Thyristors • Triacs

Symbology

1. Power semiconductor devices, general use

Symbol	Parameter	Definition/description
R_{th}	Thermal resistance	Defined when junction power dissipation results in a balanced state of thermal flow. Specifies the degree of temperature rise per unit of power, measuring junction temperature from a specified external point.
$R_{th(j-a)}$	Junction-to-ambient thermal resistance	The thermal resistance between the junction and ambient atmosphere.
$R_{th(j-c)}$	Junction-to-case thermal resistance	The thermal resistance between the junction and surface of the case.
$R_{th(j-f)}$	Junction-to-fin thermal resistance	The thermal resistance between the junction and the fin.
$R_{th(c-f)}$	Contact thermal resistance (Case-to-fin thermal resistance)	The thermal resistance between the surface of the case and the fin.
Z_{th}	Transient thermal impedance	Defined when case temperature (stud temperature) is constant, and power dissipation at the junction is pulsating. Specifies the degree of temperature rise per unit of power, measuring junction temperature from a specified external point.
$Z_{th(j-a)}$	Junction-to-ambient transient thermal impedance	The transient thermal impedance between the junction and ambient atmosphere.
$Z_{th(j-c)}$	Junction-to-case transient thermal impedance	The transient thermal impedance between the junction and surface of the case.
$Z_{th(j-f)}$	Junction-to-fin transient thermal impedance	The transient thermal impedance between the junction and the fin.
T_a	Ambient temperature	When used in the natural cooling or forced-air cooling, it is the temperature of the surrounding atmosphere of a device that is dependent on geographical location and season, and is not influenced by heat dissipation of the device.
T_f	Fin temperature	The temperature at a specified point of the device heatsink.
T_c	Case temperature	The temperature at a specified point of the device case.
T_j	Junction temperature rating	The device junction temperature rating. Indicates the maximum and minimum allowable operation temperatures.
T_{stg}	Storage temperature rating	The device storage temperature (with no electrical connection). Indicates the maximum and minimum allowable temperatures.

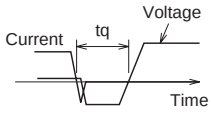
2. Thyristors

Symbol	Parameter	Definition/description
V_{RRM}	Repetitive peak reverse voltage	Within the rated junction temperature range, and when there is no signal between the gate and cathode, specifies the repetitive peak reverse voltage applicable on each cycle. For low power devices, tested with a specified resistance between the gate and cathode.
V_{RSM}	Non-repetitive peak reverse voltage	Within the rated junction temperature range, and when there is no signal between the gate and cathode, specifies the non-repetitive peak reverse voltage applicable for time width equivalent to less than a half of a sine wave at commercial frequency. For low power devices, tested with a specified resistance between the gate and cathode.
$V_{R(DC)}$	DC reverse voltage	Within the rated junction temperature range, and when there is no signal between the gate and cathode, specifies the maximum value for DC voltage applicable in reverse direction.
V_{DRM}	Repetitive peak off-state voltage	Within the rated junction temperature range, and when there is no signal between the gate and cathode, specifies the repetitive peak off-state voltage applicable for each cycle. Includes the maximum instantaneous value for repetitive transient off-state voltage.
V_{DSM}	Non-repetitive peak off-state voltage	Within the rated junction temperature range, and when there is no signal between the gate and cathode, specifies the non-repetitive peak off-state voltage applicable for time width equivalent to less than a half of a sine wave at commercial frequency. Indicates the maximum instantaneous value for non-repetitive transient off-state voltage. For low power devices, tested with a specified resistance between the gate and cathode.
$V_{D(DC)}$	DC off-state voltage	Within the rated junction temperature range, and when there is no signal between the gate and cathode, specifies the maximum value for DC voltage applicable in forward direction. For low power devices, tested with a specified resistance between the gate and cathode.
dv/dt	Critical rate-of-rise of off-state voltage	At maximum rated junction temperature, and when there is no signal between the gate and cathode, specifies the maximum rate-of-rise of off-state voltage that will not cause the device change from an off-state to an on-state when an exponential function waveform off-state voltage of specified amplitude is applied to the device, $\frac{dv}{dt} = \frac{0.632V_D}{\tau}$ Here, V_D: Specified off-state voltage τ: Time constant for the exponential function waveform For low power devices, tested with a specified resistance between the gate and cathode.
V_{TM}	On-state voltage	At specified case (or point) temperature, and when on-state current (commercial frequency, half sine wave of specified amplitude) is applied to the device, indicates peak value for the resulting voltage drop.

Thyristors (continued)

Symbol	Parameter	Definition/description
$I_{T(RMS)}$	RMS on-state current	At specified case (or point) temperature, indicates the RMS value for on-state current that can be continuously applied to the device.
$I_{T(AV)}$	Average on-state current	At specified case (or point) temperature, and with the device connected to a resistive or inductive load, indicates the average value for forward current (sine half wave, commercial frequency) that can be continuously applied to the device.
I_{TSM}	Surge-on current	Within the rated junction temperature range, indicates the peak value for non-repetitive on-state current (sine half wave, commercial frequency). This value is defined at one cycle, or as a function of multiple cycles.
I^2t	Current-squared, time integration	Indicates peak value for surge-on current as the square of a half of a current sine wave, time integrated over a half of a cycle. $I^2t = \int_0^{\frac{\pi}{\omega}} I_{TSM}^2 \sin^2 \omega t \, dt$
di/dt	Critical rate-of-rise of on-state current	At specified case (or point) temperature, specified off-state voltage, specified gate conditions, and at a frequency of less than 60Hz, indicates the maximum rate-of-rise of on-state current that the thyristor will withstand after switching from an off-state to an on-state.
I_H	Holding current	At specified junction temperature, gate conditions and off-state voltage, indicates the minimum anode current required holding the thyristor in an on-state.
I_L	Latching current	At specified junction temperature, off-state voltage and gate conditions, and when the gate trigger current is lifted immediately following switching from an off-to on-state, indicates the minimum anode current required to hold the thyristor in an on-state.
I_{RRM}	Reverse current	At maximum rated junction temperature, indicates the peak value for reverse current flow when a voltage (sine half wave, commercial frequency, and with a peak value as specified for repetitive peak reverse voltage rating) is applied in a reverse direction to the device For low power devices, tested with a specified resistance between the gate and cathode.
I_{DRM}	Off-state current	At maximum rated junction temperature, indicates the peak value for off-state current flow when a voltage (sine half wave, commercial frequency, and with a peak value as specified for repetitive peak off-state voltage rating) is applied in a forward direction to the device. For low power devices, tested with a specified resistance between the gate and cathode.
P_{GM}	Peak gate power dissipation	Within the rated junction temperature range, indicates the peak value for maximum allowable power dissipation over a specified time period, when the device is forward-conducting between the gate and cathode.
$P_{G(AV)}$	Average gate power dissipation	Within the rated junction temperature range, indicates the average value for maximum allowable power dissipation over a specified period of time, when the device is forward-conducting between the gate and cathode.
I_{FGM}	Peak gate forward current	Within the rated junction temperature range, indicates the peak value for forward current flow between the gate and cathode.

Thyristors (continued)

Symbol	Parameter	Definition/description
V_{RGM}	Peak gate reverse voltage	Within the rated junction temperature range, indicates the peak value for reverse voltage applied between the gate and cathode.
V_{FGM}	Peak gate forward voltage	Within the rated junction temperature range, indicates the peak value for forward voltage applied between the gate and cathode.
I_{GT}	Gate trigger current	At a junction temperature of 25°C, with an off-state voltage of 6 V, and a specified load resistance, indicates the minimum gate DC current required switching the thyristor from an off-state to an on-state.
V_{GT}	Gate trigger voltage	At a junction temperature of 25°C, with an off-state voltage of 6 V, and a specified load resistance, indicates the minimum gate DC voltage required to switch the thyristor from an off-state to an on-state. For low power devices, does not include current flow through the connected gate resistor, current flow through the connected gate resistor.
V_{GD}	Gate non-trigger voltage	At maximum rated junction temperature, and with a specified off-state voltage applied to the device, indicates the maximum gate DC voltage that will not switch the device from an off-state to an on-state.
$P_{T(AV)}$	On-state power dissipation	At a specified conducting angle, and with on-state current of specified waveform applied to the device, indicates the average value for internal power dissipation occurring over a one-cycle interval.
t_{gt}	Turn-on time	At specified junction temperature, and with a peak repetitive off-state voltage of a half of the rated value, followed by device turn-on using specified gate current, when specified on-state current of specified di/dt flows, indicated as the time required for the applied off-state voltage to drop to 10% of its initial value after gate current application. “Delay time” is the term used to define the time required for applied voltage to drop to 90% of its initial value following gate current application, and the time required for the level to drop from 90% to 10% is referred to as “rise time”. The sum of both of these defines turn-on time.
t_q	Turn-off time	Specified at maximum rated junction temperature. Device set up to conduct on-state current, followed by application of specified reverse voltage to quench the on-state current, and then increasing voltage at a specified rate-of-rise as determined by circuit conditions controlling the point where specified off-state voltage is reached. Turn-off time defines the minimum time that the device will hold its off-state, starting from the point when on-state current reached zero, and after forward voltage is again applied. 
Qrr	Reverse recovery charge	Indicates the total amount of reverse recovery charge due to current integrated time in a reverse direction (as part of the internally stored charge). Specified at a certain junction temperature, and time measured starting at the point when the device switched from forward to reverse, following specified current flow, and after current has decreased at a specified rate-of-fall.

3. Triacs

Symbol	Parameter	Definition/description
V_{DRM}	Repetitive peak off-state voltage	Within the rated junction temperature range, and with no signal between the gate and T1 terminal, indicates the applicable peak repetitive off-state voltage value. Indicated as maximum instantaneous value that includes repetitive transient voltage, but excludes non-repetitive transient voltage.
V_{DSM}	Non-repetitive peak off-state voltage	Within the rated junction temperature range, and when there is no signal between the gate and T1 terminal, specifies the non-repetitive peak off-state voltage applicable for a time width equivalent to less than a half of a sine wave at commercial frequency. Indicates the maximum instantaneous value for non-repetitive transient off-state voltage.
V_{TM}	On-state voltage	At specified case (or point) temperature, and when current having a specified amplitude (commercial frequency, sine half wave) is applied in both directions, indicates the peak value of the resulting on-state voltage in the direction producing the larger voltage.
$I_{T(RMS)}$	RMS on-state current	At a specified case (or point) temperature, indicates the RMS value for commercial frequency sine wave (360 degree) current that can be continually applied to the device.
I_{TSM}	Surge on-current	Within the rated junction temperature range, indicates the peak value for a non-repetitive type current sine wave at commercial frequency. Indicated for one cycle, or as a function of multiple cycles.
I^2t	Current squared, time integration	Indicates peak value for surge on-current rating as the square of a half of a current since wave, time integrated over a half cycle.
di/dt	Critical rate-of-rise for on-state current	At specified case (or point) temperature, specifies a half of repetitive peak off-state voltage, specified gate conditions, and at a frequency of less than 60Hz, indicates the maximum rate-of-rise for on-current which the triac will withstand after switching from an off-state to an on-state.
dv/dt	Critical rate-of-rise of off-voltage	At maximum rated junction temperature, and when there is no signal between the gate and T1 terminal specified the maximum rate-of-rise of off-state voltage that will not drive the device from an off-state to an on-state when an exponential function from off-state voltage of specified amplitude is applied to the device. $\frac{dv}{dt} = \frac{0.632V_D}{\tau}$ Here, V_D: Specified off-state voltage τ: Time constant for the exponential function waveform
I_{DRM}	Off-state current	At maximum rated junction temperature, and indicates the peak value for off-state current flow when voltage (commercial frequency, sine half wave) have a peak value equal to peak repetitive off-state voltage rating is applied in both directions.
P_{GM}	Peak gate dissipation	Within the rated junction temperature range, indicates peak value of the maximum allowable power dissipation for both directions between the gate and T1 terminal over a specified time period.
$P_{G(AV)}$	Average gate dissipation	Within the rated junction temperature range, indicates average value of the maximum allowable power dissipation for both directions between the gate and T1 terminal.

Triacs (continued)

Symbol	Parameter	Definition/description
V_{GM}	Peak gate voltage	Within the rated junction temperature range, indicates the peak value of voltage (commercial frequency, sine half wave) applicable in both directions between the gate and T1 terminal.
I_{GM}	Peak gate current	Within the rated junction temperature range, indicates the peak value of current (commercial frequency, sine half wave) applicable in both directions between the gate and T1 terminal.
V_{GT}	Gate trigger voltage	With a junction temperature of 25°C, 6V of off-voltage, and a specified load resistance, indicates the minimum gate DC voltage required to switch the triac from an off-state to an on-state. There are up to four values, depending on the polarity of the T1 terminal and gate.
I_{GT}	Gate trigger current	With a junction temperature of 25°C, 6V of off-voltage, and a specified load resistance, indicates the minimum gate DC current required switching the triac from off-state to an on-state. There are up to four values, depending on the polarity of the T1 terminal and gate.
V_{GD}	Gate non-trigger voltage	At maximum rated junction temperature, and with specified off-state voltage applied, indicates the maximum gate DC voltage that will not switch the device from an off-state to an on-state.
$P_{T(AV)}$	On-state power dissipation	With an on-state current sine wave of specified conducting angle, specifies the average value for internal power dissipation occurring over one cycle.
(dv/dt)c	Critical rate-of-rise of off-state voltage at commutation	At maximum rated junction temperature, and when conducting a specified on-state current, followed by reversing the current at a specified rate-of-fall, indicates the maximum rate-of-rise of off-state voltage which will not cause the device to conduct in the opposite direction when a specified voltage is applied to the opposite of the previously conducting direction. Specifies the smaller value for the two conducting directions.

Revision Record

Rev.	Date	Description	
		Page	Summary
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