



Test: Single Panel Spectrum Calibration																			
Objective: Determine the spectrum and relative intensity for each light 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 data PAR bands correspond to: FR (701-780 nm), R (600-700 nm), G (500-599 nm), B (400-499 nm), UV (380-399 nm)																			
Distance (cm)	10																		
Measured Data							Sum Analysis		Relative Intensity (%)		Spectrum Map								
Channel (type)	Total (umol)	FR (umol)	R (umol)	G (umol)	B (umol)	UV (umol)	Channel (type)	SUM (umol)	Channel (type)	Relative PAR (%)	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%			
B	239	0	0	2	237	0	B	239	B	19.87%	B	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%			

Test: Single Panel DAC Calibration												
Objective: Determine relationship between DAC output and PAR output for a single panel.												
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, and all channels at the same level, measure total and segmented PAR (umol) for DAC output range in increments of 5%.												
Questions: Is the spectrum consistent across DAC outputs? If so, determine the lookup table for mapping DAC voltage output % to panel relative PAR output %.												
Note: Mesured data PAR bands correspond to: FR (701-780 nm), R (600-700 nm), G (500-599 nm), B (400-499 nm), UV (380-399 nm)												
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%	

intensities, and distances? How well?

Recipe Spectrums																																																											
Green											FR (%)	R (%)	G (%)	B (%)	UV (%)																																												
Sun Noon											23.31%	31.09%	23.27%	20.30%	2.03%																																												
Red											0.00%	0.00%	100.00%	0.00%	0.00%																																												
Blue											0.00%	0.00%	0.00%	100.00%	0.00%																																												
															Collected Data																																												
Intensity										Reported Channels										Reported Spectrum & Intensity										Measured PAR										Intensity Analysis										Analysis									
Distance (cm) Intensity (umol)										CH FR (%)	CH R (%)	CH G (%)	CH B (%)	CH CW (%)	CH WW (%)	FR (%)	R (%)	G (%)	B (%)	UV (%)	Intensity (umol)	Total (umol)	FR (umol)	R (umol)	G (umol)	B (umol)	UV (umol)	Des. PAR (umol)	Rep. PAR (umol)	Meas. PAR (umol)	Error Rep / Meas (%)	Error Des / Meas (%)	Reported Relative Spectrum					Measured Relative Spectrum					Error																
Spectrum	10	300	0.00%	0.00%	100.00%	0.00%	2.00%	19.40%	57.80%	20.80%	0.00%	361	362	7.7	72.5	211.3	78.8	0	300	361	3.64%	17.13%	1.70%	12.30%	62.40%	19.70%	0.00%	2.08%	19.58%	57.06%	21.26%	0.00%	0.08%	0.19%	-0.74%	0.48%	0.00%																						
Green	10	200	0.00%	0.00%	100.00%	0.00%	57.80%	0.00%	1.70%	12.30%	62.40%	19.70%	0.00%	245.1	243	4.4	49	154.8	48.1	0	200	245.1	0.86%	17.70%	0.50%	5.60%	80.40%	13.60%	0.00%	0.57%	3.22%	81.93%	14.29%	0.00%	0.07%	-2.38%	1.53%	0.69%	0.00%																				
Green	10	100	0.00%	0.00%	100.00%	0.00%	13.50%	2.33%	92.50%	4.31%	0.87%	0.00%	316	319	7.7	304.7	11.5	2.4	0	100	110.7	105	5.43%	4.76%	0.50%	5.60%	80.40%	13.60%	0.00%	0.57%	3.22%	81.93%	14.29%	0.00%	0.07%	-2.38%	1.53%	0.69%	0.00%																				
Red	10	300	0.00%	100.00%	0.00%	0.00%	0.00%	13.50%	2.33%	92.50%	4.31%	0.87%	0.00%	316	319	7.7	304.7	11.5	2.4	0	300	316	0.94%	5.96%	0.53%	5.02%	9.49%	84.96%	0.00%	0.77%	4.82%	9.14%	85.27%	0.00%	0.24%	-0.020%	-0.35%	0.31%	0.00%																				
Blue	10	300	0.00%	0.00%	100.00%	20.40%	0.00%	0.53%	5.02%	9.49%	84.96%	0.00%	273	284	2.2	13.8	28.2	244.3	0	300	273	0.84%	5.03%	10.80%	36.80%	28.80%	23.30%	0.00%	41.81%	26.23%	16.61%	13.36%	0.00%	31.01%	-10.57%	-12.19%	-7.84%	0.00%																					
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	190.8	118.7	75.8	70.1	0	300	256.9	0.26%	12.78%	13.80%	35.60%	27.60%	23.00%	0.00%	49.29%	24.00%	13.94%	12.76%	0.00%	35.49%	-11.60%	-13.66%	-10.24%	0.00%																				
Sun Noon	10	200	100.00%	0.00%	0.00%	13.70%	0.00%	51.80%	13.80%	36.60%	27.60%	23.00%	0.00%	177	193	187.7	91.4	53.1	48.6	0	200	177	193	8.29%	3.63%	21.90%	32.70%	24.36%	21.10%	0.00%	65.04%	18.40%	7.96%	8.60%	0.00%	43.14%	-14.30%	-16.40%	-12.50%	0.00%																			
Sun Noon	10	100	100.00%	0.00%	0.00%	6.90%	0.00%	24.90%	21.90%	32.70%	24.36%	21.10%	0.00%	96	98	183.1	51.8	22.4	24.2	0	100	96	98	2.04%	2.04%	12.54%	36.11%	28.06%	23.28%	0.00%	46.12%	25.42%	15.48%	12.98%	0.00%	33.58%	-10.89%	-12.58%	-10.30%	0.00%																			
Sun Noon	6	300	100.00%	0.00%	0.00%	15.90%	0.00%	12.54%	36.11%	28.06%	23.28%	0.00%	262	321	275	151.6	92.3	77.4	0	300	262	321	18.38%	6.54%	9.34%	37.53%	28.85%	24.28%	0.00%	33.98%	29.01%	18.89%	19.12%	0.00%	24.64%	-9.52%	-9.96%	-5.16%	0.00%																				
Sun Noon	14	300	100.00%	1.00%	0.00%	26.70%	0.00%	100.00%	9.34%	37.53%	28.85%	24.28%	0.00%	251	262	134.9	111.2	75	75.9	0	300	251	262	4.20%	14.50%																																		
																																			5.05%										9.07%														