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A and B Channel

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1.1 GENERAL

This manual provides the information required by an application programmer to write programs that will run in a processing channel of the C-System. General information concerning the requirements that these programs must meet is included in this section.

1.2 LANGUAGE

Applications programs can be written in any language for which a C-System assembler or compiler is available. However, most applications programs are written in the MA61 basic assembler language, and it has been used for the coding examples in this manual. Refer to the programming manual on MA61, P/N 523-0561760, for further details on the language.

In support of MA61, the macro definition language allows development of problem oriented languages. For further details on its use, refer to the Macro Definition Language Programming Manual, P/N 523-0561699.

The application system is defined in control program language, described in Control Program Language Programming Manual, P/N 523-0561782.

1.3 CORE AVAILABILITY

C-System processors are divided into four processing channels as a means of sharing their processing capabilities and core storage. Use of the processor is time shared among the channels and core storage space is allocated to each channel.

The A and B processing channels are designed for application programs. The A processing channel typically provides 32, 768 words of core, and the B processing channel typically provides 8096 words of core. Processors are configured to provide other processing channel sizes for certain applications. Programs are loaded into either channel, as specified in the control program. The user must specify A channel for any program requiring more than 8096 words of core, but can specify that channel for any program. Specifying the B channel for programs requiring 8096 words of core or less reserves A channel for longer programs, and is encouraged.

1.4 SYSTEM FILE STRUCTURE

A fundamental philosophy of the C-System is that many user programs may have common access to data files required during execution. In the execution of the elements of a control program, files are created and stored on disc or tape to be used by subsequent programs in the control programs enabling the required files to be located and accessed as required. Having multiple users of files requires that a common file structure be implemented. In the C-System this structure is provided through the indirect file transfer commands which automatically read, write, search and structure the information files for the user programs. The files may be located on either tape or disc units and the capability exists in the system to derive tape files from disc files and vice versa.

Direct file transfer commands are available to the user for reading and writing files on tape and disc independently of the file structure. However, files compatible with the file structure can be written using these commands, if the characteristics of the structure are adhered to.

Related to the file structure is the documentation of files. Documentation consists of identifying the cells on disc and reels of tape that contain active files. Indirect file transfer commands provide a means of specifying documentation as a file is opened. Actual documentation is accomplished by space management functions called when files are closed.

A program writes one output file, that must be opened as a documented file, causing the open routine to build a file status pointer word in the program status record. This word contains file status bits and the address of the file linkage block which describes the file. This information is used when the file is closed, and results in documenting an output file as active for disc space management purposes, to prevent reallocation of disc space.

A program can use one or more work files, which are files written and later read by the same program. If these files are opened as documented files, file status pointer words are built for them, and they are closed and documented as inactive by the close routine that closes the output file.

It is possible to pass work files to other programs by placing their identifiers in the output file. These work files must be opened undocumented, and the user must call the close routine and the document file routine to close and document these files as active.

1.4.1 Disc File Structure

A file identifier built by the close command and placed in the input lists of appropriate program control instructions uniquely identifies each disc file. The second word of the file identifier is the cell address of the high-level connector cell. The high-level connector cell is one of three types, depending upon the size of the file.

For a single-cell file, the cell is both a connector cell and a data cell. This is a special case, in that the structure is altered to separate the connector cell portion from the data cell portion. In the case of a single-cell file, the address of that cell appears in the file identifier as the address of the high-level connector cell.

For a file consisting of a few cells, one cell is a connector cell that identifies the other cells, the data cells. Data cells are identified by connector cell items that contain the data cell address, and the item parameter. The item parameter, 2 to 254 bytes long, describes the data cell. A connector cell consisting of items describing data cells is a low-level connector cell. When a single low-level connector cell contains items for all data cells of a file, the cell address of that connector cell appears in the file identifier as the high-level connector cell address.

A larger file requires more low-level connector cells. The low-level connector cells are described in items of a higher-level connector cell. Each item of a higher-level connector cell contains the cell address and the right hand halfword of the identifier of a lower-level connector cell. When written by the direct command, a connector cell item can also contain an item parameter up to 254 bytes long, describing the section of the file identified in that connector cell. There is no limit to the number of levels of connector cells. A higher level is created as the second connector cell at the previously highest level is initiated. Thus, regardless of the number of levels in the file connector cell structure, there is a single high-level connector cell from which any data cell of the file can be located. The address of this cell is placed in the file identifier.

At any point during the writing of a file, the connector cell structure is not necessarily complete, and the current high-level connector cell is not necessarily the final high-level connector cell. When a file is closed, the existing connector cell structure is completed and the current high-level connector cell is completed as the final high-level connector cell.

Zones of disc are allocated according to the cell size of a file. Four sizes, 128, 256, 512, and 2048 bytes, are permitted, and all data and connector cells of a file are the same length.

Refer to Appendix B for the detailed disc file structure.

1.4.2 Tape File Structure

The tape file structure differs from the disc file structure only as required by the serial nature of magnetic tape. The low-level connector cell item is prefixed to the data cell and the item parameter is read along with the data. The connector cell structure is optionally written on disc. The high-level connector cell is a reels list consisting of items that identify a reel of the file and include the address of the corresponding connector cell. The connector cell structure is also written on tape at the end of the file.

The connector cell structure on disc may be released when the file is closed. In this case, the connector cell addresses in the reels list items are replaced by zeros. The reels list is retained on disc, and the connector cell structure on tape is not altered.

If the file is written without writing the connector cell structure on disc, the reels list is written on disc with zeros in the cell address fields of the reels list items. The reels list is also written on tape at the close of the file.

Refer to appendix B for the detailed tape file structure.

If it is desired to write item parameters in connector cells other than the low-level connector cells, the cells must be written with the direct command, and the connector cell structure must be retained on disc or restored to disc prior to reading. The advantage of writing a file in this way is to allow selecting desired reels of a multi-reel file by reading item parameters within connector cells on disc.

1.5 SYSTEM INTERFACES

System interfaces with a user program include control program service, device acquisition and control service, data collection service, and secondary storage management.

1.5.1 Control Program Service

Control program service, which is resident in each processor in a center, is responsible for the execution of the program control instructions of a control program. A program control instruction represents a portion of an application system, and consists of an input count, the location of an application program on disc, an input list, a list of the dependent program control instructions, and a list of files to be released. In executing a program control instruction, control program service completes the input list, and issues a service message that calls the application program. Control program service later receives a return service message indicating that a processor has executed the application program, and releases the files listed in the program control instruction release list. Control program service then refers to the list of dependent program control instructions, and decrements the input count of each one. Finally, control program service executes each program control instruction whose count is zero, indicating that all inputs are ready.

The program control instructions of a control program are assembled from source statements in control program language. For details of the source statements, refer to the Control Program Language Programming Manual, P/N 523-0561782.

Interface of a user program with control program service consists of the program status record described in detail in paragraph 2.2. The program status record includes the input file identifiers, in the same order in which the source program INPUT statement lists them. The program status record also includes the zone parameter for program files.

It is frequently necessary that interface with system programs is through the control program executed by control program service. Obtaining input files from data collection service and acquiring devices on the time division exchange are examples of this type of interface. In both cases, the information the user

requires is contained in the output file of the service program. Control program service moves the output file identifier to the input list for the user program, under control of the source program INPUT statement. Similarly, the user program can prepare an input for a service program as the literal output or the output file. Control program service, as directed in a source program INPUT statement, places the file identifier or literal in the input list for the service program.

1.5.2 Device Acquisition and Control Service

Device acquisition and control service performs the functions necessary to prepare magnetic tape for access by user programs. Access to tape requires tape library functions, printing of operator instructions on reel labels, and assignment of working channels for data transfers to or from the tape units. User programs also require device acquisition and control service functions that do not directly relate to access of tapes. These functions are the release of tape files and the deleting of reels removed from the library. Still other functions of device acquisition and control service prepare other devices on the time division exchange for access by user programs. These functions require printing of operator instructions specifying the media and optional settings of controls, and assignment of working channels for data transfers. In addition to these functions, device acquisition and control service provides output of messages by means of devices on the time division exchange. This is an indirect access that requires calling a utility program to transfer the message in addition to the normal access functions.

Preparation of tapes and devices for access by a user program requires a call to device acquisition and control service by a program control instruction in a control program. The input list of the program control instruction can contain a literal single tape or device request, the address of the reels list of a tape file, or an indirect request, which may be a data collection service collection file.

The literal request requires two entries in the input list. A literal output from another program can provide one entry in the input list, or both entries can be defined in the control program. The following shows the format of a literal request.

Input List	A (16)		B (16)	
Entry 1	C (8)	D (8)	ZERO (16)	
Input List	E (16)		SPARE (16)	
Entry 2	SPARE (32)			

Field	Definition
A	Device dependent - See following list
B	Device dependent - See following list
C	Device dependent - See following list
D	Party line address or zero
E	Loop 1 and loop 2 addresses, or zero

For input tapes:

Field	Definition
A	Time halfword of reel identifier
B	Reel key number
C	X'50 for 7-channel tape
	X'51 for 9-channel tape

For scratch tape:

Field	Definition
A	Zero
B	Library zone, X'1 - X'F
C	X'50 for 7-channel tape
	X'51 for 9-channel tape

For card reader:

Field	Definition
A, B	Forms identifier, first four characters on card
C	X'10

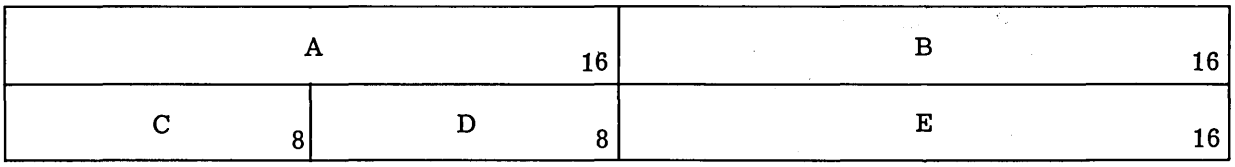
For CRT display and entry station:

Field	Definition
A, B	Forms identifier, four characters to be placed on first line
C	X'40

For line printer:

Field	Definition
A, B	Forms identifier, four digit form number
C	X'30

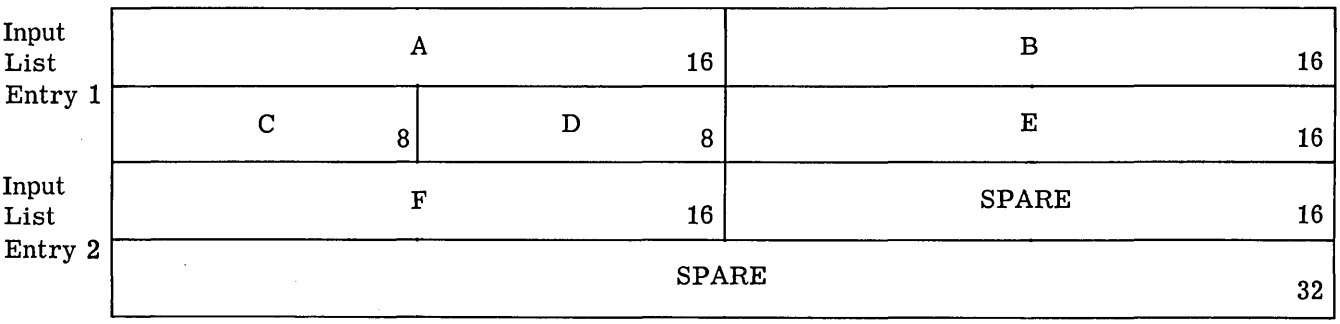
Input of the address of a reels list requires a single entry in the input list. This entry is the output of a user program, placed in the input list by control program service. The following is the format of an input list entry for a reels list of a tape file.



Field	Definition
A	Time halfword in identifier of reels list cell
B	Cell allocation count in identifier of reels list cell
C	Zone parameter of reels list cell
D	Loop 1 address of disc containing reels list cell
E	Reels list cell address

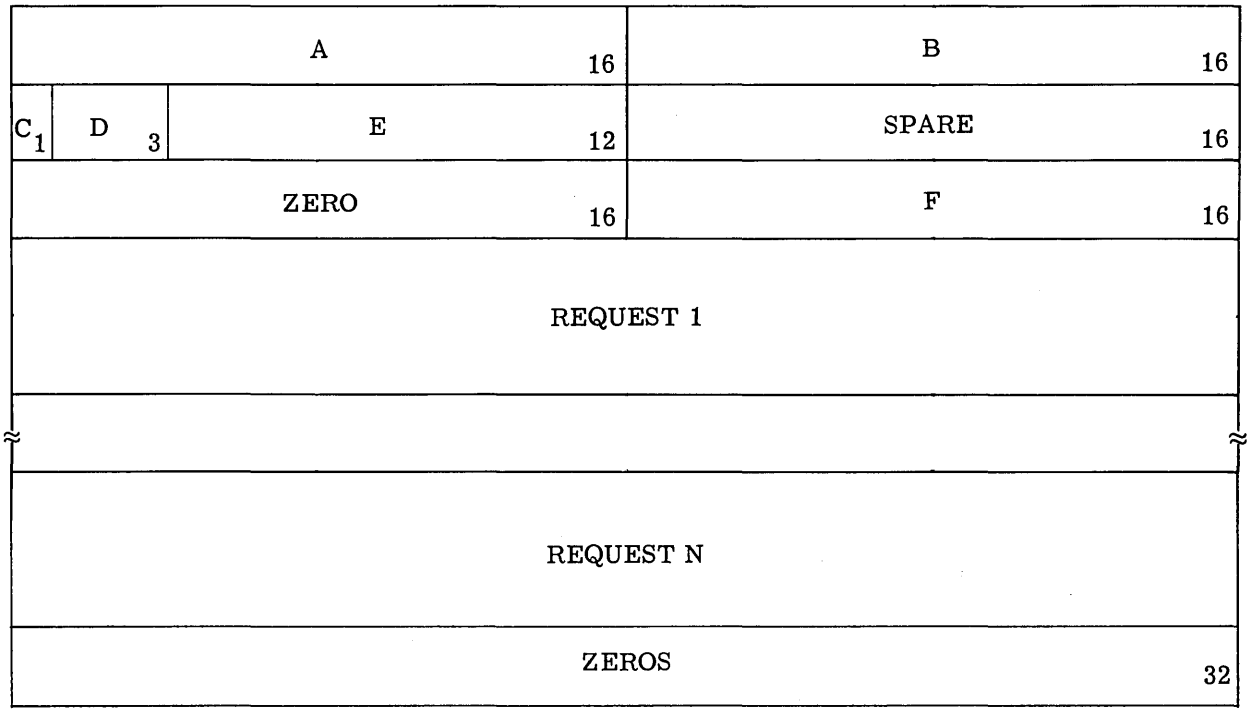
An indirect request is a multiple request built by a user program, or a collection file built by data collection service. It allows a single call to device acquisition and control service to specify preparation of one or more tape files, one or more devices, or both. Disc file entries in a collection file are ignored. The user program that builds this request can place it in a single cell disc file or in a uniquely identified cell of another file. Data collection service collection files are single cell files. Identification of the request cell in another file is by means of the item parameter of that cell, specified in the input to device acquisition and control service.

An indirect request type input to device acquisition and control service requires two input list entries. The first is the output of the program that built the request. The second input list entry is specified literally in the control program. The format of these two entries is as follows.



Field	Definition
A	Time halfword in identifier of disc file
B	Cell allocation count in identifier of disc file
C	Zone parameter of disc file
D	Loop 1 address of disc file
E	Cell address of single cell file or of high level connector cell of file containing request cell
F	0 for single cell file, or two character item parameter of request cell in other file

The indirect request cell format is:



Field	Definition
A	Time halfword in indentifier of disc file
B	Cell allocation count in identifier of disc file
C	0 = single cell file
	1 = cell of other file
D	1

Field	Definition
E	12
F	1

The 12-byte header is followed by one or more requests, with an all-zero word immediately following the last request. The format of the request depends upon the type of device or tape. The following six formats are recognized by device acquisition and control service.

For input tapes, internal or external:

A														16	B															16
1	0	0	0	C										12	D															16
E														16	F															16
1	G							7	H					8	I															16

Field	Definition
A, B	User-built protection keys, non-zero
C	16
D	Type code
	1 = mount data reels
	2 = mount reels containing connector cell structure
	5 = mount data reels for an external file
E	Time halfword of file identifier
F	Cell allocation count of identifier of reels list cell
G	Zone parameter of reels list on disc
H	Loop 1 address of disc containing reels list
I	Cell address of reels list

For output tapes, internal or external:

A 16			B 16
1	0 0 0	C 12	D 16
E 8		F 8	ZERO 16

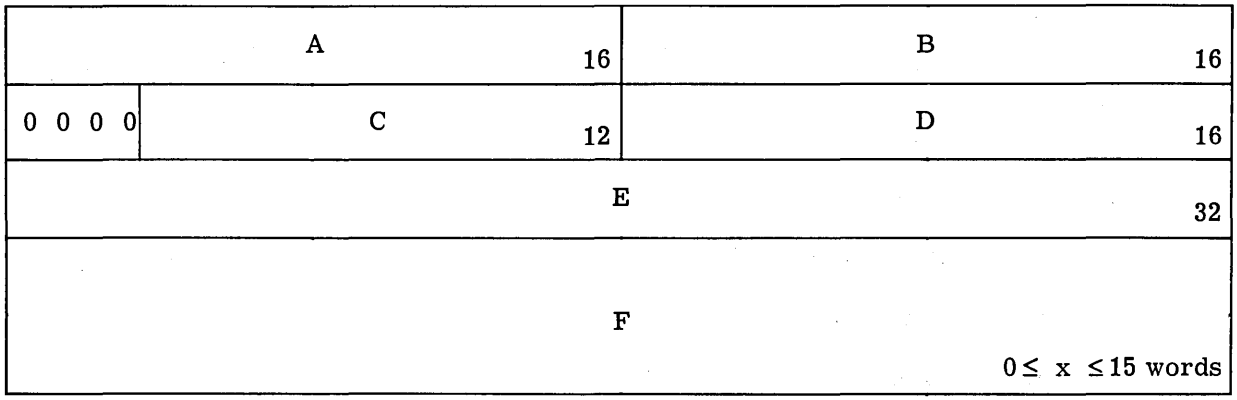
Field	Definition
A, B	User-built protection keys, non-zero
C	12
D	Type code
	4 = Internal tape
	6 = External tape
E	1 = 9-channel tape
	2 = 7-channel tape
F	Library zone
	2 = External tape
	3-15 = Internal tape

For card reader:

A 16		B 16
0 0 0 0	C 12	D 16
E 32		
F $0 \leq x \leq 15$ words		

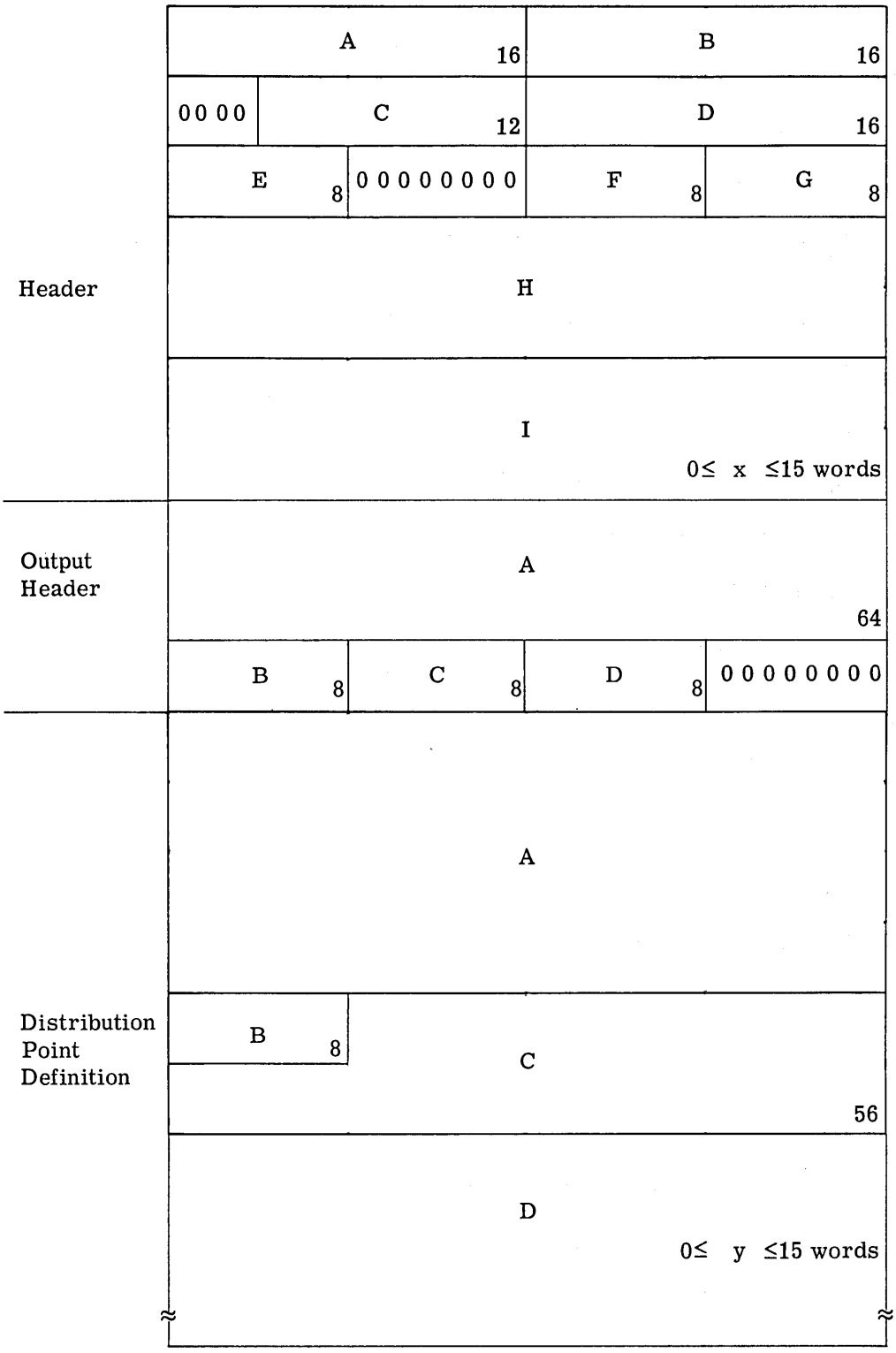
Field	Definition
A, B	User-built protection keys, non-zero
C	Length of request entry (bytes)
	C = 12 + 4x
D	X'10
E	ASCII representation of first four columns on card
F	Operator Message in ASCII, 0-15 words in length

For CRT display and entry station:



Field	Definition
A, B	User-built protection keys, non-zero
C	Length of request entry (bytes)
	C = 12 + 4x
D	X'11
E	ASCII representation of first four characters to be entered
F	Operator message in ASCII, 0-15 words in length

For line printer:



A line printer request consists of a header, and one or more outputs each having one or more distribution points. The number of distribution points per output and the number of outputs is limited only by the size of the indirect request cell.

The request header consists of:

Field	Definition
A, B	User-built protection keys, non-zero
C	Length of request entry (bytes), where n is the number of outputs, and m is the number of distribution points $C = 20 + 4x + 12n + 24m + 4y_1 + 4y_2 \ldots + 4y_m$
D	X'12
E	X'30
F	Byte increment to first output header
G	Vertical spacing, 6 or 8, for lines per inch
H	Eight ASCII character form number
I	Setup message to operator, ASCII characters, 0-15 words

The header for each output consists of:

Field	Definition
A	Eight ASCII character output identifier
B	Number of distribution points for output
C	Byte increment to next output header
D	Length of distribution point definition (bytes), constant for each output

The distribution point definition consists of:

Field	Definition
A	Name of recipient, 16 ASCII characters
B	Number of copies for this recipient
C	Mail station of recipient, seven ASCII characters
D	Note to distribution, ASCII characters, 0-15 words

For null request:

A 16		B 16	
0 0 0 0	C 12	D 16	
E 0≤ x ≤n			

Field	Definition
A, B	User-built protection keys, non-zero
C	Length of request entry (bytes) C = 8 + 4x
D	3
E	Null entry file identifiers or data, 0-n words

Note

Size of n is limited only by size of indirect request cell. The normal use of the null request is for disc file identifiers in a data collection service collection file.

In response to a request for one or more tapes or devices, device acquisition and control service provides a file containing one or more allocations. Control program service places the identifier of this file in the input list of the program control instruction for the user program. The following shows the header for this file.

A 16		B 16	
0 0 0 1	C 12	SPARE 16	
ZEROS 16		D 16	
≈ ALLOCATION 1-n ≈			
ZEROS 32			

Field	Definition
A	Time halfword of file identifier
B	Cell allocation count of file identifier
C	12
D	1

Allocation entries follow the header. A tape file request or literal request results in one allocation entry. An indirect request results in one allocation entry for each entry in the indirect request cell, in the same sequence. The input tape allocation entry is shown in paragraph 4.1.3.1.2. The output tape allocation entry is shown in paragraph 4.1.4.1.2. The allocation entry for a line printer, a card reader, or a CRT display and entry station, is shown in paragraph 4.1.6.2. The allocation entry corresponding to a null request entry is identical to the request entry. An all-zero word immediately follows the last allocation entry.

When writing a multi-reel tape file using the direct command, the user must obtain a new reel when the current reel is full. The user can use a common function, replace output tape, as described in paragraph 4.4.1.4, or call device acquisition and control service directly, using a service message in the following format. The user must also call direct commands to rewind the tape and to set mount output reel, if device acquisition and control service is called.

A 8	SPARE 8	B 8	C 8
D 16		E 8	SPARE 8
F 16		G 16	
H 8	I 8	J 8	K 8
SPARE 32			
SPARE 32			

Field	Definition
A	X'84
B	Orderwire 1 address of calling processor
C	Channel specification
	X'02 = S channel
	X'05 = M channel
	X'06 = B channel
	X'07 = A channel

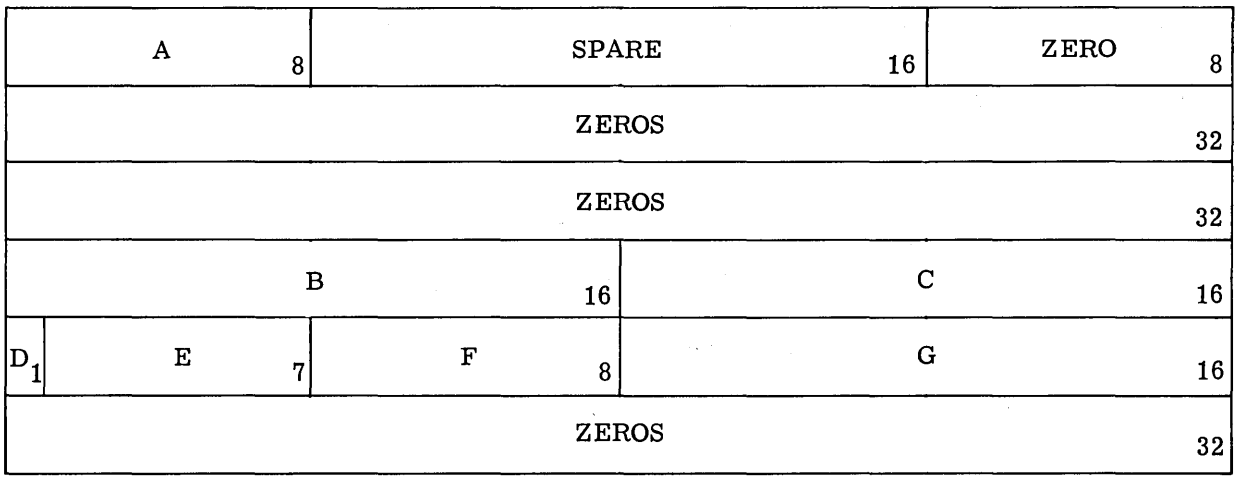
Field	Definition
D	Core address of word which is to contain status
E	Loop 1 address of tape unit
F	Time halfword for tape identifier
G	Zero
H	Spare
I	Party line address of tape unit
J	First byte of replace output tape command packet, paragraph 4.1.4.4.2
K	Library zone into which reel is to be placed

After performing the function, device acquisition and control service returns the service message with altered data in the following fields.

Field	Definition
A	X'01
F, G	If field H contains X'C0, field F contains the time halfword and field G the reel key number of the new output reel If field H contains X'E0, fields F and G combined contain the device status word of the tape unit, paragraph 4.1.4.4.3
H	X'C0 = Successful completion X'E0 = Tape unit error defined in fields F and G

When the orderwire 1 input program identifies a replace output tape return service message, it moves fields F, G, H, I, J, and K of the service message to the location specified in field D.

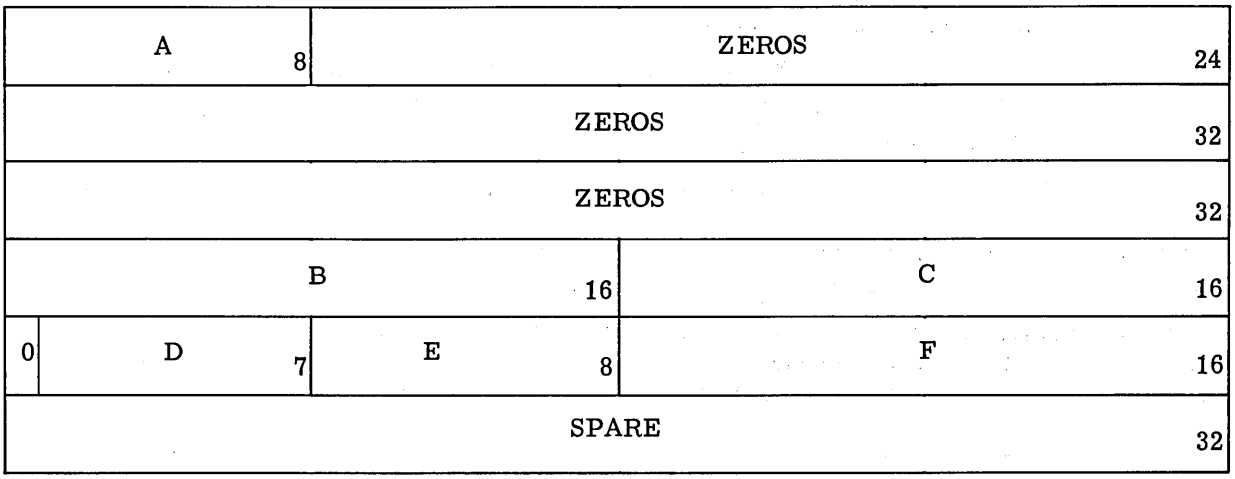
Control program service can issue a call to device acquisition and control service to release tape files. Alternatively, a release of tape files can be accomplished by a service message from a user program. The format of the service message from a user program to release tape files is as follows.



Field	Definition
A	X'80
B	Time halfword in file identifier of file to be released
C	Cell allocation count in file identifier of file to be released
D	0 = Disc file
	1 = Tape file
E	Zone parameter of reels list of file to be released
F	Loop 1 address of disc containing reels list of file to be released
G	Cell address of reels list

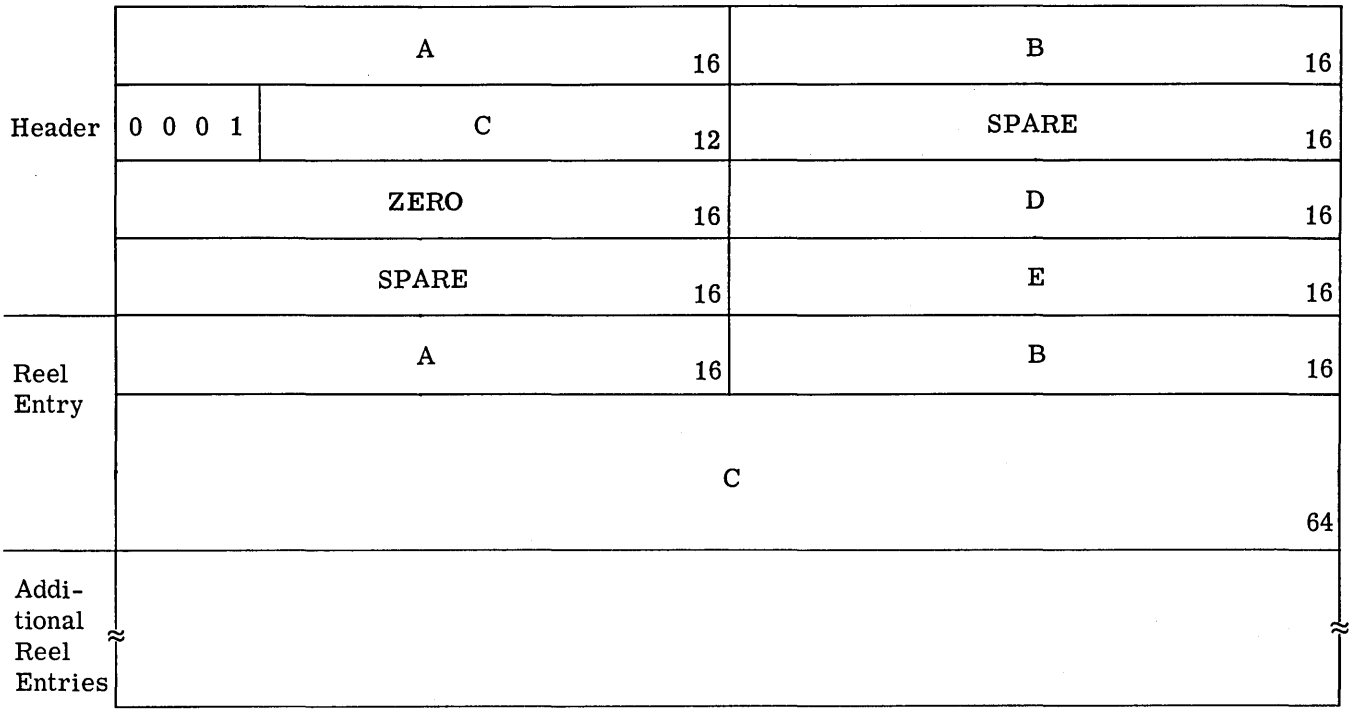
Device acquisition and control service releases the reels and generates a space release message to release disc space.

To delete one or more reels from the library (external tapes being sent to another system, for example) the user program initiates a service message that points to a single cell file of reel identifier entries. The following shows the service message format.



Field	Definition
A	X'83
B	Time halfword in identifier of single cell file
C	Cell allocation count in identifier of single cell file
D	Zone parameter or single cell file
E	Loop 1 address of disc containing single cell file
F	Cell address of single cell file

The following is the format of the single cell file. It must contain an entry for each reel to be deleted.



The header consists of:

Field	Definition
A	Identifier time halfword
B	Identifier cell allocation count
C	12
D	3
E	Length of list (bytes) E = 4 + 12 n, where n is number of reel entries

The reel entry consists of:

Field	Definition
A	Reel serial number
B	Reel key number
C	Destination - eight ASCII characters

Note

The 8-character destination field is typed on the label. It consists of information that identifies the destination, in accordance with operating practices.

A user program can communicate with a time division exchange device by initiating a routing request service message. This message references a file containing the message to be output on the device. The following is the format of the service message.

A 8	ZERO 8	B 8	ZERO 8
ZERO 32			
ZERO 32			
C 16		D 16	
E 8	F 8	G 16	
H 16		I 8	J 8

Field	Definition
A	X'8D
B	Orderwire 1 address of originating processor
C	Time halfword in identifier of message file
D	Cell allocation count in identifier of message file
E	Zone parameter of message file
F	Loop 1 address of disc containing the message file
G	Cell address of message file
H	C-number of program to output message, zero for general service program
I	Party line address of device or zero if device is to be assigned
J	Output device type
	X'30 = line printer
	X'40 = CRT display and entry station

1.5.3 Data Collection Service

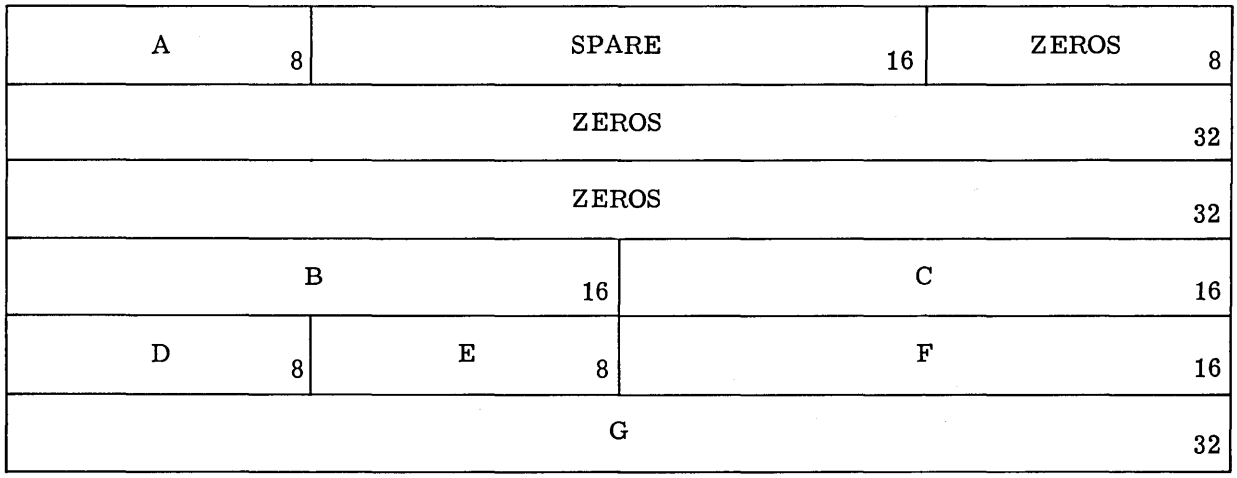
Data collection service provides applications systems with a means of collecting, categorizing, and distributing input data from any point in the system. Data is identified by a 4-digit hexadecimal data collection service code, and is contained in files built by input programs or user programs. A single-cell collection file contains file identifiers of input files for a data collection service code. The file identifiers of added disc files are appended to the disc input file identifier in the collection file for the data collection service

code. The reels lists of added tape files are merged with the reels list of a tape input file identifier in the collection file for the data collection service code.

Data collection service returns the collection file identifier of the collection file for a data collection service code in response to a file extract call in a control program. The application system must be able to accept files on tape, disc, or both. This means that device acquisition and control service must be called to prepare tape files for access. The collection file of data collection service is compatible as an indirect request input to device acquisition and control service. Disc input file identifiers in the collection file are placed unaltered in the output of device acquisition and control service. The application program can read either tape or disc files using the information in the device acquisition and control service output file.

Tape files for a data collection service code can be disc files transferred to tape by data collection service to conserve disc space. These tape file data cells contain up to 2048 bytes with 4-word low-level connector cell items prefixed to the data cells, and 4-word reels list entries. The connector cell structure is not written. This imposes restrictions on a disc file to be input to data collection service. The file must be written using indirect commands, and the low-level connector cell items must not be longer than four words.

Input of files to data collection service can be directly from a program or through control program service. The following is the format of the service message to input a file to data collection service.



Field	Definition
A	X'81
B	Time identifier halfword of file
C	Cell allocation count identifier of high-level connector cell (disc file) or reels list
D	Zone parameter of disc file or of reels list on disc.
E	Loop 1 address of disc.
F	Cell address of high-level connector cell (disc file) or reels list.
G	Hexadecimal data collection service code in ASCII.

Assignment of data collection service codes is a system function. Application programs can delete a code if necessary, and any data in files under this code is transferred to data collection service code 1. The following is the format for the service message to delete a data collection service code.

A 8	ZERO 8	B 8	ZERO 8
ZERO 32			
ZERO 32			
ZERO 16		C 16	
D 32			
E 16		SPARE 16	

Field	Definition
A	X'87
B	Orderwire 1 address of originating processor
C	Truncated binary C-number of intercept station
D	Four ASCII characters identifying responsible area or person at intercept station
E	Data collection service code in hexadecimal

Note

Contents of fields C and D must be identical to information supplied when data collection service assigned the code.

The service message to extract files having a specific data collection service code must be sent by control program service because data collection service returns the identifier of the collection file to the output field of a program control instruction. The following is the format of a file extract service message.

A 8	B 8	C 8	D 8
E 16		F 16	
G 8	H 8	I 16	
J 16		ZERO 16	
ZERO 32			
SPARE 32			

Field	Definition
A	Operation Code
	X'82 Extract and delete
	X'90 Extract and save
B	Number of program control instruction inputs
C	Orderwire 1 address of originating processor
D	Double word increment of calling program control instruction
E	Time halfword identifier of control program status record
F	Cell allocation count identifier of control program status record
G	Zone parameter of control program status record
H	Loop 1 address of control program status record
I	Cell address of control program status record
J	Data collection service code in hexadecimal

The output field of the calling program control instruction contains the identifier of the collection file upon completion. Should there be no file for the requested data collection service code the identifier is zero.

The following is the format of the collection file.

Header	A 16		B 16	
	0 0 0 1	C 12	SPARE 16	
	ZERO 16		D 16	
Tape Entry	A 16		B 16	
	1 0 1 0	C 12	D 16	
	E 16		F 16	
	1	G 7 H 8	I 16	
Disc Entry Header	A 16		B 16	
	0 0 1 0	C 12	D 16	
Disc File Entry	E 16		F 16	
	0	G 7 H 8	I 16	
	ZERO 32			

Field	Definition
A	Time halfword identifier
B	Cell allocation count identifier
C	12
D	1

Following the header are one or more tape entries (omitted if no tape files):

Field	Definition
A	Data collection service code in hexadecimal
B	Time of last alteration of entry (high order 16 bits of absolute time)
C	16
D	1 = C-System file 5 = External file
E	Time halfword in identifier of reels list
F	Cell allocation count in identifier of reels list
G	Zone parameter of reels list
H	Loop 1 address of reels list
I	Cell address of reels list

Following the tape entry is a disc entry, two words of header and two words for each disc file (omitted if no disc files):

Field	Definition
A	Data collection service code in hexadecimal
B	Time of last alteration of entry (high order 16 bits of absolute time)
C	Number of bytes in entry C = 8 + 8 per disc file
D	3
E	Time halfword in identifier of high-level connector cell
F	Cell allocation count in identifier of high-level connector cell
G	Zone of disc file
H	Loop 1 address of disc file
I	Cell address of high-level connector cell

Fields E-I are repeated for each disc file.

Device acquisition and control service assigns a tape unit for each tape entry in the collection file. Data collection service makes a tape entry for each type of file. When the reels list of a tape entry exceeds a maximum size, data collection service makes an additional entry for that type of file. The type of tape file, for data collection service purposes, is indicated by the contents of the right-hand halfword of the second word of the reels list. If the first byte of that halfword contains 0, the file was written by data collection service from disc files. A one in that byte identifies an external (non-C-System) file. Other values are user defined for C-System files. The second byte contains 7 in a file on 7-channel tape, or 9 in a file on 9-channel tape.

In the event the user program does not use all files listed in a collection file, the user program updates collection file appropriately and returns the collection file to data collection service. The following is the format of the service message to return a collection file.

1.5.4 Disc Space Management

Disc space management is accomplished by common functions with which the channel programs interface, and service functions that provide housekeeping of space for the common functions. The common functions are zone allocation, document file, release file, and single cell release. The service functions are write zone connector, update zone connector, and read released connector.

Disc file storage is partitioned into zones that contain cells of the same size, that is, 128, 256, 512 or 2048 byte cells. The number of cells within a given zone is a function of the cell size and the zone boundaries determined at initialization.

The zone allocation common function designates a zone for a program's files. The cell allocation common function, accessible to the user indirectly through file transfer commands, assigns cells within a zone. The document file common function enters a file in the list of files for a zone as an active or inactive file. Documenting a file as active prevents reallocation of that space prior to a release file operation. Documenting an inactive file releases the file. The release file common function lists a file in a list of released files. The cells of these files are available for allocation by the cell allocation function. The single-cell release function makes individual cells available for allocation.

section 2
channel description

2.1 GENERAL

The environment of the user program channel consists of the initiation of the program in the channel, techniques of sharing processor capabilities during execution, means of input and output to the program, and types of completion that can occur.

2.2 INITIATION

The channel initiation functions of operations control service install a user program in a processing channel at the completion of the previous program. The work queue of the processing channel contains work for the channel in the form of service messages from control program service specifying programs to be run. The initiation function of operations control service initiates the program called by the next service message in sequence.

Initiation consists of placing the program into the core area of the processing channel. An area at the low-address end of the core area is reserved for the program status record, which is described in paragraphs 2.2.1 and 2.2.2. The relocatable program loader places the program in the channel core area immediately following the program status record. The loader adjusts the addresses in the program as the actual location in core requires, and transfers control to the desired command.

2.2.1 Program Status Record Functions

The length of the program status record is variable, to allow 29 words for the fixed length portion of the record, two words for each input, and one word for each file status pointer. The PROG pseudo-instruction in MA61 assembler language provides space for the program status record. The number of inputs declared in that instruction should allow the maximum possible number of inputs, rather than the number in a specific program control instruction. The number of file status pointers should be the maximum number of files open at one time.

The application program call service message is placed in the record, starting at relative address X'50, at the beginning of initiation. It enables access to the control program status record, and forms part of the program return service message sent at completion. Refer to appendix C for the service message format.

The initiation routine places the input list of the program control instruction into the program status record, starting at relative address X'74, and fills any additional input entry space with zeros. The program requires this information to access input files.

The load packet used by the relocatable program loader begins at relative address X'64 of the program status record. The initiation routine builds the packet, and the data it contains is available to the user. With modification, the packet can be used to load additional phases of the program into the channel core area.

The initiation routine places information in the file transfer status field, relative address X'48. The zone parameter for program files is specified in the source OUTPUT statement of the control program instruction in the control program. The initiation routine supplies the address of the first file status pointer word.

After the initiation routine transfers control to the program, at each BRLP instruction in the program, the BRLP handler stores the contents of index registers 1 and 2 in relative addresses X'8 and X'C, respectively. The handler also stores the contents of the instruction address counter in relative address X'10 and takes control. The trapped op code handler uses the same locations in the program status record for the same purposes when a transfer to a trapped op code routine occurs.

The 8-word area of the program status record starting at relative address X'20 is used by common functions as a work area. This area is available to the user as temporary storage between executions of common functions.

When control of the processor transfers to another channel at the end of a channel interval, operations control service stores registers and status information in the program status record. The D accumulator is stored at relative address X'0, and index registers 1, 2, and 3 are stored at relative addresses X'14, X'18, and X'1C. The instruction address counter, condition code indicators, and overflow indicator are stored in a single word at relative address X'40.

At abnormal completion of a program, the system or user program stores the abnormal completion status word at relative address X'44.

When files are opened, the open file routine builds a file status pointer in the program status record. The routine examines the pointers to locate an available existing pointer, and builds a new pointer at the end of the list if none is available. Refer to paragraph 2.2.2 for the pointer format. When the file is closed, the close file routine alters the file status pointer to indicate that the file is closed and the pointer is not busy. When a work file is closed as an output file, the word address of the file identifier replaces that of the file linkage block in the file status pointer.

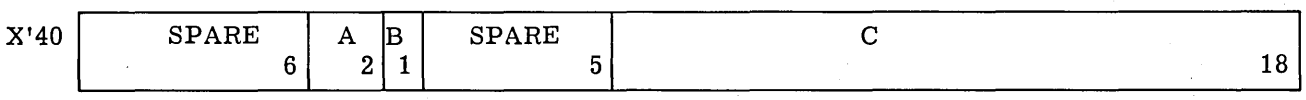
The close routine places the file identifier of the program output file in the program status record at relative address X'5C when the output file is closed. If a program does not provide an output file, it can move a literal output of up to two words into this field of the program status record. This output is passed to other programs by control program service as if it were an output file identifier. Either byte 1 or bytes 2 and 3, or both, of the second word of a literal output must contain zeros.

2.2.2 Program Status Record Structure

The following shows the program status record structure.

Program Status Record (PSR)	X'0	REGISTER 1: CHANNEL DISCONNECT REGISTER A	16 Words Channel Status Registers
	4	REGISTER 2: CHANNEL DISCONNECT REGISTER B	
	8	REGISTER 3: BRLP LINKAGE SAVE INDEX 1	
	C	REGISTER 4: BRLP LINKAGE SAVE INDEX 2	
	10	REGISTER 5: BRLP LINKAGE SAVE IAC	
	14	REGISTER 6: CHANNEL DISCONNECT INDEX 1	
	18	REGISTER 7: CHANNEL DISCONNECT INDEX 2	
	1C	REGISTER 8: CHANNEL DISCONNECT INDEX 3	
	20	REGISTERS 9-16: CHANNEL WORK REGISTERS FOR BRLP LINKED COMMON FUNCTIONS	
	40	CHANNEL DISCONNECT AND COMPLETION STATUS	2 Words
	48	FILE TRANSFER STATUS	2 Words
	50	AP CALL SERVICE MESSAGE (Appendix C)	3 Words
	5C	FORMAL OUTPUT FILE IDENTIFIER (Paragraph 4.1.2.1.2)	2 Words
	64	CHANNEL INITIALIZATION LOAD PACKET AS REQUIRED FOR RELOCATABLE LOADER (Paragraph 4.4.1.2)	4 Words
	74	PCI INPUT LIST: MAXIMUM NUMBER DECLARED AT ASSEMBLY TIME (Appendix C)	2 Words Per Input
		FILE STATUS POINTERS: MAXIMUM NUMBER DECLARED AT ASSEMBLY TIME	1 Word Per FLB
		CHANNEL PROGRAM SPACE: STATUS AND INSTRUCTIONS	Remainder of Channel Space

Channel disconnect and completion status:

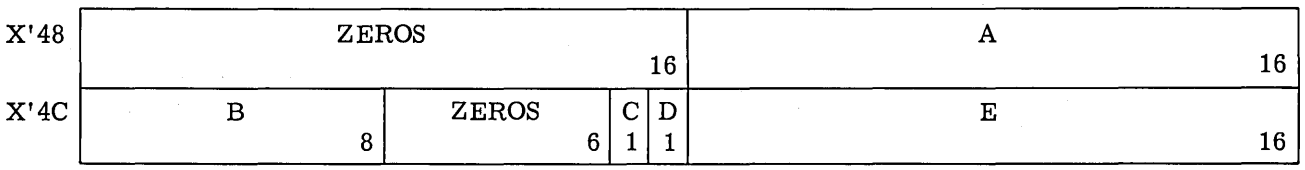


Word at relative address X'40

Field	Definition
A	Condition code indicators
B	Overflow indicator
C	Instruction address counter

The word at relative address X'44 contains the status word when a channel abnormal completion occurs. The channel abnormal completion status word is defined in paragraph 4.5.4.

File transfer status:



Field	Definition
A	Word address of first word of channel program space
B	Disc zone parameter for documented indirect files: X'00 = 128 byte cell file X'10 = 256 byte cell file X'20 = 512 byte cell file X'30 = 2048 byte cell file
C	0 = No file status pointer word yet initialized 1 = One or more file status pointer words has been initialized
D	0 = No program output file has been opened 1 = A program output file has been opened
E	Word address of first file status pointer word

File Status Pointer:

A	B	C	D	E	F	G	H	SPARE	I
1	1	1	1	1	2	1	1	7	16

Field	Definition
A	0 = Not last word in list
	1 = Last used word in list
B	0 = Read file
	1 = Write file
C	0 = Program input or output file
	1 = Work read or write file
D	0 = File status pointer not busy (can be allocated)
	1 = File status pointer busy (cannot be allocated)
E	0 = Work file open
	1 = Work file closed
F	00 = Disc file
	01 = 9-channel tape file
	10 = 7-channel tape file
G	0 = Disc connector structure has been retained
	1 = Disc connector structure has been released A reels list was retained.
H	0 = Working channel is active
	1 = Working channel is released
I	Word address of file linkage block, or, if field E =1, word address of file identifier

Note

Fields G and H apply to tape files and are spare for disc files.

2.3 EXECUTION

The application program is executed as if it were the only user of the processor and the common functions. Operations control service accomplishes this by periodically allowing the channel in which

the program is loaded sole use of the processor for an interval of time. Other channels share these facilities in the same manner.

A program run is a series of intervals of processor use. A hardware interrupt occurs as each interval ends, and control is transferred to operations control service when the current instruction completes. Operations control service stores all registers in the program status record, and passes control to the next channel after restoring the registers to values stored in that channel program status record. Thus a channel resumes operation at the beginning of each interval as if the interrupt had not occurred.

However, a program may terminate an interval in either of two ways. The first is by branching to the checkpoint busy entry of operations control service. In this case, the next channel is given control and operations control service monitors a specified chain of input/output operations for completion, at each time interval allotted to the program. The program resumes operation when the input/output operation completes.

The other way in which a program alters its normal processing interval is by branching to the checkpoint entry of operations control service. The interval is simply terminated early, the next channel is given control, and the program resumes at the start of its next interval. A program should branch to the checkpoint entry whenever it is unable to continue due to a busy return from an input/output operation.

2.4 INPUT/OUTPUT

An input/output operation using a time division multiplex device requires a service message to the M-channel. The service message format is shown in appendix A. For detailed M-channel information refer to the M-Channel Programming Manual, 523-0561-800.

Input/output operations on the time division exchange are accomplished by the data channel associated with a processing channel. The data channel transfers data between core and the terminal unit of the time division exchange under control of a device control message. A device control message contains one or more data control words, each of which specifies an area of core from which, or into which, to transfer data. A data channel services two chains of device control messages. To initiate an input/output operation, an application program must cause a device control message to be placed in one of the chains for its channel.

It is the responsibility of the application programmer to specify the chain in which the message is placed. The data channel alternately executes a device control message from each chain, and the time required to execute a message varies. Thus a group of operations that must complete in a certain sequence must be properly sequenced in the same chain. However, when independent operations are appropriate, grouping messages in the two chains can provide an advantage. A permanent error in attempting to execute a device control message blocks the entire chain, but execution of the messages in the other chain continues. Finally, either chain can be left idle, but a greater volume of time division exchange communication is possible when both chains are used.

An application program initiates a device control message by calling a common function. In general, each of the direct file transfer common functions sends a device control message corresponding to a single device operation. Indirect file transfer common functions write and read magnetic tape files in accordance with C-System file structure, linking to direct commands for the required device operations. Use of the indirect file transfer commands allows the applications programmer to read and write files with a minimum of effort. If it is desirable to include item parameters in all levels of the connector cell structure, direct commands must be used to write and read these cells.

2.4.1 Indirect File Transfer Operations

There are three basic indirect commands; open a file, read or write data cells, and close a file. The open file command is a housekeeping function. Optionally, it builds a file status pointer word in the program status record, which contains file status information and the address of the file linkage block. The open routine always initializes a file linkage block in which the read and write routines maintain connector cell addresses. For an input file the open routine reads the high-level connector cell. For an output file the open routine initializes a connector cell.

After reading the necessary connector cell structure, the disc file indirect read routine transfers a data cell to a specified area of core. The first read operation after opening the file begins at the high-level connector cell, which was read into core by the open routine. If this connector cell is not a low-level connector cell, the connector cell addressed by the first item is read and examined to determine if it is a low-level connector cell. Subsequent levels of connector cells are read until a low-level connector cell is in the connector cell area of core. Using the address in the first low-level connector cell item, the indirect read routine then reads the first data cell.

To execute subsequent read commands, the indirect read routine reads data cells listed in the low-level connector cell until its entries are exhausted. Then the next low-level connector cell is read into core and data cells listed in its entries are read. This process includes reading at least one higher level connector cell and updating the file linkage block appropriately. When the file linkage block indicates that the reading of connector cells at all levels is complete, a subsequent read command results in an end of file return. Optionally, a selection process causes reading only selected data cells, but the same manipulation of connector cells occurs.

For a tape file an indirect read operation reads the data cells sequentially. Although the low-level connector cell item is prefixed to the data cell, allowing selective or sequential reading, the indirect read command transfers the connector cell item and data cell to core separately. The necessary operations for a multi-reel file are automatically provided at the end of each reel.

In writing a disc file, the write routine builds the connector cell structure as the file is written. Data and connector cells are written at addresses automatically allocated. Writing a tape file is similar to writing a disc file, except that the data cells with connector-cell items prefixed are written on tape sequentially. The operations required for a multi-reel file are automatically provided at the end of each reel.

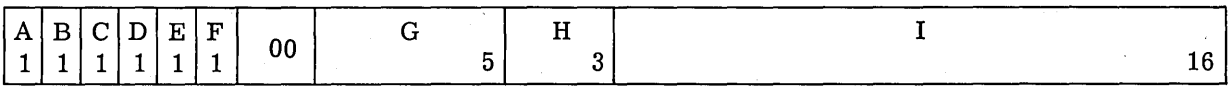
Closing the output file when it is on disc causes the current connector cell at each level to be completed and written on disc, and the high-level connector cell address to be placed in the file identifier. For a tape file, the reels list is completed, and its address is placed in the file identifier. The connector cell structure, if provided, is completed and written on tape at the end of the file, and the reels list is written on tape in all cases. The connector cell structure on disc can be released at this time, and when this option is used, the connector cell addresses are replaced by zeros in the reels list items. The close routine places the file identifier in the output file field of the program status record and documents the file active, whether on tape or disc. The close routine then closes all files having a file status pointer entry in the program status record, to rewind tape files, and to document work files as inactive.

A work output file on disc can be closed individually when it has been completed, to complete the connector cell structure. When the program status record includes a file status pointer word for this file, the address of the file identifier replaces the address of the file linkage block in that word and the close bit is set. A work file on tape can only be closed along with the output file, which requires that it be listed in a file status pointer word. Closing a disc input file having a file status pointer word makes that word available for another file.

2.4.2 File Linkage Block

The open file routine initializes a file linkage block for a file, and the indirect read and write routines build the block. The file linkage block allows these routines to build and manipulate the connector cell structure. The block contains an entry for each level of connector cell, and this entry contains the address of the current connector cell at that level and the current item in the cell. The connector cell address in the file linkage block is a disc cell address except for the low-level connector cell for which the address is the core address of the connector cell area.

The format of the file linkage block heading for a disc file is as follows:



Field	Definition
A	0 = Read file
	1 = Write file
B	0 = Device control message chain 1
	1 = Device control message chain 2
C	0 = Program file
	1 = Work file
D	0 = File routine not busy
	1 = File routine busy
E	0 = Normal
	1 = File aborted due to unsuccessful connector cell read
F	0 = Active file
	1 = Closed file
G	Word length of core bin for file linkage block
H	Item length (table 4-1)
I	Word address of file identifier (input list entry or file identification packet)

The following is the file linkage block heading for a tape input file:

O	A 1	B 1	C 1	D 1	E 1	F 2	G 5	H 3	I 16
J 1	K 1	L 2		M 12					N 16

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	0 = Program input file
	1 = Work input file
C	0 = File routine not busy
	1 = File routine busy
D	0 = Normal
	1 = File aborted due to unsuccessful connector cell read
E	0 = Active file
	1 = Closed file
F	01 = 9-channel tape
	10 = 7-channel tape
G	Word length of core bin for file linkage block
H	Item length (table 4-1)
I	Word address of input parameter packet from device acquisition and control service
J	0 = Current tape not at end of reel
	1 = Current tape at end of reel
K	0 = File not at end
	1 = End of file condition

Field	Definition
L	00 = Connector cells on disc
	01 = Reels list on disc
	10 = Single reel with no connector cells on disc
M	Relative byte increment to next item in the high-level connector cell or reels list
N	Disc cell address of reels list or high-level connector cell, or zero, if nothing on disc

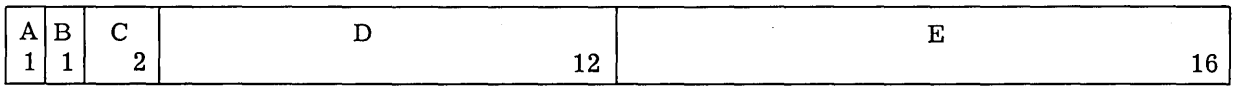
The following is the file linkage block heading for a tape output file:

1	A 1	B 1	C 1	D 1	E 1	F 2	G 5	H 3	I 16
J 1	K 1	L 1	M 1	N 12					O 16

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	0 = Program output file
	1 = Work output file
C	0 = File routine not busy
	1 = File routine busy
D	0 = Normal
	1 = File aborted due to unsuccessful connector cell update
E	0 = Active file
	1 = Closed file
F	01 = 9-channel tape
	10 = 7-channel tape
G	Word length of core bin for file linkage block
H	Item length (table 4-1)

Field	Definition
I	Word address of output parameter packet from device acquisition and control service
J	0 = Current tape not at end of reel
	1 = Current tape at end of reel
K	0 = High-level connector cell of multi-reel file not full
	1 = High-level connector cell of multi-reel file full, current reel is last reel of file
L	0 = File not limited to single reel
	1 = File limited to single reel
M	0 = Connector cells to be written on disc
	1 = Reels list to be written on disc
N	Current reel count
O	Disc cell address of reels list or high-level connector cell, zero if cell has not been assigned

Following the header, there is an entry for each level of connector cell. The following is the format used for all files.



Field	Definition
A	0 = The referenced connector cell is currently not in core
	1 = The referenced connector cell is currently in core
B	0 = The referenced connector cell has space for more entries or has entries that have not been read
	1 = The referenced connector cell is full or has no entries that have not been read
C	01 = First entry in file linkage block
	11 = Last entry in file linkage block
D	Relative byte increment to next item of connector cell
E	Address of connector cell - if first connector cell entry, word address in core - otherwise, disc cell address

2.5 COMPLETION

Three types of channel completion may occur during the execution of an application program in an A or B channel. Either the program completes normally, the system detects an abnormal condition, or the program recognizes an abnormal condition. Each of these channel completions builds and transmits a return service message to update the control program status record. These types of channel completions are discussed in the following paragraphs.

2.5.1 Normal Completion

When the execution of an application program in an A or B channel is successfully concluded, a normal completion occurs and control reverts to the channel normal completion routine. This routine builds and transmits a normal return service message. Once this routine concludes, control reverts to the channel initiation routine which loads the next job into the channel.

2.5.2 System Abnormal Completion

Initiation of the abnormal completion by a system routine is indicated if bit 0, A field, of the channel abnormal completion status word in the program status record contains a zero. Occurrence of the system abnormal completion transfers control to the channel abnormal completion routine. This routine builds and writes an abnormal status record that provides checkpoint information on disc to all active files. This routine builds and sends an abnormal return service message to the processor that initiated the program call service message.

2.5.3 User Abnormal Completion

Initiation of the abnormal completion by the user program requires the user to set bit 0, A field, of the channel abnormal completion status word in the program status record. Also, the user can identify the abnormal condition by placing a code in bits 2-13 of the status word. Occurrence of the user abnormal completion transfers control to the channel abnormal completion routine. This routine builds and writes an abnormal status record that provides checkpoint information on disc to all active files, and builds and sends an abnormal return service message to the processor that initiated the program call service message.

section 3
descriptions of common functions

3.1 FILE TRANSFER SERVICE FUNCTIONS

File transfer service functions are common functions that enable the user to build and retrieve data files and to physically activate I/O devices. Available file transfer commands include direct as well as indirect commands. All commands are re-entrant and reside in protected memory.

3.1.1 Indirect File Transfer Commands

The indirect file tranfer commands enable the user to build and retrieve data files using a common file structure. The indirect commands operate on either disc or tape files. In addition to the transfer of data cells, the indirect commands enable up to 254 bytes of user-supplied identification data to be associated with a data cell when the cell is created. The user-supplied identification is retrievable along with the data cell. The indirect file transfer commands are open input/output file, read/write indirect, and close file.

3.1.1.1 Open Input/Output File

The open file command initializes the reading or writing of a storage file. This command provides the user with the option of specifying whether a file is or is not to be referenced in the program status record by a file status pointer word. The file status pointer word contains a reference to a file linkage block and identifies those files on which the indirect close routine is to perform completion functions when the program output file is closed. A file initialized by the open file command can be read or written using either direct or indirect commands.

3.1.1.2 Read/Write Indirect

The read indirect command routine transfers a data cell from storage to core. The cell is the next data cell in sequence, or the next data cell to satisfy a desired selection mode. Optionally, transfer of data to core can be omitted.

The write indirect command routine transfers a data cell from core to the next available cell in storage. The disc address or relative position on tape of the cell transferred from core is entered into a connector cell that links together all data cells within the file. Optionally, the connector cell entry can be made without writing the data cell.

3.1.1.3 Close File

The close file command routine invokes completion of the files initialized by the user program. The program output file must be closed to document the file as active, thus retaining the file within the operating system.

The closing of the program output file automatically closes all documented files initialized by the user program. Closing of tape files in this manner also releases the working channels. Work output files on disc and input files can be closed individually. Closing a documented input file allows reallocation of the file status pointer word for the referencing of a new file.

Closing a work output disc file writes the remaining low-level connector cell structure on disc, updates the higher level structure to reference all elements of the file, completes a file identifier which references the highest level connector, and stores the address of the file identifier in the file status pointer word.

Closing tape files rewinds the tape reels in addition to the other closing functions. However, documented work tape files must not be closed individually. Completion of these files is provided by the closing of the program output file.

3.1.2 Direct File Transfer Commands

The direct file transfer commands are general purpose commands that activate input/output devices for data transfer and control and specify the core area into which data is to be read or from which data is to be written. Direct commands are invoked either by the indirect file transfer common functions or by the user. Direct commands are executed as part of the user program and are re-entrant to allow use of the commands by multiple processor channels simultaneously. In the event an error occurs during execution of a direct command, an error recovery program makes retry attempts as appropriate. The direct file transfer commands are read/write direct, tape control transfer, and device control transfer.

3.1.2.1 Read/Write Direct

When the read direct command is used for disc, a disc cell is transferred to processor core. The user specifies the address of the particular disc cell to be transferred. When the read direct command is used for tape, the read direct command routine transfers the next physical record on the tape to processor core.

When the write direct command is used for disc, the routine transfers a cell in processor core to the disc address specified by the user or the allocator. When the write direct command is used for tape, the routine transfers a cell in processor core to the next record in sequence on tape.

3.1.2.2 Tape Control Transfer

The tape control function consists of commands that initiate a number of tape control operations, as described in the following paragraphs.

3.1.2.2.1 Rewind Command

The command initiates the rewind operation, and places the tape unit in a busy condition to subsequent commands until this routine completes. Since the tape is rewound to load point, the user must avoid undesired rewriting of the reel header.

3.1.2.2.2 Rewind Make Not Ready Command

The command initiates the rewind operation and puts the tape unit in a not ready condition. Operator intervention is required to ready the tape unit for subsequent operations.

3.1.2.2.3 Backspace a Record Command

This command initiates the backspace record operation and an error occurs if this operation is attempted when the tape is positioned at load point. Detection of a tape mark during this operation causes the end of file status to be set upon reception of the next tape control command. The user must not issue a write command following a backspace command.

3.1.2.2.4 Skip and Blank Command

This command is used in recovery from a write error by causing the tape unit to skip and blank approximately one foot of tape as the tape passes through the heads in a forward direction. The result is a very long end-of-record gap. Detection of an end of reel marker during this routine does not set the end-of-file status. A subsequent write or write tape mark operation indicates the end-of-file status.

3.1.2.2.5 Write Tape Mark Command

This command releases a working channel and causes the tape drive to rewind and be made not ready. If the indirect close closes the file along with the program output file, this command is not required.

3.1.2.2.6 Search Command

This command performs a search of a tape file, comparing the first word of each record to a specified key. When the equal search mode is specified, the record is read if the result of the comparison is equal. When the greater-than-or-equal search mode is specified, and the result of the comparison is greater-than, the preceding record is read. If the result of the comparison is equal, the record is read. Optionally, transfer of the record to core may be omitted, but the tape is positioned as if the record had been read. To search a 7-channel tape, tape density and mode must be specified. The search operation is accomplished only in the forward direction. In the event a tape mark is detected during this search operation, the operation is terminated past the tape mark, and an error condition is indicated. The end of reel marker is not detected, since the search assumes that tape marks follow the last record on the reel.

3.1.2.2.7 Release Working Channel Command

This command releases a working channel and causes the tape drive to rewind and be made not ready. If the indirect close command is issued for the file, this command is not required.

3.1.2.2.8 Forward Space a Record Command

This command positions the tape forward one record and places the tape unit in a busy condition to subsequent commands until this operation completes. Detection of an end of reel marker during this operation does not set the end-of-file status. Detection of a tape mark during this operation causes the end-of-file status to be set upon reception of the next tape command.

3.1.2.2.9 Forward Space a File Command

This command positions the tape forward to the next file and places the tape unit in a busy condition to subsequent commands until this operation completes. Detection of an end of reel marker during this operation does not set the end-of-file status. Detection of a tape mark during this operation causes the end-of-file status to be set upon reception of the next tape command.

3.1.2.2.10 Backward Space a File Command

This command moves the tape backward an entire file. Completion of this operation leaves the tape positioned to read the tape mark at the beginning of the file. Until the operation completes, the tape unit is busy to subsequent commands. Detection of an end-of-reel marker during this operation does not set the end-of-file status. Detection of a tape mark causes the next operation to set the end-of-file status.

3.1.2.2.11 Replace Output Tape Command

This command initiates the replace output tape operation. This operation uses other tape control commands to rewind the tape and turn the MOUNT OUTPUT TAPE lamp on, and calls device acquisition and control service to select a scratch tape and direct the operator to mount it as an additional reel for the

file. The user continues writing the file after the channel status indicates completion. When using indirect write commands to write a file, this command is not required.

3.1.2.2.12 Set Mount Input Tape Command

This command lights the MOUNT INPUT REEL lamp on a tape unit to signal the operator that a new input reel is required. If indirect read commands are used, or if the replace input tape command is used, this command is not required.

3.1.2.2.13 Set Mount Output Tape Command

This command lights the MOUNT OUTPUT REEL lamp on a magnetic tape unit to signal the operator that a new output reel is required. If indirect write commands are used, or if the replace output tape command is used, this command is not required.

3.1.2.2.14 Status Request Command

This command interrogates a tape control unit and associated tape unit for status information. The tape control unit transmits status word to the processor, without performing any other function. This command can be used to verify operator compliance with the MOUNT INPUT REEL or the MOUNT OUTPUT REEL lamp. If the replace input tape or replace output tape command is used, this command is not required.

3.1.2.2.15 Replace Input Tape Command

This command initiates the replace input tape operation, which signals replacement of an input tape. This operation also verifies the replacement tape header, and leaves the tape positioned for reading the record that immediately follows the tape header. This command is implemented by other tape commands, and terminates in error if the new tape is not ready after 10 minutes. If indirect read commands are used, this command is not required.

3.1.2.3 Device Control Transfer

The device control transfer command allocates device control message space in the requested chain, builds a message from the device command and data transfer parameters provided in the command packet, and initiates transmission of the device control message. Error recovery procedures are initiated if required. This command is used with card readers, line printers, and CRT display and entry stations on the time division exchange. When device support routines are used, this command is not required.

3.1.2.4 Direct Error Correction

The direct error correction command allows the skipping of a device control message that is blocking the message chain due to a permanent error. This routine includes the option of skipping just the message containing the error condition, or of skipping all direct command device control messages in the chain.

3.2 DISC SPACE MANAGEMENT FUNCTIONS

Space management functions consist of four routines that manage secondary storage space: zone allocation module, single cell release module, document file module, and release file module. All routines are re-entrant and reside in protected core. The release file module and the single cell release module must be used with care to avoid releasing the same cell twice. If a cell is released a second time, it might also be allocated a second time.

3.2.1 Zone Allocation Module

Zone allocation is a routine that allocates an available zone and associated loop 1 address to satisfy file transfer command storage requirements. When the open command is used for a disc file, the user does not request zone allocation module.

3.2.2 Single Cell Release Module

The single cell release routine returns a single cell to the secondary storage allocator for reallocation. The cell must not be documented as part of a file.

3.2.3 Document File Module

Document file is a routine that accepts new file entries into the system. This routine distinguishes between active and inactive new file entries, and places each new file entry appropriately into an active list or an inactive list. A file documented as inactive is automatically flagged for release. Files not listed in the program status record by the open routine must be documented by the user. The close file operation documents those files listed in the program status record.

3.2.4 Release File Module

Release file is a routine that accepts entries of released files and places the entries in the release file list. Normal release of program files is by means of the release list of a program control instruction. This routine must be used to release nonprogram files and other files not released in that manner.

3.3 SERVICE MESSAGE FUNCTIONS

Service message functions verify and initiate orderwire 1 service message transfer requests, convert symbolic machine addresses into absolute routing parameters, provide correlation between disc addresses and processor addresses, and convert ASCII C-numbers to equivalent binary C-numbers and vice versa. All routines reside in protected core and are re-entrant.

3.3.1 Service Message Transfer

This common function verifies an orderwire 1 service message transfer request from any channel program, builds a device control message and initiates transmission of the message. To communicate with service programs and time division multiplex devices, the user program builds a service message and calls service message transfer to transmit the message. Service message formats for service program functions are shown in section 1. Additional service message formats are shown in appendix A.

3.3.2 Routing Service

The routing service routine is available to all processing channel programs to convert a symbolic machine address into absolute routing parameters. The symbolic machine address, a C-number, consists of up to eleven decimal digits which identify every center, computer, device, and service program in a C-System. The use of a C-number isolates application programs from dynamic routing parameters.

The C-number can include up to four fields: the area code field, the exchange code field, the subscriber code field, and the party line code field. Each of these fields consists of three decimal digits, except for the two-digit party line code field. The area code field is omitted within an area, and the exchange code is omitted within an exchange (processor). The party line code field is omitted unless the subscriber code requires a party line code. Thus, in its decimal form a C-number consists of three, five, six, eight, nine, or eleven digits.

In its binary form as input to routing service, a C-number consists of 38 bits. Ten-bit binary numbers represent the three digit area, exchange, and subscriber codes, and an eight-bit binary number represents the party line code. All bits of a binary number representing an omitted field must be ones.

The routing parameters supplied by routing service are described in detail in paragraph 4.3.2.3, and can include a processor orderwire 1 address, a multiplex status record address, a file identifier, or other parameters as appropriate for the destination corresponding to the C-number.

3.3.3 Orderwire Translation Service

Orderwire translation service is a routine that provides the correlation between disc addresses and processor addresses. The routine accepts the zone and loop 1 addresses of a disc file and supplies the orderwire 1 address of the processor responsible for allocation of space in that disc zone. Orderwire translation is used by an application program that must identify the processor corresponding to a disc address for space release or similar purposes.

3.3.4 C-Number Conversion

3.3.4.1 ASCII to Binary

The conversion routine converts an ASCII C-number to an equivalent binary C-number. The routine accepts the decimal digits in ASCII code and supplies the equivalent binary form, replacing omitted fields with the appropriate number of 1 bits as required for input to routing service. The ASCII C-number must be in the proper format and the routine identifies the fields as follows:

a. If three digits are present, the routine places the binary equivalent into the subscriber code field and supplies 1 bits in all other fields.
b. If five digits are present, the routine places the binary equivalent of the first three digits into the subscriber code field and the binary equivalent of the last two digits into the party line code field, and supplies 1 bits in the other two fields.
c. If six digits are present, the routine places the binary equivalent of the first three digits into the exchange code field and the binary equivalent of the last three digits into the subscriber code field, and supplies 1 bits in the other two fields.
d. If eight digits are present, the routine places the binary equivalent of the first three digits into the exchange code field, the binary equivalent of the second three digits into the subscriber code field, and the binary equivalent of the last two digits into the party line code field. The routine supplies 1 bits in the area code field.
e. If nine digits are present, the routine places the binary equivalent of the first three digits into the area code field, the binary equivalent of the second three digits into the exchange code field, and the binary equivalent of the last three digits into the subscriber code field. The routine supplies 1 bits in the party line code field.
f. If 11 digits are present, the routine places the binary equivalent of the first three digits into the area code field, the binary equivalent of the second three digits into the exchange code field, the binary equivalent of the third three digits into the subscriber code field, and the binary equivalent of the last two digits into the party line code field.

Because of this interpretation of the input, it is possible for the binary C-number returned by the conversion routine to require correction.

3.3.4.2 Binary to ASCII

This conversion routine converts a binary C-number to an equivalent ASCII C-number. This allows restoration of the C-number in ASCII code to include in a message or report. The input format is that used by routing service, which remains in the routing service output.

3.4 PROGRAM FUNCTIONS

The program functions are the relocatable program loader, object text address adjustment routine, the set channel trap entry point routine, and four routines that control a timer. All routines are re-entrant and reside in common core.

3.4.1 Relocatable Program Loader

This routine is a utility function that loads an object program in relocatable format into core at any desired location. The routine uses the file transfer commands to read the program, and adjusts addresses to the core area in which it is placed. Application programs use the loader to load subsequent program phases.

3.4.2 Object Text Address Adjustment

This routine is a utility function that adjusts relocatable addresses in an object program as required for the core area in which it resides. An application program uses this routine after directly reading object text into core. If an application program uses the relocatable program loader, the loader calls this routine automatically.

3.4.3 Set Channel Trap Entry Point

This routine accepts the address of an entry point to an appropriate trapped op code routine and enables transfer of control to that routine when a trapped op code interrupt occurs. The trapped op code routine must reside in the same channel as the applications program. An application program containing trapped op codes must use this routine and must include a routine to execute those codes.

3.4.4 Timer 1

An application program can use timer 1 to time any operation for which the 2.4 ms period of that timer is appropriate. Timer 1 is activated by the declare timer 1 entry point routine, and controlled by the reset/start timer 1 routine, the stop timer 1 routine, and the start timer 1 routine.

3.4.4.1 Declare Channel Timer 1 Entry Point

This routine stores the address of an entry point within core space of the invoking channel to which control is to be transferred when a timer 1 interrupt occurs. An option of this routine initiates the reset/start timer 1 routine as this routine completes. An application program that utilizes timer 1 must use this routine and must include a timer 1 interrupt routine.

3.4.4.2 Reset/Start Timer 1

This routine resets timer 1 to zero and starts the timer. In the event no entry point is specified for the interrupt, the reset/start timer 1 instruction is ignored.

3.4.4.3 Stop Timer 1

This routine inhibits timing by timer 1. In the event no entry point is specified for the interrupt, the stop timer 1 instruction is ignored.

3.4.4.4 Start Timer 1

This routine causes timer 1 to resume timing if it was stopped and complete the unfinished portion of the 2.4-ms cycle. The start timer 1 instruction is ignored if no entry point for the interrupt is specified.

3.5 OPERATIONS CONTROL ENTRIES

Operations control program allocates time to the processing channels defined for a particular processor. This program, a generalized table driven program, maintains two pointers to provide identification of the channel presently using the computer time and the lowest core location of the channel.

The operations control entries are channel disconnect busy, channel disconnect checkpoint, channel normal completion, and channel abnormal completion.

3.5.1 Channel Disconnect Busy

The channel disconnect busy entry to operations control allows an application program to suspend its execution until an input/output operation completes. The user specifies the device control message chain for the operation, and operations control returns control at the instruction following the exit when the operation has completed.

3.5.2 Channel Disconnect Checkpoint

The channel disconnect checkpoint entry to operations control allows an applications program to suspend its execution for the remainder of the channel time period. Operations control returns control at the instruction following the exit, when the next time period for that channel begins.

3.5.3 Channel Normal Completion

The application program uses the normal completion entry to operations control as its normal termination. The operations control completion routine sends the program return service message to control program service and transfers control to the initiation routine, which installs another program in the channel.

3.5.4 Channel Abnormal Completion

The application program uses the abnormal completion to operations control when an abnormal termination occurs. The user can identify various abnormal conditions. The operations control abnormal completion routine sends the abnormal return service message to control program service, and transfers control to the initiation routine, which installs another program in the channel.

section 4
common functions interfaces

4.1 FILE TRANSFER SERVICE

4.1.1 Input Disc File

4.1.1.1 Open Input Disc File

4.1.1.1.1 Calling Sequence

The calling sequence for the common function to open an input file of disc storage is shown in the following example.

```
NAME                OPERATION AND CONDITION     OPERAND
1 2 3 4 5 6 7 8   9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                     LDX                 2,ADDRS OF FT CMD PACKET
                     BRLP                20
                     B                   EXCEPTION RETURN
                     . . .               NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.1.1.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of the first word must be a 0. Bit 1 specifies the chain of device control messages in which the message for this operation is placed. A 0 indicates chain 1, and a 1 indicates chain 2. In bit 2, a 1 specifies a work file, and a 0 specifies a program input file. A 1 in bit 5 inhibits documenting the file. Bits 6 and 7 must be zeros. Bits 8 through 12 of the first word specify the length, in words, of a core area to be used for building a file linkage block. A length of four words, to provide three levels of connector cells, is recommended. Bits 13 through 15 contain the item length indicator. This refers to the length of the item to be read from a low-level connector cell. Table 4-1 shows the item lengths, in bytes, corresponding to the values in these bit positions.

Table 4-1. Item Length

FIELD VALUE	ITEM LENGTH (BYTES)
0	2
1	4
2	8
3	16
4	32
5	64
6	128
7	256

The address of the file linkage block is in bits 16 through 31 of word 0. Bits 0 through 15 of word 1 contain the address of a data control word describing a connector cell area. Bits 16 through 31 of word 1 contain the address of the input list item in the program status record for a program input file or the address of the output file identification packet for a work file. The first two words of the output file identification packet are compatible in content and format with the input list item. These addresses are in the 16-bit word address format.

The following is an example of typical coding for a file transfer packet, named FTPAC. It refers to a documented program file. The device control message will be placed in chain 2. The file linkage block bin area is four words long, and the low-level connector cell item length is 4 bytes. The file linkage block is FLBR and the data control word is DCWA. The input list item is the thirty-second word of the program status record, PROG.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
FTPAC		DF		8/B'01000000,5/4,3/1,16/FLBR.W
		DF		16/DCWA.W,16/PROG.W+31
		DF		0,,2

The data control word indicated by DCWA refers to an area of core for connector cells. The first bit is a 1, indicating that there is only one data control word in these operations. The next four bits are zeros. The length field specifies the length of connector cells. The area address is in word address format.

NAME	OPERATION AND CONDITION	OPERAND
DCWA	DCW	1,0,0,0,0,32,CONCELL.W

The resulting data control word calls for reading into a 32-word area designated CONCELL.

4.1.1.1.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0	0	A_1	B_1	SP 2	C_1	D_2	E 5					F 3			G 16																	
Word 1	A 16																B 16															
DSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	SP_1	I_1	SP 3					J_1	K_1	L_1	SP_2	M_1	SPARE 11												N_2
CSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9											I 16													

Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	0 = Program file
	1 = Work file
C	0 = Normal file
	1 = File not to be documented
D	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel

Field	Definition
E	Word length of file linkage block bin area
F	Item length indicator (table 4-1)
G	Core address for file linkage block

Word 1

Field	Definition
A	Address of data control word that describes a core area for connector cells
B	Address of input list item

All fields of words 0 and 1 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Malfunction
I	Line overrun
J	Check sum error
K	Track verification error
L	Invalid address
M	Error indicator
N	Command status
	00 = Successful completion
	11 = Indirect command in error

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words not processed from area referred to by terminated data control word
I	Address of data control word being processed at termination

At successful termination, field H contains zero and field I, the address of last data control word plus one.

For details of error terminations, refer to paragraph 4.1.8.2.

4.1.1.2 Read Disc File Indirect

4.1.1.2.1 Calling Sequence

The calling sequence for the common function to read a cell of disc storage indirectly is shown in the following example.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS OF FT CMD PACKET
	BRLP	28
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved. Registers 3, A, and B are not saved.

4.1.1.2.2 Input Parameters

The file transfer command packet consists of four words. In the first two words the user specifies options and addresses for the operation. Bit 0 of the first word must be 0. Bits 2 and 3 specify read options. Zeros in those positions provide a sequential read operation. A 1 in bit 3 calls for reading the first cell, the item parameter of which is equal to that in the command. A 1 in bit 2 calls for reading the first cell having an item parameter that yields a non-zero result in an AND operation with that of the command. Do not place ones in both positions. Bit 4 specifies the use of bits 16 through 31 of word 1. Bits 6 and 7 must be zeros. Bits 16 through 31 of the first word contain the address of the file linkage block of the file. Bits 0 through 15 of the second word contain an address or zeros. If non-zero, the contents is the word address of the data control word list that defines the core area into which data read is stored. Zeros specify not to store data read. Bits 16 through 31 must contain a literal item parameter if bit 4 of word 0 is 0. Bits 16 through 31 must contain the word address of a bin for low-level connector cells, if bit 4 of word 0 is 1. The item parameter is placed in the second halfword of the bin. If the file is selectively read, and selection is by the AND option, the item parameter must be restored after a successful read.

If bit 4 of word 0 is a 1 indicating that this field is an address, and the field contains zeros, the file is read sequentially.

Typical coding of a file transfer packet for an indirect read of a secondary storage file follows. The packet name is FRDPKT, designed to read a file described in FLBR1 selectively. The cells are selected by equality of the item parameter with the literal TX. The data in selected cells is stored according to a data control word list starting with RDCW1.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
F R D P K T         D F                   8 / B ' 0 0 0 1 0 0 0 0 , 8 / 0 , 1 6 / F L B R 1 . W
                    D F                   1 6 / R D C W 1 . W , 1 6 / C ' T X '
                    D C                   0 , , 2
```

Each data control word of the data control word list describes an area of core into which data read will be placed. Bit 0 is a 1 to specify a single data control word or the last word of a list. Bit 1 is a 1 for a data control word consisting of an address for chaining to another data control list. If bit 2 is set to 1, the number of words specified in the count is skipped. Bit 3 is 0 for a read operation. If bit 4 is 1, data is stored in decending sequence. Bits 7 through 15 contain the count of words to be transferred to core. Bits 16 through 31 contain the core address of the first word of the area into which data is transferred. If bit 1 contains a 1, the address is that of a data control word list to which to chain at the end of the current list. The following is typical coding for a data control word list.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
R D C W 1           D C W                 0 , 0 , 0 , 0 , 0 , 2 , P R E A M B . W
                    D C W                 0 , 0 , 0 , 0 , 0 , 5 0 8 , T E X T . W
                    D C W                 1 , 0 , 0 , 0 , 0 , 2 , F I N . W
```

4.1.1.2.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0	0	SP_1	A_2	B_1	SP_1	C_2	SPARE 8								D 16									
Word 1	A 16														B 16									
DSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	SP_1	I_1	SP 3			J_1	K_1	L_1	SP_2	M_1	SPARE 11					N_2
CSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9							I 16									

Word 0

Field	Definition
A	00 = Sequential read
	01 = Search for equal item parameters
	10 = Search for non-zero result of an AND of item parameters
	11 = Not used
B	0 = Literal item parameter
	1 = Field B of word 1 is the address of a bin for the item entry
C	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
D	Address of file linkage block

Word 1

Field	Definition
A	Address of data control word list. If zero, no data cell is read.

Field	Definition
B	If field B of word 0 is zero, contains the literal item parameter. If field B of word 0 is 1, contains the address of a bin into which the low level connector item is read. The item parameter is the second half-word of the bin. A zero address provides sequential reading.

All fields of words 0 and 1 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Malfunction
I	Line overrun
J	Check sum error
K	Track verification error
L	Invalid address
M	Error indicator
N	Channel status 00 = Successful completion 11 = Indirect command error

Channel Status Word

Field	Definition
A	Command complete
B	0 = Channel status word stored at completion of transaction 1 = Channel status word not stored - error

Field	Definition
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count. Number of words not processed from the area described in the terminated data control word.
I	Data control word address. Address of data control word being processed at termination.

A count of zero in field H and an address in field I one greater than that of the last data control word indicate successful completion.

For details of error terminations, refer to paragraph 4.1.8.2

4.1.1.3 Read Disc File Direct

4.1.1.3.1 Calling Sequence

The calling sequence for the common function to read a cell of disc storage directly is shown in the following example.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LDX                    2,ADDRS OF CMD PACKET
                    BRLP                   24
                    B                      EXCEPTION RETURN
                    . . .                  NORMAL RETURN
```

Registers 1 and 2 are saved. Registers 3, A, and B are not saved.

4.1.1.3.2 Input Parameters

The file transfer command packet consists of four words. In the first two words the user specifies options and addresses for the operation. Bit 0 of the first word must be 0. Bit 1 specifies the device control message chain to be used. A 0 indicates chain 1 and a 1 indicates chain 2. Bits 6 through 9

must be zeros. The disc zone identifier and loop 1 address from the input list of the program status record are placed in bits 16 through 31. Bits 0 through 15 of word 1 contain the word address of a list of data control words defining the core areas into which data is to be read. Bits 16 through 31 contain cell location, from a connector cell item, the input list, or the output file identification packet.

The following is typical coding for a file transfer command packet, DRDPKT. The device control message will be placed in chain 1. The right hand half-words of the first two words are initialized zero. Coding must be provided to move the zone identifier and loop 1 address into the first word, and the cell location into the second word, prior to executing the command at run time. The list of data control words is named RDCW2.

NAME		OPERATION AND CONDITION		OPERAND
DRDPKT		DF		10/B'0000000000000,6/0,16/**
		DF		16/RDCW2.W,16/**
		DC		0,,2

Each data control word defines a core area into which data is read. Bit 0 is a 1 for a single-word list or for the last word in a list. Bit 1 is a 1 when the word contains a chain address. If bit 2 contains a 1 data read by the device is not transferred to core. Bit 3 contains a 0 for a read operation. If bit 4 is a 1, data is stored in descending sequence. Bits 7 through 15 contain a count of the number of words. Bits 16 through 31 contain the word address of a core area for the data. If bit 1 is a 1, the address in bits 16 through 31 is that of a list of data control words to which to chain at the completion of the current list.

Typical coding of a data control word for a direct read operation follows. The cell size is 512 words. The core area address is READIN.

NAME		OPERATION AND CONDITION		OPERAND
RDCW2		DCW		1,0,0,0,0,512,READIN.W

4.1.1.3.3 Operation Status

The common function attempts to initiate the operation, and if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program.

The contents of the file transfer command packet reflect the status of the operation.

Word 0	0	A_1	SP 4		00		B_2	SPARE 6							C 8								D 8								
Word 1	A 16																						B 16								
DSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	SP_1	I_1	SP 3			J_1	K_1	L_1	SP_2	M_1	SPARE 11												N_2	
CSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9									I 16														

Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
C	Zone identifier
D	Loop 1 address of disc

Word 1

Field	Definition
A	Data control word list address
B	Cell location

All fields of word 0 and 1 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error

Field	Definition
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Malfunction
I	Line overrun
J	Check sum error
K	Track verification error
L	Invalid address
M	Error indicator
N	Command status 00 = Successful completion 01 = Direct command - device status word error 10 = Direct command - channel status word error

Channel Status Word

Field	Definition
A	Command complete
B	0 = Channel status word stored 1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words not processed from area described in terminated data control word
I	Word address of data control word being processed at termination

A count of zero in Field H and an address in Field I one greater than that of the last data control word indicate successful completion.

For details of error terminations, refer to paragraph 4.1.8.3

4.1.1.4 Close Input Disc File

The operation of closing an input file on disc makes the file status pointer of the program status record available for another file. Its use is appropriate only when an input file is closed and another file is to be opened. With this exception, closing input files is unnecessary.

4.1.1.4.1 Calling Sequence

The calling sequence for the common function to close an input file on disc storage is shown in the following example.

```
NAME        OPERATION AND CONDITION   OPERAND
            LDX                       2,ADDRS OF FT CMD PACKET
            BRLP                      32
            B                         EXCEPTION RETURN
            ...                       NORMAL RETURN
```

Registers 1 and 2 are saved. Registers 3, A, and B are not saved.

4.1.1.4.2 Input Parameters

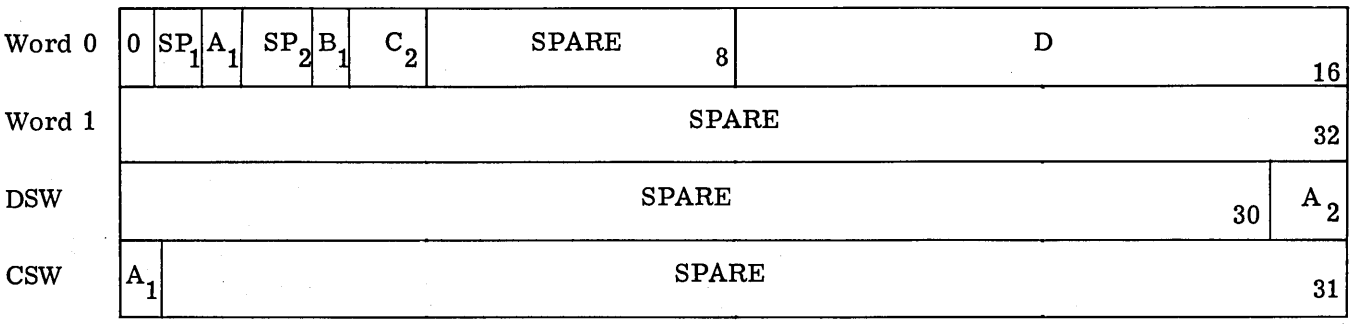
The file transfer command packet consists of four words. In the first two words the user specifies options and addresses for the operation. Bit 0 of the first word must be 0. A 0 in bit 2 indicates a program file, and a 1 in bit 2 indicates a work file. A 1 in bit 5 indicates that the file is not documented in the file status pointer list. Bits 6 and 7 must be zeros. Bits 16 through 31 contain the word address of the file linkage block.

The following coding for file transfer command packet CFTPAC is typical. The file is a documented work file defined in file linkage block FLBA.

```
NAME        OPERATION AND CONDITION   OPERAND
CFTPAC      DF                        8/B'0010000000,8/0,16/FLBA.W
            DC                        0,,3
```

4.1.1.4.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If successful, the common function returns control at the normal return. When the normal return occurs, the contents of the file transfer command packet reflect the status of the completed operation.



Word 0

Field	Definition
A	0 = Program file
	1 = Work file
B	0 = Normal file
	1 = File is not documented in PSR file status pointer list
C	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
D	Core address of file linkage block

All fields of word 0 contain user-supplied information.

Device Status Word

Field	Definition
A	Command status
	00 = Successful completion
	11 = Indirect command error

Channel Status Word

Field	Definition
A	Command complete

For details of error terminations, refer to paragraph 4.1.8.2.

4.1.2 Output Disc File

4.1.2.1 Open Output Disc File

4.1.2.1.1 Calling Sequence

The calling sequence for the common function to open an output file of disc storage is shown in the following example.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8   9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                     LDX                   2,ADDRS OF FT CMD PACKET
                     BRLP                  20
                     B                     EXCEPTION RETURN
                     ...                   NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.2.1.2 Input Parameters

The file transfer command packet consists of four words. The user specifies options and addresses for the operation in the first two words. Bit 0 of the first word, word 0, must be a 1. Bit 1 specifies the device control message chain, 0 for chain 1 or 1 for chain 2. Bit 2 specifies the type of file, 0 for a program file or 1 for a work file. If bit 5, is a 1, documenting the file in the program status record file status pointer list is inhibited. Bits 6 and 7 must be zeros. Bits 8 through 12 specify the length of the file linkage block in words. The recommended length, four words, allows three levels of connector cells. Bits 13 through 15 contain the item length indicator, specifying the length of items in low-level connector cells according to table 4-1. Bits 16 through 31 contain the word address of the file linkage block area. Bits 0 through 15 of word 1 contain the word address of a data control word that defines the core area for connector cells. Bits 16 through 31 contain the word address of a three word core bin in which to build the file identification packet.

The following example shows typical coding for a file transfer command packet. With packet OUTPAC, an open output file command opens an undocumented work file to be described in identification packet

IDPAC. The operation utilizes chain 1 for device control messages. A file linkage block four words in length is to be built at FLBW. Connector cells are manipulated with data control word DCWB.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
OUTPAC              DF                  8/B'1010010010,5/4,3/1,16/FLBW.W
                    DF                  16/DCWB.W,16/IDPAC.W
                    DF                  0,,2
```

The data control word defines an area of core for transfer of data to or from a device. The data control word for this operation refers to the area for connector cells. Bit 0 must be 1 since this word will be used alone. Bits 1 and 2 must be zeros. Bit 3 must be a 1 and bit 4, a 0. Bits 7 through 15 contain the word count of the data area. Bits 16 through 31 contain the word address of a connector cell bin in core.

Coding for data control word DCWB follows. The connector cell bin is CCBIN, 32 words long.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
DCWB                DCW                 1,0,0,1,0,32,CCBIN.W
```

The indirect commands build an output file identification packet in a 3-word area. The open file operation places the low-order sixteen bits of the absolute time word in the left hand half of the first word. The right hand half of the word contains the cell allocation count of the highest level connector cell. It is updated as the file is written, and completed when the file is closed. For a documented file, the open file operation places a disc zone identifier in the left hand byte of word 1. Otherwise, the user must place a cell size code in this byte, as follows:

X'00	128 byte cell
X'10	256 byte cell
X'20	512 byte cell
X'30	2048 byte cell

The open file operation places the loop 1 address in the second byte. The close file operation places the disc cell address of the highest-level connector in the right hand halfword. The left hand half of the third word contains user-supplied data-directing codes. The right hand half contains the disc cell count of the file, which is maintained by the indirect commands.

The following example shows coding for an output file identification packet for an undocumented file of 32 word cells. The data directing codes, used only within the program, are X'CC23. The packet is named IDPAC.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8   9   10 11 12 13 14   15   16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
I D P A C           D C                    * *
                    D F                    8 / X ' 0 0 , 2 4 / * *
                    D F                    1 6 / X ' C C 2 3 , 1 6 / * *
```

4.1.2.1.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If successful, the common function returns control at the normal return. When the normal return occurs, the contents of the file transfer command packet reflect the status of the completed operation.

Word 0	1	A_1	B_1	SP_2	C_1	D_2	E 5	F 3	G 16	
Word 1	A 16								B 16	
DSW	A 32									
CSW	A_1	SPARE 31								

Word 0

Field	Definition
A	0 = Device control message chain 1 1 = Device control message chain 2
B	0 = Program output file 1 = Output work file
C	0 = Normal file 1 = File not to be documented in program status record
D	Channel device control message chain specification 00 = Current channel 01 = S channel 10 = A channel 11 = B channel
E	Word length of core bin for file linkage block

Field	Definition
F	Item length indicator for connector cell item (table 4-1)
G	Word address of core bin for file linkage block

Word 1

Field	Definition
A	Word address of data control word that defines a core bin for connector cells
B	Word address of output file identification packet

The contents of words 0 and 1 are supplied by the user.

Device Status Word

The open output file operation places zeros in the device status word at completion.

Channel Status Word

Field A is set to one at completion of the open output file operation, resulting in the word becoming a negative number.

4.1.2.2 Write Disc File Indirect

4.1.2.2.1 Calling Sequence

The following is an example of the calling sequence for the common function to write a cell on disc indirectly.

```
NAME     OPERATION AND CONDITION     OPERAND
         LDX                         2,ADDRS OF FT CMD. PACKET
         BRLP                        28
         B                           EXCEPTION RETURN
         ...                         NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.2.2.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of the first word, word 0, must be a 1. A 0 in bit 4 specifies that the right half of word 1 contains a literal item parameter. A 1 in bit 4 specifies that the right half of word 1 contains the word address of the item to be placed in low level connector cells. Bits 6 and 7

of word 0 must be zeros. Bits 16 through 31 contain the word address of the file linkage block. Bits 0 through 15 of word 1 can contain either a word address or zeros. The address is that of the data control word list describing the core cell containing the data to be written. If zeros are present, no data is written and a null item entry is placed in the low-level connector cell. Bits 16 through 31 of word 1 contain the literal item parameter for the cell unless bit 4 of word 0 is a 1. In that case, an item containing additional user-supplied information is indicated, and the word address of the item is placed in bits 16 through 31 of word 1.

When the connector cell item is supplied by the user, the item length is specified in the file transfer command packet for the open file operation. The write operation places the disc cell address in the first halfword. The second halfword is the item parameter. The remainder of the item contains any type of identification data, or other data, which an application requires.

The following coding represents typical coding of a file transfer command packet, named FTW. The literal item parameter is PR and the file linkage block is FLBW. The data control word list is DCWC.

```
NAME      OPERATION AND CONDITION   OPERAND
FTW       DF                        8/B'10000000,8/0,16/FLBW.W
          DF                        16/DCWC.W,16/C'PR'
          DC                        0,,2
```

The data control word list defines the data to be written. Bit 0 of each data control word is a 1 for a single-word list or the last word of a list. Bit 1 is a 1 when a word contains the address of another list to which to chain at the end of the current list. Bit 2 is a 1 to cause zeros to be written. Bit 3 is a 1 for a write operation. If bit 4 is a 1, the data is written in descending address sequence. The count in bits 7 through 15 specifies the number of words to be written. This count is the number of words in the core bin specified in bits 16 through 31, or the number of words of zeros if bit 2 is 1. Bits 16 through 31 contain the word address of a core bin that contains the data to be written, or a chain address if bit 1 is 1.

The following is typical coding for a data control word list. Data from four areas of core are placed in a single cell on disc. The name of the list is DWCW.

```
NAME      OPERATION AND CONDITION   OPERAND
DCWC      DCW                       0,0,0,1,0,2,HEADER
          DCW                       0,0,0,1,0,10,REC1
          DCW                       0,0,0,1,0,10,REC2
          DCW                       1,0,0,1,0,10,REC3
```

4.1.2.2.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragaaph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0	1	SP 3			A_1	SP_1		B_2	SPARE 8								C 16															
Word 1	A 16																B 16															
DSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	SP_1	I_1	SP 3			J_1	K_1	L_1	SP_2	M_1	SPARE 11														N_2
CSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9									I 16															

Word 0

Field	Definition
A	0 = Literal item parameter in field B of word 1
	1 = Item bin address in field B of word 1
B	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
C	Address of file linkage block

Word 1

Field	Definition
A	Address of data control word list, or zeros if no data is to be written
B	Literal item parameter if field A of word 0 contains 0 Address of low level connector cell item in core if field A of word 0 contains 1

All fields of words 0 and 1 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Malfunction
I	Line overrun
J	Check sum error
K	Track verification error
L	Invalid address
M	Error indicator
N	Command status
	00 = Command completed successfully
	11 = Indirect command in error

Channel Status Word

Field	Definition
A	Channel completion
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error

Field	Definition
H	Residual count - number of words not processed of area described in terminated data control word
I	Address of data control word being processed at termination

A count of zero in field H, and an address in field I one greater than that of the last data control word indicates successful completion.

For details of error terminations, refer to paragraph 4.1.8.2

4.1.2.3 Write Disc File Direct

4.1.2.3.1 Calling Sequence

The following is an example of the calling sequence to write a cell of a disc file directly.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS OF FT. CMD. PACKET
	BRLP	24
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.2.3.2 Input Parameters

The file transfer command packet consists of four words. The user specifies options and addresses in the first two words. Bit 0 of the first word, word 0, must be a 1. Bit 1 specifies the chain of device control messages to be used. A 0 specifies chain 1 and a 1 specifies chain 2. If a 0 is placed in bit 4, the right half of word 1 contains the cell location. If this bit is a 1, the cell allocator places a cell location in the right half of word 1. Bit 5 only has significance if bit 4 is a 1, and in that case, controls storage of the cell allocation count. If bit 5 is a 1, the cell allocation count is placed in the cell header and incremented by one. If bit 5 is a 0, the cell allocation count is omitted and is not changed. Bits 6 and 7 must be zeros. Bits 16 through 23 contain the zone identifier. Bits 24 through 31 contain the loop 1 address. Bits 0 through 15 of word 1 contain the word address of a list of data control words that describe the core bin containing the data to be written. Bits 16 through 31 contain the cell location, supplied by the user, or inserted by the allocator, as specified in bit 4 of word 0.

The following coding example shows coding for a typical file transfer command packet, DWPKT. The device control message is to be placed in chain 1, and cell allocation and cell allocation count are requested.

Other coding places the zone identifier and loop 1 address in the right half of word 0 prior to execution at run time. The data control word list is DCWDW.

NAME (1–8)	OPERATION AND CONDITION (10–14)	OPERAND (16–45)
DWPKT	DF	8/B'10001100,8/0,16/**
	DF	16/DCWDW.W,16/**
	DC	0,,2

The data control word list consists of one or more data control words describing a core area containing data to be written. Bit 0 of a word is a 1 if it is the only word, or the last word in the list. If bit 1 is a 1, the data control word contains a chain address. Bit 2 is set to 1 to cause zeros to be written. Bit 3 is a 1 for a write operation. If bit 4 is a 1, data is written from addresses in descending sequence. Bits 7 through 15 contain the count of the number of words of data to be written, or the number of words of zeros to be written if bit 2 is a 1. Bits 16 through 31 contain a word address of an area of core containing data to be written, or of another list to which to chain at the completion of this list, if bit 1 is a 1.

The following coding example shows a single data control word to write a 32-word cell from an area named OUTCELL.

NAME (1–8)	OPERATION AND CONDITION (10–14)	OPERAND (16–45)
DCWDW	DCW	1,0,0,1,0,32,OUTCELL.W

4.1.2.3.3 Operation Status

The common function attempts to initiate the operation, and, if unsucessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0	1, A_1, SP_2, B_1, C_1, 00, D_2, $SPARE_6$, E_8, F_8
Word 1	A_{16}, B_{16}
DSW	A_1, B_1, C_1, D_1, E_1, F_1, G_1, H_1, SP_1, I_1, SP_3, J_1, K_1, L_1, SP_2, M_1, $SPARE_{11}$, N_2
CSW	A_1, B_1, C_1, D_1, E_1, F_1, G_1, H_9, I_{16}

Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	0 = Field B of word 1 contains a cell location
	1 = Allocator places cell location in field B of word 1
C	If field B contains 0, spare
	If field B contains 1
	0 = Do not store cell allocation count in header
	1 = Store cell allocation count in header and increment count
D	Channel Device Control Message Chain Specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
E	Zone identifier
F	Loop 1 address

Word 1

Field	Definition
A	Word address of data control word list
B	Cell location

All fields of word 0 and field A of word 1 contain user-supplied information. Error routines overlay the user-supplied cell location with the cell location actually used.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error

Field	Definition
E	Received data control bit S1
F	Received data control bit S2
G	Invalid command
H	Malfunction
I	Line overrun
J	Check sum error
K	Track verification error
L	Invalid address
M	Error indicator
N	Command status 00 = Successful completion 01 = Error in device status word 10 = Error in channel status word

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored 1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words of the terminated data control word area, not processed at termination
I	Word address of terminating data control word

A count of zero in field H and an address in Field I one greater than that of the last data control word indicates successful completion.

For details of error terminations, refer to paragraph 4.1.8.2.

4.1.2.4 Close Output Disc File

4.1.2.4.1 Calling Sequence

The calling sequence for the common function to close an output disc file is shown in the following example.

```
NAME      OPERATION AND CONDITION   OPERAND
          LDX                       2,ADDRS OF FT CMD. PACKET
          BRLP                      32
          B                         EXCEPTION RETURN
          ...                       NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A and B are not saved.

4.1.2.4.2 Input Parameters

The file transfer command packet consists of four words. In the first two words the user specifies options and addresses for the operation. Bit 0 of word 0 must be a 1. Bit 2 specifies the type of file. A 0 specifies the program output file and a 1 specifies a work file. A 1 in bit 5 indicates that the file is not documented in the program status record file status pointer lists. Bits 6 and 7 must be zeros. Bits 16 through 31 contain the word address of the file linkage block.

The following is an example of coding a file transfer command packet FTPK for closing an undocumented output work file defined in file linkage block FLBW3.

```
NAME      OPERATION AND CONDITION   OPERAND
FTPK      DF                        8/B'1010010010000,8/0,16/FLBW3.W
          DC                        **,,3
```

4.1.2.4.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0	1	SP_1	A_1	SP_2	B_1	C_2	SPARE 8								D 16																
Word 1	SPARE 32																														
DSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	SP_1	I_1	SP 3			J_1	K_1	L_1	SP 2	M_1	SPARE 11												N_2
CSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9									I 16														

Word 0

Field	Definition
A	0 = Program file
	1 = Work file
B	0 = Normal file
	1 = File is not documented in program status record file status pointer list
C	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
D	Word address of file linkage block

All fields of word 0 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry

Field	Definition
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bits S3
G	Invalid command
H	Malfunction
I	Line overrun
J	Check sum error
K	Track verification error
L	Invalid address
M	Error indicator
N	Command status
	00 = Successful completion
	11 = Indirect command in error

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	TDX error
E	Count error
F	Initiate error
G	Error

Field	Definition
H	Residual count - the number of words of the area described in the terminated data control word remaining unprocessed at termination
I	The word address of the data control word being processed at termination

A count of zero in field H and an address in field I one greater than that of the last data control word indicates successful completion.

For details of error terminations, refer to paragraph 4.1.8.2

4.1.3 Input Tape File

4.1.3.1 Open Input Tape File

4.1.3.1.1 Calling Sequence

The calling sequence for the common function that opens an input tape file is shown in the following example.

```
NAME      OPERATION AND CONDITION   OPERAND
          LDX                       2,ADDRS OF FT CMD PACKET
          BRLP                      20
          B                         EXCEPTION RETURN
          ...                       NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.3.1.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of the first word, word 0, must be 0. Bit 1 specifies the chain in which this operation places the device control message. A 0 specifies chain 1 and a 1 specifies chain 2. Bit 2 specifies the type of file. A 0 indicates a program input file and a 1 indicates a work file that must be a single reel file. If bit 4 is 0, the tape is positioned to read the first record past the header without verifying the header. A 1 in bit 4 provides header verification. The tape is positioned

at the load point. A 1 in bit 5 inhibits documenting the file. Bits 6 and 7 must be zeros. Bits 8 through 12 contain the word length of a bin for the file linkage block. A length of six is recommended. Bits 13 through 15 specify the length of items in the low level connector cells to be transferred, as shown in table 4-1. Bits 16 through 31 contain the word address of the file linkage block. Bits 0 through 15 of word 1 contain the word address of a data control word that refers to a bin for connector cells. Bits 16 through 31 contain the word address of a read packet in the device acquisition and control service output file that refers to the file.

The following coding example is typical of coding for a file transfer command packet to open tape input file described in the first read packet, starting at the fourth word of ALFILE. It is a work input file consisting of one reel, which is not to be documented. The device control messages will use chain 2, and the device control word is DCWT. The file linkage block, six words long, is named FLBR, and low-level connector cell items are 8 bytes long. The reel header is to be verified, and the packet is named TRPAC.

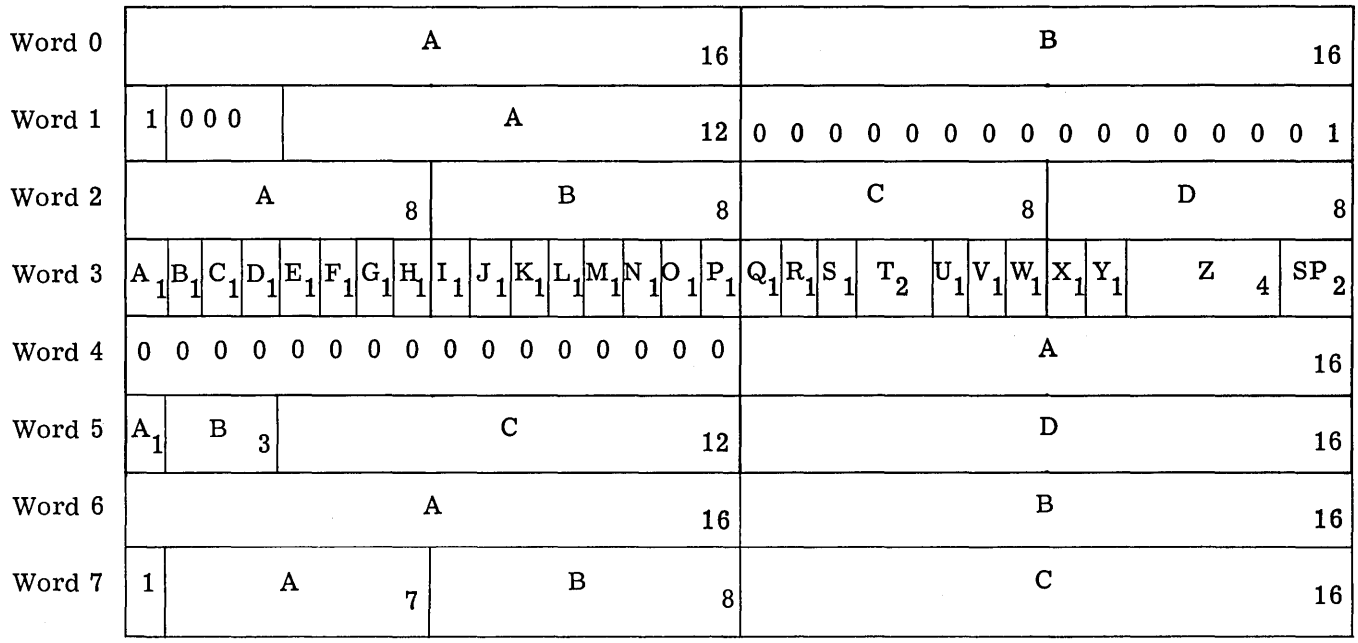
NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
TRPAC		DF		8/B'01111100,5/6,3/2,16/FLBR.W
		DF		16/DCWT.W,16/ALFILE.W+3
		DC		0,,2

The data control word that refers to an area for connector cells has a 1 in bit 0, and zeros in bits 1 through 4. Bits 7 through 15 contain the connector cell length, in words. The right half word contains the word address of the connector cell area.

The following is an example of coding for a data control word. The word, named DCWT, refers to a 512-word area named CONN.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
DCWT		DCW		1,0,0,0,0,512,CONN.W

The read packet is a part of an output file from device acquisition and control service. In order to read a tape file, data acquisition and control service must request mounting of the first reel of the file, assign a working channel to the tape unit on which the reel is mounted, and write an output file containing allocation information. This file is an input to the program and the user must read the file and extract or address the data. The read packets follow a 3-word file header, as described in paragraph 1.5.2. The following is the format for the read packet for the open input file operation.



Words 0 and 1 are the entry header.

Word 0

Field	Definition
A	User-supplied protection key
B	User-supplied protection key

Word 1

Field	Definition
A	Entry length in bytes: 32 for multireel file or single-reel file with connector cell structure on disc. 24 for single-reel file without connector cell structure on disc

Words 2 and 3 contain device parameters.

Word 2

Field	Definition
A	Device party line address
B	Device type X'50
C	Loop 1 address of device
D	Loop 2 address of device

Word 3

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Error interrupt
T	Byte count
U	7 channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Tape at load point
X	Cyclic redundancy check error
Y	Correctable error

Field	Definition
Z	Channel in error

Fields X-Z are zeros for 7-channel tape.

Words 4 and 5 contain mounted reel parameters.

Word 4

Field	Definition
A	Reel key number from reel header

Word 5

Field	Definition
A	1 = reel includes connector file
B	Item length indicator (table 4-1)
C	Length of data cells in bytes, 128, 256, 512, or 2048
D	Time halfword from reel header

Words 6 and 7 are the tape file identifier.

Word 6

Field	Definition
A	Time halfword of high-level connector cell protection key
B	Cell allocation count of high-level connector cell or reels list

Word 7

Field	Definition
A	Disc zone parameter-connector or reels list cell
B	Loop 1 address of disc
C	Cell address of high-level connector or reels list cell

4.1.3.1.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation

continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0									
0	A_1	B_1	SP_1	C_1	D_1	E_2	F_5	G_3	H_{16}

Word 1	
A_{16}	B_{16}

DSW																										
A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	I_1	J_1	K_1	L_1	M_1	N_0	O_1	P_1	Q_1	R_1	S_1	T_2	U_1	V_1	W_1	X_1	Y_1	Z_4	AA_2

CSW								
A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_9	I_{16}

Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	0 = Program file
	1 = Work file
C	0 = Header verify inhibit
	1 = Header verify enable
D	0 = Documented file
	1 = Non-documented file
E	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
F	Word length of file linkage block bin
G	Item length indicator
H	Word address of file linkage block

Word 1

Field	Definition
A	Word address of data control word describing connector cell bin
B	Word address of read packet

All fields of words 0 and 1 contain user supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Error interrupt
T	Byte count
U	7-channel tape unit

Field	Definition
V	Non return to zero, change on 1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	11 = Indirect command error

Fields X-Z contain zeros for 7-channel operation.

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words not processed from area referred to in terminated data control word
I	Word address of terminated data control word

At successful completion, field H contains a count of zero and field I contains the word address of the last data control word, plus one.

For details of error terminations, refer to paragraph 4.1.8.2

4.1.3.2 Read Tape File Indirect

4.1.3.2.1 Calling Sequence

The following example shows the calling sequence for the common function that reads a tape file cell indirectly.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LDX                   2,ADDRS OF FT CMD PACKET
                    BRLP                  28
                    B                     EXCEPTION RETURN
                    ...                   NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.3.2.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bits 0 and 2 of the first word, word 0, must be zeros. If bit 3 is a 0, the next sequential data cell is read. When bit 3 is a 1, a cell is read if the item parameters of the command and the low-level connector cell item prefixed to the data cell are equal. Bit 4 specifies the location of the command item parameter. Bits 6 and 7 must be zeros. Bits 16 through 31 contain the word address of the file linkage block. Bits 0 through 15 of word 1 contain a word address or zeros. The address is that of a data control word list describing the input area. If zeros are placed in this field, data cells are not read into core. Bits 16 through 31 can contain a literal item parameter, a word address, or zeros. If bit 4 of word 0 is a 0, place the literal item parameter in bits 16 through 31. If bit 4 of word 0 is a 1, place the word address of a connector cell item bin in bits 16 through 31, and the item parameter in the second halfword of that bin. An address of zeros results in sequential reading of the file.

The following is an example of coding for a file transfer command packet to read a tape file described in file linkage block FLBRT selectively, on the basis of equality with a literal item parameter B'0000000010101111. The data control word list is DCW. The packet is named FTPT3.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
FTPT3               DF                    8/B'0000100000,8/0,16/FLBRT.W
                    DF                    16/DCW.W,16/B'0000000010101111
                    DC                    0,,2
```

The data control word list consists of one or more data control words describing the core bin into which the data is placed. Bit 0 is a 1 in the last word of a list, or in a single word. Bit 1 is a 1 when the word contains a chain address. If bit 2 is a 1, data is skipped. Bit 3 is zero for a read operation. If bit 4 is a 1, data is read into addresses in descending sequence. Bits 7 through 15 must contain the count

of words to be read or skipped. Bits 16 through 31 must contain the word address of the core bin into which data is read or the word address of another data control word list.

The following is an example of coding of a data control word for reading a file bin RECIN. The data control word name is DCWT.

NAME (1–8)	9	OPERATION AND CONDITION (10–14)	15	OPERAND (16–45)
DCWT		DCW		0,0,0,0,0,512,RECIN.W

4.1.3.2.3 *Operation Status*

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0								
0	SP_1	A_2	B_1	SP_1	C_2	SPARE 8	D 16	

Word 1	
A 16	B 16

DSW																										
A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	I_1	J_1	K_1	L_1	M_1	N_1	O_1	P_1	Q_1	R_1	S_1	T_2	U_1	V_1	W_1	X_1	Y_1	Z_4	AA_2

CSW								
A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9	I 16

Word 0

Field	Definition
A	Read Mode
	00 = Sequential read
	01 = Selective read, selecting cells with item parameters equal to that specified
	10, 11 = Not used
B	0 = Literal item parameter in field B of word 1
	1 = Low level connector cell item bin contains item parameter

Field	Definition
C	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
D	Word address of file linkage block

Word 1

Field	Definition
A	Word address of a data control word list that describes the core area into which data is read, or zeros to inhibit transfer of data to core
B	Literal item parameter, when field B of word 0 is 0 - if field B of word 0 is 1, the word address of the low-level connector cell bin, or zeros

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error

Field	Definition
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Error interrupt
T	Byte count
U	7 channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	11 = Indirect command error

Fields X-Z are zeros for 7-channnel tape.

Channel Status Word

Field	Definition
A	Command complete
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - the number of words remaining unprocessed in the area described by the terminated data control word

Field	Definition
I	Word address of the terminated data control word

For successful completion, the H field count is zero, and the I field contains a word address one greater than that of the last data control word.

For details of error terminations, refer to paragraph 4.1.8.2

4.1.3.3 Read Tape File Direct

4.1.3.3.1 Calling Sequence

The calling sequence for the common function that reads a tape file cell directly is shown in the following example.

BRLP

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS OF FT CMD. PACKET
	BRLD	24
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.3.3.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of the first word, word 0, must be 0. Bit 1 specifies the device control message chain for the operation. A 0 specifies chain 1, and a 1 specifies chain 2. Bits 2 and 3 specify the recording format of seven-channel tape. Zeros in both positions specify hexadecimal format. A 1 in bit 2 specifies binary format, and a 1 in bit 3 specifies binary-coded-decimal format. Do not place a 1 in both positions. Bit 4 specifies the recording bit density for 7-channel tape. A 0 specifies 800-bit-per-inch recording, and a 1 specifies 556-bit-per-inch recording. If bit 5 is a 1, the tape unit moves and reads the tape backwards. The first word sent to the processor is the last word of the cell. Only A-Channel tapes may be read backwards. Bit 6 is a 1 for 7-channel tape, and bit 7 is a 1, for 9-channel tape. One, but not both of these bits must be a 1. Bits 8 and 9 must be zeros. Bits 16 through 23 must contain the party line address of the tape unit, from word 2 of the device acquisition and control service read packet. Bits 24 through 31 must contain the loop 1 (working channel) address, from word 2 of the device acquisition and control service read packet. Bits 0 through 15 of word 1 must contain the word address of the data control word list.

The following coding example is typical of coding for a file transfer command packet to read a 9-channel tape sequentially in the forward direction. Other coding must place addresses for the tape unit in the

right half of word 0 prior to execution of the packet at run time. The data control word list is TRDCW. The packet is named TRPKT. The data control message will be placed in chain 1.

```
NAME     OPERATION AND CONDITION   OPERAND
TRPKT    DF                        8/B'00000001,8/X'00,16/**
         DF                        16/TRDCW.W,16/0
         DC                        0,,2
```

The read packet is included in the output file of the device acquisition and control service program. This program must be called to request mounting of reels and to assign working channels to tape units required, prior to entering a program using tape files. Detailed format of the read packet is given in paragraph 4.1.3.1.2.

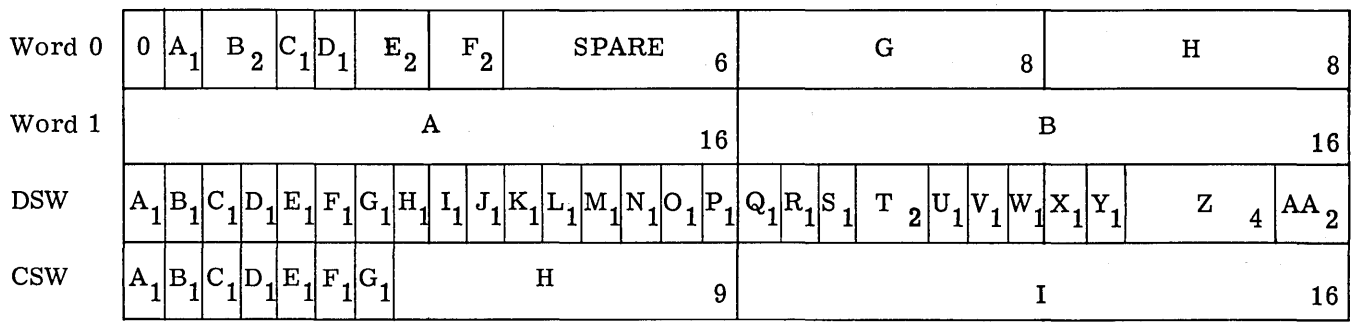
The data control word list consists of one or more data control words which describe the area into which the data from tape is transferred. Bit 0 is a 1 in single data control word lists and in the last word of a list. Bit 1 is a 1 if the word contains a chain address. Bit 2 is a 1 to skip data from a tape cell. Bit 3 is a 0 for read operations. If bit 4 is a 1, data is read into addresses in descending sequence. Bits 7 through 15 must contain the count of words to be read or skipped. Bits 16 through 31 must contain a word address, that of a bin for data read, or that of a data control word list to which to chain at the end of the current list.

The following coding example shows a data control word list to read an item from each of four records in a 512-word cell. The items are the 15th words of each record, and are placed in locations T0T1 through T0T4. The list is named TRDCW.

```
NAME     OPERATION AND CONDITION   OPERAND
TRDCW    DCW                       0,0,1,0,0,16,0
         DCW                       0,0,0,0,0,1,T0T1.W
         DCW                       0,0,1,0,0,126,0
         DCW                       0,0,0,0,0,1,T0T2.W
         DCW                       0,0,1,0,0,126,0
         DCW                       0,0,0,0,0,1,T0T3.W
         DCW                       0,0,1,0,0,126,0
         DCW                       0,0,0,0,0,1,T0T4.W
         DCW                       1,0,1,0,0,114,0
```

4.1.3.3.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.



Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	00 = Hex mode
	01 = BCD mode
	10 = Binary mode
C	0 = 800 bits-per-inch
	1 = 556 bits-per-inch
D	0 = Read forward
	1 = Read backward
E	01 = 9-channel tape
	10 = 7-channel tape
F	Channel device control message queue specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel

Field	Definition
G	Tape unit party line address
H	Tape unit loop 1 address

Word 1

Field	Definition
A	Word address of data control word list

All fields of words 0 and 1 contain user supplied information. Fields B and C apply only to 7-channel tape. Field D applies only to 9-channel tape.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt

Field	Definition
T	Byte count
U	7-channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	01 = Direct command error - device status word
	10 = Direct command error - channel status word

Fields X-Z are zeros for 7-channel tape.

Channel Status Word

Field	Definition
A	Command complete
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words not processed of bin referred to by terminated data control word
I	Word address of terminated data control word

Successful completion leaves a count of zero in field H and the address of the word following the last data control word in field I.

For details of error terminations, refer to paragraph 4.1.8.3.

4.1.3.4 Replace Input Tape

4.1.3.4.1 Calling Sequence

The following example shows the calling sequence for the common function to replace an input tape.

```
NAME        OPERATION AND CONDITION   OPERAND
            LDX                       2,ADDRS OF FT. CMD. PACKET
            BRLP                      G4
            B                         EXCEPTION RETURN
            ...                       NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.3.4.2 Input Parameters

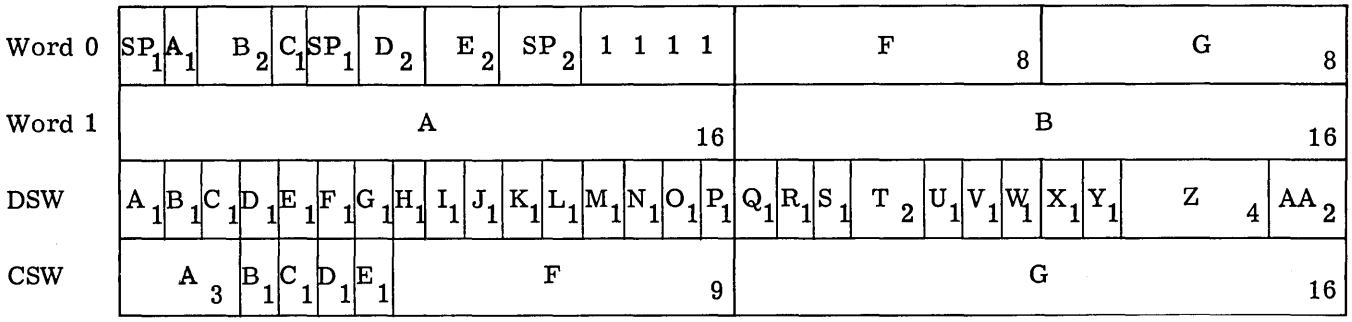
The file transfer command packet consists of four words. In the first two words the user specifies options and addresses for the operation. Bit 1 of the first word, word 0, specifies the device control message chain in which the operation is placed. A 0 specifies chain 1 and a 1 specifies chain 2. Bits 2 through 4 are used to specify recording modes on 7-channel tape. Bits 2 and 3 are zeros to specify the hexadecimal mode. Bit 2 is a 1 for the binary mode, and bit 3 is a 1 for the binary coded decimal mode. Bits 2 and 3 must not both be a 1. If bit 4 is a 1, the density is 556 bits per inch, and if bit 4 is 0, the density is 800 bits per inch. Bit 6 is a 1 for 7-channel tape, and bit 7 is a 1 for 9-channel tape. One, but not both bits must be a 1. Bits 8 and 9 must be zeros. Bits 12 through 15 must contain X'F, the op code. Bits 16 through 23 must contain the party line address of the tape unit, from word 2 of the device acquisition and control service read packet. Bits 24 through 31 must contain the loop 1 address of the tape unit, also from word 2 of the read packet. Bits 0 through 15 of word 1 must contain the time halfword of the header on the new reel. Bits 16 through 31 of word 1 must contain the reel key number halfword of the header on the new reel. These halfwords are moved from the reels list of the file.

The following coding example shows a file transfer command packet for replacing an input tape of a nine-channel tape file. Device control message chain 2 is used for the operation. Other coding must be provided to move the tape unit party line address and loop 1 address, and the reel header information into the packet. The packet name is RITPAC.

```
NAME        OPERATION AND CONDITION   OPERAND
RITPAC      DF                        8/B'01000001,8/X'0F,16/**
            DC                        **,,3
```

4.1.3.4.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.



Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	00 = Hexadecimal mode
	01 = Binary-coded-decimal mode
	10 = Binary mode
C	0 = 800 bits-per-inch
	1 = 556 bits-per-inch
D	01 = 9-channel tape
	10 = 7-channel tape
E	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
F	Tape unit party line address
G	Tape unit loop 1 address

Word 1

Field	Definition
A	Time halfword of tape header
B	Reel key number from tape header

All fields of words 0 and 1 contain user-supplied information. Fields B and C of word 0 apply to 7-channel tape only.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt
T	Byte count
U	7-channel tape unit

Field	Definition
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	01 = Direct command error - device status word
	10 = Direct command error - channel status word

Fields X-Z are zeros for 7-channel tape.

Channel Status Word

Field	Definition
A	Status code
	000 Operation in progress
	010 Tape not readied within time limit
	100 Permanent error - contents of right-hand byte corresponds to contents of A register for initiation error
	101 Tape header read error
	110 Identifier from tape header invalid - identifier replaces device status word
	111 Successful completion
B	Loop error
C	Count error
D	Initiate error
E	Error
F	Residual count - number of unprocessed words from area referred to by terminated data control word
G	Word address of terminated data control word

Successful completion leaves a count of zero in field F and the address of the word following the last data control word in field G.

For details of error terminations, refer to paragraph 4.1.8.3.

4.1.3.5 Close Input Tape File

All documented input tape files are closed as a part of the close output file operation. If it is desired to close them at any other time, documented program input files can be closed. Undocumented files should be closed to rewind tapes. The working channels must be released using the tape control command, paragraph 4.1.5.

Note

Do not close documented work input files.

4.1.3.5.1 Calling Sequence

The calling sequence for the common function that closes an input tape file is shown in the following example.

```
NAME      OPERATION AND CONDITION   OPERAND
          LDX                       2,ADDRS OF FT CMD. PACKET
          BRLP                      32
          B                         EXCEPTION RETURN
          ...                       NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.3.5.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of the first word, word 0, must be a 0. Bit 2 specifies the type of file, a 0 for a program file, or a 1 for a work file. If bit 5 is a 1, the file is not documented. Bits 6 and 7 must be zeros. Bits 16 through 31 must contain the word address of the file linkage block.

The following is an example of coding of a file transfer command packet to close a program input tape file described in file linkage block FLBR3. The file is documented, and the packet is named TIFILE.

```
NAME      OPERATION AND CONDITION   OPERAND
TIFILE    DF                        8/B'00000000,8/0,16/FLBR3.W
          DC                        0
          DC                        **,,2
```

4.1.3.5.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0	0	SP_1	A_1	SP_2		B_1	C_2	SPARE 8								D 16																
Word 1	SPARE 32																															
DSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	I_1	J_1	K_1	L_1	M_1	N_1	O_1	P_1	Q_1	R_1	S_1	T_2		U_1	V_1	W_1	X_1	Y_1	Z 4					AA 2	
CSW	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9									I 16															

Word 0

Field	Definition
A	0 = Program file
	1 = Work file
B	0 = Normal file
	1 = Undocumented file
C	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
D	Word address of file linkage block

All fields of word 0 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error

Field	Definition
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt
T	Byte count
U	7-channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	11 = Indirect command error

Fields X-Z are zeros for 7-channel tape.

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored 1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words not processed of area referred to by terminated data control word
I	Word address of terminated data control word

Successful completion leaves a count of zero in field H and the address of the word following the last data control word in field I.

For details of error terminations, refer to paragraph 4.1.8.2.

4.1.4 Output Tape File

4.1.4.1 Open Output Tape File

4.1.4.1.1 Calling Sequence

The following illustrates the calling sequence for the common function that opens an output file on tape.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS OF FT. CMD. PACKET.
	BRLP	20
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.4.1.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of the first word, word 0, must be a 1. Bit 1 specifies the device control message chain to be used by the operation. A 0 specifies chain 1, and a 1 specifies chain 2. Bit 2 specifies the type of file, a 0 for the program file, or a 1 for a work file. A work file must be limited to a single reel. If bit 4 is a 1, a reels list is built. Otherwise the full connector cell structure is built. If bit 5 is a 1, the file is not documented. Bits 6 and 7 must be zeros. Bits 8 through 12 specify the word length of a bin for the file linkage block. A length of six words is recommended. Bits 13 through 15 must contain an item length indicator (table 4-1) which specifies the length of low level connector cell items. These items are prefixed to data cells. Bits 16 through 31 must contain the word address of the file linkage block. Bits 0 through 15 of word 1 must contain the word address of a data control word which describes a bin for connector cells. Bits 16 through 31 must contain the word address of the six-word write packet, from the device acquisition and control service output file. The operation modifies this packet to become the file identifier packet.

The following illustrates coding for a file transfer command packet to open a tape output file. The second write packet beginning at the tenth word of ALFILE, output file from device acquisition and control service, refers to this file. Device control messages are placed in chain 2. The file is an undocumented work file, limited to a single reel, listed in a reels list. A six-word file linkage block FLBW5 is specified, and low-level connector cell items are 8 bytes long. Connector cells use data control word DCWCC. The packet is named TPAC.

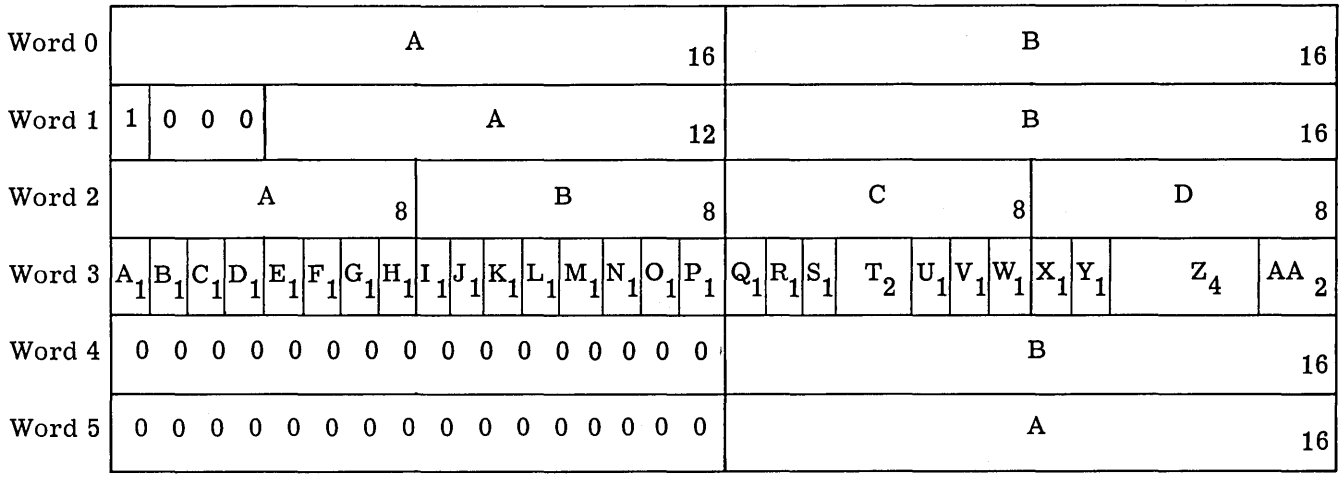
NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
TPAC		DF		8/B'11111100,5/6,3/2,16/FLBW5.W
		DF		16/DCWCC.W,16/ALFILE.W+9
		DC		**,,2

The data control word defines a bin for connector cells. Bit 0 must be a 1. Bits 1 and 2 must be zeros. Bit 3 must be a 1, and bit 4 must be a 0. Bits 7 through 15 must contain a word count for connector cells. Bits 16 through 31 must contain the word address of the bin. The following is an example of coding for a data control word, DCWCC. The cell size is 512 words, and the bin is RLIST.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
DCWCC		DCW		1,0,1,0,0,512,RLIST.W

An application program using tape files may not run until device acquisition and control service has requested the operator to mount the reels, determined that this has been done, and assigned working channels to the tape units. This service program writes an output file consisting of a three-word header

followed by packets corresponding to the requests received. The write packet, referring to an output tape file, is in the following format.



Word 0

Field	Definition
A	User-supplied protection key
B	User-supplied protection key

Word 1

Field	Definition
A	Entry Length, 24 bytes
B	X'0004 = Internal file
	X'0006 = External file

Word 2

Field	Definition
A	Tape unit party line address
B	Device type, X'50
C	Loop 1 address
D	Loop 2 address, 0

Word 3

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt
T	Byte count

Field	Definition
U	7-channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error

Fields X-Z are zeros for 7-channel tape.

Word 4

Field	Definition
A	Reel key number

Word 5

Field	Definition
A	Time halfword of tape header

The open routine alters the write packet, to become the tape file identifier having the following format.

Word 0	A															16	B															16
Word 1	1	A							7	B						8	C															16
Word 2	A															16	B															16
Word 3	A							8	B							8	C															16
Word 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	A															16
Word 5	A_1	B_3											C			12	D															16

Word 0

Field	Definition
A	Time halfword of file
B	Cell allocation count of reels list or high-level connector cell

Word 1

Field	Definition
A	Zone parameter of zone containing cell in field C
B	Loop 1 address of disc containing cell in field C
C	Cell address for reels list or high-level connector cell

Word 2

Field	Definition
A	Data-directing codes for file
B	Current count of allocated disc cells

Word 3

Field	Definition
A	Tape unit party line address
B	Tape unit loop 1 address
C	Block sequence number of last data cell written

Word 4

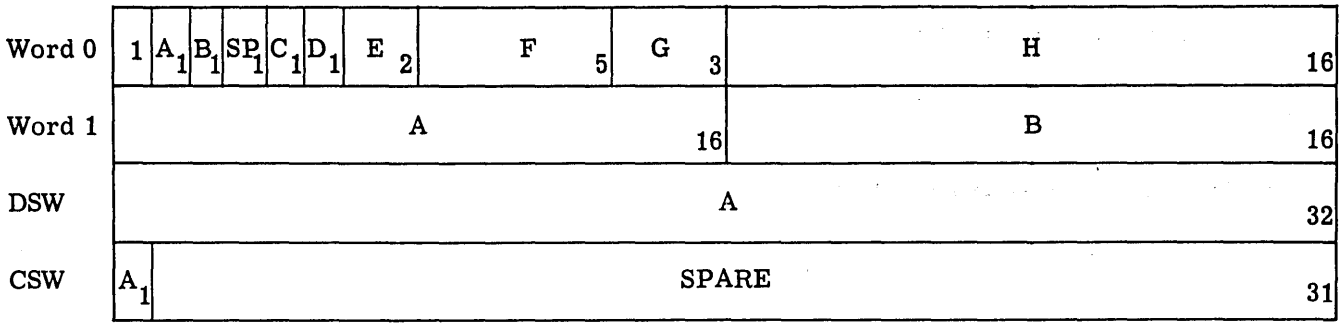
Field	Definition
A	Reel key number of mounted reel

Word 5

Field	Definition
A	Reel contains connector cells
B	Item length of low level connector cell items prefixed to data cells
C	Byte length of data cells
D	Time halfword of tape identifier

4.1.4.1.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If successful, the common function returns control at the normal return. When the normal return occurs, the contents of the file transfer command packet reflect the status of the completed operation.



Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	0 = Program file
	1 = Work file
C	0 = Connector cell structure
	1 = Reels list
D	0 = Normal file
	1 = Undocumented file
E	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
F	Word length of file linkage block bin
G	Item length indicator (table 4-1)
H	Word address of bin for file linkage block

Word 1

Field	Definition
A	Word address of data control word for connector cells
B	Word address of write packet from device acquisition and control service

All fields of words 0 and 1 contain user-supplied information.

Device Status Word

The device status word is filled with zeros at completion of the open output file operation.

Channel Status Word

Field A is set to one at completion of the operation, making the word negative.

4.1.4.2 Write Tape File Indirect

4.1.4.2.1 Calling Sequence

The following illustrates the calling sequence for the common function that writes a tape file cell indirectly.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS.@FT.FT.CMD.PACKET
	BRLP	28
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.4.2.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of word 0 must be a 1. A 0 in bit 4 specifies that the right half of word 1 contains a literal item parameter.

A 1 in bit 4 specifies that the right half of word 1 contains the word address of the item to be placed in the low-level connector cell. Bits 6 and 7 must be zeros. Bits 16 through 31 must contain the word address of the file linkage block. Bits 0 through 15 of word 1 may contain a word address or zeros. The address is that of a data control word list defining the cell to be written on tape. Zeros specify creating a null low-level connector item entry, and no data cell is written. When bit 4 of word 0 is a 1, bits 16 through 31 must contain the word address of a bin for low-level connector cell items. The item parameter must be placed in the second halfword of this bin.

The following is an example of coding for a file transfer command packet to write a tape file described in file linkage block FLBWT7. The data control word list is named DCWT7, and the low-level connector cell item bin is named LLCCI. The packet is named TWPAC7.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
T W P A C 7         D F                 8 / B ' 1 0 0 0 1 0 0 0 , 8 / 0 , 1 6 / F L B W T 7 . W
                    D F                 1 6 / D C W T 7 . W , 1 6 / L L C C I . W
                    D C                 * * , , 2
```

The data control word list describes a bin in core from which the cell is written. Bit 0 of a data control word is a 1 in the last word of a list, or in a single word list. Bit 1 is a 1 if the word contains a chain address. If bit 2 is a 1, zeros are to be written instead of data. Bit 3 is a 1 for a write operation. If bit 4 is 1, the address is decremented after each word is transferred. Bits 7 through 15 must contain a count of the number of words of data or of zeros to be written. Bits 16 through 31 must contain the word address of the data, or of a data control word list to which to chain at the completion of this list.

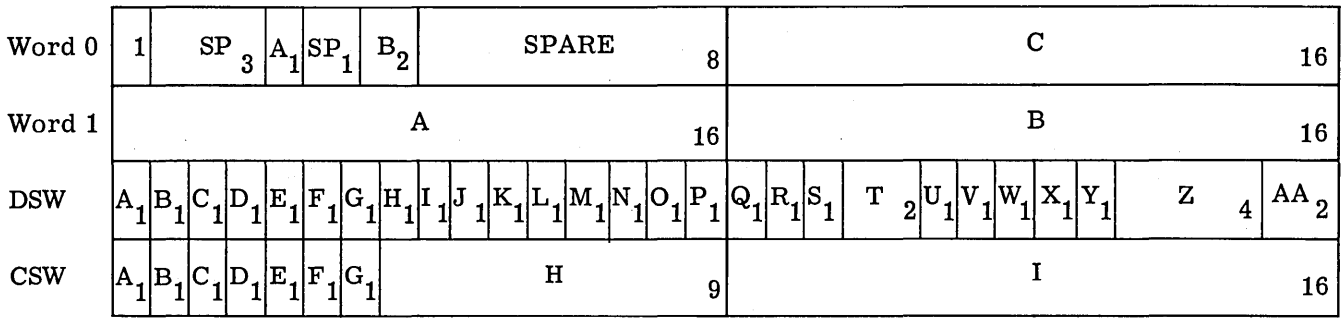
The following is an example of coding a data control list for a write operation. Three data control words refer to three portions of the cell, 512 words long.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
D C W T 7           D C W               0 , 0 , 0 , 1 , 0 , 2 , H E A D . W
                    D C W               0 , 0 , 0 , 1 , 0 , 2 5 5 , R E C 1 . W
                    D C W               1 , 0 , 0 , 1 , 0 , 2 5 5 , R E C 2 . W
```

4.1.4.2.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The

operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.



Word 0

Field	Definition
A	0 = Literal item parameter in field B of word 1
	1 = Word address of low-level connector cell item bin in field B of word 1
B	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
C	Word address of file linkage block

Word 1

Field	Definition
A	Word address of data control word list, or zeros
B	Literal item parameter, when field A, word 0 is a 0
	Word address of low-level connector cell item bin, when field A, word 0 is a 1

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error

Field	Definition
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt
T	Byte count
U	Seven-channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	11 = Indirect command error

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words not processed of area described in terminated data control word
I	Word address of terminated data control word

For a successful completion, the count in field H is zero and the address in field I is that of the word following the last data control word.

For details of error terminations, refer to paragraph 4.1.8.2.

4.1.4.3 Write Tape File Direct

4.1.4.3.1 Calling Sequence

The following illustrates the calling sequence for the common function to write a tape file cell directly.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS. OF FT. CMD. PACKET
	BRLP	24
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.4.3.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of word 0 must be a 1. Bit 1 specifies the chain of device control message to be used for the operation. Bits 2 and 3 specify the data mode for 7-channel tape. Zeros in both positions specify hexadecimal mode. A 1 in bit 2 position specifies binary mode. A 1 in bit 3 position specifies binary-coded-decimal mode. Do not place a 1 in both positions. Bit 4 specifies bit density for 7-channel tape. A 0 specifies 800 bits per inch, and a 1 specifies 556 bits per inch. A 1 in bit 6 position specifies 7-channel tape, and a 1 in bit 7 specifies 9-channel tape. Either bit 6 or bit 7 must be a 1, but not both. Bits 8 and 9 must be zeros. Bits 16 through 23 must contain the tape unit party line address from the tape file identifier. Bits 24 through 31 must contain the tape unit loop 1 address from the tape file identifier. Bits 0 through 15 of word 1 must contain the word address of the data control word list defining the cell to be written.

The following is an example of coding a file transfer command packet to write a cell of a tape file directly. The device control message chain used for the operation is chain 1. The file is on 9-channel tape, and the data cell is assembled from core according to data control word list named DCWTW1. Other coding must move the party line and loop 1 addresses of the tape unit to word 0. The name of the packet is TFILW1.

NAME	OPERATION AND CONDITION	OPERAND
TFILW1	DF	8/B'10000001,8/0,16/**
	DF	16/DCWTW1.W,16/0
	DC	**,,2

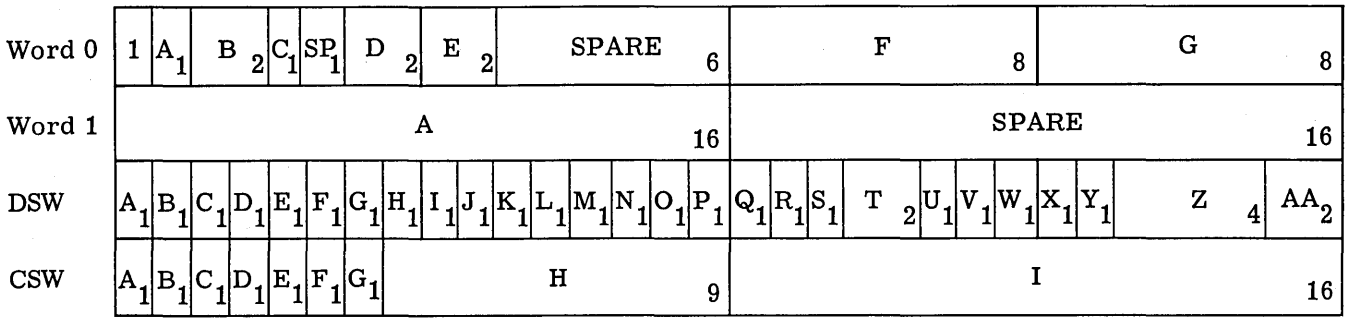
The data control word list refers to the areas of memory containing data to be written. Bit 0 of a data control word is a 1 if it is the last word of a list, or if it is a single-word list. Bit 1 is a 1 if the word contains a chain address. If bit 2 is a 1, zeros are to be written. Bit 3 is a 1 for a write operation. If bit 4 is a 1, the address is decremented after each word is transferred. Bits 6 through 15 must contain a count of the number of words, of data or of zeros, to be written. Bits 16 through 31 must contain a word address of the data to be written, or of a list of data control words to which to chain at the end of the current list.

The following is an example of a single data control word to write a 32-word cell from location CELOUT. The word name is DCWTW1.

NAME	OPERATION AND CONDITION	OPERAND
DCWTW1	DCW	1,0,0,1,0,32,CELOUT.W

4.1.4.3.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.



Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	00 = Hexadecimal
	01 = Binary-coded-decimal
	10 = Binary
C	0 = 800 bits-per-inch
	1 = 556 bits-per-inch
D	01 = 9-channel tape
	10 = 7-channel tape
E	Channel device control message chain specification
F	Tape unit party line address
G	Tape unit loop 1 address

Fields B and C apply to 7-channel tape only.

Word 1

Field	Definition
A	Word address of data control word list

All fields of words 0 and 1 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of reel
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt
T	Byte count
U	7-channel tape unit
V	Non-return-to-zero, change-on-1 mode

Field	Definition
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	01 = Direct command - device status word error
	10 = Device command - channel status word error

Fields X-Z contain zeros for 9-channel tape.

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Time out error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of unprocessed words of area referred to by terminated data control word
I	Word address of terminated data control word

For successful completion, field H contains a count of zero and field I contains the address of the word following the last data control word.

For details of error terminations, refer to paragraph 4.1.8.3.

4.1.4.4 Replace Output Tape

4.1.4.4.1 Calling Sequence

The following illustrates the calling sequence for the common function to replace an output tape.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LDX                   2,ADDRS. OFF FT. CMD. PACKET
                    BRLP                  G4
                    B                     EXCEPTION RETURN
                    ...                   NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.4.4.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. The second bit, bit 1, of word 0, specifies the device control message chain to be used for the operation. A 0 specifies chain 1, and a 1 specifies chain 2. Bit 6 is a 1 for 9-channel tape, and bit 7 is a 1 for 7-channel tape. Either bit 6 or bit 7 must be a 1, but not both. Bits 8 and 9 must be zeros. Bits 12 through 15 must contain X'B. Bits 16 through 23 must contain the tape unit party line address and bits 24 through 31, the tape unit loop 1 address, from the tape file identifier. Bits 0 through 15 of word 1 must contain the time halfword of the file identifer. Bits 24 through 31 must contain the stack zone into which the reel is to be placed. The left-hand four bits of the reel key number in the tape file identifier is the zone of the file.

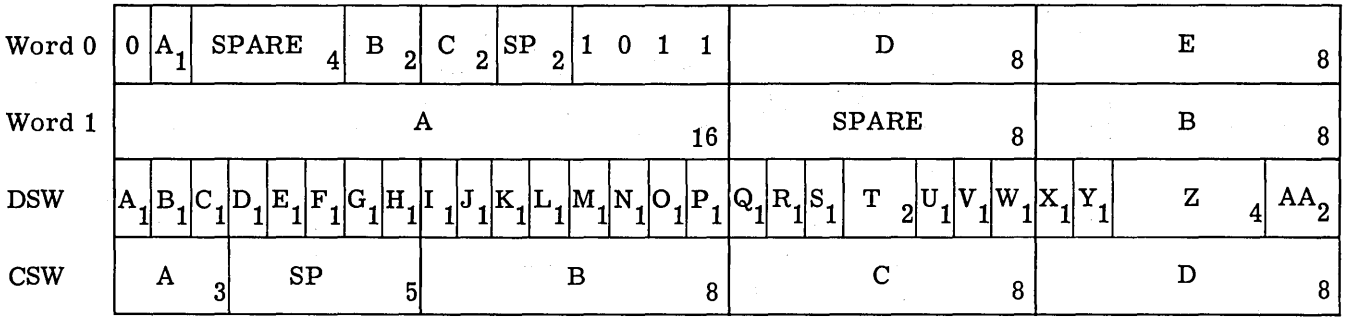
The following is an example of coding for a file transfer command packet to replace a completed 9-channel output tape with an additional reel. The device control message chain for the operation is chain 2. Other coding moves the tape unit party line and loop 1 addresses into word 0, prior to execution at run time. Similarly, the time halfword and the zone also must be moved into word 1. The packet name is ROTPAK.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
ROTPAK              DF                    8/B'01000010,8/X'0B,16/**
                    DC                    **,,3
```

4.1.4.4.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the

common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with the user program. The contents of the file transfer command packet reflect the status of the operation.



Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	01 = 9-channel tape
	10 = 7-channel tape
C	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
D	Tape unit party line address
E	Tape unit loop 1 address

Word 1

Field	Definition
A	Time halfword for file
B	Zone location

All fields of words 0 and 1 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt
T	Byte count
U	7-channel tape
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error

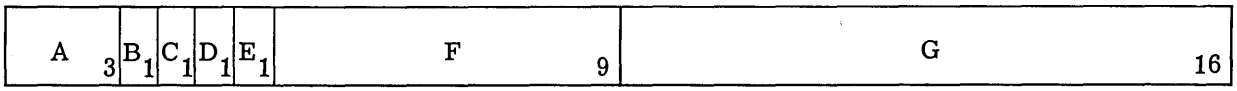
Field	Definition
AA	Command status
	00 = Successful completion
	01 = Direct command - error in device status word
	10 = Direct command - error in channel status word

Fields X-Z contain zeros for 7-channel tape.

Channel Status Word, Completion Codes 110 and 111

Field	Definition
A	Completion code
	110 Successful completion - device status word contains tape reel identifier
	111 Tape unit error - device status word contains tape unit error status
B	Tape unit party line address
C	First byte of word 0
D	Zone location

Channel Status Word, Other Completion Codes



Field	Definition
A	Compleition Code
	00X Service message to device acquisition and control service has been sent
	01X Service message to device acquisition and control service is being sent
	10X Transmission of service message to device acquisition and control service is in permanent error
B	Loop error
C	Count error
D	Initiate Error

Field	Definition
E	Error
F	Residual count - number of unprocessed words remaining in area referred to by terminated data control word
G	Word address of terminated data control word

After completion code 00X is recognized, the completion code should be monitored to provide error recovery if excessive time for readying tape has elapsed. A count of zero in field F and the address of the word following the data control word in field G indicates successful transmission of the service message.

4.1.4.5 Close Output Tape File

4.1.4.5.1 Calling Sequence

The following illustrates the calling sequence for the common function that closes an output tape file.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS.@F FT. CMD. PACKET
	BRLP	32
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.4.5.2 Input Parameters

The file transfer command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 0 of word 0 must be a 1. Bit 2 specifies the type of file, a 0 for a program file, or a 1 for a work file. If bit 3 is a 1, the connector cell structure on disc is released, and only a single-cell reels list is retained. If bit 5 is a 1, the file is undocumented. Bits 6 and 7 must be zeros. Bits 16 through 31 must contain the word address of the file linkage block describing the file.

The following is an example of coding for a file transfer command packet to close a documented program output file on magnetic tape. The connector cell structure on disc is to be released, and the file linkage block is FLBWT1. The name of the packet is TWPAC1.

NAME (1–8)	9	OPERATION AND CONDITION (10–14)	15	OPERAND (16–45)
TWPAC1		DF		8/B'10010000,8/0,16/FLBWT1.W
		DC		**,,3

4.1.4.5.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, the operation continues simultaneously with execution of the user program. The contents of the file transfer command packet reflect the status of the operation.

Word 0	1	SP 1	A 1	B 1	SP 1	C 1	D 2	SPARE 8	E 16

Word 1	SPARE 32

DSW	A 1	B 1	C 1	D 1	E 1	F 1	G 1	H 1	I 1	J 1	K 1	L 1	M 1	N 1	O 1	P 1	Q 1	R 1	S 1	T 2	U 1	V 1	W 1	X 1	Y 1	Z 4	AA 2

CSW	A 1	B 1	C 1	D 1	E 1	F 1	G 1	H 9	I 16

Word 0

Field	Definition
A	0 = Program file
	1 = Work file
B	0 = Retain disc connector cell structure
	1 = Release disc connector cell structure and write reels list on disc
C	0 = Documented file
	1 = Undocumented file

Field	Definition
D	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
E	Word address of file linkage block

All fields of word 0 contain user-supplied information.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew error
P	Tape unit in write
Q	Write enable
R	Tape movement

Field	Definition
S	Interrupt
T	Byte count
U	7-channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	11 = Indirect command error

Fields X-Y are zeros for 7-channel tape.

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - the number of words remaining unprocessed of the area referred to by the terminated data control word
I	Word address of terminated data control word

For successful completion, the count in field H is zero, and the address in field I is that of the word following the last data control word.

For details of error terminations, refer to paragraph 4.1.8.2.

4.1.5 Tape Control Command

The tape control command is a means of initiating one of fifteen tape unit functions. The most complex function, search, reads a cell of a tape file located by a search that compares the first word of a cell to a single word key. Other functions are rewind, rewind and make not ready, backspace a record, backspace a file, forward space a record, forward space a file, skip and blank, write tape mark, set mount input reel, set mount output reel, status request, and release working channel.

4.1.5.1 Calling Sequence

The following illustrates the calling sequence for the tape control command common function.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS. OF COMMAND PACKET
	BRLP	64
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.1.5.2 Input Parameters

The tape control packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 1 of word 0 specifies the device control message chain to be used in the operation. A 0 specifies chain 1, and a 1 specifies chain 2. Bits 2 through 5 are spare for all operations except search. For a search operation, on 7-channel tape, if bits 2 and 3 are both zeros, the tape is read in hexadecimal mode. If bit 2 is a 1, the tape is read in binary mode, and if bit 3 is a 1, the tape is read in binary-coded-decimal mode. Bits 2 and 3 must not both be ones. Bit 4 specifies the bit density for 7-channel tape, a 0 for 800 bits per inch, or a 1 for 566 bits per inch. Bit 5 specifies the mode of search. The first word of a cell is compared to a one-word search key. Only equality satisfies the search if bit 5 is a 0, and a greater than or equal condition satisfies the search if bit 5 is a 1. Bits 6 and 7 specify the type of tape for all operations. A 1 in bit 6 specifies 7-channel tape, and a 1 in bit 7 specifies 9-channel tape. One of these bits must be a 1, but not both. Bits 8 and 9 must be zeros. Bits 12 through 15 must contain a hexadecimal command code as defined in table 4-2. Bits 16 through 23 must contain the tape unit party line address, from the tape file identifier. Bits 24 through 31 must contain the tape unit loop 1 address, also from the tape file identifier. Word 1 is spare for operations other than search. For a search operation, bits 0 through 15 must contain the word address of the data control word describing the bin into which cells are read. Zeros in bits 0 through 15 inhibit reading the cell. Bits 16 through 31 of word 1 must contain the word address of a 1-word search key.

The following is an example of coding for a tape control command packet to search a 9-channel tape and read a cell, the first word of which is equal to a key word at location LLCC1. The device control messages are to be placed in chain 2. Other coding moves the tape unit addresses into word 0 prior to execution at run time. The cell is placed in a bin defined in data control word list DCW7. The packet name is SPKT.

NAME		OPERATION AND CONDITION		OPERAND
SPKT		DF		8/B'01000001,8/X'06,16/**
		DF		16/DCW7.W,16/LLCC1.W
		DC		**,,2

Table 4-2. Tape Control Command Codes.

COMMAND	CODE
Rewind	1
Rewind Not Ready	2
Backspace a Record	3
Skip and Blank	4
Write Tape Mark	5
Search	6
Release Working Channel	7
Forward Space a Record	8
Forward Space a File	9
Backspace a File	A
Set Mount Input Reel	C
Set Mount Output Reel	D
Status Request	E

Another example illustrates coding for a tape control command packet to rewind a 9-channel tape. Device control message chain 1 is to be used, and other coding moves the tape unit addresses into word 0 prior to execution. The packet name is WIND.

NAME (1–8)	OPERATION AND CONDITION (10–14)	OPERAND (16–45)
WIND	DF	8/B'00000001,8/X'01,16/**
	DC	**,,3

The data control word list describes an area of core into which data from a cell located by a search operation is placed. Bit 0 of a data control word is a 1 in the last word of a list, or in a single word list. Bit 1 is a 1 if the word contains a chain address. If bit 2 is a 1, data is to be skipped, and not placed in core. Bits 3 and 4 must be zeros for a search operation. Bits 7 through 15 must contain the count of the number of words to be read or skipped. Bits 16 through 31 must contain the word address of the core bin into which data is to be read, or of a data control word list to which to chain at the end of the current list.

4.1.5.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. In either case, the contents of the tape control packet reflect the status of the operation.

Word 0

SP 1	A 1	B 2	C 1	D 1	E 2	F 2	SP 2	G 4	H 8	I 8

Word 1

A 16	B 16

DSW

A 1	B 1	C 1	D 1	E 1	F 1	G 1	H 1	I 1	J 1	K 1	L 1	M 1	N 1	O 1	P 1	Q 1	R 1	S 1	T 2	U 1	V 1	W 1	X 1	Y 1	Z 4	AA 2

CSW

A 1	B 1	C 1	D 1	E 1	F 1	G 1	H 9	I 16

Word 0

Field	Definition
A	0 = Device command message chain 1
	1 = Device command message chain 2
B	00 = Hexadecimal mode
	01 = Binary-coded-decimal mode

Field	Definition
	10 = Binary mode
C	0 = 800 bits per inch
	1 = 556 bits per inch
D	0 = Search for equal
	1 = Search for greater than or equal
E	01 = 9-channel tape unit
	10 = 7-channel tape unit
F	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
G	Tape control command code (table 4-2)
H	Tape unit party line address
I	Tape unit loop 1 address

Fields B, C, and D are spare for tape control commands other than search.

Fields B and C are spare for 9-channel search.

Word 1

Field	Definition
A	Word address of data control word list for read with search
B	Word address of one-word search key

All fields of words 0 and 1 contain user-supplied information. Word 1 is spare for tape control commands other than search.

Device Status Word

Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2

Field	Definition
F	Received data control bit S3
G	Invalid command
H	Tape unit malfunction
I	Control unit busy
J	Line overrun
K	End of file
L	Data format error
M	Character parity error
N	Record parity error
O	Read-after-write skew check
P	Tape unit in write
Q	Write enable
R	Tape movement
S	Interrupt
T	Byte count
U	7-channel tape unit
V	Non-return-to-zero, change-on-1 mode
W	Load point
X	Cyclic redundancy check error
Y	Correctable error
Z	Channel in error
AA	Command status
	00 = Successful completion
	01 = Direct command error in device status word
	10 = Direct command error in channel status word

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words remaining unprocessed of area referred to by terminated data control word
I	Word address of terminated data control word

For unsuccessful termination, field H contains a count of zero and field I contains the address of the word following the last data control word.

For details of error terminations, refer to paragraph 4.1.8.3.

4.1.6 Device Control Command

The device control command is a means of directly initiating operations of devices on the time division exchange. The command and packet format is applicable to the line printer, CRT display and input station, and the card reader, initially. This section describes the format of the command, command packet, device command words, and device status words. For more detailed hardware information, if required, the application programmer must consult the instruction manual for the specific unit.

The devices to which the device control commands refer must have been initialized by device acquisition and control service as a result of a previous call by control program service. The output from device acquisition and control service is a file consisting of a packet for each requested tape or device. The device packet includes party line and time division addresses of the working channel to the device, and identification of the forms, card deck, or entry format. The application program must move information from this file to the device command packet and the device command area.

4.1.6.1 Calling Sequence

The following illustrates the calling sequence for a device control command.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LDX                   2,ADDRS. OF DEVICE CMND PACKET
                    BRLP                  68
                    B                     EXCEPTION RETURN
                    ...                   NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

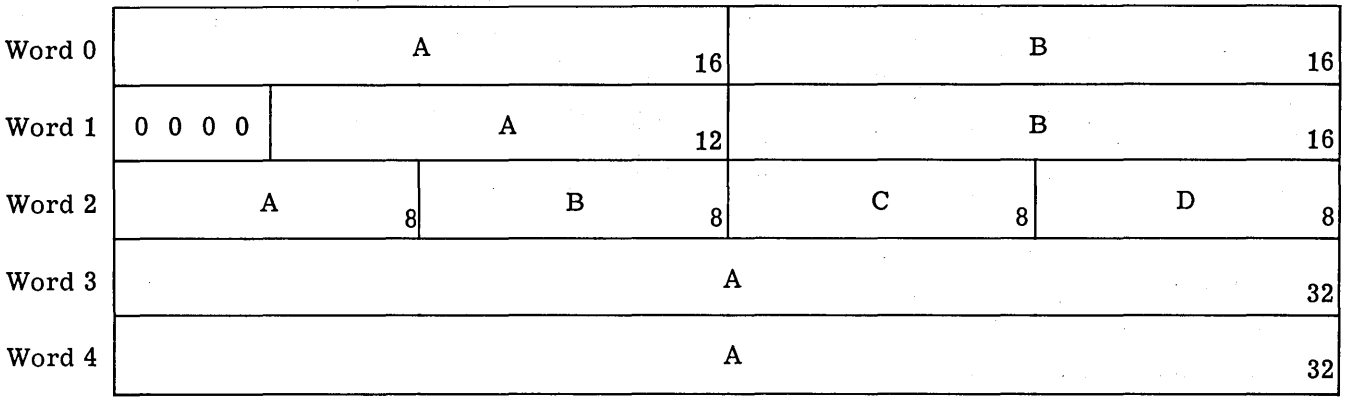
4.1.6.2 Input Parameters

The device control command packet consists of four words. In the first two words, the user specifies options and addresses for the operation. Bit 1 of word 0 specifies the device control message chain to be used for the operation. A 0 specifies chain 1, and a 1 specifies chain 2. Bit 2 specifies a maximum length of time for the data transfers associated with an operation. If this period is exceeded, a timeout error occurs. A 0 specifies a 300-ms period and a 1 specifies an 8-second period. The 300-ms period is appropriate for most user operations. Bits 8 and 9 must be zeros. Bits 12 through 15 must contain the number of words, minus 1, in the device command area. Bits 16 through 23 must contain the loop 1 address, and bits 24 through 31 must contain the loop 2 address of the device, obtained from the device acquisition and control service output file packet. Bits 0 through 15 of word 1 must contain the word address of a data control word list referring to the area for transfer of data, if required. If no data transfer is involved, place zeros in bits 0 through 15. Bits 16 through 31 must contain the word address of the device command area.

The following is an example of coding of a device control command packet. The device control message is to be placed in chain 2, and the timeout period is to be 300 ms. Other coding will move the loop addresses of the working channel into word 0 prior to execution. A data control word list, DCWCR, describes the core area for the data transfer. The device command area, a single word, is DEVCOM. The packet name is DEVPAC.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
DEVPAC              DF                    8/B'01000000,8/X'00,16/**
                    DF                    16/DCWCR.W,16/DEVCOM.W
                    DC                    **,,2
```

The following illustrates the device packet from a device acquisition and control service output file.



Word 0

Field	Definition
A	Users protection key, non-zero
B	Users protection key, non-zero

Word 1

Field	Definition
A	Packet length in bytes
B	Entry code X'10 For card reader X'11 For CRT display and entry station X'12 For line printer

Word 2

Field	Definition
A	Party line address of device
B	Device type X'10 = Card reader X'40 = CRT display and entry station X'30 = Line printer
C	Working channel loop 1 address
D	Working channel loop 2 address

Word 3 contains the device status word from the device at initiation. The formats of device status words for current devices are shown in paragraph 4.1.6.3.

Word 4 contains the control data word identifying the device setup. Its contents are specified in the call to device acquisition and control service, as a means of verifying the setup.

Table 4-3 lists the device operations which require data transfers, and the number of words they required.

Table 4-3. Device Command Data Transfer Requirements.

DEVICE	OPERATION	CODE	NUMBER OF WORDS
Card Reader	Feed, Read ASCII	X'4	13 or 20
	Feed, Read Binary	X'5	26 or 40
	Read ASCII	X'6	13 or 20
	Read Binary	X'7	26 or 40
	Re-Read ASCII	X'2	13 or 20
	Re-Read Binary	X'3	26 or 40
	Load Memory*	X'A	256
	Read Memory*	X'1	256
CRT Display and Entry Station	Read	X'4	1 - 504
	Read at Address	X'6	1 - 504
	Write	X'8	1 - 504
	Clear and Write	X'9	1 - 504
	Clear and Write Format	X'3	504
	Alert and Write	X'A	1 - 504
	Alert, Clear, and Write	X'B	1 - 504
	Read Card Reader	X'5	5
	Turn Around*	X'D	No limit
Line Printer	Write	X'8	1 - 33
	Read Memory*	X'1	128
	Load Memory*	X'9	1 - 128

*Diagnostic commands - not normally issued by user programs.

The data control word list describes an area of memory for transfer of data to or from the device. Bit 0 of a data control word is a 1 if the word is the last word of a list, or a single-word list. Bit 1 is a 1 if the word contains a chain address. If bit 2 is a 1, the data channel sends zeros to the device, or discards data from the device. Bit 3 is a 1 if data is to be transferred to the device, or a 0 if data is to be transferred to core. If bit 4 is a 1, data is transferred to or from words in descending sequence. Bits 7 through 15 must contain a count of the number of words to be transferred or skipped, or the number of words of words of zeros to be sent. Bits 16 through 31 must contain the word address of the data area, or of a data control word list to which to chain at the end of the current list.

The following is an example of coding for a data control word list describing three areas into which data from three fields of a punched card is to be placed. The fields consist of columns 1-8, columns 13-16, and columns 21-32, respectively. Data is placed in an area of core named CDREC and the list name is DCWCR.

NAME	OPERATION AND CONDITION	OPERAND
DCWCR	DCW	0,0,0,0,0,2,CDREC.W
	DCW	0,0,1,0,0,1,0
	DCW	0,0,0,0,0,1,CDREC.W+2
	DCW	0,0,1,0,0,1,0
	DCW	0,0,0,0,0,3,CDREC.W+3
	DCW	1,0,1,0,0,12,0

The device command area must contain the device command. The length of this area is specified in bits 12 through 15 of word 1 of the device control packet. Currently available devices require a single command word. The left-hand byte of the device command word must contain the device party line address, from the device packet supplied by device acquisition and control service. Contents of the remaining bytes of the word vary for each device and command as defined in tables 4-4, 4-5, and 4-6, for the card reader, CRT display and entry station, and line printer, respectively.

The following is an example of coding a device command to read a card, ASCII mode. The command name is DEVCOM.

NAME	OPERATION AND CONDITION	OPERAND
DEVCOM	DF	8/**,4/X'6,2010

Table 4-4. Card Reader Commands.

OPERATION	CODE BITS 8-11	BIT 15	BITS 16-23	BITS 24-31
Feed	X'8	0	0	0
Feed, Read ASCII	X'4	0	0	0
Feed, Read Binary	X'5	0	0	0
Read ASCII	X'6	0	0	0
Read Binary	X'7	0	0	0
Re-Read ASCII	X'2	0	0	0
Re-Read Binary	X'3	0	0	0
Skip Feed	X'9	0	0	0
Release Channel	X'F	0	0	0
Make Not Ready	X'E	0	0	0
Clear	X'D	0	0	0
Assign Channel*	X'0	Initiate Bit	Loop 1 Address	Loop 2 Address
Status Request*	X'C	0	0	0
Read Memory**	X'1	0	0	0
Load Memory**	X'A	0	0	0
Diagnostic Status**	X'B	0	0	0

Note: Bits 12 through 14 are spare for all commands.

*Operations performed by device acquisition and control service.

**Diagnostic operations - not normally issued by user programs.

Table 4-5. CRT Display and Entry Station Commands.

OPERATION	CODE BITS 8-11	BIT 15	BITS 16-23	BITS 24-31
Read	X'4	0	0	0
Read at Address	X'6	0	Char. Address	Line Address
Write	X'8	0	Char. Address	Line Address
Clear and Write	X'9	0	Char. Address	Line Address
Clear and Write Format	X'3	0	0	0
Alert and Write	X'A	0	Char. Address	Line Address
Alert, Clear and Write	X'B	0	Char. Address	Line Address
Alert	X'1	0	0	0
Print	X'2	0	0	0
Read Card Reader	X'5	0	0	0
Release Channel	X'F	0	0	0
Assign Channel*	X'0	Initiate Bit	Loop 1 Address	Loop 2 Address
Status Request*	X'C	0	0	0
Diagnostic Status**	X'E	0	0	0
Turnaround**	X'D	0	0	0

Note: Bits 12 through 14 are spare for all commands.

*Operations performed by device acquisition and control service.

**Diagnostic operations. Not normally issued by user programs.

Table 4-6. Line Printer Commands.

OPERATION	CODE BITS 8-11	BIT 15	BITS 16-23	BITS 24-31
Line Count	X'A	0	Number of lines per form	0
Write	X'8	0	Line number	0
Override	X'D	0	0	0
Make Not Ready	X'E	0	0	0
Release Channel	X'F	0	0	0
Assign Channel *	X'0	Initiate Bit	Loop 1 Address	Loop 2 Address
Status Request*	X'C	0	0	0
Read Memory**	X'1	0	0	0
Load Memory**	X'9	0	0	0
Diagnostic Status**	X'B	0	0	0

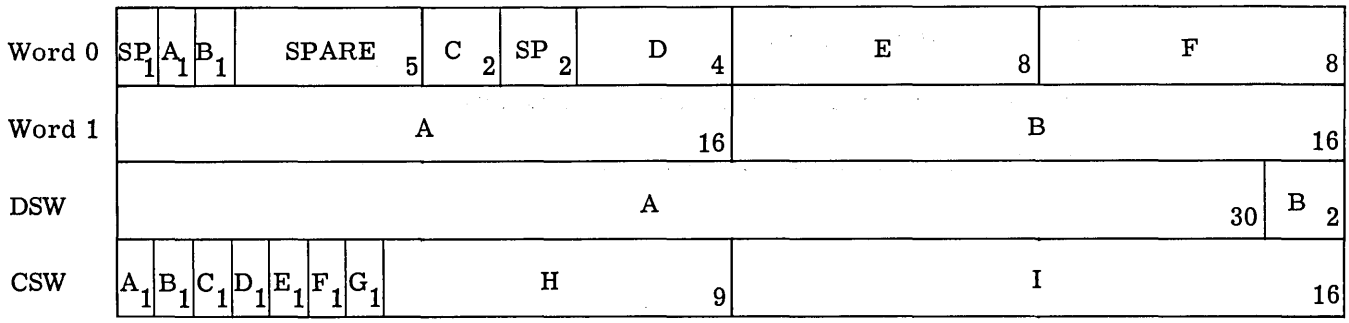
Note: Bits 12 through 14 are spare for all commands.

*Operations performed by device acquisition and control service.

**Diagnostic operations - not normally issued by user programs.

4.1.6.3 Operation Status

The common function attempts to initiate the operation, and, if unsuccessful, returns control to the user program at the exception return. Refer to paragraph 4.1.8.1 for details of exception returns. If the common function successfully initiates the operation, control is returned at the normal return. The operation continues simultaneously with execution of the user program. The contents of the device control command packet reflect the status of the operation.



Word 0

Field	Definition
A	0 = Device control message chain 1
	1 = Device control message chain 2
B	0 = 300-ms timeout
	1 = 8-sec timeout
C	Channel device control message chain specification
	00 = Current channel
	01 = S channel
	10 = A channel
	11 = B channel
D	Number of words in device command area
E	Device loop 1 address
F	Device loop 2 address

Word 1

Field	Definition
A	Word address of data control word list
B	Word address of device command area

All fields of words 0 and 1 contain user-supplied information.

Device Status Word

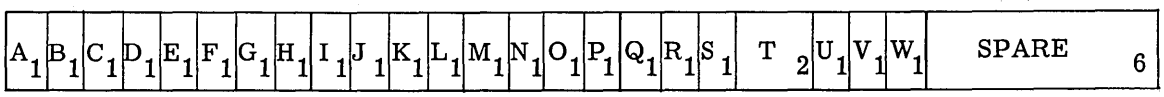
Field	Definition
A	Separately defined for each device
B	Command status
	00 = Successful completion
	01 = Direct command error in device status word
	10 = Direct command error in channel status word

Channel Status Word

Field	Definition
A	Command completed
B	0 = Channel status stored
	1 = Channel status not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words remaining unprocessed of area referred to by terminated data control word
I	Word address of terminated data control word

At successful completion, the count in field H is zero, and the address in field I is that of the word following the last data control word.

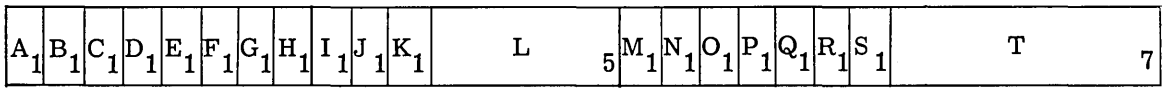
The left-hand 30 bits of the device status word sent by the card reader are defined as follows:



Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	False feed
I	Feed command initiated

Field	Definition
J	Manual mode
K	End of file
L	Hopper empty
M	Compare error
N	Check sum error
O	Pre-read error
P	Validity check
Q	Fail to feed
R	Card jam
S	Error indicator
T	Buffer status
U	51-column mode
V	Stacker full
W	Feed in progress

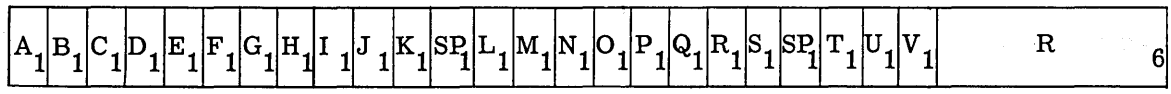
The left-hand 30 bits of the device status word sent by the CRT display and entry station are defined as follows:



Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Invalid address

Field	Definition
I	Hold
J	Send
K	Parity error
L	Line address
M	Alert
N	Overflow
O	Error indicator
P	Command not performed
Q	Acknowledge/initiate
R	Print
S	Card reader
T	Character address

The left-hand 30 bits of the device status word sent by the line printer are defined as follows:



Field	Definition
A	Program retry
B	Not ready
C	Loop sync error
D	Word sequence error
E	Received data control bit S2
F	Received data control bit S3
G	Invalid command
H	Data format error
I	Buffer active
J	Buffer full

Field	Definition
K	Top
L	Parity error
M	Hammer fire error
N	Sync error
O	Undefined character
P	Stop
Q	Forms check
R	Error indicator
S	Gate interlock
T	Load memory
U	End of forms
V	Excess forms error

For details of error terminations, refer to paragraph 4.1.8.3.

4.1.7 Direct Error Correction

4.1.7.1 Calling Sequence

The following illustrates the calling sequence for the common function which causes a device control message in error to be skipped, allowing execution of other messages in the chain.

NAME	OPERATION AND CONDITION	OPERAND
	LD	A,PARAMETERS
	BRLP	72
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Register 1 is saved; other registers are not saved.

4.1.7.2 Input Parameters

The input parameters consist of the A register contents. The left hand halfword must contain zeros. Device control message chain 1 is specified by zeros in byte 2, and device control message chain 2 is specified by a non-zero value in byte 2. To skip only the device control message in error, place zeros in byte 3. To skip all direct command device control messages in the chain, place a non-zero value in byte 3. A parameter word may be placed in the A register as in the following example. An operation using this word, PW1, would clear all direct device control messages in chain 2.

NAME (1–8)	OPERATION AND CONDITION (10–14)	OPERAND (16–45)
PW1	DC	X'00000101

4.1.7.3 Terminations

After clearing the specified device command message chain in the specified manner, the common function returns control to the normal return point.

The function transfers control to the exception return if the specified chain is not blocked by an error. The device control messages are not altered in this case.

4.1.8 Abnormal Terminations

The file transfer common functions all transfer control to the user program at the exception return when they are unable to initiate the transfer operation. Otherwise, at some later time, the operation completes, and the routines indicate completion by setting the command completion bit in the channel status word of the file transfer command packet. The interpretation of bits in the file transfer command packet differs for direct and indirect commands.

4.1.8.1 Exception Returns

When a file transfer command results in an exception return, the A register contents indicate the reason for the rejection.

A Register Contents	Description of Status
0	Busy - resubmit after checkpoint
4	Device control message chain blocked by error - resubmit after error is corrected
8	Command or packet error
12	Disc space not available
16	Open command for second output file
20	Output file closed

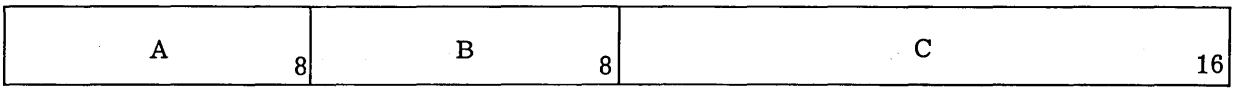
A Register Contents	Description of Status
24	Indirect file aborted by previous operation, after current operation was successfully initiated - see status of previous operation
28	Indirect file aborted while attempting to initiate this command - see status of current operation

The first three conditions are detected by all commands, and the last is detected by all indirect commands. The write commands, direct and indirect, and the close indirect commands, detect lack of disc space. All indirect commands other than open detect a file aborted by a previous command while the current command awaits execution. Both the write and close indirect commands detect a closed output file.

4.1.8.2 Error Terminations - Indirect Commands

When a user program detects that the command completion bit is set, or when execution resumes following a busy checkpoint exit, the user program should check the command status code in the right-hand two bits of the device status word. Even if this code is 00, indicating successful completion, a count disparity can exist.

A command status code of 11 indicates an error in the execution of an indirect command. The channel status word is in the following format.



Field	Definition
A	Error type
	X'80 - End of file
	X'81 - Invalid connector cell identifier
	X'82 - Cell retrieval error
	X'83 - Cell write error
	X'84 - Lack of file linkage block space
	X'85 - Close command references an output file in error
	X'86 - Disc space not available
	X'87 - System error
	X'88 - Invalid work input file identifier
	X'89 - Close command has written a reels list at the end of a tape file because the requested connector cell structure could not be written
	X'8A - Replace input tape or replace output tape error

Field	Definition
B	X'00 = File aborted X'01 = Unretrievable data cell X'02 = Unretrievable low-level connector cell Any other non-zero value indicates an unretrievable connector cell at a higher level. The difference between the value and X'02 is the number of intermediate levels affected.
C	Cell address of unretrievable cell

For error types X'82, X'83, and X'85, the device status word is that of the operation in error, unless the channel status word indicates the error. In that case, the channel status word is shifted left two positions and placed in the device status word.

4.1.8.3 Error Terminations - Direct Commands

When a user program detects that the command completion bit is set, or when execution resumes following a busy checkpoint exit, the user program should check the command status code in the right-hand two bits of the device status word. A code of 00 indicates successful completion, but a count disparity may exist. When a read operation calls for more data than exists, the amount of data obtained can be determined by identifying the terminating data control word and noting the count field contents. A command status code of 01 or 10 indicates that an error occurred in executing a direct command. The user program should call direct error correction service for the device control message chain involved, so that other operations can proceed in that chain. A command status code of 01 indicates that the device status word indicates the error, and a code of 10 indicates that the channel status word indicates the error. In either case, the address and count in the channel status word indicate how much data, if any, was transferred correctly. The formats of the device status word and the channel status word vary, and are shown with the command operation status.

4.2 DISC SPACE MANAGEMENT FUNCTIONS

4.2.1 Zone Allocation

4.2.1.1 Calling Sequence

The following illustrates the calling sequence for the common function that supplies a zone and loop 1 address for a user disc file.

NAME	OPERATION AND CONDITION	OPERAND
	LD	A,PARAMETERS
	BRLP	76
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Register 1 is saved; other registers are not saved.

4.2.1.2 Input Parameters

The A register contents are the input parameters for the common function. The left-hand byte specifies the cell size for the file. X'00 specifies a 128-byte cell, X'10 specifies a 256-byte cell, X'20 specifies a 512-byte cell, and X'30 specifies a 2048-byte cell. The right-hand halfword must contain the approximate number of cells required for the file.

The following is an example of coding a parameter word requesting a zone for 2048 byte cells for a file expected to consist of approximately 2000 cells. The word is named PW2.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
PW2		DF		8/X'30,8/0,16/+2000

4.2.1.3 Terminations

The common function selects the zone with the most available cells from those for the requested cell size, places the zone parameter in byte 0 of the A register and the loop 1 address in byte 1 of the A register, and transfers control back to the user program at the normal return point.

If a zone for the requested cell size is not available, or does not have sufficient available cells, the common function transfers control to the exception return.

4.2.2 Single Cell Release

4.2.2.1 Calling Sequence

The following illustrates the calling sequence for the common function that releases a single cell of disc storage.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
		LD		A,PARAMETERS
		BRLP		16
		B		EXCEPTION RETURN
		...		NORMAL RETURN

Register 1 is saved; other registers are not saved.

4.2.2.2 Input Parameters

The A register contents are the input parameters for the operation. Byte 0 specifies the zone parameter, and byte 1 specifies the loop 1 address of the zone containing the cell to be released. The cell address is placed in the right-hand halfword.

The following is an example of coding to load the parameters from the file transfer command packet used in reading or writing the cells of the file directly. The packet name is DWPKT.

```
NAME     OPERATION AND CONDITION     OPERAND
         LD                          A(0,1),DWPKT+2
         LD                          A(2,3),DWPKT+6
```

4.2.2.3 Terminations

The common function releases the specified cell and returns control to the user program at the normal return, without altering the A register contents.

If the zone parameter or loop 1 address is not valid, or the cell address is zero, the routine returns control to the exception return. The A register is not altered and no cell is released.

4.2.3 Document File

4.2.3.1 Calling Sequence

The following illustrates the calling sequence for the common function that documents a file.

```
NAME     OPERATION AND CONDITION     OPERAND
         LDX                         2,ADDR.INPUT PARAMETER PACKET
         LD                          A,DOCUMENTATION VECTOR
         BRLP                        36
         B                           EXCEPTION RETURN
         ...                         NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.2.3.2 Input Parameters

The input parameters required are an input parameter packet and a documentation vector. The packet consists of two words. Bits 0 through 15 of the first word must contain the time halfword of the file identifier. Bits 16 through 31 must contain the cell allocation count halfword of the file identifier. Byte 0 of the second word must contain the zone parameter, and byte 1 must contain the loop 1 address. The right-hand halfword must contain the cell address of the high-level connector cell for the file. The format of the packet is identical to that of the first two words of the output file identifier maintained by the indirect commands, which can be used as the packet. Similar information should be maintained in the same format for a file written directly.

The documentation vector is a single word to be loaded into the A register. One, but only one, of the first two bits must be a 1. Bit 0 is a 1 for an inactive file. Bit 1 is a 1 for an active file. The right-hand halfword of the vector must contain the cell count of the file. Indirect commands maintain this count in the third word of the output file identifier.

The following is an example of coding to place a documentation vector in the A register. The file is to be documented active, and the output file identifier is named OFID.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9 10 11 12 13 14 15			16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
		LD		A(0),B'01000000
		LD		A(2,3),OFID+10

4.2.3.3 Terminations

The common function documents the file and transfers control to the user at the normal return.

If the input parameter packet or documentation vector contains invalid data, the file cannot be documented and the routine returns control to the exception return. The A register contents indicate the reason for failure.

Contents	Description of Error
0	Invalid zone parameter or loop 1 address
4	Invalid contents of documentation vector high-order two bits
8	Zero cell address

4.2.4 Release File

4.2.4.1 Calling Sequence

The following illustrates the calling sequence for the common function that releases a file.

```
NAME                OPERATION AND CONDITION     OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LDX                 2,ADDR. INPUT PARAMETER PACKET
                    BRLP                40
                    B                   EXCEPTION RETURN
                    ...                 NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.2.4.2 Input Parameters

The input parameter packet consists of two words. The first word must contain the file identifier, with the time halfword in bits 0 through 15 and the cell allocation count halfword in bits 16 through 31. The second word must contain the zone parameter in the left-hand byte, and the loop 1 address in byte 1. The right-hand halfword must contain the cell address of the high-level connector cell. The format of the packet is identical to that of the first two words of the output file identifier maintained by the indirect commands, which can be used as the packet. Similar information should be maintained in the same format for a file written directly.

4.2.4.3 Terminations

The common function places the file in the released file list and returns control to the user's program at the normal return.

If the input parameter packet contains an invalid zone parameter or loop 1 address, the routine transfers control to the user's program at the exception return.

4.3 SERVICE MESSAGE FUNCTIONS

4.3.1 Service Message Transfer

4.3.1.1 Calling Sequence

The following illustrates the calling sequence for the common function that issues a service message.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LDX               2,ADDR. INPUT PARAMETER PACKET
                    BRLP              52
                    B                 EXCEPTION RETURN
                    ...               NORMAL RETURN
```

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.3.1.2 Input Parameters

The input parameter packet consists of four words. In the first two words, the user specifies options and addresses. Bit 0 of word 0 must be 0. Bit 1 specifies the device control message chain in which the message for transmitting the service message is to be placed. A 0 specifies chain 1 and a 1 specifies chain 2. Bits 6 through 7, and bits 24 through 31 must contain zeros. Bits 0 through 15 of word 1 must contain the word address of a data control word list describing a six-word service message area in which the service message has been built. Bits 24 through 31 must contain the orderwire party line address of the destination processor, or 0 for an orderwire 2 destination.

The following is an example of coding for an input parameter packet. The device control message to transmit the service message is to be placed in chain 1. A single data control word, DCWSM, describes the service message bin, SWO. The party line address of the processor is X'01. The packet name is SMTPKT.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
SMTPKT              DF                8/B'00000000,8/0,16/0
                    DF                16/DCWSM.W,8/0,8/X'01
                    DC                **,,2
DCWSM               DCW               1,0,0,1,0,6,SMTPKT.W
```

should not be the same.

4.3.1.3 Operation Status

The common function attempts to initiate the transmission of the service message, and, if unsuccessful, transfers control to the user program at the exception return. The contents of the A register indicate the reason for rejection.

Contents	Description of Status
0	Busy - resubmit after checkpoint
4	Device control message chain blocked by error - resubmit after clearing error
8	Command or packet error

If the common function successfully initiates transmission of the message, control transfers to the user program at the normal return. Transmission of the message continues simultaneously with execution of the user program. The contents of the input parameter packet reflect the status of the operation.

Word 0	0	A_1	SPARE 4				B 2	SPARE 16									0 0 0 0 0 0 0 0		
Word 1	A 16															SPARE 8		B 8	
CSW 0	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9								I 16			
CSW 1	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H 9								I 16			

Word 0

Field	Definition
A	0 = Device control message chain 1 1 = Device control message chain 2
B	Channel device control message chain specification 00 = Current channel 01 = S channel 10 = A channel 11 = B channel

Word 1

Field	Definition
A	Word address of data control word list describing the service message bin
B	Destination processor party line address

All fields of words 0 and 1 contain user-supplied information.

Channel Status Word

Channel status words 0 and 1 contain the status of the data channel of the destination and originating processors, respectively.

Field	Definition
A	Command completed
B	0 = Channel status word stored
	1 = Channel status word not stored
C	Timeout error
D	Loop error
E	Count error
F	Initiate error
G	Error
H	Residual count - number of words remaining unprocessed of area referred to by terminated data control word
I	Word address of terminated data control word

A count of zero in field H and the address, in field I of the word following the last data control word indicate successful completion of the transfer of the message.

4.3.2 Routing Service

4.3.2.1 Calling Sequence

The following illustrates the calling sequence for the common function that converts a C-number in binary form to routing parameters.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8   9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                     L  D  X                    2  ,  A  D  D  R  S  .     R  T  S     P  A  R  A  M  E  T  E  R     P  A  C  K  E  T
                     B  R  L  P                 4  4
                     B                          E  X  C  E  P  T  I  O  N     R  E  T  U  R  N
                     .  .  .                    N  O  R  M  A  L     R  E  T  U  R  N
```

Registers 1 and 2 are unchanged; registers 3, A, and B are not saved.

4.3.2.2 Input Parameter

The routing service parameter packet consists of four words. In the first two words, the user specifies the C-number. Bit 0 of word 0 is a 1 if the user does not require the parameters for routing purposes. Bits 2 through 11 must contain the area code of the C-number, in binary, or all ones. Bits 12 through 21 must contain the exchange code, in binary, or all ones. Bits 22 through 31 must contain the subscriber code, in binary. If the exchange code represents a group exchange, this field may contain ones. The party line code, where applicable, must be placed in bits 0 through 7 of word 1, in binary. Otherwise the field is filled with ones. The ASCII to binary conversion function provides the binary numbers in this format.

The following is an example of coding for a routing service parameter packet. The C-number in decimal digits, is 001001010. No party line code is used. The request is for routing purposes. The packet name is RTSPK.

NAME (1–8)	OPERATION AND CONDITION (10–14)	OPERAND (16–45)
RTSPK	DF	1/0,1/0,10/001,10/001,10/010
	DF	8/X'FF,8/0,16/**
	DC	**,,2

4.3.2.3 Terminations

If routing service is unable to service a parameter packet, control is returned to the user program at the exception return. The A register contents indicates the reason for rejection.

Contents	Description of Status
0	Busy - resubmit after checkpoint
4	Parameter packet outside channel core limits

The common function returns control at the normal return in all other cases. The packet contents indicate the type of routing information returned. The A register also contains word 3 of the packet, the left-hand bit of which is the completion bit. This bit is zeroed at initiation and changed to one when the operation is completed. At completion bits 3 through 7 contain a code identifying the information in the packet, as defined in the following charts.

Unresolvable C-number return:

Word	Fields
Word 0	0 | SP_1 | A (10) | B (10) | C (10)
Word 1	A (8) | SPARE (24)
Word 2	SPARE (32)
Word 3	1 0 0 0 0 0 0 0 | A (8) | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Word 0

Field	Definition
A	C-number area code in binary
B	C-number exchange code in binary
C	C-number subscriber code in binary

Word 1

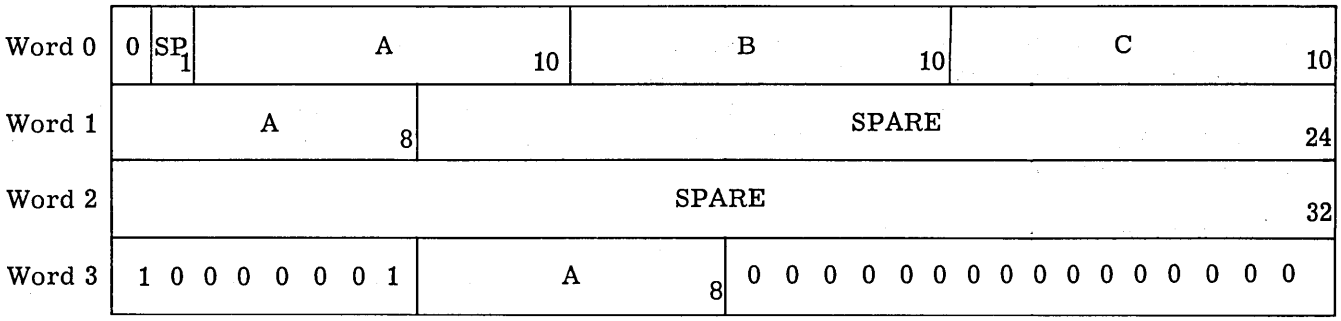
Field	Definition
A	C-number party line code in binary

All fields of words 0 and 1 contain user-supplied information. Unused optional fields are filled with ones.

Word 3

Field	Definition
A	Value indicating first unresolvable C-number component
	0 = Area code
	4 = Exchange code
	8 = Subscriber code
	C = Party line code

Return consisting of an exchange code of another processor in the center:



Word 0

Field	Definition
A	C-number area code in binary
B	C-number exchange code in binary
C	C-number subscriber code in binary

Word 1

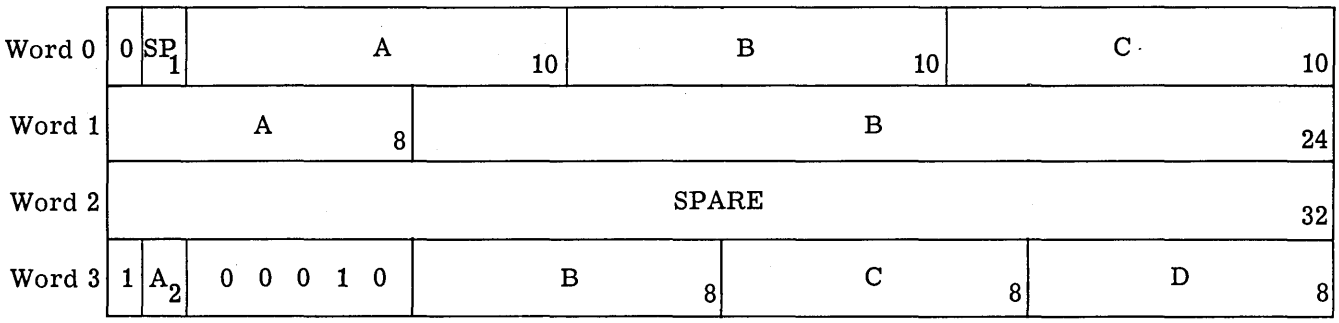
Field	Definition
A	C-number party line code

All fields of words 0 and 1 contain user-supplied information. Unused optional fields are filled with ones.

Word 3

Field	Definition
A	Orderwire 1 address of processor in which the C-number may be resolved

Return consisting of a device address of a multiplex device available on the time division multiplex loop of this processor:



Word 0

Field	Definition
A	C-number area code in binary
B	C-number exchange code in binary
C	C-number subscriber code in binary

Word 1

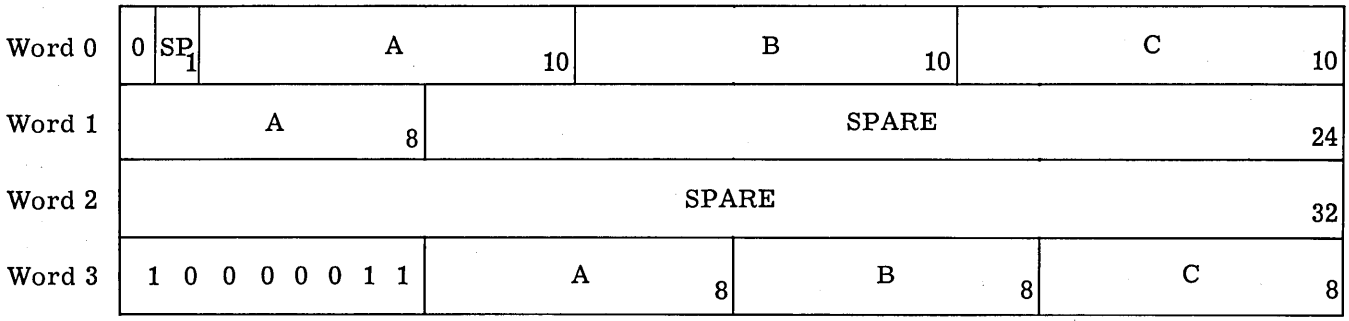
Field	Definition
A	C-number party line code in binary
B	Prefix character for message header (8 or 9) or zeros

All fields of word 0 and field A of word 1 contain user-supplied information. Unused optional fields are filled with ones.

Word 3

Field	Definition
A	Range of multiplex status record address
	00 = first range, 0-255
	11 = second range, 256-511
B	Orderwire 1 address of processor
C	Multiplex status record address
D	Party line address or zero

Return consisting of parameters for a device acquisition and control service routing request:



Word 0

Field	Definition
A	C-number area code, in binary
B	C-number exchange code, in binary
C	C-number subscriber code, in binary

Word 1

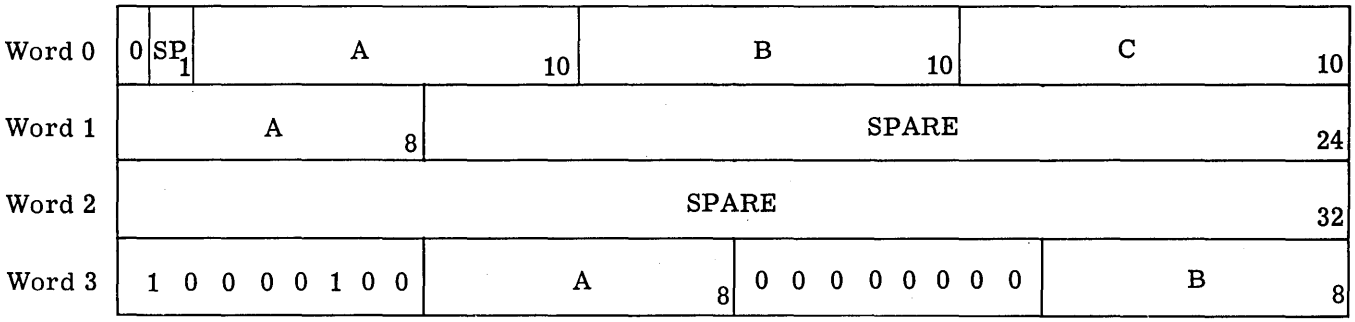
Field	Definition
A	C-number party line code, in binary

All fields of words 0 and 1 contain user-supplied information. Unused optional fields are filled with ones.

Word 3

Field	Definition
A	Orderwire 1 address of processor which runs device acquisition and control service
B	Party line address of device, or 0
C	Device type, as defined for device acquisition and control service

Return consisting of parameters for a resident service function:



Word 0

Field	Definition
A	C-number area code, in binary
B	C-number exchange code, in binary
C	C-number subscriber code, in binary

Word 1

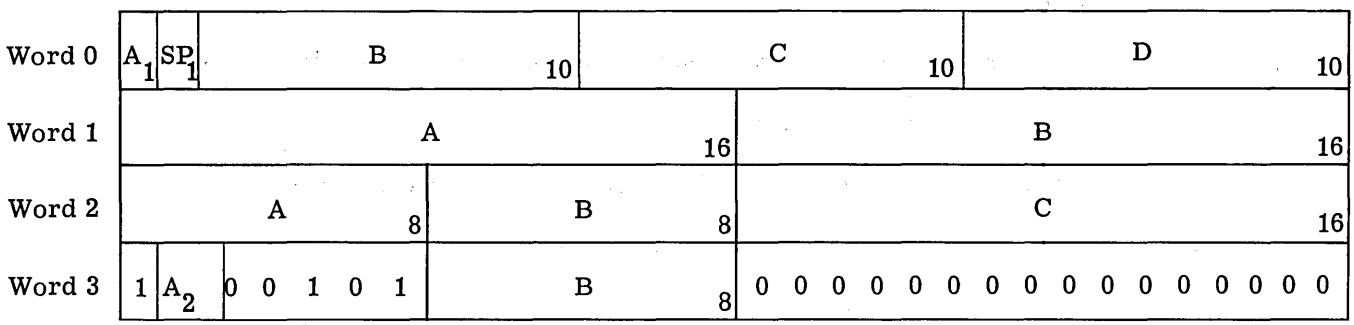
Field	Definition
A	C-number party line code, in binary

All fields of words 0 and 1 contain user-supplied information. Unused optional fields are filled with ones.

Word 3

Field	Definition
A	Orderwire 1 address of processor which runs specific resident service function
B	Op code of service message for this function

Return consisting of parameters for a program call service message to call a nonresident service function:



Word 0

Field	Definition
A	Rotary allocation indicator: 0, for rotary allocation 1, for information only
B	C-number area code, in binary
C	C-number exchange code, in binary
D	C-number subscriber code, in binary

All fields in word 0 contain user-supplied information. The user also supplies a C-number party line code, in binary, in bits 0 through 7 of word 1, which is overlaid. Unused optional fields are filled with ones.

Word 1

Field	Definition
A	Time half word in file identifier of non-resident service function
B	Zone allocation count in file inditifier of non-resident service function

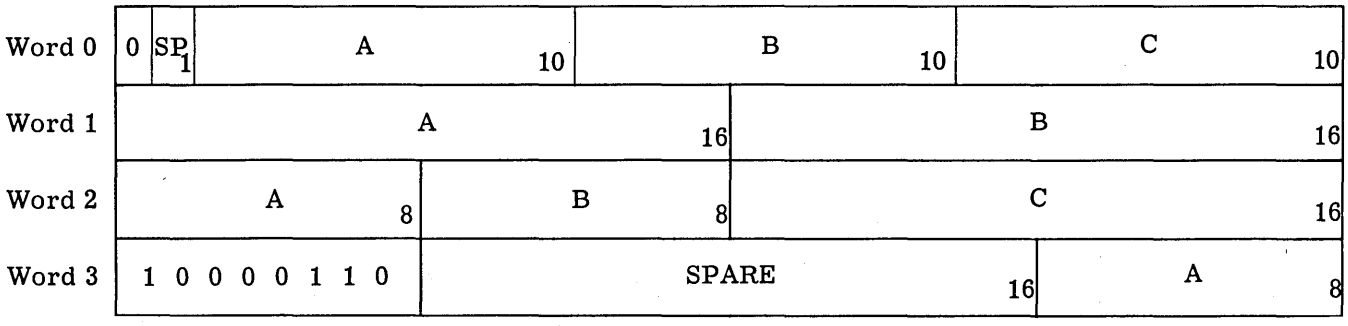
Word 2

Field	Definition
A	Zone parameter in file identifier of non-resident service function
B	Loop 1 address in file identifier of non-resident service function
C	Cell address in file identifier of non-resident service function

Word 3

Field	Definition
A	Channel queue specification 00 = B channel on load 01 = B channel off load 10 = A channel on load 11 = A channel off load
B	Orderwire 1 address of allocated processor

Return consisting of an address of a group address auxiliary table:



Word 0

Field	Definition
A	C-number area code, in binary
B	C-number exchange code, in binary
C	C-number subscriber code, in binary

All fields of word 0 and byte 0 of word 1 contain user-supplied information. Unused optional fields are filled with ones. Word 1 is overlaidby the result after byte 0 has been moved to word 3.

Word 1

Field	Definition
A	Time halfword of file identifier of group address auxiliary table, or zeros if table is resident
B	Zone allocation count of file identifier of group address auxiliary table, or zeros if table is resident

Word 2

Field	Definition
A	Zone parameter of file identifier of group address auxiliary table, or zeros if table is resident
B	Loop 1 address of file identifier of group address auxiliary table, or zeros if table is resident
C	Cell address of file identifier of group address auxiliary table, or core address of table, if resident

4.3.3 Orderwire Translation Service

4.3.3.1 Calling Sequence

The following illustrates the calling sequence for the common function that supplies the orderwire 1 address of the processor responsible for space allocation of a disc zone.

```
NAME                OPERATION AND CONDITION     OPERAND
1 2 3 4 5 6 7 8   9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LDX                 2,ADDRS. OF OTS PACKET
                    BRLP                84
                    B                   EXCEPTION RETURN
                    ...                 NORMAL RETURN
```

Registers 1 and 2 are unchanged; registers 3, A, and B are not saved.

4.3.3.2 Input Parameters

The orderwire translation service parameter packet consists of four words. The disc zone parameter and loop 1 address must be placed in the left-hand halfword of word 2. This information may be moved into the packet from the second word of the file identifier.

4.3.3.3 Terminations

If the common function is unable to process the packet, control is returned to the user program at the exception return. The A register contents indicate the reason for rejection.

Contents	Description of Status
0	Busy-resubmit after checkpoint
4	Parameter packet is outside channel limits

The common function returns control at the normal return after locating the processor orderwire 1 address. The following shows the contents of the packet at this point. The A register contains the fourth word of the packet.

Word 0	SPARE 32		
Word 1	SPARE 32		
Word 2	A 8	B 8	SPARE 16
Word 3	1 0 0 0 0 0 0 0	A 8	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Word 2

Field	Definition
A	Zone parameter of disc
B	Loop 1 address of disc

Word 3

Field	Definition
A	Orderwire 1 address of processor responsible for space management of disc

4.3.4 C-Number Conversion

4.3.4.1 ASCII to Binary

4.3.4.1.1 Calling Sequence

The following illustrates the calling sequence for the common function to convert a C-number in ASCII to a C-number in binary, in the format required for the routing service parameter packet.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS. OF PARAMETER PACKET
	BRLP	88
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.3.4.1.2 Input Parameters

The input parameter is a byte address, that of the first character of a C-number. The C-number consists of three, five, six, eight, nine, or eleven decimal digits in ASCII, followed by a period. The address is placed within a four-word parameter packet which may later be used as a routing service input parameter packet. The right-hand 18 bits of word 1 of the packet must contain the byte address of the C-number.

The following is an example of coding to build a parameter packet. The C-number begins at MSG + 1, and the packet name is PARPK.

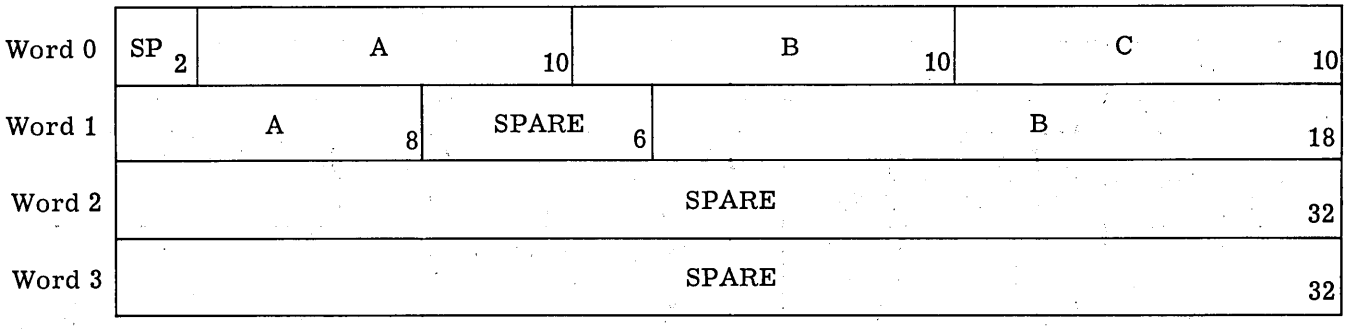
```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8   9 10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
P A R P K         D C               *  *
                  D F               1  4  /  *  *  ,  1  8  /  M  S  G  +  1
                  D C               *  *  ,  ,  2
```

4.3.4.1.3 Terminations

The common function returns control to the user program at the exception return if the input does not conform to the C-number format. In this case, byte 0 of the A register contains the nonconforming character and bytes 1, 2, and 3 contain the character address relative to the first character of the C-number.

After successfully converting the input to binary, the common function transfers control to the normal return. The A register contains the period in byte 0, and the number of characters of the C-number in byte 1, 2, and 3.

The parameter packet contains:



Word 0

Field	Definition
A	C-number area code, in binary, or ones
B	C-number exchange code, in binary, or ones
C	C-number subscriber code, in binary

Word 1

Field	Definition
A	C-number party line code, in binary, or ones
B	Byte address of first character of ASCII C-number

The converted C-number is placed in word 0 and byte 0 of word 1. Unused optional fields are filled with ones.

4.3.4.2 Binary to ASCII

4.3.4.2.1 Calling Sequence

The following illustrates the calling sequence for the common function that converts a binary C-number to ASCII characters.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDR. PARAMETER PACKET
	BRLP	92
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved: registers 3, A, and B are not saved.

4.3.4.2.2 Input Parameters

The input parameters are a C-number in binary form, and the address of an area in which the C-number will be placed. If no data is lost by placing the C-number area byte address in bits 14 through 31 of word 1, the routing service parameter packet may be used. To build a packet, place the binary area code, or 10 ones, in bits 2 through 11 of word 0. The binary exchange code, or 10 ones, must be placed in bits 12 through 21, and the binary subscriber code must be placed in bits 22 through 31. Bits 0 through 7 of word 1 must contain the party line code, or eight ones. Bits 14 through 31 must contain the byte address of the C-number area.

The following is an example of coding for a parameter packet. The C-number will be placed in an area starting at address CNUM. Other coding will move the binary C-number into word 0 and byte 0 of word 1 at run time. The name of the packet is PKPAR.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
PKPAR		DC		**
		DC		CNUM
		DC		**,,2

4.3.4.2.3 Terminations

If the binary C-number is not a valid C-number, the common function returns control to the user program at the exception return. The A register contains the count of characters placed in the ASCII C-number area in byte 0. A code in bytes 0, 1, and 2 identifies the reason for termination.

Code	Error
0	Area code neither all ones nor 999 or less
4	Exchange code neither all ones nor 999 or less
8	Subscriber code not 999 or less
12	Party line code neither all ones nor 99 or less
16	Area code 999 or less, with exchange codes all ones

The common function returns control at the normal return when the entire C-number has been placed in the ASCII area. The A register contains the count of ASCII characters in the converted C-number. The contents of the packet are unchanged, as follows:

Word 0	SP 2	A 10	B 10	C 10
Word 1	A 8	SPARE 6	B 18	
Word 2	SPARE 32			
Word 3	SPARE 32			

Word 0

Field	Definition
A	C-number area code, in binary, or ones
B	C-number exchange code, in binary, or ones
C	C-number subscriber code, in binary

Word 1

Field	Definition
A	C-number party line code, in binary, or ones
B	Byte address of area in which ASCII C-number is to be placed

All fields of word 0 and field A of word 1 contain user-supplied information. Unused optional fields are filled with ones.

Words 2 and 3 are not used by the common function and may be used for other purposes.

4.4 PROGRAM FUNCTIONS

4.4.1 Relocatable Program Loader

4.4.1.1 Calling Sequence

The following illustrates the calling sequence for the relocatable program loader.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDR. INPUT PARAMETER PACKET
	BRLP	48
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.4.1.2 Input Parameters

The input parameter packet consists of four words, in which the user supplies addresses, options, and other information required by the relocatable program loader. Byte 0 of word 0 must contain a value of one, when loading subsequent object program phases. Byte 1 must contain an object phase number. Bytes 2 and 3 must contain the word address to be used as the relocation value. The left-hand halfword of word 1 must contain the word address of the low load limit within the channel. The right-hand halfword must contain the word address of the high load limit within the channel. Words 2 and 3 identify the object program connector cell. The left-hand halfword of word 2 must contain the time identifier, and the right-hand halfword must contain the cell allocation count identifier. Byte 0 of word 3 must contain the zone parameter, and byte 1 must contain the loop 1 address. Bytes 2 and 3 must contain the cell address.

The input parameter packet used by relocatable program loader in initiating a channel is in the program status record, at address X'64 relative to the start of the record. The most common use of relocatable program loader by a user program is to load a new phase of a program. A one value must be placed in byte 0, a new phase number must be placed in byte 1, and optionally a new relocation value may be provided, in order to load a new phase. Otherwise, the original packet is valid. In some cases, however, changing the limits is desirable to protect portions of the program previously loaded.

4.4.1.3 Terminations

If the loader is unable to load the complete phase of a program, the loader returns control to the user program at the exception return. The A register contents indicate the reason for return.

Contents	Description of Status
0	Busy-resubmit after checkpoint
4	Load limits exceed available channel space
8	Object program connector cell retrieval failure
12	Illegal object program load format
16	Object program phase not defined in connector cell
20	Violation of load limits
24	Object program data cell retrieval failure

When the loader successfully loads the program, control returns to the user program at the normal return. Two loader status words are placed in channel status words 9 and 10 of the program status record. The following shows the input parameter packet.

Word 0	A 8	B 8	C 16
Word 1	A 16		B 16
Word 2	A 16		B 16
Word 3	A 8	B 8	C 16

Word 0

Field	Definition
A	Load requirement type
	0 = Object program phase assembled for channel initiation
	1 = Object program phase
B	Object program phase number
C	Word address to be used as relocation value

Word 1

Field	Definition
A	Word address of low load limit
B	Word address of high load limit

Word 2

Field	Definition
A	Time halfword of object program connector cell identifier
B	Cell allocation count halfword of object program connector cell identifier

Word 3

Field	Definition
A	Zone parameter of object program connector cell
B	Loop 1 address of object program connector cell
C	Cell address of object program connector cell

The following shows the contents of channel status words after a successful load.

Word 0	A 8	B 8	C 16
Word 1	A 16		B 16

Word 0 (Relative address X'20 in program status record)

Field	Definition
A	Object program format loaded
B	Number of inputs allowed by object program (not used if byte 0 of packet contains 1)
C	Word address of start point of object program phase

Word 1

Field	Definition
A	Word address of lowest location modified during load
B	Word address of highest location modified during load

4.4.2 Object Text Address Adjust

4.4.2.1 Calling Sequence

The following illustrates the calling sequence for the common function that adjusts the addresses of a relocatable object program.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDR. PARAMETER INPUT PACKET
	BRLP	96
	B	EXCEPTION RETURN
	...	NORMAL RETURN

Registers 1 and 2 are saved; registers 3, A, and B are not saved.

4.4.2.2 Input Parameters

The input parameters are placed in a 4-word packet, with a 4-word work space immediately following. The left-hand 14 bits of each word must be zeros. The right-hand 18 bits of word 0 must contain the relocation base address, in byte address form. The right-hand 18 bits of word 1 must contain the byte address of the first word of the object text. The corresponding bits of word 2 must contain the byte address of the last word of the object text. The corresponding bits of word 3 must contain the word address of the last word of the text relocation vector, normally the last word of the object text data cell.

The following is an example of coding for a packet to adjust relocatable object text in an area at PROGIN. The packet name is LOCPROG.

NAME	OPERATION AND CONDITION	OPERAND
LOCPROG	DC	NXTPH
	DC	PROGIN+8
	DC	PROGIN+2020
	DC	PROGIN+2044
	DC	**,,4

4.4.2.3 Terminations

The common function returns control to the user's program at the exception return if the indicated text addresses are not within the channel limits, or if the first word address is greater than the last word address.

After adjusting the object text correctly, the common function returns control at the normal return. The following shows the input parameter packet. Words 1 and 3 of the packet are modified by the address adjustment function, so they must be reset if the parameter packet is to be re-used.

Word 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	A 18
Word 1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	A 18
Word 2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	A 18
Word 3	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	A 18
Word 4	WORK AREA	
Word 5		
Word 6		
Word 7		

Word, Field	Definition
0, A	Relocation base address (byte address)
1, A	Byte address of first word of object text
2, A	Byte address of second word of object text
3, A	Byte address of last word of text relocation vector

4.4.3 Set Channel Trap

4.4.3.1 Calling Sequence

The following illustrates the calling sequence for the common function that sets the address for the trapped instruction routine within a channel.

NAME	OPERATION AND CONDITION	OPERAND
	LDX	2,ADDRS. OF CHANNEL ENTRY PT
	BRLP	5 6
	B	EXCEPTION RETURN
	...	NORMAL RETURN

4.4.3.2 Input Parameter

The address of the channel entry point is the only input parameter. Control is transferred to this address each time the hardware trapped op code interrupt occurs during the channel's time period.

4.4.3.3 Terminations

If the address in index register 2 is outside of the channel limits, control returns to the user program at the exception return.

After placing the trap address appropriately, the common function returns control to the normal return. Index register 2 contains the channel trapped op code entry address previously set, or zeros.

4.4.4 Timer 1

4.4.4.1 Declare Entry

4.4.4.1.1 Calling Sequence

The following illustrates the calling sequence for the common function to declare an entry point to which control is transferred when a timer 1 hardware interrupt occurs.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    LD                    A,PARAMETERS
                    BRLP                  256
                    B                     EXCEPTION RETURN
                    ...                   NORMAL RETURN
```

Only register A is altered.

4.4.4.1.2 Input Parameters

Register A must contain the word address of an entry point within channel limits, in bytes 2 and 3. Zeros in bytes 2 and 3 discontinues use of timer 1. In bit 0 a 1 calls for a reset/start timer 1 operation immediately following this operation. A 0 in bit 0 provides an immediate return.

4.4.4.1.3 Terminations

If the channel entry point word address is not within the channel limits, control returns to the exception return in the user program.

If the channel entry point is valid, the common function stores it appropriately, resets and starts timer 1 if required, and returns control to the user program at the normal return. The A register contains the previously specified entry point, or zeros, in bytes 2 and 3.

4.4.4.2 Reset/Start Timer 1

The following illustrates the calling sequence for the common function to reset and start timer 1.

```
NAME                OPERATION AND CONDITION   OPERAND
1 2 3 4 5 6 7 8  9  10 11 12 13 14  15  16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
                    BRLP                  260
```

All registers are saved.

No parameters are required. The timer 1 running bit in the operations control table is set, and the timer is reset and started. If an entry point for the channel has not been declared, no operation is performed.

4.4.4.3 Stop Timer 1

The following illustrates the calling sequence for the common function to stop timer 1.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
		BRLP		264

All registers are saved.

No parameters are required. Timer 1 is stopped and the timer 1 running bit in the operations control table is reset. If an entry point has not been declared for the channel, no operation is performed.

4.4.4.4 Start Timer 1

The following illustrates the calling sequence for the common function to start timer 1.

NAME		OPERATION AND CONDITION		OPERAND
1 2 3 4 5 6 7 8	9	10 11 12 13 14	15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
		BRLP		268

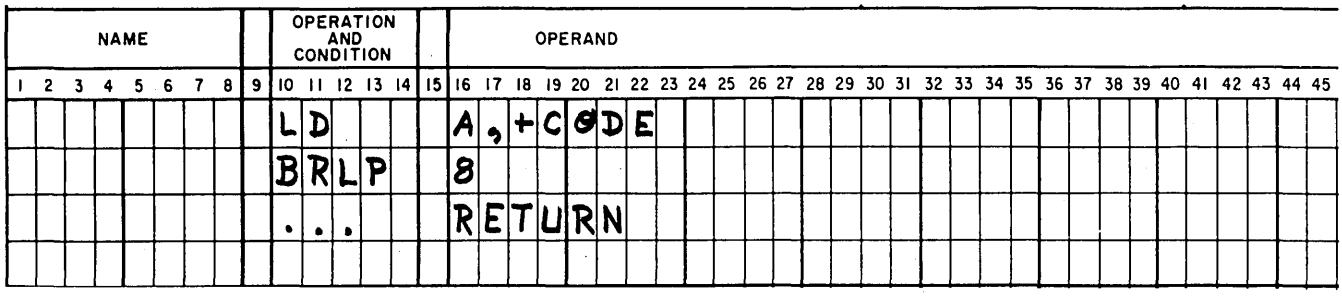
All registers are saved.

No parameters are required. Timer 1 is started without altering its setting, and the timer 1 running bit in the operations control table is set. If a timer 1 entry point for the channel has not been declared, no operation is performed.

4.5 OPERATIONS CONTROL SERVICE ENTRIES

4.5.1 Channel Disconnect Busy

The following illustrates the calling sequence for the entry to operations control that allows the channel to remain inactive until an input/output operation has been completed.



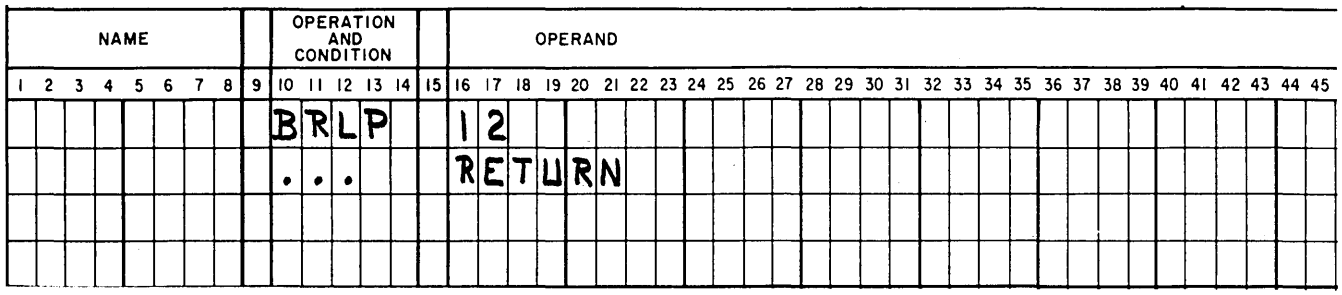
No register is saved.

The single parameter specifies the device control message chain used by the input/output operation. A zero value in the A register specifies chain 1, and a nonzero value specifies chain 2.

Operations control service returns control to the user's program at the return point when the input/output operation has completed.

4.5.2 Channel Disconnect Checkpoint

The following illustrates the calling sequence for the entry to operations control that terminates the channel time period.

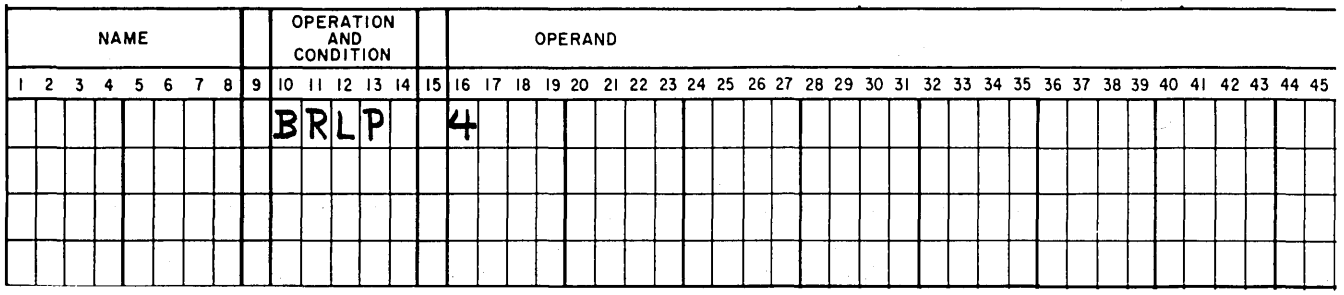


No register is saved.

No parameter is required. At the beginning of the next period for the channel, operations control service returns control to the user program at the return point.

4.5.3 Channel Normal Completion

The following illustrates the calling sequence to enter operations control indirectly at the normal completion entry.

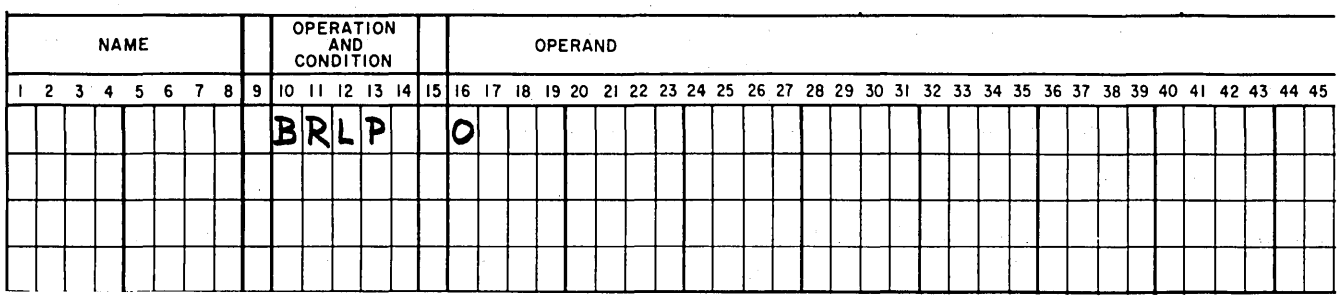


No register is saved.

No parameter is required. When operations control service has completed its normal completion functions, control passes to the channel initiation routine.

4.5.4 Channel Abnormal Completion

The following illustrates the calling sequence to enter operations control indirectly for an abnormal completion.



All registers are saved.

It is a user responsibility to place a channel abnormal completion status word in the program status record at relative address X'44, prior to entering this routine. Those abnormal completions initiated by system routines, defined in table 4-7, place a 0 in bit 0 of this word. The user places a 1 in bit 0. The abnormal completion routine places a 1 in bit 1 if an error occurs during an attempt to write a core dump on disc. The user identifies his abnormal completion by a code in bits 2 through 13.

Table 4-7. System Defined Abnormal Completions.

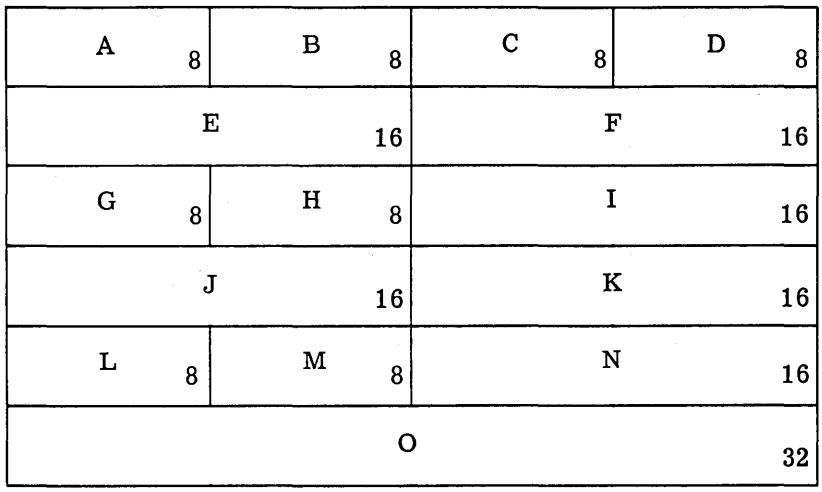
TYPE	CHANNEL ABNORMAL COMPLETION STATUS WORD				CORE DUMP
Program Interrupt	0	A_1	000000000001	Address of interrupt	Yes
Memory Parity Int.	0	A_1	000000000010	Address of interrupt	No
Unavailable Instr. Int.	0	A_1	000000000011	Address of interrupt	Yes
Program Timeout	0	A_1	000000000100	Address of last instruction executed	Yes
Load Error	0	A_1	000000000101	Status from loader	No
Q Read Error	0	A_1	000000000110	Cell address	No
CPSR Read Error	0	A_1	000000000111	Cell address	No
Input Number Discrepancy	0	A_1	000000001000	Input numbers	No
Invalid C-number	0	A_1	000000001001	C-number subscriber code	No

The fourth and fifth words of the abnormal return service message sent to control program service contain the file identifier of the core dump file. If a core dump file was not written, the fourth word of the service message contains zeros and the channel abnormal status word is in word 5.

The routine returns control to the initiation routine, to initiate the next program in the channel.

appendix a
list of service messages

Program Return



A - Program Return Op-Code - X'42

B, C - Spare

D - Double word increment to referenced program control instruction

E, F - Protection keys of control program status record (AK + K2)

G - Disc zone identifier

H - L1 address of disc containing the control program status record

I - Cell address of control program status record

J-K - Protection keys of highest level connector cell of the output file (AK + K2) or literal data

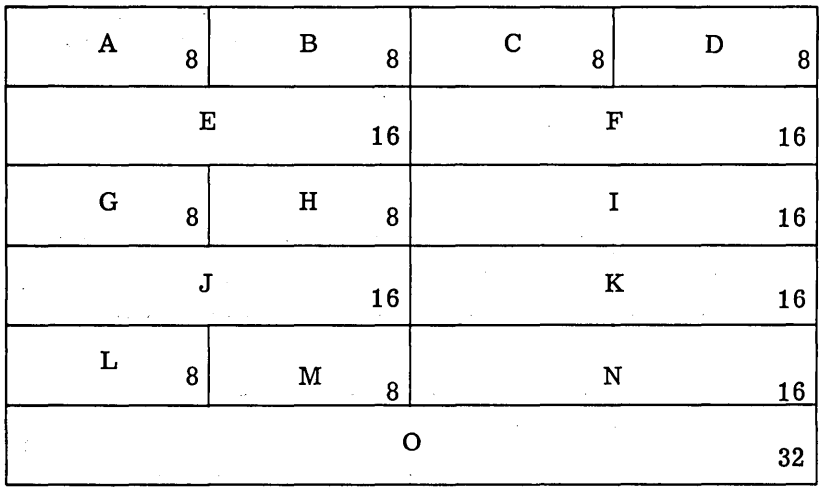
L - Disc zone identifier, or zero if literal data

M - L1 address of output file, or zero if literal data

N - Cell address of output file connector, or literal data

O - Spare

AP Abnormal Return



A - AP Abnormal Return Op-Code - X'44

B - Spare

C - Spare

D - Double word increment to the referenced program control instruction

E-F - Protection keys of control program status record (AK + K2)

G - Disc zone identifier

H - L1 address of control program status record

I - Cell address of control program status record

J-K - Protection keys of abnormal status

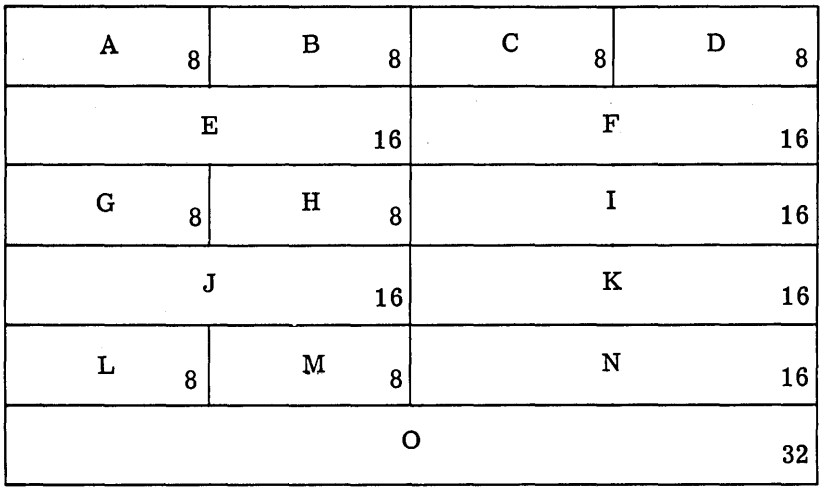
L - Disc zone identifier

M - L1 address of abnormal status

N - Cell address of abnormal status

O - Spare

Space Release



A - Space Release Op-Code - X'45

B - Spare

C - Spare

D - Double word increment to referenced program control instruction

E-F - Protection keys of control program status record

G - Zone identifier of control program status record

H - L1 address of control program status record

I - Cell address of control program status record

J-K - Protection keys of file to be released

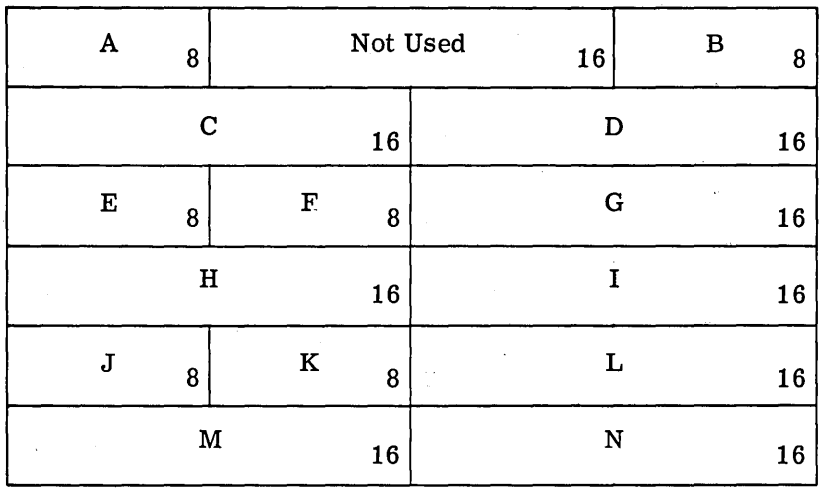
L - Zone identifier of file to be released

M - L1 address of file to be released

N - Cell address of high level connector of file being released

O - Spare

DCS File Update



A - File Update Op-Code - X'81

B, C, D, E, F, G - Zeros

H - AK of file to be added to data collection service

I - K2 of file to be added to data collection service

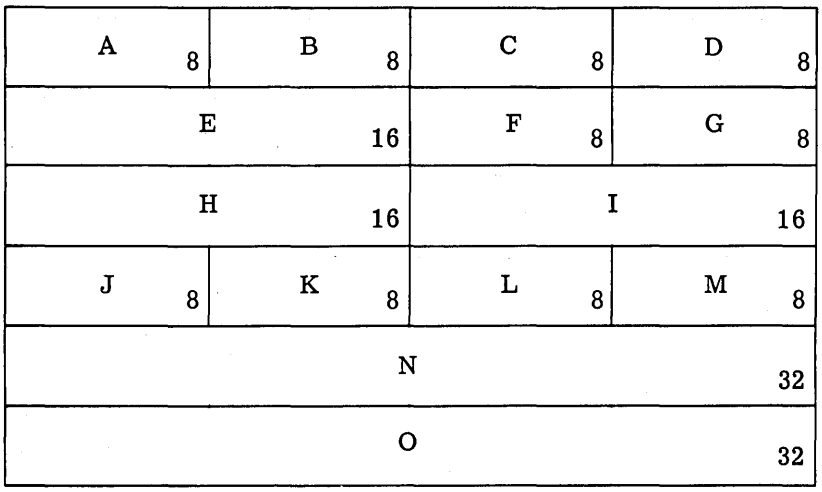
J - Disc zone identifier of the file

K - L1 address of disc containing the file

L - Cell address of the file

M, N - Hexadecimal data collection service code as ASCII characters

Replace Output Tape



A - Replace Output Tape Op-Code - X'84

B - Spare

C - OW1 address of calling processor

D - Calling processor channel, 000 - Not used, 010 - service channel, 101 - MUX channel, 110 - B/OW2 channel, 111 - A channel

E - Core address where the return status is to be stored

F - L1 working channel of tape servo

G - Spare

H - AK to be used as AK for tape ID

I - Zeros in replace output tape message

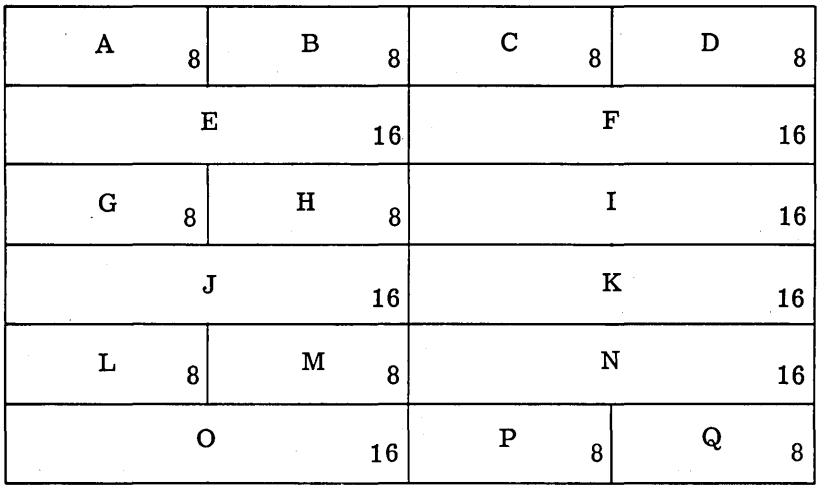
J - Spare

K - PLA of tape servo

L - First byte of tape control transfer command packet which initiated replace output tape

M - Library zone into which tape reel is to be placed

DACS Routing Request



A - DACS Routing Request Op-Code - X'8D

B - Count the number of I's in the calling program control instruction; zero if from a program

C - OW1 address of the originating processor

D - Zero or double word increment of calling program control instruction

E, F, G,

H, I - File identifier of calling control program status record; zero if from a program (ie, D=0)

J, K, L,

M, N - File identifier of message

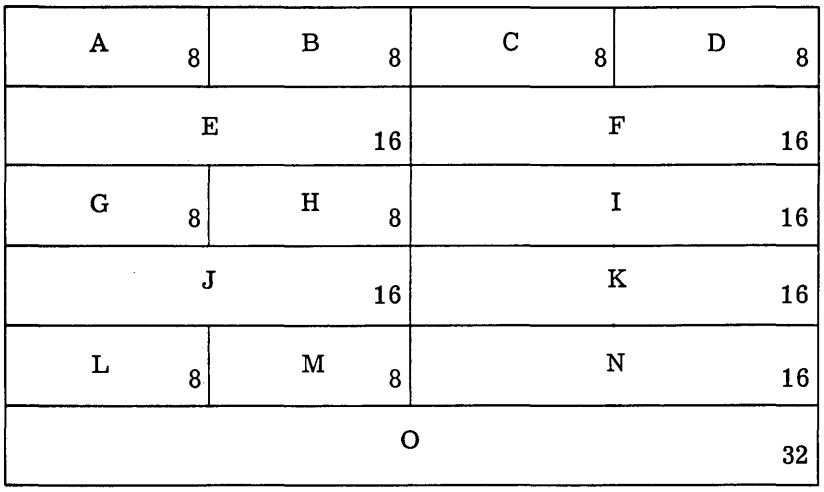
O - If D=0, C-number to substitute in program call service message or zero indicating request for general service program

If D≠0, zero or PI selection key for message in file of fields J, K, L, M, N

P - Zero or party line address of particular device

Q - Output device type

Regulator Tables Update Return



A - Regulator Tables Update Return Op-Code - X'96

B - Spare

C - OW1 address of originating processor

D - Double word increment to calling program control instruction

E, F - Protection keys (AK + K2)

G - Disc zone identifier

H - L1 address of disc containing control program status record

I - Cell address of the calling control program status record

J, K - Protection key (AK + K2) for new tables file

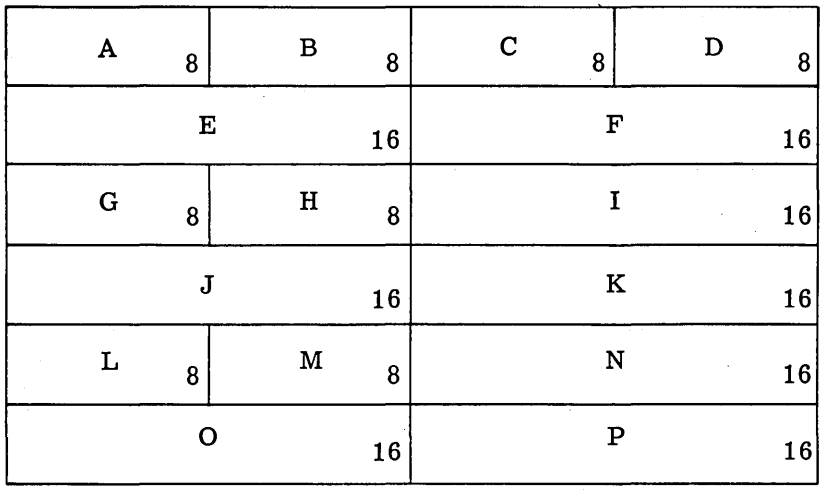
L - Disc zone identifier

M - L1 address of disc containing updated tables

N - Cell address of updated tables

O - Spare

I/O Call 1



A - I/O Call 1 Service Message Op-Code - X'AO

B - Count of the number of I's in the calling program control instruction; zero if from a program

C - OW1 address of originating processor

D - Double word increment to calling program control instruction; zero if from service program

E, F - Protection key of calling control program status record, zero if from service program

G - Control program status record zone; zero if from a service program

H - L1 address of control program status record disc; zero if from a service program

I - Cell address of the control program status record; zero if from a service program

J, K - Protection key of message file

L - Zone of message file

M - L1 address of message file

N - Cell address of message file

O - Selection key of subfile if multiplexed file; zero if non-multiplexed

P - Spare

appendix b
file structure

GENERAL

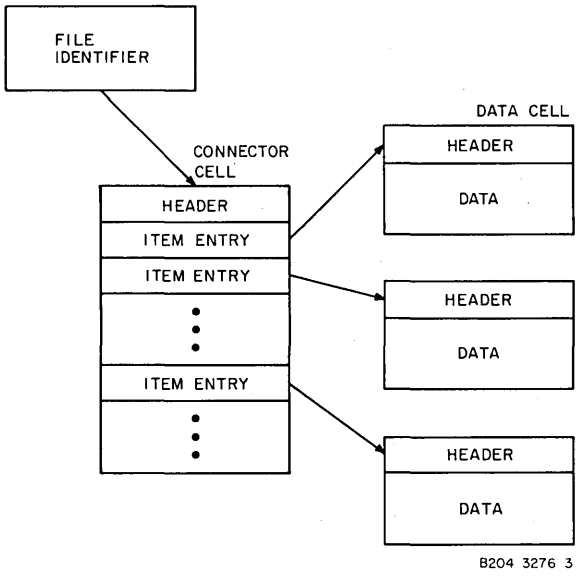
Data within the C-System is physically maintained in either disc or tape storage. Disc is most useful in the storage of transient data, while tape is a practical medium for the storage of permanent data.

In order that data may be used by or transferred between programs within the system, the data must be organized into files that have a common file structure. While it is recognized that an identical file structure cannot be maintained for data on disc and for data on tape, the file structure is such that a file structure on disc can be derived from a file structure on tape, and vice versa.

The file structure may be built and utilized via the common software modules available in each C-System processor. Enforcement of the file structure is a function of storage space allocation, release, and recovery software modules within the C-System.

GENERAL FILE STRUCTURE

The following illustration depicts the general file structure.



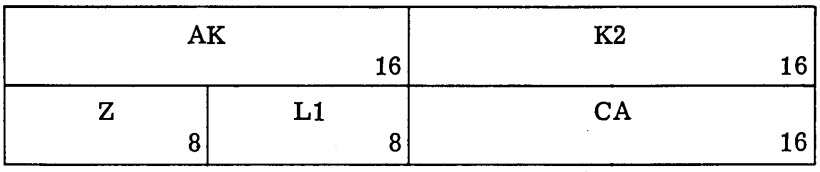
The basic unit of a file is a cell. A cell is defined as a specified number of contiguous bytes that can be addressed. The first two words of all cells within a file are reserved for header information. Cells are divided into two classes; data cells and connector cells. Data cells contain user data. Connector cells

contain addresses of data cells or other connector cells in a field defined as a connector cell item entry. Connector cells can also contain the user data.

The file structure within the C-System environment is defined as a tree structure. Elements in the tree are cells. Connectors between elements in the tree are cell addresses. Data cells are the lowest element of a tree. Data cell addresses are stored in a cell referred to as a connector cell. If more than one level of connector cell exists in the file structure, lower level connector cell addresses are stored in a higher level connector cell. The process of building higher level connector cells to contain the addresses of two or more cells of the same, but lower, level continues until only one connector cell is required to hold the next lower level cells. The lowest level connector cells are referred to as low level connectors. The highest level connector cell is referred to as the high level connector. All other levels of connector cells are referred to as intermediate level connectors.

FILE IDENTIFIER

A file is addressed by a 2-word file identifier that consists of a protection key and the physical address of a disc cell to allow retrieval of the file. File identifiers are normally communicated between programs through the linkages provided by control programs. The structure for file identifiers is depicted as follows.



AK - This field contains 16 bits of the system absolute time clock at the time the file was opened.

K2 - This field contains the value of a 16-bit counter which is read and incremented each time a cell is allocated.

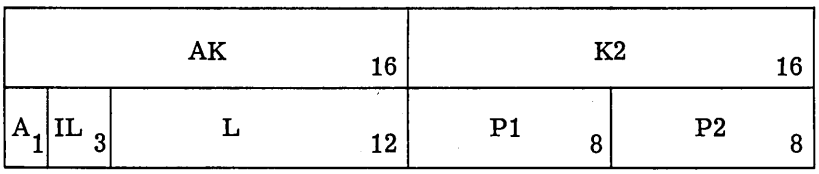
Z - This field contains the disc zone in which the file resides. If the file is on tape, bit zero of the zone is set to one, and the remaining bits indicate the disc zone in which the reels list resides, or in which the connector cell structure associated with the tape file resides.

L1 - This field contains the time division exchange address of the disc on which the disc file or tape connector cell structure resides.

CA - This field contains the disc cell address of the high level connector or reels list.

CELL HEADER

All cells within a file have a header in the first two words of a cell. The structure for cell headers is depicted as follows.



AK - This field normally contains the value of the time identifier at the time the file was opened; however, if the cell is written to tape, this field will contain either a block sequence number or a connector level indicator. A block sequence number is a binary number which describes the displacement of a data cell from the tape header. A connector level indicator is a binary number which describes the displacement of a connector cell from the file identifier (that is, the number of intervening connector cells plus one).

K2 - For connector cells of a disc file structure, this field contains the value of the cell counter at the time the field is allocated. If the connector cell structure on disc is associated with a tape file, this field may contain either the value of the cell counter at the time the cell is allocated, or a reel key number. A reel key number is a binary value that is combined with the time halfword to form a unique tape identifier. For data cells on disc or tape, this field contains the value of the second two bytes of the item parameter field in the low level connector cells.

A - This field contains zero if the cell is a low level connector cell; otherwise, the field contains one.

IL - This field contains the item length specification for connector cell items and is not used for data cells. The connector cell item length is encoded as follows:

IL Field Value	Item Length (Bytes)
0	2
1	4
2	8
3	16
4	32
5	64
6	128
7	256

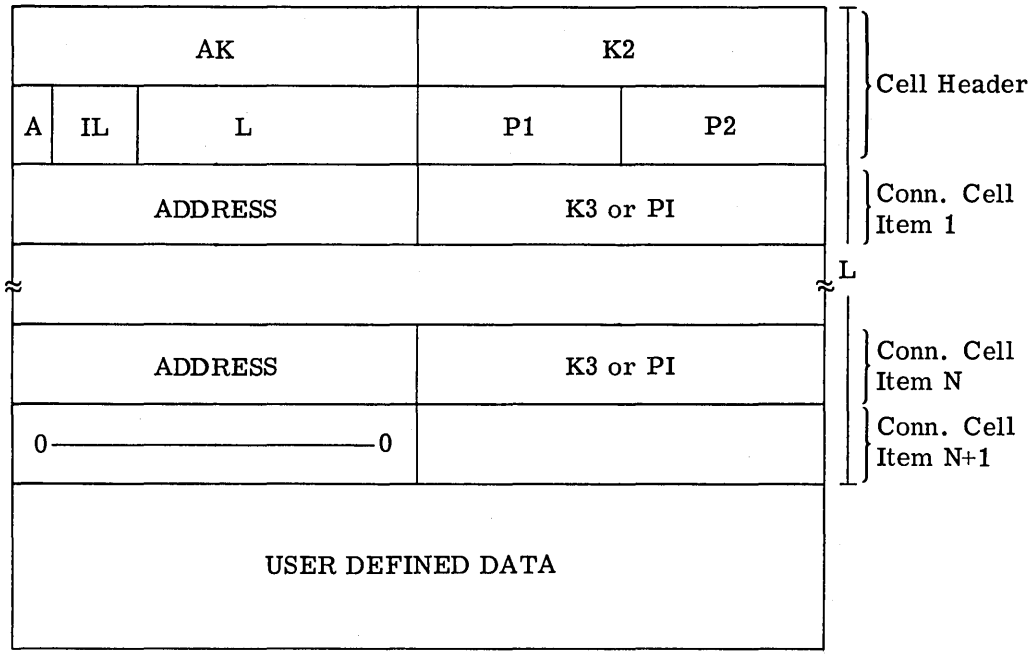
L - This field contains the number of bytes of useful data where the count is taken from the start of the cell and includes the header space. For connector cells, the count is taken from the start of the cell to the last byte of the last connector cell item. For data cells, this field can be specified by the user. If the L field is used as an address modifier; that is, added to the cell address, the resultant address points to the next available space in the cell. For example, if a low level connector cell is being prepared in core with an item length specification of 1, and the connector cell currently contains one data cell address, the L field would contain the value 12. The cell address plus 12 would point to the word in which the next data cell address is to be placed.

P1 - The P1 field is used for data directing codes. For files that interface with system functions, this field may be used by the applied system to contain detail information concerning data formats, editing required, compression, and expansion.

P2 - The P2 field is used in conjunction with the P1 field. For files that interface with system functions, this field contains parameters that are required by the program specified in P1. For files that are used strictly within applied systems, this field may be used by the applied system in the same manner as described for field P1.

CONNECTOR CELL

Connector cells for files maintained on disc contain the addresses of lower level cells. For files maintained on tape, the low level connector cells contain a block sequence number for data cells on tape. Information about the lower level cell can be contained in a connector cell. The address of a lower level cell or a cell sequence number and any related information is referred to as a connector cell item. Connector cell items within a cell are the same length as specified in the header. If the item length field specifies a length of two bytes, then the connector cell item only consists of an address or block sequence number. The structure of a connector cell is depicted as follows.

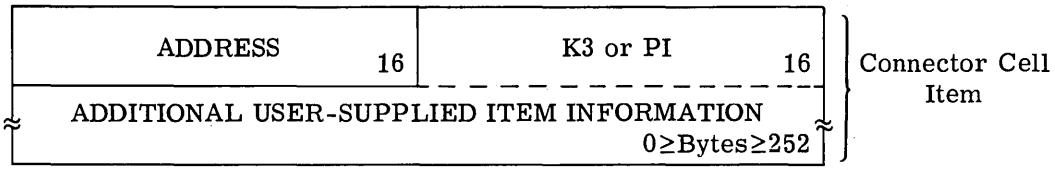


ADDRESS - This field contains the storage address of the next lower level cell in the file or a block sequence number. If the field is equal to zero and the L field points to the next item, data is contained in the connector cell immediately following the last byte of the connector cell item entry containing the zero cell address.

K3 - The K3 field is normally used in higher level connector cells. It contains the same value as the K2 field in the lower level connector cell that is addressed. The K3 field is used along with the AK field for the file as a key to verify that the cell addressed is the correct lower level connector cell.

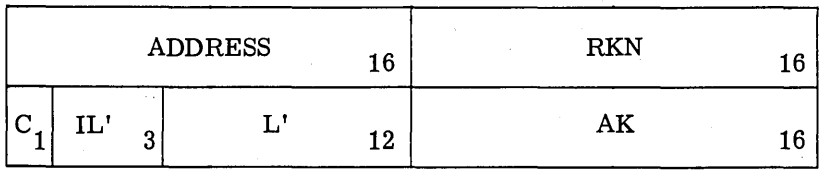
PI - The PI field, referred to as the item parameter field, contains information related to the cell addressed by the address field. The first two bytes of the PI field are normally used along with the AK field for the file as a key to verify that the cell addressed contains the requested data, that is, the same value contained in the K2 field of the lower level cell. The user may specify other information to follow this 2-byte key.

The illustration depicting the structure of a connector cell shows a connector cell item as a four-byte entry with the connector cell. The connector cell item may have any length as specified by the entry with the IL field. The general format of a connector cell item is depicted as follows.



The user-supplied information portion of the connector cell item may contain any type of information. A key identifying a data cell or subfile is appropriate.

If a connector cell structure on the disc is associated with a file on tape, the item entries in the high level connector are eight bytes in length. A typical item entry is depicted as follows.



ADDRESS - This field contains the storage address of the next lower level cell (that is, first intermediate level connector) in the connector cell structure.

RKN - This field contains the reel key number of the tape and provides in the high level connector the ability to convert a high level connector into a reels list.

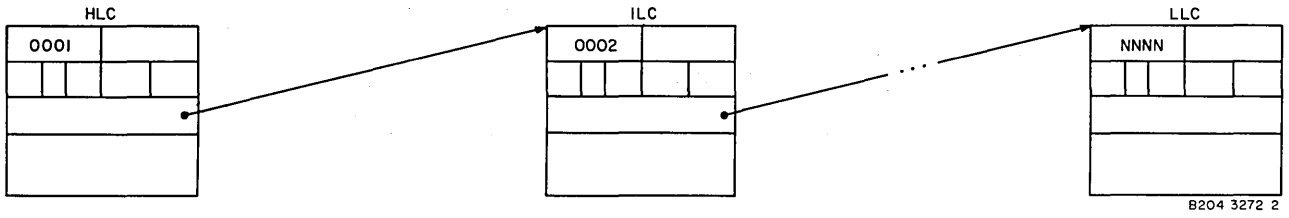
C - This bit is used to indicate whether or not connectors are contained on this reel of tape. C=1 indicates the presence of the full connector structure or reels list on the reel.

IL' - Item length indicator for low level connector present on reel.

L' - Length in bytes of data cells on reel. L=0 indicates that no data cells are on the reel referenced.

AK - This field is equal to the AK found in the first two bytes of the cell header at the time a file is created. It allows reels created at different times, in different file structures, to be combined into a common structure at a later time. It is this AK and the associated RKN within the connector cell item that uniquely identifies a reel of tape.

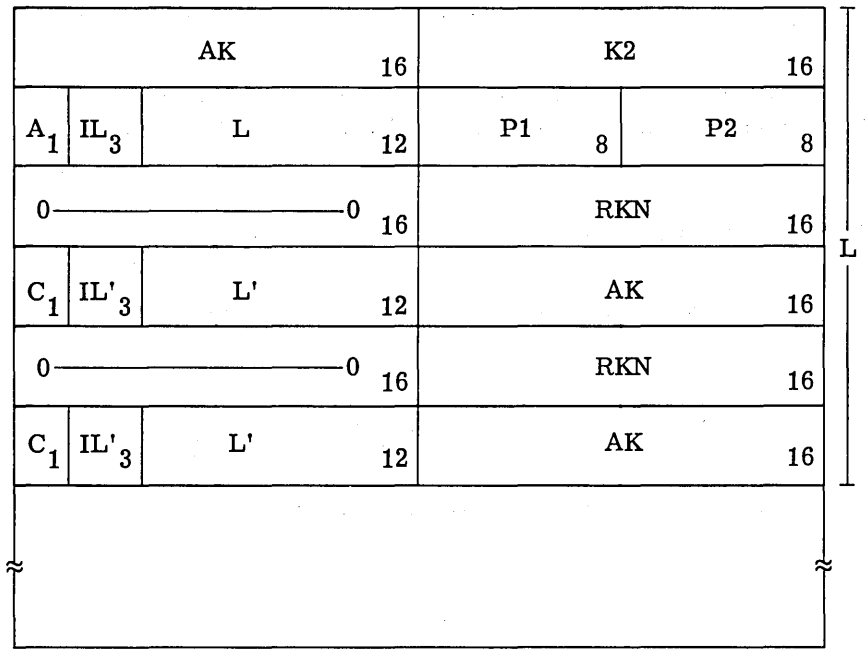
When the connector cell structure or reels list is written to tape, the AK field is changed to a connector level indicator. An example of the structure in which AK fields have been changed to connector level indicators is depicted as follows.



REELS LIST

A reels list is the vehicle by which pointers to reels of tape within a tape file are retained on disc without keeping the complete connector cell structure on disc. The high level connector cell is identical in format to the reels list with one exception. The left half of the first word in each connector cell item normally contains a disc cell address; in a reels list, this half word is set to zero. Each connector cell item of a high level connector points to a connector cell substructure which in turn points to the information on one reel of tape. In a reels list, the connector cell items identify only the tape reels within a file and provide information as to which reels have a second file containing connector cells. From this information and the connector level indicator in each connector cell on tape, the connector cell structure can be reconstructed on disc.

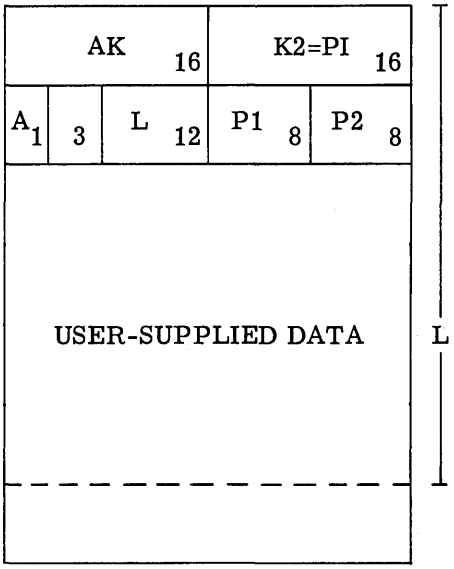
A zero address within a connector cell structure denotes a null entry. The structure of a reels list is depicted as follows.

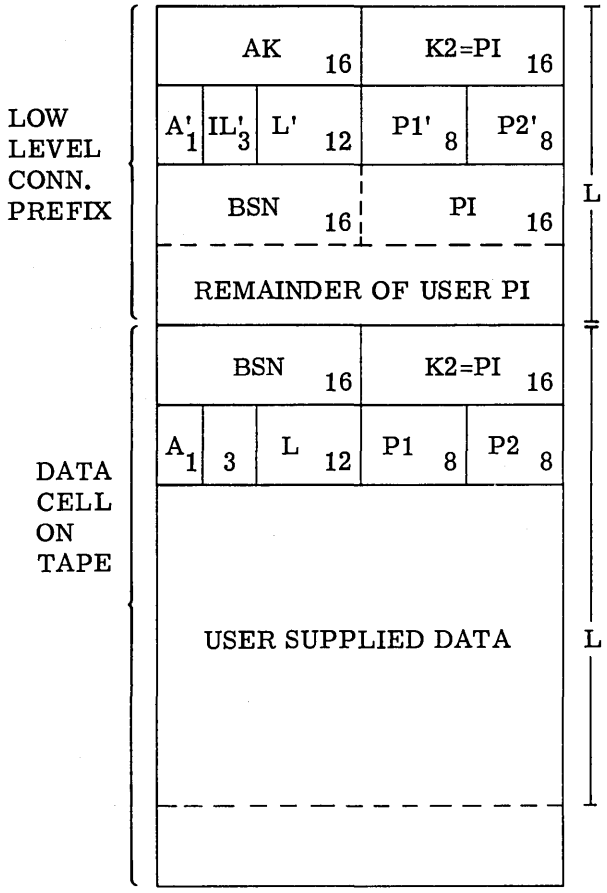


DATA CELL

A data cell contains a 2-word header and user supplied data. The difference between tape and disc data cells is the information contained in the cell header. Due to the differences in the storage media, that portion of the low level connector which pertains to the data cell is written to tape as a prefix on the data cell for checkpoint as well as sequential access purposes. The resident software indirect commands make the prefix to the data cell on tape transparent to the user.

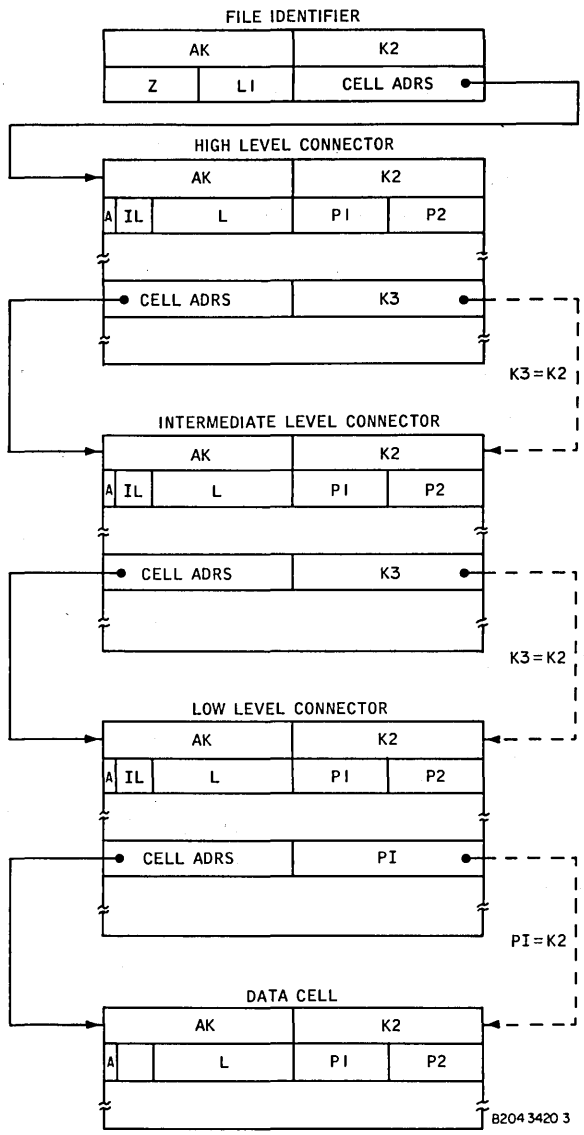
DATA CELL ON DISC





DISC FILE STRUCTURE

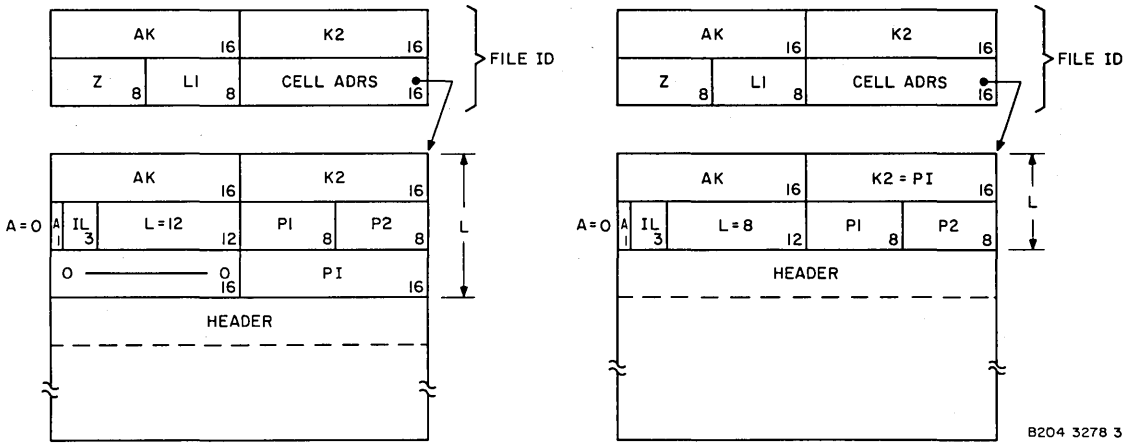
All cells within a given file structure are the same size. The file is identified by the cell address of the associated high level connector. The general structure of a file on disc is depicted in the following illustration.



Data can be contained in the connector cell by use of a zero cell address. If a zero cell address is used, the L field in the header of the connector cell applies only to the connector cell. The format of the data within the connector cell is user-defined; for example, the first word of the data might be in the same format as the second word of a data cell header. The address of the first word of data in the connector cell can be determined by adding the L field for the connector cell to the address of the connector cell. If the first cell address in the high level connector cell is zero, then the file is a 1-cell file.

Data can be contained in connector cells in the connector cell item field if the connector cells are formatted by the user. If files within the C-System are relocated by system functions, data within low level connector cells are not altered; however, data contained in intermediate or high level connectors can be altered.

The formats of a single cell file are depicted as follows.

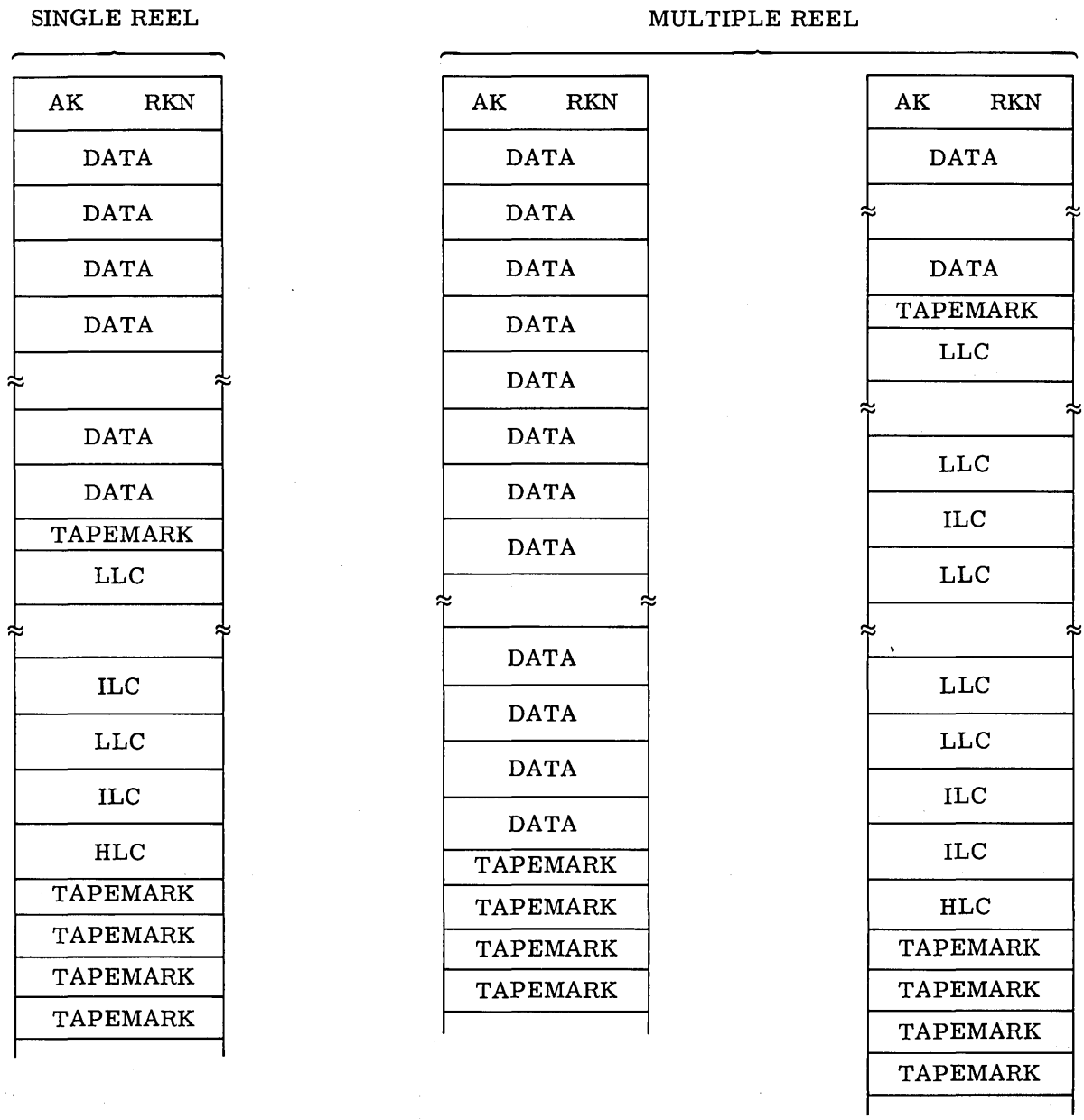


A reel list is a single cell file because all connector cell item entries contain cell addresses of zero.

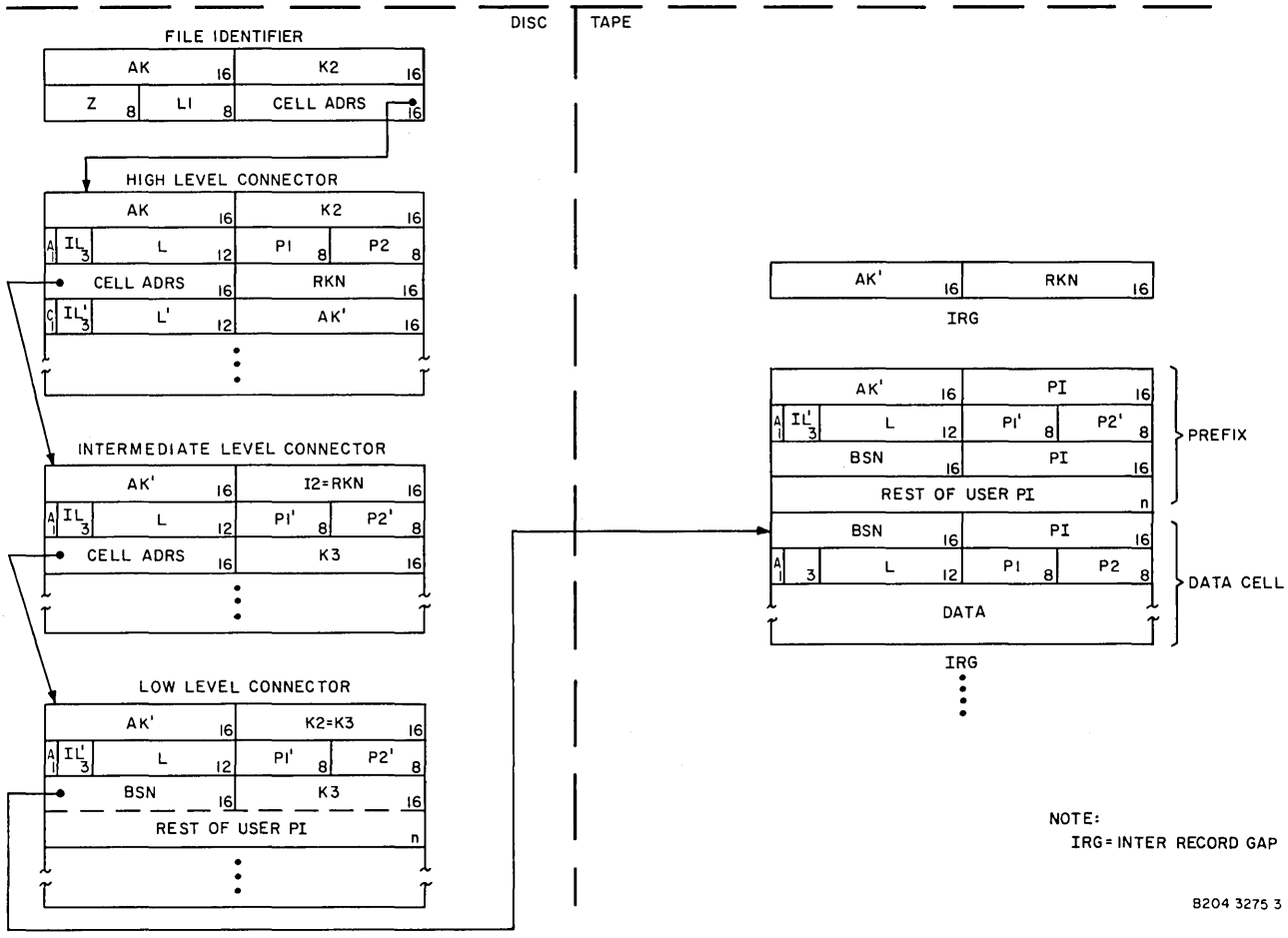
TAPE FILE STRUCTURE

Each tape within the system has a 1-word header consisting of the AK value of the file and the reel key number. Files contained on tape follow the same restriction on files on disc: all cells within the file are the same size. A file structure on tape created by indirect tape commands is contained in two physical files separated by a tape mark. In multiple reel files, the first tape mark on the last tape is used to delimit the second file. The first physical file contains data cells.

The second physical file contains all the connector cells or the reels list. Low level connector cells are written to tape, followed by the intermediate level connector cell that addresses the low level connector cell. The high level connector cell is the last cell written to tape. The order in which data cells and connector cells are written to tape is depicted in the following illustration.



When a tape file is created, a disc file structure which consists of connector cells only can also be created. For file structures that are unblocked, the file structure on disc is copied as the second file of the tape. The reel key number for the tape is contained in the K2 field of the intermediate level connector whose connector level indicator is equal to two. A high level connector cell item is used to contain the cell addresses and the reel key numbers of the connector cell structure associated with one physical tape. The disc file structure for a single or multiple reel tape file in the case where the optional connector cell structure on disc has been constructed is depicted in the following illustration.



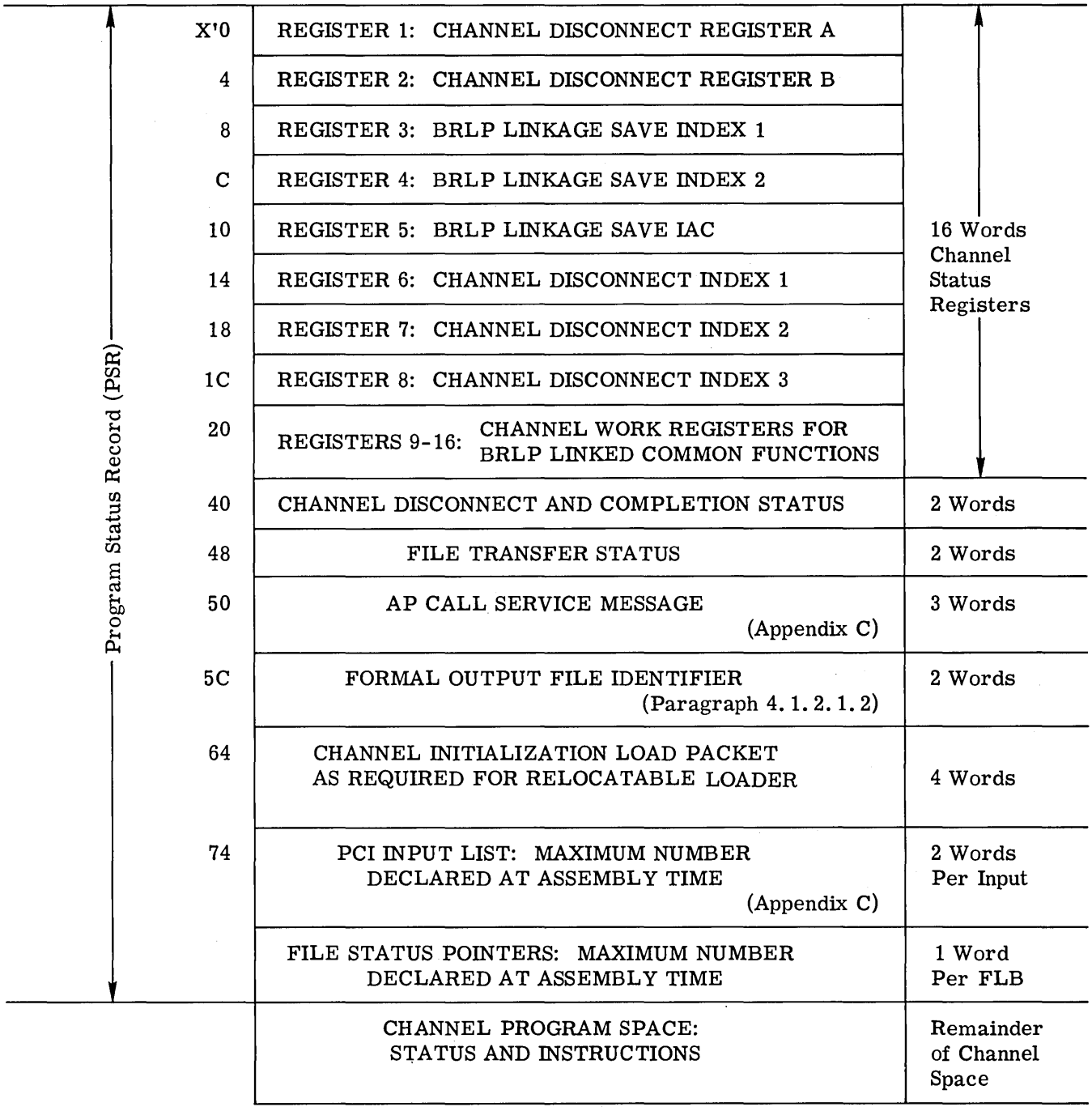
Data cells are written to tape until the file is complete or the end of tape is reached. If the file is complete, a tape mark is written. If the optional connector cell structure is not built on disc, a reels list is written as a second file to tape followed by four tape marks. If the end of tape is reached prior to the file being complete, four tapemarks are written and the remaining data cells are written to the next tape. In either case, the cell address of the intermediate level connector cell and the reel key number are stored in a high-level connector cell. As new tapes are required, the intermediate level connector cell addresses and the associated reel key numbers are added to the high level connector until the file is complete.

Following the tape mark of the last tape, the connector cell structure is written to tape followed by four tape marks.

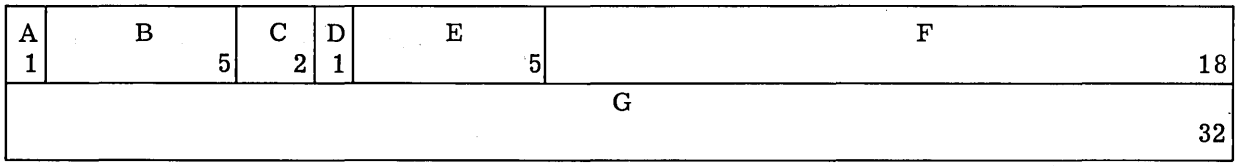
In the event that the end of reel is reached while writing the second file, the tape is backspaced to the first tape mark and three more tape marks are written. A new tape is obtained for the connector cells. The tape reel key number is written in the K3 field of the highest level connector. A zero cell address is used in the address portion of the connector item since no lower level connector cells are involved in the new tape.

appendix C
program status record

Processor Channel Space



Channel Disconnect and Completion Status



A - Spare

B - Spare

C - Condition code indicators at channel disconnect

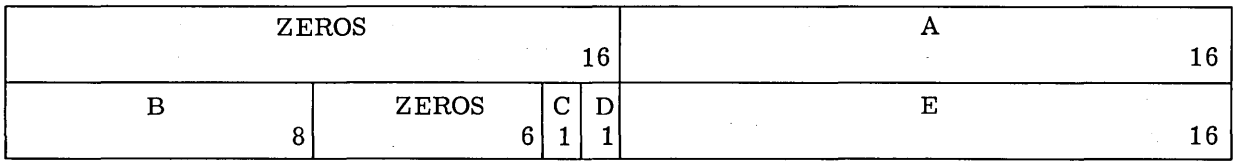
D - Overflow indicator at channel disconnect

E - Spare

F - Instruction Address Counter (IAC) at channel disconnect

G - Channel abnormal completion status word

File Transfer Status



A - Word address of first word of channel program space

B - Disc zone parameter for documented indirect files:

X'00 = 128 byte cell file

X'10 = 256 byte cell file

X'20 = 512 byte cell file

X'30 = 2048 byte cell file

C - 0 = No file status pointer word yet initialized

1 = One or more file status pointer words has been initialized

D - 0 = No program output file has been opened

1 = A program output file has been opened

E - Word address of first file status pointer word

Application Program Call Service Message

A 8	B 8	C 8	D 8
E 16		F 16	
G 8	H 8	I 16	
J 16		K 16	
L 32			
M 32			

A - Application Program Call Op-Code - X'EO, X'FO

B - Spare

C - Spare

D - Double word increment to calling program control instruction

E-F - Protection keys (AK + K2) of calling control program status record

G - Disc zone identifier of calling control program status record

H - L1 address of disc containing the control program status record

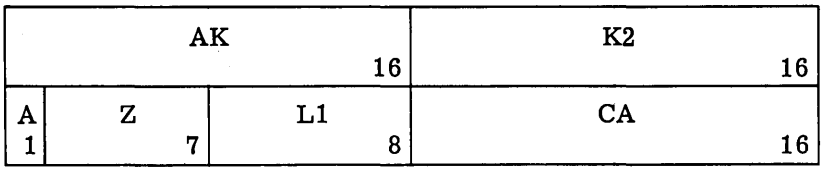
I - Cell address of control program status record

J - Spare

K - Maximum run time in minutes

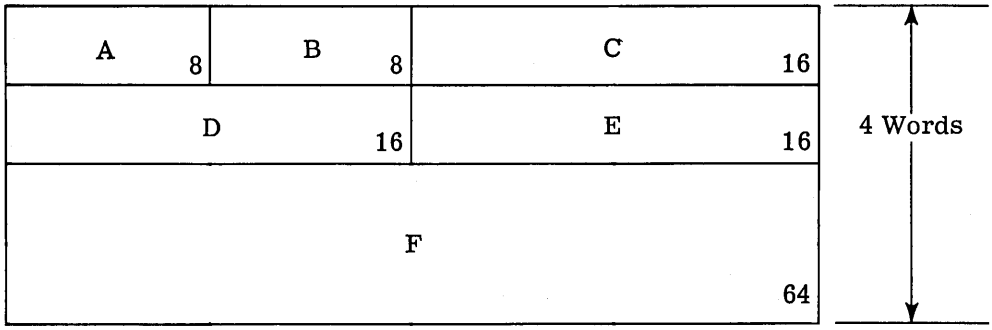
L, M - Spare

Formal Output File Identifier



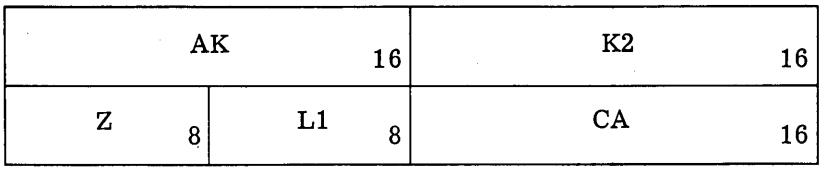
Field	Definition
AK	The AK of the file. This value is determined by the Open File routine and can be referenced after the Open routine has completed.
K2	The K2 of the highest level connector of the file. This value is determined by the Close routine and can be referenced after the Close routine has been completed.
A	Zero to indicate a disc storage file.
Z	The zone disc parameter which identifies the area of the disc into which the file is written. If the Open Command packet specifies that the file is not to be documented in the program status record file linkage block list, the cell size must be supplied by the calling program in this field before the Open command is initialized. Otherwise, the Open routine will access the program status record for the cell size, allocate a zone, and store it in this field. The calling program may then reference the zone after the Open routine has been completed.
L1	The L1 address of the disc to which the file is written which is obtained from the zone allocation module by the Open routine, and which can be referenced by the calling program after the routine has completed.
CA	The disc address of the highest level connector of the file. The address is determined by the Close routine and can be referenced after the routine has completed.

Channel Initialization Load Packet



Field	Definition
A	Load requirement type 0 - Object program phase assembled for channel initiation 1 - Object program phase
B	Number of the object program phase to load - if field A is 0, then phase 0 will be loaded
C	Word address of relocation value
D	Word address of low load limit within channel space (low load limit varies according to the length of the program status record area)
E	Word address of high load limit within channel space
F	Full disc address of the object program connector cell (AK/K2/Zone/L1/Addr) - normally that found in the P field of the invoking program control instruction

PCI Input List Item Entry



Field	Definition
AK	This field contains the value of the AC register at the time the file was opened. The AC register is a register which contains the low order sixteen bits of the system absolute time clock.
K2	This field contains the value of the KG register at the time the cell is allocated in which the highest level connector cell is to be placed. The KG register is a sixteen bit counter which is read and incremented each time a cell is allocated.
Z	This field contains the disc zone in which the file resides.
L1	The time division exchange address of the disc on which the file resides.
CA	The disc cell address which contains the highest level connector cell of the file.

File Status Pointers

A	B	C	D	E	F	G	H	Spare	I
1	1	1	1	1	2	1	1	7	16

Field	Description
A	0 = Not last used word in list 1 = Last used word in list
B	0 = Read file 1 = Write file
C	0 = Output file 1 = Work file
D	0 = Not busy (may be allocated) 1 = Busy (may not be allocated)
E	0 = Work file opened 1 = Work file closed
F	00 = Disc file 01 = Tape file 10 = Tape file
G	0 = Disc connector structure has been retained 1 = Disc connector structure has been released
H	0 = Working channel is active 1 = Working channel is released
I	If Field E=0, word address of file linkage block If E=1, a 3-word File ID Bin