IEC 62707-1

Edition 1.0 2013-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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

IEC 62707-1:2013

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX U

ICS 29.140.99

ISBN 978-2-8322-1282-0

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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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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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.

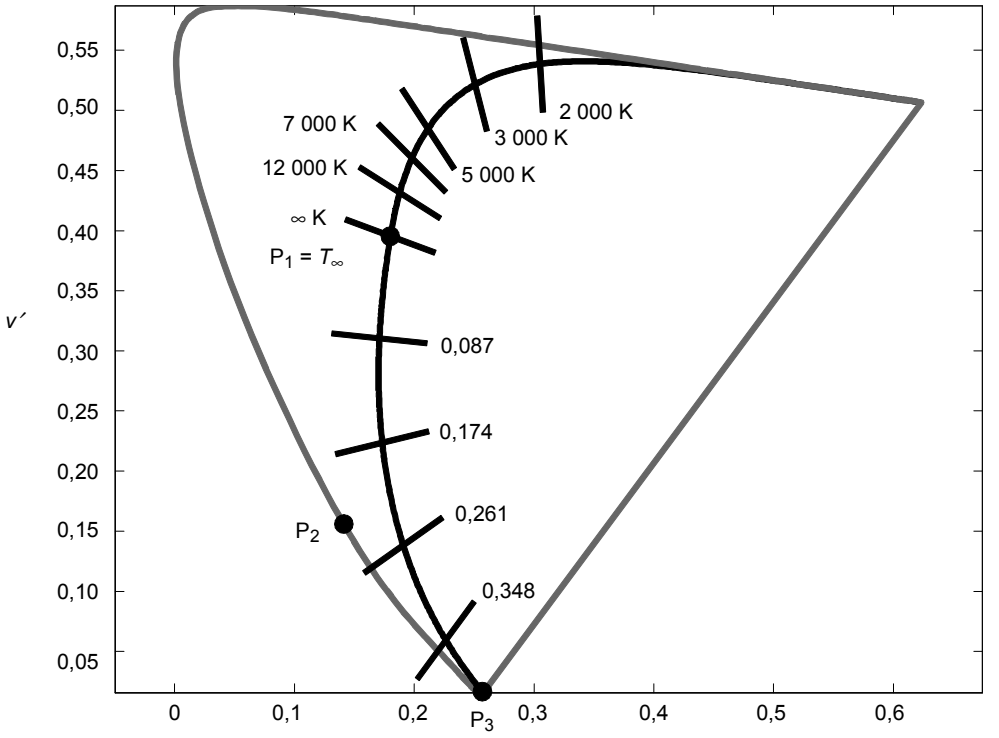
NOTE 1 s = 0,0017 4 has been chosen as providing for the best alignment with existing chromaticity requirements.

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 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)] and [u', v' (p+m, j+n)]

or

[x, y (p, j)], [x, y (p+m, j)], [x, y (p, j+n)] 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 forth 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| ≤ 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| ≤ 32 respectively |n| ≤ 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.

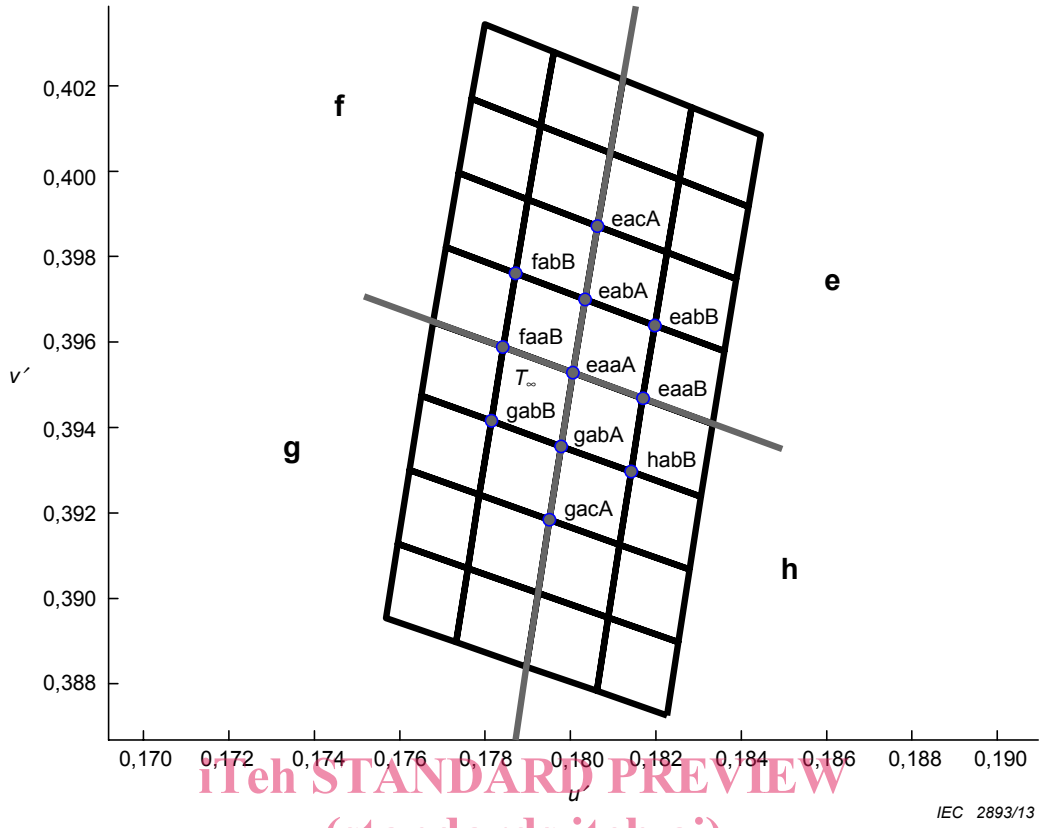
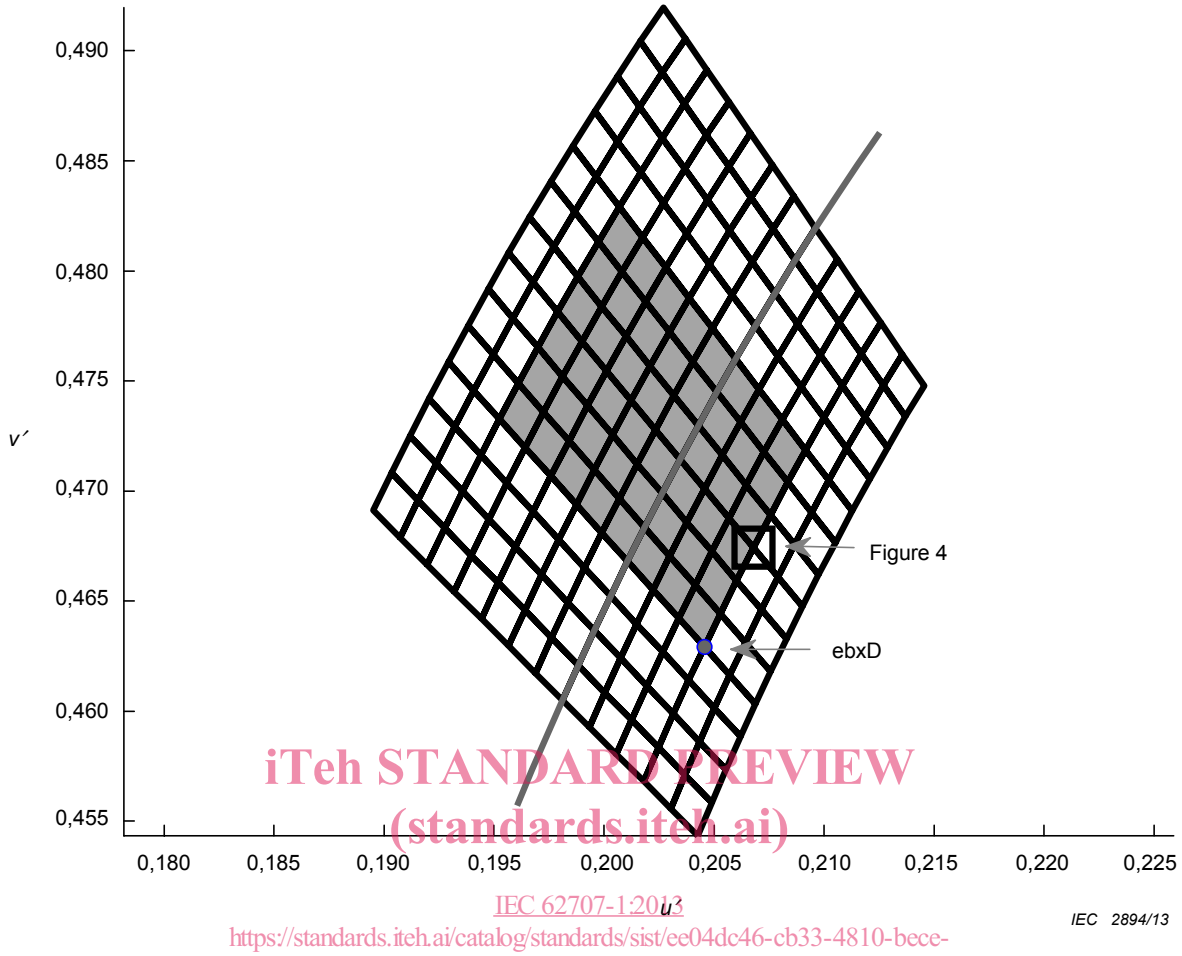


Figure 2 – Example of grid points with four digit designation

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.

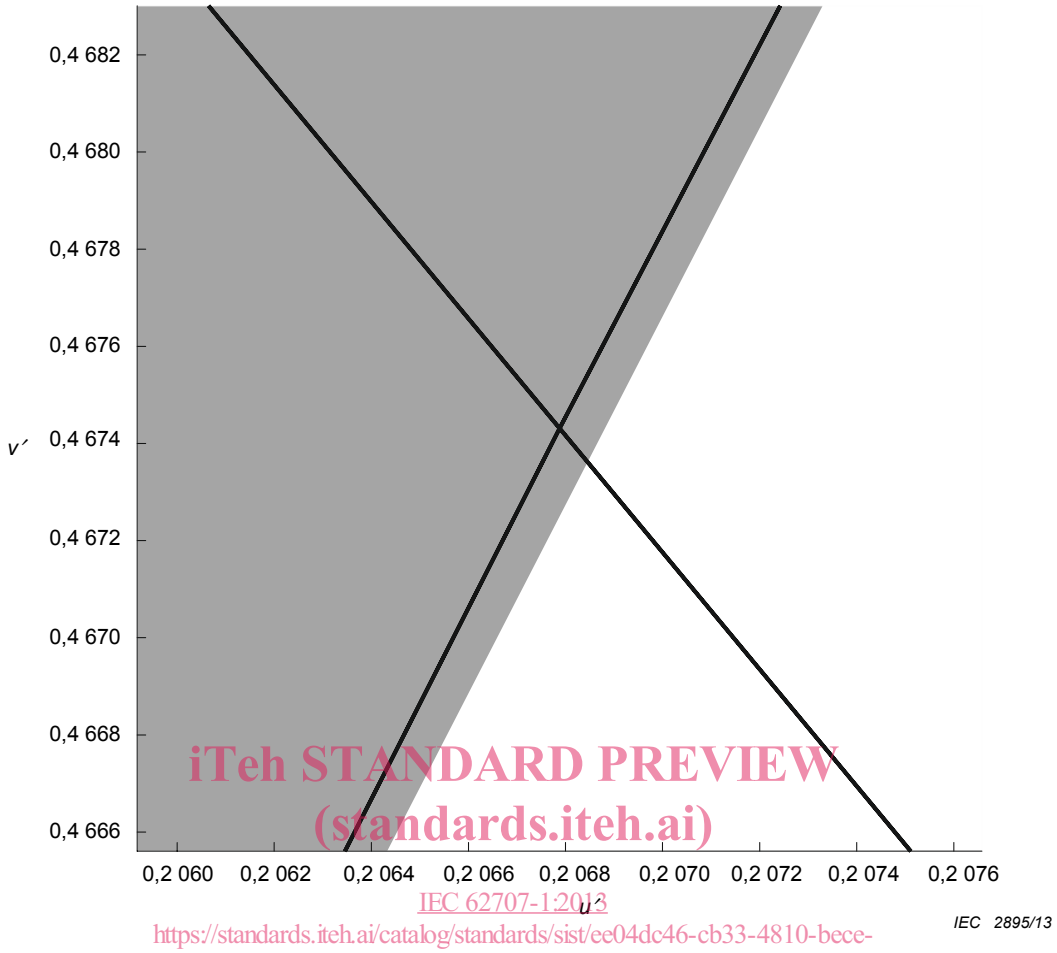


Figure 4 – Detail of Figure 3

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