Diodes: Electronic Components Cheat Sheet

A concise cheat sheet covering various types of diodes, their characteristics, and common applications in electronic circuits. This guide provides a quick reference for students, hobbyists, and professionals working with electronics.

Diode Fundamentals

Basic Diode Operation

A diode is a two-terminal semiconductor device that conducts current primarily in one direction (from anode to cathode) and blocks current in the opposite direction.

Anode (A): The positive terminal of the diode.
Cathode (K): The negative terminal of the diode; usually indicated by a band on the diode body.

Forward Bias: When the anode is at a higher potential than the cathode, the diode conducts.

Reverse Bias: When the cathode is at a higher potential than the anode, the diode blocks current (ideally).

Breakdown Voltage: The reverse voltage at which the diode starts to conduct in the reverse direction.

Key Parameters

Forward Voltage (Vf)	Voltage drop across the diode when conducting (typically 0.7V for silicon diodes).
Reverse Current (Ir)	Small current that flows in the reverse direction when the diode is reverse biased (ideally zero).
Maximum Forward Current (If)	The maximum current the diode can handle in the forward direction without being damaged.
Peak Inverse Voltage (PIV)	The maximum reverse voltage the diode can withstand without breaking down.

Types of Diodes

Signal Diodes

Small diodes used for signal processing and switching applications.

Examples: 1N4148, 1N914.

Fast switching speed and low forward current capability.

Rectifier Diodes

Used in power supplies to convert AC voltage to DC voltage.

Examples: 1N4001 - 1N4007 (different PIV ratings).

Higher forward current and lower switching speed compared to signal diodes.

Zener Diodes

Operation	Designed to operate in the reverse breakdown region, maintaining a constant voltage across them.
Applications	Voltage regulation and overvoltage protection.
Example	1N4728A (3.3V Zener), 1N4742A (12V Zener).
Note	Specified by their Zener voltage (Vz) and power dissipation.

Light Emitting Diodes (LEDs)

Function	Emit light when forward biased.
Colors	Available in various colors (red, green, blue, yellow, white).
Applications	Indication, illumination, displays.
Parameters	Forward voltage (Vf) and forward current (If) are critical parameters.

Schottky Diodes

Low forward voltage drop and fast switching speed.

Used in high-frequency applications and clamping circuits.

Example: 1N5817, 1N5819.

Diode Circuits and Applications

Half-Wave Rectifier

A simple rectifier circuit that allows only one half-cycle of the AC voltage to pass through.

Output is pulsating DC with a significant ripple.

Efficiency is relatively low.

Full-Wave Rectifier

Center-Tapped	Uses two diodes and a center-tapped transformer to rectify both halves of the AC cycle.
Bridge Rectifier	Uses four diodes in a bridge configuration to rectify both halves of the AC cycle without a center-tapped transformer. More efficient than the half-wave rectifier.
Output	Provides a smoother DC output compared to the half-wave rectifier.

Clipping Circuits

Use diodes to clip off a portion of a signal above or below a certain voltage level.

Series clippers and shunt clippers are common configurations.

Used for signal shaping and protection.

Clamping Circuits

Function	Shift the entire signal voltage by a DC level.
Components	Typically consist of a diode and a capacitor.
Usage	Used to set a specific voltage level for a signal.

Reverse Polarity Protection

A diode placed in series with the power supply to protect the circuit from reverse polarity connection.

The diode conducts only when the polarity is correct.

Advanced Diode Concepts

Diode Models

Ideal Diode Model	Acts as a perfect switch, with zero forward voltage drop and infinite reverse resistance (theoretical).
Practical Diode Model	Includes a forward voltage drop (e.g., 0.7V for silicon) and a small reverse leakage current.
Complete Diode Model	Includes junction capacitance and reverse recovery time for more accurate simulation.

Diode Specifications

Datasheets provide detailed specifications of diode characteristics, including:

- Maximum forward current
- Peak inverse voltage
- Forward voltage drop
- Reverse recovery time

Temperature Effects

Forward Voltage	Decreases with increasing temperature (approximately -2mV/°C for silicon diodes).
Reverse Current	Increases with increasing temperature.

Avalanche Diodes

Designed to operate in the reverse breakdown region, similar to Zener diodes, but using avalanche breakdown.
Used for surge protection and high-voltage applications.