

PHILIPS

sense and simplicity

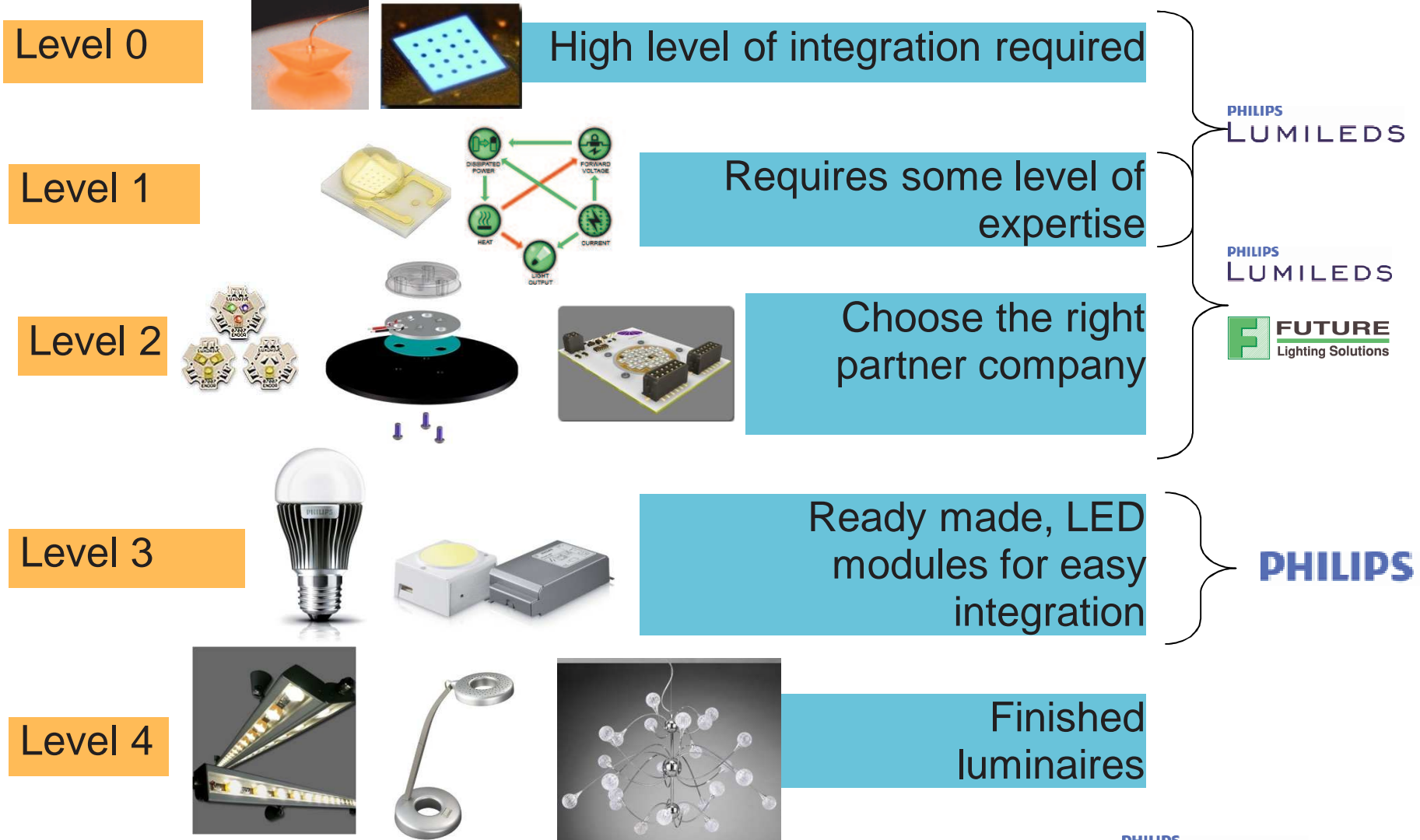
LUXEON Technology & Roadmap

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Jan, 2010

PHILIPS
LUMILEDS

De-mystifying The Supply Chain



Expanding the LUXEON Rebel white LED Portfolio

- LUXEON Rebel white LEDs
 - The LUXEON Rebel white portfolio can address virtually all your general lighting and illumination needs. LUXEON Rebel LEDs are optimized for CCT, CRI, Flux, and efficacy so you can identify the right part with the right attributes for each application.
- LUXEON Rebel new illumination emitters
 - The new LUXEON Rebel emitters are designed for illumination solutions that require specific color temperature and color rendering combinations in addition to high-flux to achieve their lighting objective. These LUXEON Rebel emitters are binned in accordance with ANSI standards and meet market requirements for the development of ENERGY STAR applications.



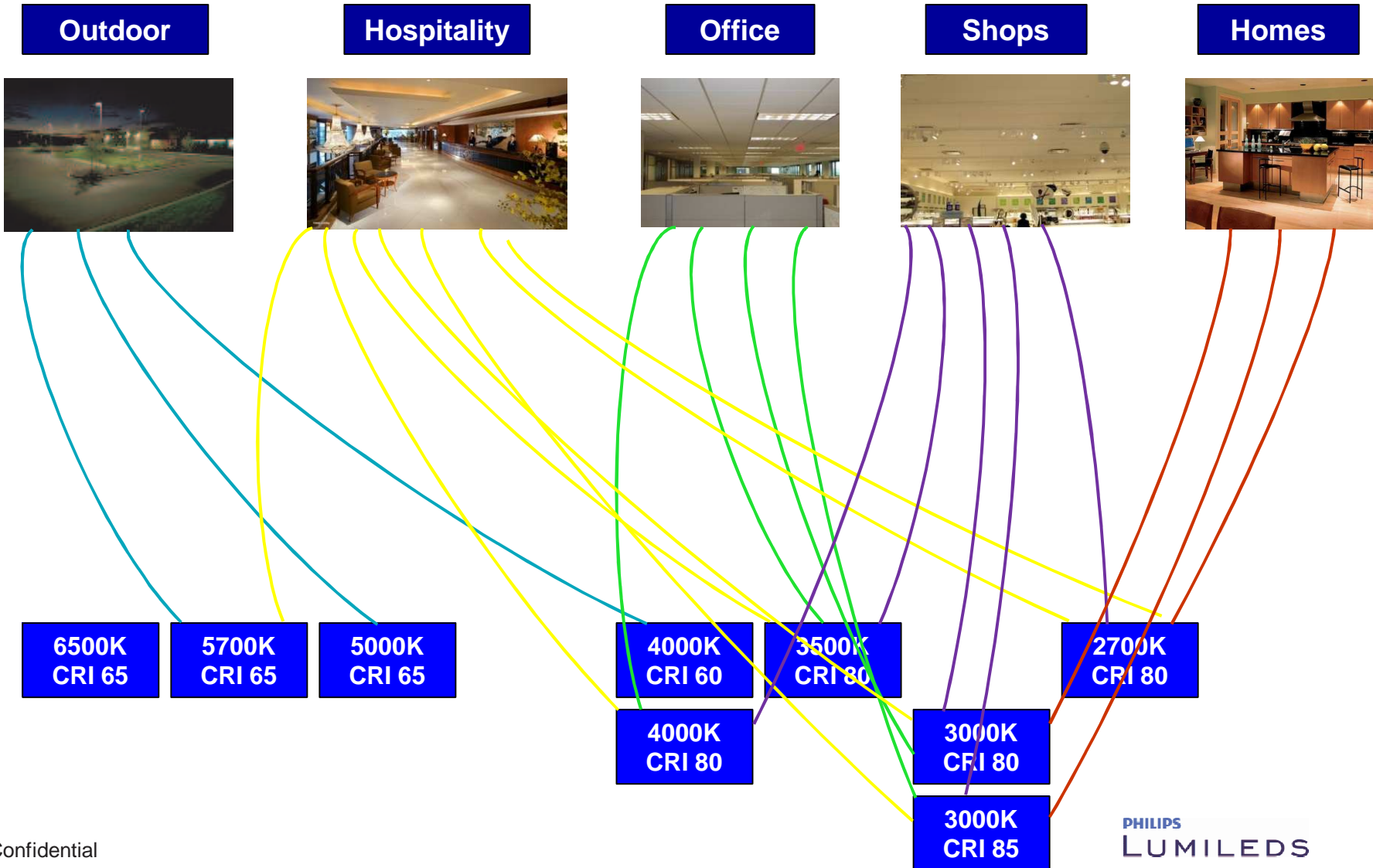
LUXEON Rebel White Portfolio

Nominal CCT	CCT Range	Min CRI	Typical CRI	Min Flux	Typ Flux @ 350 mA	Typical Efficacy lm/w	Part Number	Data Sheet
ANSI 2700K		80	85	65	73	70	LXM3-PW8I	DS63
ANSI 3000K		80	85	66	77	73	LXM3-PW7I	DS63
ANSI 3000K		85	90	50	66	63	LXML-PW7I	DS63
ANSI 3500K		80	85	67	80	76	LXM3-PW6I	DS63
ANSI 4000K		60	70	90	105	100	LXML-PW5I	DS63
ANSI 4000K		80	85	75	85	90	LXM3-PW5I	DS63
ANSI 5000K		65	70	90	105	100	LXML-PW3I	DS63
ANSI 5700K		65	70	90	105	100	LXML-PW2I	DS63
ANSI 6500K		65	70	90	105	100	LXML-PW1I	DS63
	2540K-3500K		85	60		55	LXML-PWWI-0060	DS64
	2540K-3500K		85	50		45	LXML-PWWI-0050	DS64
	3500K-4500K		70	100		91	LXML-PWNI-0100	DS64
	3500K-4500K		70	90		82	LXML-PWNI-0090	DS64
	3800K-4500K		70			min 100*	LXLW-PWNI-0100	DS6I
	5000K-6300K		70			min 100*	LXLW-PWCI-0100	DS6I
	4500K-10000K		70	100		91	LXML-PWCI-0100	DS64
	4500K-10000K		70	90		82	LXML-PWCI-0090	DS64

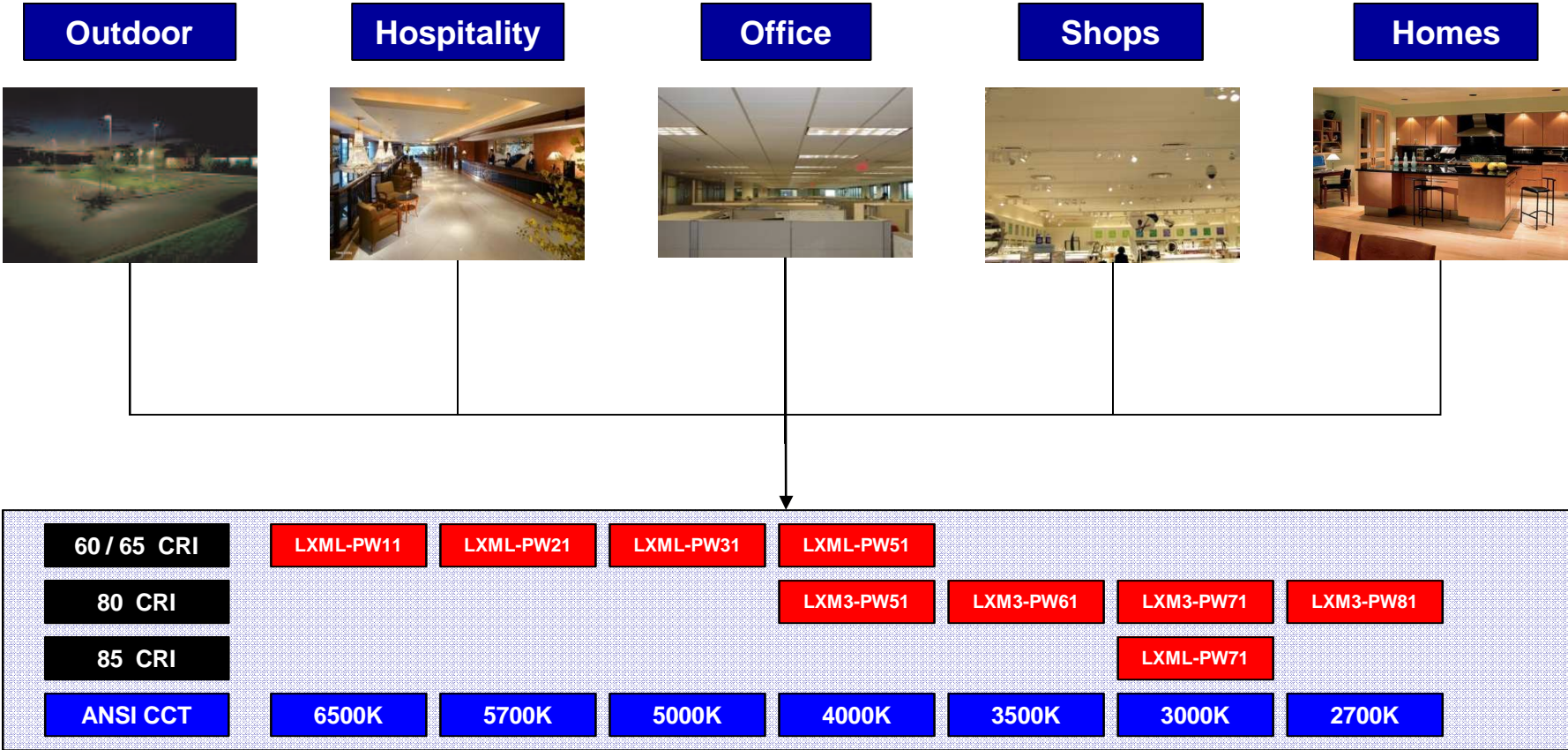
* LUXEON Rebel ES parts are a minimum efficacy rated

LUXEON Rebel Illumination Portfolio

Translating Market Requirements To Products



LUXEON Rebel Illumination Portfolio

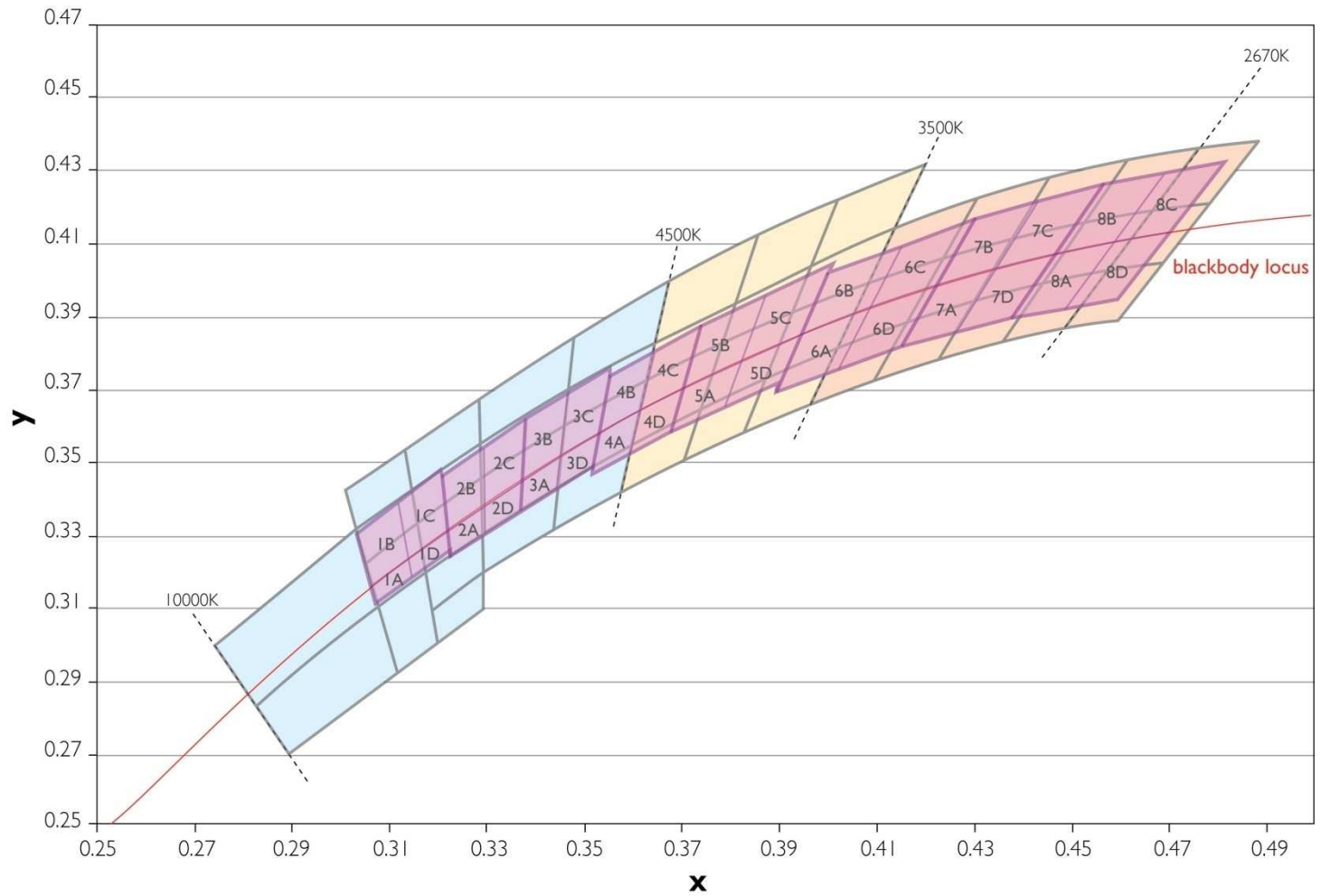


LUXEON Rebel Technical Overview

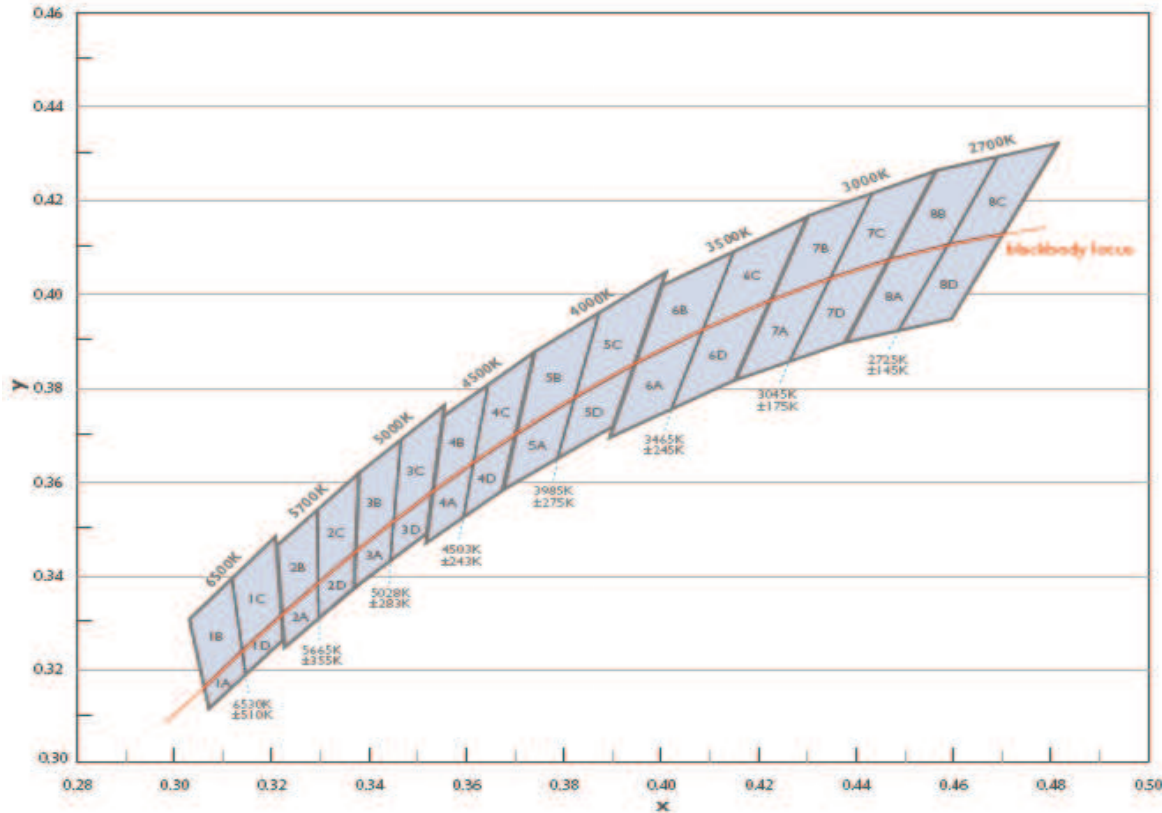
- Binning
- CRI
- Hot / Cold Factor
- Lumen Maintenance

LUXEON Rebel White Binning

- Current bin chart is still valid.
- LUXEON Rebel White ANSI bin chart is added.



LUXEON Rebel White ANSI Binning



- Color bins defined to ANSI C78.377 Standard
- Each ANSI bin (1-8) is ~7-step MacAdam Ellipse
 - Quadrants A-D are each ~3 MacAdam ellipses
- Full distribution per CCT = 4 fine bins. i.e. 4000K CCT 5A, 5B, 5C, 5D
- Consult your Regional Marketing Center for supportability on all sub-selections

Color Rendering

The Color Rendering Index (CRI) was created to help indicate how colors appear under different light sources.

Its mathematical result allows two different light sources to be compared.



Color Rendering

The market is using CRI as a decision point and needs vary by segment

- Outdoor: 60 - 80
- Shops: 80 - 100
- Office: 80 – 100
- Hospitality: 80 - 100
- Homes: 70 – 100

Strategic Marketing validated with customers determined which combinations of CCT / CRI would be offered initially.

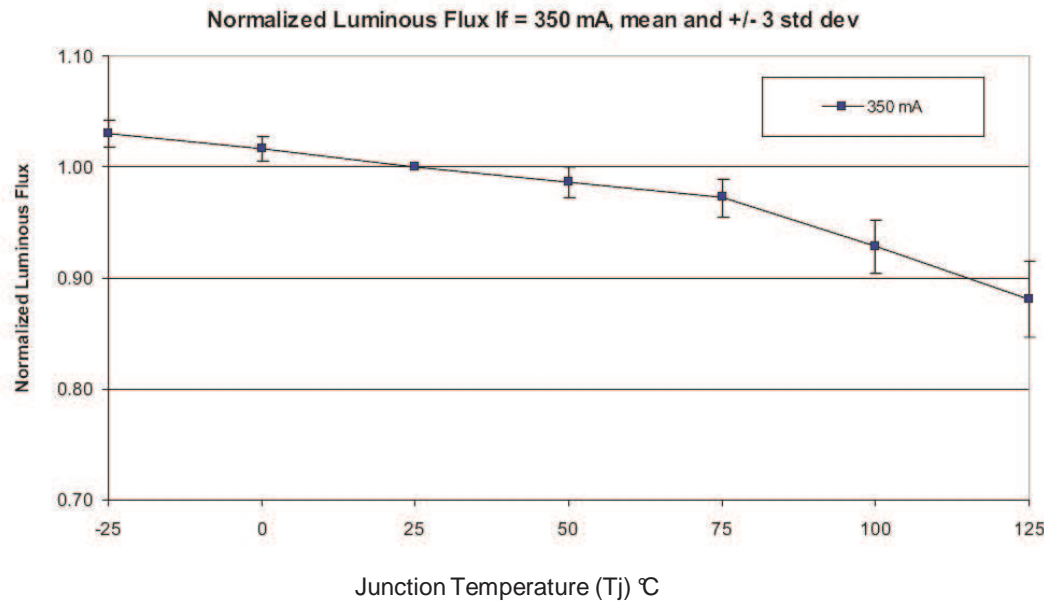
Nominal CCT	CCT Range	Min CRI	Typical CRI
ANSI 2700K		80	85
ANSI 3000K		80	85
ANSI 3000K		85	90
ANSI 3500K		80	85
ANSI 4000K		60	70
ANSI 4000K		80	85
ANSI 5000K		65	70
ANSI 5700K		65	70
ANSI 6500K		65	70
	2540K-3500K		85
	2540K-3500K		85
	3500K-4500K		70
	3500K-4500K		70
	3800K-4500K		70
	5000K-6300K		70
	4500K-10000K		70
	4500K-10000K		70

Hot / Cold Factor for the illumination portfolio

More light delivered under operating conditions

Significantly improved usable light under normal operating conditions

- i.e. 100°C junction temperature
- Datasheet characteristics now include both mean and +/- 3 std dev distribution
- **Simpler design effort for luminaire manufacturer**



HOT-COLD Factor : Flux at Tj 100°C/Flux at Tj 25°C	 LUXEON Rebel	0.93
	 CREE XP-E	0.8

IESNA LM-80 and Lumen Maintenance

- What is LM-80?
 - LM-80 is a lumen maintenance testing methodology for LEDs and LED Modules.
- What is an LM-80 test report?
 - An LM-80 test report contains the results of lumen maintenance testing conducted for a specified product or family of products, per the methodology.
- Is there a score or rating for an LM-80 report?
 - No. Other standards or requirements may define lumen maintenance levels for compliance, as tested per LM-80. For instance, ENERGY STAR requires that LEDs achieve 91.8% and 94.1% lumen maintenance at 6k hours for Residential and Commercial applications, respectively. The testing must be in accordance with LM-80 methodology, and the LM-80 report is evidence that the LEDs do achieve this level of performance.
- Are LM-80 test reports publicly available documents?
 - Yes and No. LUXEON LM-80 reports are reviewed by The Pacific Northwest Laboratory and filed with D&R International, who manages the SSL Energy Star program for the DOE. Philips Lumileds TSMs will distribute reports to customers as requested. Customer submissions to D&R International for SSL Luminaire Energy Star compliance must contain an LM-80 report. We do not publicly publish the test reports.

LUXEON Rebel LM-80 Results & Test Report



Philips Lumileds
Lighting Company
3715 Aliso Viejo Road
San Juan Capistrano, CA 92675
USA

Subject: LM-80 Test Report

Date: July 10, 2009
Rev: B

Cool-White (LXML-PWC1), Neutral-White (LXML-PWN1),
and Royal-Blue (LXML-PR01) LUXEON[®] Rebel using TFCC
technology

1. Number of LED light sources tested

See table in section 10.

2. Description of LED light sources

Devices tested: LUXEON Rebel p/n: LXML-PWC1
Report also applies to LUXEON Rebel p/n's: LXML-PWN1 and LXML-PR01

3. Description of auxiliary equipment

LUXEON Rebel devices are soldered to reliability stress board that can accommodate up to 160 devices. LUXEON Rebel LEDs are connected in series strings of up to 20 devices and driven by a constant current source for each series string.

Reliability stress boards are mounted in a thermal chamber which provides water-cooling to the bottom-side of the reliability stress board.

The reliability stress board is periodically removed from the thermal chamber, allowed to cool to room temperature, and then tested.

The tester consists of a computer-controlled x-y table, integrating sphere, programmable current-source matrix, and relay switching-matrix. Each LUXEON Rebel is positioned underneath the integrating sphere, and driven with a constant-current pulse. Luminous flux, (L_v, V_f), and forward voltage are measured for each

Device ID	Lot #	Part #	Bin #
01.000	01.001	01.002	01.003
01.004	01.005	01.006	01.007
01.008	01.009	01.010	01.011
01.012	01.013	01.014	01.015
01.016	01.017	01.018	01.019
01.020	01.021	01.022	01.023
01.024	01.025	01.026	01.027
01.028	01.029	01.030	01.031
01.032	01.033	01.034	01.035
01.036	01.037	01.038	01.039
01.040	01.041	01.042	01.043
01.044	01.045	01.046	01.047
01.048	01.049	01.050	01.051
01.052	01.053	01.054	01.055
01.056	01.057	01.058	01.059
01.060	01.061	01.062	01.063
01.064	01.065	01.066	01.067
01.068	01.069	01.070	01.071
01.072	01.073	01.074	01.075
01.076	01.077	01.078	01.079
01.080	01.081	01.082	01.083
01.084	01.085	01.086	01.087
01.088	01.089	01.090	01.091
01.092	01.093	01.094	01.095
01.096	01.097	01.098	01.099
01.100	01.101	01.102	01.103
01.104	01.105	01.106	01.107
01.108	01.109	01.110	01.111
01.112	01.113	01.114	01.115
01.116	01.117	01.118	01.119
01.120	01.121	01.122	01.123
01.124	01.125	01.126	01.127
01.128	01.129	01.130	01.131
01.132	01.133	01.134	01.135
01.136	01.137	01.138	01.139
01.140	01.141	01.142	01.143
01.144	01.145	01.146	01.147
01.148	01.149	01.150	01.151
01.152	01.153	01.154	01.155
01.156	01.157	01.158	01.159
01.160	01.161	01.162	01.163
01.164	01.165	01.166	01.167
01.168	01.169	01.170	01.171
01.172	01.173	01.174	01.175
01.176	01.177	01.178	01.179
01.180	01.181	01.182	01.183
01.184	01.185	01.186	01.187
01.188	01.189	01.190	01.191
01.192	01.193	01.194	01.195
01.196	01.197	01.198	01.199
01.200	01.201	01.202	01.203
01.204	01.205	01.206	01.207
01.208	01.209	01.210	01.211
01.212	01.213	01.214	01.215
01.216	01.217	01.218	01.219
01.220	01.221	01.222	01.223
01.224	01.225	01.226	01.227
01.228	01.229	01.230	01.231
01.232	01.233	01.234	01.235
01.236	01.237	01.238	01.239
01.240	01.241	01.242	01.243
01.244	01.245	01.246	01.247
01.248	01.249	01.250	01.251
01.252	01.253	01.254	01.255
01.256	01.257	01.258	01.259
01.260	01.261	01.262	01.263
01.264	01.265	01.266	01.267
01.268	01.269	01.270	01.271
01.272	01.273	01.274	01.275
01.276	01.277	01.278	01.279
01.280	01.281	01.282	01.283
01.284	01.285	01.286	01.287
01.288	01.289	01.290	01.291
01.292	01.293	01.294	01.295
01.296	01.297	01.298	01.299
01.300	01.301	01.302	01.303
01.304	01.305	01.306	01.307
01.308	01.309	01.310	01.311
01.312	01.313	01.314	01.315
01.316	01.317	01.318	01.319
01.320	01.321	01.322	01.323
01.324	01.325	01.326	01.327
01.328	01.329	01.330	01.331
01.332	01.333	01.334	01.335
01.336	01.337	01.338	01.339
01.340	01.341	01.342	01.343
01.344	01.345	01.346	01.347
01.348	01.349	01.350	01.351
01.352	01.353	01.354	01.355
01.356	01.357	01.358	01.359
01.360	01.361	01.362	01.363
01.364	01.365	01.366	01.367
01.368	01.369	01.370	01.371
01.372	01.373	01.374	01.375
01.376	01.377	01.378	01.379
01.380	01.381	01.382	01.383
01.384	01.385	01.386	01.387
01.388	01.389	01.390	01.391
01.392	01.393	01.394	01.395
01.396	01.397	01.398	01.399
01.400	01.401	01.402	01.403
01.404	01.405	01.406	01.407
01.408	01.409	01.410	01.411
01.412	01.413	01.414	01.415
01.416	01.417	01.418	01.419
01.420	01.421	01.422	01.423
01.424	01.425	01.426	01.427
01.428	01.429	01.430	01.431
01.432	01.433	01.434	01.435
01.436	01.437	01.438	01.439
01.440	01.441	01.442	01.443
01.444	01.445	01.446	01.447
01.448	01.449	01.450	01.451
01.452	01.453	01.454	01.455
01.456	01.457	01.458	01.459
01.460	01.461	01.462	01.463
01.464	01.465	01.466	01.467
01.468	01.469	01.470	01.471
01.472	01.473	01.474	01.475
01.476	01.477	01.478	01.479
01.480	01.481	01.482	01.483
01.484	01.485	01.486	01.487
01.488	01.489	01.490	01.491
01.492	01.493	01.494	01.495
01.496	01.497	01.498	01.499
01.500	01.501	01.502	01.503
01.504	01.505	01.506	01.507
01.508	01.509	01.510	01.511
01.512	01.513	01.514	01.515
01.516	01.517	01.518	01.519
01.520	01.521	01.522	01.523
01.524	01.525	01.526	01.527
01.528	01.529	01.530	01.531
01.532	01.533	01.534	01.535
01.536	01.537	01.538	01.539
01.540	01.541	01.542	01.543
01.544	01.545	01.546	01.547
01.548	01.549	01.550	01.551
01.552	01.553	01.554	01.555
01.556	01.557	01.558	01.559
01.560	01.561	01.562	01.563
01.564	01.565	01.566	01.567
01.568	01.569	01.570	01.571
01.572	01.573	01.574	01.575
01.576	01.577	01.578	01.579
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01.600	01.601	01.602	01.603
01.604	01.605	01.606	01.607
01.608	01.609	01.610	01.611
01.612	01.613	01.614	01.615
01.616	01.617	01.618	01.619
01.620	01.621	01.622	01.623
01.624	01.625	01.626	01.627
01.628	01.629	01.630	01.631
01.632	01.633	01.634	01.635
01.636	01.637	01.638	01.639
01.640	01.641	01.642	01.643
01.644	01.645	01.646	01.647
01.648	01.649	01.650	01.651
01.652	01.653	01.654	01.655
01.656	01.657	01.658	01.659
01.660	01.661	01.662	01.663
01.664	01.665	01.666	01.667
01.668	01.669	01.670	01.671
01.672	01.673	01.674	01.675
01.676	01.677	01.678	01.679
01.680	01.681	01.682	01.683
01.684	01.685	01.686	01.687
01.688	01.689	01.690	01.691
01.692	01.693	01.694	01.695
01.696	01.697	01.698	01.699
01.700	01.701	01.702	01.703
01.704	01.705	01.706	01.707
01.708	01.709	01.710	01.711
01.712	01.713	01.714	01.715
01.716	01.717	01.718	01.719
01.720	01.721	01.722	01.723
01.724	01.725	01.726	01.727
01.728	01.729	01.730	01.731
01.732	01.733	01.734	01.735
01.736	01.737	01.738	01.739
01.740	01.741	01.742	01.743
01.744	01.745	01.746	01.747
01.748	01.749	01.750	01.751
01.752	01.753	01.754	01.755
01.756	01.757	01.758	01.759
01.760	01.761	01.762	01.763
01.764	01.765	01.766	01.767
01.768	01.769	01.770	01.771
01.772	01.773	01.774	01.775
01.776	01.777	01.778	01.779
01.780	01.781	01.782	01.783
01.784	01.785	01.786	01.787
01.788	01.789	01.790	01.791
01.792	01.793	01.794	01.795
01.796	01.797	01.798	01.799
01.800	01.801	01.802	01.803
01.804	01.805	01.806	01.807
01.808	01.809	01.810	01.811
01.812	01.813	01.814	01.815
01.816	01.817	01.818	01.819
01.820	01.821	01.822	01.823
01.824	01.825	01.826	01.827
01.828	01.829	01.830	01.831
01.832	01.833	01.834	01.835
01.836	01.837	01.838	01.839
01.840	01.841	01.842	01.843
01.844	01.845	01.846	01.847
01.848	01.849	01.850	01.851
01.852	01.853	01.854	01.855
01.856	01.857	01.858	01.859
01.860	01.861	01.862	01.863
01.864	01.865	01.866	01.867
01.868	01.869	01.870	01.871
01.872	01.873	01.874	01.875
01.876	01.877	01.878	01.879
01.880	01.881	01.882	01.883
01.884	01.885	01.886	01.887
01.888	01.889	01.890	01.891
01.892	01.893	01.894	01.895
01.896	01.897	01.898	01.899
01.900	01.901	01.902	01.903
01.904	01.905	01.906	01.907
01.908	01.909	01.910	01.911
01.912	01.913	01.914	01.915
01.916	01.917	01.918	01.919
01.920	01.921	01.922	01.923

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