Basic Definitions

Basic Sinterglass Diode Parameters

The major parameters for the selection of the appropriate sinterglass diodes are the maximum reverse voltage (V_{RRM}), the average forward current (I_{FAV}) and for switching application the reverse recovery characteristic (t_{rr}), too. Additional parameters may be for example the reverse avalanche energy capability (E_R) and forward surge capability (I_{FSM}) etc.

V_R	Reverse voltage
V_{RRM}	Repetitive peak reverse voltage, including all repeated reverse transient voltages
$V_{(BR)R}$	Reverse breakdown voltage
I_R	Reverse (leakage) current, at a specified reverse voltage V_R and temperature T_J
I_F	Forward current
V_F	Forward voltage drop, at a specified forward current I_F and temperature T_J
I_{FAV}	Average forward output current, at a specified current waveform (normally 10ms/50Hz half-sine-wave, sometimes 8.3ms/60Hz half-sine-wave), a specified reverse voltage and a specified mounting condition (e.g. lead-length = 10mm or PCB mounted with certain pads and distance)
I_{FSM}	Peak forward surge current, with a specified current waveform (normally 10ms/50Hz half-sine-wave, sometimes 8.3ms/60Hz half-sine-wave),
t_{rr}	Reverse recovery time, at a specified forward current (normally 0.5A), a specified reverse current (normally 1.0A) and specified measurement conditions (normally from 0 to 0.25A)
E_R	Reverse avalanche energy, non-repetitive

Polarity Conventions

The voltage direction is given

- by an arrow which points from the measuring point to the reference point
  or
- by a two letter subscript, where the first letter is the measuring point and the second letter is the reference point.

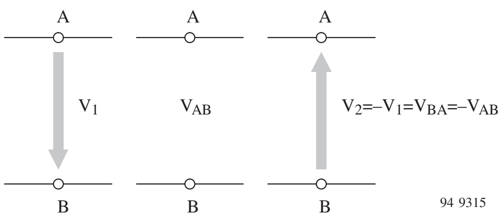

Figure 1.

The numerical value of the voltage is positive if the potential at the arrow tail is higher than at the arrow head; i.e., the potential difference from the measuring point (A) to the reference point (B) is positive.

The numerical value of the voltage is negative if the potential at the arrow head is higher than the tail; i.e., the potential difference from the measuring point to the reference point is negative.

In the case of alternating voltages, once the voltage direction is selected it is maintained throughout. The alternating character of the quantity is given with the time dependent change in sign of its numerical values.

Figure 2.

The numerical value of the current is positive if the charge of the carriers moving in the direction of the arrow is positive (conventional current direction), or if the charge of the carriers moving against this direction is negative. The numerical value of the current is negative if the charge of the carriers moving in the direction of the arrow is negative, or if the charge of the carriers moving against this direction is positive.

The general rules stated above are also valid for alternating quantities. Once the direction is selected, it is maintained throughout. The alternating character of the quantity is given with the time-dependent change in sign of its numerical values.

Polarity conventions for diodes

Here, the direction of arrows is selected in such a way that the numerical values of currents and voltages are positive both for forward (F or f) and reverse (R or r) directions.

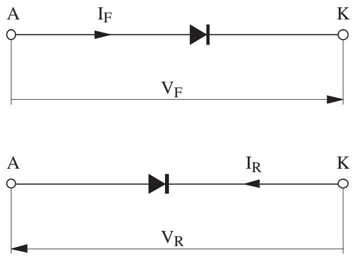

Figure 3.

Arrangement of Symbols

Letter symbols for current, voltage and power

(according to DIN 41 785, sheet 1)

To represent current, voltage and power, a system of basic letter symbols is used. Capital letters are used for the representation of peak, mean, DC or root-mean-square values. Lower case letters are used for the representation of instantaneous values which vary with time.

Capital letters are used as subscripts to represent continuous or total values, while lower case letters are used to represent varying values.

The following table summarizes the rules given above .

Basic letter	
Upper-case	Upper-case
Instantaneous values which vary with time	Maximum (peak) average (mean) continuous (DC) or root-mean-square (RMS) values

Subscript(s)	
Upper-case	Upper-case
Varying component alone, i.e., instantaneous, root-mean-square, maximum or average values	Continuous (without signal) or total (instantaneous, average or maximum) values

Letter symbols for impedance, admittances, two-port parameters etc.

For impedance, admittance, two-port parameters, etc. capital letters are used for the representation of external circuits of which the device is only a part. Lower case letters are used for the representation of electrical parameters inherent in the device.

CAPITAL letters are used as subscripts for the designation of static (DC) values, while lower case letters are used for the designation of small-signal values.

If more than one subscript is used (h_{FE}, h_{fe}), the letter symbols are either all capital or all lower case.

If the subscript has numeric (single, double, etc.) as well as letter symbol(s) (such as h_{21E} or $h_{21e'}$), the differentiation between static and small-signal value is made only by a subscript letter symbol.

Other quantities (values) which deviate from the above rules are given in the list of letter symbols.

The following table summarizes the rules given above .

Basic letter	
Upper-case	Upper-case
Electrical parameters inherent in the semiconductor devices except inductances and capacitances	Electrical parameters of external circuits and of circuits in which the semiconductor device forms only a part; all inductances and capacitances

Subscript(s)	
Upper-case	Upper-case
Small-signal values	Static (dc) values

Examples:

G_P Power gain
Z_S Source impedance
f_T Transition frequency
I_F Forward current

Example for the use of symbols

according to 41785 and IEC 148

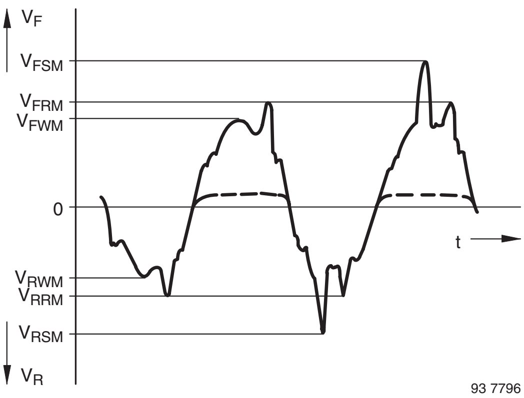

Figure 4.

V_F Forward voltage
V_R Reverse voltage
V_{FSM} Surge forward voltage (non-repetitive)

V_{RSM} Surge reverse voltage (non-repetitive)
V_{FRM} Repetitive peak forward voltage
V_{RRM} Repetitive peak reverse voltage
V_{FWM} Crest working forward voltage
V_{RWM} Crest working reverse voltage

List of Symbols

A Anode
a Distance (in mm)
b_{pn} Normalized power factor
C Capacitance, general
C_{case} Case capacitance
C_D Diode capacitance
C_j Junction capacitance
C_L Load capacitance
C_P Parallel capacitance
E_R Reverse avalanche energy, non-repetitive
F Noise figure
f Frequency
f_g Cut-off-frequency
g Conductance
K Kelvin, absolute temperature
I_F Forward current
i_F Forward current, instantaneous total value
I_{FAV} Average forward current, rectified current
I_{FRM} Repetitive peak forward current
I_{FSM} Surge forward current, non-repetitive
I_{FWM} Crest working forward current
I_R Reverse current
I_{RM} Maximum reverse current
i_R Reverse current, instantaneous total value
I_{RAV} Average reverse current
I_{RRM} Repetitive peak reverse current
I_{RSM} Non-repetitive peak reverse current
I_{RWM} Crest working reverse current
I_S Supply current
I_Z Z-operating current
I_{ZM} Z-maximum current
l Length (in mm), (case-holder/soldering point)
LOCEP (local epitaxy)
A registrated trade mark of TEMIC for a process of epitaxial deposition on silicon. Applications occur in planer Z-diodes. It has an advantage compared to the normal process, with improved reverse current.
P Power
P_R Reverse Power
P_{tot} Total power dissipation
P_V Power dissipation, general
Pvp Pulse-power dissipation
Q Quality
Q_{rr} Reverse recovery charge
R_F Forward resistance
r_f Differential forward resistance
R_L Load resistor
r_P Parallel resistance, damping resistance
R_R Reverse resistance
r_r Differential reverse resistance
r_s Series resistance
R_{thJA} Thermal resistance between junction and ambient
R_{thJC} Thermal resistance between junction and case
R_{thJL} Thermal resistance junction lead
r_z Differential Z-resistance in breakdown region (range) $r_z = r_{zj} + r_{zth}$
r_{zj} Z-resistance at constant junction temperature, inherent Z-resistance
r_{zth} Thermal part of the Z-resistance
T Temperature, measured in centigrade
T Absolute temperature, Kelvin temperature
T Period duration
T_{amb} Ambient temperature (range)
t_{av} Integration time
T_{case} Case temperature
t_{fr} Forward recovery time
T_j Junction temperature
T_K Temperature coefficient
T_L Connecting lead temperature in the holder (soldering point) at the distance/(mm) from case
t_P Pulse duration (time)
$\frac{t_p}{T}$ Duty cycle
t_r Rise time
t_{rr} Reverse recovery time
t_s Storage time
T_{sd} Soldering temperature
T_{stg} Storage temperature (range)
$V_{(BR)}$ Breakdown voltage
VF Forward voltage
V_F Forward voltage, instantaneous total value
V_{FAV} Average forward voltage
V_o Rectified voltage
V_{FP} Turn on transient peak voltage

V_{FSM}	Surge forward voltage, non-repetitive
V_{FRM}	Repetitive peak forward voltage
V_{FWM}	Crest working forward voltage
V_{HF}	RF voltage, RMS value
V_{HF}	RF voltage, peak value
V_R	Reverse voltage
V_R	Reverse voltage, instantaneous total value
V_{RSM}	Surge reverse voltage, non-repetitive
V_{RRM}	Repetitive peak reverse voltage
V_{RWM}	Crest working reverse voltage
V_S	Supply voltage
V_T	Temperature voltage
V_Z	Z-operating voltage
Z_{thp}	Thermal resistance - pulse operation
φ	Angle of current flow
η_r	Rectification efficiency
T_o	Time constant
ΔC_D	Capacitance deviation

Data Sheet Construction

Data sheet information is generally presented in the following sequence:

- Device description
- Absolute maximum ratings
- Thermal data - thermal resistances
- Characteristics, switching characteristics
- Electrical characteristics
- Dimensions (mechanical data)

Additional information on device performance is provided where necessary.

Device Description

The following information is provided: part number, semiconductor materials used, sequence of zones, technology used, device type and, if necessary construction.

Also, information on the typical Applications and special Features is given

Absolute Maximum Ratings

The absolute maximum ratings indicate the maximum permissible operational and environmental conditions. Exceeding any one of these conditions could result in the destruction of the device. Unless otherwise specified, an ambient temperature of 25°C ± 3°C is assumed for all absolute maximum ratings. Most absolute ratings are static characteristics; if they are measured by a pulse method, the associated measurement conditions are stated.

Maximum ratings are absolute

(i.e., not interdependent).

Any equipment incorporating semiconductor devices must be designed so that even under the most unfavorable operating conditions the specified maximum ratings of the devices used are never exceeded. These ratings could be exceeded because of changes in:

- Supply voltage
- The properties of other components used in the equipment
- Control settings
- Load conditions
- Drive level
- Environmental conditions
- The properties of the devices themselves (aging)

Thermal Data - Thermal Resistances

Some thermal data (e.g., junction temperature, storage temperature range, total power dissipation), impose a limit on the application range of the device, and are given under the heading "Absolute Maximum Ratings".

A special section is provided for thermal resistances.

Temperature coefficients, on the other hand, are listed together with the associated parameters under „Characteristics, Switching Characteristics“.

Characteristics, Switching Characteristics

Under this heading, the most important operational electrical characteristics (minimum, typical and maximum values) are grouped together with associated test conditions supplemented with graphs.

Dimensions (Mechanical Data)

Important dimensions and the sequence of connections supplemented by a circuit diagram are included in the mechanical data. Case outline drawings carry DIN, JEDEC or commercial designations. Information on weight complete is also included.

Note:

If the dimension information does not include any tolerances, then lead length and mounting hole dimensions are minimum values. All other dimensions are maximum.

Additional Information

Not for new developments: This heading indicates that the device concerned should not be used in equipment under development. It is, however, available for devices presently in production.