

Orthogonal Array Lists

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This report provides a list of virtually all known strength-two orthogonal arrays up through 143 runs¹ (rows or factor combinations) and a list of additional orthogonal arrays up through 1,000 runs. At the end of these lists is a reference list of books and papers on orthogonal array construction. The reference list mostly covers newer and larger arrays. Many of the older arrays were created based on secondary sources such as *Orthogonal Fractional Factorial Designs* by Dey (1985); *Orthogonal Arrays* by Hedayat, Sloane, and Stufken (1999); and *A Library of Orthogonal Arrays*, by Sloane (2005). Their reference lists are not duplicated here. The work so far could not have happened without the work of many people over the span of over 110 years (the earliest reference in this list is an 1893 paper by the French mathematician Jacques Hadamard). This resource cannot continue to grow without your help. Thanks to Don Anderson, StatDesign; Warwick de Launey, Center for Communications Research; Nam-Ky Nguyen, Gendex; Shanqi Pang, Henan Normal University; Neil Sloane, AT&T Shannon Lab; Chung-yi Suen, Cleveland State University; Randy Tobias, SAS Institute Inc.; Ian Wakeling, Qi Statistics; J. C. Wang, Western Michigan University; and Yingshan Zhang, Henan Normal University, who have all kindly helped with some of the arrays in this catalog.

While the orthogonal array lists are virtually complete for the smaller arrays, new arrays are being discovered all the time. If you know of any arrays that are not in this catalog or references that should be in this list, please email Warren.Kuhfeld@sas.com. The goal is to create the most complete strength-two orthogonal array source ever assembled and to provide computerized tools that completely automate their construction.

The first listing presents strength-two orthogonal arrays up through 143 runs. The columns include the number of runs, the array, and the lineage or rules for making the array. The listing is sorted by the number of runs. Within runs, it is sorted by the number of two-level factors, then the number of three-level factors, and so on, all in descending order. Hence within runs, the arrays with the most two-level factors are listed first. The second column after the number of runs contains a running count of the number of arrays that can be made for this number of runs. The first array is 2^3 , which has 3 two-level factors in 4 runs. Further down the list you see $2^1 3^7$, which has 1 two-level factor and 7 three-level factors in 18 runs. The base is the number of levels and the exponent is the number of factors. Hence, $2^1 3^7$ means a $2 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$ design. All of these arrays are strength-two main-effects designs, which means that all level pairs occur equally often within every pair of columns.

The lineage of an array shows how it can be made from other arrays. Some arrays have no lineage. These arrays are called *parent* arrays. They are constructed in many different ways—some with simple algebra, some with very complicated algebra, and others through computerized searches. The remaining arrays are constructed from the parents. For example, the array 2^7 has a lineage of $2^4 4^1$, $4^1 \rightarrow 2^3$, which means it can be made from $2^4 4^1$ by replacing 4^1 with copies of the array 2^3 in 4 runs. The first part of the lineage gives the parent array, which will always have the same number of runs as the array of interest. Subsequent parts of the lineage show how to replace one or more factors in the parent with copies of smaller arrays that appear before this array in the listing. The replacement array appears after the arrow (for example, the 2^3 in $4^1 \rightarrow 2^3$). The factor that

¹There are a few missing designs in 108 runs. I would welcome help in making them.

needs to be replaced appears before the arrow, and it also gives the number of runs in the replacement array. The exponent on this factor will always be 1. Some replacements, particularly for four-level factors, might occur more than once. The lineage provides information on what to do. The number of times it needs to happen is not explicitly stated in this listing, but it is obvious from the context. Consider, for example, the array 2^{15} whose lineage consists of $4^5, 4^1 \rightarrow 2^3$. 4^1 must be replaced by 2^3 a total of 5 times. The lineage does not consist of something like $4^5, 4^5 \rightarrow 2^{15}$ because that would hide the critical information that it is the array 2^3 that is needed to make the larger array. The array 4^5 becomes $2^3 4^4$ after the first replacement. This array has too many four-level factors and not enough two-level factors, so $2^3 4^4$ becomes $2^6 4^3$, which becomes $2^9 4^2$, which becomes $2^{12} 4^1$, which finally, after the last replacement, becomes 2^{15} , the desired result.

Replacing a four-level factor by 3 two-level factors consists of replacing: a 0 in the four-level factor by the first row of the 2^3 array, a 1 in the four-level factor by the second row of 2^3 , and so on. More generally, to replace a p -level factor by an array in p runs, replace level $i = 0, \dots, p - 1$ with row $i + 1$ of the array in p runs. The following example illustrates:

$2^4 4^1, n = 8$	and	$2^3, n = 4$	makes	$2^7, n = 8$	where	$4^1 \rightarrow 2^3$
0000 0		000		0000 000		0 \rightarrow 000
0011 2		011		0011 101		1 \rightarrow 011
0101 1		101		0101 011		2 \rightarrow 101
0110 3		110		0110 110		3 \rightarrow 110
1001 3				1001 110		
1010 1				1010 011		
1100 2				1100 101		
1111 0				1111 000		

In practice, you never have to actually do any of this because the SAS macro %MktEx does it all for you. See the Web book *Marketing Research Methods in SAS* for more information on the %MktEx macro, which automates orthogonal array and nonorthogonal factorial design creation. In particular, see the chapters “Experimental Design and Choice Modeling Macros” and “Discrete Choice” for documentation and numerous examples of its use. The book and macros are free on the Web at http://support.sas.com/techsup/tnote/tnote_stat.html#market.

The following examples show how easy it is to run %MktEx to get orthogonal arrays:

```
%mktex(2 ** 15, n=16)
%mktex(2 3 ** 7, n=18)
%mktex(2 ** 18 4 4 8, n=32)
```

However, %MktEx has many more options because it has many other capabilities, including facilities for making highly restricted designs. While the examples in *Marketing Research Methods in SAS* have a marketing research orientation, researchers in many other areas use %MktEx to make designs for a variety of purposes.

When orthogonal arrays are not available, the %MktEx macro automatically constructs a D -efficient nonorthogonal design. For $3^{15} 2^5$ in 36 runs, %MktEx usually makes a design that is mostly orthogonal but with a few correlated factors. For 2^{31} in 33 runs (which is an unusual request, since there is an orthogonal array in 32 runs), %MktEx makes a design that is nonorthogonal but with all factors slightly and equally correlated.

```
%mktex(3 ** 15 2 ** 5, n=36)
```

```
%mktex(2 ** 31, n=33)
```

%MktEx can also make designs with interactions and complicated restrictions.

While this listing shows virtually all known orthogonal arrays up to 143 runs, it does not contain all known lineages for each orthogonal array, nor does it indicate that many orthogonal arrays, including many parent arrays, can be made in multiple ways. For example, the array 2^7 in 8 runs can alternatively be constructed as a Hadamard array based on the fact that $8-1 = 7$ is prime or based on the fact that $8 = 2^3$. The page http://support.sas.com/techsup/technote/ts723_Designs.txt provides one orthogonal array for every parent in this listing (except for the full-factorial designs, which require no special expertise to generate). Also see Neil Sloane's orthogonal array page, <http://neilsloane.com/oadir/>. Sloane's page provides many strength two-orthogonal arrays including some arrays that are alternatives to the ones shown here. His page also contains arrays of strength greater than 2, assorted Hadamard matrices constructed in alternative ways, and many other useful designs not covered here. There is also a link to the official Web page for the 1999 book *Orthogonal Arrays* by Hedayat, Sloane, and Stufken.

Runs	Count	Design	Lineage
4	1	2^3	
6	1	$2^1 3^1$	
8	1	2^7	$2^4 4^1, 4^1 \rightarrow 2^3$
8	2	$2^4 4^1$	
9	1	3^4	
10	1	$2^1 5^1$	
12	1	2^{11}	
12	2	$2^4 3^1$	
12	3	$2^2 6^1$	
12	4	$3^1 4^1$	
14	1	$2^1 7^1$	
15	1	$3^1 5^1$	
16	1	2^{15}	$4^5, 4^1 \rightarrow 2^3$
16	2	$2^{12} 4^1$	$4^5, 4^1 \rightarrow 2^3$
16	3	$2^9 4^2$	$4^5, 4^1 \rightarrow 2^3$
16	4	$2^8 8^1$	
16	5	$2^6 4^3$	$4^5, 4^1 \rightarrow 2^3$
16	6	$2^3 4^4$	$4^5, 4^1 \rightarrow 2^3$
16	7	4^5	
18	1	$2^1 3^7$	$3^6 6^1, 6^1 \rightarrow 2^1 3^1$
18	2	$2^1 9^1$	
18	3	$3^6 6^1$	
20	1	2^{19}	
20	2	$2^8 5^1$	
20	3	$2^2 10^1$	
20	4	$4^1 5^1$	
21	1	$3^1 7^1$	
22	1	$2^1 11^1$	
24	1	2^{23}	$2^{20} 4^1, 4^1 \rightarrow 2^3$
24	2	$2^{20} 4^1$	
24	3	$2^{16} 3^1$	$2^{13} 3^1 4^1, 4^1 \rightarrow 2^3$
24	4	$2^{14} 6^1$	$2^{11} 4^1 6^1, 4^1 \rightarrow 2^3$
24	5	$2^{13} 3^1 4^1$	
24	6	$2^{12} 12^1$	
24	7	$2^{11} 4^1 6^1$	

Runs	Count	Design	Lineage
24	8	$3^1 8^1$	
25	1	5^6	
26	1	$2^1 13^1$	
27	1	3^{13}	$3^9 9^1, 9^1 \rightarrow 3^4$
27	2	$3^9 9^1$	
28	1	2^{27}	
28	2	$2^{12} 7^1$	
28	3	$2^2 14^1$	
28	4	$4^1 7^1$	
30	1	$2^1 3^1 5^1$	$2^1 15^1, 15^1 \rightarrow 3^1 5^1$
30	2	$2^1 15^1$	
30	3	$3^1 10^1$	
30	4	$5^1 6^1$	
32	1	2^{31}	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	2	$2^{28} 4^1$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	3	$2^{25} 4^2$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	4	$2^{24} 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	5	$2^{22} 4^3$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	6	$2^{21} 4^1 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	7	$2^{19} 4^4$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	8	$2^{18} 4^2 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	9	$2^{16} 4^5$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	10	$2^{16} 16^1$	
32	11	$2^{15} 4^3 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	12	$2^{13} 4^6$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	13	$2^{12} 4^4 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	14	$2^{10} 4^7$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	15	$2^9 4^5 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	16	$2^7 4^8$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
32	17	$2^6 4^6 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	18	$2^4 4^9$	$4^8 8^1, 8^1 \rightarrow 2^4 4^1$
32	19	$2^3 4^7 8^1$	$4^8 8^1, 4^1 \rightarrow 2^3$
32	20	$4^8 8^1$	
33	1	$3^1 11^1$	
34	1	$2^1 17^1$	
35	1	$5^1 7^1$	
36	1	2^{35}	
36	2	$2^{27} 3^1$	

Runs	Count	Design	Lineage
36	3	$2^{20}3^2$	
36	4	$2^{18}3^16^1$	
36	5	$2^{16}3^4$	$2^{16}9^1, 9^1 \rightarrow 3^4$
36	6	$2^{16}9^1$	
36	7	$2^{13}3^26^1$	
36	8	$2^{13}6^2$	
36	9	$2^{11}3^{12}$	$3^{12}12^1, 12^1 \rightarrow 2^{11}$
36	10	$2^{10}3^86^1$	
36	11	$2^{10}3^16^2$	
36	12	$2^93^46^2$	
36	13	2^86^3	
36	14	2^43^{13}	$3^{12}12^1, 12^1 \rightarrow 2^43^1$
36	15	$2^43^16^3$	
36	16	$2^33^96^1$	
36	17	$2^33^26^3$	
36	18	$2^23^{12}6^1$	$3^{12}12^1, 12^1 \rightarrow 2^26^1$
36	19	$2^23^56^2$	
36	20	2^218^1	
36	21	$2^13^86^2$	$3^76^3, 6^1 \rightarrow 2^13^1$
36	22	$2^13^36^3$	
36	23	$3^{13}4^1$	$3^{12}12^1, 12^1 \rightarrow 3^{14}1$
36	24	$3^{12}12^1$	
36	25	3^76^3	
36	26	4^19^1	
38	1	2^119^1	
39	1	3^113^1	
40	1	2^{39}	$2^{36}4^1, 4^1 \rightarrow 2^3$
40	2	$2^{36}4^1$	
40	3	$2^{28}5^1$	$2^{25}4^15^1, 4^1 \rightarrow 2^3$
40	4	$2^{25}4^15^1$	
40	5	$2^{22}10^1$	$2^{19}4^110^1, 4^1 \rightarrow 2^3$
40	6	$2^{20}20^1$	
40	7	$2^{19}4^110^1$	
40	8	5^18^1	
42	1	$2^13^17^1$	$6^17^1, 6^1 \rightarrow 2^13^1$
42	2	2^121^1	
42	3	3^114^1	
42	4	6^17^1	
44	1	2^{43}	
44	2	$2^{16}11^1$	
44	3	2^222^1	
44	4	4^111^1	

Runs	Count	Design	Lineage
45	1	$3^{10}5^1$	$3^9 15^1, 15^1 \rightarrow 3^1 5^1$
45	2	$3^9 15^1$	
45	3	$5^1 9^1$	
46	1	$2^1 23^1$	
48	1	2^{47}	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	2	$2^{44} 4^1$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	3	$2^{41} 4^2$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	4	$2^{40} 3^1$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	5	$2^{40} 8^1$	
48	6	$2^{38} 4^3$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	7	$2^{38} 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	8	$2^{37} 3^1 4^1$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	9	$2^{36} 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	10	$2^{35} 4^4$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	11	$2^{35} 4^1 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	12	$2^{34} 3^1 4^2$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	13	$2^{33} 3^1 8^1$	
48	14	$2^{33} 4^1 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	15	$2^{32} 4^5$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	16	$2^{32} 4^2 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	17	$2^{31} 3^1 4^3$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	18	$2^{31} 6^1 8^1$	
48	19	$2^{30} 4^2 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	20	$2^{29} 4^6$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	21	$2^{29} 4^3 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	22	$2^{28} 3^1 4^4$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	23	$2^{27} 4^3 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	24	$2^{26} 4^7$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	25	$2^{26} 4^4 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	26	$2^{25} 3^1 4^5$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	27	$2^{24} 4^4 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	28	$2^{24} 24^1$	
48	29	$2^{23} 4^8$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	30	$2^{23} 4^5 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	31	$2^{22} 3^1 4^6$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	32	$2^{21} 4^5 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	33	$2^{20} 4^9$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	34	$2^{20} 4^6 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	35	$2^{19} 3^1 4^7$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	36	$2^{18} 4^6 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	37	$2^{17} 4^{10}$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	38	$2^{17} 4^7 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$
48	39	$2^{16} 3^1 4^8$	$4^{12} 12^1, 12^1 \rightarrow 2^{43^1}, 4^1 \rightarrow 2^3$
48	40	$2^{15} 4^7 12^1$	$4^{12} 12^1, 4^1 \rightarrow 2^3$
48	41	$2^{14} 4^{11}$	$4^{12} 12^1, 12^1 \rightarrow 2^{11}, 4^1 \rightarrow 2^3$
48	42	$2^{14} 4^8 6^1$	$4^{12} 12^1, 12^1 \rightarrow 2^2 6^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
48	43	$2^{13}3^14^9$	$4^{12}12^1, 12^1 \rightarrow 2^43^1, 4^1 \rightarrow 2^3$
48	44	$2^{12}4^812^1$	$4^{12}12^1, 4^1 \rightarrow 2^3$
48	45	$2^{11}4^{12}$	$4^{12}12^1, 12^1 \rightarrow 2^{11}$
48	46	$2^{11}4^96^1$	$4^{12}12^1, 12^1 \rightarrow 2^26^1, 4^1 \rightarrow 2^3$
48	47	$2^{10}3^14^{10}$	$4^{12}12^1, 12^1 \rightarrow 2^43^1, 4^1 \rightarrow 2^3$
48	48	$2^94^912^1$	$4^{12}12^1, 4^1 \rightarrow 2^3$
48	49	$2^84^{10}6^1$	$4^{12}12^1, 12^1 \rightarrow 2^26^1, 4^1 \rightarrow 2^3$
48	50	$2^73^14^{11}$	$4^{12}12^1, 12^1 \rightarrow 2^43^1, 4^1 \rightarrow 2^3$
48	51	$2^64^{10}12^1$	$4^{12}12^1, 4^1 \rightarrow 2^3$
48	52	$2^54^{11}6^1$	$4^{12}12^1, 12^1 \rightarrow 2^26^1, 4^1 \rightarrow 2^3$
48	53	$2^43^14^{12}$	$4^{12}12^1, 12^1 \rightarrow 2^43^1$
48	54	$2^34^{11}12^1$	$4^{12}12^1, 4^1 \rightarrow 2^3$
48	55	$2^24^{12}6^1$	$4^{12}12^1, 12^1 \rightarrow 2^26^1$
48	56	3^14^{13}	$4^{12}12^1, 12^1 \rightarrow 3^14^1$
48	57	3^16^1	
48	58	$4^{12}12^1$	
49	1	7^8	
50	1	2^15^{11}	$5^{10}10^1, 10^1 \rightarrow 2^15^1$
50	2	2^125^1	
50	3	$5^{10}10^1$	
51	1	3^117^1	
52	1	2^{51}	
52	2	$2^{17}13^1$	
52	3	2^226^1	
52	4	4^113^1	
54	1	2^13^{25}	$3^{20}6^19^1, 9^1 \rightarrow 3^4, 6^1 \rightarrow 2^13^1$
54	2	$2^13^{21}9^1$	$3^{20}6^19^1, 6^1 \rightarrow 2^13^1$
54	3	2^127^1	
54	4	$3^{24}6^1$	$3^{20}6^19^1, 9^1 \rightarrow 3^4$
54	5	$3^{20}6^19^1$	
54	6	$3^{18}18^1$	
55	1	5^111^1	
56	1	2^{55}	$2^{52}4^1, 4^1 \rightarrow 2^3$
56	2	$2^{52}4^1$	
56	3	$2^{40}7^1$	$2^{37}4^17^1, 4^1 \rightarrow 2^3$
56	4	$2^{37}4^17^1$	
56	5	$2^{30}14^1$	$2^{27}4^114^1, 4^1 \rightarrow 2^3$
56	6	$2^{28}28^1$	
56	7	$2^{27}4^114^1$	
56	8	7^18^1	
57	1	3^119^1	

Runs	Count	Design	Lineage
58	1	$2^1 29^1$	
60	1	2^{59}	
60	2	$2^{30} 3^1$	
60	3	$2^{24} 6^1$	
60	4	$2^{23} 5^1$	
60	5	$2^{21} 10^1$	
60	6	$2^{18} 3^1 5^1$	$2^{18} 15^1, 15^1 \rightarrow 3^1 5^1$
60	7	$2^{18} 15^1$	
60	8	$2^{16} 3^1 10^1$	$2^{15} 6^1 10^1, 6^1 \rightarrow 2^1 3^1$
60	9	$2^{16} 5^1 6^1$	$2^{15} 6^1 10^1, 10^1 \rightarrow 2^1 5^1$
60	10	$2^{15} 6^1 10^1$	
60	11	$2^2 30^1$	
60	12	$3^1 4^1 5^1$	$4^1 15^1, 15^1 \rightarrow 3^1 5^1$
60	13	$3^1 20^1$	
60	14	$4^1 15^1$	
60	15	$5^1 12^1$	
62	1	$2^1 31^1$	
63	1	$3^{13} 7^1$	$3^{12} 21^1, 21^1 \rightarrow 3^1 7^1$
63	2	$3^{12} 21^1$	
63	3	$7^1 9^1$	
64	1	$2^6 3$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	2	$2^6 0 4^1$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	3	$2^5 7 4^2$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	4	$2^5 6 8^1$	$2^5 4^{17} 8^1, 4^1 \rightarrow 2^3$
64	5	$2^5 4^3$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	6	$2^5 3 4^{18} 1$	$2^5 4^{17} 8^1, 4^1 \rightarrow 2^3$
64	7	$2^5 1 4^4$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	8	$2^5 0 4^2 8^1$	$2^5 4^{17} 8^1, 4^1 \rightarrow 2^3$
64	9	$2^4 9 8^2$	$4^{14} 8^3, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
64	10	$2^4 8 4^5$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	11	$2^4 8 16^1$	$4^{16} 16^1, 4^1 \rightarrow 2^3$
64	12	$2^4 7 4^3 8^1$	$2^5 4^{17} 8^1, 4^1 \rightarrow 2^3$
64	13	$2^4 6 4^{18} 2$	$4^{14} 8^3, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
64	14	$2^4 5 4^6$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	15	$2^4 5 4^1 16^1$	$4^{16} 16^1, 4^1 \rightarrow 2^3$
64	16	$2^4 4 4^4 8^1$	$2^5 4^{17} 8^1, 4^1 \rightarrow 2^3$
64	17	$2^4 3 4^2 8^2$	$4^{14} 8^3, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
64	18	$2^4 2 4^7$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	19	$2^4 2 4^2 16^1$	$4^{16} 16^1, 4^1 \rightarrow 2^3$
64	20	$2^4 2 8^3$	$4^{14} 8^3, 4^1 \rightarrow 2^3$
64	21	$2^4 1 4^5 8^1$	$2^5 4^{17} 8^1, 4^1 \rightarrow 2^3$
64	22	$2^4 0 4^3 8^2$	$4^{14} 8^3, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
64	23	$2^3 9 4^8$	$4^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	24	$2^3 9 4^3 16^1$	$4^{16} 16^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
64	25	$2^{39}4^18^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	26	$2^{38}4^68^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	27	$2^{37}4^48^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	28	$2^{36}4^9$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	29	$2^{36}4^416^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	30	$2^{36}4^28^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	31	$2^{35}4^78^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	32	$2^{35}8^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	33	$2^{34}4^58^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	34	$2^{33}4^{10}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	35	$2^{33}4^516^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	36	$2^{33}4^38^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	37	$2^{32}4^88^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	38	$2^{32}4^{18}4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	39	$2^{32}32^1$	
64	40	$2^{31}4^68^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	41	$2^{30}4^{11}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	42	$2^{30}4^616^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	43	$2^{30}4^48^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	44	$2^{29}4^98^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	45	$2^{29}4^28^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	46	$2^{28}4^78^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	47	$2^{28}8^5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	48	$2^{27}4^{12}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	49	$2^{27}4^716^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	50	$2^{27}4^58^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	51	$2^{26}4^{10}8^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	52	$2^{26}4^38^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	53	$2^{25}4^88^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	54	$2^{25}4^{18}5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	55	$2^{24}4^{13}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	56	$2^{24}4^816^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	57	$2^{24}4^68^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	58	$2^{23}4^{11}8^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	59	$2^{23}4^48^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	60	$2^{22}4^98^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	61	$2^{22}4^28^5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	62	$2^{21}4^{14}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	63	$2^{21}4^916^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	64	$2^{21}4^78^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	65	$2^{21}8^6$	$4^78^6, 4^1 \rightarrow 2^3$
64	66	$2^{20}4^{12}8^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	67	$2^{20}4^58^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	68	$2^{19}4^{10}8^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	69	$2^{19}4^38^5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	70	$2^{18}4^{15}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	71	$2^{18}4^{10}16^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	72	$2^{18}4^88^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
64	73	$2^{18}4^18^6$	$4^78^6, 4^1 \rightarrow 2^3$
64	74	$2^{17}4^{13}8^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	75	$2^{17}4^68^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	76	$2^{16}4^{11}8^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	77	$2^{16}4^48^5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	78	$2^{15}4^{16}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	79	$2^{15}4^{11}16^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	80	$2^{15}4^98^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	81	$2^{15}4^28^6$	$4^78^6, 4^1 \rightarrow 2^3$
64	82	$2^{14}4^{14}8^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	83	$2^{14}4^78^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	84	$2^{14}8^7$	$8^9, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	85	$2^{13}4^{12}8^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	86	$2^{13}4^58^5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	87	$2^{12}4^{17}$	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	88	$2^{12}4^{12}16^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	89	$2^{12}4^{10}8^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	90	$2^{12}4^38^6$	$4^78^6, 4^1 \rightarrow 2^3$
64	91	$2^{11}4^{15}8^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	92	$2^{11}4^88^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	93	$2^{11}4^18^7$	$8^9, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	94	$2^{10}4^{13}8^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	95	$2^{10}4^68^5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	96	2^94^{18}	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	97	$2^94^{13}16^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	98	$2^94^{11}8^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	99	$2^94^48^6$	$4^78^6, 4^1 \rightarrow 2^3$
64	100	$2^84^{16}8^1$	$2^54^{17}8^1, 4^1 \rightarrow 2^3$
64	101	$2^84^98^4$	$2^54^{10}8^4, 4^1 \rightarrow 2^3$
64	102	$2^84^28^7$	$8^9, 8^1 \rightarrow 2^44^1$
64	103	$2^74^{14}8^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	104	$2^74^78^5$	$4^78^6, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	105	2^78^8	$8^9, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
64	106	2^64^{19}	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	107	$2^64^{14}16^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	108	$2^64^{12}8^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	109	$2^64^58^6$	$4^78^6, 4^1 \rightarrow 2^3$
64	110	$2^54^{17}8^1$	
64	111	$2^54^{10}8^4$	
64	112	$2^44^{15}8^2$	$4^{14}8^3, 8^1 \rightarrow 2^44^1$
64	113	$2^44^88^5$	$4^78^6, 8^1 \rightarrow 2^44^1$
64	114	$2^44^18^8$	$8^9, 8^1 \rightarrow 2^44^1$
64	115	2^34^{20}	$4^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
64	116	$2^34^{15}16^1$	$4^{16}16^1, 4^1 \rightarrow 2^3$
64	117	$2^34^{13}8^3$	$4^{14}8^3, 4^1 \rightarrow 2^3$
64	118	$2^34^68^6$	$4^78^6, 4^1 \rightarrow 2^3$
64	119	4^{21}	$4^{16}16^1, 16^1 \rightarrow 4^5$
64	120	$4^{16}16^1$	

Runs	Count	Design	Lineage
64	121	$4^{14}8^3$	
64	122	4^78^6	
64	123	8^9	
65	1	5^113^1	
66	1	$2^13^111^1$	$2^133^1, 33^1 \rightarrow 3^111^1$
66	2	2^133^1	
66	3	3^122^1	
66	4	6^111^1	
68	1	2^{67}	
68	2	$2^{19}17^1$	
68	3	2^234^1	
68	4	4^117^1	
69	1	3^123^1	
70	1	$2^15^17^1$	$2^135^1, 35^1 \rightarrow 5^17^1$
70	2	2^135^1	
70	3	5^114^1	
70	4	7^110^1	
72	1	2^{71}	$2^{68}4^1, 4^1 \rightarrow 2^3$
72	2	$2^{68}4^1$	
72	3	$2^{63}3^1$	$2^{60}3^14^1, 4^1 \rightarrow 2^3$
72	4	$2^{60}3^14^1$	
72	5	$2^{56}3^2$	$2^{53}3^24^1, 4^1 \rightarrow 2^3$
72	6	$2^{54}3^16^1$	$2^{51}3^14^16^1, 4^1 \rightarrow 2^3$
72	7	$2^{53}3^24^1$	
72	8	$2^{52}3^4$	$2^{49}4^19^1, 9^1 \rightarrow 3^4, 4^1 \rightarrow 2^3$
72	9	$2^{52}9^1$	$2^{49}4^19^1, 4^1 \rightarrow 2^3$
72	10	$2^{51}3^14^16^1$	
72	11	$2^{49}3^44^1$	$2^{49}4^19^1, 9^1 \rightarrow 3^4$
72	12	$2^{49}3^26^1$	$2^{46}3^24^16^1, 4^1 \rightarrow 2^3$
72	13	$2^{49}4^19^1$	
72	14	$2^{49}6^2$	$2^{46}4^16^2, 4^1 \rightarrow 2^3$
72	15	$2^{47}3^{12}$	$2^{44}3^{12}4^1, 4^1 \rightarrow 2^3$
72	16	$2^{46}3^86^1$	$2^{43}3^84^16^1, 4^1 \rightarrow 2^3$
72	17	$2^{46}3^24^16^1$	
72	18	$2^{46}3^16^2$	$2^{43}3^14^16^2, 4^1 \rightarrow 2^3$
72	19	$2^{46}4^16^2$	
72	20	$2^{45}3^46^2$	$2^{42}3^44^16^2, 4^1 \rightarrow 2^3$
72	21	$2^{44}3^{12}4^1$	
72	22	$2^{44}6^3$	$2^{41}4^16^3, 4^1 \rightarrow 2^3$
72	23	$2^{43}3^84^16^1$	
72	24	$2^{43}3^14^16^2$	
72	25	$2^{42}3^44^16^2$	

Runs	Count	Design	Lineage
72	26	$2^{41}4^16^3$	
72	27	$2^{40}3^{13}$	$2^{37}3^{13}4^1, 4^1 \rightarrow 2^3$
72	28	$2^{40}3^16^3$	$2^{37}3^14^16^3, 4^1 \rightarrow 2^3$
72	29	$2^{39}3^96^1$	$2^{36}3^94^16^1, 4^1 \rightarrow 2^3$
72	30	$2^{39}3^26^3$	$2^{36}3^24^16^3, 4^1 \rightarrow 2^3$
72	31	$2^{38}3^{12}6^1$	$2^{35}3^{12}4^16^1, 4^1 \rightarrow 2^3$
72	32	$2^{38}3^56^2$	$2^{35}3^54^16^2, 4^1 \rightarrow 2^3$
72	33	$2^{38}18^1$	$2^{35}4^118^1, 4^1 \rightarrow 2^3$
72	34	$2^{37}3^{13}4^1$	
72	35	$2^{37}3^86^2$	$2^{34}3^84^16^2, 4^1 \rightarrow 2^3$
72	36	$2^{37}3^36^3$	$2^{34}3^34^16^3, 4^1 \rightarrow 2^3$
72	37	$2^{37}3^14^16^3$	
72	38	$2^{36}3^{12}12^1$	$2^{36}36^1, 36^1 \rightarrow 3^{12}12^1$
72	39	$2^{36}3^94^16^1$	
72	40	$2^{36}3^76^3$	$2^{36}36^1, 36^1 \rightarrow 3^76^3$
72	41	$2^{36}3^24^16^3$	
72	42	$2^{36}36^1$	
72	43	$2^{35}3^{12}4^16^1$	
72	44	$2^{35}3^54^16^2$	
72	45	$2^{35}4^118^1$	
72	46	$2^{34}3^84^16^2$	
72	47	$2^{34}3^34^16^3$	
72	48	$2^{31}6^4$	
72	49	$2^{30}3^16^4$	
72	50	$2^{29}3^{11}6^2$	$2^{27}3^{11}6^112^1, 12^1 \rightarrow 2^{26}6^1$
72	51	$2^{28}3^26^4$	
72	52	$2^{27}3^{11}6^112^1$	
72	53	$2^{27}3^66^4$	
72	54	$2^{23}3^{24}$	$3^{24}24^1, 24^1 \rightarrow 2^{20}4^1, 4^1 \rightarrow 2^3$
72	55	$2^{22}3^{20}6^1$	$2^{19}3^{20}4^16^1, 4^1 \rightarrow 2^3$
72	56	$2^{21}3^{16}6^2$	$2^{18}3^{16}4^16^2, 4^1 \rightarrow 2^3$
72	57	$2^{20}3^{24}4^1$	$3^{24}24^1, 24^1 \rightarrow 2^{20}4^1$
72	58	$2^{20}3^{12}6^3$	$2^{17}3^{12}4^16^3, 4^1 \rightarrow 2^3$
72	59	$2^{19}3^{20}4^16^1$	
72	60	$2^{19}3^86^4$	$2^{15}3^74^16^5, 6^1 \rightarrow 2^13^1, 4^1 \rightarrow 2^3$
72	61	$2^{18}3^{16}4^16^2$	
72	62	$2^{18}3^76^5$	$2^{15}3^74^16^5, 4^1 \rightarrow 2^3$
72	63	$2^{17}3^{12}4^16^3$	
72	64	$2^{17}3^36^6$	$2^{14}3^34^16^6, 4^1 \rightarrow 2^3$
72	65	$2^{16}3^{25}$	$3^{24}24^1, 24^1 \rightarrow 2^{13}3^14^1, 4^1 \rightarrow 2^3$
72	66	$2^{16}3^84^16^4$	$2^{15}3^74^16^5, 6^1 \rightarrow 2^13^1$
72	67	$2^{15}3^{21}6^1$	$2^{12}3^{21}4^16^1, 4^1 \rightarrow 2^3$
72	68	$2^{15}3^74^16^5$	
72	69	$2^{14}3^{24}6^1$	$3^{24}24^1, 24^1 \rightarrow 2^{11}4^16^1, 4^1 \rightarrow 2^3$
72	70	$2^{14}3^{17}6^2$	$2^{11}3^{17}4^16^2, 4^1 \rightarrow 2^3$
72	71	$2^{14}3^34^16^6$	
72	72	$2^{13}3^{25}4^1$	$3^{24}24^1, 24^1 \rightarrow 2^{13}3^14^1$
72	73	$2^{13}3^{20}6^2$	$2^{10}3^{20}4^16^2, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
72	74	$2^{13}3^{13}6^3$	$2^{10}3^{13}4^16^3, 4^1 \rightarrow 2^3$
72	75	$2^{12}3^{24}12^1$	$3^{24}24^1, 24^1 \rightarrow 2^{12}12^1$
72	76	$2^{12}3^{21}4^16^1$	
72	77	$2^{12}3^{16}6^3$	$2^93^{16}4^16^3, 4^1 \rightarrow 2^3$
72	78	$2^{12}3^96^4$	$2^83^84^16^5, 6^1 \rightarrow 2^13^1, 4^1 \rightarrow 2^3$
72	79	$2^{11}3^{24}4^16^1$	$3^{24}24^1, 24^1 \rightarrow 2^{11}4^16^1$
72	80	$2^{11}3^{20}6^112^1$	
72	81	$2^{11}3^{17}4^16^2$	
72	82	$2^{11}3^{12}6^4$	$2^83^{12}4^16^4, 4^1 \rightarrow 2^3$
72	83	$2^{11}3^86^5$	$2^83^84^16^5, 4^1 \rightarrow 2^3$
72	84	$2^{10}3^{20}4^16^2$	
72	85	$2^{10}3^{16}6^212^1$	
72	86	$2^{10}3^{13}4^16^3$	
72	87	$2^{10}3^46^6$	$2^73^44^16^6, 4^1 \rightarrow 2^3$
72	88	$2^93^{16}4^16^3$	
72	89	$2^93^{12}6^312^1$	
72	90	$2^93^94^16^4$	$2^83^84^16^5, 6^1 \rightarrow 2^13^1$
72	91	$2^93^76^6$	$2^63^74^16^6, 4^1 \rightarrow 2^3$
72	92	$2^83^{12}4^16^4$	
72	93	$2^83^84^16^5$	
72	94	$2^83^86^412^1$	$2^73^76^512^1, 6^1 \rightarrow 2^13^1$
72	95	$2^83^36^7$	$2^53^34^16^7, 4^1 \rightarrow 2^3$
72	96	$2^73^76^512^1$	
72	97	$2^73^44^16^6$	
72	98	$2^63^74^16^6$	
72	99	$2^63^36^612^1$	
72	100	$2^53^34^16^7$	
72	101	$3^{25}8^1$	$3^{24}24^1, 24^1 \rightarrow 3^{18}1$
72	102	$3^{24}24^1$	
72	103	8^19^1	
74	1	2^137^1	
75	1	3^15^9	$5^815^1, 15^1 \rightarrow 3^15^1$
75	2	3^125^1	
75	3	5^815^1	
76	1	2^75	
76	2	$2^{20}19^1$	
76	3	2^238^1	
76	4	4^119^1	
77	1	7^111^1	
78	1	$2^13^113^1$	$2^139^1, 39^1 \rightarrow 3^113^1$
78	2	2^139^1	
78	3	3^126^1	
78	4	6^113^1	

Runs	Count	Design	Lineage
80	1	2^{79}	$2^{51}4^320^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	2	$2^{76}4^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	3	$2^{73}4^2$	$2^{51}4^320^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	4	$2^{72}8^1$	
80	5	$2^{70}4^3$	$2^{51}4^320^1, 20^1 \rightarrow 2^{19}$
80	6	$2^{68}5^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	7	$2^{65}4^15^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	8	$2^{62}4^25^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	9	$2^{62}10^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	10	$2^{61}5^18^1$	
80	11	$2^{60}20^1$	$2^{51}4^320^1, 4^1 \rightarrow 2^3$
80	12	$2^{59}4^35^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^{85^1}$
80	13	$2^{59}4^110^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	14	$2^{57}4^120^1$	$2^{51}4^320^1, 4^1 \rightarrow 2^3$
80	15	$2^{56}4^210^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	16	$2^{55}8^110^1$	
80	17	$2^{54}4^220^1$	$2^{51}4^320^1, 4^1 \rightarrow 2^3$
80	18	$2^{53}4^310^1$	$2^{51}4^320^1, 20^1 \rightarrow 2^210^1$
80	19	$2^{51}4^45^1$	$2^{51}4^320^1, 20^1 \rightarrow 4^15^1$
80	20	$2^{51}4^320^1$	
80	21	$2^{40}40^1$	
80	22	$2^{34}4^5$	$4^{10}20^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	23	$2^{31}4^6$	$4^{10}20^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	24	$2^{28}4^7$	$4^{10}20^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	25	$2^{25}4^8$	$4^{10}20^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	26	$2^{23}4^55^1$	$4^{10}20^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	27	$2^{22}4^9$	$4^{10}20^1, 20^1 \rightarrow 2^{19}, 4^1 \rightarrow 2^3$
80	28	$2^{20}4^65^1$	$4^{10}20^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	29	$2^{20}4^410^1$	$4^{10}20^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	30	$2^{19}4^{10}$	$4^{10}20^1, 20^1 \rightarrow 2^{19}$
80	31	$2^{18}4^420^1$	$4^{10}20^1, 4^1 \rightarrow 2^3$
80	32	$2^{17}4^75^1$	$4^{10}20^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	33	$2^{17}4^510^1$	$4^{10}20^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	34	$2^{15}4^520^1$	$4^{10}20^1, 4^1 \rightarrow 2^3$
80	35	$2^{14}4^85^1$	$4^{10}20^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	36	$2^{14}4^610^1$	$4^{10}20^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	37	$2^{12}4^620^1$	$4^{10}20^1, 4^1 \rightarrow 2^3$
80	38	$2^{11}4^95^1$	$4^{10}20^1, 20^1 \rightarrow 2^{85^1}, 4^1 \rightarrow 2^3$
80	39	$2^{11}4^710^1$	$4^{10}20^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	40	$2^94^720^1$	$4^{10}20^1, 4^1 \rightarrow 2^3$
80	41	$2^84^{10}5^1$	$4^{10}20^1, 20^1 \rightarrow 2^{85^1}$
80	42	$2^84^810^1$	$4^{10}20^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	43	$2^64^820^1$	$4^{10}20^1, 4^1 \rightarrow 2^3$
80	44	$2^54^910^1$	$4^{10}20^1, 20^1 \rightarrow 2^210^1, 4^1 \rightarrow 2^3$
80	45	$2^34^920^1$	$4^{10}20^1, 4^1 \rightarrow 2^3$
80	46	$2^24^{10}10^1$	$4^{10}20^1, 20^1 \rightarrow 2^210^1$
80	47	$4^{11}5^1$	$4^{10}20^1, 20^1 \rightarrow 4^15^1$
80	48	$4^{10}20^1$	

Runs	Count	Design	Lineage
80	49	$5^1 16^1$	
81	1	$3^4 0$	$3^{27} 27^1, 27^1 \rightarrow 3^9 9^1, 9^1 \rightarrow 3^4$
81	2	$3^{36} 9^1$	$3^{27} 27^1, 27^1 \rightarrow 3^9 9^1$
81	3	$3^{32} 9^2$	$9^{10}, 9^1 \rightarrow 3^4$
81	4	$3^{28} 9^3$	$9^{10}, 9^1 \rightarrow 3^4$
81	5	$3^{27} 27^1$	
81	6	$3^{24} 9^4$	$9^{10}, 9^1 \rightarrow 3^4$
81	7	$3^{20} 9^5$	$9^{10}, 9^1 \rightarrow 3^4$
81	8	$3^{16} 9^6$	$9^{10}, 9^1 \rightarrow 3^4$
81	9	$3^{12} 9^7$	$9^{10}, 9^1 \rightarrow 3^4$
81	10	$3^8 9^8$	$9^{10}, 9^1 \rightarrow 3^4$
81	11	$3^4 9^9$	$9^{10}, 9^1 \rightarrow 3^4$
81	12	9^{10}	
82	1	$2^1 41^1$	
84	1	2^{83}	
84	2	$2^{33} 3^1$	
84	3	$2^{28} 7^1$	
84	4	$2^{27} 6^1$	
84	5	$2^{23} 3^1 7^1$	$2^{22} 6^1 7^1, 6^1 \rightarrow 2^1 3^1$
84	6	$2^{22} 6^1 7^1$	
84	7	$2^{21} 21^1$	
84	8	$2^{20} 3^1 14^1$	
84	9	$2^{14} 6^1 14^1$	
84	10	$2^2 42^1$	
84	11	$3^1 4^1 7^1$	$3^1 28^1, 28^1 \rightarrow 4^1 7^1$
84	12	$3^1 28^1$	
84	13	$4^1 21^1$	
84	14	$7^1 12^1$	
85	1	$5^1 17^1$	
86	1	$2^1 43^1$	
87	1	$3^1 29^1$	
88	1	2^{87}	$2^{84} 4^1, 4^1 \rightarrow 2^3$
88	2	$2^{84} 4^1$	
88	3	$2^{60} 11^1$	$2^{57} 4^1 11^1, 4^1 \rightarrow 2^3$
88	4	$2^{57} 4^1 11^1$	
88	5	$2^{46} 22^1$	$2^{43} 4^1 22^1, 4^1 \rightarrow 2^3$
88	6	$2^{44} 44^1$	
88	7	$2^{43} 4^1 22^1$	
88	8	$8^1 11^1$	

Runs	Count	Design	Lineage
90	1	$2^1 3^{31} 5^1$	$3^{30} 30^1, 30^1 \rightarrow 2^1 15^1, 15^1 \rightarrow 3^1 5^1$
90	2	$2^1 3^{30} 15^1$	$3^{30} 30^1, 30^1 \rightarrow 2^1 15^1$
90	3	$2^1 5^1 9^1$	$2^1 45^1, 45^1 \rightarrow 5^1 9^1$
90	4	$2^1 45^1$	
90	5	$3^{31} 10^1$	$3^{30} 30^1, 30^1 \rightarrow 3^1 10^1$
90	6	$3^{30} 5^1 6^1$	$3^{30} 30^1, 30^1 \rightarrow 5^1 6^1$
90	7	$3^{30} 30^1$	
90	8	$3^{26} 6^1 15^1$	
90	9	$5^1 18^1$	
90	10	$9^1 10^1$	
91	1	$7^1 13^1$	
92	1	2^{91}	
92	2	$2^{22} 23^1$	
92	3	$2^2 46^1$	
92	4	$4^1 23^1$	
93	1	$3^1 31^1$	
94	1	$2^1 47^1$	
95	1	$5^1 19^1$	
96	1	2^{95}	$2^{26} 4^{23}, 4^1 \rightarrow 2^3$
96	2	$2^{92} 4^1$	$2^{26} 4^{23}, 4^1 \rightarrow 2^3$
96	3	$2^{89} 4^2$	$2^{26} 4^{23}, 4^1 \rightarrow 2^3$
96	4	$2^{88} 3^1$	$2^{19} 3^1 4^{23}, 4^1 \rightarrow 2^3$
96	5	$2^{88} 8^1$	$2^{43} 4^{15} 8^1, 4^1 \rightarrow 2^3$
96	6	$2^{86} 4^3$	$2^{26} 4^{23}, 4^1 \rightarrow 2^3$
96	7	$2^{86} 6^1$	$2^{17} 4^{23} 6^1, 4^1 \rightarrow 2^3$
96	8	$2^{85} 3^1 4^1$	$2^{19} 3^1 4^{23}, 4^1 \rightarrow 2^3$
96	9	$2^{85} 4^1 8^1$	$2^{43} 4^{15} 8^1, 4^1 \rightarrow 2^3$
96	10	$2^{84} 12^1$	$2^{18} 4^{22} 12^1, 4^1 \rightarrow 2^3$
96	11	$2^{83} 4^4$	$2^{26} 4^{23}, 4^1 \rightarrow 2^3$
96	12	$2^{83} 4^1 6^1$	$2^{17} 4^{23} 6^1, 4^1 \rightarrow 2^3$
96	13	$2^{82} 3^1 4^2$	$2^{19} 3^1 4^{23}, 4^1 \rightarrow 2^3$
96	14	$2^{82} 4^2 8^1$	$2^{43} 4^{15} 8^1, 4^1 \rightarrow 2^3$
96	15	$2^{81} 3^1 8^1$	$2^{39} 3^1 4^{14} 8^1, 4^1 \rightarrow 2^3$
96	16	$2^{81} 4^1 12^1$	$2^{18} 4^{22} 12^1, 4^1 \rightarrow 2^3$
96	17	$2^{80} 4^5$	$2^{26} 4^{23}, 4^1 \rightarrow 2^3$
96	18	$2^{80} 4^2 6^1$	$2^{17} 4^{23} 6^1, 4^1 \rightarrow 2^3$
96	19	$2^{80} 16^1$	
96	20	$2^{79} 3^1 4^3$	$2^{19} 3^1 4^{23}, 4^1 \rightarrow 2^3$
96	21	$2^{79} 4^3 8^1$	$2^{43} 4^{15} 8^1, 4^1 \rightarrow 2^3$
96	22	$2^{79} 6^1 8^1$	$2^{43} 4^{12} 6^1 8^1, 4^1 \rightarrow 2^3$
96	23	$2^{78} 3^1 4^1 8^1$	$2^{39} 3^1 4^{14} 8^1, 4^1 \rightarrow 2^3$
96	24	$2^{78} 4^2 12^1$	$2^{18} 4^{22} 12^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
96	25	$2^{77}4^6$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	26	$2^{77}4^36^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	27	$2^{77}8^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	28	$2^{76}3^14^4$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	29	$2^{76}4^48^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	30	$2^{76}4^16^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	31	$2^{75}3^14^28^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	32	$2^{75}4^312^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	33	$2^{74}4^7$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	34	$2^{74}4^46^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	35	$2^{74}4^18^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	36	$2^{73}3^14^5$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	37	$2^{73}3^116^1$	
96	38	$2^{73}4^58^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	39	$2^{73}4^26^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	40	$2^{72}3^14^38^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	41	$2^{72}4^412^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	42	$2^{72}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	43	$2^{71}4^8$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	44	$2^{71}4^56^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	45	$2^{71}4^28^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	46	$2^{71}6^116^1$	
96	47	$2^{70}3^14^6$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	48	$2^{70}4^68^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	49	$2^{70}4^36^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	50	$2^{69}3^14^48^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	51	$2^{69}4^512^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	52	$2^{69}4^124^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	53	$2^{68}4^9$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	54	$2^{68}4^66^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	55	$2^{68}4^38^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	56	$2^{67}3^14^7$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	57	$2^{67}4^78^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	58	$2^{67}4^46^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	59	$2^{66}3^14^58^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	60	$2^{66}4^612^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	61	$2^{66}4^224^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	62	$2^{65}4^{10}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	63	$2^{65}4^76^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	64	$2^{65}4^48^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	65	$2^{64}3^14^8$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	66	$2^{64}4^88^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	67	$2^{64}4^56^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	68	$2^{63}3^14^68^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	69	$2^{63}4^712^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	70	$2^{63}4^324^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	71	$2^{62}4^{11}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	72	$2^{62}4^86^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
96	73	$2^{62}4^58^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	74	$2^{61}3^14^9$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	75	$2^{61}4^98^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	76	$2^{61}4^66^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	77	$2^{60}3^14^78^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	78	$2^{60}4^812^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	79	$2^{60}4^424^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	80	$2^{59}4^{12}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	81	$2^{59}4^96^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	82	$2^{59}4^68^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	83	$2^{58}3^14^{10}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	84	$2^{58}4^{10}8^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	85	$2^{58}4^76^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	86	$2^{57}3^14^88^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	87	$2^{57}4^912^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	88	$2^{57}4^524^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	89	$2^{56}4^{13}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	90	$2^{56}4^{10}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	91	$2^{56}4^78^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	92	$2^{55}3^14^{11}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	93	$2^{55}4^{11}8^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	94	$2^{55}4^86^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	95	$2^{54}3^14^98^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	96	$2^{54}4^{10}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	97	$2^{54}4^624^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	98	$2^{53}4^{14}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	99	$2^{53}4^{11}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	100	$2^{53}4^88^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	101	$2^{52}3^14^{12}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	102	$2^{52}4^{12}8^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	103	$2^{52}4^96^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	104	$2^{51}3^14^{10}8^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	105	$2^{51}4^{11}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	106	$2^{51}4^724^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	107	$2^{50}4^{15}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	108	$2^{50}4^{12}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	109	$2^{50}4^98^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	110	$2^{49}3^14^{13}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	111	$2^{49}4^{13}8^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	112	$2^{49}4^{10}6^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	113	$2^{48}3^14^{11}8^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	114	$2^{48}4^{12}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	115	$2^{48}4^824^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	116	$2^{48}48^1$	
96	117	$2^{47}4^{16}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	118	$2^{47}4^{13}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	119	$2^{47}4^{10}8^112^1$	$2^{44}4^{11}8^112^1, 4^1 \rightarrow 2^3$
96	120	$2^{46}3^14^{14}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
96	121	$2^{46}4^{14}8^1$	$2^{43}4^{15}8^1, 4^1 \rightarrow 2^3$
96	122	$2^{46}4^{11}6^18^1$	$2^{43}4^{12}6^18^1, 4^1 \rightarrow 2^3$
96	123	$2^{45}3^14^{12}8^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	124	$2^{45}4^{13}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	125	$2^{45}4^924^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	126	$2^{44}4^{17}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	127	$2^{44}4^{14}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	128	$2^{44}4^{11}8^112^1$	
96	129	$2^{43}3^14^{15}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	130	$2^{43}4^{15}8^1$	
96	131	$2^{43}4^{12}6^18^1$	
96	132	$2^{42}3^14^{13}8^1$	$2^{39}3^14^{14}8^1, 4^1 \rightarrow 2^3$
96	133	$2^{42}4^{14}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	134	$2^{42}4^{10}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	135	$2^{41}4^{18}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	136	$2^{41}4^{15}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	137	$2^{40}3^14^{16}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	138	$2^{39}3^14^{14}8^1$	
96	139	$2^{39}4^{15}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	140	$2^{39}4^{11}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	141	$2^{38}4^{19}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	142	$2^{38}4^{16}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	143	$2^{37}3^14^{17}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	144	$2^{36}4^{16}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	145	$2^{36}4^{12}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	146	$2^{35}4^{20}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	147	$2^{35}4^{17}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	148	$2^{34}3^14^{18}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	149	$2^{33}4^{17}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	150	$2^{33}4^{13}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	151	$2^{32}4^{21}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	152	$2^{32}4^{18}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	153	$2^{31}3^14^{19}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	154	$2^{30}4^{18}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	155	$2^{30}4^{14}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	156	$2^{29}4^{22}$	$2^{26}4^{23}, 4^1 \rightarrow 2^3$
96	157	$2^{29}4^{19}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	158	$2^{28}3^14^{20}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	159	$2^{27}3^14^{15}8^1$	$2^{12}4^{20}24^1, 24^1 \rightarrow 3^18^1, 4^1 \rightarrow 2^3$
96	160	$2^{27}4^{19}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	161	$2^{27}4^{15}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	162	$2^{26}4^{23}$	
96	163	$2^{26}4^{20}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	164	$2^{25}3^14^{21}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	165	$2^{24}3^14^{16}8^1$	$2^{12}4^{20}24^1, 24^1 \rightarrow 3^18^1, 4^1 \rightarrow 2^3$
96	166	$2^{24}4^{20}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	167	$2^{24}4^{16}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	168	$2^{23}4^{21}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
96	169	$2^{22}3^14^{22}$	$2^{19}3^14^{23}, 4^1 \rightarrow 2^3$
96	170	$2^{21}3^14^{17}8^1$	$2^{12}4^{20}24^1, 24^1 \rightarrow 3^18^1, 4^1 \rightarrow 2^3$
96	171	$2^{21}4^{21}12^1$	$2^{18}4^{22}12^1, 4^1 \rightarrow 2^3$
96	172	$2^{21}4^{17}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	173	$2^{20}4^{22}6^1$	$2^{17}4^{23}6^1, 4^1 \rightarrow 2^3$
96	174	$2^{19}3^14^{23}$	
96	175	$2^{18}3^14^{18}8^1$	$2^{12}4^{20}24^1, 24^1 \rightarrow 3^18^1, 4^1 \rightarrow 2^3$
96	176	$2^{18}4^{22}12^1$	
96	177	$2^{18}4^{18}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	178	$2^{17}4^{23}6^1$	
96	179	$2^{15}3^14^{19}8^1$	$2^{12}4^{20}24^1, 24^1 \rightarrow 3^18^1, 4^1 \rightarrow 2^3$
96	180	$2^{15}4^{19}24^1$	$2^{12}4^{20}24^1, 4^1 \rightarrow 2^3$
96	181	$2^{12}3^14^{20}8^1$	$2^{12}4^{20}24^1, 24^1 \rightarrow 3^18^1$
96	182	$2^{12}4^{20}24^1$	
96	183	3^132^1	
98	1	2^17^{15}	$7^{14}14^1, 14^1 \rightarrow 2^17^1$
98	2	2^149^1	
98	3	$7^{14}14^1$	
99	1	$3^{14}11^1$	$3^{13}33^1, 33^1 \rightarrow 3^111^1$
99	2	$3^{13}33^1$	
99	3	9^111^1	
100	1	2^{99}	
100	2	$2^{51}5^3$	
100	3	$2^{40}5^4$	
100	4	$2^{34}5^310^1$	
100	5	$2^{29}5^5$	
100	6	$2^{23}5^6$	$2^{23}25^1, 25^1 \rightarrow 5^6$
100	7	$2^{23}25^1$	
100	8	$2^{19}5^{20}$	$5^{20}20^1, 20^1 \rightarrow 2^{19}$
100	9	$2^{18}5^910^1$	
100	10	$2^{17}5^410^2$	$2^{16}5^310^3, 10^1 \rightarrow 2^{15}1$
100	11	$2^{16}5^310^3$	
100	12	2^85^{21}	$5^{20}20^1, 20^1 \rightarrow 2^85^1$
100	13	$2^75^{10}10^1$	
100	14	$2^65^510^2$	$2^55^410^3, 10^1 \rightarrow 2^{15}1$
100	15	$2^55^410^3$	
100	16	2^410^4	
100	17	$2^25^{20}10^1$	$5^{20}20^1, 20^1 \rightarrow 2^210^1$
100	18	2^250^1	
100	19	$2^15^910^2$	$5^810^3, 10^1 \rightarrow 2^{15}1$
100	20	4^15^{21}	$5^{20}20^1, 20^1 \rightarrow 4^15^1$
100	21	4^125^1	
100	22	$5^{20}20^1$	
100	23	5^810^3	

Runs	Count	Design	Lineage
102	1	$2^1 3^1 17^1$	$2^1 5^1 1^1, 5^1 \rightarrow 3^1 17^1$
102	2	$2^1 5^1 1^1$	
102	3	$3^1 3^1 4^1$	
102	4	$6^1 17^1$	
104	1	$2^{10} 3$	$2^{10} 4^1, 4^1 \rightarrow 2^3$
104	2	$2^{10} 4^1$	
104	3	$2^{69} 13^1$	$2^{66} 4^1 13^1, 4^1 \rightarrow 2^3$
104	4	$2^{66} 4^1 13^1$	
104	5	$2^{54} 26^1$	$2^{51} 4^1 26^1, 4^1 \rightarrow 2^3$
104	6	$2^{52} 52^1$	
104	7	$2^{51} 4^1 26^1$	
104	8	$8^1 13^1$	
105	1	$3^1 5^1 7^1$	$3^1 35^1, 35^1 \rightarrow 5^1 7^1$
105	2	$3^1 35^1$	
105	3	$5^1 21^1$	
105	4	$7^1 15^1$	
106	1	$2^1 53^1$	
108	1	$2^{10} 7$	
108	2	$2^4 13^1$	$2^{40} 6^1, 6^1 \rightarrow 2^1 3^1$
108	3	$2^{40} 6^1$	
108	4	$2^{35} 3^{36}$	$3^{36} 36^1, 36^1 \rightarrow 2^{35}$
108	5	$2^{34} 3^{29} 6^1$	
108	6	$2^{27} 3^{37}$	$3^{36} 36^1, 36^1 \rightarrow 2^{27} 3^1$
108	7	$2^{27} 3^{33} 9^1$	
108	8	$2^{24} 27^1$	
108	9	$2^{21} 3^{16} 2$	
108	10	$2^{21} 18^1$	
108	11	$2^{20} 3^{38}$	$3^{36} 36^1, 36^1 \rightarrow 2^{20} 3^2$
108	12	$2^{20} 3^{34} 9^1$	
108	13	$2^{18} 3^{37} 6^1$	$3^{36} 36^1, 36^1 \rightarrow 2^{18} 3^1 6^1$
108	14	$2^{18} 3^{33} 6^1 9^1$	
108	15	$2^{18} 3^{31} 18^1$	
108	16	$2^{17} 3^{29} 6^2$	
108	17	$2^{16} 3^{40}$	$3^{36} 36^1, 36^1 \rightarrow 2^{16} 9^1, 9^1 \rightarrow 3^4$
108	18	$2^{16} 3^{36} 9^1$	$3^{36} 36^1, 36^1 \rightarrow 2^{16} 9^1$
108	19	$2^{15} 6^1 18^1$	
108	20	$2^{13} 3^{38} 6^1$	$3^{36} 36^1, 36^1 \rightarrow 2^{13} 3^2 6^1$
108	21	$2^{13} 3^{36} 6^2$	$3^{36} 36^1, 36^1 \rightarrow 2^{13} 6^2$
108	22	$2^{13} 3^{30} 6^1 18^1$	
108	23	$2^{13} 6^3$	
108	24	$2^{12} 3^{29} 6^3$	
108	25	$2^{11} 3^{48}$	$3^{44} 9^1 12^1, 12^1 \rightarrow 2^{11}, 9^1 \rightarrow 3^4$
108	26	$2^{11} 3^{44} 9^1$	$3^{44} 9^1 12^1, 12^1 \rightarrow 2^{11}$
108	27	$2^{11} 3^{34} 6^1 9^1$	$2^{10} 3^{33} 6^2 9^1, 6^1 \rightarrow 2^1 3^1$

Runs	Count	Design	Lineage
108	28	$2^{11}3^{32}18^1$	$2^{10}3^{31}6^118^1, 6^1 \rightarrow 2^13^1$
108	29	$2^{10}3^{44}6^1$	$3^{36}36^1, 36^1 \rightarrow 2^{10}3^86^1$
108	30	$2^{10}3^{40}6^19^1$	
108	31	$2^{10}3^{37}6^2$	$3^{36}36^1, 36^1 \rightarrow 2^{10}3^16^2$
108	32	$2^{10}3^{35}18^1$	$2^93^{34}6^118^1, 6^1 \rightarrow 2^13^1$
108	33	$2^{10}3^{33}6^29^1$	
108	34	$2^{10}3^{31}6^118^1$	
108	35	$2^93^{40}6^2$	$3^{36}36^1, 36^1 \rightarrow 2^93^46^2$
108	36	$2^93^{36}6^29^1$	
108	37	$2^93^{34}6^118^1$	
108	38	$2^83^{36}6^3$	$3^{36}36^1, 36^1 \rightarrow 2^86^3$
108	39	$2^83^{30}6^218^1$	
108	40	$2^73^{20}6^4$	$2^33^{16}6^8, 6^1 \rightarrow 2^13^1$
108	41	$2^63^{19}6^5$	$2^33^{16}6^8, 6^1 \rightarrow 2^13^1$
108	42	$2^53^{18}6^6$	$2^33^{16}6^8, 6^1 \rightarrow 2^13^1$
108	43	2^43^{49}	$3^{44}9^112^1, 12^1 \rightarrow 2^43^1, 9^1 \rightarrow 3^4$
108	44	$2^43^{45}9^1$	$3^{44}9^112^1, 12^1 \rightarrow 2^43^1$
108	45	$2^43^{37}6^3$	$3^{36}36^1, 36^1 \rightarrow 2^43^16^3$
108	46	$2^43^{33}6^39^1$	
108	47	$2^43^{31}6^218^1$	
108	48	$2^43^{17}6^7$	$2^33^{16}6^8, 6^1 \rightarrow 2^13^1$
108	49	$2^33^{45}6^1$	$3^{36}36^1, 36^1 \rightarrow 2^33^96^1$
108	50	$2^33^{41}6^19^1$	
108	51	$2^33^{39}18^1$	
108	52	$2^33^{38}6^3$	$3^{36}36^1, 36^1 \rightarrow 2^33^26^3$
108	53	$2^33^{34}6^39^1$	
108	54	$2^33^{32}6^218^1$	
108	55	$2^33^{16}6^8$	
108	56	$2^23^{48}6^1$	$3^{44}9^112^1, 12^1 \rightarrow 2^26^1, 9^1 \rightarrow 3^4$
108	57	$2^23^{44}6^19^1$	$3^{44}9^112^1, 12^1 \rightarrow 2^26^1$
108	58	$2^23^{42}18^1$	
108	59	$2^23^{41}6^2$	$3^{36}36^1, 36^1 \rightarrow 2^23^56^2$
108	60	$2^23^{37}6^29^1$	
108	61	$2^23^{35}6^118^1$	
108	62	$2^23^66^9$	$3^46^{11}, 6^1 \rightarrow 2^13^1$
108	63	2^25^41	
108	64	$2^13^{44}6^2$	$3^{36}36^1, 36^1 \rightarrow 3^76^3, 6^1 \rightarrow 2^13^1$
108	65	$2^13^{40}6^29^1$	$3^{39}6^39^1, 6^1 \rightarrow 2^13^1$
108	66	$2^13^{39}6^3$	$3^{36}36^1, 36^1 \rightarrow 2^13^36^3$
108	67	$2^13^{38}6^118^1$	$3^{37}6^218^1, 6^1 \rightarrow 2^13^1$
108	68	$2^13^{35}6^39^1$	
108	69	$2^13^{33}6^218^1$	
108	70	$2^13^56^{10}$	$3^46^{11}, 6^1 \rightarrow 2^13^1$
108	71	$3^{49}4^1$	$3^{44}9^112^1, 12^1 \rightarrow 3^14^1, 9^1 \rightarrow 3^4$
108	72	$3^{48}12^1$	$3^{44}9^112^1, 9^1 \rightarrow 3^4$
108	73	$3^{45}4^19^1$	$3^{44}9^112^1, 12^1 \rightarrow 3^14^1$
108	74	$3^{44}9^112^1$	
108	75	$3^{43}6^3$	$3^{36}36^1, 36^1 \rightarrow 3^76^3$

Runs	Count	Design	Lineage
108	76	$3^{39}6^39^1$	
108	77	$3^{37}6^218^1$	
108	78	$3^{36}36^1$	
108	79	3^46^{11}	
108	80	4^127^1	
110	1	$2^15^111^1$	$2^155^1, 55^1 \rightarrow 5^111^1$
110	2	2^155^1	
110	3	5^122^1	
110	4	10^111^1	
111	1	3^137^1	
112	1	2^{111}	$2^{75}4^328^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	2	$2^{108}4^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	3	$2^{105}4^2$	$2^{75}4^328^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	4	$2^{104}8^1$	
112	5	$2^{102}4^3$	$2^{75}4^328^1, 28^1 \rightarrow 2^{27}$
112	6	$2^{96}7^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	7	$2^{93}4^17^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	8	$2^{90}4^27^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	9	$2^{89}7^18^1$	
112	10	$2^{87}4^37^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^{12}7^1$
112	11	$2^{86}14^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	12	$2^{84}28^1$	$2^{75}4^328^1, 4^1 \rightarrow 2^3$
112	13	$2^{83}4^114^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	14	$2^{81}4^128^1$	$2^{75}4^328^1, 4^1 \rightarrow 2^3$
112	15	$2^{80}4^214^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	16	$2^{79}8^114^1$	
112	17	$2^{78}4^228^1$	$2^{75}4^328^1, 4^1 \rightarrow 2^3$
112	18	$2^{77}4^314^1$	$2^{75}4^328^1, 28^1 \rightarrow 2^214^1$
112	19	$2^{75}4^47^1$	$2^{75}4^328^1, 28^1 \rightarrow 4^17^1$
112	20	$2^{75}4^328^1$	
112	21	$2^{56}56^1$	
112	22	$2^{48}4^5$	$4^{12}28^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	23	$2^{45}4^6$	$4^{12}28^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	24	$2^{42}4^7$	$4^{12}28^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	25	$2^{39}4^8$	$4^{12}28^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	26	$2^{36}4^9$	$4^{12}28^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	27	$2^{33}4^{10}$	$4^{12}28^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	28	$2^{33}4^57^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	29	$2^{30}4^{11}$	$4^{12}28^1, 28^1 \rightarrow 2^{27}, 4^1 \rightarrow 2^3$
112	30	$2^{30}4^67^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	31	$2^{27}4^{12}$	$4^{12}28^1, 28^1 \rightarrow 2^{27}$
112	32	$2^{27}4^77^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	33	$2^{26}4^414^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	34	$2^{24}4^87^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	35	$2^{24}4^428^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
112	36	$2^{23}4^514^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	37	$2^{21}4^97^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	38	$2^{21}4^528^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$
112	39	$2^{20}4^614^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	40	$2^{18}4^{10}7^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	41	$2^{18}4^628^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$
112	42	$2^{17}4^714^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	43	$2^{15}4^{11}7^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1, 4^1 \rightarrow 2^3$
112	44	$2^{15}4^728^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$
112	45	$2^{14}4^814^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	46	$2^{12}4^{12}7^1$	$4^{12}28^1, 28^1 \rightarrow 2^{12}7^1$
112	47	$2^{12}4^828^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$
112	48	$2^{11}4^914^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	49	$2^94^928^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$
112	50	$2^84^{10}14^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	51	$2^64^{10}28^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$
112	52	$2^54^{11}14^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1, 4^1 \rightarrow 2^3$
112	53	$2^34^{11}28^1$	$4^{12}28^1, 4^1 \rightarrow 2^3$
112	54	$2^24^{12}14^1$	$4^{12}28^1, 28^1 \rightarrow 2^214^1$
112	55	$4^{13}7^1$	$4^{12}28^1, 28^1 \rightarrow 4^{17}1$
112	56	$4^{12}28^1$	
112	57	7^116^1	
114	1	$2^13^119^1$	$2^157^1, 57^1 \rightarrow 3^119^1$
114	2	2^157^1	
114	3	3^138^1	
114	4	6^119^1	
115	1	5^123^1	
116	1	2^{115}	
116	2	$2^{24}29^1$	
116	3	2^258^1	
116	4	4^129^1	
117	1	$3^{14}13^1$	$3^{13}39^1, 39^1 \rightarrow 3^113^1$
117	2	$3^{13}39^1$	
117	3	9^113^1	
118	1	2^159^1	
119	1	7^117^1	
120	1	2^{119}	$2^{116}4^1, 4^1 \rightarrow 2^3$
120	2	$2^{116}4^1$	
120	3	$2^{90}3^1$	$2^{87}3^14^1, 4^1 \rightarrow 2^3$
120	4	$2^{87}3^14^1$	
120	5	$2^{84}6^1$	$2^{60}60^1, 60^1 \rightarrow 2^{24}6^1$

Runs	Count	Design	Lineage
120	6	$2^{83}5^1$	$2^{60}60^1, 60^1 \rightarrow 2^{23}5^1$
120	7	$2^{81}10^1$	$2^{60}60^1, 60^1 \rightarrow 2^{21}10^1$
120	8	$2^{79}4^15^1$	
120	9	$2^{78}3^15^1$	$2^{75}4^115^1, 15^1 \rightarrow 3^15^1, 4^1 \rightarrow 2^3$
120	10	$2^{78}15^1$	$2^{75}4^115^1, 4^1 \rightarrow 2^3$
120	11	$2^{76}3^110^1$	$2^{60}60^1, 60^1 \rightarrow 2^{15}6^110^1, 6^1 \rightarrow 2^13^1$
120	12	$2^{76}5^16^1$	$2^{60}60^1, 60^1 \rightarrow 2^{15}6^110^1, 10^1 \rightarrow 2^15^1$
120	13	$2^{75}3^14^15^1$	$2^{75}4^115^1, 15^1 \rightarrow 3^15^1$
120	14	$2^{75}4^16^1$	
120	15	$2^{75}4^110^1$	
120	16	$2^{75}4^115^1$	
120	17	$2^{75}6^110^1$	$2^{60}60^1, 60^1 \rightarrow 2^{15}6^110^1$
120	18	$2^{70}3^14^110^1$	
120	19	$2^{70}4^15^16^1$	
120	20	$2^{68}4^16^110^1$	
120	21	$2^{62}30^1$	$2^{59}4^130^1, 4^1 \rightarrow 2^3$
120	22	$2^{60}3^120^1$	$2^{60}60^1, 60^1 \rightarrow 3^120^1$
120	23	$2^{60}5^112^1$	$2^{60}60^1, 60^1 \rightarrow 5^112^1$
120	24	$2^{60}60^1$	
120	25	$2^{59}4^130^1$	
120	26	$2^{30}6^120^1$	
120	27	$2^{28}10^112^1$	
120	28	$3^15^18^1$	$3^140^1, 40^1 \rightarrow 5^18^1$
120	29	3^140^1	
120	30	5^124^1	
120	31	8^115^1	
121	1	11^{12}	
122	1	2^161^1	
123	1	3^141^1	
124	1	2^{123}	
124	2	$2^{24}31^1$	
124	3	2^262^1	
124	4	4^131^1	
125	1	5^{31}	$5^{25}25^1, 25^1 \rightarrow 5^6$
125	2	$5^{25}25^1$	
126	1	$2^13^{24}7^1$	$3^{24}14^1, 14^1 \rightarrow 2^17^1$
126	2	$2^13^{21}21^1$	$3^{20}6^121^1, 6^1 \rightarrow 2^13^1$
126	3	$2^17^19^1$	$2^163^1, 63^1 \rightarrow 7^19^1$
126	4	2^163^1	
126	5	$3^{24}14^1$	
126	6	$3^{23}6^17^1$	
126	7	$3^{21}42^1$	

Runs	Count	Design	Lineage
126	8	$3^{20}6^12^11$	
126	9	7^118^1	
126	10	9^114^1	
128	1	2^{127}	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	2	$2^{124}4^1$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	3	$2^{121}4^2$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	4	$2^{120}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	5	$2^{118}4^3$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	6	$2^{117}4^18^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	7	$2^{115}4^4$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	8	$2^{114}4^28^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	9	$2^{113}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	10	$2^{112}4^5$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	11	$2^{112}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	12	$2^{111}4^38^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	13	$2^{110}4^18^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	14	$2^{109}4^6$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	15	$2^{109}4^116^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	16	$2^{108}4^48^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	17	$2^{107}4^28^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	18	$2^{106}4^7$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	19	$2^{106}4^216^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	20	$2^{106}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	21	$2^{105}4^58^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	22	$2^{105}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	23	$2^{104}4^38^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	24	$2^{103}4^8$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	25	$2^{103}4^316^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	26	$2^{103}4^18^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	27	$2^{102}4^68^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	28	$2^{102}4^18^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	29	$2^{101}4^48^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	30	$2^{100}4^9$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	31	$2^{100}4^416^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	32	$2^{100}4^28^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	33	$2^{99}4^78^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	34	$2^{99}4^28^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	35	$2^{99}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	36	$2^{98}4^58^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	37	$2^{98}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	38	$2^{97}4^{10}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	39	$2^{97}4^516^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	40	$2^{97}4^38^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	41	$2^{96}4^88^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	42	$2^{96}4^38^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	43	$2^{96}4^18^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	44	$2^{96}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	45	$2^{95}4^68^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	46	$2^{95}4^18^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	47	$2^{94}4^{11}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	48	$2^{94}4^616^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	49	$2^{94}4^48^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	50	$2^{93}4^98^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	51	$2^{93}4^48^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	52	$2^{93}4^28^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	53	$2^{93}4^132^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	54	$2^{92}4^78^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	55	$2^{92}4^28^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	56	$2^{92}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	57	$2^{91}4^{12}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	58	$2^{91}4^716^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	59	$2^{91}4^58^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	60	$2^{91}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	61	$2^{90}4^{10}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	62	$2^{90}4^58^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	63	$2^{90}4^38^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	64	$2^{90}4^232^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	65	$2^{89}4^88^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	66	$2^{89}4^38^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	67	$2^{89}4^18^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	68	$2^{88}4^{13}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	69	$2^{88}4^816^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	70	$2^{88}4^68^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	71	$2^{88}4^18^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	72	$2^{87}4^{11}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	73	$2^{87}4^68^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	74	$2^{87}4^48^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	75	$2^{87}4^332^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	76	$2^{86}4^98^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	77	$2^{86}4^48^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	78	$2^{86}4^28^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	79	$2^{85}4^{14}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	80	$2^{85}4^916^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	81	$2^{85}4^78^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	82	$2^{85}4^28^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	83	$2^{85}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	84	$2^{84}4^{12}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	85	$2^{84}4^78^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	86	$2^{84}4^58^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	87	$2^{84}4^432^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	88	$2^{84}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	89	$2^{83}4^{10}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	90	$2^{83}4^58^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	91	$2^{83}4^38^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	92	$2^{82}4^{15}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	93	$2^{82}4^{10}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	94	$2^{82}4^88^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	95	$2^{82}4^38^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	96	$2^{82}4^18^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	97	$2^{81}4^{13}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	98	$2^{81}4^88^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	99	$2^{81}4^68^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	100	$2^{81}4^532^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	101	$2^{81}4^18^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	102	$2^{80}4^{11}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	103	$2^{80}4^68^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	104	$2^{80}4^48^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	105	$2^{79}4^{16}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	106	$2^{79}4^{11}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	107	$2^{79}4^98^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	108	$2^{79}4^48^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	109	$2^{79}4^28^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	110	$2^{78}4^{14}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	111	$2^{78}4^98^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	112	$2^{78}4^78^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	113	$2^{78}4^632^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	114	$2^{78}4^28^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	115	$2^{78}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	116	$2^{77}4^{12}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	117	$2^{77}4^78^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	118	$2^{77}4^58^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	119	$2^{77}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	120	$2^{76}4^{17}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	121	$2^{76}4^{12}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	122	$2^{76}4^{10}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	123	$2^{76}4^58^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	124	$2^{76}4^38^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	125	$2^{75}4^{15}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	126	$2^{75}4^{10}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	127	$2^{75}4^88^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	128	$2^{75}4^732^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	129	$2^{75}4^38^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	130	$2^{75}4^18^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	131	$2^{74}4^{13}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	132	$2^{74}4^88^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	133	$2^{74}4^68^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	134	$2^{74}4^18^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	135	$2^{73}4^{18}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	136	$2^{73}4^{13}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	137	$2^{73}4^{11}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	138	$2^{73}4^68^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	139	$2^{73}4^48^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	140	$2^{72}4^{16}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	141	$2^{72}4^{11}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	142	$2^{72}4^98^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	143	$2^{72}4^832^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	144	$2^{72}4^48^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	145	$2^{72}4^28^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	146	$2^{71}4^{14}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	147	$2^{71}4^98^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	148	$2^{71}4^78^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	149	$2^{71}4^28^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	150	$2^{71}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	151	$2^{70}4^{19}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	152	$2^{70}4^{14}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	153	$2^{70}4^{12}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	154	$2^{70}4^78^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	155	$2^{70}4^58^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	156	$2^{70}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	157	$2^{69}4^{17}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	158	$2^{69}4^{12}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	159	$2^{69}4^{10}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	160	$2^{69}4^932^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	161	$2^{69}4^58^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	162	$2^{69}4^38^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	163	$2^{68}4^{15}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	164	$2^{68}4^{10}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	165	$2^{68}4^88^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	166	$2^{68}4^38^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	167	$2^{68}4^18^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	168	$2^{67}4^{20}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	169	$2^{67}4^{15}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	170	$2^{67}4^{13}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	171	$2^{67}4^88^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	172	$2^{67}4^68^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	173	$2^{67}4^18^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	174	$2^{66}4^{18}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	175	$2^{66}4^{13}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	176	$2^{66}4^{11}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	177	$2^{66}4^{10}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	178	$2^{66}4^68^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	179	$2^{66}4^48^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	180	$2^{65}4^{16}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	181	$2^{65}4^{11}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	182	$2^{65}4^98^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	183	$2^{65}4^48^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	184	$2^{65}4^28^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	185	$2^{64}4^{21}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	186	$2^{64}4^{16}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	187	$2^{64}4^{14}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	188	$2^{64}4^98^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	189	$2^{64}4^78^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	190	$2^{64}4^28^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	191	$2^{64}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	192	$2^{64}64^1$	
128	193	$2^{63}4^{19}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	194	$2^{63}4^{14}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	195	$2^{63}4^{12}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	196	$2^{63}4^{11}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	197	$2^{63}4^78^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	198	$2^{63}4^58^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	199	$2^{63}8^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	200	$2^{62}4^{17}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	201	$2^{62}4^{12}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	202	$2^{62}4^{10}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	203	$2^{62}4^58^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	204	$2^{62}4^38^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	205	$2^{61}4^{22}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	206	$2^{61}4^{17}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	207	$2^{61}4^{15}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	208	$2^{61}4^{10}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	209	$2^{61}4^88^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	210	$2^{61}4^38^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	211	$2^{61}4^18^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	212	$2^{60}4^{20}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	213	$2^{60}4^{15}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	214	$2^{60}4^{13}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	215	$2^{60}4^{12}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	216	$2^{60}4^88^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	217	$2^{60}4^68^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	218	$2^{60}4^18^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	219	$2^{59}4^{18}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	220	$2^{59}4^{13}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	221	$2^{59}4^{11}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	222	$2^{59}4^68^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	223	$2^{59}4^48^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	224	$2^{58}4^{23}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	225	$2^{58}4^{18}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	226	$2^{58}4^{16}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	227	$2^{58}4^{11}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	228	$2^{58}4^98^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	229	$2^{58}4^48^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	230	$2^{58}4^28^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	231	$2^{57}4^{21}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	232	$2^{57}4^{16}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	233	$2^{57}4^{14}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	234	$2^{57}4^{13}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	235	$2^{57}4^98^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	236	$2^{57}4^78^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	237	$2^{57}4^28^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	238	$2^{57}8^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	239	$2^{56}4^{19}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	240	$2^{56}4^{14}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	241	$2^{56}4^{12}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	242	$2^{56}4^78^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	243	$2^{56}4^58^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	244	$2^{56}8^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	245	$2^{55}4^{24}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	246	$2^{55}4^{19}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	247	$2^{55}4^{17}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	248	$2^{55}4^{12}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	249	$2^{55}4^{10}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	250	$2^{55}4^58^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	251	$2^{55}4^38^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	252	$2^{54}4^{22}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	253	$2^{54}4^{17}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	254	$2^{54}4^{15}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	255	$2^{54}4^{14}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	256	$2^{54}4^{10}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	257	$2^{54}4^88^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	258	$2^{54}4^38^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	259	$2^{54}4^18^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	260	$2^{53}4^{20}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	261	$2^{53}4^{15}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	262	$2^{53}4^{13}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	263	$2^{53}4^88^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	264	$2^{53}4^68^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	265	$2^{53}4^18^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	266	$2^{52}4^{25}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	267	$2^{52}4^{20}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	268	$2^{52}4^{18}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	269	$2^{52}4^{13}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	270	$2^{52}4^{11}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	271	$2^{52}4^68^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	272	$2^{52}4^48^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	273	$2^{51}4^{23}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	274	$2^{51}4^{18}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	275	$2^{51}4^{16}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	276	$2^{51}4^{15}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	277	$2^{51}4^{11}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	278	$2^{51}4^98^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	279	$2^{51}4^48^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	280	$2^{51}4^28^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	281	$2^{50}4^{21}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	282	$2^{50}4^{16}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	283	$2^{50}4^{14}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	284	$2^{50}4^98^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	285	$2^{50}4^78^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	286	$2^{50}4^{28}8^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	287	$2^{50}8^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	288	$2^{49}4^{26}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	289	$2^{49}4^{21}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	290	$2^{49}4^{19}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	291	$2^{49}4^{14}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	292	$2^{49}4^{12}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	293	$2^{49}4^78^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	294	$2^{49}4^58^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	295	$2^{49}8^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	296	$2^{48}4^{24}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	297	$2^{48}4^{19}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	298	$2^{48}4^{17}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	299	$2^{48}4^{16}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	300	$2^{48}4^{12}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	301	$2^{48}4^{10}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	302	$2^{48}4^58^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	303	$2^{48}4^38^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	304	$2^{47}4^{22}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	305	$2^{47}4^{17}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	306	$2^{47}4^{15}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	307	$2^{47}4^{10}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	308	$2^{47}4^88^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	309	$2^{47}4^38^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	310	$2^{47}4^{18}11$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	311	$2^{46}4^{27}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	312	$2^{46}4^{22}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	313	$2^{46}4^{20}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	314	$2^{46}4^{15}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	315	$2^{46}4^{13}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	316	$2^{46}4^88^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	317	$2^{46}4^68^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	318	$2^{46}4^{18}916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	319	$2^{45}4^{25}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	320	$2^{45}4^{20}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	321	$2^{45}4^{18}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	322	$2^{45}4^{17}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	323	$2^{45}4^{13}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	324	$2^{45}4^{11}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	325	$2^{45}4^68^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	326	$2^{45}4^48^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	327	$2^{44}4^{23}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	328	$2^{44}4^{18}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	329	$2^{44}4^{16}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	330	$2^{44}4^{11}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	331	$2^{44}4^98^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	332	$2^{44}4^48^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	333	$2^{44}4^28^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	334	$2^{43}4^{28}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	335	$2^{43}4^{23}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	336	$2^{43}4^{21}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	337	$2^{43}4^{16}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	338	$2^{43}4^{14}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	339	$2^{43}4^98^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	340	$2^{43}4^78^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	341	$2^{43}4^28^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	342	$2^{43}8^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	343	$2^{42}4^{26}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	344	$2^{42}4^{21}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	345	$2^{42}4^{19}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	346	$2^{42}4^{18}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	347	$2^{42}4^{14}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	348	$2^{42}4^{12}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	349	$2^{42}4^78^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	350	$2^{42}4^58^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	351	$2^{42}8^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	352	$2^{41}4^{24}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	353	$2^{41}4^{19}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	354	$2^{41}4^{17}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	355	$2^{41}4^{12}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	356	$2^{41}4^{10}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	357	$2^{41}4^58^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	358	$2^{41}4^38^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	359	$2^{40}4^{29}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	360	$2^{40}4^{24}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	361	$2^{40}4^{22}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	362	$2^{40}4^{17}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	363	$2^{40}4^{15}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	364	$2^{40}4^{10}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	365	$2^{40}4^88^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	366	$2^{40}4^38^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	367	$2^{40}4^18^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	368	$2^{39}4^{27}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	369	$2^{39}4^{22}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	370	$2^{39}4^{20}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	371	$2^{39}4^{19}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	372	$2^{39}4^{15}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	373	$2^{39}4^{13}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	374	$2^{39}4^88^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	375	$2^{39}4^68^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	376	$2^{39}4^18^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	377	$2^{38}4^{25}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	378	$2^{38}4^{20}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	379	$2^{38}4^{18}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	380	$2^{38}4^{13}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	381	$2^{38}4^{11}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	382	$2^{38}4^{6}8^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	383	$2^{38}4^48^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	384	$2^{37}4^{30}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	385	$2^{37}4^{25}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	386	$2^{37}4^{23}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	387	$2^{37}4^{18}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	388	$2^{37}4^{16}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	389	$2^{37}4^{11}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	390	$2^{37}4^98^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	391	$2^{37}4^48^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	392	$2^{37}4^28^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	393	$2^{36}4^{28}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	394	$2^{36}4^{23}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	395	$2^{36}4^{21}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	396	$2^{36}4^{20}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	397	$2^{36}4^{16}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	398	$2^{36}4^{14}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	399	$2^{36}4^98^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	400	$2^{36}4^78^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	401	$2^{36}4^28^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	402	$2^{36}8^{13}$	$2^34^{11}8^{13}, 4^1 \rightarrow 2^3$
128	403	$2^{35}4^{26}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	404	$2^{35}4^{21}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	405	$2^{35}4^{19}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	406	$2^{35}4^{14}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	407	$2^{35}4^{12}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	408	$2^{35}4^78^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	409	$2^{35}4^58^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	410	$2^{35}8^{11}16^1$	$2^54^{10}8^{11}16^1, 4^1 \rightarrow 2^3$
128	411	$2^{34}4^{31}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	412	$2^{34}4^{26}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	413	$2^{34}4^{24}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	414	$2^{34}4^{19}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	415	$2^{34}4^{17}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	416	$2^{34}4^{12}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	417	$2^{34}4^{10}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	418	$2^{34}4^58^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	419	$2^{34}4^38^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	420	$2^{33}4^{29}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	421	$2^{33}4^{24}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	422	$2^{33}4^{22}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	423	$2^{33}4^{21}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	424	$2^{33}4^{17}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	425	$2^{33}4^{15}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	426	$2^{33}4^{10}8^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	427	$2^{33}4^88^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	428	$2^{33}4^38^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	429	$2^{33}4^18^{13}$	$2^34^{11}8^{13}, 4^1 \rightarrow 2^3$
128	430	$2^{32}4^{27}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	431	$2^{32}4^{22}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	432	$2^{32}4^{20}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	433	$2^{32}4^{15}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	434	$2^{32}4^{13}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	435	$2^{32}4^88^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	436	$2^{32}4^68^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	437	$2^{32}4^18^{11}16^1$	$2^54^{10}8^{11}16^1, 4^1 \rightarrow 2^3$
128	438	$2^{31}4^{32}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	439	$2^{31}4^{27}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	440	$2^{31}4^{25}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	441	$2^{31}4^{20}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	442	$2^{31}4^{18}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	443	$2^{31}4^{13}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	444	$2^{31}4^{11}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	445	$2^{31}4^68^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	446	$2^{31}4^48^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	447	$2^{30}4^{30}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	448	$2^{30}4^{25}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	449	$2^{30}4^{23}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	450	$2^{30}4^{22}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	451	$2^{30}4^{18}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	452	$2^{30}4^{16}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	453	$2^{30}4^{11}8^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	454	$2^{30}4^98^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	455	$2^{30}4^48^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	456	$2^{30}4^28^{13}$	$2^34^{11}8^{13}, 4^1 \rightarrow 2^3$
128	457	$2^{29}4^{28}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	458	$2^{29}4^{23}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	459	$2^{29}4^{21}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	460	$2^{29}4^{16}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	461	$2^{29}4^{14}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	462	$2^{29}4^98^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	463	$2^{29}4^78^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	464	$2^{29}4^28^{11}16^1$	$2^54^{10}8^{11}16^1, 4^1 \rightarrow 2^3$
128	465	$2^{29}8^{14}$	$2^54^88^{14}, 4^1 \rightarrow 2^3$
128	466	$2^{28}4^{33}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	467	$2^{28}4^{28}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	468	$2^{28}4^{26}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	469	$2^{28}4^{21}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	470	$2^{28}4^{19}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	471	$2^{28}4^{14}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	472	$2^{28}4^{12}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	473	$2^{28}4^78^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	474	$2^{28}4^58^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	475	$2^{28}8^{12}16^1$	$2^44^88^{12}16^1, 4^1 \rightarrow 2^3$
128	476	$2^{27}4^{31}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	477	$2^{27}4^{26}8^1 16^1$	$2^6 4^{33} 8^1 16^1, 4^1 \rightarrow 2^3$
128	478	$2^{27}4^{24}8^4$	$2^6 4^{26} 8^4 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	479	$2^{27}4^{23}32^1$	$4^{32} 32^1, 4^1 \rightarrow 2^3$
128	480	$2^{27}4^{19}8^4 16^1$	$2^6 4^{26} 8^4 16^1, 4^1 \rightarrow 2^3$
128	481	$2^{27}4^{17}8^7$	$2^3 4^{25} 8^7, 4^1 \rightarrow 2^3$
128	482	$2^{27}4^{12}8^7 16^1$	$2^6 4^{19} 8^7 16^1, 4^1 \rightarrow 2^3$
128	483	$2^{27}4^{10}8^{10}$	$2^3 4^{18} 8^{10}, 4^1 \rightarrow 2^3$
128	484	$2^{27}4^5 8^{10} 16^1$	$2^6 4^{12} 8^{10} 16^1, 4^1 \rightarrow 2^3$
128	485	$2^{27}4^3 8^{13}$	$2^3 4^{11} 8^{13}, 4^1 \rightarrow 2^3$
128	486	$2^{26}4^{29}8^2$	$2^5 4^{31} 8^2 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	487	$2^{26}4^{24}8^2 16^1$	$2^5 4^{31} 8^2 16^1, 4^1 \rightarrow 2^3$
128	488	$2^{26}4^{22}8^5$	$2^5 4^{24} 8^5 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	489	$2^{26}4^{17}8^5 16^1$	$2^5 4^{24} 8^5 16^1, 4^1 \rightarrow 2^3$
128	490	$2^{26}4^{15}8^8$	$2^5 4^{17} 8^8 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	491	$2^{26}4^{10}8^8 16^1$	$2^5 4^{17} 8^8 16^1, 4^1 \rightarrow 2^3$
128	492	$2^{26}4^8 8^{11}$	$2^5 4^{10} 8^{11} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	493	$2^{26}4^3 8^{11} 16^1$	$2^5 4^{10} 8^{11} 16^1, 4^1 \rightarrow 2^3$
128	494	$2^{26}4^1 8^{14}$	$2^5 4^8 8^{14}, 4^1 \rightarrow 2^3$
128	495	$2^{25}4^{34}$	$2^4 4^{36} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	496	$2^{25}4^{29} 16^1$	$2^4 4^{36} 16^1, 4^1 \rightarrow 2^3$
128	497	$2^{25}4^{27}8^3$	$2^4 4^{29} 8^3 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	498	$2^{25}4^{22}8^3 16^1$	$2^4 4^{29} 8^3 16^1, 4^1 \rightarrow 2^3$
128	499	$2^{25}4^{20}8^6$	$2^4 4^{22} 8^6 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	500	$2^{25}4^{15}8^6 16^1$	$2^4 4^{22} 8^6 16^1, 4^1 \rightarrow 2^3$
128	501	$2^{25}4^{13}8^9$	$2^4 4^{15} 8^9 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	502	$2^{25}4^8 8^9 16^1$	$2^4 4^{15} 8^9 16^1, 4^1 \rightarrow 2^3$
128	503	$2^{25}4^6 8^{12}$	$2^4 4^8 8^{12} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	504	$2^{25}4^1 8^{12} 16^1$	$2^4 4^8 8^{12} 16^1, 4^1 \rightarrow 2^3$
128	505	$2^{24}4^{32}8^1$	$4^{32} 32^1, 32^1 \rightarrow 4^8 8^1, 4^1 \rightarrow 2^3$
128	506	$2^{24}4^{27}8^1 16^1$	$2^6 4^{33} 8^1 16^1, 4^1 \rightarrow 2^3$
128	507	$2^{24}4^{25}8^4$	$2^6 4^{26} 8^4 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	508	$2^{24}4^{24}32^1$	$4^{32} 32^1, 4^1 \rightarrow 2^3$
128	509	$2^{24}4^{20}8^4 16^1$	$2^6 4^{26} 8^4 16^1, 4^1 \rightarrow 2^3$
128	510	$2^{24}4^{18}8^7$	$2^3 4^{25} 8^7, 4^1 \rightarrow 2^3$
128	511	$2^{24}4^{13}8^7 16^1$	$2^6 4^{19} 8^7 16^1, 4^1 \rightarrow 2^3$
128	512	$2^{24}4^{11}8^{10}$	$2^3 4^{18} 8^{10}, 4^1 \rightarrow 2^3$
128	513	$2^{24}4^6 8^{10} 16^1$	$2^6 4^{12} 8^{10} 16^1, 4^1 \rightarrow 2^3$
128	514	$2^{24}4^4 8^{13}$	$2^3 4^{11} 8^{13}, 4^1 \rightarrow 2^3$
128	515	$2^{23}4^{30}8^2$	$2^5 4^{31} 8^2 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	516	$2^{23}4^{25}8^2 16^1$	$2^5 4^{31} 8^2 16^1, 4^1 \rightarrow 2^3$
128	517	$2^{23}4^{23}8^5$	$2^5 4^{24} 8^5 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	518	$2^{23}4^{18}8^5 16^1$	$2^5 4^{24} 8^5 16^1, 4^1 \rightarrow 2^3$
128	519	$2^{23}4^{16}8^8$	$2^5 4^{17} 8^8 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	520	$2^{23}4^{11}8^8 16^1$	$2^5 4^{17} 8^8 16^1, 4^1 \rightarrow 2^3$
128	521	$2^{23}4^9 8^{11}$	$2^5 4^{10} 8^{11} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	522	$2^{23}4^4 8^{11} 16^1$	$2^5 4^{10} 8^{11} 16^1, 4^1 \rightarrow 2^3$
128	523	$2^{23}4^2 8^{14}$	$2^5 4^8 8^{14}, 4^1 \rightarrow 2^3$
128	524	$2^{22}4^{35}$	$2^4 4^{36} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	525	$2^{22}4^{30}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	526	$2^{22}4^{28}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	527	$2^{22}4^{23}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	528	$2^{22}4^{21}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	529	$2^{22}4^{16}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	530	$2^{22}4^{14}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	531	$2^{22}4^98^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	532	$2^{22}4^78^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	533	$2^{22}4^28^{12}16^1$	$2^44^88^{12}16^1, 4^1 \rightarrow 2^3$
128	534	$2^{22}8^{15}$	$8^{16}16^1, 16^1 \rightarrow 4^5, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
128	535	$2^{21}4^{33}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	536	$2^{21}4^{28}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	537	$2^{21}4^{26}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	538	$2^{21}4^{25}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	539	$2^{21}4^{21}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	540	$2^{21}4^{19}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	541	$2^{21}4^{14}8^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	542	$2^{21}4^{12}8^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	543	$2^{21}4^78^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	544	$2^{21}4^58^{13}$	$2^34^{11}8^{13}, 4^1 \rightarrow 2^3$
128	545	$2^{21}8^{13}16^1$	$2^64^58^{13}16^1, 4^1 \rightarrow 2^3$
128	546	$2^{20}4^{31}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	547	$2^{20}4^{26}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	548	$2^{20}4^{24}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	549	$2^{20}4^{19}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	550	$2^{20}4^{17}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	551	$2^{20}4^{12}8^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	552	$2^{20}4^{10}8^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	553	$2^{20}4^58^{11}16^1$	$2^54^{10}8^{11}16^1, 4^1 \rightarrow 2^3$
128	554	$2^{20}4^38^{14}$	$2^54^88^{14}, 4^1 \rightarrow 2^3$
128	555	$2^{19}4^{36}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	556	$2^{19}4^{31}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	557	$2^{19}4^{29}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	558	$2^{19}4^{24}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	559	$2^{19}4^{22}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	560	$2^{19}4^{17}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	561	$2^{19}4^{15}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	562	$2^{19}4^{10}8^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	563	$2^{19}4^88^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	564	$2^{19}4^38^{12}16^1$	$2^44^88^{12}16^1, 4^1 \rightarrow 2^3$
128	565	$2^{19}4^{18}15$	$8^{16}16^1, 16^1 \rightarrow 4^5, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
128	566	$2^{18}4^{34}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	567	$2^{18}4^{29}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	568	$2^{18}4^{27}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	569	$2^{18}4^{26}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	570	$2^{18}4^{22}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	571	$2^{18}4^{20}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	572	$2^{18}4^{15}8^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	573	$2^{18}4^{13}8^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	574	$2^{18}4^88^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	575	$2^{18}4^68^{13}$	$2^34^{11}8^{13}, 4^1 \rightarrow 2^3$
128	576	$2^{18}4^{18}8^{13}16^1$	$2^64^58^{13}16^1, 4^1 \rightarrow 2^3$
128	577	$2^{17}4^{32}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	578	$2^{17}4^{27}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	579	$2^{17}4^{25}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	580	$2^{17}4^{20}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	581	$2^{17}4^{18}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	582	$2^{17}4^{13}8^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	583	$2^{17}4^{11}8^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	584	$2^{17}4^68^{11}16^1$	$2^54^{10}8^{11}16^1, 4^1 \rightarrow 2^3$
128	585	$2^{17}4^48^{14}$	$2^54^88^{14}, 4^1 \rightarrow 2^3$
128	586	$2^{16}4^{37}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	587	$2^{16}4^{32}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	588	$2^{16}4^{30}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	589	$2^{16}4^{25}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	590	$2^{16}4^{23}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	591	$2^{16}4^{18}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	592	$2^{16}4^{16}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	593	$2^{16}4^{11}8^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	594	$2^{16}4^98^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	595	$2^{16}4^48^{12}16^1$	$2^44^88^{12}16^1, 4^1 \rightarrow 2^3$
128	596	$2^{16}4^28^{15}$	$8^{16}16^1, 16^1 \rightarrow 4^5, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
128	597	$2^{15}4^{35}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	598	$2^{15}4^{30}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	599	$2^{15}4^{28}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	600	$2^{15}4^{27}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	601	$2^{15}4^{23}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	602	$2^{15}4^{21}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	603	$2^{15}4^{16}8^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	604	$2^{15}4^{14}8^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	605	$2^{15}4^98^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	606	$2^{15}4^78^{13}$	$2^34^{11}8^{13}, 4^1 \rightarrow 2^3$
128	607	$2^{15}4^28^{13}16^1$	$2^64^58^{13}16^1, 4^1 \rightarrow 2^3$
128	608	$2^{15}8^{16}$	$8^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	609	$2^{14}4^{33}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	610	$2^{14}4^{28}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	611	$2^{14}4^{26}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	612	$2^{14}4^{21}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	613	$2^{14}4^{19}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	614	$2^{14}4^{14}8^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	615	$2^{14}4^{12}8^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	616	$2^{14}4^78^{11}16^1$	$2^54^{10}8^{11}16^1, 4^1 \rightarrow 2^3$
128	617	$2^{14}4^58^{14}$	$2^54^88^{14}, 4^1 \rightarrow 2^3$
128	618	$2^{14}8^{14}16^1$	$8^{16}16^1, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
128	619	$2^{13}4^{38}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	620	$2^{13}4^{33}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	621	$2^{13}4^{31}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	622	$2^{13}4^{26}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	623	$2^{13}4^{24}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	624	$2^{13}4^{19}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	625	$2^{13}4^{17}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	626	$2^{13}4^{12}8^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	627	$2^{13}4^{10}8^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	628	$2^{13}4^58^{12}16^1$	$2^44^88^{12}16^1, 4^1 \rightarrow 2^3$
128	629	$2^{13}4^38^{15}$	$8^{16}16^1, 16^1 \rightarrow 4^5, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
128	630	$2^{12}4^{36}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	631	$2^{12}4^{31}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	632	$2^{12}4^{29}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	633	$2^{12}4^{28}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	634	$2^{12}4^{24}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	635	$2^{12}4^{22}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$
128	636	$2^{12}4^{17}8^716^1$	$2^64^{19}8^716^1, 4^1 \rightarrow 2^3$
128	637	$2^{12}4^{15}8^{10}$	$2^34^{18}8^{10}, 4^1 \rightarrow 2^3$
128	638	$2^{12}4^{10}8^{10}16^1$	$2^64^{12}8^{10}16^1, 4^1 \rightarrow 2^3$
128	639	$2^{12}4^88^{13}$	$2^34^{11}8^{13}, 4^1 \rightarrow 2^3$
128	640	$2^{12}4^38^{13}16^1$	$2^64^58^{13}16^1, 4^1 \rightarrow 2^3$
128	641	$2^{12}4^18^{16}$	$8^{16}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	642	$2^{11}4^{34}8^2$	$2^54^{31}8^216^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	643	$2^{11}4^{29}8^216^1$	$2^54^{31}8^216^1, 4^1 \rightarrow 2^3$
128	644	$2^{11}4^{27}8^5$	$2^54^{24}8^516^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	645	$2^{11}4^{22}8^516^1$	$2^54^{24}8^516^1, 4^1 \rightarrow 2^3$
128	646	$2^{11}4^{20}8^8$	$2^54^{17}8^816^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	647	$2^{11}4^{15}8^816^1$	$2^54^{17}8^816^1, 4^1 \rightarrow 2^3$
128	648	$2^{11}4^{13}8^{11}$	$2^54^{10}8^{11}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	649	$2^{11}4^88^{11}16^1$	$2^54^{10}8^{11}16^1, 4^1 \rightarrow 2^3$
128	650	$2^{11}4^68^{14}$	$2^54^88^{14}, 4^1 \rightarrow 2^3$
128	651	$2^{11}4^18^{14}16^1$	$8^{16}16^1, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
128	652	$2^{10}4^{39}$	$2^44^{36}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	653	$2^{10}4^{34}16^1$	$2^44^{36}16^1, 4^1 \rightarrow 2^3$
128	654	$2^{10}4^{32}8^3$	$2^44^{29}8^316^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	655	$2^{10}4^{27}8^316^1$	$2^44^{29}8^316^1, 4^1 \rightarrow 2^3$
128	656	$2^{10}4^{25}8^6$	$2^44^{22}8^616^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	657	$2^{10}4^{20}8^616^1$	$2^44^{22}8^616^1, 4^1 \rightarrow 2^3$
128	658	$2^{10}4^{18}8^9$	$2^44^{15}8^916^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	659	$2^{10}4^{13}8^916^1$	$2^44^{15}8^916^1, 4^1 \rightarrow 2^3$
128	660	$2^{10}4^{11}8^{12}$	$2^44^88^{12}16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	661	$2^{10}4^68^{12}16^1$	$2^44^88^{12}16^1, 4^1 \rightarrow 2^3$
128	662	$2^{10}4^48^{15}$	$8^{16}16^1, 16^1 \rightarrow 4^5, 8^1 \rightarrow 2^44^1, 4^1 \rightarrow 2^3$
128	663	$2^94^{37}8^1$	$4^{32}32^1, 32^1 \rightarrow 4^88^1, 4^1 \rightarrow 2^3$
128	664	$2^94^{32}8^116^1$	$2^64^{33}8^116^1, 4^1 \rightarrow 2^3$
128	665	$2^94^{30}8^4$	$2^64^{26}8^416^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	666	$2^94^{29}32^1$	$4^{32}32^1, 4^1 \rightarrow 2^3$
128	667	$2^94^{25}8^416^1$	$2^64^{26}8^416^1, 4^1 \rightarrow 2^3$
128	668	$2^94^{23}8^7$	$2^34^{25}8^7, 4^1 \rightarrow 2^3$

Runs	Count	Design	Lineage
128	669	$2^9 4^{18} 8^7 16^1$	$2^6 4^{19} 8^7 16^1, 4^1 \rightarrow 2^3$
128	670	$2^9 4^{16} 8^{10}$	$2^3 4^{18} 8^{10}, 4^1 \rightarrow 2^3$
128	671	$2^9 4^{11} 8^{10} 16^1$	$2^6 4^{12} 8^{10} 16^1, 4^1 \rightarrow 2^3$
128	672	$2^9 4^9 8^{13}$	$2^3 4^{11} 8^{13}, 4^1 \rightarrow 2^3$
128	673	$2^9 4^4 8^{13} 16^1$	$2^6 4^5 8^{13} 16^1, 4^1 \rightarrow 2^3$
128	674	$2^9 4^2 8^{16}$	$8^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	675	$2^8 4^{35} 8^2$	$2^5 4^{31} 8^2 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	676	$2^8 4^{30} 8^2 16^1$	$2^5 4^{31} 8^2 16^1, 4^1 \rightarrow 2^3$
128	677	$2^8 4^{28} 8^5$	$2^5 4^{24} 8^5 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	678	$2^8 4^{23} 8^5 16^1$	$2^5 4^{24} 8^5 16^1, 4^1 \rightarrow 2^3$
128	679	$2^8 4^{21} 8^8$	$2^5 4^{17} 8^8 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	680	$2^8 4^{16} 8^8 16^1$	$2^5 4^{17} 8^8 16^1, 4^1 \rightarrow 2^3$
128	681	$2^8 4^{14} 8^{11}$	$2^5 4^{10} 8^{11} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	682	$2^8 4^9 8^{11} 16^1$	$2^5 4^{10} 8^{11} 16^1, 4^1 \rightarrow 2^3$
128	683	$2^8 4^7 8^{14}$	$2^5 4^8 8^{14}, 4^1 \rightarrow 2^3$
128	684	$2^8 4^2 8^{14} 16^1$	$8^{16} 16^1, 8^1 \rightarrow 2^4 4^1$
128	685	$2^8 8^{17}$	$8^{16} 16^1, 16^1 \rightarrow 2^8 8^1$
128	686	$2^7 4^{40}$	$2^4 4^{36} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	687	$2^7 4^{35} 16^1$	$2^4 4^{36} 16^1, 4^1 \rightarrow 2^3$
128	688	$2^7 4^{33} 8^3$	$2^4 4^{29} 8^3 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	689	$2^7 4^{28} 8^3 16^1$	$2^4 4^{29} 8^3 16^1, 4^1 \rightarrow 2^3$
128	690	$2^7 4^{26} 8^6$	$2^4 4^{22} 8^6 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	691	$2^7 4^{21} 8^6 16^1$	$2^4 4^{22} 8^6 16^1, 4^1 \rightarrow 2^3$
128	692	$2^7 4^{19} 8^9$	$2^4 4^{15} 8^9 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	693	$2^7 4^{14} 8^9 16^1$	$2^4 4^{15} 8^9 16^1, 4^1 \rightarrow 2^3$
128	694	$2^7 4^{12} 8^{12}$	$2^4 4^8 8^{12} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	695	$2^7 4^7 8^{12} 16^1$	$2^4 4^8 8^{12} 16^1, 4^1 \rightarrow 2^3$
128	696	$2^7 4^5 8^{15}$	$8^{16} 16^1, 16^1 \rightarrow 4^5, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
128	697	$2^7 8^{15} 16^1$	$8^{16} 16^1, 8^1 \rightarrow 2^4 4^1, 4^1 \rightarrow 2^3$
128	698	$2^6 4^{38} 8^1$	$4^{32} 32^1, 32^1 \rightarrow 4^8 8^1, 4^1 \rightarrow 2^3$
128	699	$2^6 4^{33} 8^1 16^1$	
128	700	$2^6 4^{31} 8^4$	$2^6 4^{26} 8^4 16^1, 16^1 \rightarrow 4^5$
128	701	$2^6 4^{30} 32^1$	$4^{32} 32^1, 4^1 \rightarrow 2^3$
128	702	$2^6 4^{26} 8^4 16^1$	
128	703	$2^6 4^{24} 8^7$	$2^3 4^{25} 8^7, 4^1 \rightarrow 2^3$
128	704	$2^6 4^{19} 8^7 16^1$	
128	705	$2^6 4^{17} 8^{10}$	$2^3 4^{18} 8^{10}, 4^1 \rightarrow 2^3$
128	706	$2^6 4^{12} 8^{10} 16^1$	
128	707	$2^6 4^{10} 8^{13}$	$2^3 4^{11} 8^{13}, 4^1 \rightarrow 2^3$
128	708	$2^6 4^5 8^{13} 16^1$	
128	709	$2^6 4^3 8^{16}$	$8^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	710	$2^5 4^{36} 8^2$	$2^5 4^{31} 8^2 16^1, 16^1 \rightarrow 4^5$
128	711	$2^5 4^{31} 8^2 16^1$	
128	712	$2^5 4^{29} 8^5$	$2^5 4^{24} 8^5 16^1, 16^1 \rightarrow 4^5$
128	713	$2^5 4^{24} 8^5 16^1$	
128	714	$2^5 4^{22} 8^8$	$2^5 4^{17} 8^8 16^1, 16^1 \rightarrow 4^5$
128	715	$2^5 4^{17} 8^8 16^1$	
128	716	$2^5 4^{15} 8^{11}$	$2^5 4^{10} 8^{11} 16^1, 16^1 \rightarrow 4^5$

Runs	Count	Design	Lineage
128	717	$2^5 4^{10} 8^{11} 16^1$	
128	718	$2^5 4^8 8^{14}$	
128	719	$2^4 4^4$	$2^4 4^{36} 16^1, 16^1 \rightarrow 4^5$
128	720	$2^4 4^{36} 16^1$	
128	721	$2^4 4^{34} 8^3$	$2^4 4^{29} 8^3 16^1, 16^1 \rightarrow 4^5$
128	722	$2^4 4^{29} 8^3 16^1$	
128	723	$2^4 4^{27} 8^6$	$2^4 4^{22} 8^6 16^1, 16^1 \rightarrow 4^5$
128	724	$2^4 4^{22} 8^6 16^1$	
128	725	$2^4 4^{20} 8^9$	$2^4 4^{15} 8^9 16^1, 16^1 \rightarrow 4^5$
128	726	$2^4 4^{15} 8^9 16^1$	
128	727	$2^4 4^{13} 8^{12}$	$2^4 4^8 8^{12} 16^1, 16^1 \rightarrow 4^5$
128	728	$2^4 4^8 8^{12} 16^1$	
128	729	$2^4 4^6 8^{15}$	$8^{16} 16^1, 16^1 \rightarrow 4^5, 8^1 \rightarrow 2^4 4^1$
128	730	$2^4 4^1 8^{15} 16^1$	$8^{16} 16^1, 8^1 \rightarrow 2^4 4^1$
128	731	$2^3 4^{39} 8^1$	$4^{32} 32^1, 32^1 \rightarrow 4^8 8^1, 4^1 \rightarrow 2^3$
128	732	$2^3 4^{31} 32^1$	$4^{32} 32^1, 4^1 \rightarrow 2^3$
128	733	$2^3 4^{25} 8^7$	
128	734	$2^3 4^{18} 8^{10}$	
128	735	$2^3 4^{11} 8^{13}$	
128	736	$2^3 4^8 8^{16}$	$8^{16} 16^1, 16^1 \rightarrow 4^5, 4^1 \rightarrow 2^3$
128	737	$4^{40} 8^1$	$4^{32} 32^1, 32^1 \rightarrow 4^8 8^1$
128	738	$4^{32} 32^1$	
128	739	$4^5 8^{16}$	$8^{16} 16^1, 16^1 \rightarrow 4^5$
128	740	$8^{16} 16^1$	
129	1	$3^1 4^3$	
130	1	$2^1 5^1 13^1$	$2^1 65^1, 65^1 \rightarrow 5^1 13^1$
130	2	$2^1 65^1$	
130	3	$5^1 26^1$	
130	4	$10^1 13^1$	
132	1	$2^{13} 1$	
132	2	$2^4 3^3 1$	$2^4 26^1, 6^1 \rightarrow 2^1 3^1$
132	3	$2^4 26^1$	
132	4	$2^{28} 11^1$	
132	5	$2^{24} 3^1 11^1$	$2^{24} 33^1, 33^1 \rightarrow 3^1 11^1$
132	6	$2^{24} 33^1$	
132	7	$2^{22} 6^1 11^1$	
132	8	$2^{21} 22^1$	
132	9	$2^{20} 3^1 22^1$	
132	10	$2^{15} 6^1 22^1$	
132	11	$2^2 66^1$	
132	12	$3^1 4^1 11^1$	$3^1 44^1, 44^1 \rightarrow 4^1 11^1$
132	13	$3^1 44^1$	
132	14	$4^1 33^1$	
132	15	$11^1 12^1$	
133	1	$7^1 19^1$	

Runs	Count	Design	Lineage
134	1	$2^1 6 7^1$	
135	1	$3^3 7 5^1$	$3^3 2 9^1 15^1, 15^1 \rightarrow 3^1 5^1, 9^1 \rightarrow 3^4$
135	2	$3^3 6 15^1$	$3^3 2 9^1 15^1, 9^1 \rightarrow 3^4$
135	3	$3^3 3 5^1 9^1$	$3^3 2 9^1 15^1, 15^1 \rightarrow 3^1 5^1$
135	4	$3^3 2 9^1 15^1$	
135	5	$3^2 7 4 5^1$	
135	6	$5^1 2 7^1$	
136	1	$2^1 3 5$	$2^1 3 2 4^1, 4^1 \rightarrow 2^3$
136	2	$2^1 3 2 4^1$	
136	3	$2^8 7 17^1$	$2^8 4^1 17^1, 4^1 \rightarrow 2^3$
136	4	$2^8 4^1 17^1$	
136	5	$2^7 0 3 4^1$	$2^6 7 4^1 3 4^1, 4^1 \rightarrow 2^3$
136	6	$2^6 8 6 8^1$	
136	7	$2^6 7 4^1 3 4^1$	
136	8	$8^1 17^1$	
138	1	$2^1 3^1 2 3^1$	$2^1 6 9^1, 6 9^1 \rightarrow 3^1 2 3^1$
138	2	$2^1 6 9^1$	
138	3	$3^1 4 6^1$	
138	4	$6^1 2 3^1$	
140	1	$2^1 3 9$	
140	2	$2^3 8 7^1$	
140	3	$2^3 7 5^1$	$2^3 6 10^1, 10^1 \rightarrow 2^1 5^1$
140	4	$2^3 6 10^1$	
140	5	$2^3 4 1 4^1$	
140	6	$2^2 7 5^1 7^1$	
140	7	$2^2 5 5^1 1 4^1$	
140	8	$2^2 4 3 5^1$	
140	9	$2^2 2 7^1 10^1$	
140	10	$2^1 7 10^1 1 4^1$	
140	11	$2^2 7 0^1$	
140	12	$4^1 5^1 7^1$	$4^1 3 5^1, 3 5^1 \rightarrow 5^1 7^1$
140	13	$4^1 3 5^1$	
140	14	$5^1 2 8^1$	
140	15	$7^1 2 0^1$	
141	1	$3^1 4 7^1$	
142	1	$2^1 7 1^1$	
143	1	$11^1 1 13^1$	

Orthogonal Array Parents

This next listing shows virtually all known parent orthogonal arrays up through 143 runs, a reasonably comprehensive set of parent orthogonal arrays for 144 through 513 runs, and some additional parent orthogonal arrays up through 1,000 runs. While this listing is virtually complete for the smaller arrays, new arrays are being discovered all the time. If you know of any arrays that are not in this catalog, please email Warren.Kuhfeld@sas.com.

The number of parents up through 143 runs is fairly reasonable; currently there are 874. Beyond that, the number of parents grows at a very rapid rate. At some point, it becomes impossible to make the catalog complete. 143 runs was chosen as the stopping point for completeness and 144 runs as the stopping point for defining child arrays. This means that this catalog has at most 144-level factors. Arrays, for example, in 288 and 432 runs are made by replacing the 144-level factor in $2^{144}144^1$ and $3^{144}144^1$ with all of the arrays in 144 runs, and replacing (72, 36, 48, 24, 18, 12, 9, 8, 6, and 4)-level factors by arrays in that many runs, providing a rich mix of levels. Hence, *many* large and varied arrays can be made from this catalog even if it is not complete beyond 143 runs. Beyond 288 runs, 145-level and larger factors are not available, so in their place, arrays are listed that are manufactured from the most important arrays in $n > 144$ runs. Such arrays are not true parents—they just provide a convenient mechanism to get a large catalog of arrays up through 513 runs without the computational burden of enabling (145 through 256)-level factors. These designs are usually of the form $2^{3n/4}(n/4)^1$ in n runs where the real parent would be $2^{n/2}(n/2)^1$. Examples include: $2^{264}88^1$ in 352 runs (the real parent is $2^{176}176^1$) and $2^{300}100^1$ in 400 runs (the real parent is $2^{200}200^1$). Note that most arrays in this listing, even those with more than 288 runs, are true parents. Just a few are not.

This listing shows the number of parents, the total number of arrays in n runs, and a list of the parents. The 874 parents in this catalog can generate a total of 130,147 orthogonal arrays.² All of the arrays in this catalog can be generated with the SAS %MktEx macro. The %MktOrth macro maintains this catalog and can be used to list and process it. For example, all of the tables in this report were automatically generated using the %MktOrth macro and a SAS program to write a L^AT_EX file complete with the tabular markups. When the catalog grows, it only takes a few minutes to regenerate this entire report. The %MktRuns macro enables you to specify a design and see all of the orthogonal arrays that fit your specification along with suggestions for sizes for smaller nonorthogonal designs. See the Web book *Marketing Research Methods in SAS* for more information. In particular, see the chapters “Experimental Design and Choice Modeling Macros” and “Discrete Choice” for documentation and numerous examples of their uses. The book and macros are on the Web at http://support.sas.com/techsup/tnote/tnote_stat.html#market.

The page http://support.sas.com/techsup/technote/ts723_Designs.txt provides one orthogonal array for every parent in this listing up through 143 runs (except for the full-factorial designs, which require no special expertise to generate).

²The %MktEx macro can additionally generate a number of orthogonal designs that are not explicitly in the %MktOrth catalog, including full-factorial designs with more than 143 runs, large fractional factorial designs where the number of runs is the power of a prime number, and larger designs with two-level factors based on large Hadamard matrices.

Parents	Designs	Runs		Parents	Designs	Runs		Parents	Designs	Runs	
1	1	4	2^3	20	26	36	2^{35}	4	4	52	2^{51}
1	1	6	$2^1 3^1$				$2^{27} 3^1$				$2^{17} 13^1$
1	2	8	$2^4 4^1$				$2^{20} 3^2$				$2^2 26^1$
1	1	9	3^4				$2^{18} 3^1 6^1$				$4^1 13^1$
1	1	10	$2^1 5^1$				$2^{16} 9^1$	3	6	54	$2^{12} 7^1$
4	4	12	2^{11}				$2^{13} 3^2 6^1$				$3^{20} 6^1 9^1$
			$2^4 3^1$				$2^{13} 6^2$				$3^{18} 18^1$
			$2^2 6^1$				$2^{10} 3^8 6^1$	1	1	55	$5^1 11^1$
			$3^1 4^1$				$2^{10} 3^1 6^2$	5	8	56	$2^5 2^4$
1	1	14	$2^1 7^1$				$2^9 3^4 6^2$				$2^3 7^4 17^1$
1	1	15	$3^1 5^1$				$2^8 6^3$				$2^{28} 28^1$
2	7	16	$2^8 8^1$				$2^4 3^1 6^3$				$2^{27} 4^1 14^1$
			4^5				$2^3 3^9 6^1$				$7^1 8^1$
2	3	18	$2^1 9^1$				$2^3 3^2 6^3$	1	1	57	$3^1 19^1$
			$3^6 6^1$				$2^2 3^5 6^2$	1	1	58	$2^1 29^1$
4	4	20	2^{19}				$2^2 18^1$	11	15	60	2^{59}
			$2^8 5^1$				$2^1 3^3 6^3$				$2^{30} 3^1$
			$2^2 10^1$				$3^{12} 12^1$				$2^{24} 6^1$
			$4^1 5^1$				$3^7 6^3$				$2^{23} 5^1$
1	1	21	$3^1 7^1$				$4^1 9^1$				$2^{21} 10^1$
1	1	22	$2^1 11^1$	1	1	38	$2^1 19^1$				$2^{18} 15^1$
5	8	24	$2^{20} 4^1$	1	1	39	$3^1 13^1$				$2^{15} 6^1 10^1$
			$2^{13} 3^1 4^1$	5	8	40	$2^{36} 4^1$				$2^2 30^1$
			$2^{12} 12^1$				$2^{25} 4^1 5^1$				$3^1 20^1$
			$2^{11} 4^1 6^1$				$2^{20} 20^1$				$4^1 15^1$
			$3^1 8^1$				$2^{19} 4^1 10^1$				$5^1 12^1$
1	1	25	5^6				$5^1 8^1$	1	1	62	$2^1 31^1$
1	1	26	$2^1 13^1$	3	4	42	$2^{12} 1^1$	2	3	63	$3^{12} 21^1$
1	2	27	$3^9 9^1$				$3^1 14^1$				$7^1 9^1$
4	4	28	2^{27}				$6^1 7^1$	7	123	64	$2^{32} 32^1$
			$2^{12} 7^1$	4	4	44	2^{43}				$2^5 4^{17} 8^1$
			$2^2 14^1$				$2^{16} 11^1$				$2^5 4^{10} 8^4$
			$4^1 7^1$				$2^2 22^1$				$4^{16} 16^1$
3	4	30	$2^1 15^1$				$4^1 11^1$				$4^{14} 8^3$
			$3^1 10^1$	2	3	45	$3^9 15^1$				$47 8^6$
			$5^1 6^1$				$5^1 9^1$				8^9
2	20	32	$2^{16} 16^1$	1	1	46	$2^1 23^1$	1	1	65	$5^1 13^1$
			$4^8 8^1$	6	58	48	$2^{40} 8^1$	3	4	66	$2^1 33^1$
1	1	33	$3^1 11^1$				$2^{33} 3^1 8^1$				$3^1 22^1$
1	1	34	$2^1 17^1$				$2^{31} 6^1 8^1$				$6^1 11^1$
1	1	35	$5^1 7^1$				$2^{24} 24^1$	4	4	68	2^{67}
							$3^1 16^1$				$2^{19} 17^1$
							$4^{12} 12^1$				$2^2 34^1$
				1	1	49	7^8				$4^1 17^1$
				2	3	50	$2^1 25^1$	1	1	69	$3^1 23^1$
							$5^{10} 10^1$	3	4	70	$2^1 35^1$
				1	1	51	$3^1 17^1$				$5^1 14^1$
											$7^1 10^1$

Parents	Designs	Runs		Parents	Designs	Runs		Parents	Designs	Runs	
3	4	105	$3^1 35^1$	7	57	112	$2^{10} 4^8 1$	21	740	128	$2^6 4^6 1$
			$5^1 21^1$				$2^{89} 7^1 8^1$				$2^6 4^{33} 8^1 16^1$
			$7^1 15^1$				$2^{79} 8^1 14^1$				$2^6 4^{26} 8^4 16^1$
1	1	106	$2^1 53^1$				$2^{75} 4^3 28^1$				$2^6 4^{19} 8^7 16^1$
40	80	108	2^{107}				$2^{56} 56^1$				$2^6 4^{12} 8^{10} 16^1$
			$2^{40} 6^1$				$4^{12} 28^1$				$2^6 4^5 8^{13} 16^1$
			$2^{34} 3^{29} 6^1$				$7^1 16^1$				$2^5 4^3 1^8 2^1 16^1$
			$2^{27} 3^{33} 9^1$	3	4	114	$2^1 57^1$				$2^5 4^{24} 8^5 16^1$
			$2^{24} 27^1$				$3^1 38^1$				$2^5 4^{17} 8^8 16^1$
			$2^{21} 3^1 6^2$				$6^1 19^1$				$2^5 4^{10} 8^{11} 16^1$
			$2^{21} 18^1$	1	1	115	$5^1 23^1$				$2^5 4^8 8^4$
			$2^{20} 3^{34} 9^1$	4	4	116	2^{115}				$2^4 4^{36} 16^1$
			$2^{18} 3^{33} 6^1 9^1$				$2^{24} 29^1$				$2^4 4^{29} 8^3 16^1$
			$2^{18} 3^{31} 18^1$				$2^2 58^1$				$2^4 4^{22} 8^6 16^1$
			$2^{17} 3^{29} 6^2$				$4^1 29^1$				$2^4 4^{15} 8^9 16^1$
			$2^{15} 6^1 18^1$	2	3	117	$3^{13} 39^1$				$2^4 4^8 8^{12} 16^1$
			$2^{13} 3^{30} 6^1 18^1$				$9^1 13^1$				$2^3 4^{25} 8^7$
			$2^{13} 6^3$	1	1	118	$2^1 59^1$				$2^3 4^{18} 8^{10}$
			$2^{12} 3^{29} 6^3$	1	1	119	$7^1 17^1$				$2^3 4^{11} 8^{13}$
			$2^{10} 3^{40} 6^1 9^1$	16	31	120	$2^{116} 4^1$				$4^{32} 32^1$
			$2^{10} 3^{33} 6^2 9^1$				$2^{87} 3^{14} 1^1$				$8^{16} 16^1$
			$2^{10} 3^{31} 6^1 18^1$				$2^{79} 4^1 5^1$	1	1	129	$3^1 43^1$
			$2^9 3^{36} 6^2 9^1$				$2^{75} 4^1 6^1$	3	4	130	$2^1 65^1$
			$2^9 3^{34} 6^1 18^1$				$2^{75} 4^1 10^1$				$5^1 26^1$
			$2^8 3^{30} 6^2 18^1$				$2^{75} 4^1 15^1$				$10^1 13^1$
			$2^4 3^{33} 6^3 9^1$				$2^{70} 3^1 4^1 10^1$	12	15	132	2^{131}
			$2^4 3^{31} 6^2 18^1$				$2^{70} 4^1 5^1 6^1$				$2^4 26^1$
			$2^3 3^{41} 6^1 9^1$				$2^{68} 4^1 6^1 10^1$				$2^{28} 11^1$
			$2^3 3^{39} 18^1$				$2^{60} 60^1$				$2^{24} 33^1$
			$2^3 3^{34} 6^3 9^1$				$2^{59} 4^1 30^1$				$2^{22} 6^1 11^1$
			$2^3 3^{32} 6^2 18^1$				$2^{30} 6^1 20^1$				$2^{21} 22^1$
			$2^3 3^{16} 6^8$				$2^{28} 10^1 12^1$				$2^{20} 3^1 22^1$
			$2^2 3^{42} 18^1$				$3^1 40^1$				$2^{15} 6^1 22^1$
			$2^2 3^{37} 6^2 9^1$				$5^1 24^1$				$2^2 66^1$
			$2^2 3^{35} 6^1 18^1$				$8^1 15^1$				$3^1 44^1$
			$2^2 54^1$	1	1	121	11^{12}				$4^1 33^1$
			$2^1 3^{35} 6^3 9^1$	1	1	122	$2^1 61^1$				$11^1 12^1$
			$2^1 3^{33} 6^2 18^1$	1	1	123	$3^1 41^1$	1	1	133	$7^1 19^1$
			$3^{44} 9^1 12^1$	4	4	124	2^{123}	1	1	134	$2^1 67^1$
			$3^{39} 6^3 9^1$				$2^{24} 31^1$	3	6	135	$3^{32} 9^1 15^1$
			$3^{37} 6^2 18^1$				$2^2 62^1$				$3^{27} 45^1$
			$3^{36} 36^1$				$4^1 31^1$				$5^1 27^1$
			$3^4 6^{11}$	1	2	125	$5^{25} 25^1$	5	8	136	$2^{132} 4^1$
			$4^1 27^1$	7	10	126	$2^1 63^1$				$2^{84} 4^1 17^1$
3	4	110	$2^1 55^1$				$3^{24} 14^1$				$2^{68} 68^1$
			$5^1 22^1$				$3^{23} 6^1 7^1$				$2^{67} 4^1 34^1$
			$10^1 11^1$				$3^{21} 42^1$				$8^1 17^1$
1	1	111	$3^1 37^1$				$3^{20} 6^1 21^1$	3	4	138	$2^1 69^1$
							$7^1 18^1$				$3^1 46^1$
							$9^1 14^1$				$6^1 23^1$

Parents	Designs	Runs		Parents	Designs	Runs		Parents	Designs	Runs	
13	15	140	2^{139}	1	1	164	2^{163}	3	13	225	$3^{27}7^5$
			$2^{38}7^1$	2	16	168	$2^{164}4^1$				$5^{20}45^1$
			$2^{36}10^1$				$2^{84}84^1$				15^6
			$2^{34}14^1$	1	1	169	13^{14}	1	1	228	2^{227}
			$2^{27}5^17^1$	1	1	171	$3^{28}19^1$	2	6	232	$2^{228}4^1$
			$2^{25}5^114^1$	1	1	172	2^{171}				$2^{116}116^1$
			$2^{24}35^1$	1	2	175	$5^{10}35^1$	1	5	234	$3^{30}78^1$
			$2^{22}7^110^1$	4	56	176	$2^{168}8^1$	1	1	236	2^{235}
			$2^{17}10^114^1$				$2^{166}4^3$	6	302	240	$2^{232}8^1$
			$2^{27}0^1$				$2^{88}88^1$				$2^{230}4^3$
			4^135^1				$4^{12}44^1$				$2^{205}5^124^1$
			5^128^1	3	24	180	2^{179}				$2^{199}10^124^1$
			7^120^1				$3^{30}60^1$				$2^{120}120^1$
1	1	141	3^147^1				6^230^1				$4^{20}60^1$
1	1	142	2^171^1	2	6	184	$2^{180}4^1$	1	2	242	$11^{22}22^1$
1	1	143	11^113^1				$2^{92}92^1$	2	58	243	$3^{81}81^1$
17	1,248	144	$2^{136}8^1$	1	1	188	2^{187}				$9^{27}27^1$
			$2^{117}8^19^1$	1	4	189	$3^{36}63^1$	1	1	244	2^{243}
			$2^{113}3^124^1$	4	726	192	$2^{160}32^1$	1	2	245	$7^{10}35^1$
			$2^{111}6^124^1$				$2^{96}96^1$	2	6	248	$2^{244}4^1$
			$2^{103}8^118^1$				$4^{48}48^1$				$2^{124}124^1$
			$2^{76}3^{12}6^48^1$				8^824^1	1	4	250	$5^{50}50^1$
			$2^{76}3^74^16^512^1$	3	12	196	2^{195}	3	23	252	2^{251}
			$2^{75}3^34^16^612^1$				$7^{28}28^1$				$3^{42}84^1$
			$2^{74}3^46^68^1$				14^6				6^242^1
			$2^{72}72^1$	1	5	198	$3^{30}66^1$	2	6,101	256	$8^{32}32^1$
			$2^{44}3^{11}12^2$	4	42	200	$2^{196}4^1$				16^{17}
			$2^{23}3^416^124^1$				$2^{100}100^1$	1	1	260	2^{259}
			$2^{16}3^36^624^1$				$5^{20}40^1$	1	2	261	$3^{27}87^1$
			$3^{48}48^1$				10^520^1	2	17	264	$2^{260}4^1$
			$4^{36}36^1$	1	1	204	2^{203}				$2^{132}132^1$
			$4^{11}12^2$	1	1	207	$3^{25}23^1$	1	1	268	2^{267}
			12^7	4	72	208	$2^{200}8^1$	1	11	270	$3^{90}90^1$
1	2	147	7^921^1				$2^{198}4^3$	4	136	272	$2^{264}8^1$
1	1	148	2^{147}				$2^{104}104^1$				$2^{262}4^3$
1	5	150	$5^{11}30^1$				$4^{16}52^1$				$2^{136}136^1$
2	6	152	$2^{148}4^1$	1	1	212	2^{211}				$4^{32}68^1$
			$2^{76}76^1$	6	259	216	$2^{212}4^1$	1	2	275	$5^{11}55^1$
1	1	153	$3^{25}17^1$				$2^{108}108^1$	1	1	276	2^{275}
1	1	156	2^{155}				$2^{11}3^{77}12^118^1$	1	2	279	$3^{30}93^1$
6	110	160	$2^{144}16^1$				$3^{72}72^1$	2	17	280	$2^{276}4^1$
			$2^{138}4^7$				$3^{66}6^512^118^1$				$2^{140}140^1$
			$2^{133}5^116^1$				6^736^1	1	1	284	2^{283}
			$2^{127}10^116^1$	1	1	220	2^{219}				
			$2^{80}80^1$	5	351	224	$2^{208}16^1$				
			$4^{16}40^1$				$2^{193}7^116^1$				
3	61	162	$3^{65}6^127^1$				$2^{183}14^116^1$				
			$3^{54}54^1$				$2^{112}112^1$				
			$9^{18}18^1$				$4^{56}56^1$				

Parents	Designs	Runs		Parents	Designs	Runs		Parents	Designs	Runs	
8	3,207	288	2 ²⁷² 16 ¹	1	5	342	3 ³⁰ 114 ¹	1	2	408	2 ⁴⁰⁴ 4 ¹
			2 ²⁵³ 9 ¹ 16 ¹	1	2	343	7 ⁴⁹ 49 ¹	1	1	412	2 ⁴¹¹
			2 ²³⁹ 16 ¹ 18 ¹	1	2	344	2 ³⁴⁰ 4 ¹	1	5	414	3 ⁴⁸ 138 ¹
			2 ¹⁴⁴ 144 ¹	1	1	348	2 ³⁴⁷	4	299	416	2 ⁴⁰⁰ 16 ¹
			3 ⁹⁶ 96 ¹	1	5	350	5 ²⁰ 70 ¹				2 ³⁹⁴ 4 ⁷
			4 ³⁶ 72 ¹	1	4	351	3 ³⁹ 117 ¹				2 ³¹² 104 ¹
			6 ¹⁰ 48 ¹	4	203	352	2 ³³⁶ 16 ¹				4 ⁴⁸ 104 ¹
			12 ⁶ 24 ¹				2 ³³⁰ 4 ⁷	1	1	420	2 ⁴¹⁹
1	1	289	17 ¹⁸				2 ²⁶⁴ 88 ¹	1	2	423	3 ³⁰ 141 ¹
1	1	292	2 ²⁹¹				4 ³² 88 ¹	1	2	424	2 ⁴²⁰ 4 ¹
1	5	294	7 ¹⁸ 42 ¹	1	1	356	2 ³⁵⁵	1	2	425	5 ²⁰ 85 ¹
1	2	296	2 ²⁹² 4 ¹	3	133	360	2 ³⁵⁶ 4 ¹	1	1	428	2 ⁴²⁷
1	4	297	3 ³⁹ 99 ¹				3 ⁴⁸ 120 ¹	7	10,953	432	2 ⁴²⁴ 8 ¹
3	24	300	2 ²⁹⁹				6 ⁸ 60 ¹				2 ³⁸⁹ 9 ¹ 24 ¹
			5 ²⁰ 60 ¹	1	1	361	19 ²⁰				2 ³⁷⁵ 18 ¹ 24 ¹
			10 ² 30 ¹	1	2	363	11 ¹¹ 33 ¹				3 ¹⁴⁴ 144 ¹
4	70	304	2 ²⁹⁶ 8 ¹	1	1	364	2 ³⁶³				4 ¹⁰⁸ 108 ¹
			2 ²⁹⁴ 4 ³	4	150	368	2 ³⁶⁰ 8 ¹				6 ¹² 72 ¹
			2 ²²⁸ 76 ¹				2 ³⁵⁸ 4 ³				12 ⁶ 36 ¹
			4 ¹⁶ 76 ¹				2 ²⁷⁶ 92 ¹	1	1	436	2 ⁴³⁵
1	5	306	3 ⁴⁸ 102 ¹				4 ³⁶ 92 ¹	1	2	440	2 ⁴³⁶ 4 ¹
1	1	308	2 ³⁰⁷	1	2	369	3 ³⁰ 123 ¹	3	12	441	3 ⁴² 7 ⁷ 21 ¹
1	2	312	2 ³⁰⁸ 4 ¹	1	1	372	2 ³⁷¹				7 ¹⁴ 63 ¹
1	5	315	3 ²⁹ 105 ¹	1	4	375	5 ⁴⁰ 75 ¹				21 ⁷
1	1	316	2 ³¹⁵	1	2	376	2 ³⁷² 4 ¹	1	1	444	2 ⁴⁴³
5	725	320	2 ²⁸⁸ 32 ¹	1	11	378	3 ⁷² 126 ¹	4	8,598	448	2 ⁴¹⁶ 32 ¹
			2 ²⁷⁴ 4 ¹⁵	1	1	380	2 ³⁷⁹				2 ³³⁶ 112 ¹
			2 ²⁴⁰ 80 ¹	3	3,252	384	2 ³²⁰ 64 ¹				4 ⁵⁶ 112 ¹
			4 ⁴⁰ 80 ¹				4 ⁹⁶ 96 ¹				8 ⁵⁶ 56 ¹
			8 ¹⁰ 40 ¹				8 ¹⁶ 48 ¹	3	35	450	3 ¹⁵⁰ 5 ¹¹ 30 ¹
6	1,004	324	2 ³²³	1	2	387	3 ⁴⁸ 129 ¹				5 ⁹⁰ 90 ¹
			3 ¹⁴³ 12 ¹ 27 ¹	1	1	388	2 ³⁸⁷				15 ⁵ 30 ¹
			3 ¹⁰⁸ 108 ¹	4	28	392	2 ³⁸⁸ 4 ¹	1	2	456	2 ⁴⁵² 4 ¹
			6 ² 54 ¹				2 ¹⁹⁶ 7 ²⁸ 28 ¹	1	2	459	3 ⁷² 9 ¹ 17 ¹
			9 ³⁶ 36 ¹				7 ²⁸ 56 ¹	1	1	460	2 ⁴⁵⁹
			18 ⁵				14 ⁵ 28 ¹	4	150	464	2 ⁴⁵⁶ 8 ¹
1	2	325	5 ²⁰ 65 ¹	3	24	396	2 ³⁹⁵				2 ⁴⁵⁴ 4 ³
1	2	328	2 ³²⁴ 4 ¹				3 ¹³² 132 ¹				2 ³⁴⁸ 116 ¹
1	1	332	2 ³³¹				6 ² 66 ¹				4 ³⁶ 116 ¹
1	2	333	3 ³⁶ 111 ¹	7	996	400	2 ³⁹² 8 ¹	3	17	468	2 ⁴⁶⁷
6	487	336	2 ³²⁸ 8 ¹				2 ³⁹⁰ 4 ³				3 ⁴⁹ 52 ¹
			2 ³²⁶ 4 ³				2 ³⁰⁰ 100 ¹				6 ² 78 ¹
			2 ²⁹⁷ 7 ¹ 24 ¹				4 ³⁶ 100 ¹	1	2	472	2 ⁴⁶⁸ 4 ¹
			2 ²⁸⁷ 14 ¹ 24 ¹				5 ⁸⁰ 80 ¹	1	2	475	5 ²⁰ 95 ¹
			2 ²⁵² 84 ¹				10 ⁶ 40 ¹	1	1	477	3 ³⁷ 53 ¹
			4 ³⁶ 84 ¹				20 ⁶	4	1,210	480	2 ⁴⁶⁴ 16 ¹
1	2	338	13 ²⁶ 26 ¹	1	1	404	2 ⁴⁰³				2 ⁴⁵⁸ 4 ⁷
1	1	340	2 ³³⁹	2	60	405	3 ⁸¹ 135 ¹				2 ³⁶⁰ 120 ¹
							9 ¹⁸ 45 ¹				4 ⁵⁶ 120 ¹

Parents	Designs	Runs		Parents	Designs	Runs		Parents	Designs	Runs	
3	11	484	2^{483}	1	2	600	$2^{596}4^1$	1	1	756	2^{755}
			$11^{44}44^1$	1	1	604	2^{603}	1	2	760	$2^{756}4^1$
			22^5	2	10	608	$2^{592}16^1$	1	125	768	$2^{640}128^1$
1	277	486	$9^{54}54^1$				$2^{586}4^7$	1	2	776	$2^{772}4^1$
1	2	488	$2^{484}4^1$	1	1	612	2^{611}	1	1	780	2^{779}
1	5	490	$7^{18}70^1$	1	2	616	$2^{612}4^1$	3	130	784	$2^{776}8^1$
1	1	492	2^{491}	1	1	620	2^{619}				$2^{774}4^3$
1	2	495	$3^{42}5^{13}33^1$	2	5	624	$2^{616}8^1$				28^5
4	78	496	$2^{488}8^1$				$2^{614}4^3$	1	1	788	2^{787}
			$2^{486}4^3$	1	27	625	25^{26}	1	2	792	$2^{788}4^1$
			$2^{372}124^1$	1	1	628	2^{627}	1	1	796	2^{795}
			$4^{18}124^1$	1	2	632	$2^{628}4^1$	2	10	800	$2^{784}16^1$
3	29	500	2^{499}	1	1	636	2^{635}				$2^{778}4^7$
			$5^{100}100^1$	1	124	640	$2^{576}64^1$	1	1	804	2^{803}
			$10^{25}0^1$	1	1	644	2^{643}	1	2	808	$2^{804}4^1$
3	111	504	$2^{500}4^1$	1	2	648	$2^{644}4^1$	1	1	812	2^{811}
			$2^{84}3^{84}84^1$	2	5	656	$2^{648}8^1$	2	5	816	$2^{808}8^1$
			6^884^1				$2^{646}4^3$				$2^{806}4^3$
2	73,992	512	$8^{64}64^1$	1	1	660	2^{659}	1	1	820	2^{819}
			$16^{32}32^1$	1	2	664	$2^{660}4^1$	1	2	824	$2^{820}4^1$
1	2	513	$3^{81}9^{19}19^1$	2	10	672	$2^{656}16^1$	1	1	828	2^{827}
1	1	516	2^{515}				$2^{650}4^7$	2	27	832	$2^{800}32^1$
1	2	520	$2^{516}4^1$	2	8	676	2^{675}				$2^{786}4^{15}$
1	1	524	2^{523}				26^6	1	2	840	$2^{836}4^1$
2	5	528	$2^{520}8^1$	1	2	680	$2^{676}4^1$	1	1	841	29^{30}
			$2^{518}4^3$	1	1	684	2^{683}	1	1	844	2^{843}
1	1	529	23^{24}	2	5	688	$2^{680}8^1$	2	5	848	$2^{840}8^1$
1	2	536	$2^{532}4^1$				$2^{678}4^3$				$2^{838}4^3$
1	1	540	2^{539}	1	1	692	2^{691}	1	2	856	$2^{852}4^1$
2	10	544	$2^{528}16^1$	1	2	696	$2^{692}4^1$	1	1	860	2^{859}
			$2^{522}4^7$	1	1	700	2^{699}	2	10	864	$2^{848}16^1$
1	1	548	2^{547}	2	27	704	$2^{672}32^1$				$2^{842}4^7$
1	2	552	$2^{548}4^1$				$2^{658}4^{15}$	1	1	868	2^{867}
1	1	556	2^{555}	1	1	708	2^{707}	1	2	872	$2^{868}4^1$
2	5	560	$2^{552}8^1$	1	2	712	$2^{708}4^1$	2	5	880	$2^{872}8^1$
			$2^{550}4^3$	2	5	720	$2^{712}8^1$				$2^{870}4^3$
1	1	564	2^{563}				$2^{710}4^3$	1	1	884	2^{883}
1	2	568	$2^{564}4^1$	1	1	724	2^{723}	1	2	888	$2^{884}4^1$
1	1	572	2^{571}	1	2	728	$2^{724}4^1$	1	124	896	$2^{832}64^1$
3	11,028	576	$2^{544}32^1$	1	435	729	27^{28}	1	1	900	2^{899}
			$2^{530}4^{15}$	1	1	732	2^{731}	1	1	908	2^{907}
			24^9	2	10	736	$2^{720}16^1$	2	5	912	$2^{904}8^1$
1	1	580	2^{579}				$2^{714}4^7$				$2^{902}4^3$
1	2	584	$2^{580}4^1$	1	1	740	2^{739}	1	1	916	2^{915}
1	1	588	2^{587}	1	2	744	$2^{740}4^1$	1	2	920	$2^{916}4^1$
2	5	592	$2^{584}8^1$	1	1	748	2^{747}	1	1	924	2^{923}
			$2^{582}4^3$	2	5	752	$2^{744}8^1$	2	10	928	$2^{912}16^1$
1	1	596	2^{595}				$2^{742}4^3$				$2^{906}4^7$

Parents	Designs	Runs	
1	2	936	$2^{932}4^1$
2	5	944	$2^{936}8^1$ $2^{934}4^3$
1	1	948	2^{947}
2	27	960	$2^{928}32^1$ $2^{914}4^{15}$
1	1	961	31^{32}
1	2	968	$2^{964}4^1$
1	1	972	2^{971}
2	5	976	$2^{968}8^1$ $2^{966}4^3$
1	2	984	$2^{980}4^1$
2	10	992	$2^{976}16^1$ $2^{970}4^7$
1	2	1000	$2^{996}4^1$
874	130,147		

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