





DESIGNS	unctions/C	cells Isc	Misma	atch (,	JC
		A Better S	olar Sir	nulato	r N
Casev Hare, Scott Ir	eton. Andrew Sch	wab - Angstror	n Desians.	Space P	OW6
1 Mativation - W	hu Ack Mar				
	IIY ASK WUU			L	. –
Illuminated Ground Testing?				• The A	
 In R&D and manufacturing: "test as you fly" 				Dest	acc + :
 Existing methods give large errors: Collibration Standarda: 0 5% (for bolloopa) or bigbor 				— D S	ut i imu
 Calibration Standards: 0.5% (for balloons) or higher Spectral Match: 1% (ASTM is 25%) 				 AIAA 	rec
 Spectral Match. 1% (ASTM is 25%) Spatial Uniformity: 3% (or higher for large areas) 				space	е
 Temporal Stability: 2% 				AIAA	allo
 Errors mean too many cells on every array we fly 				3% Sr	Dati
 Larger circuits = larger wings, satellites and rockets 				• vve C	an (
Better Ground Testing Gives Lighter, More Efficient Satellites					
3. All-Junctions/	Cells Isc Mi	smatch (.	JCM) M	easure	em
All-Junctions, All-Cells I	sc Mismatch = JC	M	•	JCM cap	otur
 JCM uses isotypes to measure the short-circuit current for 				spatial n	on-
every junction in every o	cell location in the	circuit			
$\downarrow \downarrow $	V V V	* * * * * * * * * * * *	▼ ▼	•••	••
		lso 1		Is	so 2
					مال ۵
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					
J2 Image: Second seco					
J4 Iso	1			Iso 1	
Cell	A Cell B Cell C]	Cell A Cel	I B Cell C	
4. JCM vs AIAA or	n a 5J, 60 ce	ell panel			5.
 3x20 circuit of 5J cells an 	d a <u>partially-calibra</u>	ated 5J pLEDs	S S	•	JC
 JCM is fully automated 	/ / _				AS
 AIAA Current matching: do ASTM enotiol non-uniform 	besnit say where (i bity: cub complex (n XY) in the be prop doocn't to			
which junction	JCM JCM Max-	SNU small SNU large Cur	rrent Match		JC
Land Land Land Land Land Land Land Land	e Max Min Min/Max+Min nse, all 3.97 -1.77 2.87	(2%) (3%) Fail Pass	All (1%) Fail		
-0.13 2.79 -0.15 -0.80 2.37 -1.06 0.16 1.67 0.32 -0.05 2.41 -0.02 -0.06 3.57 0.35 JUNCTI -0.20 2.89 -0.19 -0.80 2.52 -0.90 0.28 1.80 0.09 -0.37 2.12 -0.30 -0.21 3.30 0.35 JUNCTI -0.57 2.56 -0.46 -0.89 2.41 -0.99 0.08 1.30 -0.25 -0.64 1.89 -0.50 -0.19 3.19 0.09 -0.80 2.35 -0.66 -0.72 2.52 -1.00 -0.16 1.11 -0.29 -0.73 1.63 -0.64 -0.05 3.22 0.03 0.09 -1.08 2.31 -0.87 -0.80 2.66 -0.74 -0.60 0.54 -0.48 -0.88 1.50 -0.83 0.00 3.15 0.01 -1.02 2.22 -0.82 -0.83 2.53 -0.87 -1.17 0.35 -0.61 -0.90 1.64 -0.83 -0.03 3.20 0.05 1UNCTI </th <th>se, all 1.80 -0.28 1.04</th> <th>Pass Pass</th> <th>Fail</th> <th>•</th> <th>W</th>	se, all 1.80 -0.28 1.04	Pass Pass	Fail	•	W
-1.09 2.52 -0.53 -0.82 2.57 -0.85 -1.53 0.01 -1.09 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 1.64 -1.03 0.10 3.26 -0.21 -0.61 -0.61 -0.61 1.03 -0.27 -0.63 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.29 -0.28 -0.29 -0.26 -0.27 -0.26 1.93 -0.68 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 -0.28 </th <th>case, 3.81 -1.31 2.56</th> <th>Fail Pass</th> <th>Fail</th> <th></th> <th>_</th>	case, 3.81 -1.31 2.56	Fail Pass	Fail		_
-1.17 2.37 -1.10 -1.22 0.51 -0.43 -0.65 1.76 -0.73 0.56 3.89 0.17 -1.16 2.50 -0.85 -0.87 2.61 -0.86 -1.03 0.30 -0.97 -0.67 1.95 -0.92 0.55 3.97 0.27 -1.17 2.38 -0.91 -0.64 2.89 -0.79 -0.99 0.75 -0.55 -0.62 2.01 -0.72 0.39 3.81 0.03 -1.26 2.42 -0.87 -0.78 2.80 -0.71 -1.19 0.62 -0.67 -0.61 1.94 -0.99 0.00 3.54 -0.24 -1.77 1.85 -1.55 -1.46 2.27 -1.23 -1.15 0.91 -0.92 -1.18 1.65 -1.02 -0.98 2.56 -1.04 Worset-colspan="5">Worset-colspan="5">Worset-colspan="5">Worset-colspan=5"	ase, 1.60 -0.28 0.94 se, J1 2.89 -1.77 2.33	Pass Pass	Pass Fail		
	11 ic the	ROL ourront lin	nitor		
	(and the non-limiting JCM	1 errors are within the	J1 current margi	n)	
2023 by Anastrom Desians.					

CM) Measurement

Metric

er Workshop, Torrance CA, April 27, 2023

AIAA Standards Are For Space

A S111A and S112A uses isotype current matching for uracy

includes the short-comings of pulsed, Xenon-lamp solar lators

cognizes that spectral binning isn't good enough for

ows the E927-10 stacking of errors: 1% current match + al nonuniformity + 2% temporal stability

do better than this

Even the AIAA Standard Allows for Large 1% + 3% + 2% Error Stack

nent?

es all the aspects of spectral binning/ matching and uniformity at the resolution of the present test



Conclusion: JCM is a Better Metric

CM is measured data, in all locations critical to the test STM/ AIAA and Xenon Lamps gives errors of 6% (or more) Larger error while under-sampling spatial non-uniformity CM and LEDs gives errors of 2.2% (or less) for large panels pLEDss has demonstrated JCM < 0.3% for small coupons CM is measured data rather than calibration assumptions hy should programs want a 4% (or more) improvement? Smaller circuits, Higher confidence in on-orbit power, Lower mass, Lower MOI, Lower cost, ... for every panel we fly.

JCM: strict, direct measurements

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