Handling Recommendations

Rectifiers are hermetically sealed against external influences, and any leak in the case could cause a reduction of their life. Protection against hard shocks is, therefore, essential. Moreover, gripping the case with pliers, application of clamping pressure to any part, and the imposition of any unnecessary strain on the connecting leads should be avoided. Also, the connecting leads should not be bent close to the case.

The low thermal capacity of silicon rectifiers makes it essential that the devices are short-circuit protected by means of quick-blow fuses.

In circuits employing several parallel-connected rectifiers there is a distinct danger that, because of the spread in forward characteristics, at least one device may be overloaded. Therefore a series resistor should be connected in series with each rectifier to ensure that the total power is evenly distributed.

Silicon rectifiers have one characteristic in common with gas-filled rectifiers - they require a certain time to switch from the forward conducting to the reverse blocking state. This so-called reverse recovery time, during which charge carriers are removed from the depletion layer, is of the order of several microseconds and varies from device to device. If several rectifiers are connected in series without any precautions being taken, then the rectifiers with the shortest reverse recovery time blocks first and thereby delays the removal of charge carriers in all the other devices, with the result that this rectifier is liable to be damaged. This disadvantage can be overcome by shunting each rectifier in the stack with a network consisting of a resistor connected in series with a capacitor. The time constant of this RC network should be at least 50 µsec, but should be considerably shorter than the duration of one half-cycle of the applied AC voltage (e.g. for f_{in} = 50 Hz; R = 1 kΩ, C = 50 nF). Use of these networks ensures that the total reverse voltage is evenly distributed over all the rectifier units in the stack.

Design Information for Rectifier Circuits

The following tables contain design information for most of the commonly employed rectifier circuits. The information is listed according to load conditions, i.e. for resistive, inductive and back EMF loads (back EMF loads include a source of back EMF, such as a capacitor, a battery, or a DC motor). The figures for resistive and inductive loads are, as a rule, identical; if they differ, then the inductive load figures are given in brackets.

The tables are arranged so that once the DC voltage, DC current and DC power requirements are known, all the more important design parameters can be quickly determined. It should be noted that a maximum overvoltage factor of 10% (permissible in industrial supplies) was taken into consideration when the tabulated figures were calculated.

No rectifier currents are given for circuits intended for back EMF load applications, because under these conditions the rectifier current depends largely on the magnitude of the back EMF. It is recommended that in this case the rectifiers be rated only for up to 70% of the current admissible with resistive loads.

If the circuit incorporates a "high-inductance" smoothing choke, then the figure in brackets should be used. High-inductance means in this contest that

$$L > 0.2 \frac{V_{BR}}{I_{DC} \cdot f_{BR}}$$

where L is the chocke inductance in henry, V_{BR} the RMS value of the superimposed ripple voltage in volts, I_{DC} the direct current in amperes, and f_{BR} the ripple frequency in Hertz. The voltage dropped across the smoothing chocke must be taken into consideration in the calculation.

The necessary capacitance of the reservoir capacitor can be calculated by use of the following approximate formula:

For half-wave and voltage multiplier circuits:

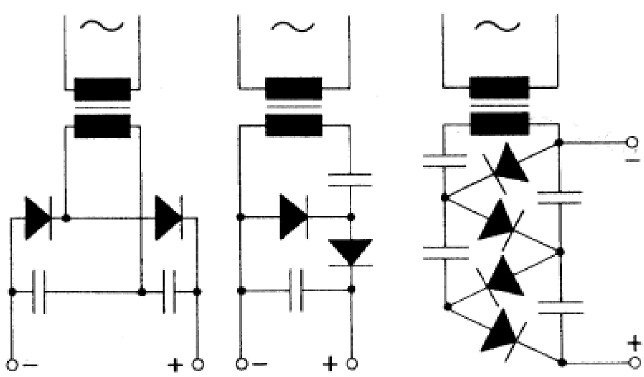
$$C = 250 \cdot \frac{I_{DC}}{V_{BR} \cdot f_{BR}}$$

For single-phase, full-wave circuits:

$$C = 200 \cdot \frac{I_{DC}}{V_{BR} \cdot f_{BR}}$$

where C is the capacitance of the reservoir capacitor in micro-farad, I_{DC} the DC current in milliamperes, V_{BR} the RMS value of the superimposed ripple voltage in volts and f_{BR} the ripple frequency in Hertz.

DC output voltages substantially higher than the applied RMS AC voltage can be obtained by the use of voltage doubler or voltage multiplier circuits, a circuit incorporating n rectifiers and n reservoir capacitors producing an open circuit output voltage of approximately n times the peak value of the applied AC voltage. In this case each rectifier should be rated for the same reverse voltage as that applicable to a half-wave rectifier circuit with back EMF load.



Series-connected voltage doubler | Shunt-connected voltage doubler | Voltage multiplier