



## J-Ramp Test:

### Test Procedure:

This test is performed with the device biased in accumulation, the diffusion connected to the substrate at room temperature.

The J-Ramp test begins at a low value of current and ramps exponentially until oxide breakdown or until the maximum current density or maximum  $Q_{bd}$  is exceeded. The test contents:

- Pre-Ramp oxide test  
The  $V_{use}$  is applied to device and the oxide current measured, if the measured current exceeds the current  $I_{initi}$ , the test termination.
- J-Ramp stress test  
The current is stepped in logarithmic intervals (by a constant factor F). The J-Ramp will be terminated if the most recent measured oxide voltage decreases below a certain fraction (typically 0.85-0.95) of the highest previously measured oxide voltage.
- Post-ramp oxide test  
A post ramp voltage at  $I_{initi}$  is measured to determine the final state of the test device.

Based on these test results, the oxide failure category is then determined.

The J-Ramp input and output parameters are listed in table

Input	Output
$V_{use}(V)$ , $I_{initi}(A)$ , $I_{start}(A)$ , F, $t_{step}(s)$ , $I_{max}(A)$ , $q_{max}(C/cm^2)$ , $V_{max}(V)$	$Q_{bd}(C)$ , $q_{bd}(C/cm^2)$ , $V_{bd}(V)$ , $V_{use-pre}(V)$ , $V_{use-post}(V)$ , Failure Types (initial; catastrophic, masked catastrophic, non- catastrophic failure, others failures)

### Input:

- $V_{use}$ : oxide current under normal operation conditions. Typically the power supply voltage or normal use voltage of the process.
- $I_{initi}$  oxide breakdown failure current when biased at  $V_{use}$ . Typical value is  $10\mu A/cm^2$ . higher value for ultra-thin oxide.
- $I_{start}$  Start current for current ramp. Typical value is  $I_{initi}$ .
- F current multiplier between two successive current steps
- $t_{step}$  current ramp step time
- $I_{max}$  maximum ramp current
- $V_{max}$  maximum voltage limit for ramp. Typically is at 30MV/cm for oxide <20nm and 15MV/cm for thicker oxide.
- $q_{max}$  maximum accumulate oxide charge.



**Basic J-ramp test flow diagram:**

