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APPROVED BY

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IDENTIFICATION

Variable Column Floating Decimal Print, MU PFD1

J. F. McNall - February 3, 1957

Midwestern Universities Research Association, Madison, Wisconsin

PURPOSE

To print via the 716 on-line printer, from zero to five columns of floating point decimal numbers, P, and an identification column.

RESTRICTIONS

The MURA PRINTER BOARD 1 is required. See attached wiring diagram. The numbers to be printed can be normalized or unnormalized.

METHOD

Accuracy: $\pm$ 1/2 in the eighth significant figure.

Range: $1/2\,(2^{-128}) \leq |P| \leq (1 - 2^{-27})\,(2^{127})$

USAGE

Calling Sequence:

UA SAP

Loc.	Instruction
α	TSX PFD1, 4
$\alpha + 1$	(Prefix) B, 0, C
$\alpha + 2$	Return

MURASS

Loc.	Instruction
α	BTSX A 4
$\alpha + 1$	C N B 0 C
$\alpha + 2$	Return

Where:

(Prefix) = N = The number of floating point numbers to be printed, $0 \leq N \leq 5$.
B = The integer label to identify the line of print.
C = The location of the first number, with successive numbers in C + 1, C + 2, etc.

Upon entry to this routine, the floating point numbers, $P_0, P_1, \cdots P_{N-1}$, in storage locations, C, C + 1, $\cdots$ C + N - 1, respectively, will be printed via the 716 printer as eight digit signed numbers followed by two digit signed exponents. The numbers will appear in order $P_0, P_1, \cdots P_{N-1}$, from left to right in N columns on one line. Positive numbers are printed without sign.

The decimal point is not printed and is assumed to be immediately to the right of the first significant figure. 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.

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

The MQ OVERFLOW light may be turned on by this routine.

Numbers outside of the specified range will be incorrectly converted.

Space Required:

	UA SAP	MURASS
181 words program at:	PFD1	A
21 words temporary at:	COMMON	T

CODING INFORMATION

Timing: 510.1 + 19.6N 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 per minute) if the time between exit and re-entry to this routine does not exceed 111.9 - 19.6 N ms.

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        REM PFD1 MURA VARIABLE COLUMN FLOATING DECIMAL PRINT                MU   PFD1
PFD1    SXD COMMON,1      SAVE IR1                                          PFD1  0001
        SXD COMMON+1,2    SAVE IR2                                          PFD1  0002
        SXD COMMON+2,4    SAVE IR4                                          PFD1  0003
        PXD 11,0          CLEAR AC                                          PFD1  0004
        LDQ 1,4           PROGRAM PARAMETER IN MQ                           PFD1  0005
        LGL 3             N INTO AC                                         PFD1  0006
        STO COMMON+3      STORE N (WORDS PER LINE)                          PFD1  0007
        LGL 15            ADDRESS INTO AC                                   PFD1  0008
        ADD COMMON+3      ADD N                                             PFD1  0009
        STA PFD1+30       PLANT NUMBER CALL                                 PFD1  0010
        STA PFD1+125      PLANT ADDRESS                                     PFD1  0011
        RQL 18            PUT ID IN ADDRESS OF MQ                           PFD1  0012
        LXA PFD1+3,1      SET IR=11                                         PFD1  0013
        CLA COMMON+3      N INTO AC                                         PFD1  0014
        ALS 2             4N                                                PFD1  0015
        STA PFD1+17       PLANT SHIFT ADDRESS                               PFD1  0016
        CAL PFD1+173      SET UP NUMBER BANK                                PFD1  0017
        ARS               (ADDRESS PLANT BY PFD1+15)                        PFD1  0018
        STO COMMON+20,1   PREPARE FOR ENTRY                                 PFD1  0019
        TIX PFD1+18,1,1   OUT AFTER 11 PASSES                               PFD1  0020
        PXD 6,0           CLEAR AC (ID SECTION)                             PFD1  0021
        DVP PFD1+171      10                                                PFD1  0022
        ALS 28            POSITION REMAINDER                                PFD1  0023
        ORS COMMON+20,1   REMAINDER TO STORAGE                              PFD1  0024
        TXI PFD1+25,1,1   ADD 1 TO IR1                                      PFD1  0025
        TXL PFD1+20,1,5   OUT AFTER 6 PASSES                                PFD1  0026
        LXA COMMON+3,4    SET IR4=N                                         PFD1  0027
        TXL PFD1+123,4    TEST FOR N=0                                      PFD1  0028
        LXA PFD1+29,2     SET IR2=8                                         PFD1  0029
        PXD 8,0           CLEAR AC                                          PFD1  0030
        FAD 0,4           NORMALIZE (PLANT BY PFD1+9)                       PFD1  0031
        TZE PFD1+121      IF 0 PROCEED TO NEXT WORD                         PFD1  0032
        LRS 27            POSITION CHARACTERISTIC                           PFD1  0033
        STQ COMMON+4      STORE BINARY FRACTION                             PFD1  0034
        SSP                                                                 PFD1  0035
        SUB PFD1+175      CHANGE CHARACTERISTIC TO EXPONENT                 PFD1  0036
        LRS 35                                                              PFD1  0037
        MPY PFD1+176      EXPONENT TIMES LN2/LN10                           PFD1  0038
        SUB PFD1+170      1                                                 PFD1  0039
        STO COMMON+5      STORE INTEGER PART OF BASE 10 EXPONENT            PFD1  0040
        MPR PFD1+177      FRACTIONAL PART TIMES LN10/4                      PFD1  0041
        STO COMMON+6      STORE AS X                                        PFD1  0042
        PXD 0,0           EXPONENTIAL X ROUTINE                             PFD1  0043
        STO COMMON+7      SET (J)=0,(J)=INDEX                               PFD1  0044
        STO COMMON+8      SET (S)=0,(S)=SUMMATION TO DATE                   PFD1  0045
        CLA PFD1+178      2 EXP-4                                           PFD1  0046
        STO COMMON+20     STORE (T), (T)=JTH TERM                           PFD1  0047
        ADD COMMON+8      ADD (S)                                           PFD1  0048
        STO COMMON+8      STORE NEW (S)                                     PFD1  0049
        CLA COMMON+7      (J)                                               PFD1  0050
        ADD PFD1+170      FORM NEW (J)                                      PFD1  0051
        STO COMMON+7      STORE (J)                                         PFD1  0052
        PXD 14,0          CLEAR AC                                          PFD1  0053
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LDQ COMMON+20     (T)                                          PFD1  0054
LLS 2             SHIFT SIGN AND SCALE (T)                     PFD1  0055
DVH COMMON+7      (J)                                          PFD1  0056
MPR COMMON+6      X, (T)X/J IN AC                              PFD1  0057
TNZ PFD1+46       OUT AFTER NO ADDITIONAL SIGNIFICANCE         PFD1  0058
LDQ COMMON+8      (S)=EXPONENTIAL X                            PFD1  0059
MPY COMMON+4      TIMES BINARY FRACTION                        PFD1  0060
STO COMMON+4      A, BASE 10 SIGNIFICANT FIGURES               PFD1  0061
TOV PFD1+62       RESET OVERFLOW INDICATOR                     PFD1  0062
LLS 4                                                          PFD1  0063
TOV PFD1+72       TRANSFER MEANS A IS GREATER THAN OR=1        PFD1  0064
SSP                                                            PFD1  0065
SUB PFD1+179      SUBTRACT .1                                  PFD1  0066
TMI PFD1+83       TRANSFER MEANS A IS LESS THAN .1             PFD1  0067
ADD PFD1+179      .1                                           PFD1  0068
LDQ COMMON+4      A                                            PFD1  0069
LLS 0             SHIFT SIGN                                   PFD1  0070
STO COMMON+4      STORE A (NORMALIZED)                         PFD1  0071
TRA PFD1+92                                                    PFD1  0072
LRS 4             RESTORE MQ                                   PFD1  0073
CLA COMMON+4      A IN AC                                      PFD1  0074
LRS 31            POSITION FOR DIVIDE                          PFD1  0075
DVH PFD1+171      10                                           PFD1  0076
STQ COMMON+4      STORE A (NORMALIZED)                         PFD1  0077
CLA COMMON+5      B, BASE 10 EXPONENT                          PFD1  0078
ADD PFD1+170      ADJUST EXPONENT                              PFD1  0079
TNZ PFD1+81                                                    PFD1  0080
SSP               IF 0, SET SIGN PLUS                          PFD1  0081
STO COMMON+5      STORE ADJUSTED EXPONENT                      PFD1  0082
TRA PFD1+92                                                    PFD1  0083
ADD PFD1+179      HERE IF A IS LESS THAN .1                    PFD1  0084
LDQ COMMON+4      A                                            PFD1  0085
LLS 0             SHIFT SIGN                                   PFD1  0086
LRS 35                                                         PFD1  0087
MPY PFD1+171      10                                           PFD1  0088
STQ COMMON+4      STORE A (NORMALIZED)                         PFD1  0089
CLA COMMON+5      B                                            PFD1  0090
SUB PFD1+170      ADJUST EXPONENT                              PFD1  0091
STO COMMON+5      B                                            PFD1  0092
LDQ COMMON+4      A                                            PFD1  0093
MPY PFD1+171      10                                           PFD1  0094
ALS 30,1          POSITION DIGIT FOR STORAGE                   PFD1  0095
ORS COMMON+17,2   OR TO NUMBER BANK                            PFD1  0096
TIX PFD1+93,2,1   OUT AFTER 8 PASSES                           PFD1  0097
LXA PFD1+14,2     SET IR2=2                                    PFD1  0098
LDQ COMMON+5      B                                            PFD1  0099
PXD 12,0          CLEAR AC                                     PFD1  0100
DVP PFD1+171      10                                           PFD1  0101
STA COMMON+8,2    STORE B1 AND B2, DIGITS OF B                 PFD1  0102
TIX PFD1+99,2,1   OUT AFTER 2 PASSES                           PFD1  0103
CLA COMMON+6      B1, LEAST SIG. PART OF EXPONENT              PFD1  0104
LRS 4             B1 TO MQ                                     PFD1  0105
CLA COMMON+7      B2, MOST SIG. PART OF EXPONENT               PFD1  0106
TNZ PFD1+108      IF 0, LEAVE BLANK                            PFD1  0107
CLA PFD1+171      10                                           PFD1  0108
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LRS 4              B2 TO MQ                                  PFD1  0109
CLA COMMON+5       B                                         PFD1  0110
TMI PFD1+113       TEST FOR SIGN OF EXPONENT                 PFD1  0111
CLA PFD1+52        IF PLUS, MAKE=14                          PFD1  0112
TRA PFD1+114                                                 PFD1  0113
CLA PFD1+7         IF MINUS, MAKE=15                         PFD1  0114
LRS 4              SIGN TO MQ (EXPONENT IN MQ)               PFD1  0115
LXA PFD1+116,2     SET IR2=3                                 PFD1  0116
PXD 3,0            CLEAR AC                                  PFD1  0117
LLS 4              SHIFT ONE DIGIT OF EXPONENT TO AC         PFD1  0118
ALS 30,1           POSITION DIGIT                            PFD1  0119
ORS COMMON+20,2    DIGIT TO STORAGE                          PFD1  0120
TIX PFD1+116,2,1   OUT AFTER 3 PASSES                        PFD1  0121
TXI PFD1+122,1,4   ADD 4 TO IR1                              PFD1  0122
TIX PFD1+28,4,1    TO LOOP, OUT AFTER N                      PFD1  0123
WPR                SELECT PRINTER                            PFD1  0124
LXA COMMON+3,1     SET IR1=N                                 PFD1  0125
CLA 0,1            NUMBER IN AC (PLANT BY PFD1+10)           PFD1  0126
TPL PFD1+128       TEST SIGN OF NUMBER                       PFD1  0127
SPR 243,4          PULSE EXIT HUB FOR MINUS                  PFD1  0128
TXI PFD1+129,4,-1  SUBTRACT 1 FROM IR4                       PFD1  0129
TIX PFD1+125,1,1   OUT AFTER N PASSES                        PFD1  0130
CAL PFD1+174       (T)=10, IN AC                             PFD1  0131
ACL PFD1+172       EXTRACTOR, (T) REDUCED BY 1               PFD1  0132
SLW COMMON+4       STORE (T), (FIXED)                        PFD1  0133
SLW COMMON+5       STORE (T), (SHIFTING)                     PFD1  0134
CAL PFD1+172       EXTRACTOR                                 PFD1  0135
SLW COMMON+6       STORE EXTRACTOR                           PFD1  0136
LXA PFD1+20,1      SET IR1=6                                 PFD1  0137
LXA PFD1+5,2       SET IR2=3                                 PFD1  0138
LXA PFD1+14,4      SET IR4=2                                 PFD1  0139
CAL COMMON+7,4     (T), (SHIFTING), THEN EXTRACTOR           PFD1  0140
ARS 4              POSITION FOR NEXT COLUMN                  PFD1  0141
SLW COMMON+7,4                                               PFD1  0142
TIX PFD1+139,4,1   OUT AFTER 2 PASSES                        PFD1  0143
LXA PFD1+3,4       SET IR4=11                                PFD1  0144
CAL COMMON+20,4    NUMBER IN AC                              PFD1  0145
ANA COMMON+6       EXTRACT COLUMN                            PFD1  0146
CAS COMMON+5       COMPARE WITH (T)                          PFD1  0147
TRA PFD1+149                                                 PFD1  0148
CLA PFD1+149       IF DIGIE=(T), ACCUMULATE A BIT            PFD1  0149
LRS 1              BIT TO MQ                                 PFD1  0150
TIX PFD1+144,4,1   OUT AFTER 11 PASSES                       PFD1  0151
TNX PFD1+155,1,1   TRANSFER WHEN ALL COLUMNS DONE            PFD1  0152
TIX PFD1+138,2,1   OUT AFTER 3 PASSES                        PFD1  0153
STQ COMMON+7       STORE LEFT IMAGE                          PFD1  0154
TRA PFD1+137                                                 PFD1  0155
STQ COMMON+8       STORE RIGHT IMAGE                         PFD1  0156
CPY COMMON+7       COPY LEFT IMAGE                           PFD1  0157
CPY COMMON+8       COPY RIGHT IMAGE                          PFD1  0158
CAL COMMON+4       (T) IN AC                                 PFD1  0159
ANA PFD1+172       EXTRACTOR (CLEAN IT OFF)                  PFD1  0160
ACL PFD1+180       A BIT IN POSITION 3                       PFD1  0161
SUB PFD1+170       1                                         PFD1  0162
TZE PFD1+166       IF 0, WE ARE DONE                         PFD1  0163
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CAL COMMON+4      (T) IN AC                                PFD1  0164
ANA PFD1+172      EXTRACTOR                                PFD1  0165
TRA PFD1+131                                               PFD1  0166
LXD COMMON,1      RESTORE IR1                              PFD1  0167
LXD COMMON+1,2    RESTORE IR2                              PFD1  0168
LXD COMMON+2,4    RESTORE IR4                              PFD1  0169
TRA 2,4           EXIT                                     PFD1  0170
HTR 1             1                                        PFD1  0171
HTR 10            10                                       PFD1  0172
OCT 740000000000 EXTRACTOR                                 PFD1  0173
OCT 001252525252 NUMBER BANK SET UP                        PFD1  0174
OCT 500000000000 (T)=10                                    PFD1  0175
HTR 128           128                                      PFD1  0176
OCT 115040465022 LN2/LN10                                  PFD1  0177
OCT 223273067355 LN10/4                                    PFD1  0178
OCT 020000000000 2 EXP-4                                   PFD1  0179
OCT 031463146315 .1                                        PFD1  0180
OCT 100000000000 BIT IN POSITION 3                         PFD1  0181
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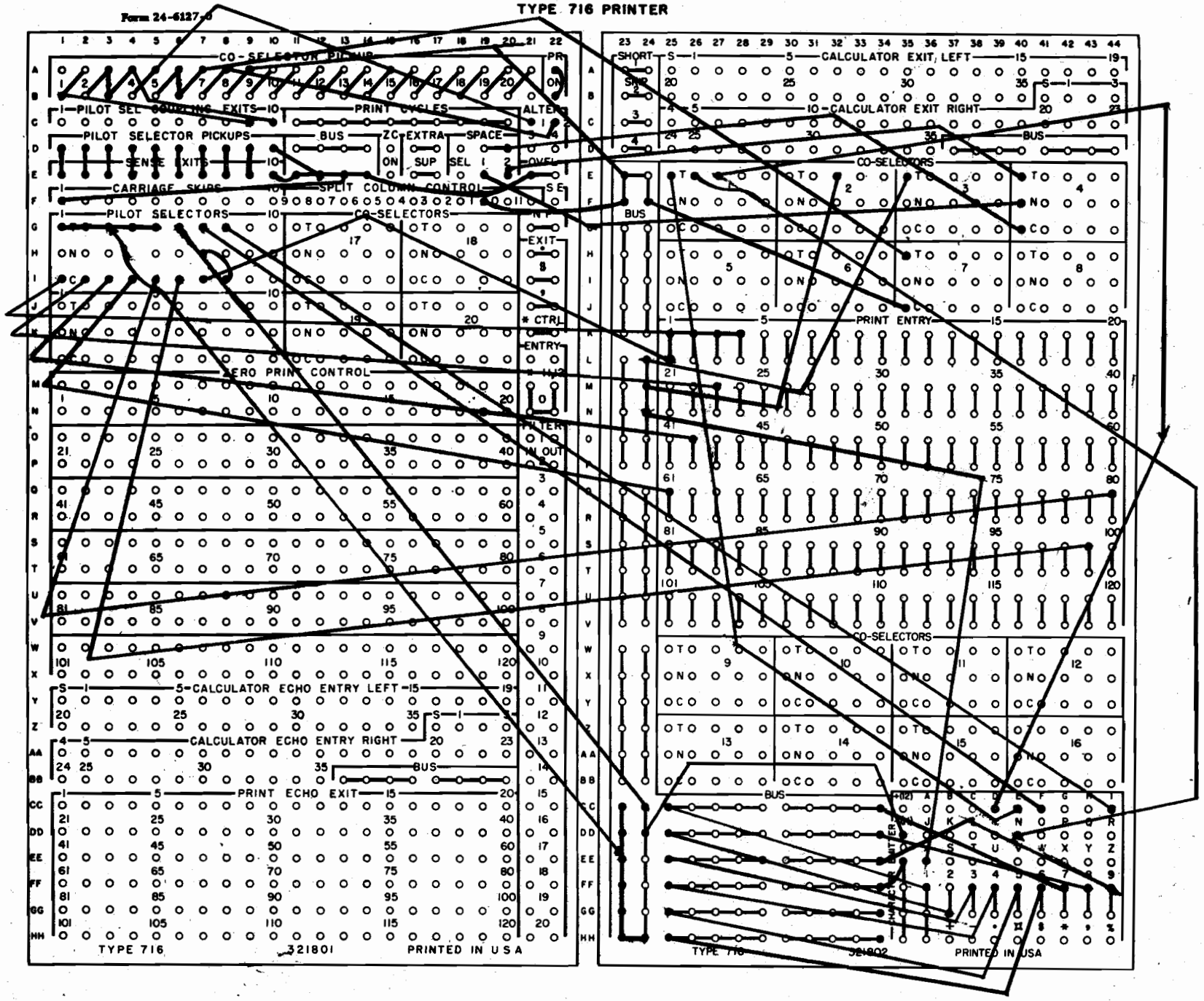
MURA PRINTER BOARD

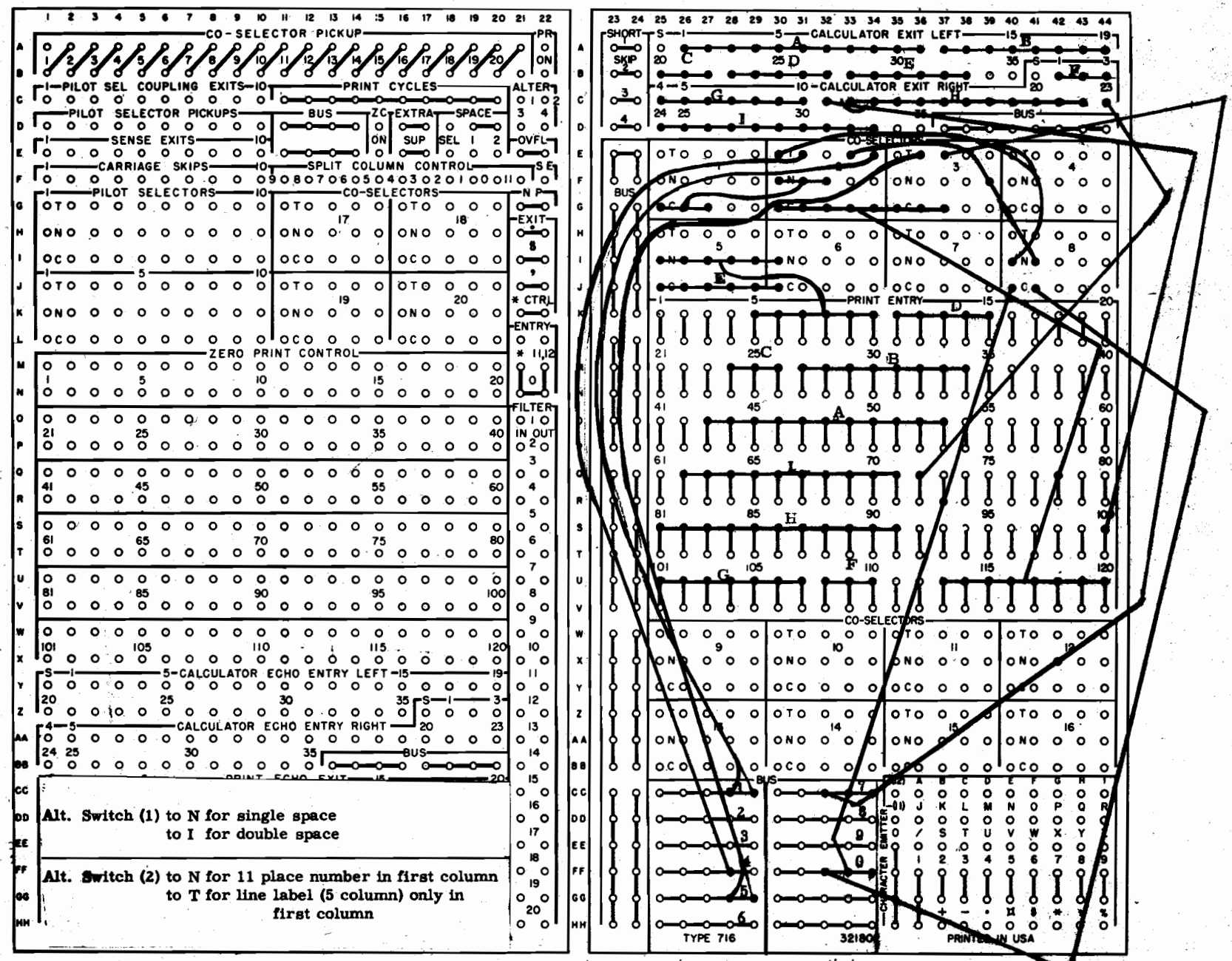
Form 24-6127-0

TYPE 716 PRINTER



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

MURA PRINTER BOARD

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