60334600

CONTROL DATA CORPORATION

CONTROL DATA®
6671/6671-2
DATA SET CONTROLLER
STANDARD OPTION 10295-1

HARDWARE REFERENCE MANUAL

New features, as well as changes, deletions, and additions to information in this manual are indicated by bars in the margins or by a dot near the page number if the entire page is affected A bay by the page number indicates pagination rather than content has changed.

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or use Comment Sheet in the back of this manual.

PREFACE

This manual contains system application, descriptive, operational, and programming information on the CONTROL DATA® 6671/6671-2 Data Set Controllers. Standard Option 10295-1 provides the additional capability for 134.5 baud and 300 baud operation. Customer Engineering information is in separate manuals. Refer to the Literature Distribution Services Catalog for ordering information.

NOTE

EXCEPTION TO COMPLIANCE WITH EIA STANDARD RS-232-C

The 6671 and 6671-2 Data Set Controllers do not comply with the following statement in EIA Standard RS-232-C: "The data terminal equipment shall hold circuit BA {Transmitted Data} in a marking condition during intervals between characters or words, and at all times when no data is being transmitted." The Transmitted Data circuit in the 6671/6671-2 is in a spacing condition when no data is being transmitted if a port is selected for synchronous {201} mode.

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FIGURES

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DATA SET CONTROLLER

The CONTROL DATA® 6671/6671-2 Data Set Controller are multiplexers which interface CONTROL DATA® CYBER 70 or 6000 Series Computer Systems with remote communications terminals. The 6671 has a maximum DSC⟷modem transfer rate of 2400 baud. The 6671-2 has a maximum DSC⟷modem transfer rate of 4800 baud. Terminals can be located several thousand miles away, anywhere that voice-grade telephone lines or telephone data service is available, thus providing immediate on-line access to a centrally located 6000 Series computing facility. The data set controller (DSC), together with a software package, permits users at remote terminal locations to write routines, debug programs, establish files, and modify existing data at any time without the necessity of requesting computer time. A typical 6000 Series computer interfaced with remote communications terminals is shown in Figure 1.

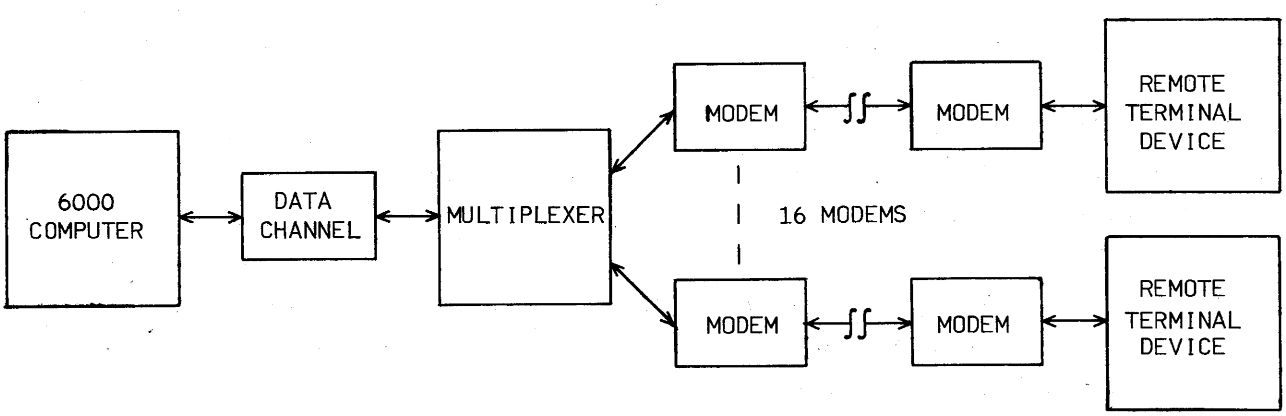

Figure 1. Typical Controller Application

FUNCTIONAL DESCRIPTION

The DSC interfaces as many as 16 remote-terminal modems (AT&T 103 Teletype Data Sets, 201A/B Dataphone Data Sets, or any standard interface as defined by EIA RS232 specifications). The 16 terminals can be arranged with any combination of modems.

DATA TRANSFER

Rate

The transfer rate of 12-bit data words between the 6000 Series Data Channel and the DSC is approximately 0.5 MHz. This permits the input of a 16-word block in approximately 32 μsec. Transmission rates of 8-bit characters (plus Data Control pulses) between the DSC and remote-terminal equipment are determined by the modem as follows:

103 Data Set	110, 134.5, **300** baud*	6671 or 6671-2
201A Data Set	2000 baud	6671 or 6671-2
201B Data Set	2400 baud	6671 or 6671-2
Milgo 4400/4800 Data Set	4800 baud	(6671-2 only)

At these rates, with a terminal active, the DSC requires an input operation every 100 ms (110 baud), 66.92 ms (134.5 baud**), 33.33 ms (300 baud**), 4 ms (2000 baud), 3.3 ms (2400 baud) or 1.65 ms (4800 baud) or data may be lost.

Mode

The DSC operates in both Half- and Full-Duplex modes, the mode being determined by the type and configuration of modem used. Data is transferred between the DSC and terminals in only one direction at a time (either transmit or receive) in the Half-Duplex mode and in both directions at the same time in the Full-Duplex mode. The 6671-2 DSC is capable of Full-Duplex operation with 16 4800-baud data terminals in either Line or Consecutive Character Data Block mode (16 2400-baud data terminals for the 6671 DSC). The number of possible system configurations is dependent on the various modem speeds used and on the nature of the software operating system. The interconnecting transmission lines between the DSC and the Data Channel and the major DSC circuits are shown in Figure 2.

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*Baud=bits per second
**Applies to Standard Option 10295-1 only.

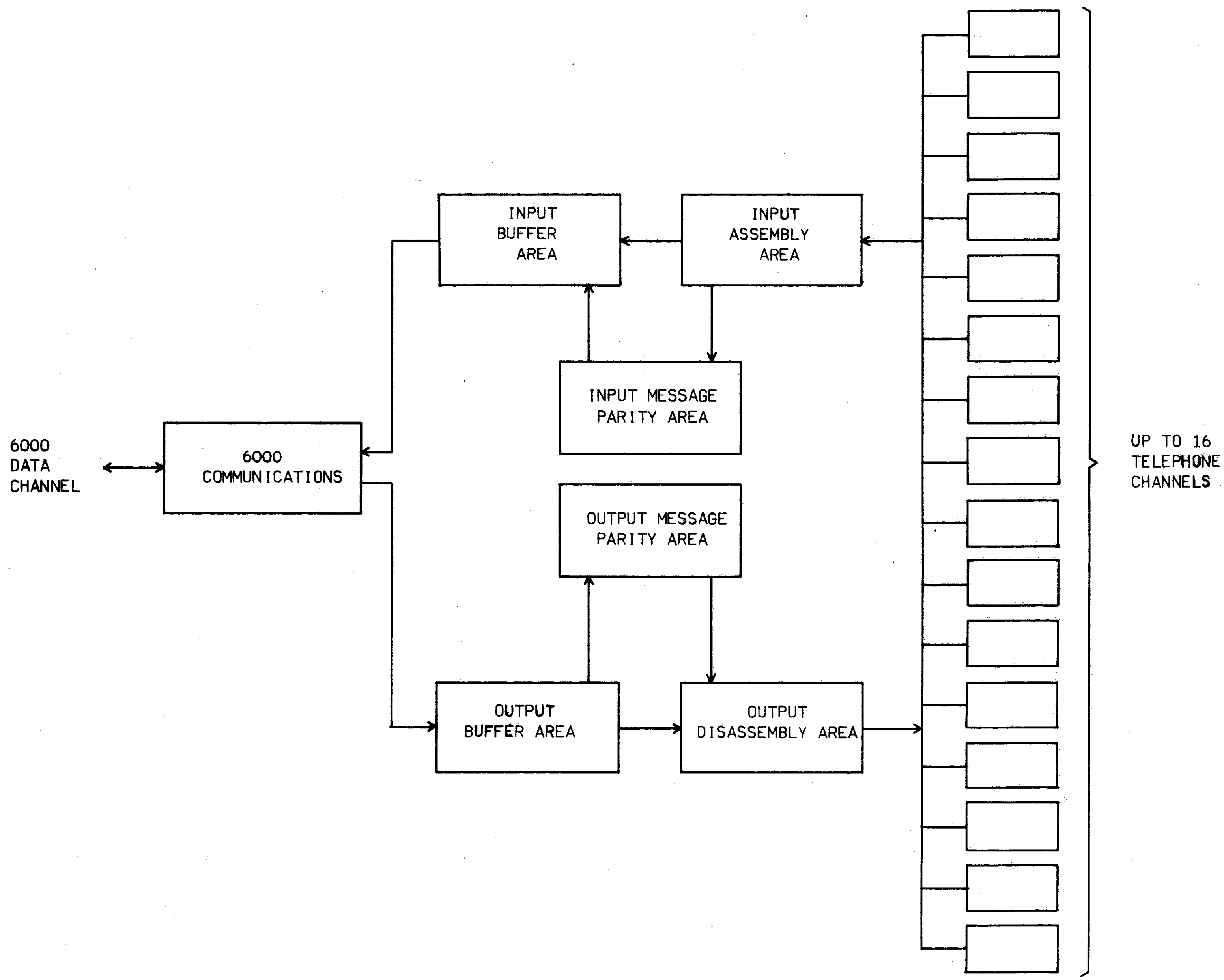


Figure 2. Controller Block Diagram

Data Channel⟷Controller

The transfer of data between the Data Channel and the DSC is in blocks containing from one to sixteen 12-bit data words. Each 12-bit data word uses the lower 8 bits to form a data character and the remaining 4 bits, as necessary, for I/O control. During output operations, I/O control bits must be generated by the programmer; during input operations, status bits are generated by the DSC.

Controller ⟷Modem Terminals

The transfer of data between the DSC and the modem terminals is performed serially by means of 8-bit characters plus additional Start/Stop pulses, if required, for each character. The DSC then associates each data word in the data block with one of the sixteen terminals. It transfers data word 0 both to and from terminal 0 and transfers subsequently numbered data words to and from correspondingly numbered terminals. This format (order of operation) applies regardless of the number of terminals available or that require service. With 201 Data Sets, the DSC attaches a message parity character (MPC) to the output Data Channel message (the MPC itself has odd character parity). Incoming data is checked for USASCII formated messages, and a message parity check character replaces the incoming MPC (MPC character parity not checked).

DATA STORAGE

Locations

The DSC uses a 64-word, 28-bit-per-word core memory (only 25 bits are actually used) to buffer data/control information to and from the modems. Sixteen core locations are used to store information received from or sent to the 6X00 Data Channel. A second group of 16 memory locations stores information used to control the disassembly of output characters. A third group of 16 memory locations stores information used to control the assembly of input characters. The final 16 locations store the MPC for input/output data.

Memory locations are assigned four to a communications channel. For example: memory locations 0-3 are associated with channel zero, locations 4-7 with channel 1, etc. During an I/O operation with the computer each word sent to the DSC is stored in one of the four locations associated with the channel for which it was intended. Words sent to the computer from the DSC are read from one of the four locations associated with the channel from which it was derived.

Each communication line operation requires that the three words (buffer, input, and output) be read for processing. The MPC word is read only when a character is completed and when a MPC must be updated or generated.

Memory Words

Core memory is partitioned according to line channels. Each line channel has an input information word, an output information word, a buffer word, and a message parity character associated with it (Figure 3).

The first word read from core memory during the processing of a telephone channel is the output information word which is read from location XXXX00. This word contains the following information:

Bits 0-7	Data in the process of being disassembled.
Bits 8-11	Clock count (used for 103 teletype timing and synchronization).
Bits 12-15	Bit count to keep track of the disassembly process.
Bits 16	Indicates that an I/O instruction was in progress when this telephone channel was previously processed. The I/O operation will resume upon completion of this processing.
Bit 18	Used for synchronization of teletype data.
Bits 21-23	Used to convey carrier and phone line connection information to the telephone channel such that data is not lost.

The second word read from memory is the buffer word which is contained in the Output/Input Buffer registers and is read from location XXXX01. The Output Buffer holds in bits 0-11 information received from the Data Channel.

Next the updated output information word is returned to memory. The input information word is then read from location XXXX11. This word contains the following information:

Bits 0-7	Data in the process of being assembled.
Bits 8-11	Clock count (used for 103 timing and synchronization).
Bits 12-15	Bit count to keep track of assembly process.
Bits 16-17	Synchronization indicators for 201 modems.
Bits 18-20	Synchronization indicators for 103 modems.

After the reading of the input information word, the MPC word is read from memory location XXXX10 if either the input or output portions of the telephone channel require MPC updating. This word contains the output MPC in bits 0-7 and the input MPC in bits 12-19. Bit 20 indicates the next input character will be an MPC. The MPC word is then returned to memory.

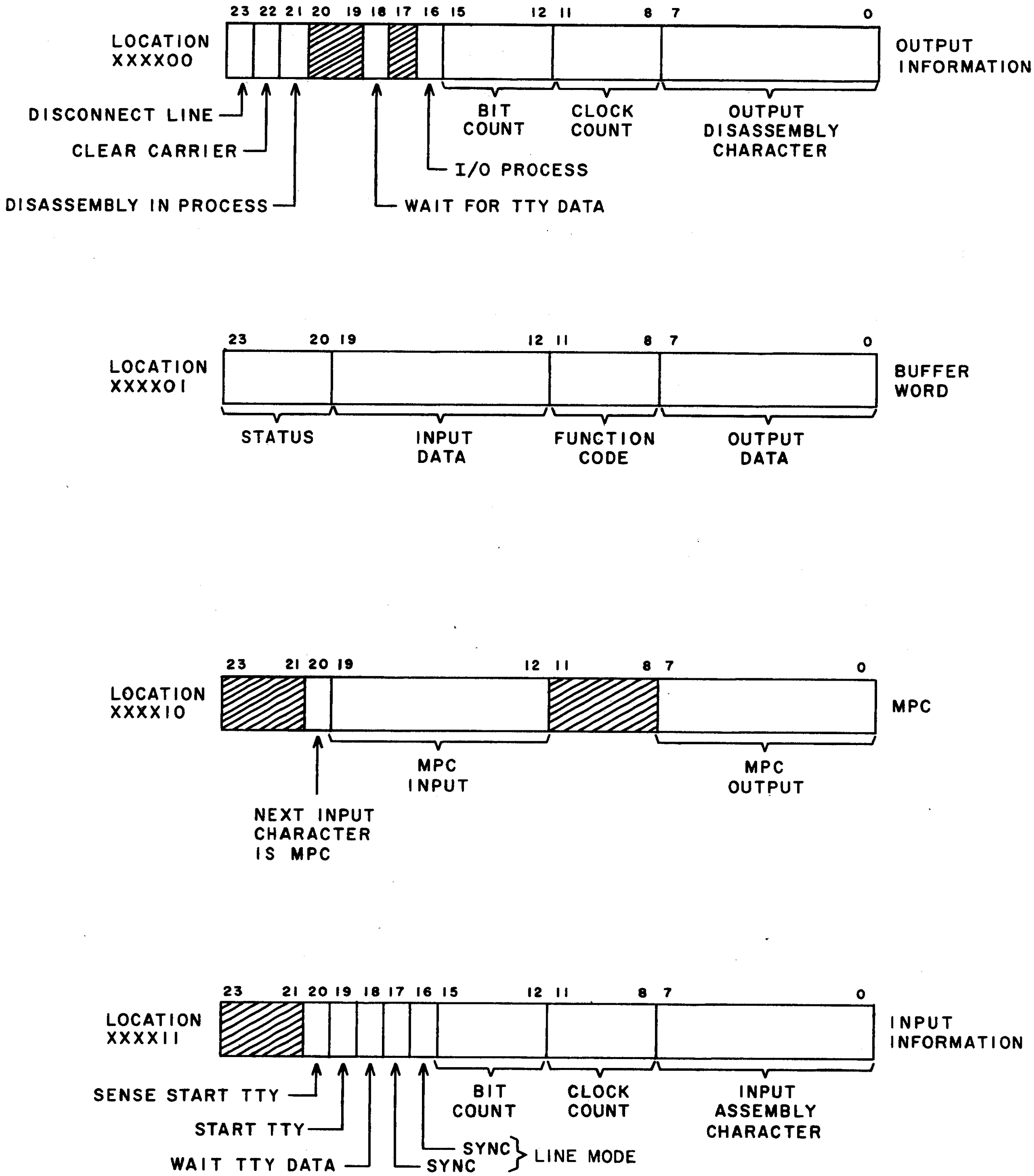


Figure 3. Memory Word Formats

Regardless of whether the MPC processing is performed or not, the final events are the return of the updated buffer and input information words to memory (in that order).

DATA CONTROL

To initiate a data transfer to a remote terminal, the processor must select the DSC by means of a function select code. This code contains an equipment code and select bits which designate the DSC operating modes. Two basic methods of sending function select codes to the DSC exist. One selects operating modes for the entire DSC and includes data transfers to or from the Data Channel and the presentation of DSC status. The other selects an operating mode for a single communication channel and includes the information necessary for the control of the modem. This latter function select code is transmitted to the DSC as part of an output word.

The DSC must receive a function select code before it can generate an Inactive and enable the requested operating mode. Nonacceptance of a code is indicated by no response from the DSC. The DSC is ready for an I/O operation when the processor has successfully selected the DSC and an operating mode by means of one of the codes in Table 1.

Data Output

The processor, after selecting the output mode with a function select code, activates the DSC Data Channel and transfers a block of data words to the DSC. The data block is held in the DSC Output Buffer register. If the DSC receives a data word for a terminal when the Output Buffer register for that terminal is full, the DSC performs a pseudo-accept of the new data word and sets the Character Reject status bit. After completing the block storage, the DSC prepares the terminals which require an output for transmit operation. The DSC begins a data buffer transfer (if there is a valid character in the buffer) after receiving a signal indicating terminal readiness. The lower 8 bits (data character) for each terminal are transferred from the Output Buffer register to the Output Disassembly register if the disassembly section of the terminal is clear. If the Output Disassembly is not clear, the data transfer for that terminal must wait for the next data-transfer cycle. The DSC also transfers control information to the modem during the data transfer.

The bits are transferred to the modem according to the serial pattern set for 103 or 201 (see Table 4). Data Sets and this transfer continues for each of the terminals. The DSC is ready for another data character following the transfer of the previous data character from the Output Buffer register to the Output Disassembly register. The DSC can store the next data character in the Output Buffer register while the preceding data character is in the Output Disassembly register.

Data Input

The terminal data input consists of taking the serial data bits from the active terminals and reassembling them in the Input Assembly register. When a character has been reassembled, the DSC transfers its data portion to the lower 8 bits of the memory area for that terminal and sets bit 11 of the Input Buffer register of that terminal. The Input Assembly continues the reassembling and transferring of characters as long as serial data from the terminals is available.

After receiving an input function selection and a subsequent Activate pulse, the DSC transfers to the Data Channel up to 16 12-bit data words (contained in the Input Buffer). The data blocks may contain both completed data characters and words which contain zeros even though the I/O control bits may be set. The validity of data characters is detected by examining bit 11 of each data word.

If the DSC should complete the assembly of a data character when the Input Buffer of the terminal section is full, it writes the new data character into the buffer, destroying the previous character, and sets the Lost Data I/O control bit.

SIGNAL SYNCHRONIZATION

103 Data Set

Teletype Output: The DSC accepts a 12-bit word from the processor if the valid data bit of the word is set and transfers the lower 8 bits (0 through 7) to the Output Disassembly register. The DSC adds to this 8-bit data character a Start bit and two Stop bits (these synchronizing bits are deleted during Receive) to form an 11-bit asynchronous character. This 11-bit word is then disassembled and transmitted serially beginning at an integral bit time.

Teletype Input: A Start bit from the modem is initially issued to the DSC. This Start bit is sampled several times to eliminate synchronization on a noise pulse. At 1/10 of a bit time after initiation, the DSC checks to determine if the Start bit has persisted. If it has, the DSC checks it again at what would be the center of the Start bit. If a Start bit is still present, the DSC begins to time out the next 10 bit times and samples each of them. The DSC assembles this character, sends it to the Input Buffer register, and then awaits another Start bit from the modem.

201A/B Data Sets

The DSC receives clock information from the modem (201A/B or its equivalent) for data both received and transmitted. It does not itself supply clock pulses to the modem.

Clocked Output: After receiving a 4XXX data word on a telephone-channel output, the DSA places the modem in the proper condition, if required, for data transmission. The 6671 presents the first data bit to the modem at the first clock pulse following confirmation of the modem condition. The 6671-2 presents the first data bit to the modem at the second clock pulse following confirmation of the modem condition.

The controlling computer program must generate synchronizing characters according to those required by the remote site along with the header, data, and end of message (EOM). The DSC appends the MPC with odd character parity immediately after the EOM character. MPC is calculated from the start of message (SOM) header character. Note that all characters are standard USASCII types.

Output data bits are transmitted at each clock pulse received from the modem. Any code needed for synchronization of receiving equipment must be supplied by the controlling computer program. (Refer to the appropriate equipment reference manual to determine the types of codes required.) The DSC sets the Output Failure status bit when a break in the flow of transmitted data occurs if the computer does not supply data characters at a fast enough rate.

Clocked Input: The processor initially sends an xx1XXX code to a specific telephone channel which returns bits under modem-clock regulation. The DSC monitors the incoming data until it detects an 8-bit 026 code (USASCII sync character). It then records the character and accepts another 8-bit byte. It examines this byte to determine if it is a 026 code. When two consecutive 026 codes are sensed, the DSC logic is synchronized with the data characters that follow. The DSC ignores any subsequent 026 codes after establishing synchronization. If a second 026 code is not found, the DSC logic senses a non-synchronized condition exists and continues to check for two consecutive 026 codes.

The processor controlling the DSC must send an xx1XXX word to the DSC prior to the arrival of the first 026 code word, and any device supplying clocked information to the DSC must send a minimum of four 026 code words before each message to provide synchronizing reliability. Sync codes are never considered valid data.

Once synchronized, the DSC must be sent a function code to cause it to inaugurate a Sync Seeking sequence.

Message Parity Character

MPC Output: The DSC begins computing a message parity character when it transmits an USASCII SOM character. Any USASCII sync codes contained in the message which follows are ignored. The DSC appends a MPC with odd character parity immediately after the EOM character is transmitted.

MPC Input: The DSC begins computing a MPC when it receives an USASCII SOM character. USASCII sync codes contained in the message are ignored. After receipt of an EOM, the DSC takes the logical difference between the lower 7 bits of the next assembled character (incoming MPC) and its calculated MPC and sends it to the Input Buffer register.

PROGRAMMING

FUNCTION SELECT CODES

Function select codes (Table 1), after being recognized, select the DSC and designate its normal operating mode. Function code selection does not prevent the DSC from transferring output data characters from the buffer to the terminals, nor does it prevent input data characters from being transferred from the terminals to the buffer registers.

TABLE 1. FUNCTION SELECT CODES

Octal Code	Description
X001*	Select Output
X002	Select Status Request
X003	Select Input
*The X portion must correspond to the setting of the Equipment Number switches. Note: Additional codes are used for diagnostic test routines (see CE Manual).	

Select Output (X001)

Receipt of this code enables the DSC, causing it to accept data blocks from the Data Channel. These blocks consist of as many as 16 data words. Figure 4 illustrates the output word format.

Select Status Request (X002)

The DSC transfers a 12-bit status word to the Data Channel input lines when it has received a X002 code. This code must be followed by a one word input operation in order to examine the status bits. Specific bit assignments are given in Figure 5.

Select Input (X003)

A Select Input code enables the DSC, causing it to transfer a data block to the Data Channel. As soon as it receives an Active (Activate Channel instruction), the DSC transfers a data block of up to 16 words (Figure 4). For block lengths less than 16 words, refer to Programming Considerations, Input Block Length.

After receiving a function select code, the DSC sends an Inactive to the processor to indicate it has recognized and accepted the code (no response by the DSC indicates it has not accepted the code). An Inactive is generated by the DSC when bits 9 through 11 of the function select code correspond to the code determined by the setting of the Equipment Number switches and a recognized operation select code has been received. These switches (located at J022A/B/C, respectively) are UP for a "1" and DOWN for a "0". After generating an Inactive, the DSC enables the selected operating mode (Output, Status Request, or Input) when it receives an Active from the Data Channel.

DATA WORD

The DSC communicates with the processor by means of a 12-bit data word. The 12-bit data word is comprised of either an 8-bit character which the DSC receives from or transfers to the terminals together with 4 output-control bits or 4 input-status bits, or a 12-bit status character (status word). The position of a word in the data block determines the channel with which it will be associated. For example: The first word in the block is associated with channel 0, the second with channel 1, etc.

Output Word

The output word format required by the DSC during data transfers with the Data Channel is shown in Figure 4.

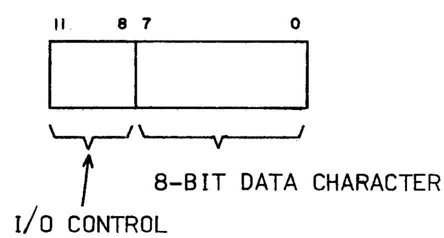


Figure 4. Output Word Format

The lower 8 bits (0 through 7) of the output word form the data character. The DSC, when enabled performs a serial transfer of the 8-bit data characters as shown in Table 2.

TABLE 2. DATA CHARACTER SERIAL TRANSFER

103 Teletype			201 Clocked Form		
Transfer Sequence	Bit	Data Character Bit Position	Transfer Sequence	Bit	Data Character Bit Position
1	0	Start	1	0	0
2	1	1	2	1	1
3	2	2	3	2	2
4	3	3	4	3	3
5	4	4	5	4	4
6	5	5	6	5	5
7	6	6	7	6	6
8	7	7	8	7	7
9	8	0			
10	9	Stop			
11	10	Stop			

The upper 4 bits (8 through 11) of the output word provide I/O control and act, in various combinations, either as a flag for data characters or as a control for the modem. Any data to be transmitted must be accompanied by either a 4XXX or a 5XXX function code (see Table 3) which turns on the carrier. At least one character time should elapse before the processor sends out a 4XXX or 5XXX code if a 2XXX, 3XXX, or 6XXX function code was previously sent out to turn off the carrier.

TABLE 3. CONTROLLER DATA WORD FUNCTION CODES

Code	Description
0XXX	A do-nothing function; no data is transferred.
1XXX	Enables the receiver section of the DCS to resync*. Does not affect the carrier or the line connection. No data should be contained in this word.
2XXX	Turns off the carrier. No data should be contained in this word.
3XXX	Turns off the carrier and allows the receiver to resync. No data should be contained in this word. The valid data character preceding this function code is transmitted prior to carrier turn-off. Note that MPC's appended to a clocked-data modem message are considered to be valid data characters.

*The resynchronization is immediate and does not wait for completion of the input character.

TABLE 3. CONTROLLER DATA WORD FUNCTION CODES (Cont'd)

Code	Description
4XXX*	Turns on the carrier. Must be appended to all data words (see 5XXX code description).
5XXX	Turns on the carrier and resyncs the receiver. Can contain data to be transmitted; primarily a function for Full-Duplex operation. Should be used whenever it is desirable to resync the receiver and transmit data simultaneously.
6XXX	Resyncs the receiver, turns off the carrier, and disconnects the telephone connection. No data should be contained in this word. Used primarily to disconnect the phone line. NOTE The 2XXX, 3XXX, and 6XXX codes await the disassembly of the previous valid character before they affect the carrier; 4XXX and 5XXX codes act immediately. The 6XXX code does not wait for completion of the last bit of the last output character before becoming active. Software timing for the use of the 6XXX code is desirable.
7XXX	Resyncs the receiver and enables the telephone connections for data transmissions. This word contains no information to be transmitted.
X(1xx)XX (Bit 8 set)	Used to disconnect a modem when output operation has failed in the middle of a character. Indicates that any valid character in the Output Buffer should be ignored, and that any data accompanying the function code should be transferred into the buffer memory. The DSC does not recognize that it is disassembling a character on this terminal and it executes the incoming function.

* When outputing with a 6671-2 DSC, a 4XXX code should be sent after each MPC (Message Parity Character) so that the 6XXX code does not cut off the last bit of the MPC.

Output Word (134.5 baud** only)

Each 12-bit output data character transmitted from the processor to the DSC must have a character stop bit, a one, in the lowest bit position. Each output data character transmitted from the processor has the format shown in Figure 5.

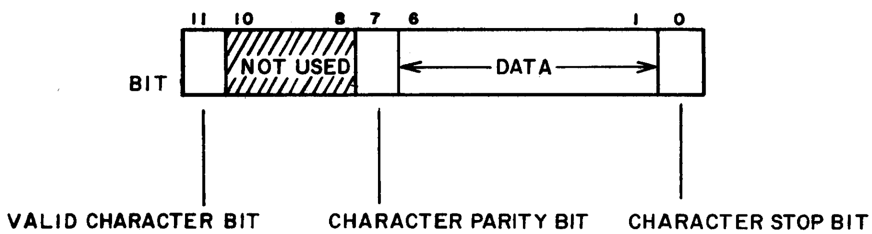


Figure 5. Output Word Format (134.5 baud)

Input Word

The input word format used by the DSC during data transfer with the Data Channel is shown in Figure 6.

**Applies to Standard Option 10295-1 only.

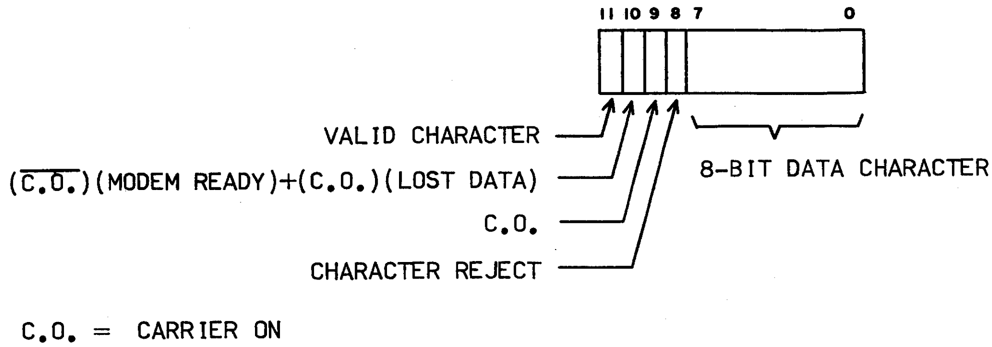


Figure 6. Input Word Format

Data Character (Bits 0 through 7): The lower 8 bits (0 through 7) of the input word form the data character. The DSC forms this character serially from data received from the modem. An all-zeros data character is transferred to the Data Channel when a MPC is passed by the DSC and no error has occurred. A non-zero character is transferred to the Data Channel if an error has occurred. The order of data character assembly is shown in Table 4.

TABLE 4. DATA CHARACTFR ASSEMBLY/DISASSEMBLY

103 Teletype			201 Clocked Format	
MODEM Bit Order	BIT USE Assembly	Disassembly	MODEM Bit Order	BIT USE Input and Output
1	Discard	Start (0)	1	0
2	1	1	2	1
3	2	2	3	2
4	3	3	4	3
5	4	4	5	4
6	5	5	6	5
7	6	6	7	6
8	7	7	8	7
9	0	0		
10	Discard	Stop (1)		
11	Discard	Stop (1)		

Character Reject (Bit 8): Bit 8 of the DSC input word sets if a Data Channel output word has been pseudo-accepted and then discarded (output buffer for that terminal was full). This control bit indicates that the DSC has not accepted a data output word. The DSC clears bit 8 after transferring the input word to the processor.

Terminal Ready (Bit 9): Bit 9 is set when the modem Interlock signal is present and indicates that a connection exists between the terminal and the modem. Bit 9 clears as the Interlock signal terminates.

Lost Data (Bit 10): When set, bit 10 of the DSC word indicates that the processor has failed to perform an input operation before the next character has been assembled. When a terminal is active, the processor must perform an input operation within 100 ms (110 baud), 66.92 ms (134.5 baud**), 33.33 ms (300 baud**), 4 ms (2000 baud) or 3.3 ms (2400 baud) after Input Required sets (status bit 1). The DSC clears control bit 10 after transferring the input word to the processor. Note that USASCII sync characters (026 code) are not considered to be data and, as such, do not cause a Lost Data condition to be indicated.

Valid Character (Bit 11): Bit 11 is set after the DSC assembles a complete data character from the active terminal. Bit 11 indicates that bits 0 through 7 contain a data character.

Input Word (134.5 baud** only)

Each 12-bit data character received by the processor from a 134.5 terminal via the DSC has the format shown in Figure 7.

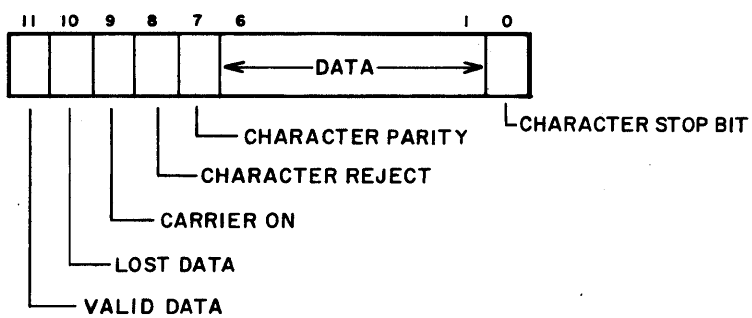


Figure 7. Input Word Format (134.5 baud)

A long space (break) signal can be transmitted from the processor to a 134.5 baud terminal via the DSC by sending consecutive codes of 4000. In most cases, a 200 millisecond space (three consecutive 4000 characters) is equivalent to a break signal. Likewise, a long space signal sent by a 134.5 baud terminal can be detected by the processor. The lowest bit in each character will be a logical zero whenever a long space signal is transmitted or received.

**Applies to Standard Option 10295-1 only.

Data Word (300 baud** only)

Data characters at 300 baud, as seen by the processor, have the same format as for 110 baud operation. Use of the long break signal at 300 (or 110) baud is not possible.

STATUS WORD

A status word provides the processor with a means of determining the condition of the DSC. The processor, to determine the status of the DSC, issues a Status Request code (X002) followed by an input operation. Figure 8 shows the format of the DSC status response word.

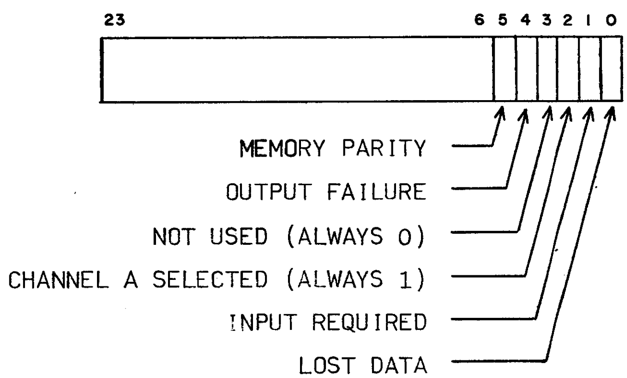


Figure 8. Status Response Word Format

DSC Lost Data (0005)

Status Bit 0 sets when the processor fails to perform an input operation before a telephone channel has assembled the next input character. This status bit indicates the presence of lost data in at least one telephone channel. The DSC clears status bit 0 after receiving a Select Input code.

**Applies to Standard Option 10295-1 only.

NOTE

Use care when configuring the hardware and software driver for the DSC so that false lost data errors do not occur. Errors will occur if the software executes a status (X002 code) of the DSC and if the following conditions exist:

1. Modem Selection switches for unused ports in the DSC are set in the asynchronous (103) mode.
2. Software does not input from one or more of the sixteen DSC ports (i.e., the word count during input/output operations is less than 20_8).
3. Input circuits on receiver (HA91) cards in the DSC are open (i.e., there is no cable between an unused port and a powered-on modem).

To prevent the potential lost data problem, set unused port switches to synchronous (201) mode.

Input Required (0006)

Status bit 1 sets when a character is available for input. The input operation requested by DSC should follow within 100 ms (110 baud), 4 ms (2000 baud), or 3.3 ms (2400 baud) or data may be lost.

Channel A Selected (0004)

Bit 2 (always a "1") is required for CONTROL DATA® 6676 Data Set Controller Compatibility.

Output Failure (0024)

Status bit 4 sets when a Clocked Line or Block Mode (2000 or 2400 baud) output operation does not find a character to disassemble in the Output Buffer register. A XXX1 function code clears this bit (output).

Memory Parity Error (0044)

Status bit 5 sets when a parity error is detected in a data transfer to or from the DSC memory. A XXX2 function code (status) clears this bit after it has been presented to the Data Channel.

PROGRAMMING CONSIDERATIONS

Status

The DSC has the following two types of status available:

1. Equipment status - Consists of DSC Lost Data and Input Required; available by means of Status Request code.
2. Operation Control status - Consists of Lost Data and Terminal Ready indications (for input operations) and Character Reject indications (for output operations) for each channel.

Output Status Check

The output operation must be followed by an input operation to obtain complete status. The terminal for which an output character has been rejected will have bit 8 set in the next input word for the 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

The I/O data block length can be a function of the terminals available if the DSC controls less than 16 terminals. For example, The I/O data blocks need only be eight words if a DSC only controls eight terminals and the terminals are consecutively numbered starting with terminal 0. The DSC considers all data transfers to start at terminal 0. The output data block length can also be a function of the number of active terminals. The data block can be 10 words if only terminal 10 is active, i.e., must service the highest numbered active channel.

Input Block Length

An input operation may be up to 16 words long. Blocks shorter than 16 words can be read, but they should contain at least as many words as the number of active data terminals. Due to the nature of the 6000 Data Channel, the DSC will present the Data Channel with one more word than requested. In most situations this is of no consequence. In the DSC, however, the extra word presented will correspond to a data terminal one higher in number than the last word requested by the Data Channel. The DSC considers this word as having actually been transferred to the Data Channel and destroys any information that it may contain. It is possible, therefore, to lose data when a block of insufficient length is read.

To prevent loss of data on 16-word blocks, the DSC ceases to process Data Channel signals after 16 words (or after the first word on an input which follows a status function). Abnormal program termination will result if longer block inputs are attempted.

Output Timing

The DSC accepts 16 words from the Data Channel in 32 μsec (one word each 2 μsec) in a block-output format. The complete output on communication lines (including disassembly and transfer) requires an additional 100 ms (110 baud), (66.92 ms (134.5 baud**), 33.33ms (300 baud**), 4 ms (2000 baud), 3.3 ms (2400 baud), or 1.65 ms (4800 baud). If the DSC receives a new data word before the preceding word is in the Output Disassembly register, the new word is lost and Character Reject sets in the next input word. Because of these output-timing restrictions, each output block should be followed by an input block in which bit 8 (Character Reject) is checked.

Input Timing

The DSC can transmit a 16-word data block to the Data Channel in 32 μsec (one word each 2 μsec). The time required by the DSC to assemble a complete input code from a terminal is the same as that required for data output. The DSC assembles the character and then transfers it to the Input Buffer register. With a word assembled and status bit 11 set, an input to the Data Channel must be activated within 100 ms (110 baud), 66.92 ms (134.5 baud**), 33.33 ms (300 baud**), 4 ms (2000 baud), or 3.3 ms (2400 baud) or the word may be lost and result in Lost Data for the corresponding word.

**Applies to Standard Option 10295-1 only.

General Timing

When a number of high- and low-speed data terminals are used with the DSC, it is advisable to connect the higher-speed terminals to the low-numbered channels and the lower-speed terminals to the high-numbered channels. In this way, the controlling computer program need communicate with only those terminals which require frequent servicing at a high rate. The slower terminals can then be serviced at a lower rate. These arrangements will provide a considerable shortening of programming time, but should be used only after consideration of the input block length.

Processor Restrictions

Input: The processor must perform inputs that equal or exceed the input character rate to avoid lost information.

Output: The processor must perform outputs that equal or exceed the character rate to avoid lost information when transmitting line-mode (clocked) information.

Character Format

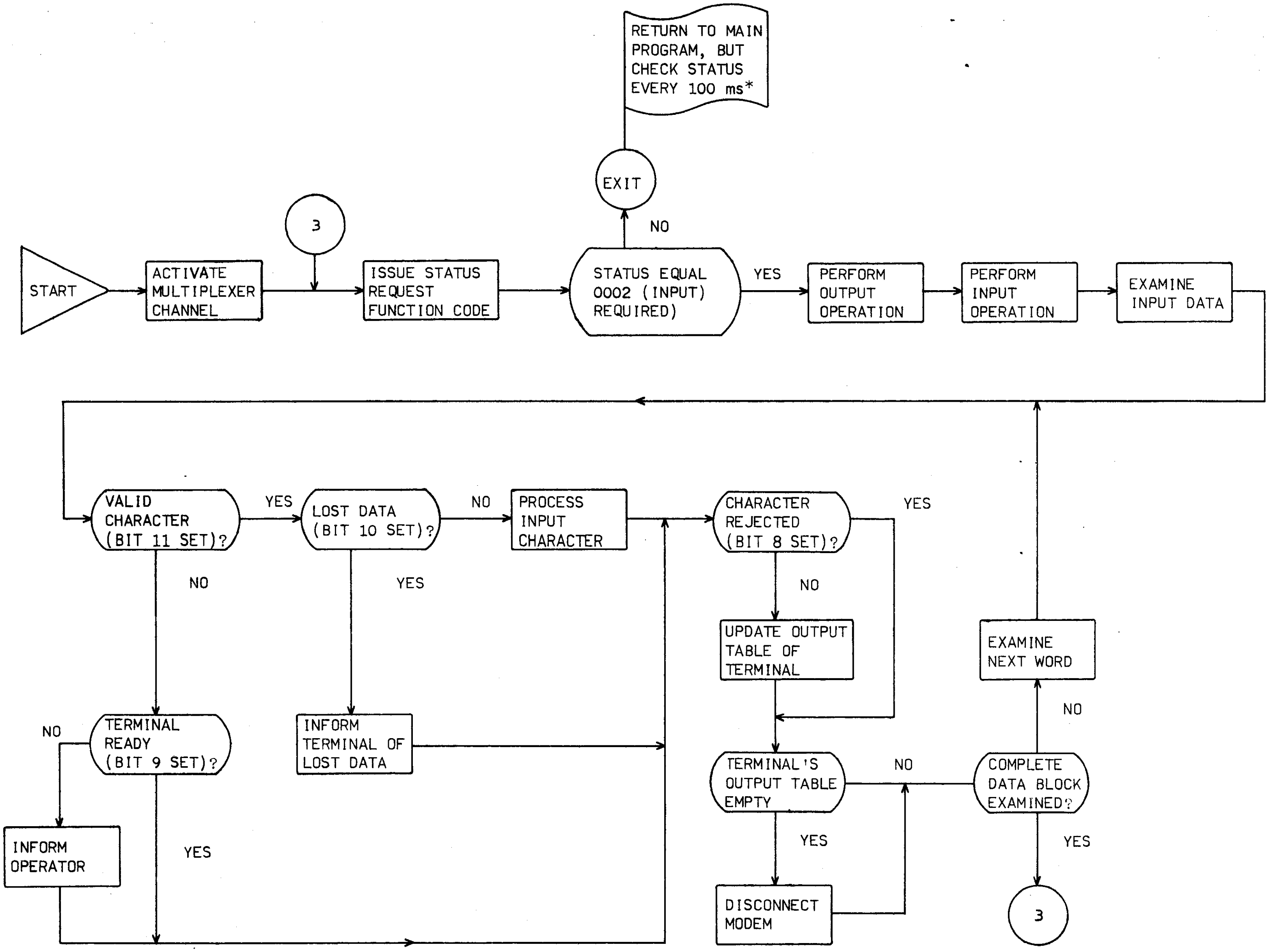
During transmission, the DSC performs a serial transfer of the 11-bit synchronized data character. This serialized character stream is required for compatibility with the 6676 Data Set Controller. Refer to Table 2 for the 103/201 Data Sets character format and transfer sequence.

Programming Example

The flow chart (Figure 9) shows the DSC servicing routine and is useful in understanding the DSC operation. Programming the DSC is similar to programming other peripheral equipment. A typical ordering of programming steps is as follows:

1. Clear (dead start)
2. Function select status
3. Input status (determine if DSC requires service)
4. Function select output
5. Output data to terminals
6. Function select input
7. Input data plus I/O control bits for terminals

**Applies to Standard Option 10295-1 only.



*100 ms (110 BAUD); THIS RATE VARIES ACCORDING TO THE SPECIFIC DATA SET EQUIPMENT BEING USED.

Figure 9. Sample Controller Servicing Routine

200 User Terminal Simulation

Customers who desire to program their own remote terminal to simulate the Control Data 200 User Terminal should read the following information carefully and be familiar with the referenced publications. The topics are presented in order of relative importance.

Data Communications Theory: It is imperative that the user have a working knowledge of data communications theory. This prerequisite is necessary to program a system successfully. The following Control Data publication may be helpful.

Title	Publication Number
Introduction to Data Communications (Basic Systems and Hardware)	13798900

200 User Terminal Protocol: The user must recognize the messages the remote terminal sends and receives, as well as all other 200 User Terminal protocol. Refer to the following Control Data publication for information.

Title	Publication Number
200 User Terminal Hardware Reference Manual	82128000

INTERCOM/EXPORT-IMPORT and SCOPE/KRONOS Theory: The SCOPE operating system is the higher level processor's (HLP) supervisory program. An operating system controls the main activities of the HLP such as input/output operations. One of SCOPE's communications systems is INTERCOM. The INTERCOM system is the program link between the remote terminal site and the HLP operating program. SCOPE can operate without INTERCOM but INTERCOM cannot operate without SCOPE (or an equivalent operating system). Therefore, INTERCOM is subservient to SCOPE. KRONOS is also an operating system. Its communications system counterpart is EXPORT/IMPORT. The statements applying to the relationship between SCOPE and INTERCOM also apply to the relationship between KRONOS and EXPORT/IMPORT.

The INTERCOM/EXPORT-IMPORT communication system permits the remote terminal operator to submit a job for processing to the higher level processor at the central site, and also work interactively with an executing program. Jobs are created and submitted from a remote terminal to the SCOPE/KRONOS operating system input queue at the central site for batch processing. The job is entered in the SCOPE/KRONOS input queue via the INTERCOM/EXPORT-IMPORT communication system. The sequence of events in the HLP program is "nice to know" information and is not a prerequisite for programming the remote terminal. Refer to the following Control Data publications for information. Refer to the Control Data Literature Catalog, Publication Number 90310400, if a particular operating/communication system manual is not listed.

Title	Publication Number
SCOPE Reference Manual (Version 3.3)	60305200
SCOPE Reference Manual (Version 3.4)	60307200
SCOPE Users Guide (Version 3.3)	60252700
SCOPE Users Guide (Version 3.4)	60358700
KRONOS Reference Manual (Version 2.0)	59150600
KRONOS Time-Sharing Users Reference Manual (Version 2.1)	60407600
INTERCOM 2 Reference Manual	60306000
INTERCOM 3 Reference Manual	60252800
INTERCOM 4 Reference Manual	60307100
EXPORT/IMPORT Reference Manual (KRONOS Version 2)	59150500
EXPORT/IMPORT High Speed Reference Manual	60235400
EXPORT/IMPORT 200 Reference Manual	60234600

<u>6671/6671-2 Data Set Controller Theory:</u> Detailed knowledge of the 6671/6671-2 Data Set Controller is not required to program a remote terminal which simulates a 200 User Terminal. There are a few points on message formatting and synchronization that may be helpful and these are discussed in general below. Refer to the specific descriptions in this manual for additional information. In particular, refer to the data transfer, data control, and signal synchronization descriptions.

1. The 6671/6671-2 is basically transparent; that is, the input messages and the output messages are a function of the higher level processor communication drivers and the remote terminal device. The 6671 does not control the contents of its data messages but it does require a specific format. The data messages contain the following communication control characters and USASCII codes: synchronization (SYN - 026 code), start of header (SOH - 001 code), and end of text (ETX - 003 code) to generate or check longitudinal parity

(message parity character). Refer to Control Data System Standard 1.10.000 for a complete description and listing of the USASCII codes and communication control characters.

2. The 6671 monitors all incoming line noise or data until it detects † two consecutive sync codes (026, 026). The 6671 logic is then synchronized with the data characters that follow. Sync codes received after input synchronization is established are ignored.

† NOTE

Although two sync codes is the minimum number required to establish input sync, four codes are normally sent.

3. The 6671 hardware appends a message parity character (MPC) to all output data messages (the MPC itself has odd character parity). Input data messages are checked for USASCII formatted messages. A message parity check character is generated and compared with the received message parity character (the MPC parity is not checked). The data was correct if the characters were identical.

4. The SOH and ETX codes are special characters to the 6671 and should never be transmitted as part of the data message.

OPERATION

The DSC employs 3000 Series logic and is entirely program controlled. In normal operation, the DSC requires no operator intervention and is on when system power is on. It can, however, be turned on or off at any time by means of the circuit breaker switch (CB1) contained in the cabinet. The operator control panel is shown in Figure 10, and the operator switches and indicators are described in Table 5. Table 6 lists the Modem Selection switches.

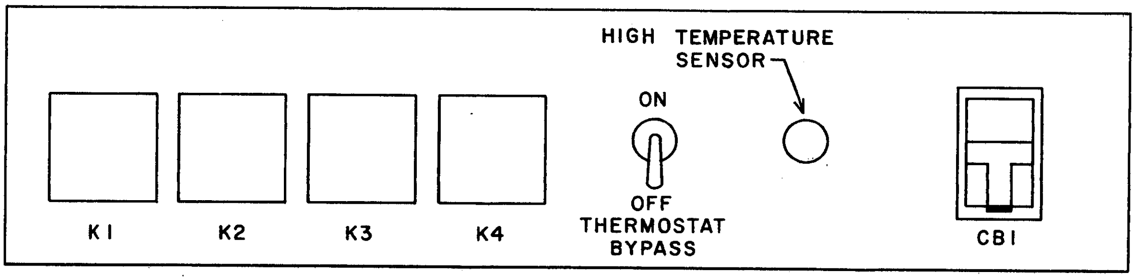


Figure 10. Operator Control Panel

TABLE 5. SWITCHES AND INDICATORS

Name		Function
CB1	S*	Turns on 400-Hz power for the power supply and 60-Hz power for the blowers.
	I*	Lights when the CB1 switch on the power supply trips or is in the OFF position.
400-HZ CB1	S	Turns on the 400-Hz power for the power supply.
THERMOSTAT BYPASS	S	Bypasses the thermal-protection devices. For emergency use only.
	I	Lights when the thermostat is bypassed (switch in ON position).
Temperature Warning	I	Lights when temperature of air entering the cabinet is above 80^{o}F, when a blower fails, or when a blower provides insufficient air circulation.
*S = Switch; I = Indicator		

TABLE 5. SWITCHES AND INDICATORS (Cont'd)

Name		Function
High Temperature	I	Lights when air temperature inside the cabinet rises above 110°F.
MASTER CLEAR	S	Generates a Clear pulse for DSC circuits and memory.
Equipment Number	S	These three 0-7 position switches determine the X portion of the function select code sent to the DSC.
Modem Selection	S	These switches determine which modem type (Teletype or Clocked Data) the DSC recognizes. See Table 6.
Baud Switches*	S	These switches select 110 baud or 300 baud on channels 00, 01, 02, or 03. They select 110 baud or 134.5 baud for channels 04, 05, 06, or 07. See Table 7.

TABLE 6. MODEM SELECTION SWITCHES

Switch	Location	Description
Channel 00	C044 A	
Channel 01	C044 B	
Channel 02	C044 C	
Channel 03	C044 D	
Channel 04	D044 A	Mode Selection:
Channel 05	D044 B	
Channel 06	D044 C	UP for Teletype
Channel 07	D044 D	
Channel 08	E044 A	DOWN for Clocked Data
Channel 09	E044 B	
Channel 10	E044 C	
Channel 11	E044 D	
Channel 12	F044 A	
Channel 13	F044 B	
Channel 14	F044 C	
Channel 15	F044 D	

Note: For normal operations, the switches in 1J003 should be positioned so A is UP and B, C, D are DOWN. Consult the CE manual for switch functions.

*Applies to Standard Option 10295-1 only.

TABLE 7. BAUD SWITCHES*

Switch	Location	Function
Channel 00	D002A	Up for 110 baud Down for 300 baud
Channel 01	D002B	
Channel 02	D002C	
Channel 03	D002D	
Channel 04	E002A	Up for 110 baud Down for 134.5 baud
Channel 05	E002B	
Channel 06	E002C	
Channel 07	E002D	

*Applies to Standard Option 10295-1 only.

COMMENT SHEET

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