

CLASSIFICATION OF TWO-SYMBOL ORTHOGONAL ARRAYS OF SIZE 24, STRENGTH 2, 6 CONSTRAINTS AND INDEX 6 DERIVABLE FROM SATURATED ORTHOGONAL ARRAYS HAVING 23 CONSTRAINTS

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Abstract. An enhanced algorithm and the computational results on the classification of two-symbol orthogonal arrays of strength 2, size 24, 6 constraints and index 6 derivable from 130 representatives of saturated orthogonal arrays having maximal constraints are given. A table of 1,317 representative 2-OA(24,6,2)'s obtained is given by indicating the selected set of 6 columns of a representative saturated array of 23 constraints each.

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§0. Introduction

Orthogonal 2^m factorial designs have widely been used in factor screening and related experiments. Among others, such designs obtained by assigning factors to the appropriate columns of a saturated orthogonal array, or an array having maximal constraints, have been recommended for practical use (see, e.g., Taguchi [6,7], Box and Hunter [1,2], Hedayat [3], Namikawa, Fujii and Yamamoto [5] and Yamamoto, Fujii, Hyodo and Yumiba [10]). Such kind of saturated orthogonal arrays, however, have been restricted to those constructed by the standard orthogonal polynomial models. Moreover, the

size or the number of runs of such a design is necessarily restricted to the power of two.

All of the saturated orthogonal arrays of size 4λ are isomorphic to each other with respect to the permutation of $4\lambda - 1$ columns (factors) and symbols (levels) in each case of $\lambda = 1, 2$ and 3 , respectively. There are, however, several isomorphic classes since Hadamard matrices of size 4λ which are not isomorphic to each other do exist for those integral $\lambda \geq 4$. In fact, as it has been shown in our previous papers (Yamamoto, Fujii, Hyodo and Yumiba [8,9,13]), there are 5, 3 and 130 isomorphic classes of orthogonal arrays in those cases of $\lambda = 4, 5$ and 6 , respectively. The possibility, therefore, of obtaining so many useful orthogonal 2^m factorial designs from such saturated orthogonal arrays is expected as it has been illustrated in our preceding paper (Yamamoto, Fujii, Hyodo and Yumiba [11]). The results of the classification of two-symbol orthogonal arrays of size 16 and 20, and 5 and 6 constraints derivable from representative saturated orthogonal arrays of size 16 and 20 with respect to the permutation of columns and symbols within columns have been given in Yamamoto, Fujii, Hyodo and Yumiba [12]. The same with respect to the arrays of size 24 and 5 constraints is given in Yamamoto, Fujii, Hyodo and Yumiba [14].

In this paper, an enhanced algorithm and the results of the classification of all two-symbol orthogonal arrays of size 24, 6 constraints and index 6 derivable from 130 representatives of saturated orthogonal arrays of strength 2, size 24, 23 (maximal) constraints and index 6 are given.

§1. Orthogonal arrays and modular vectors

An $N \times m$ array of two symbols 0 and 1 is said to be a two-symbol *orthogonal array* of strength t , size N , m constraints and index λ and is denoted by $2\text{-OA}(t, m, \lambda)$ if every $N \times t$ subarray contains all possible $1 \times t$ binary row vectors with the same frequency λ . Note that the order of the arrangement of rows is immaterial in an orthogonal array. An orthogonal array is said to be *isomorphic* to the other if one can obtain from the other by permuting columns and symbols within columns.

Let T be a two-symbol orthogonal array of strength 2, i.e., $2\text{-OA}(2, m, \lambda)$ of size $N = 4\lambda$, and suppose $(j_1^{(\alpha)}, j_2^{(\alpha)}, \dots, j_m^{(\alpha)})$ be its α th row with $j_p^{(\alpha)} = 1$ or 0 for $p = 1, 2, \dots, m$ and $\alpha = 1, 2, \dots, N$.

If the α th row of T is considered to be a binary number of m figures, a decimal number $b_\alpha^* = \sum_{p=1}^m 2^{m-p} j_p^{(\alpha)}$ may be associated to the row for every $\alpha = 1, 2, \dots, N$. Arranging b_α^* in the order of α , a faithful representation vector, i.e.,

$$B^*(T) = [b_1^*, b_2^*, \dots, b_N^*],$$

of T can be constructed.

Rearranging those components of $B^*(T)$ in their order of magnitudes, a vector $B(T)$ which may be called the modular vector of T , i.e.,

$$B(T) = [b_1, b_2, \dots, b_N], \quad b_i \leq b_j \text{ for all } i < j,$$

can be constructed.

Clearly, the correspondence between an orthogonal array T and its modular vector $B(T)$ is one to one.

§2. Essentials of the classification algorithm

Consider all two-symbol orthogonal arrays, $2\text{-OA}(2, m, \lambda)$'s of size $N = 4\lambda$, which are derivable from saturated orthogonal arrays, $2\text{-OA}(2, N - 1, \lambda)$'s, by selecting sets of m columns. In order to classify those orthogonal arrays into isomorphic classes with respect to the permutation of columns and symbols within columns, it is sufficient to classify those derivable from the $\nu(\lambda)$ representatives of all isomorphic classes of saturated $2\text{-OA}(2, N - 1, \lambda)$'s. Here, $\nu(\lambda)$ denotes the number of isomorphic classes of saturated $2\text{-OA}(2, N - 1, \lambda)$'s.

The essentials of the algorithm for the classification of those orthogonal arrays with respect to the permutation of columns and symbols within columns are as follows:

Step 1. Get a representative saturated $2\text{-OA}(2, N - 1, \lambda)$ of size $N = 4\lambda$ labeled by a loop parameter a_k ($1 \leq a_k \leq \nu(\lambda)$) indicating serially the numbers of representative saturated two-symbol orthogonal arrays. If the loop parameter moves up to $a_k > \nu(\lambda)$, the classification process is terminated.

Step 2. Select a set $\{i_1, i_2, \dots, i_m\}$ of m columns ($1 \leq i_1 < i_2 < \dots < i_m \leq N - 1$) of the representative $2\text{-OA}(2, N - 1, \lambda)$ using i_p 's ($1 \leq p \leq m$) as m -fold nested loop parameters and construct a $2\text{-OA}(2, m, \lambda)$ composed of the selected m columns. If the first loop parameter moves up to $i_1 > N - m$, the selection process is terminated and go to Step 1 after setting $a_k \leftarrow a_k + 1$.

Step 3. Applying the symbol and column permutation to the constructed $2\text{-OA}(2, m, \lambda)$, compute the modular vector of the permuted array and search whether the same is already registered in the RF-file or not step by step until the answer becomes affirmative. Here, the RF-file is that of the modular vectors of the representatives of isomorphic classes of $2\text{-OA}(2, m, \lambda)$.

Step 4. If the answer in Step 3 is affirmative, the symbol and column permutation will be terminated and go to Step 2. While, if the answer is not affirmative until the end of the symbol and column permutation, the modular vector of originally selected $2\text{-OA}(2, m, \lambda)$ will be registered to the RF-file of $2\text{-OA}(2, m, \lambda)$ and go to Step 2.

§3. Two remarks on Step 2

Since we can provide the representative saturated two-symbol orthogonal arrays to be those having $(1, 1, \dots, 1)$ in their first row, the number of symbol permutations to be executed may be reduced from 2^m to N which preserve the presence of the row $(1, 1, \dots, 1)$ if $2^m > N$, e.g., from 64 to 24 in the case $\lambda = 6$ and $m = 6$.

The other remark concerns with the method of searching and storing the array with respect to the RF-file. The method of sequential search, that of binary search, etc., are applicable for such purpose. In our case, however, the size (or number of records) of the RF-file to be constructed grows up step by step during the classification process. The method of key (array) to address transformation by hashing for searching and storing the array, which does not depend on the size of the file, is, therefore, preferable in this case. If the final size of RF can be estimated to some extent, it will be helpful in selecting the better function for hashing (see, e.g., Knuth [4]).

The modular vector $B(T)$ of an array T can be considered to be a 2^m -ary number of $N - 1$ figures, i.e.,

$$(b_1 b_2 \dots b_{N-1})_{2^m} = \sum_{i=1}^{N-1} b_i (2^m)^{N-i-1} (= c(T)),$$

since b_N can be disregarded for all arrays considered here. Clearly, T , $B(T)$ and the decimal number $c(T)$ are one to one to each other.

Let $h(B(T))$ be a hash function of the key $B(T)$ to the address defined by

$$h(B(T)) = c(T) \bmod p = c(T) - p \cdot [c(T)/p],$$

which satisfies $0 \leq h(B(T)) \leq p - 1$ for some appropriately chosen prime number p , where $[x]$ denotes the greatest integer not exceeding x .

Except some cases of small m and λ , the number $c(T)$ is too large to handle in the usual computer system. The hash function $h(B(T))$ for a $c(T)$ can, however, be evaluated recursively by calculating $(2^m)^i \bmod p$ as follows:

$$(2^m)^{i+1} \bmod p = 2^m \{(2^m)^i \bmod p\} \bmod p.$$

This makes us possible to evaluate $h(B(T))$ in the usual computer system.

§4. Use of the intermediate file

Applying the algorithm given in Section 2, those results given in Yamamoto, Fujii, Hyodo and Yumiba [12,14] can be obtained easily. This algorithm, however, is not so effective in the case $m = 6$ and $\lambda = 6$, i.e., in the

classification of all 2-OA(2,6,6) ($\binom{23}{6} \times 130 := 1.3 \times 10^7$ in all) derivable from 130 representative 2-OA(2,23,6). A crude estimate obtained after running on the DECstation 5000/125 about 3 months, it seems to take about 1 year and half running in order to get a complete answer of the classification. In view of the fact, the application of the column and symbol permutation group in Step 3 is limited to a subgroup in order to get the affirmative answer as earlier stage of permutation as possible, since the size of the intermediate file of the representatives (IRF-file) may increase considerably by duplicated registration of final representatives in the RF-file.

In our case, a product of two column transpositions, (1,2) and (3,4), has been applied instead of the column permutation of order 6!. In this case, the final size of the IRF-file has been reduced to about 1.7×10^5 and it took about 2.8 days running to get the file.

Using the IRF-file and applying the algorithm of the classification in Section 2, the RF-file has been constructed. It took only about 5.7 days running in our DECstation 5000/125 system. The final size of the RF-file obtained amounts to 1,317.

§5. Results obtained on the classification of 2-OA(2,6,6)

Those representative arrays of 1,317 isomorphic classes are given in Table 1 by indicating respectively the selected set of 6 columns of the generating saturated orthogonal array. Note that precise number of isomorphic classes of all 2-OA(2,6,6) may or may not be greater than 1,317. A table of 18 saturated arrays of 23 constraints among 130 representatives (Yamamoto, Fujii, Hyodo and Yumiba [13]) which are sufficient to derive those 1,317 arrays is given in Appendix.

Table 1. Representative arrays of 1,317 isomorphic classes of 2-OA(2,6,6)

x: Serial number of representative 2-OA(2,6,6)
y: Number of representative saturated orthogonal array
z: Selected set of 6 columns

x	y	z	x	y	z	x	y	z
(1)[A 1](1 2 3 4 5 6)	(2)[A 1](1 2 3 4 6 8)	(3)[A 1](1 2 3 4 6 9)	(4)[A 1](1 2 3 4 7 9)	(5)[A 1](1 2 3 5 7 9)	(6)[A 1](1 2 4 6 8 10)	(7)[A 1](1 2 4 6 8 11)	(8)[A 1](1 2 4 6 8 12)	(9)[A 1](1 2 4 6 8 13)
(10)[A 1](1 2 4 6 9 11)	(11)[A 1](1 2 4 6 9 13)	(12)[A 1](1 2 4 7 9 11)	(13)[A 1](1 2 4 7 9 13)	(14)[A 1](1 2 5 7 9 11)	(15)[A 1](1 2 5 7 9 13)	(16)[A 1](1 3 5 7 9 11)	(17)[A 1](1 3 5 7 9 13)	(18)[A 1](2 3 4 5 6 7 9)
(19)[A 1](2 3 4 5 6 8)	(20)[A 1](2 3 4 5 6 9)	(21)[A 1](2 3 4 5 7 9)	(22)[A 1](2 3 4 6 8 11)	(23)[A 1](2 3 4 6 8 13)	(24)[A 1](2 3 4 6 9 11)	(25)[A 1](2 3 4 6 9 13)	(26)[A 1](2 3 4 6 9 15)	(27)[A 1](2 3 4 7 9 11)
(28)[A 1](2 3 4 7 9 13)	(29)[A 1](2 4 6 8 10 12)	(30)[A 1](2 4 6 8 11 13)	(31)[A 1](2 4 6 8 12 14)	(32)[A 1](2 4 6 8 13 15)	(33)[A 1](2 4 6 8 13 17)	(34)[A 1](2 4 6 9 11 13)	(35)[A 1](2 4 6 9 13 15)	(36)[A 1](2 4 6 9 13 17)
(37)[A 1](2 4 7 9 11 13)	(38)[A 1](2 4 7 9 13 15)	(39)[A 1](2 4 7 9 13 17)	(40)[A 1](2 5 7 9 11 13)	(41)[A 1](2 5 7 9 13 15)	(42)[A 2](1 2 4 6 8 12)	(43)[A 2](1 2 4 6 8 13)	(44)[A 2](1 2 4 6 9 12)	(45)[A 2](1 2 4 6 9 13)
(46)[A 2](1 2 4 6 12 14)	(47)[A 2](1 2 4 6 12 15)	(48)[A 2](1 2 4 6 12 16)	(49)[A 2](1 2 4 6 12 17)	(50)[A 2](1 2 4 6 13 15)	(51)[A 2](1 2 4 7 8 13)	(52)[A 2](1 2 4 7 8 14)	(53)[A 2](1 2 4 7 9 21)	(54)[A 2](1 2 4 8 12 16)
(55)[A 2](1 2 4 8 12 17)	(56)[A 2](1 2 4 8 13 16)	(57)[A 2](1 2 4 9 12 16)	(58)[A 2](2 3 4 6 8 12)	(59)[A 2](2 3 4 6 8 13)	(60)[A 2](2 3 4 6 8 16)	(61)[A 2](2 3 4 6 8 18)	(62)[A 2](2 3 4 6 8 19)	(63)[A 2](2 3 4 6 9 12)
(64)[A 2](2 3 4 6 9 13)	(65)[A 2](2 3 4 6 9 16)	(66)[A 2](2 3 4 6 9 17)	(67)[A 2](2 3 4 6 12 16)	(68)[A 2](2 3 4 6 12 17)	(69)[A 2](2 3 4 6 12 20)	(70)[A 2](2 3 4 6 12 22)	(71)[A 2](2 3 4 6 12 23)	(72)[A 2](2 3 4 6 13 15)
(73)[A 2](2 3 4 6 13 17)	(74)[A 2](2 3 4 6 13 23)	(75)[A 2](2 3 4 8 12 16)	(76)[A 2](2 3 4 8 12 17)	(77)[A 2](2 3 4 8 12 22)	(78)[A 2](2 3 4 8 12 23)	(79)[A 2](2 3 4 8 13 16)	(80)[A 2](2 3 4 8 16 21)	(81)[A 2](2 4 6 8 10 12)
(82)[A 2](2 4 6 8 10 13)	(83)[A 2](2 4 6 8 11 12)	(84)[A 2](2 4 6 8 12 14)	(85)[A 2](2 4 6 8 12 15)	(86)[A 2](2 4 6 8 12 16)	(87)[A 2](2 4 6 8 12 17)	(88)[A 2](2 4 6 8 12 18)	(89)[A 2](2 4 6 8 12 19)	(90)[A 2](2 4 6 8 12 21)
(91)[A 2](2 4 6 8 12 22)	(92)[A 2](2 4 6 8 12 23)	(93)[A 2](2 4 6 8 13 15)	(94)[A 2](2 4 6 8 13 17)	(95)[A 2](2 4 6 8 13 19)	(96)[A 2](2 4 6 8 13 23)	(97)[A 2](2 4 6 9 11 13)	(98)[A 2](2 4 6 9 12 14)	(99)[A 2](2 4 6 9 12 15)
(100)[A 2](2 4 6 9 12 16)	(101)[A 2](2 4 6 9 12 17)	(102)[A 2](2 4 6 9 12 19)	(103)[A 2](2 4 6 9 12 21)	(104)[A 2](2 4 6 9 12 22)	(105)[A 2](2 4 6 9 12 23)	(106)[A 2](2 4 6 9 13 17)	(107)[A 2](2 4 6 9 13 19)	(108)[A 2](2 4 6 9 13 23)
(109)[A 2](2 4 6 12 14 16)	(110)[A 2](2 4 6 12 14 17)	(111)[A 2](2 4 6 12 14 18)	(112)[A 2](2 4 6 12 14 19)	(113)[A 2](2 4 6 12 15 16)	(114)[A 2](2 4 6 12 15 17)	(115)[A 2](2 4 6 12 15 18)	(116)[A 2](2 4 6 12 15 19)	(117)[A 2](2 4 6 12 15 20)
(118)[A 2](2 4 6 12 15 21)	(119)[A 2](2 4 6 12 15 23)	(120)[A 2](2 4 6 12 16 20)	(121)[A 2](2 4 6 12 16 21)	(122)[A 2](2 4 6 12 17 19)	(123)[A 2](2 4 6 13 15 17)	(124)[A 2](2 4 6 13 15 19)	(125)[A 2](2 4 7 8 10 12)	(126)[A 2](2 4 7 8 11 14)
(127)[A 2](2 4 7 8 11 15)	(128)[A 2](2 4 7 8 12 16)	(129)[A 2](2 4 7 8 12 17)	(130)[A 2](2 4 7 8 12 20)	(131)[A 2](2 4 7 8 12 21)	(132)[A 2](2 4 7 8 12 23)	(133)[A 2](2 4 7 8 13 14)	(134)[A 2](2 4 7 8 13 16)	(135)[A 2](2 4 7 8 13 17)
(136)[A 2](2 4 7 8 13 20)	(137)[A 2](2 4 7 8 13 21)	(138)[A 2](2 4 7 8 13 23)	(139)[A 2](2 4 7 8 14 16)	(140)[A 2](2 4 7 8 14 17)	(141)[A 2](2 4 7 8 15 17)	(142)[A 2](2 4 7 8 15 22)	(143)[A 2](2 4 7 8 15 23)	(144)[A 2](2 4 7 9 12 17)
(145)[A 2](2 4 7 9 12 21)	(146)[A 2](2 4 7 9 13 17)	(147)[A 2](2 4 7 9 13 19)	(148)[A 2](2 4 7 9 13 21)	(149)[A 2](2 4 7 9 15 17)	(150)[A 2](2 4 7 9 12 13)	(151)[A 2](2 4 8 10 12 14)	(152)[A 2](2 4 8 10 12 15)	(153)[A 2](2 4 8 10 12 16)
(154)[A 2](2 4 8 10 12 17)	(155)[A 2](2 4 8 10 12 18)	(156)[A 2](2 4 8 10 12 19)	(157)[A 2](2 4 8 10 13 14)	(158)[A 2](2 4 8 10 13 15)	(159)[A 2](2 4 8 10 13 16)	(160)[A 2](2 4 8 10 13 17)	(161)[A 2](2 4 8 10 13 19)	(162)[A 2](2 4 8 10 14 20)
(163)[A 2](2 4 8 10 14 21)	(164)[A 2](2 4 8 10 14 22)	(165)[A 2](2 4 8 10 14 23)	(166)[A 2](2 4 8 10 15 21)	(167)[A 2](2 4 8 10 15 23)	(168)[A 2](2 4 8 11 12 14)	(169)[A 2](2 4 8 11 12 15)	(170)[A 2](2 4 8 11 12 16)	(171)[A 2](2 4 8 11 12 17)
(172)[A 2](2 4 8 11 12 18)	(173)[A 2](2 4 8 11 12 19)	(174)[A 2](2 4 8 11 12 20)	(175)[A 2](2 4 8 11 12 21)	(176)[A 2](2 4 8 11 12 22)	(177)[A 2](2 4 8 11 12 23)	(178)[A 2](2 4 8 11 13 14)	(179)[A 2](2 4 8 11 13 16)	(180)[A 2](2 4 8 11 13 17)

Table 1. (continued)

x	y	z	x	y	z	x	y	z
(181) [A 2] (2 4 8111319)	(182) [A 2] (2 4 8111320)	(183) [A 2] (2 4 8111321)	(184) [A 2] (2 4 8111420)	(185) [A 2] (2 4 8111422)	(186) [A 2] (2 4 8111522)	(187) [A 2] (2 4 8121418)	(188) [A 2] (2 4 8121419)	(189) [A 2] (2 4 8121923)
(190) [A 2] (2 4 8131419)	(191) [A 2] (2 4 8131519)	(192) [A 2] (2 4 8131622)	(193) [A 2] (2 4 8131920)	(194) [A 2] (2 4 8141720)	(195) [A 2] (2 4 8141723)	(196) [A 2] (2 4 8151720)	(197) [A 2] (2 4 9111215)	(198) [A 2] (2 4 9111216)
(199) [A 2] (2 4 9111218)	(200) [A 2] (2 4 9121622)	(201) [A 2] (2 4 9131622)	(202) [A 2] (2 4 9152122)	(203) [A 2] (2 412141820)	(204) [A 2] (2 412141821)	(205) [A 2] (2 412141920)	(206) [A 2] (2 412151718)	(207) [A 2] (2 413141622)
(208) [A 2] (2 413141623)	(209) [A 11] (1 2 3 41216)	(210) [A 11] (1 2 3 41217)	(211) [A 11] (1 2 3 41218)	(212) [A 11] (1 2 3 41221)	(213) [A 11] (1 2 3 41316)	(214) [A 11] (1 2 3 41317)	(215) [A 11] (1 2 3 41318)	(216) [A 11] (1 2 3 41319)
(217) [A 11] (1 2 3 41321)	(218) [A 11] (1 2 3 41323)	(219) [A 11] (1 2 3 41516)	(220) [A 11] (1 2 3 41521)	(221) [A 11] (1 2 3 41720)	(222) [A 11] (1 2 4 51216)	(223) [A 11] (1 2 4 51223)	(224) [A 11] (1 2 4 51318)	(225) [A 11] (1 2 4 51323)
(226) [A 11] (1 2 4 51519)	(227) [A 11] (1 2 4121316)	(228) [A 11] (1 2 4121317)	(229) [A 11] (1 2 4121318)	(230) [A 11] (1 2 4121321)	(231) [A 11] (1 2 4121516)	(232) [A 11] (1 2 4121517)	(233) [A 11] (1 2 4121518)	(234) [A 11] (1 2 4121521)
(235) [A 11] (1 2 4121617)	(236) [A 11] (1 2 4121618)	(237) [A 11] (1 2 4121620)	(238) [A 11] (1 2 4121621)	(239) [A 11] (1 2 4121718)	(240) [A 11] (1 2 4121720)	(241) [A 11] (1 2 4121721)	(242) [A 11] (1 2 4121820)	(243) [A 11] (1 2 4121821)
(244) [A 11] (1 2 4121823)	(245) [A 11] (1 2 4122021)	(246) [A 11] (1 2 4131416)	(247) [A 11] (1 2 4131417)	(248) [A 11] (1 2 4131418)	(249) [A 11] (1 2 4131421)	(250) [A 11] (1 2 4131516)	(251) [A 11] (1 2 4131517)	(252) [A 11] (1 2 4131518)
(253) [A 11] (1 2 4131519)	(254) [A 11] (1 2 4131521)	(255) [A 11] (1 2 4131523)	(256) [A 11] (1 2 4131618)	(257) [A 11] (1 2 4131620)	(258) [A 11] (1 2 4131621)	(259) [A 11] (1 2 4131622)	(260) [A 11] (1 2 4131623)	(261) [A 11] (1 2 4131718)
(262) [A 11] (1 2 4131720)	(263) [A 11] (1 2 4131820)	(264) [A 11] (1 2 4131821)	(265) [A 11] (1 2 4131823)	(266) [A 11] (1 2 4132021)	(267) [A 11] (1 2 4151621)	(268) [A 11] (1 2 4151719)	(269) [A 11] (1 2 4151720)	(270) [A 11] (1 2 4151721)
(271) [A 11] (1 2 4151722)	(272) [A 11] (1 2 4151821)	(273) [A 11] (1 2 4171920)	(274) [A 11] (1 4 5121416)	(275) [A 11] (1 4 5121421)	(276) [A 11] (1 4 5121423)	(277) [A 11] (1 4 5121617)	(278) [A 11] (1 4 5121620)	(279) [A 11] (1 4 5121623)
(280) [A 11] (1 4 5131418)	(281) [A 11] (1 4 5131423)	(282) [A 11] (1 4 5131518)	(283) [A 11] (1 4 5131620)	(284) [A 11] (1 4 5131823)	(285) [A 11] (1 4 5141521)	(286) [A 11] (1 4 5141621)	(287) [A 11] (1 4 5141821)	(288) [A 11] (1 4 5141823)
(289) [A 11] (1 4 5141921)	(290) [A 11] (1 4 5151921)	(291) [A 11] (1 4 5161720)	(292) [A 11] (1 4 6121316)	(293) [A 11] (1 4 6121618)	(294) [A 11] (1 412131416)	(295) [A 11] (1 412131423)	(296) [A 11] (1 412141516)	(297) [A 11] (1 412141517)
(298) [A 11] (1 412141518)	(299) [A 11] (1 412141519)	(300) [A 11] (1 412141521)	(301) [A 11] (1 412141523)	(302) [A 11] (1 412141617)	(303) [A 11] (1 412141618)	(304) [A 11] (1 412141620)	(305) [A 11] (1 412141621)	(306) [A 11] (1 412141623)
(307) [A 11] (1 412141718)	(308) [A 11] (1 412141719)	(309) [A 11] (1 412141723)	(310) [A 11] (1 412141820)	(311) [A 11] (1 412141821)	(312) [A 11] (1 412141823)	(313) [A 11] (1 412142123)	(314) [A 11] (1 412161718)	(315) [A 11] (1 412161719)
(316) [A 11] (1 412161723)	(317) [A 11] (1 412171819)	(318) [A 11] (1 412171823)	(319) [A 11] (1 414151621)	(320) [A 11] (1 414151623)	(321) [A 11] (1 414151718)	(322) [A 11] (1 414151719)	(323) [A 11] (1 414151720)	(324) [A 11] (1 414151721)
(325) [A 11] (1 414151723)	(326) [A 11] (1 414151821)	(327) [A 11] (1 414151823)	(328) [A 11] (1 414151923)	(329) [A 11] (1 414152021)	(330) [A 11] (1 414152123)	(331) [A 11] (1 414161718)	(332) [A 11] (1 414161720)	(333) [A 11] (1 414161819)
(334) [A 11] (1 414172023)	(335) [A 11] (1 414192021)	(336) [A 11] (4 5 6131423)	(337) [A 11] (4 512131416)	(338) [A 11] (4 512131418)	(339) [A 11] (4 512131423)	(340) [A 11] (4 512131516)	(341) [A 11] (4 512131518)	(342) [A 11] (4 512131617)
(343) [A 11] (4 512131620)	(344) [A 11] (4 512131623)	(345) [A 11] (4 512131823)	(346) [A 11] (4 512131920)	(347) [A 11] (4 512161718)	(348) [A 11] (4 512161720)	(349) [A 11] (4 513141521)	(350) [A 11] (4 513141618)	(351) [A 11] (4 513141623)
(352) [A 11] (4 513141821)	(353) [A 11] (4 513141823)	(354) [A 11] (4 513151821)	(355) [A 11] (41213141516)	(356) [A 11] (41213141517)	(357) [A 11] (41213141518)	(358) [A 11] (41213141521)	(359) [A 11] (41213141618)	(360) [A 12] (1 2 3 61219)

Table 1. (continued)

x	y	z	x	y	z	x	y	z
(361)[A 12](1 2 4 61213)	(362)[A 12](1 2 4 61214)	(363)[A 12](1 2 4 61219)	(364)[A 12](1 2 4 61220)	(365)[A 12](1 2 4 61223)	(366)[A 12](1 2 4 61416)	(367)[A 12](1 2 4 61422)	(368)[A 12](1 2 4 71213)	(369)[A 12](1 2 4 71214)
(370)[A 12](1 2 4 71220)	(371)[A 12](1 2 4 71223)	(372)[A 12](1 2 4 71322)	(373)[A 12](1 2 4 71416)	(374)[A 12](1 2 4 71422)	(375)[A 12](1 2 5 61315)	(376)[A 12](1 2 5 61321)	(377)[A 12](1 2 5 61416)	(378)[A 12](1 2 5 61517)
(379)[A 12](1 2 5 61523)	(380)[A 12](1 2 5 71214)	(381)[A 12](1 2 5 71223)	(382)[A 12](1 2 5 71315)	(383)[A 12](1 2 5 71321)	(384)[A 12](1 2 5 71416)	(385)[A 12](1 2 5 71421)	(386)[A 12](1 2 5 71517)	(387)[A 12](1 2 5 71523)
(388)[A 12](1 2 6 71214)	(389)[A 12](1 2 6 71219)	(390)[A 12](1 2 6101214)	(391)[A 12](1 2 6101219)	(392)[A 12](1 2 6111214)	(393)[A 12](1 2 6111219)	(394)[A 12](1 2 6121314)	(395)[A 12](1 2 6121315)	(396)[A 12](1 2 6121318)
(397)[A 12](1 2 6121319)	(398)[A 12](1 2 6121320)	(399)[A 12](1 2 6121321)	(400)[A 12](1 2 6121415)	(401)[A 12](1 2 6121417)	(402)[A 12](1 2 6121418)	(403)[A 12](1 2 6121419)	(404)[A 12](1 2 6121421)	(405)[A 12](1 2 6121422)
(406)[A 12](1 2 6121517)	(407)[A 12](1 2 6121519)	(408)[A 12](1 2 6121520)	(409)[A 12](1 2 6121523)	(410)[A 12](1 2 6121619)	(411)[A 12](1 2 6121721)	(412)[A 12](1 2 6121722)	(413)[A 12](1 2 6121920)	(414)[A 12](1 2 6121921)
(415)[A 12](1 2 6121923)	(416)[A 12](1 2 6122022)	(417)[A 12](1 2 6122123)	(418)[A 12](1 2 6131415)	(419)[A 12](1 2 6132021)	(420)[A 12](1 2 7111219)	(421)[A 12](1 2 7121318)	(422)[A 12](1 2 7121319)	(423)[A 12](1 2 7121417)
(424)[A 12](1 2 7121419)	(425)[A 12](1 2 7121421)	(426)[A 12](1 2 7121519)	(427)[A 12](1 2 7121520)	(428)[A 12](1 2 7121523)	(429)[A 12](1 2 7121619)	(430)[A 12](1 2 7121719)	(431)[A 12](1 2 7121720)	(432)[A 12](1 2 7121721)
(433)[A 12](1 2 7121722)	(434)[A 12](1 2 7121920)	(435)[A 12](1 2 7121921)	(436)[A 12](1 2 7121923)	(437)[A 12](1 2 7122123)	(438)[A 12](1 2 7131519)	(439)[A 12](1 2 7132123)	(440)[A 12](1 3 5 71223)	(441)[A 12](1 3 6101214)
(442)[A 12](1 3 6101219)	(443)[A 12](1 3 6111214)	(444)[A 12](1 3 6111219)	(445)[A 12](1 3 6121314)	(446)[A 12](1 3 6121315)	(447)[A 12](1 3 6121318)	(448)[A 12](1 3 6121319)	(449)[A 12](1 3 6121320)	(450)[A 12](1 3 6121415)
(451)[A 12](1 3 6121416)	(452)[A 12](1 3 6121418)	(453)[A 12](1 3 6121420)	(454)[A 12](1 3 6121421)	(455)[A 12](1 3 6121422)	(456)[A 12](1 3 6121519)	(457)[A 12](1 3 6121619)	(458)[A 12](1 3 6121722)	(459)[A 12](1 3 6121921)
(460)[A 12](1 3 6121923)	(461)[A 12](1 3 6132021)	(462)[A 12](1 3 7111219)	(463)[A 12](1 3 7121319)	(464)[A 12](1 3 7121419)	(465)[A 12](1 3 7121523)	(466)[A 12](1 3 7121920)	(467)[A 12](1 3 7121923)	(468)[A 12](1 3 7122123)
(469)[A 12](1 3 7131519)	(470)[A 12](1 3 7131523)	(471)[A 12](1 3 7132123)	(472)[A 12](1 6 7101214)	(473)[A 12](1 6 7121419)	(474)[A 12](1 6 7121421)	(475)[A 12](1 6 7121422)	(476)[A 12](1 610121415)	(477)[A 12](1 610121417)
(478)[A 12](1 610121421)	(479)[A 12](1 610121422)	(480)[A 12](1 611121314)	(481)[A 12](1 611121417)	(482)[A 12](1 611121419)	(483)[A 12](1 611121421)	(484)[A 12](1 611121422)	(485)[A 12](1 611121423)	(486)[A 12](1 612131415)
(487)[A 12](1 612131417)	(488)[A 12](1 612131421)	(489)[A 12](1 612131422)	(489)[A 12](1 612131423)	(491)[A 12](1 612131516)	(492)[A 12](1 612131518)	(493)[A 12](1 612131519)	(494)[A 12](1 612131618)	(495)[A 12](1 612131620)
(496)[A 12](1 612131621)	(497)[A 12](1 612131622)	(498)[A 12](1 612131718)	(499)[A 12](1 612131719)	(500)[A 12](1 612131720)	(501)[A 12](1 612131723)	(502)[A 12](1 612131821)	(503)[A 12](1 612131822)	(504)[A 12](1 612131823)
(505)[A 12](1 612131921)	(506)[A 12](1 612131923)	(507)[A 12](1 612132122)	(508)[A 12](1 612141517)	(509)[A 12](1 612141519)	(510)[A 12](1 612141522)	(511)[A 12](1 612141719)	(512)[A 12](1 612142122)	(513)[A 12](1 612142123)
(514)[A 12](1 711121415)	(515)[A 12](1 711121417)	(516)[A 12](1 711121419)	(517)[A 12](1 711121421)	(518)[A 12](1 711121423)	(519)[A 12](1 712131416)	(520)[A 12](1 712131417)	(521)[A 12](1 712131419)	(522)[A 12](1 712131421)
(523)[A 12](1 712131422)	(524)[A 12](1 712131423)	(525)[A 12](1 712131618)	(526)[A 12](1 712131619)	(527)[A 12](1 712131621)	(528)[A 12](1 712131622)	(529)[A 12](1 712131718)	(530)[A 12](1 712131719)	(531)[A 12](1 712131820)
(532)[A 12](1 712131822)	(533)[A 12](1 712131823)	(534)[A 12](1 712132122)	(535)[A 12](1 712132123)	(536)[A 12](1 712141517)	(537)[A 12](1 712141519)	(538)[A 12](1 712141522)	(539)[A 12](1 712141923)	(540)[A 12](1 712142122)

Table 1. (continued)

x	y	z	x	y	z	x	y	z
(541) [A 12] (1 712142123)	(542) [A 12] (2 3 4 61213)	(543) [A 12] (2 3 4 61214)	(544) [A 12] (2 3 4 61219)	(545) [A 12] (2 3 4 61223)	(546) [A 12] (2 3 4 61416)	(547) [A 12] (2 3 4 61421)	(548) [A 12] (2 3 4 61617)	(549) [A 12] (2 3 4 61623)
(550) [A 12] (2 3 4 71223)	(551) [A 12] (2 3 4 71322)	(552) [A 12] (2 3 4 71421)	(553) [A 12] (2 3 4 71617)	(554) [A 12] (2 3 5 71223)	(555) [A 12] (2 3 5 71421)	(556) [A 12] (2 3 6 71219)	(557) [A 12] (2 3 6 71220)	(558) [A 12] (2 3 6101214)
(559) [A 12] (2 3 6111219)	(560) [A 12] (2 3 6121318)	(561) [A 12] (2 3 6121320)	(562) [A 12] (2 3 6121415)	(563) [A 12] (2 3 6121421)	(564) [A 12] (2 3 6121519)	(565) [A 12] (2 3 6121619)	(566) [A 12] (2 3 7111219)	(567) [A 12] (2 3 7121319)
(568) [A 12] (2 3 7121419)	(569) [A 12] (2 3 7121523)	(570) [A 12] (2 3 7121920)	(571) [A 12] (2 3 7121923)	(572) [A 12] (2 3 7122123)	(573) [A 12] (2 3 7131519)	(574) [A 12] (2 4 6 71214)	(575) [A 12] (2 4 6 71219)	(576) [A 12] (2 4 6 71422)
(577) [A 12] (2 4 6 91213)	(578) [A 12] (2 4 6 91214)	(579) [A 12] (2 4 6 91219)	(580) [A 12] (2 4 6 91220)	(581) [A 12] (2 4 6 91223)	(582) [A 12] (2 4 6 91316)	(583) [A 12] (2 4 6 91322)	(584) [A 12] (2 4 6111213)	(585) [A 12] (2 4 6111214)
(586) [A 12] (2 4 6111219)	(587) [A 12] (2 4 6111220)	(588) [A 12] (2 4 6111322)	(589) [A 12] (2 4 6111416)	(590) [A 12] (2 4 6111422)	(591) [A 12] (2 4 7 91214)	(592) [A 12] (2 4 7 91219)	(593) [A 12] (2 4 7 91220)	(594) [A 12] (2 4 7 91223)
(595) [A 12] (2 4 7 91322)	(596) [A 12] (2 4 7 91416)	(597) [A 12] (2 4 7 91422)	(598) [A 12] (2 4 7121317)	(599) [A 12] (2 4 7121417)	(600) [A 12] (2 4 7121419)	(601) [A 12] (2 4 7121423)	(602) [A 12] (2 4 7121719)	(603) [A 12] (2 4 7121720)
(604) [A 12] (2 4 7121920)	(605) [A 12] (2 4 7121923)	(606) [A 12] (2 4 7122023)	(607) [A 12] (2 4 7131416)	(608) [A 12] (2 4 7131422)	(609) [A 12] (2 4 7132022)	(610) [A 12] (2 4 7141623)	(611) [A 12] (2 4 7141722)	(612) [A 12] (2 5 6 71321)
(613) [A 12] (2 5 6 71517)	(614) [A 12] (2 5 6 91213)	(615) [A 12] (2 5 6 91214)	(616) [A 12] (2 5 6 91217)	(617) [A 12] (2 5 6 91219)	(618) [A 12] (2 5 6 91223)	(619) [A 12] (2 5 6 91315)	(620) [A 12] (2 5 6 91321)	(621) [A 12] (2 5 6101315)
(622) [A 12] (2 5 6101321)	(623) [A 12] (2 5 6101422)	(624) [A 12] (2 5 6101517)	(625) [A 12] (2 5 6101523)	(626) [A 12] (2 5 6101617)	(627) [A 12] (2 5 6101623)	(628) [A 12] (2 5 6111213)	(629) [A 12] (2 5 6111214)	(630) [A 12] (2 5 6111219)
(631) [A 12] (2 5 6111220)	(632) [A 12] (2 5 6111315)	(633) [A 12] (2 5 6111316)	(634) [A 12] (2 5 6111321)	(635) [A 12] (2 5 6111322)	(636) [A 12] (2 5 6111416)	(637) [A 12] (2 5 6111422)	(638) [A 12] (2 5 6111517)	(639) [A 12] (2 5 6111523)
(640) [A 12] (2 5 6111617)	(641) [A 12] (2 5 6111623)	(642) [A 12] (2 5 6121415)	(643) [A 12] (2 5 6121416)	(644) [A 12] (2 5 6121417)	(645) [A 12] (2 5 6121423)	(646) [A 12] (2 5 6121517)	(647) [A 12] (2 5 6121519)	(648) [A 12] (2 5 6121523)
(649) [A 12] (2 5 6121623)	(650) [A 12] (2 5 6121718)	(651) [A 12] (2 5 6121719)	(652) [A 12] (2 5 6121721)	(653) [A 12] (2 5 6121722)	(654) [A 12] (2 5 6121921)	(655) [A 12] (2 5 6121922)	(656) [A 12] (2 5 6121923)	(657) [A 12] (2 5 6122123)
(658) [A 12] (2 5 6131415)	(659) [A 12] (2 5 6131416)	(660) [A 12] (2 5 6131421)	(661) [A 12] (2 5 6131516)	(662) [A 12] (2 5 6131517)	(663) [A 12] (2 5 6131519)	(664) [A 12] (2 5 6131520)	(665) [A 12] (2 5 6131521)	(666) [A 12] (2 5 6131523)
(667) [A 12] (2 5 6131617)	(668) [A 12] (2 5 6131620)	(669) [A 12] (2 5 6131621)	(669) [A 12] (2 5 6131621)	(670) [A 12] (2 5 6131623)	(671) [A 12] (2 5 6131721)	(672) [A 12] (2 5 6131722)	(673) [A 12] (2 5 6132021)	(674) [A 12] (2 5 6132122)
(676) [A 12] (2 5 6141517)	(677) [A 12] (2 5 6141523)	(678) [A 12] (2 5 6141617)	(679) [A 12] (2 5 6141622)	(680) [A 12] (2 5 6141721)	(681) [A 12] (2 5 6142122)	(682) [A 12] (2 5 6142123)	(683) [A 12] (2 5 6151617)	(684) [A 12] (2 5 6151623)
(685) [A 12] (2 5 6151721)	(686) [A 12] (2 5 6151722)	(687) [A 12] (2 5 6151723)	(688) [A 12] (2 5 6152223)	(689) [A 12] (2 5 6161722)	(690) [A 12] (2 5 6161723)	(691) [A 12] (2 5 7 91213)	(692) [A 12] (2 5 7 91214)	(693) [A 12] (2 5 7 91217)
(694) [A 12] (2 5 7 91219)	(695) [A 12] (2 5 7 91220)	(696) [A 12] (2 5 7 91223)	(697) [A 12] (2 5 7111213)	(698) [A 12] (2 5 7111214)	(699) [A 12] (2 5 7111219)	(700) [A 12] (2 5 7111220)	(701) [A 12] (2 5 7111223)	(702) [A 12] (2 5 7111322)
(703) [A 12] (2 5 7111416)	(704) [A 12] (2 5 7111623)	(705) [A 12] (2 5 7121314)	(706) [A 12] (2 5 7121317)	(707) [A 12] (2 5 7121318)	(708) [A 12] (2 5 7121319)	(709) [A 12] (2 5 7121322)	(710) [A 12] (2 5 7121416)	(711) [A 12] (2 5 7121417)
(712) [A 12] (2 5 7121419)	(713) [A 12] (2 5 7121519)	(714) [A 12] (2 5 7121619)	(715) [A 12] (2 5 7121620)	(716) [A 12] (2 5 7121718)	(717) [A 12] (2 5 7121723)	(718) [A 12] (2 5 7121920)	(719) [A 12] (2 5 7121921)	(720) [A 12] (2 5 7121923)

Table 1. (continued)

x	y	z	x	y	z	x	y	z
(721) [A 12] (2 5 7122022)			(722) [A 12] (2 5 7122023)			(723) [A 12] (2 5 7122123)		
(724) [A 12] (2 5 7131416)			(725) [A 12] (2 5 7131519)			(726) [A 12] (2 5 7131522)		
(727) [A 12] (2 5 7131617)			(728) [A 12] (2 5 7131620)			(729) [A 12] (2 5 7131623)		
(730) [A 12] (2 5 7132022)			(731) [A 12] (2 5 7132123)			(732) [A 12] (2 5 7151623)		
(733) [A 12] (2 5 7151723)			(734) [A 12] (2 5 7161723)			(735) [A 12] (2 6 7101214)		
(736) [A 12] (2 6 7111219)			(737) [A 12] (2 6 7121318)			(738) [A 12] (2 6 7121321)		
(739) [A 12] (2 6 7121418)			(740) [A 12] (2 6 7121517)			(741) [A 12] (2 6 7121920)		
(742) [A 12] (2 6 7121923)			(743) [A 12] (2 6 611121314)			(744) [A 12] (2 6 611121319)		
(745) [A 12] (2 6 611121417)			(746) [A 12] (2 6 611121418)			(747) [A 12] (2 6 611121419)		
(748) [A 12] (2 6 611121420)			(749) [A 12] (2 6 611121421)			(750) [A 12] (2 6 611121422)		
(751) [A 12] (2 6 611121719)			(752) [A 12] (2 6 611121720)			(753) [A 12] (2 6 611121920)		
(754) [A 12] (2 6 611121923)			(755) [A 12] (2 6 611122023)			(756) [A 12] (2 6 611131415)		
(757) [A 12] (2 6 611131519)			(758) [A 12] (2 7 11121314)			(759) [A 12] (2 7 11121720)		
(760) [A 12] (2 7 11121923)			(761) [A 12] (2 7 12131417)			(762) [A 12] (2 7 12131419)		
(763) [A 12] (2 7 12131420)			(764) [A 12] (2 7 12131421)			(765) [A 12] (2 7 12131718)		
(766) [A 12] (2 7 12131719)			(767) [A 12] (2 7 12131720)			(768) [A 12] (2 7 12131723)		
(769) [A 12] (2 7 12131820)			(770) [A 12] (2 7 12131920)			(771) [A 12] (2 7 12132022)		
(772) [A 12] (2 7 12141519)			(773) [A 12] (2 7 12141719)			(774) [A 12] (2 7 12141720)		
(775) [A 12] (2 7 12141722)			(776) [A 12] (2 7 12141921)			(777) [A 12] (2 7 12142123)		
(778) [A 12] (2 7 12151719)			(779) [A 12] (2 7 12151920)			(780) [A 12] (2 7 12161923)		
(781) [A 12] (2 7 12171920)			(782) [A 12] (2 7 12172022)			(783) [A 12] (2 7 13141519)		
(784) [A 12] (2 7 13141523)			(785) [A 12] (2 7 13151719)			(786) [A 12] (2 7 13202123)		
(787) [A 12] (3 5 6 91213)			(788) [A 12] (3 5 6 91214)			(789) [A 12] (3 5 6101214)		
(790) [A 12] (3 5 6101416)			(791) [A 12] (3 5 6101422)			(792) [A 12] (3 5 6111213)		
(793) [A 12] (3 5 6111214)			(794) [A 12] (3 5 6111220)			(795) [A 12] (3 5 6111416)		
(796) [A 12] (3 5 6121315)			(797) [A 12] (3 5 6121318)			(798) [A 12] (3 5 6121415)		
(799) [A 12] (3 5 6121418)			(800) [A 12] (3 5 6121520)			(801) [A 12] (3 5 6121617)		
(802) [A 12] (3 5 6121620)			(803) [A 12] (3 5 6121722)			(804) [A 12] (3 5 6122022)		
(805) [A 12] (3 5 6122023)			(806) [A 12] (3 5 6141617)			(807) [A 12] (3 5 6141622)		
(808) [A 12] (3 5 7 91223)			(809) [A 12] (3 5 7111213)			(810) [A 12] (3 5 7111219)		
(811) [A 12] (3 5 7121315)			(812) [A 12] (3 5 7121317)			(813) [A 12] (3 5 7121318)		
(814) [A 12] (3 5 7121319)			(815) [A 12] (3 5 7121320)			(816) [A 12] (3 5 7121321)		
(817) [A 12] (3 5 7121423)			(818) [A 12] (3 5 7121519)			(819) [A 12] (3 5 7121617)		
(820) [A 12] (3 5 7121719)			(821) [A 12] (3 5 7121720)			(822) [A 12] (3 5 7121721)		
(823) [A 12] (3 5 7121923)			(824) [A 12] (3 5 7131422)			(825) [A 12] (3 5 7141617)		
(826) [A 12] (3 6 7101214)			(827) [A 12] (3 6 7101219)			(828) [A 12] (3 6 7111219)		
(829) [A 12] (3 6 7121421)			(830) [A 12] (3 6 7121920)			(831) [A 12] (3 6 7121923)		
(832) [A 12] (3 6 7122123)			(833) [A 12] (3 610121318)			(834) [A 12] (3 610121320)		
(835) [A 12] (3 610121415)			(836) [A 12] (3 610121416)			(837) [A 12] (3 610121418)		
(838) [A 12] (3 610121420)			(839) [A 12] (3 610121421)			(840) [A 12] (3 610121422)		
(841) [A 12] (3 610121517)			(842) [A 12] (3 610121920)			(843) [A 12] (3 610122023)		
(844) [A 12] (3 611121314)			(845) [A 12] (3 611121315)			(846) [A 12] (3 611121318)		
(847) [A 12] (3 611121319)			(848) [A 12] (3 611121321)			(849) [A 12] (3 611121415)		
(850) [A 12] (3 611121418)			(851) [A 12] (3 611121421)			(852) [A 12] (3 611121423)		
(853) [A 12] (3 611121519)			(854) [A 12] (3 611121523)			(855) [A 12] (3 611121719)		
(856) [A 12] (3 611121720)			(857) [A 12] (3 611121722)			(858) [A 12] (3 611121923)		
(859) [A 12] (3 611122021)			(860) [A 12] (3 611122023)			(861) [A 12] (3 611122123)		
(862) [A 12] (3 611131415)			(863) [A 12] (3 611131421)			(864) [A 12] (3 611132021)		
(865) [A 12] (3 612131415)			(866) [A 12] (3 612131418)			(867) [A 12] (3 612131518)		
(868) [A 12] (3 612131618)			(869) [A 12] (3 612131620)			(870) [A 12] (3 612131621)		
(871) [A 12] (3 612131819)			(872) [A 12] (3 612131820)			(873) [A 12] (3 612131821)		
(874) [A 12] (3 612131823)			(875) [A 12] (3 612132021)			(876) [A 12] (3 612141516)		
(877) [A 12] (3 612141518)			(878) [A 12] (3 612141522)			(879) [A 12] (3 612141820)		
(880) [A 12] (3 612141920)			(881) [A 12] (3 711121321)			(882) [A 12] (3 711121921)		
(883) [A 12] (3 711131415)			(884) [A 12] (3 711131421)			(885) [A 12] (3 711131523)		
(886) [A 12] (3 712131421)			(887) [A 12] (3 712131518)			(888) [A 12] (3 712131521)		
(889) [A 12] (3 712131719)			(890) [A 12] (3 712131720)			(891) [A 12] (3 712131721)		
(892) [A 12] (3 712131920)			(893) [A 12] (3 712151719)			(894) [A 12] (3 712151921)		
(895) [A 12] (3 712171922)			(896) [A 12] (3 712172021)			(897) [A 12] (3 713141517)		
(898) [A 12] (3 713141519)			(899) [A 12] (3 713142123)			(900) [A 12] (3 713151723)		

Table 1. (continued)

x	y	z	x	y	z	x	y	z
(901) [A 12] (6 710111214)			(902) [A 12] (6 710121417)			(903) [A 12] (6 710121423)		
(904) [A 12] (6 711121415)			(905) [A 12] (6 711121421)			(906) [A 12] (6 711121423)		
(907) [A 12] (6 712131415)			(908) [A 12] (6 712131417)			(909) [A 12] (6 712131418)		
(910) [A 12] (6 712131419)			(911) [A 12] (6 712131422)			(912) [A 12] (6 712131518)		
(913) [A 12] (6 712131618)			(914) [A 12] (6 712131719)			(915) [A 12] (6 712131723)		
(916) [A 12] (6 712131819)			(917) [A 12] (6 712131821)			(918) [A 12] (6 712131822)		
(919) [A 12] (6 712141519)			(920) [A 12] (6 712142122)			(921) [A 12] (6 712142123)		
(922) [A 12] (61112131415)			(923) [A 12] (61112131417)			(924) [A 12] (61112131419)		
(925) [A 12] (61112131719)			(926) [A 12] (61112131923)			(927) [A 12] (61112141517)		
(928) [A 12] (61112141719)			(929) [A 12] (61112141723)			(930) [A 12] (71112131719)		
(931) [A 12] (71112141519)			(932) [A 12] (71112142123)			(933) [A 12] (71213141517)		
(934) [A 12] (71213141519)			(935) [A 12] (71213141617)			(936) [A 12] (71213141620)		
(937) [A 12] (71213141623)			(938) [A 12] (71213141719)			(939) [A 12] (71213141720)		
(940) [A 12] (71213141722)			(941) [A 12] (71213161820)			(942) [A 12] (71213161923)		
(943) [A 12] (71213162123)			(944) [A 12] (71214151719)			(945) [A 12] (71214151722)		
(946) [A 13] (1 2 6121316)			(947) [A 13] (1 2 6121418)			(948) [A 13] (1 2 7121418)		
(949) [A 13] (1 212131415)			(950) [A 13] (1 212131521)			(951) [A 13] (1 212131618)		
(952) [A 13] (1 212131721)			(953) [A 13] (1 212131819)			(954) [A 13] (1 212131821)		
(955) [A 13] (1 212131920)			(956) [A 13] (1 212132021)			(957) [A 13] (1 312131415)		
(958) [A 13] (1 312131419)			(959) [A 13] (1 312131821)			(960) [A 13] (1 312131920)		
(961) [A 13] (11213141516)			(962) [A 13] (2 3 7121418)			(963) [A 13] (2 312131415)		
(964) [A 13] (2 312131519)			(965) [A 13] (2 312131521)			(966) [A 13] (2 312131618)		
(967) [A 13] (2 312131721)			(968) [A 13] (2 312132021)			(969) [A 13] (2 4 6 91316)		
(970) [A 13] (2 4 7 91415)			(971) [A 13] (2 4 7 91422)			(972) [A 13] (2 4 7121415)		
(973) [A 13] (2 4 7121416)			(974) [A 13] (2 4 7121617)			(975) [A 13] (2 4 7121920)		
(976) [A 13] (2 5 6 91213)			(977) [A 13] (2 5 6 91214)			(978) [A 13] (2 5 6 91316)		
(979) [A 13] (2 5 6 91321)			(980) [A 13] (2 5 6121314)			(981) [A 13] (2 5 6121417)		
(982) [A 13] (2 5 6131416)			(983) [A 13] (2 5 7 91219)			(984) [A 13] (2 5 7 91415)		
(985) [A 13] (2 5 7121418)			(986) [A 13] (2 512131417)			(987) [A 13] (2 6 9111213)		
(988) [A 13] (2 6 9111316)			(989) [A 13] (2 6 9121315)			(990) [A 13] (2 6 9121316)		
(991) [A 13] (2 6 9121321)			(992) [A 13] (2 6 9121417)			(993) [A 13] (2 6 9121422)		
(994) [A 13] (2 6 9121617)			(995) [A 13] (2 6 9121721)			(996) [A 13] (2 6 9121923)		
(997) [A 13] (2 6 9131617)			(998) [A 13] (2 6 9131619)			(999) [A 13] (2 6 9131620)		
(1000) [A 13] (2 6 9131621)			(1001) [A 13] (2 6 9131623)			(1002) [A 13] (2 7 9121416)		
(1003) [A 13] (2 7 9121722)			(1004) [A 13] (2 7 9141517)			(1005) [A 13] (2 7 9141722)		
(1006) [A 13] (2 712131420)			(1007) [A 13] (2 712131618)			(1008) [A 13] (2 712141516)		
(1009) [A 13] (2 712141518)			(1010) [A 13] (2 712141618)			(1011) [A 13] (2 712141620)		
(1012) [A 13] (2 712141722)			(1013) [A 13] (2 712161722)			(1014) [A 13] (2 712172123)		
(1015) [A 13] (3 412151921)			(1016) [A 13] (3 5 7121316)			(1017) [A 13] (3 5 7121617)		
(1018) [A 13] (3 7 9121316)			(1019) [A 13] (3 7 9121322)			(1020) [A 13] (3 712131416)		
(1021) [A 13] (3 712131421)			(1022) [A 13] (3 712131516)			(1023) [A 13] (3 712131618)		
(1024) [A 13] (3 712141618)			(1025) [A 13] (3 712161721)			(1026) [A 13] (3 712161722)		
(1027) [A 13] (31213141517)			(1028) [A 13] (31213141518)			(1029) [A 13] (31213151821)		
(1030) [A 13] (51213141517)			(1031) [A 14] (1 2 6151722)			(1032) [A 14] (1 2 7121320)		
(1033) [A 14] (1 2 7121920)			(1034) [A 14] (1 2 7151722)			(1035) [A 14] (1 2 7161722)		
(1036) [A 14] (1 214151617)			(1037) [A 14] (1 214161722)			(1038) [A 14] (1 215161722)		
(1039) [A 14] (1 216172223)			(1040) [A 14] (1 3 7121319)			(1041) [A 14] (1 3 7121320)		
(1042) [A 14] (1 312131415)			(1043) [A 14] (1 312131819)			(1044) [A 14] (2 3 5 61722)		
(1045) [A 14] (2 3 6111617)			(1046) [A 14] (2 312131415)			(1047) [A 14] (2 312132021)		
(1048) [A 14] (2 4 6 91517)			(1049) [A 14] (2 4 6 91721)			(1050) [A 14] (2 4 6 91722)		
(1051) [A 14] (2 4 7 91517)			(1052) [A 14] (2 4 7 91617)			(1053) [A 14] (2 4 7 91721)		
(1054) [A 14] (2 4 7 91722)			(1055) [A 14] (2 4 7121722)			(1056) [A 14] (2 4 7151617)		
(1057) [A 14] (2 4 7172122)			(1058) [A 14] (2 4 9121517)			(1059) [A 14] (2 4 9121523)		
(1060) [A 14] (2 4 9121617)			(1061) [A 14] (2 4 9131617)			(1062) [A 14] (2 4 9131721)		
(1063) [A 14] (2 4 9141722)			(1064) [A 14] (2 4 9151617)			(1065) [A 14] (2 4 9151721)		
(1066) [A 14] (2 4 9151722)			(1067) [A 14] (2 5 6 81517)			(1068) [A 14] (2 5 6 91214)		
(1069) [A 14] (2 5 6 91617)			(1070) [A 14] (2 5 6 91722)			(1071) [A 14] (2 5 6121517)		
(1072) [A 14] (2 5 6131517)			(1073) [A 14] (2 5 7 91517)			(1074) [A 14] (2 5 7 91617)		
(1075) [A 14] (2 5 7 91722)			(1076) [A 14] (2 5 7111213)			(1077) [A 14] (2 5 7121523)		
(1078) [A 14] (2 5 7122023)			(1079) [A 14] (2 5 7171922)			(1080) [A 14] (2 5 8131517)		

Table 1. (continued)

x	y	z	x	y	z	x	y	z
(1081) [A 14] (2 5 8151722)			(1082) [A 14] (2 5 9121417)			(1083) [A 14] (2 5 9141617)		
(1084) [A 14] (2 5 9141722)			(1085) [A 14] (2 512131516)			(1086) [A 14] (2 512141517)		
(1087) [A 14] (2 512151617)			(1088) [A 14] (2 513141617)			(1089) [A 14] (2 513151617)		
(1090) [A 14] (2 6 8111517)			(1091) [A 14] (2 6 9111517)			(1092) [A 14] (2 6 9111721)		
(1093) [A 14] (2 6 9121517)			(1094) [A 14] (2 6 9121617)			(1095) [A 14] (2 6 9161721)		
(1096) [A 14] (2 7 8151722)			(1097) [A 14] (2 7 9111517)			(1098) [A 14] (2 7 9121523)		
(1099) [A 14] (2 7 9121623)			(1100) [A 14] (2 7 9121923)			(1101) [A 14] (2 7 9122023)		
(1102) [A 14] (2 7 9131617)			(1103) [A 14] (2 7 9151617)			(1104) [A 14] (2 7 9151723)		
(1105) [A 14] (2 711121315)			(1106) [A 14] (2 711121321)			(1107) [A 14] (2 711121623)		
(1108) [A 14] (2 711151722)			(1109) [A 14] (2 712131921)			(1110) [A 14] (2 712142022)		
(1111) [A 14] (2 712151617)			(1112) [A 14] (2 712151722)			(1113) [A 14] (2 712162022)		
(1114) [A 14] (2 712172022)			(1115) [A 14] (2 713161720)			(1116) [A 14] (2 713172021)		
(1117) [A 14] (2 717192021)			(1118) [A 14] (2 717192022)			(1119) [A 14] (2 912131416)		
(1120) [A 14] (2 912131621)			(1121) [A 14] (2 912151722)			(1122) [A 14] (2 913161720)		
(1123) [A 14] (2 913161721)			(1124) [A 14] (3 5 7 91213)			(1125) [A 14] (3 5 9121315)		
(1126) [A 14] (3 5 9121316)			(1127) [A 14] (3 5 9121320)			(1128) [A 14] (3 512131415)		
(1129) [A 14] (3 512131417)			(1130) [A 14] (3 512131719)			(1131) [A 14] (3 512141516)		
(1132) [A 14] (3 513141517)			(1133) [A 14] (3 7 9121319)			(1134) [A 14] (3 7 9121523)		
(1135) [A 14] (3 712131719)			(1136) [A 14] (3 712141516)			(1137) [A 14] (3 712141522)		
(1138) [A 14] (3 912131415)			(1139) [A 14] (3 912131516)			(1140) [A 14] (3 912131518)		
(1141) [A 14] (31213141518)			(1142) [A 14] (31213151719)			(1143) [A 14] (31214161722)		
(1144) [A 15] (2 4 7111217)			(1145) [A 15] (2 4 7111722)			(1146) [A 15] (2 4 7121721)		
(1147) [A 15] (2 4 7131921)			(1148) [A 15] (2 4 7151723)			(1149) [A 15] (2 5 7121418)		
(1150) [A 15] (2 5 7121820)			(1151) [A 15] (3 4 6 91217)			(1152) [A 15] (3 4 6 91219)		
(1153) [A 15] (3 4 6 91318)			(1154) [A 15] (3 4 6 91722)			(1155) [A 15] (3 4 6121316)		
(1156) [A 15] (3 4 6121417)			(1157) [A 15] (3 4 6131721)			(1158) [A 15] (3 4 7 81318)		
(1159) [A 15] (3 4 7 91316)			(1160) [A 15] (3 4 7 91623)			(1161) [A 15] (3 4 7 91823)		
(1162) [A 15] (3 4 7 91922)			(1163) [A 15] (3 4 7111623)			(1164) [A 15] (3 4 7162223)		
(1165) [A 15] (3 5 7121317)			(1166) [A 15] (3 5 7121319)			(1167) [A 15] (4 6 9111318)		
(1168) [A 15] (4 6 9121319)			(1169) [A 15] (4 6 9121418)			(1170) [A 15] (4 6 9121920)		
(1171) [A 15] (4 6 9131418)			(1172) [A 15] (4 7 8111217)			(1173) [A 15] (4 7 8121418)		
(1174) [A 15] (4 7 8121922)			(1175) [A 15] (4 7 8131819)			(1176) [A 15] (4 7 9111623)		
(1177) [A 15] (4 7 9131416)			(1178) [A 15] (4 7 9131623)			(1179) [A 15] (4 7 9131819)		
(1180) [A 15] (4 7 9131921)			(1181) [A 15] (4 7 9141922)			(1182) [A 15] (4 7 9192223)		
(1183) [A 15] (4 712141822)			(1184) [A 15] (4 713181921)			(1185) [A 15] (4 713181923)		
(1186) [A 15] (4 714151723)			(1187) [A 15] (4 714161822)			(1188) [A 15] (4 714181922)		
(1189) [A 15] (4 714182223)			(1190) [A 15] (4 718192023)			(1191) [A 15] (5 7 9121721)		
(1192) [A 15] (5 712131419)			(1193) [A 15] (5 712141719)			(1194) [A 15] (5 712151721)		
(1195) [A 16] (2 4 7121921)			(1196) [A 16] (2 4 7131519)			(1197) [A 16] (2 4 7151721)		
(1198) [A 16] (2 4 7192122)			(1199) [A 16] (2 4 7202122)			(1200) [A 16] (2 5 6151721)		
(1201) [A 16] (2 5 6192123)			(1202) [A 16] (2 6 9131521)			(1203) [A 16] (2 6 9131617)		
(1204) [A 16] (2 611141620)			(1205) [A 16] (2 611141623)			(1206) [A 16] (2 611161722)		
(1207) [A 16] (2 712131416)			(1208) [A 16] (2 712141720)			(1209) [A 16] (2 712192122)		
(1210) [A 16] (3 5 7121316)			(1211) [A 16] (3 612131819)			(1212) [A 16] (3 612141820)		
(1213) [A 16] (3 614151723)			(1214) [A 16] (3 617192223)			(1215) [A 16] (3 7 9171922)		
(1216) [A 16] (3 713151621)			(1217) [A 16] (3 716182223)			(1218) [A 16] (3 719202123)		
(1219) [A 16] (5 610171922)			(1220) [A 30] (1 4 5121617)			(1221) [A 30] (1 4 5121620)		
(1222) [A 30] (1 4 5121718)			(1223) [A 30] (1 4 5121719)			(1224) [A 30] (1 4 5121820)		
(1225) [A 30] (1 4 5121823)			(1226) [A 30] (1 4 5122021)			(1227) [A 30] (1 4 5131617)		
(1228) [A 30] (1 4 5131620)			(1229) [A 30] (1 4 5131823)			(1230) [A 30] (1 4 5132021)		
(1231) [A 30] (1 4 5141922)			(1232) [A 30] (1 4 5142123)			(1233) [A 30] (1 4 5151620)		
(1234) [A 30] (1 4 5151922)			(1235) [A 30] (2 4 5121721)			(1236) [A 30] (2 4 5141721)		
(1237) [A 30] (2 4 5142123)			(1238) [A 30] (2 4 6121922)			(1239) [A 30] (4 5 7121718)		
(1240) [A 30] (4 5 9131923)			(1241) [A 30] (4 512131617)			(1242) [A 30] (4 512131620)		
(1243) [A 30] (4 512131718)			(1244) [A 30] (4 512131719)			(1245) [A 30] (4 512131823)		
(1246) [A 30] (4 512132021)			(1247) [A 30] (4 512141721)			(1248) [A 30] (4 512141821)		
(1249) [A 30] (4 512142123)			(1250) [A 30] (4 512151720)			(1251) [A 30] (4 512161718)		
(1252) [A 30] (4 512171819)			(1253) [A 30] (4 512171822)			(1254) [A 30] (4 512171823)		
(1255) [A 30] (4 512181922)			(1256) [A 30] (4 513161822)			(1257) [A 31] (1 3 6121521)		
(1258) [A 31] (1 3 7131516)			(1259) [A 31] (1 3 7131518)			(1260) [A 31] (1 3 7141722)		

Table 1. (continued)

x	y	z	x	y	z	x	y	z
(1261) [A 31] (1 3 7151618)			(1262) [A 31] (1 3 7161819)			(1263) [A 31] (1 3 7171822)		
(1264) [A 31] (1 3 8121417)			(1265) [A 31] (1 3 8131516)			(1266) [A 31] (1 3 8131621)		
(1267) [A 31] (1 312141718)			(1268) [A 31] (1 313151618)			(1269) [A 31] (1 313151619)		
(1270) [A 31] (1 313161923)			(1271) [A 31] (1 4 6131518)			(1272) [A 31] (1 6 7121418)		
(1273) [A 31] (1 6 7121420)			(1274) [A 31] (1 6 7131516)			(1275) [A 31] (1 6 7151617)		
(1276) [A 31] (1 6 9141921)			(1277) [A 32] (1 3 6121521)			(1278) [A 32] (1 3 7131518)		
(1279) [A 32] (1 3 7141722)			(1280) [A 32] (1 3 7151618)			(1281) [A 32] (1 3 7171822)		
(1282) [A 32] (1 3 8121417)			(1283) [A 32] (1 312141718)			(1284) [A 32] (1 313151619)		
(1285) [A 32] (1 4 6131518)			(1286) [A 32] (1 5 6121617)			(1287) [A 32] (1 512161720)		
(1288) [A 32] (1 513151822)			(1289) [A 32] (1 6 7141920)			(1290) [A 32] (1 6 8152223)		
(1291) [A 32] (1 6 8161721)			(1292) [A 32] (1 6 8181920)			(1293) [A 32] (1 612171820)		
(1294) [A 32] (1 7 8181920)			(1295) [A 32] (3 812141823)			(1296) [A 34] (1 3 6121421)		
(1297) [A 34] (1 3 6141921)			(1298) [A 34] (1 3 6161722)			(1299) [A 34] (1 3 8121819)		
(1300) [A 34] (1 6 7131621)			(1301) [A 34] (1 6 9131819)			(1302) [A 35] (1 3 6121421)		
(1303) [A 35] (1 3 6141921)			(1304) [A 35] (1 3 6161722)			(1305) [A 35] (1 3 8121819)		
(1306) [A 35] (1 613161921)			(1307) [A 35] (61012151821)			(1308) [A 37] (2 810141617)		
(1309) [A 37] (3 812151822)			(1310) [A 37] (3 913141617)			(1311) [A 38] (2 4 8 91719)		
(1312) [A 48] (1 2 3121418)			(1313) [A 71] (2 4 5131822)			(1314) [A 71] (2 512141721)		
(1315) [A 73] (1 310131823)			(1316) [A 73] (1 410121416)			(1317) [A 73] (1 410141622)		

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Appendix
Saturated orthogonal arrays giving 1,317 2-OA(2,6,6)

[A1]	[A2]	[A11]	[A12]	[A13]	[A14]
77770000	77770000	77770000	77770000	77770000	77770000
73207320	73206642	77007700	77007700	77007700	77007700
73200457	73201135	60747460	77000077	77000077	77000077
70457045	70457320	74606017	70707070	70707070	70707070
70450732	70450457	74031474	70700707	70700707	70700707
66426642	66427045	63600374	54466443	54466443	54466443
66421135	66420732	74140363	54461334	54461334	54461334
64346434	64346434	60176314	52256225	52256225	52256225
64341343	64341343	63141417	52251552	52251552	52251552
61136113	61136113	60631703	51136116	51136116	51136116
61131664	61131664	63036063	51131661	51131661	51131661
56115611	56115611	52525252	64235123	64235123	64235123
56112166	56112166	52522525	64152632	64152564	64153415
55065506	55065506	52255225	62432564	62432632	62433246
55062271	55062271	45515145	62165246	62165415	62164564
50725072	50725072	46454532	61455415	61455246	61454632
50722705	50722705	46263151	61262351	61262351	61262351
45614561	45614561	51452651	46514351	46514351	46514351
45613216	45613216	46312646	46323415	46323246	46322632
43544354	43544354	45324631	45613246	45613415	45612564
43543423	43543423	51313132	45344564	45344632	45345246
42274227	42274227	45463226	43624632	43624564	43625415
42273550	42273550	51264546	43543123	43543123	43543123
[A15]	[A16]	[A30]	[A31]	[A32]	[A34]
77770000	77770000	77770000	77007700	77007700	77007700
77007700	77007700	77007700	77770000	77000077	77770000
77000077	77000077	60747460	74606074	74176003	74606074
70707070	70707070	74606017	74141463	74631414	74141463
70700707	70700707	74031474	74030317	74740360	74030317
54466443	54466443	63600374	63601253	63171224	63601253
54461334	54461334	74140363	63144136	63634141	63144136
52256225	52256225	60176314	63032465	63742412	63032465
52251552	52251552	63141417	60742705	60032772	60742705
51136116	51136116	60631703	60635522	60145555	60635522
51131661	51131661	63036063	60177250	60607227	60177250
64235123	64235123	52525252	52524646	52254631	52524646
64152632	64152632	52522525	52523131	52253146	52523131
62432564	62432564	52255225	52254551	52524526	52255225
62165246	62165415	45515145	51453146	51323131	51452632
61454351	61455246	46314532	51312632	51462645	51313146
61263415	61262351	46263151	51265225	51515252	51264551
46515415	46514351	51312651	46451634	46321643	46451554
46322351	46323246	46452646	46317007	46467070	46316413
45613246	45613415	45464631	46262362	46512315	46262362
45344564	45344564	51453132	45321554	45451523	45321634
43624632	43624632	45323226	45466413	45316464	45467007
43543123	43543123	51264546	45514361	45264316	45514361

[A35]	[A37]	[A38]	[A48]	[A71]	[A73]
77007700	77770000	77770000	77770000	77770000	77007700
77000077	77007700	77007070	77007700	77007700	77770000
74176003	77000077	77000707	77000077	60747460	74606074
74631414	70707070	70707700	70707070	74606017	74141463
74740360	70700707	70700077	70700707	74031474	74030317
63171224	46644664	46644664	46644664	63600374	63601253
63634141	46643113	46643113	46643113	74140363	63144136
63742412	64436443	64436443	64436443	60176314	63032465
60032772	64232334	64232334	64232334	63141417	60742705
60145555	52431554	52431554	52431554	60631703	60635522
60607227	52235223	52235223	52235223	63036063	60177250
52254631	45525216	45525216	45525216	52525252	52524646
52253146	43522361	43522361	43326145	52522525	52523131
52525252	61261651	61261651	61461361	46455225	52254551
51322645	51266146	51266146	51262652	51315145	51453416
51463131	62164532	62164532	62164532	52254532	51312362
51514526	54163425	54163425	54163425	46263151	51265225
46321523	45311562	45311562	45311562	51452651	46451364
46466464	43316415	43316415	43512631	46312646	46317007
46512315	61455125	61455125	61255415	45324631	46262632
45451643	51452632	51452632	51456126	45513132	45321554
45317070	62153246	62153246	62153246	51263226	45466143
45264316	54154351	54154351	54154351	45464546	45514631

(Every representation of the column of the orthogonal
arrays in transposed form is octal.)