Craig's Guide to Diodes

See page 839 of the 2011/12 catalogue

Customers generally ask for a specific diode, or a like-for-like replacement, so you shouldn't have to worry too much about the specifics.

If there is any doubt, or we're out of stock, then for normal signal or rectifier diodes, a device with higher specifications, i.e. higher voltage and/or current capability will suffice.

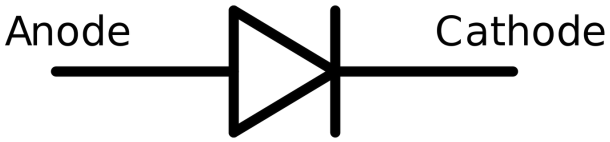
Zener diodes are used in a different manner (see appendix) and their 'zener voltage' is specific to the application, although a higher current rating will again suffice.

SALES

This is just going to be a case of checking our customer has everything they need as they are likely to be performing a repair.
For example; soldering iron & solder, heatshrink, 'Helping Hands With Magnifier' [N30CH] on W037

WHAT?

Diodes in general operate like the electrical equivalent of a one-way valve, in that they only allow electricity to flow in one direction. They conduct when forward-biased, that is the anode (+ve) is more positive than the cathode (-ve and marked by the band on the diode); and for silicon diodes this difference needs to be around 0.6V before conduction begins.



NOTE: for LEDs (Light Emitting Diodes) this voltage drop can be as high as 4.0V for blue/violet devices, and it is this that we call the *forward voltage* denoted V_f.

Diodes have a maximum reverse voltage, up until which no current will flow. Once this reverse voltage has been breached, the diode will conduct but it will likely be irreparably damaged. There are however special diodes known as **zener** and **avalanche** diodes, which are specifically designed for this purpose and don't become FUBAR in this case!

WHY?

They are used to convert AC into DC (alternating current to direct current) through a process called rectification, using an arrangement of four diodes. As the input voltage alternates between positive and negative on both input terminals, the current flows in one direction to one output terminal and the opposite direction to the other output terminal. This provides an unsmoothed DC output where one output terminal is positive, and the other negative.

They can be used to demodulate radio signals and extract the audio signal.

They can be used to prevent devices being damaged if they are wired up the wrong way.

APPENDIX

Most modern silicon diodes are constructed from a French-sandwich (that's an open one, y'know, without a lid; stuff on bread) of two types of silicon, each 'doped' with a different impurity, giving the material an excess of electrons in the n-type, and missing electrons or 'holes*' in the p-type. The boundary where these types of silicon meet is known as a **P-N junction**, and here an intermingling of holes and electrons occurs: some electrons flow to the p-type silicon, and some holes flow to the n-type silicon. This diffusion of holes and electrons happens over a tiny distance of less than a micron (less than 1.0×10^{-6} m).

***Holes — how can they "flow"?!**
Imagine the front row of a theatre, with an empty seat (a hole if you will) on the far right-hand side of the row as we look at it. The person next to this empty seat then moves across to the right, and the empty seat now appears to the left of the person. The old lady to the left of the now empty seat performs the same manoeuvre, and again the empty seat jumps a space to the left. Now it's between the old lady and her husband, so he moves across, then his brother does the same, followed by his brother's wife and their five kids, and their friends. As this occurs, the empty seat, our 'hole' is zipping across to the left. It's an empty space composed primarily of nothingness, yet it moves..!

So, this thin band of socialising holes and electrons, a kind of "charge equilibrium", is known as the **depletion region**, and it forms a potential barrier. That is, a barrier of potential, or voltage.
In essence, we need 'some voltage' to coax the holes and the electrons back where they should be in order for charge to be able to flow (which is current). If we put the voltage the wrong way round, then more holes flow into the n-type material and more electrons flow into the p-type material. This means that the depletion region grows and makes a big fat barrier of intermingling holes and electrons that prevent any charge from flowing, i.e. no current.

The typical value of the 'some voltage' is around 0.6v for a silicon diode, and causes a voltage drop of that value across the device.

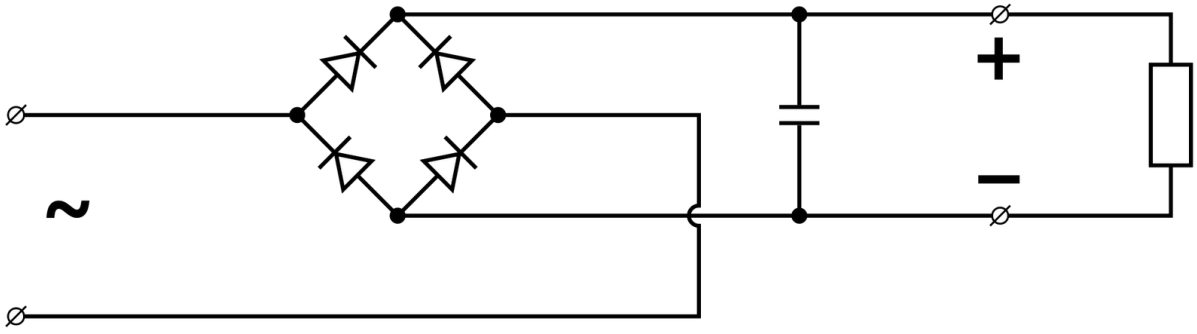
Different types of diode are used for various purposes and here are some of the more common varieties:

Signal diodes are small diodes for use with small voltages and currents associated with signals.

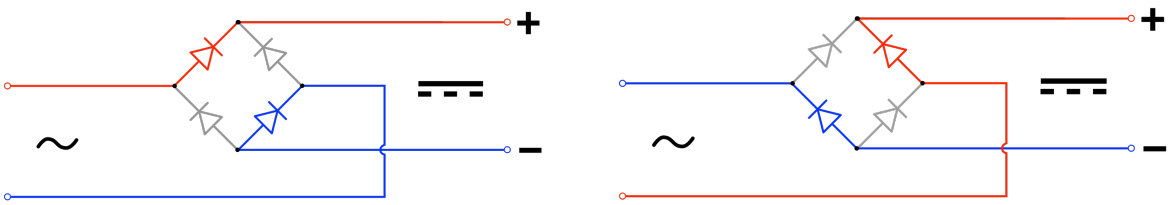
Switching diodes are similar to the above but are for use with high frequencies as they have a fast recovery time from conducting to non-conducting.

Schottky diodes have a very small voltage drop and no recovery time due to their construction.

Rectifier diodes handle much higher voltages and current, and are used in power supplies for the purpose of rectification, in an arrangement known as a bridge rectifier. More often this is a single package with four legs containing the four diodes, marked with the symbols "~ ~ + -", two for the AC input and two for the DC output, respectively.



You can see in the following diagrams (if it's in colour!) that as the AC input alternates, the currents follow different paths so that the positive components always follow a path to the positive output, and likewise with the negative components:



Zener diodes are in a sense used back-to-front or reverse-biased, which from what you've read already would suggest that no current will flow (near as damn it). However, at a specified voltage known as the zener voltage, the diode will conduct. In a normal diode this voltage is called the breakdown voltage and the diode will be destroyed.

Bibliography

Amdahl, K. (1991). *There Are No Electrons: Electronics For Earthlings.* Clearwater Publishing (Oct 1991).

Plant, M. (2010). *Understand Electronics.* UK: Hodder Education.

Robertson, C. R. (1993). *Electrical & Electronic Principles 1.* UK.

Wilson, F. A. (1989). *From Atoms to Amperes.* UK.