APPROVED BY
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IDENTIFICATION

Variable Column, Variable Digit Rounded Fraction Print, MU PRF3

E. M. Zographos, February 28, 1957

Midwestern Universities Research Association, Madison, Wisconsin

PURPOSE

To print, on-line, one to five rounded fixed point fractions, F_i, in from one to five columns, with a five digit integer line label. The number of digits in each fraction is variable.

RESTRICTIONS

The MURA PRINTER BOARD 1 is required. See attached sheet for wiring diagram.

METHOD

Accuracy: $\pm 5 \times 10^{-(P+1)}$, where P = the number of digits

Range: $-(1 - 2^{-35}) \leq F_i \leq 1 - 2^{-35}$

USAGE

Calling Sequence:

UA SAP

Loc.	Instruction
α	TSX PRF3, 4
$\alpha + 1$	(prefix) B, P - 3, C
$\alpha + 2$	return

MURASS

Loc.	Instruction
α	BTSX A 4
$\alpha + 1$	C N B P - 3 C
$\alpha + 2$	return

where:
(prefix) = N = the number of fractions, $1 \leq N \leq 5$.
B = integer label to identify line of print
C = location of first fraction, with successive fractions in C + 1, C + 2, etc.
P = the number of digits, $3 \leq P \leq 10$

On entry to this subroutine the fixed point fractions $F_0, F_1, \ldots, F_{N-1}$ in memory locations C, C + 1, . . . , C + N - 1, respectively, will be printed via the 716 printer as P digit rounded fractions. The fractions will appear in order, $F_0, F_1, \ldots, F_{N-1}$, from left to right in N columns on one line.

Positive fractions are printed without sign, negative fractions with sign. The decimal point is not printed and is assumed to be immediately to the left of the first digit of the fraction. To the left of the N columns on the same line a five digit integer B will be printed to serve as a line label. At the far left of the line the letter F will appear to indicate that the numbers printed are fractions.

If the prefix is PZE, that is N = 0, and C is the location of any positive number, then just the label B is printed.

Space Required:

	UA SAP	MURASS
133 words program at:	PRF3	A
26 words temporary at:	COMMON	T

CODING INFORMATION

Timing: 511.6 + 3.8N ms. is the average time if the printer is not in motion upon entry. The printer will be kept running at full speed (150 lines/min.) if the time between exit and re-entry does not exceed 110.4 - 3.8N ms.

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      REM PRF3 MURA VARIABLE COL. + DIGIT ROUNDED FRACT.  PRINT          MU   PRF3
PRF3  SXD COMMON,1      SAVE IR1                                       PRF3  0001
      SXD COMMON+1,2    SAVE IR2                                       PRF3  0002
      SXD COMMON+2,4    SAVE IR4                                       PRF3  0003
      PXD 11,0          CLEAR AC                                       PRF3  0004
      LDQ 1,4           PARAMETER TO MQ                                PRF3  0005
      LGL 3             SHIFT N TO AC                                  PRF3  0006
      STO COMMON+3                                                     PRF3  0007
      LGL 15            C, STARTING ADDRESS, TO AC                     PRF3  0008
      ADD COMMON+3      C+N                                            PRF3  0009
      STA PRF3+32       PLANT FRACTION CALL                            PRF3  0010
      STA PRF3+42       ADDRESSES                                      PRF3  0011
      PXD 4,0           CLEAR AC                                       PRF3  0012
      LGL 3             (P-3) TO AC                                    PRF3  0013
      ADD PRF3+131      (P-3) + 3                                      PRF3  0014
      STO COMMON+4                                                     PRF3  0015
      RQL 15            B TO ADDRESS OF MQ                             PRF3  0016
      LXA PRF3+3,1      SET IR1=11                                     PRF3  0017
      CLA COMMON+3      N                                              PRF3  0018
      ALS 2             4N                                             PRF3  0019
      STA PRF3+21       PLANT SHIFT ADDRESS                            PRF3  0020
      CAL PRF3+126                                                     PRF3  0021
      ARS 0             SET UP NUMBER BANK                             PRF3  0022
      STO COMMON+22,1   FOR FIRST ENTRY                                PRF3  0023
      TIX PRF3+22,1,1   LOOP RE-ENTRY, OUT AFTER 11 PASSES             PRF3  0024
      PXD 6,0           CLEAR AC                                       PRF3  0025
      DVP PRF3+123      DIVIDE BY 10                                   PRF3  0026
      ALS 28            POSITION REMAINDER                             PRF3  0027
      ORS COMMON+22,1   FOR STORAGE                                    PRF3  0028
      TXI PRF3+29,1,1   ADD 1 TO IR1                                   PRF3  0029
      TXL PRF3+24,1,5   LOOP RE-ENTRY, OUT AFTER 5 PASSES              PRF3  0030
      LXA COMMON+3,4    SET IR4=N                                      PRF3  0031
      LXA PRF3+3,2      SET IR2=11                                     PRF3  0032
      LDQ 0,4           FRACTION IN MQ                                 PRF3  0033
      MPY PRF3+123      MULTIPLY BY 10                                 PRF3  0034
      ALS 30,1          POSITION CODED DIGIT                           PRF3  0035
      ORS COMMON+22,2   FOR STORAGE                                    PRF3  0036
      TIX PRF3+33,2,1   LOOP RE-ENTRY, OUT AFTER 11 PASSES             PRF3  0037
      TXI PRF3+38,1,4   ADD 4 TO IR1                                   PRF3  0038
      TIX PRF3+31,4,1   LOOP RE-ENTRY, OUT AFTER N PASSES              PRF3  0039
      MPR               SELECT PRINTER                                 PRF3  0040
      SPR 7             PULSE EXIT HUB 7 FOR F                         PRF3  0041
      LXA COMMON+3,1    SET IR1=N                                      PRF3  0042
      CLA 0,1           FRACTION IN AC                                 PRF3  0043
      TPL PRF3+45       TRANSFER IF FRACTION IS +                      PRF3  0044
      PSE 243,4         PULSE EXIT HUBS IF -                           PRF3  0045
      TXI PRF3+46,4,-1  ADD -1 TO IR4                                  PRF3  0046
      TIX PRF3+42,1,1   LOOP RE-ENTRY, OUT AFTER N PASSES              PRF3  0047
      LXA PRF3+11,1     SET IR1=4                                      PRF3  0048
      CAL PRF3+131,1    SET UP CONSTANTS                               PRF3  0049
      SLW COMMON+26,1   FOR FIRST USE                                  PRF3  0050
      TIX PRF3+48,1,1   LOOP RE-ENTRY, OUT AFTER 4 PASSES              PRF3  0051
      CLA PRF3+132      HTR11                                          PRF3  0052
      SUB COMMON+4      11-P                                           PRF3  0053
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STO COMMON+5                                                          PRF3  0054
LXA COMMON+3,1   SET IR1=N                                            PRF3  0055
LXA COMMON+5,2   SET IR2=11-P                                         PRF3  0056
LXA COMMON+4,4   SET IR4=P                                            PRF3  0057
CAL COMMON+22,2  (P+1)ST DIGIT                                        PRF3  0058
ANA COMMON+22    EXTRACT COLUMNS                                      PRF3  0059
SUB COMMON+23    DIGIT-5                                              PRF3  0060
TMI PRF3+70      TRANSFER IF DIGIT LESS THAN 5                        PRF3  0061
TXI PRF3+62,2,1  DIGIT=5 OR MORE, ADD 1 TO IR2                        PRF3  0062
CAL COMMON+22,2  P-TH DIGIT                                           PRF3  0063
ANA COMMON+22    EXTRACT COLUMNS                                      PRF3  0064
CAS COMMON+24    COMPARE WITH 9                                       PRF3  0065
TRA PRF3+80      AC MORE THAN 9                                       PRF3  0066
TRA PRF3+115     AC=9                                                 PRF3  0067
CAL COMMON+22,2  AC LESS THAN 9                                       PRF3  0068
ADD COMMON+25    CODED DIGIT + 1                                      PRF3  0069
SLW COMMON+22,2                                                       PRF3  0070
LXA PRF3+11,4    SET IR4=4                                            PRF3  0071
CAL COMMON+26,4  SHIFT CONSTANTS, EXTRACTOR                           PRF3  0072
ARS 4            4 PLACES TO RIGHT                                    PRF3  0073
SLW COMMON+26,4  FOR NEXT COLUMNS                                     PRF3  0074
TIX PRF3+71,4,1  LOOP RE-ENTRY, OUT AFTER 4 PASSES                    PRF3  0075
TIX PRF3+55,1,1  LOOP RE-ENTRY, OUT AFTER N PASSES                    PRF3  0076
LXA COMMON+5,2   SET IR2=11-P                                         PRF3  0077
CAL PRF3+126                                                          PRF3  0078
ORS COMMON+22,2                                                       PRF3  0079
TIX PRF3+78,2,1  LOOP RE-ENTRY, OUT AFTER 11-P PASSES                 PRF3  0080
CAL PRF3+124     T IN AC                                              PRF3  0081
ACL PRF3+125     T-1                                                  PRF3  0082
SLW COMMON+6     STORE T (FIXED)                                      PRF3  0083
SLW COMMON+7     STORE T (SHIFTING)                                   PRF3  0084
CAL PRF3+125     EXTRACTOR IN AC                                      PRF3  0085
SLW COMMON+8                                                          PRF3  0086
LXA PRF3+24,1    SET IR1=6                                            PRF3  0087
LXA PRF3+5,2     SET IR2=3                                            PRF3  0088
LXA PRF3+18,4    SET IR4=2                                            PRF3  0089
CAL COMMON+9,4   SHIFT T, EXTRACTOR                                   PRF3  0090
ARS 4            4 PLACES TO RIGHT                                    PRF3  0091
SLW COMMON+9,4   FOR NEXT COLUMNS                                     PRF3  0092
TIX PRF3+89,4,1  LOOP RE-ENTRY, OUT AFTER 2 PASSES                    PRF3  0093
LXA PRF3+3,4     SET IR4=11                                           PRF3  0094
CAL COMMON+22,4  NUMBER IN AC                                         PRF3  0095
ANA COMMON+8     EXTRACT COLUMN                                       PRF3  0096
CAS COMMON+7     COMPARE WITH T                                       PRF3  0097
TRA PRF3+99      AC MORE THAN T                                       PRF3  0098
CLA PRF3+99      AC=T                                                 PRF3  0099
LRS 1            AC LESS THAN T                                       PRF3  0100
TIX PRF3+94,4,1  LOOP RE-ENTRY, OUT AFTER 11 PASSES                   PRF3  0101
TNX PRF3+105,1,1 LOOP RE-ENTRY, OUT AFTER 6 PASSES                    PRF3  0102
TIX PRF3+88,2,1  LOOP RE-ENTRY, OUT AFTER 3 PASSES                    PRF3  0103
STO COMMON+9     STORE LEFT IMAGE                                     PRF3  0104
TRA PRF3+87                                                           PRF3  0105
STO COMMON+10    STORE RIGHT IMAGE                                    PRF3  0106
CPY COMMON+9     COPY LEFT IMAGE                                      PRF3  0107
CPY COMMON+10    COPY RIGHT IMAGE                                     PRF3  0108
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CAL COMMON+6      T IN AC                                    PRF3  0109
ANA PRF3+125      CLEAN IT OFF                               PRF3  0110
TNZ PRF3+81       TRANSFER IF NOT ZERO TO CONTINUE           PRF3  0111
LXD COMMON,1      HERE IF=0, RESTORE IR1                     PRF3  0112
LXD COMMON+1,2    RESTORE IR2                                PRF3  0113
LXD COMMON+2,4    RESTORE IR4                                PRF3  0114
TRA 2,4           OUT                                        PRF3  0115
CAL COMMON+22     HERE IF P-TH DIGIT IS 9                    PRF3  0116
COM                                                          PRF3  0117
ANS COMMON+22,2 0 REPLACES P-TH DIGIT                        PRF3  0118
TIX PRF3+61,4,1 TO TEST NEXT DIGIT                           PRF3  0119
CAL COMMON+24     HERE IF ALL DIGITS WERE NINES              PRF3  0120
ORS COMMON+22,2 REPLACE WITH ALL NINES                       PRF3  0121
TIX PRF3+120,2,1 LOOP RE-ENTRY, OUT AFTER 11 PASSES          PRF3  0122
TRA PRF3+70                                                  PRF3  0123
HTR 10            CONSTANT                                   PRF3  0124
OCT 500000000000 EXTRACTOR                                   PRF3  0125
OCT 740000000000 T                                           PRF3  0126
OCT 001777777777 CONSTANTS                                   PRF3  0127
OCT 001700000000                                             PRF3  0128
OCT 000500000000                                             PRF3  0129
OCT 001100000000                                             PRF3  0130
OCT 000100000000                                             PRF3  0131
HTR 9                                                        PRF3  0132
HTR 11                                                       PRF3  0133
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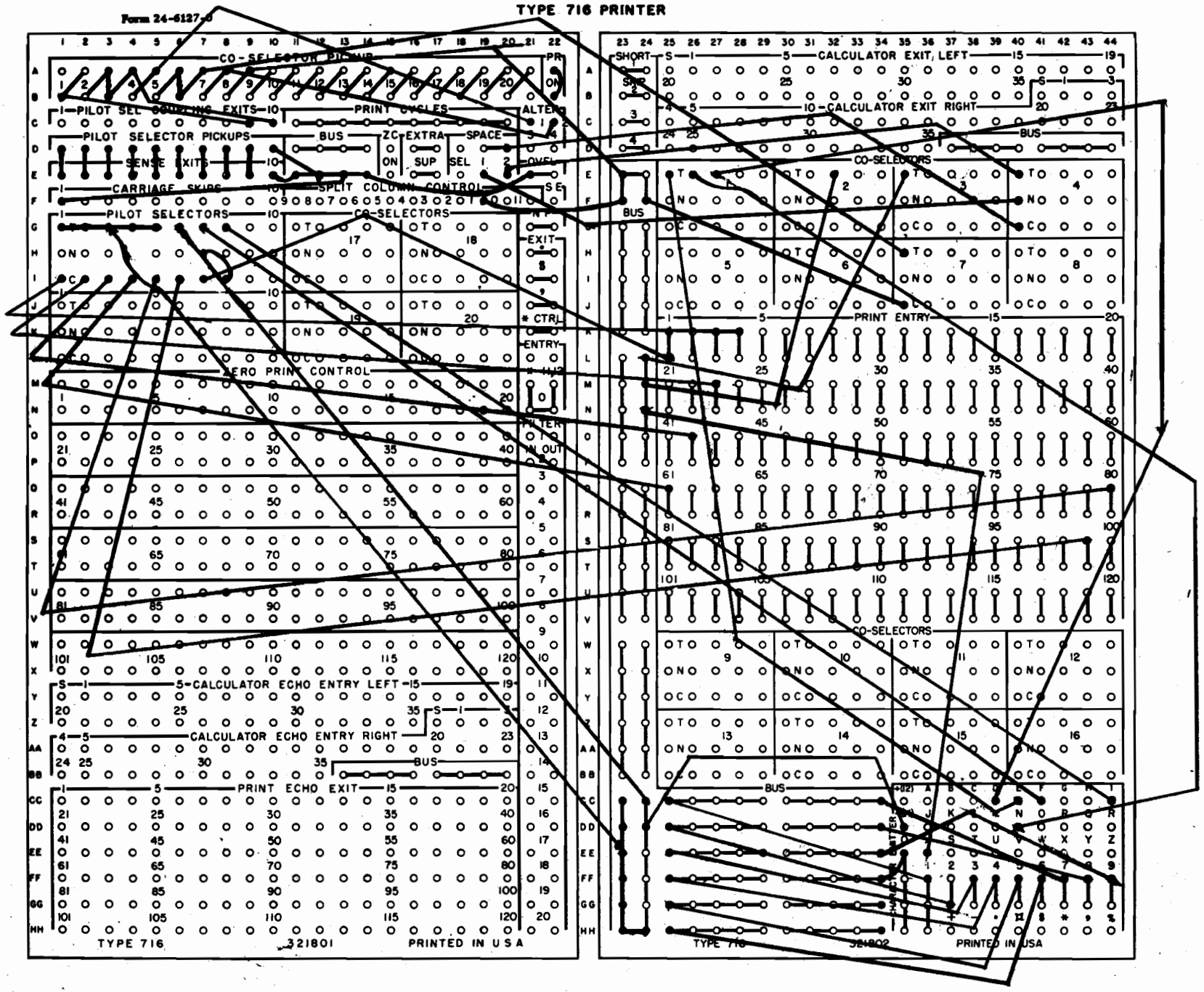
MURA PRINTER BOARD

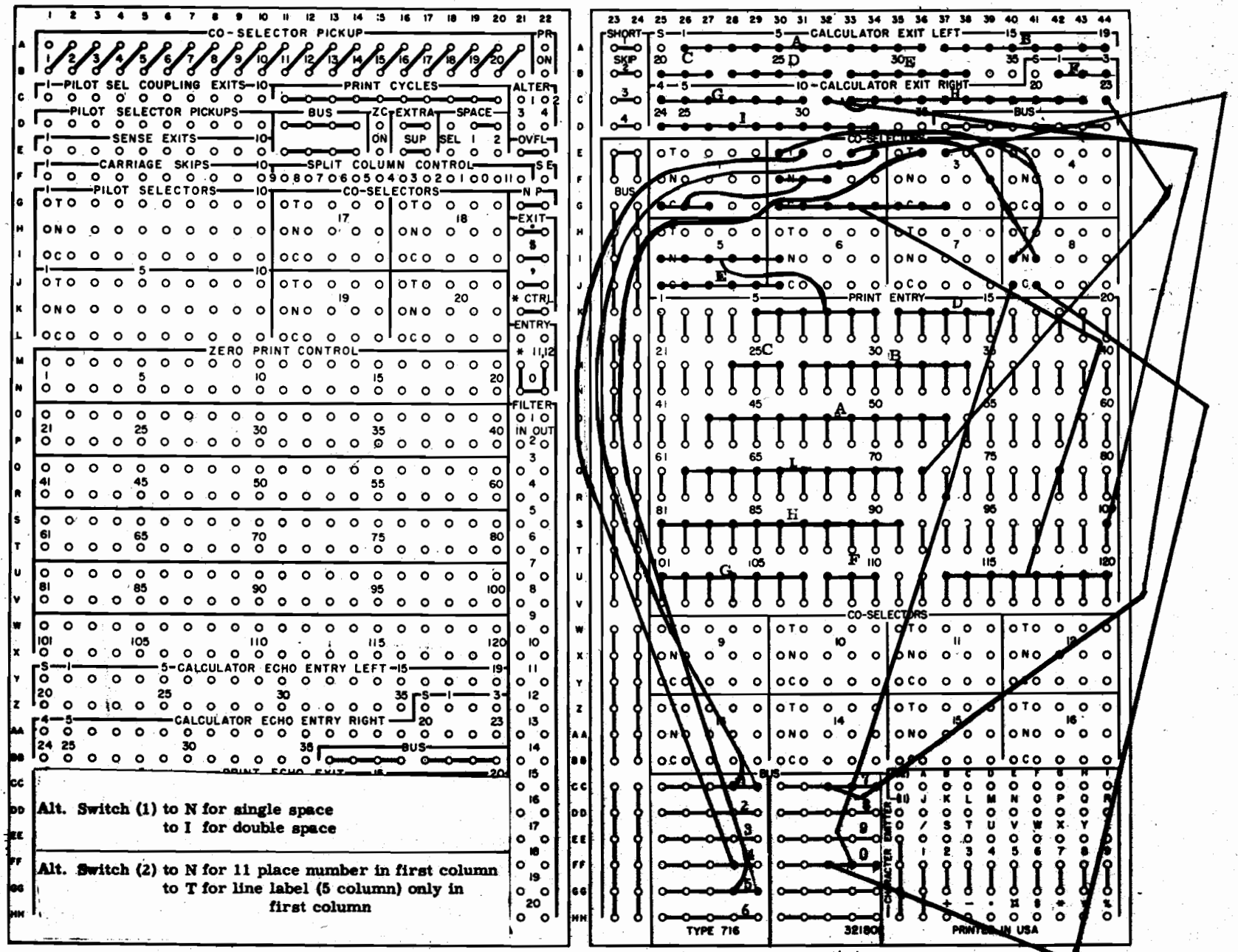
TYPE 716 PRINTER



MURA PRINTER BOARD

Form 24-6127-0

TYPE 716 PRINTER



Alt. Switch (1) to N for single space
to I for double space

Alt. Switch (2) to N for 11 place number in first column
to T for line label (5 column) only in
first column

EXAMPLE DATE 04/01/57