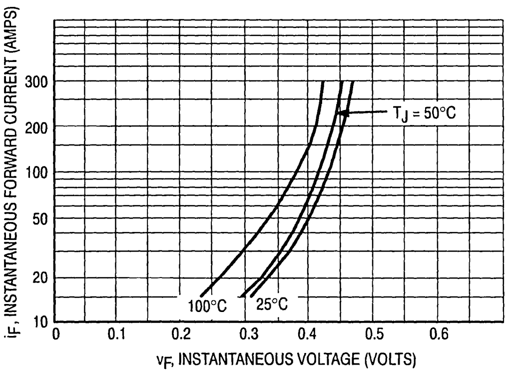


Figure 1. Typical Forward Voltage (PER LEG)

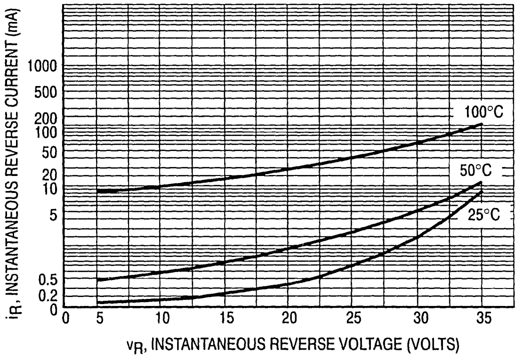


Figure 2. Typical Instantaneous Reverse Current (PER LEG)

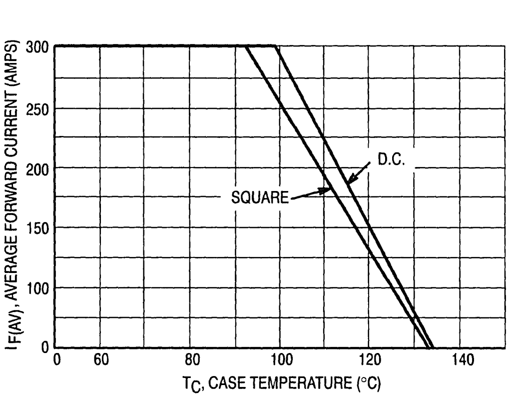


Figure 3. Forward Current Derating (PER LEG)

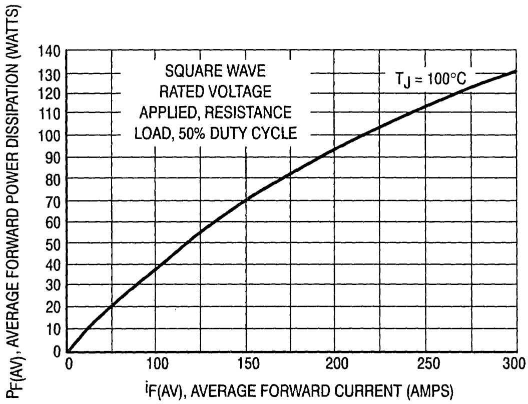


Figure 4. Power Dissipation (PER LEG)

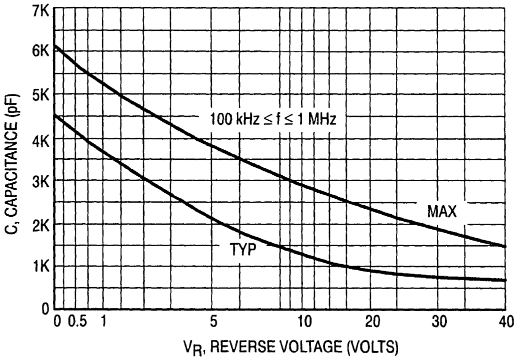


Figure 5. Typical Capacitance (PER LEG)

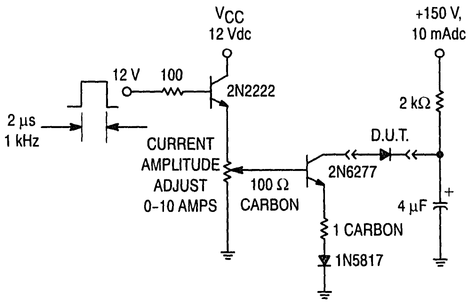


Figure 6. Test Circuit for Repetitive Reverse Current

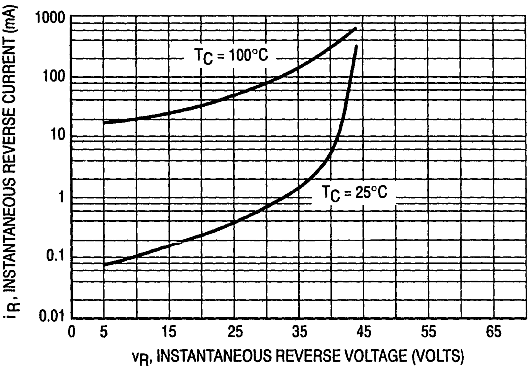


Figure 7. Typical Instantaneous Reverse Avalanche Current

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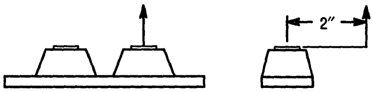
MAXIMUM MECHANICAL RATINGS

Terminal Penetration:	0.235 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:	30–40 in-lb max
Mounting Torque — Center Hole:	8–10 in-lb max
Seating Plane Flatness	1 mil per in. (between mounting holes)

POWERTAP MECHANICAL DATA APPLIES OVER OPERATING TEMPERATURE



Vertical Pull 250 lbs max

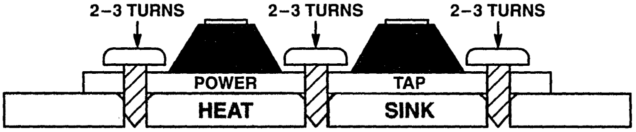
2 in. Lever Pull 50 lbs max

Note: While the POWERTAP is capable of sustaining these vertical and levered tensions, the intimate contact between POWERTAP and heat sink may be lost. This could lead to thermal runaway. The use of very flexible leads is recommended for the anode connections. Use of thermal grease is highly recommended.

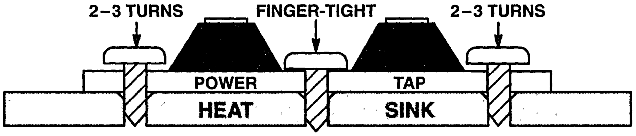
MOUNTING PROCEDURE

The POWERTAP package requires special mounting considerations because of the long longitudinal axis of the copper heat sink. It is important to follow the proper tightening sequence to avoid warping the heat sink, which can reduce thermal contact between the POWERTAP and heat sink.

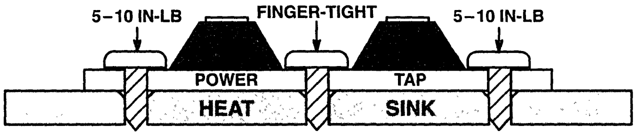
STEP 1:
Locate the POWERTAP on the heat sink and start mounting bolts into the threads by hand (2 or 3 turns).



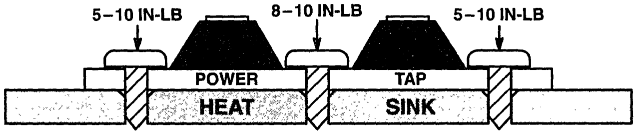
STEP 2:
Finger tighten the center bolt. The bolt may catch on the threads of the heat sink so it is important to make sure the face of the bolt or washer is in contact with the surface of the POWERTAP.



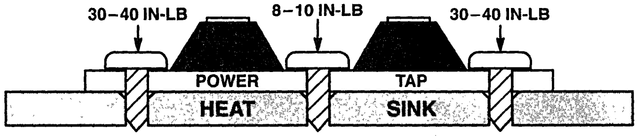
STEP 3:
Tighten each of the end bolts between 5 to 10 in-lb.



STEP 4:
Tighten the center bolt between 8 to 10 in-lb.



STEP 5:
Finally, tighten the end bolts between 30 to 40 in-lb.



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Designer's™ Data Sheet

SWITCHMODE™ Power Rectifier
D2PAK Surface Mount Power Package

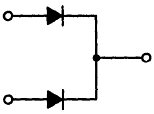
MBRB1545CT

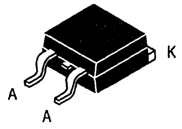
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER 15 AMPERES 45 VOLTS

The D2PAK Power Rectifier employs the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO-220 Package
- Available in Tape and Reel. Add a T4 Suffix to Part Number to order the 24 mm, 13 inch/800 Unit Reel.





CASE 418B-01
D2PAK

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 105°C Total Device	$I_{F(AV)}$	7.5 15	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 105°C	I_{FRM}	15	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Storage Temperature	T_{stg}	−65 to +175	°C
Operating Junction Temperature	T_J	−65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/µs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Maximum Instantaneous Forward Voltage (2) (i_F = 7.5 Amps, T_J = 125°C) (i_F = 15 Amps, T_J = 125°C) (i_F = 15 Amps, T_J = 25°C)	v_F	 0.57 0.72 0.84	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 15 0.1	mA

(1) When mounted using minimum recommended pad size on FR-4 board.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design

Preferred devices are Motorola recommended choices for future use and best overall value.

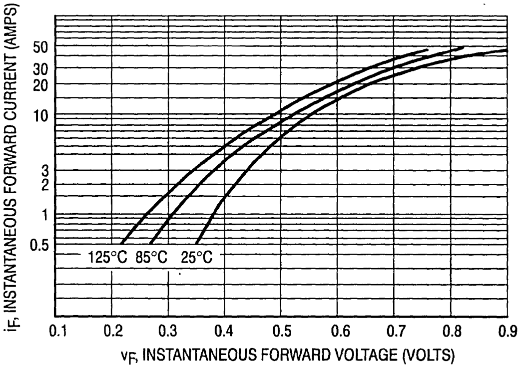


Figure 1. Typical Forward Voltage, Per Leg

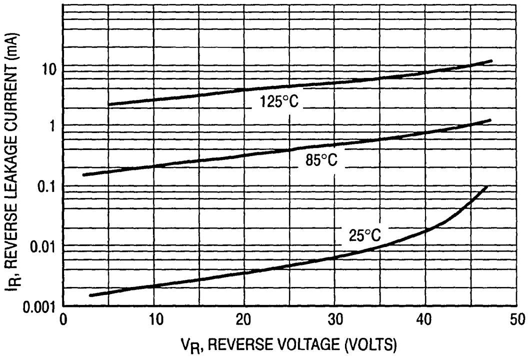


Figure 2. Typical Reverse Current, Per Leg

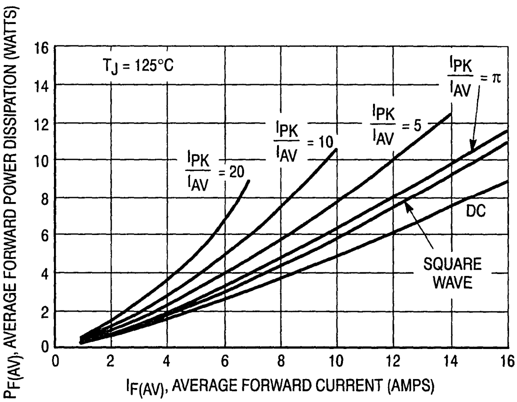


Figure 3. Typical Forward Power Dissipation

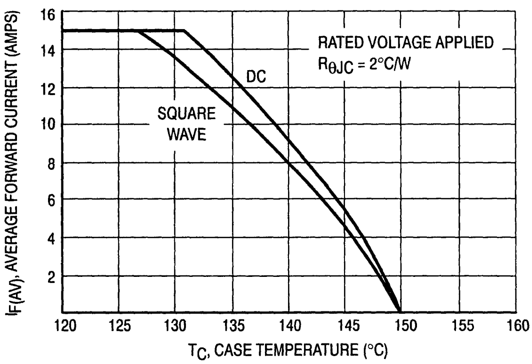


Figure 4. Current Derating, Case

3

Designer's™ Data Sheet
SWITCHMODE™ Power Rectifier
D2PAK Surface Mount Power Package

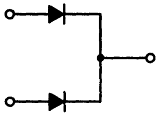
MBRB2060CT

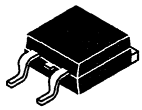
Motorola Preferred Device

**SCHOTTKY BARRIER RECTIFIER
20 AMPERES
60 VOLTS**

Employs the use of the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, V_O at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to Industry Standard TO-220 Package





CASE 418B-01

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MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	60	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C Total Device	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	20	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	0.5	Amp
Storage Temperature	T_{stg}	−65 to +175	°C
Operating Junction Temperature	T_J	−65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/µs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance — Junction to Case — Junction to Ambient (2)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Maximum Instantaneous Forward Voltage (1) (i_F = 20 Amps, T_J = 125°C) (i_F = 20 Amps, T_J = 25°C)	v_F	 0.85 0.95	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 150 0.15	mA

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%
(2) See Page 3 for mounting conditions

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

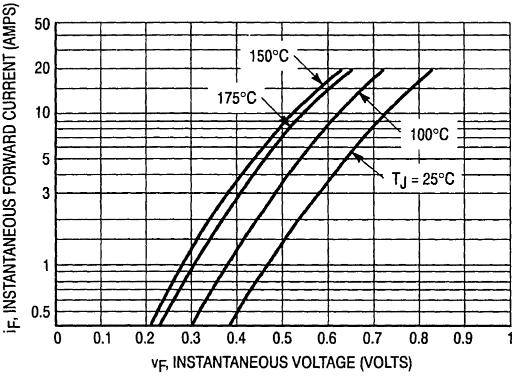


Figure 1. Typical Forward Voltage Per Diode

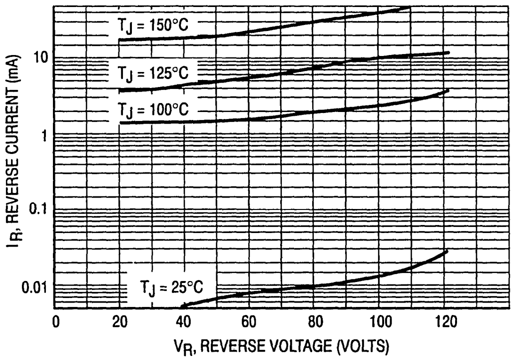


Figure 2. Typical Reverse Current Per Diode

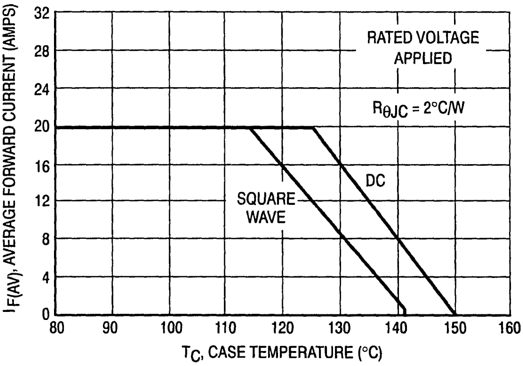


Figure 3. Typical Current Derating, Case, Per Leg

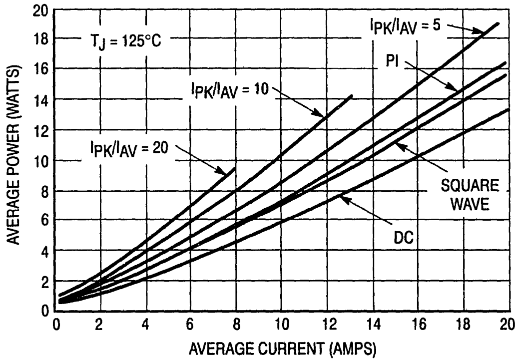


Figure 4. Average Power Dissipation and Average Current

3

MBRB2515L

Motorola Preferred Device

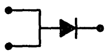
Designer's™ Data Sheet

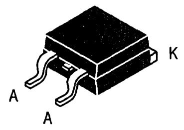
SWITCHMODE™ Power Rectifier
OR'ing Function Diode
D2PAK Surface Mount Power Package

SCHOTTKY BARRIER RECTIFIER
25 AMPERES
15 VOLTS

The D2PAK Power Rectifier employs the Schottky Barrier principle in a large metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use in low voltage, high frequency switching power supplies, free wheeling diodes, and polarity protection diodes. These state-of-the-art devices have the following features:

- Guardring for Stress Protection
- Low Forward Voltage
- 100°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO-220 Package
- Available in Tape and Reel. Add a T4 Suffix to Part Number to order the 24 mm, 13 inch/800 Unit Reel.





CASE 418B-01
D2PAK

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	15	Volts
Average Rectified Forward Current (Rated V_R) T_C = 90°C	$I_{F(AV)}$	25	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Storage Temperature	T_{stg}	−65 to +150	°C
Operating Junction Temperature	T_J	100	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/μs

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	1.0 50	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2) (i_F = 19 Amps, T_J = 70°C) (i_F = 25 Amps, T_J = 70°C) (i_F = 25 Amps, T_J = 25°C)	v_F	 0.28 0.42 0.45	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_J = 70°C) (Rated dc Voltage, T_J = 25°C)	i_R	 200 15	mA

(1) When mounted using minimum recommended pad size on FR-4 board.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Preferred devices are Motorola recommended choices for future use and best overall value.

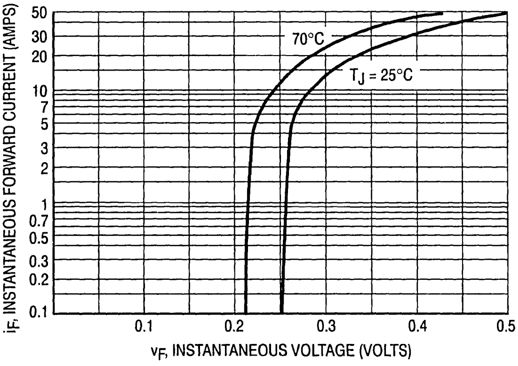


Figure 1. Typical Forward Voltage

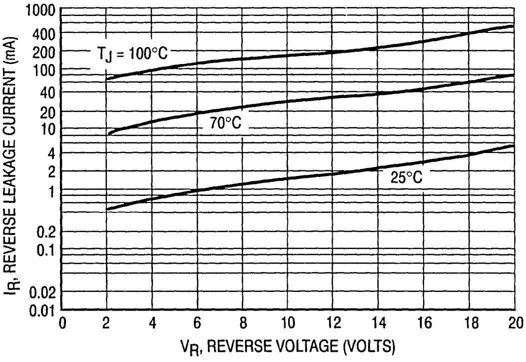


Figure 2. Typical Reverse Leakage Current

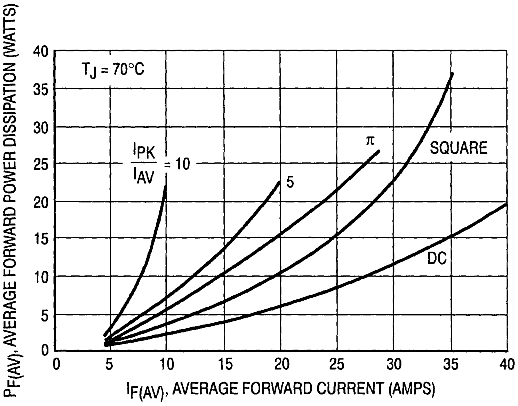


Figure 3. Typical Forward Power Dissipation

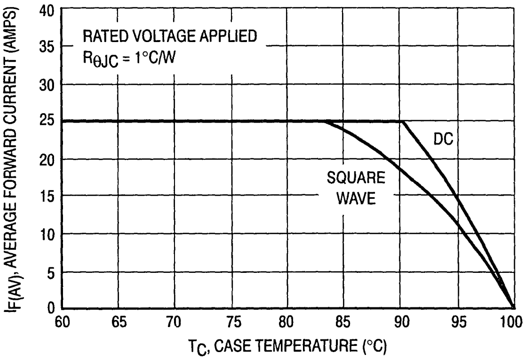


Figure 4. Current Derating, Case

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Designer's™ Data Sheet

SWITCHMODE™ Power Rectifier

D2PAK Surface Mount Power Package

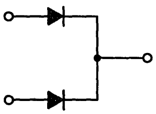
MBRB2535CTL

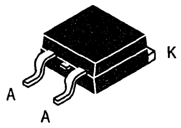
Motorola Preferred Device

**SCHOTTKY BARRIER RECTIFIER
25 AMPERES
35 VOLTS**

The D2PAK Power Rectifier employs the Schottky Barrier principle in a large metal-to-silicon power diode. State-of-the-art geometry features epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for use in low voltage, high frequency switching power supplies, free wheeling diodes, and polarity protection diodes. These state-of-the-art devices have the following features:

- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 125°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO-220 Package
- Available in Tape and Reel. Add a T4 Suffix to Part Number to order the 24 mm, 13 inch/800 Unit Reel.





**CASE 418B-01
D2PAK**

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	40 35 35	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C	$I_{F(AV)}$	12.5	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 90°C	I_{FRM}	25	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Storage Temperature	T_{stg}	−65 to +150	°C
Operating Junction Temperature	T_J	−65 to +125	°C
Voltage Rate of Change (Rated V_R)	dv/dt	10,000	V/µs

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (2) (i_F = 25 Amps, T_J = 25°C) (i_F = 12.5 Amps, T_J = 125°C) (i_F = 12.5 Amps, T_J = 25°C)	v_F	0.55 0.41 0.47	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	500 10	mA

(1) When mounted using minimum recommended pad size on FR-4 board.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design

Preferred devices are Motorola recommended choices for future use and best overall value.

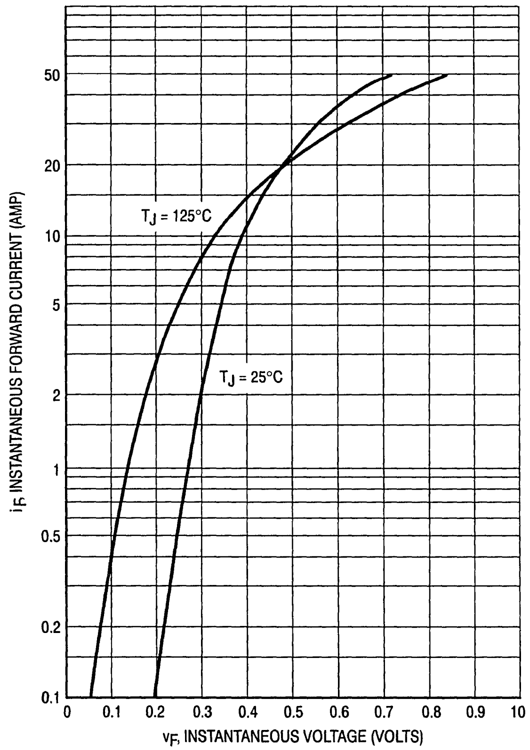


Figure 1. Typical Forward Voltage, Per Leg

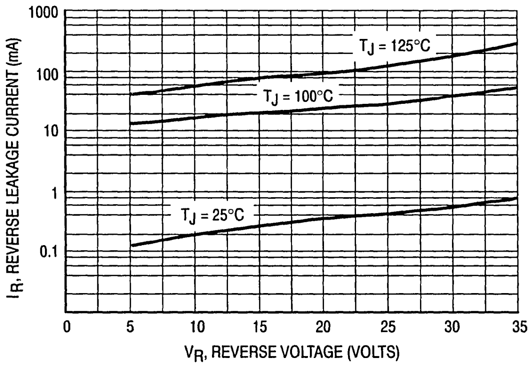


Figure 2. Typical Reverse Current, Per Leg

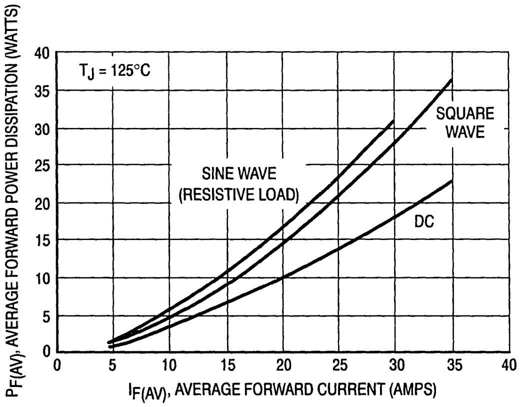


Figure 3. Typical Forward Power Dissipation

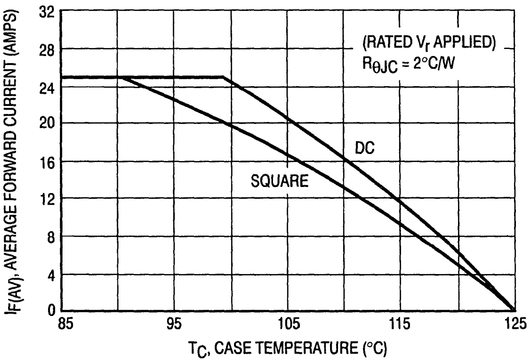


Figure 4. Current Derating, Case

3

Designer's™ Data Sheet

SWITCHMODE™ Power Rectifier

D2PAK Surface Mount Power Package

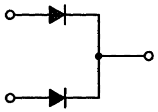
MBRB2545CT

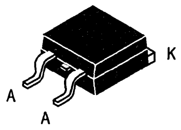
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER 30 AMPERES 45 VOLTS

The D2PAK Power Rectifier employs the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, VO at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to the Industry Standard TO-220 Package
- Available in Tape and Reel. Add a T4 Suffix to Part Number to order the 24 mm, 13 inch/800 Unit Reel.





CASE 418B-01
D2PAK

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	45	Volts
Average Rectified Forward Current (Rated V_R) T_C = 130°C Total Device	$I_{F(AV)}$	15 30	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 130°C	I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0	Amp
Storage Temperature	T_{stg}	−65 to +175	°C
Operating Junction Temperature	T_J	−65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/µs

THERMAL CHARACTERISTICS, PER LEG

Thermal Resistance — Junction to Case — Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	1.5 50	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Maximum Instantaneous Forward Voltage (2) (i_F = 30 Amps, T_J = 125°C) (i_F = 30 Amps, T_J = 25°C)	v_F	0.73 0.82	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	40 0.2	mA

(1) When mounted using minimum recommended pad size on FR-4 board.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

Designer's and SWITCHMODE are trademarks of Motorola Inc.
Thermal Clad is a trademark of the Bergquist Company

Preferred devices are Motorola recommended choices for future use and best overall value

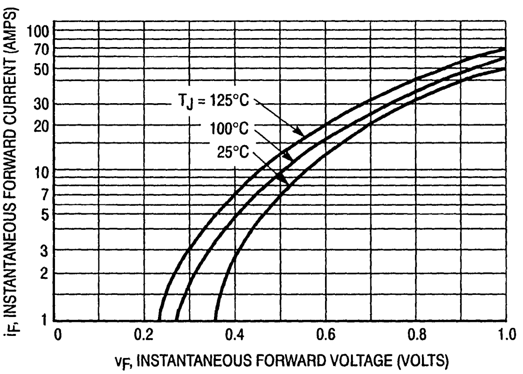


Figure 1. Typical Forward Voltage, Per Leg

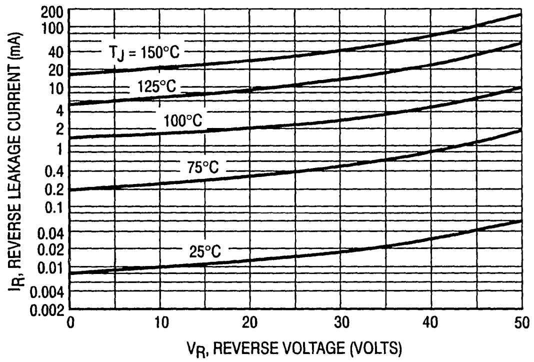


Figure 2. Typical Reverse Current, Per Leg

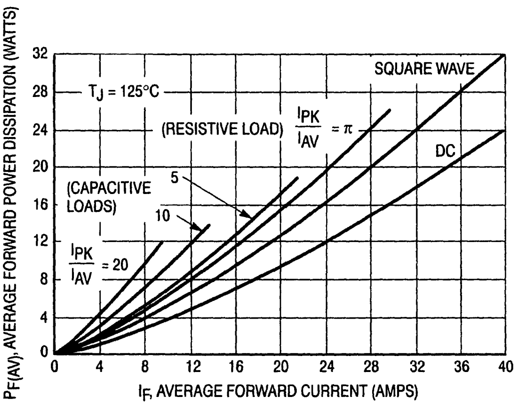


Figure 3. Typical Forward Power Dissipation

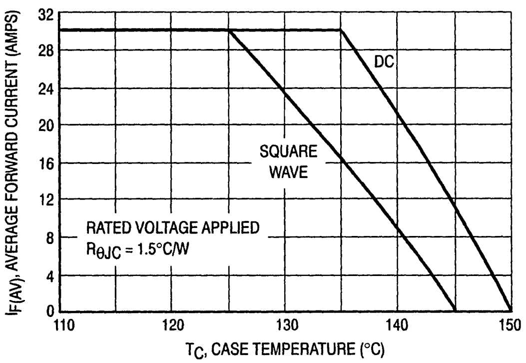


Figure 4. Current Derating, Case

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Designer's™ Data Sheet

SWITCHMODE™ Power Rectifier

D2PAK Surface Mount Power Package

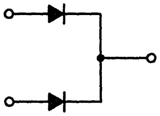
MBRB20100CT

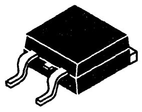
Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
20 AMPERES
100 VOLTS

The D2PAK Power Rectifier employs the use of the Schottky Barrier principle with a platinum barrier metal. These state-of-the-art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Center-Tap Configuration
- Guardring for Stress Protection
- Low Forward Voltage
- 150°C Operating Junction Temperature
- Epoxy Meets UL94, V_O at 1/8″
- Guaranteed Reverse Avalanche
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to Industry Standard TO-220 Package





CASE 418B-01

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current (Rated V_R) T_C = 110°C — Total Device	$I_{F(AV)}$	10 20	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	150	Amps
Peak Repetitive Reverse Surge Current (2.0 μs, 1.0 kHz)	I_{RRM}	0.5	Amp
Storage Temperature	T_{stg}	−65 to +175	°C
Operating Junction Temperature	T_J	−65 to +150	°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000	V/μs

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Thermal Resistance — Junction to Case — Junction to Ambient (2)	$R_{\theta JC}$ $R_{\theta JA}$	2.0 50	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 10 Amp, T_C = 125°C) (i_F = 10 Amp, T_C = 25°C) (i_F = 20 Amp, T_C = 125°C) (i_F = 20 Amp, T_C = 25°C)	v_F	0.75 0.85 0.85 0.95	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	150 0.15	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%
(2) See Page 3 for mounting conditions

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

TYPICAL ELECTRICAL CHARACTERISTICS

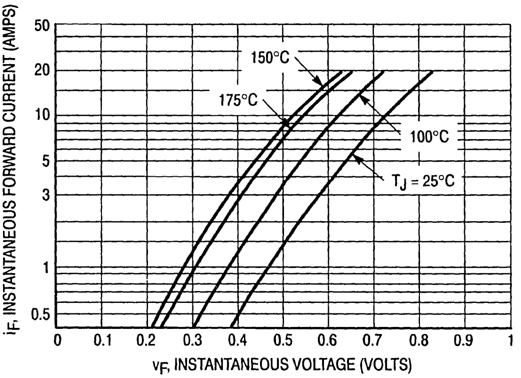


Figure 1. Typical Forward Voltage Per Diode

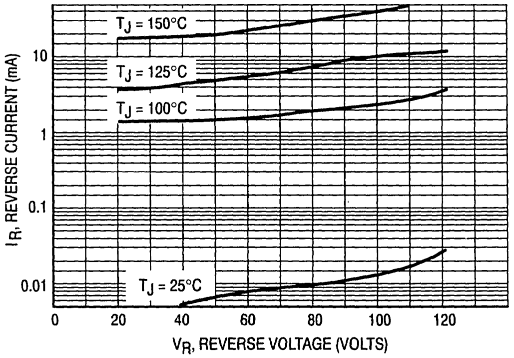


Figure 2. Typical Reverse Current Per Diode

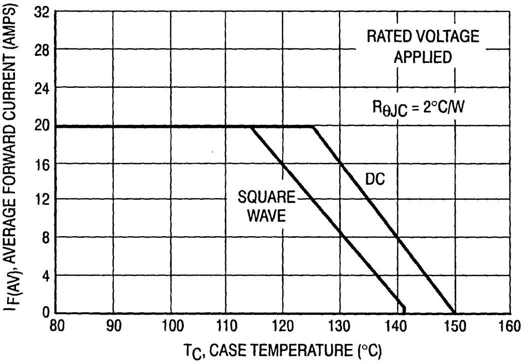


Figure 3. Typical Current Derating, Case, Per Leg

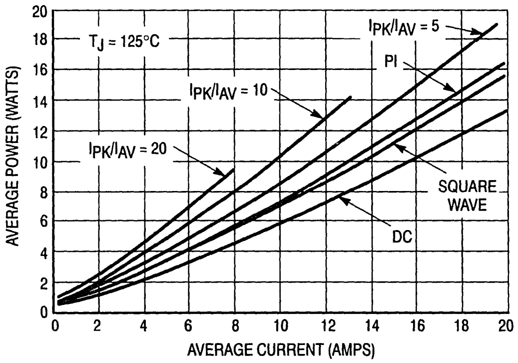


Figure 4. Average Power Dissipation and Average Current

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MBRD320
MBRD330
MBRD340
MBRD350
MBRD360

MBRD320, MBRD340 and MBRD360 are Motorola Preferred Devices

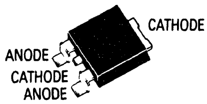
SWITCHMODE Power Rectifiers
DPAK Surface Mount Package

. . . designed for use as output rectifiers, free wheeling, protection and steering diodes in switching power supplies, inverters and other inductive switching circuits. These state-of-the-art devices have the following features:

- Extremely Fast Switching
- Extremely Low Forward Drop
- Platinum Barrier with Avalanche Guardrings
- Guaranteed Reverse Avalanche

Mechanical Characteristics
- Case: Epoxy, Molded
- Finish: All External Surface Corrosion Resistance and Terminal Leads are Readily Solderable
- Lead Formed for Surface Mount
- Available in 16 mm Tape and Reel or Plastic Rails
- Compact Size
- Lead and Mounting Surface Temperature for Soldering Purposes 260°C Max. for 10 Seconds

SCHOTTKY BARRIER RECTIFIERS
3 AMPERES
20 TO 60 VOLTS



CASE 369A-11
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBRD 320	MBRD 330	MBRD 340	MBRD 350	MBRD 360	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	50	60	Volts
Average Rectified Forward Current (T_C = +125°C, Rated V_R)	$I_{F(AV)}$	3					Amps
Peak Repetitive Forward Current, T_C = +125°C (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	6					Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	75					Amps
Peak Repetitive Reverse Surge Current (2 μs, 1 kHz)	I_{RRM}	1					Amp
Operating Junction Temperature	T_J	−65 to +150					°C
Storage Temperature	T_{stg}	−65 to +175					°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000					V/μs

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	6	°C/W
Maximum Thermal Resistance, Junction to Ambient (1)	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (2) i_F = 3 Amps, T_C = +25°C i_F = 3 Amps, T_C = +125°C i_F = 6 Amps, T_C = +25°C i_F = 6 Amps, T_C = +125°C	v_F	 0.6 0.45 0.7 0.625	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = +25°C) (Rated dc Voltage, T_C = +125°C)	i_R	 0.2 20	mA

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

TYPICAL CHARACTERISTICS

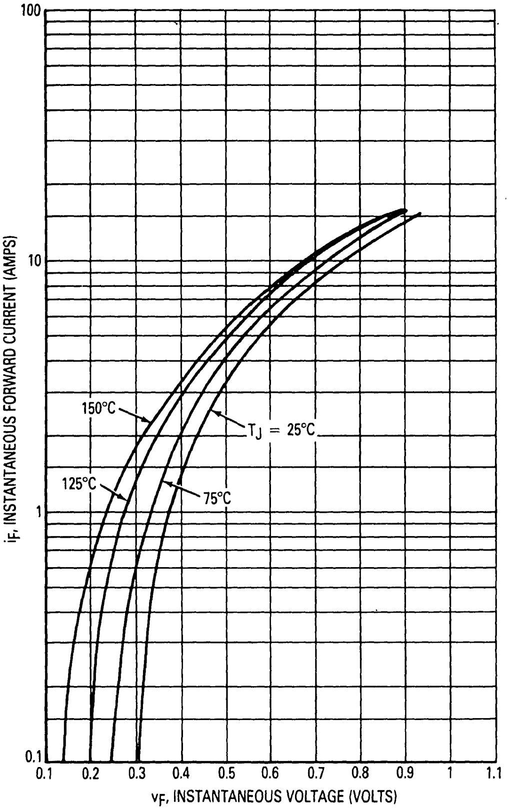
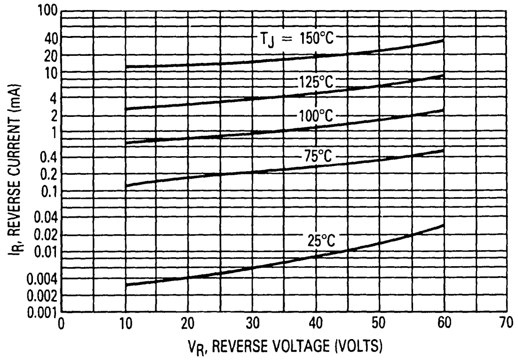


Figure 1. Typical Forward Voltage



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Reverse Current

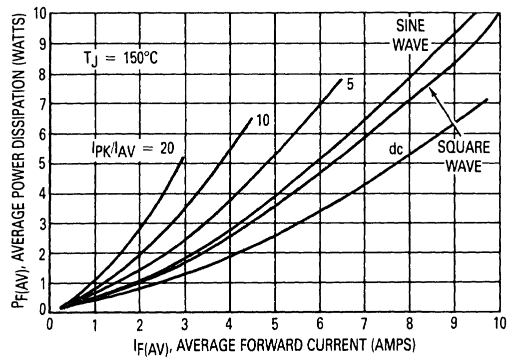


Figure 3. Average Power Dissipation

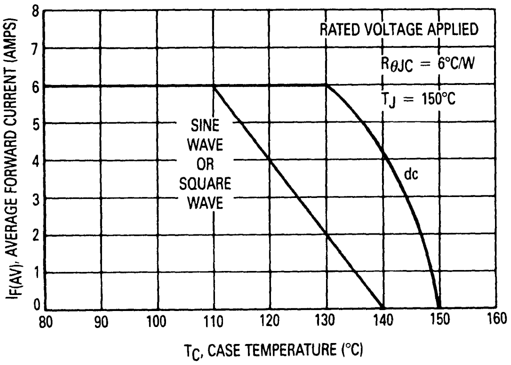


Figure 4. Current Derating, Case

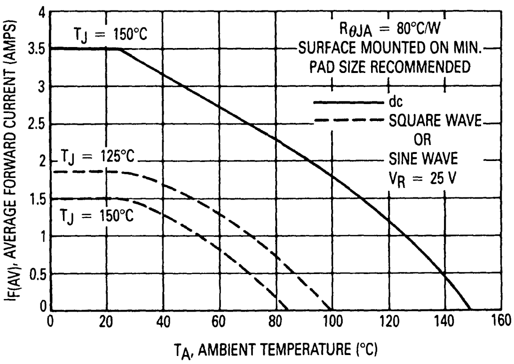


Figure 5. Current Derating, Ambient

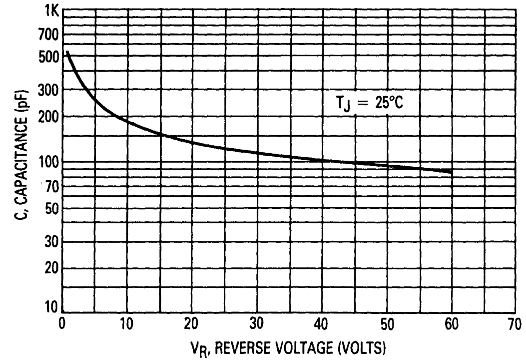


Figure 6. Typical Capacitance

MBRD620CT
MBRD630CT
MBRD640CT
MBRD650CT
MBRD660CT

MBRD620CT, MBRD640CT and MBRD660CT are Motorola Preferred Devices

SWITCHMODE Power Rectifiers

DPAK Surface Mount Package

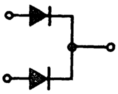
. . . in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

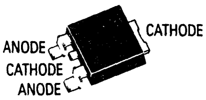
- Extremely Fast Switching
- Extremely Low Forward Drop
- Platinum Barrier with Avalanche Guardrings
- Guaranteed Reverse Avalanche

Mechanical Characteristics

- Case: Epoxy, Molded
- Finish: All External Surface Corrosion Resistance and Terminal Leads are Readily Solderable
- Lead Formed for Surface Mount
- Available in 16 mm Tape and Reel or Plastic Rails
- Compact Size
- Lead and Mounting Surface Temperature for Soldering Purposes 260°C Max. for 10 Seconds

SCHOTTKY BARRIER RECTIFIERS
6 AMPERES
20 TO 60 VOLTS





CASE 369A-11
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MBRD 620CT	630CT	640CT	650CT	660CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	30	40	50	60	Volts
Average Rectified Forward Current Per Diode / Per Device T_C = 130°C (Rated V_R)	$I_{F(AV)}$	3 6					Amps
Peak Repetitive Forward Current, T_C = 130°C (Rated V_R, Square Wave, 20 kHz) Per Diode	I_{FRM}	6					Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	75					Amps
Peak Repetitive Reverse Surge Current (2 µs, 1 kHz)	I_{RRM}	1					Amp
Operating Junction Temperature	T_J	−65 to +150					°C
Storage Temperature	T_{stg}	−65 to +175					°C
Voltage Rate of Change (Rated V_R)	dv/dt	1000					V/µs

THERMAL CHARACTERISTICS PER DIODE

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	6	°C/W
Maximum Thermal Resistance, Junction to Ambient (1)	$R_{\theta JA}$	80	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Maximum Instantaneous Forward Voltage (2) i_F = 3 Amps, T_C = 25°C i_F = 3 Amps, T_C = 125°C i_F = 6 Amps, T_C = 25°C i_F = 6 Amps, T_C = 125°C	v_F	 0.7 0.65 0.9 0.85	Volts
Maximum Instantaneous Reverse Current (2) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	i_R	 0.1 15	mA

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

TYPICAL CHARACTERISTICS

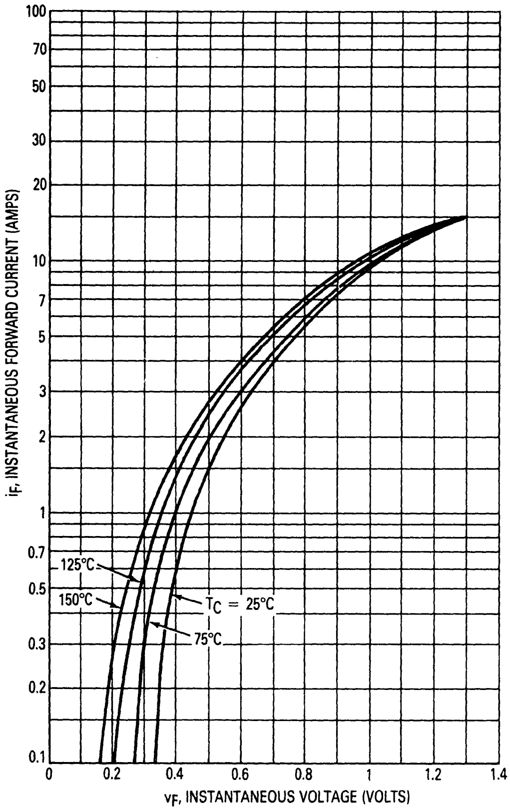
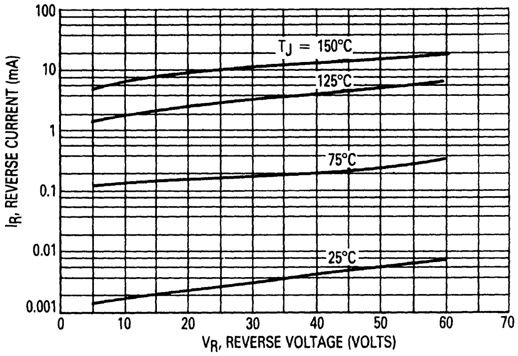


Figure 1. Typical Forward Voltage, Per Leg



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Reverse Current,* Per Leg

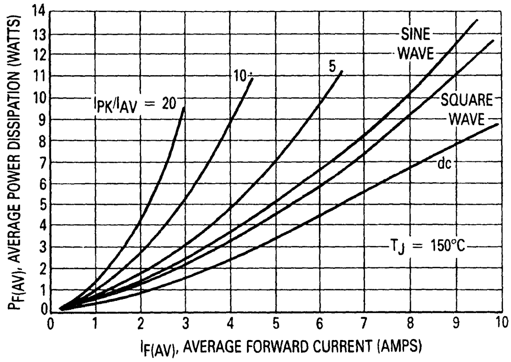


Figure 3. Average Power Dissipation, Per Leg

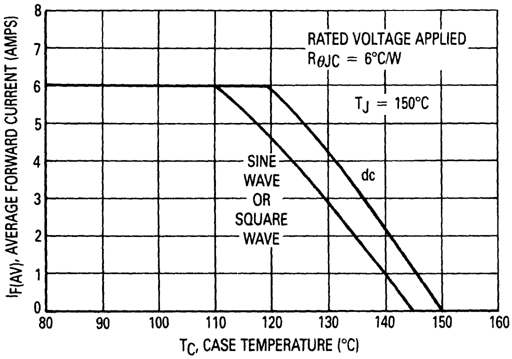


Figure 4. Current Derating, Case, Per Leg

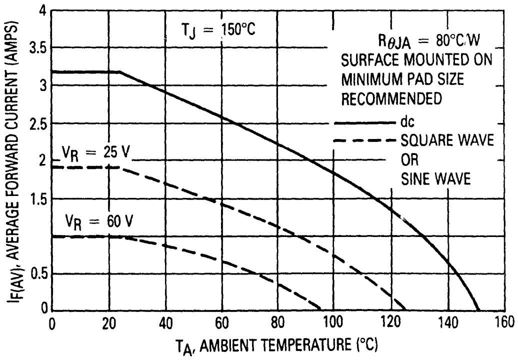


Figure 5. Current Derating, Ambient, Per Leg

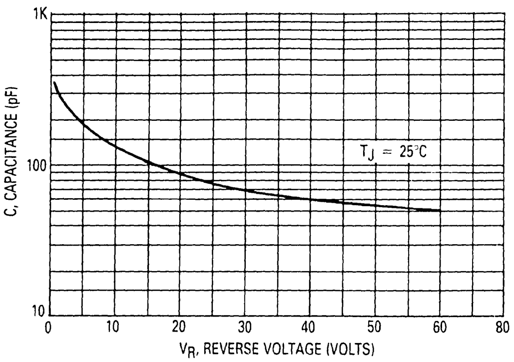


Figure 6. Typical Capacitance, Per Leg

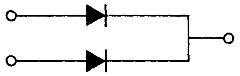
SWITCHMODE
Dual Schottky Power Rectifiers

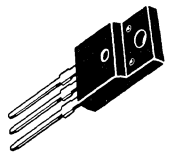
MBRF2535CT
MBRF2545CT

MBRF2545CT is a Motorola Preferred Device

- Low Forward Voltage Drop
- Guardring for Stress Protection
- 150°C Operating Junction Temperature
- High dv/dt Capability
- Electrically Isolated, No Insulating Hardware Required
- Electrically Similar to the Popular MBR2535CT and MBR2545CT

SCHOTTKY BARRIER RECTIFIERS
25 AMPERES
35 and 45 VOLTS





CASE 221D-02
(ISOLATED TO-220)

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	MBR2535CT	MBR2545CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	35	45	Volts
Average Rectified Forward Current (Rated V_R) Per Leg, T_C = 125°C	$I_{F(AV)}$	12.5		Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz) T_C = 125°C	I_{FRM}	25		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	150		Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	1.0		Amp
Operating Junction Temperature	T_J	−65 to +150		°C
Storage Temperature	T_{stg}	−65 to +175		°C
Voltage Rate of Change (Rated V_R)	dv/dt	10000		V/µs
Isolation Voltage	V_{ins}	1500		Volts

THERMAL CHARACTERISTICS (PER LEG)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	3.5	°C/W

ELECTRICAL CHARACTERISTICS (PER LEG)

Maximum Instantaneous Forward Voltage (1) (I_F = 12.5 Amps, T_C = 25°C) (I_F = 12.5 Amps, T_C = 125°C)	v_F	 0.7 0.62	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 125°C)	i_R	 0.2 40	mA

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

Switchmode is a trademark of Motorola Inc.

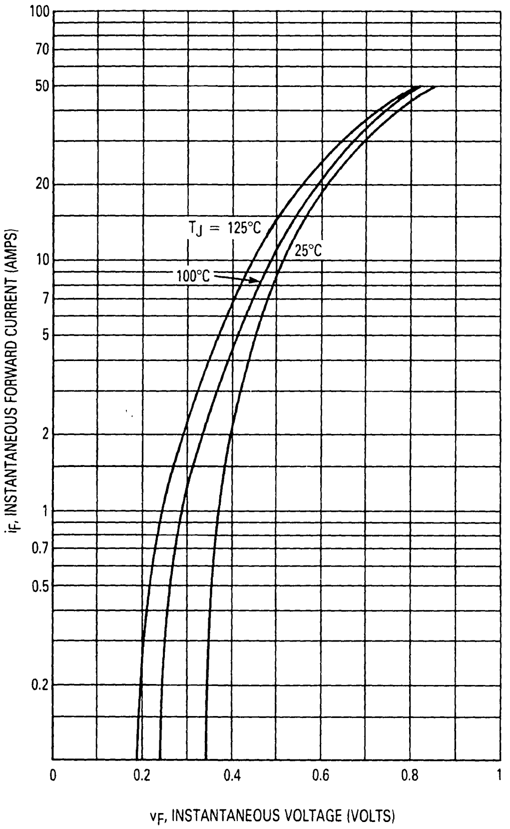


Figure 1. Typical Forward Voltage, Per Leg

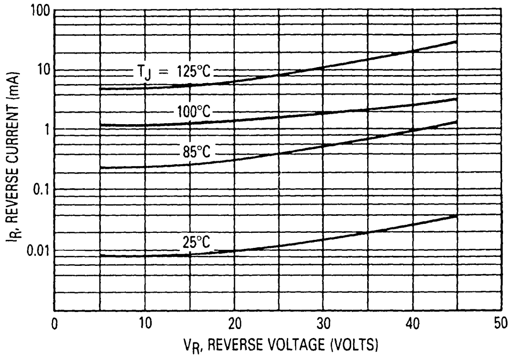


Figure 2. Typical Reverse Current, Per Leg

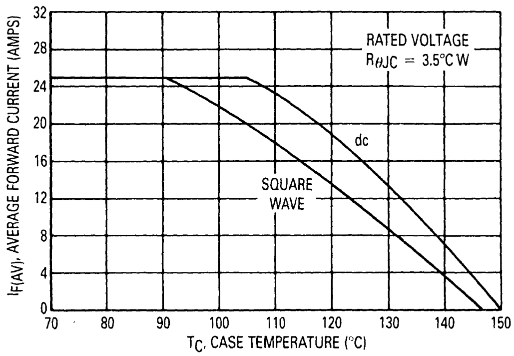


Figure 3. Current Derating, Case

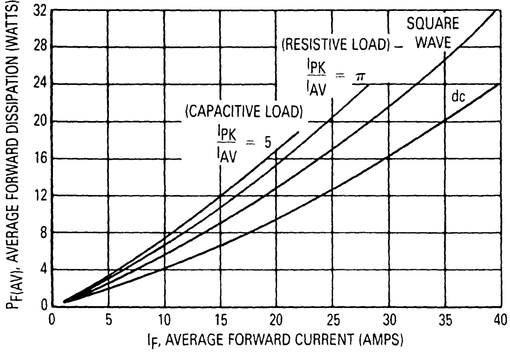


Figure 4. Forward Power Dissipation

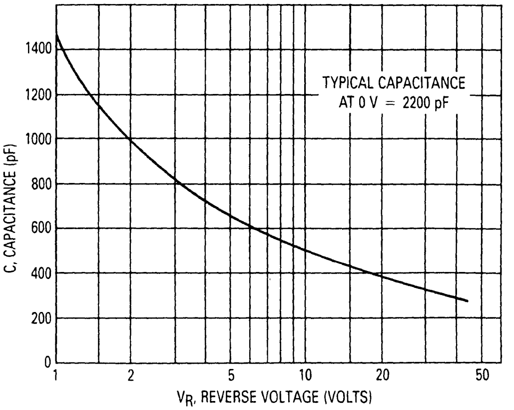


Figure 5. Typical Capacitance

Designer's™ Data Sheet

Schottky Power Rectifier

Surface Mount Power Package

MBRS130LT3

Motorola Preferred Device

**SCHOTTKY BARRIER RECTIFIER
1.0 AMPERE
30 VOLTS**

CASE 403A-03

Employs the use of 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 overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes, in surface mount applications where compact size and weight are critical to the system.

- Very Low Forward Voltage Drop (0.395 Volts Max @ 1.0 A, T_J = 25°C)
- Small Compact Surface Mountable Package with J-Bend Leads
- Packaged in 12 mm Pocket Tape and Reel
- Highly Stable Oxide Passivated Junction
- Guardring for Stress Protection

Mechanical Characteristics

Case: Transfer Molded Plastic Package, Case 403A-03
Lead Finish: Plated Leads, Readily solderable in surface Mount Applications
Polarity Identification: Notch in Plastic Body Indicates Cathode Lead
Device Marking: 1BL3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	30	Volts
Average Rectified Forward Current T_L = 120°C T_L = 110°C	$I_{F(AV)}$	1.0 2.0	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	40	Amps
Operating Junction Temperature	T_J	−65 to +125	°C
THERMAL CHARACTERISTICS			
Thermal Resistance — Junction to Lead (T_L = 25°C)	$R_{\theta JL}$	12	°C/W
ELECTRICAL CHARACTERISTICS			
Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 A, T_J = 25°C) (i_F = 2.0 A, T_J = 25°C)	v_F	 0.395 0.445	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 100°C)	i_R	 1.0 10	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

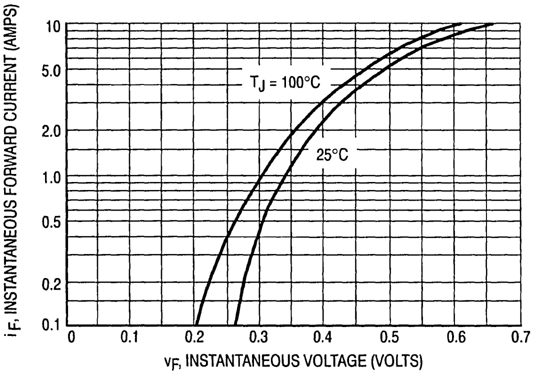


Figure 1. Typical Forward Voltage

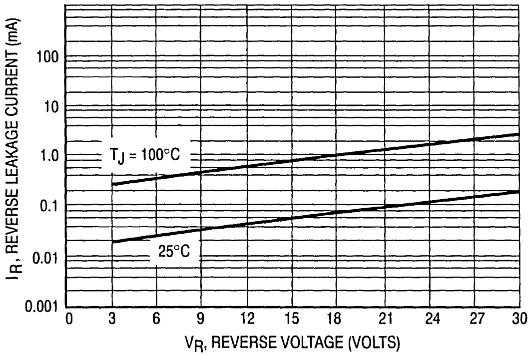


Figure 2. Typical Reverse Leakage Current

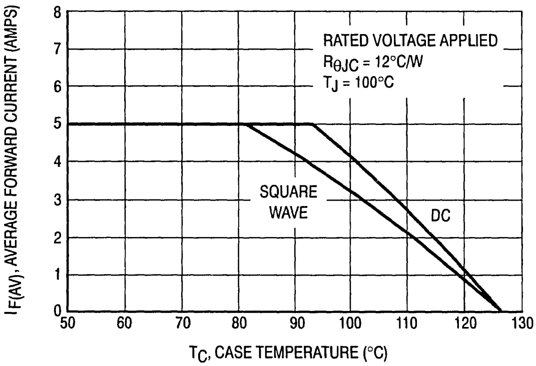


Figure 3. Current Derating (Case)

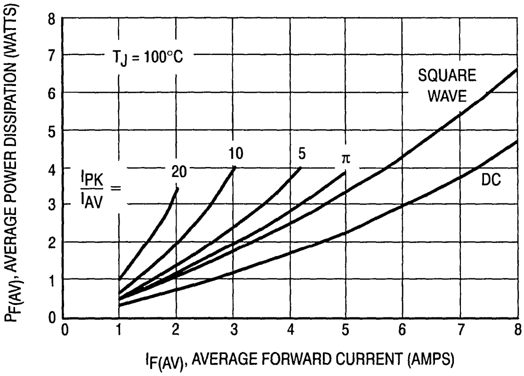


Figure 4. Power Dissipation

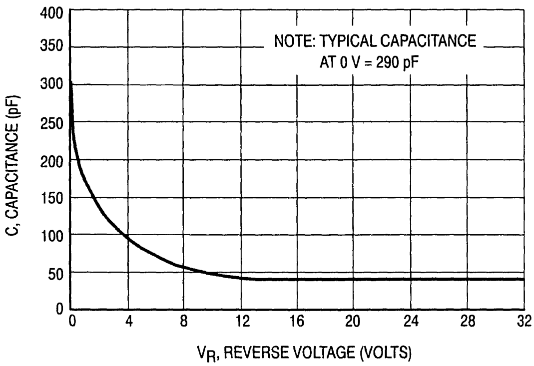


Figure 5. Typical Capacitance

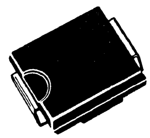
3

Surface Mount Schottky Power Rectifier

MBRS140T3

Motorola Preferred Device

**SCHOTTKY BARRIER RECTIFIERS
1.0 AMPERE
40 VOLTS**



CASE 403A-03

... 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 overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Packaged in 12 mm Pocket Tape and Reel
- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop (0.55 Volts Max @ 1.0 A, T_J = 25°C)
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection

MECHANICAL CHARACTERISTICS

CASE: Transfer Molded Plastic Package
LEAD FINISH: Plated Leads, Readily Solderable in Surface Mount Applications
POLARITY IDENTIFICATION: Notch in Plastic Body Indicates Cathode Lead
DEVICE MARKING: MBRS140T3..........B14

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	40	Volts
Average Rectified Forward Current	$I_{F(AV)}$	1 @ T_L = 115°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	40	Amps
Operating Junction Temperature	T_J	−65 to +125	°C

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Lead (T_L = 25°C)	$R_{\theta JL}$	12	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 A, T_J = 25°C)	v_F	0.6	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 100°C)	i_R	 1.0 10	mA

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

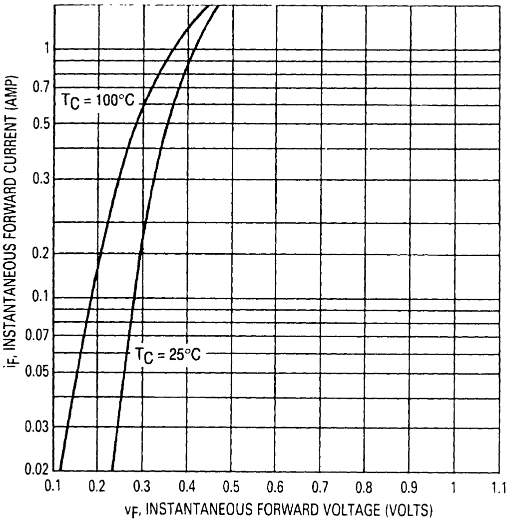


Figure 1. Typical Forward Voltage

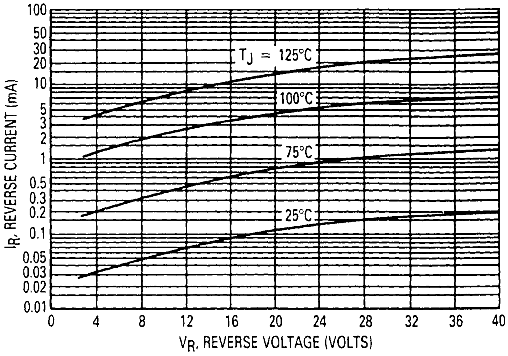


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if applied V_R is sufficiently below rated V_R.

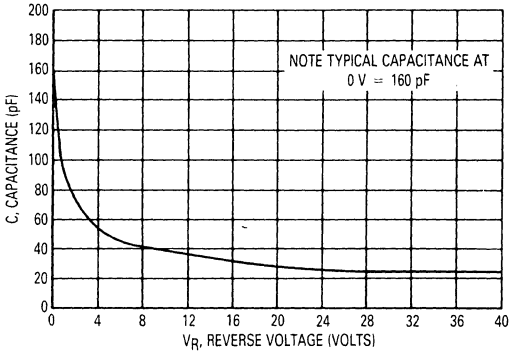


Figure 3. Typical Capacitance

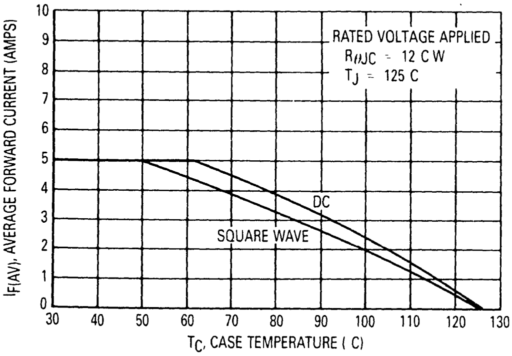


Figure 4. Current Derating (Case)

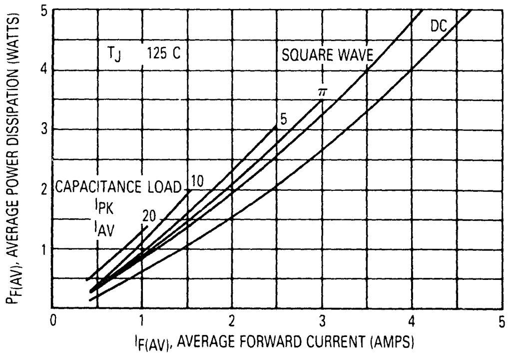


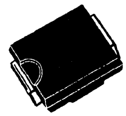
Figure 5. Power Dissipation

Surface Mount
Schottky Power Rectifier

MBRS340T3

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIERS
3.0 AMPERES
40 VOLTS



CASE 403-03

. . . 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 overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes, in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Packaged in 16 mm Pocket Tape and Reel
- Highly Stable Oxide Passivated Junction
- Very Low Forward Voltage Drop (0.5 Volts Max @ 3.0 A, T_J = 25°C)
- Excellent Ability to Withstand Reverse Avalanche Energy Transients
- Guardring for Stress Protection

MECHANICAL CHARACTERISTICS

CASE: Transfer Molded Plastic Package
LEAD FINISH: Plated Leads, Readily Solderable in Surface Mount Applications
POLARITY IDENTIFICATION: Notch in Plastic Body Indicates Cathode Lead
DEVICE MARKING: MBRS340T3..........B34

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	40	Volts
Average Rectified Forward Current	$I_{F(AV)}$	3.0 @ T_L = 100°C 4.0 @ T_L = 90°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	80	Amps
Operating Junction Temperature	T_J	−65 to +125	°C

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Resistance — Junction to Lead	$R_{\theta JL}$	11	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 3.0 A, T_J = 25°C)	v_F	0.525	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 100°C)	i_R	 2.0 20	mA

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

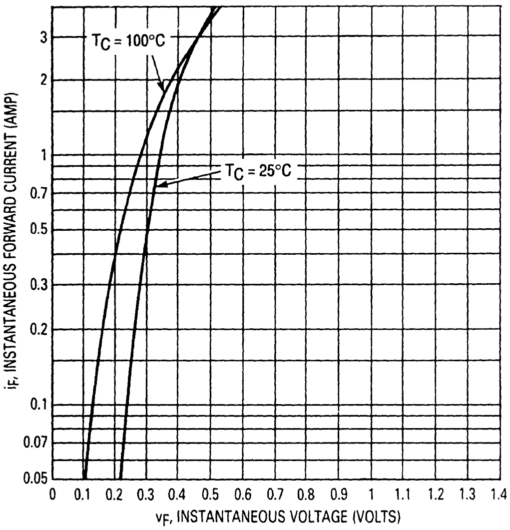


Figure 1. Typical Forward Voltage

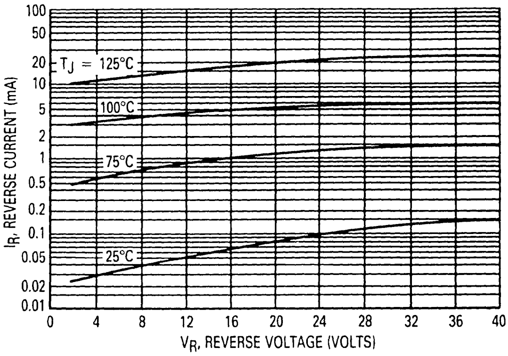


Figure 2. Typical Reverse Current

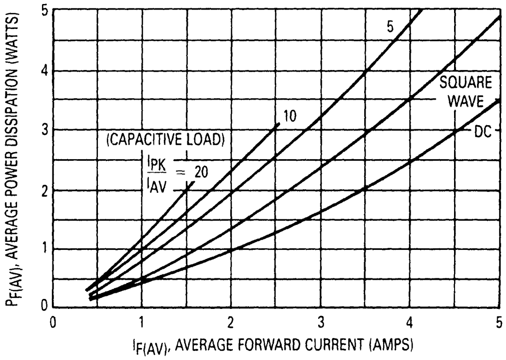


Figure 3. Power Dissipation

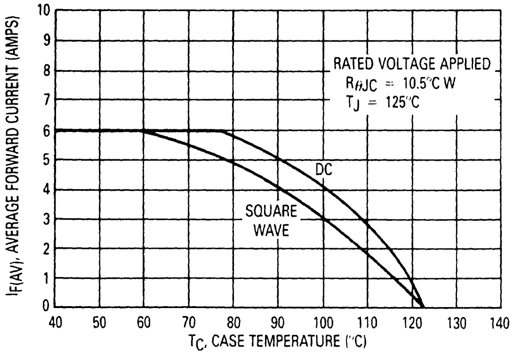


Figure 4. Current Derating (Case)

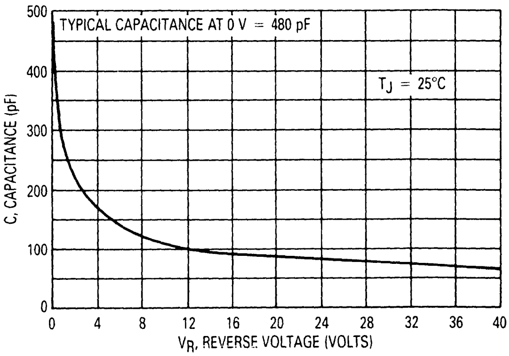


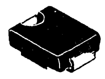
Figure 5. Typical Capacitance

Designer's™ Data Sheet
Schottky Power Rectifier
Surface Mount Power Package

MBRS1100T3

Motorola Preferred Device

SCHOTTKY BARRIER RECTIFIER
1.0 AMPERE
100 VOLTS



CASE 403A-03

Schottky Power Rectifiers employ the use of 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 overlay contact. Ideally suited for low voltage, high frequency rectification, or as free wheeling and polarity protection diodes, in surface mount applications where compact size and weight are critical to the system. These state-of-the-art devices have the following features:

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Packaged in 12 mm Pocket Tape and Reel
- Highly Stable Oxide Passivated Junction
- High Blocking Voltage — 100 Volts
- 150°C Operating Junction Temperature
- Guardring for Stress Protection

Mechanical Characteristics

Case: Transfer Molded Plastic Package
Lead Finish: Plated leads, Readily Solderable in Surface Mount Applications
Polarity Identification: Notch in Plastic Body Indicates Cathode Lead
Device Marking: MBRS1100T3 .... B1C

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current $T_L = 120°C$ $T_L = 100°C$	$I_{F(AV)}$	1.0 2.0	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	50	Amps
Operating Junction Temperature	T_J	−65 to +150	°C
Voltage Rate of Change	dv/dt	10	V/ns

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Resistance — Junction to Lead ($T_L = 25°C$)	$R_{\theta JL}$	22	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) ($i_F = 1.0$ A, $T_J = 25°C$)	v_F	0.75	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, $T_J = 25°C$) (Rated dc Voltage, $T_J = 100°C$)	i_R	 0.5 5.0	mA

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

TYPICAL ELECTRICAL CHARACTERISTICS

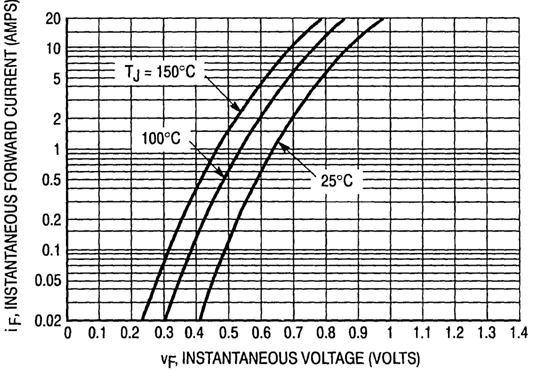


Figure 1. Typical Forward Voltage

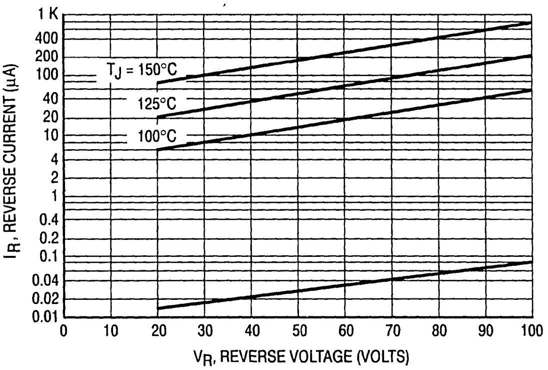


Figure 2. Typical Reverse Current

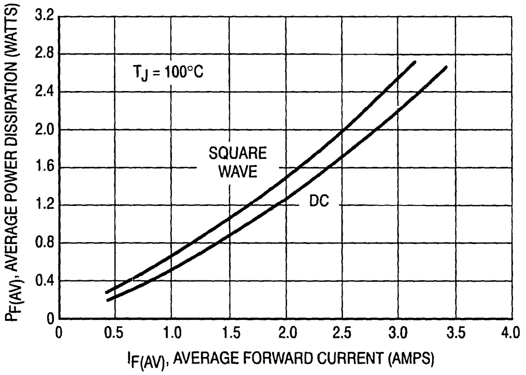


Figure 3. Power Dissipation

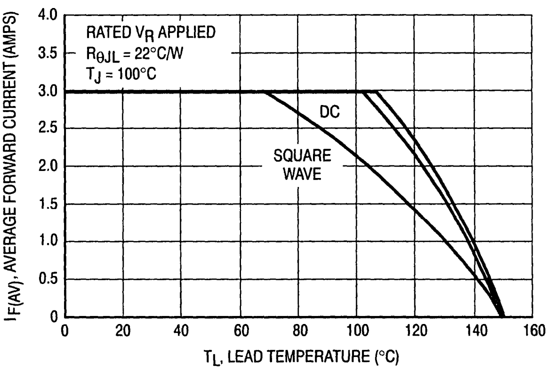


Figure 4. Current Derating, Lead

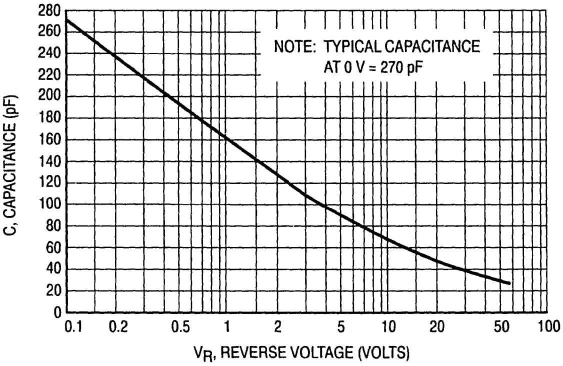


Figure 5. Typical Capacitance

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR750
MR751 MR752
MR754 MR756
MR758 MR760

MR754 and MR760 are
Motorola Preferred Devices

Designers Data Sheet

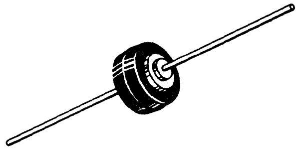
HIGH CURRENT LEAD MOUNTED RECTIFIERS

- Current Capacity Comparable To Chassis Mounted Rectifiers
- Very High Surge Capacity
- Insulated Case

Designer's 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.

HIGH CURRENT LEAD MOUNTED SILICON RECTIFIERS 50–1000 VOLTS DIFFUSED JUNCTION



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***MAXIMUM RATINGS**

Characteristic	Symbol	MR750	MR751	MR752	MR754	MR756	MR758	MR760	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
Non-Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz peak)	V_{RSM}	60	120	240	480	720	960	1200	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	Volts
Average Rectified Forward Current (single phase, resistive load, 60 Hz) See Figures 5 and 6	I_O	22 (T_L = 60°C, 1/8" Lead Lengths) 6.0 (T_A = 60°C, P.C. Board mounting)							Amp
Non-Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	400 (for 1 cycle)							Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +175							°C

ELECTRICAL CHARACTERISTICS

Characteristic and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage Drop (i_F = 100 Amp, T_J = 25°C)	v_F	1.25	Volts
Maximum Forward Voltage Drop (I_F = 6.0 Amp, T_A = 25°C, 3/8" leads)	V_F	0.90	Volts
Maximum Reverse Current (rated dc voltage) T_J = 25°C T_J = 100°C	I_R	25 1.0	μA mA

MECHANICAL CHARACTERISTICS

CASE: Transfer Molded Plastic
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 350°C 3/8" from case for 10 seconds at 5.0 lbs. tension
FINISH: All external surfaces are corrosion-resistant, leads are readily solderable
POLARITY: Indicated by diode symbol
WEIGHT: 2.5 Grams (approx.)

FIGURE 1 — FORWARD VOLTAGE

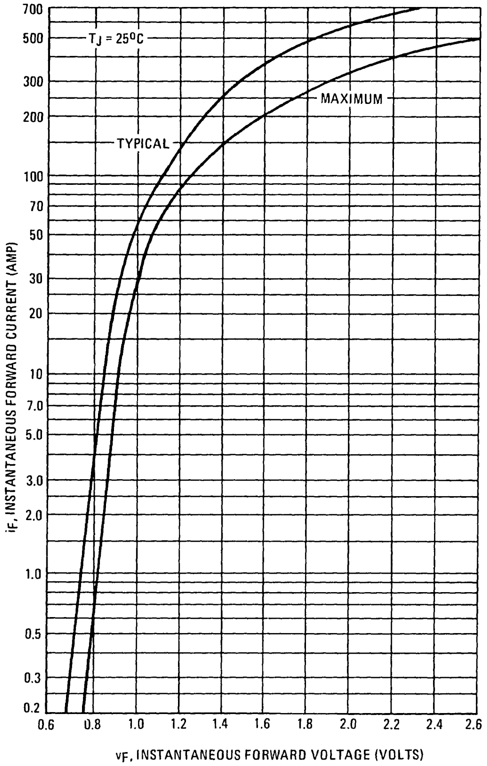

FIGURE 2 — MAXIMUM SURGE CAPABILITY

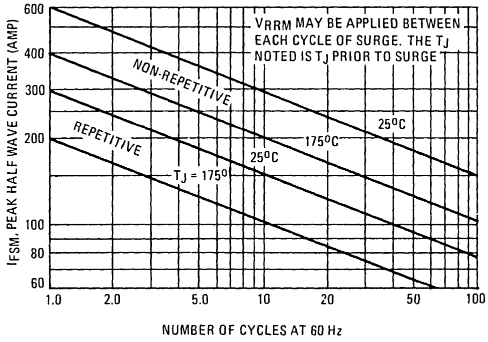

FIGURE 3 — FORWARD VOLTAGE TEMPERATURE COEFFICIENT

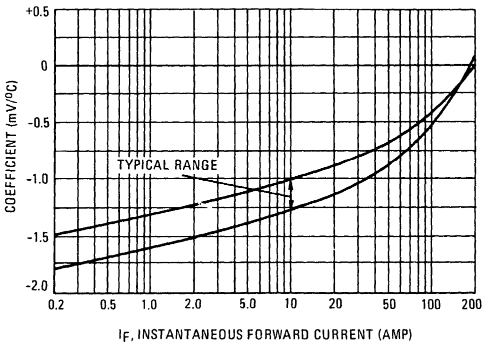

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FIGURE 4 — TYPICAL TRANSIENT THERMAL RESISTANCE

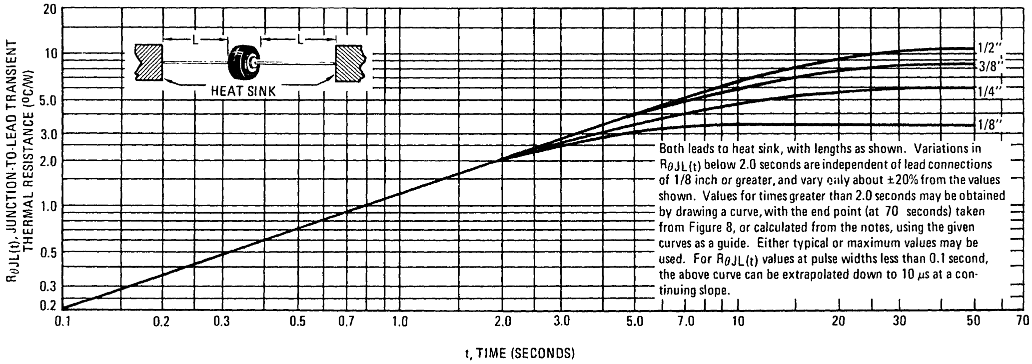


FIGURE 5 – MAXIMUM CURRENT RATINGS

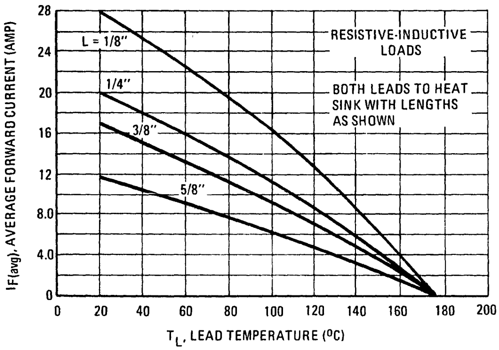


FIGURE 6 – MAXIMUM CURRENT RATINGS

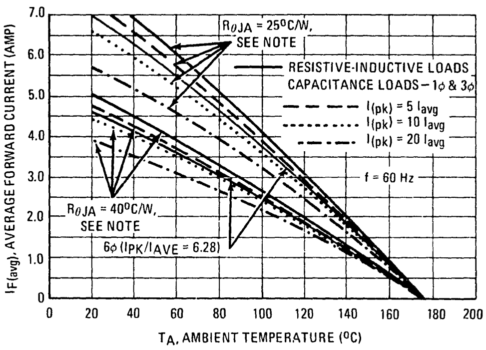


FIGURE 7 – POWER DISSIPATION

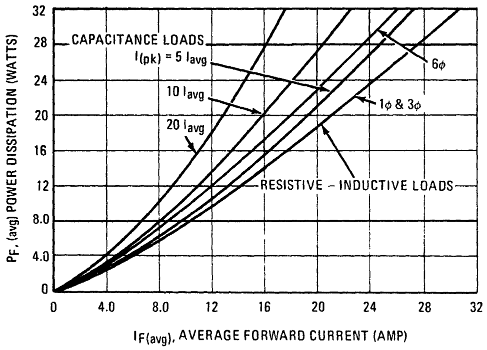
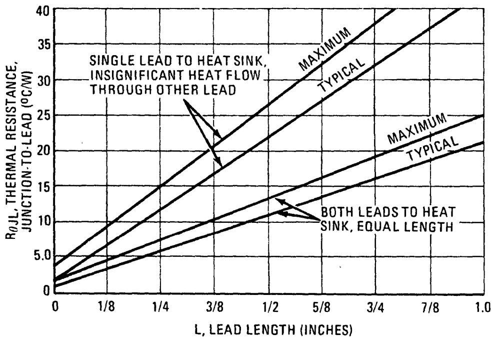


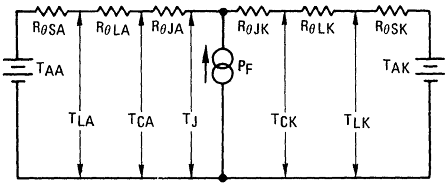
FIGURE 8 – STEADY STATE THERMAL RESISTANCE



NOTES

THERMAL CIRCUIT MODEL

(For Heat Conduction Through The Leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. Lowest values occur when one side of the rectifier is brought as close as possible to the heat sink as shown below. Terms in the model signify:

T_A = Ambient Temperature $R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
T_L = Lead Temperature $R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
T_C = Case Temperature $R_{\theta J}$ = Thermal Resistance, Junction to Case
T_J = Junction Temperature P_F = Power Dissipation

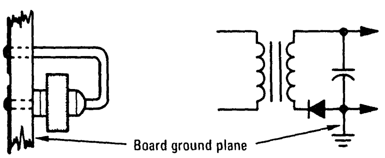
(Subscripts A and K refer to anode and cathode sides respectively.)

Values for thermal resistance components are:

$R_{\theta L}$ = 40°C/W/IN. Typically and 44°C/W/IN Maximum
$R_{\theta J}$ = 2°C/W Typically and 4°C/W Maximum

Since $R_{\theta J}$ is so low, measurements of the case temperature, T_C, will be approximately equal to junction temperature in practical lead mounted applications. When used as a 60 Hz rectifier, the slow thermal response holds $T_{J(PK)}$ close to $T_{J(AVG)}$. Therefore maximum lead temperature may be found from: $T_L = 175° - R_{\theta JL} P_F$. P_F may be found from Figure 7.

The recommended method of mounting to a P.C. board is shown on the sketch, where $R_{\theta JA}$ is approximately 25°C/W for a 1-1/2" x 1-1/2" copper surface area. Values of 40°C/W are typical for mounting to terminal strips or P.C. boards where available surface area is small.



Recommended mounting for half wave circuit

TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 9 – RECTIFICATION EFFICIENCY

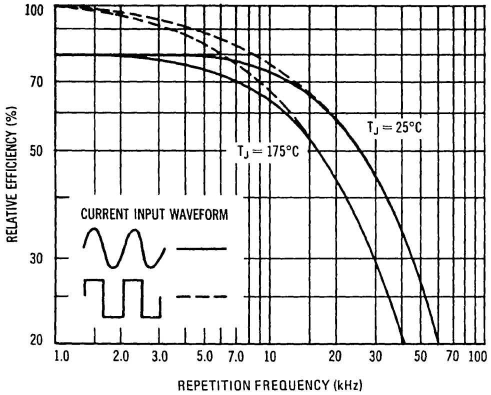


FIGURE 10 – REVERSE RECOVERY TIME

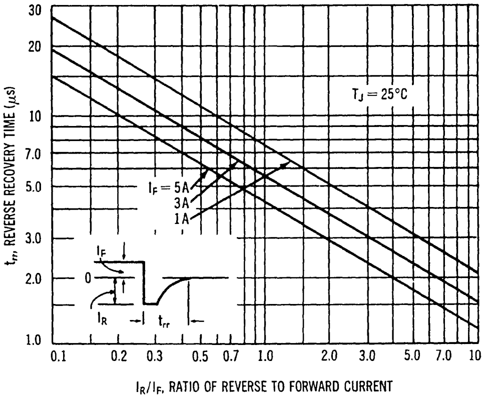


FIGURE 11 – JUNCTION CAPACITANCE

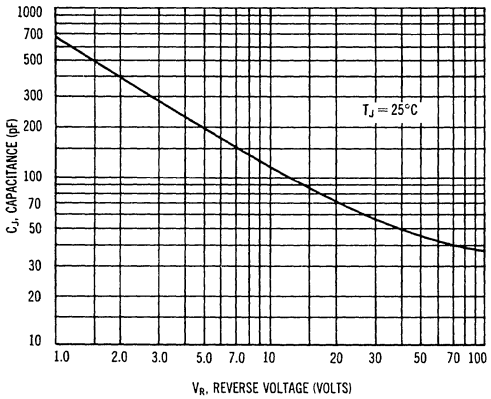


FIGURE 12 – FORWARD RECOVERY TIME

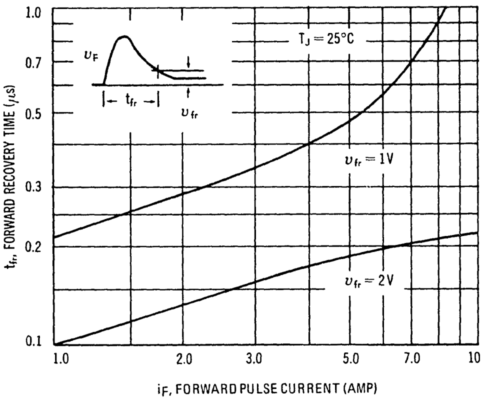
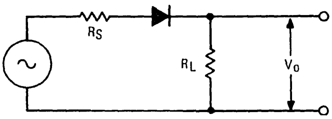


FIGURE 13 – SINGLE-PHASE HALF-WAVE RECTIFIER CIRCUIT



The rectification efficiency factor σ shown in Figure 9 was calculated using the formula:

$$\sigma = \frac{P_{(dc)}}{P_{(rms)}} = \frac{\frac{V^2_{o(dc)}}{R_L}}{\frac{V^2_{o(rms)}}{R_L}} \cdot 100\% = \frac{V^2_{o(dc)}}{V^2_{o(ac)} + V^2_{o(dc)}} \cdot 100\% \quad (1)$$

For a sine wave input $V_m \sin(\omega t)$ to the diode, assumed lossless, the maximum theoretical efficiency factor becomes:

$$\sigma_{(sine)} = \frac{\frac{V^2_m}{\pi^2 R_L}}{\frac{V^2_m}{4R_L}} \cdot 100\% = \frac{4}{\pi^2} \cdot 100\% = 40.6\% \quad (2)$$

For a square wave input of amplitude V_m, the efficiency factor becomes:

$$\sigma_{(square)} = \frac{\frac{V^2_m}{2R_L}}{\frac{V^2_m}{R_L}} \cdot 100\% = 50\% \quad (3)$$

(A full wave circuit has twice these efficiencies)

As the frequency of the input signal is increased, the reverse recovery time of the diode (Figure 10) becomes significant, resulting in an increasing ac voltage component across R_L which is opposite in polarity to the forward current, thereby reducing the value of the efficiency factor σ, as shown on Figure 9.

It should be emphasized that Figure 9 shows waveform efficiency only; it does not provide a measure of diode losses. Data was obtained by measuring the ac component of V_o with a true rms ac voltmeter and the dc component with a dc voltmeter. The data was used in Equation 1 to obtain points for Figure 9.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR820
MR821 MR822
MR824 MR826

MR822 and MR826 are Motorola Preferred Devices

Designers Data Sheet

SUBMINIATURE SIZE, AXIAL LEAD MOUNTED FAST RECOVERY POWER RECTIFIERS

. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

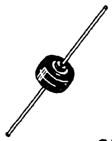
Designer's Data for "Worst Case" Conditions

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.

3

FAST RECOVERY POWER RECTIFIERS

50-600 VOLTS
5.0 AMPERES



CASE 194-04

MAXIMUM RATINGS

Rating	Symbol	MR820	MR821	MR822	MR824	MR826	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Non-Repetitive Peak Reverse Voltage	V_{RSM}	75	150	250	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	Volts
Average Rectified Forward Current (Single phase, resistive load, $T_A = 55^oC$) (1)	I_O	← 5.0 →					Amp
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions)	I_{FSM}	← 300 →					Amp
Operating and Storage Junction Temperature Range (2)	T_J, T_{stg}	← -65 to +175 →					^oC

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (Recommended Printed Circuit Board Mounting, See Note 6)	$R_{\theta JA}$	25	$^oC/W$

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (i_F = 15.7 Amp, $T_J = 150^oC$)	v_F	–	0.75	1.05	Volts
Forward Voltage (I_F = 5.0 Amp, $T_J = 25^oC$)	V_F	–	0.9	1.1	Volts
Maximum Reverse Current, (rated dc voltage) $T_J = 25^oC$	I_R	–	5.0	25	μA
$T_J = 100^oC$		–	0.4	1.0	mA

REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	t_{rr}				ns
(I_F = 1.0 Amp to V_R = 30 Vdc, Figure 25)		–	150	200	
(I_{FM} = 15 Amp, di/dt = 25 A/μs, Figure 26)		–	150	300	
Reverse Recovery Current (I_F = 1.0 Amp to V_R = 30 Vdc, Figure 25)	$I_{RM(REC)}$	–	–	2.0	Amp

(1) Must be derated for reverse power dissipation. See Note 3
(2) Derate as shown in Figure 1.

MECHANICAL CHARACTERISTICS

CASE: Transfer Molded Plastic

FINISH: External Surfaces are Corrosion Resistant

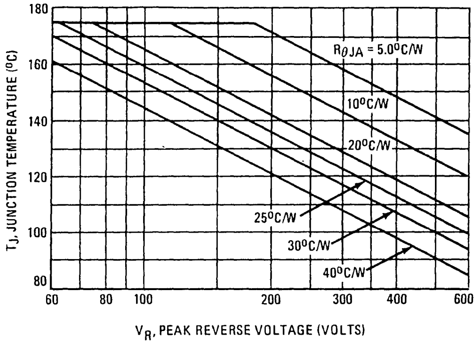
POLARITY: Indicated by Diode Symbol

WEIGHT: 2.5 Grams (Approximately)

MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 350°C, 3/8" from case for 10 s at 5.0 lb. tension.

MAXIMUM CURRENT AND TEMPERATURE RATINGS

FIGURE 1 – MAXIMUM ALLOWABLE JUNCTION TEMPERATURE



NOTE 1
MAXIMUM JUNCTION TEMPERATURE DERATING

When operating this rectifier at junction temperatures over approximately 85°C, reverse power dissipation and the possibility of thermal runaway must be considered. The data of Figure 1 is based upon worst case reverse power and should be used to derate $T_{J(max)}$ from its maximum value of 175°C. See Note 3 for additional information on derating for reverse power dissipation.

When current ratings are computed from $T_{J(max)}$ and reverse power dissipation is also included, ratings vary with reverse voltage as shown on Figures 2 thru 5.

3

RESISTIVE LOAD RATINGS

PRINTED CIRCUIT BOARD MOUNTING – SEE NOTE 6

FIGURE 2 – SINE WAVE INPUT

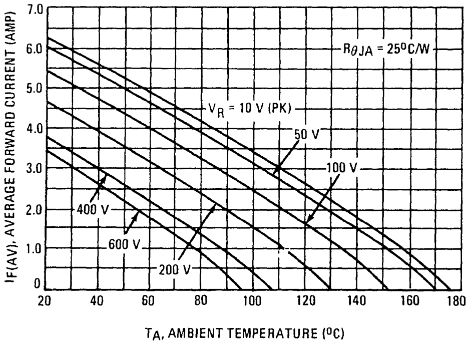


FIGURE 3 – SQUARE WAVE INPUT

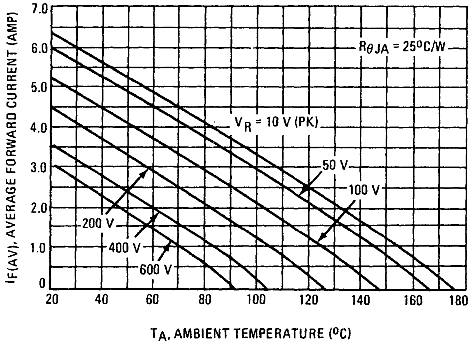


FIGURE 4 – SINE WAVE INPUT

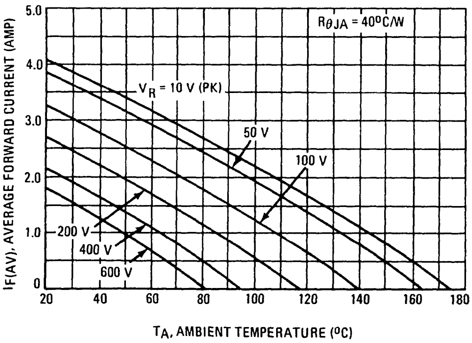
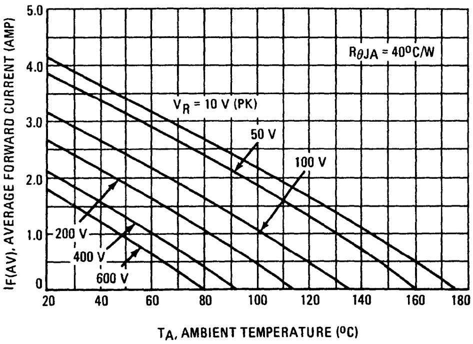


FIGURE 5 – SQUARE WAVE INPUT



MAXIMUM CURRENT RATINGS

NOTE 2

Current derating data is based upon the thermal response data of Figure 29 and the forward power dissipation data of Figures 19 and 20. Since reverse power dissipation is not considered in Figures 6 thru 11, additional derating for reverse voltage and for junction to ambient thermal resistance must be applied. See Note 3.

SINE WAVE INPUT

FIGURE 6 – EFFECT OF LEAD LENGTHS, RESISTIVE LOAD

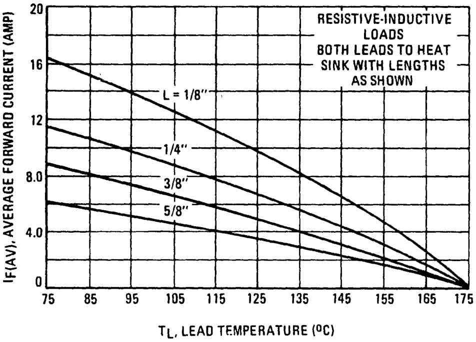


FIGURE 8 – 1/8" LEAD LENGTH, VARIOUS LOADS

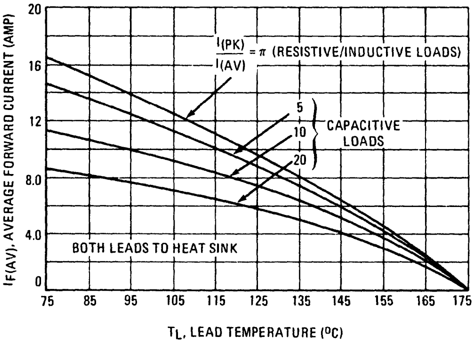
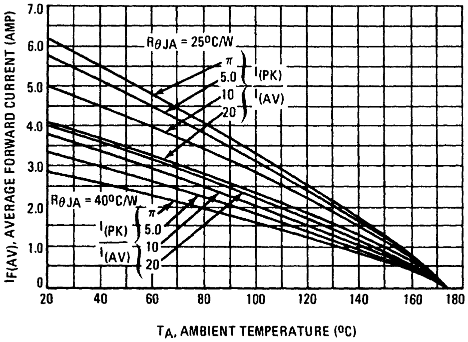


FIGURE 10 – PRINTED CIRCUIT BOARD MOUNTING, VARIOUS LOADS



SQUARE WAVE INPUT

FIGURE 7 – EFFECT OF LEAD LENGTHS, RESISTIVE LOAD

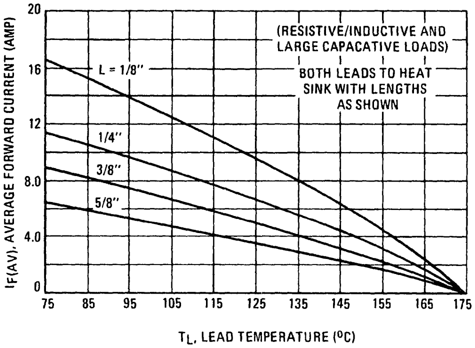


FIGURE 9 – 1/8" LEAD LENGTH, VARIOUS LOADS

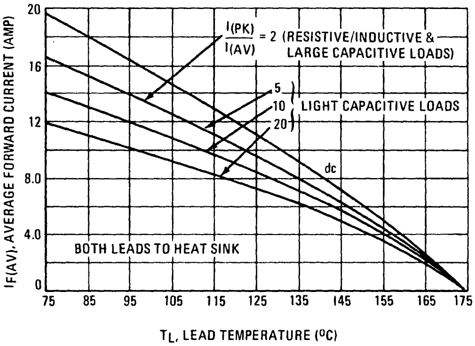
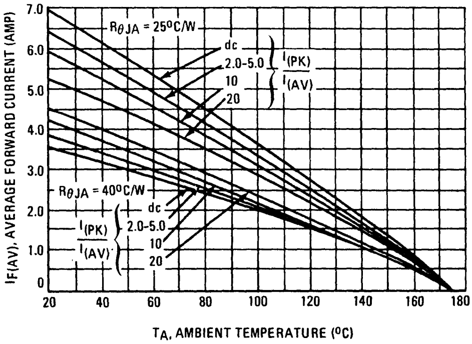


FIGURE 11 – PRINTED CIRCUIT BOARD MOUNTING, VARIOUS LOADS



REVERSE POWER DISSIPATION AND CURRENT

NOTE 3
DERATING FOR REVERSE POWER DISSIPATION

In this rectifier, power loss due to reverse current is generally not negligible. For reliable circuit design, the maximum junction temperature must be limited to either 175°C or the temperature which results in thermal runaway. Proper derating may be accomplished by use of equation 1 or equation 2.

Equation 1 $T_A = T_1 - (175 - T_{J(max)}) - P_R R_{\theta JA}$

Where:

T_1 = Maximum Allowable Ambient Temperature neglecting reverse power dissipation (from Figures 10 or 11)

$T_{J(max)}$ = Maximum Allowable Junction Temperature to prevent thermal runaway or 175°C, whichever is lower. (See Figure 1).

P_R = Reverse Power Dissipation (From Figure 12 or 13, adjusted for $T_{J(max)}$ as shown below)

$R_{\theta JA}$ = Thermal Resistance, Junction to Ambient.

When thermal resistance, junction to ambient, is over 20°C/W, *the effect of thermal response is negligible.* Satisfactory derating may be found by using:

Equation 2 $T_A = T_{J(max)} - (P_R + P_F) R_{\theta JA}$

P_F = Forward Power Dissipation (See Figures 19 & 20)

Other terms defined above.

The reverse power given on Figures 12 and 13 is calculated for T_J = 150°C. When T_J is lower, P_R will decrease, its value can be found by multiplying P_R by the normalized reverse current from Figure 14 at the temperature of interest.

The reverse power data is calculated for half wave rectification circuits. For full wave rectification using either a bridge or a center-tapped transformer, the data for resistive loads is equivalent when V_P is the line to line voltage across the rectifiers. For capacitive loads, it is recommended that the dc case on Figure 13 be used, regardless of input waveform, for bridge circuits. For capacitively loaded full wave center-tapped circuits, the 20:1 data of Figure 12 should be used for sine wave inputs and the capacitive load data of Figure 13 should be used for square wave inputs regardless of $I_{(pk)}/I_{(av)}$. For these two cases, V_P is the voltage across one leg of the transformer.

EXAMPLE:

Find Maximum Ambient Temperature for I_{AV} = 2 A, Capacitive Load of I_{PK}/I_{AV} = 20, Input Voltage = 120 V (rms) Sine Wave, $R_{\theta JA}$ = 25°C/W, Half Wave Circuit.

Solution 1:

Step 1: Find V_P; $V_P = \sqrt{2}\, V_{in}$ = 169 V, $V_{R(pk)}$ = 338 V
Step 2: Find $T_{J(max)}$ from Figure 1. Read $T_{J(max)}$ = 119°C.
Step 3: Find $P_{R(max)}$ from Figure 12. Read P_R = 770 mW @ 140°C
Step 4: Find I_R normalized from Figure 14. Read $I_{R(norm)}$ = 0.4
Step 5. Correct P_R to $T_{J(max)}$. $P_R = I_{R(norm)} \times P_R$ (Figure 12)
P_R = 0.4 x 770 = 310 mW.
Step 6: Find P_F from Figure 19. Read P_F = 2.4 W.
Step 7: Compute T_A from $T_A = T_{J(max)} - (P_R + P_F) R_{\theta JA}$
T_A = 119 - (0.31 + 2.4)(25)
T_A = 51°C

Solution 2:

Steps 1 thru 5 are as above.
Step 6: Find $T_A = T_1$ from Figure 10. Read T_A = 115°C.
Step 7 Compute T_A from $T_A = T_1 - (175 - (T_{J(max)}) - P_R R_{\theta JA}$
T_A = 115 - (175 - 119) - (0.31)(25)
T_A = 51°C

At times, a discrepancy between methods will occur because thermal response is factored into Solution 2.

FIGURE 12 — SINE WAVE INPUT DISSIPATION

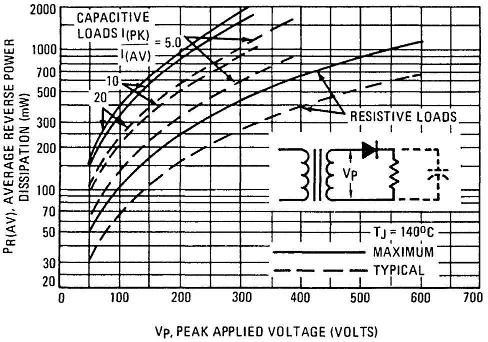


FIGURE 13 — SQUARE WAVE INPUT DISSIPATION

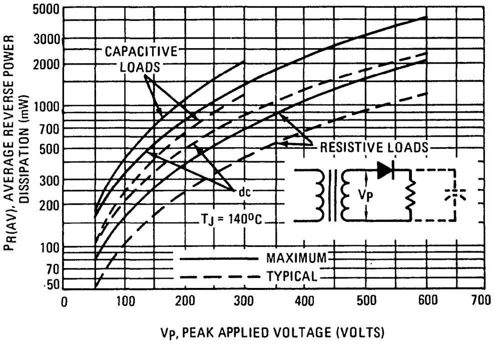


FIGURE 14 — NORMALIZED REVERSE CURRENT

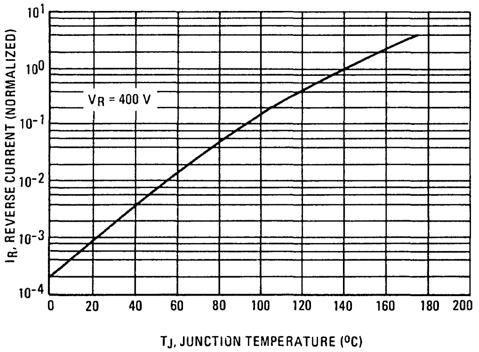
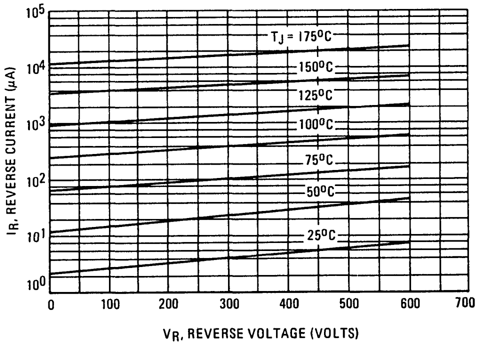


FIGURE 15 — TYPICAL REVERSE CURRENT



3

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STATIC CHARACTERISTICS

FIGURE 16 – FORWARD VOLTAGE

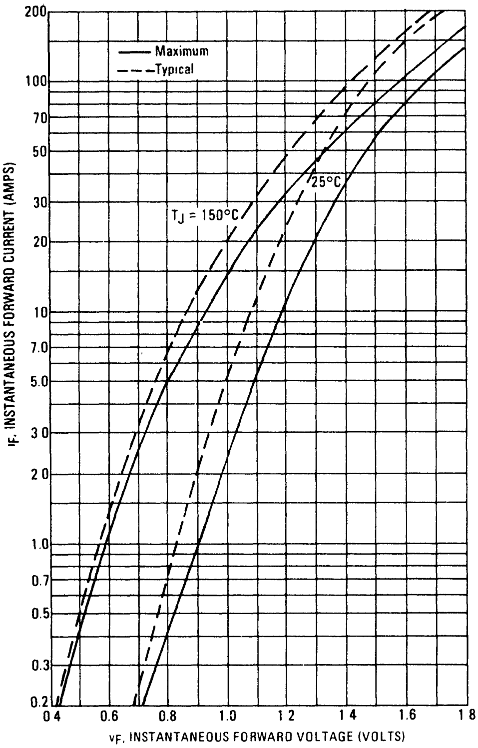


FIGURE 17 – MAXIMUM SURGE CAPABILITY

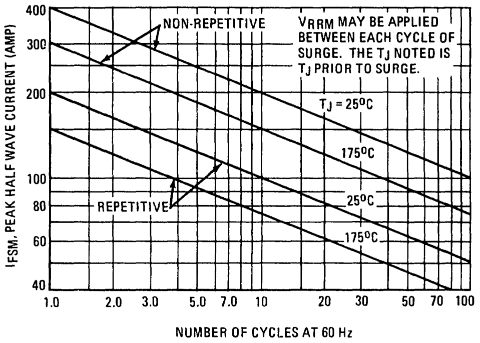
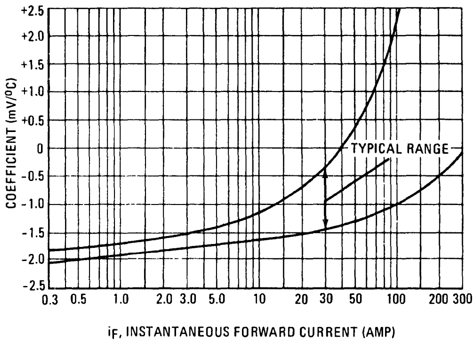


FIGURE 18 – FORWARD VOLTAGE TEMPERATURE COEFFICIENT



MAXIMUM FORWARD POWER DISSIPATION

FIGURE 19 – SINE WAVE INPUT

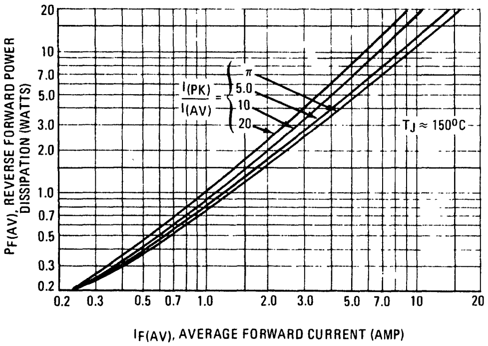
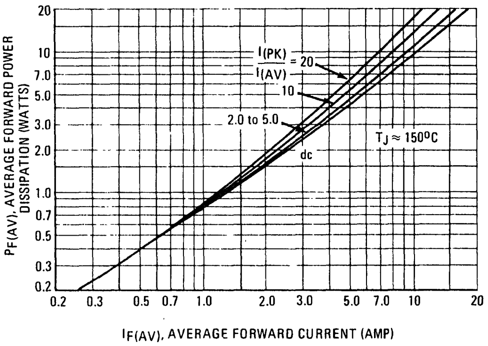


FIGURE 20 – SQUARE WAVE INPUT



TYPICAL RECOVERED STORED CHARGE DATA

(See Note 4)

FIGURE 21 — $T_J = 25^oC$

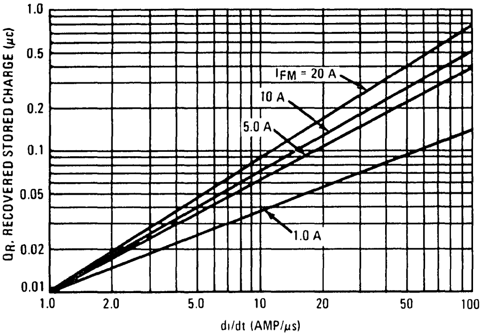


FIGURE 22 — $T_J = 75^oC$

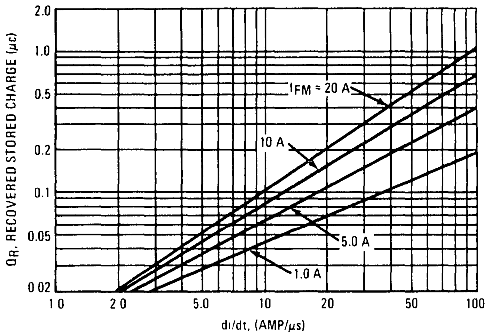


FIGURE 23 — $T_J = 100^oC$

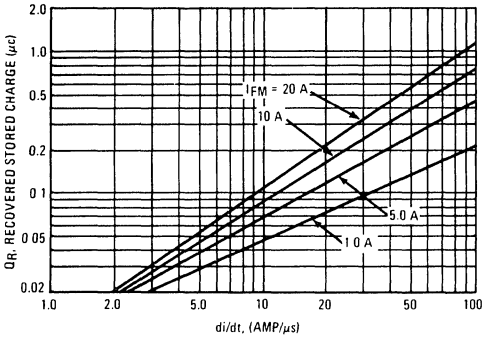
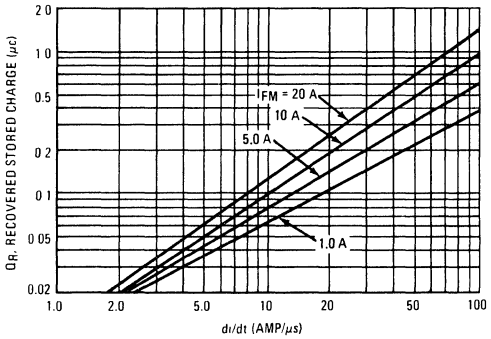


FIGURE 24 — $T_J = 150^oC$



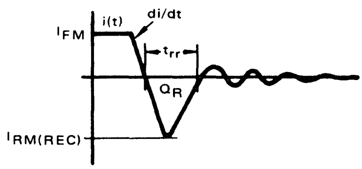
NOTE 4

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using $I_F \approx 1.0$ A, $V_R = 30$ V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, 100°C, and 150°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times \left[Q_R \times di/dt\right]^{1/2}$$

DYNAMIC CHARACTERISTICS

FIGURE 25 — JEDEC REVERSE RECOVERY CIRCUIT

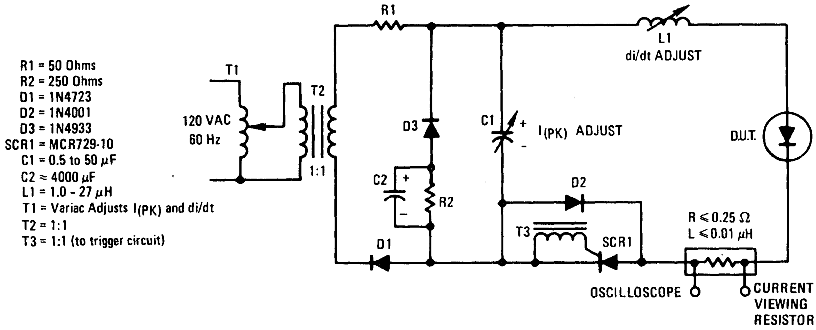


FIGURE 26 — FORWARD RECOVERY TIME

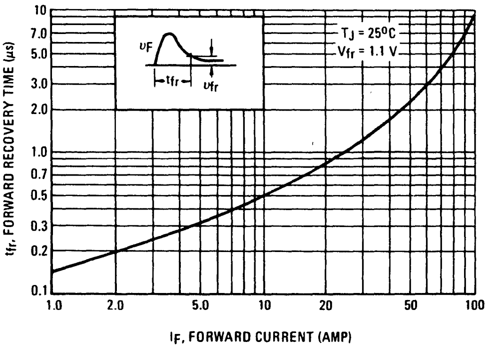
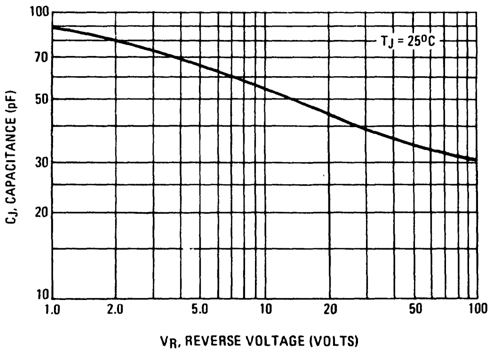
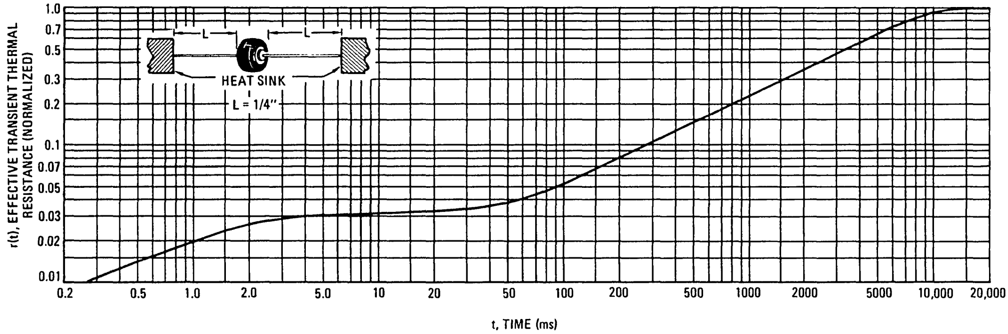


FIGURE 27 — JUNCTION CAPACITANCE



THERMAL CHARACTERISTICS

FIGURE 28 — THERMAL RESPONSE



NOTE 5

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the lead should be measured using a thermocouple placed on the lead as close as possible to the tie point. The thermal mass connected to the tie point is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_L, the junction temperature may be determined by:

$$T_J = T_L + \Delta T_{JL}$$

where ΔT_{JL} is the increase in junction temperature above the lead temperature. It may be determined by:

$$\Delta T_{JL} = P_{pk} \cdot R_{\theta JL}\ [D + (1 - D) \cdot r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where r(t) = normalized value of transient thermal resistance at time t from Figure 29, i.e.:

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.

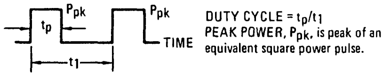
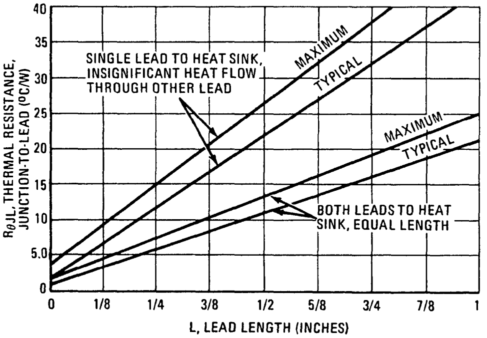
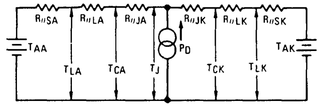


FIGURE 29 — STEADY-STATE THERMAL RESISTANCE



NOTE 6



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. Lowest values occur when one side of the rectifier is brought as close as possible to the heat sink as shown below. Terms in the model signify:

T_A = Ambient Temperature	$R_{\theta S}$ = Thermal Resistance, Heat sink to Ambient
T_L = Lead Temperature	$R_{\theta L}$ = Thermal Resistance, Lead to Heat Sink
T_C = Case Temperature	$R_{\theta J}$ = Thermal Resistance, Junction to Case
T_J = Junction Temperature	P_D = Power Dissipation = P_F + P_R
	P_F = Forward Power Dissipation
	P_R = Reverse Power Dissipation

(Subscripts A and K refer to anode and cathode sides respectively) Values for thermal resistance components are:

$R_{\theta L}$ = 40°C/W/IN. Typically and 44°C/W/IN Maximum.
$R_{\theta J}$ = 2°C/W Typically and 4°C/W Maximum.

Since $R_{\theta J}$ is so low, measurements of the case temperature, T_C, will be approximately equal to junction temperature in practical lead mounted applications. When used as a 60 Hz rectifier, the slow thermal response holds $T_{J(PK)}$ close to $T_{J(AV)}$. Therefore maximum lead temperature may be found as follows:

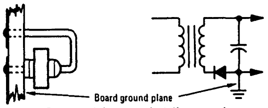
$$T_L = T_{J(max)} - \Delta T_{JL}$$

where

ΔT_{JL} can be approximated as follows:

$\Delta T_{JL} \approx R_{\theta JL} \cdot P_D$; P_D is the sum of forward and reverse power dissipation shown in Figures 12 & 19 for sine wave operation and Figures 13 & 20 for square wave operation.

The recommended method of mounting to a P.C. board is shown on the sketch, where $R_{\theta JA}$ is approximately 25°C/W for a 1-1/2" x 1-1/2" copper surface area. Values of 40°C/W are typical for mounting to terminal strips or P.C. boards where available surface area is small.



Recommended mounting for half wave circuit

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR830 MR831 MR832 MR834 MR836

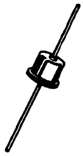
MR832 and MR836 are Motorola Preferred Devices

HERMETICALLY SEALED, AXIAL LEAD MOUNTED FAST RECOVERY POWER RECTIFIERS

. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

FAST RECOVERY POWER RECTIFIERS

50-600 VOLTS
3 AMPERES



CASE 60-01

3

MAXIMUM RATINGS

Rating	Symbol	MR830	MR831	MR832	MR834	MR836	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Average Rectified Forward Current (Single phase, resistive load, $T_C = 100°C$)	I_O	← 3.0 →					Amps
Non-Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	← 100 →					Amps
Operating Junction Temperature Range	T_J	← −65 to +150 →					°C
Storage Temperature Range	T_{stg}	← −65 to +175 →					°C

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Max	Unit
Forward Voltage ($I_F = 3.0$ Adc, $T_A = 25°C$)	V_F	–	1.1	Volts
Reverse Current (rated DC Voltage) $T_A = 25°C$	I_R	–	0.5	mA
$T_A = 100°C$		–	1.5	

REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time ($I_F = 1.0$ Amp to $V_R = 30$ Vdc)	t_{rr}	–	150	200	ns
($I_{FM} = 15$ Amp, di/dt = 25 A/μs)		–	150	300	ns
Reverse Recovery Current ($I_F = 1.0$ Amp to $V_R = 30$ Vdc)	$I_{RM(REC)}$	–	–	2.0	Amp

MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed
FINISH: All external surfaces corrosion resistant and leads readily solderable
POLARITY: Cathode to Case
WEIGHT: 2.4 Grams (Approximately)

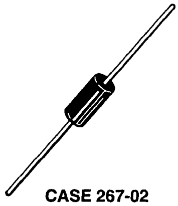
Axial Lead Fast Recovery Rectifiers

MR850
MR851
MR852
MR854
MR856

MR852 and MR856 are Motorola Preferred Devices

Axial lead mounted fast recovery power rectifiers are designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 100 nanoseconds providing high efficiency at frequencies to 250 kHz.

FAST RECOVERY POWER RECTIFIERS
50–600 VOLTS
3.0 AMPERE



CASE 267-02

Mechanical Characteristics

Case: Void free, Transfer Molded
Finish: External Leads are Plated, Leads are readily Solderable
Polarity: Cathode Indicated by Polarity Band
Weight: 1.1 Grams (Approximately)
Maximum Lead Temperature for Soldering Purposes: 300°C, 1/8″ from case for 10 s at 5.0 lb. tension

3

MAXIMUM RATINGS

Rating	Symbol	MR850	MR851	MR852	MR854	MR856	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Non-Repetitive Peak Reverse Voltage	V_{RSM}	75	150	250	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	Volts
Average Rectified Forward Current (Single phase resistive load, T_A = 80°C)	I_O	3.0					Amp
Non-Repetitive Peak Surge Current (surge applied at rated load conditions)	I_{FSM}	100 (one cycle)					Amp
Operating and Storage Junction Temperature Range	T_J, T_{stg}	– 65 to +125 – 65 to +150					°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient (Recommended Printed Circuit Board Mounting, See Note 4, Page 5)	$R_{\theta JA}$	28	°C/W

Preferred devices are Motorola recommended choices for future use and best overall value.

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Forward Voltage (I_F = 3.0 Amp, T_J = 25°C)	V_F	—	1.04	1.25	Volts
Reverse Current (rated dc voltage) T_J = 25°C	I_R	—	2.0	10	μA
T_J = 80°C MR850		—	—	150	
T_J = 80°C MR851		—	60	150	
T_J = 80°C MR852		—	—	200	
T_J = 80°C MR854		—	—	250	
T_J = 80°C MR856		—	100	300	

REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	t_{rr}				ns
(I_F = 1.0 Amp to V_R = 30 Vdc, Figure 9)		—	100	200	
(I_F = 15 Amp, di/dt = 10 A/μs, Figure 10)		—	150	300	
Reverse Recovery Current (I_F = 1.0 Amp to V_R = 30 Vdc, Figure 9)	$I_{RM(REC)}$	—	—	2.0	Amp

3

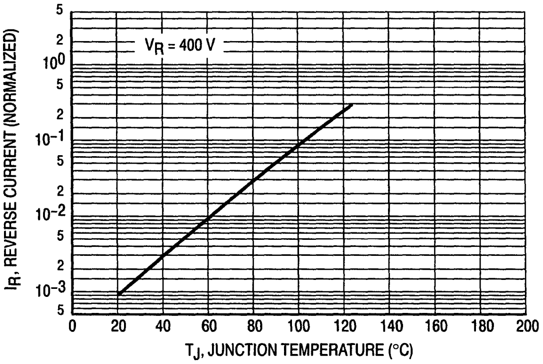


Figure 1. Normalized Reverse Current

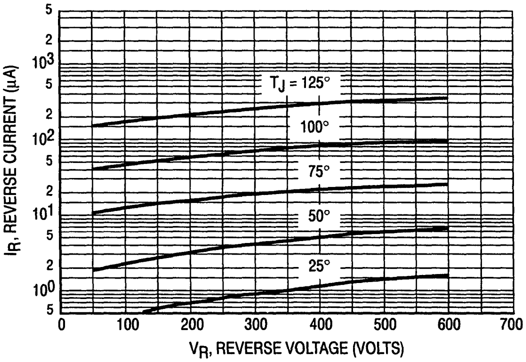


Figure 2. Typical Reverse Current

STATIC CHARACTERISTICS

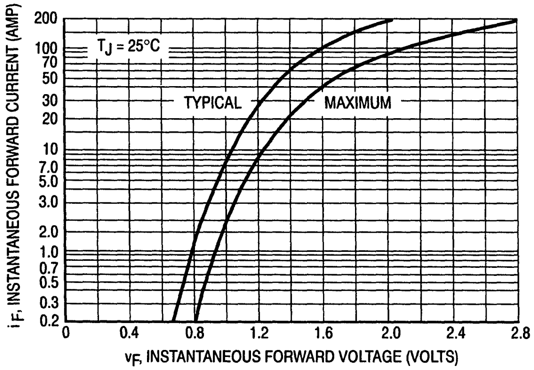


Figure 3. Forward Voltage

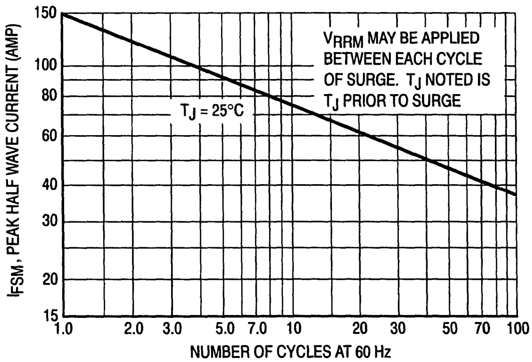


Figure 4. Maximum Non-Repetitive Surge Capability

STATIC CHARACTERISTICS (continued)

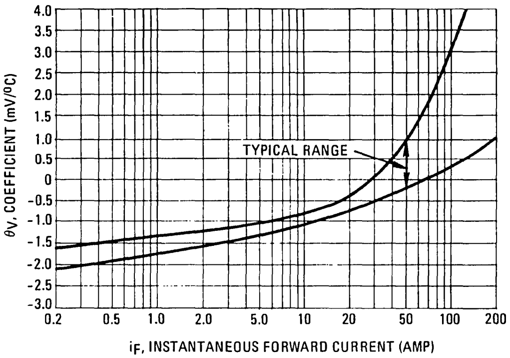


Figure 5. Forward Voltage Temperature Coefficient

TYPICAL RECOVERED STORED CHARGE DATA (See Note 1)

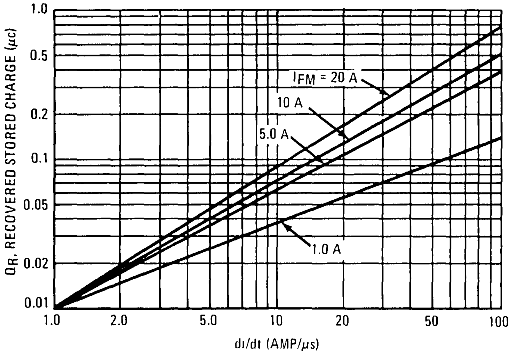


Figure 6. $T_J = 25°C$

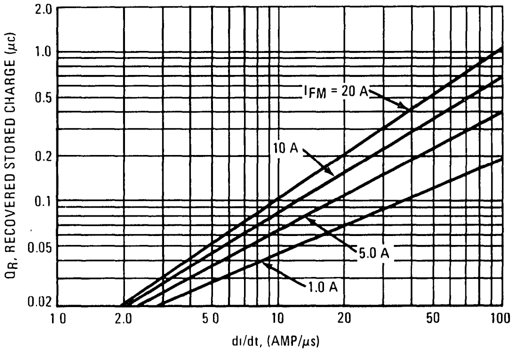


Figure 7. $T_J = 75°C$

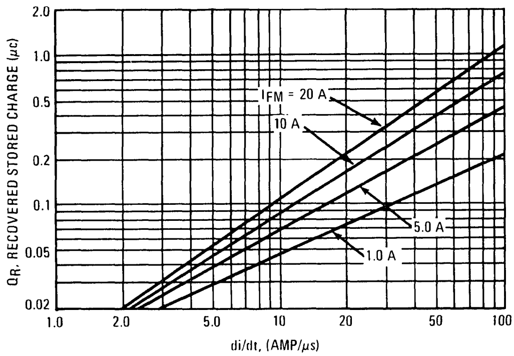


Figure 8. $T_J = 100°C$

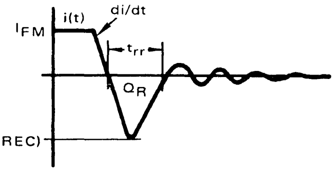
NOTE 1

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers is rated under a fixed set of conditions using $I_F = 1.0$ A, $V_R = 30$ V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, and 100°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



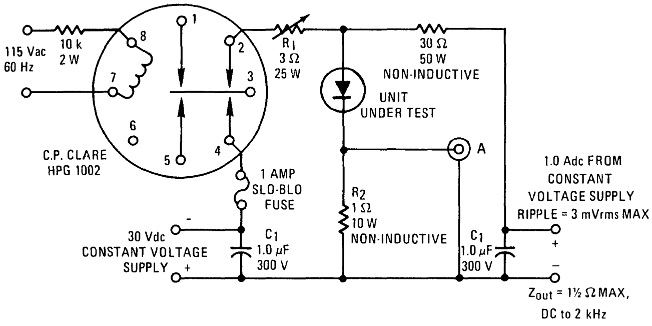
From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt} \right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times [Q_R \times di/dt]^{1/2}$$

3

DYNAMIC CHARACTERISTICS



MINIMIZE ALL LEAD LENGTHS

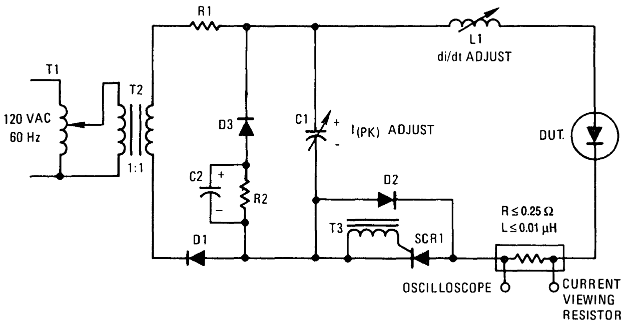
A – TEKTRONIX 545A, K PLUG IN PRE-AMP, P6000 PROBE OR EQUIVALENT

R_1 – ADJUSTED FOR 1.4 Ω BETWEEN POINT 2 OF RELAY AND RECTIFIER INDUCTANCE ≈ 38 μH

R_2 – TEN-1 W, 10 Ω, 1% CARBON CORE IN PARALLEL

$T_A = 25 ^{+10}_{-0}$ °C FOR RECTIFIER

Figure 9. Reverse Recovery Circuit



R1 = 50 Ohms
R2 = 250 Ohms
D1 = 1N4723
D2 = 1N4001
D3 = 1N4934
SCR1 = MCR729-10
C1 = 0.5 to 50 μF
C2 ≈ 4000 μF
L1 = 1.0 - 27 μH
T1 = Variac Adjusts $I_{(PK)}$ and di/dt
T2 = 1:1
T3 = 1:1 (to trigger circuit)

Figure 10. JEDEC Reverse Recovery Circuit

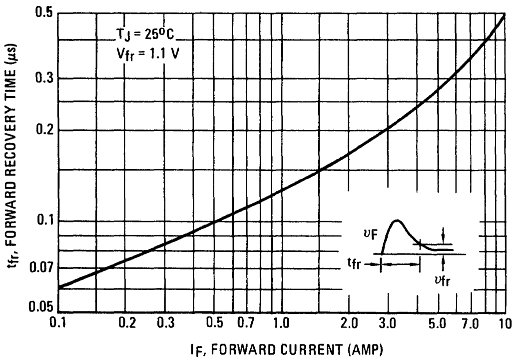


Figure 11. Forward Recovery Time

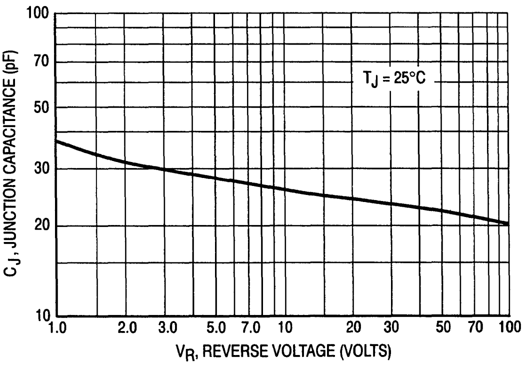


Figure 12. Junction Capacitance

DYNAMIC CHARACTERISTICS (continued)

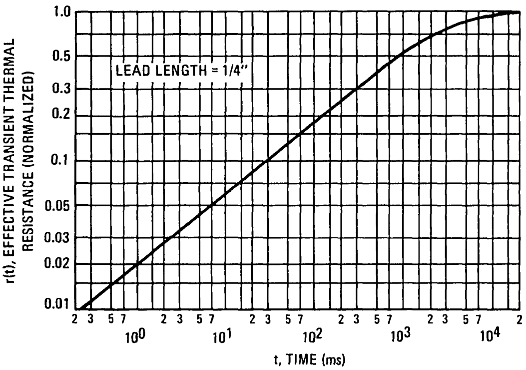


Figure 13. Thermal Response

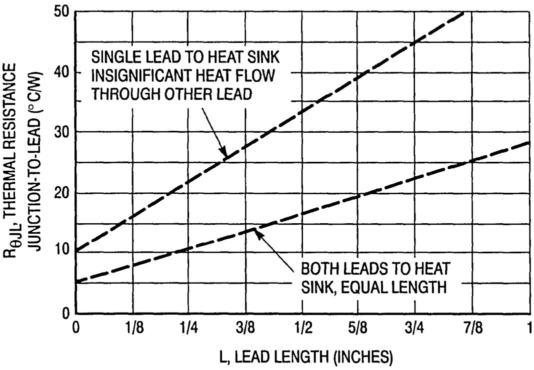


Figure 14. Steady-State Thermal Resistance

NOTE 2

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended:

The temperature of the lead should be measured using a thermocouple placed on the lead as close as possible to the tie point. The thermal mass connected to the tie point is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_L, the junction temperature may be determined by:

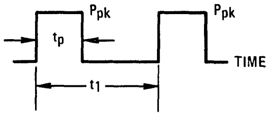
$$T_J = T_L + \Delta T_{JL}$$

where ΔT_{JL} is the increase in junction temperature above the lead temperature. It may be determined by:

$$\Delta T_{JL} = P_{pk} \bullet R_{\theta JL} [D + (1 - D) \bullet r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where r(t) = normalized value of transient thermal resistance at time t from Figure 13, i.e.:

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$.



DUTY CYCLE = t_p/t_1
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

NOTE 3

Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heat sink. Terms in the model signify:

T_A = Ambient Temperature
T_L = Lead Temperature
T_C = Case Temperature
T_J = Junction Temperature
$R_{\theta S}$ = Thermal Resistance, Heat Sink to Ambient
$R_{\theta JL}$ = Thermal Resistance, Lead to Heat Sink
$R_{\theta J}$ = Thermal Resistance, Junction to Case
P_D = Total Power Dissipation = $P_F + P_R$
P_F = Forward Power Dissipation
P_R = Reverse Power Dissipation

(Subscripts A and K refer to anode and cathode sides respectively.) Values for thermal resistance components are:

$R_{\theta L}$ = 46°C/W/IN. Typically and 48°C/W/IN Maximum.
$R_{\theta J}$ = 10°C/W Typically and 16°C/W Maximum.

The maximum lead temperature may be found as follows:

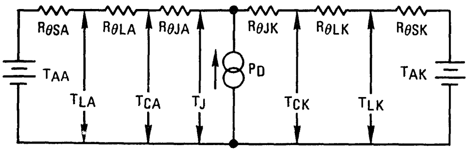
$$T_L = T_{J(max)} - \Delta T_{JL}$$

where

ΔT_{JL} can be approximated as follows:

$\Delta T_{JL} \approx R_{\theta JL} \bullet P_D$; P_D is the sum of forward and reverse power dissipation.

THERMAL CIRCUIT MODEL
(For Heat Conduction Through the Leads)

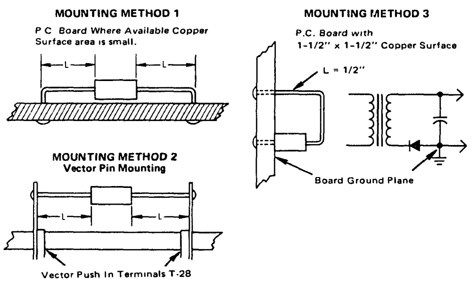


NOTE 4

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD	LEAD LENGTH, L (IN)				$R_{\theta JA}$
	1/8	1/4	1/2	3/4	
1	50	51	53	55	°C/W
2	58	59	61	63	°C/W
3	28				°C/W



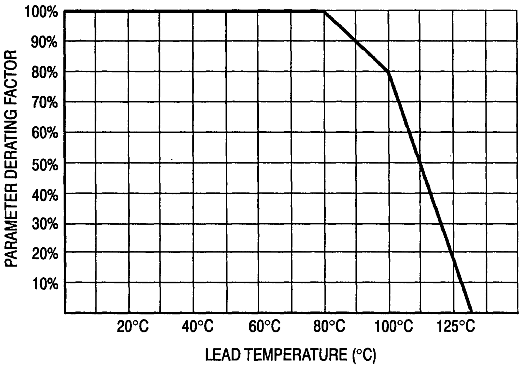


Figure 15. Parametric Derating Curve

SCANSWITCH™

Power Rectifier For High and Very High Resolution Monitors

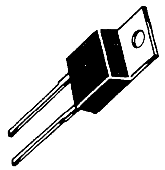
MR10120E

Motorola Preferred Device

This state-of-the-art Power Rectifier is specifically designed for use as a Damper Diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MR10120E is fully realized when paired with either the MW16206 or MJF16206 monitor specific, 1200 volt bipolar power transistor.

- 1200 Volt Blocking Voltage
- 20 mJ Avalanche Energy (Guaranteed)
- 12 Volt (Typical) Peak Transient Overshoot Voltage
- 135 ns (Typical) Forward Recovery Time

SCANSWITCH POWER RECTIFIER 10 AMPERES 1200 VOLTS



CASE 221B-02
TO-220AC

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	$I_{F(AV)}$	10	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 125°C	I_{FRM}	20	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction Temperature	T_J	−65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage (1)	v_F			Volts
(i_F = 6.5 Amps, T_J = 125°C)		0.9	1.3	
(i_F = 6.5 Amps, T_J = 25°C)		1.0	1.5	
Maximum Instantaneous Reverse Current (1)	i_R			μA
(Rated dc Voltage, T_J = 25°C)		5.0	50	
(Rated dc Voltage, T_J = 125°C)		50	500	
Maximum Reverse Recovery Time (I_F = 1.0 Amps, di/dt = 50 Amps/μs)	t_{rr}	0.75	1.0	μs
Maximum Forward Recovery Time (I_F = 6.5 Amps, di/dt = 12 Amps/μs) (As Measured on a Deflection Circuit)	t_{fr}	135	175	ns
Peak Transient Overshoot Voltage	V_{RFM}	12	14	Volts

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

SCANSWITCH is a trademark of Motorola Inc.

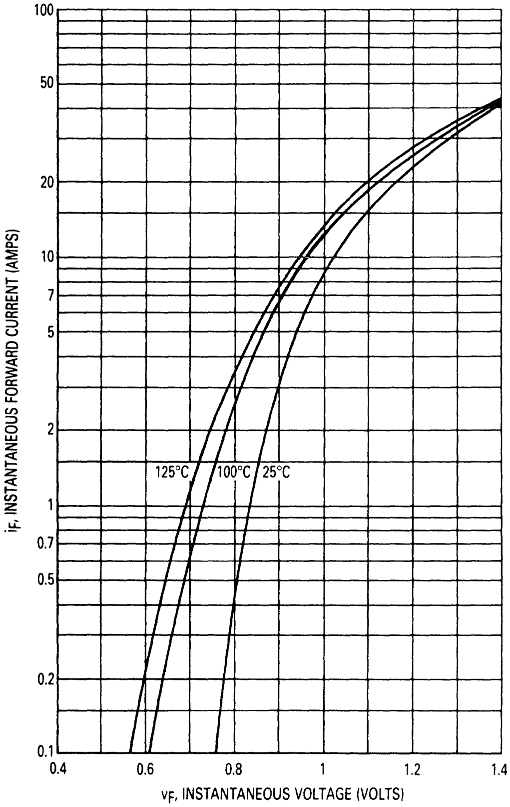


Figure 1. Typical Forward Voltage

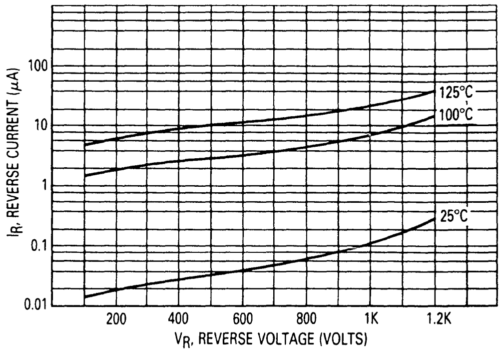


Figure 2. Typical Reverse Current

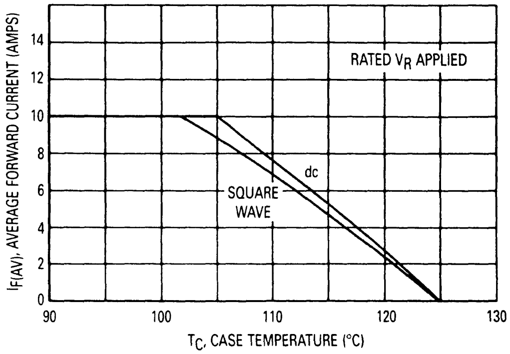


Figure 3. Current Derating (Case)

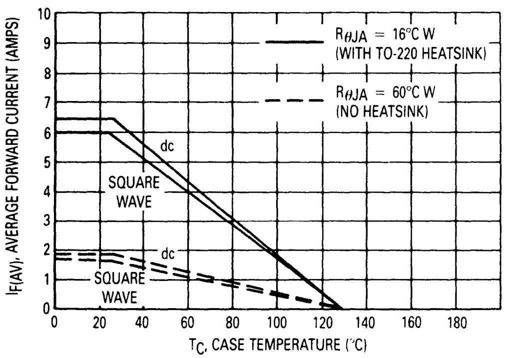


Figure 4. Current Derating Ambient

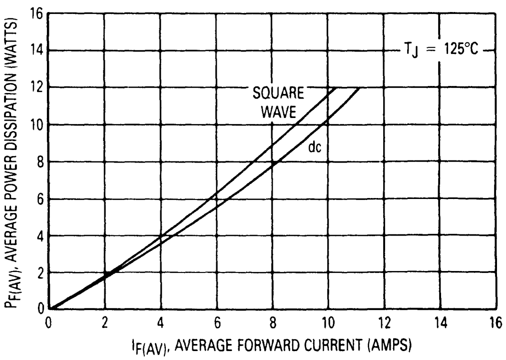


Figure 5. Forward Power Dissipation

3

Advance Information

SCANSWITCH™

Power Rectifier for use as a Damper Diode in High and Very High Resolution Monitors

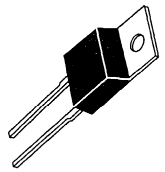
MR10150E

Motorola Preferred Device

**SCANSWITCH RECTIFIERS
10 AMPERES
1500 VOLTS**

The MR10150E is a state-of-the-art Power Rectifier specifically designed for use as a damper diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MR10150E is fully realized when paired with either the MJW16212 or MJF16212 monitor specific, 1500 V bipolar power transistor.

- 1500 V Blocking Voltage
- 20 mJ Avalanche Energy Guaranteed
- Peak Transient Overshoot Voltage Specified, 14 Volt (typical)
- Forward Recovery Time Specified, 175 ns (typical)
- Epoxy Meets UL94, V_O at 1/8″



CASE 221B-02
TO-220AC

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1500	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 125°C	$I_{F(AV)}$	10	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 125°C	I_{FRM}	20	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage (1)	v_F			Volts
(i_F = 6.5 Amps, T_J = 125°C)		1.1	1.6	
(i_F = 6.5 Amps, T_J = 25°C)		1.3	1.8	
Maximum Instantaneous Reverse Current (1)	i_R			µA
(Rated dc Voltage, T_J = 125°C)		750	1000	
(Rated dc Voltage, T_J = 25°C)		25	100	
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/µs)	t_{rr}	0.5	1.0	µs
Maximum Forward Recovery Time (I_F = 6.5 Amp, di/dt = 12 Amps/µs)	t_{fr}	135	175	ns
Peak Transient Overshoot Voltage	V_{RFM}	14	16	Volts

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR1120 thru MR1126 MR1128 MR1130

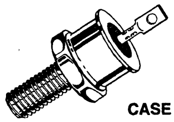
MR1124 and MR1130 are Motorola Preferred Devices

MEDIUM-CURRENT SILICON RECTIFIER

Medium-current silicon rectifiers feature high surge current capacity, and low forward voltage drop.

MEDIUM-CURRENT SILICON RECTIFIERS

50-1000 VOLTS
12 AMPERES



CASE 245A-02

3

MAXIMUM RATINGS

Rating	Symbol	MR 1120	MR 1121	MR 1122	MR 1123	MR 1124	MR 1125	MR 1126	MR 1128	MR 1130	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	300	400	500	600	800	1000	Volts
Non-Repetitive Peak Reverse Voltage (one half-wave, single phase, 60 cycle peak)	V_{RSM}	100	200	300	400	500	600	720	100	1200	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	210	280	350	420	560	700	Volts
Average Rectified Forward Current (single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	← 12 →									Amp
Peak Repetitive Forward Current (T_C = 150°C)	I_{FRM}	← 75 →									Amp
Non-Repetitive Peak Surge Current (superimposed on rated current at rated voltage, T_C = 150°C)	I_{FSM}	← 300 (for 1/2 cycle) →									Amp
I^2t Rating (non-repetitive, 1 ms <t <8.3 ms)	I^2t	← 375 →									$A_{(rms)}^2s$
Maximum Junction Operating and Storage Temperature Range	T_J, T_{stg}	← −65 to +190 →									°C

ELECTRICAL CHARACTERISTICS (All Types)

Characteristic	Symbol	Max	Unit
Full Cycle Average Forward Voltage Drop (I_O = 12 Amps and Rated V_r, T_C = 150°C, Half Wave Rectifier)	$V_{F(AV)}$	0.55	Volts
DC Forward Voltage Drop (I_F = 12 Adc, T_C = 25°C)	V_F	1.0	Volts
Full Cycle Average Reverse Current (I_O = 12 Amps and Rated V_r, T_C = 150°C, Half Wave Rectifier)	$I_{R(AV)}$	1.5	mA
DC Reverse Current (Rated V_R, T_C = 25°C)	I_R	0.5	mA

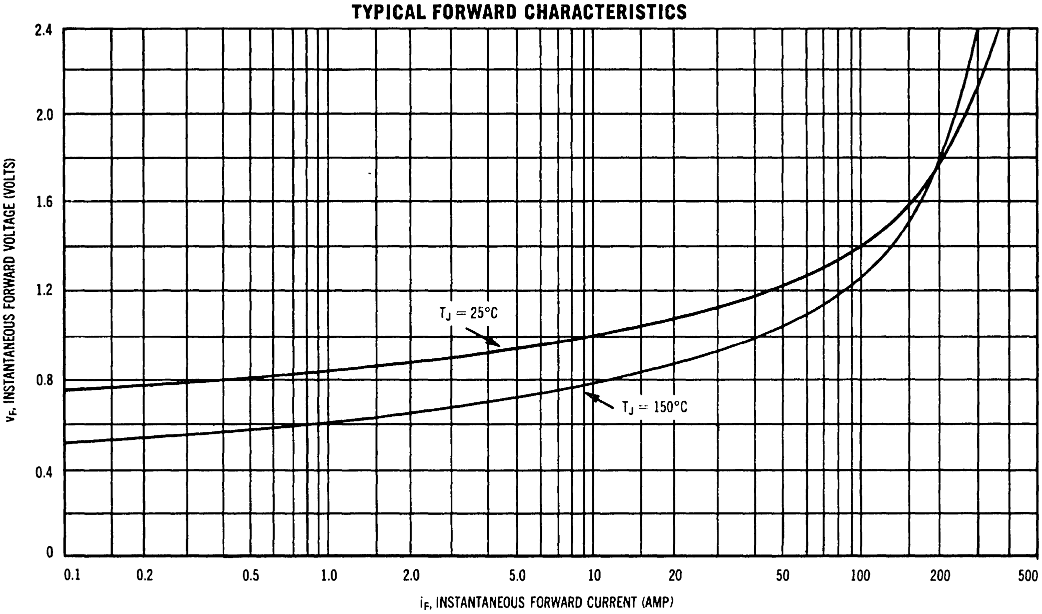
THERMAL CHARACTERISTICS

Maximum Steady State DC Thermal Resistance, $R_{\theta JC}$: 2.5°C/Watt

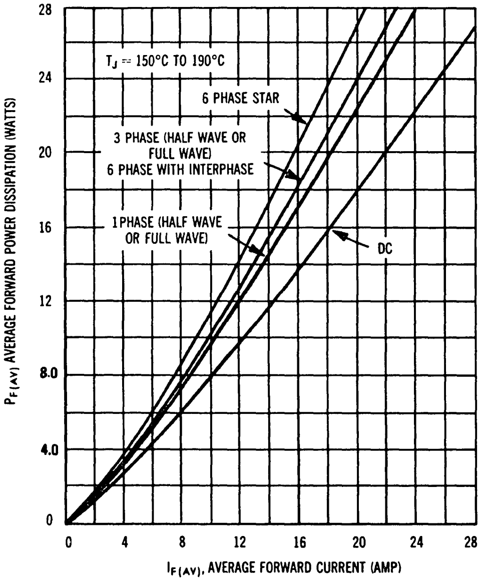
MECHANICAL CHARACTERISTICS

CASE: Welded, hermetically sealed construction.
FINISH: All external surfaces corrosion-resistant and the terminal lug is readily solderable.
POLARITY: CATHODE-TO-CASE (reverse polarity units are available upon request and are designated by an "R" suffix i.e. MR1120R).
MOUNTING POSITIONS: Any
STUD TORQUE: 15 in-lbs maximum.

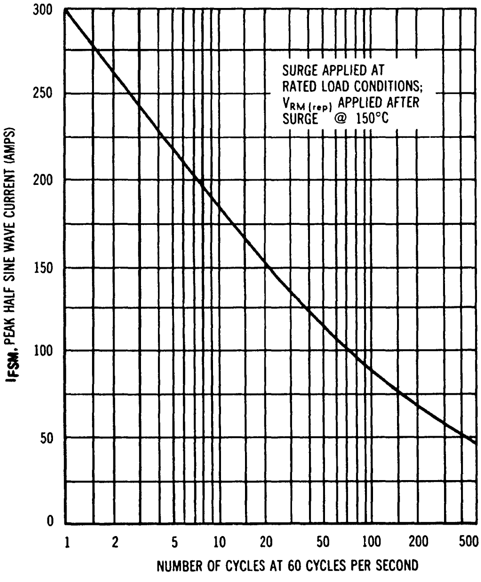
TYPICAL FORWARD CHARACTERISTICS



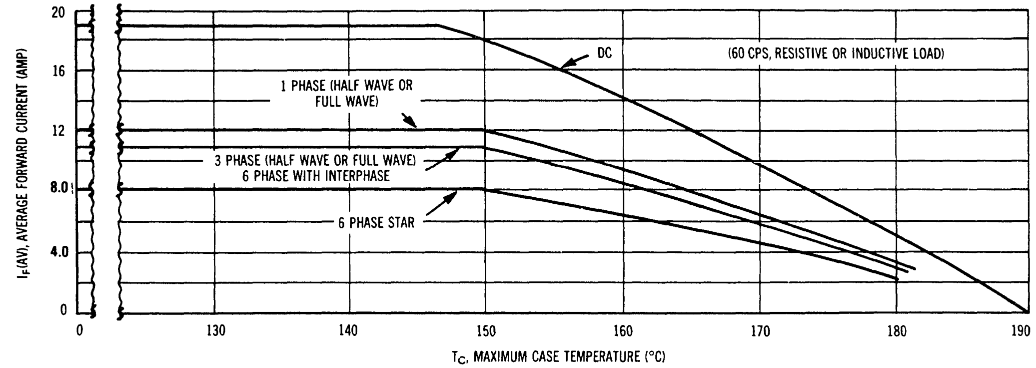
FORWARD POWER DISSIPATION



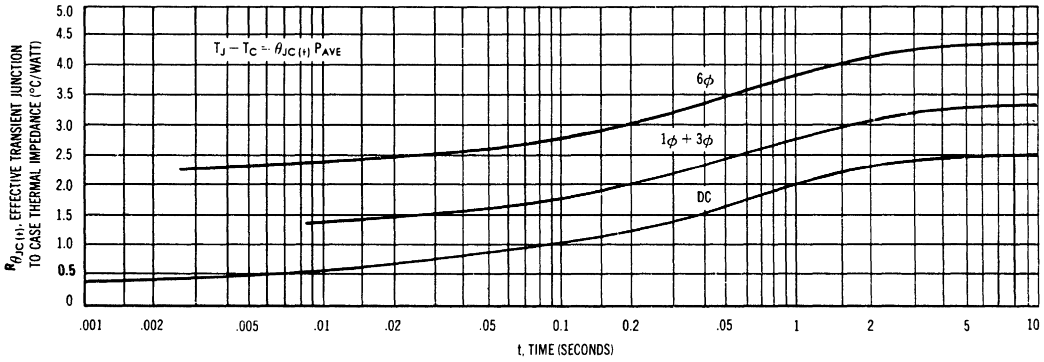
MAXIMUM ALLOWABLE SURGE CURRENT



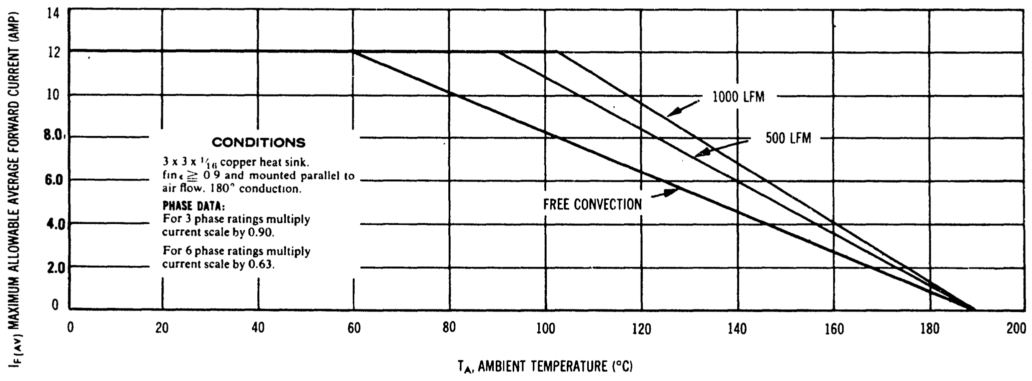
MAXIMUM CURRENT RATINGS



EFFECTIVE TRANSIENT THERMAL IMPEDANCE



CURRENT DERATING DATA



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR2000 Series

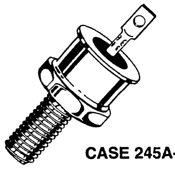
MR2004 and MR2010 are Motorola Preferred Devices

MEDIUM-CURRENT SILICON RECTIFIERS

. . . compact, highly efficient silicon rectifiers for medium-current applications requiring:

- High Current Surge — 400 Amperes @ T_J = 175°C
- Peak Performance @ Elevated Temperature — 20 Amperes @ T_C = 150°C
- Low Cost
- Compact, Molded Package — For Optimum Efficiency in a Small Case Configuration

MEDIUM-CURRENT SILICON RECTIFIERS
50-1000 VOLTS
20 AMPERES
DIFFUSED JUNCTION



CASE 245A-02

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MECHANICAL CHARACTERISTICS

CASE: Void Free, Transfer Molded.
FINISH: All External Surfaces are Corrosion-Resistant and the Terminal Lead is Readily Solderable.
POLARITY: Cathode to Case (Reverse Polarity Units are Available and Designated by an "R" Suffix i.e., MR2000SR).
MOUNTING POSITIONS: Any
MOUNTING TORQUE: 15 in-lb max
MAXIMUM TERMINAL TEMPERATURE FOR SOLDERING PURPOSES: 275°C for 10 Seconds @ 3 Kg Tension.
WEIGHT: 6 Grams (Approximately).

MAXIMUM RATINGS

Characteristic	Symbol	MR 2000	MR 2001	MR 2002	MR 2004	MR 2006	MR 2008	MR 2010	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
Non-Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz peak)	V_{RSM}	60	120	240	480	720	960	1200	Volts
RMS Forward Current	$I_{(RMS)}$	← 40 →							Amp
Average Rectified Forward Current (Single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	← 20 →							Amp
Non-Repetitive Peak Surge Current (surge applied @ rated load conditions, half wave, single phase, 60 Hz)	I_{FSM}	← 400 (for 1 cycle) →							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 Case	$R_{\theta JC}$	1.3	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (i_F = 63 Amp, T_C = 25°C)	v_F	1.1	Volts
Maximum Reverse Current (rated dc voltage) T_C = 25°C T_C = 100°C	I_R	100 500	μA

3

FIGURE 1 – FORWARD VOLTAGE

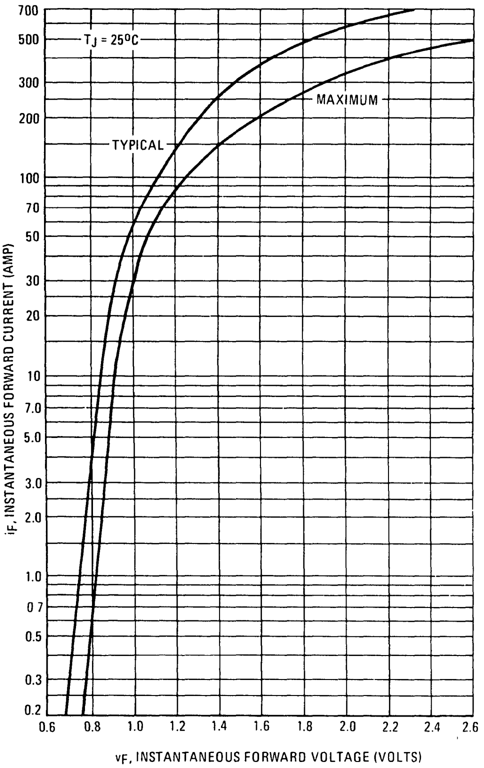


FIGURE 2 – NON-REPETITIVE SURGE CURRENT

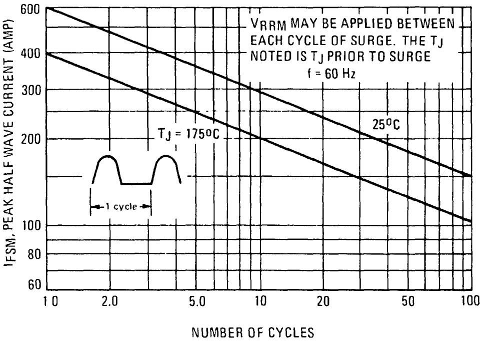


FIGURE 3 – FORWARD VOLTAGE TEMPERATURE COEFFICIENT

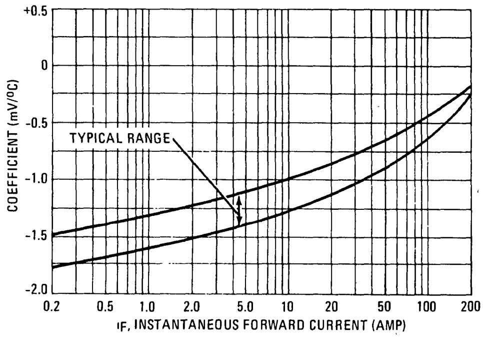


FIGURE 4 – CURRENT DERATING

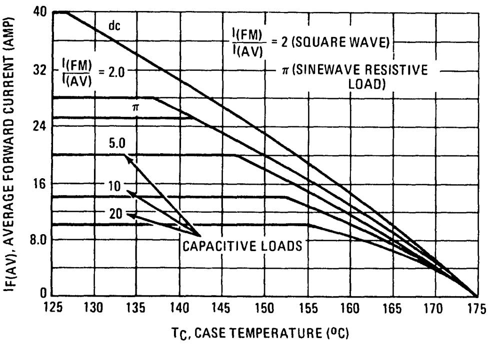


FIGURE 5 – FORWARD POWER DISSIPATION

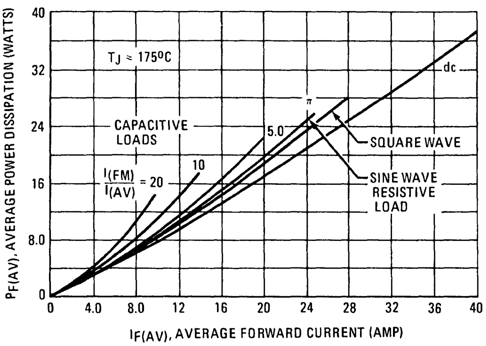
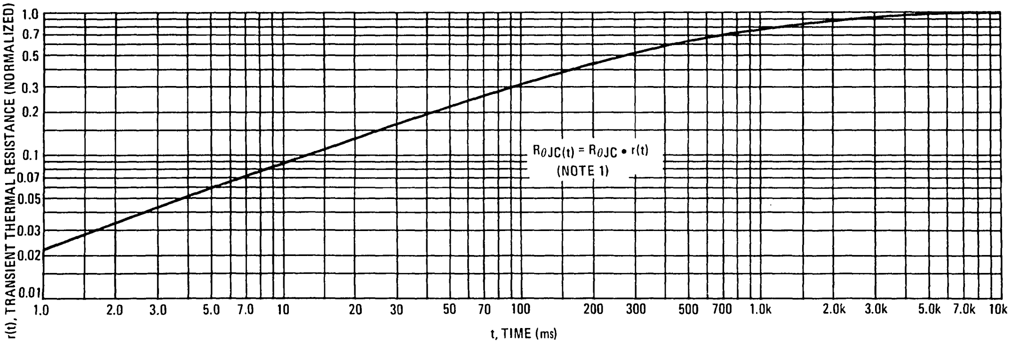
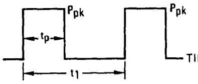


FIGURE 6 – THERMAL RESPONSE



NOTE 1



DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended.

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see the outline drawing on page 1) The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady state conditions are achieved Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature It may be determined by.

$$\Delta T_{JC} = P_{pk} \bullet R_{\theta JC} [D + (1 - D) \bullet r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 6, i.e.,

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

FIGURE 7 – CAPACITANCE

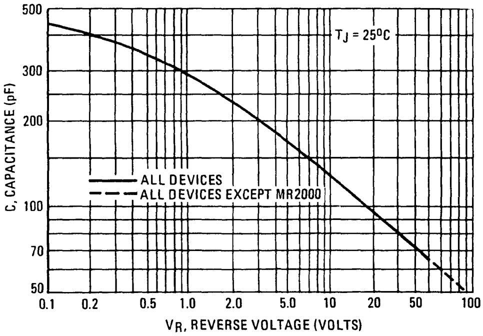


FIGURE 8 – FORWARD RECOVERY TIME

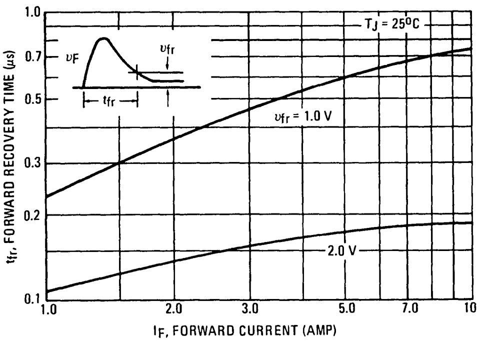


FIGURE 9 – REVERSE RECOVERY TIME

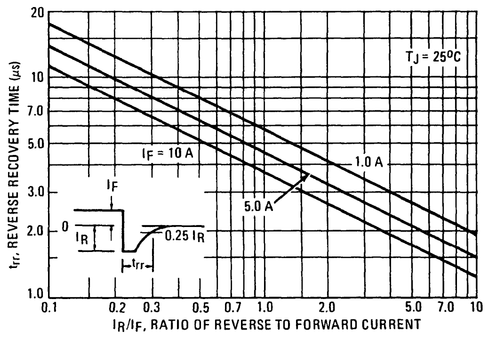
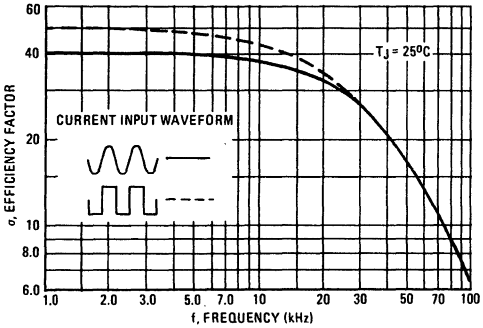


FIGURE 10 – RECTIFICATION WAVEFORM EFFICIENCY



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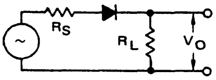
RECTIFICATION EFFICIENCY NOTE

FIGURE 11 – SINGLE-PHASE HALF-WAVE RECTIFIER CIRCUIT



The rectification efficiency factor σ shown in Figure 10 was calculated using the formula:

$$\sigma = \frac{P_{dc}}{P_{rms}} = \frac{\frac{V^2_{O(dc)}}{R_L}}{\frac{V^2_{O(rms)}}{R_L}} \bullet 100\% = \frac{V^2_{O(dc)}}{V^2_{O(ac)} + V^2_{O(dc)}} \bullet 100\% \quad (1)$$

For a sine wave input $V_m \sin(\omega t)$ to the diode, assume lossless, the maximum theoretical efficiency factor becomes:

$$\sigma_{(sine)} = \frac{\frac{V^2_m}{\pi^2 R_L}}{\frac{V^2_m}{4R_L}} \bullet 100\% = \frac{4}{\pi^2} \bullet 100\% = 40.6\% \quad (2)$$

For a square wave input of amplitude V_m, the efficiency factor becomes:

$$\sigma_{(square)} = \frac{\frac{V^2_m}{2R_L}}{\frac{V^2_m}{R_L}} \bullet 100\% = 50\% \quad (3)$$

(A full wave circuit has twice these efficiencies)

As the frequency of the input signal is increased, the reverse recovery time of the diode (Figure 9) becomes significant, resulting in an increasing ac voltage component across R_L which is opposite in polarity to the forward current, thereby reducing the value of the efficiency factor σ, as shown on Figure 10.

It should be emphasized that Figure 10 shows waveform efficiency only; it does not provide a measure of diode losses. Data was obtained by measuring the ac component of V_O with a true rms ac voltmeter and the dc component with a dc voltmeter. The data was used in Equation 1 to obtain points for Figure 10.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR2400 thru MR2406

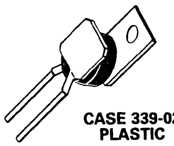
MR2404 and MR2406 are Motorola Preferred Devices

TAB-MOUNTED MEDIUM-CURRENT SILICON RECTIFIERS

. . . compact, highly efficient silicon rectifiers for medium current applications requiring:

- High Current Surge — 400 Amperes @ T_J = 175°C
- Peak Performance @ Elevated Temperature — 24 Amperes @ T_C = 150°C
- Low Cost
- Same Mounting as a TO-220AB

MEDIUM-CURRENT SILICON RECTIFIERS
50-600 VOLTS
24 AMPERES



CASE 339-02
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MR2400	MR2401	MR2402	MR2404	MR2406	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Nonrepetitive Peak Reverse Voltage (half wave, single phase, 60 Hz peak)	V_{RSM}	60	120	240	480	720	Volts
Average Rectified Forward Current (Single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	← 24 →					Amp
Nonrepetitive Peak Surge Current (surge applied @ rated load conditions, half wave, single phase, 60 Hz)	I_{FSM}	← 400 (for 1 cycle) →					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 Case	$R_{\theta JC}$	0.8	°C/W
Thermal Resistance, Junction to Air PC Board Mount, Perpendicular to Surface	$R_{\theta JA}$	55	°C/W

ELECTRICAL CHARACTERISTICS

Characteristics and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (i_F = 75.4 Amp, T_C = 25°C)	v_F	1.18	Volts
Maximum Reverse Current (rated dc voltage) T_C = 25°C T_C = 100°C	I_R	 25 1.0	 μA mA

MECHANICAL CHARACTERISTICS

CASE: Plastic encapsulated, metal tabs.

FINISH: All external surfaces are corrosion resistant and the leads are readily solderable.

POLARITY: Cathode to tab with hole; Reverse polarity available by adding "R" Suffix, MR2402R.

MOUNTING TORQUE: 8 in-lb max

MAXIMUM TEMPERATURE FOR SOLDERING PURPOSES: 350°C, 3/8" from case for 10 seconds.

WEIGHT: 3.6 Grams (Approximately).

3

FIGURE 1 — FORWARD VOLTAGE

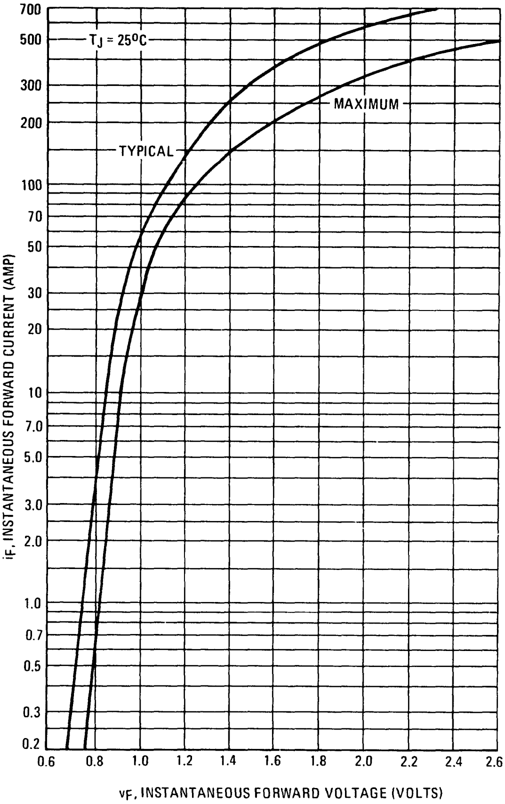


FIGURE 2 — NONREPETITIVE SURGE CURRENT

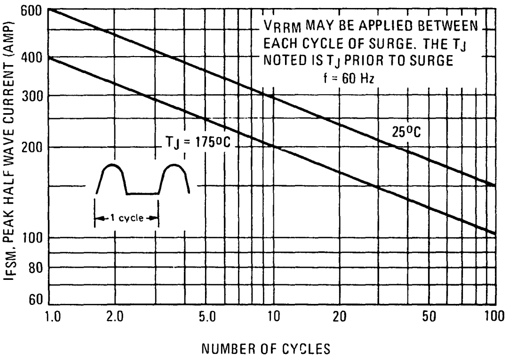


FIGURE 3 — FORWARD VOLTAGE TEMPERATURE COEFFICIENT

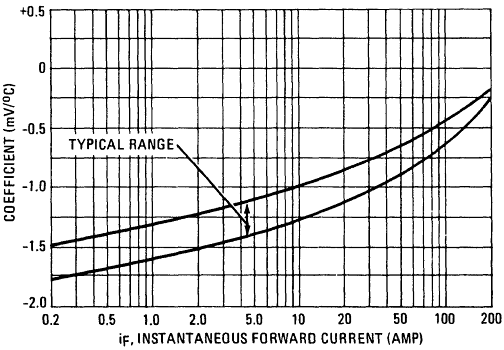


FIGURE 4 — CURRENT DERATING

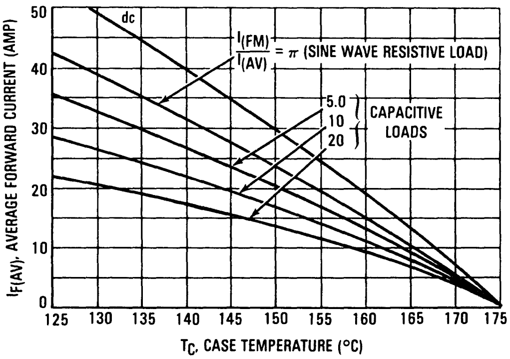


FIGURE 5 — FORWARD POWER DISSIPATION

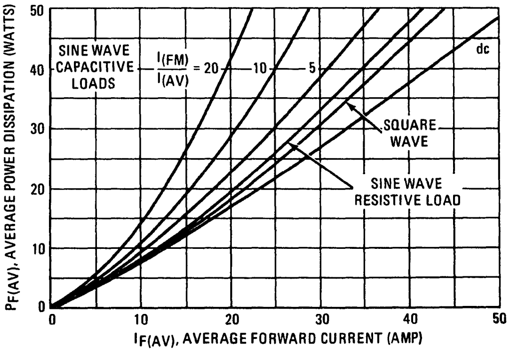
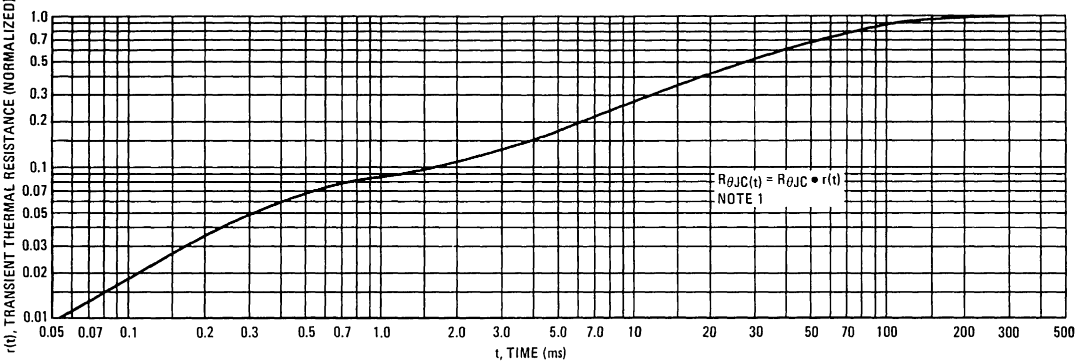
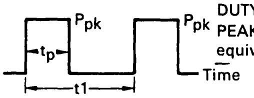


FIGURE 6 — THERMAL RESPONSE



NOTE 1



DUTY CYCLE, $D = t_p/t1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended.

The temperature of the case should be measureed using a thermocouple placed on the case at the temperature reference point. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature. It may be determined by:

$$\Delta T_{JC} = P_{pk} \bullet R_{\theta JC} [D + (1 - D) \bullet r(t1 + t_p) + r(t_p) - r(t1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 3, i.e.:

$r(t1 + t_p)$ = normalized value of transient thermal resistance at time $t1 + t_p$.

FIGURE 7 — CAPACITANCE

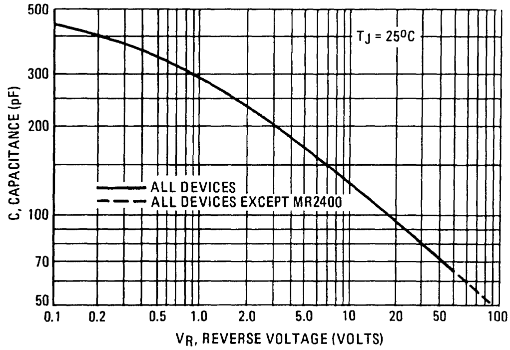


FIGURE 8 — FORWARD RECOVERY TIME

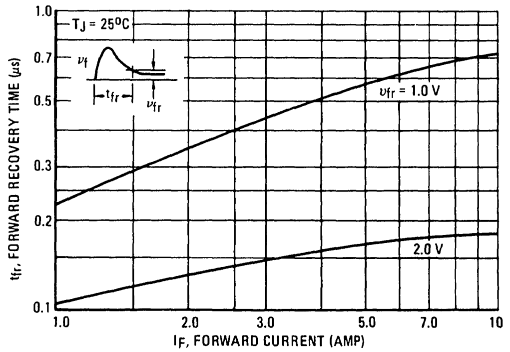


FIGURE 9 — REVERSE RECOVERY TIME

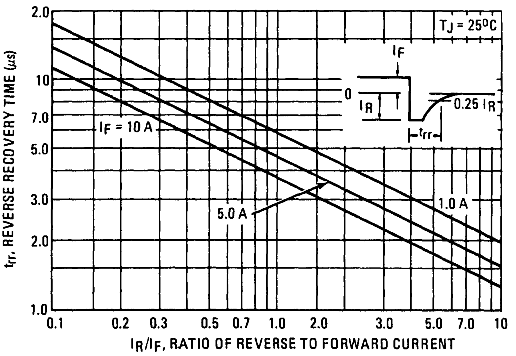
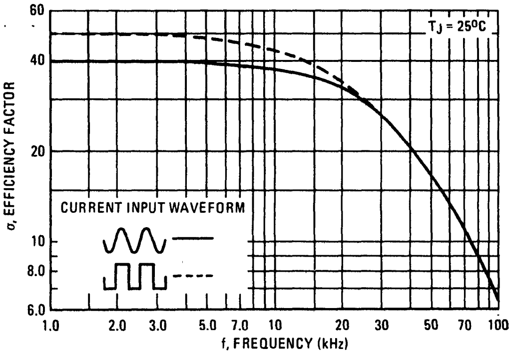
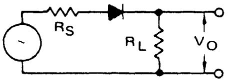


FIGURE 10 – RECTIFICATION WAVEFORM EFFICIENCY



RECTIFICATION EFFICIENCY NOTE



The rectification efficiency factor σ shown in Figure 10 was calculated using the formula:

$$\sigma = \frac{P_{dc}}{P_{rms}} = \frac{\dfrac{V^2_{O(dc)}}{R_L}}{\dfrac{V^2_{O(rms)}}{R_L}} \bullet 100\% = \frac{V^2_{O(dc)}}{V^2_{O(ac)} + V^2_{O(dc)}} \bullet 100\% \qquad (1)$$

For a sine wave input $V_m \sin(\omega t)$ to the diode, assume lossless, the maximum theoretical efficiency factor becomes:

$$\sigma_{(sine)} = \frac{\dfrac{V^2_m}{\pi^2 R_L}}{\dfrac{V^2_m}{4R_L}} \bullet 100\% = \frac{4}{\pi^2} \bullet 100\% \quad 40.6\% \qquad (2)$$

For a square wave input of amplitude V_m, the efficiency factor becomes:

$$\sigma_{(square)} = \frac{\dfrac{V^2_m}{2R_L}}{\dfrac{V^2_m}{R_L}} \bullet 100\% = 50\% \qquad (3)$$

(A full wave circuit has twice these efficiencies)

As the frequency of the input signal is increased, the reverse recovery time of the diode (Figure 9) becomes significant, resulting in an increasing ac voltage component across R_L which is opposite in polarity to the forward current, thereby reducing the value of the efficiency factor σ, as shown on Figure 10.

It should be emphasized that Figure 10 shows waveform efficiency only; it does not provide a measure of diode losses. Data was obtained by measuring the ac component of V_O with a true rms ac voltmeter and the dc component with a dc voltmeter. The data was used in Equation 1 to obtain points for Figure 10.

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR2400F thru MR2406F

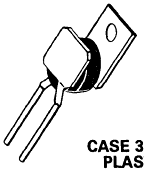
MR2402F and MR2406F are Motorola Preferred Devices

TAB-MOUNTED FAST RECOVERY POWER RECTIFIERS

. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference, sonar power supplies and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 250 kHz.

- Same Mounting as a TO-220AB
- Cost Effective in Low Current Applications
- Lead or Chassis Mounted
- High Surge Current Capability

FAST RECOVERY POWER RECTIFIERS
50–600 VOLTS
24 AMPERES



CASE 339-02
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MR2400F	MR2401F	MR2402F	MR2404F	MR2406F	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	Volts
Nonrepetitive Peak Reverse Voltage	V_{RSM}	75	150	250	450	650	Volts
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	Volts
Average Rectified Forward Current (Single phase, resistive load, T_C = 125°C)	I_O	← 24 →					Amp
Nonrepetitive Peak Surge Current (surge applied @ rated load conditions)	I_{FSM}	← 300 (for 1 cycle) →					Amp
Operating Junction Temperature Range	T_J	← −65 to +150 →					°C
Storage Temperature Range	T_{stg}	← −65 to +175 →					°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	°C/W
Thermal Resistance, Junction to Air, PC Board Mount; Perpendicular to Surface	$R_{\theta JA}$	55	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Instantaneous Forward Voltage (I_F = 75 Amp, T_J = 150°C)	v_F	—	1.15	1.29	Volts
Forward Voltage (I_F = 24 Amp, T_C = 25°C)	V_F	—	1.00	1.15	Volts
Reverse Current (rated dc voltage) T_C = 25°C T_C = 100°C T_C = 150°C	I_R	— — —	10 0.5 7.0	25 1.0 10	μA mA mA

REVERSE RECOVERY CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Reverse Recover Time — Soft Recovery ($\lvert I_F \rvert$ = 1.0 Amp to V_R = 30 Vdc, Figure 19) (I_{FM} = 36 Amp, di/dt = 25 A/μs, Figure 20)	t_{rr}	 — —	 150 200	 200 300	ns
Reverse Recovery Current (I_F = 1.0 Amp to V_R = 30 Vdc, Figure 19)	$I_{RM(REC)}$	—	—	4.0	Amp

FIGURE 1 — MAXIMUM FORWARD VOLTAGE

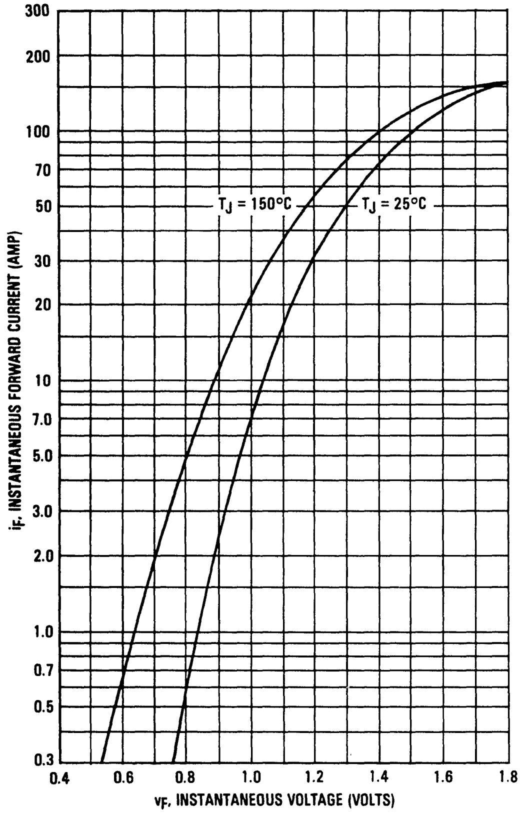
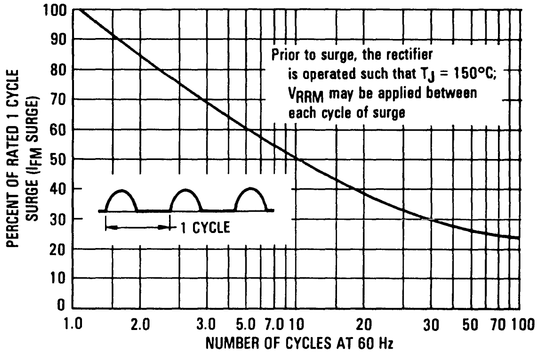
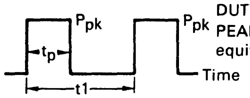


FIGURE 2 — MAXIMUM SURGE CAPABILITY



NOTE 1



DUTY CYCLE, $D = t_p/t1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended.

The temperature of the case should be measureed using a thermocouple placed on the case at the temperature reference point. The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_C, the junction temperature may be determined by:

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature. It may be determined by:

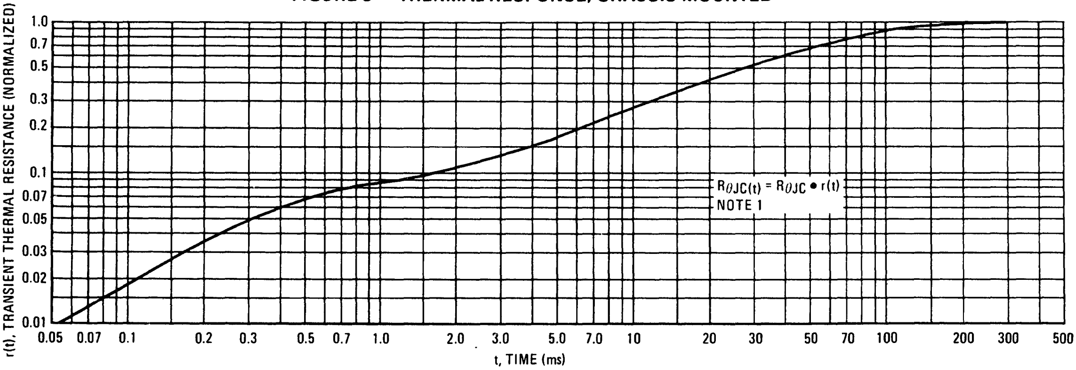
$$\Delta T_{JC} = P_{pk} \bullet R_{\theta JC} [D + (1 - D) \bullet r(t1 + t_p) + r(t_p) - r(t1)]$$

where

r(t) = normalized value of transient thermal resistance at time, t, from Figure 3, i.e.:

$r(t1 + t_p)$ = normalized value of transient thermal resistance at time $t1 + t_p$.

FIGURE 3 — THERMAL RESPONSE, CHASSIS MOUNTED



CHASSIS MOUNT RATING DATA

Sine Wave Input

FIGURE 4 — FORWARD POWER DISSIPATION

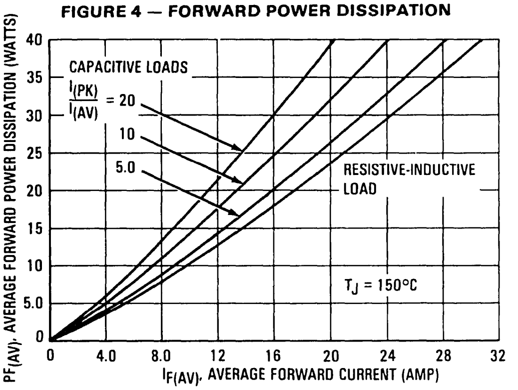
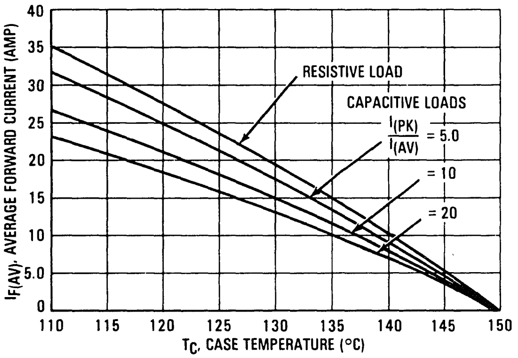


FIGURE 6 — CURRENT DERATING



Square Wave Input

FIGURE 5 — FORWARD POWER DISSIPATION

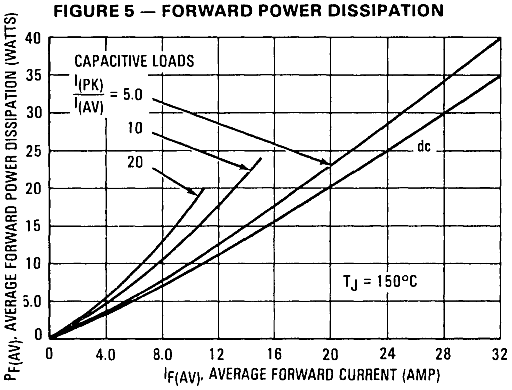
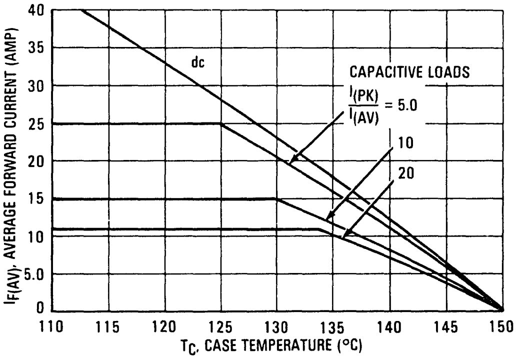


FIGURE 7 — CURRENT DERATING



PRINTED CIRCUIT BOARD RATING DATA

FIGURE 8 — FORWARD POWER DISSIPATION

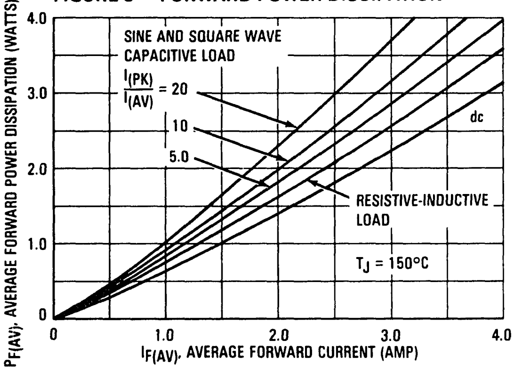
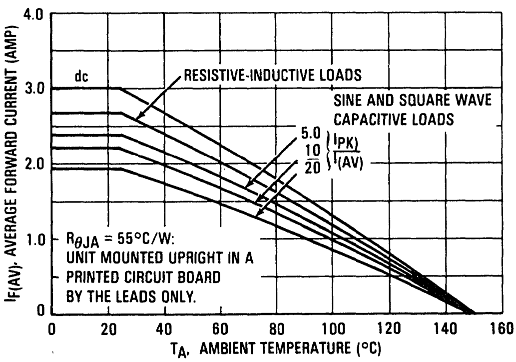


FIGURE 9 — CURRENT DERATING



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 10 — FORWARD RECOVERY TIME

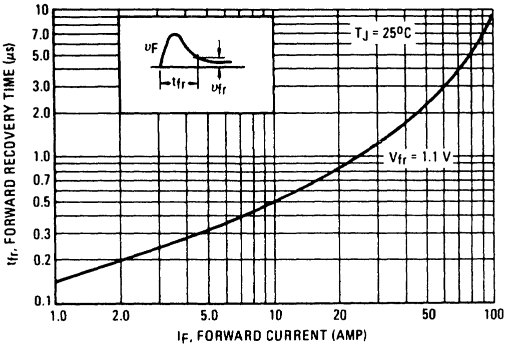


FIGURE 11 — JUNCTION CAPACITANCE

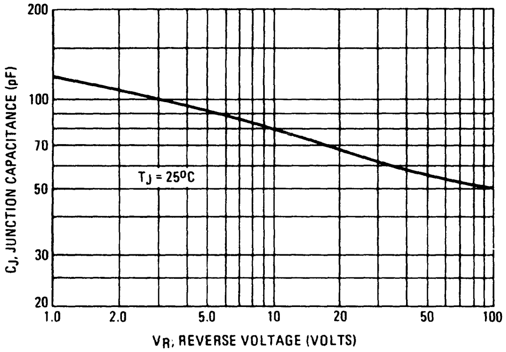


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FIGURE 12 — TYPICAL REVERSE CURRENT

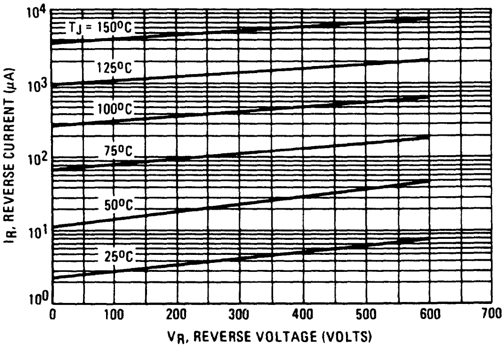
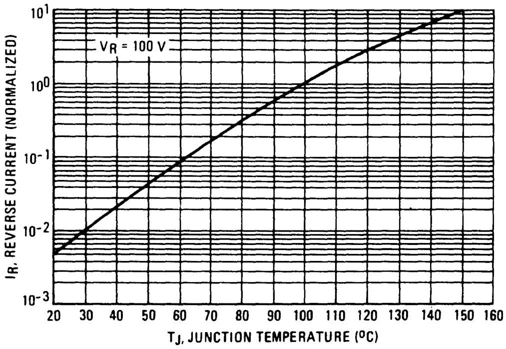
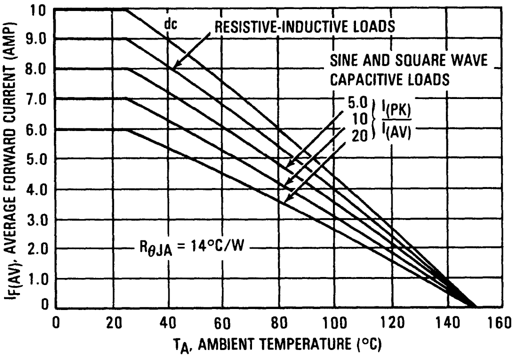


FIGURE 13 — NORMALIZED REVERSE CURRENT



TYPICAL MOUNTING DATA

FIGURE 14 — CURRENT DERATING



NOTE 2

Figure 14 shows the current carrying capability of a device mounted on a printed circuit board with a typical TO-220 type heatsink having a sink-to-air thermal resistance of 12°C/W. Allowing another 2°C/W for $R_{\theta JC}$ plus $R_{\theta CS}$ (case-to-sink) puts the total at 14°C/W as indicated. The unit and heatsink were mounted perpendicular to the printed circuit board for this data.

TYPICAL RECOVERED STORED CHARGE DATA
(See Note 3)

FIGURE 15 — T_J = 25°C

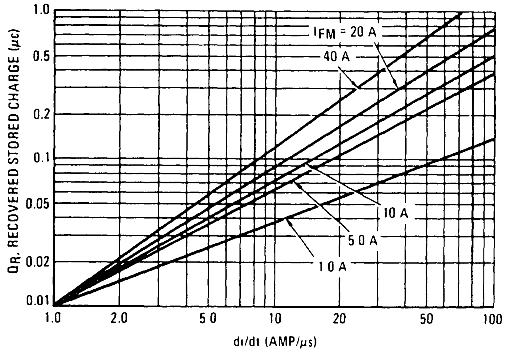


FIGURE 16 — T_J = 75°C

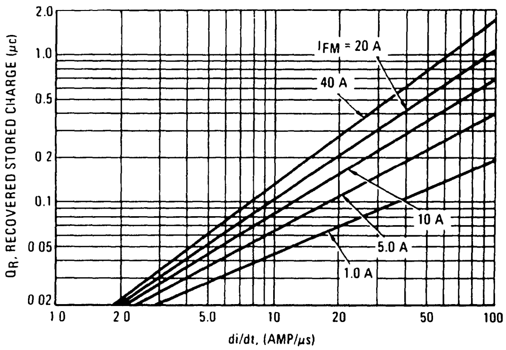


FIGURE 17 — T_J = 100°C

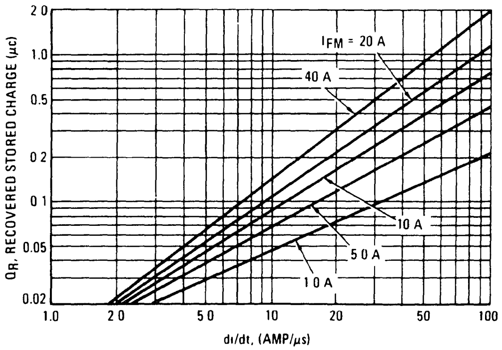
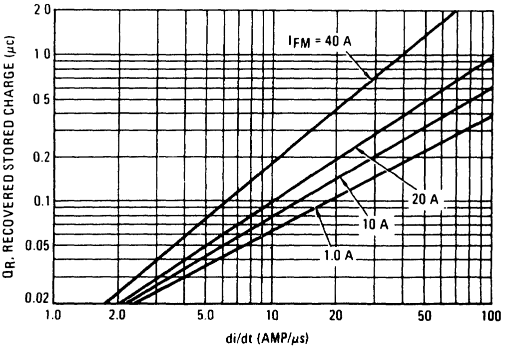


FIGURE 18 — T_J = 150°C



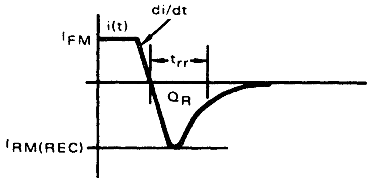
NOTE 3

Reverse recovery time is the period which elapses from the time that the current, thru a previously forward biased rectifier diode, passes thru zero going negatively until the reverse current recovers to a point which is less than 10% peak reverse current.

Reverse recovery time is a direct function of the forward current prior to the application of reverse voltage.

For any given rectifier, recovery time is very circuit dependent. Typical and maximum recovery time of all Motorola fast recovery power rectifiers are rated under a fixed set of conditions using I_F = 1.0 A, V_R = 30 V. In order to cover all circuit conditions, curves are given for typical recovered stored charge versus commutation di/dt for various levels of forward current and for junction temperatures of 25°C, 75°C, 100°C, and 150°C.

To use these curves, it is necessary to know the forward current level just before commutation, the circuit commutation di/dt, and the operating junction temperature. The reverse recovery test current waveform for all Motorola fast recovery rectifiers is shown.



From stored charge curves versus di/dt, recovery time (t_{rr}) and peak reverse recovery current ($I_{RM(REC)}$) can be closely approximated using the following formulas:

$$t_{rr} = 1.41 \times \left[\frac{Q_R}{di/dt}\right]^{1/2}$$

$$I_{RM(REC)} = 1.41 \times \left[Q_R \times di/dt\right]^{1/2}$$

3

FIGURE 19 — JEDEC REVERSE RECOVERY CIRCUIT

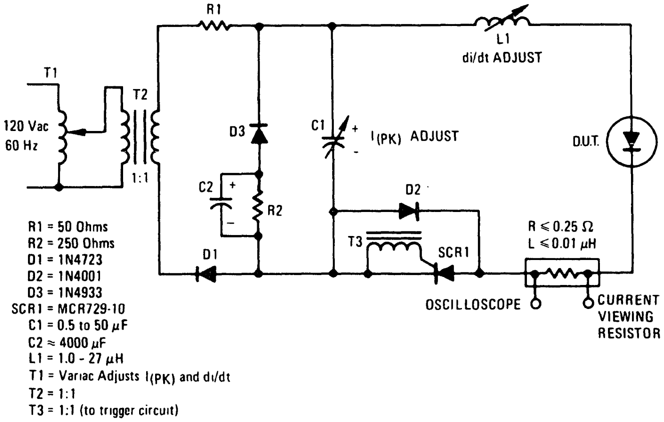
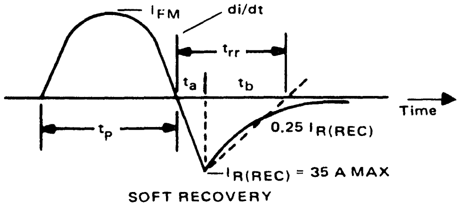


FIGURE 20 — REVERSE RECOVERY CHARACTERISTIC



MECHANICAL CHARACTERISTICS

CASE: Plastic Encapsulated, Metal Tabs.

FINISH: All external surfaces are corrosion resistant and are readily solderable.

POLARITY: Cathode to Tab with hole; Reverse polarity available by adding "R" Suffix, MR2402FR.

WEIGHT: 3.6 Grams (Approximately).

MOUNTING TORQUE: 8 in-lbs max.

MAXIMUM TEMPERATURE FOR SOLDERING PURPOSES: 350°C, 3/8" from case for 10 seconds.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MR2500 Series

MR2504 and MR2510 are Motorola Preferred Devices

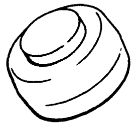
MEDIUM-CURRENT SILICON RECTIFIERS

. . . compact, highly efficient silicon rectifiers for medium-current applications requiring:

- High Current Surge — 400 Amperes @ T_J = 175°C
- Peak Performance @ Elevated Temperature — 25 Amperes @ T_C = 150°C
- Low Cost
- Compact, Molded Package — For Optimum Efficiency in a Small Case Configuration
- Available With a Single Lead Attached

MEDIUM-CURRENT SILICON RECTIFIERS

50 — 1000 VOLTS
25 AMPERES
DIFFUSED JUNCTION



3

MECHANICAL CHARACTERISTICS

CASE: Transfer Molded Plastic

FINISH: All External Surfaces are Corrosion Resistant and the Contact Areas Readily Solderable.

POLARITY: Indicated by dot on Cathode Side

MOUNTING POSITIONS: Any

MAXIMUM TEMPERATURE FOR SOLDERING PURPOSES: 250°C

WEIGHT: 1.8 Grams (Approximately)

MAXIMUM RATINGS

Characteristic	Symbol	MR 2500	MR 2501	MR 2502	MR 2504	MR 2506	MR 2508	MR 2510	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	Volts
Non-Repetitive Peak Reverse Voltage (halfwave, single phase, 60 Hz peak)	V_{RSM}	60	120	240	480	720	960	1200	Volts
Average Rectified Forward Current (Single phase, resistive load, 60 Hz, T_C = 150°C)	I_O	← 25 →							Amp
Non-Repetitive Peak Surge Current (surge applied @ rated load conditions, half wave, single phase, 60 Hz)	I_{FSM}	← 400 (for 1 cycle) →							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 Case (Single Side Cooled)	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristics and Conditions	Symbol	Max	Unit
Maximum Instantaneous Forward Voltage (i_F = 78.5 Amp, T_C = 25°C)	v_F	1.18	Volts
Maximum Reverse Current (rated dc voltage) T_C = 25°C T_C = 100°C	I_R	 100 500	µA

FIGURE 1 — FORWARD VOLTAGE

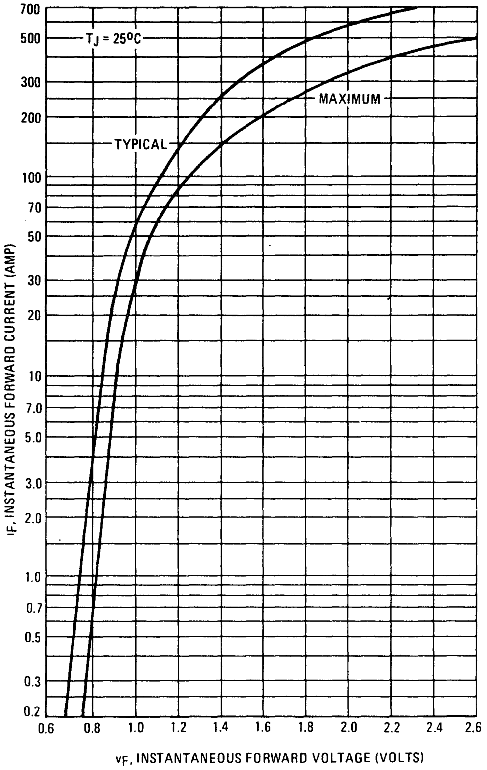


FIGURE 2 — NON-REPETITIVE SURGE CURRENT

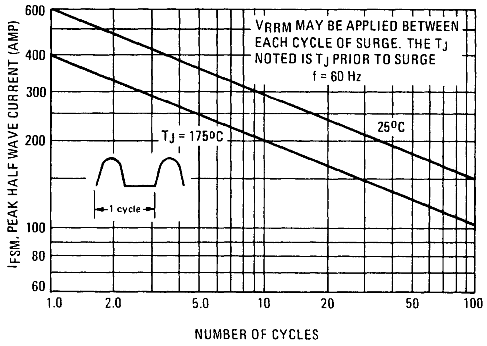


FIGURE 3 — FORWARD VOLTAGE TEMPERATURE COEFFICIENT

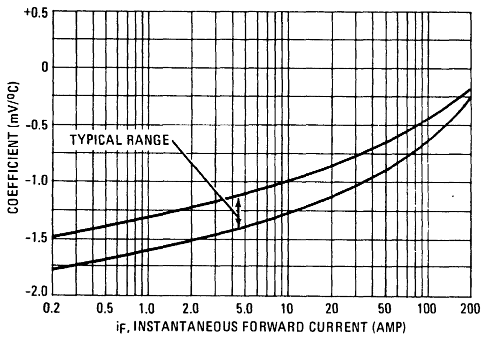


FIGURE 4 — CURRENT DERATING

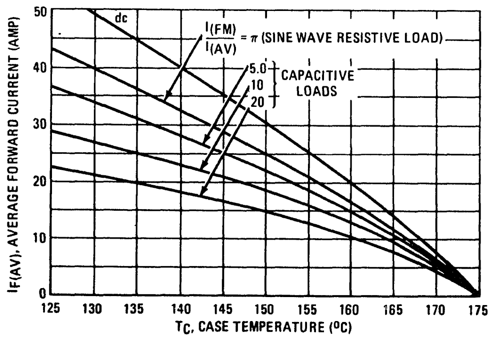


FIGURE 5 — FORWARD POWER DISSIPATION

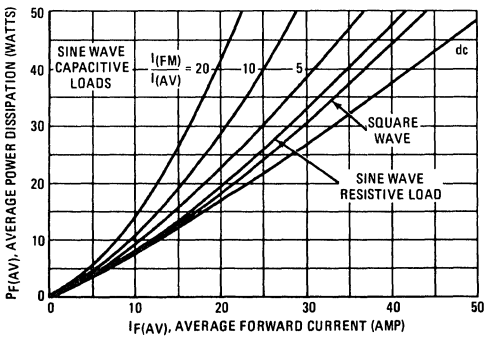
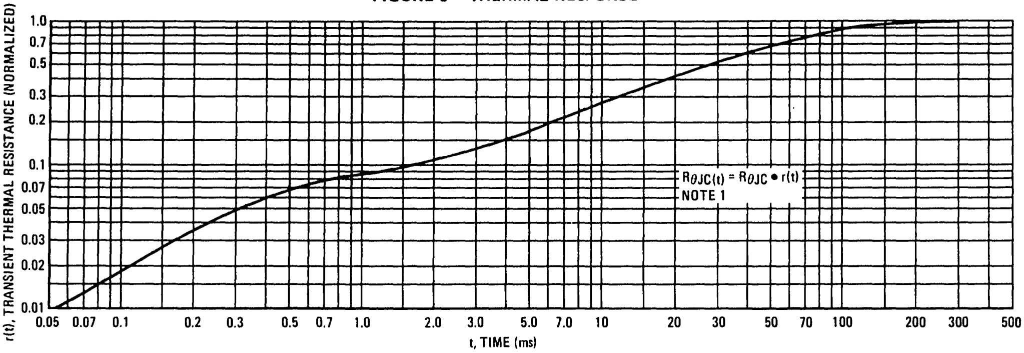
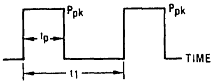


FIGURE 6 – THERMAL RESPONSE





DUTY CYCLE, $D = t_p/t_1$
PEAK POWER, P_{pk}, is peak of an equivalent square power pulse.

To determine maximum junction temperature of the diode in a given situation, the following procedure is recommended

The temperature of the case should be measured using a thermocouple placed on the case at the temperature reference point (see the outline drawing on page 1) The thermal mass connected to the case is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady state conditions are achieved Using the measured value of T_C, the junction temperature may be determined by

$$T_J = T_C + \Delta T_{JC}$$

where ΔT_{JC} is the increase in junction temperature above the case temperature It may be determined by

$$\Delta T_{JC} = P_{pk} \bullet R_{\theta JC} [D + (1 - D) \bullet r(t_1 + t_p) + r(t_p) - r(t_1)]$$

where

$r(t)$ = normalized value of transient thermal resistance at time, t, from Figure 6, i.e.,

$r(t_1 + t_p)$ = normalized value of transient thermal resistance at time $t_1 + t_p$

FIGURE 7 – CAPACITANCE

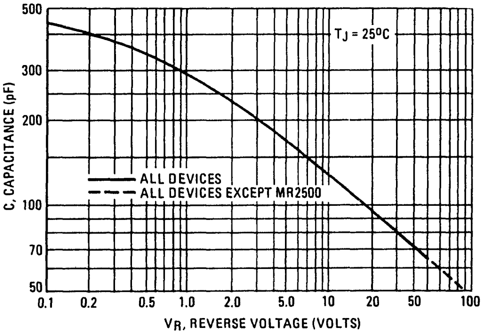


FIGURE 8 – FORWARD RECOVERY TIME

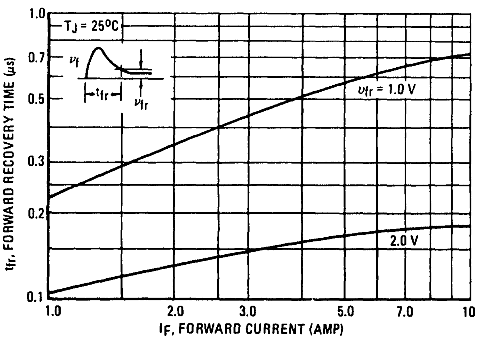


FIGURE 9 – REVERSE RECOVERY TIME

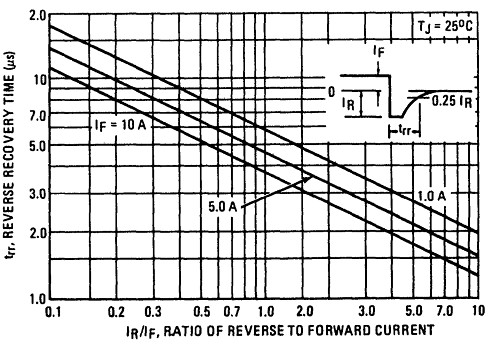
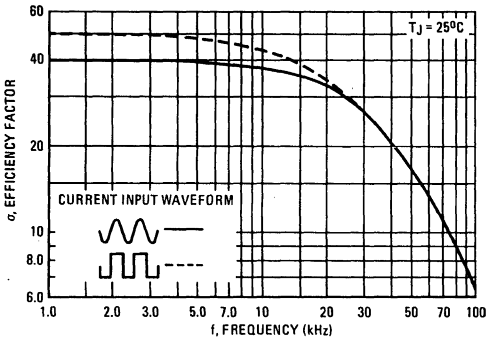


FIGURE 10 — RECTIFICATION WAVEFORM EFFICIENCY



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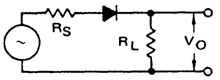
RECTIFICATION EFFICIENCY NOTE

FIGURE 11 — SINGLE-PHASE HALF-WAVE RECTIFIER CIRCUIT



The rectification efficiency factor σ shown in Figure 10 was calculated using the formula:

$$\sigma = \frac{P_{dc}}{P_{rms}} = \frac{\frac{V^2_{O(dc)}}{R_L}}{\frac{V^2_{O(rms)}}{R_L}} \bullet 100\% = \frac{V^2_{O(dc)}}{V^2_{O(ac)} + V^2_{O(dc)}} \bullet 100\% \quad (1)$$

For a sine wave input $V_m \sin(\omega t)$ to the diode, assume lossless, the maximum theoretical efficiency factor becomes:

$$\sigma_{(sine)} = \frac{\frac{V^2_m}{\pi^2 R_L}}{\frac{V^2_m}{4R_L}} \bullet 100\% = \frac{4}{\pi^2} \bullet 100\% = 40.6\% \quad (2)$$

For a square wave input of amplitude V_m, the efficiency factor becomes:

$$\sigma_{(square)} = \frac{\frac{V^2_m}{2R_L}}{\frac{V^2_m}{R_L}} \bullet 100\% = 50\% \quad (3)$$

(A full wave circuit has twice these efficiencies)

As the frequency of the input signal is increased, the reverse recovery time of the diode (Figure 9) becomes significant, resulting in an increasing ac voltage component across R_L which is opposite in polarity to the forward current, thereby reducing the value of the efficiency factor σ, as shown on Figure 10.

It should be emphasized that Figure 10 shows waveform efficiency only; it does not provide a measure of diode losses. Data was obtained by measuring the ac component of V_O with a true rms ac voltmeter and the dc component with a dc voltmeter. The data was used in Equation 1 to obtain points for Figure 10.

ASSEMBLY AND SOLDERING INFORMATION

There are *two basic areas* of consideration for successful implementation of button rectifiers:

1. Mounting and Handling
2. Soldering

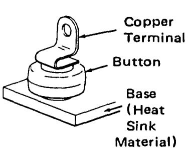
each should be carefully examined before attempting a finished assembly or mounting operation.

MOUNTING AND HANDLING

The button rectifier lends itself to a multitude of assembly arrangements but one key consideration must *always* be included:

One Side of the Connections to the Button Must Be Flexible!

Strain Relief Terminal for Button Rectifier



This stress relief to the button should also be chosen for maximum contact area to afford the best heat transfer — but not at the expense of flexibility. For an annealed copper terminal a thickness of 0.015" is suggested.

The base heat sink may be of various materials whose shape and size are a function of the individual application and the heat transfer requirements.

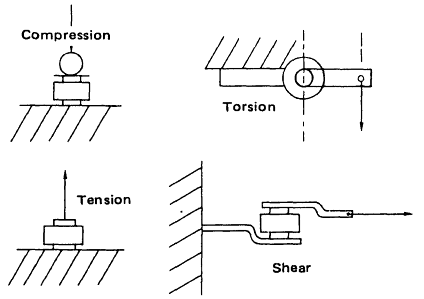
Common Materials	Advantages and Disadvantages
Steel	Low Cost; relatively low heat conductivity
Copper	High Cost; high heat conductivity
Aluminum	Medium Cost; medium heat conductivity Relatively expensive to plate and not all platers can process aluminum.

Handling of the button during assembly must be relatively gentle to minimize sharp impact shocks and avoid nicking of the plastic. Improperly designed automatic handling equipment is the worst source of unnecessary shocks. Techniques for vacuum handling and spring loading should be investigated.

The mechanical stress limits for the button diode are as follows:

Compression	32 lbs.	142.3 Newton
Tension	32 lbs.	142.3 Newton
Torsion	6-inch lbs.	0.68 Newton-meters
Shear	55 lbs.	244.7 Newton

MECHANICAL STRESS



Exceeding these recommended maximums can result in electrical degradation of the device.

SOLDERING

The button rectifier is basically a semiconductor chip bonded between two nickel-plated copper heat sinks with an encapsulating material of thermal-setting silicone. The exposed metal areas are also tin plated to enhance solderability.

In the soldering process it is important that the temperature not exceed 250°C if device damage is to be avoided. Various solder alloys can be used for this operation but two types are recommended for best results:

1. 96.5% tin, 3.5% silver; Melting point is 221°C (this particular eutetic is used by Motorola for its button rectifier assemblies).
2. 63% tin, 37% lead; Melting point 183°C (eutetic).

Solder is available as preforms or paste. The paste contains both the metal and flux and can be dispensed rapidly. The solder preform requires the application of a flux to assure good wetting of the solder. The type of flux used depends upon the degree of cleaning to be accomplished and is a function of the metals involved. These fluxes range from a mild rosin to a strong acid; e.g., Nickel plating oxides are best removed by an acid base flux while an activated rosin flux may be sufficient for tin plated parts.

Since the button is relatively light-weight, there is a tendency for it to float when the solder becomes liquid. To prevent bad joints and misalignment it is suggested that a weighting or spring loaded fixture be employed. It is also important that severe thermal shock (either heating or cooling) be avoided as it may lead to damage of the die or encapsulant of the part.

Button holding fixtures for use during soldering may be of various materials. Stainless steel has a longer use life while black anodized aluminum is less expensive and will limit heat reflection and enhance absorption. The assembly volume will influence the choice of materials. Fixture dimension tolerances for locating the button must allow for expansion during soldering as well as allowing for button clearance.

HEATING TECHNIQUES

The following four heating methods have their advantages and disadvantages depending on volume of buttons to be soldered.

1. **Belt Furnaces** readily handle large or small volumes and are adaptable to establishment of "on-line" assembly since a variable belt speed sets the run rate. Individual furnace zone controls make excellent temperature control possible.

2. **Flame Soldering** involves the directing of natural gas flame jets at the base of a heatsink as the heatsink is indexed to various loading-heating-cooling-unloading positions. This is the most economical labor method of soldering large volumes. Flame soldering offers good temperature control but requires sophisticated temperature monitoring systems such as infrared.

3

ASSEMBLY AND SOLDERING INFORMATION (continued)

3. **Ovens** are good for batch soldering and are production limited. There are handling problems because of slow cooling. Response time is load dependent, being a function of the watt rating of the oven and the mass of parts. Large ovens may not give an acceptable temperature gradient. Capital cost is low compared to belt furnaces and flame soldering.
4. **Hot Plates** are good for soldering small quantities of prototype devices. Temperature control is fair with overshoot common because of the exposed heating surface. Solder flow and positioning can be corrected during soldering since the assembly is exposed. Investment cost is very low.

Regardless of the heating method used, a soldering profile giving the time-temperature relationship of the particular method must be determined to assure proper soldering. Profiling must be performed on a scheduled basis to minimize poor soldering. The time-temperature relationship will change depending on the heating method used.

3

SOLDER PROCESS EVALUATION

Characteristics to look for when setting up the soldering process:

I **Overtemperature** is indicated by any one or all three of the following observations.

1. Remelting of the solder inside the button rectifier shows the temperature has exceeded 285°C and is noted by "islands" of shiny solder and solder dewetting when a unit is broken apart.
2. Cracked die inside the button may be observed by a moving reverse oscilloscope trace when pressure is applied to the unit.
3. Cracked plastic may be caused by thermal shock as well as overtemperature so cooling rate should also be checked.

II **Cold soldering** gives a grainy appearance and solder build-up without a smooth continuous solder fillet. The temperature must be adjusted until the proper solder fillet is obtained within the maximum temperature limits.

III **Incomplete solder fillets** result from insufficient solder or parts not making proper contact.

IV **Tilted buttons** can cause a void in the solder between the heatsink and button rectifier which will result in poor heat transfer during operation. An eight degree tilt is a suggested maximum value.

V **Plating problems** require a knowledge of plating operations for complete understanding of observed deficiencies.

1. Peeling or plating separation is generally seen when a button is broken away for solder inspection. If heatsink or terminal base metal is present the plating is poor and must be corrected.
2. Thin plating allows the solder to penetrate through to the base metal and can give a poor connection. A suggested minimum plating thickness is 300 microinches.
3. Contaminated soldering surfaces may out-gas and cause non-wetting resulting in voids in the solder connection. The exact cause is not always readily apparent and can be because of:
   (a) improper plating
   (b) mishandling of parts
   (c) improper and/or excessive storage time

SOLDER PROCESS MONITORING

Continuous monitoring of the soldering process must be established to minimize potential problems. All parts used in the soldering operation should be sampled on a lot by lot basis by assembly of a controlled sample. Evaluate the control sample by break-apart tests to view the solder connections, by physical strength tests and by dimensional characteristics for part mating.

A shear test is a suggested way of testing the solder bond strength.

POST SOLDERING OPERATION CONSIDERATIONS

After soldering, the completed assembly must be unloaded, washed and inspected.

Unloading must be done carefully to avoid unnecessary stress. Assembly fixtures should be cooled to room temperature so solder profiles are not affected.

Washing is mandatory if an acid flux is used because of its ionic and corrosive nature. Wash the assemblies in agitated hot water and detergent for three to five minutes. After washing; rinse, blow off excessive water and bake 30 minutes at 150°C to remove trapped moisture.

Inspection should be both electrical and physical. Any rejects can be reworked as required.

SUMMARY

The Button Rectifier is an excellent building block for specialized applications. The prime example of its use is the output bridge of the automative alternator where millions are used each year. Although the material presented here is not all inclusive, primary considerations for use are presented. For further information, contact the nearest Motorola Sales Office or franchised distributor.

MR2535L

Motorola Preferred Device

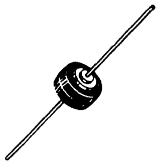
Advance Information

Overvoltage Transient Suppressors

... designed for applications requiring a low voltage rectifier with reverse avalanche characteristics for use as reverse power transient suppressors. Developed to suppress transients in the automotive system, these devices operate in the forward mode as standard rectifiers or reverse mode as power avalanche rectifier and will protect electronic equipment from overvoltage conditions.

- Avalanche Voltage 24 to 32 Volts
- High Power Capability
- Economical
- Increased Capacity by Parallel Operation
- Replaces MR2520L/2525L

MEDIUM CURRENT OVERVOLTAGE TRANSIENT SUPPRESSORS



CASE 194-04
MR2535L

MECHANICAL CHARACTERISTICS:
CASE: Transfer Molded Plastic
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 350°C 3/8″ from case for 10 seconds at 5 lbs. tension
FINISH: All external surfaces are corrosion-resistant, leads are readily solderable
POLARITY: Indicated by diode symbol or cathode band
WEIGHT: 2.5 Grams (approx.)

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
DC Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	20	Volts
Repetitive Peak Reverse Surge Current (Time Constant = 10 ms, Duty Cycle ≤ 1%, T_C = 25°C) (See Figure 1)	I_{RSM}	62	Amps
Average Rectified Forward Current (Single Phase, Resistive Load, 60 Hz, T_C = 150°C)	I_O	35	Amps
Non-Repetitive Peak Surge Current Surge Supplied at Rated Load Conditions Halfwave, Single Phase	I_{FSM}	400	Amps
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS

Characteristic	Lead Length	Symbol	Max	Unit
Thermal Resistance, Junction to Lead @ Both Leads to Heat Sink, Equal Length	1/4″ 3/8″ 1/2″	$R_{\theta JL}$	7.5 10 13	°C/W
Thermal Resistance Junction to Case		$R_{\theta JC}$	0.8*	°C/W

*Typical

This document contains information on a new product. Specifications and information herein are subject to change without notice.

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Max	Unit
Instantaneous Forward Voltage (1) (i_F = 100 Amps, T_C = 25°C)	v_F	—	1.1	Volts
Reverse Current (V_R = 20 Vdc, T_C = 25°C)	I_R	—	200	nAdc
Breakdown Voltage (1) (I_R = 100 mAdc, T_C = 25°C)	$V_{(BR)}$	24	32	Volts
Breakdown Voltage (1) MR2535L only (I_R = 90 Amp, T_C = 150°C, PW = 80 μs)	$V_{(BR)}$	—	40	Volts
Breakdown Voltage Temperature Coefficient	$V_{(BR)TC}$	—	0.096*	%/°C
Forward Voltage Temperature Coefficient @ I_F = 10 mA	V_{FTC}	—	2*	mV/°C

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
* Typical.

3

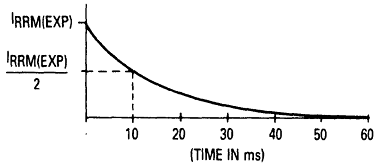


Figure 1. Surge Current Characteristics

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Advance Information

Complementary Medium Current Silicon Rectifiers

For Linear Power Supply Applications

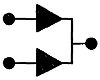
MR4422CT
MR4422CTR

Motorola Preferred Devices

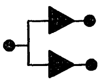
POWER RECTIFIERS
30 AMPERES
100 VOLTS

. . . using monolithic silicon technology for perfect matching of diodes in center tap configuration. These state-of-the-art devices have the following features:

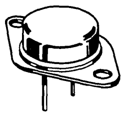
- Low Forward Voltage Drop
- Soft Reverse Recovery for Low Noise
- High Surge Current Capability
- 150°C Operating Junction Temperature
- Direct Replacement for Varo R711 and R711A



MR4422CT



MR4422CTR



CASE 1-07
(TO-204AA)
METAL

3

MAXIMUM RATINGS (PER LEG)

Rating	Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	100	Volts
Average Rectified Forward Current Per Leg (Rated V_R) T_C = 125°C Per Device	$I_{F(AV)}$	15 30	Amps
Peak Repetitive Forward Current, Per Diode Leg (Rated V_R, Square Wave, 20 kHz) T_C = 125°C	I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400	Amps
Peak Repetitive Reverse Surge Current (2.0 µs, 1.0 kHz)	I_{RRM}	2.0	Amps
Operating Junction Temperature	T_J	–65 to +150	°C
Storage Temperature	T_{stg}	–65 to +175	°C

THERMAL CHARACTERISTICS (PER LEG)

Thermal Resistance — Junction to Case	$R_{\theta JC}$	1.4	°C/W

ELECTRICAL CHARACTERISTICS (PER LEG)

Maximum Instantaneous Forward Voltage (1) (I_F = 15 Amps, T_C = 25°C) (I_F = 10 Amps, T_C = 125°C)	v_F	 1.2 1.1	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 125°C)	i_R	 1.0 250	mA

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

This document contains information on a new product. Specifications and information herein are subject to change without notice.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR105 MUR110 MUR115 MUR120 MUR130 MUR140 MUR150 MUR160

MUR120, MUR140 and MUR160 are Motorola Preferred Devices

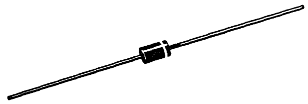
SWITCHMODE POWER RECTIFIERS

... designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 25, 50 and 75 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 600 Volts

ULTRAFAST RECTIFIERS

1.0 AMPERE
50–600 VOLTS



CASE 59-04
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MUR 105	110	115	120	130	140	150	160	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	300	400	500	600	Volts
Average Rectified Forward Current (Square Wave Mounting Method #3 Per Note 1)	$I_{F(AV)}$	1.0 @ T_A = 130°C				1.0 @ T_A = 120°C				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	35								Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175								°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MUR105–120	MUR130–160	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 Amp, T_J = 150°C) (i_F = 1.0 Amp, T_J = 25°C)	v_F	 0.710 0.875	 1.05 1.25	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 150°C) (Rated dc Voltage, T_J = 25°C)	i_R	 50 2.0	 150 5.0	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 A)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (I_F = 1.0 A, di/dt = 100 A/μs, I_{REC} to 1.0 V)	t_{fr}	25	50	ns

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

MUR105, 110 AND 115

FIGURE 1 — TYPICAL FORWARD VOLTAGE

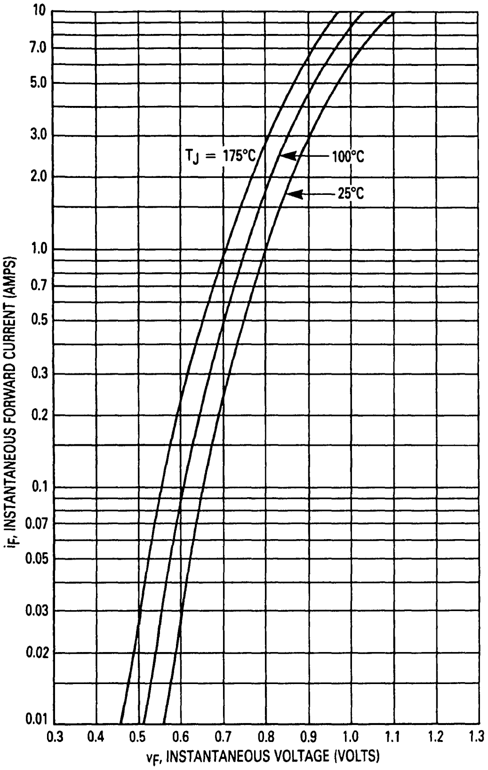


FIGURE 2 — TYPICAL REVERSE CURRENT*

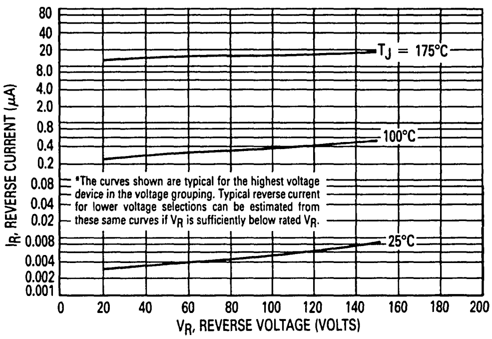


FIGURE 3 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

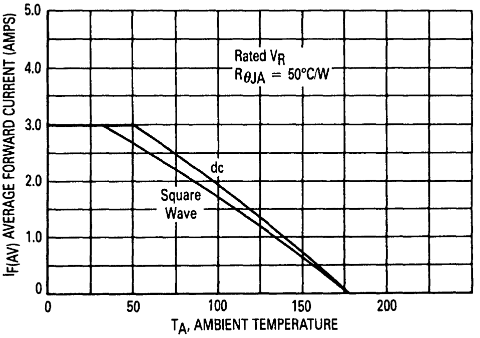


FIGURE 4 — POWER DISSIPATION

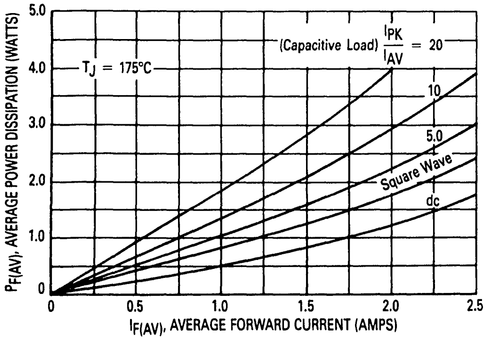
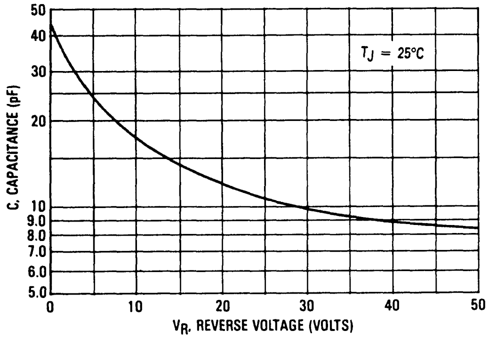


FIGURE 5 — TYPICAL CAPACITANCE



MUR120, 130, 140, 150, 160

FIGURE 6 — TYPICAL FORWARD VOLTAGE

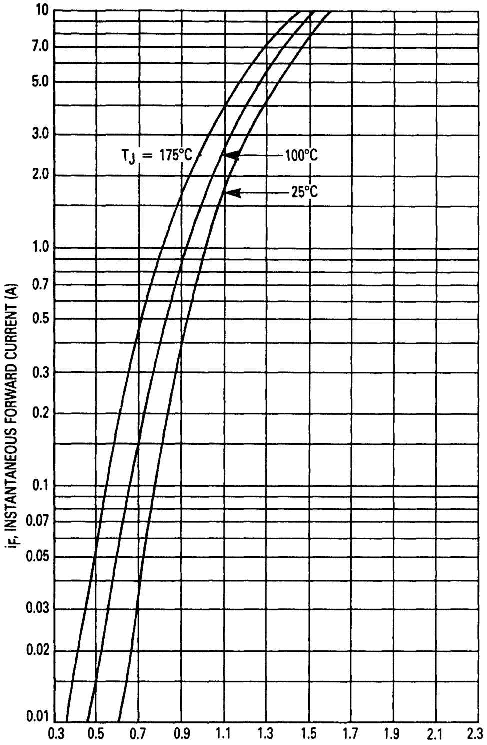


FIGURE 7 — TYPICAL REVERSE CURRENT*

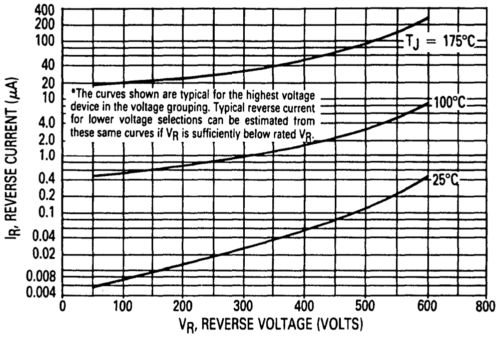


FIGURE 8 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

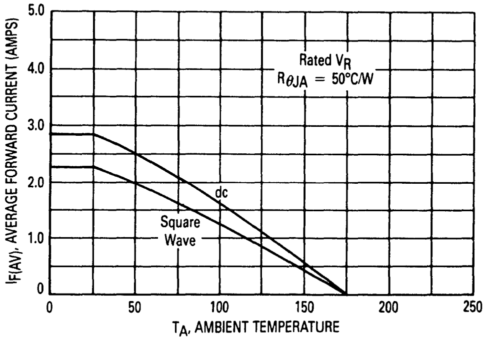


FIGURE 9 — POWER DISSIPATION

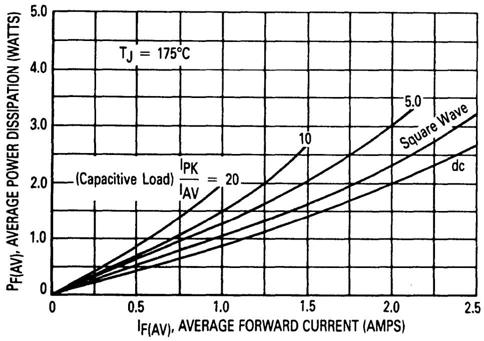


FIGURE 10 — TYPICAL CAPACITANCE

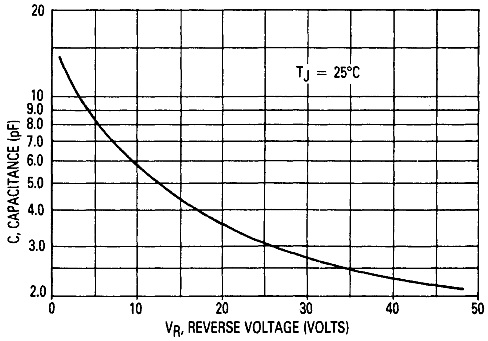


FIGURE 11 — TYPICAL FORWARD VOLTAGE

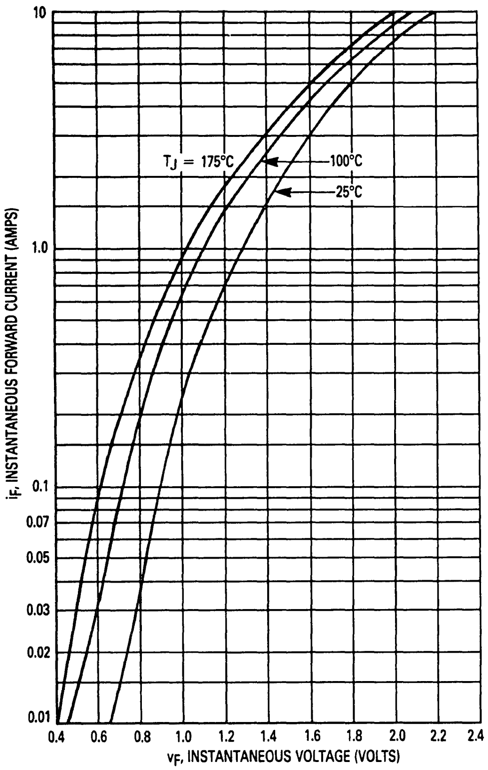


FIGURE 12 — TYPICAL REVERSE CURRENT*

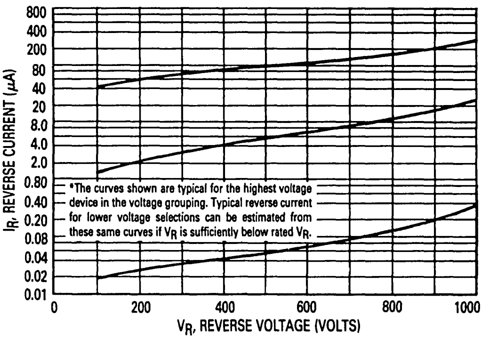


FIGURE 13 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

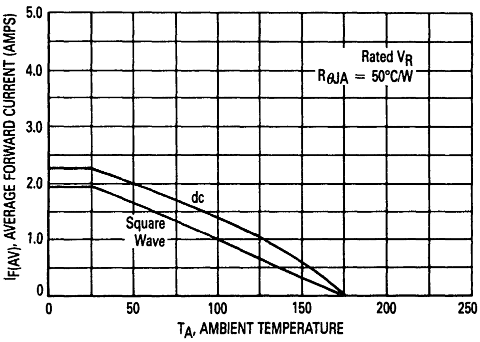


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FIGURE 14 — POWER DISSIPATION

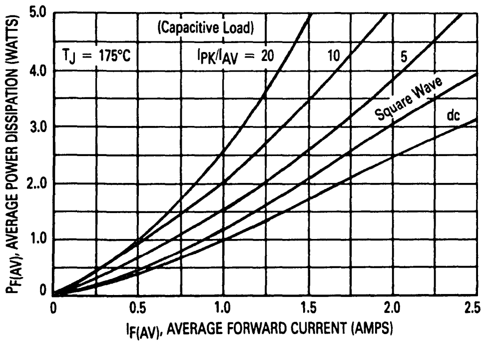
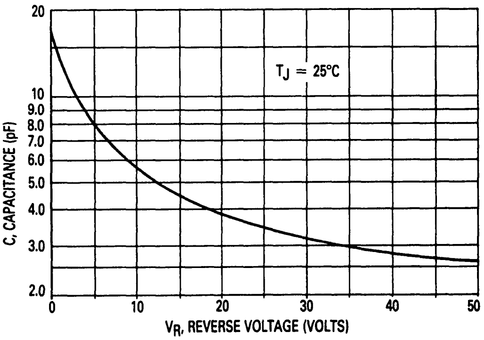


FIGURE 15 — TYPICAL CAPACITANCE



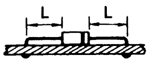
NOTE 1 — AMBIENT MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

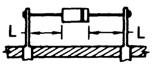
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD		LEAD LENGTH, L			UNITS
		1/8	1/4	1/2	
1	$R_{\theta JA}$	52	65	72	°C/W
2	$R_{\theta JA}$	67	80	87	°C/W
3	$R_{\theta JA}$		50		°C/W

MOUNTING METHOD 1

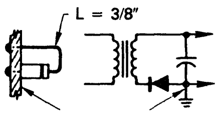


MOUNTING METHOD 2



Vector Pin Mounting

MOUNTING METHOD 3



Board Ground Plane

P.C. Board with 1-1/2″ x 1-1/2″ Copper Surface

MECHANICAL CHARACTERISTICS

Case: Transfer Molded Plastic
Finish: External Leads are Plated, Leads are readily Solderable
Polarity: Indicated by Cathode Band
Weight: 1.1 Grams (Approximately)
Maximum Lead Temperature for Soldering Purposes: 240°C, 1/8″ from case for 10 seconds at 5.0 lbs. tension.

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

SWITCHMODE Power Rectifiers Ultrafast "E" Series w/High Reverse Energy Capability

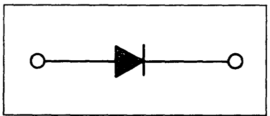
MUR170E
MUR180E
MUR190E
MUR1100E

MUR1100E is a
Motorola Preferred Device

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- 20 mjoules Avalanche Energy Guaranteed
- Excellent Protection Against Voltage Transients in Switching Inductive Load Circuits
- Ultrafast 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 1000 Volts

ULTRAFAST RECTIFIERS
1.0 AMPERE
700–1000 VOLTS



CASE 59-04

3

MAXIMUM RATINGS

Rating	Symbol	MUR 170	MUR 180	MUR 190	MUR 1100	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	700	800	900	1000	Volts
Average Rectified Forward Current (Square Wave) (Mounting Method #3 Per Note 1)	$I_{F(AV)}$	1.0 @ T_A = 95°C				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	35				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175				°C

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (I_F = 1.0 Amps, T_J = 150°C) (I_F = 1.0 Amps, T_J = 25°C)	v_F	 1.50 1.75	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 100°C) (Rated dc Voltage, T_J = 25°C)	i_R	 600 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 100 75	ns
Maximum Forward Recovery Time (I_F = 1.0 Amp, di/dt = 100 Amp/μs, Recovery to 1.0 V)	t_{fr}	75	ns
Controlled Avalanche Energy (See Test Circuit in Figure 6)	W_{AVAL}	10	mJ

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.
SWITCHMODE is a trademark of Motorola Inc.

3

ELECTRICAL CHARACTERISTICS

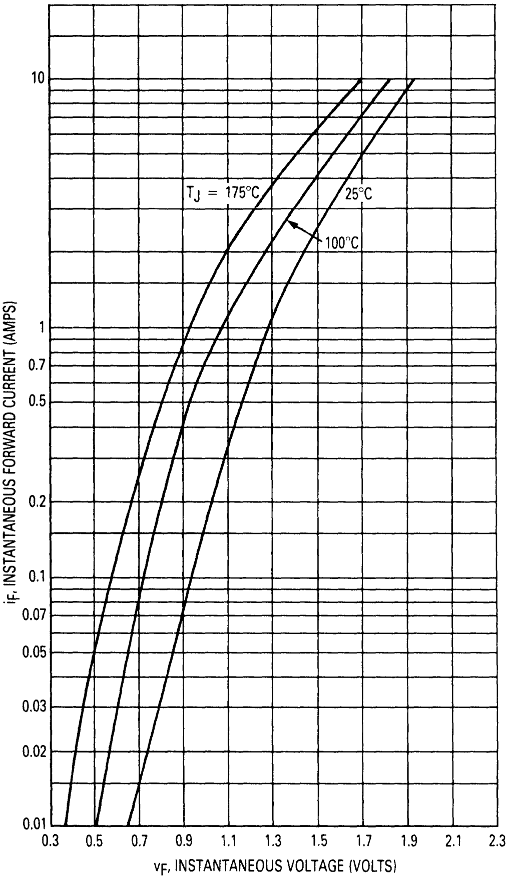


Figure 1. Typical Forward Voltage

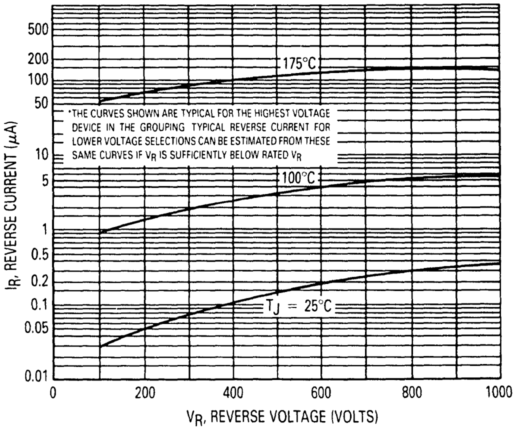


Figure 2. Typical Reverse Current*

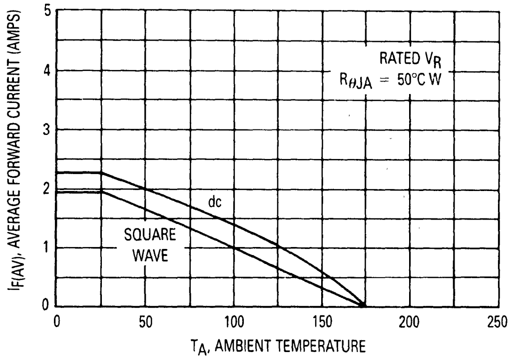


Figure 3. Current Derating (Mounting Method #3 Per Note 1)

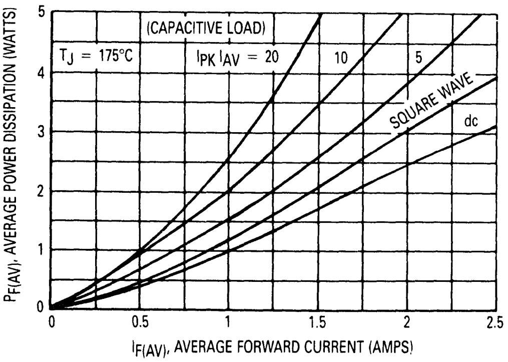


Figure 4. Power Dissipation

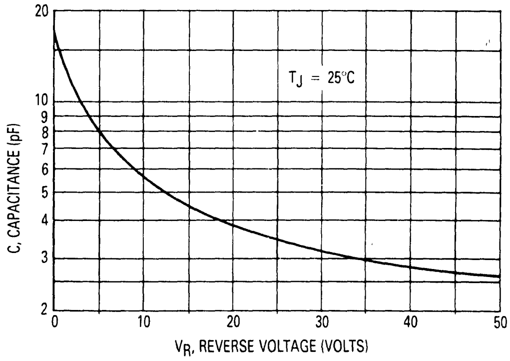


Figure 5. Typical Capacitance

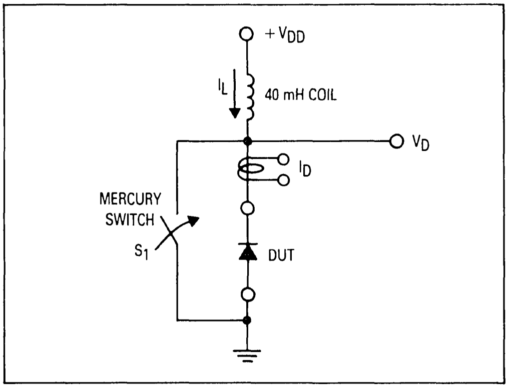


Figure 6. Test Circuit

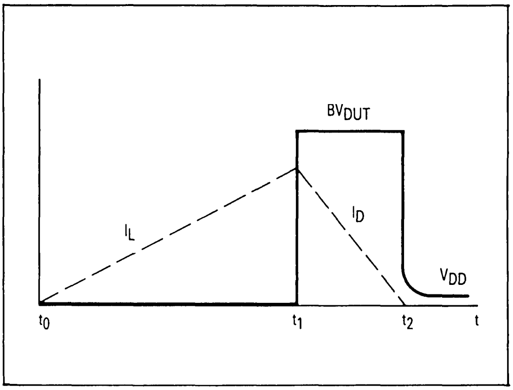


Figure 7. Current-Voltage Waveforms

The unclamped inductive switching circuit shown in Figure 6 was used to demonstrate the controlled avalanche capability of the new "E" series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When S_1 is closed at t_0 the current in the inductor I_L ramps up linearly; and energy is stored in the coil. At t_1 the switch is opened and the voltage across the diode under test begins to rise rapidly, due to di/dt effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at BV_{DUT} and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at t_2.

By solving the loop equation at the point in time when S_1 is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the V_{DD} power supply while the diode is in breakdown (from t_1 to t_2) minus any losses due to finite component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the V_{DD} voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when S_1 was closed, Equation (2).

The oscilloscope picture in Figure 8, shows the information obtained for the MUR8100E (similar die construction as the MUR1100E Series) in this test circuit conducting a peak current of one ampere at a breakdown voltage of 1300 volts, and using Equation (2) the energy absorbed by the MUR8100E is approximately 20 mjoules.

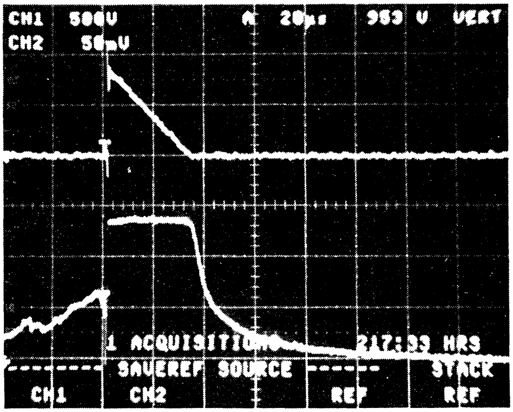
Although it is not recommended to design for this condition, the new "E" series provides added protection against those unforeseen transient viruses that can produce unexplained random failures in unfriendly environments.

EQUATION (1):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2 \left(\frac{BV_{DUT}}{BV_{DUT} - V_{DD}} \right)$$

EQUATION (2):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2$$



CHANNEL 2:
I_L
0.5 AMPS/DIV.

CHANNEL 1:
V_{DUT}
500 VOLTS/DIV.

TIME BASE:
20 µs/DIV.

Figure 8. Current-Voltage Waveforms

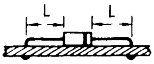
Note 1. Ambient Mounting Data

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

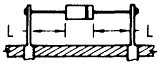
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD		LEAD LENGTH, L			UNITS
		1/8	1/4	1/2	UNITS
1	$R_{\theta JA}$	52	65	72	°C/W
2	$R_{\theta JA}$	67	80	87	°C/W
3	$R_{\theta JA}$	50			°C/W

MOUNTING METHOD 1

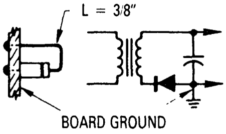


MOUNTING METHOD 2



VECTOR PIN MOUNTING

MOUNTING METHOD 3



P.C. BOARD WITH
1-1 2" x 1-1 2" COPPER SURFACE

MECHANICAL CHARACTERISTICS

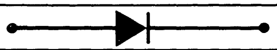
Case: Transfer Molded Plastic
Finish: External Leads are Plated, Leads are readily Solderable
Polarity: Indicated by Cathode Band
Weight: 1.1 Grams (Approximately)
Maximum Lead Temperature for Soldering Purposes:
240°C, 1/8" from case for 10 seconds

3

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

MUR405 MUR410 MUR415 MUR420 MUR430 MUR440 MUR450 MUR460

MUR420, MUR440 and MUR460 are Motorola Preferred Devices



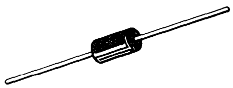
SWITCHMODE POWER RECTIFIERS

... designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 25, 50 and 75 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 600 Volts

ULTRAFAST RECTIFIERS

4.0 AMPERES 50–600 VOLTS



CASE 267-03 PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MUR 405	410	415	420	430	440	450	460	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	300	400	500	600	Volts
Average Rectified Forward Current (Square Wave) (Mounting Method #3 Per Note 1)	$I_{F(AV)}$	4.0 @ T_A = 80°C				4.0 @ T_A = 40°C				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	125				70				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	–65 to +175								°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

		MUR405–420	MUR430–460	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 3.0 Amp, T_J = 150°C) (i_F = 3.0 Amp, T_J = 25°C) (i_F = 4.0 Amp, T_J = 25°C)	v_F	 0.710 0.875 0.890	 1.05 1.25 1.28	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 150°C) (Rated dc Voltage, T_J = 25°C)	i_R	 150 5.0	 250 10	µA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/µs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (I_F = 1.0 A, di/dt = 100 A/µs, Recovery to 1.0 V)	t_{fr}	25	50	ns

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

MUR405, 410 AND 415

FIGURE 1 — TYPICAL FORWARD VOLTAGE

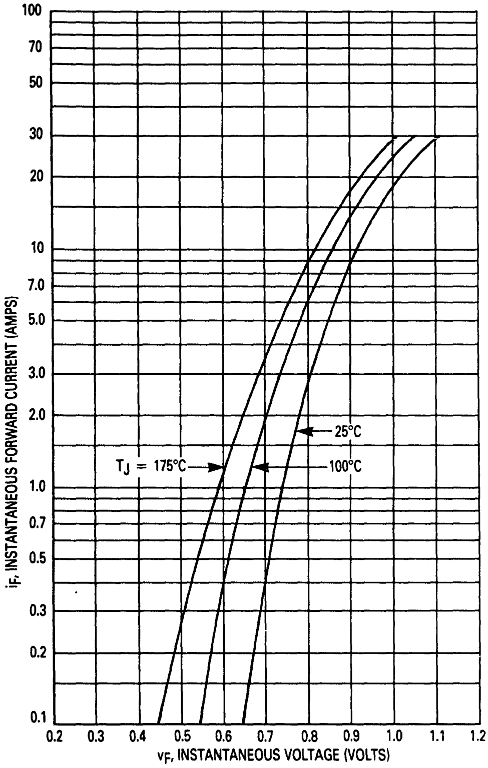


FIGURE 2 — TYPICAL REVERSE CURRENT*

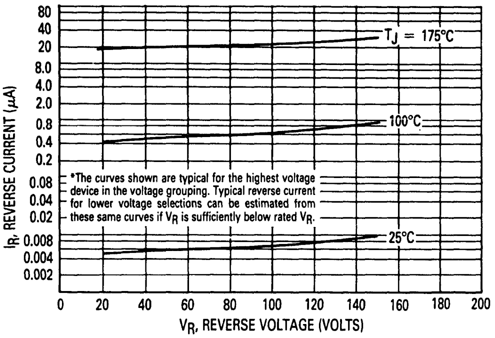


FIGURE 3 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

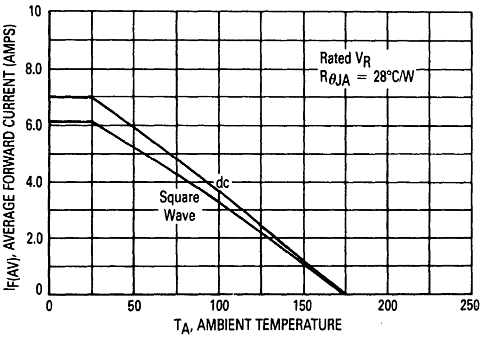


FIGURE 4 — POWER DISSIPATION

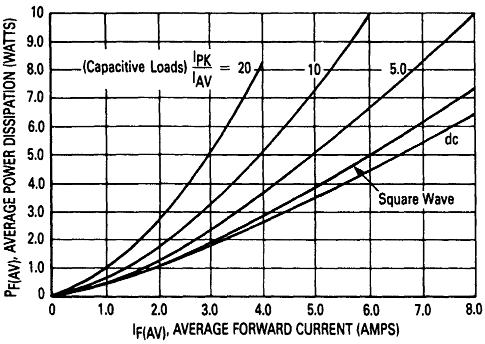
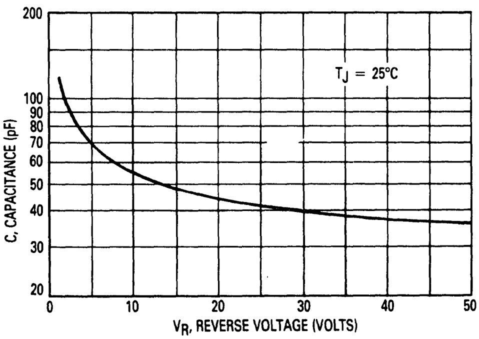


FIGURE 5 — TYPICAL CAPACITANCE



MUR420, 430, 440, 450 AND 460

FIGURE 6 — TYPICAL FORWARD VOLTAGE

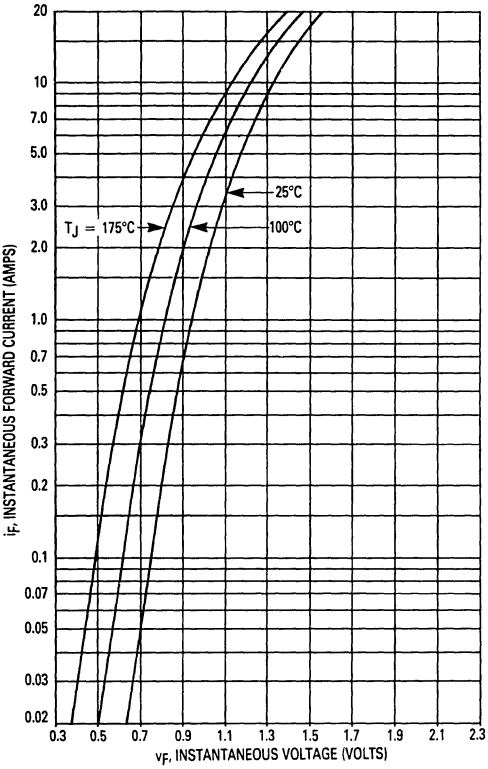


FIGURE 7 — TYPICAL REVERSE CURRENT*

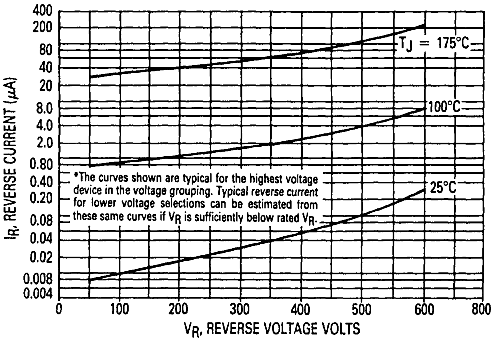


FIGURE 8 — CURRENT DERATING (MOUNTING METHOD #3 PER NOTE 1)

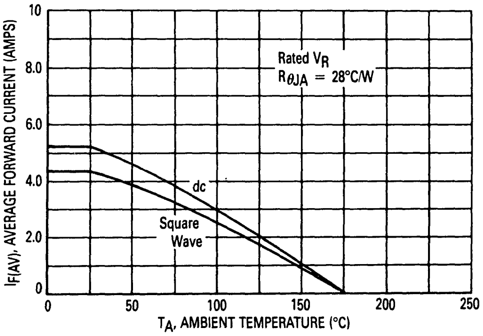


FIGURE 9 — POWER DISSIPATION

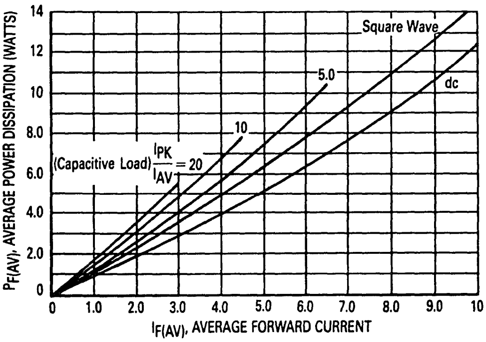
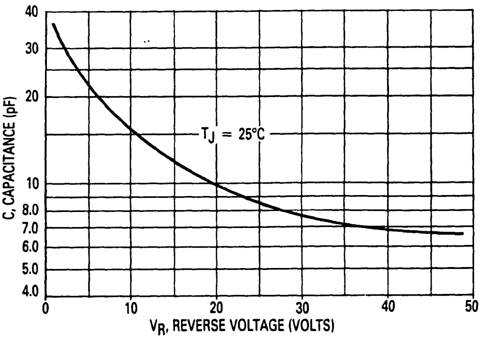


FIGURE 10 — TYPICAL CAPACITANCE



3

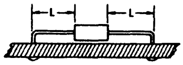
NOTE 1 — AMBIENT MOUNTING DATA

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

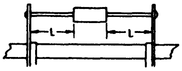
TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

MOUNTING METHOD		LEAD LENGTH, L (IN)				UNITS
		1/8	1/4	1/2	3/4	
1	$R_{\theta JA}$	50	51	53	55	°C/W
2	$R_{\theta JA}$	58	59	61	63	°C/W
3	$R_{\theta JA}$	28				°C/W

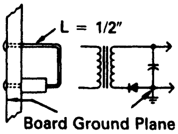
MOUNTING METHOD 1
P.C. Board Where Available Copper Surface area is small.



MOUNTING METHOD 2
Vector Push-In Terminals T-28



MOUNTING METHOD 3
P.C. Board with
1-1/2" x 1-1/2" Copper Surface



MECHANICAL CHARACTERISTICS

Case: Transfer Molded Plastic
Finish: External Leads are Plated, Leads are readily Solderable
Polarity: Indicated by Cathode Band
Weight: 1.1 Grams (Approximately)
Maximum Lead Temperature for Soldering Purposes:
300°C, 1/8" from case for 10 s

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Switchmode Power Rectifiers Ultrafast "E" Series w/High Reverse Energy Capability

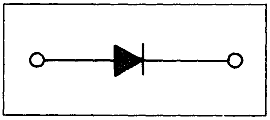
MUR470E
MUR480E
MUR490E
MUR4100E

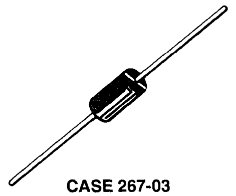
MUR4100E is a Motorola Preferred Device

ULTRAFAST RECTIFIERS
4.0 AMPERES
700–1000 VOLTS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- 20 mJ Avalanche Energy Guaranteed
- Excellent Protection Against Voltage Transients in Switching Inductive Load Circuits
- Ultrafast 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 1000 Volts





CASE 267-03

3

MAXIMUM RATINGS

Rating	Symbol	MUR				Unit
		470	480	490	4100	
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	700	800	900	1000	Volts
Average Rectified Forward Current (Square Wave) (Mounting Method #3 Per Note 1)	$I_{F(AV)}$	4.0 @ T_A = 35°C				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	70				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175				°C

THERMAL CHARACTERISTICS

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	See Note 1	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage (1) (I_F = 3.0 Amps, T_J = 150°C) (I_F = 3.0 Amps, T_J = 25°C) (I_F = 4.0 Amps, T_J = 25°C)	v_F	 1.53 1.75 1.85	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 100°C) (Rated dc Voltage, T_J = 25°C)	i_R	 900 25	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 100 75	ns
Maximum Forward Recovery Time (I_F = 1.0 Amp, di/dt = 100 Amp/μs, Recovery to 1.0 V)	t_{fr}	75	ns
Controlled Avalanche Energy (See Test Circuit in Figure 6)	W_{AVAL}	20	mJ

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

3

ELECTRICAL CHARACTERISTICS

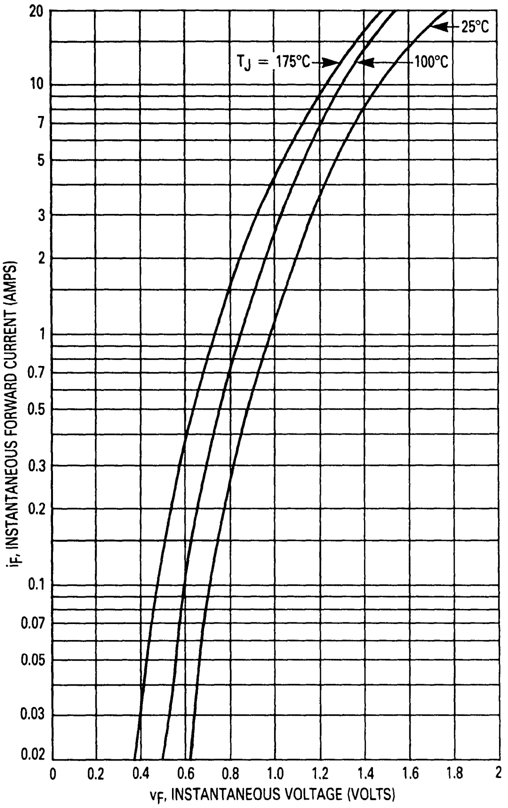


Figure 1. Typical Forward Voltage

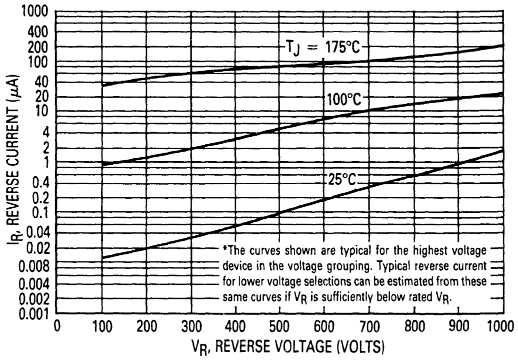


Figure 2. Typical Reverse Current*

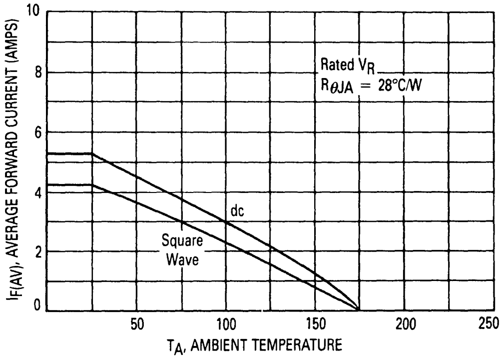


Figure 3. Current Derating (Mounting Method #3 Per Note 1)

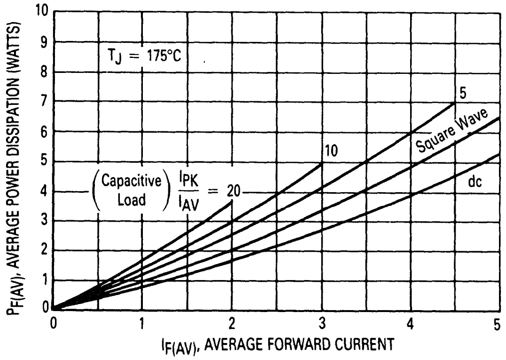


Figure 4. Power Dissipation

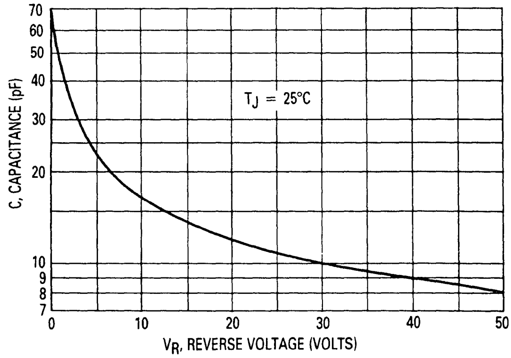


Figure 5. Typical Capacitance

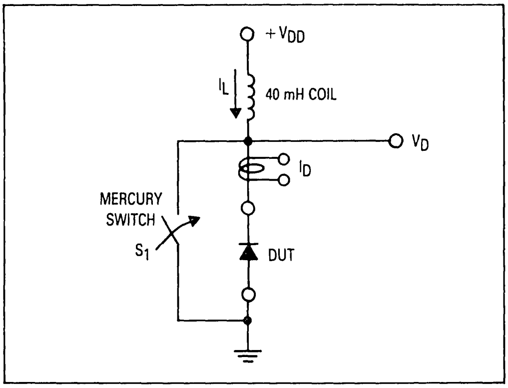


Figure 6. Test Circuit

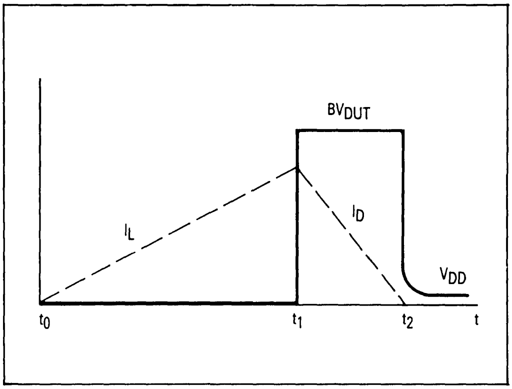


Figure 7. Current-Voltage Waveforms

The unclamped inductive switching circuit shown in Figure 6 was used to demonstrate the controlled avalanche capability of the new "E" series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When S_1 is closed at t_0 the current in the inductor I_L ramps up linearly; and energy is stored in the coil. At t_1 the switch is opened and the voltage across the diode under test begins to rise rapidly, due to di/dt effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at BV_{DUT} and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at t_2.

By solving the loop equation at the point in time when S_1 is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the V_{DD} power supply while the diode is in breakdown (from t_1 to t_2) minus any losses due to finite component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the V_{DD} voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when S_1 was closed, Equation (2).

The oscilloscope picture in Figure 8, shows the information obtained for the MUR8100E (similar die construction as the MUR4100E Series) in this test circuit conducting a peak current of one ampere at a breakdown voltage of 1300 volts, and using Equation (2) the energy absorbed by the MUR8100E is approximately 20 mjoules.

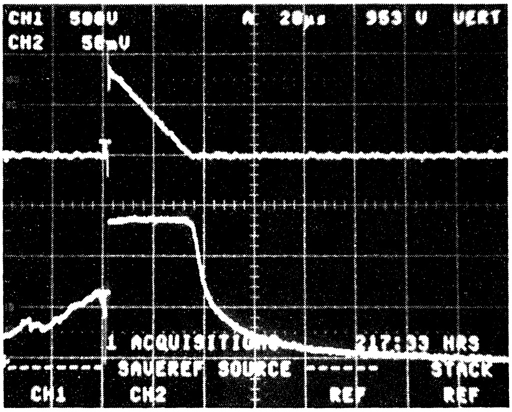
Although it is not recommended to design for this condition, the new "E" series provides added protection against those unforeseen transient viruses that can produce unexplained random failures in unfriendly environments.

EQUATION (1):

$$W_{AVAL} \approx \frac{1}{2} L I_{LPK}^2 \left(\frac{BV_{DUT}}{BV_{DUT} - V_{DD}} \right)$$

EQUATION (2):

$$W_{AVAL} \approx \frac{1}{2} L I_{LPK}^2$$



CHANNEL 2:
I_L
0.5 AMPS/DIV.

CHANNEL 1:
V_{DUT}
500 VOLTS/DIV.

TIME BASE:
20 µs/DIV.

Figure 8. Current-Voltage Waveforms

Note 1 — Ambient Mounting Data

Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering or in case the tie point temperature cannot be measured.

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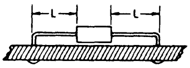
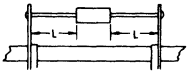
2	$R_{\theta JA}$	58	59	61	63	°C/W
3	$R_{\theta JA}$	28				°C/W

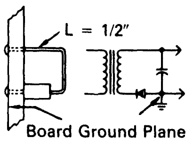
MOUNTING METHOD 1
P.C. Board Where Available Copper Surface area is small.



MOUNTING METHOD 2
Vector Push-In Terminals T-28



MOUNTING METHOD 3
P.C. Board with
1-1/2″ x 1-1/2″ Copper Surface



MECHANICAL CHARACTERISTICS

Case: Transfer Molded Plastic
Finish: External Leads are Plated, Leads are readily Solderable
Polarity: Indicated by Cathode Band
Weight: 1.1 Grams (Approximately)
Maximum Lead Temperature for Soldering Purposes:
300°C, 1/8″ from case for 10 seconds

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR605CT
MUR610CT
MUR615CT
MUR620CT

MUR620CT is a
Motorola Preferred Device

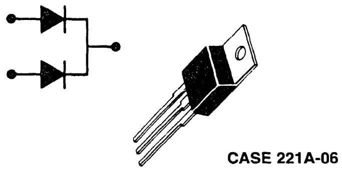
SWITCHMODE POWER RECTIFIERS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package

ULTRAFAST RECTIFIERS

6 AMPERES
50–200 VOLTS



CASE 221A-06
TO-220AB
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MUR605CT	MUR610CT	MUR615CT	MUR620CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 130°C — Per Diode Total Device	$I_{F(AV)}$	← 3.0 → ← 6.0 →				Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz) T_C = 130°C	I_{FRM}	← 6.0 →				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	← 75 →				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	← −65 to +175 →				°C

THERMAL CHARACTERISTICS PER DIODE LEG

Rating	Symbol	Typical	Maximum	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	5.0–6.0	7.0	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE LEG

Rating	Symbol	Typical	Maximum	Unit
Instantaneous Forward Voltage (1) (i_F = 3.0 Amp, T_C = 150°C) (i_F = 3.0 Amp, T_C = 25°C)	v_F	 0.80 0.94	 0.895 0.975	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 2.0–10 0.01–3.0	 250 5.0	μA
Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs)	t_{rr}	20–30	35	ns

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

FIGURE 1 — TYPICAL FORWARD VOLTAGE

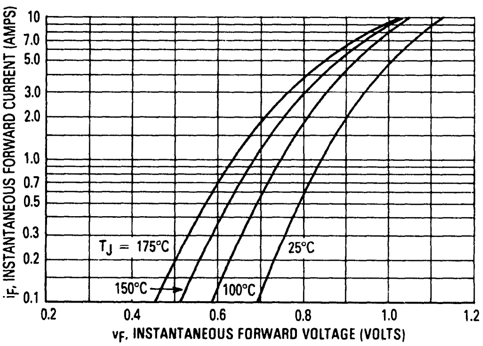


FIGURE 2 — TYPICAL REVERSE CURRENT

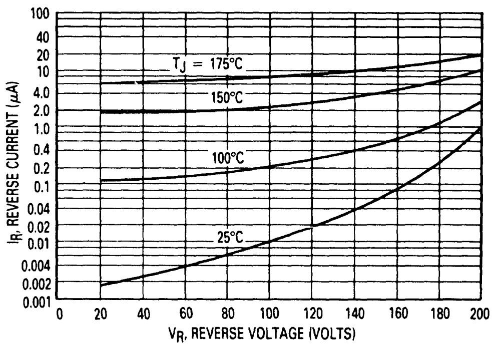


FIGURE 3 — TOTAL DEVICE CURRENT DERATING, CASE

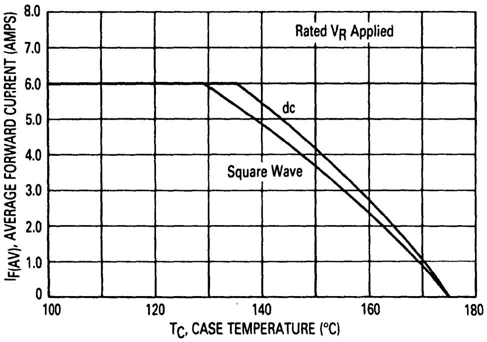


FIGURE 4 — TOTAL DEVICE CURRENT DERATING, AMBIENT

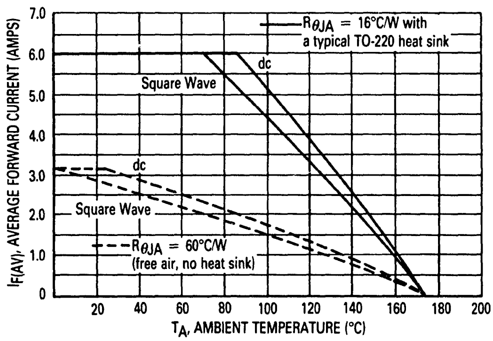
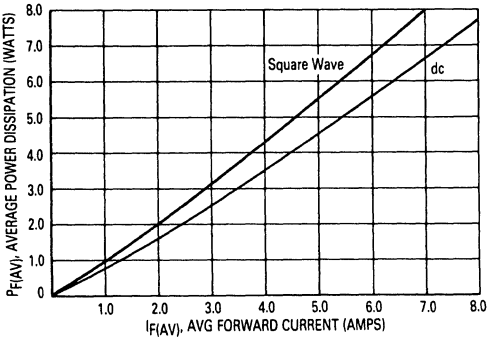


FIGURE 5 — POWER DISSIPATION



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR805 MUR810 MUR815 MUR820 MUR830 MUR840 MUR850 MUR860

MUR820, MUR840 and MUR860 are Motorola Preferred Devices

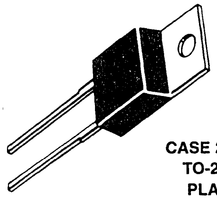
SWITCHMODE POWER RECTIFIERS

... designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 25, 50 and 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy meets UL94, V_O @ 1/8″
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 600 Volts

ULTRAFAST RECTIFIERS

8 AMPERES 50–600 VOLTS



CASE 221B-02
TO-220AC
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MUR								Unit
		805	810	815	820	830	840	850	860	
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	300	400	500	600	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C	$I_{F(AV)}$	8.0								Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16								Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100								Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175								°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	805	810	815	820	830	840	850	860	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0				2.0				°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	805	810	815	820	830	840	850	860	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	 0.895 0.975				 1.00 1.30		 1.20 1.50		Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 150°C) (Rated dc Voltage, T_J = 25°C)	i_R	 250 5.0				 500 10		 500 10		μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 35 25				 60 50				ns

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

MUR805, 810 AND 815

FIGURE 1 — TYPICAL FORWARD VOLTAGE

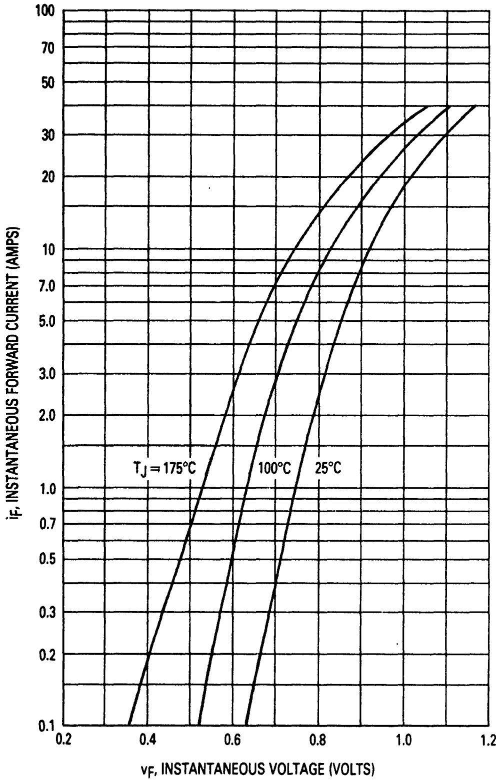


FIGURE 2 — TYPICAL REVERSE CURRENT*

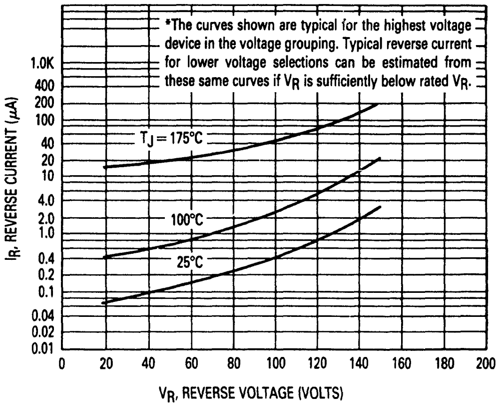


FIGURE 3 — CURRENT DERATING, CASE

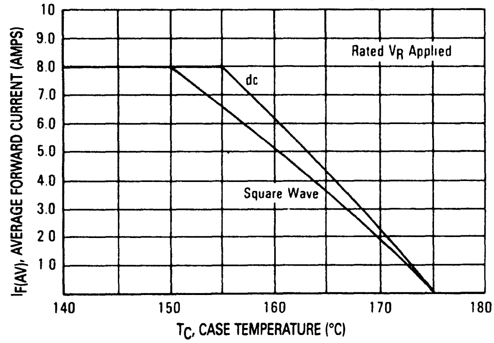


FIGURE 4 — CURRENT DERATING, AMBIENT

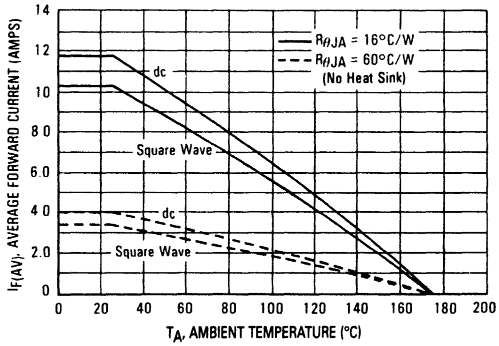
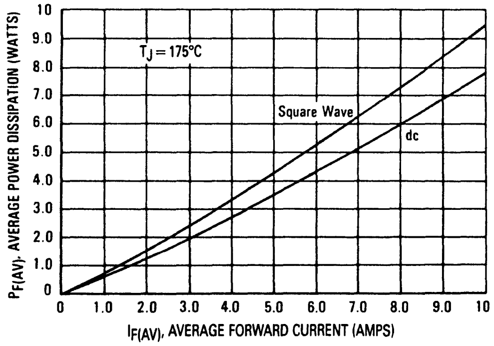


FIGURE 5 — POWER DISSIPATION



MUR820, 830 AND 840

FIGURE 6 — TYPICAL FORWARD VOLTAGE

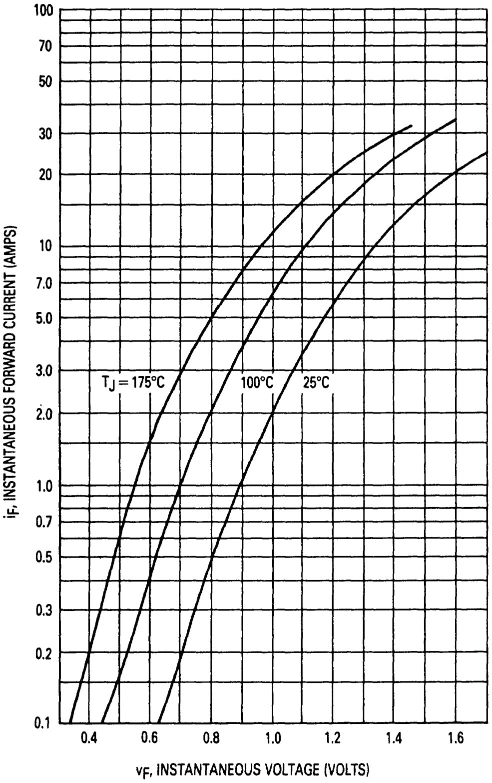


FIGURE 7 — TYPICAL REVERSE CURRENT*

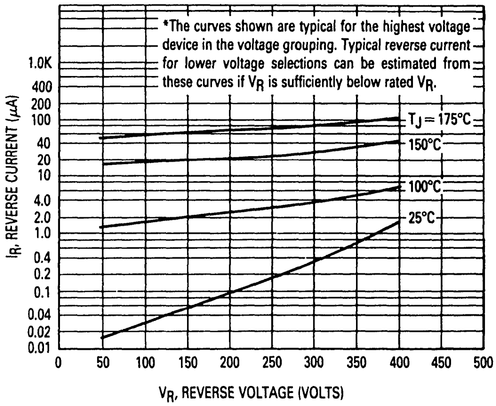


FIGURE 8 — CURRENT DERATING, CASE

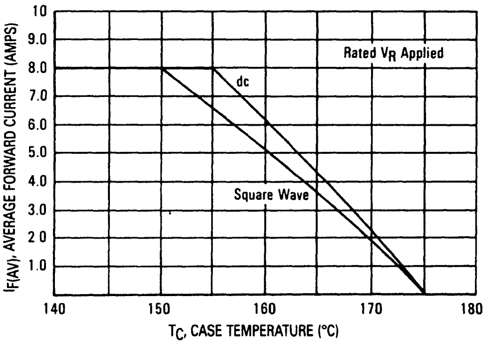


FIGURE 9 — CURRENT DERATING, AMBIENT

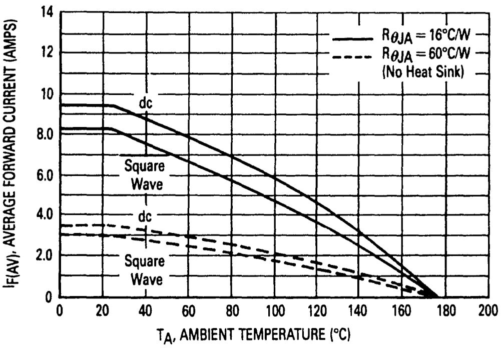
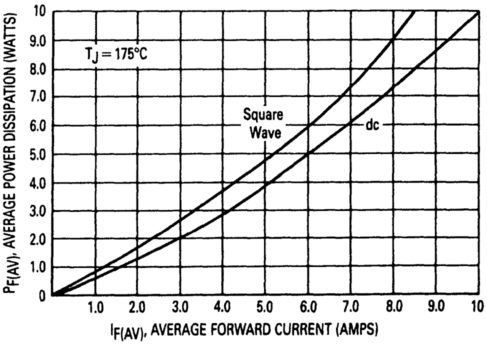


FIGURE 10 — POWER DISSIPATION



3

MUR850 AND 860

FIGURE 11 — TYPICAL FORWARD VOLTAGE

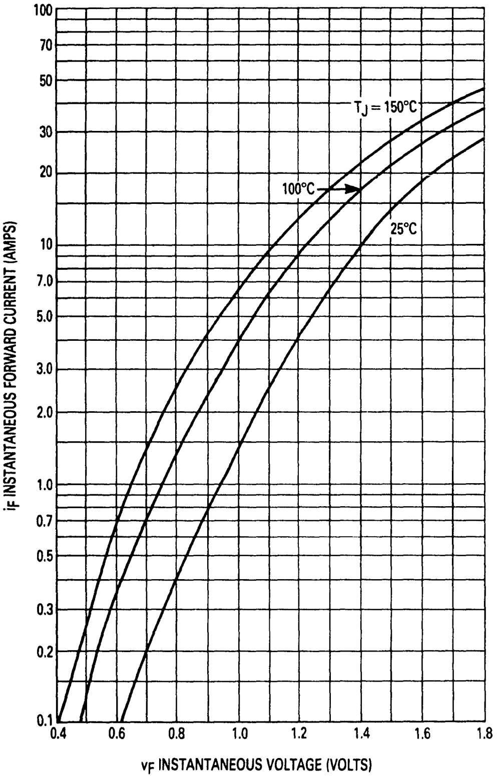


FIGURE 12 — TYPICAL REVERSE CURRENT*

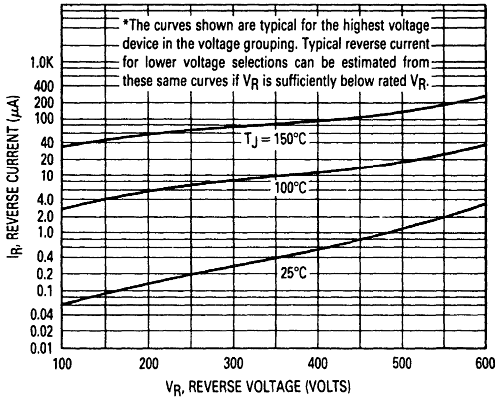


FIGURE 13 — CURRENT DERATING, CASE

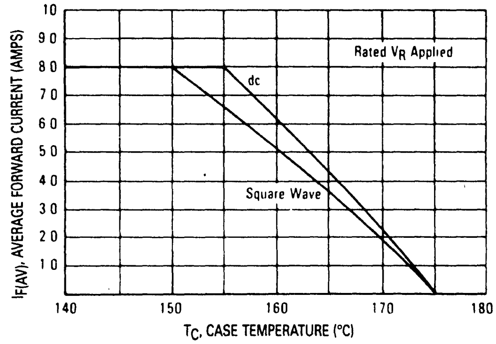


FIGURE 14 — CURRENT DERATING, AMBIENT

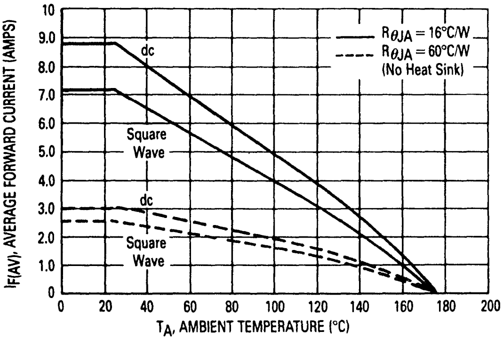
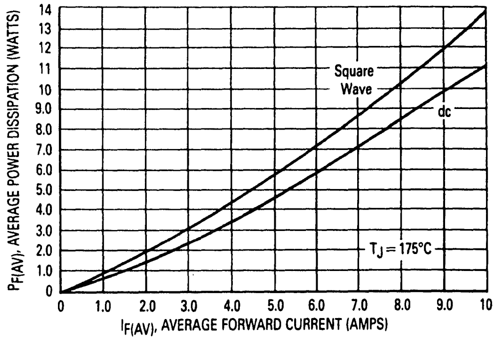


FIGURE 15 — POWER DISSIPATION



3

FIGURE 16 — THERMAL RESPONSE

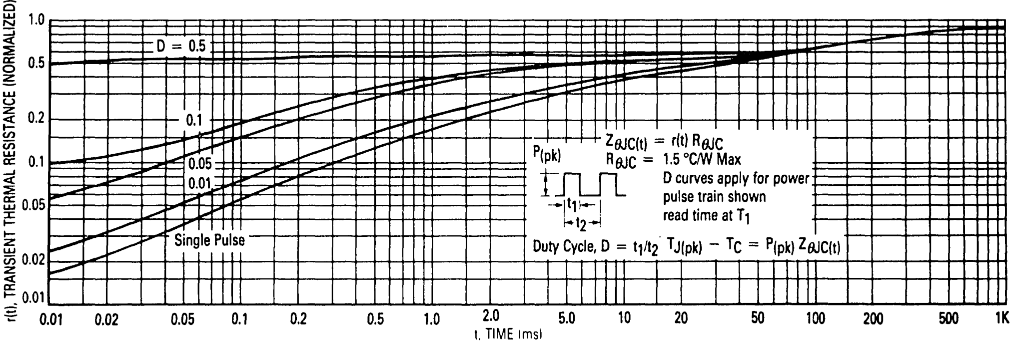
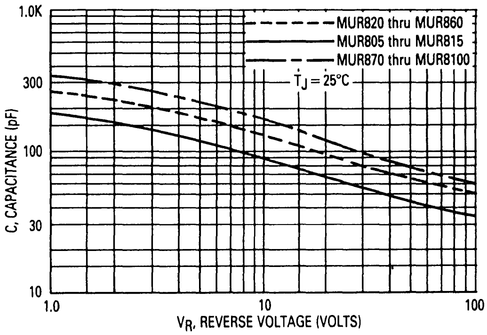


FIGURE 17 — TYPICAL CAPACITANCE



3

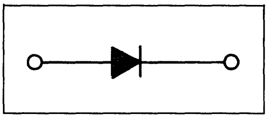
MUR870E
MUR880E
MUR890E
MUR8100E

MUR8100E is a Motorola Preferred Device

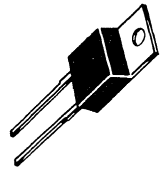
Switchmode Power Rectifiers Ultrafast "E" Series w/High Reverse Energy Capability

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- 20 mjoules Avalanche Energy Guaranteed
- Excellent Protection Against Voltage Transients in Switching Inductive Load Circuits
- Ultrafast 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8″
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 1000 Volts



ULTRAFAST RECTIFIERS
8.0 AMPERES
700–1000 VOLTS



CASE 221B-02
TO-220AC

3

MAXIMUM RATINGS

Rating	Symbol	MUR 870	MUR 880	MUR 890	MUR 8100	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	700	800	900	1000	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 150°C	$I_{F(AV)}$	8.0				Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FM}	16				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175				°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	 1.5 1.8	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 100°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 25	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	 100 75	ns
Controlled Avalanche Energy (See Test Circuit in Figure 6)	W_{AVAL}	20	mJ

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.
SWITCHMODE is a trademark of Motorola Inc.

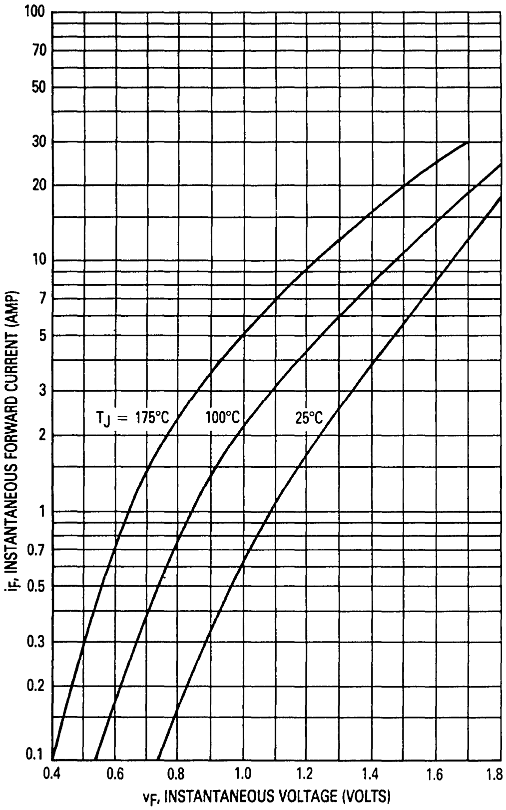


Figure 1. Typical Forward Voltage

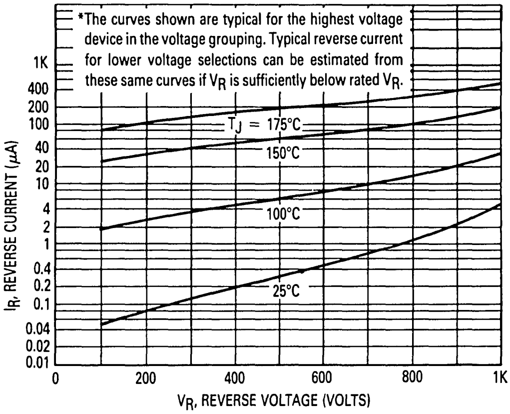


Figure 2. Typical Reverse Current*

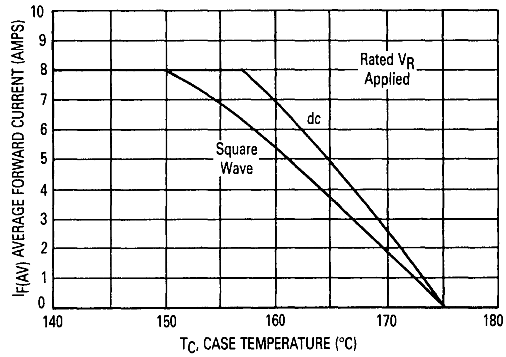


Figure 3. Current Derating, Case

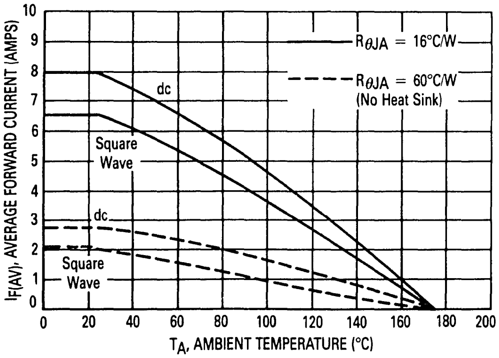


Figure 4. Current Derating, Ambient

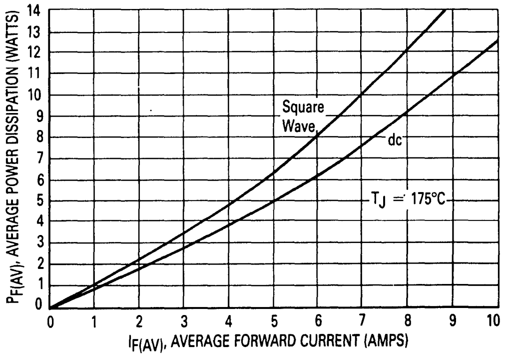


Figure 5. Power Dissipation

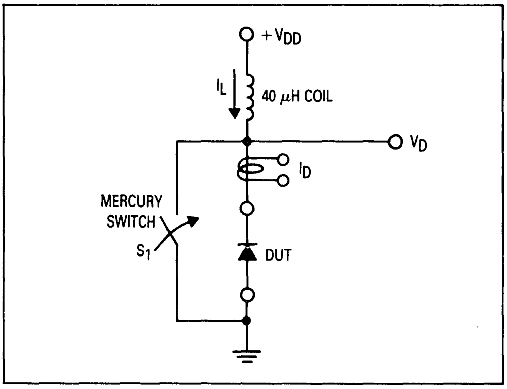


Figure 6. Test Circuit

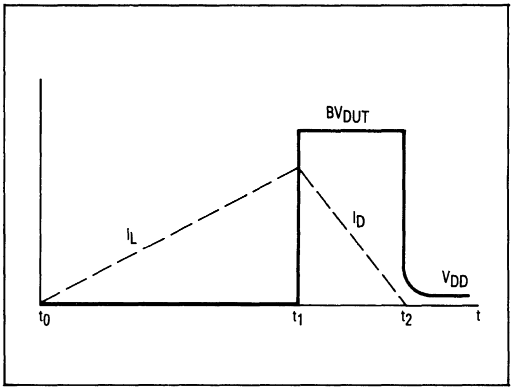


Figure 7. Current-Voltage Waveforms

The unclamped inductive switching circuit shown in Figure 6 was used to demonstrate the controlled avalanche capability of the new "E" series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When S_1 is closed at t_0 the current in the inductor I_L ramps up linearly; and energy is stored in the coil. At t_1 the switch is opened and the voltage across the diode under test begins to rise rapidly, due to di/dt effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at BV_{DUT} and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at t_2.

By solving the loop equation at the point in time when S_1 is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the V_{DD} power supply while the diode is in breakdown (from t_1 to t_2) minus any losses due to finite component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the V_{DD} voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when S_1 was closed, Equation (2).

The oscilloscope picture in Figure 8, shows the MUR8100E in this test circuit conducting a peak current of one ampere at a breakdown voltage of 1300 volts, and using Equation (2) the energy absorbed by the MUR8100E is approximately 20 mjoules.

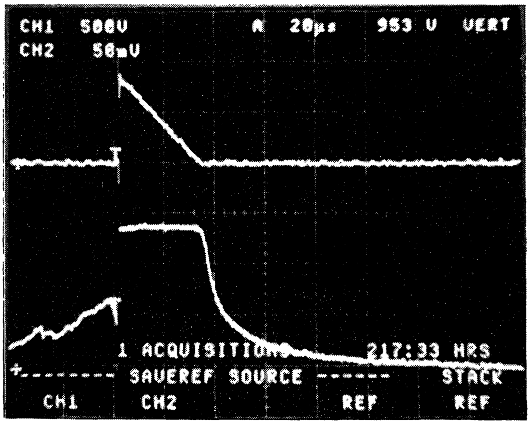
Although it is not recommended to design for this condition, the new "E" series provides added protection against those unforeseen transient viruses that can produce unexplained random failures in unfriendly environments.

EQUATION (1):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2 \left(\frac{BV_{DUT}}{BV_{DUT} - V_{DD}} \right)$$

EQUATION (2):

$$W_{AVAL} \approx \frac{1}{2} LI_{LPK}^2$$



CHANNEL 2:
I_L
0.5 AMPS/DIV.

CHANNEL 1:
V_{DUT}
500 VOLTS/DIV.

TIME BASE:
20 μs/DIV.

Figure 8. Current-Voltage Waveforms

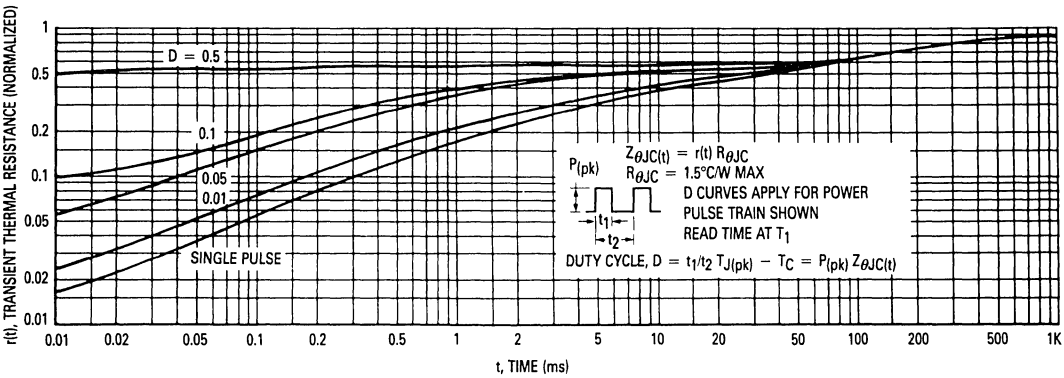


Figure 9. Thermal Response

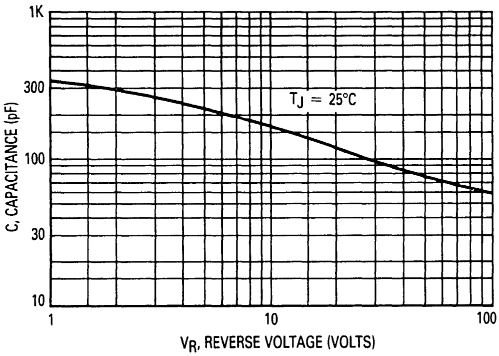


Figure 10. Typical Capacitance

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR1505 MUR1530 MUR1510 MUR1540 MUR1515 MUR1550 MUR1520 MUR1560

MUR1520, MUR1540 and MUR1560 are Motorola Preferred Devices

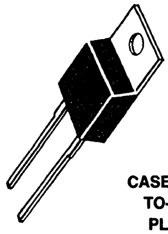
SWITCHMODE POWER RECTIFIERS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- High Voltage Capability to 600 Volts
- Low Forward Drop
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating Specified @ Both Case and Ambient Temperatures

ULTRAFAST RECTIFIERS

15 AMPERES 50–600 VOLTS



CASE 221B-02 TO-220AC PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MUR 1505	1510	1515	1520	1530	1540	1550	1560	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	300	400	500	600	Volts
Average Rectified Forward Current (Rated V_R)	$I_{F(AV)}$	15 @ T_C = 150°C						15 @ T_C = 145°C		Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz)	I_{FRM}	30 @ T_C = 150°C						30 @ T_C = 145°C		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	200				150				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175								°C

THERMAL CHARACTERISTICS

Rating	Symbol	1505	1510	1515	1520	1530	1540	1550	1560	Unit
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5								°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	1505	1510	1515	1520	1530	1540	1550	1560	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 15 Amp, T_C = 150°C) (i_F = 15 Amp, T_C = 25°C)	v_F	 0.85 1.05				 1.12 1.25		 1.20 1.50		Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10						 1000 10		μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs)	t_{rr}	35				60				ns

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

MUR1505, 1510, and 1515

FIGURE 1 — TYPICAL FORWARD VOLTAGE

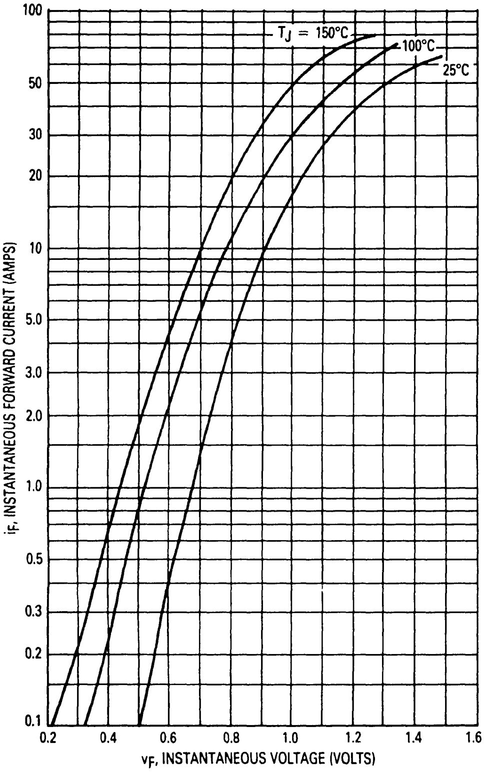
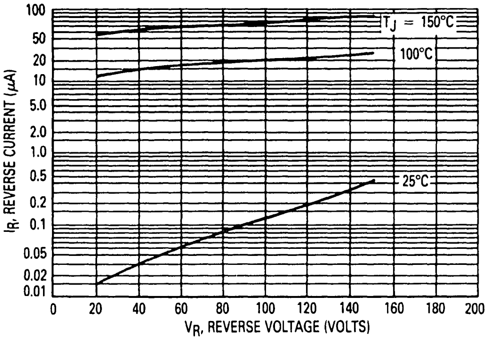


FIGURE 2 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

FIGURE 3 — CURRENT DERATING, CASE

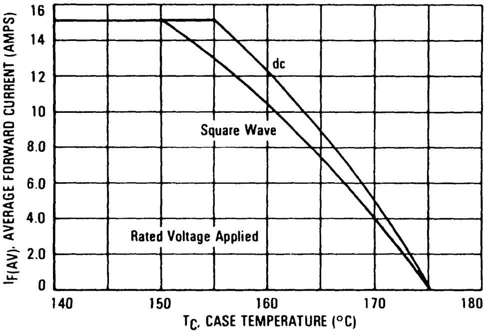


FIGURE 4 — CURRENT DERATING, AMBIENT

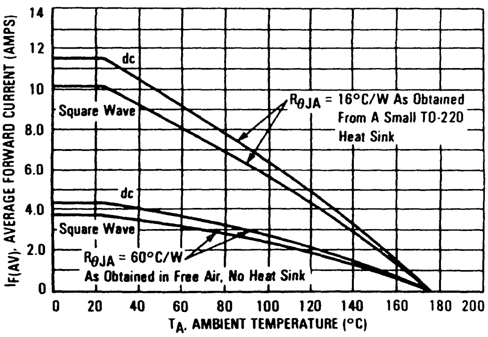
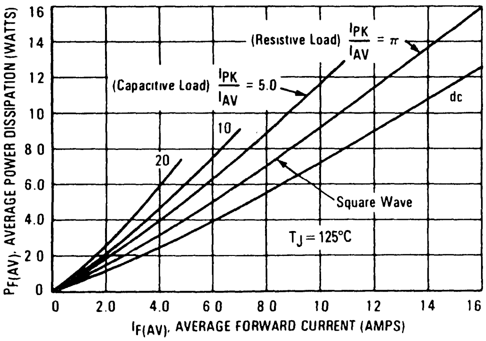


FIGURE 5 — POWER DISSIPATION



3

MUR1520, 1530, 1540

FIGURE 6 — TYPICAL FORWARD VOLTAGE

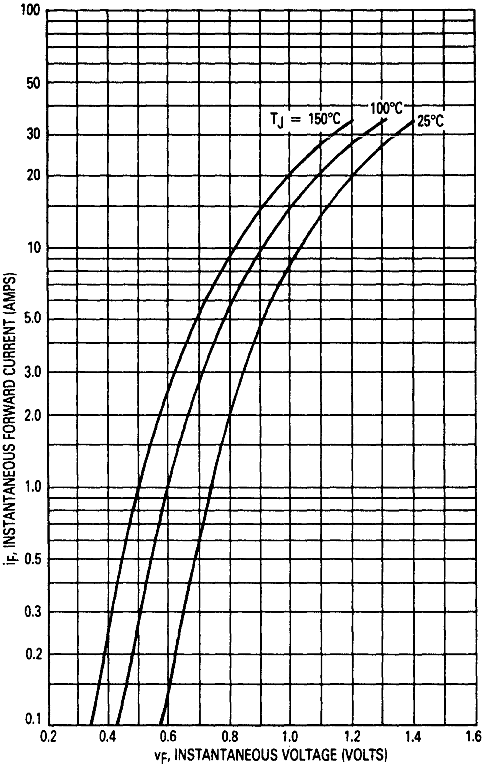
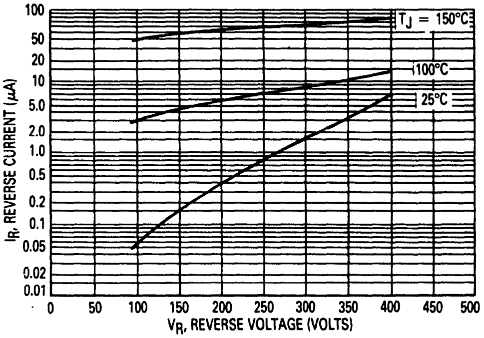


FIGURE 7 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

FIGURE 8 — CURRENT DERATING, CASE

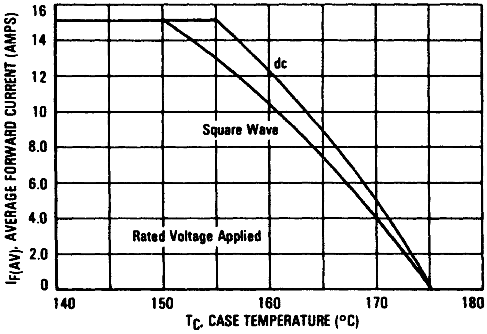


FIGURE 9 — CURRENT DERATING, AMBIENT

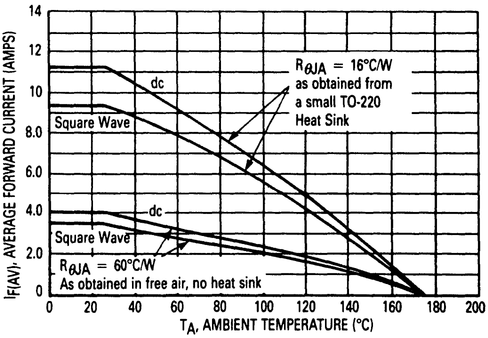
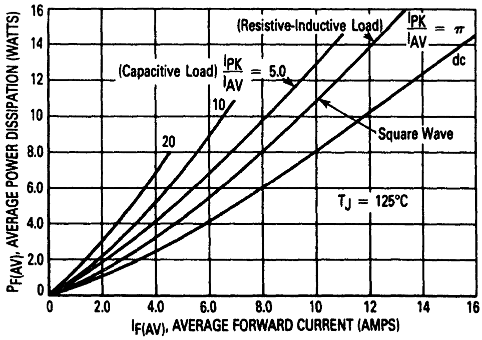


FIGURE 10 — POWER DISSIPATION



MUR1550, 1560

FIGURE 11 — TYPICAL FORWARD VOLTAGE

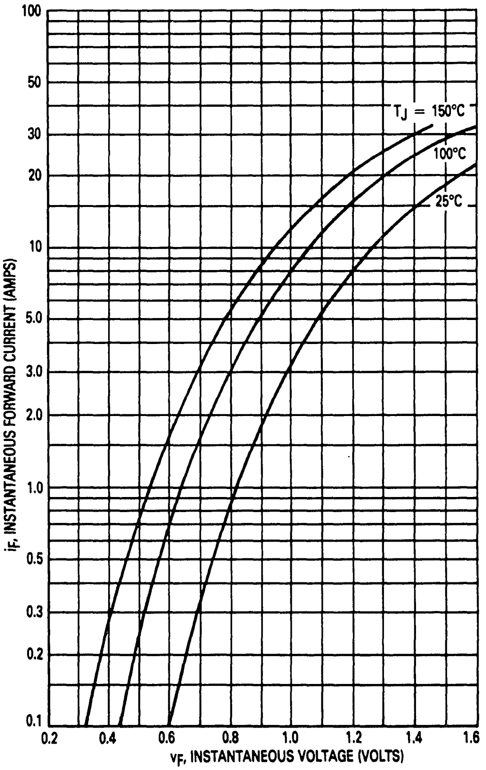
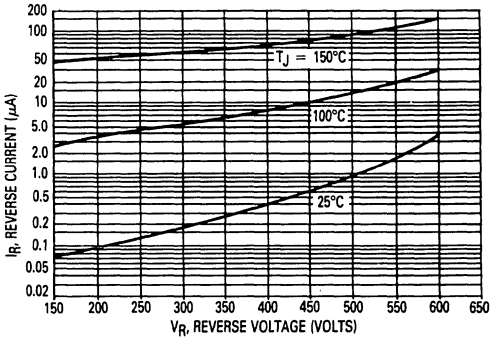


FIGURE 12 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

FIGURE 13 — CURRENT DERATING, CASE

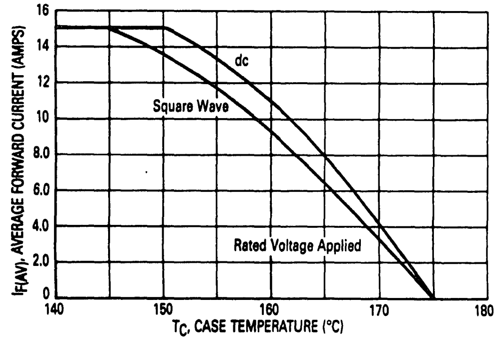


FIGURE 14 — CURRENT DERATING, AMBIENT

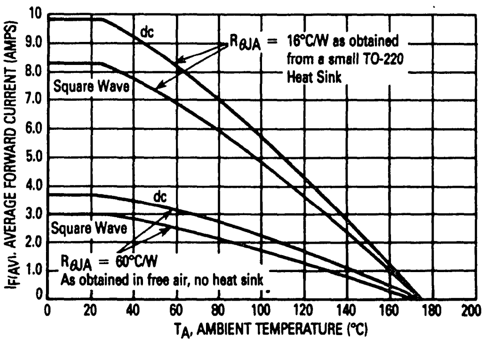
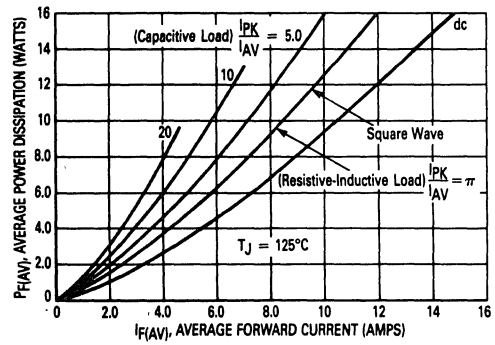
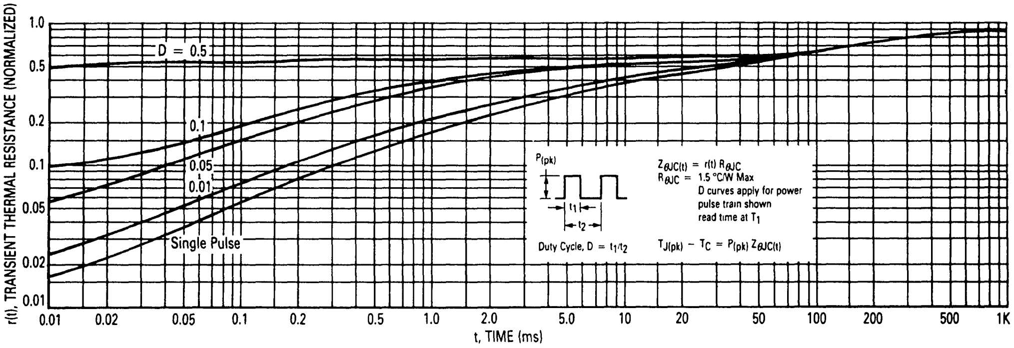


FIGURE 15 — POWER DISSIPATION



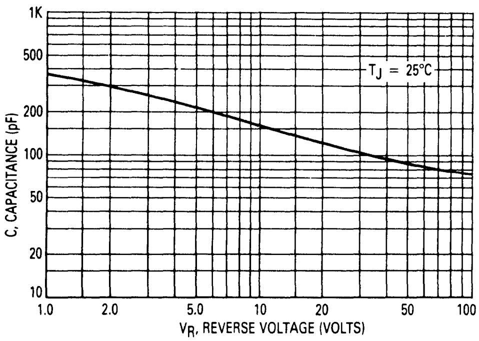
3

FIGURE 16 — THERMAL RESPONSE



3

FIGURE 17 — TYPICAL CAPACITANCE



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR1605CT MUR1630CT
MUR1610CT MUR1640CT
MUR1615CT MUR1650CT
MUR1620CT MUR1660CT

MUR1620CT, MUR1640CT and MUR1660CT are Motorola Preferred Devices

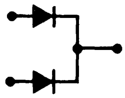
SWITCHMODE POWER RECTIFIERS

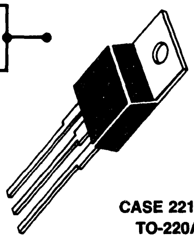
. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy meets UL94, V_O @ ⅛″
- High Temperature Glass Passivated Junction
- High Voltage Capability to 600 Volts
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures

ULTRAFAST RECTIFIERS

8 AMPERES
50–600 VOLTS





CASE 221A-06
TO-220AB
PLASTIC

3

MAXIMUM RATINGS

Rating	Symbol	MUR 1605CT	1610CT	1615CT	1620CT	1630CT	1640CT	1650CT	1660CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	300	400	500	600	Volts
Average Rectified Forward Current Per Leg Total Device, (Rated V_R), $T_C = 150°C$ Total Device	$I_{F(AV)}$	8.0 16								Amps
Peak Repetitive Forward Current Per Diode Leg (Rated V_R, Square Wave, 20 kHz), $T_C = 150°C$	I_{FM}	16								Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100								Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175								°C
THERMAL CHARACTERISTICS, PER DIODE LEG										
Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0				2.0				°C/W
ELECTRICAL CHARACTERISTICS, PER DIODE LEG										
Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 150°C) (i_F = 8.0 Amp, T_C = 25°C)	v_F	0.895 0.975				1.00 1.30		1.20 1.50		Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	250 5.0				500 10		500 10		μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, i_R = 1.0 Amp, I_{REC} = 0.25 Amp)	t_{rr}	35 25				60 50				ns

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

3

MUR1605CT, 1610CT AND 1615CT

FIGURE 1 — TYPICAL FORWARD VOLTAGE, PER LEG

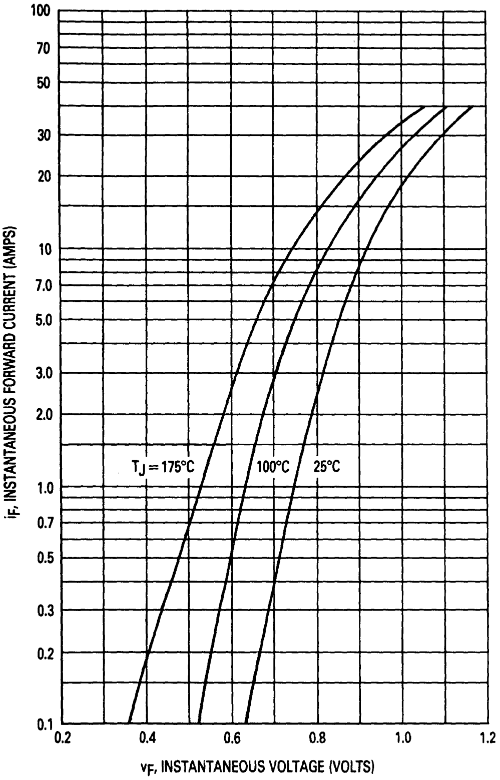


FIGURE 2 — TYPICAL REVERSE CURRENT, PER LEG*

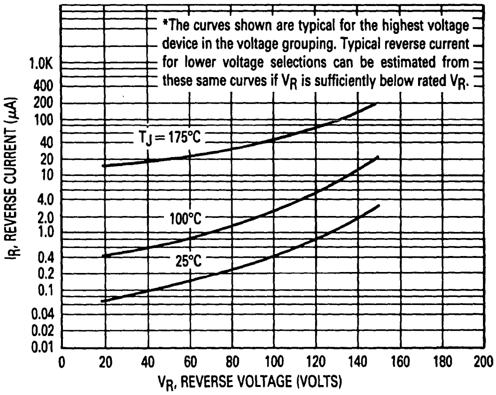


FIGURE 3 — CURRENT DERATING CASE, PER LEG

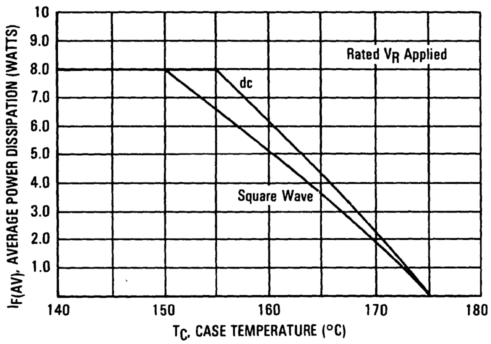


FIGURE 4 — CURRENT DERATING, AMBIENT, PER LEG

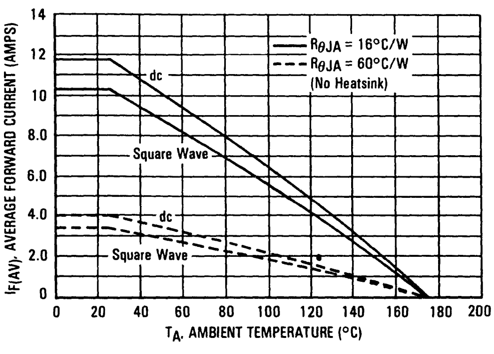
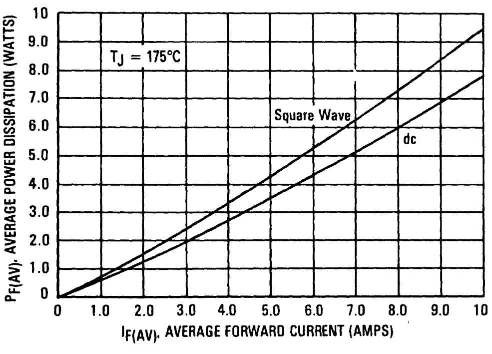


FIGURE 5 — POWER DISSIPATION, PER LEG



MUR1620CT, 1630CT AND 1640CT

FIGURE 6 — TYPICAL FORWARD VOLTAGE, PER LEG

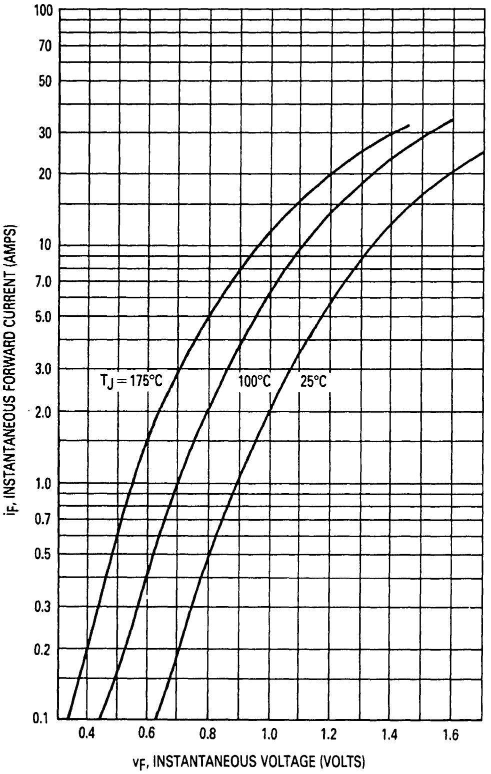


FIGURE 7 — TYPICAL REVERSE CURRENT, PER LEG*

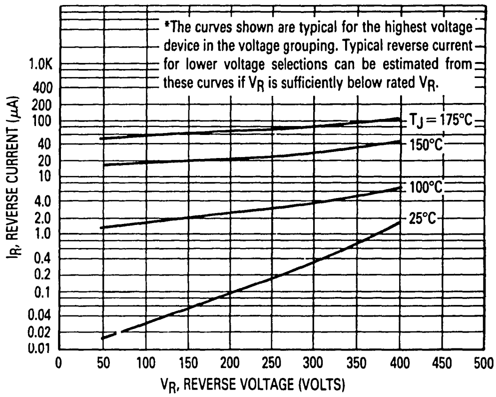


FIGURE 8 — CURRENT DERATING, CASE, PER LEG

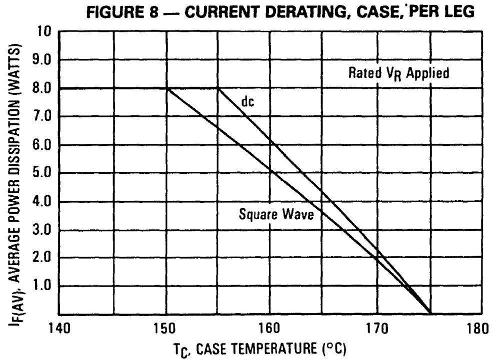


FIGURE 9 — CURRENT DERATING, AMBIENT, PER LEG

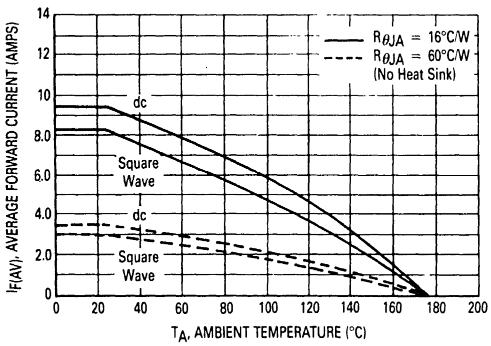
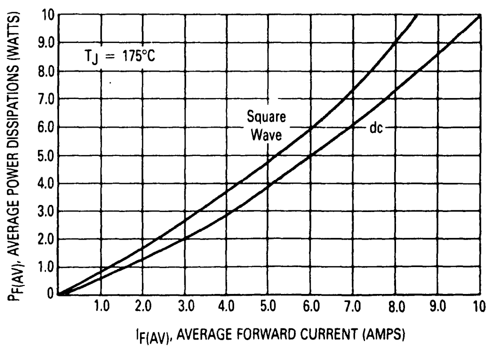


FIGURE 10 — POWER DISSIPATION, PER LEG



3

MUR1650CT AND 1660CT

FIGURE 11 — TYPICAL FORWARD VOLTAGE, PER LEG

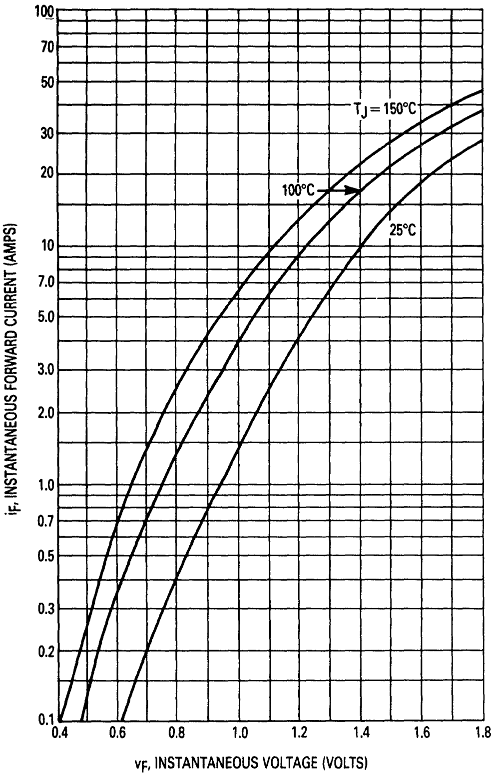


FIGURE 12 — TYPICAL REVERSE CURRENT, PER LEG*

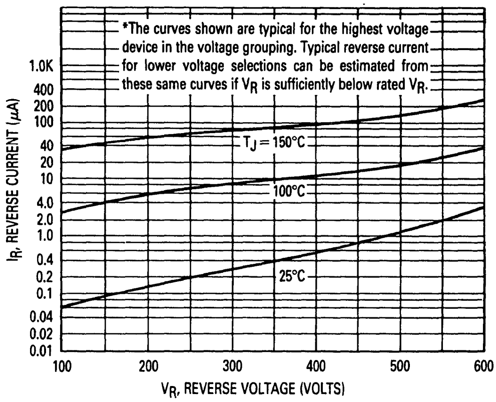


FIGURE 13 — CURRENT DERATING, CASE, PER LEG

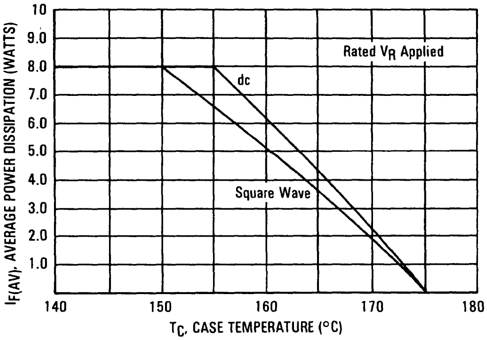


FIGURE 14 — CURRENT DERATING, AMBIENT, PER LEG

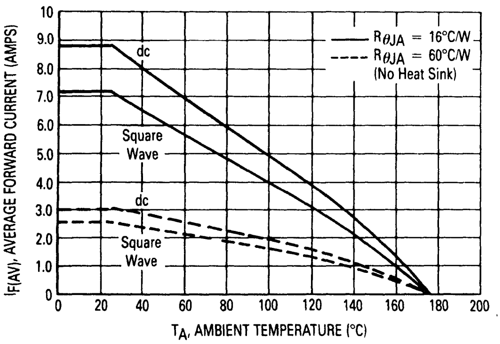


FIGURE 15 — POWER DISSIPATION, PER LEG

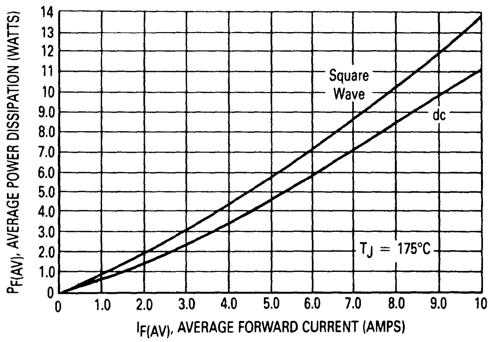


FIGURE 16 — THERMAL RESPONSE

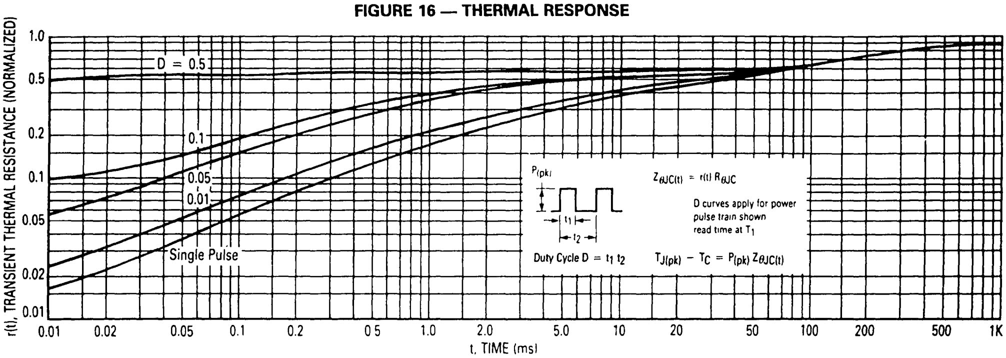
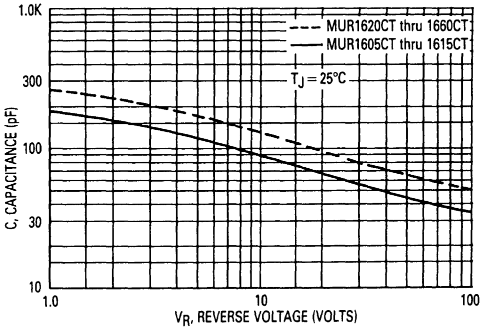


FIGURE 17 — TYPICAL CAPACITANCE, PER LEG



3

MUR1605CTR MUR1610CTR MUR1615CTR MUR1620CTR

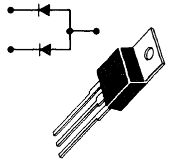
MUR1620CTR is a Motorola Preferred Device

Switchmode
Dual Ultrafast Power Rectifiers

. . . designed for use in negative switching power supplies, inverters and as free wheeling diodes. Also, used in conjunction with common cathode dual Ultrafast Rectifiers, makes a single phase full-wave bridge. These state-of-the-art devices have the following features:

- Common Anode Dual Rectifier (8.0 A per Leg or 16 A per Package)
- Ultrafast 35 Nanosecond Reverse Recovery Times
- Exhibits Soft Recovery Characteristics
- High Temperature Glass Passivated Junction
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures
- Epoxy Meets UL94, V_O @ 1/8″
- Complement to MUR1605CT Series of Common Cathode Devices

**ULTRAFAST RECTIFIERS
16 AMPERES
50–200 VOLTS**



**CASE 221A-06
TO-220AB**

3

MAXIMUM RATINGS (Per Leg)

Rating	Symbol	MUR 1605CTR	MUR 1610CTR	MUR 1615CTR	MUR 1620CTR	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 160°C Per Leg Per Total Device	$I_{F(AV)}$	 8.0 16				Amps
Peak Repetitive Surge Current, Per Diode (Rated V_R, Square Wave, 20 kHz), T_C = 140°C	I_{FM}	16				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	–65 to +175				°C

THERMAL CHARACTERISTICS (Per Leg)

Characteristic	Symbol	Value	Unit
Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS (Per Leg)

Characteristic	Symbol	Value	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 8.0 Amp, T_C = 25°C) (i_F = 8.0 Amp, T_C = 150°C)	v_F	 1.2 1.1	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 25°C) (Rated dc Voltage, T_C = 150°C)	i_R	 5.0 500	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amp/μs) (I_F = 0.5 Amp, di/dt = 100 Amp/μs)	t_{rr}	 85 35	ns

(1) Pulse Test: Pulse Width ≤ 5.0 ms, Duty Cycle ≤ 10%.
Switchmode is a trademark of Motorola Inc.

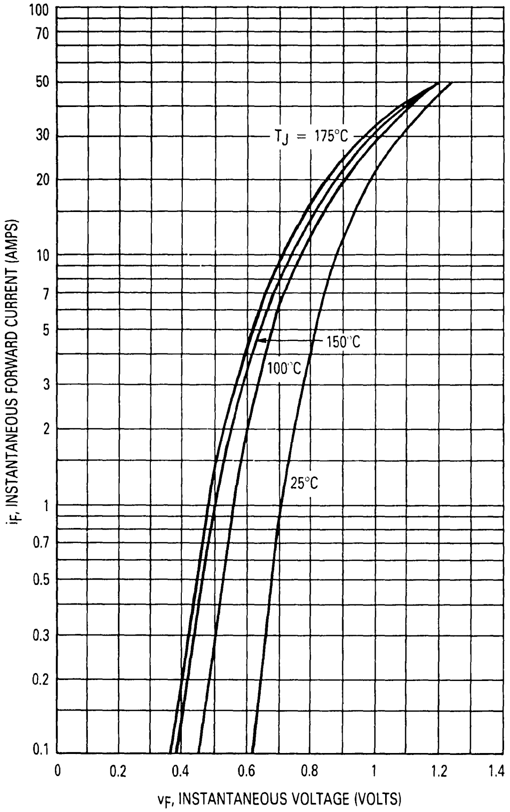


Figure 1. Typical Forward Voltage (Per Leg)

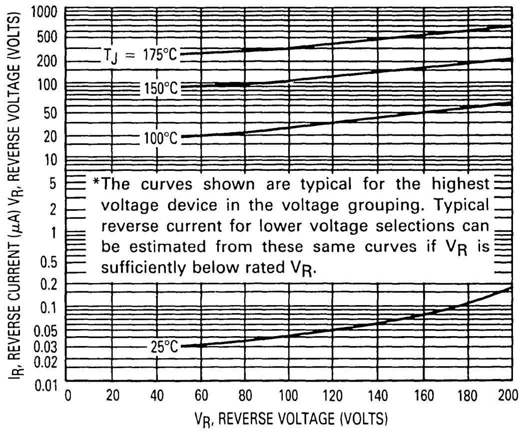


Figure 2. Typical Reverse Current* (Per Leg)

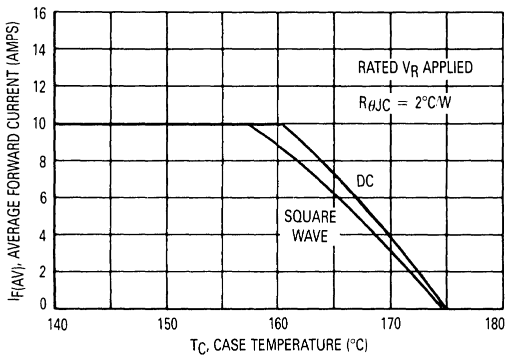


Figure 3. Current Derating, Case (Per Leg)

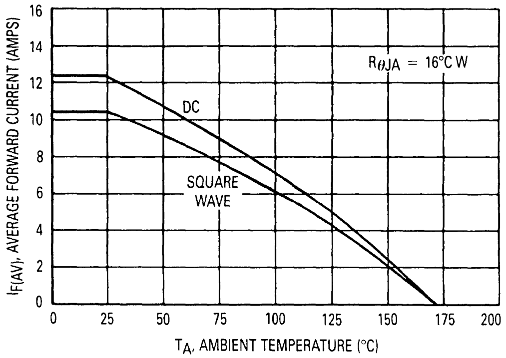


Figure 4. Current Derating, Ambient (Per Leg)

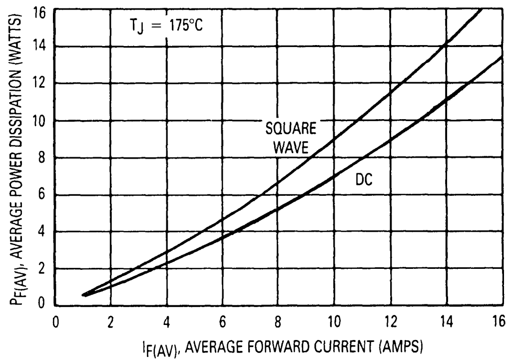


Figure 5. Power Dissipation (Per Leg)

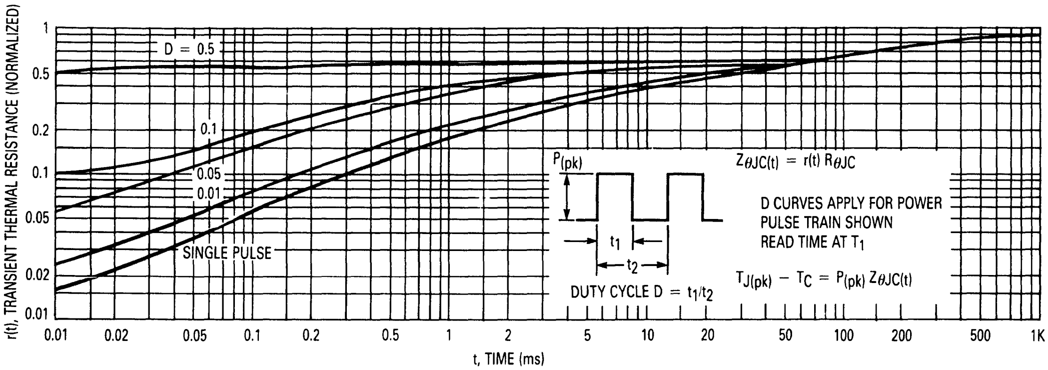


Figure 6. Thermal Response

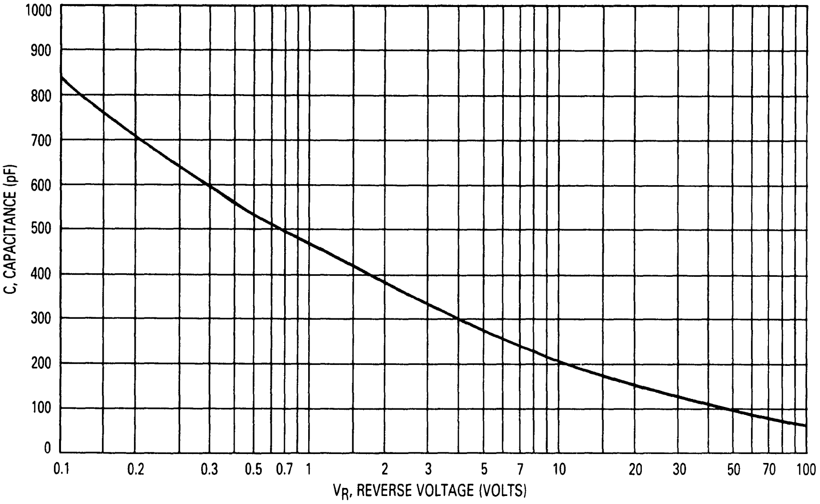


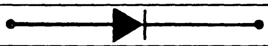
Figure 7. Typical Capacitance (Per Leg)

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR2505
MUR2510
MUR2515
MUR2520

MUR2520 is a Motorola Preferred Device



SWITCHMODE POWER RECTIFIERS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 50 Nanosecond Recovery Time
- Low Forward Voltage Drop
- Hermetically Sealed Metal DO-203AA (DO-4) Package

ULTRAFAST RECTIFIERS

25 AMPERES
50 to 200 VOLTS

CASE 245A-02
DO-203AA
METAL

MECHANICAL CHARACTERISTICS
CASE: Welded, hermetically sealed
FINISH: All external surface corrosion resistant and terminal leads are readily solderable
POLARITY: Cathode to Case
MOUNTING POSITIONS: Any
MOUNTING TORQUE: 15 in-lb max

MAXIMUM RATINGS

Rating	Symbol	MUR 2505	MUR 2510	MUR 2515	MUR 2520	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Nonrepetitive Peak Reverse Voltage	V_{RSM}	55	110	165	220	Volts
Average Forward Current $T_C = 145°C$	$I_{F(AV)}$	25				Amps
Nonrepetitive Peak Surge Forward Current (half cycle, 60 Hz, Sinusoidal Waveform)	I_{FSM}	500				Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	-65 to +175				°C

THERMAL CHARACTERISTICS

Rating	Symbol	All Devices	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1 3	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage Drop (i_F = 25 Amp, T_J = 25°C) (i_F = 25 Amp, T_J = 125°C) (i_F = 50 Amp, T_J = 125°C)	v_F	 0.95 0.80 0.88	Volts
Maximum Reverse Current @ DC Voltage (T_J = 25°C) (T_J = 125°C)	I_R	 10 1.0	 μA mA
Maximum Reverse Recovery Time (I_F = 1 0 Amp, di/dt = 50 Amp/μs, V_R = 30 V, T_J = 25°C)	t_{rr}	50	ns

3

FIGURE 1 — TYPICAL FORWARD VOLTAGE

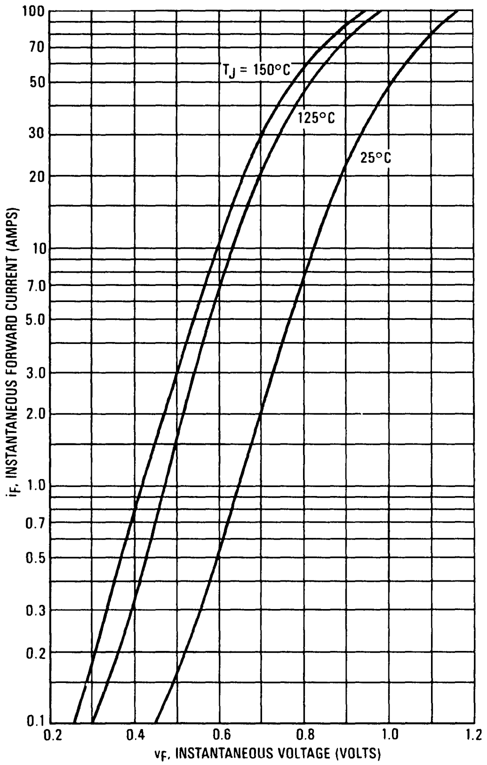
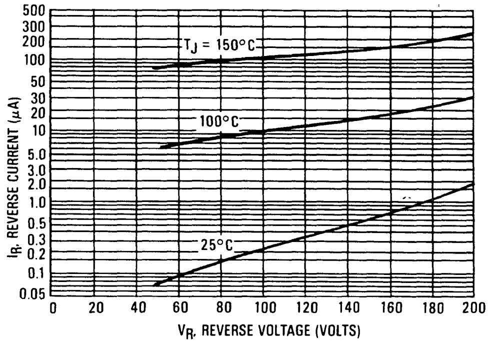


FIGURE 2 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R

FIGURE 3 — CURRENT DERATING, CASE

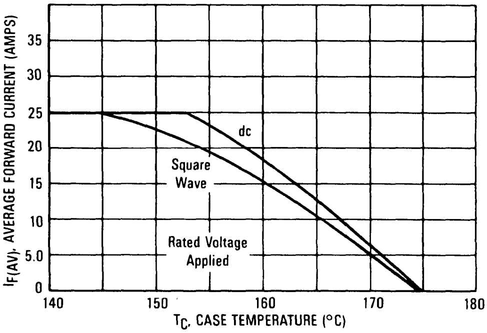


FIGURE 4 — POWER DISSIPATION

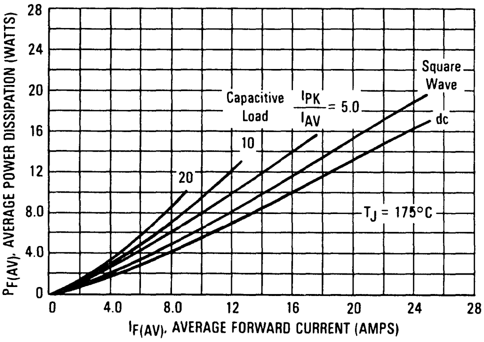


FIGURE 5 — TYPICAL CAPACITANCE

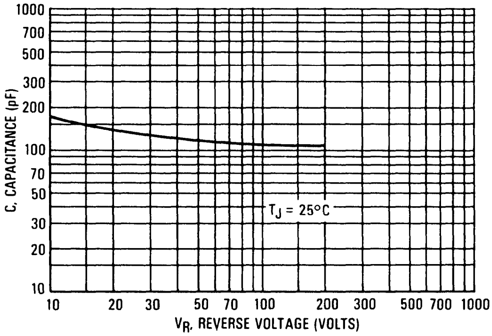
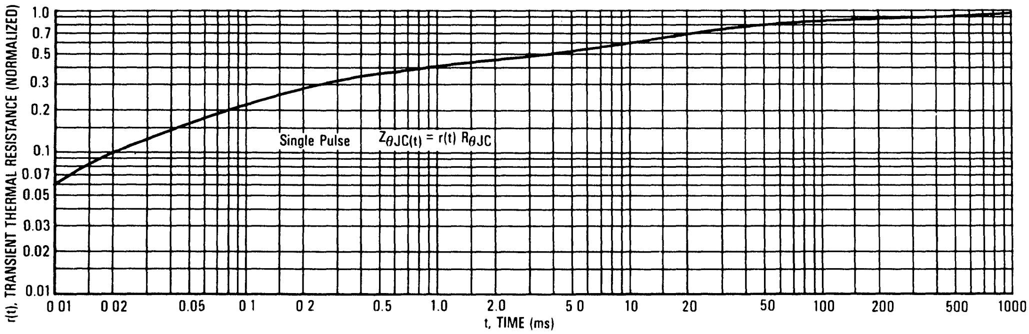


FIGURE 6 — THERMAL RESPONSE



MUR3005PT thru MUR3060PT

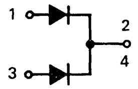
MUR3020PT and MUR3060PT are Motorola Preferred Devices

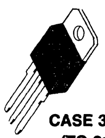
Switchmode Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- High Voltage Capability to 600 Volts
- Low Forward Drop
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating Specified @ Both Case and Ambient Temperatures
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction

ULTRAFAST RECTIFIERS
30 AMPERES
50–600 VOLTS





CASE 340D-01
(TO-218AC)

MAXIMUM RATINGS

Rating	Symbol	MUR 3005PT	3010PT	3015PT	3020PT	3030PT	3040PT	3050PT	3060PT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	300	400	500	600	Volts
Average Rectified Forward Current (Rated V_R) Per Leg Per Device	$I_{F(AV)}$	15 30 T_C = 150°C						15 T_C = 30 145°C		Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 150°C	I_{FRM}	30 @ T_C = 150°C						30 @ T_C = 145°C		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz) Per Leg	I_{FSM}	200				150				Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175								°C

THERMAL CHARACTERISTICS PER DIODE LEG

Maximum Thermal Resistance, Junction to Case Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.5 40	°C/W °C/W

ELECTRICAL CHARACTERISTICS PER DIODE LEG

		3005PT	3010PT	3015PT	3020PT	3030PT	3040PT	3050PT	3060PT	
Maximum Instantaneous Forward Voltage (1) (i_F = 15 Amps, T_C = 150°C) (i_F = 15 Amps, T_C = 25°C)	v_F	0.85 1.05				1.12 1.25		1.2 1.5		Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	500 10						1000 10		μA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/μs)	t_{rr}	35				60				ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

MUR3005PT, 3010PT, and 3015PT

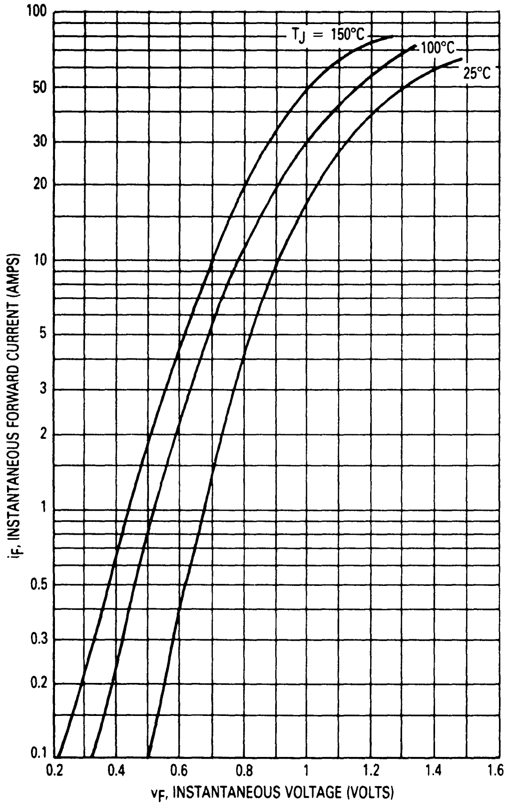
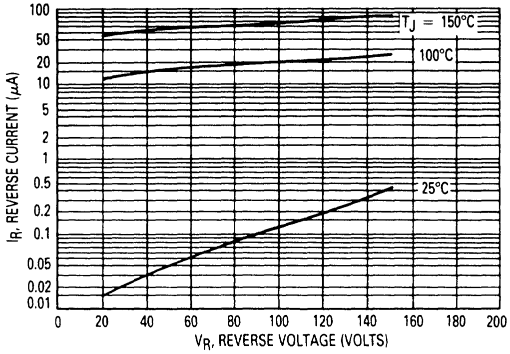


Figure 1. Typical Forward Voltage (Per Leg)



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 2. Typical Reverse Current (Per Leg)*

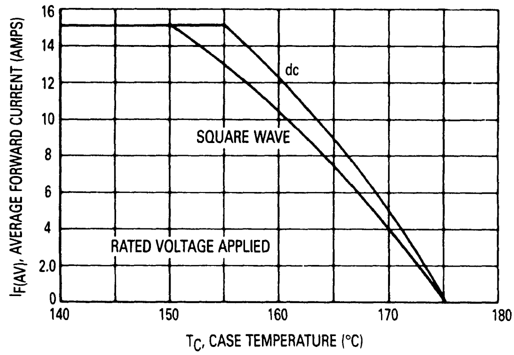


Figure 3. Current Derating, Case (Per Leg)

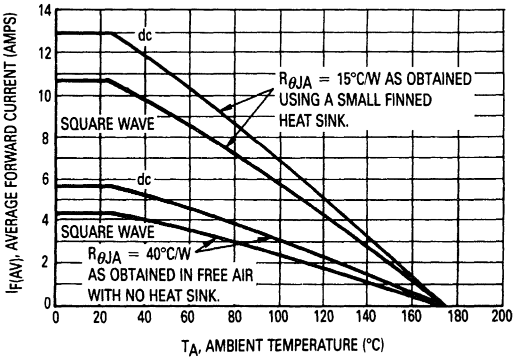


Figure 4. Current Derating, Ambient (Per Leg)

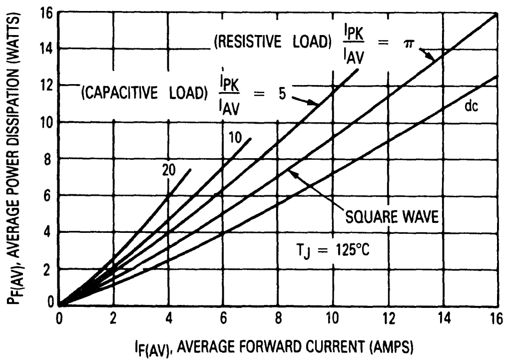


Figure 5. Power Dissipation (Per Leg)

MUR3020PT,3030PT, and 3040PT

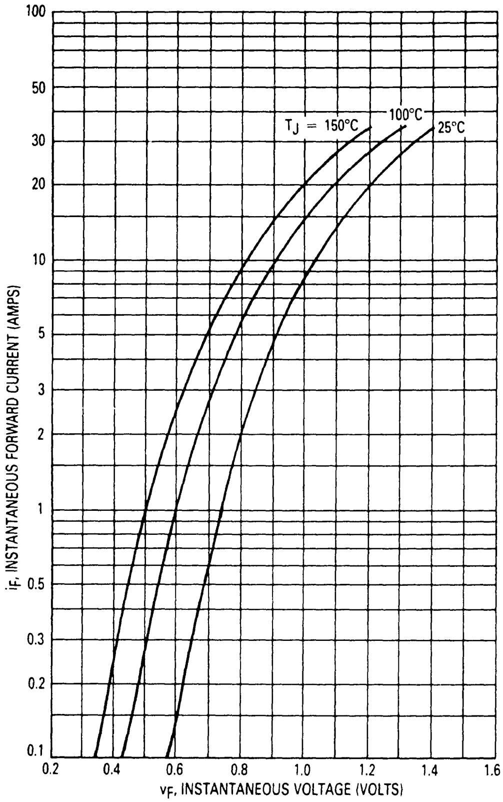
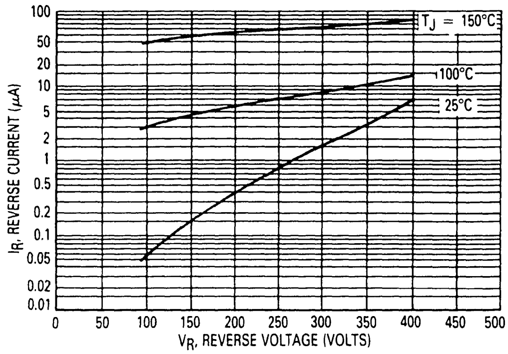


Figure 6. Typical Forward Voltage (Per Leg)



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 7. Typical Reverse Current (Per Leg)*

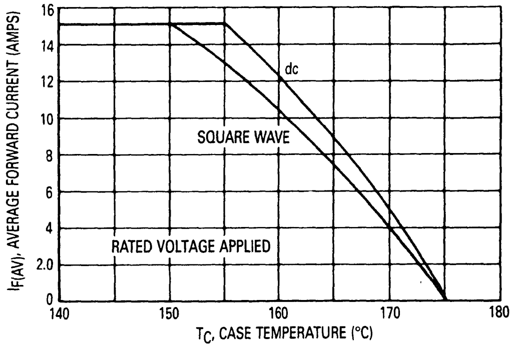


Figure 8. Current Derating, Case (Per Leg)

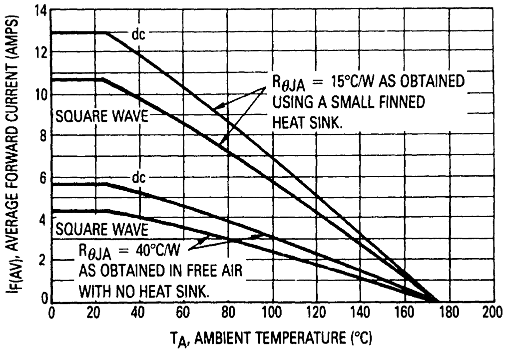


Figure 9. Current Derating, Ambient (Per Leg)

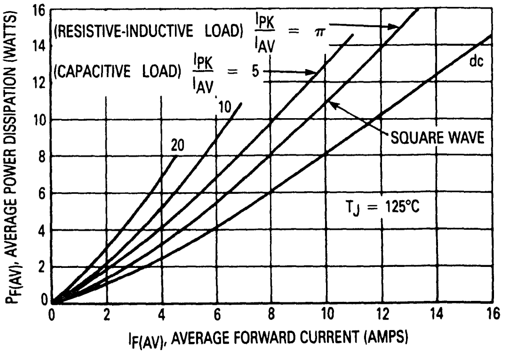


Figure 10. Power Dissipation (Per Leg)

3

MUR3050PT and MUR3060PT

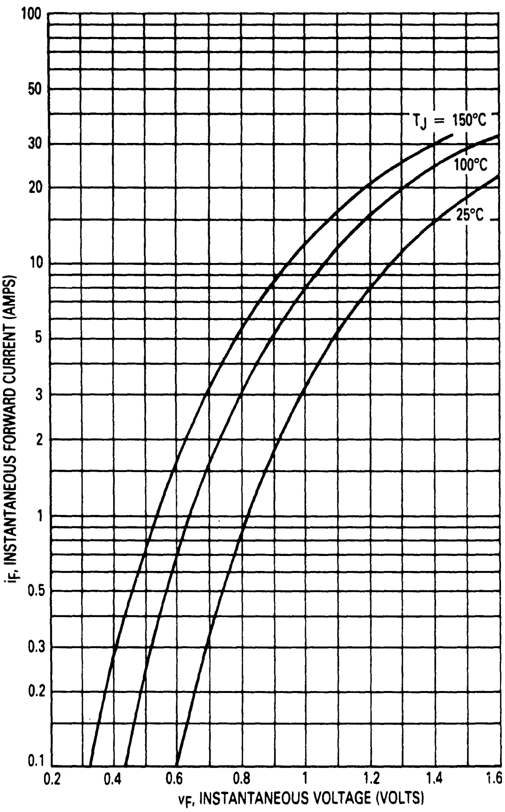
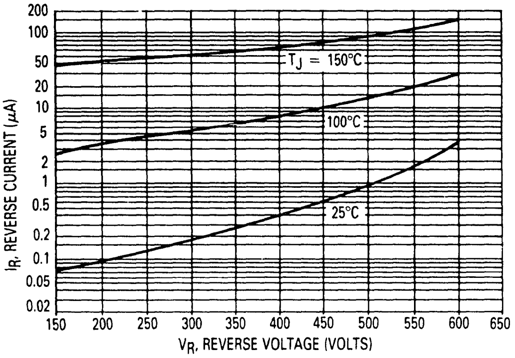


Figure 11. Typical Forward Voltage



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 12. Typical Reverse Current*

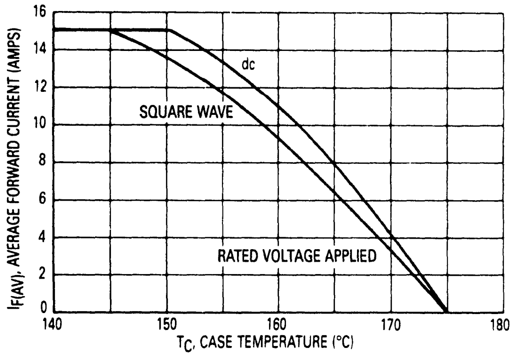


Figure 13. Current Derating, Case

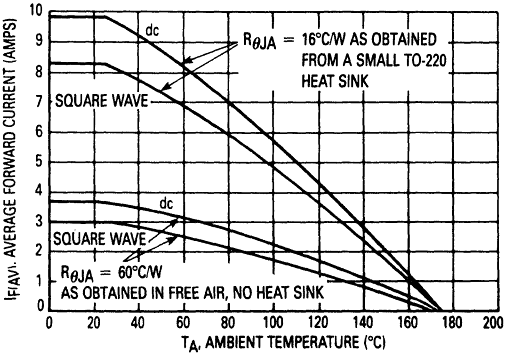


Figure 14. Current Derating, Ambient

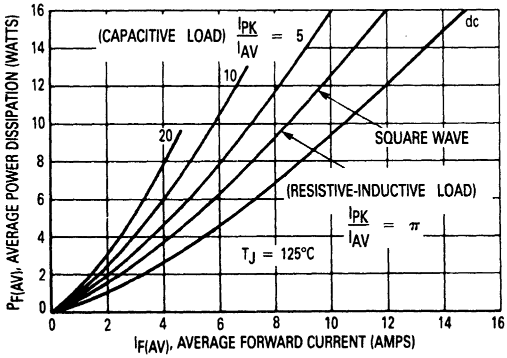


Figure 15. Power Dissipation

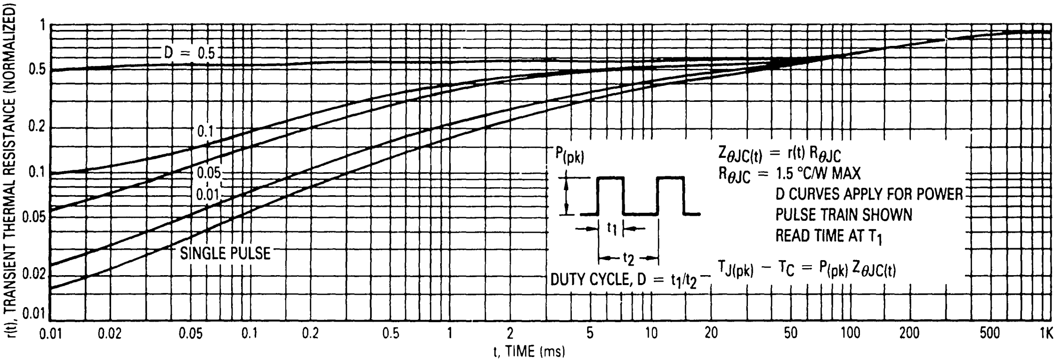


Figure 16. Thermal Response

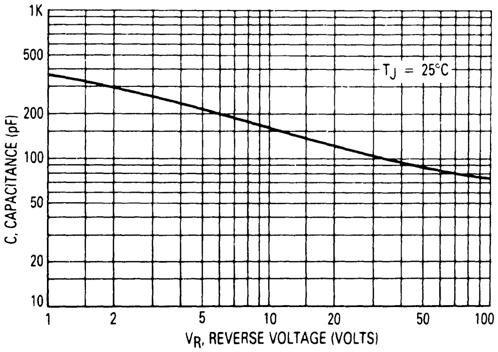


Figure 17. Typical Capacitance (Per Leg)

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR3020
MUR3030
MUR3040

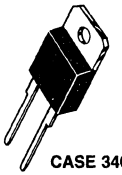
MUR3020 and MUR3040 are Motorola Preferred Devices

SWITCHMODE Power Rectifiers

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 100 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- State-of-the-Art Single TO-218 Atlas Package
- High Voltage Capability to 400 Volts
- Low Forward Voltage Drop
- High Temperature Glass Passivated Junction

ULTRAFAST RECTIFIERS
30 AMPERES
200–400 VOLTS



CASE 340E-01

3

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MUR3020 MUR3030 MUR3040	V_{RRM} V_{RWM} V_R	200 300 400	Volts
Average Rectified Forward Current $T_C = 70°C$		$I_{F(AV)}$	30	Amps
Peak Repetitive Forward Current (Rated V_R Square Wave 20 kHz) $T_C = 150°C$		I_{FRM}	30	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	300	Amps
Operating Junction Temperature and Storage Temperature		T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Instantaneous Forward Voltage (I_F = 30 Amp, T_C = 100°C) (I_F = 30 Amp, T_C = 25°C)	v_F	 1.4 1.5	Volts
Instantaneous Reverse Current (Rated dc Voltage, T_C = 100°C) (Rated dc Voltage, T_C = 25°C)	i_R	 6.0 35	 mA μA
Reverse Recovery Time (I_F = 1.0 Amp dI/dt = 15 Amp/μs	t_{rr}	100	ns

SWITCHMODE is a trademark of Motorola, Inc.

TYPICAL ELECTRICAL CHARACTERISTICS

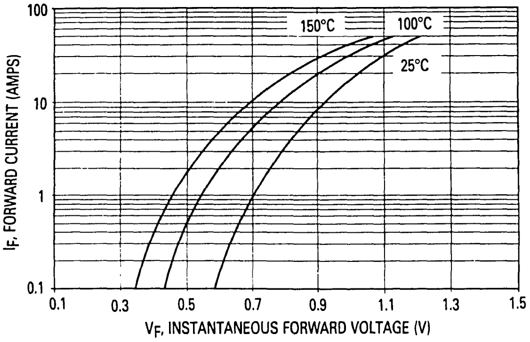


Figure 1. Typical Forward Voltage

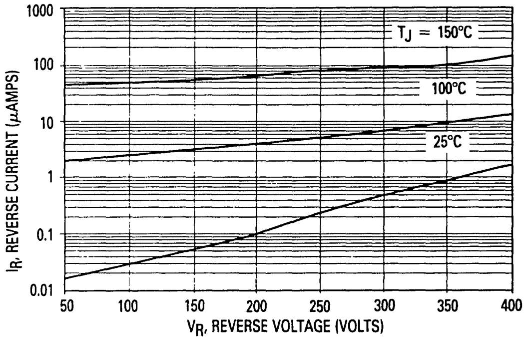


Figure 2. Typical Reverse Current

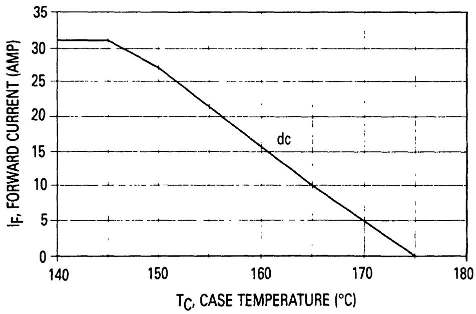


Figure 3. Current Derating, Case

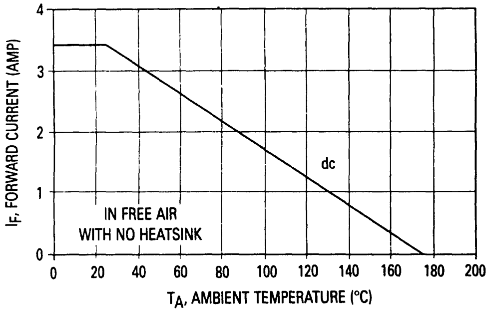


Figure 4. Current Derating, Ambient

3

SWITCHMODE Power Rectifiers

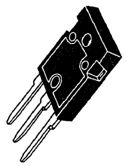
MUR3060WT
MUR3040WT
MUR3020WT

MUR3060WT, MUR3040WT and MUR3020WT are Motorola Preferred Devices

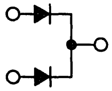
. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO-247 Package
- High Voltage Capability to 600 Volts
- Low Forward Drop
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating Specified @ Both Case and Ambient Temperatures
- Epoxy Meets UL94V-O @ 1/8″
- High Temperature Glass Passivated Junction

ULTRAFAST RECTIFIERS
30 AMPERES
200-400-600 VOLTS



CASE 340F-03
TO-247AE



3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	MUR3020WT	MUR3040WT	MUR3060WT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	400	600	Volts
Average Rectified Forward Current @ 145°C Total Device	$I_{F(AV)}$		15 30		Amps
Peak Repetitive Surge Current (Rated V_R, Square Wave, 20 kHz, T_C = 145°C)	I_{FM}		30		Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}		350		
Operating Junction and Storage Temperature	T_J, T_{stg}		– 65 to +175		°C

THERMAL CHARACTERISTICS, PER LEG

Rating	Symbol	Value	Unit
Maximum Thermal Resistance — Junction to Case — Junction to Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.5 40	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Characteristic	Symbol	MUR3020WT	MUR3040WT	MUR3060WT	Unit
Maximum Instantaneous Forward Voltage (1) (I_F = 15 Amp, T_C = 150°C) (I_F = 15 Amp, T_C = 25°C)	v_F	0.85 1.05	1.12 1.25	1.4 1.7	Volts
Maximum Instantaneous Reverse Current (1) (Rated DC Voltage, T_J = 150°C) (Rated DC Voltage, T_J = 25°C)	i_R	500 10		1000 10	μA
Maximum Reverse Recovery Time (i_F = 1.0 A, di/dt = 50 Amps/μs)	t_{rr}	35	60		ns

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

MUR3020WT

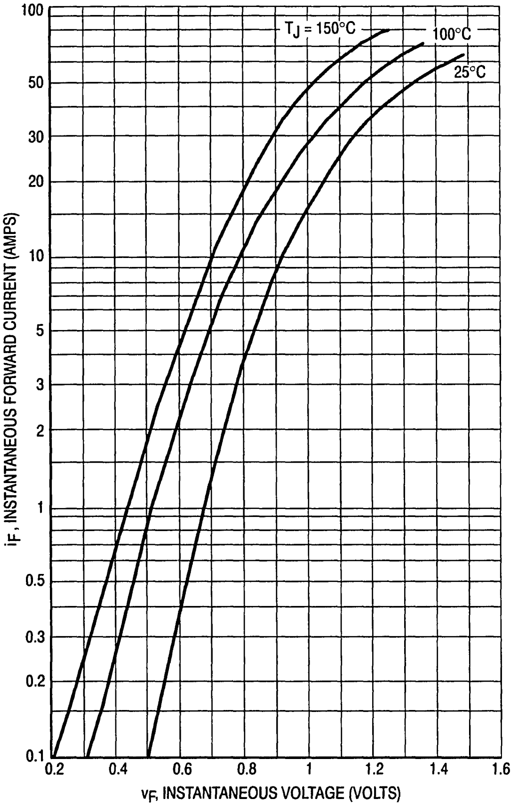
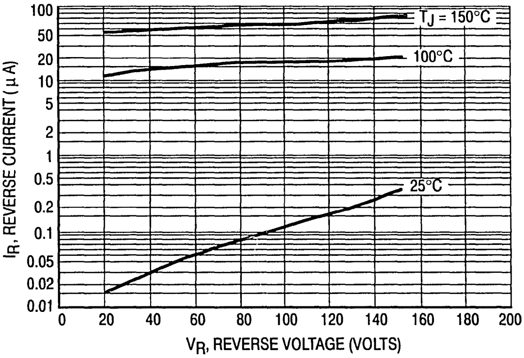


Figure 1. Typical Forward Voltage (Per Leg)



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 2. Typical Reverse Current (Per Leg)*

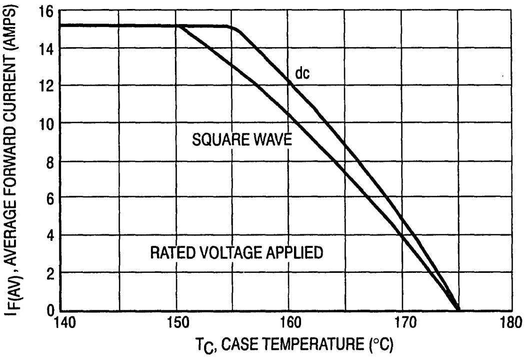


Figure 3. Current Derating, Case (Per Leg)

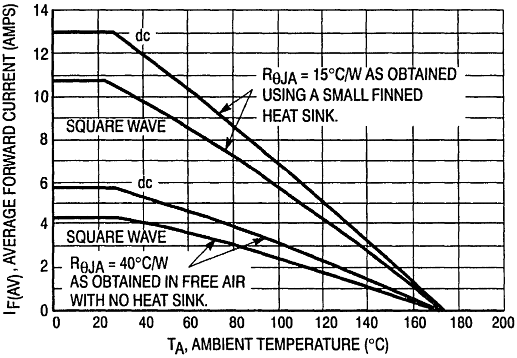


Figure 4. Current Derating, Ambient (Per Leg)

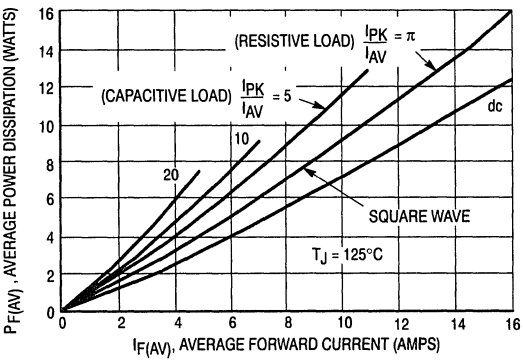


Figure 5. Power Dissipation (Per Leg)

MUR3040WT

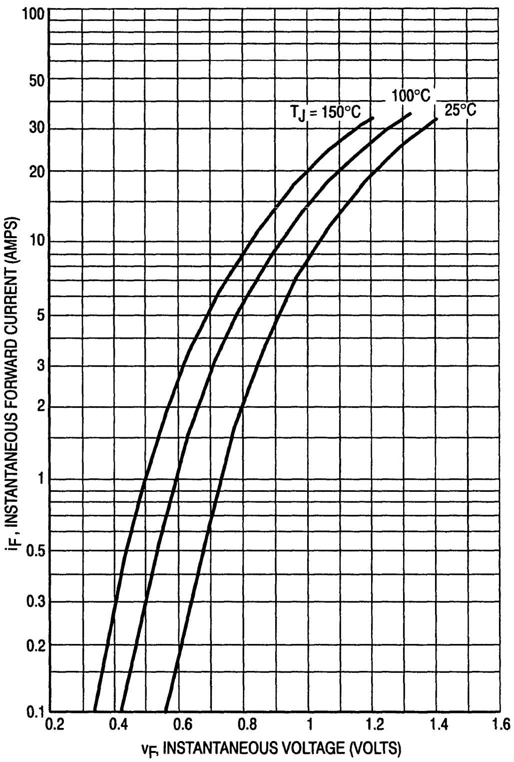
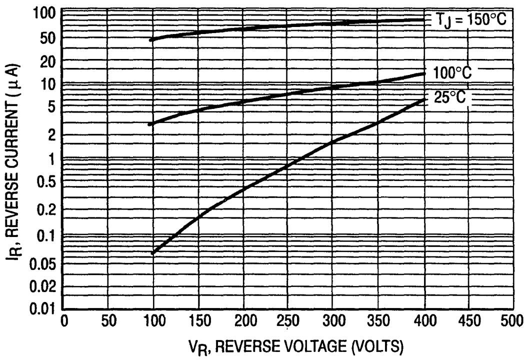


Figure 6. Typical Forward Voltage (Per Leg)



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 7. Typical Reverse Current (Per Leg)*

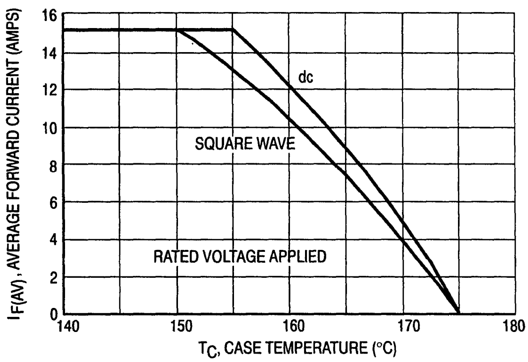


Figure 8. Current Derating, Case (Per Leg)

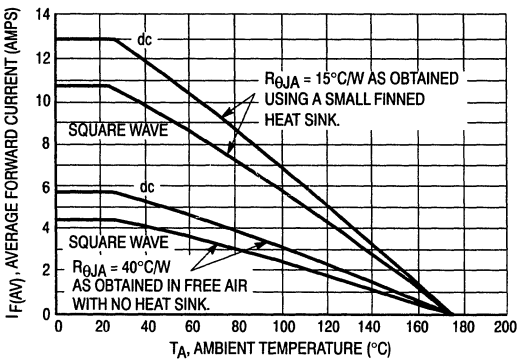


Figure 9. Current Derating, Ambient (Per Leg)

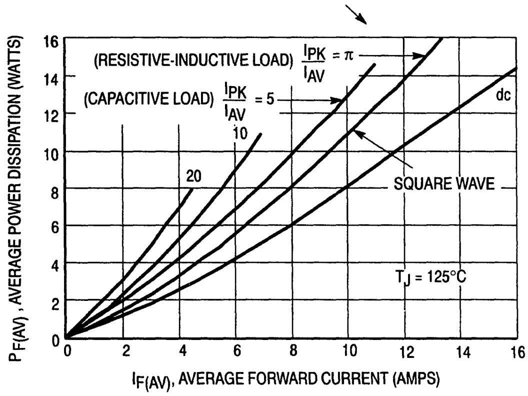


Figure 10. Power Dissipation (Per Leg)

MUR3060WT

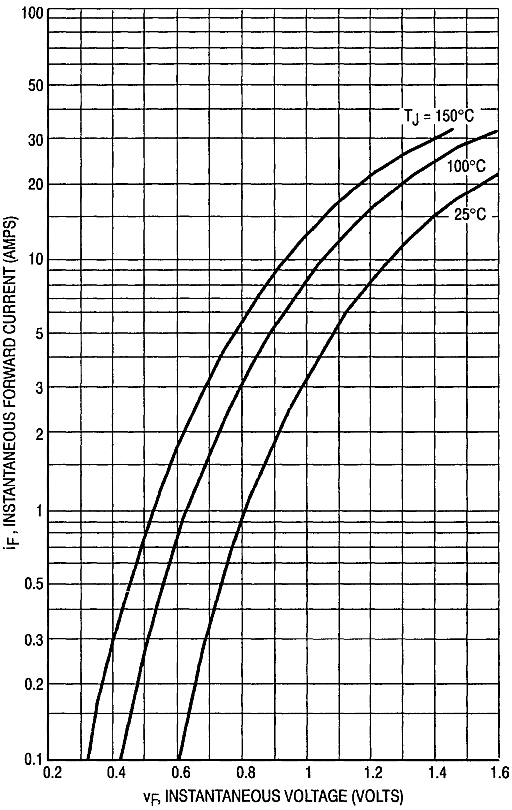
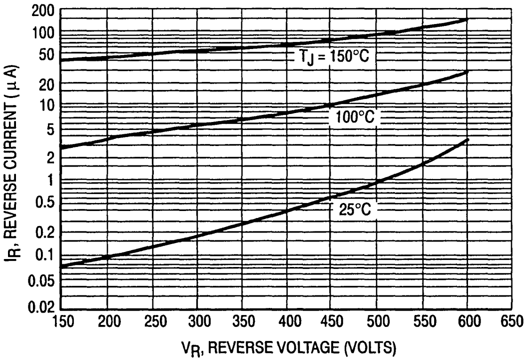


Figure 11. Typical Forward Voltage (Per Leg)



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 12. Typical Reverse Current (Per Leg)*

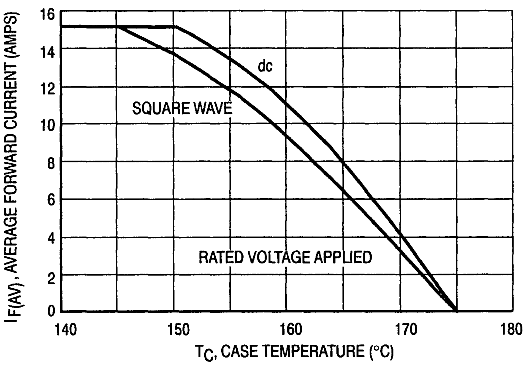


Figure 13. Current Derating, Case (Per Leg)

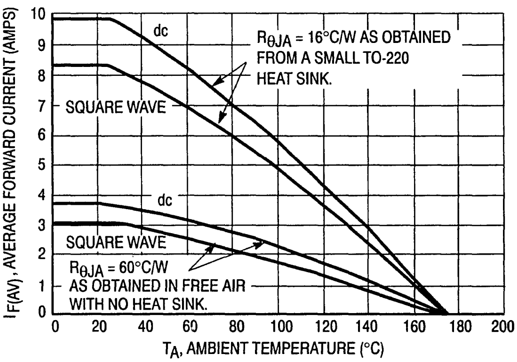


Figure 14. Current Derating, Ambient (Per Leg)

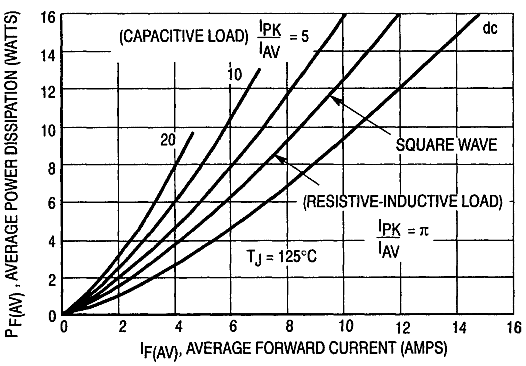


Figure 15. Power Dissipation (Per Leg)

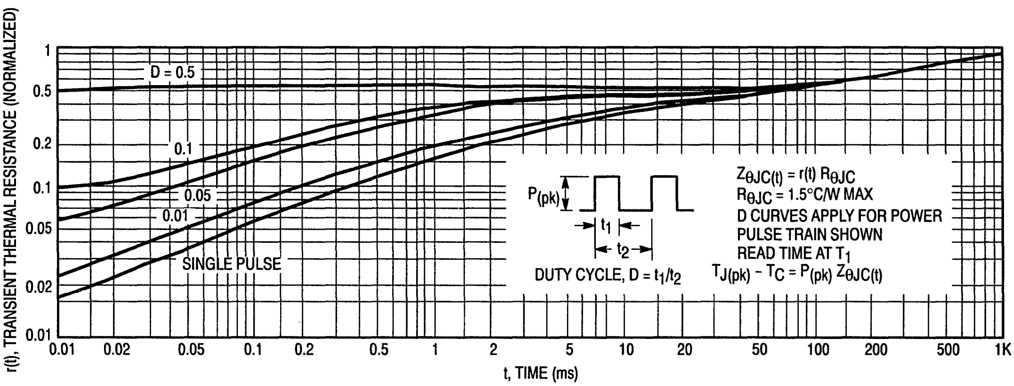


Figure 16. Thermal Response

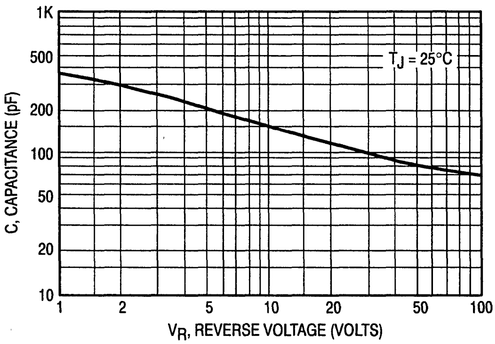


Figure 17. Typical Capacitance (Per Leg)

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR5005
MUR5010
MUR5015
MUR5020

MUR5020 is a Motorola Preferred Device

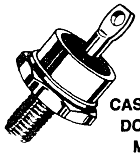
SWITCHMODE POWER RECTIFIERS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 50 Nanosecond Recovery Time
- Low Forward Voltage Drop
- Hermetically Sealed Metal DO-203AB Package

ULTRAFAST RECTIFIERS

50 AMPERES
50 to 200 VOLTS



CASE 257-01
DO-203AB
METAL

MECHANICAL CHARACTERISTICS
CASE: Welded, hermetically sealed
FINISH: All external surface corrosion resistant and terminal leads are readily solderable
POLARITY: Cathode to Case
MOUNTING POSITIONS: Any
MOUNTING TORQUE: 25 in-lb max

3

MAXIMUM RATINGS

Rating	Symbol	MUR 5005	MUR 5010	MUR 5015	MUR 5020	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Nonrepetitive Peak Reverse Voltage	V_{RSM}	55	110	165	220	Volts
Average Forward Current $T_C = 125°C$	$I_{F(AV)}$	50				Amps
Nonrepetitive Peak Surge Forward Current (half cycle, 60 Hz, Sinusoidal Waveform)	I_{FSM}	600				Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−55 to +175				°C

THERMAL CHARACTERISTICS

Rating	Symbol	All Devices	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage Drop ($i_F = 50$ Amp, $T_J = 25°C$) ($i_F = 50$ Amp, $T_J = 125°C$) ($i_F = 100$ Amp, $T_J = 125°C$)	v_F	 1.15 0.95 1.10	Volts
Maximum Reverse Current @ DC Voltage ($T_J = 25°C$) ($T_J = 125°C$)	I_R	 10 1.0	 μA mA
Maximum Reverse Recovery Time ($I_F = 1.0$ Amp, di/dt = 50 Amp/μs, $V_R = 30$ V, $T_J = 25°C$)	t_{rr}	50	ns

FIGURE 1 — TYPICAL FORWARD VOLTAGE

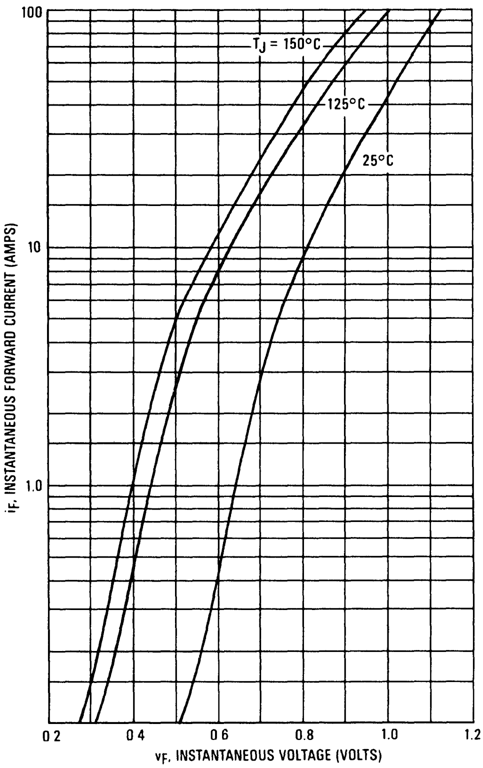
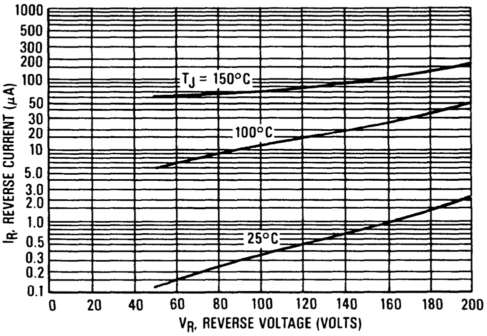


FIGURE 2 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

FIGURE 3 — CURRENT DERATING, CASE

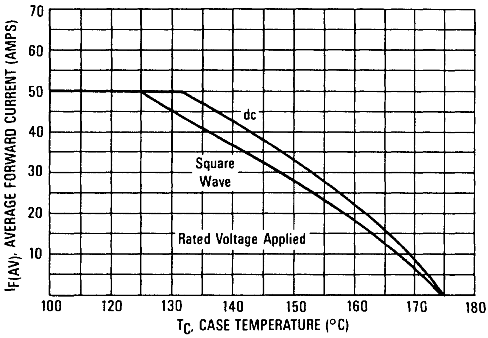


FIGURE 4 — POWER DISSIPATION

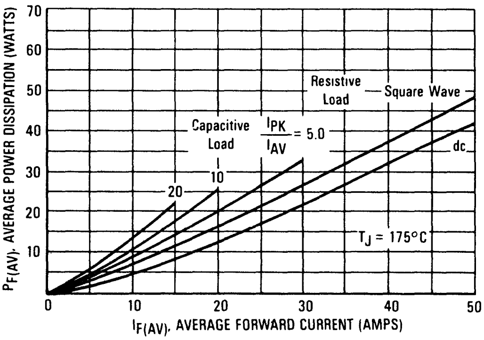


FIGURE 5 — TYPICAL CAPACITANCE

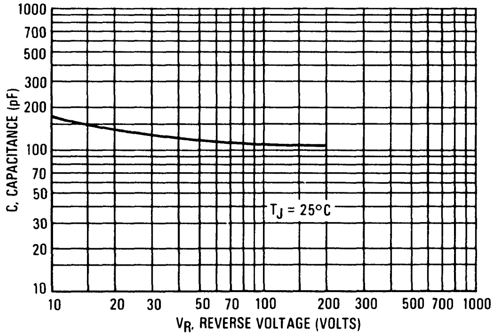
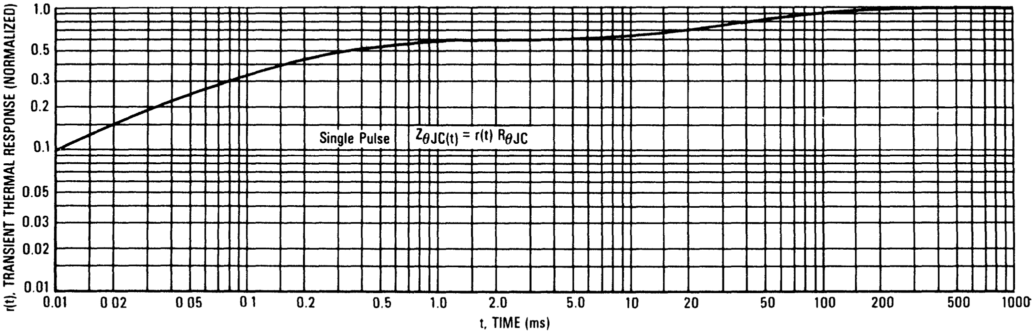


FIGURE 6 — THERMAL RESPONSE



Designer's™ Data Sheet

SCANSWITCH™ Power Rectifier

For Use As A Damper Diode In High and Very High Resolution Monitors

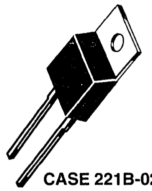
MUR5150E

Motorola Preferred Device

SCANSWITCH RECTIFIER 5.0 AMPERES 1500 VOLTS

The MUR5150E is a state-of-the-art Ultrafast Power Rectifier specifically designed for use as a damper diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MUR5150E is fully realized when paired with the appropriate 1500V SCANSWITCH Bipolar Power Transistor.

- 1500 V Blocking Voltage
- 20 mjoules Avalanche Energy Guaranteed
- Peak Transient Overshoot Voltage Specified, 17 Volts (typical)
- Forward Recovery Time Specified, 175 ns (typical)
- Epoxy Meets UL94, V_O at 1/8"



CASE 221B-02
TO-220AC

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1500	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 100°C	$I_{F(AV)}$	5.0	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 100°C	I_{FRM}	10	Amps
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	–65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Typ	Max	Units
Maximum Instantaneous Forward Voltage (1) (i_F = 2.0 Amps, T_J = 25°C) (i_F = 5.0 Amps, T_J = 25°C)	v_F	 1.7 2.0	 2.0 2.4	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 100 10	 500 50	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amps, di/dt = 50 Amps/μs)	t_{rr}	130	175	ns
Maximum Forward Recovery Time (I_F = 6.5 Amps, di/dt = 12 Amps/μs)	t_{fr}	175	225	ns
Peak Transient Overshoot Voltage	V_{RFM}	17	20	Volts

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%

Preferred devices are Motorola recommended choices for future use and best overall value

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

TYPICAL ELECTRICAL CHARACTERISTICS

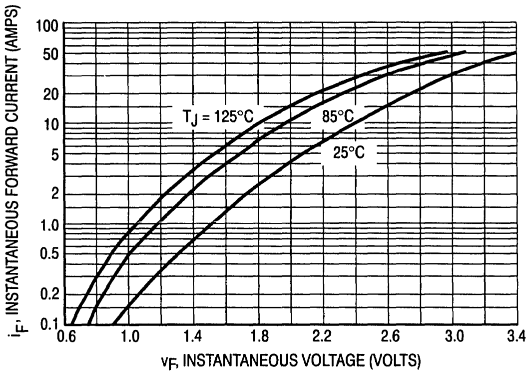


Figure 1. Typical Forward Voltage

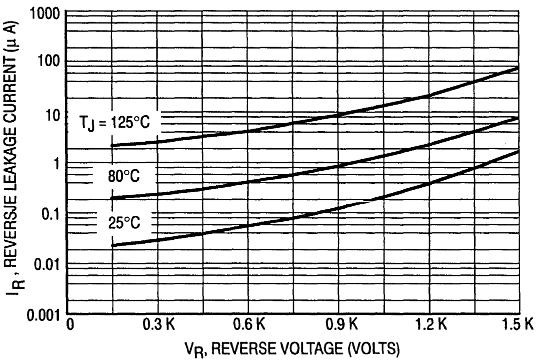


Figure 2. Typical Reverse Leakage Current

3

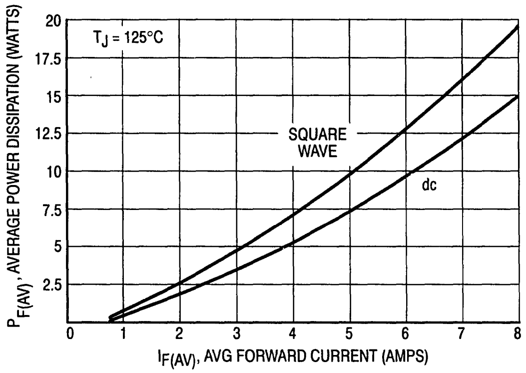


Figure 3. Forward Power Dissipation

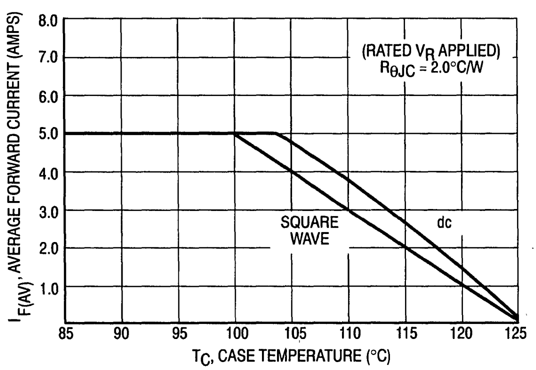


Figure 4. Current Derating Case

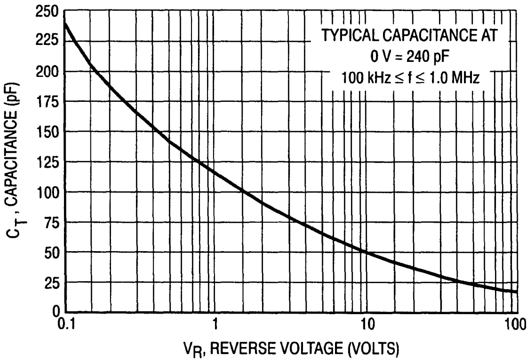


Figure 5. Typical Capacitance

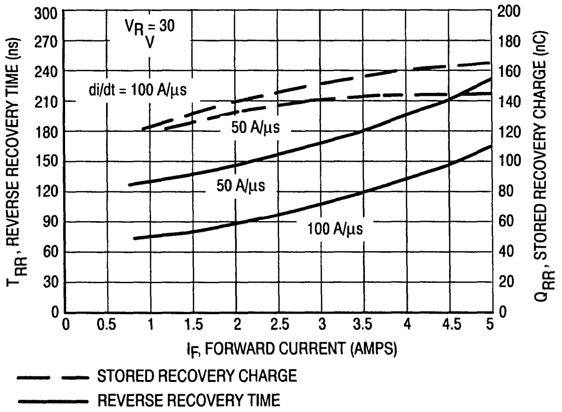


Figure 6. Typical Reverse Switching Characteristics

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR6020
MUR6030
MUR6040

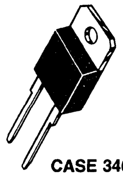
MUR6020 and MUR6040 are Motorola Preferred Devices

SWITCHMODE Power Rectifiers

ULTRAFAST RECTIFIERS
60 AMPERES
200–400 VOLTS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 100 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- State-of-the-Art Single TO-218 Atlas Package
- High Voltage Capability to 400 Volts
- Low Forward Voltage Drop
- High Temperature Glass Passivated Junction



CASE 340E-01

3

MAXIMUM RATINGS

Rating		Symbol	Max	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	MUR6020 MUR6030 MUR6040	V_{RRM} V_{RWM} V_R	200 300 400	Volts
Average Rectified Forward Current T_C = 70°C		$I_{F(AV)}$	60	Amps
Peak Repetitive Forward Current (Rated V_R Square Wave 20 kHz) T_C = 150°C		I_{FRM}	60	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	600	Amps
Operating Junction Temperature and Storage Temperature		T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	°C/W

ELECTRICAL CHARACTERISTICS

Instantaneous Forward Voltage (I_F = 60 Amp, T_C = 100°C) (I_F = 60 Amp, T_C = 25°C)	V_F	 1.4 1.5	Volts
Instantaneous Reverse Current (Rated dc Voltage, T_C = 100°C) (Rated dc Voltage, T_C = 25°C)	I_R	 10 60	 mA μA
Reverse Recovery Time (I_F = 1.0 Amp dI/dt = 15 Amp/μs	t_{rr}	100	ns

TYPICAL ELECTRICAL CHARACTERISTICS

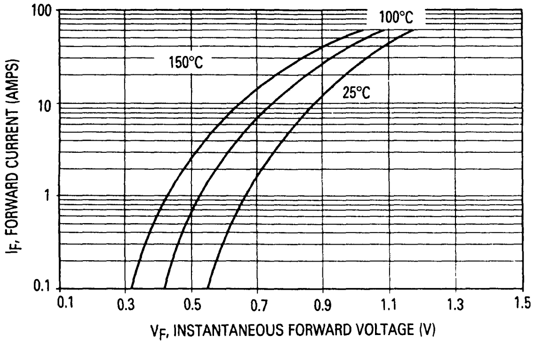


Figure 1. Typical Forward Voltage

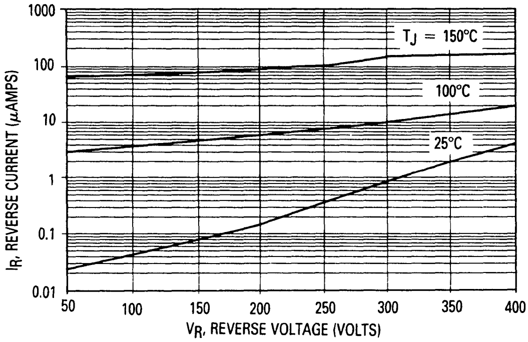


Figure 2. Typical Reverse Current

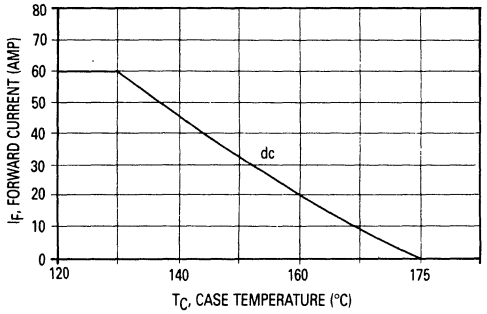


Figure 3. Current Derating, Case

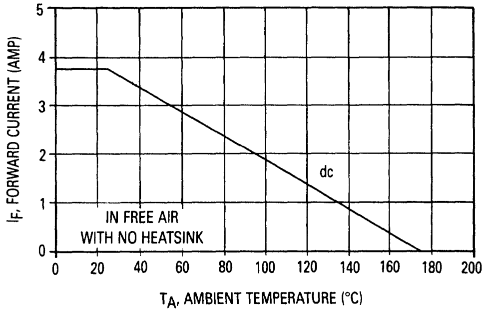


Figure 4. Current Derating, Ambient

MUR7005
MUR7010
MUR7015
MUR7020

MUR7020 is a
Motorola Preferred Device

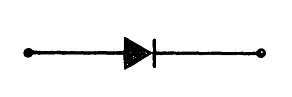
Switchmode Power Rectifiers

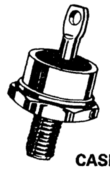
. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 50 Nanosecond Recovery Time
- Low Forward Voltage Drop
- Hermetically Sealed Metal DO-203AB (DO-5) Package

Mechanical Characteristics
Case: Welded, hermetically sealed
Finish: All external surface corrosion resistant and terminal leads are readily solderable
Polarity: Cathode to Case
Mounting Positions: Any
Mounting Torque: 25 in-lb max

ULTRAFAST RECTIFIERS
70 AMPERES
50 TO 200 VOLTS





CASE 257-01
DO-203AB

3

MAXIMUM RATINGS

Rating	Symbol	MUR				Unit
		7005	7010	7015	7020	
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Nonrepetitive Peak Reverse Voltage	V_{RSM}	55	110	165	220	Volts
Average Forward Current $T_C = 125°C$	$I_{F(AV)}$	70				Amps
Nonrepetitive Peak Surge Forward Current (half cycle, 60 Hz, Sinusoidal Waveform)	I_{FSM}	1000				Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−55 to +175				°C

THERMAL CHARACTERISTICS

Rating	Symbol	All Devices	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.8	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage Drop (i_F = 70 Amps, T_J = 25°C) (i_F = 70 Amps, T_J = 150°C)	v_F	 0.975 0.840	Volts
Maximum Reverse Current @ DC Voltage (T_J = 25°C) (T_J = 150°C)	I_R	 25 30	 μA mA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/μs, V_R = 30 V, T_J = 25°C) (I_F = 0.5 Amp, i_R = 1 Amp, I_{REC} = 0.25 A, V_R = 30 V, T_J = 25°C)	t_{rr}	 60 50	ns

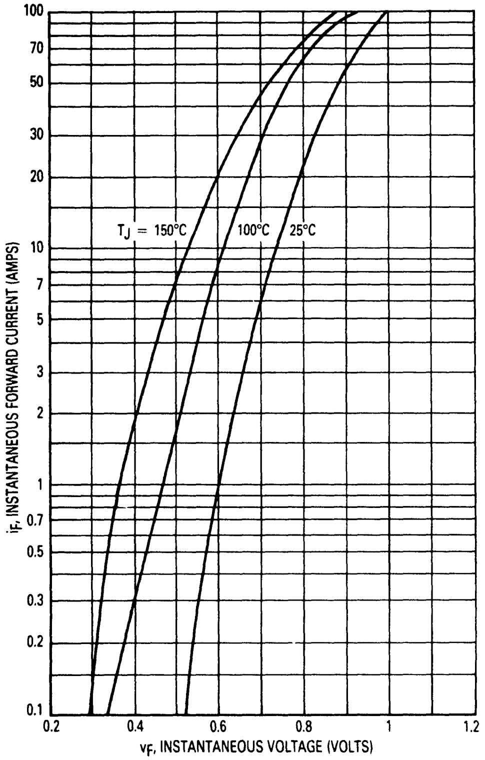


Figure 1. Typical Forward Voltage

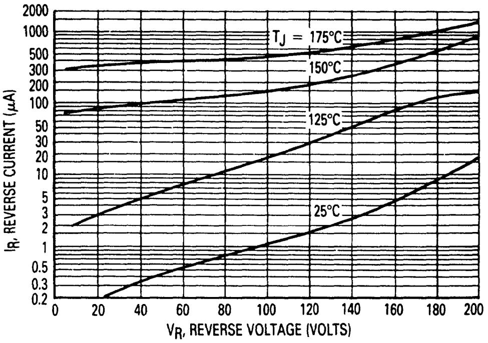


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

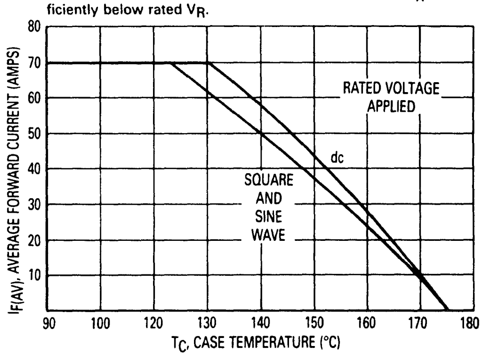


Figure 3. Current Derating, Case

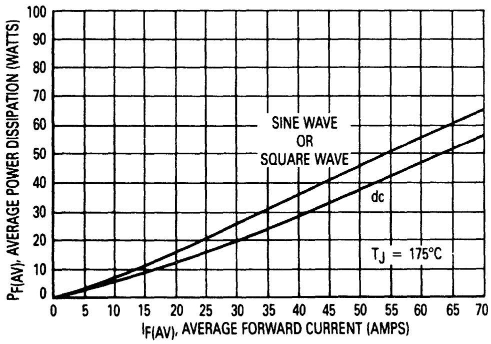


Figure 4. Average Power Dissipation

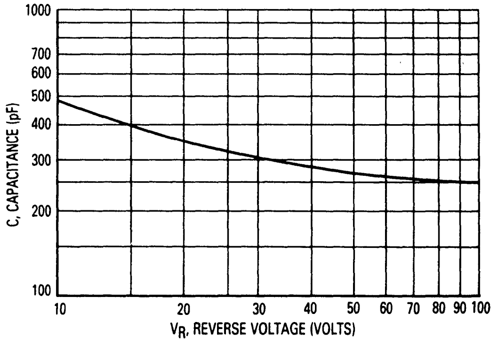


Figure 5. Typical Capacitance

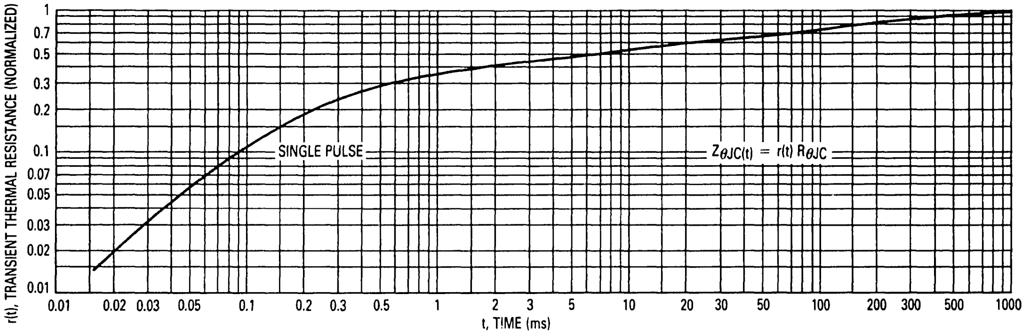


Figure 6. Thermal Response

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR10005CT
MUR10010CT
MUR10015CT
MUR10020CT

MUR10020CT is a Motorola Preferred Device

Advance Information

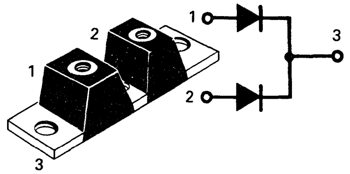
ULTRAFAST SWITCHMODE POWER RECTIFIERS

. . . designed for use in switching power supplies, inverters, and as free wheeling diodes. These state-of-the-art devices have the following features:

- Dual Diode Construction
- Low Leakage Current
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Labor Saving POWERTAP Package

ULTRAFAST RECTIFIERS

100 AMPERES
50 TO 200 VOLTS



CASE 357C-03

Terminal Penetration:	0.280 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:*	30–40 in-lb max
*Center Hole Must be Torqued First:	8–10 in-lb max

3

MAXIMUM RATINGS

Rating	Symbol	MUR 10005CT	MUR 10010CT	MUR 10015CT	MUR 10020CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Average Rectified Forward Current, (Rated V_R), $T_C = 140°C$ Per Device Per Leg	$I_{F(AV)}$	 100 50				Amps
Peak Repetitive Forward Current, Per Leg, (Rated V_R, Square Wave, 20 kHz), $T_C = 140°C$	I_{FRM}	100				Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	400				Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +175				°C

THERMAL CHARACTERISTICS PER LEG

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Characteristic	Symbol	Max	Unit
Instantaneous Forward Voltage (1) ($i_F = 50$ Amp, $T_C = 25°C$)	v_F	1.10	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, $T_C = 125°C$) (Rated dc Voltage, $T_C = 25°C$)	i_R	 250 25	μA
Maximum Reverse Recovery Time ($I_F = 1.0$ Amps, di/dt = 50 Amps/μs)	t_{rr}	50	ns

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

This document contains information on a new product. Specifications and information herein are subject to change without notice.

FIGURE 1 — FORWARD VOLTAGE

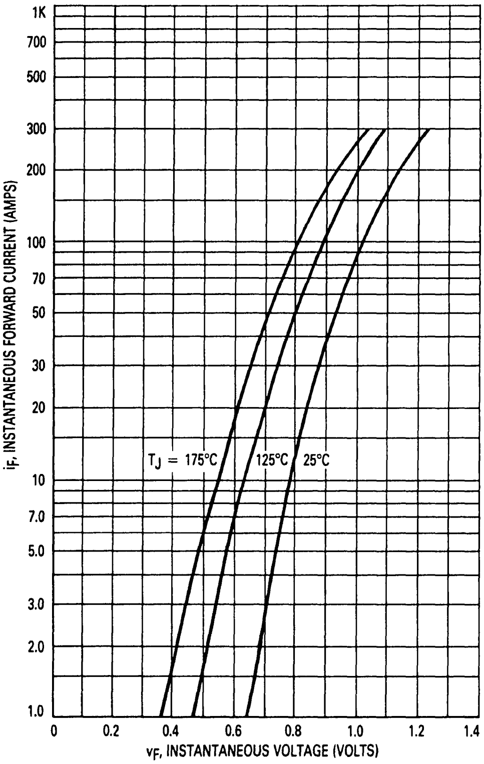
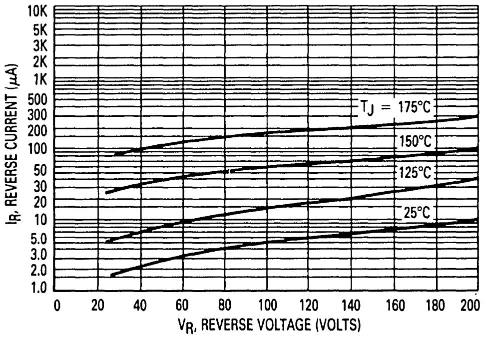


FIGURE 2 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves, if V_R is sufficiently below rated V_R.

FIGURE 3 — CURRENT DERATING (PER LEG)

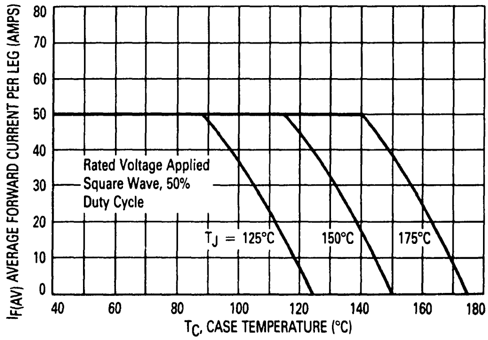


FIGURE 4 — POWER DISSIPATION (PER LEG)

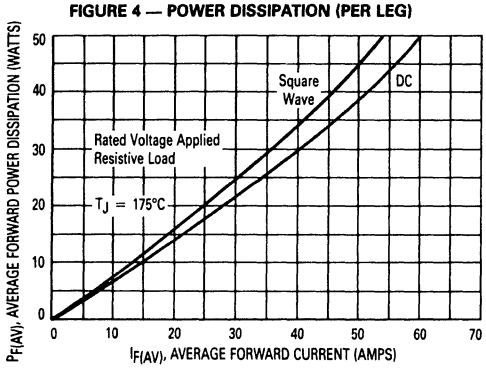
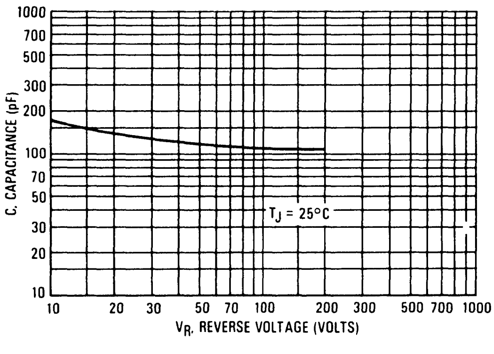


FIGURE 5 — CAPACITANCE (PER LEG)



3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

3

SCANSWITCH™
Power Rectifier For High and Very High Resolution Monitors

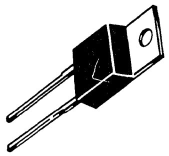
MUR10120E

Motorola Preferred Device

SCANSWITCH RECTIFIER
10 AMPERES
1200 VOLTS

This state-of-the-art power rectifier is specifically designed for use as a damper diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MUR10120E is fully realized when paired with either the MJH16206 or MJF16206 monitor specific, 1200 volt bipolar power transistor.

- 1200 Volt Blocking Voltage
- 20 mJ Avalanche Energy (Guaranteed)
- 12 Volt (Typical) Peak Transient Overshoot Voltage
- 135 ns (Typical) Forward Recovery Time



CASE 221B-02
(TO-220AC)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1200	Volts
Average Rectified Forward Current (Rated V_R) T_C = 125°C	$I_{F(AV)}$	10	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz) T_C = 125°C	I_{FRM}	20	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction Temperature	T_J	−65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage (1) (I_F = 6.5 Amps, T_J = 125°C) (I_F = 6.5 Amps, T_J = 25°C)	v_F	 1.7 1.9	 2.0 2.2	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 125°C)	i_R	 25 750	 100 1000	μA
Maximum Reverse Recovery Time (I_F = 1.0 A, di/dt = 50 Amps/μs)	t_{rr}	150	175	ns
Maximum Forward Recovery Time I_F = 6.5 Amps, di/dt = 12 Amps/μs (As Measured on a Deflection Circuit)	t_{fr}	135	175	ns
Peak Transient Overshoot Voltage	V_{RFM}	12	14	Volts

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

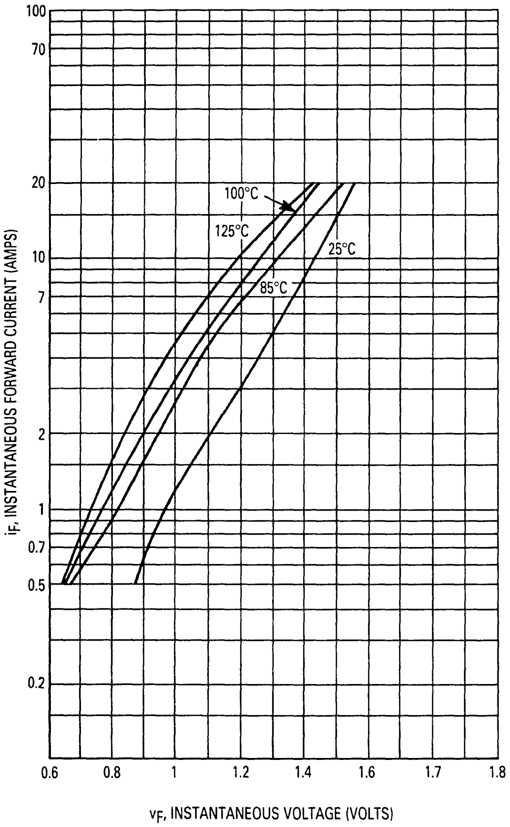


Figure 1. Typical Forward Voltage

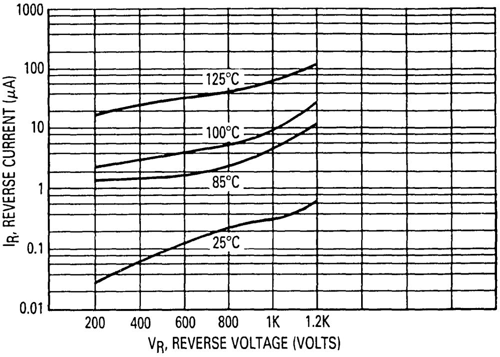


Figure 2. Typical Reverse Current

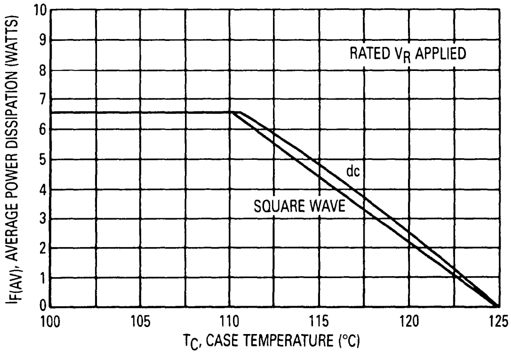


Figure 3. Current Derating, Case

3

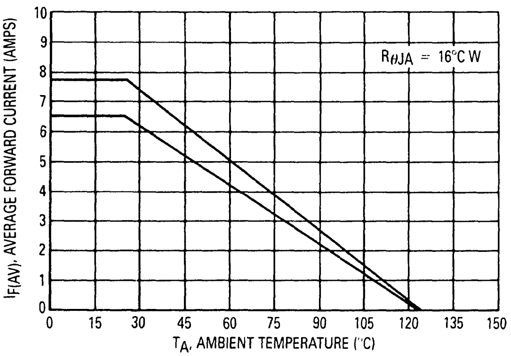


Figure 4. Current Derating, Ambient

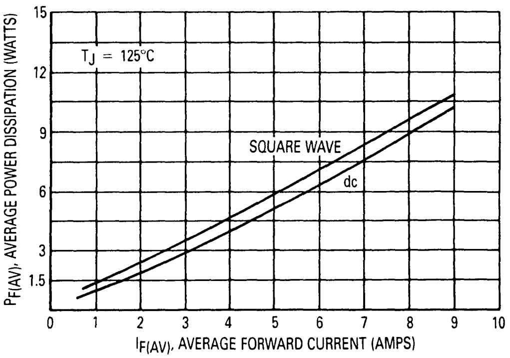


Figure 5. Power Dissipation

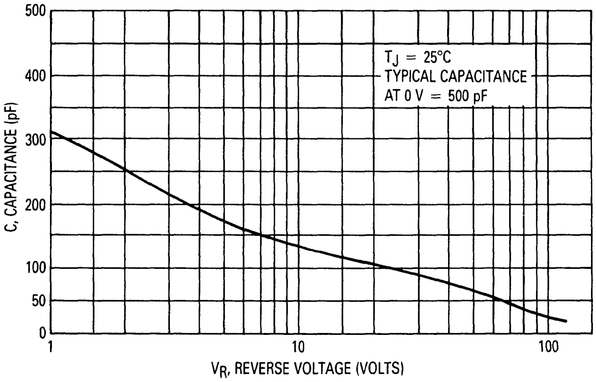


Figure 6. Typical Capacitance

3

Designer's™ Data Sheet

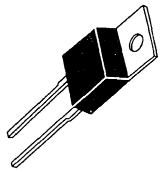
SCANSWITCH™ Power Rectifier

For Use As A Damper Diode In High And Very High Resolution Monitors

MUR10150E

Motorola Preferred Device

SCANSWITCH RECTIFIERS
10 AMPERES
1500 VOLTS



CASE 221B-02
TO-220AC

The MUR10150E is a state-of-the-art Power Rectifier specifically designed for use as a damper diode in horizontal deflection circuits for high and very high resolution monitors. In these applications, the outstanding performance of the MUR10150E is fully realized when paired with either the MJW16212 or MJF16212 monitor specific, 1500 V bipolar power transistor.

- 1500 V Blocking Voltage
- 20 mJ Avalanche Energy Guaranteed
- Peak Transient Overshoot Voltage Specified, 14 Volt (typical)
- Forward Recovery Time Specified, 135 ns (typical)
- Epoxy Meets UL94, V_O at 1/8″

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	1500	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 125°C	$I_{F(AV)}$	10	Amps
Peak Repetitive Forward Current, Per Leg (Rated V_R, Square Wave, 20 kHz), T_C = 125°C	I_{FRM}	20	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	–65 to +125	°C
Controlled Avalanche Energy	W_{AVAL}	20	mJ

THERMAL CHARACTERISTICS

Thermal Resistance — Junction to Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Rating	Symbol	Typ	Max	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 6.5 Amps, T_J = 125°C) (i_F = 6.5 Amps, T_J = 25°C)	v_F	 1.7 1.9	 2.2 2.4	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 125°C) (Rated dc Voltage, T_J = 25°C)	i_R	 750 25	 1000 100	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/μs)	t_{rr}	150	175	ns
Maximum Forward Recovery Time (I_F = 6.5 Amp, di/dt = 12 Amps/μs)	t_{fr}	135	175	ns
Peak Transient Overshoot Voltage	V_{RFM}	14	16	Volts

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

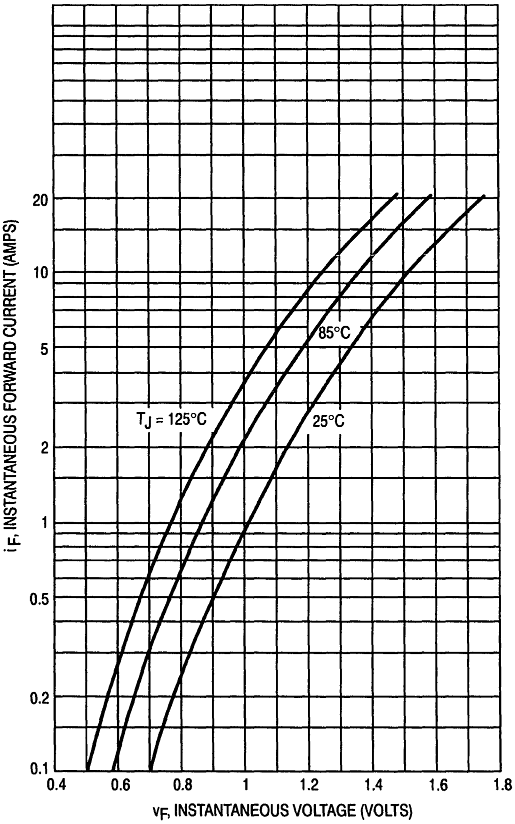


Figure 1. Typical Forward Voltage

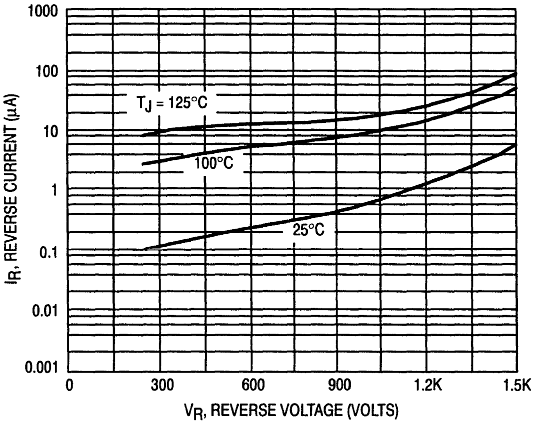


Figure 2. Typical Reverse Current

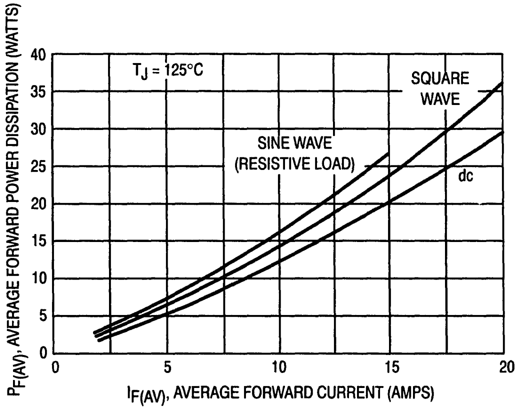


Figure 3. Forward Power Dissipation

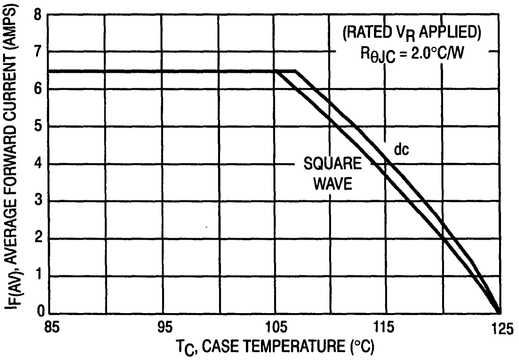


Figure 4. Current Derating Case

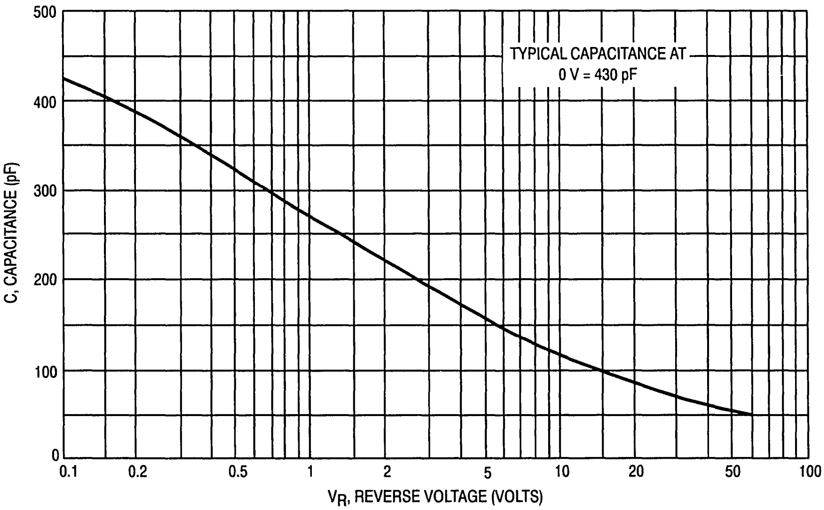


Figure 5. Typical Capacitance

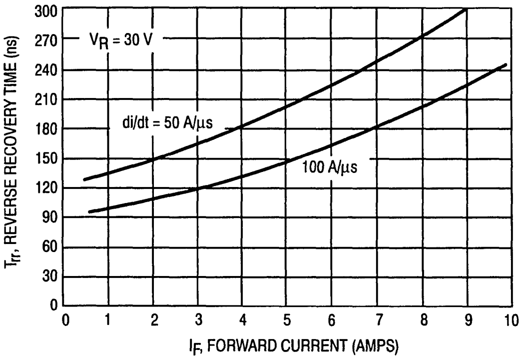


Figure 6. Typical Reverse Recovery Time

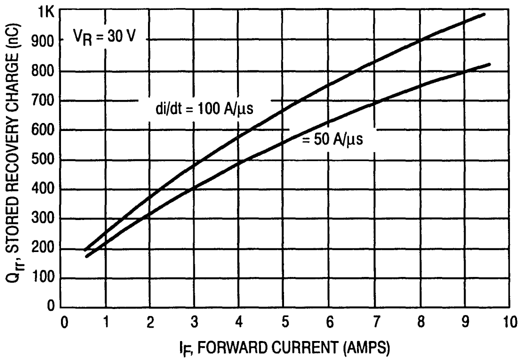


Figure 7. Typical Stored Recovery Charge

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MUR20005CT
MUR20010CT
MUR20015CT
MUR20020CT

MUR20020CT is a Motorola Preferred Device

Designer's Data Sheet

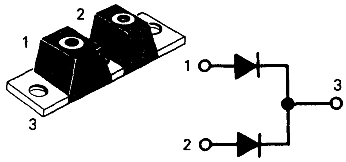
ULTRAFAST SWITCHMODE POWER RECTIFIERS

. . . designed for use in switching power supplies, inverters, and as free wheeling diodes. These state-of-the-art devices have the following features:

- Dual Diode Construction
- Low Leakage Current
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Labor Saving PowerTap Package

ULTRAFAST RECTIFIERS

200 AMPERES 50 TO 200 VOLTS



CASE 357C-03
POWERTAP

Terminal Penetration:	0.280 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:*	30–40 in-lb max
*Center Hole Must be Torqued First:	8–10 in-lb max

3

MAXIMUM RATINGS

Rating	Symbol	MUR 20005CT	MUR 20010CT	MUR 20015CT	MUR 20020CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 95°C Per Device Per Leg	$I_{F(AV)}$		200 100			Amps
Peak Repetitive Forward Current, Per Leg, (Rated V_R, Square Wave, 20 kHz), T_C = 95°C	I_{FRM}		200			Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}		800			Amps
Operating Junction and Storage Temperature	T_J, T_{stg}		−65 to +175			°C

THERMAL CHARACTERISTICS PER LEG

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.70	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 100 Amp, T_C = 25°C)	v_F	1.25	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 50	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amps, di/dt = 50 Amps/μs)	t_{rr}	50	ns

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

Designer's 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.

FIGURE 1 — TYPICAL FORWARD VOLTAGE (PER LEG)

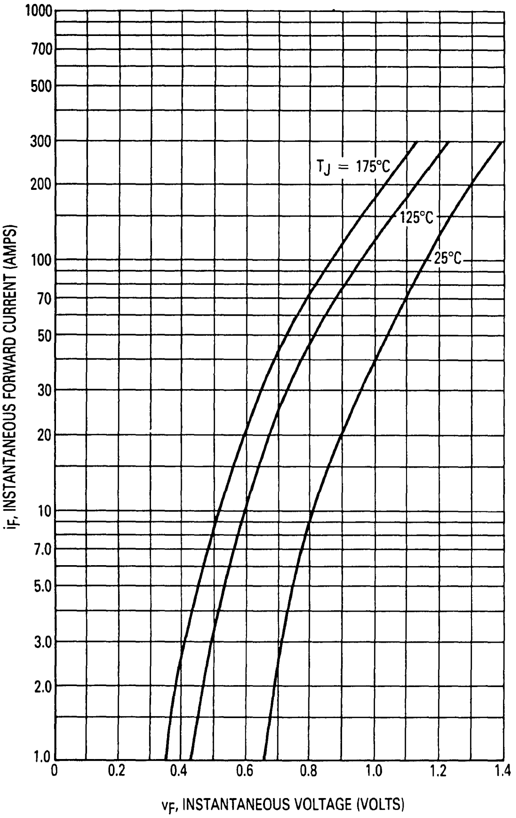
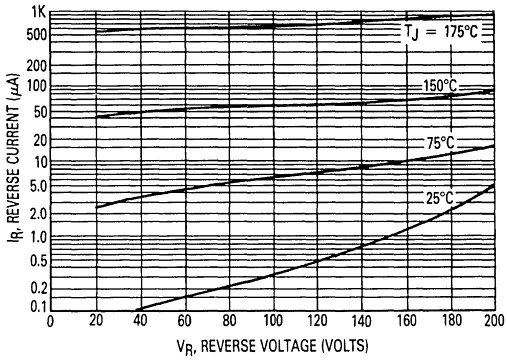


FIGURE 2 — TYPICAL REVERSE CURRENT*



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves, if V_R is sufficiently below rated V_R.

FIGURE 3 — CURRENT DERATING (PER LEG)

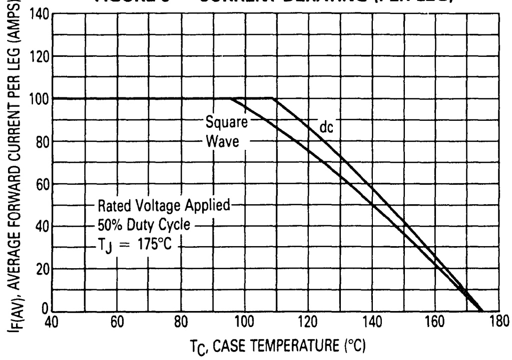


FIGURE 4 — POWER DISSIPATION (PER LEG)

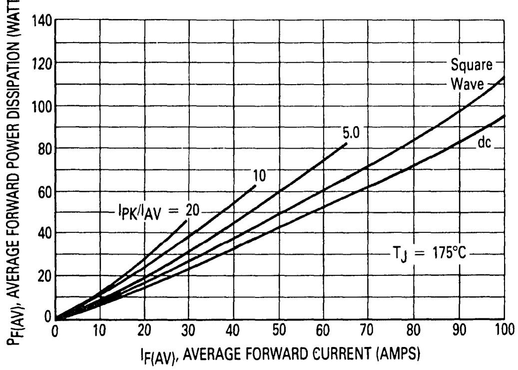
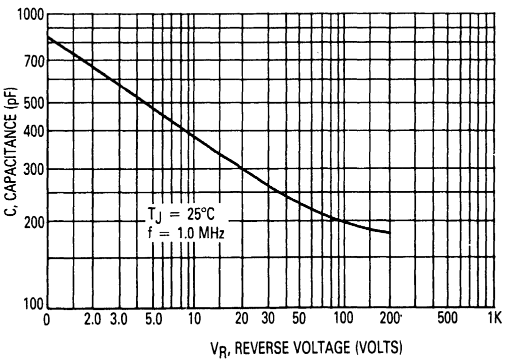


FIGURE 5 — CAPACITANCE (PER LEG)



3

MUR20030CT
MUR20040CT

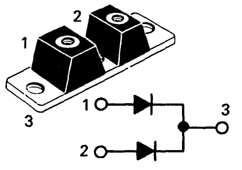
MUR20040CT is a Motorola Preferred Device

Ultrafast SWITCHMODE Power Rectifiers

... designed for use in switching power supplies, inverters, and as freewheeling diodes. These state-of-the-art devices have the following features:

- Dual Diode Construction — May Be Paralleled For Higher Current Output
- Low Leakage Current
- Low Forward Voltage
- 175°C Operating Junction Temperature
- Labor Saving POWERTAP Package

ULTRAFAST RECTIFIERS
200 AMPERES
300 and 400 VOLTS



CASE 357C-03
POWERTAP

Mounting Specifications

Terminal Penetration:	0.280 max
Terminal Torque:	25–40 in-lb max
Mounting Torque — Outside Holes:*	30–40 in-lb max
*Center Hole Must be Torqued First:	8–10 in-lb max

MAXIMUM RATINGS

Rating	Symbol	MUR20030CT	MUR20040CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	300	400	Volts
Average Rectified Forward Current, (Rated V_R), T_C = 95°C Per Device Per Leg	$I_{F(AV)}$	 200 100		Amps
Peak Repetitive Forward Current, Per Leg, (Rated V_R, Square Wave, 20 kHz), T_C = 95°C	I_{FRM}	200		Amps
Nonrepetitive Peak Surge Current Per Leg (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	800		Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +175		°C

THERMAL CHARACTERISTICS PER LEG

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.75	°C/W

ELECTRICAL CHARACTERISTICS PER LEG

Instantaneous Forward Voltage (1) (i_F = 100 Amp, T_C = 25°C) (i_F = 100 Amp, T_C = 125°C)	v_F	 1.35 1.25	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 125°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 50	μA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/μs)	t_{rr}	75	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

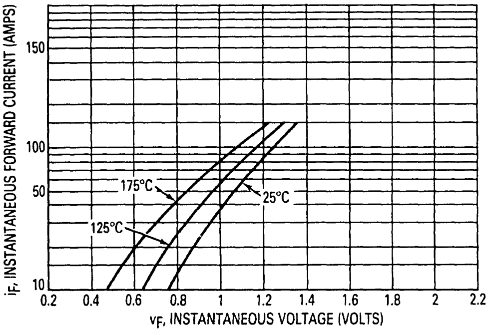


Figure 1. Typical Forward Voltage

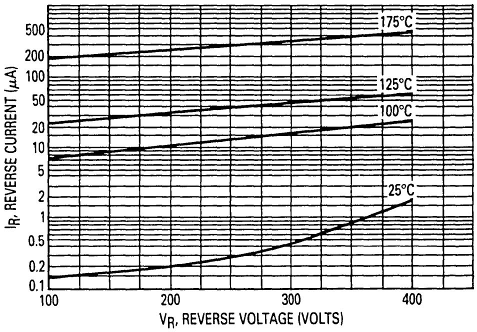


Figure 2. Typical Reverse Current

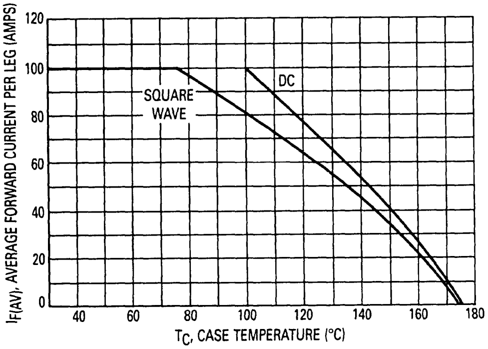


Figure 3. Current Derating (Per Leg)

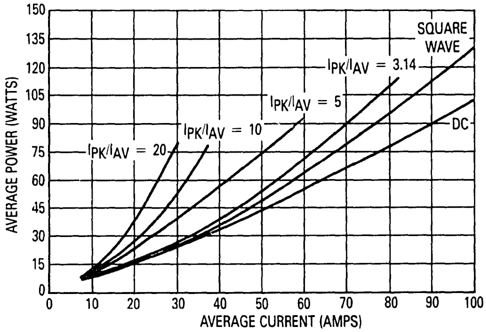


Figure 4. Average Power Dissipation and Average Current

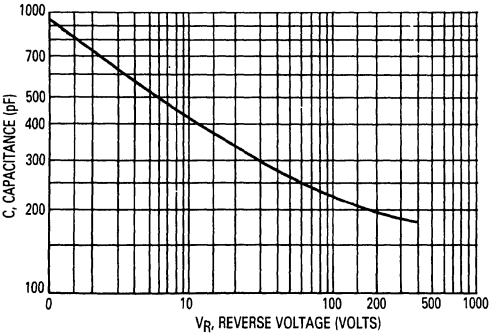


Figure 5. Capacitance (Per Leg)

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MURD305
MURD310
MURD315
MURD320

MURD320 is a Motorola Preferred Device

SWITCHMODE Power Rectifiers
DPAK Surface Mount Package

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

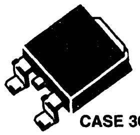
- Ultrafast 35 Nanosecond Recovery Time
- Low Forward Voltage Drop
- Low Leakage

Mechanical Characteristics

- Case: Epoxy, Molded
- Finish: All External Surface Corrosion Resistance and Terminal Leads are Readily Solderable
- Lead Formed for Surface Mount
- Available in 16 mm Tape and Reel or Plastic Rails
- Compact Size
- Lead and Mounting Surface Temperature for Soldering Purpose 260°C Max. for 10 Seconds

3

ULTRAFAST RECTIFIERS
3 AMPERES
50 TO 200 VOLTS



CASE 369A-11
DPAK

MAXIMUM RATINGS

Rating	Symbol	MURD				Unit
		305	310	315	320	
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Average Rectified Forward Current (T_C = 158°C, Rated V_R)	$I_{F(AV)}$	3				Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz, T_C = 158°C)	I_{FRM}	6				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, 60 Hz)	I_{FSM}	75				Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +175				°C

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	6 80	°C/W

ELECTRICAL CHARACTERISTICS

Maximum Instantaneous Forward Voltage Drop (2) (i_F = 3 Amps, T_J = 25°C) (i_F = 3 Amps, T_J = 125°C)	v_F	 0.95 0.75	Volts
Maximum Instantaneous Reverse Current (2) (T_J = 25°C, Rated dc Voltage) (T_J = 125°C, Rated dc Voltage)	i_R	 5 500	μA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/μs, V_R = 30 V, T_J = 25°C) (I_F = 0.5 Amp, i_R = 1 Amp, I_{REC} = 0.25 A, V_R = 30 V, T_J = 25°C)	t_{rr}	 35 25	ns

(1) Rating applies when surface mounted on the minimum pad sizes recommended.
(2) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

TYPICAL CHARACTERISTICS

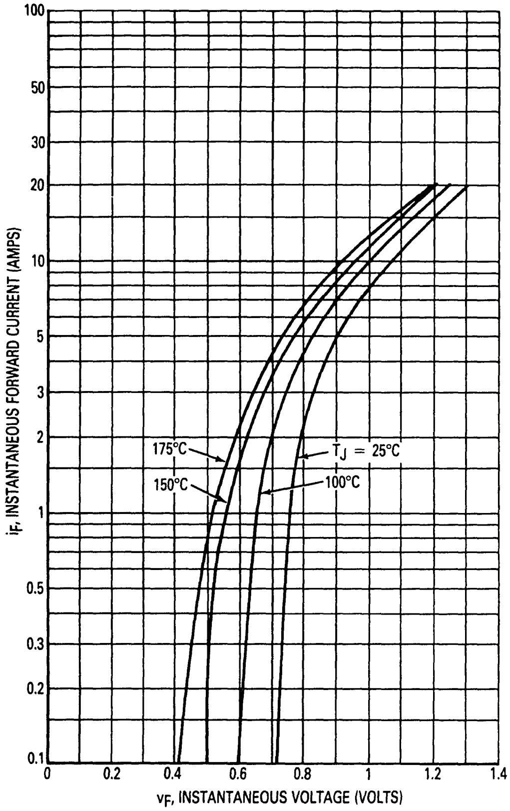
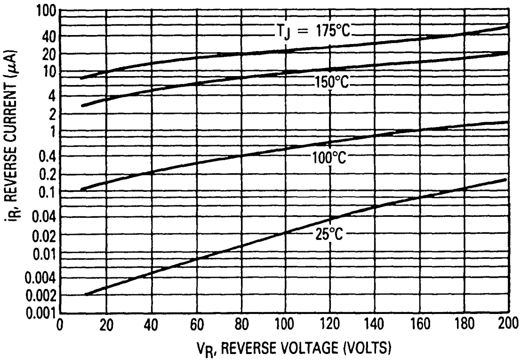


Figure 1. Typical Forward Voltage



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Reverse Current*

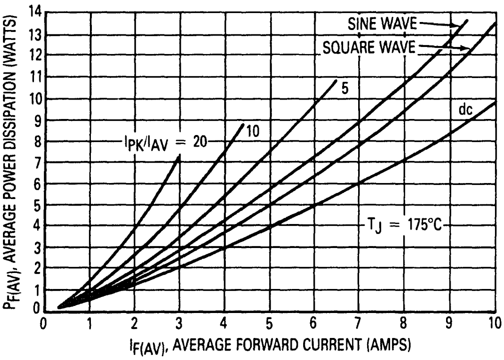


Figure 3. Average Power Dissipation

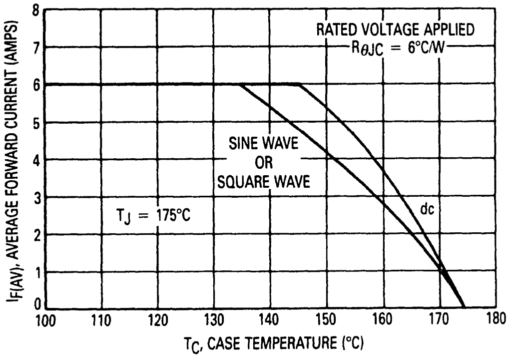


Figure 4. Current Derating, Case

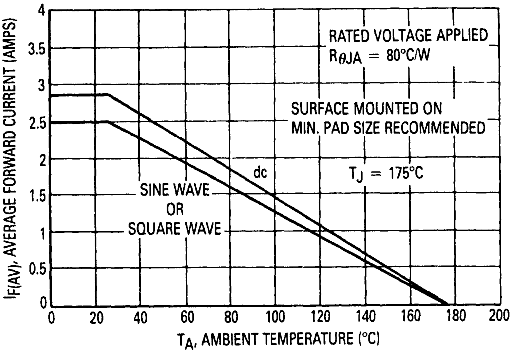


Figure 5. Current Derating, Ambient

3

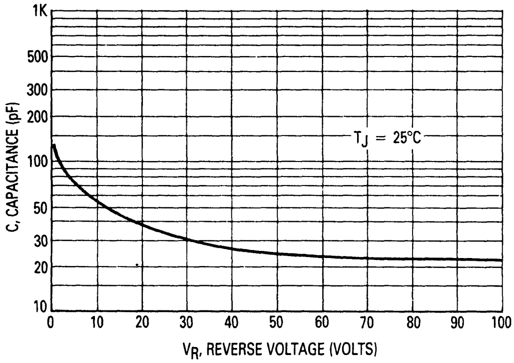


Figure 6. Typical Capacitance

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MURD605CT MURD610CT MURD615CT MURD620CT

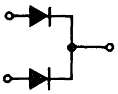
MURD620CT is a Motorola Preferred Device

SWITCHMODE Power Rectifiers
DPAK Surface Mount Package

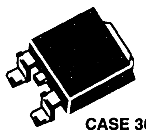
... designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 Nanosecond Recovery Time
- Low Forward Voltage Drop
- Low Leakage

Mechanical Characteristics
- Case: Epoxy, Molded
- Finish: All External Surface Corrosion Resistance and Terminal Leads are Readily Solderable
- Lead Formed for Surface Mount
- Available in 16 mm Tape and Reel or Plastic Rails
- Compact Size
- Dual Rectifier Single Chip Construction
- Lead Temperature for Soldering Purpose: 260°C for 10 Seconds



ULTRAFAST RECTIFIERS 6 AMPERES 50 TO 200 VOLTS



CASE 369A-11
PLASTIC

MAXIMUM RATINGS

Rating	Symbol	MURD 605CT	MURD 610CT	MURD 615CT	MURD 620CT	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	150	200	Volts
Average Rectified Forward Voltage (T_C = 145°C, Rated V_R) Per Diode Per Device	$I_{F(AV)}$	3 6				Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz, T_C = 145°C) Per Diode	I_F	6				Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, 60 Hz)	I_{FSM}	63				Amps
Operating Junction and Storage Temperature	T_J, T_{stg}	−65 to +175				°C

THERMAL CHARACTERISTICS PER DIODE

Thermal Resistance, Junction to Case Junction to Ambient (1)	$R_{\theta JC}$ $R_{\theta JA}$	9 80	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Maximum Instantaneous Forward Voltage Drop (2) i_F = 3 Amps, T_C = 25°C i_F = 3 Amps, T_C = 125°C i_F = 6 Amps, T_C = 25°C i_F = 6 Amps, T_C = 125°C	v_F	 1 0.95 1.2 1.1	Volts
Maximum Instantaneous Reverse Current (2) (T_J = 25°C, Rated dc Voltage) (T_J = 125°C, Rated dc Voltage)	i_R	 5 250	µA
Maximum Reverse Recovery Time (I_F = 1 Amp, di/dt = 50 Amps/µs, V_R = 30 V, T_J = 25°C) (I_F = 0.5 Amp, i_R = 1 Amp, I_{REC} = 0.25 A, V_R = 30 V, T_J = 25°C)	t_{rr}	 35 25	ns

(1) Rating applies when surface mounted on the minimum pad size recommended.
(2) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2%.

3

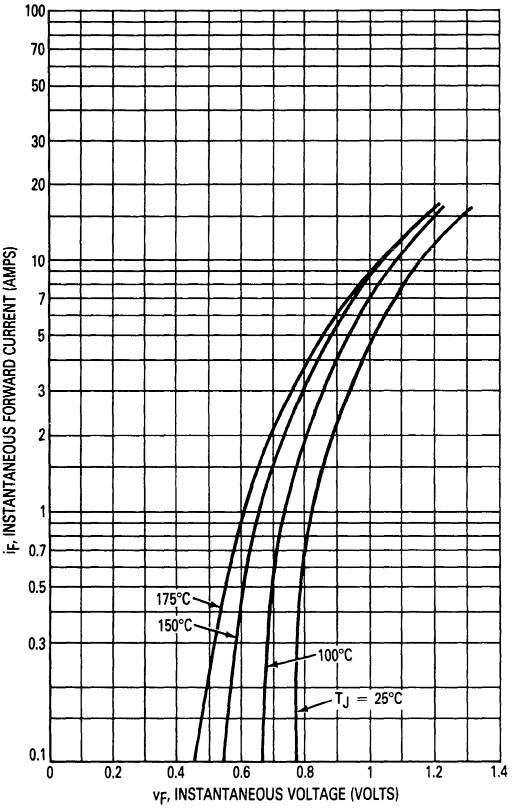
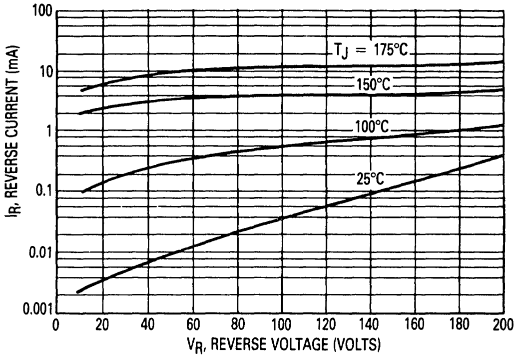


Figure 1. Typical Forward Voltage (Per Leg)



*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these curves if V_R is sufficient below rated V_R.

Figure 2. Typical Leakage Current* (Per Leg)

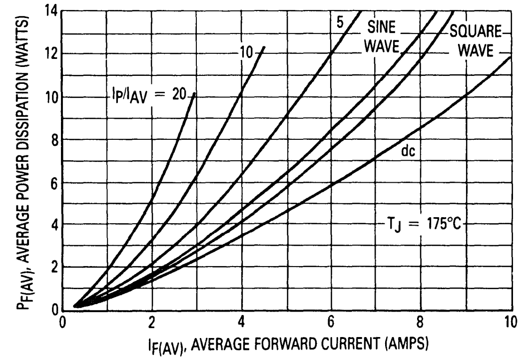


Figure 3. Average Power Dissipation (Per Leg)

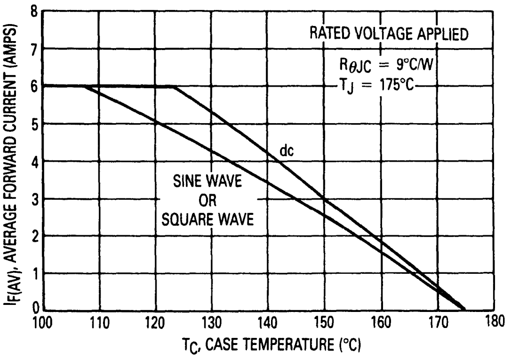


Figure 4. Current Derating, Case (Per Leg)

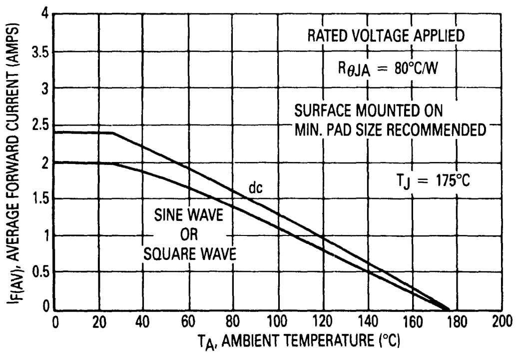


Figure 5. Current Derating, Ambient (Per Leg)

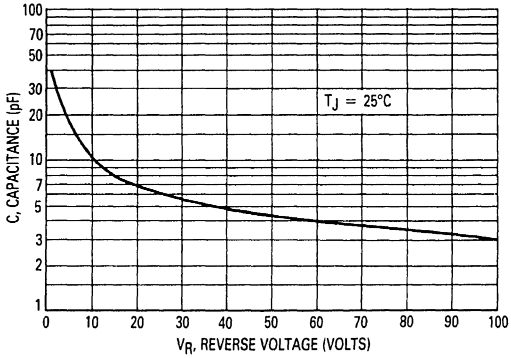


Figure 6. Typical Capacitance (Per Leg)

3

Switchmode Power Rectifiers

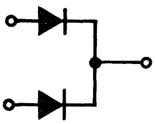
MURH840CT

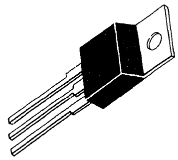
Motorola Preferred Device

**ULTRAFAST RECTIFIER
8.0 AMPERES
400 VOLTS**

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 28 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability to 400 Volts
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures





CASE 221A-06
TO-220AB

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage		V_{RRM} V_{RWM} V_R	400	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 120°C	Per Leg Total Device	$I_{F(AV)}$	4.0 8.0	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 120°C	Per Diode Leg	I_{FM}	16	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	100	Amps
Controlled Avalanche Energy		W_{AVAL}	20	mJ
Operating Junction Temperature and Storage Temperature		T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS, PER DIODE LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

ELECTRICAL CHARACTERISTICS, PER DIODE LEG

Maximum Instantaneous Forward Voltage (1) (I_F = 4.0 Amps, T_C = 150°C) (I_F = 4.0 Amps, T_C = 25°C)	v_F	 1.9 2.2	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/μs)	t_{rr}	28	ns

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

Switchmode is a trademark of Motorola Inc.

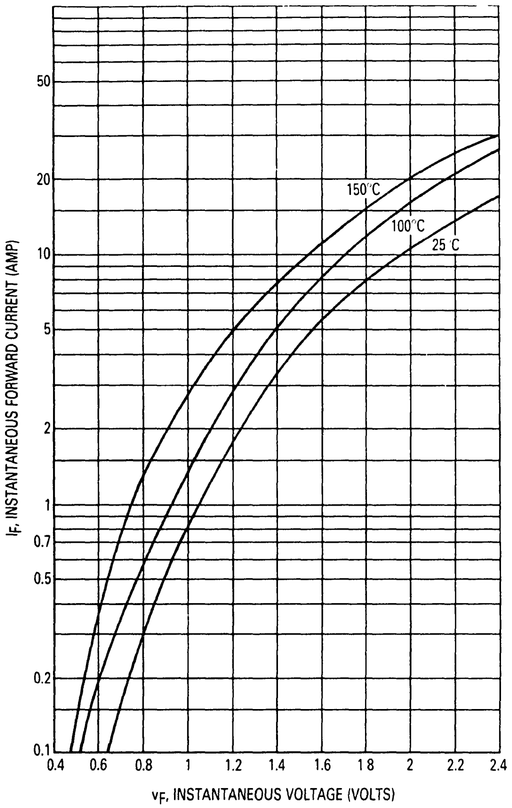


Figure 1. Typical Forward Voltage

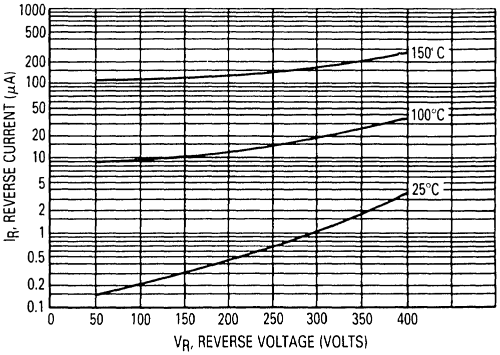


Figure 2. Typical Reverse Current, Per Leg

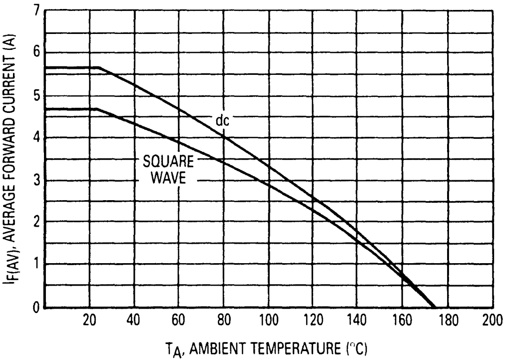


Figure 3. Forward Current Derating, Ambient, Per Leg

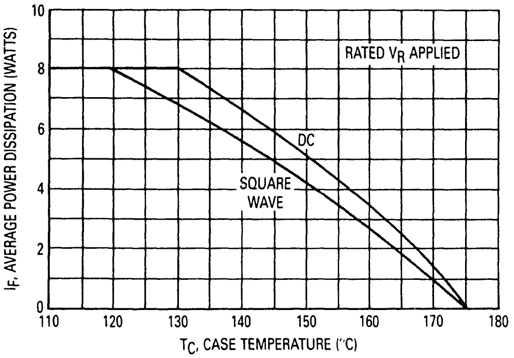


Figure 4. Current Derating, Case, Per Leg

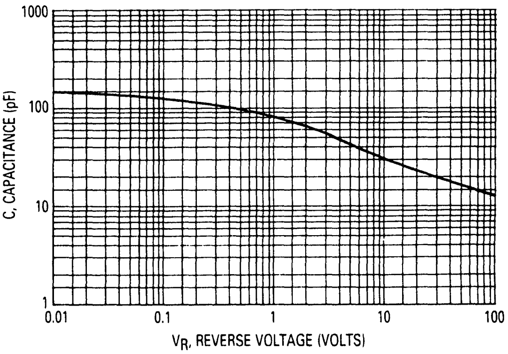


Figure 5. Typical Capacitance, Per Leg

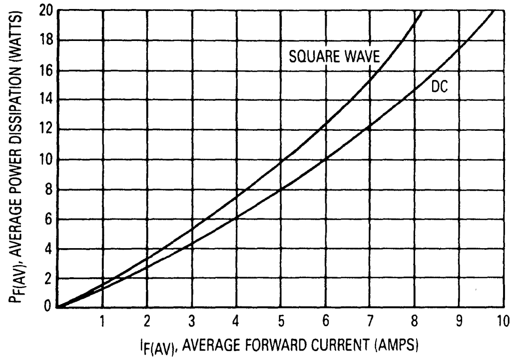


Figure 6. Forward Power Dissipation, Per Leg

3

Designer's™ Data Sheet
SWITCHMODE™ Power Rectifiers

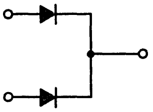
MURH860CT

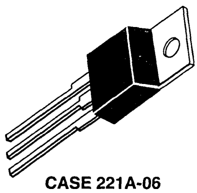
Motorola Preferred Device

ULTRAFAST RECTIFIER
8.0 AMPERES
600 VOLTS

. . . designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability to 600 Volts
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures





CASE 221A-06
TO-220AB

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	600	Volts
Average Rectified Forward Current Total Device, (Rated V_R), T_C = 120°C — Total Device	$I_{F(AV)}$	4.0 8.0	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 120°C	I_{FM}	16	Amps
Non-repetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.0	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Maximum Instantaneous Forward Voltage (1) (i_F = 4.0 Amps, T_C = 150°C) (i_F = 4.0 Amps, T_C = 25°C)	v_F	 2.5 2.8	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	 500 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/μs)	t_{rr}	35	ns

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

Preferred devices are Motorola recommended choices for future use and best overall value.

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

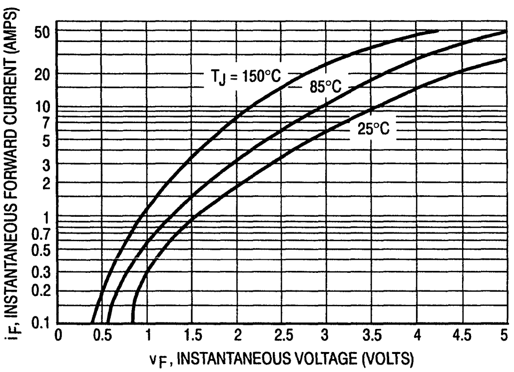


Figure 1. Typical Forward Voltage, Per Leg

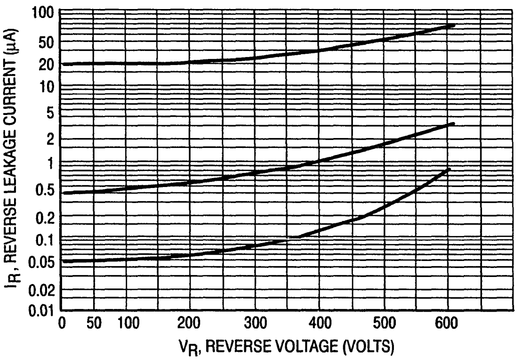


Figure 2. Typical Reverse Leakage Current, Per Leg

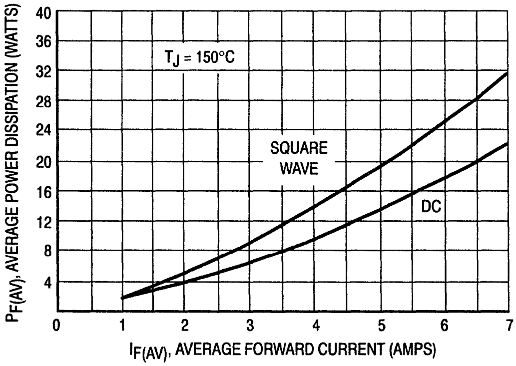


Figure 3. Typical Forward Dissipation, Per Leg

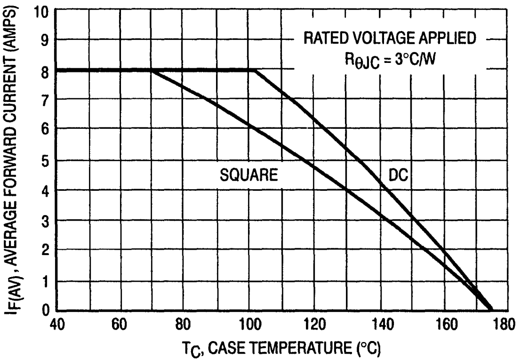


Figure 4. Typical Current Derating, Case, Per Leg

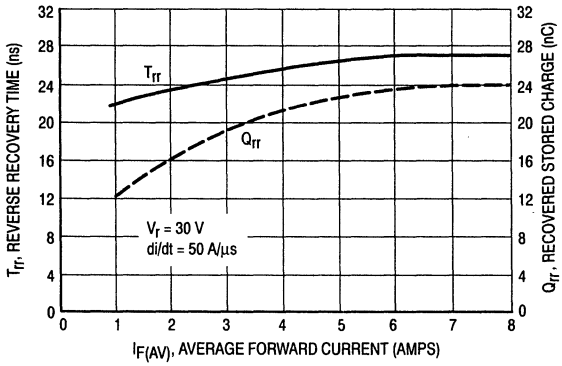


Figure 5. Typical Recovery Characteristics

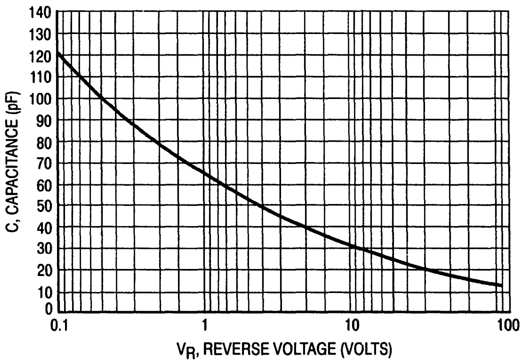


Figure 6. Typical Capacitance, Per Leg

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

SWITCHMODE™ Power Rectifiers
D2PAK Surface Mount Power Package

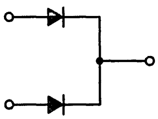
MURHB840CT

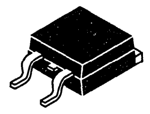
Motorola Preferred Device

ULTRAFAST RECTIFIER
8.0 AMPERES
400 VOLTS

Designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Package Designed for Power Surface Mount Applications
- Ultrafast 28 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Epoxy Meets UL94, V_O @ 1/8″
- High Temperature Glass Passivated Junction
- High Voltage Capability
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures
- Short Heat Sink Tab Manufactured — Not Sheared!
- Similar in Size to Industry Standard TO-220 Package





CASE 418B-01

3

MAXIMUM RATINGS, PER LEG

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	400	Volts
Average Rectified Forward Current (Rated V_R), T_C = 120°C Total Device	$I_{F(AV)}$	4.0 8.0	Amps
Peak Repetitive Forward Current (Rated V_R, Square Wave, 20 kHz), T_C = 120°C	I_{FM}	16	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	100	Amps
Controlled Avalanche Energy	W_{AVAL}	20	mJ
Operating Junction Temperature and Storage Temperature	T_J, T_{stg}	−65 to +175	°C

THERMAL CHARACTERISTICS, PER LEG

Maximum Thermal Resistance — Junction to Case — Junction to Ambient (2)	$R_{\theta JC}$ $R_{\theta JA}$	3.0 50	°C/W

ELECTRICAL CHARACTERISTICS, PER LEG

Maximum Instantaneous Forward Voltage (1) (I_F = 4.0 Amps, T_C = 150°C) (I_F = 4.0 Amps, T_C = 25°C)	v_F	1.7 2.0	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 150°C) (Rated dc Voltage, T_C = 25°C)	i_R	500 10	μA
Maximum Reverse Recovery Time (I_F = 1.0 Amp, di/dt = 50 Amps/μs)	t_{rr}	28	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%
(2) See Page 3 for mounting conditions

Preferred devices are Motorola recommended choices for future use and best overall value

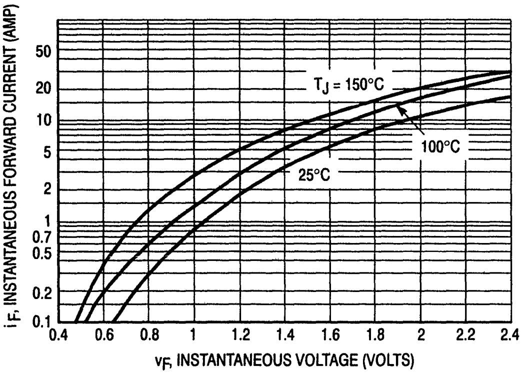


Figure 1. Typical Forward Voltage

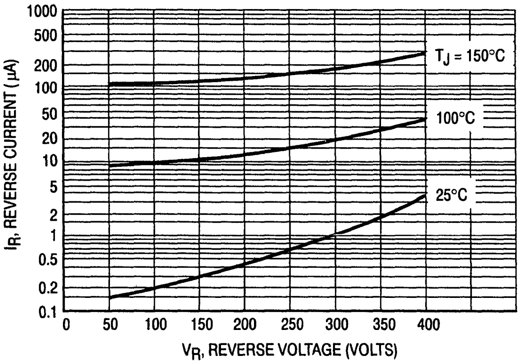


Figure 2. Typical Reverse Current, Per Leg

3

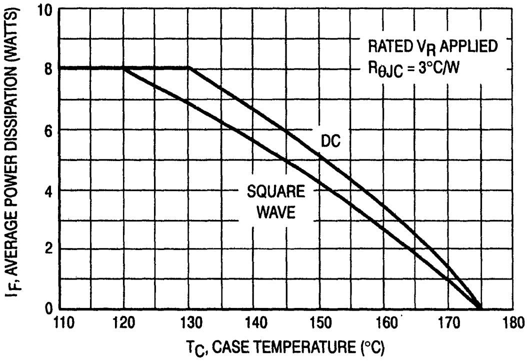


Figure 3. Current Derating, Case

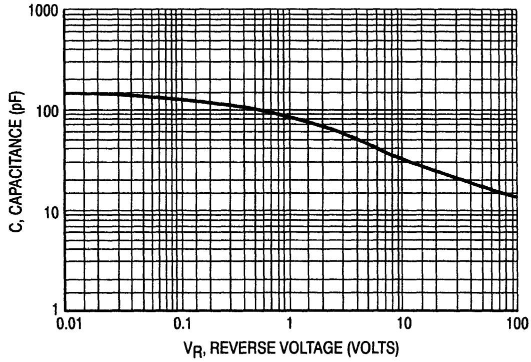


Figure 4. Typical Capacitance, Per Leg

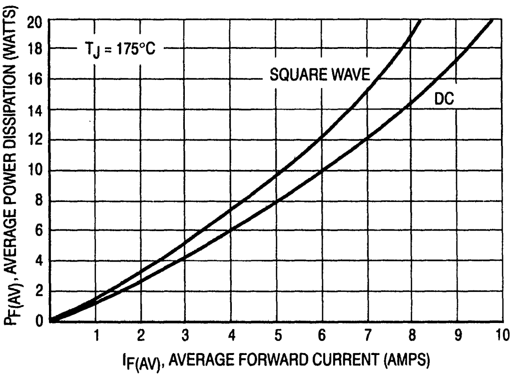


Figure 5. Forward Power Dissipation, Per Leg

Surface Mount Ultrafast Power Rectifiers

MURS120T3
MURS160T3

Motorola Preferred Devices

Ideally suited for high voltage, high frequency rectification, or as free wheeling and protection diodes in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Packaged in 12 mm Pocket Tape and Reel
- High Temperature Glass Passivated Junction
- Low Forward Voltage Drop (0.71 to 1.05 Volts Max @ 1.0 A, T_J = 150°C)

ULTRAFAST RECTIFIERS
1.0 AMPERE
200–600 VOLTS

CASE 403A-03

MECHANICAL CHARACTERISTICS

CASE: Transfer Molded Plastic Package
LEAD FINISH: Plated Leads, Readily Solderable in Surface Mount Applications
POLARITY IDENTIFICATION: Notch in Plastic Body Indicates Cathode Lead
DEVICE MARKING: MURS120T3..........U1D MURS160T3..........U1J

MAXIMUM RATINGS

Rating	Symbol	MURS 120T3	MURS 160T3	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	600	Volts
Average Rectified Forward Current	$I_{F(AV)}$	1.0 @ T_L = 155°C 2.0 @ T_L = 145°C	1.0 @ T_L = 150°C 2.0 @ T_L = 125°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	40	35	Amps
Operating Junction Temperature	T_J	−65 to +175		°C

THERMAL CHARACTERISTICS

Rating	Symbol	MURS 120T3	MURS 160T3	Unit
Thermal Resistance — Junction to Lead (T_L = 25°C)	$R_{\theta JL}$	13		°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MURS 120T3	MURS 160T3	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 1.0 A, T_J = 25°C) (i_F = 1.0 A, T_J = 150°C)	v_F	 0.875 0.71	 1.25 1.05	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 150°C)	i_R	 2.0 50	 5.0 150	μA
Maximum Reverse Recovery Time (i_F = 1.0 A, di/dt = 50 A/μs) (i_F = 0.5 A, i_R = 1.0 A, I_R to 0.25 A)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (i_F = 1.0 A, di/dt = 100 A/μs, Rec. to 1.0 V)	t_{fr}	25	50	ns

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

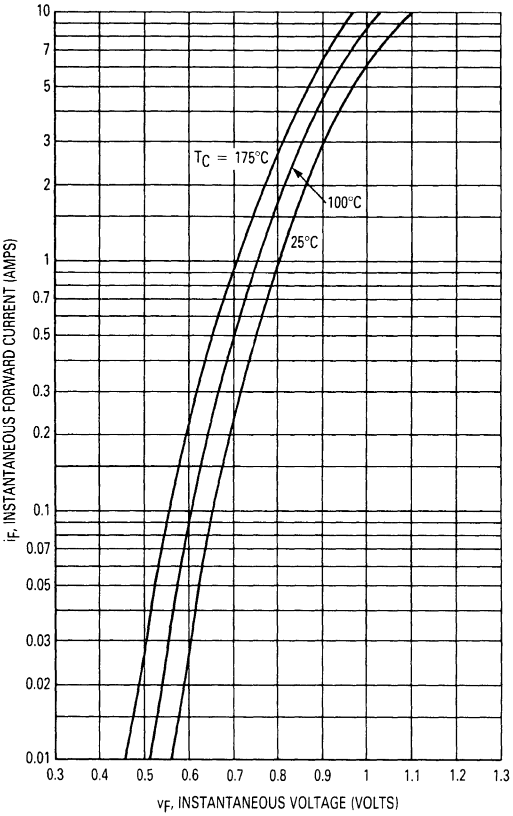


Figure 1. Typical Forward Voltage

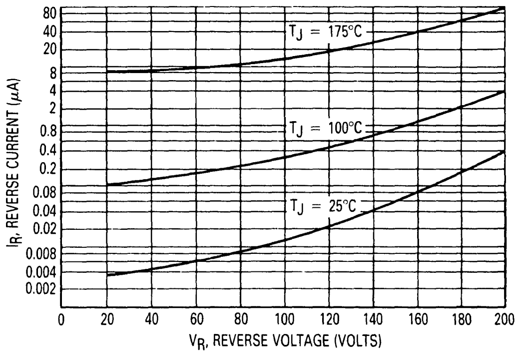


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if applied V_R is sufficiently below rated V_R.

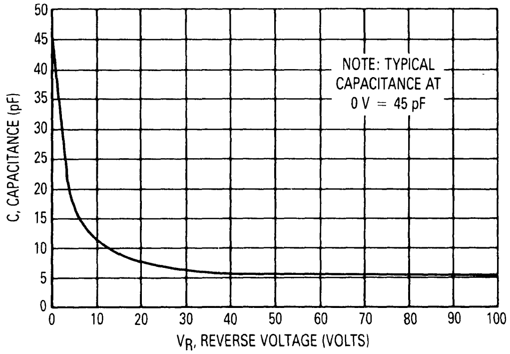


Figure 3. Typical Capacitance

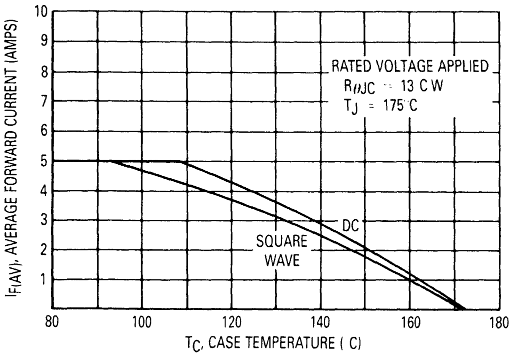


Figure 4. Current Derating, Case

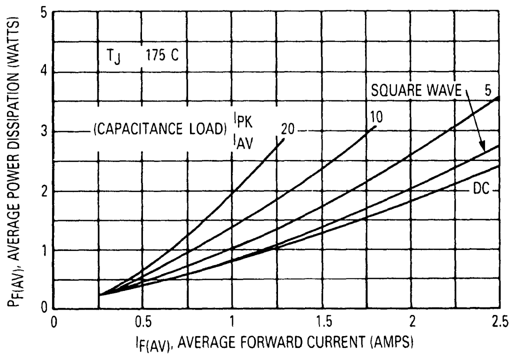


Figure 5. Power Dissipation

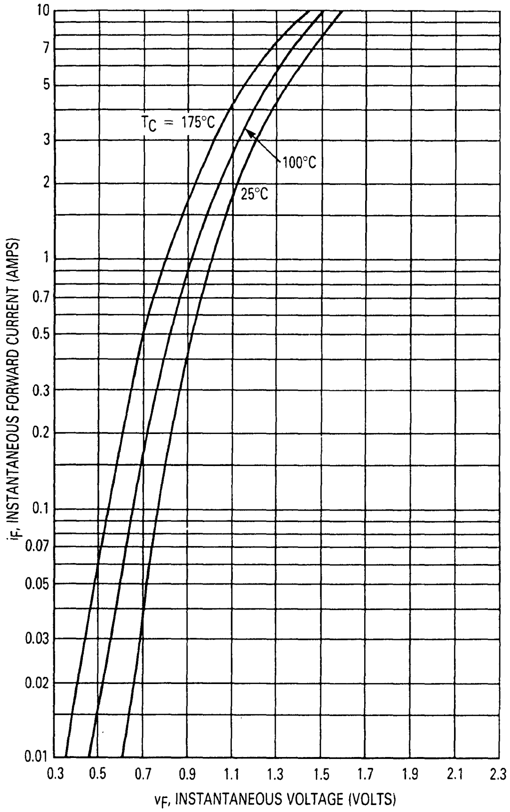


Figure 6. Typical Forward Voltage

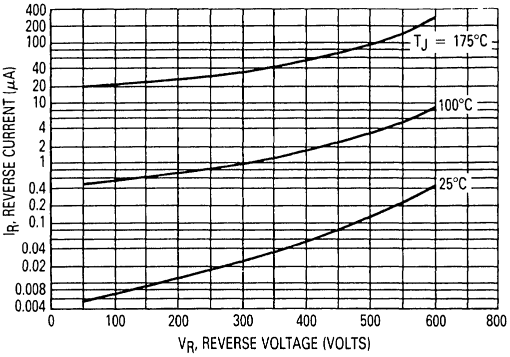


Figure 7. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if applied V_R is sufficiently below rated V_R.

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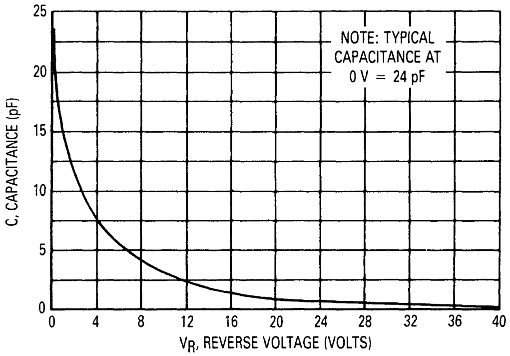


Figure 8. Typical Capacitance

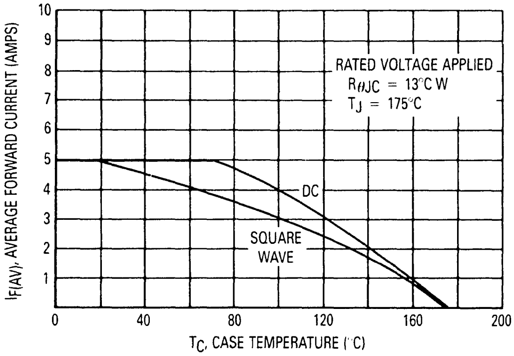


Figure 9. Current Derating, Case

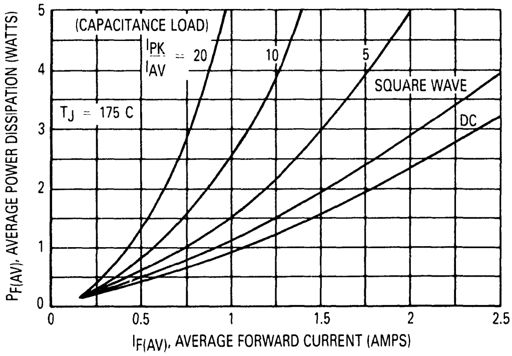


Figure 10. Power Dissipation

MURS320T3
MURS360T3

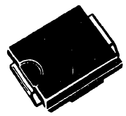
Motorola Preferred Devices

Surface Mount
Ultrafast Power Rectifiers

. . . employing state-of-the-art epitaxial construction with oxide passivation and metal overlay contact. Ideally suited for high voltage, high frequency rectification, or as free wheeling and protection diodes, in surface mount applications where compact size and weight are critical to the system.

- Small Compact Surface Mountable Package with J-Bend Leads
- Rectangular Package for Automated Handling
- Packaged in 16 mm Pocket Tape and Reel
- Highly Stable Oxide Passivated Junction
- Low Forward Voltage Drop (0.71 to 1.05 Volts Max @ 3.0 A, T_J = 150°C)

ULTRAFAST RECTIFIERS
3.0 AMPERES
200–600 VOLTS



CASE 403-03

MECHANICAL CHARACTERISTICS

CASE: Transfer Molded Plastic Package
LEAD FINISH: Plated Leads, Readily Solderable in Surface Mount Applications
POLARITY IDENTIFICATION: Notch in Plastic Body Indicates Cathode Lead
DEVICE MARKING: MURS320T3..........U3D MURS360T3..........U3J

MAXIMUM RATINGS

Rating	Symbol	MURS 320T3	MURS 360T3	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	200	600	Volts
Average Rectified Forward Current	$I_{F(AV)}$	3.0 @ T_L = 140°C 4.0 @ T_L = 130°C	3.0 @ T_L = 130°C 4.0 @ T_L = 115°C	Amps
Nonrepetitive Peak Surge Current (Surge applied at rated load conditions halfwave, single phase, 60 Hz)	I_{FSM}	75		Amps
Operating Junction Temperature	T_J	−65 to +175		°C

THERMAL CHARACTERISTICS

Rating	Symbol	MURS 320T3	MURS 360T3	Unit
Thermal Resistance — Junction to Lead	$R_{\theta JL}$	11		°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	MURS 320T3	MURS 360T3	Unit
Maximum Instantaneous Forward Voltage (1) (i_F = 3.0 A, T_J = 25°C) (i_F = 4.0 A, T_J = 25°C) (i_F = 3.0 A, T_J = 150°C)	v_F	 0.875 0.89 0.71	 1.25 1.28 1.05	Volts
Maximum Instantaneous Reverse Current (1) (Rated dc Voltage, T_J = 25°C) (Rated dc Voltage, T_J = 150°C)	i_R	 5.0 15	 10 250	μA
Maximum Reverse Recovery Time (I_F = 1.0 A, di/dt = 50 A/μs) (I_F = 0.5 A, i_R = 1.0 A, I_{REC} to 0.25 A)	t_{rr}	 35 25	 75 50	ns
Maximum Forward Recovery Time (I_F = 1.0 A, di/dt = 100 A/μs, Recovery to 1.0 V)	t_{fr}	25	50	ns

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

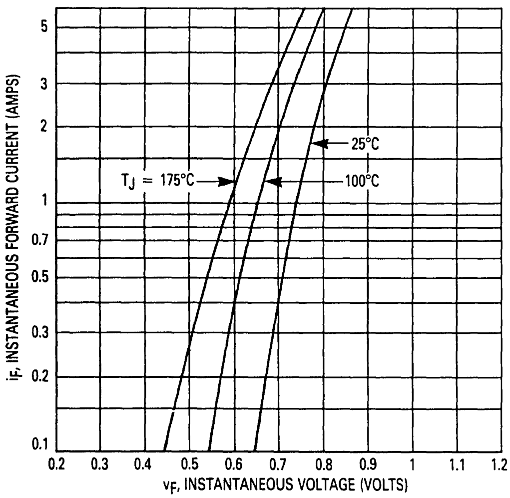


Figure 1. Typical Forward Voltage

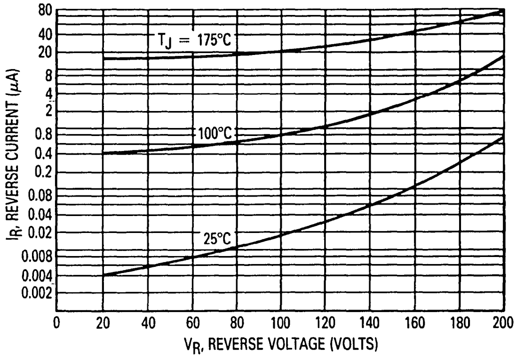


Figure 2. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

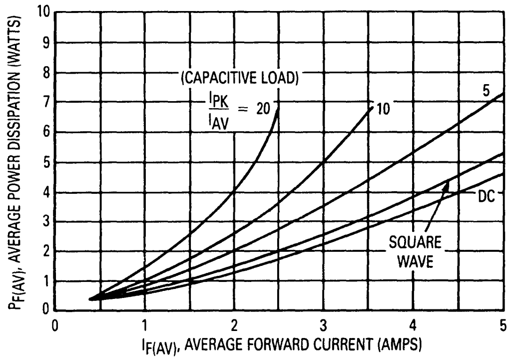


Figure 3. Power Dissipation

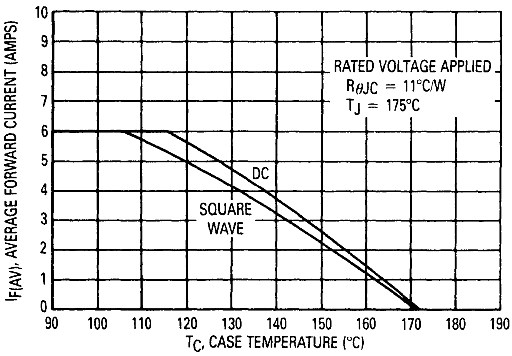


Figure 4. Current Derating (Case)

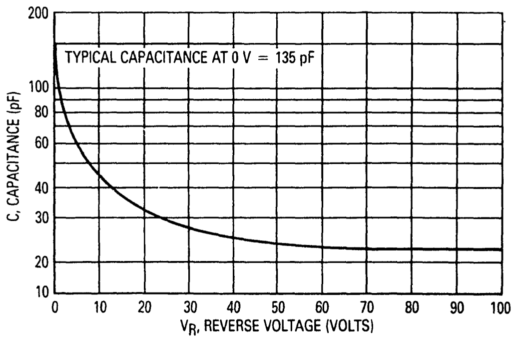


Figure 5. Typical Capacitance

3

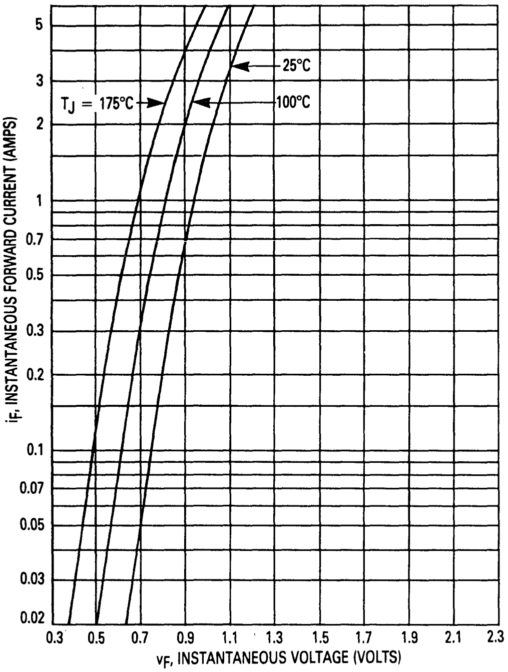


Figure 6. Typical Forward Voltage

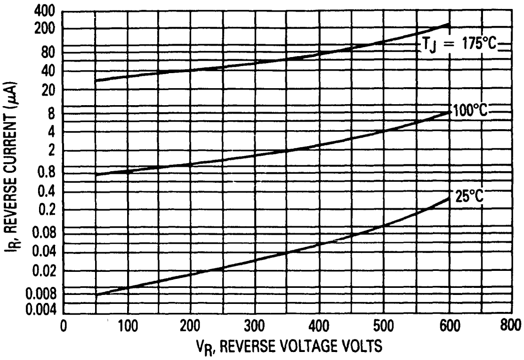


Figure 7. Typical Reverse Current*

*The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

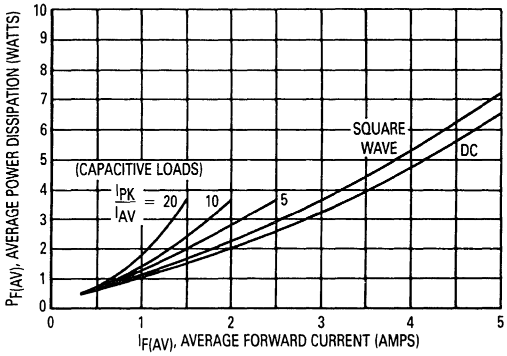


Figure 8. Power Dissipation

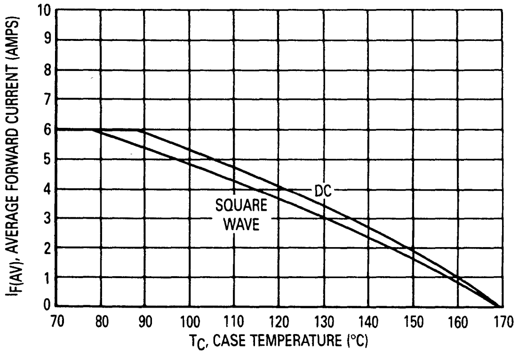


Figure 9. Current Derating (Case)

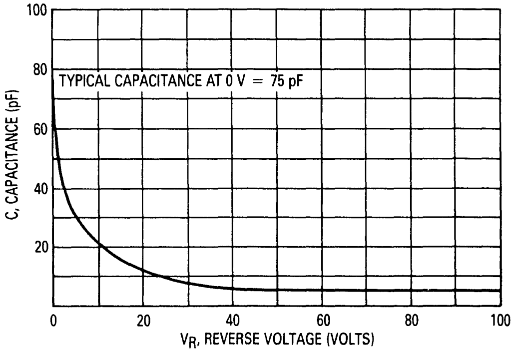


Figure 10. Typical Capacitance

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

R710XPT R712XPT
R711XPT R714XPT

R712XPT is a Motorola Preferred Device

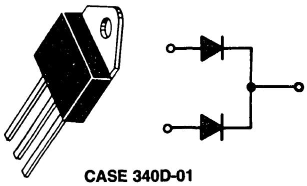
SWITCHMODE POWER RECTIFIERS

. . . designed for special applications such as dc power supplies, inverters, converters, ultrasonic systems, choppers, low RF interference, sonar power supplies and free wheeling diodes. A complete line of fast recovery rectifiers having typical recovery time of 150 nanoseconds providing high efficiency at frequencies to 50 kHz.

- Dual Diode Construction
- 150°C Operating Junction Temperature

ULTRAFAST RECOVERY RECTIFIERS

30 AMPERES
50 to 400 VOLTS



CASE 340D-01
TO-218AC

3

MAXIMUM RATINGS

Rating		Symbol	Maximum	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	R710XPT R711XPT R712XPT R714XPT	V_{RRM} V_{RWM} V_R	50 100 200 400	Volts
Average Rectified Forward Current (Rated V_R) T_C = 100°C	Per Device Per Diode	I_O	30 15	Amps
Peak Repetitive Forward Current, Per Diode (1 Second at 60 Hz, T_C = 100°C)		I_{FRM}	50	Amps
Nonrepetitive Peak Surge Current Per Diode (Surge applied at rated load conditions halfwave, single phase, 60 Hz)		I_{FSM}	150	Amps
Operating Junction and Storage Temperature		T_J, T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS PER DIODE

Characteristic	Symbol	Maximum	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	40	°C/W

ELECTRICAL CHARACTERISTICS PER DIODE

Characteristic	Symbol	Maximum	Unit
Instantaneous Forward Voltage (1) (i_F = 15 Amp, T_C = 25°C)	v_F	1 30	Volts
Instantaneous Reverse Current (1) (Rated dc Voltage, T_C = 100°C) (Rated dc Voltage, T_C = 25°C)	i_R	 1 0 0 015	mA
Reverse Recovery Time (I_F = 1 0 Ampere to V_R = 30 Vdc)	t_{rr}	100	ns

(1) Pulse Test Pulse Width ≤ 300 μs, Duty Cycle ≤ 2 0%

FIGURE 1 — TYPICAL FORWARD VOLTAGE

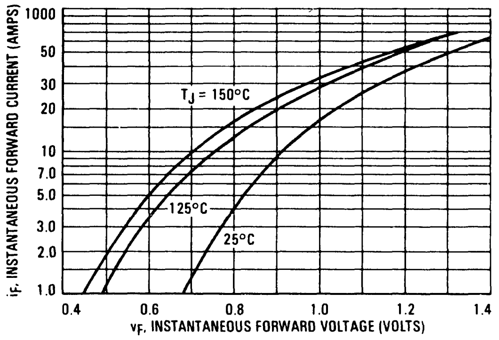


FIGURE 2 — TYPICAL REVERSE CURRENT

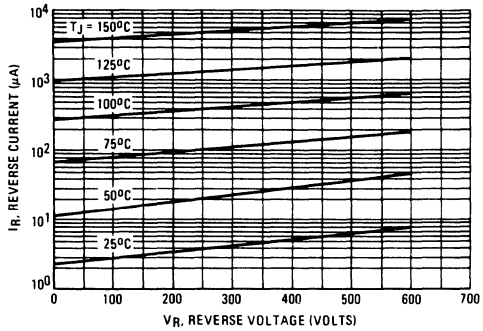


FIGURE 3 — CURRENT DERATING — TOTAL UNIT

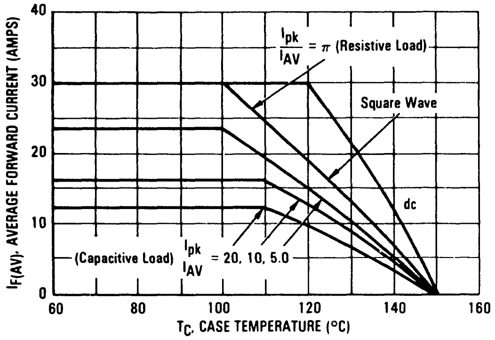


FIGURE 4 — TYPICAL CAPACITANCE

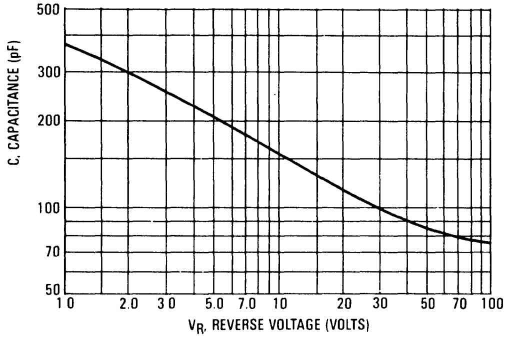


FIGURE 5 — POWER DISSIPATION — TOTAL UNIT

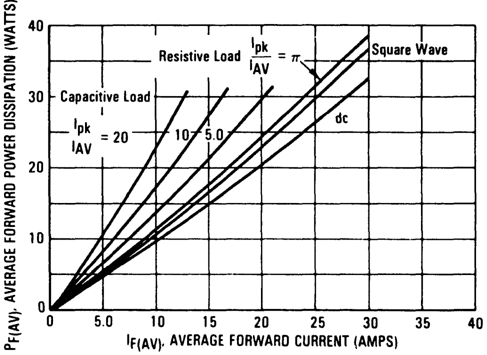
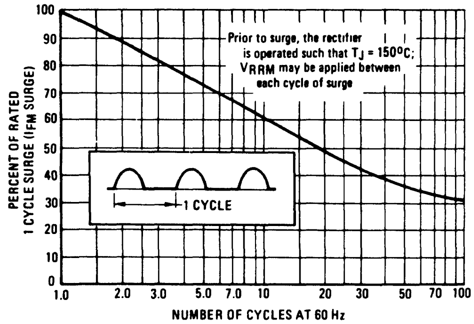
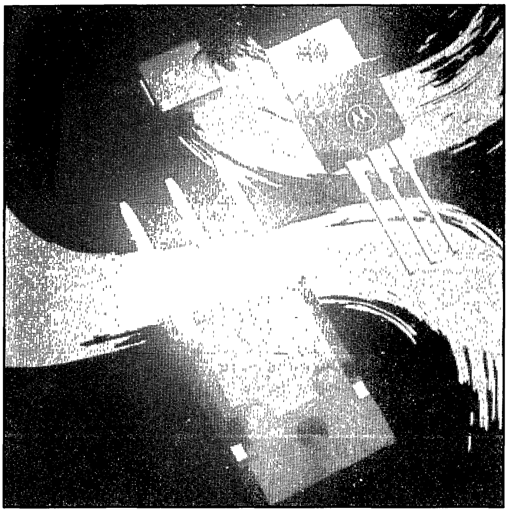


FIGURE 6 — MAXIMUM SURGE CAPABILITY





Tape and Reel/ Packaging Specifications

4

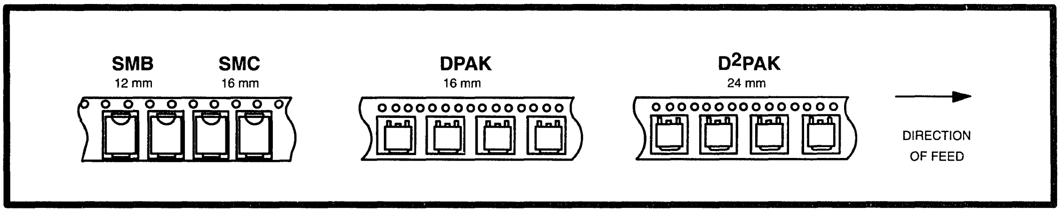
Tape and Reel/ Packaging Specifications

In Brief . . .

Embossed Tape and Reel is used to facilitate automatic pick and place equipment feed requirements. The tape is used as the shipping container for various products and requires a minimum of handling. The antistatic/conductive tape provides a secure cavity for the product when sealed with the "peel-back" cover tape.

- Reel Size (13″)
- Used for Automatic Pick and Place Feed Systems
- Minimizes Product Handling
- EIA 481A
- SMB in 12 mm Tape
- DPAK, SMC in 16 mm Tape
- D2PAK in 24 mm Tape

Use the standard device title and add the required suffix as listed in the option table on the following page. Note that the individual reels have a finite number of devices depending on the type of product contained in the tape. Also note the minimum lot size is one full reel for each line item, and orders are required to be in increments of the single reel quantity.



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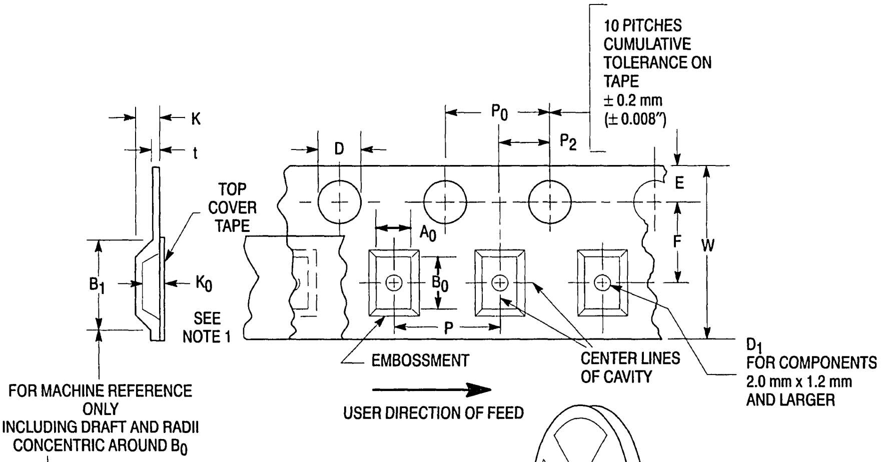
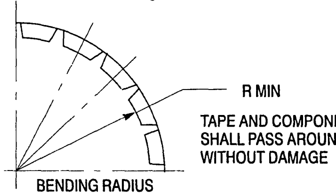
EMBOSSED TAPE AND REEL ORDERING INFORMATION

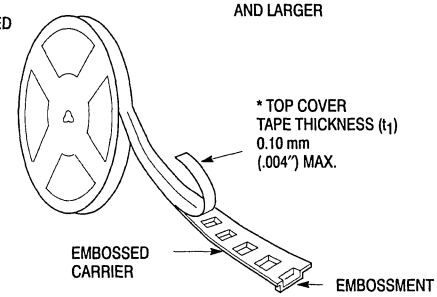
Package	Tape Width (mm)	Reel Size (inch)	Devices Per Reel and Minimum Order Quantity	Device Suffix
DPAK	16	13	2,500	T4
D2PAK	24	13	800	T4
MLL-34	8	7	2,000	T1
SMB	12	13	2,500	T3
SMC	16	13	2,500	T3
SO-8, OPTO SO-8	12	7	500	R1
SO-14	16	7	500	R1
SO-16	16	7	500	R1
SOT-23	8	7	3,000	T1
SOT-143	8	7	3,000	T1
SOT-223	12	7	1,000	T1

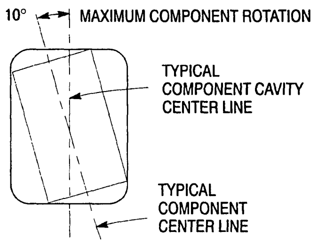
EMBOSSED TAPE AND REEL DATA FOR DISCRETES

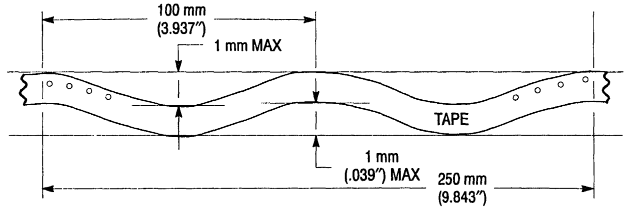
CARRIER TAPE SPECIFICATIONS











CAMBER (TOP VIEW)
ALLOWABLE CAMBER TO BE 1 mm/100 mm NONACCUMULATIVE OVER 250 mm

DIMENSIONS

Tape Size	B_1 Max	D	D_1	E	F	K	P	P_0	P_2	R Min	T Max	W Max
8 mm	4.55 mm (.179″)	1.5+0.1 mm -0.0 (.059+.004″ -0.0)	1.0 Min (.039″)	1.75±0.1 mm (.069±.004″)	3.5±0.05 mm (.138±.002″)	2.4 mm Max (.094″)	4.0±0.1 mm (.157±.004″)	4.0±0.1 mm (.157±.004″)	2.0±0.1 mm (.079±.002″)	25 mm (.98″)	0.6 mm (.024″)	8.3 mm (.327″)
12 mm	8.2 mm (.323″)		1.5 mm Min (.060″)		5.5±0.05 mm (.217±.002″)	6.4 mm Max (.252″)	4.0±0.1 mm (.157±.004″) 8.0±0.1 mm (.315±.004″)			30 mm (1.18″)		12±.30 mm (.470±.012″)
16 mm	12.1 mm (.476″)				7.5±0.10 mm (.295±.004″)	7.9 mm Max (.311″)	4.0±0.1 mm (.157±.004″) 8.0±0.1 mm (.315±.004″) 12.0±0.1 mm (.472±.004″)					16.3 mm (.642″)
24 mm	20.1 mm (.791″)				11.5±0.1 mm (.453±.004″)	11.9 mm Max (.468″)	16.0±.01 mm (.63±.004″)					24.3 mm (.957″)

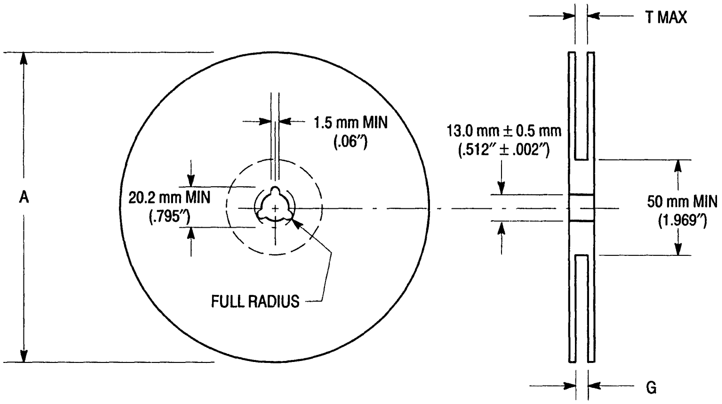
Metric dimensions govern — English are in parentheses for reference only.

NOTE 1: A_0, B_0, and K_0 are determined by component size. The clearance between the components and the cavity must be within .05 mm min. to .50 mm max., the component cannot rotate more than 10° within the determined cavity.

4

Reel Dimensions

Metric Dimensions Govern — English are in parentheses for reference only



4

Size	A Max	G	T Max
8 mm	330 mm (12.992″)	8.4 mm + 1.5 mm, −0.0 (.33″ + .059″, −0.00)	14.4 mm (.56″)
12 mm	330 mm (12.992″)	12.4 mm + 2.0 mm, −0.0 (.49″ + .079″, −0.00)	18.4 mm (.72″)
16 mm	360 mm (14.173″)	16.4 mm + 2.0 mm, −0.0 (.646″ + .078″, −0.00)	22.4 mm (.882″)
24 mm	360 mm (14.173″)	24.4 mm + 2.0 mm, −0.0 (.961″ + .070″, −0.00)	30.4 mm (1.197″)

LEAD TAPE PACKAGING STANDARDS FOR AXIAL-LEAD COMPONENTS

Case Type	Product Category	Device Title Suffix	MPQ Quantity Per Reel (Item 3.3.7)	Component Spacing A Dimension	Tape Spacing B Dimension	Reel Dimension C	Reel Dimension D (Max)	Max Off Alignment E
Case 59-03	DO-41 Glass & DO-41 Surmetic 30	RL	6000	0.2 +/– 0.015	2.062 +/– 0.059	3	14	0.047
	Rectifier							
Case 59-04	500 Watt TVS	RL	5000	0.2 +/– 0.02	2.062 +/– 0.059	3	14	0.047
	Rectifier							
Case 194-04	110 Amp TVS (Automotive)	RL	800	0.4 +/– 0.02	1.875 +/– 0.059	3	14	0.047
	Rectifier							
Case 267-02	Rectifier	RL	1500	0.4 +/– 0.02	2.062 +/– 0.059	3	14	0.047
Case 299-02	DO-35 Glass	RL	5000	0.2 +/– 0.02	2.062 +/– 0.059	3	14	0.047

Table 1. Packaging Details (all dimensions in inches)

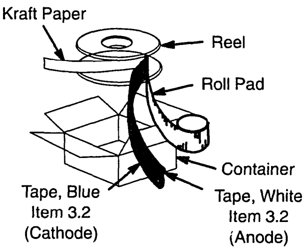


Figure 1. Reel Packing

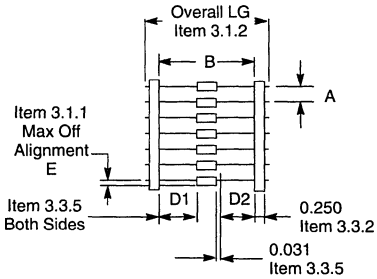


Figure 2. Component Spacing

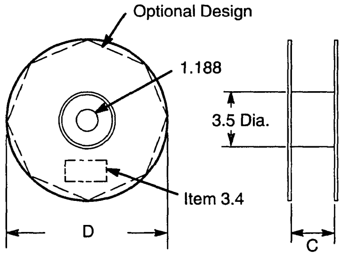
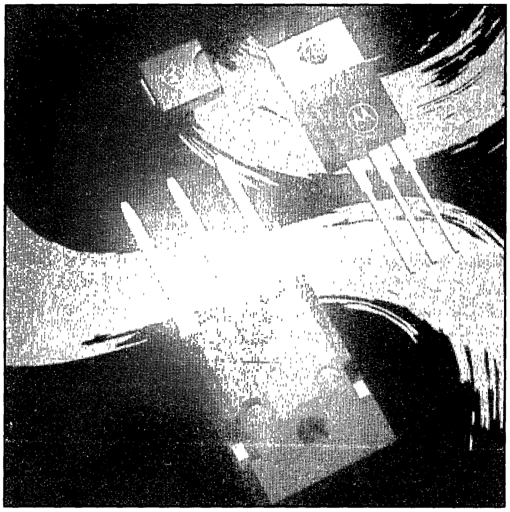


Figure 3. Reel Dimensions

4



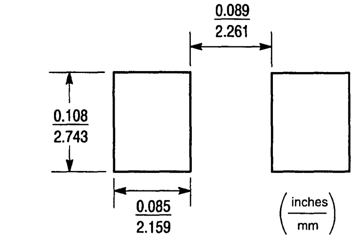
Surface Mount Information

5

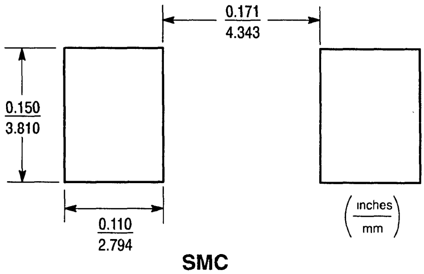
Information For Using Surface Mount Packages

MINIMUM RECOMMENDED FOOTPRINTS FOR SURFACE MOUNTED APPLICATIONS

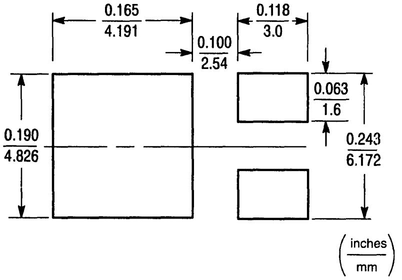
Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



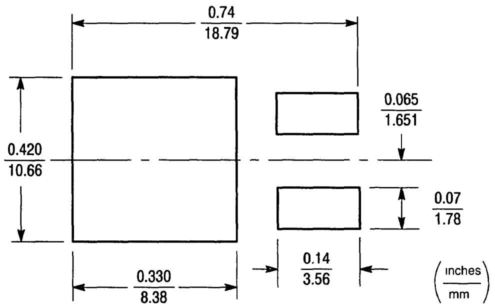
SMB



SMC



DPAK



D2PAK

5

POWER DISSIPATION FOR A SURFACE MOUNT DEVICE

The power dissipation for a surface mount device is a function of the input pad size. These can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient, and the operating temperature, T_A. Using the values provided on the data sheet, P_D can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device. For example:

- D2PAK

$$P_D = \frac{150°C - 25°C}{50°C/W} = 2.5 \text{ watts}$$

The 50°C/W for the D2PAK package assumes the use of the recommended footprint on FR-4 glass epoxy printed circuit board to achieve a power dissipation of 2.5 watts. Another alternative is to use a ceramic substrate or an aluminum core board such as Thermal Clad™. By using an aluminum core board material such as Thermal Clad, the power dissipation can be doubled using the same footprint.

GENERAL SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference shall be a maximum of 10°C.
- The soldering temperature and time shall not exceed 260°C for more than 5 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

* Due to shadowing and the inability to set the wave height to incorporate other surface mount components, the D^2PAK is not recommended for wave soldering.

RECOMMENDED PROFILE FOR REFLOW SOLDERING

For any given circuit board, there will be a group of control settings that will give the desired heat pattern. The operator must set temperatures for several heating zones, and a figure for belt speed. Taken together, these control settings make up a heating "profile" for that particular circuit board. On machines controlled by a computer, the computer remembers these profiles from one operating session to the next. Figure 1 shows a typical heating profile for use when soldering a surface mount device to a printed circuit board. This profile will vary among soldering systems but it is a good starting point. Factors that can affect the profile include the type of soldering system in use, density and types of components on the board, type of solder used, and the type of board or substrate material being used. This profile shows temperature versus time. The line on the graph shows the actual temperature that might be experienced on the surface of a test board at or near a central solder joint. The two profiles are based on a high density and a low density board. The Vitronics SMD310 convection/infrared reflow soldering system was used to generate this profile. The type of solder used was 62/36/2 Tin Lead Silver with a melting point between 177–189°C. When this type of furnace is used for solder reflow work, the circuit boards and solder joints tend to heat first. The components on the board are then heated by conduction. The circuit board, because it has a large surface area, absorbs the thermal energy more efficiently, then distributes this energy to the components. Because of this effect, the main body of a component may be up to 30 degrees cooler than the adjacent solder joints.

5

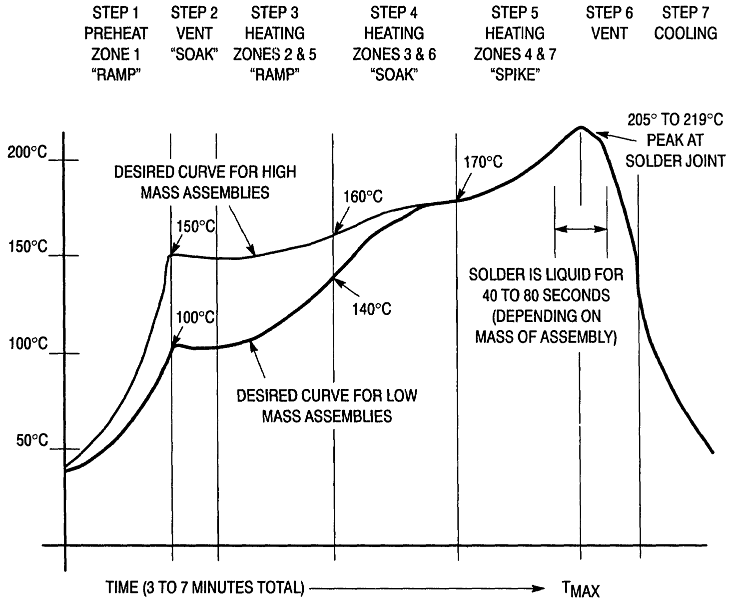
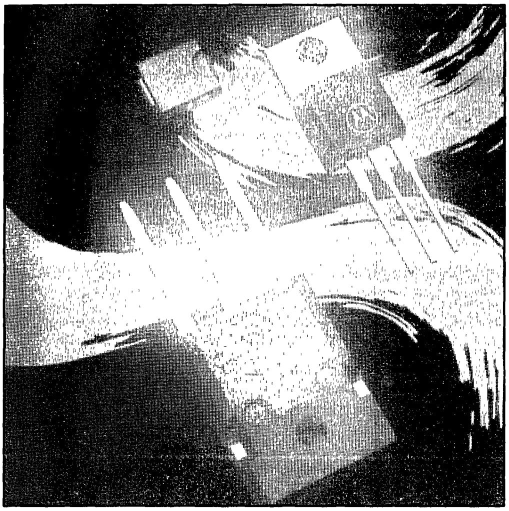


Figure 1. Typical Solder Heating Profile

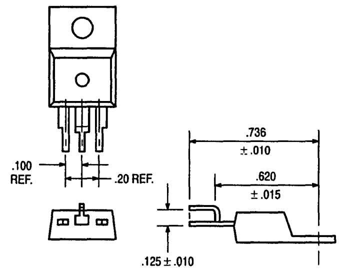


TO-220 Leadform Information

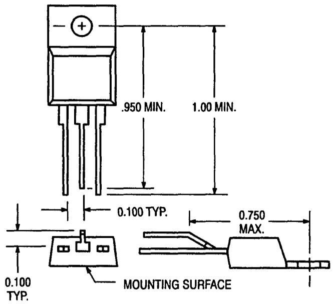
6

- **Leadform options require assignment of a special part number before ordering.**
- **Contact your local Motorola representative for special part number and pricing.**
- **10,000 piece minimum quantity orders are required.**
- **Leadform orders are non-cancellable after processing.**
- **Leadforms apply to both Motorola Case 221A-04 and 221A-06 except as noted.**

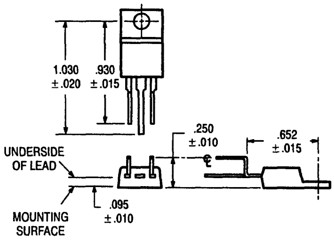
LEADFORM AS



LEADFORM BC

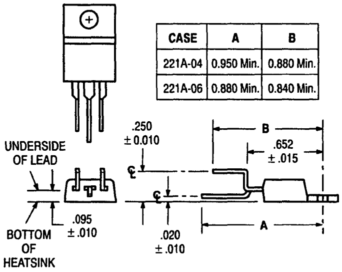


LEADFORM AC

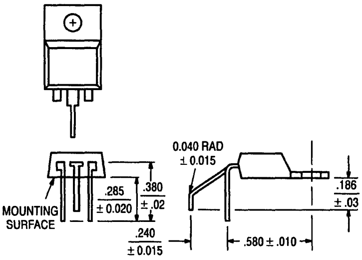


LEADFORM AD

CASE	A	B
221A-04	0.950 Min.	0.880 Min.
221A-06	0.880 Min.	0.840 Min.

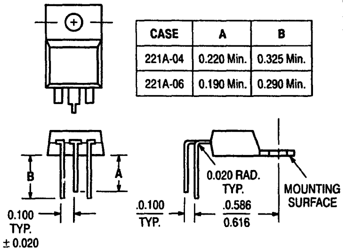


LEADFORM AN



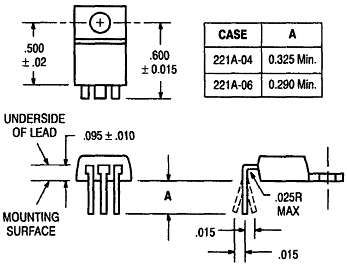
LEADFORM BA

CASE	A	B
221A-04	0.220 Min.	0.325 Min.
221A-06	0.190 Min.	0.290 Min.

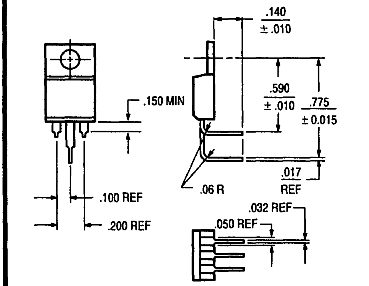


LEADFORM BL

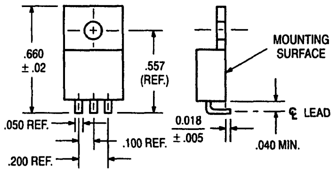
CASE	A
221A-04	0.325 Min.
221A-06	0.290 Min.



LEADFORM AK

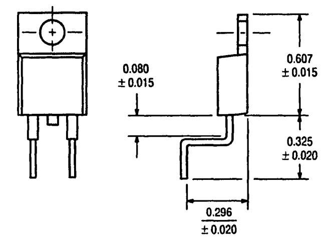


LEADFORM AF

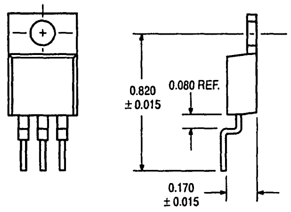


Primary TO-220 Leadform Dimensions (continued)

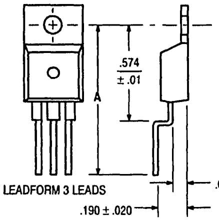
LEADFORM BS



LEADFORM BR

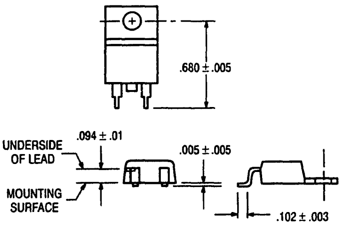


LEADFORM AU

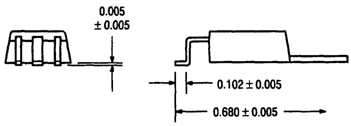


CASE	A
221A-04	0.920 Min.
221A-06	0.885 Min.

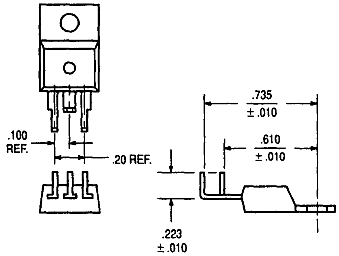
LEADFORM BU



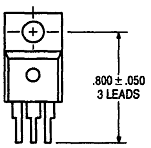
LEADFORM BV



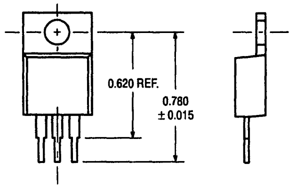
LEADFORM BD



LEADFORM DW

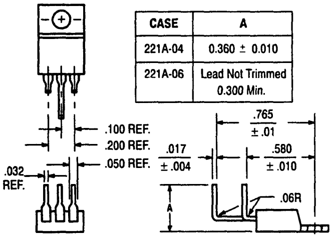


LEADFORM BG



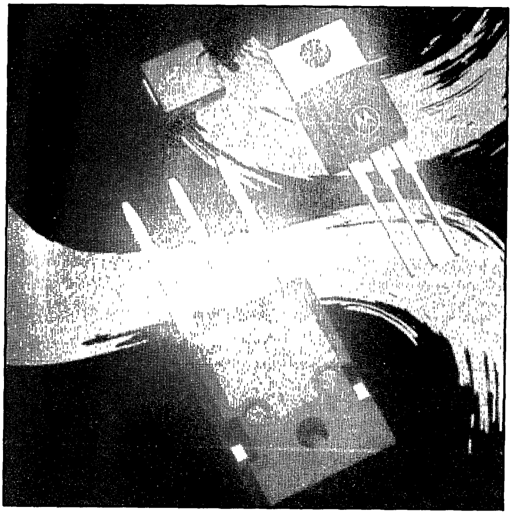
LEADFORM AJ

CASE	A
221A-04	0.360 ± 0.010
221A-06	Lead Not Trimmed 0.300 Min.



6

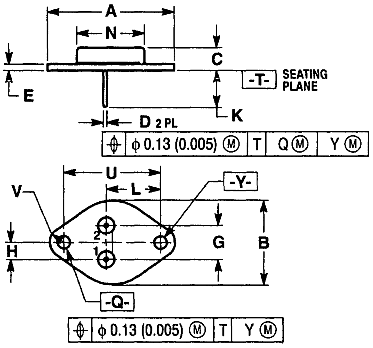
6



Package Outline Dimensions and Footprints

7

Package Outline Dimensions and Footprints



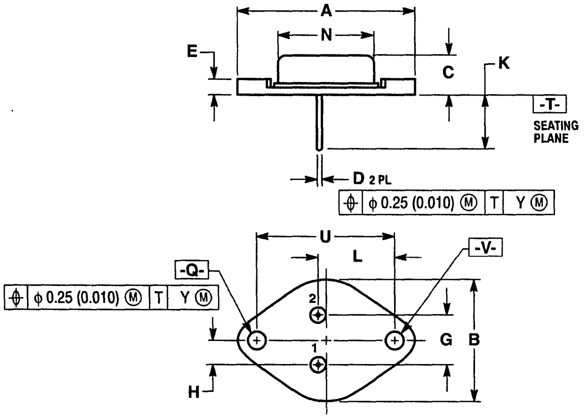
STYLE 8:
PIN 1. CATHODE #1
2. CATHODE #2
CASE: ANODE

STYLE 9:
PIN 1. ANODE #1
2. ANODE #2
CASE: CATHODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.
4. 001-05 AND -06 OBSOLETE, NEW STANDARD 001-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	39.37 REF		1.550 REF	
B	—	26.67	—	1.050
C	6.35	8.51	0.250	0.335
D	0.97	1.09	0.038	0.043
E	1.40	1.77	0.055	0.070
G	10.92 BSC		0.430 BSC	
H	5.46 BSC		0.215 BSC	
K	11.18	12.19	0.440	0.480
L	16.89 BSC		0.665 BSC	
N	—	21.08	—	0.830
Q	3.84	4.19	0.151	0.165
U	30.15 BSC		1.187 BSC	
V	3.33	4.77	0.131	0.188

CASE 1-07

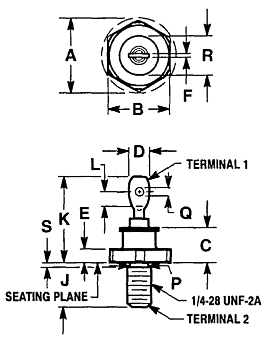


STYLE 4:
PIN 1. ANODE #1
2. ANODE #2
CASE: CATHODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	—	39.37	—	1.550
B	—	26.67	—	1.050
C	6.35	11.43	0.250	0.450
D	0.99	1.09	0.039	0.043
E	—	3.43	—	0.135
G	10.92 BSC		0.430 BSC	
H	5.46 BSC		0.215 BSC	
K	11.18	12.19	0.440	0.480
L	16.89 BSC		0.665 BSC	
N	—	21.08	—	0.830
Q	3.84	4.09	0.151	0.161
U	30.15 BSC		1.187 BSC	
V	3.84	4.09	0.151	0.161

CASE 11-03

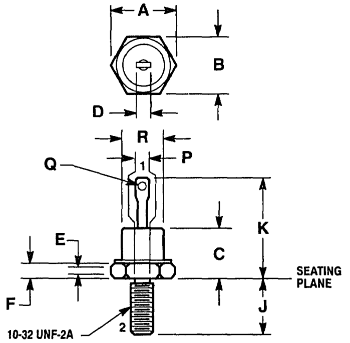


STYLE 1:
TERM. 1. CATHODE
2. ANODE

NOTES:
1. CHAMFER OR UNDERCUT ON ONE OR BOTH ENDS OF HEXAGONAL BASE IS OPTIONAL.
2. ANGULAR ORIENTATION AND CONTOUR OF TERMINAL ONE IS OPTIONAL.
3. THREADS ARE PLATED.
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1982.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	—	20.07	—	0.790
B	16.94	17.45	0.669	0.687
C	—	11.43	—	0.450
D	—	9.53	—	0.375
E	2.92	5.08	0.115	0.200
F	—	2.03	—	0.080
J	10.72	11.51	0.422	0.453
K	19.05	25.40	0.750	1.00
L	3.96	—	0.156	—
P	5.59	6.32	0.220	0.249
Q	3.56	4.45	0.140	0.175
R	—	16.94	—	0.667
S	—	2.26	—	0.089

CASE 42A-01

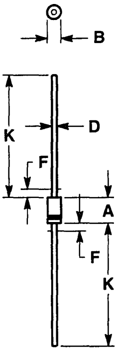


STYLE 2:
TERM. 1. ANODE
2. CATHODE

NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED DO-4 OUTLINE SHALL APPLY.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. CONTROLLING DIMENSION: INCH.
4. 056-01, -02 OBSOLETE, NEW STANDARD 056-03.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	—	12.82	—	0.505
B	10.77	11.09	0.424	0.437
C	—	10.28	—	0.405
D	—	6.35	—	0.250
E	1.53	—	0.060	—
F	1.91	4.44	0.075	0.175
J	10.72	11.50	0.422	0.453
K	15.24	20.32	0.600	0.800
P	4.14	4.80	0.163	0.189
Q	1.53	2.41	0.060	0.095
R	6.74	10.76	0.265	0.424

CASE 56-03



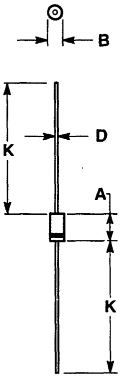
NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
2. POLARITY DENOTED BY CATHODE BAND.
3. LEAD DIAMETER NOT CONTROLLED WITHIN "F" DIMENSION.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.07	5.20	0.160	0.205
B	2.04	2.71	0.080	0.107
D	0.71	0.86	0.028	0.034
F	—	1.27	—	0.050
K	27.94	—	1.100	—

CASE 59-03

7

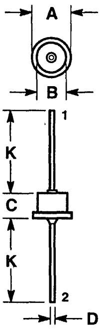
PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)



NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
2. POLARITY DENOTED BY CATHODE BAND.
3. LEAD DIAMETER NOT CONTROLLED WITHIN "F" DIMENSION.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.97	6.60	0.235	0.260
B	2.79	3.05	0.110	0 120
D	0.76	0.86	0.030	0 034
K	27.94	—	1.100	—

CASE 59-04

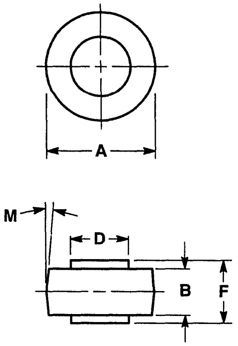


STYLE 1:
PIN 1. CATHODE
2. ANODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

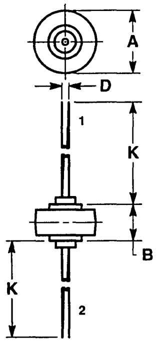
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	—	11.43	—	0.450
B	—	8 89	—	0.350
C	—	7.62	—	0 300
D	1.17	1 42	0 046	0.056
K	24.90	—	0.980	—

CASE 60-01



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.43	8.69	0.332	0.342
B	4.19	4.45	0.165	0.175
D	5.54	5.64	0.218	0.222
F	5.94	6.25	0.234	0.246
M	5° NOM		5° NOM	

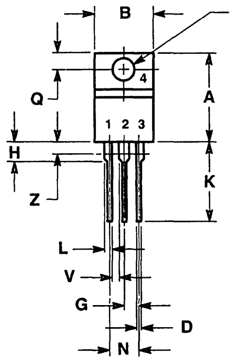
CASE 193-04

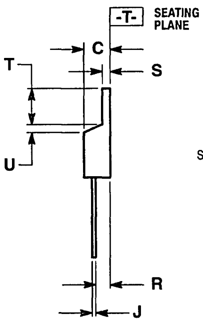


NOTE:
1. CATHODE SYMBOL ON PKG.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.43	8.69	0.332	0 342
B	5.94	6 25	0 234	0 246
D	1.27	1.35	0.050	0.053
K	25.15	25.65	0.990	1.010

CASE 194-04



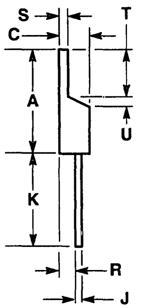


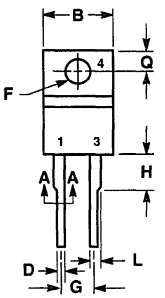
STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

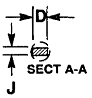
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIM Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	14.48	15.75	0.570	0.620
B	9.66	10.28	0.380	0.405
C	4.07	4.82	0.160	0.190
D	0.64	0.88	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.42	2.66	0.095	0.105
H	2.80	3.93	0.110	0.155
J	0.46	0.64	0.018	0.025
K	12.70	14.27	0.500	0.562
L	1.15	1.52	0.045	0.060
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.15	1.39	0.045	0.055
T	5.97	6.47	0.235	0.255
U	0.00	1.27	0.000	0.050
V	1.15	—	0.045	—
Z	—	2.04	—	0.080

CASE 221A-06







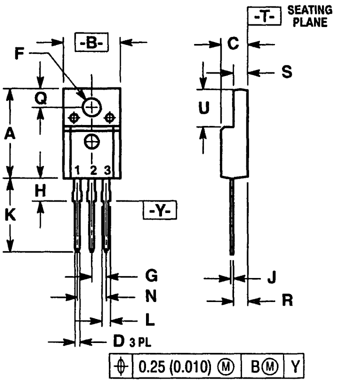
STYLE 1:
PIN 1. CATHODE
2. N/A
3. ANODE
4. CATHODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 221B-01 OBSOLETE, NEW STANDARD 221B-02.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	15.11	15.75	0.595	0.620
B	9.65	10.29	0.380	0.405
C	4.06	4.82	0.160	0.190
D	0.64	0.89	0.025	0.035
F	3.61	3.73	0.142	0.147
G	4.83	5.33	0.190	0.210
H	2.79	3.30	0.110	0.130
J	0.46	0.64	0.018	0.025
K	12.70	14.27	0.500	0.562
L	1.14	1.27	0.045	0.050
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.14	1.39	0.045	0.055
T	5.97	6.48	0.235	0.255
U	0.76	1.27	0.030	0.050

CASE 221B-02

7

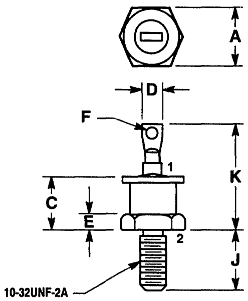


STYLE 3:
PIN 1. ANODE
2. CATHODE
3. ANODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 221D-01 OBSOLETE, NEW STANDARD 221D-02.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	15.78	15.97	0.621	0.629
B	10.01	10.21	0.394	0.402
C	4.60	4.80	0.181	0.189
D	0.67	0.86	0.026	0.034
F	3.08	3.27	0.121	0.129
G	2.54 BSC		0.100 BSC	
H	3.13	3.27	0.123	0.129
J	0.46	0.64	0.018	0.025
K	12.70	14.27	0.500	0.562
L	1.14	1.52	0.045	0.060
N	5.08 BSC		0.200 BSC	
Q	3.21	3.40	0.126	0.134
R	2.72	2.81	0.107	0.111
S	2.44	2.64	0.096	0.104
U	6.58	6.78	0.259	0.267

CASE 221D-02

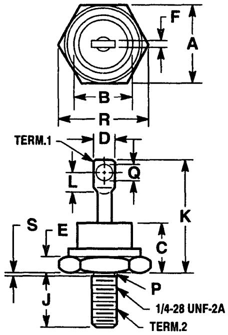


STYLE 2:
PIN 1. ANODE
2. CATHODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 245A-01 OBSOLETE, NEW STANDARD 245A-02.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	10.75	11.12	0.423	0.438
C	—	10.28	—	0.405
D	4.07	4.69	0.160	0.185
E	1.91	4.44	0.075	0.175
F	2.29	2.41	0.090	0.095
J	10.72	11.50	0.422	0.453
K	18.80	20.32	0.740	0.800

CASE 245A-02



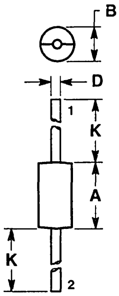
STYLE 2:
TERM.1. ANODE
2. CATHODE (CASE)

NOTES:
1. DIM "P" IS DIA.
2. CHAMFER OR UNDERCUT ON ONE OR BOTH ENDS OF HEXAGONAL BASE IS OPTIONAL.
3. ANGULAR ORIENTATION AND CONTOUR OF TERMINAL ONE IS OPTIONAL.
4. THREADS ARE PLATED.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1982.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	16.94	17.45	0.669	0.687
B	—	16.94	—	0.667
C	—	11.43	—	0.450
D	—	9.53	—	0.375
E	2.92	5.08	0.115	0.200
F	—	2.03	—	0.080
J	10.72	11.51	0.422	0.453
K	—	25.40	—	1.000
L	3.86	—	0.156	—
P	5.59	6.32	0.220	0.249
Q	3.56	4.45	0.140	0.175
R	—	20.16	—	0.794
S	—	2.26	—	0.089

CASE 257-01

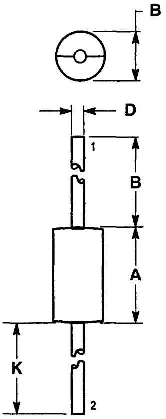
PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)



NOTES:
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	—	9.39	—	0.370
B	—	6.35	—	0.250
D	1.22	1.32	0.048	0.052
K	25.40	—	1.000	—

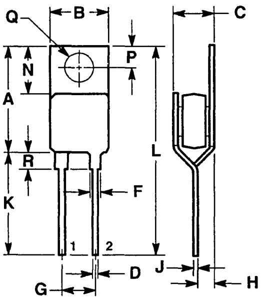
CASE 267-02



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.40	9.65	0.370	0.380
B	4.83	5.33	0.190	0.210
D	1.22	1.32	0.048	0.052
K	25.40	—	1.000	—

CASE 267-03



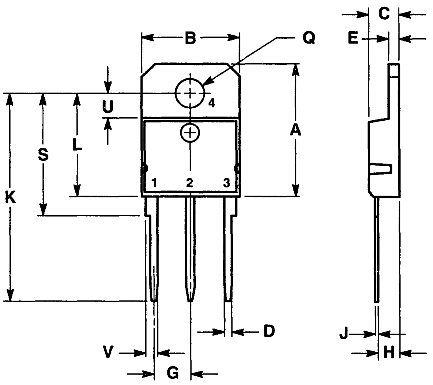
STYLE 1:
PIN 1. CATHODE
2. ANODE

NOTES:
1. 339-01 OBSOLETE, NEW STANDARD 339-02.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	14.22	15.88	0. 560	0.625
B	9.65	10.67	0.380	0.420
C	7.21	7.87	0.284	0.310
D	0.64	1.14	0.025	0.045
F	1.52	2.29	0.060	0.090
G	4.32	5.33	0.170	0.210
H	2.03	2.92	0.080	0.115
J	0.58	0.74	0.023	0.029
K	—	14.27	—	0.562
L	—	30.15	—	1.187
N	5.84	6.86	0.230	0.270
P	2.54	3.05	0.100	0.120
Q	3.53	3.73	0.139	0.147
R	—	5.08	—	0.200

CASE 339-02

PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)

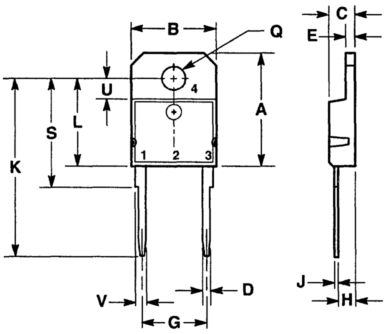


STYLE 2:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	19.00	19.60	0.749	0.771
B	14.00	14.50	0.551	0.570
C	4.20	4.70	0.165	0.185
D	1.00	1.30	0.040	0.051
E	1.45	1.65	0.058	0.064
G	5.21	5.72	0.206	0.225
H	2.60	3.00	0.103	0.118
J	0.40	0.60	0.016	0.023
K	28.50	32.00	1.123	1.259
L	14.70	15.30	0.579	0.602
Q	4.00	4.25	0.158	0.167
S	17.50	18.10	0.689	0.712
U	3.40	3.80	0.134	0.149
V	1.50	2.00	0.060	0.078

CASE 340D-01

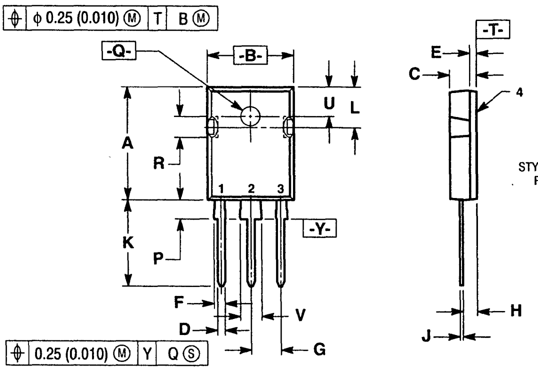


STYLE 1:
PIN 1. CATHODE
3. ANODE
4. CATHODE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982
2. CONTROLLING DIMENSION; MILLIMETER.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	19.00	19.60	0.749	0.771
B	14.00	14.50	0.551	0.570
C	4.20	5.00	0.165	0.196
D	1.00	1.30	0.040	0.051
E	1.45	1.65	0.058	0.064
G	10.42	11.44	0.411	0.450
H	2.60	3.00	0.103	0.118
J	0.40	0.60	0.016	0.023
K	28.50	32.00	1.123	1.259
L	14.70	15.30	0.579	0.602
Q	4.00	4.25	0.158	0.167
S	17.50	19.50	0.689	0.767
U	3.40	3.80	0.134	0.149
V	1.50	2.00	0.060	0.078

CASE 340E-01



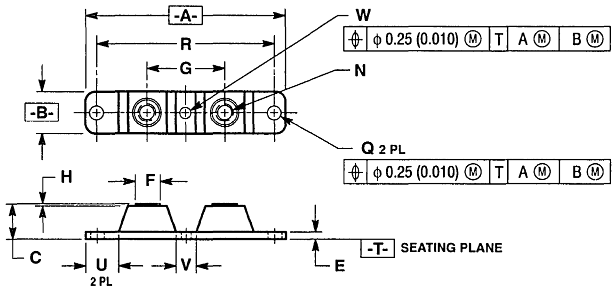
STYLE 2:
PIN 1. ANODE 1
2. CATHODE(S)
3. ANODE 2
4. CATHODE(S)

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. 340F-01 AND -02 OBSOLETE, NEW STANDARD 340F-03.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	20.40	20.90	0.803	0.823
B	15.44	15.95	0.608	0.628
C	4.70	5.21	0.185	0.205
D	1.09	1.30	0.043	0.051
E	1.50	1.63	0.059	0.064
F	1.80	2.18	0.071	0.086
G	5.45 BSC		0.215 BSC	
H	2.56	2.87	0.101	0.113
J	0.48	0.68	0.019	0.027
K	15.57	16.08	0.613	0.633
L	7.26	7.50	0.286	0.295
P	3.10	3.38	0.122	0.133
Q	3.50	3.70	0.138	0.145
R	3.30	3.80	0.130	0.150
U	5.30 BSC		0.209 BSC	
V	3.05	3.40	0.120	0.134

CASE 340F-03

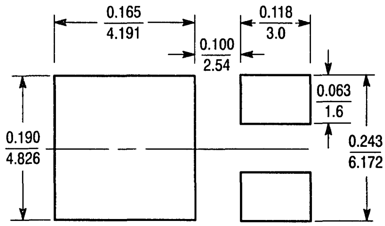
7



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. TERMINAL PENETRATION: 5.97(.235) MXIMUM.
4. 357C-01 AND -02 OBSOLETE. NEW STANDARD 357C-03.

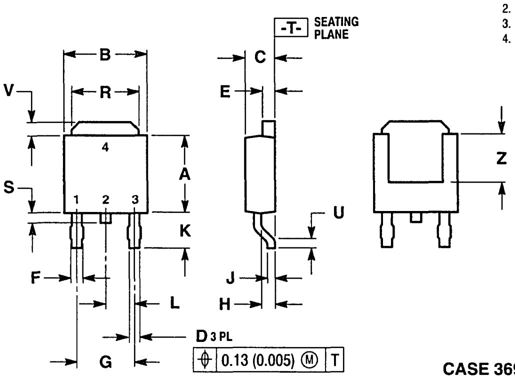
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	87.63	92.20	3.450	3.635
B	17.78	20.57	0.700	0.810
C	15.63	16.26	0.615	0.640
E	3.05	3.30	0.120	0.130
F	11.05	11.30	0.435	0.445
G	34.80	35.05	1.370	1.380
H	0.18	0.68	0.007	0.030
N	1/4-20UNC-2B		1/4-20UNC-2B	
Q	6.86	7.23	0.270	0.285
R	80.01 BSC		3.150 BSC	
U	15.24	16.00	0.600	0.630
V	8.39	9.52	0.330	0.375
W	4.32	4.82	0.170	0.190

CASE 357C-03



DPAK FOOTPRINT

(inches / mm)



STYLE 3:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

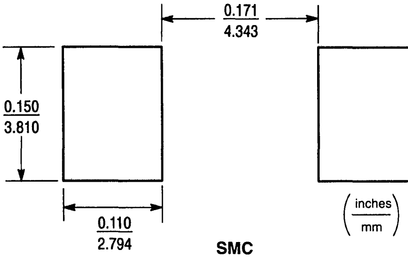
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 369A-01 THRU -03 OBSOLETE.
4. 369A-04 THRU -10 OBSOLETE, NEW STANDARD 369A-11.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	5.97	6.22	0.235	0.245
B	6.35	6.73	0.250	0.265
C	2.19	2.38	0.086	0.094
D	0.69	0.88	0.027	0.035
E	0.84	1.01	0.033	0.040
F	0.94	1.19	0.037	0.047
G	4.58 BSC		0.180 BSC	
H	0.87	1.01	0.034	0.040
J	0.46	0.58	0.018	0.023
K	2.60	2.89	0.102	0.114
L	2.29 BSC		0.090 BSC	
R	4.45	5.46	0.175	0.215
S	0.51	1.27	0.020	0.050
U	0.51	—	0.020	—
V	0.77	1.27	0.030	0.050
Z	3.51	—	0.138	—

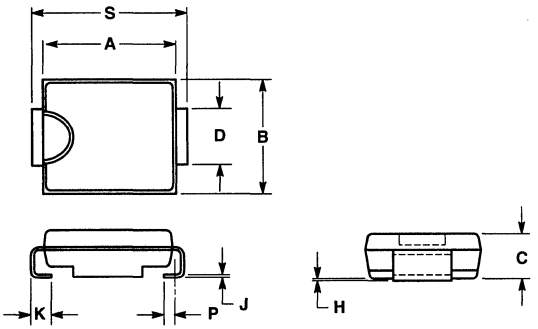
CASE 369A-11

7

PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)



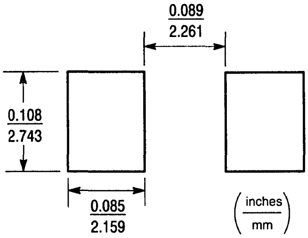
SMC FOOTPRINT



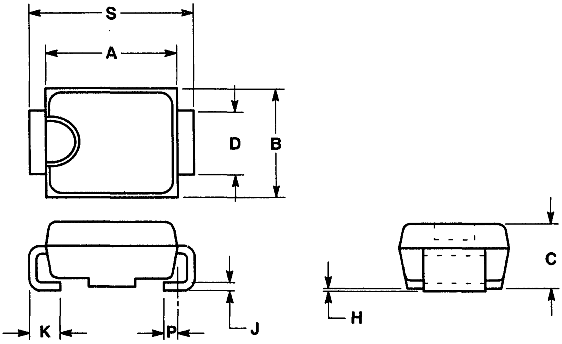
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.
4. 403-01 AND -02 OBSOLETE, NEW STANDARD 403-03.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.60	7.11	0.260	0.280
B	5.59	6.10	0.220	0.240
C	1.90	2.41	0.075	0.095
D	2.92	3.07	0.115	0.121
H	0.051	0.152	0.0020	0.0060
J	0.15	0.30	0.006	0.012
K	0.76	1.27	0.030	0.050
P	0.51 REF		0.020 REF	
S	7.75	8.13	0.305	0.320

CASE 403-03



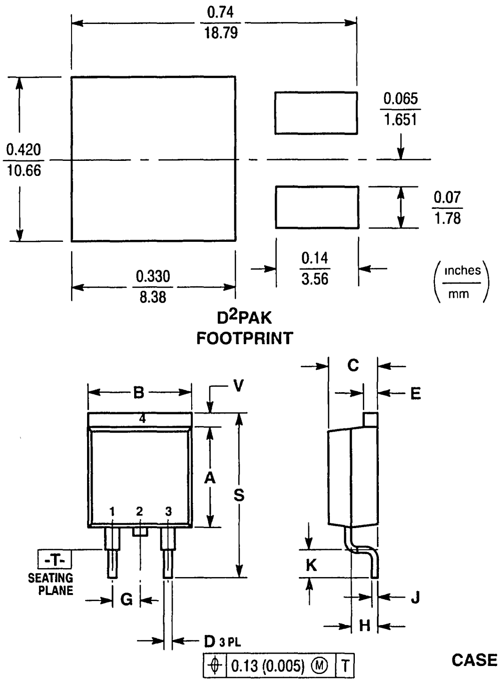
SMB FOOTPRINT



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.
4. 403A-01 AND -02 OBSOLETE, NEW STANDARD 403A-03.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.06	4.57	0.160	0.180
B	3.30	3.81	0.130	0.150
C	1.90	2.41	0.075	0.095
D	1.96	2.11	0.077	0.083
H	0.051	0.152	0.0020	0.0060
J	0.15	0.30	0.006	0.012
K	0.76	1.27	0.030	0.050
P	0.51 REF		0.020 REF	
S	5.21	5.59	0.205	0.220

CASE 403A-03



CASE 418B-01

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.64	9.65	0.340	0.380
B	9.65	10.29	0.380	0.405
C	4.06	4.83	0.160	0.190
D	0.51	0.89	0.020	0.035
E	1.14	1.40	0.045	0.055
G	2.54 BSC		0.100 BSC	
H	2.03	2.79	0.080	0.110
J	0.46	0.64	0.018	0.025
K	2.29	2.79	0.090	0.110
S	14.60	15.88	0.575	0.625
V	1.14	1.40	0.045	0.055

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7

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