

MODULE DEVELOPMENT AND ENGINEERING SCIENCES

N86-29407

PVARRAY: A SOFTWARE TOOL FOR PHOTOVOLTAIC ARRAY DESIGN

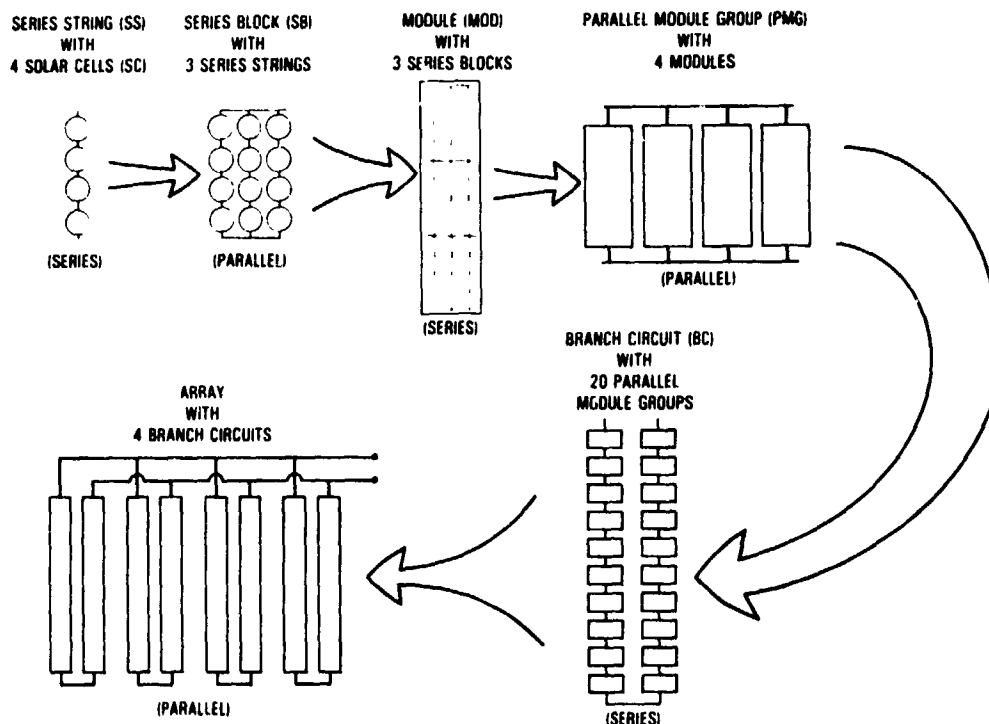
JET PROPULSION LABORATORY

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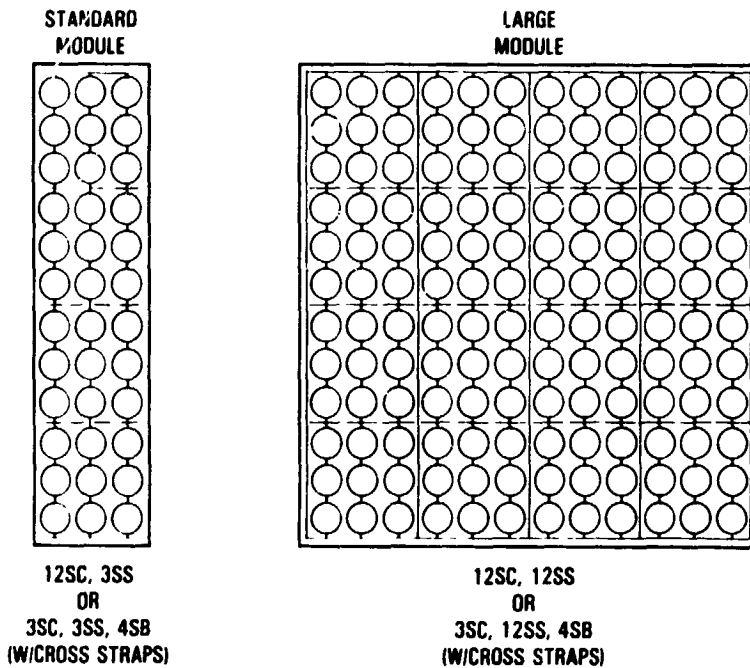
Background

- Part of a PV costing system
 - SAMIS-PC (module cost)
 - PVARRAY (array performance)
 - LCP (life-cycle cost/performance)
- Funded by PA&I

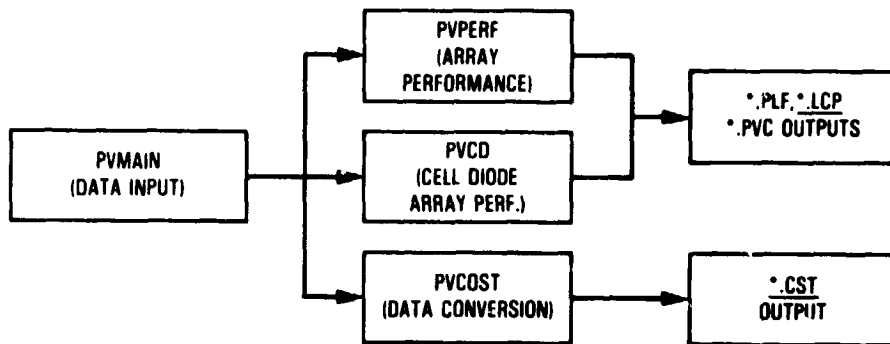
PVARRAY Terminology



PVARRAY Module Configurations



PVARRAY Flow Chart



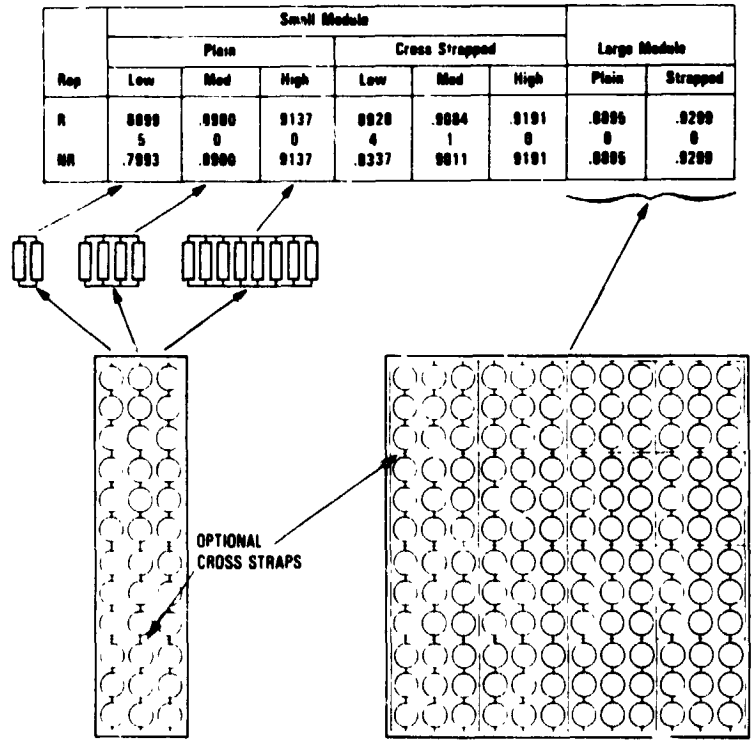
Array Analysis

- Fixed number of cells at 11520
- Fixed random number seed as 2560 which gave large number of early failures
- Ignored certain array design problems
 - Shadowing
 - Hot-spot heating
 - Shorts

Assumptions and Caveats

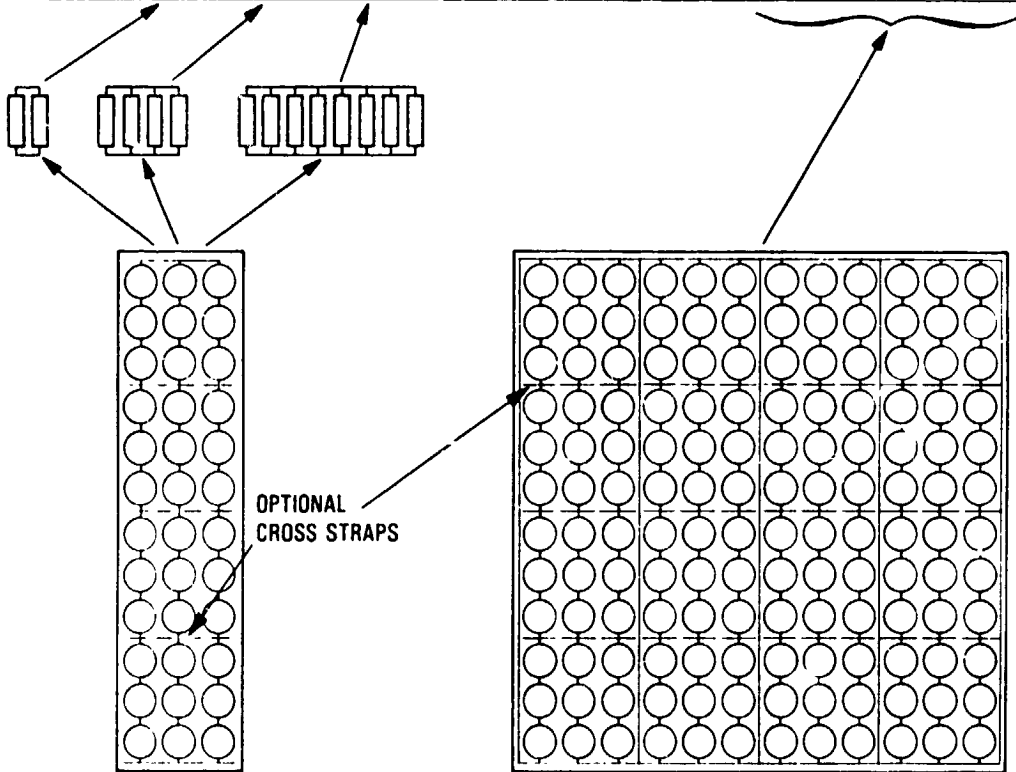
- Parallel redundancy
- Diode placement
- Replacement strategy
- High-efficiency cells

Parallel Redundancy, No Diodes



Parallel Redundancy, Module Diodes

Rep.	Small Module						Large Module	
	Plain			Cross Strapped (4D)			Plain	Strapped (4D)
	Low	Med	High	Low	Med	High		
R	1.000	.8912	.9144	(Note 1)	(Note 1)	(Note 1)	.8915	(Note 1)
NR	34 .8684	1 .8900	0 .9144	.8793	.9071	.9243	1(4) .8902	.9385



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Diode Placement

Diode Location	Rep.	Small Module						Large Module	
		Plain			Cross Strapped			Plain	Strapped
		Low	Med	High	Low	Med	High		
Around Group	R	1.000 34	.8931 2	.9144 0	1.000 34	.9369 4	.9217 0	.9166 4(16)	.9299 0
	NR	.8655	.8900	.9144	.8744	.8011	.9217	.8895	.9299
Around Module	R	1.000 34	.8912 1	.9144 0	(Note 1)	(Note 1)	(Note 1)	.8915 1(4)	(Note 1)
	NR	.8684	.8900	.9144				.8902	
Around Block	R	(NA)	(NA)	(NA)	1.000 34	1.000 34	.9783 17	(NA)	.9658 3(12)
	NR				.9131	.9361	.9438		.9531
Around Cell	R	.9520 0	.9608 0	.9657 0	.9580 0	.9663 0	.9731 0	.9601 0	.9667 0
	NR	.9520	.9608	.9657	.9580	.9663	.9731	.9601	.9667
NO Diode	R	.8899 5	.8900 0	.9137 0	.8928 4	.9084 1	.9191 0	.8895 0	.9299 0
	NR	.7993	.8900	.9137	.8337	.8011	.9191	.8895	.9299

Note 1: Module diode has no effect on cross strapped modules.

Replacement Strategy

Replacement Fraction	Small Module						Large Module	
	Plain			Cross Strapped (4D)			Plain	Strapped (4D)
	Low	Med	High	Low	Med	High		
1.00 D	1.000 34	.8912 1	.9144 0	1.000 34	1.000 34	.9783 34	.9166 4(16)	.9658 3(12)
ND	.8899 5	.8900 0	.9137 0	.8928 4	.9084 1	.9191 0	.8895 0	.9299 0
.98 D	1.000 34	.8931 2	.9144 0	.9928 32	.9917 32	.9783 17	.8915 1(4)	.9658 3(12)
ND	.8899 5	.8900 0	.9144 0	.8928 8	.9084 1	.9191 0	.8895 0	.9299 0
.95 D	.9711 29	.8931 2	.9144 0	.9605 17	.9516 7	.9632 8	.8915 1(4)	.9531 0
ND	.8679 3	.8900 0	.9137 0	.8793 0	.9084 1	.9191 0	.8895 0	.9299 0
.90 D	.8684 0	.8900 0	.9144 0	.9783 0	.9071 0	.9243 0	.8902 0	.9385 0
ND	.7993	.8900	.9137	.8337	.8011	.9191	.8895	.9299

Effect of High-Efficiency Cells

Diode Location	Rep.	Low Redundancy		Large Module			
		STD I-V	HEFF I-V	Plain		Cross-Strapped	
				STD	HEFF	STD	HEFF
No Diode	R	.8899 5	.8572 7	.8895 0	.9030 0	.9299 0	.9493 3(12)
	NR	.7993	.7515	.8895	.9030	.9299	.9241
Around Module	R	1.000 34	1.000 34	.8915 1(4)	.9042 1(4)	(NA)	(NA)
	NR	.8684	.8612	.8902	.9031		
Around Block	R	1.000 34	1.000 34	(NA)	(NA)	.9658 3(12)	.9677 23(92)
	NR	.9131	.9094			.9531	.9445
Around Cell	R	.9520 0	.9512 0	.9601 0	.9537 0	.9667 0	.9657 0
	NR	.9520	.9512	.9601	.9537	.9667	.9657

Conclusions

- PVARRAY could simulate a variety of configurations
- Results were consistent with previous parametric study results