

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**LED-binning –
Part 1: General requirements and white colour grid**

**Tri des LED –
Partie 1: Exigences générales et matrice de couleur blanche**



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International Standard IEC 62707-1 has been prepared by subcommittee 34A: Lamps, of IEC technical committee 34: Lamps and related equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
34A/1702/FDIS	34A/1736/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This first edition cancels and replaces IEC/PAS 62707-1, published in 2011.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62707 series, published under the general title *LED-binning*, can be found on the IEC website.

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LED-BINNING –

Part 1: General requirements and white colour grid

1 Scope

This part of IEC 62707 specifies general requirements, a grid and a corresponding code for the colour binning of white LED packages emitting incoherent, visible radiation. It applies for LED packages.

Other parts of the IEC 62707 series covering chromaticity of coloured LED packages, luminous flux/luminous intensity, colour rendering and forward voltage are in preparation or under consideration.

NOTE 1 This International Standard does not apply for LED modules, LED lamps and LED luminaires.

NOTE 2 Even though the words "white light" are used, the purpose of this International Standard is not to define "white light", but to specify a grid and a corresponding colour code for the colour binning of white LED packages emitting incoherent, visible radiation. The area covered by the grid may differ from the definition of white light given in other standards or regulations.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC/TS 62504, *General lighting – LEDs and LED modules – Terms and definitions*

3 Terms and Definitions

For the purposes of this document, the terms and definitions given in IEC/TS 62504, as well as the following apply.

3.1

bin

restricted range of LED package performance characteristics used to delimit a subset of LED packages near a nominal LED package performance as identified by chromaticity, photometric performance and forward voltage

3.2

grid

entity representing colour coordinates and specified by a set of grid points

3.3

grid point

colour coordinate in u' , v' colour space (or its equivalent in the x , y colour space) identified by two discrete indices, the first index p counting steps along the Planckian locus, and its extension beyond the high temperature boundary towards blue colours and second index j along Judd isothermal lines

Note 1 to entry: The u' , v' colour space is specified in ISO 11664-5 CIE S 014-5/E. The x , y colour space is specified in ISO 11664-1 CIE S 014-1/E.

3.4

white color bin

area inside a quadrilateral defined by four grid points

4 Chromaticity bins for white LED packages

4.1 Grid for white LED packages

The grid shall be aligned in equidistant steps along the Planckian locus, and its extension beyond the high temperature boundary towards blue colours, in the first direction (Planck-axis) and in equidistant steps along the Judd isothermal lines in the second direction (Judd-axis).

The origin of the grid shall be on the Planckian locus at T_{∞} (u'/v') = (0,180 06/0,395 28).

The distance between adjacent grid points along the Planckian locus and its extension beyond the high temperature boundary towards blue colours and along Judd isothermal lines in the u' , v' colour space shall be $s = 0,001\ 74$. Steps along the Planckian locus are counted with a positive index p , steps toward blue with a negative index p . Steps towards the saturated colour line (gamut) along the Judd-axis are counted with a positive index j and with negative index j in the opposite direction.

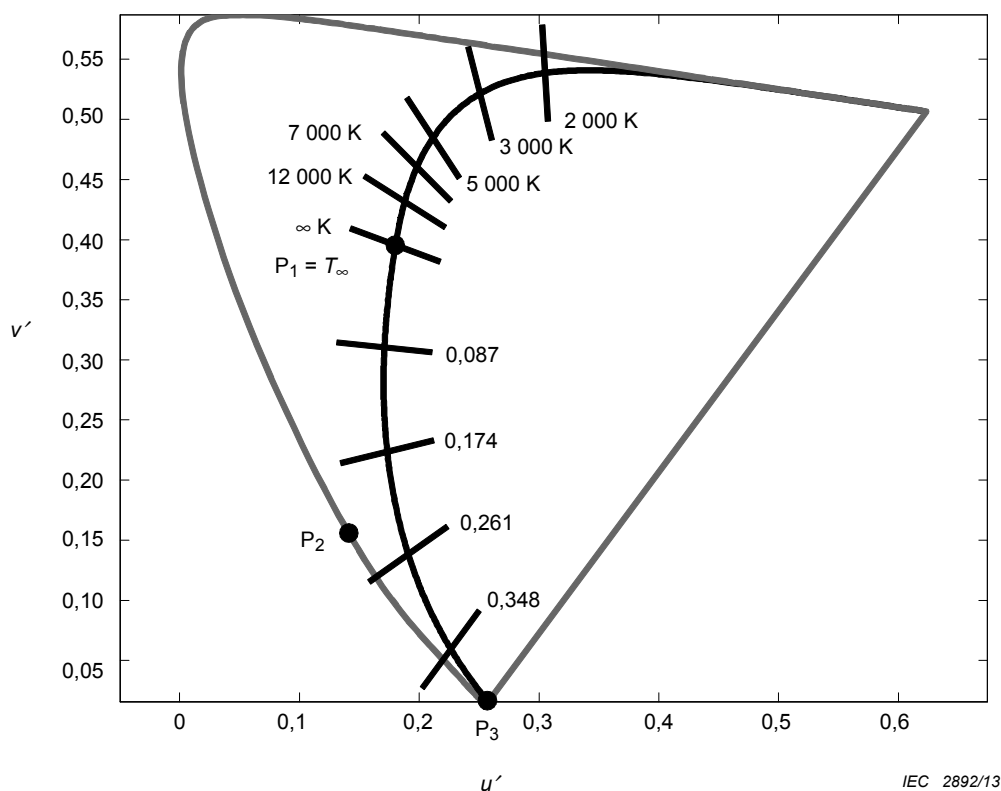
NOTE 1 $s = 0,0017\ 4$ has been chosen as providing for the best alignment with existing chromaticity requirements.

The Planckian locus shall be extended beyond T_{∞} (towards blue) as follows (see Figure 1):

- Quadratic Bézier locus defined by three points:
 - P_1 : T_{∞} (u'/v') = (0,180 06/0,395 28)
 - P_2 : (u'/v') = (0,141 22/0,155 93)
 - P_3 : (u'/v') = (0,256 80/0,016 59)
- The Bézier locus is $B(t) = P_1 \times (1-t)^2 + 2P_2 \times t \times (1-t) + P_3 \times t^2$; $t \in (0;1)$.

NOTE 2 P_2 is the intersection of spectral locus of the u' , v' colour space and tangent of Planckian locus at T_{∞} in direction of blue wavelength.

NOTE 3 P_3 corresponds to a wavelength of 380 nm on the spectral locus of the u' , v' colour space.



The decimal values at the Beziér curve give the distance from T_{∞} along the Beziér.

Figure 1 – Extension of the Planckian locus beyond T_{∞}

The coordinates $u'_{BB}(p)$ and $v'_{BB}(p)$ of the grid points on the Planckian locus (BB = Black Body) and the extension on the Planckian locus are given in Annex A and Annex B, as well as the unit increments $\Delta u'_{BB}(p)$ and $\Delta v'_{BB}(p)$ of the corresponding Judd isothermal lines.

The u' and v' coordinates of a grid point specified by the indices p and j are given by

$$u'(p, j) = u'_{BB}(p) + j \times \Delta u'_{BB}(p)$$

$$v'(p, j) = v'_{BB}(p) + j \times \Delta v'_{BB}(p)$$

or

$$u', v'(p, j) = (u'_{BB}(p) + j \times \Delta u'_{BB}(p); v'_{BB}(p) + j \times \Delta v'_{BB}(p))$$

The index $(p, j) = (0, 0)$ corresponds to the T_{∞} point and the coordinates are (rounded to five digits):

$$u'(0, 0) = 0,180\,06, v'(0, 0) = 0,395\,28 \text{ or}$$

$$u', v'(0, 0) = (0,180\,06; 0,395\,28)$$

Grid points in the u', v' coordinate system can be translated into equivalent grid points in the x, y coordinate system using the following equations:

$$x(p, j) = 9u'(p, j)/(6u'(p, j) - 16v'(p, j) + 12)$$

$$y(p, j) = 4v'(p, j)/(6u'(p, j) - 16v'(p, j) + 12)$$

It is recommended to round grid point coordinates to 5 digits after the decimal sign.

4.2 White colour bins

White colour bins are defined as the area inside a quadrilateral. An origin (p, j) and a positive step size m, n along the Planckian locus (or its extension beyond T_{∞}) and the Judd lines respectively is given. The quadrilateral is constructed by connecting the four grid points

$$[u', v' (p, j)], [u', v' (p+m, j)], [u', v' (p, j+n)] \text{ and } [u', v' (p+m, j+n)]$$

or

$$[x, y (p, j)], [x, y (p+m, j)], [x, y (p, j+n)] \text{ and } [x, y (p+m, j+n)]$$

It should be noted that white colour bins with step sizes of m or n equal 1 are not considered to be practical in view of measurement accuracy.

4.3 Code for the chromaticity of white LED packages

4.3.1 Optional six digit code for the designation of white colour bins

Subclause 4.3.1 specifies an optional code for white colour bins using only six digits. The first four digits are reserved for the identification of the grid point representing the origin of the white colour bin. The last two digits are reserved for the number of steps along the Planckian locus (or its extension beyond T_{∞}) and the Judd lines respectively.

The first digit is:

“e” for $p \geq 0$ and $j < 0$

“f” for $p \geq 0$ and $j \geq 0$

“g” for $p < 0$ and $j \geq 0$

“h” for $p < 0$ and $j < 0$

The second and third digits represent the absolute value of p starting at “aa”. Only the following letters shall be used in the counting for the second and third digit:

a b c d e f g h j k l m n p r s t u v w x y z

NOTE 1 The coding for the second and third digit can also be found in the column “Code” in Annex A ($p \geq 0$), respectively in Annex B ($p < 0$).

The code for $|p|$ is specified in Table 1.

Table 1 – Code for $|p|$

$ p $	0	1	...	7	8	...
code	aa	ab	...	ah	aj	...

The fourth digits represent the absolute value of j starting at “A”. Only the following letters shall be used in the counting for the fourth digit:

A B C D E F G H J K L M N P R S T U V W X Y Z

The code for $|j|$ is specified in Table 2.

NOTE 2 The fourth digit is limited to $|j| \leq 22$.

Table 2 – Code for $|j|$

$ j $	0	1	2	3	4	5	6	7	8	9	10
code	A	B	C	D	E	F	G	H	J	K	L

The fifth and sixth digits represent the number of steps m and n along the Planckian locus (or its extension beyond T_∞) and the Judd lines respectively. The following characters shall be used in the counting for the fifth and sixth digit:

(1) 2 3 4 5 6 7 8 9 a b c d e f g h j k l m n p r s t u v w x y z

The code for m and n is specified in Table 3.

NOTE 3 The fifth and sixth digit is limited to $|m| \leq 32$ respectively $|n| \leq 32$.

Table 3 – Code for m and n

m, n	...	8	9	10	11	...
code	...	8	9	a	b	...

Examples for white colour bin codes are given in Table 4.

Table 4 – Examples for white colour bin codes

p	j	m	n	6 digit code
0	0	2	3	faaA23
9	-3	5	6	eakD56
0	0	10	10	faaAaa
43	-3	6	8	ebxD68
41	-5	6	8	ebvF68
45	-1	6	8	ebzB68

An example of the codes of grid points around the T_∞ point is given in Figure 2.

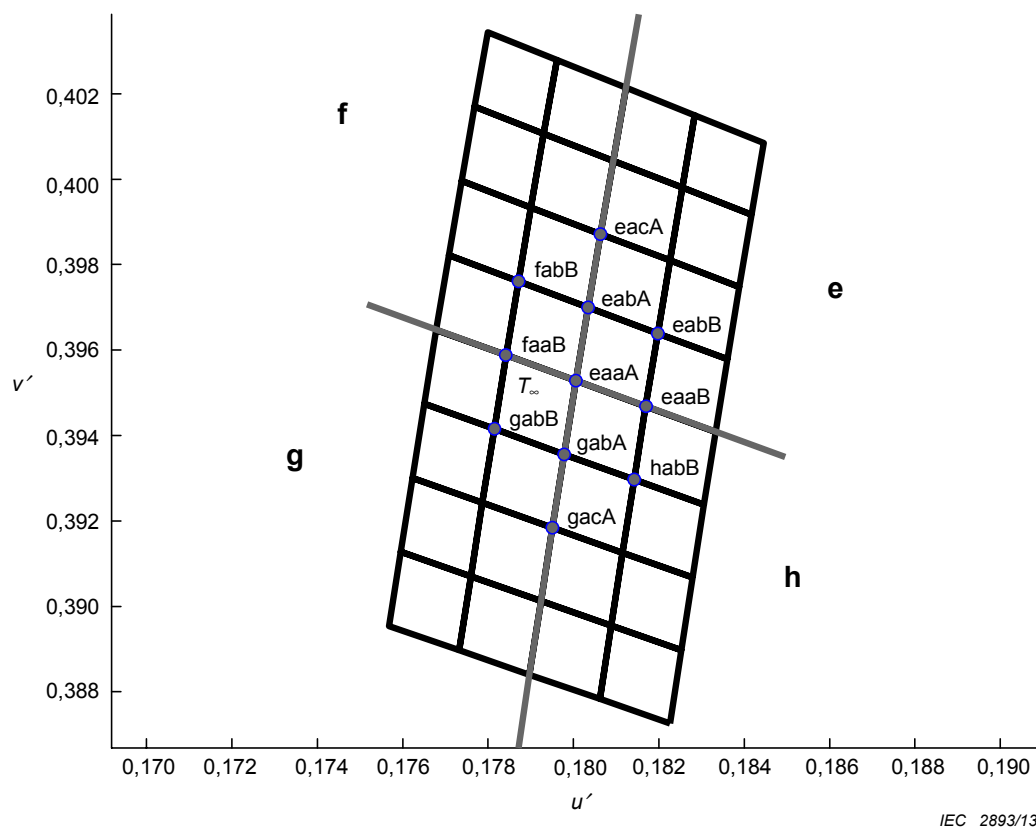
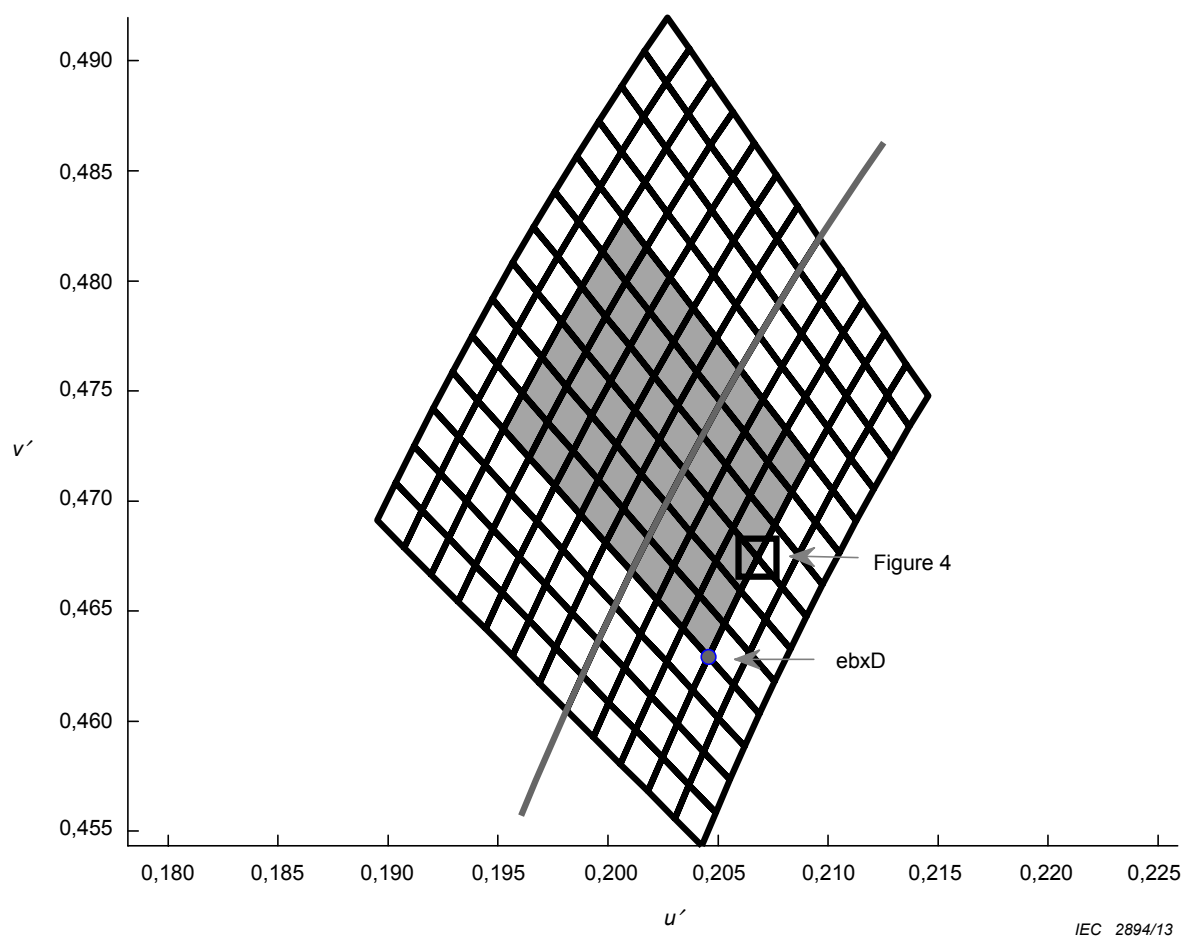


Figure 2 – Example of grid points with four digit designation

An example of a 6 by 8 white color bin with the six digit code is given in Figure 3.



The pale curve represents the Planckian locus.

Figure 3 – Example of white color bin ebxD68

Figure 4 is a detail of Figure 3 and shows the very small difference between the grid lines and the border lines of the bin.

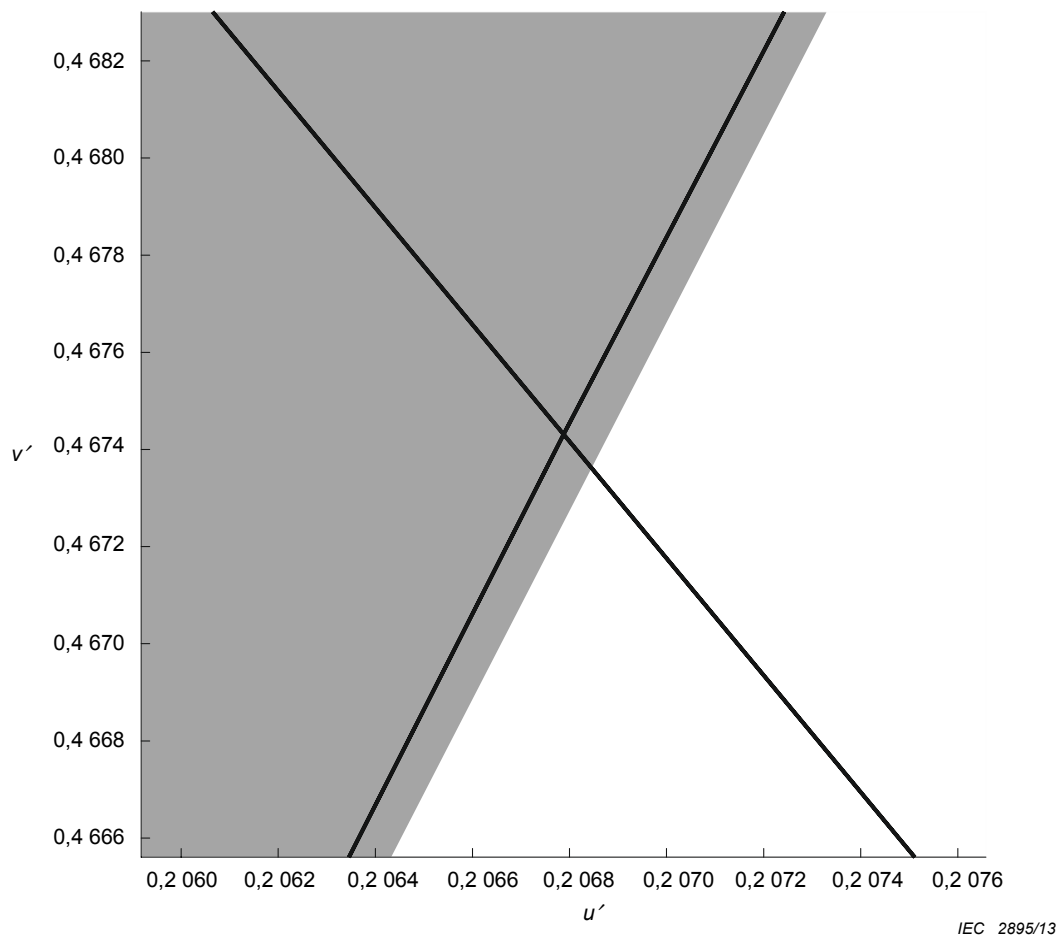


Figure 4 – Detail of Figure 3

4.3.2 Other codes for the designation of white colour bins

Other codes for the designation of white colour bins may be applicable (e. g. application-specific).

Annex A

(informative)

White binning grid coordinates for $p \geq 0$

**Table A.1 – White binning grid coordinates for the grid points
along the Planckian locus ($p \geq 0$)**

p	Code	u'_{BB}	v'_{BB}	$\Delta u'_{BB}$	$\Delta v'_{BB}$
0	aa	0,180064	0,395283	-0,00163	0,000597
1	ab	0,180346	0,397	-0,00163	0,000608
2	ac	0,180634	0,398716	-0,00163	0,00062
3	ad	0,180928	0,400431	-0,00162	0,000633
4	ae	0,181229	0,402145	-0,00162	0,000646
5	af	0,181537	0,403857	-0,00161	0,00066
6	ag	0,181853	0,405568	-0,0016	0,000674
7	ah	0,182176	0,407278	-0,0016	0,000689
8	aj	0,182508	0,408986	-0,00159	0,000704
9	ak	0,182848	0,410692	-0,00158	0,000719
10	al	0,183197	0,412397	-0,00158	0,000735
11	am	0,183554	0,4141	-0,00157	0,000751
12	an	0,183921	0,415801	-0,00156	0,000767
13	ap	0,184297	0,4175	-0,00155	0,000784
14	ar	0,184682	0,419196	-0,00154	0,000801
15	as	0,185078	0,420891	-0,00154	0,000817
16	at	0,185483	0,422583	-0,00153	0,000834
17	au	0,185899	0,424273	-0,00152	0,000852
18	av	0,186326	0,42596	-0,00151	0,000869
19	aw	0,186763	0,427644	-0,0015	0,000886
20	ax	0,187211	0,429325	-0,00149	0,000904
21	ay	0,18767	0,431003	-0,00148	0,000921
22	az	0,188141	0,432678	-0,00147	0,000939
23	ba	0,188623	0,43435	-0,00145	0,000956
24	bb	0,189118	0,436018	-0,00144	0,000974
25	bc	0,189624	0,437683	-0,00143	0,000992
26	bd	0,190143	0,439344	-0,00142	0,001009
27	be	0,190674	0,441001	-0,0014	0,001027
28	bf	0,191218	0,442654	-0,00139	0,001044
29	bg	0,191775	0,444302	-0,00138	0,001062
30	bh	0,192346	0,445946	-0,00136	0,001079
31	bj	0,192929	0,447585	-0,00135	0,001097
32	bk	0,193527	0,449219	-0,00134	0,001114
33	bl	0,194138	0,450848	-0,00132	0,001131
34	bm	0,194764	0,452472	-0,00131	0,001148
35	bn	0,195403	0,45409	-0,00129	0,001165
36	bp	0,196058	0,455702	-0,00128	0,001182

p	Code	u_{BB}^t	v_{BB}^t	Δu_{BB}^t	Δv_{BB}^t
37	br	0,196727	0,457309	-0,00126	0,001198
38	bs	0,197411	0,458908	-0,00125	0,001215
39	bt	0,198111	0,460502	-0,00123	0,001231
40	bu	0,198825	0,462088	-0,00121	0,001247
41	bv	0,199556	0,463667	-0,0012	0,001263
42	bw	0,200302	0,465239	-0,00118	0,001278
43	bx	0,201065	0,466803	-0,00116	0,001294
44	by	0,201844	0,468359	-0,00115	0,001309
45	bz	0,202639	0,469907	-0,00113	0,001323
46	ca	0,203451	0,471445	-0,00111	0,001338
47	cb	0,20428	0,472975	-0,00109	0,001352
48	cc	0,205126	0,474496	-0,00108	0,001367
49	cd	0,205989	0,476006	-0,00106	0,00138
50	ce	0,20687	0,477507	-0,00104	0,001394
51	cf	0,207768	0,478997	-0,00102	0,001407
52	cg	0,208685	0,480477	-0,00101	0,00142
53	ch	0,209619	0,481945	-0,00099	0,001433
54	cj	0,210571	0,483401	-0,00097	0,001445
55	ck	0,211541	0,484845	-0,00095	0,001457
56	cl	0,21253	0,486277	-0,00093	0,001469
57	cm	0,213537	0,487696	-0,00091	0,00148
58	cn	0,214562	0,489102	-0,0009	0,001491
59	cp	0,215606	0,490494	-0,00088	0,001502
60	cr	0,216669	0,491871	-0,00086	0,001513
61	cs	0,21775	0,493235	-0,00084	0,001523
62	ct	0,21885	0,494583	-0,00082	0,001533
63	cu	0,219969	0,495915	-0,00081	0,001543
64	cv	0,221107	0,497232	-0,00079	0,001552
65	cw	0,222263	0,498532	-0,00077	0,001561
66	cx	0,223437	0,499816	-0,00075	0,00157
67	cy	0,224631	0,501082	-0,00073	0,001578
68	cz	0,225842	0,502331	-0,00072	0,001586
69	da	0,227073	0,503562	-0,0007	0,001594
70	db	0,228321	0,504774	-0,00068	0,001601
71	dc	0,229587	0,505967	-0,00066	0,001609
72	dd	0,230871	0,507141	-0,00065	0,001615
73	de	0,232173	0,508296	-0,00063	0,001622
74	df	0,233492	0,50943	-0,00061	0,001628
75	dg	0,234829	0,510544	-0,0006	0,001635
76	dh	0,236182	0,511638	-0,00058	0,00164
77	dj	0,237552	0,512711	-0,00056	0,001646
78	dk	0,238939	0,513762	-0,00055	0,001651
79	dl	0,240341	0,514792	-0,00053	0,001657
80	dm	0,241759	0,515801	-0,00052	0,001662

p	Code	u'_{BB}	v'_{BB}	$\Delta u'_{BB}$	$\Delta v'_{BB}$
81	dn	0,243192	0,516787	-0,0005	0,001666
82	dp	0,24464	0,517752	-0,00049	0,001671
83	dr	0,246103	0,518694	-0,00047	0,001675
84	ds	0,24758	0,519614	-0,00046	0,001679
85	dt	0,24907	0,520512	-0,00044	0,001683
86	du	0,250574	0,521387	-0,00043	0,001686
87	dv	0,252091	0,52224	-0,00041	0,00169
88	dw	0,25362	0,52307	-0,0004	0,001693
89	dx	0,255161	0,523878	-0,00039	0,001696
90	dy	0,256714	0,524663	-0,00038	0,001699
91	dz	0,258278	0,525426	-0,00036	0,001702
92	ea	0,259852	0,526166	-0,00035	0,001704
93	eb	0,261437	0,526885	-0,00034	0,001707
94	ec	0,263032	0,527581	-0,00033	0,001709
95	ed	0,264636	0,528256	-0,00031	0,001711
96	ee	0,266248	0,528908	-0,0003	0,001714
97	ef	0,26787	0,52954	-0,00029	0,001715
98	eg	0,269499	0,53015	-0,00028	0,001717
99	eh	0,271136	0,530739	-0,00027	0,001719
100	ej	0,272781	0,531308	-0,00026	0,001721
101	ek	0,274432	0,531856	-0,00025	0,001722
102	el	0,27609	0,532383	-0,00024	0,001724
103	em	0,277755	0,532891	-0,00023	0,001725
104	en	0,279425	0,53338	-0,00022	0,001726
105	ep	0,2811	0,533849	-0,00021	0,001727
106	er	0,282781	0,534299	-0,0002	0,001728
107	es	0,284467	0,534731	-0,00019	0,001729
108	et	0,286157	0,535144	-0,00018	0,00173
109	eu	0,287851	0,53554	-0,00018	0,001731
110	ev	0,28955	0,535918	-0,00017	0,001732
111	ew	0,291252	0,536278	-0,00016	0,001733
112	ex	0,292957	0,536622	-0,00015	0,001733
113	ey	0,294666	0,53695	-0,00014	0,001734
114	ez	0,296378	0,537261	-0,00014	0,001735
115	fa	0,298093	0,537557	-0,00013	0,001735
116	fb	0,29981	0,537837	-0,00012	0,001736
117	fc	0,30153	0,538102	-0,00012	0,001736
118	fd	0,303252	0,538353	-0,00011	0,001737
119	fe	0,304976	0,538589	-0,0001	0,001737
120	ff	0,306701	0,538811	-9,6E-05	0,001737
121	fg	0,308429	0,53902	-9E-05	0,001738
122	fh	0,310158	0,539215	-8,4E-05	0,001738
123	fj	0,311888	0,539397	-7,8E-05	0,001738
124	fk	0,31362	0,539566	-7,3E-05	0,001738

p	Code	u'_{BB}	v'_{BB}	$\Delta u'_{BB}$	$\Delta v'_{BB}$
125	fl	0,315353	0,539724	-6,7E-05	0,001739
126	fm	0,317087	0,539869	-6,2E-05	0,001739
127	fn	0,318822	0,540002	-5,7E-05	0,001739
128	fp	0,320557	0,540124	-5,2E-05	0,001739
129	fr	0,322294	0,540235	-4,7E-05	0,001739
130	fs	0,324031	0,540335	-4,2E-05	0,001739
131	ft	0,325769	0,540424	-3,7E-05	0,00174
132	fu	0,327507	0,540503	-3,3E-05	0,00174
133	fv	0,329246	0,540573	-2,9E-05	0,00174
134	fw	0,330985	0,540632	-2,4E-05	0,00174
135	fx	0,332724	0,540682	-2E-05	0,00174
136	fy	0,334463	0,540723	-1,6E-05	0,00174
137	fz	0,336203	0,540755	-1,2E-05	0,00174
138	ga	0,337943	0,540778	-8,4E-06	0,00174
139	gb	0,339683	0,540793	-4,7E-06	0,00174
140	gc	0,341423	0,5408	-1,1E-06	0,00174
141	gd	0,343163	0,540798	2,4E-06	0,00174
142	ge	0,344903	0,540789	5,79E-06	0,00174
143	gf	0,346643	0,540772	9,09E-06	0,00174
144	gg	0,348383	0,540748	1,23E-05	0,00174
145	gh	0,350122	0,540717	1,54E-05	0,00174
146	gj	0,351862	0,540679	1,85E-05	0,00174
147	gk	0,353601	0,540634	2,14E-05	0,00174
148	gl	0,355341	0,540583	2,43E-05	0,00174
149	gm	0,35708	0,540525	2,71E-05	0,00174
150	gn	0,358818	0,540461	2,98E-05	0,00174
151	gp	0,360557	0,540391	3,24E-05	0,00174
152	gr	0,362295	0,540315	3,5E-05	0,00174
153	gs	0,364033	0,540234	3,75E-05	0,00174
154	gt	0,365771	0,540147	3,99E-05	0,00174
155	gu	0,367509	0,540055	4,22E-05	0,001739
156	gv	0,369246	0,539957	4,45E-05	0,001739
157	gw	0,370983	0,539855	4,67E-05	0,001739
158	gx	0,37272	0,539747	4,89E-05	0,001739
159	gy	0,374456	0,539635	5,09E-05	0,001739
160	gz	0,376192	0,539519	5,3E-05	0,001739
161	ha	0,377928	0,539397	5,49E-05	0,001739
162	hb	0,379663	0,539272	5,68E-05	0,001739
163	hc	0,381399	0,539142	5,87E-05	0,001739
164	hd	0,383133	0,539008	6,05E-05	0,001739
165	he	0,384868	0,538871	6,23E-05	0,001739
166	hf	0,386602	0,538729	6,4E-05	0,001739
167	hg	0,388336	0,538584	6,56E-05	0,001739
168	hh	0,39007	0,538435	6,72E-05	0,001739