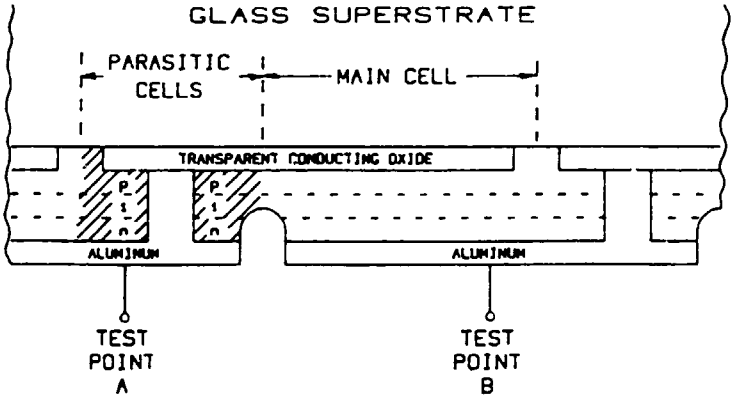
N87-16429

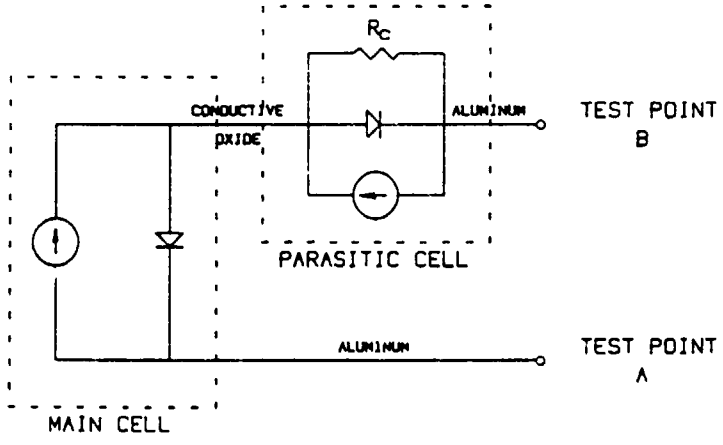
SOLAR CELL RELIABILITY TESTING

SOLAR CELL DESTRUCTION LABORATORY
CLEMSON UNIVERSITY

J. Lathrop

Equivalent Circuit of Series Connected Amorphous Silicon Cell





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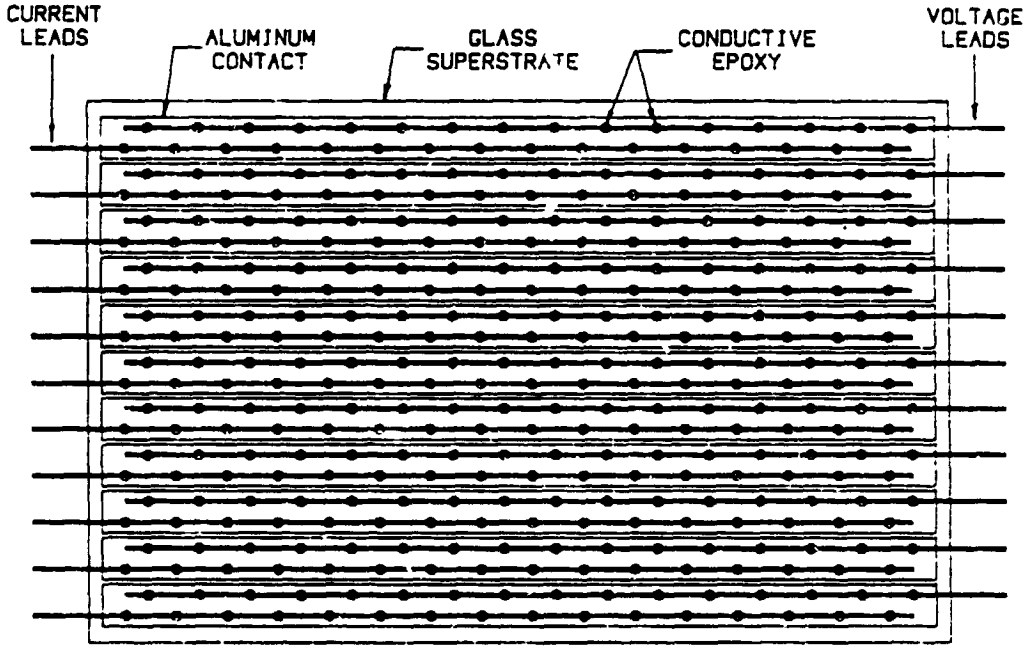
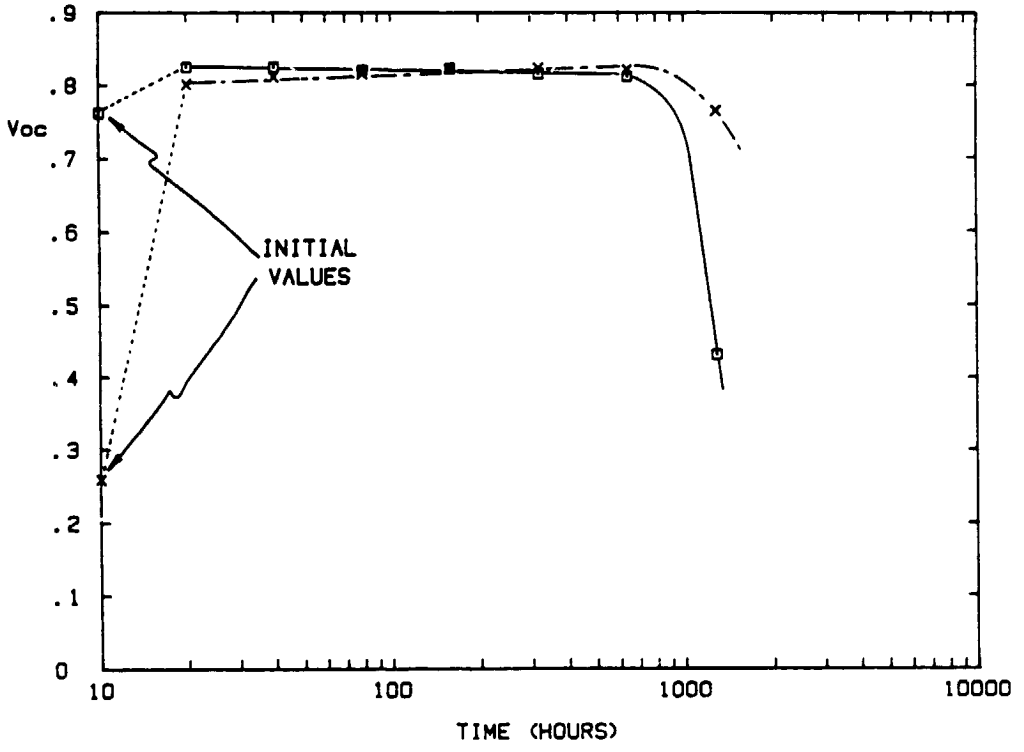
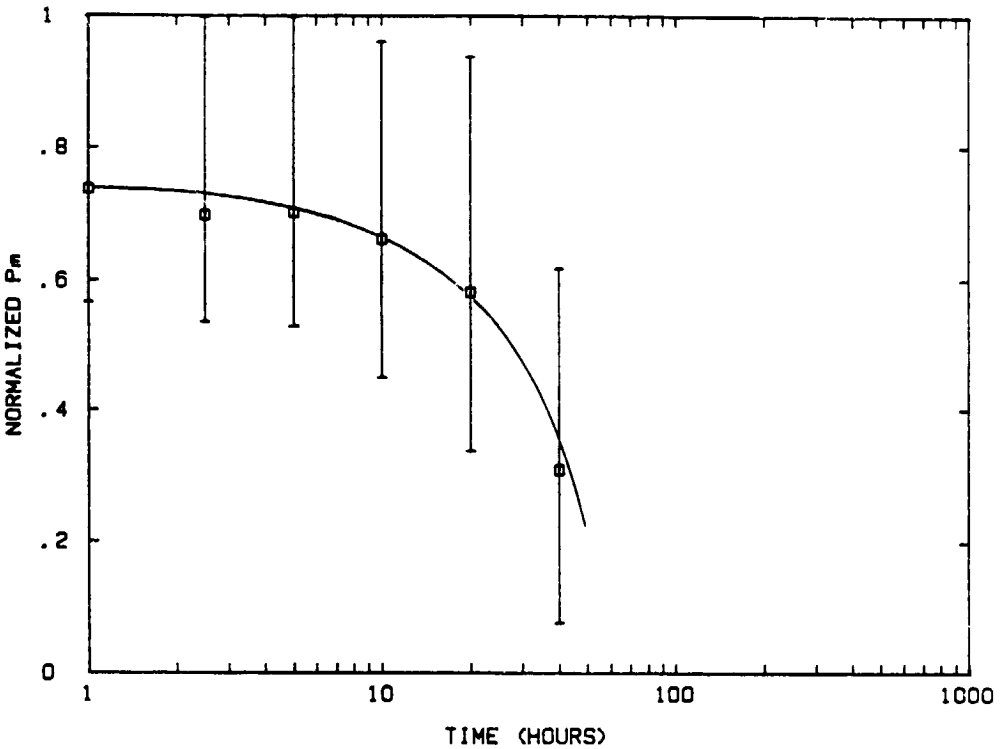
Bottom View of Unencapsulated Amorphous Silicon Module Showing Attachment of Kelvin Probe Contacts for Individual Cell Measurement



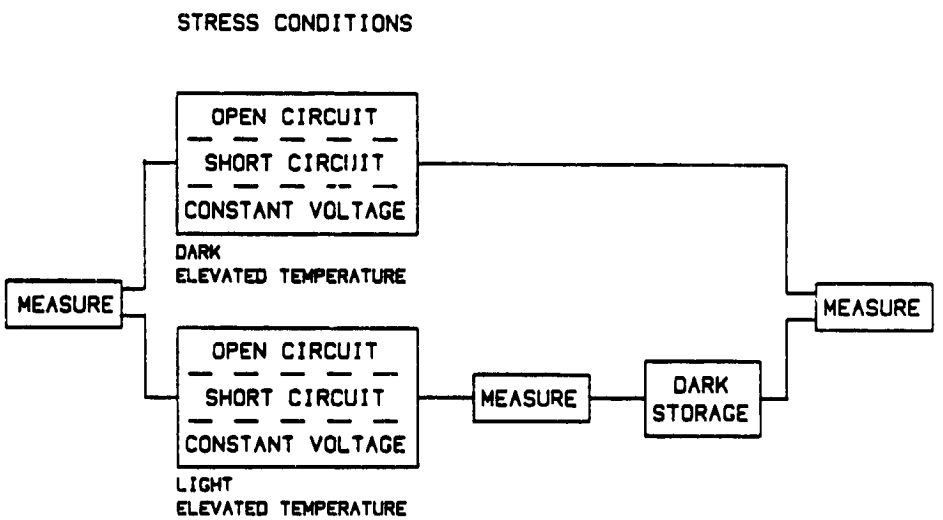
Cell Type "A" Non-Illuminated 140°C Stress Test



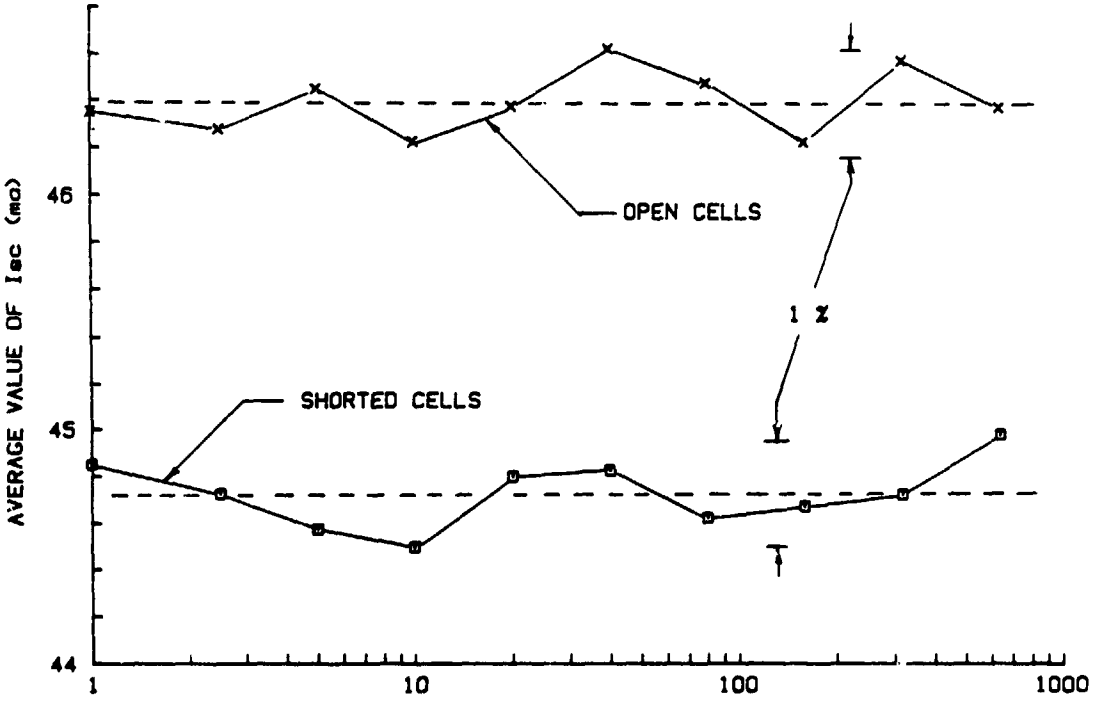
Cell Type "B" Non-Illuminated 140°C Stress Test

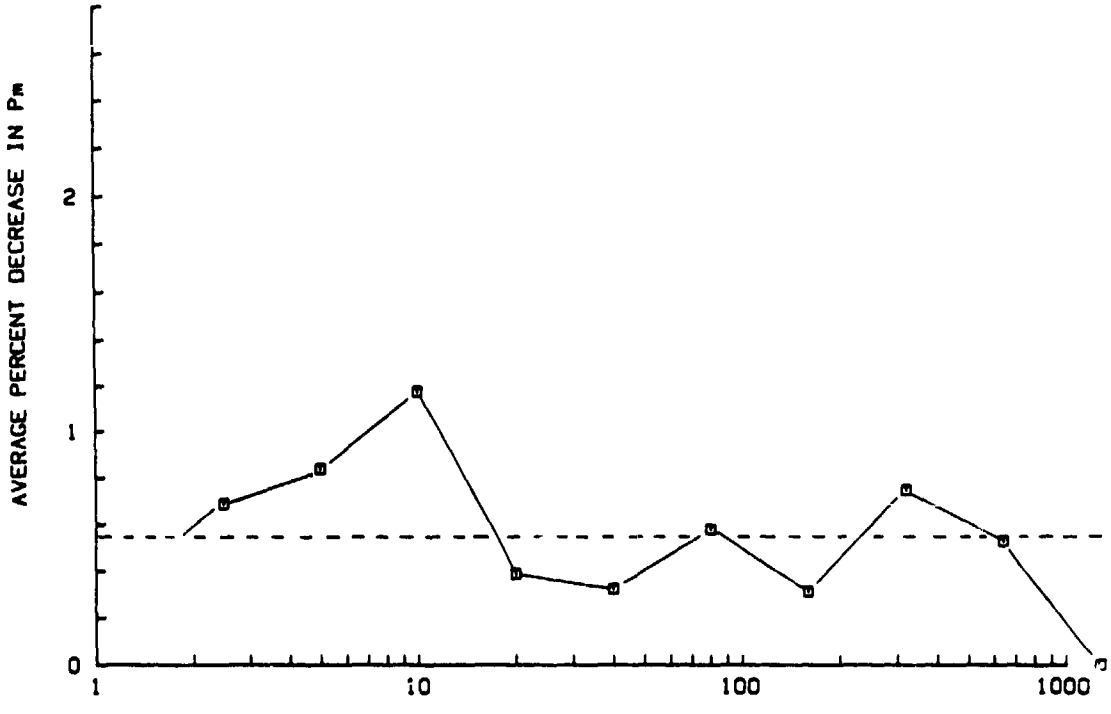


Amorphous Silicon Accelerated Stress Test Plan

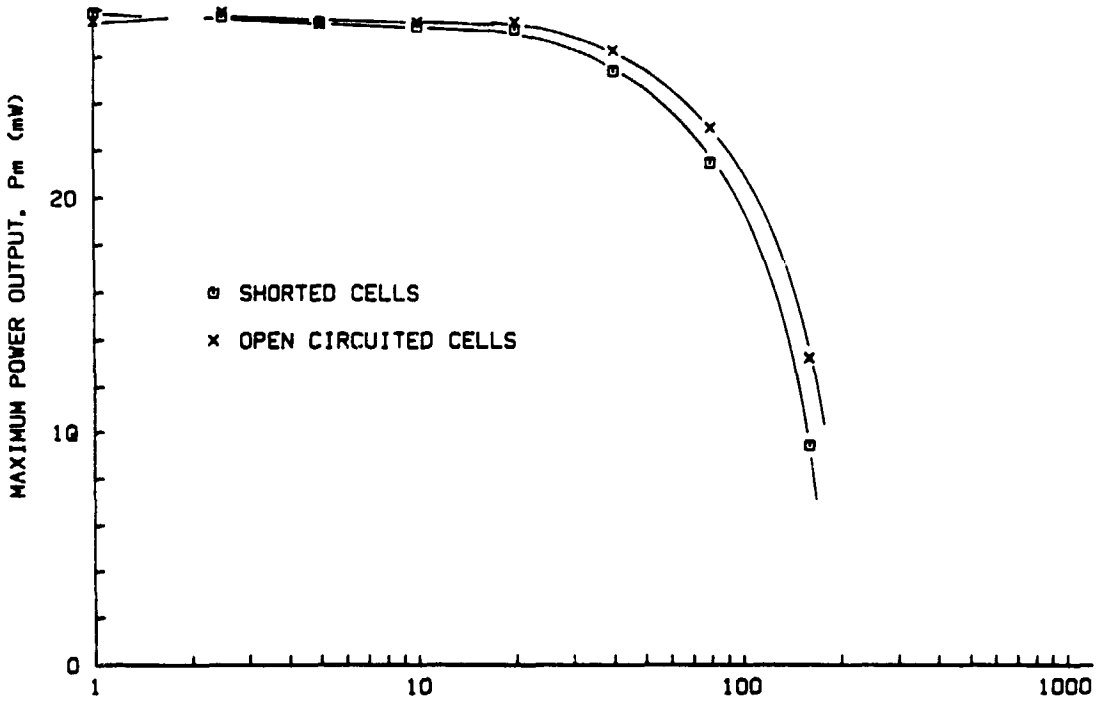


Cell Type "C" 16-Cell Non-Illuminated Control Module

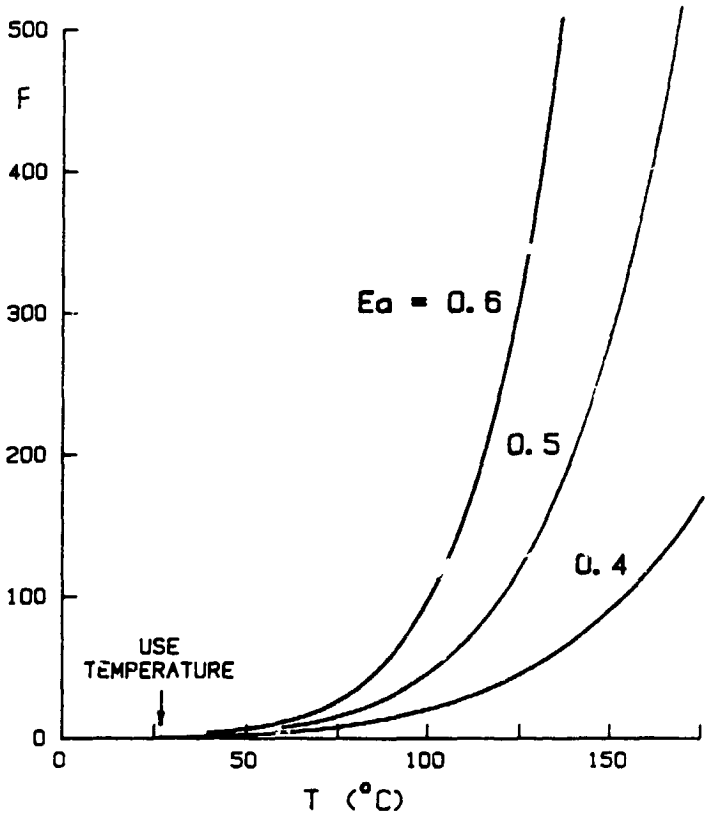




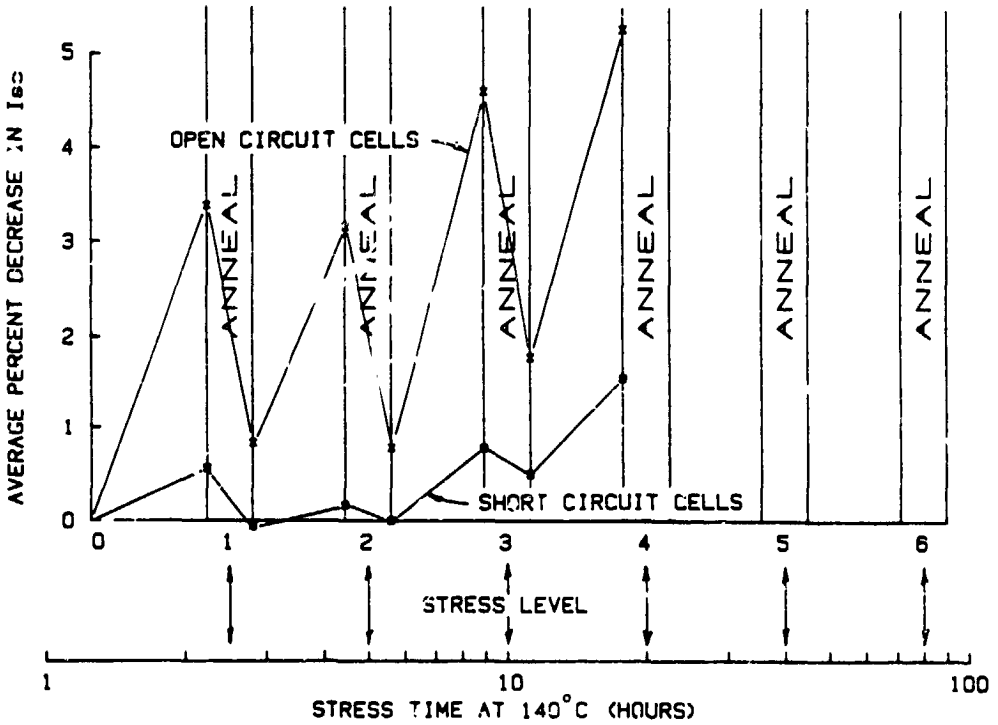
Cell Type "C" Non-Illuminated 140°C Stress Test



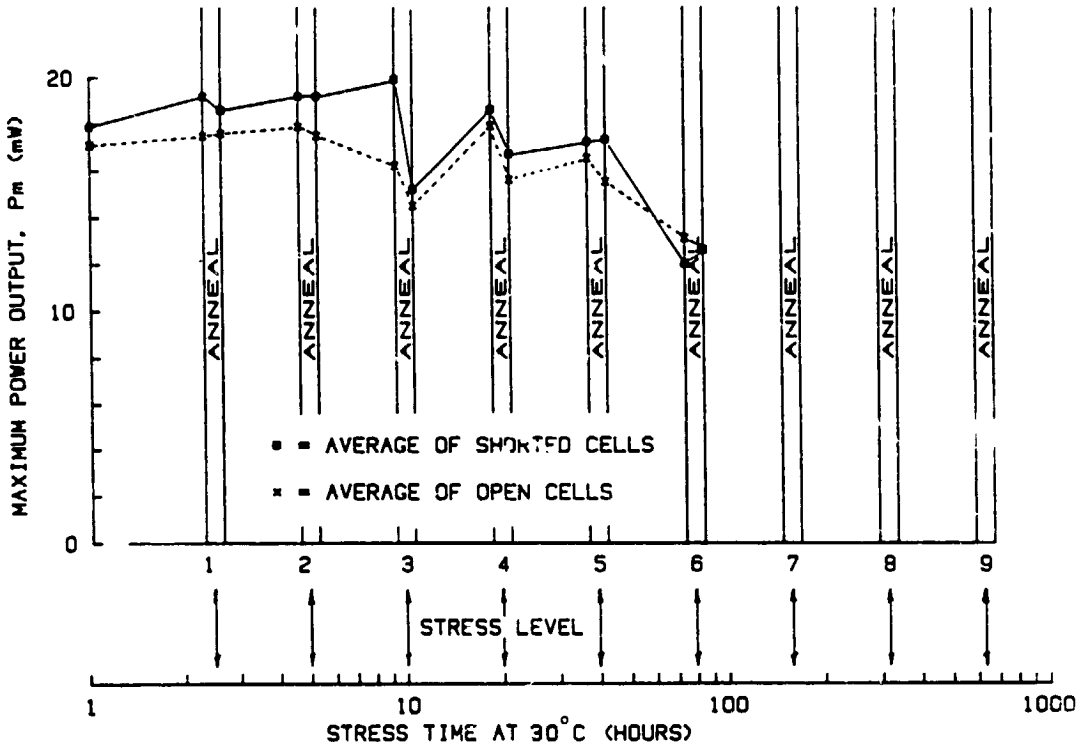
Acceleration Factor "F" as a Function of Stress Temperature



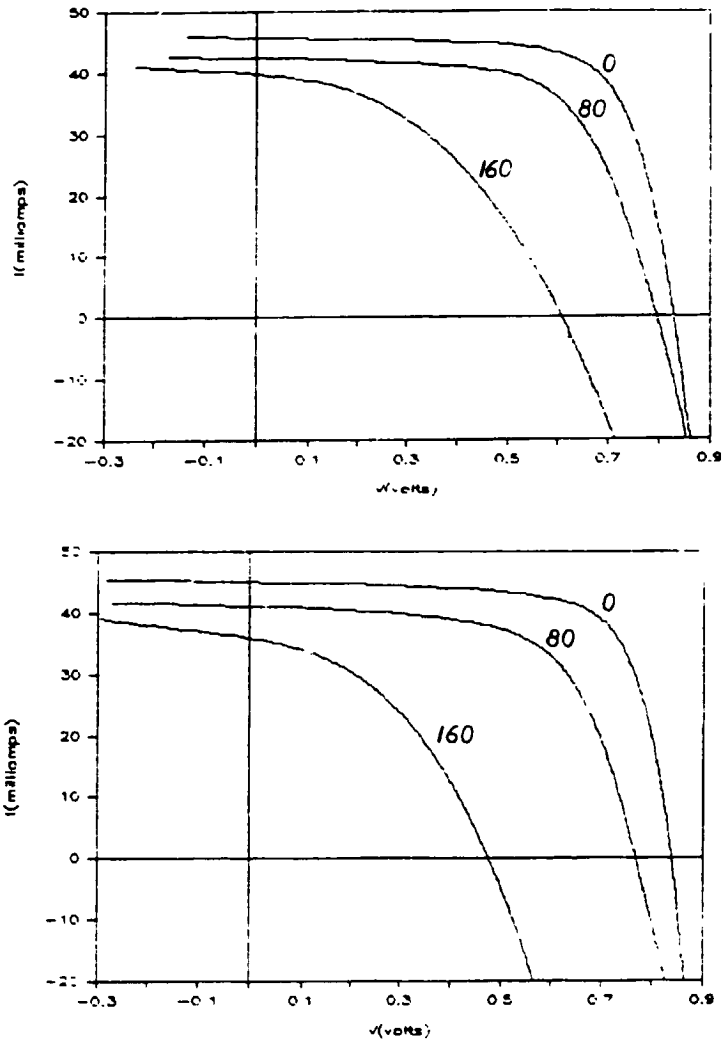
Cell Type "C" Illuminated Control Module



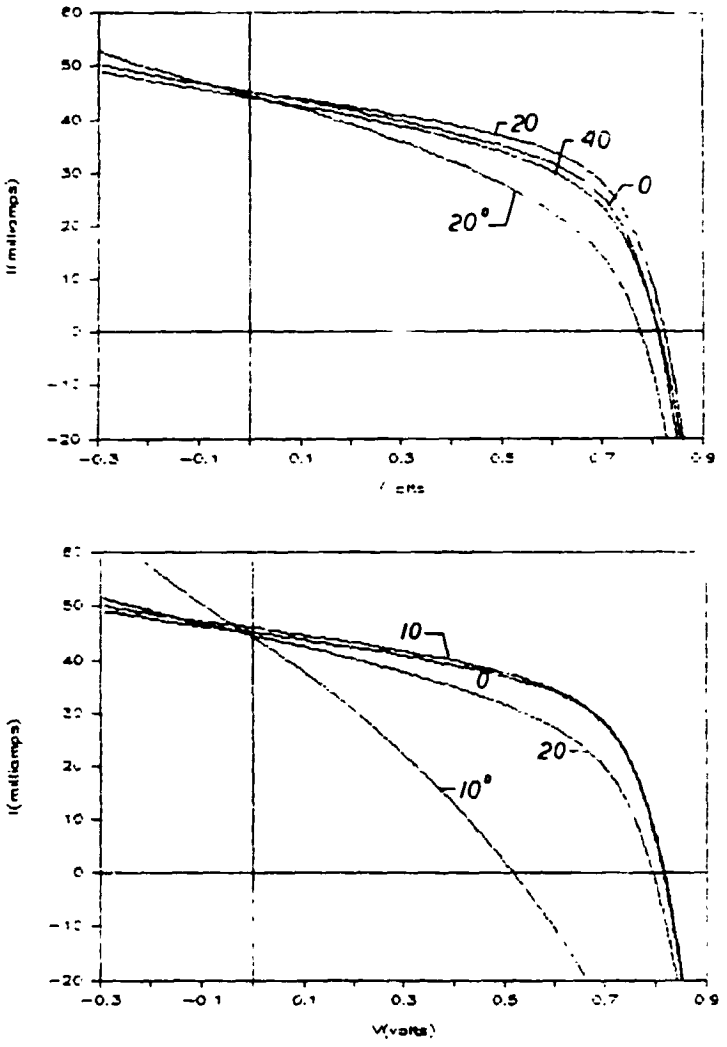
Cell Type "C" Illuminated Stress Test



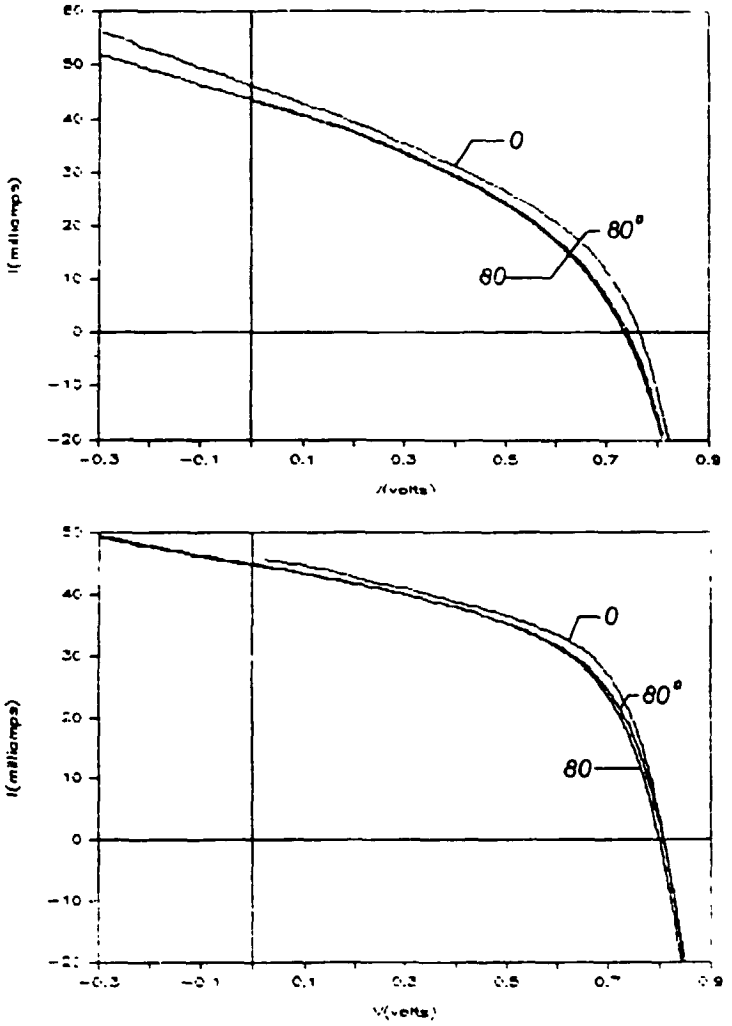
I-V Characteristics Initially and After 80 and 160 Hours for Two Type "C" Cells Subjected to 140°C (Non-Illuminated Stress Under Shorted Conditions)



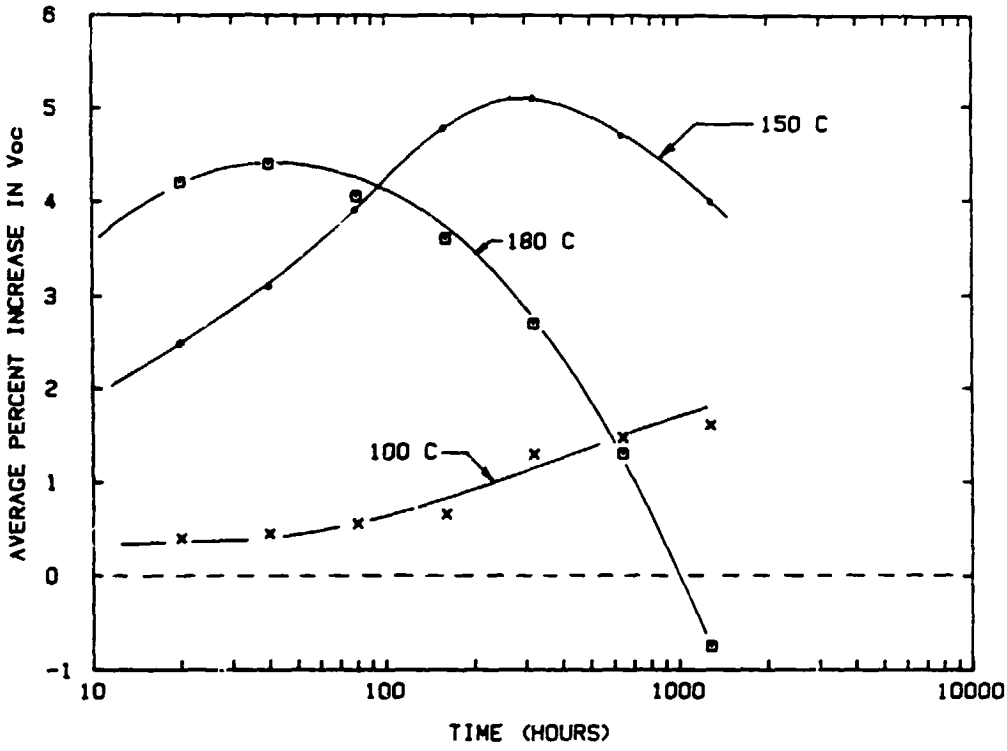
I-V Characteristics for Two Type "C" Cells as a Function of Hours at 140°C Under Illumination and While Shorted (□ Indicates Measurement Taken Following 2.5 Hours 100°C Anneal)



I-V Characteristics for Two Type "C" Cells as a Function of Hours at 140°C Under Illumination and While Open Circuited (□ Indicates Measurement Taken Following 2.5 Hours 100°C Anneal)



Tandem Cells: Non-Illuminated Stress



Conclusions

- MEASUREMENT SYSTEM FOR ACCELERATED TESTING OF a-Si CELLS WITH 1% REPEATABILITY DEMONSTRATED
- WELL MADE MODULES SHOW INITIAL Voc (Pm) IMPROVEMENT UNDER ELEVATED TEMPERATURE STRESS (CAN BE DRAMATIC FOR LOW Voc CELLS)
- SINGLE JUNCTION CELLS SHOW IRREVERSIBLE DEGRADATION UNDER ELEVATED TEMPERATURE STRESS IN THE DARK

T	TIME	Pm LOSS	
140 C	50 hours	10 %	
140 C	150 hours	50 %	
30 C	3 years	50 %	(Ea = 0.5 eV)

- SINGLE JUNCTION CELLS SHOW THE SAME LONG TERM IRREVERSIBLE DEGRADATION WHEN STRESSED IN LIGHT AS IN THE DARK, BUT WITH REVERSIBLE LIGHT INDUCED CHANGES SUPERIMPOSED
- LIGHT INDUCED EFFECTS AT ELEVATED TEMPERATURES AFFECT CELL CHARACTERISTICS DIFFERENTLY THAN AT ROOM TEMPERATURE
- MACROSCOPIC PHYSICAL OBSERVATION APPEARS TO CONFIRM THAT IRREVERSIBLE DEGRADATION AT ELEVATED TEMPERATURES IS THE RESULT OF A SOLID STATE REACTION BETWEEN ALUMINUM AND a-Si FILMS
- TANDEM JUNCTION CELLS SHOW LITTLE DEGRADATION UNDER ELEVATED TEMPERATURE STRESS IN THE DARK

T	TIME	Pm LOSS	
180 C	1000 hours	<1 %	
30 C	>30 years	50 %	(Ea = 0.5 eV)