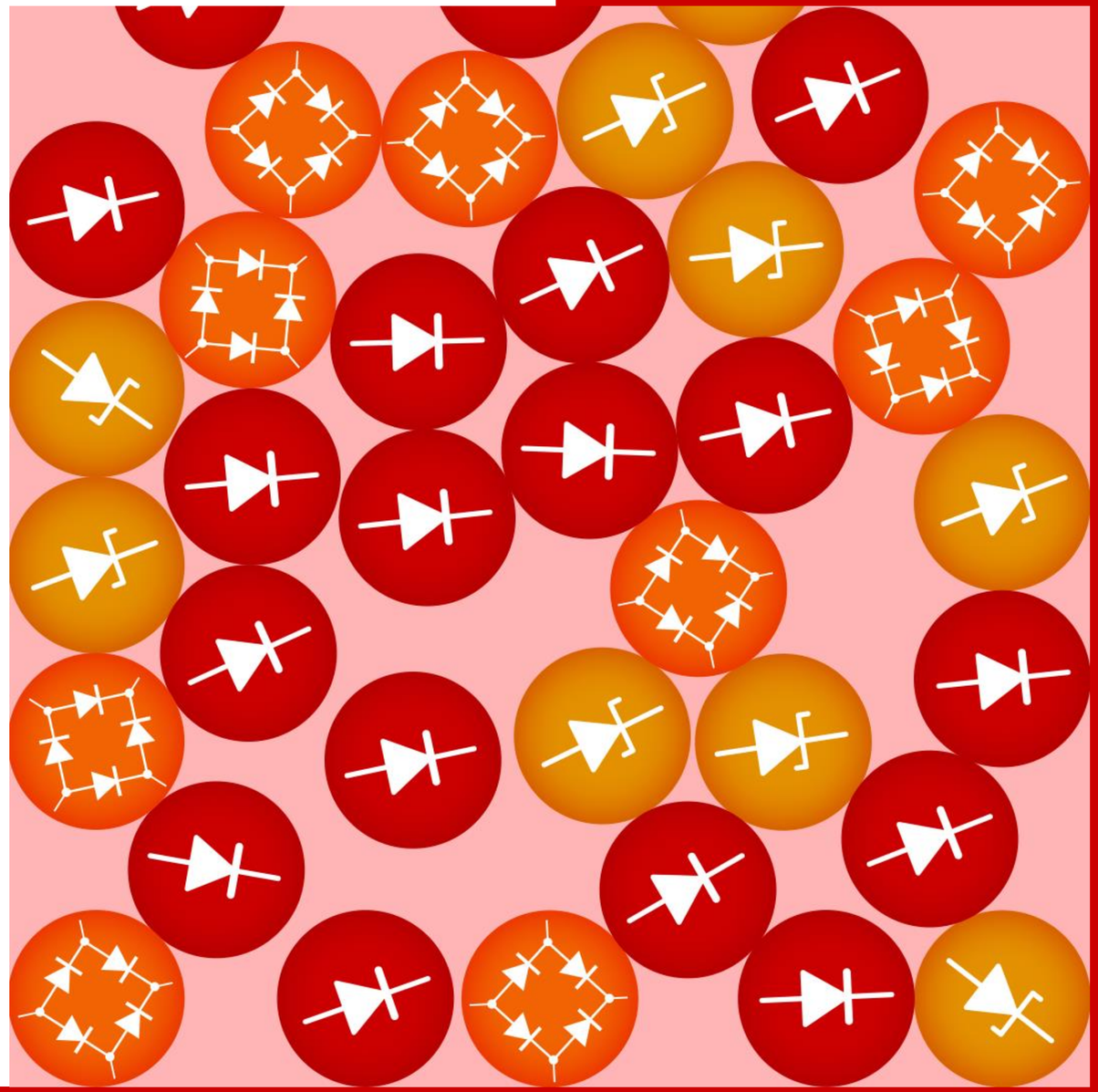
MCC Solutions Guide

Rectifier Diodes



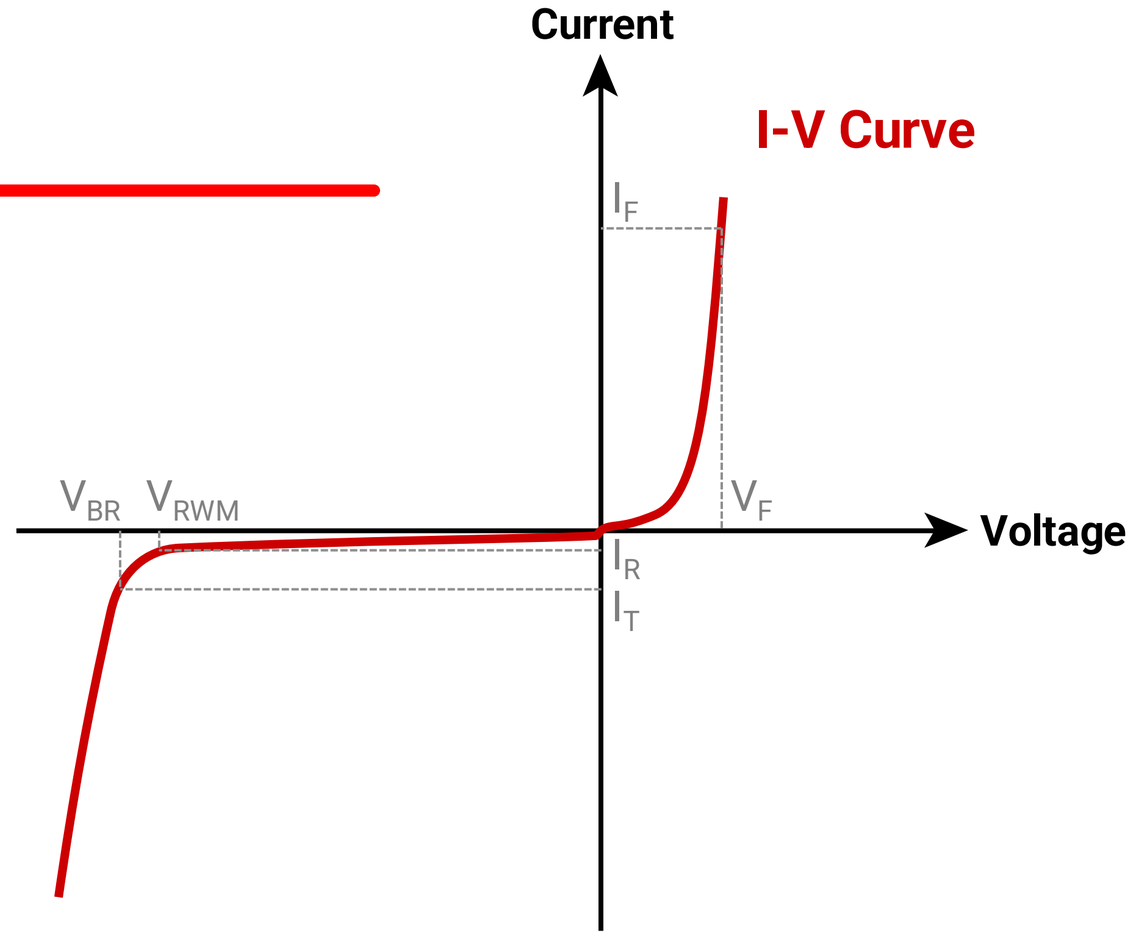
What is a Rectifier Diode?

Rectifier

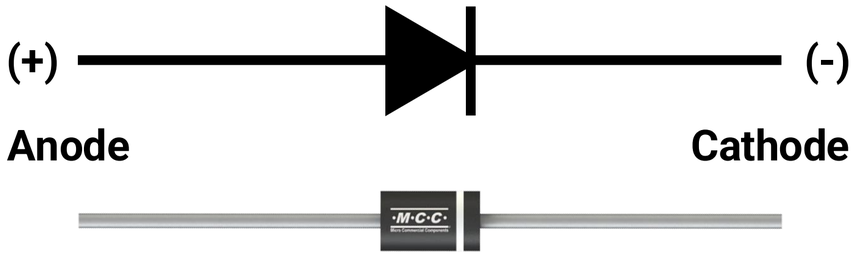
Semiconductor device designed to allow current to flow in one direction only, effectively converting alternating current (AC) into direct current (DC).

Essential Component

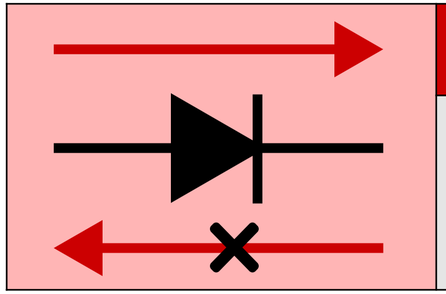
It is a critical component in power supplies and other electronics where DC is required.



Schematic symbols for a diode

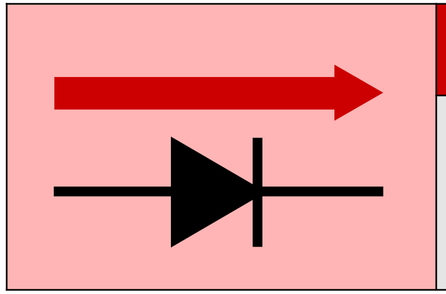


How does a Rectifier Diode work?



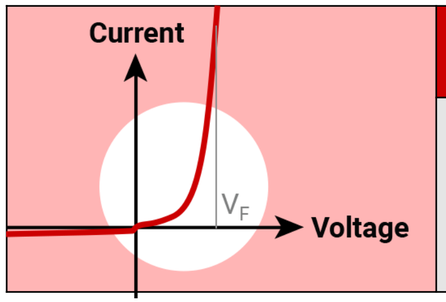
Unidirectional Current Flow

It blocks current in the reverse direction while allowing it in the forward direction.



High Current Capacity

Rectifiers are built to handle high currents, which makes them suitable for applications like power rectification.



Low Forward Voltage Drop

This minimizes power loss when current flows through the diode.

Key Categories

Rectifiers are categorized based on their switching speed, voltage drop, and efficiency particularly when the forward current exceeds 0.5A

	Standard	Fast	Super Fast	Schottky
Switching Speed	Slow (>500ns)	Medium (150-500ns)	Very fast (<150ns)	Negligible recovery time
Efficiency	Moderate	Higher than standard	High	Maximum
	Best for low-frequency, low-cost applications	**Improved switching for moderate-speed systems**	**Ideal for high-frequency systems with low switching losses**	**Ultra-fast switching and low voltage drop but higher leakage current**
	• AC to DC conversion in household appliances (e.g. washing machines, refrigerators) • Power supplies for devices operating at 50/60 Hz • Battery chargers for slow charging applications	• Switched-mode power supplies (SMPS) in desktop computers and TVs • Inverters for solar panel systems operating at moderate frequencies • Motor drives in industrial equipment requiring moderate switching speeds	• High-frequency SMPS for modern laptops and LED lighting • High-efficiency DC-DC converters in renewable energy systems • Electric vehicle charging stations with fast switching requirements	• Low-voltage DC-DC converters in mobile phones and tablets • RF circuits in communication devices (e.g., Wi-Fi routers, transmitters) • Fast-switching circuits in automotive electronics (e.g., electronic control units)

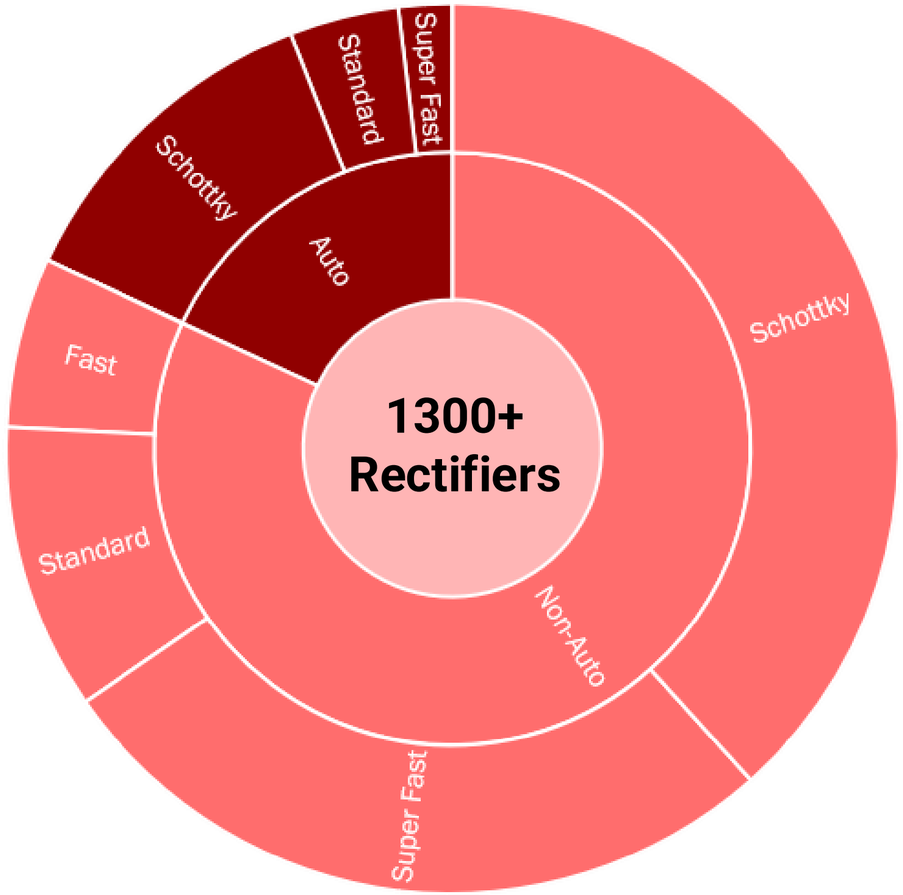
Rectifier Overview

Diode
IF <= 0.5A

VS

Rectifier
IF > 0.5A

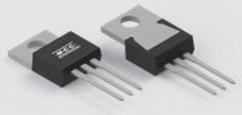
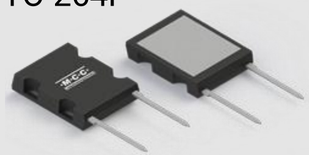
Categories	Static Behavior	Dynamic Behavior
Standard	▪ PN junction structure ▪ High forward voltage ▪ High breakdown voltage	t_{rr} >= 500ns
Fast		500ns > t_{rr} < 150ns
Super Fast		t_{rr} < 150ns
Schottky	▪ Metal barrier design ▪ Low forward voltage ▪ Low breakdown voltage	By theory, no t_{rr} due to majority carrier effect. Little t_{rr} observed due to parasitic capacitance and other causes.



MCC Rectifier: Package Type & Size

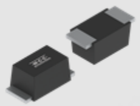
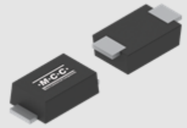
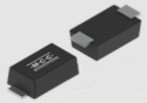
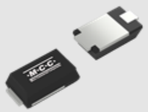
Through Hole & Axial Leaded Packages

Axial Leaded	
A-405 	R-3 
DO-41 	
DO-15 	
DO-201AD 	R-6 

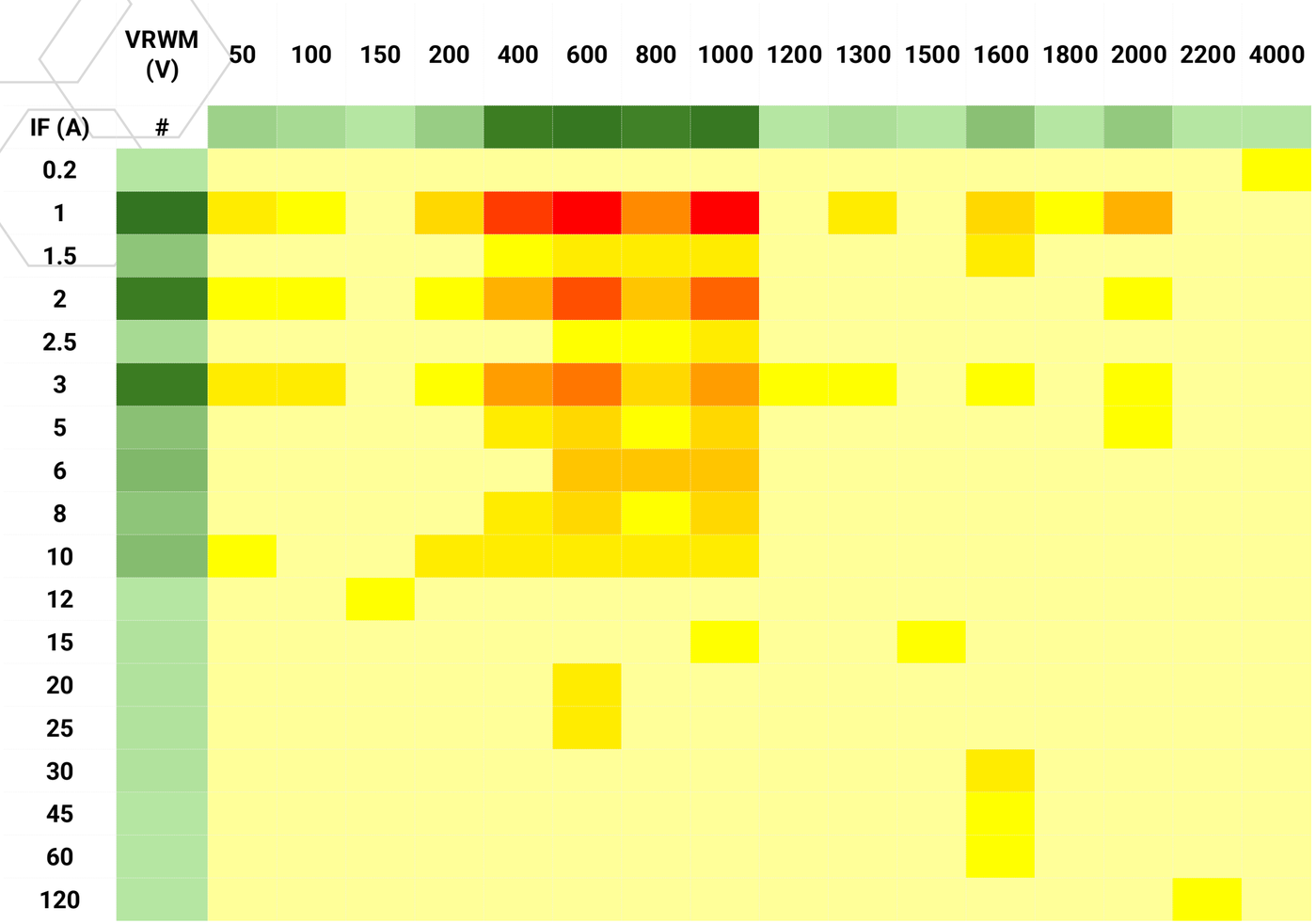
Through Hole	
TO-220AB 	TO-220AC 
ITO-220AB 	ITO-220AC 
TO-247 	TO-247AD 
TO-264P 	

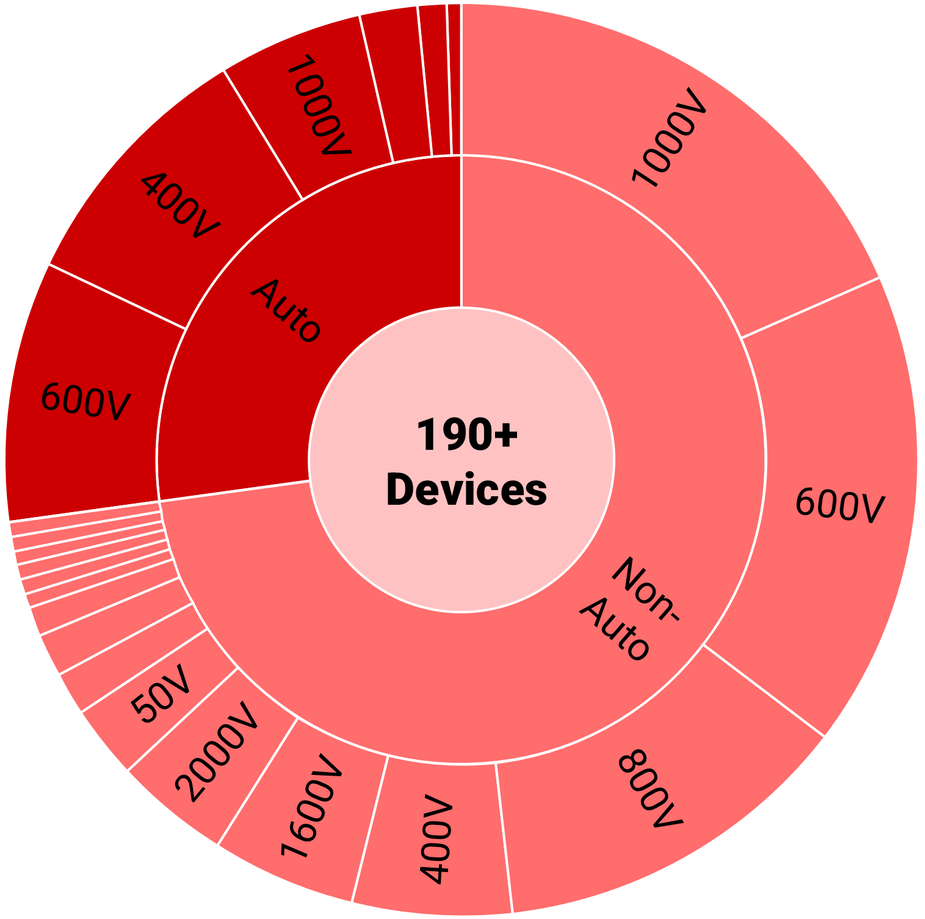
MCC Rectifier: Package Type & Size

Surface Mount Packages

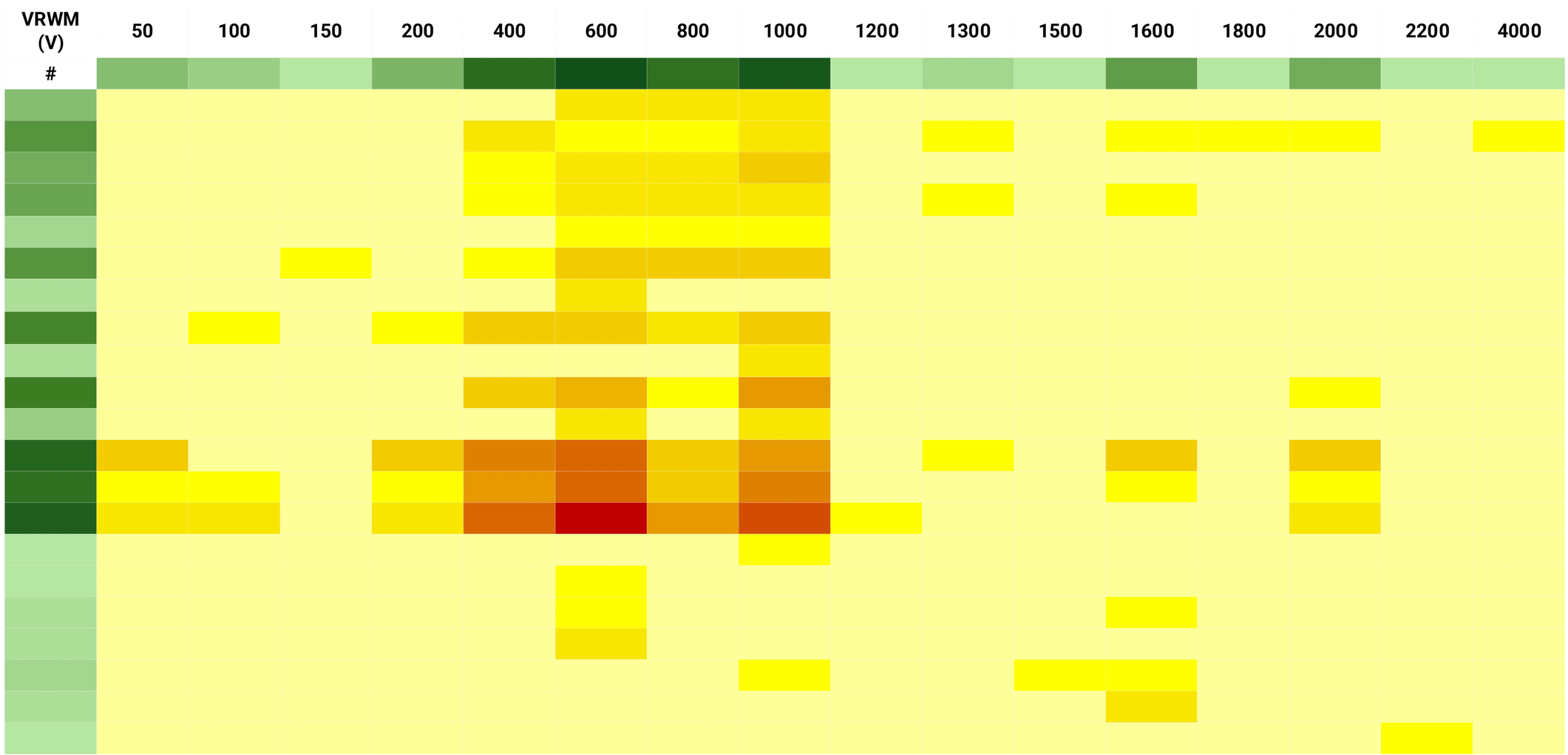
Leaded					Leadless
DPAK 	SOD-323HL 	SOD-123FL 	SMA 	DO-221AC 	DFN5060 
D2-PAK 	SOD-323HE 	SOD-123TFL 	SMB 	SMBF 	
TO-263AC 	SOD-323HE-B 	SOD-123HE1 	SMC 		
TO-277 		SOD-123HL 			

Standard Recovery Rectifier Portfolio Overview





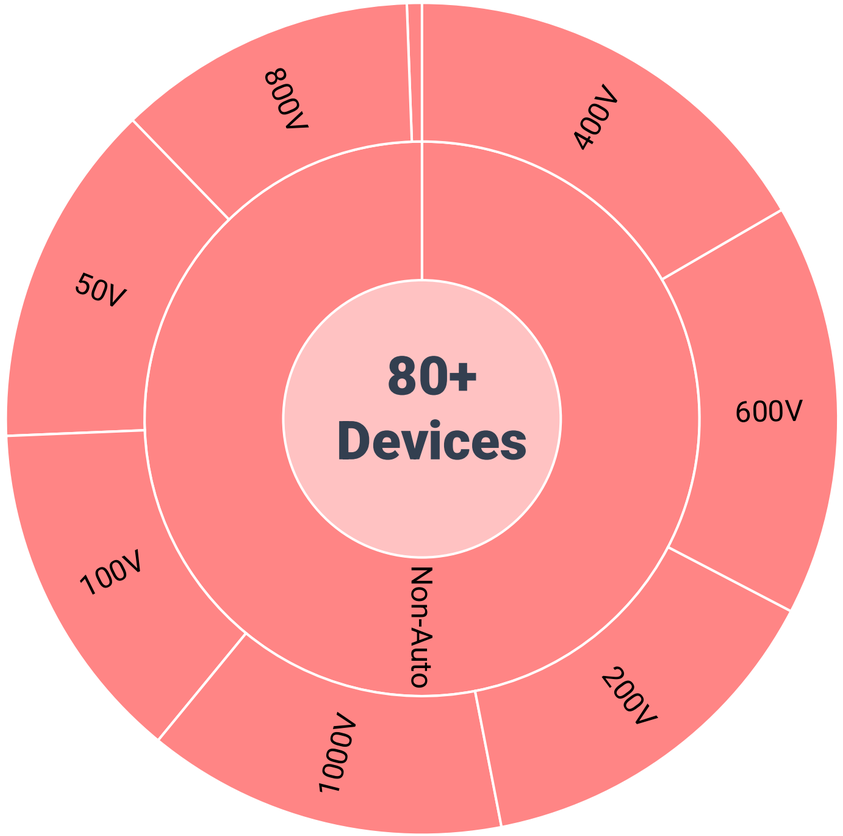
Standard Recovery Rectifier Packages Heat Map



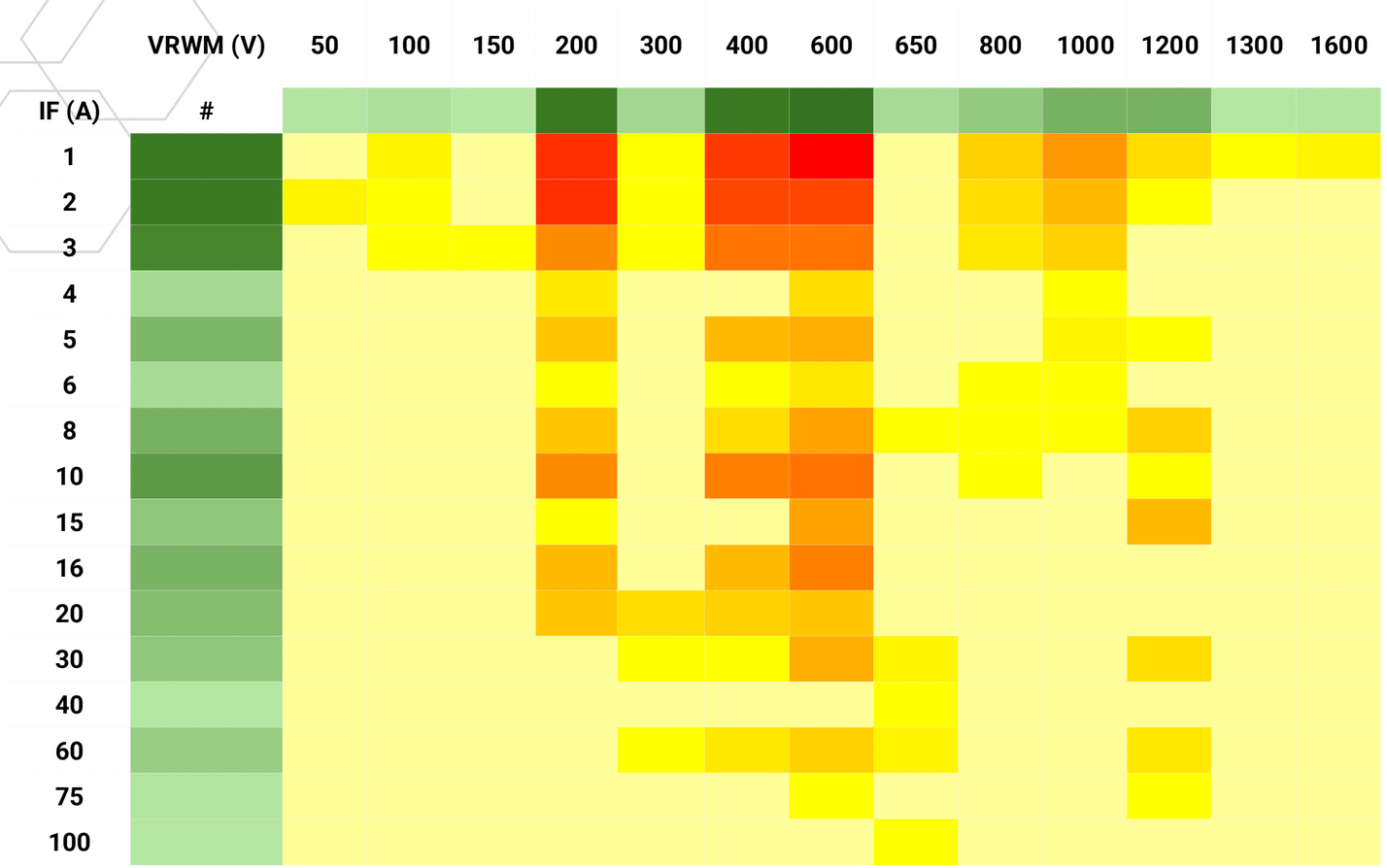
Fast Recovery Rectifier Portfolio Overview

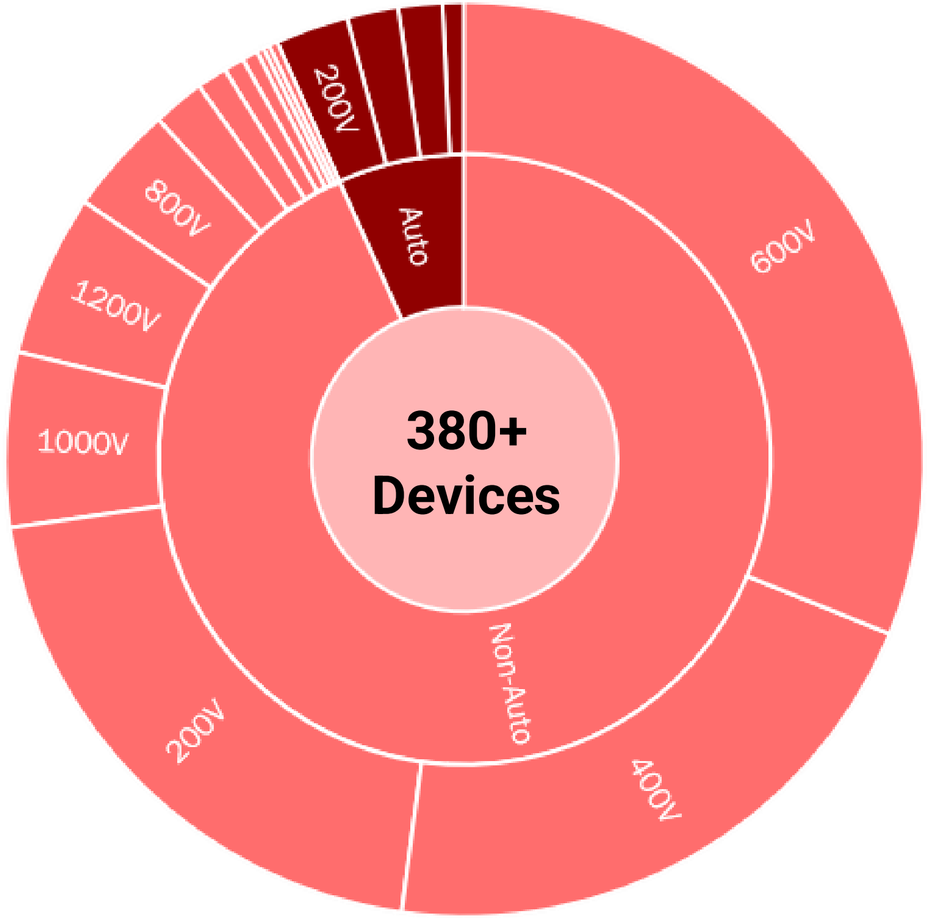
IF (A)	#	VRWM (V) 50	100	200	400	600	800	1000	2000
0.5									
1									
1.5									
2									
3									
4									
5									
6									
10									

Package	#	VRWM (V) 50	100	200	400	600	800	1000	2000
DO-41									
DO-15									
DO-201AD									
R-6									
SOD-123FL									
SOD-123HL									
DO-221AC									
SMBF									
SMA									
SMB									
SMC									

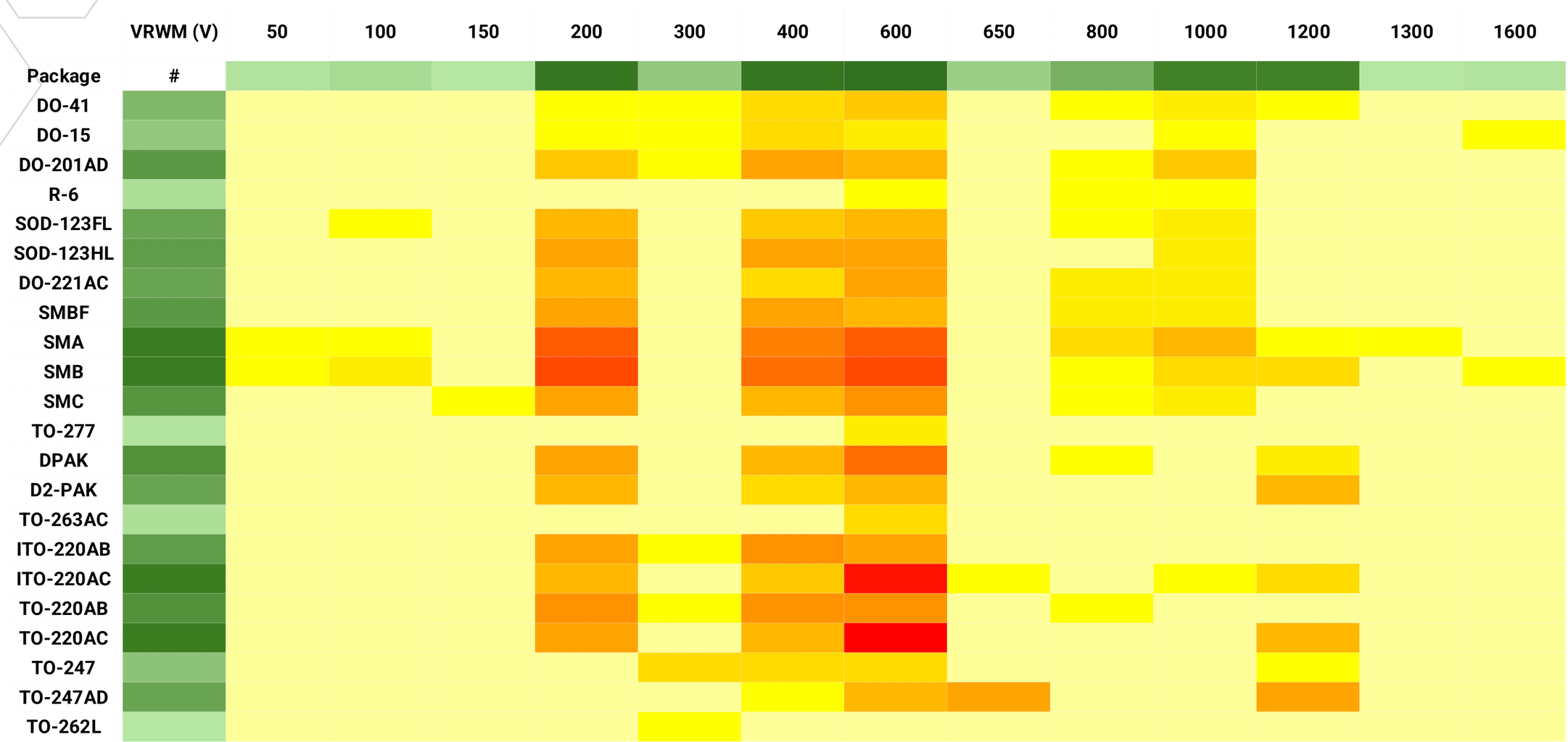


Super Fast Recovery Rectifier Portfolio Overview





Super Fast Recovery Rectifier Packages Heat Map

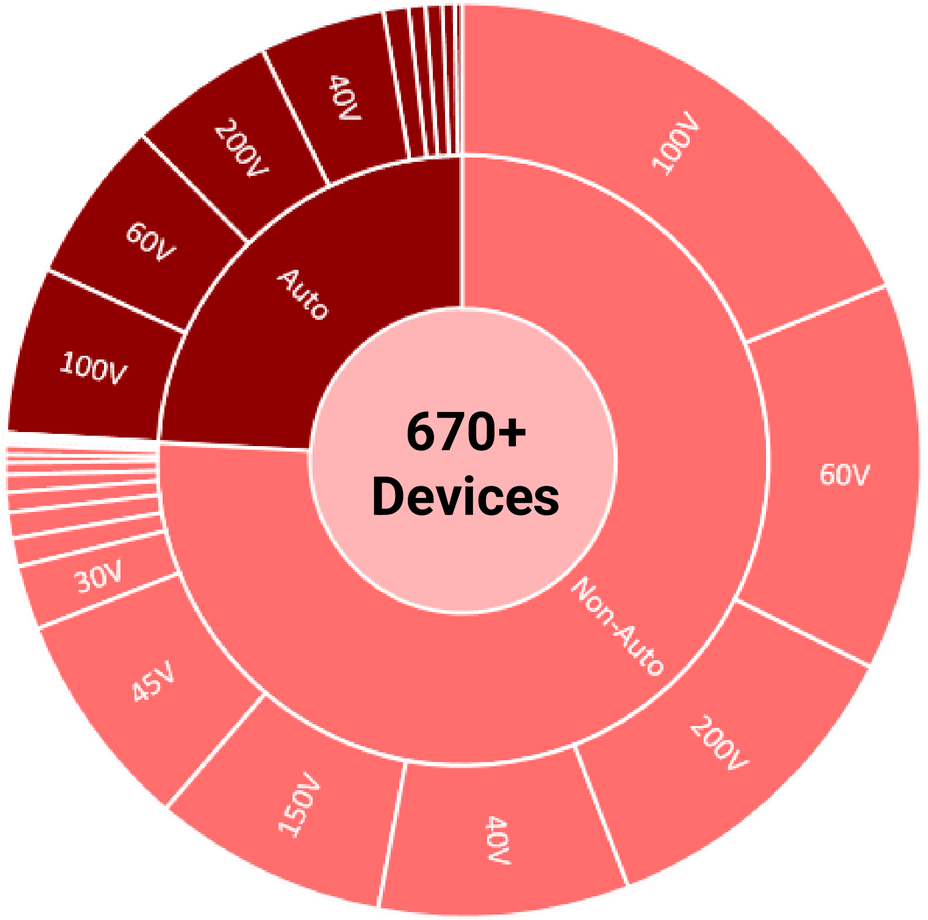


Non-Automotive Grade
Super Fast Recovery Rectifier – 600V

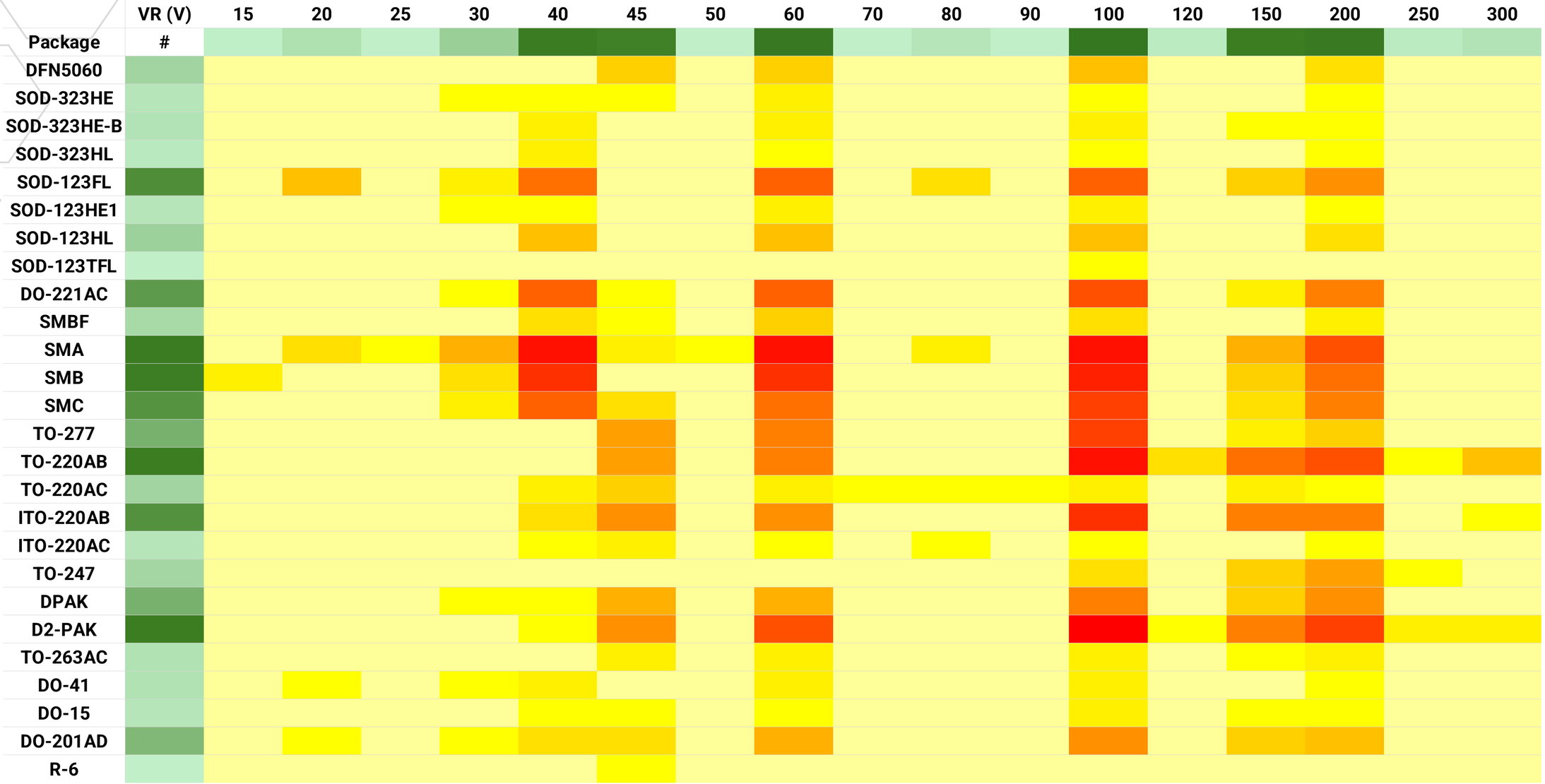
	ES2J-L	ER2J-L	ER3J	MURSD1060A	MURSB1560	MURSB3060C	MUR1560H	MURS3060A
V_{RWM} (V)	600	600	600	600	600	600	600	600
I_F(AV) (A)	2	2	3	10	15	30	15	30
V_F @I_F max (V)	1.7	1.7	1.7	1.6	1.55	1.6	1.65	1.6
I_R @V_R max. (uA)	1	5	5	5	10	5	3	5
T_{rr} (ns)	35	35	35	35	40	35	35	35
I_{FSM} (A)	50	50	100	120	180	300	180	300
T_j max. (ºC)	175	175	175	175	175	175	175	175
Package	SMA	SMB	SMC	DPAK	D2-PAK	D2-PAK	TO-220AC	TO-220AC

Schottky Barrier Rectifier Portfolio Overview

IF (A)	#	VR (V) 15	20	25	30	40	45	50	60	70	80	90	100	120	150	200	250	300
1																		
2																		
3																		
4																		
5																		
6																		
7.5																		
8																		
10																		
12																		
15																		
16																		
20																		
25																		
30																		
40																		
60																		
80																		
90																		
100																		



Schottky Barrier Rectifier Packages Heat Map



Non-Automotive Grade
Schottky Barrier Rectifier – 100V

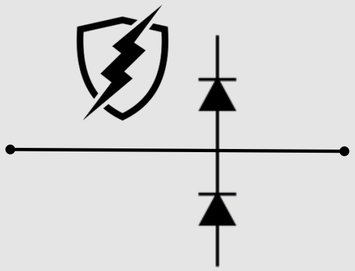
	SMD310PL	SK510A-L	SK510AFL	SK510BH-L	SK1010H-L	MBRD20100CTH	MBRB40100CTH	MBR20U100L	MBRL40100FCT	MBRL60100CT
V_{RWM} (V)	100	100	100	100	100	100	100	100	100	100
I_F(AV) (A)	3	5	5	5	10	20 (10 x2)	40 (20 x2)	20	40 (20 x2)	60 (30 x2)
V_F @I_F max (V)	0.85	0.85	0.85	0.85	0.82	0.85	0.85	0.7	0.71	0.79
I_R @V_R max. (uA)	5	10	10	5	10	10	10	100	80	200
T_{rr} (ns)	80	120	100	100	100	130	300	300	300	320
I_{FSM} (A)	150	150	150	150	150	150	150	150	150	150
T_j max. (ºC)	Single	Single	Single	Single	Single	Common Cathode	Common Cathode	Single	Common Cathode	Common Cathode
Package	SOD-123FL	SMA	DO-221AC	SMB	SMC	DPAK	D2-PAK	TO-277	ITO-220AB	TO-220AB

Automotive Grade
Schottky Barrier Rectifier – 100V

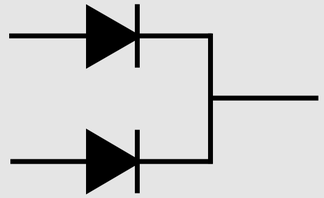
	SMD310PLQ	SK510AQ-L	SK510AFLQ	SK510BQ-L	SK810LQ	MBRD10100CTQ	MBRB30100CTQ	MBR15U100Q
V_{RWM} (V)	100	100	100	100	100	100	100	100
I_F(AV) (A)	3	5	5	5	8	10 (5 x2)	30 (15 x2)	15
V_F @I_F max (V)	0.85	0.85	0.8	0.8	0.85	0.8	0.82	0.88
I_R @V_R max. (uA)	5	5	5	5	5	10	10	10
T_{rr} (ns)	80	120	120	120	150	120	250	300
I_{FSM} (A)	175	175	175	175	175	175	175	175
T_j max. (ºC)	Single	Single	Single	Single	Single	Common Cathode	Common Cathode	Single
Package	SOD-123FL	SMA	DO-221AC	SMB	SMC	DPAK	D2-PAK	TO-277

Rectifier
Application Examples

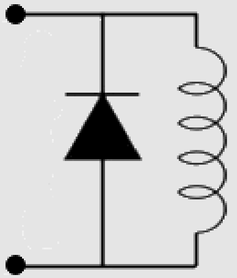
RF Equipment



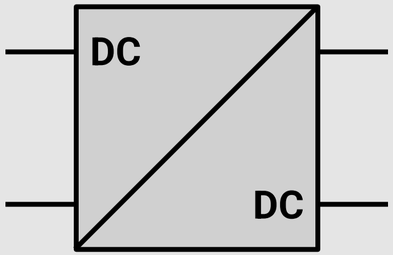
ESD Protection



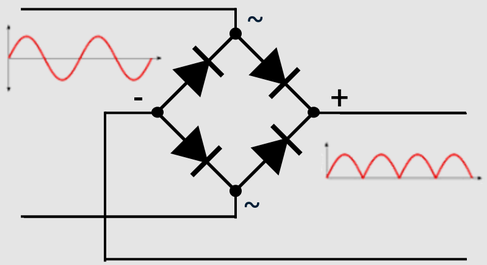
OR-ring



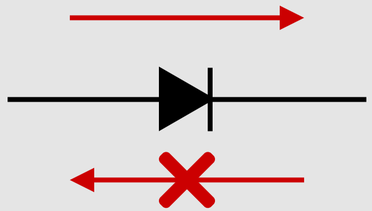
Free Wheeling Diode



DC-DC Converter



Rectification



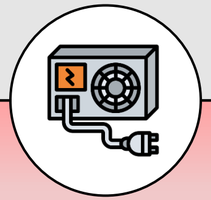
Polarity Protection

Rectifier Application

Rectifier diodes are crucial components for controlling current flow and converting AC to DC in various electronic and electrical applications

AC-to-DC Power Supplies

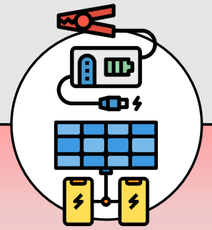
- Phone chargers
- Small appliances
- Power Adapters



Rectifiers are used to convert AC mains voltage (50Hz/60Hz) into DC voltage for powering electronic devices.

Battery Chargers

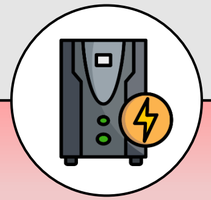
- Car battery chargers
- Solar battery chargers



Rectifiers are used in battery charging circuits to convert AC to DC for charging lead-acid, lithium-ion, or other types of batteries.

Uninterruptible Power Supplies UPS

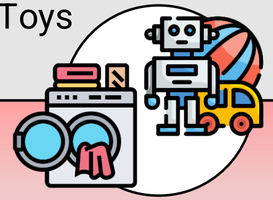
- Industrial UPS systems
- Heavy duty UPS systems



Low-frequency rectifiers are used in UPS systems to charge the backup batteries while converting AC power to DC.

DC Motor Drives

- Household appliances
- Fans
- Washing machines
- Toys



Rectifiers are used to supply DC power to drive low-frequency DC motors used in various applications.

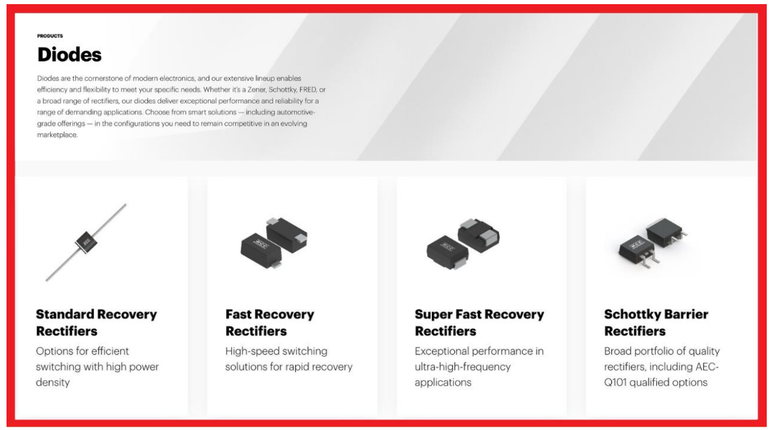
Welding Machines

- Industrial arc welding machines

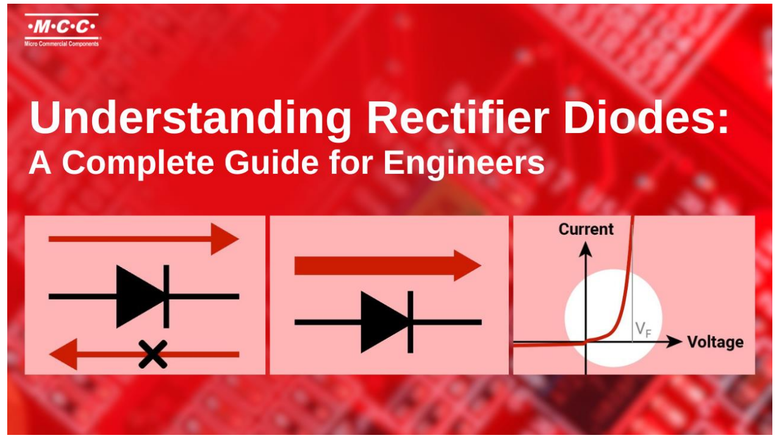
Rectifiers are used in welding machines to convert AC current into DC current required for specific welding processes.

Explore the additional Rectifier Diodes resources below, or contact us at mccsemi.com

On-Demand Educational Webinar



Online Rectifier Diodes Catalog



Rectifier Diodes Guide