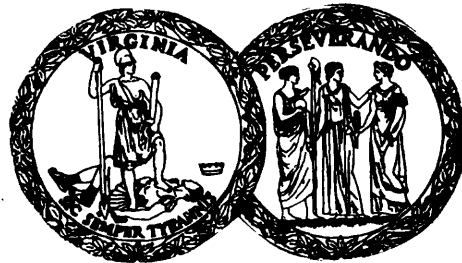# SOSO

Simulation Of Six-fifty On 1620

Written By

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Refer Inquiries to Your

IBM District 1620 Co-ordinator

VIRGINIA   DEPARTMENT   OF   HIGHWAYS

LOCATION   &   DESIGN   DIVISION

november, 1961

VIRGINIA DEPARTMENT OF HIGHWAYS

SOSO
(Simulation Of Six-fifty On 1620)

Written By

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Virginia Department of Highways
Location and Design
Richmond 19, Virginia

1620 USERS Group Library

Program Abstract

Title:	Simulation of Six-fifty on 1620.
Author; Organization:	William C. Moore, Jr. Virginia Department of Highways 1221 East Broad Street Richmond 19, Virginia
Direct Inquiries to:	IBM District 1620 Co-ordinator.
Purpose/Description:	To allow 650 programs to be run on the 1620 without reprogramming.
Mathmetical Method:	Fixed Point Arithmetic.
Restrictions, Range:	The program simulates a basic 2,000 word 650. The card formats are handled by a control panel program which must be written by each individual user. A sample 533 control panel diagram and the program necessary to simulate the panel is included.
Storage Requirements:	26, 244 digits plus the storage required to simulate the 533 Control Panel.
Equipment Specifications:	40K (min.), Automatic Divide, Indirect Addressing, Additional Instructions (71-73) and R.P.Q. No. E07386 to convert 12-0 punch into an alpha-code of 30.
Remarks:	Written in S.P.S. Running time: approximately three times slower than that of the 650. Number of times run successfully: 50.

TABLE OF CONTENTS

SOSO

(Simulation of Six-fifty on 1620)

I.   Machine Requirements for the 1620

      In order to use the simulator, it is necessary to have the
      1620 equipped as follows:

      1.   40,000 digits of memory
      2.   Automatic Division
      3.   Indirect addressing
      4.   1622 - Card Reader and Punch Unit
      5.   Additional Instructions (TNS, TNF and MF)*
      6.   R.P.Q. No. E07386 to convert a 12-0 punch into an alpha-
           betic code of 30.*
           (Except as noted in X (A)
      * Needed only for the 533 control panel program

II.   Scope of Simulation

      This 1620 program will simulate a basic 2,000 word 650
      computer. Floating point arithmetic hardware, immediate
      access storage, magnetic tapes, indexing registers and
      online printers have not been programmed.

      There is no limit to card format either for input or output,
      however, a separate program must be written by the user to
      do the functions of the 533 control panel. Further expla-
      nations are given in Section VIII and IX.

III. Timing of the Simulator Program

      All the 650 programs used for program testing and time stud-
      ies were optimized by S.O.A.P. The simulator is approxi-
      mately 3 times slower than the 650 assuming the 650 program
      is computer bound. If the 650 is input or output bound, the
      ratio will be better.

      A group of 13 different highway design programs were timed on
      the 650 and simulated on the 1620. The ratio of 1620 time to
      the 650 time ranged from 1.2 to 4.2 with the average being 3.3.

IV.   Method of Simulation

      The procedure for determining the address of the 1620 units
      digit of the 650 word is:
           10 (2044-650 address) = Address of 1620 units position.

      For a few drum addresses and the addresses of the accumulators,

This would be:

650 Drum Address	1620 Address of Simulated 650 location	
	High Order	Low Order
0000	20431	20440
0001	20421	20430
1999	441	450
2000	431	440
2001	421	430
2002	411	420
2003	401	410

The reason for the 650 words being stored in the reverse
order in the 1620 is that the units digit of the upper
accumulator must be next to the high order digit of the
lower accumulator. This permits the program to use the
addresses indiscriminately and not test for either accumu-
lator address. Therefore, all 650 programs that use
8000-8003 addresses must have program decks converted to
change the 8000 addresses to 2000 addresses; ie. 8000 to
2000, 8001 to 2001, etc. Example:

$$\text{For } 650 \begin{cases} 0001 & 60 & 8001 & 0002 \\ 0002 & 10 & 1023 & 8003 \end{cases} \text{For } 1620 \begin{cases} 0001 & 60 & 2001 & 0002 \\ 0002 & 10 & 1023 & 2003 \end{cases}$$

This is the only change necessary to adapt all 650 programs
for use by this simulator. A separate program is provided
to do this and is explained in Part XI.

V.   A. Explanation of Block Diagram and Program Listing

In order to explain how the simulator works, it is best to
go by each of the block divisions given in the program list-
ing and shown in the block diagram.

The block labeled START initializes the program and clears
the digits that correspond to the drum and accumulator of
the 650 to zero with flags over the high order position of
each 650 word. If it is desired to clear the 650 memory to
other than zeros, this may be done by a 650 program routine
in 650 machine language. Also, this block allows the
operator to enter the console setting of the 650 and start
the program.

The block labeled BEGIN is executed once for each instruct-
ion in the 650 program and serves the same purpose as the
program register. This block interprets the instruction,
checks for invalid addresses and operation codes, and branches

to the correct operation code subroutine by the use of
a table which gives the starting address of the routine.

Following the block labeled BEGIN are the routines for
the 650 operation codes labeled HLT, AUP, SUP, etc.
Some parts of one routine are common to another routine,
ie. Block STL, STU, SDA, SIA, continue into the routine
labeled STD.

The block labeled RCD transfers the simulator to the
control panel program which reads a card, changes the
80 column card format into ten-10 digit words, and trans-
fers the ten words to the simulated drum from the 1620
storage named symbolically BUFFER.

The block labeled PCH transfers ten words to the 1620
storage named BUFFER, changes the 10 digit words into an
80 column card format and punches the card.

The block labeled SUB is necessary since when addressing
the lower accumulator only the 10 low order digits are
used. All 20 digits would give an incorrect field length.
Also the sign of the upper accumulator is carried with the
units digit of the lower accumulator.

The block labeled TRACE types out the contents of the pro-
gram register, the upper and lower accumulator and the dis-
tributor when called for.

The block labeled HLT 650 stops the 1620 in case of an
invalid 650 drum address or operation code. It also stops
when a Branch on Distributor occurs and an 8 or 9 is not
present. Provision is made for restarting the 650 program,
when an error occurs.

The block labeled RCDIN and RCDOUT permits the manual entry
of data into or out of the simulated 650 drum. The block
serves the same purpose as the manual read-in and read-out
switches on the 650 console.

START

TRACE

13030 RCTY
10050
13060 TYPE PROGRAM REGISTER
13080 SPTY
13090 TYPE UPPER ACCUMULATOR
13110 SPTY

13040 TYPE LOWER ACCUMULATOR

1040 CLEAR 20,040 DIGITS TO ZERO (401-20,441)

13180 RCD IN
13180 RCTY
13190 TYPE "ENTER STORAGE SELECTION SWITCHES PUSH RELEASE START"
13200 RCTY
13210 RNTY 10 DIGITS

1110 RCTY

ENTER

1115 TYPE "ENTER STORAGE SELECTION SWITCHES PUSH RELEASE START"

1120 RCTY

1125 RNTY 10 DIGITS

1128 SW 3 ON?

13220 SW 3 ON?

13240 RCTY

13250 TYPE "ENTER ADDRESS SELECTION SWITCHES PUSH RELEASE START"

13130 SPTY

13150 TYPE DISTRIBUTOR

13160 H
13170 BB

2160 BRANCH TO OPERATION CODE SUBROUTINE

2140 FIND LOCATION OF FIRST INST OF SUBROUTINE FROM OP CODE TABLE

2070 IS D-ADDRESS = 2003?

1130 TRANSFER STORAGE SELECTION SWITCHES TO 8000 (440)

13260 RCTY

13270 RNTY 4 DIGITS

13280 SW 3 ON?

13290 TRANSFER 40-DIGIT WORD TO ADDRESS GIVEN

1140 RCTY

1145 TYPE "ENTER ADDRESS SELECTION SWITCHES PUSH RELEASE START"

1150 RCTY

1155 RNTY 4 DIGITS

2090 TRANSFER CONVERTED 650 ADDRESSES TO DA AND IA

2010 TRANSFER CONTENTS OF I-ADDRESS TO THE PROGRAM REGISTER

12150 MLT 650

1260 IS I-ADDRESS > 2003?

1158 SW 3 ON?

1160 STORE CONVERTED ADDRESS IN STOP

12150 TRACE SUBROUTINE

12160 H

1185 SET UP 1620 INSTRUCTIONS SO WHEN RESET, INSERT, RELEASE, START IS PUSHED, IT PERFORMS A 650 PROGRAM RESET, PROGRAM START

CMRJST

1195 1 → OVERFLOW 440 → IA

1250 TRACE SUBROUTINE

1230 IA = STOP?

1220 SW 3 ON?

1210 SW 4 ON?

0610 BEGIN (RE-ENTRY FROM SUBROUTINE)

RCD OUT

14020 RCTY

14030 TYPE "ENTER ADDRESS SELECTION SWITCHES PUSH RELEASE START"

14035 RCTY

14040 RNTY 4 DIGITS

14045 SW 3 ON?

14050 LOCATE WORD ADDRESS

14090 TYPE OUT 10-DIGIT WORD

14080 RCTY

650-1620 SIMULATOR
FIGURE I — BLOCK DIAGRAM
VIRGINIA DEPARTMENT OF HIGHWAYS
LOCATION & DESIGN DIVISION
-4-
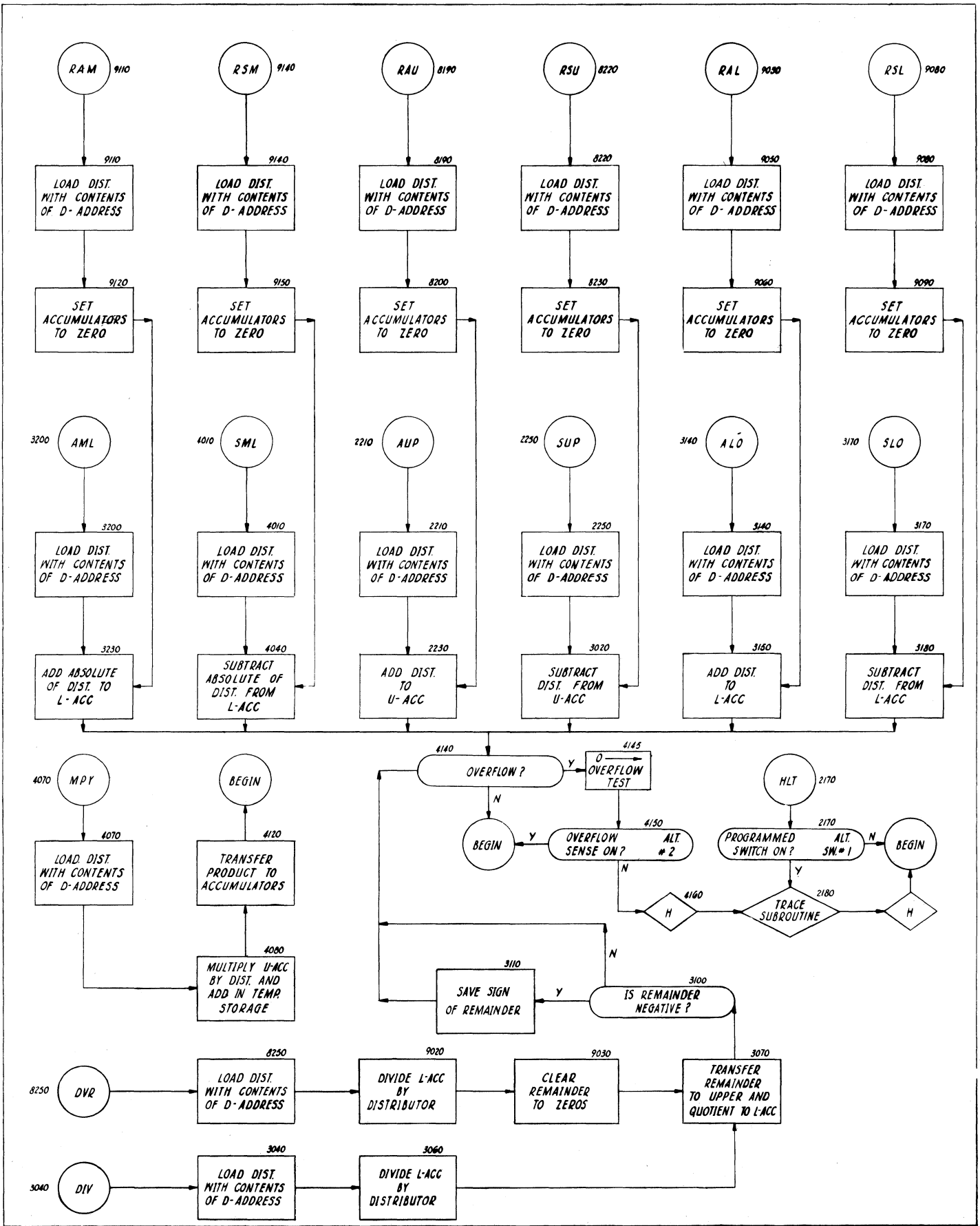
650–1620 SIMULATOR
FIGURE II – BLOCK DIAGRAM
VIRGINIA DEPARTMENT OF HIGHWAYS
LOCATION & DESIGN DIVISION
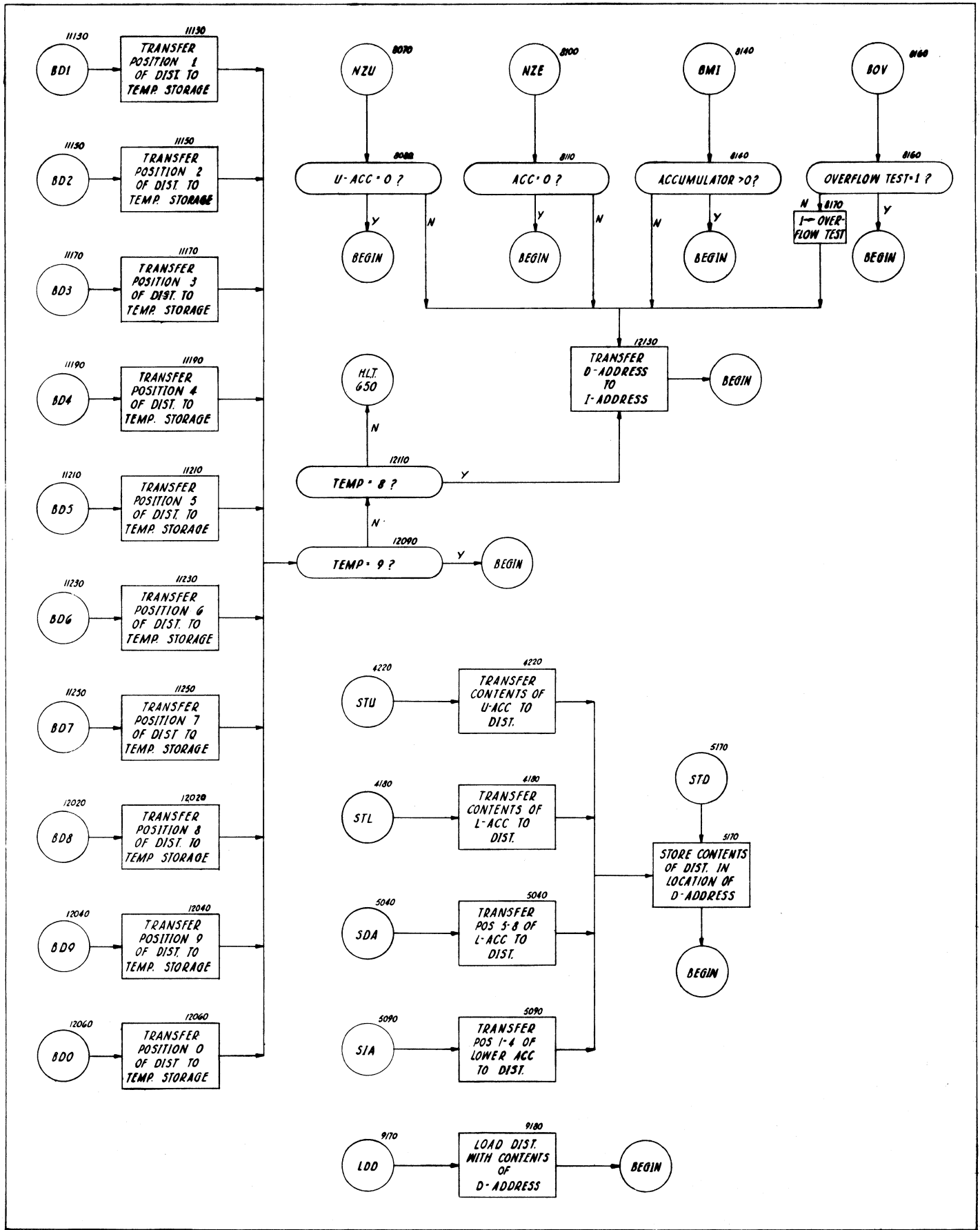
650-1620 SIMULATOR
FIGURE III - BLOCK DIAGRAM
VIRGINIA DEPARTMENT OF HIGHWAYS
LOCATION & DESIGN DIVISION

SRT — CONVERT 1620 DA TO 650 ADDRESS TRANSFER NO. OF SHIFTS FROM DA TO CTR → TRANSFER ACCUMULATOR TO TEMPORARY STORAGE (99) → SET ACC. TO ZERO ADD TO L-ACC, THE DATA IN LOC. (99-CTR) → TEMP STORAGE MINUS? — Y → MAKE L-ACC MINUS → BEGIN; N → BEGIN

SRD — CONVERT 1620 DA TO 650 ADDRESS TRANSFER NO. OF SHIFTS FROM DA TO CTR → CTR=0? — Y → 10→CTR; N → CLEAR 89-99 TO ZERO TRANSFER "5" TO LOC. (100-CTR) → ADD 99 TO L-ACC WITH THE CORRECT SIGN

RCD — TRANSFER 100 ZEROS TO BUFFER (10-10 digit wds) → CONTROL PANEL READ ROUTINE → CONVERT 1620 DA TO 650 ADD. 650 ADD.-MOD. 50 OF 650 ADD +01 → TRANSFER BUFFER TO READ BAND (10-10 digit wds) → BEGIN

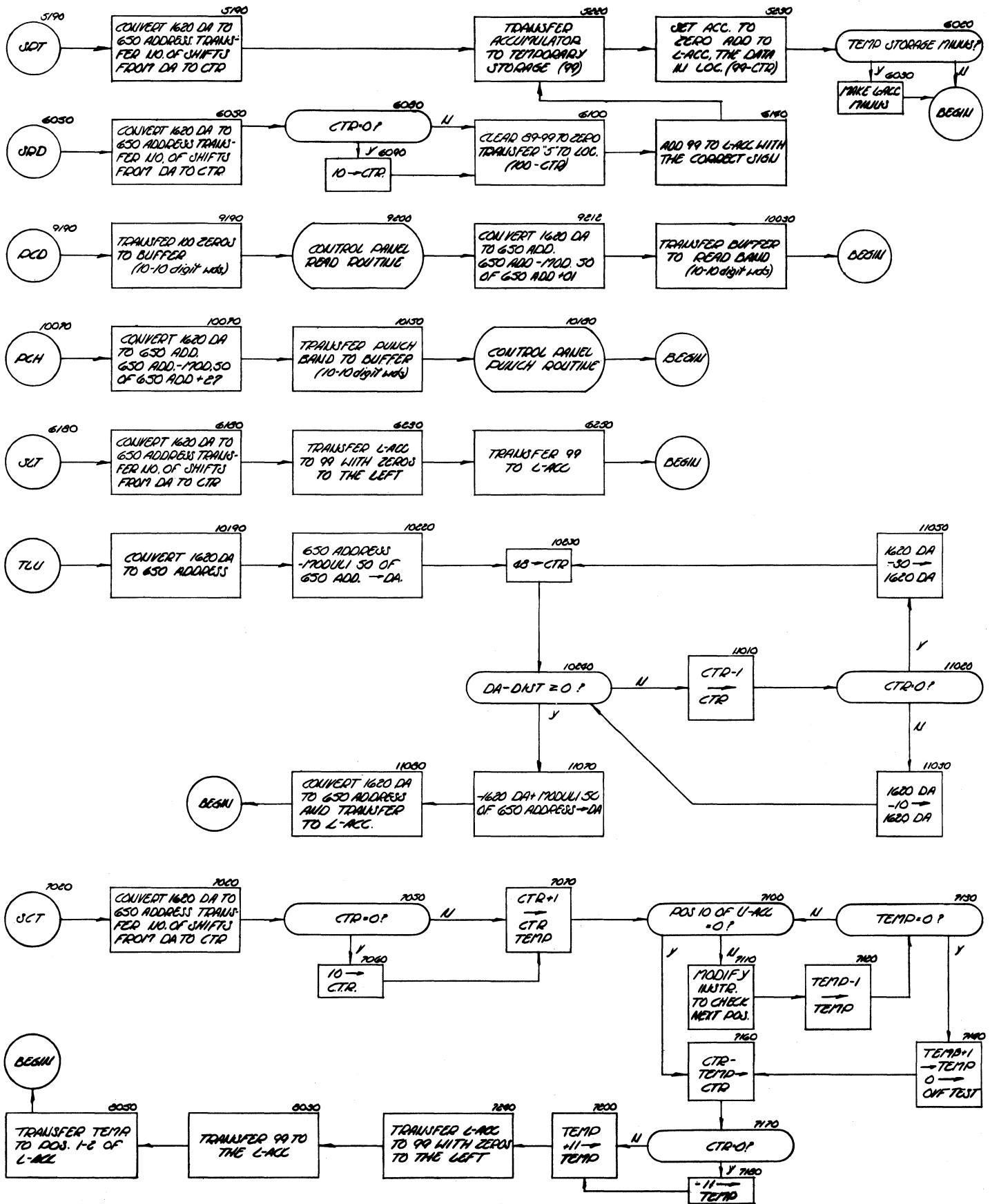**PCH** — CONVERT 1620 DA TO 650 ADD. 650 ADD.-MOD. 50 OF 650 ADD +2? → TRANSFER PUNCH BAND TO BUFFER (10-10 digit wds) → CONTROL PANEL PUNCH ROUTINE → BEGIN

SLT — CONVERT 1620 DA TO 650 ADDRESS TRANSFER NO. OF SHIFTS FROM DA TO CTR → TRANSFER L-ACC TO 99 WITH ZEROS TO THE LEFT → TRANSFER 99 TO L-ACC → BEGIN

TLU — CONVERT 1620 DA TO 650 ADDRESS → 650 ADDRESS -MODULI 50 OF 650 ADD. →DA. → 48→CTR → ... → 1620 DA -30 → 1620 DA

DA-DNST ≥ 0? — N → CTR-1 → CTR → CTR=0? — N → 1620 DA -10 → 1620 DA; Y → 1620 DA -30 → 1620 DA

DA-DNST ≥ 0? — Y → -1620 DA+ MODULI 50 OF 650 ADDRESS →DA → CONVERT 1620 DA TO 650 ADDRESS AND TRANSFER TO L-ACC. → BEGIN

SCT — CONVERT 1620 DA TO 650 ADDRESS TRANSFER NO. OF SHIFTS FROM DA TO CTR → CTR=0? — Y → 10 → CTR; N → CTR+1 → CTR TEMP → POS 10 OF U-ACC =0? — N → TEMP=0? — Y → TEMP+1 → TEMP 0 → OFF TEST

POS 10 OF U-ACC =0? — Y → ... ; U → MODIFY INSTR. TO CHECK NEXT POS. → TEMP-1 → TEMP → TEMP=0?

CTR-TEMP → CTR → CTR=0? — N → TEMP +11 → TEMP; Y → "11 → TEMP

TRANSFER L-ACC TO 99 WITH ZEROS TO THE LEFT → TRANSFER 99 TO THE L-ACC → TRANSFER TEMP TO POS. 1-2 OF L-ACC → BEGIN

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650 — 1620 SIMULATOR
FIGURE IV — BLOCK DIAGRAM

```
                          1010 *VIRGI NIA    DEPARTMENT OF HIGHWAYS 650 MDDPM SIMULATOR FOR THE IBMZ
                          1020 *                         1620 DATA PROCESSING SYSTEM.Z
00401                     1030        DORG  401Z
00410          10 02004   1035 DRUM   DSB   10,2004Z
20442 31 00401 24946      1040 START  TR    UPPER-9,ZEROS-9Z
20454 16 20472 -0441      1050        TFM   *&18,441Z
20466 31 00441 24946      1060        TR    441,ZEROS-9Z
20478 11 20472 -0100      1070        AM    *-6,100Z
20490 14 20472 K0441      1080        CM    *-18,20441Z
20502 47 20466 01200      1090        BNE   START&24Z
20514 34 00000 00102      1110 ENTER  RCTY  Z
20526 39 26049 00100      1115        WATY  MESSAZ
20538 34 00000 00102      1120        RCTY  Z
20550 36 24822 00100      1125        RNTY  PROGRG-19Z
20562 46 20514 00300      1128        BC3   ENTERZ
20574 32 24822 00000      1130        SF    PROGRG-19Z
20586 26 00440 24831      1135        TF    CONSLE,PROGRG-10Z
20598 34 00000 00102      1140        RCTY  Z
20610 39 26143 00100      1145        WATY  MESSBZ
20622 34 00000 00102      1150        RCTY  Z
20634 36 24822 00100      1155        RNTY  PROGRG-19Z
20646 46 20598 00300      1158        BC3   *-48Z
20658 32 24822 00000      1160        SF    PROGRG-19Z
20670 15 24826 0000-      1165        TDM   PROGRG-15,0,11Z
20682 11 24826 K0440      1170        AM    PROGRG-15,20440Z
20694 26 24791 24826      1175        TF    STOP,PROGRG-15Z
20706 33 00411 00000      1180        CF    UPPER&1Z
20718 26 00006 20736      1185        TF    6,*&18Z
20730 M9 20742 00000      1190        B     CMPRST,,0Z
20742 15 24774 00001      1195 CMPRST TDM   OFTEST,1Z
20754 33 00411 00000      1200        CF    UPPER&1Z
20766 16 24786 -0440      1205        TFM   IA,440Z
20778 47 20838 00400      1210 BEGIN  BNC4  *&60Z
20790 47 20826 00300      1220        BNC3  *&36Z
20802 24 24786 24791      1230        C     IA,STOPZ
20814 47 20838 01200      1240        BNE   *&24Z
20826 17 24258 -0320      1250        BTM   TRACE,320Z
20838 44 20862 24786      1260        BNF   *&24,IAZ
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```
20850 49 24102 00000   1270        B     HLT650Z
20862 26 24841 24780   2010        TF    PROGRG,IA,11Z
20874 33 24841 00000   2020        CF    PROGRGZ
20886 32 24832 00000   2030        SF    PROGRG-9Z
20898 32 24834 00000   2040        SF    PROGRG-7Z
20910 32 24838 00000   2050        SF    PROGRG-3Z
20922 16 00099 0K044   2060        TFM   99,2044,8Z
20934 22 00099 24837   2070        S     99,PROGRG-4Z
20946 47 24102 01300   2080        BN    HLT650Z
20958 26 24781 00100   2090        TF    DA,100Z
20970 16 00099 0K044   2100        TFM   99,2044,8Z
20982 22 00099 24841   2110        S     99,PROGRGZ
20994 26 24786 00100   2130        TF    IA,100Z
21006 16 21036 K505J   2140        TFM   *&30,TABLE,711Z
21018 21 21035 24833   2150        A     *&17,PROGRG-8Z
21030 49 2505J 00000   2160        B     TABLE,,6Z
21042 46 20778 00100   2170 HLT    BC1   BEGINZ
21054 17 24258 -0320   2180        BTM   TRACE,320Z
21066 48 00001 00001   2190        H     1,1Z
21078 49 20778 00000   2200        B     BEGINZ
21090 27 24138 00320   2210 AUP    BT    SUB,320Z
21102 28 00089 00430   2220        LD    89,DISTZ
21114 21 00420 00099   2230        A     LOWER,99Z
21126 49 21630 00000   2240        B     OVERFLZ
21138 27 24138 00320   2250 SUP    BT    SUB,320Z
21150 28 00089 00430   3010        LD    89,DISTZ
21162 22 00420 00099   3020        S     LOWER,99Z
21174 49 21630 00000   3030        B     OVERFLZ
21186 27 24138 00320   3040 DIV    BT    SUB,320Z
21198 28 00099 00420   3050        LD    99,LOWERZ
21210 29 00090 00430   3060        D     90,DISTZ
21222 26 00410 00099   3070        TF    UPPER,99Z
21234 26 00420 00089   3080        TF    LOWER,89Z
21246 33 00411 00000   3090        CF    UPPER&1Z
21258 44 21294 00410   3100        BNF   *&36,UPPERZ
21270 32 21186 00000   3110        SF    DIVZ
21282 33 00410 00000   3120        CF    UPPERZ
21294 49 21630 00000   3130        B     OVERFLZ
21306 27 24138 00320   3140 ALO    BT    SUB,320Z
```

```
21318 21 00420 00430    3150            A     LOWER,DISTZ
21330 49 21630 00000    3160            B     OVERFLZ
21342 27 24138 00320    3170 SLO        BT    SUB,320Z
21354 22 00420 00430    3180            S     LOWER,DISTZ
21366 49 21630 00000    3190            B     OVERFLZ
21378 27 24138 00320    3200 AML        BT    SUB,320Z
21390 25 00099 00430    3210            TD    99,DISTZ
21402 33 00430 00000    3220            CF    DISTZ
21414 21 00420 00430    3230            A     LOWER,DISTZ
21426 25 00430 00099    3240            TD    DIST,99Z
21438 49 21630 00000    3250            B     OVERFLZ
21450 27 24138 00320    4010 SML        BT    SUB,320Z
21462 25 00099 00430    4020            TD    99,DISTZ
21474 33 00430 00000    4030            CF    DISTZ
21486 22 00420 00430    4040            S     LOWER,DISTZ
21498 25 00430 00099    4050            TD    DIST,99Z
21510 49 21630 00000    4060            B     OVERFLZ
21522 27 24138 00320    4070 MPY        BT    SUB,320Z
21534 44 21558 00420    4072            BNF   *&24,LOWERZ
21546 32 00410 00000    4074            SF    UPPERZ
21558 23 00410 00430    4080            M     UPPER,DISTZ
21570 32 00411 00000    4090            SF    UPPER&1Z
21582 33 00420 00000    4100            CF    LOWERZ
21594 21 00089 00420    4110            A     89,LOWERZ
21606 26 00420 00099    4120            TF    LOWER,99Z
21618 49 20778 00000    4125            B     BEGINZ
21630 47 21654 01200    4130 OVERFL     BNE   *&24Z
21642 33 00420 00000    4135            CF    LOWERZ
21654 47 20778 01400    4140            BNV   BEGINZ
21666 15 24774 00000    4145            TDM   OFTEST,0Z
21678 46 20778 00200    4150            BC2   BEGINZ
21690 48 00002 00002    4160            H     2,2Z
21702 49 21054 00000    4170            B     HLT&12Z
21714 32 00411 00000    4180 STL        SF    UPPER&1Z
21726 26 00430 00420    4190            TF    DIST,LOWERZ
21738 33 00411 00000    4200            CF    UPPER&1Z
21750 49 22002 00000    4210            B     STDZ
21762 26 00430 00410    4220 STU        TF    DIST,UPPERZ
21774 44 21810 21186    4230            BNF   *&36,DIVZ
```

```
21786 33 21186 00000   4240        CF    DIVZ
21798 49 21822 00000   4250        B     *&24Z
21810 44 21834 00420   5010        BNF   *&24,LOWERZ
21822 32 00430 00000   5020        SF    DISTZ
21834 49 22002 00000   5030        B     STDZ
21846 32 00413 00000   5040  SDA   SF    LOWER-7Z
21858 26 00426 00416   5050        TF    DIST-4,LOWER-4Z
21870 33 00413 00000   5060        CF    LOWER-7Z
21882 33 00423 00000   5070        CF    DIST-7Z
21894 49 22002 00000   5080        B     STDZ
21906 25 24801 00430   5090  SIA   TD    TEMP,DISTZ
21918 32 00417 00000   5100        SF    LOWER-3Z
21930 26 00430 00420   5110        TF    DIST,LOWERZ
21942 33 00417 00000   5120        CF    LOWER-3Z
21954 33 00427 00000   5130        CF    DIST-3Z
21966 33 00430 00000   5140        CF    DISTZ
21978 44 22002 24801   5150        BNF   STD,TEMPZ
21990 32 00430 00000   5160        SF    DISTZ
22002 26 2478J 00430   5170  STD   TF    DA,DIST,6Z
22014 49 20778 00000   5180        B     BEGINZ
22026 32 24781 00000   5190  SRT   SF    DAZ
22038 11 24781 K0440   5200        AM    DA,20440Z
22050 15 24779 0000-   5210        TDM   DA-2,0,11Z
22062 26 00099 00420   5220        TF    99,LOWERZ
22074 26 00420 24821   5230        TF    LOWER,ZEROZ
22086 16 22121 -0099   5240        TFM   *&35,99Z
22098 22 22121 24780   5250        S     *&23,DA-1Z
22110 21 00420 00099   6010        A     LOWER,99Z
22122 44 20778 00099   6020        BNF   BEGIN,99Z
22134 32 00420 00000   6030        SF    LOWERZ
22146 49 20778 00000   6040        B     BEGINZ
22158 32 24781 00000   6050  SRD   SF    DAZ
22170 11 24781 K0440   6060        AM    DA,20440Z
22182 15 24779 0000-   6070        TDM   DA-2,0,11Z
22194 43 22218 24780   6080        BD    *&24,DA-1Z
22206 15 24779 0000J   6090        TDM   DA-2,1,11Z
22218 18 00093 -0000   6100        LDM   93,0Z
22230 16 22260 -0100   6110        TFM   *&30,100Z
22242 22 22260 24780   6120        S     *&18,DA-1Z
```

```
22254 15 00100 00005   6130        TDM   100,5Z
22266 44 22290 00420   6140        BNF   *&24,LOWERZ
22278 32 00099 00000   6150        SF    99Z
22290 21 00420 00099   6160        A     LOWER,99Z
22302 49 22062 00000   6170        B     SRT&36Z
22314 32 24781 00000   6180  SLT   SF    DAZ
22326 11 24781 K0440   6190        AM    DA,20440Z
22338 15 24779 0000-   6200        TDM   DA-2,0,11Z
22350 16 22380 -0099   6210        TFM   *&30,99Z
22362 22 22380 24780   6220        S     *&18,DA-1Z
22374 28 00099 00420   6230        LD    99,LOWERZ
22386 32 00080 00000   6240        SF    80Z
22398 26 00420 00099   6250        TF    LOWER,99Z
22410 49 20778 00000   7010        B     BEGINZ
22422 32 24781 00000   7020  SCT   SF    DAZ
22434 11 24781 K0440   7030        AM    DA,20440Z
22446 15 24779 0000-   7040        TDM   DA-2,0,11Z
22458 43 22482 24780   7050        BD    *&24,DA-1Z
22470 15 24779 0000J   7060        TDM   DA-2,1,11Z
22482 11 24780 000-1   7070        AM    DA-1,1,10Z
22494 26 24801 24780   7080        TF    TEMP,DA-1Z
22506 16 22529 -0401   7090        TFM   *&23,UPPER-9Z
22518 43 22590 00401   7100        BD    *&72,UPPER-9Z
22530 11 22529 -0001   7110        AM    *-1,1Z
22542 12 24801 000-1   7120        SM    TEMP,1,10Z
22554 47 22518 01200   7130        BNZ   *-36Z
22566 11 24801 000-1   7140        AM    TEMP,1,10Z
22578 15 24774 00000   7150        TDM   OFTEST,0Z
22590 22 24780 24801   7160        S     DA-1,TEMPZ
22602 47 22626 01200   7170        BNZ   *&24Z
22614 16 24801 000J1   7180        TFM   TEMP,11,10Z
22626 32 24801 00000   7190        SF    TEMPZ
22638 11 24801 000J1   7200        AM    TEMP,11,10Z
22650 33 24801 00000   7210        CF    TEMPZ
22662 16 22692 -0099   7220        TFM   *&30,99Z
22674 22 22692 24780   7230        S     *&18,DA-1Z
22686 28 00099 00420   7240        LD    99,LOWERZ
22698 32 00080 00000   7250        SF    80Z
22710 44 22734 00420   8010        BNF   *&24,LOWERZ
```

```
22722  32  24801  00000   8020        SF    TEMPZ
22734  26  00099  24801   8030        TF    99,TEMPZ
22746  33  00098  00000   8040        CF    98Z
22758  26  00420  00099   8050        TF    LOWER,99Z
22770  49  20778  00000   8060        B     BEGINZ
22782  14  00410  -0000   8070  NZU   CM    UPPER,0Z
22794  46  20778  01200   8080        BE    BEGINZ
22806  49  24078  00000   8090        B     BRANCHZ
22818  14  00420  -0000   8100  NZE   CM    LOWER,0Z
22830  46  20778  01200   8110        BE    BEGINZ
22842  49  24078  00000   8120        B     BRANCHZ
22854  44  20778  00420   8140  BMI   BNF   BEGIN,LOWERZ
22866  49  24078  00000   8150        B     BRANCHZ
22878  43  20778  24774   8160  BOV   BD    BEGIN,OFTESTZ
22890  15  24774  00001   8170        TDM   OFTEST,1Z
22902  49  24078  00000   8180        B     BRANCHZ
22914  27  24138  00320   8190  RAU   BT    SUB,320Z
22926  26  00420  24821   8200        TF    LOWER,ZEROZ
22938  49  21102  00000   8210        B     AUP&12Z
22950  27  24138  00320   8220  RSU   BT    SUB,320Z
22962  26  00420  24821   8230        TF    LOWER,ZEROZ
22974  49  21150  00000   8240        B     SUP&12Z
22986  27  24138  00320   8250  DVR   BT    SUB,320Z
22998  26  00099  00420   9010        TF    99,LOWERZ
23010  29  00090  00430   9020        D     90,DISTZ
23022  26  00099  24955   9030        TF    99,ZEROSZ
23034  49  21222  00000   9040        B     DIV&36Z
23046  27  24138  00320   9050  RAL   BT    SUB,320Z
23058  26  00420  24821   9060        TF    LOWER,ZEROZ
23070  49  21318  00000   9070        B     ALO&12Z
23082  27  24138  00320   9080  RSL   BT    SUB,320Z
23094  26  00420  24821   9090        TF    LOWER,ZEROZ
23106  49  21354  00000   9100        B     SLO&12Z
23118  27  24138  00320   9110  RAM   BT    SUB,320Z
23130  26  00420  24821   9120        TF    LOWER,ZEROZ
23142  49  21390  00000   9130        B     AML&12Z
23154  27  24138  00320   9140  RSM   BT    SUB,320Z
23166  26  00420  24821   9150        TF    LOWER,ZEROZ
23178  49  21462  00000   9160        B     SML&12Z
```

```
23190 27 24138 00320   9170 LDD    BT    SUB,320Z
23202 49 20778 00000   9180        B     BEGINZ
23214 31 24845 24946   9190 RCD    TR    BUFFER,ZEROS-9Z
23226 33 23250 00000   9195        CF    STOREZ
23238 49 30000 00000   9200        B     30000Z
23250 44 23274 23250   9212 STORE  BNF   *&24,*Z
23262 26 24786 24781   9214        TF    IA,DAZ
23274 16 00099 0K044   9216        TFM   99,2044,8Z
23286 22 00100 24781   9220        S     100,DAZ
23298 19 00098 000N0   9230        DM    98,50,10Z
23310 21 24780 00099   9240        A     DA-1,99Z
23322 12 24781 -0009   9250        SM    DA,9Z
23334 25 24801 2478J  10010        TD    TEMP,DA,11Z
23346 12 24781 -0100  10020        SM    DA,100Z
23358 31 2478J 24845  10030        TR    DA,BUFFER,6Z
23370 11 24781 -0100  10040        AM    DA,100Z
23382 25 2478J 24801  10050        TD    DA,TEMP,6Z
23394 49 20778 00000  10060        B     BEGINZ
23406 16 00099 0K044  10070 PCH    TFM   99,2044,8Z
23418 22 00100 24781  10080        S     100,DAZ
23430 19 00098 000N0  10090        DM    98,50,10Z
23442 21 24780 00099  10100        A     DA-1,99Z
23454 12 24781 -0269  10110        SM    DA,269Z
23466 25 24801 2478J  10120        TD    TEMP,DA,11Z
23478 25 2478J 25046  10130        TD    DA,ZEROS&91,6Z
23490 12 24781 -0100  10140        SM    DA,100Z
23502 31 24845 2478J  10150        TR    BUFFER,DA,11Z
23514 11 24781 -0100  10160        AM    DA,100Z
23526 25 2478J 24801  10170        TD    DA,TEMP,6Z
23538 49 35000 00000  10180        B     35000Z
23550 16 00099 0K044  10190 TLU    TFM   99,2044,8Z
23562 22 00100 24781  10200        S     100,DAZ
23574 19 00098 000N0  10210        DM    98,50,10Z
23586 21 24780 00099  10220        A     DA-1,99Z
23598 16 24776 000M8  10230        TFM   CTR,48,10Z
23610 24 2478J 00430  10240        C     DA,DIST,6Z
23622 46 23706 01300  10250        BNL   *&84Z
23634 12 24776 000-1  11010        SM    CTR,1,10Z
23646 46 23682 01200  11020        BZ    *&36Z
```

```
23658 12 24780 000-1 11030         SM    DA-1,1,10Z
23670 49 23610 00000 11040         B     *-60Z
23682 12 24780 000-3 11050         SM    DA-1,3,10Z
23694 49 23598 00000 11060         B     *-96Z
23706 22 24780 00099 11070         S     DA-1,99Z
23718 32 24781 00000 11080         SF    DAZ
23730 11 24781 K0440 11090         AM    DA,20440Z
23742 26 00416 24780 11100         TF    LOWER-4,DA-1Z
23754 33 00413 00000 11110         CF    LOWER-7Z
23766 49 20778 00000 11120         B     BEGINZ
23778 25 24801 00430 11130 BD1     TD    TEMP,DISTZ
23790 49 24018 00000 11140         B     BDDZ
23802 25 24801 00429 11150 BD2     TD    TEMP,DIST-1Z
23814 49 24018 00000 11160         B     BDDZ
23826 25 24801 00428 11170 BD3     TD    TEMP,DIST-2Z
23838 49 24018 00000 11180         B     BDDZ
23850 25 24801 00427 11190 BD4     TD    TEMP,DIST-3Z
23862 49 24018 00000 11200         B     BDDZ
23874 25 24801 00426 11210 BD5     TD    TEMP,DIST-4Z
23886 49 24018 00000 11220         B     BDDZ
23898 25 24801 00425 11230 BD6     TD    TEMP,DIST-5Z
23910 49 24018 00000 11240         B     BDDZ
23922 25 24801 00424 11250 BD7     TD    TEMP,DIST-6Z
23934 49 24018 00000 12010         B     BDDZ
23946 25 24801 00423 12020 BD8     TD    TEMP,DIST-7Z
23958 49 24018 00000 12030         B     BDDZ
23970 25 24801 00422 12040 BD9     TD    TEMP,DIST-8Z
23982 49 24018 00000 12050         B     BDDZ
23994 25 24801 00421 12060 BDO     TD    TEMP,DIST-9Z
24006 33 24801 00000 12070         CF    TEMPZ
24018 15 24800 0000- 12080 BDD     TDM   TEMP-1,0,11Z
24030 14 24801 000-9 12090         CM    TEMP,9,10Z
24042 46 20778 01200 12100         BE    BEGINZ
24054 14 24801 000-8 12110         CM    TEMP,8,10Z
24066 47 24102 01200 12120         BNE   HLT650Z
24078 26 24786 24781 12130 BRANCH  TF    IA,DAZ
24090 49 20778 00000 12140         B     BEGINZ
24102 17 24258 -0320 12150 HLT650  BTM   TRACE,320Z
24114 48 39999 39999 12160         H     39999,39999Z
```

```
24126 49 20514 00000 12170          B      ENTERZ
24138 32 00411 00000 12180  SUB     SF     UPPER&1Z
24150 44 24186 21186 12190          BNF    *&36,DIVZ
24162 33 21186 00000 12200          CF     DIVZ
24174 49 24198 00000 12210          B      *&24Z
24186 44 24210 00420 12220          BNF    *&24,LOWERZ
24198 32 00410 00000 12230          SF     UPPERZ
24210 26 00430 2478J 12240          TF     DIST,DA,11Z
24222 33 00410 00000 12250          CF     UPPERZ
24234 33 00411 00000 13010          CF     UPPER&1Z
24246 42 00000 00000 13020          BB     Z
24258 33 24834 00000 13030  TRACE   CF     PROGRG-7Z
24270 33 24838 00000 13040          CF     PROGRG-3Z
24282 34 00000 00102 13050          RCTY   Z
24294 38 24832 00100 13060          WNTY   PROGRG-9Z
24306 26 24841 00410 13070          TF     PROGRG,UPPERZ
24318 34 00000 00101 13080          SPTY   Z
24330 38 24832 00100 13090          WNTY   PROGRG-9Z
24342 26 24841 00420 13100          TF     PROGRG,LOWERZ
24354 34 00000 00101 13110          SPTY   Z
24366 38 24832 00100 13120          WNTY   PROGRG-9Z
24378 26 24841 00430 13130          TF     PROGRG,DISTZ
24390 34 00000 00101 13140          SPTY   Z
24402 38 24832 00100 13150          WNTY   PROGRG-9Z
24414 48 00000 00000 13160          H      Z
24426 42 00000 00000 13170          BB     Z
24438 34 00000 00102 13180  RCDIN   RCTY   Z
24450 39 26049 00100 13190          WATY   MESSAZ
24462 34 00000 00102 13200          RCTY   Z
24474 36 24822 00100 13210          RNTY   PROGRG-19Z
24486 46 24438 00300 13220          BC3    RCDINZ
24498 32 24822 00000 13230          SF     PROGRG-19Z
24510 34 00000 00102 13240          RCTY   Z
24522 39 26143 00100 13250          WATY   MESSBZ
24534 34 00000 00102 13260          RCTY   Z
24546 36 24832 00100 13270          RNTY   PROGRG-9Z
24558 46 24510 00300 13280          BC3    *-48Z
24570 32 24832 00000 13290          SF     PROGRG-9Z
24582 15 24836 0000- 13300          TDM    PROGRG-5,0,11Z
```

```
24594 11 24836 K0440  13310          AM    PROGRG-5,20440Z
24606 26 24830 24831  13320          TF    PROGRG-5,PROGRG-10,6Z
24618 49 24438 00000  14010          B     RCDINZ
24630 34 00000 00102  14020 RCDOUT   RCTY  Z
24642 39 26143 00100  14030          WATY  MESSBZ
24654 34 00000 00102  14035          RCTY  Z
24666 36 24822 00100  14040          RNTY  PROGRG-19Z
24678 46 24630 00300  14045          BC3   RCDOUTZ
24690 32 24822 00000  14050          SF    PROGRG-19Z
24702 15 24826 0000-  14055          TDM   PROGRG-15,0,11Z
24714 11 24826 K0440  14060          AM    PROGRG-15,20440Z
24726 26 24841 24820  14065          TF    PROGRG,PROGRG-15,11Z
24738 34 00000 00102  14080          RCTY  Z
24750 38 24832 00100  14090          WNTY  PROGRG-9Z
24762 49 24630 00000  14100          B     RCDOUTZ
24774         1        14110 OFTEST  DS    1Z
24776         2        14120 CTR     DS    2Z
24781         5        14130 DA      DS    5Z
24786         5        14140 IA      DS    5Z
24791         5        14150 STOP    DS    5Z
24801        10        14160 TEMP    DS    10Z
24821        20        14165 ZERO    DC    20,0Z
24841        20        14170 PROGRG  DC    20,0Z
24842         1        14180          DC    1,@Z
24845        51        14190 BUFFER  DAS   51Z
24955        10        14200 ZEROS   DC    10,0Z
24965        10        14210          DC    10,0Z
24975        10        14220          DC    10,0Z
24985        10        14230          DC    10,0Z
24995        10        14240          DC    10,0Z
25005        10        14250          DC    10,0Z
25015        10        15010          DC    10,0Z
25025        10        15020          DC    10,0Z
25035        10        15030          DC    10,0Z
25046        11        15040          DC    11,0@Z
00410        10        15060 UPPER   DS    10,410Z
00420        10        15070 LOWER   DS    10,420Z
00430        10        15080 DIST    DS    10,430Z
00440        10        15090 CONSLE  DS    10,440Z
```

```
25051          5 K0778 15100 TABLE  DSA   BEGIN,HLT650,HLT,HLT650,HLT650,HLT650,HLT650,HLT650Z
25056          5 K4102
25061          5 K1042
25066          5 K4102
25071          5 K4102
25076          5 K4102
25081          5 K4102
25086          5 K4102
25091          5 K4102 15110        DSA   HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25096          5 K4102
25101          5 K4102
25106          5 K4102
25111          5 K4102
25116          5 K4102
25121          5 K4102
25126          5 K4102
25131          5 K4102 15120        DSA   HLT650,HLT650,HLT650,HLT650,AUP,HLT650,SUP,HLT650,HLT650Z
25136          5 K4102
25141          5 K4102
25146          5 K4102
25151          5 K1090
25156          5 K4102
25161          5 K1138
25166          5 K4102
25171          5 K4102
25176          5 K4102 15130        DSA   HLT650,HLT650,HLT650,DIV,HLT650,ALO,HLT650,SLO,HLT650Z
25181          5 K4102
25186          5 K4102
25191          5 K1186
25196          5 K4102
25201          5 K1306
25206          5 K4102
25211          5 K1342
25216          5 K4102
25221          5 K1378 15140        DSA   AML,HLT650,SML,HLT650,MPY,HLT650,STL,HLT650,STU,HLT650Z
25226          5 K4102
25231          5 K1450
25236          5 K4102
25241          5 K1522
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25246        5 K4102
25251        5 K1714
25256        5 K4102
25261        5 K1762
25266        5 K4102
25271        5 K1846 15150     DSA    SDA,HLT650,SIA,HLT650,STD,HLT650,HLT650,HLT650,HLT650Z
25276        5 K4102
25281        5 K1906
25286        5 K4102
25291        5 K2002
25296        5 K4102
25301        5 K4102
25306        5 K4102
25311        5 K4102
25316        5 K4102 15160     DSA    HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,SRTZ
25321        5 K4102
25326        5 K4102
25331        5 K4102
25336        5 K4102
25341        5 K4102
25346        5 K4102
25351        5 K2026
25356        5 K4102 15170     DSA    HLT650,SRD,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25361        5 K2158
25366        5 K4102
25371        5 K4102
25376        5 K4102
25381        5 K4102
25386        5 K4102
25391        5 K4102
25396        5 K4102 15180     DSA    HLT650,SLT,HLT650,SCT,HLT650,HLT650,HLT650,HLT650,HLT650Z
25401        5 K2314
25406        5 K4102
25411        5 K2422
25416        5 K4102
25421        5 K4102
25426        5 K4102
25431        5 K4102
25436        5 K4102
```

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25441        5 K4102 15190     DSA   HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25446        5 K4102
25451        5 K4102
25456        5 K4102
25461        5 K4102
25466        5 K4102
25471        5 K4102
25476        5 K4102
25481        5 K4102 15200     DSA   HLT650,HLT650,NZU,HLT650,NZE,HLT650,BMI,HLT650,BOV,HLT650Z
25486        5 K4102
25491        5 K2782
25496        5 K4102
25501        5 K2818
25506        5 K4102
25511        5 K2854
25516        5 K4102
25521        5 K2878
25526        5 K4102
25531        5 K4102 15210     DSA   HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25536        5 K4102
25541        5 K4102
25546        5 K4102
25551        5 K4102
25556        5 K4102
25561        5 K4102
25566        5 K4102
25571        5 K4102 15220     DSA   HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25576        5 K4102
25581        5 K4102
25586        5 K4102
25591        5 K4102
25596        5 K4102
25601        5 K4102
25606        5 K4102
25611        5 K4102 15230     DSA   HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25616        5 K4102
25621        5 K4102
25626        5 K4102
25631        5 K4102
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25636      5 K4102
25641      5 K4102
25646      5 K4102
25651      5 K2914  15240    DSA    RAU,HLT650,RSU,HLT650,HLT650,HLT650,HLT650,HLT650,DVRZ
25656      5 K4102
25661      5 K2950
25666      5 K4102
25671      5 K4102
25676      5 K4102
25681      5 K4102
25686      5 K4102
25691      5 K2986
25696      5 K4102  15250    DSA    HLT650,RAL,HLT650,RSL,HLT650,RAM,HLT650,RSM,HLT650,LDDZ
25701      5 K3046
25706      5 K4102
25711      5 K3082
25716      5 K4102
25721      5 K3118
25726      5 K4102
25731      5 K3154
25736      5 K4102
25741      5 K3190
25746      5 K4102  16010    DSA    HLT650,RCD,HLT650,PCH,HLT650,HLT650,HLT650,HLT650,HLT650Z
25751      5 K3214
25756      5 K4102
25761      5 K3406
25766      5 K4102
25771      5 K4102
25776      5 K4102
25781      5 K4102
25786      5 K4102
25791      5 K4102  16020    DSA    HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25796      5 K4102
25801      5 K4102
25806      5 K4102
25811      5 K4102
25816      5 K4102
25821      5 K4102
25826      5 K4102
```

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25831     5 K4102 16030     DSA   HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25836     5 K4102
25841     5 K4102
25846     5 K4102
25851     5 K4102
25856     5 K4102
25861     5 K4102
25866     5 K4102
25871     5 K4102 16040     DSA   HLT650,HLT650,HLT650,HLT650,TLU,HLT650,HLT650,HLT650Z
25876     5 K4102
25881     5 K4102
25886     5 K4102
25891     5 K3550
25896     5 K4102
25901     5 K4102
25906     5 K4102
25911     5 K4102 16050     DSA   HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650,HLT650Z
25916     5 K4102
25921     5 K4102
25926     5 K4102
25931     5 K4102
25936     5 K4102
25941     5 K4102
25946     5 K4102
25951     5 K3994 16060     DSA   BD0,HLT650,BD1,HLT650,BD2,HLT650,BD3,HLT650,BD4,HLT650Z
25956     5 K4102
25961     5 K3778
25966     5 K4102
25971     5 K3802
25976     5 K4102
25981     5 K3826
25986     5 K4102
25991     5 K3850
25996     5 K4102
26001     5 K3874 16070     DSA   BD5,HLT650,BD6,HLT650,BD7,HLT650,BD8,HLT650,BD9,HLT650Z
26006     5 K4102
26011     5 K3898
26016     5 K4102
26021     5 K3922
```

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26026          5 K4102
26031          5 K3946
26036          5 K4102
26041          5 K3970
26046          5 K4102
26049         47            16080 MESSA   DAC    47,TYPE STORAGE ENTRY SWITCHES,PUSH RELEASE,START@Z
26143         50            16090 MESSB   DAC    50,TYPE ADDRESS SELECTION SWITCHES,PUSH RELEASE,STARTZ
26243          1            16100         DAC    1,@Z
20442                       16110         DEND STARTZ
```

VI.   Core Layout

From	To	Contents
00000	00399	Console area, multiply tables, and add tables.
00400		Record mark.
00401	00410	650 simulated upper accumulator.
00411	00420	650 simulated lower accumulator.
00421	00430	650 simulated distributor.
00431	00440	650 simulated console storage entry switches.
00441	20440	650 simulated drum.
20441		Record mark.
20442	21041	Program initialization and simulated 650 program register operation.
21042	24101	Simulated operation code subroutines.
24102	24773	Subroutines used in simulator program.
24774	24776	Temporary data storage.
24777	24781	1620 address of 650 instruction being processed.
24782	24786	1620 address of 650 instruction address of next instruction.
24787	24791	1620 address of 650 address selection switches.
24792	24801	Data storage area.
24802	24821	20 digit field of zeros.
24822	24841	Simulated 650 program register.
24842		Record mark.
24843	24844	Not used.
24845	24945	101 digit storage buffer area for read-punch routine.
24946	25046	101 digits composed of ten-10 digit words of zeros and a record mark.
25047	26046	200 digits operation code table.
26048	26243	Alphabetic data storage.
26244	29999	Not used.
30000	?	Control panel read routine.
25000	?	Control panel punch routine.

VII.   Operating Instructions

A.   Console Settings:

    a.   Parity Check Switch: STOP
    b.   Input - Output Switch: STOP
    c.   Overflow Check Switch: PROGRAM
    d.   Program Switch #1:

       OFF: Simulated 650 programmed switch at STOP

position.

ON: Simulated 650 programmed switch at RUN position.

e. Program Switch #2:

OFF: Simulated 650 overflow sense switch in STOP
      position.
ON: Simulated 650 overflow sense switch in SENSE
      position.

f. Program Switch #3:

OFF: When entering storage selection or address
      selection switches from typewriter, this
      switch must be OFF. If an error occurs when
      typing, turn this switch ON, push release and
      start, turn switch OFF, and reenter the correct
      data.
ON: With switch #4 also ON, simulates the address
      stop feature of the 650, tracing only the in-
      struction set in the address selection switch-
      es.

g. Program Switch #4:

OFF: No tracing is performed.
ON: All 650 instructions will be typed on the 1620
      typewriter as four ten-digit words provided
      switch #3 if OFF. The four words will be the
      program register, the upper and lower accumu-
      lator, and the distributor. After typing out
      one instruction, the program will stop, and
      the start button is to be depressed to display
      the next instruction.

B. Simulation of 650 console operation and loading of the
    simulator program;

    a. Program Loading:

        1. Push RESET and INSERT.
        2. Type 310000300002.
        3. Push RELEASE and START.
        4. When memory has cleared, push INSTANT STOP, and
            RESET.
        5. If only one control panel program is to be used,
            follow the directions given in Step 6 to load
            the simulator and control panel programs to-
            gether. If two or more control panel programs

are to be used with the simulator, follow the directions given in Step 7.

6. Remove the first two cards (load routine) and the last seven cards (add and multiply tables) from the compressed control panel deck. The remaining cards are inserted between cards numbered 98 and 99 of the simulator program deck. Place this deck in the card read feed and push the LOAD button on the 1622 unit. When the card reader stops, push READER START to process the last two cards.

7. Place the simulator program deck in the card read feed and push LOAD on the 1622 unit. When the card reader stops, push READER START to process the last two cards. Then place the compressed control panel program deck (with no cards removed) in the card read feed and push LOAD on the 1622 unit. When the card reader stops, push READER START to process the last two cards.

8. Push START on 1620, to initialize the simulator program.

9. The typewriter will type "TYPE STORAGE ENTRY SWITCHES, PUSH RELEASE, START."

10. Enter switch settings, such as 7019519000, and push RELEASE and START. If an error occurs in typing, turn switch #3 on, push RELEASE and START, turn switch #3 off, and re-enter the settings. If the word is negative, a flag must be set over the units digit.

11. The typewriter will type "TYPE ADDRESS SELECTION SWITCHES, PUSH RELEASE, START."

12. Enter switch settings, such as 1234, and push RELEASE and START. If an error occurs in typing, turn switch #3 on, push RELEASE and START, turn switch #3 off, and re-enter the settings.

13. After START is pushed above, the simulator will execute the instruction in the console and proceed.

b. To simulate a 650 program reset, program start using the previous storage and address selection switch settings, push RESET, INSERT, RELEASE and START.

c. To re-enter the storage and address selection switch settings, push RESET, INSERT, type 4920514, push

RELEASE and START.   Then follow directions given
in (a) 9-13.

d.   To re-initialize the simulator program and set
the simulated drum to zeros, push RESET, INSERT,
type 4920442, and push RELEASE and START.   Then
follow directions given in (a) 10-13.

e.   To manually read data into the simulated 650
drum by use of the 1620 typewriter, push RESET,
INSERT, type 4924438, push RELEASE and START.

1.   The typewriter will type "TYPE STORAGE ENTRY
SWITCHES, PUSH RELEASE AND START."

2.   Enter switch settings, such as 0123456789, and
push release and start.   If an error occurs in
typing, turn switch #3on, push RELEASE and START,
turn switch #3 off, and re-enter the settings.
If the word is negative, a flag must be set over
the units digit.

3.   The typewriter will type "TYPE ADDRESS SELECTION
SWITCHES, PUSH RELEASE, START."

4.   Enter switch settings, such as 1234, and push
RELEASE and START.   If an error occurs in typing
turn switch #3 on, push RELEASE and START, turn
switch #3 off, and re-enter the settings.

5.   After START is pushed, the simulator will store
the storage entry switches settings in the address
given by the address selection switches.

6.   After all data is stored on the simulated drum,
go to Step C.

f.   To manually read data out of the simulated 650 drum
by use of the 1620 typewriter, push RESET, INSERT,
type 4924630, push RELEASE and START.

1.   The typewriter will type "TYPE ADDRESS SELECTION
SWITCHES, PUSH RELEASE, START."

2.   Enter switch settings, such as 1234, and push
RELEASE AND START.   If an error occurs in typing,
turn switch #3 on, push RELEASE and START, turn
switch #3 off, and re-enter the settings.

3.   After START is pushed, the simulator will type
the contents of the address given by the address
selection switches.   If a flag is typed over the
units digit, the word is negative.

4.   After all data is read from the simulated drum,
go to Step C.

g. If a new address is desired in the address selection
    switches, when tracing a 650 program (Switch #4on)
    wait for the 1620 to halt after typing out an in-
    struction, push SAVE, INSERT, type 362478700l0042,
    push RELEASE, START. Now type the five digits of the
    converted 650 address $\lceil$10 (2044 - 650 address)$\rceil$
    with a flag over the high order digit, turn switch
    #3 on, if the address stop feature is desired, then
    push RELEASE and START.

h. If it is desired to branch the 650 program to a
    specific instruction, push RESET, INSERT, type
    3624782001004920778, push RELEASE and START. Now
    type the five digits of the converted 650 address
    $\lceil$10 (2044 - 650 address)$\rceil$ with a flag over the high
    order digit, push RELEASE and START. The accumu-
    lator and distributor will remain the same (not be
    reset to zeros).

i. If it is desired to clear the 650 memory to other
    than zeros, this may be done, by a 650 program
    routine in 650 language.

C. Expected Stops and action to be Taken.

a. If an invalid operation code, drum location or a
    branch on distributor error (No 8 or 9 present)
    occurs, the simulator will type the contents of the
    program register, the upper and lower accumulator, and
    the distributor. (The 650 drum addresses of 2004-
    2044 are not recognized as being invalid, but they
    will in most cases cause the add or multiply tables
    to be destroyed.) Then it will halt and if START
    is pushed, the simulator will allow new console
    switch settings to be made. Follow directions under
    B (a) 10-13 📷 to continue.

b. If a 650 programmed stop occurs and the simulated
    650 programmed switch is on STOP (switch 1 off) the
    simulator will type the contents of the program
    register, the upper and lower accumulator and the
    distributor. It will then halt and if START is
    pushed _twice_, the 650 program will continue.

c. If a 650 overflow occurs and the simulated 650 over-
    flow sense switch is on STOP (switch 2 off) the
    simulator will type the contents of the program re-
    gister, the upper and lower accumulator and the dis-
    tributor. It will then halt and if START is pushed,
    the 650 program will continue. The simulator will
    not stop due to an overflow on shift and count.

d. If the simulator stops, due to a 650 error, the
error card is the second card from the back in the
reader non-select stacker. Follow the correction
procedure as given in the 650 program write-up.

e. If the simulator stops for a 1620 error, follow
the correction procedure as given in the 1620
manual.

VIII. <u>Simulation of the 533 Control Panel</u>

In order to simulate the 533 Control Panel for the 1620-650
simulator, a read and punch routine must be written.

When the simulator interprets a read instruction, it clears
one hundred digits of storage to a record of ten-10 digit
words of zeros, symbolically called BUFFER and branches to
location 30000. Starting at location 30000, a program must
be written to read a card, (alphabetically, if R.P.Q. device
is used) and transfer the 160 digits of alphabetic data in-
to the 100 digits of BUFFER storage. In this routine all
control panel decisions must be made such as Load, Entry A
Entry B, Column splits, Pilot and Co-selectors, etc. When
this has been programmed, a branch to 23250 is made, sym-
bolically called STORE in the simulator program. The simulator
then moves the 100 digit record of BUFFER storage onto the
READ band of the simulated drum.

When the simulator interprets a punch instruction, it transfers
the data in the punch band of the simulated drum to BUFFER
storage and branches to 35000. Starting at location 35000,
a routine must be written to transfer the 100 digits in BUFFER
storage into a 160 digits format. All control panel decisions
such as Control information, Entry A, Entry B, Column splits,
Pilot and Co-selectors, etc., must be made and the card punched
(alphabetically, if R.P.Q. device is used). When this has been
programmed, a branch to 20778 is made, symbolically called
BEGIN in the simulator program.

In order to explain the program requirements for any control
panel program for the simulator, it is best to show the
required symbols in S.P.S. and instructions needed for any
program and then give a specific example.

There are three symbols that have been defined in the simulator
program which are required in the control panel program. They
are:

Label	Operation	Remarks
BUFFER	DS	24845
BEGIN	DS	20778
STORE	DS	23250

BUFFER is a hundred digit record followed by a record mark which contains ten-10 digit words that will be or has been transferred from the simulated drum storage.

BEGIN is the location of the next 1620 instruction to be executed after punching a card in the punch routine.

STORE is the location of the next 1620 instruction to be executed after filling BUFFER storage with ten-10 digit words in the read routine.

Since increasing 650 drum locations are stored in decreasing 1620 addresses as explained in Part IV, the BUFFER storage is set up as follows:

650 Digit Position

	10	9	8	7	6	5	4	3	2	1	S
Word 1	90	91	92	93	94	95	96	97	98	99	99
Word 2	80	81	82	83	84	85	86	87	88	89	89
Word 3	70	71	72	73	74	75	76	77	78	79	79
Word 4	60	61	62	63	64	65	66	67	68	69	69
Word 5	50	51	52	53	54	55	56	57	58	59	59
Word 6	40	41	42	43	44	45	46	47	48	49	49
Word 7	30	31	32	33	34	35	36	37	38	39	39
Word 8	20	21	22	23	24	25	26	27	28	29	29
Word 9	10	11	12	13	14	15	16	17	18	19	19
Word 10	0	1	2	3	4	5	6	7	8	9	9

Example: Digit position 3 of 650 word 4 is called symbolically BUFFER + 67.

Before branching to the control panel read routine, the simulator clears the BUFFER to 100 zeros with flags at BUFFER, BUFFER + 10, BUFFER + 20, etc., to BUFFER + 90. If these flags are removed they must be replaced before branching back into

the simulator. If any of the 650 words are negative,
flags must be set at the BUFFER sign positions, BUFFER + 9,
BUFFER + 19, etc., to BUFFER + 99. No other flags than those
stated above must be in BUFFER before branching into the
simulator.

Before branching to the control panel punch routine, the
simulator transfers the 10-10 digit words of the 650 punch
band into BUFFER storage. Flags are over the 650 digit
position 10 of each word. These flags may be removed if
necessary and other flags set as required. If any 650
word is negative, flags are set over the 650 digit position
1 of that word, ie. BUFFER + 9, BUFFER + 19, etc.

A method for translating card column to read area addresses
for the read or punch routine is given below:

The following formulae assume that the read or punch area in
the control panel routine is defined as follows:

$$\text{READ} \qquad \text{DAS} \qquad 80$$

Where "READ" is an arbitrarily assigned label of the alpha
read area. Any label acceptable by S.P.S. can be used.

The formulae give the increment for the READ symbol (or any
other acceptable symbol) which will symbolically locate the
zone or digit position of any desired card column in the
READ area.

Let N = card column desired.

Then numeric portion digit of card column N is READ + N (2)
-2.
Then zone portion digit of card column N is READ + N (2) -3.
Example:

Address of numeric portion of C.C. 21. = READ + 21 (2) -2 =
READ + 40.
Address of zone portion of C.C. 21. = READ + 21 (2) -3 =
READ + 39.

For the read routine, the card is programmed to read alpha-
betically (if R.P.Q. device is used) or numerically as the
case may be, and the branches are programmed to switch the
program to Entry A, Entry B, Entry C, or LOAD. If the 533

panel uses only one read entry, only one has to be pro-
grammed. For each of the four entries used, the data
must be moved from the card into the correct 100 digits
format in BUFFER storage. Then the branch is made to
STORE. If the card being read is a 650 load card, the
80 columns of card data must be moved to the BUFFER and
a flag set at STORE (23250) before branching.

For the punch routine, the 100 digits must be moved
from the BUFFER storage and placed in the correct columns
before punching the correct punch card (PUNCH A, PUNCH B,
PUNCH C) must be selected from control information (Word 10),
the branch made, the data stored in the correct columns,
the card punched, and then a branch to BEGIN is made. It
is not possible to punch numeric from BUFFER, since the 650
words are in reversed order as explained in Part IV.

When the control panel program has been written in S.P.S.,
assemble the program and compress the S.P.S. output by
using the Compressor program. Direction as to the method
of loading this deck with the simulator are given in Section
VII (B).

Notes:

1. The alphabetic coding of the 650 differs from the
   1620 by a constant of twenty.

	650 Code	1620 Code
A	61	41
I	69	49
J	71	51
R	79	59
S	82	62
Z	89	69
0	90	70
9	99	79

This means if any alphabetic data is read by the 650
programs, the control panel routine must convert the 1620
coding into the 650 coding and vice-versa for output. If
the 650 does not operate upon the alphabetic data but just
passes it through, the conversion would not be necessary.

2. The 650, when reading cards, performs an automatic validity check for double punches and blank columns. If this check is required when using the simulator, the control panel routine must be programmed to test for double punches (by alphabetic codes) or blank columns (alphabetic code of 00)

3. When using R.P.Q. E07386, check the load column for the presence of both alpha code 30 and alpha codes 41-49 to determine if the card is a load card.

4. In the control panel read routine, if the signs are not over the units digit in the card, the routine must move the signs from the specific card column to the units digits of the 650 word in BUFFER storage. Also for the punch routine, the signs of the 650 words in BUFFER storage must be moved to the specific cards column whether the sign is in the units position or not. When punching a "+,0" combination and the "+" sign is required in the card, be sure to use a code 30.

5. In order to test the control panel read routine, it would be good to include a 382484500100 instruction before branching into the simulator. This would type out the BUFFER which could be examined before the data is transferred into the simulator. The WNTY BUFFER instruction could be changed to a NOP later. The same procedure could be followed for the punch routine.

IX.   A.   Control Panel Program Example

Following is the wiring for a 533 control panel that uses all three read entries and all three punch exits. This panel has been used as an example for a control panel program.

```
Col.   1   to  Load
       7   "   P. Sel. 6N (top row)
      10   "   Load
      12   "   P. Sel. 7 DPU
      31   "   P. Sel. 1 DPU
      34   "   P. Sel. 13 XPU
      35   "   P. Sel. 8 DPU
      41   "   P. Sel. 2 DPU
      42   "   P. Sel. 14 XPU
```

```
        Col.  43 to P. Sel.  9 DPU
              50 "  P. Sel. 15 XPU
              51 "  P. Sel.  3 DPU
              53 "  P. Sel. 10 DPU
              58 "  P. Sel. 16 XPU
              59 "  P. Sel. 11 DPU
              61 "  P. Sel.  4 DPU
              66 "  P. Sel. 17 XPU
              67 "  P. Sel. 12 DPU
              71 "  P. Sel.  5 DPU
              74 "  P. Sel. 18 XPU
              79 "  R. Col. Split 1-C
```

Read Card A-

```
        Col.  1-7  to Sto. Ent. A-Wd.  1 - Pos. 7-1
              8-12 "    "     "   A "   2 -  "   5-1
             13-20 "    "     "   A "   3 -  "   8-1
             21-30 "    "     "   A "   5 -  "  10-1
             31-40 "    "     "   A "   6 -  "  10-1
             41-50 "    "     "   A "   7 -  "  10-1
             51-60 "    "     "   A "   8 -  "  10-1
             61-70 "    "     "   A "   9 -  "  10-1
             71-80 "    "     "   A " 10 _  "  10-1
```

Read Card B-

```
        Col.  1-10 to Sto. Ent. B-Wd.  1 - Pos. 10-1
             11-18 "    "     "   B "   2 -  "   8-1
             19-26 "    "     "   B "   3 -  "   8-1
             27-36 "    "     "   B "   4 -  "  10-1
```

Read Card C-

```
        Col.  1-7  to Sto. Ent. C-Wd  1 - Pos. 7-1
              8-12 "    "     "   C "   2 -  "   5-1
             13-20 "    "     "   C "   3 -  "   8-1
             21-26 "    "     "   C "   4 -  "   6-1
             27-34 "    "     "   C "   5 -  "   8-1
             35-42 "    "     "   C "   6 -  "   8-1
             43-50 "    "     "   C "   7 -  "   8-1
             51-58 "    "     "   C "   8 -  "   8-1
             59-66 "    "     "   C "   9 -  "   8-1
             67-74 "    "     "   C " 10 -  "   8-1
```

Word Size Emmiters

Zero   to   BW5, BW6, BW7, BW8, BW9, BW10
Using BUS and Split wires Send Zero Size
To P. Sel. 1 thru 5, N's on Second row,
P. Sel. 7 thru 12, N's on second row,

Five   to   AW2; & P. Sel. 7, T second row.

Six   to   CW4

Seven   to   AW1, CW1,

Eight   to   AW3, CW3, BW3.

Nine   to   BW2, CW5, and using split wires
         to   P. Sel. 8 thru 12, T's on second row.

Ten   to   BW1, BW4, AW5, and using split wires to P.
Sel. 1 thru 5, T's on second row.

Pilot Selectors −

IPU P. Sel. 6 from Rd. Col. Split 1-12-x

P. Sel. 8, T Top Row to P. Sel. 14, C Second Row
  "   9, " " " " " " 15, " " "
  "   10, " " " " " " 16, " " "
  "   11, " " " " " " 17, " " "
  "   12, " " " " " " 18, " " "

P. Sel. 6, C Top Row to Rd.   D Sel. C
  "   8, " " " " Sto. Ent. C-Wd. 6, Pos. 9
  "   9, " " " " " " " " 7,   " 9
  "   10, " " " " " " " " 8,   " 9
  "   11, " " " " " " " " 9,   " 9
  "   12, " " " " " " " " 10, " 9

P. Sel. 6, T Second Row From Rd. Imp. 8

P. Sel. 13 thru 18, T Second Row, from Rd. Imp. 9
using BUS.

P. Sel. 13 thru 18, N Second Row, from Rd. Imp. 8
using BUS.

```
P. Sel.  1, C Second Row to AW6  (WD. Size Entry)
   "      2, C Second Row to AW7  (WD. Size Entry)
   "      3, C    "     "   "  AW8 ("    "      " )
   "      4, C    "     "   "  AW9 ("    "      " )
   "      5, C    "     "   "  AW10("    "      " )
   "      6, C    "     "   "  Entry B
   "      7, C    "     "   "  CW2 (Wd. Size Entry)
P. Sel.  8, C Second Row to CW6  (Wd. Size Entry)
   "      9, C    "     "   "  CW7 ("    "      " )
   "     10, C    "     "   "  CW8 ("    "      " )
   "     11, C    "     "   "  CW9 ("    "      " )
   "     12, C    "     "   "  CW10("    "      " )
```

P. Sel. 12, C Second Row to Sto. Ent. C, Wd. 5, Pos. 9

Read Hold to P. Sel. Holds 1 thru 18

Digit Selector Read
0 & 3 Split wired to Entry A

RSU is jack plugged.

Read impluse 8 to Sto. Ent. B-Wd. 2, Pos. 9

Punch Card A

```
Col.  1-9  from Sto. Exit, A, Wd, 1, Pos. 10-2
Col. 10-     "   Pch. Col. Split Pos. 10, 0-9
 "   11-18   "   Sto. Exit. A, Wd. 2, Pos. 8-1
 "   19-26   "    "      "    ", "   3,  "   8-1
 "   27-36   "    "      "    ", "   4,  "  10-1
 "   37-42   "    "      "    ", "  10,  "   6-1
 "   43-48   "    "      "    ", "   6,  "   6-1
 "   49-54   "    "      "    ", "   7,  "   6-1
 "   55-62   "    "      "    ", "   8,  "   8-1
 "   63-70   "    "      "    ", "   9,  "   8-1
 "   71-78   "    "      "    ", "   5,  "   8-1
 "   79      "   Pch. Code Sel. Pos. 9-T
```

Punch Card B

```
Col.  1-7  from Sto. Exit B, Wd. 1, Pos. 7-1
 "    8-12   "    "     "   ", "   2,  "   5-1
 "   13-20   "    "     "   ", "   3,  "   8-1
```

```
Col. 21-26 from Sto. Exit B, Wd. 10, Pos. 6-1
 "   27-34  "    "    "   ",  "    4,  "    8-1
 "   35-42  "    "    "   ",  "    5,  "    8-1
 "   43-50  "    "    "   ",  "    6,  "    8-1
 "   51-58  "    "    "   ",  "    7,  "    8-1
 "   59-66  "    "    "   ",  "    8,  "    8-1
 "   69-74  "    "    "   ",  "    9,  "    8-1
 "   76-80  "    "    "   ",  "    2,  "   10-6
```

Punch Card C -

```
Col.  1-9 from Sto. Exit. C, Wd. 1, Pos. 10-2
 "   11-19  "    "    "   ",  "    2,  "   10-2
 "   21-29  "    "    "   ",  "    3,  "   10-2
 "   31-39  "    "    "   ",  "    4,  "   10-2
 "   41-49  "    "    "   ",  "    5,  "   10-2
 "   51-59  "    "    "   ",  "    6,  "   10-2
 "   61-69  "    "    "   ",  "    7,  "   10-2
 "   71-79  "    "    "   ",  "    8,  "   10-2
```

Note - Col. 65 is also split wired to Pch. Code Se-
lector Pos. 10-T.
   Col. 77 is also split wired to Pch. Code Se-
lector Pos. 7-T

Col. 10 Split wired from Pch Col. Spl. Pos. 10-C &
Co. Sel. 15-Pos. 3-N.
Col. 20 Split wired from Punch Col. Spl. Pos. 9-C &
Co. Sel. 15- Pos. 2-N.
Col. 30 Split wired from Pch, Col. Spl. Pos. 8-C &
Co. Sel. 15- Pos. 1-N.
Col. 40 Split wired from Pch. Col.SPl. Pos. 7-C &
Co. Sel. 16- Pos. 5-N.
Col. 50 Split wired from Pch Col. Spl. Pos. 6-C &
Co. Sel. 16- Pos. 4-N.
Col. 60 Split wired from Pch. Col. Spl. Pos. 5-C &
Co. Sel. 16- 3-N.
Col. 80 Split wired from Pch. Col. Spl. Pos. 3-C &
Co. Sel. 16- Pos. 1-N.

Col. 70 Split wired from Pch Col. Spl. Pos. 4-C
 "   70   "   "   "   Co. Sel. 16   Pos. 2-N
 "   70   "   "   "   Pch. Col. Spl. Pos. 2-(0-9)

Co Selectors -

Co. Sel. Pick-up 15 & 16 wired to control Information Pos. 5.
Co Sel. Hold 15 & 16 wired to Pch. Hold.
Co. Sel. 15, Pos. 3 through 1-T wired to Pch. Col. Spl. Pos. 10-8 (0-9).
Co Sel. 16, Pos. 5 through 1-T wired to Pch Col. Spl. Pos. 7-3 (0-9).

Co. Sel.	15-Pos.	3-C	from Sto.	Exit	Wd.	1	-	Pos.	1
"	" 15- "	2-C	"	"	"	"	2	-	"	1
"	" 15- "	1-C	"	"	"	"	3	-	"	1
"	" 16- "	5-C	"	"	"	"	4	-	"	1
"	" 16- "	4-C	"	"	"	"	5	-	"	1
"	" 16- "	3-C	"	"	"	"	6	-	"	1
"	" 16- "	1-C	"	"	"	"	8	-	"	1
"	" 16- "	2-C	"	Pch. Code Sel. 6-N					

Punch Signs -

> PSU is jack plugged
> P + is jack plugged

Control Information -

> Pos. 10 to Pch Code Sel. Pos. 10 - IPU
> "   9 "   "   "   "   "   9 - IPU
> "   9 "   Punch A
> "   8 "   Punch B
> "   7 "   Pch. Code Sel. Pos. 7 - IPU
> "   6 "   "   "   "   "   6 - IPU

Punch Code Selectors -

> Pos. 6-T to Pch. Col Spl. Pos. 2-C
> "   7, 9, & 10 - C from X-IMP
> "   6-C from S to. Exit C, Wd. 7, Pos. 1

> Punch Col. Split Pos. 1-C from Sto. Exit A, Wd. 1, Pos. 1

> DPBC Jack Plugged to STOP

Double Punch, Blank Columns Detection wiring -

Punch	Brushes	1-6	to	DP	&	BC	Det.	Ent.	1-6
"	"	8-9	"	"		"	"	"	8-9
"	"	11	"	"		"	"	"	11
"	"	13-17	"	"		"	"	"	13-17
"	"	19	"	"		"	"	"	19
"	"	21-25	"	"		"	"	"	21-25
"	"	27-29	"	"		"	"	"	27-29
"	"	31-33	"	"		"	"	"	31-33
"	"	35	"	"		"	"	"	35
"	"	37-39	"	"		"	"	"	37-39
"	"	41	"	"		"	"	"	41
"	"	43-47	"	"		"	"	"	43-47
"	"	49	"	"		"	"	"	49

Punch	Brushes	49	to	DP	&	BC	Det.	Ent.	49
"	"	51-53	"	"		"	"	"	51-53
"	"	55-57	"	"		"	"	"	55-57
"	"	59	"	"		"	"	"	59
"	"	61	"	"		"	"	"	61
"	"	63-64	"	"		"	"	"	63-64
"	"	67-69	"	"		"	"	"	67-69
"	"	71-73	"	"		"	"	"	71-73
"	"	75-76	"	"		"	"	"	75-76
"	"	79	"	"		"	"	"	79

Punch	Brushes	7	to	BC	Det.	Ent.	7
"	"	10	"	"	"	"	10
"	"	12	"	"	"	"	12
"	"	18	"	"	"	"	18
"	"	20	"	"	"	"	20
"	"	26	"	"	"	"	26
"	"	30	"	"	"	"	30
"	"	34	"	"	"	"	34
"	"	36	"	"	"	"	36
"	"	40	"	"	"	"	40
"	"	42	"	"	"	"	42
"	"	48	"	"	"	"	48
"	"	50	"	"	"	"	50
"	"	54	"	"	"	"	54
"	"	58	"	"	"	"	58
"	"	60	"	"	"	"	60
"	"	62	"	"	"	"	62
"	"	65-66	"	"	"	"	65-66
"	"	70	"	"	"	"	70
"	"	74	"	"	"	"	74
"	"	77-78	"	"	"	"	77-78

Jack plug BC Det. Control 74 to 75
  "   "   "   "   "   79 to 80

Explanation of the program listing, for the program
written, for the above control panel.

S.P.S. Card No.	Remarks
01030 –	The required starting location for the first instruction of the read routine.
01040 – 01080 –	Symbol definitions which are required to tie into the simulator program.
01090 –	The card is read alphanumerically, in order to check for the presence of "12" punches in load cards and for missing "12" punches in non-load cards.
01100 – 01110 –	Initialization for the read subroutine.
01120 – 01240 –	Tests for load cards (columns 1 and 10).
01250 – 02020 –	Test for Read Entry B (x – punch in col. 79).
02030 – 02070 –	Tests for READ Entry A ("0" or "3" in col. 7).
02080 – 02190 –	Transfers READ Card C data to BUFFER storage using a subroutine.
02200 – 03060 –	Transfers Read Card A data to BUFFER storage using a subroutine.
03070 – 03120 –	Transfers Read Card B data to BUFFER storage using a subroutine.
03130 – 03200 –	Transfers Load Card Data to BUFFER storage using a subroutine.
03210 –	Instruction necessary to branch to data address of the 650 Read Instruction when a load card occurs.
03230 – 04190 –	Subroutine for transferring card fields to words in BUFFER storage.
04200 –	The required starting location for the first instruction of the punch routine.
04220 – 05020 –	Tests for Punch Card A.
05030 – 05050 –	Test for Punch Card B.
05060 – 05100 –	Test for Punch Card C.
05110 – 05180 –	Transfers BUFFER storage to the Punch out locations for Punch Card C.
05190 – 06060 –	Tests control information for sign control and x – impulses for Punch Card C.

06070 – 06230 –	Transfers BUFFER storage to the Punch out location for Punch Card B.
06240 – 07120 –	Transfers BUFFER storage to the Punch out location for Punch Card A.
07130 –	Instruction to Punch Card alphabetically.
07140 –	Required branch instruction back into the simulator program.
07150 – 08150 –	Subroutine for transferring words in BUFFER storage to card fields.
08160 – 08200 –	Symbol definitions for control panel program.

```
                                1010 *VIRGI NIA    DEPARTMENT OF HIGHWAYS ROAD DESIGN SERIES CONTROL PANELZ
                                1020 *                    FOR THE IBM 1620 DATA PROCESSING SYSTEM.Z
30000                           1030        DORG 30000,,,REQUIRED FOR C. P. PROGRAM.Z
24845                           1040 BUFFER DS   ,24845,,REQUIRED FOR C. P. PROGRAMZ
20778                           1070 BEGIN  DS   ,20778,,REQUIRED FOR C.P. PROGRAMZ
23250                           1080 STORE  DS   ,23250,,REQUIRED FOR C. P. PROGRAMZ
30000 37 36141 00500            1090 READ   RACD CARDZ
30012 16 36304 K4944            1100        TFM  WORD,BUFFER&99Z
30024 16 36309 L6139            1110        TFM  CDCOL,CARD-2Z
30036 25 30057 36158            1120        TD   *&21,CARD&17Z
30048 14 30057 0-0-4            1130        CM   *&9,4,810Z
30060 46 30648 01200            1140        BE   LOADZ
30072 32 36140 00000            1150        SF   CARD-1Z
30084 14 36141 000L0            1160        CM   CARD,30,10Z
30096 46 30648 01200            1170        BE   LOADZ
30108 71 36158 36140            1180        MF   CARD&17,CARD-1Z
30120 25 30141 36140            1190        TD   *&21,CARD-1Z
30132 14 30141 0-0-4            1200        CM   *&9,4,810Z
30144 46 30648 01200            1210        BE   LOADZ
30156 14 36159 000L0            1220        CM   CARD&18,30,10Z
30168 33 36158 00000            1230        CF   CARD&17Z
30180 46 30648 01200            1240        BE   LOADZ
30192 25 30213 36296            1250        TD   *&21,CARD&155Z
30204 14 30213 0-0-2            2010        CM   *&9,2,810Z
30216 46 30576 01200            2020        BE   ENTRYBZ
30228 25 30249 36153            2030        TD   *&21,CARD&12Z
30240 14 30249 0-0-0            2040        CM   *&9,0,810Z
30252 46 30432 01200            2050        BE   ENTRYAZ
30264 14 30249 000-3            2060        CM   *-15,3,10Z
30276 46 30432 01200            2070        BE   ENTRYAZ
30288 17 30768 -0007            2080        BTM  SUBR,7Z
30300 17 30768 -0005            2090        BTM  SUBR,5Z
30312 17 30768 -0008            2100        BTM  SUBR,8Z
30324 17 30768 -0006            2110        BTM  SUBR,6Z
30336 17 30768 -000@            2120        BTM  SUBR,8,711Z
30348 17 30768 -000@            2130        BTM  SUBR,8,711Z
30360 17 30768 -000Q            2140        BTM  SUBR,8,711Z
30372 17 30768 -000Q            2150        BTM  SUBR,8,711Z
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30384 17 30768 -000Q   2160          BTM   SUBR,8,711Z
30396 17 30768 -000Q   2170          BTM   SUBR,8,711Z
30408 41 24943 00005   2180          NOP   BUFFER&98,5Z
30420 49 23250 00000   2190          B     STORE,,,REQUIRED FOR C. P. PROGRAM.Z
30432 17 30768 -0007   2200 ENTRYA   BTM   SUBR,7Z
30444 17 30768 -0005   2210          BTM   SUBR,5Z
30456 17 30768 -0008   2220          BTM   SUBR,8Z
30468 12 36304 -0010   2230          SM    WORD,10Z
30480 17 30768 -0010   2240          BTM   SUBR,10Z
30492 17 30768 -0010   2250          BTM   SUBR,10Z
30504 17 30768 -0010   3010          BTM   SUBR,10Z
30516 17 30768 -0010   3020          BTM   SUBR,10Z
30528 17 30768 -0010   3030          BTM   SUBR,10Z
30540 17 30768 -0010   3040          BTM   SUBR,10Z
30552 41 24943 00005   3050          NOP   BUFFER&98,5Z
30564 49 23250 00000   3060          B     STORE,,,REQUIRED FOR C. P. PROGRAM.Z
30576 17 30768 -0010   3070 ENTRYB   BTM   SUBR,10Z
30588 15 36174 00007   3080          TDM   CARD&33,7Z
30600 17 30768 -000Q   3090          BTM   SUBR,8,711Z
30612 17 30768 -0008   3100          BTM   SUBR,8Z
30624 17 30768 -0010   3110          BTM   SUBR,10Z
30636 49 23250 00000   3120          B     STORE,,,REQUIRED FOR C. P. PROGRAM.Z
30648 17 30768 -0010   3130 LOAD     BTM   SUBR,10Z
30660 17 30768 -0010   3140          BTM   SUBR,10Z
30672 17 30768 -0010   3150          BTM   SUBR,10Z
30684 17 30768 -0010   3160          BTM   SUBR,10Z
30696 17 30768 -0010   3170          BTM   SUBR,10Z
30708 17 30768 -0010   3180          BTM   SUBR,10Z
30720 17 30768 -0010   3190          BTM   SUBR,10Z
30732 17 30768 -0010   3200          BTM   SUBR,10Z
30744 32 23250 00000   3210          SF    STORE,,,REQUIRED FOR C. P. PROGRAM.Z
30756 49 23250 00000   3220          B     STORE,,,REQUIRED FOR C. P. PROGRAM.Z
30768 71 30768 30767   3230 SUBR     MF    SUBR,SUBR-1Z
30780 26 36314 36304   3240          TF    TEM,WORDZ
30792 22 36314 30767   3250          S     TEM,SUBR-1Z
30804 11 36314 -0001   4010          AM    TEM,1Z
30816 32 3631M 00000   4020          SF    TEM,,6Z
30828 21 36309 30767   4030          A     CDCOL,SUBR-1Z
30840 21 36309 30767   4040          A     CDCOL,SUBR-1Z
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30852 72 3630R 3630M    4050          TNS   CDCOL,WORD,611Z
30864 33 3631M 00000    4060          CF    TEM,,6Z
30876 43 30900 30767    4070          BD    *&24,SUBR-1Z
30888 32 3631M 00000    4080          SF    TEM,,6Z
30900 44 31008 30768    4090          BNF   *&108,SUBRZ
30912 12 36314 -0001    4100          SM    TEM,1Z
30924 15 3631M 00009    4110          TDM   TEM,9,6Z
30936 12 36309 -0001    4120          SM    CDCOL,1Z
30948 25 30969 3630R    4130          TD    *&21,CDCOL,11Z
30960 14 30969 0-0-7    4140          CM    *&9,7,810Z
30972 47 30996 01200    4150          BNE   *&24Z
30984 15 3631M 00008    4160          TDM   TEM,8,6Z
30996 11 36309 -0001    4170          AM    CDCOL,1Z
31008 12 36304 -0010    4180          SM    WORD,10Z
31020 42 00000 00000    4190          BB    Z
35000                   4200          DORG  35000,,,REQUIRED FOR C. P. PROGRAM.Z
35000 16 36309 L6139    4210  PUNCH   TFM   CDCOL,CARD-2Z
35012 26 36322 24852    4220          TF    TEMP,BUFFER&7Z
35024 15 36321 0000-    4230          TDM   TEMP-1,0,11Z
35036 33 36315 00000    4240          CF    TEMP-7Z
35048 25 36322 36316    4250          TD    TEMP,TEMP-6Z
35060 14 36322 000-8    5010          CM    TEMP,8,10Z
35072 46 35636 01200    5020          BE    PUNCHAZ
35084 25 36322 36317    5030          TD    TEMP,TEMP-5Z
35096 14 36322 000-8    5040          CM    TEMP,8,10Z
35108 46 35432 01200    5050          BE    PUNCHBZ
35120 25 36322 36320    5060          TD    TEMP,TEMP-2Z
35132 14 36322 000-8    5070          CM    TEMP,8,10Z
35144 32 35828 00000    5080          SF    SUBPZ
35156 47 35180 01200    5090          BNE   *&24Z
35168 33 35828 00000    5100          CF    SUBPZ
35180 17 35828 -0110    5110          BTM   SUBP,110Z
35192 17 35828 -1110    5120          BTM   SUBP,1110Z
35204 17 35828 -2110    5130          BTM   SUBP,2110Z
35216 17 35828 -3110    5140          BTM   SUBP,3110Z
35228 17 35828 -4110    5150          BTM   SUBP,4110Z
35240 17 35828 -5110    5160          BTM   SUBP,5110Z
35252 17 35828 -6110    5170          BTM   SUBP,6110Z
35264 17 35828 -7110    5180          BTM   SUBP,7110Z
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35276 25 36322 36318    5190            TD      TEMP,TEMP-4Z
35288 14 36322 000-8     5200            CM      TEMP,8,10Z
35300 47 35324 01200     5210            BNE     *&24Z
35312 15 36292 00005     5220            TDM     CARD&151,5Z
35324 25 36322 36315     5230            TD      TEMP,TEMP-7Z
35336 14 36322 000-8     5240            CM      TEMP,8,10Z
35348 47 35372 01200     5250            BNE     *&24Z
35360 15 36268 00005     6010            TDM     CARD&127,5Z
35372 25 36322 36319     6020            TD      TEMP,TEMP-3Z
35384 14 36322 000-8     6030            CM      TEMP,8,10Z
35396 47 35804 01200     6040            BNE     ENDZ
35408 15 36278 00007     6050            TDM     CARD&137,7Z
35420 49 35804 00000     6060            B       ENDZ
35432 32 35828 00000     6070   PUNCHB   SF      SUBPZ
35444 17 35828 -0407     6080            BTM     SUBP,407Z
35456 17 35828 -1605     6090            BTM     SUBP,1605Z
35468 17 35828 -2308     6100            BTM     SUBP,2308Z
35480 17 35828 -9506     6110            BTM     SUBP,9506Z
35492 17 35828 -3308     6120            BTM     SUBP,3308Z
35504 17 35828 -4308     6130            BTM     SUBP,4308Z
35516 17 35828 -5308     6140            BTM     SUBP,5308Z
35528 17 35828 -6308     6150            BTM     SUBP,6308Z
35540 17 35828 -7308     6160            BTM     SUBP,7308Z
35552 17 35828 -8308     6170            BTM     SUBP,8308Z
35564 11 36309 -0002     6180            AM      CDCOL,2Z
35576 33 35828 00000     6190            CF      SUBPZ
35588 17 35828 -1105     6200            BTM     SUBP,1105Z
35600 15 36288 00000     6210            TDM     CARD&147,0Z
35612 15 36289 00000     6220            TDM     CARD&148,0Z
35624 49 35804 00000     6230            B       ENDZ
35636 33 35828 00000     6240   PUNCHA   CF      SUBPZ
35648 17 35828 -0110     6250            BTM     SUBP,110Z
35660 32 35828 00000     7010            SF      SUBPZ
35672 17 35828 -1308     7020            BTM     SUBP,1308Z
35684 17 35828 -2308     7030            BTM     SUBP,2308Z
35696 17 35828 -3110     7040            BTM     SUBP,3110Z
35708 17 35828 -9506     7050            BTM     SUBP,9506Z
35720 17 35828 -5506     7060            BTM     SUBP,5506Z
35732 17 35828 -6506     7070            BTM     SUBP,6506Z
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35744 17 35828 -7308    7080            BTM   SUBP,7308Z
35756 17 35828 -8308    7090            BTM   SUBP,8308Z
35768 17 35828 -4308    7100            BTM   SUBP,4308Z
35780 16 36299 0K000    7110            TFM   CARD&158,2000,8Z
35792 33 36296 00000    7120            CF    CARD&155Z
35804 39 36141 00400    7130  END       WACD  CARDZ
35816 49 20778 00000    7140            B     BEGIN,,,REQUIRED FOR C. P. PROGRAM.Z
35828 32 35826 00000    7150  SUBP      SF    SUBP-2Z
35840 32 35824 00000    7160            SF    SUBP-4Z
35852 21 36309 35827    7170            A     CDCOL,SUBP-1Z
35864 21 36309 35827    7180            A     CDCOL,SUBP-1Z
35876 32 35825 00000    7190            SF    SUBP-3Z
35888 25 35909 35825    7200            TD    *&21,SUBP-3Z
35900 11 35909 0-0J0    7210            AM    *&9,10,810Z
35912 25 35825 35909    7220            TD    SUBP-3,*-3Z
35924 16 35954 K4944    7230            TFM   *&30,BUFFER&99Z
35936 22 35954 35825    7240            S     *&18,SUBP-3Z
35948 32 24944 00000    7250            SF    BUFFER&99Z
35960 21 35954 35827    8010            A     *-6,SUBP-1Z
35972 12 35954 -0001    8020            SM    *-18,1Z
35984 73 3630R 3595M    8030            TNF   CDCOL,*-30,611Z
35996 44 36128 35828    8040            BNF   *&132,SUBPZ
36008 12 36309 -0001    8050            SM    CDCOL,1Z
36020 25 36041 3630R    8060            TD    *&21,CDCOL,11Z
36032 14 36041 0-0-5    8070            CM    *&9,5,810Z
36044 46 36116 01200    8080            BE    *&72Z
36056 15 3630R 00004    8090            TDM   CDCOL,4,6Z
36068 11 36309 -0001    8100            AM    CDCOL,1Z
36080 43 36128 3630R    8110            BD    *&48,CDCOL,11Z
36092 12 36309 -0001    8120            SM    CDCOL,1Z
36104 15 3630R 00003    8130            TDM   CDCOL,3,6Z
36116 11 36309 -0001    8140            AM    CDCOL,1Z
36128 42 00000 00000    8150            BB    Z
36141       80          8160  CARD      DAS   80Z
36304        5          8170  WORD      DS    5Z
36309        5          8180  CDCOL     DS    5Z
36314        5          8190  TEM       DS    5Z
36322        8          8200  TEMP      DS    8Z
20442                   8210            DEND  20442,,,REQUIRED FOR C. P. PROGRAM.Z
```

X. A. Explanation of R.P.Q. E07386

When reading a card alphabetically on the standard 1620

A	0		punch is internally coded as		70
"	11	" "	"	" "	20
"	12	" "	"	" "	10
"	11-0	" "	"	" "	50
"	12-0	" "	"	" "	70

A "0" punch and a "12-0" punch are both coded as a "70".
This creates a problem for simulation. If a card had
a "12-0" punch in the load column and the "12" punch
was necessary to recognize it as being a load card,
there would be no way of making the decision. Also if
load cards are to be punched by the simulator, there
would be no way of punching a "12-0" punch.

R.P.Q. E07386 will allow a card that is read alpha-
betically containing a "12-0" punch to be converted
internally to a code of 30. Also code of 30 will punch
out alphabetically as a "12-0". Therefore, using this
R.P.Q. it is possible to recognize load cards with the
control panel program. This R.P.Q. is necessary to pro-
vide full compatibility with 650 computers, so that cards
may be used interchangeably during a period of transition
from the 650 to the 1620. If there is no transition period
from the 650 to the 1620, or full compatibility is not de-
sired, it would be possible to use the simulator without
the R.P.Q. As explained previously, the R.P.Q. is used
only in the control panel program. Therefore, if there
is any punch by which load cards may be distinguished from
data cards, it would be possible to write a control panel
program without using the R.P.Q.

    Example: 1.   In the load column, an 11-punch could be
                    used instead of a 12 punch to distinguish
                    load cards.

                2.   In the load column, if a 12-0 combination
                    does not occur, but if 12-punches are pre-
                    sent, the 4 of the alphabetic codes (A-1,
                    41-49) could be used to distinguish load
                    cards.

B. Example of Control Panel Program without R.P.Q. E07386

Following is a short control panel wiring diagram that
has been programmed and will show how the simulator may
be used without using the R.P.Q. device by the method
shown in Example 1.

Load Card, if "12" punch in column 1
READ Card C, RSU plugged.

Col.	1-2	to Sto. Ent.	C. Word	1	Pos.	10-9
"	7-10	" " " " "	"	"	"	8-5
"	3-6	" " " " "	"	"	"	4-1
"	11-12	" " " " "	"	2	"	9-8
"	zeros	" " " " "	"	"	"	7-3
"	13-14	" " " " "	"	"	"	2-1
"	15-21	" " " " "	"	3	"	7-1
"	23-24	" " " " "	"	4	"	9-8
"	zeros	" " " " "	"	"	"	7-3
"	25-26	" " " " "	"	"	"	2-1
"	27-33	" " " " "	"	5	"	7-1
"	35-43	" " " " "	"	6	"	9-1
"	46-53	" " " " "	"	7	"	8-1

"	80	if "X" emit 8 in Sto. Ent. C Word 10 Pos. 1
"	"	" "No X" Emit 9 in Sto. Ent. C word 10 Pos. 1

Punch Card C, RSU plugged

Word	1	Pos.	10-9	wired	to	Punch	Card	C	col.	1-2
"	1	"	8-5	"	"	"	"	"	"	7-10
"	1	"	4-1	"	"	"	"	"	"	3-6
"	2	"	9-8	"	"	"	"	"	"	11-12
"	2	"	2-1	"	"	"	"	"	"	13-14
"	3	"	7-1	"	"	"	"	"	"	15-21
"	4	"	9-8	"	"	"	"	"	"	23-24
"	4	"	2-1	"	"	"	"	"	"	25-26
"	5	"	7-1	"	"	"	"	"	"	27-33
"	6	"	9-1	"	"	"	"	"	"	35-43
"	7	"	8-1	"	"	"	"	"	"	46-53
"	8	"	7-1	"	"	"	"	"	"	54-60

If 8 in pos. 1 of Sto. Exit C Word 10, Emit X in col. 80.
The 650 program deck of load cards after being processed
by the address conversion program as explained in Part XI
was reproduced with an "11" punch in Col. 1 instead of
"12" punch.

Following is the program necessary to simulate this con-
trol panel without using the R.P.Q. device. Notice that
the card may be read numerically.

```
                         1010 *EXAMP LE C ONTROL PANEL PROGRAM WITHOUT USING R.P.Q. E07386ZZ
30000                    1020       DORG 30000,,,REQUIRED FOR C.P.PROGRAMZ
24845                    1030 BUFFER DS   ,24845,,REQUIRED FOR C.P.PROGRAMZ
20778                    1040 BEGIN  DS   ,20778,,REQUIRED FOR C.P.PROGRAMZ
23250                    1050 STORE  DS   ,23250,,REQUIRED FOR C.P.PROGRAMZ
30000 36 35372 00500     1060 READ   RNCD CARD-79Z
30012 44 30228 35372     1070       BNF  ENTRYC,CARD-79Z
30024 32 35382 00000     1080       SF   CARD-69Z
30036 32 35392 00000     1090       SF   CARD-59Z
30048 32 35402 00000     1100       SF   CARD-49Z
30060 32 35412 00000     1110       SF   CARD-39Z
30072 32 35422 00000     1120       SF   CARD-29Z
30084 32 35432 00000     1130       SF   CARD-19Z
30096 32 35442 00000     1140       SF   CARD-9Z
30108 26 24944 35381     1150       TF   BUFFER&99,CARD-70Z
30120 26 24934 35391     1160       TF   BUFFER&89,CARD-60Z
30132 26 24924 35401     1170       TF   BUFFER&79,CARD-50Z
30144 26 24914 35411     1180       TF   BUFFER&69,CARD-40Z
30156 26 24904 35421     1190       TF   BUFFER&59,CARD-30Z
30168 26 24894 35431     1200       TF   BUFFER&49,CARD-20Z
30180 26 24884 35441     1210       TF   BUFFER&39,CARD-10Z
30192 26 24874 35451     1220       TF   BUFFER&29,CARDZ
30204 32 23250 00000     1225       SF   STORE,,,REQUIRED FOR C.P.PROGRAMZ
30216 49 23250 00000     1230       B    STORE,,,REQUIRED FOR C.P.PROGRAMZ
30228 32 35372 00000     1240 ENTRYC SF   CARD-79Z
30240 32 35378 00000     1250       SF   CARD-73Z
30252 32 35374 00000     2010       SF   CARD-77Z
30264 21 24936 35373     2020       A    BUFFER&91,CARD-78Z
30276 21 24940 35381     2030       A    BUFFER&95,CARD-70Z
30288 21 24944 35377     2040       A    BUFFER&99,CARD-74Z
30300 32 35382 00000     2050       SF   CARD-69Z
30312 32 35384 00000     2060       SF   CARD-67Z
30324 21 24927 35383     2070       A    BUFFER&82,CARD-68Z
30336 21 24934 35385     2080       A    BUFFER&89,CARD-66Z
30348 32 35386 00000     2090       SF   CARD-65Z
30360 21 24924 35392     2100       A    BUFFER&79,CARD-59Z
30372 32 35394 00000     2110       SF   CARD-57Z
30384 32 35396 00000     2120       SF   CARD-55Z
```

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30396 21 24907 35395    2130          A     BUFFER&62,CARD-56Z
30408 21 24914 35397    2140          A     BUFFER&69,CARD-54Z
30420 32 35398 00000    2150          SF    CARD-53Z
30432 21 24904 35404    2160          A     BUFFER&59,CARD-47Z
30444 32 35406 00000    2170          SF    CARD-45Z
30456 21 24894 35414    2180          A     BUFFER&49,CARD-37Z
30468 32 35417 00000    2190          SF    CARD-34Z
30480 21 24884 35424    2200          A     BUFFER&39,CARD-27Z
30492 15 24854 00009    2210          TDM   BUFFER&9,9Z
30504 44 30528 35451    2220          BNF   *&24,CARDZ
30516 15 24854 00008    2230          TDM   BUFFER&9,8Z
30528 49 23250 00000    2240          B     STORE,,,REQUIRED FOR C.P.PROGRAMZ
35000                   2250          DORG  35000,,,REQUIRED FOR C.P.PROGRAMZ
35000 31 35372 35453    3010 PUNCH    TR    CARD-79,BLANKS-49Z
35012 26 35373 24936    3020          TF    CARD-78,BUFFER&91Z
35024 71 24937 35372    3030          MF    BUFFER&92,CARD-79Z
35036 26 35381 24940    3040          TF    CARD-70,BUFFER&95Z
35048 71 24941 35378    3050          MF    BUFFER&96,CARD-73Z
35060 26 35377 24944    3060          TF    CARD-74,BUFFER&99Z
35072 71 24926 35374    3070          MF    BUFFER&81,CARD-77Z
35084 26 35383 24927    3080          TF    CARD-68,BUFFER&82Z
35096 71 24933 35382    3090          MF    BUFFER&88,CARD-69Z
35108 26 35385 24934    3100          TF    CARD-66,BUFFER&89Z
35120 71 24918 35384    3110          MF    BUFFER&73,CARD-67Z
35132 26 35392 24924    3120          TF    CARD-59,BUFFER&79Z
35144 71 24906 35386    3130          MF    BUFFER&61,CARD-65Z
35156 26 35395 24907    3140          TF    CARD-56,BUFFER&62Z
35168 71 24913 35394    3150          MF    BUFFER&68,CARD-57Z
35180 26 35397 24914    3160          TF    CARD-54,BUFFER&69Z
35192 71 24898 35396    3170          MF    BUFFER&53,CARD-55Z
35204 26 35404 24904    3180          TF    CARD-47,BUFFER&59Z
35216 71 24886 35398    3190          MF    BUFFER&41,CARD-53Z
35228 26 35414 24894    3200          TF    CARD-37,BUFFER&49Z
35240 71 24877 35406    3210          MF    BUFFER&32,CARD-45Z
35252 26 35424 24884    3220          TF    CARD-27,BUFFER&39Z
35264 71 24868 35417    3230          MF    BUFFER&23,CARD-34Z
35276 26 35431 24874    3240          TF    CARD-20,BUFFER&29Z
35288 33 35425 00000    3250          CF    CARD-26Z
35300 25 35321 24854    3260          TD    *&21,BUFFER&9Z
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```
35312 14 35321 0-0-8     3270         CM    *&9,8,810Z
35324 47 35348 01200     3280         BNE   *&24Z
35336 32 35451 00000     3290         SF    CARDZ
35348 38 35372 00400     3300         WNCD  CARD-79Z
35360 49 20778 00000     3310         B     BEGIN,,,REQUIRED FOR C.P.PROGRAMZ
35451          80        3320 CARD    DS    80Z
35452           1        3330         DS    1Z
35502          50        3340 BLANKS  DNB   50Z
35532          30        3350         DNB   30Z
35533           1        3360         DC    1,@Z
20442                    3370         DEND  20442,,,,REQUIRED FOR C.P.PROGRAMZ
```

XI. A. <u>Address Conversion Program</u>

This program is used to convert 8000-8003 addresses to
2000-2003 addresses for the 650 simulator. The 650 program
deck will be the input to this program and the output will
be the same program deck with all 8000-8003 addresses con-
verted to 2000-2003 addresses.

The 650 program may be in the standard one, four, five, or
seven per card format. Also provision is made for testing
and changing all eight words.

Procedure to convert a 650 program deck for use by the
simulator.

1. Push RESET and INSERT.
2. Type 310000300002.
3. Push RELEASE and START.
4. When memory has cleared, push INSTANT STOP and RESET.
5. Place 1620 program deck in 1622 read feed followed
    by the 650 program deck to be converted.
6. Place blank card in the 1622 punch feed.
7. Push LOAD button on 1622 read feed.
8. When program has been loaded, the 1620 will stop, to
    allow the alteration switches to set.
9. Set the alteration switches:
    Switch #1 on; 2,3, and 4 off - 650 program is in
    standard one word / card format.
    Switch #2 on; 1,2, and 4 off - 650 program is in
    standard four word ' card format.
    Switch #3 on; 1,2, and 4 off - 650 program is in
    standard five word / card format.
    Switch #4 on; 1,2, and 3 off - 650 program is in
    standard seven word / card format.
    If all switches are off, all eight words will be con-
    verted.
10. Push the START button on 1620 and Punch START on 1622.
11. The deck will be converted.
12. Clear out read and punch feed.
13. The punch feed contains the program to be used by the
    simulator.
14. If other 650 decks are to be converted, set the alter-
    ation switches as in Step 9. Place cards in the read
    and punch feeds and continue.

NOTE: 1. Care must be exercised when converting a
four, five, or seven word per card deck
because the load routine is in another
format. The load routine should be pro-
cessed separately with all switches off.
2. Care must be exercised when a constant
of 8000 to 8003 is used in the data or
instruction address of a word. These
addresses will be converted to 2000 to
2003 and if the constant was to be used
with a BDX operation code or to select
control information, it would give an in-
correct result. Also, numerical constants
of 8000 to 8003 must not be changed.

The program listing of this program is given. No block
diagram is required.

```
                            1010 *8000  TO 2 000 ADDRESS CONVERSION PROGRAMZZ
                            1020 *FOR U SE W ITH 650-1620 SIMULATOR  PROGRAMZZ
02178 37 03029 00500        1030 READ   RACD CARDZ
02190 46 02346 00100        1040        BC1  ONEZ
02202 46 02382 00200        1050        BC2  FOURZ
02214 46 02442 00300        1060        BC3  FIVEZ
02226 46 02514 00400        1070        BC4  SEVENZ
02238 17 02598 -3047        1080        BTM  SUB,CARD&18Z
02250 17 02598 -3067        1090        BTM  SUB,CARD&38Z
02262 17 02598 -3087        1100        BTM  SUB,CARD&58Z
02274 17 02598 -3107        1110        BTM  SUB,CARD&78Z
02286 17 02598 -3127        1120        BTM  SUB,CARD&98Z
02298 17 02598 -3147        1130        BTM  SUB,CARD&118Z
02310 17 02598 -3167        1140        BTM  SUB,CARD&138Z
02322 17 02598 -3187        1150        BTM  SUB,CARD&158Z
02334 49 02994 00000        1155        B    PUNCHZ
02346 17 02598 -3087        1160 ONE    BTM  SUB,CARD&58Z
02358 17 02598 -3107        1170        BTM  SUB,CARD&78Z
02370 49 02994 00000        1180        B    PUNCHZ
02382 17 02598 -3067        1190 FOUR   BTM  SUB,CARD&38Z
02394 17 02598 -3107        1200        BTM  SUB,CARD&78Z
02406 17 02598 -3147        1210        BTM  SUB,CARD&118Z
02418 17 02598 -3187        1220        BTM  SUB,CARD&158Z
02430 49 02994 00000        1230        B    PUNCHZ
02442 17 02598 -3067        1240 FIVE   BTM  SUB,CARD&38Z
02454 17 02598 -3087        1250        BTM  SUB,CARD&58Z
02466 17 02598 -3107        2010        BTM  SUB,CARD&78Z
02478 17 02598 -3127        2020        BTM  SUB,CARD&98Z
02490 17 02598 -3147        2030        BTM  SUB,CARD&118Z
02502 49 02994 00000        2040        B    PUNCHZ
02514 25 03019 03047        2050 SEVEN  TD   CTR,CARD&18Z
02526 16 02549 -3067        2051        TFM  *&23,CARD&38Z
02538 17 02598 -3067        2060        BTM  SUB,CARD&38Z
02550 12 03019 000-1        2070        SM   CTR,1,10Z
02562 46 02994 01200        2080        BZ   PUNCHZ
02574 11 02549 -0020        2090        AM   *-25,20Z
02586 49 02538 00000        2100        B    *-48Z
```

```
02598 72 0259P 03027   2110 SUB    TNS   SUB-1,WORD,6Z
02610 14 03023 0Q000    2121         CM    WORD-4,8000,8Z
02622 46 02946 01200    2122         BE    DATWOZ
02634 14 03023 0Q001    2130         CM    WORD-4,8001,8Z
02646 46 02946 01200    2140         BE    DATWOZ
02658 14 03023 0Q002    2150         CM    WORD-4,8002,8Z
02670 46 02946 01200    2160         BE    DATWOZ
02682 14 03023 0Q003    2170         CM    WORD-4,8003,8Z
02694 46 02946 01200    2180         BE    DATWOZ
02706 71 02598 03027    2190         MF    SUB,WORDZ
02718 71 03024 03020    2200         MF    WORD-3,WORD-7Z
02730 14 03027 0Q000    2201         CM    WORD,8000,8Z
02742 46 02970 01200    2202         BE    INTWOZ
02754 14 03027 0Q001    2210         CM    WORD,8001,8Z
02766 46 02970 01200    2220         BE    INTWOZ
02778 14 03027 0Q002    2230         CM    WORD,8002,8Z
02790 46 02970 01200    2240         BE    INTWOZ
02802 14 03027 0Q003    2250         CM    WORD,8003,8Z
02814 46 02970 01200    3010         BE    INTWOZ
02826 71 03027 02598    3020         MF    WORD,SUBZ
02838 71 03020 03024    3030         MF    WORD-7,WORD-3Z
02850 73 0259P 03027    3040         TNF   SUB-1,WORD,6Z
02862 12 02597 -0001    3041         SM    SUB-1,1Z
02874 44 02898 03027    3042         BNF   *&24,WORDZ
02886 42 00000 00000    3043         BB    Z
02898 15 0259P 00004    3044         TDM   SUB-1,4,6Z
02910 43 02934 03027    3045         BD    *&24,WORDZ
02922 15 0259P 00003    3046         TDM   SUB-1,3,6Z
02934 42 00000 00000    3050         BB    Z
02946 15 03020 0000K    3060 DATWO  TDM   WORD-7,2,11Z
02958 49 02706 00000    3070         B     SUB&108Z
02970 15 03024 0000K    3080 INTWO  TDM   WORD-3,2,11Z
02982 49 02826 00000    3090         B     *-156Z
02994 39 03029 00400    3100 PUNCH  WACD  CARDZ
03006 49 02178 00000    3110         B     READZ
03019        2          3120 CTR    DC    2,00Z
03027        8          3130 WORD   DC    8,0Z
03029       80          3140 CARD   DAS   80Z
02178                   3150         DEND  READZ
```