Silicon Rectifiers

The definitions of terms given below are, in the main, those used in the DIN Standards listed on page 23.

Electrical Date

The electrical data, especially the nominal values, apply, unless stated otherwise, to as half-wave rectifier circuit, a sinusoidal 50 Hz AC supply, a resistive load, and operation at altitudes not greater than 1000 m above sea level. In the following paragraphs the definitions of some of the more important electrical data (grouped according to bias conditions) are given.

Forward direction of current flow through a rectifier is that direction at which the rectifier exhibits its lower resistance.

Forward voltage V_F is the voltage drop across a rectifier due to a current in the forward direction (the "forward current"). The forward characteristic gives the relationship between instantaneous forward current and forward voltage.

Nominal current is the arithmetic mean value I_{FAV} of the rectified forward current recommended by the manufacturers; it applies to a half-wave rectifier circuit with resistive load.

Maximum admissible mean forward current is the arithmetic mean value of the maximum admissible continues forward current in a half-wave rectifier circuit with resistive load. It is usually quoted in conjunction with specified cooling conditions or a specified case temperature. Devices operating under maximum mean forward current conditions have no overload safety margin.

Repetitive peak forward current I_{FRM} is the peak value of any repetitive current (this could be non-sinusoidal, as may be the case with capacitive loads).

Overload mean forward current $I_{F(OV)}$ is any current whose mean value over one cycle exceeds the nominal current value. Devices should only be loaded up to the overcurrent limit if they are operated intermittently. The maximum admissible overload current depends on the duty factor (ED/SD) and the period time (SD). Period time = on time + off time.

The maximum current is that overload current which, if permitted to persist, would cause the destruction of the device. It can be derived from a maximum current curve in which the maximum current is plotted as a function of overload duration with the operational state of the device prior to the overload period as parameter. The maximum current curve is used to arrive at the correct fuse rating.

Rated overload factor is the ratio of maximum current to nominal current. If the maximum current is quoted following to nominal current, then it may be admissible to multiply the maximum current with the basic load factor, provided that the forward current prior to the overload condition was less than the nominal current. The basic load factor is given as a function of the ratio of basic load current to nominal current.

The surge (non-repetitive) forward current I_{FSM} is the maximum admissible instantaneous amplitude of a single current pulse of defined shape and duration produced under defined operational conditions. The time interval between any two such current pulses should be not less than 1 min.

Reverse direction of current flow through a rectifier is that direction at which the device exhibits its higher resistance.

Nominal operating voltage is the RMS value of the operational alternating voltage recommended by the manufacturers.

Maximum admissible repetitive peak reverse voltage V_{RRM} is the maximum admissible instantaneous value of any repetitive reverse voltage peaks.

Maximum admissible surge (non-repetitive) peak reverse voltage V_{RSM} is the maximum peak value of any non-repetitive reverse voltage. This must not be exceeded - however short in duration.

Thermal Characteristics

The heat generated in a silicon rectifier during operation must be removed, otherwise the maximum admissible junction temperature would be exceeded. This heat is almost entirely due to the forward losses, and the reverse losses can be ignored under normal working conditions. Since, for reasons of economy, rectifiers are designed to operate at high current density, and possess only a low thermal capacity, it is essential that special attention is paid to cooling problems if the destruction of the rectifiers by thermal overloads is to be avoided. In small rectifiers it is adequate that the heat is radiated from the surface of the case and conducted away via the connecting leads, but power rectifiers require additional cooling aids; they are, therefore, bolted to cooling fins or heat sinks which reduce the termal resistance between the junction and the surrounding air. In the following paragraphs the most important terms used in the thermal data are explained.

Operating temperature range T_{amb} is that range between two limits of the cooling agent temperature where the rectifier may be operated with its maximum admissible repetitive peak reverse voltage. The current load has to be determined from the graphs. Because of the lower air density and consequent reduction in cooling, the current load must be reduced at altitudes of more than 1000 m above sea level.

The storage temperature range T_S is the range of temperatures at which the device may be stored without being subjected to any electrical stresses.

The junction temperature T_j is the (spatial) average temperature of the depletion layer. Temperatures up to the maximum admissible junction temperature will not cause any irreversible changes in the performance of the device.

The case temperature T_C is the temperature on the surface of the case.