

# IBM

**Customer Engineering  
Manual of Instruction**

## 1620

**Data Processing System Model 1  
1622 Card Read-Punch Feature**

# IBM

## Customer Engineering Manual of Instruction

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# 1620

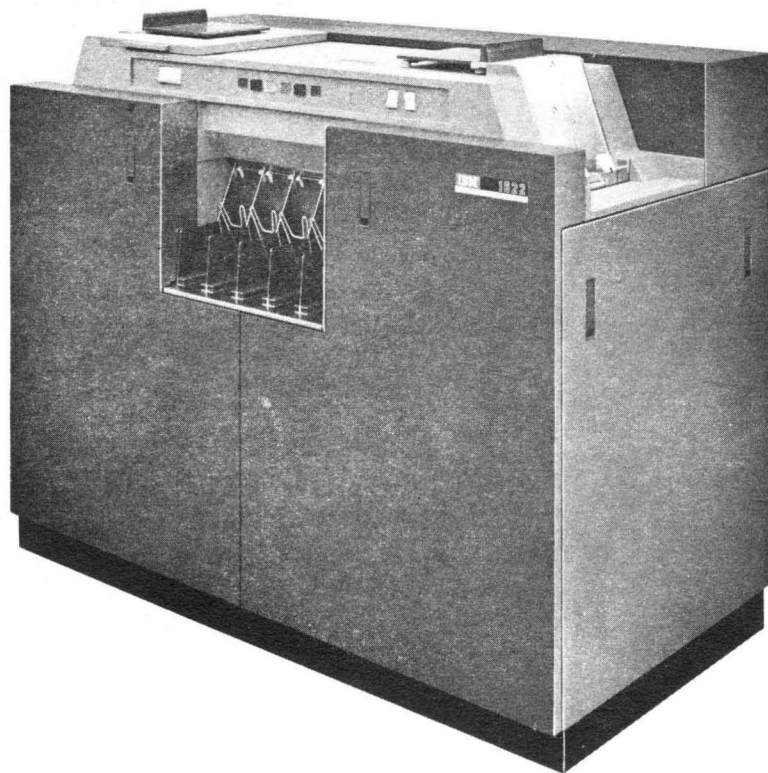
## Data Processing System Model 1

### 1622 Card Read-Punch Feature

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## DESCRIPTION OF UNIT

The IBM 1622 Card Read-Punch is a solid-state electronic and mechanical unit designed to provide punched card input and output for the 1620-1 Data Processing System. The 1622 Model 1 read feed operates at a speed of 250 cards per minute and the punch operates at 125 cards per minute. The 1622 Model 2 read feed operates at a speed of 500 cards per minute and the punch operates at 250 cards per minute. The reader and punch feeds are separate and function independently; each has its individual switches, lights, checking circuits,

buffer storage, and instruction codes. The individual buffer storage units permit reading, punching, and processing to occur simultaneously.

Viewed from the front of the machine, the read feed is located at the right and the punch feed at the left, with five radial stackers in between (Figure 1-1).

The two right-hand stackers are read nonselect and read error select. The two left-hand stackers are punch nonselect and punch error select. The center stacker is not used. IBM card code data that is read by the 1622 Read unit is converted to 7-bit Binary-Coded Decimal (BCD) form A, B, C, 8, 4, 2, 1 for storage in the 1622 Read Buffer, and is transmitted

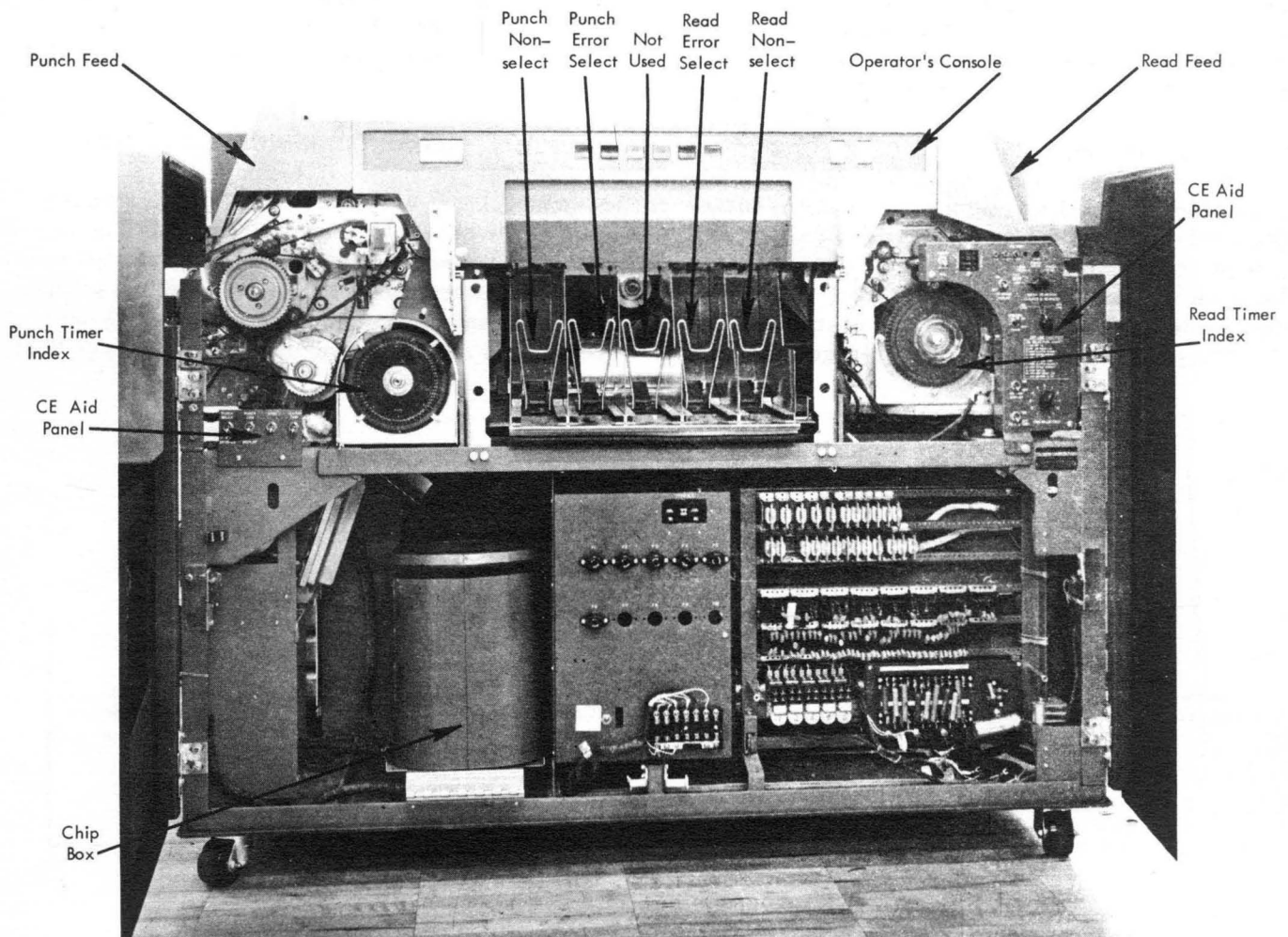


Figure 1-1. 1622 Card Read-Punch — Inside Front View

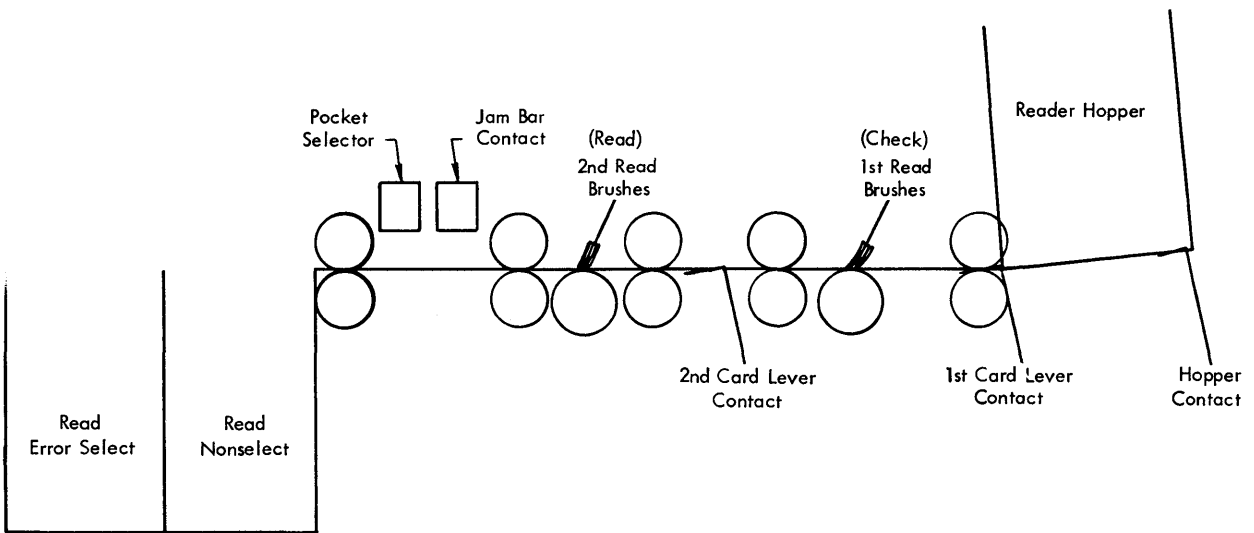


Figure 1-2. Read Feed Schematic

to the 1620-1 in the same 7-bit BCD form. Data is transmitted from the 1620-1 to the 1622 Punch Buffer in the 7-bit BCD form. Subsequently, the punch buffer data is converted to IBM card code for punching into cards by the 1622 Punch unit. See Appendixes for Character Coding Charts.

The card reader feeds cards, 9-edge first, face down, past two reading stations: check and read (Figure 1-2). Input buffer storage is initially loaded with 80 columns of card data during the Start key or Load key run-in operation. Thereafter, each card feed cycle is under 1620-1 program control.

The card punch feeds cards, 12-edge first, face

down, to the punch station during the Start key operation (see Figure 1-3). Thereafter, each card punch cycle is under 1620-1 program control.

#### SWITCHES, KEYS, AND INDICATOR LIGHTS

Switches, keys, and indicator lights are mounted on a single panel above the stackers (see Figure 1-4). The card reader and card punch have separate power switches, start keys, stop keys, nonprocess run-out keys, and ready lights. In addition, the card reader has a reader ready light, reader check light,

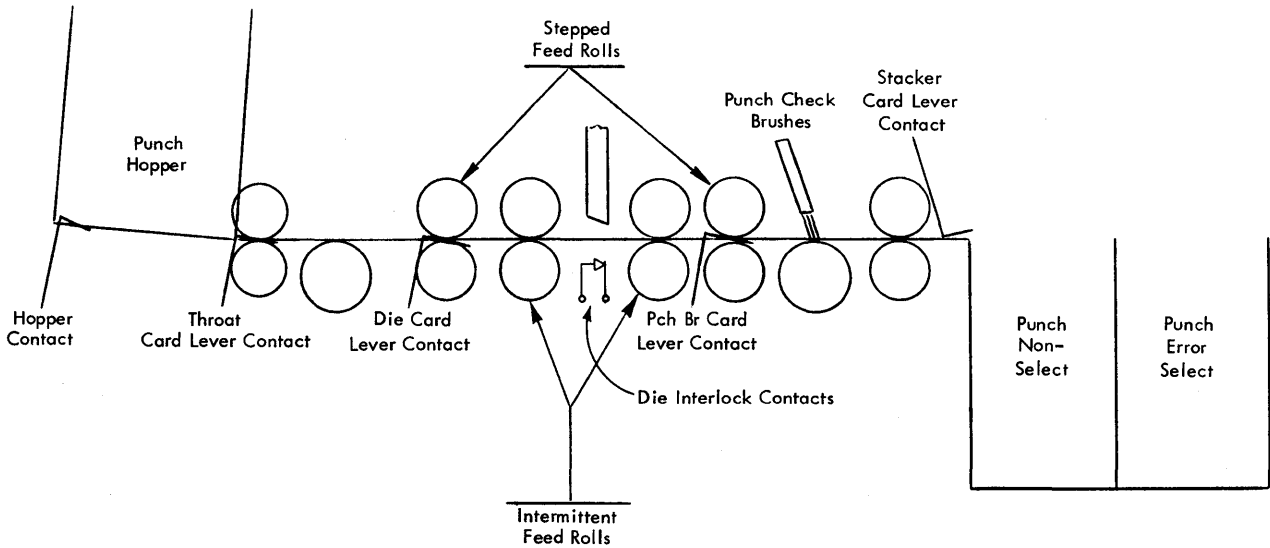


Figure 1-3. Punch Feed Schematic

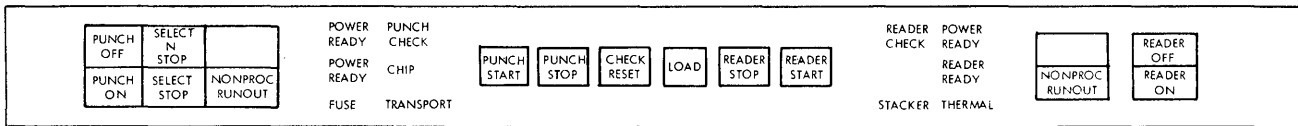


Figure 1-4. 1622 Switch, Key, and Indicator Light Panel

and a load key. The card punch has a punch ready light, punch check light, select stop, select nonstop switch, and a check reset key. The stacker, thermal, fuse, and transport lights are common to both the read and punch feeds.

### Card Reader Controls

#### Reader On/Off Switch

This switch is active after the 1620-1 power is on. It provides power to the reader start and run relay circuits and turns on the reader power ready light.

#### Reader Start Key

This key is used to feed cards on initial run-in (three feed cycles) to set up a reader ready status and to turn on the reader ready light. After the reader has been stopped by the stop key or an empty hopper, the start key restores the reader to the ready status. It also restores the ready status after an error, misfeed, or transport jam is cleared by a nonprocess runout.

#### Reader Stop Key

This key stops the read feed at the end of the card feed cycle in progress and/or removes the reader from the ready status. The computer continues processing until the next read card command causes a reader no feed stop on the 1620-1.

#### Nonprocess Runout Key

This key runs cards out of the read feed after the stop key has been used to stop the reader, or following a reader check error. The cards are run out into the read error select stacker without the transfer of read buffer storage to 1620-1 core storage. The reader check light and check circuits are turned off. Cards must be removed from the hopper to make the nonprocess runout key active.

#### Load Key

This key causes three card feed cycles on initial run-in, initiates an Insert operation in the 1620-1, and after the data is transferred, simulates Release and Start operations. Data from the first card is checked, read into the read buffer storage, and transferred in numerical mode to 1620-1 memory positions 00000 through 00079. Upon completion of this data transfer, the 1620-1 starts an I-cycle to address 00000 for the first instruction of the load card. Another card feed cycle occurs which loads read buffer storage with the data from the second card. To transfer data from the second card to the 1620-1 memory, a Read Numerically or Read Alphamerically operation is required. The 1620-1 must be in manual mode to make the load key active. A function chart of the load key operation is in the Customer Engineering Instructional System Diagrams, (Form 227-5771), on page CRP-2.

#### Reader Check Light

This light is turned on during card reading when an unequal comparison between the read and check stations is detected at read buffer storage or when the reader scan ring is not at home position at clutch latch time. When the light comes on, the reader is stopped, the ready status is terminated, and the buffer storage data which has just been read cannot be transferred to the 1620-1 on a subsequent read command until the error has been cleared. Then the error card can be reread, and if the card is correct, the information will be transferred to the 1620-1.

### Card Punch Controls

#### Punch On/Off Switch

This switch is active after the 1620-1 is on. It provides power to the punch circuits and turns on the punch power ready light.



### Punch Start Key

This key causes cards to feed into the punch station on initial run-in (two feed cycles) and turns on the punch ready light. It is also used to re-establish a ready status after a nonprocess runout has been performed to clear an error, a misfeed, or a transport jam; and to restore the machine to ready status after an empty hopper or a stop key operation has caused the machine to stop.

### Punch Stop Key

This key stops the punch feed at the end of the card cycle in progress and/or removes the punch from ready status.

### Punch Nonprocess Runout Key

This key is used to run out and check the last punched card of a group. Pressing the nonprocess runout key following a punch error causes the error card to proceed to the error select stacker. The card following the error card is checked, and if correct, will go to the punch nonselect stacker; if in error, it will go to the punch error select stacker. Cards must be removed from the hopper to make the nonprocess runout key operative.

### Check Reset Key

This key resets error circuits and turns off the punch check light. If it is desired to ignore the error and proceed with the punch operation, press the check reset key, then the start key.

### Select N Stop - Select Stop Switch

This switch controls the punch when an error is detected and the error card is selected into the error select stacker. If the switch is set to Stop, the punch feed stops with the error card in the punch error select stacker. If the switch is set to N Stop, the error card is selected into the error select stacker and the punch feed continues to process (punch) cards without interruption.

### Punch Check Light

This light turns on when there is an unequal comparison between the data punched and the data written into the punch buffer storage. It also turns on after one punch feed cycle if a parity error occurs during punching or if the punch scan ring is not at "home" position at punch check time. The machine stops and the ready status terminates if the Select N Stop-Select Stop switch is in the Select Stop position. The punch continues to process cards if the switch is in the Select N Stop position.

### Card Reader and Punch Lights

#### Stacker Light

This light turns on and both feeds stop when any stacker is full. Operation is automatically resumed after the stacker is emptied.

#### Transport Light

This light turns on when a card, in either feed, jams in transport. When the jam occurs, both feeds are stopped and removed from the ready status. Both start keys must be pressed to resume operation after the condition is corrected.

#### Fuse Light

This light turns on to indicate an open DC signal fuse.

#### Thermal Light

This light turns on when any one of the four 1622 thermal switches opens because of excessive gate temperature. After the condition which causes the excessive temperature is cleared, the 1620-1 console Reset key is pressed to turn off the thermal light and allow operations to be resumed.

## CE PANELS

Three panels are provided on the 1622 to aid in servicing the machine. (See Figure 1-1 and 1-5). One CE aid panel is located on the front upper right end adjacent to the read dynamic timer index. This panel contains voltage test hubs, dynamic timer control hubs and switches. These switches include a brush display switch, a ready brush selection switch, a read clutch trip switch, a cam select switch, and an off-line switch. Brush and CE timing checks for analyzing trouble or for preventive maintenance may be

made by using the CE aid panel. Four switches for punch brush selection, punch cam display, and sync and punch clutch trip are located on the front upper left of the machine, adjacent to the punch dynamic timer index.

The CE analysis panel (Figure 1-5) is located at the rear of the machine, mounted on the A-gate. This panel contains error indicator lights and lights indicating the Units Tens Ring (UTR) step and the status of all registers and of the scan ring. It also contains the read or punch select, single cycle, and UTR control switches.

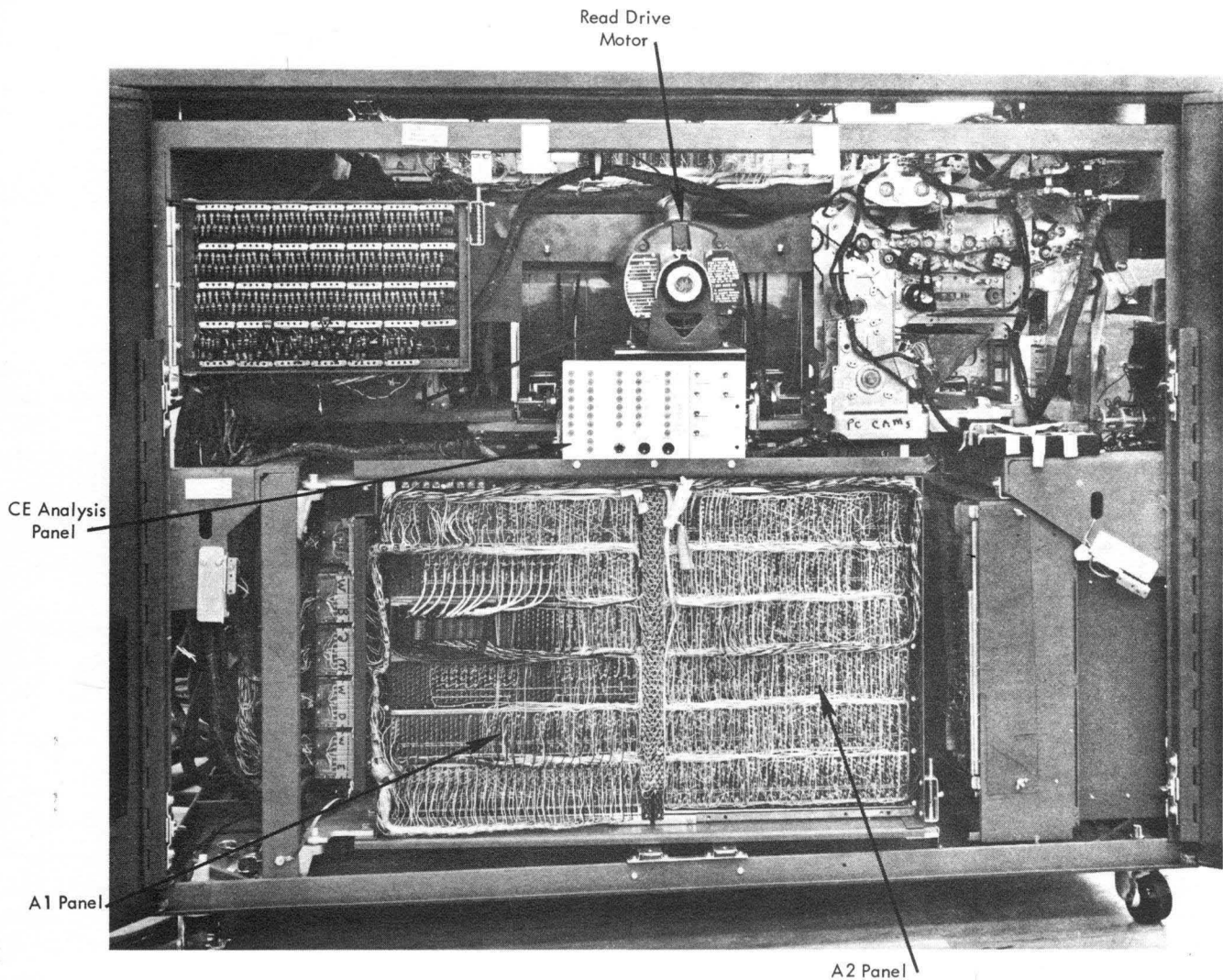


Figure 1-5. 1622 Card Read-Punch — Inside Rear View

POWER-ON SEQUENCE

The sequence, objectives, and functions of operations necessary to place the 1622 in a ready status are described in this section (Figures 2-1 and 2-2).

1620 Power Circuit Breaker (PCB)

Objectives

1. To apply voltage to the 1622 convenience outlet
2. To put the "normal" relay, R103, under control of:
  - a. Relay 104 which in turn is controlled by the gate overtemp thermal trips
  - b. SMS power supply overload-trip CB contacts.
3. To supply 24-v DC for power-on sequence control circuits and for DC monitor circuits
4. To pick R110. The slow dropout time of R110 sets the time limit during which all DC power supplies come up to rated level.

Turning on the 1620 PCB develops 1620-1 24-v AC which picks K1. The points of K1 make, supply-ing voltage to the 1622 convenience outlet and to the 24-v rectifier. The output of the 24-v rectifier turns on the 1622 thermal light and picks R110 (timer). Pressing the 1620-1 Reset key picks R104 (1622) which remains up until the PCB is turned off or a thermal switch opens. When R104 is picked, the 1622 thermal light goes off and R103 (1622 normal) is picked. Relay 104 is under control of the n/c contacts of the overtemp thermostats. A normal power-on and power-off operation does not affect the operation of R104. Therefore, under normal conditions, the 1620-1 Reset key needs to be operated only once after the PCB is turned on in order to reset a thermal.

1620 Console Power Switch

Objectives

1. To bring DC voltages up to operating levels. These voltages are: -12; +12; -20; +3.

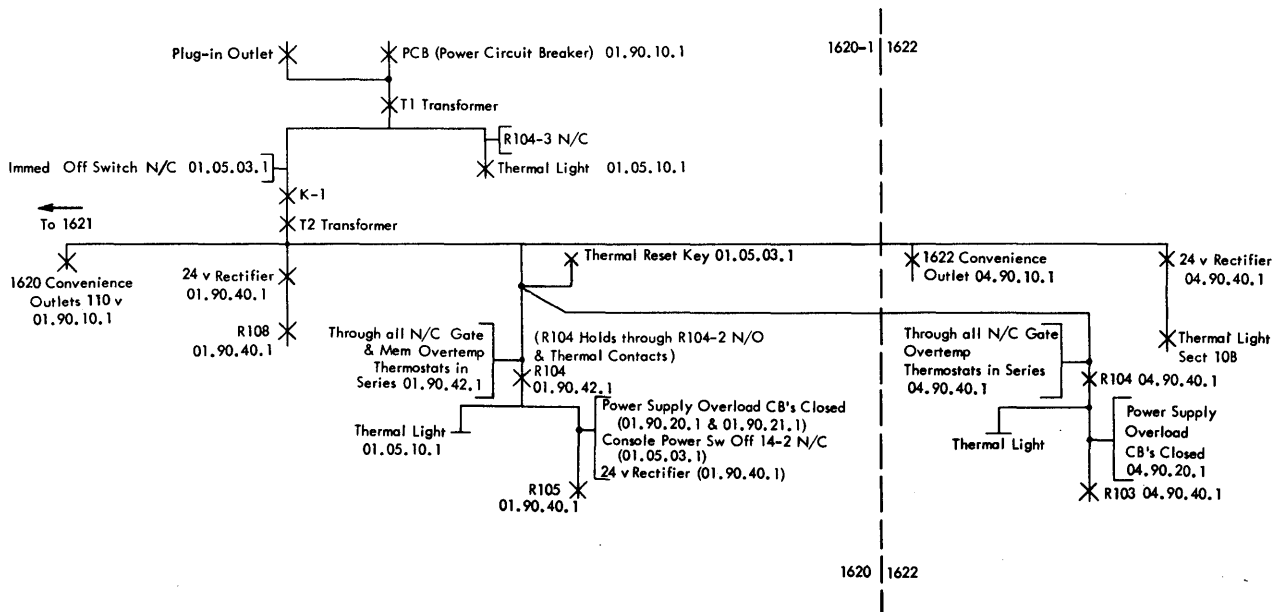


Figure 2-1. Power ON Sequence - 1620 PCB

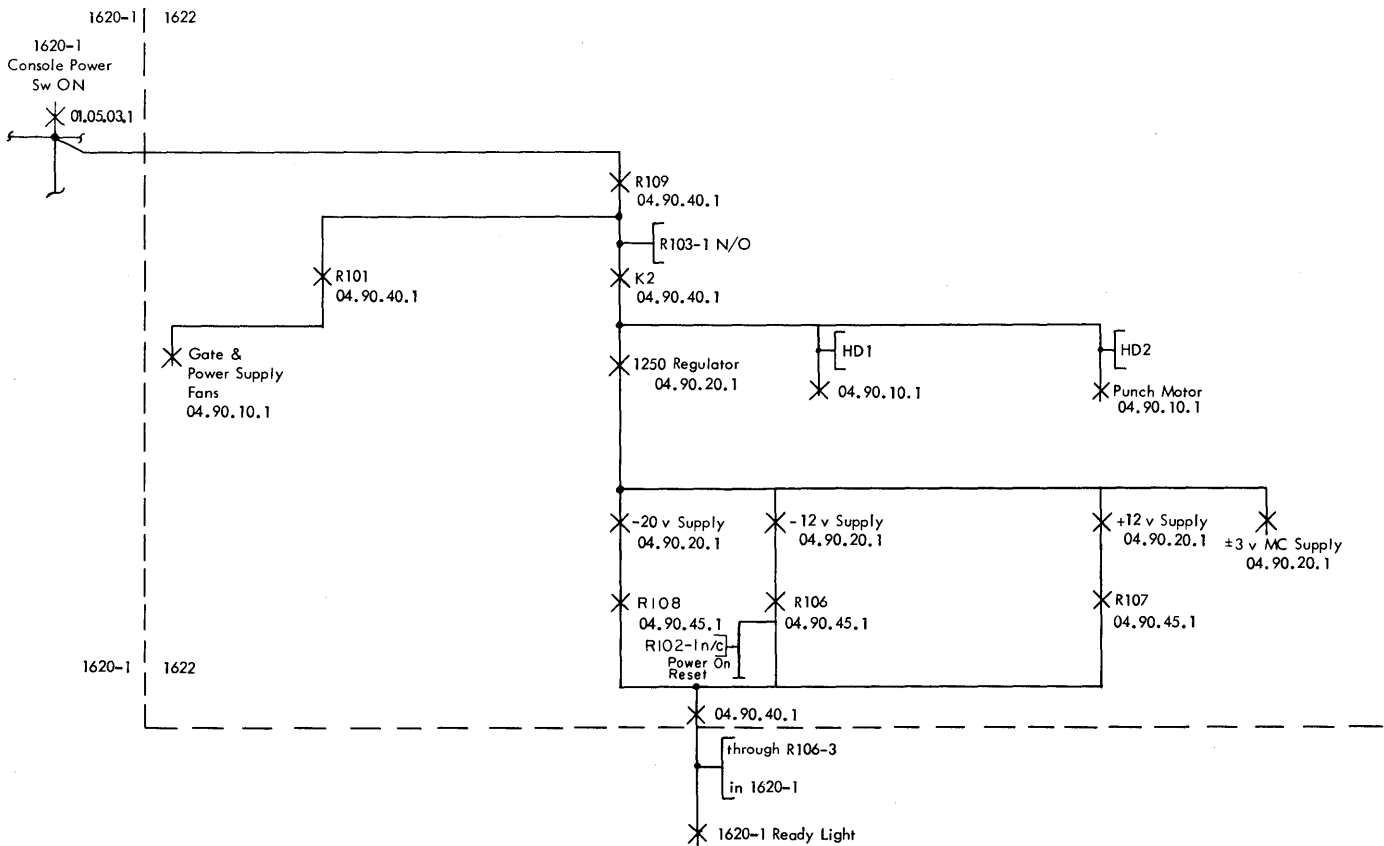


Figure 2-2. Power ON Sequence — 1620 Console Power Switch

NOTE: The 1620-1 power-on reset resets all 1622 latches except Error and Ready latches (04.10.10.1 and 04.10.11.1). The 48 volts passing through a sequence relay point in the 1622 is supplied by the 1620-1.

2. To turn on gate and power supply fans
3. To provide a computer ready indication (1620-1 ready light).

NOTE: Both R106 in the 1620-1 and R102 in the 1622 must be up to turn on the 1620-1 ready light or, if the 1622 AC power control switch is off (SW2-3), the 1620-1 ready light is controlled by the 1620-1 only.

When the 1620-1 console power switch is turned on, R109 (1622) is picked. Relay 109 picks R101 which turns on the gate and power supply fans and opens the pick circuit to R110. Relay 110 starts its slow dropout. Relay 109 also picks K2 through R103-1.

Contactor K2 supplies voltage to HD1 and HD2 contacts, and the 1250-w regulator. The power

supplies come up to level and pick voltage sense relays R105, R106, R107, and R108. The points of these relays provide the hold for R103, the "normal" relay, through the power supply CB's. If one of the voltage fails to reach its level, the voltage sense relay for that supply will not pick and, when R110 drops out, no hold for R103 will be available. Relay 103, when dropped, drops K2, and the primary supply to the regulator and drive motors is removed.

If either the 1620-1 or 1622 powers down independently, the 1620-1 ready light is extinguished and a power-OFF reset resets both machines.

#### POWER-OFF SEQUENCE

##### Console Power Switch

Turning off the console power switch causes:

1. Power-off reset (manual reset) to be enabled
2. Ready lights to turn off
3. Fan motors and all DC voltages to turn off.

### Gate Thermal Trip

A gate thermal trip causes power to turn off in the following sequence:

1. Power-off reset enabled and ready lights OFF (both machines).
2. All DC voltages OFF (both machines).
3. Thermal lights ON (both machines).
4. Fans and power-on lights (both machines).  
The 24-v DC sequencing remains ON.

When the condition causing the thermal trip is cleared and the Reset key is pressed, the thermal light turns off. The console power switch must be turned off, then on, to get a normal power-on sequence.

### SMS Power Supply Overload Trip

An SMS power supply overload CB tripping causes power-off in the following sequence:

1. DC voltage of a particular power supply drops, power-off resets (both machines), fan motors turn off.
2. All DC voltages off except 48v (supplied by 1620-1).

### Immediate Off Switch

Activating the Immediate OFF switch causes power to turn off in the following sequence:

1. Both machines - fan motors, convenience outlets, ready lights, and all DC voltages OFF.
2. 24-v AC to thermal circuits drop, and the thermal light comes ON. Transformer T1 (1620) remains energized with 208/230-v input.

## SMS CARDS

The 1622 uses some of the same SMS cards as the IBM 1620-1 Computer. These cards are described in the Customer Engineering Manual of Instruction, 1620 Data Processing System Model 1, (Form 227-5751).

This section describes SMS card types used in the 1622. Table 1 lists the SMS cards by Card Code, Part No., Symbol, Description, and System Diagrams. The system diagrams include a schematic of the SMS card, the block symbol, and the input and output levels.

Card Code	Part No.	Symbol	Description	System Diagram No.
ACY	370169	IS	Current Source, Alloy	C.00.03.1
AHS	370336	DCM	Clutch Magnet driver, Alloy	C.00.06.1
AHT	370337	DPM	Punch Magnet driver, Alloy	C.00.06.1
DAT	370173	DP	Driver, Heavy power, Inverting, Drift	C.00.15.1
DAW	370083	E	3-way Inverter, N-type, Unloaded collector, Drift	C.00.17.1
DED	371987	DL	Transmission Line Driver, Cable Driver, Drift	C.00.20.1
DEE	371988	DT	Transmission Line terminator, Cable terminator, Drift.	C.00.22.1
DFA	370224	L	Latch, Drift	C.00.24.1
PF	371750	D	Driver, Light or Relay, Alloy	C.00.42.1
TBD	370171	SW	Switch, Decode, Alloy	C.00.50.1
TCZ	370335	L	Latch, Drift	C.00.55.1
YAR	370321	Diode Card	Diode Card	C.00.65.1

Table 1. 1622 SMS Cards

## DED and DEE Cards

The DED cards are used as data line drivers (DL), the DEE cards as data line terminators (DT). Each card contains four independent circuits. The combination of a DED block and DEE block connected by a twisted pair or wires, forms the necessary circuitry for one transmission line between the 1620-1 and the 1622 (Figure 3-1).

A +S input to a DED block results in a +C output and a -S input results in a -C output. A +C input to a DEE block results in a -S output and a -C input results in a +S output. Note the inversion factor between the DED input and the DED output. The +C level between machines is nominally +1.0v; -C level is nominally -2.0v.

## TCZ and DFA Cards

Each card contains two latches which are logically and functionally independent. Each latch is shown on the systems diagrams as one block. Therefore, one TCZ or DFA card is represented as two separate blocks on the systems diagrams (Figure 3-2). On both TCZ and DFA cards, a -S input to pin K or pin L will turn on Latch No. 1. A +S input to pin P will turn on Latch No. 1 by collector pullover. Pin C is at a +S level when Latch No. 1 is off and is at a -S level when the latch is on. Latch No. 1 is off and is at a +S level when the latch is on. Pin B is at a -S level when Latch No. 1 is off and is at a +S level when the latch is on.

Latch No. 2 of both the TCZ and DFA cards is turned on by a -S input to the A or G pin. A +S input to pin F will turn on latch No. 2 by collector pullover. Output pin D is at -S when latch No. 2 is on and is at +S when the latch is off. Output pin E is at +S when the latch is on and is at -S when the latch is off. The TCZ and DFA latches are turned off as follows:

- TCZ    -S applied to pin Q turns off circuit 1.  
        -S applied to pin H turns off circuit 2.  
        -S applied to pin R turns off circuits 1 and 2.
- DFA    -S applied to pin Q turns off circuit 1.  
        -S applied to pin H turns off circuit 2.  
        -S applied to pin R turns off circuit 1.

## POWER SUPPLIES

The IBM 1622 receives its primary power supply from the 1620-1 system. The 1622 requires an input voltage of 208 v AC or 230 v AC. The 208 v supply can vary between the limits of 187 v and 228 v and the 230-v supply can vary between 207 v and 253 v.

SMS Power Supplies

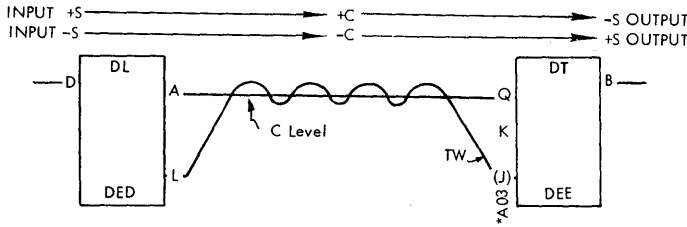
-20 from -19.20 to -20.80  
 +48\* from +43.20 to +52.80

The internal functions of the individual SMS power supplies and the theory of ferroresonant regulator transformers are explained in the Customer Engineering Manual of Instruction, 60-cycle SMS Power Supply (Form 225-6478). For normal operation, the 1622 SMS Power Supply DC output voltages must be maintained within the following levels:

- +12 from +11.52 to +12.48
- +12M from +11.52 to +12.48
- 12 from -11.52 to -12.48

These levels must be measured at the gate voltage bus assembly. A +3-v MC Power Supply is provided for use in making marginal voltage checks. All machine functions must operate correctly when the +12M DC supply is set between +10.2 and +13.8 (marginal test).

\* Supplied by the 1620-1



NOTE: CIRCUIT NO. 1 ILLUSTRATED

DL-DED INPUT PIN	"C" LEVEL OUTPUT PIN	GND LEVEL OUTPUT PIN	CIRCUIT NUMBER	-12v LEVEL INPUT PIN	"C" LEVEL INPUT PIN	DT-DEE OUTPUT PIN
D	A	L	1	P	Q	B
C	E	Q	2	K	D	A
B	G	K	3	F	E	C
F	H	P	4	R	H	LG

\* Card location where the TW ground wire is connected to a J pin. This location is not necessarily on the same block as its associated signal wires.

Figure 3-1. 1622 Data Line Drivers and Terminators

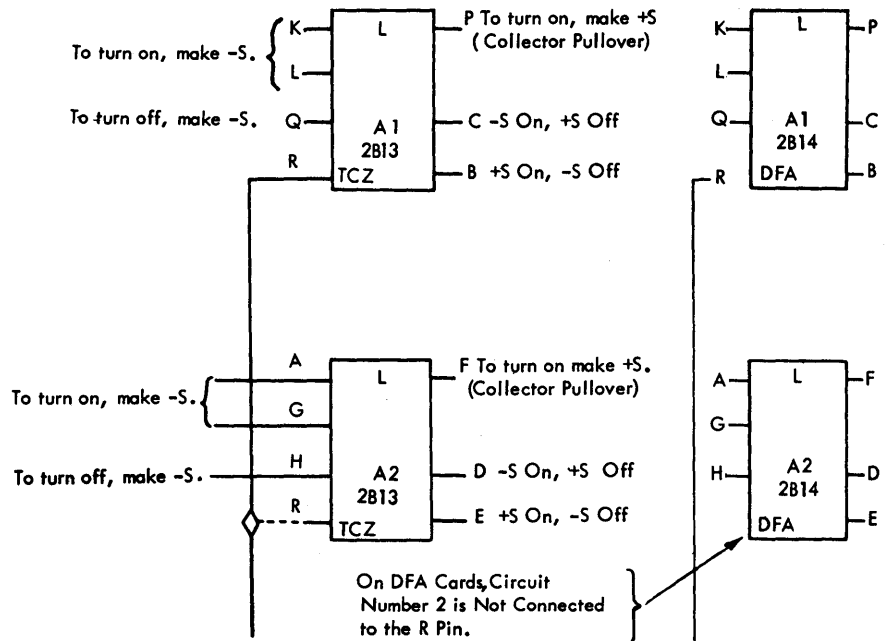


Figure 3-2. TCZ and DFA Latches

## READ NUMERICALLY WITH 1622

## Objectives (Figure 4-1)

1. To transfer numerical information into the 1620-1 memory from the 1622 Read Buffer.
2. To store the information at the memory location designated by the P-address and 79 successively higher memory locations.
3. To initiate a card feed cycle after transfer of card data from the 1622 Read Buffer.

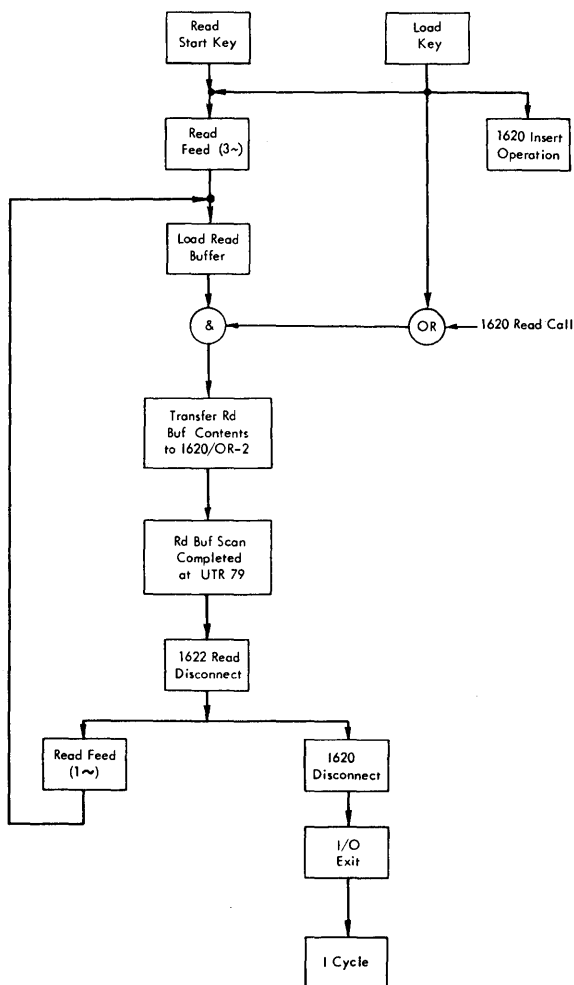


Figure 4.1. Read Operation Functional Objectives

## Function

A function chart and a sequence chart of this operation are shown on pages CRP-3, CRP-4, and CRP-5 in the Instructional System Diagrams.

During the I-cycle, the  $Q_8$  and  $Q_9$  digits of the instruction are placed in the Digit/Branch register and are decoded to specify the input device. The 1622 Card Reader is specified by 05.

Transmission of input data from the card reader is accomplished by transmitting the output of the 1622 Single Character Register (SCR) to the 1620-1 input translator. Digits are transmitted serially. Transmission is terminated when 80 digits have been transferred.

The Code 36 operation signals the 1622 to read out a position of read buffer storage and store it in SCR. The 1622 clock is started and the UTR takes one step. During the clock cycle of a given UTR step, the SCR is loaded and a signal (card read sync) is sent back to the 1620-1 to indicate that the 1622 SCR is presenting a digit to the 1620-1 input translator. Upon receiving the card read sync signal, the 1620-1 accepts the data, stores it into the memory location designated by OR-2 and sends a signal to the 1622 to start processing the next digit. This request-response sequence continues until 80 digits have been transmitted to the 1620-1 memory. The UTR, upon reaching Step 79, signals the end of transmission by sending a card read disconnect signal to the 1620-1. The 1620-1 ends the Code 36 operation and enters the I-cycle for the next instruction in sequence. The 1622 Read Clutch is energized to cause a card feed cycle. During this cycle, data from the next card is read into the read buffer storage where it remains until the 1620-1 program calls for the next Code 36 operation.

The request for the first digit is made via a different circuit than are requests for the remaining 79 digits. See the function chart on page CRP-3 in the Instructional System Diagrams.

Request for the first digit is made when the Read-Write Call trigger is turned on. If the read buffer is ready and a punch operation is not in progress, the 1620 Read Scan latch is turned on which in turn causes the Trans-to-1620 latch to be turned on. The Trans-to-1620 latch ON starts the 1622 clock which steps the UTR, and the first digit is transmitted as previously described.

If the read buffer is ready and a punch operation is in progress, the 1620 Read Scan latch waits until



UT-79 time of the operation in progress before turning on. The delay, until UT-79 is ANDed with B13-D1 time, ensures that the transfer of data to the 1620-1 occurs immediately following a punch-buffer scan or punch-trans-accu operation. If the program calls for a Code 36 operation and the 1622 has completed a punch buffer scan or punch-trans-accu operation (after UT-79 and B13 time), the read operation must wait until the end of the next punch operation. This delay prevents the read operation from overlapping when the next punch operation must occur. With the 1620 Read Scan latch on, the Trans-to-1620 latch is turned on to start the 1622 clock, step the UTR, and transmit the first digit to the 1620-1.

Request for the second and all subsequent digits comes as a result of the 1622 clock being started for the preceding digit. At B5 time of the 1622 clock cycle, a card read sync signal is sent to the 1620-1 to turn on the Sync trigger. Timing relations between the 1620-1 and 1622 result in the Sync trigger being OFF for about 2  $\mu$ sec during the 40  $\mu$ sec that Trigger 31 and 30 are ON. The Sync trigger ON prevents the Hold trigger from being turned on. (See Sequence Charts, pages CRP-4 and CRP-5 in the Systems Diagram Manual). The normal sequence of 1620-1 triggers during a read operation is to turn on Trigger 30 at A-Advance time and Trigger 31 at B-Advance time followed by Trigger 30. During Trigger 30 time at T5-D3, the set MDR sample I/O line is impulsed to set the MDR triggers. At the same time, this impulse turns on the Trans-to-1620 latch in the 1622 to initiate the transfer of the following digit. This sequence continues until the 1620-1 receives a card read disconnect signal which turns on the Disconnect Gate trigger. The Disconnect Gate trigger turns on the I/O Exit trigger. With the I/O Exit trigger ON, the 1620-1 enters the I-cycle for the next instruction in sequence.

A card read operation may occur when no punch operation is in progress or it may occur concurrently with a card punching operation. The latter condition is known as an "Interleave" operation. During an Interleave operation, all 80 characters in the read buffer storage are transferred to the 1620 between the time one punch scan operation ends and before the next punch scan begins, that is, it requires about 3.2 msec (80 characters X 40  $\mu$ sec) to transfer the contents of read buffer storage to the 1620-1, and approximately 30 msec for a card in the punch feed to move from one row to the next.

If the 1620-1 calls for a Code 36 operation and the 1622 card reader is not ready to transfer data, the reader no feed lamp is turned on and the request for the first digit is not sent to the 1622. The 1620-1 waits until the 1622 card reader is ready and then both proceed with the Code 36 operation.

The Read Check trigger is turned on if a character with incorrect parity is presented to the input translator. However, the computer continues to accept input data until the read operation is terminated. With the Read Check trigger ON, the 1622 read clutch is not energized and the automatic next card feed cycle does not take place.

#### Auxiliary Triggers

##### Increment/Decrement Trigger (01.60.05.1).

1. Turned off (Increment) when the I-cycle is entered
2. Remains off throughout E-cycle

##### Read/Write Call Trigger (01.64.14.1).

1. Off when the E-cycle is entered
2. Is turned on by the Hold trigger and remains on until the read operation is terminated. Request for first digit is made at this time.
3. Turned off by I/O Exit trigger.

##### Sync Trigger (01.64.13.1).

1. Off when the E-cycle is entered
2. Turned on by a card read sync signal from the 1622
3. Turned off during Trigger 30 time.

##### Disconnect Gate Trigger (01.80.25.1).

1. Off when the E-cycle is entered
2. Turned on by a card read disconnect signal from the 1622 to terminate the read operation
3. Turned off by the I/O Exit trigger.

##### I/O Exit Trigger (01.64.13.1).

1. Off when the E-cycle is entered
2. Turned on by the Disconnect Gate trigger when termination of read operation has been signalled by the 1622
3. Turned off by Trigger 1 of the I-cycle.

#### E-Timer Trigger Objectives

##### Hold Trigger (01.64.12.1).

1. Turns on Read/Write Call trigger
2. Blocks MAR reset to prevent VRC error
3. Stops the computer clock to prevent unnecessary cycling of memory.

Under normal conditions, the action of the Sync trigger allows the Hold trigger to be ON only momentarily at the start of the read operation and keeps it OFF thereafter. Therefore, the 1620-1 clock runs

continuously during the read operation, If a condition occurs where the Sync trigger is not turned on, the Hold trigger turns on when impulsed and carries out its normal objectives.

#### Trigger 31 (01.64.11.1).

1. Reads out of memory per OR-2
2. Writes back OR-2 bypassed
3. Turns on Trigger 30.

Trigger 31 has no functional objectives when used with the typewriter or paper tape reader and Code 36. However, with the 1622 card reader and Code 36, more time is needed for transmitting certain digits between the 1622 and the 1620 than one memory cycle allows. In this case, Trigger 31 time is used to advantage, though it causes no specific function.

#### Trigger 30 (01.64.10.1).

1. Reads out of memory per OR-2 with either the odd or even sense amplifiers blocked (Read-Y), depending on whether the OR-2 address is odd or even. This operation clears the memory location.
2. Writes back OR-2 incremented plus 1
3. Sets input character into MDR
4. Requests next digit from 1622 Card Reader
5. Transfers MDR to MBR
6. Writes into memory per OR-2 from MBR
7. Turns on Hold trigger
8. Turns on Trigger 31.

#### 1622 Latches

##### Read Buffer Ready Latch (04.10.11.1).

1. Turned on during 12 read time (RSR12), at the end (UT-79) of the last read row bit scan, provided Card Lever 2 is made. This latch ON indicates that a complete card has been read, that data from the card is stored in read buffer storage, and that it is ready to be transferred to the 1620-1.
2. Turned off by the 1620 I/O Exit trigger ON ANDed with the 1622 Read Clutch Control latch ON.

##### 1620 Read Scan Latch (04.10.09.1).

1. Turned on by the 1620-1 requesting the first digit (reader data gate)
2. Turns on the Trans-to-1620 latch for first digit requested
3. Remains on until UT-79 time.

##### Trans-to-1620 Latch (04.10.09.1).

1. Turned on by the 1620 Read Scan latch for first digit to be transferred

2. Turned on by Trigger 30 for the second and all subsequent digits to be transferred
3. This latch ON starts the 1622 clock
4. Turned off at B14 time of each 1622 clock cycle.

##### Read Disconnect Control Latch (04.15.06.1).

1. Turned on (B5-D8) during UT-79 time (80th digit transferred)
2. Turned off by I/O Exit trigger.

##### Read Clutch Control Latch (04.15.06.1).

1. Turned on by Read Disconnect Control latch ANDed with the 1620 sample I/O from Trigger 30
2. Turned off by Read Trans-Accu Pulse shaper which is turned on following clutch engagement for the next card feed cycle.

##### Read Disconnect Latch (04.15.06.1).

1. Turned on by Read Disconnect Control latch ANDed with the 1620 sample I/O (Trigger 30)
2. Read Disconnect latch ON provides the card read disconnect signal to the 1620-1 to turn on the Disconnect Gate trigger
3. Turned off by the I/O Exit trigger.

##### Read Clutch Drive Latch (04.15.06.1).

1. Turned on by Read Clutch Control latch ANDed with RC-5 (M272<sup>0</sup>) open. This condition ensures that the read clutch is picked by a complete 50<sup>0</sup> impulse from RC-5.
2. Read Clutch Drive latch ON ANDed with RC-5 picks the read clutch to initiate the next card feed cycle.

#### READ ALPHAMERICALLY WITH 1622

Read Alphamerically - Code 37 and Read Numerically - Code 36 are alike except that in Code 37 operations the input translator supplies a digit (zone) to MBR-even as well as to MDR.

#### Objectives

1. With the computer in alphameric mode, Code 37 reads information into memory from the read buffer storage in the 1622.
2. Stores the information as two adjacent digits at the memory locations designated by the P-address minus 1 and the P-address (OR-2) and successively higher pairs of memory locations.

## Functions

During the I-cycle, the Q<sub>8</sub> and Q<sub>9</sub> digits of the instruction are placed in the Digit/Branch register and decoded to specify the input device. The 1622 Card Reader is specified by 05.

Characters of input data are transmitted serially. Each character is stored in memory as two adjacent digits beginning at the memory locations designated by the P-address minus 1 and the P-address (OR-2). This process continues with successively higher pairs of memory locations. The P-address must designate an odd-numbered memory location for storage of the numerical digit of the first character. The zone digit of the first character is placed at the next lower memory address, which is an even address. Increment plus 2 is used to provide memory addresses for successive characters.

If an even-numbered memory location is erroneously designated by the P-address, input data is not correctly placed in memory and parity errors may occur.

All flag bits existing in memory locations to which input data is being transmitted remain unchanged. Data from the input device may consist of a random mixture of numerical, alphabetic, and special characters.

The Read Check trigger is turned on if a character with incorrect parity is presented to the input translator. However, the computer continues to accept input data until the read operation is terminated. With the Read Check trigger on, the 1622 Read Clutch is not energized and the next card feed cycle does not take place automatically.

## Auxiliary Triggers Used

See READ NUMERICALLY WITH 1622

### E-Timer Trigger Objectives

#### Hold Trigger (01.64.12.1).

See READ NUMERICALLY WITH 1622

#### Trigger 31 (01.64.11.1).

1. Reads out of memory per OR-2 to set F-bit triggers in MBR for retention of any F-bits in the memory locations receiving input data.
2. Write back OR-2 bypassed to retain the address for clearing and writing into the memory locations during Trigger 30 time.

#### Trigger 30 (01.64.10.1).

1. Reads out of memory per OR-2 with both the odd and even sense amplifiers blocked to clear the memory locations (Block-Memory-SA)
2. Writes back OR-2 incremented plus 2
3. Blocks reset of F-bit triggers in MBR-even and MBR-odd
4. Sets MBR-even and MDR triggers per character from 1622 buffer
5. Transfers MDR to MBR-odd
6. Writes into memory per OR-2 from MBR.

### 1622 Latches

See READ NUMERICALLY WITH 1622

## WRITE NUMERICALLY WITH 1622

## Objectives (Figure 5-1)

1. To transmit numerical information, including flag bits, from the memory location designated by the P-address (OR-2) and successively higher memory locations to punch buffer storage in the IBM 1622.
2. To initiate a card feed (punch) cycle after the transfer of 1620-1 data to the punch buffer storage. This card feed causes the data in the punch buffer to be punched in the card.

NOTE: The 1620-1 proceeds with the next instruction while punching is taking place.

## Functions

During the I-cycle, the  $Q_8$  and  $Q_9$  digits of the instruction are placed in the Digit/Branch register and decoded to specify the output device. The Card Punch is specified by 04.

Transmission of output data from the 1620-1 memory to the 1622 punch buffer storage is accomplished by transmitting the output of MDR through the output translator to the Single Character Register (SCR) in the 1622. Digits are transmitted serially-by-character and parallel-by-bit. Transmission is terminated when 80 digits have been transferred. Page CRP-6 in the Instructional System Diagrams is a function chart of this operation.

The Code 38 operation signals the 1622 (-C card punch data gate) that the 1620-1 is ready to send data to the punch buffer. When the punch buffer is ready, the 1622 (-C card punch sync) first sends a signal back requesting the 1620-1 to proceed with presenting a digit to the output translator, and then the digit is sent to the SCR. The 1620-1 responds (Trigger 30, Hold trigger) and presents a digit to the output translator. The 1620-1 then signals (-C set I/O sample MDR) the 1622 to store the digit in the SCR. The 1622 clock is started and the UTR takes one step. During the clock cycle of any given UTR step, the input to the SCR is gated, the contents of the SCR are written into punch buffer storage, and a signal (-C card punch sync) is sent back requesting the 1620-1 to proceed with sending the next digit to the 1622. This request-response sequence continues

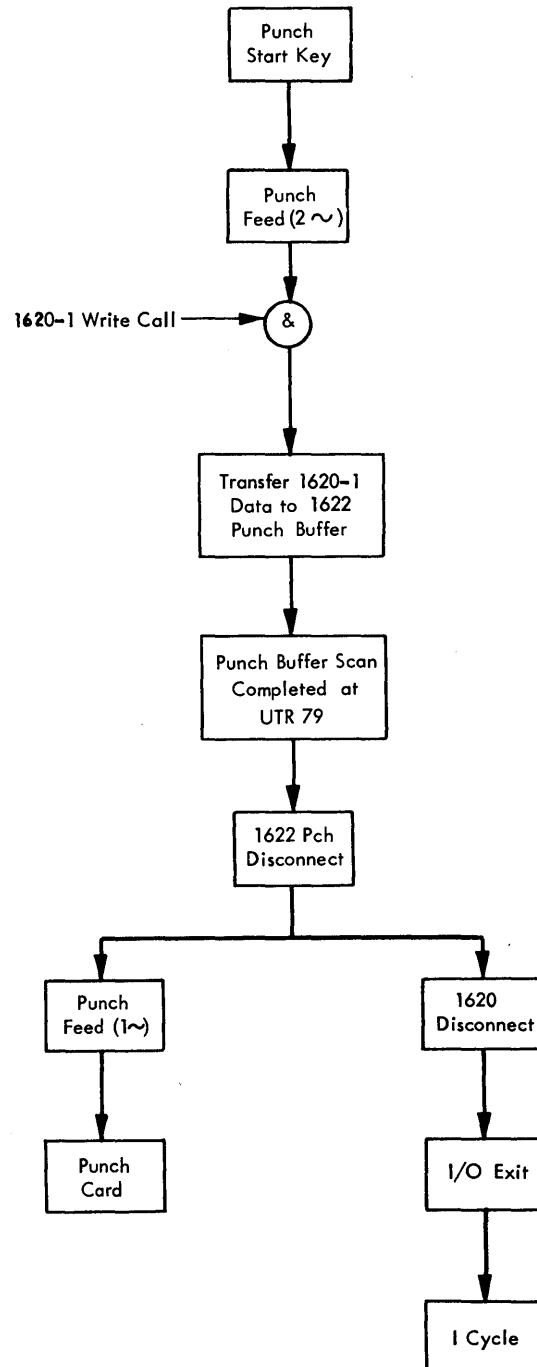


Figure 5-1. Punch Operation Functional Objectives

until 80 digits have been transmitted to the 1622 punch buffer storage. When UTR Step 79 is reached, the 1622 signals (-C card punch disconnect) the 1620-1 to disconnect and enter the I-cycles for the next instruction in sequence.

Following a disconnect signal (if there was no 1620-1 write check), the punch clutch is engaged. The data now stored in the punch buffer is translated to IBM card code and punched in the card that is moving through the punch station.

The initial interrogation of the 1622 punch as to its status, is made by the Read/Write Call trigger. The -C card punch data gate is used to determine that the 1622 is ready to accept data before the 1620-1 presents the first digit to the output translator. If no read operation is in progress, the card punch data gate turns on the Punch Scan latch, which in turn sends a request (-C card punch sync) back to the 1620-1 for the first digit to be sent to the punch buffer. The 1620-1 responds by turning on Trigger 30 which places the desired digit (per OR-2) in MDR. The Hold trigger is then turned on and Trigger 30 is turned off. Trigger 30 OFF signals the 1622 (-C set I/O sample MDR) to accept the digit. The UTR is started, the digit is written into the punch buffer storage, and the 1620-1 is signalled to send the next digit as previously explained.

If a read operation is in progress, the transfer of digits is delayed until the end of a read-buffer-scan operation. This is to ensure sufficient time for the transfer of 1620-1 data to punch buffer storage between read-buffer-scan operations, without interfering with the read operation. Thus, a Write-Code 38 operation can load the punch buffer between the reading of two adjacent rows in the card, at the second read brushes. This operation is termed interleaving.

Flag bits in memory with digits of output data are recorded as 11 punches (X punches) over the digit punched in the card.

Alphabetic characters, special characters, and numerical characters that have been stored in memory as two adjacent digits, because the computer was in alphameric mode, are punched in the card as two separate numerical characters.

The write operation leaves output data unchanged in memory.

The Write Check trigger is turned on, if a character with incorrect parity is presented to the output translator. However, the computer continues to send output data to the 1622 until the write operation is terminated. When the Write Check trigger is ON, the punch clutch cycle following the transfer of data cannot be initiated, and the data stored in punch buffer storage is not punched in a card.

## Auxiliary Triggers

### Read/Write Call Trigger (01.64.14.1).

1. Turned on when the E-cycle is entered and remains on until the punch operation is terminated.

The test for the status of the 1622 is made at this time. Note that set I/O sample MDR is not active until Trigger 30 has been turned on and then turned off again. (Trigger 30 ON turns off Trigger 8 which is used as a first cycle control.)

2. Turned off by I/O Exit trigger.

### Sync Trigger (01.64.13.1).

1. Off when the E-cycle is entered
2. Turned on by the card punch sync signal from the 1622
3. Turned off during Trigger 30 time.

### Disconnect Gate Trigger (01.80.25.1).

1. Off when the E-cycle is entered
2. Turned on by a card punch disconnect to terminate the punch data transfer operation
3. Turned off by the I/O Exit trigger.

### I/O Exit Trigger (01.64.13.1).

1. Off when the E-cycle is entered
2. Turned on by the Disconnect Gate trigger when termination of the write operation has been signalled by the 1622.

## E-Timer Trigger Objectives

### Hold Trigger (01.64.12.1).

1. Blocks MAR reset
2. Stops the computer clock if a -C card punch sync signal from the 1622 is missed or delayed.

Under normal circumstances, the Hold trigger is turned off by the Sync trigger before it can stop the clock. If the 1622 punch is not ready to receive punch data, the turn-on time of the Sync trigger may be delayed. In this case the Hold trigger remains on and stops the clock. The computer then hangs up in the automatic mode, waiting for the ready signal from the 1622.

### Trigger 30 (01.64.10.1).

1. Reads out of memory per OR-2 and stores the digit in MDR
2. Write back OR-2 incremented plus 1
3. Turns off Trigger 8
4. Turns on the Hold trigger.

Trigger 30 OFF blocks the reset of MBR-odd, MBR-even and MDR.

Punch-Buffer-Ready Latch (04.10.11.1).

1. Turned on at the end of punch check time (B13 time of UT-79) provided the punch die card lever contact is closed (R23 picked). When this latch is on, it indicates that the punching and checking of a card started by a previous write operation has been completed.
2. Turned off by the Punch Disconnect latch which is turned on at the end of the write operation.

1620 Punch-Scan Latch (04.10.09.2).

1. Turned on by the punch data gate when the 1620-1 interrogates the status of the 1622 to determine if the 1622 is ready to receive the first digit to be transferred
2. Turned off at UT-79 time of the write operation when all 80 digits have been transferred from the 1620-1 to the 1622 punch buffer storage.

Transfer-from 1620 Latch (04.10.09.2).

1. After Trigger 30 has been turned off, this latch is turned on by the Read/Write Call trigger to signal the 1622 (-C set I/O sample MDR) to start the 1622 clock and accept the digit being sent to the SCR through the output translator.
2. Turned off at B14 time of each 1622 clock cycle.

Punch-Disconnect Latch (04.15.06.1).

1. Turned on at B3 time of UTR-79 to: (A) initiate the 1620-1 disconnect operation which releases the 1620-1 to proceed with the next instruction, and (B) initiate a punch clutch operation.
2. Turned off when the Punch-Trans-accu-Stacking latch is turned on.

Punch-Clutch-Control Latch (04.15.06.1).

1. Turned on by the Punch Disconnect latch if there is no write check
2. Turned off when the Punch-Trans-accu-Stacking latch is turned on.

Punch-Clutch-Drive Latch (04.15.06.1).

1. Turned on by the Punch Clutch Control latch ANDed with PC3 not made. This is to ensure that the punch clutch magnet receives a complete 30<sup>0</sup> impulse from PC3.

With the Punch Clutch Drive latch ON ANDed with PC3 made, the punch clutch magnet is energized.

**DUMP NUMERICALLY WITH 1622**

**Objectives:**

1. To transmit numerical information from memory, starting at the location designated by the P-address (OR-2) and continuing through location 19999.
2. The dump operation is terminated, provided this digit is the 80th digit of a group, when the digit in memory location 19999 is transmitted. A full 80 columns of data must be transferred for each card to be punched. If all 80 columns have not been transferred when memory location 19999 is reached, memory locations in the next highest module are used or a loop back to locations 00000, 00001, etc., occurs to complete the last card.

**Functions**

The dump operation is identical with a write numerically operation except for the end of the operation. The -C card punch disconnect signal is inoperative until the end of the group of digits containing a digit in memory location 19999 is transferred. A number of transfers (cards punched) can take place before the computer disconnects and enters I-cycle for the next instruction in sequence. If an entire memory module is dumped, 250 cards are then punched in succession.

**Auxiliary Triggers**

For Read/Write Call trigger, Sync trigger, and I/O Exit trigger, see WRITE NUMERICALLY WITH 1622.

Disconnect Gate Trigger (01.80.25.1).

1. Off when the E-cycle is entered
2. Turned on by the card punch disconnect following the transfer of the digit in memory location 19999, to terminate the punch data transfer (dump) operation.
3. Turned off by the I/O Exit trigger.

**E-Timer Trigger Objectives**

See WRITE NUMERICALLY WITH 1622.

## 1622 Latches

See WRITE NUMERICALLY WITH 1622.

## WRITE ALPHAMERICALLY WITH 1622

### Objectives

1. With the computer in alphameric mode, to transmit characters stored as two adjacent digits from the memory locations designated by the P-address minus 1, P-address (OR-2), and successively higher pairs of memory locations.
2. To decode each 2-digit memory character into BCD form for each numerical, alphabetic, or special character.
3. To transfer the information to punch buffer storage in the 1622.
4. To initiate a punch-clutch cycle.

### Functions

Output characters are transmitted serially from memory as two adjacent digits, beginning at the memory location designated by the P-address minus 1, the P-address (OR-2), and continuing with the successively higher 80 pairs of memory locations.

The P-address of the instruction must designate the odd-numbered memory location at which the numerical digit of the first character to be transmitted is stored. The zone digit of the first character is located at the next lower memory address (P minus one) which is an even address. Increment plus 2 is used to provide addresses for successive characters.

If an even-numbered memory location is erroneously designated by the P-address, data presented

to the 1622 will be incorrect and parity errors may occur.

Output data may consist of a random mixture of numerical, alphabetic, and special characters which exist in memory as 2-digit characters. If an attempt is made to write a record or field containing single-digit numerical characters by means of the write alphamerically instruction, invalid combinations of disassociated numerical digits will result and parity errors may occur.

Flag bits existing in memory locations from which an output record or field is written are not transmitted to the 1622. The write operation leaves output data unchanged in memory.

A negatively signed number stored in the alphameric mode will contain a 5 in the zone portion of the two-digit character. This 5 causes an 11 punch (X punch) over the numerical punch.

### Auxiliary Triggers

See WRITE NUMERICALLY WITH 1622.

### E-Timer Triggers

#### Hold Trigger (01.64.12.1).

See WRITE NUMERICALLY WITH 1622.

#### Trigger 30 (01.64.10.1).

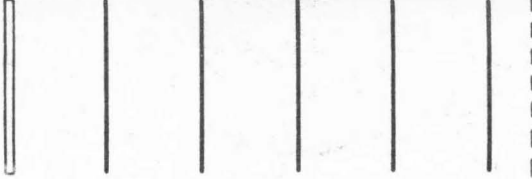
1. Reads out of memory per OR-2
2. Stores the zone portion of the character in MBR-even and the numerical portion of the character in MDR
3. Writes back OR-2 incremented plus 2
4. Turns off Trigger 8
5. Turns on the Hold trigger.

## 1622 Latches

See WRITE NUMERICALLY WITH 1622

**1620**

**Model 1  
System**



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**IBM**

**International Business Machines Corporation  
Data Processing Division  
112 East Post Road, White Plains, N. Y. 10601**

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