IBM

practice problems

650 Data-Processing System

ADDITIONAL FEATURES

For Use with Form 29-1199-0, Outline for
Customer Training on 650 Additional Features

October 1956

Form 22-6319-1

650 DATA-PROCESSING SYSTEM

WITH

High-Speed Storage
Indexing Accumulators
Automatic Floating-Decimal Arithmetic

727 Magnetic-Tape Unit

407 Accounting Machine

CUSTOMER TRAINING--PRACTICE PROBLEMS

HIGH-SPEED STORAGE

Write the program for the following problems

1. Transfer the contents of Band 1650 to HSS starting at location 9006. What is the position of the Timing Ring at the completion of the transfer?

2. Transfer 31 words from HSS to Band 1650. Start at location 9018. What is the position of the Timing Ring at the completion of the transfer?

3. Load 10 words into HSS from the drum. Start at locations 9030 and 1810. What is the position of the Timing Ring at the end of the transfer?

4. Store 6 words from HSS onto Band 1800. Start at location 9000. What is the position of the Timing Ring at the completion of the transfer?

5. Read a card, from an input unit connected to area 2, into HSS starting at location 9010. What is the position of the Timing Ring at the completion of the transfer?

6. Read 10 words from a card into HSS starting at location 9015. Assume the input unit is connected to area 3. What is the position of the Timing Ring at the completion of the transfer?

7. What is the position of the Timing Ring at the completion of the following program?

```
SET     27-9016
STBB    28-1201
LB      09-1343
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8. The objective of this problem is to build up a record in HSS from data on the drum, in the accumulator and entering on a card. Assume the input unit to be connected to area 1.

Type of Data	No. of Characters	From	To
1. Part number	7-Alphamerical	Words 1-2 card	9046-47
2. Description	20-Alphamerical	Words 3-6 card	9048-51
3. Quantity on hand Quantity on order	5 5	Word 7 card	9052
4. Economical order quantity Average unit cost	4 6	Word 8 card	9053
5. Lead time Protective stock level Daily usage	3 3 3	Drum-1999	9054
6. Requirements for each of the next 5 months	5 each	Drum-0147-49	9055-57
7. Total requirements	6	8002	9058
8. Unit of measure Source code Vendor number	1 1 4	Drum-0015	9059

TAPE

1. (a) Lay out the following data for a tape record that will be written using the 06 (WT) code.

   (b) Lay out the same data for a tape record to be written using the 07 (WTA) code. Show the digital makeup of the control words (use form 22-6253).

DATA	CHARACTER LENGTH AND TYPE
1. Part number	7-Alphamerical
2. Description	20-Alphamerical
3. Quantity on hand	5-Numerical
4. Quantity on order	5-Numerical
5. Economical order quantity	4-Numerical
6. Average unit cost	6-Numerical
7. Lead time (days)	3-Numerical
8. Protective stock level (days)	3-Numerical
9. Planned average daily usage	3-Numerical
10. Requirements for each of the next 5 months	5 each Numerical
11. Total requirements	6-Numerical
12. Unit of measure	1-Numerical
13. Source code	1-Numerical
14. Vendor number	4-Numerical

2. Write the programs necessary to create tape records, like those produced in the preceding problem, from the following input cards.

CARD 1

Item No.	Input Word
1	1-2
2	3-6
5-6	8
11	9
12-14	10

CARD 2

Item No.	Input Word
1	1-2
7-9	3
10	4-6
11	7
3-4	8

CONSTANTS

Words	1995-1998	Zeros
Word	1999	Control word for 9059
Word	1899	Control word for 9049

Assume that card 1 always precedes card 2. Do not include systems checks. In the interest of uniformity, use the tape record layout supplied by the instructor.

TAPE REEL CAPACITY--TAPE RECORD PASSING SPEED

* in each of the following problems, the objectives are to
1. determine the number of reels of tape necessary to contain the entire file when the tape is written with the 06 (WT) code (650 character representation).
2. determine the number of reels of tape necessary to contain the entire file when the tape is written with the 07 (WTA) code (705 character representation).
3. determine the daily process time needed to update each file above when a complete rewrite of the entire file is done (active and inactive items).
4. determine the daily process time needed to update each file above (102) when the "Change Tape" method is used (only active items written on new tape). Consider only the time on the first day.
5. determine the reel change time needed. This will be important only if one tape unit is available for input or output. Where multiple units are available, this can probably be overlapped with process time. The average reel change time is about 5 minutes.

1. Given:
   a. 50,000 records
   b. 15% activity rate per day
   c. Each record 32 words in length
   d. Each record has a total of 22 Alphamerical words.
   e. 300 ms process time per active record

2. Given:
   a. 93,000 records
   b. 10% activity rate per day
   c. Each record 26 words in length
   d. Each record has a total of 2 Alphamerical words
   e. 150 ms process time per active record

GROUPED RECORDS

1. Draw the logic diagram to insert/delete a record into a file that is grouped as follows:
   a. Type of record--same as that constructed in tape practice problem 1 using the 07 (WTA) code.
   b. Three records per group.
   c. Use "dummy" record (method 1).

   Logic diagram should process all of the following conditions:
   a. Insertion/deletion record does not belong within this tape record.
   b. Insertion/deletion record equal to 3rd record.
   c. Insertion/deletion record lower than 3rd record and higher than 2nd record.
   d. Insertion/deletion record equal to 2nd record.
   e. Insertion/deletion record lower than 2nd record and higher than 1st record.
   f. Insertion/deletion record equal to 1st record.
   g. Insertion/deletion record lower than 1st record.

END OF FILE

1. Write the Input-Output Tape--End of file program for a 650 System with four 727 Tape Units. Two of these units are used for input, and two, for output. The output tapes from one day's processing become the input tapes for the following day's processing. The tape used on the output units can be from any job provided that the data is obsolete.

   For purposes of uniformity and simplicity the following assumptions should be made:
   a. Job is relatively static in nature
      1. Insertions and deletions balance each other.
      2. The number of input reels of tape remain constant--in this case 6.
      3. The input and output tapes are rewound at the same time whenever a Tape Mark is sensed at the input tape.
   b. The first record on each input tape consists of Tape Identification and Control Data. In addition, some of the Instruction and constants for the program are also contained in this record. The total record length is 40 words, of which 6 words are the actual Identification and Control Data, and the remaining 34 are constants and instructions.
   c. The layout of the identification and control data is as follows:

1. Last date passed	Word 9054
2. Reel number (1-6)	Word 9055
3. Job identification number	Word 9056
4. Date on which the data on this reel of tape become obsolete and the tape can be used for new data	Word 9057
5. Number of times this tape passed	Word 9058
6. Instruction for determining whether this is "End of Reel" or "End of Job"	Word 9059

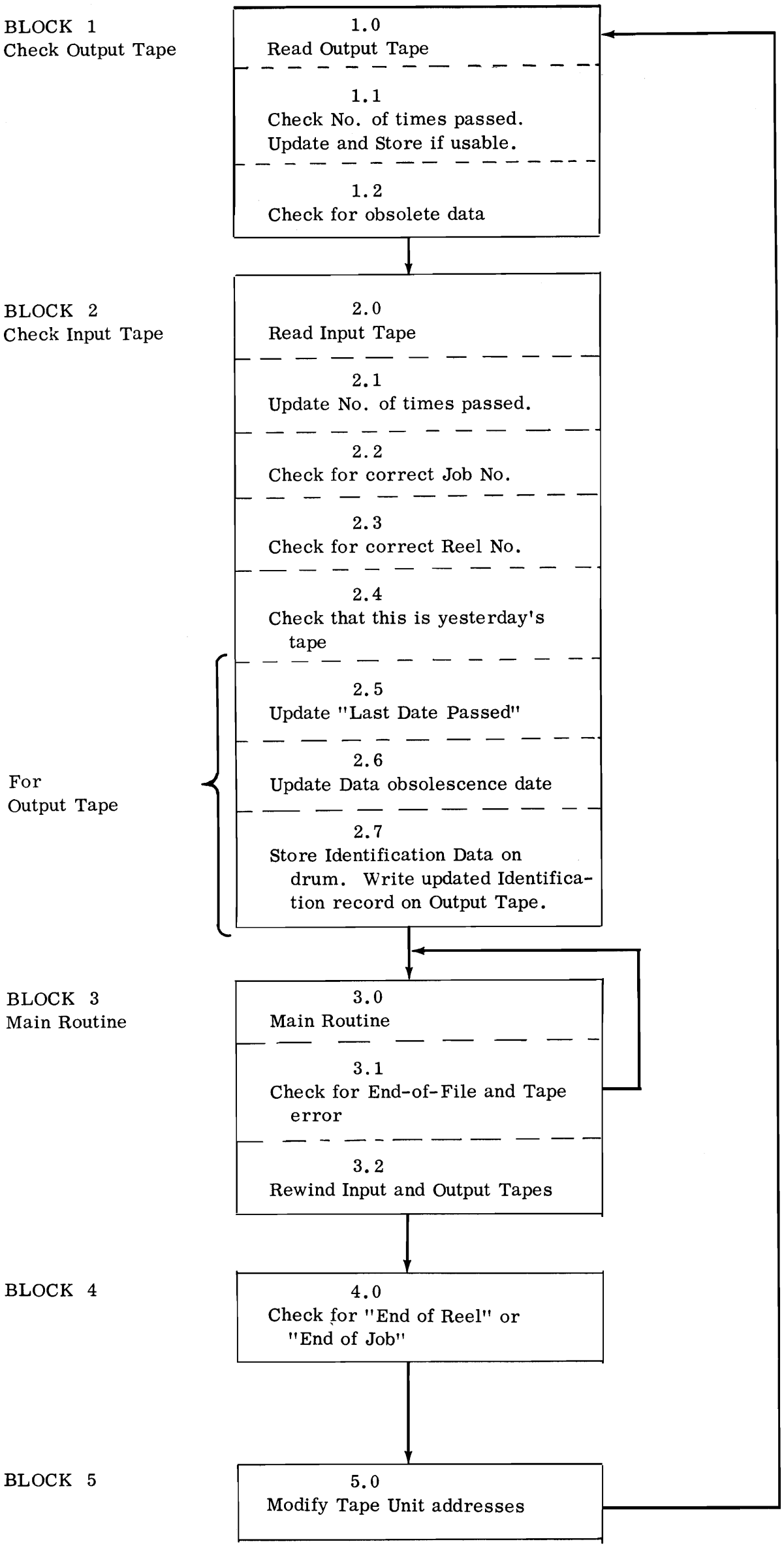
   d. Each working day of the year is numbered on a consecutive basis.
   e. Tape data becomes obsolete 3 working days after it is created.

   Your program should assure the following:
   a. Automatic switch-over to alternate tape units on "End of Reel"
   b. Automatic stop at "End of Job"

c. The correct input tapes are on the correct tape units prior to operation.
d. Input tapes are used in the correct sequence.
e. Data on output tapes is at least 3 days old.
f. Output tape has not been passed more than the specified number of times.

NOTE--Use 8010-8011 for input tape-unit addresses. Use 8014-8015 for output tape-unit addresses. Use the following block diagram as a guide.

PRACTICE PROBLEM BLOCK DIAGRAM



INDEXING ACCUMULATORS

1. Reset IA-C to zero and then add 0123 to it.

2. Reset IA-C to zero and then add the contents of IA-B to it.

3. Initialize IA-A to 0001. Set up a loop program that will increase IA-A to 0002 on the first pass, reduce IA-A to 0001 on the second pass, increase IA-A to 0002 on the third pass, and so on.

4. There are a total of 22 cards to be entered into the 650 from an input unit connected to area 1. The first 21 cards each contain the following data:
   a. Model number ---------- Input word 1
   b. Total already built ---------- Input word 2
   c. No. to be built in January ---- Input word 3
   d. No. to be built in February -- Input word 4
   e. No. to be built in March ---- Input word 5
   f. No. to be built in April ----- Input word 6
   g. No. to be built in May ------ Input word 7
   h. Total to be built through May-- Input word 8

   The 21 cards represent a total of 21 models. Store each of the 21 cards sequentially on the drum starting at location 0300. Follow the pattern shown below:

   0300 - Model number 1
   0301 - Total already built
   0302 - No. to be built in January
   0303 - No. to be built in February
   0304— No. to be built in March
   0305 - No. to be built in April
   0306 - No. to be built in May
   0307 - Total to be built through May

   0308 - Model number 2
   0309 - Total already built
   etc. etc.

   The 21 cards should be in ascending sequence, and a programmed check should be made to assure that they are. The program should be stopped if an out-of-sequence condition occurs. A 22nd card will follow immediately behind these cards and will form the basis for problem 5.

5. The 22nd card is a control card for the preceding 21. It has the sum of all the model numbers punched in it. These data are entered through input word 1.

   After reading the control card, sum up the model numbers of all 21 groups and zero balance against the control card. Stop the program if not zero. If zero, sum up items 2-7 and balance against item 8 for each of the 21 groups. If any group does not zero balance, stop the program.

1. A 407 is being used as input to the 650 System. Wire the control panel to select any one of three input cards (A, B, C). Card "A" is identified by an "X" in column 35. Card "B" is identified by an "X" in column 38. Card "C" is identified by an "X" in column 75. The selection format is as follows:

Card Type	Card Columns	Input Word
A	1-10	1
A	11-20	2
B	1-10	2
B	11-20	3
C	1-10	3
C	11-20	1

2. As cards A, B or C are entered (problem 1), the following conditions should be satisfied by control-panel wiring.
   a. When the "A" card is read, Input Word 3 should be filled with zeros.
   b. When the "B" card is read, Input Word 1 should be filled with zeros.
   c. When the "C" card is read, Input Word 2 should be filled with zeros.

   Make the assumption that these zeros are not available in the input card.

3. A 407 is being used as output for the 650 System. There are to be two output formats (A, B). These formats are grouped such that for each Type "A" there may be one or more Type "B." After the last Type "B" format of a group, a skip should be initiated to Channel 2 of the carriage tape. Format "A" is identified by the presence of an 8 at position 3 of Control Information. Format "B" is identified by the presence of an 8 at position 9 of Control Information. The actual formats are as shown below:

Type "A"	Output Words 1-2	Print Positions 1-20
Type "B"	Output Words 1-2	Print Positions 31-50

Show the control-panel wiring necessary to accomplish the above.....

PARALLEL OPERATION

Problem:

Parallel a Tape-to-Printer and Card-to-Tape Operation

Requirements: Tape-to-Printer

Printer must operate at maximum possible speed
Tape records are 30 words each
One line to be printed from each record
The first 10 words comprise the printed record
Format of line to be arranged by control-panel wiring
Printer operates from Output Storage Area 2
Tape Drive assigned the number 8010
25,000 lines to be printed

Requirements: Card-to-Tape

Cards to be converted to 10-word tape record
Tape drive assigned the number 8012
Card reader operates from Input Storage Area 1
Cards should be sequence-checked
Re-arrangement of words not necessary prior to tape writing
30,000 cards to be converted
Speed of this conversion is not critical

NOTE: Assume volumes to be unequal

COMPREHENSIVE PRACTICE PROBLEM

I INTRODUCTION

This problem on inventory control has been designed to give you practice in formulating detailed block diagrams and constructing the actual 650 programs necessary to meet the objectives of a specific accounting situation.

From the information that follows you are to construct the detailed block diagrams and program necessary to meet the following objectives of inventory control:

1. Maintain inventory balance figures up to date.
2. Determine when "order-point" has been reached.
3. Determine the quantity to be ordered.
4. Determine the expected delivery date.
5. Punch a "to-be-ordered" card.
6. Determine if expediting is necessary.
7. Punch an "expedite" card if needed.
8. Determine if an "exceptional usage" condition exists.
9. Punch an "exceptional usage" card if needed.
10. Print an inventory control report of active items.

II DETAILS OF PROBLEM

A. Order-Point. Can be expressed as that date on which an order must be placed so that sufficient stock can be maintained to meet the planned usage. In determining when the order-point has been reached the following factors must be considered:

1. Quantity on hand
2. Quantity already on order
3. Planned average daily usage
4. Lead time (the number of days between when an order is placed and the expected delivery date to stock).
5. Protective stock level (this value, expressed in terms of days, is stock that is to be used only in case of emergency).

Order-point can be determined from the following formula:

Number of days coverage - protective stock level - lead time = zero or minus

NOTE: In this problem, days are numbered in consecutive order for every working day of the year without reference to month or day. In this way the first working day of January becomes 001 and the last working day of December becomes 253. This number, 253, will vary depending upon the number of holidays taken during the year, and the number of Saturdays and Sundays worked. The number was based on a 5-day week with 8 holidays during the year.

The number of day's coverage can be determined from the following formula:

$$\frac{\text{Quantity on hand + Quantity on order}}{\text{Planned average daily usage}} = \text{Number of day's coverage}$$

The planned average daily usage figure is part of the master inventory record on tape. It is computed periodically by dividing the total requirements for a given period (5-6 months) by the number of working days in the period.

When the order point has been reached, a "to-be-ordered" card should be punched.

B. Quantity to be ordered. Is based upon the cost of acquisition as balanced against the cost of maintaining the item in stock. This is called the Economical Order Quantity. It has been computed in advance and made part of the master inventory tape record.

C. Expected delivery date. Is determined by the following formula:

Today's date + lead time = expected delivery date

NOTE: The to-be-ordered card is sent to the Purchasing Department for action. When the order is placed, the card is returned, as an on-order card, for processing. This will normally be before the next day's processing.

D. Expediting. The need for expediting occurs whenever the actual stock balance on hand falls below that which has been established as the minimum protective stock level. When the actual number of days in stock is less than the protective stock level, expediting is mandatory.

To determine the actual number of days in stock, use the following formula:

$$\frac{\text{Quantity on hand}}{\text{Planned average daily usage}} = \text{Days in stock}$$

E. Exceptional Usage. An exceptional usage condition is indicated whenever the actual usage differs from the planned usage by a factor of $\pm$ 15%.

III SCOPE OF PROBLEM

A. 60,000 inventory items

B. 12,000 daily transactions on 9,000 items.

IV DAILY OUTPUT

A. Updated master inventory tape

B. To-be-ordered cards

C. Expedite cards

D. Exceptional usage cards

E. Inventory control report on active items

V DAILY INPUT

A. Master inventory tape

B. On-order cards

C. Stock receipt cards

D. Stock issue cards

VI 650 SYSTEM COMPONENTS

A. One 407 Accounting Machine

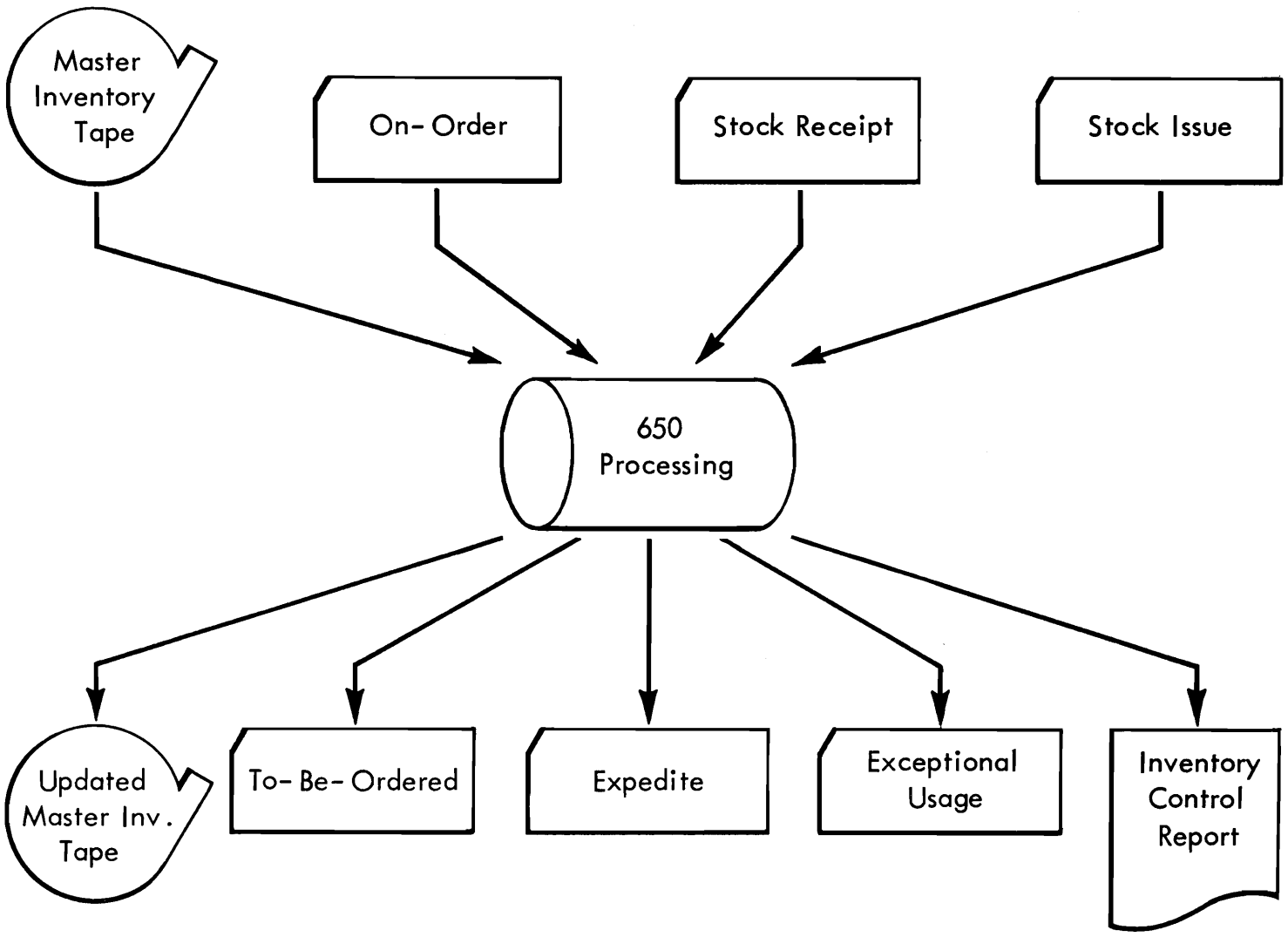
B. One 533 Card Read Punch

C. Four 727 Magnetic Tape Units

D. One each--650, 655, 653, 652

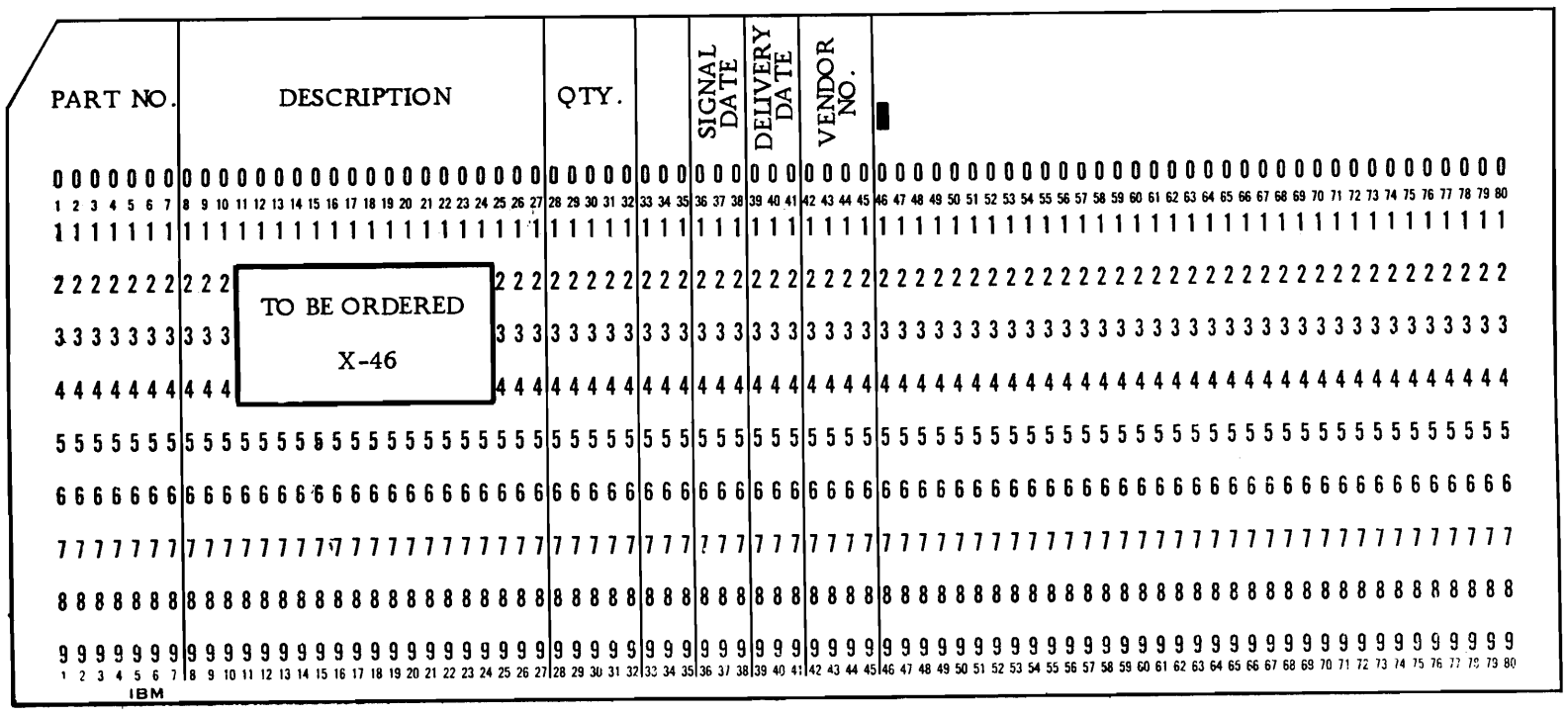
E. Indexing Registers

VII GENERAL BLOCK DIAGRAM



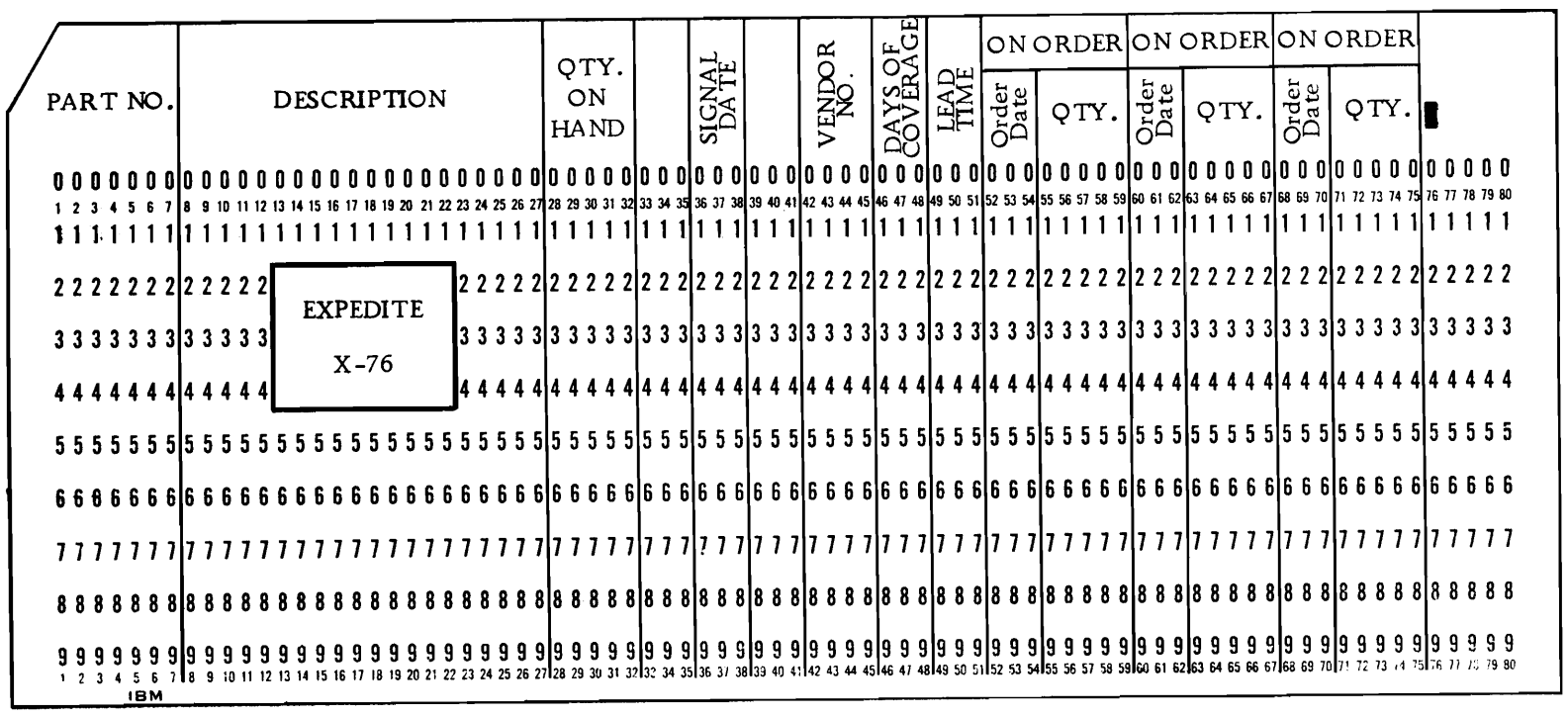
VIII. OUTPUT CARDS

A. To be Ordered

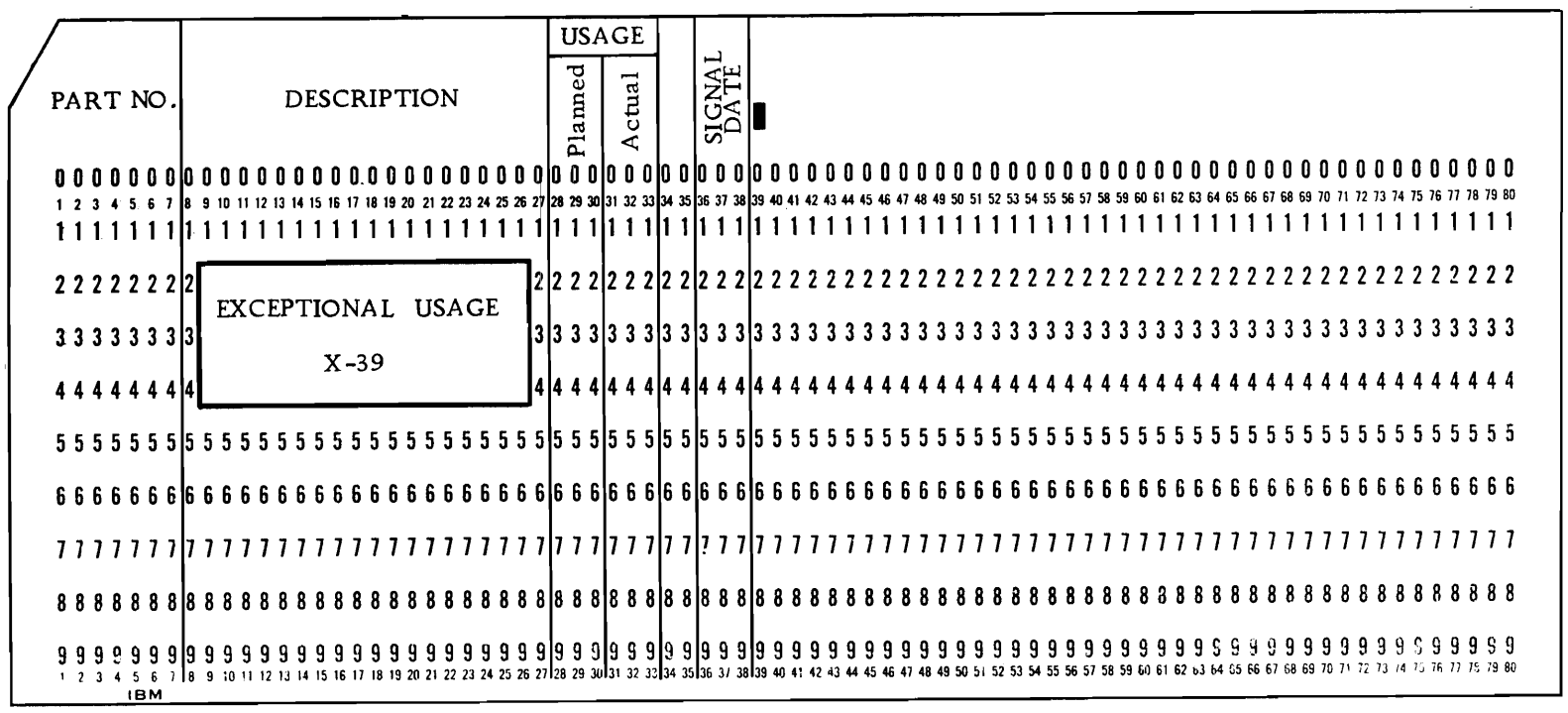


*Note - Signal Date is the day on which the card is originated by the 650 System

B. Expedite



C. Exceptional Usage



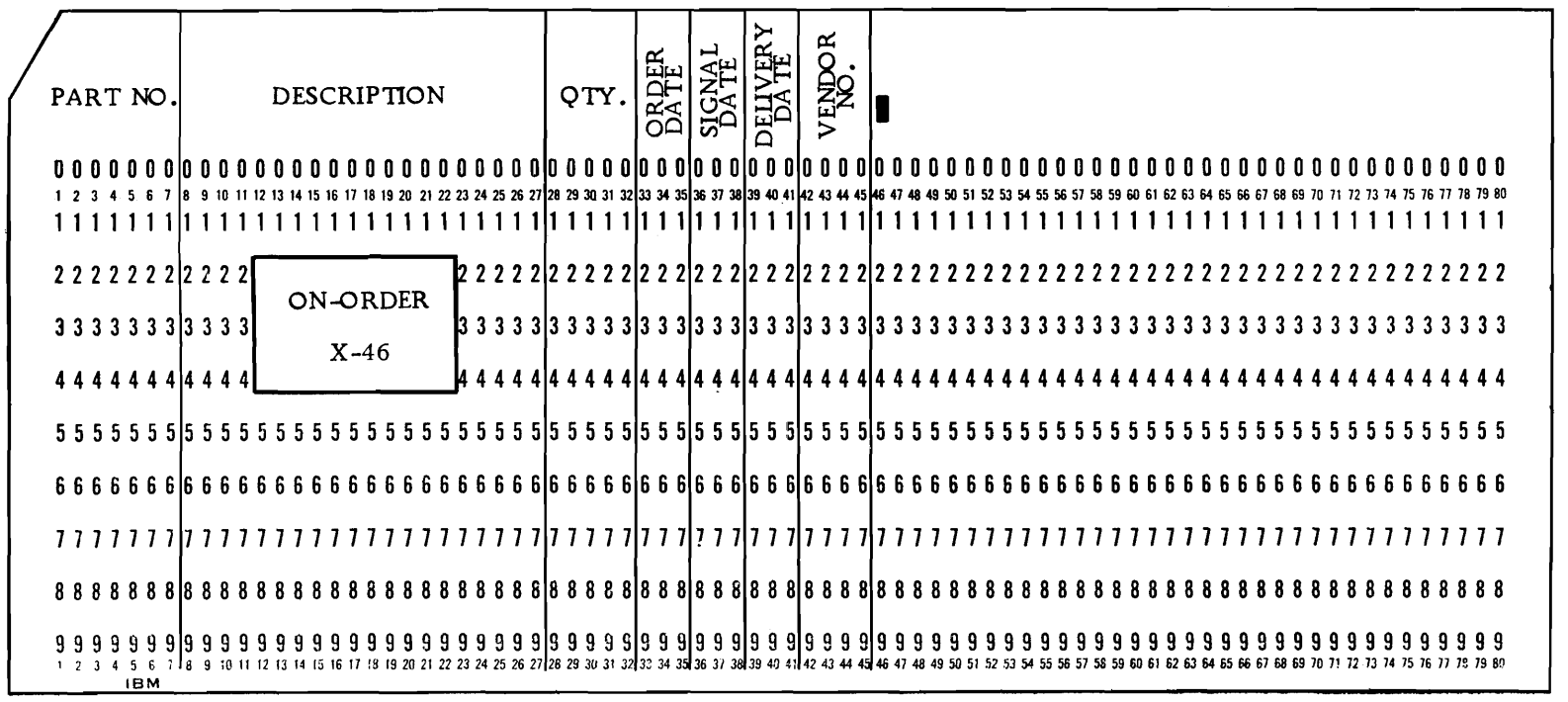
IX. OUTPUT DOCUMENT

INVENTORY CONTROL REPORT

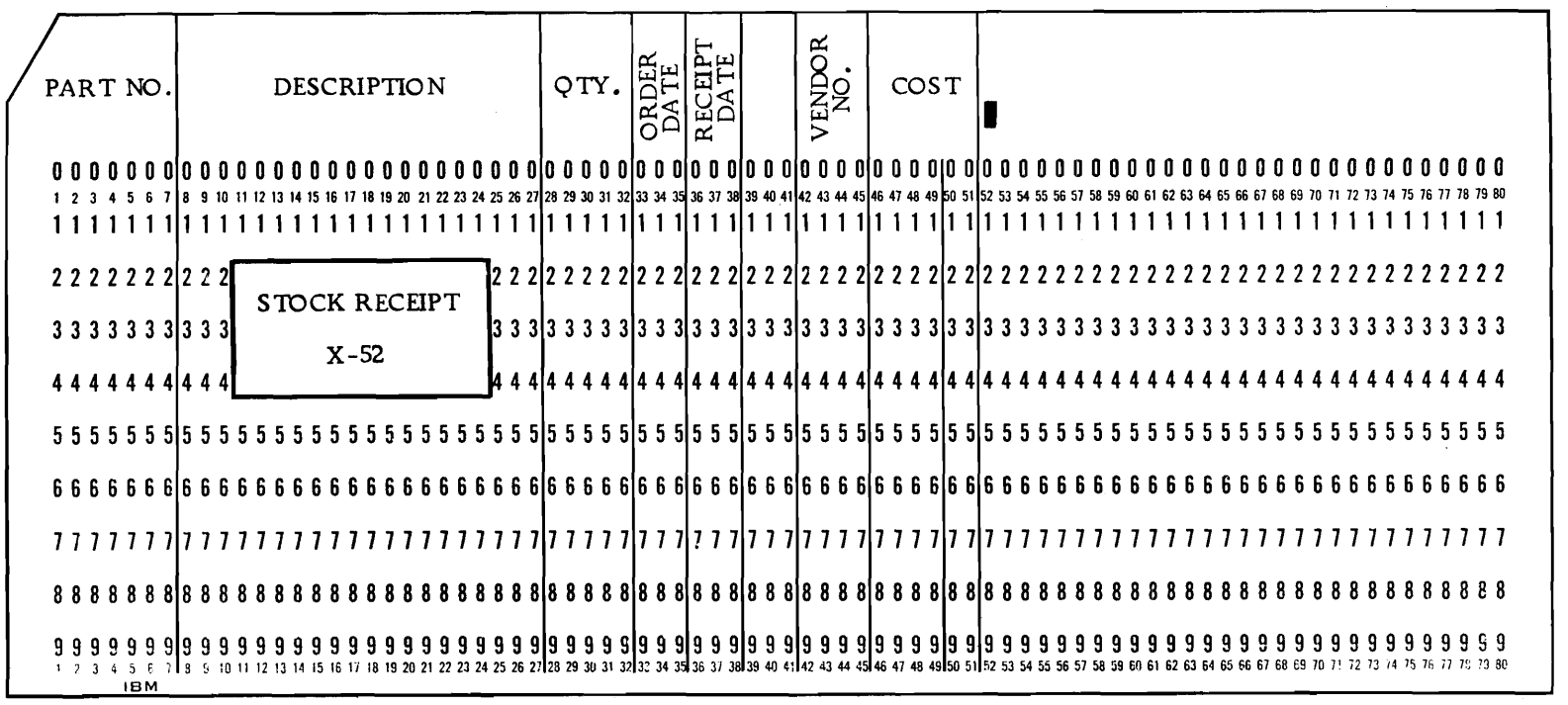
Part No.	On hand	On Order	Issues	Requirements	Total Issues To Date	Last Activity Date

X. INPUT CARDS

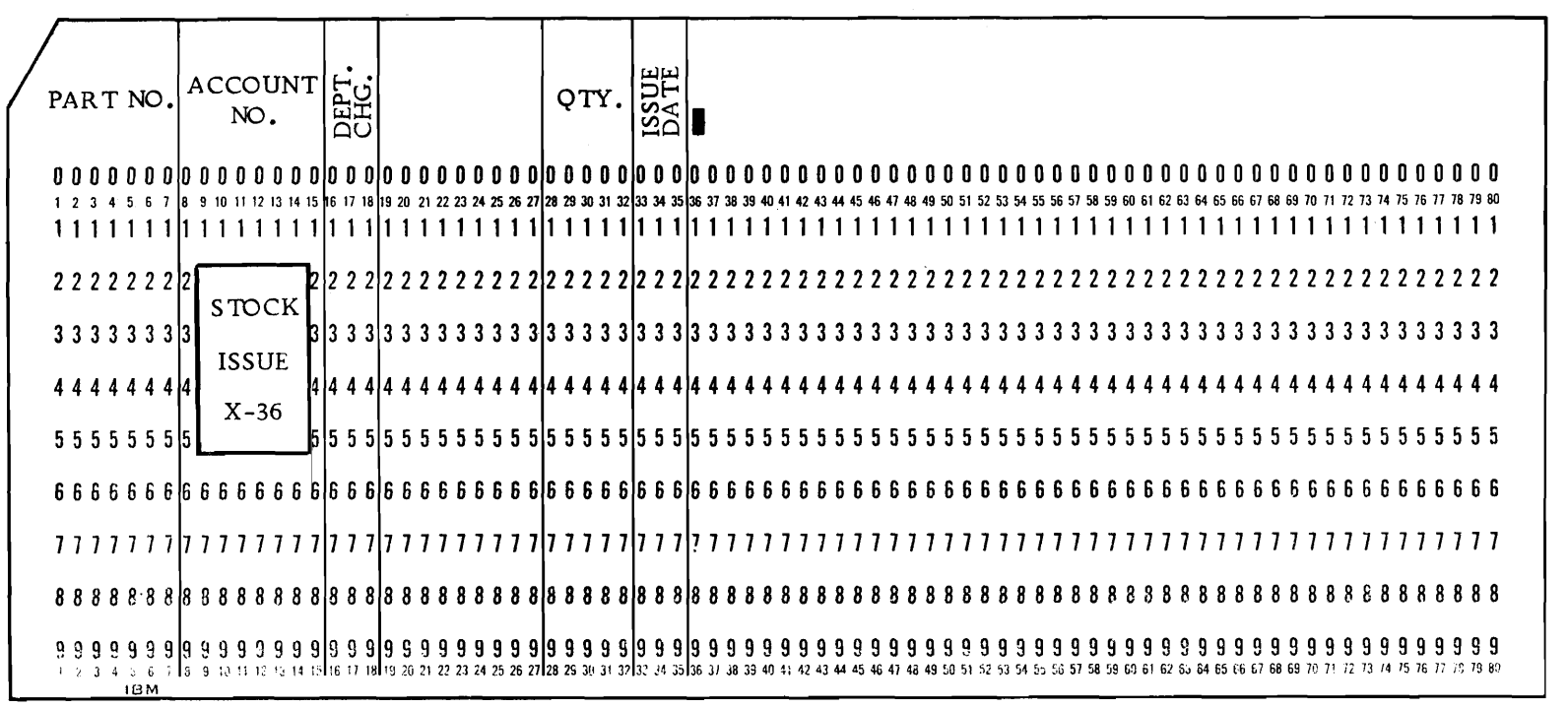
A. On-Order



B. Stock Receipt



C. Stock Issue



XI MASTER INVENTORY TAPE RECORD (two of these are grouped to form one 60-word tape record).

Word 1	Word 2	Word 3	Word 4	Word 5	Word 6	Word 7	Word 8	Word 9	Word 10
PART NO.		DESCRIPTION				Qty. on Hand	Qty. on Order	Planned Average Daily Usage	Lead Time (days)

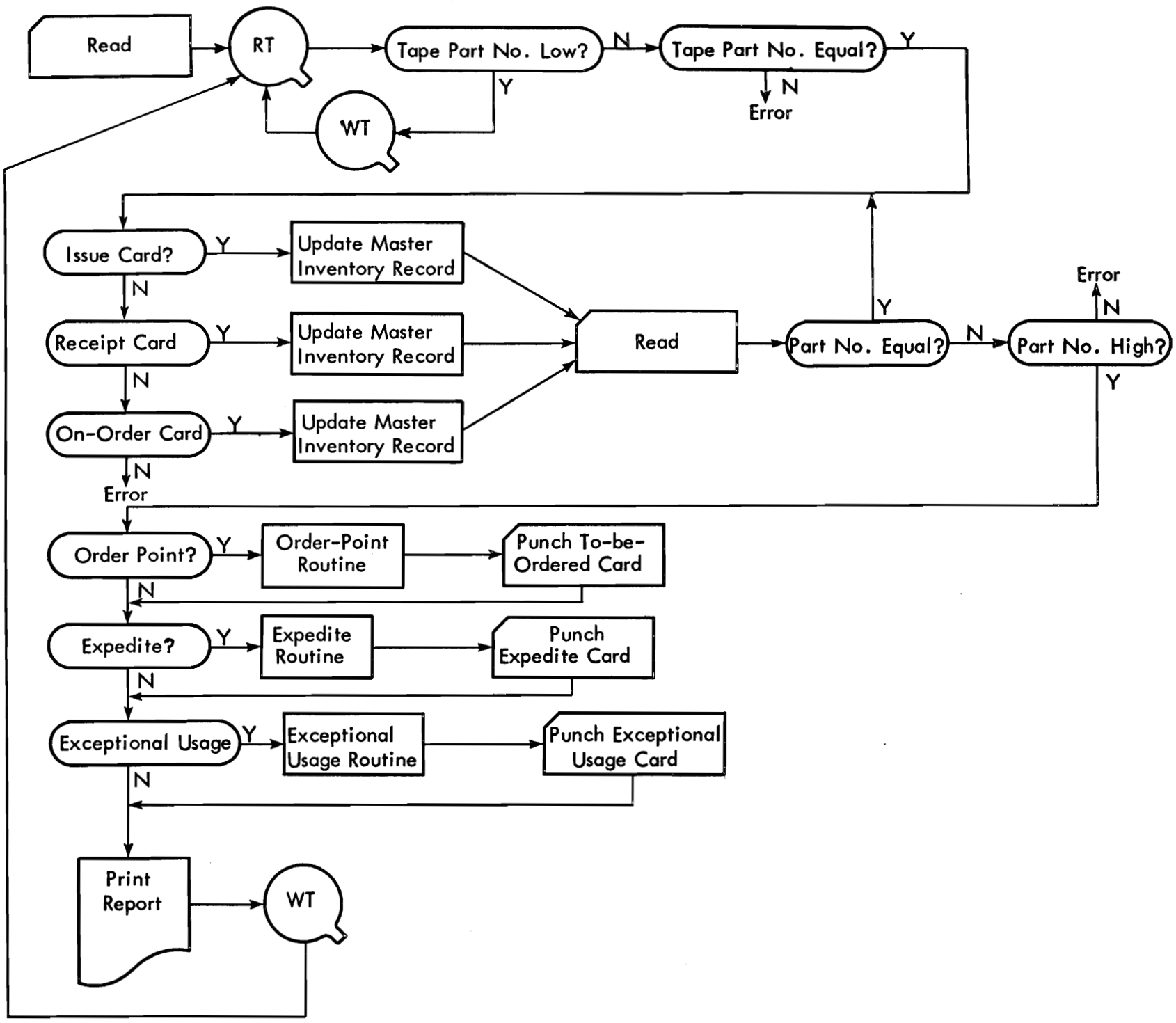
Word 11	Word 12	Word 13	Word 14	Word 15	Word 16	Word 17	Word 18	Word 19	Word 20
Protective Stock Level (days)	Total Issues to Date	Last Date Activity / Warehouse Location	Vendor Number	Average Unit Cost	Economical Order Qty.	Batch Qty. I	Batch Price I	Batch Qty. II	Batch Price II

Word 21	Word 22	Word 23	Word 24	Word 25	Word 26	Word 27	Word 28	Word 29	Word 30
Max. Qty. that can be stocked	Tot. Req. Period 1 through Period 5	Req. Period 1	Req. Period 2	Req. Period 3	Req. Period 4	Req. Period 5	Order Date / Qty.	Order Date / Qty.	Order Date / Qty.

NOTE: Whenever a to-be-ordered card is originated by the 650 system, the quantity ordered is posted to the on-order amount (word 8). In this the 650 is assuming that the order has actually been placed. To exercise a control at this point, the quantity ordered and the signal date are kept as separate items of the master inventory record. Provision is made for keeping up to three control items. These are stored in words 28, 29 and 30. These controls will be kept until the actual receipt of the material. The oldest order is stored in word 28. When the quantity ordered and the signal date are placed in the control location, they carry a negative sign. When the to-be-ordered card is returned from the Purchasing Department as an on-order card, it is used to change the sign of the control and substitute the on-order date for the signal date. No further processing of the on-order card is necessary because the quantity was posted when the card was a to-be-ordered card.

When a stock receipt card is processed, it is used to delete the control from the master inventory record (word 28, 29, or 30). It is also added to the on-hand amount (word 7) and subtracted from the on-order amount (word 8).

When a control is deleted by the receipt of material, any controls to the right in the tape record are moved to the left to make room for additional later controls.

When an expedite condition is sensed, words 28, 29, and 30 are punched into the expedite card (columns 52-75). This information can then be used to determine the cause of the expedite condition.

XII OVER-ALL BLOCK DIAGRAM