

**CONTROL DATA® 6400/6600 COMPUTER SYSTEMS**  
**EXPORT/IMPORT 8231 Reference Manual**



Additional copies of this manual may be obtained  
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# CONTENTS

	INTRODUCTION	v
CHAPTER 1	BASIC CONCEPTS	1-1
	1.1 System Components	1-1
	1.1.1 EXPORT	1-1
	1.1.2 IMPORT	1-1
	1.2 System Dependencies	1-2
CHAPTER 2	HARDWARE REQUIREMENTS	2-1
	2.1 Central Computer	2-1
	2.2 Remote Computer Terminal	2-1
	2.3 Communications Equipment	2-2
CHAPTER 3	JOB FLOW	3-1
	3.1 Simplified Job Flow	3-1
	3.2 SCOPE Interface	3-2
	3.2.1 Initialization of EXPORT	3-2
	3.2.2 Job Processing	3-2
	3.3 Termination of EXPORT	3-2
	3.4 Job Flow Diagrams	3-2
CHAPTER 4	OPERATOR REQUESTS	4-1
	4.1 Central Operator Actions	4-1
	4.2 Remote Operator Actions	4-2
	4.2.1 Startup Procedure	4-2
	4.2.2 Typewriter Input	4-3
	4.2.3 Typewriter Messages	4-4
	4.2.4 Input/Output Messages	4-5
	4.2.5 Recovery Procedures	4-5
	4.2.6 Jump Keys	4-6
CHAPTER 5	EXCHANGE LOGIC	5-1
	5.1 Communication Rules	5-1
	5.2 Transfer Formats	5-2
	5.2.1 Status Transfer Format	5-2
	5.2.2 Directive Transfer Format	5-3
	5.3 Character Set	5-3
	5.4 Initiation Procedure	5-3

	5.5	Error Detection Scheme	5-3
	5.5.1	Error Causes	5-4
	5.5.2	Detection Logic	5-4
	5.5.3	Detection Capability and Features	5-5
	5.5.4	Error Compensation	5-6
CHAPTER 6		EXPORT PROGRAM	6-1
	6.1	Initialization of EXPORT	6-1
	6.2	Overall Flow	6-1
	6.2.1	Resident Activities	6-1
	6.2.2	Communications Overlay	6-2
	6.2.3	Processor Overlay	6-3
	6.3	Central Memory Requirements	6-5
	6.4	Special Routine	6-6
CHAPTER 7		IMPORT PROGRAM	7-1
	7.1	Initialization of IMPORT	7-1
	7.2	IMPORT Processing Routines	7-2
	7.2.1	Determine Directive Code (CC)	7-2
	7.2.2	Line Printer Driver (LP)	7-2
	7.2.3	Card Reader Driver (CR)	7-3
	7.2.4	Card Punch Driver (CP)	7-3
	7.2.5	Typewriter Driver (TW)	7-3
	7.2.6	Interrupt Processing (INT)	7-4
	7.3	Utility Functions	7-5
		INDEX	Index-1

# INTRODUCTION

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6400/6600 EXPORT/IMPORT 8231 is a system of programs which provides multi-access to a central CONTROL DATA<sup>®</sup> 6400 or 6600 computer system from remotely located terminal stations. Users at remote sites may submit jobs under the EXPORT/IMPORT system and may enter input to the system. They will receive output in the same manner in which the user would receive it at the central computer. An operator at any remote terminal has extensive access to the central processor, almost as if he actually were working at the site of the central processor. In addition, off-line utility operations are available with EXPORT/IMPORT.

During operation, parts of EXPORT/IMPORT reside, not only in different portions of the central computer system, but also in each remote station. Three basic elements comprise the system:

IMPORT, the remote computer resident program

EXPORT, the peripheral processor resident program

SCOPE, the central computer operating system

A familiarity with SCOPE is a prerequisite for the use of this manual.



## 1.1 SYSTEM COMPONENTS

6400/6600 EXPORT/IMPORT 8231 runs under the SCOPE Version 3.0 operating system on the 6400 and 6600 CONTROL DATA computer systems. It is composed of two separate but dependent programs:

The Executive Processor of Remote Tasks (EXPORT) resides in each peripheral processor† (PP) assigned to remote communications by the central facility.

The Input/Output Monitor for Processing of Remote Tasks (IMPORT) resides in each remote facility.

Features of SCOPE for remote job processing supplement these two programs.

### 1.1.1 EXPORT

EXPORT consists of a resident program with two main overlays: one for handling communications and another for processing data. In addition, several SCOPE system overlays are called as needed.

EXPORT communicates with transient SCOPE input and output routines in another PP through central memory buffers and flags. EXPORT communicates with IMPORT through the data communications facility. With the data received from IMPORT, EXPORT prepares input files for processing under SCOPE; and EXPORT intercepts output files for transmission back to IMPORT. Operator communication is accomplished through the system display console.

### 1.1.2 IMPORT

IMPORT is a monitor program which resides in an 8231 remote computer terminal. IMPORT communicates with EXPORT over the data communications facility. It is interrupt controlled for transmitting data to EXPORT. Operator communication is carried out through the on-line typewriter attached to the 8231. Utility operations may be performed when IMPORT is not communicating with EXPORT.

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† In a 6400 or 6600 computer, ten peripheral processors operate independently and simultaneously as stored program computers.

**1.2  
SYSTEM  
DEPENDENCIES**

Since EXPORT/IMPORT runs under the SCOPE operating system, any modifications to or restrictions on SCOPE must be made with full consideration of the requirements that EXPORT places on the system. Efficient use by EXPORT of the data communications facility is dependent upon consistently good disk access and upon the availability of transient PP's.

The basic minimum hardware configuration for SCOPE also applies to EXPORT/IMPORT. In addition, certain other equipment is required to provide the data communications facility and its interface with access to the central computer and the remote 8231 computer terminal.

## 2.1 CENTRAL COMPUTER

At least one 6675 data set controller (DSC) model B or D is required on a dedicated 6400 or 6600 data channel. A 6675 DSC provides adapters for the 301-B DATA PHONE<sup>†</sup> data sets and connects directly to a data channel. More than one 6675 DSC may be attached to the computer system; however, each DSC must be on a separate channel. Model B of the 6675 DSC connects one or two 301-B data sets; model D connects one to four 301-B data sets.

## 2.2 REMOTE COMPUTER TERMINAL

The remote computer terminal consists of an 8231 system with the following components:

- Computer (with 8K memory)
- On-line I/O typewriter
- Data channel converter
- Card reader controller (buffered)
- Card reader (1200 cards per minute)
- Line printer controller (buffered)
- Line printer (1000 lines per minute)
- Data set controller

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<sup>†</sup>A registered trademark of AT & T and the Bell System.

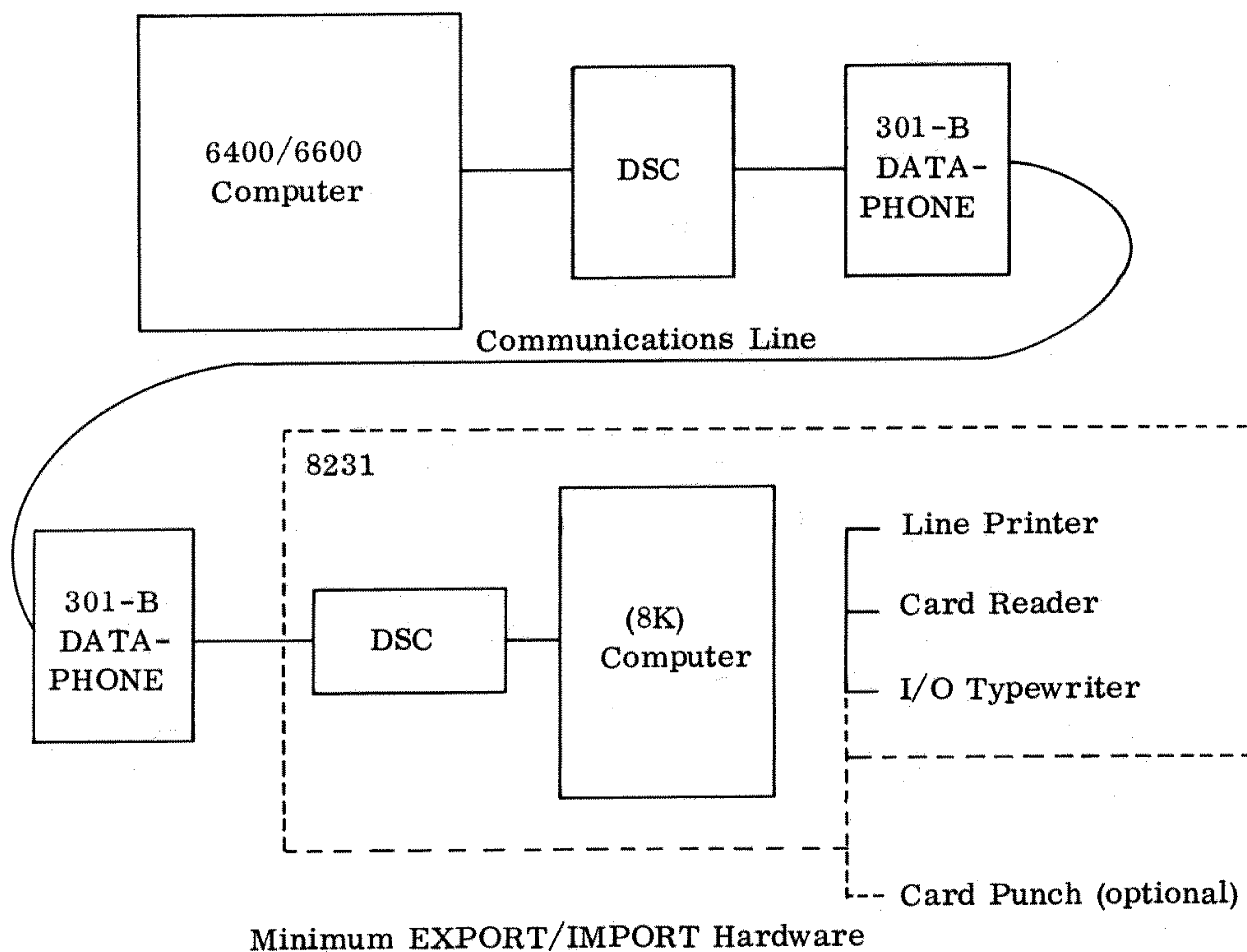
The following optional equipment may be attached to the 8231 system:

- 3446 Card punch controller
- 415 Card punch (250 cards per minute)
- 8073 Paper tape perforator
- 8074 Paper tape reader

### 2.3 COMMUNICATIONS EQUIPMENT

A 301-B DATA PHONE data set, which operates at a nominal data rate of 40,800 bits per second, is the standard communications MODEM (modulator demodulator) used with EXPORT/IMPORT. This data set provides the interface between the DSC and the communications line.

The communications line may be either a Telpak-A<sup>†</sup> facility, which is available from a telephone company, or a private coaxial cable. Transmission is half duplex, except for the SYNC word acknowledgment which is provided in full duplex mode.



<sup>†</sup> A registered trademark of AT & T and the Bell System.

### 3.1 SIMPLIFIED JOB FLOW

A simplified description of the overall job flow for both input and output (with respect to only one terminal) follows. General input/output functions are identical to the read and output packages under SCOPE.

#### INITIALIZATION

- Load IMPORT program deck.
- Prepare to read cards.
- Call EXPORT to a control point.

#### INPUT FROM CARDS

- Cards are read by IMPORT.
- Trailing blanks are deleted.
- Internal BCD is converted to display code.
- Data is packed into buffers equal in size to 64 central memory words (one disk sector).
- Full buffers and end-of-record (EOR) or end-of-file (EOF) indicators are transmitted to EXPORT.
- EXPORT requests SCOPE to write data from buffers to disk.
- At EOF, the file is set to INPUT and released to SCOPE.

#### OUTPUT TO PRINTER AND PUNCH

- File Name Table/File Status Table (FNT/FST) is scanned by EXPORT for remote OUTPUT files.
- Sectors are read by SCOPE to central memory (CM)
- Output is transmitted to IMPORT in one-sector blocks.
- IMPORT deblocks print lines and punch cards.
- Lines are printed with carriage control.
- Cards are punched.

## 3.2

### SCOPE INTERFACE

Before EXPORT/IMPORT can be used, the following initialization activities must be completed:

- Entries should be made to the Equipment Status Table (EST) for each 6675 DSC attached to the computer system.
- Care must be taken to determine the correct equipment number and channel number for each 6675 and the number of units attached to it.
- It may be desirable to reassemble EXPORT to make adjustments for 32K systems or for other core management problems, since the number of disk sectors buffered into central memory is a system parameter.

### 3.2.1

#### INITIALIZATION OF EXPORT

The EXPORT initialization program is called manually by operator request. The operator enters: n. EXPORT which calls the routine to control point n.

### 3.2.2

#### JOB PROCESSING

The files associated with remote jobs are identified by the remote bit (highest order bit) of the 12-bit disposition code (dc) in the FNT/FST. Normally, this bit is not interpreted until the job has been processed completely. At that time, print and punch files are ignored by SCOPE if the remote bit is set, and the disposition is handled by EXPORT. The remaining bits of the dc field are used by EXPORT to identify the file for printing or punching. In all other respects, the job is processed identically to non-remote jobs.

## 3.3

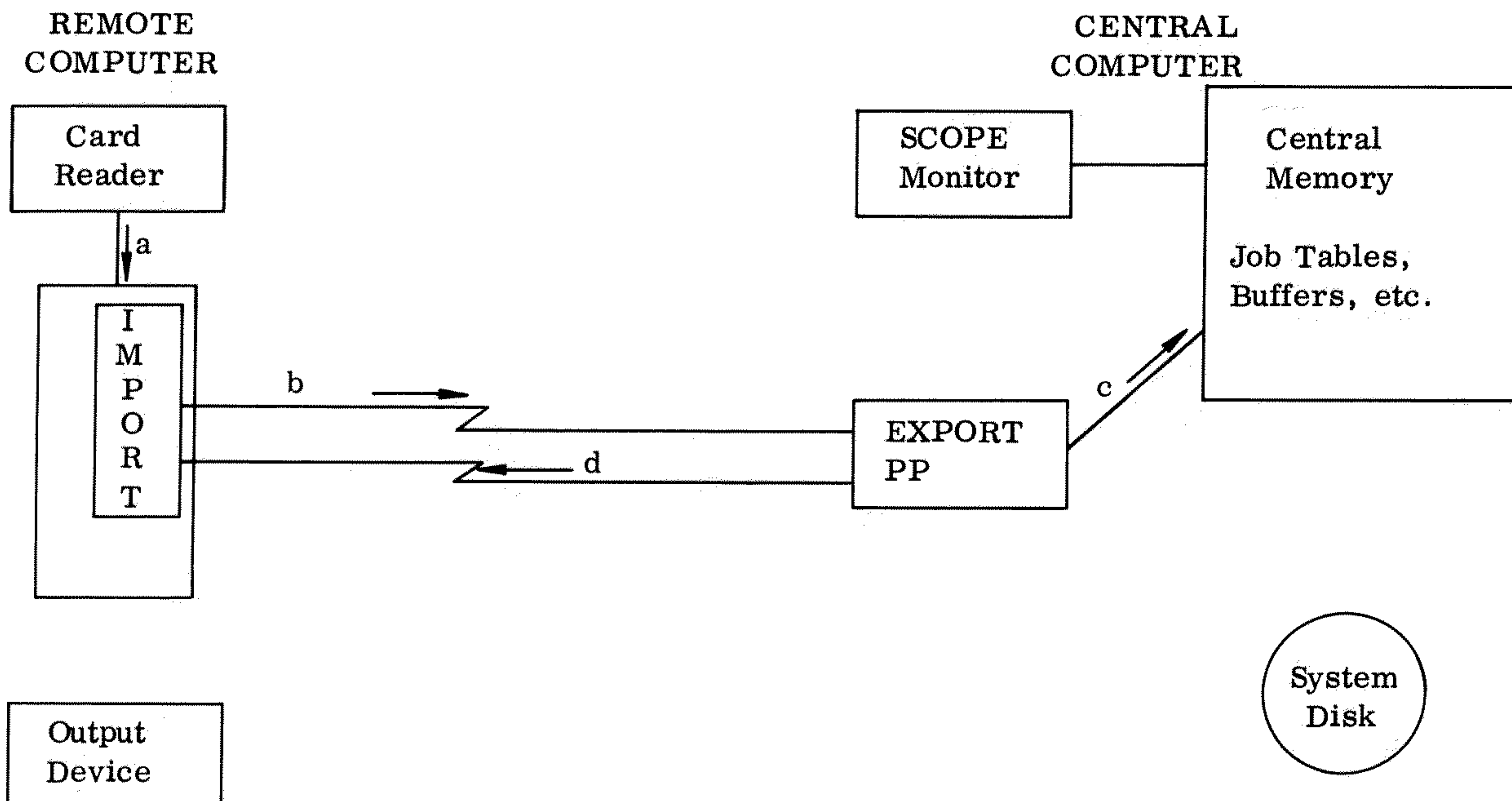
### TERMINATION OF EXPORT

Each terminal notifies EXPORT when communication is finished. When all lines become inactive, EXPORT enters PP recall at its control point. The operator may drop EXPORT if he wishes to free the control point.

## 3.4

### JOB FLOW DIAGRAMS

The following diagrams illustrate the flow of data and control from the beginning to the end of a job. The diagrams assume that EXPORT has been assigned and loaded into a peripheral processor at the central site and that IMPORT has been loaded into the remote facility.



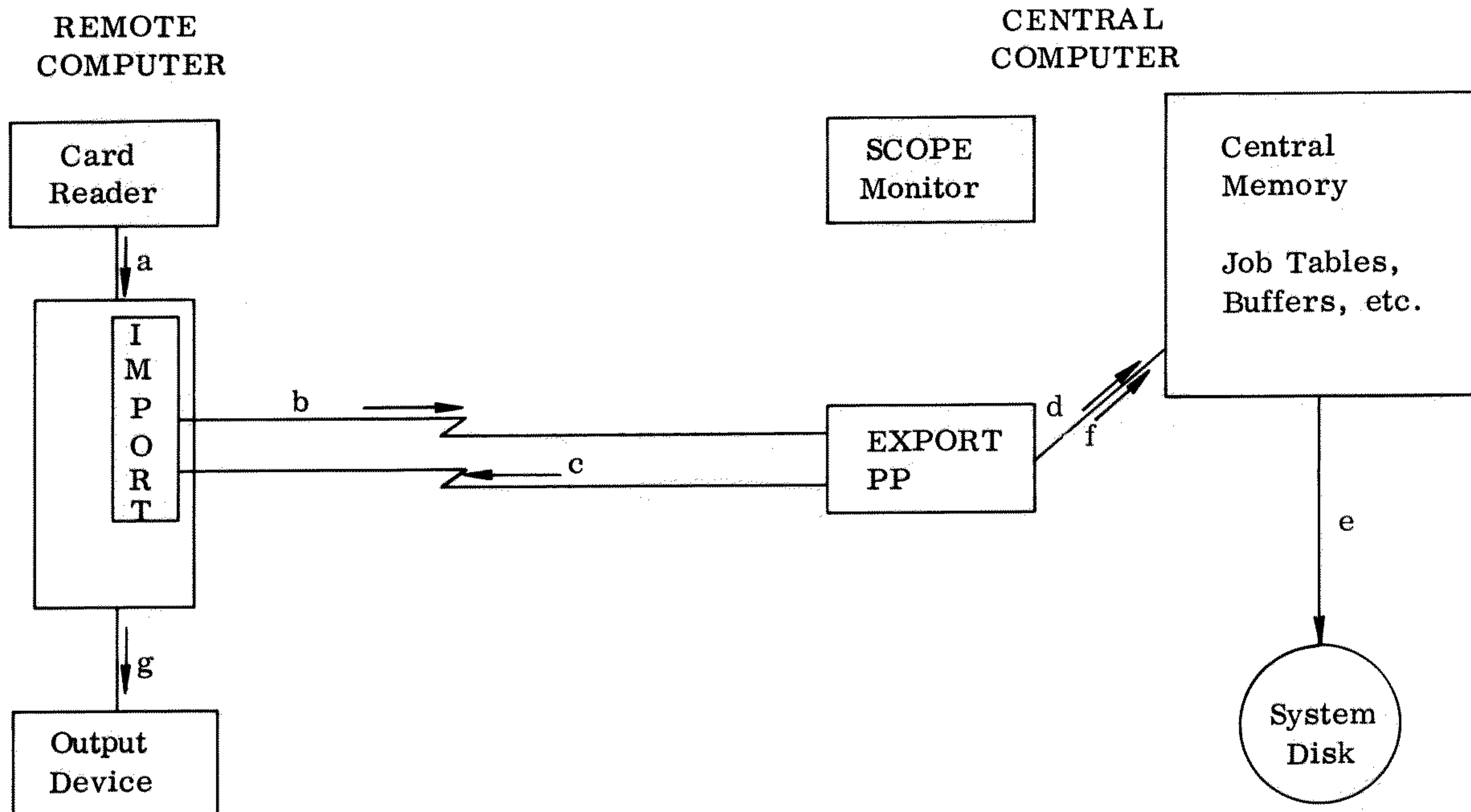
**IMPORT:**

- Reads job card (a)
- Requests permission to send job (b)

**EXPORT:**

- Obtains central memory buffer area (c)
- Notifies remote site that it is ready to accept job (d)

**JOB FLOW, STEP 1, REQUEST TO LOAD**



**IMPORT:**

Reads job into remote computer (a)  
 Transmits data to central site (b)

**EXPORT:**

Acknowledges receipt of each block of data (c)  
 Transfers data to buffer area in central memory (d)

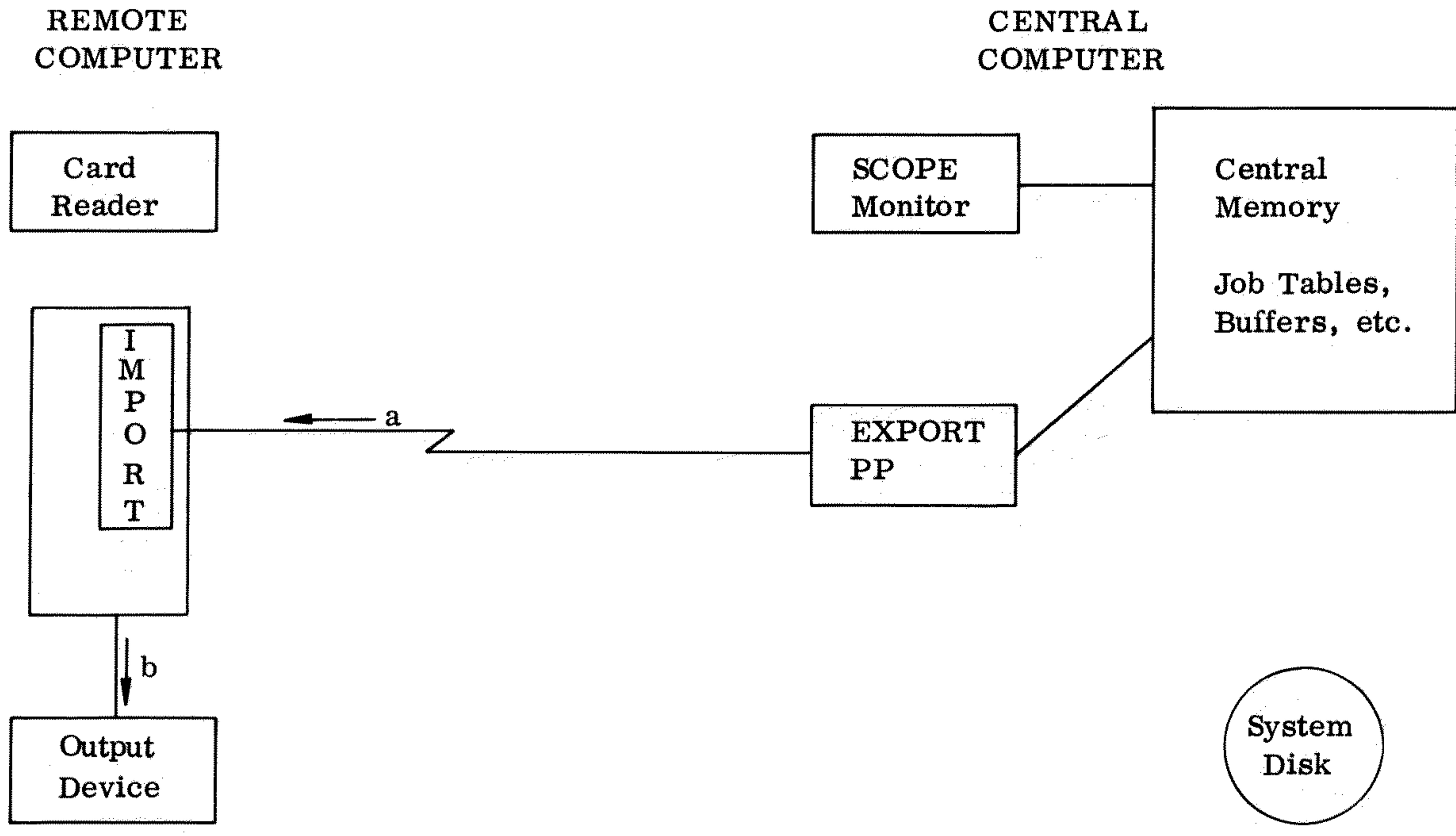
**SCOPE:**

Transfers data from buffer area onto system disk (e)  
 Records job in job table upon receipt of last card (f)

**IMPORT:**

Remote operator is notified when job transmission is completed (g)

**JOB FLOW, STEP 2, LOAD JOB**



**SCOPE:**

Processes job

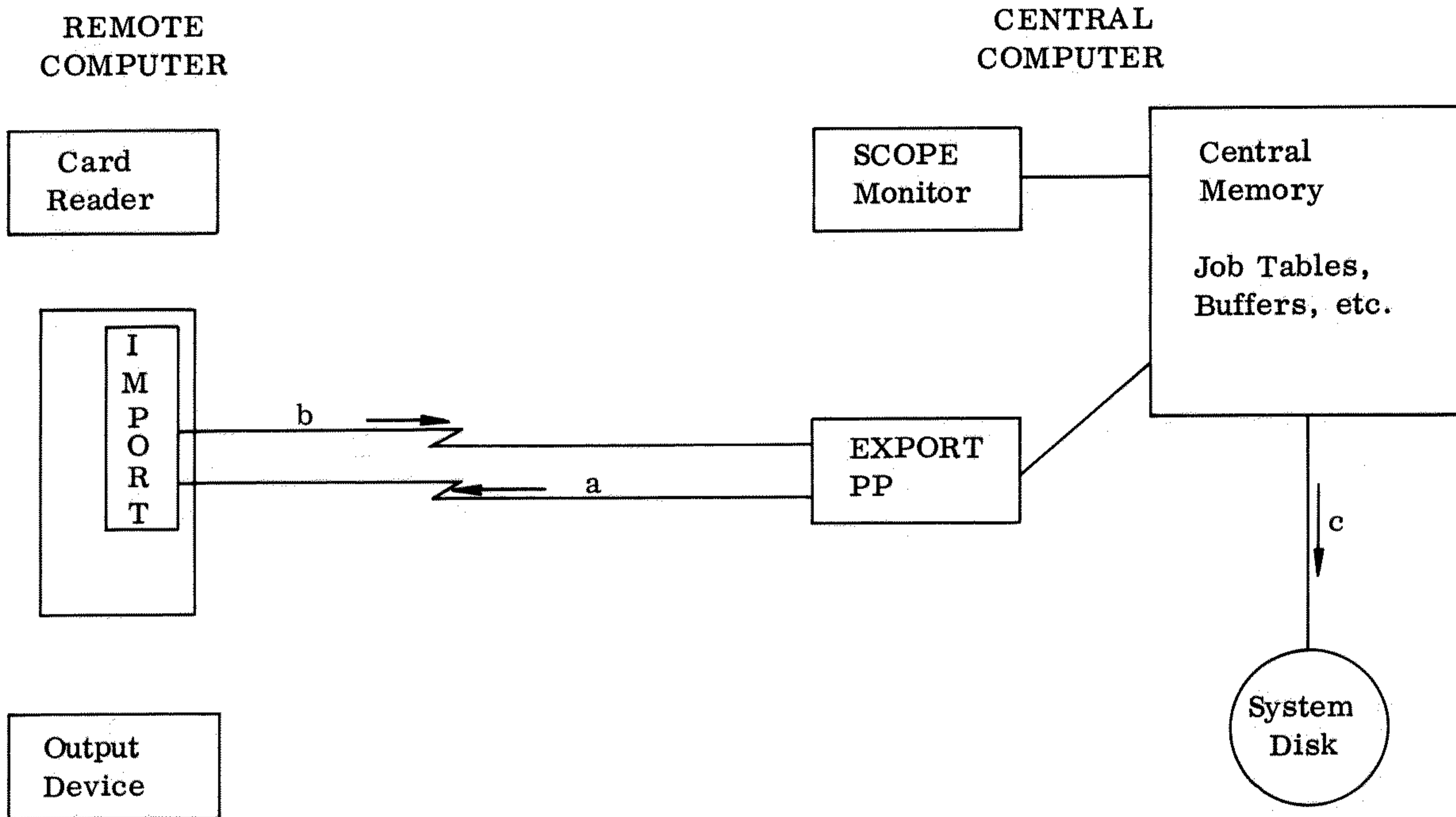
**EXPORT:**

Obtains remote job status by monitoring the job table and jobs in memory  
 Notifies IMPORT of messages pertinent to remote jobs (a)

**IMPORT:**

Outputs message to operator (b)

**JOB FLOW, STEP 3, JOB PROCESSING**



**SCOPE:**

Directs job output data to system disk (c)

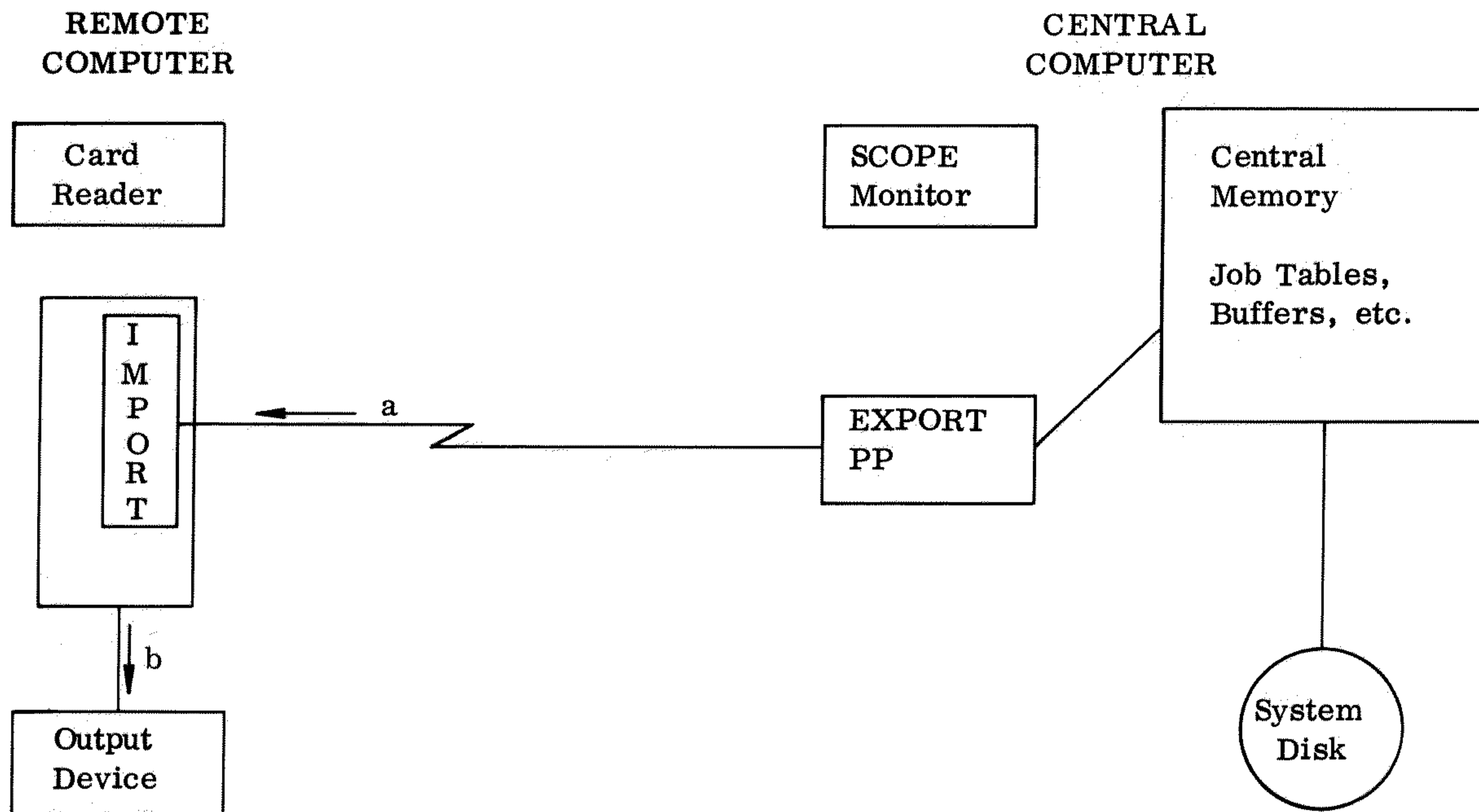
**EXPORT:**

Searches job table for job ready for output (a)  
 Notifies import that output is ready

**IMPORT:**

Requests output which it currently can handle (b)

**JOB FLOW, STEP 4, JOB TERMINATION**



**EXPORT:**

Issues request to transfer output from disk to buffer  
 Transmits data from buffer to remote site (a)

**IMPORT:**

Receives data and outputs it to appropriate device (b)

**JOB FLOW, STEP 5, JOB OUTPUT**



The requests, commands, and responses used by the central and remote operators are described below.

## 4.1 CENTRAL OPERATOR ACTIONS

The central operator initiates the operation of the EXPORT/IMPORT system by entering n.EXPORT from the system display console keyboard, where n is an available control point. All messages from the remote operators, and messages generated internally by EXPORT, are displayed at the control point of EXPORT. Messages pertaining to a particular job are entered into the dayfile for that job.

All messages from remote terminals are displayed at the second line of the message area in the form x.Message, where x is the remote terminal identification. Before another message can be displayed, each message must be acknowledged by the central operator's typing n.GO. A message may be sent to a particular remote terminal by the central operator's typing n.TMR. x.Message, where n is the control point of EXPORT and x is the terminal identification.

Information and action messages are displayed separately for each terminal at the first line of the message area. They appear in the following form:

A. Message    B. Message    C. Message    D. Message

A, B, C, and D represent terminal identifications; the messages are listed below.

### Information Only:

<u>Message</u>	<u>Description</u>
IDLE	Not transmitting data
READ	Receiving card reader data
PRINT	Sending printer data
PUNCH	Sending punch data
SHUTDOWN	Inactive or shutdown

<u>Message</u>	<u>Description</u>
CYCLIC	Cyclic error detected
LOST	Communication lost
(blank)	Line not attached

Messages Which Require Operator Action:

STORAGE	Free CM storage for EXPORT
MESSAGE	Acknowledge by entering n. GO.
ERR = yyyy	DSC status error yyyy
REX = mmmm	mmmm transmissions

} hardware failure

## 4.2 REMOTE OPERATOR ACTIONS

Communications between EXPORT and IMPORT are initiated by the remote operator. Once begun, the operation of IMPORT is controlled by the cards read and by the messages input at the typewriter.

### 4.2.1 STARTUP PROCEDURE

The following sequence is required to load the IMPORT program:

- Press Master Clear.
- Set the Enter-Sweep switch to Enter.
- Set the P register to 7000.
- Set the Z register to the following values, pressing the Run-Step switch once after each value is entered.

The value in the P register advances by 1 with each entry.

0060  
7500  
6004  
2200  
3000  
7677  
7500  
6020  
7202  
7132  
7012

- Both the P and Z registers should contain 7012.
- Set the P register to 7000. Select jump keys, if desired.
- Place the IMPORT program deck in the card reader. Press Motor Power and Ready.
- Set the Run-Step switch to Run.
- IMPORT 8231 IS NOW OPERATING appears when communications are established with EXPORT.

#### 4.2.2 TYPEWRITER INPUT

The following steps are necessary to enter a statement on the typewriter:

- Initiate a carriage return.
- Type the statement.
- Backspace once to re-enter an erroneous statement.
- Terminate with a carriage return.

If an error is detected in the statement, the carriage is tabbed and \*\*U, \*\*J, or \*\*P is typed on the same line. These indicate an unidentified operation, an improper job name, or an improper priority value, respectively. Valid typewriter input statements are listed below; job name is the name returned from EXPORT.

<u>Statement</u>	<u>Function</u>
STAT, job name	Obtain information on status of job.
CPR, job name, priority	Change priority of job; priority is octal.
CPT, job name, seconds	Change central processor (CP) run time limit; maximum of 5 octal digits.
RPNT or RPNT, n	Reprint entire job currently being output on the printer if n is not given; if n is given, the output file is backed up n sectors and reprinted from that point.
RPCH	Repunch entire job currently being output on card punch.
DVT, job name	Divert all remote output for job named to central facility.
TERM, dt	Terminate output on device specified by dt for job currently being output, dt = LP (line printer) or CP (card punch).

<u>Statement</u>	<u>Function</u>
ABT, job name	Abort job named; receive output generated up to this point.
DISP, message	Transmit display message (one line of 40 characters).
LIST	List current contents of IMPORT job table.
END	Shut down remote communications.

### 4.2.3

**TYPEWRITER MESSAGES** Messages that may appear on the typewriter include responses to a status request and messages from IMPORT. Messages relating to peripheral equipment operations are given by a two-character code of the form \*nx.

<u>Monitor Message</u>	<u>Definition</u>
*job name IN STACK	Job name has been loaded at the remote site and is in the input stack waiting to be assigned a control point; this message supplies the SCOPE job name, which differs (characters 5-7) from the name supplied on the job card.
*job name AT CP n status CPT sec	SCOPE has loaded the job from disk to control point n; status equals X, W, A, etc.; CPT is the accumulated central processor run time in octal seconds.
*job name IN OUTPUT STACK	Central processor has completed execution of job named.
*job name NOT IN SYSTEM	Job has been completed, or it never existed.
JOB TABLE FULL, STOP LOADING	IMPORT job table is full; temporarily stop loading jobs.
job name PR C	Printing is complete for the job named.
job name PU C	Punching is complete for the job named.
job name JOB CARD ERROR	The batch loader has detected an illegal job card; IMPORT continues to read cards looking for a correct job card; when it is found, IMPORT transmits that job to the central site. It does not transmit the job with the illegal job card until the card has been corrected and the job reloaded.

Monitor Message

Definition

CL	IMPORT has lost communication with the central facility; IMPORT automatically attempts to re-establish communication.
DSC FAIL TO CONNECT	The remote data set controller is not connected, not installed, or in the test mode; fatal error.
INOPERATIVE DSC	The line carrier signal is lost and/or a malfunction has occurred in the local data set; equipment failure.

(Messages preceded by an asterisk are generated in response to a STAT request.)

**4.2.4  
INPUT/OUTPUT  
MESSAGES**

<u>n</u>	<u>x</u>	<u>Definition</u>	
3		Card reader operation	
4		Card punch operation	
5		Line printer operation	
C		Connect reject	} Equipment failure
S		Select reject	
I		Input reject	
O		Output reject	
R		Read error or punch deck	
F		Failure to feed (check for card jam)	
P		Out of paper (line printer only)	
N		Device not ready (ready device)	

**4.2.5  
RECOVERY  
PROCEDURES**

The following descriptions apply to the I/O error messages given above; n is 3, 4, or 5, depending upon the device in error. If equipment failures persist, a customer engineer should be consulted.

- nC - Connect reject  
Device n cannot be connected. Correct the equipment select code if necessary; otherwise, an equipment malfunction exists.
- nS - Select reject  
Device n has rejected a function select (such as printer spacing) which indicates an equipment malfunction.
- nI - Input reject  
The channel has rejected the last input command for device n, which indicates equipment malfunction.
- nO - Output reject  
The channel has rejected the last output command for device n, which indicates equipment malfunction.
- nR - Read error or punch deck  
For the card reader (n = 3), reload the last card from the output tray and ready the reader. For the card punch (n = 4), feed three blank cards and throw away the new cards which appear in output tray. Ready the punch; and after punching resumes, remove the three blank cards.
- nF - Failure to feed  
Device n is not feeding properly. Check the input tray for possible card jam or damaged cards. Ready the reader when the cards are loaded properly.
- nP - Out of paper  
Check the printer for paper tear, jam, or out-of-paper condition. If it appears that information was lost, the RPNT typewriter command should be used to recover.
- nN - Device not ready  
Ready device n.

**4.2.6  
JUMP KEYS**

The following functions are performed when jump keys on the 8231 are selected.

Key

- 1 Suppress COMMUNICATIONS LOST message
- 2 Bypass remote communications
- 4 Bypass use of typewriter

The EXPORT and IMPORT programs communicate through the hardware and communications equipment described in Chapter 2. The equipment is connected serially in the following sequence from the central computer to the 8231 remote terminal:

6675 data set controller  
301-B DATA PHONE data set  
Telpak-A line or coaxial cable  
301-B DATA PHONE data set  
8231 data set controller

The data set controller converts the 12-bit parallel data from the central computer channel to serial bit data for the data set. The data set, in turn, converts the serial bit patterns for wide band transmission. Conversely, at the opposite end of the line, data is converted to serial bits by the data set and then to 12-bit parallel form for the data channel of the remote terminal. Transmission from the remote terminal to the central computer is accomplished in the same manner, but in reverse order.

## 5.1 COMMUNICATION RULES

Transfer of data between the central computer and the remote terminal involves an exchange of control information which has a fixed format and an unambiguous meaning. The information sent from EXPORT to IMPORT is contained in a status word of 12 bits. This status word specifies the types of data EXPORT is prepared to handle. IMPORT sends control information in the form of a 12-bit directive word. This directive word selects one or more of the options offered by the last EXPORT status word, or it makes a special request. In either case, data may accompany the status word or directive word, in which case the transmission is called a status transfer or a directive transfer.

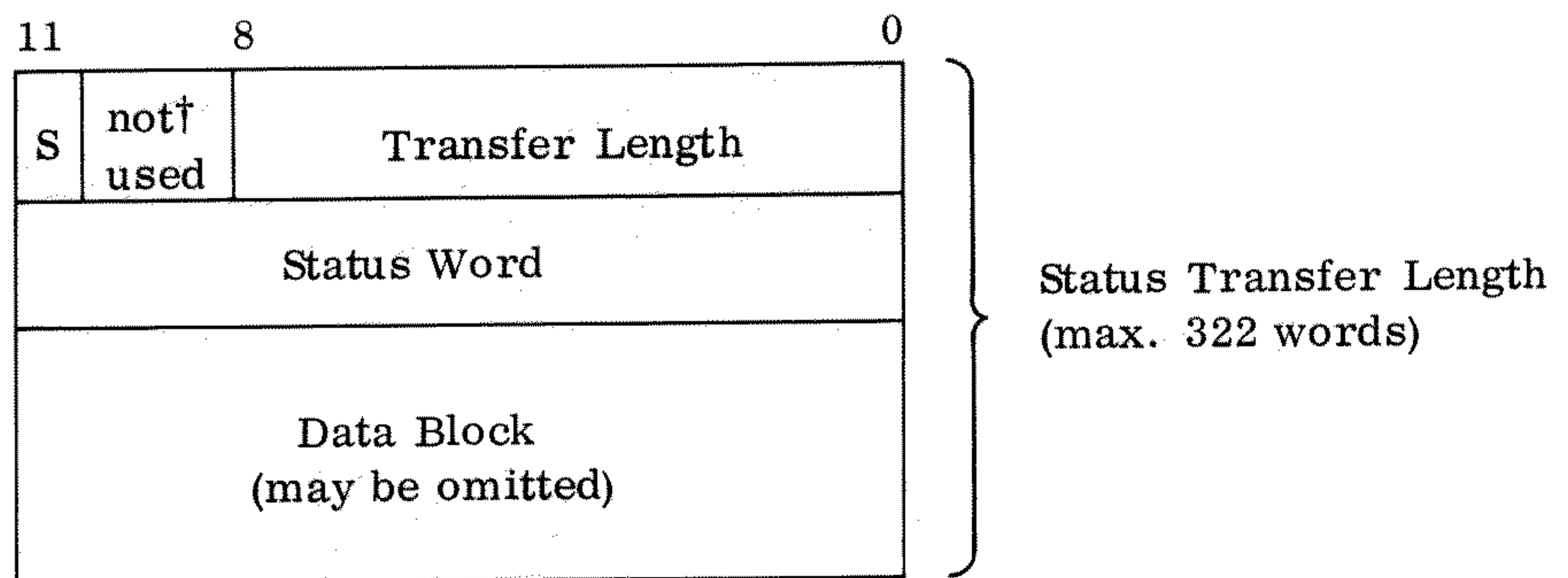
IMPORT must select only from the options offered in the latest status word, and EXPORT must accept the directive word sent. Data included in a status transfer must correspond to the latest directive received, and data in a directive transfer is always of the type indicated in the attached directive word.

**5.2  
TRANSFER  
FORMATS**

The first 12-bit word of each status and directive transfer contains a sequence bit and a 9-bit transfer length. The sequence bit indicates to the transmitting site whether or not its messages are being received properly. The transfer length gives the count of the total number of 12-bit words contained in the message, including the first word but excluding the hardware-appended cyclic code word. A typical transfer would contain 322 12-bit words (the maximum length), since, normally, data blocks corresponding to 64 central memory words are transmitted. The minimum transfer length is two words.

**5.2.1  
STATUS  
TRANSFER FORMAT**

The format of a status transfer depends upon whether or not data is included in the message. A fixed-length message without any data consists of only two 12-bit words. The first word contains the sequence bit and transfer length; the second is the status word. A variable-length message with data may contain up to 322 words (12-bit) and is simply an extension of the first format with data appended after the status word.



- S sequence bit (0 or 1)
- † reserved for future use



In this scheme, the central and remote control programs are governed by the following rules:

- Only error-free transmissions are acknowledged.
- Acknowledgment is indicated by a bit in the subsequent transfer.
- Absence of an acknowledgment implies a retransmission request.

Conditions that are checked by each computer before initiating input or output include malfunctions that may occur in the communications facilities. Operators receive messages concerning any malfunctions.

Whenever the message received is not identical to the message sent (bit for bit), a transmission error occurs. If the error is not detected, incorrect information is received. Several error types and conditions are described in the following sections. Only errors in the communication facility are considered here.

#### **5.5.1 ERROR CAUSES**

##### Message Lost Completely

The leading SYNC words may be lost or mutilated so that the entire message is passed over as noise on the line.

##### Message Garbled

Lightning, electrical disturbances, and random noise may introduce errors on the communications line or between the MODEM and the DSC.

##### Bit Loss

Inaccurate timing in the MODEM may cause the entire message to be shifted forward by 1 bit.

#### **5.5.2 DETECTION LOGIC**

The primary error detection capability is provided by the 6675 DSC and the 8231 DSC hardware in the form of a 12-bit cyclic code encoder. Continuously, a 12-bit cyclic code word is generated automatically by the transmitting data set adapter and appended as the last transmitted word. Likewise, the receiving DSC generates a 12-bit word which is compared to the last word received. When the two cyclic code words are identical, no errors have been detected and transmission is assumed to be correct as received.

The detection logic flows as follows: The data stream may be considered to be equivalent to a binary polynomial, where the 1's and 0's of data are the coefficients of the terms in the polynomial. The first bit transmitted (the high order bit of the first word) corresponds to the highest order term of the polynomial. Each data set adapter divides (Exclusive OR) the data polynomial by a fixed 12-bit divisor. At the end of transmission, the remainder is appended to the data stream by the transmitting DSC. The receiving DSC continues dividing to include the remainder transmitted, yielding a new remainder of zero if the data polynomials are identical.

By terminating input or output on the line, the computer indicates to the DSC when to expect the cyclic code word. For example, when a message is being received, the transfer length is used by the receiving program to read the exact number of words in the transfer. After the last word is read, the program allows the maximum time between words (about 290 microseconds) to be exceeded, indicating to the DSC that the next word to be read is the cyclic code word. A subsequent status check of the DSC will indicate if a cyclic code error occurred. If the transfer length is received incorrectly, the wrong word will be signaled as the cyclic code word, which usually results in a cyclic code error.

In some cases, a transmission error is detected apart from the cyclic code check. This occurs when analysis of the control data received shows an impossible condition (such as an invalid transfer length) or an inconsistent request. In these cases, the transmission is treated as if a cyclic code error has been detected.

### 5.5.3 DETECTION CAPABILITY AND FEATURES

The scheme outlined in the previous section provides the following error detection checks:

- Any odd number of errors
- All error bursts of 12 bits or less in length
- 99.95 percent of all error bursts 13 bits long
- 99.98 percent of all error bursts longer than 13 bits

An error burst is defined as any pattern of errors with length equal to the number of bits between the first and last errors of the transmission.

This cyclic code protection scheme is highly efficient, since only 12 parity bits are required for the entire transmission. For the usual 322 word transmission, only one extra word is added — the transfer is 99.7 percent data. Each 12-bit word contains two 6-bit characters in display code. Since each data bit in the polynomial has positional value, any bit or word loss is detectable.

**5.5.4  
ERROR  
COMPENSATION**

With each transmission of EXPORT/IMPORT, the sequence bit normally alternates between 0 and 1. However, when the receiving computer detects an error, the sequence bit for its next transmission is not changed, and the previous transfer is retransmitted.

Therefore, when a transfer is received with a sequence bit that has not changed from the last transmission, the receiver must retransmit its previous transfer.

This scheme may be summarized in the following rules which are observed by both EXPORT and IMPORT:

Acknowledge only error-free transmissions.

Retransmit until acknowledgment is received.

(Acknowledgment means a change in the sequence bit.)

An additional error recovery scheme provides for recovery from a SYNC word error. Should both computers be in the transmit mode, the remote computer will be placed in the receive mode when it has attempted to transmit  $n^\dagger$  times without receiving a SYNC word acknowledgment.

If, for any reason, the communications line goes down between transfers, the data set controllers detect and inform the computers of the malfunction. This is one of several conditions that are checked by each computer before initiating input or output. Should communications go down, EXPORT and IMPORT also output messages to their respective operators, notifying them of the malfunction.

For example, when a computer goes down while transmitting, the receiving computer inputs idle characters for the remainder of the transfer. Then, at the conclusion of input, the cyclic code indicates that a malfunction occurred. Further attempts to retransmit will not hang up the sending computer, but the sending computer continues to detect that the other computer is down or offline.

If either computer goes down before or during input or output, however, the other computer detects this and informs its operator of the malfunction.

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<sup>†</sup> Assembly time parameter.

## 6.1 INITIALIZATION OF EXPORT

When EXPORT is called to a control point by the operator request n. EXPORT, an initialization program is loaded into an available PP and started running. Sufficient central memory storage for working storage and overlays is requested immediately. EXPORT overlays are read from disk into the PP and then placed in central memory at its control point for rapid accessibility. The communications overlay is intercepted before it is written to central memory; and a routine is entered to initialize it for the appropriate channel (of the 6675), to build function codes from the Equipment Status Table entry, etc. Finally, the resident program is loaded and the initialization of EXPORT is complete.

## 6.2 OVERALL FLOW

Processing is controlled by the EXPORT resident which resides in PP memory until all lines become inactive. The main control loop of the EXPORT program cycles among several activities in the resident routine and two overlays called from central memory. The first overlay handles all communications with IMPORT. The second overlay processes directives from all active remote terminals.

### 6.2.1 RESIDENT ACTIVITIES

The resident routine described below is one of the three major areas through which the main control loop of the EXPORT program passes.

#### Check SCOPE Write Requests

The CM card input buffer status is checked for each active line; and if a completed write is indicated, the buffer parameters are updated. Status is set to indicate Reader Buffer Empty.

#### Central Operator to Remote Messages

The buffer that contains messages from the central operator is checked for an entry. The message buffer for the terminal specified by the entry is checked and if there is sufficient space, the message is moved to the buffer. The indicator is cleared to allow additional operator messages. Status is set to indicate that a message is waiting.

