Test: Single Pa	nel Distance Calibr	ation																
Objective: Dete	rmine relationship I	oetween illuminati	on distance and F	AR output for a s	ingle panel.													
Procodure: At the center of the panel, with all channels fully powered, and with all other panels off, measure total and segmented PAR (monif) for distance in range in increments of -5cm. Questions: Is the spectrum consistent across illumination distances? Is there a distinct point where the spectrum becomes inconsistent?																		
Note: Measured UV (380-399 nr	data PAR bands	correspond to: FR	(701-780 nm), R	(600-700 nm), G	(500-599 nm), B	(400-499 nm),												
OV (300-399 III	")																	
			Measured Data				Distan	ce Map		Sum Reliabilit	tv			Channel Relative	Spectrums			
																		Notes
Distance (cm)	Total (umol)	FR (umol)	R (umol)	G (umol)	B (umol)	UV (umol)	Distance (cm)	Total (umol)	Total (umol)	Sum (umol)	Sum Accuracy (%)	Distance (cm)	FR (%)	R (%)	G (%)	B (%)	UV (%)	IVOIES
Distance (cm) 2	Total (umol) 1615	FR (umol) 417	R (umol) 744	G (umol) 511	B (umol) 360	UV (umol)	Distance (cm)	Total (umol) 1615	Total (umol) 1615	Sum (umol) 2032	Sum Accuracy (%) 79.48%	Distance (cm)	FR (%) 20.52%	R (%) 36.61%	G (%) 25.15%	B (%) 17.72%	UV (%) 0.00%	Notes
Distance (cm) 2 6						0 0	Distance (cm) 2 6					Distance (cm) 2 6						
Distance (cm) 2 6 10	1615	417	744	511	360	0 0 0	Distance (cm) 2 6 10	1615	1615	2032	79.48%	Distance (cm) 2 6 10	20.52%	36.61%	25.15%	17.72%	0.00%	Channel begins to diverger here
2	1615 1437	417 313	744 635	511 461	360 341	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 6	1615 1437	1615 1437	2032 1750	79.48% 82.11%	6	20.52% 17.89%	36.61% 36.29%	25.15% 26.34%	17.72% 19.49%	0.00%	
2 6 10	1615 1437 1115	417 313 204	744 635 498	511 461 320	360 341 297	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 6 10	1615 1437 1115	1615 1437 1115	2032 1750 1319	79.48% 82.11% 84.53%	6 10	20.52% 17.89% 15.47%	36.61% 36.29% 37.76%	25.15% 26.34% 24.26%	17.72% 19.49% 22.52%	0.00% 0.00% 0.00%	
2 6 10 14	1615 1437 1115 860	417 313 204 143	744 635 498 372	511 461 320 231	360 341 297 257	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 6 10	1615 1437 1115 860	1615 1437 1115 860	2032 1750 1319 1003	79.48% 82.11% 84.53% 85.74%	2 6 10 14	20.52% 17.89% 15.47% 14.26%	36.61% 36.29% 37.76% 37.09%	25.15% 26.34% 24.26% 23.03%	17.72% 19.49% 22.52% 25.62%	0.00% 0.00% 0.00% 0.00%	

Test: Single Pane	el Spectrum Calib	ration														
Objective: Deterr	nine the spectrun	n and relative inte	ensity for each ligh	t channel type.												
Procedure: At a fixed distance from a single panel where the overall spectrum is consistent (reference distance calibration test) and total PAR output highest, at the center of the panel, with all other lights off, cycling through channel types, where for each channel type all channels of that type are powered fully, measure total and segmented PAR (umol).																
Questions: What is the relative spectrum percents and intensities for each channel type?																
Note: Measured UV (380-399 nm)		correspond to: FF	R (701-780 nm), R	t (600-700 nm), G	(500-599 nm), B (400-499 nm),										
Distance (cm)	10															
			Measured Data				Sum A	nalysis	Relat	ve Intensity (%)			Spectr	um Map		
Channel (type)	Total (umol)	FR (umol)	R (umol)	G (umol)	B (umol)	UV (umol)	Channel (type)	SUM (umol)	Channel (typ		Channel (type)	FR (%)	R (%)	G (%)	B (%)	UV (%)
FR	22	178	21.4	0	0	0	FR	199.4	FR	1.83%	FR	89.27%	10.73%	0.00%	0.00%	0.00%
R	301	6	300	1	0	0	R	307	R	25.02%	R	1.95%	97.72%	0.33%	0.00%	0.00%
G	107	0	1	91	15	0	G	107	G	8.89%	G	0.00%	0.93%	85.05%	14.02%	0.00%
В	239	0	0	2	237	0	В	239	В	19.87%	В	0.00%	0.00%	0.84%	99.16%	0.00%
CW	272	8	75	132	66	0	CW	281	CW	22.61%	CW	2.85%	26.69%	46.98%	23.49%	0.00%
ww	262	14	133	106	23	0	ww	276	ww	21.78%	ww	5.07%	48.19%	38.41%	8.33%	0.00%

Γest: Single Pan	el DAC Calibration	1														
hiective: Deter	mine relationship b	netween DAC out	nut and PAR outn	ut for a single par	nel											
•	•			0 .												
	fixed distance from AR output highest,					istance calibration										
	id segmented PAF				u ali Cilalilleis at	trie Sarrie level,										
		DAG -			4-bl- fi	- DAO										
	spectrum consisted relative PAR out		oupuis? II so, dete	imine the lookup	table for mapping	J DAC voltage										
	DAD b		704 700\ D //	200 700> 0 //	-00 F00\ D (100 100 111/										
note: Mesurea a 380-399 nm)	ata PAR bands co	rrespona to: FR (701-780 nm), R (500-700 nm), G (500-599 nm), B (4	400-499 nm), UV										
,																
Distance (a)	10															
Distance (cm)	10															
			Measured Data				DAC	Map	Sum Reliability							
DAC (%)	Total (umol)	FR (umol)	R (umol)	G (umol)	B (umol)	UV (umol)	DAC (%)	Total (%)	Total (umol)	Sum (umol)	Sum Accuracy (%)					
100.00%	1115	204	498	320	297	0	100.00%	100.00%	1115	1319	84.53%					
95.00%	1115	204	498	320	297	0	95.00%	100.00%	1115	1319	84.53%					
90.00%	1115	204	498	320	297	0	90.00%	100.00%	1115	1319	84.53%					
85.00%	1115	204	498	320	297	0	85.00%	100.00%	1115	1319	84.53%					
80.00%	1115	204	498	320	297	0	80.00%	100.00%	1115	1319	84.53%					
75.00%	1115	204	498	320	297	0	75.00%	100.00%	1115	1319	84.53%					
70.00%	1067	191	475	305	286	0	70.00%	95.70%	1067	1257	84.88%					
65.00%	1013	179	450	288	275	0	65.00%	90.85%	1013	1192	84.98%					
60.00%	961	166	425	272	264	0	60.00%	86.19%	961	1127	85.27%					
55.00%	897	151	395	252	252	0	55.00%	80.45%	897	1050	85.43%					
50.00%	826	137	359	231	235	0	50.00%	74.08%	826	962	85.86%					
45.00%	743	122	316	209	218	0	45.00%	66.64%	743	865	85.90%					
40.00%	668	107	279	187	202	0	40.00%	59.91%	668	775	86.19%					
35.00%	575	91	235	161	179	0	35.00%	51.57%	575	666	86.34%					
30.00%	474	75	191	134	148	0	30.00%	42.51%	474	548	86.50%					
25.00%	367	58	146	105	115	0	25.00%	32.91%	367	424	86.56%					
20.00%	265	43	104	78	83	0	20.00%	23.77%	265	308	86.04%					
15.00%	149	26	57	44	48	0	15.00%	13.36%	149	175	85.14%					
10.00%	44	11	15	13	16	0	10.00%	3.95%	44	55	80.00%					
5.00%	0	0	0	0	0	0	5.00%	0.00%	0	0	100.00%					
0.00%	0	0	0	0	0	0	0.00%	0.00%	0	0	100.00%					

Test: Single Panel Verification	on																																		
bjective: Verify reported sp	ectrum and inter	nsity are accurate	for multiple sp	ectrums, inte	nsities and	distances.																													
Procedure: Compare reporte	ed and measured	for 3 spectrums,	3 distances, ar	nd 3 intensiti	es that are li	ikely to be us	ed in normal o	operation.																											
Questions: Does the algorith ntensities, and distances? I	mically reported low well?	intensity and sper	ctrum match th	e measured	intensity and	d spectrum fo	r multiple spe	ectrums,																											
Recipe Spectrums			FR (%)	R (%)	G (%)	B (%)	UV (%)																												
Green			0.00%	0.00%	100.00%	0.00%	0.00%																												
Sun Noon			23.31%	31.09%	23.27%	20.30%	2.03%																												
Red			0.00%	100.00%	0.00%	0.00%	0.00%																												
Blue			0.00%	0.00%	0.00%	100.00%	0.00%																												
								Collected D	nte																	Analysis									
	Intensity				Reports	ed Channels				Reported	Spectrum & Inter	sitv			Mea	sured PAR						Intensity Analy	rsis				Relative S	pectrum		Measured Re	elative Spec	trum		E	rror
Spectrum	Distance (c	m) Intensity (umo) CH. FR (%)	CH.R (%)	CH. G (%	6) CH. B (%)	CH. CW (%)	CH. WW (9) FR (%) R		B (%) UV (%		nol) Total (u	mal) FR (un	ool) R (u	mol) G (un	nol) B (u	mol) UV	(umal)	Des. PAR (umol)	Rep. PAR (umol)	Meas. PAR (umol) Error Rep / Meas (%	6) Error Des / Meas (%)	FR (%) R (%)	G (%)	B (%) UV (%) FR (%)	R (%)	G (%) B	(%) UV (%)	FR (%)	R (%)	G (%) B (%) UV
Green	10	300	0.00%	0.00%	100.00%	0.00%	100.00%	0.00%	2.00% 19	40% 57.80%	20.80% 0.00%	5 351	362	7.7	72	.5 211.	3 78	3.8	0	300	351	362	3.04%	17.13%	2.009	6 19.40%	57.80%	20.80% 0.00	% 2.08%	19.58% /	57.06% 21.7	28% 0.00%	0.08%	0.18%	0.74% 0.48% 0.0
Green	10	200	0.00%	0.00%	100.00%	0.00%	57.90%	0.00%	1.70% 12	30% 62.40%	19.70% 0.00%	245.1	243	4.4	4	0 154.	8 48	3.1	0	200	245.1	243	0.86%	17.70%	1.709	6 12.30%	62.40%	19.70% 0.00	% 1.78%	16.17% /	32.60% 19.4	45% 0.00%	0.08%	3.87%	0.20% -0.25% 0.0
Green	10	100	0.00%	0.00%	100.00%	0.00%	0.50%	4.20%	0.50% 5.	80.409	6 13.60% 0.00%	110.7	105	0.6	3	4 86.6	3 15	6.1	0	100	110.7	105	5.43%	4.76%	0.509	6 5.60%	80.40%	13.60% 0.00	% 0.57%	3.22% €	d1.93% 14.2	29% 0.00%	0.07%	-2.38%	1.53% 0.69% 0.0
Red	10	300	0.00%	100.00%	0.00%	0.00%	0.00%	13.50%	2.33% 92	50% 4.31%	0.87% 0.009	316	319	7.7	30	4.7 11.5	5 2	.4	0	300	316	319	0.94%	5.96%	2.339	6 92.50%	4.31%	0.87% 0.00	% 2.36%	93.38%	3.52% 0.7	4% 0.00%	0.03%	0.88%	0.79% -0.13% 0.0
Blue	10	300	0.00%	0.00%	0.00%	100.00%	20.40%	0.00%	0.53% 5.	02% 9.49%	84.96% 0.009	b 273	284	2.2	13	.8 26.2	2 24	4.3	0	300	273	284	3.87%	5.63%	0.539	6 5.02%	9.49%	84.96% 0.00	% 0.77%	4.82%	9.14% 85.2	27% 0.00%	0.24%	-0.20%	0.35% 0.31% 0.0
Sun Noon	10	300	100.00%	0.00%	0.00%	20.40%	0.00%	78.80%	10.80% 36	80% 28.80%	23.30% 0.00%	256.9	266	190.	B 11	9.7 75.8	3 70	J.1	0	300	256.9	266	3.42%	12.78%	10.809	% 36.80%	28.80%	23.30% 0.00	% 41.81%	26.23% 1	16.61% 15.5	36% 0.00%	31.01%	-10.57% -	12.19% -7.94% 0.0
Sun Noon	10	200	100.00%	0.00%	0.00%	13.70%	0.00%	51.80%	13.80% 35	60% 27.609	23.00% 0.00%	177	193	187.	7 91	.4 53.1	1 48	3.6	0	200	177	193	8.29%	3.63%	13.809	% 35.60%	27.60%	23.00% 0.00	% 49.29%	24.00% *	13.94% 12.7	76% 0.00%	35.49%	-11.60% -	13.66% -10.24% 0.0
Sun Noon	10	100	100.00%	0.00%	0.00%	6.90%	0.00%	24.90%	21.90% 32	70% 24.369	21.10% 0.009	6 96	98	183.	1 51	.8 22.4	24	4.2	0	100	96	98	2.04%	2.04%	21.909	% 32.70%	24.36%	21.10% 0.00	% 65.04%	18.40%	7.96% 8.6	30% 0.00%	43.14%	-14.30% -	16.40% -12.50% 0.0
Sun Noon	6	300	100.00%	0.00%	0.00%	15.90%	0.00%		12.54% 36	11% 28.069	23.28% 0.00%	6 262	321	275	15	1.6 92.3	3 77	7.4	0	300	262	321	18.38%	6.54%	12.549	% 36.11%	28.06%	23.28% 0.00	% 46.12%	25.42%	15.48% 12.5	98% 0.00%	33.58%	-10.69% -	12.58% -10.30% 0.0
Sun Noon	14	300	100.00%	1.00%	0.00%	26.70%	0.00%	100.00%	9.34% 37	53% 28.859	24.28% 0.00%	ь 251	262	134.	9 11	1.2 75	75	5.9	0	300	251	262	4.20%	14.50%	9.349	6 37.53%	28.85%	24.28% 0.00	% 33.98%	28.01% 1	8.89% 19.1	12% 0.00%	24.64%	-9.52% -	9.96% -5.16% 0.0
																							5.05%	9.07%											
																							5.00%	5.0779											