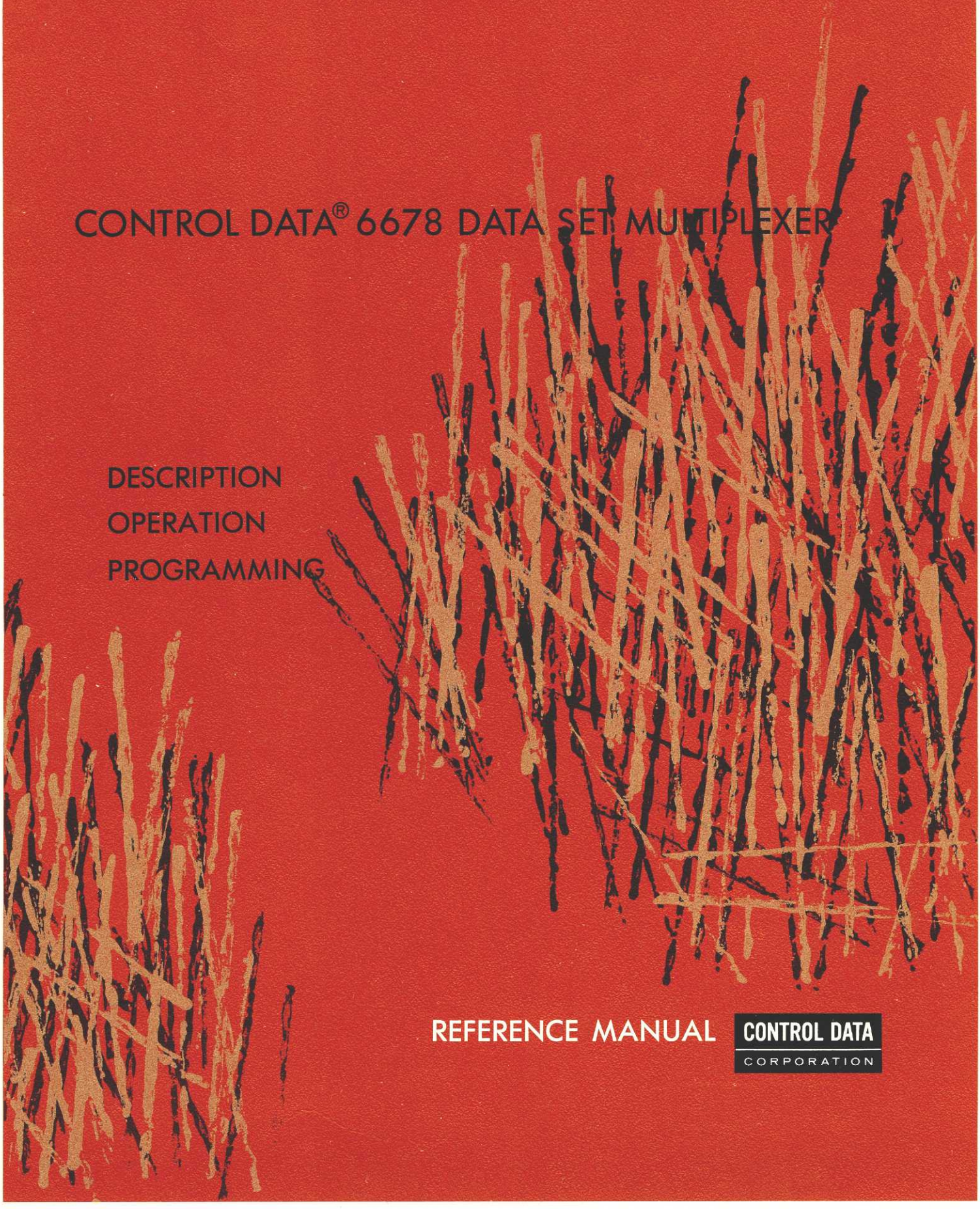
SPECIAL SYSTEMS

CONTROL DATA® 6678 DATA SET MULTIPLEXER

DESCRIPTION
OPERATION
PROGRAMMING



REFERENCE MANUAL

CONTROL DATA
CORPORATION

CONTROL DATA® 6678 DATA SET MULTIPLEXER

DESCRIPTION

OPERATION

PROGRAMMING

RECORD OF REVISIONS	
REVISION	NOTES

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PREFACE

The Communications and Special Systems Division of Control Data Corporation developed the CONTROL DATA* 6678 Data Set Multiplexer to satisfy the data communications needs of certain customers. The 6678 Data Set Multiplexer interfaces the high-speed CONTROL DATA 6000 Series computer systems to a number of medium-speed remote terminals. These remote terminals can be input/output devices such as keyboard/display systems, and can be located wherever a phone line exists. Users of Control Data 6000 Series computer systems can obtain the 6678 Data Set Multiplexer on an individual quotation basis.

This manual gives the programming codes and operating characteristics of the 6678 Data Set Multiplexer. It is assumed that the reader is acquainted with the programming (especially I/O formats) and operating characteristics of the 6000 Series computer system. This manual does not contain engineering hardware information. The following Control Data publications detail specific hardware maintenance information for the 6678 Data Set Multiplexer.

PUBLICATION NUMBER	TITLE
38706300	6678 Data Set Multiplexer Customer Engineering Manual
38702600	6678 Data Set Multiplexer Engineering Documentation

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SECTION 1

INTRODUCTION

The CONTROL DATA* 6678 Data Set Multiplexer interfaces up to 64 high-speed remote terminals (i.e., 2000 bits per second and/or 2400 bits per second) to a Control Data 6000 Series computer system. The multiplexer is designed for remote terminal communications with a large central computing facility. The multiplexer, plus its Class B** software package, allows an immediate contact between the terminal and the computer and permits maximum on-line access to the central computing facility. This permits the user to write routines, debug programs, establish files or modify existing data from the remote terminal any time he chooses without requesting scheduled time at the central facility. The remote terminal may be located adjacent to the computer or several thousand miles away, wherever a phone line connection is available.

Figure 1-1 illustrates a remote system utilizing Control Data Remote Conversational Console Stations. This remote system consists of a 6678 plus its modems (DATA PHONE*** Data Set 201 B) interfacing up to 64 Conversational Console Stations to a 6000 series data channel.

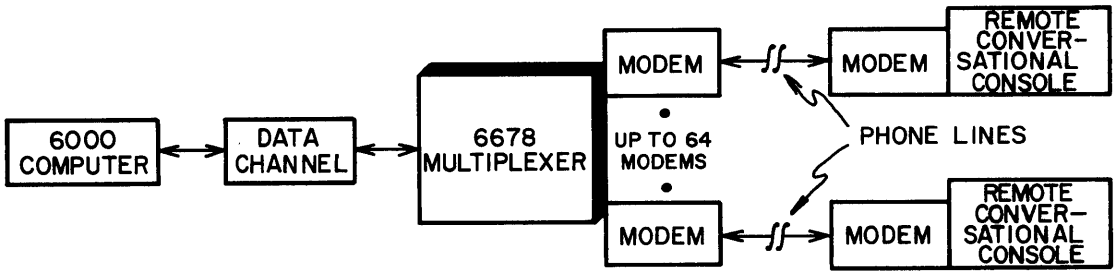

Figure 1-1. Typical 6000 Computer/6678/Remote Conversational Console Relationship

*Registered trademark of Control Data Corporation.
**Generalized remote conversational time-sharing system.
***Registered trademark of Bell System.

DATA TRANSFER RATE

The 12-bit data word transmission between the data channel and the multiplexer is at a 1 MHz rate. This rate permits input/output of a 64-word block in 64 usec. The 8-bit character transmission, plus data control pulses, between the multiplexer and the modem terminal is at 2000 or 2400 bits per second (2000 bps for 201A modem, or 2400 bps for 201B modem). The modem speed is such that, with a terminal active, the multiplexer requires an input operation every 5 ms (2000 baud) or 4.1 ms (2400 baud) or Lost Data may occur. Because of the modem I/O rate, the multiplexer requires a 5 ms or 4.1 ms delay between sequential output data blocks.

CAPABILITIES

DATA TRANSFER MODE

The multiplexer can operate in half-duplex mode and/or full-duplex mode. In half-duplex mode (denoted block mode) data transfer between the multiplxer and the modems is only in one direction (either receive or transmit) at a time. In full-duplex mode (denoted character mode) data transfer between the multiplexer and the modems may be in both directions at the same time.

DUAL CHANNEL CONTROL

An optional interface permits control by a second 6000 series data channel. This second data channel can be from the same computer system or from a completely separate computer system. Section 4 of this manual describes the changes for the optional interface.

SECTION 2

DESCRIPTION AND OPERATION

PHYSICAL DESCRIPTION

The multiplexer is contained in a standard Control Data Type B cabinet and can be installed in any area that meets computer requirements. It offers no environmental restrictions other than normal cleanliness, air circulation, and accessibility.

Cabinet Dimensions	
Height	56 7/8 inches
Width	42 inches
Depth	20 1/2 inches
Cabinet Weight	850 pounds (estimated)
Cabinet Power Requirements	400 cycle, 208 volts, 3 phase, 852 VA 60 cycle, 120 volts, 1 phase, 344 VA
Cabinet Cooling Requirements	3593 BTU/hr
Operating Temperature	60° to 80° F

FUNCTIONAL DESCRIPTION

Figure 2-1 is a functional block diagram of the multiplexer. The block diagram shows the interconnecting lines between the data channel and the multiplexer. It also shows the major circuits of the multiplexer.

DATA CHANNEL ←→ MULTIPLEXER

Data transfer between the data channel and the multiplexer must be via data blocks. These blocks contain from one to 64 12-bit data words. Each 12-bit data word may contain a data character in the lower eight bits, while the remaining four bits contain I/O control bits or unused bits. During output operations the programmer must generate the I/O control bits. During input operations the multiplexer generates the I/O control bits.

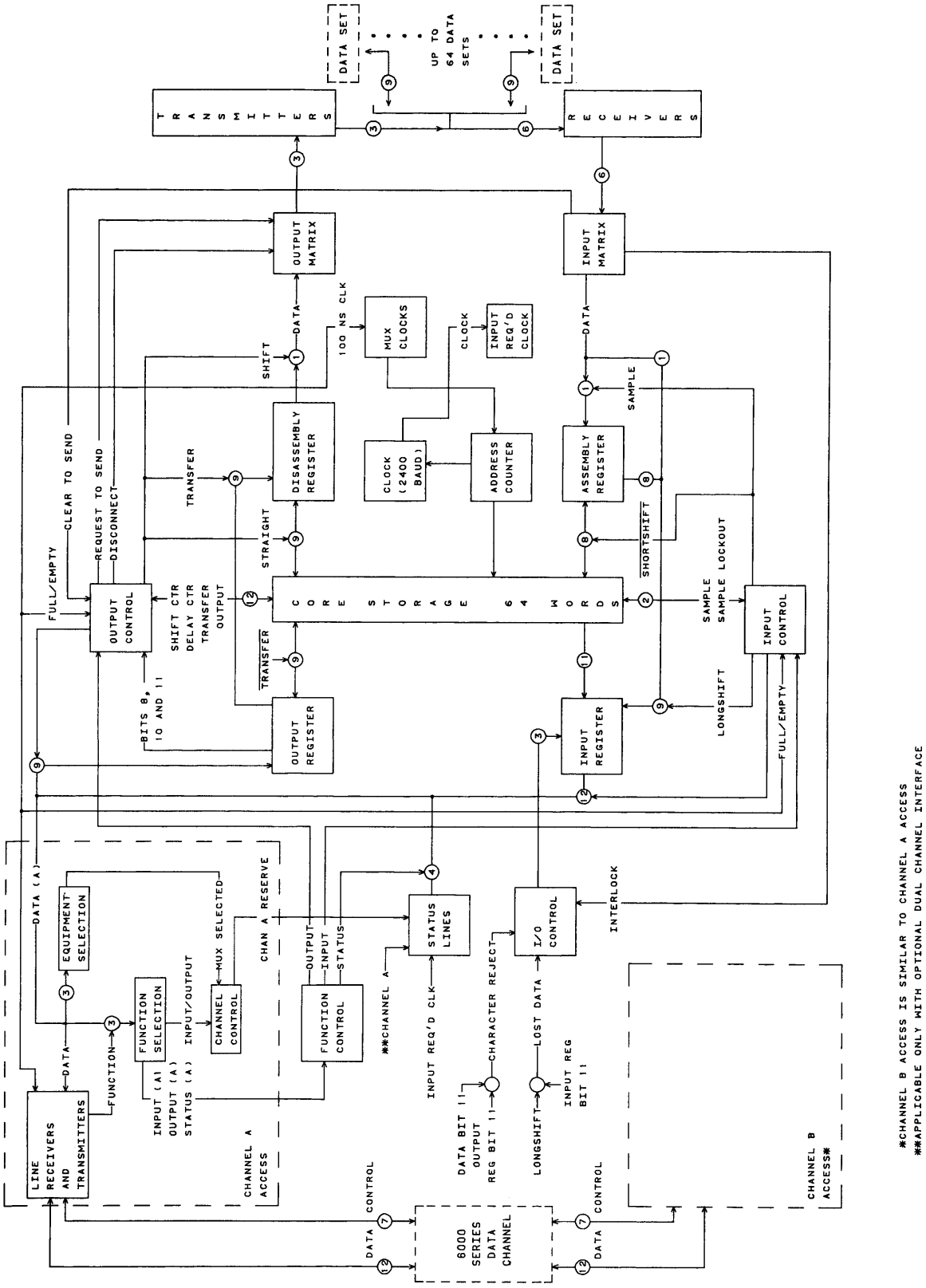

Figure 2-1. Multiplexer Block Diagram

MULTIPLEXER ←→ MODEM TERMINALS

Data transfer between the multiplexer and the modem terminals is via serial 8-bit characters plus start and stop pulses for each character. The multiplexer associates each data word in the data block with one of the 64 modem terminals. The multiplexer transfers data word 0 to and from terminal 0, data word 1 to and from terminal 1, etc. This format applies regardless of the number of terminals available or requiring service.

MEMORY

The multiplexer utilizes a 64-word, 56-bit memory core storage for buffering data to and from the data channel and terminals. The memory word bits are divided into six sections.

1) Output buffer
2) Serial output disassembly
3) Output control
4) Serial input assembly
5) Input buffer
6) Input control

Each memory word is assigned to a particular modem terminal. Memory word 0 receives data words from and for terminal 0, memory word 1 from and for terminal 1, etc. The buffered memory allows the multiplexer to output to some terminals, while simultaneously performing an input from other terminals. For example, the output disassembly memory section can perform an output to modem terminals 0 through 10, while the input assembly memory section performs an input from modem terminals 60 through 63.

FUNCTION CONTROL

To initiate a data transfer with a remote terminal, the processor must select the multiplexer via a function select code. The function select code contains an equipment code and select bits which designate the multiplexer operating modes. Upon receipt of a function code, the multiplexer generates an Inactive signal and enables the operating mode requested, or it does not respond indicating nonacceptance of the function code. Upon successfully selecting the multiplexer and an operating mode, the multiplexer is ready for an input or output operation.

OUTPUT

Upon successfully selecting output mode via a function select code, the processor activates the data channel of the multiplexer and transfers a block of data words to the multiplexer. The multiplexer stores the data block in its output buffer memory section. After completing the block storage, the multiplexer prepares the modems which require an output for a transmit operation.

Upon receipt of a signal indicating modem readiness, the multiplexer begins a memory transfer. The memory transfer consists of transferring the lower eight bits (data character) and bit 11 for each terminal from the output buffer memory section to the output disassembly memory section if the disassembly memory section of the terminal is clear. If the disassembly memory section is not clear, the memory transfer for that terminal must wait for the next memory cycle. During this memory transfer the multiplexer also transfers a start pulse to the modem if bit 11 (Output Required) is set.

Following the start pulse transmission, the multiplexer begins the serial character transmission. The serial character transmission consists of transmitting a bit to each terminal which requires an output before the next bit is transmitted to any terminal. A character for a terminal is first read from the disassembly memory section. Then the multiplexer transfers the higher-order bit to the modem and left-shifts the lower-order bits while writing them back into the disassembly memory section. The multiplexer continues this transfer for each of the modem terminals.

The multiplexer is ready for another data block following the transfer of the previous data block from the output memory section to the output disassembly memory section. The multiplexer can store a data block in the output memory section while the preceding data block is in the output disassembly memory section. If the multiplexer receives a data word for a terminal when the output memory section of the terminal is full, the multiplexer performs a pseudoaccept of the new data word and sets the Character Reject status bit.

INPUT

Upon successfully selecting input mode via a function code, the processor activates the multiplexer channel. Upon receipt of the Activate Channel the multiplexer immediately transfers a 64-word data block from the input memory section to the data channel. The data block consists of 12-bit words which contain an 8-bit data character plus I/O control bits for each active terminal. Prior to the block transfer, the multiplexer performs an assembly operation with the active terminals.

The assembly consists of assembling the serial data bits from the active terminals and storing the data characters in memory. The assembly memory section scans for a bit from each terminal before scanning for the next bit from any terminal. Upon completing a character assembly for a terminal, the multiplexer transfers that portion of the assembly memory section to the lower eight bits of the input buffer memory section of that terminal and sets bit 11 of that memory word. The assembly memory section continues assembling and transferring characters as long as serial data from the terminals is available.

Upon receipt of an input function selection followed by an Activate Channel, the multiplexer transfers the 64-word data block contained in the input memory section to the data channel. The block will contain completed data characters, and words which contain zeros although the I/O control bits can be set. Valid data characters are detected by examining bit 11 of each data word.

If the multiplexer completes assembly of a data character when the input memory of the terminal section is full, the multiplexer writes the new data character into memory (destroying the previous character) and sets the Lost Data I/O control bit and the Service Failure status bit.

OPERATION

The multiplexer is entirely program controlled, and requires no operator intervention during normal operations. Normally, multiplexer power is on when system power is on. However, multiplexer power can be turned off or on at any time by the Circuit Breaker 1 (CB1) switch in the cabinet.

MULTIPLEXER CONTROLS AND INDICATORS

The multiplexer controls and indicators consist of the cabinet controls and indicators and the multiplexer control panel.

CABINET CONTROLS AND INDICATORS

The controls and indicators are described below.

Circuit Breaker Indicator

The Circuit Breaker indicator lights when the 400 cycle circuit breaker trips or when it is in the Off position.

Thermostat Bypass Indicator

The Thermostat Bypass indicator lights when the Thermostat Bypass switch is in the On position.

Low Temperature Indicator

The Low Temperature indicator lights when the temperature of air entering the cabinet exceeds 80°, or a blower fails, or a blower does not provide sufficient air.

High Temperature Indicator

The High Temperature indicator lights when the termperature in the cabinet exceeds 110°. The 400 cycle circuit breaker trips when the High Temperature indicator lights.

CB1 Switch

The CB1 switch turns on 400 cycle power to the power supply. In the Off position, the Circuit Breaker indicator is lit.

Thermostat Bypass Switch

The Thermostat Bypass switch lights the Thermostat Bypass indicator and bypasses the equipment thermal protection.

CAUTION

With the Thermostat Bypass switch in the On position, the multiplexer does not have thermal protection. It is recommended that the multiplexer be operating in this condition only in an emergency.

CONTROL PANEL

Figure 2-2 illustrates the multiplexer control panel.

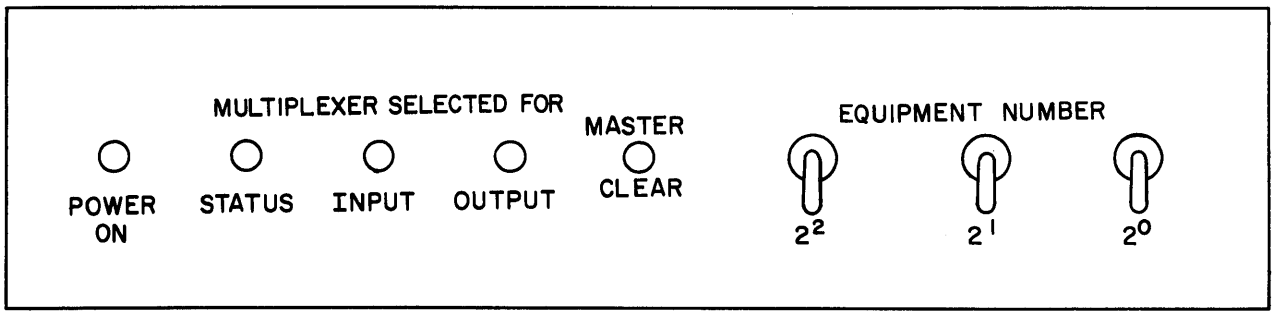

Figure 2-2. Multiplexer Control Panel

Equipment Number Switches

The Equipment Number switches determine the equipment number which the multiplexer recognizes.

Master Clear Switch

The Master Clear switch generates a clear pulse to the multiplexer circuits and the multiplexer memory.

Select Status Indicator

The Select Status indicator momentarily lights upon receipt of an X002 function code.

Select Input Indicator

The Select Input indicator momentarily lights upon receipt of an X003 function code.

Select Output Indicator

The Select Output indicator momentarily lights upon receipt of an X001 function code.

Mixed/Half Duplex Switch

The Mixed/Half Duplex switch (located on back of chassis) in the Half Duplex position indicates that the modem interfaces are all half duplex. In the Mixed position, it indicates that some or all of the modem interfaces are in full duplex. The Full Duplex Select switches designate which modem interfaces are in full duplex mode.

Full Duplex Select Switches

The Full Duplex Select (located on the back of the chassis) switches designate the modem interfaces which are in the full duplex mode. The switches designate the first full duplex modem. For example, if there are 16 terminals available, and seven of these terminals are full duplex, the Full Duplex Select switches must be set to 11_8.

SECTION 3
PROGRAMMING

FUNCTION SELECT CODES

Function select codes recognized by the multiplexer select it and initiate its three operating modes. Table 3-1 gives the multiplexer function codes and a short description. The X prefix of each function select code must compare with the Equipment Select switch setting. Function code selection does not disable the multiplexer from transferring output data characters from memory to the terminals, or input data characters from the terminals to memory.

TABLE 3-1. MULTIPLEXER FUNCTION CODES

OCTAL CODE	DESCRIPTION
X001	Select Output
X002	Select Status Request
X003	Select Input

Upon receipt of a function code, the multiplexer generates an Inactive signal to the processor indicating acceptance of the function code, or it does not respond indicating nonacceptance of the function code. The multiplexer generates an Inactive signal when bits 9 through 11 of the function code correspond to the setting of the Equipment Select switch. The multiplexer does not respond when the above conditions are not present (for example, function codes bits 9 through 11 do not match Equipment Select switch setting). After generating an Inactive signal, the multiplexer enables the selected operating mode (for example, Output, Status Request, or Input).

SELECT OUTPUT (X001)

Receipt of a Select Output function code (X001) enables the multiplexer to accept data blocks from the data channel. These data blocks can contain up to 64 data words. See word format for a sample of an output word.

STATUS REQUEST (X002)

Upon receipt of a Status Request function code (X002), the multiplexer transfers a 12-bit status word to the data channel input lines. This Status Request function code must be followed by an input operation in order to examine the status bits. See word format for the specific bit assignments of the status word.

SELECT INPUT (X003)

Receipt of a Select Input function code (X003) enables the multiplexer to transfer a data block to the data channel. Upon receipt of an Active Activate Channel instruction, the multiplexer immediately transfers a 64-word data block. See word format for an input word sample.

WORD FORMATS

The multiplexer communicates with the processor via a 12-bit data word. A 12-bit data word contains an 8-bit character, which the multiplexer receives from or transfers to the terminals, and control bits which indicate input/output conditions within the multiplexer or status bits in the case of a status word.

OUTPUT WORD FORMAT

Figure 3-1 illustrates the output word format required by the multiplexer during data transfers with the data channel.

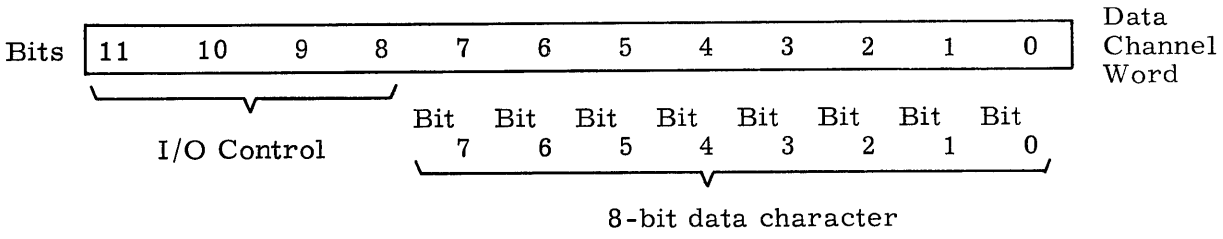

Figure 3-1. Output Word Format

8-Bit Data Character (4XXX)

Bits 0 through 7 of the data channel word contain the 8-bit character. When enabled, the multiplexer performs a serial transfer of the 8-bit character, bit 7 first, to the modem terminal.

I/O Control

Bits 8 through 11 of the data channel word are I/O control bits. These bits, via various combinations, terminate an input, disconnect the modem, act as a pass character, and act as a flag for data characters. Table 3-2 gives a short description of each octal code. Note that only Output Required (4XXX) can contain a data character in the lower eight bits of the data channel word.

TABLE 3-2. I/O CONTROL OCTAL CODES

OCTAL CODE	DESCRIPTION
0400	Terminate Input
4400	Pass Character
6000	Disconnect Modem
4XXX	Output Required

Terminate Input (0400) Bit 8 of a data channel word, when set, enables termination of the input data transfer between the multiplexer and the modem. This termination prevents the multiplexer from inputting any noise (stray signals) from the modem transmission lines for approximately 150 ms. The programmer should set this bit upon receipt of an end of message (EOM) character from a half duplex terminal. This termination will not disconnect a terminal.

NOTE

The data word which utilizes this terminate input feature should not contain a data character, because the data character will be lost.

Pass Character (4400) Bits 8 and 11 of a data channel word, when set, enable the modem control signals to remain active without having to transfer data characters. Upon receipt of the 4400 octal code, the multiplexer keeps the modem control signals active for one character time (5 ms at 2000 baud, or 4.1 ms at 2400 baud). The programmer sets these bits when a delay is required by the terminal equipment (for example, following a Master Clear to the Remote Conversational Consoles).

NOTE

The data word which utilizes this pass character feature should not contain a data character because the data character will be lost.

Disconnect Modem (6000) Bits 10 and 11 of a data channel word, when set, enable termination of the data and control signal transfer between the multiplexer and the modem. These bits generate a Disconnect signal to the modem. The programmer should set bits 10 and 11 of a data channel word to completely disconnect a terminal.

NOTE

The data word which utilizes this disconnect feature should not contain a data character, because the data character will be lost when the data transfer terminates.

Output Required (4XXX) Bit 11 of a data channel word, when set, indicates bits 0 through 7 of the word contain a data character. The programmer should set this bit when the multiplexer transfers a data character to the modems.

INPUT WORD FORMAT

Figure 3-2 illustrates the input word format utilized by the multiplexer during data transfer with the data channel.

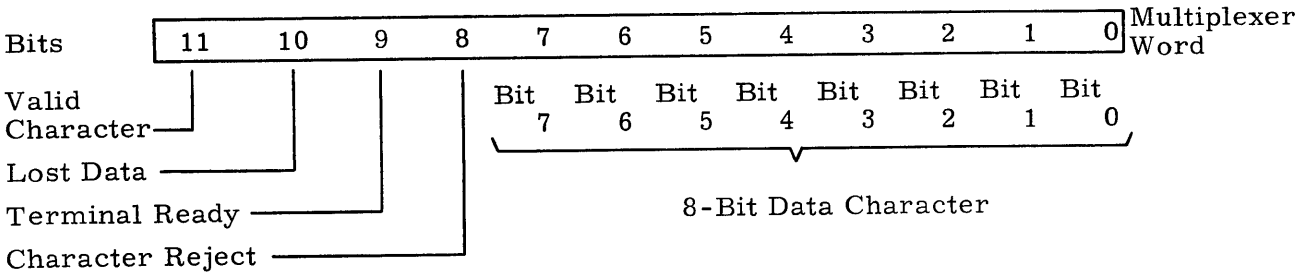

Figure 3-2. Input Word Format

8-Bit Data Character

Bits 0 through 7 of the multiplexer word contain the 8-bit data character. The multiplexer assembles the character from serial data, bit 7 first, received from the modem.

Character Reject

Bit 8 of multiplexer word, when set, indicates the multiplexer did not accept a data word because memory was full. This control bit sets if a preceding data channel output word was pseudoaccepted and discarded because the output buffer memory section was full. The multiplexer clears this control bit after transferring the input word to the processor.

Terminal Ready

Bit 9 of a multiplexer word, when set, indicates a connection exists between the terminal and the modem. This control bit sets when the modem Interlock signal is present and clears when the Interlock signal terminates.

Lost Data

Bit 10 of multiplexer word, when set, indicates the processor failed to perform an input operation within the prescribed time limit. When a terminal is active, the processor must perform an input operation within .5 ms (2000 baud) or .4 ms (2400 baud) after Input Required (status bit 1) sets. The multiplexer clears this control bit after transferring the input word to the processor.

Valid Character

Bit 11 of an input word, when set indicates bits 0 through 7 contain a data character. The multiplexer sets this bit after assembling a complete data character from an active terminal.

STATUS WORD FORMAT

Status permits the processor to determine the condition of the multiplexer. To determine the multiplexer status, the processor issues a Status Request function select code (X002), followed by an input operation. Figure 3-3 is the format of the multiplexer status response word.

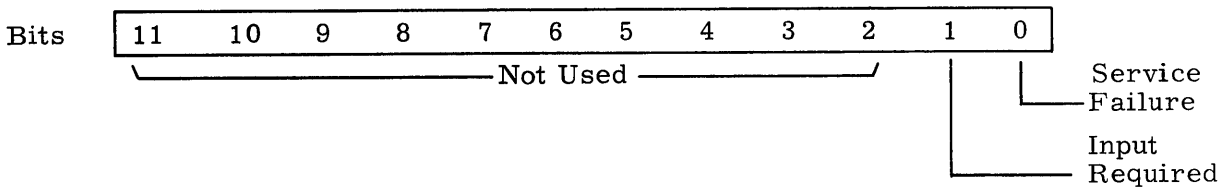

Figure 3-3. Status Response Word

Service Failure (0001)

Status bit 0 sets when the processor fails to perform an input operation within 5 ms or 4.1 ms after Input Required sets. Status bit 0 indicates the possibility of Lost Data. The multiplexer clears status bit 0 upon receipt of a Select Input function code.

Input Required (0002)

The multiplexer requests an input operation when status bit 0 is set. The Input Required status bit is a clock function which sets when 90 percent of a character time has elapsed. The character rate of terminal 0 determines the period of the clock. The input operation requested by the status bit should follow within .5 ms (2000 baud) or .4 ms (2400 baud) or Lost Data may occur.

PROGRAMMING CONSIDERATIONS

STATUS

The multiplexer has two types of status available which are equipment status available via a Status Request function code, and operation control status available via an input word. The equipment status consists of Service Failure and Input Required. The operation status consists of Lost Data and Terminal Ready indications for input operations, and Character Rejected indications for output operations.

OUTPUT STATUS CHECK

In order to obtain complete status of an output operation, it is necessary to follow the output operation with an input operation. The terminal for which an output character has been rejected will have bit 8 set in the next input word for that terminal. For example, if an output character to terminal 10 (word 10 of the output block) is rejected, the next input block will have bit 8 set in word 10.

DATA BLOCK LENGTH

For multiplexer installations which control less than 64 terminals, the input/output data block length can be a function of the terminals available. For example, if a multiplexer only controls 16 terminals, the I/O data blocks need only be 16 words if the terminals are consecutively numbered starting with terminal 0. The multiplexer considers all data transfers start at terminals 0.

The output data block length can also be a function of the number of active terminals. If terminal 10 is the only active terminal, the output data block can then be 10 words.

OUTPUT TIMING

The multiplexer is capable of accepting a 64-word data block from the data channel in 64 μsec (1 μsec/word). The complete output, including disassembly and transfer, requires an additional 4.1 ms (2400 baud) or ms (2000 baud). If the multiplexer receives a new data word before the preceding word is in the disassembly memory section, the new word will be lost and Character Rejected sets in the next input word. Because of these output timing restrictions, it is recommended that each output block be followed by an input block in which bit 8 is checked.

INPUT TIMING

The multiplexer is capable of transmitting a 64-word data block to the data channel in 64 μsec (1 μsec/word). The time required by the multiplexer to assemble a complete

input code from a terminal is 4.1 ms (2400 baud) or 5 (2000 baud) ms. After assembling a character, the multiplexer transfers it into the input buffer memory section.

With a word assembled and status bit 1 set (status bit 1 sets when 90 percent of the character is assembled), an input to the data channel must be activated within .4 ms (2400 baud) or .5 ms (2000 baud) or the word is lost and Lost Data sets in the corresponding word.

PROGRAMMING EXAMPLE

Figure 3-4 is a flow chart of a multiplexer servicing routine. The program is a sample to aid in the understanding of the multiplexer operations. Programming the multiplexer is similar to programming other peripheral equipment. A typical order of programming steps follows.

1) Clear (dead start)
2) Function select status (determine if multiplexer requires service)
3) Function select output (output data to terminals)
4) Function select input (input data plus I/O control bits for terminals)

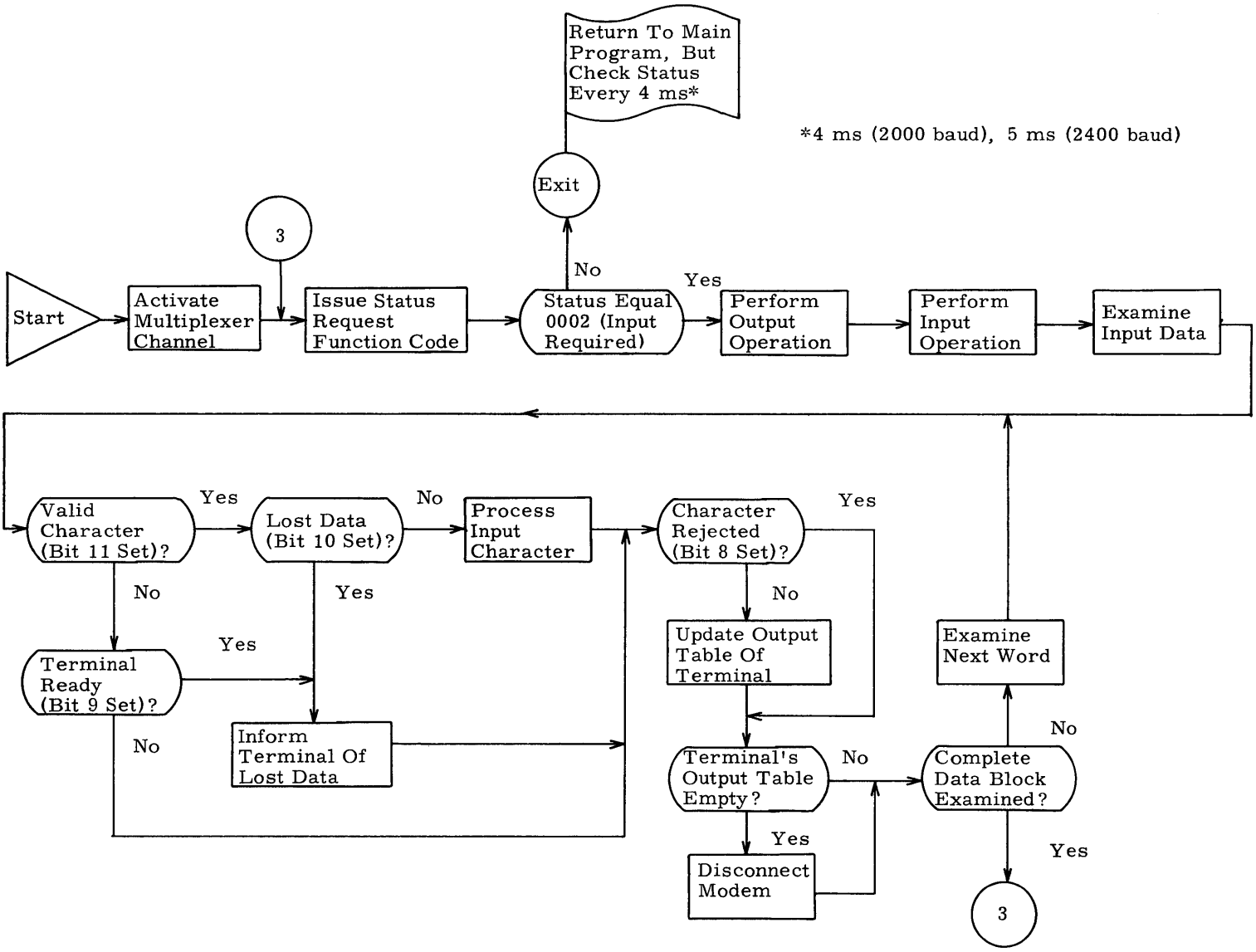

Figure 3-4. Sample Multiplexer Servicing Routine

SECTION 4

OPTIONAL INTERFACE INFORMATION

This section provides operating and programming information for the optional dual access interface.

DESCRIPTION AND OPERATION

The description and operation of the dual access multiplexer is the same as the single access multiplexer described in Section 2 of this manual. However, the dual access multiplexer contains another control panel (Equipment Select and Master Clear switches, and Select Status, Select Input, and Select Output indicator) minus the Mixed/Half Duplex and Full Duplex Select switches. Figure 4-1 illustrates a 6678 plus its modem (DATA PHONE Data Set 201B) interfacing Remote Conversational Consoles to a 6600 computer system via the optional dual channel interface.

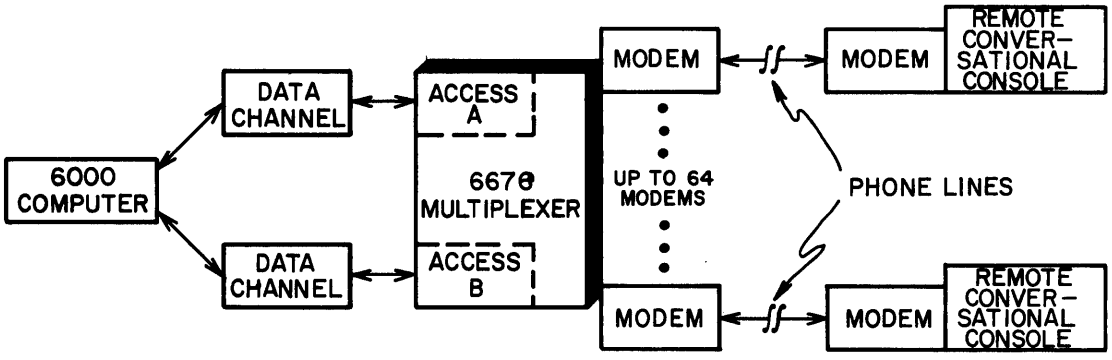

Figure 4-1. 6600/Dual Channel 6678/Remote Conversational Console Relationship

PROGRAMMING

FUNCTION SELECT CODES

Table 4-1 contains the dual access multiplexer function select codes. The "X" prefix of each function code must compare with one of the Equipment Select Switch settings.

TABLE 4-1. DUAL ACCESS MULTIPLEXER FUNCTION CODES

OCTAL CODES	DESCRIPTION
X001	Select Output
X002	Select Status Request
X003	Select Input
X004	Select Reservation

Select Output, Status Request, and Input

These function codes are described in Section 3.

Select Reservation

Receipt of a Select Reservation function code (X004), connects the multiplexer to the data channel issuing the function code. This reservation function code must precede an input or output function code. This code clears all previous function codes, including a reservation made by another data channel. The multiplexer accepts Request Status function codes from either data channel even though the multiplexer is reserved.

STATUS

Figure 4-2 is the status response format for a dual access multiplexer.

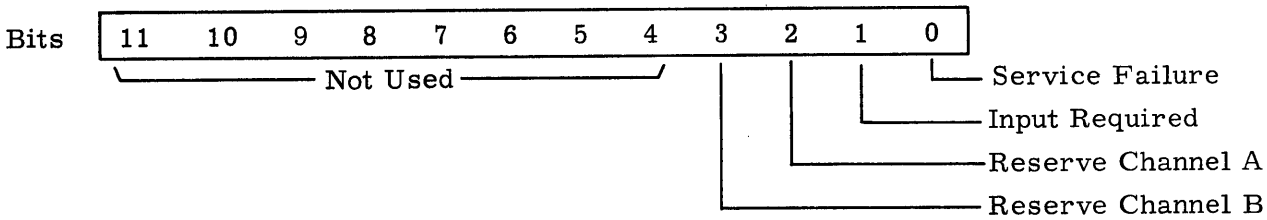

Figure 4-2. Dual Access Multiplexer Status Response Word

Service Failure, and Input Required

These status bits are described in Section 3.

Reserve Channel A

The multiplexer is reserved by peripheral processor A. This status bit clears only when peripheral processor B issues a Select Reservation function code.

Reserve Channel B

The multiplexer is reserved by peripheral processor B. This status bit clears only when peripheral processor A issues a Select Reservation function code.

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